BioMethanol from forest residues – a growing asset

Over the past 100 years, forest reserves have doubled as logging has fallen short of growth by 20-30% since the 1920s in Sweden. This is also the case in Värmland. VärmlandsMethanol intends to utilize forest residues that would otherwise after logging be left in the forest to rot and emit carbon dioxide to no avail.

It is entirely in line with the EU's view of using forest residues for the production of biofuels. According to the EU Commission's assessment, forest-based bioMethanol reduces fossil carbon dioxide emissions by about 95% compared to gasoline. The forest is sufficient both for the needs of the forest industry and to replace Sweden's gasoline and diesel consumption with bioMethanol. Several government studies have shown that bioMethanol, produced by gasifying wood, is the way to fossil freedom.

"In order to shift to the fuels that, over time, provide the lowest costs for achieving climate goals, policy should then be focused as soon as possible on starting the production of methane, methanol and/or DME from forest residues, possibly supplemented with hydropyrolysis-based drop-in fuels from forest residues".

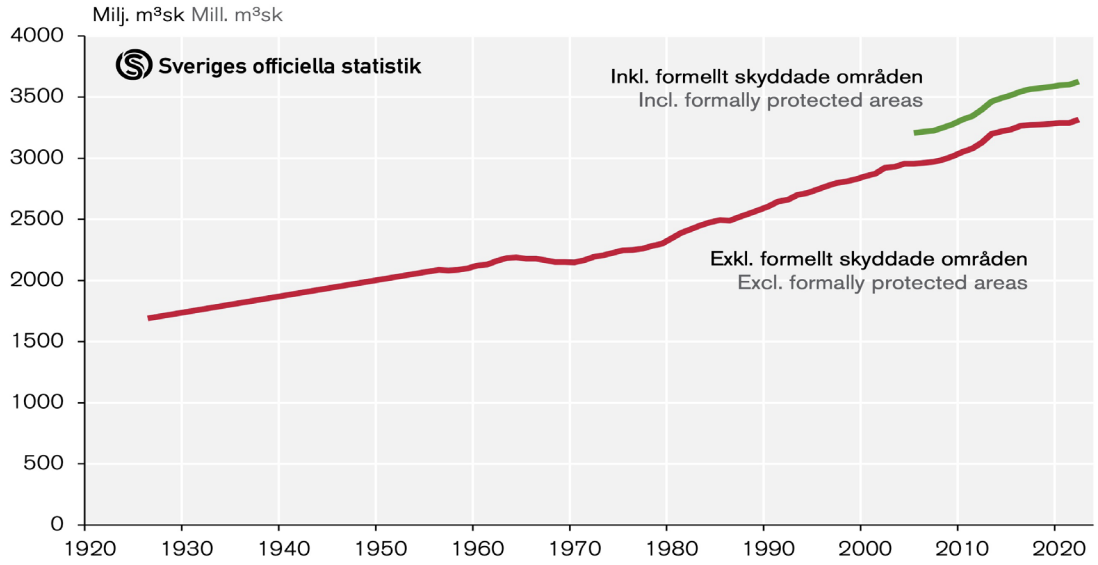
The Swedish Energy Agency, 2019

Supply of forest biomass in Värmland

	Mill m³ fub	*TWh*
Standing volume*	198	398
Annual increment	8,2	16,5
Annual felling	5,2	10,5
Annual consumption VärmlandsMetanol	0,4	0,88

*GROT (foresst residues) not included (avaliable GROT = 5.8 TW/year)

Standing volume in Sweden since the 1920´s.



Total growing stock 1926-2023.

Total growing stock. 1926–2022. All land use classes outside urban land. Including alpine areas from 2018. Excluding (red) and including (green) formally protected areas as of 2023. Mean value for 1923–29, linear interpolation for to 1954 followed by moving five year averages.

Sources: Statistics Sweden, Official Statistics

Forest – a green factory powered by solar energy

If we do not use the forest, but leave the trees to die and decompose, the trees' bound carbon is released into the atmosphere as carbon dioxide to be captured again by growing forests. The result is a zero-sum game with constant carbon storage in our forests.

But by felling and replanting the forest, we can increase carbon storage. Approximately 45 percent of the felled Swedish forest is used for the production of pulp and paper, the same amount is used for sawn timber products and less than 10 percent is used for heating purposes, mainly district heating.

