



SCANIA ON SUSTAINABLE TRANSPORT

Green light for alternative fuels

Sustainable urban transport – here and now

There is no single “silver bullet” solution for achieving sustainable transport.

To solve the problems of polluted air, CO₂ emissions, congestion and energy security that plague most growing cities today, many parallel developments are necessary. Improved public transport, better logistics, driver training, new energy-efficient vehicle technologies (e.g. hybridization) and alternative fuels are all important parts of the green toolbox. To make the transition towards sustainable transport as quickly as possible and in scale, we also need these solutions to be cost-efficient and industrialized.

And here the use of alternative fuels and biofuels will play an especially important role for the transport sector, today and tomorrow. This is particularly true for heavy transport like trucks and buses, where electrification will not be as easy to achieve in a commercial way, as for lighter vehicles and cars.

Scania is convinced that the transition to alternative fuels and biofuels, based on existing and proven technology, can – and should – start here and now.



Combining Bus Rapid Transit (BRT) with locally produced alternative fuels or biofuels, is a great way of achieving attractive public transport, whilst at the same time cleaning up the air and creating local jobs and energy security.

“Start with the heavy fleets”

It is possible to break the dependency of fossil fuels here and now. Stockholm, the first city to be awarded the title “Green Capital of Europe” in 2010, has been replacing fossil fuels in many types of transport since 1994 in a pro-active and planned way. Due to Stockholm’s pioneering efforts, the world’s largest biofuel bus fleet rolls the streets of Stockholm – over 80 % of the 2200 buses are fossil free. Both bioethanol, biomethane and biodiesel fuels are used in a number of heavy duty applications, like buses, waste trucks and distribution trucks. Parts of this fleet is now also hybridized. And Stockholm keeps driving the development. In 2015, the

Stockholm “CleanTruck” project was finished, clearly demonstrating that several sustainable options for commercial truck operation now is available – and Scania’s bioethanol ED95 trucks were the solution that achieved the highest CO₂ savings.

“It is often best to start with the heavy fleets,” says Eva Sunnerstedt, “since they often represent a very high proportion of a city’s emissions, and it also keeps infrastructure costs low and builds commercial volumes quickly.”

Eva Sunnerstedt, responsible for clean vehicles, City of Stockholm, Sweden.



“The Scania model provides a viable option to create local fuel from local waste and use it for local transport”

At the opening of Scania’s new factory in India in 2015, the Indian Transport Minister, Nitin Gadkari, praised Scania’s work to develop sustainable fuels such as biogas and ethanol. When speaking at the inauguration of Scania’s Naraspura bus facility Mr. Gadkari stated:

“This is not only an opening of a new bus factory, it’s also the opening of a new clean technology for India. Our Government is recognising the need for clean fuel and sustainability, to build our Smart Cities (Indian Government initiative to improve the environment and transport systems in India’s 100 largest cities) and a quality of life for our citizens. Public transport in India has to be redefined as sustainable and clean. Scania’s strategy for India helps reduce India’s dependence on fossil fuels. The Scania model also provides a viable option to create local fuel from local waste and use it for local transport”



Mr. Anders Grundströmer, MD Scania India, Senior Vice President Scania CV; Mr. Martin Lundstedt, President and CEO Scania CV; Mrs. Anna Johansson, Swedish Minister for Infrastructure, Mr. Harald Sandberg, Ambassador of Sweden to India, Shri Nitin Gadkari, Indian Union Minister of Road Transport and Highways.

Three commercially available biofuels

Today – there are only three biofuels that can fulfil the important requirements of sustainability, commercial availability and volume production – bioethanol, biomethane and biodiesel. Increasing shares of these biofuels could also be generated from waste.

Other interesting biofuels – and new sources for biofuels – already exists in small volumes, and are under further development, such as synthetic diesels (e.g. Hydrotreated Vegetable Oil/HVO) and alcohol type fuels (e.g. bioethanol and biobutanol) from cellulose. These biofuels will not be globally available in commercial

volumes for some time, but it is important to keep pushing this development.

