



A report by the Energy Technologies Institute

# ENABLING EFFICIENT NETWORKS FOR LOW CARBON FUTURES:

## OPTIONS FOR GOVERNANCE & REGULATION



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# Chapter 1

## Background to the project

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**This report summarises key themes emerging from the Energy Technologies Institute's (ETI) project 'Enabling efficient networks for low carbon futures'. The project aimed to explore the options for reforming the governance and regulatory arrangements to enable major changes to, and investment in, the UK's energy network infrastructures. ETI commissioned four expert perspectives on the challenges and options facing the UK.**

The ETI decided to initiate this new thinking because its scenarios<sup>1</sup> for a low carbon UK energy transition highlight major challenges for energy network infrastructures and how investment decisions are governed, incentivised and regulated. The ETI scenarios were developed from a 'whole system' perspective, and point to the high value of enabling a broader mix of energy vectors (heat, power and gaseous fuels), within a more integrated 'system' of energy transmission, storage and distribution.

In terms of energy network infrastructure, the scenarios implied the need to:

1. Substantially adapt and enhance existing network infrastructures (e.g. by investing to adapt electricity networks to meet the needs of decarbonised generation).
2. Create efficiently configured new network infrastructures (e.g. new heat networks and/or heat-based energy storage).
3. Integrate different networks to operate together in real time as a 'system', and enable efficient transmission, storage and use of energy in different forms (e.g. power, heat and gaseous energy vectors).

Enabling these kinds of future energy mixes would raise new and different issues for the regulation and governance of the UK's energy network infrastructure which both challenge and go beyond the current essentially 'vector-specific' statutory regimes (e.g. the electricity and gas acts).

Summaries of the papers produced in carrying out this project are contained in the appendix to this paper and the full papers are published alongside this summary paper.

- Energy governance and regulation frameworks – time for a change?  
Keith MacLean, February 2016
- Enabling efficient future energy networks – what governance and regulation will be needed in 2030?  
Robert Hull, February 2016
- Enabling efficient networks for low carbon futures.  
Jorge Vasconcelos, February 2016
- Markets, Policy and Regulation in a Low Carbon Future.  
John Rhys, January 2016

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<sup>1</sup> Options Choices Actions: UK Scenarios for a Low Carbon Energy System Transition  
<http://www.eti.co.uk/wp-content/uploads/2015/02/Options-Choices-Actions-Hyperlinked-Version-for-Digital.pdf>

## New thinking on energy network governance and regulation

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The ETI recognises that a range of work to examine the future of energy network governance and regulation is already being taken forward by a number of different bodies. This includes for example:

- **Ofgem's** work through its Smart Grid forum, on new 'non-traditional' business models, on extending competition into the design, construction and ownership of new onshore network assets, and more generally on horizon-scanning.
- **The University of Exeter's IGov** project aims to 'understand and explain the nature of sustainable change within the energy system, focusing on the complex inter-relationships between governance and innovation'. For example, IGov has put forward proposals for a new institutional framework to govern the GB energy system, drawing on international comparisons (Denmark and New York state).
- **The Energy Systems Catapult and the Institution of Engineering and Technology** have collaboratively led a project on Future Power Systems Architecture for the former Department of Energy and Climate Change (now part of the Department of Business, Energy and Industrial Strategy). The project has focused on the new technical functions needed to plan, design and operate the future power system in response to new technical challenges. These challenges are beyond the traditional technical boundaries and include new business models which will require whole systems analysis to deliver flexible, future proofed user needs.
- A number of projects being taken forward by the **UK Energy Research Centre (UKERC)** to address themes relevant to energy network governance and regulation – including for example, its Energy System Decision Making programme.
- The **Oxford Martin Programme** on integrating renewable energy 'aims to deliver a framework for understanding technical, market and policy requirements for integrating renewables'.
- The **Energy Research Partnership** has done work on a range of issues, including for example, the financial, regulatory, political, commercial, legal barriers to system-wide energy storage. ERP is currently leading a project (with stakeholders) to examine the future of electricity utilities, including alternative business models and regulation.

The ETI aims to complement this activity, in particular by providing a **whole energy system perspective**, and by contributing analysis and scenarios that are built on sound understanding of the underlying **engineering and technology** challenges.

## Chapter 2

### Overview of the four expert perspectives

In order to explore these issues the ETI commissioned four experts to produce conceptual perspectives on the key governance and regulatory issues arising from the need to adapt and invest in energy networks for low carbon futures.

The four expert perspectives provide contrasting and challenging views and have been produced by:

- **Bob Hull** KPMG, formerly Managing Director of Ofgem eServe & Director of Transmission, Ofgem.
- **John Rhys** Oxford Institute of Energy Studies, formerly Managing Director at NERA Economic Consulting and Chief Economist of the UK Electricity Council.
- **Jorge Vasconcelos** Chair NEWES, New Energy Solutions, formerly Chair of the Portuguese energy regulator, founder and chair of the Council of European Energy Regulators.
- **Keith Maclean** Chair of UK Energy Research Centre, Co-chair of the Energy Research Partnership and formerly Policy and Research Director at SSE.

