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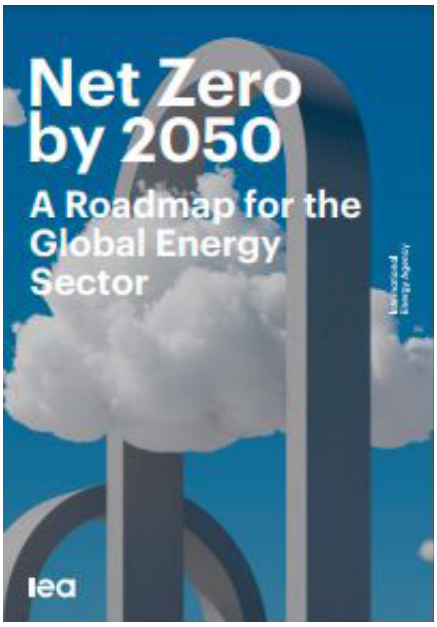
Monthly Highlights

IEA Publishes World's First Detailed Roadmap to Net-Zero Emissions by 2050

The International Energy Agency (IEA) released a comprehensive roadmap mapping out a technology-driven pathway including policy recommendations on how to reach net-zero carbon dioxide (CO_2) emissions globally by 2050.



In the report released on May 18, **Net Zero by 2050: A Roadmap for the Global Energy Sector**[1], the IEA underlined that climate pledges by governments to date, even if fully achieved, would fall well short of what is required to bring global energy-related CO_2 emissions to net zero by 2050 (Figure 1). Although the number of countries that have pledged to achieve net-zero emissions has grown rapidly over the last year, the IEA points out that most pledges are not yet underpinned by near-term policies and that the pledges to date would still leave around 22 billion tons of CO_2 emissions worldwide in 2050. This would result with a 2.1°C temperature rise by 2100, much higher than the critical threshold of 1.5°C.

Published ahead of the 26th Conference of the Parties (COP26) of the United Nations Climate Change Framework Convention to be held in Glasgow in November, the report identifies more than 400 milestones to guide the global journey to net zero by 2050.

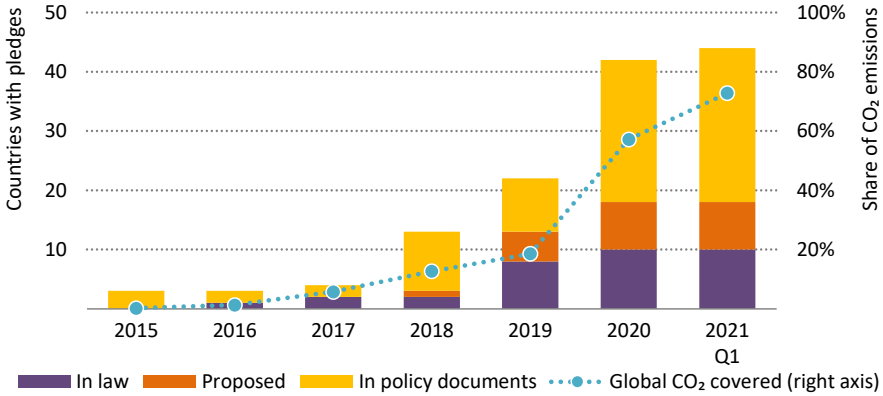


Figure 1: *Number of National Net-Zero Pledges and Share of Global CO_2 Emissions Covered*

"The race is not between countries, but against time. If governments cannot finish the race, nobody wins."
Dr. Fatih Birol, Executive Director, IEA

Dr. Birol: "Clean energy transition must be fair and inclusive, leaving nobody behind."

Commenting on the highlights of the report, Dr. Fatih Birol, Executive Director of the IEA, said that the pathway, although global in scope, requires each country to design its own strategy, considering its own specific circumstances. "Nonetheless, it anticipates that advanced economies will reach net zero before developing economies," Dr. Birol cautioned.

"The clean energy transition is for and about people," said Dr. Birol. "Our roadmap shows that the enormous challenge of rapidly transitioning to a net-zero energy system is also a huge opportunity for our economies. The transition must be fair and inclusive, leaving nobody behind. We have to ensure that developing economies receive the financing and technological know-how they need to build out their energy systems to meet the needs of their expanding populations and economies in a sustainable way."

[1] https://www.iea.org/reports/net-zero-by-2050

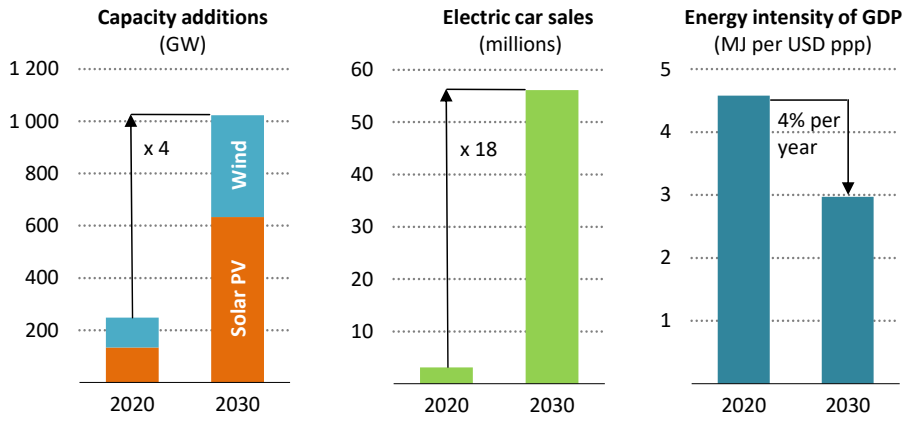
Stressing that promoting secure and affordable energy supplies to foster economic growth remained the key concern of the Net-Zero Roadmap, Dr. Birol said: "Governments need to create markets for investments in batteries, digital solutions, and electricity grids that reward flexibility and enable adequate and reliable supplies of electricity. The rapidly growing role of critical minerals calls for new international mechanisms to ensure both their timely availability of supplies and sustainable production."

Priority Actions

While the IEA describes the global goal of net zero by 2050 as "narrow but still achievable," it urges governments to embrace the **Seven Priority Actions** for the Net Zero Emissions pathway (NZE) outlined in the report:

1. Make the 2020s the decade of massive clean-energy expansion

The report demonstrates that global CO_2 emissions-reduction targets can be achieved with clean-energy technologies readily available today but that achieving net zero by 2050 requires major innovative efforts to bring brand new technologies, which are currently at the demonstration or prototype phase, to market in a timely fashion. While the IEA underlines that innovation in many areas, including advanced battery technologies, hydrogen applications, and direct air capture and storage, will play a critical role in CO_2 emissions-reduction efforts, R&D projects should be accompanied by large-scale infrastructure investments that enable these new technologies, such as new pipelines for captured CO_2 emissions and systems to transport hydrogen, including between ports and industrial zones. Between 2020 and 2030, the combined annual capacity additions of wind and solar grows fourfold, while electric car sales increase 18-fold. Energy efficiency is a key enabler of a net-zero transition with the energy intensity of GDP declining 4% annually this decade (Figure 2).



Note: MJ = megajoules; GDP = gross domestic product in purchasing power parity.

Figure 2: *Key Clean Technologies Ramp up by 2030 in the Net Zero Pathway*

2. Prepare for the next phase of the transition by boosting innovation

In conjunction with the first priority action, the IEA highly recommends governments to increase their R&D budgets for clean-energy innovations in electrification, hydrogen, bioenergy, and carbon capture, utilization and storage (CCUS). Around half of the emissions reductions until 2050 should come from technologies that are currently under development (Figure 3). Besides, net-zero targets cannot be achieved without sustained support and participation from citizens. The Agency estimates that 55% of the cumulative emissions reductions in the 2050 pathway are linked to consumer choices, such as purchasing electric vehicles (EVs), as well as behavioral changes, including replacing car trips with walking or cycling. Since some climate policies may be challenging and costly to implement, the IEA strongly recommends that clean-energy transitions are people-centered and inclusive.

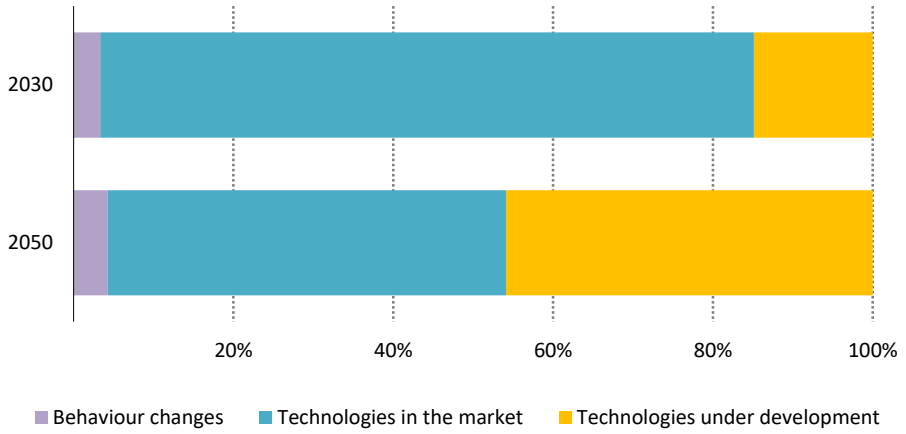


Figure 3: *Annual CO_2 Emissions Savings in the Net-Zero Pathway, Relative To 2020*

3. Clean energy jobs grow strongly but must be assigned widely

According to the IEA's projections, 14 million clean-energy jobs are created by 2030, in addition to 16 million jobs in attendant sub-sectors. At the same time, the decarbonization pathway results in 5 million jobs lost, mostly in the fossil fuel industry. Therefore, the IEA recommends

that governments implement social policies to minimize the effects of such radical shifts in employment patterns and to direct clean-energy investments to heavily affected areas (Figure 4). Renewables are the main growth avenue; two-thirds of total energy supply and almost 90% of electricity generation in 2050 comes from renewables. Solar photovoltaic (PV) capacity is projected to increase 20-fold and wind power 11-fold within three decades. The projections show that global energy demand in 2050 is 8% lower than today. However, this demand serves an economy more than twice as large and with a population that increases by 2 billion.

