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The pace of governed energy transitions: agency, international dynamics and the global Paris agreement accelerating decarbonisation processes?

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Abstract

The recent debate on the temporal dynamics of energy transitions is crucial since one of the main reasons for embarking on transitions away from fossil fuels is tackling climate change. Long-drawn out transitions, taking decades or even centuries as we have seen historically, are unlikely to help achieve climate change mitigation targets. Therefore, the pace of energy transitions and whether they can be sped up is a key academic and policy question. Our argument is that while history is important in order to understand the dynamics of transitions, the pace of historic transitions is only partly a good guide to the future. We agree with Sovacool's (2016) argument that quicker transitions have happened in the past and may therefore also be possible in the future globally. The key reason for our optimism is that historic energy transitions have not been consciously governed, whereas today a wide variety of actors are engaged in active attempts to govern the transition towards low carbon energy systems. In addition, international innovation dynamics can work in favour of speeding up the global low-carbon transition. Finally, the 2015 Paris agreement demonstrates a global commitment to move towards a low carbon economy for the first time, thereby signalling the required political will to foster quick transitions and to overcome resistance, such as from from incumbents with sunk infrastructure investments.

Key words

Energy transitions; pace; governance; political will; creative destruction; policy mix; UNFCCC Paris agreement

1. Introduction

A recent thought-provoking paper by Sovacool (2016) challenges a 'conventional truth' in the field of transition studies: that transitions take at least 30-50 years (Grin et al., 2010; Markard et al., 2012), if not centuries as some historical examples show (Fouquet, 2010). By arguing that transitions can occur much faster, Sovacool's paper is stimulating a very welcome debate, since the urgency of climate change requires swift energy transitions. Not surprisingly, much thinking over the last ten years has therefore been about whether it is possible to speed up transitions through means of policy as well as wider societal mobilisation (Verbong and Loorbach, 2012).

In this short communication – despite sharing some of the criticisms voiced in Grubler et al (this issue) – we agree with Sovacool's (2016) argument that quicker transitions in certain circumstances have happened in the past and may therefore also be possible in the future globally. We offer three main reasons for the possibility of low-carbon transitions of the energy system occurring faster than was the case for historical transitions, and elaborate these in the subsequent sections: First, historical transitions have not been governed, but were emergent processes as a result of new fuel sources being discovered, new services becoming available, or by technologies reducing their relative cost (Fouquet, this issue). However, in the ongoing low carbon transition, there are a wide variety of actors engaged in active attempts to govern the transition towards low carbon energy systems, including policy makers but also a variety of other actors. Second, in an increasingly interconnected world, national developments can much more easily influence the global economy, thereby creating dynamic feedback mechanisms which can work in favour of speeding up the global low-carbon transition. Finally, we argue that the global climate agreement struck at the international climate conference in Paris in December 2015 seals a global paradigm shift in thinking about limiting climate change which has the potential to set in motion a significant acceleration of current decarbonisation trends.

2. Enter agency: from emergent to governed energy transitions

While history is important in order to understand the dynamics and patterns of transitions, we argue that the pace of historic transitions is only partly a good guide to the future (also see contributions by Fouquet and Bromley in this issue). One key difference between historic energy transitions and the ongoing low carbon transition is that historic transitions have not been planned or governed towards a particular direction but were emergent processes. Typically economic historians argue that transitions were driven by the development of new energy sources (e.g. the discovery of natural gas in the North Sea), the availability of better energy services (such as electric lighting compared to using candles), or the decrease of relative costs compared to alternatives (e.g. coal heating instead of wood) (Fouquet, 2010; this issue). In contrast, in the ongoing low carbon transition, there are a wide variety of actors currently engaged in active attempts to govern the transition towards low carbon energy systems. Sovacool (2016) points to the important role played by public policy in several of his examples and Grubler et al (this issue) acknowledge the benefits of well-coordinated public policies and institutions. Also Fouquet (this issue) points out that governments in specific instances have created the institutional setting to stimulate energy transitions to low-polluting energy sources. We argue that important actors in governing energy transitions do not only include policy makers, but also businesses, such as clean tech companies or finance sector actors, as well as actors from civil society, such as grassroots initiatives or environmental groups.

