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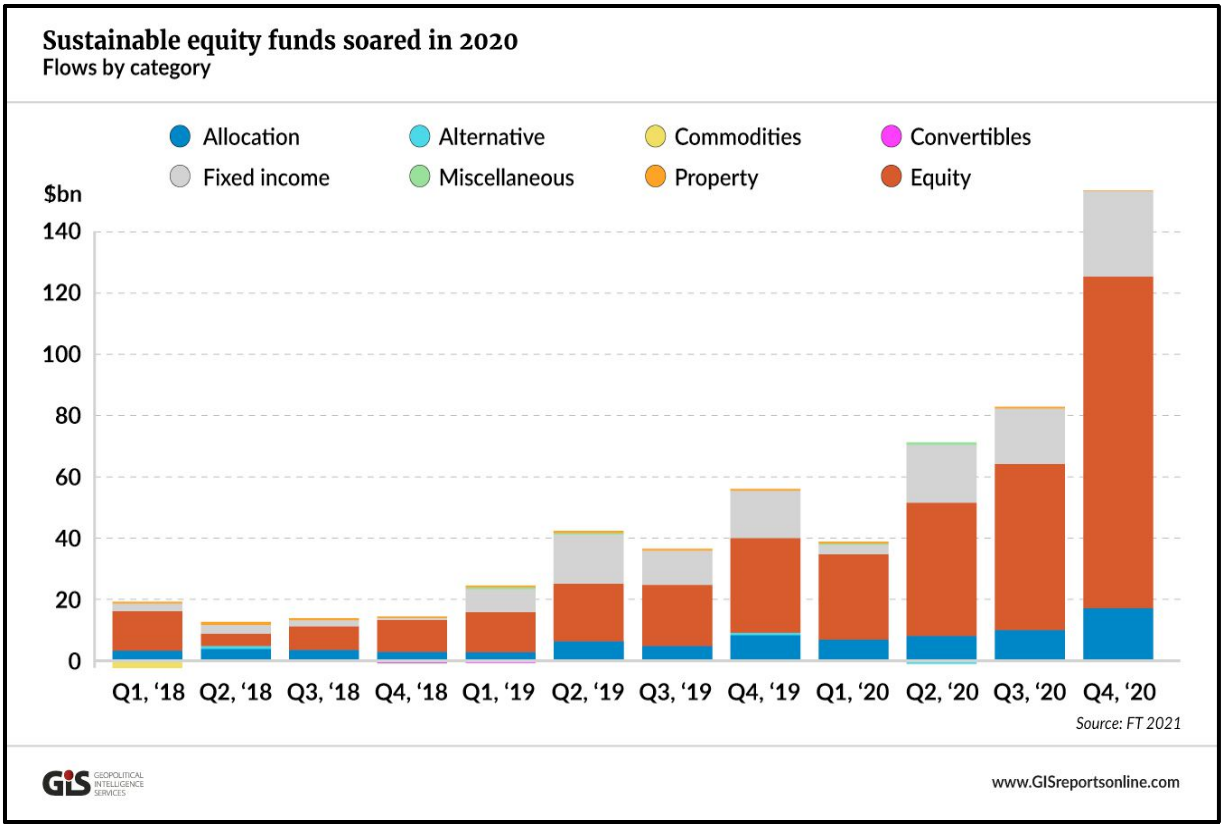
Europe's New Green Deal's Energy Aspects: Cooperation, Synergies and Opportunities for India

Contents

1. Introduction

The global energy sector has remarkably shifted during the last decade and has strengthened worldwide efforts for decarbonizing it for achieving the 1.5°C target in context of the Paris Agreement to mitigate global warming and avoiding disastrous impacts across the globe. A growing number of countries has adopted net-zero pledges. Equally, an increasing number of companies and equity funds have also begun to reflect a growing sense of attention for accelerating a reduction of their carbon footprint and promoting a clean energy transition.

Figure 1: Sustainable Equity Funds Soared in 2020

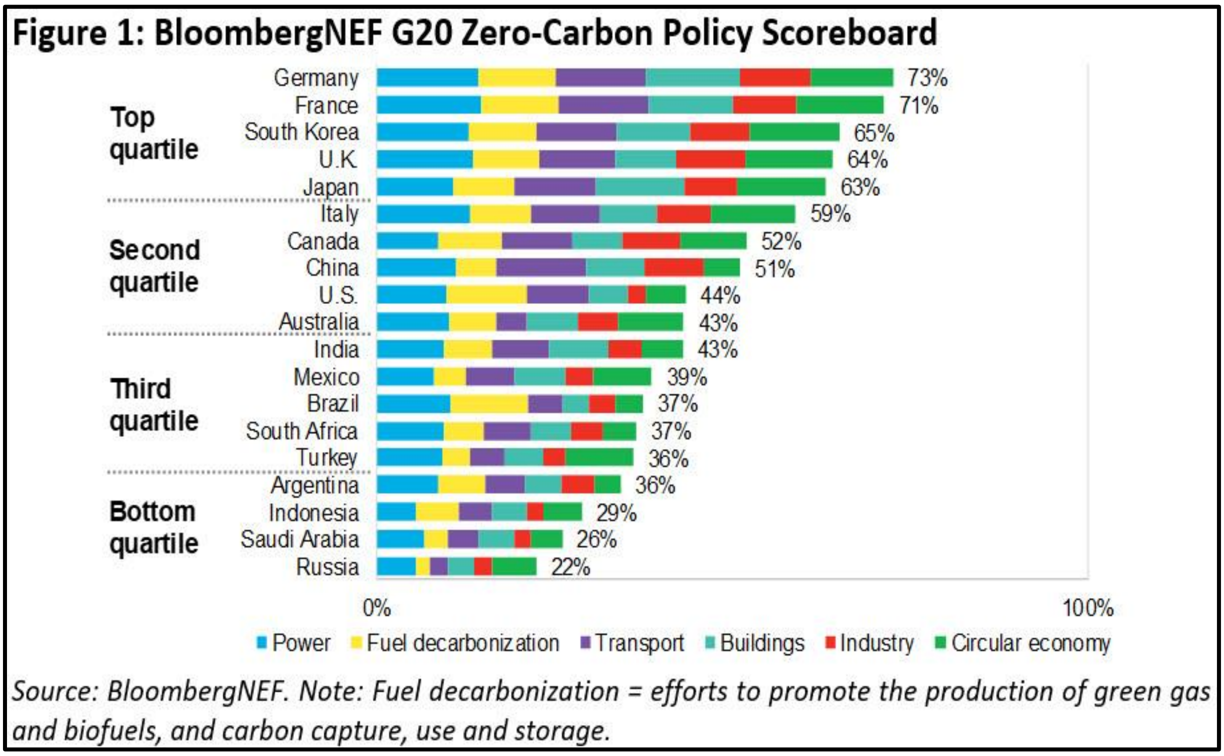


Source: GIS 2021

For all countries, the energy transition to a non-fossil fuel age, determined by the interplay between fossil fuels and renewables, is a challenging, risky, and vulnerable process in the forthcoming decades. An unprecedented pace of the energy transition is accompanied by a high degree of unpredictability, "tsunamis of innovation" and non-anticipated disruptive developments as well as cascading impacts.

Despite an increasing worldwide support for net-zero emissions target by 2050 and 2060 - including by the EU, U.S., China, Japan, South Korea, and some other countries - and the expansion of renewables as well as many other green technologies, the world is still on the pathway to warm up by 2.5-3°C by the end of the century. Ahead of the COP26 global climate change summit at the end of this year in Glasgow, the discrepancies between major countries as well as much more ambitious energy policies for the green energy transition and the realities on the global energy markets have grown further during the worldwide pandemic.[1]

Figure 2: G20 Net-Zero Carbon Policy Scoreboard



Source: Bloomberg/NEF 2021

The present energy transition affects particularly the global electricity sector, which is being transformed by the three reinforcing strategic trends of '3 Ds': decarbonization, digitalization and decentralization.[2] This energy transition is based on the integration of renewable energy sources (RES) and other distributed energy resources. It is highly dependent on modernizing energy infrastructures (especially electricity grids) and fundamental reforms of regulatory frameworks to accommodate the shifting energy supply structure at a time when societies are becoming ever more dependent on the stable functioning of critical energy infrastructures (CEIs). But political decision-making and regulators are often unable to adapt quickly enough to disruptive technology innovations to benefit from these new technological options such as enhancing safety, accessibility, connectivity, productivity, efficiency and sustainability of the energy transition. The IEA warned in its annual 'World Energy Out 2019'-report: "The faster the transformation required – and the scientific evidence shows that this push needs to be very

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1 See also Frank Umbach, 'Strengthening Energy Security and Building Resilience in the Asia–Pacific", United Nations-Economic and Social Committee in Asia and Pacific (UN-ESCAP), Bangkok 2021, 150 pp. (forthcoming).

2 See also F.Umbach, 'Energy Security in a Digitalized World and its Geostrategic Implications', Study of the Konrad Adenauer Foundation (KAS)/Regional Project: Energy Security and Climate change Asia-Pacific (RECAP), Hongkong, September 2018, 171 pp. (http://www.kas.de/wf/doc/kas_53447-1522-2-30.pdf).

rapid indeed – the greater the risk of poor co-ordination or unintended consequences for the reliability or affordability of supply."[3] Unless the difficult and complex energy transition with its huge associated costs is planned and implemented carefully, it could worsen energy inequalities, energy-related poverty, undermine economic growth and lose public acceptance.

Given the electrification of end uses and the proliferation of low-cost renewable power generation technologies, electricity is emerging as the strategic energy carrier of the 21st century. The creation of 'prosumers' (energy consumers simultaneously becoming energy or electricity producers) and the redistribution of economic as well as political power offers new opportunities for participation, investment and strategic influence to new centralized powers (i.e. internet giants such as Facebook, Amazon, Netflix, Google and others) as well as to new players on the local level. But political decision-making and regulators often adapt too slowly to be able to benefit from new options arising from disruptive technology.

But at the same time, societies and states are becoming ever more dependent on the stable functioning and resilience of critical energy infrastructures against increasing sophisticated cyberattacks. Supply chains will increasingly shift along the decarbonization and include hydrogen, and batteries for electric vehicles, which will also increase the global dependence on critical raw materials (CRMs).[4] But these supply chains from mining to end-products are often much less transparent than traditional fossil fuel supply chains despite many efforts to improve industry practice for responsible and ethical sourcing during the last years.[5]

Furthermore, the COVID-19 pandemic has caused more economic disruption and increased financial debts of the energy sector worldwide than the global financial crisis in 2008, the economic depression in the 1930s or any other event in peace time history with lasting impacts for at least the next decade.[6] At present, it is unclear how long the worldwide pandemic will last as the third wave of the pandemic is currently affecting many economies again. In 2018, over 200 million people (5% of the population) had still no access to electricity, and some 1.8 billion people (nearly 40% of the population) had still to rely on polluting and unhealthy cooking fuels and technologies. The global pandemic has also highlighted the criticality of electricity supply for hospitals, other healthcare services, other critical infrastructures, teleworking and remote learning. Too often governments have overlooked or marginalized potential supply crisis and have either no or at least insufficient emergency plans and built-in resilience capacities. Investing in much needed redundancies for cybersecurity or global pandemics is

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3 See IEA, 'World Energy Outlook 2019' (Paris: OECD/IEA, 2019), p. 78.

4 See also F.Umbach, 'The New 'Rare Metal Age'. New Challenges and Implications of Critical Raw Materials' Supply Security in the 21st Century', Working Paper No. 329, S. Rajaratnam School of International Studies (RSIS)/ Nanyan Technological University NTU, Singapore, 27 April 2020.

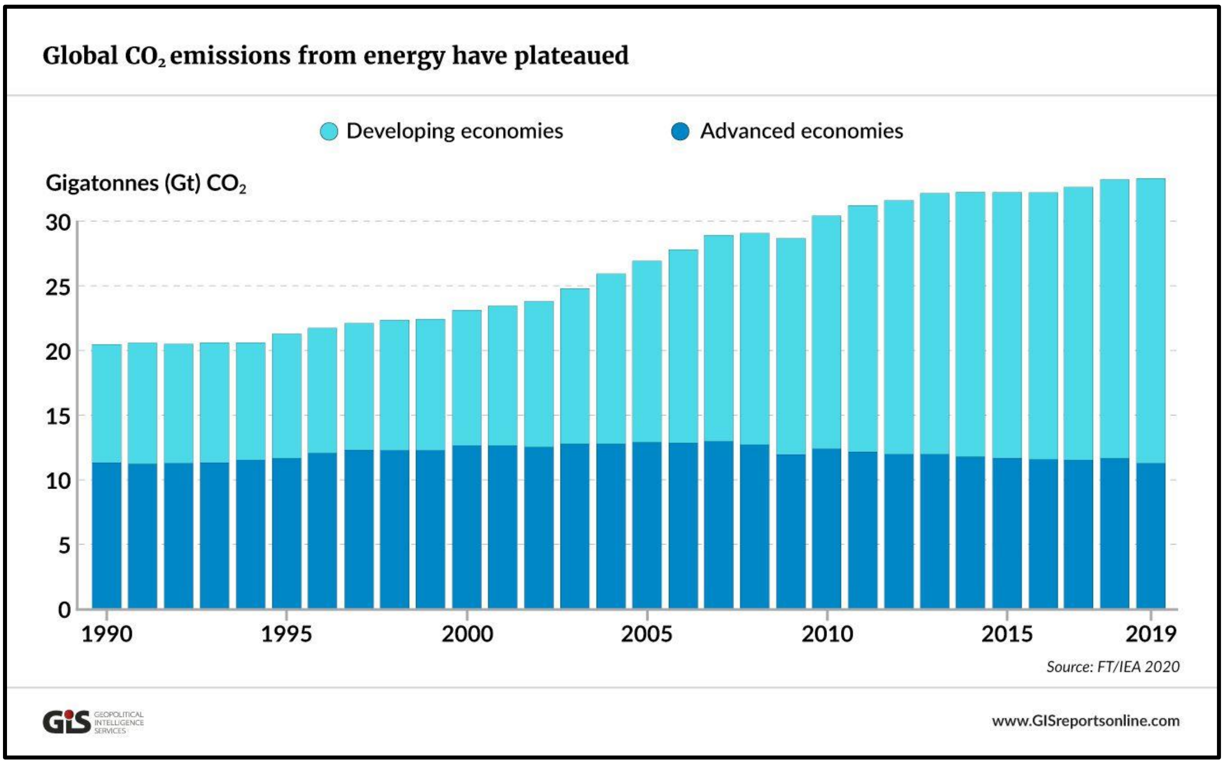
5 See also F.Umbach, 'Critical Raw Materials: Assessing EU Vulnerabilities', Geopolitical Intelligence Service (GIS), 30 March 2021.

6 See also Charles Ellinas, 'Groping towards the light', Natural Gas World, Vol. 5, Issue 20, 20 October 2020, pp. 21-27.

of course a cost factor. Insufficient investment in redundancies as part of resilient concepts may serve short-term interests but is contradicting long-term interests as those crises may turn out as much costlier than any preventive policies and investments.[7]

How long the COVID-19 economic downturn will last and how large the impacts on the world economy will be as well as for the energy demand and greenhouse gas (GHG)-emissions is almost impossible to forecast concretely as the second wave of Covid-19 currently highlights in India. But the "polypandemic"[8] might have more long-term implications on economic recovery, the countries' resilience and the world energy sector than anticipated last year. Improving access to finance often require more fundamental reforms at the global, regional and bilateral levels, which appears even more difficult in times of a deepening regional economic recession and rising state debts.[9]

Figure 3: Global CO2-Emissions 1990-2019



Source: GIS 2021

The economic impact of Covid-19 is threatening the massive investments needed to achieve global carbon neutrality by 2050. The IEA has warned that, without radical changes in energy

7 See also F.Umbach, 'Supply Chain Security: The Energy Sector's Lessons for Healthcare', GIS, 4 May 2020.

8 See to the multiple dimensions and impacts of the global Covid-19 pandemic - Sophie Eisentraut et.al., 'Polypandemic'. Munich Security Report, Special Edition on Development, Fragility, and Conflict in the Era of Covid-19, Munich, November 2020.

