
Article

COP27 and Critical Minerals: Greenflation and Other Complications

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Abstract

This paper explores the background to COP27 and its concern with critical minerals. We discuss the differences between COP26 and COP27, especially the energy and materials crises that dramatically worsened between the two events. Then we turn our attention to the myriad issues involved in securing sufficient, ESG-compliant critical minerals to pursue decarbonization and smart adaptation. We conclude that it will be very difficult to pursue the popularized “green” model of decarbonization. A more comprehensive approach that includes nuclear and other “clean” technologies seems essential. Moreover, the sheer scale of decarbonization and digitization needs far deeper understanding, as the basis for actionable goals rather than rhetoric.

Introduction

The COP26 climate conference, held in Glasgow during November of 2021, was very ambitious. Its emphasis was on limiting global warming to 1.5 degrees Celsius and helping finance mitigation and adaptation in climate-vulnerable countries. The Glasgow agreements were certainly not as aggressive as many participants and observers wanted, including the UK organizers. But Glasgow did reach the first-ever COP agreement to explicitly reference moving away from coal and phasing out fossil fuel subsidies. At the time, there was considerable disappointment that the agreement was qualified by such phrases as “phaseout inefficient fossil fuel subsidies” and “phasedown unabated coal.” The overriding rhetorical force was focused on “keep it in the ground” (meaning fossil fuels), and to such an extent that the UK COP26 President Alok Sharma had to fight back tears after Chinese and Indian intervention prevented the coal commitment from being an explicit “phase out” instead of “phase-

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down.”¹⁾

COP26 was very much animated by hopes for accelerated mitigation and a decarbonizing recovery from COVID 19. A succession of countries announced net-zero targets, and ambitious “green new deal” programmes aimed at securing rapid rollouts of renewable energy in tandem with an emphasis on social justice and other liberal causes.²⁾ Nuclear power was sidelined, even though the world’s top climate scientists warned the COP leadership that “[a] major expansion of nuclear power is essential to avoid dangerous anthropogenic interference with the climate system this century... We’ve done the math and we can’t power the world without nuclear energy.”³⁾ The oil and gas companies were even more unwelcome at COP26, their then low market capitalization being seen as further confirmation that they and other fossil-fuel interests were yesterday’s energy interests.⁴⁾

A year later, the world was very different. As we see in **figure 1**, the trend towards higher energy prices was already underway before COP26, after reaching a low in the spring of 2020. The price declines were due to the economic ravages of COVID 19 and the influence of ESG thinking about the future of fossil fuels. The COP 26 meeting generally ignored the data, but by early 2022 observers were warning that “[t]he higher prices are not necessarily positive for renewable energy, and certainly not for the climate... Because gas has become more expensive, there has been a partial switch back to coal as a source of electricity in 2021. And because coal is more polluting, we’ve seen CO2 emissions increase.”⁵⁾

During the following months of 2022, especially as the Russia-Ukraine war continued, energy prices climbed even higher. The crises compelled the Germans to postpone their planned exit from nuclear power, after months of intensely ideological opposition from the

1) Freddie Daley and Peter Newell, “Why COP26 failed on fossil fuels,” Institute of Development Studies, December 2, 2021: <https://www.ids.ac.uk/opinions/why-cop26-failed-on-fossil-fuels/>

2) Zaheer Allam, et al., “Green new deals could be the answer to COP26’s deep decarbonisation needs,” Sustainable Horizons, Volume 1, January 2022: <https://www.sciencedirect.com/science/article/pii/S2772737822000013>

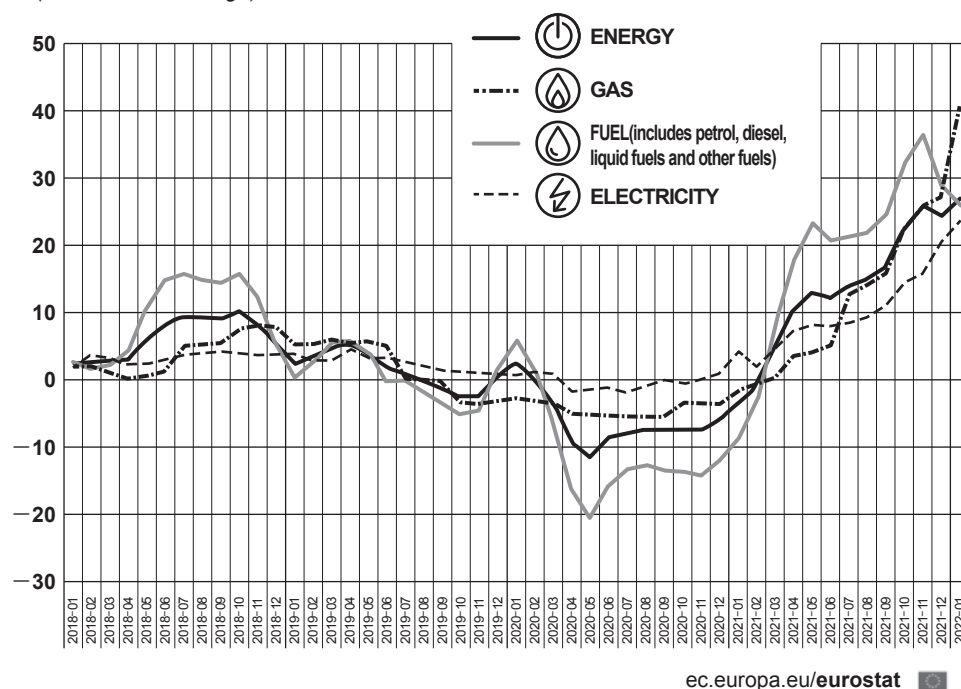
3) James Conca, “Why was Nuclear side-lined at COP26?,” EnergyPost.EU, November 16, 2021: <https://energypost.eu/why-was-nuclear-side-lined-at-cop26/>

4) Naomi Klinge, “‘At COP26, nobody wanted to see us’: Oil and gas companies see geopolitics shifting sentiments,” Upstream, March 10, 2022: <https://www.upstreamonline.com/energy-transition/at-cop26-nobody-wanted-to-see-us-oil-and-gas-companies-see-geopolitics-shifting-sentiments/2-1-1181359>

5) See Patrick Gill and Per Jorgensen, “What do rising energy prices mean for the green energy transition?,” Ramboll, April 27, 2022: <https://ramboll.com/media/rgr/what-do-rising-energy-prices-mean-for-the-green-energy-transition>

