

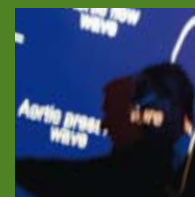
INFRASTRUCTURE

FUELS

VEHICLES

LOGISTICS

RESEARCH



# On the Road to Climate Neutral Freight Transportation

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# Summary

*In recent years, we have reached a very broad-based understanding of how human-caused emissions impact the climate and what the consequences of this interference may be. Everyone—the general public, politicians, corporations, and authorities—now appreciate that future societal development must be vastly more sustainable.*

## **WORKING TOGETHER TOWARD CLIMATE NEUTRAL TRANSPORTATION**

Efficient freight transportation is necessary in a modern growth-oriented society. But today, freight transportation is responsible for significant emissions of carbon dioxide, the major greenhouse gas. Reducing the climate impact from the transportation sector is a serious challenge, not least because this sector to such a great extent depends on fossil fuels. Since the beginning of the 1990's, a number of measures have been implemented: sulfur-free fuels—a pre-requirement for environmentally efficient vehicle engines—vehicles and engines that are vastly more fuel-efficient, more efficient transportation logistics, and renewable fuels. But in order to really make possible a transition to climate neutral transportation, additional major initiatives are required. Collaboration between various stakeholders in the transportation sector, other business and industry agents, society as a whole, and the research community needs to expand, in order to accelerate this development.

## **MORE EFFICIENT TRANSPORTATION LOGISTICS, MORE EFFICIENT VEHICLES, RENEWABLE FUELS**

For this reason, the Centre for Environment and Sustainability at Göteborg University and Chalmers Institute of Technology, Preem, Schenker, Volvo Trucks, and the Swedish Road Administration are

working together On the Road to Climate Neutral Freight Transportation. The objective is to show how to reduce emissions associated with freight transportation by road in Sweden and how the individual participants can contribute. This partnership focuses on improving the efficiency of transportation logistics, fuel production efficiency, vehicle efficiency, as well as expanding the use of renewable fuels.

## **OUR VISION: CLIMATE NEUTRAL FREIGHT TRANSPORTATION BY ROAD IN SWEDEN**

## **THE BEGINNING OF A LONG JOURNEY AND PARTNERSHIP**

The road to climate neutral freight transportation is neither simple nor short. All indications are that freight transportation will continue to increase in Sweden, keeping step with economic growth. This means that much of the immediate improvement that is possible will be cancelled by transportation growth. But we have to start somewhere. And the sooner we start and the more partners who join, the sooner we will change the trend.

## **POSSIBILITIES AND TARGETS**

The climate impact of the average Swedish long-distance shipment can be cut in half between 2005 and 2025. Total greenhouse gas emissions from

freight transportation by road can be reduced by 15% during this period, despite the expected increase in traffic. Therefore, the historic trend of more traffic resulting in more emissions can be reversed. This is the foundation for climate neutral freight transportation.

Our joint, ambitious target is to cut the climate impact of the average shipment in half, already by 2020.

**WE ENCOURAGE EVERYONE TO JOIN**

We encourage all businesses and organizations to join in this collaboration. As an initial commitment, each participant will account for what they want to accomplish in the coming three-year period, in order

to reverse the alarming trend. The second part of the partnership involves working together to identify joint projects that will help us reach the target in 2020. As this publication shows, there are several areas where we can join forces and dig in.

**Preem Petroleum**  
**Schenker**  
**Volvo Trucks**  
**Swedish Road Administration**  
**Center for Environment and Sustainability, GMV,**  
at Chalmers and Göteborg University



# Background

*The most recent Assessment Report by the UN panel on climate change (Intergovernmental Panel on Climate Change, IPCC) has determined that it is very likely that human emissions of greenhouse gases already have impacted global climate. If emissions continue to increase, the global average temperature will increase by 2 to 6 degrees centigrade over the next century (IPCC, 2007). Extreme weather conditions, flooding, disease, and lack of clean water are some of the impacts associated with additional global warming.*

## **RADICAL REDUCTION OF EMISSIONS REQUIRED**

In order to try to avoid raising the average global temperature by more than 2 degrees compared to the pre-industrial level, greenhouse gas<sup>1</sup> emissions must be radically reduced. Burning fossil fuels—oil, natural gas, and coal—is the main cause of the increasing concentration of carbon dioxide in the atmosphere and the resulting global warming. Successful work on the climate issue will require each sector of society to assess what can be done to reduce emissions.

## **25–30% REDUCTION BY 2020**

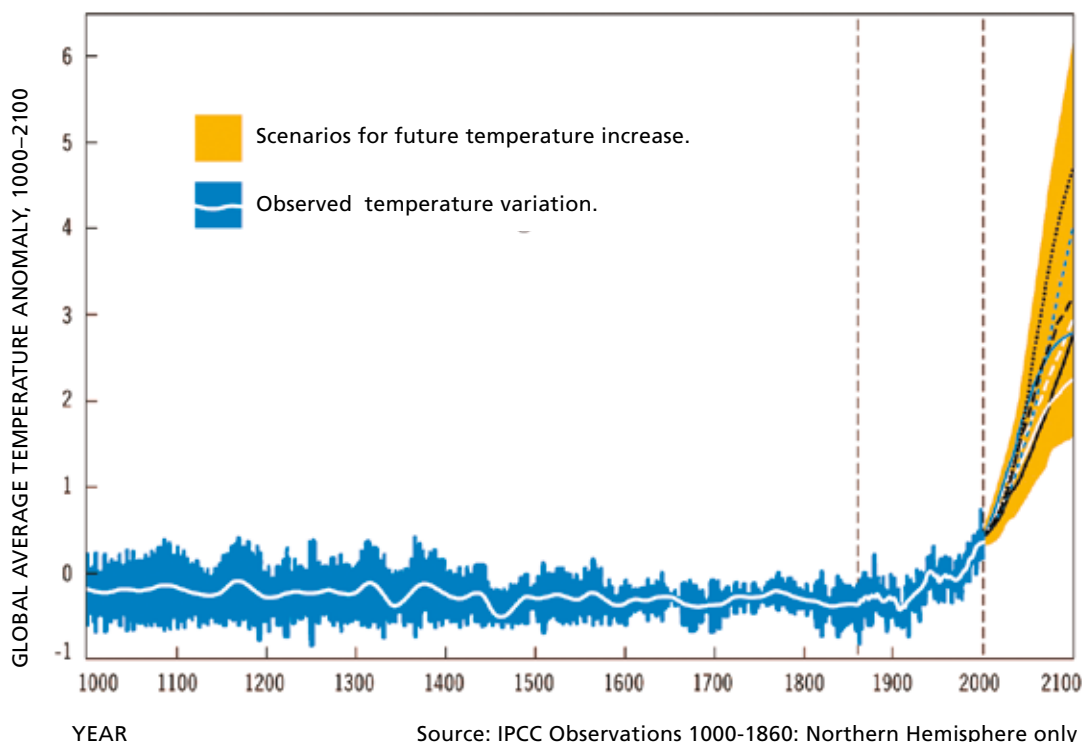
The Swedish Government has proposed a 25% reduction from 1990 levels in climate pollution by 2020 and has stated its firm support for an overall reduction within the EU of 30%, by 2020. The strategy for reducing emissions from transportation by road encompasses measures within five areas: a transportation efficient society, energy efficient road maintenance, energy efficient use of vehicles, energy efficient vehicles, and biofuels. In addition to these areas, the strategy also emphasizes long-term initiatives and international cooperation. A transportation efficient society includes transportation efficient regional and urban planning and production chains, choice of energy efficient transportation modes, and choice of energy efficient alternatives to travel and transpor-

