UK HFCA Response to 'A smart, flexible energy system' Call for Evidence

Introduction

This response to the Call for Evidence is submitted by the UK Hydrogen and Fuel Cell Association (UK HFCA). The UK HFCA works to ensure that fuel cell and hydrogen energy can realise the many benefits offered across economic growth, energy security, carbon reduction and beyond. Through the breadth, expertise and diversity of our membership, we work to trigger the policy changes required for the UK to fully deliver the opportunities offered by these clean energy solutions and associated elements of the supply chain.

Summary

In the foreword to this Consultation the Secretary of State for Business, Energy and Industrial Strategy's refers broadly to a smart and singular energy system, including a backbone of 53 million electricity and gas meters. However, the Consultation document and the referenced papers are only about electricity issues with a single, minimal reference to 'gas, heat and transport sectors'[1]. We were disappointed to see the use of the term 'energy system' throughout the Consultation to mean electricity system. This is particularly disturbing when over four times more energy per annum flows through the transport sector and gas sector than the electricity sector.

Furthermore, the flexibility, storage, balancing and ancillary services markets should have a low-carbon paradigm, not just a low cost paradigm. However, the Consultation document is almost devoid of a low carbon driver. We believe that the emphasis should be on storing low-carbon energy and discharging it later; the carbon consequences of implementing storage need to be traceable.

The Consultation view of the system, as shown in Figure 1 as below (section 5.1, p.73), is not complete and, as a result, is significantly sub-optimal. Non-electrical and co-product solutions that will affect system requirements, such as distributed gas CHP, are missing, and the analysis of less regrets investments in electricity system flexibility[2] is seriously weakened by the exclusion of the flexibility in energy use provided by the gas system, and the changing requirements for transport energy / fuels.

[1] A smart, flexible energy system; Call for evidence, p73, section 5.1, point 3.

[2] An analysis of electricity system flexibility for Great Britain, November 2016, uses MARKEL 2011 scenarios and excludes hydrogen to reduce complexity and the scope of the study. (Appendix, Section 5, p59)

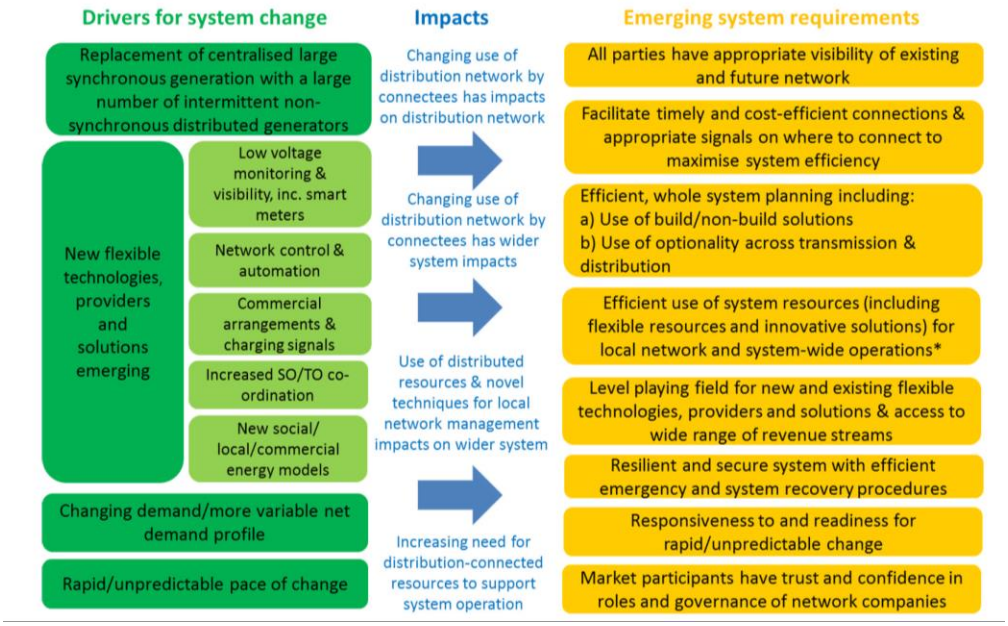

Figure 1: Drivers for change and system requirements – as shown in the Consultation, and not representative of whole energy system

Our specific responses to the 48 questions are presented below. In summary, these argue that:

1. None of the Enabling Storage issues (Q1-Q7) address gas storage options, or the opportunity for using the transport energy system to help provide flexibility in the overall energy system. For instance, a hydrogen gas distribution system and gas storage should be included as an intrinsic part of the lowest cost UK energy system, if a whole energy system approach was being considered.

