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THE CONSUMER-FACING ENERGY INNOVATION CHALLENGE

DESIGNING A 'MISSION' FOR THE EU'S CLEAN ENERGY INNOVATION STRATEGY

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Innovation policy has traditionally focused on demonstrating the commercial viability of promising new technologies and then allowing them to compete with alternative products in the market. This approach is insufficient to meet the clean energy innovation challenge. This briefing proposes a framework to reflect on this challenge, and a few recommendations on how to move forward.

Decarbonising the economy requires a goal-driven rate of deployment of zero carbon energy sources. There is a vast amount of money at stake in achieving the best value deployment pathway and innovation policy should include a focus on delivering this objective. This will require a systematic and co-ordinated process of learning about consumer engagement at scale, in a predictable and politically acceptable way, and the integration of low carbon technologies. It will also require innovation in the market and regulatory arrangements. Our recommendations for a successful clean energy innovation strategy are as follows.

1. The EU should **adopt the mission of achieving 100 carbon neutral EU cities by 2030** to help steer work on clean energy innovation and ensure that sufficient funds are set aside under the 2021-27 EU budget's "Horizon Europe" programme.
2. Implement a **programme of large-scale demonstrators** of the future energy system as the vehicle for delivering the learning necessary to achieve the mission.
3. Ensure an **appropriate governance system** is in place to deliver the mission. This should specify the learning requirements, support project delivery and process the lessons learnt to inform the next phase of demonstration, wider rollout or recommendations for changes to the regulatory and market framework.
4. Research and innovation priorities for Horizon 2020 work in the period 2018 to 2020 should ensure that **feasibility studies** are prepared for a range of potential demonstration projects.

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Innovation and deployment

One of the major policy challenges facing Europe is to decarbonise the energy system in line with international agreements to limit the impacts of climate change. This 'grand challenge' is usually expressed in terms of the need to make a certain amount of progress in decarbonising the energy system by a certain date – say, by 2030 or 2050. Whilst the technologies already exist that could replace most of the current energy system with zero carbon alternatives, a transformation based purely on the integration of these available technologies is likely to be high cost and politically unpalatable. It is, therefore, essential that new, cheaper technology and integration solutions emerge and that the cost of the current options continues to reduce. It is this logic that demands innovation – both incremental and breakthrough – is placed at the heart of the decarbonisation policy challenge.

The characteristics of energy system decarbonisation mean that the end-point can only be achieved through steady progress in delivery throughout the intervening period. Traditionally, innovation policy has focused on helping to demonstrate the commercial viability of promising new technologies and then allowing them to compete with alternative products in the market. Whilst the demonstration of new 'breakthrough' technologies will remain a vital element of the innovation agenda, more focus must be placed on finding the best way to ensure efficient delivery of minimum rates of deployment of zero carbon energy sources and the associated infrastructure and services. This can only be achieved using technologies and integration solutions that are readily available to be deployed.

There is a fundamental policy question that must, therefore, be addressed:

What is the minimum acceptable rate for deployment of zero carbon technologies?

To answer this question, it is necessary to take a view on the future costs of technologies and integration solutions and how quickly they can be deployed. If the potential for future cost reduction or the rate of deployment is under-estimated, then significant amounts of money will be wasted on deploying high-cost technologies that are immediately available. Alternatively, over-optimism about cost reduction and/or deployment rates will lead to insufficient deployment and ultimate policy failure.

The technologies that are available to be deployed are often 'immature' to some degree which means that there is still potential – often considerable – to reduce costs through innovation in system integration, product design, supply chain and manufacturing[1]. However, the investment needed to achieve these improvements can be significant and it will often be necessary to provide investors with some certainty over future earnings before they are prepared to commit the necessary funding.

[1] There will always be opportunities to further reduce costs through incremental innovation. Therefore, rather than talk about mature and immature technologies, it is more accurate to consider those that generate sufficient earnings from sales to fund on-going innovation and those that do not.

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Therefore, the approach taken to deployment will directly impact future technology costs since immature technologies can only achieve their future cost potential through significant on-going deployment. Deployment mechanisms should, therefore, be focused on those technologies and services that have the potential to play a significant role in the future decarbonised energy system and should be designed to create strong drivers for continued innovation and cost reduction[2]. This raises a second key policy question:

What are the appropriate mechanisms that achieve the required deployment and provide incentives for on-going innovation and cost reduction?

