Appendix 2 CO_2 emissions from the transport sector in the Nordic countries

1 Introduction

The aim of this synthesis is to provide data on CO_2 emissions from the transport sector in the Nordic countries (Denmark, Finland, Norway and Sweden) in order to present abatement scenarios, based on measures that will contribute to emission reductions in the sector. The main purpose is to provide a basis for the analyses of NEP. Since NEP so far only considers CO_2 emissions in its models, no other greenhouse gases but CO_2 are included in the scenarios.

Beside EU's target of reducing its emissions of greenhouse gases by 20 % in 2020 (compared to 1990 levels), we also have had a focus on measures linked to the target of a 20 % share of renewable energies in EU energy consumption in 2020, including a minimum of 10 % biofuels in the transport sector, as well as the EU goal of saving 20 % of energy consumption to 2020 through energy efficiency measures.

CO_2 emission projections for the transport sector in this study were derived from the GAINS model[1] to create a reference scenario for the year 2020. With the reference scenario as a basis, abatement scenarios for the Nordic countries have been combined with the application of various measures, expressed as reductions in CO_2 emissions. In order to show the CO_2 emission reduction potential, each abatement scenario has been compared to corresponding emission statistics for 1990 and 2005. The abatement scenarios have also been compared to similar scenarios suggested by others, including scenarios for EU-27 that we have made as a part of another research program.

The quality of our scenarios is, of course, dependent on the assumptions made. These are in part based on work by mainly IMO (2000), Kågeson (2008), Kahn Ribeiro et al. (2007) and Smokers et al. (2006).

2 Reference scenario

2.1 Assumptions and underlying data

2.1.1 The GAINS model

As a starting-point for our suggested abatement scenarios, we have constructed a reference scenario based on data from a GAINS scenario called *NEC2007 baseline, current policy.* The data were downloaded from the GAINS Europe online, during the period of November 2008 to January 2009. The GAINS model includes data for different sectors (e.g. energy, industry, domestic and transport) on emissions of CO_2 as well as energy consumption. The projections in the GAINS model are based on a combination of PRIMES energy projections, GAINS model

[1] *The Greenhouse Gas and Air Pollution Interactions and Synergies*-model from IIASA (Institute for Applied Systems Analysis) available online at http://gains.iiasa.ac.at/gains/EU/index.login

emission calculations and national data on energy and emissions provided to IIASA by each country (for details see Amann et al., 2008).

NEC2007 baseline, current policy is an emission scenario that assumes an energy projection that does not meet the objectives of the *Climate & Energy Package* of the European Commission (Amann et al., 2008). The scenario employs assumptions of the PRIMES baseline projection of November 2007 (European Commission, 2008), concerning the implications on the national energy systems of the macro-economic development and international energy prices in 2020. In large, the PRIMES baseline projection of November 2007 simulates current trends and policies that have been implemented in the Member States up until the end of 2006, and it is said to reflect business-as-usual trends (European Commission, 2008).

2.1.2 Vehicle categories and comparison of GAINS' data to emission statistics

The downloaded data from GAINS contain emission projections for different kinds of vehicle categories (listed in detail in the Appendix) for the year 2000, 2005, 2010, 2015 and 2020, respectively. These vehicle categories have been grouped into sub-sectors in the following way:

- Shipping (maritime vessels; excluding international bunkers)
- Civil Aviation (excluding international bunkers)
- Off-road vehicles (i.e. dumpers, tractors, mobile cranes etc.)
- Railway (only diesel traction)
- Heavy duty vehicles (trucks and buses)
- Light commercial trucks
- Cars and motorcycles

When comparing the emission data derived from GAINS for the year 2005 to corresponding statistical data from UNFCCC for the same year, the major discrepancy is found in the sector concerning emissions from off-road vehicles.

As far as we have been able to ascertain, the GAINS' data for the transport sector include emissions from all off-road vehicles, something which seem to differ from the statistics reported by UNFCCC. In the statistics from UNFCCC, only emissions from off-road vehicles, actually used in the transport sector itself (i.e. vehicles used for ground activities in harbours and airports), are included. The remaining emissions from off-road vehicles seem to be included in other sectors; for example off-road vehicles used in industries are included in the sector called *Industry*, off-road vehicles used in agriculture and forestry are included in the corresponding categories and so forth.

