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Renewables

The real energy revolution in the US

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20 June 2019

Ask anyone about the US energy revolution and people will talk about the country's rise to the biggest oil producer in the world. But behind the scenes, a green revolution is taking shape with solar PV and wind energy already amongst the cheapest sources of electricity in most parts of the US. With more and more states and municipalities reacting to the current Federal administration's withdrawal from the Paris Climate Accord by committing themselves to ambitious climate change goals, renewable energy is one of the most attractive investment areas in the country. Whether it is stable income from solar PV and onshore wind farms or more growth-oriented investments in batteries and electricity storage, we think renewables have a bright future in the US.

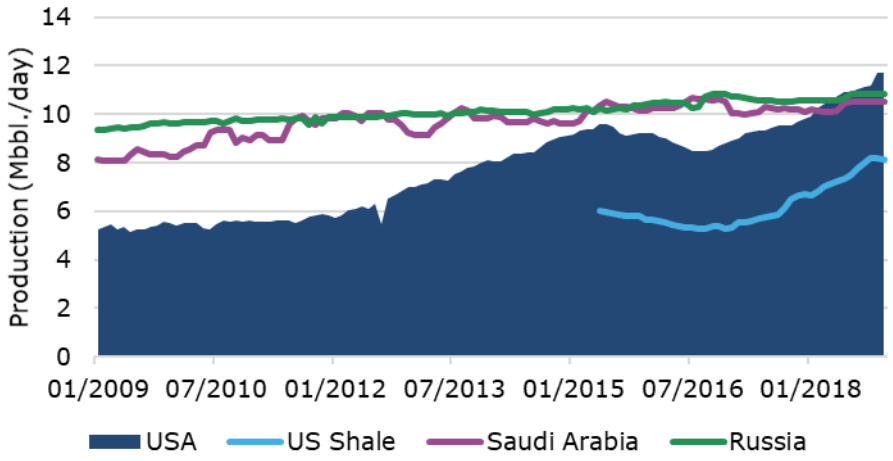
The energy revolution everybody talks about

For many, President Trump boosting oil and coal was tantamount to the end of Dr Strangelove, when the bomber captain goes hurtling towards planetary oblivion sitting astride a humungous nuke. At the very minimum, it seemed a case of filing renewables in the US under "forget for the next four years". But despite Trump's Thermidorian reaction, the renewables revolution continues unabated. Or, at least, little abated. Certainly, there's still much to excite investors in this still-dynamic sector.

Google the term "US energy revolution" and you get a plethora of results on how the US has become the largest oil producer in the world, which seem to confirm initial impressions.

With the development of shale oil and shale gas as a source of energy, the US has overtaken Russia and Saudi Arabia in 2018 to be the largest oil producer – indeed the largest energy producer – in the world (see Fig. 1). At the end of 2018, the US become a net oil exporter for the first time in 75 years.[1]

Fig 1: The US has become the world's largest oil producer



Source: Bloomberg, Fidante Partners.

[1] https://www.bloomberg.com/news/articles/2018-12-06/u-s-becomes-a-net-oil-exporter-for-the-first-time-in-75-years

This is at the expense of OPEC and Russia, the influence of which is declining. According to the St. Louis Fed, "while OPEC members represent a large portion of oil production, a number of other countries – including the US – account for 58% of the oil production and are not part of the OPEC agreement to reduce production."[2] Effectively, OPEC lost its war against the US's shale producers in the mid-point of this decade, after trying to force them out through playing beggar-thy-neighbour. Although many US shale companies did indeed go bust, others invested in technologies which allowed them to produce more oil with fewer rigs "bringing down their break-even oil price from over $80 per barrel in 2014 to $50-$60 per barrel at present".[3] Turns out the US oil industry has deep pockets and great engineers.

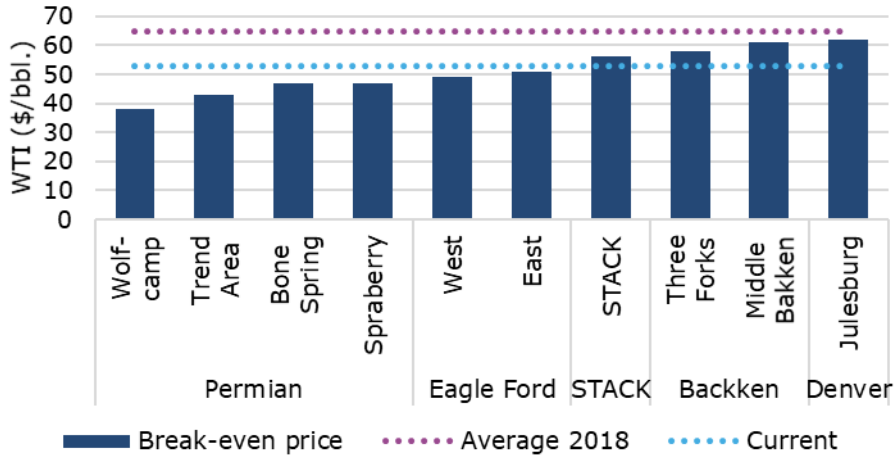
This victory is further reinforced by the current US administration's support for the production of fossil fuels, in order to ensure cheap energy supply and energy independence for the country.

