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A transport policy tool for reduction of CO_2 emissions in Finland – Visions, scenarios and pathways using pluralistic backcasting method

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Abstract

The reduction of greenhouse gas emission was the basis of a Delphi study where expert opinions about future development were asked and used to form visions of the future, and further elaborated to scenarios using a pluralistic backcasting method. A new innovative approach on how to use and combine methods and data from various disciplines in scenario modelling, on transport policy packaging and determining pathways to reach the desired futures, is presented for two of the visions analysed in detail. This paper focuses on the diverse methods and data used while the scientific background of the backcasting method has already been published in Tuominen et al. (2014).

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Keywords: transport; emission reduction; impact assessment; scenarios; policy packages; backasting

1. Introduction

Global warming, urbanisation, security issues, aging population as well as digitalisation of our technical and service environments are grand challenges for the transport sector. In addition, long-term investments and the strong role of regulation are typical features of the transport system, posing challenges for strategic long-term planning. They call for systemic innovations or transitions in transport systems, i.e. a shift from the current socio-technical

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system to a more sustainable one for a long period of time. Strategic planning and transitions can be supported by interdisciplinary, systemic and integrated research approaches presenting alternative visions of the future and pathways to reach them. Tuominen et al. (2014)

In a national Finnish research project ILARI funded by the Ministry of Transport and Communications the aim was to structure multiple visions of the future on CO_2 emissions of transport in Finland up to the year 2050 for the use of the policy-makers in their decision-making process. For this purpose a pluralistic backcasting method was developed and a set of visions of the future that were transformed to scenarios for different sectors of transport was formed. The process was finally complemented with pathways from present to the future. Calculations of the actual impacts on GHG emissions were based on trends and forecasts for both transport behaviour and technical development including a wide set of policy packages to achieve the futures set by the visions.

For the entire process from vision formulation to transport behavioural changes and policy packages to steer the transformation from present to the desired future several methods, travel surveys, statistics, trends and other databases as well as literature for parameters were used and combined. The overall structure of the method is presented in Figure 1 and in more detail with data sources in Appendix A. This paper concentrates on the methods and data sources used and how they were combined in the different phases of the study.

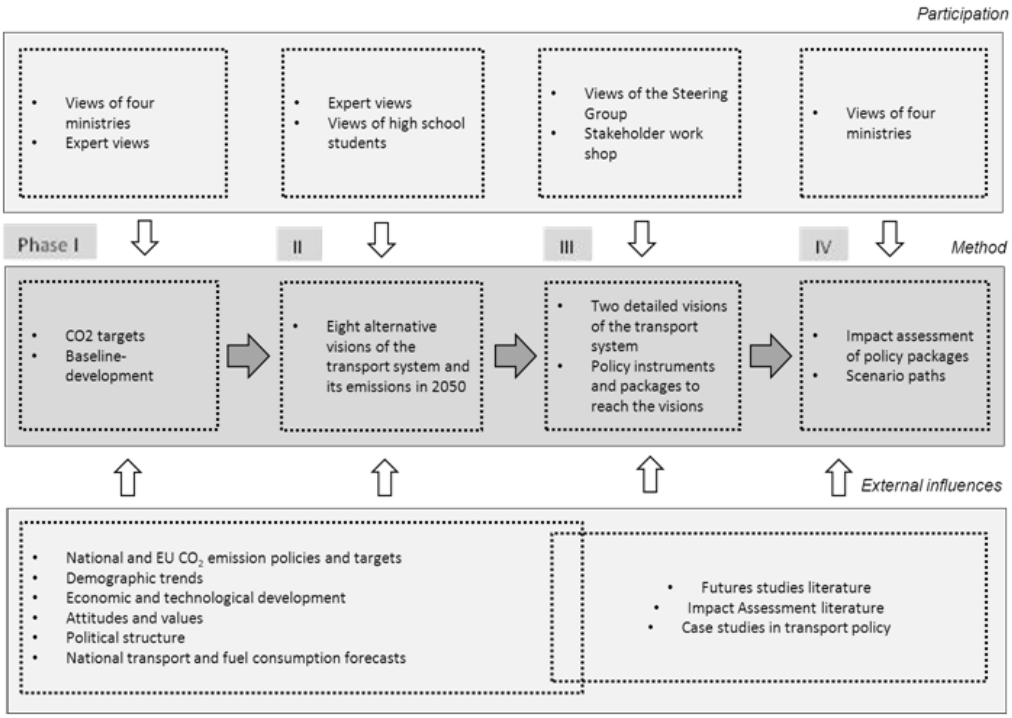

Figure 1 The method for pluralistic backcasting of national climate policy for transport

2. Setting the future

2.1. Theory of backcasting

Scenario building provides a family of methods that can be used in futures studies for developing strategies and pathways. Many of the scenarios are constructed from the past and present towards the future and are hence forward looking. Backcasting scenarios instead look backwards from the desired future (Robinson, 1990; Hirschorn,1980). The major concern is not which futures are most likely to occur, but how to attain desirable futures. The two types of scenarios are illustrated as cases a and b in Figure 2. The purpose of this study is to develop a third option (c), where multiple preferred or desirable futures are taken as starting points of the backcasting exercise. Hence, we call it pluralistic backcasting.

