

Innovation and governance in the British energy transition

Matthew Lockwood
Energy Policy Group, University of Exeter

Karlsruhe Institute of Technology
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New Thinking For Energy



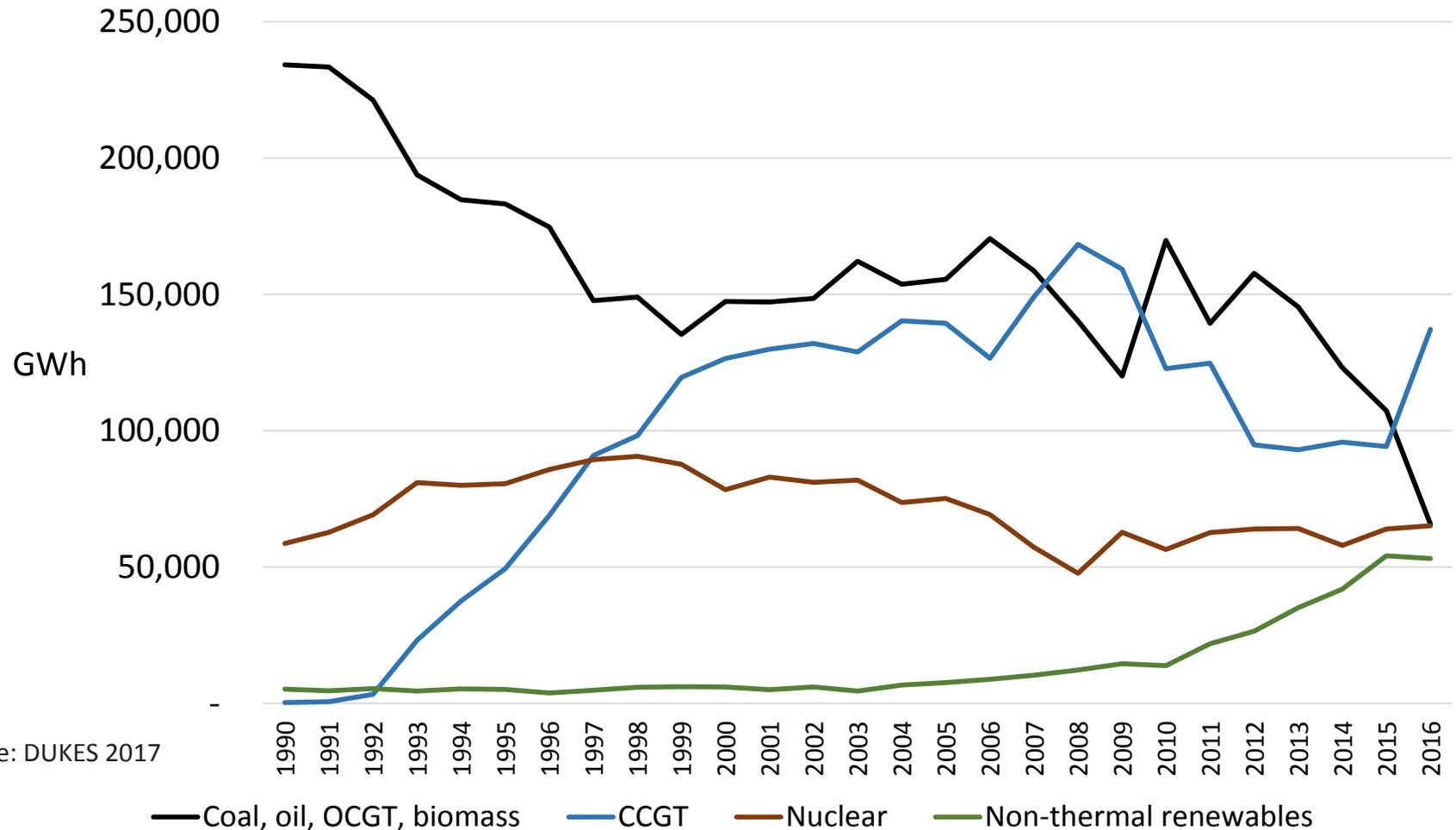
Overview

1. The British energy transition to date
2. The GB energy governance approach
3. Challenges for the next phase of transition

