

**ATKINS**

Member of the SNC-Lavalin Group



# UTILITY 2050

REGULATION, INVESTMENT AND  
INNOVATION IN A RAPID ENERGY TRANSITION

MARCH 2021





## THE UK'S NET-ZERO EMISSIONS BY 2050 TARGET BECAME LAW IN 2019

- WE KNOW THAT ACHIEVING IT WILL REQUIRE FAR-REACHING AND DISRUPTIVE CHANGE ACROSS MANY DIFFERENT SECTORS.
- A KEY ELEMENT OF SUCCESS IS A VIRTUALLY CARBON FREE POWER SECTOR.
- HOW WILL THIS AFFECT ENERGY UTILITIES?
- WHAT NEEDS TO CHANGE FOR A DECARBONISED POWER SECTOR TO THRIVE?



**THE UTILITY 2050** PROJECT WAS A PARTNERSHIP OF ENERGY INDUSTRY PROFESSIONALS, FINANCIERS AND ACADEMICS WITH A SHARED OBJECTIVE TO EXPLORE WHAT NET ZERO COULD MEAN FOR THE ENERGY SECTOR.

We found that there are growing pressures in the retail and wholesale markets caused by the net-zero energy transition.

These need a deeper rethink of the business models that make up the energy market and the regulation which supports them.

The energy sector has an 'innovation dilemma': It is challenging to plan for and regulate the energy market even 2-5 years ahead. Equally, there is a pressing need to make decisions, in the face of deep uncertainties, which are commensurate with hitting the 2050 net-zero target.

**DECISIONS WITHIN THIS DILEMMA FALL INTO THREE BROAD CATEGORIES:**

- (1) Enabling innovation whilst protecting consumers in the retail market;
- (2) Evolving the business model for large generators; and
- (3) Balancing the contributions of retail and wholesale innovation.

Please cite this report as: Author affiliations, titles and links

Hall, S., Cole, D., Workman, M., Hardy, J., Mazur, C., Anable, J., (2021) Utility 2050 – Regulation, investment and innovation in a rapid energy transition, Atkins, London Available at:

Steven Hall is an Academic Fellow at the Sustainability Research Institute at Leeds. [Profile on this](#)

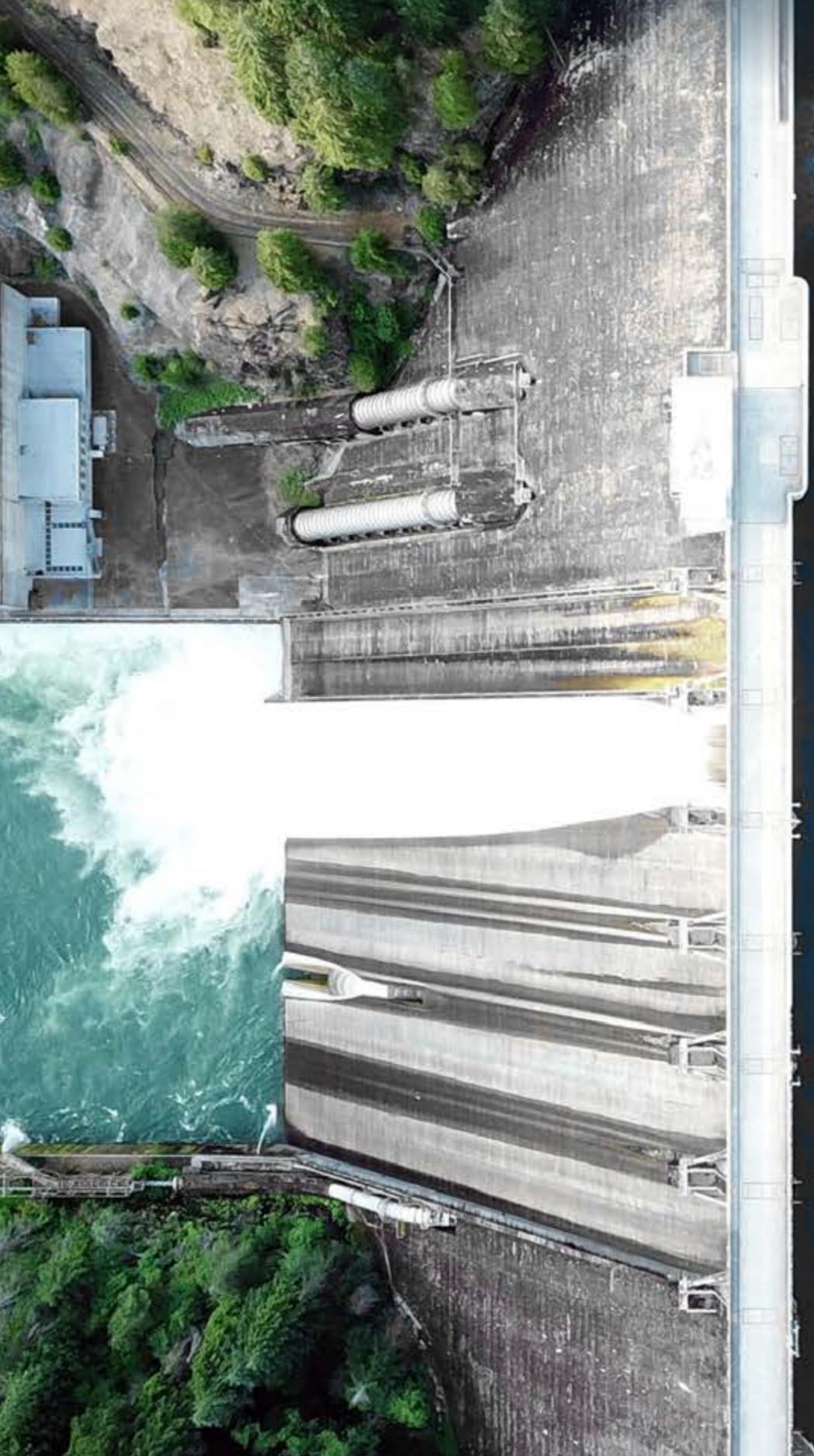
David Cole is Director of Atkins Power business in UK and Europe and Head of Engineering Net Zero for Nuclear and Power Markets. [Profile on this](#)

