Past and Prospective UK Energy Transitions

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Perspective on Energy System Transitions

- Energy systems are complex evolutionary entities
- Transitions mean interactions between
  - Fuels & energy converting technologies
  - Infrastructures (transport networks, pipes & wires…)
  - Institutions (markets, companies, finance…)
  - Policy regimes (institutions, bureaux, regulations…)
  - Economic variables (prices, income/output…)
  - Environment & resources
  - And people…
- Can we learn from past transitions & policies?
  - The British Industrial Revolution
  - Prospective Pathways for the UK Electricity Sytem

Energy & Britain's 1st 'Industrial Revolution': C16th-19th Energy Transitions

- From a traditional agricultural economy, with limited
  - Productivity of scarce land & **flows** of energy
  - For food, clothing, housing & **fuel**
- To a new regime: growth &welfare transformed by
  - Using fossil fuel **stock** (coal) for larger energy flows
- With innovations including
    - Steam engine
    - Cotton mills
    - Substitution of coal for wood in metal manufacture
    - Other social, political, institutional & technological changes
- Coal & steam helped drive mechanisation, urbanisation & Britain's 'Industrial Revolution'

Fig. 1: UK Final Energy Consumption, 1500-1800 (TWh)

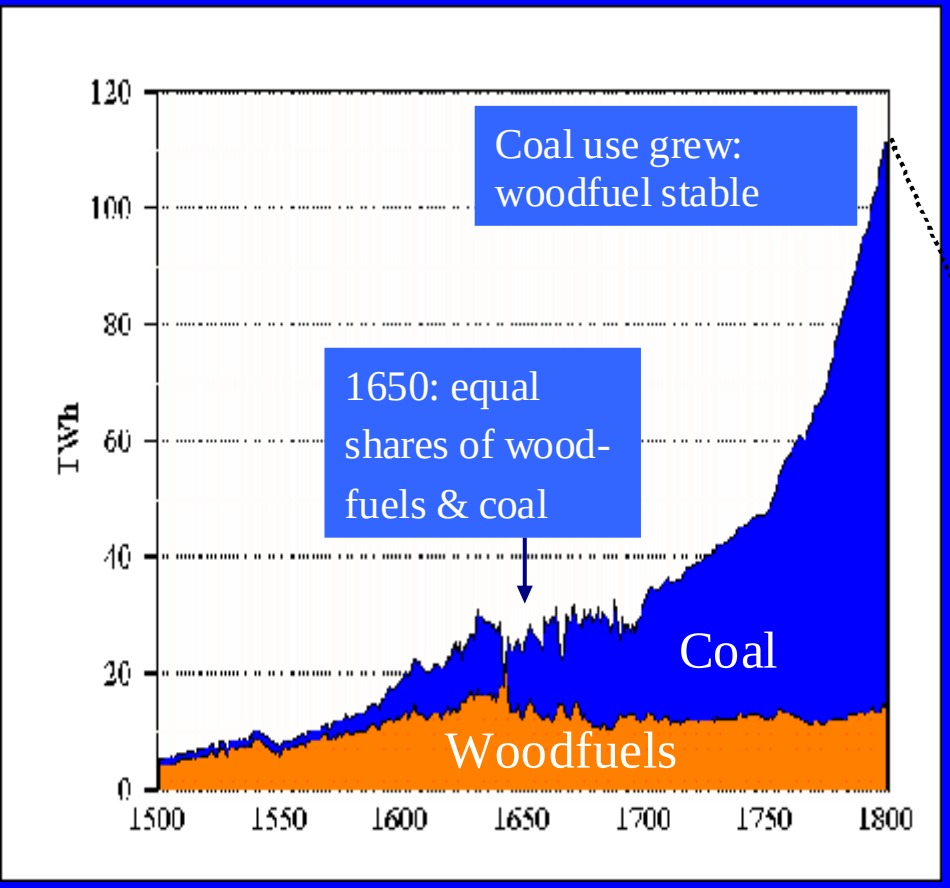
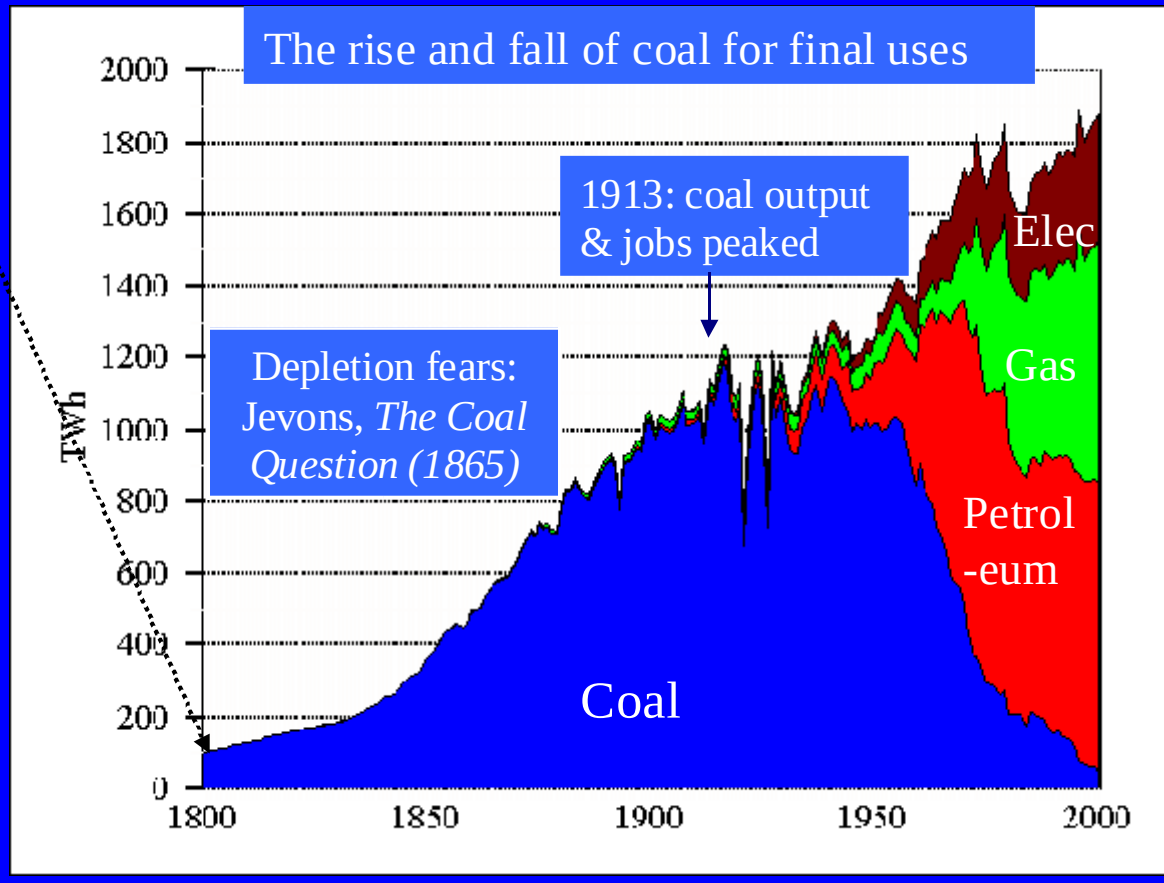