Evolution of energy prices in the last 5 years, EU

(annual rate of change)



ec.europa.eu/eurostat 

Source: Gilly and Jorgensen, 2022 ⁶⁾

Figure 1 Evolution of EU energy prices from January 2018 to January 2022

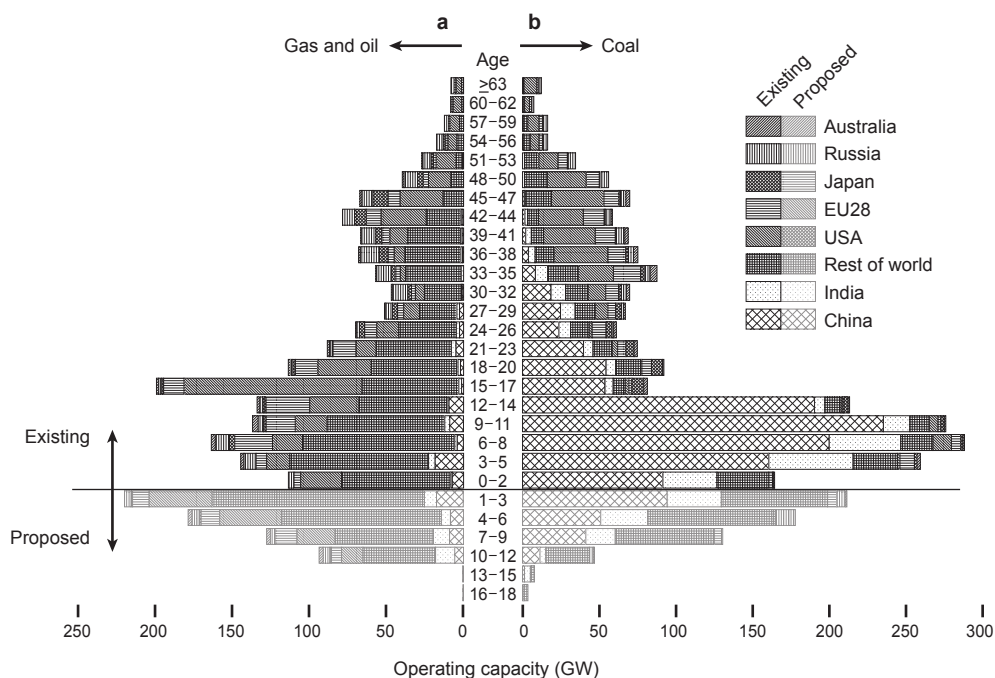
Greens within its coalition government.⁷⁾ And critical discourse concerning energy subsidies virtually disappeared. On the eve of COP27, energy subsidies – whether efficient or inefficient – have not declined. Rather, amidst the ravages of energy inflation unseen since the 1970s, subsidies ballooned into the hundreds of billions of dollars and Euros and trillions of yen, as rich governments ramped up protections for vulnerable and politically rebellious populations. At the same time, the combined effect of ESG-encouraged underinvestment in fossil fuel projects, and then the Russian invasion of Ukraine, forced the Germans to restart mothballed coal plant, though they loudly insisted that accelerated rollouts of green energy would render

6) See Patrick Gill and Per Jorgensen, “What do rising energy prices mean for the green energy transition?,” Ramboll, April 27, 2022: <https://ramboll.com/media/rgr/what-do-rising-energy-prices-mean-for-the-green-energy-transition>

7) Peter Sorge, et al., “Scholz Extends Germany’s Last Nuclear Plants to Quell Feud,” *Bloomberg News*, October 18, 2022: <https://www.bloomberg.com/news/articles/2022-10-17/germany-to-extend-lifetime-of-all-three-nuclear-power-plants>

the coal restarts a temporary blip. European Commission executive vice president Frans Timmermans thus complained that observers are misunderstanding Europe, declaring that “Even if we use a bit more coal today, we’ll be going much faster in our energy transition. On balance, emissions will be reduced even faster than before.”⁸⁾

Few observers seemed ready to take the Europeans at their word. As we see in figure 2, fossil-powered energy projects are aging in the EU 28 countries and the US, whereas the newer and planned plant is largely sited in China (especially coal) and the rest of the world (especially gas). This result reflects the fact that the developed countries built up their wealth with cheap fossil-powered electricity generation. In recent years, their accumulated wealth plus slowing population and economic growth have allowed them to reduce their



Source: UNECE, 2022⁹⁾

Figure 2 Operating capacity of existing and planned fossil fuel power plans, oil and gas on the left, coal on the right (baseline year 2018)

8) “EU settles its Cop 27 position,” Argus Media, October 24, 2022: <https://www.argusmedia.com/en/news/2383639-eu-settles-its-cop-27-position>

9) See UNECE, “Carbon Neutrality in the UNECE Region: Integrated Life-cycle Assessment of Electricity Sources,” United Nations Economic Commission for Europe, March, 2022: https://unece.org/sites/default/files/2022-04/LCA_3_FINAL%20March%202022.pdf

comparative reliance on fossil fuels in the power mix, and particularly the role of coal. One consequence of this was years of EU constraints on and criticism of Africa for seeking to exploit its natural gas reserves. But suddenly there is ample EU funding of African natural gas projects for so-called short-term imports, in spite of the years of hectoring Africans that they must develop via renewables.

Indeed, during 2022, billions of dollars of European finance began flowing into Senegal, Tanzania and other African countries for gas development and export projects that Rystad Energy calculates could equate to 75% of current Russian gas output by the late 2030s.¹⁰⁾ German NGOs such as Germanwatch, Greenpeace, and others expressed deep concern that ongoing German chancellery and economy ministry discussions are likely to further loosen the purse strings for upstream extraction and midstream transport infrastructure projects.¹¹⁾ Yet at the same time there was scant external help with financing the USD 100 billion of planned African power plant, including 35 GWs of gas, and royalties from exports are deemed inadequate.¹²⁾ Amani Abou-Zeid, the African Union's commissioner for energy and infrastructure, lamented to the October 27 *New York Times* that "Just two to three months ago, those same Europeans who were lecturing us on 'no gas' say they'll make a compromise ... We are trying to survive. But instead we are being infantilized."¹³⁾ And Vijaya Ramachandran, the outspoken director for energy and development at California's Breakthrough Institute, castigates this emerging paradigm as "green colonialism," wherein rich countries exploit poorer nations' resources while essentially denying them similar access, in the name of climate action.¹⁴⁾

This background led observers to expect the simmering discontent to be articulated

