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A Model for Climate Target–Oriented Planning and Monitoring of Corporate Travel

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ABSTRACT
The objectives of this study are to (a) demonstrate the importance and motivation for large private companies taking action against climate change and (b) develop a backcasting-oriented framework for comprehensive and manageable corporate travel policies. The backcasting framework consists of four parts: (1) target description at a conceptual level; (2) mapping of the current status of the company regarding staff travel patterns and preferences, individual and collective emissions, and costs against the targets described; (3) a policy-oriented transformation of the backcasting target; and (4) alternative sets of company policies and strategies that would allow targets to be achieved. A detailed cost-benefit analysis is supplemented by statistical and econometric models that test employee acceptance of the different policy alternatives.
Key Words: backcasting, climate change, emission target, mobility management, policy assessment, sustainable travel

1. INTRODUCTION

The human population is projected to level out somewhere around 8–10 billion during the middle of this century (United Nations, 2004). Assuming that the economic growth and transport requirements of China, India, and other developing countries will continue to increase, trajectories of the number of private vehicles in the world have been estimated to culminate at around 4 billion in the future, an 800% increase from the approximately 500 million cars today (Kågeson, 2005). This projection is linked to many uncertainties and needs to be placed in the context of today's inequitable distribution and depletion of global natural resources, as well as the social and geopolitical reasons for taking action against such changes.

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In essence, the future transport system faces a complex situation with many uncertain factors:

Peak oil: The global depletion of fossil fuels in combination with the rapid economic growth in the developing world implies that the world is now facing a peak oil era with stricter requirements on technological efficiency and economic use of energy in all sectors of society (Aleklett, 2006; Robèrt et al., 2007).

Climate change: Road traffic accounts for almost 30% of total greenhouse gas emissions in Sweden (Ministry of Sustainable Development, 2005). In 2005, the private vehicle fleet in Sweden was by far the most energy-intensive in the EU15, responsible for 21% higher emissions per vehicle kilometer than the EU15 average (European Commission, 2005).

Resource constraints: Constraints on other natural resources apart from fossil fuel (e.g., metals), and encroachment of road infrastructure on ecosystems (Ny et al., 2006; Robèrt et al., 2007).

Health-related aspects: Local problems from increased traffic loads causing congestion and undesired increases in travel times, stress, respiratory diseases, cancer, and accidents (Department of Health, 2004; WHO, 2006).

The peak oil and climate change factors will drive the price balance between fossil and renewable types of energy to a gradual transition toward renewable energy sources (e.g., biomass, wind, hydro, and solar power). These energy sources will all play an important role in the production of renewable fuels such as ethanol, methanol, biogas, and hydrogen (Nonhebel, 2005; Schäfer et al., 2006; Worldwatch Institute, 2006). However, in order for these energy sources to satisfy future transport demand and in order to avoid the other problems listed above while not restricting personal mobility, energy-efficient vehicles and mobility management services will gain increasing importance in the future as regards all four factors listed (Robèrt and Jonsson, 2006; Poudenx and Merida, 2007; Robèrt et al., 2007).

Commuting to work and business travel are the most dominant trip generators in Sweden (National Travel Survey, 2001). Consequently, efforts in this energy sector are likely to be of high priority to market-oriented traffic and energy planners in the future. In comparison with total energy use in companies with a large workforce, employee travel is often the most energy- and emission-intensive activity (Robèrt, 2000). One of the reasons why Sweden lags behind in the energy-efficiency standard of private cars is that companies often offer employees fringe benefits or tax preferential deals on car purchases (Kågeson, 2004). Consequently, finding alternatives to this type of incentive through company travel plans is believed to be crucial for the development of more energy-efficient and cost-effective travel in the future (Rye and MacLeod, 1998; Coleman, 2000; Robèrt, 2003; Robèrt, 2005).

Because employee travel (especially during peak hours) represents a large proportion of the transport requirement, some companies have taken their own initiatives by launching various commuting programs and company travel plans (Newson, 2000; Litman, 2007). Providing employees with commuting alternatives to the car is a way to widen individual choice and flexibility without abolishing those more essential car trips that should remain. Studies carried out at the Victoria Transport Policy Institute in Canada (VTPI, 2007) show that companies with corporate travel plans typically reduce private vehicle travel by at least

15%, to 20%through, for example, economic reforms such as parking cashbacks (employees may choose free parking or the equivalent in money), transit benefits, or introduction of alternative transport modes or means of virtual communication (Department of Transport, 2002; Litman, 2007).