In general, three classes of future scenarios have been distinguished by Vergragt & Quist (2011) answering to the questions: what will happen (trend extrapolations, business as usual scenarios, probable scenarios); what could happen (forecasting, foresighting, strategic scenarios) and what should happen (normative scenarios like those used in backcasting). Normative scenarios can also be called desirable futures or visions of the future. All of the three scenario classes can be made in a forward- and backward-looking way.

Our study is based on a backcasting approach that builds upon Robinson's (1990) thinking of working backwards from a particular desired endpoint to the present and estimating what policy measures would be required to reach that point. Robinson uses a single end point, but here a method of multiple visions of the future is presented, in which the different visions will be achieved, but with divergent pathways as presented in Figure 2. Multiple visioning or scenario building in backcasting is a novel approach in transport studies, but in some other sectors it has already been used successfully.

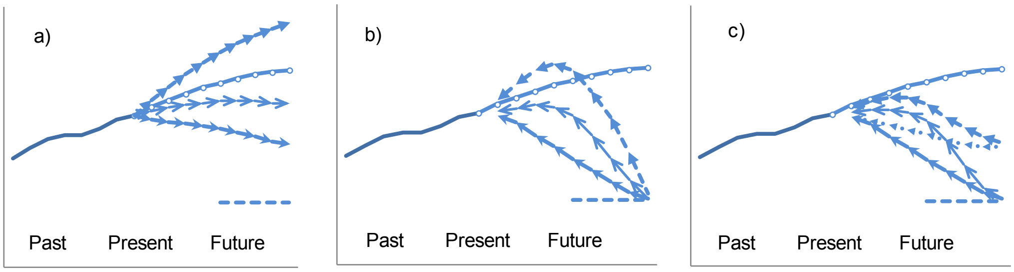

Figure 2 Baseline forecast with (a) three forward-looking scenarios, (b) single vision backcasting with three scenarios and (c) pluralistic backcasting with two visions and four scenarios.

2.2. Forming the futures

Surveys

The goal set by the Finnish Government is to reduce Finland's greenhouse gas emissions by 80% from the 1990 levels by 2050 whereas the EU target requires for a 60% reduction. The reduction of GHG emissions was also the base of the future scenarios formed for the year 2050.

The visions of the future were formed using expert opinions about future development and trends obtained through a two-rounded Delphi study of around thirty experts complemented by an interview round in between (Varho et al., 2011). The participants were asked to give their opinion for two different futures, the future they considered most probable and for the future they considered most desirable. Also the desirable future had to be realistic in the opinion of the respondent as stated by Amara (1981). In addition, visions of the future of high school students around Finland were gathered from their essays especially written for this purpose for increasing novelty in the goal setting.

The experts first gave quantitative estimates of volumes of different transport modes in both passenger and freight sectors: total CO_2 emissions from various modes, vehicle density, share of biofuels, average CO_2 emissions/km of new passenger car fleet, and GDP. This was obtained through a questionnaire survey (first round) after which the respondents were interviewed (round two) about both the qualitative arguments related to the quantitative estimates and about their broader views on the development of the transport sector and climate issues in Finland in 2020 and 2030. The third round consisted of an expanded questionnaire that, in addition to the previous questions about volumes and shares, contained many questions regarding policies and drivers of development covering the years 2020, 2030 and 2050. The anonymous answers of the whole expert panel from the first round were shown in the third-round questionnaire, and a summary paper of the qualitative arguments from the interviews was sent to the panellists.

In the ILARI exercise only the views for the year 2050 were used although the source material contained views for the years 2020 and 2030 as well. Altogether we had 4560 quantitative observations in the expert data matrix and 1152 observations in the student data matrix. The qualitative material consisted of 650 pages of tape-recorded and transcribed expert interview talk, and about 50 pages of original essays written by the students.

Vision formation

Unlike the traditional Delphi studies, consensus was not the main objective here. Instead, the intention was to condense the views of the expert panels into a small number of different views about the future. The method belongs to the family of dissensus based Delphi variants by Steiner (2009) that reject the search for probability and aim at diversity instead (Varho & Tapio, 2005 and 2013).

