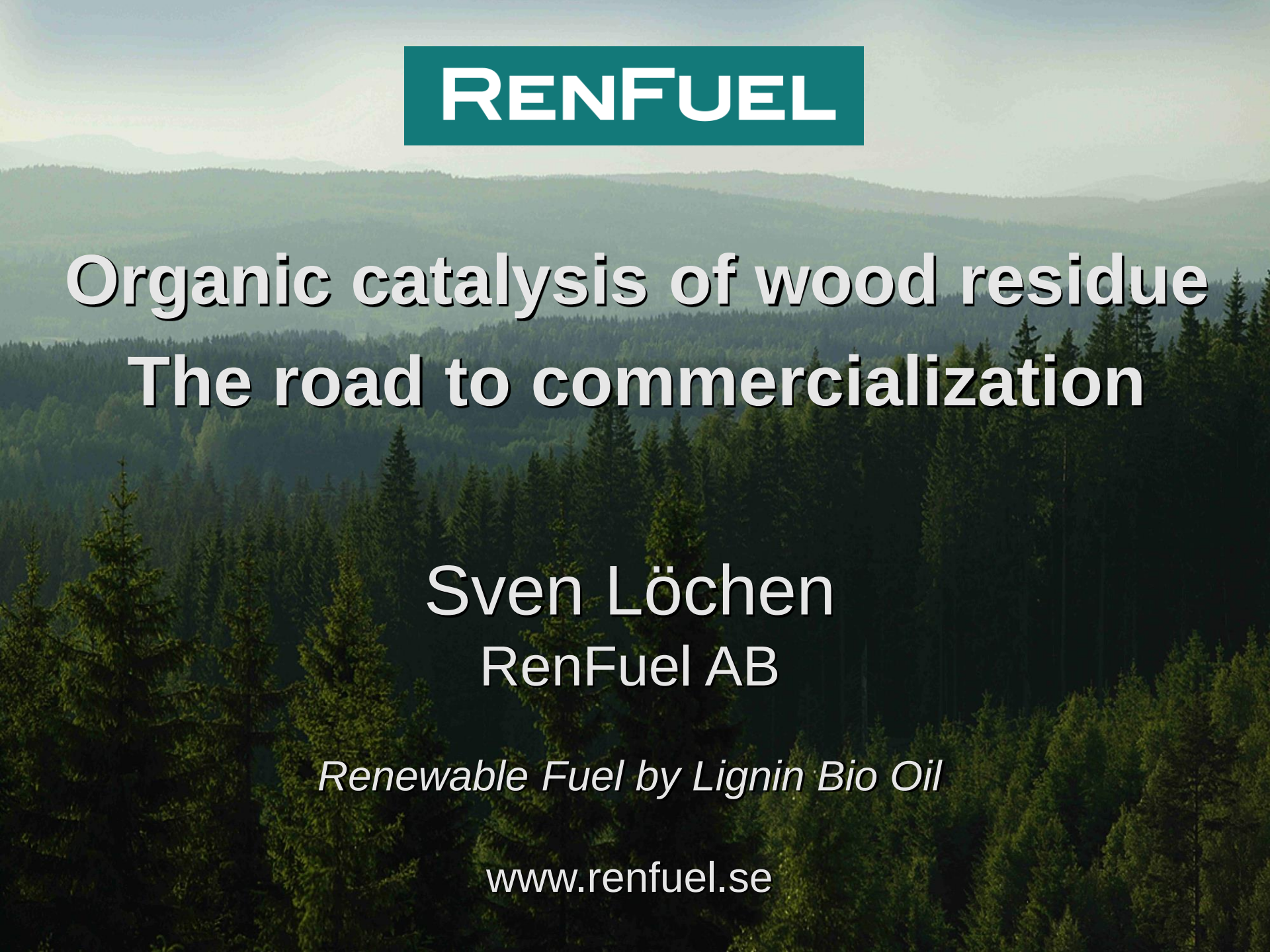




RENFUEL

Organic catalysis of wood residue The road to commercialization

Sven Löchen
RenFuel AB

Renewable Fuel by Lignin Bio Oil

www.renfuel.se

RENFUEL

Lignin Bio Oil

*RenFuel turns lignin into
sustainable lignin oil...*



Prof Joseph Samec



CEO Sven Löchen



Chm Mats Odell

RENFUEL

Lignin Bio Oil

- We have developed a patented catalytic process that energy efficiently transforms lignin from black liquor in the pulp industry into renewable lignin oil – LIGNOL®
- 15 patent families in over 40 countries and 15-20% of R&D spent on IPR annually
- So far invested well over SEK 200 milj in processes infrastructure and Intellectual properties