9 See F.Umbach, 'Strengthening Energy Security and Building Resilience in the Asia–Pacific', and idem, 'New Opportunities 2021: Energy Megatrends and the Challenges of Decarbonization', Geopolitical Intelligence Service (GIS), 5 March 2021.

consumption and production, as well as in consumer behaviour, global temperatures will increase by another 1.65°C. Around 40 percent of cumulative emissions reductions needed to reach the net-zero goal by 2050 still rely on large-scale industrial technology that is not commercially available at large industrial scale, like hydrogen, batteries, and carbon capture, use and storage (CCUS).[10]

Moreover, technology innovations and their implementation in other sectors will be fueled by the accelerating digitalization. But the worldwide spread of cryptocurrencies, blockchain, smart home and IoTs, cloud systems and other disruptive technologies, for instance, has proved to be very energy intensive and threaten many energy forecasts. One of the latest examples is the worldwide introduction of 5G[11], which could dramatically increase network electricity consumption as it has already been the experience with the deployment of 3G and 4G. Some experts have estimated a doubling of the energy consumption of communication service providers.[12]

The worldwide decrease of CO_2 emissions in 2020 may be a rather short-term development as emissions may increase again due to a worldwide economic recovery. Energy-related CO_2 emissions grew by 1.9 percent in 2018. In 2019, while economic growth in advanced economies still averaged 1.7 percent in 2019, total energy-related CO_2 emissions fell by 3.2 percent after years of increases. In 2020, and the GHG-emissions declined by 5.8 percent in 2020. A peak of global emissions has not been achieved and might not be realized prior to 2030. For 2021, global energy-related CO_2-emissions have been forecasted to rebound by 4.8 percent (1,500mt) for the second-largest growth ever alongside of an increasing global energy demand of 4.6 percent (after a 4% decline in 2020). The worldwide coal demand alone for this year has been projected to rise by 60 percent (with 80% in Asia) more than all renewables combined – to exceed 2019 levels.[13] Moreover, climate scientists have noted that greenhouse gas (GHG)-emissions need already to fall by 7.6 percent every year between now and 2030 of achieving the 1.5° goal for preventing severe climate change.

In 2020, major emitters such as China, India, Russia, and the United States poured more than 50 percent of their new investments into fossil fuels as part of pandemic rescue packages. Many other governments bailed out their fossil fuel industries and rolled back environmental

10 See IEA, 'World Energy Outlook (WEO) 2020' (Paris: OECD/IEA, 2020).

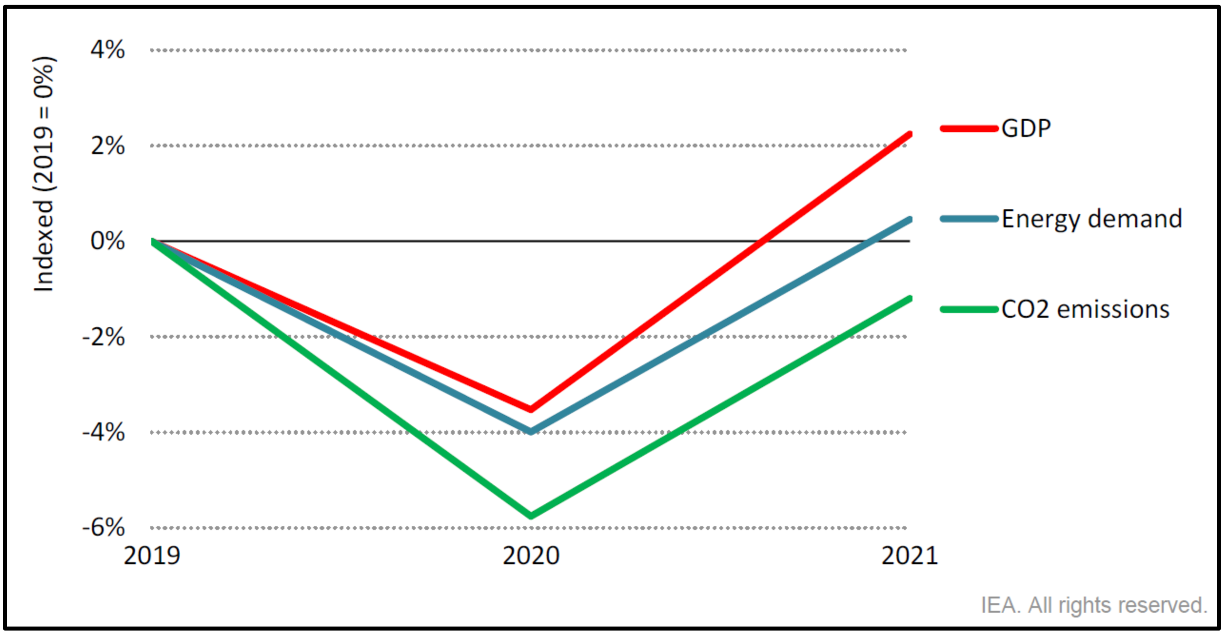
11 See also F.Umbach, 'EU Policies on Huawei and 5G Wireless Networks. Economic-Technological Opportunities vs. Cybersecurity Risks'. Working Paper No. 332, S. Rajaratnam School of International Studies (RSIS)/ Nanyan Technological University NTU, Singapore, 23 December 2020.

12 See Davine Janssen, 'Ericsson: 5G could 'dramatically increase' network energy consumption', Euractiv, 24 July 2020. To perspectives for reducing this energy demand see Pal Frenger/Richard Tano, 'More Capacity and Less Power: How 5G NR can reduce network energy consumption', IEEE Xplore 2019.

13 See IEA, 'Global Energy Review 2021', (Paris: OECD/IEA 2021).

regulations during the pandemic. The health crisis has widened, not narrowed, the gap between reality and the ambitious goals of the Paris Agreement.[14]

Figure 4: Evolution of Global GDP, Total Primary Energy Demand, and Energy-Related CO_2-Emissions, relative to 2019



Source: GIS 2021

In December 2019, the EU introduced the European Green Deal (EGD) and a new ambitious emissions reduction target of minus 55 percent for 2030 (instead of the previous -40%). The EU hopes to become the worldwide green energy technology leader.[15] The EGD has huge implications on the EU's future energy mix and energy security, including for the financing of new energy sources and infrastructures. But even by phasing-out coal in Europe completely, the EU will not be able to achieve its long-term emission reduction goal of minus 95 percent by 2050 and also need to reduce its overall gas consumption at latest by 2030.

In Europe, the Covid-19 pandemic might also have wider implications for the regional energy consumption and changing the energy mix by intensifying its "greening". In addition, those defined policy changes in the EU with its EGD is supported by the rapidly declining costs of renewables (particularly in the electricity sector) as well as by the digitalization of the energy as well as other industrial sectors.

One of the most important actors and factors internationally for mitigating global warming and containing the global energy demand is India. Together with China and a growing population fast approaching 1.4bn, which might surpass China as the world's largest population around

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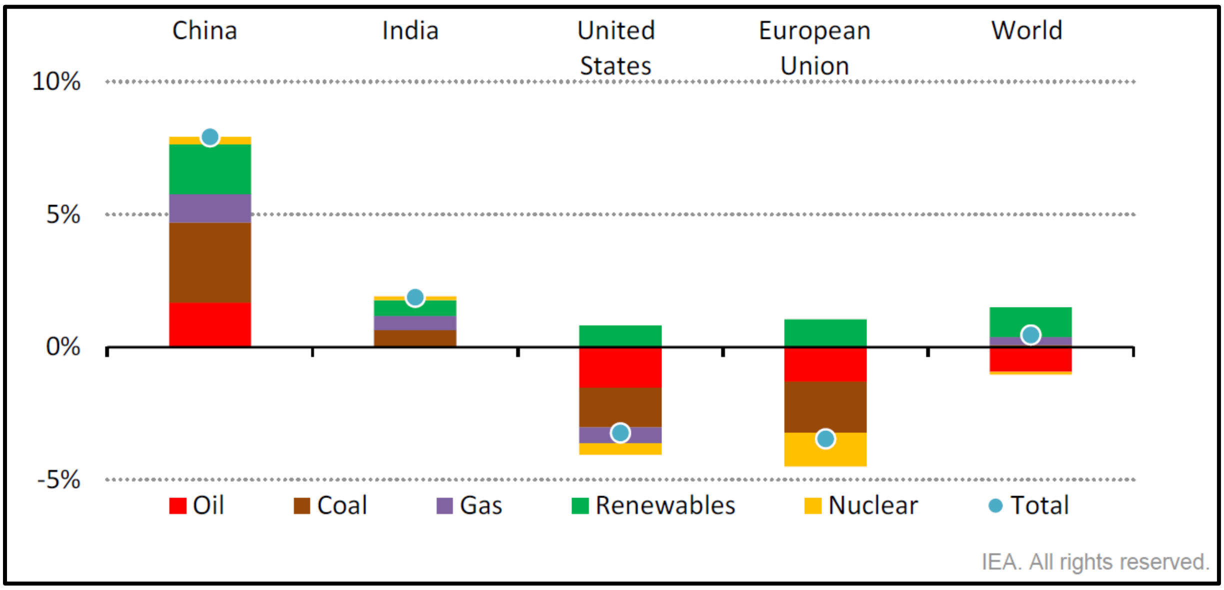
14 See also F.Umbach, 'Strengthening Energy Security and Building Resilience in the Asia–Pacific'.
15 See also Stephanie Butcher, 'Europe's Chance to Lead the Green Technology Race', FT, 1 April 2021.

2028, it is also considered one of the biggest growth markets for all kinds of energy and infrastructure developments.[16] Its energy demand has also being projected to grow the fastest in the world.[17] At the Himalayas, India and the world are facing one of the world's most volatile geopolitical fault lines, with water shortages and climate change being a multiplying factor for the geopolitical conflict between India and China as the recent escalation of the bilateral conflict demonstrated once again.[18]

India's energy policies have made a tremendous progress in providing access to electricity for millions of its population in recent years and its renewable energy sector has also expanded. The Indian continent is facing numerous short-term risks, but also offers many medium- and long-term opportunities for the EU as a major global energy partner. India is assumed to become one of the leaders of solar power and batteries in the next decades. But despite the progress, India's coal and oil consumption is still increasing.[19]

Figure 5: Change of Primary Energy Demand by Region and Fuel in 2021 relative to 2019



Source: IEA 2021

India's share of coal in total primary energy consumption has been rather stable at around 45 percent in recent years. But if India will realize net-zero emissions in the mid-2060s as some experts have called for, it would need more fundamental and far-reaching reforms of its energy and climate policies. In March 2021, for instance, India's state miner 'Coal India' approved as

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16 See also Eurasia Group, 'Focus on: India', Gas, Power & Infrastructure, 22 April 2020, and Yagyavalk Bhatt, 'India's Future Commitments to the Paris Agreement: A Conflict between Energy Security and Economic Growth', Commentary KAPSARC, December 2019.

17 See also Benjamin Parkin, 'India Energy Demand Set to Grow Fastest in the World', FT, 9 February 2021.

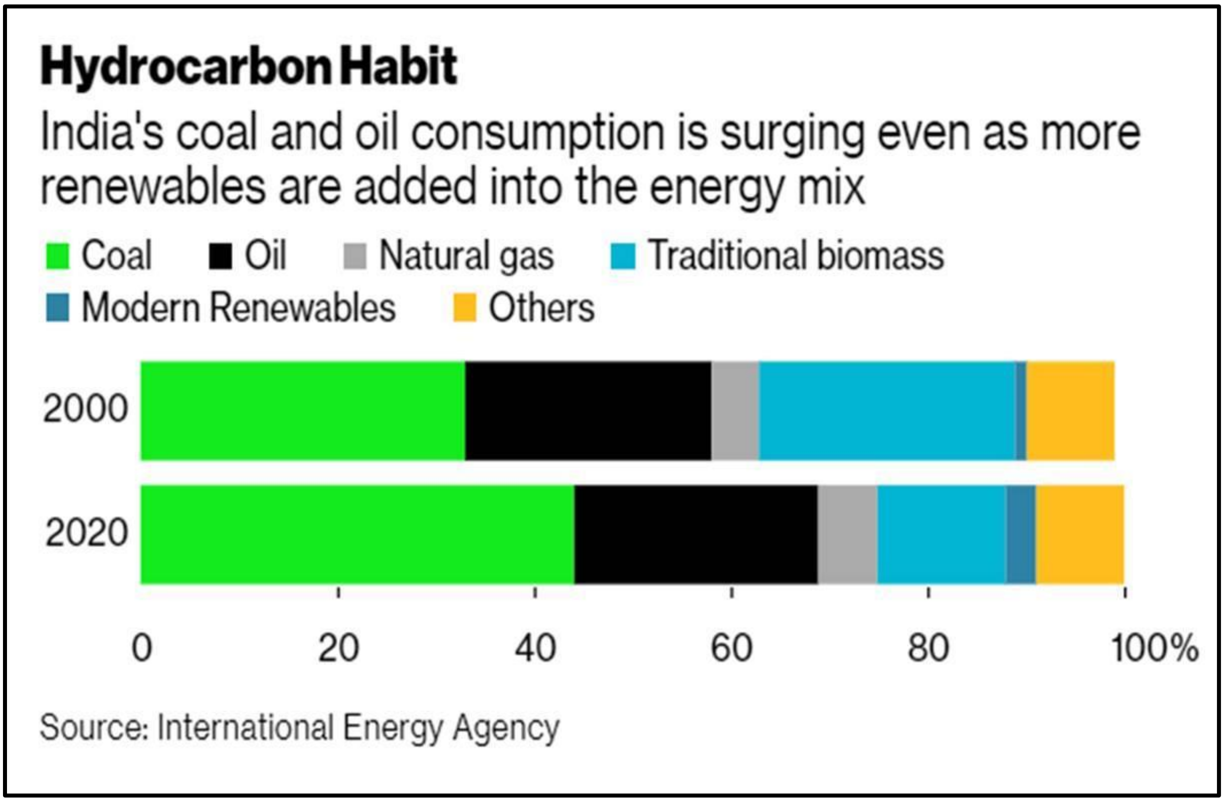
18 See also Benjamin Parkin, 'Crisis in the Himalayas: Climate Change and Unsustainable', FT, 21 March 2021, and Amy Kazmin, India Blames China for deadly Himalayan Clashes', FT, 20 May 2021.

19 See International Energy Agency (IEA), 'India Energy Outlook 2021' (Paris: OECD/IEA, 2021).

many as 32 new coal mining projects with a total investment of US$6.4 bn for one of the world's largest coal consumers.[20] While the G7 countries have just approved a common policy of no longer funding coal-power plants[21], India is still heavily expanding its coal power consumption contrary to the worldwide efforts for decreasing GHG-emissions and its need to limit any new emissions with new energy projects.[22]

India's economic crisis in 2020 decreased its oil demand by 8 percent, coal demand for power generation and industry by 5 and 7 percent respectively and its emissions by 40 percent in April 2020. But its energy demand for 2021 could rebound by up to 7 percent and its coal demand by 9 percent, dependent on the lasting pandemic. Its emissions are now comparable with those of the EU, although they remain on a per capita basis two-thirds lower and 60 percent below the global average.[23] However, India's economic recovery in 2021 is now being threatened by the second wave of Covid-19 and its impacts on a vast scale of its society and economic sector.[24]

Figure 6: India's Fossil Fuel Consumption 2000 versus 2020



Source: Eurasia Group/IEA 2021

20 See Charles Kennedy, 'India Is Pushing for more Coal Capacity', Oilprice.com, 19 April 2021.

21 See Leslie Hook/Camilla Hodgson, 'G7 Agrees to Stop Overseas Funding of Coal to Limit Global Warming', FT, 21 May 2021.

22 See Sudarshan Varadhan, 'India may Build new Coal Plants due to low Cost despite Climate Change', Reuters, 26 April 2021.

23 See IEA, 'Global Energy Review 2021', p. 12.

24 See Editorial Board, 'The Tragedy of India's Second Wave', FT, 26 April 2021.

In this light of changing EU policy objectives and directives as well as fastening technology innovations due to the digitalization of the energy sector, this analysis will review the EU's EGD, its fastening decarbonization policies, India's energy and decarbonization challenges as well as identifying areas and topics of EU-India energy cooperation in the forthcoming years and decades.

2. The EU's new "European Green Deal" and the Implications for its Energy Policies

2.1 The European Green Deal and the Financial Dimensions for its Fastened Decarbonization Strategy

In December 2019, the European Commission announced a EGD, which would make Europe collectively the first carbon-neutral continent by 2050. For 2030, the EU plans to decrease its Greenhouse Gas (GHG) emissions up to 50-55 percent (compared with 1990 levels) - compared with the previously already disputed 40 percent. The Commission's target increase would require de facto an additional reduction in emissions of 30-35 percent compared with 1990 in just ten years and would mean a five-fold increase in the previous rate of reduction of all EU-27 Member States.[25] Originally, the European Parliament wanted to reduce the emissions even by 60 percent. For Germany, this balancing act is even more challenging and problematic, as it is on one hand by far the largest net contributor to the EU and, on the other hand, no other country in the world has so far undertaken a double phase-out of nuclear energy (until 2021) and coal (by 2038 at the latest) simultaneously.

In March 2020, the European Council of EU governments agreed on the EGD a new climate law (codifying the new emission goal for 2030) and its "next generation fund" with its €750bn economic recovery programme in the wake of the Covid-19 pandemic in 2020.[26]

Until the autumn of 2020, it was the only region which has offered an ambitious mid-term perspective by 2030 and a concrete pathway as well as strategies for implementing its new targets, including using more than 30 percent of its €750 billion 'Next Generation Fund' for green projects.

