nordic green

Biomass-to-Methanol, is there enough biomass?

”The 3 E’s”

2015 European Methanol Policy Forum

13 & 14 October - Brussels

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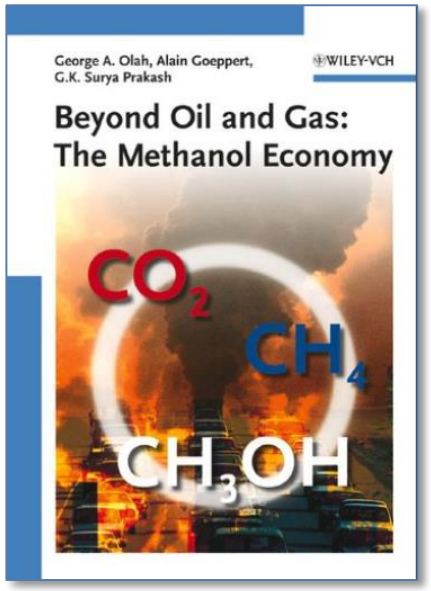
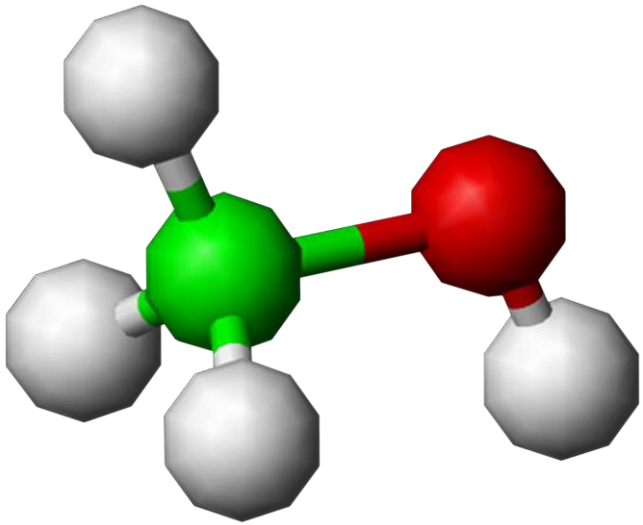
Founded in August 2011, Nordic Green is the result of two guys meeting by chance…

One was inspired by
"The Methanol Economy"



The other was looking for green products with
a unique identity in the market



both wanting to make an impact,
perhaps even **change the world**

Todays agenda

1) Who is Nordic Green
2) Understanding bio-MeOH – in more than one way
    1) From a production POV
    2) From a customer POV
3) Our friends and allies
4) ”Novel Concept”
5) ”The 3 E’s”
   - And why there is plenty of biomass in the future…
6) The nearer future…
7) Plato…

In an ideal world…

All the noble ideas triumph

But in the real world; without economics in place…
You crash and burn!

Making sure message is not lost…

Our main-key to success is

“The Nordic Green Value Tool”,

enabling us to understand the VP from our customers POV

Economics

We have made our way into several major fuel companies and more are in the pipeline by understanding the business-case from their POV: “**The Black Box**” of the gasoline companies.

We can calculate the earnings the companies will achieve with high accuracy based on a “snapshot”
One of the major companies said, about our prediction on their earnings:
“*This is very very close*”

Economics

A look inside…

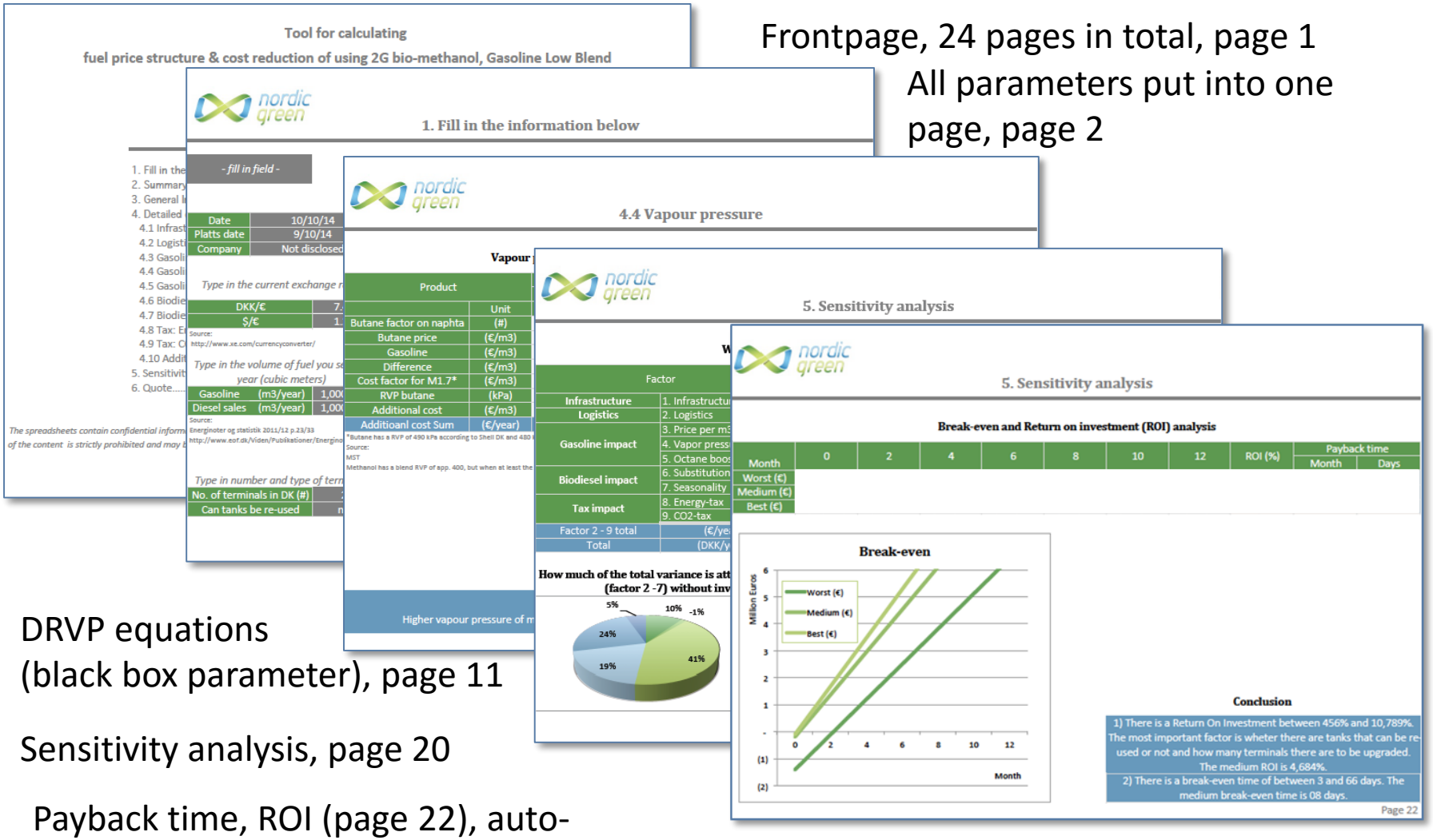
Nordic Green has developed tools that breaks down into pieces all the different cost and value-adding components of bio-methanol in a Gasoline Low Blend.

