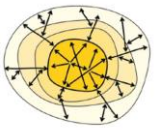

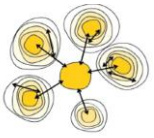

Backcasting and Sustainable transport scenarios for 2050

Contents

- Different kinds of future studies/scenarios
- Backcasting
- Example of backcasting study: Scenarios for the Swedish energy- and transport system until 2050

  - Step 1: Problem and target setting

  - Step 2: Trend analysis and Technology scenario

  - Step 3: Images of Swedish energy- and transport systems in 2050 that reach the targets

  - Step 4: Policies leading towards the images

Different kinds of future studies/scenarios

Three questions – Three kinds of scenarios

What *will* happen? ➔ Predictive

What *can* happen ➔ Explorative (external)

How can a specific *target be met*? ➔ Target oriented (Backcasting)

Predictive scenarios/forecasts

Often a more or less simplified model of the real world is used. With this model predictions about the future can be made.

Area of use:

Often effective in the natural sciences where laws of nature are modelled.

Usefulness in social sciences varies a lot. Difficult to handle longer time perspectives and trend breaks.

Aim: To give an actor the possibility to (slightly) adjust his strategy in the short term.

Examples: ?

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Aim: To give an actor the possibility to (slightly) adjust his strategy in the short term.

Examples: Weather forecaststst, demography, traffic forecasts (short term)

Explorative (external) scenarios

Aim and area of use:

Appropriate when an actor want to find strategies that can handle different developments in the surrounding world

The actor in question is not assumed to be able to affect what external scenario that will materialize.

Target group:

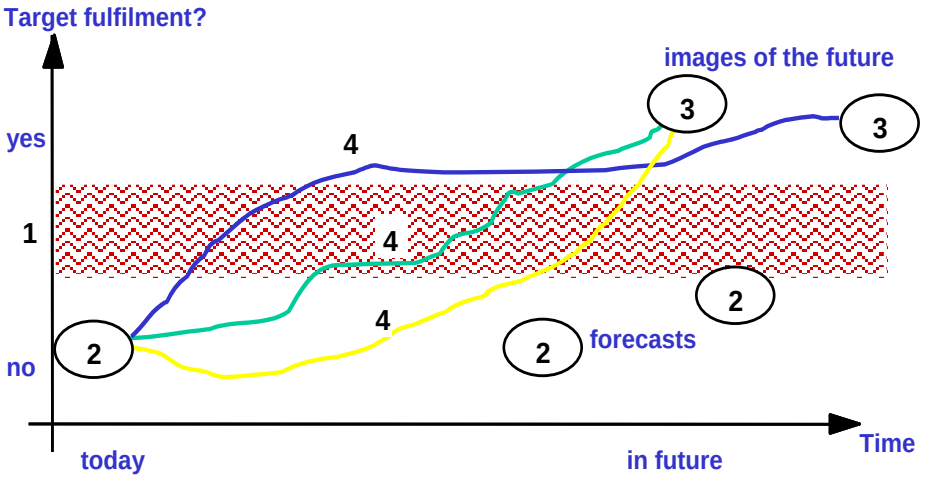
Often a well defined actor.

Examples:

Long term development of:

- The global economy (which a single actor cannot steer)
- Social values
- Technology development

Backcasting



1: Identification of problem, system delimitation and target setting.

2: Analysis of whether target could be reached by marginal changes to present trends

3: Outlining of images of future transport systems achieving the targets (typically for 2050)

4: Conclusions for current policy making and tentative paths towards the images

Backcasting

In what situations is it suitable?

- When a solution to a major societal problem is searched for and more than marginal changes to present trends seem to be needed.

Aim:

- To widen perceptions about possible futures.
- To guide present strategic decisions regarding (especially) long-lived structures (e.g. buildings, roads, railroads, airports etc)

Time perspective:

Long-term, since it focus on large changes to society that often takes time. Typically 40-50 years.

Target group:

- Often different groups in society. In particular politicians, other decision makers, researchers and interested parts of the public.

Different kinds of future studies/scenarios

Three questions – Three kinds of scenarios

What *will* happen? ➔ Predictive

What *can* happen ➔ Explorative (external)

How can a specific *target be met*? ➔ Target oriented (Backcasting)

An example of a backcasting study: **Sustainable Swedish energy- and transport systems 2050**

Possible to generalize to a global population of 9.5 billion people!