In table 1 emission data from GAINS are compared to corresponding statistics from UNFCCC. Note that the categories *Heavy duty vehicles*, *Light commercial trucks* and *Cars and motorcycle*s have been put together to represent the road transport sector. Also, note that UNFCCC lacks data from Denmark regarding the sector *Other transport*, i.e. off-road vehicles, which means that the emissions from this sector in the Nordic countries may be somewhat underestimated in the data from UNFCCC.

Table 1 **Emission data for the Nordic countries for the year 2005 according to GAINS and UNFCCC.**

Nordic countries 2005	According to GAINS *[Mt CO_2]*	According to UNFCCC *[Mt CO_2]*
Road[1]	53.13	52.06
Civil Aviation	1.85	2.05
Shipping	6.00	4.06
Railway	0.41	0.47
Other Transport	9.67	2.21
All sectors	**71.06**	**60.86**

[1] Includes *Heavy duty vehicles*, *Light commercial trucks* and *Cars and motorcycles*.

Compared to the statistics from UNFCCC there is a surplus of 7.45 Mtons of CO_2 in the GAINS' data regarding the category *Other transport*. We have assumed that this surplus corresponds to the emissions from off-road vehicles in all sectors outside the transport sector. To be able to compare our abatement scenarios to emission levels in 1990, we have downsized the GAINS' emission data for the sector *Other transport* (called *Off-road vehicles* in our scenarios), so that it corresponds to how it is reported to UNFCCC, that is, we have only included emissions from off-road vehicles used in the transport sector itself[2].

2.1.3 Adjustments of the biofuels share

In the GAINS' energy projections for the transport sector biofuels are included in the fuel categories of *Medium destillates* (diesel light fuel oils) and *Gasoline and other light fractions* (includes kerosoene). The assumed share of biofuels in these fuel categories is given separately for each country. In the Nordic countries, the assumed average share of biofuels (in both medium destillates and gasoline) in the transport sector, as projected in *NEC2007 baseline, current policy*, increase from 1.3 % in 2000 to 5.9 % in 2020. This increase, however, does not reflect a so called business-as-usual trend, because that would imply a share of biofuels which do not increase but instead is the same in 2000 as in 2020. For this reason, the share of biofuels in the reference scenario has been downsized for the year 2020. We have assumed an average share of 2.5 % biofuels in the road transport sector in 2020 in the Nordic countries, based on the situation in 2007, when the average share of biofuels in EU's road transport sector was 2.6 % (EurObserv'ER, 2008). Based on this assumption we have added about 2 Mtons of CO_2 to the road transport sector in the reference scenario.

2.1.4 The expected increase of total kilometres driven per year

In figure 1 and 2 the kilometres driven per year (expressed as Gvehicle-km) in the Nordic countries and the EU-27 in the period 2000-2020 are shown, as projected in the GAINS' scenario *NEC2007 baseline, current policy*. As seen, there is an expected increase in the total kilometres driven per year in the Nordic countries of 28 % in the period 2005-2020. For the EU-27, the expected increase during the same period is 41 %.

[2] However, the emission surplus that corresponds to off-road vehicles used in other sectors is included in scenarios made for the stationary energy system, as another part of this research project.

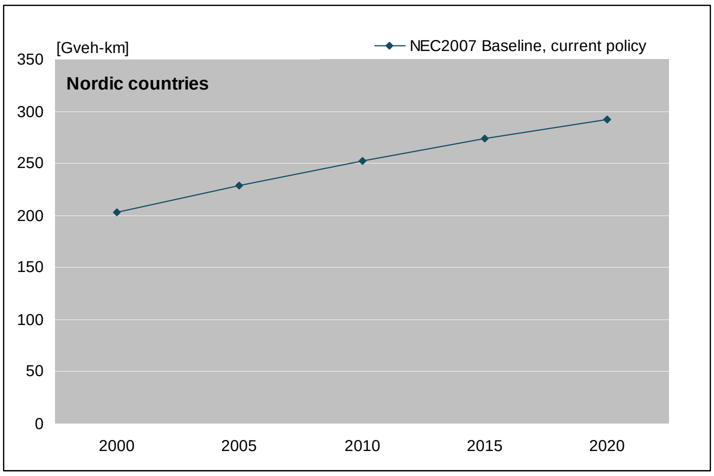

Figure 1 **Kilometres driven per year in the Nordic countries as projected in GAINS *NEC2007 baseline, current policy* in the period 2000-2020.**

