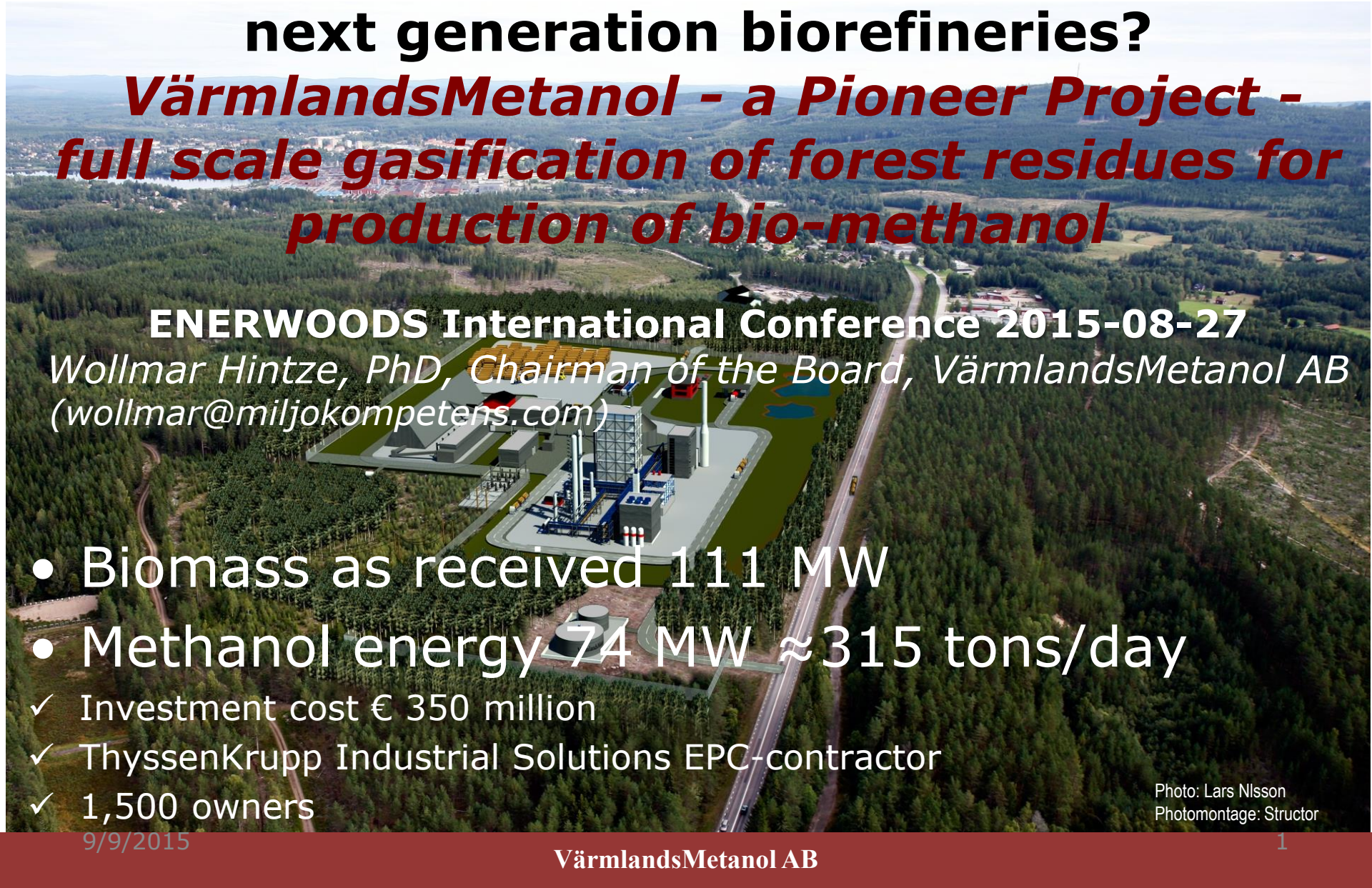
# Breakthrough for the liquid biofuels from next generation biorefineries?

