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UTILITIES: POWERHOUSES OF INNOVATION

FINDINGS AND RECOMMENDATIONS

A EURELECTRIC Innovation Action Plan

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The **Union of the Electricity Industry–EURELECTRIC** is the sector association representing the common interests of the electricity industry at pan-European level, plus its affiliates and associates on several other continents.

In line with its mission, EURELECTRIC seeks to contribute to the competitiveness of the electricity industry, to provide effective representation for the industry in public affairs, and to promote the role of electricity both in the advancement of society and in helping provide solutions to the challenges of sustainable development.

EURELECTRIC's formal opinions, policy positions and reports are formulated in Working Groups, composed of experts from the electricity industry, supervised by five Committees. This "structure of expertise" ensures that EURELECTRIC's published documents are based on high-quality input with up-to-date information.

For further information on EURELECTRIC activities, visit our website, which provides general information on the association and on policy issues relevant to the electricity industry; latest news of our activities; EURELECTRIC positions and statements; a publications catalogue listing EURELECTRIC reports; and information on our events and conferences.

EURELECTRIC pursues in all its activities the application of the following sustainable development values:

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▶ Growth, added-value, efficiency

Environmental Leadership
▶ Commitment, innovation, pro-activeness

Social Responsibility
▶ Transparency, ethics, accountability

Dépôt légal: D/2013/12.105/14

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FINDINGS AND RECOMMENDATIONS

ACKNOWLEDGEMENTS

We are very grateful to the numerous industry executives, policymakers, and other experts who agreed to share their insights and experience in interviews during the course of the project.

These include: Pierre-Marie Abadie (French Ministry for Environment, Sustainable Development and Transport), José Arrojo (ENEL), Karl Bergman (Vattenfall), Maria Luisa Castaño Marin (Spanish Ministry for Economy and Competitiveness), Wolfgang Crasemann (German Federal Ministry of Economics and Technology), Marie Donnelly (DG Energy), Tetsuro Fukuyama (Japanese Parliament), Toshiki Hanada (Kansai Electric Power Company), Tatsuo Hatta (Gakushuin University), Jörg Hermsmeier (EWE), Naoto Kan (Japanese Parliament), Ichiro Maeda (FECP), David Mohler (Duke Energy), Charles Nielsen (DONG Energy), Diego Pavia (KIC InnoEnergy), Michael Peevey (California Public Utilities Commission), Wolfgang Pell (Verbund), Stephan Ramesohl (E.ON), Herbert Reul (European Parliament – ITRE), Bernard Salha (EDF), Rudy Shankar (TVA), András Siegler (DG Research and Innovation), Pekka Soini (Finnish TEKES), Pavel Solc (Czech Ministry for Industry and Trade), Petr Štulc (CEZ), Taishi Sugiyama (CRIEPI), Yoshiharu Tachibana (CRIEPI), Patrick Van Hove (DG Research and Innovation), Hans van Steen (DG Energy), Antonio Vidigal (EDP), Robert Weisenmiller (California Energy Commission), and Cathy Zoi (Silver Lake), as well as a number of interviewees that requested to remain anonymous.

We also thank a number of people who have been instrumental in making these interviews possible: BB Blevins (California Strategies), Kenichi Kimura (FEPC), Joanne Kozberg (California Strategies), Steve Larson (California Strategies), and Mika Ohbayashi (JREF).

Interviewees have provided input in their personal capacity; their opinions do not necessarily reflect official positions of their companies or institutions.

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N.B. This report represents a revised version as of 8 May 2013.

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PREFACE

With our Innovation Action Plan, EURELECTRIC, the European power sector association, seeks to address innovation head on. This document provides a detailed summary of our findings and recommendations; the full study can be found at the EURELECTRIC website.[1]

EURELECTRIC is engaging its members in a joint effort to elaborate a common industry-wide perspective on the power sector's transition to 2030—the most significant changes ahead, the perceived threats and opportunities, and the overall shared vision of what the future sector will look like. As concrete support for discussion and decision-making, we have begun mapping what is required to enable successful change, in terms of both private sector initiatives and public policies. We have also critically assessed EU innovation policy and put forward recommendations for an improved policy framework to enable private sector engagement in the transition of the energy sector.

To guide the overall effort, EURELECTRIC set up a high-level Task Force in 2012, including utilities and equipment suppliers as well as independent experts. The Task Force has conducted a large number of interviews with experts, including utility Chief Technology Officers, energy and innovation policymakers, and innovation experts, in Europe as well as internationally.

EURELECTRIC is committed to working with Europe's power sector and policymakers to make the energy transition a success, with innovation as a high priority in our strategy.

Brussels, May 2013

1 www.eurelectric.org/innovation/

INTRODUCTION

INTRODUCTION

A decade into the twenty-first century, the EU power sector finds itself in the midst of transformative change. A low-carbon and more decentralised electricity generation system is emerging, while smart grid technologies are creating significant new capabilities. At the same time, conventional generation is under pressure, facing a decline in its future value. Change also is coming as a "new downstream" service model based around energy efficiency offerings, decentralised generation, and new products and services, which are about to take off. Meanwhile, the EU is grappling with how to ensure this transformation achieves decarbonisation and energy security objectives whilst keeping costs at manageable levels.

These changes and pressures have propelled innovation to the fore in the power sector. From a relatively peripheral phenomenon, innovation now is central to fundamental shifts in power sector value creation as well as a precondition for achievement of societal objectives. All power sector participants—from equipment manufacturers to energy retailers—will need to find new ways to improve their products and manage their businesses. EU electric utilities are ready to play their part, and are increasing their investment in innovation.