All this seems to reinforce the headlines: Google got it right. But there's more going on than can be easily captured by an internet engine and a simple set of search parameters. After all, if there was, we would all be out of a job. This is why it is important to go beyond the headlines and the photo-ops of Mr Trump in a hard hat.

First, this energy revolution is highly vulnerable to lower oil prices because marginal production costs for shale oil in the US is typically around $50/bbl. (see Fig. 2). That wasn't a problem in 2018, when the average price for a barrel of crude oil was $65/bbl., and prices peaked in September just shy of $73/bbl. for WTI, but at current oil prices (about $55/bbl. for WTI), production in the STACK, Bakken and Denver-Julesburg shale oil fields has become a loss-maker. This means that energy producers in these regions will face losses or have to shut down existing rigs until prices are high enough for profitable extraction again.

Because these adjustment processes take about six to 18 months, from a supply perspective it is unlikely that oil prices will rise substantially in 2019. On the demand side, prices will likely further be dampened by a slowing global economy, giving us a negative outlook on oil prices for most of 2019.

Fig 2: Breakeven prices for US shale oil production



Source: Bloomberg, Fidante Partners.

[2] Is OPEC Losing Its Ability to Influence Oil Prices? https://www.stlouisfed.org/on-the-economy/2017/march/opec-losing-ability-influence-oil-prices

[3] https://www.forbes.com/sites/greatspeculations/2017/06/02/opecs-influence-on-oil-prices-waning/#1e082b264eb0

The real energy revolution in the US

Last December, the US Senate confirmed Bernard McNamee, fossil fuel advocate and climate sceptic, as head of the Federal Energy Regulatory Commission. In his previous position at the Department of Energy, he played a key role in supporting uneconomic coal and nuclear plants. That in itself would seem to signal the energy revolution has been thrown into reverse. Yet there is reason to believe that history will remember McNamee as a King Canute figure, if he is remembered at all.

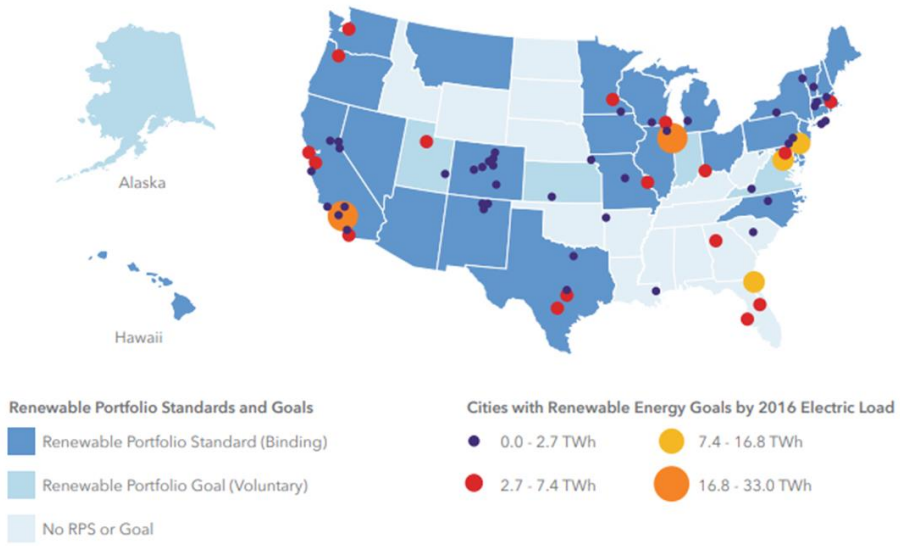
When it comes to the US' broader energy mix, the President's headline-grabbing love affair with traditional energy provision is running against the prevailing wind. According to Bloomberg New Energy Finance (NEF), the Trump administration's goal "of boosting the economics of existing nuclear and coal-fired power plants [has been opposed by] US power market operators, gas plant owners, and renewables proponents, among others".[4]

More importantly, what we're seeing is not simply passive opposition, but the further development of positive alternatives. The real energy revolution in the US has been underway for some time but has, paradoxically, been accelerated by the decision of President Trump to withdraw from the Paris Climate Accord.