## *VärmlandsMetanol - a Pioneer Project - full scale gasification of forest residues for production of bio-methanol*



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- Biomass as received 111 MW
- Methanol energy 74 MW ≈315 tons/day

✓ Investment cost € 350 million
✓ ThyssenKrupp Industrial Solutions EPC-contractor
✓ 1,500 owners

Photo: Lars NIsson
Photomontage: Structor

# History of VärmlandsMetanol AB

- 2001 VM was founded to build and operate a pilot gasification plant for production of biomethanol from forest residue
- 2003 Conceptual design study completed - 21 MWth (17 000 tons/a)
- 2006 Pilot plant upscaled to 100 MWth, 90 000 tons/a
- 2007 VM goes public
- 2009 ThyssenKrupp Industrial Solutions (former ThyssenKrupp Uhde) selected as technology supplier and engineering partner
- 2010 EPC-contract agreement between VM and Uhde
- 2011-2013 Engineering, licence agreements with providers of key technologies, selection of other technology providers, Environmental Impact Assessment (EIA) and Risk Assessment – Project is currently in the permitting stage
- 2012 The project delayed due to political circumstances – $CO_2$-and energy tax on low blends of biofuels above 5%
- 2015 Start-up 36 months after securing capital

# ThyssenKrupp references

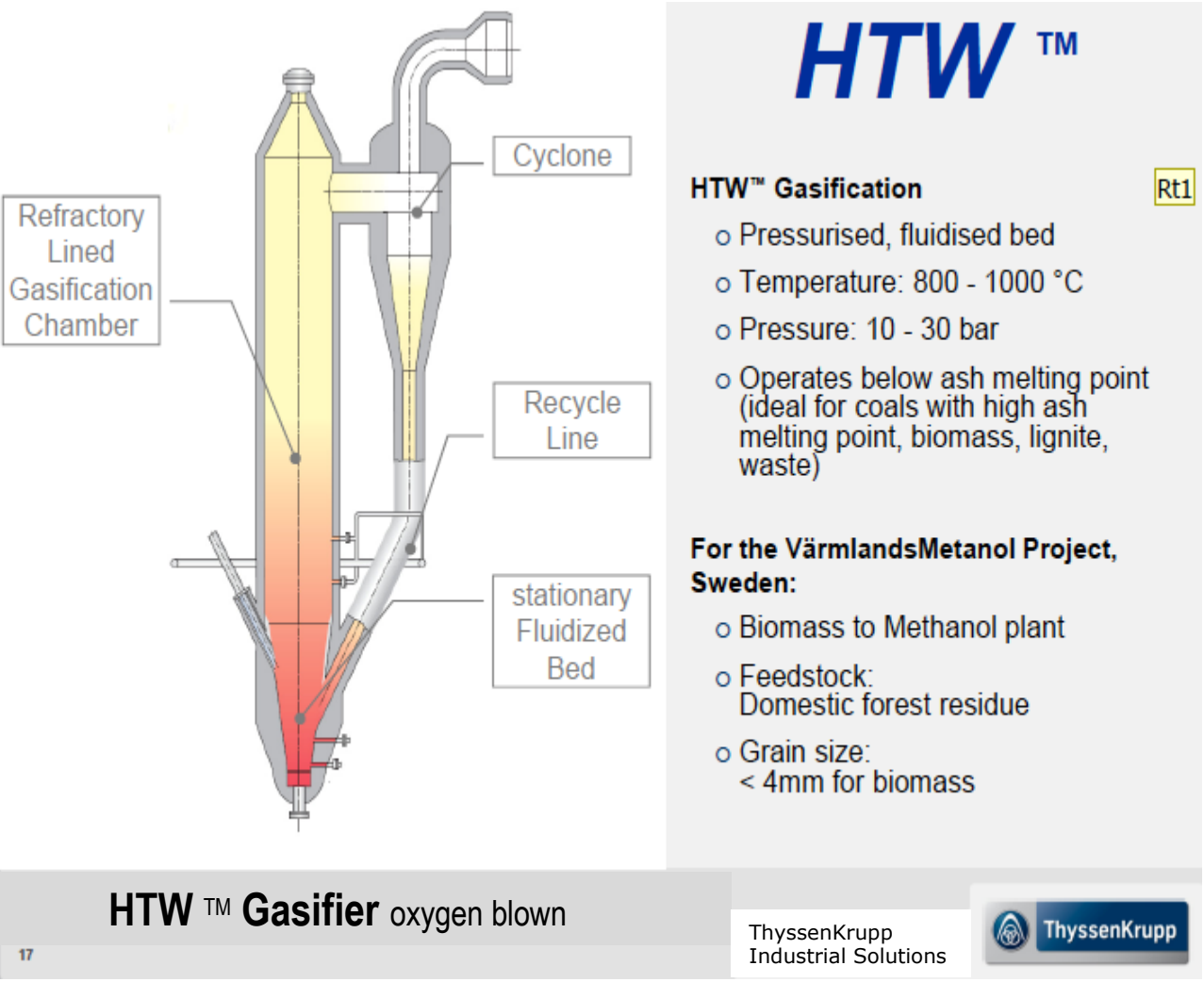
The list of ThyssenKrupp references includes over 100 gasifiers worldwide based on different gasification technologies covering a variety of feedstocks, two examples