The first step in this process was to group the quantitative estimates from the third round expert questionnaire using cluster analysis. First, we grouped the variables from the questionnaire into six themes (transport volumes, emissions, economy, vehicles, policies, and other drivers). Each variable within a theme was given a weight describing its relative importance in the theme, for example, road was given a higher weight than rail in passenger transport. In addition, all variables were standardised to a scale between 0 and 100 in order to make them proportional to each other. Then, using cluster analysis the various answers were grouped to a manageable number of clusters, which can be used in creating alternative visions of the future (Varho & Tapio, 2013). This way of grouping meant that the answers of one respondent did not necessarily end in the same cluster. In this study each variable received four to seven alternative future states. The average value of answers given to each question within a cluster was considered the cluster centre.

The qualitative material, i.e. the interview transcripts and the students' essays, was analysed separately using qualitative content analysis. This material was distilled to qualitative variables and their alternative future states. For example, ''car fashions'' was a variable that described what type of cars would become popular.

Combining the quantitative and qualitative material, a table of themes and future states of the variables was produced, known as the futures table (Varho & Tapio, 2013). This table forms the basis of scenario construction. In the table, each row represents a variable, such as "passenger car density" or "GDP". Each variable has either quantified (the cluster centre) or qualitative alternative future states, marked in the cells of the row in Figure 3.

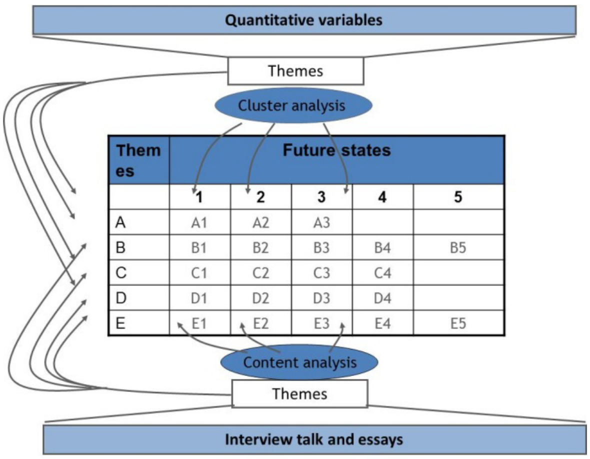

Figure 3 Futures table, combining quality and quantity.

Using the futures table the alternative future states were organised into coherent visions for the future by reorganising the cells showing the alternative states of variables on each horizontal row so that a vertical column represents one coherent vision. In practise, from all plausible combinations of the variables eight different visions for 2050 were selected by the researchers using their expert opinion, for example in Figure 3 terms one vision could be A2, B2, C1, D2 and E1, and another A3, B5, C4, D3 and E5 (Varho et al., 2011). Out of the eight visions formed six were based on combined data, one ("Developing degrowth") on Delphi study expert visions only and one ("Cornucopia") on high school students' essays only (Tapio et al., 2011). Being based on the results of cluster analysis or contents analysis the visions did not represent the thinking of any one expert but each vision element was a combination of views and ideas of various experts.

Two of the eight visions originally created and presented in Table 1 were chosen by the Steering Group of the ILARI project, consisting of both policy makers and researchers, for full analysis regarding the scenarios and pathways. Surprisingly, these visions were nearly the outmost ones, far from the business-as-usual trends: The "Urban Beat" is a radical vision, based on compact cities and high use of ICT, and the "Cornucopia" vision is based on fast technological development and new transport solutions that help to cut CO_2 emissions radically (Tuominen et al., 2012). As the "Cornucopia" vision was originally based on qualitative data, for the scenario description quantitative data from the expert study was combined.

Table 1 The eight visions of the future formed

Name of the vision	Description
Urban Beat	**The vision is based on compact cities and high use of ICT. The economy has grown steadily. Passenger transport volume has not grown, but there has been a radical modal shift towards rail and soft modes, decreasing emissions radically.**
Transit Finland	The economy has grown slowly and settled on the 2020 level. Passenger transport has decreased with the simultaneous increase of transit freight transport.
Eco-modernity	The economy has grown faster than transport volumes and the share of non-material consumption has increased. Technologies have developed fast and the share of biofuels is high.
Small steps	The vision clings to the present and any changes have been very cautious. The economy has grown slower than before.
Business as usual	Certain improvements and new policies have been introduced, but the vision of the future is rather conservative.
Material growth	The economy has grown fairly fast and urban sprawl has continued. Transport volumes have continued to grow. The vision is pessimistic in terms of emission reductions.
Cornucopia	**The vision is based on radical technological development and new transport solutions that have helped to cut emissions substantially. The economy has grown substantially and transport volumes slightly.**
Developing degrowth	The economy has become increasingly service-intensive and as measured by GDP, has started to decline. Road transport volumes and emissions have declined dramatically.

