

VärmlandsMetanol AB

(publ.) founded in 2001



The planned bioMethanol plant, with Hagfors in the background, strategically located in the forest rich county of Värmland

Photo: Lars Nilsson Photomontage: Structor, Örebro

Methanol from Wood Residues - an excellent multipurpose fossil free chemical!

An Urgent, Sustainable Industrial Project

VärmlandsMetanol in Hagfors, Sweden, intends to build and operate the world's first commercial biomass-to-methanol plant.

VärmlandsMetanol will gasify forest residues to syngas that will be converted to

BioMethanol – a Sustainable

- **Motor Fuel**
- **Fuel for Electric Cars with Fuel Cells**
- **Marine Fuel**
- **Turbine Fuel**
- **Key Component of Hundreds of Chemicals**

ThyssenKrupp Industrial Solutions, (TKIS, former Uhde) has been selected as a technology and EPC contractor for the entire plant.

Planned annual production 130 000 m³ fuel grade methanol.

Forest residues – a sustainable "Swedish oil-well" that won't run dry

www.varmlandsmetanol.se

VärmlandsMetanol AB, Postbox 61, SE-683 22 Hagfors, Sweden

VärmlandsMetanol AB is a public company - shareholders are registered by Euroclear.

History

VärmlandsMetanol AB was founded in 2001 by Dr. Björn O. Gillberg and the Miljöcentrum Foundation. The initial purpose was to build and operate a pilot plant (20 MWth) producing methanol, district heating and electricity from forest biomass using gasification technology. The objective was to demonstrate the great potential of gasification technology and to create a research and development centre for large-scale bioMethanol production.

Based on research and two pre-feasibility studies the company decided in 2006 to build a full-scale commercial plant of 111 MWth that would have a production capacity of 130 000 m³/year fuel grade methanol.

In 2007 VärmlandsMetanol became a public stock company. It is today owned by the Miljöcentrum Foundation, the Municipality of Hagfors, the Swedish Federation of Farmers, TRB (an umbrella organization for the 12 largest haulage contractors in Sweden), 1 800 private persons and 60 small companies.

ThyssenKrupp Industrial Solutions (TKIS), a world leading engineering contractor, has been selected as technology supplier and engineering partner for the project.

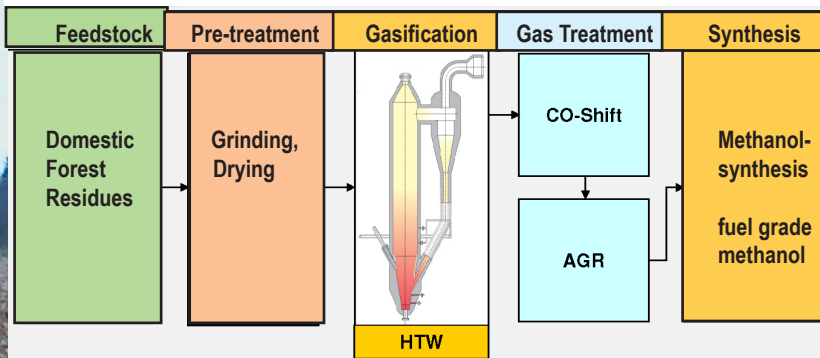
An Engineering, Procurement and Construction (EPC) contract will be applied with a cost, time, quality and performance guarantee. TKIS' list of references includes over 100 gasifiers worldwide based on different gasification technologies covering a variety of feedstock.

The business plan is to produce and sell bioMethanol as a sustainable multipurpose chemical to be used as motor fuel, marin fuel, turbine fuel and a key component of hundreds of chemicals.

A primary business objective is to develop a "turnkey" concept with interested parties and build additional plants in Sweden and also export the concept to other forest rich countries. Letters of intent/ support have been signed with potential buyers of methanol and raw gas from the gasification process. A cooperation agreement has also been signed with Siemens Energy AB.

VärmlandsMetanol, together with E.ON Gasification Development AB, PEAB, SAKAB AB and the Municipality of Kumla, have completed a pre-feasibility concept study for a biorefinery, output 250 MW bioMethane and bioMethanol as well as 50 MW district heating.

