Tracking Clean Energy Progress – Informing the Energy Transitions

Tracking Clean Energy Progress (TCEP), the International Energy Agency's (IEA) newly updated website (www.iea.org/tcep), assesses the latest progress made by key energy technologies, and how quickly each technology is moving towards the goals of the IEA's Sustainable Development Scenario. The website provides easy navigation across technologies and sectors and draws links across the IEA's resources. The report will be updated throughout the year as new data becomes available, and will be complemented by cutting-edge analysis and commentary on notable developments on the global clean energy transition

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The International Energy Agency's new and most comprehensive analysis of the clean-energy transition finds that only 4 out of 38 energy technologies and sectors were on track to meet long-term climate, energy access and air pollution goals in 2017.

Only 4 out of 38 clean-energy technology areas are on track to meet long-term climate goals

The findings are part of the IEA's latest *Tracking Clean Energy Progress (TCEP),* a newly updated website released recently that assesses the latest progress made by key energy technologies, and how quickly each technology is moving towards the goals of the IEA's Sustainable Development Scenario (SDS).

Where are we?

The IEA estimates that in 2017, *energy-related CO_2 emissions* rose 1.4% after remaining flat for three years, reaching a historic high of 32.5 Gt indicating that the stall in emissions from 2014-2016 does not yet reflect a peak. Though the 2017 emissions rise is moderate compared to historical rates, it heightens the already monumental challenge ahead. IEA analysis shows that emissions must peak around 2020 then show a steep decline afterwards to meet Paris Agreement goals.

This increase in emissions reflects strong underlying growth in *energy demand*, which grew an estimated

2.1% in 2017, double the rate of increase in 2016. While energy intensity – primary energy demand per unit of gross domestic product – has improved over time, this improvement slowed to 1.7% in 2017, compared with an average of 2.3% over the previous three years, and only half the annual improvement rate consistent with delivering the Paris Agreement goals.

The second critical factor is *the carbon intensity of energy supply*, which tracks CO_2 emissions per unit of total primary energy supply. In 2017, the *Energy Sector Carbon Intensity Index* (*ESCII)* increased for the first time in three years as fossil fuels met over 70% of the growth in energy demand.

In fact, over the past three decades the ESCII has barely changed, indicating the energy supply has not become any "cleaner" on average over time. While significant progress has been made in deploying renewables, in particular solar PV and wind, the deployment of low-carbon energy has not kept up with energy demand growth. This remains a crucial challenge for the energy sector, as under an IEA scenario compatible with meeting Paris Agreement goals, the ESCII drops 22% by 2030.

Some technologies made tremendous progress in 2017, with solar PV seeing record deployment, LEDs quickly becoming the dominant source of lighting in the residential sector, and electric vehicle sales jumping by 54%. But IEA analysis finds that most technologies are not on track to meet long-term sustainability goals. Energy efficiency improvements, for example, have slowed and progress on key technologies like carbon capture and storage remains stalled. This contributed to an increase in global energy-related CO_2 emissions of 1.4% last year.

TCEP provides a comprehensive, rigorous and up-to-date analysis of the status of the clean-energy transition across a full range of technologies and sectors, their recent progress, deployment rates, investment levels, and innovation needs. It is the result of a bottom-up approach backed by the IEA's unique understanding of markets, modeling and energy statistics across all fuels and technologies, and its extensive global technology network, totaling 6,000 researchers across nearly 40 Technology Collaboration Programmes.

The analysis includes a series of high-level indicators that provide an overall assessment of clean energy trends

and highlight the most important actions needed for the complex energy sector transformation.
For the first time, the analysis also highlights more than 100 key innovation gaps that need to be addressed to speed up the development and deployment of these clean energy technologies. It provides an extensive analysis of public and private clean energy research and development investment. It found that total public spending on low-carbon energy technology innovation rose 13% in 2017, to more than USD 20 billion.
A total of 11 of 38 technologies surveyed by the IEA were significantly not on track. In particular, unabated coal electricity generation (meaning generation without Carbon Capture, Utilisation and Storage, or CCUS), which is responsible for 72% of power sector emissions, rebounded in 2017 after falling over the last three years.
Meanwhile, two technologies, onshore wind and energy storage, were downgraded this year, as their progress slowed. This brought the number of technologies "in need of improvement" to a total of 23.

