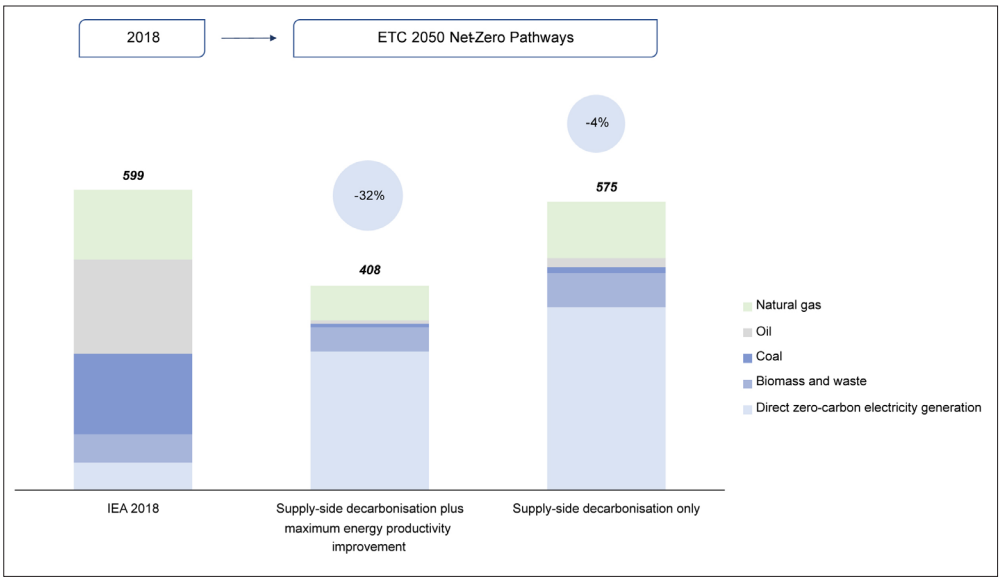
Flexibility is central to our low carbon future, and a major economic opportunity

Economics | As energy systems the world over embrace renewables en masse, flexibility is quickly outpacing generation as the most valuable provision an asset has. Alexa Capital CEO Bruce Huber examines the rise of flexibility and the major economic opportunity it poses for the energy sector.



Source: International Energy Agency, Alexa Capital

Primary energy demand (EJ/year)

You wouldn't use fossil fuels if you wanted to build a low carbon energy system from scratch. Apart from producing emissions, fossil fuel-powered generators are inefficient and prone to breakdowns. Take a car, for instance: a petrol or diesel internal combustion engine has around a 30% efficiency, while electric engines are more than 90% efficient. The energy required for one internal combustion engine could drive three electric vehicles.

Thus, with the technologies we have today, it makes far more sense to convert limitless renewable energy straight to electricity and use that to power as much of our society as possible. This is why electrification is a key theme for net zero emissions pathways published by authorities such as the International Energy Agency — and why clean energy is such an important growth opportunity for investors today. But electrification is not without its challenges.

As the need for electricity increases, and with it the amount of variable renewable generation feeding into the grid, it gets harder to match supply and demand. If demand goes up on a fossil fuel-powered grid, you can deal with it by putting more coal or gas into your thermal plants. But if demand goes up on a clean energy-based grid, you cannot get the wind to blow harder or the sun to shine more. Instead, you need to find new ways of keeping supply and demand in lockstep. If not, you risk spiralling energy costs whenever demand exceeds supply.

You also risk frequent blackouts, since the massive rotating masses of today's fossil fuel-powered turbines act as metronomes to keep the alternating current on the grid pulsing with a constant frequency. Without it, the grid crashes. Overcoming the need to accurately balance demand, supply and frequency in tomorrow's electrified energy systems is one of today's most significant economic opportunities.

