System Operators in Electricity: From Unbundled Liberalisation to Climate Change Management

Jon Stern
CCRP, City University London

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What an SO is and isn't

- A "pure" SO is not the same thing as a transmission operator, as it does not operate the network

- It is not a regulator, which has supervisory powers over firms
  - But it can come close if it requests transmission investment to be implemented by others (e.g. a TO)

- Best shot at defining an SO is Keyworth and Yarrow, 2005:

  "the development whereby the distinct service activity of 'co-ordination', supplied to companies in the relevant sectors, has been identified and whereby responsibility for its provision has, subject to regulatory supervision, been allocated to a specific organisation or part of an organisation (a 'system operator')."

Origins of SOs

- SO functions originated in C19 with railways (usually *implicit SOs)*
  - Timetables most obvious example but also:
    - Recovery from accidents/incidents
    - Planning maintenance
    - Organising network access (e.g. with regional rail companies)
    - Planning and carrying out network expansion (for vertically integrated national or regional rail companies

- In late C20, ISOs (explicit SOs) emerged in US electricity and ITSOs (linked with transmission) in US electricity
  - UK and EU nation states have energy SOs – mainly ITSOs in electricity
  - GB has ISO linking E&W plus Scottish ITSOs
  - Much of EU electricity has ‘virtual’ SOs – ITSOs or ITOs linked by codes (CWE, Nordel, etc)

I. Electricity SOs 1980 – 2008

ITSOs and ISO’s as agents of Liberalisation

Industry structure and separation

- The need for an SO depends on industry structure.
  - In electricity, development of *explicit* SOs have been most associated with the introduction of significant upstream/wholesale competition (in generation) and downstream retail competition – particularly for large industrial users

- Structural options include:
  - integrated monopoly network: the role for SO is purely operational,
  - competition with vertically integrated incumbent (includes cases of JVs, alliances etc.)
  - separated monopoly : no vertical leveraging opportunity, but scope for abuse of market power, avoidance of regulatory rules etc.

- ***Implies anti-trust argument for explicit SO (incl ITSO) where competition is a major policy objective***.

Types of SO

- Implicit SOs: co-ordination functions performed without ceremony in a vertically integrated company;
- Explicit SOs: as in fully ownership unbundled networks by ITSO or separate ISO; and
- Virtual SOs: as in the proposed EU-wide models, where markets and networks in different areas are linked by network codes or general obligations to co-operate rather than by an explicit SO.

The three SO time zones I

- **The Short Term**: *traffic management* – dealing with emergencies, contract management and execution.

- An analytical framework is provided by *transactions costs economics* (Coase, Williamson), which offers a comparative analysis of the performance of market and hierarchical governance systems in adaptation functions.

Conclusion: potential role for SO to take charge of process, especially when network is conflicted (e.g. generation-transmission + short-term narket linkages)

The three SO time zones II

- **The Medium Term**: *access to the network* – implementing and assisting in enforcement of regulator-set regime for capacity allocation and contract approval.

- An analytical framework is provided by – anti-trust economics, specifically the prevention of non-price discrimination in partially vertically integrated network context based on market opening by unbundling.
  - *Conclusion: role for explicit SO, especially for introduction of upstream competition into vertical integration.*

The three SO time zones III

- **The Long Term**: *network expansion* – planning investment to expand capacity and eliminate bottlenecks.

- The task is for a trusted party to co-ordinate expectations of competitors in way designed to optimise network expansion. The approach can be bottom-up (synthetic) or top-down (analytic), or both.
- *Conclusion: in some structures can be done by ITSO network operator. But possible role for separate ISO, especially in multi-area context.*
  - *The planning role can be pre-empted by a government providing funds (e.g. renewable generation).*

Electricity: Relative Importance of Short, Medium and Long-term Functions

- Short-term SO functions are very important (and complex) in electricity.
  - Electricity travels at the speed of light; there are no storage possibilities; and transmission networks need to be continuously balanced.
  - Doing this while co-ordinating with upstream competition in generation markets is a complicated, difficult and sensitive process.

- Medium-term network capacity allocation functions are important in electricity e.g. linkages between upstream markets and network use, managing capacity use around transmission constraints.
  - Allocating use of interconnector capacity can be problematic (unless auctions or similar)

- Long-term investment issues important – both (a) planning and (b) implementation. Except in ITSOs, these are separated.

Electricity: Single-area/Jurisdiction Transmission Ownership Systems

- ITSOs dominate ISOs in electricity systems with single TSO.
  - ITSOs integrate the planning and the implementation of network investment.
  - The divide between them is a major weakness with energy ISOs in both the EU and the US.
  - ITSOs also provide the co-ordinating economies of scope that operate within vertically integrated utilities but which do not with ISOs.

- BUT, countervailing effect in that ITSOs have an incentive to focus on safe investments to be operated by their TO arm.
  - This can be offset by some combination of functional separation within ITSOs and regulatory activism.