Mark Workman is Director at Foresight Transitions. [Profile on this](#)

Jeff Hardy is a Senior Research Fellow, Society led low carbon transformations at Imperial College London. [Profile on this](#)

Christoph Mazur is Project Lead of Zero Carbon Rugeley Smart Local Energy System Design Demonstrator at Engie. [Profile on this](#)

Jillian Anable is a Professor with a Chair in Transport and Energy at the University of Leeds, Institute for Transport Studies. [Profile on this](#)



///

## THE **UTILITY 2050 PROJECT** EXPLORED HOW A NET ZERO ENERGY TRANSITION NEEDS NEW UTILITY BUSINESS MODELS AND NEW CONSUMER RELATIONSHIPS.

By launching our work in partnership with ATKINS, part of the SNC Lavallin Group, and their work on 'Engineering Net Zero', we can say more about what needs to happen in the wholesale market.

By partnering with the **Energy Institute** we can develop the commercial and skills implications of this research by speaking to utilities and other sector stakeholders about the size of the governance challenge and the impact of new business models on consumers. Together, these initiatives amount to more than the sum of their parts.

They show how co-ordinated strategic decisions can be made that balance the increasing need for consumer participation with the concurrent urgency of setting in motion hard engineering solutions. The work advocates the need for a co-ordinated approach at both ends of the market.

This work further supports recent calls for new institutions of energy governance with powers to shape the wholesale and retail markets for the benefit of both consumers and the wider energy transition. This will give utilities the confidence to innovate and the finance sector the confidence to invest.

### THE KEY MESSAGES FROM THE UTILITY 2050 AND ATKINS ENGINEERING NET ZERO PROJECTS ARE:

1. We need rapid and bold decisions on the supply side to increase build rates and lock-in secure low carbon supply.
2. We need to manage consumer risk and maximise the fair participation of households in the energy transition.
3. Delivering **Net Zero** requires new governance architectures and an 'anticipatory' culture to manage, shape and react to a fast moving energy transition.

THE **UTILITY 2050 PROJECT** AND ATKINS ENGINEERING **NET ZERO** ARE COMPLEMENTARY AND SEPARATE PIECES OF ANALYSIS.

The Utility 2050 project is a co-ordinated set of insights communicated in world leading academic articles.

The Engineering Net Zero project is a comprehensive professional study available here. Here, we summarise what they both mean when read together, and how they culminate in a compelling case for pro-active decisions to be made which require a new governance architecture in the UK energy market.

All the materials from the project are available on this link:

**What is the size of the prize?**

Up to £21bn per year is at stake by 2050. This is financial value for utilities to capture in a net zero transition

**What value is at stake?**

**Which business models can capture this value?**

Five crowd sourced business models were found to match well with these new values in a Net Zero future

**What technological barriers exist?**

There are few remaining technology barriers: Ensuring conditions for deployment is key

**Which consumers will select which business models?**

Consumers split into four segments: Some affluent consumers will adopt these models while others face further market disengagement

**How do we innovate responsibly?**

Experts can agree principles for regulating these issues. Evidence based, facilitated processes for doing so accelerate this.

We need to reshape the retail energy market to maximise the contribution of the demand side without exacerbating existing social inequalities.

