Prot. n. 119480 del 21/07/2022
Convenzione del 07/11/2022

2. Progetto:
"Il ritorno della geopolitica nell'industria"

Policy Paper "Falling into Pieces. The EU in the Puzzle of Global Trade", a cura di Lucia Tajoli e Davide Tentori, 24 gennaio 2023

https://www.ispionline.it/en/publication/falling-into-pieces-the-eu-in-the-puzzle-of-global-trade-108334

https://ispi.therope.co/wp-content/uploads/2023/01/pp_tentori_tajoli_2023.pdf

Contributi di:
Ilaria Fusacchia
M. Sait Akman
Luca Salvatici
Claudia Schmucker

Rapporto "Industrial Policy's Comeback. The Next Geopolitical Great Game", a cura di Alessandro Gili e Davide Tentori, 30 settembre 2023

https://www.ispionline.it/it/pubblicazione/industrial-policys-comeback-the-next-geopolitical-great-game-145627

Indice del Rapporto:

10. China's Long March Towards Global Industrial and Tech Leadership
Zongyuan Zoe Liu

Commentary

Global Gateway alla prova dei fatti, di Alessandro Gili, 10 febbraio 2023

Tra la fine del 2022 e l'inizio del 2023 l'Unione europea ha schiacciato l'acceleratore per il piano di sviluppo infrastrutturale internazionale Global Gateway, mirante ad aumentare la connettività dell'Europa con il resto del mondo, in particolare con i Paesi in via di sviluppo e del vicinato europeo. Lanciato a dicembre 2021, è parte di un più ampio disegno per garantire all'Unione europea un'autonomia strategica nelle sue relazioni economiche e politiche con il resto del mondo, comprendente quindi il settore industriale, della difesa, dello spazio, dell'approvvigionamento di materie prime e, infine, le infrastrutture.

https://www.ispionline.it/it/pubblicazione/global-gateway-alla-prova-dei-fatti-112441

USA-Canada-Messico: grandi manovre per l'integrazione 4.0, di Antonella Mori, 13 febbraio 2023

Le prospettive dell'integrazione nordamericana sembrano decisamente migliori rispetto a qualche anno fa, quando l'allora presidente Trump sosteneva che il North America Free Trade Agreement (NAFTA) del 1994 fosse il peggior accordo commerciale che gli USA avessero firmato. Il NAFTA è stato poi sostituito dall'US-Mexico-Canada Agreement (USMCA), entrato in vigore il 1° luglio 2020. Il cambiamento di atteggiamento è emerso chiaramente durante il 10° North American Leaders' Summit (NALS), svoltosi a Città del Messico il 10 gennaio 2023.

https://www.ispionline.it/it/pubblicazione/usa-canada-messico-grandi-manovre-per-lintegrazione-4-0-114461

Allarme protezionismo, di Davide Tentori, 31 marzo 2023

Se dovessimo attribuire una definizione sintetica alla geoeconomia, potremmo dire che è da intendersi come "l'utilizzo degli strumenti economici per il perseguimento degli obiettivi geopolitici". Non è dunque un mistero se l'utilizzo di questo termine ha preso sempre più piede negli ultimi anni: la crescente competizione per la leadership tecnologica globale, che era già iniziata da qualche tempo ma che è stata accelerata dai "cigni neri" che si sono susseguiti in rapida successione (dalla pandemia di Covid-19 alla guerra in Ucraina), ha reso il ricorso da parte degli Stati agli strumenti di politica commerciale e industriale sempre più centrale e frequente, non solo in vista del raggiungimento dei propri obiettivi ma anche per ostacolare quelli dei diretti rivali.

https://www.ispionline.it/it/pubblicazione/allarme-protezionismo-123049

Clean Tech: l'UE risponde all'IRA (e a Xi), di Alessandro Gili, 4 aprile 2023

Le rivoluzioni energetica e tecnologica, fondamentali per aumentare la competitività del sistema economico e per raggiungere ambiziosi obiettivi climatici, stanno progressivamente evidenziando un effetto collaterale che potrebbe raggiungere dimensioni preoccupanti. Si è avviata, nel quadro di una più complessiva riconfigurazione e regionalizzazione delle catene globali del valore, una gara di sussidi per supportare l'industria nazionale, in particolare per i settori del clean tech e dell'alta tecnologia come i semiconduttori. È il ritorno della politica industriale, della geopolitica e della sicurezza degli approvvigionamenti che vanno a prevalere su logiche liberiste e di mercato.

https://www.ispionline.it/it/pubblicazione/clean-tech-lue-risponde-allira-e-a-xi-121339

Minerali critici, ma davvero rari?, di Alberto Prina Cerai, 14 aprile 2023

La lista delle materie prime critiche (CRMs) interessate dalla transizione energetica è ampia e complessa. A seconda degli obiettivi di decarbonizzazione e al posizionamento dei principali Paesi consumatori/produttori nelle filiere globali, la percezione di vulnerabilità, le priorità industriali o i vantaggi competitivi esistenti influiscono sul grado di "criticità" delle materie prime. Basti pensare che fino all'ultimo aggiornamento della Commissione europea, nelle precedenti 4 liste (2011, 2014, 2017, 2020) il litio non era considerato come "critico" seppur rappresentasse già da un decennio un ingrediente fondamentale per la produzione di batterie per l'elettronica e i veicoli elettrici (EV).

https://www.ispionline.it/it/pubblicazione/minerali-critici-ma-davvero-rari-123623

Scambi sull'ottovolante geopolitico, di Davide Tentori, 5 maggio 2023

Nel 2021, per chiunque si interessasse di economia internazionale – o anche solo per chi leggesse un giornale o guardasse un notiziario in TV – l'espressione "collo di bottiglia" era diventata familiare. A simboleggiare in maniera estremamente concreta tale situazione di difficoltà sul lato dell'offerta erano venute "in soccorso" le immagini della portacontainer Evergiven, che si era incagliata nel canale di Suez impedendo per diversi giorni il passaggio delle navi mercantili dirette da Oriente verso Occidente attraverso il Mediterraneo. Due anni fa, una somma di circostanze sfavorevoli quali le restrizioni dovute alla pandemia, prezzi dei noli marittimi alle stelle, carenza di personale nei settori della logistica e dei trasporti (pensiamo ad esempio agli scaffali vuoti nel Regno Unito risvegliatosi dall'illusoria euforia post-Brexit) avevano messo a dura prova le supply chains internazionali causando una carenza complessiva sul lato dell'offerta (soprattutto in settori hi-tech).

https://www.ispionline.it/it/pubblicazione/scambi-sullottovolante-geopolitico-127589

In principio fu il decoupling, di Filippo Fasulo, 5 maggio 2023

La più pressante domanda per la politica internazionale oggi riguarda il rapporto con la Cina. La crescita di Pechino degli ultimi decenni, la radicalizzazione ideologica sotto la leadership di Xi Jinping e la polarizzazione globale come conseguenza della pandemia e della guerra russa in Ucraina portano l'amministrazione americana a considerare questa fase storica come un momento "costituente" che richiede il ripensamento delle relazioni economiche internazionali. A questo proposito, nelle scorse settimane si sono espressi sia Janet Yellen – Segretario al Tesoro USA – sia il National Security Advisor Jake Sullivan, provando a dare corpo a una nuova strategia economica, partendo dal presupposto della possibilità – o persino desiderabilità – o meno del cosiddetto decoupling, ovvero il disaccoppiamento dell'economia americana da quella cinese.

https://www.ispionline.it/it/pubblicazione/in-principio-fu-il-decoupling-127741

Terre rare: quattro ricette per filiere sicure, Massimo Lombardini 19 maggio 2023

Nei prossimi anni la transizione energetica e la progressiva elettrificazione delle nostre economie aumenteranno il consumo di terre rare e di altri elementi, come litio, cobalto, nichel, e rame indicati nel loro insieme come materie prime critiche (critical raw materials). La crescita della domanda delle materie prime critiche, accoppiata a una produzione delle stesse concentrata in pochi Paesi, solleva preoccupazioni sulla sicurezza del loro approvvigionamento.

https://www.ispionline.it/it/pubblicazione/terre-rare-quattro-ricette-per-filiere-sicure-129255

Chip: si infiamma la gara in Asia, Paola Morselli 19 maggio 2023

La domanda globale dei semiconduttori nell'ultimo semestre è in calo: dopo anni in cui la richiesta di apparecchi elettronici aveva fatto salire alle stelle anche la domanda dei semiconduttori usati per la loro produzione, il mercato ha raggiunto un livello di saturazione. Tuttavia, in previsione di una ripresa forte nella seconda parte del 2023, gli investimenti delle grandi industrie dei chip nei principali mercati asiatici continuano e così anche gli sforzi dei governi per rafforzare il tessuto industriale domestico. Di fatti, resta prioritario per le grandi potenze mondiali il raggiungimento dell'autosufficienza, anche parziale, nel settore e per i leader il consolidamento delle posizioni di vantaggio competitivo.

https://www.ispionline.it/it/pubblicazione/chip-si-infiamma-la-gara-in-asia-129440

Cina: le mani sull'auto, Guido Alberto Casanova 9 giugno 2023

Mentre il resto del mondo si affanna, l'industria dell'auto cinese continua a correre e lo fa andandosi a prendere l'ambito titolo di primo esportatore di automobili al mondo. Nel primo trimestre di quest'anno, infatti, la Cina ha superato la concorrenza giapponese per numero di auto vendute all'estero. Il sorpasso però non arriva inaspettato, dal momento che negli ultimi anni Pechino ha conosciuto una fortissima espansione produttiva in questo settore.

https://www.ispionline.it/it/pubblicazione/cina-le-mani-sullauto-131209

Economia globale: l'era della "sicurezza" economica", Filippo Fasulo 15 giugno 2023

Allo scorso G7 a Hiroshima il tema dominante è stato il ricorso alla sicurezza economica. In particolare, nel comunicato finale si è parlato di "coordinare l'approccio per la resilienza economica, la sicurezza economica che si basa sulla diversificazione, sul rafforzamento delle partnership e sul de-risking, non il decoupling".

https://www.ispionline.it/it/pubblicazione/economia-globale-lera-della-sicurezza-economica-131758

UE: la mappa del de-risking, Davide Tentori 16 giugno 2023

Re-shoring, near-shoring, friend-shoring, de-coupling… e da qualche settimana anche de-risking. In attesa di sapere se questi termini saranno recepiti dall'Accademia della Crusca entrando a far parte ufficialmente della lingua italiana, è indubbio che negli ultimi mesi il glossario del commercio internazionale si è arricchito con parole che descrivono come l'architettura della globalizzazione, caratterizzata da supply chains fortemente integrate e ramificate, stia andando incontro a un processo di ridefinizione. La profondità di tale processo sarà determinata dal modo in cui le filiere cambieranno: la combinazione tra accorciamento e regionalizzazione, frammentazione, diversificazione delle partnership economiche traccerà il nuovo volto della globalizzazione. Un volto che sarà disegnato soprattutto dalle scelte delle tre principali potenze economiche mondiali: Cina, Stati Uniti e Unione Europea.

https://www.ispionline.it/it/pubblicazione/ue-la-mappa-del-de-risking-132439

Da supply chain a supply network, Angela Bergantino 30 giugno 2023

La pandemia di Covid-19 ha evidenziato la vulnerabilità delle catene di approvvigionamento globali. Molte aziende, nei mesi di blocco dei commerci, hanno subito carenze di materie prime, semilavorati e prodotti finiti e ritardi dovuti alle interruzioni dei servizi di trasporto e logistici, con lavoratori bloccati da lockdowns stringenti o, anche, da problemi di operatività di alcune infrastrutture fondamentali – soprattutto i porti – e canali di accesso alle principali rotte internazionali. Chi non ha ancora in mente le immagini dei porti di Shangai o di Los Angeles con navi alla fonda per settimane in attesa di caricare o scaricare merci? Oppure la coda di navi nel canale di Suez dopo l'incidente della Evergiven? La guerra tra Russia e Ucraina ha inasprito la situazione, bloccando di fatto alcune rotte e rendendo più congestionati (e cari) i canali alternativi. Infine, anche l'incertezza e l'inflazione stanno spingendo le aziende a riorganizzare le attività produttive e di vendita al dettaglio.

https://www.ispionline.it/it/pubblicazione/da-supply-chain-a-supply-network-134053

Politiche industriali: paga giocare in difesa?, Lucia Tajoli 30 giugno 2023

Le politiche industriali attive, dopo decenni in cui erano state messe in disparte, in particolare dall'Unione Europea (UE), ritenendole potenzialmente dannose per la concorrenza internazionale, stanno facendo la loro ricomparsa. In anni turbolenti per l'economia mondiale, con tensioni nel commercio internazionale, brusche cadute e rimbalzi, e dopo diversi shock che hanno colpito l'economia di tanti Paesi, molti governi hanno ritenuto necessario sostenere le proprie economie con diverse tipologie di interventi diretti, come sussidi alla produzione e incentivi a specifici settori.

https://www.ispionline.it/it/pubblicazione/politiche-industriali-paga-giocare-in-difesa-134035

Nuova fabbrica del mondo cercasi, Nicolo Deiana 30 giugno 2023

Nel maggio 2019, un ordine esecutivo dell'allora presidente degli Stati Uniti Donald Trump vietò alle aziende americane l'impiego di componenti prodotti da aziende straniere considerate come una "minaccia per la sicurezza nazionale", andando a colpire in particolar modo le aziende cinesi Huawei e ZTE. Il provvedimento, basato sull'International Emergency Powers Act, si richiamava alla facoltà del presidente USA di intervenire in materia di commercio estero qualora la sicurezza nazionale fosse considerata a rischio. Nel caso specifico, il pericolo rappresentato dall'uso della tecnologia delle due aziende cinesi rischiava di minare la sicurezza della nuova rete di telecomunicazione basata sulla tecnologia 5G.

https://www.ispionline.it/it/pubblicazione/nuova-fabbrica-del-mondo-cercasi-134135

Chip wars: la mossa di Pechino, Guido Alberto Casanova e Paola Morselli 7 luglio 2023

La sfida tecnologica tra Cina e Stati Uniti continua a salire di livello e al centro rimangono le tecnologie emergenti come i semiconduttori. Il conflitto a distanza tra Pechino e Washington nell'ultimo anno ha subito un cambio di passo radicale ma, se fino a pochi mesi fa le misure più drastiche erano state prese dagli Stati Uniti, nelle ultime settimane sembra che anche la Cina si stia pian piano adattando alle nuove logiche della competizione in campo aperto.

https://www.ispionline.it/it/pubblicazione/chip-wars-la-mossa-di-pechino-134783

UE: il boomerang aiuti di Stato, Stefano Riela 21 luglio 2023

L'Unione europea li vieta per principio, ma adesso sono necessari per competere nell'era della post-globalizzazione. Sono gli aiuti di Stato, i sussidi concessi dai governi nazionali che, anche in risposta a quelli statunitensi, sono diventati strumento principe della politica industriale per gli investimenti nelle tecnologie del futuro e per raggiungere la carbon neutrality. Tuttavia, questo strumento, in quanto gestito dai singoli governi, potrebbe creare distorsioni nel mercato unico europeo e allargare i divari tra Paesi membri.

https://www.ispionline.it/it/pubblicazione/ue-il-boomerang-aiuti-di-stato-136099

Nearshoring: il Messico è attrezzato?, Davide Serraino 21 luglio 2023

Di nearshoring, cioè di ricollocazione (anche parziale) di produzioni o parti di produzioni vicino a un Paese avanzato, si parla sempre di più negli ultimi anni dopo le disruptions alle catene del valore provocate dalla pandemia e dall'aggressione dell'Ucraina da parte della Russia. A ben vedere, già prima dell'avvento del Covid il confronto (e scontro) sempre più acceso in materia commerciale tra Stati Uniti e Cina aveva mutato il quadro geopolitico. Fiumi d'inchiostro sono stati versati sul nearshoring, anche se le evidenze empiriche spesso latitano, o quantomeno, sono deboli.

https://www.ispionline.it/it/pubblicazione/nearshoring-il-messico-e-attrezzato-136218

Industrial Policy's Comeback.
The Next Geopolitical Great Game

Edited by Alessandro Gili and Davide Tentori

Ministry of Foreign Affairs
and International Cooperation

This project is realized with the contribution 1ft he Ministry of Foreign Affairs and International Cooperation pursuant to art. 23-bis of Presidential Decree 18/1967. The opinions expressed in this publication are solely those 1ft he authors and do not necessarily reflect the opinions 1ft he Ministry of Foreign Affairs and International Cooperation and ISPI.

TABLE OF CONTENTS

MAPPING GLOBAL VALUE CHAINS:
FROM UP TO DOWNSTREAM

1. A Matter of Geopolitics (and Industrial Policy Too): The Fight for Global Technology Leadership

Alessandro Gili, Davide Tentori

Reshuffle Of Power in an Increasingly Fragmented World

Today's world looks substantially different if compared to 30 years ago. Back then, the United States was the only superpower (both in political and economic terms) and the liberal order shaped by the so-called "Washington Consensus" was considered as the leading set of rules (based on free market practices) to which emerging markets should comply in order to catch-up with advanced ones.[1] Today, the global landscape is quite different as the US (together with the group of Western powers) is increasingly challenged by other States whose agendas and values are – at least to some extent – conflicting with Washington's. China is obviously the leader of this alternative front, and is gradually building up a different set of values, economic practices and institutions that could be extremely summarized as "Beijing Consensus".[2] If measured in purchasing power parity terms, China is currently the world's largest economy with a 19% share of world GDP: this target was achieved thanks to an unprecedented growth rate over the last three decades (an annual average of 8.9% from 1990 to 2022). In between China and the US (whose GDP share is today equal to 16%), the European Union is the third major economic block (with a 18% share). Therefore, this means that the global economy now appears to be organized around three main blocks: the US, the EU and Asia (of course revolving around the pivotal role of China). As the US and Europe seem to share similar values and objectives, one could (over)simplify and look at them as a single block (the "West").

How close are the two Western blocks to the Chinese one? Considering the high degree of globalization (which could be proxied with the percentage of trade as a share of world GDP), one could say that they are strongly tied to each other. International trade amounted in 2021 to 57% of GDP, a contraction with respect to the peak reached in 2009 at 61%, but still an impressive figure if compared to 38% in 1990.[3] Moreover, China is the largest trading partner of the European Union, with the latter recording a broadening trade deficit.[4] However, at the same time it is not

---

[1] D.A. Irwin and O. Ward, "What is the 'Washington Consensus'?", Peterson Institute for International Economics, 8 September 2021.

[2] M. Frenza Maxia and A. Pigoli, "Washington Consensus vs Beijing Consensus", Commentary, ISPI, 9 June 2023.

[3] World Bank, https://data.worldbank.org/indicator/NE.TRD.GNFS.ZS.

[4] M.A. Green, "China is the top trading partner to more than 120 countries", Wilson Center, 17 January 2023.

possible to deny the signals of increasing economic fragmentation that have come to the surface over the last three years. In fact, geopolitical tensions have lately contributed to redefine global value chains (GVCs) through the practices (or, rather the intentions to put in practice) of re-shoring, friend-shoring, near-shoring. Regardless of the differences among these policies aimed at repatriating foreign investments (ranging from enhanced diversification of economic routes and partnerships to relocation of capitals and assets in closer countries or at domestic level), the transformation of the "geography" of GVCs will comply to the target of achieving "economic security", which has become increasingly important in the West. In the US, the role of National Security Advisor (currently covered by Jake Sullivan) has lately gained relevance also from an economic point of view, as it was clearly shown by Sullivan's speech on "Renewing American Economic Leadership" given at the Brookings think tank in April 2023.[5] And in the EU, the European Commission recently launched its strategy aimed at enhancing economic security[6] and intended as a guide for the EU to promote the competitiveness of its industry, protect itself from external threats, and forge partnerships with other countries.[7]

The last point is of utmost importance: the deep and strong economic interdependence, combined with the insufficient endowment of energy and raw materials, makes striking partnerships with countries from the so-called "Global South" an imperative from the West's (and in particular Europe's) point of view, with respect to the overarching goal of economic security. Let us consider only a few examples: Russia is still the world's second largest producer of oil and gas despite Europe's attempts to make itself independent from imports from Moscow; OPEC+ countries are able to influence the price of hydrocarbons by acting on the supply leverage (as it was clearly shown by the latest production cuts implemented by Russia and Saudi Arabia); on the front of renewable energy sources, China is a major shareholder, occupying a leading position in terms of total photovoltaic capacity installed on its territory (one third of the world total). Beijing is also the leading producer of solar panels (over 80% of the global total) and lithium batteries (with a 76% share), which are essential for the manufacturing of electric cars around the world.[8] Not to mention raw materials: above all critical minerals and rare earths that will be increasingly decisive as the 'fuel' for both the digital and the "green" transition, that will characterize the coming years. According to the International Energy Agency, global demand for these commodities is set to grow by more than 500% between now and 2050. Currently, China holds 35% of global nickel refining capacity, between 50-70% of lithium and cobalt and over 90% of rare earths.[8] Not only is Beijing lucky enough to own most of the world resources, but it has been smart and forward-looking in making an early move through strategic investments in Africa and Latin America that strengthened its position.

---

[5] The White House, Remarks by National Security Advisor Jake Sullivan on Renewing American Economic Leadership at the Brookings Institution, 27 April 2023.

[6] European Commission, "An EU approach to enhance economic security", Communication, 20 June 2023.

[7] F. Steinberg and E. Benson, "Evaluating Europe's Economic Security Strategy", Center for Strategic and International Studies, 13 July 2023.

[8] D. Peraza, "Lithium monopoly in the Making? Beijing expands in the Lithium Triangle", *Geopolitical Monitor*, 25 August 2022.

In a nutshell: today's world is substantially different from the one we used to know until a few years ago.: there are three major players who are able to compete for economic power globally and not only one (or two) like it used to be back in the 1990s. But the strong degree of interdependence and economic integration along GVCs means that cooperation must remain an option in order to avoid economic self-destruction. The course of the future will depend much on the balance that will be reached along the spectrum between cooperation and competition, that will characterize the "twin" digital and green transitions, the landmark of the forthcoming decades.

International Trade and the Future of Globalization

Over the last couple of years, the several shocks that have hit the global economy contributed to raise doubts and questions about the future of globalization. International trade experienced unprecedented expansion from 1990 onwards, reaching an all-time record 61% share of world GDP in 2008. This was made possible because of increasing trade openness and economic liberalization, two trends which followed the collapse of the Soviet Union and that culminated with the establishment of the World Trade Organization (WTO) in 1994 and the accession of China in 2001. Trade flows were then hit by a serious blow in 2009 as a consequence of the global financial crisis (with a 12% contraction in only one year[9]), but they experienced a swift recovery as a proof of the resilience of an ever more integrated economic system. And what we saw during the Covid-19 pandemic made no exception: against all odds and pessimistic forecasts, in 2020 international trade flows shrank by only 6%, which is a daunting number by itself but not so impressive when considering that supply chains were subject to a prolonged paralysis because of lockdowns imposed in many regions across the globe.

The sustained recovery of the global economy coming out of the pandemic was unfortunately soon stifled by the arrival of another "black swan", the outbreak of the war in Ukraine. The conflict lit another economic crisis (which mainly affected the West), weakening GDP growth prospects and also affecting international trade. According to the WTO, global trade is expected to grow by +1.7% in 2023 (but eventually this figure could be further revised downward, at least to 1.5%) against an expected GDP growth of +2.4%:[10] usually, a litmus test to assess whether the global economy is slowing down is provided by the trade growth being lower than GDP growth. Therefore, such scenario cannot be considered as entirely positive, but should be still welcome with optimism given the series of economic shocks, bottlenecks, geopolitical and geoeconomic tensions that have put a brake on international trade.

Currently, there are several factors pulling down on trade flows. First of all, this lacklustre performance can be explained by the economic slowdown ongoing in Europe (while the United States have shown an impressive and unexpected degree of resilience so far): if during the pandemic the supply chains were stressed by bottlenecks on the supply side, now the mismatch has shifted to the demand side as a consequence of high inflation and tight monetary policy that

[9] World Trade Organization (WTO), "Trade to expand by 9.5% in 2010 after a dismal 2009, WTO reports", Press Release, 2010.

[10] World Trade Organization (WTO), "Global trade outlook and statistics", April 2023.

could lead to a further moderation in consumption patterns.[11] Then, geopolitical factors should be also considered: starting with the war in Ukraine, the outcome of which is still uncertain and could cause further problems with regard to the transportation of agricultural commodities and mining raw materials, should the Black Sea route be stopped again. And continuing with tensions between the United States and China, which could lead to a dangerous escalation of trade restrictive measures through a tit-for-tat retaliatory approach that could ultimately bring about an increase of global economic fragmentation. However, recently some signs hinting to a possible détente between the two countries have materialized. After US Trade Secretary Gina Raimondo's visit to China in August 2023, the US agreed to remove export controls on 27 Chinese companies and, in return, it was agreed to create a joint working group aimed at exchanging information on the implementation of future export restrictions as well as other trade measures.[12] Moreover, a few weeks later the US Treasury announced the launch of two new US-China working groups on economic and financial issues aimed at providing a regular policy communications forum between the world's two largest economies.

How are States and other economic actors getting ready to cope with the risk of enhanced fragmentation? A "buzzword" characterizing this period is "decoupling", with a very specific reference to China and the attempt to reduce economic interdependence with Beijing. However, it should be also reminded that decoupling was originally attributed to China, which began to implement it a few years ago through the strategy of so-called "dual circulation" in order to ensure a transition of its development model from one highly dependent (and unbalanced) on international demand (thus based on exports) to one more focused on domestic demand and consumption while improving the quality and value added of exports.[13]

In recent months, however, plans to put in place "decoupling" have been implemented on a much wider scale, pushed by more geopolitical and strategic motivations. The United States introduced a series of export restrictions to Beijing (the latest of which are some regulations aimed at limiting U.S. direct investment in China) pursuing the goal to hinder China's technology development and remain ahead of it in the competition to achieve global technological leadership, with a specific aim to delay Chinese hi-tech industries in semiconductor-intensive sectors.[14] But the underlying dynamics are much more complex and go beyond the bilateral economic spat between China and the US. On one hand, the growing tensions between Beijing and Washington related to the sovereignty of Taiwan are motivated by geopolitical competition in the Indo-Pacific region (as shown by the establishment of the Indo-Pacific Economic Framework, a US-led initiative) and Taipei's key role in the production of next-generation microchips (of which it holds 90% of global production); on the other hand, it should not be forgotten that this is a 3-player game, involving also the European Union. Brussels (and Member States) are keen to obtain "strategic autonomy" also in the field of chips, but at present Europe is lagging behind from a

---

[11] D. Tentori, "Scambi sull'ottovolante geopolitico", Commentary, ISPI, 5 May 2023.
[12] D. Tentori, "Trade: arriva il *re-coupling*", ISPI, 2023.
[13] H. Tran, "Dual circulation in China: A progress report", Atlantic Council, 24 October 2022.
[14] M. Chorzempa, "New rules curbing US investment in China will be tricky to implement", Peterson Institute for International Economics, 3 May 2023.

technological point of view also due to the (understandable) reluctance of several member states (especially Germany and France) to cut economic ties with China: so much so that European investment in China's automotive sectors are on the rise.[15] So, despite American and European attempts to reduce their dependence of China, the benefits of globalization still counterbalance its negative aspects. This is why the future of globalization might not be so gloomy as many depict it.

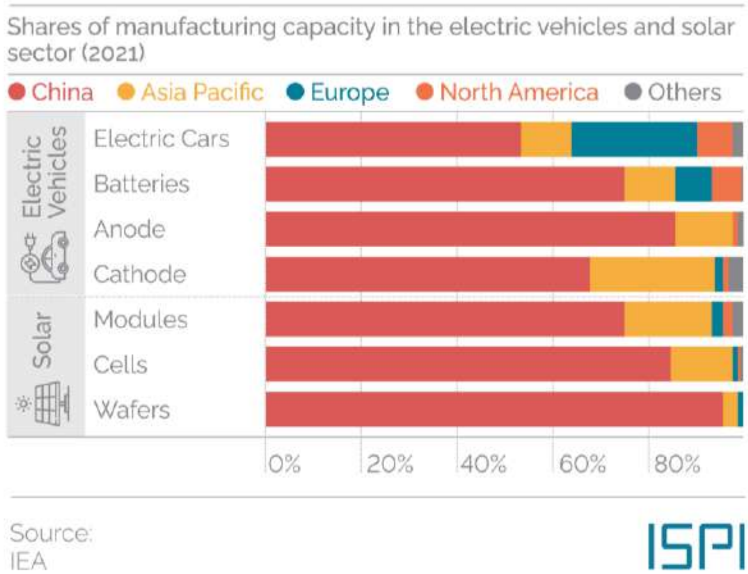
Tech and Energy Transitions: Engine of New Tensions

As far as industrial policy is concerned, any discussion cannot ignore two core pillars: energy and digital/tech developments. Energy and digital transitions are the backbone of new resilient and competitive value chains. In the first place, affordable and secure energy supplies are the precondition for every kind of industry to develop and thrive. Secondly, the pandemic, the outbreak of the war in Ukraine and the consequent global energy crisis, as well as rising concerns about the fast-changing climate, all accelerated the efforts made by governments to boost energy transition, but also to decarbonize the whole economy, by introducing carbon neutrality goals, increasing public financial support and designing new clean-tech value chains. According to the latest IEA (International Energy Agency) data, 2023 marked a record high in global energy investment. Out of US$2.8 trillion invested in energy, 1.7 was earmarked to clean energy, including renewable power, nuclear, grids, storage, low-emission fuels, efficiency improvements and end-use renewables and electrification. This trend is the result of recent volatile fossil fuel prices but is mostly due to enhanced and competing national policies. Between 2021 and 2023, clean energy investments have risen by 24%; however, more than 90% of this increase comes from China and Western countries, widening a dangerous gap with low-income and developing countries.[16]

As is well known, Beijing leads the global race in the manufacturing of clean technologies. For example, over the last 20 years solar panel manufacturing capacity has increasingly moved from Europe, Japan and the United States to China. China has invested more than US$50 billion in new photovoltaic capacity – compared to about US$5 billion in Europe. The result is that today China's share in all the manufacturing stages of solar panels manufacturing exceeds 80%.[17] The Chinese predominance in clean tech value chains extends to many other sectors. China is the world's largest onshore and offshore wind market in terms of both generation and capacity[18].

FIG. 1.1 – CHINA DOMINATES KEY SECTOR FOR THE GREEN TRANSITION

[15] E. White, "European carmakers play catch-up in China with record investment", *Financial Times*, 3 May 2023.
[16] International Energy Agency (IEA), *World Energy Investment 2023*, 2023.
[17] International Energy Agency (IEA), *Special Report on Solar PV Global Supply Chains*, 2022.
[18] J. Webster, "China's wind industrial policy 'succeeded' – but at what cost?", Atlantic Council, 1 May 2023.



More impressive are the figures for electric vehicles, where the Chinese share in sales and manufacturing currently fear no rivals. In the first half of 2023, more than 5.8 million plug-in electric cars were sold, accounting for about 15% of the total car sales globally[19]. Against this thriving landscape, China dominated the market, with a global share of 60%, mainly thanks to its manufacturing giant BYD and its production and sale costs, 30% lower than Western competitors. Again, Europe lags behind with a share of 15% of the global EVs sales, although far better than the US, which accounts for roughly 10%[20]. What worries Europe the most is the alleged Chinese EVs invasion of the European market: new energy vehicle shipments to the EU rose by 112% in the first seven months of 2023 on the year; meanwhile China's share of the European EVs market has increased to 8% and could reach 15% by 2025. Beijing has an excess of auto capacity production of about 10 million vehicles a year, and Europe has been targeted as a key export market. Through a long-lasting policy of incentives and subsidies, as well as price competition, China controls the entire EVs supply chain, raw materials included and, in the past, has drawn investment from the main foreign automakers, which established production plants in the country.[21] As a result, President of the EU Commission Ursula von der Leyen announced in her 2023 State of the Union speech the launch of an anti-subsidy investigation into Chinese electric vehicles, which ultimately could result in increased tariffs on EVs imported from China.[22]

In the batteries sector, China seems to remain unchallenged. Underpinned by generous and vast State subsidies, battery manufacturers are heavily investing in new facilities and production capacity. To date, production capacity at China's battery factories is set to reach 1,500 GW this

---

[19] M. Kane, "World's Top 5 EV Automotive Groups Ranked By Sales: H1 2023", InsideEVs, 7 August 2023.
[20] International Energy Agency (IEA), *Global EV Outlook 2023*, 2023.
[21] B. Goh, "What is driving Chinese EV exports and their price competitiveness", *Reuters*, 15 September 2023.
[22] European Commission, "2023 State of the Union Address by President von der Leyen", Press Release 13 September 2023; see also A. Hancock, H. Foy, H. Lockett, and P. Campbell (2023), "EU to launch anti-subsidy probe into Chinese electric vehicles", *Financial Times*, 13 September 2023.

year, roughly twice the country's demand. The risk of a new industrial bubble that could suddenly burst is increasing as the race of several Chinese regions to take advantage of government subsidies is not stopping. Notwithstanding, China's battery energy storage demand is projected to increase 70-fold and a fast-rising demand could rapidly reduce the existing overproduction[23]. In the meanwhile, two Chinese companies – CATL and BYD dominate the global market, with a share of 37% and 16% respectively, with plans to increase production in the Western countries. Thanks to a fully-fledged and competitive value chain, the two Chinese giants have succeeded to increase their competitiveness *vis-à-vis* their international competitors: capital costs at their factories to less than US$60 per gigawatt hour of batteries produced, against US$88/GWh for LG and SK and 103/GWh for Panasonic.[24]

China dominates even in the field of green hydrogen. Beijing accounts for 40% of global electrolyzers production, far ahead of Europe and the United States. Although Chinese electrolyzers are still considered less energy-efficient than Western ones, China is scaling up its capacity and widening the gap with Western countries: if Beijing had a cumulated capacity of almost 220 MW in 2022, 750 MW are under construction and should be operational at the end of 2023. On the other hand, the European Union installed about 80 MW in 2022, more than twice that installed in 2021, and is striving to enhance production capabilities. Finally, the US, in particular through the Inflation Reduction Act (IRA) is providing incentives to boost electrolyzer manufacturing.[25]

The second driver of the new industrial revolution is digitalization and tech competition. According to the World Bank, the digital economy contributes to more than 15% of global GDP and it has been estimated that by 2025, digital economy will be worth US$20.8 trillion globally.[26] At the beginning of this new decade, geopolitical and industrial competition to secure the key stages of digital economy has kicked off and accelerated, as the US-China confrontation over the control of 5G technology has witnessed. 5G alone could add about US$13.2 trillion in global economic value by 2035, generating 22.3 million jobs in the 5G global value chain and enabling an unprecedented level of connectivity that may transform many sectors, such as manufacturing, transportation, public services and health.[27] Since 2019, claiming national security reasons, the US has progressively banned Chinese 5G hardware from being installed in the US, in particular equipment from Huawei and ZTE, thus fostering the development of a national 5G value chain. In particular, the US government has vetoed American firms from using telecom hardware from Chinese firms that Washington has deemed to be national security threats, and it has banned several Chinese state-owned telecom companies from operating in US territory. Moreover, the US government urged allies – in particular European ones – to phase out Chinese hardware in their

---

[23] H. Dempsey and E. White, "China's battery plant rush raises fears of global squeeze", *Financial Times*, 4 September 2023.
[24] E. White, C. Davies, R. McMorrow, and H. Dempsey, "Can anyone challenge China's EV battery dominance?", *Financial Times*, 27 August 2023.
[25] International Energy Agency (IEA), Tracking Electrolyzers, 2023.
[26] Z. Hayat, "Digital trust: How to unleash the trillion-dollar opportunity for our global economy", World Economic Forum, August 2022.
[27] H. Galal, The Impact of 5G: Creating New Value across Industries and Society, PwC, 2020.

national 5G infrastructure, with critical consequences in terms of costs and the pace of deployment.[28]

A key sector where geopolitical dynamics are deeply affecting industrial and economic ones is data submarine cables. They are critical for data flows and economic transactions since 99% of international internet traffic flows through and roughly US$10tn-worth of financial transactions are transmitted via these cables every day. Until 2008, the submarine cable industry was a monopoly of companies from the advanced economies: America's SubCom, Japan's NEC Corporation and France's Alcatel Submarine Networks, Inc. Afterwards, besides the skyrocketing increase of investments in submarine cables of international tech giants such as Amazon, Meta and Amazon, the Chinese Huawei Marine Networks Co Ltd entered the competition and the submarine cable race progressively have become a matter of geopolitics and security. Most recently, amid rising tensions between Washington and Beijing, the United States has prohibited private companies – namely Google, Meta and Amazon – to build trans-oceanic cables connecting (even indirectly) the United States to China, adducing concerns for national security, especially espionage. This is the case of the Pacific Light Cable Network, which was supposed to connect the United States to Hong Kong. Following Washington's decision to cut any terminus in Hong Kong, the cable – renamed Cap-1 – was aimed to transmit data only from the United States to Taiwan and the Philippines. Notwithstanding, the project was abandoned in late 2022, in a phase when the construction process was almost completed. A similar pattern has occurred for the South East Asia-Middle East-Western Europe 6, or SeaMeWe-6, aimed at linking Singapore to Europe. Originally envisaged by a consortium including the Chinese HMN Technologies (the rebranded Huawei Marine), the US Microsoft and the French telecom company Orange, the contract was finally awarded in 2022 to the US SubCom, thanks to a successful US campaign through incentives and pressure on consortium members. On the other hand, the Chinese HMN Technologies HMN Tech was successful with the PEACE cable, which came online last year and connects Asia, Africa and Europe.[29]

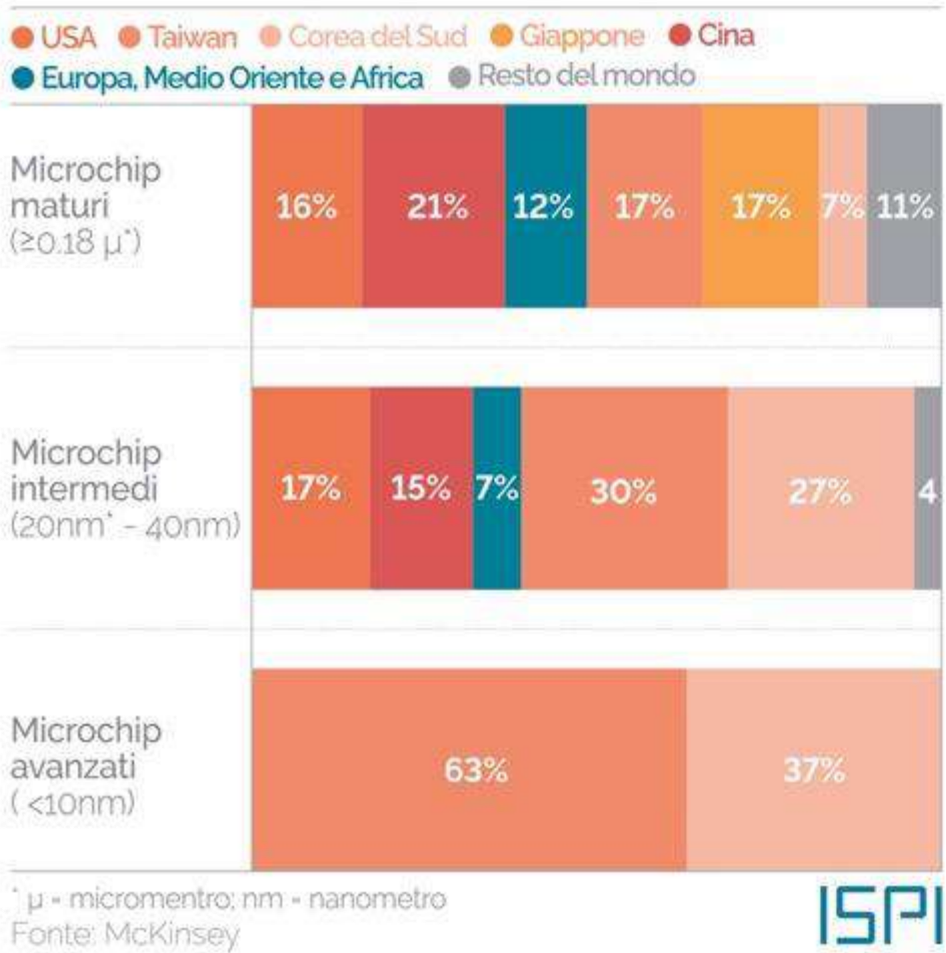
This is how economic and industrial decoupling is working under the sea, with the perils of dividing the subsea cable market into blocs. Through an assertive and strategic-oriented policy, the US has succeeded in preventing Beijing from becoming a dominant player in the global submarine cable market. According to the latest data, the Chinese HMN Technologies has provided or is set to provide the equipment to only 10% of all existing and planned global cables, vanishing the hopes to affirm itself as the largest worldwide player[30].

Chips: The New Industrial Battlefield?

[28] See N.T. Lee, Navigating the US-China 5G competition, Brookings, April 2020; see also J. Nocetti, *Europe and the Geopolitics of 5G Walking a Technological Tightrope*, IFRI, January 2022.
[29] J. Brock, *U.S. and China wage war beneath the waves – over internet cables*, Reuters Special Report, 2023.
[30] A. Gross, A. Heal, C. Campbell, D. Clark, I. Bott, and I. de la Torre Arenas, "How the US is pushing China out of the internet's plumbing", *Financial Times*; see also E. Braw (2023), "Decoupling Is Already Happening – Under the Sea", *Foreign Policy*, 24 May 2023.

Chips are the backbone for building a strong and competitive industry. From the automotive to the computers/supercomputers and smartphones, from the tech and data industry to domestic appliances, chips are key to ensure the smooth functioning of an increasingly automatized and digitalized economy. Semiconductor manufacturing plants are among the most expensive in the world, and the whole sector is a complex grid of interdependencies across highly specialized regions and companies. Only a few companies can compete at the cutting edge, where breakthroughs are very expensive and require years of research: among these companies, the Taiwanese TMSC plays a key role in global production. The result is an industry structured as a series of choke points. The chips shortage crisis that unfolded in 2021 – because of increasing demand, bottlenecks in key exporting countries, drought in Taiwan and rising tensions between Washington and Beijing – triggered a global rethinking in the chips sector. Governments and suppliers strived to design new resilient value chains, tackling one of the main shortcomings affecting the chips industry: the high concentration of production in a few countries. Moreover, Western countries have seen their market share in the chip industry decline over the years, with an increasing concentration in Far East regions. In particular, the most advanced chips (less than 8 nanometers), are produced only in Taiwan (63%) and South Korea (37%).

FIG. 1.2 - DIDASCALIA

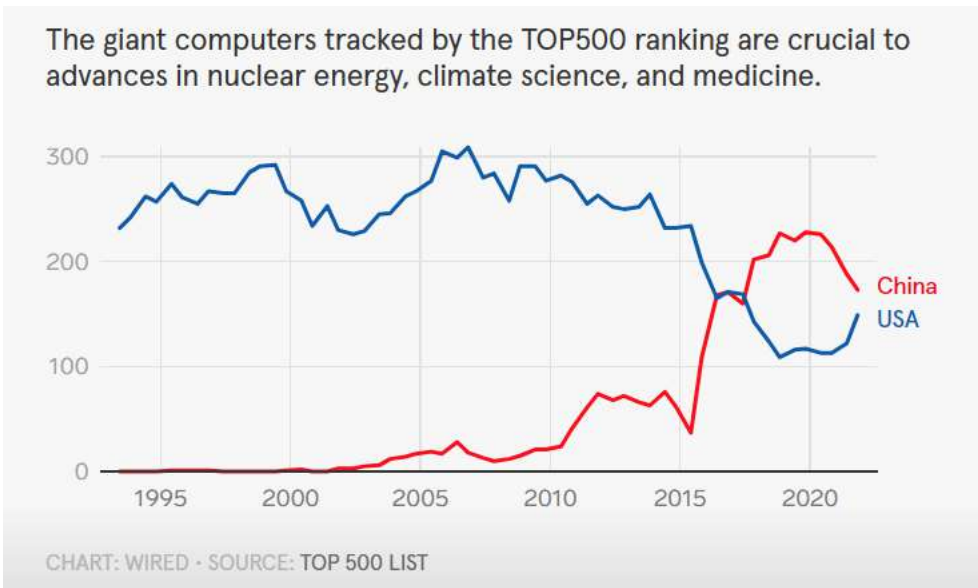


This situation led Western countries to introduce new pieces of legislation, such as the EU Chips Act or the US Chips and Science Act, aimed at fostering reshoring processes and, above all, building new domestic manufacturing capacity. To make the picture more complicated, against a backdrop of increasing economic and industrial tensions, Washington started a chip war on China, aimed to slow down the Chinese progress in industrial and tech development. The US move is intended to slow down the pace of China's progress in advanced quantum and supercomputers, as well as the development of AI capabilities, especially in the military sector. Indeed, on 7 October 2022, Washington introduced new export controls aimed at hindering China's ability to obtain, develop, manufacture, or even purchase advanced semiconductor technology. The US policy is intended to prevent China from getting access to 14 nanometers chips, or about eight years behind the most advanced technology. Because of the new US policy, American and foreign companies that use US technology may be forced to cut off supplies to China's leading factories and chip designers.[31]

[31] S. Nellis, K. Freifeld, and A. Alper, "U.S. aims to hobble China's chip industry with sweeping new export rules", *Reuters*, 7 October 2022.

As a natural consequence, industrial and geopolitical competition is also affecting the supercomputing industry. Traditionally a sector under the leadership of the United States, in the last ten years the US edge over China declined sharply, although it rebounded after the pandemic. This trend is partly due to the skyrocketing advances of China's investment in science and technology research, with breakthrough advancements through indigenous technology, but also due to America's decline in manufacturing the most advanced computer chips. This is one of the reasons behind the decision of the US government to accelerate spending in science matters, R&D, and chips manufacturing through the US Chips and Science Act, as well as to introduce export and investment restriction in chip sector.[32]

FIG.1.3 – CHINA HAS MORE TOP SUPERCOMPUTERS THAN THE US



Nvidia, for example, compliant with the new regulations, stopped the export of the most advanced chips but created variants for the Chinese market (i.e. the H800 chip), less performant but still representing an improvement for China's industry.[33] To be effective, however, the US actions need to be supported by similar measures taken by allied countries. Accordingly, under undeniable US diplomatic pressure, the Netherlands government agreed on tightening export controls, in particular restricting the sales of Dutch manufacturer ASML's advanced chip printer machines to China.[34] Moreover, Japan joined US and Netherlands, by blocking the export to China of 23 types of equipment used to make semiconductors: the move is part of a three-way agreement aimed at curtailing China's ability to import equipment used to produce the most advanced types of

---

[32] R. Waters, "US rushes to catch up with China in supercomputer race", *Financial Times*, 17 May 2022.
[33] S. Nellis, J. Ye, and J. Lee, "Focus: China's AI industry barely slowed by US chip export rules", *Reuters*, 3 May 2023; see also E. Martin and J. Leonard, "US Is Planning New AI Chip Export Controls Aimed at Nvidia", *Bloomberg*, 28 June 2023.
[34] P. Haeck, "Dutch slap new restrictions on chips exports to China", *Politico*, 30 June 2023.

semiconductors.[35] Moreover, to prevent Chinese parallel chips import via third countries, the US geographically broadened the restriction of sophisticated Nvidia and Advanced Micro Devices artificial-intelligence chips beyond China to other regions, such as some Middle Eastern countries.[36] A step forward was made through a US Executive order in August 2023, by which US outward investment to China in semiconductors and microelectronics, quantum information technologies, and artificial intelligence sectors were restricted for natural security reasons.[37] Against this fast-evolving backdrop, the effectiveness of export and investment restrictions is something controversial. Huawei and China's chipmaker Semiconductor Manufacturing International Corporation (SMIC) have built an advanced 7-nanometer processor on the latest Huawei smartphone Mate 60 Pro. Through this breakthrough, China could have demonstrated to be able to circumvent sanctions and to produce at least limited quantities of chips five years behind the cutting-edge.[38]

Furthermore, China reacted to the escalation of Western hostile measures by introducing export controls for metals highly used in the chip industry. In particular, Chinese exporters will be required to receive permission to ship some gallium and germanium products. Gallium, in particular, is key in the semiconductor industry and germanium is widely used in infrared technology, fiber optic cables and solar cells.[39] In addition to this retaliatory action, Chinese enterprises and AI groups are also avoiding export controls to access high-end US chips through intermediaries, witnessing shortcomings in Washington's strategy. AI surveillance groups targeted by US sanctions have found ways to obtain restricted technology by using third parties' cloud providers, as well as purchasing the chips through subsidiary companies in China, a move not formally barred by US controls.[40]

A Matter of Critical Resources

As China's move demonstrates, critical minerals are key to producing intermediate goods, such as chips, which in turn are crucial to move ahead in tech development and in the digital transition. However, their use is even broader in scope when it comes to energy transition. The clean-tech industry is intensive in critical minerals and rare earths, whose production and refining are actually concentrated in a few countries: this could replicate some of the shortcomings of the previous fossil era, with high bargaining power for producing and exporting countries. Moreover, countries

---

[35] L. Lewis and K. Inagaki, "Japan to restrict semiconductor equipment exports as China chip war intensifies", *Financial Times*, 31 March 2023.

[36] S. Nellis and M.A. Cherney, "US curbs AI chip exports from Nvidia and AMD to some Middle East countries", *Reuters*, 30 August 2023.

[37] The White House, "President Biden Signs Executive Order on Addressing United States Investments In Certain National Security Technologies And Products In Countries Of Concern", Press Release, 8 September 2023.

[38] V. Savov and D. Wu, "Huawei Teardown Shows Chip Breakthrough in Blow to US Sanctions", *Bloomberg*, 4 September 2023.

[39] S. Liu, A. Lv, and D. Patton, "China to restrict exports of chipmaking materials as US mulls new curbs", *Reuters*, 4 July 2023.

[40] E. Olcott, Q. Liu, and D. Sevastopulo, "Chinese AI groups use cloud services to evade US chip export controls", *Financial Times*, 8 March 2023.

producing and refining critical minerals are better positioned and competitive to build fully-fledged and resilient supply chains in fast-growing sectors such as wind turbines, solar panels, electric vehicles and batteries. Indeed, the rapid development of clean energy technologies is fostering unprecedented growth in the critical minerals markets: the market size doubled over the last five years, reaching US$320 billion in 2022. In the same year, investments in critical minerals rose by 30%, with a record registered for lithium (+50%), and China roughly doubled investment spending in the year. Exploration spending also grew rapidly by 20%, with Canada and Australia leading the race.[41]

Overall, critical minerals are abundant in the world and geographically widespread. Notwithstanding, capabilities for mining and refining are constrained. In mining, Australia leads the race for lithium (46.9% of the global share), Chile for copper and lithium (23.6% and 30% respectively), China for graphite (64.6%) and rare earths, the Democratic Republic of Congo for Cobalt (70%), Indonesia for nickel (48.8%) and South Africa for platinum and iridium (73.6% and 88.9% respectively). Even more concentrated are processing and refining operations, with China accounting for 100% of refined natural graphite and dysprosium (a rare earth element), 70% of cobalt and 60% for lithium and manganese. Moreover, critical mineral output is highly concentrated at the industry level, with the top five mining enterprises accounting for 61% of lithium production and 56% of cobalt production respectively.[42] This complex grid of interdependencies poses risks to the resilience of critical minerals supply chains, especially when political factors or external shocks intervene. Recent China's export control measures or Chile's nationalization of its lithium industry could trigger significant impacts on supply chains and global prices.[43] Moreover, critical minerals are a possible key economic weapon to hamper the cleantech industrial development of economic or geopolitical rivals. To tackle these arising risks, the leading economic powers are adopting policies, such as the EU Critical Raw Materials Act or the US Inflation Reduction Act, to build resilient value chains for critical materials, by establishing joint purchases and increasing national production. Indeed, increased and distributed global critical mineral production and augmented refining capacity are associated with lower volatility in prices and reduced risk of disruption in value chains. To enhance the security of the critical minerals supply chains, the G7 countries agreed at the 2023 Summit in Hiroshima to step up coordination among the bloc and conclude shared partnerships with third-producing countries, especially developing ones.[44] A step in this direction is the joint agreement of Australia and the USA aimed to create a Critical Minerals and Clean Energy Transformation Compact.[45] Accordingly, Australia decided to break historical China's monopoly in lithium processing, by establishing a national industry and capacity in lithium refining. The move makes Canberra the first Western country to process a critical mineral for the clean-tech industry, especially batteries, securing Western

---

[41] International Energy Agency (IEA), *Critical Minerals Market Review 2023*, 2023.
[42] International Renewable Energy Agency (IRENA), *Geopolitics of the Energy Transition: Critical Materials*, 2023.
[43] A. Cohen, "Chile's Nationalization Of Lithium : "Green Protectionism" Endangering Energy Transition", *Forbes*, 16 May 2023.
[44] G7, G7 Leaders' Statement on Economic Resilience and Economic Security, 2023.
[45] See The White House, "Australia-United States Climate, Critical Minerals and Clean Energy Transformation Compact", Press Release, 20 May 2020.

supplies amid rising geopolitical tensions.[46] Japan – one of the largest car manufacturing countries – followed a similar path by signing a Critical Minerals Agreement with the United States aimed at diversifying key supply chains and strengthening the US-Japan bilateral economic and trade relationship.[47] Moreover, Japan and the UK are set to make joint investments in critical minerals in such places as Africa, in a bid to increase their economic security.[48] Finally, for Europe, the recent discovery in Sweden by the LKAB State-owned company of a large deposit of over 1 million tonnes of rare earths may be key to reduce EU dependence on imports in the medium and long-term.[49]

The struggle to exploit critical minerals is not bound to the land surface. A new race for critical minerals is emerging in the deep-sea waters too. These areas are governed by the International Seabed Authority (ISA), operating after the 1982 UN Convention on the Law of the Sea (UNCLOS) entered into force in 1994.[50] In early July 2023, a United Nations deadline to agree on regulations over deep-sea mining expired without finding a compromise. To date, according to ISA regulations, although companies are entitled to explore international waters for minerals, deep-sea mining has been forbidden outside exclusive economic zones (EEZs), in order to protect the common heritage of humankind. But now, the resulting limbo may give countries the chance to apply for mining licenses.[51] Hence, the boom of cleantech production and the race to secure supplies of critical minerals linked to the green transition, as well as advancement in mining technologies, may soon transform the oceans into the next frontier of a geopolitical and industrial scramble. Scraping minerals from the sea could expand critical minerals production, lower prices and reduce dependencies on countries – such as China – that control critical raw markets. Notwithstanding, this outcome is controversial because China could also expand its control of global mining: in fact, Beijing holds the largest number of exploration licenses issued by the International Seabed Authority. Moreover, scraping sea minerals entails sustainability concerns, since many fragile ecosystems could be seriously damaged by mining operations.