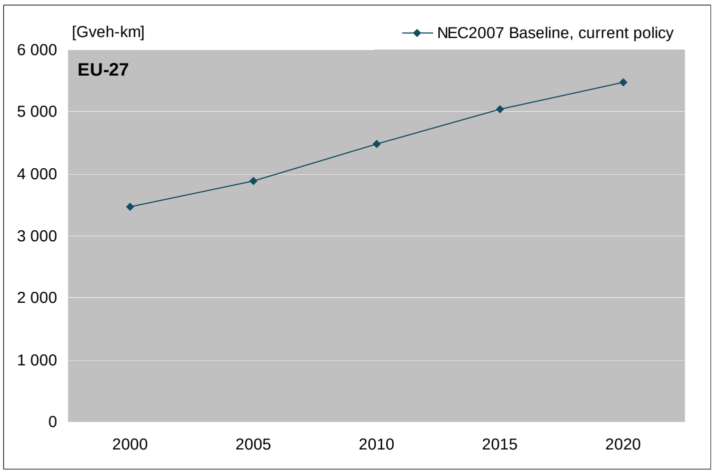

Figure 2 **Kilometres driven per year in the EU-27 as projected in GAINS *NEC2007 baseline, current policy* in the period 2000-2020.**

2.2 CO_2 emissions in the reference scenario

In table 2 the CO_2 emissions from the transport sector, divided into sub-sectors, in the Nordic countries according to our reference scenario are shown. Note that only off-road vehicles from the transport sector are included in the sub-sector *Off-road vehicles*.

Table 2 **Emission data for the Nordic countries in 2020 according to the reference scenario.**

The Nordic countries 2020	**Reference scenario** *[Mt CO_2]*	**Share**
Shipping	5.79	8 %
Civil aviation	2.61	4 %
Off-road vehicles[1]	2.10	3 %
Railway	0.40	1 %
Heavy duty vehicles	18.97	27 %
Light commercial trucks	9.83	14 %
Cars and motorcycles	30.83	44 %
All sectors	**70.54**	

[1] Includes off-road vehicles in the transport sector itself.

3 Measures for emission reductions in the Nordic transport sector used in the abatement scenarios

A number of technologies and measures are possible to reduce CO_2 emissions from the transport sector. For our abatement scenarios we have mainly considered mitigation potentials as suggested in IMO (2000), Kahn Ribeiro et al. (2007), Kågeson (2008), and Smokers et al. (2006). The main focus has been on measures in the road transport sector.

3.1 The road transport sector

3.1.1 Technical measures and emission requirements in the road transport sector

Kågeson (2008) estimates a possible CO_2 emission reduction potential of 20 % in 2020 for passenger cars in EU-27. This is based on the assumption of an emission requirement for new cars of 130 g per km in 2012 and 100 g per km in 2020 that would result in emissions from the existing fleet of passenger cars of around 140 g per km, compared to approximately 174 g per km in 2020 (assuming that the average car is 10 years old in 2020). Kågeson also makes allowance for a rebound effect[3] of 15 %, which means that the actual CO_2 emission reduction potential for passenger cars would be 17 % in 2020 compared to the reference scenario.

With the use of light-weight materials and improved vehicle design, total vehicle weight and air resistance can be reduced significantly, thereby reducing the loads on the vehicle and the amount of fuel needed to operate it. Rolling resistance can be reduced by improving tyre design and materials as well as maintaining proper tyre pressure. According to Kahn Ribeiro et al. (2007), a 10 % weight reduction from the total vehicle weight can improve fuel economy by 4-8 %. In table 3, some of the mitigation measures for passenger cars, together with the estimated CO_2-reduction potentials, are listed.

Table 3 Mitigation measures and estimated CO_2-reduction potentials (examples from Smokers et al, 2006).