tation. Energy efficiency within the road transportation sector involves increasing the energy efficiency of the vehicle fleet, energy efficient use of vehicles, and energy efficient road maintenance. The biofuels area includes supply, production, and distribution of renewable fuels at competitive costs.

## **FREIGHT TRANSPORTATION IS INCREASING**

Today, transportation accounts for roughly 30% of Swedish greenhouse gas emissions—carbon dioxide, mainly—and freight transportation by road accounts for about 6%. Emissions from passenger travel have not increased in recent years, while emissions from freight transportation by road have increased by 8% in the past 15 years. Historically, freight transportation has increased in step with economic growth. For instance the GDP has grown by 68% since 1980. During the same period, transportation work (measured in ton-km) increased by 43% (Hedenus, 2007). Most of the increase is in shipments by road, which is not good news for the climate because transportation by road requires on average 10 times more energy per ton-km than transportation by rail or sea. High flexibility, time savings, and the high capacity of transportation by road are important competitive advantages compared to rail and sea.

<sup>1</sup> Carbon dioxide is the most important greenhouse gas, currently accounting for almost 80% of climate-impacting emissions in Sweden (NV, 2006). Other important greenhouse gases are methane and nitrous oxide, for which the agricultural sector is one source.



### LIMITED OPPORTUNITIES FOR IMPROVEMENTS BY 2015

Up until 2015, the possibilities for reducing the overall greenhouse gas emissions from freight transportation by road, relative to current levels, are limited, even if all the measures suggested in this report were to be implemented. This is in part due to the projected increase in transportation (Hedenus, 2007). However, within certain areas, the situation holds more promise, for example, with respect to partial load packaged goods for which the transportation work can be reduced through improved logistics. In order to move forward, stake-holders in so-called bulk freight, such as energy, lumber, paper, agricultural products, minerals, and gravel must also participate actively in the transition and determine what can be done to make transportation in these areas more efficient.

### WORKING TOGETHER—A NECESSITY

Major commitments from numerous stake-holders are required in order to make carbon neutral transportation possible. Society can contribute long-term policy measures and infrastructure. We need research in fuel and vehicle technology in order to develop energy efficient and climate neutral transportation solutions. Fuel and vehicle manufacturers can ensure that the most energy efficient solutions are brought to market. The transportation industry can improve logistics and make sure each vehicle is used in the most efficient manner. And last but by no means least, we—producers and consumers—can consider how we can contribute to reducing the impact on climate from freight transportation, through our everyday choices and decisions.

#### References:

IPCC (2001) Climate Change 2001: Synthesis Report. Summary for Policymakers. [www.ipcc.ch](http://www.ipcc.ch)  
 Naturvårdsverket (2006) Report by the Swedish Environmental Protection Agency in accordance with the EU mechanism for monitoring greenhouse gas emissions (Utsläppsrapportering av växthusgaser enligt EU:s övervakningsmekanism och klimatkonvention) PM 2006-12-07. In Swedish.

# More efficient transportation logistics

Society depends on efficient transportation. The demand from consumers for an increasing supply of products, and the demand from industry for large-scale production, reduced inventory, and a continuous flow of goods to a large extent determine how the current transportation system works. And as the economy grows, the demand for transportation increases. Simultaneously, the efficiency of transportation depends on the structure of society. The location of settled areas, industry, warehouses, highway networks, and other infrastructure matters greatly to the efficiency of transportation. For this reason, it is critically important that initiatives in long-term urban and rural planning have a strong focus on designing transportation solutions in a resource-efficient manner. However, there is already a significant potential for improving energy efficiency of freight transportation, for instance through:

## **OPTIMAL USE OF TRANSPORTATION MODES**

In order to satisfy the increasing demand for transportation in a resource-efficient manner, use of transportation modes must be optimized, for instance through co-modal transportation, involving both rail and road. This also places conditions on the placement of reloading terminals.

## **BETTER USE OF EXISTING FREIGHT CAPACITY**

With improved logistics, coordination of shipments, increased load relative to load capacity, and larger vehicle combinations, more transportation work can be carried out with existing vehicles.

## **ECO-DRIVING**

Providing eco-driving training can improve fuel economy and reduce the environmental impact per vehicle and driver significantly.





## More efficient vehicles

60% of all freight in Sweden is transported by road. The flexibility of shipping by truck, and the possibility of rapidly and efficiently bringing goods from door to door, have made trucks a necessary component of modern society. The climate impact of trucks is directly proportional to the use of fossil fuel. Burning one liter diesel oil emits 2.6 kg carbon dioxide emissions.

