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The geopolitics of climate change and cleantech

BY ALEX CAPRI
RESEARCH FELLOW, HINRICH FOUNDATION

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Introduction

The quest to decarbonize the global economy by 2050 has led to a sizable shift in investment toward "clean tech," hereafter referred to as "cleantech". A transition from fossil fuels to sustainable energy sources such as wind, solar and hydrogen, and electrified vehicles could stoke an epic wave of research and development (R&D), investment, and business opportunities.

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But the road to a carbon-neutral world must pass through a quagmire of economic nationalism, inward-looking domestic politics, and a new kind of climate-driven realpolitik. The cleantech sector is going through the same contortions as the electric vehicle (EV) sector, as the United States and its allies react to China's overwhelming manufacturing capacities and its dominance of critical supply chains – both of which allow Beijing to leverage cleantech as a geopolitical asset.

Meanwhile, the Covid-19 pandemic provides a valuable lesson in the difficulties of persuading competing nations to mount a unified effort in the face of a global crisis. Instead of prompting global collaboration, the pandemic produced vaccine nationalism.[1] Similarly, the inconvenient truths of climate geopolitics may emerge in coming years. Public and private investment in decarbonization will play out in an increasingly fragmented landscape.

The high stakes of decarbonization

The Paris Agreement set a target of holding global warming to a range of 1.5 to 2 Celsius above pre-industrial levels by the year 2050. Achieving this goal will require at least US$4 trillion of annual spending on the development and deployment of cleantech by the year 2030.[2]

The consequences of climate change are likely to be astronomical. Violent weather events, crop failures, rising sea levels, and the increase in disease and human conflict will bear an enormous toll. According to the World Economic Forum, each degree of overall temperature rise will adversely affect one billion people. A two-degree Celsius rise in temperature by 2050 can potentially constrict world GDP by about 14 percent. If the temperature rises by three degrees, expect global GDP to shrink by 18 to 20 percent.[3]

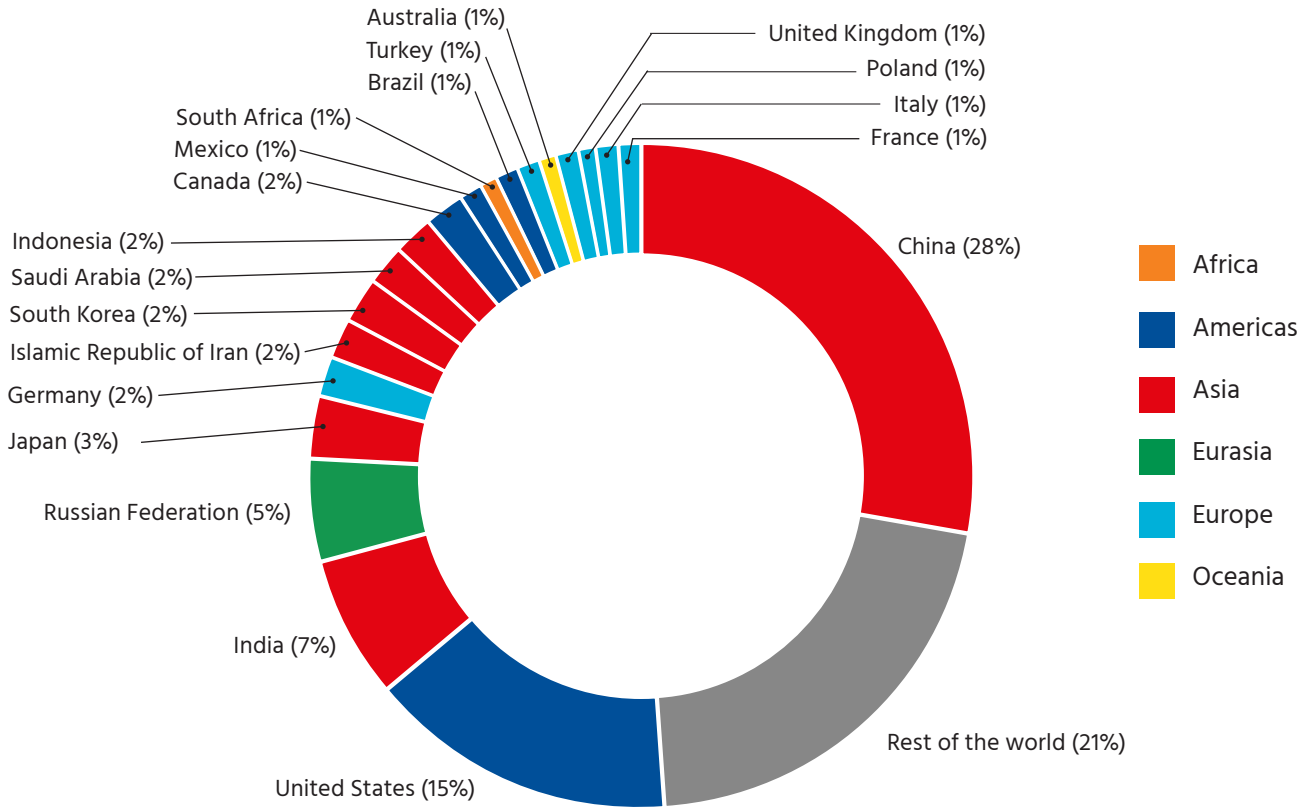
Cleantech assets are geopolitical assets and represent yet another manifestation of 21st century techno-nationalism: a neo-mercantilist mindset that links the technological capabilities of a state's key actors and institutions to its national security and economic strength, and socio-political stability.

As such, climate realpolitik will complicate how and where cleantech is developed, produced, traded, and how it will be leveraged as a political and economic tool.

Cleantech assets are geopolitical assets and represent yet another manifestation of 21st century techno-nationalism: a neo-mercantilist mindset that links the technological capabilities of a state's key actors and institutions to its national security and economic strength, and socio-political stability.[4] Like other sectors, governments will seek to control or at least achieve independence from strategic supply chains and engage in innovation mercantilism around cleantech development.

The cleantech sector relies on leading-edge technologies such as semiconductors, the Internet of Things (IOT), Artificial Intelligence (AI), and quantum sensors.

Figure 1 – Percentage of global carbon emissions by country, 2020



Source: 2020 Union of Concerned Scientist, **Data:** Earth System Science Data 11, 1783-1838, 2019

Many of the technologies used in cleantech are designated as "dual use"; that is, it can be used for both commercial and military purposes by either state or non-state actors. The entire sector is vulnerable to export controls and government regulation.

Report overview

The race to build clean energy infrastructure across continents will showcase a competition between China, the US, and its close partners.

This report – the 12th in a series of reports on techno-nationalism which include a trilogy on semiconductors, the innovation race, quantum computing, and electric vehicles – outlines the impact of climate realpolitik in three key areas: infrastructure geopolitics, carbon-related market dynamics, and rule frameworks.

The first section will focus on the geopolitics of clean infrastructure. The race to build clean energy infrastructure across continents will showcase a competition between China, the US, and its close partners. Consider, for example, China's Belt and Road Initiative (BRI). The deployment of energy projects in developing countries exemplifies Beijing's geopolitical strategy to transition away from the building of coal-fired plants and towards cleantech projects along the BRI. If Washington and other nations wish to compete with Beijing for influence in these regions, they will have to offer competitive alternatives.

Competition in climate-related infrastructure will extend across the Indo-Pacific, as China's island building capabilities are deployed amongst the low-lying island states grappling with the destructive forces of rising sea levels. Such projects could extend China's influence and pose long-term strategic implications.

Climate change will forge symbiotic relationships between markets, governments, and non-state actors – which will be subject to tensions and perhaps conflict.

The second section will focus on the market dynamics of cleantech. Climate change will forge symbiotic relationships between markets, governments, and non-state actors – which will be subject to tensions and perhaps conflict.

Green finance[5], venture capital, and green subsidies will play a role in pushing the needle toward a net-zero carbon economy. So too will carbon taxes, carbon penalties, and carbon trading schemes, all of which could stimulate trade in cleantech.

