Longer Term Investments

Renewables

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- Population growth and ongoing urbanization are increasing the consumption of electricity. The fossil fuels burned to generate it are naturally finite and environmentally harmful, which is why the ongoing transition toward more plentiful and less polluting alternative energy sources is essential.
- Political support initially boosted the attraction of renewables. Technological progress in recent years has also dramatically improved the economics. With falling costs and improving efficiency, solar and wind are now cost competitive with fossil fuels. In some markets they are already the cheapest way of producing electricity.
- We think the renewables theme has great potential, particularly for project developers and wind turbine manufacturers. Clean air, energy efficiency and storage, and electric vehicles are topics closely linked to the theme.

Our view

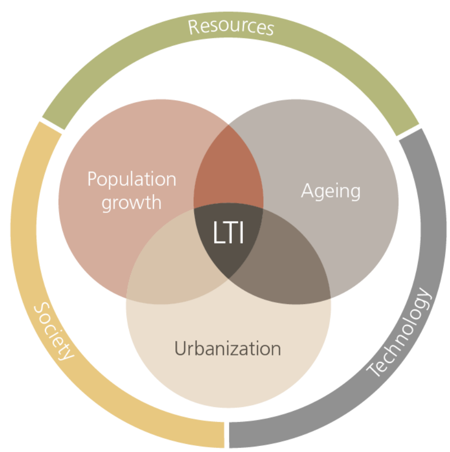
The rise of renewable energy has been impressive, and the growth in its share of the global power generation mix is continually rising. In key markets an inflection point has already been reached as renewables have become the cheapest means of producing electricity. We see three primary renewable technologies that should continue to grow:

1. **Wind**: Global wind capacity is expected to exceed 1,000 GW by 2025 (around 600 GW at the end of 2018), while the share of global power generation mix should increase to 10% from today's 4%-5%.
2. **Solar photovoltaic (PV)**: New solar installation will continue to grow strongly worldwide, while the costs of electricity generation should continue to decline. Already the solar PV market currently has around 500 GW of capacity.
3. **Hydro:** We expect the growth of hydro to continue but vary by country because of geographical restrictions and relatively high capital intensity. Its share in power generation already surpasses 15%, with global capacity topping 1,000 GW.

Rising population and ongoing urbanization are the key drivers of the increasing demand for electricity. We think alternative fuels will play an essential part in the future generation mix. Cumulative investment in renewables is forecast to exceed USD 9trn by 2050.

Introduction to the Longer Term Investments (LTI) series

- **The Longer Term Investments (LTI)** series contains thematic investment ideas based on long term structural developments.
- Secular trends such as population growth, ageing, and increased urbanization create a variety of longer term investment opportunities.
- These investment opportunities are influenced by the interplay of technological advancement, resource scarcity, and the societal changes.
- Investors willing to invest over multiple business cycles can benefit from potential mispricings created by the typically shorter term focus of stock markets.



The political and regulatory support for renewable energies varies widely by region (see annex). However, in recent years falling costs and technological advances have made renewables attractive for investors with a long-term, selective and diversified focus.

1. Energy, electricity and alternative fuels

Global electricity demand is following a clear upward trend due to technological progress, urbanization, and economic and population growth. Renewable energy enjoys advantages over fossil fuels and nuclear power thanks to falling costs, enhanced political support and greater social acceptance.

Energy and electricity demand increases

Primary energy is found in nature and has not been subjected to any conversion or transformation process. It is a basic need, the demand for which is as old as the human race itself. We use primary energy sources both for direct consumption (e.g. we burn fossil fuel for cooking and heating purposes) and in conversion processes that create secondary energy, also called energy carriers (e.g. electricity).

Global demand for primary energy increased from 4 billion tonnes of oil equivalents in 1965 to almost 14 billion in 2017. The International Energy Agency (IEA) expects this figure to rise to 18 billion by 2040. While the energy consumption of OECD countries has stabilized in the early 21st century, in non-OECD countries it is likely to continue rising, especially in emerging markets.

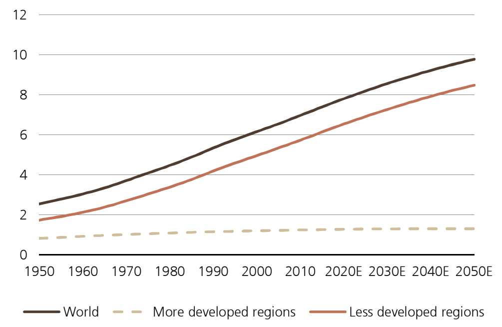
Demand for electricity is almost certain to increase despite the intense political focus on energy efficiency. The ongoing economic and social development of emerging markets, combined with their persistent population growth, will cause their electricity consumption to continue to climb. The IEA forecasts electricity production to increase 50%-60% by 2040 thanks to three key factors.

- According to UN forecasts, the global population will approach 10 billion by 2050 from 7.6 billion today (see Fig. 1). The increase will be greatest in less-developed countries, while the populations of more developed nations will stay relatively flat. In emerging markets, a growing number of people will have access to modern energy services. Not only will they use more electricity, industrial demand will climb since larger populations require more goods and services.

- Ongoing **technological progress**, i.e. digitalization, automation and robotics, improves and simplifies people's lives. Developing countries are also being transformed by it,

Fig. 1: World population (in billions, 1950–2050)

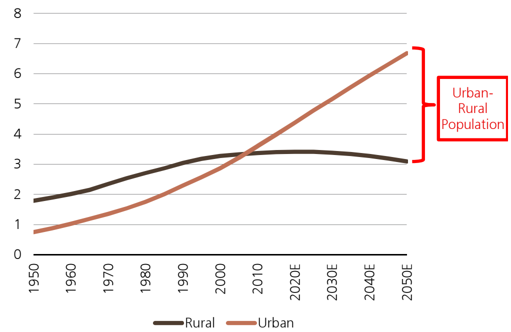
Less-developed countries drive growth



Source: United Nations, Department of Economic and Social Affairs, Population Division (2018). World Population Prospects: The 2018 Revision, UBS.

Fig. 2: World urban and rural population (in billions, 1950–2050)

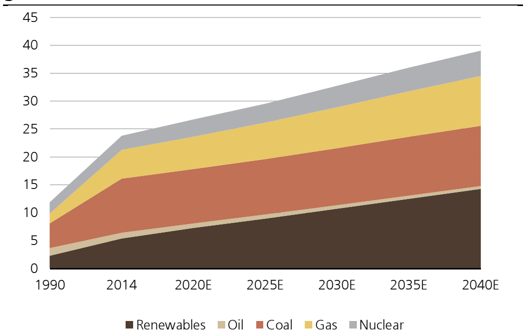
By 2050 a majority of the world's population will live in urban areas



Source: UN, Department of Economic and Social Affairs, Population Division (2018). World Population Prospects: The 2018 Revision, UBS.

Fig. 3: Global electricity generation (in thousand TWh, 1990-2040 projected)

More than half of global electricity is still generated from fossil fuels



Source: © OECD/IEA 2016, World Energy Outlook 2016, IEA Publishing; as modified by UBS. Licence: www.iea.org/t&c

Note: Based on non-annual data

with a time lag but at an even faster pace. So global GDP should go on expanding. But every step forward in science and technology requires an energy source. So the demand for primary energy and electricity is likely to increase alongside technological progress for many years to come.

- The global balance between urban and rural populations is estimated to shift from 1950's minus 1 billion to more than plus 3.5 billion in 2050 (see Fig. 2). **Increasing urbanization** fuels the demand for electricity in various ways. Inadequate urban infrastructure will have to be upgraded. Large urban populations require greater supplies of drinking water, more effective public transport services, more extensive networks of supermarkets, a well-functioning job market, and better provisioning of goods and services to combat poverty (see other Longer Term Investment themes, e.g. "Water scarcity"). These collective improvements directly or indirectly require more electricity. Rising use of electrical appliances by households will also raise demand from individuals.

Transition to alternatives underway

The 19th and 20th centuries ran on fossil fuels, whose combined share of primary energy consumption is still 85%. More than two-thirds of global electricity production still depends on coal, gas and oil as well (see Fig. 3), with the share of nuclear power exceeding 10%. But fossil fuels are by nature finite. So alternative energy sources have to be discovered and/or further developed as a sustainable solution to soaring energy needs. According to IEA forecasts, the global share of renewables (including hydro generation) used in electricity generation will exceed 35% by 2040 from 25% today, while the percentage derived from nuclear power is expected to follow a stable upward trend. The relatively high share of renewable energy in the global electricity mix today is mainly due to hydropower, but solar and wind will be key as renewables grow.