Where do we want to go?

This year, the *TCEP* tracks progress against Sustainable Development Scenario (SDS) , introduced in the *World Energy Outlook 2017*, which depicts a rapid but achievable transformation of the energy sector. It outlines a path to limiting the rise of average global temperatures to "well below 2°C," as specified in the Paris Agreement, as well as increasing energy access around the world and reducing air pollution.
In this scenario, meeting long-term sustainability goals requires an ambitious combination of more energy efficient buildings, industry and transport, and more renewables and flexibility in power.
Compared to scenarios addressing only the climate mitigation objective, the SDS places a stronger emphasis on decentralised, modular low-carbon technologies (such as solar PV and wind) as a means to achieving multiple objectives. For example, there is roughly 50% more solar PV in this scenario than in previous IEA scenarios focused primarily on decarbonisation.
As low-carbon energy takes center stage in the SDS, fossil fuels step back substantially from their current position. Coal demand peaks very soon, around 2020. In stark comparison, the IEA estimates that coal demand grew in 2017 after a two-year decline and forecasts continued demand growth at least for the next five years, absent a change in policy and market conditions.
In the SDS, oil demand peaks soon after coal, with demand decline coming from transport: electric vehicles make up over 40% of new passenger car sales by 2030.

How do we get there?

As countries drive forward their ambition, a few guiding questions can help guide their paths forward.
First, how do investment patterns need to change? In IEA's SDS, a modest 13% additional investment in energy is required to 2030 – a net of USD 4 trillion – relative to investment that would be required under the New Policies Scenario (NPS), which accounts only for current and announced policies. Annual supply-side investment to 2030 remains relatively flat from today's levels, although a substantial shift occurs away from fossil-fuel supply and fossil-fuel power generation, for which investment falls by USD 2.8 trillion through 2030, moving towards toward low-carbon power supply and improving the energy efficiency of end-use sectors.
Second, how much will technology costs decline? As clean technology costs continue to drop, ambition can be further raised. Looking ahead in the next five years, IEA forecasts that costs are expected to drop further by almost a quarter for large, utility-scale solar PV, almost 15% for onshore wind, and a third for offshore wind between 2017-2022 at the global scale. Towards 2030, costs are expected to continue declining. In IEA's NPS for new utility-scale solar PV and electric vehicle batteries, costs approximately halve from 2016 to 2030.
Third, are governments and private sector investments in energy technology research and innovation adequate to the level of ambition desired? We estimate that government RD&D spending on low-carbon energy technologies grew by 13% in 2017. If true, then it may have passed the USD 20 billion mark for the first time. This is – a very welcome increase after years of decreases and stagnation. Our improved estimate for corporate clean energy R&D investment shows that while corporate clean energy R&D dropped slightly in 2017, the five-year trend shows 5% annual growth. A major factor has been rising R&D spending by the automotive sector; this faltered in 2017 but is expected to pick up again in coming years. Clean energy VC investment is on a rising trajectory. USD 2.5 billion was invested in 2017, following a spike in big deals in clean transport in 2016. The trend is towards pre-2012 averages. Growth is dominated by transport and com-

plemented by digital efficiency technology plays, while renewable hardware has not received a similar boost and remains lower than 2014.
And finally how can an integrated approach enhance chances of success? A fundamental message emerging from all facets of IEA analysis is the need for an integrated technology and policy approach to drive and accelerate clean energy transitions based on a country's national context. For example, policies driving electrification can produce greater environmental benefits if implemented alongside ones to decarbonize electricity supply.
Applying such an integrated policy approach requires significant national coordination and capacity, including domestic technology and policy expertise. The IEA will continue to share international best practice and advice, and support countries as they undertake their own clean energy transitions.

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Find out more at www.iea.org/tcep/.