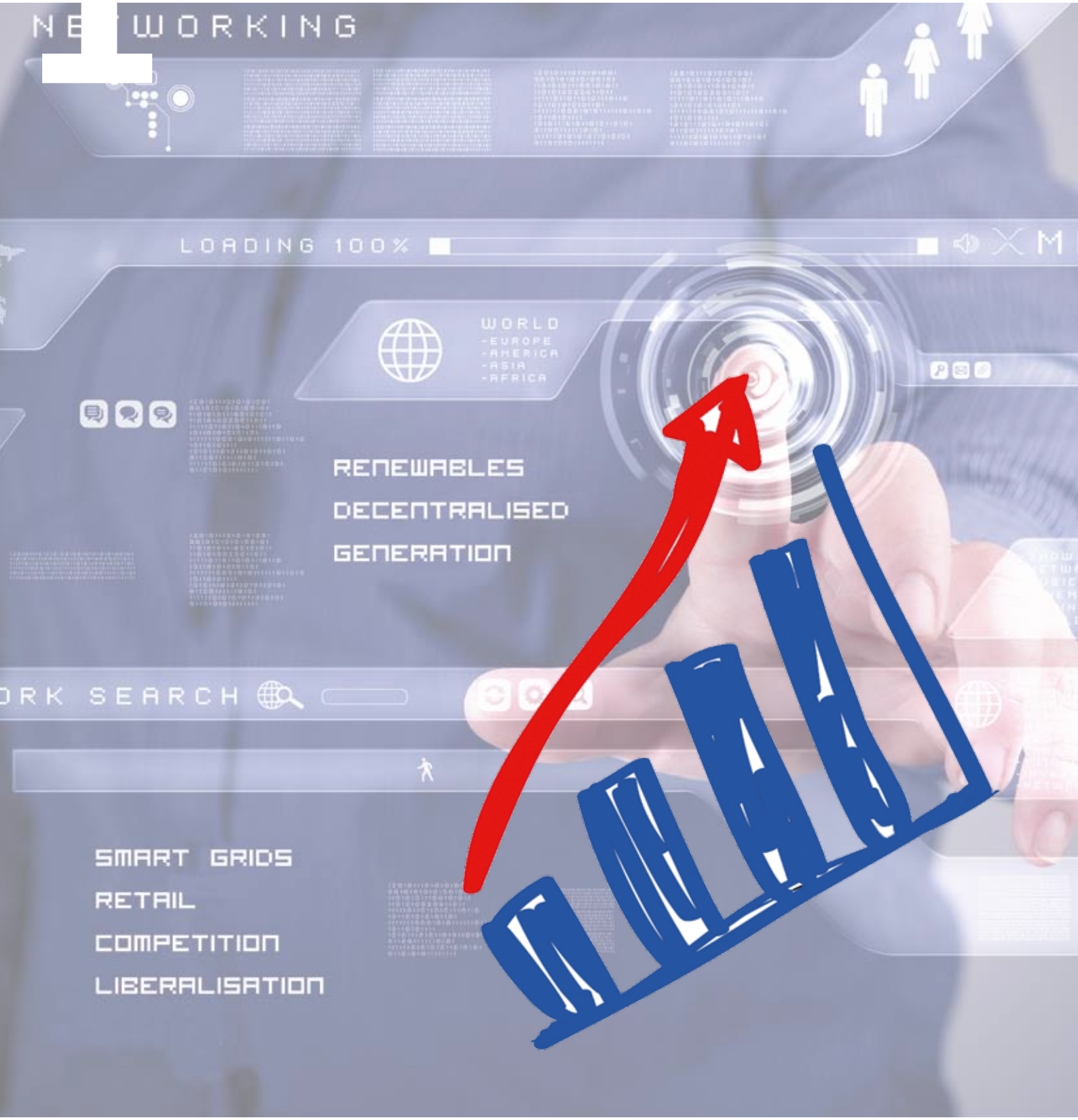
There is no mistaking the significant potential value of power sector innovation. We estimate that accelerated innovation in power supply technologies and business models for energy efficiency could be worth 70 billion euro to the EU economy in 2030. Additional benefits are also expected in energy security, lower system costs, and consumer convenience. Conversely, if innovation were to slow, the adverse impact could deal a severe blow to EU growth and competitiveness.

Capturing the potential of innovation requires a dynamic power sector, acting within a strong enabling policy framework. The EU has come a long way in creating conditions for innovation. Yet much remains to be done to create the market setting in which innovation can thrive, and to steer public support for innovation effectively.

EURELECTRIC is committed to supporting power sector innovation in both areas – creating the market setting and steering public support for innovation to the most effective uses. Our key findings and recommendations are structured into the following sections:

- Innovation is an economic imperative for the power sector and EU economy
- Faster innovation could be worth 70 billion euro in 2030
- Capturing the potential depends on an agile private sector
- Five actions to improve EU enabling of energy innovation.

1 DEEP AND ACCELERATING CHANGE MAKES INNOVATION IMPERATIVE



The past decade saw changes that left no part of the EU power sector untouched. In a survey of utility executives conducted by the EURELECTRIC Task Force in the context of this study, several themes stand out (Figure 1). To name but a few:

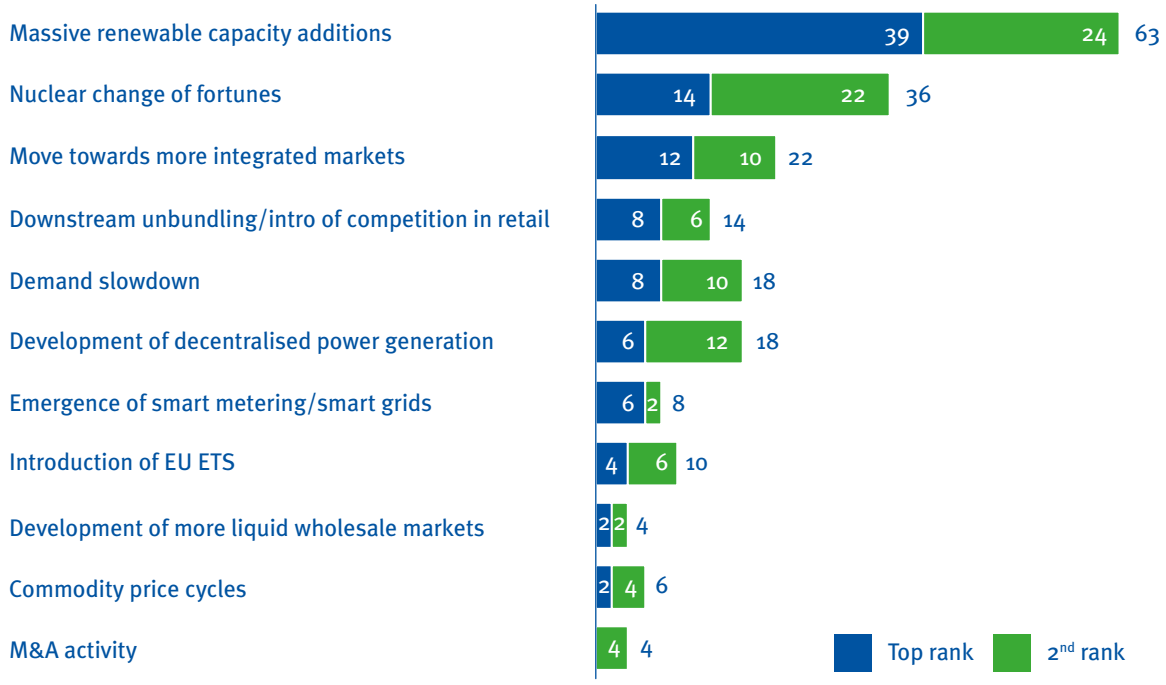
- New renewable energy sources (RES) have advanced from a relatively minor phenomenon to a large majority of 70 percent in new capacity additions.
- Decentralised RES have or has also emerged as a major force, as more than 3 million Europeans started generating their own electricity.
- Continued liberalisation and market integration have redefined utilities' operating environment, as unbundling and retail competition enable increasing customer engagement.
- The EU has also started laying the foundation for a smart grid, with the installation of 50 million smart meters.

Looking ahead, there is every reason to believe that change will continue and indeed accelerate. EU objectives for continued decarbonisation have set a fundamentally new frame for the sector, complemented by concerns over energy security as well as the overarching need to keep power affordable and the EU economy competitive. Against this backdrop, strong technology trends and new customer demands will significantly expand the set of options available to the sector.

