

# **Has the Low Carbon Network Fund been successful at stimulating innovation in the electricity networks?**

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# What is a smart grid?

## *A Smarter Grid:*

- Active instead of passive
- Responsive instead of proactive

*Should be able to sense, understand and react to the flow of electricity.*

*Able to actively integrate demand, storage and distributed generation.*

## *Smarter Uses of the Grid:*

- Prosumers instead of Consumers
- Informed Users instead of Passive Users

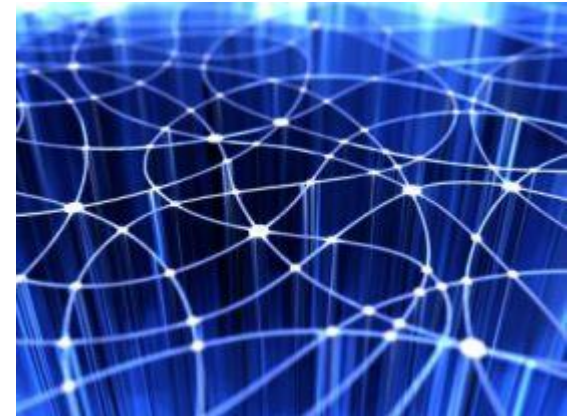
*Allowing customers to actively participate in the energy market*

*Able to inform customers of their energy demand and usage*

## Incremental Improvement vs Systemic Change

- A **component**-oriented approach to the grid can be taken, viewing the process of implementing a smart grid to be an incremental modernisation process.

