



A BRIGHT FUTURE

Fatih Birol

BIG IDEAS III

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pdf: QH-03-19-395-EN-N ISBN 978-92-861-4290-1 doi: 10.2867/67846

eBook: QH-03-19-395-EN-E ISBN 978-92-861-4301-4 doi: 10.2867/775582

BIG IDEAS

There is good news and bad news in the renewable energy industry.

We have made a lot of progress in green energy over the past few years as technologies have improved and the costs of production have fallen.

But we are not doing enough.

Fatih Birol, Director of the International Energy Agency, writes that despite progress, renewables still have a long way to go. We need much more action to make sure that everyone has access to energy and that we slow climate change, reduce pollution and make the world sustainable.

This is the sixth essay in the *Big Ideas* series created by the European Investment Bank.

The EIB has invited international thought leaders to write about the most important issues of the day. These essays are a reminder that we need new thinking to protect the environment, promote equality and improve people's lives around the globe.



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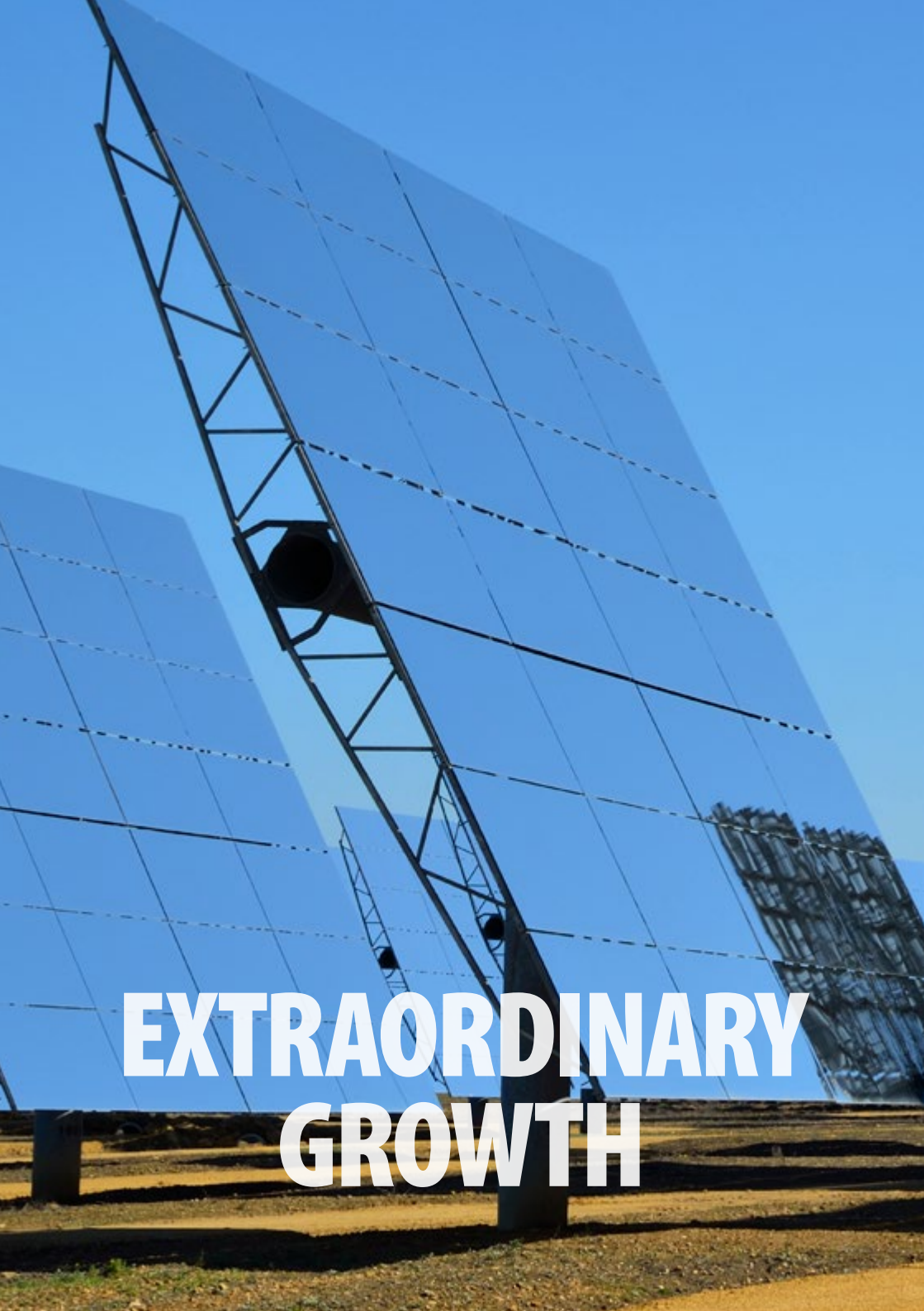
There are two ways to look at renewable energy today.