1.1. Why Company Travel Plans?

A vast challenge to future traffic planners and decision makers is to include company travel plans as a market-oriented traffic planning strategy as these may involve substantial external benefits and socioeconomic savings to society in terms of reduced traffic volumes, pollution, congestion, noise, and accidents. An empirical example of a transport modeling scenario in Stockholm County 2030 demonstrates that reducing private vehicle commuter and business trips by 10% would correspond with annual socioeconomic savings of more than 80 million Euro (Robèrt and Jonsson, 2006).

It is therefore crucial to identify potential incentives to companies considering taking such initiatives. Based on information provided by company managers involved in the Stockholm Mobility project and on current data regarding travel plans, the main motives for corporate travel plans targeting reduced emissions and incorporating *all* travel activities (i.e., not only business travel) would be the following:

Reduce travel costs for employer and employee: Travel costs and emissions go hand in hand. This is evident from Figure 1, which shows employee travel costs and emissions in one of the companies included in this study (Swedbank). Reducing employee commuting by car is of economic interest to companies for two main reasons: (a) to cut the costs of expensive parking facilities (Cairns et al., 2004), and (b) to reduce travel allowances (including laborious processing of receipts)

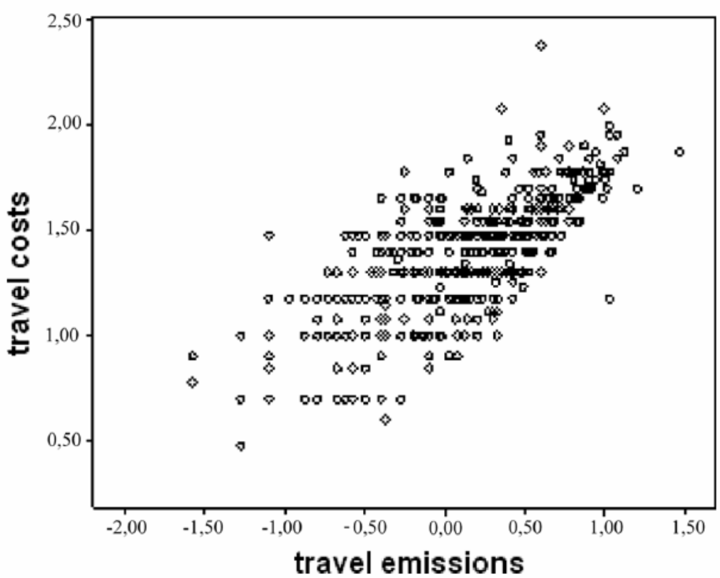

Figure 1. Emissions and costs from employees' daily commute trips by car to one of the companies analyzed in this study. The correlation is significant at an 0.001 significance level.

for local business trips (Jonsson, 2007), as we discovered that employees traveling by car to work more often use this mode even for business trips. Thus, employees choosing modes other than private cars for commuting might be more flexible toward less expensive alternatives such as car-sharing and public transport for business trips (Huwer, 2004).

Improve PR: Demonstrating environmental responsibility is likely to become increasingly important in the future in light of increased public awareness and with a Swedish target of 20% to 30% reduction in greenhouse gas emissions by 2020 (BLICC, 2007). Companies deciding to formulate policies targeting all travel activities in the company (including commutes to work) might automatically challenge competitors to raise the standard for company emission audits. Some companies have reason to show best practice on how to apply and utilize energy- and cost-effective products or services. One example would be companies in the IT sector showing good examples of how to implement virtual means of communication into corporate travel policy (Lundéno, D personal communication). Other examples in the transport sector could be companies marketing, for example, energy- and cost-effective vehicles.

Plan ahead: Problems such as climate change, scarce energy and other resources, and increased urban congestion will probably continue to affect personal travel substantially in the future beyond peak oil (Cleary and McClintock, 2000; Aleklett, 2006; WHO, 2006; Robèrt et al., 2007). Hence, companies providing employees with cost-effective alternatives to car travel will facilitate the transition to the post-oil era where constraints other than fossil fuels and climate change will influence costs and policies.

Increase health and work efficiency: Improving commuting to work is a means to improve working conditions. Corporate travel plans might also have a positive effect on employee health, which might repay the employer in terms of increased work efficiency and fewer days lost to illness (Department of Health, 2004; WHO, 2006). A medical appraisal of car versus public transport commuters in Sweden has shown that the latter group has relatively better absorption of oxygen and is less overweight due to the longer walking distances associated with public transport (Hemmingsson et al., 2005). However, in more highly congested cities than Stockholm, part of the exercise benefits from walking and bicycling might be negated by the traffic fumes inhaled during the journey. The challenge, both from an employer's perspective and from a traffic planner's perspective, is to ensure that the benefits to the individual are commensurate with the efforts and costs he or she incurs by changing travel behavior.