Mitigation measures in passenger cars	Minimum CO_2-reduction potential*
Improved aerodynamic efficiency	1.5 %
Mild weight reduction, -1.5 % in vehicle weight	0.9 %
Medium weight reduction, -3.6 % in vehicle weight	2.2-2.4 %
Strong weight reduction, -9.0 % in vehicle weight	5.5-5.9 %
Piloted gearbox	4.0 %
Low rolling resistance tyres	2.0-2.3 %
Tyre pressure monitoring systems	2.5 %
Low viscosity lubricants	2.5 %
Reduced engine friction losses	3.0 %
Electrically assisted steering	3.0 %

* Variations in percentages show differences between potentials for petrol and diesel cars.

[3] More fuel efficient cars can lower the variable costs associated with driving a car. This gives the owner the possibility of using the car even more, something that would counteract the reduction in CO_2 emissions due to a more fuel efficient car. This effect is called the rebound effect. The size of the effect is dependent on income level and fuel prize.

The potential of reducing CO_2-emissions from heavy duty vehicles (HDVs) are somewhat smaller than the potential for passenger cars, mainly because diesel engines of HDVs used for transportation over longer distances already have a proportionately high efficiency. Kågeson (2008) assumes that the reduction potential for other vehicles in the road transport sector in the EU-27 in 2020 is 7 %, with the assumption that there is no rebound effect for commercial vehicles.

In addition to the reduction potentials, based on emission requirements, in passenger cars and other vehicles in the road transport sector, Kågeson (2008) suggests a further reduction potential of 5 % for the entire road transport sector in the EU-27, based on measures such as eco-driving, tyre improvements, road improvements etc.

In December 2008, a compromise agreement to reduce CO_2 emissions from new vehicles in EU was adopted. The agreement implies a gradual limitation of CO_2 emissions to 120 g per kilometre for 65 % of new cars in 2012, 75 % in 2013, 80 % in 2014 and 100 % in 2015. A target of 130 g per kilometre is meant to be reached by improvements in vehicle motor technology. The final 10 g reduction towards 120 g per kilometre should be obtained by other technical improvements, such as tyres with lower friction or the use of biofuels. In the long term, the compromise sets an average emissions target of 95 g of CO_2 per kilometre for the fleet of new cars in EU by 2020 (Euractiv, 2009).

3.1.2 Electric cars and plug-in hybrids

Electric cars and plug-in hybrids constitute a significant reduction potential when only considering CO_2 emissions in the transport sector itself.

3.1.2.1 20 % emission reduction potential in the sector *Cars and motorcycles*

According to Vägval Energi (2008) there is a 20 % CO_2 emission reduction potential in the sector *Cars and motorcycles* if 600 000 cars in Sweden were to be replaced by plug-in hybrids and electric cars. 600 000 cars represent about 12 % of all petrol cars in Sweden. Applying this assumption of a 20 % emission reduction potential to the Nordic countries would mean that some 1.3 million cars in the Nordic countries would have to be replaced by electric cars and hybrids in 2020.

3.1.2.2 30 % emission reduction potential in the sector *Cars and motorcycles*

Assuming that 900 000 cars in Sweden would be replaced by electric cars and plug-in hybrids there would be approximately a 30 % CO_2 emission reduction in the sector *Cars and motorcycles* in 2020. 900 000 cars in Sweden represent about 18 % of all petrol cars in Sweden. This would mean that some 1.9-2 million cars in the Nordic countries would have to be replaced by electric cars and plug-in hybrids in 2020.

3.1.3 Share of biofuels

EU's target of a 20 % share of renewable energies in EU energy consumption in 2020 includes a minimum requirement of a 10 % share of biofuels in the transport sector. Assuming that the minimum share of biofuels in 2020 is reached, in addition to the assumption made for the reference scenario (i.e. that there was a 2.5 % share of biofuel in

2020), the CO_2 emission reduction potential for the road transport sector in the Nordic countries would be 7.5 % in 2020. If one assumes a biofuels share of 15 %, there would be a 12.5 % CO_2 emission reduction in 2020.

3.1.4 Excise duties on vehicle fuels

Another measure for reducing CO_2 emissions from the road transport sector is an increase of the excise duties on vehicle fuels. Assuming that the road transport sector have to cut its emissions with 12 % in 2020 compared to emissions in 2005, Kågeson (2008) estimates the necessary increase of excise duties on vehicle fuels to 86 %. This is based on an average price elasticity of -0.25 and a fuel price at the pump that will have to increase by 45%. The reduction potential of the net emissions based on these assumptions is equivalent to 11.3 % in 2020.

