

Why data is vital to build a better energy future for the world

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In this contribution, Dr. Fatih Birol, Executive Director of the International Energy Agency (IEA), highlights how data is essential to understand and map progress in clean energy transition, to bring down global greenhouse gas emissions, achieve key international Sustainable Development Goals on universal access to modern energy and ensure energy security worldwide. The article depicts how the IEA produces, maintains and continuously improves essential datasets, indicators and data-based projections to help countries navigate this challenge.

Data is essential to understand and improve our complex global energy system. It allows us to map pathways for and track progress on countries' transitions to cleaner and more secure energy – efforts that are essential to bring down greenhouse gas emissions and achieve key international Sustainable Development Goals, such as universal access to modern energy.

In its half-century of existence, the International Energy Agency (IEA) has become the authoritative point of reference and go-to source for independent, data-driven analysis on energy security and clean energy transitions. Data-based projections are at the core of the IEA's all-fuels and all-technologies analysis, notably our annual flagship report, the World Energy Outlook. Advanced and comprehensive collection of energy statistics is one of the key requirements of Membership to the IEA. Without reliable data, countries would struggle to secure the energy supplies needed to power their economies today and to chart their transitions to a low-emissions future, which is essential to avoid the worst effects of climate change. Robust, comparable and timely data and statistics are key to foreseeing shortages, identifying priorities, setting clear targets and measuring progress.

Data is also crucial for responding to crises. As early as September 2021 the IEA was the first observer to publicly provide data-based evidence that Russia was deliberately holding back natural gas supplies to European customers. That early anticipation allowed the Agency to act rapidly in providing advice to policy makers. Within a week of Russia's invasion of Ukraine in February 2022, we produced a 10-Point Plan to Reduce the European Union's Reliance on Russian Natural Gas¹, with a focus

on the measures to prepare Europe for the following winter.

The Plan drew on detailed data and quantitative estimates of energy supply sources, gas storage refilling needs, trends in the deployment of renewables, and many other key elements. It proposed a suite of measures – spanning resource management, diversification options, consumer protection and end-user adaptability – to enable the EU to reduce its imports of Russian natural gas by a third within a year. The 10-Point Plan, with its emphasis on greater energy efficiency and accelerated rollout of renewables, was also aligned with the EU's own climate goals.

The Plan and our subsequent follow-up work with the European Commission and governments across the EU helped to enable Europe to go into the 2022-2023 winter with EU gas storage facilities filled well above their five-year average, providing an important buffer. And our work with our EU partners continues, with the aim of ensuring Europe has sufficient energy supplies for next winter as well, while at the same time avoiding price spikes, factory closures, increased use of coal for power generation and fierce international competition for cargoes of liquefied natural gas.

Similarly, more than nine months before the EU implemented a ban on Russian crude oil imports, we put forward a 10-point plan on oil² to immediately avert the risk that rising oil demand during the northern hemisphere summer "driving season" would coincide with curtailed supply from Russia. This plan proposed 10 actions that can be taken to reduce oil demand with immediate impact – and provides recommendations to put oil demand onto a more sustainable downward

¹ <https://www.iea.org/reports/a-10-point-plan-to-reduce-the-european-unions-reliance-on-russian-natural-gas>

² <https://www.iea.org/reports/a-10-point-plan-to-cut-oil-use>

longer-term path. Many of those measures, from hastening the adoption of electric and more efficient vehicles to preferring high-speed trains to planes when possible, were implemented by governments worldwide, notably in France.

As well as working with governments around the world on responding to the current global energy crisis, the IEA is committed to assessing and spurring progress on clean energy transitions globally. Efforts to reduce greenhouse gas emissions need to accelerate rapidly if the world is to meet the climate goals set out in the Paris Agreement, including limiting the average rise in global temperatures to well below 2°C – preferably to 1.5°C – compared with pre-industrial levels.

Developing accurate, up-to-date and innovative tools to track the many facets of clean energy transitions is essential to measure how the world is faring in efforts to reach net zero emissions globally by 2050, which would provide an even chance of limiting global warming to 1.5°C. Data helps us understand what trajectory we are on – and to determine where to channel investment and policy attention to shift onto a more sustainable path.

Because no single index can fully capture the complexity of clean energy transitions, the IEA maintains comprehensive sets of indicators at global, regional, national and sectoral levels. The Agency notably monitors global carbon dioxide (CO₂) emissions from energy combustion and industrial processes, based on detailed region-by-region and fuel-by-fuel analysis, drawing on the latest official national statistics, as well as energy, economic and weather data.