Engineering commitments are needed, and these will come from innovations in wholesale business models and modes of market participation.

We do not currently have the governance capacity to make these decisions. We are reaching the limits of an 'incremental' approach to system regulation and should adopt an 'anticipatory' model.

These components are explored in further detail below....



## WHAT IS THE SIZE OF THE PRIZE? WHAT FINANCIAL VALUE IS AT STAKE?

Utility 2050 has identified up to £21 billion per year of new value is available by 2050 in the net-zero energy system transition.

This financial value falls into six 'pools': The largest and most robust is energy service provision, which consists of heat and transport electrification with associated energy management and efficiency gains. Flexibility is a smaller market but critical to enable others to thrive. Low carbon generation at a large scale, such as offshore windfarms, will also be a major contributor as will improvements in the efficiency of existing energy plants.

Our work is supported by other studies which show a large volume of latent financial value in energy transitions which the sector needs utility business model innovation to capture.

National Infrastructure Commission suggest a smart power revolution could save consumers

**£8bn** PER YEAR BY 2030

THE CLIMATE CHANGE COMMITTEE in their 6th Carbon Budget suggest low-carbon investment will need to grow from

**£10bn - £50bn** A YEAR BY 2030

THE INTERNATIONAL ENERGY AGENCY in their Net Zero Emissions scenario suggests power sector investment will need to

TRIPLE GLOBALLY BY 2030 TO **\$2,200bn.**

Business model innovation needs supportive policy and regulation in both retail and wholesale markets. Without an evolution of utility business models the energy transition could slow down.

## TOTAL VALUES TO BE CAPTURED PER POOL Up to £21bn of new value is available to electricity utilities per year by 2050



Plant efficiency  
£75-1809m



Service provision  
£5-9bn



Local LC generation  
£42 -4600bn



Large LC generation  
£0.61 - 8bn



Flexibility optimisation  
£400 - 2000m



CCS  
£0.14 - 1669m

You can read more about how we got to these values in our research paper

## WHICH BUSINESS MODELS CAN CAPTURE THIS VALUE?

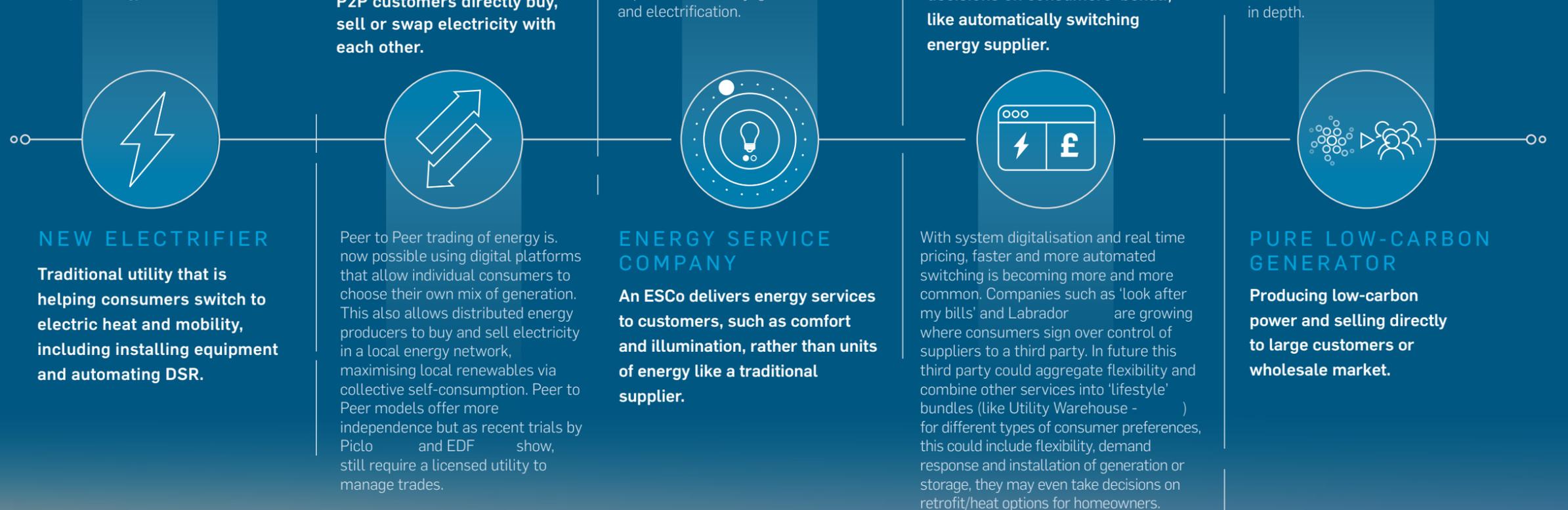
Utility 2050 crowdsourced five core business models that could capture the new values created by the energy transition.