2. Aggregators (Q7-Q10) will benefit from cross sector energy shifting to match resource use and customer utility requirements. This can be done by Government recognition of decarbonized energy vectors, encompassing electricity (electrons) and hydrogen (H2), to underpin a policy framework based on the premise of low societal cost at material scale.

3. The questions around System Value Pricing and Smart Tariffs (Q11-Q27) give an inappropriate amount of attention to electricity distribution issues which reflect assumptions about changes in electricity production and demand which are not proven. This results in risks of an asymmetric policy response.

4. In the Consultation, consumers (Q28-Q42) are defined by possible behaviour with respect to demand side response and access to more data, and more low emission cars - in a confusion of push and pull possibilities. There seems a real potential for a plethora of complicated policy adjustments, with relatively small parts of the UK system being developed in detail, missing and perhaps undermining greater benefits for the UK.

5. The roles of parties in the system (Q43-Q46) is completely focused on electricity, and is also based on the wrong assumptions. For example, Figure 1 above assumes no material de-carbonisation of

the gas supply system, therefore placing a heavy burden on the electricity system in the coming decades. This can only result in the conclusions of this Call for Evidence being wrong.

6. In the Consultation, innovation (Q47-Q48) is defined around electricity[3] (rather than more widely) and support is primarily defined with respect to regulatory issues[4]. Whilst the latter is very useful, the former will lead to suboptimal outcomes. The budget allocation to BEIS of £50m is also welcome, but not specified, so we await more details.

Key Conclusions:

The premise and inputs to the consultation only reflect the UK with one material future energy vector - electricity. This is basically ignoring consumers' use of gas, and the future potential of consumer options with decarbonised gas, as well as changes needed to decarbonise transport fuels (including alternative fuels). The consideration of an alternative energy vector, defined around hydrogen, together with the electricity vector, would maximize use of existing infrastructure, decarbonise at lowest social cost, increase innovation options, and maximize consumer value with the lowest regulated system bills. The role of hydrogen as an energy vector is summarized in Figure 2 below. This allows the UK to exploit existing assets and known skills to deliver low carbon, non-polluting energy for heating homes and businesses, transport, and energy security across the UK.

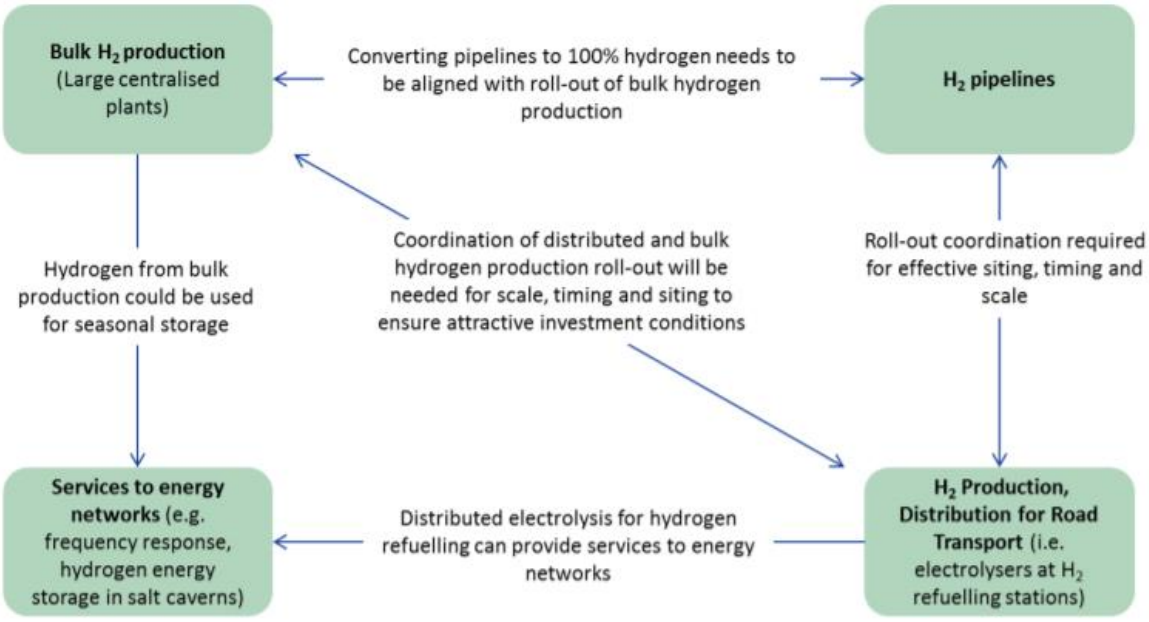

Figure 2: Role of hydrogen in the future energy system[5]