The figures show that after the largest ever annual decline in global energy-related CO₂ emissions, which took place in 2020 as a result of the Covid-19 pandemic, emissions rebounded sharply in 2021 and grew again, albeit more slowly, in 2022. Emissions are still going in the wrong direction for us to reach international climate goals – making clear the need for stronger policies by governments.

However, despite these troubling trends, we at the IEA see reasons for optimism. Responses by governments around the world promise to make this a historic turning point towards a cleaner, more affordable and more secure energy system.

The data-driven energy modelling in the 2022 edition of our World Energy Outlook (WEO 2022) concludes, for the first time, that a definitive peak in global demand for fossil fuels is now within sight. Under today's policy settings, coal demand is set to peak in the next few years, natural gas demand reaches a plateau by the end of the decade, and oil demand reaches its highest point in the mid-2030s before falling slightly. From 80% today – a level that has been constant for decades – the share of fossil fuels in the global energy mix is set to drop just below 75% by 2030 and to just above 60% by midcentury.

WEO 2022 also shows that policy and technology changes since the Paris Agreement in 2015 have reduced projected temperature increases, although we are still far from what is needed to limit them to 1.5°C. In a scenario based on today's policy settings, emissions reach a plateau at around 37 billion tonnes a year before falling slowly to 32 billion tonnes in 2050, a trajectory that would lead to a 2.5°C rise in global average

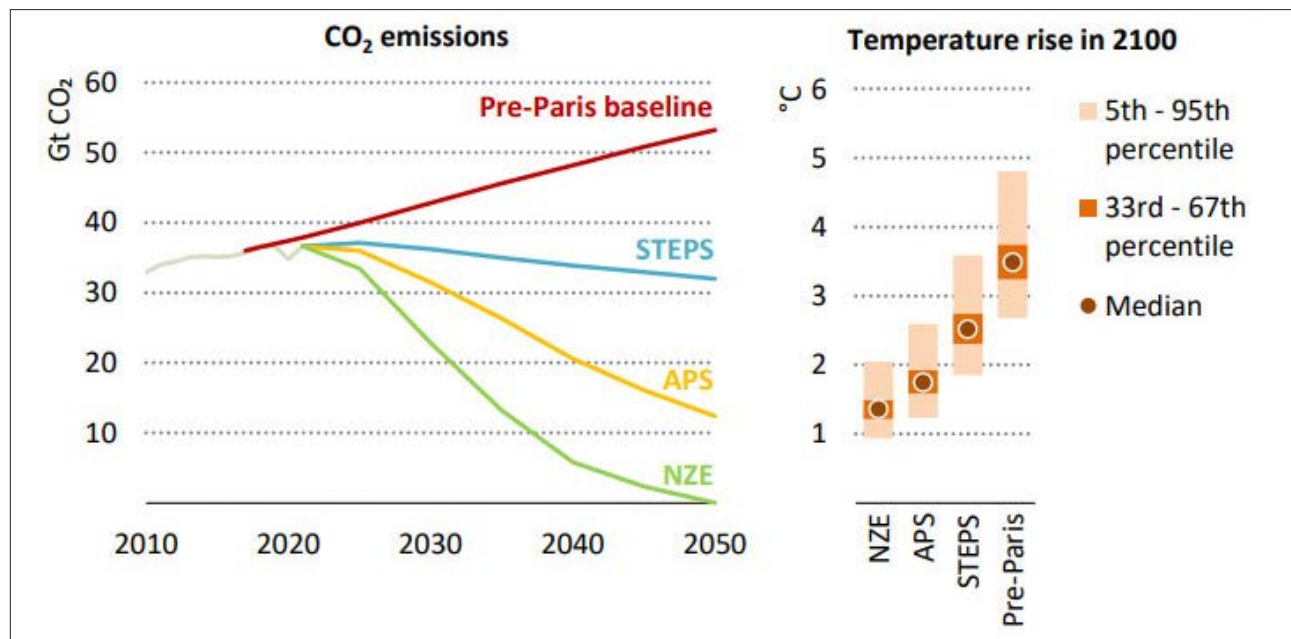


Figure 1: Energy-related and process CO₂ emissions, 2010-2050 and temperature rise in 2100 by scenario: policy and technology advances since 2015 have shaved 1°C off the temperature rise in 2100 but stated policies still lead to a temperature rise well above the Paris Agreement goals.