On the one hand, falling costs and strong policies are promoting the rapid spread of solar energy and wind power all across the world. Solar power is one of the few bright spots among clean energy technologies as the world transitions away from fossil fuels.

On the other hand, renewables make up only a fraction of global energy consumption. In the power sector, they still compete with fossil-fuel power plants; in the heat and transport sectors, which account for 80% of energy consumption, renewables still play a relatively marginal role.

The potential for increasing the role of renewables is massive: biofuels can be scaled up in transport, while bioenergy, solar thermal and geothermal energy can produce a larger share of heat for buildings and industry. Greater electrification, coupled with the increase in renewable electricity generation, is a key route to decarbonisation.

However, to realise this potential, strong policies, research, innovation and investment are needed. Only in this way will renewables be able to contribute to the emission reductions demanded by the Paris Climate Agreement and help us meet the Sustainable Development Goals, meant to provide access to affordable and reliable energy for all.



**EXTRAORDINARY
GROWTH**

RENEWABLES: EXTRAORDINARY GROWTH

First, the good news. The global renewable energy industry has experienced extraordinary growth over the past few years. Renewable power capacity¹ has grown by 4% per year since 2000, twice the rate of energy demand.

In 2017, renewable electricity generation (i.e. the quantity of energy produced) grew by 6% and reached a quarter of global power output. A market analysis commissioned by the International Energy Agency suggests further strong growth over the next five years, and by 2022 almost 1,000 gigawatts is expected to come from new renewables. This is happening at an extraordinary speed – it amounts to half the current capacity of coal-fired power plants, which took 80 years to build. As a result, the share of renewables in the power mix is expected to reach almost 30%.

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But growth rates vary considerably between technologies. **Solar power** led the expansion in renewable power generation in 2017, as deployment boomed in China and prices continued to fall. Power generation from solar photovoltaics is estimated to have grown by over a third in 2017, up to 416 terawatt hours, representing almost 2% of total world electricity generation.

¹ Power capacity refers to the quantity of energy that can be stored in a battery.



Offshore wind² also showed strong signs of progress, with 23% generation growth in 2017. Offshore wind capacity was led by China, Germany and the United Kingdom. The European Union added a record 11.5 gigawatts of **onshore wind**³ capacity. And global onshore wind power generation has continued to increase, especially with 2017 being a very windy year.

Hydropower remains the largest renewable power source and generation increased by an estimated 2% in 2017, even though growth in capacity was lower than in previous years. Growth in **bioenergy** and **geothermal** energy has also been sluggish as investors focused on more reliable and profitable sources of energy.

One reason for the rapid growth of wind and solar is the impressive fall in costs. For example, solar power prices for large utility-scale systems have fallen by 70% since 2010. These have been achieved through technological advances (e.g. higher photovoltaics efficiencies and larger wind turbines) but also through the emergence of competitive auctions.

Auctions with private companies, which combine better pricing with volume control, have been adopted by an increasing number of governments. In 2017, almost 24 gigawatts of new renewable capacity was awarded in auctions in 20 countries, with solar and wind technologies representing over 95% of that capacity.

With most renewables investment going into solar and wind, the contribution of these technologies to total power output will increase (we must remember that wind and solar energy is variable depending on the time of day and the weather, unlike the output from fossil-fuel power plants).

² Offshore wind power or offshore wind energy is the use of windfarms constructed usually in the ocean on the continental shelf, to harvest wind energy to generate electricity (Wikipedia).