FIGURE 1

Utility executives saw a range of powerful trends acting on the sector in the last decade, with new renewables the single most powerful influence

Utility executives ranking of trends impacting the power sector in the last decade
% of respondents

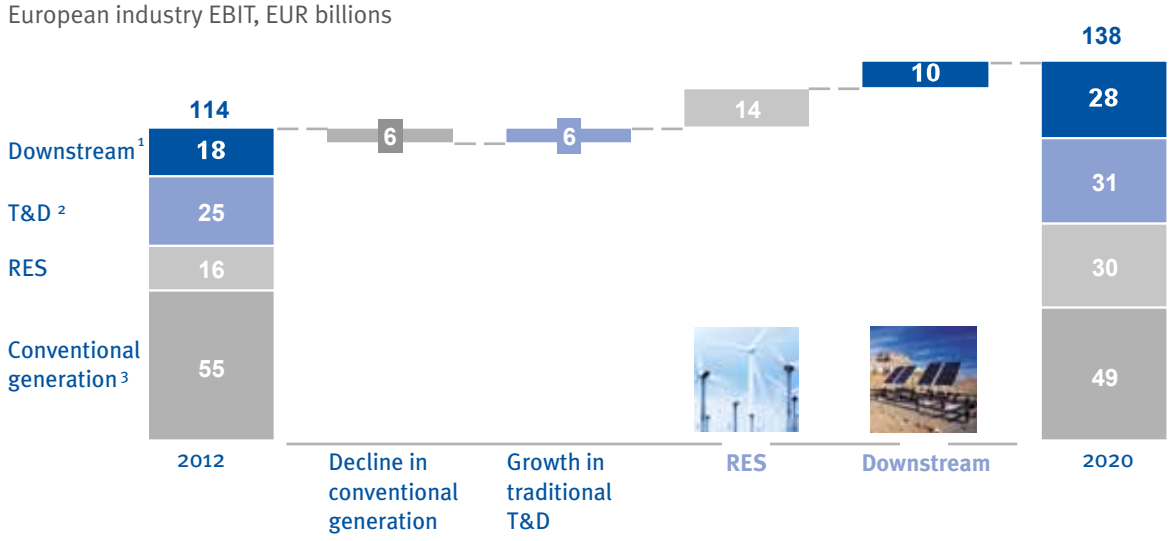


Source: EURELECTRIC Innovation Action Plan Survey, December 2012

FIGURE 2

Utilities' traditional core business is shrinking, but new growth areas can offset the decline

European industry EBIT, EUR billions



1 Includes power sales and new downstream (distributed generation and storage, electric vehicle infrastructure, new downstream products and services, power flow optimization)
2 Includes smart grids
3 Assuming no change in commodity prices vs. today

Source: McKinsey Industry Vision

As this change plays out, the EU power sector faces a significant reconfiguration of its sources of value. The current mainstay of conventional generation already has begun to shrink, and little growth can be expected in the next decade. Traditional utilities feel the impact of this challenge, including through lower and more volatile returns to shareholders. Yet there is a silver lining, as new potential sources of value are emerging, both in large-scale generation from low-carbon sources, and in the new opportunities downstream. The sector will see net growth, but from a very different set of opportunities than in the past (Figure 2).

- **Generation will continue to shift heavily towards low-carbon sources, but with an uncertain future mix.** The EU's long-term targets for decarbonisation require a substantial increase in generation from low-carbon sources by the 2030s. Yet the future generation mix is still highly uncertain. The pace of technology development is fast, spanning multiple rival technologies with different system characteristics and different stages of maturity. It currently appears fair to say that RES will co-exist, with some geographic concentrations, rather than running a "winner takes it all" race. Long-term, the EU will likely need to advance beyond solar and wind towards a wider set of low-carbon sources. The past decade has certainly taught us how quickly new technologies can enter into the mix once costs fall, and financing and regulatory structures are put into place.
- **New downstream offerings could provide new services and transform the approach to energy supply towards a service-based model.** New downstream opportunities are emerging as a number of technologies are on the brink of mass-market take-up (Figure 3). A large set of opportunities across energy efficiency, decentralised generation technologies, and the electrification of transport and heating/ cooling are at or near commercial viability. The next step in capturing their potential is innovation to enable mass-market take-up. In addition,

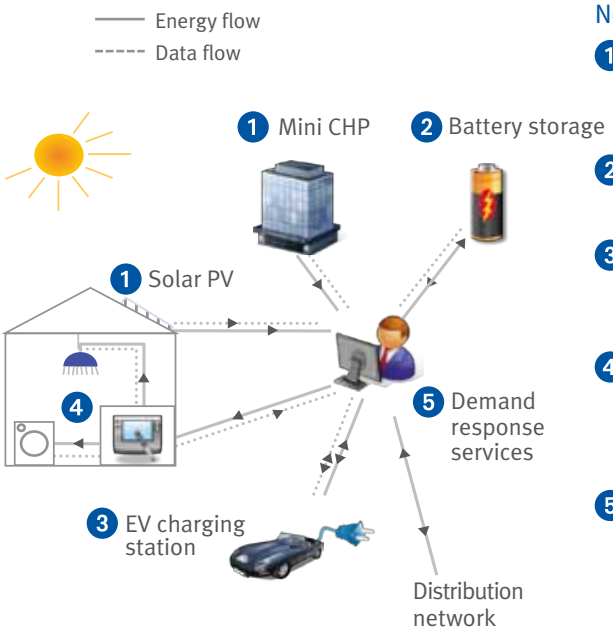
a range of new services built on smart grid functionality will emerge. These developments will benefit customers, and the take-up wave is likely to represent a major advance towards policy objectives for increased energy efficiency and low-carbon supply through decentralised RES generation sources.

Cumulatively, the changes have profound implications for the power sector by redefining fundamental operating parameters:

- **Decarbonisation objectives and resource scarcity are at the centre of new sources of value.** The new sources of value have been created to a large extent through regulatory intervention, especially for decarbonisation. Added to this, high and volatile fossil fuel prices create much of the underlying drive for both RES and energy efficiency.
- **The new technology mix will be highly capex-intensive.** Compared with the current model of electricity supply and consumption, new generation sources as well as energy efficiency solutions require high upfront capital expenditures (capex). New institutions and business models that enable investment on the required scale will be critical to the sector's transformation.
- **Innovation will be at the heart of the transformation.** The new sources of value depend on *innovation*, understood in the words of the European Commission, as *'change that speeds up and improves the way we conceive, develop, produce and access new products, industrial processes and service'*.[2] Innovation will thus cover the spectrum from technology cost reductions and process performance improvements to new business models, and new service and product offerings to end-users.