*Laboratory scale **2010**...*

*Verification project **2013**...*

*Pilot project **2015**...*

Comm. engineering phase

2019

Biofuels Based on Lignin

- Biofuels based on lignin - high impact to reduce CO₂
- Lignin Oil ethically problem free and within RED II, Annex 9a
- Swedish target 2030: 70% reduction, 2040: 100%
- Reduction quota obligations 2018-2030 – step by step to 60%/26% for diesel/gasoline



An aerial photograph showing a vast lumber yard. On the left, a dark asphalt road runs parallel to the stacks of logs. To the right of the road, hundreds of neat, long stacks of cut logs are piled up, stretching far into the distance. The logs are light brown and appear to be spruce or fir. In the background, a dense green forest of tall trees covers a hillside. A yellow crane or loader is visible in the middle of the log stacks. Several small figures of people can be seen near the road on the left.

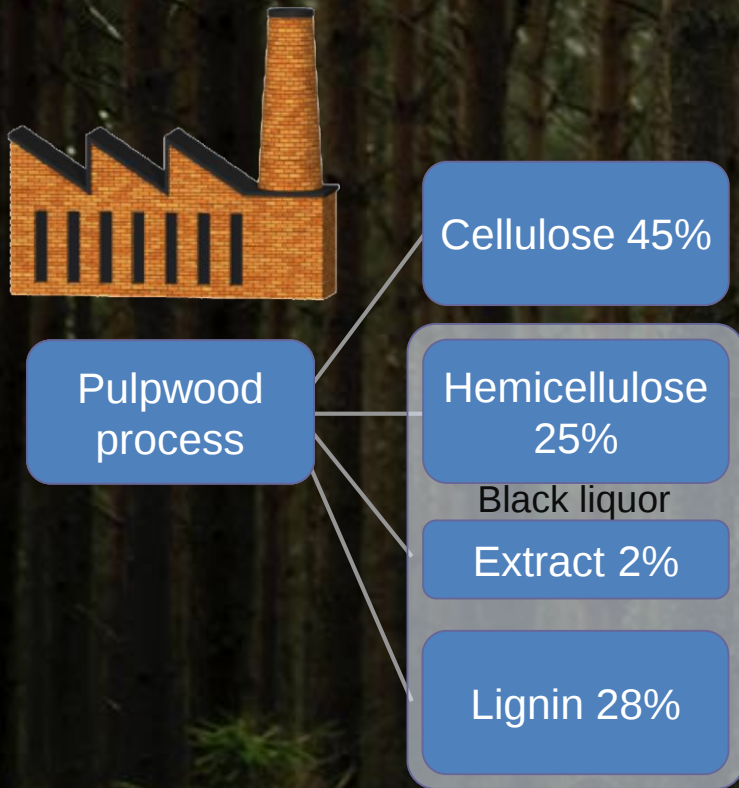
Feed stock

More forest than ever...

