# Drop-in fuels from black liquor

## – Combining increased pulp capacity with production of sustainable biofuels

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# Message

- Drop-in biofuels from kraft black liquor are cost competitive
- Added value from increased pulp production capacity
- Biofuel production is an efficient way to utilize a pulp mill energy surplus
- Hydrogen supply and refinery energy integration are critical issues for lignin separation and upgrading

# Pulping and chemical recovery – black liquor processing often bottleneck

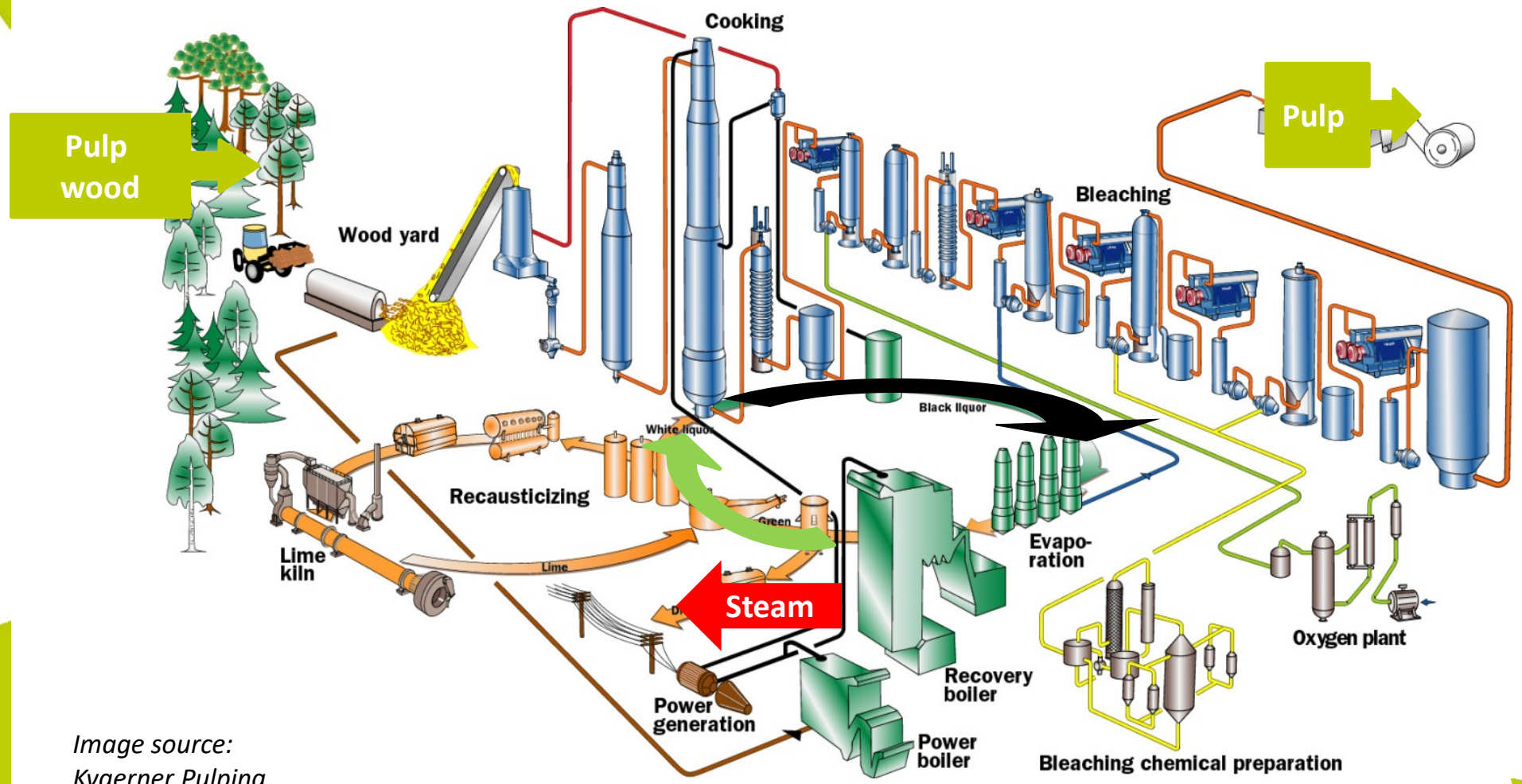


*Image source:*
*Kvaerner Pulping*

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# Studied technology tracks

## Lignin separation and upgrading to diesel and gasoline

- Lignin membrane-based separation
- Purification, stabilization in VGO matrix
- Hydrodeoxygenation and -cracking
- Partly validated in pilot scale, partly in lab
- Overall TRL 4-5