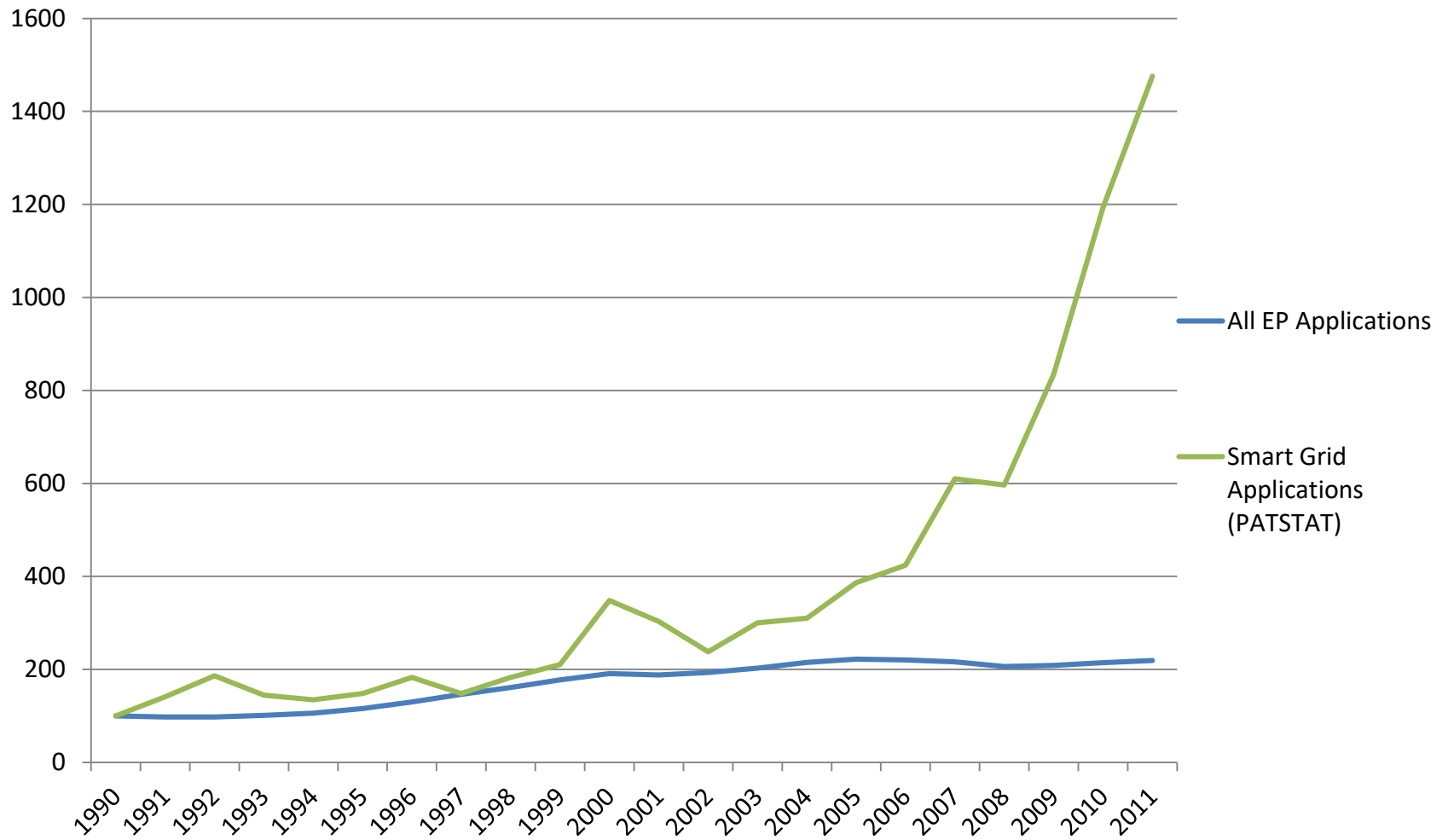
OR



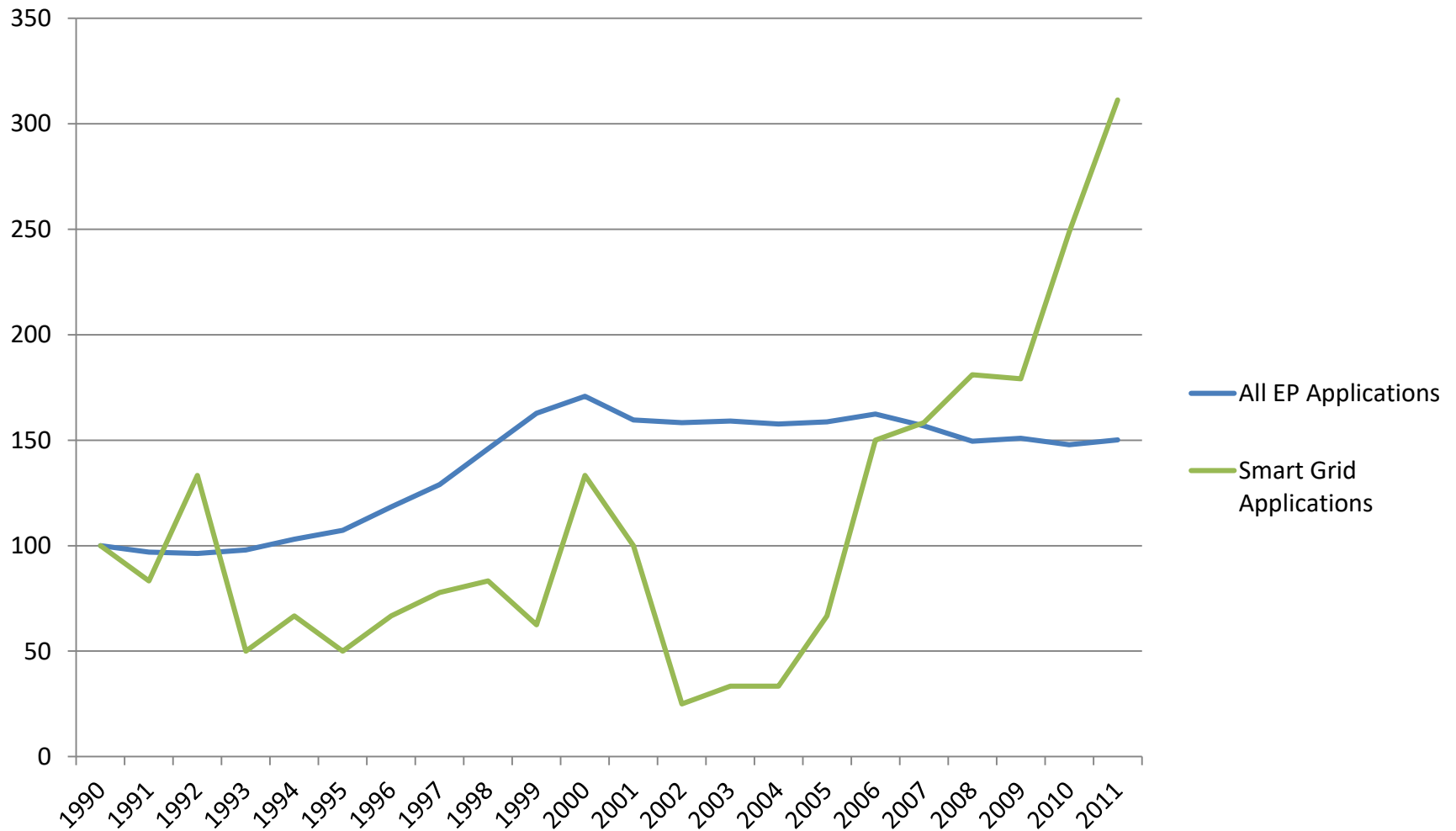
- The smart grid can be seen as a **systemic innovation**, in which the increasing level and quality of communication and connectivity between system components allows the grid to be seen as a holistic system enabling radical new uses and technologies.

Are different innovation systems required for each perspective?