Where are these resources concentrated? Although geographically widespread, particularly promising for undersea mining is the Clarion-Clipperton Zone (CCZ), an area in the Pacific Ocean which could unveil trillions of potato-sized lumps called "nodules", rich in nickel, cobalt, manganese and copper, all of which are of interest to battery-makers.[52] When it comes to national strategies, India has announced it is eager to explore nodules in the Indian Ocean, in a bid to become self-sufficient in nickel and cobalt. In Europe, Norway is planning to become the first

---

[46] N. Frost, "Australia Tries to Break Its Dependence on China for Lithium Mining", *The New York Times*, 23 May 2023.

[47] United States Trade Representative, "United States and Japan Sign Critical Minerals Agreement", Press Release, March 2023.

[48] A. Nishino, "Japan and U.K. to jointly invest in critical minerals in Africa", *Nikkei Asia*, 4 September 2023.

[49] J. Ahlander, N. Pollard, M. Mannes, and J. Strupczewski, "Sweden's LKAB finds Europe's biggest deposit of rare earth metals", *Reuters*, 12 January 2023.

[50] The United States has never ratified the UNCLOS.

[51] A. Ahuja, "Deep-sea mining is a watery wild west", *Financial Times*., 12 July 2023; see also K. Bryan and H. Dempsey, "'Playing with fire': the countdown to mining the deep seas for critical minerals", *Financial Times*, 24 April 2023.

[52] "Deep-sea mining may soon ease the world's battery-metal shortage", *The Economist*, 2 July 2023.

country to extract battery metals from its sea floor, mining an area of the Arctic Ocean partly involving the Svalbard archipelago, on which Norway exerts a particular form of sovereignty.[53]

The Revival of Industrial Policies

As the issue of critical minerals witnesses, the role of States and national industrial policies is often key to boost investment in cutting-edge technologies and sectors deemed as strategic for steady and sustainable economic growth. Amid growing geopolitical tensions, with the rising of competing economic blocs, as well as ambitious climate neutrality targets that many countries are setting as priorities in their national agendas, the State plays a growing role in setting industrial priorities, but also contributing to the development of strategic sectors through subsidies or other policy tools that affects the autonomous functioning of the market. Indeed, Governments are increasingly intervening through industrial policies targeted to help domestic sectors reach goals that markets alone are unlikely to achieve. After being neglected for a long time, due to alleged scarce effectiveness during their large implementation during the 1980s, they have regained centrality after multiple shocks. Covid-19 called for an increased role of the State with countercyclical policies targeted to counter the sudden and deep recession triggered by the health crisis. The climate crisis itself is pushing governments to adopt industrial policies to reconvert the whole manufacturing and meet carbon neutrality targets. The pandemic and the war in Ukraine demonstrated the intrinsic fragility of global supply chains, and the need to increase their resilience also considering processes such as the re-shoring or near-shoring. Finally, against a backdrop of rising geoeconomic tensions, countries are concerned about the possible weakening of their strategic sectors or technologies, and the implications for economic growth, national security, and innovation capacity.[54]

The game changer and first most important example in the new century of a comprehensive and fully-fledged industrial policy goes back to 2015, with the launch by the Chinese government of Made in China 2025, aimed to transform China into the world manufacturing leader by 2025, particularly in advanced sectors. Artificial intelligence, Internet of Things, robotics, aerospace, clean tech technologies and electric vehicles among others, were identified as core sectors to be prioritized and to invest in. Made in China 2025 has nine strategic goals: to foment innovation; promote integrated manufacturing with the use of digital and high technology; strengthen the general industrial base; improve product quality and create Chinese global brands; concentrate efforts on ecological means of manufacturing; restructure industries for greater efficiency and production; improve service industries; globalize Chinese manufacturing industries; carry out technological innovations in ten priority sectors with high value-added.[55] Moreover, the Chinese government in 2013 launched the strategic Belt and Road Initiative, a large-scale infrastructure plan aimed at ensuring China's global connectivity, in particular along the East-West route, and underpinning the country's export capabilities. With $965 billion invested abroad since its

[53] K. Bryan and R. Milne, "Norway seeks to open vast ocean area to deep-sea mining", *Financial Times*, 8 June 2023.
[54] See W.C. Shih, "The New Era of Industrial Policy Is Here", *Harvard Business Review*, September 2023.
[55] R. Balderrama and A. Trejo, "Made in China 2025", Harvard University, 3 September 2028.

establishment, the Belt and Road Initiative (BRI) is by far the largest infrastructure investment plan in the world and has proven the strict linkage existing between industrial policies, infrastructure investments and trade priorities, as well as being a powerful tool to exert geopolitical influence in recipient countries.[56] However, it should be also said that currently doubts are rising about the future of the initiative, which seems to have lost traction because of financial distress in many member countries (which owe large debt amounts to China) and poor risk management about bankability and feasibility of many investment projects.[57] Moreover, the actual Chinese economic slowdown cycle might result in reduced Chinese investment abroad.

On the rise during the current decade, Western countries – hit by multiple external shocks such as the Covid crisis and the war in Ukraine, but also faced with new challenges such as the digital and energy transitions – have dramatically changed the stance in economic strategies, with targeted but also widespread policy interventions in industrial and trade issues. Dating back to late 2019, President Ursula von der Leyen in her inaugural speech as chief of the European Commission stressed the importance of building a Geopolitical Commission, announcing the establishment of new international partnerships and the launch of a new Industrial Strategy for Europe, as well as a new European Green Deal.[58] The European Green Deal was the first EU milestone of a more comprehensive industrial strategy aimed at relaunching European manufacturing and decarbonizing the European industry. In order to reduce by 55% the greenhouse gas emissions (compared to 1990 levels) and become climate neutral by 2050, the European Union intended to decouple economic growth from resource use, renovate buildings, enhance public transport, develop cutting-edge clean technologies.[59]

Building on these goals, the EU presented in March 2020 the EU Industrial Strategy, a day before the Covid-19 was declared a global pandemic.[60] Hence, in early 2021 an updated version was released to take into account the lessons learned after the pandemic. The Industrial Strategy, as envisaged by the EU Commission, should have served as the backbone to support the digital and green transitions. For the first time, the concept of strategic autonomy and diversification of supply chains was enshrined in an official EU Strategy. It aimed to increase the resilience of the single market, especially in 14 strategic sectors, through enhanced and diversified international partnerships, as well as monitoring strategic dependencies and building new industrial alliances to accelerate the development of strategic sectors, sharing the burden with the private sector. The first industrial alliances were launched on semiconductor technologies, hydrogen, industrial data edge and cloud, space launchers, zero-emission aviation.[61]

In addition, the European Commission has flanked the Industrial Strategy with other industrial policy instruments targeted at specific sectors to be developed, mainly the EU Hydrogen

---

[56] See American Enterprise Foundation, "China Investment Tracker", 2023.

[57] N. Clark, "The Rise and Fall of the BRI", Council on Foreign Relations, 6 April 2023.

[58] European Commission, Speech by President-elect von der Leyen in the European Parliament Plenary on the occasion of the presentation of her College of Commissioners and their programme, Speech, 27 November 2019.

[59] European Commission, European Green Deal, COM (2019) 640 final, 11 December 2019.

[60] European Commission, A New Industrial Strategy for Europe, COM(2020) 102 final, 10 March 2020.

[61] European Commission, Updating the 2020 New Industrial Strategy: Building a stronger Single Market for Europe's recovery. COM (2021) 350 final, May 2020.

Strategy and the EU Chips Act. The two initiatives share quantitative goals to be reached by the European industry. The first one, launched in July 2020, mandates the EU to produce at least 10 million tonnes of green hydrogen by 2030, at the same time fostering the creation of an energy ecosystem through the establishment of hydrogen valleys across the Continent.[62] Moreover, to spur private investment, sustain production and demand, as well as create a hydrogen market and related infrastructure, the EU is working to establish an EU Hydrogen Bank, which will be intended to ease the import of green hydrogen through green hydrogen partnerships.[63]

The second one, launched in February 2022 and entered into force in September 2023, required a 20% EU share of the global microchips market by 2030 (from the current 9% share), with planned €43 billion in public and private investments. Besides trying to facilitate the transfer of knowledge between from the lab to the fab, the EU Chips Act has established a coordination mechanism for enhancing collaboration with and across Member States, monitoring the semiconductor supply chains, in particular through an early-warning assessment system in case of crisis.[64] To reach these goals, a key EU industrial policy tool is also the Important Project of European Common Interest (IPCEI). Launched in 2018, IPCEIs are crucial in supporting cross-border innovation and infrastructure projects, potentially contributing to economic growth, jobs, the green and digital transition and competitiveness for the Union industry and economy. Through the IPCEIs, Member States are authorized to provide State aid to certain specific sectors or cross-border infrastructure, otherwise forbidden by the EU rules. So far, the State aid approved linked to IPCEIs, including private-related investments, add up to almost €80 billion. The first six IPCEIs have been launched in the chips, battery and hydrogen sectors.[65]

As above mentioned, one of the main battlefields in the global industrial scramble is the chips sector. After the launch of the European Union Chips Act, the US responded roughly five months later with the US Science and Chips Act, although mainly targeted to contain and counter Chinese chip development.[66] The Strategy aims to foster investments in domestic semiconductor manufacturing capacity. It also seeks to jump-start R&D and commercialization of leading-edge technologies, such as quantum computing, AI, clean energy, and nanotechnology, as well as create new regional high-tech hubs and financing. A key part of the Strategy is centered around workforce upskilling in science, technology, engineering, and math (STEM). This is intended to result in increased competitiveness, innovation, and national security. The US Chips Act earmarks US$280 billion in spending until 2032. US$200 billion is directed to scientific R&D and commercialization; US$52.7 billion is made up of federal government incentives for semiconductor manufacturing, R&D, and workforce development, with another US$24 billion worth of tax credits for chip production. Concerning chips, the Strategy will focus on increasing

---

[62] European Commission, A Hydrogen Strategy for a Climate-Neutral Europe, COM(2020) 301 final, 8 July 2020.
[63] European Commission, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the European Hydrogen Bank, COM(2023) 156 final, 16 March 2023.
[64] European Commission, Digital sovereignty: European Chips Act enters into force today, 21 September 2023.
[65] See European Commission, Important Projects of Common European Interest (IPCEI).
[66] The White House, 2FACT SHEET: CHIPS and Science Act Will Lower Costs, Create Jobs, Strengthen Supply Chains, and Counter China", Press Release, 9 August 2022.

the manufacturing capacity of mature and advanced chips, whose supply chains are almost under the full control of Taiwan and South Korea. Finally, a security dimension shapes the US Chips Strategy: the Act will fund a national network of semiconductor technologies for the defence industrial base, as well as funding past industrial strategies focused on telecommunications and 5G hardware, such as the US Telecommunications Act approved in 2020.[67]

The US Chips and Science Act, in the framework of a renewed race to reshoring critical productions, has so far spurred new private investment in chips manufacturing capacity in the country, bringing leading-edge manufacturing back to the US. The most technologically advanced chips company in the world, the Taiwanese TMSC, announced in late 2022 an investment for a second chips manufacturing plant in Arizona worth US$40 billion which, coupled with existing investments, will meet the US annual demand for advanced chips, 600,000 wafers per year.[68] The South Korean tech giant Samsung, in partnership with Texas Instrument, is building a US$17 billion semiconductor fabrication plant north of Austin, Texas.[69] Intel, which has lost ground in designing and manufacturing cutting-edge chips in the last decade, is trying to catch up. Partly benefitting from the US Chips Act, the company announced new giant manufacturing hubs, known as fabs, facilities that are key to achieve economies of scale for capital-intensive processes. Two Intel fabs are planned in the Phoenix area and two more in Ohio. Moreover, before the US Chips Act was announced, Intel had already invested US$20 billion to build two new giant chip factories in Ohio.[70] Overall, under the Chips Act, Intel could receive up to $12 billion in financial support for investments made in the US.[71]

However, being a global company, Intel is investing on a global scale. In Europe, in particular – attracted by the new industrial framework established through the EU Chips Act – the US company announced several investments. Intel picked Germany and the city of Magdeburg as the location for a new chip manufacturing site worth US$30 billion, with the German government that will cover a third of overall spending. The investment represents a crucial increase in Europe's manufacturing capacity, as well as the largest foreign investment ever made in Germany[72]. Intel also plans to build an assembly and test facility near Wroclaw, Poland and another chip factory in Ireland is being expanded with an investment of US$12 billion.[73]

Simultaneously, the Taiwanese TSMC announced in August an investment of about €3.5 billion into a microchip production plant in Dresden, Germany, its first in Europe, which will be operational by 2027. TSMC is investing together with Germany's Bosch and Infineon and Dutch-based NXP Semiconductors, pushing the total amount of investment above €10 billion.[74]

---

[67] McKinsey&Company (2022).

[68] E. Kinery, "TSMC to up Arizona investment to $40 billion with second semiconductor chip plant", *CNBC*, 6 December 2022.

[69] K. Tarasov, "How Samsung and Texas Instruments made the Lone Star State the hub of U.S. chip manufacturing", *CNBC*, 20 July 2023.

[70] D. Shepardson and J. Lee (2022), Intel's $20 bln Ohio factory could become world's largest chip plant, *Reuters*, 21 January 2022.

[71] R. Waters, "Can Intel become the chip champion the US needs?", *Financial Times*, 13 April 2023.

[72] "Intel to build €30 billion chip plant in Germany", *Euronews*, 20 June 2023.

[73] See Intel, "Intel Plans Investments in Europe", 16 June 2023.

[74] P. Haeck and G. Volpicelli, "Taiwanese chips giant moves ahead with German plant investment", *Politico*, 8 August

Moreover, the TSMC investment is taking advantage of huge State support, with the German Government earmarking up to €5 billion for the project in State subsidies.[75] Germany's moves once again demonstrate that countries in the EU with larger fiscal space are the most likely to attract high-tech industrial strategic investment, possibly deepening economic and political fractures within the Union.

At the same time, the US and the EU chip strategies will have to cope with rival chip subsidies in other countries, with large investments planned. This means that if the EU and the US are likely to halt the relative decline of their chip manufacturing base, the struggle to win back global shares will be more complicated. As a title of example, Japan, whose share of the global chip market fell from 50% in 1980s to about 10%, is encouraging investment and offering support to reach more than US$100 billion chip production value by 2030. TMSC announced in November 2022 a US$7 billion chip plant on Kyushu Island, starting production of 12 and 16-nanometre chips by 2024. The company also plans to build a second US$7.4 billion plant to manufacture 5 and 10-nanometre chips by 2025, with the Japanese Government expected to cover half of the cost.[76] The national chipmaker Rapidus is building a plant to produce cutting-edge 2 nanometre chips on the northern island of Hokkaido by 2027, with a US$2.3 billion subsidy by the Japanese government.[77]

China, on its own, is set to launch its biggest-ever fund to boost its chips industry, worth US$41 billion. The move is key to achieve self-sufficiency in semiconductors and fund key technological improvements for the national chip industry in a bid to produce the most advanced chips, especially after export controls have been set by several countries to curb China's tech advancements in the sector.[78]

One of the most advanced chipmaker countries, South Korea, in March 2023 passed into law the K-Chips Act, which would increase tax credits for semiconductor firms, to boost domestic investments for South Korea tech companies.[79] Most importantly, to challenge Taiwan's chip industry, the South Korean tech company Samsung announced that it will build a giant facility to produce computer chips in the greater Seoul area, with the largest investment in the world in a chip cluster of five fabs, worth about US$230 billion of investment until 2042.[80] The rising initiative Chip 4 Alliance, aimed at establishing semiconductor integrated value chains among like-minded countries – namely US, Japan, Taiwan and South Korea – could accelerate technology development, and generate economies of scale, by reducing costs and fostering production.[81]

Finally, within the broader efforts to become a leading hi-tech manufacturing economy by 2030, India is striving to establish an Indian chips value chain. The first step was taken during

---

[75] K. Hille and L. Pitel, "TSMC to build €10bn chip plant in Germany", *Financial Times*, 8 August 2023.

[76] T. Kelly and B. Blanchard, "TSMC plans second Japan factory to make higher-end chips", *Reuters*, 24 February 2023.

[77] K. Komiya, "Japan to add $2.3 billion subsidy to Rapidus for Chitose chip plant", *Reuters*, 10 April 2023.

[78] J. Zhu, K. Huang, Y. Mo, and R. Liu, "China to launch $40 billion state fund to boost chip industry", *Reuters*, 5 September 2023.

[79] J. Lee and S. Kim, South Korea Passes Its 'Chips Act' Amid US-China Friction, *Bloomberg*, 29 March 2023.

[80] J. Liu, Y. Seo, and G. Bae, "South Korea to build 'world's largest' chip center with $230 billion investment from Samsung", *CNN*, 16 March 2023; see also L. Kyung-min, "Korea to build $229 bil. mega chip cluster in Seoul metro area by 2042", *The Korea Times*, 9 September 2023.

[81] "Taiwan says 'Fab 4' chip group held first senior officials meeting", *Reuters*, 25 February 2023.

Indian Prime Minister Modi's visit to the US in June 2023, when the two countries signed a Memorandum of Understanding coordinating semiconductor incentive programmes and fostering joint development of technologies in the area of semiconductors.[82] As followed, US chipmaker Micron announced a US$2.7 billion investment to build a semiconductor assembly and test facility in Gujarat, which should be operational in 2024. Micron's investment will be highly subsidized: Micron will receive 50% fiscal support for the entire project from the Indian federal Government and 20% from the State of Gujarat. As the second step, and within the framework of the production-linked incentive (PLI),[83] the Indian Government intends to establish an Indian chips foundry. Announcing a US$20 billion plan, the Indian company Vedanta is in talks with three companies to join as technology partners for setting up a foundry fab, with up to 70% of federal or state-related subsidies. However, building a complete domestic value chain for chips requires considerable time and investment and expanding India's role within the world's chips value chains might be a more feasible and effective industrial policy.[84]

The Game Changer: the IRA and the European response

In this big picture, the real game changer that has triggered a global reshaping in global industrial relations is the US Inflation Reduction Act (IRA), a massive US$369 billion plan of subsidies and tax credits. The largest part of the IRA is renewable energy production measures (about US$160 billion in tax credits), with support targeted at households, businesses and backward regions, especially through subsidies for manufacturers of clean-tech products. Goals: reduce energy costs, increase energy security, and invest in the decarbonization of all economic sectors through innovative solutions. To this end, the other two pillars underpinning the package are subsidies for vehicle purchases and subsidies to produce carbon-neutral electricity. The entire package aims to reduce emissions by 40% by 2030 compared to 2005 levels. About US$46 billion will be directed to reduce pollutant emissions and to improvements to transport and infrastructure. The IRA, when launched in August 2022, upended global energy markets and started a new US industrial policy era. It could be considered as both an economic and geopolitical instrument. On the one hand, the IRA aims to put the country on the right track to achieve its decarbonization targets, revive national manufacturing and create new highly skilled workplaces. President Biden, as part of his so-called "Bidenomics", has considered the green revolution as a pillar of his re-election program in 2020. On the other, the IRA is part of a broader geopolitical strategy to decouple or de-risk from China, reducing interdependencies between the Chinese and the US economies and supply chains.[85]

[82] Government of India, Ministry of Commerce and Industry, MoU on semiconductor Supply Chain and Innovation Partnership between India and the US, 10 March 2023.
[83] The Indian government, in order to transform the country into a global manufacturing powerhouse, has introduced the Production Linked Incentive (PLI) scheme, which provides US$25 billion in government support for the development of 14 strategic sectors such as vehicles and auto components, steel, advanced batteries, solar panels, cell phones and electronic components.
[84] N. Tripathi, Can India truly become a global semiconductor hub?, *Forbes India*, 7 August 2023; see also A. Travelli, "Modi Wants to Make India a Chip-Making Superpower. Can He?", *The New York Times*, 13 September 2023.
[85] The White House, Inflation Reduction Act Guidebook, 2023.

It was not the first US important infrastructure and industrial policy legislation in recent years. Back in 2021, with the passing into law of the Bipartisan Infrastructure Investment and Jobs Act (IIJA) about US$550 billion in investment was earmarked to enhance national competitiveness, improve infrastructure endowment of road, rail and ports and accelerate decarbonization and electric mobility.[86]

However, since the passing of the IRA legislation, new private investments have been announced. US companies agreed to re-shore part of their production abroad and foreign companies decided to increase their manufacturing investment in the US. Over the last year, the US more than doubled the EU on manufacturing investment going towards start-ups in areas such as carbon storage, electric vehicles and clean power (US$21.7 billion vs. US$8.7 billion) and US$84 billion in cleantech manufacturing projects were announced.[87] European and South Korean companies are now among the top foreign investors in the green tech US market, competing to secure a stake in the US supply chains. For instance, the LG battery manufacturer announced three new factories in the US, investing US$5.5 billion in a battery factory in Arizona.[88] Hyundai and LG will spend roughly US$8 billion on a battery and a electric-vehicle manufacturing plant in Georgia.[89] Moreover, after finalizing an investment worth US$2.5 billion in a US battery plant in 2021, the Italian-French automaker Stellantis announced the plan to open a second joint-venture plant in the US to build electric vehicle batteries, with a target to start production in 2027.[90] Finally, the German automaker Volkswagen is financing a US$2 billion assembly plant to produce electric vehicles in Columbia, South Karolina.[91]

The launch of the IRA has drawn international backlash for distorting markets and further creating an uneven playing field for international competition. Although the plan is mainly directed at countering China's effort to maintain and strengthen global leadership in cleantech manufacturing, it has largely been criticized by the main allied countries, especially the EU. What makes the IRA attractive is the overall simple framework that ensures certain and predictable rules, *vis-à-vis* a more fragmented and complicated European subsidies system, coupled with higher energy prices.

What worries the European ally, however, is the strong presence of protectionist elements and, in particular, subsidies related to local-content requirements, which are market and trade-distorting and prohibited by WTO rules. In contrast to previous European subsidies that were essentially non-discriminatory, some subsidies under the IRA (about 60% of total tax credits) discriminate against foreign producers, potentially making trade in green technologies more fragmented and less efficient, even in securing energy transition goals. Such US subsidies would thus negatively impact the competitiveness of European industry, causing relocations, reducing exports and ultimately leading to technology outflows.

---

[86] The White House, UPDATED FACT SHEET: Bipartisan Infrastructure Investment and Jobs Act, 2 August 2021.

[87] A. Chu and M. McCormick, "The impact of the Inflation Reduction Act, one year on", *Financial Times*, 17 August 2023.

[88] N. Chokshi, "LG Will Spend $5.5 Billion on a Battery Factory in Arizona", *The New York Times*, 24 March 2023.

[89] "Hyundai, LG to spend $2 billion more on Georgia battery plant", *Reuters*, 31 August 2023.

[90] B. Klayman and H. Yang, "Stellantis, Samsung SDI set plan to build second US battery plant", *Reuters*, 24 July 2023.

[91] P. Campbell, "VW to build $2bn electric vehicle plant in South Carolina", *Financial Times*, 3 March 2023.

For example, the IRA provides that the US$7,500 tax credits guaranteed to consumers for the purchase of electric vehicles apply only to cars that secure final assembly in North America (thus including Canada or Mexico). In addition, half of the tax credit is linked to the origin of the batteries and the other half to the raw materials used to produce the vehicle. To qualify for each half, a minimum portion of the battery components (currently 50%) or critical minerals (currently 40%) must come from the United States or from countries with which the United States has a free trade treaty. The required thresholds will increase by 10% each year. In addition, from 2024 and 2025, any use of batteries or critical minerals from China, Russia, Iran and North Korea will make it impossible to access the tax credit.[92]

Added to these credits are subsidies for the production of batteries, wind turbine parts and solar panel components, as well as for critical materials such as aluminum, cobalt and graphite. For the 50 critical minerals identified by the IRA, they are expected to be produced domestically, if possible, or imported from countries with which the US has a free trade agreement. As of 2021, only 24% of imported critical minerals came from countries with which the US had a free trade agreement. The IRA requirements could therefore lead to trade diversion phenomena. But the goal is precisely to become less and less dependent on China – which produces roughly 60% of rare earths – and Russia, through the creation of new resilient supply chains and, possibly, with like-minded countries.[93]

Most recently, to ease tensions with European and Western allies, the US Treasury released guidance stating that the critical minerals agreements under negotiations (notably with the EU and Japan) are to be considered equivalent to free agreements in terms of eligibility for subsidies.[94] This is notably a key move to build consensus on the establishment of a more integrated Western supply chain in strategic, clean tech and critical minerals sectors, as outlined in the G7 Clean Energy Economy Action Plan.[95]

Caught between imminent dangers of loss of competitiveness and the risk of being cut off from the development of an industrial supply chain for critical technologies for the energy and technology transition, the EU has responded as of early 2023 with a package of coordinated measures including the European Green Deal Industrial Plan, the Net Zero Industry Act, and the Critical Raw Materials Act. Alongside with the Next Generation EU and the Multiannual Financial Framework 2021-27, these plans are aimed at increasing the resilience of the EU economy while facing challenging internal and international shock, also putting the European industry at the cutting-edge. An urgency motivated by the fact that the global market for the production of net-zero technologies is expected to triple by 2030, with a turnover estimated at about €600 billion. The production of electric vehicles will grow 15-fold by 2050, as will the production of heat pumps by 6-fold.

---

[92] D. Kleimann et al., "How Europe should answer the US Inflation Reduction Act", Bruegel, 23 February 2023.
[93] K. Bernoth and J. Meyer, "US Inflation Reduction Act Demands Quick Strategic Action from the EU", DIW Weekly Report 6/2023, 2023.
[94] J. Politi, A. Williams, A. Chu, and C. Bushey, "Biden offers olive branch to allies in electric vehicle subsidy dispute", *Financial Times*, 31 March 2023.
[95] G7, G7 Leaders' Statement on Economic Resilience and Economic Security, G7 2023 Hiroshima Summit.

Europe, today, is an importer of emission-cutting technologies: about a quarter of the electric cars and batteries in the Old Continent and almost all of its photovoltaic production modules are imported. In other sectors, however, the European industry is still strong, as in the case of wind turbines and heat pumps, but competitiveness and trade surplus in these products are deteriorating because of rising energy and critical raw material costs. Therefore, the European goal is not only to regain competitiveness but also to strengthen its industrial production capacity in these critical technologies, reduce strategic dependencies, overcome bottlenecks in value chains and create resilient supply chains for critical materials, as well as provide European industry with the technologies it needs to advance on decarbonization. If a comprehensive agreement with the United States is welcome to avoid a subsidy spiral that would be detrimental to important industrial partnerships already in place, effective policy responses were equally urgent to avoid losing technological and manufacturing capacity *vis-à-vis* Chinese clean-tech products.

The first act on which Europe's renewed action in the clean tech and high-tech industry is based on the Green Deal Industrial Plan, underpinned by four key pillars.[96] The first, mainly to align European regulation as closely as possible with that of the US IRA, is directed at creating a simpler regulatory framework that eases permits for clean-tech manufacturing and assembly sites, thereby accelerating European industrial production in these sectors. Second, there are plans to bolster investment by revising the Temporary Crisis and Transition Framework to allow state aid aimed at increasing production in these critical sectors. But here arises the first point of friction among European countries. Indeed, these latest measures risk leading to a fragmentation of the European single market and favoring countries with greater fiscal space, such as Germany and France. That is why many other European countries, including Italy, are pushing instead for the creation of a European Sovereignty Fund or the use of Eurobonds for joint EU funding in green and high-tech industries. A solution that naturally finds Berlin and the frugal countries opposed.[97] The European Commission, looking to find common ground among different positions, proposed the establishment of the STEP Platform (Strategic Technologies for Europe Platform). Recognizing that an effective European industrial policy requires common European funding, the Commission intends to build on existing programs to create a financial pool that can serve the development of clean tech, deep and digital technologies (such as microelectronics, high-performance computing, quantum computing, AI and 5G) and biotechnologies. Although according to the Commission the total estimated amount of new investments through STEP could reach up to €160 billion, only €10 billion of additional financial resources have been announced so far. To narrow the competitive gap *vis-à-vis* the Chinese and US industrial competitors, a far larger pool of resources is probably needed, as well as to spur new private investments.[98]

The industrial core of the initiative, however, is the Net Zero Industry Act, released on 16 March.[99] The plan reiterates measures to simplify the regulatory framework and speed up

[96] European Commission, "A Green Deal Industrial Plan for the Net-Zero Age", COM(2023) 62 final, 1 February 2023.
[97] T. Bourgery-Gonse, "European Sovereignty Fund: Commission's best chance or empty shell?", *Euractiv*, 6 June 2023.
[98] See European Commission, "EU budget: Commission proposes Strategic Technologies for Europe Platform (STEP) to support European leadership on critical technologies", Press Release, 20 June 2023.
[99] European Commission (2023), The Net-Zero Industry Act: Accelerating the transition to climate neutrality, 2023.

permitting for the construction of production complexes in the clean tech sector. Moreover, eight categories of technologies considered strategic and in need of strategic support are identified in the proposal: photovoltaics and solar thermal; onshore and offshore wind components; batteries and storage; heat pumps and geothermal; electrolyzers; biogas and biomethane; Carbon Capture and Storage (CCS); and grid technologies. Most recently, in July 2023 the list was updated by the European Parliament to include nuclear energy, in a bid to speed up decarbonization efforts.[100]

The Net Zero Industry Act confirms the European Commission's strong geopolitical traction and a new approach that, in the name of strategic autonomy, includes strong elements of economic and industrial intervention. Indeed, it is envisaged that, in the eight categories considered strategic, a 40% domestic production target will be reached by 2030. Overall, the Commission estimates that reaching the 40% domestic target of domestic products will require around €92 billion in investments, with the main burden shared by the private sector (about 80%). Moreover, precisely to ensure the diversification of supply chains for these products, it is required that, in the framework of public procurement, those bids that plan to use products from a third country that holds more than 65% of the market share in the EU in that sector will receive a lower score. This is a measure clearly aimed at curbing the winning of public contracts by (more price-competitive) Chinese companies and products, considering that China has in most of the sectors considered strategic more than 65% of the EU market share. Indeed, the Net Zero Industry Act states that the supply of a given product should be considered insufficiently diversified where a single third country supplies more than 65% of the demand for a specific net-zero technology within the European market.[101]

It is a measure that can be overall considered discriminatory, and it comes close to some of the measures provided for in the US IRA through local content requirements. It is hence possible that this provision is in partial violation of WTO rules, which expressly prohibit discriminatory measures. Moreover, measures limiting China's presence in European clean tech chains are likely to lead to higher prices for consumers in the short run. But in the medium and long run, achieving economies of scale in production will also lead to a gradual decrease in European production costs. To stimulate innovation, the Net Zero Industry Act allows member states to establish regulatory incubators (sandboxes) to test innovative zero-emission technologies and stimulate innovation, under flexible regulatory conditions. Finally, a Net-Zero Europe Platform will help the Commission and member states coordinate actions and funding to limit public subsidies at the national level, meanwhile fostering an increased burden sharing for private investments.

A crucial tool established through the Net Zero Industry Act is the Net-Zero Strategic Projects (NZSPs), industrial policy instruments under the control of Member States and with a bland check of the European Commission aimed at contributing to CO2 reductions, as well as enhancing competitiveness and security of supplies. If traditionally the EU support is mainly focused on research, innovation and early-stage deployment of new technologies, the NZSP should involve technologies close to commercialization. This may, to some extent, get the Net Zero

[100] P. Messad, "Lawmakers reintroduce nuclear in EU's net-zero industry list", *Euractiv*, 20 July 2023.
[101] A. Bounds and A. Hancock, "Brussels to curb imports of Chinese green tech", *Financial Times*, 15 March 2023.

Industry Act closer to the US IRA, more focused on accelerating the deployment of existing technologies.[102]

In July 2023, the Commission awarded over €3.6 billion to 41 large-scale clean tech projects, to be financed through the EU Innovation Fund.[103] Many other projects in clean tech have been recently announced, in a bid to increase Europe's manufacturing capacity in the clean tech sector. In Sicily, one of the main Italian utilities is investing €600 million to expand a solar panels factory, with €118 million contribution from the European Commission, making it one of the largest in Europe.[104] The race is even more competitive in the batteries sector. Automotive Cells Company, a joint venture of Stellantis, Mercedes Benz and TotalEnergies, is spending roughly €7 billion on three gigafactories across Europe, with a capacity of 40 GWh each. The first was inaugurated in May in Douvrin, France;[105] the second one, operational by 2025, is to be located in Kaiserslautern, Germany; the third one, which will start operation in 2026, will be built in Termoli, Italy.[106] In Dunkirk, France, the French company Verkor is planning to build a factory to supply Renault, with a capacity of 12 GWh.[107] Volkswagen will invest over €20 billion in battery manufacturing in Europe, planning six plants in Europe with a joint capacity of 240 GWh, creating up to 20,000 jobs. The first one is under construction in Salzgitter, Germany, and others will follow across Europe.[108] In Heide, Germany, the Swedish Northwolt will invest up to €5 billion, with Government subsidies expected to reach €600 million (ranted by Germany under the EU's Temporary Crisis and Transition Framework - TCTF).[109] Investments in European clean tech are not just a European affair. In Dunkirk, France, Taiwan's ProLogium is reaching an agreement with the French government to invest in a €5.2 billion battery factory which, operational by 2026, will reach a capacity of 48 GWh[110]. In Hungary, the Chinese giant CATL is establishing a €7.3 billion plant with a planned capacity of 100 GWh[111] When it comes to electric vehicles, Germany is leading the European race. The US company Tesla has recently announced plans to double production in its Brandenburg factory, with a target to produce 1 million EVs annually, making Germany's largest automotive plant.[112]

Finally, the last pillar of the initiative envisions a diversification of value chains with regard to critical raw materials, which are prerequisites to realize any sort of leadership in clean

---

[102] See D. Kleimann et al., "Green tech race? The US Inflation Reduction Act and the EU Net Zero Industry Act", *The World Economy*, 7 August 2023.

[103] European Commission, "Innovation Fund: EU invests €3.6 billion of emissions trading revenues in innovative clean tech projects", Press Release, 13 July 2023.

[104] "A Catania la gigafactory Enel Green Power di pannelli solari. Creerà mille posti di lavoro", *Il Sole 24 Ore*, 1 April 2022; see also F. Pascale, "Italy invests in clean energy to become European energy hub", *Euractiv*, 30 November 2022; V. Romano, "Italy expands Europe's first solar 'gigafactory'", *Euractiv*, 7 February 2023.

[105] "France to open first electric car battery factory in a bid to catch up with China", *Euronews*, 30 May 2023.

[106] "Stellantis' ACC JV plans to start operations at Italian gigafactory in 2026", *Reuters*, 10 March 2023.

[107] G. Guillaume, "Renault plugs into premium EV battery deal with start-up Verkor", *Reuters*, 13 April 2023.

[108] Z. Szymanska, "Volkswagen, partners to invest $20 bln in car battery business", R*euters*, 7 July 2023.

[109] "Germany wins competition with US for multi-billion battery plant", *Euractiv* , 12 May 2023.

[110] S. Mukherjee and V. Waldersee, "Europe set for two new gigafactories as it lures battery makers", *Reuters*, 12 May 2023.

[111] "China's CATL to build $7.6 bln Hungary battery plant to supply Mercedes, BMW", *Reuters*, 12 August 2023.

[112] "Tesla aims to double production capacity in German Gigafactory, targeting 1 million EVs annually", *Euronews*, 21 July 2023.

technologies. This is pursued through the Critical Raw Materials Act, which also provides for the creation of a club of like-minded countries for critical materials trade and the strengthening of supply chains. Most importantly, the Critical Raw Materials Act requires the EU, by 2030, to cover through domestic production 10% of critical minerals extraction consumption, 40% of their processing, and at least 15% for their recycling. In addition, no more than 65% of the Union's annual consumption of each critical raw material, at any relevant processing stage, must come from a single third country.[113] Europe's industrial revival is at the core of the last track of the EU Commission efforts. In her last State of the Union speech as President of the European Commission for this mandate, Ursula von der Leyen outlined the main priorities for the European Industry, which are centered around the concepts of de-risking, strategic autonomy and economic security as means to preserve and enhance European edge on critical and emerging technologies.[114] Most importantly, to strengthen economic and industrial competitiveness, the strong link between industrial policies and infrastructure connectivity has clearly emerged. The Global Gateway, a €300 billion plan launched in December 2021, could serve as an effective tool to enhance the security of supplies (i.e. energy, raw materials), boost strategic and economic ties with economic partners, as well as to spread and affirm Europe's technical, social, and environmental standards worldwide.[115] In this regard, the €150 billion Global Gateway Investment Package, among other things, is establishing 11 strategic corridors within the African Continent, aimed at integrating the African and European multimodal transport networks, supporting the creation of integrated value chains that can benefit industries in both Africa and Europe.[116] Second, the EU is committed to strengthening the capacity of the Middle Corridor, connecting Europe and China through Central Asia. The European Investment Bank (EIB) is investing in boosting infrastructure in the region and the European Bank for Revolution and Development (EBRD) has been mandated to investigate the feasibility of establishing sustainable transport connections between Europe and Central Asia, by integrating Central Asia transport infrastructure into the Trans-European Networks – Transport (TEN-T).[117] Finally, with the recent announcement on the sidelines of the G20 Summit in New Delhi of a new India – Middle East – Europe Corridor, the European Union could further strengthen connectivity along the West-East route. The plan, part of the G7 $600 billion plan Partnership for Global Infrastructure and Investment (PGII), might also be a key pillar of the Global Gateway, with the goal of reducing risks of bottlenecks, enhancing economic security and supporting Western value chains and industries.[118]

---

[113] European Commission, Critical Raw Materials Act, 2023.
[114] European Commission, 2023 State of the Union Address by President von der Leyen, Speech, 13 September 2023.
[115] European Commission, The Global Gateway, JOIN(2021) 30 final, 1 December 2021.
[116] European Commission, EU-Africa: Global Gateway Investment Package, 2023.
[117] European Bank for Revolution and Development (EBRD), "Sustainable transport connections between Europe and Central Asia", 30 June 2023.
[118] The White House, FACT SHEET: World Leaders Launch a Landmark India-Middle East-Europe Economic Corridor, 9 September 2023.

Conclusions: Towards an Increasingly Polarized World?

The fact that major world powers have embarked on a competition around technology leadership – along with the energy and digital "twin" transitions – cannot be denied. This will have substantial economic and geopolitical implications, accelerating the already ongoing shift and redistribution of economic power. This means that the focus of analysts, scholars and policymakers should not be on whether a clash among the "West" and the so-called "rest" will take place, but rather on whether and to what extent this process will assume antagonistic features, and hence what could be done in order to avoid practices of economic warfare that would lead to a negative-sum game.

At present, an "end of globalization" scenario seems highly unlikely. US "*decoupling*" from China is real, but it is happening gradually and around sectors considered strategic to national security: Washington's imports from Beijing are being scaled back to reduce dependence on China as a major supplier. A similar dynamic could strengthen in the coming years in the EU as well, albeit with even more nuanced tones and speed: Europe's cutting ties with China will affect sectors critical to the future of continental manufacturing related especially to electric cars and semiconductors market. However, these dynamics do not seem to imply at the moment a retreat of globalization but the beginning of a process that will lead to a new geography of trade, in which China will necessarily continue to play a leading role but other players will also increasingly find space thanks to the deep and entrenched interconnectedness of GVCs (think, for instance, of the increasing importance assumed by countries like Vietnam and Mexico which are partnering both with Beijing and Washington).

Managing this process cautiously and gradually will be key to avoid exacerbating economic tensions between States. To this end, existing multilateral fora do not seem in their best shape: the G20, for instance, is a portrait of the widening gap between Western countries and emerging economies and has proved unable to come up with pragmatic, cooperative solutions, while the G7 risks putting in place a "fortress scenario" that would multiply the adoption of defensive economic measures which could ultimately widen further the fracture with China and other emerging markets. The WTO seems even less trustworthy in this juncture, as it is in need for a deep reform and hasn't been able to make any substantial progress in multilateral negotiations over the last decade. Therefore, innovative solutions should be found, starting from a more stable and trust-based dialogue between the US and China (in which the EU should also try to engage and play a constructive role), and continuing with the pursuit of new bilateral, or plurilateral trade agreements, which can be considered as second-best solution in the absence of a fully functioning WTO. In other words, openness and flexibility should be preferred to protectionist and short-sighted economic policies. The transformation of globalization, based on the unavoidable redistribution of global economic power, is a matter of fact: therefore, it should be wisely accompanied and managed, instead of being hindered.

2. Commodities for the Digital and Green Transition: Who Controls Them?

Kristin Vekasi

As the world gears up for major industrial and technological changes needed in the digital and green transitions, there is a looming mismatch in supply and demand in many of the necessary raw materials. In particular, rising demand for key commodities, including what many governments call "critical minerals", necessitates rapid action so a lack of raw materials does not become a chokepoint for increased output in downstream technologies.[119] One source of the current disequilibrium for many commodities is a geographic or even firm-level concentration in the upstream segments of the supply chain that makes it difficult to quickly adapt to new market conditions. While some commodities have many suppliers around the world and are readily able to adapt to unexpected crises and the more mundane issue of increased demand, more have intense geographic concentrations that make them vulnerable to many possible risks or disruptions.[120] In particular, China plays a pivotal role and holds a commanding position along the supply chain in multiple key commodities.

Commodity supply chains are in part determined by location: the mining of ores is ultimately determined by geological distribution and as such is immutable. However, the current geographic concentration in global production is not solely determined by geology and most of the commodities with looming shortages are neither scarce nor lacking in unmined reserves. Government policy has also played a key role in the distribution of mining and production, and thus can also play a role in alleviating some risks today. The contemporary geography of commodity supply chains is far from independent from government intervention, and most chokepoints in commodity markets have either been created by government policy or alleviated by the same. Sometimes it is industrial policy, investment in basic research and technical expertise, or a favourable regulatory environment that has encouraged new projects or innovation within a commodity market. On the reverse side, geographic concentration has also been encouraged when new environmental and labour regulations that seek to eliminate or rectify the negative

[119] S.H. Ali et al., "Closing the Infrastructure Gap for Decarbonization: The Case for an Integrated Mineral Supply Agreement", *Environmental Science & Technology*, vol. 56, no. 22, 2022, pp. 15280-89; "Climate-Smart Mining: Minerals for Climate Action", World Bank, 2019.

[120] S. Kalantzakos, *Critical Minerals, the Climate Crisis and the Tech Imperium*, Switzerland, Springer Nature, 2023.

externalities of commodity production make it challenging to maintain production in markets due to high costs.

With the partial exception of China, patterns of industrial policy and regulatory environments have created (or exacerbated) a division of labour along "North-South" lines. Countries in the Global North have largely taken on the higher value added elements of the supply chain at the beginning and end points and outsourced resource extraction. Countries in the Global South have largely taken lower value added activities in commodity mining and sometimes processing, often financed by multinationals based in higher-income countries.[121] As a result, these countries have also shouldered many of the negative externalities that higher-income countries have regulated out of profitability in their domestic markets. These patterns of policy and resource exploitation have created particular nodes of control in commodity supply chains. These market patterns, which rely on low costs and assume that countries in the global South will bear the bulk of the environmental and social burden, introduce challenges for meeting new market demands for emerging technologies.

The next section describes the major players for selected commodities that are key in technologies central to the digital and green transformations and identifies places where severe geographic concentration has introduced potential vulnerabilities or chokepoints along the supply chain from mining to processing and end-use technologies. This chapter includes some key commodities used in the batteries and magnets which are technologies core to electric vehicles, renewable energy, and all forms of digitalisation. It does not include every possible critical commodity, but rather a sample that illustrates risks and resilience in different supply chains. The following section includes a brief analysis of four commodities (cobalt, lithium, nickel, and rare earths), followed by a discussion of nodes of control in commodity markets and the power and limit of policy to influence global supply chains.

Nodes of Control

Every commodity has its own geography and specific supply chain peculiarities; there is no single risk profile for a "critical mineral". There are different ways to measure the control of commodities, all of which reveal different aspects of resilience or vulnerability. The simplest is percentage of mining production by country, which is often how commodity control is measured, but the initial extraction of the resource is only a small part of the supply chain. Materials must be separated, refined, and processed to be transformed from raw sediment or ore to pure, industry-ready materials. Some commodities, such as rare earths, require substantial technical expertise to go from mined sediment to refined minerals while others, such as copper, require less. Sometimes commodity processing occurs in the same market as initial extraction and other times the raw material is exported to be processed. While processing can certainly be environmentally costly, the mining sector is particularly sensitive to both environmental regulation and the cost of labour.

[121] Note that this pattern is not unique to commodities and is broadly similar to macro-patterns in economic globalisation over the past fifty years. On the distribution of labour along the supply chain see G. Gereffi, *Global Value Chains and Development: Redefining the Contours of 21st Century Capitalism*, Cambridge, Cambridge University Press, 2018.

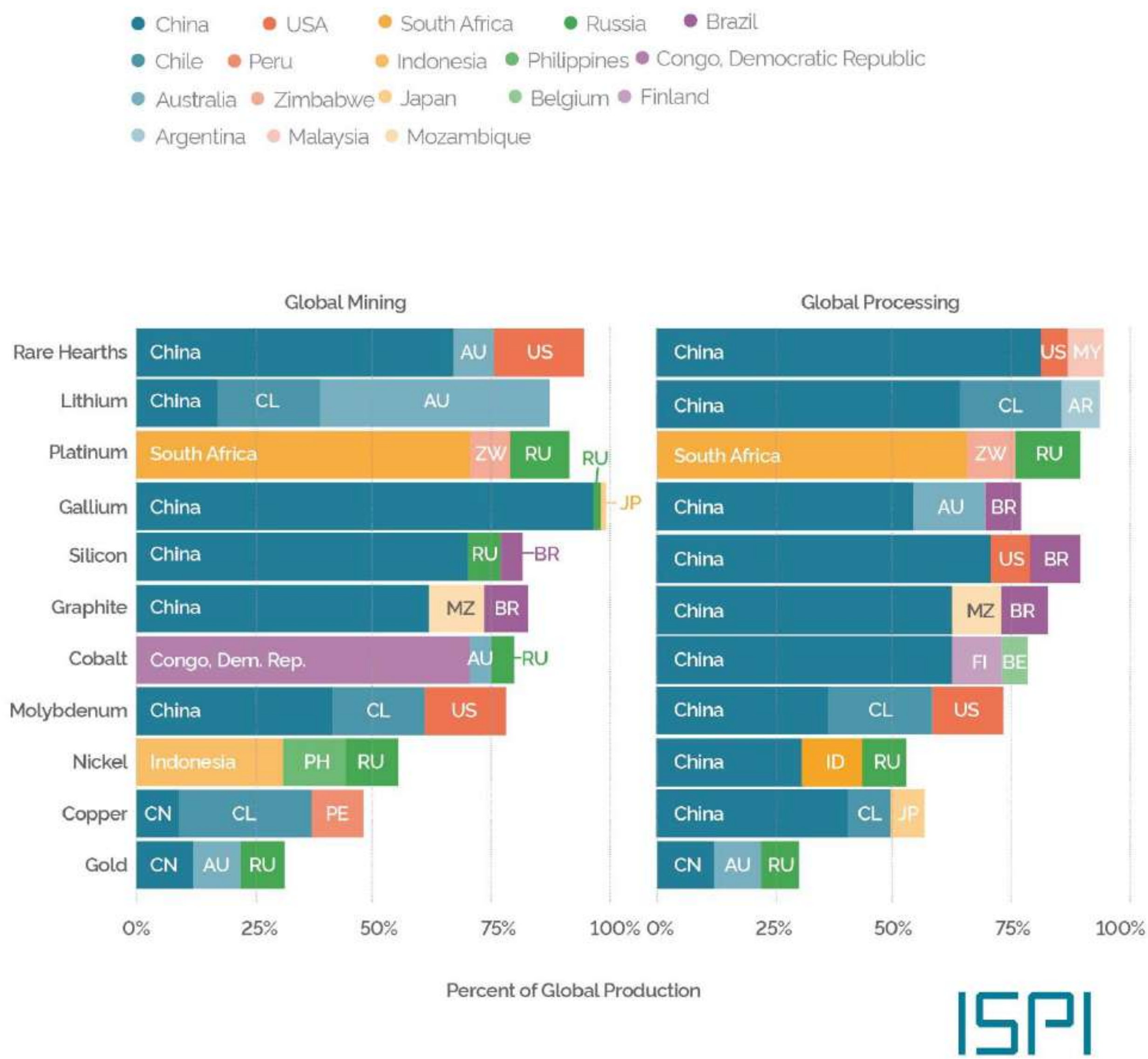
Concentrations in mining are more dependent on geography and regulation, and concentrations in processing more dependent on technical skill and training although both are to some extent true in each stage.

Commodity control by production

Figure 2.1 shows the 2021 global distribution of production for eleven commodities necessary for the green and digital transformations: rare earths, lithium, platinum, silicon, graphite, cobalt, gallium, molybdenum, nickel, copper and gold. The figure only shows the top three producers by country for these commodities for both mining and processing. These data reveal the range of geographic concentration across these key commodities, where some are dominated by a particular country and others more dispersed. It is important to note that geographic concentration in a country does not necessarily indicate industry consolidation into mega-firms, although this is also sometimes true, and is addressed in following sections.

Overall, mining is less concentrated than processing although both have similar patterns. In global mining, gallium has the highest geographic concentration, with 97% mined in China, followed by platinum (71% in South Africa), cobalt (70% in the Democratic Republic of the Congo), silicon (70% in China), rare earths (67% in China) and graphite (62% in China). Other materials are not quite so concentrated, such as lithium (48% in Australia), molybdenum (36% in China), nickel (31% in Indonesia), copper (28% in Chile) and gold (12% in China). For seven of the eleven commodities, over 50% of global processing is found within a single country: rare earths are the most concentrated (81% in China), followed by silicon (71% in China), platinum (65% in South Africa), lithium (64% in China), cobalt (62% in China), graphite (64% in China), and gallium (54% in China). Of the remaining four, 40% of copper processing is in China followed by molybdenum (36% in China), nickel (30% in China), and gold (12% in China).

FIG. 2.1 - TOP THREE PRODUCERS FOR KEY COMMODITIES



Notes: Data on global mining production from United States Geological Survey (USGS, *Mineral Commodity Summaries 2023*. United States Geological Survey, 2023); data on global processing from British Geological Survey and private consulting groups (Adamas Intelligence 2020; Argus Media, *Argus Media Rare Earth Prices*, various years; N.E. Idoine et al. *World Mineral Production 2016-2020*, British Geological Survey, 2022). Analysis by author.

One distinct pattern is the dominance of China in global commodity supply chains, a trend that has been broadly recognised.[122] Even in commodities where China does not hold a large share of global

[122] A. Chang and K. Bradsher, "Can the World Make an Electric Car Battery Without China?", *The New York Times*, 16 May 2023; Kalantzakos (2023).

mining, such as cobalt or copper, it is still the largest downstream supplier of processed materials. A notable exception to this pattern is platinum where South Africa does the vast bulk of both mining and processing. Also notable is that for all but two of these commodities (copper and gold), over 50% of mining occurs in just three countries, and the same is true in processing for everything but gold. While geopolitical concerns can introduce risk, a natural or epidemiological disaster unrelated to foreign policy could also severely disrupt these critical global markets.

Commodity control by asset ownership

An alternative way to measure the control of commodities is through industry concentration at the firm level. Figure 2.2 shows concentration of corporate assets by country of origin in a selection of the same commodities, as well as some of the downstream products for the digital and green transformations. The top grid shows firms involved in commodity extraction and processing, and the bottom grid shows the downstream products. Similar to the data in Figure 2.1, these sectors also show geographic concentration, but this time measured in assets by the firm's country of origin rather than the amount produced.