There are five groups of components for Gasoline Low Blend and a total of nine factors. The factors are seen below (DK as example)

Impact factor	
Infrastructure	1. Infrastructure inv.
Logistics	2. Logistics
Gasoline impact	3. Price per m3
	4. Vapor pressure
	5. Octane boost
Biodiesel (EtOH)	6. Substitution
	7. Seasons
Tax	8. Energy-tax
	9. CO2-tax

Nordic Greens black box

Verified by purchasers in major oil companies



Frontpage, 24 pages in total, page 1

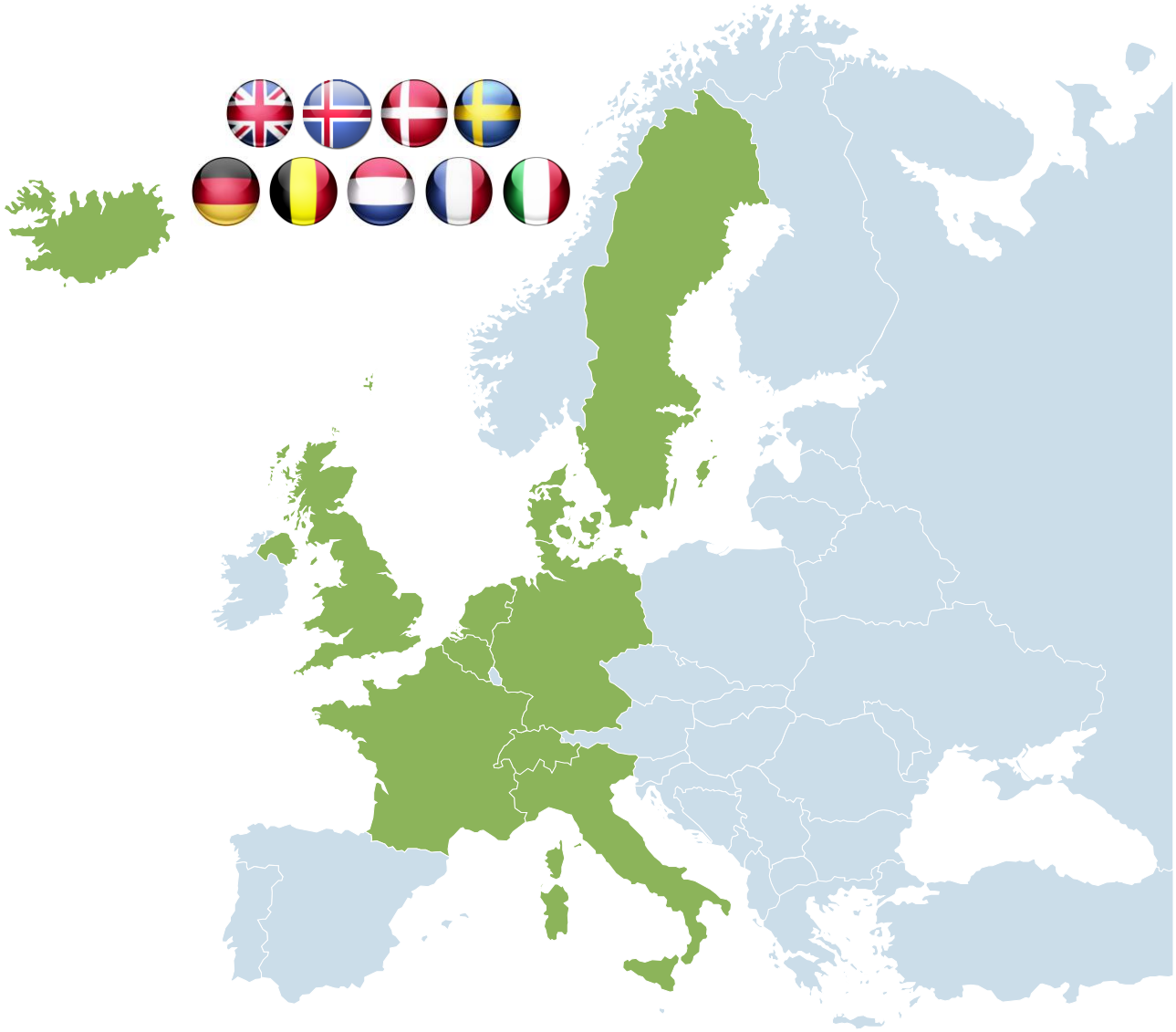
All parameters put into one page, page 2

DRVP equations (black box parameter), page 11

Sensitivity analysis, page 20

Payback time, ROI (page 22), auto-generated quotation (not shown), page 24

Renewable methanol map



Nordic Green; Always expanding network

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?