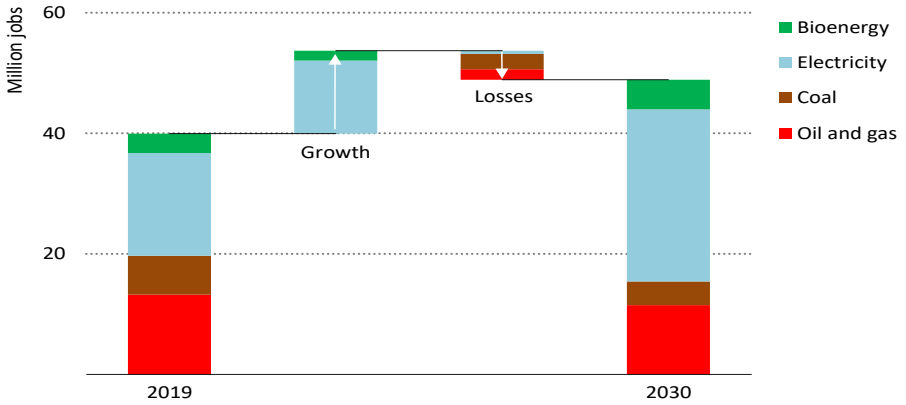


Figure 4: *Global Employment in Energy Supply in the Net Zero Pathway, 2019-2030*

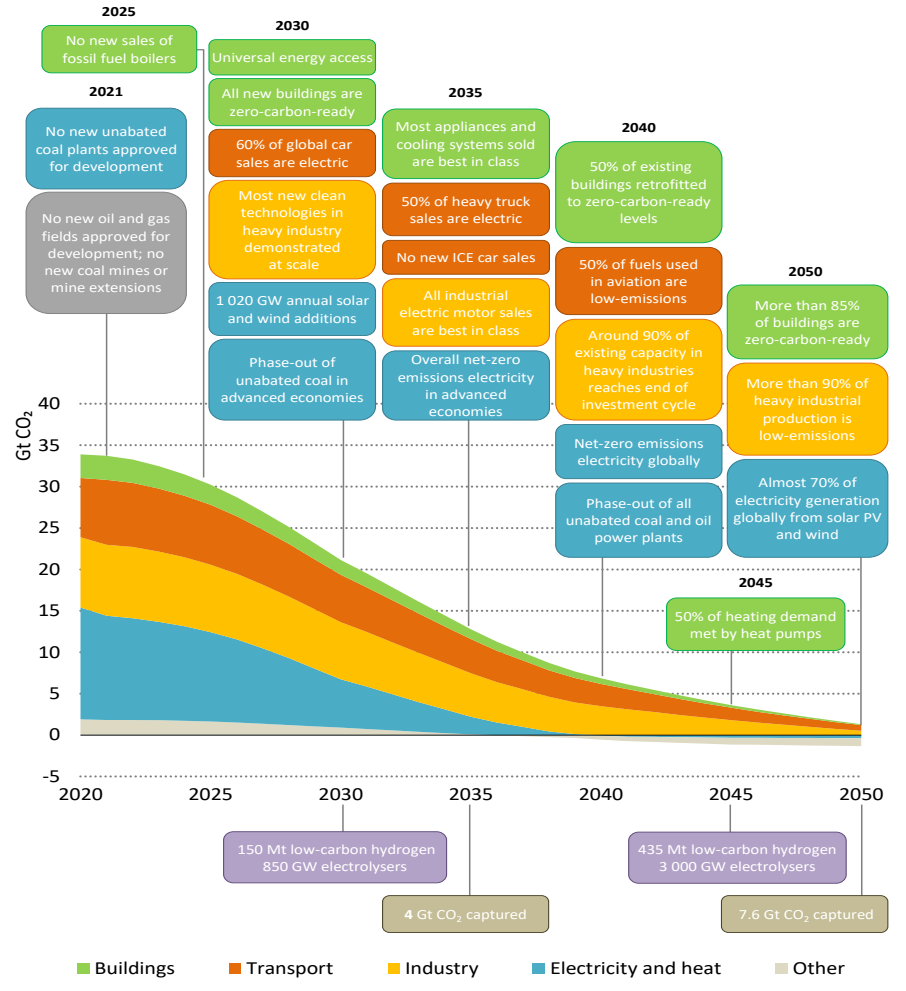


Figure 5: *Key Milestones in the Pathway to Net Zero*

4. Set near-term milestones to get on track to meet long-term targets

Although the IEA praises the ambitious net-zero targets of various countries in line with their long-term national low-emissions strategies, it underlines the importance of detailed short-term targets and policies. The report outlines the key milestones in the net-zero pathway (Figure 5).

Hydrogen production and use expands across the energy system

NZE Highlights:

- Hydrogen use increases almost six-fold (from less than 90 Mt in 2020 to over 500 Mt in 2050).
- The share of low-carbon hydrogen rises from 10% in 2020 to 70% in 2030. By 2050, almost all of hydrogen production is based on low-carbon technologies.
- Global electrolyzer capacity reaches 850 GW by 2030 and 3,600 GW by 2050,respectively, up from only 0.3 GW today.
- The combined share of low-carbon hydrogen and hydrogen-based fuels in total final energy use reaches 13% in 2050.

5. Drive a historic surge in clean-energy investment

According to the joint analysis of the IEA and the International Monetary Fund (IMF), global annual energy investment surges to USD 5 trillion by 2030, adding an extra 0.4%/year on average to annual global GDP growth. Clean-energy investments triple by 2030 (Figure 6). The report emphasizes the importance of planning to ensure that the welfare of the clean-energy transition is shared equitably.

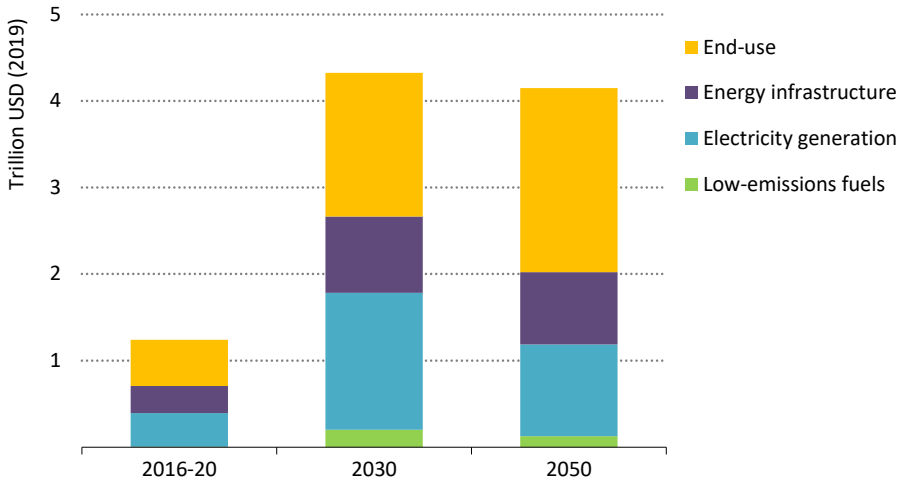
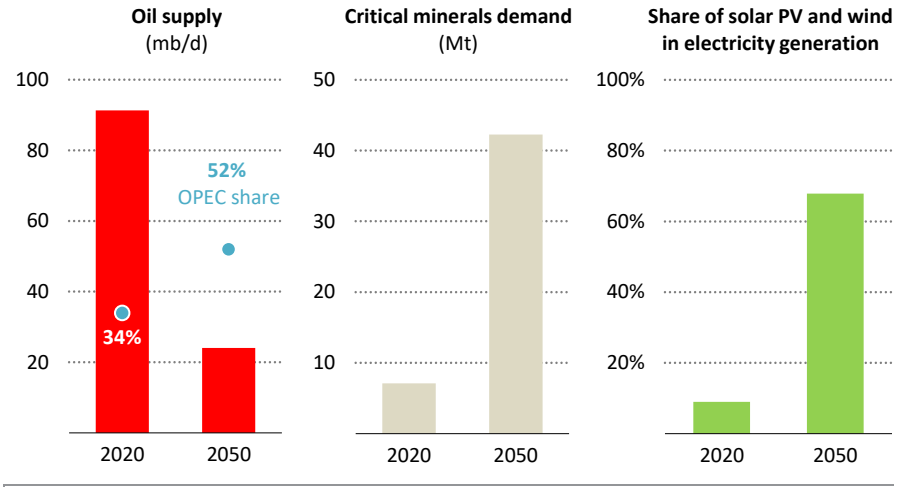
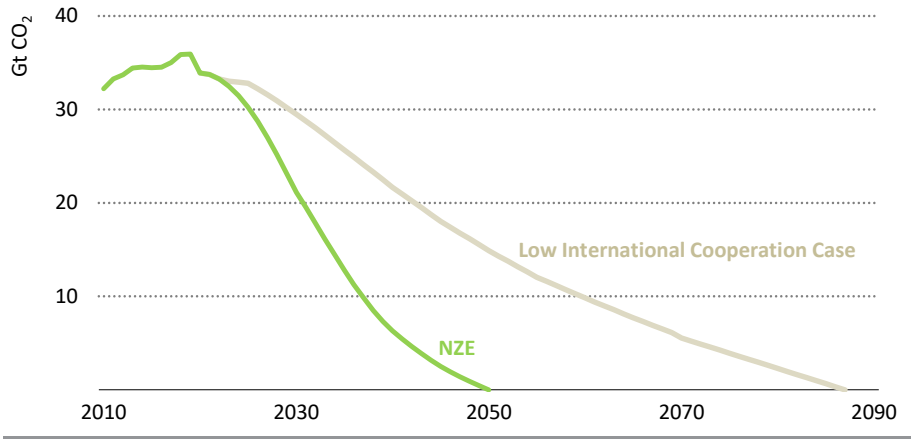