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## Black liquor gasification with methanol-to-gasoline (MTG)

- BL gasification + methanol synthesis
- Methanol-to-gasoline (and LPG)
- Gasification pilot 3 MW >28,000 h operation
- Exxon Mobil MTG Commercial operation
- Overall TRL ~7

SCHMIDTSCHE SCHACK

ARVOS GROUP

CHEMREC
Energy to succeed

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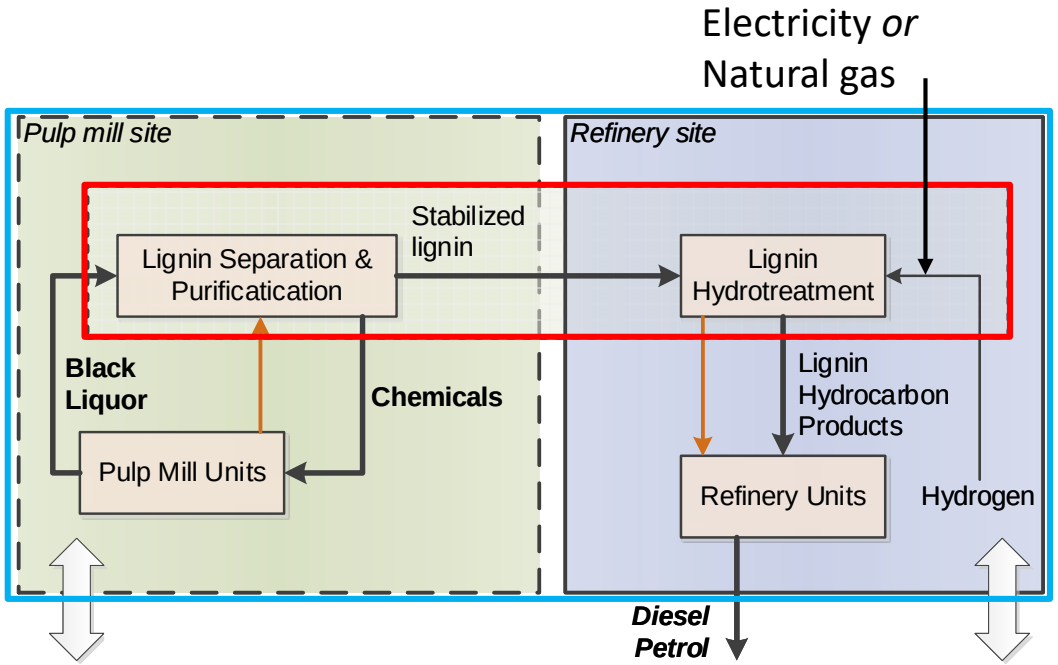
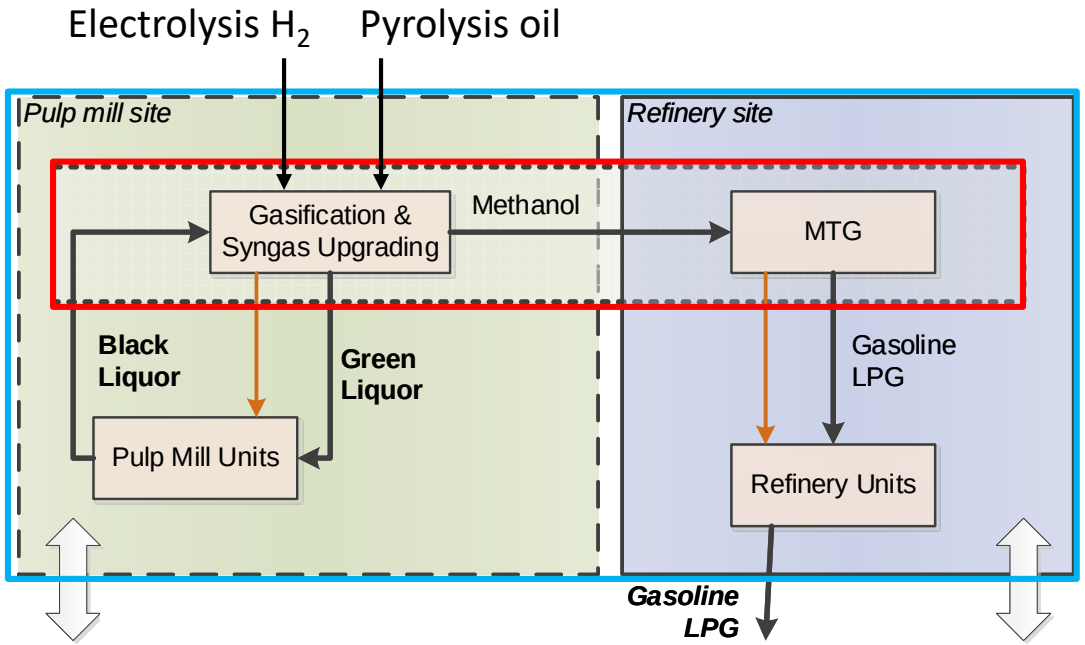
# Studied technology tracks

