Past and Future Transitions in the Gas Networks in Britain

Prof. Peter J.G. Pearson
Director, Low Carbon Research Institute
Cardiff University

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A Contested Transition from Natural Gas?

- UK gas industry now challenged by its role in the low carbon transition
- UK pathways to meet 80% GHG targets for 2050 (Climate Change Act 2008) suggest
  - Low-pressure gas mains networks might need decommissioning by 2050
  - The need to go from gas as a heating fuel, to
    - » Electric heat pumps, biomass boilers, etc; or
    - » Gas decarbonisation (inject biogas; inject/ convert to H2)
- None of the alternatives to gas are simple or costless
- Does the natural gas network have a future?
- How has the industry changed in the past?

Outline

- Transitions in the UK gas industry & networks
- Implications of the UK's low carbon transition
- Governance & 3 Key Actor Groups
  - Market, Government & Civil Society
- Past responses by the gas industry
- Branching points in the town (coal) gas regime
- Gas and the low carbon transition

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The British Gas Industry: Origins1780-1820

- Development of the coal gas lighting industry
  - Helped by British scientific knowledge & mechanical skills & growing coal-based economy
- 1790s experiments by Lebon & Murdoch (Boulton & Watt)
  - 1805: installations in UK cotton mills (Murdoch; Clegg)
- Gas Light & Coke Company (1812)
  - Built path-breaking integrated, tightly-coupled *network* in London, before the railways
  - By 1820, 120 miles of mains, supplying 30,000 lamps
  - Drew on experience, legal forms & models of existing networks (canals & water supply)
- Gas supplies in several cities by 1819

1st Transition: 1820-1880

- Transition to widespread supply in town networks
  - 1826: supply in almost all towns with >10,000 people
- Regulation: Gasworks Clauses Acts
  - 1847: dividend control;
  - 1871: obligation to supply all consumers on demand
- 1881 professional Gas Institute founded
- By 1882, 490 private & municipally-owned firms
  - Seeking profits or revenue

2nd Transition: 1877–1914

- 2nd Transition: the creation of new markets for manufactured gas, in a market-led transition
  - Pressures on regime actors: new competition from incandescent electric light, low load factors, negative customer perceptions
  - Industry broadened customer base (hire purchase & pre-pay slot meters)
  - Widened services from lighting to cooking & heating
  - Eventually adopted more efficient Welsbach incandescent mantle
- Customers tripled to 7 million by 1914; growing working class users

3rd Transition: 1915-1945

- 3rd Transition: growth, fragmentation & 'incoherence'
- By World War II, 800 private & municipal firms supplying 'town gas'
- By late 1930s: largest in Europe (11 million customers) but precariously competitive
- Industry fragmented: small scale firms & uncoordinated relative to electricity
- 1941: senior industry figure called it 'incoherent'; must
  - Expand or be left with 'limited & costly supply of gas'
  - Struggling to compete with electricity in the home & coal, coke & oil in commerce & industry
  - And with a costly feedstock (coal)

4th Transition: 1945-1977

- 1948 nationalisation, reorganisation & new processes
- State-owned company, led by Gas Council, rationalised industry structure with Area Boards & vertical integration
- Experimented with niche technologies:
  - Lurgi coal gasification, reforming oil & imported LNG (new pipeline to deliver regasified LNG to Area Boards)
- 1966: bold move to new North Sea natural gas
  - Reorganised industry & actors, developed terminals & national gas grid from the LNG 'backbone'
- Challenging 10-year conversion of appliances of 6 million consumers' by 1977

5th transition: 1978 - 2008

- Privatisation, re-regulation & gradual liberalisation
- 1987: UK's 1st major energy privatisation
- British Gas sold as vertically integrated *monopoly* in transmission, distribution & supply of gas
- New regulator appointed (Ofgas)
  - Gradual unbundling & competition: British gas 'demerged' in 1997 (Centrica/ Transco)
- 1996: Network Code for control & regulation of transmission, distribution & supply
- From 1998: interconnectors to Belgium, the Netherlands & Norwegian gas fields.