Similar to the patterns revealed in Figure 2.1, China has a commanding market share for many commodities. Chinese companies hold 81% of global corporate assets in the rare earth industry, 54% for lithium, 36% for nickel, 33% for molybdenum, 22% for cobalt, and 21% for platinum. Looking at downstream products, China holds 63% of global assets in permanent magnets, and 54% in lithium-ion batteries. China thus has a dominant market role not only in raw material markets, but also in the downstream products dependent on these critical materials. Although the data are not included in this chapter, analysis done on patents in these areas also shows the extent of research and development and technical skill acquisition that Chinese firms and the state have invested in these sectors.[123]

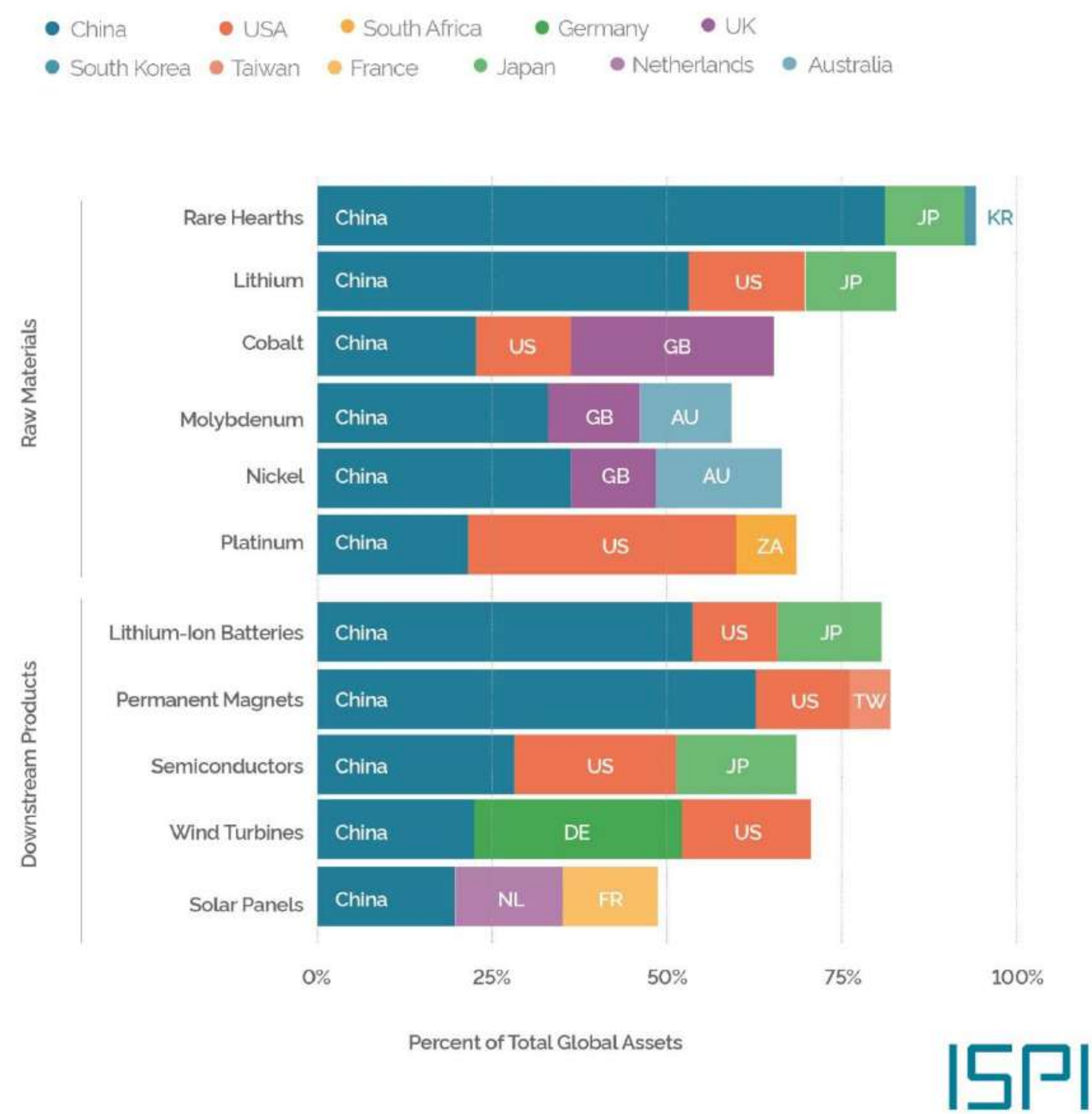
Even when production is more fragmented across multiple countries without the kind of overwhelming market concentration present for rare earths, lithium, or permanent magnets, it is notable that for these products and commodities, a majority of production is typically concentrated in three or fewer countries, much like the prior patterns. Critical minerals and their downstream products lack geographic diversity whether measured by country of origin of asset ownership or production.

Figure 2.2 also demonstrates the concentration of asset ownership in these sectors in either China or high-income countries, even when the bulk of resource extraction is elsewhere. Three commodities stand out in particular: cobalt, nickel, and platinum. These are three commodities where the bulk of mining (and in the case of platinum, also processing) occurs in low- or middle-income countries: the Democratic Republic of the Congo, Indonesia, and South Africa. However, none of these countries are among the top three holders of global corporate assets with the exception of South African firms, which hold 8% of global assets in platinum-related companies. These data show the North-South division of labour in critical commodity supply chains.

---

[123] K. Vekasi "Hearing on 'U.S.-China Competition in Global Supply Chains': Kristin Vekasi Written Testimony", *United States-China Economic and Security Review Commission*, 26 June 2023.

FIG. 2.2 - GLOBAL ASSET SHARE BY COUNTRY OF ORIGIN



Notes: Corporate data from the Orbis database, current as of August 2022 (Bureau van Dijk. 2022. "Orbis." https://orbis.bvdinfo.com/), analysis by author.

Commodity Control by Firm

A final way to think about control in critical mineral supply chains is concentration in specific firms. The data from the Orbis database in Figure 2.2 represents thousands of active companies operating along the value chain, from the mining giant Glencore to electric vehicle manufacturer

Tesla as well as thousands of smaller companies. These data include 5,789 cobalt-related companies, 7,138 lithium companies, 6,624 molybdenum companies, 16,341 nickel companies, 18, 248 platinum companies, and 5,023 rare earth companies.

Table 2.1 restricts this sample to only mining companies and shows the top five mining companies by global revenue for the commodities in Figure 2.2. Revenue streams in the mining of cobalt (64.6%), lithium (89.1%), and molybdenum (59.9%) in particular are highly concentrated in just the top five firms. Platinum (49.4%) and rare earths (37%) show less concentration. Similar to the patterns of asset ownership in Figure 2.2, these top revenue-earning companies are largely from high-income countries. Australia and China are the only countries that both mine and/or process critical minerals while also headquartering top revenue-earning companies in the same commodity.

While the results are not included here, the full sample shows the top five revenue-earning firms for the same six materials are far less concentrated.[124] The most concentrated commodities are cobalt and molybdenum, where almost 50% of the revenue is generated by the top five firms, followed by lithium with almost 30%. Within the broader industries, control is more dispersed. This pattern shows less concentrated control than in the previous measurement strategies and suggests more flexibility and resilience as alternative firms could step in as suppliers. However, if the primary risk is geopolitical or a fear of economic coercion, then the measurement techniques using country of origin are more appropriate and policymakers should take notice.

TAB. 2.1 - TOP FIVE MINING COMPANIES BY GLOBAL REVENUE SHARE, SELECTED COMMODITIES

[124] Values are available from author upon request.

Commodity	Company	Country of Origin	Percent
Cobalt	Jinchuan Group Co., Ltd.	China	19.0
	Umicore	Belgium	15.6
	Freeport-Mcmoran Inc.	United States	13.0
	Public Joint Stock Company Mining And Metallurgical Company Norilsk Nickel	Russia	10.2
	Phelps Dodge Corp	United States	6.8
	TOTAL		64.6
Lithium	Eramet	France	53.5
	Cyprus Amax Minerals Co	United States	25.9
	Citic Dameng Mining Industries Limited	China	4.1
	Sons Of Gwalia Limited	Australia	4.1
	Baikalrud	Russia	1.5
	TOTAL		89.1
Molybdenum	China Molybdenum Co.,Ltd.	China	16.6
	Freeport-Mcmoran Inc.	United States	14.0
	Corporacion Nacional Del Cobre De Chile	Chile	12.9
	Grupo Mexico S.A.B De C.V.	Mexico	9.2
	Phelps Dodge Corp	United States	7.3
	TOTAL		59.9
Nickel	Anglo American Plc	United Kingdom	15.2
	Jinchuan Group Co.,Ltd.	China	13.2
	China Nonferrous Metal Mining (Group) Co.,Ltd.	China	7.2
	Public Joint Stock Company Mining And Metallurgical Company Norilsk Nickel	Russia	6.2
	Impala Platinum Holdings Limited	South Africa	3.5
	TOTAL		45.4
Platinum	Anglo American Plc	United Kingdom	17.4
	Gold Corporation	Australia	9.6
	Gold Corporation	Australia	8.0
	Vedanta Limited	India	7.2
	Public Joint Stock Company Mining And Metallurgical Company Norilsk Nickel	Russia	7.2
	TOTAL		49.4
Rare Earths	Molycorp, Inc.	United States	9.7
	Lynas Rare Earths Limited	Australia	7.5
	Mp Materials Corp	United States	6.7
	Conghua Jianfeng Rare Earth Co., Ltd.	China	6.7
	Jiangxi Tungsten Industry Group. Co., Ltd.	China	6.4
	TOTAL		37.0

Notes: Corporate data from the Orbis database, current as of August 2022 (Bureau van Dijk. 2022. "Orbis." https://orbis.bvdinfo.com/), analysis by author. Data are calculated from 2662 cobalt, 130 lithium, 3582 nickel, 8429 platinum, and 312 rare earth mining companies. Note that the top five companies when percentages are calculated with assets rather than revenue change. Numbers are available from author upon request.

Vertically integrated supply chains where mining, processing, and end-use technologies are developed and produced by a single firm in geographic proximity can be economically and technologically advantageous for research and development and sometimes for cost. This approach became more rare beginning in the 1980s and 1990s as firms started to fragment their production processes in the quest for greater efficiency. This pattern in commodity markets resembles other global supply chains such as semiconductors as well as general manufacturing.[125] The current global map of commodity control has shifted away from vertical integration with some important exceptions. In the next sections, industry trends towards vertical integration versus industrial fragmentation is discussed for specific commodities in batteries and magnets along with specific risk profiles and patterns of control.

Batteries

Batteries are one of the key technologies needed for cutting-edge and emerging green and digital technologies. Increased demand in the battery industry is particularly driven by the transition to electric vehicles, but the need for advanced energy storage is seen all across the green transition.[126] Advanced batteries, particularly lithium-ion batteries, have also facilitated the digital transformation and will continue to do so. With respect to raw materials, cobalt, lithium and nickel have all seen dramatically increased demand due to the battery industry, and it is anticipated by industry actors as well as governments that supply will fall short of demand.[127] While new advances in technology will likely shift demand to other minerals in the future, current technology demands these, and their particular risk profiles lead to some generalisable conclusions.

These three minerals all have vulnerabilities in their supply chains. Cobalt, an essential ingredient in rechargeable lithium-ion batteries, is one of the most vulnerable and concerning supply chains.[128] 70% of the resource is mined in the Democratic Republic of the Congo, often under horrific labour and environmental conditions. After the cobalt is mined, some of it in "artisanal" mines (unlicensed operations that rely on child labour and little to no regulatory oversight), it is sent to China for processing before it becomes an essential ingredient in batteries and other products. Concerns about the cobalt supply chain are high enough that major producers of electric vehicles such as the US-headquartered Tesla shifted their sourcing strategies to buy directly from mines in addition to investing in R&D to develop alternative battery technologies in order to reduce supply chain risks.[129]

---

[125] Gereffi (2018); C. Miller, *Chip War: The Fight for the World's Most Critical Technology*, Simon and Schuster, 2022.

[126] R. Castilloux, "The 2020 Super Recovery: EVs, Battery Metals, and Rare Earths", *Adamas Intelligence*, 2020, p. 15; K, Hund, D. La Porta, T.P. Fabregas, T, Laing, and J. Drexhage, "Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition", World Bank, 11 May 2020.

[127] Castilloux (2020); F. Lambert, "Rivian CEO Warns That Battery Shortage Is Going to Make Chip Supply Issue Look like a 'Small Appetizer'", *Electrek*, 18 April 2022; White House, "Building Resilient Supply Chains, Revitalizing American Manufacturing, and Fostering Broad-Based Growth", *White House 100 Day Supply Chain Review Report*, June 2021; World Bank (2019).

[128] B. Nogrady, "Cobalt Is Critical to the Renewable Energy Transition. How Can We Minimize Its Social and Environmental Cost?", *Ensia*, 14 May 2020; D. Searcey, M. Forsythe, E. Lipton, and A. Gilbertson, "A Power Struggle Over Cobalt Rattles the Clean Energy Revolution", *The New York Times*, 20 November 2021.

[129] F. Lambert, "Tesla Explains Its Approach to Sourcing Lithium, Nickel, and Cobalt Directly from Mines in Impressive Detail", *Electrek*, 9 May 2022; P. Lienert, "For EV Batteries, Lithium Iron Phosphate Narrows the Gap with Nickel, Cobalt", *Reuters*, 22 June 2023.

Compared to other minerals, cobalt holds particular risks due to its relative geological scarcity. Even with vigorous recycling and substitution research and implementation, it is likely that there will be cobalt shortages in the short- and medium-term.[130] While new approaches such as seabed mining may alleviate some of this scarcity, it is unclear whether these new mining practices will be either environmentally feasible or can be quickly scaled up to meet new demand.[131] However, the variety of companies and governments that are investing in cobalt technologies and processing does show that there is possibility for diversification in the future. The short- and medium-term challenge is to improve the human rights situation where most of the cobalt is mined.

Lithium has a similar pattern to cobalt in that the bulk of lithium mining takes place in Chile and Australia, while the majority of lithium processing occurs in China. Lithium is not as geologically scarce as cobalt and does not have as deep human rights concerns. Although there are fears of lithium shortages driven by increased use in electric vehicles, lithium mining is expanding, including in the high-income countries that are driving demand.[132] Nevertheless, due to concerns about vulnerability as well as increasing costs, producers are looking to move away from reliance on lithium and the lithium-ion battery.[133]

One key difference in the geopolitics of lithium supply chains compared to cobalt is that much of the world's lithium is mined in Australia, a country that is deeply involved in a variety of supply chain resiliency and critical mineral initiatives. These include the Indo-Pacific Economic Forum, the Minerals Security Partnership, as well as a number of bilateral or trilateral agreements with countries in the Asia-Pacific region.[134] Although the bulk of lithium processing still occurs in China, there is a much clearer path to building a less concentrated supply chain compared to cobalt.

With respect to commodity mining, most countries are not eager to enter the market without safeguards. There have long been discussions within Africa on the need for the continent to derive more benefit from its natural resource endowments by insisting on the local treatment and processing of minerals.[135] In recent years, Zimbabwe and Nigeria have both passed policies to try and implement this approach with lithium. Zimbabwe issued a regulation that bans the export of

---

[130] A. Zeng et al., "Battery Technology and Recycling Alone Will Not Save the Electric Mobility Transition from Future Cobalt Shortages", *Nature Communications*, vol. 13, no. 1, 2022, p. 1341.

[131] S. Foster, "Japan Dives into Rare Earth Mining under the Sea", *Asia Times*, January 2023; https://asiatimes.com/2023/01/japan-dives-into-rare-earth-mining-under-the-sea/; Japan Organization for Metals and Energy Security (JOGMEC), "JOGMEC Conducts World's First Successful Excavation of Cobalt-Rich Seabed in the Deep Ocean; Excavation Test Seeks to Identify Best Practices to Access Essential Green Technology Ingredients While Minimizing Environmental Impact", 2020.

[132] M. Lee and H. Northey, "Making the Entire U.S. Car Fleet Electric Could Cause Lithium Shortages", *Scientific American*, E&E, 25 January 2023.

[133] Department of Energy, "Reducing Reliance on Cobalt for Lithium-Ion Batteries", Energy.gov, 6 April 2021; C. Nunez, "Researchers Eye Manganese as Key to Safer, Cheaper Lithium-Ion Batteries | Argonne National Laboratory", 4 June 2020; K. Turcheniuk, D. Bondarev, V. Singhal, and G. Yushin, "Ten Years Left to Redesign Lithium-Ion Batteries", *Nature*, vol. 559, no. 7715, 2018, pp. 467-70.

[134] K. Vekasi, *Building Resilient Critical Mineral Supply Chains: Lessons from Japan and South Korea*. Washington, DC, National Bureau of Asian Research, 2022.

[135] African Development Bank, "Africa Must Reduce Its Dependency on Raw Material Exports and Imports", *African Development Bank Group - Making a Difference*, 2015.

unprocessed lithium from the country in an effort that is primarily aimed at curbing artisanal mining.[136] This ban notably excluded the three Chinese-owned mining and processing projects that were under development at the time. Nigeria's minister of natural resources announced in 2022 that they had rejected Tesla's offer to mine and export lithium from the country for its EV battery production, explaining that battery manufacturing should be done in Nigeria to enhance technology transfer and job creation in the local economy rather than exported.[137]

The nickel market is less concentrated than cobalt or lithium. Indonesia is a key player, mining around a third of global supply, but processing far less, with China the major downstream player. In recent years, much like Zimbabwe and Nigeria, Indonesia has passed new legislation that imposes an export ban on unprocessed raw nickel in a bid to encourage new investments in domestic smelters.[138] Such export bans are not uncommon in critical battery minerals, where many low- and middle-income countries would like to see bigger gains in their industries beyond initial resource extraction. At the same time, electric vehicle companies have responded to the vulnerabilities, market concentration, and price volatility for some critical minerals. United States-based automakers like Tesla and General Motors are returning to a vertical integration model that seeks to internalise as much of the battery supply chain as possible.[139]

General dynamics in critical mineral and battery supply chains are evident from the discussion of these three minerals. Mining, whether concentrated in a single country or three, has significant negative externalities borne by local communities without commensurate benefits. Processing often happens in another country – commonly China – and the mining countries are dissatisfied with this status quo. Battery supply chains demonstrate the imbalance between countries in the Global North and the Global South. Looking at firm assets in these minerals as well as the downstream lithium-ion batteries, this pattern is again evident. Assets are concentrated in China, Great Britain, Australia, United States, and Japan, and (with the partial exceptions of China and Australia) are not in the locations where initial resource exploitation occurs. In order to build more resilient and diverse battery material supply chains, it will be necessary to increase mining and processing capacity. One way to accomplish this task is to share both the risks of mining as well as the downstream dividends.

Magnets and Motors

Along with advanced batteries, permanent magnets are a core component for green technology as well as crucial in the digital transformation. In particular, magnets made with alloys of the rare earth elements neodymium and praseodymium are used in electric vehicle and wind turbine motors. Unlike cobalt, rare earths are not geologically scarce. They are made scarce by the severe environmental costs of both mining and processing them, as well as by the technical expertise that

---

136 "Zimbabwe Bans Raw Lithium Exports to Curb Artisanal Mining", *Reuters*, 2022.

137 "Why Nigeria Rejected Telsa's Bid to Mine Raw Lithium", *The Nation*, 22 August 2022.

138 C.S. Hendrix, "Indonesia Wants to Sell Nickel to the US, but First It Should Scrap Its Export Bans", Peterson Institute for International Economics (PIIE), 26 April 2023.

139 A. St. John, "Automakers Are Replacing Decades of Know-How with Strategies from Tesla's Playbook", *Business Insider*, 16 June 2023.

is needed to efficiently process and utilise the materials. Similar to the materials used in advanced batteries, it is likely that rare earths (particularly those used in magnets) will face a shortfall in the coming years due to increased demand.[140] Even in China, the dominant actor in the global rare earth market, prices are increasing and there is pressure on demand. Chinese companies are even seeking new sources of rare earths across the southeastern border and in Myanmar.[141]

Rare earths are perhaps the earliest minerals to earn the "critical" sobriquet, labelled so when Japanese companies claimed that China had placed a ban on exporting the minerals to Japan in the midst of a territorial dispute. At that time, Japan relied on China for around 90% of its rare earths, many of which were used in permanent magnets crucial to Toyota's hybrid vehicles as well as smart phones, MRIs, and other products for which Japanese companies manufactured profitable precision components.[142]

Although China has consistently denied an export ban, because of the (at minimum) perceived threat of economic coercion, rare earths were identified by countries around the world as a potential chokepoint, vulnerable to geopolitical risk. Japan, along with Australia and Malaysia, built an alternative supply chain not reliant on Chinese companies.[143] While governments in Europe and the United States discussed the possibility of doing the same, little direct action was taken at that time to diversify the supply of rare earths. Today, using some of the same initiatives outlined in the prior section, such as the Mineral Security Partnership, governments and companies around the world are making efforts to diversify the supply of rare earths.[144]

There are challenges, however, to diversifying this market. China has deep investment in the rare earth industry, dating back to the 1980s when there was a great deal of state investment in the sector, particularly in training a new generation of scientists with rare earth expertise. This expertise has paid off for the Chinese market, not only in mining and global processing but also in downstream industries, particularly in permanent magnets. Over the past decade China has also consolidated its rare earth industry into large vertically integrated mega-firms, controlling a large part of the world's research and development, mining, and processing capacity.[145] While not reflected in the Orbis revenue data, China has a dominant intellectual and market share in rare earths along the entire supply chain.

One of the key lessons to take from the concentration of the rare earth supply chain is that long-term investment and research and development and the training of expertise is core to

[140] "Rare Earth Elements: Market Issues and Outlook", *Adamas Intelligence*, 28 September 2020.
[141] D. Kang, L. Hinnant, and V. Milko, "'The Sacrifice Zone': Myanmar Bears Cost of Green Energy", *AP News*, 9 August 2022.
[142] J.M. Klinger, *Rare Earth Frontiers: From Terrestrial Subsoils to Lunar Landscapes*, Ithaca N.Y., Cornell University Press, 2018.
[143] E. Gholz and L. Hughes, "Market Structure and Economic Sanctions: The 2010 Rare Earth Elements Episode as a Pathway Case of Market Adjustment", *Review of International Political Economy*, vol. 28, no. 3, 2021, pp. 611-34; K. Vekasi, "Politics, Markets, and Rare Commodities: Responses to Chinese Rare Earth Policy", *Japanese Journal of Political Science*, vol. 20, no. 1, 2019, pp. 2-20.
[144] G7, *Five-Point Plan for Critical Minerals Security (Annex to the Climate, Energy and Environment Ministers' Communiqué*, Hiroshima, Japan, 2023, R. Kabir, "Explained: What Is Mineral Security Partnership? Which Countries Are Part Of It?", *abp Live*, 5 August 2022.
[145] Q. Zhou and S. Brooke, "China Merges Three Rare Earths State-Owned Entities to Increase Pricing Power and Efficiency", *China Briefing News*, 12 January 2022.

developing more diverse and resilient supply chains. These are not actions that can be accomplished within a short-term horizon like five years, but rather must be nurtured over decades.

Conclusion

There are two clear global patterns in the control of commodity supply chains. The first pattern is that China has claimed a dominant position in critical mineral supply chains, sometimes in mining, and even more commonly in downstream processing. China's position may have initially been driven by low regulatory standards and lack of environmental regulations but has also been earned through long-term and deep investment in critical minerals and their downstream products.

When chokepoints in commodity supply chains exist, it is typically for a good reason. While it is sometimes due to geological scarcity, it is typically more complicated: market efficiencies are created by state policies that lower the cost of doing business or provide the skills and know-how to make an industry efficient and effective. These are the factors that created the conditions for China's control of rare earths, as well as the downstream battery and magnet supply chains. We also see these patterns play out in battery supply chains.

However, it is also evident that supply chains can be modified and diversified. Japan showed this in their diversification efforts with Australia and Malaysia following the 2010 rare earth crisis. Indonesia, Zimbabwe, and Nigeria have also made efforts to change existing supply chains through their use of domestic and trade policy to shift the dynamics to better favour their domestic economies. Private companies, as well, have been responding to market risks with diversification efforts and a return to vertical integration and more domestic production.

In the current moment, it is clear that the coming demand pinch will require dramatic action on the part of the world in order to meet the challenges of the green and digital transitions. In order to fulfil this challenge in the smoothest possible way, and to minimise the risks and vulnerabilities of concentrated supply chains, it will be necessary to heed the voices of producers both upstream and downstream. The data clearly show that the upstream is largely concentrated in low- and middle-income countries, while the downstream is focused on higher-income countries. This balance produces additional risks and vulnerabilities because of the lack of local stakeholders at the corporate and government negotiating tables, introducing the possibility of new policy instability as governments use critical mineral policy to improve domestic economic gains or reject the injustices of the past.

Many of the global initiatives that exist today to try and solve these challenges speak the language of equity, and sometimes environmental justice. Moving forward, in order to avoid the mistakes of the past and make the critical mineral space more resilient, inclusive, and green, those promises will need significant oversight and follow-through. That could happen through forums like the World Bank, the United Nations, or smaller regional organisations such as Asia-Pacific Economic Cooperation, the Indo-Pacific Economic Forum, or the European Union, all of which have their own initiatives. Our challenge now is making those promises reality.

3. From Ambition to Action in Europe: Chips, the Smaller, the Better

Antonio Calcara and Raluca Csernatoni

Semiconductors are the backbone of today's economic and industrial production system. Semiconductors or chips power washing machines, smartphones and the computers on which we are writing this chapter, but they are also essential for sophisticated military equipment and a prerequisite for future advances in emerging and disruptive technologies (EDTs) such as artificial intelligence (AI), quantum computing, the Internet of Things (IoT), supercomputers and automated vehicles.[1] Given their importance for economic and military power, it is no coincidence that access to, and control of semiconductors has gradually become the focus of geopolitical competition between the United States and China and, more generally, the key industrial and technological sector for understanding contemporary economic and (geo)political changes. Semiconductors, for example, have been one of the main areas on which Western sanctions against Russia have been focused since the invasion of Ukraine, with the explicit aim of weakening the defence industry and, more generally, Russia's technological and industrial base.[2]

Such devices are produced through an extremely complex and costly manufacturing and assembly process and, given their technological complexity, their research and industrial production is structured around highly specialised companies and global value chains. Indeed, no single company can operate across the semiconductor value chain end-to-end, and the development of the fabless or foundry model – a business model in which a company focuses on designing and developing chips without owning the manufacturing facilities – has allowed companies to outsource intensive manufacturing to specialised foundries around the world. This model entails the need to collaborate across a multitude of suppliers around the globe, with research and design being done, for instance, in Silicon Valley, critical equipment being produced in the US, Europe, Japan, and South Korea, and special chemicals and gases being sourced from Europe and East Asia, while manufacturing, packaging, assembly, and testing is located in East Asian countries like

[1] M. Blumenthal and R. Csernatoni, "Computers on Wheels: Automated Vehicles and Cybersecurity Risks in Europe", Carnegie Europe & EU Cyber Direct, 24 March 2022.

[2] U.S. Department of State, "The Impact of Sanctions and Export Controls on the Russian Federation", 2022.

Taiwan. This global distribution complicates the geopolitics behind the research, development, and manufacturing of semiconductors.[3]

It is therefore very difficult to put into context the many initiatives that different countries are taking either to strengthen their competitive position in this value chain, to support their home-grown semiconductor production or to prevent other countries from gaining an advantage in this crucial technology sector. While the quantities and quality demanded of chips have risen substantially over the last decade, only a few countries – such as the US, Taiwan, South Korea, Japan, some EU countries, and increasingly, China, possess the expertise and the complex, capital-intensive manufacturing required to produce cutting-edge semiconductors.[4] Because of this, the global supply chain is subjected to high levels of interdependencies, and exposed to disruption risks and trade wars. In particular, Taiwan holds an almost monopolistic position, taking up over 63% of total manufacturing revenue in 2020.[5]

Europe relies on semiconductors to power its tech and industrial base, as they are an essential component driving innovation, digital transformation, and economic growth. The debate in Europe about strategic autonomy, as well as digital and technological sovereignty, has been building over recent years at both EU and Member State levels, and recently it has also framed European efforts in the semiconductor sector. In this respect, the EU's Chips Act is intended to address the bloc's precarious position in the global semiconductor supply chain, and aims to boost the EU's market share of advanced semiconductors to 20% by 2030.[6] This initiative was not only driven by European geopolitical ambitions, but also by the necessity to quickly address geo-economic dependencies, exacerbated by the semiconductor supply crisis from 2021 to 2022.

Against this background, this chapter has two objectives. First, it aims to provide a brief overview of the semiconductor value chain and to show which countries and companies control the nodes of this complex production and industrial process. Second, the chapter looks at the European catch-up initiatives in this sector from a medium-term historical perspective, comparing the convergences and divergences between current European initiatives and those of the recent past. The rest of this chapter is structured as follows: in the next section, we will briefly present the structure of the semiconductor value chain and try to outline its dominant technological and industrial aspects, as well as the main industrial players. We will then focus on European initiatives, starting with those developed during the previous period of great competition in this sector, i.e. the 1980s, and ending with current developments, which will also be set in the context of the broader economic and political competition between the US and China. The conclusions will analyse critical aspects of the European position in the semiconductor sector.

The Semiconductor Value-Chain

[3] Accenture, "Harnessing the power of the semiconductor value chains", 1 February 2022.

[4] R. Csernatoni, "For the EU, microchips and geopolitics are two sides of the same coin", *Euronews*, 11 February 2022.

[5] Yen Nee Lee, "2 charts show how much the world depends on Taiwan for semiconductors", *CNBC*, 15 March 2021.

[6] European Commission, European Chips Act – The Need for EU Action, 2023.

Semiconductors are an enabling technology for the entire electronics value chain. Semiconductors are a sector characterised by exponential technological complexity, encapsulated in the famous Moore's Law, the observation that the number of transistors on an integrated circuit (IC) doubles approximately every two years.[7] The semiconductor industry is the most capital-intensive in the world, with research and development (R&D) representing 20% of revenues, and is characterised by a complex and highly specialised value chain.

Semiconductor technology originated in the US in the 1950s, first with the invention of the transistor, developed by Bell Labs in 1947, and later with the introduction of the integrated circuit by the US company Texas Instruments-Fairchild (in 1959).[8] The main customers of early semiconductor companies such as Fairchild and Texas Instruments were mainly the US defence industry and military equipment manufacturers. In 1965, military and space applications would use over 95% of the circuits produced by Fairchild Semiconductors and 72% of all integrated circuits produced that year.[9] From the late 1960s, however, the computer industry also began to systematically use semiconductors to power its products. By 1968, the computer industry was buying as many chips as the military. The entry of semiconductors into the commercial market favoured the spread of large industrial giants that produced semiconductors through a vertically integrated structure. Companies such as Fairchild, Texas Instruments and Intel designed, manufactured, and assembled their own chips in-house.

Things began to change in the 1980s. The relentless technological progress of semiconductors necessitated a change in the industrial structure, with companies becoming more specialised in the different stages of production. This period saw the emergence of the so-called "fabless" phenomenon, i.e. companies that design, develop, and market semiconductor products but do not manufacture them.[10] As mentioned above, this business model allows fabless companies to focus on their core competency of product research and development, while leaving manufacturing to those with the necessary facilities and expertise. As a result, semiconductor production has become multi-layered, with an intricate network of relationships between those who design semiconductors, those who manufacture them, and those who assemble them.

There are many different types of semiconductor today,[11] but, for simplicity's sake, we can distinguish between three production processes: design, manufacturing, and assembly. Chip designers (the so-called fabless companies) rely on design software and intellectual property blocks. Chip design is skill intensive with high R&D costs. Fabless companies typically spend 25%

---

[7] In his 1965 *Electronics* paper, "Cramming more components onto integrated circuits", Intel co-founder and at that time Head of research and development at Fairchaild Gordon Moore predicted that – over a ten year span – the number of transistors on a chip would double each year.

[8] Jack Kilby at Texas Instruments and Robert Noyce at Fairchild were the main protagonists of this invention.

[9] C. Miller, *Chip War: The Fight for the World's Most Critical Technology*. Simon and Schuster, 2022.

[10] But there are rare exceptions. Intel, for example, designs almost all its chips and builds them in its own factories. See S. Sarma and S.L. Sun, "The genesis of fabless business model: Institutional entrepreneurs in an adaptive ecosystem", *Asia Pacific Journal of Management*, vol. 34, 2017, pp. 587-617 for an overview.

[11] There are seven broad categories: memory, logic, micro, analog, optoelectronics, discrete and sensors. See J.P. Kleinhans and N. Baisakova, "The global semiconductor value chain: A technology primer for policy makers", Stiftung Neue Verantwortung, 2020, pp. 1-30.

of their revenues on R&D. According to recent data, designing a chip for 5nm nodes costs more than $540 million.[12] Companies like Qualcomm (US), Nvidia (US) Broadcom (US) and HiSilicon (China) are the main players in chip design. In addition to the traditional fabless companies, many new players have entered the market: Alibaba, Alphabet (Google), Amazon, Apple, Facebook and Tesla all design their own chips.

Fabrication plants (i.e. "fabs") transfer the chip design onto a wafer. Chip manufacturing is also very capital intensive because of expensive facility and equipment costs to buy chemical and silicon wafers. Today, it costs about $20 billion to build a single foundry and costs will continue to rise exponentially.[13] Fabs also use a lot of water and the rooms in which chips are made need to be kept clean, as even a few random particles landing on a chip can ruin it. The air in the fab needs to be completely changed every few seconds, with high-efficiency particulate air filters in the ceiling blowing air down and out through perforations in the floor for it to be filtered and recirculated.[14] Companies such as the Taiwan Semiconductor Manufacturing Company Limited (TSMC) in Taiwan and Samsung in South Korea are major players in chip manufacturing. Fabless companies have to work closely with these foundries, because a chip design has to fit a particular production process.[15] Fabs have therefore developed a symbiotic relationship with some chip designers. According to a recent report from Taiwan, around 90% of TSMC's 3nm family capacity will be dedicated to Apple's orders.[16]

Assembly is labour intensive and has lower profit margins. Companies specialising in the back end of the semiconductor manufacturing process are called Outsourced Semiconductor Assembly & Test (OSAT) companies, and major assembly companies are based in China (including JCET, TFMC, Hua Tian). Some suppliers play an essential role in this value chain. For example, chip designers are dependent on electronic design automation (EDA) tools, a highly concentrated market dominated by three US-based companies: Cadence Design Systems, Synopsys and Mentor. Those who manufacture semiconductors, TMSC and Samsung *in primis*, depend on EUV lithography tools, without which making an advanced chip is simply impossible.[17] ASML, a Dutch-based company, has a virtual monopoly in this area and works closely with TMSC to supply this type of equipment, which costs US$150 million.[18]

ASML Holding N.V., commonly shortened to ASML, originally standing for Advanced Semiconductor Materials Lithography, is a Dutch-based multinational corporation founded in 1984, specialising in the development and manufacturing of the photolithography machines used to produce chips. This tech company is extremely important, due to the fact that it is the only company

---

[12] In 2016, designing a chip for 10nm nodes costed around $170 million. See Ibid.

[13] Rock's law or Moore's second law, named for Arthur Rock or Gordon Moore, says that the cost of a semiconductor chip fabrication plant doubles every four years.

[14] D. Nenni and P.M. McLellan, *Fabless: The Transformation of the Semiconductor Industry*, Colorado Springs, CO, CreateSpace Independent Publishing Platform, 2014, p. 16.

[15] For example, switching a chip design from Samsung's 7nm node to TSMC's 7nm node means almost a complete redesign and thus, years of work for cutting-edge chips. See Kleinhans and Baisakova (2020).

[16] "Apple reportedly hoards 90% of TSMC's 3nm capacity this year", GSMarena, 15 May 2023.

[17] Lithography is the process of using light to create patterns on silicon wafers.

[18] N. Patel, "Inside the global battle over chip manufacturing", *The Verge*, 31 January 2023.

in the world that makes extreme ultraviolet lithography (EUV) machines – the most sophisticated type of lithography equipment, required to make every single advanced processor chip used in the world today. ASML's 2022 second-quarter results boasted the highest quarterly level of orders in the company's history, with new orders rising to US$8.39 billion (€8.46 billion) from US$2.76 billion during the same quarter in 2019.[19] Furthermore, the semiconductor value chain is highly dependent on critical raw materials, including silicon of course, but also palladium, cobalt, gallium, and germanium.[20]

What Europe Has Done in the Past

Europe's technological and industrial base, as well digital transformation and future competitiveness are heavily dependent on a robust semiconductor ecosystem. Historically, Europe has faced challenges due to an increasing reliance on imported chips, and recent EU efforts have focused on investments in semiconductor research, development, and manufacturing. But what has Europe contributed to the semiconductor sector and what key players does it have in this field?

US companies were the first to enter the semiconductor market, enjoying strong demand from the military (especially for building missiles and aircraft) and then strong demand from the computer industry.[21] As a result, US companies were the undisputed leaders in the 1960s and 1970s, and the history of semiconductors was fully intertwined with the development of the aptly named Silicon Valley.[22] Things began to change in the 1970s with Japan's entry into the semiconductor market. On the one hand, during the 1970s and 1980s, the US government took several measures to protect its semiconductor sector from Japanese competition, including the introduction of tariffs and trade barriers to encourage domestic production, anti-dumping actions, Intellectual Property Rights (IPR) protections, the stricter enforcement of patents, copyrights and trade secrets, export controls, and the allocation of significant state-subsidised resources for R&D and market development, especially in defence and space-related technologies.

On the other hand, Japanese companies benefited from deliberate integration into America's semiconductor industry, a process supported by Japanese business elites and the US government. Japanese companies also took advantage of the strong demand for digital integrated circuits in the early 1970s from Japanese consumer electronics companies (including Sony and Sharp) and from the computer industry.[23] The Japanese government succeeded in fostering the development of the semiconductor industry through major government programmes[24] and the

---

[19] L. Williams, "Why ASML is the most important company you've never heard of", *Investment Monitor*, 5 October 2022.
[20] J. Teer and M. Bertolini, *Reaching breaking point*, The Hague Centre for Strategic Studies, April 2023, pp.16-18.
[21] S. Martin, "Protection, promotion and cooperation in the European semiconductor industry", *Review of industrial organization*, vol. 11, 1996, pp. 721-35.
[22] See A. Saxenian, "Regional networks and the resurgence of Silicon Valley", *California management review*, vol. 33, no. 1, 1990, pp. 89-112.
[23] Japanese computer producers in fact, held 48% of the Japanese computer market in 1967, 58% in 1976 and 53% in 1983. F. Malerba, "Demand structure and technological change: The case of the European semiconductor industry", *Research Policy*, vol. 14, no. 5, 1985, pp. 283-97.
[24] The best-known example of this is the MITI-godfathered VLSI [very Large Scale Integrated circuit] Technology Research Association, set up in 1976 to stimulate innovation in semiconductor technology.

integration of semiconductor producers led to divisions of vertically integrated firms, which in turn were interlinked through the so-called *Keiretsu* system.[25] In the 1980s, South Korea took advantage of the relocation of US and Japanese companies (a process that gave rise to Samsung), while Taiwan, through a well-designed government plan, was able to attract capital and expertise from Silicon Valley, eventually leading to the creation of TSMC in 1987.

Europe was thus at a disadvantage compared to the US and Japan and was threatened by the advances of South Korea and Taiwan in semiconductor production. The 1986 agreement between the US and Japan[26] was seen by Europe as a possible cartelisation of the world semiconductor market. By the early 1980s, in fact, Japan had overtaken Europe in the production of semiconductors (with a global share of 30% compared to 17%).[27] In the 1970s, major European states tried to build their own national champions, but achieved poor results.[28] This was due to the fact that semiconductor companies were concentrated in a few countries in particular (mainly Germany and the Netherlands). Large countries such as the UK and France, which did not have national champions of the calibre of Philipps and Siemens, began to favour mergers with non-European firms with the effect of reducing "indigenous competition in the face of penetration by subsidiaries of American firms and generated champions that were unfit to take on the Americans".[29]

European industry was also late in adopting silicon, as germanium remained more reliable for consumer equipment. This was because there was not much demand in Europe for integrated circuit technology for use in the advanced computer industry, and this small demand was met mainly by imports from the US or by products from newly established American subsidiaries in Europe.[30] Demand from the military was also much lower than in the US.[31]

After the failure of the national champion strategy, companies such as Siemens and Philipps lobbied the European Commission and Member States for European plans to support the semiconductor industry. In 1980, Etienne Davignon, then Commissioner of Industry in the European Community brought together 12 of Europe's largest information technology companies and invited them to work together to develop a work programme for their industry. The European Commission and Member States thus launched several European strategic cooperation programmes. In 1985, the Eureka programme was launched, which also contributed to the creation

---

[25] Y. Aoyama, "Networks, keiretsu, and locations of the Japanese electronics industry in Asia", *Environment and Planning A*, vol. 32, no. 2, 2000, pp. 223-44.

[26] In which Japan agreed to limit its exports of semiconductors, mainly the "dynamic random access memory" (DRAM) chips, to America. See D.A. Irwin, "The US-Japan semiconductor trade conflict", in *The political economy of trade protection*, University of Chicago Press, 1996, pp. 5-14.

[27] https://www.phenomenalworld.org/analysis/the-eurochip/

[28] G. Dosi, *Technical Change and Industrial Transformation. The Theory and an Application to the Semiconductor Industry*, no. 0583, 1983. Department of Economics, University of Sussex Business School.

[29] Langlois + Stenmuller. Quoted in D.C. Mowery and R.R. Nelson (eds.), *Sources of Industrial Leadership: Studies of Seven Industries*, New York, Cambridge University Press, 1999

[30] F. Malerba, "Demand structure and technological change: The case of the European semiconductor industry", *Research Policy*, vol. 14, no. 5), 1985, pp. 283-97.

[31] Demand for semiconductors from the military reached at least 10% only in France and the UK.

of a pan-European start-up under the French initiative called European Silicon Structure (ES2).[32] In 1989, the Joint European Submicron Silicon Initiative (JESSI) was launched to strengthen Europe's position in semiconductor manufacturing by focusing on submicron technology and manufacturing research.[33] In 1992, in the context of the Maastricht Treaty, the European Commission launched the ESPRIT project, to create synergies between the various semiconductor manufacturers in Europe.[34]

These programmes have not been entirely satisfactory. On the one hand, they have produced positive results. STMicroelectronics (the result of a Franco-Italian merger), Infineon, and NXP, the few major European chipmakers today, benefited from these plans. However, this was not accompanied by the creation of a competitive European semiconductor industry. There are several reasons for this failure. First, these plans to support the semiconductor industry proved to be unambitious. In fact, the European Commission set strict limits on direct government support for company activities, favouring pre-competitive research and limiting commercial considerations in projects. As noted by Malerba, Western governments decided to support policies designed to reinforce existing company strategies, but if "existing strategies had had much possibility of success, public support would not have been nearly so necessary".[35]

Second, these programmes suffered from one of the classic problems of industrial policy, namely that of picking winners and being captured by the interests of large companies. In fact, the ESPRIT programme funded a very limited number of well-known companies, rather than trying to broaden the funding to the development of innovative new companies.[36] There were also structural problems in the European economy, which missed the computer revolution and fell behind in digital products.[37] This had negative repercussions for the demand for advanced semiconductors in Europe, giving private companies little incentive to invest in new semiconductor research.

What Europe Is Doing Today

Partly as a result of the failures of previous decades, first with the national champion strategy and then with European programmes, Europe is dependent on other states and regions of the world for the design and manufacture of semiconductors. Today, Europe produces only 9% of the world's

[32] https://www.phenomenalworld.org/analysis/the-eurochip/

[33] H. Gruber, "Trade policy and learning by doing: the case of semiconductors", *Research policy*, vol. 25, no. 5, 1996, 723-739.

[34] W. Sandholtz, " ESPRIT and the politics of international collective action", *J. Common Mkt. Stud.*, vol. 30, no. 1, 1992.

[35] Malerba (1985).

[36] J. Peterson, "Technology policy in Europe: explaining the framework programme and Eureka in theory and practice", *JCMS: Journal of Common Market Studies*, vol. 29, no. 3, 1991, pp. 269-90, p. 277.

[37] This has larger implications, which may explain why Europe lacks big tech and is dependent on digital and cloud services produced by companies such as Amazon Web Service, Microsoft Azure and Google Cloud Computing. See K. Sahin and T. Barker, "Europe's Capacity to Act in the Global Tech Race", German Council on Foreign Relations (DGAP), April. 2021.

chips, mainly for industrial and automotive applications, while it has limited capacity to produce advanced computer chips, especially in chip design, where it has only 2% of the market.[38]

Europe also finds itself caught in the middle of an increasingly intense geopolitical competition between other states and China for control of and access to new technologies, exacerbated by the fact that the manufacturing of chips is overwhelmingly based in Taiwan. China currently imports most of its semiconductors and is highly dependent on US-origin semiconductor technology.[39] The US is therefore trying to pursue a two-pronged strategy: on the one hand, it wants to strengthen its domestic production of semiconductors. The Biden administration has launched the Chips and Science Act, a $280 billion package that includes $52 billion in funding to boost US domestic manufacturing.[40] On the other hand, the US wants to use the dominant position of its companies in the higher segments of the value chain, such as chip design, to block Chinese companies' access to the most advanced semiconductors.[41] In this context, the US has also pressured allies such as Japan and the Netherlands (where the aforementioned ASLM is based) to align themselves with US priorities.

Indeed, after months of dialogue and "persuasion", The Netherlands and Japan have finally agreed to a US request to tighten their controls on the export of chip manufacturing equipment and technologies to China. Both countries have joined hands with the US to further strengthen restrictions meant to cripple China's technological and digital prowess in the global arena. China is responding to US initiatives by seeking to strengthen its domestic semiconductor production plans and also by filing a complaint with the World Trade Organization's dispute-settlement body.[42] Due to the fact that China's presence in the global chip value chain remains weak, it has few options to mitigate dependencies, namely relying on its sole lithography systems maker, Shanghai Micro Electronics Equipment (Group) Co, which was added to the US' Entity List in December 2022, thus restricting its access to US technologies.[43]

Europe is therefore in a complicated position: on the one hand, it is lagging behind in both design and semiconductor manufacturing. On the other hand, it is forced to respond to American and Chinese initiatives. In this regard, European officials argue that they have no choice as, "if Europe fails to act, it risks losing the race for the technology of the future".[44]

---

[38] A. García-Herrero and N. Poitiers, "Europe's promised semiconductor subsidies need to be better targeted", Bruegel, 17 October 2022.

[39] Kleinhans and Baisakova (2020).

[40] Chips and Science Act. The US idea is also to attract TSMC investment in the US territory. At the time of writing, TSMC is planning to build a mega-fab in Arizona with an initial investment of US$12 billion.

[41] In October, the US used its Foreign Direct Product Rule (FDPR) to apply some of these controls extraterritorially. The FDPR allows the US government to extend export controls to certain foreign products made with US technology. See Bureau of Industry and Security, Office of Congressional and Public Affairs, For Immediate Release, "Commerce Implements New Export Controls on Advanced Computing and Semiconductor Manufacturing Items to the People's Republic of China (PRC)", 7 October 2022.

[42] M.C.M. Chu, "China's defence semiconductor industrial base in an age of globalisation: Cross-strait dynamics and regional security implications", *Journal of Strategic Studies*, 2023, pp. 1-26.

[43] K. Dashveenjit, "The US-Japan-Netherlands chip export restrictions are leaving China uneasy. Here's why", *TechWire Asia*, 17 January 2023.

[44] See "Germany's new chip factories: a bet on the future or waste of money?", *Financial Times*, 11 May 2023.

Europe's aim is therefore to reassert its role in the semiconductor market. Europe has launched its Chips Act, a plan for €43 billion of public and private investment in the bloc's chip industry and an essential new piece in the EU's digital sovereignty puzzle.[45] This has provided the European Commission with a window of opportunity to put forward the Act, which seeks to rectify Europe's critical dependencies in the global supply chain. The Commission, given the urgency born out of the global semiconductor shortage, and by leveraging the notions of digital and technological sovereignty[46], has carved out a new policy agenda, turning a strategic European vulnerability into an opportunity for EU agenda-setting and unprecedented investments in this sector to create a state-of-the-art European chip ecosystem.[47] According to the Commission, this would "include production, as well as connecting the EU's world-class research, design and testing capacities".[48]

The Chips Act is based on three pillars: first, the Chips for Europe initiative, which supports large-scale technological capacity building and innovation; second, a framework to ensure security of supply and resilience by attracting increased investment; and third, a monitoring and crisis response system to anticipate shortages and coordinate action in crisis situations. As previously mentioned, the stated aim is to reverse the decades-long decline in Europe's share of the global semiconductor value chain and increase it to 20% by 2030 (from 9% today).[49] The European Commission has also recently kick-started the European Alliance for Processors and Semiconductors, bringing together EU member states, businesses, research, and technology organisations.[50] The European plan is to attract foreign investment, especially in semiconductor manufacturing. In this regard, Intel has stated that it wants to construct a $19 billion semiconductor fabrication plant in Germany.[51] STMicroelectronics and GlobalFoundries have signed up with the French government for a $6 billion fab in France.[52]

These ambitious European plans are part of a larger strategy to make Europe strategically autonomous[53] or, at least, to "de-risk" the European continent from dangerous dependencies and vulnerabilities to third countries.[54] These plans could therefore have a positive impact on the revitalisation and consolidation of strategic companies on the European continent and on European trade and foreign policy. However, they could also encounter problems: first, there is a problem

---

[45] R. Csernatoni, "The EU's Chips Act: A New Piece in the Digital Sovereignty Puzzle", in D. Broeders (ed.) *Digital Sovereignty: From Narrative to Policy?*, EU Cyber Direct & The Hague Program on International Cyber Security, December 2022.

[46] R. Csernatoni, "The EU's Hegemonic Imaginaries: From European Strategic Autonomy in Defence to Technological Sovereignty", *European Security*, vol. 31, no. 3, 2022, pp. 395-414.

[47] R. Csernatoni, The EU's Chips Act: A New Piece in the Digital Sovereignty Puzzle…, cit.

[48] European Commission, European Chips Act – The Need for EU Action, 2023.

[49] Ibid.

[50] European Commission, Digital sovereignty: Commission kick-starts alliances for Semiconductors and industrial cloud technologies, Press release19 July 2021.

[51] "Germany's new chip factories: a bet on the future or waste of money?"…, cit.

[52] S. Kar-Gupta and S. Mukherjee, "STMicro, GlobalFoundries plan new $5.7 billion French chip factory", Reuters, 11 July 2022.

[53] "Europe needs more factories and fewer dependencies", *Financial Times*, 11 May 2023.

[54] https://ec.europa.eu/commission/p11 may 2023.resscorner/detail/en/speech_23_2063

that remains unresolved and that has characterised both the European efforts in the 1980s and 1990s and those of today, namely the problem of demand. Europe is not a major importer of cutting-edge chips and the chips that the European automotive industries require are not the most advanced ones. Others say that cars will become increasingly digitised and software-driven and that the most advanced semiconductors will be indispensable for European carmakers. At this point, however, it would make more sense to specialise in chip design and the higher end of the value chain rather than subsidise the manufacture of semiconductors.[55]

The second problem is that industrial policy plans are repeating the same mistakes as in the 1980s and 1990s. At the moment, European investment is not keeping pace with that of other countries, especially the US (between 2021 and 2025, the US will spend US$122 billion on new chip capacity, while the Europeans will spend only US$31 billion).[56] Industrial policy plans could also run the risk of "picking winners" and favouring some players over others. Moreover, in such a complex value chain, it will still be virtually impossible to be fully autonomous and sovereign. To give an example, possible new European fabs will still be dependent on imports of chemicals from non-European countries.[57]

The third problem is the fact that the Commission must also anticipate competition between Member States for technology-related funding programmes and investments in this sector. The Chips Act, for example, foresees the establishment of a European Semiconductor Board comprising representatives from EU Member States and chaired by the European Commission,[58] giving Member States an increased role in deciding which projects receive funding, in contrast to the Horizon Europe Programme, for example, where Member States have much less decision-making power. As technology-related funding grows, it may become increasingly difficult to balance the interests of the EU as a whole against those of individual Member States, and this may require changes to decision-making procedures.

Fourth, a lack of resources and specialised personnel could hamper European plans. Energy costs, exacerbated by Russia's invasion of Ukraine, could significantly increase, thus making investment in factories much more expensive than anticipated. Furthermore, building fabs would require large amounts of water, which may not be sustainable in some parts of Europe.[59] Because of this, the planned STMicroelectronics and GlobalFoundaries factory in southern France resulted in a protest over the facility's water consumption and environmental impact.[60] What is more,

---

[55] N.F. Poitiers and P. Weil, "A new direction for the European Union's half-hearted semiconductor strategy", Policy Contribution, Issue no. 17/21, Bruegel, July 2021; J.-P. Kleinhans and J. Lee, "China's rise in semiconductors and Europe. Recommendations for policy makers", Stiftung Neue Verantwortung, December 2021.

[56] Data compiled by Everstream and quoted here "Germany's new chip factories: a bet on the future or waste of money?", *Financial Times*, 11 may 2023.

[57] In fact, TSMC asked Taiwan Specialty Chemicals Corp. to set up facilities in the US to support TSMC's plan to build a 5nm fab in Arizona.

[58] R. Csernatoni, The EU's Chips Act: A New Piece in the Digital Sovereignty Puzzle…, cit.

[59] TSMC is no stranger to water scarcity. Taiwan is facing its worst drought in 56 years, which TSMC says has not affected production. See K. Tarasov, "Inside TSMC, the Taiwanese chipmaking giant that's building a new plant in Phoenix", *CNBC*, 16 October 2021.

[60] "Water: hundreds of demonstrators opposed to STMicroelectronics", *News in France*, 1 April 2023.

Europe does not seem to have the skilled personnel to support its large investments. In comparison, Japan's and Taiwan's strategy to compete with the US has been to combine government investments with policies to attract personnel trained in electrical engineering from Ivy League universities in the US. If Europe is serious in catching up, it needs to strengthen its skills and talent policies and address the underlying causes of brain drain, such as the European innovation ecosystem and competitive salaries.

