2023-IP02

Energy Technology Perspectives 2023

On 12 January, the IEA's Executive Director, Fatih Birol, and Head of Technology Policy Division, Timur Gül, presented key findings of the IEA's flagship publications, Energy Technology Perspectives 2023 (*ETP2023*), during a livestreamed press event.

Recognising that key clean energy technologies[1] were flourishing around the world, Dr Birol spoke of the emergence of a new global energy economy, driven by three factors:

- Governments' pursuit of energy security
- The climate commitments made by most governments, and
- By pushing these clean energy options, countries hope to position themselves to take advantage of this new emerging economy.

As the world was entering a new age of clean energy technology manufacturing, *ETP2023* was described as the global guidebook to the clean energy technology industry of tomorrow. From the mining of minerals, the processing of those minerals through the manufacturing of equipment for clean energy technologies, a new market worth billions of dollars would create millions of jobs around the world. For *ETP2023*, the IEA had looked closely at all announced energy projects around the world and disregarded all except those judged as robust to go. They found that, by aggregating the content of all the 'robust to go' projects, a full two-thirds of the investments needed to reach net-zero targets by 2050 were realised.

While only 20 years ago, solar PV and wind were in their infancy, as were electric vehicles batteries just 10 years ago, these technologies are now advanced manufacturing operations … with more to come! Solar PV is set to surpass coal in capacity terms within the next five years. Ten million electric cars were manufactured in 2022, reaching 13% of all vehicles sold in the world last year. And **carbon capture, utilisation and storage[2]** (**CCUS**) is projected to play an important role, with CO_2 capture growing from around 0.04 Gt in 2021 to 1.2 Gt in 2030 and 6.2 Gt in 2050. Indeed, the role of **CCUS** will be important. It can contribute to decarbonising industry, power and fossil-based hydrogen production, as well as provide carbon dioxide removal and CO_2 for synthetic fuel production. As a result, any disruptions to the supply of CO_2 capture components or along the CO_2 transport and storage infrastructure could have an impact on clean energy supply across several sectors.

In fact, IEA's analysis shows a massive deployment of clean energy technologies is needed. The decarbonisation of the energy system envisioned to meet net-zero emissions by 2050

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[1] Clean energy technologies comprise those technologies that result in minimal or zero emissions of CO_2 and pollutants. For the purposes of this report, clean energy technologies refers to low or near zero emissions technologies that do not involve the production or transformation of fossil fuels – coal, oil and natural gas – **unless they are accompanied by carbon capture, utilisation and storage** (**CCUS**) and other anti-pollution measures.

[2] In terms of deployment, while **CCUS** has seen only modest progress to date, the number of announced projects is very high –with around 300 projects currently in various stages of development across the **CCUS** value chain.

rests on eight main pillars: behavioural change and avoided demand, energy efficiency, hydrogen, electrification, bioenergy, wind and solar, **CCUS**, and other fuel shifts (e.g., switching from coal and oil to natural gas, nuclear, hydropower, geothermal, concentrating solar power and marine energy).

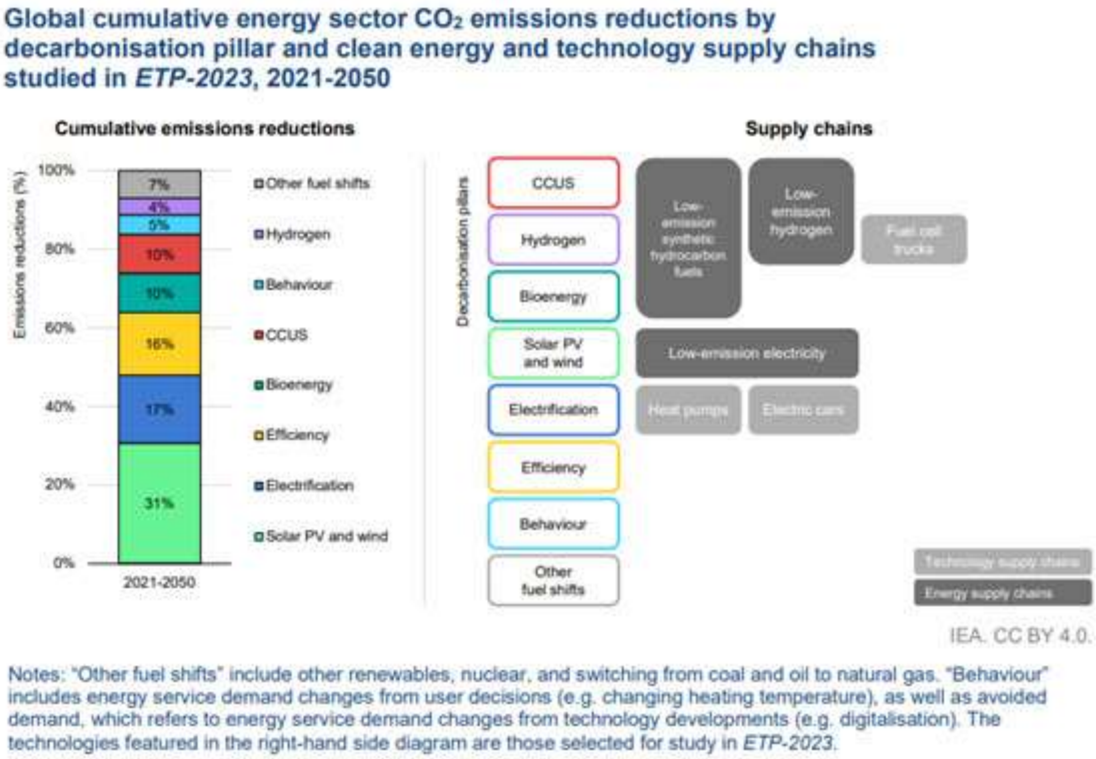

Figure extracted from Energy Technology Perspectives 2023, p45, Figure 1.5.