- Functionally separated ISOs and ITSOs achieve little in terms of promoting efficiency and competition on short, medium or long-term SO functions.
  - Still major doubts over ITOs as a compromise – Germany now moving to ITSOs along with other main Western EU countries (except France)

Electricity: Multi-area/Jurisdiction Transmission Ownership Systems

- ISOs only effective option available – either explicit ISO or Virtual ISO
  - GB and Ireland both ISOs, Virtual ISOs in Nord Pool and other main EU regions
- US and other experience shows (explicit) ISOs handle well both short and medium-term SO functions.
  - In that case, for multi-area cases, (explicit) ISO but with some additional mechanism(s) to implement network capacity investment programmes looks to be the best option.
- Major problems remain over (long-term) transmission investment in ISOs – especially interconnection investment
  - Incumbent utilities with market power within their own area have strong incentives to resist additional interconnector investment
  - Proposals for explicit ISO for EU multi-area interconnection from outside experts

Electricity ISOs: Governance and Evaluation Issues

Electricity ISOs can have major governance problems

- ISOs, unlike ITSOs are very asset-light.
  - Hence, difficult to impose incentives on them with any significant downside risk.

- All successful US electricity ISOs have been not-for-profit organizations.
  - Necessary to retain the independence of the board
  - Makes it difficult to provide effective financial incentives for cost containment or greater efficiency.

"The ISO remains a complex entity producing a large number of outputs for which it would be difficult to design a comprehensive set of performance metrics which could form the basis of an external evaluation of its performance" [M. Pollitt (2011)]

II. Post-2008

SOs as delivery agents for climate change and renewables mandated investment

UK as pathfinder in return to single buyer model?

The Challenge of EU Climate Change and Renewables Policy

- EU agreed in 2008 for "20-20-20" policy with 20% reduction in carbon emissions and 20% renewable energy supply for energy (not just electricity) by 2020.
  - UK Ministers were advised against acceptance of this by their officials, not least because of its implications for wholesale generation markets.

- The problem with "20-20-20" is not climate change targets.
  - Climate change targets could have been addressed by market-friendly policies including:
    - carbon taxation,
    - tradeable carbon permit (as in EUETS), and/or
    - low carbon volume obligations on suppliers

- The problem with "20-20-20" is the renewables obligation.
  - For countries without large-scale hydro resources, the renewables target poses major problems
  - ***and is arguably primarily a high-cost way of addressing climate change obligations – at least for UK.***

Effective climate change policies do not necessarily imply large-scale domestic renewable generation (See David MacKay 2009)

Renewables Policy and the Consequences for UK Electricity SO Arrangements I

- In 2012, UK renewables accounted for 10.7% of UK electricity generation.
  - To meet target of 15% UK energy consumption from renewables implies at least 30% generation from renewable sources.

- For UK, renewable generation means primarily intermittent wind power, on-shore and increasingly off-shore. Solar is also intermittent and of little help in meeting winter peaks
  - The nuclear programme remains in place with expected costs of around £70-100/Mwh but doesn't count towards renewable obligation (UK tried to argue this briefly in 2008)
  - Onshore wind has lower costs (around £95/MWh) but is strongly resisted by rural residents
  - Offshore wind has expected costs currently of £150-190/MWh, which might fall to around £100-125/MWh by 2025

(Source Mott Macdonald 2012)

Renewables Policy and the Consequences for UK Electricity SO Arrangements II

- Renewable wind-plants are almost ‘must-run’ and nuclear is also very costly to use except as ‘must-run’ => thermal (largely CCGT gas) must also operate primarily as supplier when wind doesn’t blow
  - Much GB wind-powered generation being delivered from Scotland plus imported wind power from Ireland *may* ease intermittency problem somewhat

- Result is that growing amounts of UK generation are inflexible and high cost, much with high capital costs and very low short-run marginal costs
  - Given low level of interconnection with Continental Europe, (4 GW interconnector capacity relative to max demand of 55-60 GW), imports from other EU countries not a significant offset to intermittency problem.

- Wholesale market players highly unlikely to invest on this basis -> a much more interventionist approach by UK Government on (a) how much generation to build and (b) the generation mix
  - Energy planning is back with a vengeance and both Ofgem and the SO are being turned into delivery agents for achieving the policy targets

Renewables Policy and the Consequences for UK Electricity SO Arrangements III

- The proposed UK Government solution is EMR – the Energy Market Reform which include:
  a) CfD-FITs (contracts for differences) which reduce the revenue risk for renewable generators by setting wholesale generation prices and support levels via a set of strike prices; and
  b) Capacity markets - not least to provide protection for thermal generators, <u>but</u> only likely to be introduced 2018/19 or later

- This combination means that generation competition is competition *for* the market and <u>not</u> competition *in* the market
  – companies compete against their contracts not against one another

- The SO's role in this model is to run the competitions for the market – i.e. to be the Single Buyer

Renewables Policy and the Consequences for UK Electricity SO Arrangements IV

- The new ‘single buyer SO’ is the centre of these arrangements and the UK Government has chosen National Grid for this role
  - National Grid is the ITSO for England and Wales and runs the GB ISO (which includes Scotland)
  - Ofgem monitors delivery performance by NG of Government-set targets as laid down by DECC and the Climate Change Committee

- As predicted, the 2008 EU targets, particularly for renewables look likely to destroy the England and Wales wholesale generation market and replace it with a high-cost (and price), centrally planned electricity market
  - SO becomes a single buyer planning generation and transmission investment rather than a pro-competition network-market co-ordinator
  - This has major potential efficiency problems – single buyer models are notoriously inefficient and investment-heavy.