For about a hundred years, the growth in Swedish forests has annually exceeded the amount of felling. Today's forest reserves, as well as the amount of carbon bound in the forest, have therefore doubled during this period. With each passing year, more carbon is sequestered in our growing forests than is removed through felling. Add to this the fact that wood raw material for construction, furniture manufacturing and other wooden structures become a permanent carbon sink. Under such circumstances, our **Swedish forestry is carbon dioxide neutral.** The Swedish forest's net carbon dioxide sequestration corresponds to the total annual emissions from Swedish road traffic and industry.

In Värmland, there is GROT (branches and tops) after thinning and felling, which could sustainably supply six factories the size of VärmlandsMethanol with raw materials.

If Salix (energy forest) was grown on about 1 million of poorer forest land and poorer overgrown arable land, bioMethanol produced from energy forest with gasification technology could power Sweden's entire vehicle fleet.

Methanol as fuel for vehicles

VärmlandsMethanol's original idea was to produce bio-Methanol for low-blending in gasoline. However, since 2013, such bioMethanol has been taxed with twice as high an energy and carbon dioxide tax as fossil gasoline. This unfair taxation currently makes it impossible to invest in bioMethanol, because the taxation makes bio-Methanol more expensive than fossil gasoline. The same applies to ethanol. Therefore, 85% of Sweden's biofuels are imported from low-cost countries.

However, we are not abandoning the idea of a future market for bioMethanol as a motor fuel in Sweden. It is necessary to open up to domestically produced motor alcohols, if Sweden is to achieve a fossil-free vehicle fleet by 2030. National energy security and health aspects are other strong arguments for investing in motor alcohols such as methanol.

Motor alcohols can save lives

Today, more than 4 000 people die prematurely per year due to the particulate matter and unburned hydrocarbons in car exhaust. Far more people are exposed to illness. It is common knowledge that alcohols such as methanol and ethanol burn cleaner and more efficiently than gasoline and diesel and therefore also produce cleaner exhausts and save lives. Biogasoline and biodiesel burn just as poorly as fossil gasoline and diesel.

Alcohols are environmentally friendly as fuels

Gasoline and diesel consist of hydrocarbon compounds, that is compounds of carbon and hydrogen. It is a mixture of many different hydrocarbon compounds. Gasoline contains about 500 different hydrocarbon compounds. The most common are compounds consisting of a dozen carbon atoms. Diesel is dominated by compounds with up to 20 carbon atoms.

Hydrocarbons burn more efficiently and cleaner, the shorter the carbon chains they consist of. Optimal engine power is obtained if combustion engines are fed with a homogeneous fuel, based on a single hydrocarbon molecule, which contains few carbon atoms. An engine designed to burn a single compound can be optimized maximally for this compound Today's engines for gasoline and diesel are, in terms of combustion technology, a poor compromise for a "blissful" fuel mixture.

Methanol, which has one carbon atom per molecule, burns the cleanest of all alcohols, followed by ethanol with two carbon atoms per molecule. Alcohols contain oxygen, unlike gasoline and diesel. Oxygen is needed for the combustion process.

The Lotus Exige 270 E Tri-Fuel is a sports car that can run on both petrol, methanol and ethanol. It becomes significantly more powerful when run on alcohols. The car is part of Lotus' research to develop vehicles that can run on the environmentally friendly fuels of the future.

The electric cars of the future will not have heavy batteries or heavy hydrogen tanks, but will be powered by fuel cells, which convert chemical energy into electrical energy. Methanol is a perfect fuel in this context and, unlike hydrogen, can be stored at normal air pressure in a tank just like gasoline. You get a light electric car with good range and quick refueling.

Drop-in fuel

Methanol is ideal for low-level blending with up to 25% in gasoline for all existing gasoline cars with injection engines. Blending alcohols, both bio- and fossil-based, into gasoline improves the combustion process and results in cleaner exhaust gases and reduced energy consumption. Therefore, emissions of fossil carbon dioxide are also reduced even when blended with fossil alcohols, e.g. methanol made from coal/natural gas.

Methanol for E85 cars

Methanol works in existing E-85 cars in the same way as ethanol. Distribution systems and cars are already in place. Today's E-85 cars have their origins in M85 cars developed in the USA in the 1980s.