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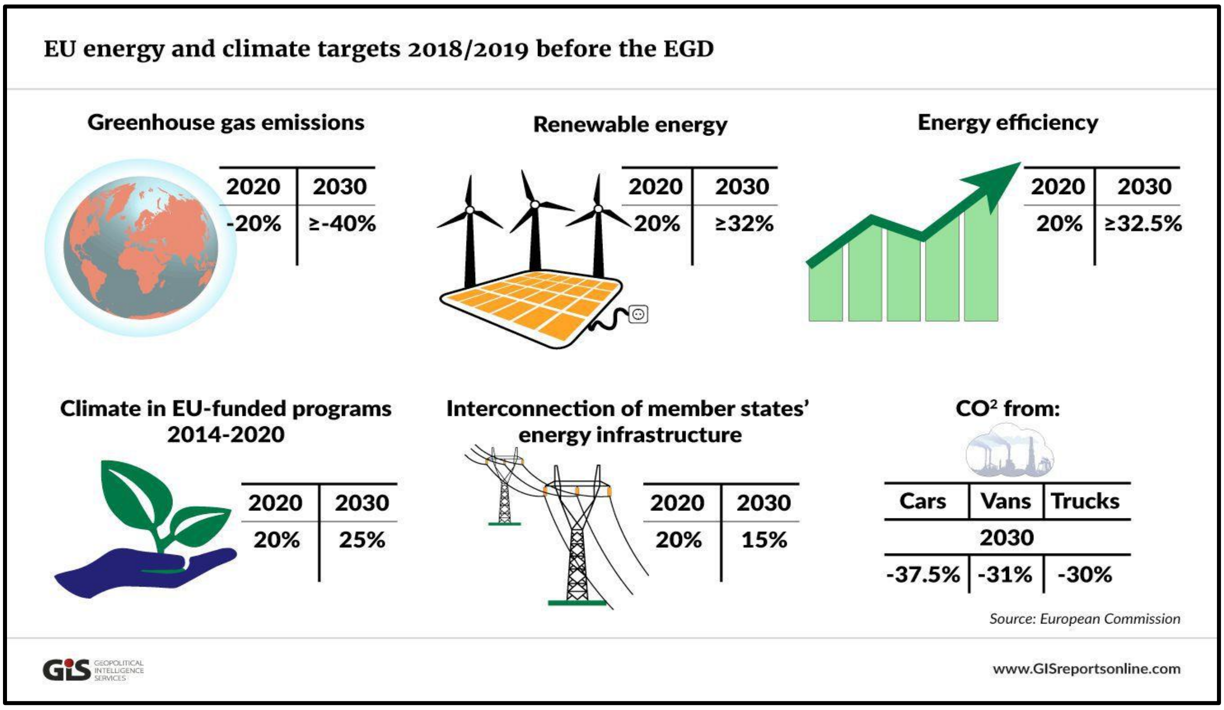
25 See DEBRIV-Informationen und Meinungen 03/2020, p. 3.

26 See F.Umbach, 'Der European Green Deal. Strategische Perspektiven und Auswirkungen der Corona-Pandemie' ('The European Green Deal. Strategic Perspectives and the Impacts of the Corona-Pandemic'), Politische Studien, No. 494, November-Dezember 2020, pp. 50-59; idem/Joachim Pfeiffer, 'Der European Green Deal' – Neue Herausforderungen einer systemischen Transformation' ('The 'European Green Energy Deal' – New Challenges of a Systemic Transformation'), Energiewirtschaftliche Tagesfragen (ET), 1-2/2020, pp. 66-67, and idem, 'The European Green Deal Faces Huge Challenges', GIS, 10 February 2020.

The goal of the “man on the moon moment” (to quote President of the European Commission Ursula von der Leyen) is based on a comprehensive growth and innovation strategy for all economic sectors in Europe in support of its ambition for reducing greenhouse gas (GHG) emissions to zero by 2050. The EGD and its emission goal has been enshrined as a binding legal obligation in the new Climate law of March 2020. Its binding long-term plan and centrepiece strategy for reconciling “the economy with our planet” subordinates the EU’s economic, energy and finance policies to the objectives of its climate policies and emission reduction targets. It currently includes 50 specific policy initiatives, though most of them are not new.

Figure 7: Previous EU energy and Climate Policy Goals prior to the EGD



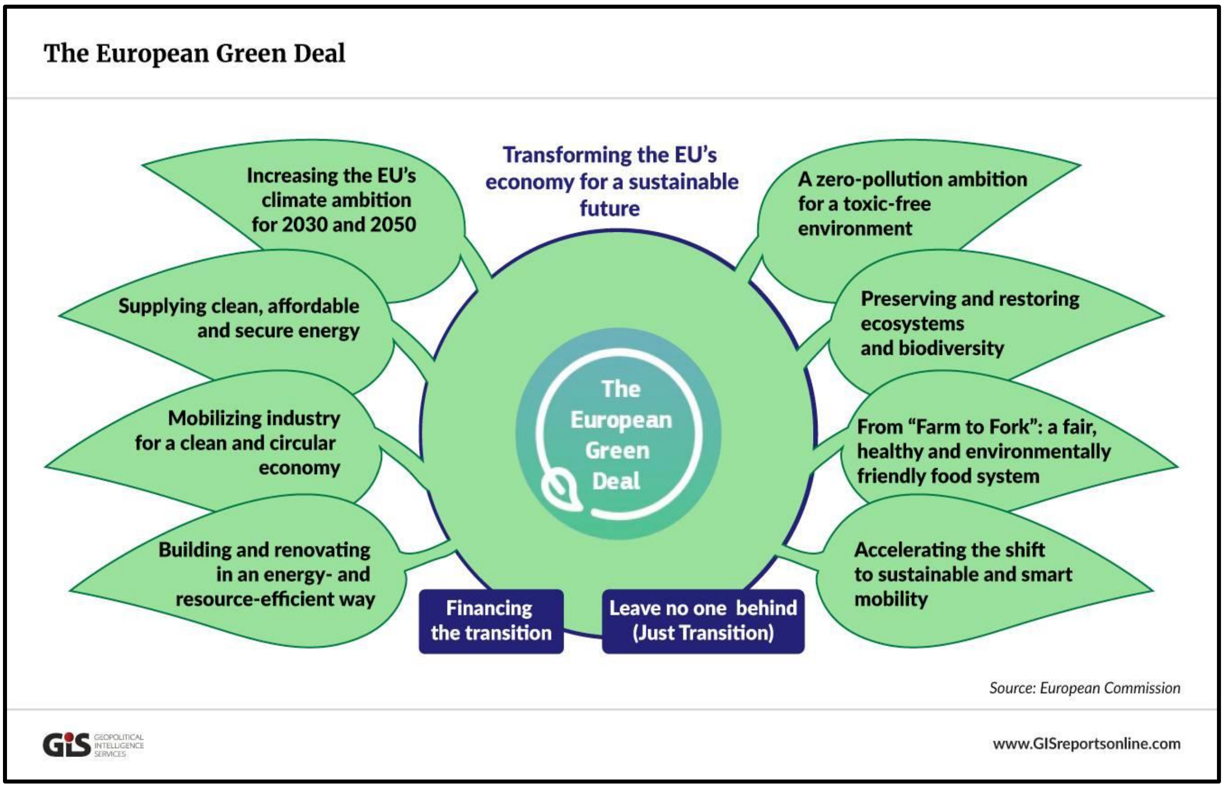
Source: GIS 2020

However, the basis for calculation remains unclear, as Brexit will leave the UK, which is the EU's second-largest emitter with its legally binding national climate target of reducing emissions by 57 percent by 2030 compared to 1990 and the EU emissions reduction agreed so far by 40 percent is already premature (2018: -44%) and has been surpassed. The EU will then only reach 37 percent of its previous climate target of reducing emissions by 40 percent by 2030 without the UK. By increasing emissions by 55% by 2030, the EU would have to add an additional 504 million tons GHG emissions - comparable to total emissions from Italy and Austria. If the UK were to be excluded from the EU- 28, that would be as much as 863 million tons - comparable to total emissions from Poland and France in 2017.[27]

[27] See STEAG-Position Regarding European Climate Law, Berlin, March 2020, p. 8 f.

The EU seeks to use the COVID-19 pandemic as an opportunity for a global green recovery and has materialized its ‘European Green Deal (EGD)’ by detailing concrete pathways for achieving its new emissions mid-term target for 2030 by reducing them by 55 percent (previously 40 percent) and by devoting more than 30 percent (some €225 billion) of its €750 billion ‘Next Generation Recovery Fund’ to green objectives and programmes, only few other countries have followed Europe’s example.[28]

Figure 8: The European Green Deal (EGD) of December 2019



Source: GIS 2020

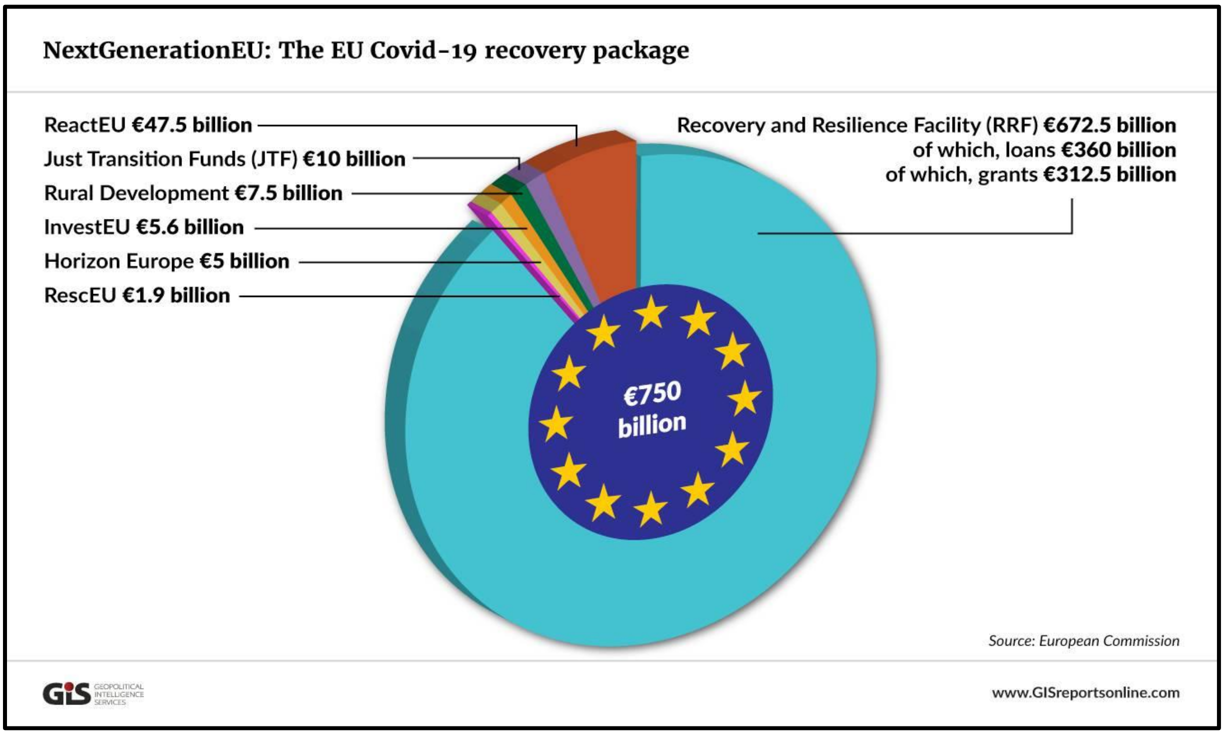
President von der Leyen has also proposed a “Sustainable Europe Investment Plan” of the EIB to unlock €1 trillion of private and public green investments until 2030. The European Commission has also raised its funding for climate change efforts to more than 30 percent (€350bn) of its proposed “Multiannual Financial Framework for 2021-2027” budget compared with 20 percent (€206bn) over the previous one of 2014-2020. The EU countries will also be supported or allowed national subsidies for compensating the increasing carbon costs for its societies. Just for meeting the previous climate and energy targets before the declared EGD, the Commission estimated the additional *annual* investments up to €260bn for the EU by 2030.

28 See also F.Umbach/ Joachim Pfeiffer, ‘Die Auswirkungen der Corona-Pandemie auf den ‘European Green Deal‘ und die Industrietransformation“(„The Impacts of the Corona-Pandemic on the ‘European Green Deal and the Industry Transformation‘), CSU-Bulletin Außen- und Sicherheitspolitik, August 1/2020, pp. 2-6.

A successful implementation of the new emissions' target demands a much more systemic transformation of the EU's energy and other economic sectors, dependent on sufficient funding as well as international support and public acceptance at home in all member states.

France and some of the CEE countries might also be allowed to include nuclear power as a clean energy source for meeting the EU's climate targets, which is currently still opposed by Germany, Austria, and Luxembourg. A new rule book on sustainable green investments can be possible by including nuclear power as the more ambitious climate target of 50-55 percent by 2030 but cannot realistically be achieved without it over just the next 10 years. Even more uncertainties exist regarding the future role of natural gas. Originally, the European Parliament didn't want to allow any new financing and investment in new fossil fuel projects, including natural gas. But the debate seemed to have achieved a compromise that will allow member states to build new gas-related projects for replacing dirty coal-plants when the gas infrastructure can be still used after 2030 when the EU will increasingly replace conventional gas with 'green gas'. However, the debate is continuing and also influenced not just by political factors and climate policy factors, but also by the rising competitiveness of renewables towards fossil fuels as well as technology innovations such as batteries for electricity storage.

Figure 9: Next Generation Fund of the EU



Source: GIS 2021

In 2020, gas power plants already overtook lignite to become the EU's single largest source of emissions in the power sector due to a more rapid coal phase-out and high carbon prices. But at the same time, the phasing-out of gas in power generation may have already started in

Europe. Emissions-wary investors and utilities are phasing out gas even at a quicker pace than they did with coal before. European companies are already struggling to sell-gas power plants.[29] A new report is warning that €87 bn are at risk as stranded assets though Europe's gas import capacity is increasing by another 35 percent.[30]

The carbon pricing and the EU's ETS are the most important instruments for its clean energy transition and decarbonization strategy. In April this year, European carbon permit prices have already reached new record levels of €55 per ton of carbon. At this price level, coal fired power generation is highly unprofitable. At around €50 per barrel, gas-fired generation will also start losing its profitability for baseload supply. The economics of Europe's gas power supply chain are increasingly challenged as renewables plus battery storage solutions are becoming ever cheaper and better according to the latest analyses.[31]

The European Commission's Vice-President Frans Timmermans made clear in March that fossil fuels and fossil gas "has no viable future" and will only play a "marginal role" and "for a limited period of time".[32] On 18 April 2021, the European Commission has postponed again its decision whether it will include nuclear power and natural gas in its classification of green energy and green finance.[33] In the view of climate campaigners, only "green hydrogen" projects should be allowed in the EU which would exclude "blue hydrogen" (based on natural gas in combination with CCUS).

2.2 The EGD's Implications for the EU's Clean Energy Policies

Electrification and digitalization of the transport and heating sectors as well as the "industry 4.0"-revolution, based on automation, robotics, and artificial intelligence systems, will significantly increase the role and demand of electricity in final energy consumption.[34] The electricity sector will also have to play a key role in supporting economic recovery of the countries, and an increasingly important long-term role in providing the energy that the world needs for a sustainable development. But the power and electricity sector need to evolve into an energy system with lower CO_2 emissions, a more resilient infrastructural ecosystem and enhanced 24 hours' flexibility.

29 See Rachel Morison, 'Gas Is the new Coal with Risk of 100 Billion in Stranded Assets', Bloomberg.com, 17 April 2021.

30 See Masin Inman/Greig Aitken/Scott Zimmerman, 'Europe Gas Tracker Report', April 2021.

31 See Eurasia Group, 'Energy, Climate & Resources Briefing', 19 April 2021.

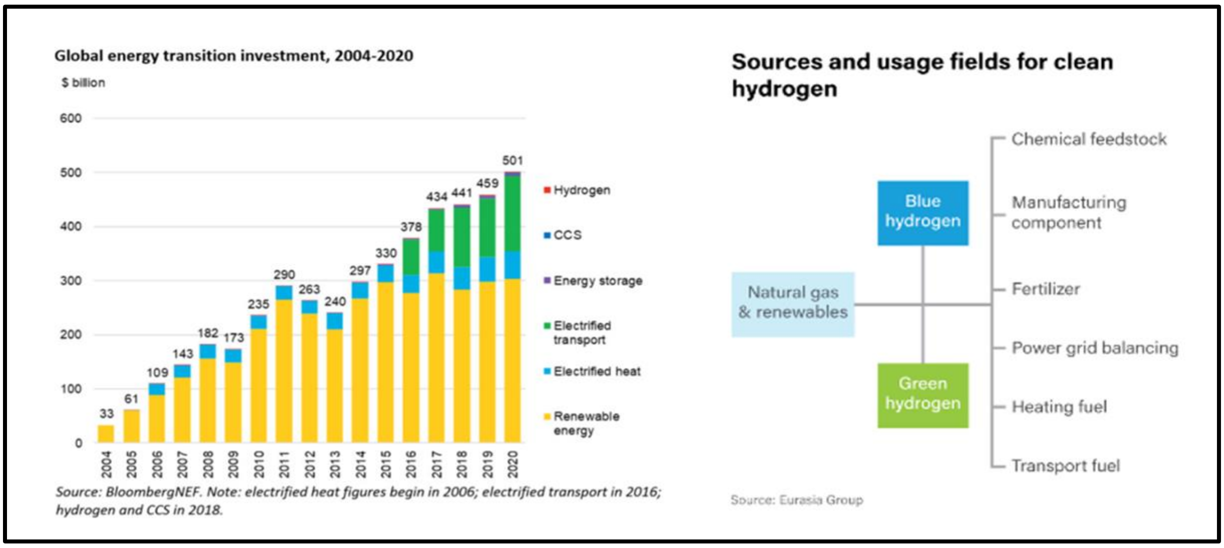
32 Quoted following Frederic Simon, 'Fossil Gas 'has no viable Future', EU's Timmermans Says', Euractiv.com, 26 March 2021.