3. Reaching the desired future

3.1. Calculation methodology

Having the two different futures for nearly forty years ahead selected for detailed analysis of the scenarios and definition of pathways we had to answer the question whether either or even both could be reached and how. For forming the pathways and conducting a detailed analysis of the CO_2 reduction impacts a large number of different data bases, surveys, trends and forecasts were used as well as elasticities or probability for change regarding response for transport policy measures. In addition, technology development of both the vehicles and ICT and ITS supporting emission reduction were taken into account. The elements of the pathway definition and impact analysis are shown in Figure 4.

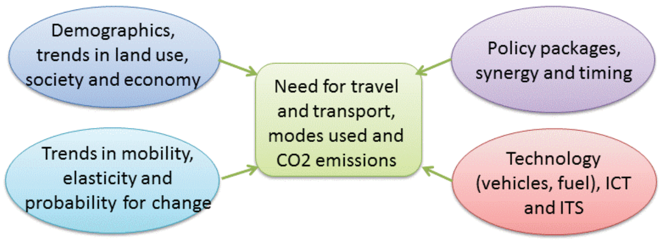

Figure 4 Elements of pathway definition and impact analysis

Analysis was carried out by mode, trip purpose and user or transport group by calculating reduction factors for each policy and policy package, and finally adding all these up stepwise starting from the most powerful policy and continuing with additional effects of the supplementary policies. A detailed description of databases used is presented in Appendix A.

3.2. Baseline scenario for CO_2 emissions

For assessing greenhouse gas (GHG) reduction potential in 2050 a trustworthy reference scenario i.e. the baseline scenario was needed. In our case this was not a problem as in Finland we have a national transport emission calculation system LIPASTO (http://lipasto.vtt.fi/). This unique database and calculation system, supported by four Ministries and Statistics Finland, covers all modes of transport and is also used for official reporting of transport emissions in Finland, as well as to monitor progress towards transport and environmental targets. Presently the system provides annually updated projections and also a baseline forecast up to 20 years to the future.

The baseline scenario for the ILARI exercise up to 2050 was made by updating and further elaborating the LIPASTO forecast in accordance with:

- Population forecast up to 2050 (data source: Statistics Finland)
- Demographics, driving licence holding and mobility behaviour trends (data sources for trend analysis: Statistics Finland and National Travel Surveys)
- Extended forecasts of mileage by vehicle type (data source for forecasts: Finnish Transport Agency)
- Baseline forecast for the technical development of the vehicle fleet in terms of CO_2 emissions (data sources for forecasts: Finnish Transport Safety Agency and VTT car fleet model).

As can be seen in Figure 5 the baseline for CO_2 emissions is not a business-as-usual forecast but includes already launched policies that only begin to result in emission reductions over a period of time, like the share of biofuels in fuel mix and the effect of GHG targets set for the European car industry. Tapio et al. (2011)

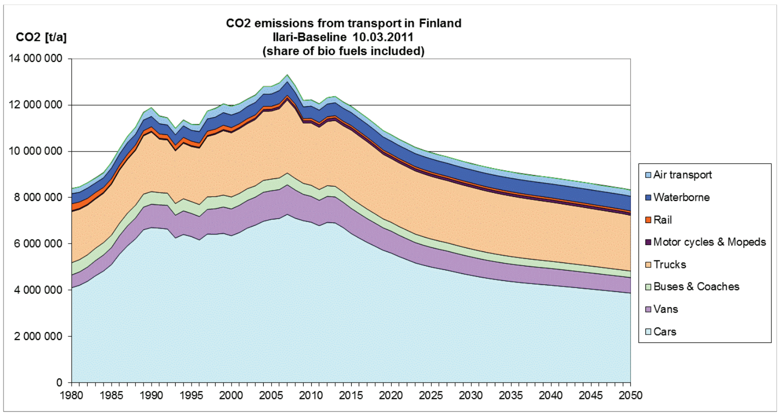

Figure 5 CO_2 emissions of domestic transport in Finland 1980–2010 and the Baseline development for 2011–2050

3.3. Policies, policy packages and timing

Based on the literature (Tuominen et al., 2014) and comments from the Steering Group of the ILARI-project, policy packages were constructed to include two main elements. These are the primary measures, which act as the leading and steering elements of the package, and additional measures, which promote the effectiveness, acceptability and feasibility of the primary measures (see e.g. Optic, 2010 and Sessa et al., 2003).