Figure 6: *Clean-Energy Investment in the Net-Zero Pathway*



Note: mb/d = million barrels per day; Mt = million tonnes.

Figure 7: *Global Energy-Security Indicators in the Net-Zero Pathway*



Note: Gt = gigatonnes.

Figure 8: *Global Energy-Related CO_2 Emissions in the Net-Zero Pathway and Low International Cooperation Case*

Financing is critical for mobilizing the required investments to achieve the net-zero target. The regulatory framework governing clean-energy technologies should be designed to mobilize capital for large-scale infrastructure, reduce risks for investors, and attract more private finance. In this regard, the IEA emphasizes that oil- and gas-producing countries and companies should gradually direct their investments to some specific clean-energy technologies with which their industry expertise aligns, such as hydrogen, CCUS, and offshore wind.

6. Address emerging energy-security risks now

As the energy industry turns towards higher electrification and renewables, countries and energy companies are increasingly exposed to cybersecurity risks and electricity grid-flexibility challenges. This trend necessitates closer cooperation among governments and energy industry players. Meanwhile, oil production declines substantially but becomes more concentrated by 2050. The need for critical minerals surges, as the role of hydrocarbons decreases. This significant transition also shapes future energy-security concerns, while critical minerals, such as copper, cobalt, and manganese, replace fossil fuels (Figure 7).

7. Take international co-operation to new heights

The IEA strongly recommends governments to work together and harmonize their climate policy-making efforts in order to create jobs, accelerate innovation, develop international standards, and coordinate the scale-up of clean technologies, since the net-zero goal cannot be achieved simply through the total sum of national-emissions pledges. Without greater international cooperation, global CO_2 emissions do not fall to net zero by 2050, according to the report. Under the Net-Zero Emissions (NZE) scenario,

energy-related CO_2 emissions decline almost 40% from 2020 to 2030, a key milestone for achieving net zero by 2050. In a scenario with low international cooperation, this can only be achieved by 2090 (Figure 8).

The report can be downloaded from here.

Dr. Birol's message to Leaders at the Climate Summit: "Commitments alone are not enough."

"I will be blunt: commitments alone are not enough. We need real change in the real world. Emissions are on track for their second-largest increase in history. We are not recovering from Covid-19 in a sustainable way and remain on a path of dangerous levels of global warming."
Dr. Fatih Birol, Executive Director, IEA

U.S. President Joe Biden convened forty world leaders in the virtual **"Leaders Summit on Climate"**[2] on April 22-23 to discuss innovative pathways to a net-zero economy ahead of the UN Climate Change Conference (COP 26) to be held this November in Glasgow. Over the course of two days and five sessions, leaders from around the globe and distinguished representatives from international organizations, businesses, and indigenous communities shared their visions for addressing climate change.

Session 4 of the Summit, entitled "Unleashing Climate Innovation," hosted six heads of state (Denmark, Israel, Kenya, Norway, Singapore, and the UAE) as well as Dr. Fatih Birol, the Executive Director of the IEA, together with several business leaders. Opened with speeches by the U.S. Secretary of Energy Jennifer M. Granholm and the U.S. Secretary of Commerce Gina M. Raimondo and closed by a speech from the U.S. Special Presidential Envoy for Climate John Kerry, the session allowed leaders to describe their approaches to investing in mitigation and adaptation technologies, which included highlighting various key technologies for a more digitalized, electrified, and decarbonized energy system.

During his speech, Dr. Birol underlined the widening gap between emissions-reduction commitments and peaking CO_2 emissions. (*Please see page 14* for further details.)

Massive leaps needed in many clean technologies

Praising the new global records in renewables generation and EV sales, Dr. Birol cautioned that the net-zero target requires an all-out transformation in the energy sector and in all carbon-intensive sectors. Emphasizing that roughly half the reduction to get to net-zero emissions in 2050 will need to come from technologies that are not yet ready for market, he added: "This means massive leaps in innovation across batteries, hydrogen, synthetic fuels, carbon capture, and many other technologies."

Bill Gates & IEA Director Dr. Fatih Birol's ARPA-E Summit Fireside Chat

Breakthrough Energy founder Bill Gates and IEA Executive Director Dr. Fatih Birol met for a fireside chat during the virtual 2021 ARPA-E Energy Innovation Summit, on May 26th, 2021.

The role of government in creating innovation solutions to global energy and climate challenges, scaling technologies and lowering the "green premium", and the path to net zero emissions by 2050 were discussed by Gates and Dr. Birol. This important conversation also touched on many technologies including direct air capture, air conditioning, hydrogen, electrification of the transportation sector, low-carbon liquid fuels for aviation, and nuclearpower.

Link: https://www.youtube.com/watch?v=T4oNiQM_p_8

twitter.com/sabanciu_iicec

[2] https://www.state.gov/leaders-summit-on-climate/

IICEC Webinar Discusses Renewables' Future in the World and Turkey

The IICEC webinar titled **"Renewable Energy in the World and Turkey: Today and Tomorrow"** featured the Minister of Energy and Natural Resources Fatih Dönmez, Founding Chair of Sabancı University Board of Trustees Güler Sabancı, and Executive Director of the International Energy Agency (IEA) Dr. Fatih Birol.

Moderated by Sabancı University Faculty of Engineering and Natural Sciences Deputy Dean **Selmiye Alkan Gürsel,** the webinar began with introductory remarks by Founding Chair of Sabancı University Board of Trustees **Güler Sabancı,** who said: "As the pandemic rages on, we must once again meet virtually. I believe that guided by science, the worst of our days will soon be over. The scientific approach and technology are the best tools we have to prepare for the present and future of the energy sector. Strategies, plans, investments, technologies, cooperation, and exchange of information on empowering sustainability in economic, social, and environmental matters are crucial at times of uncertainty such as this."

Noting Turkey's remarkable steps in many areas of the energy industry, **Güler Sabancı** continued: "We can see that important developments will continue in central and complementary areas like securing and diversifying energy supplies, reducing import intensity, ensuring further competitiveness of energy markets, improving efficiency in the energy supply and demand chain, and developing and disseminating energy technologies. Turkey achieved significant growth in electricity production from renewable energy. We have a firm position in Europe in terms of our installed renewable capacity. A perspective of growth in renewable energy, focusing on technology, will have great and varied benefits to security of supply, environmental performance, and opportunities for high-value industrialization."

Emphasizing that energy and climate have long been priorities at Sabancı University, Güler Sabancı said: "We established IICEC 11 years ago as a tripartite thought center between the public sector, industry, and academy to contribute to a cleaner, safer, and better energy future for economic growth, social development, and future generations. I am delighted to see that IICEC's contribution to these objectives grows."

Invoking IICEC's pioneer report, the Turkey Energy Outlook (TEO) published in November of last year, Güler Sabancı continued: "This report was widely appreciated by industry stakeholders and received great feedback. Turkey Energy Outlook met a crucial need in the Turkish energy sector and became a reference point for all stakeholders. Another ambitious project by IICEC this year will be the Turkey Electric Vehicles Outlook, which will take a comprehensive analysis at electric vehicles, the e-mobility ecosystem, and EV growth potential in Turkey. IICEC will continue to contribute to a safer and cleaner energy future with pioneering work and exemplary outcomes."

Widening gap between climate related commitments and reality

Executive Director of International Energy Agency (IEA) **Dr. Fatih Birol provided his keynote address on developments in the energy sector in general and renewables in particular.** Dr. Birol said that the pandemic had devastating effects in 2020 and shared his key observations about 2021:

"The worst impact of the pandemic was on human health, of course. The global economy was also devastated. Every country was affected by the economic crisis. However, the outlook became more positive in 2021. An expectation emerged that people would be more involved in climate change or clean and sustainable energy in the wake of the pandemic.

We took a cautious stance. We believe that energy policies, technologies, and costs play just as great a role as human behavior. We know what happened in the first three months of 2021 and think that emissions will spike this year, becoming the second largest spike in history. Europe, Japan, United States, China . . . many countries have committed to achieving zero emissions by 2050, so the expectation is that emissions will drop, but the actual figures show a widening gap between commitments and reality. The rate at which emissions are increasing is concerning for the climate."