Many states and municipalities in the US already had in place targets for renewable energy production at the local level (see Fig. 3). After the withdrawal from the Paris Climate Accord, more states and municipalities stepped up their efforts to foster a green energy revolution or accelerated the build-up of renewable energy (see California and Texas examples, below).

Additionally, private initiatives, such as 'America's Pledge' by former New York City mayor, Michael Bloomberg, and former Governor of California, Jerry Brown, try to accelerate the green revolution in order to achieve the Paris goals without federal assistance. By the end of 2018, 21 states, 142 cities and 1,361 corporations across the US had committed to climate pledges. These entities are together responsible for 43% of US greenhouse gas emissions – almost as much CO2 emission as India. According to America's Pledge, with these commitments the US is on track to achieve the goals it committed to without the help of the Federal government.[5]

Fig 3: Entities with clean energy targets in the US



Source: American Council for an Energy-Efficient Economy, LBNL, World Resources Institute.

[4] Bloomberg New Energy Outlook 2018.

[5] See https://www.latimes.com/opinion/op-ed/la-oe-brown-bloomberg-climate-summit-20180912-story.html

Two areas that will have an impact on the sector are the withdrawal of tax incentives and the implementation of tariffs: the latter negative; the former, paradoxically, will have a positive medium-term effect on supply.

Taxation

The phase out of federal tax incentives will drive growth across all market segments from 2019, and support 173GW of clean energy capacity additions over 2018-25,[6] as companies rush to get their developments through before the incentives disappear. These comprise:

The **Investment Tax Credit** (ITC), applicable to utility-scale, commercial, and leased residential PV systems. This is scheduled to step down from 30% to 26% in 2020, 22% in 2021, and 10% in 2022 and beyond. The personal credit follows the same path but expires in 2023.

The **Production Tax Credit** (PTC) for wind is already being phased out (otherwise known as the PTC stepdown). Projects "commencing construction" in 2018 receive 60% of the $23/MWh credit. The credit falls to 40% in 2019 and is eliminated for projects commissioning in 2020 or beyond.

Nevertheless, this phase out may not be a done deal. The Democrats taking control of the House of Representatives in January has "ignited rumours that the investment tax credit and production tax credit could be re-opened for extension (by proponents) or early termination (by opponents); while further modifications to the credits are always possible, a divided Congress makes it difficult for either side to prevail."[7]

There is a possibility that tax credits could be extended, perhaps as part of broader horse-trading on budget measures, as was the case in 2015, although the earliest this would likely occur is towards the end of this year. However, it must be emphasised that, while tax credits could be extended as part of such legislative barter, the positive investment case for renewables is not premised on hand-outs – a case we have previously made.

Tariffs

As in so many other areas, the ongoing trade war is more unambiguously negative for renewables. In September 2018, the US imposed tariffs on another $200bn of Chinese imports, with particular impacts on the PV industry. China hit back with tariffs of up to 10% on $60bn of US exports, including Lithium-ion batteries and PV inverters. As things stand, it is unlikely that these tariffs will be lifted anytime soon.

[6] 2H 2018 U.S. Renewable Energy Market Outlook, Bloomberg NEF.
[7] Ibid.

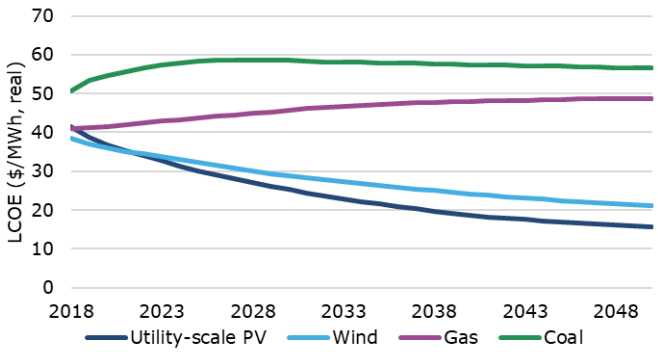
The force that drives the green age

Analysts estimate that renewables will supply 55% of US energy by 2050. This green energy revolution in the US is not driven by idealism, but by business interest and costs.