FIGURE 3

New downstream value pools are expected to emerge from the green agenda and new technologies



New downstream value pools

1 **Distributed generation**
Installation, maintenance, and possibly ownership of:
- Solar PV systems
- Mini/micro CHPs

2 **Battery storage**
- Ownership, installation, and maintenance of battery storage at local distribution level

3 **Public infrastructure for electric vehicles**
- Grid connection works
- Ownership, installation, and maintenance of public charging points

4 **New products and services at customer premises**
- Installation, maintenance, and possibly ownership of products that:
  - Increase customer comfort and enable new services
  - Make home and other buildings more efficient

5 **Power flow optimization**
- Leverage local sources of net load flexibility (distributed storage, EV batteries, DSM, DG) to:
  - Optimize power flow at local and system level to manage congestions and stabilize grid
  - Shift net system load to capture price arbitrage opportunities

Source: EURELECTRIC Innovation Action Plan Taskforce analysis

2 European Commission, Press Release Innovation Union. http://europa.eu/rapid/press-release_MEMO-10-473_en.htm?locale=en

2 FASTER POWER SECTOR INNOVATION COULD BE WORTH 70 BILLION EURO IN 2030

FASTER POWER SECTOR INNOVATION COULD BE WORTH 70 BILLION EURO IN 2030

In the EU, financing the power sector transformation is starting to put pressure on companies and consumers, as well as on public budgets. By 2012, European consumers were paying a total of 38 billion euros per year in subsidies for renewable electricity. Support schemes that seemed affordable with smaller volumes of renewables have been difficult to maintain in the protracted economic downturn. Overall, the EU is still feeling its way in balancing decarbonisation and security of supply objectives against the need to manage the increasing cost burden, an essential goal to put Europe back on track to solid economic growth.

Increased innovation has the potential to contribute significantly to resolving the three-way dilemma of decarbonisation, security of supply, and economic viability. Two mechanisms stand out as particularly important:

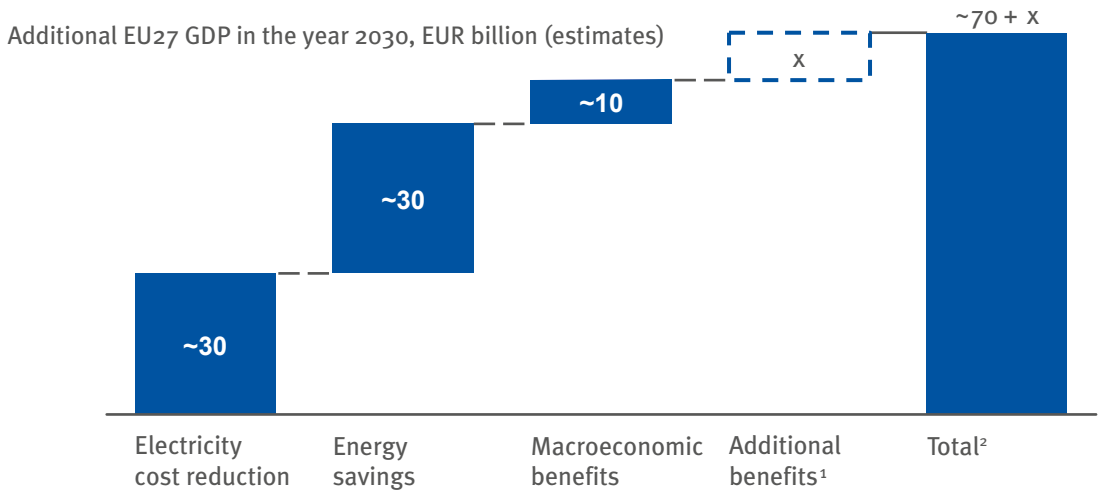
- Lower power supply costs: faster technology development could enable extensive continued cost reductions in renewable and other low-carbon electricity generation technologies.
- Increased energy efficiency: a switch to a service-based model of energy supply could unlock mass-market adoption of cost-effective energy efficiency technologies.

Initial estimates suggest that breakthrough innovation in these areas could be worth 70 billion euro to the EU economy in increased GDP in the year 2030, or 135 EUR per capita. The additional value would be shared by a range of beneficiaries of innovation: households and companies consuming energy, electric utilities and other companies in the electricity supply chain, and various other actors throughout the wider economy. These estimates are based on comparing and contrasting a reference case and high-innovation case for technology cost and energy efficiency capture, using detailed bottom-up models of EU electricity generation costs as well as energy efficiency potential. Electricity cost reductions and energy savings would have a combined value of 60 billion euro in the year 2030. The benefits could be even larger when wider macro-economic effects are considered, including improved competitiveness (Figure 4).

These estimates show the importance of power sector innovation. Yet they also omit important additional benefits. Increased innovation also could result in reduced costs of balancing the power system, improved consumer convenience and value, additional economic benefits or contributions to EU objectives through accelerated electrification of transport and heat, and opportunities for EU industry in the context of an expanded global market.

FIGURE 4

Accelerated innovation in the EU power sector could be worth 70 billion EUR in 2030



1 Additional innovation benefits not included in this calculation could include reduced costs of balancing the power system, improved consumer convenience and value, additional economic benefits or contributions to EU objectives through accelerated electrification of transport and heat, and clean technology and other business opportunities that could be captured by European industry in the context of an expanded global market.

2 The estimate is of additional gross domestic product, and in total corresponds to 135 EUR per capita in 2030. The benefits would be shared between households and companies consuming energy, electric utilities and other companies in the electricity supply chain, and various other actors throughout the wider economy.

Source: EURELECTRIC Innovation Action Plan Task Force analysis

3 CAPTURING THE INNOVATION POTENTIAL DEPENDS ON AN AGILE PRIVATE SECTOR

The shift in value creation and drive created by policy objectives creates strong innovation imperatives across the power sector. Power sector participants, including utilities, need to innovate on three fronts:

- **Master new technology.** Continued technology development will put an increasing number of technologies within market reach, across electricity generation, power networks, energy efficiency, and end-use applications. Power sector participants will need not only to find the means to finance solutions that require higher capital expenditure upfront, but also to translate technologies into workable end-user offerings in the context of the overall power system.
- **Get close to customers.** General customer trends in developed economies as a whole will also affect the power sector. More aware and engaged customers will demand socially and environmentally responsible practices, place a higher value on convenience and experience, and use more complex criteria for their purchasing decisions. A private sector capable of understanding and responding to these needs will be an important source of innovation in the power sector to ensure consumers benefit from the changes ahead.
- **Develop new business models and services.** The power sector may stand before a significant change in the way energy needs are met. The key will be new business models that simultaneously offer greater financial benefits and improved convenience than the current volumetric and grid-based supply model. To judge by other sectors, such as telecommunications, future power sector business models could be based on a range of solutions to meet energy service needs, such as heating or cooling comfort, mobility, or lighting. New end-use technology will help, while smart grids and Big Data will be indispensable enablers, likely supporting more pay-per-use or lease-based contracts.

Cumulatively, these requirements amount to far-reaching change. Much of the success of the transition thus depends on power sector participants—from equipment manufacturers through to energy retailers—stepping up to innovate their products and the way they manage their business and serve their customers. Innovation at heart will be a private sector creation.

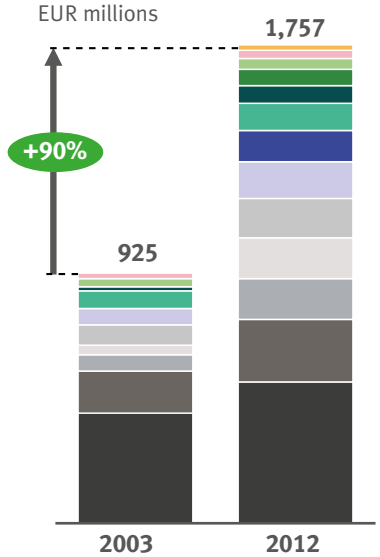
EU utilities will be active participants in this change. In the past, it may have seemed that the EU power sector was slow to embrace change and taking a reactive approach to trends such as increasing opportunities for RES or new downstream opportunities. These are signs that this is starting to change. Utilities now account for a majority of the current pipeline of new large-scale RES capacity. Moreover, EU utilities have nearly doubled their expenditure on R&D in the past decade (Figure 5). A survey of EU utility executives conducted by EURELECTRIC confirms that innovation is becoming a major priority for EU utilities.