10) Rystad Energy, "Europe Looks To African Gas To Reduce Dependence On Russian Imports," Oil Price, May 14, 2022: <https://oilprice.com/Energy/Natural-Gas/Europe-Looks-To-African-Gas-To-Reduce-Dependence-On-Russian-Imports.html>

11) Julian Wettengel, "NGOs call on German govt to close door on foreign fossil fuel support," Clean Energy Wire, October 31, 2022: <https://www.cleanenergywire.org/news/ngos-call-german-govt-close-door-foreign-fossil-fuel-support>

12) Rahul Tongia, "It is unfair to push poor countries to reach zero carbon emissions too early," Brookings Planet Policy Blog, October 26, 2022: <https://www.brookings.edu/blog/planetpolicy/2022/10/26/it-is-unfair-to-push-poor-countries-to-reach-zero-carbon-emissions-too-early/>

13) Max Bearak, et al., "A Power Balance Shifts as Europe, Facing a Gas Crisis, Turns to Africa for Help," *New York Times*, October 27, 2022: <https://www.nytimes.com/2022/10/27/climate/europe-africa-natural-gas.html>

14) Neil Munshi, et al., "Europe's Rush to Buy Africa's Natural Gas Draws Cries of Hypocrisy," *Bloomberg News*, July 11, 2022: <https://www.bloomberg.com/news/features/2022-07-10/europe-s-africa-gas-imports-risk-climate-goals-leave-millions-without-power>

at COP27, also known as the *African COP*. Indeed, the Egyptian interests were already – as they did at the October 26 Cairo meet of the Gas Exporting Countries Forum – arguing that natural gas is the perfect solution to strike a balance between the imperatives of energy security and addressing climate change. As *Reuters* reported on November 8, “[t]he backsliding by major economies on their promises to shift from fossil fuels has led some nations, especially in Africa, to call for a formal recognition that they should be allowed to develop their fossil fuel reserves. This is likely to be evident in African leaders’ opening statements at COP27.”¹⁵⁾

Europe Backpedals While Promising Green

We have seen that the EU is financing ample African gas projects for its own use, and Germany has delayed its planned nuclear exit while restarting mothballed coal projects. As to renewables within the EU, there were plenty of bold initiatives announced, such as raising the share of renewable electricity in the power mix from 37% in 2021 to 69% by 2030.¹⁶⁾ Yet at the same time, Vestas – the world’s largest wind turbine firm – was desperately and rather bizarrely calling on COP27 bureaucrats to “save the world” via relaxing permitting rules,¹⁷⁾ something the COP is not empowered to do. A witches’-brew of greenflation, fossilflation and climateflation was undermining European supply chains for green power systems, per se, not to mention fertilizers, aluminum, glass, cement, steel, and other essentials. The sad fact is that European wind installations declined 39% from the third quarter of last year. The Vestas CEO has taken to insisting that “delegating wind farm permitting to municipalities is delegating defence policy,” in a bid to accelerate deployment as akin to a wartime measure.¹⁸⁾ But permitting was certainly not Vestas’ only problem, as we shall see later in our examination of supply chains.

Interestingly, the IEA seemed inclined to offer rhetorical support for this desperation.

15) Valerie Volcovici, “Explainer – COP27: what’s on the U. N. climate talks agenda,” *Reuters*, November 8, 2022: <https://jp.reuters.com/article/climate-un-issues-explainer-idAFKBN2RY0MM>

16) See “The share of renewables in the EU power mix should reach 69% in 2030,” Enerdata, October 21, 2022: <https://www.enerdata.net/publications/daily-energy-news/share-renewables-eu-power-mix-should-reach-69-2030.html>

17) See “Let the Bureaucrats Save the World at COP27,” Vestas, 2022: <https://www.vestas.com/en/about/cop27>

18) Craig Richard, “Vestas CEO: ‘Delegating wind farm permitting to municipalities is delegating defence policy,’” *Wind Power Monthly*, October 13, 2022: <https://www.windpowermonthly.com/article/1801980/vestas-ceo-delegating-wind-farm-permitting-municipalities-delegating-defence-policy>

The IEA's summary of its World Energy Outlook 2022 blithely asserts that current policies are putting renewables and electric vehicles on the cusp of driving out coal over the next few years, making gas demand peak out by 2030, and then driving down oil demand.¹⁹⁾ Critics countered that the IEA's questionable projections are predicated on current increases in fossil fuel use being a short-term blip when in fact there are massive structural shifts underway making the energy transition more protracted rather than compacted. Moreover, Goldman Sachs' Jeffrey Currie pointed out on October 3, 2022 that USD 3.8 trillion had been spent on renewables over the previous decade, and yet this huge investment only trimmed the global energy mix's reliance on fossil fuels by 1%, from 82 percent to 81 percent.²⁰⁾ On top of that, the recent increases in coal and other fossil demand have likely erased even that tiny decline in fossil fuels' role.²¹⁾