The so-called "North-South" divide, on display at the COP26 summit in Glasgow in 2021, may compel the world's rich nations to pay more for the developing world's transition to net-zero. But it may also result in individual or collective action by nations to impose conditions on climate finance. Punitive taxes and tariffs have the potential to be weaponized against carbon offenders, resulting in further geopolitical fragmentation.

Differences in standards may result in climate action groups splintering into values-driven blocs.

The third section will focus on rule frameworks and climate change alliances, as governments may seek to support their preferred standards regarding the trade in cleantech. These efforts can manifest through specialized agreements between like-minded nations rather than through mega free trade agreements (FTAs) such as the Comprehensive and Progressive Trans-Pacific Partnership (CPTPP). Differences in standards may result in climate action groups splintering into values-driven blocs. For the G7 countries, rules for cleantech may find a home within the agreements for supply chain resiliency and technology partnerships that have emerged between the US, the UK, the European Union, India, Japan, Australia, and Singapore.

Climate realpolitik will complicate how and where cleantech is developed, produced, traded, and how it will be leveraged as a political and economic tool.

The geopolitics of clean infrastructure

Accounting for about 28 percent of the world's carbon emissions in 2020, China is critical in global efforts to mitigate climate change. Yet China's contribution to the climate crisis is increasing. For example, construction of highways, dams, railroads, ports, and bridges along the BRI – which require millions of tons of cement and steel as well as machinery fueled by fossil fuels – has significantly raised global carbon emissions.

Energy lies at the heart of China's grand stratagem for infrastructure building. Between 2000 and 2020, China's banks invested US$160 billion in overseas energy projects in 152 countries, many of which were parties to the BRI.[6] The scale of this endeavour easily matched the number of energy projects supported by the World Bank and other development banks during the same timeframe.

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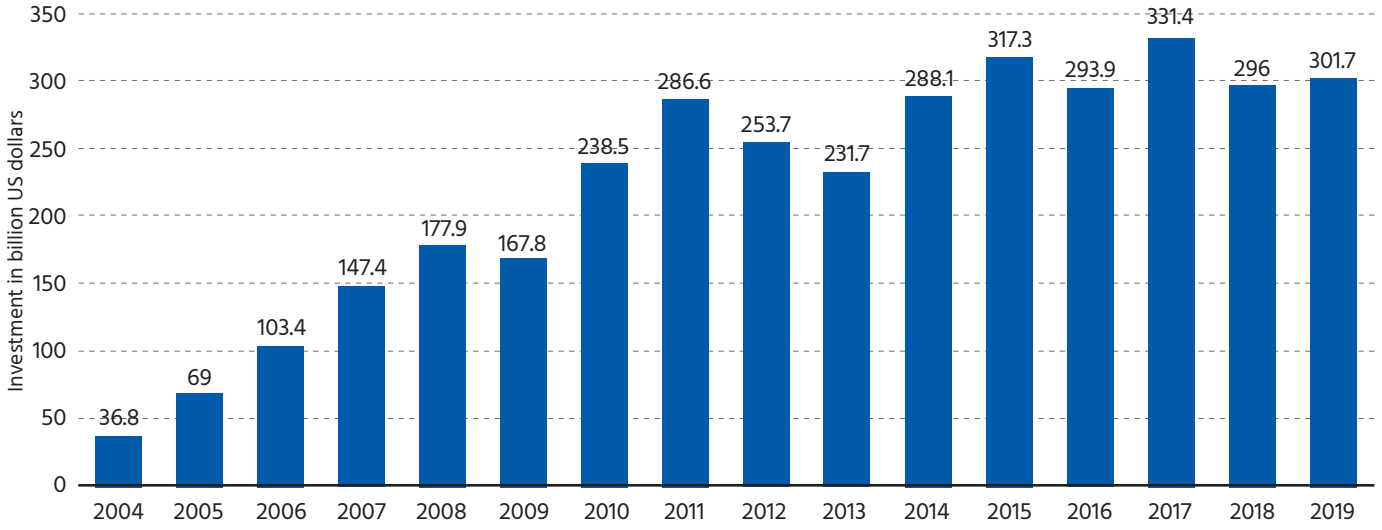
China's infrastructure diplomacy reveals the paradox of great power rivalry in the face of climate change: Geopolitical gains have been achieved at the expense of increased greenhouse gas emissions. From 2000 to 2020, 80 percent of China's overseas energy investments focused on fossil fuels: US$54.6 billion on oil, US$43.5 billion on coal, and US$18.8 billion on natural gas.[7] About 17 percent was directed at hydro-power projects.

From 2010 to 2020, Chinese state-owned enterprises (SOEs) invested in some 250 "dirty" coal-fired projects in 25 countries that are part of the BRI, including Bangladesh, Pakistan, Serbia, Kenya, Ghana, Malawi, and Zimbabwe.[8] According

Figure 2 – Global investment in clean energy, 2004-2019 (in US$ billion)



Note(s): Worldwide; 2004 to 2019
Source(s): BloombergNEF; UNEP; FS-UNEP Collaborating Centre; ID 186807

to a study by Quartz, roughly 70 percent of all coal plants built around the world in 2020 relied on Chinese funding.[9]

From 2010 to 2020, Chinese state-owned enterprises invested in some 250 "dirty" coal-fired projects in 25 countries that are part of the BRI. For China's rivals, the coal issue presents an opportunity to pry their way into Beijing's geopolitical sphere of influence by providing alternative green technologies to eager nations.

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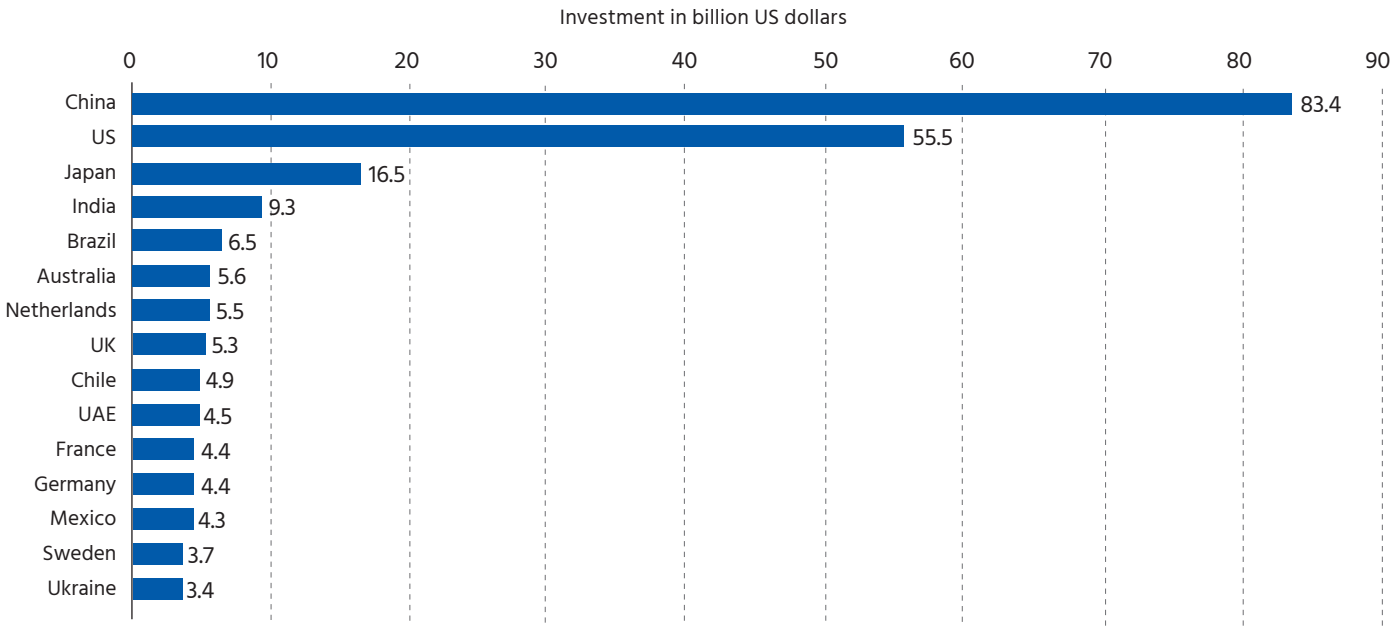
A geopolitical playing field

In September 2021, China's President Xi Jinping announced that the country would "not build any new coal-fired power projects abroad" and that it would "step up support for other developing countries in developing green and low-carbon energy."[10]

When viewed through the prism of climate geopolitics, Xi's proclamation represented the crucial linkage between clean technologies and geopolitical capital. While the cancellation of 44 coal plants globally would bring US$50 billion of economic loss, it would reduce annual emissions by some two hundred million tonnes – and deliver high public relations value.[11]

Subsequently at COP26, China pledged to achieve net-zero carbon emissions at home by the year 2060. This is significant for several reasons. First, China's Communist Party seems to fully understand the strategic benefits of climate diplomacy. Secondly, China's cleantech industry is well positioned to expand Beijing's influence.