Scope: *All energy use in Sweden; Transport, Buildings and Industry. And all energy supply.*

http://www.naturvardsverket.se/Documents/bokhandeln/620-5754-1.htm

A backcasing study concerning transport often takes an overall perspective on:

- Urban planning
- Travel patterns of citizens
- Trade patterns
- Technology
- Fuels
- etc

Step 1: Problem definition, target setting and system delimitation

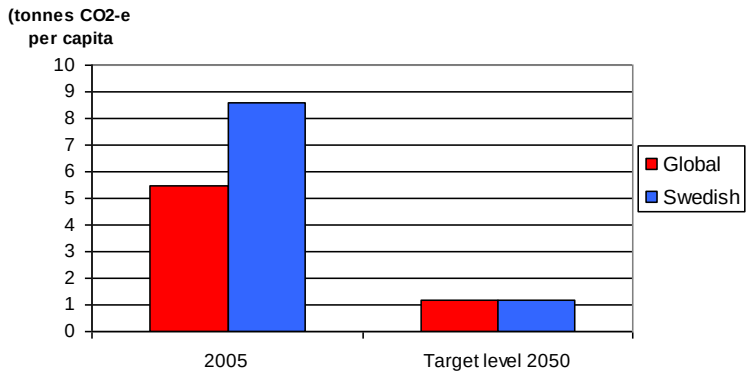
Main problem to solve: Impact of climate change

Target setting

- **Primary target:** Global warming should be limited to maximum **2 degrees** above preindustrial level.
- To analyse what emission levels that are consistent with this, we used several scientific documents, IPCC(2007), Stern (2006), EEA (2005) etc
- At least **70% reduction** of GHG emissions globally seem to be needed to have a fair chance of reaching the **"2 degree target".**
- Simplifying assumption: **Equal energy use per capita** all over the world in 2050.
- All this means that the transport and consumption volumes assumed for Swedes in the images **could be generalized to all parts of the earth.**
- Global population increasing from 6,5 billion to 9 billion in 2050.

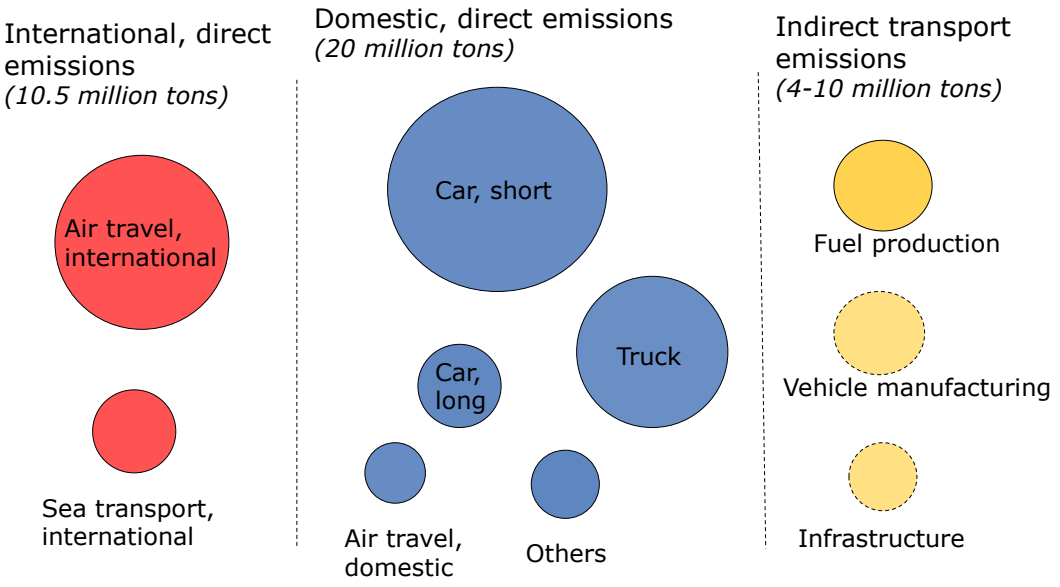
Target levels for emissions 2050 in order to keep global warming below two degrees

(-80% per capita globally, -87% for Swedes)



Sources: Stern, Nicholas (2006), STERN REVIEW: The Economics of Climate Change; EEA (2005), Climate change and a European low-carbon system.