Integrated Process Chain for the Production of Bio-Methanol



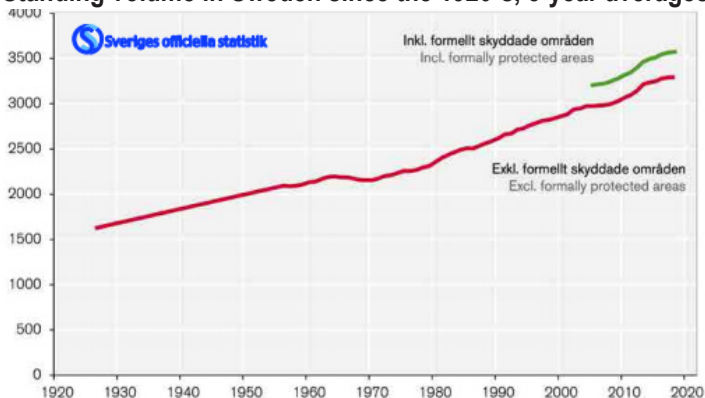
Facts about the plant

- Required capital – € 350 million
- Raised 50/50 private placements and bank loans
- ThyssenKrupp Industrial Solutions selected as EPC-contractor
- Three years of construction
- Input 1 100 tonnes forest residues /day (35 trucks /day)
- Output 375 000 litres of methanol /day (12 trucks /day)
- About 700 jobs during three years of construction
- About 50 permanent jobs at the plant
- About 50 permanent external jobs

The process is "fed" with sustainable forest residues that is chipped, dried and processed to wood pellets. The wood pellets are converted to raw gas in the gasifier. In the next step the raw gas is purified and adjusted to the correct relation carbon monoxide/hydrogen used for the synthesis of fuel grade bio-Methanol. The gasification takes place at high temperature, high pressure and reduced oxygen feeding. The integrated process generates waste heat that is used for drying the feedstock and district heating. The only by-products are wood ash and slightly polluted waste water.

The mineral rich wood ash will be pelletised and returned to forest land where it belongs. The slightly polluted waste water can/will be treated in the local sewage treatment plant. The gasification technology can be used for production of methanol, ethanol or gasoline from wood. The highest energy efficiency at the lowest cost is achieved producing methanol. About fifty plants of VärmlandsMetanols size will cover Swedens future need of motorfuels. In addition without interfering with the needs of the conventional forest industry.

Standing volume in Sweden since the 1920's, 5-year averages



Total growing stock 1926-2018

Sources: Statistics Sweden, Official Statistics

Supply of Forest Biomass – Värmland

	Million m ³ 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 (forest residue) not included (available GROT = 5.8 TWh/year)

Sources: Swedish National Forest Inventory
Potential för skogsbränsle i Värmland (Projekt SWX-Energi)

What is Methanol?

- ♦ The simplest form of alcohols, wood alcohol, (CH₃OH)
- ♦ An excellent high octane (105 octane) motor fuel
- ♦ Low blends in gasoline will increase engine efficiency and reduce fuel consumption
- ♦ Ranks as one of the top 4 globally used chemicals
- ♦ So far mainly produced from fossil natural gas
- ♦ Also produced through gasification of coal at approximately 100 plants globally (including China)
- ♦ Can also be produced through gasification of wood
- ♦ Used by the German army to keep their vehicles running during World War II
- ♦ Used in Sweden during the 1940's as a low-blend in gasoline
- ♦ Introduced as a motor fuel by the Swedish company Nynäs in the 1980's as M15 (produced from fossil natural gas)
- ♦ An important motor fuel in China

Is Methanol dangerous?

- ♦ No, only if you drink it. (Gasoline is also unhealthy to drink).
- ♦ No, contrary to gasoline and diesel it is not mutagenic or carcinogenic and degrades rapidly in soil and water.
- ♦ Burning methanol is extinguished with regular water.

Market for bioMethanol?

- ♦ **The renewable energy directive** 2018/2001/EU stipulates that 14 % of all motor fuels in the EU shall be renewable by 2030.
- ♦ This EU Directive is **an important market driver** as it, based on default values for greenhouse gas savings, defines the phasing out of the 1st generation agro-based ethanol, and **prescribes the use of advanced biofuels** such as bioMethanol. Contribution of biofuels produced from food crops is capped at 7 %.
- ♦ In order to meet the 14 % target by 2030, approximately 500 000 m³ gasoline and 500 000 m³ diesel must annually be replaced by biofuels in Sweden.
- ♦ BioMethanol used as **low-blend** (up to 25 %) requires no adaptation of gasoline engines or infrastructure, moreover flexi-fuel cars (E85) run equally well on M85.
- ♦ BioMethanol is an excellent **fuel for the electric cars** of tomorrow, powered by direct methanol fuel cells (DMFC).
- ♦ Methanol is **an emerging Marine Fuel** reducing SO_x, NO_x and particulates 99 %, 60 % and 95 % respectively, compared to conventional marine fuels. BioMethanol will in addition reduce emissions of fossil CO₂ up to 95 %.
- ♦ Stena Germanica has since 2015 been running 15 000 hours on fossil methanol. Methanex has eleven methanol tankers running on fossil methanol. Møller-Maersk has recently ordered eight ocean going vessels capable of operation on methanol. Stena Bulk and Proman are planning to build two tankers fuelled with methanol. The idea is to switch from fossil methanol to bioMethanol in the future. However, there is as of today not enough of bioMethanol on the global market to keep one of these ships running on bioMethanol.
- ♦ There is a growing demand for a **power balancing** of an electric grid supplied by wind and solar power. **Gas turbines** fed with bioMethanol will play a significant role for balancing power to become fossil free.
- ♦ Fossil methanol is a basic **building block for hundreds of chemical products**. Growing consumer demand will force the chemical industry to widen its feedstock base, particularly by broader use of bio-based, renewable raw materials such as bioMethanol.