Figure 3 – Global clean energy investment by selected country, 2019 (in US$ billion)



Note(s): Worldwide; 2019
Source(s): BloombergNEF; ID 799098

After all, China is both the world's top polluter and the largest producer of wind and solar power.[12] In 2020, China built more than half of the world's newly installed capacity for wind power. Seven of the world's ten largest wind turbine manufacturers are Chinese state-backed companies.[13] In 2019, China dominated all facets of global production of photovoltaic (PV) cells, including 97 percent of the production of solar-related silicon wafers and 79 percent of PV cells manufacturing.[14]

China also dominates the upstream supply chains for the materials and components that go into solar and wind cleantech. China dominates rare earths and critical minerals supply chains, which are critical for batteries and other EV components such as magnets. As with EVs, strategic decoupling and diversification from China-dominated supply chains will drive geographic ring-fencing within the cleantech sector.

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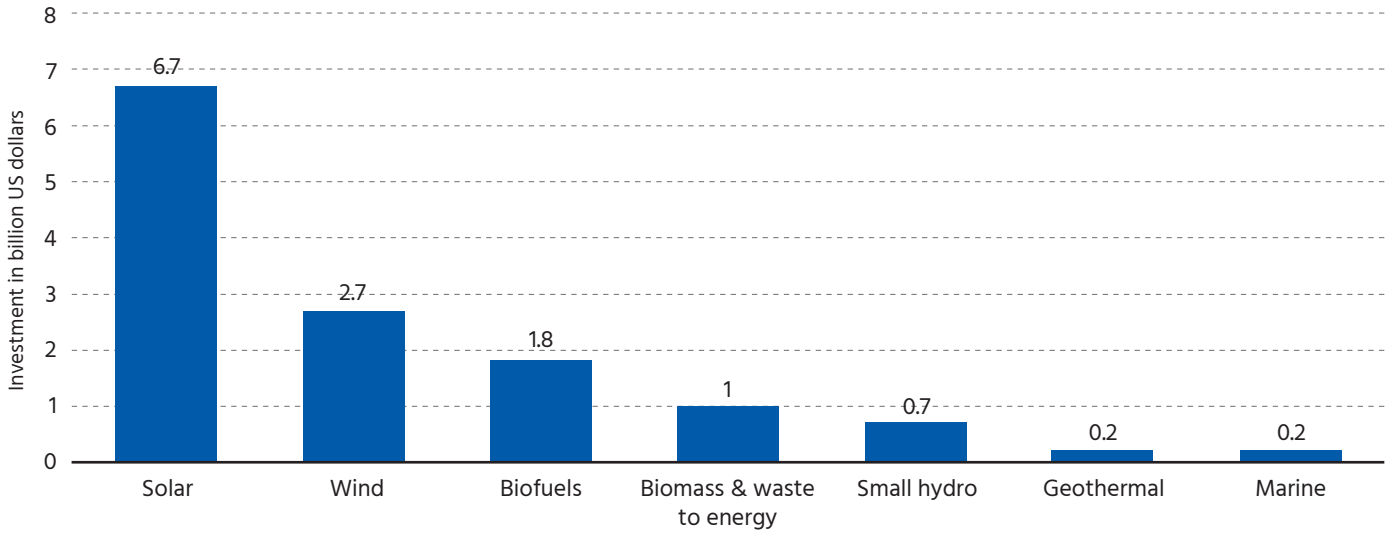
Certainly, China's investment in energy transition R&D has outpaced its strategic competitors. Between 2010 and 2020, China outspent R&D spending by the US by a margin of two to one.[15]

Finally, economies of scale matter. China can leverage its capacity for wind and solar manufacturing with its access to a broad base of client states. In response, Washington and its strategic partners can only double down to develop their own capabilities.

Climate competition in emerging markets

The world's affluent nations possess the technology and expertise to drive decarbonization in their own economies. However, they must extend their resources to developing economies or risk catastrophic climate change – and expansion of China's influence.

Figure 4 – Global R&D investment in clean energy by sector, 2019 (in US$ billion)



Note(s): Worldwide; 2019; includes corporate and government investments.
Source(s): BloombergNEF; FS-UNEP Collaborating Centre; UNEP; ID 519522

At COP26, leaders of developing economies – particularly India, the world's third largest polluter – reiterated their demands that the wealthiest nations pay for the decarbonization of poorer countries. Conceding that earlier pledges towards climate aid have fallen short, developed countries committed to extend US$100 billion in green finance and other initiatives annually through to 2025.[16]

Emerging markets are poised to become a stage for climate-related competition between the superpowers.

Ultimately, climate adaptation goals cannot be achieved without significant decarbonization across all economies. Therefore, emerging markets are poised to become a stage for climate-related competition between the superpowers.

Vulnerabilities along the Belt & Road Initiative

China's imprint would seem indelible in many emerging markets. Yet the door remains open to Beijing's competitors if they can convince local governments that their energy projects will deliver more inclusive decarbonization – one with high standards regarding labour practices, transparency, and accountability to local stakeholders. At issue is the nature of the terms and conditions that China extracts from its overseas hosts for infrastructure projects. China's methods of economic diplomacy are at the core of geopolitical climate competition.

CASE STUDY

China: A first-mover advantage

China's activities along the BRI continue to pay geopolitical dividends, particularly as Beijing shifts its focus from coal to cleantech. In 2020, China's clean energy investments in the BRI reached some US$11 billion.[17] In 2021, as part of its efforts to catch up with China, the US committed an annual benchmark of US$11.4 billion in climate financing for the entire developing world.

The US is also lagging in its migration to green energy, which in China accounts for more than half of new energy-related projects. In Africa, China's investments have sparked a shift to both photovoltaic (solar) and wind power in some of the world's most challenging environments. Despite a decades-long civil war, Chinese SOE Dongfang Electric is near completion of a 120-megawatt (MW) wind park in Ethiopia.[18] In Ghana, the Synohydro Group, another Chinese SOE, brought the first 5 MW component of a much larger 250 MW floating solar farm online.[19] Other examples include the 100 MW Gwanda solar power plant in Zimbabwe, built by CHINT Electrics, and the 50 MW Garissa solar farm in Kenya built by the China Jiangxi construction company.

China's drive toward clean energy in Africa and throughout the BRI perpetuates the building of railroads, highways, and ports which support Beijing's geopolitical interests.

Ultimately, China's drive toward clean energy in Africa and throughout the BRI perpetuates the building of railroads, highways, and ports which support Beijing's geopolitical interests. The network facilitates access to strategic minerals, food resources, and markets for Chinese companies, involving both hard goods and digital services like wireless communications, e-commerce, and financial technology. From a security perspective, experts argue that infrastructure built and controlled by China doubles as a ready-made deployment network for its military assets.[20]

Despite ongoing complaints, Chinese companies continue the practice of shipping in thousands of workers from China to large overseas projects, often excluding local workers.

Consider China's investments in wind farms in Africa. The construction of these farms by Chinese SOEs may be welcomed, but the projects' terms and conditions are often viewed as one-sided in favour of Beijing. Despite ongoing complaints, Chinese companies continue the practice of shipping in thousands of workers from China to large overseas projects, often excluding local workers.[21] Chinese construction companies bring their own machinery and are yoked to a wider ecosystem of policy-driven banks and companies serving across sectors, from telecommunications to transportation, agriculture, and energy.