For the delivery of a smart, flexible energy system the Government needs to adopt a whole energy system view taking into account the interconnection between heat, power and transport.

[3] Ofgem low carbon networks fund
[4] Ofgem's The Innovation Link launched 8th December 2016
[5] UK HFC Roadmap, http://www.e4tech.com/wp-content/uploads/2016/11/UKHFC-Roadmap-Final-Main-Report-171116.pdf

Game changing solutions such as hydrogen and fuel cells have a range of positive implications for the flexibility of the system - please see Figure 3 below. Clear understanding of these will help to optimise outcomes. For example, fuel cells as stationary power or CHP are delivering substantial benefits to the energy system - better grid resilience, increased use of renewables, localised carbon reduction, air quality benefits etc. Similarly, hydrogen is an excellent energy storage medium - avoiding the cost of renewables curtailment and simultaneously decarbonising heat, power and transport.

Alongside the recently published UK Hydrogen and Fuel Cell Roadmap, three evidence based White Papers will be published in March 2017 by Hydrogen and Fuel Cell Research Hub (H2FC Supergen), covering:

i) The role of hydrogen and fuel cells in the future energy system;

ii) The economic impact of hydrogen and fuel cells in the UK; and

iii) The role of hydrogen and fuel cells in delivering energy security for the UK

We'd encourage careful consideration of these by the relevant Government Departments.

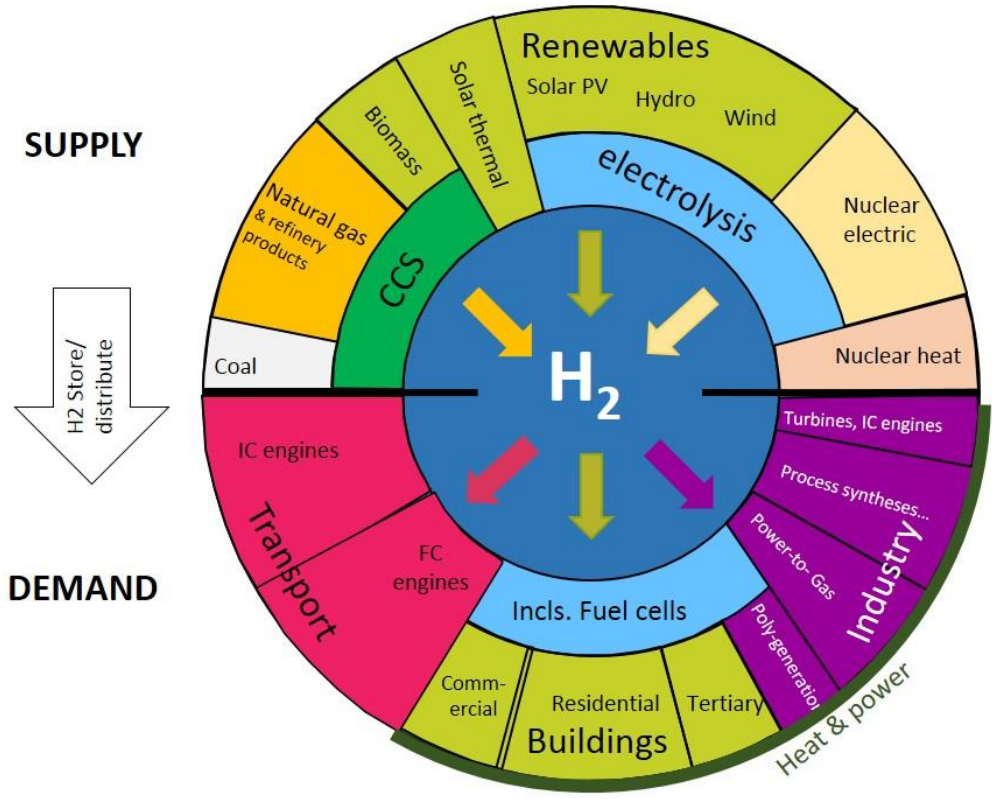

Figure 3: Hydrogen and Fuel Cells into a Smart, Flexible System[6]