These new business models were a 'Pure low-carbon generator'; a 'New Electrifier'; 'Peer to Peer'; Energy service companies; and 'Third Party control'. Between them, they can capture a share of the £21 billion in value and drive the net-zero transition. To do so, they need regulatory and policy reform to thrive.

The electrification of heat and transport is critical for a Net Zero future. Rather than simply allowing demand to expand, electric utilities can become involved in and promote the transition with domestic consumers by offering heat and mobility tariffs which may come with rewards for flexibility, along with other deals and contracts for the conversion kit, i.e. heat pumps, domestic efficiency measure, electric vehicles and chargers. Early signals of this can be seen in OVO's heat pump trial and Octopus Energy's smart EV tariff.

Energy service companies aim to reduce the consumer risk of investing in retrofit, storage and microgeneration. Energy measures can be financed from bill savings over the long term or be supported by a mix of grants and low interest loans, projects such as energysprong and Brighton and Hove Energy Services Cooperative are growing in social housing in new build developments and also in communities. Though entrance into the retail market is hampered by current regulation, ESCO's can combine many aspects of flexibility, generation and electrification.

This business model represents utilities in the wholesale market exploring new ways of financing and operating Wind, Nuclear, and CCS enabled generation. Atkins ENZ work has explored the engineering feasibility of achieving Net Zero by 2050 and considered the roles of policy and market interventions to support the energy transition. The next page shows how Atkins ENZ project has assessed the suitability of the current policy and market framework for delivering Net Zero. The Utility 2050 project did not explore the Pure Low Carbon Generator business model in depth.



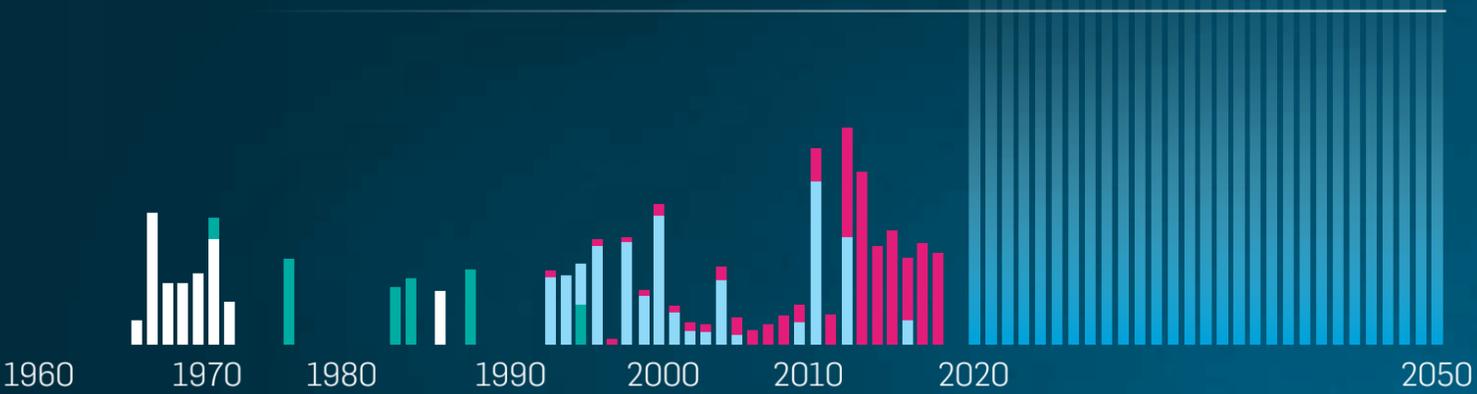


## HOW WILL WHOLESALE GENERATION BUSINESS MODELS CAPTURE THIS VALUE?

The utility 2050 project has not analysed how a 'pure low carbon generator' business model could evolve, but ATKINS has. It is clear that deep systems change is needed, which is technology-specific, not technology agnostic.

ATKINS has analysed the published output of multiple attempts to model the potential 2050 Net Zero energy system, focusing on the large-scale power generation requirements. Over the next 30 years, the UK will have to replace almost all our current generating capacity. In addition, the UK will have to build at least as much again to double our electricity production. This £multi-billion investment programme must be funded based on robust business models.

Between **9-12GW** annual installed capacity required to achieve Net Zero



## CURRENT BUSINESS MODELS ARE NOT DELIVERING NEW GENERATION CAPACITY AT THE REQUIRED RATE.

We cannot approach Net Zero without at least doubling (maybe tripling) our electricity production. The required build rate to achieve this over the next 30 years is higher than the UK has ever achieved and more than double our current rate.