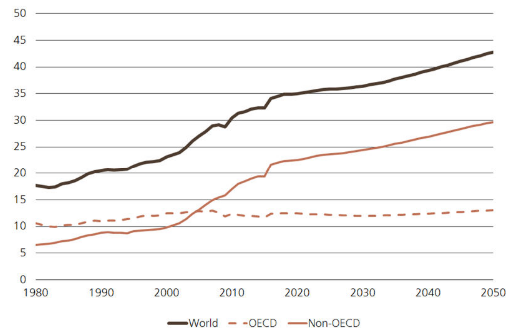
Another serious problem posed by fossil fuels is the pollution they cause, in particular the greenhouse gases that burning them releases. According to the IEA, CO2 emissions have almost doubled since the 1980s, reaching 33 billion tons in 2016, a figure expected to strongly climb in the coming years (see Fig. 4). Since 2005 non-OECD countries, which in general are less developed, have accounted for most of the rise. About two-thirds of per-capita global CO2 emissions stem from generating electricity and heat and powering transportation. The percentage is much higher in OECD than in non-OECD countries (see Fig. 5). To meet these needs the global electricity generation mix will likely shift toward a higher share of alternative fuels.

Fossil vs. alternative fuels, economically and politically

The cost of installing **renewable power plants** has plummeted

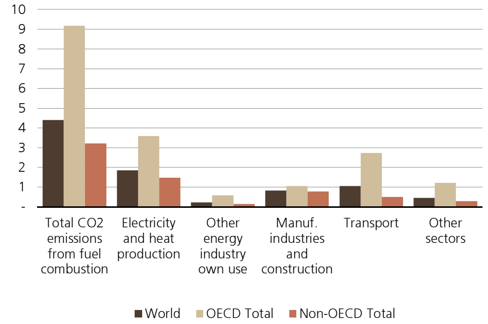
Fig. 4: Global CO2 emissions (in billion tons of CO2, 1980–2050 projected)

CO2 emissions follow an upward trend globally



Source: Based on IEA data from: CO2 Emissions from fuel combustion 2017 © OECD/IEA/ US Energy Information Administration (EIA) 2017, www.iea.org/statistics, Licence: www.iea.org/t&c; as modified by UBS
Note: Historical data 1980-2015 refers to IEA, data 2016-2050 refers to the reference scenario of EIA.

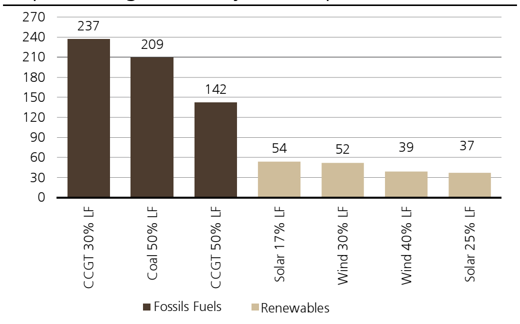
Fig. 5: Global CO2 emissions per industrial sector (in tons of CO2 per capita annually)



Source: Based on IEA data from: CO2 Emissions from fuel combustion 2017 © OECD/IEA 2017, www.iea.org/statistics, Licence: www.iea.org/t&c; as modified by UBS

Fig. 6: Levelized cost of energy (LCOE) incl. investment costs in Europe (in USD/MWh)

Wind and solar are currently the cheapest ways of producing electricity in Europe



Source: Goldman Sachs Global Investment Research (GS), UBS
* CCGT = Combined cycle gas turbine
** percentage numbers indicate assumed load factors
Note: LCOE = stream of equal payments, divided by expected output, which would allow owner to recover all costs over production cycle.
LF = Load Factor.

in the last few years. So the transition to renewable sources for electricity generation, in particular in Europe, will likely accelerate. When investment costs are taken into account, wind and solar are already the cheapest way of generating electricity in some regions. Depending on the assumed load factors (i.e. the measure of utilization rate), the cost for wind or solar-generated electricity in Europe is less than half that of coal (see Fig. 6), have fallen by 50% and 70%, respectively, since 2009. On the other hand, installing new hydropower plants is still relatively expensive, although their operating costs are quite low.

Nuclear-generated power could also become a clean alternative and a direct competitor to renewables. The higher costs it necessitates for security and its low social acceptance in some regions have led to significant cost disadvantages, although it could remain an alternative in China and Korea, for example, and the technology could evolve further and gain greater acceptance.

Various governments worldwide have promoted clean energy from renewables in recent years. This political will is reflected in the numerous national and local policies and regulations supporting them.

The UN has emphasized the global relevance of meeting the demand for clean energy as enshrined in one of its 17 **Sustainable Development Goals** (SDGs). It is all the more relevant since greater access to affordable, reliable, sustainable energy affects nine other SDGs, including reducing poverty and improving the quality of education.

Nevertheless, in recent years the focus has shifted from purely political measures to an economically supportive framework. In other words, politics launched the rocket and economic competitiveness now serves as the propellant.

2. Renewable energies in detail

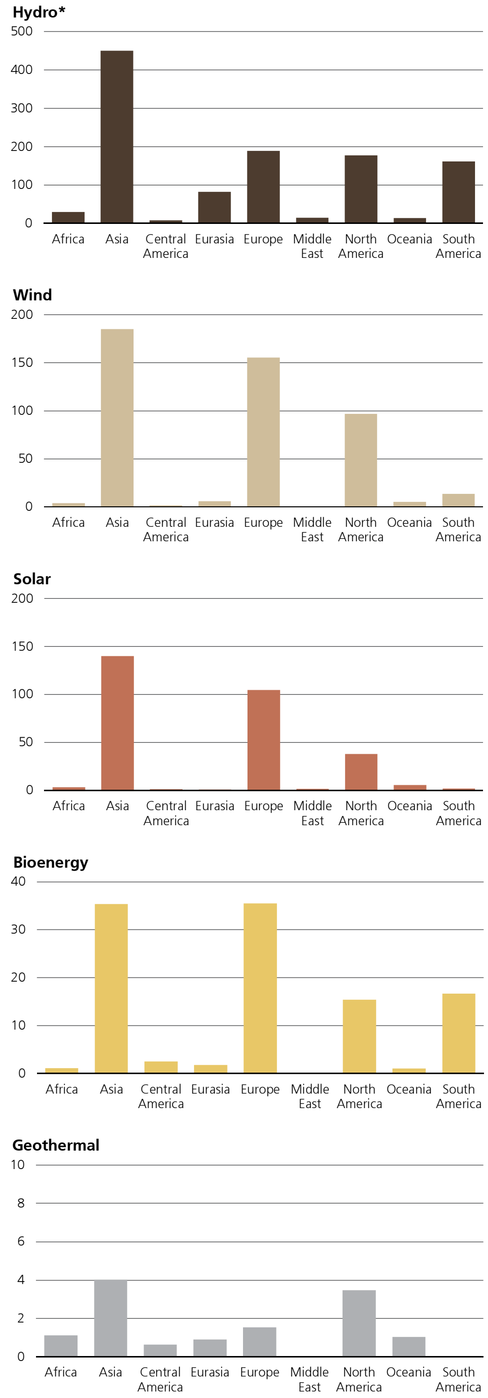
Renewable sources have taken center stage to satisfy the increasing demand for electricity and to reduce global carbon emissions. Hydropower constitutes the bulk of global installed capacity for renewable electricity generation today. But solar and wind are likely to gradually overtake it.

Renewable energies rediscovered

The great advantage of renewables is their plentiful availability and low carbon emissions, which have gained them broad support in many countries. It also has led to a cost-related advantage and so reinforced their growth. In recent years, wind and solar have enjoyed a big boost.

Fig. 7: Global installed renewable energy capacity (in GW)

Asia, Europe and North America as pioneers in renewable energies



Source: © The International Renewable Energy Agency (IRENA) 2018, UBS.
* including marine

They also suffer from certain weaknesses: their efficacy varies according to time and location. The wind does not blow constantly nor does the sun always shine. Here, energy storage could be a solution, either via traditional batteries or innovative technologies like power-to-gas.