Powered on by constantly evolving technology, leading to ever-cheaper energy production, utility-scale PV and wind – the most prevalent renewables in the US – are already cheaper than building new large-scale coal and gas plants in US. Indeed, the tipping point (where renewable production becomes cheaper) for renewables versus *existing* gas power generation is predicted to happen in 2027.[8]

Last year, the levelised cost of electricity (LCOE)[9] for an **onshore windmill** was 6% cheaper than for natural gas and 24% cheaper than for coal, and these gaps will widen to gulfs over the coming years (see Fig. 4). **Utility-scale PV** plants produced energy at roughly the same price as modern gas power plants and at costs 18% below a coal powered plant. Utility PV sits on the cusp of a three-year accelerated growth spurt, as developers rush to beat the 2023 ITC deadline. Bloomberg NEF expects 72GW of capacity to be commissioned between 2018 and 2025 in this area.

Fig 4: Solar and wind are cheaper sources of energy



Source: Bloomberg NEF, Fidante Partners.

Offshore wind is gathering momentum, although has some catching up to do on its onshore sibling. The US could install 22GW offshore by 2030 with stable policies, according to the Department of Energy, although Bloomberg expects a more modest 11.4GW cumulative installation by then, with new capacity focused on the Northeast. One spoke in this wheel (or turbine) is that it is unclear who in the value chain will be responsible for building and funding transmission lines, as this is virgin territory. A further problem is the Jones Act, requiring that vessels transporting goods between US ports be owned by US firms, and operated by US crews. "Europe is the most seasoned offshore market and developers would prefer to use foreign vessels, because currently there is no US vessel capable of installing offshore turbines," reckons Bloomberg NEF.[10] Until issues such as this are resolved, onshore still has the advantage. And, as we've previously noted, while offshore costs are coming down more quickly than other renewables, offshore will still be more expensive than onshore well into the next decade, and the gap opens once again towards 2040, as cost efficiencies level off for offshore while increasing for onshore.

Onsite commercial and institutional PV growth is expected to pick up this year, after a dip last year on the back of breakneck growth the preceding period.[11]

Key developments are best illustrated by looking at how this is playing out in two pivotal states – and ones with very different political leaderships: California and Texas.

[8] Data in this section is from Bloomberg New Energy Outlook 2018, unless otherwise stated.
[9] The net present value of the unit-cost of electricity over the lifetime of a generating asset.
[10] 2H 2018 U.S. Renewable Energy Market Outlook, Bloomberg NEF.
[11] Ibid.

Case study 1: California über alles

California has been a long-time driver of environmental protection within the US. The state legislature has recently introduced several laws to boost clean energy production; the most important being SB100, which mandates that by 2026 the state produces 50% of its electricity from renewable sources, 60% by 2030, and a target of 100% carbon-free electricity by 2045.[12] The state's utilities have exceeded previous targets, which is why they keep getting raised. Most have already met their 2020 targets.

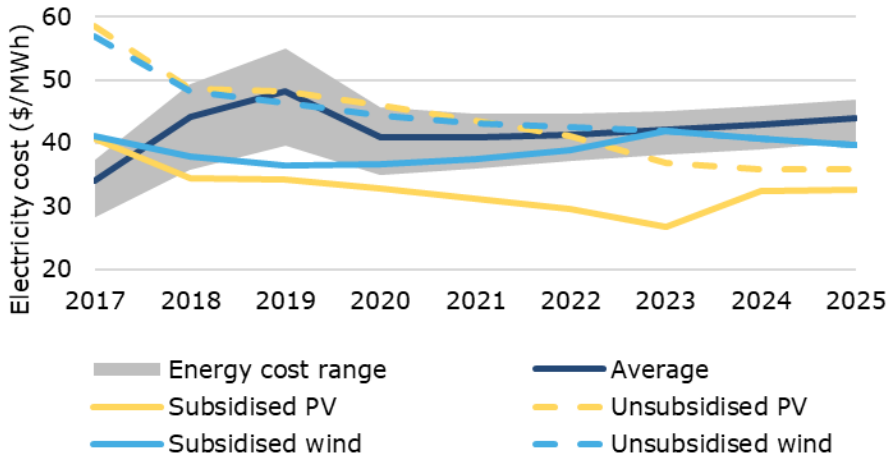
> I am Governor Jerry Brown, my aura smiles and never frowns. Soon, I will be President.
> *Dead Kennedys, California Über Alles (1978).*

State guaranteed subsidies for wind and solar are protected until at least 2023. While utility-scale solar PV and onshore wind are already the cheapest energy sources in the state, Bloomberg NEF believes that last year saw them become cost competitive even without subsidies, and that by 2023 unsubsidised solar PV could become California's cheapest source of electricity (See Fig. 5). It expects the state's utility-scale PV LCOE to fall below $30/MWh for projects commissioned in 2020, and that LCOEs will approach $25/MWh by 2023 for those projects with a 30% ITC rate. The higher renewables targets enshrined in SB100 will support an additional 14GW of new solar by 2025, reckons Bloomberg.