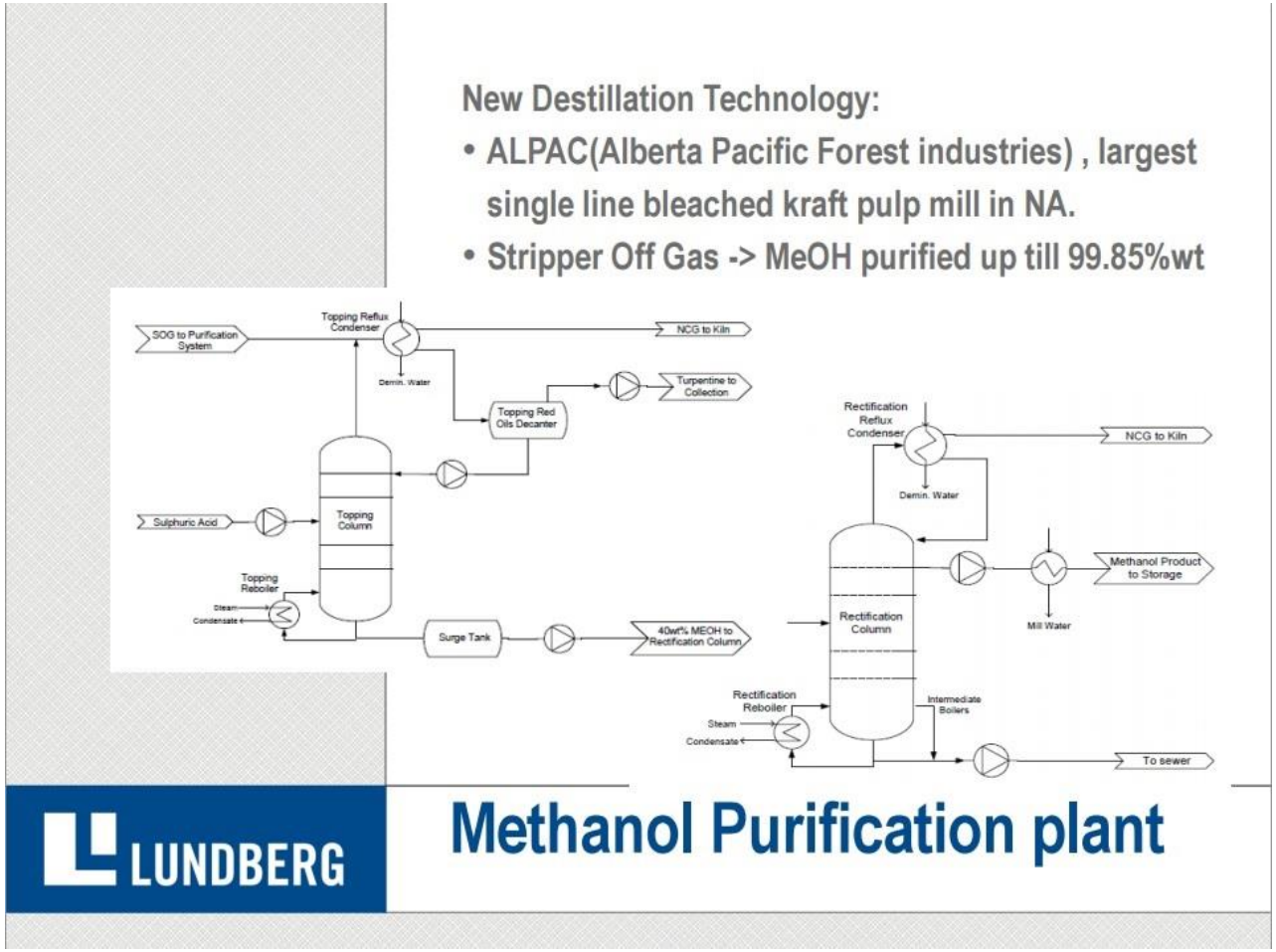
?

Methanol – not only a fuel

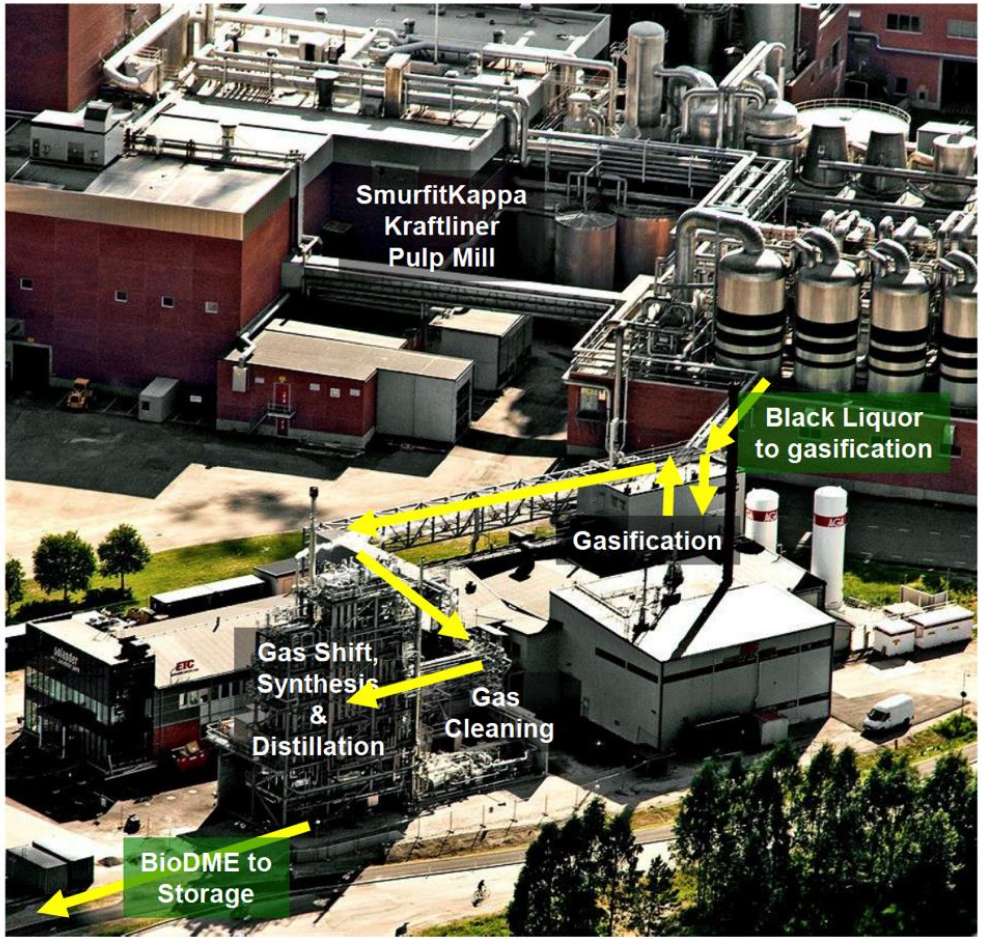
Bio-methanol production pathways

1) Paper pulp → Lundberg
2) Black liquor conversion → Chemrec
3) Black liquor purification → Invicotech AB
4) Crude Glycerine → BioMCN
5) Biogas (both from sugar and municipal waste) → BioMCN
6) Electrolysis → CRI
7) Wood gasification → VärmlandsMetanol AB
8) Waste → Enerkem

Paper pulp
- It is obvious: ”wood alcohol”