### **ENERGY EFFICIENCY—ALPHA AND OMEGA**

Vehicle manufacturers have long prioritized improving fuel economy, mainly in response to customer demand. No matter the fuel, the issue of energy efficiency will entirely determine the transition from the fossil-fueled transportation system of today to the carbon neutral freight transportation of tomorrow.

### **STEADY IMPROVEMENTS**

The steady development of the diesel engine—today's most energy efficient drivetrain for heavy engine-powered vehicles—has entailed a significant increase in efficiency. During the past 20 years, the fuel economy for heavy trucks has improved by about 25%. And there is still room for improvement.

### **NEW TECHNOLOGY**

Alongside the steady improvements in fuel efficiency of engines and transmissions other solutions make possible additional reductions in fuel consumption. Hybrids, where diesel engines are combined with electric drivetrains are one example. In certain applications, this makes possible reducing fuel consumption by 30%.

## More efficient fuel production

Fuel used for transportation has to have a good overall energy efficiency, i.e., be energy dense and produced in an energy efficient manner with low emissions.

Here, fuel manufacturers have a great responsibility for implementing the best technology.



# Increased use of renewable fuels

Using biomass for producing biofuels creates the potential for reduced carbon dioxide emissions but also raises a number of other issues. First, supply is limited. For this reason, biomass use must be optimized in terms of resource and environmental efficiency.

## **MOST EFFICIENT TO REPLACE FUELS IN STATIONARY UNITS**

From a system perspective, using biomass in stationary applications is most efficient in terms of carbon dioxide emissions. In these, 1 unit of “green” carbon replaces 1 unit of fossil carbon. The process of producing the components of first generation biofuels requires roughly 40% of the resulting energy, so 1 unit of green “carbon” is required in order to replace 0.6 units of fossil carbon. According to the European Environment Agency, agricultural and forest land can produce 16% of the projected energy demand in 2030 with no conflict between this and environmental protection and ecological diversity. In order to supply all of the fuel required for transportation by road, energy consumption per km has to be reduced by roughly 75% while energy efficiency in industry and residential heating improve to the same degree. Given current energy use, in addition to the competition between biomass for transportation fuel and biomass used for more climate efficient energy production, there are several other environmentally-related and ethically challenging issues pertaining to the raw materials for biofuels. We have to work toward development that is sustainable in the long-term yet reduce fossil carbon dioxide emissions rapidly.

## **ETHICAL DILEMMA**

How to use biomass may also lead to an ethical dilemma. The biomass the Earth produces needs to

provide food, paper, wood products, shoes, clothing, and fuel for 8–10 billion people. The ability of people in industrialized nations to pay for vehicular fuels and therefore for the feedstock crops may surmount the domestic ability to pay for food, while for certain nations, agricultural products are the only existing possibility for exports. Raw biomaterials may provide significant increases in living standards if exports are not limited as they are today by barriers such as tariffs and subsidies. Living and working conditions in the developing world need to be considered. The earth’s renewable resources have to be used in a sustainable fashion, or else erosion, acidification, desertification, elimination of rain forests, etc., may render them non-renewable.

## **HIGH ENERGY EFFICIENCY—A REQUIREMENT**

To justify the use of biofuels, these need to offer low greenhouse gas emissions and high energy efficiency throughout the entire life cycle, from extraction to combustion. Furthermore, other environmental and health impacts of biofuels need to be no worse than those of current fuels. Biofuels also have to meet high standards for functionality, performance, low-temperature properties, corrosion, function in cleaning equipment, etc. How well we manage to reduce carbon dioxide emissions from transportation and replace a greater proportion of conventional fuels with biofuels is in part determined by developments in energy production, but mainly by how well we manage to reduce our energy consumption as a whole and the fuel use of our vehicles. The fastest way to increase the use of renewable fuels is to increase the amount blended into conventional fuels in so-called low blends. Currently, renewable fuels are blended into conventional fuels at 5%, the amount allowed by European specifications.

In Sweden, 73% of the renewable fuel used is used in low blends.

### **SECOND GENERATION RENEWABLE FUELS**

Most of the renewable fuels currently under discussion, can be used with current diesel engine technology in conjunction with smaller or more major

modifications. Well-to-wheel studies suggest that the most interesting options can be found among second generation fuels, such as DME, methane and methanol, or synthetic diesel from biomass gasification. This technology is not expected to be implemented large-scale until after 2015 and is theoretically poised to replace vast quantities of fossil diesel fuel.





GMV—A COLLABORATION BETWEEN CHALMERS AND GÖTEBORG UNIVERSITY FOR ADDRESSING ENVIRONMENTAL QUESTIONS AND SUSTAINABLE DEVELOPMENT. OUR MISSION IS TO INITIATE, PROMOTE, DEVELOP, AND COORDINATE RESEARCH AS WELL AS FURTHER DEVELOP EDUCATION. GMV SUPPORTS AND DEVELOPS RELATIONSHIPS WITH PARTIES OUTSIDE CHALMERS AND GÖTEBORG UNIVERSITY IN ORDER TO GENERATE A GREATER NETWORK OF PARTNERS FOR SUSTAINABLE DEVELOPMENT. OUR PURPOSE IS TO CREATE, BUILD ON, AND REINFORCE WHAT ALREADY EXISTS, AND TO BOTH LINK AND TRANSCEND THE DISCIPLINARY FRAMEWORKS. 400 RESEARCHERS AT CHALMERS AND GÖTEBORG UNIVERSITY HAVE JOINED THE NETWORK AND PROVIDE THE SCIENTIFIC BASIS FOR OUR WORK.

## Centre for Environment and Sustainability, GMV *at Chalmers and Göteborg University*

*The current report is the product of a Chalmers-based partnership; as part of this project, Chalmers takes on the commitments detailed below.*

### FEASIBILITY STUDY

During the course of 2007, GMV has participated in the project On the Road to Climate Neutral Freight Transportation. Our role has included engaging researchers from our research network in a feasibility study in this area. This study characterizes the current situation as well as trends for the future and visions for climate neutral freight transportation in Sweden (Hedenus, F. 2007). The study covers limitations and difficulties associated with these visions due to costs, resource bases, and interconnections with other areas of the energy system, and outlines steps that can be taken toward these visions today and in the coming 5–10 years. The study also includes estimates of greenhouse gas emissions reductions possible with these measures. To reach climate neutral transportation, Hedenus suggests a three-part strategy.