While economics favour solar over wind in the state, wind LCOEs should fall to $36/MWh for projects financed in 2019 to come online for the last year of PTC-subsidised build. The federal Bureau of Ocean Energy Management has identified three potential sites for offshore wind development for evaluation, although the depth of the continental shelf and rights to access federal waters may be problematic.

These developments are producing a knock-on effect in energy storage. Californian battery manufacturer Stem Inc's signature product, Athena, combines batteries and artificial intelligence to manage energy use for commercial customers. Chief Executive Officer John Carrington is quoted as saying: "California has been at the front of most regulatory activities. They required utilities to add storage and took other actions to help the industry get off the ground."[13]

Fig 5: California electricity costs



Source: Bloomberg NEF, Fidante Partners.

[12] Data from 2H 2018 U.S. Renewable Energy Market Outlook, unless otherwise stated.

[13] https://about.bnef.com/blog/stem-sees-solar-plus-storage-plus-ai-winning-combo-qa/

Case study 2: Texas oils the wheels of renewables

It's not only the progressive states such as California in the vanguard of the green energy revolution. Even the home state of the US oil industry, Texas, is in on the act.[14]

Wind

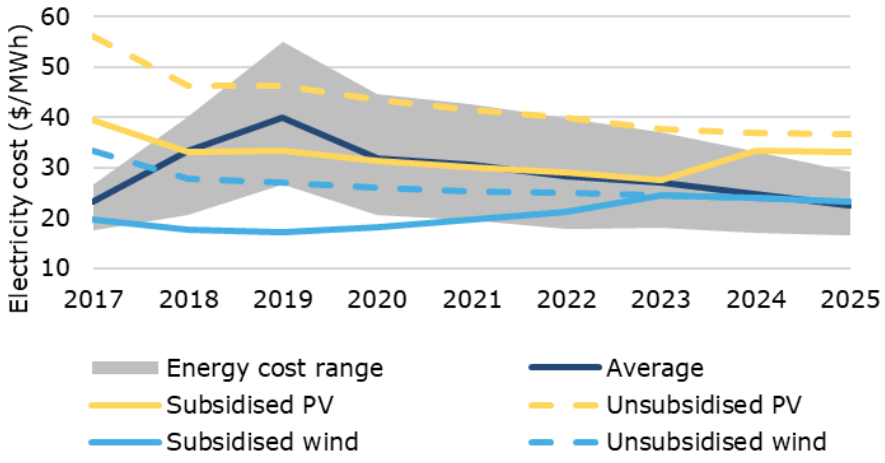
The big deal in Texas is wind power. Under Governor Rick Perry, who now heads the Department of Energy, Texas became the largest producer of wind energy in the country, surpassing coal power in 2017.[15] The large open plains in Western Texas provide a cost-effective source of onshore wind energy. Texas wind costs continue to be among the lowest in the world, with projects funded in 2018 estimated at $18/MWh. Even after the PTC phase-out, Texas wind costs will undercut the operating costs of many incumbent generators within Ercot – the Electric Reliability Council of Texas, which manages 90% of Texas' electrical load. Without subsidies, wind energy in Texas is already competitive with other sources of electricity and, this year, unsubsidised wind energy will become one of – if not the – cheapest source of electricity in the state.

Solar

Solar energy is more expensive but, with subsidies guaranteed until 2024, it is at least competitive with other sources of energy. The tapering of subsidies has caused an expanded pipeline, in order to take advantage of them before they disappear, and this is expected to bring 5.8GW online between 2020 and 2023.

Some 2.4GW of wind and solar under development in Texas have corporate offtake agreements, which will increase the odds of receiving backing for the 80% of those not yet financed. Wind and solar levelised costs will converge around $25/MWh in 2023 (see Fig. 6). While wind will remain the cheaper alternative after the ITC phase down, Bloomberg NEF believes.

Fig 6: Texas electricity costs



Source: Bloomberg NEF, Fidante Partners.

[14] Data from 2H 2018 U.S. Renewable Energy Market Outlook, unless otherwise stated.