Conclusions and Questions on Role of Electricity SO under EU Climate Change and Renewable Targets

- The UK led the way into wholesale and retail competition in the EU (at least in England and Wales). Is it now leading the way back to electricity and generation planning?

- The UK EMR model has taken much longer to develop and implement than intended and some key parts remain to be specified (e.g. the nuclear strike price and the capacity mechanism).
  - It will certainly push up consumer prices significantly: Household retail prices predicted +30%, Medium Non-domestic by 30% and Large Industrial by 69% by 2030 (Source M. Pollitt 2013)

- Almost all UK energy economists have been highly critical (see, for instance, papers by Dieter Helm and Michael Pollitt).
  - Is the UK policy viable, let alone sensible? Will it collapse under the weight of its own contradictions?

Conclusions and Questions on Role of Electricity SO under EU Climate Change and Renewable Targets

- Is the UK example the likely future electricity model for other EU Member States or will the availability of sufficient, hydro and solar resources lessen the problems in other EU Member States?
  - Germany, Holland and others could have similar problems
- Will the EU significantly relax the renewable targets for 2020 and 2030?
  - This may be necessary to salvage climate change targets
- Given pressures on industrial competitiveness will EU Member States relax their commitment to climate change targets?
  - The difficulties with negotiating binding climate change commitments in Doha suggest co-ordinated national solutions rather than binding international targets
  - US and China have both refused multi-national targets but at State/Provincial level are taking significant action
- Given the very high cost-benefit ratio, will the 2008 EU Climate Change agreement go the way of the Lisbon Agreement?

Annex Slides

Electricity: US SO Origins I

- ‘Implicit’ SOs existed in all vertically integrated power companies covering a wide geographic area and with a number of generating plants

- ‘Explicit’ SOs developed in US electricity post-1975

- Objective of developing explicit SOs was to obtain unbiased competition between generation owned by utility and other (PURPA etc) generation
  - Originally only functionally separated SOs – very ineffective
  - Post-1996, ownership separated ISOs
  - Most ISOs multi-state (PJM, New England) but single state ISOs in New York and California <u>but</u> all with multiple ownership of transmission grids

Electricity: US SO Origins II

- US ISOs developed *either* from ‘tight pool’ with central dispatch (PJM, New England) *and/or* as a result of policy to introduce competitive generation markets
  - Operation of generation and related markets (ancillary services, etc) integrated with management of network, payment systems, etc

- In all US ISO areas, transmission ownership is fragmented, preventing an ITSO (Ercot comes closest to an ITSO)
  - Result is ISOs responsible for transmission planning but not transmission investment
  - In multi-state ISOs, disconnect between operational areas and regulatory oversight areas
    - State regulators have to approve new transmission investment – including interconnecting lines between States

Electricity: Short-term SO and TO Functions

The short-term is defined as within-day operations which NordReg (2006) lists as:

A <u>Short-term SO Functions</u>

i. Securing short-term (1 hour or less) system operation according to operational agreements and codes

ii. Maintaining demand supply balance within short-term (1 hour)

iii. Managing disturbances and emergencies by system planning procedures and methods

iv. Managing shortage situations by agreed action plans (including disconnections or equivalent)

Electricity: Medium-term SO and TO Functions

NordReg (2006) define these as:

A <u>Medium-term SO Functions</u>

i. Adopting and implementing consistent and co-ordinated capacity calculation and allocation procedures

ii. Adopting and implementing common and consistent procedures for congestion management

iii. Operational planning for network operation for up to 1 year ahead, including maintenance planning and co-ordination

iv. Setting imbalance prices, settlement principles and executing national balance settlement

B <u>Medium-term TO functions</u>:

i. Ensuring the technical compatibility within and between networks

ii. Maintaining the proper functioning of the transmission system by appropriate planning methods and tools

Electricity: Long-term SO and TO Functions

- NordReg define these as

A <u>Long-term SO Functions</u>

i. Defining common technical requirements for secure system operation and expansion

B <u>Long-term TO Functions</u>

i. Plan the expansion of the network, including interconnection*

ii. Carry out network expansion (new investment) in a timely manner**

* This is often thought of as an SO function, particularly for ISOs

** This is the critical difference in responsibility between ISOs without transmission ownership and ITSOs