33 See Mehreen Khan, 'EU Split over Delay to Decision on Classifying Gas as Green Investment', FT, 18 April 2021.

34 See also DNV-GL, 'Sustainable Energy and Digitalisation: Practices and Perspectives in Asia-Pacific'. Study on behalf of the Regional Project Energy Security and Climate Change Asia-Pacific (RECAP) of the Konrad Adenauer-Foundation (KAS), Hongkong February 2020.

In this light of rapidly changing energy sectors, technologies and commercial profitability, the global and especially European demand forecasts of natural gas have proved overtly optimistic and, meanwhile, even as unrealistic. The global and European clean energy transition rests on three pillars: renewables, electric vehicles and batteries for storage, and clean hydrogen. They will enable the decarbonization of global energy sectors and other industries as well as supply chains.[35]

Figure 10: Global Energy Transition Investments (2004-2020)



Source: Eurasia Group 2021.

The competitiveness of renewables and batteries for electricity storage has already dramatically changed the energy markets and businesses. Since 2010, costs of solar PV have decreased by 70 percent, wind by 25 percent and battery costs for electric vehicles by 40 percent.[36] Already in 2017, renewable-based electricity generation grew worldwide at 6.3 percent. It was the highest growth rate of any energy source. They now account for 25 percent of global electricity generation.[37]

By 2040, renewables could account for at least 34 percent of the worldwide electricity generation[38] and even 50 percent by 2050. According to Bloomberg New Energy Finance (BNEF), solar and wind costs might further drop 71 percent and 58 percent respectively by

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35 See Eurasia Group, 'Energy, Climate & Resource Security', 19 April 2021.

36 See IEA, 'WEO 2017', Paris, pp. 281 ff., and Editorial Board, 'Renewable Energy at a 'Tipping Point', Christian Science Monitor, 26 June 2017.

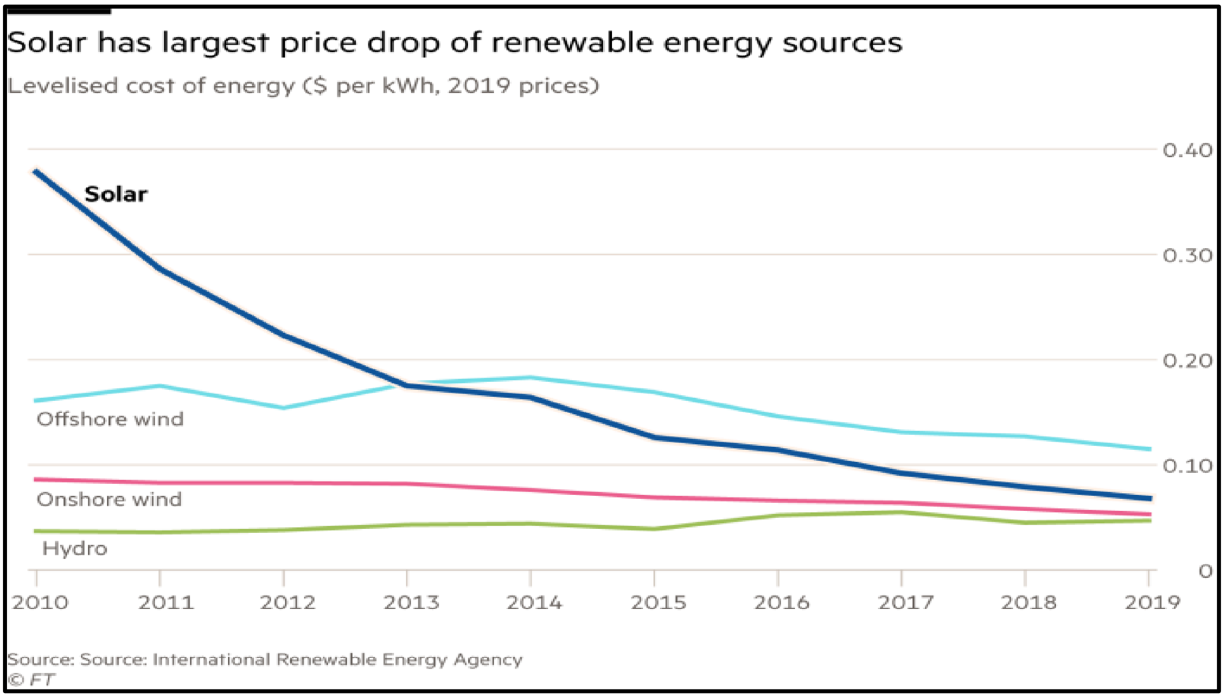
37 See IEA, 'Global Energy & CO_2 Status Report 2017' (Paris: IEA/OECD, March 20 2018) and IRENA/IEA, 'Renewable Energy Policies in a Time of Transition' (Paris: IEA/OECD), April 2018.

38 See Ed Crooks, 'Wind and Solar Expected to Supply Third of Global Power by 2040', FT, 15.6.2017. Tim Buckley, 'Cheap Renewables Are Transforming the Global Electricity Business', Energypost.eu, 14 February 2018.

2050.[39] The rapid decline in technology costs is a factor in overall investment as less investment is required to install the same capacity each year.[40]

Solar PV is already projected to become the largest component of global installed capacity. The expansion of generation from wind and solar PV has been anticipated to overtake coal in the power generation mix in the mid-2020s. Renewables will meet 80 percent of the worldwide electricity demand growth during the next decade. They might already overtake coal by 2025 as the primary energy source of producing electricity ahead of fossil fuels. By 2030, renewables might provide nearly 40 percent of electricity supply. Renewables have become consistently cheaper than coal- and gas-fired plants nowadays and may meet 80 percent of growth in the worldwide electricity consumption until 2030.

Figure 11: Renewables - Declining Costs 2010-2019



Source: FT 2020

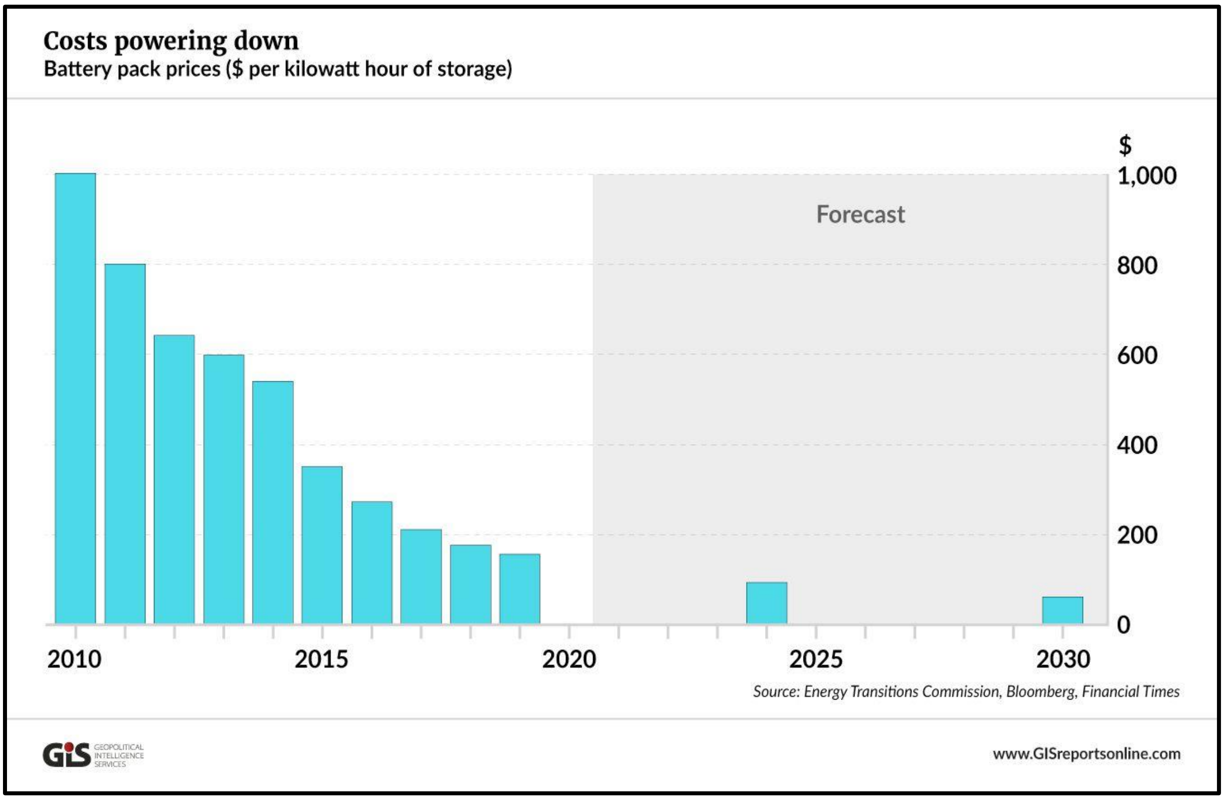
In addition, flexibility from power plants, energy storage and demand-side resources is becoming the cornerstone of electricity supply security and resilience in modern power as well as electricity ecosystems. The forthcoming technology innovations and their implementation in other sectors will be fueled by the accelerating digitalization. The development of a new generation of batteries does not just matter for the electrification of the worldwide transport sector, but also offer new storage perspectives, including in other sectors (such as power plants/electricity sector and heating).

39 See Robert Walton, 'World on Track for 50% Renewables by 2050, Says Bloomberg Energy Outlook', Utilitydrive.com, 19 June 2018.

40 See IRENA, 'Renewable Capacity Highlights', 31 March 2020.

Energy utilities have already begun to use utility grade lithium-ion batteries for large industry storage systems and grid-scale energy storage applications. Battery storage systems are well suited to short-duration storage that involves charging and discharging over a span of hours or days. This makes them a good partner for variable renewables. Battery storage is increasingly paired with solar PV and wind. In addition, battery storage is also the fastest growing source of power flexibility costs. It can also reduce the need for coal and gas-fired peaking plants. Declining battery costs are both a challenge as well as an opportunity for energy utilities. If batteries become a cheap storage option for private and industrial consumers and are built into intermittent solar and wind power stations of the electricity system - as an integrated part build-in retrofitted storage option - countries and utilities will no longer need the same amount of conventional backup capacity by traditional coal and gas power plants.[41]

Figure 12: Declining Battery Costs



Source: GIS 2020

Modular battery storage systems especially, allow a wide range of industry applications beyond the transport sector. They also offer a storage technology for power generators as it enhances overall utilisation of power system assets based on intermittent renewable energy sources. The future electricity supply will need more flexibility than ever, to adopt to rapid changes in the power supply and demand. Batteries decrease the risks of overcapacities and offer higher

41 See IEA, 'WEO 2020', p. 246 f., and also F.Umbach, 'New Opportunities 2021: Energy Megatrends and the Challenges of Decarbonization'.

average revenues. The availability of second-use batteries (such as from EVs after the end of their regular lifecycle) are widespread. They have increased three times during the last three years, largely been driven by lithium-ion batteries for providing short-term storage, which account for just over 80 percent of all battery capacity. But for longer-term storage, different batteries are needed. It suggests various battery developments, including as build-in units for solar PV and wind power as they increase their dispatchability.[42]

The increasingly wide range of applications also enhance the overall industry competition and decrease the prices of batteries. Between 2010 and 2018, battery production costs have already decreased by 45 percent. By 2040, cost reduction by large-scale production and intensive research could make batteries up to 70 percent less expensive than today.[43]

The present expansion of renewables has already transformed energy markets and shattered traditional business models and strategies with great damages to European fossil-fuel based utilities. Batteries and hydrogen (see next chapter) will further undermine the fossil fuel demand.[44] But a faster transition will also increase uncertainties for investment decisions, political governance, and geopolitics.

However, the declining costs for renewables do not include a number of hidden (or "systemic") extra costs for the modernization of grid, rising grid interventions and the subsidized back-up of conventional power plant capacities for grid stabilization and baseload stability due to the rising intermittency problems of renewables as the example of the German "Energiewende" highlights.[45] Thus, an expanded use of batteries is needed for guaranteeing stability of the electricity supplies and grids as well as boosting flexibility and supplementing renewables for peaking capacity In this regard, the sole reference to declining costs of renewables and batteries is also misleading as the expansion of renewables results in higher overall costs and investments into the entire (changing) energy system. These huge systemic investments alongside of the expansion of renewables are often overlooked and need to receive more attention in the affordability of ambitious energy transition strategies.

A wider expansion of renewables in the energy and electricity mix demands massive investments in other energy infrastructures (such as smart grids and smart metering) as well as subsidizing fossil fuel power plants as they are not operating 24 hours a day but are still needed for peak-times due to the variability of renewables for a continuous electricity supply around the clock. The expansion of renewables ultimately is changing the entire energy

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42 See F.Umbach, 'Europe's Battery Strategy', GIS, 16 September 2020.

43 See ibid.; idem, 'Strengthening Energy Security and Building Resilience in the Asia–Pacific', and idem, 'Energy Security in a Digitalized World and its Geostrategic Implications', pp. 144 ff. and 113 ff.

44 See also Eurasia Group, 'Batteries and Hydrogen will Undermine Fossil Fuel Demand and Forge new Supply Chains', Gas, Power & Infrastructure Monthly, 31 August 2020.

45 See also Jonathan Ford, 'The Hidden Costs of Renewable Power', FT, 21 August 2018.

system, which needs to be modernized at large. The often overlooked hidden (or systemic) costs by expanding renewables are particularly challenging for developing countries, which need access to electricity and modern energy sources. But by advancing their economies, they are also becoming increasingly dependent on a stable supply of electricity for 24 hours a day. Thus, the storage of electricity, along with flexibility in use of electricity, energy forecasting and cross border exchanges of power, becomes an ever more important solution for expanding renewables. Declining battery costs have allowed to address at least the short-term challenges of storage in the power sector. But batteries are unable to store electricity at scale and for longer-term use in the energy intensive industries. In this regard, gas power plants as well as natural gas for heating are still important.

But a medium-term phase-out of coal and corresponding energy and political alternatives are expensive, especially in the Eastern European member states, as these countries are economically much weaker than Germany. A rapid phase-out of coal threatens to overwhelm them economically and calls into question their economic development as well as competitiveness. The phase-out of coal in Germany alone will require around €50bn in structural aid, social cushioning programmes, and compensation payments to coal-fired power plant operators. Thereby, the new investments and subsidies in alternative generation and system capacities to compensate for the failing power generation capacity are not included in this €50bn bill. In Germany, around 18,000 jobs will be lost (another 10,000 jobs are indirectly affected) when coal is phased out. In Poland, however, around 100,000 jobs (indirectly up to 450,000 jobs) would be directly affected by a forced coal phase-out. Nor can Poland provide anywhere near to the comparable national financial aid for a medium-term coal phase-out, which can cost every second job regionally in Silesia.[46] Key details of financing the EGD - such as the questions about co-financing of the JTM and the distribution keys - have not yet been agreed. Poland is not wrong to argue that it should receive only 27 percent of the "Just Transition Fund (JTF)" so far, while the country represents almost half of the EU's coal industry workforce of 237,000 workers. But the cuts and redeployments have now led to even the JTF earmarked for coal phase-out being cut from the original €37.5 billion to €17.5 billion, according to the EU-27's latest budget agreement in 2020. Thus Poland and many East European EU member states are still opposed to the overall cost of decarbonization for their societies and economies. Lower incomes and the industry, struggling to be competitive globally, may not be able to carry the burden of rapidly rising carbon prices and extending the ETS to additional sectors (such as buildings and cars).[47]

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[46] See also F.Umbach, 'Coal Phase-out in Central Europe: Cooperation Is Better than Law Suits', Energypost.eu, 26 February 2021.

[47] See Mehreen Khan/Sam Fleming, 'Poland Pushes Back over Cost of EU's Climate Targets', FT, 25 May 2021; idem, 'EU Leaders Brace for Clash on how to Implement Climate Goals', FT, 22 May 2021, and Kira Taylor, 'Little Progress Made in Fifth Round of Negotiations on EU Climate Law', Euractiv, 30 March 2021.