– **More efficient shipments.** This means reducing the total amount of transportation work through for instance more efficient logistics systems, but also reducing fuel consumption through so-called eco-driving.

– **More efficient vehicles.** Improving fuel efficiency through better engines and new technology, for instance hybrid and fuel-cell technology.

– **New fuels and biofuel blends.**

### CHALMERS' GOALS AND VISION

Our goal is for engineers and architects trained here to participate in the design of our future society, not for them to be mere cogs in the machinery. Our vision is to participate in creating a sustainable society. Our long-term strategic work to incorporate environmental issues and the entire concept of sustainable development as an obvious and integral part of our

educational and research programs has paid off.

Today, environmental issues and sustainable development are part of Chalmers' core brand and one of our strengths. These areas have developed based on mission-driven work by the University, combined with initiatives by Chalmers Foundation through Chalmers Environmental Initiative. Within many areas relevant to environmental issues and sustainable development, our competency is both wide-ranging and deep, for instance within climate and energy questions generally speaking, in additional global resource questions, such as water and land use, monitoring technology, as well as within vehicles, transportation and logistics, sustainable construction and city planning, etc.

Chalmers' many networks, contacts, and partnerships are important components in this development. The demand for expertise supporting sustainable development is increasing, and students educated at Chalmers are expected to understand complex relationships and global issues. During perhaps 40 years, they will be professionally active in a changing world, and during their education, Chalmers must provide them with the tools, insights, and appropriate approaches they will need to rely on in order to feel at home in their future professional roles.

### CHALMERS: OUR COMMITMENTS ON THE ROAD TO CLIMATE NEUTRAL TRANSPORTATION

- Ensure that all our students reflect on sustainable development and the role of transportation in this development, during their studies at Chalmers.
- Develop efficacious cross-disciplinary research environments and initiate new research projects aiming to reduce the climate impacts from transportation.
- Organize cross-sector workshops to initiate knowledge exchange between various agents in order to promote further engagement and partnering in this area.

#### Reference:

Hedenus, F (2007) On the Road to Climate Neutral Freight Transportation. Scientific Feasibility Study. Fredrik Hedenus, Dept. of Physical Resource Theory, Chalmers University of Technology, Göteborg, hedenus@chalmers.se



PREEM PETROLEUM IS SWEDEN'S LARGEST TRANSPORTATION FUEL COMPANY AND ONE OF SWEDEN'S LEADING EXPORTERS. PREEM'S REFINERIES IN LYSEKIL AND GÖTEBORG ACCOUNT FOR 80% OF THE SWEDISH AND 30% OF THE NORDIC REFINERY CAPACITY AND ARE AMONG THE MOST MODERN AND ENVIRONMENTALLY EFFICIENT IN EUROPE. PREEM ALSO HAS A NATIONAL NETWORK OF FILLING STATIONS WITH 500 GAS STATIONS AND 160 DIESEL STATIONS FOR HEAVY VEHICLES. ABOUT ONE THIRD OF ALL TRUCKS RUN ON PREEM DIESEL.

## Preem Petroleum

*As a transportation fuel company, Preem has a dual responsibility. Society needs our products, but we also must ensure that these are produced and used in the most energy and environmentally efficient way possible.*

Among other things, this means that we strive to reduce carbon dioxide emissions at every step along the way from production to use. Our initiatives to date have been successful. Today, our refineries emit 40% less carbon dioxide per fuel unit produced than the average for Western Europe. Current and planned projects and measures to further reduce carbon dioxide emissions can be divided into the following categories: Carbon-dioxide efficient production, Optimized shipments, Efficient use of resources including renewable fuels, and Improving fuel economy.

#### **CARBON-DIOXIDE EFFICIENT PRODUCTION**

In order to reduce energy consumption and climate impacts, we work to, for example:

**Improve recovery of waste heat.** Our refineries generate considerable amounts of process waste heat. This is a valuable resource that can be used for heat or to generate power and thereby replace other energy production. In 2006, Preem supplied 500 GWh of excess heat to Volvo, the City of Göteborg, and Lysekil. But Preem has the capacity to supply additional parties with excess heat. An additional 700 GWh can be converted to power or heat. In collaboration with Chalmers, Preem is exploring options for turning the waste heat into electricity. It can also be delivered in the form of district heating to additional municipalities.

**Increase use of natural gas.** Preem is part of a collaboration seeking to establish a natural gas pipeline from the Norwegian coast to the West coast of Sweden. By using natural gas to produce hydrogen, Preemraff Lysekil can reduce its carbon dioxide emissions by 140,000 tons annually.

**Wind power.** Preem is also part of the VindIn project, a partnership among parties within energy intensive industries. The goal is to generate 1 TWh of wind power annually.

**Carbon capture and sequestration.** Chalmers and Preem are partnering to determine the options for separating, capturing, and safely sequestering the carbon dioxide generated at our refineries.

#### **OPTIMIZED SHIPMENTS**

Our road shipments are optimized via logistics planning, monitoring and command systems, driver training and development, and through collaboration with customers, drivers, and suppliers. As of 2005, all drivers delivering Preem products are required to undergo eco-driving training. Björnkoll, an information system for eco-driving, enables Preem to monitor fuel consumption per vehicle but also per individual driver. Measures can be taken if fuel use is above average, either via extra monitoring of the vehicle in question or through further eco-driving training for the driver.

#### **EFFICIENT USE OF RESOURCES, INCLUDING RENEWABLE FUELS**

We believe oil is a valuable resource that should be used in the best possible way. For instance, where alternatives are available, fossil resources should not be used in heat applications. Our long-term strategy is



to optimize petroleum production and guide production toward the most beneficial fossil transportation fuel, climate-wise: sulfur-free diesel. In 2006, we completed the so-called Gas Oil project, which has enabled the conversion of 3.4 million tons of fuel oil to diesel fuel. Our goal is to convert the remaining 4 million tons of heating oil to high-quality diesel fuel, by 2011 at the latest. Refinery upgrades will also create better opportunities for using biomass as refinery feedstock.