Greenhouse gas emissions from different sub- systems of "Swedish" transport in 2005 (CO_2-equivalents)

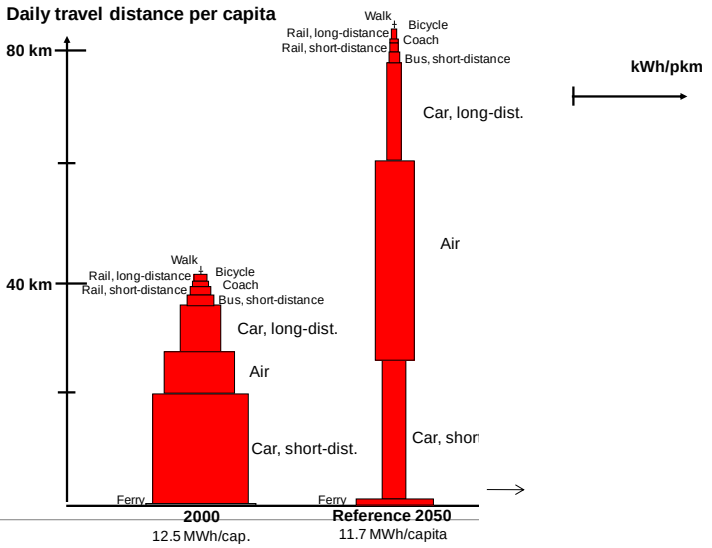


Step 2: Analysis of "moderate" adjustments of present trends

How far can improved technology and increased supply of carbon neutral energy take us?

"Technology scenario" for 2050

Transport image for 2050 with much improved vehicle technology and low carbon fuels but no demand management,



Is it possible to stop growth of car and air travel and truck transport?

Is it possible to stop growth car and air travel and truck transport?

Often increasing transport volumes is seen as an indicator of progress in society.

But, transport is a derived demand.

What is important is to get **access to different functions**. Which could be achieved by:

- Information and Communication Technology
- City planning for short distances.
- Efficient delivery services
- Less cross trade

Step 3: Outlining of images that will meet the target

Here: Five images for the Swedish energy and transport system in 2050.

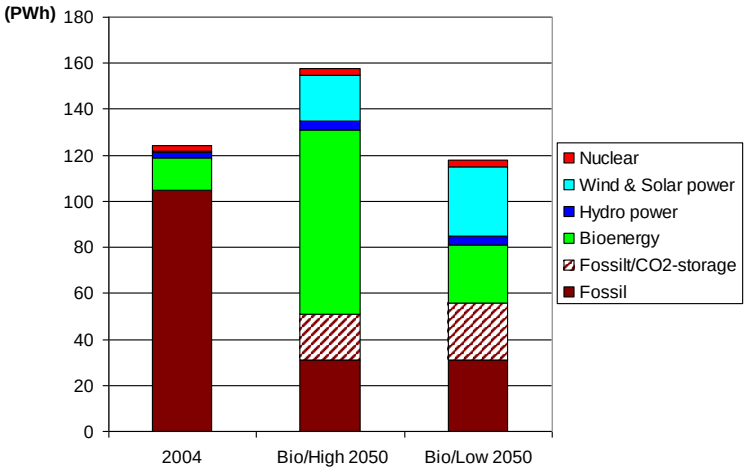
The images should:

- **Reach the targets**: Greenhouse gas emissions are reduced from 8,5 tonnes to **1,15 tonnes until 2050**
- Illustrate strategic decision points regarding long-lived structures (e.g. buildings, roads, railroads) so as to **avoid ”dead-ends”.**
- Illustrate the rather profound changes of the images compared to the present
- Include as attractive features as possible (different actors/persons have different opinions on what is attractive!)
- So, if possible more than one image should be designed

Five scenarios for the Swedish energy and transport system where greenhouse gas emissions are reduced from 8,5 tonnes to **1,15 tonnes** until 2050

- Same emission target per capita for Sweden as for the entire globe in 2050!