The importance of deployment strategies for clean energy innovation was recognised in the recent review of 'mission-based innovation' prepared for the European Commission by Professor Mazzucato.[3] This identified a deployment challenge (100 carbon neutral EU cities by 2030) as an appropriate mission to drive the innovation needed to meet the decarbonisation challenge. In addition to helping to drive cost reductions, deployment mechanisms must improve understanding of the technologies and services that have the potential to play a key role in decarbonising the energy system as well as the rate at which they can be deployed in future.

The role of consumers

It is possible to decarbonise a large proportion of the energy system without any action on the part of consumers. The power system can be decarbonised using large, zero-carbon power generators connected to the transmission grid, with supply and demand balanced using large power storage units and highly interconnected grid systems. The gas supplied to heat homes could be replaced with hydrogen and the internal combustion engines within vehicles could use bio-fuels rather than petrol or diesel. However, there are almost certainly practical limits to the deployment of these centralised decarbonisation solutions and, in many cases, they would be prohibitively expensive.

Some direct action on the part of consumers is, therefore, essential and, in many instances, is likely to be much cheaper than centralised alternatives. For example, more efficient use of energy reduces the need to invest in zero carbon energy solutions. Indeed, the European Commission has calculated that a fully active demand side of the market could save €60-100bn each year across Europe[4]. Therefore, decarbonisation measures that involve action on the part of consumers have a huge potential to help

[2] 'Deployment mechanisms' refer to an administered market intervention that is designed to achieve a certain deployment of zero carbon technologies. Feed in tariffs represent an example of a deployment mechanism that has evolved significantly over the last decade to improve incentives for reductions in renewable technology costs.

[3] See recent review of the role of mission-based innovation in EU policy: **https://publications.europa.eu/en/publication-detail/-/publication/5b2811d1-16be-11e8-9253-01aa75ed71a1/language-en**

[4] **http://europa.eu/rapid/press-release_SPEECH-15-4596_en.htm**

drive the cost-effective transformation to the future energy system and must be central to the deployment agenda.

Table 1: Examples of measures that require direct action on the part of consumers

Example of type of measure	Decarbonisation benefit
Improve energy efficiency of premises	Reduces requirement to invest in decarbonisation solutions
Install new heating and cooling systems	Allows moves away from fossil fuel-based systems
Switch to electric vehicles	Reduces use of petrol/diesel
Install 'smart' appliances (including storage)	Avoids waste in energy and allows energy to be consumed when it is cheapest
Install renewable generation (e.g. rooftop solar)	Reduces requirement for centralised generation which includes fossil-fired power plant.
Contract with third party (usually and aggregator) to allow remote control of energy usage.	Reduces need for supply side measures to help balance supply and demand – both short term (generation) and long term (network investment)

Source: E3G

There are a myriad of technologies and devices that support decarbonisation through changing the energy consumption of consumer premises or vehicles (see Table above). The deployment challenges facing these technologies are very different from those facing large centralised zero carbon technologies. For example, relatively small unit size, lifetime and speed to market can make it easier to justify investment in supply chain capacity that will drive cost reductions, and this avoids the need for significant subsidy to allow these technologies to reach cost maturity. However, products must be designed to meet the evolving needs of a diverse consumer base rather than the requirements of a single buyer, thereby creating a significant and on-going product development challenge. Also, deployment strategies must consider the wider social desirability of new technologies along with issue of equity between different types of consumer.

Perhaps the most significant difference between the deployment of centralised technologies and those requiring action on the part of consumers is that it is difficult to predict consumer behaviour and, therefore, the rate of deployment. Indeed, whilst it is possible to envisage a rapid consumer-led uptake of products such as electric vehicles, the way that energy is consumed in buildings has hitherto failed to excite the interest of most consumers. So long as consumers remain free not to act, then experience suggests that this is what the majority will do. Indeed, the amount of important and interesting information available to consumers is increasing exponentially and it is difficult to imagine that the energy industry is well-placed to win in this increasingly intense 'battle for attention'. These challenges create strong temptations to rely on

centralised solutions, despite the potentially significant cost penalty involved. These issues raise two critical policy questions that the innovation agenda must address:

How to optimise the mix of deployment between centralised zero carbon technologies and those whose deployment requires action on the part of consumers?