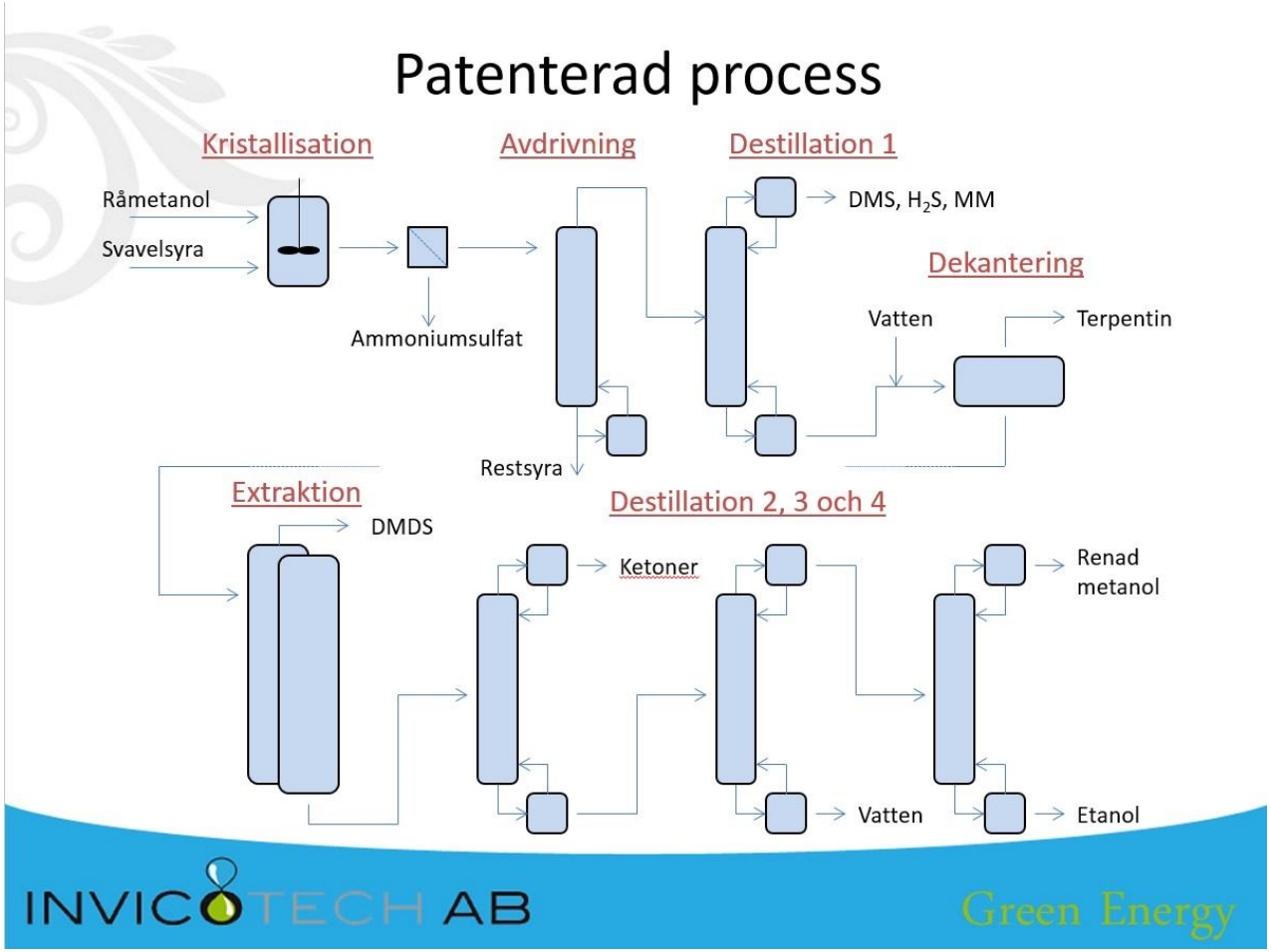
Chemrec – turning black liqour into MeOH and then into bio-DME



DME production capacity:	4 tons / d
Pipe installation:	~ 10 000 m
Hand valves & on/off valves:	~ 1400 pieces
Instruments:	~ 450 pieces
Vessels:	~ 30 pieces
Heat exchangers:	~ 25 pieces
Process Plant Foot Print:	20 x 30 m
Investment cost (excl gasification):	~ 22 million €

European Project BioDME
7th Framework Programme

Black liquor purification
- often you find sulphur levels to be high

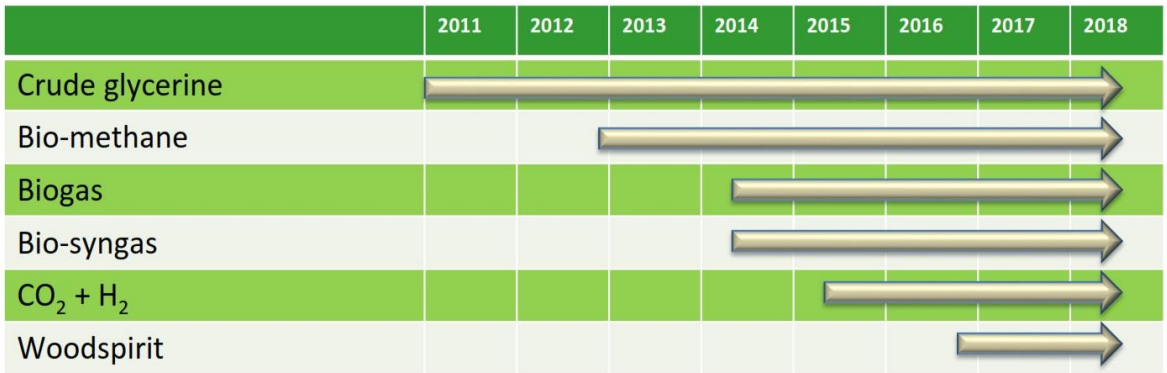


Biogas (from sugar and municipal waste)