Unlike in the past, the EGD no longer explicitly links its own climate policy and new ambitious targets to the climate policies of other key states, such as those of the US, China, India, Russia, Japan, Brazil, and other countries. Without this link, however, these countries might only be encouraged to take a political step and their climate protection policies will be much more subordinated to the direction of their economic policies at the expense of global climate protection. A study of researchers at the Copenhagen University concluded that up to 61.5 percent of emissions in the EU could turn out to be carbon leakage (only 385 kg would be saved instead of one ton) and lead to larger emissions in other parts of the world.[48] As a result, both global climate change and the global competitiveness of the European economy are in danger of being weakened if the other key global players do not follow the EU example.[49]

Independent of this, the example of the yellow vests in France and also the elections in European countries during the last years have shown that an increasing socio-political polarization threatens to increase over ever-increasing costs for the consumer as a result of increasingly ambitious climate targets. This problem threatens to be exacerbated in the short term by the pandemic effects and in the medium and long term by the necessary orientation towards sustainable developments in climate, energy, and industrial policy because at the same time higher unemployment and economic recession threaten political-social acceptance in the short term.

Furthermore, while globalization has increased the worldwide economic interdependence by stretching supply chains across the globe, it has not ended strategic competition and geopolitical rivalry. Likewise, geopolitical risks do not just end with decarbonization and the proclaimed end of the fossil fuel age by 2050. The global demand for CRMs, for instance, for the manufacturing of batteries and renewable energy sources (i.e. solar and wind power) as well as for high-tech weaponry, robotics and digitalisation technologies might dramatically increase, create new import dependencies, bottlenecks, supply shortages and disruption as well as even higher geopolitical supply risks on each stage ranging from mining to processing, refining, and manufacturing.[50]

The challenge is not so much a physical scarcity of those materials, but rather their production concentrated in even fewer producer countries and companies. Compared with the conventional oil and gas resources, the production of CRMs is geopolitically even more challenging and problematic – particularly when the future rise of the global demand is taken into consideration. Currently 50 percent of CRMs are located in fragile states or politically

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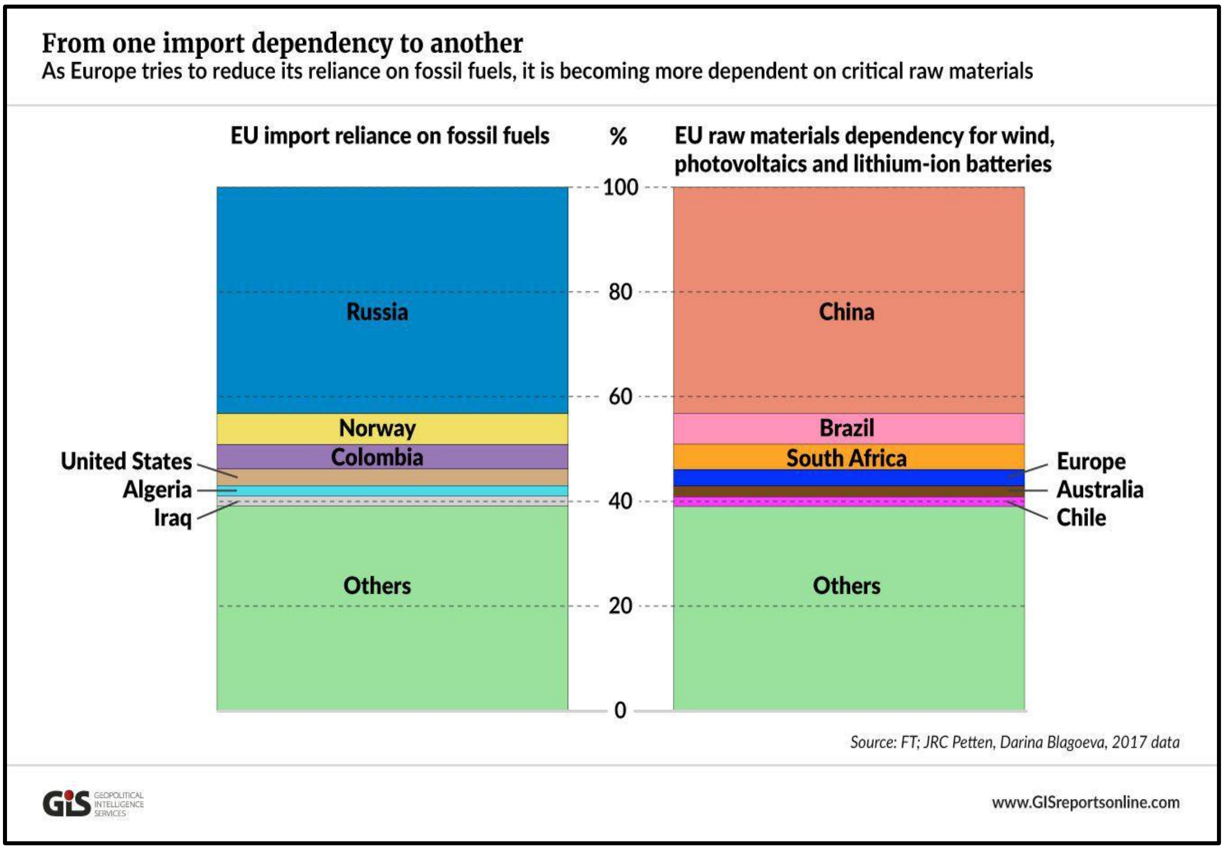
48 See Yu, Wusheng/Clora, Francis: Implications of Decarbonizing the EU Economy on Trade Flows and Carbon Leakages, EUCALC, Policy Brief-Pathways towards a European Low Emission Society No.7, edited by the Potsdam Institute for Climate Impact Research (PIK), Potsdam, February 2020.

49 See ‘Chapter 4.3: Was bedeutet der European Green Deal für Deutschland?‘.

50 See also F.Umbach, ‘’The New ‘Rare Metal Age’. New Challenges and Implications of Critical Raw Materials’ Supply Security in the 21st Century’.

unstable regions. At present, China provides 98 percent of the EU's supply of REEs, and around 62 percent for all of its defined 30 CRMs as of 2020. The low substitutability and low recycling rates of many CRMs also magnify its potential future supply risks.[51]

Figure 13: Changing Geopolitical Import Dependencies

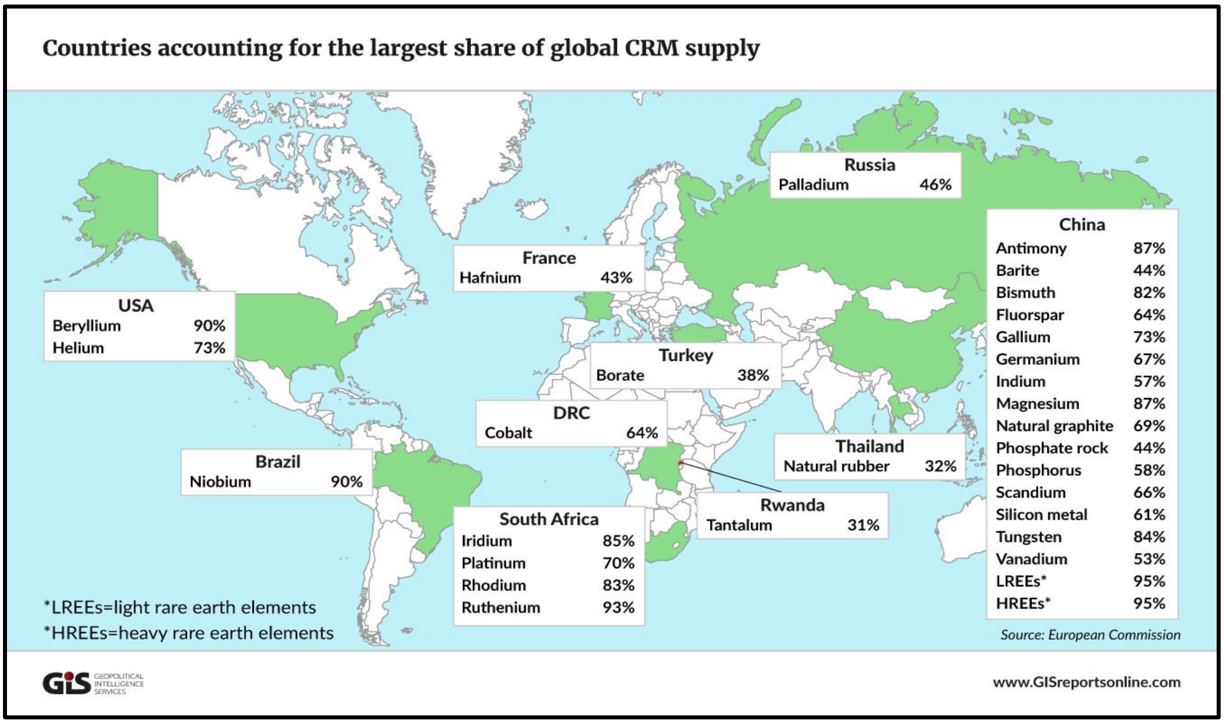


Source: GIS 2020

Access to and stable supply of these CRMs as well as their supply chains are pre-conditions to any new technology entering the market and being used. Also the EU's strategic objectives of its EGD and the further expansion of renewables can only be realized with a rising use and a reliable supply of CRMs. It demands a widespread introduction of a circular economy, a reduction of unsecure imports, and an expansion of domestic mining of CRMs in Europe itself. But no individual measure is a silver bullet solution. Moreover, opening new mines and reprocessing as well as refining capacities in the U.S. and Europe usually takes 10-15 years (worldwide 7 years) to bring them online.

51 See also F.Umbach, 'Critical Raw Materials: Assessing EU Vulnerabilities',

Figure 14: Country Concentration of Global CRM Supply



Source: GIS 2021

2.3 The EU’s Focus on Hydrogen Projects

Hydrogen is being viewed as a clean, secure, and affordable energy carrier (like electricity rather than an energy source) and an industrial raw material, which can play a key role and the “missing link” as feedstock in hard-to-abate sectors such as steel making and refineries, ammonia production and chemical industry in decarbonized energy systems. In the future it can also fuel buses, trains, and trucks and even ships and planes.

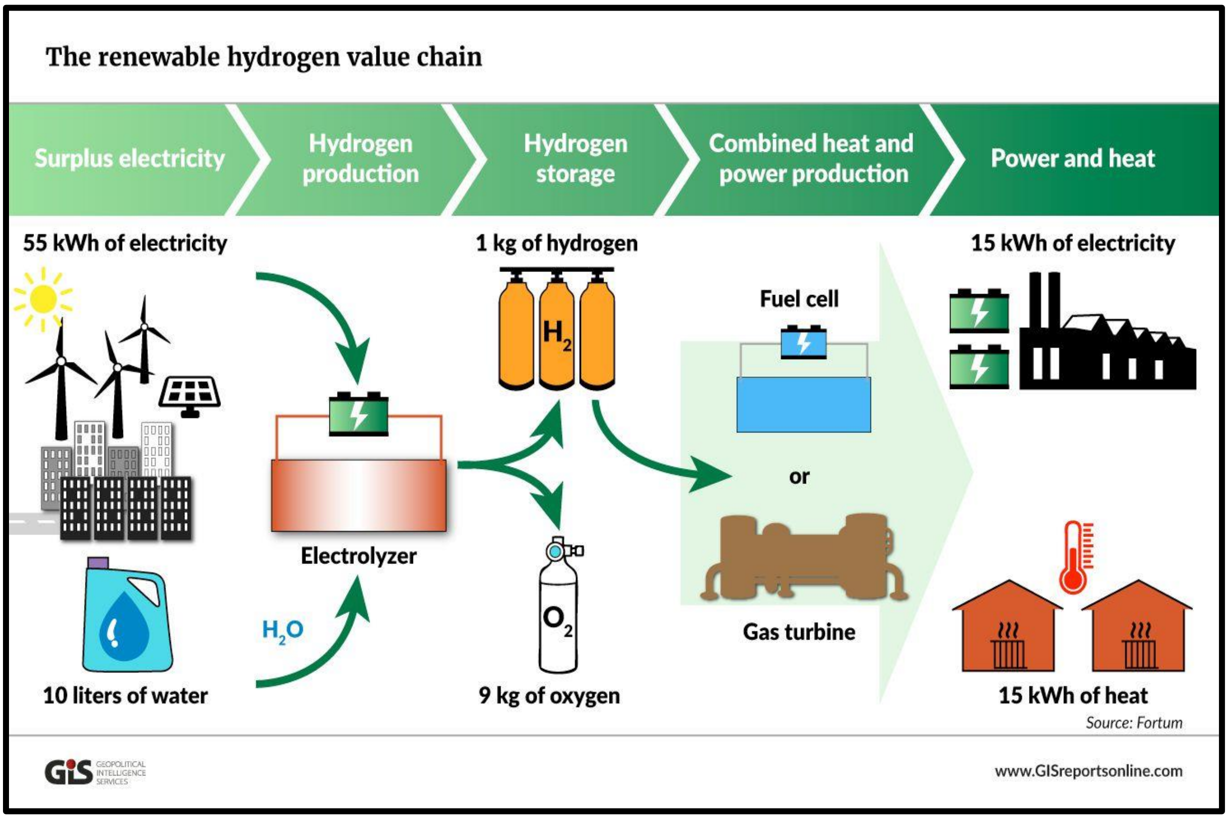
Already existing technologies allow hydrogen being produced, stored, moved, and used in different ways and for various purposes. Hydrogen can be produced by renewables, biomass, nuclear as well as fossil fuels (oil, gas, coal). It is seen as the leading und currently only realistic option for storing electricity from renewables for a longer time. In Europe, the focus is particularly on green hydrogen – though it is also currently the most expensive option.[52]

While bridging the cost gap with competing fuels is a key near-term challenge, the gap is projected to narrow considerably by 2030. While low-carbon hydrogen is expensive today, costs are expected to decline as production expands and as the necessary infrastructure is

[52] See also F.Umbach/J.Pfeiffer, ‘Germany and the EU’s Hydrogen Strategies in Perspective – The Need for Sober Analyses’, Periscope-Occasional Analysis Brief Series No.1, Konrad Adenauer-Foundation-Australia, Canberra, August 2020, and F.Umbach, ‘Hydrogen: Decarbonization’s Silver Bullet?’, GIS, 2 July 2020.

rolled out. But at present, the cost gap between electrolysis hydrogen and merchant hydrogen from natural gas reforming has recently grown wider for key hydrogen-using sectors that could provide near-term end-uses (such as refineries, ammonia, methanol, and steel production) as a result of low natural gas prices. As a result, policies in Europe and Asia may need to ensure that a gap of $50/MBtu or more can be bridged by consumers or taxpayers in order to incentivise new electrolysis hydrogen. Electrolyser costs might also fall as manufacturing and installation scales up and efficiencies are expected to increase.[53]

Figure 15: The Green Hydrogen Value Chain



Source: GIS 2020

Natural gas is currently used for three-quarters of the global hydrogen production of some 70mt per year with amount of 205 bcm/y (or 6% of global natural gas consumption). Coal currently accounts for 23 percent of global hydrogen production with some 107 mt (or 2% of global coal use). Only 4 percent of the worldwide hydrogen production in 2018 was based on renewable energy sources. By 2050, clean hydrogen could meet some 24 percent of the global energy demand with annual sales of around €630 according to some analytical estimates.[54]

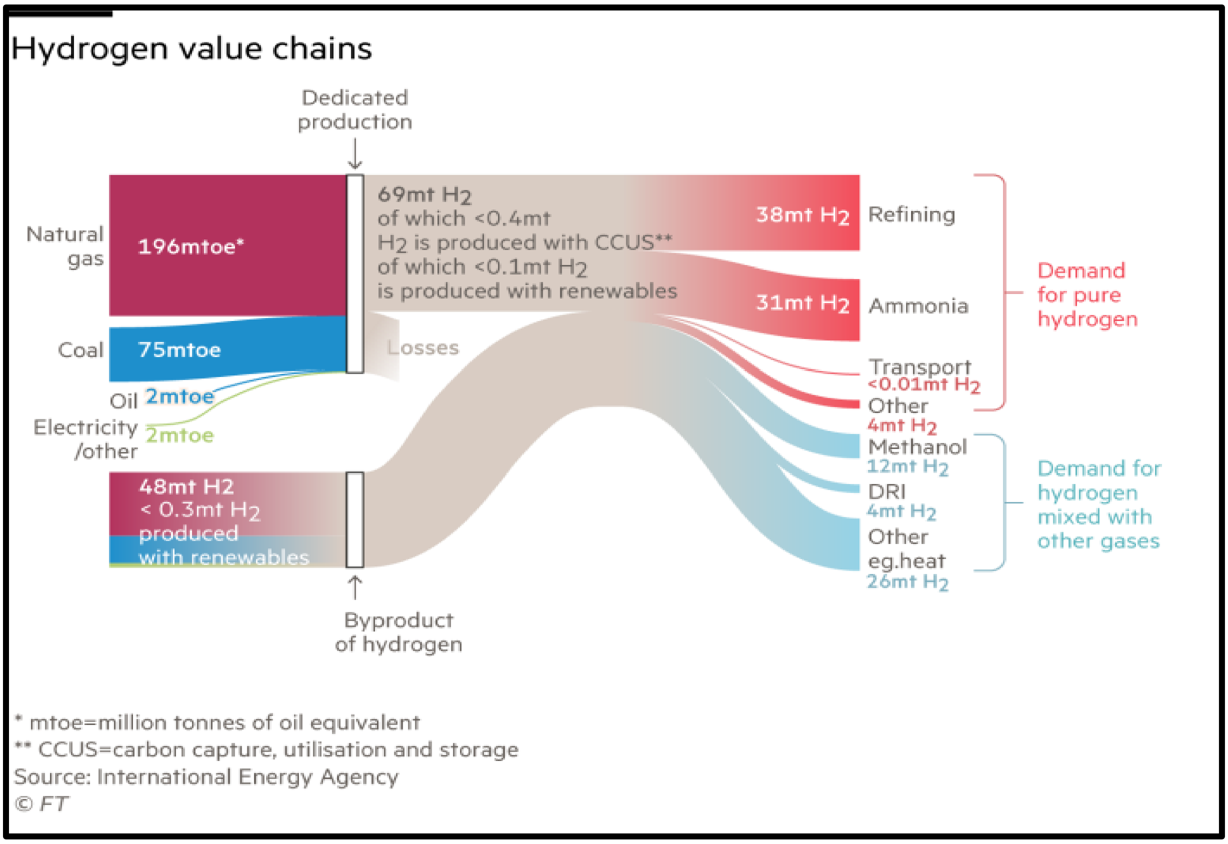
In contrast to the past, with the rapidly declining costs for renewables, batteries and EVs as well as other new technology innovation, hydrogen has now become a real option for solving

53 See IEA, 'WEO 2020', pp. 289 ff.

54 See also F.Umbach/Joachim Pfeiffer, 'Germany and the EU's Hydrogen Strategies in Perspective – The Need for Sober Analyses'.

the storage problem of electricity and also to decarbonize the hard-to-abate sectors of the economy, such as the energy-intensive industry. 'Power-to-X'-projects can convert electricity to other energy carriers or chemicals – generally referred to hydrogen produced by the electrolysis of water.