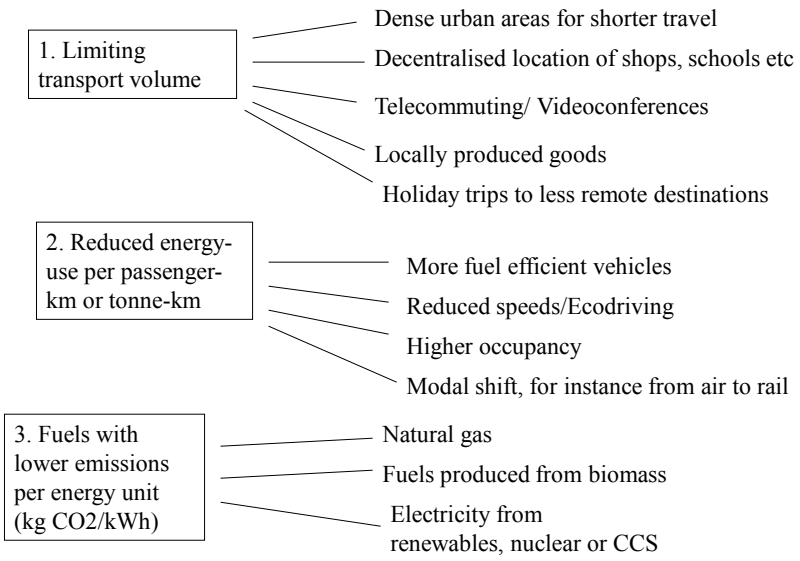
Two alternatives for global energy supply in 2050



Main characteristics of the images of the future in 2050 (part of the scenrios)

Behaviour / Energy supply	Material consumption and a fast pace	Service consumption and a fast pace	Increased leisure time and lower consumption
High global supply of bioenergy (80 PWh)	Scenario 2	Scenario 4	Not treated. Easiest to reach targets here.
Low global supply of bioenergy (25 PWh)	Scenario 1	Scenario 3	Scenario 5

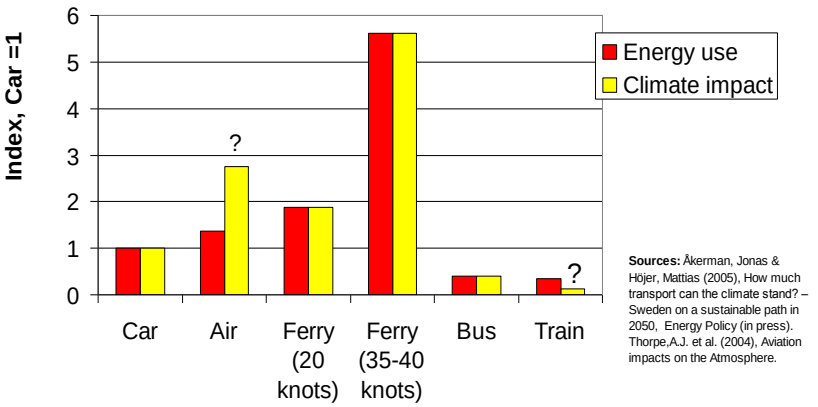
Some ”building blocks” for reducing greenhouse gas emissions in the transport sector



Three main transport segments

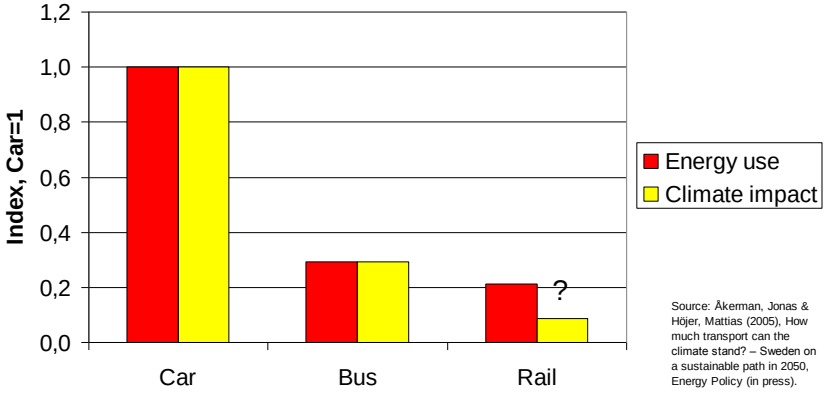
1. Long-distance travel (mainly air travel)
2. Short-distance travel (mainly urban travel)
3. Freight transport