1. The British energy transition to date

The rise of intermittent renewable electricity generation

Gross electricity supply



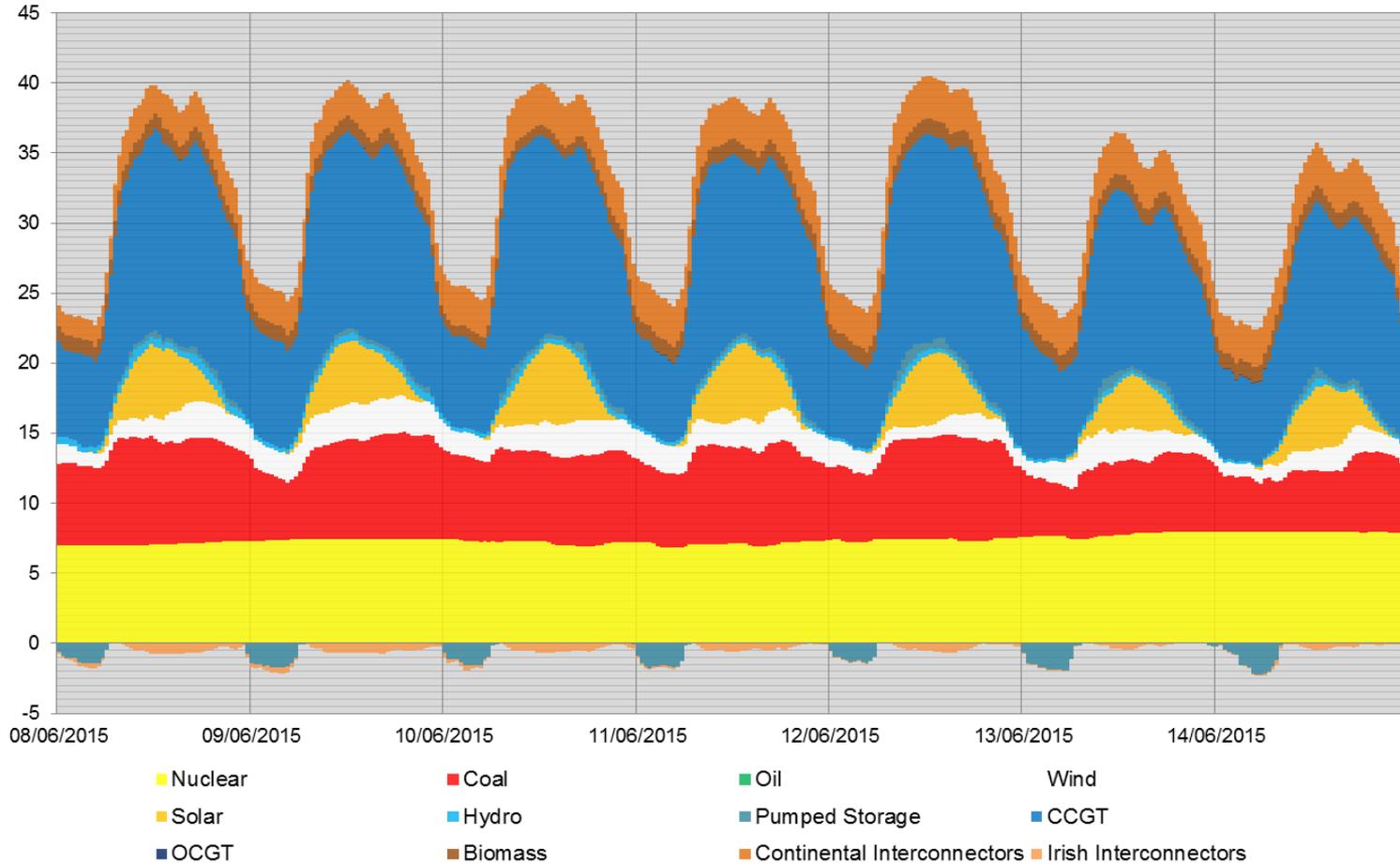
Source: DUKES 2017

Generation summer 2015



GB GENERATION BY FUEL TYPE, GW
WITH EMBEDDED WIND & SOLAR ESTIMATES

Week Ending 14-Jun-15



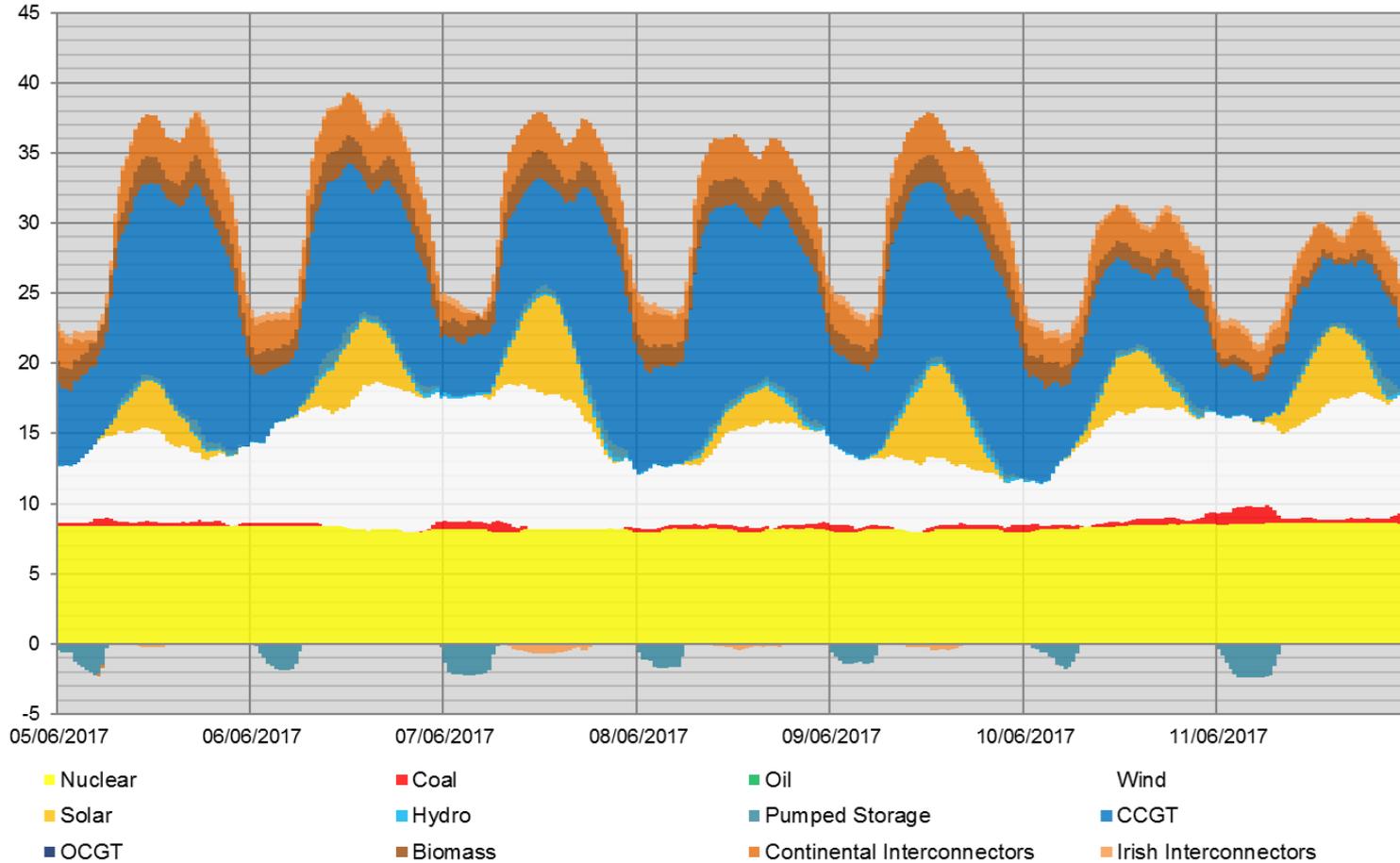
Source: National Grid

Generation summer 2017



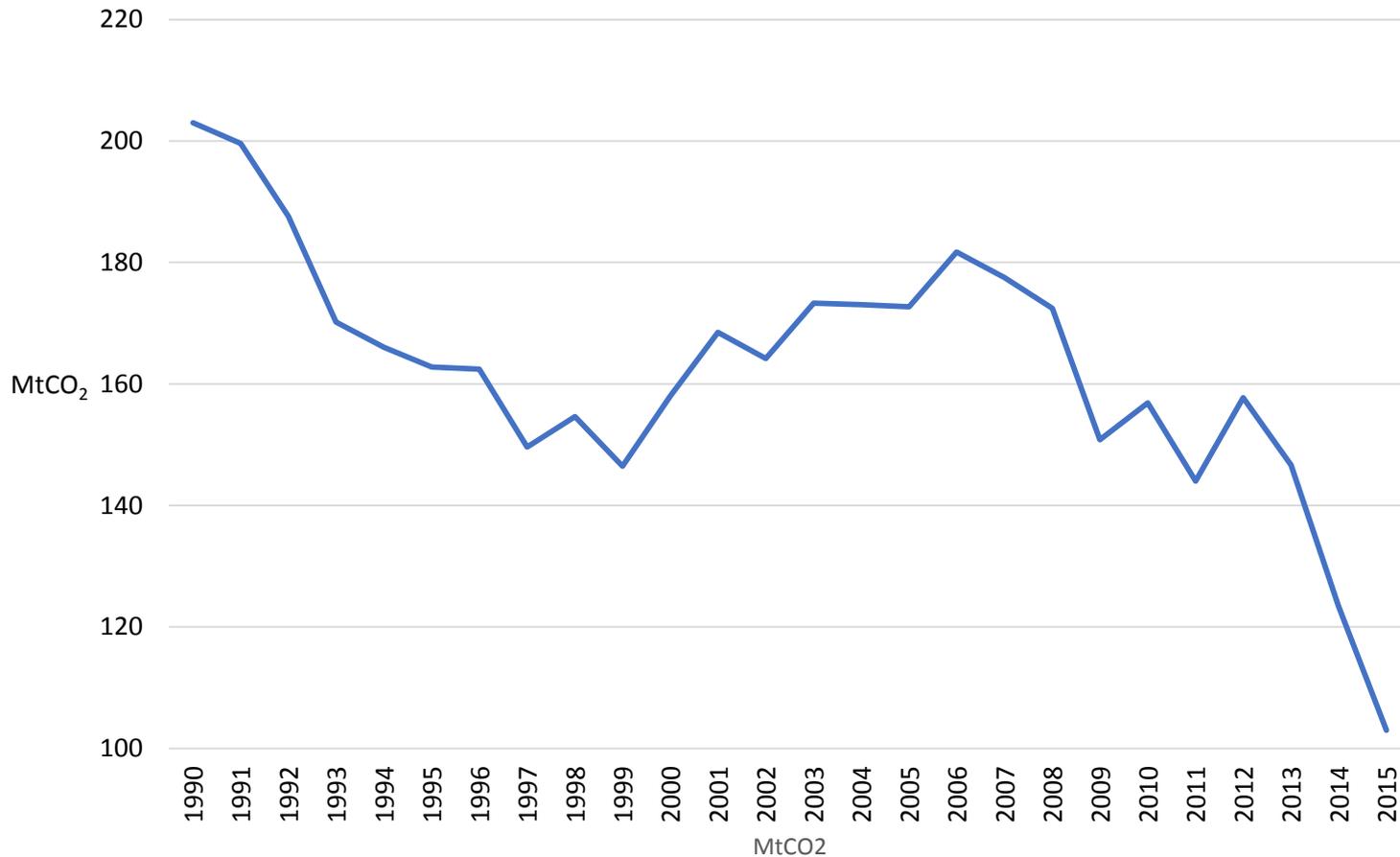
GB GENERATION BY FUEL TYPE, GW
WITH EMBEDDED WIND & SOLAR ESTIMATES

Week Ending 11-Jun-17



Source: National Grid

Power sector carbon emissions



Source: <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2015>

Other consequences

- Emergence of negative system pricing in balancing mechanism
- Reduced inertia and higher RoCoF
- More variable (residual) demand