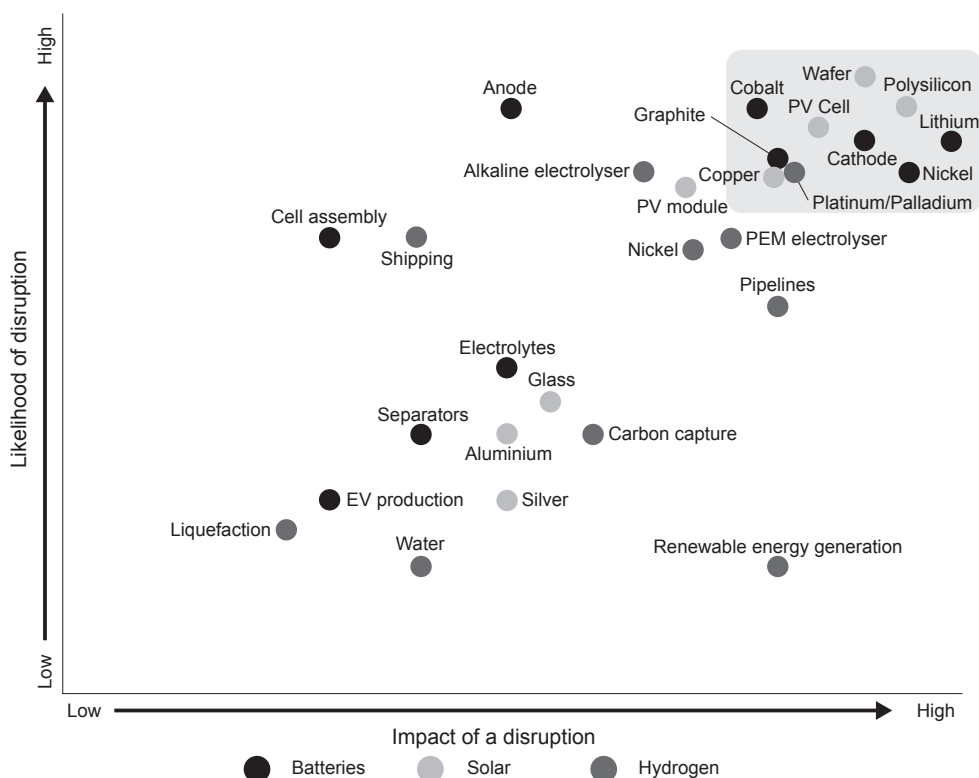
COP27 could not do more than give lip service to an accelerated rollout of renewables, consistent with ambitious climate goals from the previous year. If anything, COP27 acknowledged that the decarbonizing transition must necessarily be more protracted and more expensive than what was assumed at COP26. One reason is evident in **figure 3**, which portrays material risks for batteries, solar and hydrogen. The figure shows that the key critical minerals (especially nickel, copper, cobalt, lithium, and platinum/palladium) for these core "green"²²⁾ technologies are especially at risk for high likelihood and impact of disruption. Added to that are myriad difficulties in securing the massive supplies of copper, lithium, platinum, manganese, graphite, rare earths and other 30-odd critical minerals needed to build all the wind turbines, solar farms, EVs, hydrogen electrolyzers and ancillary infrastructure, even as the global economy deteriorates. COP 26 essentially ignored the issue of critical minerals, but COP 27 featured a host of dedicated events due to their urgency. Those events helped inform a more realistic consensus that we need a broader portfolio of clean energy – not least of which being more nuclear – to balance the critical-mineral intensive green energy

19) IEA, "Executive Summary: World Energy Outlook 2022, International Energy Agency, 2022: <https://www.iea.org/reports/world-energy-outlook-2022/executive-summary>

20) Marc Pickren, "3.8 Trillion Green Investment Yields No Change in Fossil Fuel Consumption and Related Climate Impact," Medium, October 31, 2022: <https://medium.com/@marc.pickren/3-8-trillion-green-investment-yields-no-change-in-fossil-fuel-consumption-and-related-climate-90144dcec940>

21) "Energy addition versus energy transition," BIC Magazine, November 1, 2022: <https://www.bicmagazine.com/energy-addition-versus-energy-transition/>

22) Here, we refer to green hydrogen, which most anti-nuclear advocates of decarbonization favour over pink hydrogen (produced by nuclear) and other colours. On these colours of hydrogen, see National Grid "The hydrogen colour spectrum": <https://www.nationalgrid.com/stories/energy-explained/hydrogen-colour-spectrum>



Source: IEA, 2022²³⁾

Figure 3 Critical minerals and supply-chain disruption risks for batteries, solar and hydrogen

solutions that were all the rage at COP26.

The United States Goes “Clean”

One reason was that the US came back in a big and broad-based way. In 2021, the US was focused on a Green New Deal and Build Back Better initiative, essentially a \$555 billion spending program that was addressed primarily at green energy, environmental justice, and a host of wish-list items favoured by the powerful progressive wing in the Democratic Party. This complex initiative was stymied by Joe Manchin, the centrist Democratic Senator from West Virginia.²⁴⁾ Manchin was vilified in the US press as a captive of fossil fuel interests,

23) See IEA, “Securing Clean Energy Technology Supply Chains,” International Energy Agency, July 2022: <https://www.iea.org/reports/securing-clean-energy-technology-supply-chains>

24) James Politi, “Joe Manchin demolishes Biden’s plans to Build Back Better,” *Financial Times*, December 20, 2021: <https://www.ft.com/content/aad74276-bafd-4090-ab2a-6000ed4a1187>

with one widely tweeted article being titled “Joe Manchin to Planet Earth: Drop Dead.”²⁵⁾ But in fact Manchin is not a climate denier nor an opponent of clean energy, and is one of the key figures who has been building comprehensive and critical-mineral inclusive climate industrial policy. His main concern was with the material and inflationary impacts of extra subsidies to further incentivize renewables.

Thus during August of 2022, Manchin bargained with his Senate counterparts and reached agreement on a leaner, \$369 billion measure called the Inflation Reduction Act, or “IRA.” The IRA stands as America’s largest-ever climate program, and is expected to trim US emissions by 31% to 44% (depending on modeling assumptions) by 2030 relative to 2005 levels. Equally important was that IRA is based on technologically neutral tax incentives rather than direct expenditures. The result is that even political change will likely not see these measures eviscerated. Tax expenditures do not get cut in Washington; indeed, even under Trump wind and other tax incentives were increased.²⁶⁾ What Manchin got was a rationalization of energy-transition incentives, to include nuclear and critical minerals on an even footing with solar, wind, renewable-generated hydrogen, and other “green” favourites of the progressive Democrats. So the US has more credibility, but it is also “all of the above,” including carbon capture and all colours – green, pink, blue, and so on – of hydrogen. Technological neutrality means that no specific energy source – among the renewable, nuclear, and other options – is advantaged for producing hydrogen.²⁷⁾

A measure of broad-portfolio developments in the US is seen in what is being done by the infamous Koch family, billionaire owners of Koch Industries and reputed puppet-masters of US right-wing politics.²⁸⁾ Though the American liberal press seem unwilling to question their entrenched narrative of the climate-denying Kochs, the fact is their firms are betting on an energy transition. The evidence can be seen in their Koch Engineered Solutions that encompasses critical minerals, hydrogen, renewable fuels, biogas, and other explicitly “envi-

25) Jordan Weissman, “Joe Manchin to Planet Earth: Drop Dead,” *Slate Magazine*, July 15, 2022: <https://slate.com/news-and-politics/2022/07/joe-manchin-climate-spending-democrats.html>

26) Janet Nodar, “US spending bill benefits wind power development,” *Journal of Commerce Online*, January 6, 2020: https://www.joc.com/breakbulk/energy-and-renewables-project-logistics/us-spending-bill-benefits-wind-power-development_20200106.html

27) Mona Dajani, “Diving into the Inflation Reduction Act’s tax credits and the ambitious plan to reshape the US energy sector,” *Utility Dive*, August 9, 2022: <https://www.utilitydive.com/news/diving-into-the-inflation-reduction-acts-tax-credits-and-the-ambitious-pla/629075/>

