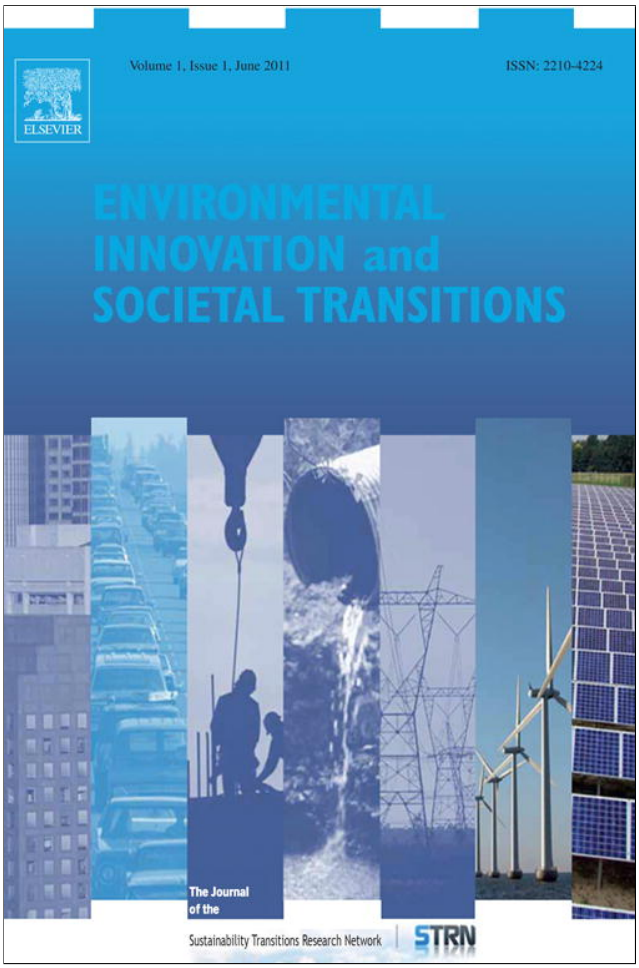

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The dual challenge of sustainability transitions

René Kemp[a,*], Harro van Lente[b]

[a] ICIS & UNU-MERIT, Maastricht University, The Netherlands
[b] Utrecht University and ICIS & UNU-MERIT, Maastricht University, The Netherlands

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ABSTRACT

In this essay we argue that sustainability transitions include two challenges: on the one hand a long-term change to various technologies and infrastructures, while on the other hand ensuring that consumer criteria change in the same move. Transitions that fail to do so will disappoint in the end. We review two sustainability-oriented transitions where criteria have changed: the hygienic transition around 1900 and the waste management transitions at the end of the 20th century. While in these cases the values, perceptions and criteria of people changed as part of the transition, this does not seem to apply to sustainable mobility and energy, where the main target is decarbonisation. What is missing is a reconsideration of individual mobility and conspicuous energy use.

The notion of transitions was introduced as a response to major socio-economic challenges including depletion of natural resources and global warming. The idea is that systems of transportation, agriculture and energy have to be superseded by other systems. Such encompassing transitions have occurred in the past, like the shift from sailing boats to steam ships in the 19th century or the change from coal to natural gas in the 1960s in the Netherlands. And thus, the argument goes, they may happen again.

Such systemic changes have been studied by evolutionary researchers, historians, and scholars in the fields of science, technology and society. Frameworks such as the multi-level perspective and strategic niche management highlight both the persistence of incumbent regimes, as well as their vulnerability. The general message is that it is possible – based on the understanding of the systemic and dynamic properties of existing and emerging systems – to guide or actively encourage a transition from the current to a new system. To do so will be a major challenge that goes well beyond the capability of government and individual actors.

* Corresponding author. Tel.: +31 433884405.
E-mail addresses: r.kemp@maastrichtuniversity.nl (R. Kemp), h.vanlente@geo.uu.nl (H. van Lente).

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In this essay we argue that the cause of sustainability adds an additional challenge. The idea of sustainability transitions not only includes the challenge of orchestrating a *change of systems* (transportation, agriculture, energy) but also *a change in criteria* that actors use to judge the appropriateness of products, services and systems. In the transitions from sailing ships to steam ships fuelled by coal, for instance, the criteria for choosing ships did not change dramatically. Both type of ships competed in terms of tonnage, reliability and speed, as sailing ships had done already for decades, or even centuries. Also, in the transition from coal to gas the basic aspects on which technologies had to compete did not change dramatically in terms of price, ease and reliability.