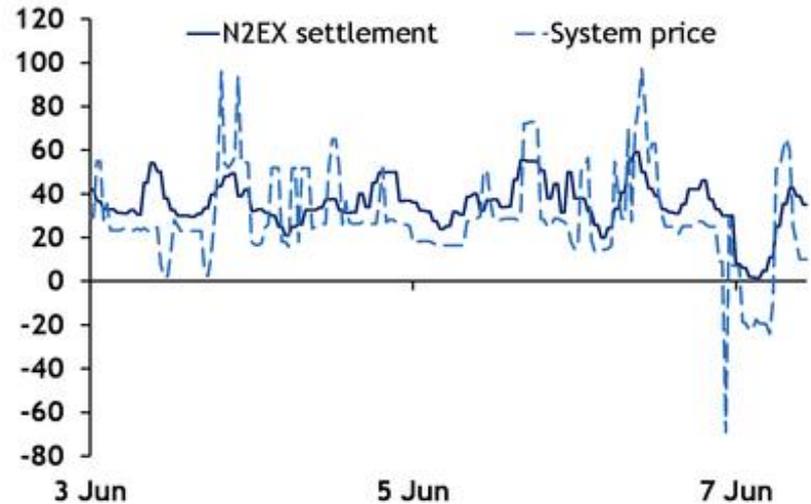
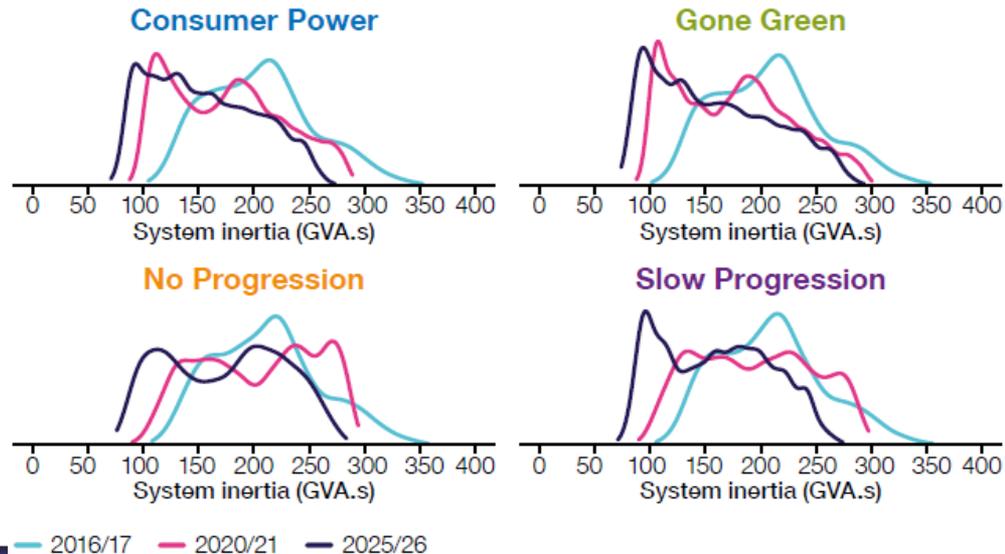
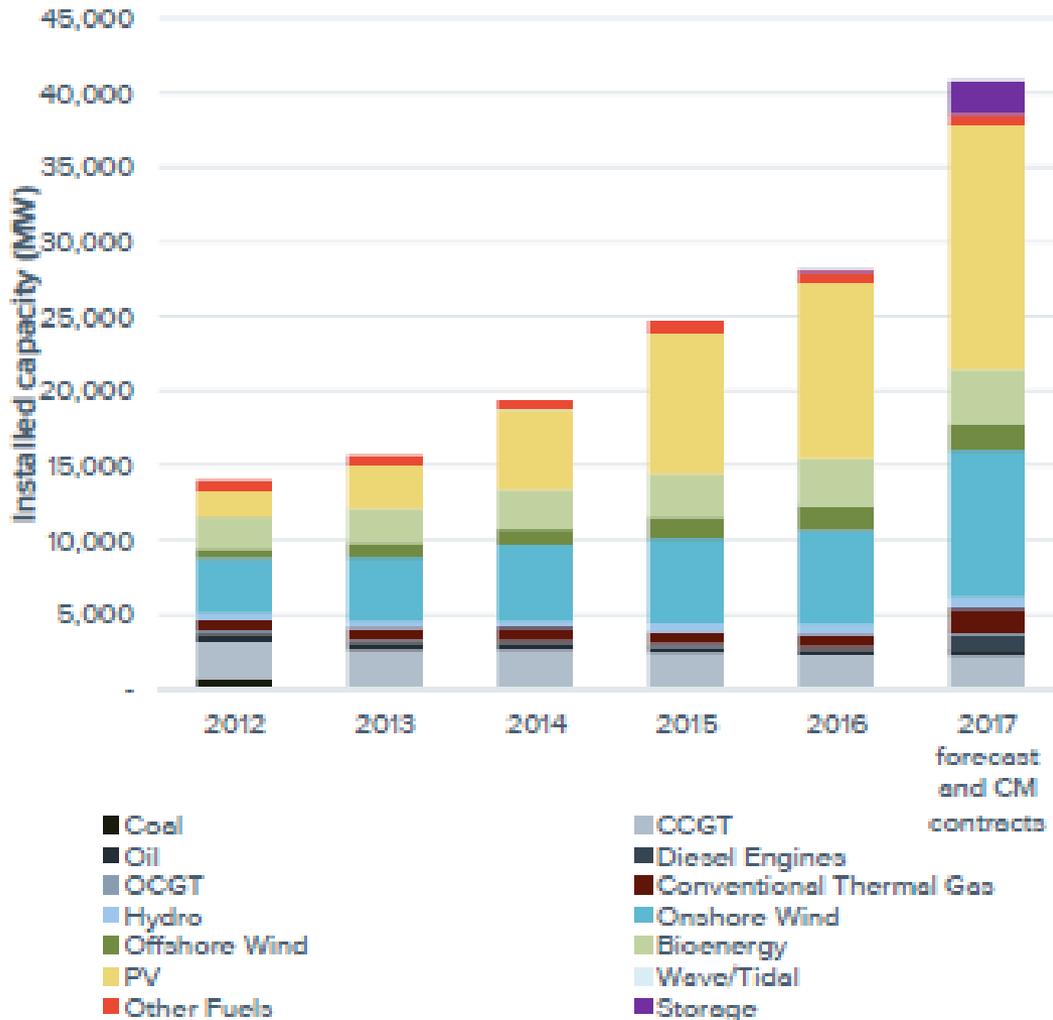


Figure 3.7 Annual distributions of system inertia (GVA.s) by scenario (flexibility case B)



Shift towards distributed generation

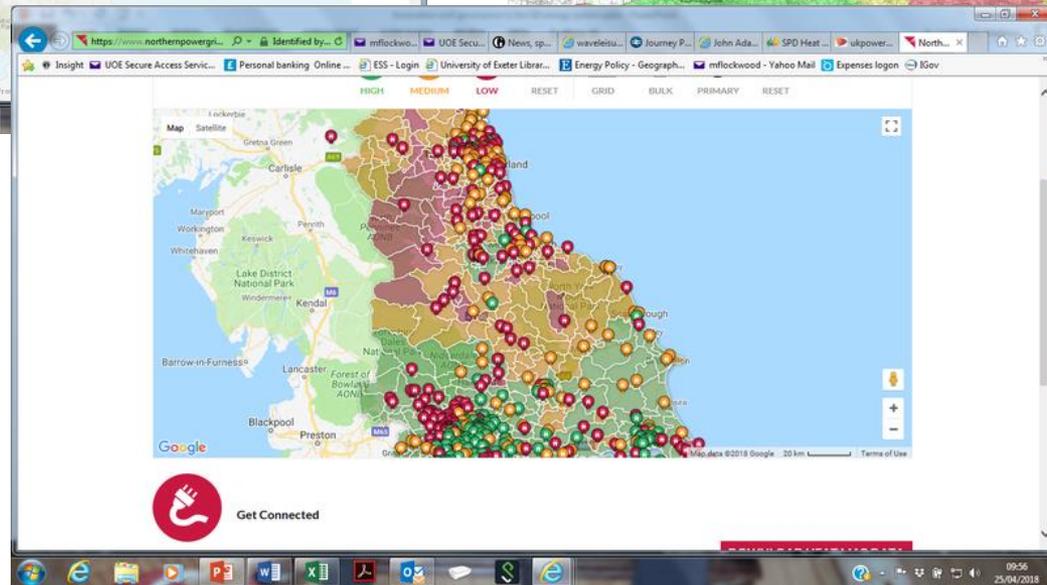
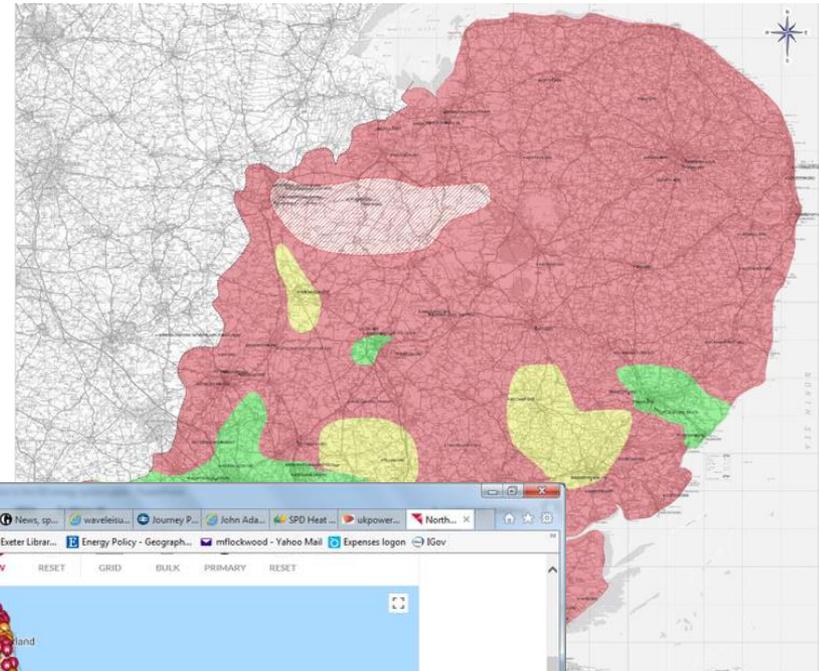
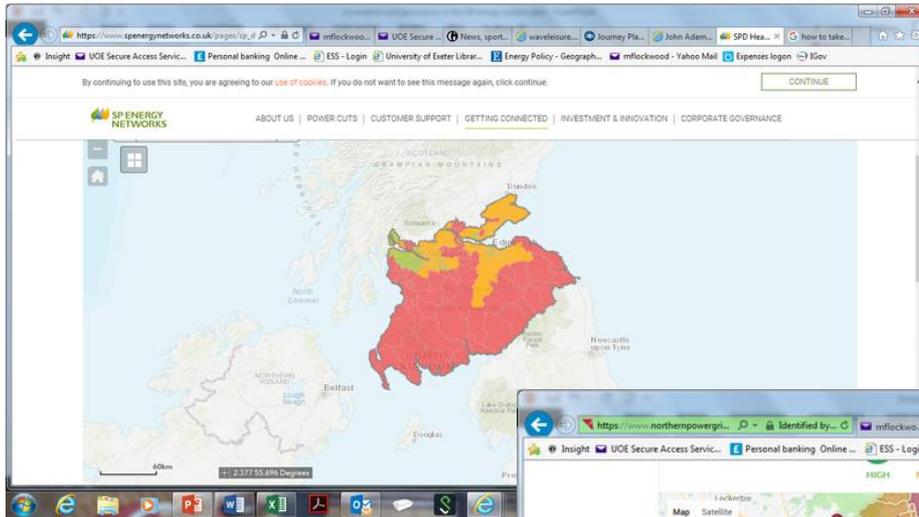
Embedded Generation Capacity (existing and contracted)