28) On this, see the summary at “Koch Industries: Secretly Funding the Climate Denial Machine,” *Greenpeace*, nd.: <https://www.greenpeace.org/usa/fighting-climate-chaos/climate-deniers/koch-industries/>

ronmental solutions.” Another impressive example of their activity is seen in their commitment to investing USD 1.7 billion energy transition including renewables and critical minerals.²⁹⁾

The Kochs are the ultimate pragmatists. Hence, Koch Industries invest in areas where they do not need to bargain with bothersome federal and regional regulators, meaning in particular that they avoid California like the plague. Indeed, many investors have bailed out of California’s over-hyped Salton Sea source of lithium, because the regulatory and tax issues are deemed too onerous.³⁰⁾

In short, the Kochs and others are committed to energy transition, but on their terms. The great irony is that COP27 may benefit by the weakened Biden Democrat control of the Senate and House of Representatives from the November 8 midterm elections. As noted, the Republicans are very, very unlikely to cut tax expenditures. Moreover, they may be inclined to address the regulatory and permitting issues that the Biden Democrats cannot or will not.³¹⁾ It is difficult to exaggerate the salience of the permitting issue: as a detailed expert analysis points out: “the IRA would not address impediments arising from the complex system of US federal and state environmental laws, regulations, and permitting processes applicable to mining operations. Some experts consider these permitting obstacles to be the single largest impediment to expanding domestic production of critical minerals at a scale needed to support the energy transition.”³²⁾ The Japanese, South Koreans, Europeans and others are of course upset that the US wants to reshore clean energy production, or at least “friend-shore” it towards close trading partners such as Canada.³³⁾ But here, the important point is that the US is technologically neutral in its massive tax-expenditure financed industrial poli-

29) A summary of the commitments can be seen at “Powering Up Energy Transformation,” Koch Newsroom, January 19, 2022: <https://news.kochind.com/news/2022/powering-up-energy-transformation>

30) Ernest Scheyder, “California approves lithium tax despite industry’s warnings,” *Reuters*, July 1, 2022: <https://www.reuters.com/business/sustainable-business/california-approves-lithium-tax-despite-industrys-warnings-2022-07-01/>

31) Jael Holzman and Hannah Northey, “Biden wants minerals, but mine permitting lags,” *E&E News*, August 9, 2022: <https://www.eenews.net/articles/biden-wants-minerals-but-mine-permitting-lags/>

32) David Bond and Brian Picone, “New US Climate Bill Seeks to Bolster Domestic Critical Minerals Supply Chain,” *White & Case*, August 2, 2022: <https://www.whitecase.com/insight-alert/new-us-climate-bill-seeks-bolster-domestic-critical-minerals-supply-chain>

33) Adrian Wooldridge, “The West Needs Friendshoring, Not Reshoring,” *Bloomberg News*, August 29, 2022: <https://www.bloomberg.com/opinion/articles/2022-08-29/the-west-needs-to-friendshore-not-reshore-supply-chains>

cy, and just needs permitting to accelerate even faster. The US midterm elections of 2022 may prove to have helped deliver permitting much faster than the COP bureaucrats Vestas is appealing to.

China Digs Deep on Coal

China's position became incredibly difficult to discern, due to turmoil in its economy and its relations with the US. But what became after COP26 was that China is building 270 GWs of new coal capacity, an increment that exceeds the installed coal fleets of any other country.³⁴⁾ Some observers – such as the environmental lobby Ember – sought to quell concerns by insisting that “As long as China's not inventing a whole new use for thousands of terrawatt-hours of power, then from a demand perspective it's got to be reducing coal power, because there's nowhere else for that electricity to go.” But China's 2000–2020 net electricity generation data show that the Chinese have indeed been inventing new uses for 1,000 TWh increments, at an accelerating pace that recently reached every 2 to 3 years.³⁵⁾ The Chinese also have plenty of electrification to do in mobility, industrial processes, and elsewhere. So it would appear the demand will be there, and hence it seems very possible that their new coal capacity could be used along with everything else they are building. To mollify worries about this, China sought to showcase its impressive rollout of renewables and EVs, while articulating the concerns of developing countries. But Japanese press accounts wondered if China would get its first-even “fossil of the day” award from the anti-nuclear Climate Action Network, which is basically an annual rite of passage for Japan at COP.³⁶⁾

Japan's Cautious Position

Japan sought to deflect criticism at COP27, caught in the vice-grip of a cheap yen and very expensive energy. In decades past, a cheap yen was key to “export drives” by Japan's

34) On this data, see the summary at “China Is Doubling Down on Coal Despite Its Green Ambitions,” *Bloomberg News*, October 31, 2022: <https://www.bloomberg.com/news/articles/2022-10-31/china-wants-more-coal-power-and-to-hit-climate-change-targets>

35) See the data and analysis at Lucas Davis, “Putting China's Coal Consumption in Context,” *Energy Institute Blog*, UC Berkeley, October 31, 2022: <https://energyathaas.wordpress.com/2022/10/31/putting-chinas-coal-consumption-in-context/>

36) The Network is comprised of 1,800 civil society organizations from over 130 countries. See “Fossil of the Day,” *Climate Action Network*: https://climatenetwork.org/resource_type/fossil-of-the-day/

manufacturing powerhouse, and an appreciating yen worried business and policymakers. But along with subsequent offshoring of much of the manufacturing base, the legacy of Japan's 2011 Fukushima catastrophe coupled with strikingly expensive and insecure energy make the yen's depreciation in 2022 very different from two decades before. So Japan's COP27 approach was cautious, earning it COP27's first "fossil of the day award" from the Climate Action Network, on November 9. They claimed that "In a year of unprecedented climate disasters, with vulnerable communities all over the world suffering from the impacts of climate change, Japan's public finances are flowing into the fossil fuel projects responsible for this destruction rather than going towards financing the loss and damage caused by its own greenhouse gas emissions."³⁷⁾

The Fukushima disaster idled nuclear plant that once supplied a third of Japan's power needs at very low cost. The 11 years since have seen restarts – overseen by overzealous regulators – proceed at a needlessly slow pace. As of November 2022, just six of 33 viable reactors are operating, providing about 6 percent of overall electricity. Expensive natural gas, coal and fickle solar fill the gap, and consequently power prices have climbed nearly 30 percent in October, with a further 20–30 percent in the pipeline for 2023. The Japanese government began deploying a whopping 6 trillion yen to subsidize power, gasoline and other energy costs that collectively were expected to rise from JPY 37.4 trillion in 2021 to JPY 50.9 trillion in 2022.³⁸⁾ The government is also keen to accelerate restarts, as each reactor restart cuts costly LNG demand by 1 million tonnes per year.³⁹⁾ But observers caution that only a couple more may restart before year's end, with at best 15 or so in operation over the next few years.