ETP2023 provides analysis on the risks and opportunities surrounding the development and scale-up of clean energy technologies and supply chains in the years ahead, highlighting the risks and bottlenecks to sustainably scale up those supply chains at the pace needed. One of the major findings was the geopolitical **concentration** of mining, mineral processing and manufacturing:

- **Mining**. The top three producer countries globally in each case produce 80% of cobalt, more than 90% of lithium and 45% of copper. One country, the Democratic Republic of Congo produces 70% of the world's cobalt.
- **Critical mineral processing**. The top three producer countries globally process more than 80% of cobalt, 98% of lithium and more than 50% of copper.
- **Bulk material production**. The top three producer countries globally produce more than 60% of both aluminium and steel.
- **Technology manufacturing**. For batteries, wind, solar PV, heat pumps and electrolysers, the top three countries for each case manufacture between 70% and 85%.

On the supply side, manufacturing is heavily concentrated, with China dominant. In fact, China plays a dominant role in all sectors except for mining, where resource endowment is the critical factor. China hosts two of the three main manufacturers of car batteries, with 75% of batteries built there. On the demand side, many other countries are seeking to carve out a role for themselves. Trade is important for clean energy technologies to date. For example, almost 60% of solar PV modules are traded internationally, with China providing around three-quarters of Europe's annual installation. As markets for clean technologies constitute a major opportunity, China is far away the best placed to tap into this market based on current project announcements. As not all of China's manufacturing capacity can be deployed domestically, China is well placed to remain a chief energy exporter through 2030 if all its projects materialise.

Whereas the geographical distribution of critical mineral extraction is closely linked to resource endowments, placing too many eggs in one basket brings obvious risks. This has been exemplified recently with the serious negative consequences suffered in Europe resulting from an over-reliance on Russian natural gas. With disruptions possible due to, for example, political decisions, natural disasters, technology failures and geopolitics, it is important to diversify manufacturing and the mining of critical minerals as far as possible. Dr Birol emphasised that energy security and supply chain challenges of today's energy economy cannot be allowed to be repeated in the energy economy of tomorrow.

It is notable that, in *ETP2023*, CCUS is not mentioned among those clean energy technologies with supply chain risks relating to the availability of critical minerals, which suggests that CCUS is less exposed to them.

Investment in the supply of clean energy technologies is on the rise:

- **Electrolysers**. The supply of electrolysers has increased from 3 GW to 10 GW in just three years. The outlook for electrolysers could exceed 100 GW by 2030 or, according to IEA analysis, around half the level needed to achieve net zero by 2050 … still leaving a significant gap.
- **EV batteries**. The announced capacity is very close to that required to achieve net zero by 2050.
- **Solar PV**. The announced capacity is sufficient to achieve net zero by 2050.

As stated earlier, if the manufacturing projects announced materialise, it would fulfil two-thirds of investment needs to 2030.

In the last year or thereabouts, countries have been devising new energy strategies, all committed to establishing their share in the new industrial age of clean energy manufacturing. Examples are the United States (IRA), European Commission (REPowerEU), Japan (Green Transformation), India (PLI scheme for battery manufacture) and China (7th Five-Year Plan).

Indeed, big dividends are promised to those countries that are successful with their clean energy manufacturing policies. In doing so, high standards will be required to prevent polluting practices, to do no environmental harm and for progress not to be at the expense of vulnerable people.

Smart industrial policies will matter. Not all countries can compete across all clean energy technologies. Countries will need to take account of their geography, their geology, their neighbours and their existing industrial expertise in building their own industrial policies.

Importantly, international collaboration will be the key to success for many countries. While healthy competition is good, collaboration will help bring down costs and accelerate innovation. It is important to realise that getting to net zero is not possible without more innovation. To reach net-zero by 2050, about half of the emissions reductions come from technologies at prototype or demonstration stages today, including key technologies, such as cement, steel and aluminium production with **CCUS**. And though a healthy trade in clean energy technologies will be important if they are to become affordable, Dr Birol observed that, at present, the wind seems to be blowing in the other direction!

Dr Gül finished with some key takeaways:

- With clean energy technology supply chains lying at the nexus of climate, energy and industrial policies, an all-government approach is required.
- High geographical and market concentrations threaten security of supply. Policies to deal with this must build on competitive advantages and strengths.

- Supply chain resilience is crucial. Market disruptions and import prices can have profound cost implications. Clean energy technologies are more sustainable than the use of fossil fuels.
- Industrial strategies must build on mapping domestic opportunities and identifying strategic partnerships. It is not realistic for most countries to compete across all supply chains.
- Finally, while time was of the essence, it was not too late for countries to take part.

Keith Burnard