BioMCN

driven by nature

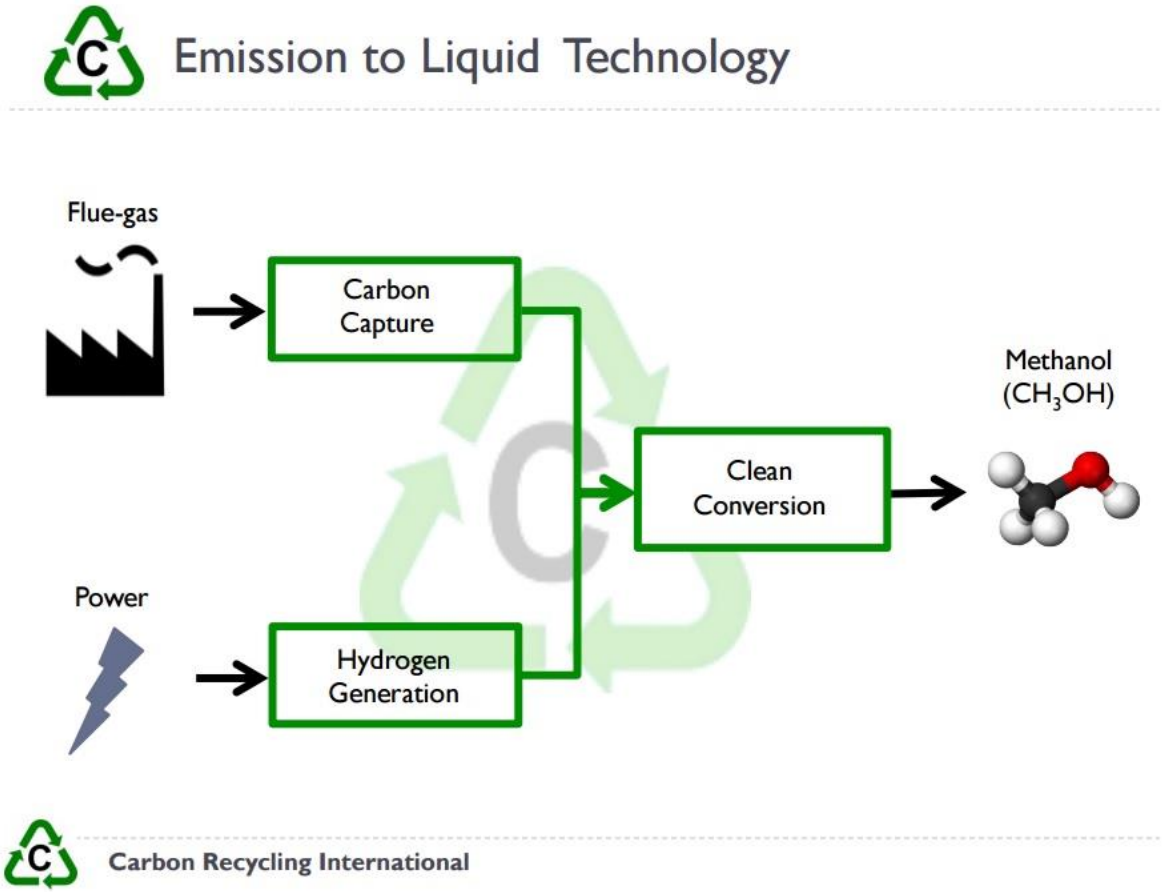
Alternative feedstocks identified



Use of alternative feedstock:

- increases capacity
- improves flexibility
- reduces risk

Electrolysis, by CRI



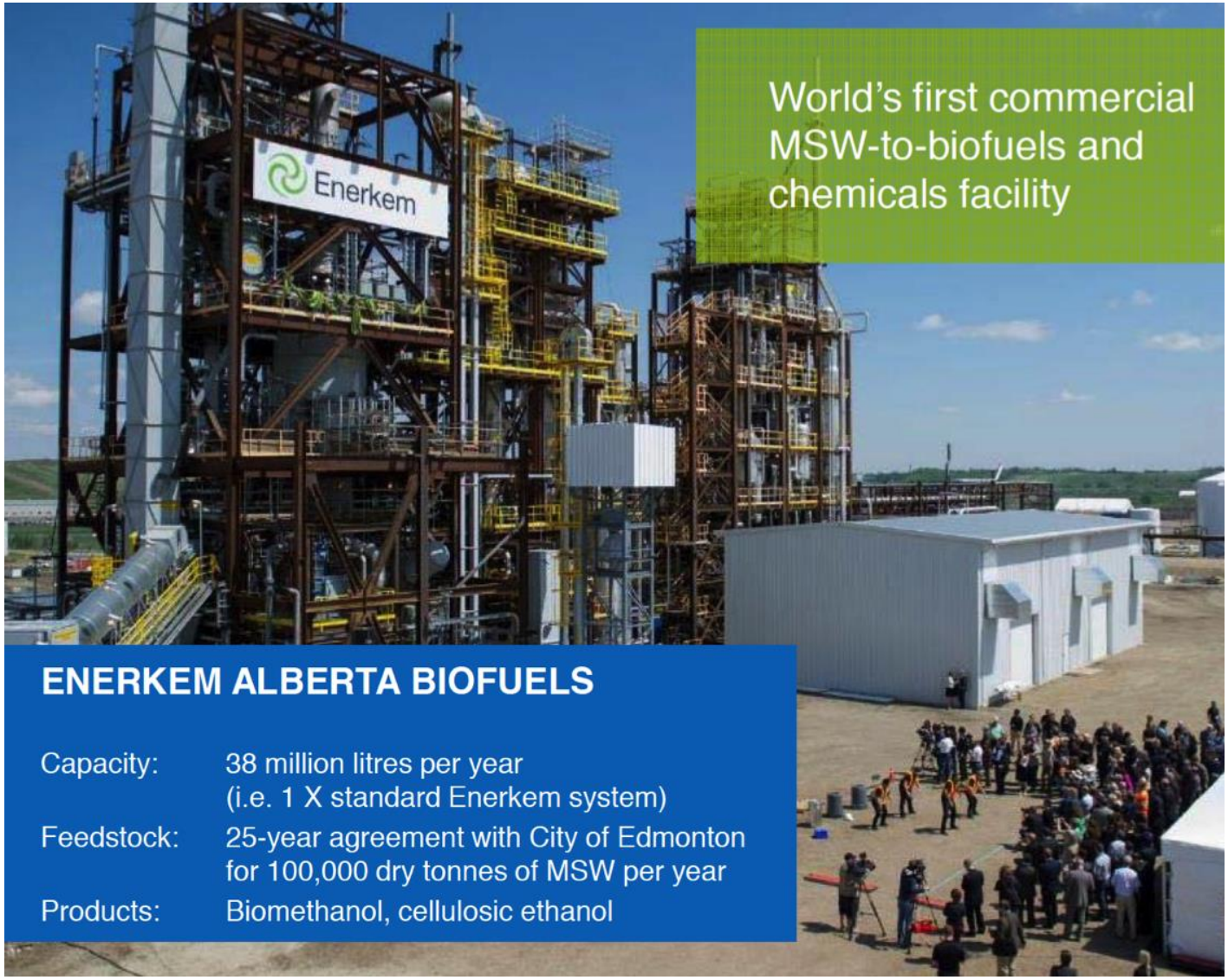
VärmlandsMetanol - a Pioneer Project

- Biomass as received 111 MW
- Methanol energy 74 MW ≈315 t/d

✓ Investment cost € 350 million
✓ Start up 36 months after investment decision
✓ ThyssenKrupp Industrial Solutions EPC-contractor
✓ 1 500 owners