Conclusion

This chapter had two objectives: first, to describe the complex value chain around which semiconductor manufacturing is structured; second, to highlight the evolution of European policy in this sector and the challenges and opportunities for Europe at a time of strong geopolitical competition for access to semiconductors between the US and China. For Europe, seeking full autonomy and digital sovereignty in the semiconductor sector is unrealistic and to a large degree undesirable. The fact that parts of the sovereignty agenda are linked to EU-US disagreement over the behaviour and business models of large American technology companies complicates transatlantic relations in this field. Particularly with regard to strengthening the resilience of semiconductor supply chains, the EU should pursue diplomatic channels to coordinate its efforts with the US, for example through the EU-US Trade and Technology Council. Counterproductive zero-sum subsidy races, both international and intra-European, should be avoided. Given that "sovereignty" is a contested concept, likely to breed different understandings in different national contexts, the EU should pay particular attention to aligning goals and determining common interests to mitigate the risk of strategic confusion. In the area of semiconductors in particular, the EU must also focus on building relationships with technology alliances beyond the transatlantic connection. Collaboration can facilitate R&D efforts, technology transfers, and access to advanced manufacturing processes, also enabling the EU to leverage external expertise. Efforts should be concentrated on building strategic interdependence in addition to strategic autonomy.

4. Green Transition and the Energy Industry: The Key Role of Technological Innovation

Laura Cozzi

At the start of last year, the first truly global energy crisis brought about unprecedented levels of energy prices, amid increasing energy-security concerns. At the same time, one question in particular was pervasive: would the crisis acts as a brake or an accelerator for clean energy transitions?

One year on, the answer is clear: global energy transitions have been supercharged over the past 12 months**.**

Deployment of solar increased by 40%, and the pipeline of manufacturing projects is set to deliver what is needed by 2030 to be on a track to meet the most stringent climate goals. Nuclear capacity addition was also up by 40%, and a number of countries are considering extending the lifetime of reactors. Electric vehicles (EVs) reached 15%, up from less than 5% just three years ago. Heat pumps are also showing double-digit growth.

Looking at 2023 the trend is clear. For the first time in 2023, investment in solar energy will outstrip spending in upstream oil, and investment in clean energy alone is set to reach attain US$1.7 trillion – around 60% of total energy investments for the year. In other words, for every dollar invested in fossil fuels, about 1.7 dollars are now going into clean energy. Five years ago, this ratio was one-to-one.

The falling price of clean-energy technologies is driving investments, and so are government policies. The International Energy Agency (IEA) Government Energy Spending Tracker finds US$1.34 trillion allocated by governments for clean-energy investment support since 2020. Government spending has played a central role in the rapid growth of clean-energy investment since 2020, which rose nearly 25% from 2021 to 2023, outpacing growth in fossil fuels in the same period. The newest outlays identified are predominantly aimed at boosting mass and alternative transit modes, low-carbon electricity generation projects and low-carbon vehicle sales. Among all measures tracked since 2020, direct incentives for manufacturers aimed at bolstering domestic manufacturing of clean energy now total around US$90 billion.

The clean-energy transition is opening up major opportunities for a new industrial age, with considerable potential for innovation and job creation. But an orderly transition will hinge upon managing new energy-security risks relating to critical minerals and clean tech supply chains. We explore them one by one.

The New Energy Economy

Clean-energy supply chains are a key indicator of the transformation ahead. In particular they clearly show the unique alignment of energy-security policy, climate policy and industrial policy that is emerging, as remarked in May of this year in the G7 Clean Energy Economy Action Plan.

Change is already happening apace in sectors such as electric vehicles and solar PhotoVoltaic (PV), heralding a new era in manufacturing, with countries around the world introducing policies to shore up their position in the emerging clean-energy economy. This fast-moving transition has been given added impetus by the current global energy crisis, which has increased energy-security concerns and starkly illustrates the need for clean-energy technologies with diversified supply chains.

The place of clean-technology manufacturing in industrial strategy is now a critical consideration for governments, with policy makers committing to scaling up investments and diversifying supply chains. Strategic policy making in the area of clean-technology manufacturing will require a clear understanding of the expected demand for clean-energy technologies in different regional and policy contexts, and an assessment of bottlenecks that need to be addressed in order to fulfil climate ambitions.

Three key technologies – solar, batteries and electrolysers – are extremely dynamic, and the manufacturing pipeline is expanding at breakneck speed.

Solar PV manufacturing – which increased at a compound annual growth rate of 25% during the period 2010-21 – shows no sign of slowing down. In 2022, global manufacturing capacity rose by nearly 40% to about 640 GW, with 90% of the growth relative to 2021 taking place in the People's Republic of China.

As of late 2022, the IEA's analysis of announced solar PV projects suggested that manufacturers were already on track to meet projected demand in 2030, thus paving the way to reaching net-zero emissions by 2050. By the end ofQ1 2023, the project pipeline had expanded even further, increasing the total volume of planned capacity by 60%.

Major project announcements made in Q1 2023 include new manufacturing facilities for the world's top three producers – LONGi, Jinko Solar and Trina – as well as for other larger (e.g., Tongwei, Suntech) and smaller or emerging players (e.g., Solar Grids, REC Group, Hoshine, Royal), mostly based in China. These major projects account for 45% of the total additional capacity announced as of Q1 2023.

Battery manufacturing capacity is also booming, owing to rapid increases in electric vehicle sales. In 2021, battery manufacturing throughput stood at 340 GWh, with this figure nearly doubling to 660 GWh in 2022. 580 GWh of manufacturing capacity was added in 2022, up 85% from the capacity added in 2021. Looking at the pipeline of announced projects, from late 2022 to the end of Q1 2023, planned manufacturing capacity rose from around 5.5 TWh to 6.8 TWh per year – an increase of 25%. As of late 2022, the total potential output from these announced projects stood at around 80% of what was needed by 2030 to be on track with a scenario compatible with 1.5 degrees.

Electrolyser manufacturing for use in the production of hydrogen is still nascent. In 2021, electrolyser manufacturing capacity stood at around 8 GW, increasing to 11 GW in 2022. Looking forward, announced projects as of the end of Q1 2023 suggest nearly 125 GW of additional installed manufacturing capacity could be expected by 2030. The resulting throughput projected from these announced projects – together with that from existing installations – would achieve more than 60% of the levels needed in the IEA's scenario compatible with 1.5 C.

The Role of Innovation

Achieving net zero emissions by 2050 will also need a significant boost in clean-energy innovation. The technologies presently available in the market offer nearly all the required emissions reductions until 2030, which sets the world on the path to achieving net-zero emissions by 2050.

As highlighted in the International Energy Agency's Net Zero Emissions by 2050 report, however, the widespread adoption of technologies still in the developmental stage today will be necessary for achieving net-zero emissions beyond 2030. By 2050, approximately 50% of CO2 emissions reductions will originate from technologies that are presently being demonstrated or are in the prototype stage. This percentage is even higher in sectors like heavy industry and long-distance transport. Significant innovation endeavours are crucial during this decade to ensure that the technologies essential for achieving net-zero emissions enter the market as quickly as possible.

In order to achieve net zero emissions by 2050, it is crucial to accelerate the development of early-stage clean energy technologies significantly compared to past achievements. The majority of clean energy technologies that are still in the experimental phase today need to be introduced to the market by 2030, at the latest. This means that the time it takes for these technologies to go from initial prototypes to being available in the market needs to be approximately 20% faster than the fastest energy technology developments in the past and around 40% faster than the case of solar PV.

At the moment, some technologies currently in the demonstration stage, like Carbon Capture, Utilisation and Storage (CCUS) in cement production or low-emissions ammonia-fuelled ships, are expected to be commercially viable within the next three to four years. Hydrogen-based steel production, direct air capture (DAC), and other technologies in the large prototype stage are anticipated to reach the market later, in about six years. Similarly, most technologies in the small prototype stage, such as solid-state refrigerant-free cooling or solid-state batteries, are projected to become available in the market within the next nine years.

Achieving such a significant acceleration is undeniably ambitious. It will necessitate the rapid demonstration of technologies that are not yet available on the market, with a focus on scalability and applicability in various regional contexts.

The required acceleration will also call for a substantial increase in investment in demonstration projects – an investment of US$90 billion will have to be mobilised as quickly as possible to create a diverse portfolio of projects, as also agreed by the 13th Clean Energy Ministerial (CEM) in September of last year. The objective is to facilitate rapid learning and facilitate the transition towards widespread deployment. These projects must encompass a range of technologies and must be aimed at proving their viability, scalability and effectiveness on a larger scale, across four different areas:

There are numerous technologies that will play a key part in accelerating the clean energy transition:

- Clean fuels such as clean hydrogen, ammonia and bioenergy: electrification will have to play a crucial part in the transition to a more sustainable global energy system, but clean fuels will play a crucial role in some end-use sectors. These low-emission fuels include, for example, modern forms of bioenergy, whose consumption will have to increase from around 41 EJ today to more than 75 EJ in 2030 and 100 EJ in 2050. These fuels, for example, will provide high-temperature heat to meet industry needs in cement or paper production. In the transport sector, biofuels from advanced feedstocks such as wastes and residues will be used. Other types of clean fuels which will be necessary for the energy transition include hydrogen and hydrogen-based fuels. Clean hydrogen will be necessary for industrial processes as well as the transport sector such as in shipping, just like hydrogen-based fuels such as ammonia, which will be essential to cover around 45% of global shipping demand by 2050.

- **Flexibility**: the enhanced role of electrification to accommodate a scenario in which net greenhouse emissions are reduced to zero will make it necessary to significantly increase the flexibility of both existing and new infrastructure, as well as supporting technologies. All sources of flexibility – advanced batteries, demand response and low-carbon flexible power plants, as well as smarter and more digital electricity grids, will need to quadruple investments by 2050, *vis-à-vis* a two-and-a half-fold increase in electricity supply. Some of these new technologies will also reduce dependence on critical minerals. Sodium-ion batteries, for example, have the potential to completely avoid the use of less abundant types of these resources, and do not require lithium. Technologies supporting the flexibility of electricity demand, as well as supply, will be equally important. These can be used in fields such as EV charging, with the development of smart chargers to optimise profiles based on how much energy vehicles need over a specified span of time.
- **New advances in nuclear technology**: nuclear power plays a global role in decarbonising the electricity sector. Advances in the technology involve the full commercialisation of small modular reactors (SMRs), which are nuclear reactors with a capacity below 300 MW and with lower capital costs. The modular design of these reactors can significantly increase the flexibility, as well as reduce the high upfront costs of nuclear technology.

Employment

The transition to a cleaner global energy system will simultaneously generate enormous employment opportunities, and require careful interventions to ensure that the process is as just, and as socially sustainable, as possible.

As stated in the IEA's *World Energy Outlook 2022*, a scenario in which the world reaches net zero greenhouse gas emissions by 2050 will see employment opportunities in the energy sector increase from slightly over 65 million at present to 90 million by 2030, including both direct jobs within the energy sectors and indirect jobs involved in manufacturing essential components for energy technologies and infrastructure. By 2030, there could be nearly 40 million new jobs in clean energy. As a result, the proportion of employment in the energy sector linked to clean energy is expected to rise from approximately half at present to 80% by 2030.

Most of these jobs will be added by the power generation sector, complemented by 4 million jobs in power grids and electricity storage. Employment opportunities linked to solar PV, as well as wind power, will experience an annual increase of 10% to keep up with the necessary expanded capacity. Large numbers of jobs will also be added in vehicle manufacturing and business focused on enhancing equipment, industrial and building efficiency. In vehicle manufacturing, three-fifths of the current jobs will transition to EVs and their batteries. While EVs require fewer components and entail less labour-intensive assembly, additional jobs will be created in the battery supply chain. However, these jobs may not be concentrated in the same locations as the current manufacturing jobs.

To accomplish this growth in clean energy jobs within the next decade, it is crucial for industry, governments and educational and training institutions to engage in proactive strategic planning. This planning is necessary to prevent shortages of skilled labour from becoming a bottleneck for energy transitions. It will require a concerted effort to anticipate and address the demand for skilled workers, ensuring that the workforce is adequately trained and prepared to meet the requirements of the evolving energy sector.

Coal miners, particularly those involved in modern mechanised operations, may have skills that could be relevant in critical minerals production. However, the transition to this sector could be limited due to the smaller quantities of minerals required and the different geographical locations of coal and mineral deposits. It will therefore be essential to implement people-centred, and just transition policies to provide support for fossil fuel workers who will have limited prospects for transitioning to the energy sector or parallel industries. These policies will be vital in ensuring a smooth and fair transition for these workers and in countering the negative impact of job losses in fossil fuel industries caused by electrification and decarbonisation efforts.

Critical Minerals

Global energy systems, including clean-energy infrastructure and technologies, rely on a steady and secure supply of critical minerals, materials and manufacturing capacity. These minerals are crucial for the production of solar PV panels and wind turbines, but also for batteries to power the rising EV industry as well as electricity cables to sustain the necessary electrification of energy systems. A study on critical minerals demand in the IEA's *World Energy Outlook 2022* indicates that, as clean-energy transitions accelerate, the demand for these critical minerals from the energy system is bound to multiply, especially for minerals such as lithium, cobalt, nickel and graphite. Recent price spikes in these minerals have, however, made it clear how supply chain disruptions and rising mineral supply costs threaten to increase the cost of clean-energy technology and slow its deployment. The strengthening and diversification of these supply chains is therefore an objective of global importance and priority.

The first element of this fragility lies in the raw materials required for the production of renewable technologies. These rely on a wide array of critical minerals, whose uses vary by technology. Lithium, nickel, cobalt, manganese and graphite are crucial to battery performance, longevity and energy density. Rare earth elements are essential for permanent magnets that are vital for wind turbines and EV motors. Electricity networks need a huge amount of copper and aluminium, with copper being a cornerstone for all electricity-related technologies. Wind turbines, which will be used to generate electricity in Northern Europe, for example, will require rare earth elements for their magnets.

Moreover, the quantities of the minerals necessary for energy-transition technologies are substantially higher than the quantities required for their fossil fuel counterparts. For example, making a 55-kWh battery for a small electric car typically requires over 200 kg of a wide variety of critical minerals. In comparison, the powertrain of an internal-combustion engine will require only 35 kg of copper. Solar and wind power also require, comparatively, more materials and critical minerals such as steel and aluminium per unit of capacity. For example, an onshore wind plant will require, for the same level of capacity as an equivalent gas-fuelled power plant, at least nine times more mineral resources.

The shift to a clean energy system is set to drive a huge increase in the requirements for these minerals, meaning that the energy sector is emerging as a major force in mineral markets. Until the mid-2010s, for most minerals, the energy sector represented a small part of total demand. However, as energy transitions gather pace, clean-energy technologies are becoming the fastest-growing segment of demand. In a scenario that meets the Paris Agreement goals, their share of total demand will have to rise significantly over the next two decades to over 40% for copper and rare earth elements, 60-70% for nickel and cobalt, and almost 90% for lithium. EVs and battery storage have already displaced consumer electronics to become the largest consumer of lithium and are set to take over from stainless steel as the largest end-user of nickel by 2040.

In climate-driven scenarios, demand for minerals for use in EVs and battery storage is a major force, and is set to rise by a multiple of at least thirty times by 2040. Lithium sees the fastest growth, with demand growing by over 40 times in the Sodium dodecyl sulfate (SDS) by 2040, followed by graphite, cobalt and nickel (around 20-25 times). The expansion of electricity networks means that demand for copper for grid lines more than doubles over the same period. The rise of low-carbon power generation to meet climate goals also means a tripling of mineral demand from this sector by 2040. Wind takes the lead, bolstered by material-intensive offshore wind. Solar PV follows closely, due to the sheer volume of capacity that is added. Hydropower, biomass and nuclear make only minor contributions given their comparatively low mineral requirements. In other sectors, the rapid growth of hydrogen as an energy carrier underpins major growth in demand for nickel and zirconium for electrolysers, and for platinum-group metals for fuel cells.

This reality holds a series of sobering implications: there is the potential for numerous choke points along various nodes of these supply chains – raw mineral extraction, the production of materials, and finally assembly and manufacturing of components. As of today, there is therefore an urgent need to increase investments across all these nodes to cover the gap between where we are today and where we need to be to reach net zero. The IEA estimates that the sums needed to sustain the additional mining, critical material production and manufacturing of clean-energy technologies needed from today to 2030 to secure supply chains will have to amount to US$1.2 trillion. Moreover, these investments will need to be mobilised across different regions, technologies and supply chains.

The picture varies, however, according to the type of mineral we are discussing. Some minerals such as lithium raw material and cobalt are expected to be in surplus in the near term, while lithium chemical, battery-grade nickel and key rare earth elements (e.g., neodymium and dysprosium) might face tight supply in the years ahead. However, looking further ahead in a scenario consistent with climate goals, expected supply from existing mines and projects under construction is estimated to meet only half of projected lithium and cobalt requirements and 80% of copper needs by 2030.

The general picture is therefore that critical mineral supply chains must be strengthened to sustain today's global energy system and to support the clean-energy transition.
While there is a host of projects at varying stages of development, there are many vulnerabilities that may increase the possibility of market tightness and greater price volatility:

- **High geographical concentration of production**: production of many energy-transition minerals is more concentrated than that of oil or natural gas. For lithium, cobalt and rare earth elements, the world's top three producing nations control well over three-quarters of global output. In some cases, a single country is responsible for around half of worldwide production. The Democratic Republic of the Congo and People's Republic of China (China) were responsible for some 70% and 60% of global production of cobalt and rare earth elements respectively in 2019. The level of concentration is even higher for processing operations, where China has a strong presence across the board. China's share of refining is around 35% for nickel, 50-70% for lithium and cobalt, and nearly 90% for rare earth elements. Chinese companies have also made substantial investment in overseas assets in Australia, Chile, the DRC and Indonesia. High levels of concentration, compounded by complex supply chains, increase the risks that could arise from physical disruption, trade restrictions or other developments in major producing countries.
- **Long project-development lead times**: our analysis suggests that it has taken 16.5 years on average to move mining projects from discovery to first production. These long lead times raise questions about the ability of suppliers to ramp up output if demand were to pick up rapidly. If companies wait for deficits to emerge before committing to new projects, this could lead to a prolonged period of market tightness and price volatility.
- **Declining resource quality**: concerns about resources relate to quality rather than quantity. In recent years ore quality has continued to fall across a range of commodities. For example, the average copper ore grade in Chile declined by 30% over the past 15 years. Extracting metal content from lower-grade ores requires more energy, exerting upward pressure on production costs, greenhouse gas emissions and waste volumes.
- **Growing scrutiny of environmental and social performance:** production and processing of mineral resources gives rise to a variety of environmental and social issues that, if poorly managed, can harm local communities and disrupt supply. Consumers and investors are increasingly calling for companies to source minerals that are sustainably and responsibly produced. Without efforts to improve environmental and social performance, it may be challenging for consumers to exclude poor-performing minerals as there may not be sufficient quantities of high-performing minerals to meet demand.
- **Higher exposure to climate risks:** mining assets are exposed to growing climate risks. Copper and lithium are particularly vulnerable to water stress given their high water

requirements. Over 50% of today's lithium and copper production is concentrated in areas with high water-stress levels. Several major producing regions such as Australia, China and Africa are also subject to extreme heat or flooding, which pose greater challenges in ensuring reliable and sustainable supplies.

Diversifying Clean Energy Supply Chains

The IEA's report on Securing Clean-Energy Technology Supply Chains indicates that the heavy reliance of clean-energy technologies on critical minerals makes their supply chains particularly vulnerable due to their geographical location and level of geographical concentration. This vulnerability has been highlighted particularly in recent times, where the current model of international trade and sourcing of resources from different parts of the world is being put to the test by renewed and highlighted conflicts between world powers. The invasion of Ukraine by Russia, for example, has highlighted critical vulnerabilities in fossil fuels, and stressed the urgency to avoid a repeated scenario for the sourcing of critical minerals for clean energy technologies.

Currently, the People's Republic of China dominates the extraction of rare earth elements, accounting for 60% of their global output. Meanwhile, a small number of other countries specialise in the extraction of critical minerals – South Africa, for example, supplies more than 70% of the world's platinum needs for all uses. The Democratic Republic of Congo (DRC), on the other hand, holds 70% of the global extraction of ores of cobalt, a vital component for lithium-ion batteries and superalloys used in turbines, nuclear reactors and sensors. Lithium is also highly concentrated in Australia and Chile.

The processing and purification of these minerals are also heavily concentrated, and they are as much a vital component as their extraction. Again, China dominates this critical node of the supply chain, holding 30% of the global share of processing for nickel, 60-70% for lithium and cobalt, and 90% for rare earth elements.

Lastly, we can see similar levels of concentration for technology manufacturing, be they for mass-manufactured technologies such as solar PV modules, wind turbine components and EV batteries, or for more large-scale, site-tailored technologies such as CCUS applications, synthetic hydrocarbon production or bioenergy-related technologies. In the former case, China dominates the market thanks to low manufacturing costs, a strong base in materials production and sustained policy support. For both solar PV module and wind turbine component production, Chinese companies feature among the world's top 10 and 15 suppliers, respectively. Similarly, China dominates production at every stage of the EV battery supply chain, with policies in support of the EV sector finally bearing fruit on the world stage. Even the production of heat pumps, which are at the centre of major energy transition plans such as the EU's RePowerEU, is dominated by China, with almost 40% of total manufacturing capacity and with Chinese companies also presiding over the manufacture of refrigerants.

China's dominance of these supply chains, especially in material production and in component mass-manufacturing, is not a coincidence. It is the result of decade-long policies in industrial development, which have put this country squarely at the centre of all component-related international trade networks. Other countries, or other geographical groupings, are now beginning to follow the same path. The new EU industrial strategy for domestic battery production, for example, alongside policies to cut CO_2 emissions from road transport, have led to large investments in the production of batteries in Europe, although no large-scale production has yet taken place. The United States' Inflation Reduction Act (IRA), meanwhile, has spurred recent investments into battery giga factories, although some components of the same act prohibit the import of other vital components for EVs that are not produced in countries with which the US has bilateral trade agreements, which could slow down the production of EVs.

Conclusion

This is a pivotal moment of the global energy crisis, as the Covid pandemic and Russia's invasion of Ukraine ushered the world into the new energy economy. Ensuring that the transition is orderly, secure and affordable will hinge on tackling new energy-security challenges, namely critical minerals and clean-tech supply chains.

To balance all of these requirements, governments will have to closely align energy-security policies, climate policies and industrial policies, while scaling up investments, devising specific strategies and diversifying supply chains.

The vulnerability of clean-energy supply chains based on geographical location and concentration highlights the importance of strengthening and diversifying these chains on a global scale.

Achieving the net zero emissions target by 2050 will require a significant boost in clean-energy innovation and the introduction of technologies that have not yet reached the market. Timely market entry of these technologies is crucial, necessitating faster development compared to past achievements. The transition to a clean energy system presents vast employment opportunities, with the energy sector projected to witness a substantial increase in jobs, but these will have to be accompanied by just transition policies to absorb the workforce made redundant in certain parts of the energy sector.

While it is clear that the scale of this task is large, the economic case and energy-security benefits are before us. A possible new clean-energy golden age awaits us, but it will be up to us to steer it and reap its benefits.

5. Green Hydrogen Value Chains. Geopolitical and Market Implications in the Industrial Sector

Nicola de Blasio and Laima Eicke

The global transition to a low-carbon economy will significantly impact existing energy value chains and transform the production to consumption lifecycle, dramatically altering interactions among stakeholders. Thanks to its versatility, green hydrogen is gaining economic and political momentum and could play a critical role in a carbon-free future. Furthermore, its adoption will be critical for decarbonizing industrial processes at scale, especially hard-to-abate ones such as steel and cement production. Overall, hydrogen demand is expected to grow by 700% by 20.[1] Currently, the two central challenges to green hydrogen adoption and use at scale are limited infrastructure availability and cost. While recent spikes in fossil fuel prices due to the war in Ukraine have made green hydrogen cost-competitive with blue and grey hydrogen,[2] from a long-term perspective, the International Renewable Energy Agency (IRENA) predicts a decline in green hydrogen costs by up to 85% by 2050,[3] making it the dominant hydrogen form.[4]

A New Framework to Assess Countries' Roles in Industrial Green Hydrogen Value Chains

This report studies the role countries could play in future green hydrogen industrial markets, focusing on three key applications: ammonia, methanol, and steel production. Today, these sectors are among the largest consumers of hydrogen, accounting for about 41% of global demand, and are expected to increase their shares due to global decarbonisation efforts.[5] Analysing a country's potential positioning in these markets is key to helping policymakers define strategic industrial policies. To elucidate the impact of the transition to a low-carbon economy on energy value chains, we propose an analytical framework to cluster countries into five groups based on the variables of resource endowment, existing industrial production, and economic relatedness:

Frontrunners. These countries could lead in green hydrogen production and industrial applications at scale globally. Potential frontrunners should focus on industrial policies that foster green hydrogen up-scaling to gain global leadership.

Upgraders**.** Countries with adequate resources for green hydrogen production and highly related economic activities could potentially upgrade their value chain positioning and attract green hydrogen-based industries. Potential upgraders could benefit from strategic partnerships with frontrunners to foster technological and know-how transfer. Policies should focus on attracting foreign capital, for example, by lowering market risk, developing public-private partnerships, and forming joint ventures.

Green hydrogen exporters**.** Resource-rich countries with limited upgrading potential should prioritize green hydrogen exports and would benefit from partnerships with green hydrogen importers to deploy enabling infrastructure and reduce market risk. Furthermore, coordination of international standards for green hydrogen production and use would facilitate trade on a global scale.

---

* The authors thank Andreas Goldthau, Silvia Weko, Henry Lee, John Holdren, Venky Narayanamurti, and Abishek Malhotra for feedback and comments on earlier versions of this chapter.

[1] BP, *Statistical Review of World Energy*, 2019.

[2] B. Radowitz, *Russia's war pushes blue and grey hydrogen costs way above those of green H2: Rystad*, Recharge: Global News and Intelligence for the Energy Transition, 2022.

[3] International Renewable Energy Agency (IRENA), *Green Hydrogen Cost Reduction. Scaling up Electrolysers to Meet the 1.5°C Climate Goal*. I. R. E. Association, 2020.

[4] International Renewable Energy Agency (IRENA), *Geopolitics of the Energy Transformation: The Hydrogen Factor*, I. R. E. Association, 2022.

[5] Ibid.

Green hydrogen importers. Resource-constrained countries with industrial hydrogen-based production will need to develop strategic partnerships to ensure secure and stable green hydrogen supplies. Additionally, stimulating innovation and knowledge creation through targeted policies will be critical to sustaining competitiveness and avoiding industrial relocations to frontrunners or upgraders.

Bystanders. Countries with significant constraints along all three critical variables should assess whether some of these constraints, such as limited infrastructure or freshwater availability, must be overcome to integrate into future green hydrogen value chains. Otherwise, they will continue to be the final importers of industrial products. Countries in these groups face unique challenges and opportunities, which we exemplify through case studies focusing on the United States, Germany, and Thailand.

The Geopolitical Map of Green Hydrogen in the Industrial Sector

The low-carbon transition in existing energy value chains will also give rise to new market and geopolitical dynamics and dependencies. Our analysis elucidates key geopolitical trends that could shape international relations in the upcoming decades, with countries competing for industrial leadership, markets, and opportunities for job creation.

Only a few countries, including China and the United States, may emerge as clear frontrunners. These countries have vast resource endowments and considerable market shares in today's hydrogen industrial applications that would enable them to integrate the green hydrogen value-chain segments of production and industrial applications. Locating industrial facilities close to low-cost green hydrogen production would create value by increasing a country's control over supply chains and minimizing hydrogen transportation costs. These countries could thus reap the most extensive benefits and become geopolitical and market winners. However, these dynamics could spur a green race for industrial leadership, creating tensions in international relations. Furthermore, competing dynamics for green hydrogen-based industries could foster market tensions between green hydrogen importers and upgraders. Resource-rich countries, such as Thailand and Mexico, have the potential for green industrialisation and would likely compete with import-dependent industrial powers for market share and jobs, leading to new geopolitical tensions.

Second, new dependencies might emerge. Most countries that currently have highly developed ammonia, methanol, or steel industries, such as Saudi Arabia, Japan, and Germany, are resource constrained and would depend on green hydrogen imports to meet demand. Hence, from a geopolitical perspective, dependencies and supply disruption risks will likely persist in a low-carbon energy world, but will be different from those of today. These new geopolitical dependencies will involve new alliances and will also be a function of future market structures. Like natural gas markets, hydrogen markets will emerge as regional ones, but only global and more structured markets will allow for risk reduction.

Finally, tensions between higher-income countries in the Global North and lower-income countries, often located in the Global South, might intensify. Our analysis shows how the potential for the three industrial hydrogen applications – ammonia, methanol, and steel – is unevenly distributed across the globe. Although there are opportunities for economic gains in all world regions, most frontrunners are middle- to high-income countries. Many lower-income countries, especially in Africa, will be limited to green hydrogen exports since they cannot compete in value-added segments of the value chains. Hence the promise of 'sustainable development' and green industrialisation, often associated with the energy transition, might not be replicable everywhere. This might intensify the need for technology transfer and financial support to enable sustainable development and green industrialisation for all.

Introduction

Green hydrogen[6] could play a significant role in the decarbonisation of hard-to-abate industrial sectors, such as steel and cement. Global hydrogen demand is expected to grow by 700% by 2050,[7] from today's 70 million tons per year.[8] The use of hydrogen at this scale will significantly impact existing value chains[9] and create economic opportunities for countries that strategically position themselves in future green hydrogen markets. To gain leadership, several countries, including the United States, Norway, and Chile, have started to adopt industrial policies; these policies support green hydrogen adoption at scale and foster innovation in key industries.[10]

Previous studies on the geopolitics of hydrogen have analysed the different roles that countries could adopt in future green hydrogen markets and how the associated economic gains might affect international relations.[11] These studies mainly identified the countries with a higher potential for green hydrogen production and the associated market and geopolitical implications. In contrast, few studies have focused on the demand for green hydrogen driven by the industrial sector.[12] Since industrial applications drive the majority of today's fossil fuel-based hydrogen demand, this sector will most likely play a key role in shaping emerging green hydrogen value chains. This will be especially true in the early stages of adoption when fragile, nascent market dynamics are supported by the sector's higher economies of scale and are lower risk than other potential applications.[13]

This study answers the question of which countries have the potential to play a critical role in green hydrogen value chains in key industries, not only for green hydrogen production but also in its industrial applications. To this end, we draw on a mixed-methods approach. First, we propose

---

[6] Green hydrogen refers to hydrogen produced by water splitting using renewable electricity.
[7] Bp (2019).
[8] International Energy Agency (IEA), *The Future of Hydrogen*., 2019.
[9] We use the term "value chain" to define a more conceptual design of business relationships between stakeholders that support the development and adoption of a market or technology at scale. This differs from the term "supply chain", which is typically used to define a set of operational relationships designed to benefit a single stakeholder and deliver products or services.
[10] International Energy Agency (IEA), *Hydrogen*, 2021.
[11] F. Pflugmann and N. De Blasio, "The Geopolitics of Renewable Hydrogen in Low-Carbon Energy Markets", *Geopolitics, History, and International Relations*, vol. 12, no. 1, 2020, pp. 9-44; T. Van de Graaf et al., „The new oil? The geopolitics and international governance of hydrogen", *Energy Research & Social Science*, vol. 70, 101667, 2020.
[12] IRENA (2022).
[13] Ibid.

a framework to cluster countries based on three variables that would give them a distinct advantage in future green hydrogen markets: resource endowment, current industrial production, and economic relatedness.[14] We then apply this framework to identify countries' potential in using hydrogen at scale for three industrial applications: ammonia, methanol, and steel production. Finally, we analyze three country case studies, illustrating the challenges and opportunities of different country groups in their strategic industrial positioning in future green hydrogen markets, and outline their concrete policy options.

Our findings highlight how the potential for green hydrogen production and associated industrial applications is distributed unevenly across the globe. We argue that countries like the United States and China, who can lead in both green hydrogen production and its industrial applications, could emerge as frontrunners in a green hydrogen economy. Other resource-rich countries, such as Thailand or Mexico, have the potential for green industrialisation and will likely compete with import-dependent industrial powers for market share and jobs, leading to new geopolitical dependencies and tensions.

This chapter not only contributes empirical evidence to the ongoing debate on the geopolitics of hydrogen but integrates it based on insights from the global value chain literature. Our findings demonstrate that this perspective offers new insights into both the different roles countries could assume in a green hydrogen economy and the distribution of associated economic gains and losses. Furthermore, it provides guidance and recommendations for defining strategic industrial policies.

The remainder of this paper is structured as follows: Section 2 reviews existing literature on the geopolitics of green hydrogen and the scholarly debate on global value chains and proposes a framework for understanding economic gains in a green hydrogen economy. Section 3 describes the methodology used for analysing a country's role in green hydrogen value chains. Section 4 draws the geopolitical map of green hydrogen applications for ammonia, methanol, and steel production. Section 5 uses three case studies to analyse the opportunities and challenges for different country groups in emerging hydrogen markets. Section 6 addresses the geopolitical challenges and opportunities arising from green hydrogen adoption in the industrial sector. Finally, Section 7 addresses conclusions and policy recommendations.

Literature Review and Framework

The debate on the geopolitical implications of an emerging hydrogen economy has intensified over the past few years. Scholars have argued that the projected rapid growth in green hydrogen demand might lead to new geopolitical opportunities and challenges.[15] New trade patterns might give rise

---

[14] Economic relatedness indicates the percentage of related activities in a particular location; the relatedness ω between a location c and an activity p is calculated based on the following formula: $\omega_{cp}=(\sum_{p'}M_{cp'}\phi_{pp'})/(\sum_{p'}\phi_{pp'})$, where M_{cp} refers to a matrix indicating the presence of activity p in location c; $\phi_{pp'}$ is a measure of similarity between activities p and p'; For further details on the methodology, see Observatory of Economic Complexity (OEC), *Economic Relatedness Data*, 2021a, https://oec.world/

[15] IRENA (2022); Pflugmann and De Blasio (2020); Van De Graaf et al. (2020); T. Van de Graaf, T. (2021). "Clean Hydrogen: Building Block of a New Geopolitical Landscape", in *Energy and Geostrategy 2021*, Spanish Institute for Strategic Studies, 2021, pp. 185-230.

to novel export champions, and resource-poor countries might face new geopolitical dependencies.[16] In this context, hydrogen has been identified as the 'new oil'.[17] Authors have also warned that emerging hydrogen markets could lead to geo-economic competition and conflict.[18] Some studies have analysed the potential for hydrogen production worldwide to identify potential winners in future green hydrogen markets.[19] Others have discussed potential global trade patterns and governance.[20] Few articles hint at the importance of value chains in international relations.[21] But only very few examine in detail the geopolitical implications of hydrogen adoption at scale in industrial applications and the associated impact on value chains.[22] Some of these studies have explored the technological and cost improvements in hydrogen applications[23] or examined hydrogen value chains in country-specific case studies, for example, in Germany,[24] Japan[25] and the United States.[26] However, there has not been a comprehensive, empirically driven analysis of the role countries could assume in green hydrogen value chains. Therefore, we believe that the geopolitical and market implications of hydrogen adoption at scale require further analysis.

We address this gap using insights from global value chain literature. This perspective offers new insights into the distribution of gains and losses in a green hydrogen economy among different country groups based on a country's potential to engage in green hydrogen value chain segments. In our analysis, critical segments of future green hydrogen value chains include its production, distribution, and utilisation – focusing, as discussed, on industrial applications of green hydrogen, such as ammonia, methanol, and steel production (see figure 5.1).

FIG. 5.1 - GREEN HYDROGEN VALUE CHAIN SEGMENTS FOR INDUSTRIAL APPLICATIONS

[16] Pflugmann and De Blasio (2020).
[17] Van De Graaf et al. (2020).
[18] M. Blondeel, M.J. Bradshaw, G. Bridge, and C. Kuzemko, "The geopolitics of energy system transformation: A review", *Geography Compass*, vol. 15, no. 7, 2021.
[19] Pflugmann and De Blasio (2020); Van de Graaf (2021).
[20] Van de Graaf et al. (2020).
[21] Blondeel et al. (2021); Van De Graaf et al. (2020); B. Lebrouhi et al., "Global hydrogen development-A technological and geopolitical overview", *International Journal of Hydrogen Energy*, 2022; M. Noussan, P.P. Raimondi, R. Scita, and M. Hafner, "The role of green and blue hydrogen in the energy transition – a technological and geopolitical perspective", *Sustainability*, vol. 13, no. 1, 2021, p. 298.
[22] IRENA (2022).
[23] S. Chen et al., "Hydrogen value chain and fuel cells within hybrid renewable energy systems: Advanced operation and control strategies", *Applied energy*, vol. 233, 2019, pp. 321-37; Lebrouhi et al. (2022).
[24] D. Coleman, M. Kopp, T. Wagner, and B. Scheppat, "The value chain of green hydrogen for fuel cell buses – a case study for the Rhine-Main area in Germany", *International Journal of Hydrogen Energy*, vol. 45, no. 8, 2020, pp. 5122-33.
[25] M. Nagashima, "Japan's hydrogen strategy and its economic and geopolitical implications", Ifri, 8 October 2018.
[26] M.F. Ruth et al., *The Technical and Economic Potential of the H2@ Scale Hydrogen Concept within the United States*, National Renewable Energy laboratory (NREL), 2020.

Literature on global value chains highlights that the final value of a product increases in each manufacturing stage and varies along value chain segments. Resource extraction is the least profitable segment of a value chain, whereas the value-added in industrial applications is much higher.[27] In the case of green hydrogen, this implies that industrial applications, such as ammonia, methanol, or steel production, could yield more added value than simple production and commodity trading.

In this context, it can be beneficial for countries to improve their value chain positioning by moving from lower- to higher-value activities,[28] a process referred to as upgrading. China is a successful example of value chain upgrading. In the past three decades, Beijing has supported the solar and wind green energy sectors thanks to favourable and stable policies aimed at growing its global market shares and the required skilled labour force.[29] Pursuing green industrialisation has been especially important for the Global South countries, where policymakers have used strategic industrial policies to try to upgrade their country's value chain position.[30] A few studies have highlighted the importance of technology transfer and knowledge spillovers from related industries in enabling upgrading processes in renewable energy value chains.[31]

Nascent hydrogen markets might provide new opportunities for countries to upgrade along value chains and attract added-value applications and sectors. Furthermore, evolving value chains

[27] G. Gereffi and L. Lee, "Why the world suddenly cares about global supply chains", *Journal of Supply Chain Management*, vol. 48, no. 3, 2012, pp. 24-32; S. Pipkin and A. Fuentes, "Spurred to upgrade: A review of triggers and consequences of industrial upgrading in the global value chain literature", *World Development*, vol. 98, 2017, pp. 536-54.

[28] G. Gereffi, "The global economy: organization, governance and development", in N.J.S.a.R. Swedberg (Eed.), *The Handbook of Economic Sociology*, (vol. 2nd edition), Princeton, Princeton University Press and Russell Sage Foundation, 2005, p. 171.

[29] C. Binz and B. Truffer, "Global Innovation Systems – A conceptual framework for innovation dynamics in transnational contexts", *Research policy*, vol. 46, no. 7, 2017, pp. 1284-98; G.C. Chen and C. Lees, "Growing China's renewables sector: a developmental state approach", *New Political Economy*, vol. 21, no. 6, 2016, 574-86; C. Gandenberger, D. Unger, M. Strauch, and M. Bodenheimer, *The international transfer of wind power technology to Brazil and China*, Working Paper Sustainability and Innovation, Issue, Fraunhofer ISI and MERIT, June 2015.

[30] M. Bazilian, V. Cuming, and T. Kenyon, "Local-content rules for renewables projects don't always work", *Energy Strategy Reviews*, vol. 32, 2020, 100569,; Pipkin and Fuentes (2017).

[31] Pipkin and Fuentes (2017); L. Tajoli and G. Felice, "Global value chains participation and knowledge spillovers in developed and developing countries: An empirical investigation", *The European Journal of Development Research*, vol. 30, no. 3, 2018, pp. 505-32.

have significant implications on the distribution of gains and losses, especially with respect to varying degrees of segmentation or integration. An analysis of existing energy value chains helps to highlight how stakeholders position their offerings, for example by adopting sustainable business models, specializing in critical technologies to gain a competitive advantage, or responding to regulatory constraints. However, these decisions generally result in two outcomes: segmentation or integration.

Segmented value chains consist of stakeholders specializing in single segments to gain a unique competitive advantage. On the other hand, integration refers to combining different segments in one firm or location.[32]

Integration has usually been associated with gains in higher value accumulation and a more substantial degree of control.[33] Countries could thus benefit by integrating green hydrogen value chains' production and industrial applications segments in various ways. Integration could increase the local added value and create jobs; it could reduce distribution costs,[34] increase control, and reduce dependencies, which can also create vulnerability. The latter has become even more apparent in the recent supply chain interruptions due to Covid-19[35] and the war in Ukraine.[36] The benefits associated with integration along value chains might incentivize carbon-intensive industries to relocate closer to low-cost green hydrogen production locations,[37] which strategic industrial policies might further incentivise.

We argue that combining the two research streams on global value chains and the geopolitics of hydrogen can provide novel and more granular insights into the different roles countries might assume in future green hydrogen markets. Previous studies on the geopolitics of hydrogen highlighted the countries that could benefit from the adoption of green hydrogen at scale and those that could benefit from green hydrogen applications in domestic markets. Integrating insights from global value chains literature, we argue that countries that combine both green hydrogen value chain segments – production and industrial applications – could emerge as frontrunners in future green hydrogen markets. This is because the synergies deriving from the integration of these two segments enable countries to leverage and compound the intrinsic value of each segment, while increasing control over value chains and reducing dependencies.

Framing the challenge

Building and expanding existing literature on both the geopolitics of hydrogen and global value chains, this paper analyzes a country's potential in future green hydrogen markets, focusing on

---

[32] Gereffi et al. (2005).
[33] Gereffi (2005); Gereffi et al. (2005).
[34] IRENA (2020).
[35] I. Øverland, I. et al., Covid-19 and the politics of sustainable energy, *Energy Research & Social Science*, vol. 68, October 2020, 101685.
[36] D. Simchi-Leviand P. Haren, "How the War in Ukraine Is Further Disrupting Global Supply Chains", *Harvard Business Review*, March 2022.
[37] IRENA (2022).

two segments of its value chain: a) production and b) industrial applications, using three criteria: resource endowment, current industrial production, and economic relatedness.

Resource endowment. Green hydrogen is hydrogen produced by splitting water into hydrogen and oxygen using renewable electricity. The availability of plentiful renewable energy sources, such as solar and wind, together with freshwater availability and enabling infrastructure, is thus critical for producing green hydrogen at scale. Accordingly, these variables have been used by Pflugmann and De Blasio (2020) to assess green hydrogen potentials globally.[38]

Industrial production. Existing and mature hydrogen markets increase the potential for green hydrogen adoption because they provide sectoral knowledge and skills, enabling infrastructure, strong networks, and practices that offer a competitive advantage compared to new market entrants.[39] The size of existing hydrogen markets can be measured based on sectoral production figures and has been used as an indicator of future green hydrogen demand.[40]

Economic Relatedness. The global transition to a low-carbon economy will significantly impact existing energy value chains and transform the production to consumption lifecycle, dramatically altering stakeholders' interactions. Since global value chains are not static, this dynamism must be addressed using the concept of economic relatedness. Future green hydrogen demand could diverge from current hydrogen market dynamics; for example, as hard-to-abate sectors decarbonize, economic incentives to relocate industrial green hydrogen applications closer to low-cost green hydrogen production could emerge.[41] Related economic activities would build up transferable skills that can increase the potential for new markets and sectoral economic growth.[42] For this reason, economic relatedness has been successfully used to predict new economic opportunities and the growth of specific products or industries at a national or subnational level.[43]

---

[38] Pflugmann and De Blasio (2020).

[39] M. Lambkin, "Order of entry and performance in new markets", *Strategic Management Journal*, vol. 9(S1), 1988, pp. 127-40.

[40] IRENA (2022)

[41] Ibid.

[42] R. Hausmann and C.A. Hidalgo, "The network structure of economic output", *Journal of economic growth*, vol. 16, no. 4, 2011, pp. 309-42; R. Hausmann, R., et al., *The atlas of economic complexity: Mapping paths to prosperity*. Mit Press, 2014; C.A. Hidalgo et al., "The Principle of Relatedness: Proceedings of the Ninth International Conference on Complex Systems", in *Unifying Themes in Complex Systems*, July 2018; C.A: Hidalgo, B. Klinger, A.-L., Barabási, and R. Hausmann, "The product space conditions the development of nations", *Science*, vol. 317, no. 5837, 2007, pp. 482-87.

[43] Hausmann et al. (2014); F. Neffke, M. Henning, and R. Boschma, "How do regions diversify over time? Industry relatedness and the development of new growth paths in regions", *Economic geography*, vol. 87, no. 3, 2011, pp. 237-65.

TAB. 5.1 - KEY CRITERIA FOR ASSESSING COUNTRIES' ROLES IN VALUE CHAINS FOR GREEN HYDROGEN APPLICATIONS

Resource endowment	Industrial production	Economic relatedness	Country Group
+	+	(+/-)	1: Frontrunners
+	-	+	2: Upgraders
-	+	(+/-)	3: Green Hydrogen Importers
+	-	-	4: Green Hydrogen Exporters
-	-	(+/-)	5: Bystanders

Using these three criteria, we cluster countries into five groups (see table 5.1): Resource-rich countries with industrial hydrogen-based productions show the best preconditions to emerge as frontrunners (Group 1). Resource-rich countries with high economic relatedness have the potential to become value chain upgraders by expanding their industrial hydrogen applications or developing new green industrialisation opportunities (Group 2). Resource-poor countries with industrial hydrogen-based production rely on green hydrogen imports for their industrial applications (Group 3). Resource-rich countries without industrial hydrogen-based production or related economic activities could become hydrogen exporters (Group 4). Finally resource-poor countries without industrial hydrogen-based production will be "Bystanders" (Group 5). These countries will – most likely – not be able to integrate into green hydrogen value chains and will continue to be importers of final products.

To elucidate the value chain dynamics and implications of green hydrogen adoption at scale, we focus our analysis on three major industrial applications: ammonia, methanol, and steel production.[44] Today, these applications are among the most significant consumers of hydrogen; their combined demand accounts for 41% of global hydrogen supply and is expected to further increase due to industrial decarbonisation efforts.[45] Ammonia (accounting for about 27% of global hydrogen demand) mainly serves as a feedstock in chemical processes, especially in fertilizer production, but also for cooling systems or explosives.[46] Ammonia could also be used as a hydrogen carrier for the long-distance transport of green hydrogen.[47] Most methanol (accounting for 11% of global hydrogen demand) is used in the chemical industry.[48] Like ammonia, methanol could further enable global hydrogen markets as it can be used as a fuel or as a carrier for the transport of hydrogen.[49] Finally, steel production (accounting for 3% of global hydrogen demand) represents a hard-to-abate sector requiring high-heat processes, which cannot be easily achieved by electrification. The IEA estimates that this sector's demand will significantly increase as hydrogen's share could grow from today's 7% to eventually cover 100% of steel production by substituting natural gas.[50]

While our analysis focuses on green hydrogen, we acknowledge that fossil fuel-based hydrogen, especially in combination with CCS technologies, could play a role in emerging hydrogen value chains, especially in the early stages. While more than 99% of today's hydrogen supply is based on fossil fuels, the share of green hydrogen is expected to increase significantly. Furthermore, recent surges in fossil fuel prices due to the war in Ukraine have made green hydrogen cost-competitive with blue and grey hydrogen.[51] From a long-term perspective, IRENA predicts a decline in green hydrogen costs by up to 85% by 2050,[52] making it the dominant hydrogen source.[53]

Finally, it is important to note that our framework only elucidates a country's potential to engage in future green hydrogen value chains. It should not be seen as a prediction of the future. While high potentials indicate the expectation of future economic gains along value chains, countries may or may not live up to these expectations, depending on how market dynamics and interactions between national and international policies play out in the future.

Building the Geopolitical Map of Green Hydrogen Industrial Applications

Our analysis leverages a mixed-method approach to define a country's potential in industrial green hydrogen applications. Building on the framework described in the previous section, we start by clustering countries into five groups based on the critical variables of resource endowment,

---

[44] Refining would be another prominent hydrogen application, accounting for 33% of the current demand International Energy Agency (IRENA), *Hydrogen: A renewable energy perspective*, 2019, (Excluded from the analysis).
[45] IRENA (2022).
[46] IEA (2029), p. 56.
[47] De Blasio (2021); IEA (2019).
[48] IEA (2019).
[49] Ibid.
[50] International Renewable Energy Agency (IRENA), *Hydrogen: A renewable energy perspective*, 2019.
[51] Radowitz (2022).
[52] IRENA (2020).
[53] IRENA (2022).

existing industrial production, and economic relatedness. Leveraging case studies, we then elucidate the opportunities and challenges for frontrunners, upgraders, and green hydrogen importers, the country groups that will most likely shape future hydrogen value chains, markets, and geopolitics. To define the role countries could play in future green hydrogen markets, the following coding was used:

Resource endowment: For coding green hydrogen production potentials, we use the methodology devised by Pflugmann and De Blasio (2020): "zero" implies resources constraints, defined as either a) renewable energy sources potential[54] lower than 1.5 times a country's primary energy consumption,[55] also taking into account land constraints with population densities higher than 150 inhabitants per square kilometer; b) freshwater renewable resources lower than 800 cubic meters per inhabitant; [56] or c) limited infrastructure potential to operate hydrogen production, transportation, and distribution at scale, based on a score below 4 (out of 7) of the overall infrastructure score in the World Economic Forum's 2019 Global Competitiveness Index.[57] Otherwise countries were coded with "one".

Industrial production: Existing industrial hydrogen applications will most likely improve a country's role in future green hydrogen value chains and markets. Hence this criterium is coded as "one" if a country's existing global market share for the production capacity of ammonia[58] and steel[59] is above 1%, or in the case of methanol,[60] a country's share of global net exports is above 1%.[61] Otherwise, it is coded as "zero".

Economic relatedness: Comparatively high economic relatedness will most likely improve a country's role in future green hydrogen value chains and markets. Hence this criterium is coded as

[54] The combined potential for renewable electricity production per country is calculated based on the wind power potential, which is based on National Renewable Energy Laboratory (NREL), "Global CFDDA-based Onshore and Offshore Wind Potential Supply Curves by Country, Class, and Depth (quantities in GW and PWh)", OpenEI, 25 November 2014), and the solar power potential, which is based on R.C. Pietzcker, D. Stetter, S. Manger, and G. Luderer, G. (2014). "Using the sun to decarbonize the power sector: The economic potential of photovoltaics and concentrating solar power", *Applied energy*, vol. 135, 2014, pp. 704-20.

[55] Primary energy consumption is based on the year 2019 (U.S. Energy Information Administration (EIA), *Total Primary Energy Consumption*, 2019).

[56] Countries with freshwater resources below this threshold predominantly use these for current drinking, household consumption, industrial use, and/or irrigation demand and have no additional capacities for increased water demand for hydrogen production (Pflugmann and De Blasio, 2020). Freshwater resource data are based on AQUASTAT, "Conventional Water Resources: Surface Water and Groundwater", 2020.

[57] World Economic Forum (WEF), *The Global Competitiveness Report*, 2019.

[58] USGS, *Mineral Commodity Summaries 2021*, U. S. G. Survey, 2021.

[59] Worldsteel, *2021 World Steel in Figures*, Worldsteel Association, 2021.

[60] Since we could not access methanol production global data, we rely on a positive net trade balance as a proxy for a country's methanol production. While this approach does account for countries with small productions consumed domestically or supplemented with imports, nevertheless the proxy allows us to identify key global methanol exporters. Methanol trade balances were derived from Observatory of Economic Complexity (OEC), *Methyl alcohol*, 2021b.

[61] This threshold was chosen to ensure that only key players in global markets are considered.

"one" if a country's economic relatedness to ammonia, methanol, or steel production is higher than the global average;[62] otherwise, it is coded as "zero".[63]

First we map countries' potential roles in green hydrogen value chains, looking at ammonia, methanol, and steel production separately. In a second step, we build an integrated map across these three applications. We code each criterium as "one" if it was met in at least two of the three industrial applications; otherwise, we coded it with "zero". This allows us to identify frontrunners across multiple industrial applications.

Overall, frontrunners, upgraders, and green hydrogen importers are the groups that will shape future hydrogen markets and geopolitics more than others. To elucidate the associated value chain dynamics, we use three case studies: the United States for frontrunners, Thailand for upgraders, and Germany for green hydrogen importers. It should be noted that the current dominance in industrial hydrogen applications and markets was not the driving selection parameter for these case studies. For example, while China and India dominate today's steel markets, they are influenced by unique domestic dynamics that cannot be easily transferred to other countries.[64] Therefore, we selected countries that showcase dynamics and patterns representing the entire group, and provided consistency across the three analysed industrial green hydrogen applications. While some countries are in different country groups depending on the application, the United States and Thailand are in the same country group in all cases and Germany in two out of three. Finally, we also prioritised a geographically diverse distribution to include key regional markets. See Section 5 for a detailed analysis, including an overview of current policies promoting green hydrogen development and deployment.

4. The Potential for Industrial Applications of Green Hydrogen in Ammonia, Methanol, and Steel Production

The following section gives an overview of the roles countries could assume in future value chains for green hydrogen-based ammonia, methanol, and steel production.