[6] Adapted from: http://hho-hydrogen-energy.com/html/abouthydrogen.html

Responses to specific Questions:

1. **Have we identified and correctly assessed the main policy and regulatory barriers to the development of storage? Are there any additional barriers faced by industry? Please provide evidence to support your views.**

   No – it fails to recognize the requirements of the whole energy system.

   Companies providing decarbonised gas solutions, based around hydrogen storage, are effectively excluded from this debate. The gas system offers sector shifting, end of pipe, and embedded storage infrastructure in the existing and future hydrogen gas distribution system. Gaseous energy storage in say salt caverns is part of gas supply, but is also an energy store just like CAES or other bulk storage requiring conversion to electrons, as say in hydro plants.

   Removal of barriers to hydrogen as an energy storage solution will also facilitate low cost decarbonisation across heat, power and transport, while simultaneously fostering further flexibility through cross-sectoral linkages.

   Power-to-gas systems are currently being trialled in Europe as a mechanism for absorbing excess renewables. The generated hydrogen is transferred at low concentration into the gas grid forming a good short term measure as part of the transition to a hydrogen grid. In the UK, National Grid's HyDeploy project, which aims to provide flexibility / storage to National Grid, is looking at concentration of 10-20% hydrogen being injected into the gas grid.

2. **Have we identified and correctly assessed the issues regarding network connections for storage? Have we identified the correct areas where more progress is required? Please provide evidence to support your views.**

   No - it only focusses on electricity and electricity storage solutions, and fails to consider the energy system as a whole.

   Gas based solutions are mainly focused on material and 'minutes to months' storage solutions. The potential for fuel cell CHP and flexible demand devices is not well explored, and should be incorporated as part of a whole system approach. Fuel cell CHP, currently running on natural gas, provides low carbon heating and low carbon power without any impact on the electricity grid whilst simultaneously offering significant air quality benefits. Such systems can also utilise electrolytic hydrogen as fuel in the future, with additional grid balancing benefits. The key offerings of fuel cells are summarized in the figure below:

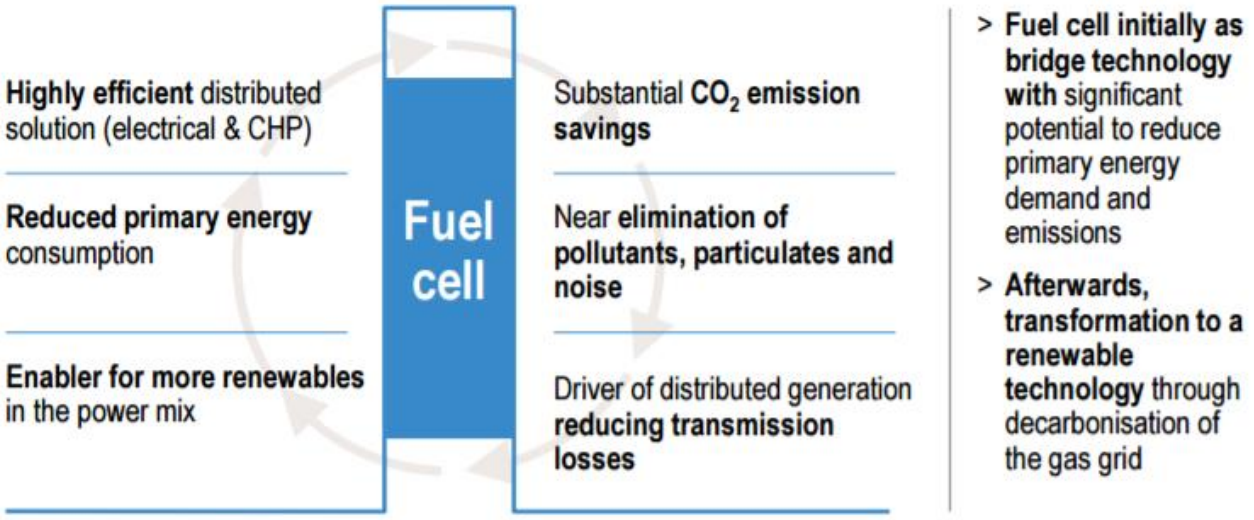

Figure 4: Fuel cells: smart, flexible solutions[7]

There is also a need to take account of the requirements and implications of non-electricity linked storage such as those related to transport energy.