Policymakers at international, national, regional and local levels have been trying to promote change towards low carbon energy around the world for years: whether this is in the form of incentivising new nuclear power stations (such as in the UK), equipping fossil fuel power stations with carbon capture and storage (such as in Canada) or focussing on the deployment of renewables (such as in Germany or Denmark). Also policies to increase the efficiency of consumer products are key for transitions (e.g. Japan's top runner policy) (Hamamoto, 2011). Having recognized their future global market potential, many countries are attempting to be pioneers in low carbon technologies, and support the establishment of domestic lead markets, such as for solar PV or onshore wind (Quitzow et al., 2014). Another striking example of countries having recognized the market potential for low carbon technologies is China whose 13^{th} five year plan heavily emphasises innovation in low carbon and clean technologies. This may not come as a big surprise, as China has already for several years been the largest investor in the deployment of renewable energy technologies, with its investment in renewables exceeding $102.9 billion in 2015 (or 36% of the world total). But China is not alone. Developing countries altogether invested a total of $156 billion which exceeded for the first time the investment in developed economies ($130 billion) in 2015 (UNEP Frankfurt School of Finance and Management and Bloomberg New Energy, 2016). In addition, the establishment of new public institutions such as the International Renewable Energy Agency (IRENA) as a sister organisation to the International Energy Agency (IEA), or the independent Climate Change Committee in the UK responsible for recommending carbon budgets, further underlines the multiple activities originating from public sector actors. Finally, there is also much activity at the local level with a growing number of cities pledging to become 100% renewable energy powered or to reduce their greenhouse gas emissions by 80% by 2050, as set out in the Paris City Hall Declaration which was signed by nearly 1,000 majors of cities from five continents in 2015 (REN21, 2016).

Also businesses are acting on carbon. For example businesses started to disclose their greenhouse gas emissions (e.g. under the Carbon Disclosure Project), commit themselves to internal carbon reduction targets (e.g. German electric utilities inspired by the EU 2020 targets) (Rogge et al., 2011), and are bringing forward radical low carbon innovations which have started to revolutionize markets (such as the electric mobility boom caused by Tesla in the US). In addition, new business models for 'prosuming' low-carbon energy are being developed around the world, including for off-grid access to electricity from solar PV on rooftops in developing countries, thereby serving multiple objectives. Also the financial sector has started to adjust to the new realities posed by climate change, an example being pension funds divesting from their fossil-fuel investments (e.g. the Norwegian state pension fund). A final example of the increasing engagement of the business sector with low carbon energy solutions are the applications for patents in renewable energy technologies which have increased significantly after 1997 due to innovators' expectations of future climate policies resulting from the Kyoto Protocol (Johnstone et al., 2011). This is promising as Fouquet (this issue) argues that 'markets might take the lead in certain sectors and services in the transition to low carbon energy sources'.

Actors from civil society are also working towards low carbon energy transitions, actively pushing for ambitious action on climate change. For example, there are initiatives like the carbon tracker, a think tank in London, which attempts to focus attention on the financial risks of investing in ultimately 'unburnable carbon' (Leaton, 2011). Also, large foundations, such as the Gates Foundation, have pledged to invest in the development of low carbon solutions, thereby providing additional impetus to public R&D funds for low carbon innovation. An example of a grassroots movements is the international spread of transition towns in which citizens contribute to the low-carbon transformation of their city (Seyfang and Haxeltine, 2012). This movement started in Totnes in the UK but now encompasses 1,258 registered groups across several continents. In addition, a growing number of citizens and community cooperatives have acted as investors in renewable energy, thereby actively supporting the low carbon transition and shifting power structures in the electricity sector, such as in the case of Germany (Geels et al., 2016). This distributed ownership of renewable power generation technologies in Germany - in 2012 the renewable power generation capacity of 73 GW was mainly owned by citizen and cooperatives (47%) as well as institutional and strategic investors (41%) while only 12% was owned by energy suppliers (Morris and Pehnt, 2015) – may partly help explain the continuously high public acceptance rates for Germany's transition towards renewable energies: in 2016, 93% of respondents saw the *Energiewende* as an important or very important topic, and 55% thought it progressed too slowly, despite 69% expecting rising energy costs (BDEW, 2016). The maintenance of such high acceptance levels has been argued to become the main currency of low carbon transitions (Pfluger et al., 2016; also see Bromley, this issue).