Numbers don't lie. Japan relies on imports for roughly 90 percent of its primary energy supply, and each trillion yen of its dramatically depreciated currency buys far fewer tonnes of fuels in the midst of what IEA head Fatih Birol describes as the world's "first truly global energy crisis."⁴⁰⁾ Thus during the first half of fiscal 2022, imports climbed by 47.1 per-

37) See "COP27: First Fossil of the Day Goes to ...Japan," Climate Action Network, November 9, 2022: <https://climatenetwork.org/resource/fossil-of-the-day-9th-of-november-2022-japan/>

38) See Sugiyama Taishi, "How much will the Japanese government's new economic countermeasures reduce energy costs?" (in Japanese) Enerugii Forum, November 11, 2022: <https://energy-forum.co.jp/online-content/10883/>

39) See the data in "Rebuilding Japan's Energy Security," (in Japanese) GX Promotion Minister presentation to 2nd meeting of the GX implementation meeting, August 24, 2022: https://www.meti.go.jp/shingikai/enecho/denryoku_gas/genshiryoku/hoshasei_haikibutsu/pdf/037_05_00.pdf

40) Emily Chow, "World is in its 'first truly global energy crisis' – IEA's Birol," *Reuters*, October 25,

cent, largely due to energy costs, versus a 21.3 percent increase in exports.⁴¹⁾

Of course, were the energy crisis merely transitory, the cheap yen might soon begin to deliver more benefits than costs. But the outlook is for a protracted crisis of at least a few years.⁴²⁾ This fact threatens the recent uptick in growth through eroded consumer purchasing power and the business sector's inability to keep sucking up the pain of the highest-ever 9.1% rise in the producer price index.⁴³⁾ Adding to the gloom, Japan is also gravely exposed to the so-called "greenflation" of lithium, copper, rare earths and other imported critical minerals required for its ambitious industrial policy of growth through clean energy and digital transformation. So any brightening of its economic prospects and quick action on its climate ambitions depend very much on accelerating the restart of its long-idled nuclear capacity.

The Elephant in the Room at COP27

Other factors that impaired ambition at COP27 include the enormous weight of China in producing critical minerals and other material and components for electric vehicles and renewable energy. In addition to Chinese dominance, the price of the materials is also climbing.

As we see in **figure 4**, between 2010 and 2022 China's role in producing polysilicon (essential to solar in addition to semiconductors) rose from under 30% to over 80%. China's ability to absorb environmental and other costs and produce cheap, quality product saw the price of polysilicon dive between 2010 and 2015 as China outpaced US, German, Japanese and Korean competitors. At the same time, production volumes went into a steadily increasing trend, driving prices down even more (albeit at a slower rate) to 2020. More recently, prices have reversed their decline and started to rise. But it seems very difficult to envision a significant reduction in China's dominance over the coming decade. Indeed, market analyses suggest that 2023 will see global polysilicon capacity top 1.2 million tons, with 89% of production

2022: <https://jp.reuters.com/article/asia-energy-ia-idAFKBN2RK04F>

41) See "Japan logs record \$73bn trade deficit in 1st half of fiscal 2022," *Nikkei Asia*, October 20, 2022: <https://asia.nikkei.com/Economy/Inflation/Japan-logs-record-73bn-trade-deficit-in-1st-half-of-fiscal-2022>

42) Johanna Treeck, "Mittel-kaput? German industry stares into the abyss," *Politico*, November 10, 2022: <https://www.politico.eu/article/germany-industry-europe-energy-prices-basf/>

43) See "Last month's rise in the producer price index was 9.1% over the previous year and highest ever for seven months straight," (in Japanese) NHK News, November 11, 2022: <https://www3.nhk.or.jp/news/html/20221111/k10013887461000.html>

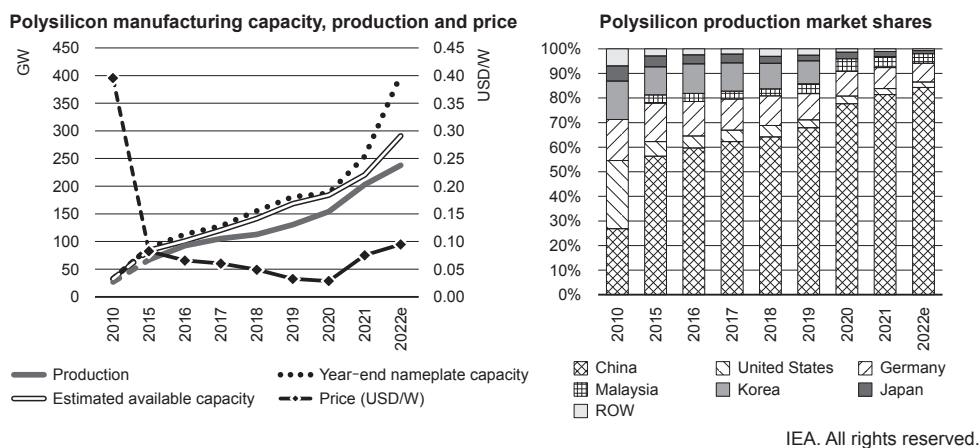


Figure 4 Global polysilicon manufacturing capacity, production, average price and market share: 2010-2022

in China. The majority of new projects – fully 72% – are expected to be outside of China, particularly in Germany and the United States. But it is unclear how much that non-China production can expand further, in the face of various regulatory and other costs.⁴⁵⁾

The point is that the more solar is emphasized in decarbonization, the greater the reliance on China. This issue already began to complicate American decarbonization options before COP27, because the Biden administration's IRA policies were avowedly protectionist and favouring its own emerging bloc of allied resource-rich countries such as Canada and Australia. The concern at COP27 was that the United States risked driving up the price of solar by as much as 25% were China and Germany to follow suit. And developing countries expressed concern that the Americans were "insisting a lot on building the power, the capacity [and] the industrial jobs within the U.S. at the expense of having a capacity for those countries to develop their part of the global supply chains — their fair share of the global supply chains — in terms of jobs and added value." The implications of such an approach for the poorer countries was seen as a transition in which "[a]ll the added value will be captured