For sustainability transitions however criteria need to change dramatically, else transitions run the risk of not being sustainable due to rebound effects and other impacts. For instance, the transition from combustion engines to electric vehicles, which is now studied intensively, will only be sustainable when not only the vehicles change (powered by fossil fuel or electricity, respectively), but also the way in which they are used. In other words, the criteria and practices of mobility need to change as well. Today cars are adopted on the basis of speed, range, reliability and 'image'. In our society it is normal to own a car and use a car for almost every (non-walking) trip. Looking at alternatives, electric vehicles address two problems that stem from the intensive use of cars (noise and pollution) but they do not address problems of congestion and safety, while the intensive use of electricity and batteries raises additional problems. Moreover, an unanticipated effect of the development of batteries for cars is their use in bicycles. Unless electric bicycles are used for longer trips, more commonly made by cars, this represents a negative development, especially if the bicycles are used to make more trips. Therefore the assumption of individual, material-intensive mobility as well as the need for mobility has to be reframed.

There are some socio-technical transitions in which criteria changed dramatically, in ways that align with sustainability concerns rather than economic benefits. Here we highlight the *hygienic transition* and the *waste management transition*, described in Geels and Kemp (2007). The hygienic transition concerned a shift from cesspools to integrated sewer systems, motivated by hygienic concerns. In the Netherlands the transition occurred over a period of 60 years (1870–1930). In the absence of toilets, most people relieved their bowels in public spaces, dumping urine and excrement on streets and (city) canals. The middle and upper classes had personal privies in-house, where excrement was collected in cesspools that were emptied a few times a year. The excrement collected served as fertilizer. The transition which involved major health and nuisance benefits was a slow process. In the Netherlands, in contrast to the UK, Germany and France, the sewer option was not used before 1893, because of a battle between different systems (with sewers competing against a barrel-collection system and the Liernur pneumatic system). In 1938, 47% of all municipalities in the Netherlands had sewers. Comfort and convenience were important drivers as well as the new criteria of public hygiene. Costs at first counted against the sewer system but with growing affluence this became less and less an obstacle. It was not an easy or obvious transition. Today some criticise the sewer system on environmental grounds for using drinking water to flush toilets and high energy consumption for waste-water treatment.

The story of the transition in waste management from 1970 to 2000 also shows a change in perceptions, practices and criteria that define what 'waste' is and how it should be handled. Before 1970 waste management consisted primarily of landfilling, a task carried out by municipalities. Getting rid of waste was the primary concern, with waste material also being used to fill up ditches and create land for housing. This changed in the 1970s: waste and the absence of good waste management practices received increasing attention. Environmentalists criticised governments and business about how waste was being managed, while local resistance grew with regard to new landfill sites. The 1972 Report to the Club of Rome about limits to growth, together with the oil crisis in 1973, drew attention to the scarcity of raw materials. The important change that we should emphasise is that waste disposal was increasingly seen as a problem instead of as a solution. Special legislation for waste was developed and responsibilities were given to provinces to put an end to the (uncontrolled) dumping on landfills and to benefit from economies of scale for incineration. An important cognitive institution was the famous 'waste hierarchy' proposed in the parliamentary motion of Ad Lansink in 1979, known as Lansink's Ladder. The waste management hierarchy went from prevention, through re-use (of products), recycling (of materials) and incineration (with energy-production) to landfilling as the last option.

The new criteria for waste were further consolidated when the Dutch government opted for a *differentiated waste-stream* approach in which certain types of waste (notably paper and glass) were singled out for recycling. Despite these intentions for upgrading waste practices, many activities in the area of waste management only occurred at a small scale and did not result in adequate environmental protection. Concerns about non-sustainable waste management did not disappear and reached a high peak in the 1980s, following the discovery of leaking landfills (Vogelmeerpolder) and contaminated land (Lekkerkerk and Griftpark). Waste scandals often figured as news items in the 1980s. At the end of the 1980s the Dutch waste management system was in a state of crisis because of capacity problems stemming from growing waste and reduced capacity. The system was reviewed by a specially created committee (the Landelijke Coördinatie Commissie Afvalbeleid) which concluded that the current organisation was too fragmented, dispersed and small scale. It argued for the creation of a national organisation to oversee and manage waste volumes and to keep disposal costs under control. Their advice resulted in the creation of four waste regions and the Waste Management Council (AOO), which would play an important role in the modernisation of the waste system.