Methanol engines

An engine adapted for pure methanol is about 30% more energy efficient than a petrol or diesel engine. This is because methanol has a higher octane rating than petrol/diesel, which allows higher compression and higher power for a given cylinder volume. In other words, a methanol engine with the same performance as a petrol engine is smaller and lighter, which is an advantage in terms of road wear and load capacity.

Methanol for electric cars

Methanol is also ideal as a fuel for electric cars with fuel cells. There are fuel cells for methanol (DMFC) and fuel cells for hydrogen. The latter can also be powered with methanol, which is then converted into hydrogen via a converter.

China is investing heavily in methanol as a vehicle fuel, both as 100% methanol fuel and as a drop-in fuel. Volvo's owner Geely has developed passenger cars and trucks that run on methanol. Geely has also manufactured the world's first truck that runs on pure methanol, M100.

New markets – New possibilities

Fossil methanol, produced from natural gas through steam reformation or from coal through gasification, is one of the world's largest raw materials in the chemical industry for the production of, among other things, paint and plastic. Globally, approximately 73 000 000 tons of fossil methanol are consumed annually. The Swedish annual consumption amounts to approximately 300 000 tons.

The Swedish annual consumption amounts to about 300 000 tons, import value about SEK 1,6 billion. The global methanol industryhas an annual turnover of about 55 billion US dollars. The climate debate has now reached methanol users, who are demanding bioMethanol.

This opens up a whole new market for VärmlandsMethanol.

- The marine sector is now investing in fossil methanol with an eye on bioMethanol
- A growing market for bioMethanol exists in the chemical industry
- The expansion of solar and wind power creates an increased need for environmentally and climate-friendly reserve power, i.e. fast-starting gas turbines powered by bioMethanol
- Aircraft jet engines can in the future be adapted to operate on methanol

Methanol – the future marine fuel

Photo: Lena Eriksson Sonebrink

Shipping is responsible for large emissions of fossil carbon dioxide and significant emissions of harmful and acidifying sulfur and nitrogen oxides. Add to this the emissions of harmful particles.

Through international agreements, emissions have been reduced and will be radically reduced in the future.
For emissions of fossil carbon dioxide applies:

2030 – reduction by 20% compared to 2008
2040 – reduction by 70% compared to 2008
2050 – reduction by 100% compared to 2008

Swedish Stena is a global methanol pioneer with tens of thousands operating hours on the Gothenburg–Kiel route. Other shipping companies have widely followed Stena. At the same time, manufacturers of marine diesel engines, primarily MAN, have started to deliver engines built for both methanol and diesel (dual fuel technology).

Waterfront Shipping ooperates the world's largest methanol ocean tanker fleet with 19 of its 30 vessels equipped with methanol dual fuel technology, representing approximately 60 per cent of its fleet.

Møller-Maersk currently has eight methanol-powered container ships in operation. It has also been decided that all future new ships will be able to be powered by methanol.

Currently, the world´s shipping companies have ordered about 350 methanol-powered ships. A condition for this development has been a marine methanol standard.

The accumulated experience of hundreds of thousands of operating hours shows that emissions of sulfur dioxide, nitrogen oxide and particles, when operating with methanol, have been reduced by 99%, 40% and 95% respectively. Despite the use of fossil methanol, fossil carbon dioxide emissions have also been reduced by about 15%. This is due to the fact that methanol burns more efficiently compared to diesel.

On the market today, only fossil methanol made from coal or natural gas and a small amount of electromethanol are available. The shipping companies see the investment in fossil methanol as a first step towards fossil-free shipping through a subsequent transition to biomethanol.

As an example of the marine methanol market, it can be mentioned that a large container ship of 200 000 deadweight tons, on the Hamburg-Hong Kong route, burns about 10 000 tons of methanol. Traveling the current route takes 30 days. In other words VärmlandsMethanol's planned annual production of 100 000 tons covers only five round trips for a container ship, operating the Hamburg-Hong Kong route.

In other words, a significant global market for bioMethanol as a marine fuel is opening up here. A market that, unlike vehicle fuel, is not subject to energy and carbon dioxide taxes.

