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Lessons from History for Transitions to a Low Carbon Economy

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Lessons from History for Transitions to a Low Carbon Economy

Roger Fouquet¹

Historical experiences can provide lessons for future transitions to a low carbon economy. Although often considered a single event, the transition from traditional energy sources to fossil fuels in the United Kingdom involved numerous services and sectors at different times between 1500 and 1920. The main economic drivers identified for energy transitions were the opportunities to produce cheaper or better energy services. The existence of a niche market willing to pay more for these characteristics enabled new energy sources and technologies to be refined gradually until they could compete with the incumbent energy source. Nevertheless, this implied that, on average, the whole innovation chain took more than one hundred years and the diffusion phase nearly fifty years. In the same way, low-carbon energy sources and technologies offer an additional characteristic (i.e. low carbon impact), which might be able to develop gradually in a niche market until they can compete with fossil fuels. However, because of consumers' tendency to free-ride, a successful transition will need governments to provide protection of this niche market – possibly for decades. Based on past experiences, a complete transition to a low carbon economy is likely to be very slow.

Keywords: energy transition; low carbon economy; technological innovation.

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1. Introduction

A possible future ‘transition to a low carbon economy’ depends on the substitution away from fossil fuels towards, for instance, new or renewable energy sources. Much of the debate has focussed on targets for achieving the transition. For instance, the EU proposed a climate target of ensuring temperatures stay below 2°C above pre-industrial levels, which has clear requirements for carbon dioxide emissions (Tol 2007). The UK Government seeks to reduce carbon dioxide emissions by 80% from the 1990 level by 2050. Shorter term targets for the EU and individual countries specify the amount of energy that should come from renewable energy sources by 2020. So, for instance, the EU as a whole and Spain in particular have targets of 20% renewable by 2020 (EU 2009). Given these and other targets, the factors driving and the speed of an energy transition are of great interest.

*This policy briefing presents evidence on past energy transitions by sector and service to identify some commonalities that may be useful for anticipating future transitions. It is based on an article (Fouquet 2010) in the journal *Energy Policy*, which builds on work from a book *Heat, Power and Light* (Fouquet 2008).*

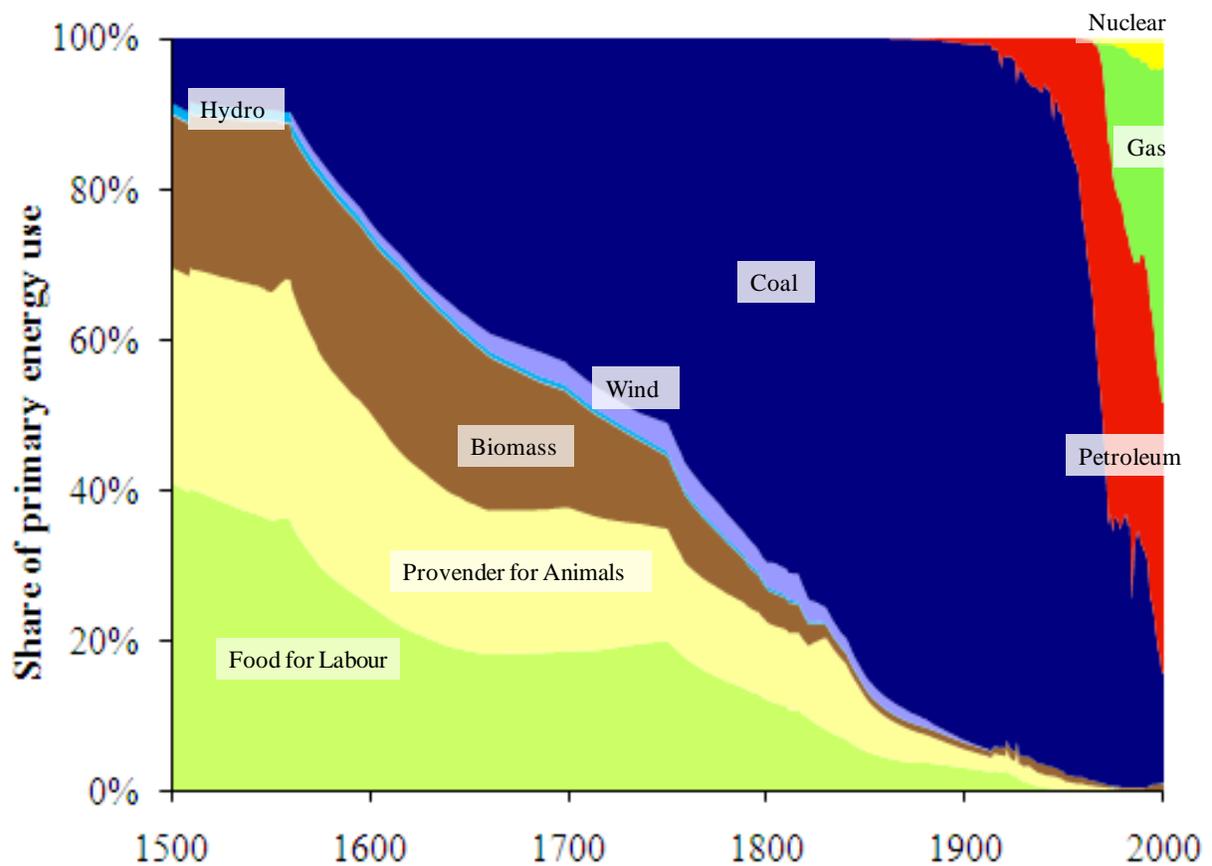
The focus is on transitions in the United Kingdom. Starting in the 1500s, this country was the first to make the transition from traditional energy sources to fossil fuels and, therefore, had to develop the necessary energy technologies. Despite numerous differences between past and future transitions, the first-mover aspect of the United Kingdom’s cases makes it relevant to our current position with respect to a transition to a low carbon economy. No country has made the full transition to a (widely applicable) low carbon economy, thus, new technologies need to be developed and adopted.