Renewables will not replace fossil fuels fully in the foreseeable future. But they will likely account for a major share of global electricity generation. While **energy efficiency**, **the transition to renewables** and **decarbonization** are not substitutes for coal, oil and gas, they can complement them. No single energy source on its own can meet the challenges of the increasing demand for electricity and the need to combat growing carbon dioxide emissions.

The major renewable energy sources currently are:

- **Hydro**, which mechanically transforms drop height and/or the kinetic energy of water into rotation energy and then electricity. Hydro power plants can be categorized as run-of-the-river or storage (technically not real power plants since they only store electricity).
- **Wind**, which employs on- and offshore turbines to convert kinetic energy from wind into mechanical energy and then electricity. Improvements in hub height and blade length have enhanced efficiency in recent years.
- **Solar**, both photovoltaic and thermal. The former transforms sun power directly into electricity; the latter is used either for heating or indirect electricity generation.
- **Bioenergy**, which consists of fuels with low carbon emissions produced through biological processes (e.g. agriculture).
- **Geothermal** is an energy source utilizing the earth's underground heat, which can be categorized as near-surface (<400 meters) or deep geothermal energy (>400 meters).

In 2017, more than 80% of all renewable capacity (about 2,200 GW), was installed in Asia, Europe or North America. In Asia low-carbon energy sources are becoming increasingly popular (see Fig. 7). Hydro power of around 1,300 GW (including pumped storage) makes up more than half of renewable capacity globally, followed by wind with 24% and solar with 18% (others like bioenergy, geothermal are 5%). But relatively high installation costs for new hydro power plants make solar and wind more attractive for investment. Over the next 20 years, market specialists expect wind and solar capacity to more than triple. From a primary energy supply point of view (see Box 1 for distinction between capacity and supply) solar and wind are already the renewable technologies with the highest annual growth rates (see Fig. 8).

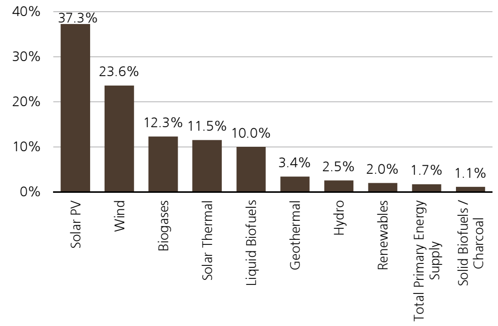
Box 1: Capacity vs. supply

- Energy generation capacity (the same is valid for electricity) is the maximum electric output an energy generator can produce under specific conditions. Capacities are typically measured in megawatt (MW) or gigawatt (GW).
- Energy production (generation) is the amount of energy a generator produces over a specific period. Many generators do not operate at their full capacity all the time. Supply (generation) is typically measured in megawatt per hour (MWh) or terawatt per hour (TWh).

Source: U.S. Energy Information Administration (EIA), UBS

Fig. 8: Global annual growth rates of total primary energy supply by renewables (in %, 1990–2016)

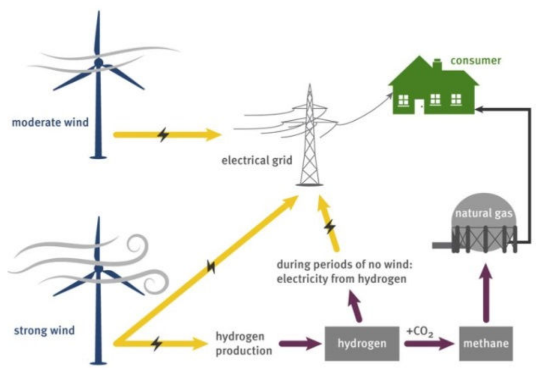
Wind and solar have been the fastest-growing renewable energy sources worldwide



Source: © OECD/IEA 2018, Key Renewables Trends 2018, IEA Publishing; as modified by UBS. Licence: www.iea.org/t&c

Fig. 9: Power-to-gas technology

An efficient way to store electricity from renewable sources or to use it directly for industry, transportation or heating



Source: Paul Scherrer Institut (PSI)

Power-to-gas technology as a derivative
Power-to-gas technologies, based on traditional renewables, could offer new electricity-generating opportunities by converting renewable sources into gas. Hydrogen captured from pure water via an electrolyzer is just one possibility. The electricity thus produced can be used in the natural gas infrastructure or directly transferred to end-consumers (see Fig. 9) for such applications as:

- Alternative, climate-friendly **fuels in the transport sector** that replace current fossil fuels.
- An ecofriendly **substitute for hydrogen** produced from fossil fuels.
- A renewable gas that could flow to **heating systems** and replace other gas fuels from fossil sources.
- An alternative to standard **energy storage** methods like lithium-ion batteries to help store renewable electricity at relatively low cost using gas tanks.

2a. Wind – support through higher efficiency

Annual installations of new wind farms are expected to remain high at 50-70 GW until 2025. The share of global electricity generation provided by off- and onshore wind should approach 10%. Wind has benefited from a supportive regulatory framework. Now its competitiveness stems primarily from the improved efficiency of wind turbines (falling costs).

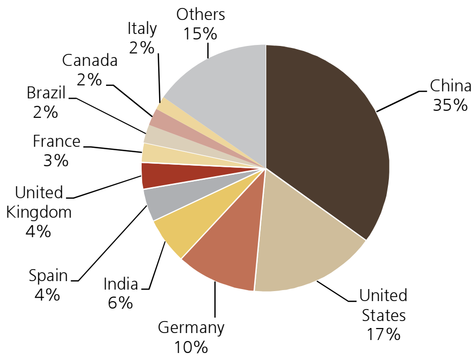
Wind market to grow further
Because wind power plants convert kinetic energy into mechanical energy and then electrical energy, there are no fuel costs, as with most fossil energy sources. This removes commodity price risk. Their operating and maintenance costs are relatively low, and in recent years efficiency has soared due to **technological improvements** in hub height and blade length. While wind power benefits from high capacity utilization, low cost structures and no carbon emissions, its greater land utilization compared with other renewable energy sources and the electricity transmission to the final consumer can be disadvantageous.

Total worldwide wind capacity (on- and offshore) is estimated at 600 GW in 2018. China and the US represent more than 50% of this figure (see Fig. 10). Market specialists expect that capacity will grow until 2025, and the share of global electricity generation provided by wind is forecast to approach 10% in 2025, up from 5%-6% today.

Global capacity in onshore wind power rose 11% from 2016 to 2017, which corresponds to an additional 52 GW for a total

Source: iStock

Fig. 10: Country share of global wind power capacities (in %)
China and US represent >50% of global wind power capacity



Source: REN21, < 2018 >, < Renewables 2018 Global Status Report > (Paris: REN21 Secretariat), UBS, as of 2018 capacity of 539 GW. Globally, between 2006 and 2017, onshore wind capacities increased more than sixfold, while the annual addition rate almost trebled, with non-OECD countries playing a key role. Onshore wind capacities worldwide should reach about 1,000 GW in 2025 (see Fig. 11).

The large investments in new offshore wind parks in recent years (e.g. by Dong Energy, Iberdrola) provide evidence that they too are following a clear growth path. Many very large wind farms, like the onshore Jaisalmer Wind Park in India (1.1 GW capacity) and the offshore London Array Farm in UK (0.6 GW capacity), have been built of late. In 2020 one of the world's largest onshore wind projects, the Gansu Wind Farm in China, should have a total capacity of 20 GW. All of this supports our expectations for renewable energy growth globally.

The wind supply chain comprises primarily mid- and large-cap operators, developers and manufactures, such as Siemens-Gamesa and Vestas, from the industrial (e.g. for blades, bearings, gearboxes, towers) and utilities sector (integrated companies and specialist renewable generators). With the exception of the generator and tower market, the wind supply chain is highly concentrated.

Declining costs support wind power generally

In the early years of renewable energy, wind primarily benefited from a supportive regulatory framework provided by governments worldwide. This purely political advantage over fossil fuels has receded. Today the ongoing growth of the wind market is mainly driven by declining costs. This accelerating fall in costs is also reflected in the low wind prices achieved in recent renewable auctions (see Box 2) worldwide.

The levelized cost of energy (LCOE) (see Fig. 12) has decreased by more than 50% since 2009, and will likely decline by another 30-35% by 2025. European power prices already exceed the LCOE of wind and the price divergence seems likely even to be magnified. This development stems mainly from economies of scale, turbine efficiency, project clustering and industrialization.