[15] https://www.houstonchronicle.com/business/energy/article/Texas-wind-generation-keeps-growing-state-13178629.php

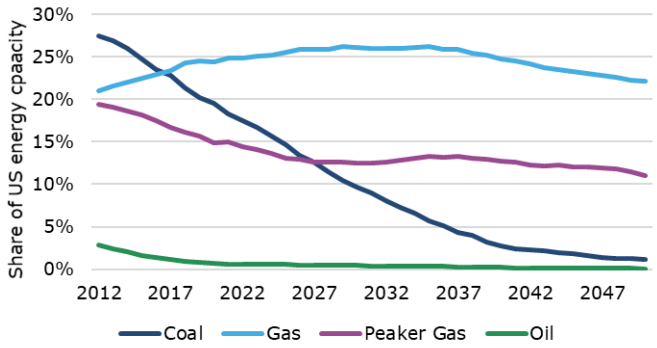
The US is going green

If even Texas is going green, we should not be surprised that the US as a whole is increasingly doing so for pure economic reasons. Bloomberg NEF estimates that coal and oil as a source of electricity will disappear pretty quickly (see Fig. 7), while natural gas continues to be an important source of energy.

The overall share of fossil fuels in US electricity production is expected to decline from 62.7% in 2018 to 56% in five years' time and about 34% in 2050.

The main drivers of this decline in fossil fuels is that existing plants will continue to run until their expected retirement date but then be replaced by cleaner sources of energy. In this context, it's instructive to look at what's happening with coal.

Fig 7: Coal is on its way out



Source: Bloomberg NEF, Fidante Partners.

Dethroning King Coal

Despite all the hoo-ha about the return of the black stuff, coal is no longer competitive and is mostly a legacy source of energy production that is relevant for energy production in the Southeast of the US – coincidentally a region that overwhelmingly voted for the current US administration. Even that looks vulnerable as an electoral strategy. The US added about 2,000 coal mining jobs since Trump took office, "but economists say the change is not statistically significant. The export-fueled bump in coal production and coal-mining employment is forecast to fade in 2019,"[16] reports CNBC. Although there are more than 50,500 people employed in coal, that's a fraction of the 800,000 in the 1920s, or even the 80,000 as recently as 2000. Miners are saying 'wait and see' for 2020 as the coal rebound looks like the fossilised equivalent of the dead cat bounce.[17]

Other structural features militate against a revival of coal, not least because this generation of plants are coming to the end of their working life: "Due to a coal build boom in the late 1970s, the average age of operating US coal plants is 40 years... Although there are advanced methods of refurbishing coal that allow for longer lifespan, poor plant profitability will deter those investments. We see 86GW of coal retiring through the mid-2020s, replaced by advanced combined-cycle gas plants, gas peakers and renewables."[18]

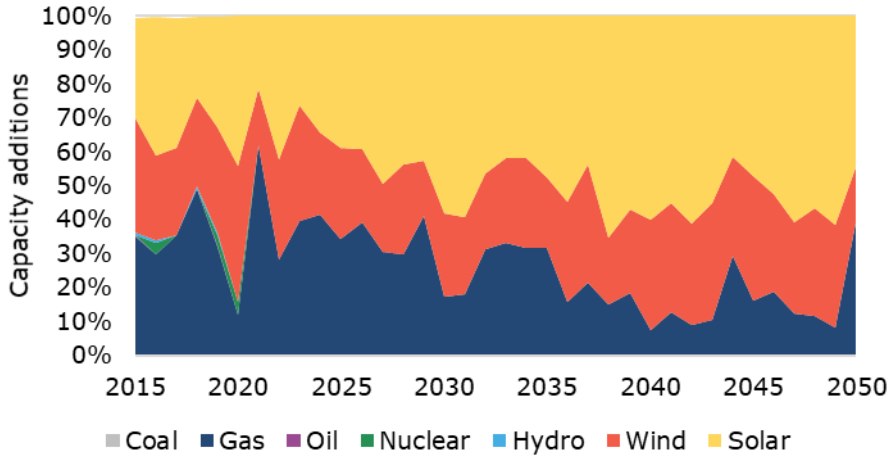
The natural replacement for fossil fuel electricity generation is neither nuclear nor hydro, but renewables such as solar PV and wind, which are seeing an ever-rising market share (see Fig. 8).

[16] https://www.cnbc.com/2018/08/23/trump-says-the-coal-industry-is-back-the-data-say-otherwise.html

[17] https://eu.northjersey.com/story/news/politics/elections/2018/10/24/coal-mine-workers-vote-donald-trump-2020-its-unclear/1381341002/.

[18] Bloomberg New Energy Outlook 2018.

Fig 8: 50% or more of new capacity is clean



Source: Bloomberg NEF, Fidante Partners.

The investment case is strong

Investments in renewable energy in the US present a strong growth case, despite the current federal administration. Guaranteed subsidies over the next few years should support high profitability of utility-scale solar PV and onshore wind farms, producing stable cash flows. Because feed-in tariffs for renewable energy are typically linked to inflation, these cash flows have an element of inflation protection which increases attractiveness for investors.