*25% more forest in Sweden than 25 years ago
and has doubled since the 1920s...*

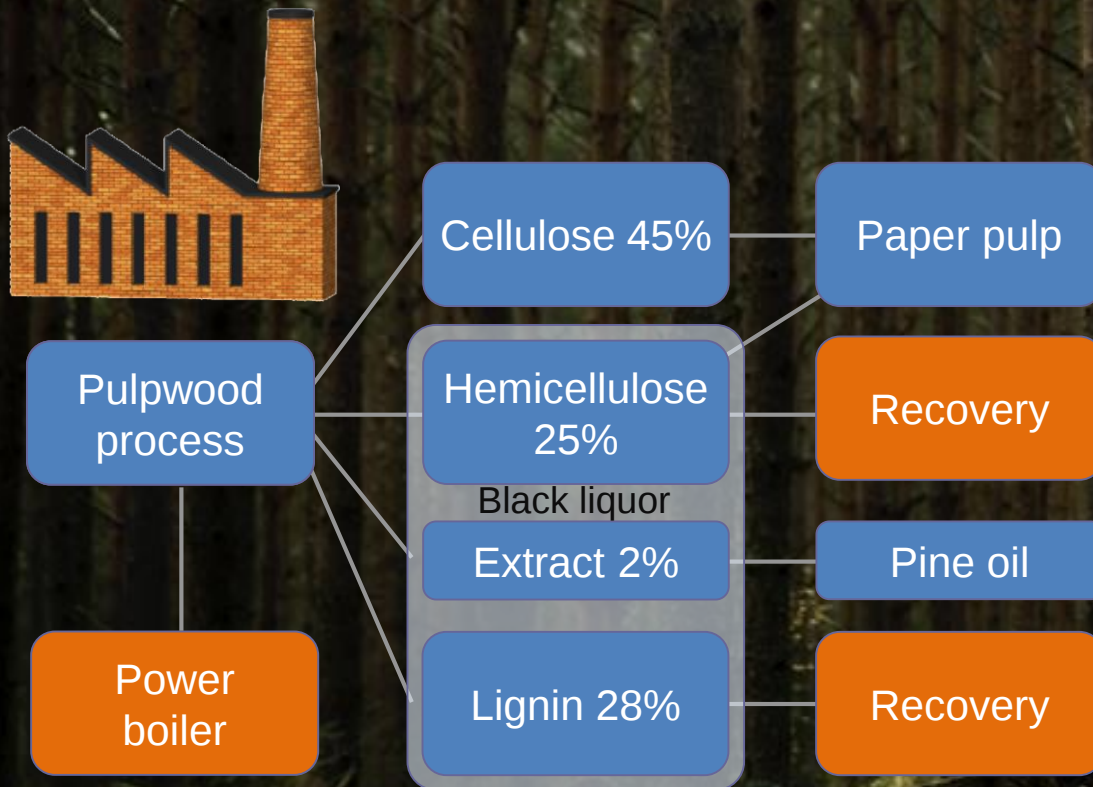
...and more regulations

1/3 of Forest Wood is Lignin