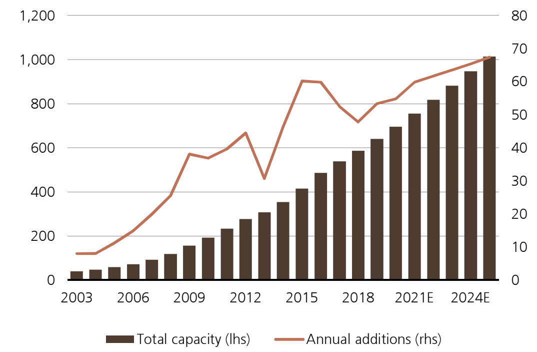
Onshore vs. offshore wind

In 1980 a standard onshore wind turbine with a diameter of 17m produced 75 KW. Fifteen years later the average capacity had already increased by 10x (diameter of 50m), and in 2018 a 165m diameter offshore wind turbine typically generates about 9.5 MW. This progress is expected to continue until, by 2025, a single wind turbine with a diameter of 200m could add 10-15 MW to existing capacities.

Global power generation from onshore wind has soared from 339 TWh in 2010 to exceed 1,000 TWh in 2017. By 2025

Fig. 11: Global onshore wind capacities and annual additions (in GW, 2003–2025 proj.)

Global capacities for wind power are expected to increase



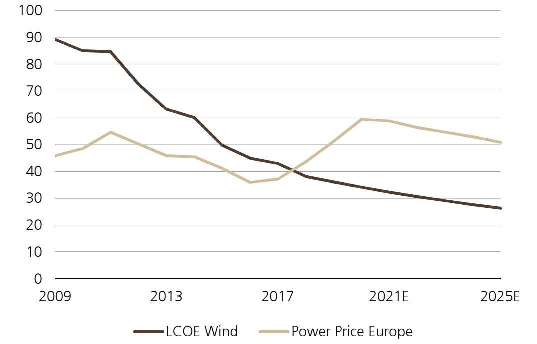
Source: Goldman Sachs Global Investment Research (GS), UBS
Note: lhs = left hand side; rhs = right hand side

Box 2: Energy auctions

Energy auctions are widely used market tools which are able to guarantee that (renewable) energy services follow the compliance of pre-defined quality standards combined with the cheapest possible price.

Fig. 12: Levelized cost of energy (LCOE) (in USD per MWh vs. power prices, 2009–2025 proj.)

Costs of generating electricity from wind power in Europe is forecast to fall further



Source: Goldman Sachs Global Investment Research (GS), UBS
Note: Power price estimates are based on the average for France, Germany, Italy, Spain and the UK

production is expected to exceed 2,100 TWh (see Fig. 13). Offshore wind power is still significantly more expensive than onshore, but the LCOE for the former is also expected to decline. Because of **efficiency improvements** the costs of wind power (on- and offshore) will further decline.

2b. Solar – significant growth opportunities

According to market estimates, global demand for solar power is expected to grow strongly, while the share of global electricity generation provided by solar will almost double from today's level. This ongoing growth stems mainly from huge cost reductions due to oversupply along the supply chain.

Solar market promises significant growth

Solar is the only renewable that requires few moving parts. This characteristic makes it suitable for distributed energy generation, where generation occurs close to the point of consumption, such as on the rooftops of individual residential homes. The solar power industry can be subdivided into solar photovoltaics (PV), concentrating solar thermal power (CSP) – also known as solar thermal electricity (STE) – and solar thermal heating and cooling in addition to utility-scale application.

PV capacity installation has grown rapidly. From about 20 GW in 2010 it rose roughly fivefold to around 100 GW installed in 2017 and 2018. PV is the most economic means of generating solar power, following intense price competition in recent years. The total global capacity of solar PV in 2018 was around 500 GW, with around 46% in China and the US (see Fig. 14). Additionally, CSP climbed to around 5 GW in 2017. The installed capacity for solar heating and cooling grew by 35 GW, pushing solar's overall global capacity. Solar installations should continue to grow steadily (see Fig. 15).

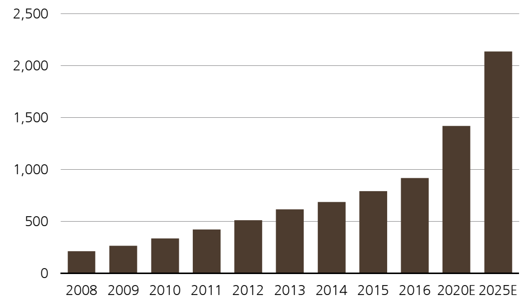
According to market estimates, 30 TWh were generated by solar globally in 2010 (for context, nuclear generated 2,600 TWh). This figure could rise to 750 TWh (nuclear: 3,000 TWh) by 2020 (see Fig. 16), which corresponds to a 40% annual growth rate. By 2025, the share of global electricity generation from solar is forecast almost to double from today's figure, which is close to 2%. The largest solar park in the world is Tengger Desert Solar Park in China, with an estimated capacity of 1547 MW. When completed, the Pavagada solar park in southern India should grow from the current 600 MW to 2,000 MW of capacity.

Supply chain consists of broad range of companies

The suppliers include operators, developers and manufacturers across the industrial and utility sectors. This characteristic of the market makes it particularly interesting for investment because it generates value in downstream and upstream manufacturing.

Fig. 13: Global electricity production from onshore wind (in TWh, 2010–2025 proj.)

Total generated electricity from onshore wind is expected to increase

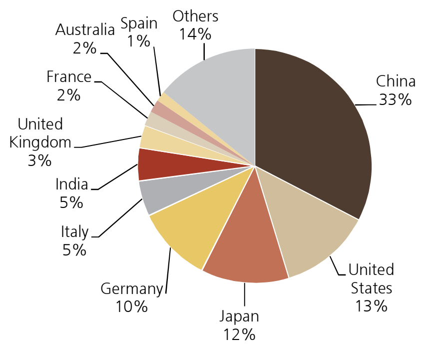


Source:© The International Renewable Agency (IRENA) , UBS forecasts
Note: Our forecasts are based on annual additions of 60 GW and average load factors of 24% in 2020, respectively 25% in 2025.

Source: iStock

Fig. 14: Country share of global capacity in solar PV power (in %)

China and the US represent 46% of global solar PV capacities



Source: REN21, < 2018 >, < Renewables 2018 Global Status Report > (Paris: REN21 Secretariat), UBS, as of 2018

The supply chain mainly consists of the following segments: glass, silicon, crystalline silicon modules (wafers, solar cells, modules), distribution, inverter, installation. In Asia the markets along the supply chain are characterized by a large number of small and mid-cap companies, facilitated by **low barriers** to new entrants. This also ratchets up competition.

Declining costs and oversupply increase competitiveness
The solar industry focuses primarily on soft costs by optimizing and improving equipment, using robotic technologies and boosting the efficiency of modules. These ongoing developments, along with the general attractiveness of the renewable/solar power market, have motivated a growing number of small and mid-cap companies to enter it along the solar supply chain. This has led to marked oversupply.

Because of **production oversupply**, costs declined by 80-90% across the polysilicon supply chain alone between 2000 and 2017. A return to significantly higher prices is not expected currently. Wafer and cell market prices too are under pressure due to oversupply, which is good for demand growth but bad for manufacturers (see Box 3).

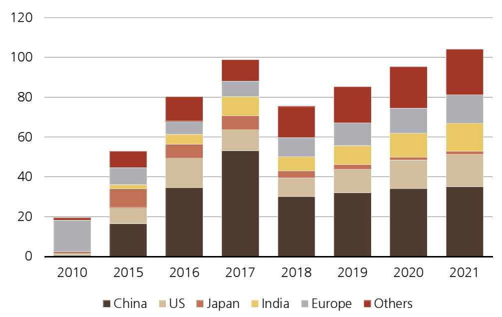
Large companies are likely to fare moderately well in this environment because of improved factory utilization, brand strengths and low cost structures. Small and mid-cap companies meanwhile may continue to suffer because of significant inabilities to fund capacity improvements or grow scale. A **continued consolidation process** across the supply chain is expected. Nevertheless, some governments recently have started to intervene against cost-dumping. India initiated an anti-dumping investigation against the importation of solar cells and modules from China and Malaysia. The US has also implemented import tariffs on solar panels (see annex).