	Year	DG capacity (GW)	Peak demand (GW)
GB	2016	28	61
Germany	2015	89	86
California	2016	10	61
Rep. of Ireland	2017	1.9	5

Source: BEIS and Cornwall Insight Forecasts

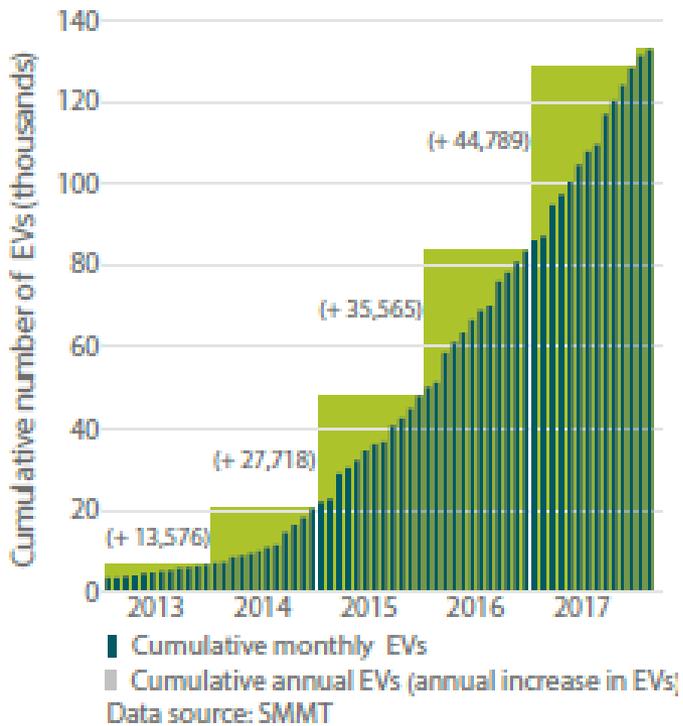
Challenges for distribution networks



New flexibility resources

- **Grid-scale storage**
 - ~1GW connected in 2017
 - A lot more accepted for connection
 - Up to 15GW by 2030? (Regen 2017)
- **I&C DSR**
 - ~5GW, mainly in STOR
 - On-site generation more than turn-down
 - Technical potential up to 20GW? (Charles River Associates 2017)
- **Interconnection**
 - ~4GW now
 - Up to 10GW new interconnection by 2025?

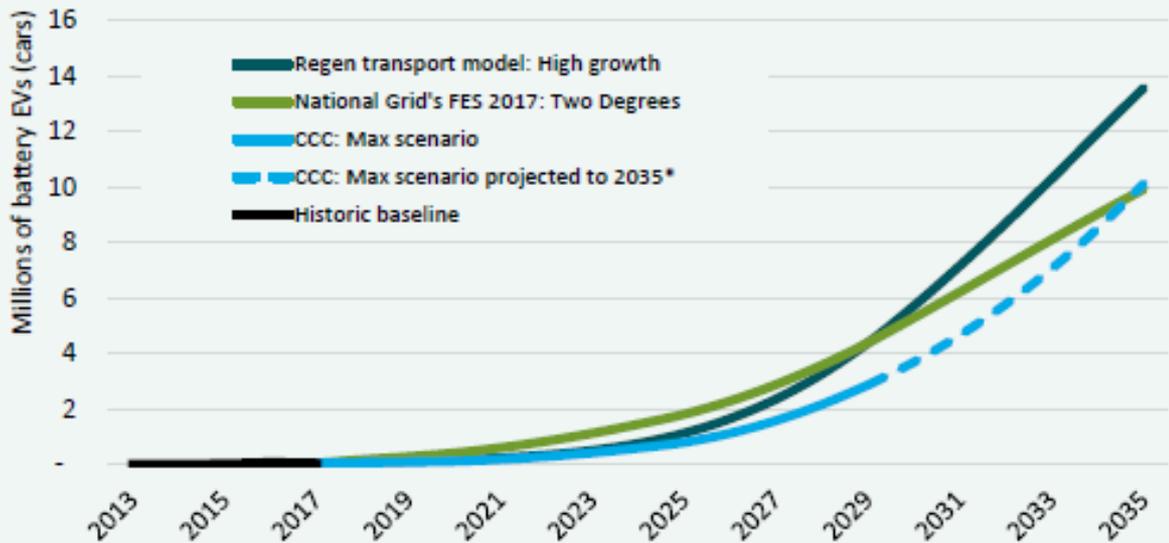
EV market growth 2013 to 2017



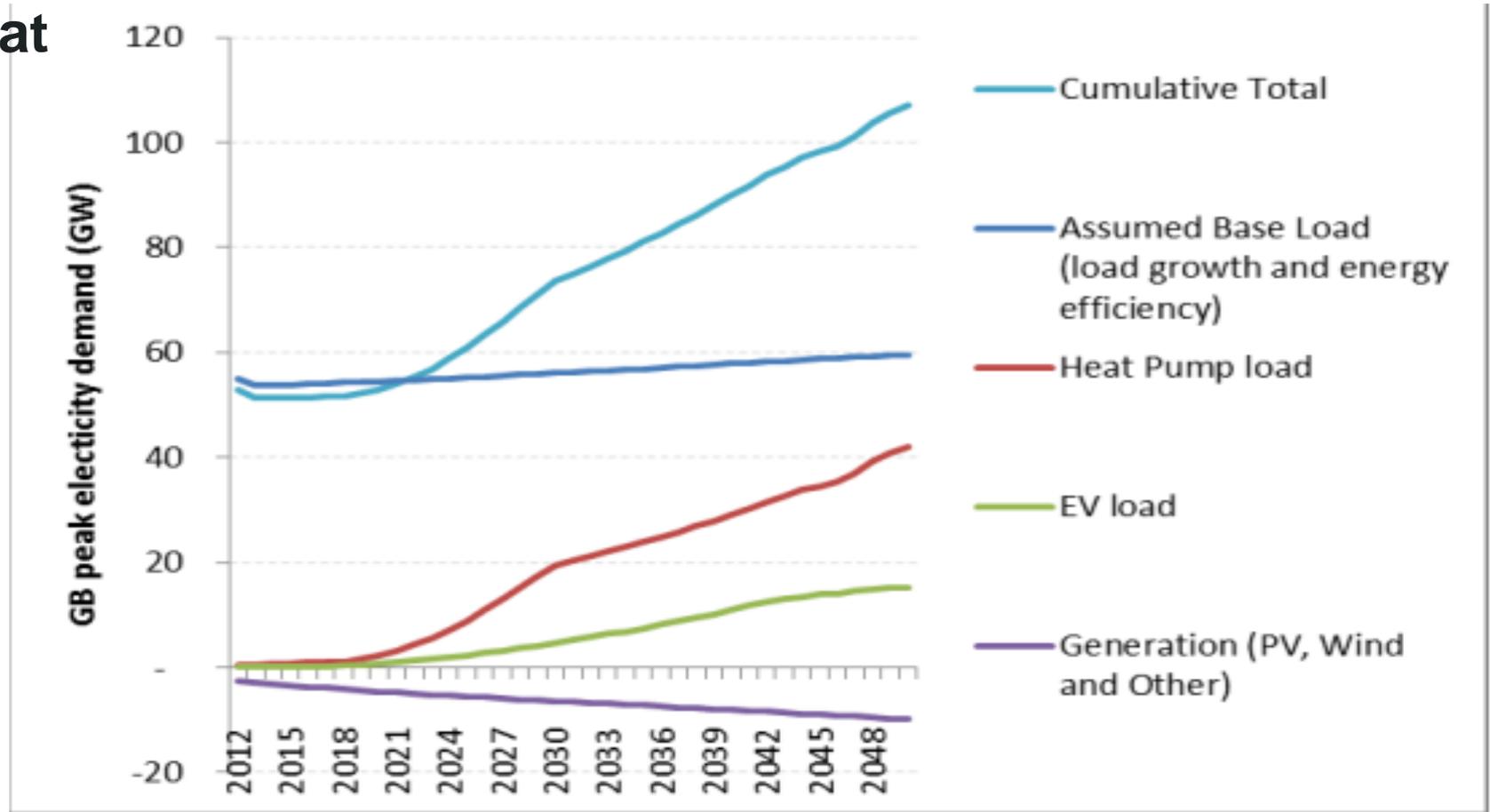
Source: Regen 2018

Growth of EVs

Regen, Committee on Climate Change (CCC) and National Grid high battery EV scenarios