We argue that taken together this level of activity of a variety of types of actors across a range of different governance levels, has led to significant momentum behind the low carbon transition which is likely to accelerate the process and which is unprecedented compared to historical transitions. However, to recognize this momentum it may be important to specifically investigate the latest trends in energy statistics (e.g. the past 3-5 years rather than the averages over the last 15-20 years) and to interpret them within the context of broader socio-technical changes.

3. Add international dynamics: from national to global energy transitions

Sovacool (2016) and Smil (this issue) both are in agreement that under certain circumstances *national* energy transitions can be fairly rapid, but Smil argues that *global* energy transitions necessarily are prolonged and multidecadal processes. Also Grubler et al. (this issue) claim that change of entire technology systems is inevitably a lengthy process. We agree that historically this has often been the case but also believe there is some cause for optimism. While we agree that 'no new technology is adopted instantaneously across all markets' (Grubler et al, this issue), we would like to challenge the logic of inevitably slow diffusion via leader-follower patterns. Compared to many historical transitions, the world today is much more globalised, and the changes unfolding in some parts of the world have important knock-on effects in other parts of the world which leads to more speedy global roll-out of low carbon technologies (after a prolonged 'formative phase').

A good example of this dynamic is the international interplay between solar PV deployment subsidies in Germany which triggered mass investment in solar module manufacturing capacity in China which significantly brought down solar module costs, thereby accelerating the further diffusion of solar PV globally (Hoppmann et al., 2014; Quitzow, 2015). This co-evolution means that solar PV is now on the verge of achieving grid parity in many parts of the world, that new business models are being enabled for off-grid regions struggling with energy access, and that global investments in solar PV have increased massively. Likewise, while today's lead market for the roll-out of offshore wind power is the UK (Kern et al 2015), its progress benefited from parallel and interconnected developments in a number of countries (Wieczorek et al., 2013), such as early experimentation in Denmark and now catching-up activities in Germany, another major player in this field (Reichardt and Rogge, 2016; Reichardt et al., 2016). A similar dynamic was at play in the development of onshore wind with Denmark originally leading the way, and now joined by turbine manufacturers from China, the US, Germany and Spain delivering the large majority of the global market which in 2015 was dominated by capacity additions in China (30.8 GW), in the US (8.6 GW), and in Germany (5.7 GW) (REN21, 2016). Originally, these pioneering countries (Germany, UK, and Denmark) may have largely pursued these national energy transitions for their own domestic reasons but the wider effects they produced have been of an international nature.

A second argument is that future energy systems might be more diverse than in the past, partly to offset risks from intermittent renewables. As Smil (this issue) rightly argues there will be a multitude of primary sources which means no single source or technology has to have a quick global penetration to more than 50% market share which has been used as a metric for global energy transitions. Energy uses are very diverse and include transport, heating and electricity and there is no silver bullet technology to decarbonise all of these sectors. For example, Germany has largely focused its past efforts on the transition of its electricity system away from nuclear energy towards renewable energy and on a number of counts has been very successful in achieving its targets (e.g. expansion targets have been reached faster than expected, and the share of renewable energy in electricity generation has increased from 6.5% in 2000 to 32.5% in 2015, with renewables covering between 9.9% and up to 83.2% of generation (Graichen et al., 2016)). In contrast and for various reasons (including vested interests and political resistance of incumbent actors), Germany has so far seen only limited progress on phasing out coal for electricity generation. As rightly alluded to by Smil (this issue), progress in other areas of the energy system has been slow as well, including the decarbonisation of transport, for which political support has remained fairly weak. However, given global carbon constraints and international competition on the e-mobility market, German policymakers have recently started to strengthen policy support for the decarbonisation of the transport sector (e.g. with incentives for purchasing electric vehicles).