While equipment costs for solar power should continue to decline, panel efficiency will likely rise further. When all costs are included, solar is already the cheapest way of producing electricity besides wind in Europe. Once installed, a solar plant runs at near-zero marginal cost for generating electricity. The annual operations and maintenance expense is around 1% of capital costs and consists of inverter replacement, panel cleaning and performance monitoring.

2c. Hydro – relevance varies by country

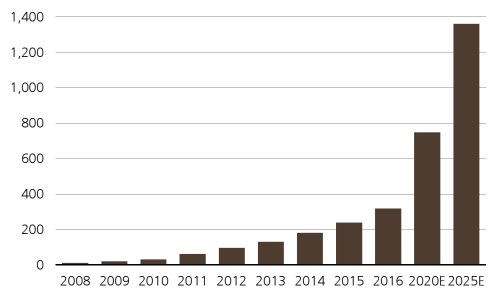
More than 15% of global electricity generation today is provided by hydropower. But its place in the electricity production mix varies by country due to geographical restrictions and its relative high capital intensity compared to solar or wind energy.

Fig. 15: Annual new installations in solar (in GW, 2010–2021 proj.)
Annual global installations of solar are expected to exceed 100 GW in 2021



Source: Goldman Sachs Global Investment Research (GS), UBS

Fig. 16: Global electricity production from solar PV (in TWh, 2010–2025 proj.)
Total generated electricity from solar PV is forecast to increase



Source: © The International Renewable Energy Agency (IRENA) 2018, UBS forecasts
Note: Our forecasts are based on annual additions of 75 GW until 2020 (after 2020 85 GW) and average loading factors of 14% in 2020, respectively 15% in 2025.

Box 3: Solar-related terms

- **Panel**: A photovoltaic module consisting of a number of solar cells.
- **Wafer**: A thin slice of semiconductor material used to fabricate wafer-based solar cells.
- **Inverter**: Converts direct current (DC) power produced by solar panels into usable alternating current (AC) power.
- **Tracker**: Advanced technology for solar panels tracking the sun. Produces higher electricity output than stationary counterpart due to increased direct sun exposure, though is more expensive.

Hydropower production varies across regions

Hydropower plants convert kinetic energy from a natural source (water) into mechanical energy by using turbines and then into electricity.

There are four general types of hydropower plants:

- An **impoundment facility** stores water in a reservoir. When released it generates electricity through turbines. In Switzerland this type of hydropower plant is in wide use.
- A **run-of-the-river hydro plant** uses the natural flow and elevation drop of a river to generate electricity.
- A **wave or marine power plant** is a special type of run-of-the-river hydro plant since it uses the energy of oceans (waves or tides) to generate electricity.
- A **pumped-storage plant** uses electricity (typically at times of low demand) to pump water uphill to an upper reservoir, so it can be used to generate electricity when demand is higher. It does not generate new power since it only stores electricity.

In 2017 global hydropower capacity additions were estimated by REN21 at 23 GW, while total hydro capacity reached 1,100 GW. This growth came largely from China (+7.3 GW) and Brazil (+3.4 GW). Overall, 28% of global capacity is provided by China, followed by 9% by Brazil while the US and Canada each contribute 7% (see Fig. 17). Additionally, the global pumped storage capacity reached around 150 GW.

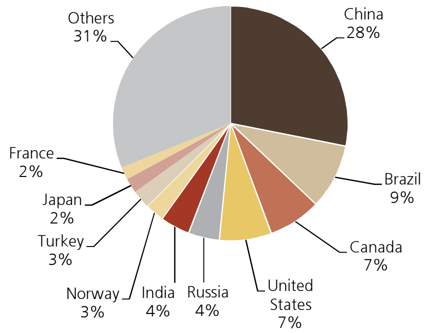
The electricity generated from hydropower worldwide was around 4,100 TWh in 2017. This corresponds to 15% of total electricity generation, a figure anticipated to reach 17% by 2030. Since 1973 hydro in Asia and South America has markedly increased with respect to regional shares of hydropower production (see Fig. 18).

Due to the geographical restrictions and the relatively high capital intensity (especially compared to solar and wind power), hydro will remain a regionally specific alternative. Switzerland has generated the majority of its electricity from hydropower for many years. In Brazil too, hydropower, at about three-quarters of the total, is an important pillar of electricity generation. In other countries it will remain more of a niche alternative.

The Three Gorges Dam in China, with an installed capacity of about 20 GW, and the Itaipú Dam in Brazil, with a capacity of 14 GW, rank among the largest hydro power plants worldwide. Both dams produce about 100 TWh of electricity.

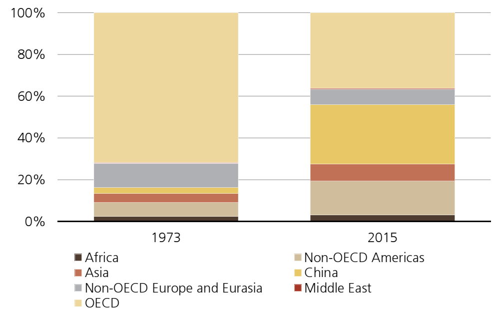
Source: iStock

Fig. 17: Country share of global capacity in hydro power (in %)
China and Brazil represent 37% of the global capacities in hydropower



Source: REN21, < 2018 >, < Renewables 2018 Global Status Report > (Paris: REN21 Secretariat), UBS

Fig. 18: Regional share of hydro production (in %, 1973 vs. 2015)
Asia's share has increased by more than 29 percentage points since 1973 mainly due to Chinese growth



Source: © OECD/IEA 2017, Key world energy statistics 2017, IEA Publishing; as modified by UBS. Licence: www.iea.org/t&c

2d. Energy storage – the key to renewables

Energy storage is vital to advancing renewable energy generation. Efficient technologies are able to reduce electricity costs to smooth volatilities in electricity supply, and to improve power quality. Because of supportive policy shifts and new applications, the share of electrical energy storage relative to global battery demand is expected to increase its share.

Source: iStock

Energy storage is closely linked to renewable energy generation

The output of renewable energy generation, especially for wind and solar PV, is characterized by relatively high volatility and uncertainty, which makes energy storage (see also pumped-storage plants) an important topic. Within this framework, electrical energy storage fulfills three main roles regarding renewable energy generation: First, it reduces costs by storing electricity obtained at off-peak periods, when its price is lower, for use at peak times, when its price is relatively high because of greater demand. Second, it can supply consumers with electricity should power network failures occur. And third, it improves power quality, frequency and voltage.

Electrical energy storage systems can be classified into:

- **Mechanical systems**, with pumped hydroelectric power plants and flywheel energy storage as the most common technologies.
- **Electrochemical and pure chemical systems**, mainly content batteries like lithium-ion cells and hydrogen or synthetic natural gas storage applications.
- **Electrical and thermal systems**, which involve technologies like double-layer capacitors or magnetic energy storage.

The growing market for electrical vehicles is positively correlated with energy storage, which benefits from the technological progress made in batteries for electric cars. Meanwhile the market for batteries has been primarily influenced since 2010 by significant reductions in cell costs, which, for lithium-ion cells, plummeted from USD 900/kWh in 2010 to USD 140 in 2018. A further large reduction is likely in the coming years. Another efficient solution to the storage issue in the context of renewables could be power-to-gas technology, which transforms renewable electricity into gas for direct use or for feeding into natural gas infrastructure.

3. Potential risks for renewable energies

Despite the current political support, renewable energies face risks. Rising commodity prices, the increasing attractiveness of nuclear power and/or greater competitive pressure could prove unfavorable. Unproven cost forecasts for new technologies or climate change could also slow the current renewables boom.

Market risks
Even if renewable technologies become more efficient, they are untested over long operational lifetimes. Returns for new projects would fall if operating and maintenance costs are higher than forecast or production levels lower than expected. In addition, an increase in popularity of non-renewable technologies (e.g. nuclear) could have negative impacts.

Commodity prices (for coal, gas, etc.) influence wholesale power prices in liberalized markets. The profitability of non-renewable power can thereby affect investment in renewables, for instance if fossil-fueled power plants generate higher returns.

Trading barriers could also worsen the cost structure and cost advantage of renewable energy production, as seen when the US levied import tariffs on solar panels. Other, less-expensive, fuels would be supported by markets and further improved in terms of efficiency and effectiveness.