In choosing the policies at first a list of policy areas was formed. All the plausible individual policy measures suitable for Finland were then listed and analysed under these areas. The list of policy areas included:

1. Measures to stop urban sprawl
2. Measures to compact community structures
3. New strategic planning model integrating land use, housing, transport, service and business sectors
4. Decreasing public transport fees controlled or subsidised by national or local authorities
5. Functional arterial network and nodes for public transport
6. National public transport information service
7. Affordable ticket products and new payment types for long distance public transport
8. Decreasing business trip mileage allowances
9. Lower speed limits
10. Decreasing work trip mileage allowances (tax allowance of work trip mileage as a compensation for poor public transport connections in low density areas)
11. National level road pricing i.e. kilometre based car use charging
12. Higher parking fees
13. Company transport plans
14. Environmentally friendly modifications in car tax policies
15. Raise of fuel taxes
16. Environmentally friendly modifications in heavy goods vehicle taxes
17. Increasing energy efficiency of heavy goods vehicles
18. Hybrid and electric vehicles for urban delivery
19. Reduction in the number of empty loads
20. Walking and cycling measures
21. Investments in rail infrastructure
22. Investments in road infrastructure
23. Awareness rising, campaigns, etc.
24. Emission norms
25. Car wrecking schemes

In order to customise the policies from the literature, national practice and strategies and to widen the perspective on the timing of implementation and synergies or conflicts between individual measures, a half-day expert workshop was organised to find a common view on packaging the measures. The workshop brought together experts from several ministries, transport administration and research institutes. In result a matrix of synergies and conflicts between the measures was produced and a separate “time scale” for the policy options on the policy area level. The main message was that most measures that need to be used in order to achieve the two visions need to be used as soon as possible. As for the “Cornucopia”, most immediate measures were increase of energy efficiency of heavy goods vehicles, increase fuel taxes and emission norms; whereas the “Urban Beat” vision would require immediate action in land-use planning activities and decrease of tax allowances of work trip mileage. Finally policy areas and detailed policy packages for both visions “Urban Beat” and “Cornucopia” were determined.

3.4. Calculation of emission reductions and evaluation of the effects

The emission reduction calculation i.e. impact of a measure was carried out using reduction factors with reference to the baseline scenario to be defined by mode, purpose and person group for person transport and by mode, industry sector and product type for goods transport. The reduction factors (or increase factors e.g. in case of a shift from car to bus, car-mode emissions are reduced but bus-mode stay at the same level or increase) were calculated directly as changes in the vehicle mileage, not as changes in the number of trips. The detailed reduction factors by each policy introduced were calculated at first and then multiplied to one factor for each mode.

In forming the reduction factor tables the following background data was used: 1. Elasticities and/or probabilities for change of different transport user groups (both person and goods transport) based on national research. 2. Mobility data by mode and purpose from national travel surveys and goods transport surveys by industry sector respectively to define the share of respective mileage.

In practice the visions of the future were transformed into scenarios directly to the target year 2050 by introducing one policy measure at a time starting from the most effective and acceptable primary policy measures and adding others from the predefined policy package introduction scheme until reaching the target. Emissions reduction factors for each mode (both person transport and freight transport modes) were defined separately for each policy measure using elasticities from national research, if available, but mostly using probabilities for change based on national research and expert opinion. In detail the reductions were calculated as follows:

- Elasticities from national research, if available (e.g. for "Public transport pricing" a long term elasticity of 0.6 to number of trips was used together with an average length of a trip by purpose)
- Emissions reduction factors were defined by multiplying influence factor by proportion of mileage affected:
  - Influence factor was determined as the probability for change or the share of transport users affected based on national research (e.g. Järvi 2009; Järvi & Himanen 2006; Koljonen et al. 2012; MinTC 2009, 2007 and 2004-2007; Nylund 2011; Mäkelä et al. 2008; Rosenberg et al. 2008 and 2007; Välipirtti et al.2011)
  - Proportion of mileage by mode and purpose affected by the measure (FTA 2006; Järvi & Himanen 2006; OSF 2011). For example for the measure "Congestion charging" proportion of mileage was determined as urban car mileage in greater cities and the influence factor for purpose "work" was 70% and for other purposes 25%.
- Development of vehicle technology and use of alternative fuels were already included in the baseline scenario but for measures promoting these (earlier and wider introduction) national literature was used (Nylund, 2011).