It is important to acknowledge that while we talk about a global transition towards low carbon energy, this will be the result of very diverse pathways followed in different countries which through their interconnectedness (e.g. through grids in the case of electricity, global technology learning and diffusion of policy models like feed in tariffs) influence each other. Still, not only do natural resources and starting points vary significantly across countries, but also their institutional contexts matter for the way in which transitions unfold, both in terms of their pace and direction (Geels et al., 2016; Kern et al., 2015). This diversity of pathways makes the conventional 50% global penetration indicator for determining the pace of energy transitions meaningless, and there may be more suitable metrics to measure progress of the low carbon transition, e.g. based on reductions in carbon intensity.

Such international dynamics and the trend towards more diversified energy systems make us optimistic that a faster global energy transition can happen not only in the area of renewable electricity generation, but also for areas such e-mobility, smart grids, heat or storage.

4. Crown with political will: from Kyoto to Paris, and the road thereafter

While some frontrunner countries such as Germany or the UK have already made some progress in decarbonising their energy system, we agree with Smil (this issue) that there is still a long way to go in globally replacing (or decarbonising) the use of fossil fuels, in reducing energy demand and increasing energy efficiency which need to be an essential part of the transition strategy. Fouquet reminds us that many historical transitions 'led to dramatically greater levels of energy consumption' (this issue) which needs to be avoided in the ongoing transition given the scale of the challenge. Much progress made so far can be traced back to the Kyoto Protocol which was adopted in 1997 and entered into force in 2005. However, given its limited ambition and coverage it may not come as a big surprise that its impact from a global perspective has been limited, as the numbers presented by Smil (this issue) demonstrate. In contrast, the Paris Agreement struck in December 2015 for the first time represents a truly global commitment to the decarbonisation of the global economy which is unprecedented in ambition and scope. The agreement is based on a polycentric, multi-stakeholder approach which can be seen as being in line with Ostrom's suggestions for the successful management of a common pool resource (Cooper, 2016).

However, while Paris shows the political will of global leaders to unite in the fight of climate change, only the implementation of these targets through concrete policies – as indicated in the INDCs – will render them credible and impactful and thus ultimately lead to an acceleration of the global energy transition which is visible in global energy statistics. In this regard, there are already several signs that underline the seriousness of policy makers in putting the Paris agreement into practice, such as the ongoing elaboration of ambitious climate change plans for 2050 (e.g. in Germany), the commitment of global leaders to double public spending on clean energy innovation (mission innovation, also see Bromley, this issue), the intention of countries such as China to introduce a national emission trading scheme, or discussions in Europe to increase the carbon price of the EU emissions trading scheme. These are important policy initiatives which will drive the energy transition, and if designed well, may enable national commitments to be further increased – within the foreseen institutional architecture for 'ratcheting up' future commitments – to bring them in line with the ambitious target to limit global temperature increases to well below 2°C or even as little as 1.5°C (UNFCCC, 2016).

In addition to these initiatives, we would like to highlight the increasing policy debates about phasing out subsidies for fossil fuels or even prematurely retiring fossil fuel infrastructure and technologies. These debates suggest the existence of a firm political will to accelerate the low carbon transition. There now is a growing number of countries which have committed to or started to negotiate a coal phase out, despite heavy resistance from incumbents, including the Netherlands, the UK, China, or Ontario in Canada as pointed out by Sovacool (2016). Based on historical studies of transitions, Fouquet (this issue) usefully points out that 'transitions are just as much about the decline of incumbent industries, as about the rise of new ones'. Also Bromley (this issue) describes transitions as 'phase out/phase in' processes. As a consequence we contend that from a public policy perspective, instead of only focussing on the development of new low carbon technologies or practices, rapid transitions also require the withdrawal of support for existing technologies or infrastructures or even to disadvantage them compared to low carbon alternatives (Kivimaa and Kern, 2016). For example, in the Netherlands there is an ongoing political discussion about whether the sale of all internal combustion engine cars should be banned by 2025, and Norway just declared to phase out the sale of all non-electric cars by 2025. Such phase-out policies and other control policies increase the attractiveness of investing in low carbon alternatives which in turn stimulates further innovation and cost reductions. For example, a survey of German manufacturers of renewable power generation technologies showed that the nuclear phase out decision in Germany by now is seen as an even more important driver for renewables than the Renewable Energy Sources Act (Rogge et al., 2015). These examples show the increased political appetite for and relevance of speeding up the low carbon transition by using instruments in the policy makers' toolkit aimed at 'creative destruction' (Kivimaa and Kern, 2016).