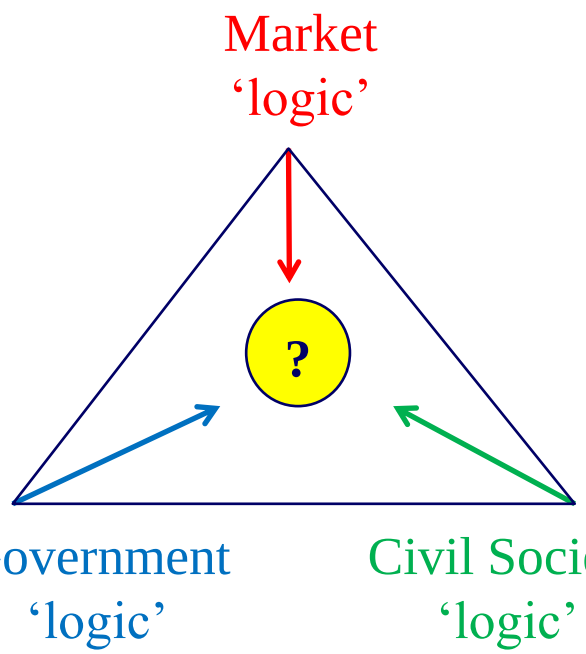
6th Transition: 2008 - ?

- Gas challenged by role in UK's low carbon transition
- UK pathways to meet 80% GHG targets for 2050 suggest:
  - Low-pressure gas mains networks might need to be decommissioned by 2050
  - & need to go from gas as heating fuel to
  - Electric heat pumps, biomass boilers, etc.,
  - Or gas decarbonisation (e.g. biogas injection; injection or conversion to hydrogen).
- None of the alternatives to gas are simple or costless
- Does the natural gas network have a future?
- How might the industry respond?

Implications of the Low Carbon Transition

- A bigger, more complex role for public policy & incentives than in the decades after gas privatisation in 1987
  - Without the advantages of state ownership & control
- Raises issues of who might fund the decline of the natural gas network
  - and with what incentives
- And will there be recompense for any stranded assets?
  - In the transition to natural gas, compensation didn't arise for stranded town gas production assets when industry state-owned
- So the industry's governance matters in a system whose governance is changing

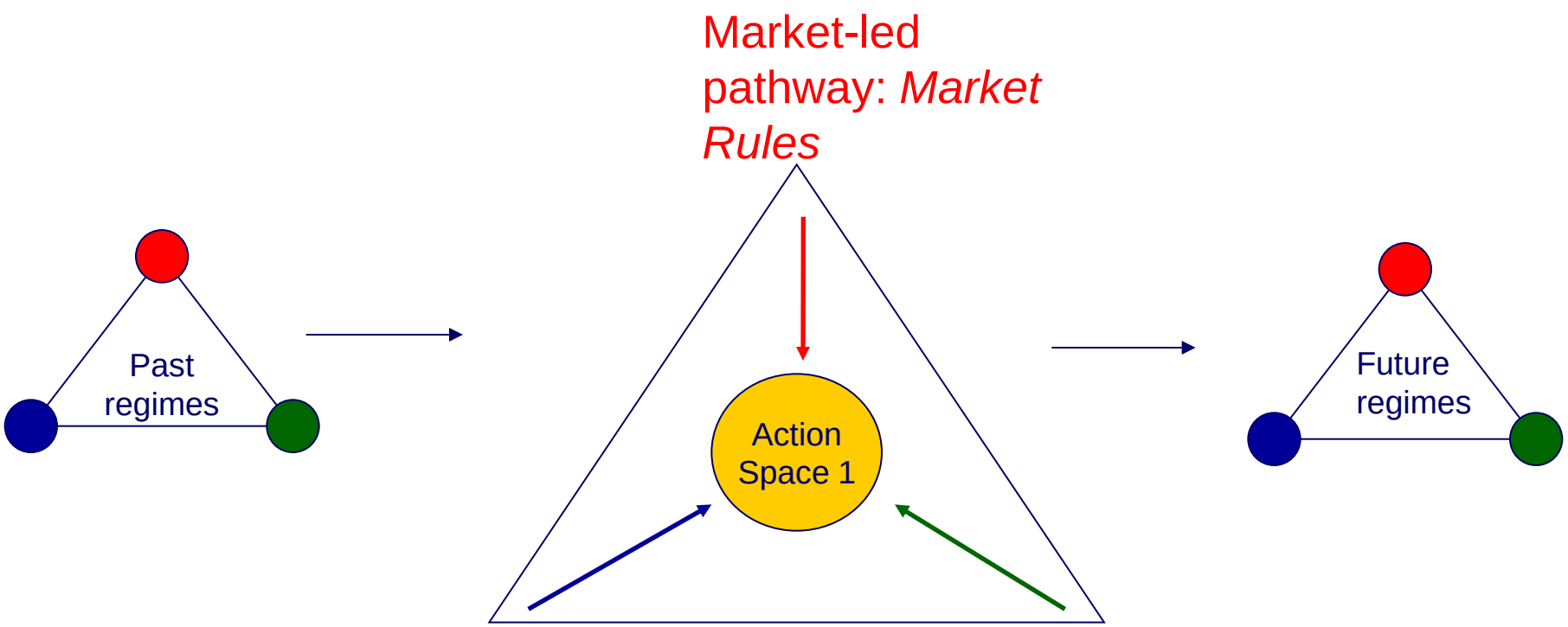
Action-Space Approach to Governance – 3 Key Actor Groups: Market, Government & Civil Society