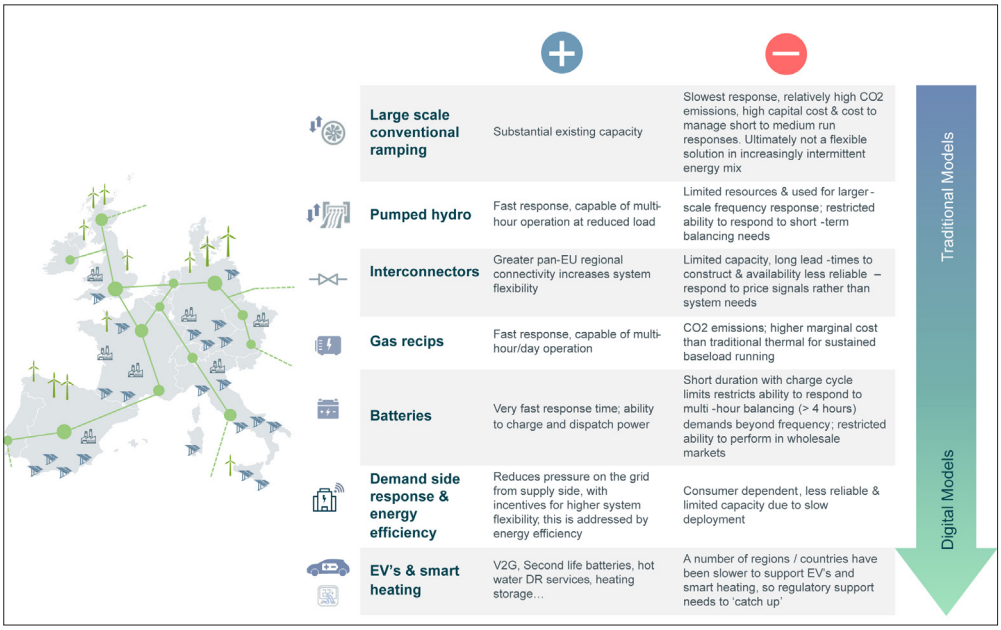
The key is flexibility, a concept which includes an array of conventional and emerging technologies and business models to support the transition to a low-carbon society.

Flexibility and the electrification challenge

There are multiple ways to make a grid flexible enough for demand to meet variable levels of supply. Conventionally, this is done by drawing on assets such as efficient, responsive combined-cycle and open-cycle gas turbines, pumped hydro reservoirs and grid interconnectors linking high-voltage distribution networks. But with changing power markets and a shift to more distributed generation, there is a growing requirement for more dynamic, digitally enabled and distributed options to address bottlenecks in electricity distribution networks. In more and more markets, we are seeing the introduction of grid-scale energy storage, mainly in the form of lithium-ion batteries, and gas peakers, with the former addressing the short-term (typically under four-hour) system volatility and the latter handling longer-duration requirements. At the same time, capital is being drawn to digital models of operation because these are better able to mitigate growing power market risks.

Emergence of new flexibility business models

We are now seeing the emergence of technology-enabled service models that pay customers to address supply-demand imbalances in increasingly decarbonised



Credit: Alexa Capital

power markets. Using smart meters and industrial control devices, electricity users such as supermarkets and food distribution groups can be rewarded for turning down freezer units during periods of peak system demand. Water utilities can turn off wastewater processing pumps. Greenhouse growers can turn up combined heat and power (CHP) units to export electricity to the grid. Data centres can do the same with backup generation. Electric vehicle fleet operators and charging networks can shift when to charge loads. And there are many more industrial examples.

These demand-side flexibility programmes can work with large energy consumers such as aluminium smelters or by aggregating smaller load centres such as households and multi-dwelling

Conventional and emerging sources of grid flexibility

housing units equipped with smart heating systems and appliances. In addition, commercial and industrial (C&I) electricity users are reducing their energy bills through a combination of efficiency investments and the digitisation of their processes, supported by an array of fast-growing service providers. Meanwhile, grid system operators can procure extra generation capacity that is kept on hand specifically to deal with peaks in demand.

Electric vehicle charging is an obvious target for flexibility services. Electric car batteries connected to the grid could deliver part of their charge back to the electricity network at times of high demand—in return for appropriate compensation, of course. There is a similar outlook for other areas of transportation that could become electrified over time, such as ferries and heavy-duty road transport. Another emerging flexibility opportunity is in what is called sector coupling, where energy use is integrated with supply sectors.

