TRANSITIONS IN THE UK GAS NETWORKS: PAST EXPERIENCES & FUTURE CHALLENGES

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A Contested Transition from Natural Gas?

- Several transitions in UK gas networks since early 1800s
- UK gas challenged by role in ongoing low carbon transition
- UK pathways to meet 80% GHG cuts by 2050 suggest
  - Low-pressure gas mains networks might need decommissioning by 2050
  - A need to go from gas as a heating fuel, to
    » Electric heat pumps, biomass boilers, etc; and/or
    » Gas decarbonisation (inject biogas; inject/convert to H2)
- None of these alternatives are simple or costless
- So how has the industry changed in the past?
- Does the natural gas network have a future?
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
The British Gas Industry: Origins 1780-1820

- 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
1\textsuperscript{st} 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.
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

- 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

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

Past regimes

Market-led pathway: Market Rules

Government-led pathway: Central co-ordination

Civil society-led pathway: Thousand Flowers

Future regimes

Action Space 1
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
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
<table>
<thead>
<tr>
<th>Choices made at branching points</th>
<th>Outcome for Transition Pathway</th>
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</table>
| **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 |

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**

<table>
<thead>
<tr>
<th>Branching Point 1: Perceived need to reduce cost in response to pressures from higher coal costs &amp; competition from electricity, coal &amp; oil</th>
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<tbody>
<tr>
<td>Promotion of central &amp; space heating (1960s)</td>
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<td>Introduction of Lurgi process (1960s)</td>
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<td>Introduction of oil gasification processes (1960-1970)</td>
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<td>Early experimental LNG transportation (1957-1960)</td>
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<td>LNG pipeline (1961)</td>
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<td>North Sea Exploration and search for natural gas (mid 1960s and 1970s)</td>
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**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’ |
| ‘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…
Sources

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