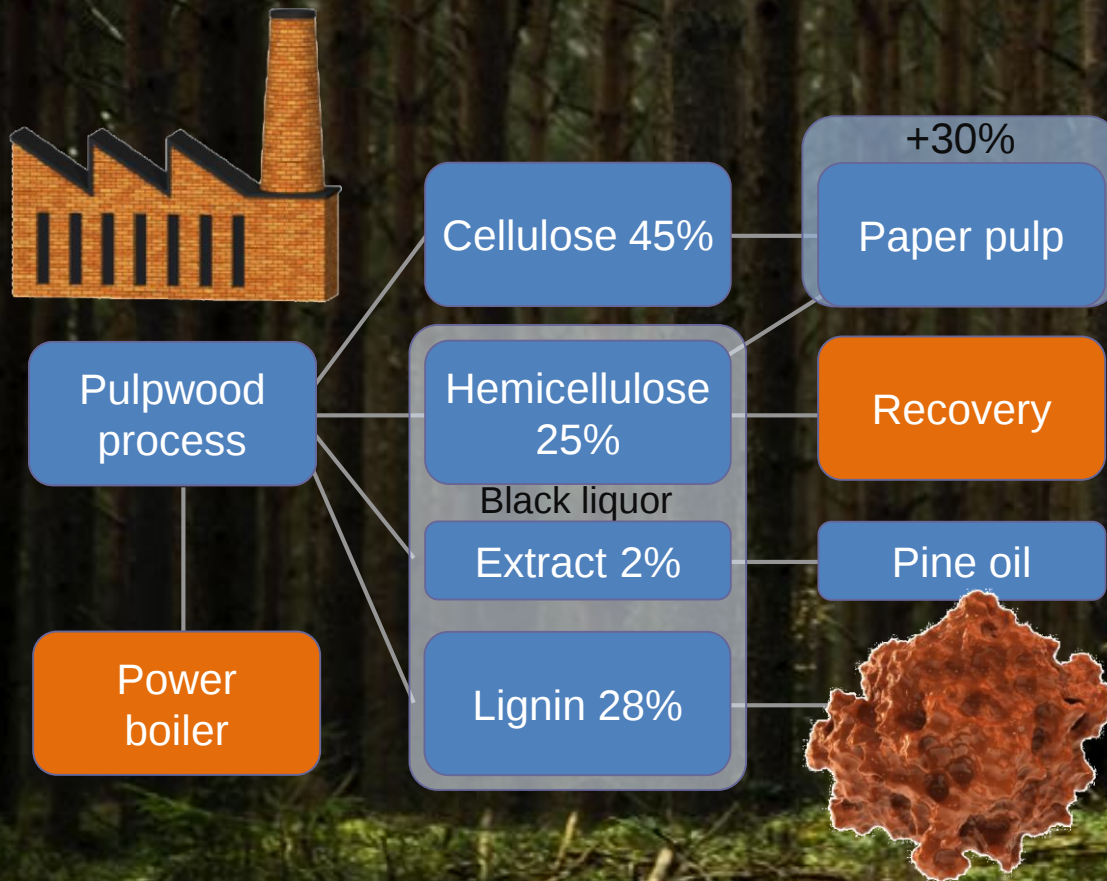
1/3 of Forest Wood is Lignin

Over 50% in the pulping process are waste products, combusted to provide heat for drying and recovery...