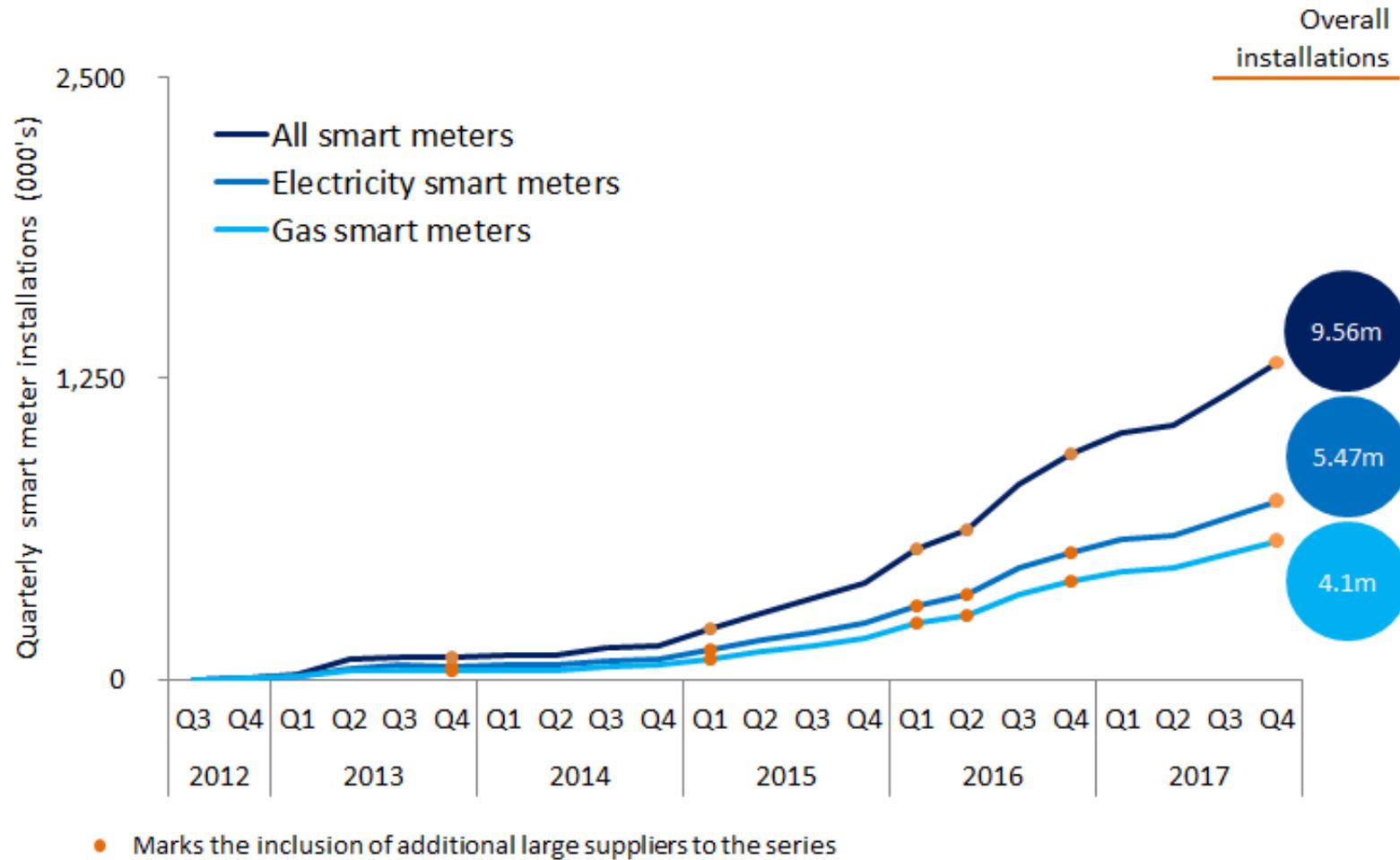
Heat



Source: Element Energy (2013)

- Currently ~70% gas
- Huge uncertainty about decarbonisation pathways and degree of electrification
- 20% take up by households of heat pumps > 14% increase in evening peak demand (Love et al 017)

Domestic and SME smart meter roll out



Source: BEIS

Local market platforms, new services and peer-to-peer experiments



Summary

- Decline of coal, rise of intermittent renewables
- Challenges to markets, system operation and balancing
- Rise of DG
- Challenge for distribution networks
- Expected growth of EV charging (and heat pumps?)
- Value in new sources of flexibility (inc. storage, DSR, interconnection)
- Business models emerging?
- Moving from 'first phase' of transition (technology deployment) to 'second phase' (integration)

2. The GB energy governance approach

British energy governance

- ‘Critical juncture’ = privatisation in 1980s
 - Market-led paradigm (Rutledge and Wright 2010)
 - ‘...provides a “preferred solution” to problems as they arise. If a particular outcome is unsatisfactory in some way, the answer, in this paradigm, is more private ownership, the removal of restrictions on trading, and the promotion of competition’ (Helm 2005: 2)
 - Delegation of regulation to arms-length body (Ofgem); double delegation of codes governance (Lockwood et al 2017)
- Continuities
 - Centralised system
 - Supply-side paradigm
 - System security
 - Enduring commitment to nuclear power (Johnstone et al 2017)
- Climate Change Act 2008
- EU Directives (RES, energy efficiency)

3. Challenges for governance of energy transition

3.1 Setting a direction for energy transition

Consequence of CCA process

- Absence of 'national conversation' on direction of energy transition
- Route to credible commitment through legislation and delegation (vs. negotiated Agreements (Denmark, Holland, Germany))
- CCC has limited, advisory role in policy (and in practice largely ignored in this role)



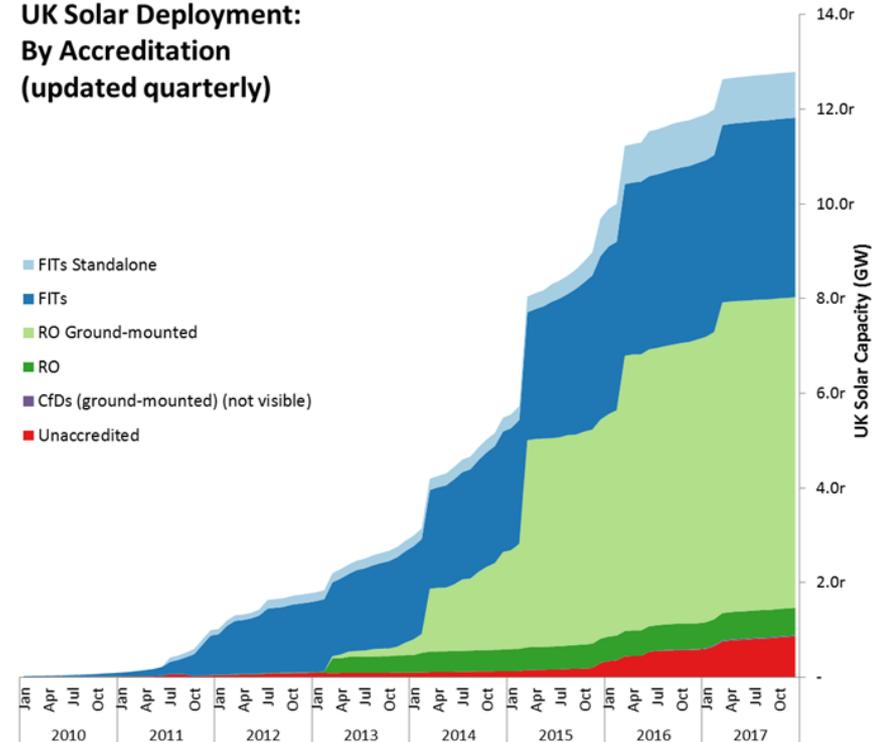
Consequences of CCA content (British direction setting in theory)

	Up to 2020	Post 2020
GHG emissions	<ul style="list-style-type: none"> 16% reduction from 2005 levels by 2020 of emissions not covered by the EU ETS (EU) 	<ul style="list-style-type: none"> Carbon budgets (2018-22; 2023-27; 2028-32) 80% reduction from 1990 levels by 2050
Renewable energy	<ul style="list-style-type: none"> 15% of consumption by 2020 (EU) 	
Energy efficiency	<ul style="list-style-type: none"> 18% reduction in final energy by 2020 relative to 2007 BAU projection (EU) 	
Other	<ul style="list-style-type: none"> Ban on new coal-fired power generation without CCS from 2009 	<ul style="list-style-type: none"> Ban on sale of new conventional petrol and diesel cars by 2040 Ban on all coal-fired power generation without CCS by 2025