## Smart grid patents (YO4S) filed to the EPO, indexed on 1990 = 100



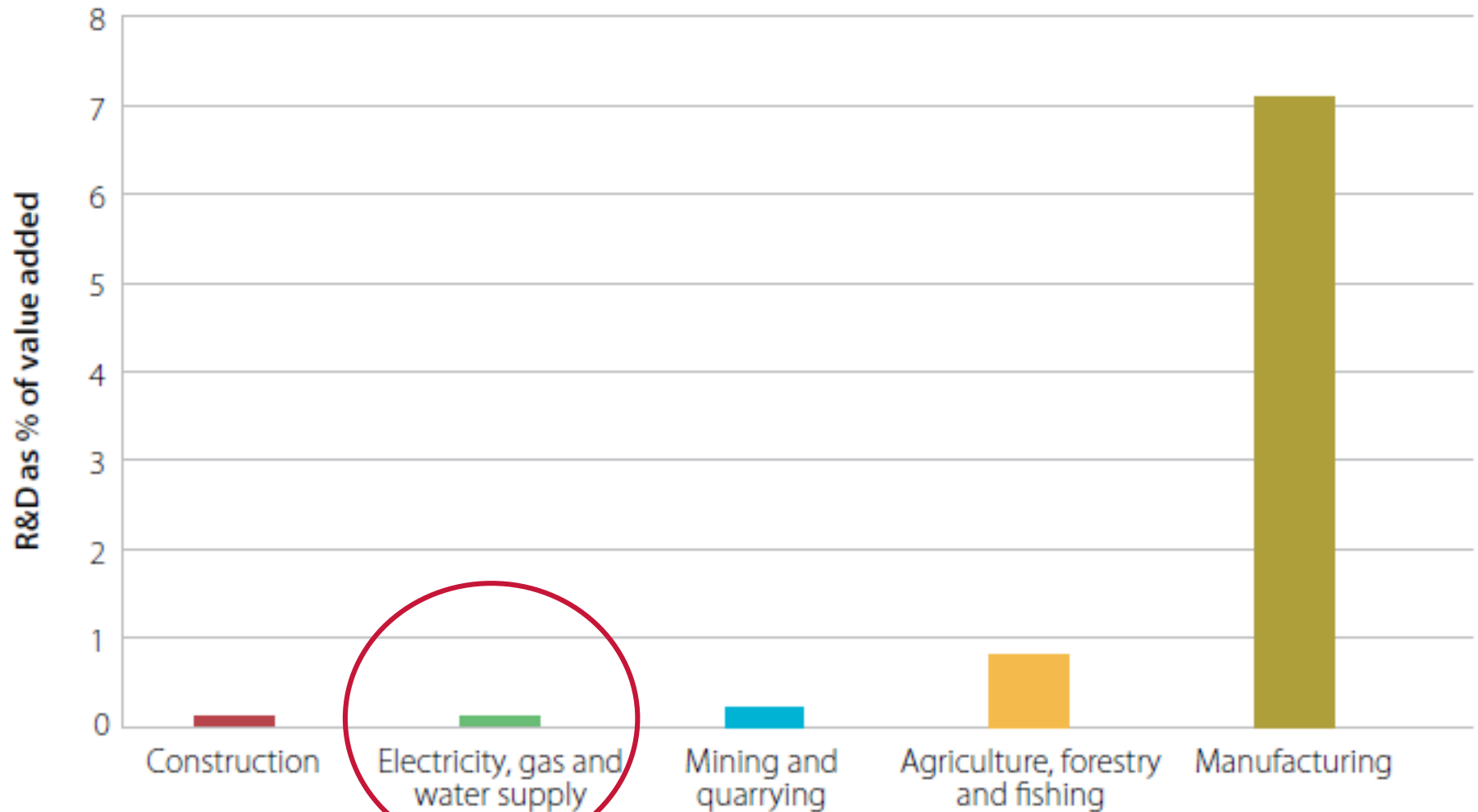
## Smart grid patents (Y04S) filed to the EPO by UK inventors, indexed on 1990 = 100