Turkey has great potential for renewable energy

"There is a silver lining to this dark picture: renewable energy is growing across the world," said **Dr. Fatih Birol.** He continued: "In 2021, we believe that the share of renewable energy will reach 30% worldwide. This is the highest that it has ever been since the Industrial Revolution. There are two reasons for this: government incentives and declining costs. We even expect growth in renewable energy to accelerate." Saying that one of the key successes in Turkey's energy sector was the giant leap in renewable energy, Dr. Birol stressed that Turkey had great potential in this area.

Renewable energy is in its youth in Turkey

The webinar's honorary guest was Minister of Energy and Natural Resources **Fatih Dönmez,** who said that the global economy was in a deep crisis due to Covid-19, adding: "One of the few sectors that managed to grow in this chaotic environment was renewable energy. It would not be entirely wrong to say that the renewable energy sector overcame the Covid-19 crisis. It developed antibodies against the disease caused by the crisis."

Saying that Turkey's total established capacity was over 97,000 MW and on the way to exceeding 100,000 MW this year, **Minister Dönmez** continued: "Private sector investments played a large part in the threefold increase in installed capacity in the last 20 years. Today, the public sector accounts for 15% to 20% of electricity production. Private investments left public investments in installed capacity behind starting in 2011. Renewable energy constitutes 53% of the total installed capacity today. In the first three months of 2021, 98% of the total capacity commissioned was based on renewables. We became 12th in the world and fifth in Europe in installed renewable capacity. We were the ninth in the world and fourth in Europe in increasing installed renewable capacity from 2002 to 2020."

Turkey to position itself as hub of research, development, and innovation in energy technologies

Emphasizing their objective to make Turkey a hub of research, development, and innovation in energy technologies and turn energy into a high-value export item, Minister Dönmez said: "Renewable energy is in its youth in Turkey. It is a dynamic sector that adds new stakeholders every day. In a global system where renewables and efficiency are key in energy production, we have to take our position accordingly."

Please click here to watch the record of the Webinar.

Renewables-based additions raise Turkey's installed capacity to 97.4 GW

Turkey's installed capacity increased by roughly 1.5 GW since the beginning of 2021, mostly driven by wind, solar, and hydroelectric power plants. Renewables represented 52% of the total installed capacity with 50.7 GW. Of the newly added installed capacity, 44% came from wind power plants with 652.5 MW, 27% from solar power plants with 398 MW, and 22% from hydroelectric power plants with 361 MW. Total thermal capacity decreased by 8 MW in the first four months of this year.

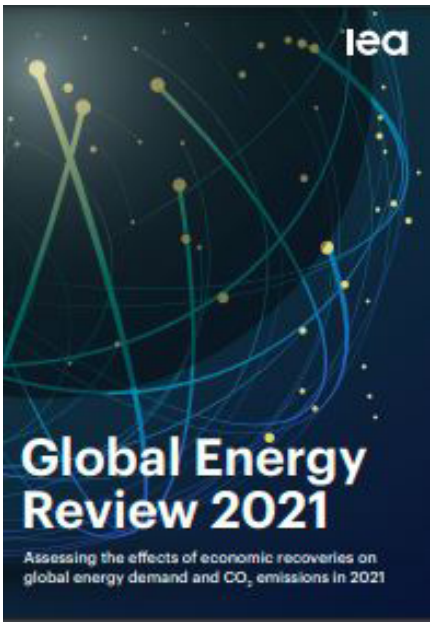
IEA: Turkey's renewable energy production more than doubled since 2009

The IEA's **Turkey 2021: Energy Policy Review**[3] report, released on March 11, 2021, also highlighted Turkey's ambitious renewable energy targets by emphasizing its renewable energy production, which has nearly doubled since 2009. However, the report suggests, in its key recommendations, that Turkey define long-term targets for the development of renewable energy that maximize the potential of each technology. Dr. Birol commented: "I am pleased to observe that Turkey has significantly diversified its energy mix over the past decade. In particular, renewable energy has staged impressive growth, with renewable electricity generation tripling over the period, led by hydro, solar, and wind. Still, Turkey could achieve much higher growth in renewables given its tremendous resource endowment, not just for electricity but also for the heating sector." The report was among the key stories in the previous IICEC Newsletter (Please click here to view Issue 20.)

[3] https://www.iea.org/reports/turkey-2021

IEA Predicts Rapid Recovery in Global Energy Demand Accompanied by Rebounding CO_2 Emissions

The IEA released an in-depth outlook of the global energy in 2021, reflecting the impact of the Covid-19 pandemic, covering all main fuels and technologies and providing insights across countries, regions, and economies.



According to the **Global Energy Review 2021**[4], published by the IEA in late April, global GDP, energy demand, and CO_2 emissions will all rebound from their historical declines in 2020 thanks to accelerating vaccine rollouts and major stimulus packages, most notably in China and the United States, followed by other advanced economies. While the IMF projects the global economy to grow by 6% in 2021 compared to a 4% drop in 2020, the IEA's projections indicate that global energy demand is expected to rebound by 5% to offset the 4% decline in 2020, which was the largest decline since World War II and the largest ever decline in absolute terms (Figure 9).

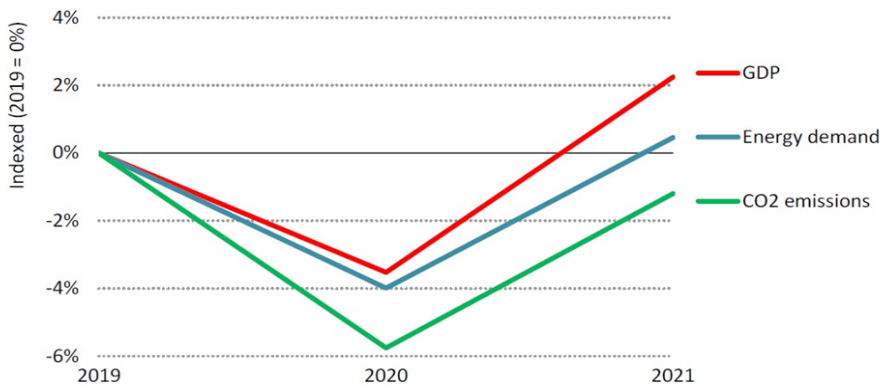


Figure 9: *Changes in Global GDP, Energy Demand, and Energy-Related CO_2 Emissions, Relative to 2019 (2019, 2020, 2021)*

The projections are sensitive to Covid-19-related trends and drivers, including the pace of vaccine rollouts, the extent of lockdowns in major economies, the lifting of international travel restrictions, and the effectiveness of stimulus packages.

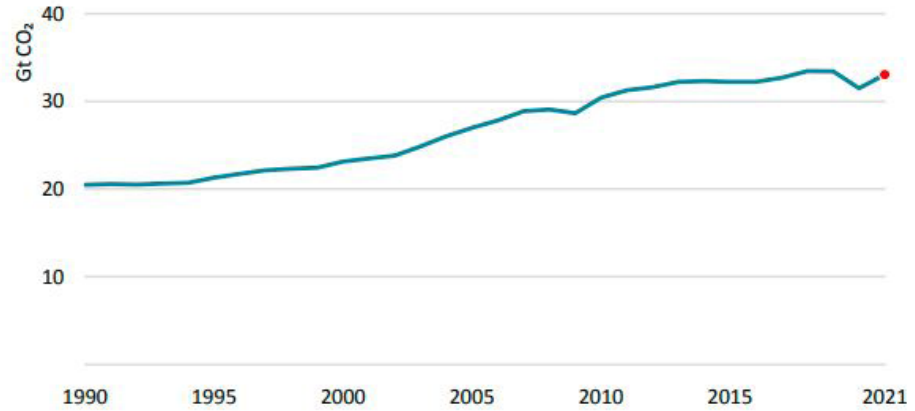


Figure 10: *Global Energy-Related CO_2 Emissions, 1990-2021, and Change in CO_2 Emissions by Fuel, 1990-2021*

Global CO_2 emissions declined by 6% in 2020 (or almost 2 Gt CO_2), the largest ever decline and nearly five times greater than that occurred in 2009 during the global financial crisis. Moreover, this decline in emissions exceeded that of energy demand, as the share of both oil and coal fell in 2020 (Figure 10).

Global CO_2 emissions are projected to grow by 5% in 2021 due to the increasing demand for fossil fuels. The increase of over 1,500 metric tons of carbon dioxide (Mt of CO_2) would be the single largest increase since the carbon-intensive economic recovery from the global financial crisis more than a decade ago (Figure 10).

[4] https://www.iea.org/reports/global-energy-review-2021

While the IEA expects oil-related emissions to recover only around half of the 2020 drop due to restrictions on transport activity, particularly in the international aviation segment, coal-related emissions are projected to increase up to 14.8 Gt CO_2, or 0.4% above pre-crisis levels and slightly below their peak in 2014. Due to rapidly increasing coal-fired generation in Asia, the power sector is expected to account for 80% of the rebound in coal-related emissions in 2021 (Figure 11).