British direction-setting in practice

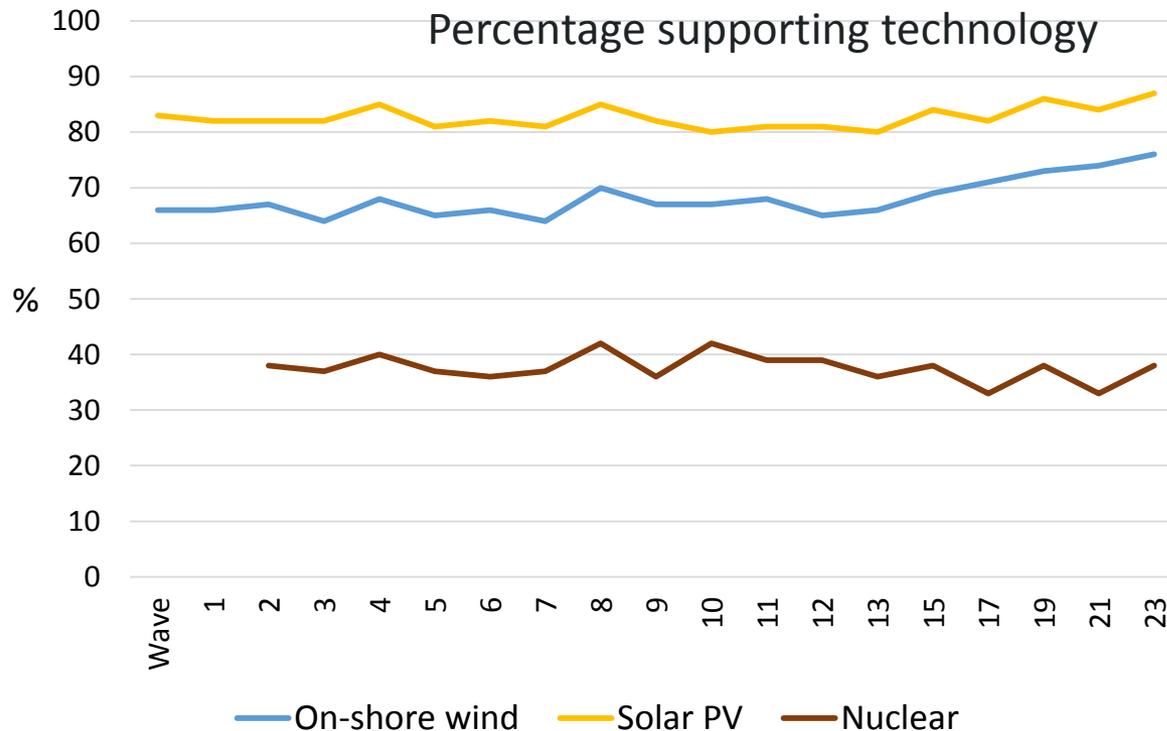
- Strong backing for carbon pricing (EU ETS, Carbon Price Support)
- Support for renewables under pressure from EU
- Mechanism reformed to allow support for new nuclear (CfD FiT)
- Capacity Market (for CCGT)
- 2016: support rates for solar PV cut by 64-85% and onshore wind removed from support framework
- CfD FiT now solely for offshore wind and nuclear
- 'Subsidy free' renewables not yet materialised

**UK Solar Deployment:
By Accreditation
(updated quarterly)**



Long-term sustainability?

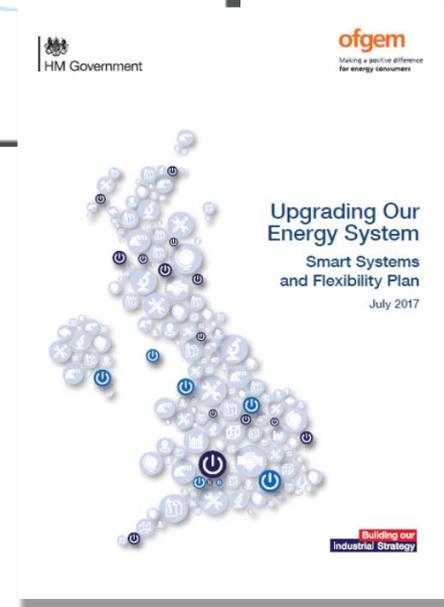
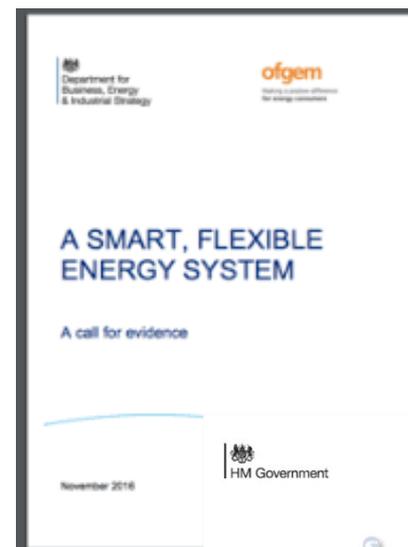
- System compatibility of nuclear and renewables (max. summer demand ~36GW, renewable capacity 35.7GW in 2016)?
- Cost?
- Societal support?



Source: BEIS Public Attitude Tracker

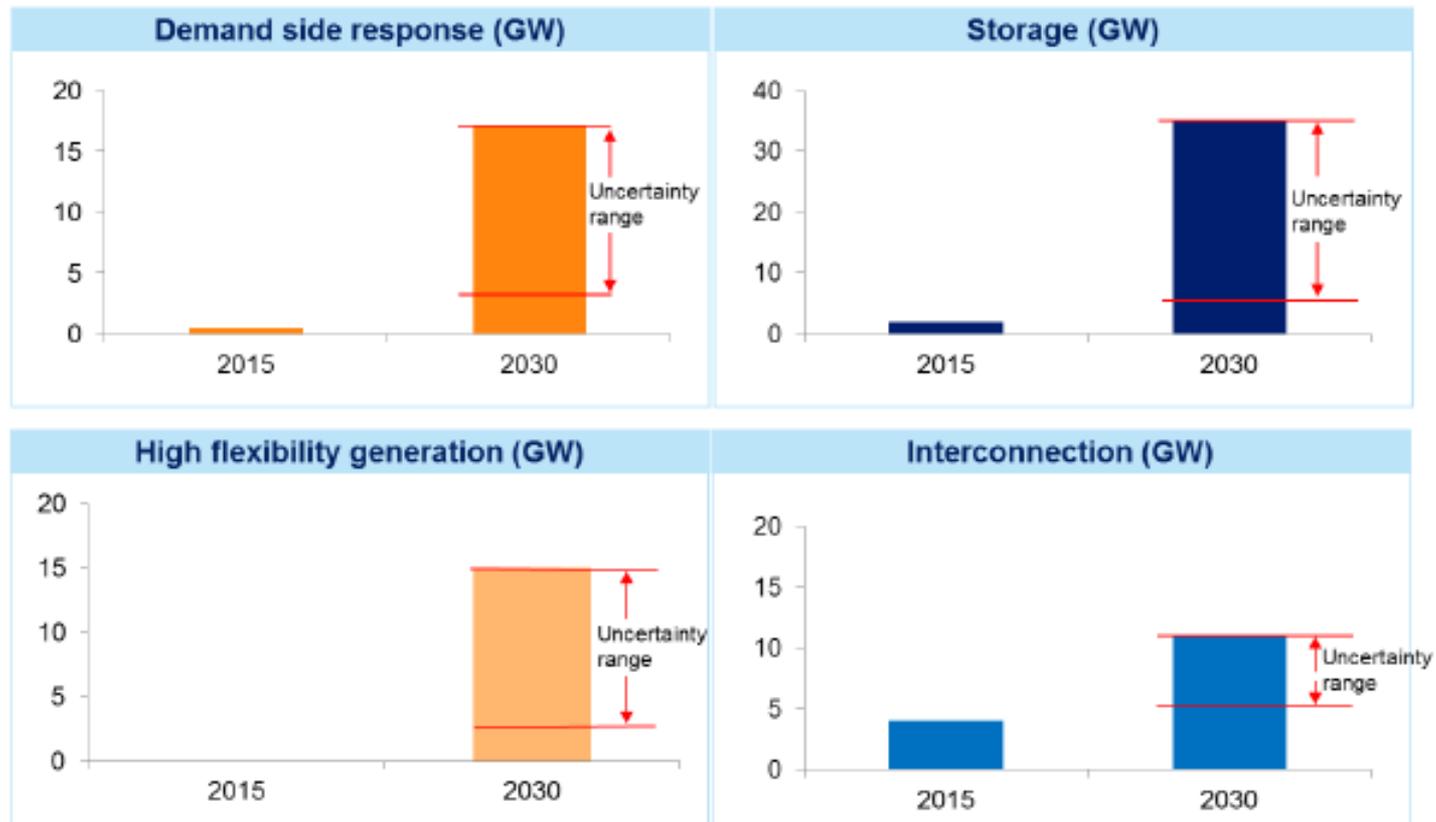
Direction-setting for flexibility?