In cases where Chinese firms use local labour, workers are reportedly subject to harsh working conditions,[22] including in Nigeria, which has faced a wide range of alleged abuses against labor.[23]

The issue of debt is also contentious. In some countries, Beijing's energy and infrastructure loans have led to high levels of debt-to-GDP ratios.[24] Some host countries find themselves unable to repay a loan and vulnerable to China seizing domestic assets and resources.[25] This system has earned the controversial moniker of "debt-trap" diplomacy.

China is the world's largest creditor nation, with outstanding loans to debtor nations equalling about 6 percent of global GDP in 2020.[26] The US$1.5 trillion in known debt owed to China – the majority of which is concentrated in emerging markets – is more than the combined loans of all nations belonging to the International Monetary Fund and the World Bank.[27]

Deals that involve infrastructure for natural resources make up many of the projects that are creating a backlash against the BRI.

US-China rivalry and techno-nationalism have heightened scrutiny of this mounting debt. Climate change and the Covid-19 pandemic have served to amplify the competition. Deals that involve infrastructure for natural resources make up many of the projects that are creating a backlash against the BRI. Take, for example, the US$2 billion investment by Chinese SOE Sinohydro Corporation in roads, housing, and rural electrification in Ghana, which has facilitated access

Ultimately, China's drive toward clean energy in Africa and throughout the BRI perpetuates the building of railroads, highways, and ports which support Beijing's geopolitical interests.

to bauxite reserves in the West African nation.[28] Under this arrangement, Ghana borrowed money from Chinese banks to finance the project with the anticipation of using the proceeds from future bauxite sales to repay the loans. Meanwhile, China gained access to a strategic mineral resource and potential political influence. The terms of contract were similar to that of Hambantota port in Sri Lanka, which served as collateral in the terms of financing and was subsequently taken over by China when the Sri Lanka government defaulted on its payments.[29]

Some of China's infrastructure investments are also associated with environmental degradation. In Ghana, the pending bauxite mine would be located within the Atewa forest reserve, a vital band of biodiversity within Africa's critical carbon sink.[30] Deforestation associated with the project has generated opposition from local communities and international environmental groups.[31] In terms of climate change, Atewa's long term environmental value as a carbon absorption sink outweighs the short-term financial benefits from the sale of bauxite.

Cleantech may become increasingly linked to ideological values and the competition nexus between geopolitics and climate resilience.

This argument for long-term climate value may gain traction across continents. As such, cleantech may become increasingly linked to ideological values and the competition nexus between geopolitics and climate resilience. Hence would-be challengers to China's cleantech efforts in BRI efforts face an opportunity. USAID's "Prosper Africa" initiative offers an example.[32] The program aims to promote investment in infrastructure using a more environmentally sustainable approach and supporting more inclusive options regarding construction, installation, and upkeep. The projects emphasize capacity building that includes participation of venture capitalists and businesses, and an ecosystem of third parties such as non-governmental organizations (NGOs) and professional services.

There are several possible scenarios. When competing with Beijing to build solar farms in a developing country, for example, G7 governments may choose to exploit the China backlash on ideological grounds. This would involve emphasizing values regarding transparency, inclusiveness, accountability to local stakeholders, labour standards, and environmental sustainability. The US and its allies may also hammer home the consequences of embracing Beijing as a partner, which entails tolerating its model of techno-authoritarianism.[33]

Matching China's larger economies of scale will require much bigger commitments from government agencies such as the United States' Development and Finance Corporation (DFC), which has committed some US$60 billion in grants and loan guarantees.

A climate strategy based on competition and ideology will incur significant costs. Matching China's larger economies of scale will require much bigger commitments from government agencies such as the United States' Development and Finance Corporation (DFC), which has committed some US$60 billion in grants and loan guarantees.[34]

Another institution that links "green" standards to infrastructure development is the US State Department's nascent "Blue Dot" initiative, which involves partnerships with Australia and Japan governments and aims to set standards that are aligned with the Paris Accords.[35] A partner of the initiative, the Organization for Economic Cooperation and Development (OECD) estimates the investment gap in clean energy infrastructure may exceed US$3.5 trillion.[36]

Narrowing the gap for the Blue Dot initiative will require public-private partnerships on a scale not seen before. Again, competitive climate strategy linked to ideology could fracture the cleantech landscape along geopolitical lines.

SPOTLIGHT

Island nations and climate diplomacy

The gradual inundation of island nations due to rising sea levels presents China with new opportunities to build strategic footholds across the Indo-Pacific region. The Alliance of Small Island States, an organization that represents the world's low-lying islands, has seen an uptick in China's island-building diplomacy.

Consider the Republic of Kiribati, which has turned to China to raise the elevation of its most populated islands. To do this, China will draw upon engineering methods and resources that Beijing developed to build up contested coral atolls in the South China Sea.[37]

Until other nations can match its capabilities, the growing urgency for climate adaptation programs helps China.

Until other nations can match its capabilities, the growing urgency for climate adaptation programs helps China. Kiribati, which switched diplomatic relations from Taiwan to China in 2019, has enthusiastically signed up to the BRI. Kiribati's infrastructural makeover includes China's rebuilding of a two-kilometer airstrip on Kanton, a low-lying coral atoll in a remote archipelago known as the Phoenix islands, a former US military shelter once used by Pan American Airways as a refuelling stopover.[38] In exchange for infrastructure, Kiribati provides Beijing with a strategic base of operations in the middle of the Pacific Ocean, with access to rich fishing grounds, undersea mining riches, and a staging point for Chinese military assets.

The Solomon Islands, another nation with strong historical ties to the US, has followed a similar course.[39] In 2019, its government switched diplomatic ties from Taiwan to China. Like Kiribati, joining China's BRI provided hope of economic gains and the prospect of mitigating the risks of rising sea levels.

Washington and its allies can double down on value-driven capacity building and the narrative of inclusive growth. But for that message to resonate, real solutions must be delivered and backed with technological prowess and economic firepower.

These examples magnify the feedback loop between climate change, geopolitics, and the technological and economic tools at the disposal of nations. In the case of the island nations, China's engineering prowess in island building is unmatched. For the US and its allies, not meeting the goal of 1.5 C threatens to speed up global warming and drive the island nations into China's orbit.

As in the case of bauxite mining in Ghana's Atewa forest reserve, the environmental destruction from large-scale dredging of coral lagoons and the paving over of atolls in the Phoenix islands is on an unimaginable scale. Washington and its allies can double down on value-driven capacity building and the narrative of inclusive growth. But for that message to resonate, real solutions must be delivered and backed with technological prowess and economic firepower.

The market dynamics of cleantech

Market forces and non-state actors will play a key role alongside state actors as governments roll out benchmarks, incentives, and punitive measures.