The table below summarises the overall concepts presented in each perspective.

High level summary of expert perspectives				
	Hull	Rhys	Vasconcelos	Maclean
<b>Key drivers of the need for reform</b>	Major decisions lie ahead – costs & benefits need to be examined on a whole system basis	Multiple market failures affect energy networks (especially power sector)	The twin cross-cutting challenges of decarbonisation & new ICT make current regulatory frameworks obsolete	Decision making has been recentralised without institutional competence; a long term whole systems approach is needed
<b>Overall reform concept</b>	Government leadership on whole energy system policies – within an <b>evolving market structure</b>	Strong reform of power sector governance, with more <b>central coordination</b> of investment and <b>long term contracting</b> via a central purchasing agency	Reforms to deliver <b>consistency and co-ordination</b> in energy market design, governance and regulatory frameworks	A <b>mixed economy</b> approach with clearer government role, system wide design, independent regulation & competitive investment & delivery

Key components of proposed reforms:			
Hull	Rhys	Vasconcelos	Maclean
Create a 'senior advisory body' or <b>'Energy Commission'</b> to advise on whole system policy	<b>Central purchasing agency</b> to manage competition for new (long-term) contracts & incentives to drive efficiency in power sector	A new <b>high level Advisory Committee to oversee and advise on consistency</b> in policies and operational developments across different energy systems	Reform and <b>clarify role of central government</b> decision making and long term objectives, backed by clear legislation & long term commitment to financing
<b>Independent System Operator</b> role to handle whole energy system planning & technical issues	Greater role for <b>competition and consumer participation in real time markets</b>	Reallocate market and system operation roles for consistency with long term targeted transition path	<b>Strengthen local authorities' role</b> in determining low carbon infrastructure for heat and transport
Reform and consolidation of existing institutions into a <b>'Clean Energy Delivery Agency'</b> and an <b>'Industry Code Administrator'</b>	Improved more <b>location specific network pricing</b>	Reform markets and system operation to manage the complexities and control issues raised by new ICT	Create a body responsible for whole system design issues and expert advice. Extend <b>'independent system architect'</b> to cover all energy networks
Adjust RIIO regime with new decarbonised incentives and consideration of 'whole energy system solutions'	Case for a <b>Heat Networks Authority</b> to enable and coordinate large scale heat investments	Create new governance mechanisms and structured dialogue to guide the process of reform	Continue with strong independent regulation – potentially extended to heat networks
Opportunities for competitive design, build, finance and maintain models			Enable <b>strong market discipline in construction/ delivery &amp; in wholesale and retail energy markets</b>

## Chapter 3

### Diagnoses of the need for reform

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**All of the perspectives agreed on the need for new or reformed governance mechanisms to steer the transformation of the energy system and infrastructure – but there was an interesting variation in the diagnoses of why there is a need for reform.**

**Bob Hull** of KPMG argues that:

“While the current governance and regulatory regime has worked effectively to drive major new investment in renewables and associated networks in pursuit of 2020 targets, there are a number of challenges if 2050 whole energy decarbonisation solutions are to be attained. In particular:

- Clarifying within government **who is responsible for a) designing and b) delivering a 2050 ‘whole energy system’** solution for decarbonisation and where accountabilities sit
- **Clarifying the regulatory responsibilities for whole energy systems**, including transport and heat” (p22).

In Hull’s view:

“Responsibility for managing energy system operation and security of supply is currently split between several different bodies. A key role is performed by National Grid’s System Operator function on behalf of the government and industry. While in the past this role has sat well with a company that owns electricity and gas transmission networks, it is less likely to suit the needs of whole system planning and operation, involving more distributed energy and heat networks” (p22).

**John Rhys’** approaches the need for reform by identifying a number of market failures, and in particular emphasises:

“The need for an institutional architecture that provide **long term commitments and security for infrastructure investors**” (p4).

For Rhys the power sector is particularly crucial, and he points to a range of challenges including:

- “Regulatory and policy uncertainty is now endemic
- Co-ordination issues, without any obvious market-based solution
- The capacity issue and system security”.

He says:

“The essential strategic **choice is a binary one, between reliance on a series of ad hoc ‘fixes’** to correct real or perceived deficiencies in existing market structures... **and a fundamental re-think and redesign** of how markets should operate in the power sector” (p22).

**Jorge Vasconcelos’** paper focuses on how:

“The creation of markets is always a social enterprise, so markets, governance and regulatory frameworks should be shaped with policy objectives in mind. Energy markets and governance and regulation of energy network infrastructures should be designed to support the broad shape of the desired transition to a low carbon future.

The complex choices around transition to a low carbon future and new technical developments, demand a **greater focus on consistency and co-ordination in energy market design, and governance and regulatory frameworks** across the energy system. This will require the introduction of explicit new mechanisms to achieve”.