One example of this is likely to be in the production of hydrogen from electrolysis. This so-called green hydrogen is free from carbon emissions and could ultimately replace fossil fuels in a wide range of applications. But for it to be cost competitive, it requires very low-price electricity. Hence, some models predict that green hydrogen could be produced in Europe whenever there is an excess of wind power. Nowadays this power is simply curtailed but in future, with sector coupling, it could be diverted to power electrolysis at near-zero cost.

Investors wake up to the potential of flexibility

Above and beyond these options, the need for grid operators to juggle different forms of flexibility —discharging a battery here, dialling down a heating system there — requires a new generation of sophisticated digital control platforms, providing yet another tier of investment opportunity. The importance and value of flexibility is growing as the level of variable clean energy on the grid increases.

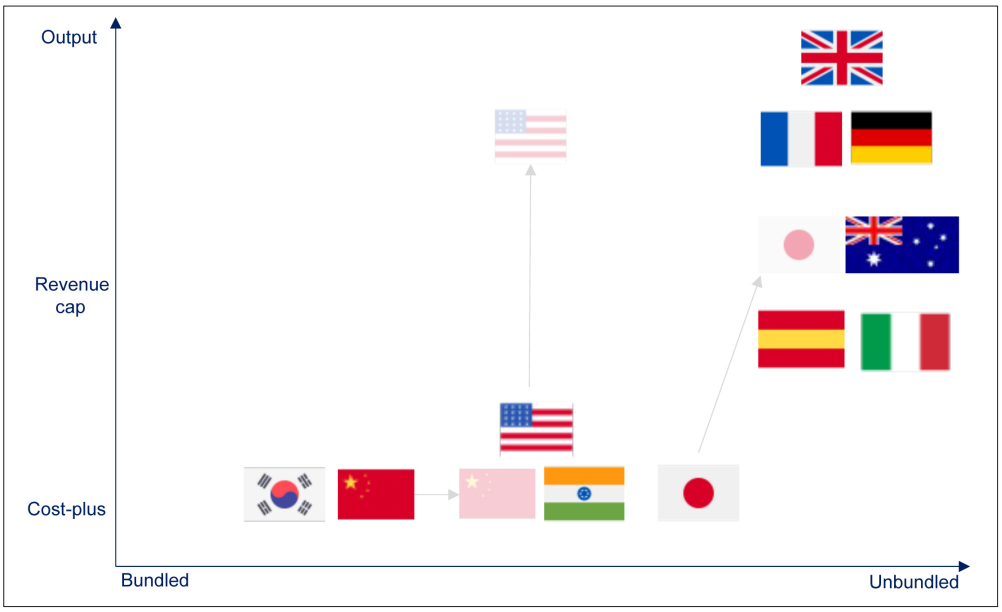
In the US, for example, Stem Inc installs energy storage in commercial properties and manages these so customers reduce energy consumption, benefit from flexible tariffs and get more reliable electricity supplies. Stem's customers include Fortune 500 companies, project developers, utilities and independent

Landmark Acquisitions and Strategic Investments in Flexibility & Grid-Scale Storage