#### **Biorefinery—integrated production of**

**renewable fuels.** Our traditional refineries form an excellent base for introducing second generation fuels. Our target is to increase our production from renewable feedstocks to 10% over a five-year period; we'll meet this target by hydrogenating bio-oils and through gasification of biomass. Preem is participating in several development and pilot projects in this area. Increasing the renewable components in our products and in our manufacturing is a top priority for us.

**Increased levels in low blends.** Our diesel oil contains 5% renewable fuel, RME (rapeseed methyl ester), the level currently permitted by EU regulations. We hope these regulations will be modified in the next few years. Increasing the level of biofuels blended in low blends makes rapid emissions reductions possible with existing vehicles and distribution systems. We would like to increase the level of renewable bio-oils (FAME) in conventional diesel fuel to 10%. We will also steadily increase the number of filling stations for "pure" biofuels.

**New plant for RME.** In November 2005, Preem and Perstorp started working together to increase sales of renewable fuels. Through this partnership, Perstorp has constructed a new RME plant for Preem. The new plant was opened in May, 2007, and will be the core component in ensuring our access to high-quality RME for low blend diesel. Initial capacity is 160,000 tons per year, but the plant is designed to be able to

### **PREEM: OUR COMMITMENTS ON THE ROAD TO CLIMATE NEUTRAL FREIGHT TRANSPORTATION**

- We will transition our pure oil refineries toward Bio-refineries. By 2011, we aim to have substituted biomass for 10% of the crude oil used to produce Swedish diesel.
- We will increase the amount of renewable fuels in low blend gasoline and diesel from 5% to 10.
- We will work toward the most efficient production and use of transportation fuel, be it fossil-based or not.
- We will improve energy efficiency at every level.
- We will use renewable energy, including wind power, to power our operations.
- Develop methods for securing carbon dioxide during production.
- Improve utilization of excess processing heat.
- Continue to develop energy-saving products and services.



ramp up capacity rapidly, as demand increases. The cold temperature performance of RME makes it the most interesting product for low blend diesel, for the Swedish market.

### IMPROVING FUEL ECONOMY

At Preem, we are working hard to improve fuel economy to reduce our customers' and our own fuel consumption. Our efforts include:

**ACP additives in diesel fuel.** This additive cleans the engine, maintains engine performance, and thereby improves fuel economy.

**High efficiency lubricants** that reduce energy and fuel consumption.

**Björnkoll**—An information system for eco-driving. Björnkoll allows our customers to monitor transportation emissions and fuel consumption in detail for individual vehicles and drivers.





SCHENKER IS ONE OF THE LEADING INTERNATIONAL PROVIDERS OF INTEGRATED TRANSPORTATION LOGISTICS SERVICES, AND THE LARGEST PROVIDER IN SWEDEN WHERE WE PUT MORE THAN 4,000 VEHICLES TO WORK EACH DAY. SCHENKER IS AN IMPORTANT PART OF THE INFRASTRUCTURE THAT KEEPS THE NATION GOING.

Schenker

*Our goal is to reduce carbon dioxide emissions per ton-km by more than 50% by 2020. This is an aggressive commitment; success will require a combination of measures. We need closer cooperation between more parties, from our own subcontractors, the trucking companies, to government agencies and those who manage our nation's infrastructure.*

Strategies spanning seven areas will help us reach this goal: Eco-driving, Reduced speed, New vehicles—better fuels, Inter/co-modality, Longer vehicles for nighttime driving, Increased load to capacity ratio/shorter driving distance, and Smarter city logistics.

#### **ECO-DRIVING**

Today, half of our drivers are trained eco-drivers. Eco-drivers reduce fuel consumption and thereby greenhouse gas emissions by 4–10%. To sustain this effect, drivers need regular feedback and positive reinforcement. Within five years, all our drivers will have received eco-driving training. This provides a potential 5% reduction in our fuel consumption, domestically.

#### **REDUCED SPEED**

Were all our vehicles on domestic routes to slow down, on average, by just 2 km/h, our total fuel use would go down by 1.7 million liters diesel per year. That's 1.5% of our total fuel use. But the extra driving time required is almost negligible. Just ten minutes would be added to the drive time from Göteborg to Stockholm. However, in order to have all drivers actually slow down while higher and higher demands are made on speed and delivery accuracy, will require significant information communications efforts.

#### **NEW VEHICLES—BETTER FUELS**

Replacing older vehicles with newer more fuel-efficient vehicles can improve fuel economy substantially and thereby reduce carbon dioxide emissions. By phasing out older vehicles over the next five years, we will reduce emissions by 10%, compared to the current situation. At the same time, we will increase use of low blend fuels and/or pure renewable fuels. In 5–15 years, we will also use hybrid vehicles for urban goods deliveries and further increase the use of biofuels.

#### **INTER/CO-MODALITY**

For long-distance shipments, i.e., longer than 450 km, combining different transportation modes is often the best option. Schenker is the leader in co-modal shipping in Sweden. Co-modal shipping (road/rail) means using more than one transportation mode to carry a shipment. The loads are carried in separate containers, transported on customized vehicles. Intermodal reloading takes place in customized terminals.

Today, co-modal shipping makes up 10% of our transportation work, in terms of ton-km. By implementing the measures below, co-modal shipments could grow to 15–20% and reduce our total fuel consumption by 3–5%. This potential can be further enhanced through new initiatives in co-modality, including flexi-trains and “co-modality light.”

Efficient co-modal transportation requires well-designed terminals for reloading. Placement, accessibility, and hours of operation are critical. We estimate a need for eight new terminals. This could increase our intermodal volume by 20–30%.

Intermodal solutions are a good complement to conventional freight transportation by road, but are not a substitute. We need to rethink conventional

transportation, including our preconceived notions regarding vehicle lengths.