Figure 16: Hydrogen Value Chain



Source: FT 2021

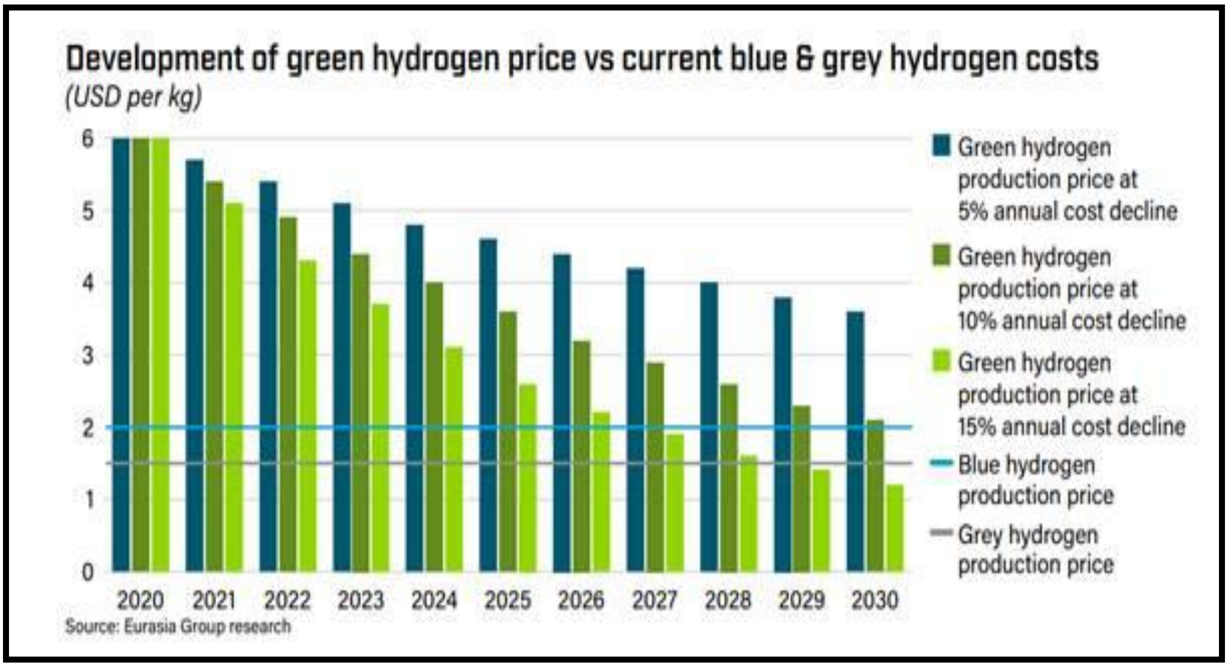
At the beginning of July 2020, the European Commission also published its own EU hydrogen strategy[55] after the EU has agreed on its newly codified target for reducing the EU-27 CO_2-emissions by 55 percent (instead of previously 40%) by 2030. As 75 percent of the EU's Greenhouse emissions result from the energy sector, the European Commission considers hydrogen also as a central element of its newly released "Energy System Integration Strategy" of July 2020 and the EGD of December 2019.[56] The latter has been viewed by the Commission as both the "motor" and "compass" of the just agreed €750bn 'Next Generation' economic recovery programme of the EU. The hydrogen strategy has been designed with a phased

55 See European Commission, 'A Hydrogen Strategy for a Climate-Neutral Europe'. Communication from the Commission to the European Parliament, the Council, The European Economic and Social Committee and the Committee of the Regions, Brussels, 8 July 2020 COM(2020) 301 final.

56 See European Commission, 'Powering a Climate-Neutral Economy: An EU Strategy for Energy System Integration'. Communication from the Commission to the European Parliament, the Council, The European Economic and Social Committee and the Committee of the Regions, Brussels, 8 July 2020 COM(2020) 299 final.

approach and the goal to increase the hydrogen share from less than 2 percent today up to 13-14 percent by 2050. As for Germany's hydrogen strategy, the priority has been given to develop renewable hydrogen with a cumulative investment up to €180-470bn in Europe by 2050.[57]

Figure 17: Development of Green versus Blue and Grey Hydrogen Costs 2020-2030



Source: Eurasia Group 2020

For implementing a successful pathway and cost-effective integration of its long-term hydrogen strategy, the EU will introduce new energy and climate legislation as well as regulations for common standards, investor certainty, terminology and certification based on life-cycle emissions, in line with EU taxonomy for sustainable investments.

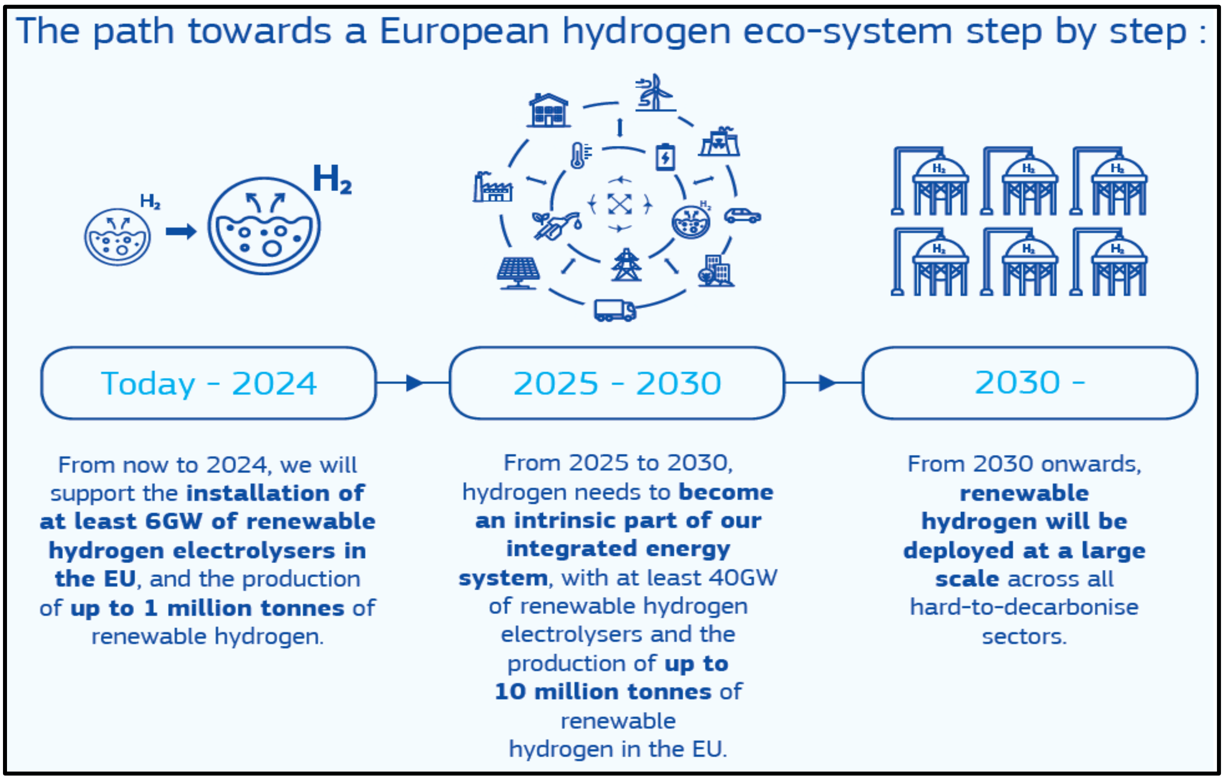
11 European gas companies from 9 EU member states unveiled a plan in the early summer of 2020, for a hydrogen pipeline network of 6,800 km by 2030 and almost 23,000 km by 2040, which could be used parallel to the natural gas grid. It could transport more than the expected 1,130 TWh of annual hydrogen demand in Europe by 2040 with rather limited costs between €27-64bn of the overall EU decarbonization. It is based on the assumption that 75 percent of the network will consist of retrofitted natural gas pipelines.[58] In April this year, the gas network operators from 11 countries have joined this initiative and presented an updated version for a pure hydrogen network of almost 40,000 km by 2040. 60 percent of this proposed hydrogen network could consist of repurposed existing natural gas pipelines, which significantly lowers

57 See also Die Bundesregierung, 'National Hydrogen-Strategy', Berlin, June 2020; European Commission, 'A Hydrogen Strategy for a Climate-Neutral Europe'; F.Umbach, 'Hydrogen: Decarbonization's Silver Bullet?', GIS, 2 July 2020 and idem/J.Pfeiffer, 'Germany and the EU's Hydrogen Strategies in Perspective' .

58 See also F.Umbach, 'Hydrogen: Decarbonization's Silver Bullet?'.

the overall cost of the needed hydrogen infrastructure. The total investment has been estimated at €43-81 bn.[59]

Figure 18: The EU's Hydrogen Strategy in Three Steps (July 2020)



Source: European Commission 2020

The EU considers hydrogen as a central element of its EGD and its new "Energy System Integration Strategy". The priority has been given to develop clean, renewable hydrogen with a cumulative investment up to €180-470bn in Europe by 2050. Brussels hopes that a green hydrogen economy could create 1 million new jobs for highly qualified personnel in the EU by 2030 and up to 5.4 million by 2050 across the entire value chain.

"Hydrogen Europe" has initiated a "2x40 GW Green Hydrogen Initiative" in April 2020, which promotes the build-up of 40GW (4.4mt or 173TWh) green hydrogen production in the EU and another very cheap one of 40GW (3mt or 118TWh) in Ukraine (10GW) and North Africa (30GW). The total investments have been estimated at €430bn with support of €145bn of grants and subsidies.

Germany's national hydrogen-strategy of June 2020 envisages the funding of green hydrogen projects with €9 billion (bn). €7bn are invested on its own national market and further €2bn have been envisaged for hydrogen projects in Ukraine and North Africa (Morocco) in forging partnerships as the future green hydrogen production might be more cost-efficient outside of

59 See Frederic Simon, 'Gas Grid Operators Outline Plans for Expanded EU 'Hydrogen Highway', Euractiv,com, 14 April 2021.

Europe than in Germany itself. Up to 5GW of electrolyser capacity are planned by 2030 in Germany.[60] But it is still the most expensive option. Many experts still see hydrogen from intermittent renewable sources as fundamentally inefficient and an uneconomic illusion.[61]

Figure 19: Hydrogen Options Based on Energy Resources

Hydrogen options based on energy resources

Green hydrogen:	Produced without CO_2 emissions (by nuclear or renewable electricity based on solar and wind).
Blue hydrogen:	Commonly used term for the production of hydrogen from fossil fuels (mostly from natural gas) with CO_2 emissions reduced by the use of Carbon Capture, Use and Storage (CCUS).
Turquoise hydrogen:	Made by pyrolysis with carbon black as a by-product.
Gray (or brown) hydrogen:	Produced with fossil fuels (hard or lignite coal or natural gas) without CCUS.
White (or natural) hydrogen:	Discovered by chance, when wells were drilled for oil and gas in Mali. It is estimated that its cost of exploitation is much cheaper than manufactured hydrogen from fossil fuels or from electrolysis.

Note: *the environmental effects cannot only vary considerably due to the energy source used for hydrogen production, but also due to production routes and supply chains, as well as the type of CCUS applied.*

GIS GEOPOLITICAL INTELLIGENCE SERVICES www.GISreportsonline.com

Source: GIS 2020

The EU seeks actively to enhance an “open strategic autonomy”. It does not mean complete self-sufficiency or isolating itself from the world through economic protectionism. Rather, it means having alternatives, introducing more competition, and avoiding “unwanted dependencies both economically and geopolitically” - particularly from authoritarian countries such as Russia, China, Saudi Arabia, and others.[62]

Hydrogen certainly offers new possibilities for cooperation between democratic countries of the G20 group. Australia, for instance, has unique conditions for becoming a renewable energy and hydrogen superpower. But the long maritime transport routes for hydrogen exports to

60 See the Federal Government of Germany, ‘The National Hydrogen Strategy’, Berlin, June 2020.

61 See also Karel Beckmann, ‘Second Thoughts on Green Hydrogen’, Gas in Transition, Vol. 1, Issue 1, 19 April 2021, and idem, ‘Energy Transition or Energy Collapse?’, ibid., p. 49 f.