Photo: Lars NIsson
Photomontage: Structor

Enerkem, turning waste into alcohol



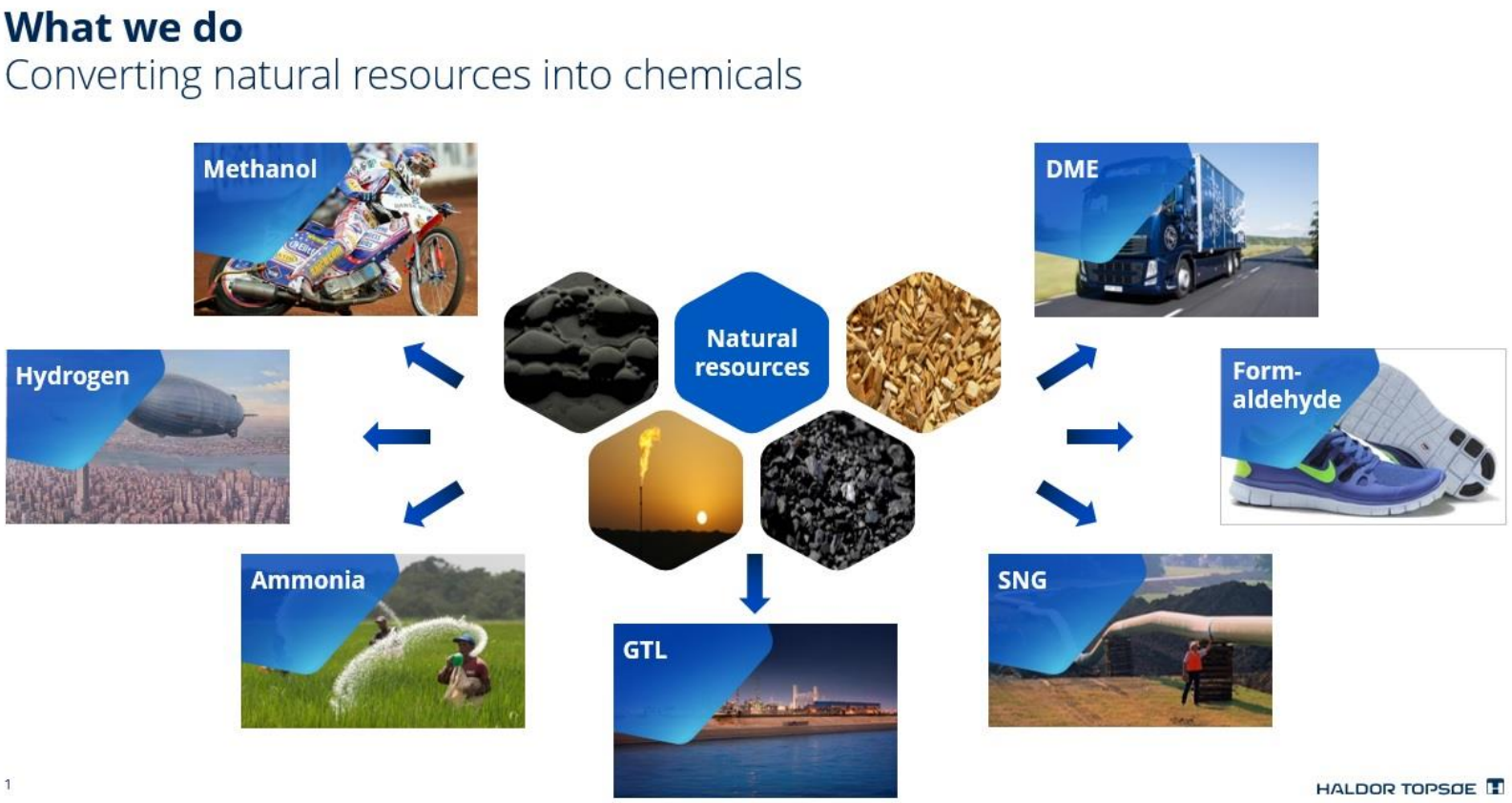
Huge investments are being incented

Further to this, billions of €'s are being awarded to bio-projects in the NER300-program and other programs
Thereby the EU are paving the way for private funding, estimated to be at least twice this size, on their own.
Included in this is the massive expansion "Wood Spirit"-project in NL.

We know also of methanol plants being planned/constructed/expanded in

- Iceland
- Sweden
- Germany
- Spain
- France
- Finland
- Denmark
- Netherlands (besides Wood Spirit)
- And several in Eastern Europe

Nordic Green was recently appointed Haldor Topsoe Ambassador



Traditional concept
1000 t/d wood → 523 t/d methanol

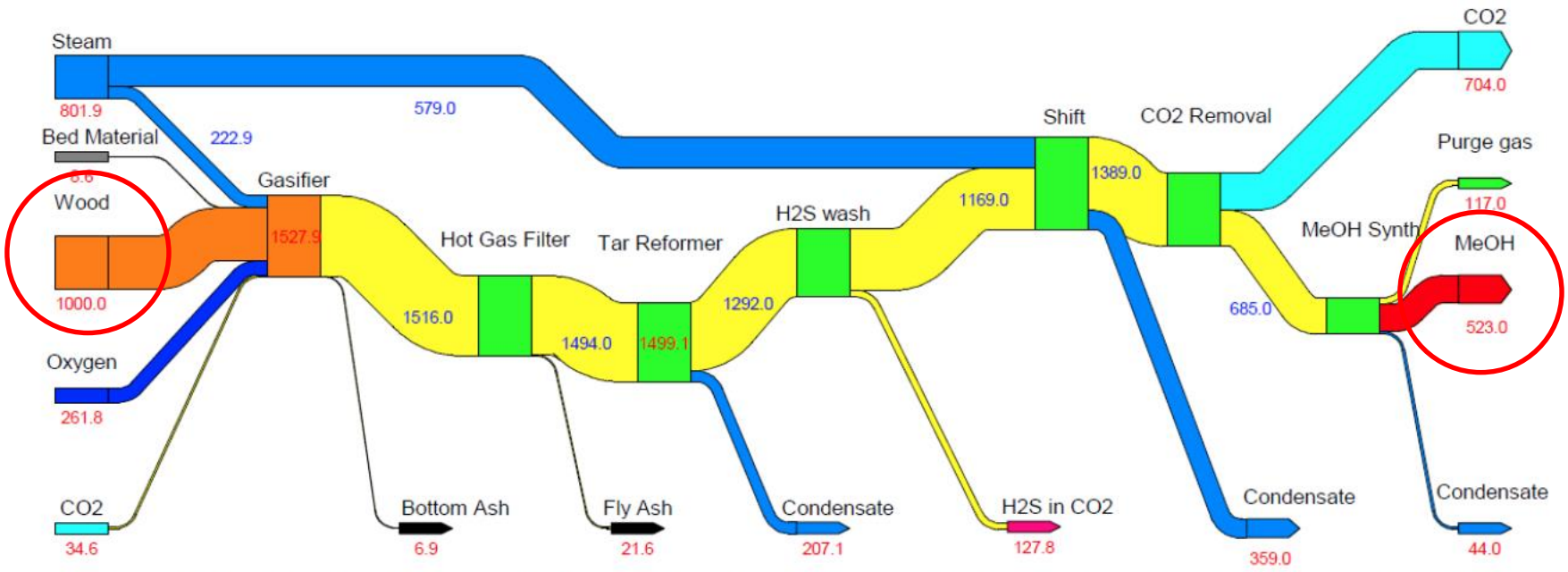


Figure 46: Traditional methanol production plant based on biomass gasification, units are in metric tonss per day [t/day]

1000 t/d wood

Efficiencies (%)	Novel Concept
Methanol	59.2
District heating	22.6
Total	81.8
Carbon utilization	42