3. **Have we identified and correctly assessed the issues regarding storage and network charging? Do you agree that flexible connection agreements could help to address issues regarding storage and network charging? Please provide evidence to support your views, in particular on the impact of network charging on the competitiveness of storage compared to other providers of flexibility.**

   The issues addressed may or may not address the needs of flexibility in the electricity network; they do not cover all the factors that require consideration as part of a whole system energy approach, including what changes are needed if transport energy and transport energy storage are included.

   Storage in gas systems tends to intrinsically be part of a lowest cost design. Given a consumer demand led approach to gas investments, both regulated and non-regulated, there is generally no distinction required.

4. **Do you agree with our assessment that network operators could use storage to support their networks? Are there sufficient existing safeguards to enable the development of a competitive market for storage? Are there any circumstances in which network companies should own storage? Please provide evidence to support your views.**

   The issues raised here are also applicable to the gas network. To serve gas suppliers, regulated gas infrastructure does initially and materially need to deploy both hydrogen production and storage assets. These could be of use to meet some of the issues facing those serving the electricity system.

   As part of a whole systems approach, there is also a need to consider the requirements of transport energy, which needs to be highly flexible and mobile.

5. **Do you agree with our assessment of the regulatory approaches available to provide greater clarity for storage? Please provide evidence to support your views, including any alternative regulatory approaches**

[7] http://www.fch.europa.eu/sites/default/files/FCHJU_FuelCellDistributedGenerationCommercialization_0.pdf

that you believe we should consider, and your views on how the capacity of a storage installation should be assessed for planning purposes.

There are no proper scenarios of the future relationship between the low carbon electricity and hydrogen vectors. As a consequence, the assessment is fundamentally flawed.

6. **Do you agree with any of the proposed definitions of storage? If applicable, how would you amend any of these definitions? Please provide evidence to support your views.**

   We view the ESN definition as a good starting point. Depending on its use, there may be an issue of co-products associated with a store. Notably, long term security of supply is not well addressed in value. We also note that, due to a simple electricity system focus and assumptions about interconnectors, the solutions for a smart and flexible energy system (outlined in references in point 7, p.7) are not based on a well-considered view of all UK energy use and dependencies.

7. **What are the impacts of the perceived barriers for aggregators and other market participants? Please provide your views on**
   · balancing services;
   · extracting value from the balancing mechanism and wholesale market;
   · other market barriers; and
   · consumer protection.

   Do you have evidence of the benefits that could accrue to consumers from removing or reducing them?

   The UK HFCA has no comment on this.

8. **What are your views on these different approaches to dealing with the barriers set out above?**

   The material regulated electricity and gas systems in the UK have been set up to provide secure essential services throughout the UK, and are now adjusting to a lower carbon, lower pollution future. In considering approaches to overcoming barriers, the public good is a key starting point; the aim of providing at least UK societal cost, clean, decarbonised energy vectors (electricity and gas) to (all metered) end users has 2 main implications:
   1) decarbonisation is a societal cost, not an individual user cost, and
   2) consumers/ aggregators and innovators are driven by consumer utility maximisation, which includes efficient energy use and new products and services.

9. **What are your views on the pros and cons of the options outlined in Table 5? Please provide evidence for your answers.**

   The table is not setting a wide enough view of the issues as it is mainly focused on the very short term, and only on electricity issues.

10. **Do you agree with our assessment of the risks to system stability if aggregators' systems are not robust and secure? Do you have views on the tools outlined to mitigate this risk?**

    Please see answer 8 regarding the intent. It is very difficult to do real bill comparisons for different consumer end use utility offers if it is also the intent to regulate them.

11. **What types of enablers do you think could make accessing flexibility, and seeing a benefit from offering it, easier in future?**

    The UK HFCA has no comment on this.