- Puertollano, 300 MWth, gas turbine in operation since 1998
- HTW Demonstration Plant Berrenrath, a plant of 140 MWth (300 ton methanol/day), 1986-1997

# HTW Demonstration Plant Berrenrath/Germany

25 t/h Dried Lignite – 140 MWth
34,000 m³/h of Syngas
≈ 300 t/d Methanol
67,000 Total Operating Hours
84 % Availability (last 10 years)
1986 - 1997

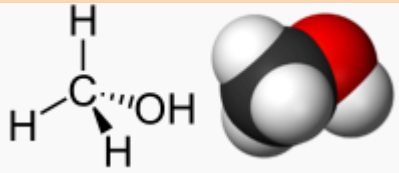
# VärmlandsMetanol Project:
## EPC-contractor ThyssenKrupp Industrial Solutions




- Project target: to produce fuel grade bio-methanol used as liquid motor fuel substituting fossil fuels.
- The HTW fluidized bed gasification has a capacity of 111 $MW_{th}$ and uses domestic forest residue to produce 100,000 tons per annum of fuel grade methanol.

# BioMethanol –
a superior $CO_2$ neutral liquid motor fuel

Methanol




- **Fuel properties are excellent** due to the high octane rating. Methanol is an ideal fuel because of its efficient combustion resulting in low emissions compared to gasoline. It can be used in spark ignition port injected gasoline engines, blended with gasoline (up to 25%) without any modification.
- **Flexibel fuel** vehicles made for E85 can also run on high methanol blends, such as M85.
- **BioMethanol can be introduced** to the market by **using present distribution systems** without additional costs.
- **Greenhouse gas savings** exceed other liquid bio-fuels by far, 80-90% in comparison to 15-40% for agrobased ethanol.
- **BioMethanol** is the most cost-efficient and environmentally friendly liquid fuel for fuel cell vehicles. Methanol can be directly fed to a fuel cell without being reformed into hydrogen.

# Inget är nytt under solen…

Nynäs sålde framgångsrikt M 15 (15% metanol) i Sverige på 80-talet. Nynäs planerade att bygga en stor kolförgasare för metanolproduktion i Nynäshamn.


Foto: Miljöcentrum

# Why BioMethanol from wood?

- **Sweden is a forest country with**
  - **2 million hectares of agricultural land and**
  - **23 million hectares of forest land**

  The biomass is to be found in the forest - not in agricultural land

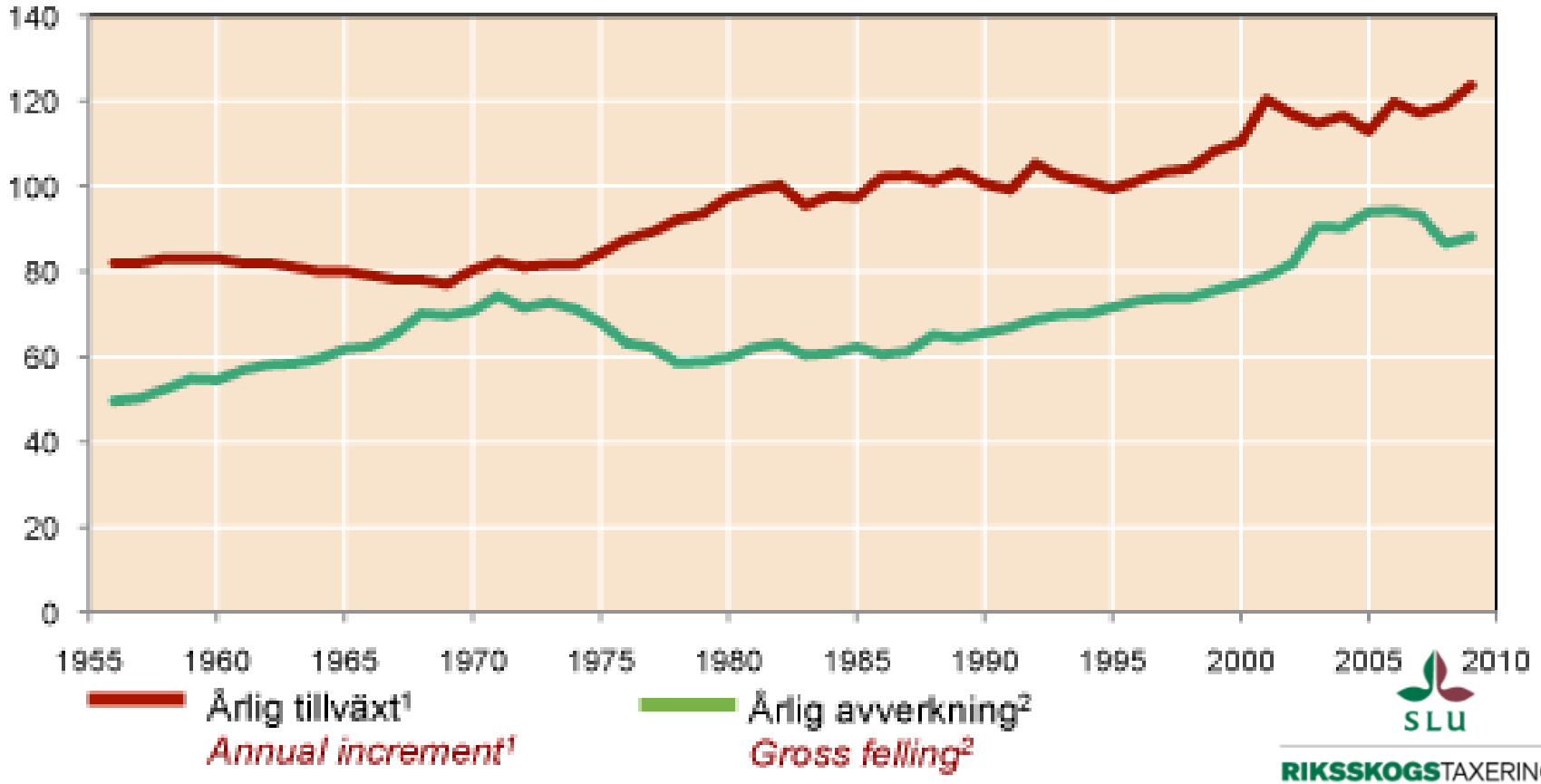
- **Gasification is the most energy efficent and environmentally friendly method** to convert cellulosic biomass to liquid motor fuel. It is possible to produce gasoline, diesel or DME. Methanol production results in the **highest energy efficiency at the lowest cost.**