3.2 Shipping

3.2.1 Technical measures and emission requirements in the shipping sector

Since ships and ship engines have considerably long service lives (30 years or more for a ship engine), it will take time before technical measures can be implemented in the shipping fleet on a significant scale. This would imply that operational measures, such as speed reduction, load optimisation, maintenance and fleet planning, must play a more important role in reducing CO_2 emissions from shipping, even though its potential is uncertain.

IMO (2000) has estimated that the potential to reduce CO_2 emissions in shipping by technical measures (such as current energy-saving technologies in relation to hydrodynamics, e.g. hull and propeller, and machinery) is 5-30 % in new ships and 4-20 % in old ships. The short-term potential of operational measures was estimated at 1-40 %. The long-term potential, based on assumptions on implementation of technical and operational measures for the world fleet, was estimated at 17.6 % in 2010 and 28.2 % in 2020.

In table 4, some of the reduction potentials for the shipping sector, expressed as energy efficiency potentials, are listed.

Table 4 Measures for reducing energy use in the shipping sector (examples from IMO, 2000).

Mitigation measures	Reduction potential in energy use
Shift from heavy fuel oil to medium distillates	4-5 %
Improved maintenance of hull	3-5 %
Improved propeller	5-10 %
Optimisation of fleet planning and fleet utilisation	5-40 %
Electronic fuel injection	2-3 %

3.2.2 Share of biofuels

According to Kahn Ribeiro et al. (2007), there will be no significant shift in the shipping sector, from a primarily diesel-only fleet to a fleet using alternative fuels including biofuels, until 2020.

3.3 Off-road vehicles

According to emissions projections for off-road vehicles in Sweden, CO_2 emissions will not decrease during the period 2010-2020. The main reason for the lack of improvement regarding fuel efficiency in off-road vehicles, such as tractors and dumpers, is that focus so far has been on reducing emissions of nitrogen oxides (NO_x), particles (PM), hydrocarbons (HC), and carbon monoxides (CO). The European legislation regarding emissions from off-road vehicles, first implemented in 1999, have had a dramatic effect on emissions of NO_x, PM, HC and CO, all of which have decreased significantly. The legislation, however, does not include regulations on fuel consumption, and therefore there has been no improvement in emissions of CO_2 from off-road vehicles. The Swedish Environmental Protection Agency (2007) believes that little progress will take place before 2014. This is the year when the final stage of emission standards for off-road vehicles, decided on so far, will be implemented on the market.

When constructing the abatement scenarios we assume that this sector follows the reference scenario.

3.4 Railway and Civil Aviation

The CO_2 emissions from the *Railway* sector constitute not even 1 % of the transport sector, since they include only CO_2 emissions from diesel traction. This is the main reason why we have not looked at measures for emission reductions in this sector. Instead, we have assumed that this sector follows the reference scenario in all abatement scenarios. The same applies for the sector *Civil Aviation*.

4 Abatement scenarios

Based on the mitigation measures discussed in chapter 3, three abatement scenarios have been put together to show possible reduction potentials in CO_2 emissions from the transport sector in the Nordic countries in 2020.

- Profu scenario 1 – baseline
- Profu scenario 2 – electric cars and plug-in hybrids
- Profu scenario 3 – maximum feasible

Profu scenario 1 – baseline
For this scenario we have assumed a 50 % penetration of the total reduction potential discussed in chapter 3.1.1. This includes an 8.5 % CO_2 emission reduction in the sector *Cars and motorcycles*, and a 3.5 % reduction of the CO_2 emissions in the sectors *Heavy duty vehicles* and *Light commercial trucks*. In addition to this, there is another 2.5 % reduction of the CO_2 emissions in the road transport sector as a whole. The scenario also includes a 7.5 % CO_2 emission reduction in the road transport sector, based on the assumption of a 10 % share of biofuels in this sector in 2020, compared to 2.5 % in the reference scenario.