The paper is structured as follows: In Section 2, the outline of the backcasting framework is presented, incorporating derivation of the target description, mapping of present conditions at the company, and formulation of strategic company policies consistent with target achievement. Finally, a discussion and the conclusions are presented in Section 3.

2. THE POLICY ASSESSMENT FRAMEWORK

The policy assessment framework is based on empirical data collected from three large Swedish companies (about 7000 employees from Swedbank, TeliaSonera, and Länsförsäkringar). The project, called Stockholm Mobility, is a collaboration between the Swedish Environmental Protection Agency, the Stockholm Traffic administration, and the Royal Institute of Technology. The research assignment was to develop a target-oriented framework for comprehensive and manageable corporate travel policies.

In order to set targets for the future and to measure the progress and efficiency of various company policies in planning for target achievement, a framework is needed that addresses the questions:

- What target has been set for the future (as regards travel emissions, travel costs, and employee working conditions)?
- Where does the company stand today in relation to this target (as regards emission levels, travel costs, and employee travel patterns)?
- How should the target be formulated in order to be comprehensible and attainable through company travel policies?
- What target-oriented corporate policies should the company prioritize in order to move from the current situation to target fulfillment?

The concept of backcasting (Robinson, 1982) is a constructive way of integrating the three questions above into a target-oriented framework (Fig. 2). In the Stockholm Mobility project, companies started by defining the target at a conceptual level (X% reduction in CO_2 in line with travel cost reductions and employee acceptance). We then mapped the current travel situation at the companies with respect to all aspects affecting prospects for target achievement. By having these two situations defined, the challenge is to create tailored sets of corporate policies and strategies that would take the company from the current situation to target achievement.

The backcasting target developed in this study is in line with Robèrt (2000) and Ny et al. (2006), who advocate principle backcasting targets rather than predestined and relatively detailed images of scenarios of the future. In this framework, the principle target consists of a cost-effective relative percentage reduction in

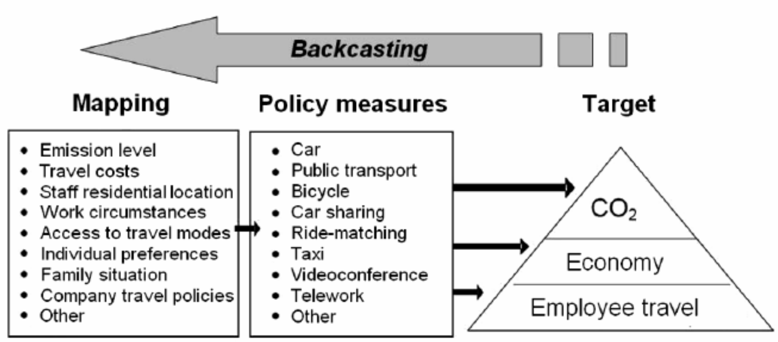

Figure 2. The three components in the backcasting framework. Observe the sequential order, where the target description (the pyramid) and the mapping procedure (left box) form the basis for the construction of efficient company travel policies (right box).

emissions in agreement with employee preferences (i.e., the target entails all three segments of the pyramid in Fig. 2).

2.1. Target

The uniform target in the Stockholm Mobility project is a 15% reduction in CO_2 emissions in 2 years. However, based on the emission reduction potential revealed in this study, some companies have considered taking their own initiatives and extending this target to longer time horizons. When company management formulates travel policies targeting reduced emissions, it is essential that the target description covers more than one dimension. The top section of the pyramid in Figure 2, representing CO_2 reductions, could be regarded as the tip of the iceberg, determined by relations to the lower segments. In order for a company to achieve reductions in emissions, there must be an economic rationale for each travel policy. Accordingly, the feasibility of achieving cost-effective reductions in emissions is strictly dependent on employee acceptance of alternative policies. Hence, in order to incorporate all three dimensions of the target description in Figure 2, policies should primarily be designed from a bottom-up perspective where employee travel behavior and choice of communication means define success as regards cost and emission reductions.

In order to make policy assessments targeting the base section of the pyramid in Figure 2, we developed a model that transforms the backcasting target of CO_2 reductions to potential numbers of employees that hypothetically adopt new travel or communication alternatives. We were then able to carry out detailed cost-benefit analyses of each policy set, supplemented by statistical and econometric models that test employee acceptance of alternative policy sets (see Section 2.3).