## HOW WILL WHOLESALE GENERATION BUSINESS MODELS CAPTURE THIS VALUE?

The UK is not currently on track to meet its 2050 target. One of the major restraining factors is the government's failure to develop investible business models for firm power generation - CCGT with CCS and Nuclear.

In the absence of an engineering and operations focussed whole system strategy, the focus on economic modelling of least cost systems and market distortion to encourage offshore wind has effectively frozen out other technologies. The implications for system stability and security of supply have not been adequately addressed and these risks do not appear to have been 'priced in' to the economic models. Anticipatory models of regulation would recognise this risk and likely create new institutions to manage them.

	CONSISTENT POLICY	BUSINESS MODEL	MARKET STRUCTURE		PROGRESS ACHIEVED
			DEMAND	PRICE	
CCGT with CCS	✓	✗	✗	✗	✗
Nuclear	?	?	✗	✓	✓
Offshore Wind	✓	✓	✓	✓	✓

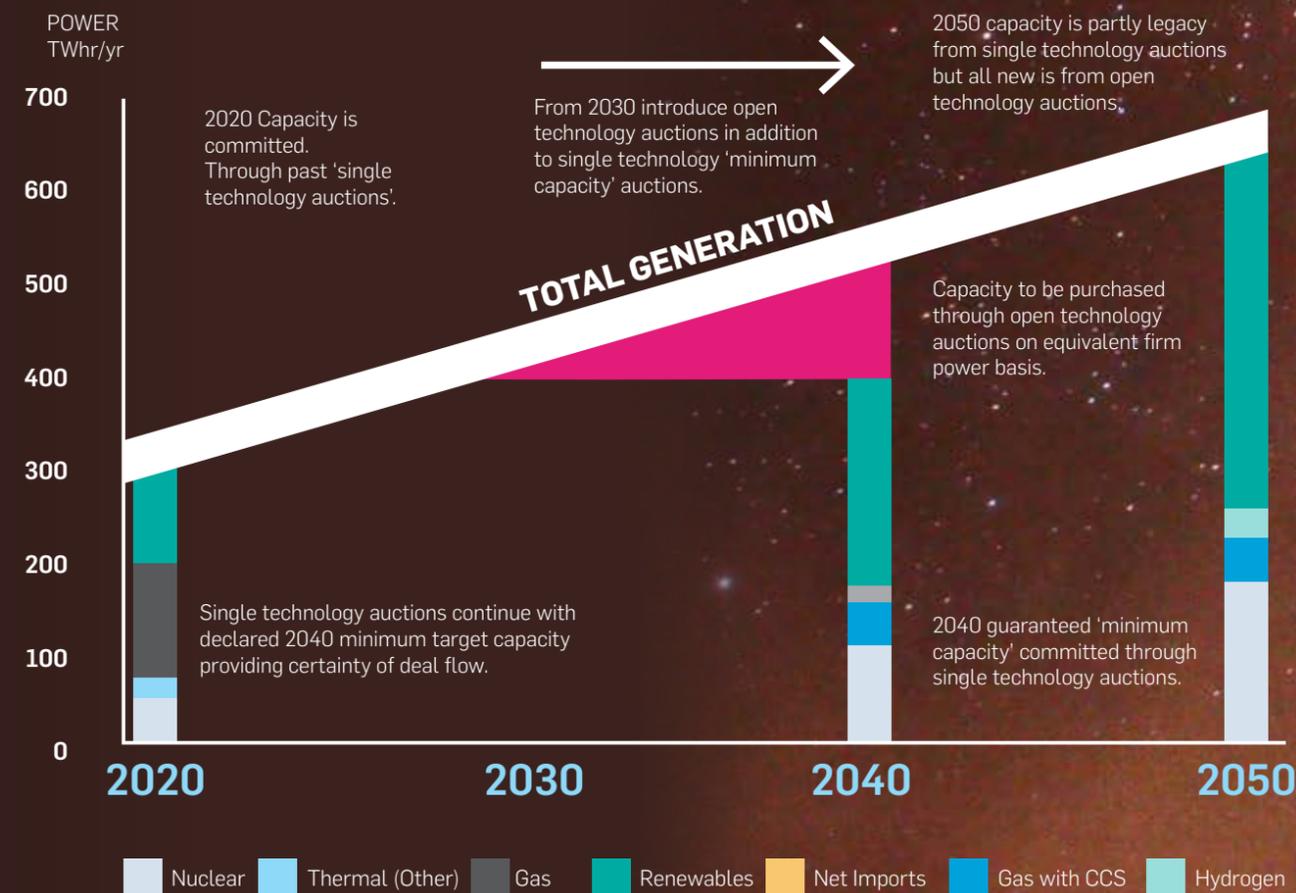
### PREREQUISITES FOR INVESTMENT MUST BE MET, INCLUDING VIABLE BUSINESS MODELS

Acting on advice from CCC the Government legislated to achieve Net Zero by 2050. In the underlying scenario 40% of UK's energy in 2050 would depend on CCS. There is still no business model for CCS and not even one full scale demo project. The only alternative firm power is nuclear. Despite long standing policy to build new nuclear the business model selected by Government is non-viable. Massive market intervention and an extremely favourable business model have delivered offshore wind.