Notes: Pre-Paris trajectory is based on the Current Policies Scenario from the WEO 2015 (IEA, 2015). Temperature rise estimates are relative to 1850-1900 and match the IPCC Sixth Assessment Report definition of warming of 0.85°C between 1995-2014 (IPCC, 2022a) – Source: IEA CC BY 4.0.

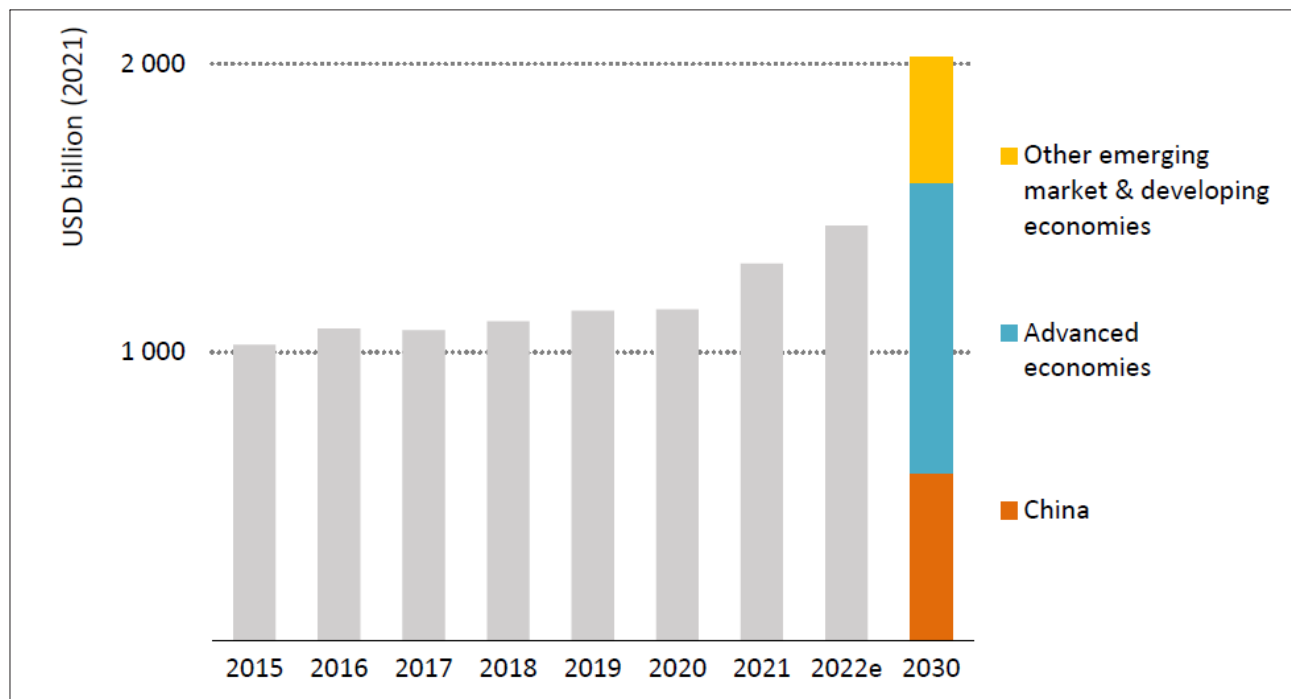


Figure 2: Annual average clean energy investment by region in the Stated Policies Scenario compared to historic levels, 2015-2030 – Source: IEA CC BY 4.0.

temperatures by 2100, around 1°C lower than the baseline trajectory prior to the Paris Agreement. If governments fully achieve the national energy and climate pledges they have announced as of today, emissions would peak in the mid-2020s and fall to 12 billion tonnes a year in 2050, resulting in a global temperature rise of 1.7°C by 2100.

Reaching net zero emissions will require innovative technologies, many of which are not yet ready for market. To support progress on this front, the IEA has in recent years developed a series of cutting-edge data tools to determine trends, developments and advances across a wide range of fields in order to keep track of the key technological advances in clean energy.