The geopolitical potential for green hydrogen-based ammonia production

Today's top producers dominating ammonia markets are China (26% market share), Russia (10%), the United States (10%), Indonesia (4%%), and Egypt (3%). Our analysis shows that China, the United States, and Indonesia are well positioned to become frontrunners in green hydrogen-based ammonia markets. Russia and Egypt are limited in their ability to produce or distribute green hydrogen at scale, Russia because of infrastructure constraints, and Egypt due to limited freshwater availability. Other top ten producers, such as Canada (3% market share) or Poland (2%), could significantly increase their global market shares, thanks to favourable green hydrogen production potentials. Countries with high resource endowments and high economic relatedness, like Mexico,

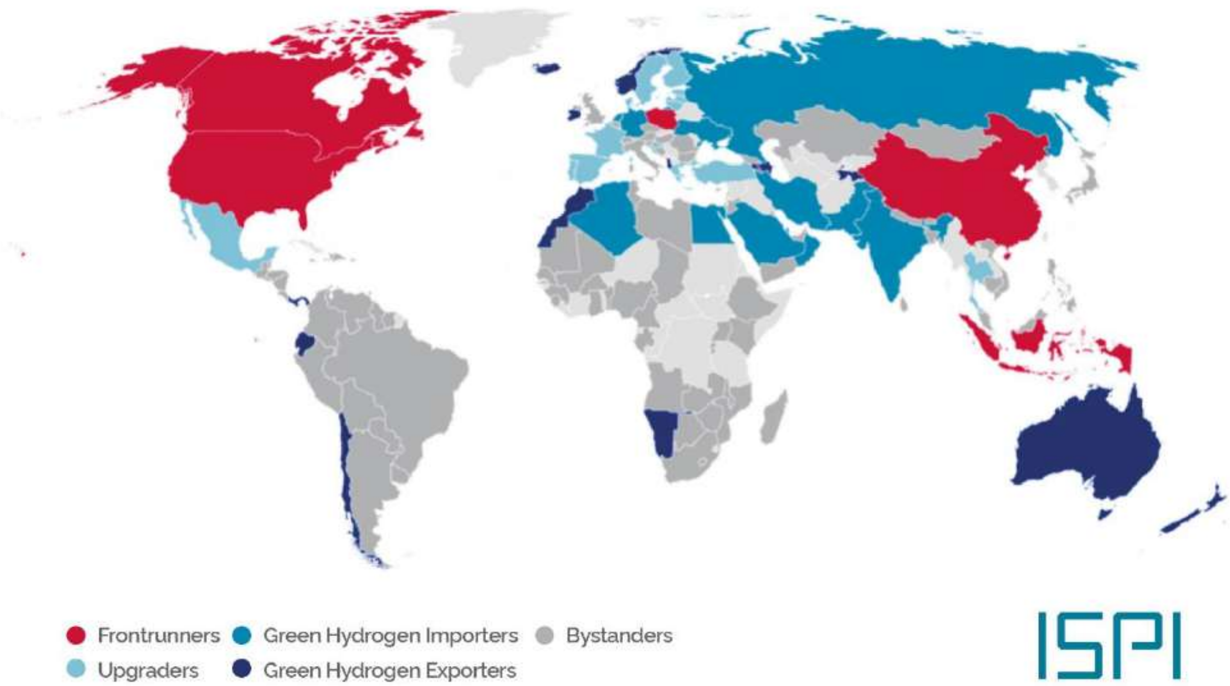
[62] Based on OEC (2020), the economic relatedness global averages are 0,152 for ammonia, 0,134 for methanol, and 0,248 for steel.

[63] OEC (2021a).

[64] A. Goldthau, L. Eicke, and S. Weko, "The Global Energy Transition and the Global South", in *The Geopolitics of the Global Energy Transition*, Springer, 2020, pp. 319-39.

Spain, or Thailand, could evolve into green ammonia upgraders. Finally, countries with high green hydrogen production potentials but low transferrable skills could also benefit by exporting green hydrogen to import-dependent ammonia producers such as Egypt or Germany (see figure 5.2).

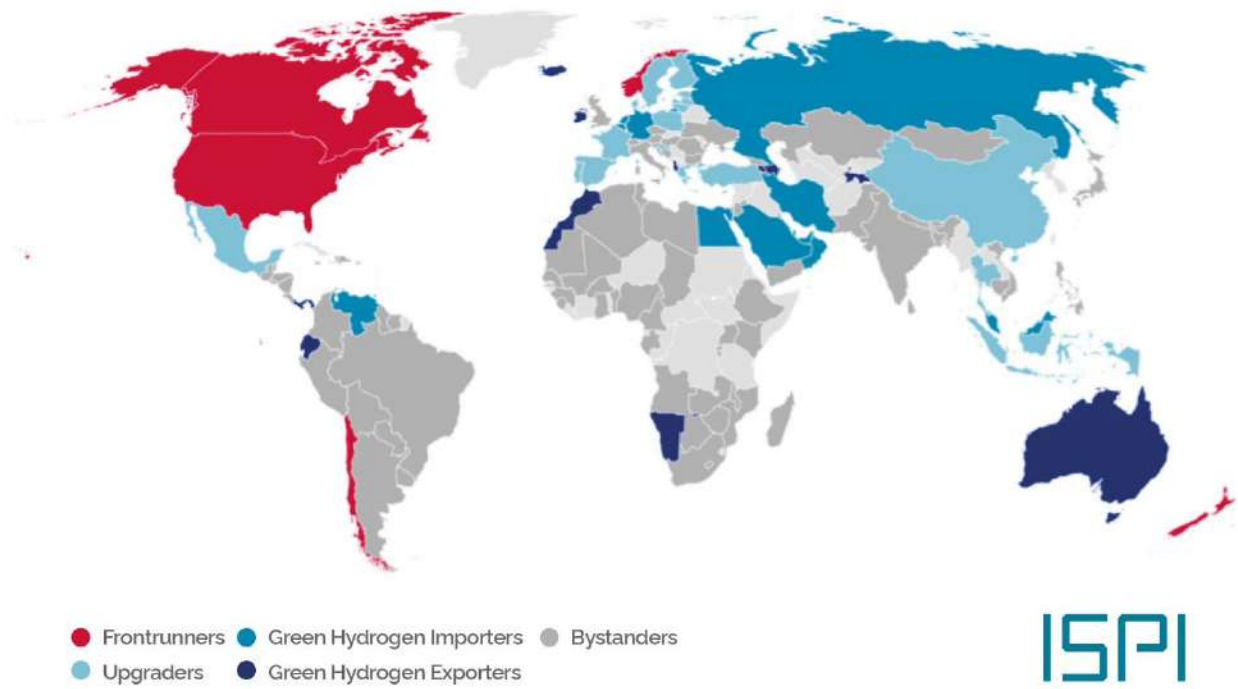
FIG. 5.2 - GEOPOLITICAL MAP OF GREEN AMMONIA PRODUCTION POTENTIAL



4.2 The geopolitical potential for green hydrogen-based methanol production

Four out of today's top five methanol exporters – Saudi Arabia (13% market share), Trinidad and Tobago (11%), Oman (9%), and the United Arab Emirates (6%) – are limited in their potential to produce green hydrogen. Therefore, they would need to rely on imports to maintain their predominance in future green methanol markets. In contrast, large exporters, such as New Zealand (4% market share), the United States (3%), Chile (3%), and Norway (2%), could increase their market shares and evolve into frontrunners thanks to their high resource endowments and significant economic relatedness. Countries such as China, Mexico, Spain, or Turkey with high economic relatedness indicating transferrable skills, but not the current industrial production needed to become frontrunners, could still upgrade their positioning by attracting industries using green methanol. Countries without highly transferrable skills, like Australia, Namibia, and Morocco, could still benefit by becoming hydrogen exporters to countries with extensive green methanol-based industries but low production potentials (see figure 5.3).

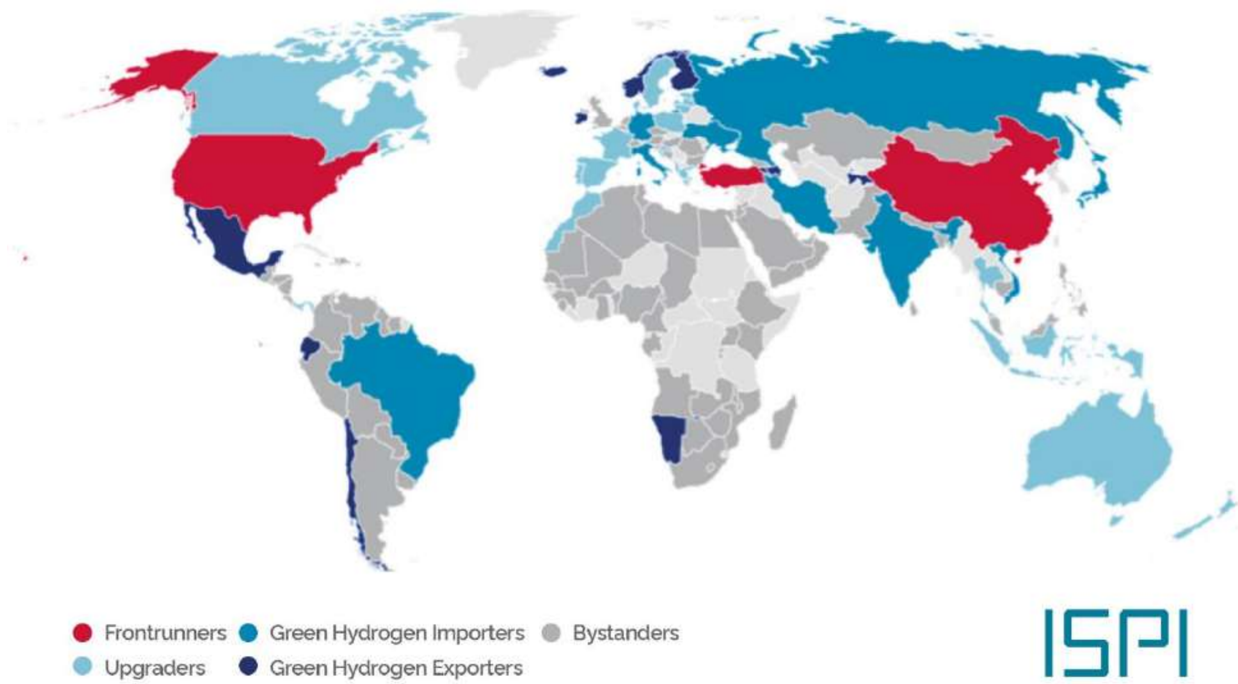
FIG. 5.3 - COUNTRY POTENTIAL FOR METHANOL PRODUCTION BASED ON GREEN HYDROGEN



The geopolitical potential for green hydrogen-based steel production

Today's steel production is dominated by China, which accounts for almost 57% of global markets, followed by India (5% market share), Japan, the United States and Russia (4% each). While China and the United States are well positioned to become frontrunners in future green steel markets, Japan, Hungary, Russia, and other major steel producers face resource endowment constraints and would depend on green hydrogen imports. Smaller producers such as France (0.6% market share) or Spain (0.6%) could benefit from evolving market dynamics and increase market shares thanks to their high economic relatedness. Countries with good resource endowments and economic relatedness, such as the Baltic States, Morocco, Turkey, and Thailand, could try to attract green steel production, thus gaining new value-creating opportunities. Countries like Norway, Chile, and Namibia could become green hydrogen exporters to countries wishing to decarbonize their steel production (see figure 5.4).

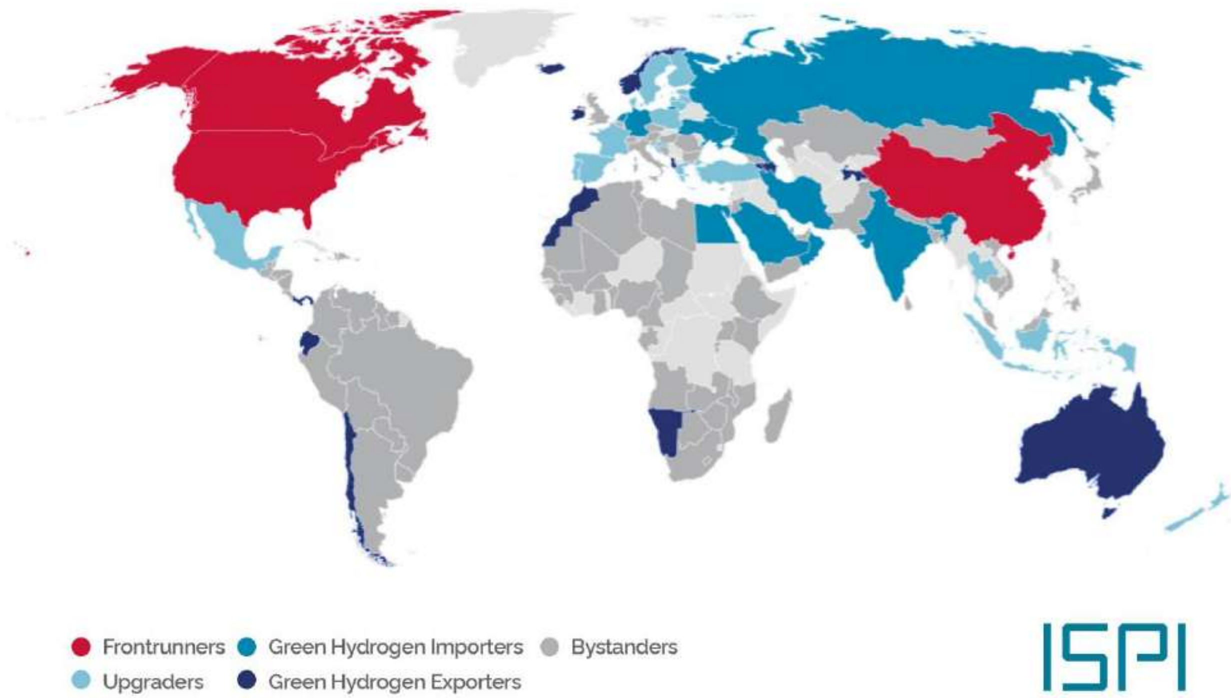
FIG. 5.4 - COUNTRY POTENTIAL FOR STEEL PRODUCTION BASED ON GREEN HYDROGEN



The geopolitical potential for green hydrogen industrial applications

Our analysis shows how only a few countries, such as Canada, China, and the United States, have the potential to emerge as leaders in at least two industrial green hydrogen applications. The majority of current steel, ammonia, and methanol production locations face resource constraints and might depend on hydrogen imports to decarbonize. Producing nations that lead in at least one industrial green hydrogen application, like Spain and Mexico, could upgrade their value chain position based on related economic activities. Most potential green hydrogen producers are good locations for at least one of the three green hydrogen industrial applications, and might consider the integration of value chain segments, whereas countries with lower economic relatedness, such as Chile, Norway, or Namibia, could focus on green hydrogen exports. While the mapping indicates that there are opportunities for countries in all world regions, most countries in South America and Africa face constraints that limit their potential for an active role in industrial green hydrogen value chains (see figure 5.5).

FIG. 5.5 - COUNTRY POTENTIAL FOR AT LEAST TWO INDUSTRIAL GREEN HYDROGEN APPLICATIONS



Case Studies – Opportunities and Challenges

The United States – a frontrunner

Today the United States is one of the world's leading hydrogen producers, accounting for 13% of global demand, with 80% of this production deriving from natural gas that, even if cost-competitive compared to green hydrogen, has a much higher carbon intensity.[65] At the same time, the country's vast solar, wind, and freshwater endowments[66] could turn the United States into a green hydrogen export champion and a frontrunner in future green hydrogen industrial applications.

Existing large ammonia and steel applications, equal to 10% and 3.9% of global production, respectively, have given rise to industrial clusters with relatively high-skilled labour forces. Stakeholders such as USS Steel Corp. are exploring decarbonisation options,[67] while the largest US ammonia producer, CF Industries, is building its first green ammonia plant in Louisiana, which should be operational by 2023.[68]

The US government has made green hydrogen a key piece of its industrial and climate policy. The "hydrogen programme plan" supports technological innovation and green hydrogen

---

[65] IEA (2019).
[66] AQUASTAT (2020); Pflugmann and De Blasio (2020).
[67] "U.S. Steel, Norway's Equinor eye clean hydrogen production", *Reuters*, 29 June 2021.
[68] "US ammonia producer unveils green hydrogen project", *Renews*, 2021.

deployment at scale.[69] One central instrument is the 'Energy Earth shot Initiative,' which aims to reduce the cost of green hydrogen by 80% to US$1 per kg by 2030.[70] With investments of about 400 million in 2022 alone, the programme provides grants to hydrogen innovation and demonstration projects focused specifically on chemical and industrial processes. One concrete example is the US Department of Energy's support for projects in Texas that explore how to scale up production and industrial uses of green hydrogen. These strategic industrial policies go in the direction of establishing the United States as a frontrunner in future global hydrogen value chains.[71]

Thailand – a potential upgrader driving green industrialisation

Thailand is driving green industrialisation partly as a means to create new job opportunities. Its long-term economic development plan 'Thailand 4.0' is aimed at moving the country from middle-income paying jobs to high-income ones in the next 20 years. Key measures include strengthening industrialisation and spurring innovation, especially for the chemical sector, which is seen as the country's "growth engine".[72] Upgrading Thailand's positioning along green hydrogen value chains would highly resonate with these economic development goals.

Thailand has vast renewable resource endowments for green hydrogen production, and already leads in the ASEAN[73] region with more than 60% of the regional installed solar capacity.[74] While biofuels still account for the majority of renewable electricity supply, government policies support the increase of wind and solar energy production.[75] Based on improvements in water management in the past decades, Thailand's water plan foresees no resource scarcity that would restrict green hydrogen production.[76] The first plants for green hydrogen production are already being built by the largest state-owned energy utility, EGAT,[77] and by the Chinese company Wison Engineering, which plans to start production in 2023.[78]

Thailand could therefore build up green hydrogen-based industrial production. While domestic ammonia, methanol, and steel production is not yet established, Thai industries currently use imported ammonia as a feedstock for fertilizers in the food industry and refrigeration

---

[69] US Department of Energy, *Department of Energy Hydrogen Program Plan*, 2020.
[70] Office of Energy Efficiency and Renewable Energy, *Hydrogen Shot*, 2021.
[71] Ibid.
[72] Royal Thai Embassy, *Thailand 4.0*, 2021.
[73] The Association of Southeast Asian Nations (ASEAN) includes the following countries: Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam.
[74] C.-S. Hong, "Thailand's Renewable Energy Transitions: A Pathway to Realize Thailand 4.0", *The Diplomat.*, March 2019; IEA (2021b).
[75] S. Sethaputra, S. Thanopanuwat, L. Kumpa, and S. Pattanee, *Thailand's Water Vision: a Case Study*, Food and Agriculture Organization (FAO), 2000.
[76] Sethaputra et al. (2000).
[77] Electricity Generating Authority of Thailand (EGAT), "EGAT to Advance Hydrogen Production in Thailand", Enapter, 2019.
[78] M.P. Bailey, "Wison Engineering awarded EPCC contract for new hydrogen plant in Thailand", *Chemical Engineering*, 2021.

systems.[79] Related industrial activities contribute to a high level of transferable skills; Thailand is a regional leader in chemicals and has an extensive refining base that has started to explore the use of green hydrogen to decarbonize diesel production.[80] These related economic activities and skills could become valuable assets for attracting green ammonia and methanol productions, but it is yet not clear whether the country could compete at scale in future green hydrogen markets and applications.

Thailand has not yet developed a national hydrogen plan outlining the country's long-term vision and supporting policies. However, nascent initiatives like the multi-stakeholder "Hydrogen Thailand Group' exist at a national level".[81] At a cross-border level, ASEAN countries hold meetings to coordinate policies among member states and foster regional initiatives for the deployment of new hydrogen plants and enabling infrastructure.[82] The production of green hydrogen and the build-up of green hydrogen industries could strengthen Thailand's role in regional trade with other ASEAN countries. However, more targeted policies will be needed to capitalize on the full potential of industrial upgrading opportunities.

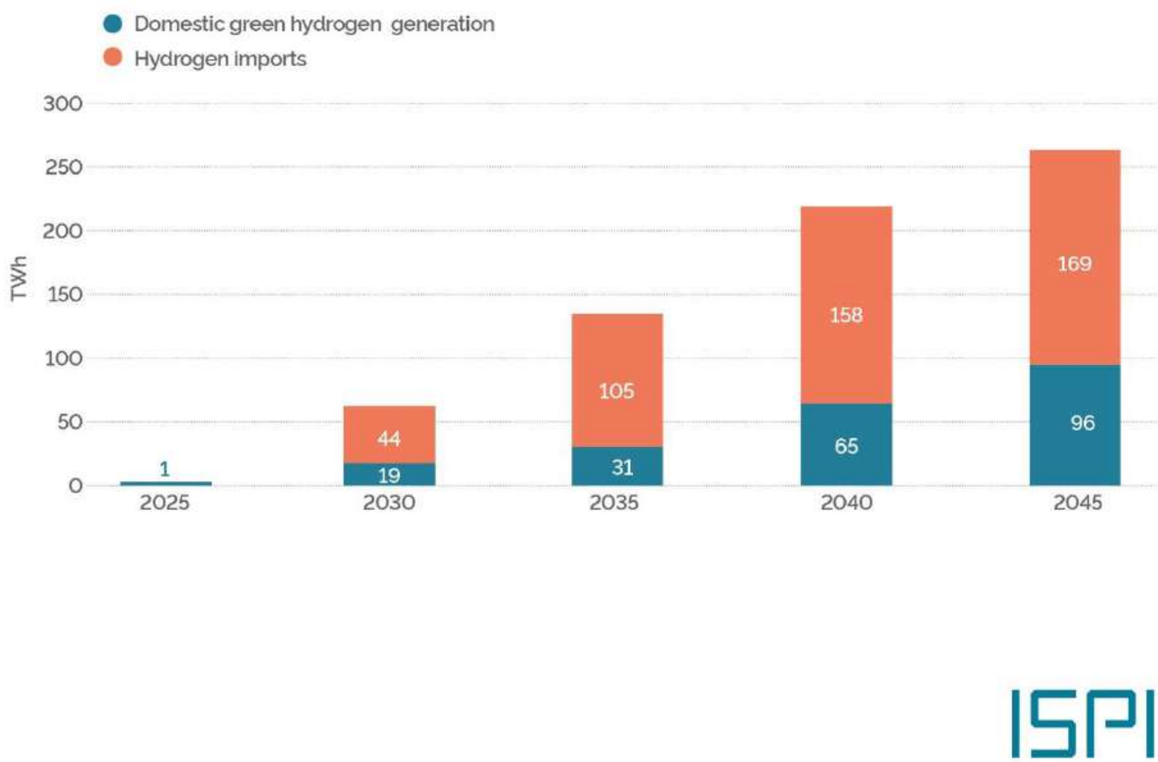
Germany – an import-dependent decarbonising industrial power

Germany will need to rely on imports to meet projected green hydrogen demand due to its comparatively low solar and wind potentials and limited land availability.[83] Although several plants for green hydrogen production are being developed,[84] recent estimates forecast that Germany could, at most, produce only a third of the needed green hydrogen demand by 2045 (See figure 5.6).[85]

---

[79] D. Yoshimoto, "Thailand sees strong interest in advanced ammonia systems", *Ammonia21*, 2017.
[80] Bailey (2021).
[81] PTT Digital, "PTT Teams Up with Leading and Public and Private Sector to Drive 'Hydrogen' to Be Alternative Energy of the Future of Thailand", 2020.
[82] ASEAN Center for Energy, "Hydrogen in ASEAN: Economic Prospect, Development & Applications", 30 August 2021.
[83] A. Nuñez-Jimenez and N. De Blasio, „The Future of Renewable Hydrogen in the European Union: Market and Geopolitical Implications", H. K. S. Belfer Center for Science and International, 2022; Prognos, Öko-Institut, and Wuppertal-Institut, *Klimaneutrales Deutschland 2045. Wie Deutschland seine Klimaziele schon vor 2050 erreichen kann*, Langfassung im Auftrag von Stiftung Klimaneutralität, Agora Energiewende und Agora Verkehrswende, 2021.
[84] Bundesministerium für Wirtschaft und Energie (BmWi), "Wir wollen bei 'Wasserstofftechnologien Nummer 1 in der Welt werden': BMWi und BMVI bringen 62 Wasserstoff-Großprojekte auf den Weg", 28 May 2021.
[85] Prognos, Öko-Institut, and Wuppertal-Institut (2021).

FIG. 5.6 - PROJECTED GREEN HYDROGEN PRODUCTION IN GERMANY AND IMPORT NEEDS [86]



While Germany is not among the world's top producers of ammonia, methanol, or steel, it still accounts for considerable steel and ammonia production market shares, 2% and 1.7%, respectively.[87] These industries are well established and often operate in captive markets with highly integrated infrastructure networks, including 400km of hydrogen pipelines.[88]

As these sectors decarbonize, a key challenge facing Germany will be how to remain competitive despite its import dependency, a challenge already seen in the chemical sector, which is under pressure due to the increasing offshoring of production facilities.[89] On the other hand, highly specialised transferable skills, especially in the plastics sector, innovation clusters, and customer proximity, could become key assets.[90]

The German government strongly supports the green hydrogen-based decarbonisation of industrial applications. Several concrete support policies have already been introduced beyond a national hydrogen strategy that provides general guidance. These policies include a national

[86] Ibid., p. 23.
[87] Bundesministerium für Wirtschaft und Energie (BmWi), "Stahl und Metall", 2021; "Ammonia production worldwide in 2020, by country", *Statista*, 16 August 2023.
[88] IEA (2019); Shell, *The Future of Hydrogen*, Shell Deutschland Oil GmbH, 2017.
[89] Prognos et al. (2021), p. 45.
[90] Ibid.

innovation programme providing up to €1.4 billion in public funding and €2 billion in private funding for hydrogen and fuel cell technologies.[91] This programme aims to build the needed know-how and skills through demonstration projects, such as the first synthetic methane production plants using green hydrogen as a feedstock being built in Werlte.[92] On top of these national initiatives, Germany is also leveraging European Union initiatives based on the "hydrogen strategy for a climate neutral Europe". The EU and its member states support large-scale deployment of green hydrogen, especially in the steel and chemical industries, by uniting stakeholders in a 'European Clean Hydrogen Alliance' that provides public funding and promotes research and innovation.[93]

Policymakers at the national and EU levels are also focusing on securing stable green hydrogen imports for industrial applications. The EU hydrogen strategy aims to address the market and geopolitical implications of green hydrogen imports and the Commission prioritizes partnerships with key suppliers,[94] mainly Middle Eastern and Northern African countries.[95] At the national level, Germany supports public partnerships and private sector collaborations with Morocco, Saudi Arabia, UAE, and Australia.[96] In addition, resource potentials for hydrogen exports have been assessed in cooperation with West and sub-Saharan African states, including Namibia.[97]

Geopolitical and Market Implications

Previous research on the geopolitics of green hydrogen has identified potential green hydrogen export champions, such as Australia, Canada, Norway, Namibia, and the United States, based on their vast resource endowments.[98] Integrating critical insights from a value chain perspective allows us to elucidate the distribution of potential economic gains and losses and the associated geopolitical and market implications in more detail.

This study argues that the role countries will assume in future green hydrogen value chains depends not only on their resource endowments but also on their current positioning in hydrogen

---

91 IEA (2019).

92 Ibid.

93 European Commission, *Supporting clean hydrogen*, 2022.

94 European Commission (EC), *A hydrogen strategy for a climate-neutral Europe*, 2020.

95 Ibid.; International Renewable Energy Agency (IRENA), "A Dialogue Between EU and North African States on a Regulatory Framework to Develop Green Hydrogen Supply, Demand and Trade", IRENA-European Union Workshop, 13 October 2021.

96 Bundesministerium für Wirtschaft und Energie (BmWi), "Altmaier unterzeichnet gemeinsame Absichtserklärung zur Deutsch-Saudischen Wasserstoffzusammenarbeit", 11 march 2021; Bundesministerium für Wirtschaft und Energie (BmWi), "Deutschland und die Vereinigten Arabischen Emirate verstärken Energiepartnerschaft mit neuer Wasserstoff-Taskforce", 2 November 2021; Bundesministerium für Wirtschaft und Energie (BmWi), "Unterzeichnung einer Absichtserklärung zur Gründung eines deutsch-australischen Wasserstoffakkords", 13 June 2021.
Ghorfa – Arab-German Chamber of Commerce and Industry, "Bundesregierung unterzeichnet Wasserstoff-Abkommen mit Marokko", 2020.

97 Bundesministerium für Bildung und Forschung (BmBF), "Potenzialatlas Wasserstoff: Afrika könnte Energieversorger der Welt werden", 20 May 2021.

98 IRENA (2022); Pflugmann and De Blasio (2020); Van de Graaf et al. (2020).

markets and the economic relatedness of their industrial sectors with green hydrogen applications. This implies that countries with significant renewable hydrogen potential could prioritize hydrogen exports ("green hydrogen exporters"), foster value creation opportunities by upgrading along value chains ("upgraders"), or both ("frontrunners").

Only a few countries, including China and the United States, might emerge as clear frontrunners that integrate numerous segments of value chains for various industrial green hydrogen applications. These countries have vast resource endowments and considerable market shares in today's hydrogen industrial applications that enable them to integrate the green hydrogen value chain segments of production and industrial applications. Locating industrial facilities close to low-cost green hydrogen production would create value by increasing a country's control over supply chains and minimizing hydrogen transportation costs. These countries could thus reap the most extensive benefits and become geopolitical and market winners. However, previous studies on the geopolitics of the energy transition have warned that these dynamics could spur a green race for industrial leadership, creating tensions in international relations.[99]

Today, most countries with highly developed ammonia, methanol, and steel industries, such as Saudi Arabia, Japan, and Germany, are resource constrained and would depend on green hydrogen imports to meet demand. Hence, from a geopolitical perspective, the past's dependencies and supply disruption risks are likely to persist in a low-carbon energy world, but will be different from today's.[100] These new geopolitical dependencies will involve new alliances and will also be a function of future market structures; like natural gas markets, hydrogen markets will emerge as regional ones, but only global and more structured markets will allow for risk reduction. [101]

Further competing dynamics for green hydrogen-based industries could foster new geopolitical and market tensions and conflicts between green hydrogen importers and upgraders. The case study on Germany clearly exemplifies these potential dynamics. As discussed, Germany will need to import green hydrogen to meet demand. However, potential exporters (especially in Southern Europe and Northern Africa) could have a substantial economic interest in attracting the respective green hydrogen industrial applications instead of relying only on hydrogen exports. Countries with high resource potentials and highly skilled labour forces, like Spain, could instead aim to upgrade their value chain position and expand industrial hydrogen applications. These competing interests would likely result in trade barriers or conflicts; green hydrogen importers would protect internal markets with import tariffs on industrial products. At the same time, upgraders would support local industries with subsidies and local content requirements. Various

---

[99] S. Fankhauser et al., "Who will win the green race? In search of environmental competitiveness and innovation", *Global Environmental Change*, vol. 23, no. 5, 2013, pp. 902-13; A. Goldthau, M. Bazilian, M. Bradshaw, and K. Westphal, "Model and manage the changing geopolitics of energy", *Nature*, vol. 569, no. 7754, 2019, pp. 29-31.

[100] M.J. Bradshaw, "The geopolitics of global energy security", *Geography Compass*, vol. 3, no. 5, 2009, pp. 1920-37; P. Toft, "Intrastate conflict in oil producing states: A threat to global oil supply?", *Energy Policy*, vol. 39, no. 11, 2011, pp. 7265-74; Pflugmann and De Blasio (2020).

[101] Pflugmann and De Blasio (2020).

studies on the dynamics of wind and solar value chains illustrate how countries, including China and India, have used trade barriers to strengthen the buildup of domestic industries.[102]

Furthermore, tensions between higher-income countries in the Global North and lower-income countries often located in the Global South might intensify. Our analysis shows how the potential for the three industrial hydrogen applications – ammonia, methanol, and steel – is unevenly distributed across the globe. Although there are opportunities for economic gains in all world regions, most frontrunners are middle- to high-income countries.[103] Our analysis shows that many lower-income countries, especially in Africa, will be limited to green hydrogen exports since they cannot compete in value-added segments of the value chains. Hence the promise of "sustainable development" and green industrialisation, often associated with the energy transition,[104] as, for example, in our case study country Thailand, might not be replicable everywhere. This finding is in line with existing literature on the 'uneven transition,' in which the gap between countries leading and benefiting from the energy transition and those that are not is widening.[105] This result might intensify previous debates in the UNFCCC on the need for technology transfer and financial support to enable sustainable development and green industrialisation for all.[106]

---

[102] Bazilian et al. (2020); Chen and Lees (2016); Y. Dai and L. Xue, "China's policy initiatives for the development of wind energy technology", *Climate Policy*, vol. 15, no. 1), 2014, pp. 30-57; A. Hipp and C. Binz, "Firm survival in complex value chains and global innovation systems: Evidence from solar photovoltaics". *Research policy*, vol. 49, no. 1, 2020, p. 103876; O. Johnson, "Promoting green industrial development through local content requirements: India's National Solar Mission", *Climate Policy*, vol. 16, no. 2, 2015, pp. 178-95; J.-C. Kuntze and T. Moerenhout, *Local Content Requirements and the Renewable Energy Industry - A Good Match?*, International Centre for Trade and Sustainable Development (ICTSD) 2013; J. Meckling and L. Hughes, "Globalizing Solar: Global Supply Chains and Trade Preferences", *International Studies Quarterly*, vol. 61, no. 2, 2017, pp. 225-35; D. Prud'homme, M. von Zedtwitz, J.J. Thraen, and M. Bader, "Forced technology transfer" policies: Workings in China and strategic implications, *Technological Forecasting and Social Change*, vol. 134, 2018, pp. 150-68; R. Quitzow, J. Huenteler, and H. Asmussen, "Development trajectories in China's wind and solar energy industries: How technology-related differences shape the dynamics of industry localization and catching up", *Journal of Cleaner Production*, vol. 158, 2017, pp. 122-33; F. Zhang and K.S. Gallagher, "Innovation and technology transfer through global value chains: Evidence from China's PV industry", *Energy Policy*, vol. 94, 2016, pp. 191-203.

[103] A country's income level classification is based on the World Bank (World Bank, "World Bank Country and Lending Groups", 2021). Low-income countries have a gross national income (GNI) per capita below US$1,045; lower middle-income countries have a GNI per capita between US$1,046 and US$4,095; upper middle-income countries between US$4,096 and US$12,695; high-income countries above US$12,695.

[104] S. Helgenberger et al., *Mobilizing the co-benefits of climate change mitigation: Building New Alliances – Seizing Opportunities – Raising Climate Ambitions in the new energy world of renewables*, COBENEFITS IMPULSE Policy Paper, IASS Brochure, 2017.

[105] L. Eicke and A. Goldthau, "Are we at risk of an uneven low-carbon transition? Assessing evidence from a mixed-method elite study", *Environmental Science & Policy*, vol. 124, 2021, pp. 370-79; Goldthau Eicke, and Weko (2020); Quitzow et al. (2021).

[106] M. Glachantand and A. Dechezleprêtre, "What role for climate negotiations on technology transfer?", *Climate Policy*, vol. 17, no. 8, 2016, pp. 962-81; B.M. Hoekman, K.E. Maskus, and K. Saggi, "Transfer of technology to developing countries: Unilateral and multilateral policy options", *World Development*, vol. 33, no. 10, 2005, pp. 1587-1602; J. Kirchherr and F. Urban, "Technology transfer and cooperation for low carbon energy technology: Analysing 30 years of scholarship and proposing a research agenda", *Energy Policy*, vol. 119, 2018, pp. 600-09; A. Lema and R. Lema, "Technology transfer? The rise of China and India in green technology sectors", *Innovation and Development*, vol. 2, no. 1, 2012, pp. 23-44; A. Lema and R. Lema, "Technology transfer in the clean development mechanism: Insights from wind power", *Global Environmental Change*, vol. 23, no. 1, 2013, pp. 301-13; J. McGee and J. Wenta, "Technology Transfer Institutions in Global Climate

Finally, we have identified several adjacent research topics in need of further academic focus. Potential areas include but are not limited to:

1. Apply the proposed framework to other sectors and applications. We exemplarily analysed countries' potential for green hydrogen-based ammonia, methanol, and steel production. Further research could concentrate on value chains for other green hydrogen applications, including the transport and refining sectors.

2. Expand the analytical framework to elucidate and compare industrial upgrading and relocation from a system dynamics perspective, considering sector-specific and local factors such as regulations and labour costs. While many previous studies highlighted the importance of economic relatedness and skill and technology transfer, these complex processes seem to depend on further interdependent factors, which vary among countries and sectors.[107] Thus, further research on the specific dynamics in the chemical and steel sectors could help clarify the relative importance of these factors, in concrete country contexts. Previous research on relocations in wind and solar value chains might offer interesting entry points for a comparative analysis.[108]

3. Model differences in green hydrogen production costs, based on various constraints. Some of the mentioned constraints in this study could be overcome. Limited resource availability does not always imply that a country will entirely depend on green hydrogen imports since it might still be able to produce some of its demand internally, as the case study on Germany highlights. Likewise, better water management systems and targeted training could increase freshwater availability and labour skills. At the same time, even if existing constraints were to be addressed, this would come at a cost, which could be modeled in future research.

Conclusion and Policy Recommendations

This chapter addresses the potential for green hydrogen adoption at scale in three key industrial applications: ammonia, methanol, and steel production. Building on existing literature that assesses countries' potential for green hydrogen production,[109] we add critical insights from a value chain perspective. We propose an analytical framework to cluster countries into five groups

---

Governance: The Tension between Equity Principles and Market Allocation", *Review of European, Comparative & International Environmental Law*, vol. 23, no. 3, 2014, pp. 367-81.

[107] L. Baker, P. Newell, and J. Phillips, "The political economy of energy transitions: the case of South Africa", *New Political Economy*, vol. 19, no. 6, 2014, pp. 791-818; Gandenberger et al. (2015); E. Giuliani, C. Pietrobelli, and R. Rabellotti, "Upgrading in global value chains: lessons from Latin American clusters", *World Development*, vol. 33, no. 4, 2005, pp. 549-73; S.J. Haakonsson and D. Slepniov, "Technology transmission across national innovation systems: The role of Danish suppliers in upgrading the wind energy industry in China", *The European Journal of Development Research*, vol. 30, no. 3, 2018, pp. 462-80; Pipkin and Fuentes (2017); Y. Qiu, L. Ortolano, and Y.D. Wang, "Factors influencing the technology upgrading and catch-up of Chinese wind turbine manufacturers: Technology acquisition mechanisms and government policies", *Energy Policy*, vol. 55, 2013, pp. 305-16.

[108] Meckling and Hughes (2017); Zhang and Gallagher (2016).

[109] Pflugmann and De Blasio (2020).

based on resource endowment, current industrial production, and economic relatedness. Our findings offer more granular insights into the different roles countries could assume in future green hydrogen markets. Thus, they contribute empirical evidence to the ongoing debate on the geopolitics of hydrogen, and elucidate the distribution of potential economic gains and losses and the associated geopolitical and market implications.

Analysing a country's potential value chain positioning in future green hydrogen markets can guide policymakers in defining strategic industrial policies for each country group:

Frontrunners. Countries with vast resource endowments and considerable market shares in today's hydrogen industrial applications could evolve into frontrunners by integrating green hydrogen value chain segments of production and industrial applications. Potential frontrunners should focus on industrial policies that foster the up-scaling of green hydrogen production and industrial applications.

Upgraders. Countries with adequate resources for green hydrogen production and highly related economic activities could potentially upgrade their value chain position and attract green hydrogen-based industries. Potential upgraders could benefit from strategic partnerships with frontrunners to foster technological and know-how transfer. Policies should focus on attracting foreign capital – for example, by lowering market risk, developing public-private partnerships, and forming joint ventures.[110]

Green hydrogen exporters. Resource-rich countries without upgrading potential should prioritize green hydrogen exports and would benefit from partnerships with green hydrogen importers to deploy enabling infrastructure and reduce market risk. Further coordination among green hydrogen exporters on international standards for green hydrogen production could avoid conflict and facilitate trade at global scale.

Green hydrogen importers. Resource-constrained countries with industrial hydrogen-based production will need to develop strategic partnerships to ensure secure and stable green hydrogen supplies. Furthermore, stimulating innovation and knowledge creation through targeted policies will be critical to sustain competitiveness during the transition to a low-carbon economy and avoid industrial relocation to frontrunners or upgraders.

Bystanders. Countries with significant constraints along all three critical variables of resource endowment, current positioning in hydrogen markets, and economic relatedness should assess whether some of these constraints, such as limited infrastructure or freshwater availability, could be overcome.

Declaration of Interests. The authors declare that they have no competing personal or financial interests that might have biased this research.

[110] E. Asiedu, "Foreign Direct Investment in Africa: The Role of Natural Resources, Market Size, Government Policy, Institutions and Political Instability", *The World Economy*, vol. 29, no. 1, 2006, pp. 63-77; M.J. Bürer and R. Wüstenhagen, "Which renewable energy policy is a venture capitalist's best friend? Empirical evidence from a survey of international cleantech investors", *Energy Policy*, vol. 37, no. 12, pp. 4997-5006; M. Busse and C. Hefeker, "Political risk, institutions and foreign direct investment", *European Journal of Political Economy*, vol. 23, no. 2, 2007, pp. 397-415.

Funding Statement. Laima Eicke is funded by the "Investigating the Systemic Impacts of the Global Energy Transition" (ISIGET) project under the "Make our Planet Great Again - German Research Initiative", grant number 57429628, which is financed by the Federal Ministry of Education and Research (BMBF) and implemented by the German Academic Exchange Service (DAAD).

POLICY INSTRUMENTS:
SETTING THE RULES OF THE GAME

6. The EU, the United States, and China: On the Brink of a New Global Industrial Policy and Trade War?

Stormy-Annika Mildner and Claudia Schmucker

A New Geoeconomic Environment

The geopolitical and geoeconomic environment is changing rapidly. Not only is the worst war since the end of World War II raging on the European continent, but the rivalry between Western democracies and autocratic regimes, principally between the United States and China, is also intensifying. Both countries are increasingly using their economic power as a lever to achieve strategic foreign policy goals. In the process, multilateral organisations such as the World Trade Organisation (WTO), which has guaranteed a transparent and open rules-based trading system over decades, are losing their relevance. In addition, China's geopolitical ambitions, as well as growing internal authoritarian trends, political repressions, and human rights violations, are increasingly calling into question the mantra of "change through trade" that has guided many foreign economic policies around the world.

The Covid-19 pandemic also led to shortages of key raw materials, inputs for manufacturing, and medical supplies, highlighting existing vulnerabilities in supply chains and production networks. However, it is particularly Russia's war against Ukraine that has shown how quickly a political shock can bring markets to a standstill. This has also led to a new awareness in the EU, the United States, and other partner countries about the interplay between trade and technology and the risk that arises when technology falls into "the wrong hands". Accordingly, export controls and foreign investment screening reviews are being tightened worldwide.

Tendencies towards "nearshoring" and "friendshoring", i.e. moving production from riskier environments to "friendlier" regions in order to reduce risks from geopolitical instability, are also intensifying. At the same time, the number of bilateral trade agreements is growing. However, many of these agreements are not classical Free Trade Agreements (FTAs) but rather looser "deals" in selected areas, such as the Trade and Technology Council (TTC) between the United States and the EU, without binding character under international law.

Yet another trend is becoming apparent: the renaissance of industrial policy. Across the globe, governments are enacting new regulations and launching new financing programmes to bolster the domestic production of strategic products that are essential for the green and digital transformation. The role of the state in the economy is increasing, and industrial policy is taking on a new geopolitical and geoeconomic importance. The trend started in 2015 with China's

“Made in China 2025” plan, which aimed to close the gap with the country’s major geopolitical and economic competitors. It identified ten strategically important sectors, focusing on advanced manufacturing, clean energy, and the digital economy.[1] In light of the Covid-19 pandemic and growing geoeconomic competition, the EU and the United States also launched industrial policy plans and massive national funding programmes. Just like trade policy, industrial policy is gaining a strong strategic and security component. Government funding is not only aimed at ensuring international competitiveness, but also at bolstering national security by investing in industries that are vital to defence capabilities.

The restructuring of global supply chains, new industrial policies, and huge subsidy packages, as well as new partnership models, will massively affect global and regional trade and investment flows, threatening significant trade distortions and a fragmentation of the global economy. In January 2023, the International Monetary Fund (IMF) calculated the long-term costs of fragmentation: while in a limited fragmentation/low cost adjustment scenario the impact of trade fragmentation on global output would only be 0.2% of GDP, in a severe fragmentation/high cost adjustment scenario, the impact could be as high as 7%. If technological decoupling comes into the picture, costs could be as high as 8 to 12% of GDP in some countries.[2]

Does the world stand on the brink of a new industrial policy and trade war? And what role do the United States, the EU, and China play in this scenario?

The United States: Trade, Industrial Policy, and China

US President Joe Biden has placed his presidency under the motto “Build Back Better.” He wants to strengthen the middle class and bring industry and manufacturing back to the United States. The first year of his presidency was devoted to overcoming the Covid-19 pandemic; during his second year in office, he succeeded in getting groundbreaking legislation passed, which includes a strong industrial policy component.

Biden’s trade policy goals are laid out in the annual Trade Policy Agendas, which note that the United States faces four key challenges: 1. building a stronger industrial and innovation base to ensure U.S. sustainability; 2. building a sustainable infrastructure and clean energy future; 3. building a stronger, more inclusive economy; and 4. promoting equal treatment, regardless of colour, across the board. The Biden administration wants to take a “worker centric approach” that puts US workers at the centre of trade policy. The aim is to establish greater independence from global supply chains, particularly for critical products such as pharmaceuticals and medical protective equipment, but also for high-tech goods like semiconductors. As such, government contracts are to be awarded to US companies as a matter of priority (“Buy American”). While Biden opposes Donald Trump’s transactional trade policy and tit-for-tat trade wars, he too wants to use trade policy to strengthen the domestic economy and to establish an international level playing field.

[1] R. Johnston, “Industrial Policy Nationalism: How Worried Should We Be?”, Center on Global Energy Policy, Columbial University, 27 February 2023.
[2] S. Aiyar et al., “Geoeconomic Fragmentation and the Future of Multilateralism”, International Monetary Fund (IMF), 15 January 2023.

Thus, it does not come as a surprise that the Biden administration did not immediately abolish the U.S. tariffs on steel an aluminium (Section 232 tariffs of the Trade Act of 1962), which the Trump administration had implemented. It was not until the sidelines of the G20 summit in late October 2021 that the EU and United States reached a compromise. The EU agreed to a tariff-rate quota that granted the EU a certain amount of duty-free exports to the United States starting in January 2022.[3] In return, the EU agreed to suspend retaliatory measures against U.S. tariffs. The agreement contains two other important aspects: first, the United States and the EU committed to work more closely together to address unfair trade practices by and overcapacities in third countries; second, they agreed to negotiate a Global Arrangement on Sustainable Steel and Aluminium within two years that would establish a level playing field and reduce greenhouse gas emissions.[4] While not referencing China directly, the agreement was clearly motivated by that country's unfair trade practices.

US trade policy is very much driven by the US-China relationship. At a press conference in 2021, Biden emphasised: "Your children or grandchildren will write their dissertations on the question of who prevailed: Autocracy or democracy? Because that is what it is all about, not just with China".[5] The conflict between the United States and China is much more than a trade dispute: it is a contest between different economic and political systems and ideas. On the one side stands China's hybrid economic model with a strong influence of the state, on the other side the free-market and democratic principles of the West. The United States feels threatened as hegemonic power in the world and fears that its ability to set the rules for the global economy in the future will be compromised.

What does this mean for US trade and economic policy? In early October 2021, the Biden administration presented its new China strategy, "New Approach to the US-China Trade Relationship."[6] First and foremost, China is to comply with the so-called "Phase One Deal," which the United States and China signed during the Trump administration. Under this deal, China committed to purchase an additional US$200 billion dollars of US goods in 2020 and 2021. In addition, Beijing agreed to comply with intellectual property rights, eliminate non-tariff barriers in the agricultural sector, and further open up the financial services sector.[7] China has only partially honoured these commitments. The "Phase Two Deal" sought by Trump has not been on the Biden's agenda so far. This second agreement was intended to address numerous points of contention, such as China's industrial policy and the unfair subsidisation of Chinese state-owned enterprises. What does the Biden trade policy agenda entail, also vis-à-vis China?

---

[3] I. Manak and S. Lincicome, "In Biden's Steel Tariff Deal with Europe, Trump's Trade Policy Lives On", CATO Institute, 2 November 2021.

[4] R. Fefer, "What's in the New U.S.-EU Steel and Aluminum Deal?", Congressional Research Service, 12 November 2021.

[5] A.D. Miller and R. Sokolsky, "Biden is right that global democracy is at risk. But the threat isn't China". *The Washington Post*, 3 December 2021.

[6] Office of the United States Trade Representative, "Fact Sheet: The Biden-Harris Administration's New Approach to the U.S. – China Trade Relationship", 4 October 2021.

[7] C. Bown, "The US-China Trade War and Phase One Agreement", Peterson Institute for International Economics (PIIE), February 2021.

Market access restrictions

The Biden administration has continued with Trump's section 301 tariffs against China. By the end of Trump's term, the average US tariff on goods imported from China was 19.3%; 58.3% of imports were affected.[8] This has not changed under Biden. There is little appetite for market access either among Democrats or Republicans, who stand united in their tough stance towards China. The Biden administration is also using the full arsenal of trade defence instruments to counter unfair trade practices abroad, with the number of antidumping and countervailing measures steadily increasing. According to the WTO, the United States has initiated a total of 39 antidumping investigations[9] and 20 investigations for countervailing measures (January 2021 to April 2022).[10]

Technological decoupling

Under Donald Trump's presidency, the United States had already repeatedly tightened measures to protect US technologies and infrastructure. In 2018, Congress passed stricter export controls on dual-use goods through the Export Control Reform Act (ECRA) and more rigorous foreign investment review procedures for certain technologies through the Foreign Investment Risk Review Modernization Act (FIRRMA). In March 2019, Trump also issued a presidential executive order (Executive Order 13873) to secure information and communications technology and services supply chains. In addition, the so-called "Entity List" was expanded, which lists foreign individuals, companies, research institutions, and government and private organisations. Exports and re-exports of certain goods to listed entities are subject to licensing requirements.

President Biden has continued this policy. In early June 2021, he signed Executive Order No. 14032, "Addressing the Threat from Securities Investments that Finance Certain Companies of the People's Republic of China," and expanded its scope to include certain Chinese surveillance technology companies. This was primarily in response to China's human rights abuses, particularly related to surveillance activities in Hong Kong and Xinjiang. In 2021, the Office of Foreign Assets Control (OFAC), part of the Department of the Treasury, placed numerous entities on the "Non-SDN Chinese Military-Industrial Complex Companies (NS-CMIC) List".[11] In addition, the Biden administration added various Chinese companies to the "Entity List". In October 2022, the Biden Administration announced new restrictions on exports to China of advanced integrated circuits (ICs), computers, and components containing advanced ICs, semiconductor manufacturing equipment, and related software and technology. The new

[8] C. Bown, "US-China Trade War Tariffs: An Up-to-Date Chart", Peterson Institute for International Economics (PIIE), 22 April 2022.
[9] World Trade Organization (WTO), Data Base for Anti-Dumping Investigations.
[10] Ibid.
[11] J.P. Barker, S.-M. Rhee, N.L. Townsend, T.G. Schmitt, and B. Johnson, *Biden Administration Issues New Sanctions and Trade Restrictions on Chinese Technology Entities and Adds 34 Chinese Entities to the Entity List*, Arnold & Portner, 2022.

measures expanded U.S. export controls under the Export Administration Regulations (EAR) to new items destined for China.[12]

Furthermore, in December 2022, President Biden signed the National Defense Authorization Act (NDAA) for Fiscal Year 2023, including prohibitions on the use of Chinese semiconductors by US government agencies. It also mandated the Director of National Intelligence to set up a pilot programme to assess the feasibility and advisability of providing enhanced intelligence support in aid of export controls and foreign investment screening.[13] In Executive Order 14083, President Biden directed the Committee on Foreign Investment in the United States (CFIUS) to consider additional factors in its review of foreign investments for national security concerns in several key areas such as biotechnology, biomanufacturing, and quantum computing, among others. The Biden administration also aims to strengthen enforcement. On 16 February 2023, the Department of Justice and Department of Commerce announced a new task force – the Disruptive Technology Strike Force – aimed at safeguarding US technology by investigating and prosecuting export control violations.

Going after human rights violations

In addition to tighter export controls, the Biden administration also announced that it would prosecute China's human rights violations in Xinjiang and Hong Kong more vigorously – together with its allies. In March 2021, the United States, Canada, the EU, and the United Kingdom imposed sanctions on China for its repression of the Uighurs. In addition, there is also cooperation within the TTC and through the Export Controls and Human Rights Initiative launched by the US at the Summit for Democracy in December 2021.

Investing in domestic production

Biden wants to invest more in domestic production to enhance U.S. manufacturing in critical areas. Two pieces of legislation stand out in this regard: the CHIPS and Science Act (CHIPS Act) and the Inflation Reduction Act (IRA). The CHIPS Act, signed into law in August 2022, plans for $280 billion in spending over the next ten years – the majority of these funds ($200 billion) being earmarked for scientific R&D and commercialisation.[14] Its goal is to bolster US semiconductor capacity. Some aspects of the law are clearly designed to discourage investment in China. Thus, the law states: "the covered entity may not engage in any significant transaction, as defined in the agreement, involving the material expansion of semiconductor manufacturing capacity in the People's Republic of China or any other foreign country of concern". Foreign entities are eligible to apply for funding, but funds must be used in the United States and no funding may be disbursed to a "foreign entity of concern". The latter includes China, Iran, North Korea, and Russia, but can be expanded by the Secretary of Commerce, in consultation with

[12] N. Dong, L. Ward, D. Townsend, and T.A. Lo, "Biden Administration Restricts U.S. Exports of Advanced Computing and Semiconductor Manufacturing Equipment, Software, and Technology to China", Dorsey and Whitney LLP, 28 November 2022.