## Lignin separation and upgrading to diesel and gasoline




## Black liquor gasification with methanol-to-gasoline (MTG)




Direct conversion efficiency

Expanded system efficiency

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# Technology evaluation

ENERGY EFFICIENCY

PRODUCTION COST

GREENHOUSE GAS PERFORMANCE

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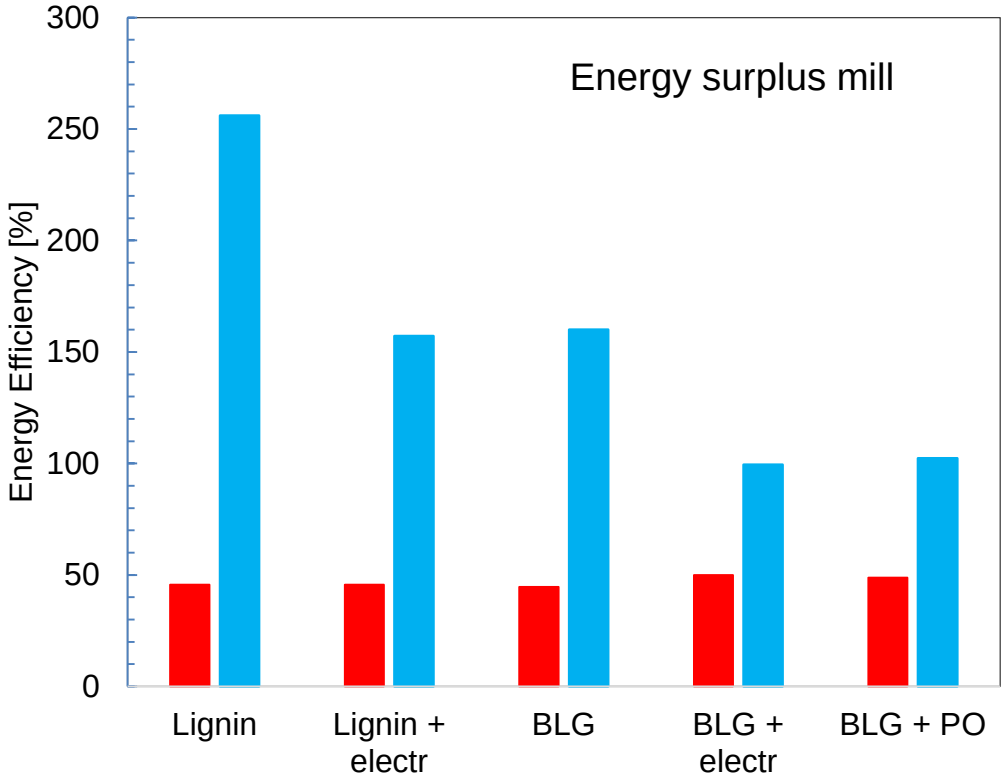
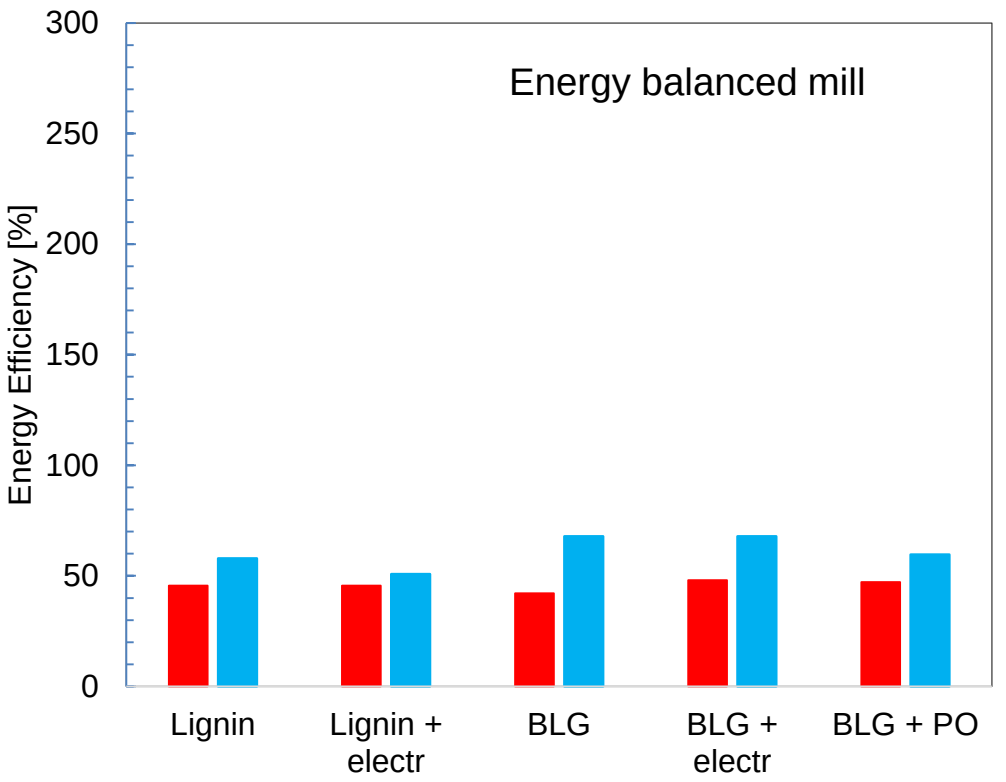
# Energy efficiency (preliminary results)