Source: Jacquie Burgess & Tom Hargreaves – Transition Pathways Project (see Foxon, T.J. 2013)

- Choices depend on actors' competing 'logics': messy, dynamic, interactive
- Action-space maps shifting relationships
- Via their *interactions,* each actor tries to '*enrol*' the others in their logic
- The dominant actor – i.e. best 'enroler' - defines that period's action-space
- Influencing the pathway & its branching points
- Recently we've seen moves from the market towards the government logic – EMR, etc.
- And questions about role of civil society, especially in the heat transition

The Action Space for Transition Pathways



Past responses of threatened incumbents

Network Closure

- **Canals: often** bought up by railways; used to help construct them; then loss of trade (now reinvented for leisure)
- **Stagecoaches –** killed by railways

Network adaptation, including hybridisation

- Networks have managed to do this
  - Telecomms
    - » *Service:* telegraph > telephone > internet & mobiles
    - » *Infrastructure:* copper cables > fibre optics, radio waves & phone masts
  - Railways (loss of freight)
  - Gas: post WWII response to costly feedstock (coal) and growing competition from electricity & oil => natural gas

Sailing Ship and Last Gasp Effects (SSE/LGE)

- The ‘sailing ship’ effect or ‘last gasp’ effect of obsolescent technologies
  - Where competition from new technologies stimulates improvements in incumbent technologies/industries
- Examples (sometimes with hybridisation)
  - sailing ship improvements after competition from steam ships
  - Eventual adoption of Welsbach gas mantle in response to incandescent electric lamps (late C19)
  - Carburettor enhancements in response to fuel injection
  - Hybrid electric/ICE vehicles
  - Disk drives with SS flash memory

Sailing ship and last gasp effects

- As well as responding with performance enhancements, high carbon actors also lobby to resist institutional changes that favour low carbon technologies
- Example: efforts of large utilities in Germany in the 1990s to lobby for the repeal of the renewable energy FiTs
- So sailing ship and last gasp effects can act to delay or weaken low carbon transitions and network decline
- *Note:* the threat here is from low carbon technologies promoted by government rather than purely by the market
- As yet not all such technologies have attributes that are superior &/or cost-competitive with incumbents
- Placing incumbents in a relatively strong position to respond & compete

Past responses by the gas industry

- The town gas industry responded to 2 challenges under two governance forms
- Late C19 response to threat from incandescent light
  - Profit oriented companies broadened customer base (hire purchase, slot meters, etc.)
  - Developed range of services: cooking & heating markets
- Post WWII challenge of expensive feedstock (coal) and growing competition from electricity, oil & coal
  - State-owned company experimented with Lurgi process, reforming oil & importing LNG
  - Eventual bold move to N. Sea natural gas: major reorganisation, network development & conversion of millions of appliances

Transition Pathways & Branching Points

- Pathways reflect many decisions by interacting actors along them
- A **branching point** is a key decision point at which actors' choices, in response to internal or external pressures, determine whether& how the pathway is followed.
- Pathways & branching points are emergent properties - so actors may not consciously pursue a branch or pathway but address particular challenges as they arise
- Path dependence literature argues that choices at one point may constrain later choices.
- We looked at branching points for two phases of the town gas industry

2nd Transition: 1877–1914 response to threats

- Pressures on regime after 1880
  - competition from elec. light, low load factors, negative customer perceptions
- By 1914, regime had developed a wider range of services
- Gas customers tripled to 7 million; many more working class users
- Transition led by actors with a market logic: the private & municipal firms
- Government had limited role, setting regulatory context without promoting or discouraging the changes
- Civil society actors responded by renting appliances, using slot meters & gas mantles