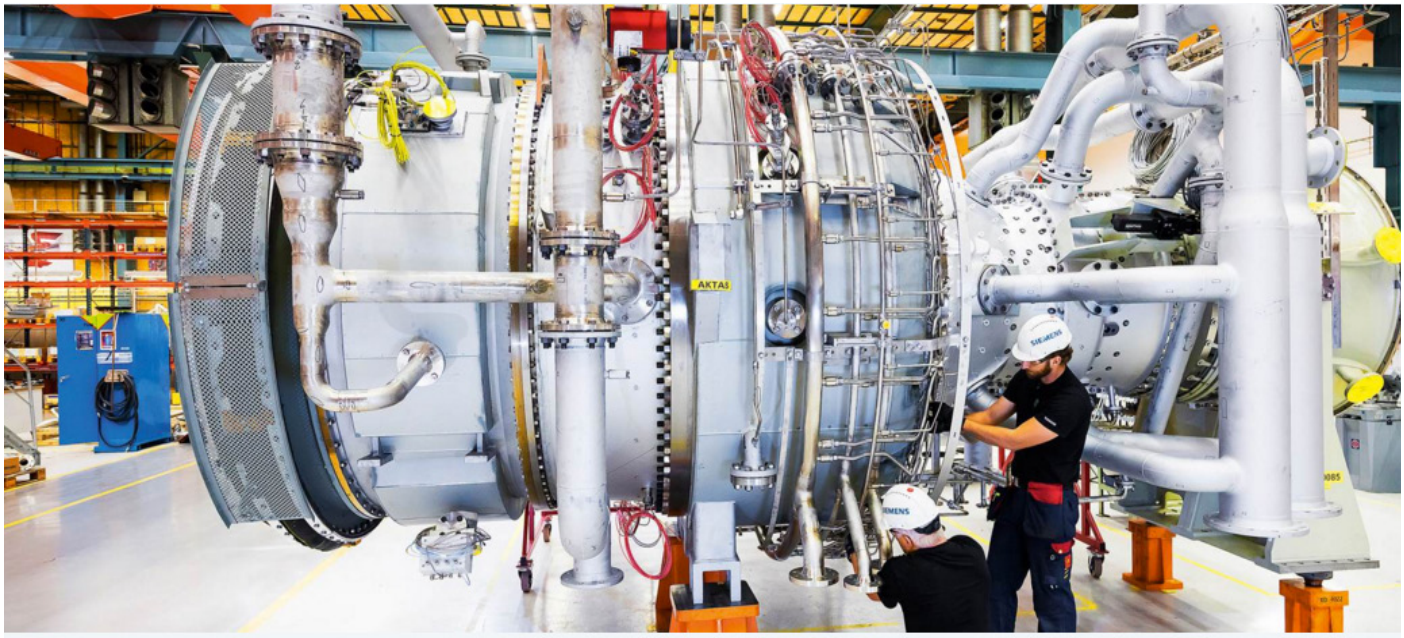
Methanol standard for marine fuels
In 2020, Björn Gillberg was appointed chairman of a Task Force within the Internationational Standardization Commission (ISO) with the task of developing a marine methanol standard. It was adopted in November 2024.

Methanol for electricity production

The rapid expansion of wind power in Sweden and the rest of the EU will eventually create an imbalance in the electricity supply when it is not windy. No resources are invested in quick-start reserve power/balance power. In the present, but not in the future, existing hydropower can handle this function.

A significant future Swedish and global market opens up here. Gas turbines, which can quickly generate reserve power, are a good alternative and in this context the most suitable and cheapest technology. Gas turbines can be powered by diesel, natural gas or biogas, but also by alcohols such as methanol. In the long term, it is obvious that gas turbines for electricity production require bio-based fuels. In the future, gas turbines powered by bioMethanol will become an important part of the power reserve.

Methanol as a fuel can be stored at significantly lower costs than gaseous fuels. In addition, methanol is preferable from a logistics point of view. A comparison between different renewable fuels turns out in methanol's favor. An investment in fossil methanol as a future turbine fuel opens up for a gradual transition to fossil-free methanol.



In Finspång, Siemens is developing gas turbines that can produce electricity and heat and run on methanol. *Photo: Siemens*

Methanol for biodiesel and chemicals

Fossil methanol produced from natural gas and/or coal is a significant global raw material for the needs of the chemical industry. Methanol is used to produce, among other things, plastics, polyesters, binders, adhesives, pigments and biodiesel.

The Swedish chemical industry uses approximately 300 000 tons of fossil methanol annually, worth approximately SEK 1,6 billion. Domestic and international chemical companies are now beginning to demand bioMethanol. Methanol is also a necessary component in the production of biodiesel and biobased fuel components.