However, the available volumes of bioethanol, biomethane and biodiesel makes it possible to act here and now, in scale and with existing technologies, in order to curb the trend of increasing CO₂ emissions from road transport, to improve air quality and to create local energy security and local jobs.

There are also other clean alternative fuels, not originating from biomass, like natural gas and synthetic diesels, that also could improve air quality and to some extent CO₂ emissions.



Biodiesel (or FAME) and **Synthetic diesels** can be made from various sources, often bio-oils like rapeseed oil, jatropha oil, soy bean oil, animal fats and waste cooking oil, all with different quality aspects.

Biodiesel is typically produced from chemically reacting the bio-oil's fatty acids with

methanol, resulting in a liquid biofuel that can be used in diesel type engines. Biodiesel is available in commercial volumes and has a global fuel standard.

Synthetic diesels, e.g. HVO, is typically produced from hydro treating of bio-oils, resulting in a diesel-like biofuel. However, commercial volumes are still limited globally. There are also many fossil based synthetic diesels, made from e.g. coal (CTL) or natural gas (GTL).

Biodiesels and synthetic diesels could be used for low-blending into diesel, but also as high-blends into diesel or in a pure 100 % biodiesel form. CO₂ reduction from biodiesel operation is normally between 35–66 %, as compared to diesel. Standards for biodiesel type fuels are available.



Bioethanol is the most widely used biofuel in transport today. It is also the biofuel that is most likely to be able to supply both large and sustainable volumes in the future. A major advantage is that it is a liquid and available in commercial volumes globally. It can be

produced very cost efficiently – even on a small scale – from a variety of raw materials, like sugar cane, beets, cellulose and organic waste, and it is used both as a pure fuel and in low blends. CO₂ reduction from bioethanol operation could be up to 90 %, as compared to diesel.

Bioethanol could also be used in bus and truck operation. Scania masters this by using a high blend bioethanol fuel in an efficient diesel engine, adapted for bioethanol.

Diesel applications give a much higher energy efficiency gain, as compared to using the bioethanol in less efficient petrol engines in cars.

The standardized high blend bioethanol fuel used in diesel engines is called ED95, a blend of 95 % hydrous ethanol and 5 % fuel components.



Biogas or Biomethane can be produced from a number of sources. The raw biogas is usually generated from the anaerobic digestion of e.g. sewage, organic waste or manure. The raw biogas typically contains around 60 % methane, but also water, CO₂, sulphur and other impurities. If treated and upgraded to a clean and standardized gas fuel quality, containing approximately 97 %

methane or more, the gas could be used as a high-quality sustainable biofuel. This fuel is often referred to as biomethane.

Even though waste volumes are limited, cities can use this favourable opportunity to power parts of local city bus and truck fleets and in this way secure a supply of a locally produced, clean and very sustainable biofuel. The sewage and organic waste (e.g. food waste) from 1 000 citizens could generate biogas necessary to power a city bus (or two waste collector trucks) for one year.

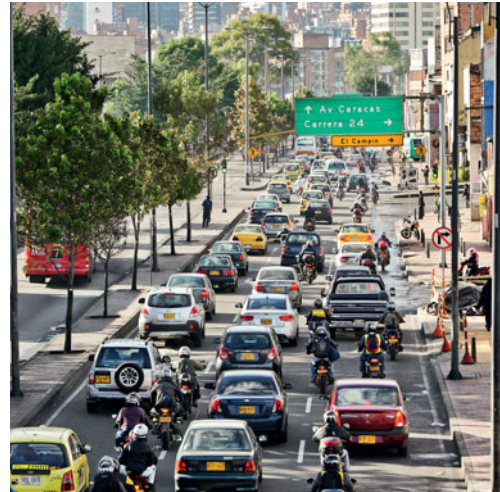
Biomethane consists of the same molecule (methane, CH₄) as natural gas but biogas is renewable and natural gas is fossil. The two can be used in parallel. While biomethane operation could reduce CO₂ with up to 90 %, natural gas CO₂ reductions is normally around 15–20 %, when using Scania's efficient engines, as compared to diesel. Gas fuel standards are available.

Scania's solutions also cover support with sustainable fuel supply and refuelling infrastructure. Scania and partners will support you in setting up solutions for alternative fuel supply, should so be required.

