Financing Energy Infrastructure
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Outline

- Background
- Public versus private finance
- Demand-side solutions
- Financing energy in low income countries
- Implications and conclusions
Background: Impacts of fuel generation

- Fuel generation a major contributor to GHGs

CO₂ emissions from fossil fuel combustion – 1870-2010
Source: IEA (2013a)
Dependence on fossil fuels: not changing rapidly

World primary energy supply (Source: IEA 2013a)
Public vs Private: A case history of UK electricity

• 1882 Electric Lighting Act → first energy supply companies

• Early 20th century: increased central control
  – Weir Report 1926 → Central Electricity Board
  – 1938: regional grids integrated into National Grid
  – 1957: Central Electricity Generating Board (CEBG) established

• 1990 onwards:
  – Privatisation, initially government retains 40% equity
  – Splitting of CEBG assets → generation vs transmission companies
Performance before and after privatisation: prices

Figure 3: Energy prices - residential and industrial

- Blue line: Residential: as component of RPI
- Red line: Electricity fuel price index - industrial sector

Privatisation starts
Losses in transmission and generation

Figure 4: Losses in transmission
Implied efficiency: energy supply as proportion of fuel input

Figure 5: Implied efficiency

Privatisation starts
Impacts on fuel source: innovation and risk?

Figure 6: Fuel inputs to electricity generation

- Coal
- Oil
- Natural gas
- Nuclear
- Hydro
- Wind
- Other

Privatisation starts
Energy infrastructure financing: constraints

• Energy infrastructure market failures
  – Common good, networked
  – Natural monopolies: low marginal costs, large and falling average costs
  – Significant externalities, positive and negative
• Market failure $\rightarrow$ distorted incentives for private provision
• Private financing: constrained by expectations of future revenue streams
Project finance for energy infrastructure: a windfarm Special Purpose Vehicle (SPV)

Source: windfarmbop.com
Is project finance fit for purpose?

- Sponsors/lenders invest for the revenue streams but problems quantifying these.
- Business cases built on calculations of NPV and IRR, using past information.
- Project risks difficult to quantify. Also policy risk.
- Rewards delivered over long time horizons: problem of high or unstable discount rates.
- Principal agent problems, asymmetric information, transaction costs → contractual tensions.
- Uncertainty and irreversibility → slows investment.
Impacts of uncertainty and irreversibility

• Real options theory - analogous to financial options: have a choice about timing
• Irreversible investment – opportunity cost of investment includes information forgone → will wait to exercise option to invest when information is valuable
• ↑Uncertainty → information valuable →↓ investment
• Uncertainty affects innovative investments more → potentially strong negative impacts on innovative renewable energy infrastructure investment
Evidence about managing demand

• Social influences, group learning have positive impacts e.g. EcoTeams and Environmental Champions programmes

• Social influences are important → normative signals affect energy demand

• Pre-payment and savings commitment devices have potential to enable people to plan energy consumption more effectively, especially those facing fuel poverty
Energy infrastructure in low income countries

• Energy poverty: access to electricity likely to fall from 50% to 33% by 2030
• Large numbers of off-grid energy consumers: large scale energy infrastructure unlikely to arrive soon
• Greater access to electricity would enable:
  – Schooling outside daylight hours
  – Productivity increases
  – Cleaner cooking facilities
Innovative solutions to energy poverty

• Most households occasionally have small savings → potential for microsaving. May be a better solution than microlcredit

• Constraints on microsaving
  – Financial/banking infrastructure underdeveloped
  – Procrastination, self-control problems

• Solutions
  – Mobile technologies e.g. mobile payment systems via MPESA or mobile phone bills
  – Savings commitment devices based on insights from behavioural economics
Other solutions: reducing demand

• Manage day-to-day demand for energy via
  – Carbon labelling to inform
  – Smart meters for feedback
  – Behavioural nudges e.g. social, normative influences to encourage energy savings
  – Group learning initiatives to encourage energy-saving behaviours
Rethinking housing infrastructure

- Sustainable design, construction and maintenance e.g. green buildings
- Building Information Modelling (BIM) to quantify and monitor environmental impacts
- Energy saving improvements for householders e.g. the Green Deal
Encouraging energy investment and savings

• Encourage self-reliance via “prosumption” → fewer drains on the grid
• Incentivise microgeneration via feed-in tariffs
• Devise savings instruments to enable energy self-reliance at micro level → microgeneration investments
• Savings commitment devices → reducing exposure to fuel poverty via better management of winter fuel bills
Implications and conclusions

• Energy infrastructure not provided in a perfect market $\rightarrow$ private financing has limits

• Financing innovative energy infrastructure investment problematic
  – Complex political and institutional contexts
  – Disproportionate focus on the short-term

• Need to find a way to unify the relative strengths of the public and private sectors via innovative designs for public-private partnerships