In identifying the need for reform Vasconcelos emphasises:

- a. “The **twin cross-cutting challenges of reducing CO<sub>2</sub> emissions from all forms of energy and the rise of modern ICT are rendering current electricity and energy market designs and policy frameworks inadequate and obsolete.** This makes comprehensive market redesign and regulatory reform inescapable.
- b. The transition to a **low carbon future challenges ‘energy silos’** (separate market and regulatory frameworks for different energy sectors and infrastructures).
- c. The **multi sectoral and multi layered nature of the energy transition,** raises new complexities for managing, regulating and co-ordinating investment efficiently.
- d. Different specific governance and regulatory challenges arise, depending on the shape and nature of the energy transition that policy makers wish to pursue.”

In approaching the task of reform, Vasconcelos argues:

“it is necessary to ensure a dynamic balance between the ‘creative destruction’ of market forces and technological innovation, on the one hand, and the intrinsic stringency of power system reliability governance, on the other hand” (p1).

**Keith Maclean** makes a case for changes to deliver ‘systems thinking and governance’:

“... **ever more layers of complexity** have been added to the energy frameworks, and the government now has more powers than the Central Electricity Generating Board (CEGB) ever did and itself admits that **little, if anything can be built in the electricity sector without some form of contract with the government** or one of its agencies. However, this was never the explicit aim of policy and it is highly questionable whether it has been accompanied by the build-up of the necessary institutional competence and resource to exercise all of these powers.

... **the energy industry is now very fragmented** which means that there is little, or no counterbalance to the decision making or the exercise of the many powers by the government – there is no single body or strong figure, like the Chief Engineer at the CEGB to authoritatively and convincingly talk for the industry.

It is now becoming apparent that significant refocussing of the agents of decision making and delivery is essential to **re-establish the institutional competence needed to consider whole system issues** and to manage the decarbonisation challenge successfully and cost effectively” (p10).

Maclean summarises the need for change in these terms (p21):

- “The current decision making frameworks have already evolved well beyond what they were originally created to do
- There has already been a fundamental shift back to state decision making, but without establishing the necessary institutional competence, resource and counterbalance
- The changes needed for decarbonisation require a whole systems approach and current frameworks are focussed on an unbundled and fragmented one
- For the scale of the challenge, an unplanned incremental approach will be ineffective and inefficient
- The long duration of the transition requires long term clarity which is not provided currently
- Investor confidence has been badly damaged and must be re-established”.



## Chapter 4

### Delivering a whole energy system perspective

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**Ensuring that a whole energy system perspective shapes decisions about investment in long life infrastructure assets is a key theme in all the papers, but the authors vary in their emphasis.**

**Bob Hull** looks ahead to the need to decarbonise heat and the potential impact on gas supply:

“Difficult decisions lie ahead. One of which is **the future of natural gas** in the energy supply mix. While decarbonisation to date has focused on electricity, if 2050 targets are to be met then gas will need to be decarbonised. Another difficult and potentially conflicting decision concerns the **deployment of heat networks** and associated energy saving measures.

... major national policy decisions may be required, for example, to promote the replacement of natural gas with hydrogen, or to possibly substitute (where appropriate) gas networks with decarbonised heat networks, or electric heating. Such **decisions will require examination of costs and benefits on a whole system basis**” (p23).

For **John Rhys** the power system is of primary importance and occupies centre stage in his analysis:

“Electricity assumes crucial significance... as the key vector in a low-carbon economy, ... the primary choice of vector for most if not all of the available low carbon technologies...

... a well organised power sector should also enable better coordination with other key parts of the energy sector. Potentially key interactions are in carbon capture and storage (CCS), combined heat power, biomass, hydrogen and transport” (p6).

**Jorge Vasconcelos** argues that:

“The multi sectoral and multi layered nature of the energy transition raises new complexities for managing, regulating and co-ordinating investment efficiently”.

He suggests:

“The **isolation of the energy sectors has been challenged** by two recent developments: **climate policy and modern information and communication** technologies. These novelties concur in abolishing the previous walls and establishing multiple interactions among these sectors, even encompassing other energy related sectors such as transportation and waste management” (p6).

**Keith Maclean’s** view is that:

“The **governance of the decision making process must be capable of covering all of the energy system – heat and transport as well as electricity –** and fully consider the networks alongside the supply and demand measures” (p13).

## Chapter 5

### Proposals for the shape of new governance arrangements

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**The four experts presented a range of proposals for the design of new governance arrangements to address the needs they had identified.**

**Bob Hull** (p22):

“There are benefits in terms of accountability, effectiveness, and cost in moving to an institutional and governance framework that includes:

- **Central Government policy oversight of whole energy systems**, supported by a new advisory ‘**Energy Commission**’.
- Maintenance of market based industry frameworks, with oversight by a national Regulator.
- Creation of an ‘**Independent System Operator**’ that fulfils technical advisory and delivery roles for Government, Regulator and the Industry.
- **Simplification of energy system administration and regulation** by consolidation of existing bodies into a ‘**Clean Energy Delivery Agency**’ and an ‘**Industry Code Administrator**’.