Year	Quarter	Target	Country	Valuation ($m)	Solution	Acquirer/Investors
2020	Q3	Advanced Microgrid Solutions LLC	US	N/A	*Energy Storage Integrator*	Fluence Energy Inc
	Q3	**Anesco Ltd***	UK	N/A	*Grid-scale Energy Storage*	Gridserve Holdings Ltd
	Q4	**Anesco Ltd***	UK	N/A	*Grid-scale Energy Storage*	Gore Street Energy Storage Fund plc
	Q4	Fluence Inc	US	N/A	*Energy Storage Integrator*	Qatar Investment Authority
	Q4	Next Kraftwerke GmbH	Germany	N/A	*Renewables Aggregator*	Royal Dutch Shell plc
2021	Q2	STEM Inc	US	1,350	*Energy Storage Integrator*	Star Peak Energy Transition Corp.
	Q2	Voltus Inc	US	N/A	*Demand Side Response*	Activate Capital
	Q2	Origami Energy Ltd	UK	N/A	*Demand Side Response*	Barclays plc
	Q3	**Aggreko plc***	UK	3,000	*Flexible Stand-By Power*	Isquared Capital Advisors US LLC, TDR Capital LLP
	Q3	**Anesco Ltd***	UK	N/A	*Energy Storage EPC*	Aksiom Group Ltd, Ara Partners Group
	Q3	Open Energi Ltd	UK	N/A	*Demand Side Response*	BP plc
	Q4	Leap Inc	US	N/A	*Demand Side Response*	Park West Asset Management, Sillicon Valley Bank
	Q4	GridX GmbH	Germany	N/A	*Demand Side Response*	E. ON SE
	Q4	**Habitat Energy Ltd***	UK	N/A	*Grid-scale Storage Aggregator*	Quinbrook Infrastructure Partners LLC
	Q4	Getec Gmbh	Germany	3,000	*Energy services Aggregator*	JP Morgan Asset Management Inc
	Q4	Voltus Inc	US	1,300	*Demand Side Response*	Broadscale Acquisition Corp
	Q4	Opus One Solutions Energy Corp	US	N/A	*Demand Side Response*	General Electric Co
	Q4	Voltagrid LLC	US	N/A	*Demand Side Response*	CPPIB

Credit: Alexa Capital

Acquisitions and investments in flexibility and grid-scale energy storage companies have grown in recent quarters (*Transactions advised by Alexa Capital)



Credit: Alexa Capital

As the power sector becomes unbundled, regulators adapt incentive mechanisms for flexibility

power producers, and its Athena software helps solve renewable intermittency across the world's largest network of distributed energy storage systems.

Two other examples are Tesla, which provides flexibility services through battery storage, and Fortum, which fills supply gaps with hydro power in the Nordics and gas-fired power generation in Central Europe. There are many other growth companies emerging in flexibility markets—and they are catching the attention of strategic corporate and institutional investors (see table 1).

Also, institutional investors are accelerating investments into companies that provide flexibility. Qatar Investment Authority invested US$125 million into energy storage solutions company Fluence Energy in the first quarter of 2021. Fluence subsequently raised nearly $900 million in a Q4 2021 public listing. And Voltus, Inc. completed a US$1.3 billion special purpose acquisition company listing, supported by Broadscale Acquisition Corp, in the same quarter.

Where to find the new technology-based business models?

It is no mistake that Open Energi, Limejump, Flexitricity, Habitat Energy and Next Kraftwerke all hailed from Europe. And the companies leading the provision of flexibility services in North America, including Stem, Fluence, Advanced Microgrid Solutions and Voltus, cut their teeth in California. That's because the largest opportunity for flexibility services has been in markets that are highly deregulated and where there is an increasing dominance of variable clean energy on the grid. Having grid constraints and high power pricing, at least at certain volatile peak periods, creates an environment where economic incentives force technology and markets to deliver new solutions.

Because of this, we see flexibility services taking off first and foremost in markets such as Germany, Italy and the UK. Outside Europe, Australia is a big market for flexibility services, particularly in states such as South Australia where clean energy is beginning to dominate the generation mix. The US, meanwhile, is somewhat lagging in flexibility innovation because of the less deregulated nature of its electricity networks – however, flexibility services are beginning to take off rapidly in states such as California and Texas. And the outlook for flexibility is on the up.

We anticipate more regions will transition toward unbundled regulation in order to attract the vast pools of institutional capital to fund renewable infrastructure. With this shift, these more deregulated markets must embrace flexibility solutions to deliver low carbon energy system stability. And we expect more cross-border capital flows into these deregulating markets – from both strategic corporates as well as institutional and 'infrastructure plus' investors which bring expertise and

Case Study: Quinbrook Infrastructure Partners

Quinbrook Infrastructure Partners has a long history of investing in flexibility, supported by a management team that has been on the leading edge of power market investing for many years.