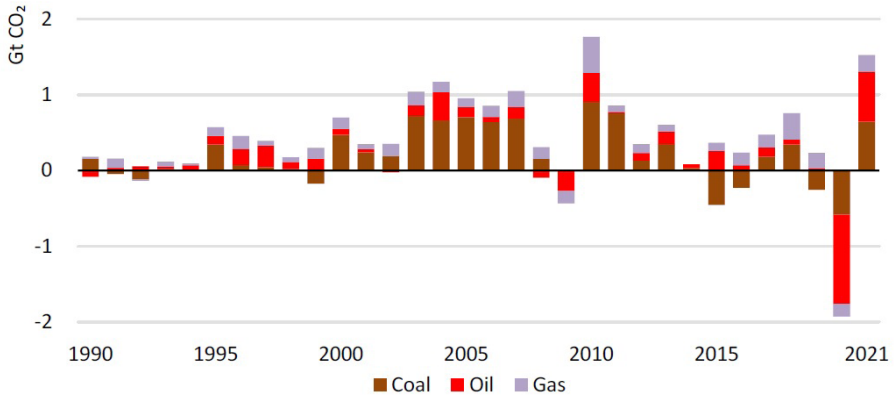


Figure 11: *Change in CO_2 Emissions by Fuel (1990-2021)*

Figure 12: *Change in Quarterly Oil Demand in 2020 and 2021 Relative to 2019 Levels*

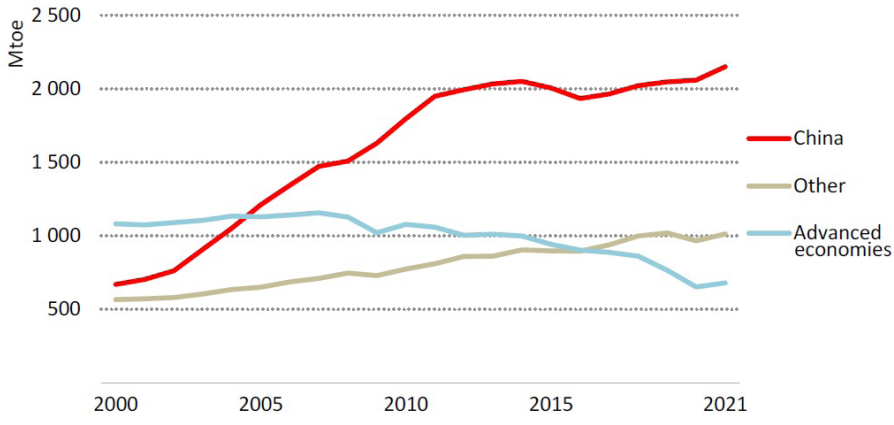


Figure 13: *Coal Consumption by Region (2000-2021)*

The IEA report also reveals that emerging markets and developing economies, led by China by 500 Mt and India by 200 Mt, account for more than two-thirds of global CO_2 emissions, while emissions in advanced economies are in a decline.

Oil demand only to recover partly due to restrictions on international aviation

The decline in global energy demand in 2020 did not affect all fuels evenly. Oil was by far the hardest hit, falling by 20% in April during the peak of restrictions and by 9%, or 8.5 million barrels per day (mb/d), for the year - the largest ever decline in both absolute and relative terms.

The IEA, in light of Covid-19-related developments, expects oil demand to rebound by 6% (or 5.4 mb/d), faster than any other fuel and also representing the largest annual increase since 1976. Despite such a strong rebound, oil demand still remains at 3% (or 3.1 mb/d) below pre-crisis levels. International aviation is the slowest segment to rebound and is expected to remain 20% below 2019 levels in December 2021. However, total oil demand excluding international aviation is anticipated to return to 2019 levels by the end of 2021 (Figure 12).

Coal demand to rebound strongly in 2021, driven by power sector

Global coal demand declined 4%, or 220 million tons of oil equivalent (mtoe), in 2020, the most significant drop since World War II, mainly due to lower electricity demand as well as competition against gas and renewables in power generation. Lower gas prices accelerated fuel switching from coal, resulting in a 20% decline in coal use for power in the United States and a 21% decline across the EU.

Despite falling in 2020, coal demand rebounded strongly during the first quarter of 2021, with a 5% increase, bringing global coal demand above 2019 levels. China remains the main

engine for coal consumption and is projected to account for the majority of the annual increase (Figure 13).

More resilient than oil and cal in 2020, natural gas to bounce back in 2021

While global natural gas consumption declined by 2% (or 75 bcm/year) in 2020, the largest recorded drop in absolute terms, the IEA projects gas demand to increase by 3% in 2021 (or 1% above 2019 levels), thanks to a combination of continued lower prices and rapid growth in economies across regions. The industrial and buildings sectors will be the major end users for increasing natural gas demand (Figure 14).

Renewables expected to set new records in 2021

Despite the historic decline in energy consumption across all sources, renewable energy use increased by 3% in 2020, mainly as a result of increasing power generation from solar PV and wind. The share of renewables in global electricity generation jumped to nearly 30% in 2020, up from 27% in 2019 (Figure 15). Renewable electricity generation in 2021 is set to expand by more than 8% to reach 8,300 TWh, while global solar PV electricity generation is expected to increase by 145 TWh (or almost 18%), reaching 1,000 TWh in 2021. Strong growth in renewables, when combined with nuclear power output, is expected to increase the total share of low carbon generation in total global power generation to 40% in 2021.

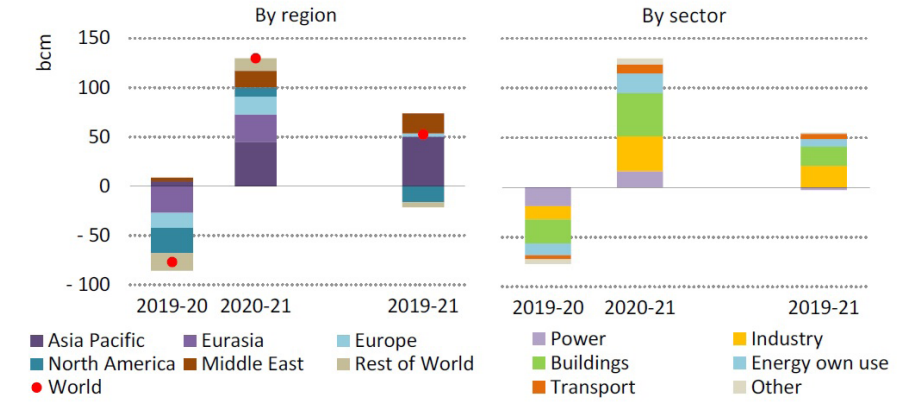


Figure 14: *Natural Gas Demand Growth by Region and Sector (2019-2021)*

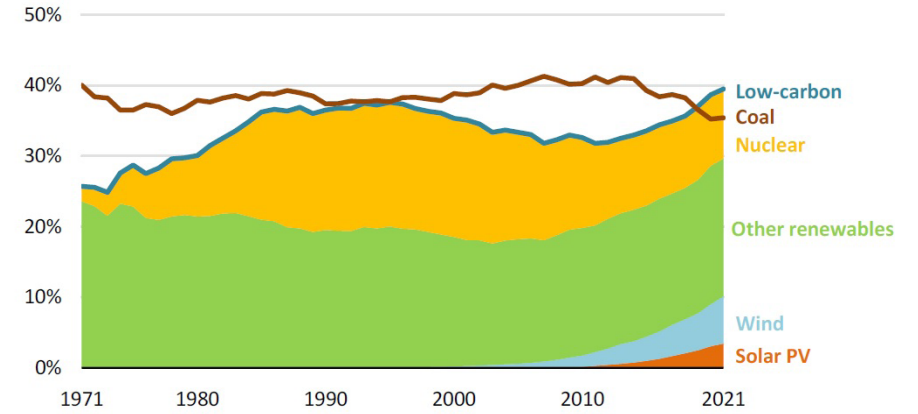


Figure 15: *Share of Low-Carbon Sources and Coal in World Electricity Generation (1971-2021)*

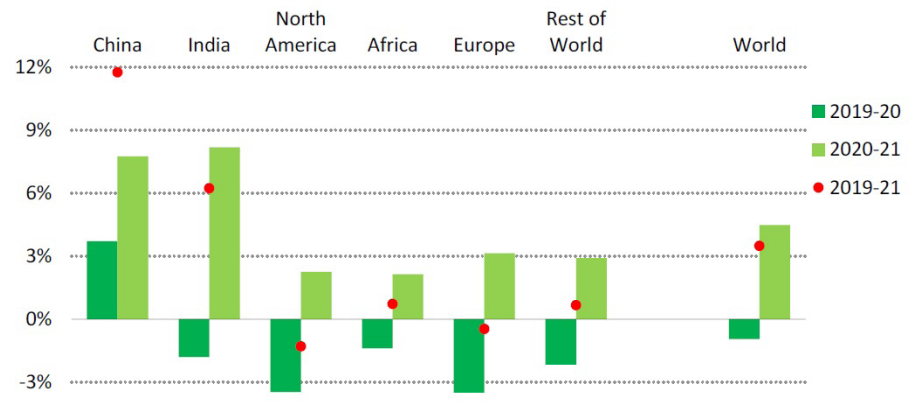


Figure 16: *Change in Electricity Demand by Region (2020-2021)*

Drastically hit by lockdowns in Q12020, electricity demand to recover rapidly in 2021

Electrification will continue to shape global energy patterns in 2021. During the first half of 2020, electricity demand fell in a range from 15% to 25% in many major economies, including China, India, the EU, and the United States. However, demand started to rebound during Q4 2020 in both advanced and emerging economies. Global electricity demand shrunk by only 1% in 2020. The IEA projects that global electricity demand will increase by 5% in 2021, supported by economic recovery both in advanced and emerging economies. With projected GDP growth of 9% in China and 12% in India in 2021, electricity demand is expected to grow by around 8% in both countries (Figure 16).