## Top inventive countries, applications to the EPO (2000 – 11), Triadic Patent Families (2000 – 10).

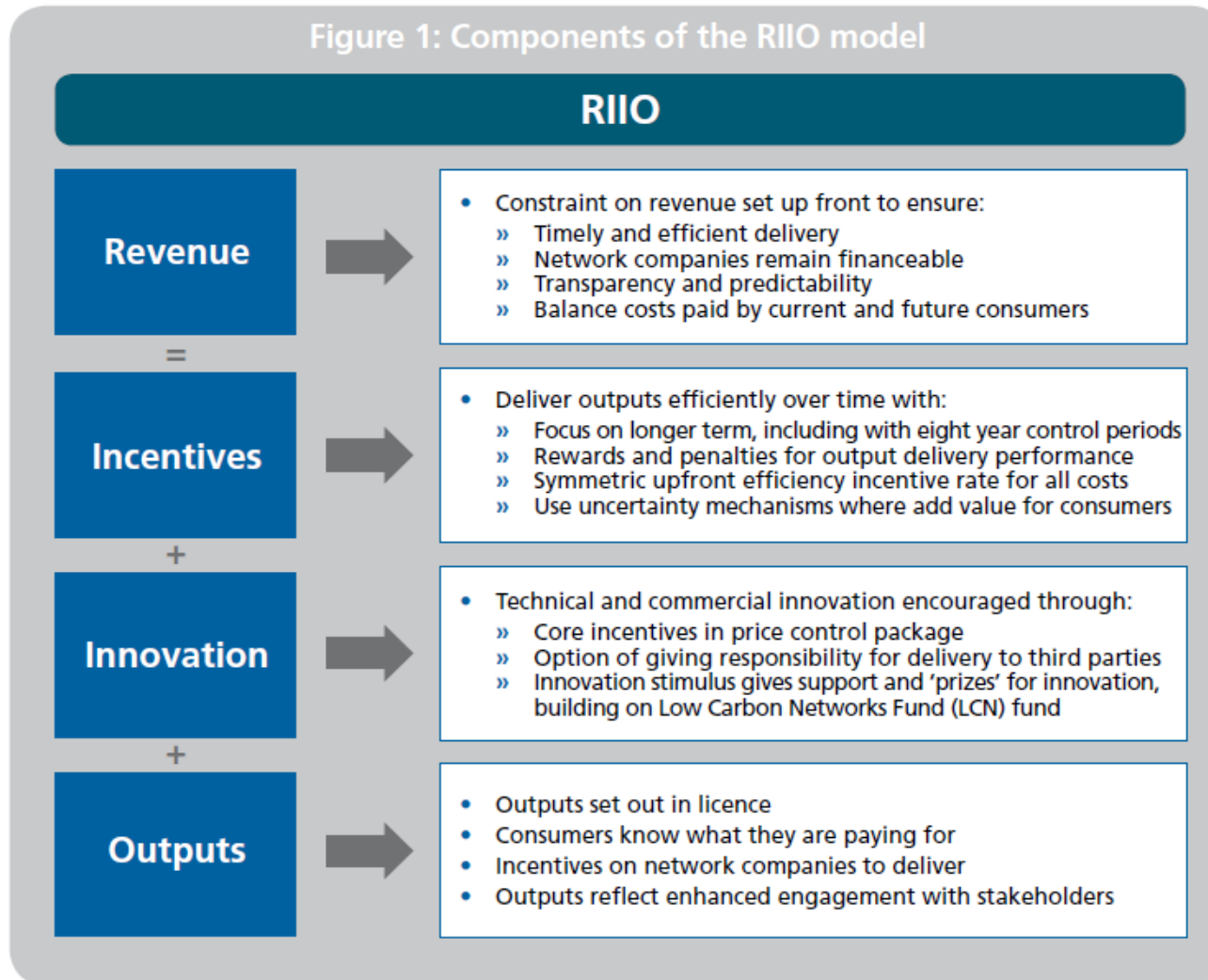
EPO (2000-11)				Triadic Patents (2000-10)		
	Country	%	Count	Country	%	Count
1	US	29.2	596.4	US	38	151.6
2	Germany	18.9	385	Japan	31.3	124.9
3	Japan	11.4	231	Germany	7	27.7
4	France	6.1	123.7	<b>UK</b>	<b>3.2</b>	<b>12.7</b>
5	Switzerland	5.5	111.2	France	2.8	11
6	<b>UK</b>	<b>4.8</b>	<b>97.2</b>	Canada	2.2	8.8
7	Korea	3.8	77.7	Korea	2	8
8	Italy	2.9	58.1	India	1.5	6.1
9	Canada	2.5	51.3	Belgium	1.4	5.6
10	India	1.7	33.7	Italy	1.1	4.3
Subclass	Description					UK Ranking
<b>Y04S 10</b>	Systems supporting electrical power generation, transmission or distribution					8
<b>Y04S 20</b>	Systems supporting the management or operation of end-user stationary applications, including also the last stages of power distribution and the control, monitoring or operating management systems at local level					5
<b>Y04S 40</b>	Communication or information technology specific aspects supporting electrical power generation, transmission, distribution or end-use application management					7
<b>Y04S 50</b>	Market activities related to the operation of systems integrating technologies related to power network operation and communication or information technologies					9
<b>All Y04S</b>						6