62 See European Commission, ‘Critical Raw Materials Resilience: Charting a Path towards greater Security and Sustainability’. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Brussels, 3 September 2020 COM(2020) 474 final, and Frederic Simon, ‘New EU Alliance for ‘Strategic Autonomy’ on Key Raw Material’, Brussels 30 September 2020. To a more critical view see Richard Youngs, ‘The EU’s Strategic Autonomy Trap’, Carnegie Europe, 8 March 2021

Europe might prove rather costly and are linked with various maritime security risks such as blockades of choke points as currently experienced in the Suez Canal. While Mali in Africa can even produce natural hydrogen (white hydrogen), the widespread political instabilities have hampered any larger foreign investments during the last years. Morocco has been identified by the EU and Germany as one of the first and potentially most important hydrogen partner countries given its ambitious plans for solar plants and the potential yield of PV being twice as high. But presently the bilateral diplomatic relations between Morocco and Germany have dramatically deteriorated almost out of the blue due to different positions regarding the West-Sahara and a perceived new national(istic) self-confidence in Morocco. Moreover, all these countries need to green their national energy mix themselves and won't have surplus green energy available for any green hydrogen exports for the time being. Hence the present European and worldwide hydrogen hype needs to be downgraded to some more realistic perspectives.[63]

3. India's Energy and Climate Policies at a Turning Point

Over the next decades, India will become an ever more important actor in the global energy and climate developments. With the forthcoming COP26 climate summit in Glasgow at the end of this year, the new energy and climate policies of the new US-administration of President Joe Biden and the net-zero carbon emissions policies of the EU, China, Japan, South Korea and others, the worldwide political pressure on India – as the third-largest energy consumer and CO_2-emitter (or the fourth-largest if one includes the EU collectively) - to decarbonize its energy mix and officially also to adopt net-zero climate and energy policy have grown.[64]

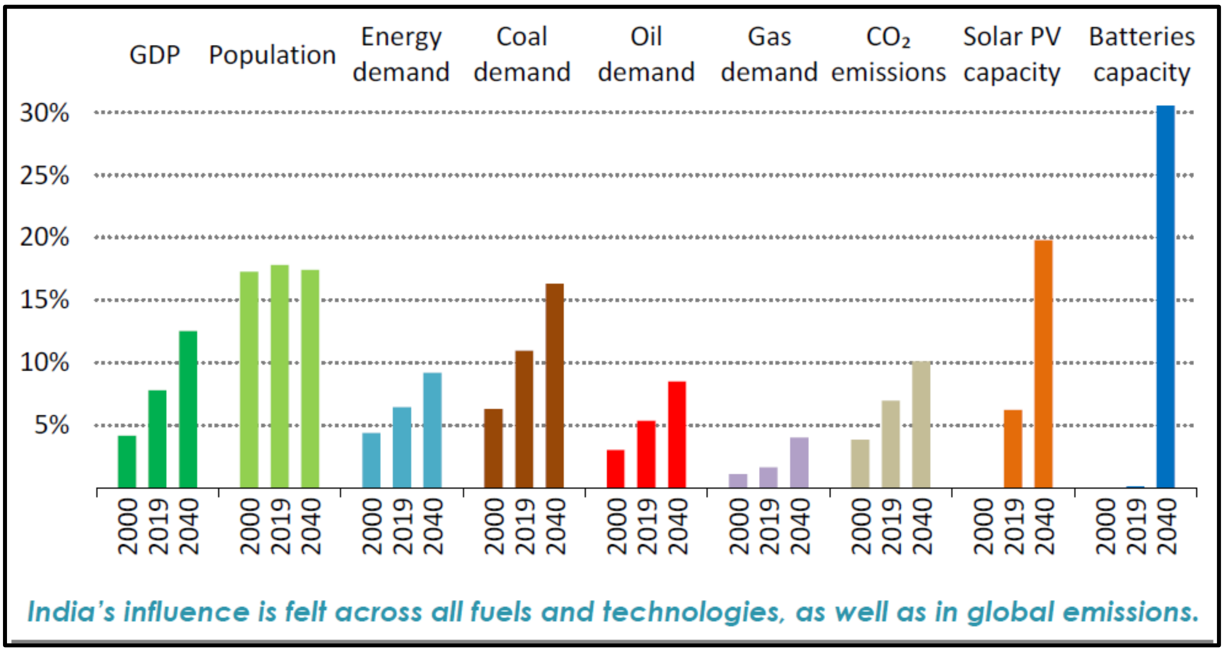
In 2019, more than 900m Indians have gained access to electricity supply in less than 20 years. But during the last years, India's energy sector and its economy at large have struggled with a financial and lending crisis, decline in consumption and investments as well as regulatory issues. The Covid-10 pandemic further impacted India, leading to decreasing economic growth and energy use. The present pandemic's impacts on India's already stressed health sector will further impact the economy and the energy sector. Beyond the present pandemic impacts, the government has to cope with the country's energy demand growth, securing affordable energy

[63] See also F.Umbach/Joachim Pfeiffer, 'Künftiger Energieträger Wasserstoff. Geraten wir in neue Abhängigkeiten?' ('Future Energy Carrier: Do We Will Fall back in new Dependencies?'), in: Europäische Sicherheit&Technik (ES&T), March 2021, pp. 33-37.

[64] See also 'China, India) Complicate Biden's Climate Ambitions', The Wall Street Journal, 23 April 20021; Editorial Board, 'Targets alone will not Solve the Climate Crisis', FT, 23 April 2021, and to the new US climate policy see Mehreen Khan et.al., 'New US Climate Strategy Opens up old Faultlines with Europe', FT, 23 April 2021.

supplies and improving the investment climate for upstream and transmission infrastructure projects.[65]

Figure 20: India's Share of Selected Global Indicators in the STEPS-Scenario



Source: IEA 2021

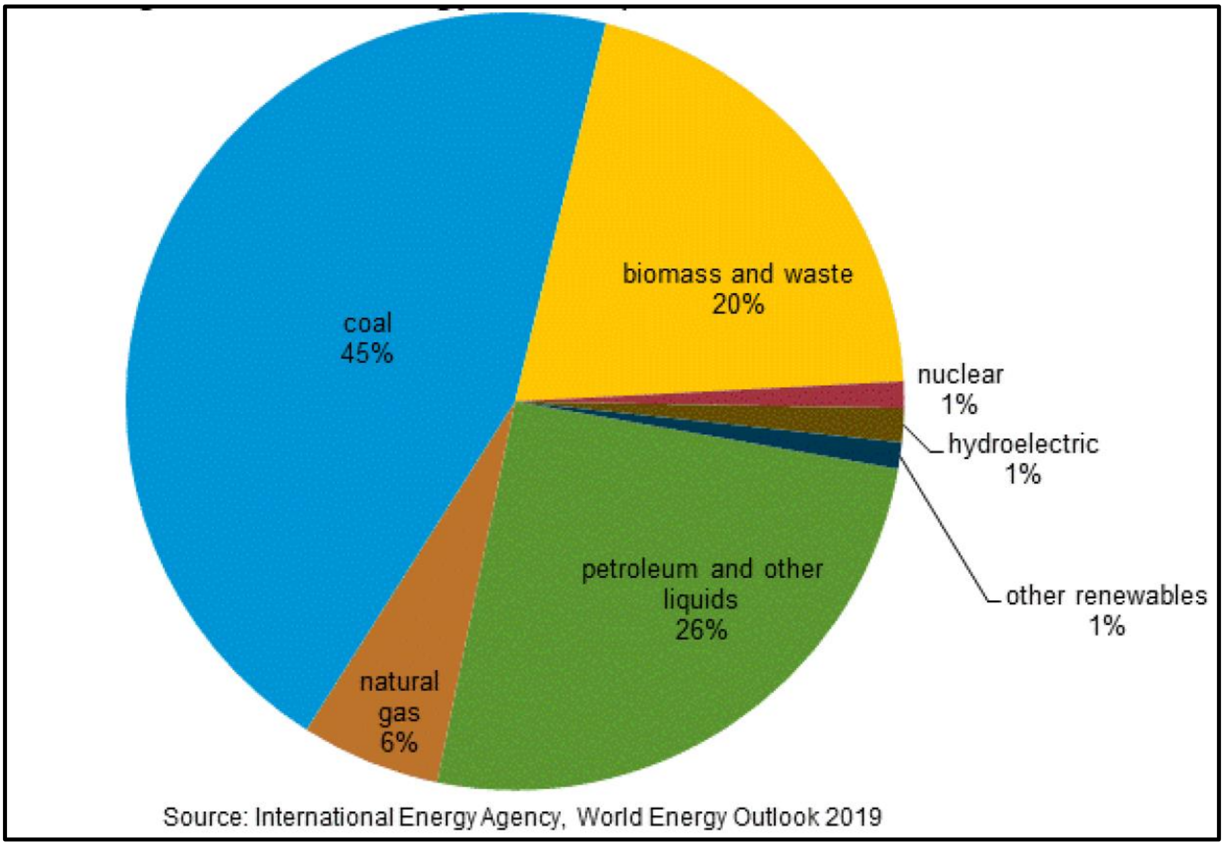
Between 1990 and 2018, India's primary energy consumption has almost tripled. As the world's second-largest coal consumer and producer (behind China), the share of coal has remained stable during the last years with some 45 percent. Its coal consumption id driven by the power sector. In 2020, the share of coal in the electricity generation was still around 55 percent. By struggling to offset oil production declines domestically, India is facing an increasing oil import dependence as the gap between its oil demand and supply is widening. It has been building a strategic petroleum reserve to enhance its country's oil supply security as the worldwide third-largest consumer of crude oil and petroleum products. The use of natural gas is still constrain-ed by falling domestic production and insufficient import capacity though the government is expanding the country's pipeline network. Nonetheless, India was globally the fourth-largest LNG importer during the last years. But the pandemic has also slowed its LNG-growth in 2020.[66]

In order to address the acute problems of air pollution, particularly in larger cities, and mitigate the coal consumption, the government has established targets for renewables (solar and wind power) to increase from about 87 GW in early 2020 up to 175 GW of capacity by 2022. The share of renewables (other than hydro) had already grown up to 24 percent of its installed

[65] See also Energy Information Administration (EIA), 'India – Country Analysis Executive Summary' (Washington D.C.: 30 September 2020).
[66] See EIA, 'India'.

power capacity by mid-2020.[67] But at the same time, India has been coping with an unreliable electricity supply for many consumers, a continued reliance on solid biomass (mainly firewood) as a cooking fuel for some 660m people. Its high coal consumption and the ailing electricity distribution networks have made Indian cities among the most polluted worldwide.

Figure 21: India's Primary Energy Mix in 2019



Source: EIA 2020

By taking the impacts of the Covid-19 pandemic into account (energy investments fell 15% in 2020), the IEA has decreased the projected energy demand growth from 50 percent prior to the pandemic to rather 25-35 percent between 2019 and 2020, depending on the IEA's developed scenarios (STEPS and Delayed Recovery Scenario). India's projected increase in energy demand, based on an expanding economy, population, urbanisation, and industrialisation, may the largest one of any country. Its urbanisation rate with 270m people to be added to the country's urban population over the next 20 years will transform India also to one of the key players for mitigating the global warming. But solar power still accounts for just 4 percent of its electricity generation.[68]

As in other countries, India's electricity demand is also bound to increase much more rapidly than its overall primary energy demand. The government hopes to expand its renewable

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67 See ibid.
68 See IEA, 'India Energy Outlook 2021'.

capacity to 450 GW and 520 GW by including large-scale hydropower by 2030. It would outstrip its existing coal-fired capacity and even go beyond its installed capacity of 369 GW of January 2020.[69] Even in 2020, in spite of being affected by the Covid-19 pandemic, India's renewable sector could attract new investments and further grow as solar energy has become cheaper than commercial and industrial grid tariffs in most Indian states. But new and legacy challenges of India's power sector are also complicating a renewable energy growth such as the rollout of new technologies such as smart meters and blockchain, redrafting laws and regulations, redesigning existing institutions and incentivising domestic manufacturing.[70] But it needs to pair it with a rapidly growing battery storage to offer baseload supply security with a "round the clock"-supply as well as the adoption of Carbon, Capture, Use and Storage (CCUS) for its fossil fuel use. By 2040, its battery capacity may have to grow up to 140-200 GW, dependent on the two major scenarios. Its clean energy workforce has been forecasted to grow by 1m over the next 10 years.[71] India's share of nuclear power with an existing generation capacity of 6.2 GW may remain rather stagnant. Although 7 more reactors with a total capacity of 4.8 GW are under construction, five have been significantly delayed and have become much more expensive.[72]

India's CO_2-emissions during 2019-2019 rose slower than in the period of 2011 to 2015 but were above the world average of 0.7 percent. In 2020, its emissions decreased by 9.7 percent more than the world average of 9.6 percent.[73] India's projected emissions could grow by 50 percent by 2040 and could be the largest growth factor worldwide, though its per capita emissions may remain below the global average. The increase of emission is not so much expected coming from the power sector but rather from industry and transport (especially trucks). It will make India the world's second-largest emitter by 2040 (behind China).[74] Alongside the urbanisation, water supply shortages may further increase and becoming an ever more important factor for India's energy and climate policies. India also needs to use the potential for synergies between improving energy access and reducing air pollution for reducing the around 600.000 premature deaths associated with household air pollution (with the traditional use of biomass for cooking) in 2019.[75] With these huge challenges ahead and

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69 See Anmar Frangoul, 'India has some huge Renewable Energy Goals. But can They be Achieved?', CNBC.com, 3 March 2021.

70 See Disha Agarwal/Rishabh Jain, 'Understanding India's Renewable Energy Ambitions', EastAsiaForum, 13 July 2020.

71 See EIA, 'India', p. 14.

72 See M V Ramana/Cassandra Jeffery, 'No Market for Australian Uranium in India', EastAsiaForum, 23 June 2020.

73 See Jacob Koshy, 'India's Percentage CO2 Emissions Rose faster than the World Average', The Hindu.com, 1 March 2021.

74 See IEA, 'India Energy Outlook', p. 181.

75 See ibid., p. 187.

becoming one of the world's largest markets for clean energy technologies, "India is in a unique position to pioneer a new model for low-carbon, inclusive growth."[76]

The IEA has recommended the following energy reforms, strategies, and targets in its latest 'India Energy Outlook 2021'-report: (1) quadrupling renewable electricity capacity by 2030; (2) more than doubling the share of natural gas in the energy mix; (3) enhancing energy efficiency and transport infrastructure; (4) increasing domestic coal output; and (5) reducing reliance on imports.[77]

But at present, India's government still favours the expansion of coal mining and consumption. The state-owned Coal India Ltd. has just approved 32 new coal mining projects last March. While 24 of them are an expansion of existing projects, 8 are new greenfield projects.[78] The government has started the biggest auction ever with even 67 mines on block. It is also seen as an instrument to create jobs in a devastated economy by Covid-19.[79] India is also the world's second-largest coal importer (after China), with Indonesia being the largest supplier.

Without changing present energy policies, coal will remain the largest source of power in 2040 and exponentially grow up to 3,565 TWh by 2037 – more than doubling from the 2020 level.[80] Thereby, 88 percent of India's total emissions are energy-related.

Although also the natural gas demand will rise uninterruptedly towards 2050 in India, its projected share in its primary energy mix might remain rather small by 2030 with just 5 percent in contrast to many other countries fast- tracking a coal-to-gas fuel change. But its natural gas production is projected to rise just from 9 million cubic meter per day (mcm/d) in 2021/2022 to 122 mcm/d in 2023/2024.

If India would follow a net-zero target by 2050 rather than mid-2060s, in a high economic GDP scenario, "India's effort to decarbonize by 2050 will be six times greater than it would take China to get there by 2060", according to calculations of an Indian energy expert.[81] In response to the IEA's new controversial publication on pathways to zero-emissions by 2050[82], Indian government representatives have criticized that zero-emission targets will undermine the principle of equity and "common but differentiated responsibilities" of developed and

76 See ibid., p. 16.
77 See IEA, 'India Energy Outlook 2021'.
78 See 'Coal India Approves 32 Mining Projects worth Rs 47,300 cr', New India Express, 9 March 2021.
79 See 'In a Message to Joe Biden, India Embarks on new Coal Boom', Bloomberg, 26 March 2021, and Sudarshan Varadhan, 'India may Build new Coal Plants due to low Cost despite Climate Change'.
80 See 'Coal Projected to be India's Largest Source of Power in 2040, World Coal Association', The Economic Times, 12 February 2021; Damon Evans, 'Coal Use Set to Surge in India despite Renewables Boom', Energyvoice.com, 17 February 2021.
81 See Akshat Rathi, 'Net Zero', Bloomberg Green Daily, 22 March 2021.
82 See IEA, 'Net Zero by 2050. A Roadmap for the Global Energy Sector' (Paris: OECE/IEA, May 2021).

developing countries.[83] India appears unlikely to commit itself to a net-zero emissions target by 2050 or 2060.[84] *But by committing to a net-zero carbon target, India would receive strong international and EU support as well as from private investors. It would also open new windows of opportunities for a much wider energy and climate cooperation for India.*

4. Summary and Strategic Perspectives for EU-India Energy Cooperation

From a geopolitical point of view, India has become an ever more important partner of the EU in its foreign and security policies, and for energy and climate cooperation. Both sides could be natural partners for greening their economies and beyond. The EU's strategic interest is also explained by the fact that the EU's relations with the autocratic countries of Russia and China have considerably deteriorated during the last years.[85] Western democracies are feeling increasingly challenged by autocratic powers such as China and Russia. As a result, a global cooperation between democratic countries have been identified as a pre-condition for preserving the Western and European influence amidst a new systemic and geopolitical conflict between democracies and autocratic countries. Thus, the EU and India are also planning to build global infrastructure projects to compete with China's Belt and Road Initiative (BRI).[86] Both sides have also revived talks on a comprehensive trade deal and have also agreed to cooperate in the areas of digital connectivity, transport, communications, human mobility and to promote multilateralism.[87] At present, India is only the EU's 10th largest trading partner, but with much more growth potential. But vice versa, the EU is for India already the second-largest export market.

The EU's EGD of December 2019 and the newly adopted Climate Law in March 2020 with its legally binding GHG-emission reduction target of minus 55 percent by 2030 have fundamental implications on the member states' energy mix, energy strategies, legislation, and regulations.

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83 Quoted following Jayashree Nandi, 'India cannot Bind itself to Net-Zero Emission Target: Chandrashekhar Dasgupta', Hindustan Times, 30 March 2021.

84 See Charles Kennedy, 'India Unlikely to Commit to Net-Zero Emissions Target', Oilprice.com, 30 March 2021.

85 See also F.Umbach, 'EU-China Relations at a Crossroads: Decoupling or a European 'Sinatra Doctrine'?', East Asian Policy, Spring 2021, pp. 47-64; idem, 'The Challenges of EU-China Decoupling', GIS, 6 October 2020; idem, 'Focus Germany: Relations with China in Perspective', ibid., 8 October 2019; idem, 'EU-China Relations at the Crossroads', ibid., 20 June 2019, and idem, 'Europe and Huawei: Rising Cybersecurity Challenges', GIS, 2 April 2020.

86 See Michael Peel/Sam Fleming/Stephanie Findlay, 'EU and Indi Plan Global Infrastructure Deal', FT, 21 April 2021; Christoph Hein/Hendrik Kafsack, 'Antwort auf die neue Seidenstraße', FAZ, 8 May 2021, p. 5; and 'Why India and EU Plan to Roll out a Global Infrastructure Deal', India Global Business.com, 23 April 2021.