2.2. Mapping

Data from employee commute travel can be collected through a conventional travel survey, whereas data from business travel is mainly (and preferably) accessed through company records or through corporate environmental audits in order to keep the number of questions in the questionnaire to a minimum. We made two distinctly different mappings of the company's current status. Section 2.2.1 describes the company's total travel distances, travel costs, emissions from business travel and work commute. These figures provide the basis for the target descriptions at different time horizons. Section 2.2.2 describes employees' individual travel habits and preferences as dependent on family and work conditions, residential locations, company travel policies, and different socioeconomic variables. The mapping provided a basis for selecting the most efficient travel policies according to emission effects, cost assessments, and employee preferences.

2.2.1. Mapping Travel Emissions and Costs

In order to evaluate the *emissions* and *cost-effectiveness* of alternative policy measures, it is important to display the current status of these two parameters as accurately as possible. To allocate the emissions and cost effects accurately between different travel activities, we introduced an orthogonal emission-cost matrix. Figure 3 shows an example of the mapping procedure at one of the companies involved in the Stockholm Mobility project. The idea is to identify the travel

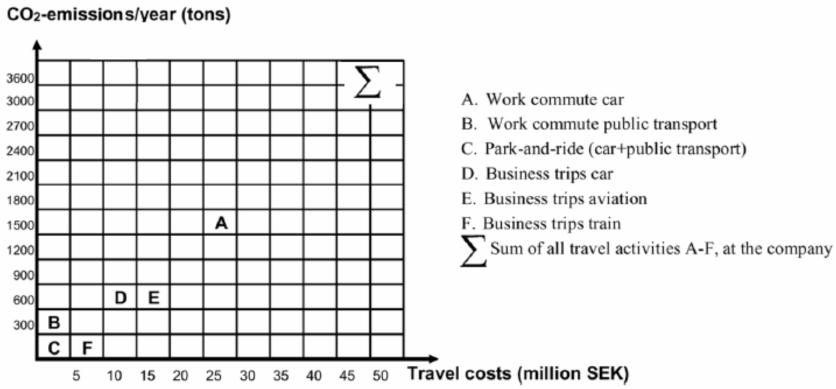

Figure 3. Mapping of travel-related costs and emissions from all different travel activities at a large company in Stockholm.

activities that are most cost- and emission-intensive. However, it is important to bear in mind the distinction between employees' and employer's expenses regarding commute and business travel. One point made in this study is that employer savings from more efficient business travel could help finance attractive commuter programs such as, for example, parking cashbacks, transit benefits, teleworking arrangements, or even more transport-oriented locations of worksites.

2.2.2. Mapping Individual Travel Behavior and Preferences

In order to determine the set of company policies that would be most acceptable to employees, and thus probably the most cost- and emissions-effective option from a company perspective, we used a selection of statistical tests and modeling techniques. To isolate the most decisive factors in the choice between different travel modes (for instance, $a =$ car travel, $b =$ public transport), we divided the employee travel data into the two user groups a and b in order to get *revealed preference data*. We also asked employees currently using travel mode a about the conditions in which they would be willing to change to travel mode b, in order to test, for example, which improvements to travel mode b would increase market share of this mode. This is called *stated preference data*. By applying econometric logit models (Ben-Akiva and Lerman, 1985), we were able to decide whether we could reject the hypothesis that one particular aspect affected the choice decision between a and b. The choice probability between a and b could then be derived on the basis of specific data collected in the travel survey, such as travel time, travel cost, residential location, or different convenience aspects or socioeconomic variables.

2.2.3. Benchmarking

One advantage of the mapping procedure described in Section 2.2.1 is that it is also appropriate for comparisons and benchmarking between different companies (Fig. 4). In the three companies in the Stockholm Mobility project, top managers have taken initiatives for joint interactive benchmarking-meetings in order to learn from best practice in the design of efficient travel policies. This systematic

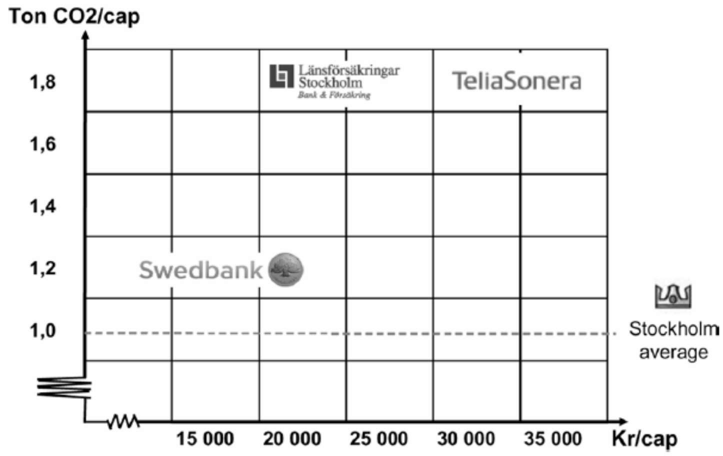

Figure 4. A benchmarking procedure revealing differences in emissions and costs between the three companies analyzed in the study.

ranking procedure can be updated from one year to the next in order to stimulate long-term comparisons over time.