Fig. 2: UK Final Energy Consumption, 1800-2000 (TWh)



Fouquet & Pearson (2003) *World Economics*, 4(3)

- British Industrial Revolution: wages high, capital & energy cheap relative to other countries in Europe & Asia
- Steam engine, cotton mill & substitution of coal for wood in metal manufacturing uniquely profitable in Britain (Allen, 2009)

Fouquet & Pearson (2003) *World Economics*, 4(3)

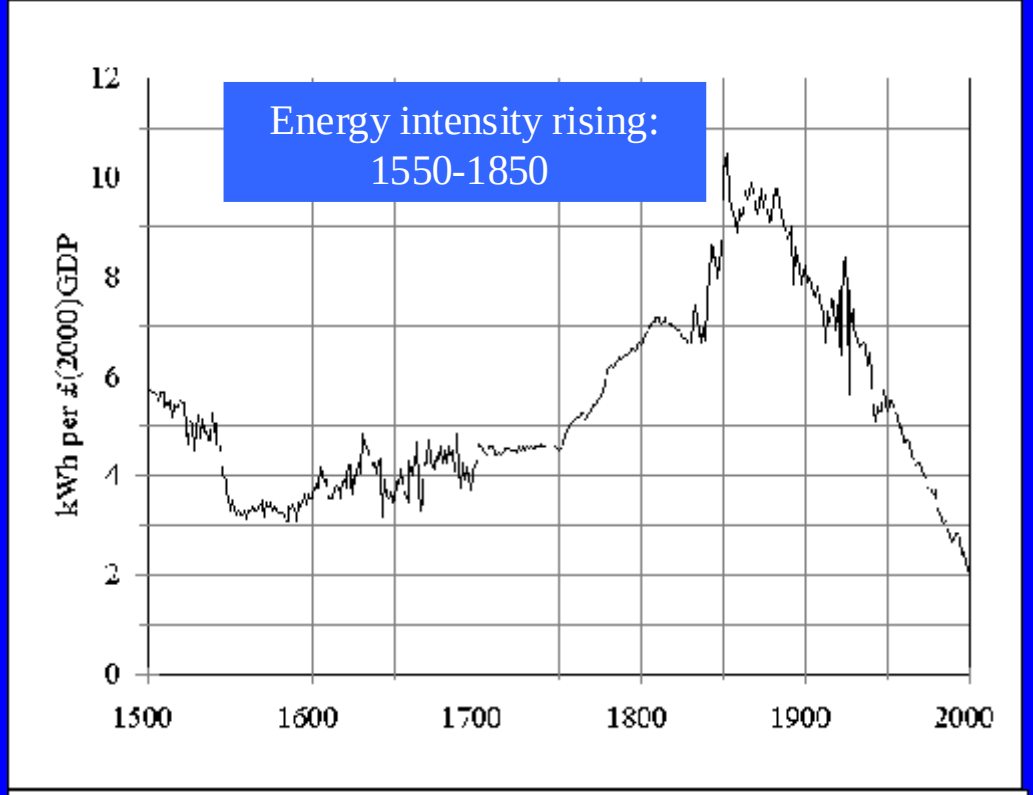
Fig. 3: prices matter

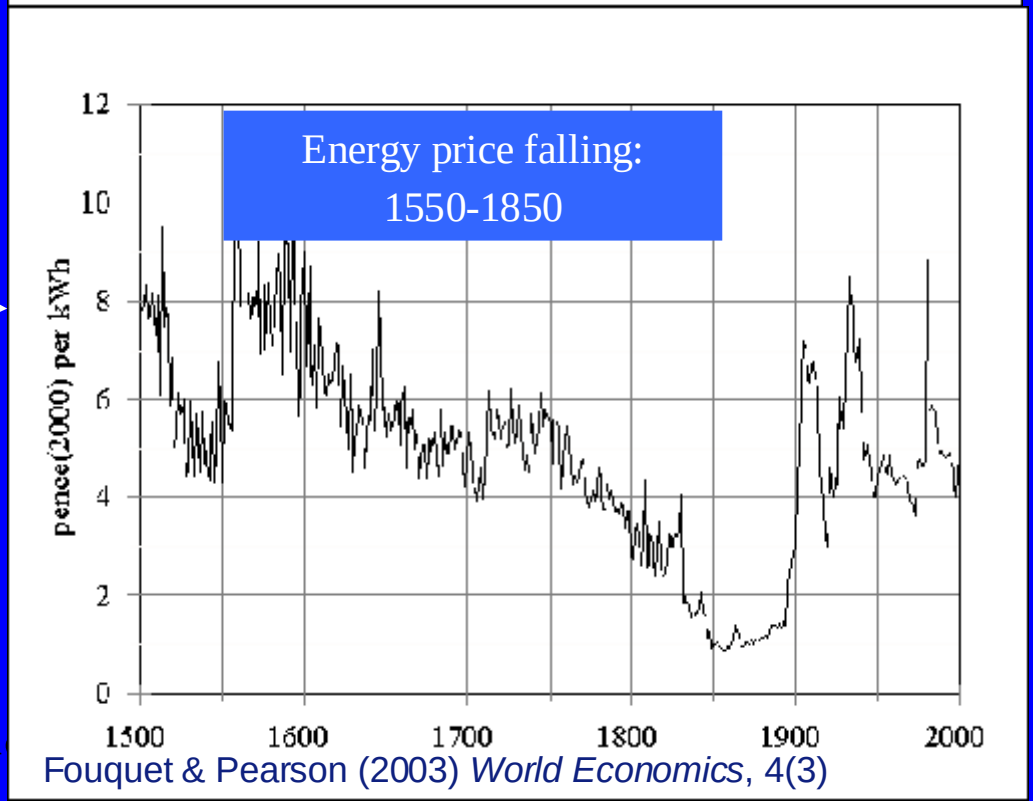
Inverse relationship between:

UK energy intensity (E/GDP)

and

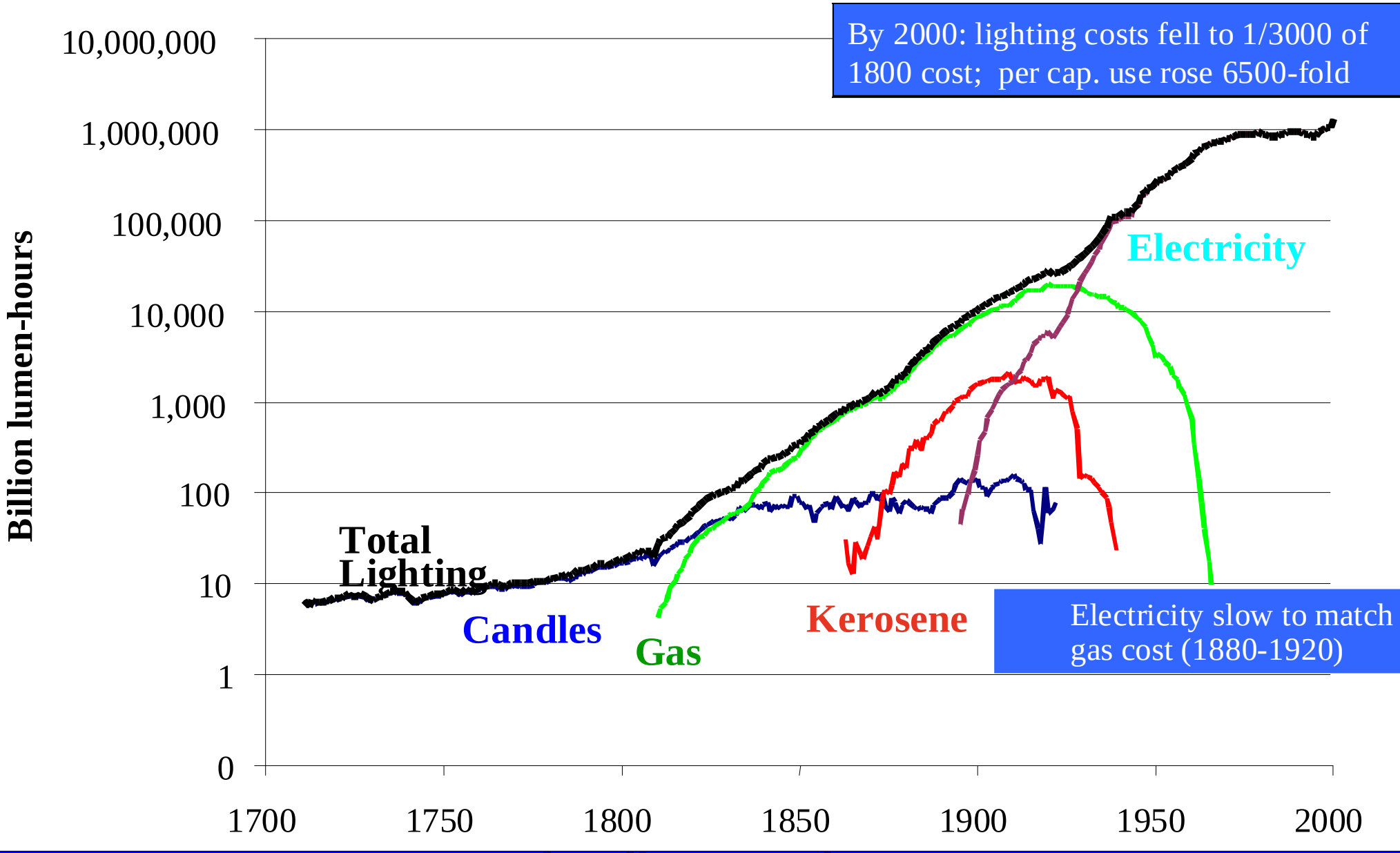
Real energy prices (p/kWh)





Fouquet & Pearson (2003) *World Economics*, 4(3)

Fig. 4. UK Energy Service Transitions: Lighting – use of Candles, Gas, Kerosene & Electricity (1700-2000)