Energy use and climate impact for Swedish long distance travel (per passenger-km)



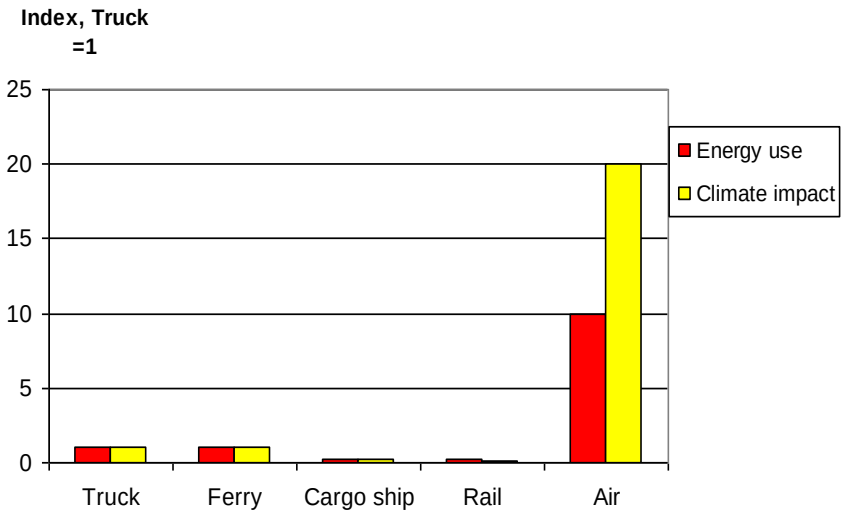
Sources: Åkerman, Jonas & Höjer, Mattias (2005), How much transport can the climate stand? – Sweden on a sustainable path in 2050, Energy Policy (in press). Thorpe,A.J. et al. (2004), Aviation impacts on the Atmosphere.

Energy use and climate impact for Swedish short distance travel (per passenger-km)

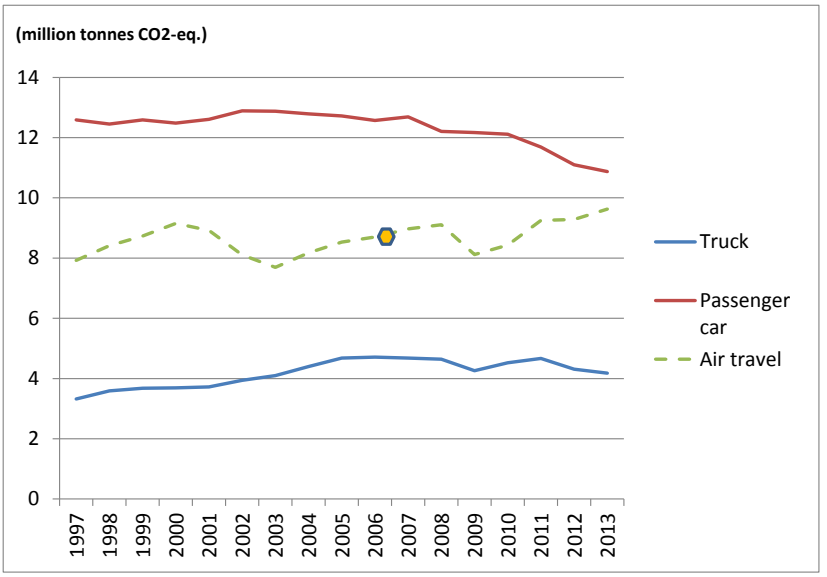


Source: Åkerman, Jonas & Höjer, Mattias (2005), How much transport can the climate stand? – Sweden on a sustainable path in 2050, Energy Policy (in press).