**John Rhys** gives primacy to the power sector in his consideration of new governance, proposing (p22) a:

“strong form... separate **central procurement agency**, with real commercial responsibilities, and a specific obligation to deliver on carbon objectives and system security”.

The agency would be “charged with implementing policy through its procurement decisions”.

In other sectors, Rhys identifies a case for a “**Heat Network Authority** to enable, promote and coordinate development of large city-wide schemes” (p45).

**Jorge Vasconcelos** focused on the theme of consistency in his recommendations for new governance arrangements, with the centre point of his vision being:

“A new **high level Advisory Committee to oversee, monitor and advise on consistency** in policies and operational developments across different energy systems and different layers.

- The remit of the Committee should **extend across all relevant energy markets and infrastructures**, thereby ending ‘silos’ in governance and regulation.
- The Committee should **propose legal or regulatory action when consistency is at risk**, threatening consumer welfare or the achievement of climate and energy policy objectives.”

This would also need to be supported by further reforms to:

“Redefine and reallocate market and system operation functions and roles to be consistent with decisions about the targeted transition path to a low carbon future.

Redesign markets and system operation arrangements to manage the complexities and control issues raised by new ICT at different levels of energy systems, and to realise the opportunities they open up.

Create new governance mechanisms and structured dialogue to guide the process of reform.”

**Keith Maclean's** recommended reforms centre around a 'mixed economy' approach and aim to create:

"A clearer role for government decision making and a greater recognition of the importance of system wide design, with truly independent regulation and competitive, efficient market investment and delivery" (p21).

Specifically Maclean recommends:

**"A body responsible for designing the system, and which could also provide expert, informed advice to decision makers"** (p24).

In Maclean's view the 'system architect' idea proposed by the IET<sup>2</sup> "would **have to be extended to also cover gas transmission and all distribution networks**, as well as national level issues covering the energy impacts of the **heat and transport sectors**. This could be further enhanced through a **network of local architects working with, or for, local authorities and dealing with the regional aspects of distribution, heat and transport**."

Only with such a comprehensive approach to design will it be possible to **recognise and value the system characteristics...** and to optimise the respective costs, benefits and values for the whole system" (p25).

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2 Britain's power system: the case for a system architect; IET briefing paper, December 2014

## Chapter 6

### The role of markets & competition

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**All the perspectives see a role for markets and competition in enabling the right kinds of investment, but envisage a variety of mechanisms for this.**

**Bob Hull** draws on Ofgem’s experience of opening up competition in distribution connections and offshore transmission – as well as more recent moves to compete the design, construction and ownership of onshore assets. Hull suggests these models could be extended to ‘local heat networks and integrated distributed energy installations’. As an example, he suggests (p27) that:

“Similar to Local Authority tendering of waste to energy projects, competitive tenders of long term heat network contracts or licences could take place for individual cities or regions”.

**John Rhys** emphasises competition between generation technologies for new contracts within a framework of central purchasing, while envisaging significant scope for more innovative market arrangements and new “consumer offerings” in retail supply. In the retail market Rhys argues (p2) for reforms to:

“Enable more effective competition in the supply market, allowing electricity suppliers to act more innovatively as demand-side aggregators, with radically different service offerings for customers that will also help shape consumer loads”.

Rhys also suggests that:

“Network pricing will play a much more important enabling and shaping role in the future and need substantial rethinking. It should be more cost reflective and... much less averaging...”

**Jorge Vasconcelos** suggests the need for **substantial redesign of electricity markets** (p40),

“Due to the deep structural changes not only in the electricity sector, but also in relevant ‘adjacent’ sectors... **redesign concerns not only wholesale energy markets, but also ancillary service markets and retail markets...** new electricity... market segments are emerging (e.g. electric vehicles, virtual power plants, hydrogen) that **challenge the functioning of traditional wholesale electricity markets** and require new governance models”.

Vasconcelos suggests that local electricity markets will emerge, reflecting the economics of bottom up decentralisation, and that the interface between system operation and market redesign will need close attention, “given the technical complexity of the matters involved”.

**Keith Maclean** offers an alternative analysis of the role of competition in the context of “high levels of intervention in this major decarbonisation transition”, suggesting that there is scope to maximise the constructive role of competition (and achieve lower financing costs) by using a staged approach to tendering for design, development, construction and operation of high capital cost new long life assets. Greater clarity in roles between government, regulators and the private sector (p20):

“Can optimise costs through competitive tendering and competition in performance, as well as reduce the cost of capital by reducing political risk and better apportionment of the residual risk”

Maclean also points to ‘iniquities’ in network charging and hints at the need for a “transition to a charging system better suited to future needs of networks as part of the overall system”.

# Chapter 7

## Local and decentralised action and decisions

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**A theme that emerges in all of the perspectives is a more prominent local and decentralised dimension to decisions on energy networks and operation.**

**Bob Hull** envisages:

“The potential emergence of locally planned energy microgrids, including heat networks, where communities are in control of their energy use and deployment” (p4).