One concern of investors is that increasing capacity additions for solar and wind energy may lead to oversupply and falling electricity prices. This is a justified concern, given that solar power plants are expected to account for about one third of new capacity installed in the next five years and almost half of the new capacity installed until 2050. Similarly, wind power plants are expected to account for around one quarter of new capacity until 2050.

However, in many states these concerns are, in our view, unjustified since subsidies are guaranteed by law until at least 2023, and quite possibly well beyond. What's more, there's also a potential for extension of tax credits at the Federal level (see above).

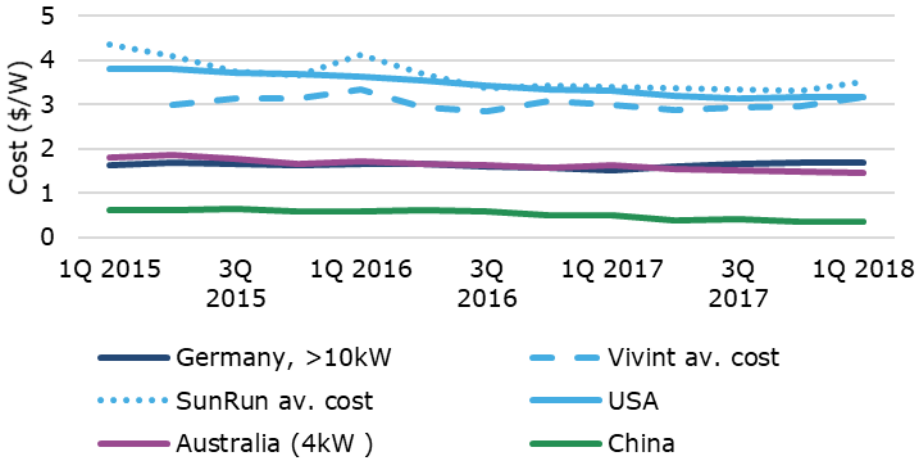
Areas with higher growth potential

However, not everywhere is the case for the green revolution as advanced and economically viable as solar PV and onshore wind. While investments in solar PV and onshore wind can provide investors with stable cash flows and relatively low volatility, other areas promise higher growth rates and, with them, higher potential returns.

Residential solar

One area where there is substantial development possible in the future is residential solar energy. The average cost of installing 1 Watt of solar power on the rooftop of a private home in the US is about twice as high as in Germany and Australia and about eight times as high as in China.

Fig 9: Residential solar PV is expensive in the US



Source: EnergySage, Solarchoice.au, BSW-Solar, Company filings, Bloomberg NEF, Fidante Partners.

This higher cost of rooftop solar PV in the US is due to a lack of subsidies and other incentives to install rooftop solar panels, an immense amount of red tape and the additional cost this implies. The regulatory approvals needed to install rooftop solar panels in the US is significantly higher than in Germany, Australia, and China. The Department of Energy has reported that costs such as instillation, financing and permits now make up more than half the price tag of installed solar power.[19] As long as these regulatory hurdles remain, there is limited growth in rooftop solar PV in the US. While there are initiatives in play to reduce this,[20] at the moment the cost barriers remain in place (see Fig. 9). But if they are eased, there is great upside potential.

Energy storage and utility-scale batteries also have great growth potential. It's an exciting area of the market: the potential answer to the main technological challenge from the rise of renewable energy – that the sun does not shine at night and the wind does not blow consistently. Unfortunately, this means that the electricity production from wind and solar does not coincide with the time of the day when the energy is actually needed. This is what makes batteries so pivotal to the success of renewables development overall: "Renewables plus batteries operating together as virtual dispatchable units allow deeper renewables penetration and eat into the most valuable operating hours for coal, gas and nuclear."[21]

This will transform the economic case for batteries in both the vehicle and the electricity sector. Bloomberg analysts anticipate 184GWh of installed battery capacity in the US system by 2050, of which 93GWh will be utility-scale, and a further 91GWh deployed behind-the-meter alongside small-scale PV systems. However, even by mid-century, gas plants may remain an important source of 'peaker' flexibility, due mainly to its low price.[22] That said, technology could still surprise on the upside, and regulatory action could well constrain gas to a smaller role than its simple economic viability.

This means there is a growing need for batteries and, thanks to advances in technology, the economics of these large-scale batteries are becoming increasingly attractive. Battery prices fell almost 80% between 2010 and 2017, and Bloomberg reports a 24% drop between 2016 and 2018 – faster than they had anticipated. As a result, expected growth rates for batteries in

[19] www.scientificamerican.com/article/red-tape-and-installation-prove-biggest-challenge-to-solar-today/
[20] For instance, the Solar Automated Permit Processing (SolarAPP). See http://www.thesolarfoundation.org/wp-content/uploads/2018/09/SolarAPP.pdf
[21] Bloomberg New Energy Outlook 2018.
[22] Ibid.