In the wind market the consolidation process is almost complete. By contrast the **market competition** within the solar supply chain is still increasing, due mainly to production overcapacity. A rising number of new market entrants could trigger ruinous competition. Consequently, many (especially solar) companies could fall by the wayside due to bankruptcy or acquisitions.

Political risks
In many developed markets the advantage of renewable over fossil fuels has already shifted from purely political to economic. Nevertheless, renewables are not yet totally independent of politics. If governments were broadly to **support other technologies** through favorable regulatory frameworks, the competitive pressure on renewables would rise. The resulting unattractiveness would dry up capital flow. Existing operators, manufacturers and developers might decide to shift their focus toward these other technologies. Start-ups would not be able to raise sufficient funds for further research on renewables.

Other risks
Climate change itself could have an impact on renewables. Hydropower generation could decline due to less water in some regions. Changes in average wind speeds could reduce production levels, while increasing extreme wind speeds could influence the loads of turbines and, hence, their cost structure.

4. Link to impact investing and UN SDGs

Investing in renewable energies contributes to many of the UN Sustainable Development Goals (SDGs). Renewables reduce carbon emissions and permit future generations to rely on a stable energy infrastructure to further develop socially and economically. In addition to improving **access to affordable and clean energy (Goal 7)** and **combating climate change (Goal 13)**, investing in renewables can contribute directly to **ending poverty (Goal 1)**, **ensure healthy lives (Goal 3)** and improve **access to inclusive and equitable quality education (Goal 4), among others.**

In particular, investors can contribute to the sustainable development agenda by investing in the following:

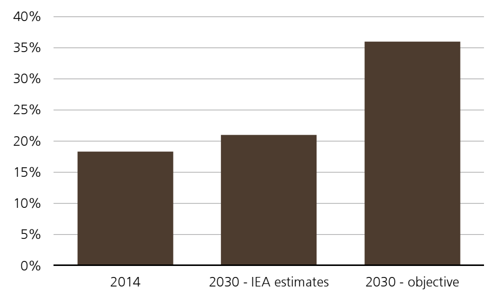
- Sustainable infrastructure which helps achieve the Paris Accord goals: the IEA's 450 Scenario is consistent with a 50% chance of keeping global warming below 2°C. In this scenario, 60% of electricity comes from renewables by 2040 and 50% of renewable power is generated by wind and solar.
- In addition to investing directly in renewable energy infrastructure, investors can support the adaptation of renewable energies through investments in innovation and support infrastructure.
- By investing in off-grid and micro-grid energy solutions, impact investors can play a key role in improving access to energy in remote communities. Likewise, pico-solar, such as solar lanterns and homes systems, have proven an increasingly popular theme for impact investors.

Investing in renewable energy and support infrastructure will be vital for combating climate change. By focusing on countries where access to energy is a persistent challenge, impact investors can also contribute to inclusive, sustainable economic growth. Increasing global renewable energy capacity (see Fig. 19) is both a necessity and an attractive investment opportunity, making it one of the most popular themes for impact investors. In addition, investors may access this theme through generalist renewable energy funds or via direct investments. As always, when investing using non-impact-specific vehicles, impact investors must assess on their own whether individual investments meet their impact criteria, including intent, measurability and verification.

James Gifford, Head of Impact Investing

Fig. 19: Renewable energy share in total electricity generation

Share of renewable energy in total electricity generation is forecast to reach 21% by 2030

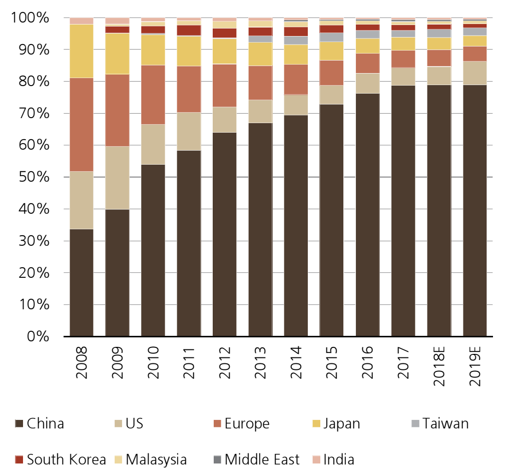


Source: The World Bank 2017, Global Tracking Framework, Progress toward Sustainable Energy (based on IEA data), 2017; UBS

5. What has happened to renewables stocks

The **PV industry** has changed from a sellers' to a buyers' market. Today, most production is from Asia (see Fig. 20). PV production is less engineering intensive than wind turbine manufacture. It is highly automated and its products can easily be shipped across the world at low cost. Mass PV production grants Chinese manufacturers one important advantage over their peers: economies of scale. An additional plus in recent years has been access to financing. In sum, the industry faces a supply/demand problem with virtually no possibility of differentiating between products, which consequently has resulted in huge price declines. Virtually no solar stock has escaped the general pullback in share prices. This picture has improved slightly due to market consolidation, but **investors still have to be very selective**, and timing is also important in this segment of the solar value chain.

Fig. 20: Nominal PV module manufacturing capacity, regional split
Chinese dominate the PV module production



Source: Goldman Sachs Global Investment Research (GS), UBS

The **wind industry** endured a tough period after the global financial crisis, but for different reasons, and most listed companies survived. A lack of project financing in developed markets, lower subsidies and fierce competition led to weak performance until 2012. In contrast to PV equipment, wind turbines are engineering products, and wind manufacturer companies' future revenue streams are highly dependent on turbine efficiency and availability. Chinese manufacturers haven't managed yet to establish a major presence outside of their domestic market as mastering developed-market technology and ensuring reliability appear are much tougher hurdles than in the PV sector. Another advantage developed-market wind manufacturer companies have over their PV counterparts stems from the maintenance and repair aspect of the business, from which manufacturers can generate additional (high-margin) revenue.

Renewable developers have increased investment spending in the past years with returns also growing strongly. The focus of large utility developers like NextEra Energy, Iberdrola and EDP has been on onshore wind. More recently, offshore wind has grown steadily, especially in Europe, with Danish utility Orsted becoming the largest offshore wind developer in terms of capacity. Pricing has moved from regulated tariffs to auctioning, which reduces the need for subsidies, but puts pressure on profit margins. However, wind energy developers tend to react to tariff pressure by demanding better contracts for wind turbines from manufacturers. In the coming years, renewable developers should continue to invest heavily in onshore and offshore wind projects. Spending on solar projects should also increase, thanks to the sharp decline in costs.

6. Investment conclusion

Energy is a basic human need, and electricity is a modern necessity. To meet our increasing energy demands (see Fig. 21) and to limit CO_2 emissions (see our LTI theme "Clean air and carbon reduction"), the relevance of renewable energy as an efficient, cost-effective alternative to fossil fuels has increased enormously in recent years.

The renewable energy market comprises a broad range of **operators**, **developers** and **manufacturers** from various industries, in particular the industrial, energy, information technology and utility sectors. According to market specialists, the **renewables market** is expected to expand by more than USD 9trn from today to 2050, which represents 80% of the entire share of investments in power generating capacity during this period (see Fig. 22). We expect major investment in solar, but also to be significant in wind, gas and hydropower. Cumulative investment in renewables is forecast to exceed USD 9trn by 2050 (see Fig. 23).

From today's market perspective, we see the greatest potential in certain **project developers from the utility sector** and **wind turbine manufacturers.**

We recommend investing in this theme because the transition from feed-in tariffs to auctions is further reducing costs for wind and solar, which makes them cost competitive now. Given the current development we expect the renewables industry to grow at an attractive pace over the next two decades. The shift from a mainly politically supported industry toward a **cost-supported** one should prove a plus. The higher penetration of **electrical vehicles** and the related increase in energy storage/capacity should solve one of today's most relevant issues for renewable energy.