Figure 4 shows a benchmarking procedure whereby results from Figure 2 are converted into per capita measures so that companies can compare travel emissions and costs in relation to company policy measures. The companies are relatively similar as regards the preconditions for travel planning. They are all relatively large service companies, with a distribution of offices across Sweden. The threshold Stockholm average is based on a macroscopic study of the transport system of Stockholm County and is used as a reference level (Robèrt and Jonsson, 2006).

2.3. Transformation of the Backcasting Target

For obvious reasons, targets for emission reductions at the corporate level are often expressed as relative percentage reductions (the top section of the pyramid in Fig. 2). In the company's emission report, this may be appropriate. However, in order to construct efficient travel policies based on strategic thinking, we need feasible backcasting paths between the current situation and the desired target, (i.e., there is reason to develop a more tangible target formulation from which to backcast). This should address the base section of the pyramid in Figure 2 (employee travel). Thus, in order to display the links between the top section and the base section of Figure 2, we need to transform the relative CO_2 reduction into actual numbers of employees choosing more energy-efficient travel alternatives.

Assuming constant travel distances, when an employee i switches from travel mode 1 to travel mode 2 for travel type j (e.g., private car to public transport, or petroleum-fueled to biofueled car, business trips, or work commute), the average relative reduction in emissions for a company of N_1^j employees using travel mode 1 for travel type j could be expressed as:

$$\sigma^j = \frac{\sum_i s^j_{i1}(u^j_{i1} - u^j_{i2})}{N^j_1 \sum_i \sum_j \sum_m u^j_{im} s^j_{im}} \qquad i = 1, \ldots N^j_1 \tag{1}$$

where $i =$ individual in the company, $j =$ travel type (business trip or work commute), $u^j_{i1} =$ emission per kilometer with current travel mode $m = 1$ for travel type j by individual i, $u^j_{i2} =$ emission per kilometer with alternative travel mode, $m = 2$ for travel type j by individual i, $m =$ travel or communication means among M alternatives (e.g., car, aviation, video conference), $s^j_{i1} =$ annual distance traveled by individual i with current transport mode, $m = 1$ for travel type j, and $N^j_1 =$ total number of employees with travel type j, using current transport mode $m = 1$.

Consequently, the expression for X commuters switching from travel mode 1 to travel mode 2, reducing emissions by a fraction Y at the company, is given by:

$$Y = X^j_{1,2}\sigma^j. \tag{2}$$

In our backcasting framework, the relative reduction Y is used as a fixed target variable, that is, a predefined percentage reduction for the company (the most extreme case would be to set this variable to 1 (100%), which would correspond with a long-term target of zero net contribution to the greenhouse effect). Thus, the formula applied for deriving the number of commuters (X) corresponding with the backcasting target is derived through rearrangement of Eq. (2):

$$X^j_{1,2} = \frac{\widehat{Y}_t}{\sigma^j}, \tag{3}$$

where $X^j_{1,2} =$ average number of commuters with travel type j, using travel mode $m = 1$, switching to alternative travel mode $m = 2$, in order for the company to achieve backcasting target $\widehat{Y}_t$ at time t (i.e., the year the backcasting target is set).

The number of employees ($X^j_{1,2}$) derived above is appropriate as an efficiency index for alternative ways of reducing emissions from employees' daily commutes (i.e., for assessing the efficiency of different mobility options). However, because the number of *business trips* often varies from time to time during the year and between different employees, it might be more appropriate to target the number of business trips rather than the number of business travelers for this travel type. Furthermore, from a company policy perspective, it is more tangible to speak in terms of substituting, for example, every fourth business trip with a video conference. Thus, in the case of business trips, we use the formula above but where N^j_1 in Eq. (3) is substituted by $N^j_1 =$ (total number of business trips with travel mode 1 for business trip type j).

Tables 1 and 2 display model predictions of the average number of car commuters and proportion of business trips by car and aviation at the company TeliaSonera that would have to switch travel mode in order for the company to reduce CO_2 reductions by 5%, based on the efficiency index, $X^j_{1,2}$.

Table 1. Options for achieving a 5% reduction in emissions at the company by encouraging car commuters to use more emission- and cost-effective options.