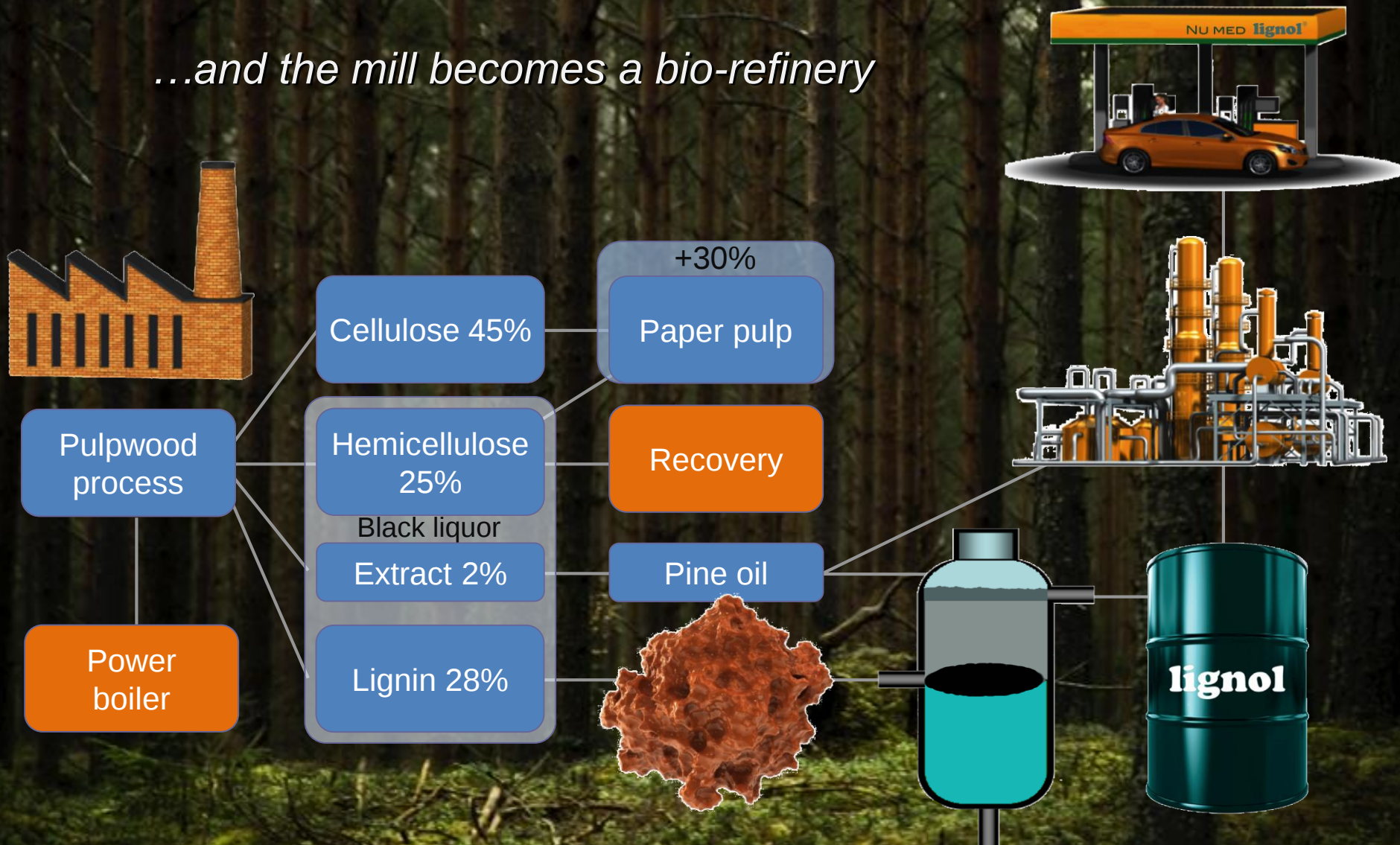
Less Lignin - More Pulp

The pulping process becomes more efficient when excess lignin is removed from black liquor...