12. **If you are a potential or existing provider of flexibility could you provide evidence on the extent to which you are currently able to access and combine different revenue streams? Where do you see the most attractive opportunities for combining revenues and what do you see as the main barriers preventing you from doing so?**

    Opportunities to access diverse revenue streams will help to deliver cost-effective and economically sustainable storage and are to be welcomed. Please refer to answer 2 and 4.

13. **If you are a potential or existing provider of flexibility are there benefits of your technology which are not currently remunerated or are undervalued? What is preventing you from capturing the full value of these benefits?**

    Societal costs around decarbonized (and improved air quality) infrastructure (answer 8) should be by Society as a whole - i.e. Government - leaving this question of value/ profit maximisation to the market.

14. **Can you provide evidence to support changes to market and regulatory arrangements that would allow the efficient use of flexibility and what might be the Government's, Ofgem's, and System Operator's role in making these changes?**

    Under a holistic energy system, infrastructure investment across the various energy vectors to achieve policy targets (such as CO_2 emissions, air quality and security of supply) would be minimised. Third party entry costs selling services to those assets need to reflect the short run marginal benefit to those assets, whilst protecting the long run average cost to secure and evolve the material UK assets.

15. **To what extent do you believe Government and Ofgem should play a role in promoting smart tariffs or enabling new business models in this area? Please provide a rationale for your answer, and, if you feel Government and Ofgem should play a role, examples of the sort of interventions which might be helpful.**

    Please see answer 8. We believe that it is debatable whether smart tariffs can drive consumer behaviour. It would be helpful if Government and Ofgem provided short term interventions to enable proof of new technologies in improving the UK's energy system with the associated industrial and trade benefits arising from that. Similarly, a framework which enables different revenue streams to be accessed would be beneficial.

16. **If deemed appropriate, when would it be most sensible for Government / Ofgem to take any further action to drive the market (i.e. what are the relevant trigger points for determining whether to take action)? Please provide a rationale for your answer.**

    Please see answer 15. R&D and innovation are the starting point for evolving the best future value for the UK.

17. **What relevant evidence is there from other countries that we should take into account when considering how to encourage the development of smart tariffs?**

    Lessons from abroad need to be carefully assessed to avoid unintended consequences. The great variability in system configurations and local details may render such lessons inappropriate to the UK context.

18. **Do you recognise the reasons we have identified for why suppliers may not offer or why larger non-domestic consumers may not take up, smart tariffs? If so, please provide details, especially if you have experienced them. Have we missed any?**

    The UK HFCA has no comment on this.

19. **Are distribution charges currently acting as a barrier to the development of a more flexible system? Please provide details, including experiences/case studies where relevant.**

    The UK HFCA has no comment on this.

20. **What are the incremental changes that could be made to distribution charges to overcome any barriers you have identified, and to better enable flexibility?**

    The UK HFCA has no comment on this.

21. **How problematic and urgent are any disparities between the treatment of different types of distribution connected users? An example could be that that in the Common Distribution Charging Methodology generators are paid 'charges' which would suggest they add no network cost and only net demand.**

    The UK HFCA has no comment on this.

22. **Do you anticipate that underlying network cost drivers are likely to substantively change as the use of the distribution network changes? If so, in what way and how should DUoS charges change as a result?**

    The UK HFCA has no comment on this.

23. **Network charges can send both short term signals to support efficient operation and flexibility needs in close to real time as well as longer term signals relating to new investments, and connections to, the distribution network. Can DUoS charges send both short term and long term signals at the same time effectively? Should they do so? And if so, how?**

    The UK HFCA has no comment on this.

24. **In the context of the DSO transition and the models set out in Chapter 5 we would be interested to understand your views of the interaction between potential distribution charges and this thinking.**

    The UK HFCA has no comment on this.

25. **Can you provide evidence to show how existing Government policies can help or hinder the transition to a smart energy future?**

    Segregation of sectors (power / heat / transport) is not helpful and the UK HFCA strongly supports a truly system wide approach – which is lacking here. Using wrong, or out of date, inputs seems to be an issue. More comparison of energy system (TIMES) models, CGE, and deployable technology models may be necessary to improve confidence in policy making.

26. What changes to CM application/verification processes could reduce barriers to flexibility in the near term, and what longer term evolutions within/alongside the CM might be needed to enable newer forms of flexibility (such as storage and DSR) to contribute in light of future smart system developments?