Substitution from car to alternative communition modes*	Number of car commuters necessary for-5% CO_2 reductions
Public transport	73
Policies targeting long-distance commuters (e. g., train)	28
Renewable fuel car (ethanol)	89
Eco-driving	445
Approximate zero emission alternatives (telecommuting, cycling, ride-matching)	64

*Currently 591 car commuters at the company.

2.4. Company Policies Providing Backcasting Paths

Once the mapping procedure (Section 2.2) and the transformation of the backcasting target have been carried out (Section 2.3), the company can formulate policies that bridge the gap between these two states in the backcasting framework illustrated in Figure 2.

2.4.1. Creating Strategy Sets Based on the Efficiency Index

By assessing (*a*) the cost benefits and (*b*) the employee acceptance of each 5% reduction in emissions given by $X_{1,2}^{j}$ in Tables 1 and 2, it is possible to derive efficient travel plans (i.e., combinations of policy sets) targeting emission reductions at the company. Utilizing the efficiency index as a tool to create efficient company travel policies might bring about several benefits in the planning process.

Table 2. Options achieving a 5% reduction in emissions at the company through reduced business travel by car and aviation.

Substitution to alternative communition modes	Proportion business trips by car replaced	Proportion business air travel replaced
Public transport	38%	—
Renewable fuel car (ethanol)	47%	—
Eco-driving	100%†	—
Approximate zero emission alternatives (virtual communication, ride-matching, train*)	34%	25%

*Travel by train corresponds to less than 0.001 kg CO_2/km.
†Only 2% CO_2 reductions achievable from eco-driving on business trips (potential total 7%).

We would like to emphasize some practical benefits discovered in the application of this framework:

Making comparisons and efficiency rankings: Different alternative policies target fundamentally different travel activities in the company (e.g., work commute trips by car versus long-distance business trips by aviation). Based on Tables 1 and 2 where all options are equal from an emissions perspective, different explicit analyses could be used to evaluate the economic payback in short or long time frames to the employees (commute trips) and to the company (business trips). Consequently, deliberate compounds of strategy sets might be selected so that policies with short-term payoffs can finance long-term payoffs. One example of this would be to implement car-sharing, leading to about 30% to 50% cost reductions in Stockholm city (Hort, 2007). This economic payoff could help finance, for example, the added cost of renewable fuel vehicles in the car-sharing vehicles, eco-driving courses, or subsidies for work commutes (e.g., public transport tickets).

Reducing the potential "fuzziness" regarding potential impacts on emissions: The efficiency index is a quantitative measure based on data from employee travel behavior, consistent with the backcasting target. A strict empirical framework is particularly required in a situation where the emission impact from "soft" aspects, such as behavioral changes, is being assessed. In order to assess the economics in each policy alternative, econometric modeling and statistical analyses serve a meaningful purpose for guidance in the ranking procedure between different policy options (see Section 2.2.2).

Improving transparency and communication: Efficiency assessments and strategy plans involve many stakeholders serving different roles in the process toward target achievement (e.g., local transport providers, the municipality, company leadership, finance managers, staff managers and environmental managers at the company). If all actors share a common vision of target achievement, but from different viewpoints (emission reductions, cost savings, health aspects, increased use rates of mobility management services), this might reduce the risks of conflict and noncompliance.

Facilitating analysis of each specific variable affecting target achievement: This is particularly useful in a situation where the company wishes to set long-term targets where the variables $u_{i1}^{j}, u_{i2}^{j}, s_{i1}^{j}, N_{1}^{j}, \widehat{Y}_{t}$ are likely to change over time (number of employees might change, new emission standards in future vehicles, stricter emission regulations, etc.). Keeping track of all factors affecting target achievement is important in order to avoid making inaccurate policy assessments.

Applying backcasting is a suitable approach when devising strategic paths to the desired targets for different time horizons. Intermediate subgoals could work as checkpoints, or feasible platforms in the planning process toward more far-reaching reductions in future emissions. The long-term target could then incorporate assumptions regarding external factors such as future fuel prices, changed public transport facilities, changed parking facilities, local travel demand measures (e.g., traffic tolls), or the future business climate for the company. These factors are sometimes beyond the scope of corporate policy but should not hinder the prospects for target achievement if borne in mind during the planning process. Figure 5 shows the long-term planning process toward climate neutrality at a conceptual level. The vertical axis measures the emission reduction planned for