Nuclear power to recover slowly in 2021

Nuclear power generation decreased by around 4% in 2020, the largest decline since the aftermath of the Fukushima accident in 2011. Significant reductions occurred in Japan and the European Union. On the other hand, the output of nuclear power increased in both China and Russia as a result of new units coming online in 2019 and 2020. Belarus and the United Arab Emirates also commissioned their first nuclear units in 2020. The IEA projects that nuclear power will increase by 2% in 2021, reversing only half of the decline last year.

Strong Momentum in the Electric Vehicles Despite the Covid-19 Pandemic

The IEA released the **Global EV Outlook 2021**[5], which examined the global status of electric vehicles (EVs), analyzed the factors for the EV market to 2030, and offered recommendations for realizing the significant benefits of e-mobility for the energy economy and emissions reduction.

According to the detailed findings of the Outlook, the worldwide stock of electric cars reached 10 million in 2020, a 43% increase compared with 2019, which represented a 1% stock share, after a decade of strong expansion. In 2020, battery-powered EVs made up two-thirds of new electric car registrations and two-thirds of the stock. China had the largest fleet, with 4.5 million EVs; however, Europe had the highest yearly rise, reaching 3.2 million in 2020. For the first time, Europe surpassed China as the world's largest EV market, selling over 3 million vehicles (a 5% share of sales). Electric bus and truck registrations also increased in major markets, with global stocks reaching 600,000 and 31,000, respectively. Worldwide auto sales declined by 6% by the end of 2020 (Figure 17).

The report emphasized that in 2020, the European auto market decreased by 22%. However, new registrations for EVs more than doubled. Despite the economic downturn, this increase in EV registrations in Europe reflected two policy actions. First, 2020 was the target year of EU CO_2 emission rules to limit average CO_2 emissions for new vehicles per kilometer. Second, as part of stimulus packages to address the consequences of the pandemic, many European governments strengthened their EV-subsidy schemes.

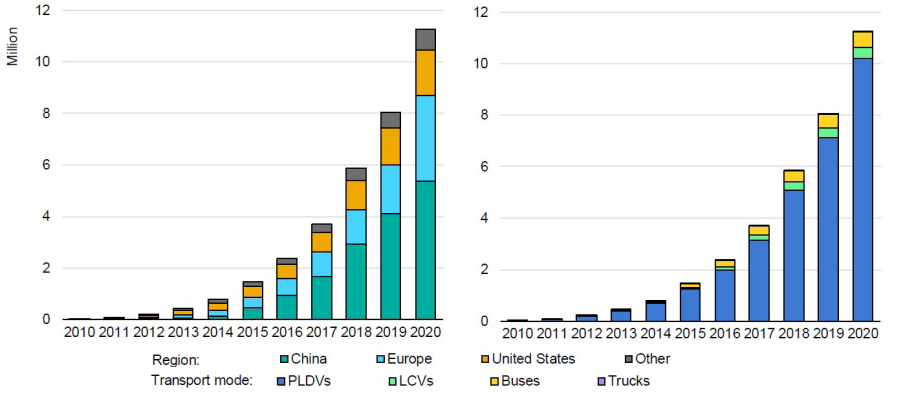


Figure 17: *Global Electric Vehicle Stock by Region (Left) and Transport Mode – (Right) (Million, 2010-2020)*

EV sales showed resiliency in the face of the pandemic for three major reasons:

- Supportive regulatory frameworks: even before the pandemic, many countries were tightening critical rules such as CO_2-emissions requirements and zero-emissions vehicles (ZEV) regulations. By the end of 2020, more than 20 governments declared bans on conventional automobile sales or mandated that all new sales be ZEVs.
- Additional incentives to safeguard EV sales from the economic downturn: some European countries raised their purchase incentives, while China postponed the phase-out of its subsidy scheme.
- The number of EV models increased, and battery costs continued to decline.

In 2020, there were over 370 electric car models available worldwide, up 40% from 2019. Vehicle manufacturers revealed ever more ambitious plans for electrification. Of the 20 top original equipment manufacturers (OEMs) (in terms of vehicles sold in 2020), 18 in particular indicated their plans to add to the number of models available and enhance electric light-duty vehicles (LDVs), which combined accounted for almost 90% of all new car registrations worldwide in 2020. OEMs announced their commitments for a total of 55-73 million electric LDVs to be produced by 2025.

In 2020, consumer spending on EVs is expected to reach USD 120 billion. Parallel to this, governments around the world spent USD 14 billion to promote EV sales, up 25% from the previous year, owing primarily to increased incentives in Europe. Nonetheless, over the last five years, the share of government subsidies in total spending on electric cars has fallen, signaling that EVs are becoming more appealing to customers (Figure 18).

[5] https://www.iea.org/reports/global-ev-outlook-2021

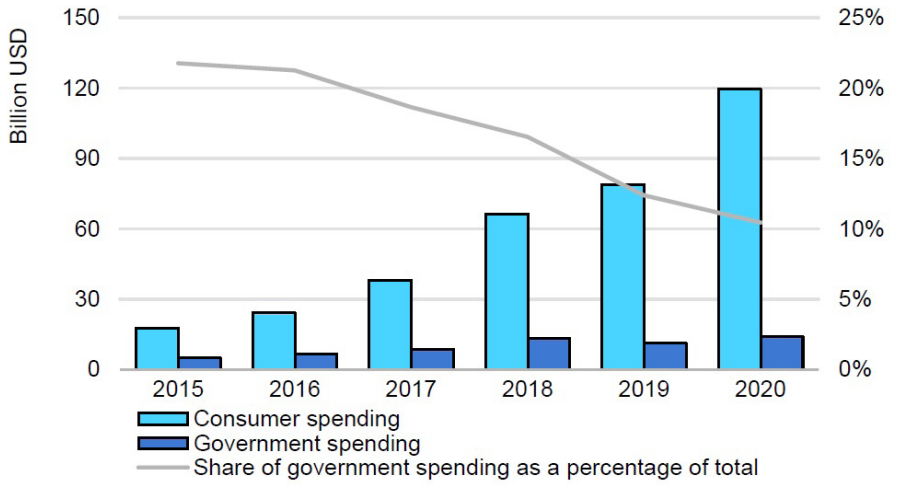


Figure 18: *Consumer and Government Spending on Electric Cars (2015-2020)*

Installation of publicly accessible chargers expanded seven-fold in the last five years

While most EV charging is done at home and at work, the roll-out of publicly accessible charging will be crucial when countries leading in EV deployment reach a point when EV owners will expect easier and improved autonomy. Publicly accessible chargers in 2020 reached 1.3 million units, 30% of which were fast chargers. The number of installed publicly accessible chargers increased by 45%, a slower rate than the 85% seen in 2019.

In China, the number of installed slow chargers -those with a charging power of less than 22 kW- increased by 65% in 2020, to almost 500,000 publicly accessible slow chargers. This accounts for more than half of the world's slow chargers. With roughly 250,000 slow chargers, Europe is in second place, with installations expected to increase by one-third in 2020. With almost 63,000 slow chargers, the Netherlands leads Europe. In 2020, the number of slow chargers installed in the United States increased by 28% over the previous year, totaling 82,000 (Figure 19).

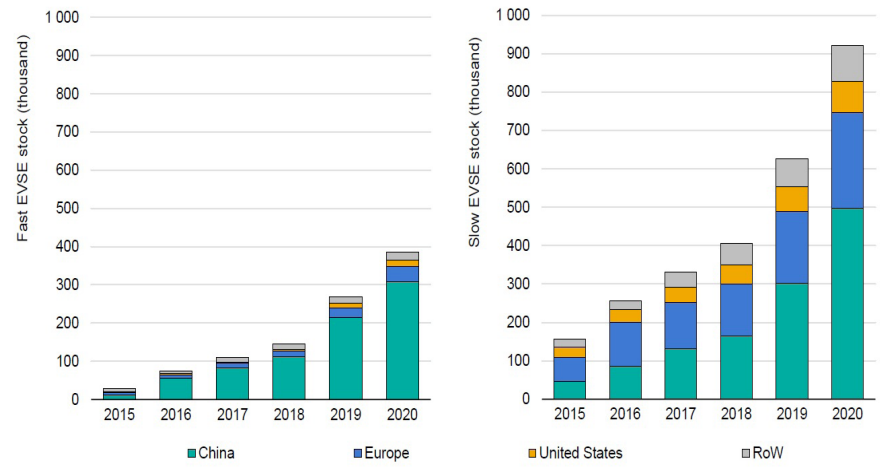


Figure 19: *Stock of Fast and Slow Publicly Accessible Chargers for Electric Light-Duty Vehicles (2015-2020)*

Brighter future for EVs in both IEA scenarios out to 2030

The outlook for EV sales in the foreseeable future is promising. Global electric car sales increased by over 140% in the first quarter of 2021 compared to the same period in 2020, driven by sales of over 500,000 vehicles in China and over 450,000 in Europe. U.S. sales, while starting from a far lower base, more than doubled in comparison to the same period in 2020.