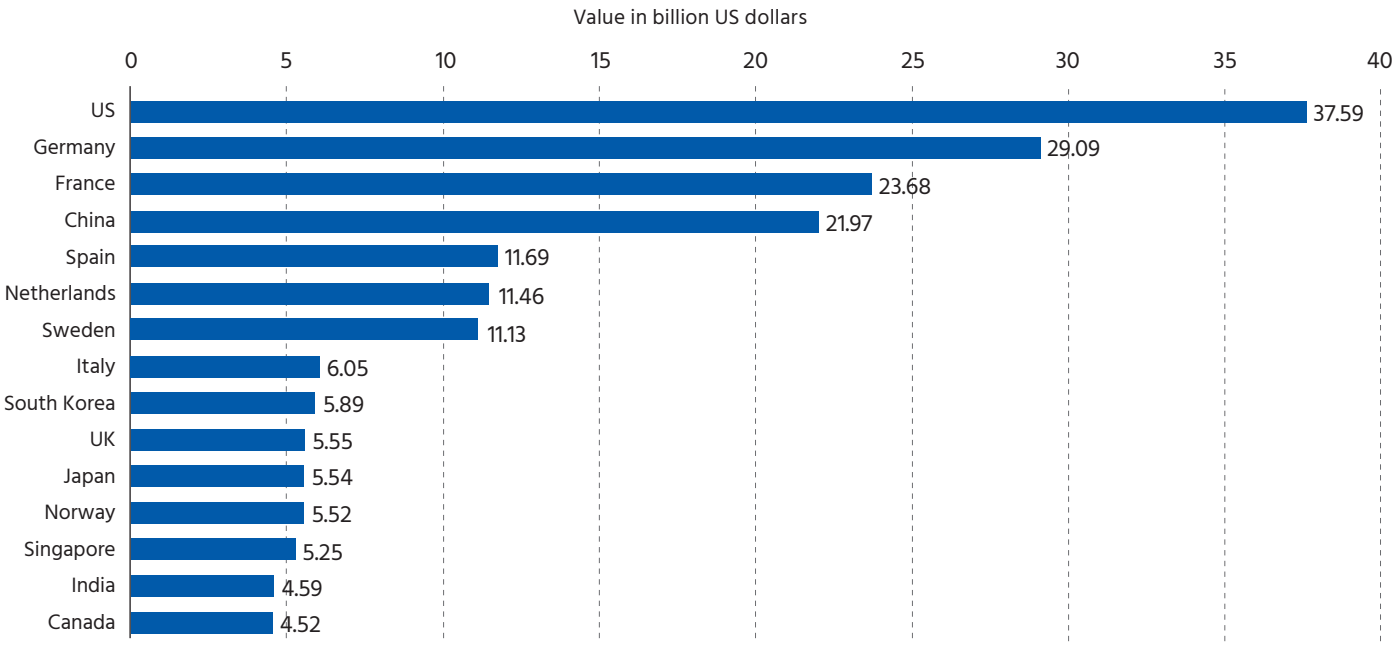
Efforts to decarbonize the global economy have sparked a surge in energy transition investment. Therefore, market forces and non-state actors will play a key role alongside state actors as governments roll out benchmarks, incentives, and punitive measures.

Even at a time of pandemics and disrupted supply chains, the migration toward sustainable energy and technologies increased in 2022.[40] Investment is poised to propel key drivers of decarbonization, which include green finance, the production and consumption of EVs and related batteries, solar and wind power installation, hydrogen electrolyzer capacity, and the growth of carbon sequestration technologies. Demand for such products and services in China alone could reach US$16 trillion.[41]

Yet efforts to contain global warming reveal unavoidable paradoxes.

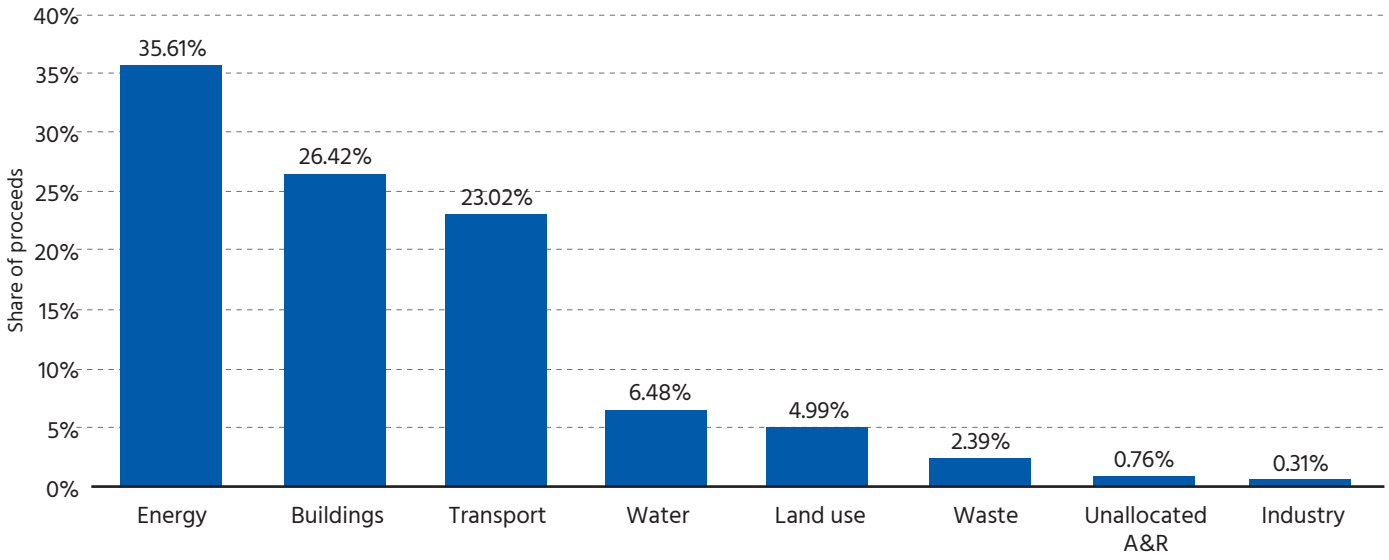
First, can market incentives and trade opportunities brought about by "carbonomics" produce mutually beneficial outcomes to rivals such as the US and China? Can trade across a range of "permissible" cleantech technologies remain robust even as the two countries remain in confrontation in other areas?

Figure 5 – Value of global green bond market by country, H1 2021 (in US$ billion)



Note(s): Worldwide; H1 2021
Source(s): Climate Bonds Initiative; ID 512030

Figure 6 – Global share of green bond proceeds by usage, by sector, 2020



Note(s): Worldwide; 2020
Source(s): Climate Bonds Initiative; ID 512542

At COP26, both China and the US agreed to cooperate on climate change.[42] Yet because elements within cleantech are designated as "dual use" technologies, any confrontational event between the superpowers could trigger export controls and the weaponization of supply chains. Once again, if unrestricted trade in cleantech affords geopolitical advantages to an opponent, free trade becomes in doubt.

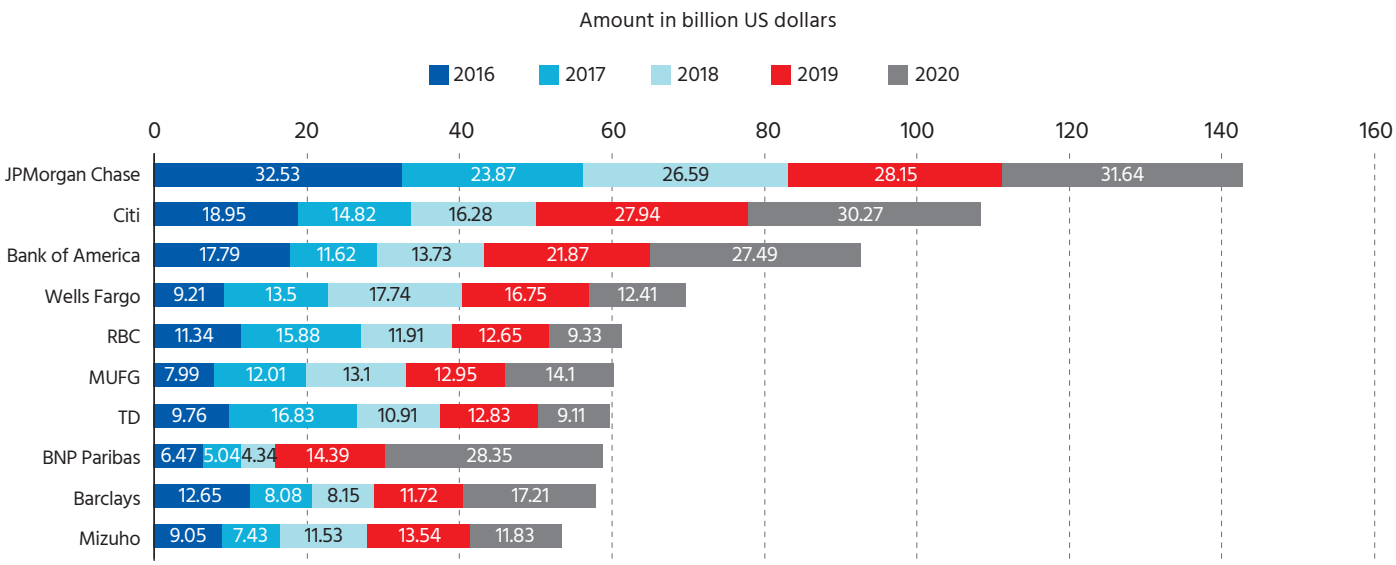
The transition away from fossil fuels can impair the economic prospects for many groups across sectors and create challenges for governments.