Based on the historic Paris Agreement and early signs of national implementation, we argue that a new paradigm has been established which may fundamentally rearrange investment patterns in the global energy system (Meadows, 1999). This can already be seen in 2015 numbers where for the first time global capacity additions in renewable electricity (53.6%) have surpassed those in conventional technologies, and global investment in renewables was more than double the amount allocated to new coal and gas generation ($265.8 billion compared to $130 billion) (Frankfurt School and UNEP Centre/BNEF, 2016). These latest figures provide a further rationale to expect an acceleration of the low carbon transition driven by expectations and changes in policy mixes motivated by the global commitment evidenced in Paris.

5. Conclusion

Given the urgency and magnitude of the challenge of decarbonising the global energy system to address climate change, we welcome the debate on the pace of energy transitions stimulated by Sovacool (2016). While we agree with his argument that the global energy transition could occur much faster than research on historic transitions suggests, our main critique is that his paper does not sufficiently emphasise the importance of the role of political will (also see Fouquet and Bromley, this issue). While we agree that new knowledge about past transitions, climate change mitigation targets, and technological innovation are all important (as Sovacool argues, p. 210-11), we contend that at the heart of the pace of low carbon energy transitions is firm political commitment at all levels of governance. Only with strong political determination and a recognition of low carbon transitions as not only a technological and economic project, but also as a political, social and cultural one will we see faster low carbon transitions than would otherwise be the case. For policymakers this implies that the low carbon energy transition requires an increase in strategic policy intelligence, openness to experimentation and policy learning, new capabilities and novel procedural policy instruments as well as the development of strategies to manage resistance to the decarbonisation of the energy system (OECD 2015). So, in that sense we agree with Grubler et al's point (this issue) that moving the discussion from 'How long does it take?' to 'What does it take?' to achieve rapid transitions is an important contribution of Sovacool's piece. However, we argue that we also need to discuss much more about the varying roles a variety of actors will need to play to make rapid transitions happen. Fouquet (this issue) is right to remind us that the 'complex interaction of the choices actors will make and the forces that continue to be applied on markets, along with a little serendipity, will influence the existence, speed and nature of transitions to low carbon economies'.

In this short communication, we have highlighted three main aspects – agency, international dynamics and the Paris Agreement –which make us optimistic about an acceleration of the global energy transition towards low carbon. Since research can only fully appreciate in hindsight how quickly or slowly the low carbon transition took place and what its key dynamics were, the argument about the pace of ongoing energy transitions is mainly about reasonable assumptions about the future based on lessons from the past and interpreting current trends adequately. This is where we disagree with Smil's scepticism (this issue) which is portrayed as a 'realistic' appraisal which he contrasts with 'some unrealistic expectations' concerning the pace of future energy transitions. Since the future by definition is unknowable, we argue that such scepticism only helps to legitimize the status quo and is therefore as political as hoping the low carbon transition can occur in time to avoid the worst consequences of climate change.

Clearly, accelerating the decarbonisation of the global energy system is by no means a straightforward exercise but requires hard political work (Raven et al., 2016) as well as strong political commitment to fighting climate change. We argue that the Paris Agreement has ushered in a new era in which decarbonisation and a focus on energy demand reduction and increasing energy efficiency will become the 'new normal', thereby leading to a new paradigm in thinking about governing energy transitions. We content that the global signal sent out by Paris has the potential to significantly accelerate the decarbonisation of the global energy system.

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