Quinbrook recently launched an aggressive investment programme around flexibility, firstly through Velox Power, a UK business managing grid-supporting clean and renewable gas generation, including high-efficiency, low capacity-factor gas generation plus grid-scale energy storage. In September 2020, Quinbrook expanded its flexible services capabilities with the acquisition of Flexitricity, one of the first companies to offer digitally-controlled demand-side flexibility services to industrial & commercial customers. Flexitricity had developed a virtual power plant (VPP) platform over the past 15 years and has developed a portfolio of nearly 1,000 megawatts of aggregated flexibility across the UK managed through its algorithmic AI control centre based in Edinburgh, Scotland.

In November 2021, Quinbrook further expanded its flexibility portfolio with the acquisition of Habitat Energy. Habitat Energy, based in Oxford, UK, has developed a leading battery storage optimisation and trading platform which enables performance management and revenue optimisation for grid-scale energy storage. These acquisitions have helped Quinbrook develop a portfolio of flexibility services that it is now using to target electricity markets in multiple geographies, including Australia and the USA, where it is focusing on clean energy intensive grids such as those operated by the Electric Reliability Council of Texas (ERCOT).

Ultimately, Quinbrook plans to provide an end-to-end suite of dynamic flexibility offerings stretching from generation grid assets to customer-based demand centres. The company is addressing what co-founder David Scaysbrook defines as 'covariance risk': where growing levels of renewable capacity leads to zero or negative energy pricing as the wind turbines or solar panels in a region produce simultaneously at times of high renewable resource.

"The market is quickly moving away from vanilla wind and solar development and shifting to favour those [projects] that are multi-technology," Scaysbrook says. "What the market wants is a carbon-free, round-the-clock product. Flexitricity was compelling because it's one of the leading demand-side response enterprises in the UK. [The] Habitat [deal] was driven by a belief in the proliferation of

battery storage. Those enabling technologies exist on their own. Our role is to synthesise them into a workable whole."

experience as well as capital. As the chart above shows, alongside continued investment into the UK, Australia, Texas and California, we anticipate a greater focus on markets such as Spain, Italy, Ireland, Germany, Holland and, in due course, Japan – all of which have aggressive renewable generation development targets.

The growing opportunity for capital flows

In fact, it is not a stretch to say that flexibility is likely to be one of the greatest investment opportunities of the energy transition. It is a prerequisite to being able to operate grids in the absence of fossil fuels. This alone should set apart flexibility as a major investment class, but in addition flexible service operators are rapidly developing new value-added offerings.

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And their sphere of action is expanding from the grid to encompass other sectors, from households and C&I companies to electric vehicle charging and carbon offsetting. This is leading to growing opportunities for flexibility-related digital integration and engineering services. The flexibility providers of the future will likely offer a broad range of value-added services, from energy management, asset optimisation and resiliency of supply to clean power provision and net-zero pathway development.

The potential for players to participate in the emerging flexibility landscape is so vast that it is hard to predict where future winners will lie. Sectors as varied as software, automotive and Big Tech are all seeing the importance of electrification and looking for ways to add value. We are moving to a world where all sources of electric supply and demand, from the solar panel on your roof and the immersion heater in your hot water tank to the kettle in your kitchen are connected by digital networks and interact with each other to keep the grid stable.

In this world, next-generation utilities will build on flexibility to offer products such as heat-as-a-service (HaaS) or decarbonisation-on-demand. There is a good chance that traditional utilities will not survive the transition. But before then, regulation needs to catch up with technology. As was evident from the wild swings in energy prices worldwide in 2021, the way power markets are regulated today does not support the way flexibility needs to work tomorrow. ■

Author

Bruce is CEO of Alexa Capital. Throughout his career, he has advised on hundreds of capital markets and M&A transactions, including IPOs, follow-ons, convertible & debt, energy project financing, as well as corporate finance, including public and private M&A. Before establishing Alexa Capital, Bruce was previously Global Head of Cleantech Investment Banking for Jefferies & Co. where he led the industry group operating across offices in Frankfurt, London, New York, San Francisco, Mumbai and Shanghai.