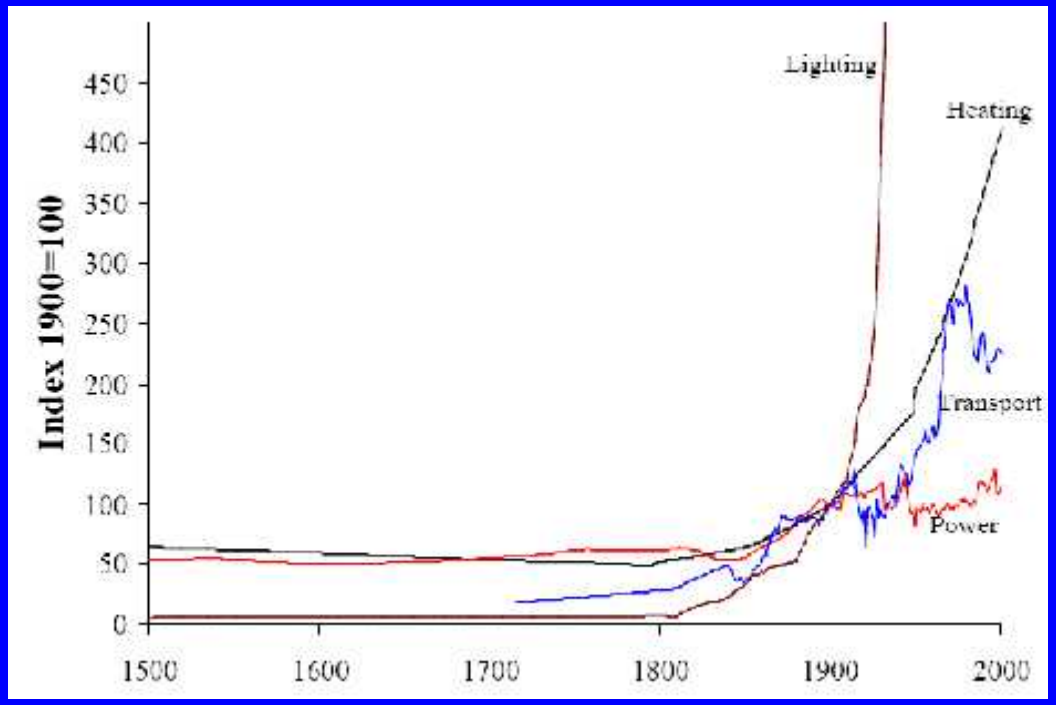


Fouquet & Pearson (2006) *Energy Journal*, Vol. 27(1)

Billion: 10^9 (i.e. one thousand million)

Other Energy Services

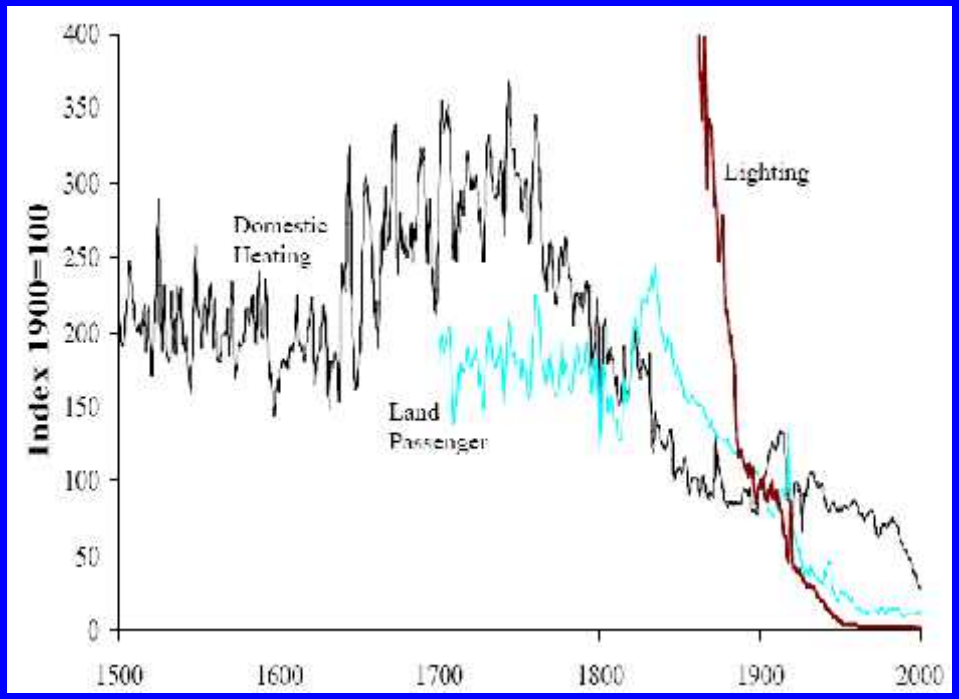
Fig. 5. Efficiency of UK energy technologies, 1500-2000 (index: 1900=100)