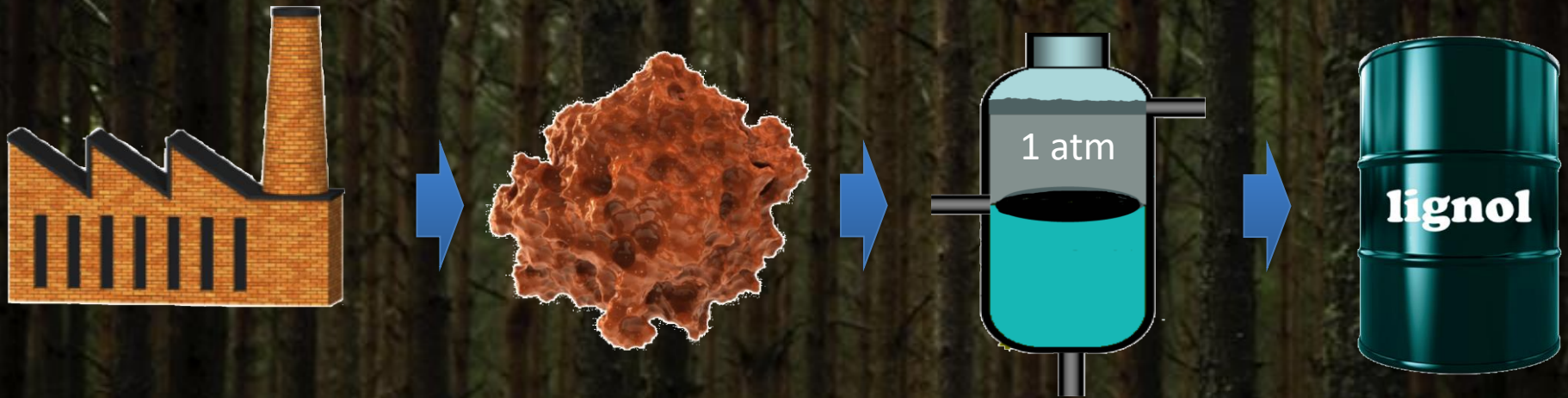
Less Lignin - More BioFuel

...and the mill becomes a bio-refinery



Our Innovation

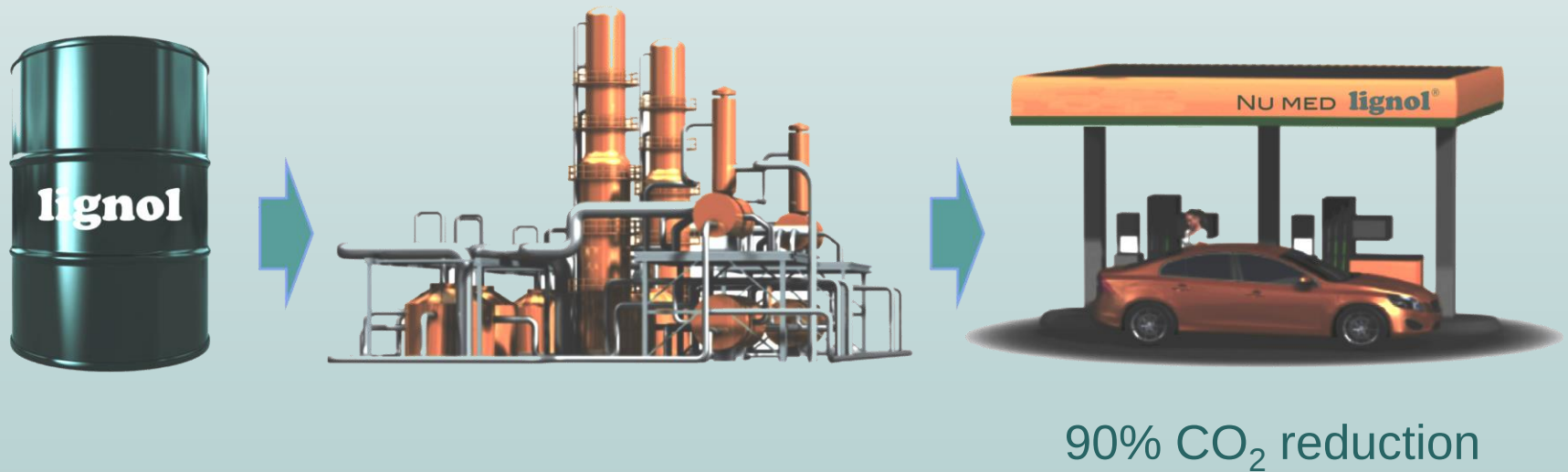
We turn lignin into sustainable lignin oil...



Low CAPEX due to catalytic process dissolving lignin

- Very energy effective
- Atmospheric pressure
- Below the boiling point
- <99% yield
- No waste products
- Without toxic emissions

Lignol has a similar structure as fossil oil,
means gasoline, diesel, jetfuel...
Needs Hydro Treatment in refinery



- Existing refineries
- Both gasoline, diesel and jet
- Mix to any degree fossil fuel to meet regulation over time

- Existing distribution system
- No investments in stations
- No adjustments on vehicles

Solid Refining Partner

Preem invest in refining lignol into gasoline & diesel to make the Swedish vehicle fleet fossil free...

Preem becomes the world's first refinery to use LIGNOL® for production of bio-gasoline and bio-diesel in Preemraff.



First establishment of bio-refinery...!