[13] K.B. Contini and B. Linskens, "U.S. President Signs Two Bills with Implications for Sanctions, Export Controls, and Related Subjects", *Global Compliance News*, 20 January 2023.

[14] J. Badlam et al., "The CHIPS and Science Act: Here's What's in it", McKinsey&Company, 4 October 2022.

Secretaries of Defense and State and the Director of National Intelligence. The Department of Commerce can also claw back the funding if the company engages in any "significant transaction" involving a material expansion of "semiconductor manufacturing" capacity in a foreign country of concern. For a foreign owned subsidiary in the United States, this does not only affect the subsidiary itself, but also the parent company. This means that if a US subsidiary, which is wholly owned by a foreign parent, receives funding under the CHIPS Act, non-US subsidiaries of the parent company would also be subject to the restrictions. Thus, the law has extraterritorial reach.

The IRA similarly aims at ensuring US technological leadership. It contains $500 billion in new spending and tax breaks with the intension to boost clean energy, reduce healthcare costs, and increase tax revenues. It also aspires to improve US economic competitiveness, innovation, and industrial productivity. Internationally, the IRA was met by considerable criticism as it features some discriminatory elements. Thus, it encompasses several tax credits in the automotive sector for the period 2022 to 2032. However, certain requirements must be met to qualify. For battery raw materials (such as lithium), 40% of the critical raw materials used must come from North America or another partner country, with which the United States has a free trade agreement, starting in 2023. This quota will increase by 10% each year until it reaches 80% in 2027. In addition, starting in 2025, critical battery raw materials must not come from Russia, China, or another critical country that is a "foreign entity of concern." Similarly, battery components must be made 50% (based on cost) in North America or a partner country with a free trade agreement with the US starting in 2023. This percentage will increase to 100% by 2029. From 2024, battery components will also no longer be allowed to come from certain countries such as China and Russia. As the EU does not have a free trade agreement with the United States, the preferential nature of the IRA led to particularly heated reactions. In March 2023, Biden and the President of the European Commission, Ursula von der Leyen, agreed to launch talks on a critical minerals agreement, which would allow EU manufacturers to qualify for the electric vehicle subsidies under the IRA.

Friendshoring and new partnerships

The concept of friendshoring was first official introduced by US Secretary of the Treasury Janet Yellen. Since then, it has become an important component of Biden's trade and industrial policy. To implement it, the Biden administration aims at new agreements with like-minded countries. These have little in common with traditional FTAs but are rather "deals" in selected areas, with selected partners, and little legally binding character.

One of these is the newly created EU-US Trade and Technology Council, which will be covered in more detail in the section on the EU-US-China triangle, below. Another initiative is the Indo-Pacific Economic Framework (IPEF), which the United States agreed with Australia, Brunei, Fiji, India, Indonesia, Japan, South Korea, Malaysia, New Zealand, Philippines, Singapore, Thailand, and Vietnam at the end of May 2022. This format is designed to counterbalance China. According to Biden, the main goal of IPEF is to make supply chains more resilient.[15] The four priority areas are the networked economy, resilient economy, clean, fair, and sustainable economy. However, IPEF does not foresee any binding commitments.

The EU: Trade, Industrial Policy, and China

In mid-February 2021, the European Commission presented its new trade strategy titled "Open, Sustainable and Assertive Trade Policy". It replaced the "Trade for All" strategy of 2015. The guiding principle is open, strategic autonomy. Ursula von der Leyen, stated in her speech to the European Parliament on 27 November 2019: "My Commission will not shy away from appearing self-confident. But we will do it our way, the European way. This is the geopolitical Commission that I have in mind and that Europe desperately needs".

This trade strategy states that "open strategic autonomy emphasises the EU's ability to make its own decisions and shape the world around it according to its interests and values through leadership and engagement". It has three aspects: 1. resilience and competitiveness, to strengthen the EU economy; 2. sustainability and fairness, reflecting the need for the EU to act responsibly and fairly; 3. assertiveness and rules-based cooperation. As such, trade is supposed to contribute to the recovery from the Covid-19 pandemic, to advance the green and digital transformation of the economy, and to build a more resilient Europe in the world.

China also plays an important role in the EU's trade policy. The EU sees China as a partner, competitor, and systemic rival. It shares many of the criticisms voiced by the United States regarding the violation of human rights, international trade law, and environmental standards. Hardly any decision-maker in the EU still believes that economic opening will also lead to democratisation. The EU is thus taking an increasingly tough stance on China. However, the EU still has a different strategic interest than the United States. It is not a hegemonic power that feels challenged by China. There are also differences in terms of the economic relationship: Many EU members – in particular Germany – are highly dependent on China both as an export market and production location. As a consequence, even if the image of China is changing in the EU, the risk perceptions and policy choices in the EU and the United States still differ. The EU still believes that China can be best contained with rules, while the United States relies on sanctions.

Trade defence

Even though the EU and the United States differ in their concrete risk perceptions, the EU has also strengthened its trade defence arsenal to defend its interests and values in the current geoeconomic environment. The EU already had powerful trade tools at its disposal, including anti-dumping and anti-subsidy instruments and the newly created Trade Enforcement Officer. Using these, the EU has initiated numerous trade protection proceedings and WTO complaints to protect companies in the single market from unfair competitors from third countries. At the same time, the EU has significantly sharpened its defensive toolbox. With regard to its

[15] T. Harris and T. Sutton, "Biden's Economic Plan Leaves Asian Leaders Wanting More", Foreign Policy, 27 May 2022.

"strategic rival" China, this primarily involves stronger protection of strategically important sectors and the establishment of a level playing field with regard to industrial subsidies. [16]

In the spring of 2019, the EU introduced a regulation on foreign investment screening. For the first time, this framework enables a systematic exchange of information between EU Member States and the European Commission on foreign takeovers and as such facilitates a more united European position. The Commission can issue opinions, when an investment threatens the security or public order of more than one Member State, or when an investment could undermine a strategic project or programme of common interest to the whole EU.

In addition, the EU introduced an international procurement instrument in 2022. This tool can restrict the access of companies from third countries to the public procurement markets of the EU if European companies do not receive reciprocal access in the respective third country. The aim is to create fair conditions on global procurement markets to protect the competitiveness of European industry vis-á-vis economic powers which keep their procurement markets comparatively closed – especially China (and to a lesser degree the United States).

In addition, a new regulation on foreign subsidies will enter into force in the EU in July 2023. The aim is to eliminate competitive distortions caused by foreign subsidies and to establish fair competition between all companies operating in the single market. Chinese state-owned enterprises are again a particular target for the regulation.

The planned Anti-Coercion Instrument is also central to the EU's new unilateral defence toolkit. The initiative was launched in December 2021 and has gained importance against the backdrop of Russia's war of aggression. It is expected to be adopted this year. Its aim is to fight against coercive economic measures by third countries who want to interfere with the open strategic autonomy of the EU and its Member States.

New partnerships

In the new geoeconomic environment, the negotiation of ambitious FTAs has gained in importance in the EU for strategic reasons. However, this is not a new policy: for decades, the EU has been negotiating agreements with partners, which go beyond traditional market access agreements and also include modern trade rules relating to technical barriers to trade (TBT), sanitary and phytosanitary measures (SPS), customs and trade facilitation, subsidies, investment, digital trade, sustainability, competition policy, the treatment of state-owned enterprises, government procurement, and the protection of intellectual property rights. FTAs also include a bilateral or regional dispute settlement system. In 2022, the Commission decided that dispute settlement should be expanded to also apply to the sustainability chapters in order to further promote the green transition. Since these comprehensive European agreements cover substantially all trade, they are in line with WTO rules under Art. XXIV GATT and Art. V GATS.

European FTAs are not only concluded with industrialised countries (such as Canada or Japan), but also with emerging market economies (Singapore) and developing countries

[16] K. Kober and C. Schmucker, "A turning point for EU trade policy after the Russian aggression?", in E. Tafuro Ambrosetti and M. Villa, *Ukraine: The War That Changed the World, One Year On*, 21 February 2023.

(Vietnam). Against the backdrop of Russia's war of aggression against Ukraine, these FTAs have also taken on a geopolitical dimension: they serve to build partnerships and alliances with reliable countries and regions. At the same time, these agreements can help European companies to diversify their trade and production networks and as such reduce their critical dependencies in supply chains, e.g. in the area of raw materials and rare earths, which are important for the green and digital transition. That is why the EU is pursuing the negotiation and ratification of FTAs with major emerging market and industrialised economies with renewed vigour. These include modernisation agreements with Chile and Mexico, the agreement with the Mercosur region (including Brazil), and negotiations with Australia, Indonesia, and India.

Industrial policy

Industrial policy is nothing new for the EU and its members. On 10 March 2020, the Commission laid the foundations for an industrial strategy with the aim of supporting "the twin transition to a green and digital economy, to make EU industry more competitive globally, and enhance Europe's open strategic autonomy".[17] This industrial strategy was written in the context of the Covid-19 pandemic. With Russia's war against Ukraine and rising geopolitical tensions with China, the strategy has gained further prominence. It has several components, among them the European Green Deal, the Chips Act, and the Green Deal Industrial Plan.

On 11 December 2019, Commission President Ursula von der Leyen introduced the European Green Deal – a concept to reduce net greenhouse gas emissions in the EU to zero by 2050. The Green Deal has since become a central component of the EU's climate policy. Over a period of ten years, over €1 trillion are to be invested through various existing EU funding mechanisms.

The EU is also working on a Chips Act. Its goal is to improve EU competitiveness and resilience in semiconductor technologies, which is seen as an important component for the implementation of the digital and green transformation. The Act consists of three parts. Pillar 1 aims to support technology capacity building and large-scale innovation across the EU to enable the development and deployment of next-generation semiconductor and quantum technologies. Pillar 2 focuses on creating a framework to ensure the security of supply by attracting investment and production capacity in semiconductor manufacturing in the EU. Pillar 3 aims to establish a mechanism for coordinating surveillance and crisis response between EU Member States and the Commission.[18]

In addition, as a response to the US IRA, the European Commission drafted the Green Deal Industrial Plan, which includes proposals to simplify state aid policies, to support education, training, and reskilling for the green and digital transitions, and to establish a European Sovereignty Fund before summer 2023 to support investment in strategic sectors. The European Council reiterated the need for a new industrial approach in its special meeting on 9 February 2023. One of the components of the industrial plan is to provide faster access to

[17] European Commission, European Industrial Strategy.
[18] European Parliament, Legislative Train Schedule, European Chips Act, 20 February 2023.

funding. To fulfil this goal, the Commission wants to (1) simplify aid for renewable energy deployments, (2) simplify aid for decarbonising industrial processes, (3) enhance investment support schemes for the production of strategic net-zero technologies, and (4) provide more targeted aid for major new production projects in strategic net-zero value chains.[19]

Transatlantic Relations and China: A Difficult Triangle

During Donald Trump's presidency, numerous trade conflicts put a massive strain on transatlantic relations: U.S. tariffs on steel and aluminium, Trump's threat to impose tariffs on automobiles, and not least the escalation of the Airbus-Boeing dispute. As a convinced transatlanticist, President Biden wants to give transatlantic relations a new impetus – and has done so.

The most notable move was the establishment of the TTC in 2021. Since then, the new institution successfully met three times in 2021 and 2022. Among other things, the United States and EU want to cooperate more closely on the development of technical standards and research, especially in strategic sectors such as semiconductors, artificial intelligence (AI), and cybersecurity. The TTC is not a free trade project aimed at removing tariffs and other market access barriers or agreeing on common rules (on competition, public procurement, etc.). Rather, it serves as a framework for coordination and information. It is intended to strengthen the transatlantic partnership, especially with regard to the competitor and rival China.

Another breakthrough was the compromise regarding the nearly 20-year dispute over aviation subsidies at the EU-US summit in mid-June 2021. The partners want to establish rules on acceptable subsidies. In addition, the United States and the EU want to take stronger joint action against unfair trade practices by China. This agreement, however, is a compromise and not a final conclusion of the disputes. It requires more work – with time ticking as the November 2024 presidential elections in the United States threaten yet again a changing environment for transatlantic cooperation.

Despite these positive developments, the relationship is not without its conflicts. The first relates to the US IRA, which Europeans perceive as an essential threat to EU competitiveness. In addition, there are still different perspectives on how to deal with China. The United States recognises that its allies have sometimes complex relationships with the autocratic country. However, Washington increasingly demands that allies like the EU shoulder more of the burden. Pressure is mounting – including on export controls and investment screening (both internal and external). This can be seen, for example, in the case of the Netherlands: the United States put pressure on the Netherlands to introduce new export controls for chip manufacturing equipment to China. The Dutch company ASML Holding Netherlands is one of the world's top suppliers of machinery and know-how, essential to advanced semiconductor production. In March 2023, the Netherlands finally agreed to US demands to add some of the latest deep ultraviolet lithography tools to its export control list by summer

[19] European Commission, Questions and Answers, Green Deal Industrial Plan for the Net-Zero Age.

after “doing assessments concerning our national security”.[20] While Europe is still focusing on de-risking and diversification with regard to China, the pressure from the US is mounting to follow the US path of technological decoupling.

Outlook: How to Avoid a Global Trade War

Should we be worried about geopolitically motivated industrial and trade policies? The clear answer is yes. Current trade and industrial strategies and policies and the view of China as a strategic rival risk a tit-for-tat subsidies race and new protectionist barriers. These (possibly) discriminatory subsidies, which favour local production (like the US IRA), increase the risks of politically motivated trade conflicts. This will not only be the case with China, but also between the two transatlantic partners. If the current trend continues, it might even lead to a zero-sum game with negative consequences for the world economy as a whole. This leads to the question what the United States and the EU can and should do to avoid such a conflictual scenario.

Open economy

The most important political and economic task is to continue to advocate for an open and global trading system despite the difficult geopolitical environment. Increasingly fragmented trade means more uncertainty and a reduced ability to absorb shocks. To receive critical inputs for the green and digital transition, both the EU and the United States should diversify their markets to include “reliable” partners. As such, the concept of friendshoring needs to be modified and expanded, as it is arbitrary, excludes many strategically important developing countries, and could potentially lead to a new geo-economic cold war.

Pursuing smart industrial policies

All major economies, including the United States and the EU, pursue industrial policies for the green transition. In order to avoid a trade war, it is important that these policies are non-discriminatory – not favouring local companies and production – and initiated in a smart way. This means that they must be implemented in a targeted, timely, temporary, and transformative way. These “four Ts” should become a guiding principle for United States and EU funding measures in the future. In addition, trade policy must be part of a smart industrial policy, as no country will ever be self-sufficient and should not aspire to be so. Partnerships with other reliable partners can improve the availability of certain inputs as well as improve market access abroad.

Setting boundaries for industrial subsidies

In order to avoid a subsidy race, which is often coupled with protectionist measures, a coordinating body is important. Therefore, the creation of the transatlantic “Clean Energy Incentives Dialogue”, initiated by US President Biden and Commission President Ursula von der Leyen in mid-March 2023, is a good step forward. Both sides want to better coordinate their

[20] S. Taguchi and M. Shimizu, “Netherlands to Tighten Export Controls of Chip Equipment: Minister”, *Nikkei Asia*, 17 March 2023.

massive subsidy schemes, which support clean tech industries and the green transition. In a second step, it could make sense to involve Japan through the Trilateral Initiative. This group, which was revitalised in November 2021,[21] mostly deals with subsidy reforms at the WTO level. However, it could clearly be used to coordinate national support programmes as well among the three major industrialised and democratic countries to avoid a subsidies race and/or subsidies overlap.

Strengthening partnerships: G7 and the Global South

Once this trilateral coordinating mechanism works successfully among the three partners, it makes sense to expand the cooperation. Even though like-minded or reliable partner countries are also competitors, the avoidance of a subsidies race, which decreases the welfare of all countries, should be a sufficient incentive. This topic should therefore be part of the G7 meetings, and possibly be expanded to democratic countries in the Global South at a later stage.

Global rules and institutions

If our goal is to maintain an open and global trading system, we need to strengthen global rules and global institutions like the WTO to facilitate trade and resolve trade conflicts. This must go hand in hand with a reform of the WTO Agreement on Subsidies and Countervailing Measures. If no multilateral consensus is in sight, an open plurilateral agreement, focusing on basic criteria and principles could be the way forward. In addition, a reform of the two-tiered WTO dispute settlement system must be a top priority to guarantee the implementation of subsidy rules. The EU and the United States should therefore seek coalitions with interested countries for a reform of subsidy rules and the dispute settlement system, possibly linking the two issues.

The US IRA has led to a flurry of activities in other countries to enhance the green and digital transition and to avoid a competitive disadvantage vis-à-vis the United States. Industrial policies and massive funding programmes are in vogue, also in the EU, where the Commission is considering a Green Deal Industrial Plan. These trends make trade conflicts a very likely possibility. In order to avoid a subsidies race and trade conflicts, the goal must be to keep an open trading system and to coordinate industrial policies. The green transition can only be accomplished by working together in an open market with strong WTO rules.

[21] European Commission, Joint Statement of the Ministers of U.S., Japan and EU on Trilateral Cooperation, 30 November 2021.

7. Strategic Capitalism: Implementing Economic Security Through Industrial Policy

J. Hillebrand Pohl, Cordelia Buchanan Ponczek and Mikael Wigell

The view on economic interdependence has shifted radically. As stated by European Union (EU) High Representative Josep Borrell a few years ago, "today we are in a situation where economic interdependence is becoming politically very conflictual".[1] Economic interdependencies are increasingly viewed as a source of potential vulnerability or leverage, not merely as opportunities and less still as an assurance against conflict, in a reversal of the neoliberal view on globalisation.[2] Dependence on foreign actors for the provision of strategic goods and services is seen as risky and something that needs to be kept in check.

This shift precipitates a new focus on the relationship between economics and national security. Again, the EU – long a harbinger of free trade and market economics – provides a telling example with the European Commission's Economic Security Strategy.[3] In the EU, as in the United States, economic and national security policies are rapidly becoming intertwined in a way not seen since the heyday of the Cold War. For this, both the EU and the United States are employing a new set of government measures aimed at strengthening economic capabilities and resilience out of security concerns. Out of this context has emerged a revival of industrial policy.

This trend is perhaps most evident in the technology-intensive sectors of the economy, with new conversations about data processing and storage requirements;[4] in the labour-intensive manufacturing sectors, with new requirements on rules of origin (RoO) and production methods;[5] and in infrastructure and connectivity networks, with increased regulation on sources of joint financing.[6] New, so-called "friend-shoring" measures are aimed at restructuring global value chains (GVCs) away from rival powers (notably China in the case of the United States and the

[1] Josep Borrell, Why European strategic autonomy matters, European Union External Action, 3 December 2020.

[2] S. Scholvin and M. Wigell, "Power politics by economic means: Geoeconomics as an analytical approach and foreign policy practice", *Comparative Strategy*, vol. 37, no. 1, 2018, pp. 73-84.

[3] European Commission, Joint Communication to the European Parliament, the European Council and the Council on "European Economic Security Strategy", JOIN/2023/20 final, 2023.

[4] A. Bradford, *Digital Empires*, Oxford: Oxford University Press, forthcoming 2023; OECD, "Shedding New Light on the Evolving Regulatory Framework for Digital Services Trade", 7 July 2022.

[5] House of Commons Library, New customs rules for trade with the EU.

[6] European Commission, Commission presents new initiatives, laying the ground for the transformation of the connectivity sector in the EU, Press release, 23 February 2023.

EU), chiefly as concerns the supply of critical inputs, such as certain raw materials along with products like textiles and concrete.[7]

This chapter argues that in adopting these measures and others like them, the EU and the United States are moving from market capitalism to a new form of *strategic capitalism* through resolute state intervention in economic sectors considered strategic and security sensitive. Industrial policy constitutes a central means in strategic capitalism. Traditionally, states have applied industrial policy to correct for market failures, i.e., situations in which market mechanisms cannot be relied upon to adequately allocate societal costs or benefits.[8] In strategic capitalism, industrial policy aims to develop domestic economic capabilities and resilience in strategic sectors of the economy. This serves to defend against rival states' attempts to undermine capabilities and exploit vulnerabilities.[9]

This chapter analyses the transformation of economic governance in the EU and the United States in response to accelerating strategic rivalry in the international system. First, it outlines the contours of the transition from market to strategic capitalism. Second, it provides an overview of the geoeconomic instruments that are propelling this change, specifically industrial policy. Third, it considers the challenges that the emergence of strategic capitalism, epitomised by the new industrial policy, pose to the incumbent international economic order. The chapter concludes with a brief reflection on the direction of future research on this topic.

From market capitalism to strategic capitalism

The notion of strategic capitalism helps make sense of the current repurposing of economic policymaking, in which states increasingly intervene in the flow of goods, services, capital and data, as well as in the development and diffusion of technologies. Instead of allowing market forces to freely shape international economic transactions, states take an increasingly active role when their strategic interests are at stake.[10]

Strategic capitalism involves a fundamental reconsideration of the benefits and risks associated with the market-led economic interdependence that has shaped globalisation. Dependence on foreign actors for the provision of strategic goods and services is seen as risky and something that needs to be kept in check. For this, states are employing a new set of government measures aimed at strengthening capabilities and resilience out of security concerns. These include measures to secure the supply of critical inputs, such as semiconductors, vaccines, rare earth elements, and the data and technologies needed to fuel the development of artificial intelligence.

---

[7] G. Maihold, "A new geopolitics of supply chains: The rise of friend-shoring", Social Science Open Access Repository, (SSOAR), Berlin, 2022.

[8] M. Mazzucato et al., "Which Industrial Policy Does Europe Need?", *Intereconomics*, vol. 50, no. 3, 2015, pp. 120-55.

[9] This is unlike mercantilist industrial policy, the aim of which is to accumulate geoeconomic power. See M. Wigell, "Conceptualizing Regional Powers' Geoeconomic Strategies: Neo-Imperialism, Neo-Mercantilism, Hegemony, and Liberal Institutionalism", *Asia Europe Journal*, vol. 14, no. 2, 2016, pp. 135-51.

[10] See H. Choer Moraes and M. Wigell, "The Emergence of Strategic Capitalism: Geoeconomics, Corporate Statecraft and the Repurposing of the Global Economy", FIIA Working Paper, no. 117, Finnish Institute of International Affairs (FIIA), 30 September 2020.

They may also include securing the capacity to manufacture critical inputs and fostering the development of such capacity, such as when states pursue industrial policies. Finally, this new set of government measures aims at securing control of critical infrastructure and assets otherwise considered strategic.

Taken together, these measures ultimately serve to "balance dependence" on foreign actors in that they (1) promote the local manufacturing of critical products to avoid relying on imports to meet domestic needs; (2) prevent foreign actors from acquiring technologies that might subsequently be further developed by a rival state; or (3) retain inputs relevant for certain economic sectors within a state's jurisdiction.[11]

The logic of strategic capitalism stands in stark contrast to the market capitalist systems which have dominated until recently. Underpinning market capitalism has been a strong belief in market mechanisms, coupled with an underestimation of the security risks of economic interdependence. Policymakers have taken a benign view of deepening interdependence for economic and political reasons. Interdependence was assumed to foster synergies and economies of scale, which would then maximise economic gains for states by increasing efficiency within and across their economies. It therefore became imperative for states to connect to the flows of goods, resources, capital, and data that crisscross the globe. Even critical infrastructure was seen to benefit from being globally distributed in order to maximise cost efficiencies provided by global value chains.[12]

This deepening of economic interdependence was assumed to incentivise cooperation and constrain conflicts between states. The ensuing global supply chains that followed from opening markets gave rise to a tangled web of interdependence that was assumed to prevent coercive strategies.[13] With states depending on each other for critical goods and services, they would become less likely to engage in adversity out of fear that they would end up hurting themselves in the process – or so the argument went.[14]

From the 2010s onwards, doubts began to surface about the resilience of the market capitalist model. In Europe, analysts who applied a geoeconomic perspective raised concerns about dependence on energy imports from Russia and how such asymmetric dependence could be leveraged for strategic gain by the Kremlin and jeopardise the sustainability of the EU's economic

---

[11] On the notion of balancing dependence, see H. Choer Moraes and M. Wigell, "Balancing Dependence: The Quest for Autonomy and the Rise of Corporate Geoeconomics", in M. Babić et al. (eds.), *The Political Economy of Geoeconomics: Europe in a Changing World*, Palgrave Macmillan, 2022.

[12] P. Khanna, *Connectography: Mapping the Future of Global Civilization*, New York, Random House, 2016; see also C. Fjäder, "Interdependence as Dependence: Economic Security in the Age of Global Interconnectedness", in M. Wigell et al. (eds.), *Geo-economics and Power Politics in the 21st Century: The Revival of Economic Statecraft*, London, Routledge, 2018.

[13] A.-M. Slaughter *The chessboard and the web: Strategies of connection in a networked world*, Connecticut, Yale University Press, 2017; G.J. Ikenberry *Liberal leviathan: The origins, crisis, and transformation of the American world order*, Princeton, Princeton University Press, 2011.

[14] P.K. Goldberg and T. Reed, "Is the Global Economy Deglobalizing? And if so, why? And what is next?", Working paper 31115 , National Bureau of Economic Research, April 2023; P. Martin, T. Mayer, and M. Thoenig, "Make trade not war?", *The Review of Economic Studies*, vol. 75, no. 3, 2008, pp. 865-900; D.A. Irwin, *Free trade under fire*, Princeton, Princeton University Press, 2020.

model.[15] More recently, overdependence on China for strategic minerals has surfaced.[16] The Obama administration sounded the alarm on the back doors of Huawei and ZTE in 2012.[17] During the Trump presidency, the United States began to view China's practices in technological transfers and intellectual property as problematic for American industrial competitiveness and national security. This precipitated the US-Chinese trade wars.[18] The open market economy, rather than a net benefit, became suspect, and was seen as providing leeway for industrial espionage and technological theft.[19]

From the 2020s onwards, three shocks accelerated the backlash against market capitalism. First, the Covid-19 pandemic revealed a disturbing lack of manufacturing capabilities in Western economies. Second, Russia's war of aggression led to an unprecedented use of economic sanctions. Third, the dire consequences of global climate change opened an economic competition on the next frontiers of low-carbon energy and critical raw materials necessary to build such capacities. Consequently, economic interdependence has been cast in a new light. Instead of heralding interdependence as a key to security and wealth, recent reviews of security doctrines by China, the EU, Russia, and the United States have put unprecedented emphasis on economic security, policies to reduce strategic dependencies and the use of state funding to build up internal capabilities.[20]

States are now looking to reclaim a measure of economic autonomy as they realise that they cannot rely on the markets or foreign actors to provide goods and services deemed strategic.[21] The need for *balancing dependence* is what ultimately drives the shift to strategic capitalism. States seek to hedge against the geostrategic risks involved with economic interdependence. This entails a renewed focus on economic autonomy in sectors considered strategic from a national security perspective, such as infrastructure, critical materials, and emerging technologies. State-business relations vary significantly depending on the economic sector. In sectors considered strategic, states will attempt to coordinate business operations and exchanges, whereas other sectors are left to operate according to market-oriented principles.[22]

The West's repurposing of economic policy should not be mistaken for a shift to state capitalism. In state capitalism, interventionism is broader than in strategic capitalism. State capitalism implies a system in which the state controls markets for political gain or "to create

---

15 A. Vihma and M. Wigell (2016), 'Unclear and Present Danger: Russia's Geoeconomics and the Nord Stream II Pipeline', *Global Affairs*, vol. 2, no. 4, pp. 377-88.
16 E.g., Charalampides et al. (2015); IEA (2022).
17 M.S. Schmidt, K. Bradsher, and C. Hauser, "US Panel Cites Risk in Chinese equipment", *New York Times*, 8 October 2012; M. Rogers (Chairman) and C.A. Dutch Ruppersberger (Ranking Member), "Investigative Report on the U.S. National Security Issues Posed by Chinese Telecommunications Companies Huawei and ZTE", Permanent Select Committee on Intelligence, U.S. House of Representatives, 112th Congress. 8 October 2012.
18 Cheng Li, "Assessing U.S.-China relations under the Obama Administration", Brookings, 30 August 2016.
19 E.g., M. Wigell, "Hybrid Interference as a Wedge Strategy: A Theory of External Interference in Liberal Democracy", *International Affairs*, vol. 95, no. 2, 2019, pp. 255-75.
20 Choer Moraes and Wigell (2022).
21 M. Leonard et al., "Redefining Europe's economic sovereignty", Policy Brief 289, European Council on Foreign Relations, June 2019,
22 Choer Moraes and Wigell (2020).

wealth that can be directed as political officials see fit".[23] The assertion of political control is thus what drives the state to intervene in the economy in state capitalist systems. By contrast, strategic capitalism is driven by strategic concerns, in which the state focuses on safeguarding control of strategic assets. This makes the uptick in state interventionism seen today in the West of a different nature.

Table 1 compares strategic capitalism to market and state capitalism, and the way it differs from established analytical categories.[24] In market capitalism, the scope of state intervention is limited. In situations where it occurs, the primary motivation is economic, such as when the state intervenes to correct for market failures. State-corporate relations are distant, if not completely separated. In state capitalism, the state intervenes broadly in the economy mainly for purposes of political control, and its relations with the corporate sector is close. By contrast, strategic capitalism is characterised by selective state intervention to address security externalities in an economy otherwise based on the pursuit of private profit. The nature of state-corporate relations is thus varied and complex.

TAB 7.1 - VARIETIES OF CAPITALISM

		market capitalism	strategic capitalism	state capitalism
State intervention	Scope	Limited	Selective	Broad
	driving motivation	Economic	Security	Political
State-corporate relations		Distant	Varied	Close

It is important to note that the distinctions we make between market, strategic and state capitalisms may not be found as pure in reality as those presented in Table 1. In practice, states may have mixed motives for intervening in the economy. Yet, they can be taken as "reference models", helping to identify and describe prevailing orientations. As a reference model, therefore, strategic capitalism does not exclude state intervention for economic reasons. Instead, it shows how security reasons have become a prevalent consideration for such intervention, much more so than before,

[23] I. Bremmer, *The end of the free market – Who wins the war between states and corporations?*, New York, Portfolio-Penguin, 2010, p. 5.

[24] See also M. Wigell et al. *Navigating Geoeconomic Risks: Toward an International Business Risk and Resilience Monitor,* FIIA Report 71/2022, The Finnish Institute of International Affairs (FIIA), 2022.

and how the concept of security as such is being stretched wider to lend credibility to selective intervention in what are deemed to be strategic sectors of the economy.

Geoeconomic instruments

General

The increasingly prevalent and intensified application of geoeconomic instruments is propelling the transition from market capitalism to strategic capitalism. These instruments are economic policy measures aimed at managing strategic external interdependencies vis-à-vis geoeconomic rivals. There are three points worth highlighting in this respect:

First, the notion of geoeconomic rivalry departs from the neoliberal understanding of economic competition as occurring between nationals of states, comprising legal and natural persons. Geoeconomics recognises the reality of states remaining units of competition, alongside non-state actors, notably private enterprises.[25] This muddled reality causes havoc to traditional economic models that assume – for theoretical simplicity – that a strict separation is observed between the state and private enterprise. This separation is in turn based on the assumption that private enterprises focus entirely on profit maximisation and stay out of politics. Meanwhile, states are meant to focus on upholding a regulatory framework for economic competition while not intervening in such competition. Consequently, from the perspective of market capitalism, the use of geoeconomic instruments modifies the conditions for competitive opportunities faced by private-sector enterprises.

Second, there is a realisation of the importance of maintaining strategic competitiveness and an ability to act independently in geoeconomic rivalry. This is underscored by a new emphasis on autonomy and economic security in the strategic doctrines of the United States, the EU, and China. Yet, autonomy does not imply the mere application of defensive strategies. For a state to retain its policymaking autonomy while staying open commercially, it must replicate domestic policies externally. An example is the EU’s carbon border adjustment mechanism (CBAM), adopted on 17 August 2023, which discourages the reallocation of CO2-intensive production outside of the EU while encouraging non-EU countries to live up to internationally agreed climate commitments.[26] This instrument could be characterised as coercive vis-à-vis non-EU trading partners insofar as the CBAM unilaterally introduces negative incentives compared to the status quo. Yet, without the CBAM, the EU would struggle to remain autonomous in its climate legislation due to competition from abroad.

Third, the range of geoeconomic instruments is broad, comprising any policy measure that serves to modify a state’s balance of dependencies. For analytical purposes,

[25] M. Babić, A.D. Dixon, and I.T. Liu, “Moving Forward: Understanding the Geoeconomic Decade of the 2020s”, in *The Political Economy of Geoeconomics: Europe in a Changing World*, Cham, Springer International Publishing, 2022, pp. 187-206.

[26] Regulation (EU) 2023/956 of the European Parliament and of the Council of 10 May 2023 establishing a carbon border adjustment mechanism (Text with EEA relevance), PE/7/2023/REV/1.

geoeconomic instruments can be categorised according to their coercive or inducive effect,[27] their addressees,[28] or the type of economic activity they address/impact.[29] As for the scope of this paper, we provide an overview based on three types of economic activity: investments, trade in goods (including energy), and finance. This list is not exhaustive. Other examples for future research include data transfers, labour migration, shipping, aeronautics, and intellectual property, to name a few. For the layperson, the most recognised geoeconomic instrument is economic sanctions.

Economic sanctions are highly malleable and can target any type of economic activity. Often, sanctions target investments, trade in goods, and finance. Despite public recognition of sanctions, they are not the nimblest of available tools. No matter how "intelligent" policy makers claim sanctions to be, they remain the geoeconomic equivalent of a sledgehammer.

Sanctions can be complemented by export controls, including on dual-use goods, as another way of using trade policy to address human rights abuses abroad or a variety of other geopolitical goals, including conflict de-escalation, nuclear non-proliferation or cyber deterrence.[30] In 2021, the EU updated its export control instrument to improve its response to evolving security risks and emerging technologies.[31]

Similar to sanctions, but essentially defensive in nature, the EU's anti-coercion instrument represents a new kind of instrument which authorises the Commission to take countermeasures against non-EU countries implementing or threatening economic coercion towards the EU or its Member States for non-economic geopolitical goals.[32] Such coercive policies interfere with the policy autonomy of the EU or the targeted Member States and can take the form of trade and investment restrictions of diverse kinds.[33] The anti-coercion instrument aims to deter non-EU countries from using economic statecraft to bring about a change of policy in the EU. It allows the Commission to impose trade, investment, or other restrictions as countermeasures against such external policy interference. The anti-coercion instrument complements the EU

[27] Whether an instrument is coercive or inducive depends to a degree on the *ex-ante* expectations of the addressee and is therefore an imprecise organising principle. For example, the CBAM could be regarded as coercing non-EU traders to align with EU climate standards but could also be regarded as offering new opportunities for non-EU traders to access the EU single market subject to conditions, such as investing up-front in new production processes. The latter situation is a case of "binding", whereby the non-EU trader becomes more dependent on trade with the EU after having invested in compliance with EU standards. See M. Wigell, "Conceptualizing Regional Powers' Geoeconomic Strategies: Neo-Imperialism, Neo-Mercantilism, Hegemony, and Liberal Institutionalism", *Asia Europe Journal*, vol. 14, no. 2, pp. 135-51.

[28] The proximate addressees of geoeconomic instruments are invariably nationals of rival powers while the ultimate addresses are the rival powers themselves.

[29] N. Helwig and M. Wigell, "The EUs Quest for Geoeconomic Power", FIIA Briefing Paper 334, Finnish Institute of International Affairs (FIIA), March 2022.

[30] See the multilateral arms embargo against supplying arms to Armenia and Azerbaijan in 1992: Organisation on Security and Co-Operation in Europe (OSCE), "Decisions based on the Inerium Report on Nagorno-Karabakh", 1992.

[31] Regulation (EU) 2021/821 of the European Parliament and of the Council of 20 May 2021 setting up a Union regime for the control of exports, brokering, technical assistance, transit and transfer of dual-use items (recast), PE/54/2020/REV/2. OJ L 206, 11 June 2021, pp. 1-461.

[32] European Commission (2021) Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the protection of the Union and its Member States from economic coercion by third countries, COM/2021/775 final.

[33] As illustrated by the Chinese trade sanctions on Lithuania late 2021.

blocking statute, an instrument introduced in the 1990s to protect EU companies from the extraterritorial effect of non-EU sanctions, notably those of the United States. The blocking statute was updated in 2018.[34]

Inbound investment screening (also known as national security review) allows a state to restrict inbound investments on grounds of national security and the risk of geoeconomic coercion related to investments linked to a rival power. This risk is particularly relevant in areas of strategic importance for maintaining vital societal functions, such as critical infrastructure, technologies, supply lines, sensitive information, and the media.[35]

While rare, investment screening can also be applied to a state's domestic investors investing abroad, so-called outbound investment screening.[36] The United States adopted an outbound investment screening mechanism in August 2023, which empowered the U.S. Department of the Treasury to either prohibit or require notification of some outbound investments. This primarily focused on investment concerning semiconductors, microelectronics, quantum information technologies, and select artificial intelligence systems.[37] The new requirements apply to specific categories of covered transactions by "U.S. persons" globally involving outbound investments in certain foreign entities.[38] The European Economic Security Strategy also includes the aim of the European Commission to examine possible measures to address security risks related to outbound investments, with a view to proposing an initiative by the end of 2023.[39]

Another set of geoeconomic instruments targets distortive trade and investment practices of various kinds. This includes unilateral trade defence measures, such as the EU trade defence instruments targeting dumping and subsidies,[40] and the EU enforcement regulation targeting investment and trade practices violating international law.[41] An addition to this toolkit are measures to counter subsidised investments and public procurements, notably the EU Foreign Subsidies Regulation, which levels the playing field between EU state aid rules and third-country

---

[34] Commission Delegated Regulation (EU) 2018/1100 of 6 June 2018 amending the Annex to Council Regulation (EC) No 2271/96 protecting against the effects of extra-territorial application of legislation adopted by a third country, and actions based thereon or resulting therefrom, C/2018/3572, OJ L 199I, 7 August 2018, p. 1-6.

[35] See Article 4(1) Regulation (EU) 2019/452 establishing a framework for the screening of foreign direct investments into the Union, 19 March 2019, OJ L 79, 21 March 2019.

[36] G. Dimitropoulos, *National security: the role of investment screening mechanisms*, Handbook of International Investment Law and Policy, 2020, pp. 1-37.

[37] Exec. Order No. 14105, 88 F.R. 54872 (2023).

[38] Provisions Pertaining to U.S. Investments in Certain National Security Technologies and Products in Countries of Concern, 88 Fed. Reg. 54,961 (2023).

[39] European Economic Security Strategy (n 3) at 11.

[40] Regulation (EU) 2017/2321 of the European Parliament and of the Council of 12 December 2017 amending Regulation (EU) 2016/1036 on protection against dumped imports from countries not members of the European Union and Regulation (EU) 2016/1037 on protection against subsidised imports from countries not members of the European Union, OJ L 338, 19 December 2017, p. 1-7.

[41] Regulation (EU) 2021/167 of the European Parliament and of the Council of 10 February 2021 amending Regulation (EU) No 654/2014 concerning the exercise of the Union's rights for the application and enforcement of international trade rules, OJ L 49, 12 February 2021, p. 1-5.

subsidies.[42] The new EU international public procurement instrument, adopted in June 2022, regulates non-EU businesses' access to EU public procurement markets based on reciprocity.[43]

Industrial policy measures as geoeconomic instruments

Unlike sanctions, investment screening, and trade defence instruments, industrial policy targets a state's domestic economic activity in the first instance. In 2021, the European Commission launched its updated "New Industrial Strategy for Europe", reflecting the experiences of shortages in the supply of critical inputs during the most intense stages of the Covid-19 pandemic, as well as an openness to incentivising reshoring and nearshoring in certain sectors.[44] The strategy identified six critical areas – raw materials, active pharmaceutical ingredients, lithium batteries, hydrogen, semiconductors, and cloud and edge computing – to be reviewed for dependencies and resilience in EU supply chains.[45] Around the same time, the EU and the United States accelerated measures prioritising state action to address global climate change. These measures included significant steps to facilitate decarbonisation, diversify energy supplies, and bolster sourcing autonomy in critical materials necessary for low-carbon technology.

To operationalise the New Industrial Strategy, the European Commission proposed revised state-aid derogations under its Communication on "important projects of common European interest".[46] This communication sets criteria for Member State support of projects that contribute to EU strategic objectives and has been applied in the battery and microelectronics sectors, as well as in research and development. Although the mandated reviews under the New Industrial Strategy found few EU imports to be a cause for concern, shortages in some of the sectors could have detrimental effects on industry, as illustrated by the microchip shortage in 2021. As a result, the European Commission tabled a proposal in February 2022 for a "European Chips Act", which the European Parliament and Council adopted on 25 July 2023, and which will direct public investments with the aim of lessening the EU's strategic technological dependencies in the semiconductor industry.[47] The equivalent in the United States was the CHIPS Act, signed into law

[42] European Commission (2021), Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on foreign subsidies distorting the internal market, COM/2021/223 final.

[43] Regulation (EU) 2022/1031 of the European Parliament and of the Council of 23 June 2022 on the access of third-country economic operators, goods and services to the Union's public procurement and concession markets and procedures supporting negotiations on access of Union economic operators, goods and services to the public procurement and concession markets of third countries (International Procurement Instrument – IPI) (Text with EEA relevance). PE/15/2022/REV/1. OJ L 173, 30 June 2022, p. 1-16.

[44] European Commission (2021), Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Updating the 2020 New Industrial Strategy: Building a stronger Single Market for Europe's recovery, COM/2021/350 final.

[45] European Commission, "Staff working document - Strategic Dependencies and capacities", 5 May 2021.

[46] European Commission. (2021). Communication from the Commission Criteria for the analysis of the compatibility with the internal market of State aid to promote the execution of important projects of common European interest 2021/C 528/02, C/2021/8481.OJ C 528, 30 December 2021, p. 10-18.

[47] European Commission (2022), Proposal for a Council Regulation amending Regulation (EU) 2021/2085 establishing the Joint Undertakings under Horizon Europe, as regards the Chips Joint Undertaking. COM/2022/47 final. Signature and publication in the EU Official Journal are expected to take place in September 2023.

by President Biden in August 2022, that included US$39 billion in subsidies to on-shore chip, semiconductor research, and labour market training and counter Chinese dominance in the field.[48]

Chips and semiconductors are not the only application of US and EU industrial policy, either in terms of measures to incentivise non-market led economic activity or regarding the aim to counter economic dependence on China. Because of the slow uptake and poor market incentives, the EU and Unite States are deploying unprecedented levels of industrial policy to address climate change. The US Inflation Reduction Act (IRA), passed at the end of 2022, aims at creating domestic incentives to scale up low-carbon business and to "friend-shore" by attracting low-carbon businesses to the US.[49] The policies and positive incentives in the IRA were so strong that the bill caught the attention of foreign companies, as well. The EU's knee-jerk reaction was to cry protectionism and erect its countermeasures, but over the past months, that line has softened, and the Biden Administration and von der Leyen's Commission have been working in equal measure to build up a transatlantic, compatible, and mutually beneficial set of measures.[50]

In the context of industrial policy, there are several pieces of draft legislation in the EU that are part of the low-carbon transition. These were originally part of the EU's rebuttal to the IRA, but more recently, there has been an increase in conversation on how to make the two sides compatible, much like the negotiations, nearly a decade ago, on the Transatlantic Trade and Investment Partnership (TTIP). The EU Net-Zero Industry Act (NZIA) and the Critical Raw Materials Act (CRMA) both introduce incentives and requirements for the sourcing, production, processing, and development of critical raw materials and businesses that are linked to climate change and energy production.[51] These policies have a domestic arm in that they set out to support individual EU Member States in facilitating low-carbon businesses and manufacturing, and also establish a roadmap for the EU, through individual Member States, to increase mining, processing, and recycling of critical raw materials.[52] There is also an implicit anti-China, strategic capitalism element, as the policy aims to reduce reliance on single suppliers or processors. Last year's REPowerEU plan, similarly, vocalised an explicit anti-Russia element, which sought to reduce dependence on "Russian fossil fuels".[53] Within EU countries, these policies will likely come with a localised effect, as certain mining or manufacturing regions and towns re-invigorate their

[48] H.R. 4346, "Chips and Science Act", 117th Congress, 2021-22; White House, "Fact Sheet: CHIPS and Science Act Will Lower Costs, Create Jobs, Strengthen Supply China, and Counter China", 9 August 2022.

[49] H.R. 5376, "Inflation Reduction Act of 2022", 117th Congress, 2021-22.

[50] The White House, "Joint Statement by President Biden and President von der Leyen", 10 March 2023.

[51] European Commission, "Proposal for a Regulation on establishing a framework of measures for strengthening Europe's net-zero technology products manufacturing ecosystem (Net Zero Industry Act)", COM (2023)161 final, 16 March 2023; European Commission, Proposal for a Regulation on establishing a framework for ensuring a secure and sustainable supply of critical raw materials and amending Regulations (EU) 168/2013, (EU) 2018/858, 2018/1724 and (EU) 2019/1020, COM (2023) 160 final, 16 March 2023; M. Siddi, "Europe's Policies for A Green Transition: The European Commission's Geopolitical Turn and Its Pitfalls", FIIA Briefing Paper 362, May 2023.

[52] European Commission, Proposal for a Regulation on establishing a framework for ensuring a secure and sustainable supply of critical raw materials and amending Regulations (EU) 168/2013, (EU) 2018/858, 2018/1724 and (EU) 2019/1020… cit.

[53] European Commission, REPowerEU Plan, COM (2022) 230 final, 18 May 2022.

business or build anew. Beyond the state-by-state basis, these policies have an evident impact on EU-wide businesses that transcend borders.

As the case of the CBAM referred to above illustrates, a corollary to industrial policy is measures to enforce them abroad. This invariably involves conditioning access to the domestic markets affected by the policy. Notably, the EU is currently considering a more comprehensive oversight and regulation of international supply chains, similar to national legislation already used by some Member States requiring companies to monitor the labour and environmental standards of their foreign suppliers and subsidiaries.[54] In February 2022, the European Commission tabled a proposal for an EU-wide supply-chain due diligence legislation and is considering a complete ban on goods produced with forced labour.[55] While strongly supported by the European Parliament, the scope of the due diligence proposal has been a matter of debate among the Member States, with some arguing that downstream value chains and the financial sector should be excluded. The inclusion of downstream value chains would mean that companies would be liable not only for human rights violations and violations of environmental standards in connection with products or services they procure, but also for instances in which the companies' own products or services are used in a harmful way, such as with respect to environmental protection or public health.

A final set of geoeconomic policies and instruments within industrial policy – and relevant to the recent initiatives of the United States and the European Union – seeks to deepen interdependence for the purpose of enabling future coercive strategies. The EU has long recognised its Single Market as its deployable asset, which gives exceptional potential for market access control that it can strategically leverage in its relations with external economic actors and third countries.[56] As the EU remains committed to openness in international economic relations, access to the single market is controlled by regulation. Given the large size of the EU market, this gives the EU an unparalleled ability to set global standards, build dependencies, and influence third countries' regulation and compliance (the "Brussels effect").[57]

The challenges of strategic capitalism to the international economic order

The adoption of geoeconomic instruments has been widespread enough to suggest that market capitalist logic is gradually and consistently being supplanted by strategic capitalist logic. Through the policies discussed in the previous section, states have started to subtract a growing number of assets considered strategic from the operation of market forces and increasingly vet transactions

---

[54] See E. Savourey and S. Brabant, "The French law on the duty of vigilance: Theoretical and practical challenges since its adoption", *Business and Human Rights Journal*, vol. 6, no. 1, 2021, pp. 141-52.

[55] European Commission, Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on Corporate Sustainability Due Diligence and amending Directive (EU) 2019/1937, COM/2022/71 final, 2022.

[56] See T. Gehrke, "Treading the trade needle on Open Strategic Autonomy", in N. Helwig (ed.), *Strategic autonomy and the transformation of the EU*, FIIA Report 67, 2021.

[57] European Economic Security Strategy (n 3) at 9; on the "Brussels Effect", see A. Bradford, *The Brussels effect: How the European Union rules the world*. Oxford, Oxford University Press, 2020.

to make sure competitors do not reap benefits from these operations. This shift towards strategic capitalism poses several important challenges for the incumbent international economic order.

The first challenge has to do with guarding the boundaries of what can be considered a "strategic asset", and by extension what can be hollowed out from the market rules. It may seem straightforward to view emerging technologies as a strategic element in national economic power, but what about face masks, paracetamol, or Hollywood movies? The Covid-19 pandemic catalysed initiatives in Europe for reshoring the production of face masks and paracetamol; US authorities were alerted to the risk of Chinese investments in Hollywood allowing the entertainment sector to be used for Chinese propaganda.[58] The shift towards strategic capitalism involves the risk of stepping onto a slippery slope towards state capitalism whereby the notion of strategic assets will be broadened indefinitely. Where can policymakers and regulators draw the line? And do practitioners – especially private firms – agree?

The second challenge with strategic capitalism is that in addition to the notion of "strategic assets" being open for states to flesh out and companies to lobby, it is also a *relative* notion, which affects foreign partners and rivals. A strategic capitalist environment is one marked by increased scrutiny over the transfer of assets to certain third parties and their countries. Transactions involving strategic assets will be allowed with some partners and not with others. The risk is that expanding the use of sanctions, including human rights sanctions, export controls, supply-chain controls, and border adjustments will be met by countermeasures, fuelling a geoeconomic chain reaction of broader and deeper measures toward a balkanisation of the global economy. How can such economic disintegration be prevented?

The third challenge is a pragmatic one, applied to normative issues like climate change, but with ramifications for other sectors impacted by strategic capitalism and industrial policy. The risk is that the overall effect of industrial policies ostensibly aimed at addressing climate change creates mutually exclusive competition, rather than collaboration, in areas of global interest. In climate change industrial policy, there is an emerging trend of "the West versus the rest". This alignment comes either explicitly, through statements of intent to create a common system, or implicitly, through similar mechanisms, approaches, and goals of shoring up strategic capabilities and reducing dependence on adversaries. So, while seeking to divest from traditional hydrocarbons and manufacturing, policies like IRA, CRMA, and NZIA also protect critical sectors and go head-to-head with supply chain behemoths, like China, and traditional hydrocarbon strongholds, like Russia and many countries in the Middle East. Many of these countries are in the "non-market-based and foreign adversary" grouping of the EU and US. In this way, many industrial policies adopted or under review to address climate change also fall squarely in the strategic capitalism bucket, as countries try to get a secure foothold in technology, practices, and sectors critical for the future. The world needs as broad a coalition as possible to address key issues

[58] L. Abboud and M. Peel, "Covid-19 hastens French push to bring home medicines manufacture", *Financial Times*, 29 July 2020; U.S Department of Justice, Transcript of Attorney General Barr's Remarks on China Policy at the Gerald R. Ford Presidential Museum, Grand Rapids, MI, Friday, 17 July 2020. For a discussion, see also H. Farrell and A. Newman, "Will the Coronavirus End Globalization as We Know It?", *Foreign Affairs* (online), 16 March 2020.

like climate change and human rights. Framing such topics as a place for state competition – rather than a place for cooperation – risks losing potential partners.

The potentially decoupling effects of strategic capitalism on international trade and investments is the fourth challenge.[59] Expanding the use of sanctions, including human rights sanctions, export control, supply-chain control, and border adjustments, poses a risk for the economic influence of the EU and the United States over the longer term as countries begin to build resilience against risks of coercion. Concentrating the actions towards strategic capitalism and climate change in the hands of a select group – like the US and Europe or, as mentioned elsewhere, the G7 and G20 – risks global fragmentation and squeezing smaller states out of the decision-making process on topics that affect them, too.[60] Already, the US has allegedly run afoul of the WTO in its IRA policy and has shown that when the chips are on the table, the influence of old Bretton Woods institutions is not enough to hold back an economic power like the United States.[61] But without an arbiter, why should others fall in line? This returns to the point on the compulsion of states, with smaller states forced to fall in line with the big movers, whether China, the EU, the US or others. Some countries, especially the BRICS+, will buck at this.

Ultimately, strategic capitalism is coupled with an *economic security dilemma*. Security dilemmas traditionally are catalysed by geopolitical balancing as states try to strengthen their military preparedness in relation to others doing the same, thus risking an arms race.[62] However, similar dynamics may be at play in geoeconomics, too. It stems from perceived vulnerabilities, such as reliance on foreign actors for the supply of critical goods and resources, triggering efforts to balance these economic dependencies. In so doing, states on the receiving end of these measures react by similarly employing measures aimed at balancing their own respective dependencies, risking a spiral that will start to revert economic interdependence and feed economic decoupling. How can actors manage this economic security dilemma, which risks fuelling spiralling protectionism around the globe?

Concluding remarks

Strategic capitalism describes the increasing tendency towards a repurposing of economic interactions for geostrategic ends. Its manifestation is transforming economic governance in the EU and the United States. This chapter looks at the role of industrial policy in propelling this transformation and the challenges this poses to the international economic order. The very real risk of decoupling deserves attention, not least in current scholarship. Yet, although such attention is warranted, more focus needs to be given to the possibility of an incremental, rather than abrupt,

---

[59] See M.A. Witt, "De-globalization: Theories, predictions, and opportunities for international business research", *Journal of International Business Studies*, vol. 50, no. 7, 2019, pp. 1053-77.

[60] S. Aiyar et al., "Geoeconomic Fragmentation and the Future of Multilateralism", IMF Staff Discussion Notes, International Monetary Fund (IMF), 15 January 2023; K. Georgieva, "Confronting Fragmentation Where it Matters Most: Trade, Debt, and Climate Action", IMF Cross-Cutting Ideas, International Monetary Fund, 16 January 2023.