Profu scenario 2 – electric cars and plug-in hybrids
In addition to the assumptions made in Profu scenario 1, Profu scenario 2 includes the use of electric cars and plug-in hybrids as discussed in chapter 3.1.2.1, which reduces the emissions from the sector *Cars and motorcycles* with 20 % in 2020 compared to the reference scenario.

Profu scenario 3 – maximum feasible
In Profu scenario 3 it is assumed that 100 % of the total reduction potential discussed in chapter 3.1.1 comes through. This includes a 17 % CO_2 emission reduction in the sector *Cars and motorcycles*, and a 7 % reduction of the CO_2 emissions from *Heavy duty vehicles* and *Light commercial trucks*. In addition to this, there is another 5 % reduction of the CO_2 emissions in entire the road transport sector, as well as an assumption of a 20 % reduction of CO_2 emissions from the shipping sector, based on the estimated reduction potential for the world fleet discussed in chapter 3.2.1.

The scenario also includes a 30 % reduction of the emissions in the sector *Cars and motorcycles* discussed in chapter 3.1.2.2, and a 12.5 % CO_2 emission reduction potential based on the assumption of a 15 % share of biofuel in the road transport sector in 2020.

As a final step we have included the emission reduction potential of an increase in the excise duties on vehicle fuels. Based on the assumptions in chapter 3.1.4, we have assumed that the reduction potential of the net emissions in the entire transport sector is 9.5 %.

Table 5 shows the CO_2 emissions in the abatement scenarios compared to emissions in 1990, 2005 and in the reference scenario. In figure 3 Profu scenario 1, 2 and 3 is shown together with the reference scenario and emissions in 1990.

Table 5 **Emissions in the transport sector in the Nordic countries in 2020 in Profu scenario 1, 2 and 3.**

The Nordic countries 2020	Profu scenario 1 *Baseline* *[Mt CO_2]*	Profu scenario 2 *Electric cars and plug-in hybrids* *[Mt CO_2]*	Profu scenario 3 *Maximum feasible* *[Mt CO_2]*
All sectors[1]	**61.3**	**55.9**	**41.6**
Compared to emissions in 1990	+18 %	+8 %	-20 %
Compared to emissions in 2005	-4 %	-12 %	-35 %
Compared to the reference scenario	-13 %	-21 %	-41 %

[1] Only off-road vehicles from the transport sector are included in the sector *Off-road vehicles*.