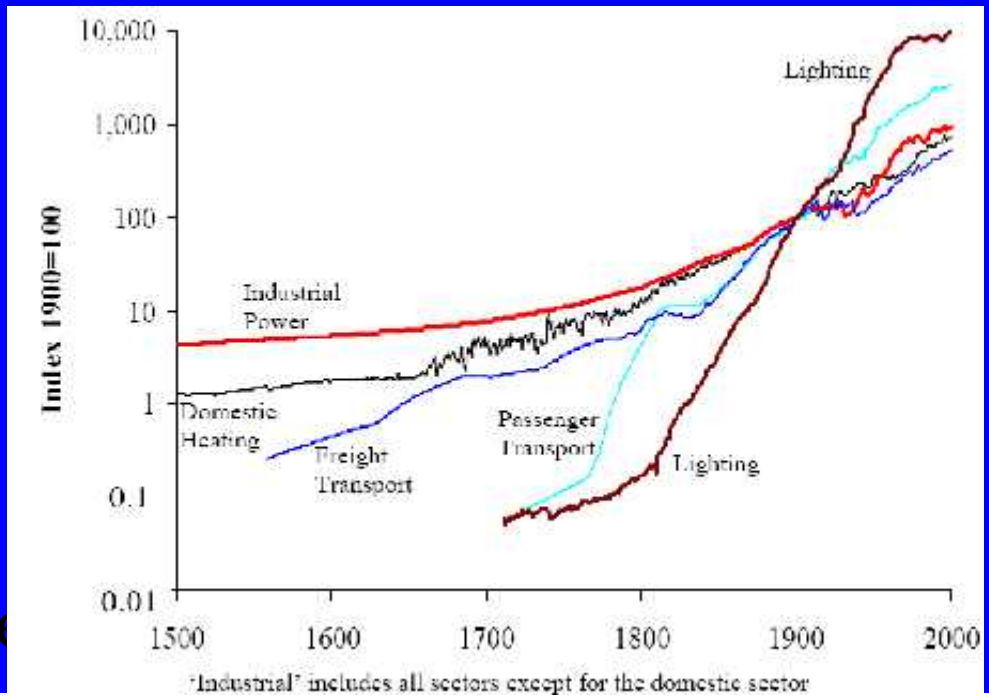


Fouquet & Pearson (2007), IAEE conference, Wellington

Fig. 7. Energy services consumed, 1500-2000

Fig. 6. Cost of consumer energy services, 1500-2000





See also: Fouquet (2008), *Heat, Power and Light*, E. Elgar

Some Lessons from UK Energy Transitions

- Transitions have profound effects on economy & welfare
  - But takes time for new fuels, technologies, infrastructures & institutions to develop & measurable benefits to come through
- There can be much inertia in UK systems
  - Path dependence? First mover advantage?
    - UK mining & textile industries 1st with steam but slow with electricity in 2nd Industrial Revolution
    - Relative to chemicals & engineering, shipbuilding & vehicles
- Modern transitions can be **faster** – but still takes time
  - To build new enthusiasm, infrastructure & institutions
  - Overcome 'lock-in', turn over old capital stock
- Evidence shows government **can** make a difference
- Now time for a 3rd, low-carbon 'Industrial Revolution'?

UK Transition Pathways to a Low Carbon Economy

EPSRC/E.ON-funded Research Consortium('08-'11)

http://www.lowcarbonpathways.org.uk

- 8 University interdisciplinary collaboration
- Research council & electricity company support
- UK legally committed to 80% GHG cut, 1990-2050
- How to get there from here?
- Project focuses on UK electricity system transition

Imperial College London

UNIVERSITY OF BATH

UEA NORWICH

University of Strathclyde Glasgow

UNIVERSITY OF SURREY

UCL lege

UNIVERSITY OF LEEDS

Loughborough University

Transition Pathways to a Low Carbon Economy

Research challenges

- Design/evaluate to UK low carbon electricity transition pathways
- Explore dynamics of past & prospective transitions
- Analyse changing roles & influences of large & small 'actors'/stakeholders, & associated governance patterns

Key aims

- Develop/explore/analyse 3 prospective transition pathways ('Market rules', 'Central Control
- Integrated assessments:
  - Technical & economic feasibility
  - Social & environmental potential & acceptability
- Inform thinking & policy towards a low carbon system