How is it possible to guarantee deployment of zero carbon technologies where there are no alternatives to direct action on the part of consumers?

The demand side innovation challenge

The actions taken by consumers will depend on the choices they are presented with and way in which these choices are presented. Currently, the consumer 'choice framework' is determined by a combination of market and regulatory rules and certain aspects of these rules are currently being amended via the 'Clean Energy for All Europeans' package of proposals.

These amendments are focused on electricity markets and aim to reinforce rights to change supplier and remove barriers that prevent consumers benefitting from offering services such as demand response. Whilst this package of measures provides opportunities for early adopters of smart power devices, it does not fully consider how most consumers can meet their requirement for comfort and convenience in a decarbonising energy system. There is no evidence that consumers will take the opportunities available at the rate required to meet decarbonisation targets and the temptation will remain to invest heavily in high-cost centralised zero-carbon solution.

New thinking is required about how to effectively engage consumers, and this is the core energy system innovation challenge. There are many ways that the consumer 'choice framework' could be further amended – ideally making it easier for consumers to take actions which benefit both themselves as individuals and society as a whole. For example, the greater use of 'default' options, with consumers expressing choice through the ability to 'opt-out', would dramatically alter the nature of consumer engagement. However, this would represent a paradigm shift in thinking since the centralised determination of the default option would dominate market outcomes[5]. Compelling evidence does not presently exist to support the need for such changes, let alone the precise nature of the changes that might be required.

The key demand side innovation challenge is to explore ***how to improve consumer engagement such that it is more predictable, and how to do so in a way that wins consumer support and is acceptable from a broader political perspective***[6]. This not

[5] The default option must be attractive to consumers and, therefore, they are less likely to seek out an alternative product. This, in turn, reduces the incentives on suppliers and other service providers to innovate and develop new products for consumers.

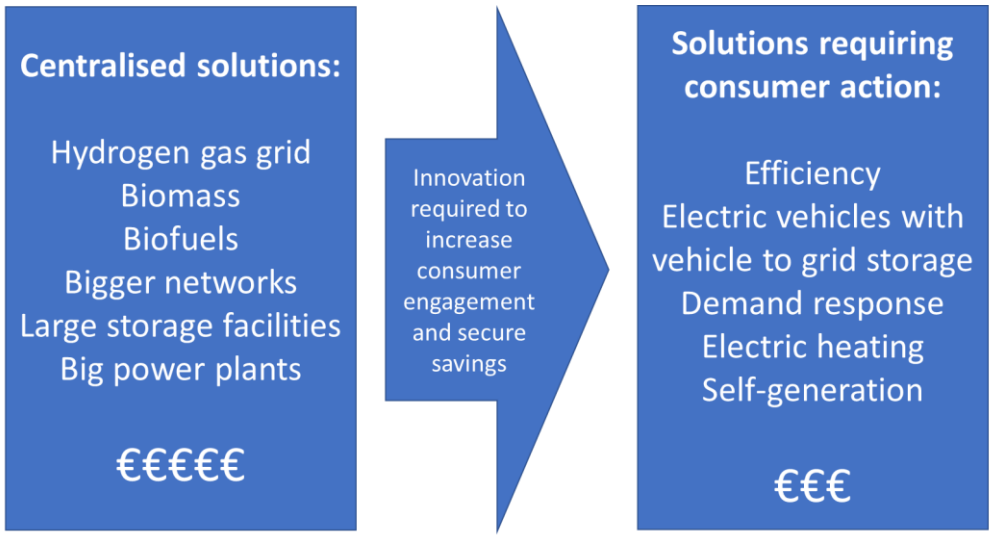
[6] The European Commission has gone some way to recognise the importance of this issue and, the Communication on Accelerating Clean energy innovation (COM(2016) 763 final), noted the need 'to deepen understanding of behavioural or other socio-economic conditions related to social acceptance of – or opposition to – climate and energy-related policies'

only requires that innovators are able to develop and test new products and services, but also that they have the freedom to adapt the regulatory and market rules that currently govern the interaction with consumers and do so in a range of different environments. For example, apart from changing the choice framework as described above, innovation in the regulatory and market framework might involve the allocation of consumers to new energy service providers underpinned by new consumer protection processes, or the direct recycling of costs saved elsewhere in the energy system to invest directly in consumer premises[7].