## SYSTEM TRANSITIONS SHOULD BE TECHNOLOGY-LED

Many novel initiatives maximise the demand side's potential and consumer participation in a NetZero system.

Though such initiatives have merit in specific circumstances, they must be placed in the context of the massive demands of repowering Britain for Net Zero by 2050. Most of these initiatives are neither large enough nor advanced enough to have a major system-changing impact by 2050. Indeed the consumer data from Utility 2050 shows the retail market may be more limited and more problematic to engage than first thought. BEIS has become the de-facto central buyer of electricity in the Wholesale Generation market and effectively determines what new generation gets built. There is no evidence of a long-term strategic plan guiding this massive purchasing power.



2020 and 2050 capacity mixes taken from Energy White Paper Fig 3.4

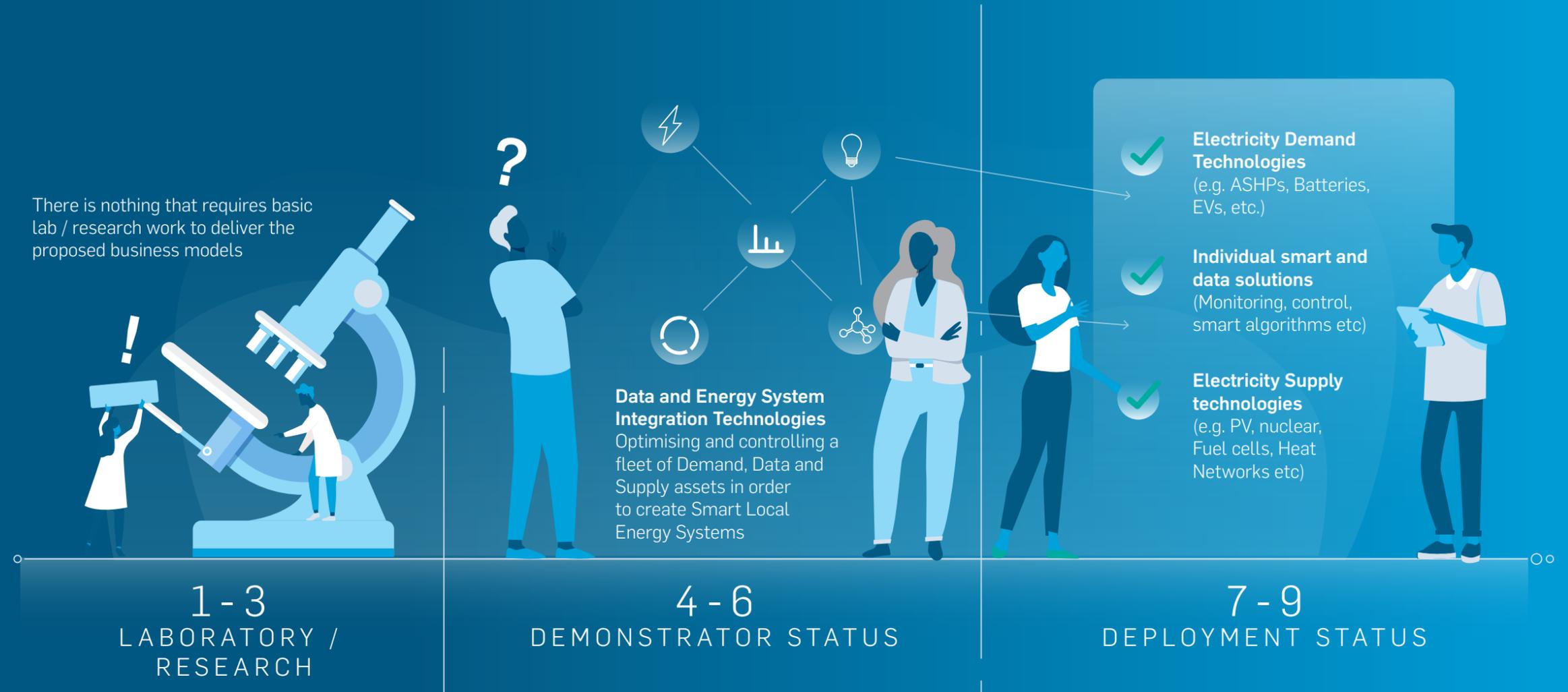
- » Mature thermal power generation technology (pre 1990) was well suited to introduction of competitive market. In the long term (beyond 2050) generation technologies (renewables, nuclear fission, fusion energy) will mature enough for competitive markets to operate.
- » From now to 2050 the system configuration will be in transition and must be technology lead, with markets designed or managed to deliver diverse new technologies.