- No agreed pathway for heat decarbonisation
- No targets for new flexibility resources (EVs, grid-scale storage, DSM, heat pumps/storage)
- ‘...we think there is significant scope for these and other system requirements to be addressed through market-based approaches. In particular, we see value in transparent and integrated markets. We expect to see such approaches used wherever it is most efficient to do so.’ (BEIS/Ofgem 2016: 76-77)
- Policies in some areas (grants for EVs, RHI support scheme for heat pumps) defined by budgetary input not outcomes
- Plan but no vision
- Government role is enabling or facilitating change



Uncertainty about future flexibility resources

Figure 2 – Indication of uncertainty in the deployment of flexibility resource based on modelling analysis



Source: Imperial/Poyry for CCC 2017

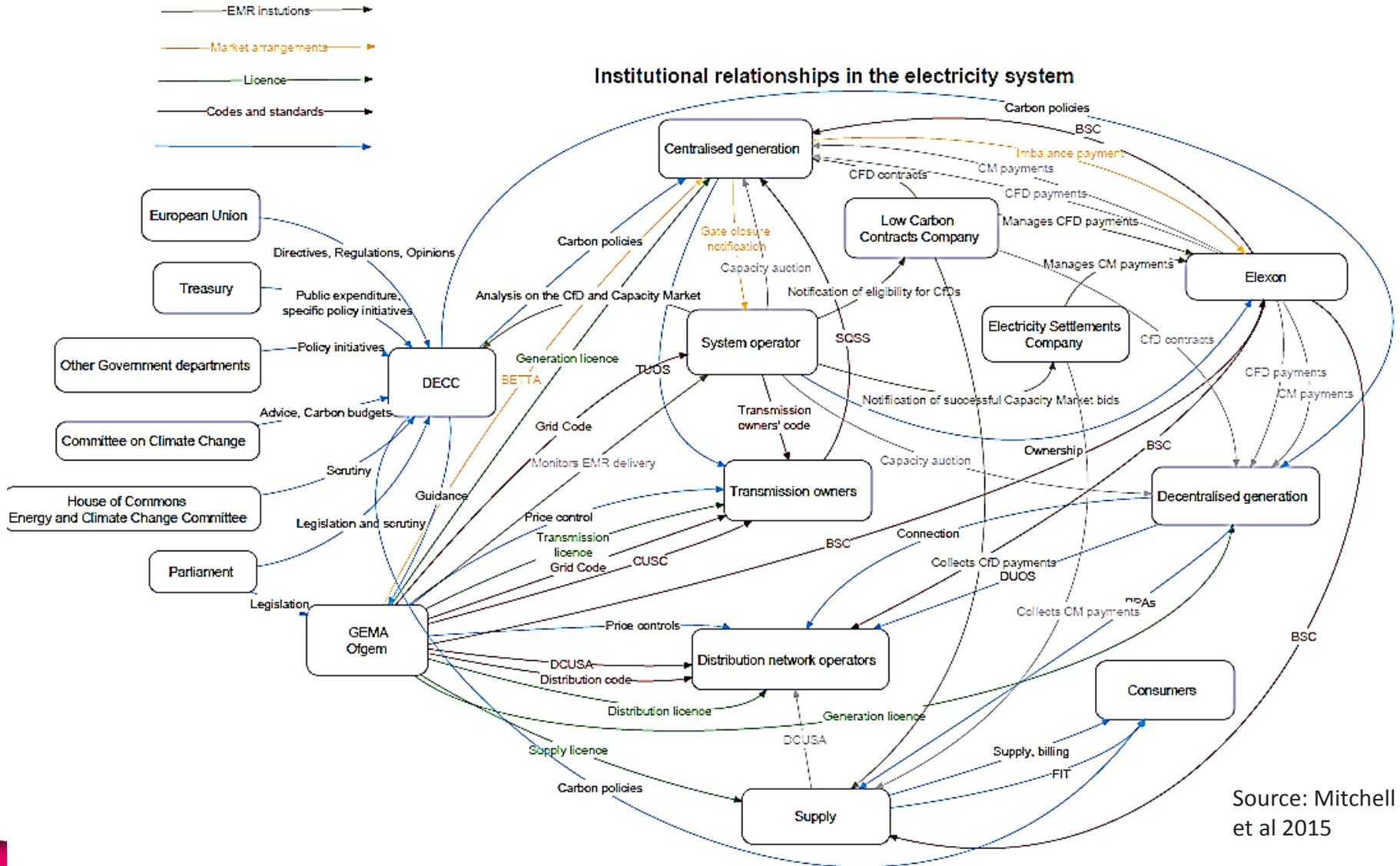
3.2 Coordinating regulatory change

Regulatory and institutional reform agenda for flexibility

	Integration into markets	Integration into networks
Generation	<ul style="list-style-type: none"> • Licences and code governance • Rules in national wholesale markets (BETTA), Capacity Market • Data protocols and governance • Rules for local markets and peer-to-peer trading 	<ul style="list-style-type: none"> • Licences and code governance • Regulatory incentives for smart operation (observability, communication and control) at all voltage levels • Charging, including locational charging • DSO model
Demand	<ul style="list-style-type: none"> • Supplier hub model • Rules governing aggregators/third parties in wholesale and Capacity Markets • Rules for local markets and peer-to-peer trading 	<ul style="list-style-type: none"> • Licences and code governance • Regulatory incentives for smart operation (observability, communication and control) at all voltage levels • Charging, including locational charging and temporal charging at low voltage levels • DSO model
Storage	<ul style="list-style-type: none"> • Legal status and definition • Rules for local markets and peer-to-peer trading 	<ul style="list-style-type: none"> • Licences and code governance • Regulatory incentives for smart operation (observability, communication and control) at all voltage levels • Clarity on network ownership • Charging, including locational charging, removal of double charging and temporal charging at low voltage levels • DSO model
Innovation	<ul style="list-style-type: none"> • Support for innovation inc. derogation from regulation 	<ul style="list-style-type: none"> • Support for innovation, inc. derogation from regulation
System operation	<ul style="list-style-type: none"> • Balancing mechanism rules, inc. data governance • Settlement rules, inc. data governance • Rules governing aggregators, including access to balancing and ancillary services markets • DSOs undertake local balancing? Independent Regional SOs? • Ensuring cyber security • Dealing with externalities and conflicts between networks and markets 	

	Integration into markets	Integration into networks
Generation	<ul style="list-style-type: none"> • Significant code review on half-hourly settlement (2017) 	<ul style="list-style-type: none"> • RIIO-ED1 (2015-2023) and RIIO2 principles (2018) • Guidance on how constraints on networks are to be managed (2017) • DNO plans for conversion to DSO (2017) • Targeted charging review (2017) • Access and forward looking charging forum (2017)
Demand	<ul style="list-style-type: none"> • Supported to voluntary code of conduct for aggregators (2017/18) • Guidance on providing fair and efficient access for independent aggregators (2017) • Power Responsive (2015) • Review of future retail regulation and the supplier hub (2017) • Significant code review on half-hourly settlement (2017) • Review of next-day switching (2017) 	<ul style="list-style-type: none"> • RIIO-ED1 (2015-2023) and RIIO2 principles (2018) • Guidance on how constraints on networks are to be managed (2017) • DNO plans for conversion to DSO • Targeted charging review (2017) • Access and forward looking charging forum (2017)
Storage	<ul style="list-style-type: none"> • Legal reform to storage definition (ongoing) • Consultation on modifying the generation license for storage (October 2017) • Significant code review on half-hourly settlement (2017) 	<ul style="list-style-type: none"> • RIIO-ED1 (2015-2023) and RIIO2 principles (2018) • Consultation on changing rules on DNO ownership of storage (2017) • Guidance on how constraints on networks are to be managed (2017) • DNO plans for conversion to DSO (2017) • Targeted charging review (2017) • Access and forward looking charging forum (2017)
Innovation	<ul style="list-style-type: none"> • New innovation competitions launched (2017) • Regulatory Sandbox (2017) 	<ul style="list-style-type: none"> • Network Innovation Competition/Network Innovation Allowance (2015 onwards)
System operation	<ul style="list-style-type: none"> • Separation of ESO from TO (2019) • Power Responsive (2015) • SNAPS (2017) • Trial of real-time balancing markets (2018) • Monitoring and analysis of inertia problem (2017) • Open Networks (2017), including transmission/distribution interface 	