# Standing forest volume is increasing in Sweden

**Figur 7.2 Årlig avverkning och tillväxt**

*Annual gross fellings and increment*

**Milj m³sk**, *mill. m³ standing volume incl. bark*

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# An industrial conversion > 5 000 000 m³standing volume without a market

- forest industries shut-down or reducing their capacity in Stora Enso area 2012-2013


**Norske Skog, Follum,** improved news and book paper. 850 000 m3 SMPW

**Petersson, Moss**, liner board, 700 000 m3 CPW and CCH

**Södra Tofte,** sulphat pulp, 1 900 000 m3 conifer and euca, new owners?

**Vafos**, ground wood pulp, 200 000 m3 SMPW

**Hellefoss,** mechanical printing paper, 120 000 m3 SMPW

**Ambjörby,** board mill, 100 000 m3 sawdust and CPW

**Karlit,** board mill, sawdust and CCH

**Rottneros,** ground wood pulp mill, 150 000 m3 SMPW, restart?

**Kvarnsveden** PM 11, newsprint and improved news, 500 000 SMPW

**Hallstavik,** SC, 200 000 m3 SMPW

**Braviken**, newsprint, 100 - 200 000 m3 SMPW

**Hylte** PM1 and PM2, newsprint, 350 000 SMPW and SCH

**Lessebo paper,** 150 000 CCH, restart?

# Opportunities

- 2020 –EU requires 10% biofuels (to replace 40 million $m^3$ fossil fuel).
- 2020 –The European Union has ruled on a 7% cap for agrobased biofuels in favour of cellulose and lignine based fuels.
- 2030 –The Swedish parliament requires a fossil-free automobile fleet (to replace 8 million $m^3$ fossil fuel).
- Methanol is a basic building block for hundreds of chemical products. At present methanol is produced from natural gas. International corporations are planning to replace fossil methanol with biobased methanol.

# VM's Business Plan

- The business plan is to produce biomethanol from forest residues and sell it as low blend in 95-octane unleaded petrol and/or as a raw material for the chemical industry.
- Present-day gasoline engines and distribution systems can handle a blend of 25% biomethanol without vehicle modifications, or additional costs for distribution.
- A primary business objective is to develop a "turnkey" concept in cooperation with ThyssenKrupp and build additional plants in Sweden and other forest rich countries.

# Breakthrough for the liquid biofuels from next generation biorefineries?

- Proven technology available – no need for research
- There is a surplus of biomass feedstock in Swedish forests
- The infrastructure – the gas stations – already exists
- Factors delaying the progress today: lack of political intentions and lack of longterm tax rules
- It is important to reduce the dependence of foreign oil suppliers

And it must pay off to fill up green!

# There is no need to reinvent the wheel!

Gasification is a proven technology with decades of experience in successfully operating plants worldwide.

Illustration: Goddard

This is Professor R.E.Cycle – discoverer of the infinitely expanding research grant.