Thanks to a range of measures (such as the ban of 32 waste streams for landfilling, a packaging covenant, and higher tariffs for landfilling), the amount of waste being landfilled fell from 14 Mton in 1990 to 5 Mton in 2002 (a total reduction of 9 Mton). Today, all landfills have advanced systems of soil protection and systems of methane extraction. In the same period the capacity of incineration increased gradually, from 2.2 Mton in 1980 to 4.9 Mton in 2000. Recycling increased between 1985 and 2000 from 23.5 Mton to 45.3 Mton.

The transformation of the waste management system is often viewed as the result of policy. Such a view, although not 'wrong' per se, overlooks how policy itself was the result of various changes: the growing volumes of waste, the waste scandals in the 1980s and early 1990s, and, in particular, changes in perception in which waste became 'a waste of resources'. In addition, the waste scandals helped to close down old incinerators and build better ones.

The AOO as an institution of governance played an important role in the transformation process. Negotiations between different layers of government and with private waste companies took place within the AOO, with the actors agreeing on the general direction of creating a modern and efficient system of waste management with less waste being landfilled. Although officially opposed to incineration, the environmental movement did not focus on this aspect because they understood the bigger picture: i.e. the high costs of advanced systems of incineration necessitated a high tax for landfilling for burnable waste, which encouraged waste prevention and recycling. The waste companies were happy with the greater scale at which they could operate. The reorganisation of the sector was seen as a blessing by the AOO, as major companies from North America including Waste Management Inc. and BFI took control of small companies. The large companies were committed to full compliance and had a strong incentive to respect the law.

In this transformation, new 'sustainability' criteria were internalised formally in law and informally in the practices of waste management of companies and consumers separating their waste. The reorganisation of the waste market suited the interests of big waste companies, and environmentalists were happy with the incentives for prevention and recycling being created through laws and waste taxes negotiated within the AOO. However the system did not manage to radically alter product features in terms of design for assembly and re-use. The final waste goal was therefore not achieved because of opposition from product manufacturers and because consumers did not seek products with second-life components.

Compared to the transitions of hygiene and waste, the transition to sustainable mobility and sustainable energy can be expected to be much more difficult because the systems of automobility and fossil-fuel based energy are much deeper embedded. Both car mobility and cheap energy are viewed as basic rights. The criterion of affordability – so important for users and governments – conflicts with sustainability because affordable mobility and energy will stimulate mobility and energy use. In this respect, the low operating costs of electric cars are an undesirable feature, as this will continue to foster mobility and energy use. Likewise, improved public transport may temporarily decrease the use of cars but can also be expected to stimulate mobility.

We argue that transitions that do not fundamentally change criteria by which decisions are made are unlikely to lead to sustainability. In their famous article on the framework of evolutionary eco-

nomics Nelson and Winter (1977) coined the notion of 'natural trajectories' referring to long term regularities like mechanisation in the 19th century or miniaturisation since the 1960s. Their argument is that while individual innovations will follow routines and heuristics (within firms), the general tendency of such innovations, e.g. to replace manual labour by machines, is more general, across firms and decades. Phrased like this, we can delineate the natural trajectory of cars as an increase of volume, weight, and mileage. This has to change through another appreciation of mobility.

Sustainability therefore has to be taken up in a more consequential way than is seen at present. Catering to people's desire for comfort, convenience and low costs may not lead to sustainability transitions. In our view, sustainability transitions require that people accept constraints and are willing to live and behave differently. Transitions are always accompanied by changes in values and beliefs, as shown by the examples of hygiene and waste. Some elements fit with sustainability, while other elements do not. Thus far, in the case of mobility and energy we do not see fundamental changes in values and beliefs. A change in consumer criteria and frames of thinking can occur through cultural change, prices and new and better knowledge. The processes through which such changes occur is a topic of further analysis and the aim of this essay is to put this topic on the agenda of sustainability transitions research.

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