FIGURE 5

R&D expenditure by large European utilities has nearly doubled over the last decade to over EUR 1.7 billion

R&D expenditure by 13 major European utilities in early 2000s[1] and early 2010s[2]

EUR millions



Statkraft
CEZ
Centrica
SSE
EDP
Enel/ Endesa[4]
Dong
Iberdrola[3]
RWE
E.ON
Vattenfall[5]
GDF Suez[6]
EDF

1 2003: Vattenfall, E.ON, Iberdrola, SSE; 2004: Dong; 2005: EDF, GDF Suez, Enel; 2006: Statkraft; 2007: CEZ, EDP, RWE; 2009: Centrica

2 2010: CEZ; 2011: Centrica, Dong, RWE, EDP; others 2012

3 Adjusted for acquisition of Scottish Power Ltd.

4 Adjusted for acquisition of Endesa

5 Adjusted for acquisition of Nuon Energy

6 Adjusted for GdF – Suez merger and spin-off of Suez Environnement Company.

Sources: Capital IQ, company annual reports; EURELECTRIC Innovation Action Plan Taskforce analysis

4 FIVE ACTIONS TO IMPROVE EU ENABLING OF POWER SECTOR INNOVATION

An important goal of European energy policy is to facilitate a *cost-efficient* transition to low-carbon power generation, not least in times of economic downturn. Innovation is indispensable to achieving this goal. The European Commission acknowledged this in its Green Paper on the 2030 climate and energy policy framework, stating it will have to *"recognise the evolution of technologies over time and promote research and innovation."*[3] EURELECTRIC fully supports this recognition.

Yet innovation never flourishes in isolation. It depends on an enabling setting: both a business environment that spurs and rewards private-sector innovation, and a public policy framework for investing in innovation where the business case needs initial support.

EURELECTRIC advocates five main actions to enhance EU innovation policy and better enable the power sector to capture the innovation opportunity.

To begin mapping what is required to enable successful change, the EURELECTRIC Innovation Task Force has critically assessed EU innovation policy and developed the following five recommendations for an improved policy framework to enable private sector engagement (Figure 6).

The description of each recommended action provides a rationale, guiding principles, and examples of the enhancements proposed.

1. ADOPT A SYSTEMS APPROACH

Power system complexity will increase as the value chain continues shifting from a linear supply-demand model to a new *systems* paradigm, a model with more feedback loops between elements. To enable successful innovation, policy must also reflect this shift to more closely intertwined elements. As examples, technological innovation has made

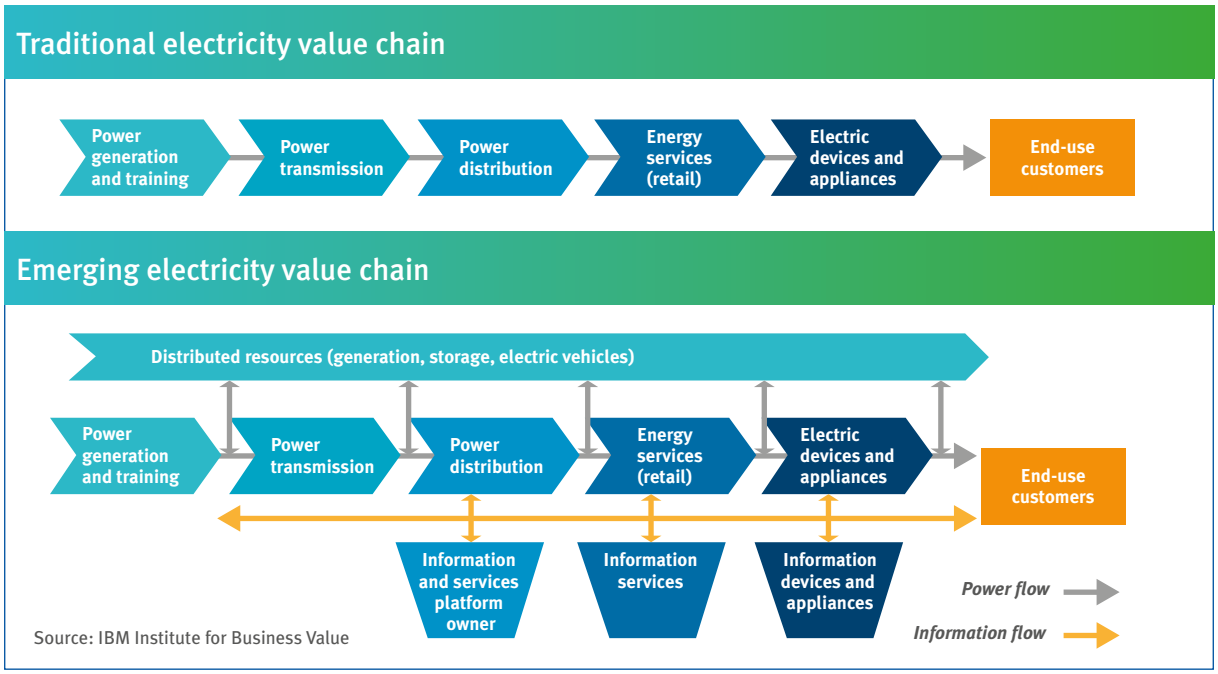
FIGURE 6

Five actions to improve EU enabling of power sector innovation

1	**Adopt a systems approach.** Innovation policy must become a tool of energy policy, avoiding focus on individual technologies in favour of an expanded and integrated perspective encompassing interconnected impacts on the overall power system.
2	**Nurture public-private dynamics.** The public and private sectors have to work hand in hand to reinvent the power system. Policymakers should harvest the low-hanging fruit: innovation through a competitive, business-friendly, and risk-rewarding market framework.
3	**Prioritise demonstration and commercialisation.** Demonstration and early deployment are indispensable parts of the power sector innovation chain. Further support mechanisms are needed to complement R&D support.
4	**Unlock downstream innovation.** Policy should move quickly to put in place the enablers of a 'new downstream' set of services and offerings: a competitive and fully liberalised market, innovation-friendly regulation, and enabling smart grid infrastructure.
5	**Create supportive governance for the innovation union.** Innovation would benefit greatly from better coordination and governance of both EU-level and Member State support mechanisms, starting with improved joint programming and pooling of resources.

3 European Commission, Green Paper "A 2030 framework for climate and energy policies", March 2013

FIGURE 7



it possible for power consumers to become producers ('prosumers'), one-way electricity and information flows become bi-directional, decentralisation challenges and complements the old centralised architecture, and closer real-time management becomes feasible as well as necessary to handle more variable generation. The diagramme above[4] illustrates the shifts from the traditional electricity value chain to the emerging one (Figure 7).