However, Hull also emphasises (p2) that ‘major national policy decisions may be required, for example, to mandate the replacement of natural gas with hydrogen, or... the replacement of gas networks with decarbonised heat networks... such decisions will require examination of costs and benefits on a whole system basis.’

Hull suggests (p27) that:

“Future infrastructure solutions may increasingly involve the local delivery of electricity, gas and heat... to a particular community. Such a community energy solution could offer opportunities for existing network companies and suppliers, and new entrants, to invest and collaborate together... However, optimum solutions may require closer integration... changes to regulations to allow local reintegration of generation, network and supply services. If integrated community energy solutions become attractive... then creation of a new utility asset class, and tendering for, cross-sectoral local solution providers may be needed”.

While **John Rhys** emphasises the role of central purchasing in relation to the power sector he also notes (p24) that:

“Relevant options for low carbon development of the heat sector are conditioned largely by geographical factors”.

Rhys notes a number of challenges and “necessary conditions for heat networks to develop” (p30), discussing for example, the tension between collective and individual solutions. Rhys proposes a National Heat Authority to stimulate, co-ordinate and advise on heat network solutions or local initiatives in ‘favourable geographies’ (p33).

**Jorge Vasconcelos** envisages the emergence of local electricity markets, which will raise new challenges for ‘traditional regulation’, with questions around how local markets are coordinated horizontally among themselves and vertically with regional, national and EU markets (p40). The interface between markets and system operation is likely to become more complex in more decentralised transitions of energy systems, and new types of risk are likely to emerge.

**Keith Maclean** suggests (p23) that:

“... many elements of the energy system can (and should) develop at a local and regional level. Local authorities also have responsibility for local planning, building standards, council tax and a number of other administrative functions which could be central to the success of decarbonisation investment.

... a significant proportion of the necessary carbon emissions reduction from the heat sector needs to come from energy efficient investment in buildings... Local authorities... are well positioned to coordinate the delivery of such investment...”

In particular, Maclean (p24) sees a clear case for local authority involvement in investment to decarbonise heat:

“With a variety of **potentially mutually exclusive infrastructure solutions to decarbonise space heating and hot water provision, local authorities could play a critical role** in determining which solutions are best suited to which areas... **planning the transition** and communicating with those affected.

Otherwise there is a real **risk that a piecemeal approach** could develop...”

Maclean also suggests that ‘with regard to heat and transport solutions local authorities can also act as anchor clients’. For local authorities to play this role, Maclean envisages investment in necessary human resources, as well as national or pooled schemes to support local expertise.

# Chapter 8

## Conclusions & next steps

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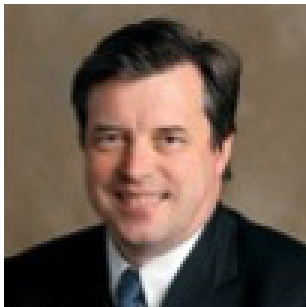
**The ETI is publishing these perspectives to stimulate engagement and new thinking about how best to govern, regulate and incentivise the billions of pounds of investment in energy network infrastructure that will be required to support the UK's transition to a low carbon future.**

We are also publishing a series of papers that explore the practical, logistical and engineering challenges for energy networks raised by the transition to low carbon futures. These point to the need for strategic and timely decision-making based on sound evidence about investments in long-life assets. The ETI will continue to explore and analyse the UK's transition to a low carbon future from a whole-system perspective and share its insights, and we welcome further engagement with stakeholders on these issues.

If the UK is to successfully deliver a low carbon energy system major changes to existing networks will be needed and clear governance and regulatory frameworks will be needed to underpin major new investments in long life network infrastructures. A range of useful work has already been undertaken focusing particularly on electricity markets and networks. **The ETI welcomes this work, but we also recommend that it is extended to consider more strongly the whole system and multi-vector dimensions of transitioning our low carbon energy infrastructure.**

## Appendix: concept summary

### Enabling efficient future energy networks: what governance and regulation will be needed in 2030?



#### A perspective for the ETI by Bob Hull

KPMG, formerly Managing Director  
of Ofgem eServe & Director of  
Transmission, Ofgem



#### Strategic concept for reform

By 2030, the UK energy system will be very different from today – decarbonisation means the energy mix for electricity, gas, heating and transport is likely to change significantly, and be more closely interlinked.

The concept presented here is for evolution of the governance and network regulatory frameworks to enable an economically efficient transition to low carbon energy, alongside new mechanisms to guide key decisions which have whole energy system dimensions. This approach to reform can extend and build on existing initiatives such as improvements to network price controls, or development of competitive frameworks for new asset design, construction and ownership, while also taking on a broader whole energy system framework.