The UK HFCA has no comment on this.

27. Do you have any evidence to support measures that would best incentivise renewable generation, but fully account for the costs and benefits of distributed generation on a smart system?

The UK HFCA has no comment on this.

28. Do you agree with the 4 principles for smart appliances set out above (interoperability, data privacy, grid security, energy consumption)? · Yes · No (please explain)

29. What evidence do you have in favour of or against any of the options set out to incentivise/ensure that these principles are followed? Please select below which options you would like to submit evidence for, specify if these relate to a particular sector(s), and use the text box/attachments to provide your evidence. · Option A Smart appliance labelling · Option B Regulate smart appliances · Option C Require appliances to be smart · Other/none of the above (please explain why)

The UK HFCA has no comment on this.

30. Do you have any evidence to support actions focused on any particular category of appliance? Please select below which category or categories of appliances you would like to submit evidence for, and use the text box/attachments to provide your evidence · Wet appliances (dishwashers, washing machines, washer-dryers, tumble dryers) · Cold appliances (refrigeration units, freezers) · Heating, ventilation and air conditioning · Battery storage systems · Others (please specify)

The UK HFCA has no comment on this.

31. Are there any other barriers or risks to the uptake of smart appliances in addition to those already identified?

The UK HFCA has no comment on this.

32. Are there any other options that we should be considering with regards to mitigating potential risks, in particular with relation to vulnerable consumers?

The UK HFCA has no comment on this.

33. How might Government and industry best engage electric vehicle users to promote smart charging for system benefit?

The Government should adopt a technology neutral approach to low carbon transport, which recognizes the full range of attributes and solutions. Hydrogen fueled vehicles are recognized as the optimal solution for certain types of journey.

A Battery Electric Vehicle (BEV) constitutes a very large electrical load in comparison to the entire electrical load of a typical domestic dwelling. Additionally, the timing of each recharge event is under the control of consumers. Thus, if a significant number of BEV users choose to recharge their vehicles on the basis of lifestyle

schedules or range anxiety concerns, rather than upon time-of-use electricity tariffs, then very substantial increases in power flows will occur in distribution networks at peak times and often at locations that do not currently have adequate electrical supply (such as car parks etc.). This will lead to increased use of high-carbon power plant, and will soon require distribution network reinforcement. Hence, there is an intrinsic incompatibility between BEV recharging and achieving a cost-effective low-carbon power system, simply because many consumers will wish to exercise control of when their BEV, which is already significantly cheaper than their previous hydrocarbon fueled vehicle, is recharged and how fully charged it is before they use it. When they are paying 2p/mile for the energy for their vehicle, the question of how cheap it would need to be, to make it worthwhile for them taking the risk that their vehicle is not fully charged & ready for their next journey is key.

Conversely, in the case of hydrogen fueled vehicles, the hydrogen storage tanks of a hydrogen refueling station (HRS) enable production and demand to be decoupled in time phasing, with electrolytic hydrogen production occurring during off-peak hours by designs.

34. What barriers are there for vehicle and electricity system participants (e.g. vehicle manufacturers, aggregators, energy suppliers, network and system operators) to develop consumer propositions for the · control or shift of electricity consumption during vehicle charging; or utilisation of an electric vehicle battery for putting electricity back into homes, businesses or the network?

Consolidated thinking is needed between the transport and power sectors in Government to appropriately manage the greater adoption of BEV and hydrogen vehicles in the UK. It is particularly important for the Government and the electricity industry to recognise the attributes of hydrogen vehicles when fuelled by hydrogen produced outside of peak times and as a means of absorbing excess renewable electricity. Electricity networks can utilise electrolyser-HRS to provide grid balancing services and assist use of renewable and nuclear power to offset present and future peak power demands.

Electrolyser-based hydrogen refuelling stations are being rolled out in the UK now and are able to operate and contribute to flexibility services due to the rapid response capability of the electrolysers. As the hydrogen demand from the FCEV population grows the aggregate load provided by such HRS will become nationally significant as a new flexible load. This is a form of 'disruptive innovation', and it's outside the electricity sector driven by a need for clean fuel from the mobility sector, which should be appreciated as a synergistic solution.

35. What barriers (regulatory or otherwise) are there to the use of hydrogen water electrolysis as a renewable energy storage medium?