[61] World Trade Organization (WTO), "Concluding remarks by the Chairperson", *Trade Policy Review*, United States 14 and 16 December 2022.

[62] Cf. R. Jervis, "Cooperation under the security dilemma", *World Politics*, vol. 30, no. 2, 1978, pp. 167-214.

reorientation of economic relations, or what has been dubbed “de-risking” in the context of Sino-Western economic relations.

More so than decoupling, de-risking is an attempt to strike a balance between safeguarding a measure of economic autonomy and minimising damage to the economy. Where Europe and the United States perceive a strategic vulnerability, they will move to de-link from China. However, to manage de-risking, a number of questions need to be asked and addressed, which ultimately require a comprehensive public-private dialogue within the United States and the European Union, respectively: (1) Which strategic assets should be subject to de-risking? (2) Are governments equipped to protect these assets, reshore these assets or invest in shoring up domestic production of these assets? And (3) is government willing to bear the costs associated with the decision to remove these strategic assets from the free interplay of market forces?

Further research is also needed into the feasibility of circumscribing strategic sectors. A clear-cut delimitation of such sectors is far from obvious and harks back to what David Baldwin called the “strategic goods fallacy”, namely, the misunderstanding that some goods are intrinsically more strategic than others.[63] The indeterminacy surrounding the boundaries of “strategic sectors” makes it difficult to determine the full extent to which strategic capitalism is modifying the operating conditions of the economy prevailing under market capitalism.

[63] D. Baldwin, *Economic statecraft*, Princeton, Princeton University Press, 1985, p. 216.

THE PLAYERS:
WHO'S IN THE GAME

9. US Resilient Infrastructure: The Key Tool for Industrial Leadership?

Michael Bennon PER DAVIDE CHIEDERE

8. The United States: Building a Fence from the Rest of the World?

Charles Lichfield

Will the United States force its allies to choose between its security guarantees and new business opportunities in China? Even if it expects a softer stance from Europe, why isn't it deploying a friendlier trade policy to its allies by granting them more favorable market access? Is this all Europe is going to get from the most pro-EU US administration in decades, perhaps ever?

Such questions were already prevalent in European policy circles before the Inflation Reduction Act was passed in July 2022. The discriminatory local content requirements in the Bill brought the venting out into the open but the criticism was there before. 2022 was meant to be the year of friendshoring but the Biden Administration's aversion to doing anything on market access always meant tariff and non-tariff barriers always unlikely to fall. The IRA has had the positive effect of bringing discussions out into the open but it is complex: the US government has done a lot to address the concerns of the EU and other allies but Europeans should by now have definitively understood that the US has many protectionist instruments in place, and the list is growing.

Why is it getting longer? It is not an exaggeration to say China is now Washington's key foreign policy preoccupation, irrespective of Russia's fully-fledged invasion of Ukraine. China's rise has also had structural implications for the US economy in a way Russia's war does not – a key difference with the EU. This chapter modestly proposes to run through a brief history of US protectionism and the genesis of Bidenomics before taking a deep dive into the institutional changes in Washington we will all have to get used to. It ends with a brief discussion on whether these evolutions should worry Europe.

- Biden sees the world as a fight between autocracy and democracy, so thinks Europe should be with us no matter what
- Biden has "European" instincts. Just this week, he was the first ever US president to join a strikers' picket line. Even FDR didn't dare do this.
- US officials view the strategic autonomy debate as Europe's problem and expects to figure out how to move forward based on the end result – no diplomatic game plan

- Biden officials obsessed with keeping Trump out of power. Takes priority over arguments to do with the future efficiency of the global economy and whether this may be undermined by a subsidies race. They say that's outdated.

Political and Econ Context

a) US protectionism and exceptionalism are hardly new

President Trump's 2016 victory (which was not expected in Washington) and the 6 January 2021, attack on the US Capitol are still at the front of every mind in the Biden Administration. This preoccupation – the fear of populist backlash in states which have suffered from divestment and deindustrialization – is a key factor in how the Administration formulates its trade policy, especially regarding China. Recent years have seen protectionism be dialled up during the Trump presidency and not dialled down during the Biden presidency.

Protectionism is not new to the United States. The US is *less* open to international trade than average (STATS), and has never been enthusiastic about free trade agreements (only 20). Naturally, this has more to do with US domestic politics than the preferences of those who design and carry out US trade and foreign policy, who have usually subscribed to the so-called "Washington consensus," for the sake of which generations of officials based in Washington have exported polices favoring free trade. Still, the US economy is less open than those it trades with the most.

Some that legislative innovations from periods when public opinion was calling for more protectionism remain place today. The Great Depression of the 1930s saw the birth of the no-longer-extant Buy American Act and the Jones Act. Still in force today, the Jones Act amended the Merchant Marine Act effectively to ban cabotage by foreign carriers. Toughened by Buy America Act of 1982. This year, President Biden even announced plans to tighten the legislation.[1]

The singling out of one country for the sudden increase of its exports' market share is not new either. The influx of Japanese cars and consumer electronics in 1970s and early 1980s caused the Reagan Administration – a notionally pro-trade Republican Administration – to use Tokyo's dependence on US security guarantees to extract hefty concessions including "voluntary" restrictions from the Japanese on their own exports and promises to increase the market share of US firms in Japan. This approach was combined with punitive Section 301 tariffs based on accusations of dumping. The success of these measures is debated to this day but it is already clear that the real reason American public opinion moved on was the US-led personal computer and internet boom, rather than the decline of Japanese firms. [2]

The final connection which feels new but isn't is that between trade and national security. A large part of the US' friction with the WTO (though supposedly a plank of the Washington

[1] https://breakbulk.com/Articles/biden-to-strengthen-us-jones-act

[2] https://www.jcie.org/researchpdfs/NewPerspectives/new_curtis.pdf

consensus) stems from its refusal to accept its courts will have jurisdiction over what it feels pertains to national security.

Still, it was possible to separate all of these and observe them at work on different parts of American trade policy. Not so with China today.

b) China

Attitudes to China have shifted remarkably over the last twenty years. When George W. Bush was running, he promised to build on the work done by the Clinton Administration to bring China into the World Trade Organization. Believing the US was now too far ahead on cutting-edge technologies to be challenged by the competition, Bush argued that "trade with China will promote freedom" and – because "freedom is not easily contained" – the result would be a more open China, willing to take its place in a US-led world order, and not just for economic reasons.[3]

No such blind faith is on display today. President Trump's successful presidential campaign – won partly on the promise being tougher on Chinese trade practices – and Covid have been the biggest milestones of a steady deterioration in relations. Being "tough on China" is now one of the rare causes which can still find bipartisan support in Washington.

- China exports net of imports has expanded as share of GDP since 2001. Focus on this stat.
- Germany relies on exports to China for 3% of GDP Germany 0.5%.
- Find out where Italy is.
- But US relies on imports from China just as much. Apple, most iconic company, cannot do without China.

The retention of most of Trump's punitive tariffs on Chinese goods by the Biden Administration is good evidence of the consistently tough approach, although this must be placed in a context of ever-growing confrontation – over Hong Kong and Xingjiang Province, the South China Sea, Russia's War in Ukraine and even a feared escalation in the Strait of Taiwan – which makes it difficult for Washington to make any perceived concession.

c) 2022

It may be too early to tell whether 2022 was a structural turning point for US protectionism. A plausible take at this point is that the Biden administration played the hand of cards it was given well, using the shock of Russia's invasion to give its domestic legislative agenda a second lease of life.

In late 2021, it appeared "Bidenomics" would only accomplish half of its goals before the midterms, when the President's party tends to lose control of Congress. AND IT WAS THE SPENDY NON LEGACY GOALS THAT GOT THROUGH: Very early in Biden's term, Congress did pass a nearly $2 trillion Covid stimulus package. The American Rescue Plan Act of 2021 included advances on workers' rights which had long proved elusive in the US, such as a minimum wage. Then, the bill meant to carry Biden's landmark "Build Back Better" infrastructure plans

[3] https://www.nytimes.com/2000/05/18/world/in-bush-s-words-join-together-in-making-china-a-normal-trading-partner.html

failed to win the approval of Manchin and Senator Kyrsten Sinema of Arizona, even after a long reconciliation process.

Russia's invasion of Ukraine and the heavy sanctions regime which the US coordinates with its G7 partners didn't entirely distract the econ team at the White House (not entirely the same people though some overlap between NSC and NEC).

The first piece of evidence that the Administration would respond economically beyond sanctions was in a speech Treasury Secretary Janet Yellen gave to the Atlantic Council on April 13, where she first used the term "friendshoring". What wasn't immediately clear is that the Biden Administration was not going to go back on its decision not to explore any trade deals reducing tariff-and-quota barriers, even with close "friends." Instead friendshoring has consisted of pursuing tough policies against non-friends (Russia and China), while pursuing minilaterals with pretty much everyone else.

What is striking is how the Biden Administration got back on top of the domestic economic legislation process from then on.

- The US$280 billion Chips and Science Act passed in August 2022 with unusual bipartisan support (2/3 of senate). It was the result of a merger between bills on Chips foundries and research funding and – while the war was perhaps helpful – it was going to make it through anyway. Orig chips bill passed the House in July 2021. Still Biden Admin gets credit.
- Masterstroke is re-branding the Build Back Better Act as the Inflation Reduction Act. Russia's invasion of Ukraine and the spike in energy prices provided an unlikely opportunity for a rebranding exercise. Using the failed bill as a basis for further negotiations, the Biden Administration kept on engaging with Congress [VIA mainly direct between Schumer and Manchin who is on Committee for Appropriations (provides agency with budget authority) and chair of Energy Committee]. His initial reservations on BBB was about inflation so new branding worked well.
    - Given subsidies involved, Manchin also insisted on local content requirements. Important to Mr W Virginia. Reality is that most had given up on the BBB/IRA except for Canada which kept its eye on the ball even in the depths of Summer 2022. Argument advanced ex-post that the USMCA obliged the US to carve Mexico and Canada in is neat but not entirely true. A convenient way for Canada to advance its interests incognito and Mexico benefited from Ottawa's negotiating prowess!
    - The Biden Administration has since tried very hard to address EU/UK/Japanese/S Korean concerns. Limits to what they can do given they no longer have a majority in the house.
        a. Leasing
        b. Guidance has still sometimes been disappointing tho
        c. Evidence is now that there isn't a huge divestment risk: the technologies at stake (transport, energy) are too heavy to transport. So factories would have been built in US anyway. Exceptions are hydrolysers and some cutting edge building materials.

- Talk of an executive order on outbound investment screening (CFIUS became powerful in 2018), which ultimately came in 2023.

Washington in Practice

a) *Worldwide – no more FTAs, minilaterals instead!*
    a. TTC Ipef etc. say more on ttc
        i. Then the mini mini laterals, like the US/Japan/NL deal on semiconductor production
    b. Remember this is about the global south too.

b) *Tariffs are not moving downward under Biden.*
    a. USTR not moving tariffs. Find more on ongoing investigation into China.
    b. The non-exhaustive table below shows that, while the Trump tariffs were not exclusively targeted at China, it was targeted more than any other trading partner. Another crucial point is that there are discussions in place to phase out tariffs on the EU, UK and Japan. No such discussions are taking place with China.

Date	Tariff	Still in place?
February 7, 2018	US Section 201 tariffs on solar panels and washing machines	**Yes** (modified and extended) (Exemption of bifacial solar panels. Duty-free pathway for Canada and Mexico. Doubled import allowance of solar cells.)
March 23, 2018	US Section 232 tariffs on steel and aluminum, temporarily exempting Argentina, Australia, Brazil, EU, Canada, Mexico, and South Korea (exemptions terminated June 1, 2018) Targeted $2.8 billion worth of Chinese products (2017 import values)	**Yes** (modified) (Steel and aluminum tariffs from EU, Japan, and UK replaced with tariff-rate quota/TRQ. Ukraine exempted.)
July 6, 2018	US Section 301 tariffs of 25% on 1,333 Chinese products ("List 1") Targeted $34 billion worth of Chinese products (2017 import values)	**Yes**
August 23, 2018	US Section 301 tariffs of 25% on 279 Chinese products ("List 2") Targeted $16 billion worth of Chinese products (2017 import values)	**Yes**
September 24, 2018 **(May 10, 2019)***	US Section 301 tariffs of 10% on 5,745 Chinese products ("List 3") (Increased to 25%) Targeted $200 billion worth of Chinese products (2017 import values)	**Yes**

September 1, 2019 **(February 14, 2020)***	US Section 301 tariffs of 15% on Chinese products ("List 4A") (Decreased to 7.5%) Targeted $112 billion worth of Chinese products (2017 import values)	**Yes**

   c. *Department of Commerce more in the driving seat for the Non Tariff barriers.*
      i. Some of this is welcome but "trade facilitation" initiatives are also weak.
      ii. scoping exercises on dependencies that Biden officials tried to launch were unproductive. Gov't lethargy. Smaller countries have been more successful and actually picked up on things they didn't know. Best example Australia.

Should Europe Be Worried?

a) It's challenging
   a. *US is confused on how to relate to Europe*
      i. Most Pro-EU administration ever, yet not a panacea to EU-US problems
      ii. Why couldn't it foresee or guide Schumer/Manchin? Some deliberate passivity from the executive branch cannot be excluded!
      iii. US doesn't believe in the WTO, the TTC is a talk-shop, and USTR and Treasury can't give guidance, so no clear mechanism for how US and EU work out tensions as they arise.
   b. *We have to hope for durable achievements in 2023/24 or whatever non-binding arrangements could be taken away by Trump*
      i. Hope for comprehensive deal on critical minerals and Global Arrangement on Steel and Alu which should allow US and EU to bury the hatchet.
      ii. End on Trump risk and nervousness about even discussing this.

b) IRA opportunities
   a. *This is good for European firms, and divestment from Europe concern is overdone*
   b. *It isn't quite over. Opportunities for a G7 deal on subsidies.*
      i. AND perhaps Europe is realizing the problem IS China, with recent surge in EV imports from China!

c) Learning from each other
   a. *VdL seminal speech before visit to Beijing. De-risking, not de-coupling! Washington DC remembers that speech and refers to the terminology as hers. O'Sullivan then acknowledged it in his Brookings speech*
      i. US still v much a rule taker from EU bcos of muddled domestic political situation. US will have to be a rule-taker from Europe, who has been developing or debating rules for digital and industrial policy

   ii. The EU is less hysterical than US on some things and can advise against including too many sectors. Can also show to the US when a policy is overreaching and argue for another approach (cf. nervousness on secondary sanctions → next time it may be investment screening negatively affecting EU/China investment into US).

b. *What can EU learn from US: the (open) strategic autonomy debate.*

   i. On the other hand, EU can definitely learn from simplicity/efficiency of IRA. Not sure this is possible however as EU rules and mistrust among member states will never allow a bottomless pit of funding. Always has to be agreed in advance. Not so for the IRA.

10. China's Long March Towards Global Industrial and Tech Leadership

Zongyuan Zoe Liu

Since its reform and opening up, introduced in 1978, China has rapidly emerged to become the world's second-largest economy and has positioned itself as a leading global science and technology powerhouse. Australian Strategic Policy Initiative's Critical Technology Tracker shows that China has a stunning lead in 37 out of 44 critical technologies, covering a range of crucial technology fields spanning defence, space, robotics, energy, the environment, biotechnology, artificial intelligence, advanced materials, and the key quantum technology area.[1] While the effectiveness of China's industrial policies in driving the success of China's technological advancements is a subject of intense scholarly debate, the Communist Party of China and the Chinese government have undeniably devoted tremendous resources to nurturing sectors and industries considered strategic by Chinese leaders. As Barry Naughton pointed out, the ambition of China's planners and policymakers has expanded as technological change has accelerated, and intervention by the Party-State has therefore continued to increase.[2] This article examines the evolution of China's industrial policies to support chosen strategic sectors, from President Hu Jintao to President Xi Jinping, and the financing model employed by the Party-State to achieve its stated goal of technology advancement and self-reliance. It concludes with a brief assessment of the challenges to China's industrial policies as the economy slows down.

China's shift towards prioritising tech self-reliance, from Hu Jintao to Xi Jinping

While the Party-State has introduced a series of industrial policies since President Xi Jinping came to power in 2013, it was President Hu Jintao who first prioritised using industrial policies with expanded government investment. President Hu started the shift from the strategy of rejuvenating China by relying on science and education, introduced during the years of Deng Xiaoping and Jiang Zemin, to the strategy of independent innovation with the explicit goal of reducing foreign technology dependence and climbing up global value chains. When President Xi took office after Hu's term, he continued pursuing independent innovation to achieve technology self-reliance.

---

[1] J. Gaida, J. Wong Leung, S. Robin, and D. Cave, "ASPI's Critical Technology Tracker - The global race for future power", Australian Strategic Policy institute, 2 March 2023.

[2] B. Naughton, *The Rise of China's Industrial Policy: 1978 to 2020*, 2021, p. 13.

With hindsight, President Hu kicked off China's pursuit of "independent innovation" in 2004. When addressing the opening ceremony of the 12th General Assembly of the Chinese Academy of Sciences and the 7th General Assembly of the Chinese Academy of Engineering in June 2004, President Hu said, "Independent innovation capability has become a decisive factor of a nation's core competitiveness" and called on Chinese scientists to "master core and frontier technologies and processes in selected fields that are related to China's socioeconomic development, national security, life and public health, and the environment".[3] In the last week of December 2004, Hu attended three technology-related events and emphasised "independent innovation" (zi zhu chuang xin).[4] Hu's attention to independent innovation was systematically programmed into China's five-year plans in the years following, starting with the 11th Five-Year Plan proposal released in October 2005, which set targeted prioritised areas for "independent innovation" to promote China's industrial technology upgrade.[5]

In January 2006, the Party and the State Council issued the "Decision to Implement the Plan for the Development of Science and Technology to Enhance Independent Innovation Capabilities" at the National Conference on Science and Technology. In a month, the State Council released the "National Medium and Long-Term Plan for the Development of Science and Technology (2006-20)"[6] (MLP), which articulated the independent innovation strategy and set three goals to make China an innovation-oriented nation: building a national innovation system; improving innovation capacity (source innovation, integration innovation, re-innovation, and strategic high-tech R&D); and cultivating creative talents and improving the innovation environment. The MLP identified firms as the main entities of innovation to achieve technological breakthroughs and identified sixty-two prioritised areas of innovation development in ten key sectors and sixteen significant special projects. It specified several quantitative targets for China to achieve by 2020, including increasing research and development (R&D) expenditure to 2.5% of GDP (a measurement of R&D intensity) and reducing the degree of dependence upon foreign technology to 30% or less. More importantly, the MLP for the first time announced that China would adopt a new scientific and technological management system in which national defence research and development would be open to the civilian sector, paving the way for the Military-Civil Fusion Strategy in later years. Since the release of the MLP, the government report delivered at the annual National People's Congress has consistently issued updates on China's innovation

[3] Full text of Hu Jintao's speech in Chinese can be accessed at http://www.gov.cn/ldhd/2004-06/02/content_11014.htm.

[4] On 24 December, Hu Jintao visited renowned scientists Zhu Guangya and Yang Le separately. On 27 December he presided over the 18th session of Politburo group study. On 29 December, he visited the pilot programme of the Knowledge Innovation Project at the Chinese academy of Sciences. Throughout these three events, Hu emphasised that improving China's independent innovation capabilities should be placed at the centre of the structural adjustment (of the Chinese economy), and that promoting independent innovation should be given a prominent place in all scientific and technological work to accelerate the construction of a national innovation system with Chinese characteristics. A brief of Hu's activities can be accessed at http://finance.people.com.cn/GB/n1/2021/0701/c1004-32145595.html.

[5] Full text of the 11th Five-Year Plan is available at https://www.gov.cn/ztzl/kjfzgh/content_883887.htm

[6] Full text of the Plan in Chinese is available at https://www.most.gov.cn/xxgk/xinxifenlei/fdzdgknr/gjkjgh/200811/t20081129_65774.html

achievements, reiterated the government's commitment to improving independent innovation capabilities, and clarified the state's list of desired strategic industries and sectors for innovation.

Beijing selected a few cities as pioneers to facilitate the implementation of the central government's plans at the local level. In January 2010, the National Development and Reform Commission (NDRC) announced the approval of sixteen cities to be the first to implement pilot projects for developing national innovation cities.[7] The NDRC specified that one of the missions of these pilot cities was to nurture the development of strategic and frontier industries, such as new energy, new materials, and biomedicine, and to promote the development of industrial innovation clusters.

At the National Science and Technology Innovation Conference in July 2012, Hu emphasised accelerating the development of a national innovation system and proposed the idea of innovation-driven development.[8] In September 2012, the CPC Central Committee and the State Council issued "Opinions on Deepening the Reform of the Scientific and Technological System and Accelerating the Building of a National Innovation System".[9] The Opinions set the goal of building a national innovation system by 2020 and achieving an innovation-oriented national status. Similar to the MLP released in 2006, the Opinions reiterated the need to strengthen the role of firms in technological innovation and in facilitating the integration of science and technology with the economy.

All these proposals were codified as policy directions in President Hu's report at the 18th National Party Congress in November 2012. When delivering his report to the Party Congress, Hu proposed implementing an innovation-driven national development strategy and called on the Party to accelerate the construction of a national innovation system and to prioritise scientific and technological innovation.[10] The 18th National Party Congress marked the transition from President Hu Jintao to President Xi Jinping. It also set a new stage for China's pursuit of technology advancement: the Party for the first time unambiguously elevated scientific and technological innovation to a national strategy and directly linked it with China's national development.

In the years following President Xi Jinping taking office in 2013, Chinese policymakers have continued calibrating the independent innovation strategy by updating quantitative targets, specifying prioritised strategic sectors, and mobilising financial resources to support a series of industrial policies in the pursuit of self-reliance. During Xi's first two terms, the Party-State reinforced its commitment to pursuing independent innovation to achieve technological self-reliance. To continue marching towards the goals set in the 2006 MLP, in May 2015 the State

---

[7] These include Dalian, Qingdao, Xiamen, Shenyang, Xi'an, Guangzhou, Chengdu, Nanjing, Hangzhou, Jinan, Hefei, Zhnegzhou, Changsha, Suzhou, Wuxi, and Yantai. See more details in the "Notice on Promoting the Development of Pilot Projects of National Innovative Cities" ("国家发展改革委关于推进国家创新型城市试点工作的通知") issued by the National Development and Reform Commission on 11 January 2010.

[8] "National Science and Technology Innovation Conference took place in Beijing" ("全国科技创新大会在京召开"), Ministry of Science and Technology news release, 6 July 2012.

[9] Full text of the Opinions in English is available at https://en.most.gov.cn/pressroom/201211/t20121119_98014.htm

[10] Full Text of Hu Jintao's Report at 18th Party Congress is available at http://np.china-embassy.gov.cn/eng/Diplomacy/201211/t20121118_1586373.htm

Council issued "Made In China 2025" (MIC2025),[11] which is a broad set of industrial plans that aim to boost national competitiveness by advancing China's position in the global manufacturing value chain, leapfrogging into emerging and frontier technologies, and reducing foreign technology dependence. While the MIC2025 emphasises indigenous innovation, it specifies that the strategy to achieve this goal is attracting foreign investment in high-tech and advanced manufacturing sectors, encouraging foreign firms and research institutions to set up R&D centres in China, and encouraging qualified Chinese companies to cooperate with foreign firms. All this means that the process of realising indigenous innovation involves acquiring, absorbing, and adapting foreign technology by Chinese entities that recast these capabilities as their own.

One of the ten strategic industrial goals set in the MIC2025 is to promote the development of the EV battery industry. Increasing R&D spending on EV batteries and lowering the unit production cost of EV batteries are key objectives listed in the EV Battery Industrial Development Action Plan (促进汽车动力电池产业发展行动方案) jointly issued in February 2017 by the National Development and Reform Commission (NDRC), the Ministry of Finance, the Ministry of Industry and Information Technology, and the Ministry of Science and Technology.[12] Promoting the development of EV battery technology to support the electric vehicle industry is a critical first step in implementing President Xi Jinping's new energy strategy, which prioritises reducing hydrocarbon consumption. China's 13th Five-Year Plan (2016-20), released in March 2016, sets a goal to achieve a 15% reduction in energy intensity and an 18% reduction in carbon intensity compared to 2015 levels.

To mobilise the Chinese masses and private entrepreneurs to act towards the goals set in MIC2025, in June 2015, the State Council issued the "Opinions to Further Boost Mass Entrepreneurship and Innovation".[13] The Opinions laid out ninety-six guidelines covering thirty actionable items in nine policy areas to encourage startups and private entrepreneurs to participate in science and technological innovation. It included detailed policies to optimise fiscal and taxation policies and utilise the financial market to provide supportive startup financing. The Opinions aimed to incentivise Chinese private entrepreneurs to support achievement of the Party-State's independent innovation targets, use financial mechanisms to guide innovation, and ultimately upgrade China's industrial supply chains and have startups create new employment opportunities.

In his "Explanation of the CPC Central Committee's Suggestions on Drafting the 13th FYP", Xi urged to "make breakthrough achievements in core technologies such as high-end general-purpose chips, integrated circuits, broadband mobile communication, high-end computer numerical control machines, nuclear power plants, and the development of new drugs." He

---

[11] The "Made In China 2025" plan highlighted ten sectors: new generation information technology, high-end computerised machines and robots, aerospace, maritime equipment and high-tech ships, advanced railway transportation equipment, new energy and energy-savings vehicles, energy-saving vehicles, energy equipment, agricultural machines, new materials, biopharma and high-tech medical devices. Full text of "Made In China 2025" is available in Chinese at http://www.dahe.com/standard/standard%20folder/made%20in%20China%202025.pdf
[12] Full text of the Plan is available at https://www.gov.cn/xinwen/2017-03/02/content_5172254.htm#1
[13] Full text of the Opinions in Chinese is available at https://www.gov.cn/zhengce/content/2015-06/16/content_9855.htm

proposed to "deploy another batch of major scientific and technological projects that reflect national strategic intentions in the fields of aero-engines, quantum communications, intelligent manufacturing and robotics, deep space and deep ocean explorations, key new materials, brain science, and health care." He pointed out that technological and economic gaps between China and advanced economies are mainly in innovation capabilities. In this context, he called for accelerating the construction of innovation base platforms led by national labs in frontier technologies guided by the state's strategic needs. His rationale for developing major strategic national labs is that such national labs have become an essential carrier for major developed economies (such as the United States) to seize the commanding heights of science and technology innovation.[14]

Under Xi's leadership, Chinese policymakers augmented the high-level "independent innovation as a national development strategy" initiated by Hu Jintao with updated ambitions over a longer term and in specific fields of innovation. In May 2016, the Party and the State Council issued the "Outline of the National Innovation-Driven Development Strategy".[15] The Outline updated the quantitative targets set in the 2006 MLP and sets new targets for 2030 and 2050, including increasing R&D expenditure to 2.8% of GDP by 2030 and making China a global powerhouse of scientific and technological innovation by 2050. It also specified prioritised fields of innovation, including advanced digital devices, integrated circuit equipment, smart manufacturing and robotics, quantum computing, telecommunication, nuclear energy, genetically modified bioproducts, and brain science, among others.

The Outline provided high-level directional guidance for the more detailed actionable items and targets laid out in the 13th Five-Year Plan (FYP) for Science and Technology Innovation released by the State Council in July 2016. The 13th FYP for Science and Technology Innovation specified twelve innovation indicators as targets for 2020, thirteen major special projects for the near term, nine major science and technology programmes for the longer term, and ten specific technological areas to build a modern industrial technology system.[16] The 13th FYP for Science and Technology Innovation marked the first time that the Party-State carried out top-level planning for technology innovation as a whole policy package that combines science and technology policies with supporting economic and financial policies, fiscal and taxation policies, trade policies, intellectual property protection, and other aspects of industrial policies. It also chose fifteen major projects for scientific and technological innovation, six critical projects, and nine major engineering projects to focus on by 2030.

As China moved beyond 2020, Chinese policymakers refreshed the 2006 MLP with new development plans following the same commitment to strengthening China's innovation capabilities and making innovation a driver for China's economic development. In March 2021, the National People's Congress approved the 14th FYP for National Economic and Social

---

[14] Full text is available in Chinese at http://cpc.people.com.cn/n/2015/1104/c64094-27773638.html

[15] Full text of the Outline in English is available at https://cset.georgetown.edu/publication/outline-of-the-national-innovation-driven-development-strategy/

[16] Full text of the "13th FYP for Science and Technology Innovation" in Chinese is available at http://www.gov.cn/zhengce/content/2016-08/08/content_5098072.htm

Development and Long-Range Objectives for 2035,[17] which became the new blueprint for China to become a leading innovation-oriented nation by 2035. While the 14th FYP shares the innovation-focused spirit of the 2006 MLP issued during the Hu Jintao era, it has clear marks of Xi Jinping's ambition. In particular, the 14th FYP emphasised guiding the optimisation of the innovation system to meet national strategic needs. While President Hu Jintao directly linked scientific and technological innovation with China's development, President Xi Jinping required innovation to serve the need of China's strategic interests, to reduce China's vulnerabilities and to advance China's national interests as defined by the Party.

To this end, Chinese policymakers under Xi's leadership have strengthened legislation to reduce fraud against R&D funding and enhance the legal basis for cracking down on the embezzlement of research funds. In December 2021, the Standing Committee of the National People's Congress revised the Law on Science and Technology Progress for the second time since it was adopted in 1993 and revised for the first time in December 2007. This law regulates how Chinese technology-related industrial policies operate and how state guidance funds for science and technology are run. It also stipulates punishments for those who embezzle science and technology funds, and so on. This latest revision put President Xi's stamp on it by including several political formulations associated with his rule.[18]

Besides improving R&D legislation, the Party led by Xi also issued new high-level guidance to continue mobilising the masses and the market to concentrate innovation in core technologies. In September 2022, the CPC Central Commission for Comprehensively Deepening Reform issued the "Opinions on Building a National System for Core Technologies under Conditions of a Socialist Market Economy".[19] While lacking concrete policy guidelines, the Opinions clearly articulated from a high-level the Party's intention to fully mobilise the government, market, and society to concentrate resources on the R&D of key technologies with first-move advantages and cutting-edge basic frontier technologies. Unlike the earlier notion of building a national innovation system first introduced by Hu Jintao and coded in the 2006 MLP, the Opinions zoomed in on breaking the bottleneck of core technologies in critical sectors of economic development and national security, with a strong emphasis on reinforcing the Party's central leadership and authority in decision making. This more focused Opinion suggests Chinese policymakers have become aware of the importance of breaking technological bottlenecks for China's continued growth and national security. It shows that while China had made progress in independent innovation and achieved the targets set in the 2006 MLP by 2020, Chinese leaders continue to update their technological innovation targets to ultimately achieve the goal of mastering indigenous frontier technologies and making China a leading global innovation powerhouse.

---

17 "中华人民共和国国民经济和社会发展第十四个五年规划和 2035 年远景目标纲要".

18 https://cset.georgetown.edu/publication/law-of-the-peoples-republic-of-china-on-progress-of-science-and-technology/#:~:text=The%20following%20document%20is%20the,S%26T%20funds%2C%20and%20so%20on

19 "关于健全社会主义市场经济条件下关键核心技术攻关新型举国体制的意见".

At the 20th National Party Congress in November 2022, Xi reiterated that the Party should remain focused on anchoring technological innovation as the core driver for China's development.

Financing National Science and Technology Innovation

Starting in 2018, *Science and Technology Daily*, the official newspaper of the Ministry of Science and Technology, published a series of reports on thirty-five stranglehold (卡脖子) technologies,[20] core technologies that China had to import due to a lack of domestic capacity to produce alternatives of sufficient quality or quantity, hence constraining China's industrial development. By 2022, publicly available information showed various Chinese entities had achieved major technological breakthroughs in at least nineteen of the thirty-five core technologies.[21]

A closer look into these achievements shows that firms have been leading the way in reported progress. Part of the reason is that major Chinese innovation-related policies since the 2006 MLP have consistently reaffirmed firms as the primary entities for innovation. To incentivise firms to engage in R&D of core technologies and advanced manufacturing sectors to serve the need of China's national security and reduce China's strategic vulnerabilities, the Chinese government has continued to provide and expand tax breaks and subsidies. To help taxpayers better understand the preferential tax policies and to promote mass entrepreneurship and innovation, the State Taxation Administration has issued annually updated "Guidelines on Preferential Tax Policies for Mass Entrepreneurship and Innovation" since 2017. According to the 2022 Guidelines, Chinese tax authorities have successively issued at least 120 preferential tax policies and favourable financial support packages to encourage innovation in core technologies such as semiconductors and software.[22] Between 2015 and 2022, the Chinese government issued at least eleven notices regarding preferential tax treatment for firms engaging in the manufacture or design of semiconductors.[23]

As part of its effort to mobilise capital to support the development of strategic industries and achieve technology self-reliance, Chinese government agencies and financial regulators encouraged Chinese banks to adopt the venture loan model championed by the once-successful

---

[20] These 35 "stranglehold" technologies included photolithography machines, chips, operation systems, aircraft engine nacelles, touch sensors, vacuum evaporators, radio frequency components for mobile phones, individual-nucleotide resolution Cross-Linking and ImmunoPrecipitation (iCLIP) technology, heavy-duty gas turbines, Light Detection and Ranging (LiDAR), airworthiness standards, high-end capacitors and resistors, core industrial software, Indium tin oxide (ITO) sputtering target materials, core algorithms, aviation-grade steel, milling cutters, steel for high-end bearings, high-pressure piston pumps, aviation design software, photoresists, common rail systems, transmission electron microscopes, main bearings of tunnel boring machines, microspheres, underwater connectors, key fuel cell materials, high-end welding power sources, lithium battery separators, components for medical imaging equipment, ultra-precision polishing techniques, epoxy, high-strength stainless steel, database management systems, and scanning electron microscopes. A collection of the reported thirty-five technologies can be accessed at https://www.fdx-fund.com/cn/case-detail-1553.html.

[21] "这就是中国速度！仅 4 年多，35 项关键技术如今我国至少突破 19 项" ("This is China speed: China achieved breakthroughs in 19 of 35 core technologies in just over four years"), *163.com*, 12 June 2022.

[22] Full text of the 2022 Guidelines is accessible in Chinese at https://www.tjhd.gov.cn/ztzl/ztzl1/zqthqzc/ssyh/202303/W020230313580456533554.pdf

[23] "A full catalogue of preferential tax policies for mass entrepreneurship and innovation" ("大众创业 万众创新"税费优惠政策文件目录").

Silicon Valley Bank (SVB). In April 2016, the China Banking and Insurance Regulatory Commission (CBIRC), the Ministry of Science and Technology, and the People's Bank of China jointly issued a "Guiding Opinions on Supporting Banking Financial Institutions to Increase Innovation and Implement the Investment-Loan Linkage Pilot Program for Science and Technology Innovation Enterprises,"[24] which set the policy course for lower-level government institutions.

The pilot programmes laid out in the scheme targeted five "national independent innovation demonstration zones" in Beijing, Wuhan, Shanghai, Tianjin, and Xi'an. Wuhan East Lake High-Tech Development Zone was one of these five pilot programmes. The Guiding Opinions designated ten banks to lead implementation of the investment-loan linkage programme, including one policy bank (China Development Bank) and two national banks (Bank of China and Hengfeng Bank) authorised to finance projects in all five demonstration zones.[25] It also allowed Shanghai Pudong Development Silicon Valley Bank, a 50-50 joint venture between Shanghai Pudong Development Bank and Silicon Valley Bank launched in 2012, to fund projects within its existing business scope and authorised six regional banks to finance projects in demonstration zones within their jurisdictions. These six regional banks were the Bank of Beijing, Bank of Tianjin, Bank of Shanghai, Hankou Bank, Bank of Xi'an, and Shanghai Huarui Bank.

It is worth noting that apart from the China Development Bank and Bank of China, the remaining eight designated banks are not necessarily the best at risk management, and their track record is far from spotless. For example, Hengfeng Bank underwent a ¥100 billion (US$14.5 billion) restructuring in 2019 after corrupt management brought the bank to the brink of bankruptcy. In 2018, the bank's nonperforming loans ratio reached 28.44%, or the colossal amount of ¥163.56 billion. Even after restructuring, Hengfeng Bank has been struggling. Between August 2021 and September 2022, Hengfeng Bank and its subsidiaries were fined 10 times by Chinese regulators, amounting to a total fine of ¥9.25 million. Recently, the bank has been unable to recover ¥658 million from investments into two subsidiaries of the same real estate developer, Rongqiao Group

The Chinese government is certainly aware of the threat to financial stability brought by the combination of poor risk management and loose financial supervision. Chinese regulators and state-owned insurance providers have proactively developed risk management solutions to support China's indigenous R&D in strategic industries, especially semiconductors. In December 2021, CBIRC issued "Guiding Opinions on the Banking and Insurance Industries Supporting Advanced Technology Self-Reliance and Self-Improvement."[26] The Guiding Opinions encourage the investment arms of commercial banks, insurance institutions, and trust companies to participate in

---

[24] "关于支持银行业金融机构加大创新力度 开展科创企业投贷联动试点的指导意见".

[25] "10家银行成投贷联动试点" ("Ten banks are designated as pilot banks for the investment-loan linkage program") *Economic Daily*, 22 April 2016.

[26] "中国银保监会印发 '关于银行业保险业支持高水平科技自立自强的指导意见'" ("China Banking and Insurance Regulatory Commission issued the 'Guiding Opinions on the Banking and Insurance Industry Supporting Advanced Technology Self-reliance and Self-improvement'"), China Banking and Insurance Regulatory Commission, 4 December 2021.

venture capital funds and government industrial investment funds and to provide equity financing to support tech firms in need of capital. Later the same month, 18 Chinese insurance and reinsurance companies jointly established an Integrated Circuit Co-Insurance Company to provide industry-specific risk solutions for China's indigenous chip developers.[27]

In light of stringent export controls imposed by the West, the Party and the government have to find alternative means to achieve technological advancement, as trading market access for cutting-edge technologies is no longer optimal. Chinese policymakers are exploring the use of SVB-style banking and venture loans to support tech SMEs and the development of high-tech zones. Over the past two years, China has launched various R&D financing pilot programmes. For example, in November 2021, the State Council approved the "Master Plan to Build a Pilot Zone of Financial Reform to Support Science and Technology Innovation in Jinan," the capital city of Shandong province.[28] This is the first plan for a multi-city pilot zone. As of 2022, China had established at least 23 national independent innovation demonstration zones in 66 national high-tech zones across 60 cities, many of which have adopted SVB's finance model.[29] The Ministry of Science and Technology has been drafting a "National Independent Innovation Demonstration Zone Development Plan for 2021-2035," which will likely encourage the nationwide application of SVB-style equity-loan venture finance for Chinese tech startups.

Conclusion

As China navigates a challenging geopolitical landscape, these efforts to promote domestic innovation through venture debt financing, regulatory reform, and strengthened supervision represent a serious commitment to improving indigenous science and technology development capability. Looking back, the PRC detonated its first atomic bomb and hydrogen bomb in the late 1960s at the height of the Cold War when the country had almost no access to Western technology: this is a reminder that China possesses indigenous science and technology development capacity. However, the cost of China's losing access to Western technology markets today is much higher than in the 1960s, partly due to China's greater integration into the U.S.-led global system. More importantly, China's renewed pursuit of technology self-reliance since President Xi Jinping took office has taken place against the backdrop of slower growth of the Chinese economy, rising tensions with the West, simmering domestic financial instability amid rising debts, a soft labour market, and an ageing society. While the government's industrial policies to improve indigenous innovation capabilities are not the cause of China's economic slowdown, the capital resources allocated to financing China's industrial policies mean missed opportunities to support Chinese

[27] "构建自主安全可控产业链，中国集成电路共保体在临港成立创新实验室" ("To build independent, safe and controllable industrial supply chains, China Integrated Circuit Co-Insurance Company established an innovation laboratory in Lingang), *Xinmin Evening News*, 28 December 2021.

[28] "济南获批全国首个科创金融改革试验区" ("Jinan was approved as the first pilot zone of financial reform to support science and technology innovation") , Department of Science & Technology of Shandong Province, 2 December 2021.

[29] "科技部火炬中心召开'国家自主创新示范区 2021-2035 年发展规划'战略研究专题调研会", ("The Torch Center of the Ministry of Science and Technology held a strategic research seminar on the development plan for national independent innovation demonstration zones 2021-2035"), Ministry of Science and Technology, 21 June 2022.

households and consumers, which should have been the government’s focus to improve the economy.

Policy Paper

Falling into Pieces. The EU in the Puzzle of Global Trade

Lucia Tajoli, Davide Tentori

Contributions by:

Ilaria Fusacchia

M. Sait Akman

Luca Salvatici

Claudia Schmucker

ISPI

- **Lucia Tajoli,** Full Professor of Economic Policy at the Department of Management Engineering of the Politecnico di Milano. She is ISPI Senior Associate Reserach Fellow.
- **Davide Tentori** is a Professional of Economic Scenarios at ENI. Until December 2022 he worked as Research Fellow at the ISPI Centre for Business Scenarios.

Falling into Pieces. The EU in the Puzzle of Global Economy
by Lucia Tajoli and Davide Tentori
First edition: January 2023
Cover Image Shutterstock Photo

ISBN 9788894469455

ISPI. Via Clerici, 5
20121, Milan
www.ispionline.it

Ministry of Foreign Affairs
and International Cooperation

This Policy Paper is realized with the support of the Policy Planning Unit of the Ministry of Foreign Affairs and International Cooperation pursuant to art. 23-bis of Presidential Decree 18/1967.
The opinions contained in this Paper are solely those of the authors and do not necessarily reflect the opinions of the Ministry of Foreign Affairs and International Cooperation and ISPI.

Table of Contents

In Brief

The international events of the last three years showed a number of signals suggesting that the "golden age" of economic globalization – started at the end of Cold-war - might have come to an end. Also as a consequence of the Covid-19 pandemic in 2020 and the outbreak of the war in Ukraine in 2022, it seems that globalization is slowing down affecting trade flows and undermining economic growth potential. In fact, despite in 2021 global trade in goods reached an all-time record value of $ 28.5 trillion, latest forecasts from the World Trade Organization (WTO) cut growth in the volume of trade in goods for 2022 from 4.7% to 3.5%, with things getting even worse in 2023 as trade flows would increase by a lackluster 1%. Moreover, current geopolitical tensions and a new "trade war" between the United States and China are putting the resilience of Global Value Chains (GVCs) to the test, potentially increasing the attractiveness of re-shoring, near-shoring and friend-shoring practices. All this in a context where the functioning and effectiveness of the WTO have been at a standstill for several years already.

Where does the European Union fit within this intricated picture? The EU is by far the largest trader in the world, before China and the United States, and it is also the top trading partner for 80 countries, being involved in more than 40 Free Trade Agreements that include more than 70 countries. While pursuing a trade liberalization agenda, the EU has become increasingly wary of the importance to preserve its own economic and security interests: this is why its external policy – including trade – is currently inspired to the 'mantra' of strategic autonomy. A key concept that basically implies that critical supply chains – those ones that are crucial to carry the green and digital transitions forward - should be secured and regionalized, starting from the EU's interests rather than prioritizing specific areas or regions as trade partners. In fact, the EU is lagging behind China and the US with respect to the control of key inputs (such as critical minerals and raw materials) and the manufacturing of semiconductors.

Are there ways to ensure that globalization can still survive (and thrive), and with it the role of the EU as a key trade player? What could be done to preserve the EU's central role in GVCs and as a broker of FTAs? In this Policy Paper, we argue that:

- Globalization will not end but it will rather face a process of "fragmentegration", which is a scenario in which actors will react to supply shocks by looking for new trade partners and ways of integrating their economies;
- The WTO no longer looks fit for purpose and is in need for a deep reform, which should be also consist of new tools aimed at establishing a level playing field in areas such as digital trade (e-commerce

but also regulation of personal data) and "green" trade (for instance by identifying an agreement towards the establishment of a Carbon Border Adjustment Mechanism);

- The EU could exploit its comparative advantage as a "global standard setter" and look for broader consensus with other WTO members, rather than following an alternative route that would lead to a more isolated position and a protectionist attitude.
- Moreover, the EU should better equip itself to face geoeconomic competition from other key players in order not to lose the race for global technology leadership, that will mark the coming years, and to enhance resilience in its critical supply chains. As empirical data show, the EU has a competitive advantage in many manufacturing sectors, mostly thanks to its integration in GVCs.

This paper is divided into two parts: the first – **"What's at stake"** – analyses current and future economic risks if economic globalization falls into pieces. The second part – **"Exploring options"** – offers a broad overview of key reform proposals by leading experts and our take on them.

Keeping the EU at the core of world trade system

How to rescue globalization and free trade?

1. First best

Multilateral reform
(Towards a "WTO 2.0")

2. Second best

Exploiting free
trade agreements

Levaraging on the EU assets:
• "Brussels effect" (standard setting)
• Competitive advantage in manufacturing GVCs

What's at stake?
Towards the End of Globalization?

$28.5 tn

World trade all-time record reached in 2021

THE EU IN THE INTERNATIONAL TRADE CONTEXT: A MODEL AT RISK?

The end of Cold-war paved the way for the "golden age" of economic globalization: since the 1990s, international trade flourished thanks to enhanced economic openness and a boost to multilateral negotiations following the establishment of the World Trade Organization (WTO) in 1995. Fast-forward to 2022, we realize that the world we were used to know has quite changed. Also as a consequence of the pandemic and the war in Ukraine, globalization is slowing down, affecting trade flows and reducing economic growth. Where does the EU fit within this picture?

Europe Facing the Risk of a Global Trade Slowdown

In 2021, global trade reached an all-time record of $ 28.5 trillion (+25% on 2020 and +13% on pre-pandemic period.[1] Prospects for 2022 looked extremely positive at the beginning of the year, but the consequences of Russia's invasion of Ukraine have contributed to frame a darker picture. Latest forecasts from the WTO cut growth in the volume of trade in goods for 2022 from 4.7% to 3.5%, with things getting even worse in 2023 as trade flows would increase by a lackluster 1%.[2] A slowdown that will negatively affect Europe, a very active participant to global markets: European exports look set to grow by only 0.8% and imports even to shrink by -0.7% (probably also as a consequence of reduced energy imports from Russia).

International Trade slowing down

Growth of international trade in goods, 2015-23 (2015=100, Q3 2022-2023 = forecasts)

Source:World Trade Organization

The EU is the largest economy and the largest market in the world, with an average GDP per head of €25,000 for its 440 million consumers. Given its economic size and relevance, the EU, considered as a unique entity (instead of a 27-Member States organization) and including intra-EU trade, is also by far the largest trader in the world, before China and the United States (see Fig. 2).

Unsurprisingly, the recently much discussed slowdown in world trade has involved the EU as well, even if less than other areas. EU exports grew at a rate slightly higher that the world average between 2000 and 2008, but they declined to about 4% since 2010. How to explain this slowdown? There are many reasons both at the world and the European level, from the more inward-oriented China's policies to the declining impact of the ITC transformation. Basically, most experts agree that what we are observing now is a normalization of trade trends, after a period of so-called "hyper-globalization".[3]

- 6%

The decline of EU exports in 2020, less than the world average

Lately, trade patterns have also become more volatile. After the sharp decline in world trade in 2020 because of the Covid pandemic and generalized lockdowns (-7% in value for world exports and -6% for EU exports), trade flows bounced back in 2021. However, with the uncertainty created especially in European markets by Russia's invasion of Ukraine and the ongoing conflict, the WTO recently revised downward its forecast for 2022 and 2023. Such a reduction in trade growth is associated to growth slows in the major trading economies for different reasons. In Europe, high energy prices stemming from the Russia-Ukraine war are already taking their toll on household spending and have raised manufacturing costs. In the United States, monetary policy tightening will hit interest-sensitive spending in areas such as housing, motor vehicles and fixed investment. China continues to grapple with COVID-19 outbreaks and production disruptions paired with weak external demand. Finally, growing import bills for fuels, food and fertilizers could lead to food insecurity and debt distress in developing countries, affecting also their imports.

200%

Increase of trade between 2002 and 2021 for Member States that joined the EU in 2004

Against today's complicated backdrop, it is possible that in the future European trade could expand further, as the potential is not exhausted. Within the EU, there are countries (like Italy and Spain, for example) that are still increasing their degree of openness and integration within the global economy. Within the EU, trade grew dramatically in most of the Member States that joined the EU in 2004 or more recently. These countries experienced growth rates of more than 200 % in total trade between 2002 and 2021. For this group, such an increase may, at least in part, be explained by their process of integration into both global markets and (in particular) the European single market. Other Member States (such as the Netherlands, Spain, Germany, Austria, Portugal, Greece, Belgium, Sweden) recorded trade growth rates between 100 % and 200 % over the same time span. Another evidence that trade remains key for the EU economy, even if the period of "hyper-globalization" is over.

As mentioned, the relevance of trade for the EU is not only due to a deeply integrated Single Market, but also considering extra-EU trade. The EU is the top trading partner for 80 countries, a much larger number than the ones having the US as the top trading partner. Because of long historical ties, many of the EU trade partners are developing countries: fuels excluded, the EU imports more from developing countries than the USA, Canada, Japan and China put together. This means that on the one hand, the EU benefits from a high diversification of markets and suppliers, but on the other, it is also more exposed to both positive and negative world shocks.

WTO: Still Up to the Task?

Given the EU's openness and integration with the rest of the world, an orderly international trade system is very important for the European economy. In fact, the EU has always been a strong supporter of the WTO. Over almost three decades, the WTO has helped reduce barriers to trade in both goods and services and created a dispute resolution system that according to most observers reduced the threat of trade wars.

As many multilateral negotiations within the WTO stalled, WTO talks have continued through what are known as plurilateral negotiations, or agreements among subsets of WTO members. Plurilateral deals are easier to negotiate, as they are narrower in focus and not all members are bound by their terms. However, even if plurilateral agreements are important to help improving trade liberalization in some areas and especially to maintain an open negotiation channel within the WTO, the lack of achievements in the main multilateral setting for a decade or more has considerably weakened the role of the WTO and the institution is under considerable pressure. Negotiations on a comprehensive development agenda have foundered due to disagreements over agricultural subsidies and intellectual property rights, areas where the positions of advanced and developing countries seem quite difficult to reconcile, while members have increasingly turned to separate bilateral and regional free trade agreements to advance their trade interests. Criticisms of the organization vary from farmers and labor groups accusing the WTO of focusing too narrowly on corporate interests, to environmentalists worrying about deregulation, and different countries' policymakers alleging that the institution has failed to handle other countries' abuses.

In particular, the WTO has been recently criticized by one of its main former supporters, the USA. Former U.S. President Trump criticized the WTO for what he saw as its weakness in confronting China's trade abuses and constraints on U.S. sovereignty. His administration intentionally crippled the organization's appeals body by delaying the appointment of some judges, ensuring that its decisions cannot be enforced and placing the future of global trade rules into doubt. President Biden's administration has emphasized the U.S. commitment to the organization but has largely continued its predecessor's approach, maintaining the block on new appointments, and reiterating its frustrations with the dispute settlement process. With the appellate body paralyzed, countries can effectively ignore adverse rulings while their appeal is pending indefinitely. A group of about two dozen countries, as well as the EU, have set up an alternative arbitration system to settle disputes in the interim.

Even if looking for alternatives, the EU has a fundamental strategic interest in ensuring the effectiveness of the WTO. Not only is trade vital for the European economy; promoting rules-based international cooperation is the very essence of the European project. The EU is therefore pushing for meaningful WTO reform that allows revitalizing the organization, and it is trying to play a leading role in shaping the future set of international trade rules,: not an easy task as the USA attempts to maintain a key role in the trading system and China's growth is tilting eastward the world equilibrium.

EU Free Trade Agreements: Enough is Enough?

In a context where the multilateral rules become weaker, preferential trade agreements (PTAs) have proliferated and currently involve nearly all countries of the world. And the EU makes no exception to this trend: over the last years it increased the number of PTAs, also in the attempt to apply at least toward selected partner countries the set of rules that the EU considers most important for having smooth and fair international trade.

The European Union negotiates free trade deals on behalf of all its member states in view of its "exclusive competence" to conclude trade agreements. Even so, member states' governments control every step of the process, via the Council of the European Union, whose members are national ministers from each national government, in order to represent the interest of all member states in the negotiations. Before negotiations start, member states' governments through the Council of Ministers approve the negotiating mandate, which can be updated if necessary during the negotiations. Upon conclusion of negotiations, member states' governments decide whether the agreement should be signed. After approval from the European Parliament and (in case the agreement covers areas other than trade such as investment protection) upon ratification in each member state parliament, member states' governments decide whether the agreement should be concluded and enter into effect. This procedure can result in a very long time to conclude some negotiations and implementing the agreements.