Both the Stated Policies Scenario (STEPS) and the Sustainable Development Scenario (SDS) of the IEA projects significant increases in EV penetration globally. According to the STEPS, the baseline scenario of the IEA flagship reports **World Energy Outlook and Energy Technology Perspectives,** the worldwide EV stock across all modes of transportation (excluding two- and three-wheelers) grows from over 11 million in 2020 to almost 145 million vehicles by 2030, representing an annual average growth rate of roughly 30%. In this scenario, by 2030 EVs represent approximately 7% of the road fleet. Sales of EVs are close to 15 million by 2025, while in 2030 they reach over 25 million, representing 10% and 15% of all road vehicle sales, respectively. According to the SDS, which is based on more supportive policies across the world to meet global climate goals in line with the Paris Agreement, the worldwide EV stock would reach about 70 million vehicles in 2025 and 230 million in 2030 (excluding two- and three-wheelers). In 2030, EVs hold a 12% market share.

Electric cars to reach 86% of total stock globally by 2050

Electrification of transport sector is among the key enablers of the net-zero by 2050[6] pathway presented in the IEA's detailed roadmap report. According to the NZE Scenario, nearly all cars sold globally are electric by 2035 and electric cars represent 86% of total car stock by 2050. Nearly all heavy trucks sold worldwide are fuel cell or electric by 2050.

Sector		2020	2030	2050
Share of electricity in total final consumption		20%	26%	49%
Industry				
Share of steel production using electric arc furnace		24%	37%	53%
Electricity share of light industry		43%	53%	76%
Transport				
Share of electric vehicles in stock:	cars	1%	20%	86%
	two/three-wheelers	26%	54%	100%
	bus	2%	23%	79%
	vans	0%	22%	84%
	heavy trucks	0%	8%	59%
Annual battery demand for electric vehicles (TWh)		0.16	6.6	14
Buildings				
Heat pumps installed (millions)		180	600	1 800
Share of heat pumps in energy demand for heating		7%	20%	55%
Million people without access to electricity		786	0	0

Table 1: *Key global milestones for electrification in the NZE*
Source: *Net Zero by 2050, IEA*

EPİAŞ Launches Two Major Markets

EPİAŞ is set to launch "YEK-G" (renewable energy source guarantee system) market by 1 June 2021, simultaneously with the electricity futures market.

"The YEK-G system and organized YEK-G market is a kind of revolution in our energy market," said EXIST's CEO Ahmet Türkoğlu in a webinar held on April 29. Speaking on the panel titled "Green Markets," Türkoğlu stated that EXIST will not charge any market operating fee from participants of YEK-G and the electricity futures market until the end of this year. EXIST activated the virtual tests of YEK-G on 15 April 2021.

The YEK-G market establishes a renewable energy source-guarantee system that allows consumers to certify that their electricity purchases are originating from renewable energy sources. This development is supportive of the broader energy policy objectives to expand renewables-based power generation. The market is also expected to be instrumental for the efforts of energy consumers, commercial and industrial sectors in particular, to reduce their carbon footprints and enhance environmental sustainability and competitiveness.

The Electricity Futures Market (VEP) also became functional on 1 June 2021, representing a major step to advance predictability and competition in the Turkish power market. VEP is based on physical deliveries. EPİAŞ will serve as the market's counterparty. With monthly, quarterly, and annual future contracts, the VEP is expected to provide price signals in an organized market to attract investments and to optimize the use of financial and energy resources in Turkey's developing electricity market.

[6] https://www.iea.org/reports/net-zero-by-2050

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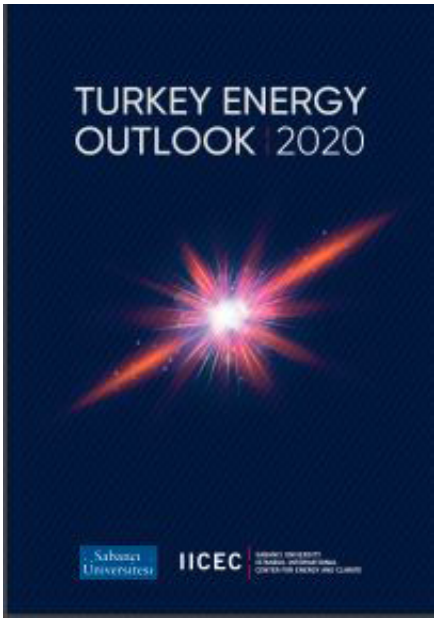
Visit https://www.epias.com.tr/en/ for further details.



Turkey Energy Outlook[7] addressed these developments in the Turkish power market with policy and market recommendations.

Please click here to watch the TEO 2020 launch.

"Notable achievements in the short-term markets include the Balancing Power Market, Day Ahead Market and Intra Day Market. These need to be complemented by advancing medium term markets with more predictability, transparency and enhanced risk management instruments, both for suppliers and consumers. These developments will enable price discovery over a longer time horizon and reflect supply and demand dynamics as well as a dynamic cost base that is linked to commodity and technology costs. The launch of an organized futures market with physical deliveries will constitute an important step to achieve a more efficient, transparent and competitive power market. Developments in the natural gas market will also be important for a better functioning power market since flexible natural gas fueled power plants are expected to continue their price setting role during peak demand periods."

"The recent initiatives introducing Green Electricity Supply Agreements in the form of market based PPAs and a voluntary green tariff are both positive steps to advance renewable energy growth in an increasingly competitive power market with demand side (customer) engagement. In the longer run, market driven approaches would permit less reliance on government tenders when electricity prices reflect full costs and overall economic parameters improve. However, even when merchant power companies are selling into a competitive market and can secure financing without government guarantees, a government role still persists to ensure that energy security, localization and environmental objectives are met."

Turkey's State-Owned Ertuğrul Gazi FSRU Moors at Dörtyol

Turkey received its first state-owned floating storage regasification unit (FSRU), the Ertuğrul Gazi, in April 2021. The vessel, having a storage capacity of 170,000 cubic meters (cm), is moored in the Dörtyol district of the Eastern Mediterranean city of Hatay. M.O.L. Challenger FSRU left Dörtyol before the arrival of Ertuğrul Gazi.


Source: *BOTAŞ*

"Our ship, which will be commissioned after testing, will contribute to the natural gas-supply security of Turkey," said Energy and Natural Resources Minister Fatih Dönmez. Emphasizing a solid increase in Turkey's storage capacity in recent years, Minister Dönmez remarked that Turkey's natural gas-storage capacity has significantly improved with new underground natural gas storage, LNG, and FSRU facilities. "The Ertuğrul Gazi FSRU will enhance our security of supply while contributing to the flexibility and diversification of gas supplies. The vessel has an LNG-storage capacity of 170,000 cm, which equals 102 mcm in gas form. It has a regasification capacity of 28 mcm per day. Thanks to the FSRU, Turkey is now able to

[7] https://iicec.sabanciuniv.edu/teo

supply gas from different sources or from a liquid market without being constrained only by pipelines. The transmission system's new entry points, close to high consumption regions, will also play a crucial role in meeting seasonal fluctuations during peak consumption, and in preventing supply interruptions due to technical or geopolitical risks."

Ertuğrul Gazi FSRU left the shipyard in Ulsan, S. Korea on March 18 and arrived in Turkey through the Suez Canal. The 294-meter-long vessel is connected to the gas-transmission system at BOTAŞ's Dörtyol terminal.

Daily entry capacity reaches 370 mcm

Turkey significantly increased the gas-transmission system's entry capacity to reduce its dependency on long-term pipeline import contracts and enhance the security of supply in case of gas cuts. Turkey's total daily entry capacity increased from 233 mcm in 2017 to 370 mcm in 2020. The daily entry capacity is targeted to reach 500 mcm in the next few years. Turkey's limited entry capacity in the early 2010s had created supply problems during peak consumption periods, halting gas supplies to power plants to secure residential consumption (Figure 20).

Turkey ranked third in the world after China and India with an annual growth of 2.3 bcm in LNG imports in 2020, according to the 2021 Annual Report of the International Group of Liquefied Natural Gas Importers (GIIGNL)[9] . The report also showed that Turkey became the fourth-largest LNG importer in Europe after Spain, United Kingdom, and France, importing 15.1 bcm in 2020. Turkey's share of global imports rose to about 3% in 2020, with a roughly 15% increase on a year-over-year basis.

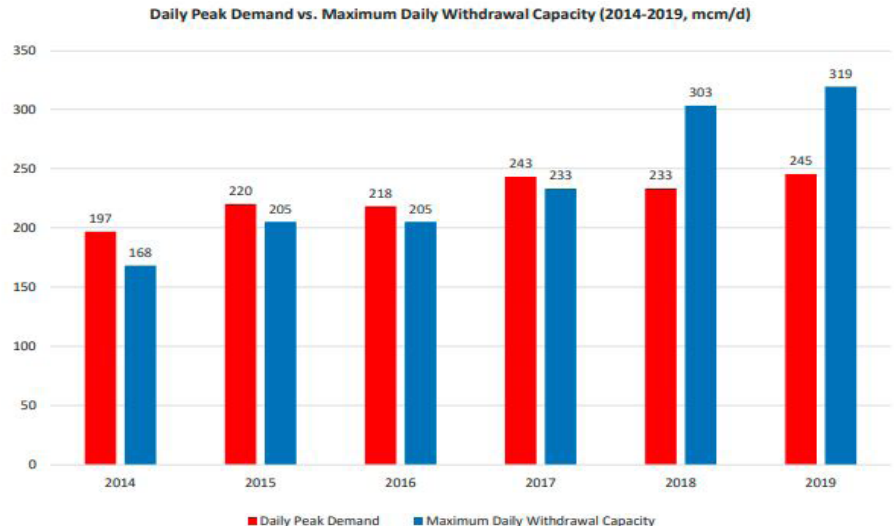


Figure 20: *Daily Peak Demand vs. Maximum Daily Withdrawal Capacity (2014-2019, mcm/d)*
Source: *Turkey Energy Outlook* [8]

Energy Efficiency Investment Trends in Turkey

Turkey invested a total of USD 4.8 billion in energy efficiency from 2017 to 2020 with an estimated energy savings of 3.2 mtoe. The investments reached USD 635 million in 2020, saving almost 0.5 mtoe, or USD 158 million, according to the Ministry's findings.