2. The Transitions from Traditional to Commercial Energy Sources

The article (Fouquet 2010) finds that the energy transition from traditional energy sources to fossil fuels, which is often considered a single event, was complex, involving numerous services and sectors at different times between 1500 and 1920 (see Figure 1). For heating,

different technologies for households and many industries, such as for iron smelting, needed to be invented, refined and adopted that could use coal rather than woodfuels. Similarly, for power and transport, the replacement of horses with steam engines depended on the development of equipment specific to each industry and on the appropriate conditions for adoption. And, in the lighting market during the nineteenth century, different new energy sources and technologies were developed for separate segments of the population (i.e. gas for the rich and kerosene for the poor), which eventually became the main fuels of the economy at the end of the twentieth and beginning of the twenty-first century.

Figure 1. Share of Primary Energy Consumption in the United Kingdom (1500-2000)



Source: Fouquet (2008)

The important drivers for the energy transitions were the opportunity to produce cheaper and/or better energy services. In a majority of cases, a successful new energy source or

technology provided the same service (i.e. heating, power, transport or light) with superior or additional characteristics (e.g. easier, cleaner or more flexible to use). Often, after their introduction, the price of the service they provided was higher than from the incumbent energy source. This implied that their adoption was limited to niche markets. However, because some consumers were willing to pay a premium for those better or additional characteristics, these technologies could be refined and costs could fall gradually. Once the price of the service fell sufficiently (either because the energy efficiency improved or the price of energy declined), their adoption was almost as swift as in cases when cheaper services drove the transitions. Nevertheless, since the Industrial Revolution, it took, on average, nearly fifty years for sector-specific energy transitions (i.e. the diffusion of energy sources and technologies) to unfold.

3. Lessons for a Future Transition to a Low Carbon Economy

The fact that many transitions were driven by additional or superior characteristics is good news for a possible move towards a low carbon economy. The greater the consumer's and government's willingness to pay for climate stability, the more protected will be the niche market enabling low carbon energy sources and technologies to be developed and refined.

However, it is unlikely that sufficient consumers will pay a premium for the social benefits associated with renewable energy sources. The innovation chain - from the creation of a niche market to widespread adoption and dominance – will probably have to be managed by government and backed by civil society.

Indeed, government will need to set mitigation targets, regulatory measures and market-based instruments (to take account of the negative externalities resulting from fossil fuels). There is great uncertainty about the existence and/or maintenance of the political will to set targets, measures and instruments, and protect renewable for the decades that may be needed to assist the transition.

Ultimately, though, for a transition to occur, low carbon energy sources and technologies have to provide cheaper energy services. And, prices will need to be sufficiently low to off-set

the unfavourable characteristics, such as intermittency and low power density, which could delay or limit diffusion. Internalisation processes, such as carbon taxes or tradable permit schemes, will improve their competitiveness.

At the same time, the threat of a transition to low carbon sources and technologies will probably encourage fossil fuel supply companies to be more competitive, delaying any uptake. Thus, for most services and sectors, a transition to a low carbon economy is likely to be slow and is unlikely to occur simultaneously in all sectors for all services. And, a complete transition (if it ever occurs) is a long way off. Finally, such a transition may not necessarily reduce fossil fuel consumption for a very long time, making it hard to meet target reductions in greenhouse gas emissions.

4. Policy Conclusions for a Transition to a Low Carbon Economy

An important policy conclusion is that, contrary to past transitions where consumers were willing to pay for niche energy sources and technologies, governments will need to support and protect these niches. Effective support of niche markets will involve incentivising the provision of ever-cheaper services and highly valued additional attributes, and minimising the problem of negative aspects of new technologies.

Also, the study (Fouquet 2010) suggests that, based on past experiences, the periods of niche development and refinement and of large scale adoption will probably be over a period of decades. Carbon dioxide emissions are likely to continue to increase for many years, raising greenhouse gas concentrations and intensifying the process of climate change. Action today will probably have a very long lag time (i.e. decades and maybe longer). This implies that early action and favourable conditions may be warranted to steer any transition to a low-carbon economy.

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