## Infrastructure: A mature sector with a weak innovation culture



Source: Committee on Climate Change

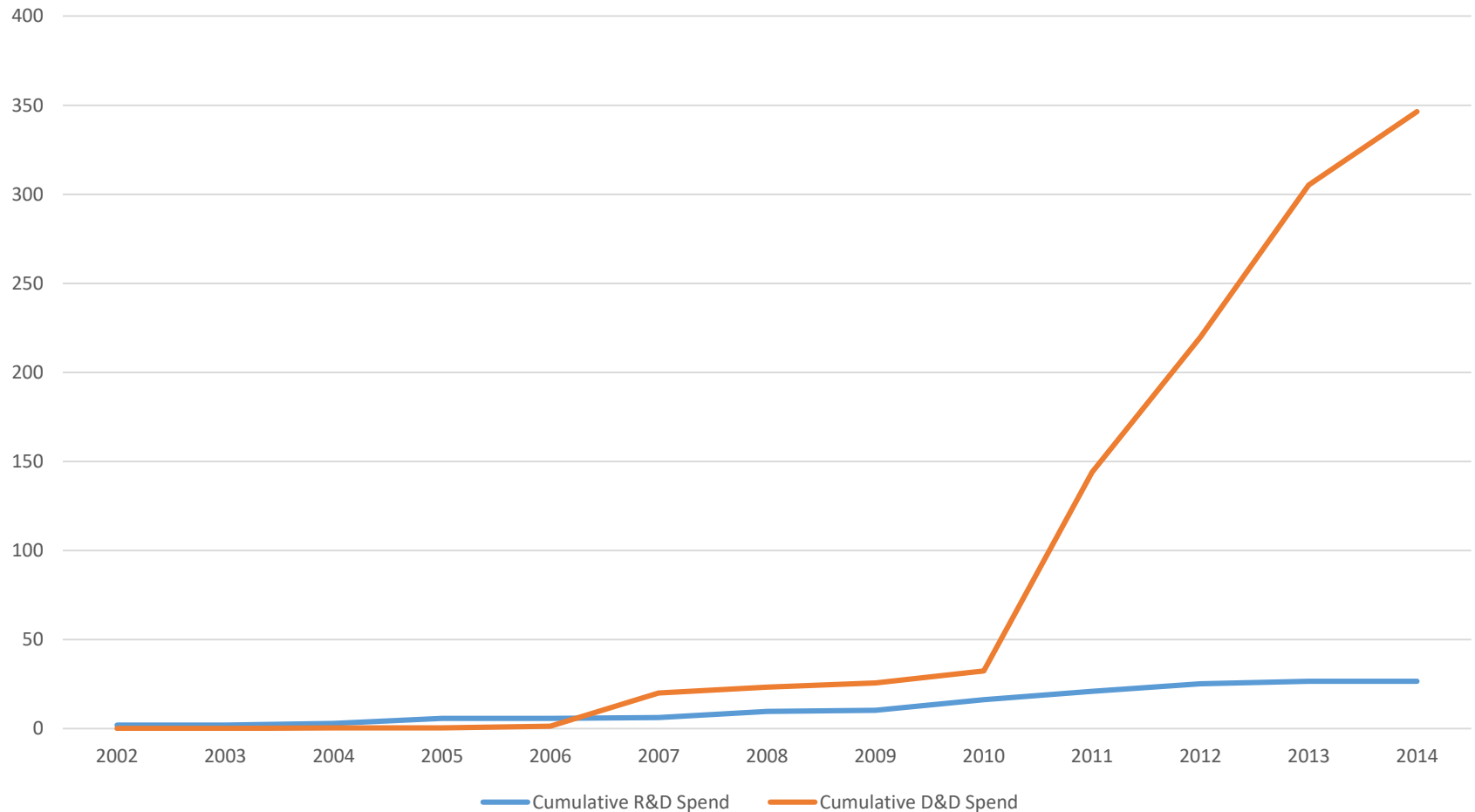
# The new RIIO model for transmission and distribution



Source: OFGEM,  
"RIIO: A new way to  
regulate energy  
networks"  
Final Decision, Oct  
2010, p. 3