87 See Maria de Deus Rodrigues, 'India's PM Narenda Modi will not Attend Porto Summit', Euractiv, 20 April 2021; Sam Fleming/Jim Brunsden/Amy Kazmin, 'EU and India Set to Revive Talks on Trade Deal', FT, 3 May 2021; Sam Fleming, 'EU and India Agree to Relaunch Trade Talks', FT, 8 May 2021, and Santosh Jha, 'India and the EU are Natural Partners for the Green Economy', ibid., 19 October 2020.

Although natural gas has been considered as a "transition bridge" fuel for decarbonization, the European Commission has now declared the phasing-out of conventional gas continuously after 2030 and replace it with hydrogen, methane, and other green gases as otherwise the EU's long-term climate objectives for 2050 cannot be realized.

At the same time, every government, unlike NGOs, must maintain and balance the energy triangle between environment/climate protection, economic competitiveness, and security of supply. In addition, without social acceptance, neither ambitious climate goals nor the preservation of economic competitiveness and security of supply will be achieved. Therefore, a process that is open to technology, focused on economic efficiency and innovation and socially balanced is more necessary than ever, in order not to further jeopardize global economic competitiveness, since the EU is rather unable to compete in terms of digitalization and artificial intelligence compared to the US and China.[88]

From the EU-point of view, India also needs also strengthen its decarbonization policies by the following policy measures:

- promoting further the expansion of renewables for coping with its projected high growth of electricity consumption by 2030;
- reducing its coal imports and stopping its future investments in new coal mining and coal power projects and begin to develop plans for a long-term coal phase-out;
- adopting a widespread use of energy efficiency and conservation measures as the "cheapest form of energy use";
- building a transport infrastructure for electric mobility;
- developing hydrogen and other green gas projects for energy intensive industries such as steel, cement, glass, and others, which cannot be transformed to a low carbon footprint by using just renewables.

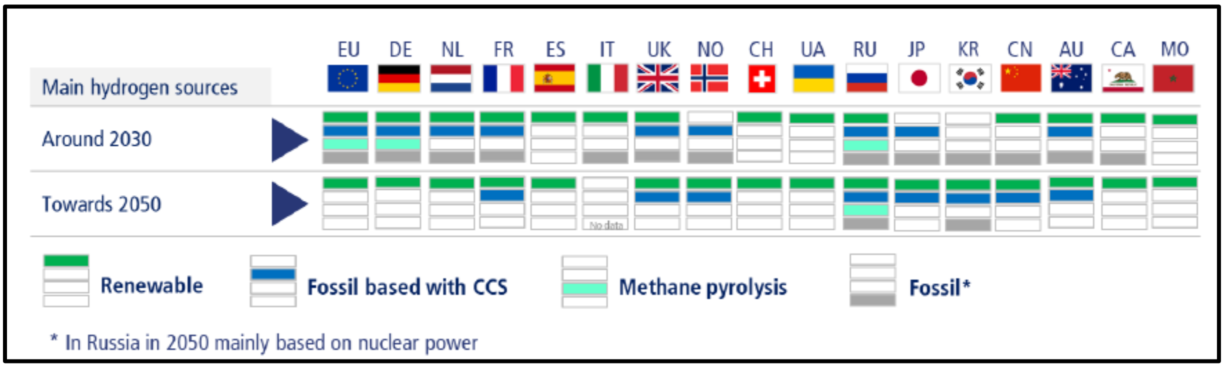
In the light of the analysis and recommendations mentioned above, the following seven areas of bilateral German/EU-India energy cooperation can be identified as follows:

- **Developing joint Hydrogen-Projects:** Hydrogen is not just very much supported in Europe by governments and industries alike, it is also enjoying an unprecedented political and industry support around the world. Hydrogen can play a key role and be the 'missing link' as feedstock in hard-to-abate sectors such as steel-making and refineries, ammonia production and chemical industry in decarbonized energy systems. In the future it can also fuel buses, trains, and trucks and even ships and planes. By

[88] See F.Umbach, ‚Globaler Wettlauf bei Künstlicher Intelligenz und Digitalisierung. Geopolitische Dimensionen' ('Global Competition for Artificial Intelligence and Digitalisation. Geopolitical Dimensions'), Europäische Sicherheit & Technik (ES&T), 05/2020, pp. 39-43, and idem, 'The U.S.-China AI Race: A 'Third Way' for Europe? ', GIS, 25 April 2019.

2050, clean hydrogen could meet some 24 percent of the global energy demand with annual sales of around €630bn according to some analytical estimates. The main actors in Asia are up to now China, Japan, South Korea, and Australia. India's huge but struggling farming sector could also benefit from the introduction of clean ammonia as fertilizer.

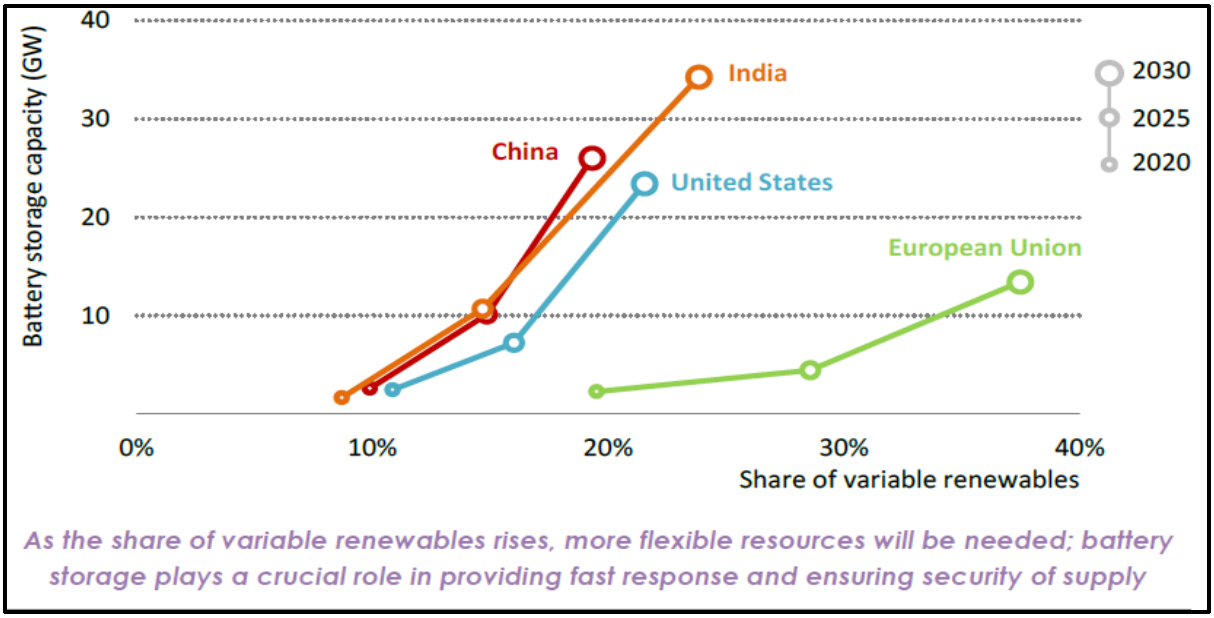
Figure 22: Considered Medium-and Long-term Hydrogen Production Options by Country



Source: WEC 2020

- **Cooperating on Battery Development:** Since the launch of the 'European Battery Alliance' in 2017, the EU is trying to catch up with China, South Korea, Japan and the US in the manufacturing of car and other batteries. It seeks to build a battery value chain in Europe as an ambitious European industrial policy to compete with its global rivals. The European Battery Alliance is also envisaged to take the lead in designing and producing the world's most environmentally-sustainable and ethically-responsible batteries with the highest recycling rates. The development of a new generation of batteries does not just matter for the electrification of the worldwide transport sector, but also offer new storage solutions, including in other sectors (such as power plants/electricity sector and heating). Further improvements of lithium batteries will also allow to use them for trucks, busses, and increasingly also for air and sea transport. Energy utilities have already begun to use utility grade lithium-ion batteries for large industry storage systems and grid-scale energy storage applications. Battery storage systems are well suited to short-duration storage that involves charging and discharging over a span of hours or days. This makes them a good partner for variable renewables. By 2040, cost reduction by large-scale production and intensive research could make batteries up to 70 percent less expensive than today.

Figure 23: Battery Storage Capacity and Share of Variable Renewables in Selected Regions in the 'Stated Policies Scenario (STEPS)'

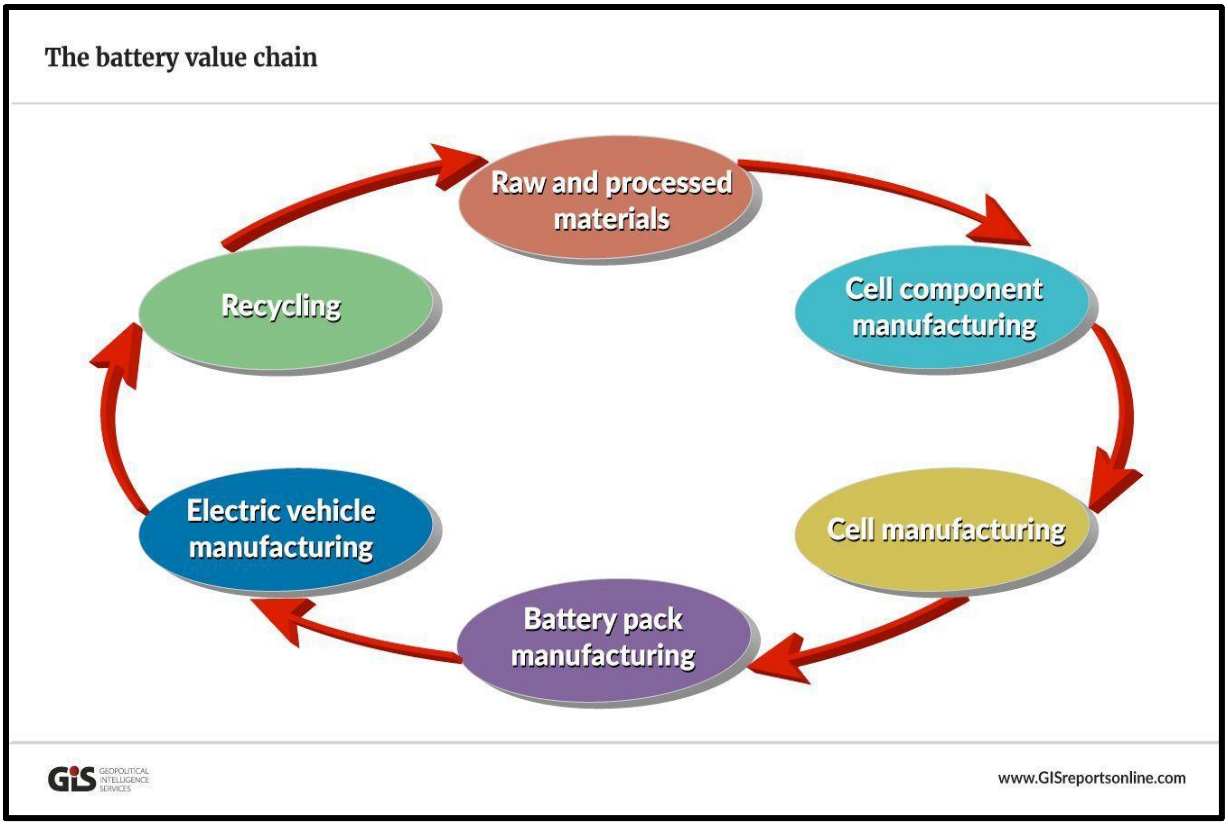


Source: IEA, 'WEO 2020'.

The IEA has projected a 20-fold increase of global utility-scale battery storage capacity between 2019 and 2030 - with 130 GW in STEPS. The largest growth market might be India, where batteries absorb peak output from solar PV during the day, store it for several hours, and then discharge to help meet electricity demand peaks in the evening. Together with the hydrogen development, batteries will also change geopolitical dynamics regionally and globally as they require new supply chains, trade routes and strategic partnerships, including for CRM supply security, and result in new geopolitical alliances as well as strategic rivalries which need to be anticipated by the EU's and India's foreign and security policies.

- **Supporting Recycling and Re-use for a Circular Economy:** China and the EU have already introduced rules that will hold carmakers responsible for recycling their batteries. But while the cost of fully recycling a battery is also falling, the value of the recycled raw materials is often still a third of that. A more attractive option is the re-use of car batteries for home and other energy storages rather than recycling. These batteries can still have up to 70 percent of their capacity, when they end their usual lifetimes in electric cars. Forced by regulations, the older lead-and nickel-based batteries have a life-end-recycling rate of 99 percent in Europe and North America. The high recycled content of lead batteries is more than 85 percent. In the future, new EVs may only be sold in the EU if they may be re-used, recovered, and recycled in line with its 'end-of-life vehicles (the 'ELV-Directive')'. Some companies have already begun investing of used EV batteries in Europe.

Figure 24: Battery Value Chain



Source: GIS 2020

But many recycling options are still often constrained due to poor data on both current and future recycling rates and insufficient profitability and commerciality for industry businesses. But the worldwide R&D and new battery development has intensified during the last years. An important development towards fast charging for EV batteries is making EVs more attractive for customers. Improved longevity, including for second-life appliances, is also important for the future competitiveness of EVs and various battery powered appliances. Some progress has been made for the buildout of the Lithium-ion ecosystems that demands enhanced collection, testing, recycling, and processing of batteries, but needs further efforts and innovation.

- **Promoting Carbon Capture, Use and Storage (CCUS)-Projects:** In contrast to previous years, CCUS is increasingly supported politically for mitigating climate warming as all technologies need to be used for the use of natural gas as a "bridging fuel" as well as for the energy-intensive industries, which will still need fossil fuels. India's CO_2 storage potential has not yet been really analysed but it might also play an important role in various Indian sectors.
- **Collaborating on Digital Innovation and Artificial Intelligence:** The energy sector worldwide is coping with unprecedented changes and challenges of numerous digitalisation technologies, new forms of mobility, autonomous driving, and the introduction of Artificial Intelligence (AI) technologies. In contrast to the past, most of

the new technologies are developed outside of the energy sector itself but also have unprecedented impacts on energy markets and traditional energy industries. For the worldwide energy industry, including India's, these changes offer both new benefits as well as operational and strategic risks: "Digitalized energy systems in the future may be able to identify who needs energy and deliver it at the right time, in the right place and at the lowest cost."[89] The combination of digitalisation with the widespread use of 'Information and Communication Technology (ICT)' is changing the established energy sector and the traditional energy business models by creating new consumption patterns, providers and platforms (also from outside of the energy sector). The digitalisation and electrification have also led to rising competition among energy companies which face at the same time new competitors from outside (i.e. IT companies). A bilateral EU-Indian cooperation can contribute to a mutual understanding, learning and cooperation on the benefits as well as related new security risks (such as cyber security risks and vulnerabilities) and also offer new perspectives for joint technology and industrial cooperation.

- **Enhancing Energy Conservation and Energy Efficiency:** Energy conservation is the cheapest energy as it is not being used and can reduce the national energy demand significantly. Sharing technology and best practices from the EU side can significantly support India's energy reform policies and reduce its energy demand growth. Global improvements in energy efficiency have been declining since 2015. As a result of the Covid-19 pandemic, and continuing low energy prices, energy intensity improved by only 0.8% in 2020, roughly half the rate of the previous years. This is also below the level needed to achieve global climate and sustainability goals.[90] Therefore an enhanced EU-India cooperation on energy efficiency would not only help India, but would also contribute to mitigate the global energy demand.

- **Strengthening Resilience of Energy Systems:** Resilience describes the capacity and ability to withstand against attacks as well as to cope with and to respond to diverse disruptions of systems and restore them to fully functional capacity as soon as possible. Hence resilience also includes the robustness, adequacy, adaptability, flexibility and reliability of energy systems, resources, and infrastructures. It also includes the ability to continuously change or modify delivery mechanisms if needed in the face of new risks as well as backups and disaster recovery operations as part of the process for restoring supply mechanisms. The concept is particularly relevant for the functioning of critical energy infrastructures as a stable electricity supply is a precondition for the functioning of all other critical infrastructures. Thus, resilience can

89 IEA, 'Digitalization & Energy', (Paris: IEA/OECD, 2017), p. 15.
90 See also IEA, 'Energy Efficiency 2020' (Paris: OECD/IEA, December 2020).

be considered and conceptualized as an important element and pre-condition of energy security. With the digitalisation of the energy sector, a stable internet access is just as essential as the power grid. Smart meters, smart grids, ‘industry 4.0’, IoTs, cloud computing and the envisaged future self-driving cars and AI are all based on several interconnected layers of continuously operating infrastructures linked with the internet. Thus resilience, particularly of a stable electricity system, will become ever more important as the electrification of the transport, industry, and building (heating) sectors and will further expand and make societies as well as economies increasingly vulnerable to supply disruptions and cyberattacks.