Nevertheless, this theme has to be actively managed because of the competitive dynamics within the global political and economic framework. The stiff competition in solar caused by the **oversupply in production**, in particular, will likely make many near-term adjustments in this segment necessary. These potential risks necessitate that investors **be highly selective, especially with regard to small and mid-cap companies within industries and regions.**

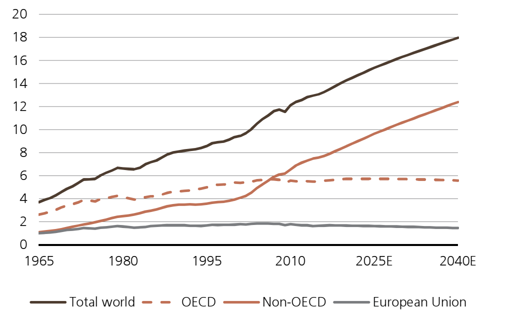
Annex: Regional politics, regulatory frameworks and economic development

In Europe at the moment renewable energies are broadly supported by national and supranational regulatory frameworks. In Asia there is wide divergence in terms of the economics and politics of renewables. Their deployment is limited in Southeast Asia by attractive economics for coal-fired power plants, while China and India offer opportunities for alternative power fuels. The Americas have a similarly divergent picture.

Renewable energy in Europe

Europe has converged greatly in terms of relative renewable/fossil economics, regulatory overlay and utility competitive positioning with respect to affordable renewable energy. The expansion of **Germany's** renewable energy industry is a central pillar in the EU's targeted energy transition. According to the Federal Ministry for Economic Affairs and

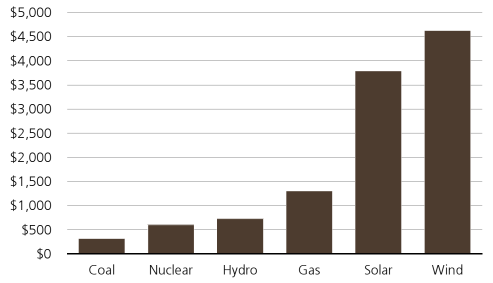
Fig. 21: Primary energy consumption (in billion tons oil equivalent, 1965–2040 proj.)



Source: BP, UBS
Note: Forecast is based on non-annual data; i.e. BP provides forecasts for 2020, 2025, 2030, 2035 and 2040 (intermediate values are linearly interpolated by UBS).

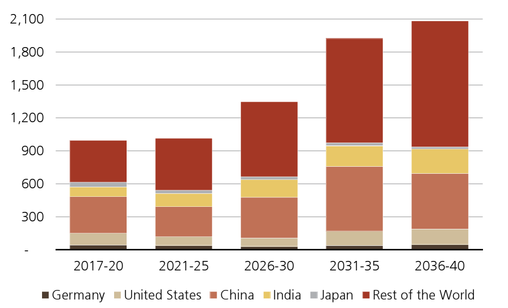
Fig. 22: Global investment in power generating capacity by technology (in billion USD, 2017 real)

Renewables is expected to make up about 80% of 2018-2050 investments in power generating capacity



Source: Citi, Bloomberg New Energy Finance (BNEF), UBS

Fig. 23: Cumulative global new investments in renewables power supply in 5 year blocks (in billion USD, 2016 real)



Source: Citi, Bloomberg New Energy Finance (BNEF), UBS
Note: Flexible capacity not part of investments.

Energy, 40%-45% and 55%-60% of electricity consumed in Germany should derive from renewables by 2025 and 2035, respectively. The country has a special focus on solar, wind and biomass power. In **France**, too, renewable energies are becoming increasingly important, especially relative to nuclear power. France has a target to reduce the share of nuclear power in the electricity mix to 50% from 75% currently.

In **Italy** and **Spain** the situation varies: while Italy has followed a renewable-friendly policy for many years, the Spanish government just returned to a clean energy policy after a four-year moratorium ended in 2016. The **UK** became an industrial powerhouse thanks in large part to fossil fuels (especially coal). But the British government has decided to close all coal plants by 2025 and focus on renewables. The potential upcoming ban of non-electric vehicles from UK roads by 2040 strengthens the government's efforts to promote a clean energy supply.

In non-EU countries there is also a special focus on renewable energies. **Nordic** countries have historically been leaders in energy transition for many years (especially through hydropower). They already rely on renewable energies to the tune of about two-thirds of their total electricity consumption for some time. In **Austria** the use of nuclear power was rejected by a national referendum in the mid-1970s. At more than 55% of the national installed power generating capacity, hydro has been the most important energy source for years, and upwards of 72% of Austria's electricity came from renewables in 2016.

Because of its lack of fossil fuels, **Switzerland** has long relied on renewable energies, especially hydropower, in its electricity generation mix. Currently hydropower makes up roughly 60% of the power generation mix. In total, renewables should generate close to 90% of Swiss electricity by 2050.

To expand these national trends to the whole of Europe, the "Renewable Energy Road Map" was created by the European Commission in 2007. It calls for a mandatory target of at least a 20% share of the EU's final energy consumption to be provided by renewables by 2020. To achieve this objective the **Directive on Renewable Energy** (RES) was adopted two years later. It also requires individual, national targets (see Table 1) and action plans regarding the gross final consumption share of renewable energy. These individual, national targets range from 10% in Malta to 72% in Iceland. Some countries had already reached their targets by 2015. Additionally, at least 10% of transport fuels used in EU countries must come from renewable sources by 2020. And beyond then renewables will play a key role in helping the EU meet its energy needs. Member countries have already agreed on a new renewable energy target of at least 27% of final energy consumption by 2030. At the end of 2016

I think we can say our energy system will be the most efficient and environmentally friendly in the world.
(Angela Merkel, Germany)

Table 1: National targets and figures achieved for share of energy from renewables in gross final energy consumption 2020 in Europe

Country	2005	2010	2015	2020
Iceland	60%	70%	70%	72%
Norway	60%	61%	69%	68%
Sweden	41%	47%	54%	49%
Latvia	32%	30%	38%	40%
Finland	29%	32%	39%	38%
Austria	24%	30%	33%	34%
Portugal	20%	24%	28%	31%
Denmark	16%	22%	31%	30%
Estonia	18%	25%	29%	25%
Slovenia	16%	20%	22%	25%
Romania	17%	23%	25%	24%
France	10%	13%	15%	23%
Lithuania	17%	20%	26%	23%
Croatia	24%	25%	29%	20%
Spain	9%	14%	16%	20%
Germany	7%	11%	15%	18%
Greece	7%	10%	15%	18%
Italy	8%	13%	18%	17%
Bulgaria	9%	14%	18%	16%
Ireland	3%	6%	9%	16%
Poland	7%	9%	12%	15%
United Kingdom	1%	4%	8%	15%
Netherlands	3%	4%	6%	14%
Slovakia	6%	9%	13%	14%
Belgium	2%	6%	8%	13%
Cyprus	3%	6%	9%	13%
Czech Republic	7%	11%	15%	13%
Hungary	5%	13%	15%	13%
Luxembourg	1%	3%	5%	11%
Malta	0%	1%	5%	10%

Source: European Environment Agency (EAA), UBS

Notes: The values prior to 2005 represent the effective share of energy from renewable sources in gross final consumption of energy; many countries have reached national targets already today. Figures in the table are rounded.

the Commission published a proposal for a **Revised Renewable Energy Directive** to make the EU a global leader in renewable energy.

However, even if European politics continues to play a key role for renewables, the true drivers of market growth will remain technological progress in advancing the efficiency of wind turbines and solar panels and the global decline in costs for producing components and installing new power plants.

Carsten Schlufter, Analyst

Renewable energy in Asia

The region diverges widely in terms of relative renewable/fossil economics, regulatory overlay and utility competitive positioning, all of which affect the growth of affordable renewable energy. China and India are the focus, not only due to the size of their economies but because 60%-70% of both countries' electricity is currently generated by coal-fired plants. CO2 emissions in China and India combined accounted for more than one-third of the global total in 2015. The countries' fast economic growth in recent decades comes at a price. A more sustainable growth model requires that they fundamentally transform their energy market and focus on renewables.

China benefits from rapid technological improvement and the cost declines of renewables, mainly through locally produced equipment. The country has now the world’s largest installation of wind and solar power facilities. China more than doubled its solar and wind power capacity between 2013 and 2016, and its wind and solar capacity combined could continue to grow to around 320 GW (210 GW wind and 110 GW solar) by 2020 under the government's plans. Renewable investments in the country still require subsidies before grid parity (i.e. demand and supply equalize) arrives, which is likely by 2020. However, the government is effectively reducing these subsidies by changing the feed-in-tariff-based subsidy into the green certificate mechanism because the country's Renewable Energy Fund is running a large deficit. The voluntary green certificate program began on 1 July 2017, while the timing of the compulsory green certificate has yet to be announced.