**TECHNOLOGY IS NOT A BARRIER, BUT BARRIERS TO DEPLOYMENT CAN BE REMOVED BY STRONGER GOVERNANCE ACTORS.**

Utility 2050 undertook and published an expert panel study to determine the readiness levels of enabling technologies in the energy transition.

The study's objective was to verify whether a focus on business model innovation, new market creation, and institutional innovation (i.e., creating a system architect) was the right thing to do. We found that experts judged all critical technologies for the energy transition to be at least at the demonstrator stage, and many were close to market readiness (see below). They needed the right conditions to thrive. Our study shows that sector innovation will benefit most from focusing on market reforms and new sector regulation.



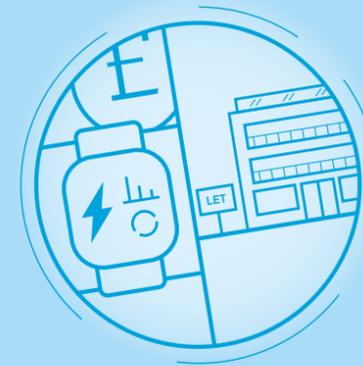


## WHICH CONSUMERS WILL SELECT WHICH BUSINESS MODELS?

There is a great deal of focus being placed on demand side trials and this is very welcome, demand side innovation reduces price risks and contributes to security of supply.

However, the 'demand side' comprises real people leading complicated lives, rather than rational actors choosing the best energy deal for them. Utility 2050 explores how a representative sample of UK bill payers responded to new business models in the energy system. The results show that we need strong new regulation to avoid a small

number of consumers' winning more' and other consumers failing to access these benefits. We found Innovative domestic energy contracts appeal to a substantive but finite segment of younger, high education, higher-income consumers. Consumers who rent their homes could be barred from these models. Some consumers that own homes do not trust the energy market and others are too satisfied with current arrangements to try new offers. Without anticipatory regulation and a body capable of reforming the retail market, the UK risks exacerbating existing social inequalities, limiting the demand side's contribution and locking some consumers out of the energy transition.



### 16% PRAGMATIC INNOVATORS

value choice and freedom, they find all of these new models attractive. They are young, high income, high education consumers. Pragmatic Innovators are early technology adopters who switch regularly because they are savvy consumers as opposed to resource constrained. However, 42% currently rent their homes and may find some models unavailable until they become owner occupiers



### 35% ENGAGED BUT CAUTIOUS

consumers already shop around to get the best deals and are likely to stick with current tariffs. They are not convinced these new types of contract will be any better than the status quo. They are environmentally conscious but unlikely to work hard for this; they will need to see new offers as low financial risk.



### 22% UNENGAGED & UNMOTIVATED

consumers are unlikely to switch regularly, have little concern over climate change and are unlikely to engage in any new offers. They are older homeowners with lower-than-average education and income. They do not trust the energy market and so rarely switch, they are likely to ignore new or more complex energy offers even if they would stand to save money.



### 27% ASPIRING OPT-OUTS

are the least affluent, and they do not trust energy companies or other social institutions. Aspiring Opt Outs are younger, often renting, and are least likely to switch supplier at the moment, but show a preference for 'peer to peer' energy contracts. These consumers might currently tend towards greatest current fuel poverty, they are engaged in that they want to 'get out', but may not have the resources to do so.





### HOW DO WE INNOVATE RESPONSIBLY?

The Utility 2050 project took these insights on new utility business models, wholesale generation needs, consumer behaviour and technology readiness to a series of four 'Decision Theatres'.

We wanted to understand what action was needed to catalyse new business models and capture the value opportunity of Net-Zero. We asked: 'What needs to change in the United Kingdom energy system to allow low carbon business models to thrive? We found a massive appetite for decisions to be made on energy futures in the UK and internationally, sending strong signals across the sector. These decisions are on specific government and regulatory policy and consumer protection.

### WHAT NEEDS TO CHANGE TO ALLOW LOW CARBON BUSINESS MODELS TO THRIVE?



#### CARBON PRICING AND WHOLESALE MARKETS

Participants from all workshops were clear that policy direction is critical for wholesale markets. They requested the hybrid model of free market rules for some technologies and explicit Government price setting for others be reformed, either with clear carbon based price signals or moved to a full central buyer function.