Similarly, the power supply is increasingly linked to other forms of energy where energy service needs (heat, lighting, mobility) are increasingly served by multiple rival products and services. The power sector is also more closely linked to other sectors—notably transport and information and communications technologies (ICT).

This development requires a systems approach to innovation policy, in contrast to the current approach of supporting innovation in individual technologies in isolation. Continued development of individual generation technologies clearly is necessary, but must be synchronised with other needs across technologies and business models, and along the entire power value chain. Examples include lower-cost storage, smart grid applications for distribution grid balancing, business model innovation for demand-side management, regulatory innovation to compensate for the value of flexibility, etc.

4 IBM, "Switching perspectives. Creating new business models for a changing world of energy", 2010

Guiding principles

To better enable utilities to act as powerhouses of innovation, EU policies for innovation and energy need to adhere to the following guiding principles:

- **Make innovation policy a tool of energy policy.** Innovation is far more than just R&D, and depends strongly on overall energy policy. The two policy agendas therefore must be seamlessly integrated. The long-term potential of innovation must not be set aside in favour of near-term targets or aims.
- **Take a broad view of innovation.** Innovation is more than technology development. The power sector transformation will require innovation in products, processes, and business models, throughout the electricity value chain. A comprehensive innovation policy needs to pay heed to all of these aspects of innovation.
- **Maintain a systems perspective.** The current tendency to focus on single issues and isolated technologies must be consciously and rapidly replaced by an expanded and integrated perspective to encompass interconnected system impacts.
- **Account for cross-sector interaction.** The systems perspective must also extend to supplier and customer industries, as the energy sector is increasingly intertwined with other sectors such as the ICT, automotive, construction, etc.

ACTION NEEDED NOW	
CURRENT CRITICAL POINTS	**RECOMMENDATIONS**
Silo approach: The Horizon 2020 Proposal from the European Commission's DG Energy of 2011 still contains elements of the silo approach to energy innovation, for example, separate budgets for ICT, transport, climate, and energy. Underlying this, the current SET Plan is structured along individual technology platforms.	**Maintain a systems perspective:** • **Create interfaces between sectors and issues;** simplify positions within Horizon 2020 to deliver on the system solution. • **Reform the SET Plan** to account for systems issues and regional dynamics, rather than just developments in individual technologies.
Initial steps towards a systems approach: The Smart Cities and Communities European Innovation Partnership is a welcome initiative to take better account of systems issues. Launched in 2012, Smart Cities aims to pool resources in cross-sector demonstration projects in urban areas, spanning energy, transport and information and communication technologies (ICT). According to the Commission, this initiative '*will enable innovative, integrated and efficient technologies to roll out and enter the market more easily, while placing cities at the centre of innovation*'. The funding will be awarded through yearly calls for proposals: €365 million for 2013.	**Maintain a systems perspective and report on results:** • Funding awards; product and process innovations and their systems linkages, between technologies, energy types (where applicable), and supplier and customer industries; describe mechanisms, if any, for preserving competition between rival solutions.

Promising private sector initiatives

Implement a systems approach: different energy types and cross-sector applications at scale. Fortum's advanced biofuel project in Joensuu, Finland illustrates the types of systems innovations that will become increasingly important. Fortum plans to integrate a combined heat and power (CHP) plant, and existing high-efficiency technology, with a bio-oil production facility to reduce use of fuel oil for heating purposes – providing carbon-free heat through an existing district heating network. This also has potential to create synergies with the transport sector by producing bio-oil suitable as vehicle fuels. The project already links different industrial sectors by re-using waste heat and waste fuel from industrial facilities in the CHP plant.

Implement a systems approach: sustainable city solutions. E.ON works with other parties in a project to develop Hyllie as a sustainable city district in Malmö, Sweden's third-largest city. The project includes fully-integrated infrastructure for electricity, heating, and cooling. By 2020, E.ON will supply 100 percent renewable or recycled energy, incorporating a significant proportion of distributed energy generation. The smart energy infrastructure in Hyllie will communicate with innovative technologies in buildings to deliver higher energy efficiency, reduced losses, better management of peak load and a more reliable electricity supply. The ambition extends to developing the technology needed to enable demand response, setting up communications between all levels in the value chain from producer to consumer.

2. NURTURE PUBLIC-PRIVATE DYNAMICS

The public and private sectors have to work hand in hand to reinvent the power system successfully, given the EU's renewable energy targets, the need to explore currently immature technologies, and the protracted economic slowdown. Policymakers should harvest the low-hanging fruit: innovation through a competitive, business-friendly, and risk-rewarding market framework. The approach should build on the EU Emissions Trading Scheme (ETS) rather than work around it or against it.

Policy also needs to make early innovation a priority and core tool of the energy transition. Current approaches pursue mass deployment, 'picking winners' at high cost, even as technology costs are falling. By contrast, an innovation-centred policy approach would support only the level of deployment needed to ensure continued innovation in immature technologies, and rely on market-based mechanisms (notably, ETS pricing signals) to drive mass deployment of near-commercial technology.

Not just "small change"

In 2011, European consumers paid 38 billion euro in subsidies to support electricity generation from renewable energy sources, adding more than 15% to the residential electricity bill in several countries. High costs have led to policy instability, as support schemes that seemed affordable with smaller volumes of renewables have proved controversial as the recession has persisted. Yet despite the scale of current RES deployment, a detailed innovation agenda still needs to be articulated. The de facto norm has been very significant early deployment with a high price-tag, but without dynamic adjustments to reflect decreasing costs, and without an assessment of the extent and type of deployment needed to achieve long-term innovation objectives.

Guiding principles

- **Restore the EU ETS as a technology-neutral and long-term engine for the market for low-carbon solutions.** The ETS is the one climate policy mechanism that has reached pan-European scale, and is effectively harmonised across the EU. It also is able to encourage competition between low-carbon solutions once they have matured in the innovation process, and offers built-in mechanisms for cost-effectiveness. The only alternative to the ETS is to pursue country-by-country solutions, which would have the bad effect of undermining European energy policy and sacrificing scale.
- **Tailor demand-side policies to innovation discovery and market adaptation as opposed to mass deployment.** RES policies should be reformulated in the run-up to 2020 to achieve innovation objectives. They should emphasise the value of discovering more about the future potential of currently immature technologies and business models.
- **Preserve competition between rival solutions.** Given finite budgets, innovation policy often tends towards 'picking winners', and needs strong corrective mechanisms to preserve competition between different approaches, as well as between stakeholders and projects.
- **Explore promising additional mechanisms to create a market setting for innovation.** For example, consider using public procurement as a tool for market deployment of both technology and business model innovations.
- **Make public-private collaboration and risk-sharing a core part of the EU approach.** The EU should consider mechanisms for applying industry insights to decisions on funding allocation. The EU can learn from international experience here, such as US Department of Energy programmes.
- **Make R&D more market-oriented and output-based**, building on the promising model of Knowledge and Innovation Communities (KIC) and specifically the KIC InnoEnergy.
- **Invest in the future**. The size of public budgets devoted to innovation should reflect the scale of the system transformation challenge. Building on the already high RD&D outlay by the private sector and continued increase in energy R&D funding in Horizon 2020, Europe should now focus on restoring the continent's competitiveness, using innovation, infrastructure, education, and regulation as its building blocks.