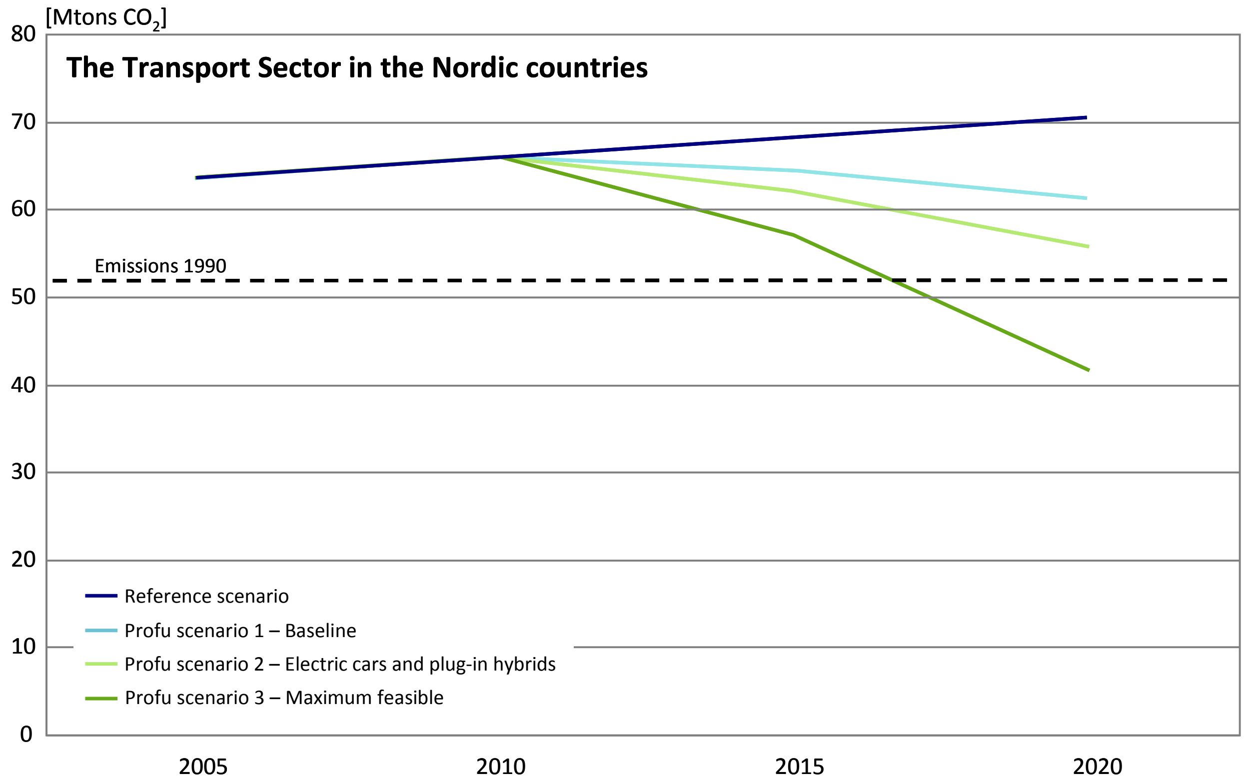

Figure 3 **CO_2 emissions from the transport sector in the Nordic countries in Profu scenario 1, 2 and 3 compared to emissions 1990 and emissions in the reference scenario.**

Compared to the reference scenario, which represents a *business-as-usual* scenario, there is a 40 % feasible emission reduction potential in 2020 if all measures as suggested in Profu scenario 3 are applied. This would cut the emissions in the transport sector in the Nordic countries with 20 % compared to emissions in 1990, almost as much as EU's goal of reducing emissions of greenhouse gases in the entire EU.

According to the baseline scenario (Profu scenario 1) there is an emission reduction potential of more than 10 % compared to the reference scenario.

5 Comparison to other emissions scenarios for the transport sector

When comparing the abatement scenarios for the Nordic countries with similar scenarios made for EU-27, as a part of the project *Pathways to Sustainable European Energy Systems*, we find that similar results are possible to reach on a European level. The results from Pathways show that emissions can be cut to nearly 20 % in EU-27 compared to emissions 1990. Figure 4 shows the Pathways scenarios for EU-27. Pathways scenario 2 corresponds to Profu scenario 3, i.e. it includes the same assumptions as those made for the Nordic countries in Profu scenario 3 but on a European level.

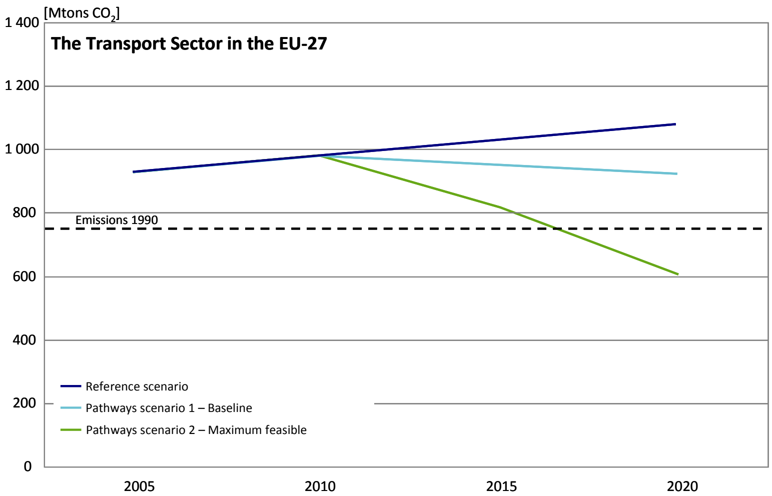

Figure 4 **CO_2 emissions from the transport sector in the EU-27 in Pathways scenario 1 and 2 compared to emissions 1990 and emissions in the reference scenario.**

ECN (2008) has studied the impact of new technologies on energy use and emissions from the Dutch road transport sector. They have quantified emission reduction potentials and the costs of several innovations in the road transport sector, and have combined them into two distinct innovation scenarios. According to their results, the Dutch road transport sector could reduce its CO_2 emissions to just below the level in 1990, although not until 2020 (figure 5).