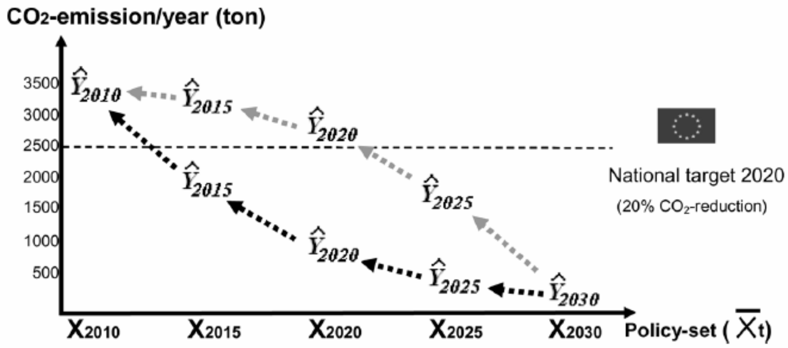

Figure 5. Two alternative backcasting paths (black and gray curves) where the company sets target for climate neutrality by the year 2030. In order to reach target fulfillment, each strategy set $\overline{X}_t$ should provide favorable prerequisites for $\overline{X}_{t+5}$. The black curve incorporates a subgoal of -20% CO_2 for the year 2020, consistent with the national target for greenhouse gases.

each 5-year interval, determined by $\widehat{Y}_t$. The horizontal axis represents the vector $\overline{X}_t$, including the most efficient strategy set at the company for each year t. The strategy set $\overline{X}_t$ should be designed in order to work as a deliberate starting point for the strategy set $\overline{X}_{t+5}$ at the next 5-year interval. The black and gray curves represent two alternative backcasting paths to zero emissions in 2030.

2.4.2. Policy Packages Based on Employee Preferences and Cost-Benefit Assessments

Econometric modeling and cost-benefit analyses of individual preferences have proved to be an effective tool for assessing prospects and requirements for future market shares of mobility management services (Robèrt, 2003; Robèrt and Börjeson, 2006). The statistical analysis presented in Section 2.2.2 could provide the company with a basis for creating efficient travel policies consistent with employee preferences. In particular, the company could:

- Create policies that are robust as regards employee acceptance (i.e., policies that have a favorable market potential) in order to avoid suboptimizations. Expensive investments on emission reductions will not produce returns in a situation of limited user acceptance. Consequently, this would hinder the economic feasibility of long-term target achievement.
- Design target-oriented company policies for groups of employees with significantly higher emissions and travel distances (e.g., distant residential locations, frequent air travelers, employees with access to company car benefits, etc.).
- Open a market-oriented dialogue with actors regarding employee criteria for choosing more resource-efficient alternatives. A few examples of such actions would be:

Provision of workplace shower/changing-room facilities for cyclists, better video conference facilities, flexible office solutions.

Table 3. Policy package designed to meet a company target of a 40% reduction in CO_2 emissions in accordance with employee preference and cost reductions.

Policy business trips	Substitution rate to alternative	CO_2 reduction	Potential cost reduction (million SEK)
Car to public transport	19%	2.5%	1.0
Car to car-sharing (biofueled)	24%	2.5%	0.6
Car to video-conference	34%	5.0%	5.7
Aviation to videoconference	33%	5.0%	3.5
Work commute trips	**Number of car commuters switching mode***		
Private car to public transport	87	5.0%	—
Private car to telework	76‡	5.0%	—
Long-distance commute to railway	35	5.0%	—
Petrol car to biofueled car	212	10.0%	—
Total		40%	10.8

*Currently 591 car commuters in the company.
‡Corresponds to two teleworking days per employee and month at the company.

Lobbying public transport providers and local governments to provide public transport connections, cycle paths, safe and well-lit footpaths.
Collaborations with transport providers such as the Swedish State Railways to offer company discounts or with car manufacturers to offer company car fleets and employees with bulk discounts on renewable fuel vehicles.

These aspects also make the model feasible for public policymakers, as the feasibility of individual actors and companies complying with planned policies can be assessed and experienced in this way. In the Stockholm Mobility project, local public transport providers (SL), Swedish State Railways (SJ), Stockholm municipality, Swedish Road Administration, car-share organizations, and so forth, played an active part in the dialogue concerning how to meet employee requirements.

Table 3 presents an example of a policy package designed for one of the companies in the Stockholm Mobility project, aiming at a long-term target of 40% reduction in CO_2 emissions by 2020. The policy package is selected with respect to modeling results from employee preferences and travel behavior. The potential economic cost reduction is calculated for each business trip component of the policy package (Jonsson, 2007). These savings could help finance work commute reforms (e.g., parking cashbacks, transit benefits, etc.) in order to obtain synergy effects between work commute and business trips.