Decarbonisation raises major new challenges, particularly in heat and transport sectors where change is at an early stage and substitute fuels are uncertain. The future of gas networks could see significant change, with potential for hydrogen or more decentralised whole energy systems to play a greater role. This could mean big changes for networks, both in planning and investment and in operation. New governance institutions with a whole energy system perspective are needed to provide an environment for clear long term investment decisions and major national policy decisions (e.g. mandating the replacement of natural gas with hydrogen), within a broader energy sector where markets continue to drive choices.



#### Key priority measures

- Establish new governance institutions (e.g. an ‘Energy Commission’ and ‘Independent System Operator’ roles) to advise on, and help deliver, 2030 whole energy system policies respectively, while retaining a broad market-based structure for energy.
- An Energy Commission should advise government on delivery of major deployment options, extending beyond the CCC’s current role in advising on carbon budgets. This could be implemented as a standalone body of technical experts or in the form of a widened role for the CCC.
- An expanded Independent System Operator role should take on wider energy planning and operational roles, to enable and govern whole energy system solutions.
- Evolve existing regulatory and market regimes to address whole energy system issues, both optimising and providing certainty for future network investment decisions. For example, Ofgem should also be required to consider trade-offs across whole energy system issues (e.g. decarbonisation of heat and transport sectors).
- Build on existing regulatory initiatives to compete the design, construction and ownership of assets (e.g. offshore and now onshore transmission assets) to enable competition for new asset ownership (where advantageous) for new discrete network infrastructure, to bring benefits of efficiency and innovation. Potential areas where this approach can be applied include local heat networks and integrated distributed energy installations.



- Reform and consolidate existing sector institutions to enable clearer and more efficient administration of functions.
- Ensure that Ofgem's RII regime for network price controls in 2021 and 2023 delivers the right investment incentives to enable longer term decarbonisation options.



### Supporting analysis: key challenges and issues

1. The approach to reform should be placed within a broad historical perspective. Energy network governance and regulation has been constantly evolving over the past century or more of history, as circumstances and challenges have changed.
2. Long term investment decisions will be needed, and changes to governance and regulation will take time to introduce. From this perspective 2030 is not far in the future.
3. The challenge of decarbonisation raises whole energy system issues. While there has been good progress in decarbonising electricity sector, heat and transport sector decarbonisation are lagging significantly. New solutions could involve more distributed energy and heat networks, raising different planning and operational issues.
4. Decarbonisation of heat and transport raises major uncertainties, particularly around the future of gas networks and the potential pattern of heat solutions and related network investments. Heat accounts for around 40% of total UK energy demand.
5. The existing market and regulatory framework has successfully evolved to enable investment in delivering significant changes to networks (e.g. investment in transmission driven by growth in renewables, or transitioning gas networks to incorporate inter connectors and LNG terminals). Similar approaches can be taken to enabling key network investments driven by decarbonisation challenges (e.g. in the heat sector).
6. Existing codes and institutions have become complex and there is a strong case to consider simplification and consolidation of this institutional architecture.

## Appendix: concept summary

### Policy and regulatory frameworks to enable network infrastructure investment for a low carbon future



#### A perspective for the ETI by John Rhys

Oxford Institute of Energy Studies, formerly Managing Director at NERA Economic Consulting and Chief Economist of the UK Electricity Council



#### Strategic concept for reform

A number of market failures and co-ordination challenges influence investment in network infrastructure and security of supply, and are accentuated in any transition to a low carbon energy economy. They apply to the energy sector and energy use in general, but the central position of electricity in all decarbonisation options results in their particular relevance to the power sector. Changes are needed to balance the roles of policy interventions, regulation and markets in achieving low carbon objectives. This implies serious attention to creation of appropriate institutional and regulatory architecture to facilitate the low carbon transition.

Policy, market and regulatory frameworks for network infrastructures need to bring forward the right investment at a reasonable cost of capital (the ‘investment phase’), enable efficient operation of networks (the ‘operational phase’), and support retail markets that empower consumer choice and involvement.

The reforms proposed in this perspective seek to provide both greater long term certainty for investors and more co-ordination in the ‘investment phase’. They aim to retain competitive disciplines, including competition between generators and technologies for new investment, and contract incentives for efficient operation. In retail electricity markets they aim to promote forms of competition, not currently present, that encourage innovative approaches to managing consumer demand. For the heat sector, this perspective recognises questions for strategies based on both individual and collective (district heating) choices, proposing initiatives to help promote and enable heat network infrastructure.



#### Key priority measures

- Formalise the recent trend towards central strategic direction of decisions for the UK energy mix, by creating a technically competent central procurement agency (CPA) for electricity capacity. The CPA’s duties would be to procure a sufficient, balanced portfolio of generating capacity, while ensuring that low carbon objectives for the sector are met.
- The CPA would enter into long term power purchase agreements (thereby securing a lower cost of capital) and would resolve investment co-ordination between capacity and power procurement, system operation and transmission functions. Contracting through a CPA would obviate the need for a separate capacity market instrument, since long term contracts could be structured to reward capacity and availability.
- Enable more effective competition in the supply market, allowing electricity suppliers to act more innovatively as demand-side aggregators, with radically different service offerings for customers that will also help shape consumer loads.
- Create a new Heat Networks Authority to facilitate early roll out of heat networks, identify the most promising candidate locations for early adoption of district heating, and promote best practice. It might also anticipate and resolve coordination and other issues with the power and other sectors in areas (possibly a majority) not covered by heat networks.
- Encourage heat network deployment by government support for and underwriting of early “model” projects, while reviewing means to regulate the decentralised heat monopolies.