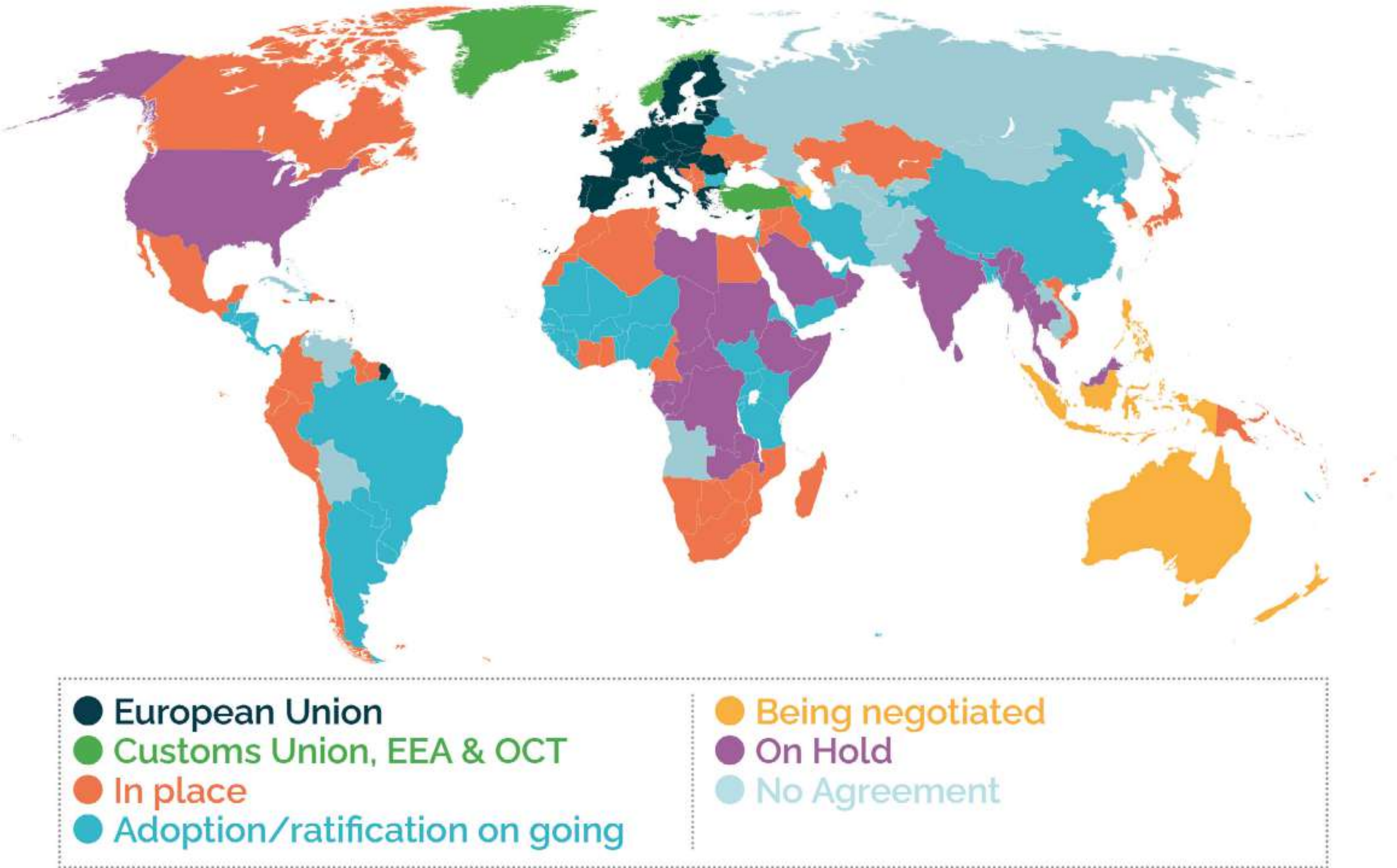
The set of concluded trade agreements involving the EU is very large (see Figure 3). There are currently 41 agreements in place between the EU and 72 countries.[5] In the past years, special attention was devoted to East Asia, and different free trade agreements with South Korea, Singapore and Japan signed between 2015 and 2019 manifest such interest. But Asia is not the only area of interest: for example, an important agreement with Canada entered into force (provisionally, as some parts still needed ratification) in 2017 – the so-called Comprehensive Economic and Trade Agreement (CETA).[6]

41

Number of FTAs signed by the EU with 72 countries

The EU's free trade agreements network

Partners with FTAs signed with the EU, and relative status



Fonte: European Commission

These are all so-called "deep" or "new generation" trade agreements, meaning that they include clauses that go well beyond the simple removal of tariffs or other restrictions to trade applied at the borders. These agreements include clauses on competition, environmental impact or consumers' protection in relation to trade, because as mentioned the EU would like to apply the same principles that rule the Single Market also to the economic relations with other countries. A clear example of this approach is given by the EU-Republic of Korea free trade agreement (FTA), provisionally applied since July 2011: this agreement went further than any of the EU's previous FTAs in lifting trade barriers, and was also the EU's first trade deal with an Asian country. It was also the first trade deal to include a chapter on Trade and Sustainable Development, reaffirming the commitment of the EU and Korea to contribute to sustainable development by integrating labour and environmental (including climate) protection in a bilateral trade relationship. Since the entry into force of the EU-Korea free trade agreement on 1 July 2011, bilateral trade and investment have expanded by a remarkable 71% in a decade.[7]

Another similar example is the EU-Singapore trade and investment protection agreements signed in October 2018. This is also very comprehensive, as it extends beyond trade to rules on foreign direct investment protection, notoriously difficult to deal with. The trade agreement entered into force in November 2019, but the investment protection agreement will enter into force after it has been ratified by all EU Member States (as of February 2022, 12 Member States have ratified it).

While the proliferation of preferential trade agreements can potentially expand EU trade, as observed in many cases, the risk is to reduce the transparency of the system of rules, as different procedures are applied toward different partners, making trade more complex for many firms, especially in the case of small exporters, increasing trade costs and fragmenting the world markets. So, it seems the EU is in the middle of a trade off between standstill of the multilateral trade system and the risk of economic fragmentation.

THE EU FACING A GLOBALIZATION IN CRISIS

Regionalization as the New EU Buzzword?

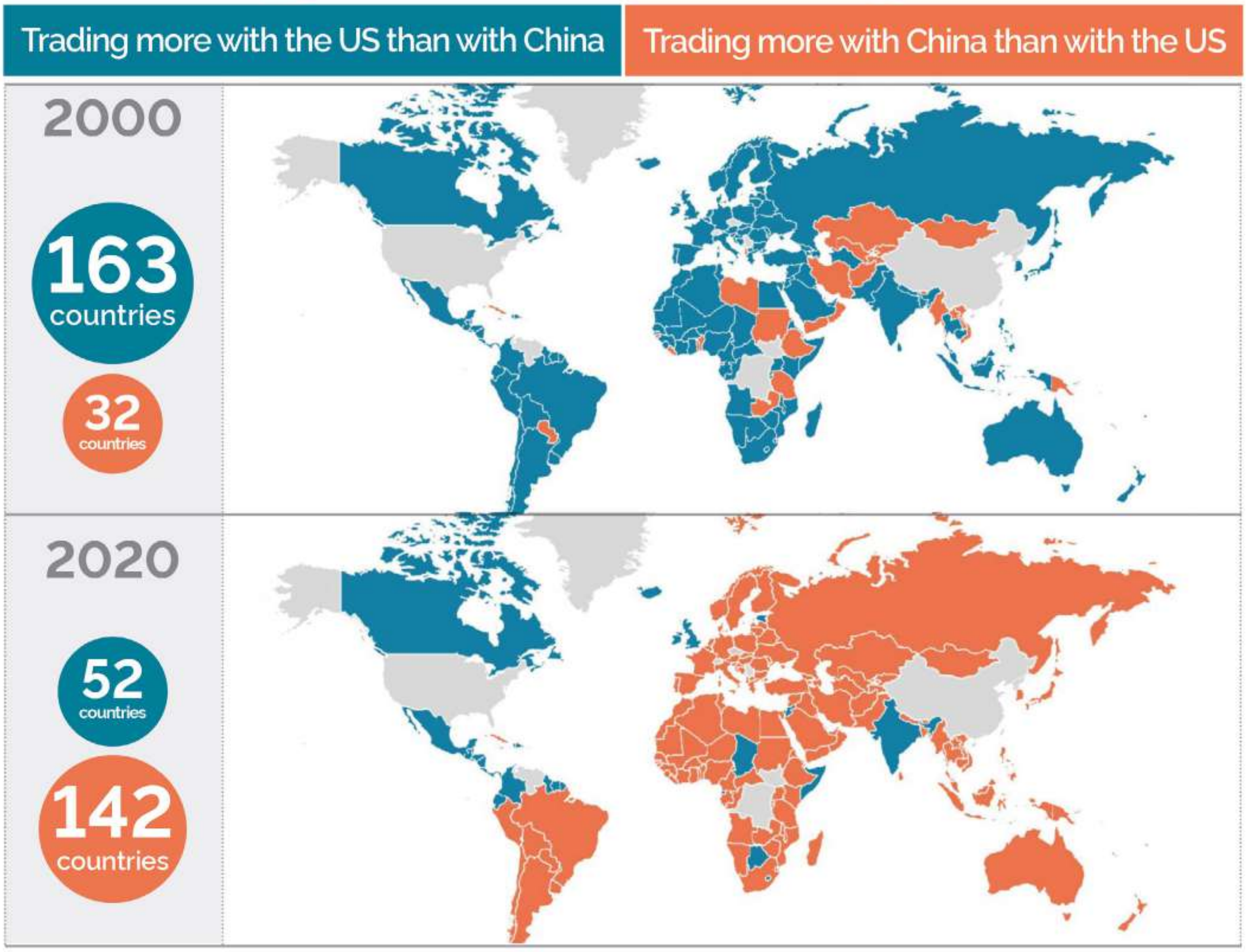
In the previous section it was discussed how the current slowdown in international trade might affect also the EU's exporting performance. But the consequences of this downward trend could go much further. Geopolitical frictions, skyrocketing energy and commodity prices, and disruptions along supply chains are questioning the future of globalization (at least as we used to know it). Can these trends help to widen and accelerate the mutual decoupling between China and the West (meaning the EU and the United States)? From the EU perspective, the economic partnership with China still seems crucial as Beijing is worth over 10% of exports and 22% of imports, making respectively for the third export destination and the first import provider.[8] These figures help to have an immediate idea of how costly an economic decoupling from China would be, at least in the short term; all the more so since China is the main shareholder in the global supply of critical minerals and rare earths, which are (and will be) increasingly crucial to propel both the digital and green transitions. Beijing's influence at this respect is telling as it holds 35% of the global refining capacity of nickel, between 50-70% of lithium and cobalt, more than 90% of rare earths.[9] Moreover, until recently the EU seemed keen to further deepen its ties with China having signed an ambitious bilateral agreement to promote investments (the so-called Comprehensive Agreement on Investment – CAI). But its ratification was then put on ice by the European Parliament: a move explained by concerns on human rights' violations in Xinjiang, but that is likely to hide more substantial economic reasons due to China's alleged unfair competition towards foreign companies.[10]

10%

Weight of China on the EU's total exports

At the same time, it is no mystery that pressures to reduce dependence on China are rising in the West, both in the United States and in the EU. In terms of industrial and trade policies, all major players are trying to secure and strengthen semi-conductor supply chains. On one hand, China aspires to reach technological leadership and made the first move: the Made in China 2025 plan – aiming to reduce technological dependence from abroad by 30% - was launched in 2015.[11] The West reacted by launching its own plans: the US launched the CHIPS and Science Act in July 2022 with a $53 billion funding to strengthen the US semiconductor industry. Moreover, the restrictions to the exports of semiconductors to China, introduced in October by the US Department

China overtook the US as main global trade power



Source: Knoema, Eurostat

€15bn

Resources made available by the EU through the European Chips Act

of Commerce, are very close to what can be called an "economic war declaration" as they are aimed at accelerating technology decoupling.[12] And the EU did its part too: in January 2022, the European Commission launched the European Chips Act, putting 15 billion euros on the table from now to 2030 to generate 43 billion in additional investments and double the global market share between now and 2030 (from 10% to 20%). But it is doubtful whether EU's resources committed so far would be enough to eventually prevail in the global race for technology leadership.[13]

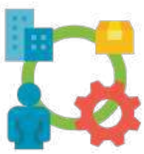
The quest for technology leadership is likely to accelerate existing trends that will reshape the geography of global value chains, through an expected increase of re-shoring, near-shoring, and friend-shoring practices. Apart from the growing narrative on the repatriation of foreign investment, how committed is the EU at this respect? These words are on everyone's lips, but how real is a scenario where global value chains are replaced by shorter, regional ones? We should look at data on investment and at policies aimed at creating regional supply chains. In terms of data, there is a caveat: at present, availability is still relatively limited and it is not easy to have extremely up-to-date figures. In the US, over the period 2010-21 repatriation of foreign investment (50% from Asia) involved more than 9000 companies, leading to the (estimated) creation on US territory of more than 800k jobs.[14] In the EU, according to the European Reshoring Monitor (initiative led by the EC) between 2015 and 2018 there were 253 projects of reshoring, with Italy and France on top of the ranking (mostly from China and Far East and in manufacturing sectors). It is still early to tell, but according to this trend it might be possible to estimate a repatriation equal to 10% of foreign production.[15]

Strategic Autonomy as the New Mantra: What About Free Trade?

It seems that the term "strategic autonomy" has become the new "mantra" for the EU. It originally comes from defence/military planning and refers to the EU's ability to chart its own course in line with its interests and values. The concept was used for the first time in December 2013 by the Foreign Affairs Council of the EU in reference to security and defence, at a time when the debate on the EU's external role as a foreign policy and defence power was beginning to frame. The concept kept evolving in the following years as the geopolitical context was becoming increasingly hostile, with the EU's scope and projection ability diminished by Brexit, and pressures arising from Trump's protectionist stance in the US and China's expansionist attitude through the pursuit of its Belt and Road Initiative.[16] Then, the economic shock induced by the pandemic in 2020 highlighted vulnerabilities along supply chains, starting from sanitary items and then extending to other manufacturing sectors because of the many "bottlenecks" that originated along global value chains (particularly from Asia towards Europe). This contributed to widen the conceptual framework of "strategic autonomy" also to other policy domains, in particular trade and industrial policy. Alongside this concept, "enhancing resilience" became another catchphrase quite popular in Brussels. In fact, in June 2020, High Representative for External Action Josep Borrell and European Commissioner for the Internal Market Thierry Breton published an opinion piece, making the case 'for a united, resilient and sovereign Europe', in which they linked the pandemic supply shortages to the need for the EU to become more resilient and independent.[17] This signalled the forthcoming extension of "strategic autonomy" to trade policy, which occurred in February 2021 with the publication of the latest EU Trade Policy Review that explicitly called for an "open, strategic autonomy" in the trade domain. What should this consist of? Basically, Europe's trade policy should be built around three main pillars – resilience and competitiveness, sustainability and equity, assertiveness and rules-based cooperation – to be pursued through the implementation of six key actions: reform the World Trade Organization, support green transition and promote sustainable supply chains, support digital transition and trade in services, strengthen the EU's position as a global rule maker and standard setter, reinforce the economic partnerships with EU neighbors, strengthen the focus on the implementation of existing free trade agreements.[18] And what does this mean in practice? It basically implies that critical supply chains – those ones that are crucial to carry the green and digital transitions forward -should be secured and regionalized, using the EU's interests as a starting point rather instead of prioritizing specific areas or regions as trade partners.[19] This applies to both China and the US (as a legacy of the tense relationship during the Trump presidency), although political and economic ties with the latter have become again much closer during the Biden administration, as it has been shown by the launch of the Trade and Technology Council.[20] All in all, the Trade Policy Review contains a number of interesting elements, which seek to map out the themes and axes of international trade in the years to come and to identify the appropriate tools for the EU to pursue its objectives by exercising leadership without having to 'follow closely stronger competitors, both economically and politically (the United States and, above all, China). But for such a 'proactive' and not merely 'reactive' approach to materialize, it would be necessary to reactivate multilateral trade governance in order to identify shared rules of the game. Only in the framework of a system truly based on shared rules Brussels could really maintain its competitive advantage as 'rule maker', exploiting the so-called "Brussels effect",[21] and become an increasingly attractive market, based on a virtuous balance between economic growth, innovation, environmental and social sustainability.[22]

The EU in Global Supply Chains: Doomed to Dependency?

If free trade agreements are the skeletal of globalization, Global Value Chains (GVCs) are the arteries that pump blood into today's globalized trade system. Production processes are structured in several stages which often take place in more than one countries. The example of the manufacturing process of an iPhone is probably the best case in point to explain the degree of fragmentation of these processes; but most manufacturing industries rely on this architecture, since more than 50% of world trade takes place along GVCs.[23]



50%

Share of world trade relying on Global Value Chains (GVCs).

As a consequence of the central position occupied within the global network of FTAs, the EU is also a key player in terms of GVCs positioning. How? The participation of the EU in GVCs is significantly higher than in the United States and China,[24] meaning that European countries rely both on backward linkages (in terms of inputs characterized by lower value added) and forward linkages (the final stages where value added is higher) of GVCs: typically, this is the case of manufacturing "powerhouses" like Germany and Italy as well as other smaller economies which are strongly connected to Germany on a more regional (rather than global) scale. Box 1 reveals that, on one hand, the EU holds a relevant position in terms of global competitiveness in many manufacturing sectors, occupying final stages in many crucial GVCs; on the other hand, its key role is also explained by the high degree of interconnectedness of EU manufacturing industries within GVCs.

The Covid-19 pandemic has had an impact on these profound economic linkages, highlighting and deepening concerns about the EU's dependence on global supply chains, from personal protection equipments to high-tech products based on semiconductors. These concerns have contributed to boost the pursuit of an "open strategic autonomy" and to declinate this concept also with respect to trade and industrial policies (see previous paragraph). The involvement in continental GVCs was already on the rise before the pandemic: 23 countries out of 27 registered an increase in the role of foreign affiliates in gross value added creation, and a simultaneous expansion in their role in international trade in the year between 2005 and 2015.[25] But redrafting the map of value chains, from a less global to a more regional scale, requires greater attention in order to preserve the strengths of EU manufacturing industries in view of the increasing competitive dynamics *vis-à-vis* other major economic blocks.[26]

BOX 1

THE EU'S POSITIONING IN GVCS: BETTER OR WORSE THAN OTHER COMPETITORS?

Luca Salvatici and Ilaria Fusacchia

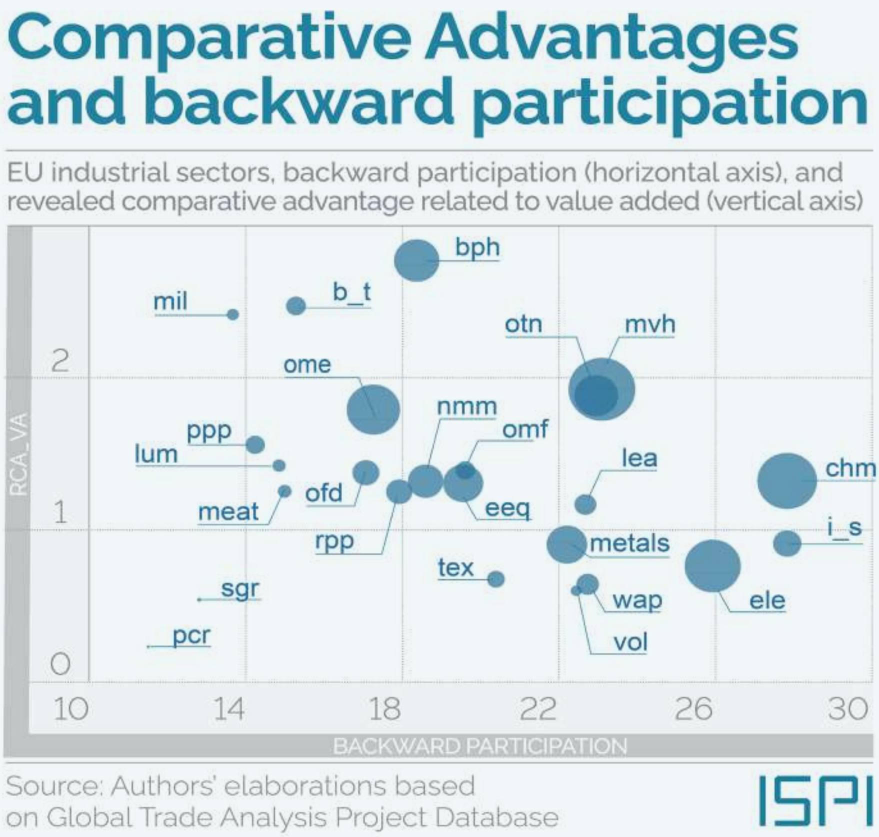
The improved availability of value-added trade data allows us to picture what European Union (EU) sectors are more competitive within global value chains (GVCs). Rather than focusing on particular sectors or examples, we determine the distribution of competitiveness in relation to the sectors' distribution in terms of backward and forward participation to the GVCs. Results reveal significant differences across sectors. Specifically, we identify the EU competitiveness by considering domestic production factors and inputs used in the production (thus excluding the contribution of foreign intermediates) and defining revealed comparative advantage (RCA) in terms of value-added (VA). The RCA index is essentially a normalized value-added export share (a country's value-added exports in some sector as a fraction of national value-added exports, divided by the world exports in that sector as a fraction of total exports). When the RCA index exceeds unity, comparative advantage is 'revealed' for the country in that particular sector. To measure EU sector integration, we use the GVC participation indexes and depict EU involvement in GVC both as a buyer of inputs from abroad to produce its exports (backward linkages) and as a seller of domestic value-added used in other countries' exports (forward linkages).

The Global Trade Analysis Project Data Base provides comprehensive and balanced data on consumption, production, trade and trade policies (Aguiar et al. 2019). The most recent version of the Data Base refers to the year 2017, includes 65 commodities and covers 140 countries (representing more than 98% of world GDP) and 18 aggregate regions. Given our focus on goods, we maintain all the processed food and manufacturing sectors included in the Data Base (Table 1). To catch the complexity of international linkages within GVCs, we distinguish final and intermediate products within bilateral trade flows.

TABLE 1. SECTOR LIST

Bovine meat products (meat)
Vegetable oils and fats (vol)
Dairy products (mil)
Processed rice (pcr)
Sugar (sgr)
Food products nec (ofd)
Beverages and tobacco products (b_t)
Textiles (tex)
Wearing apparel (wap)
Leather products (lea)
Wood products (lum)
Paper products, publishing (ppp)
Chemical products (chm)
Basic pharmaceutical products (bph)
Rubber and plastic products (rpp)
Mineral products nec (nmm)
Ferrous metals (i_s)
Metals nec (metals)
Computer, electronic and optic (ele)
Electrical equipment (eeq)
Machinery and equipment nec (ome)
Motor vehicles and parts (mvh)
Transport equipment nec (otn)
Manufactures nec (omf)
Other sectors

Source: GTAP Data Base



In Figure 1, we analyze the global production linkages of the EU and assess the positioning of the key manufacturing sectors in terms of the Revealed Comparative Advantages based on the domestic VA (RCA_VA) and the backward GVC participation index, measured as the share of foreign value added that is included in the total export value of a country.

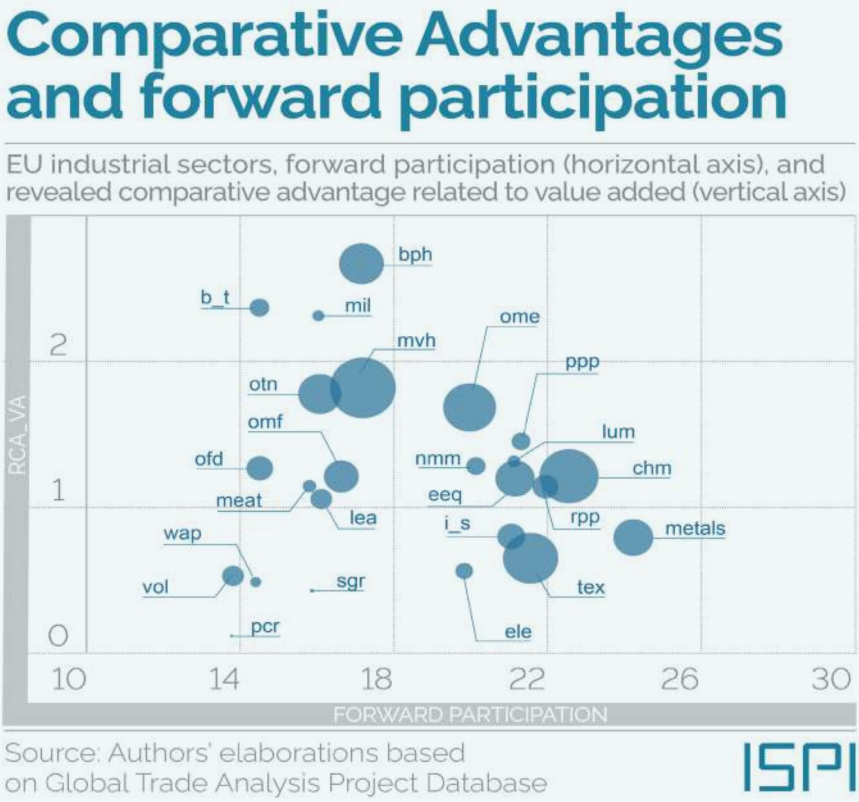
The results indicate that the EU has a comparative advantage in 16 sectors. The index values for these sectors are above 1, and this suggests a revealed comparative advantage in the value-added export of these products. Basic pharmaceuticals products register the highest value, but the most relevant sectors in terms of exports, as signaled by the size of the bubble, are Motor vehicles and Chemicals.

Comparing the overall distributions of RCA in terms of value-added across countries reveals that the EU specialization is quite different from those of countries such as China, India, Brazil or Russia since the correlation index assumes negative values. On the other hand, there is a positive correlation with countries such as Japan, Korea and the US, even if the value never exceeds 0.4.

Overall, the EU backward integration value (19.7, the blue vertical line in Figure 1) is lower, as expected, than those of smaller countries such as the UK, South Korea or Canada. On the other hand, it is in line with that of China and higher than the US. Comparing the overall distributions, the sector values are positively correlated for all countries except Russia. Accordingly, even if the backward integration intensity varies, the sector ranking is similar across countries.

Some of the most relevant EU exporting sectors, such as Motor vehicles, Transport equipment and Chemicals, show the highest levels of backward integration. The relevance of foreign inputs is broader than sectors where the EU is relatively more competitive since industries, such as Electrical equipment and Metals, show high levels of backward integration and RCA index values lower than 1.

In Figure 2, the Revealed Comparative Advantages are related to the forward GVC participation. The forward GVC participation index is measured as the share of a country's value-added arising from its exports included in other countries' exports. It is worth recalling that at the industry level, for the forward participation indicator, the value added in the exports of partner countries from intermediates sourced from each industry only includes the value added that is transferred through direct linkages: e.g., Metals' value added embodied in other sectors' exports that are subsequently used to produce exports in other countries would not count towards Metals' forward indicator.



Luca Salvatici, Professor of Political Economy, Roma Tre University.

Ilaria Fusacchia, PhD in Environmental and Developmental Economics, Roma Tre University.

THE EU IN A TRADE JIGSAW: FROM DEPENDENCY TO AUTONOMY

In the first part of this Policy Paper it was shown that the EU is a sort of "cornerstone" of the international trade system, both in terms of trade flows (volumes and values) and of the architecture (FTAs and inclusion in GVCs). Over the last three decades, in view of increasing interdependence among main economic blocks (namely the EU, US and China), globalization had become the dominant paradigm. But increasing economic competition (especially in high-technology sectors and those ones involving concerns of national interest), on top of the two major economic shocks – Covid and the war in Ukraine – that increased international fragmentation, are questioning the survival of this paradigm, questioning the future of the EU as an economic power.

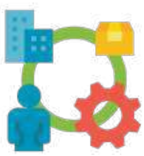
The EU is seeking to pursue a trade policy based on "open strategic autonomy", meaning that it aims to reshape globalization trying to protect its economic security while preserving its global export shares through a mercantilist approach. But can this "competitive globalism"[27] succeed in an increasingly competitive scenario, where other key players hold crucial assets in terms of financial resources (like the US through the supremacy of the dollar) or commodities (like China that controls the global supply of critical minerals and rare earths), and where the rules of the game are increasingly undermined because of the prolonged standstill of the WTO? The purpose of the second part will be to explore viable policy options to escape this dilemma and find ways to keep and strengthen the EU's position as a trade leader.

Exploring Options

Is globalization really about to fall into pieces? Or are there ways to ensure it can still survive (and thrive), and with it the role of the EU as a key trade player? Rekindling multilateral trade negotiations would certainly be an ideal solution to address ongoing fragmentation, but geopolitical tensions and disagreements among States make this option less likely to achieve in a short-term perspective. So, what else could be done to preserve the EU's central role in GVCs and as a broker of FTAs?

FIRST BEST: REVIVING MULTILATERAL TRADE

The WTO has been at the cornerstone of the architecture of multilateral trade. The Geneva-based organization was established in 1994 on the basis of the pre-existing General Agreement on Tariffs and Trade (GATT), and it got involved not only in the regulation of exchange of goods, but also of services (through the General Agreement on Trade in Services – GATS) and on the treatment of intellectual property rights (through the TRIPS agreement, its third normative pillar). At first, it seemed that the WTO was working well and reached its "zenith" in 2001, when China was finally admitted into the organization thanks also to tireless negotiation efforts by the US which managed to close (only temporarily) a long-lasting economic "schism": a cleavage between the two countries that affected also the rest of the globalized world economy.[28] Unfortunately, for a number of reasons this "multilateralist momentum" soon faded away, so much that the latest remarkable progress marked by the institution was the conclusion of the Trade Facilitation Agreement in 2015, a relatively minor advance aimed at reducing red-tape and simplifying exporting/importing procedures for developing countries so to help them include in the multilateral trade system.[29] Then, WTO entered a phase of prolonged standstill when the US – during the Trump administration – vetoed the reappointing of members of the Trade Appellate Body, which is crucial to ensure the functioning of the organization. This was paralleled also by a very negative moment for the trading relationship between the United States and the European Union as a consequence of retaliatory measures triggered by Washington in view of the dispute Airbus-Boeing, a case of alleged unfair competition.



2001

China enters the WTO, representing the biggest achievement of the organization

June 2022

The WTO 12th Ministerial Conference is held in Geneva, with small steps ahead for multilateral trade governance

This led to a tariff escalation which was averted only in 2021 after the new Democratic administration led by Joe Biden took power. However, this situation did not open up a new phase of multilateral negotiations: the modest progress reached during the latest Ministerial Conference (MC12) in June 2022 cannot be considered as a major step forward. In fact, new areas which are increasingly crucial for international trade – such as digitalization and sustainability – remain largely unregulated. This somehow frustrated the EU's expectations because of its pioneering role within these two areas. In other words, a successful WTO reform that would preserve the EU's role as a key player in international trade would rely on the following elements:

- First and foremost, framing the boundaries of WTO action: widening too much its remit risks being counterproductive and eventually weakening its effectiveness;
- Avoiding to embed values in the trading system: the EU's objective of forcing its trading partners follow its rules and values brings can bring retaliation and further trade disputes. A more cautious approach would be based on promoting EU rules and standards (so-called "Brussels effect") rather than raising too much the bar on values that not all other players are prepared to abide by;
- Pursuing level playing field in areas which are crucial to preserve EU's global economic competitiveness. For the EU, the "primary focus of any WTO reform should be to modernise rules on competitive neutrality", i.e. level the playing field regarding subsidies, state-owned enterprises (SOEs), forced technology transfer and domestic regulations. (see Box 2).

BOX 2

HELPING THE WTO MOVE FORWARD IN POST-MC12: A ROLE FOR THE EU

M. Sait Akman

Almost everyone agree that the WTO is living an "existential crisis", as its functions are becoming progressively less efficient with respect to bringing new rules, adjudicating trade disputes and monitoring derailed policies of its members. It is losing its centricity in governing world trade as the "first best". The MC12 was completed with modest outcomes revealing that the WTO is still producing multilateral results, but far from satisfying the need of reinvigorating the functioning of the institution.

Most trade policy actions and negotiations take place in other venues among "like-minded" countries. Many priority issues are regulated in regional initiatives (e.g. CPTPP, RCEP, USMCA, IPEF, TTC), however global problems like pandemic, food security and climate change still need multilateral response. Regionals can bring deeper rules and regulations among narrower groups but multilateralism is the only way to prevent fragmentation and to benefit optimal use of world's resources for the prosperity of all.

The EU has been a strong defender of multilateralism. It submitted several proposals for reforming the WTO system (including the so-called Ottawa Group). However, earlier calls for reform including those of the EU have not produced any concrete result in major areas of friction largely because the problem was not simply relevant to institutional stagnation in the WTO, but the difficulty of reducing gaps in trading powers' positions and their trade strategies amidst global developments.

On its part, the EU's response has been to design a new trade strategy to address economic recovery in post-global financial (and more recently COVID-19) crisis, resilience of global value chains, imbalances in commitments of its trading partners sustainability issues like climate change, and digitisation in international trade. Accordingly, the trade policy is expected to support EU's geopolitical goals with an updated trade rulebook in many new areas and to reinforce its trade agreements by making better use of trade defense instruments. For the EU, the "primary focus of any WTO reform should be to modernise rules on competitive neutrality", i.e. level the playing field regarding subsidies, state-owned enterprises (SOEs), forced technology transfer and domestic regulations (European Commission, 2021: 11).1 A normative aspect is also evident in its trade strategy linking trade to values through an expansive agenda such as environment, labour regulations, good governance, human rights issues to influence its trading partners through its own norms and policies.

WTO members, in MC12 document committed to undertake necessary WTO reform and asked the General Council to launch a process on the matter, and review the progress until the next Ministerial Conference. Things are not yet clear about the process while concerns over negotiations in outstanding and new issues, transparency disciplines, and dispute settlement system remain. In putting the WTO back on track in post-MC12, the following elements can be highlighted:

FRAMING THE BOUNDARIES OF THE WTO FIRST, BEFORE REFORMING IT

The dynamic nature of global economy and developments make contours of trade policy difficult to define. Many global problems need macroeconomic, social, and other policy solutions but also trade policy interventions. Hence, several cross-cutting issues are becoming part of new generation trade agreements. The centricity of WTO in global trade governance will be further challenged unless many of these issues are multilateralized under its rulebook. However, a clear demarcation is vital to save the WTO from a work overload. The WTO reform process must consider the fact that initiating and completing negotiations in issues (like labour markets, environment, corporate governance, antitrust, and taxation) largely regulated under competing domestic models is extremely challenging and more flexible methods of decision-making will be necessary. Equally important is to keep trade policy governance confined to matters that require direct trade policy intervention. The EU and many advanced economies must consider developing countries need "non-trade remedies" (contrary to trade remedy measures) like capacity building, financing, training and other domestic regulations to solve their market failures.

EMBEDDING THE VALUES IN TRADING SYSTEM

All member of the WTO as sovereign nations can have their own regulations and safeguard their domestic choices. Universal values are hard to define, and members should refrain from imposing their own regulations, norms and values on others. Trade rules and practices should not be used as trade sanctions and barriers to force others change their policies.[2] Imposing a regulatory environment from above will not work.

The new trade strategy of the EU emphasizes its openness and the need for sustainability. However, its is also "assertive" and the EU's new trade defensive policy instruments seek remedies. They aim at providing an enforcement mechanism in the form of an "aggressive unilateralism" recalling the US trade policy. The objective of forcing its trading partners follow its rules and values brings can bring retaliation and further trade disputes.[3] The trading nations, including the EU must refrain from a power-based approach which is quite the opposite of a rules-based system and does not help revival of multilateralism.

RE-ASSESSING THE DEVELOPMENT ISSUE IN WTO REFORM

An important objective of the WTO is to ensure developing countries benefit from trade commensurate with their economic development needs. Special and differential treatment (SDT) has been a major device to help developing countries secure such gains. This procedure is now challenged because it does not define the "development" and "the developmental needs" and many emerging economies continue to benefit from such privileges. Identification of needs is not an easy process, while bringing metrics to measure the development (the US attempted once) and re-categorising members (proposed by Norway on behalf of Ottawa Group) is fiercely refuted by many developing members with some exceptions only (e.g. Brazil, Taiwan and South Korea announced to give up their status). However, the current practices of lump sum exemptions will not help the WTO, but mitigate its credibility further as a venue for future talks. The EU's offer of instituting a "graduation mechanism" needs further clarification in the reform process to be taken up by the General Council, but a blanket denial of SDT through graduation may not work. A "tailor-made approach" which is supplemented by the elimination of indefinite transition periods, carefully crafted rules in each agreement, and a rollback mechanism in which developing members waive or reduce the implementation of some of their practices that fulfilled their developmental objectives, can be contemplated.

CONSIDERING COMPLEMENTARY NEGOTIATION OPTIONS TO MULTILATERALISM

The willingness, capacity and interests of members differentiate and can even lead to hostage-taking in multilateral talks. The current stalemate in consensus-based decision-making in the WTO is driving many members towards new cooperation ways to regulate many areas. They join plurilaterals to circumvent difficulties faced in initiating multilateral negotiations. JSIs (Joint statement Initiatives) on domestic regulation of subsidies, investment facilitation and e-commerce advanced and many other initiatives such as environmental goods and plastics are in the pipeline. Some leading developing countries find them controversial because plurilaterals methods can fragment the WTO rulebook instead of restoring it. However, incorporation of plurilaterals agreements -possessing transparent, inclusive and development-friendly mechanisms into the WTO system can revitalise WTO's negotiating function. To encourage wider participation of developing countries: capacity-building measures need to be assessed;4 and a "hierarchical framework" of stages can be proposed with limited obligations initially towards gradual full membership with some flexibilities (Kher, 2022 et.al.),5 even though it is still difficult to overcome deep reluctance by some (e.g. India) which opt-for "issue-linkages" in trade negotiations.

The above-mentioned elements along with robust proposals to revitalise the dispute settlement system and to provide a clear mandate for improving WTO's institutional and executive functions need further discussion in the post-MC12 process. However, much depends on the decision and willingness of members to revive the system to the benefit of all, or witness its demise.

NOTES

1. European Commission, Reforming the WTO: Towards a Sustanable and Effective Multilateral Trading System, Luxembourg, 2021, p. 11.
2. D. Rodrik, *Straight Talk on Trade*, Princiton University Press: Princeton and Oxford, 2018, p. 224.
3. See, for example Anti-Coercion Instrument (ACI), Carbon Border Adjustment Mechanism (CBAM), Foreign Subsidy Instrument (FSI), International Procurement Instrument (IPI), Updated Enforcement Regulation.
4. F. Erixon et.al.., "The New Wave of Defensive Trade Policy Measures in the EU", ECIPE Occassional Paper – 04/2022, 2022, pp. 7-8.
5. S. Akman, "Boosting G20 Cooperation for WTO Reform: Leveraging the Full Potential of Plurilateral Initiatives" (with A. Berger, F. Botti, P. Draper, A. Freytag and C. Schmucker), T20 Italy Policy Brief, 2021.
6. R. Kher et.al., "Exploration of New Methodologies and Configurations for an Effective WTO and to Strenghten the Multilateral Trading System", T20 Indonesia Policy Brief, 2022.

Mehmet Sait Akman Director, G20 Studies Centre at TEPAV- The Economic Policy Research Foundation of Turkey

330

Number of Preferential Trade Agreements in force at global level.

SECOND BEST: MAKING GOOD USE OF REGIONALIZATION

Currently, there are more than 330 Preferential Trade Agreements (PTAs) in force at global level.[32] The European Union is part of 44 PTAs involving around 70 countries worldwide.[33] It seems that negotiating PTAs has become an inevitable option to bypass the longstanding standstill at WTO level. The EU has clearly been a champion in advancing trade liberalization through PTAs; however, the use of such "second best" instruments should be made so as not to further enhance geopolitical and economic fragmentation (particularly at such a critical time for international relations) but to enhance trade openness in a context of compatibility and possibly complementarity with WTO rules. What does this mean in practice? Basically, that such agreements should not be intended as "exclusive clubs" but should be left open to potential accession by other States and, even more importantly, that these act as a sort of "stepping stones" to include new issues at multilateral level. In fact, more and more often "modern" PTAs are increasingly less focused on tariffs reduction (or not only on this aspect, as it used to be in the past) but on harmonization of administrative rules and technical standards and are also pioneering the role of rule-setters with respect to new areas such as digitalization and environment sustainability (see BOX 3). Thanks to its overarching role as standard setter, the EU would be best-placed to exploit its so-called "Brussels effect" and pursue the widening and progressive incorporation of such rules and standards also at the multilateral level. One case in point could be represented by the forthcoming introduction of a Carbon Border Adjustment Mechanism (CBAM), an innovative tool aimed at tackling carbon leakage that is set to be enforced (although in a phasing-in fashion) by the EU from 2023. In order to avoid the controversial aspects of CBAM (in particular the ones related to the accusations of "disguised" protectionism), its design should be probably fine-tuned at WTO level in a way that it is more inclusive and not harmful of Least Developed Countries.[34] In other words, the EU's first mover advantage should be exploited so that Europe does not fall into a "fortress scenario" but rather it encourages the adoption of high standards by establishing a race-to-the-top scheme.

BOX 4

A LOOK AT EU RTAS: HOW TO MAKE THEM COMPATIBLE WITH THE WTO SYSTEM

Claudia Schmucker

R The multilateral forum of the WTO is still the best option for creating global trade rules. However, due to a lack of progress on the multilateral level, free trade agreements (FTAs) are often seen as the second-best option to negotiate new rules and market access. But the ongoing trend towards regional and bilateral FTAs also poses risks for the multilateral trading system: The preferential agreements are the major exception to the WTO's most-favoured nation rule (MFN) and discriminate against other trading partners. As such they include the danger of becoming economic fortresses leading to trade diversion. In order to make good use of regionalization, the EU needs to adhere to three conditions in its regional and bilateral agreements.

MAKE SURE FTAS ARE WTO-COMPATIBLE

Under WTO rules, FTAs are allowed as an exception to the general MFN treatment, if they respect certain principles listed in GATT Article XXIV and GATS Article V. These articles state that FTAs have to cover "substantially all trade," and that the tariffs and trade provisions, which are established in the agreement, are not higher or more restrictive in aggregate than the provisions prior to the conclusion of the agreement. However, these conditions are quite vague and open to a wide range of interpretation.

The EU as a leading global player in trade needs to make sure that the negotiated agreements are undoubtedly in accordance with WTO rules. It needs to act as a role model in this regard. Since the Global Europe strategy (2007), the EU has negotiated a wide range of ambitious trade agreements, which cover a variety of sectors and provisions. As such, they are clearly in line with WTO rules. However, in this regard, a transatlantic agreement on the elimination of industrial tariffs only, which was proposed by the EU during the Trump era, should be seen with concern. Even though it would probably obey with the letter of the WTO rules, but it would go against the spirit of it.

KEEP FTAS OPEN TO MINIMIZE DISCRIMINATION

In addition, in order to minimize the negative effects of discrimination and trade diversion, the EU should try to keep the FTAs as open as possible. This means first of all low rules of origin, which are also compatible with other FTAs. But the EU could also start to think about opening up its FTAs to other interested partners, who are willing to adhere to the high EU standards.

USE FTAS AS STEPPING-STONES FOR NEW ISSUES AT THE MULTILATERAL LEVEL

EU trade agreements go way beyond traditional market access agreements and include provisions on trade in goods and services, technical barriers to trade, sanitary and phytosanitary measures, customs and trade facilitation, subsidies, investment, digital trade, competition policy, SOEs, government procurement, SMEs, and the protection of intellectual property rights (IPR).

These agreements contain a number of provisions, which go beyond the multilateral rules of the WTO. A Bruegel study (2009) divided these provisions into two categories: WTO plus (WTO+) commitments, which deepen already existing WTO rules, and WTO extra (WTOx) commitments, which deal with new issues, which are not covered by WTO rules. EU FTAs cover both areas: They include a deepening of existing WTO rules e.g. regarding tariff reductions, subsidies, or IPR rules (WTO+) and they contain new rules, particularly with regard to new issues such as digital trade, environmental and labour standards, the so called TSD chapters (WTOx).

WTO rules largely date back to 1995 and have not adapted to modern trade realities. New topics such as digital trade, and a sustainability agenda are lacking until today, despite the urgency to develop rules in this regard. By including new WTOx rules with a variety of trading partners with different levels of development (including emerging market economies such as Singapore or developing countries such as Vietnam), EU FTAs can form a good basis for plurilateral or multilateral rules at a later stage. As such they can be used as a stepping-stone for future multilateralization.

In order for this to be successful, the EU needs to stay actively engaged in the ongoing multilateral and plurilateral discussions at the WTO. It needs to incorporate its experience into the discussions and find coalitions on these new norms and standards. The wide net of existing FTAs partners already form a good basis for that. As such, based on the experiences of its ambitious FTAs, the EU can actively shape globalization and global rules on issues, which are urgently needed.

Claudia Schmucker has been Head of the DGAP's Globalization and World Economy Program since 2002.

OUR TAKE

The current geopolitical context, characterized by the war in Ukraine and other frictions among key economic powers (China, the European Union and the US) will certainly contribute to redefine globalization, at least as we used to know it. Tensions aimed at shortening key value chains – particularly those with higher technology intensity and that are crucial for industrial sectors where States hold strategic interests – are likely to increase in the coming years. This does not mean that globalization is doomed to end, but rather that it will change aspect: interdependence is still – and will remain – too high to "destroy" economic integration along GVCs. The likeliest option is that the global economy will face a process of "fragmentegration", which is not the same as disintegration but is a scenario in which actors will react to supply shocks by looking for new trade partners and ways of integrating their economies.

Unfortunately, the WTO no longer looks fit for purpose. After a prolonged standstill, the Geneva-based organization does not seem able to make considerable progress on multilateral trade negotiations. Moreover, international trade is increasingly characterized by new issues, such as digitalization and environment sustainability, which currently remain largely unregulated. Therefore, the WTO is in need for a deep reform, which should be also consist of new tools aimed at establishing a level playing field in areas such as digital trade (e-commerce but also regulation of personal data) and "green" trade (for instance by identifying an agreement towards the establishment of a CABM).

The European Union is definitely in the position to contribute to the reform of the multilateral trade environment, thus paving the way to a sort of "WTO 2.0". Thanks to early adoption of high standards both in terms of digital regulation and sustainability, Brussels could exploit its comparative advantage as a "global standard setter" and look for broader consensus with other WTO members, rather than following an alternative route that would lead to a more isolated position and a protectionist attitude. Particularly over the past decade, the EU has substantially enjoyed the benefits of free trade and open markets and should continue to pursue such an environment. At the same time, the EU should better equip itself to face geoeconomic competition from other key players in order not to lose the race for global technology leadership, that will mark the coming years, and to enhance resilience in its critical supply chains. As empirical data show, the EU has a competitive advantage in many manufacturing sectors, mostly thanks to its integration in GVCs. This is a privileged position that should not be wasted in the future by the EU through a renewed ambition to remain at the core of trade liberalization processes, be them on a multilateral (first best) or regional/plurilateral basis (second best).

Notes

1. United Nations Conference for Trade And Development (UNCTAD), "Global trade hits record high of $28.5 trillion in 2021, but likely to be subdued in 2022", 2022.
2. World Trade Organization (WTO), "Trade growth to slow sharply in 2023 as global economy faces strong headwinds", 2022.
3. C. Jones, "Was hyperglobalization an anomaly?", *Financial Times*, 2020.
4. B. Hoekman et. al., "Leveraging Digital Trade Opportunities for All", Policy Brief, T20 Italy, 2021.
5. European Council, "Global Europe – The value of free and fair trade".
6. European Commission, DG Trade, EU-Canada Comprehensive Economic and Trade Agreement.
7. European Commission, "EU trade relations with South Korea. Facts, figures and latest developments".
8. European Commission, "European Union, Trade with China", 2022.
9. International Energy Agency (IEA), "The Role of Critical Minerals in Clean Energy Transitions", 2021.
10. G. Van der Loo, "Lost in translation? The Comprehensive Agreement on Investment and EU-China trade relations", Discussion Paper, EPC-Egmont Institute, 2021.
11. F. Fasulo, "EU-Asia Relations: Economy as a Weapon?", ISPI Policy Paper, ISPI, 2022.
12. F. Fasulo and D. Tentori, "USA-Cina. Tecnologia, lo scontro si fa duro", ISPI Commentary, ISPI, 2022.
13. European Commission, "Shaping Europe's digital future – European Chips Act", 2022.
14. Reshoring Initiative, "Multiple Supply Chain Risks Accelerate Reshoring", Reshoring Initiative IH 2022 Data Report, 2022.
15. See "European Reshoring Monitor".
16. M. Damen, "EU Strategic Autonomy 2013-23 – From concept to capacity", EU Strategic Autonomy Monitor, European Parliament, 2022.
17. J. Borrell and T. Breton, "For a united, resilient and sovereign Europe", EEAS, published on several outlets, 2020.
18. European Commission, "Trade Policy Review – An Open, Sustainable and Assertive Trade Policy", 2021.
19. S. Blockmans, "The EU's New Trade Policy – An Autonomous Assertion of Strategic Objectives?", Analysis, Friedrich Ebert Stiftung, 2021.
20. O. Coelho, "EU-US Trade and Technology Council: A Litmus Test for Transatlantic Cooperation", ISPI Commentary, ISPI, 2022.
21. A. Bradford, *The Brussels Effect: How the European Union Rules the World*, Oxford University Press, 2020.
22. D. Tentori, "Scambi UE: grande riforma in sei punti", ISPI Commentary, ISPI, 2021.
23. World Bank, "World Development Report 2020 – Trading for

Development in the Age of Global Value Chains", 2020.

24. European Central Bank, "The impact of global value chains on the euro area economy", Occasional Paper Series, no. 221, 2019.
25. S. Comotti et. al., "Foreign direct investment, global value chains and regional economic development in Europe", Final Report of the project, European Commission, 2020.
26. Fasulo (2022).
27. R. Youngs and S. Ülgen, "The European Union's Competitive Globalism", in *Rewiring Globalization*, Carnegie Europe, 2022.
28. P. Blustein, "Schism – China, America and the Fracturing of the Global Trading System", CIGI, 2019.
29. World Trade Organization (WTO), "Trade Facilitation".
30. World Bank, "Global Preferential Trade Agreements Database", accessed on 10 November 2022.
31. European Commission, DG Trade, "Trade Agreements".
32. ECCO, "CBAM Council approval does not solve the main issues", 2022.
33. R. Korteweg, "'Fragmentegration', a new chapter for globalization", in *Brave New Trade: the Challenge of Rescuing Globalization*, ISPI Dossier, ISPI, 2022.

About the Authors

- **Ilaria Fusacchia** is a Research Fellow at the Department of Economics at Roma Tre University. She has experience in global supply chains analysis, international trade and trade policy evaluation. Her publications appear on *Oxford Review of Economic Policy*, *European Review of Agricultural Economics*, *Economia Politica*, *Italian Economic Journal*, and *Journal of Global Economic Analysis*. She has been involved in several national and international research projects.
- **Mehmet Sait Akman** is Associate Professor, and Director of G20 Studies Centre at TEPAV (The Economic Policy Research Foundation of Turkey), a leading policy think-tank and a senior fellow of its Centre for Multilateral Trade Studies. He is Adjunct Professor of trade policy at TOBB University of Economics and Technology, and Middle East Technical University (METU), Ankara. Previously he was academic staff and Deputy Director of European Institute at Marmara University, Istanbul. Akman has been visiting resercher at European University Institute, Florence; London School of Economics, London; formerly (2010-15) an instructor of Regional Trade Policy Courses of the WTO, delivering training to trade bureaucrats from the CEECAC (Central and Eastern Europe, Central Asia and Caucasus) region. He involved in several activities and committees of Turkey's Ministry of Trade, including the editorial board membership of its Journal of International Trade and Diplomacy, and; is trade policy advisor to TOBB (The Union of Chambers and Commodity Exchanges of Turkey). He served as the co-chair of T20 Italy-Trade, Investment and Growth Task Force (2021); and co-chair of the same Task Force during T20 Saudi Arabia (2020). Akman is a member of the steering committee in TIRN (Trade and Investment Research Network).
- **Luca Salvatici** is Full Professor in the Department of Economics and faculty of the Ph.D program in Economics at Roma Tre University. He participates in the Editorial Board of the journal Economía Agraria y Recursos Naturales and the Italian Economic Journal. He is member of the International Agricultural Trade Research Consortium, and he has been involved in several research projects both at the European and national level. He has extensive consultancy experience, having completed work for the The World Bank; the Food and Agriculture Organization of the United Nations; the International Food Policy Research Institute; the EU Commission.

His most recent publications appear on: Energy Economics; European Review of Agricultural Economics; Journal of Economic Surveys; Review of International Economics; Journal of Global Economic Analysis.

- **Claudia Schmucker** has been Head of the DGAP's Globalization and World Economy Program since 2002. She has published extensively on European and transatlantic trade policy, the world trade organization (WTO) and the Doha Round as well as on the role of informal global forums such as the G7 and the G20. She studied at Rheinische Friedrich-Wilhelms Universität in Bonn, at Elmira College in New York state, and at Yale University. She holds an MA in North American studies and a PhD in economics from the Freie Universität, Berlin.
- **Lucia Tajoli** is Full Professor of Economic Policy at the Department of Management Engineering of the Politecnico di Milano. She received the Diploma in Advanced International Economic Policy Research from the Kiel Institute of World Economics (Germany) and she obtained her PhD in Economics at Università Bocconi. She is Full Professor of Economic Policy at the Department of Management Engineering of the Politecnico di Milano. Previously she was a Lecturer at Bocconi University and then an Associate Professor at the Polytechnic University of Milan. She is Senior Associate Research Fellow with ISPI, and she collaborates with the Italian Trade Agency (ex-ICE). She has frequently been visiting scholar and visiting professor at the Ford School of Public Policy of the University of Michigan, Ann Arbor (USA).
- **Davide Tentori** is a Professional of Economic Scenarios at ENI. Until December 2022 he worked as Research Fellow at the ISPI Centre for Business Scenarios, supported by Intesa Sanpaolo. Previously, he worked for the British Embassy in Italy as Senior Trade Policy Advisor and Economic Officer, for Italy's Presidency of the Council of Ministers as G7/G20 Policy Analyst in the Office of the Diplomatic Advisor, and as Research Associate in the International Economics Department at Chatham House – The Royal Institute of International Affairs. He obtained a PhD in Institution and Policies at the Catholic University in Milan. His main areas of expertise include international economy, with particular reference to trade policy issues.