More generally, how will states reconcile economic growth with decarbonization? There are capacity and reliability constraints on some clean energy sources that still hamper their use in highly industrialised areas. The transition away from fossil fuels can impair the economic prospects for many groups across sectors and create challenges for governments. Economic strength is integral to projecting geopolitical and security-related objectives. Ideally, states will achieve economic growth through decarbonization.

These questions play out today. In contradiction to the decarbonization agenda, large economies are consuming more fossil fuels. In 2021, greenhouse gas emissions from coal struck its highest ever level, while emissions from oil hit a seven-year high.[43] As economic recovery led to fuel shortages, the Biden administration tried to open more than 80 million acres of the Gulf of Mexico to new oil drilling, which a federal judge recently blocked.[44] In Canada, the pro-environment Trudeau government expanded exports of fossil fuels.[45]

Meanwhile, Brussels agreed to pay record prices on the import of Russian natural gas, even as Russia and the EU tussled over Ukraine.

Figure 7 – Bank financing for expanding fossil fuel companies worldwide, 2016-2020 (in US$ billion)



Note(s): Worldwide; 2016 to 2020
Source(s): Rainforest Action Network; Bloomberg; ID 1130383

SPOTLIGHT

US-China natural gas diplomacy

Between October and December of 2021, while Washington issued restrictions against Chinese firms, seven billion-dollar mega-deals between state-owned energy giant China National Offshore Oil Corporation and US natural gas producers ensured decades of LNG supply.[46] Although natural gas is cleaner than oil or coal, it accounts for significant greenhouse gas emissions.

China's decision to turn to its geopolitical arch-rival for its energy needs underscores the primacy of economic imperatives, which directly affect security and geopolitical agendas, over the exigencies of climate change.

For Washington, the economic and strategic benefits of expanding its influence as an energy exporter outweighed any short-term risks of enabling its competitor. In this instance, realpolitik trumped long-term climate mitigation.

The contradictory nature of trade dynamics between the world's two largest economies demonstrates that cooperation and confrontation is far from being a zero-sum affair.

More broadly, the contradictory nature of trade dynamics between the world's two largest economies demonstrates that cooperation and confrontation is far from being a zero-sum affair. Navigating a path across this landscape between frequently moving safety parameters will prove challenging for years to come.

Navigating the growth-versus-decarbonization syndrome will depend on three key factors encompassing market dynamics and state-driven frameworks. The factors are carbon trading schemes, taxation on carbon emissions, and 'green finance'.

Affixing real impactful values and costs to carbon emissions is the key to tapping market dynamics.

Affixing real impactful values and costs to carbon emissions is the key to tapping market dynamics. Enforcing standards and establishing safe parameters through rule-frameworks is the task of government and public-private partnerships. The end game is to push economic growth towards cleantech.

Carbon trading

A carbon trading scheme involves the buying and selling of "permits" or "credits" linked to a measurable unit of carbon emissions in metric tons. Governments allocate these permits and assign a "cap" or a limit to the allowable emissions for a corporation over a specific timeframe. Emissions that exceed established caps are subject to fines and penalties. However, companies that cut their emissions can sell or trade their unused credits on an open market. This incentivizes the transition to cleaner technologies.

In 2020, the global carbon trading market was worth about US$260 billion.[47] The European Union's Emissions Trading Systems (ETS) represents the largest of some thirty schemes around the world, from Argentina to the US.[48] The value of trading rose by 20 percent from the previous year, as did the weighted average price of a ton of carbon, which jumped from US$20 in 2020 to about US$35 by mid-2021.[49]

In 2021, voluntary trading in carbon "off-sets," which include the planting of thousands of acres of tree farms (carbon sinks) and the preservation of natural forests, reached more than US$1 billion globally for the first time ever.[50]

These figures confirm the global economy's shift toward decarbonization and large-scale investment in cleantech. However, reaching the 2050 goals will require the price of carbon to increase substantially to act as a deterrent to carbon emissions. By 2030, the average price for a ton of carbon should be an estimated US$100.[51] A recent government commission in France came to an even higher estimate of US$285 per ton in 2030 and an astounding US$880 per ton in 2050.[52]

In addition to allocating permits and credits on a quota basis, governments may turn to carbon auctions. Those that do not participate in these auctions will struggle with punitive carbon costs and reduced access to financing and markets. A shift to cleantech may follow.

The complexities of imposing and managing an effective carbon trading scheme is leading to a growing number of economists to argue that a flat tax on carbon is simpler and more effective.

The complexities of imposing and managing an effective carbon trading scheme presents challenges for governments. For one, carbon trading schemes require transparent and effective institutions to administer. They also need to be rolled out alongside measures that off-set economic hardships for those bearing the costs of decarbonization. As such, a growing number of economists argue that a flat tax on carbon is simpler and more effective.

Designed to promote the transition to clean energy sources, a carbon tax of US$35 per ton of carbon emissions imposed in 2030, for example, would raise the cost of coal, electricity, and petrol (gasoline) by 100, 25 and 10 percent, respectively.[53]

Border tariffs

Climate adaptation has ushered in another form of carbon pricing: border taxes on imports which the EU hopes to roll out in 2023.[54] Known as the carbon border adjustment mechanism (CBAM), the proposed border tax will likely run afoul of WTO rules. Yet domestic economic and environmental priorities are likely to outweigh any WTO mandate.

As with human rights standards, governments can weaponize carbon standards in supply chains – by linking them to the exports of goods from targeted entities.

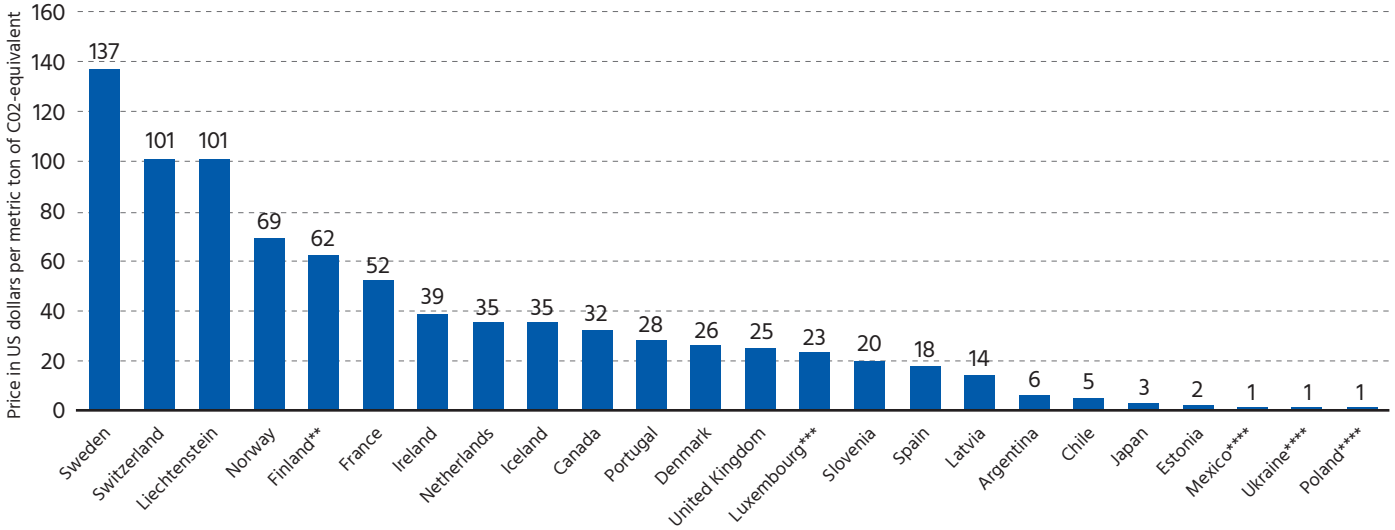
As with human rights standards, governments can weaponize carbon standards in supply chains – by linking them to the exports of goods from targeted entities.

Carbon-based import tariffs are also being discussed in the US. In 2021, Democrats in the US Congress proposed levying US$16 billion worth of carbon tariffs on imports from China and other countries with high levels of greenhouse gases.[55] Geopolitically, this is significant for China as well as US allies and other countries navigating between the two superpowers.