### Supporting analysis: key challenges and issues

1. Markets cannot be relied on to deliver low carbon policy objectives, because the price of CO<sub>2</sub> emissions does not adequately reflect the carbon externality, and may not do so in future. This affects investment, the operation of assets, and consumer choices.
2. Investors in infrastructure, or immobile, use-specific assets, face ‘time inconsistency’ risks inherent in recovering an adequate return on investment once costs have been sunk. Particularly important threats to future revenue are policy and regulatory risk, since the asset will typically not enjoy alternative sources of revenue or market outlets.
3. Relying on wholesale markets to deliver security of supply in electricity poses problems intrinsic to the market structure, since SRMC-based price signals are and will be insufficient to reward investment in new capacity, even for conventional thermal plant (reliance on scarcity and periodic price spikes attracts regulatory and political risk).
4. New low carbon generation technologies create additional complexities for system operation, and the conventional equation of merit order operation with wholesale markets is unlikely to continue as an adequate basis for efficient operations and decision making.
5. The low carbon transition raises a range of broader co-ordination issues, within and across network infrastructures, which may not be capable of resolution through familiar market mechanisms. This includes handling integration and interactions with CCS, a hydrogen sector, and vehicle charging demands and infrastructure.
6. Demand side management must play a major role in low carbon systems but this requires a mix of cost reflective price signals, control technology and new models for the service provided to consumers – the “consumer offering”.
7. Low carbon heat solutions face multiple challenges. These include: managing the diversity of alternatives, questions around compulsion and choice, and the best models for enabling collective, co-ordinated solutions where appropriate.
8. Other regulatory assumptions and policy norms will need to change. Transition to a low carbon economy may end any residual “predict and provide” approaches to energy policy, and lead to adoption of different reliability standards for different energy uses, possibly more geographical discrimination in service and pricing, and approaches to network “use of system” pricing that fully reflect system conditions rather than cost averaging.

## Appendix: concept summary

### Efficient energy transition: a question of consistency



#### A perspective for the ETI by Jorge Vasconcelos

Chair NEWES, New Energy Solutions, formerly Chair of the Portuguese energy regulator, founder and chair of the Council of European Energy Regulators



#### Strategic concept for reform

The creation of markets is always a social enterprise, so markets, governance and regulatory frameworks should be shaped with policy objectives in mind. Energy markets and governance and regulation of energy network infrastructures should be designed to support the broad shape of the desired transition to a low carbon future.

The complex choices around transition to a low carbon future and new technical developments, demand a **greater focus on consistency and co-ordination in energy market design, and governance and regulatory frameworks** across the energy system. This will require the introduction of explicit new mechanisms to achieve.

Market and system operation functions and roles will also need to be reviewed, redefined and reallocated to maintain control and reliability, while supporting policy objectives about the broad transition path to a low carbon future. Reforms will need to enable the opportunities and manage the complexities arising from the application of information and communication technologies (ICT) at different levels of energy systems.



#### Key priority measures

Establish a new high level Advisory Committee to oversee, monitor and advise on consistency in policies and operational developments across different energy systems and different layers.

- The remit of the Committee should extend across all relevant energy markets and infrastructures, thereby ending 'silos' in governance and regulation.
- The Committee should propose legal or regulatory action when consistency is at risk, threatening consumer welfare or the achievement of climate and energy policy objectives.

Redefine and reallocate market and system operation functions and roles to be consistent with decisions about the targeted transition path to a low carbon future.

Redesign markets and system operation arrangements to manage the complexities and control issues raised by new ICT at different levels of energy systems, and to realise the opportunities they open up.

Create new governance mechanisms and structured dialogue to guide the process of reform.



## Supporting analysis: key challenges and issues

### Key challenges

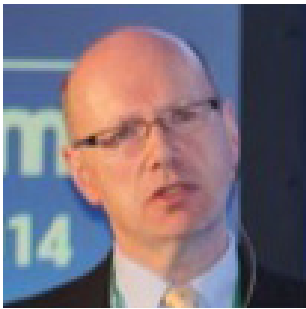
- a. The twin cross-cutting challenges of reducing CO<sub>2</sub> emissions from all forms of energy and the rise of modern ICT are rendering current electricity and energy market designs and policy frameworks inadequate and obsolete. This makes comprehensive market redesign and regulatory reform inescapable.
- b. The transition to a low carbon future challenges 'energy silos' (separate market and regulatory frameworks for different energy sectors and infrastructures).
- c. The multi sectoral and multi layered nature of the energy transition raises new complexities for managing, regulating and co-ordinating investment efficiently.