Addressing the Eurasia Cogeneration Conference[10] , Energy and Natural Resources Minister Fatih Dönmez said: "Thanks to energy-efficiency measures, the industrial sector saved 170,000 toe of energy in final energy demand per year from 2003 to 2018."

Turkey plans to invest USD 11 billion in energy efficiency by 2023 in line with the National Energy Efficiency Action Plan launched in 2017. The Action Plan foresees savings of USD 30 billion by 2033. "We announced the National Energy Efficiency Action Plan in 2017. We set a target of a 14% reduction in our primary energy consumption under 6 thematic topics and 55 actions. We invested a total of USD 4.8 billion in energy efficiency from 2017 to 2020. In return, we saved 3.2 mtoe, worth USD 1.2 billion cumulatively," Minister Dönmez underscored.

Minister Dönmez also provided information regarding developments in the Efficiency Enhancing Projects (VAP) Program. The Ministry of Energy has granted 307 million TL to 434 projects under this program, which began being implemented in 2009. "We are expanding the scope of

[8] https://iicec.sabanciuniv.edu/sites/iicec.sabanciuniv.edu/files/inline-files/TEO.pdf
[9] https://giignl.org/system/files/giignl_2021_annual_report_may4.pdf
[10] https://www.youtube.com/watch?v=fio7fh9hhHI

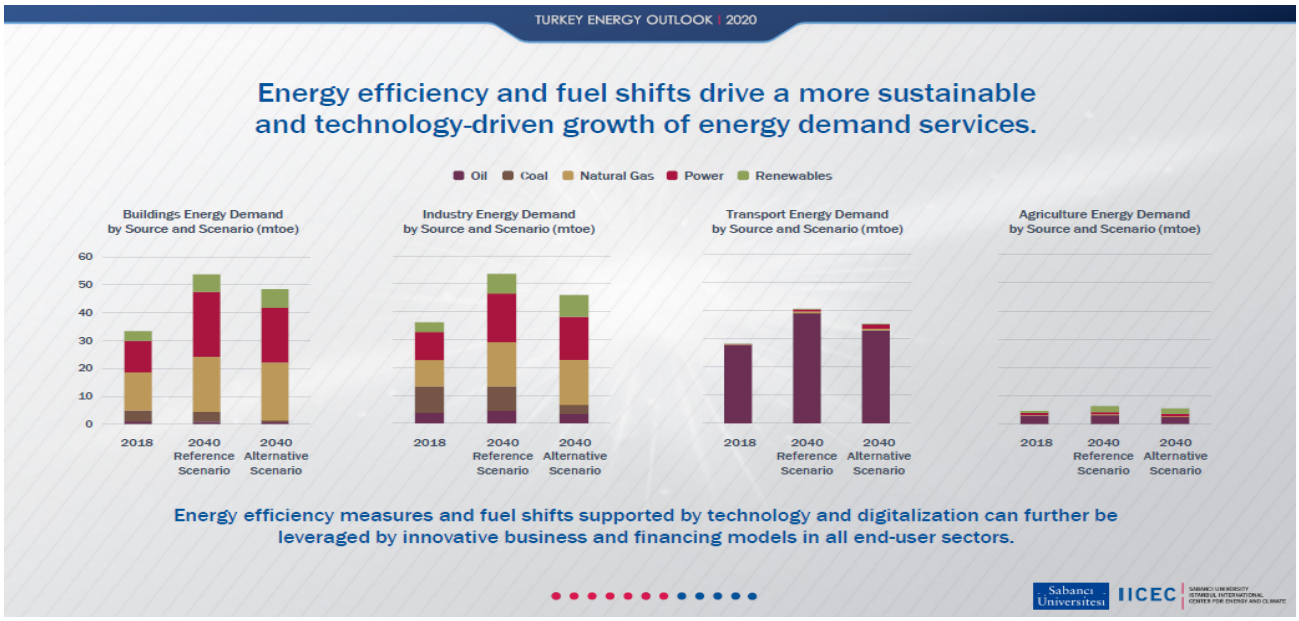
this program into commercial buildings as well as facilities related to energy, public services, and agriculture," the Minister reminded.

Energy-Saving Potential for Public Buildings Estimated at 2.4 to 3.2 Billion TL per Year

On April 15, 2021, Communiqué on the Implementation of Energy Performance Agreements in the Public was published in the Official Gazette, allowing public bodies to sign 15-year energy performance agreements for their energy-efficiency projects above 2 million TL.

"Our public institutions will now meet their energy-efficiency costs with the savings that they will achieve. Public institutions and organizations will be able to sign energy-performance agreements for up to 15 years for energy-efficiency projects exceeding 2 million TL ," said Minister Dönmez in a written statement. Referring to the consumption of buildings and campuses included in the scope of the Communiqué, Dönmez said that if the 15% savings target is achieved at the end of 2023, the amount of total savings will be around 870 million per year, given current energy prices.

Dönmez pointed out an important study carried out with the World Bank that determined savings targets in public buildings, saying: "According to the evaluation report issued as a result of this study, the total technical energy savings related potential for public buildings was determined to be 2.4 to 3.2 billion TL per year. The energy-savings related potential of the energy performance agreements market in public buildings is determined as 360 million to 480 million TL. Our aim is for the public to play a leading role in energy efficiency. In this context, we are evaluating all financing tools. This project will serve as a role model for energy efficiency."



The Turkey Energy Outlook (TEO) assesses the available policy tools and provides key recommendations to accelerate efforts to achieve a more efficient and sustainable energy-demand pattern across energy end-use sectors and services. According to the TEO's findings, the buildings sector has the largest energy-efficiency potential across all energy end-use sectors. The report noted the initial progress in enhancing energy efficiency in public buildings and addressed why and how the energy-performance contracts model can be replicated in commercial and residential buildings to exploit the great potential in energy efficiency. It also argued that the industry's incentive schemes are instrumental and suggested that these be further modified to achieve much wider benefits across different industries.

- "Turkey's steps towards a more efficient energy system gained momentum after the 2017 Energy Efficiency Action Plan. Subsequent arrangements in the regulatory framework provided a basis for advancing energy-efficiency progress in various areas. However, the pace of energy-efficiency improvements remains insufficient. In particular, there exists a critical gap in actions taken in building insulation compared to the country's vast potential,

[11] https://iicec.sabanciuniv.edu/teo

where mobilization of timely investments remains a main barrier."

- "Continuous efficiency increases are being recorded in the new appliance stock, but the old and inefficient stock, notably in refrigerators and HVAC equipment, deserves policy action. In industry, while the portfolio of projects to improve energy efficiency is growing thanks to governmental and industry initiatives, additional measures and incentives are needed to further attract energy efficiency-focused investments in Turkey's large industrial base."
- "A more secure and competitive energy sector necessitates stronger policies, new technology-driven equipment and systems, energy-management strategies, and greater investment into buildings and industrial energy-demand services."
- "In the next two decades, the Turkish energy-efficiency ecosystem will be adapting to rising incomes and increased urbanization. This is both an opportunity and a risk, as older energy-intensive behaviors can be too easily replicated instead of best practices. Turkey can exploit huge opportunities to use digitalization, electrification, renewable energy, and innovation to ensure best practices and a sustainable future."
- "Integrating policies and adopting and developing the best available technologies in the energy-supply mix and energy-demand services, including the more efficient use of energy, would contribute to the reduction of energy imports and greater localization, two of Turkey's major energy-security goals."
- "Investment allocation should be optimized towards a shift to the demand side and a greater commitment to developing competitive market mechanisms that would engage more energy users."

Turkey Enacted Electricity Storage Regulation

The new legislation, published in Official Gazette in 9 May 2021, introduces a long-awaited regulatory framework to foster integration of electricity storage into Turkey's developing power market. Market players will be able to build storage facilities as defined by the general principles set out in the regulation. The regulation categorizes electricity storage into four:

- Storage facilities integrated with generation,
- Storage facilities integrated with consumption,
- Autonomous storage facilities,
- Storage facilities by power grid operators,

The regulation also allows Universities, technology development centers and industrial zones to install up to 1 MW for R&D purposes.

All technical criteria to govern technical conditions will be announced by TEİAŞ not later than 1 September 2021.

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For any questions and additional information, please contact:

Bora Şekip Güray

Dr. Mehmet Doğan Üçok

Ersin Merdan

iicec@sabanciuniv.edu

CONTACT

Address:

IICEC, Sabancı University Minerva Palace, Bankalar Cad. No: 2, Karaköy, 34420, Istanbul Turkey

Phone: *+90 (212) 292 49 39 / 1114*