#### **LONGER VEHICLES FOR NIGHTTIME TRAFFIC**

By using longer vehicle combinations, we can use fewer vehicles to perform the same amount of transportation work. This would improve fuel economy and reduce emissions per unit shipped. What if we could run 32-meter long tractor trailers, on Sweden's largest roads? The road capacity would not need to be changed, because the total weight limit of 60 tons would be maintained. The load capacity per vehicle would increase by 50 m<sup>3</sup>, which would reduce fuel consumption per ton by roughly 15%.

Using 32-meter long vehicles, Schenker could reduce the number of long-distance vehicles dramatically. We could cut the number of shipments between Göteborg and Stockholm from 35 to 25 per day. This would reduce this fuel consumption by 15% relative to current 24 or 25-meter long vehicles, and by 40% for empty loads. This would reduce total domestic fuel consumption for Schenker by two percent.

#### **INCREASED LOAD TO CAPACITY RATIO/ SHORTER DRIVING DISTANCE**

Schenker manages the largest scheduled mass freight transportation system in Sweden. Each day, we coordinate roughly 80,000 shipping tasks in our network of terminals and scheduled transportation routes. If we could include more shipments, for instance shipments currently handled by dedicated company trucks, in the mass freight transportation system, the increase in the actual load to load capacity ratio would entail fuel savings of several percent.

The large partial load sector offers promising potential for reducing total driving distance for long-distance hauls. Developing more and better IT tools will allow transportation managers to further optimize traffic. Coordination between domestic and international shipping can also be improved.

#### **SMARTER CITY LOGISTICS**

Our major cities and municipalities are poised to deal with the congestion and increase in emissions that result from poor load capacity efficiency. Today, many vehicles are carrying small shipments infrequently to municipal distribution centres and commercial shopping centres. Mass freight transportation companies such as Schenker have ready-made solutions that can be customized according to city size. We believe in a combination of regulatory requirements and support for environmentally efficient measures. More efficient city logistics could mean fuel savings within our domestic transportation of 2–4%.

- Use existing strategically placed terminals outside city centres for reloading and supplement where needed by new construction.
- Use cutting-edge IT support and vehicles developed for urban deliveries.
- Optimize freight handling is by coordinating shipments on environmentally efficient routes.
- Prioritize co-loading.

**SUMMARY**

By improving existing technology and using current legislation and infrastructure, Schenker will be able to improve efficiency per ton-km by 20–30%, by 2020. Conservative assumptions regarding technology improvements (hybrid vehicles, biofuels, etc.), as well as support from new regulations and infrastructure, will allow Schenker to reduce by more than half the carbon dioxide emissions per ton-km, by 2020.

**SCHENKER: OUR COMMITMENTS ON THE ROAD TO CLIMATE NEUTRAL FREIGHT TRANSPORTATION**

- Provide training in eco-driving for all vehicle operators.
- Phase out all older vehicles with Euro 0/1/2 engines.
- Fill up with the most environmentally friendly diesel available.





VOLVO TRUCKS IS ONE OF THE WORLD'S LARGEST HEAVY TRUCK MANUFACTURERS. NEARLY ONE IN EVERY TWO TRUCKS OVER 16 TONS ON SWEDISH ROADS IS A VOLVO TRUCK.

## Volvo Trucks



*Volvo's initiatives in carbon neutral transportation cover the following areas: energy efficient vehicles, energy efficient transportation, and carbon neutral fuels, and includes a number of measures related to fuel and fuel efficiency, from developing new energy efficient vehicles to providing eco-driving training for drivers.*

We are also constantly looking for ways to reduce climate impacts from our production and our own transportation. For example, the energy supply at our largest manufacturing plants is based on renewable energy like biomass and wind power and is therefore climate neutral.

#### ENERGY EFFICIENT VEHICLES

Naturally, at Volvo our main focus is on energy efficient vehicles. In addition to technological development, this focus includes efforts to make it possible for trucking companies and drivers to use trucks as fuel efficiently as possible through vehicle optimization and driver development. Today, our service offerings for maximizing fuel efficiency within the Volvo Fuelwatch program include, for instance:

- Tire pressure monitoring—can reduce fuel consumption by up to 3%.
- Optimal gear-changing—Volvo I-Shift is an automated transmission system that contributes to improved fuel efficiency by optimal gear-changing and high efficiency.
- Low air resistance—air flow directors further improve the vehicle's aerodynamic properties, also resulting in reduced fuel consumption.

- Service and maintenance contracts—properly maintained vehicles remain fuel efficient.
- Eco-driving driver training—can save another 5–10%.
- Dynafleet, our transportation information system for optimal vehicle management and monitoring of fuel consumption for each vehicle and driver.

There is also room for significant improvements to existing technology and development of new solutions.

**Further improving today's technology.** The diesel engine drivetrains of today can be improved further to yield even better fuel efficiency. Modern diesel engines are efficient (ca 45%), corresponding to a 40% improvement over the past three decades. By further optimizing the technology, fuel consumption may be reduced by another 10–15%. This means fuel efficiencies above 50% may be possible within a 10-year period.

**Hybrid technology** can provide 20–30% in fuel savings for in-town driving and 5–10% on the highway. These savings mainly come from recycling energy from the brakes and by eliminating idling. In the long run, additional fuel savings are expected by specially designing and optimizing the combustion engine for the hybrid application.

**Plug-in hybrids**, in which a separate battery can be charged from the grid and used to power energy-intensive equipment for waste collection or refrigeration, can reduce diesel fuel consumption for these applications by 20%.

**Smart speed selection**, adjusts vehicle speed according to circumstances and can further improve fuel economy.



### EFFICIENT SHIPMENTS

Our efforts to improve the fuel efficiency and reduce the environmental impact of transportation include:

**European Modular System.** The use of standardized pallets for diverse transportation modes, such as road, rail, and sea, makes it easier to optimize shipments. This is the basic fact underlying EMS (European Modular System), a system Volvo has long been advocating the increased use of in other countries. Regarding transportation by road, EMS prescribes extended length vehicle combinations (25.25 m) for long-distance hauls. This improves the energy efficiency and reduces the number of vehicles required for a given amount of transportation work. Because of the standardized pallets, the load can easily be divided into smaller units for regional and local transportation. So far, EMS is mainly implemented in Sweden and Finland.