Energy use and climate impact for long distance freight transport (per tonne-km)



Emission trends for the three modes with highest impact on the climate

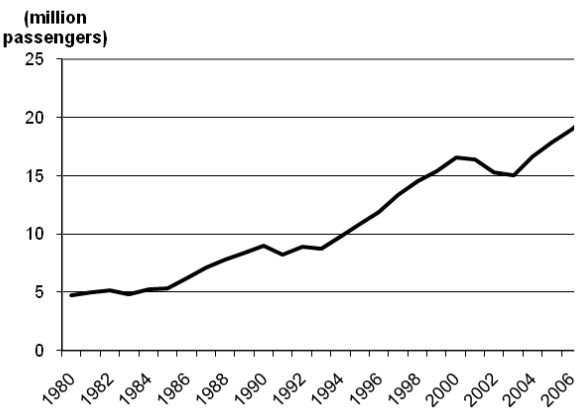


Källor: Lee, D.S. et al, 2010. Transport impacts on atmosphere and climate: aviation. Atmospheric Environment 44 (2010), 4678–4734; Åkerman, J., 2012. Climate impact of international travel by Swedish residents. Journal of Transport Geography 25 (2012) 87–93 ; Trafikverket, 2013. PM- Minskade utsläpp av växthusgaser från vägtrafiken; Trafikanalys, 2013. Civil aviation 2012. (http://trafa.se/PageDocuments/Luftfart_2012.pdf)

Aviation and climate change – a key challenge

- Emissions of NOx and H2O at high altitudes also contributes to climate change
- Greenhouse gas emissions from air travel by Swedes amounted to 8.7 million tons in 2006.
- This is 11% of all Swedish emissions (all sectors included)
- Swedes' air travel per capita is 6 times the global average.
- Air travel increases by about 5% per year while fuel consumption per passenger-km only decreases by 2% per year.

Passengers on international flights to and from Swedish airports



A scenario for climate friendly long-distance travel in 2050

- Much business travel by air has been replaced by virtual meetings (teleconferences) .
- Leisure travel by air is as high as it was 50 years ago, in 2000.
- Trains have increased market shares in Sweden and to central Europe.
- Direct overnight trains from Stockholm to Berlin, Brussels, Amsterdam etc.
- Generally less distant destinations for leisure travel.
- Car still popular for trips to ”summer houses” within Sweden, but often ”pool-cars” running on biogas or hydrogen are used.
- Slower more efficient aircraft.
- **Main drivers:** (1) In 2022 aviation’s exemption from CO_2-tax and value added tax was abolished. (2) Improved train services.

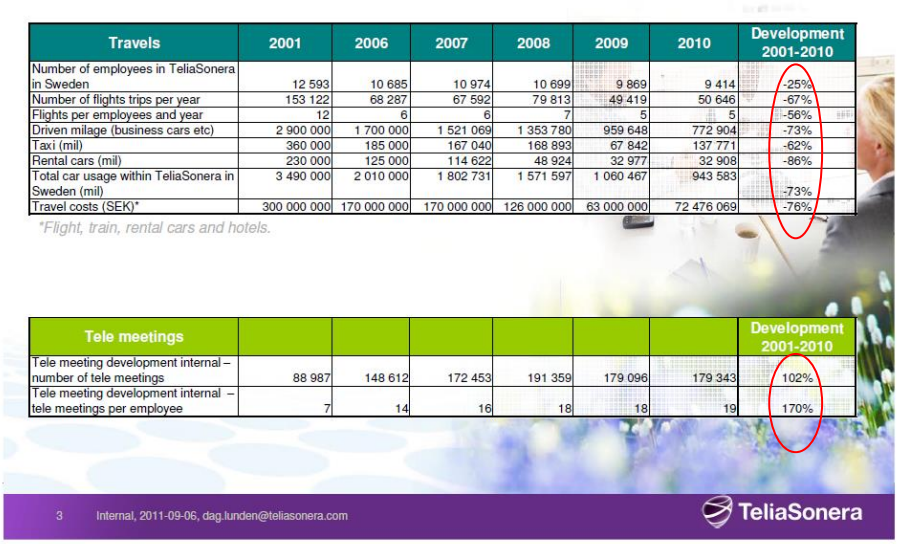
- Reduced travel costs by 230 million SEK /year
- Reduced business travel by 50-70%