44) See IEA, "Solar PV Global Supply Chains: An IEA Special Report," July, 2022: <https://www.iea.org/reports/solar-pv-global-supply-chains>

45) See CEA, "Global Polysilicon Capacity to Exceed 1.2m Tons by 2023 with Most Expansions Planned Outside Xinjiang, China, According to Latest Survey of PV Suppliers," Clean Energy Associates, August 19, 2021: <https://www.cea3.com/cea-blog/global-polysilicon-capacity-outside-xinjiang-smip>

again by the already developed countries and [leave] nothing for these countries.”⁴⁶⁾

As for the Europeans, they received a collective shock through the Russian invasion of Ukraine and the sudden exposure of their vulnerability in supplies of fossil fuels (especially Russian gas) in addition to many critical minerals and other essential commodities. Their policymakers have sought to craft a critical minerals (in Europe, referred to as critical raw materials) approach that reduces reliance on Russia and China. As the United Nations Economic Commission for Europe (UNECE) noted on October 17, 2022, in the lead-up to COP27: “To deliver on climate change and sustainable development, the UNECE region must optimize the management of endowments of natural resources, including critical raw materials (CRMs). A resilient, sustainable and ethical supply of CRMs is essential for clean energy, mobility transitions, and digital transformation. Resiliency in resource supply requires careful attention to several important environmental, economic and social considerations. Governments, industry, the financial sector, and civil society must cooperate to share relevant social and environmental information and knowledge.”⁴⁷⁾

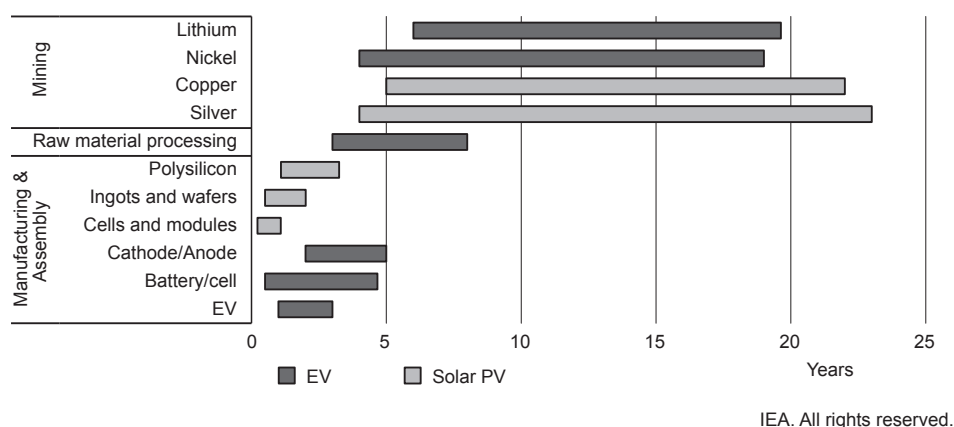
One problem with emphasizing this broadly inclusive and justice-driven approach is that it takes time. The more one expands the number of stakeholders that have a voice or even a veto, the greater the likelihood that reshoring or friendshoring of critical mineral mining and refining will be delayed, if not blocked altogether. Investor-oriented publications were already warning that “[t]here are many NGOs and mining-affected communities who feel like even the phrase ‘critical minerals’ is one which is a code language for expediting, permitting and reducing the oversight.”⁴⁸⁾ And yet at the same time, the EU insists it will nearly double its renewable power by 2030, a goal that implies massive material deployments of critical minerals in solar arrays, wind farms, transmission and distribution lines, storage systems, and other critical mineral-intensive infrastructure.

As we saw in **figure 5**, new mining projects for the lithium, nickel, copper and silver that are crucial to EVs and solar take at the very least several years in regions (eg, Australia and South America) that already have substantial critical mineral mining. And ma-

46) Jean Chemnick, “Why America’s climate law is causing rifts at COP 27,” E&E News, November 7, 2022: <https://www.eenews.net/articles/why-americas-climate-law-is-causing-rifts-at-cop-27/>

47) See UNECE, “Towards COP27: UNECE Regional Forum on Climate Initiatives to Finance Climate Action and the SDGs,” United Nations Economic Commission for Europe, October 17, 2022: <https://unece.org/sustainable-energy/events/forum-climate-financing-CRM>

48) Ben Payton, “Critical minerals: the race to finance responsible mining,” *Responsible Investor*, August 24, 2022: <https://www.responsible-investor.com/critical-minerals-the-race-to-finance-responsible-mining/>



Source: IEA, 2022⁴⁹⁾

Figure 5 Typical lead times in EV and solar supply chains

ny projects require nearly two decades. Moreover, refining and other processing facilities have lead times that range from several years to nearly a decade. Finally, downstream manufacturing and assembly plant typically require only a few years, but emphasizing those facilities means that the reliance on imported critical minerals possibly even increases. Hence the question remains: where is the EU going to source the critical minerals it needs in great abundance in order to achieve the ambitious EV and renewable energy targets it proclaimed at COP27? The answer seems likely to be that the targets are either achieved at great pecuniary expense and worsened supply chain security, or the targets are backtracked due to the unwillingness of publics and businesses to bear additional costs and risks.

The latter outcome seems likely. Even before COP27, costs were already hollowing-out European businesses that require plenty of energy in their production processes. For example, a report from August 2022 noted that “[h]alf of the EU’s aluminium and zinc output has already been lost from curtailments and closures this year, according to Eurometaux, a trade body for non-ferrous metals that do not contain iron, as producers struggle to cope with surging electricity prices. In wider Europe, which includes Norway, Iceland and the UK, consultancy CRU expects further disruption to cause zinc production to tumble about 10 per cent to 2.2mn tonnes in 2022 over the previous year and aluminium production capacity to fall 20 per cent to 3.4mn tonnes compared with last September.”⁵⁰⁾

49) See IEA, “Securing Clean Energy Technology Supply Chains,” International Energy Agency, July 2022: <https://www.iea.org/reports/securing-clean-energy-technology-supply-chains>

50) Harry Dempsey, “More smelters face closure as Europe enters power-starved winter,” *Financial Times*, August 19, 2022: <https://www.ft.com/content/0906df5d-1b92-4de1-95d6-3ae7b1055897>

In short, a lot of EU industry was shutting down, especially energy-intensive aluminum, zinc, and critical mineral smelting needed in vast quantities for EV and renewable-focused climate goals. Those smelters often take many months to get back on line, even if they are restarted. And in the interim China and Russia gain even more market share, with China's metal mining and refining being far more GHG-intensive than Europe's. In consequence, Europe may have to further compromise its ESG goals in regard to critical minerals and other green components.