Conversion of electricity to hydrogen through water electrolysis and use of this hydrogen in the gas grid (P2G), mobility or industry can productively utilise nearly all excess renewable energy, contributing to decarbonisation, while offering grid balancing services. According to a recent study[8], the European potential for installed electrolyser capacity in 2050 high-RES scenarios would be in the hundreds of GWs.

Currently, the main barrier is the electrolyser cost (and a scaled market for hydrogen use); this will significantly improve if mass deployment were facilitated and better utilization supported, as cheap excess power from low carbon sources is still limited.

Additionally, Steam Methane Reforming (SMR) is an established hydrogen production technology which is helping the transition to a low carbon future.

[8] http://www.fch.europa.eu/sites/default/files/CommercializationofEnergyStorageFinal_3.pdf

36. Can you provide any evidence demonstrating how large non-domestic consumers currently find out about and provide DSR services?

The UK HFCA has no comment on this.

37. Do you recognise the barriers we have identified to large non-domestic customers providing DSR? Can you provide evidence of additional barriers that we have not identified?

The UK HFCA has no comment on this.

38. Do you think that existing initiatives are the best way to engage large non-domestic consumers with DSR? If not, what else do you think we should be doing?

The UK HFCA has no comment on this.

39. When does engaging/informing domestic and smaller non-domestic consumers about the transition to a smarter energy system become a top priority and why (i.e. in terms of trigger points)?

The UK HFCA has no comment on this.

40. Please provide views on what interventions might be necessary to ensure consumer protection in the following areas · Social impacts · Data and privacy · Informed consumers · Preventing abuses · Other

The UK HFCA has no comment on this.

41. Can you provide evidence demonstrating how smart technologies (domestic or industrial/commercial) could compromise the energy system and how likely this is?

The UK HFCA has no comment on this.

42. What risks would you highlight in the context of securing the energy system? Please provide evidence on the current likelihood and impact.

We would note that the gas system is less prone to cyber attack due to less need for fast and close connectivity.

43. Do you agree with the emerging system requirements we have identified (set out in Figure 1)? Are any missing?

Figure 1 does not cover the full energy system and, as such, fails to capture the totality of opportunities and issues around storage, aggregation, system pricing, consumers etc.

44. Do you have any data which illustrates: a) the current scale and cost of the system impacts described in table 7, and how these might change in the future? b) the potential efficiency savings which could be achieved, now and in the future, through a more co-ordinated approach to managing these impacts?

The UK HFCA has no comment on this.

45. With regard to the need for immediate action a) Do you agree with the proposed roles of DSOs and the need for increased coordination between DSOs, the SO and TOs in delivering efficient network planning and local/system-wide use of resources? b) How could industry best carry these activities forward? Do you agree the further progress we describe is both necessary and possible over the coming year? c) Are there any legal or regulatory barriers (e.g. including appropriate incentives), to the immediate actions we identify as necessary? If so, please state and prioritise them.

Increased co-ordination is required at all levels to deliver a robust and flexible system incorporating electricity, gas, power, heat and transport.

46. With regard to further future changes to arrangements a) Do you consider that further changes to roles and arrangements are likely to be necessary? Please provide reasons. If so, when do you consider they would be needed? Why? b) What are your views on the different models, including:

- **i. whether the models presented illustrate the right range of potential arrangements to act as a basis for further thinking and analysis? Are there any other models/trials we should be aware of?**
- **ii. which other changes or arrangements might be needed to support the adoption of different models?**
- **iii. do you have any initial thoughts on the potential benefits, costs and risks of the models?**

The evolution of the regulation of the electricity system needs to be realistically aligned with the future and equally valid scenarios offered by the decarbonisation of the gas grid, and transport energy - getting the best out of the material energy vectors of electricity and hydrogen.

47. Can you give specific examples of types of support that would be most effective in bringing forward innovation in these areas?

We recommend consumer utility orientated private sector products and services (R&D, scale trial supported) based on access to decarbonised energy vectors (materially regulated infrastructure, Government driven then regulated returns).

If the price of hydrogen as a transport fuel was equal to or below that of natural gas, consumers would want to buy it. This is evidenced by the increased interest in gas itself as a transport fuel, as it saves cost relative to diesel.

48. Do you think these are the right areas for innovation funding support? Please state reasons or, if possible, provide evidence to support your answer.

Please see answers 15 and 16.