³ Onshore wind power plants are installed on land.



UPCOMING CHALLENGES

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By 2022, Denmark is expected to be the world leader, with almost 70% of its electricity generation coming from variable renewables⁴ – that is, solar and wind. In some European countries (Ireland, Germany and the United Kingdom), the share of wind and solar in total energy generation will exceed 25%. In China, India and Brazil, the share of variable generation is expected to double to over 10% in just five years.

Countries are learning quickly how to deal with these changes to power systems and new, innovative solutions are emerging. The International Energy Agency has been leading the way with its work on system integration, advising governments, grid⁵ operators and power utilities on options to deal with the new challenges for the power sector.

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The key to integrating higher shares of these renewables is flexibility, which gives the power system the ability to quickly and accurately balance supply and demand. If shares of variable renewables increase without any increase in system flexibility – i.e. grid reinforcement and interconnections, storage, demand-side response and other supply – the energy produced could lose value.

⁴ Variable renewable energy is a renewable energy source that is non-dispatchable due to its fluctuating nature, like wind power and solar power, as opposed to a controllable renewable energy source such as hydroelectricity, or biomass, or a relatively constant source such as geothermal power or run-of-the-river hydroelectricity (Wikipedia).

⁵ An electrical grid is an interconnected network for delivering electricity from producers to consumers. It consists of:

- generating stations that produce electrical power
- high-voltage transmission lines that carry power from distant sources to demand centres
- distribution lines that connect individual customers (Wikipedia).



There is an urgent need for even more flexible electricity generation and new business models. New market and policy frameworks are needed to cope simultaneously with multiple objectives, including providing long-term price signals to attract investment, ensuring efficient short-term electricity dispatching, and unlocking sufficient levels of flexibility as well as fostering a portfolio of renewable technologies.

Finally, electricity network investment is important to modernise grids and to foster a larger role for digital technologies in support of the ongoing integration of renewables.

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In 2017, spending on electricity networks was \$300 billion. Within that, spending on so-called “smart grid technologies” – a wide range of new digital-based technologies – reached over \$33 billion, an increase of nearly \$4 billion compared with 2016.



SPAIN, GEMASOLAR THERMOSOLAR PLANT





A LONG WAY TO GO

STILL A LONG WAY TO GO

Now the bad news: some renewable sectors are still lagging behind and are often ignored in public discussions. The role of renewables in heat and transport is far less developed, with renewables supplying only 10% of heat demand in buildings and industry (excluding the traditional use of biomass), and 3% of transport energy in 2017. The International Energy Agency's *Tracking Clean Energy Progress (TCEP)*, the most comprehensive and up-to-date analysis of the clean-energy transition (2018), shows that the transport, cooling and heating sectors are not on track to meet long-term climate, energy access and air pollution goals.

“ We need to produce heat for space and water heating, for cooking and for industrial uses, and it accounts for 50% of total energy consumption.

In the transport sector, the energy transition will require a major switch to electric vehicles. As yet, the share of electric vehicles in the total stock of passenger vehicles, commercial vehicles and buses is low, at less than 0.4%. However, 2017 witnessed record global sales of electric cars (1.1 million), leading to a global stock of over 3 million.

Biofuels present a complementary option for the transport sector and will be particularly important for heavy-duty vehicles and aviation. Growth of 2% in 2017 was not fast enough to meet demand. In fact, the use of biofuels needs to triple to ensure that biofuel's share of transport fuel demand reaches 10% by 2030. For this to happen, cost reductions of advanced biofuels, widespread sustainability governance and more adoption in aviation and marine transport will be necessary.



Heat is another overlooked opportunity for renewables. We need to produce heat for space and water heating, for cooking and for industrial uses, and it accounts for 50% of total energy consumption. Most heat demand today is met by fossil fuels, which in many cities across the globe also contribute to air pollution. Renewable heat consumption grew by around 20% between 2010 and 2017, but much more is needed.

Policy-makers have begun to realise the importance of this sector. China, the world's largest heat consumer, has ambitious targets and plans to increase the production of cleaner heat options including solar thermal, geothermal and bioenergy. The European Union, already the largest consumer of renewable heat, has adopted a target that encourages Member States to increase renewables in heating and cooling by 1.3 percentage points a year by 2030. And the Netherlands, currently almost totally reliant on natural gas for heating, has removed the legal right to a gas connection in new homes and is encouraging renewable heat alternatives.