**Optimal transportation solutions.** Needs-based vehicle selection simplifies the design of optimal transportation solutions, for instance efficient reloading at the juncture between transportation modes.

**IT support for optimal shipping.** The Volvo system for managing transportation information makes possible for trucking companies to optimally use existing vehicle fleets. This means fewer runs with empty vehicles and better fuel efficiency. Possible fuel savings range from 5 to 10%.

### CARBON NEUTRAL FUELS

Volvo is actively evaluating renewable fuels and already has the technology to use most of the currently available alternative fuels in Volvo trucks.

## VOLVO TRUCKS: OUR COMMITMENTS ON THE ROAD TO CLIMATE NEUTRAL FREIGHT TRANSPORTATION

- Top priority: improved fuel efficiency. Volvo will lead the way by steadily improving fuel efficiency of Volvo trucks by at least 1% each year.
- We will stay in the lead on hybrid technology for heavy trucks.
- We will actively work on the transition to renewable fuels and will assume a leadership role in the development of related vehicle technology.
- We will work toward novel shipping solutions that contribute to increased shipping efficiency and reduced carbon dioxide emissions.





THE SWEDISH ROAD ADMINISTRATION IS A GOVERNMENT AGENCY WITH A BROAD REACH AND WIDE RANGE OF TASKS. THE SWEDISH RIKSDAG AND GOVERNMENT TOGETHER DETERMINE THE FOCUS OF THE SWEDISH ROAD ADMINISTRATION. THIS IS FOR EXAMPLE DONE VIA THE LONG-TERM SWEDISH TRANSPORTATION POLICY GOALS AND THE ANNUAL APPROPRIATIONS DIRECTIVE FROM THE GOVERNMENT.

## Swedish Road Administration

*The Swedish Road Administration aims to provide citizens and businesses with the opportunity to travel and ship goods. Our work should result in a high-standard road transportation system that is cost-effective for society and accessible to everyone. The transportation system should be safe, environmentally friendly, equitable, and should contribute to balancing regional planning goals. The Swedish Road Administration is ultimately responsible for the environmental impact of the road transportation system.*

#### THE SWEDISH ROAD ADMINISTRATION'S INITIATIVES FOR REDUCING CLIMATE POLLUTION, 2008–2017

One of the great challenges for the Swedish Road Administration (SRA) is to substantially reduce greenhouse gas emissions. One of the required components is a transportation-efficient society, which means increasing the proportion of travel by efficient means of transportation and reducing the demand for travel and shipping by improving physical planning as well as through other measures.

**Our goal:** To stabilize carbon dioxide emissions from freight transportation by road at 1990 levels by 2010. By 2020, emissions should be 10% below 1990 levels.

In cooperation with our partners, we will strive toward vehicles with better fuel economy by contributing to the marketplace of ideas, work toward high quality information regarding vehicular carbon dioxide emissions and fuel economy, develop testing methods, evaluate, develop and inform regarding travel policy

and procurement directives, as well as develop solid foundations for economic policy instruments.

**Our goal:** To improve the energy efficiency of freight and passenger transportation by road during the project period.

We aim to be a driving factor for developing a Swedish strategy for introducing carbon neutral fuels. Initiatives focusing on biofuels and other renewable fuels must combine global and long-range perspectives that respect the natural environment. Internationally, Sweden must be at the cutting edge of developing the second generation of biofuels.

**Our goal:** To improve by 10% the energy efficiency of newly registered heavy vehicles in 2014, compared to 2004.

**Our goal:** Sweden will meet the EU 2010 target of 5.75% biofuels in the road transportation sector. By 2017, the portion should be at least 10%.

#### THE SWEDISH ROAD ADMINISTRATION WANTS TO FURTHER DEVELOP MEANS FOR PARTNERING AND WAYS OF WORKING TOGETHER

We have found that a systematic approach to partnering in order to reduce carbon dioxide emissions from freight transportation is needed. The current project, On the Road to Climate Neutral Transportation, is poised to make a significant contribution to this. Projects in road safety have benefited from the OLA-methodology (Objective facts, List of solutions, Action plans). We will communicate the experience we have acquired through working with OLA to our partners in the current project. We also consider it vital to make use of and expand on the work currently conducted in Transportation Quality Assurance (Kvalitetssäkring) and the Round Table methodology.

**SWEDISH ROAD ADMINISTRATION:  
Our Commitments On the Road to Climate  
Neutral Freight Transportation**

Our intention is to implement these measures by 2010.

**1. Eco-driving requirements  
for all driver's licenses**

In 2006, we introduced eco-driving requirements for passenger vehicle driver's licenses. In 2008, we will introduce analogous requirements for all driver's licenses. This initiative will result in new curricula for all the remaining driver's licenses, published in the SRA statutes by the end of 2008 at the latest. This will be monitored by verifying the changes decided on in the SRA statutes prior to January 1, 2009.

**2. Provide support to trucking companies  
wanting their trucks to observe the speed limit**

SRA can support trucking companies in three main areas—implementing ISA (Intelligent Speed Adaptation), monitoring actual speed, and developing ATK (automatic speed and traffic controls).

**Implementing ISA.** Starting in 2008, SRA intends to provide expert support for trucking companies seeking to establish technological support and methods for monitoring to improve speed limit adherence. This support is based on the method tested in the project UPÅT (monitoring for trucking-company road safety) within the research program IVSS (Intelligent Vehicle Safety Systems). The method combines two aspects—providing technical support via an expanded functionality in the existing traffic control system and monitoring by management of the extent to which drivers adhere to the speed limits. The goal is to gradually increase the number of trucking companies

implementing this or similar systems. By the end of 2010, at least 20 companies should be using this method. (Currently, adherence to speed limits is measured for 13 trucking companies.) SRA also provides high quality speed data. Follow-up is through control in existing networks, potentially complemented by trucking company surveys.

**Measuring speed.** SRA intends to perform actual speed measurements twice annually, in the coming three years. The trucks belong to 13 trucking companies and the results will be used for the purpose of Transportation Quality Assurance. Follow-up will consist of verifying that the measurements have been performed.