## UK Cumulative Spend on Smart Grid R&D and D&D projects 2002-14 (Million £)



Source: EU JRC

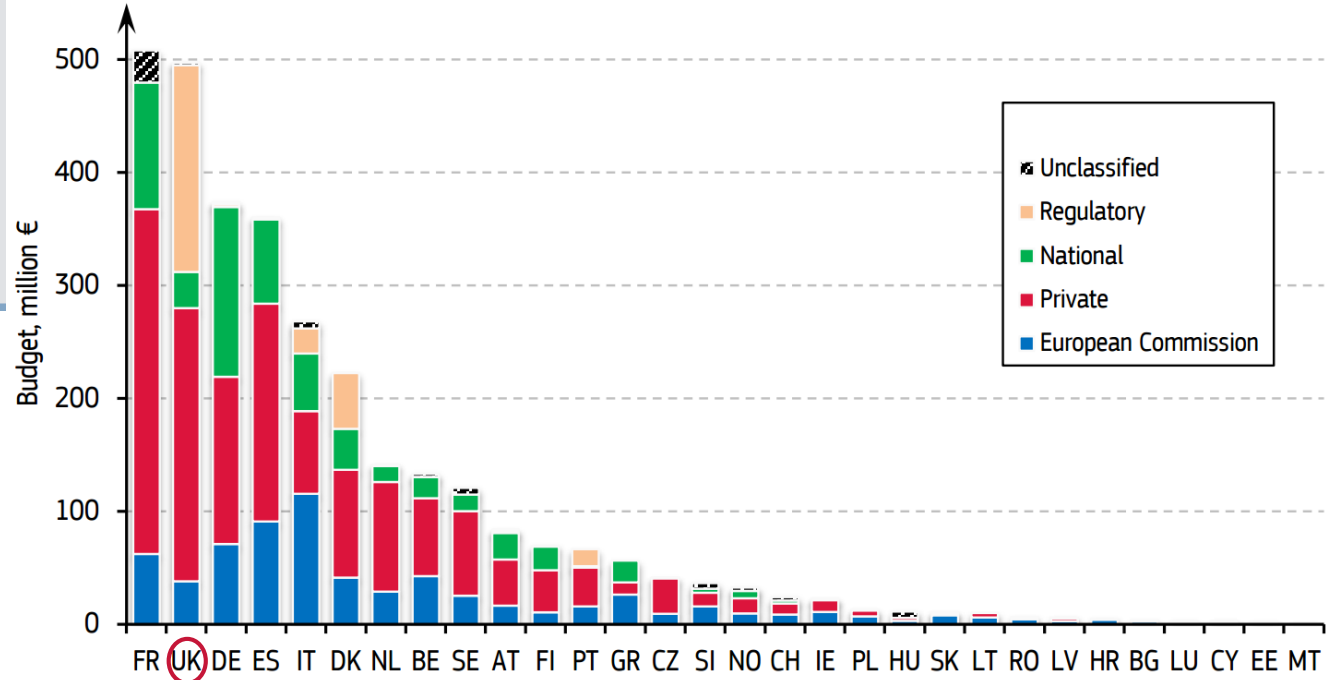
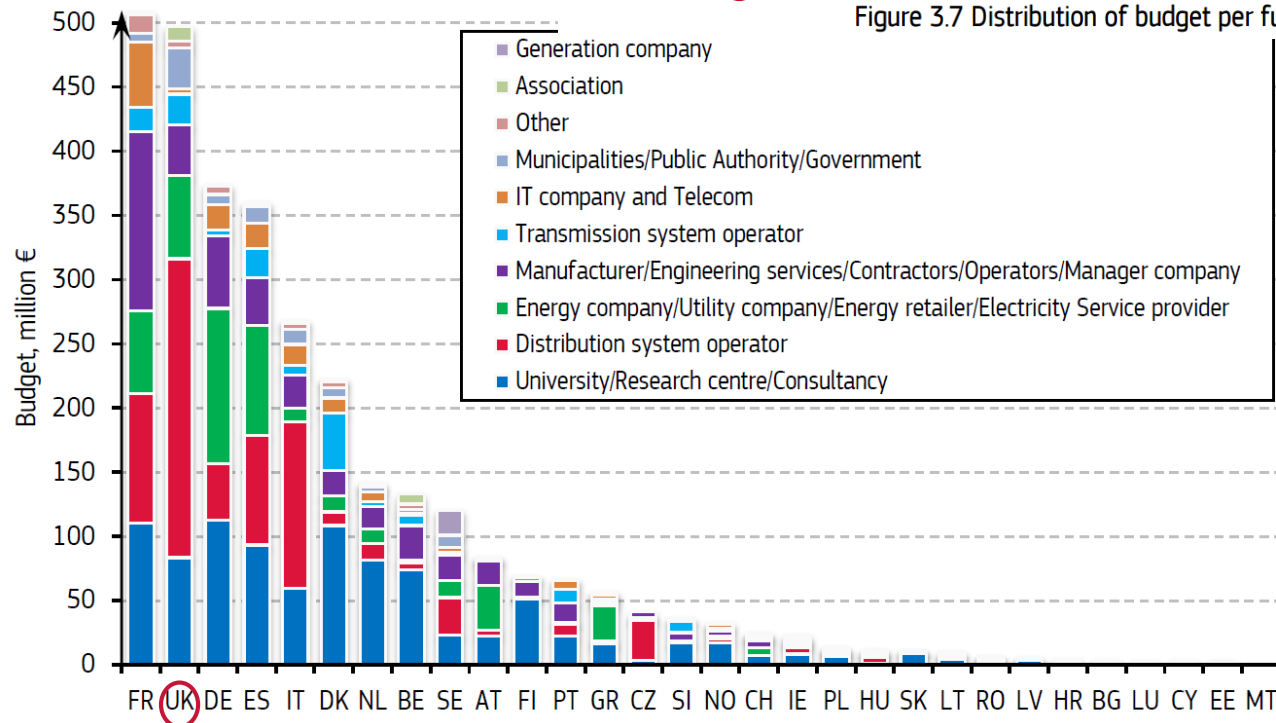