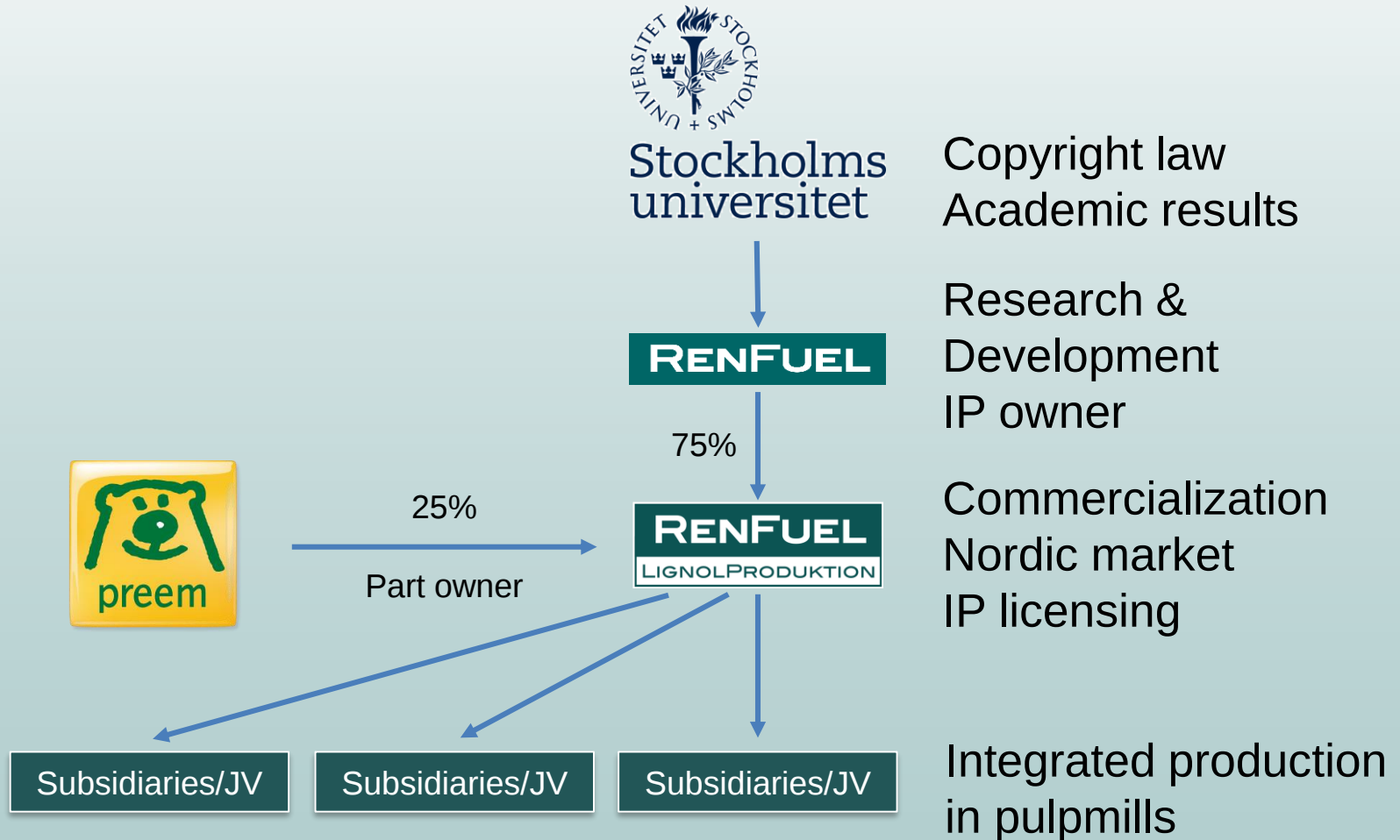
Together with Rottneros a basic engineering project phase have been concluded 2019

The results from technical scale up and regulation is very good
The results from ROI (4-5 years) from pulp mill project investment is not acceptable (lignin extraction, harbor, infrastructure)