#### CLEAR SIGNALS ON ELECTRIFICATION OF TRANSPORT AND HEAT

There is a clear need to move to a strategic approach for transport and heat electrification with much more control and planning. A strong transport and heat strategy that directs investment was seen as a top priority for driving system innovation.



#### PROTECTING CONSUMERS WHILE ALLOWING INNOVATION

We found real concerns across the industry when exposing consumers to price risk. Combined with our consumer insights above, it is clear that demand side innovation is possible, but could only benefit engaged customers and further exploit vulnerable groups. New retail market regulation i.e. needed to maximise innovation while ensuring a just transition.



#### ENABLING A FLEXIBLE SYSTEM

With increasing system needs for flexibility, all participants from the demand side to the wholesale generator need an open and accessible platform to trade on. A system level entity should create, plan and operate this platform.





## COMBINING OUR INSIGHTS; THE NEED FOR NEW INSTITUTIONS OF ENERGY GOVERNANCE

Reading the insights of Utility 2050 research and 'Engineering Net Zero' together, we find a gap in the UK's energy governance landscape.

We need firm action on the wholesale market to manage the distortions caused by the increasing penetration of zero marginal cost renewables so that other low-carbon power sources can play their part in a secure Net-Zero future.

We also need strong intervention in retail markets to maximise the demand side's contribution and ensure a just transition. With further decisions on heat decarbonisation and electric mobility imminent, we find an incremental approach to

system design that relies on piecemeal primary legislation and governance code reviews to be insufficient to meet the challenges ahead. Akins has called for creating a 'system architect' to manage the challenges of the supply side. With the work from the Utility 2050 project, we see the need to extend the call for new governance actors into the retail market, maximising ordinary electricity consumers' contribution.



## COMBINING OUR INSIGHTS; THE NEED FOR NEW INSTITUTIONS OF ENERGY GOVERNANCE

We do not propose the detail of this new institutional architecture here, but we do present some guiding principles which would enable it to take action on the challenges.

Energy system regulation requires a cultural shift toward anticipatory regulation and away from prescriptive regulation. We see an anticipatory culture as a learning process with consumers and stakeholders that can provide the principles for future system design. The principles which should guide this new institutional design are:



### INCLUSIVE & COLLABORATIVE

in engaging the public and diverse stakeholders where new technologies and how they are deployed raise ethical issues, and in leveraging the capabilities of businesses, cities and civil society to secure policy goods.



### ITERATIVE

in taking a test-and-evolve rather than solve-and-leave-approach to novel problems, for which there may be no established playbook.



### FUTURE-FACING

in developing resilient, adaptive strategies that can cope with the inherent uncertainty of fast-changing markets.



### OUTCOMES-BASED

in focusing on validating companies' efforts to achieve well-defined goals, rather than setting rules, and particularly on incentivising platforms to support regulatory objectives.



### PRO-ACTIVE

in engaging with innovators and innovation early in the cycle to provide predictability and enable timely, proportionate responses to issues that may scale rapidly.



### EXPERIMENTAL

in facilitating diverse responses to regulation of early-stage opportunities and risks and where national or global policies and standards are still to be established.

### Anticipatory regulation in the retail market should:

Be empowered to make real change, ask questions over the direction and efficacy of household switching, protect vulnerable consumers and move away from atomised price competition as an organising principle.

### Anticipatory regulation in the wholesale market should:

Recognise the gap between what a Net Zero system needs and what the market will deliver. Be empowered to direct the generation mix and create new business models that suit different technologies' characteristics. Experiment with new market designs and question the base assumption of wholesale markets for energy supply.

### Anticipatory regulation can:

Optimise the contribution of retail and wholesale innovation by combining insights from engineering analysis and business innovation research. Engineering needs and consumer behaviours go hand in hand. They co-evolve and co-produce each other. A nimble and iterative process is needed where retail and wholesale system developments inform each other, and foresight approaches help anticipate coming challenges. Anticipatory regulation is only meaningful if there is an institutional landscape with the authority and social license to deliver the needed changes and set strong signals of the direction to net zero in 2050.

# ATKINS

Member of the SNC-Lavalin Group



## UTILITY 2050

REGULATION, INVESTMENT AND  
INNOVATION IN A RAPID ENERGY TRANSITION

MARCH 2021

### CONTACT:

David Cole  
Market Director - Power Generation Assets, Energy

T: +44 1454 66 2676

[David.Cole2@atkinsglobal.com](mailto:David.Cole2@atkinsglobal.com)

Mark Workman  
Director Foresight Transitions

T: +44 7788110802

[E: mark@foresighttransitions.co.uk](mailto:mark@foresighttransitions.co.uk)

Steve Hall  
Academic Fellow at University of Leeds

[E: s.hall@leeds.ac.uk](mailto:s.hall@leeds.ac.uk)