**Developing ATK.** In partnership with the Swedish Police Service, SRA will further develop ATK (automatic speed and traffic controls). Our goal is to develop the technology to the point where distance measurements are possible and trucking companies can be provided data on their own vehicles. Follow-up consists of determining which activities have been performed each year.

**3. Support development of new transportation  
solutions that make it possible to leverage the  
road network for longer and heavier vehicles**

Skogforsk (the Forestry Research Institute of Sweden), SRA, vehicle manufacturers, and entrepreneurs are working together on a new research project to explore the possibilities for increasing the load volume on Swedish lumber vehicles. We expect this project to reduce fuel consumption, lower transportation costs, and increase road safety. The project is called One More Stack (En Trave Till). We intend to explore the prospects for using the concept and results of

this project for other kinds of freight transportation. Our aim is to start on a feasibility study by the end of 2008, by when the first results from One More Stack should be available. Follow-up will simply consist in determining whether the feasibility study has been performed.

#### 4. Support the development of innovative solutions for deliveries in urban settings

The urban development project, The Good City—a partnership between SRA, the Swedish Rail Administration, the National Board of Housing, Building and Planning, the Swedish Association of Local Authorities and Regions, and the municipalities Uppsala,

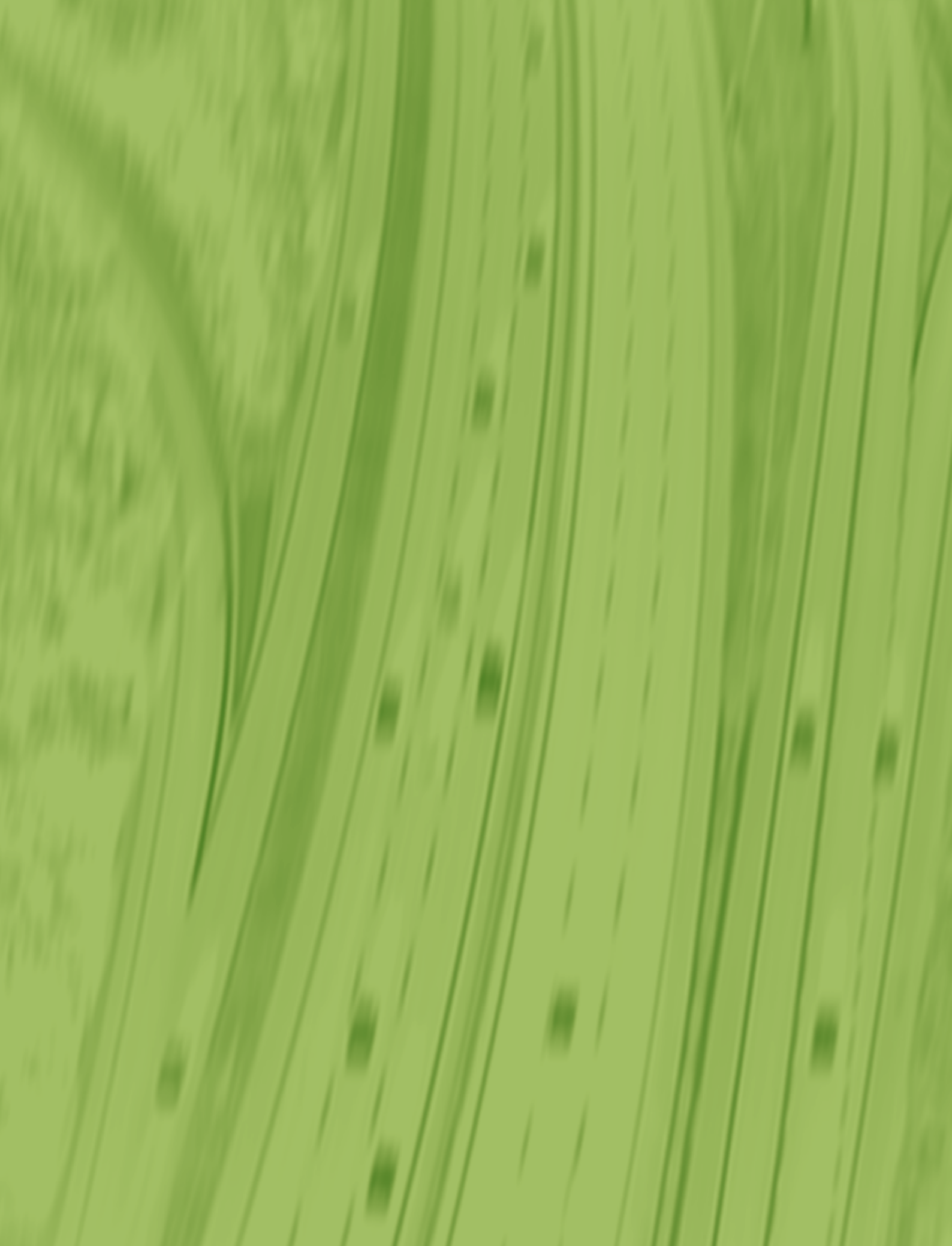
Norrköping, and Jönköping—has identified urban goods deliveries as an urgent issue. A subproject titled Strategic handling of urban goods deliveries is at the planning stage. This project will combine the goals in The Good City with the transportation policy goal of an “accessible transportation system” and the ambition to make freight transportation more energy efficient. SRA intends to complete the project Strategic handling of urban goods deliveries. The result is expected to provide a model that will simplify choosing suitable and energy efficient solutions for goods deliveries in cities. Follow-up will be performed via annual observations of interim results. The project is expected to end in 2009.

#### SWEDISH ROAD ADMINISTRATION: OUR COMMITMENTS ON THE ROAD TO CLIMATE NEUTRAL TRANSPORTATION

- Eco-driving requirements for all driver's licenses.
- Provide support to trucking companies wanting their trucks to observe the speed limit.
- Support development of new transportation solutions that make it possible to leverage the road network for longer and heavier vehicles.
- Support the development of innovative solutions for deliveries in urban settings.







**DB** SCHENKER

**VOLVO**  
Volvo Truck Corporation



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