### Issues Identified

- a. Distinct energy markets (electricity, natural gas, district heating, electric transport etc) are increasingly coupled by climate policy and the rise of ICT, requiring co-ordination of regulation, market and system operation.
- b. Electricity market redesign is necessitated by deep structural change in technology (renewables, self-generation, decentralisation, storage etc).
- c. System operation is becoming increasingly complex, affected by new ICT, and must be taken into account in redesigning roles and frameworks.
- d. Decentralisation of energy systems raises new issues for system reliability both in operation and system planning.
- e. The energy transition will require clear policy and regulatory signals to bring forward the desired investment in infrastructure to facilitate the energy transition.
- f. There are tensions that need to be reconciled at the interface between market and system operation in redesigning rules for market and system operators.

## Appendix: concept summary

### Energy governance and regulation frameworks – time for change?



#### A perspective for the ETI by Keith MacLean

Chair of UK Energy Research Centre, Co-chair of the Energy Research Partnership and formerly Policy and Research Director at SSE\*



#### Strategic concept for reform

Achieving the changes that are needed to decarbonise the energy system on the scale required to meet the 2050 climate change targets will be a massive task over the coming decades. The important role of networks was highlighted by the European Commission which estimated that, of the €1 trillion investment needed in the EU energy system to 2020, €600 million would be for networks, with two-thirds of this in distribution.

It will be important to achieve the right balance between regulation and incentives to effect positive change – too draconian an approach may lead to poor acceptance and political risk, whereas high levels of financial incentive may be considerably more costly than regulation and could prove less effective as has been the case with the RHI and the Green Deal.

For networks it is essential that there is a clear, long term and flexible framework that encourages performance competition and enables sensible levels of investment ahead of need – this means it is a prerequisite that decision making in the non-network areas must also function effectively. Lower costs and cost of capital will be achieved within a framework that offers clarity on desired outcomes, a long term perspective and a sound legal basis, including grandfathering principles.

The governance of the decision making process must be capable of covering all of the energy system – heat and transport as well as electricity – and fully consider the networks alongside the supply and demand side measures.



#### Key priority measures

- A 'mixed economy' approach should be adopted, similar to that for the 2012 Olympic Games, that combines a clearer role for government decision making and a greater recognition of the importance of system wide design, with truly independent regulation and competitive, efficient market investment and delivery.
- An independent body should be formed with responsibility for designing the system, and which could also provide expert, informed advice to decision makers.
- Strong, independent regulation will be required to oversee the ongoing, detailed delivery of the high level objectives set by government and would build on the successful work carried out by the Monetary Policy Committee and the Committee on Climate Change as well as that of Ofgem with regard to monopoly network regulation and the administration of schemes like the RO, feed-in tariffs and the RHI.
- The role of the private sector, and competition within it, should be strengthened and used to maintain a downward pressure on costs as well as an efficient approach to delivery. This can be best achieved by encouraging private sector organisations to respond competitively to suitably differentiated tenders for the element(s) of the delivery process for which they are best suited.

- The regulatory regime and statutory frameworks that currently apply to other utility networks should be extended to cover heat networks in order to support developers and operators in their activities, as well as to protect consumers and investors. It would appear logical to extend the remit of the existing regulator for gas and electricity to cover this, rather than to create a separate body.
- There should be a shift away from variable charging tariffs in energy as has been seen in the telecoms market where greater use of fixed bundle charging, rather than variable unit tariffs is made, and service characteristics rather than 'fuel' are valued.



### Supporting analysis: key challenges and issues

1. One of the greatest weaknesses in the current system is the lack of the design capability needed for a full cross-sector development of the energy system.
2. Pure markets will avoid over-capacity since this adversely impacts on price, therefore some intervention is needed to correct this natural market failure. However, without an explicit strategy to cover the approach to diversity or contingency and the resultant interventions, investors will be very hesitant which pushes up the cost of capital.
3. Uncertainty can have knock-on consequences for network owners when their customers no longer have the basis to plan ahead, and neither they nor the regulator are prepared to underwrite the necessary developments.
4. Fossil fuels are currently the only means of providing large volumes of long duration storage over a period of months. The value of this is particularly high in the heat sector where peak demand in winter is about 12 times the summer levels. Even in the electricity sector where absolute variations are much lower, current fuel levels maintain a buffer equivalent to several months' output
5. The overall system costs, especially in heat and electricity, are now increasingly dominated by high, up front capital outlays, although this has always been true of networks. Therefore, to match this shift in the cost base and risk profile, a rebalancing of the charging regime could also be considered with a shift away from variable to more fixed charging.

## About the Author

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George Day joined the ETI in November 2011 to lead work on the policy and economics of low carbon energy technologies. He has over 20 years of international experience as a policy economist in the water, energy and agricultural sectors. Before joining ETI he was a director at Ofwat the water sector regulator.

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