Branching points in the town gas regime, 1877–1914

Choices made at branching points	*Outcome for Transition Pathway*
Branching point 1: Perceived need to promote and increase the range of energy services supplied by gas	
To organise trade exhibitions to promote gas appliances (ca. late 1870s)	Start of increased emphasis on advertising and promotion of appliances – shift towards supplying more varied services
To organise the 1882-3 gas exhibition	Increased emphasis on advertising amongst undertakings
To introduce hiring of appliances (taken up widely in 1880s)	Continued the shift towards more varied services
Branching point 2: Perceived need to broaden the customer base	
To introduce prepayment meters (from 1889)	Shifted regime to broaden customer base; continued shift to more varied services
Branching point 3: Perceived need to compete on price and quality	
To introduce incandescent gas mantles (from 1898)	Strengthened competitive position of gas light, so regime continued to supply this service
Jointly mounting a legal fight against the holder of the British Welsbach mantle patent (1901)	Strengthened competitive position of gas light, so stayed in lighting market

Source: Arapostathis et al. 2013; Foxon et al. 2013, Transition Pathways Project.

4th Transition:1948–1977 - state-led transition to natural gas

- The government-led nature of the transition enabled
  - high level of co-ordination between actors
  - & imposition of change on unwilling actors, e.g. householders
- To achieve a transition that government & industry actors agreed would be socially beneficial
- At key earlier points, the system had allowed niche experimentation in alternative sources of gas
- Which facilitated the eventual transition to natural gas

4th Transition: branching points in the state-led transition to natural gas, 1948–1977

Choices made at BP	*Outcome for the Transition Pathway*
Branching Point 1: Perceived need to reduce cost in response to pressures from higher coal costs & competition from electricity, coal & oil	
Promotion of central & space heating (1960s)	Reinforcement of incumbent regime, creation of new markets; increase pressures on production side, esp. for Metropolitan Boards
Introduction of Lurgi process (1960s)	Niche technology for local problems. Internal adaptation, renewal & reconfiguration
Introduction of oil gasification processes (1960-1970)	Re-alignment of the regime/dominant technology in the late 1960s
Early experimental LNG transportation (1957-1960)	Experimental phase important for enrolment of key actors to wider scale use of LNG
LNG pipeline (1961)	Niche technology for local problem & critical infrastructure. Pathway reconfiguration through hybridisation
North Sea Exploration and search for natural gas (mid 1960s and 1970s)	Landscape pressure on the incumbent regime. Technological substitution
Branching Point 2: Perceived opportunity to respond to the discovery of North Sea gas	
Gas Council monopsony in UK nat. gas regime (mid 1960s)	Reinforced the centralisation of the regime & the state-led transition
Conversion designed as single operation without intermediate phase or period (1966)	Conversion to natural gas (1967-1977). Facilitated & provided a fast pace to the 'technological substitution'
Pilot Schemes for local conversion (1967-1977)	Facilitated 'technological substitution': developing expertise & en-rolling new actors; persuading general public to support new regime.
'Guaranteed Warmth' campaign (1969)	Important for the enrolment to the new regime
Commissioning of the Morton Report (1970)	Important for the enrolment of new actors (the general public)
Gas Act 1972	Reinforced centralisation of the regime & the state-led transition

Source: Arapostathis et al. 2013, Foxon et al. 2013, Transition Pathways Project

Gas and the Low Carbon Transition

- Much depends on how quickly heat provision changes
- Can natural gas companies re-invent themselves & move into new markets?
  - Does a gas company have to stay a gas company?
  - Can it become an energy services company?
- Can pipes & other assets be used for something other than natural gas?
  - Used for low/zero carbon gas (CCS, biogas, hydrogen) & CO2 transport?
  - Who would do it? How to fund it?

Issues in the Heat Changeover

- Issues for production & delivery of new heat
  - Supply chains; retrofits?
- Issues for consumers
  - How much change in home infrastructure?
  - How disruptive? How costly?
  - Is heat delivered in the same kind of way?
  - Do they seem to be getting broadly the same thing?.
  - Will service attributes change?
  - Will they like what they are getting?
- Compare with the natural gas conversion experience

Issues for the future of the gas network?

- Much depends on speed/ nature of moves to renewable heat & success of CCS
- Does network ultimately vanish, its assets sold off - or transmogrify into an altered, attenuated entity?
- Differences between fate of infrastructure/ services & fate of companies?
- Spatial path dependence – regional/ local impacts of network decline (major ports can die – e.g. Cardiff)?
- From its origins the gas industry has proved remarkably resilient & willing to experiment & adapt…
- Governance crucial: not just interplay between government & markets but their interactions with civil society (& there's the shale gas story…)

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