Figure 3.7 Distribution of budget per funding source and country<sup>22</sup>



Source: EU JRC

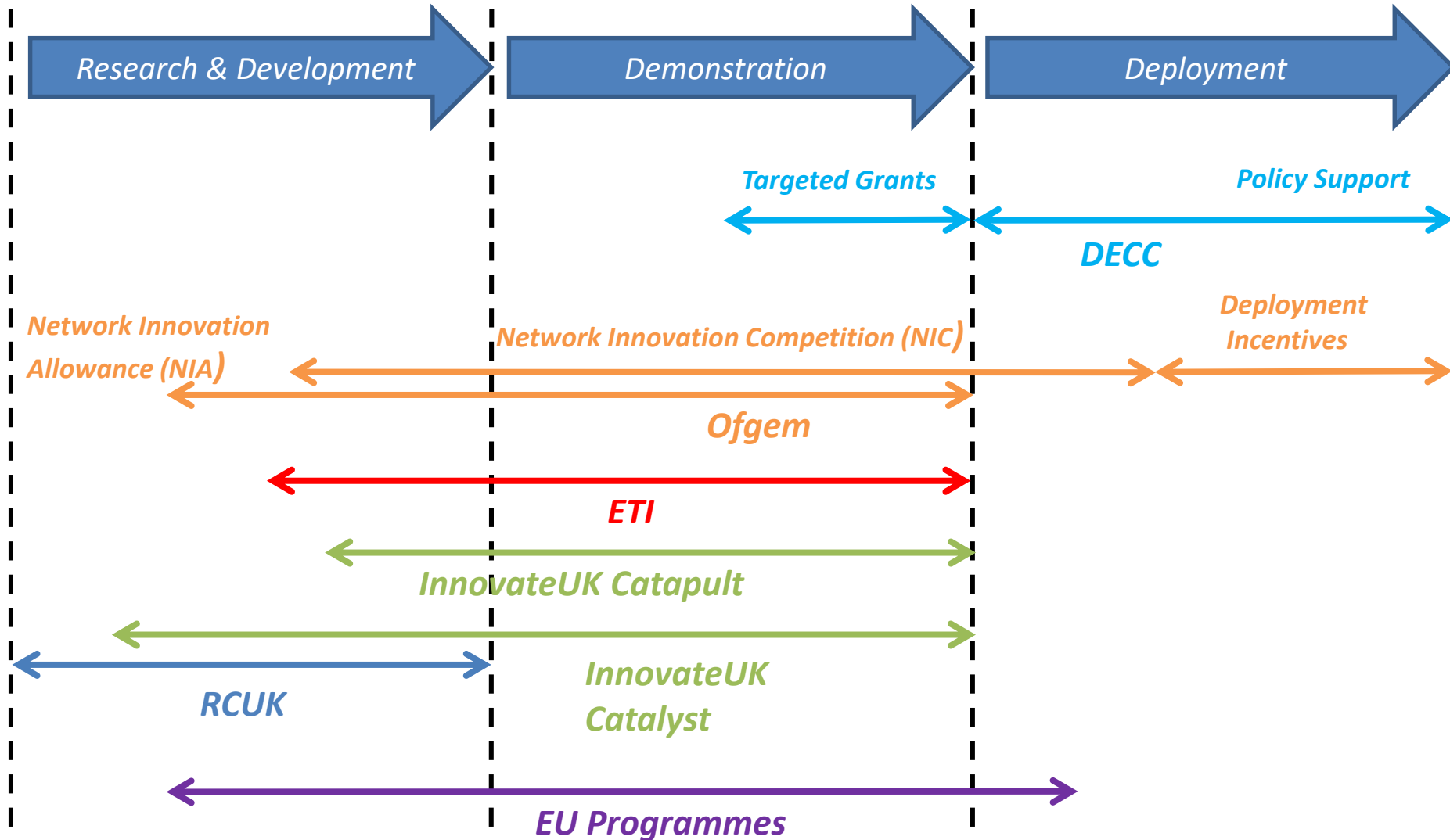
## LCNF Research questions

- The UK is currently engaged on a very significant programme of RD&D for electricity networks, with approximately **£100m per annum** of public funds available.
- The majority of this (**£81m**) is provided through the Network Innovation Competition (NIC) and funnelled through DNO/TNO-led consortia. This is a novel funding mechanism, both within the UK and internationally.
- The NIC is a successor to the Low Carbon Network Fund, which ran from 2010-15.

1. Has the LCNF, a DNO-led innovation model, been successful at developing and demonstrating smart grid technologies and practices?
2. Are technologies and practices funded through this model successfully proceeding from demonstration to deployment?
3. Is the funding mechanism open to new entrants and more radical/disruptive ideas?
4. Is this innovation model well-suited to developing a smart grid system, and does it provide good value for public money?
5. How does this model compare to other smart grid innovation models such as Jeju Island in South Korea or New York State?