ACTION NEEDED NOW	
CURRENT CRITICAL POINTS	**RECOMMENDATIONS**
Uncoordinated policy instruments have led to regulatory inefficiency and investment uncertainty.	**Restore a functioning EU ETS and tailor demand-side policies to innovation discovery:** • **Urgently agree on a 2030 GHG target;** the back-loading proposal and a revision of the annual linear reduction factor to 2.3 %.
Some new instruments and approaches, for example, the format for RD&D support, was successfully demonstrated by the launch of the EIB Risk Sharing Finance Facility. The Commission deserves recognition for creating these new instruments.	**Explore promising additional mechanisms:** • **Consolidate instruments** and increase volumes. • **Consider awarding an EU Prize** as an effective, competitive and open mechanism to reward innovation breakthroughs.
No consolidated approach to public-private collaboration with too many EU instruments / frameworks for Public Private Partnerships (PPP): Knowledge and Innovation Communities (KICs), Joint-Technology Initiatives (JTIs), Joint-Programming Initiative (JPIs), European Innovation Partnerships (EIPs), etc.	**Make public-private collaboration and risk-sharing a core part of the EU approach:** • **Simplify and rationalise EU instruments** governing public-private partnerships into a single framework.
State aid guidelines vaguely formulated, inconsistently applied. They discriminate between near-commercial technologies and R&D needs, blocking technology development. The European Commission has been very generous with subsidies to all power generation technologies, yet it has put in place inflexible guidelines on R&D state aid.	**Make R&D more market-oriented and output-based:** • **Include an innovation dimension in the ongoing state aid modernisation** to allow for more flexibility and dynamism on how to best stimulate innovation across the whole value chain.
Public spending on RD&D in energy is growing, but from a very low base.	**Invest in the future:** • **Maintain the momentum of public energy-related RD&D spending.**

3. PRIORITISE DEMONSTRATION AND COMMERCIALISATION

Demonstration and early deployment are indispensable parts of the power sector innovation chain. Not only does demonstration enable real-world validation of emerging R&D findings, but when integrated within an effective overall innovation policy, it also is a crucial step towards commercialisation and subsequent widespread deployment.

Despite its importance, demonstration is often at risk of neglect. Private actors often lack a business case to undertake demonstration projects, especially at scale, making public support a necessity. Recent steps to put greater emphasis on demonstration in the EU Framework Programmes are a welcome start and should be pursued. Member States should design their RD&D programmes accordingly, to ensure demonstration receives the attention it requires.

Guiding principles

- **Make demonstration and early deployment a priority.** Put support mechanisms on a secure footing. Set the aspiration to double the 15% share of national RD&D support currently allocated to demonstration, to avoid creating an innovation bottleneck.
- **Expand support for commercialisation.** Support through venture-style mechanisms could enhance the impact of EU efforts. The EU can learn from influential efforts in other countries such as the ARPA-E programme in the United States.
- **Link demonstration to an enabling market setting.** The disconnect between demonstration and market uptake undermines the innovation chain as promising technologies are squeezed out of and receive no pull into the market.

Demos at scale: Dashed hopes for CCS; high hopes for smart grids

Source: SEV/DONG Energy

The failure of carbon capture & storage is a cautionary example of Europe's hitherto inadequate approach to demonstration. It is widely agreed that CCS is beyond the R&D stage; it requires testing at scale in an integrated setting. Yet EU funding to date has gone to a number of projects to validate multiple solutions – for both capture and storage – at once, encouraging jockeying to benefit from both national and EU funding. Worse, as national programmes are not aligned with the EU scheme, they have impeded promising projects. The lack of a business case for CCS – undermined by a faltering ETS and an energy policy directed towards other technology solutions – deprived CCS of any appeal to market actors, and shifted all the risks and burdens of CCS demonstration onto utilities.

By contrast, many successful demonstrators are being deployed to test and validate technologies such as smart grids. One such example is DONG's project on the Faroe Islands, which aims to demonstrate how a remote outpost may reveal answers to the challenges presented by non-dispatchable RES. The country is set to inaugurate a new 'virtual power station' that uses an advanced IT system to balance the grid by shifting supply and demand across the islands in matter of seconds.

ACTION NEEDED NOW	
CURRENT CRITICAL POINTS	**RECOMMENDATIONS**
High-risk, high-reward innovation in energy calls for **innovative public financial mechanisms** able to bridge the gap between basic R&D and demonstration and commercialisation. Such mechanisms are currently missing in Europe.	**Expand support for commercialisation:** • **Create public venture capital on a European scale.** The EU should introduce a new instrument inspired by the US ARPA-E programme to support commercialisation through venture-style mechanisms.
Private venture capital is insufficient in Europe, and innovative SMEs are struggling to get access to such funds.	**Expand support for commercialisation:** • **Give private venture capital a European dimension.** The European venture capital market needs to be unified, and obstacles to cross-border venture capital activities eliminated. We welcome the efforts of the European Commission to move towards cross-border fundraising through the European Venture Capital Funds Regulation (EVCFR).
One-off programmes have shown their limits in the main EU demonstration programmes for technology development, the EEPR and the NER300.	**Make demonstration and early deployment a priority:** • **Put demonstration on a secure institutional footing** by making certain that demonstration gets priority over basic R&D. The approach taken with Horizon 2020 is a promising first step in this crucial direction.
Low share of spending on demonstration. Member states spend 85% of their public funding on R&D activities, and only 15% on demonstration. This split becomes 50-50 at EU level.	**Make demonstration and early deployment a priority:** • **Double the share of RD&D funding allocated to demonstration at Member State level.** Given that the ETS directive binds Member States to earmark 50% of all auction revenues for projects in energy and climate protection, Member States have a golden opportunity to use these revenues to support innovation and cut public expenditure currently financed through levies on customers' utility bills.
Too many actors are involved in EU-level technology demonstration support.	**Make demonstration and early deployment a priority:** • **Simplify funding governance.** Explore whether the European Investment Bank could become the "one-stop shop" and principal actor for demonstration support at EU level.

4. UNLOCK DOWNSTREAM INNOVATION

For utilities, downstream opportunities are an essential component in offsetting the erosion in value of traditional generation assets. These opportunities also hold significant promise for customers, and can contribute to overall decarbonisation and security of supply objectives.

Many uncertainties about how the downstream opportunity will unfold still exist. What is certain is that much of the most promising future innovation in downstream business models and new services depends on two crucial components: a vibrant retail market as well as effective smart infrastructure. Downstream is about value creation underpinned by smart grids and a service-based model of meeting energy needs. Customers will benefit from market-driven prices and their ability and interest in choosing between competing offers. In addition, smart grids will contribute to information technology and operational technology convergence and thus cost reduction, thereby increasing interaction and related data flows between customers, distributed generators, market parties, and grid operators.

Currently, however, innovation is largely stifled by unnecessary restrictions on service features (e.g., time-of-use and dynamic pricing, peak pricing) and price regulation. This reflects an antiquated attitude too often taken towards energy retail markets and is counterproductive. Downstream, specific market design choices should be wide open for innovation, with no prescriptions.