Internal results (TeliaSonera in Sweden): 2001-2010

Travels	2001	2006	2007	2008	2009	2010	Development 2001-2010
Number of employees in TeliaSonera in Sweden	12 593	10 685	10 974	10 699	9 869	9 414	-25%
Number of flights trips per year	153 122	68 287	67 592	79 813	49 419	50 646	-67%
Flights per employees and year	12	6	6	7	5	5	-56%
Driven milage (business cars etc)	2 900 000	1 700 000	1 521 069	1 353 780	959 648	772 904	-73%
Taxi (mil)	360 000	185 000	167 040	168 893	67 842	137 771	-62%
Rental cars (mil)	230 000	125 000	114 622	48 924	32 977	32 908	-86%
Total car usage within TeliaSonera in Sweden (mil)	3 490 000	2 010 000	1 802 731	1 571 597	1 060 467	943 583	-73%
Travel costs (SEK)*	300 000 000	170 000 000	170 000 000	126 000 000	63 000 000	72 476 069	-76%

*Flight, train, rental cars and hotels.

Tele meetings							Development 2001-2010
Tele meeting development internal – number of tele meetings	88 987	148 612	172 453	191 359	179 096	179 343	102%
Tele meeting development internal – tele meetings per employee	7	14	16	18	18	19	170%



3 Internal, 2011-09-06, dag.lunden@teliasonera.com TeliaSonera

Examples of Climate friendly leisure trips

(To compare with a trip to Thailand: 2500 kg of CO2-eq.)

Car to summer house (1-150 kg)

Train from Sweden to Italy(160 kg)

Train to ski resort in northern Sweden(20 kg)

Is high speed rail in Sweden a good idea from a climate point of view?

Is high speed rail in Sweden a good idea from a climate point of view?

- No and Yes.
- The **best imaginable solution** is to stop growth of transport volumes.
- If that is considered unrealistic the **”second best” solution** might be to build new high speed rail which also increases freight rail capacity on old tracks.
- That would reduce emissions by about **0.55 million tons** per year. The disadvantage would be the high investment cost.

Climate friendly **Urban transport** in 2050

Many changes needed to achieve climate friendly urban transport/communication in 2050

A. Urban planning and Improved alternatives

B. Pricing measures etc

Adapting vehicle size after trip purpose – Small electric vehicles

Bike sharing

”Cycle Highways”

- Straight and wide cycle lanes where cyclists are given priority at intersections
- London and Copenhagen are working with Cycle Highways.
- Proposal for a ”Cycle Highway” between Lund and Malmö

Smart combinations of different transport modes - Travel chains

Examples:

Electric car to station➔ Commuter train ➔ Bike

Bike ➔ Bike on commuter train➔ Bike

Long-distance train ➔ Rental car or pool car

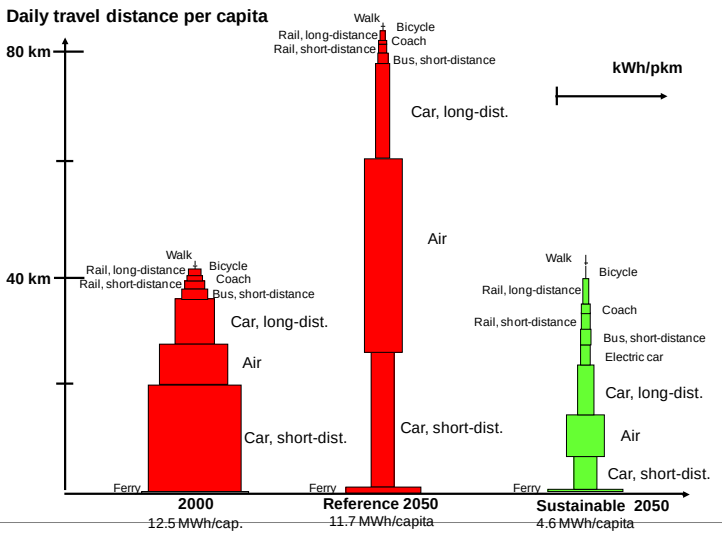
Car sharing

- **Mobility** in Switzerland is the world's biggest car pool with more than 90 000 users and 2 300 vehicles (Smartcards)
- Car pool members increase in many countries
- Being a car pool user can reduce yearly costs by 20 000 – 40 000 SEK.
- Car sharing contributes to lower emissions and reduced need for space for car parking.