Transition Pathways: from the old to the new regime

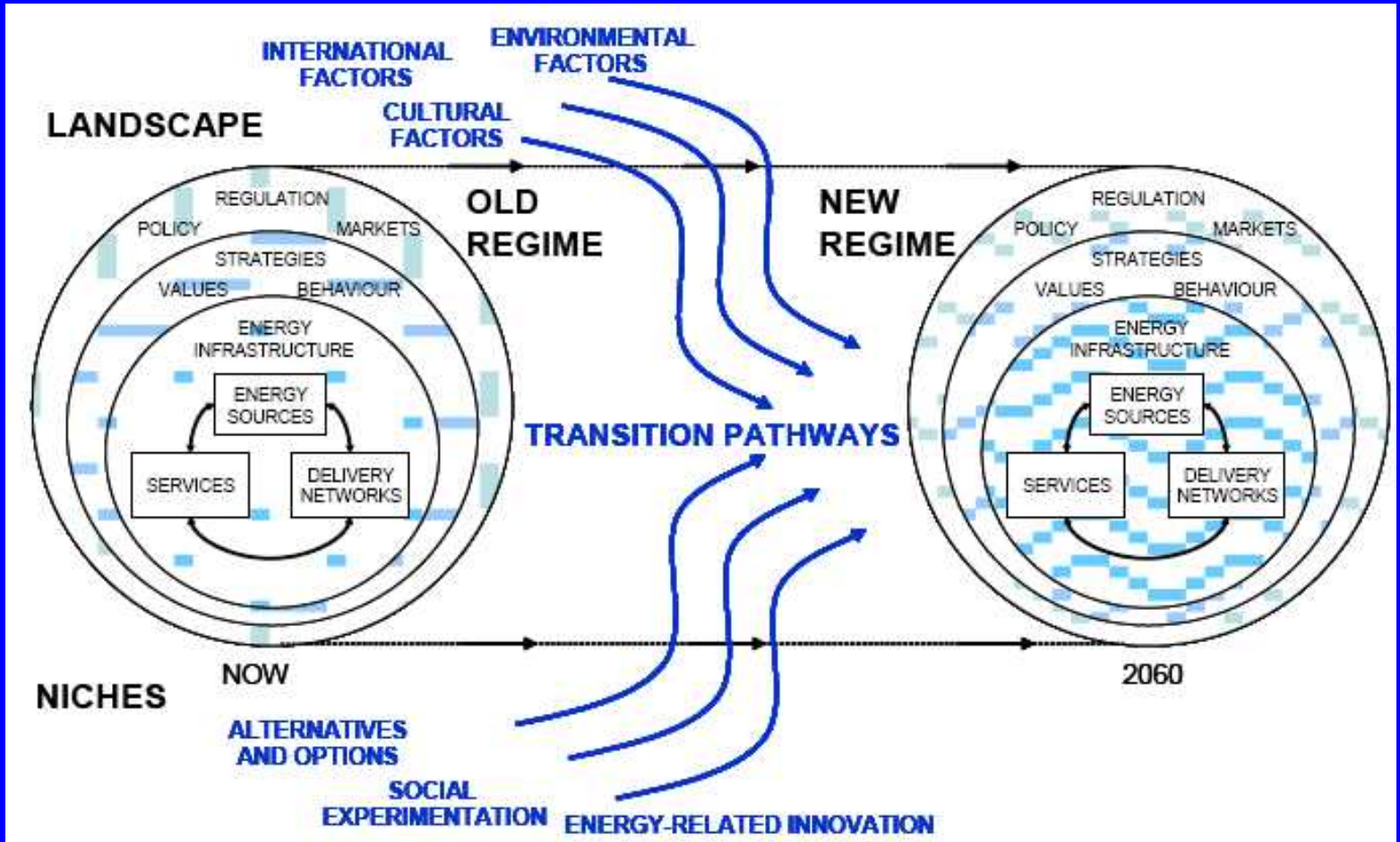
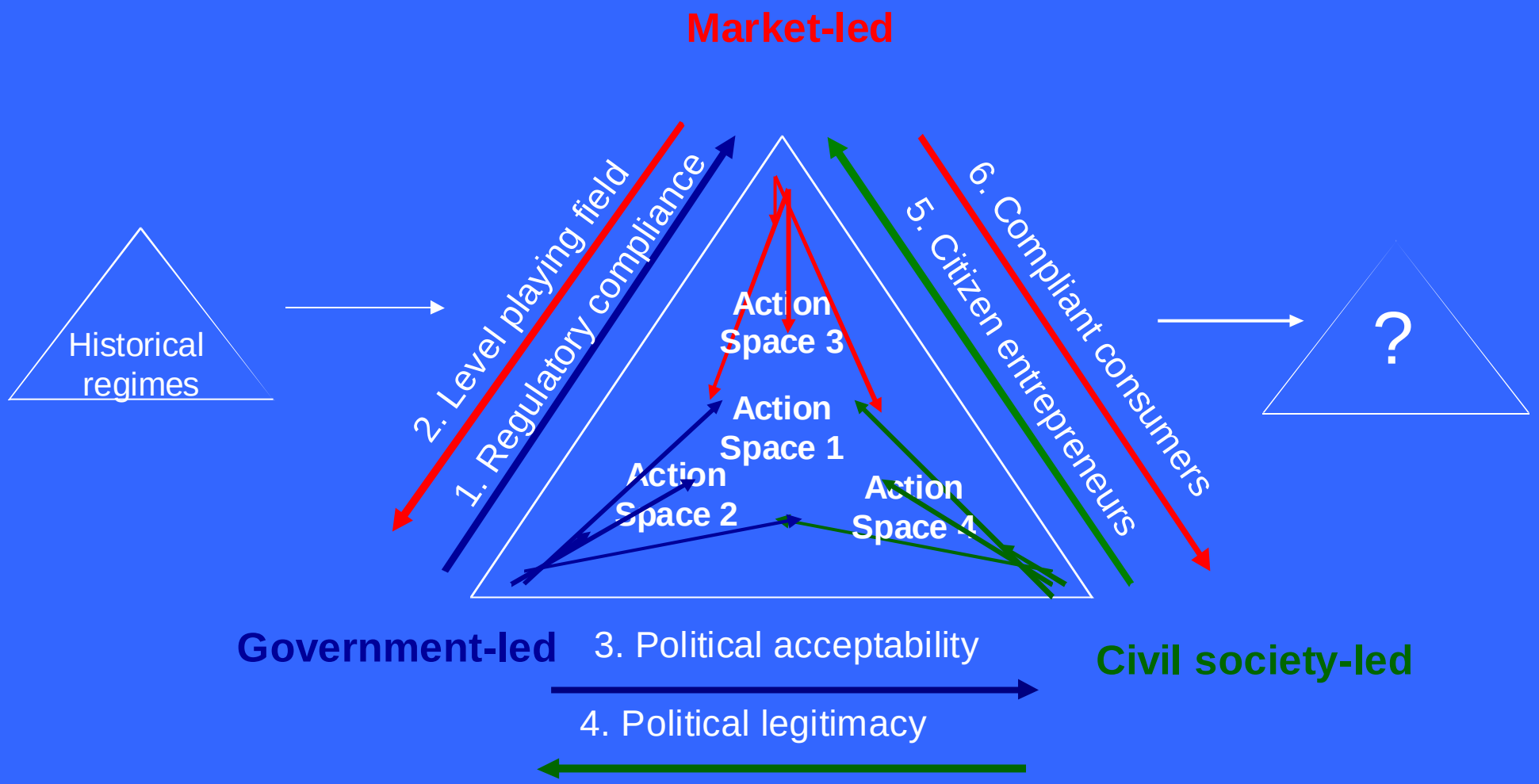


Figure 1: Possible Transition Pathways and the Factors that Influence them (Source: Transition pathways project team)

- Builds on the work of Dutch researchers on transitions & transition management (using a multi-level framework of *niches*, *socio-technical regimes* and *landscape*)
- Draws on other parts of the innovation systems literature
- And other social & engineering disciplines

Transition Pathways: The Electricity Regime Action Space - Shifting Patterns of Governance?



Source: Low Carbon Pathway Project: Jacquie Burgess & Tom Hargreaves

Transition Pathways Research Stages

1: Develop Frameworks & Outline Pathways (’08-’09)

2: Explore & Interrogate Transition Pathways (’09-’10)

3: Complete Pathway Exploration: Produce, Test & Deliver Findings (’10-’11)

Sources

Publications from the Low Carbon Pathways Project are available from http://www.lowcarbonpathways.org.uk/lowcarbon/publications/

And include

Foxon, T J, Hammond, G P, Pearson, P J, Burgess, J and Hargreaves, T (2009), 'Transition pathways for a UK low carbon energy system: exploring different governance patterns', paper for 1st European Conference on Sustainability Transitions: "Dynamics and Governance of Transitions to Sustainability", Amsterdam, Netherlands, 4-5 June 2009

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