It is essential to understand more about consumer engagement if we are to address the policy questions set out in the boxes above. However, the real value of understanding the potential for consumer engagement will only be realised if it is clear how actions taken on the part of consumers can offset the need for deployment of centralised zero carbon technologies. This will not only involve innovation in markets and regulations but in the associated institutional design. A second, but equally important, demand-side innovation challenge is, therefore, to ***explore ways in which direct action by consumers can be used to reduce overall costs of system decarbonisation***.

The objective of these innovation challenges (namely, improving consumer engagement and off-setting central system costs) is to ensure that the cost of meeting the decarbonisation challenge is significantly reduced through harnessing the power of demand side action (see Figure 1).

Figure 1: Innovation required to increase consumer engagement and save costs



[7] There has been much discussion of the need for innovation in business models. However, such innovation is most likely to flow from innovation in regulation and markets since this will create new ways to engage consumers with new products and services.

Conclusions: Mission 2030

The EU is pursuing a raft of initiatives under the Accelerating Clean Energy Innovation banner[8]. Much of this work is highly relevant to the deployment challenge described above. However, so far it lacks a clear co-ordinating principle that would ensure that this innovation work leads directly to early and substantial progress in energy system decarbonisation. The mission of '100 carbon neutral cities by 2030' that was proposed by Professor Mazzucato has the potential to provide much needed co-ordination. **This mission should be adopted by the EU to help steer work on clean energy innovation**.

This mission will only be achieved through tackling the issues surrounding the consumer 'choice framework' and the way that investment decisions are made along the energy value-chain and between energy sectors. These are key aspects of the current regulatory and market framework. Any changes to this framework that might improve confidence in the deployment potential of demand side measures will have significant commercial and political implications. There is no ready solution to these challenges and it is likely that the required changes will vary from country to country and even at a sub-national level.

The mission of achieving 100 carbon neutral cities by 2030 can only be achieved through a well-structured process of local large-scale demonstration projects. These projects must operate within a governance framework that clearly specifies the learning requirements, supports project delivery and processes the lessons learnt to inform the next phase of demonstration, wider rollout or recommendations for changes to the regulatory and market framework. Indeed, it can be expected that the successful engagement of most consumers might require changes to the fiscal regime, product standards and regulatory incentives. The involvement of large numbers of consumers will mean that the governance process must provide a strong consumer protection framework to replace those aspects of the regulation and markets that are being suspended for the purposes of the trial. This process could also begin to build a pipeline of projects whose risk profile would be attractive to the investment community.

Work should start now to ensure the demonstration process can begin as quickly as possible. For example, research and innovation priorities for Horizon 2020 work in the period 2018 to 2020 should ensure that feasibility studies are prepared for a range of potential projects. Sufficient funding from the new Horizon Europe funding instrument as part of the 2021-27 EU budget will need to be set aside to support delivery of this mission. Also, work to develop the European Innovation Council[9] should be focused on building an appropriate governance process to support delivery of the 2030 mission.

[8] See: **https://ec.europa.eu/research/energy/pdf/accelerating_clean_energy_innovation_progress_report.pdf** for latest summary of progress.

[9] A European pilot aimed at supporting top-class innovators, entrepreneurs, small companies and researchers with the intention of scaling-up internationally. More information at **https://ec.europa.eu/research/eic/index.cfm?pg=about**

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At the heart of the energy system transformation is the move from a situation where a few key decisions about technologies are made by politicians based on public value considerations, to one where a vast number of decisions are taken involving a wide range of technologies based on individual value. The clean energy innovation agenda needs to recognise that it must refocus away from creating technology options for politicians towards understanding how to create increased individual value in an ever more complex world.

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About E3G

E3G is an independent climate change think tank operating to accelerate the global transition to a low carbon economy. E3G builds cross-sectoral coalitions to achieve carefully defined outcomes, chosen for their capacity to leverage change. E3G works closely with like-minded partners in government, politics, business, civil society, science, the media, public interest foundations and elsewhere. In 2016, E3G was ranked the number one environmental think tank in the UK.

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