Freight transport 2050

- More locally produced basic goods (food, fuels, building material etc)
- High-tech goods still produced in global production chains
- More than 50% of truck transport above 300 km has been shifted to rail and waterborne transport.
- Door delivery by efficient small trucks
- Ocean sea transport has decreased
- Sea, air and truck transport are now paying more for emissions and resource use

Transport image for 2050 reaching climate target (Åkerman & Höjer, 2005)



Climate solutions may also contribute to solving other problems

Oil is getting scarce, prices will increase

Welfare diseases increase (partly due to low physical activity)

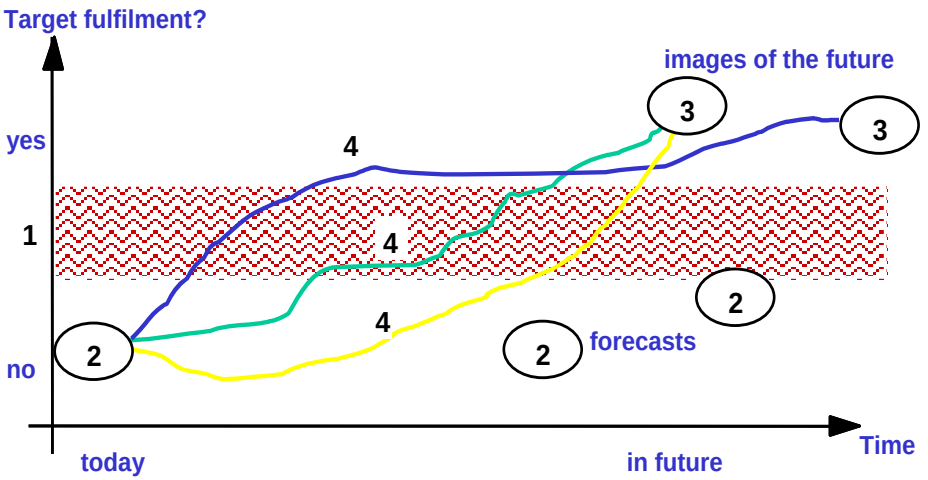
Conclusions on changes needed until 2050, if 2-degree target should be reached.

- Much more energy efficient technology and increased supply of carbon neutral energy is necessary in all sectors, but not sufficient.
- The fast **volume growth** of, e.g. road transport, air travel and resource intensive consumption, **must be also be reduced significantly**.
- **Biofuels** may replace about 1/3 of the fossil fuels now used for transport
- A shift of paradigm is needed, from **mobility** to **functional accessibility**.

  - **Urban planning** for shorter distances and increased share for cycling and public transport.

  - **ICT** substitutes some commuting by car and business travel by air
- **Electric drive** will be important in the form of trains, trams, trolley buses, electric bikes and electric cars (mainly plug-in hybrids).
- What transport volumes that are consistent with keeping global warming below two degrees should be kept in mind when planning investments in longlived infrastructure. ➔ Investments in **rail** and **ICT** shoul be given priority

Backcasting



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4: Conclusions for current policy making and tentative paths towards the images

Step 4: Analysis of current decisions and paths towards the images

- Major changes and **strategic decisions** needed are analysed
- Focus on **present policies** that might turn the development towards the images.
- **Long lived structures** (roads, railroads, urban patterns etc) are important since what we build now will remain in 2050 (and much later)
- Important to **avoid dead ends** regarding these structures
- Detailed paths from the present to the images in 2050 are not so interesting since the future will bring surprises

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Some conclusions on near term policy measures – Examples from transport

- Climate target must be given higher priority compared to other societal targets, both in theory and practise. To reduce emissions is not in conflict with economic development, it is a ***necessary condition*** for a good long term economic development (Stern, 2006)
- Combination of **carrots** and **sticks** is necessary!

Carrots (examples):

- Dense urban areas and traffic planning for improved public transport and cycling
- Demonstration of virtual meeting facilities
- Building of new rail and ICT infrastructure
- Incentives for car sharing

Sticks (examples):

- CO2-tax
- Congestion charging in cities
- Km-taxes on trucks
- CO2-tax and VAT also on aviation fuels and bunker oils (or Cap and Trade)