The coordination challenge

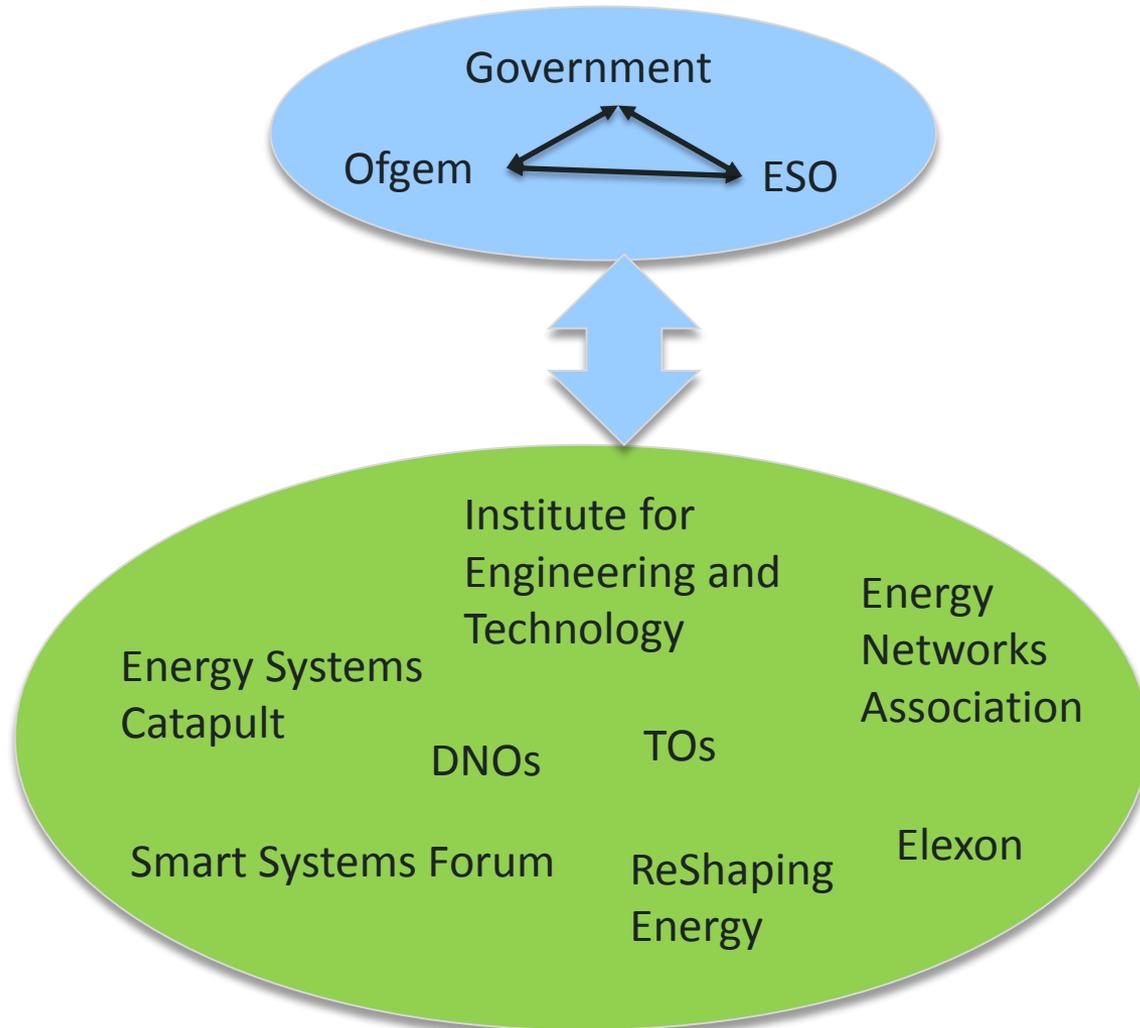


Source: Mitchell et al 2015

Calls for 'System Architect'

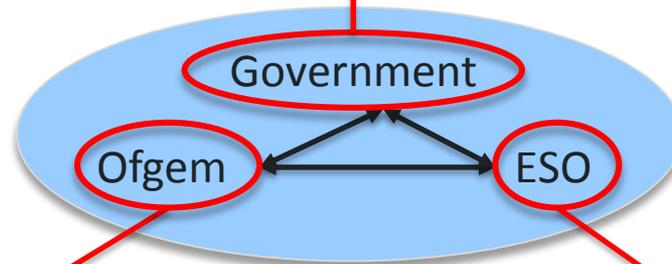
	Scope	Design	Operation
Hull (2016)	Whole system	Energy Commission	Expanded independent SO
Rhys (2016)	Whole system	Central procurement agency for electricity	
IET (2014)	Electricity	System Architect	
IET/Energy Systems Catapult (2017)	Electricity	Enablement Organisation	
Taylor and Walker (2017)	Whole system	System Architect	DSOs
Energy UK (2016)	Electricity	System Architect	
Skillings (2017)	Whole system	Energy Council	
ICE (2016)	Whole system	System Architect	System Architect

Current arrangements for flexibility reforms



Institutional design

- Distracted by Brexit
- Tendency to silo-ing
- Insufficient technical expertise

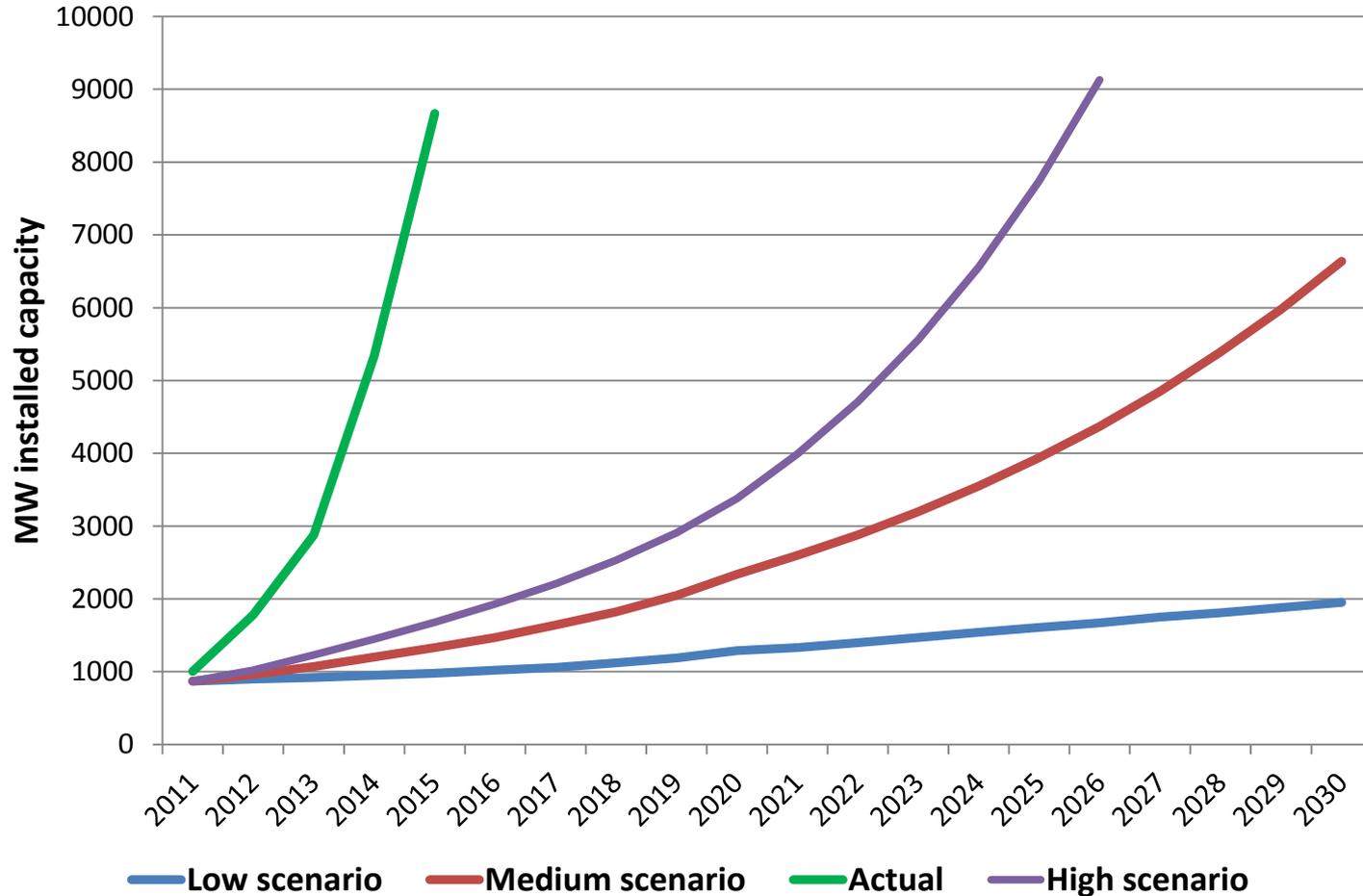


- Originally set up as arms-length economic regulator at privatisation, not a body to lead energy transition
- Mixed objectives in primary duties, requiring internal handling of trade-offs, and sometimes confusion about remit
- Fear of over-stepping remit
- Fear of legal challenge from industry

- Limited remit for coordination
- Can't take whole system view

Institutional capabilities

Solar PV installed capacity: Scenarios and actual



Source: BEIS, EA Technologies (2012)

Conclusion

- GB started energy transition from mid-to-late 2000s
- Good progress on decarbonisation so far
- Entering next phase, requiring new sources of flexibility in electricity and integration of energy vectors
- Absence of societal discussion about transition
- Direction setting in theory only through high level carbon budgets, reached through technology neutral market mechanisms
- Direction setting in practice through interventions, but questions about sustainability of current path
- Resistance to direction setting for flexibility; lots of activity in regulatory reform but approach is to enable emergence of direction
- Challenges of coordination – complicated task and institutional weaknesses suggest different approach needed

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