In industry, there is also more scope for using renewable heat. Bioenergy in particular is already used where there are suitable by-products or residues, such as in the paper and pulp industry. The rapidly falling costs of solar photovoltaics and wind could radically reduce the costs of electrolysis from water and allow a cost-effective substitution for hydrogen produced from fossil fuels. Hydrogen is already used in refineries to make oil products cleaner, and in the chemical industry to produce methanol and ammonia, a basic constituent of nitrogen fertilisers. It could also potentially be used in steelmaking to sharply reduce CO₂ emissions.

Finally, the cooling sector has been highlighted by the International Energy Agency as one of the biggest blind spots in the global energy system, as energy demand for cooling is the fastest growing energy end-use in buildings. Sales are rising three times faster than efficiency improvements, and 10 air conditioners will be sold every second over the next 30 years because of global warming.



**MORE ACTION
NEEDED**

MORE ACTION NEEDED

Despite some good progress, to achieve universal energy access, limit climate change, reduce air pollution and enhance energy security, we need more action. The pathway to achieving these interlinked goals is described in the International Energy Agency's Sustainable Development Scenario.

A key aspect of the Sustainable Development Scenario is that renewables and energy efficiency have to go hand in hand. Major improvements in end-user services mean that

“ Renewables and energy efficiency have to go hand in hand. ”

energy demand, despite a growing global population, will grow at a much lower rate. This in turn will make it easier for renewables to reach higher shares of energy consumption. Together, renewables and energy efficiency are expected to contribute to around 80% of the carbon emissions reduction.

In addition to energy efficiency improvements, the use of low-carbon fuels will increase significantly in the Sustainable Development Scenario. By 2040, their use will be around 40% higher. The main contribution will come from renewables. In the power sector, renewables will expand to provide over 60% of global electricity generation. Renewables will become the dominant option for meeting new electricity demand and displacing existing fossil-fueled generation. Wind and solar power, in particular, will become the two main technologies in terms of installed capacity, providing one third of all electricity.



The share of renewables in transport will be 21% thanks to biofuels, used in trucks, planes and ships. By 2040, the output of biofuels will grow to about 120 Mtoe (million tonnes of oil equivalent). At the same time, the consumption of electricity in the transport sector will more than quadruple, partly due to the growth in electric vehicles.

In the industry and building sectors, the call for renewables to provide heat is also increasing. By 2040, 23% of heat demand will be met by renewable sources, almost 2.5 times today's level. This is helped by the fact that the intensity of space heating in residential buildings in cold-climate countries will decline by around 30%.

To make the Sustainable Development Scenario a reality, overall energy investment, in particular for renewable energy, will have to grow considerably, especially in key technologies, such as electric cars and heat supply in the industry and buildings sectors. This investment imperative will be partially offset by the resulting lower need for investment in fossil-fuel supply and fossil-fuel power generation, which will reduce overall investment requirements by \$8 trillion up to 2040, and by lower operational fuel costs.

Make no mistake, the future is bright for renewables. The technological solutions are already there. It is now up to policy-makers to set the framework to allow this to happen. We need more investment in flexibility and energy efficiency, combined with smart, predictable and cohesive programmes across all energy sectors.

BIOGRAPHY

Fatih Birol (Ankara, 1946) is a Turkish economist and energy expert. He is currently the Executive Director of the International Energy Agency (IEA).

He previously served as the Chief Economist and Director of Global Energy Economics at the IEA in Paris.

He is responsible for the IEA's flagship *World Energy Outlook* publication, which is recognised as the most authoritative source for strategic analysis of global energy markets. He is founder and Chair of the IEA Energy Business Council, which provides a forum for cooperation between the energy industry and policymakers.

He is the Chairman of the World Economic Forum (Davos) Energy Advisory Board and a member of the UN Secretary-General's "High-level Group on Sustainable Energy for All."

In 2013, he won the Eurelectric Award for "his outstanding contribution to improving understanding of the opportunities and challenges facing the power sector."





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