The level or power of introducing a policy measure for a major measure or the complementarity effect of a side measure was then defined i.e. determining the actual effect of the measure by taking account on both the power and synergies of different policy measures based on literature, national case studies and results of the expert workshop (for example measures "city toll ring" and "parking charging" have high synergy, but "incentives for low emissions cars" and "promoting walking" have less synergy). In addition, as modelled directly to the year 2050, for measures developing by the time the phase of the measure in 2050 was imbedded in the power of the measure. Lastly, when appropriate, the transport user group response to the power of the measure was taken into consideration. In general, the maximum acceptable lever of a measure was used to achieve the maximum CO_2 reduction. Three transport user groups were used in terms of flexibility for change in respond to the power of a policy measure or policy package (Tuominen et al., 2007; MinTC 2004-2007):

- volunteers i.e. early adopters – no extra force needed,
- the majority – a group that can be influenced by light positive or negative policy measures
- laggards and opponents – a group that must be forced to the desired change.

Finally, elasticities from the literature were used for control and check-up of these national calculations.

4. Results

In the ILARI study the two visions selected for backcasting i.e. finding the pathways and policies to lead to the desired future were "Urban Beat" and "Cornucopia" visions that both turned out to require substantial investments that might be unrealistic. With their choice the decision-makers who made the selection, however, wanted to see innovative, nearly utopian results which in practice could be realised if the economic requirements could be fulfilled. Taking this, it would have been interesting to see what kind of policy packages could have led to the "Developing degrowth" scenario or the slow growth options.

The targets and final results of the two visions selected for detailed analysis are shown in Figure 6. Both of the visions were stated to reach the EU target of 60% reduction, but the "Urban Beat" vision reached even the national target of 80% reduction while the "Cornucopia" vision was very close. The scenario analysis results showing calculated potential for CO_2 emission reduction confirmed that the targets could be reached, the EU target of 60% even if somewhat weaker assumptions of policy impacts are used. However, regarding the national target, the roles change while going from visions to actual scenario modelling and definition of pathways using transport policy measures and packages. Only the "Cornucopia" scenario reaches the national target of 80% by using strong assumptions of policy measures (introduction with high power, e.g. high prices and taxation, strict regulation) and impacts accordingly, the "Urban Beat" scenario being very close.

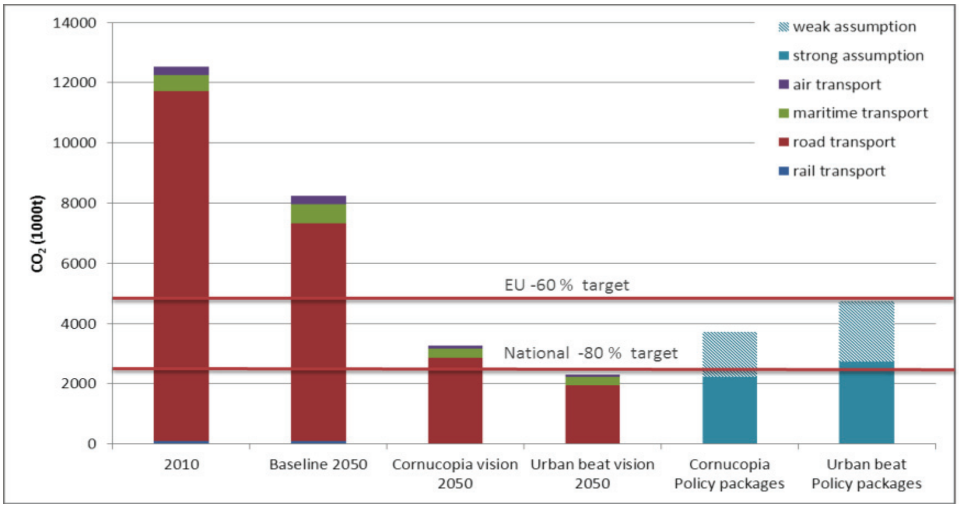

Figure 6 Transport CO_2 emissions in Finland in 2010, Baseline development and the targets of the visions "Cornucopia" and "Urban beat" by 2050; and calculated potential CO_2 emissions of the two scenarios using policy packages (weak/strong usage) and pathways by 2050.

The policy packages finally selected to fulfil the radical vision "Urban Beat" based on compact cities and high use of ICT and the "Cornucopia" vision based on radical technological development and new transport solutions that help to cut CO_2 emissions radically are shown in Table 2. The set of measure packages needed is much shorter for "Cornucopia" than for "Urban Beat" as in the former boosted technology development (e.g. motor, fuel and intelligent technology) takes care of the major part of the reductions (75%). For "Urban Beat" the first four policy packages together, with pricing as the most effective one, account for around 40% of the reductions, technology development alone for another 40% and freight measures for the rest.

Table 2 Policy Packages for Urban Beat and Cornucopia visions.