Research conducted by quantitative analysis and qualitative semi-structured interviews

# Public Innovation Support for Smart Grids in UK



## The Low Carbon Networks Fund – Tier 2 Projects

	LCNF Funding	DNO Contribution	External Funding	TOTAL
Electricity North West	£29,146	£502	£3,839	£33,487
Northern Powergrid	£27,353	£3,039	£22,227	£52,619
SSE Power Distribution	£37,957	£307	£10,016	£48,280
SP Energy Networks	£11,021	£2,588	£495	£14,104
UK Power Networks	£57,453	£8,302	£10,182	£75,937
Western Power Distribution	£50,281	£2,555	£4,099	£56,937
<b>GRAND TOTAL</b>	<b>£213,212</b>	<b>£17,293,954</b>	<b>£50,858</b>	<b>£281,365</b>

*About 2/3 of budget committed*

## Some thoughts on the LCNF

- Is customer bill funding better than taxpayer funding?
  - Regressive, proportionally falling more on poorer consumers
  - Benefits may take a long time to realise.
- What should be funded by shareholders as business as usual, and what should be funded by customers as more uncertain, longer term projects?
- Does this mechanism allow innovation in business practices as well as technology?
- Are network companies utilising scientific methods and rigour, and are they committed to open data publishing and dissemination?

# Interviews

- Three waves of semi-structured, anonymised interviews
- First focusing on high-level policymakers, academics and industry figures.
- Second focusing on project managers and participants.
- Third, to follow, testing conclusions with senior stakeholders



## DNOs and the LCNF

- How favourable are DNOs to innovation? A substantial culture change in DNOs over the last several years, driven by concerns over increasing network connections and constraints as well as the substantial innovation allowances available. SGF Workstreams 3 and 7 are led by and paid for by DNOs.
  - However, these are still seen as conservative companies, run to provide a steady rate of return. Incremental, not radical, change was expected.
- The LCNF is seen as a good, bold programme, encouraging DNOs to be innovative and giving them the space to do so. Concerns were however raised in the complexity of bid preparation, reporting and project operation. Academics in particular find the governance structure onerous and 'horrendously bureaucratic'.
- The DNO-led consortia were seen as focusing more on incremental improvements. They are incentivised to deliver impact in a short period of time, discouraging risk-taking.



## Has the LCNF been successful?

- The programme structure is designed to procure and test infrastructure over testing socio-technical solutions, which has led to limitations for some projects.
- Some concerns over a 'checklist mentality' leading to overly-prescribed and static milestones and project deliverables. In some cases, this can lead to perverse incentives.
- Data outputs from the projects are openly available in most cases, though not archived and curated well and difficult to access and use. One interviewee suggested that Ofgem is not familiar enough with data curation, including ethical and legal constraints.
- How can multi-vector projects be funded? Customers think of energy in multi-vector terms, but do companies and regulators? There was a view from several interviewees that multi-vector thinking will become increasingly important. How can RD&D projects be funded in this area?

## Successfully proceeding to deployment?

- Projects closest to deployment tend to cluster around network management and operation, with several DSM projects showing promise. Smaller projects focused on specific technologies are unsurprisingly closer to deployment.
- Dissemination was considered to be insufficient – while the annual LCNF conference was praised, more smaller and more frequent dissemination events concentrating on specific technologies were needed.
- Little follow-up on whether technologies and practices were proceeding to business-as-usual deployment.
- Very few examples of DNOs adopting technology from other DNOs LCNF projects, even though results are open and designed to be shared.
- Capex and Opex: One interviewee brought up the point that DNOs have extensive expertise in capital expenditure and infrastructure investment, but less so in the operational expenditure required to run a system operating (DSO) business. New skillsets will need to be developed, and they may need external expertise.

## Open to new entrants and disruptive ideas?

- A view from some SMEs that LCNF project consortia are somewhat of a 'closed shop', which is partially backed up by project partner lists.
- IP issues were seen as discouraging start-ups. Nobody is allowed to unanimously capture foreground IP, and partners need to invest significantly in the projects themselves, perhaps unintentionally creating a bias toward large suppliers.
- Timescales: There is a mismatch between development of assets and infrastructure, which takes years, and software, which takes months. Investment risk profiles differ substantially also, with software being much less risky.
- A possible disconnect with primary research was raised by several interviewees, partly due to a focus on demonstrating short-term results and impact as part of the projects. LCNF projects have tended to be at high TRL levels. Concerns were also raised that utility companies have stopped engaging as much with early-stage academic work since the introduction of the LCNF.

## Conclusions and Recommendations

- LCNF has been a success in stimulating an innovation culture in DNOs.
  - Would this survive a withdrawal of public funding, however?
- Bidding process should be streamlined
  - Bids should follow a rigorous research methodology
  - Success criteria should not discourage riskier, more radical research
- More open bidding process – workshops, sandpits, partnerships
  - While DNOs need to be involved, do they always need to be the initiator?
- Follow-up completed projects to ensure results are pushed to deployment where appropriate.
  - More knowledge diffusion and exchange efforts.
  - Higher-quality outputs and data, respecting scientific methodology

## Jeju Island Smart Grid Testbed, South Korea

- World's first integrated smart grid testbed, project from 2009-13
- \$250 million budget, \$70 million from government, 168 companies involved
- Fieldwork completed in late June, currently writing up results
- Benchmark against LCNF



***Thank You!***

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