Our Tracking Clean Energy Progress³ tool assesses recent developments for 55 components of the energy system that are critical for clean energy transitions, with progress assessed against the benchmark of our Net Zero Emissions by 2050 Scenario. It looks into all relevant technologies, infrastructure and sectors. In our latest update in September 2022, of the 55 components tracked, only two were judged to be fully "on track" with what is needed to reach net zero by 2050 – electric vehicles and lighting. However, recent policy action and technology developments indicate that momentum is accelerating in many areas, including renewable electricity capacity additions, which are at record levels, and hydrogen and carbon capture project announcements. But these are not yet fast enough to align with a pathway to net zero by 2050.

³ <https://www.iea.org/topics/tracking-clean-energy-progress>

In addition, the IEA brings together key technological development data through a series of other tools, such as the Energy Start-up Data Explorer⁴, and the Energy Technology Patents Data⁵ Explorer. Together, they provide an instant picture of what sectors are most benefiting from company creation, technological development and public interest.

Renewable energy technologies, especially batteries and solar panels, require large and varied quantities of critical minerals, many of which are sourced or processed in a limited number of countries. Our Critical Minerals Policy⁶ Tracker keeps track of those potential bottlenecks, highlighting prominent policies and regulations already in place around the world to enhance security of supply, incentivise new resource development and ensure sustainable and responsible production.

The IEA also keeps track of the transformation of the fossil fuel sector. A dedicated online tool follows policymakers' efforts to tackle methane emissions from the energy sector⁷, which is today one of the best near-term opportunities to limit global warming.

The transition to clean energy will require a massive increase in investment in developing and deploying the necessary technologies and the supporting infrastructure. The IEA unpacks global energy investment trends

⁴ <https://www.iea.org/data-and-statistics/data-tools/energy-start-up-data-explorer>

⁵ <https://www.iea.org/data-and-statistics/data-tools/energy-technology-patents-data-explorer>