Policy Packages, Urban Beat	***Policy Packages, Cornucopia***
Land use measures & promotion of cycling and walking	Low-emission vehicles
Intelligent urban public transport	New freight transport concepts
Energy efficient long distance travel	New technologies and service concepts
Pricing	Investments on road infrastructure
Low-emission vehicles	
New freight transport concepts	
Investments on rail infrastructure	

As an example of full contents of a policy package policies included in Cornucopia "Low-emission vehicles" policy package are given in Table 3. Taxation measures refer to improving the present already CO_2-based taxation policies, and car wrecking fees are introduced for renewal of the presently very old car fleet (e.g. at present a trial of a scrapping bonus payment of around 5% of an average price of a new car for all persons buying a new low-emitting car to replace the wrecked one is ongoing). A list of all policy measures needed to reach the targets set in the visions is shown in Appendix B.

Table 3 Policies included in Cornucopia "Low-emission vehicles" policy package and grounds for impact assessment

Primary measures	*Additional measures*	*Grounds for impact assessment*
• Taxation of new and imported, second hand cars • Incentives to purchase electric and hybrid vehicles • Taxation of vans and heavy duty vehicles • Incentives for biofuel use	• Car wrecking fees, efficient service and maintenance • Information provision, campaigns • Company transport plans.	• Electric and hybrid vehicles constitute half of the car fleet. • Share of biofuels approximately 35 % in road and waterborne transport.

5. Conclusions

Major shifts in the current transport system (socio-technical transition) seem to be inevitable to substantially reduce levels of GHG emissions. Transition can only be realised by deep structural changes. This entails co-evolution and multi-dimensional interactions between the various actors of the society: industry, technology, markets, policy, culture and civil society.

The main benefit of the method for pluralistic backcasting can be found in its ability to picture different plausible futures, open up the discussion on the policy packages to reach the visions, and to help various transport system actors to find and adjust their actions accordingly.

Expert opinion was used in several phases of the process of introducing desirable visions of the future and possible pathways to reach them. Firstly experts were used in the Delphi study for vision formulation and then again in the selection of best suitable transport policy measures, their internal timing as well as forming combinations of measures. However, the experts' opinions were only a part of the methodology, used like additional parameters in several different phases of the process, and in confirming the national viewpoint and acceptability of the policies suggested (for example taxation and pricing policies, and technology neutrality which is adopted as the basis for the Finnish transport policy).

The pluralistic backcasting approach used enables to introduce multiple visions of the future in a participatory, interdisciplinary process, and presents practical tools to support development and implementation of climate strategies and policy programmes for transport. The backcasting method determined the top down approach for all calculations and also the methodology in which way the policy packages to reach the desired futures were introduced and pathways built. The method developed provides a tool for strategic planning to reduce the gap between scientific knowledge for policy support and actual implementation of policy measures by various stakeholders. The method does not, however, produce unambiguous figures, but rather informed estimates on the direction and magnitude of the impacts and costs. Such estimates are increasingly required for longer term strategic planning and decision-making.

The used methodology of combining visioning and traditional impact assessment methods turned out to be very successful in our ILARI case with a national view on policy packaging for long-term climate change mitigation in the transport sector as a result. It opens up a debate on the various means to achieve the GHG reduction targets, emphasises the strong commitment, large investments and cooperation needed. However, there are still a number of unresolved issues, especially in relation to the impact assessment part of the method, that are challenging to formulate universally. Namely, implementation of policy measures is strongly affected by political targets and thus do not always reach the transport policy targets set, the actual level of power of a measures that should be introduced might be inappropriate as well as the expected synergy of the measures and the time span over which change is expected. In addition, the costs of the different policy packages were not explicitly estimated. All of these issues need to be considered in the future impact assessment and require further research. Still, what has been presented here is a novel, systematic and successful approach to the analysis of future options to substantially reduce the CO_2 emissions from the transport sector.

Appendix A. Methods and data sources

The pluralistic backcasting method and data sources used in this Finnish ILARI study for achieving the CO_2 reduction targets set for 2050:

1. Setting the future – formation of visions of the future, both probable and desirable
   - 2-round Delphi of around 30 experts complemented by an interview round in between
   - student essays for including innovative ideas of the young people
2. Analysis of the results and forming the visions
   - cluster analysis of the quantitative results
     - clusters of each question group separately (not by the respondent)
     - weighting of variables and standardisation to a common scale between 0 and 100
   - qualitative content analysis was used for qualitative material
   - eight different futures were formed using the help of a futures table
   - two visions of the future we chosen for further analysis
3. Scenarios and pathways
   - Baseline scenario
     - elaborated and extended using LIPASTO model as the base and latest statistics, trends and forecasts for updating
   - Transport policies, policy packaging and timing to support the desired change
     - analysis of policies affecting person transport, transport of goods, technology uptake and infrastructure development separately
     - primary measures to steer the change and
     - supporting measures for promoting effectiveness, acceptability and feasibility
4. Calculation of emission reductions
   - mobility data by mode, purpose and person group from national travel surveys and by industry sector and product type from goods transport surveys respectively
   - transport user group formation in terms of flexibility for change:
     - volunteers,
     - easy to influence group using light positive or negative policy measures and
     - a group that must be forced to the desired change
   - elasticities and probability for change for the selected user groups and goods transport sectors
   - technology development and introduction
5. Results and final evaluation of suitability

Appendix B. Policy packages

Urban Beat policy packages

Primary measures	*Additional measures*	*Grounds for impact assessment*
Land use measures & promotion of cycling and walking • Measures to bring down urban sprawl • Measures to compact community structures • New strategic planning model (MALPE) integrating potential and requirements of land use, housing, transport, service sector and businesses.	• Development of networks and new services for biking and walking. • Information provision, campaigns.	• Decrease in number (or length) of urban car trips, modal shift towards walking, cycling and public transport.
Intelligent urban public transport • New ticket products and common payment system for the largest commuter areas. • National public transport information service.	• Company transport plans • Development of networks and new services for biking and walking.	• Modal shift in commutation: from urban car trips towards public transport • Incentives for public transport

• New image for public transport system • Functional arterial network and nodes for public transport • New complimentary lines and park and ride facilities.		
Energy efficient long distance travel • Affordable ticket products and new payment types for long distance travel. • Public transport service, speed and accuracy in long distance travel • National public transport information service. • Active campaigns on modal shifts in long distance travel	• Changes in business trip mileage allowances and transport-to-work expense allowances • Speed limits	• Modal shift in long distance travel between the largest cities: from car to public transport (rail).
Pricing • National level road charging for cars and vans • National level road charging for heavy goods vehicles	• Increase of parking fees at urban areas • Company transport plans • Information provision, campaigns.	• Modal shift from car and van trips to public transport.
Low-emission vehicles • Taxation of new and imported, used cars • Incentives to purchase electric and hybrid vehicles • Taxation of vans and heavy duty vehicles • Incentives for biofuel use	• Emission norms and standards • Car wrecking fees • Information provision, campaigns.	• Increased introduction rate of hybrid and electric vehicles • Increased share of biofuels (35 % in road and waterborne transport).
New freight transport concepts • Increased energy efficiency of freight transport (from road to rail) • New urban, electric delivery concepts • Measures to reduce the number of empty loads • Increased energy efficiency of waterborne transport	• Fuel taxation • Car wrecking fees of heavy duty vehicles • Speed limits (maximum speed for heavy duty vehicles: 80 km/h)	• Modal shift from road to rail (approximately one third) • Most of the urban delivery by electric vehicles • Increased energy efficiency of vehicles.
Investments on rail infrastructure • Significant investments in rail infrastructure • Dynamic development and maintenance of existing infrastructure	• Pricing of road and rail infrastructure	

Cornucopia policy packages

Primary measures	***Additional measures***	***Grounds for impact assessment***
Low-emission vehicles • Taxation of new and imported, used cars • Incentives to purchase electric and hybrid vehicles • Taxation of vans and heavy duty vehicles • Incentives for biofuel use	• Car wrecking fees, efficient service and maintenance • Information provision, campaigns • Company transport plans.	• Electric and hybrid vehicles constitute half of the car fleet. • Share of biofuels approximately 35 % in road and waterborne transport.
New freight transport concepts • Increased energy efficiency of freight transport (aerodynamics and other structural means, ICT) • New urban, electric delivery concepts • Measures to reduce the number of empty loads • Increased energy efficiency of waterborne transport	• Emission norms and standards for heavy goods vehicles • Car wrecking fees of heavy duty vehicles • Speed limits (maximum speed for heavy duty vehicles: 80 km/h) • Energy efficiency agreements for road transport companies, information provision	• Most of the urban delivery by electric vehicles • Increased energy efficiency of vehicles.

New technologies and service concepts • Measures related to introduction of information and communications technology services and solutions (ITS) • Measures related to vehicle and engine technology development	• New models in development and deployment of new technologies (e.g. public-private partnerships, models for procurement) • ITS measures to influence driving habits.	• Increased share of new vehicles, services and biofuels.
Investments on road infrastructure • Significant investments in road infrastructure (high service level main network and lower level network supporting land use settlements) • Dynamic development and maintenance of the existing infrastructure	• Speed limits for the main road network.	

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