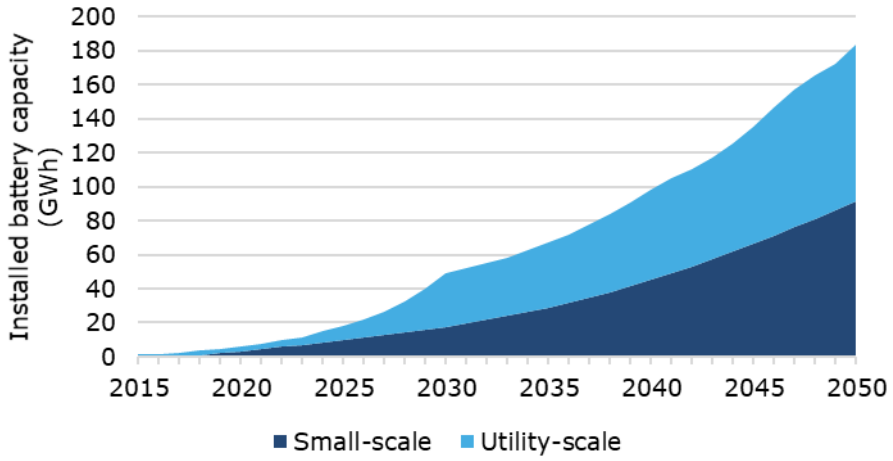
the US are extremely high. Over the next 30 years, small scale battery capacity is expected to grow by an average of 16%, utility-scale battery capacity tipped to grow by 12.5% with growth rates reaching 30% and 22% respectively.

Stationary storage battery demand is eclipsed by demand for electric vehicles, expected to exceed 1,500GWh in 2030. This, however, poses supply problems, according to Bloomberg NEF: "There is a chance of supply bottlenecks in the near term as miners and refiners struggle to match soaring demand with enough quality products. However, in the medium to long term we do not believe lithium supply will be major risk factor in our outlook. In contrast, cobalt [a necessary component of lithium batteries] supply poses a much more serious question. The long lead time to establish new mines, and the concentration of world cobalt reserves in the Democratic Republic of the Congo mean there is a more acute possibility of supply shocks in the early 2020s. Large investments in new mines will be needed. If these fail to materialise, cobalt prices could continue to spike."[23]

Both industry and academia are rising to the challenge. We've previously reported that "academics at Manchester University, where graphene was invented, are working with a number of commercial partners, including Rolls-Royce, Sharp and Morgan Advanced Materials to see how the material can be used to develop durable batteries. In the US, Tesla is building the biggest battery factory in the world, to become the biggest battery manufacturer.[24] Elon Musk made an uncharacteristic foray into the media spotlight last May to claim that the Reno-area Gigafactory was producing a "sustained rate" of 3,000 battery packs per week, reducing the time it takes to make a pack from seven hours to 70 minutes.[25]

Panasonic, the world's largest lithium-ion battery manufacturer, also has significant production operations in the US. Investment routes into this include power bonds to fund a battery infrastructure projects or shares in energy storage investment vehicles.

Fig 10: Energy storage with strong growth potential



Source: Bloomberg NEF, Fidante Partners.

[23] Bloomberg New Energy Outlook 2018.
[24] https://cleantechnica.com/2019/01/20/tesla-gigafactory-1-timeline-a-deep-dive/
[25] https://eu.usatoday.com/story/money/cars/2018/05/03/teslas-battery-gigafactory-hits-new-output-levels/576017002/

Summary and conclusions

While the US has become the world's largest oil producer, another US energy revolution is underway in renewable energy. Despite the much-publicised measures of the current administration to turn the country and clock back to fossil fuel consumption, states, municipalities and businesses in the US continue to invest in renewable energy.

From an economic perspective, renewable energy in the US is already competitive – particularly with its most prevalent forms of utility-scale solar PV and onshore wind. Given the legally binding commitments of different states in the US to increase the share of renewables in the energy mix, the risk of overcapacity is limited at the moment, which means that investments in these two areas can provide attractive and stable returns with limited downside risk.

There are other areas that have potentially higher growth rates and return expectations, such as residential solar PV and energy storage, but enhanced returns also mean enhanced risks in these instances. While residential PV is limited by both cost and red tape, the important thing with energy storage is that it isn't a 'nice to have': efficient, large scale and economically viable energy storage is a 'must have' if renewables are to keep eating away at the US energy mix. And that will remain the case, whatever your opinion of Elon Musk.

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