523 t methanol/d

Novel concept
1000 t/d wood → 1053 t/d methanol

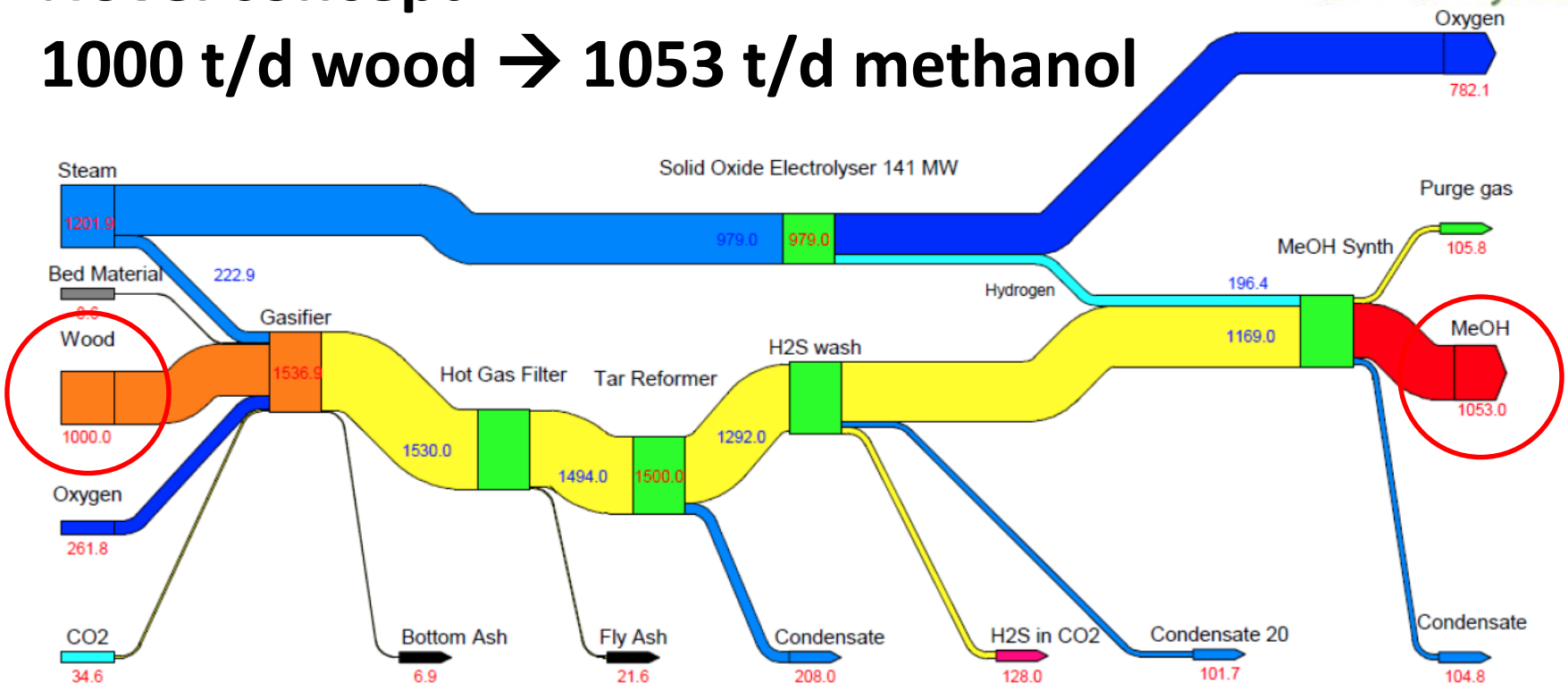


Figure 47: Sankey chart of mass flows in the gasification concept, units are in metric tons per day [t/day]

1000 t/d wood +
141 MW electricity
yields

Efficiencies (%)	Novel Concept
Methanol	70.8
District heating	10.8
Total	81.6
Carbon utilization	84

1053 t methanol/d

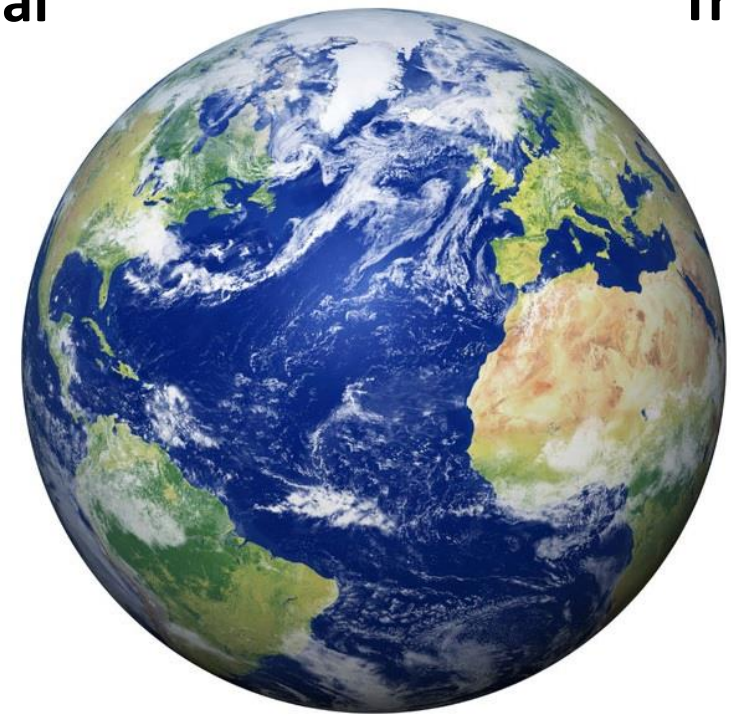
Methanol..
The two times two matrix

Bio-carbon from.. Bio-hydrogen from…	Biomass (concentrated)	Air (not concentrated)
Biomass	Pro: Simply and cheap (if biomass is cheap) Con: Low carbon utilisation (rest is emitted as CO2) ***1st to become commercial***	Not relevant
Electrolysis	Pro: Can effectively double the biomass potential Con: Depending on cheap electricity ***2nd to become commercial***	Pro: Unlimited supply of both products Con: Most CAPEX and energy-intensive ***3rd to become commercial***

Not enough bio-mass...(?)

Biomass potential

200 EJ/yr



Transport fuel demand

108 EJ (2010/7 bio)

168 EJ (2050/9-10 bio)

Conclusion

Since we can not convert ALL biomass to fuel and since there are losses the numbers DO NOT add up!.... Or do they…

Wrong conclusion from IEA

“Biofuels can provide up to 27% of world transportation fuel by 2050”

We believe the IEA conclusion is wrong and if we use the three E’s as our guiding principle there will in fact be plenty!

The three E's!