On the other hand, in order to create stronger incentives to develop smart grid solutions, a clear line does need to be drawn to distinguish which businesses should be regulated and which should be market-driven. For this infrastructure development to happen, distribution system operators (DSOs) need sufficient space for investment in technologies that can improve overall system optimisation, network availability, and efficiency.

Guiding principles

- **Continue to push for effective deregulation in retail markets.** To this end, Member States need to show a sense of urgency about deregulation and stop current intervention in retail electricity pricing. Customers will then have an incentive to experiment with tariff/price structures, new services, and product definitions. (Special measures are needed for consumers at risk/vulnerable customers.)
- **Develop a smart market model.** This requires a framework for information exchange between all parties involved, which, in turn, will spur the development of a customer-focused demand-response market and ensure active cost-efficient network management by DSOs.
- **Incentivise innovation by DSOs.** National Regulatory Agencies should make specific provisions for DSOs to implement the most cost-effective innovative network solutions and revise the balance between risk and reward for innovative activity.
- **Explore further options for cost-reflective network pricing.** This could take the form of two-part network tariffs with power (kW) and energy (kWh) components or a network tariff with peak-price differentiation, which would contribute to demand-side participation while providing adequate revenues to DSOs.

The ADDRESS project focuses on using small consumers' possible consumption flexibility to reduce load on command through aggregation.

The project, which has received funding under the EU FP7 Programme, refers to this elasticity in consumption and generation as 'active demand'. The ADDRESS project (Active Distribution networks with full integration of Demand and Distributed energy RESourceS) has led to full-scale demonstrations of technology and concepts for aggregated active demand at three sites in Italy, France, and Spain.

It is anticipated that such load reductions could be sold to electricity market players, e.g., network companies, balancing responsible parties, and owners of non-controllable generation (e.g., wind power and PV). Small consumers' surplus production from their own generation, such as small wind units, PVs, and micro-CHPs could also be aggregated into larger amounts, allowing them to participate in market sales.

Source: ADDRESS

ACTION NEEDED NOW	
CURRENT CRITICAL POINTS	**RECOMMENDATIONS**
Data handling needs and options for smart grids have been identified in the European Commission Smart Grids Task Force.	**Develop a smart market model:** • A clear European view is needed on the division of (legal) roles and responsibilities for market and regulated players as well as an enabling regulatory framework for Big Data.
Standardisation efforts at EU level are provided for in the EC Communication on Smart Grids, which contains the baseline for these efforts. Therefore, standardisation gaps are being identified and standards are being set for smart grids under Mandate 490.	**Recognise the innovation potential of smart grids:** • **Tackle the issues of interoperability and data exchange between actors while developing Mandate 490 by 2014.** This should include smart network management, integration of DG, and active customers in a smart market.

- **Unlock the potential of flexibility provided by distributed generation (DG) and demand response (DR).** Grid connection and access rules for DG/DR should be adapted to allow grid and market operators to implement cost-effective solutions to optimize the use of the network.
- **Recognise the innovation potential of smart grids.** Cost-benefit analyses of smart grids are currently narrowly defined, looking only at current applications and benefits. If a new downstream market is to develop, however, the enabling smart infrastructure needs to be built ahead of time, providing the enabling setting for continued innovation.

5. CREATE SUPPORTIVE GOVERNANCE FOR THE INNOVATION UNION

The EU should coordinate its RD&D policies and spend scarce resources prudently, both at national and central EU level. Member States' resources are dedicated to national industrial policy needs and are often not aligned with the overall EU innovation agenda or energy strategy. The result is fragmentation and duplication of efforts. Today, 4,200 research institutes in Europe deal in one way or another with energy research, a world record.[5]

While full centralisation is neither practicable nor necessarily desirable, it does offer more scope for joint programming and resource pooling. The success of the Airbus serves as a best-practice example of joint innovation that is beyond the scope of individual Member States. By contrast, energy initiatives (such as the North Sea Countries Offshore Grid Initiative; see below) often stumble on the inability to join up national efforts.

Guiding principles

- **Improve EU innovation structures.** Create clear responsibilities and coordination between the European Commission's Directorates-General (DGs) and programmes.

The North Sea Countries Offshore Grid Initiative (NSCOGI) aims to develop a major RES technology on a regional scale. It was set up within the Pentalateral Forum, has done meaningful research, and plays an instrumental role in gathering all the parties involved around the same table. A straightforward comparison by ENTSO-E shows that the European and integrated offshore approach in the North Sea adds more value than the inefficient and more expensive national approach in the same region. Despite the evidence for a European value add, the risk is high that the chosen approach will be national.

The solution lies in installing an efficient governance mechanism, and EURELECTRIC strongly supports this approach.

5 Source: CSIC, Ranking Web of World Research Centers

- **Prioritise better coordination of Member States' innovation programmes**. EURELECTRIC urges Member States to grant a more active coordination role to the European Commission. This would improve resource pooling and maximize joint-programming opportunities.
- **Sponsor joint Member States' projects and build on established foundations**, e.g., the European Energy Research Area and the Strategic Energy Technology Plan. Leveraging the role of the European Commission as a facilitator, Europe should ensure coordination of their centres of excellence around themes central to the energy transition. Public-public partnerships among Member States exist in the current Framework Programme, but they could be used to a much greater extent.

ACTION NEEDED NOW	
CURRENT CRITICAL POINTS	**RECOMMENDATIONS**
Seven DGs in charge of innovation within the European Commission is not sustainable. Despite growing awareness of change within the European Commission, a smart governance of innovation across the EU is needed to overcome the prevailing silo approach. In particular, a new solution is needed to overcome the split of responsibilities between the European Commission's DG Energy (demonstration) and DG Research and Innovation (fundamental research).	**Improve EU innovation structures:** • **The European Innovation Union needs more effective governance.** Conducting an international benchmarking exercise is a proven method and could serve to improve the European Commission's innovation governance. Europe can learn from other continents (e.g., the Japanese METI). • A 'one-stop shop' for innovation policy in the EU, covering the full innovation value chain could also contribute to the solution.
The Strategic Energy Technology Information System (SETIS) has been set up to ensure an open-access information system on energy technologies and develop a coordinated approach and capacities for innovation, throughout Member States, international organisations, and energy sectors.	**Sponsor joint Member States' projects and build on established foundations :** • **The SETIS system (as part of the SET Plan) should be reviewed and turned into a more effective instrument.** The Commission should incentivise energy innovation cooperation among Member States by topping up funds and explore alternative ways to move the cooperation from promise to practice (ERA plus).
Intergovernmental mechanisms are suboptimal for cost-efficient development of the North Sea grid	**Prioritise better coordination of Member States' innovation programmes:** • **EURELECTRIC recommends using the NSCOGI as a pilot-project** for an innovative EU energy policy. Reporting to the Electricity Coordination Group, this initiative would take the North Sea Grid from promise to practice, while avoiding inefficiencies associated with national-only solutions.

For the power industry, innovation will be the critical enabler that unlocks new sources of value in the decades to come. More than ever, a thriving industry will depend on finding new ways to improve products and to serve increasingly engaged customers. For policymakers, innovation will be the key to achieving decarbonisation and energy security objectives at acceptable cost. It should always be a 'top of mind' goal and inspiration when establishing the wide range of policies that affect the power sector and its customers.

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