Transport Policy 37 (2015) 72–82

Contents lists available at ScienceDirect

Transport Policy

journal homepage: www.elsevier.com/locate/tranpol

Bridging the implementation gap: Combining backcasting and policy analysis to study renewable energy in urban road transport

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ARTICLE INFO

Article history:
Received 28 April 2014
Received in revised form
29 October 2014
Accepted 30 October 2014
Available online 15 November 2014

Keywords:
Urban road transport
Renewable fuels
Energy efficiency
Transport policy
Energy policy
Scenario studies

ABSTRACT

This paper combines backcasting and policy analysis to identify the opportunities for and barriers to the increased use of renewable energy and energy-efficient vehicles in an urban road transport system, namely, that of Stockholm, Sweden, in 2030. The combination of methods could bridge the implementation gap between scenario-based research and actual policy implementation and thus increase the chances of research being implemented in practise. In the case study, backcasting identifies a need for diverse fuels and vehicles and for immediate policy action. However, analysis of policy integration demonstrates that such action is unlikely given current policy structures. The fundamental lack of integration between energy and transport policy obstructs measures to increase the use of renewable fuels and more energy-efficient vehicles, which in turn obstructs the reduction of CO_2 emissions from transport. The combination of backcasting and policy analysis is demonstrated to improve our understanding of the prerequisites for transitioning to a system based on renewable energy, and could thus be useful in further research.

1. Introduction

Urban road transport is the source of several environmental and human health problems. Due to its 98% dependency on fossil fuels, road transport is a major source of the anthropogenic CO_2 emissions that contribute to climate change (IEA, 2011). In urban areas, additional problems are noise and reduced air quality due to local emissions of particulate matter and nitrogen oxides. As urbanization is a global trend that is assumed to continue (World Bank, 2008), it is imperative to reduce the negative impact of urban road transport. In the European Union (EU), measures targeting this include the increased use of renewable fuels and more energy-efficient vehicle technologies (EC, 2011a, 2011b). By 2030, the aim is to reduce the number of fossil-fuelled cars in urban transport by half in the EU (EC, 2011a).

Current road transport policy can be interpreted as implying that 'renewable fuels' refer to biofuels[1] and that 'energy-efficient technologies' refer to plug-in electric vehicles. The share of biofuels is low in the EU, just over 4% of energy use in road transport in 2010 (Ecofys, 2012), but there are opportunities to greatly increase this share. Several different biofuels can be produced from a wide range of feedstocks, and there is considerable future potential for energy-efficient production in large volumes (Lindfeldt et al., 2010; Swedish Government, 2013). The diversity of biofuels could provide more or less individual energy and resource-efficient solutions for different transport needs. Currently, plug-in electric vehicles are even less common than are biofuelled ones. As they are far more energy efficient than conventional cars, are silent, and lack tailpipe emissions, they are a desirable alternative in urban traffic (EC, 2011a). With renewable electricity generation, electric vehicles could also contribute to CO_2 emission reductions.

Scenario-based research suggests that biofuels and plug-in electric vehicles could meet future transport demand in whole countries and in urban areas (Lindfeldt et al., 2010; Robèrt et al., 2007; Turton, 2006). Some studies also acknowledge the need for behavioural change and reduced transport demand as important factors in addition to technological improvements (Åkerman and Höjer, 2006; Hickman and Banister, 2007; Robèrt and Jonsson,

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[1] In this paper the terms biofuel and fossil fuel are used exclusively, although in Sweden petrol and diesel have a 5% biofuel blend-in and are thus not purely fossil.

http://dx.doi.org/10.1016/j.tranpol.2014.10.014
0967-070X/

2006). A common denominator of all these studies is that they focus on the ability of technology to create a desired, ideal future; economic conditions are sometimes considered, but societal factors rarely are.

The purpose of scenario studies is usually to initiate radical change, for instance towards greater sustainability (Banister and Hickman, 2013; Robinson, 1990). However, there is a gap between scenario-based research and actual policy implementation (Banister and Hickman, 2013). One way of bridging this gap and bringing research into policy-making could be to modify the research process. According to Nilsson et al. (2011), scenario studies are unrealistic as long as they ignore political conditions. Although scenario studies provide valuable information, they provide insufficient guidance on reaching sustainability goals. Greater attention to how to actually reach the desired future is needed, and this entails understanding relevant societal and political conditions (Nilsson et al., 2011). An analysis of current policy-making could illuminate the actual possibilities for realizing future scenarios. Thus, the gap between research and policy implementation could be diminished.