The three E's - Efficiency! (Index 100 -> 50)

EFFICIENCY GAINS AND COSTS			
	Technology	Reduction in CO_2 emissions	Incremental price per vehicle
Engine	Low-friction lubricants	0.5%	$3
	Engine friction reduction	1–3%	$50–100
	Variable valve timing and lift	3–4%	$125–259
	Cylinder deactivation	6%	$150–469
	Turbocharged downsized engine	5–7%	$149–1,099
	Camless valve actuation	5–15%	$501
	Gasoline direct injection (stoichiometric)	1–2%	$209–346
Transmission	Continuously variable transmission	6%	$192–224
	Six-speed automatic	4.5–6.5%	$99
	Six-speed dual clutch	5.5–13%	$47–92
Vehicle	Aerodynamic drag reduction (20% cars, 10% trucks)	2–3%	$42
	10% reduction in tire-rolling resistance	1–2%	$6
	10% reduction in weight	4.5%	$518–666
	High-efficiency alternator and electrified accessories	1–2%	$76
	Electric power steering	1.5–2%	$94
	Integrated stop-start system	7.5%	$351–437
	Hybrid motor assist	20–30%	$2,854–4,431

Well known incremental innovations where we know the cost and the fuel reduction

We are not here to talk about engines so let's move on!

The three E's – Electrification (Index 50 -> 40)

Battery-costs will drops and cars like VW Golf-e, Tesla Model S, BMW i3 and Nissan LEAF will become common in the future

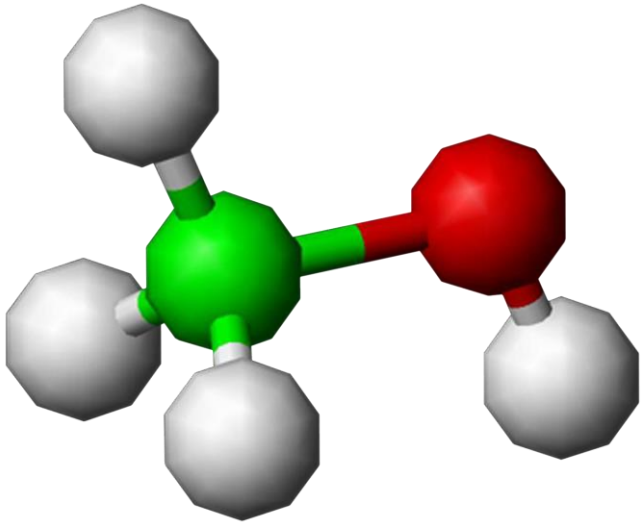
We are not here to talk about batteries so let's move on!

The three E's - Electro-fuels (Remaining 40 -> 0)

Why methanol as electro-fuel?

The simplest of all liquid energy-carriers suitable as transport fuel and having the highest hydrogen to carbon ratio

(4 hydrogen to each carbon atom)

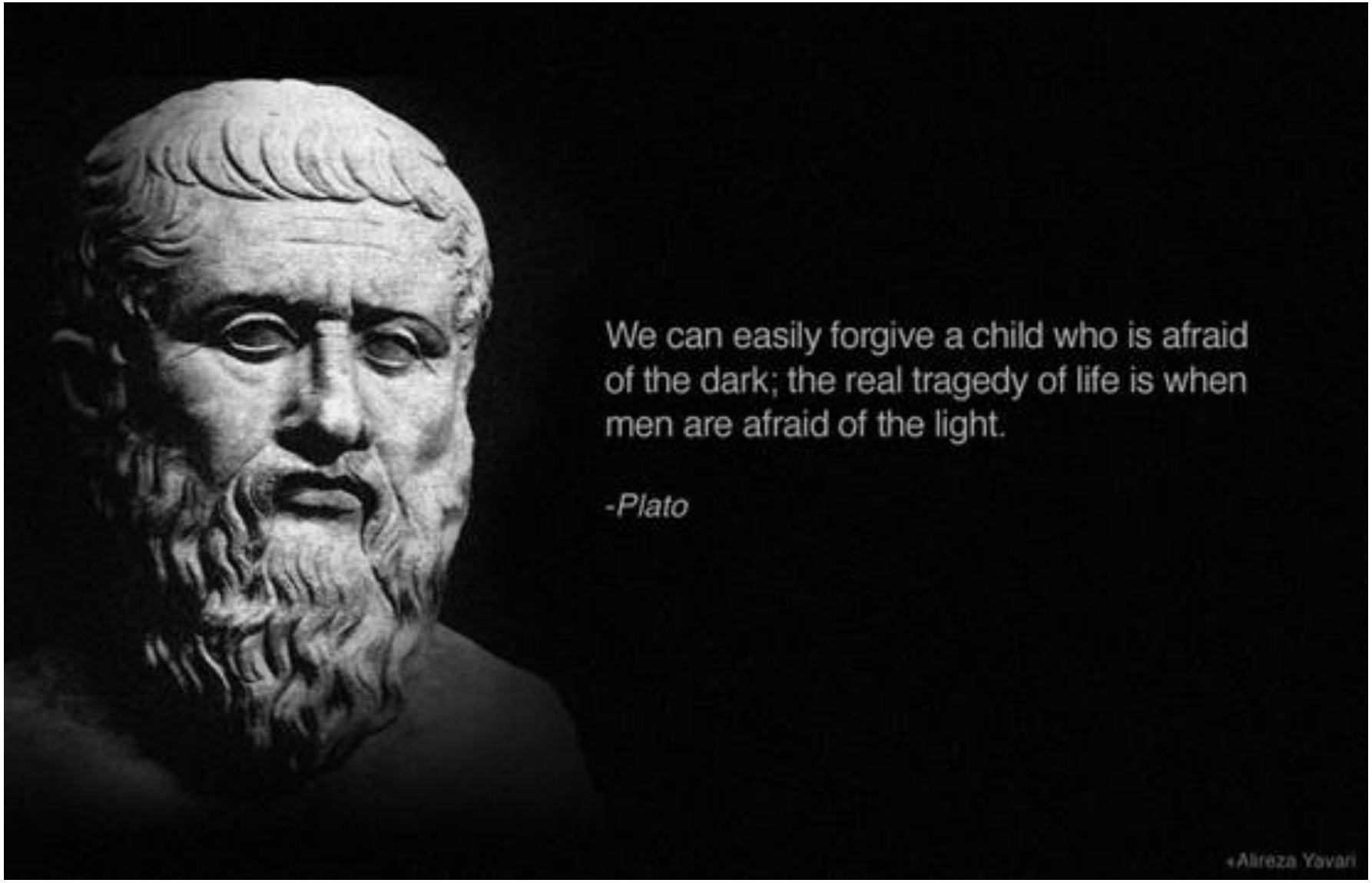


Meanwhile… for transport

(Bio-)MeOH offers a variety of easy implementable solutions:

- Switching from fossil to bio in esterification-process in biodiesels (Bio-)
- Low blends (Bio-)
- High blends, including GEM-fuels (Bio-)
- MTBE (Bio-)
- Shipping
- Trucking (DME)
- Synthetic gasoline
- Jet fuel

A few words of wisdom…



Thank you for your attention!

www.nordicgreen.eu

info@nordicgreen.eu

Nordic Green
Marselis Boulevard 80
DK-8000 Aarhus C
☎ +45 2nd-G-MeOH
(+45 263-4-6364)

Bo Gleerup
CEO & Co-Founder
M: +45 2044 2988
bg@nordicgreen.eu