3. DISCUSSION AND CONCLUSIONS

We developed a backcasting model for target-oriented planning and monitoring of more environmentally acceptable corporate travel policies. Empirical data from employees and interactive communication with companies involved in the Stockholm Mobility project formed the structure and content of this framework.

The framework is intended to be generally applicable to all types of companies and organizations wishing to develop cost-effective travel policies to counteract emissions of greenhouse gases. Nevertheless, it is important to note that the empirical findings presented (e.g., the policy package displayed in Table 3) are designed for a particular company located in Stockholm. The feasibility of introducing corporate travel policies and employees' willingness to accept them are of course strictly dependent on local factors concerning the particular company and the country in which it is located.

In this study, employee acceptance was treated as a cornerstone for obtaining changes in travel behavior in the company (the base segment in the target pyramid in Fig. 2), and large efforts were devoted to analyzing the impact of incentives for more resource-efficient travel modes. However, in a situation of more top-down travel management than is generally the case in Sweden, employee acceptance might be less crucial for target achievement, and the mapping of individual preferences (Section 2.2.2) may be less exhaustive.

Furthermore, in the creation of travel policies, it is important to incorporate internal corporate and site-specific factors such as travel time comparisons between different travel (and communication) alternatives, maintenance costs and purchase costs of, for example, videoconferencing facilities, the cost of providing employee teleworking facilities, economic returns from reduced number of days lost to illness, economic estimates of the increased corporate PR benefits from climate change initiatives, costs for specific commuting programs, and potential rebound effects (Litman, 2003). All these factors affect the final judgment of company management regarding each specific policy decision. It is difficult, if not impossible, to generalize and express these factors in monetary terms when comparing one company with another, in particular if considering different lines of businesses, or companies located in different geographic areas or different nations. Furthermore, including one such variable into the model directly raises the question of whether another omitted factor could be at least as important.

Because final emissions and cost effects from corporate travel policies will only become evident after a few years of implementation, we cannot yet evaluate the progress of the companies investigated toward target fulfillment. However, from experiences so far, we have found that the framework provides companies with an applicable basis for creating efficient travel policies to achieve cost-effective emissions targets and for identifying investment paths toward long-term targets of carbon neutrality. In order to incorporate the key components of climate change strategies, it is crucial that companies base travel policies on a "bottom-up" approach, targeting all three segments of the pyramid (illustrated in the target description of Fig. 2). Collecting concrete data such as travel distances, travel costs, and emissions from all different travel activities on the one hand and employee travel behavior steered toward more efficient alternatives on the other provides a solid foundation for target description and selection of efficient travel policies. Commuting is a travel activity often regarded as beyond the employer's concern (Rye, 2002). We argue that it is both advisable and feasible to integrate this travel activity, at least indirectly, within the scope of company policies because it (a) may affect the choice of commuting modes for business trips (i.e., car commuters tend to use the same travel mode even for business errands during the day) and (b) may bring about cost savings for the employee, the employer, and society at large.

Adaptation to future conditions regarding stricter emission restrictions and increased fuel prices beyond peak oil is a process that should be flexible over the course of time. Hence, monitoring the relevant components in target description (Section 2.3) and the various external factors affecting prospects for target achievement is essential in order to identify clear priorities. Furthermore, long-term targets should preferably be supplemented by a chain of intermediate targets where immediate benefits (primarily short-term payoffs) are provided at an early stage to fuel the process and maintain the level of motivation regarding future targets (illustrated in Fig. 5). Finally, assessments of short-term trade-offs (e.g., cost vs. emission reductions) should place initial investment costs in the context of long-term goals and smart investment paths, rather than as a financial burden (Ny et al., 2006).

The efficiency index $X_{1,2}^{j}$ in Eq. (3) is a statistical measure based on average travel distances within the company (in order to avoid breaching employee confidentiality). Consequently, the efficiency index does not give the exact number of employees corresponding with the predetermined emission target. It has merely been devised as a basis for policy formulations.

The benchmarking procedure is an example of how to involve many companies in a common arena. Our experiences from the three companies involved in this study indicate a willingness to join the benchmarking "club" and to compare results, as illustrated in Figure 4. The Stockholm Mobility project intends to invite more companies to take part and is hoping for a snowball effect where it will become common practice to incorporate all types of travel activities (not only business travel) in emissions audits and disclosures. Finally, we believe that the framework developed in this study might be an applicable tool for policymakers in the public sector (e.g., to determine consequences and feasibilities of alternative strategies or to find ways of incorporating company travel activities in emissions trading programs). So far, even though the transport sector is the single largest emissions sector in Sweden, it is still beyond the reach of emissions trading programs (STEM, 2005).

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