India recently reached an inflection point. Solar power has become the cheapest way to generate electricity for the first time in 2017. From spring 2014 to spring 2017, solar power capacity in India quadrupled to 12 GW, and the government is targeting an additional 115 GW of wind and solar by 2022. India will remain among the fastest-growing solar markets in the world through 2020. On the other hand, there are around 50 GW of coal-fired power plants under construction, implying a dependence on fossil-based generation that is not likely to be phased out as rapidly as in other parts of the world. India's current power infrastructure is still incapable of providing

Our task is tough, and our time is limited. Party organizations and governments at all levels must give priority to emission reduction and bring the idea deep into people's hearts.
(Hu Jintao, China)

sufficient reliable electricity for its fast-growing economy.

In **Southeast Asia** we do not see significant disruption from renewables occurring. Very long-term contracts tied to the output from fossil fuel power plants in the region exist, and the deployment of renewables is limited given the attractive economics for coal-fired generation and cheaper gas prices that stem partly from government subsidies.

The picture for renewable energy equipment manufacturers in Asia has been complicated by some US solar panel makers filing a petition to the US's International Trade Commission (ITC) in May 2017. The US Trade Representative subsequently decided to impose 30% tariffs on imported solar panels, which mostly come from China, in January 2018.

Hyde Chen, *analyst*

Renewable energy in the Americas

Renewable energy continues to grow in the Americas driven by declining costs of equipment, particularly for wind and solar power. While renewable energy policies diverge widely across the North and South American continents, the continued improvement of the economics of solar and wind power along with generally supportive government policies are driving increased adoption of the technology. This is particularly impressive in the US, given the low price of natural gas and the absence of additional Federal subsidies.

In the Americas, four countries account for almost 90% of the electricity generated on the two continents: the US, Canada, Brazil and Mexico, with the US representing about 65% of the total. The same four countries account for about 90% of the region's carbon emissions as well. We define renewable energy to include wind and solar power, along with hydroelectric and biomass resources (wood waste, sugarcane waste, etc.). Hydroelectric power is one of the oldest categories of renewable power, and hence remains one of the largest. **Canada** and **Brazil** are the largest hydroelectric generators in the world behind China. However, hydropower represents a significantly higher percentage of total electricity generation in Brazil (66%) and Canada (58%) than in China (19%). Brazil also has a significant amount of renewable biopower through its use of sugarcane waste and non-food energy crops (eucalyptus, etc.). Renewables including hydro made up 81% of total electricity production in Brazil in 2017, and 66% in Canada, with solar and wind constituting 6% in both countries.

In the **US,** solar and wind generation has grown notably over the last five years. The US used renewables (including hydro) to

To truly transform our economy, protect our security, and save our planet from the ravages of climate change, we need to ultimately make clean, renewable energy the profitable kind of energy.

(Barack Obama, USA)

generate about 17% of electricity in 2017, up from 12% in 2012. The growth is notable since total US electricity production is down slightly over the same five-year period as a result of energy efficiency. US nuclear power provided 20% of power production in 2017. The remaining 62% is generated using coal (30%) and natural gas-fired (32%) power plants. Hydropower is the largest renewable resource in the US. However, wind power is poised to overtake hydroelectric as the largest single renewable resource in the US by 2020.

Although Federal policies in the US limiting power plant emissions have been eased by the Trump administration, the low price of natural gas has continued to reduce the amount of coal-fired power generation. Electricity generation utilizing coal as a fuel source decreased significantly from 45% in 2010 to 30% in 2017. With ample supplies of low-cost natural gas and economic renewable resources, these cleaner resources are likely to continue to dominate the US power sector looking forward.

The US encourages installation of new wind and solar generating capacity through federal tax credits. The wind tax credits extend through 2019, while solar tax credits extend through 2022. We do not expect any additional Federal programs to be adopted to encourage installation of more renewable energy in the US. However, some state and local governments continue to encourage the expansion of renewables. Seven states in the US have adopted renewable energy portfolio standards mandating at least 50% of power from renewable resources by a certain date in the future (generally 2030 and beyond). These seven states – California, Hawaii, Maine, New Jersey, New York, Oregon and Vermont – account for about 15% of total electricity consumption in the US.

Despite expiring renewable energy tax credits in the US over the next few years, continued equipment price reductions are likely to lead to additional solar and wind project development after the expiration of the tax credits. According to NextEra Energy, one of the largest renewable developers in the US, the estimated costs of electricity excluding tax credits in 2020 from new wind facilities should be USD 20-25 per megawatt hour (MWh), while new solar facilities should generate electricity at USD 30-40 per MWh. This compares with new natural gas-fired power generation of USD 30-40 per MWh. Coupling a four-hour battery back-up system with the solar or wind project could add USD 10 per MWh to the price, but make the resource more competitive with a dispatchable resource like natural gas. This confirms our belief that natural gas and renewable resources are likely to continue to dominate the US power sector looking forward.

Turning to **Canada**, in late 2016, the Canadian government adopted a framework to implement a price for carbon emissions in the country beginning in 2018. The law applies to all provinces that do not already have a carbon tax regime in place. Quebec and British Columbia adopted a carbon tax in 2007 and 2008, while Alberta followed in 2016. That leaves the Canadian provinces of Ontario, New Brunswick, Manitoba and Saskatchewan facing carbon tax mandates from the Federal government. Canadian Prime Minister Trudeau has promised to implement the carbon taxes in the holdout provinces, setting up a key issue in the late 2019 federal election cycle. Despite a significant amount of hydroelectric generation, the carbon pricing framework is expected to encourage the continued growth of renewable energy resources in Canada, whose climate supports wind generation more than solar generation. The continued decline in installed costs of both solar and wind technologies should also boost their growth over the next decade. Since 2010 in Canada, renewables, primarily wind generation resources, have quadrupled as a percentage of total generation. With the cost of wind power declining, with or without a carbon tax, we believe additional renewable energy expansion in Canada appears likely.

Brazil has targeted expansion of non-hydro renewable power generation resources for several years given the drought cycle that negatively impacts the price of power in low water years. This follows the country's innovative use of sugarcane ethanol since the 1980s and 1990s. The legal framework for the renewable energy mandates for electricity production were adopted in the Electricity Law of 2004, which mandates an auction process for renewable resource development and specifies minimum targets for renewable energy in the country. Recently elected President Jair Bolsonaro appears likely to advance reforms in the electricity sector that would encourage more competition, and promote renewable energy resources like solar and wind. We expect this to continue the development of additional renewable energy resources in Brazil over the next five years.

In **Mexico**, the General Climate Change Law adopted in 2014 mandates targets for renewable energy additions over the next several decades. The Mexican law targets electricity production from renewable or clean energy sources of 35% by 2024, 40% by 2035 and 50% by 2050. These targets include nuclear power as a clean energy source. In 2017, clean energy resources including nuclear totaled about 24% of total electricity production. Hydro and nuclear power represent about 15% of electricity generation in Mexico. Mexico generated about 4% of electricity from solar and wind resources, which is included in the 24% figure cited above. We expect solar and wind resources to grow rapidly in Mexico and support the expansion of clean energy resources as mandated by the General Climate Change Law. A recent study by the Mexican Business Coordination Council suggested that the addition of more solar and wind resources in Mexico could reduce the average price of electricity and improve the country's competitiveness. According to the study, in Mexico, the installed price for wind power is in a range of USD 19-67 per MWh, while solar power is USD 18-66 per MWh. This compares with USD 42-78 for combined-cycle natural gas powered facilities. These economics suggest an advantage for solar and wind power in Mexico, which should support ongoing expansion of renewable energy in Mexico over the next 5 to 10 years. Although the new Mexican President Obrador's desire to revitalize the oil and gas industry in the country could have some impact on renewable growth, the improving economics of solar and wind energy are likely to propel renewable energy growth in Mexico, similar to the dynamics across the border, in the US.

James Dobson*, MLP and Utilities Equity Sector Strategist Americas*

Appendix

Terms and Abbreviations

Term / Abbreviation	Description / Definition	Term / Abbreviation	Description / Definition
A	actual i.e. 2010A	COM	Common shares
E	expected i.e. 2011E	Shares o/s	Shares outstanding
UP	Underperform: The stock is expected to underperform the sector benchmark	CIO	UBS WM Chief Investment Office