This paper combines a backcasting study of urban road transport with an analysis of current policy processes in Stockholm, Sweden. The desired future includes increased use of renewable fuels and energy-efficient technologies in the road transport system as means to reduce CO_2 emissions from road transport in line with EU goals. The policy analysis focuses on integration between transport and energy policy, as vehicles and fuels are managed in these two policy sectors. Research demonstrates that policy integration can greatly affect the outcome of policy processes (Underdal, 1980). Policy integration has been shown to be of importance for sustainable transport (Banister, 2008; Hull, 2011). A policy integration analysis can identify the ability of a policy-making structure to advance the realization of future scenarios. In this paper, integration between policy sectors is of greater interest than integration between specific institutions, wherefore the results can be considered generalizable.

This paper has two aims:

- To identify the characteristics of current policy that could hinder the increased use of renewable fuels and energy-efficient technologies in Stockholm's road transport system. This is done by identifying how policy correlates with desired future scenarios.
- To demonstrate a useful methodology for improved understanding of the prerequisites for future scenarios, by using the interdisciplinary combination of policy integration analysis and backcasting in a case study.

The case study object is Stockholm, the Swedish capital, a metropolitan area with approximately 2 million inhabitants (Eurostat, 2012). Motorized road transport is a large and important issue in this area despite a fairly high degree of public transport[2] utilization, initiatives to increase walking and cycling, and congestion charges for driving automobiles into the city centre. Sweden has fairly ambitious goals to reduce fossil fuel dependency in the transport system through using biofuels and plug-in electric vehicles (Swedish Government, 2009). There is also a policy framework for the sustainable development of road transport in the Stockholm region, in line with the ambitious national goals. Due to a dominant share of hydro and nuclear power in Swedish electricity generation, the introduction of plug-in electric vehicles is considered one way to reduce CO_2 emissions from road transport. Biofuels are produced and used to some extent. Existing technological conditions are therefore supportive of a 'renewable future'. Thus, Stockholm makes an interesting case with regard to implementation of policy for renewable fuels and energy-efficient vehicles. By analysing a situation in which technology development is not a major obstacle, the importance of the policy process should become clear.

[2] In Stockholm, public transport comprises a metro system, buses and commuter trains.

2. Background

Backcasting is increasingly popular in studies of future energy use, energy supply and climate impact. This highly normative tool is usually used with the aim of radical change (Banister and Hickman, 2013; Robinson, 1990), and as such it has been used to examine how the transport system could evolve in several countries and cities, in order to reach sustainability goals. In a Swedish backcasting study, Åkerman and Höjer (2006) establish that for a transport system that complies with the 450 ppm CO_2 target for 2050, substantial social change is required. Lindfeldt et al. (2010) present strategies for renewable road transport in Sweden 2025, concluding that a mix of demand reduction and technical improvements could lead to a road transport system without fossil fuels. Robèrt et al. (2007) investigate the possibility of relying solely on biofuels in road transport in Stockholm County in 2030. They conclude that such a future would be possible, but also point out the importance of demand reduction (Robèrt et al., 2007). The importance of a combination of technical progress and demand reduction is confirmed by backcasting studies in many other developed countries and regions, for instance California, Japan and the UK (Ashina et al., 2012; Hickman and Banister, 2007; Yang et al.; 2009).

A more sustainable transport system is shown to be possible, through a combination of technology measures and social change. But how plausible is the implementation of the suggested policy implications? To what degree can backcasting studies lead to a more sustainable transport system? The studies mentioned above focus on technological and economic conditions, as is common in backcasting studies (Robinson, 1990). However, the outcome of the studies reveals policy implications concerning not only technology but also behaviour and social structure. Not accounting for societal conditions in a study that then concludes that social change is needed might affect the implementation of policy for social change. While the desired scenarios of a backcasting study can be used to visualize opportunities and instigate change, the actual workings of the policy process can provide important constraints to the implementation of change.

In studies of sustainable urban transport, the policy process is often found problematic. For example, in a study of a major road investment in Stockholm County, the so called Bypass Stockholm, Finnveden and Åkerman (2014) found that long-term environmental sustainability goals were not included in the planning process. An alternative to Bypass Stockholm, that would include demand reduction measures such as investment in public transport and congestion charges, was found to be more environmentally sustainable. The alternative was rejected by the planners as "the goal was to find a road corridor, not to find the best solution for Stockholm's traffic and transport problems" (Finnveden and Åkerman, 2014, p. 54). In line with this, a study of two British regions, centred around London and Oxford, respectively, call for coherent and long-term planning strategies for more sustainable transport to be achievable (Hickman et al., 2013).

Several other aspects of complications in the policy process are found in international literature. A Finnish study of transport policy goals and implementation found that goals were sometimes conflicting, but also that there were often dependencies between