India, for example, is emerging as a strategic supply chain alternative to China and an important security partner to Washington and its allies. India has postponed its net-zero pledge to 2070 and will need to spend approximately US$10 trillion to meet its climate goals.[56] Its economic growth trajectory is likely to continue its reliance on coal-powered electricity, which will present Washington and other nations with hard choices.[57]

The climate paradox involving India underscores the economic divide between developed and developing nations, and the former's motivation to fund decarbonization efforts in the latter. The impetus is twofold. First, the 1.5C goal will not be reached unless the most advanced economies help pay for decarbonization

Figure 8 – Prices of implemented carbon taxes worldwide, by select country*, 2021 (per metric ton)



Note(s): Worldwide; as of April 1, 2021
Source(s): World Bank; ID 483590

*Nominal prices on April 1st, 2021
**Finland – US$73/t CO2e for transport fuels & US$62/t CO2e for all other fuels in heat and electricity generation

***Luxembourg – US$40/t CO2e for diesel fuel & US$23/t CO2e for all fossil fuels
****Less than US$1/t CO2e

throughout global value chains. Secondly, developing nations everywhere have acquired bargaining power in the broader geopolitical competition between China, the US, and its partners.

In competing with China for geopolitical influence, G7 countries are motivated to commit funding for decarbonization or risk losing influence.

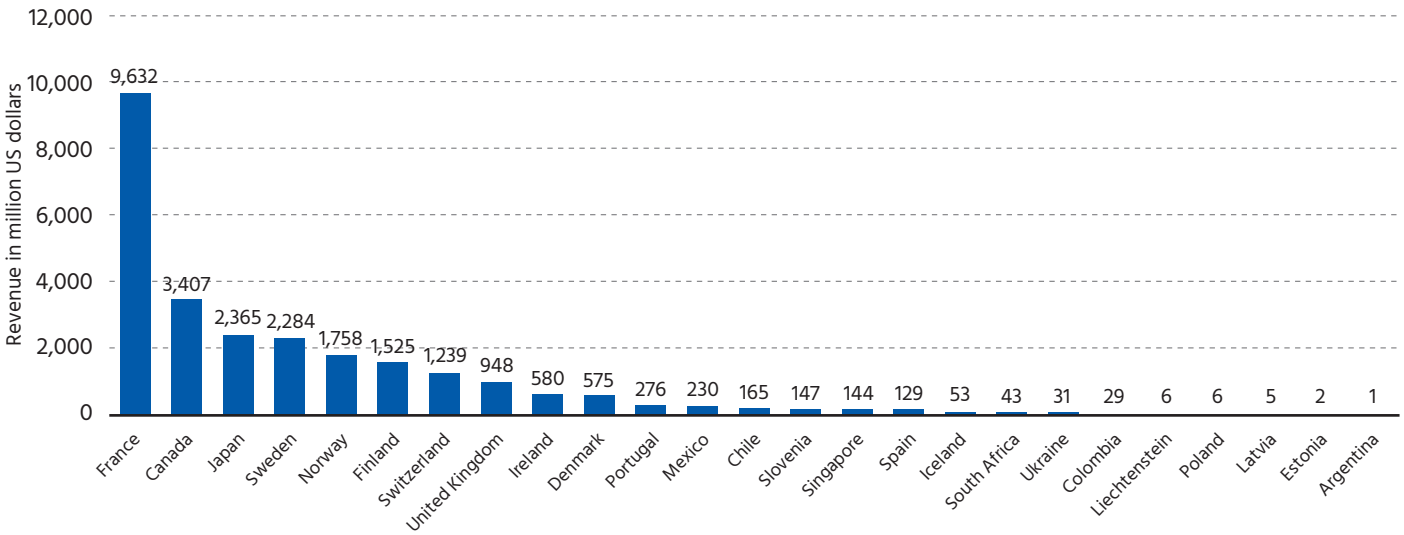
Thus, in competing with China for geopolitical influence, G7 countries are motivated to commit funding for decarbonization or risk losing influence. As such, some nations may consider a free pass for developing nations on carbon taxes and carbon pricing thresholds, especially if advanced economies fail to deliver the decarbonization financing.

Carbon taxes provide states with revenue for local decarbonization efforts but also trigger a precarious balance between economic and climate goals. A border tax of US$30 per metric ton of carbon could drive down the profits of foreign producers by 20 percent.[58] As such, a carbon tariff may increase the likelihood of foreign firms leapfrogging costs by moving production inside the import market. In the 1980s, Japanese automakers famously did so by setting up manufacturing plants in the US to avoid import tariffs.

Decarbonization would be mutually aligned with stronger calls for localized supply chains and reinforce arguments for economic nationalism.

Consequently, carbon trading schemes and carbon taxes may accelerate techno-nationalism. Consider the scenario of re-shoring semiconductor manufacturing, which have high strategic value and astronomically high carbon-emitting value chains. Consequently, decarbonization would be mutually aligned with stronger calls for localized supply chains and reinforce arguments for economic nationalism.

Figure 9 – Carbon tax revenues worldwide, by country, 2020 (in US$ million)



Note(s): Worldwide; 2020
Source(s): World Bank; ID 1241742

Green finance or greenwashing?

To meet a 1.5C target by 2050, financial institutions will have to extend the considerable capital needed for "green finance", which includes bonds, commercial loans, and targeted financing and investment in climate-related projects. In 2021, some US$362 billion in green bonds were issued, a substantial increase over previous years.

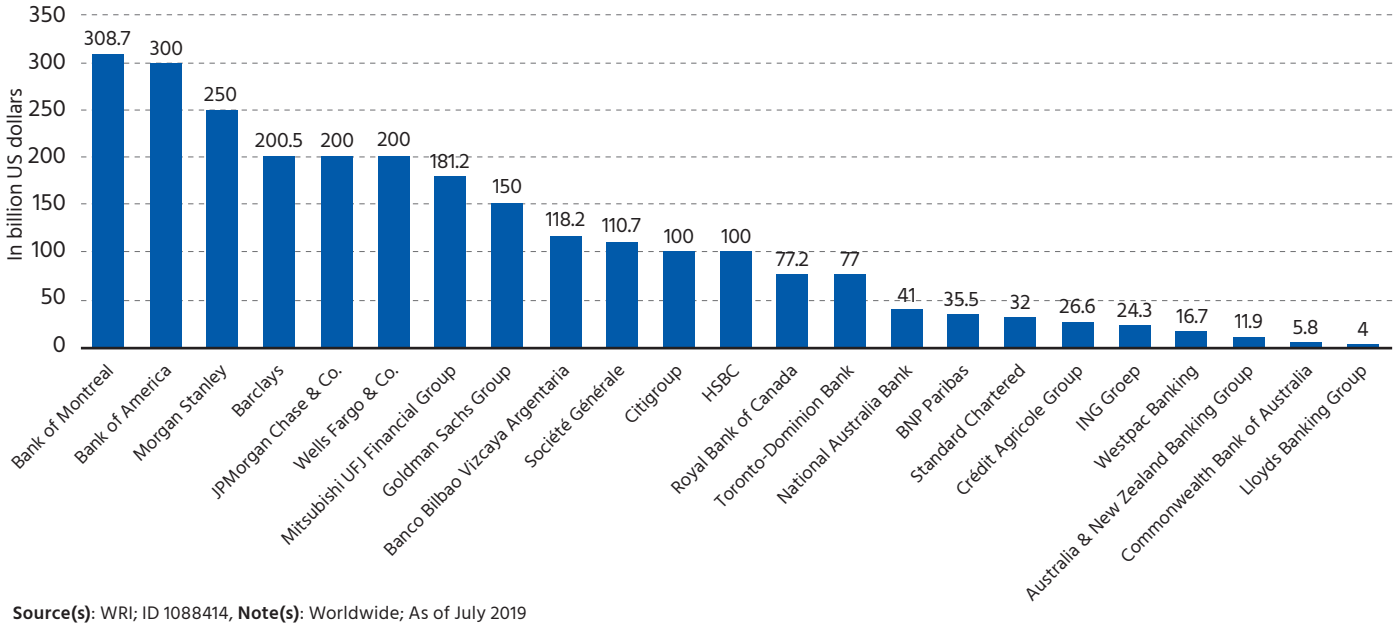
At COP26, the Glasgow Financial Alliance for Net Zero (GFANZ), with its access to an estimated US$130 trillion representing the world's largest financial institutions, pledged to prioritise green finance initiatives.[59] Organized by former Governor of the Bank of England, Mark Carney, the GFANZ estimated that meeting net-zero would require US$100 trillion over the next three decades.