⁶ <https://www.iea.org/reports/critical-minerals-policy-tracker>

⁷ <https://www.iea.org/reports/global-methane-tracker-2022>

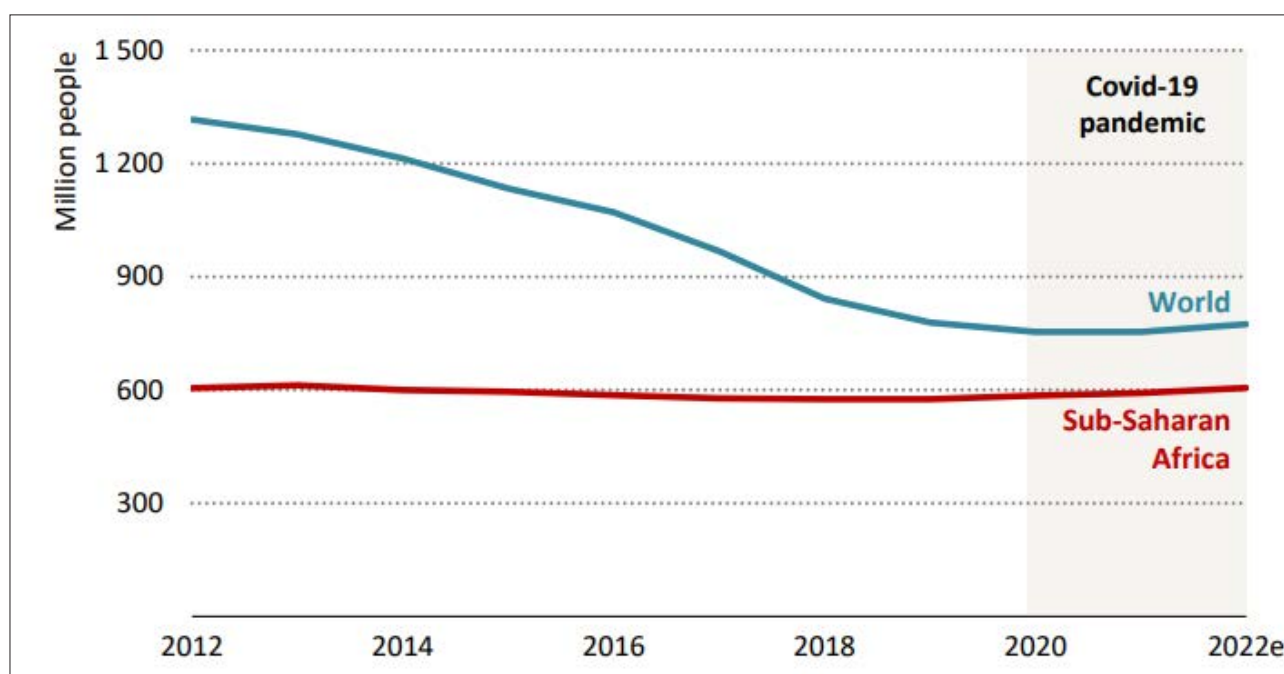


Figure 3: Number of people without access to electricity in sub-Saharan Africa and the world, 2012-2022: On the heels of the Covid-19 pandemic, the 2022 energy crisis is leading to a reversal of global progress on electricity access for the first time in more than a decade. Notes: 2022e = estimated values for 2022 – Source: IEA CC BY 4.0.

through its yearly World Energy Investment⁸ report. The most recent edition showed that clean energy investment is picking up – but not yet quickly enough to reach international energy and climate goals. Clean energy investment grew by only 2% a year in the five years after the Paris Agreement was signed in 2015. But since 2020, the pace of growth has accelerated significantly to 12%.

Our regularly updated Government Spending Tracker⁹ covers economic recovery packages enacted by governments worldwide both in response to the Covid-19 and the global energy crisis. The latest edition of the Tracker shows that such packages now represent USD 1.215 billion in clean energy investment support, well over twice the financial commitments made to green recovery measures after the 2007-2008 financial crisis. This government spending is set to mobilise substantial flows of additional public and private investment. Based on today's policy settings, total annual clean energy investment is set to grow by nearly 50% from today's levels to over USD 2 trillion in 2030. However, our data also shows that this spending is almost entirely in advanced economies and China, making clear the urgent need for policy actions and international efforts to mobilise and channel more capital into emerging and developing markets.

The transition to a clean energy future has major repercussions for employment, both in terms of job losses in fossil fuel industries and the need for new skilled

workers to install and maintain the energy technologies of the future. While the transition to clean energies will lead to a net increase in energy sector employment, the jobs being created are not always in the same places or do not require the same skills as those being lost. Detailed data are vital in this situation to know where job training and other supports are needed most.

To provide a global picture, in 2022, we launched our new World Energy Employment report¹⁰, the first comprehensive inventory and analysis of the global energy workforce. The report examines how countries around the world are looking to accelerate the growth of clean energy industries. It uses data on expected job needs to help governments identify where job training is most needed to ensure there will be enough skilled labour for the rolling out of clean and efficient energy technologies.

The IEA is also one of the international organisations charged with monitoring progress towards the United Nation's Sustainable Development Goal 7 (SDG7) to "ensure access to affordable, reliable and modern energy for all by 2030". SDG7 targets universal access to electricity and clean cooking by 2030, significantly higher shares of renewables in the global energy mix, and a doubling of the annual rate of improvement in energy efficiency compared with 2000-2010.

The Covid-19 pandemic, the energy crisis, and rising inflation have led to major setbacks on many of these targets, notably on electricity access. In order to reach universal electricity access by 2030, the world would need to connect around 110 million people every

⁸ <https://www.iea.org/reports/world-energy-investment-2022>

⁹ <https://www.iea.org/reports/government-energy-spending-tracker-2>

¹⁰ <https://www.iea.org/reports/world-energy-employment>

year from now to 2030, the vast majority of them in sub-Saharan Africa. But for the first time in decades, the number of people without access to electricity is set to increase in 2022 due to the impacts of the energy crisis and the pandemic. We estimate that around 75 million people who recently gained access to electricity actually lost the ability to pay for it in 2022, while another 100 million people have reverted to the use of traditional biomass for cooking, carrying with it serious health repercussions.

With so much of its work dependent on a steady supply of quality data, the IEA is deeply involved in helping its partners improve the quality of their energy statistics. Launched in 2017, our Clean Energy Transitions Programme¹¹ notably conducts training and capacity

building activities in major emerging economies through workshops, training events and guidance manuals. Priority countries include Brazil, China, India, Indonesia, Mexico and South Africa, as well as key regions such as Southeast Asia, Latin America and Africa.

As the world continues to grapple with the combined challenge of coping with the first truly global energy crisis while at the same time building the clean energy systems of the future, the IEA's data will continue to play a leading role in setting priorities and mobilising investment to ensure we can all benefit from sustainable, secure and affordable energy.

¹¹ <https://www.iea.org/programmes/clean-energy-transitions-programme>