These complications are what happens when ambitious goals take precedence over actual implementation capacity; and when battery gigafactories are prioritized over critical mineral mining and refining. High-minded goals can be announced in short order, particularly when like-minded policymakers gather together. And gigafactories can be built in a year or two. But as we saw in **figure 5**, mining and refining capacity takes a decade or more. The result of the mismatch is that prices climb just as EV sales start to take off, while supply chain security weakens in tandem. Though COP27 did devote more attention to critical minerals than COP26, it was still fascinating that many policymakers, green industries, and much of academe continued to downplay the critical mineral challenge. This was in spite of issues being raised in such mainstream and progressive media as the *New York Times*, which lamented that “[o]nly a few years ago analysts were predicting that electric vehicles would soon be as cheap to buy as gasoline cars. Given the savings on fuel and maintenance, going electric would be a no-brainer. Instead, soaring prices of commodities like lithium, an essential ingredient in batteries, helped raise the average sticker price of an electric vehicle 14 percent last year to \$66,000, \$20,000 more than the average for all new cars, according to Kelley Blue Book.”⁵¹⁾

The COP27 discussion also failed to understand that, in spite of all the talk and historically high prices, investment in critical mineral development stagnated due to business risk, ESG concerns, regulatory issues, and China's demonstrated ability to underprice the competition.

Substitution and Efficiency as Silver Bullets

Substitution of materials is often touted as a means to avoid worsened dependence on

51) Jack Ewing, “Electric Cars Too Costly for Many, Even With Aid in Climate Bill,” *New York Times*, August 9, 2022: <https://www.nytimes.com/2022/08/08/business/energy-environment/electric-vehicles-climate-bill.html>

expensive and geopolitically risky imports of critical minerals. But that too takes at least many years, if it is at all possible. In some areas, it does not seem to be doable for quite some time, such as the challenges that confront battery manufacturers or automakers. One expert pointed out that “[i]n the longer term, battery cell manufacturers can look to research and develop varied cell chemistries that try to avoid some of the rising raw material prices. [However] I would call lithium and graphite really irreplaceable elements in lithium-ion batteries, and these are the two that are extremely at risk of shortage in the short term. So, no, there’s not really a workaround there apart from scaling investment into the industry, but even then, I think it’s more of a mid- to long-term solution to the issue.”⁵²⁾

Efficiency and conservation are also generally looked to as a promising solution. But consider that Norway, whose power generation is nearly 100% hydro, has the world’s highest per-capita power consumption, four times the EU average and much, much higher than China’s.⁵³⁾ Some reasons for the extremely high-power consumption are that Norway:

- 1) is host to a lot of energy-intensive industries such as aluminum smelting
- 2) uses nearly 100% electricity in its heating supply and is very cold in the winter
- 3) has very electrified transport

If Norway did not host aluminum and other energy-intensive industries, those essential commodities would be produced in locales dependent on fossil power. And if Norway’s electrification of transport were not proceeding, its residents would be driving gasoline/diesel-powered vehicles.

The point is that it is easy to talk about efficiency and conservation. But it is often very, very difficult to implement it in the real world, because the engines of decarbonization and climate resilience often require more electricity (eg, air-conditioning in India). Moreover, Norway and the EU not only look to cheap Norwegian hydro as a clean power source for households and industry, but also as extra power for making hydrogen and other energy-intensive initiatives essential to displacing the role of gas. Canada’s Quebec is in a similar position, as its hydro is used domestically for decarbonization, used increasingly in

52) Charles Morris, “The EV raw materials crunch: How bad, how long, how to solve it?,” *Charged: Electric Vehicles Magazine*, August 16, 2022: <https://chargedevs.com/features/the-raw-materials-crunch-how-bad-how-long-how-to-solve-it/>

53) See “Norway Energy Information,” Enerdata: <https://www.enerdata.net/estore/energy-market/norway/>

the US Northeast's decarbonization, and counted on as a hydrogen source by Germany, Japan, and other countries.⁵⁴⁾ Either generation capacity expands apace or these hydrogen and other goals will not be met. Therefore the prospects for overall demand cuts through conservation seem unrealistic.

There is an additional factor at work: the unprecedented energy-intensiveness of the new materials and infrastructures used in decarbonization and digital transformation. One of the best observers of this phenomenon is Mark Mills, who argues as follows:

“digital devices and hardware – the most complex products ever produced at scale – require, on average, about 1,000 times more energy to fabricate, pound for pound, than the products that dominated the 20th century...it takes nearly as much energy to make one smartphone as it does one refrigerator, even though the latter weighs 1,000 times more. The world produces nearly 10 times more smartphones a year than refrigerators. Thus, the global fabrication of smartphones now uses 15% as much energy as does the entire automotive industry, even though a car weighs 10,000 times more than a smartphone. The global Cloud, society's newest and biggest infrastructure, uses twice as much electricity as the entire nation of Japan.”⁵⁵⁾

COP27 failed to understand the voracity of the energy transition and other ESG, SDG goals it emphasized. That fact is simply incredible, and highlights the need for much more input from material-literate specialists and pragmatists from the developing world.

Conclusions

We have seen that COP26 and COP27 took place in dramatically different contexts, especially due the energy and materials crises that dramatically worsened between the two events. We also noted some of the myriad issues involved in securing sufficient, ESG-compliant critical minerals to pursue decarbonization and smart adaptation. Our conclusion is that it will be very difficult to pursue the popularized “green” model of decarbonization, espe-

54) See, for example, the remarks in Nikola Kis, “Canadian companies to export hydrogen to Europe,” *Brussels Morning*, November 4, 2022: <https://brusselsmorning.com/canadian-companies-to-export-hydrogen-to-europe/27710/>

55) Cited in James Freeman, “Why the Energy Transition Will Fail,” *Wall Street Journal*, August 26, 2022: <https://www.wsj.com/articles/why-the-energy-transition-will-fail-11661547051>

cially the EU's goals for 2030. Decarbonization is an imperative, and one that transcends ideological camps. In pursuing it, a comprehensive approach that includes nuclear and other "clean" technologies seems essential. The sheer scale of decarbonization and digitization's appetite for critical minerals and electricity also needs much more objective analysis. The worsening threat from greenflation and other challenges underscore the need for least-cost and actionable goals rather than grandstanding rhetoric and wishful thinking.