Three fundamental questions arise regarding the potential of green finance. First, can financial institutions make good on their pledges? Secondly, will these same institutions continue to invest in fossil fuels? Finally, will requisite transparency and reporting frameworks emerge that will consider accurate data regarding green finance?

The question of whether green finance can deliver is far from certain, although it will depend on how effectively states can coalesce around rule-frameworks and universal standards regarding decarbonization.

Developed nations are already three years late on a previous pledge of US$100 billion of climate aid annually over five years to vulnerable states. Now reaffirmed, this pledge will commence in 2023. But divestment from fossil fuels remain in question. Financing for fossil fuel projects expanded from 2016 to 2020, when the world's largest banks ramped up investments in coal, oil, and natural gas. In 2022, supply and demand shocks may lead to increased investment in fossil fuels. The question of whether green finance can deliver is far from certain, although it will depend on how effectively states can coalesce around rule-frameworks and universal standards regarding decarbonization.

Figure 10 – Value of sustainable finance commitments made by the world's largest banks, 2019 (in US$ billion)



Source(s): WRI; ID 1088414, **Note(s)**: Worldwide; As of July 2019

Establishing rule frameworks

It is necessary to tap market dynamics to achieve economic growth through decarbonization. However, doing so will require the establishment of rule frameworks built on two of the most important features of governance: transparency and accountability.

From a geopolitical perspective, different standards associated with China's state-centric economic model and the US or European models may lead to diverging sets of climate-related rule frameworks.

From a geopolitical perspective, different standards associated with China's state-centric economic model and the US or European models may lead to diverging sets of climate-related rule frameworks. The European Union's US$ 1.1 trillion "Green Deal," which aims to decarbonize Europe's economy by 2050, for example, relies upon transparent reporting and legal frameworks to enforce migration to electric vehicles and to manage taxes on carbon. Similarly, although still in its nascency, the Blue Dot initiative relies upon clear rules and standards linked to clean infrastructure.

Partnerships between governments, NGOs, the private sector, and multilateral development banks (MDBs) – such as the Climate Investment Funds (CIF) – may also be impacted. As the world's largest mechanism for climate finance, the CIF finances clean technologies, renewable energies, and other climate resilience areas such as forest management. Donors of the CIF, which includes the US, the UK, Germany, France, Japan, South Korea, Australia, and Canada, have contributed US$8.5 billion to date.

At COP26, the US publicly supported the idea of using the CIF to set up a capital market mechanism to attract US$500 million per year into cleantech.[60] Such an endeavour is a good opportunity to move forward with green finance. However, the possibility remains that climate advocacy along geopolitical fault lines will emerge.

The role of trade agreements

By 2030, the value of cleantech could be more than oil. In theory, this should present the world with a massive trading opportunity. Arrangements to promote preferential trade in cleantech may eventually emerge, but they may manifest not through the WTO or the CPTPP and instead emerge through a series of smaller agreements between like-minded countries.

If cleantech functions as a geopolitical asset, it may find a natural home within a new form of existing supply chain resiliency agreements and digital trade agreements.

If cleantech functions as a geopolitical asset, it may find a natural home within a new form of existing supply chain resiliency agreements and digital trade agreements. One such arrangement, the Indo-Pacific Economic Framework (IPEF) proposed by Washington, would aim to link cleantech and infrastructure to a broader set of security objectives.[61]

The US-Singapore strategic partnership, signed in 2021, offers another example of collaboration on supply chain resiliency, environmental technologies, and digital trade with linkages to security imperatives. Similarly, Australia, Japan, and the EU all pursued partnerships with Asian allies with the intention of assuring supply chain resiliency across a range of goods and services, including energy and cleantech.[62]

From a geopolitical perspective, different standards associated with China's state-centric economic model and the US or European models may lead to diverging sets of climate-related rule frameworks.

Multilateral arrangements such as the IPEF, however, will require significant increases in economic engagement from the US and its key partners if they are to gain traction throughout Southeast Asia. China is the top trading partner for countries in this region and firmly positioned to leverage its massive cleantech manufacturing base, particularly in wind and solar power.[63]

Cleantech's burgeoning trade in services may also be well served by specialized agreements such as the Digital Economy Partnership Agreement (DEPA) signed by Singapore, New Zealand, and Chile.

The need for transparency and traceability will spark the next boom in the professional services industry, from legal and advisory services to security and logistics.

Putting in place climate governance standards for green finance and trade arrangements is spawning an enormous service industry that will require specialized technology to track carbon emissions across supply chains. AI, the IoT, blockchain, data science, and tracking technologies will augment a parallel universe of trade in cleantech goods. The need for transparency and traceability will spark the next boom in the professional services industry, from legal and advisory services to security and logistics. Developing this ecosystem throughout continents will likely ramp up public-private partnerships in green finance and cleantech.

Conclusion

Climate change continues unabated as economic nationalism, domestic politics, and climate realpolitik blunt impact efforts to decarbonize the global economy.

Despite the existential threat of climate change and the need to decarbonise the global economy through a substantive shift towards cleantech, geopolitics will influence the behaviour of state and non-state actors.

Governments will look to leverage cleantech manufacturing and infrastructure building capabilities to gain strategic advantage and influence. Already, China is incorporating this approach in its shift to wind and solar energy projects along the BRI, and its island-building capabilities are bolstering Beijing's influence in the Pacific region as island nations threatened by rising sea levels turn to China for assistance.

Systemic and ideological differences between liberal democracies and China regarding labour and transparency standards may factor into investment in cleantech. Shared values may also influence the public-private partnerships that coalesce around green financing. If bifurcation ensues, different systems of climate governance may follow.

If economic growth takes priority over decarbonization, tensions can mount between states with asymmetric responses to carbon emissions. This will highlight North-South differences over the financing of decarbonization, which could lead to the politicization of carbon border mechanisms.

Ultimately, increased investment in cleantech will require new rule frameworks. Trade agreements and supply chain arrangements may offer the necessary structure to embed rules and standards and reduce uncertainty for this emerging and critical industry. These rule frameworks may manifest themselves in smaller security and technology arrangements such as the IPEF. The competition with China may also extend to rule making.

Meanwhile, climate change continues unabated as economic nationalism, domestic politics, and climate realpolitik blunt impact efforts to decarbonize the global economy. How this story plays out remains to be seen, even as the stakes grow higher by the day.

Researcher bio: Alex Capri

Alex Capri is a research fellow at the Hinrich Foundation and a lecturer in the Business School and Lee Kuan Yew School of Public Policy at the National University of Singapore.

He is the author of *Techno-Nationalism: How it's reshaping trade, geopolitics, and society* (Wiley), due out in 2022.

From 2007-2012, Alex was the Partner and Regional Leader of KPMG's International Trade & Customs Practice in Asia Pacific, based in Hong Kong. Alex has over 20 years of experience in global value chains, business and international trade – both as an academic and a professional consultant.

He advises governments and businesses on matters involving trade and global value chains. Areas of focus include: IT solutions for traceable supply chains, sanctions, export controls, FTAs and trade optimization.

Alex has been a panelist and workshop leader for the World Economic Forum. He writes a column for Forbes Asia, Nikkei Asia and other publications and is a frequent guest on global television and radio networks.

He holds a MSc from the London School of Economics in International Political Economy and a BSc in International Relations from the University of Southern California.

Alex Capri

Research Fellow, Hinrich Foundation;
Lecturer, National University of Singapore

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MEDIA INQUIRIES

Ms. Theresa Fonseca,
Head of Marketing and Communications
T: +65 6982 6816
theresa.fonseca@hinrichfoundation.com

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