Do we have the feedstock?

- ♦ Yes, in Sweden we have about 23 million hectares of forest land. Annual increment has exceeded gross felling with 20-30 % since the 1920's. Currently the annual increment, not harvested, is 30 million forest cubic meters (m³f). VärmlandsMetanol will not compete with sawmills and pulp industry regarding the supply of sustainable feedstock.
- ♦ Supply of sustainable forest residues have been secured through agreements with leading producers of forest feedstock.

Project execution – status

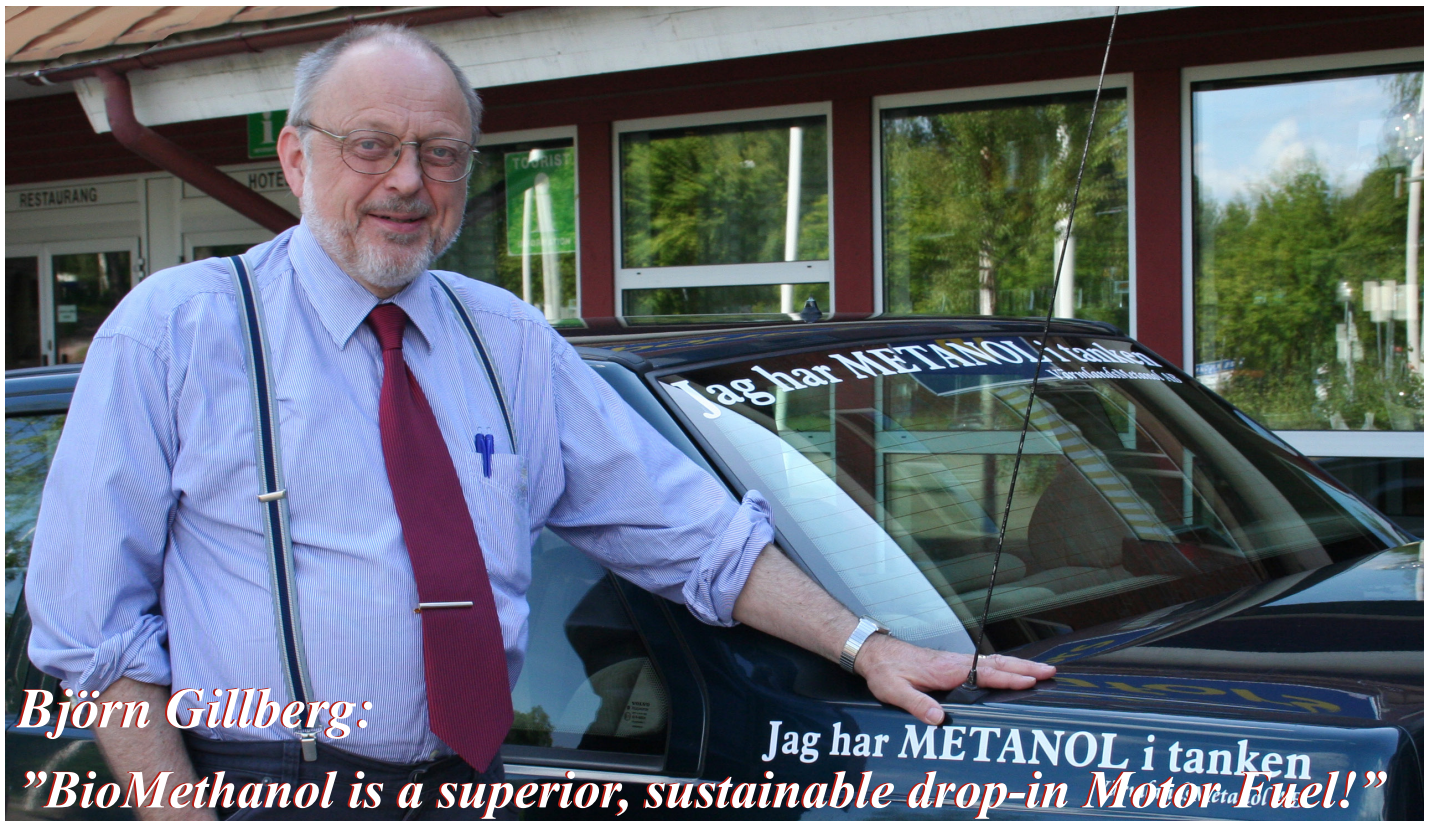
- ♦ An industrial site (20 ha) has been acquired for the plant.
- ♦ An office building (150 work places) has been acquired
- ♦ Three conceptual studies have been concluded.
- ♦ VärmlandsMetanol has selected TKIS as EPC contractor
- ♦ A detailed development plan for the site has been approved by the Municipality of Hagfors.
- ♦ Supply of feedstock/forest residue has been secured.
- ♦ A pre-Basic Engineering Package (pre-BEP) has been delivered by TKIS (Uhde).
- ♦ License agreements with different technology providers have been negotiated.
- ♦ Design Basis Document finalized by TKIS (Uhde)
- ♦ An Environmental Impact Assessment (EIA) and a Risk Assessment have been completed.
- ♦ Letters of intent/support have been signed with potential buyers of raw gas and methanol.
- ♦ The project has been delayed due to unexpected CO₂ and energy taxes on biofuels in Sweden since 2013.
- ♦ The plant can, according to the project execution plan, be ready for startup 36 months after the investment decision.