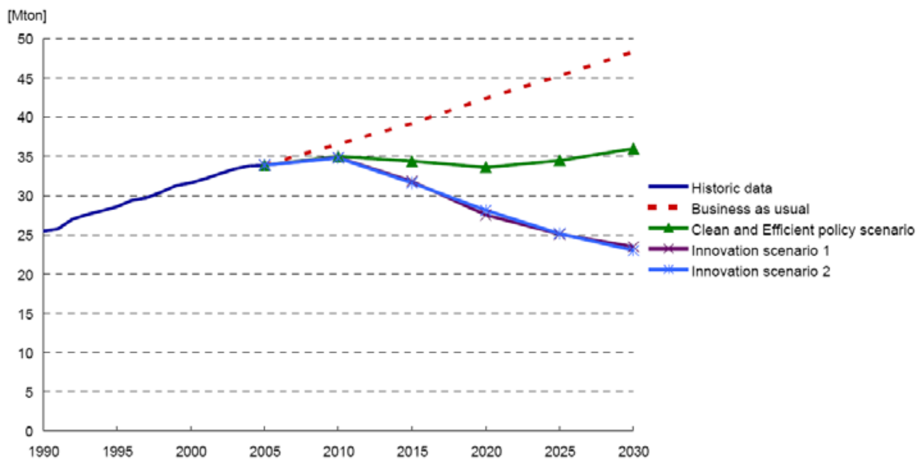

Figure 5 **CO_2 emissions from the Dutch road transport sector in two innovation scenarios compared to historic data and business-as-usual trends (ECN, 2008).**

As mentioned, Kågeson (2008) has studied CO_2 emissions from the European transport sector and analysed the impact on efficiency and costs if CO_2 emissions from the road transport sector is included in the European Emissions Trading System (EU ETS). This is compared to a situation where the road transport sector is permanently excluded from EU ETS and therefore would have to cut its emissions by other means. The results show that the road transport sector could cut its emissions by 12 % compared to emissions in 2005.

McKinsey & Company (2008) has studied greenhouse gas abatement potentials in Sweden, including emissions in the transport sector. According to this study behavioural changes are necessary in order to reach the suggested goal for Sweden: to reduce its emissions in the non-trading sectors, including the transport sector, by 17 % in 2020, compared to 2005 levels. Employing measures with a cost below 500 SEK per tonne CO_2-equivalents would reduce emissions from the Swedish transport sector with some 5 % in 2020 compared to a business-as-usual scenario, according to McKinsey & Company.

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Appendix

The transport sector categories in GAINS have been grouped into sub-sectors in the following way:

Abbrevation	Definition in GAINS	Sub-sector
TRA_OTS_L	Other transport: maritime, large vessels, >1000 GRT	Shipping
TRA_OTS_M	Other transport: maritime, medium vessels, <1000 GRT	Shipping
TRA_OT_AGR	Other transport: agriculture and forestry	Off-road vehicles
TRA_OT_AIR_DOM	Other transport: domestic air traffic - civil aviation	Civil Aviation
TRA_OT_CNS	Other transport: mobile sources in construction and industry	Off-road vehicles
TRA_OT_INW	Other transport: inland waterways	Shipping
TRA_OT_LB	Other transport: other off-road; sources with 4-strokes engines (military, households, etc., for GAS also pipeline compressors)	Off-road vehicles
TRA_OT_LD2	Other transport: off-road; sources with 2-strokes engines	Off-road vehicles
TRA_OT_RAI	Other transport: rail	Railway (diesel)
TRA_RD_HDB	Heavy duty vehicles - buses	Heavy duty vehicles
TRA_RD_HDT	Heavy duty vehicles - trucks	Heavy duty vehicles
TRA_RD_LD2	Motorcycles, mopeds and cars with 2-stroke engines	Cars and motorcycles
TRA_RD_LD4C	Light duty vehicles: cars and small buses with 4-stroke engines	Cars and motorcycles
TRA_RD_LD4T	Light duty vehicles: light commercial trucks with 4-stroke engines	Light commercial trucks
TRA_RD_M4	Motorcycles with 4-stroke engines	Cars and motorcycles