Biofuels – a contribution to sustainability, air quality, energy security, local jobs and economic growth

Alternative fuels clean up the air and save lives

The rapid growth of cities throughout the World causes problems of congestion and polluted air. According to WHO, 1 out of 8 deaths today is due to poor air quality. Heavy duty trucks and buses often represent a high share of a city's particulate emissions. But, by using clean alternative fuels and biofuels, it is possible to leapfrog from poor diesel qualities to ultra-clean emission levels like Euro 5, EEV and Euro 6, and dramatically improve both city air and citizens' health.



Biofuels increase security of fuel supply and improve local economies

A high dependency of imported oil makes local economies vulnerable for both price fluctuations and outside political pressure. In many oil-dependent countries, locally produced biofuels and alternative fuels can both increase security of fuel supply and improve state and city budgets.

Biofuels help create local job opportunities and industrial development

There is a big employment potential in the biofuel industry. Studies show that biofuels create up to a 100 times more jobs per energy unit produced, than the highly capital-intensive fossil fuel industry. And not only for farmers, the biofuels industry also create jobs for a broad range of expertise, including engineers, scientists, economists and labourers.





Biofuels helps fight poverty

According to FAO (Food and Agriculture Organisation of the United Nations), evidence shows that when developed responsibly, sustainable biofuel production systems can offer an additional source of income for poor farmers, and the focus should be food and fuel rather than food or fuel. Increased demand for biomass improves the profitability of agricultural production, generates money to invest, strengthens the agricultural economy, helps improve yields and raise the standard of living. By-products generated from biofuel production like bio-fertilizer and animal feed also improves the local farming economy.

Biofuels turn waste into clean energy

Waste water and sewage that otherwise go untreated, and organic and food waste that otherwise go to landfills or dumps, could commercially be turned into biogas and bioethanol to power local fleets. Sweden has been pioneering these technologies and Scania and partners can supply whole turnkey solutions – from waste to wheel.

Biofuels help reducing the carbon footprint from transport

Transport is the most oil dependent sector of society, and also increase its CO₂ emissions faster than other sectors. Biofuels could help to radically reduce transport's carbon footprint. The average well-to-wheel greenhouse gas (GHG) reduction, including direct land use, from some common commercial biofuels is shown in the chart. With improved methods the figure can be even higher, depending on the production process and the raw materials used.

Do biofuels compete with food?

Food is always a priority. But contrary to what is sometimes perceived, there is no global lack of land – rather the opposite. The World produced 1400 MT of grains in 1980, using 735 MHa of farmland – and in 2010, 2300 MT of grain was produced on 690 MHa. In Europe

alone, more farmland has been actively abandoned than is used for all global biofuel production today. In Africa and South America, there are also large areas of unused cropland, only fed by rain, that with sustainable land management could be used for both food and fuel, while improving both the environment and the economy. Scania strongly supports that all biofuel production should be certified from a sustainability point of view. But it is also important to remember that fossil fuels never could be sustainable.



Biofuel production pathway	Average GHG emission saving
Biogas from organic waste	73%
Sugar beet ethanol	52%
Sugar cane ethanol	71%
Ethanol from industrial wheat (with CO ₂ recycling)	95%
Biodiesel from waste oil	83%
Biodiesel from rape seed (RME)	38%

Calculated according to the EU Renewable Energy Directive's sustainability criteria.

The Sustainability Challenge: Commercial Solutions are available



The transport sector needs to tackle a multiple challenge – to break its dependency on oil and at the same time reduce its increasing local and global emissions. Scania takes active responsibility for this challenge, and not just by developing and testing technology for the future.

We also produce standardised off-the-shelf solutions that could address the sustainability challenge in a commercial way – here and now. With Scania's unique green portfolio, covering all the major commercial alternative fuels and biofuels, supported by hybridization, we can provide solutions that ensure the best operating economy and the most cost-efficient emission and CO₂ reduction for each individual customer.

Ecolution by Scania

This is Scania's cutting edge fuel and CO₂ saving program. It includes driver training, driver follow-up, fuel/CO₂ optimized vehicle specifications and maintenance programmes. Ecolution by Scania is a concept that is ready to go, here and now.