In progress

- ♦ Finish the legal procedure for obtaining the industrial environmental permit from the Environmental Court.
- ♦ Securing offtake agreements.
- ♦ Securing capital.

Strategy

- ♦ The lead time for this kind of project is approximately ten years of which seven years have been carried through in the Hagfors project.
- ♦ Enormous amount of engineering and development efforts of all technical and commercial information from the project is proprietary to VärmlandsMetanol and TKIS.
- ♦ VärmlandsMetanol and TKIS are as business partners committed to apply the wealth of existing engineering work for fast-track project realization of bioMethanol plants world wide.



Björn Gillberg:

"BioMethanol is a superior, sustainable drop-in Motor Fuel!"

- ✓ Gasoline cars run excellent on low blends of methanol without any modification
- ✓ Ethanol cars run equally well on methanol
- ✓ Methanol is an excellent fuel for electric cars of tomorrow, powered by fuelcells
- ✓ Perfect for marine fuel
- ✓ Perfect as turbine fuel
- ✓ Perfect raw material for any chemical industry to reduce their carbon footprints
- ✓ BioMethanol is a profitable investment which does not compromise with our childrens future

VärmlandsMetanol – Board of Directors

Chairman:

Wollmar Hintze, Ph.D in Chemical Engineering at The Lund Institute of Technology. Senior advisor at different large companies in Sweden on environmental issues relating to process technology. Former Environmental Director at various infrastructure projects, e.g. the Öresund Link Project between Sweden and Denmark.

Member and CEO:

Björn O Gillberg, Ph.D at Uppsala Univ. and Ph.D h.c at Lund Univ. He is the founder of VärmlandsMetanol and former Environmental Controller at the Öresund Link Project. A long-time committed front figure and advocate of environmental law and technology. He has been an advisor to European governments and corporations.

Other members:

Sture Sonebrink, co-founder of VärmlandsMetanol, entrepreneur and owner of one of the largest private forest holdings in Sweden. He has a long experience and great knowledge of forestry.

Gunnar Westlind, a Construction Engineer, working many years within the steel industry as Project Manager, currently in a leading Swedish consultancy firm. His long experience includes expert advice for the plant development and feasibility studies at VärmlandsMetanol.

Auditor: Stefan Lidén, PriceWaterhouseCooper, Karlstad.

BioMethanol right in time!

The time is more than ripe for bioMethanol. In a Swedish context a large-scale investment in gasification technology for the production of biofuels from forest biomass is a feasible, cost and energy efficient way to reach the EU fourteen percent target for renewable motor fuels by 2030. Especially considering that the EU has decided that agrobased biofuels shall be limited to seven energy percent.

The choice of methanol produced through gasification of cellulosic biomass, as a substitute for gasoline, is from a process and technological perspective, self-evident. The energy efficiency is higher than for any other liquid biofuel. Sweden has a significant and increasing surplus of forest biomass. In addition, methanol used as a drop in fuel in gasoline does not require new infrastructure, which paves the way for a cost-efficient, immediate and major reduction of CO₂ emissions from the existing and future automobile fleet.

VärmlandsMetanol's industrial partner, ThyssenKrupp Industrial Solutions, is one of the very few global actors, who have the competence and the financial "muscles" needed to guarantee a successful implementation of the project.

Björn O. Gillberg, CEO

www.varmlandsmetanol.se

VärmlandsMetanol AB, Postbox 61, SE-683 22 Hagfors, Sweden

VärmlandsMetanol AB is a public company - shareholders are registered by Euroclear