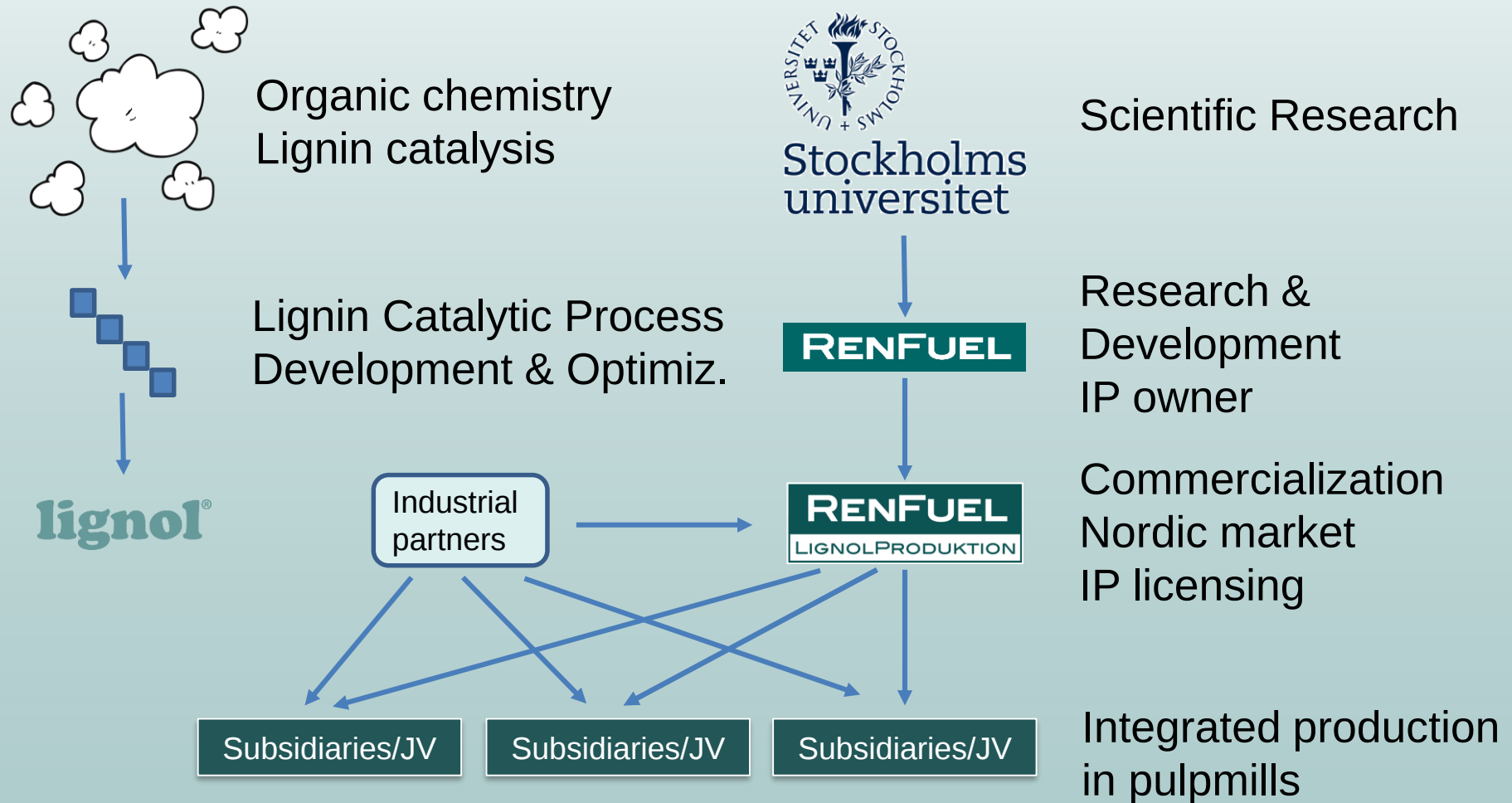
Lesson learned...

Scale of economy focus on pulpmill with capacity of +300 kton pulp and commitment to increase pulp product!

Our Legal Setup



RenFuel Development Model from research to production

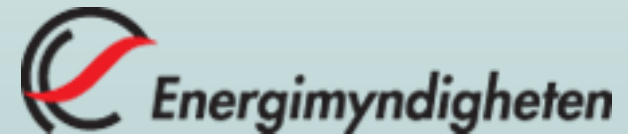


Core Stones for commercial production

- Feed stock of lignin to be secured via pulpmill
- Commitment in supply-demand chain to handle risk
- Regulation accepted RED II approved
- Low CAPEX investment for green field solution
- Risk management for investment in steps
- No infrastructure investments, fit into present supply solution
- High energy content and GHG reduction value



Our Partners





- Huge demand for biofuels due to climate & regulations.
- Secured long term supply of forest wood and lignin.
- Stable, scaleable, effective, ethic, low capex production.
- Increases pulp production and pulp mill profitability.
- Green potent "drop-in" bio-gasoline and bio-diesel.
- High climate effect, well over 90%, for low investments.
- Creates new jobs and less dependence of fossil fuel.
- RenFuel business model – great market potential.



A close-up photograph of a pine branch with vibrant green needles and a brown, textured bark. The needles are sharp and pointed, with some showing slight yellowing at the tips. The background is a soft-focus green, suggesting a forest setting.

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