Read more at www.scania.com/ecolution

Biodiesel and synthetic diesel products

A broad range of Scania's trucks and buses could be used with up to 100 percent biodiesel and HVO.

Biodiesel and HVO can be used for all types of operation and ranges.

Bioethanol (ED95) products

Scania has for over 30 years commercially produced bioethanol vehicles for heavy transport.

Our applications use a diesel engine, adapted for the standardised bioethanol fuel ED95. It achieves the same energy efficiency as a diesel engine. Daily operations are also very similar to running diesel vehicles, so it is easy to take the step and start using bioethanol vehicles.

Scania has a number of products available for the ultra-clean bioethanol fuel – e.g. buses, trucks and waste collectors.

Biogas and natural gas products

Scania's new gas Otto engines not only provides a clean, low noise operation, it is also the most fuel efficient gas engine the World has seen to date, reaching both diesel torque and diesel energy efficiency levels.

Scania supply gas buses and trucks for both urban and regional purposes. For various transport purposes, relevant fuel tank solutions are available, both for compressed (CNG/CBG) and liquid (LNG/LBG) gas.



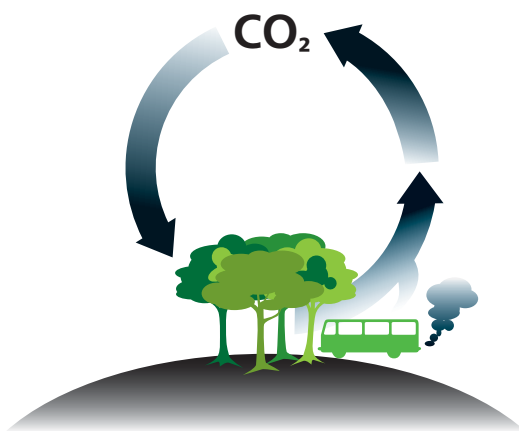
There is CO₂ – and then there is CO₂

All types of combustion causes emissions of carbon dioxide (CO₂).

But CO₂ from combustion of biofuels (that is derived from biomass) is normally part of the natural cycle – if the biomass is produced sustainably. When new biomass is replanted, carbon is removed from the atmosphere – during photosynthesis – and stored in the biomass. Thus the combustion of biofuels does not

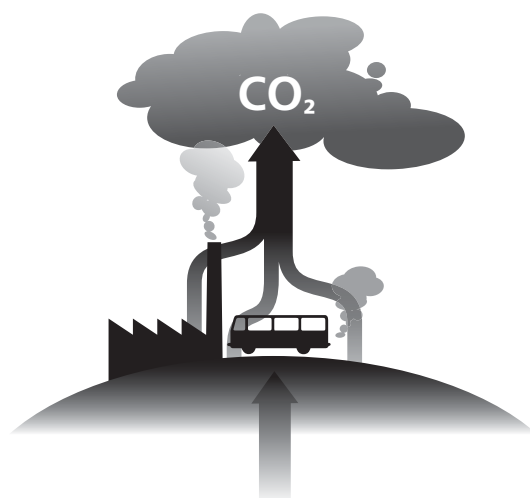
contribute to net increase of carbon dioxide in the atmosphere.

The carbon dioxide (CO₂) from burning fossil fuels like coal, oil and natural gas, release carbon that previously has been stored for millions of years in fossil deposits, into the atmosphere, and thus contribute to a net increase of carbon dioxide in the atmosphere and climate change.



Biofuels

- Part of the natural carbon cycle
- Do not contribute to a net increase of CO₂ in the atmosphere



Fossil fuels

- Release carbon from fossil deposits
- Increase CO₂-levels in the atmosphere and drive climate change



Don't wait – start here and now!

It's easy to go green – a whole range of trucks and buses are available for use with all commercially available alternative fuels. Scania is prepared – so don't wait – let us start making transport clean, sustainable and powered by local energy. Here and now!

Contact your local Scania dealer or visit www.scania.com to find out how you can make your transport business more profitable and more sustainable.

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