Direct conversion efficiency

Expanded system efficiency

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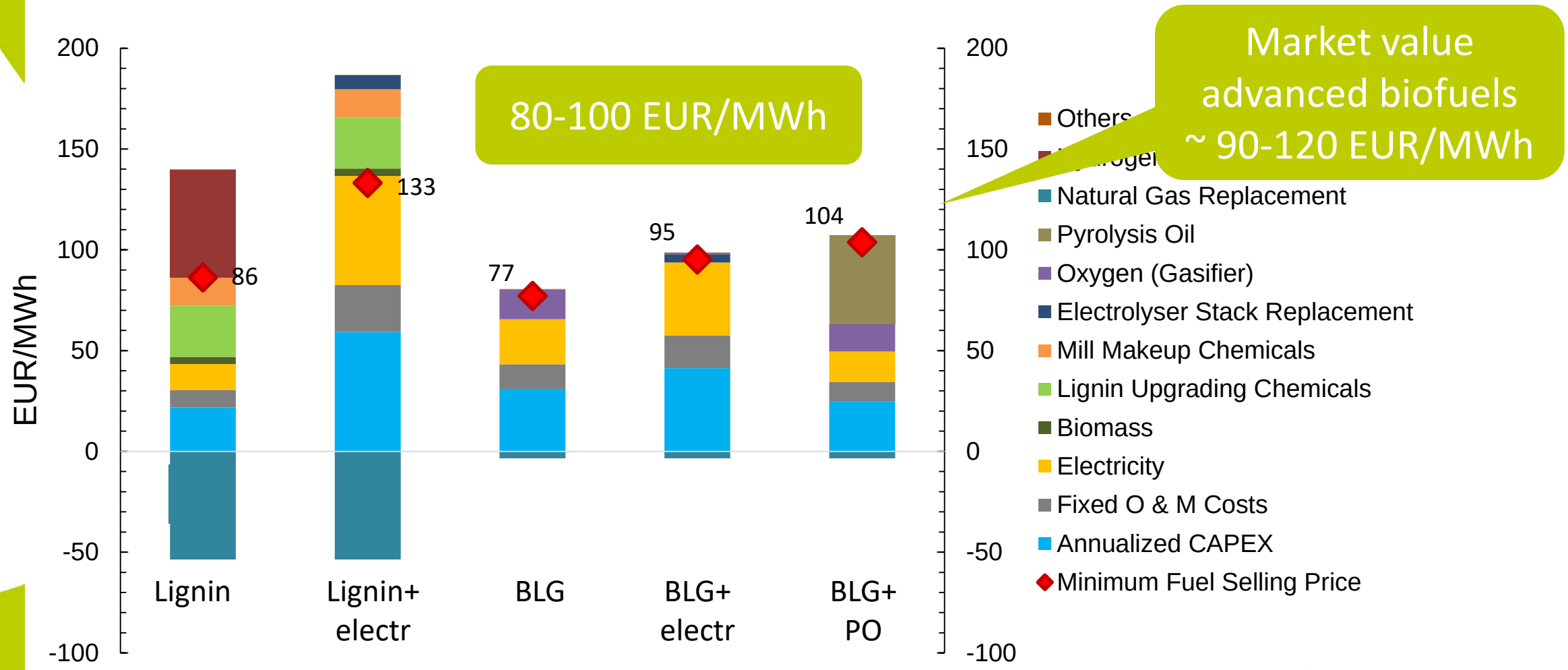
# Production costs (preliminary results)

## - Energy surplus mill (similar for balanced mill)

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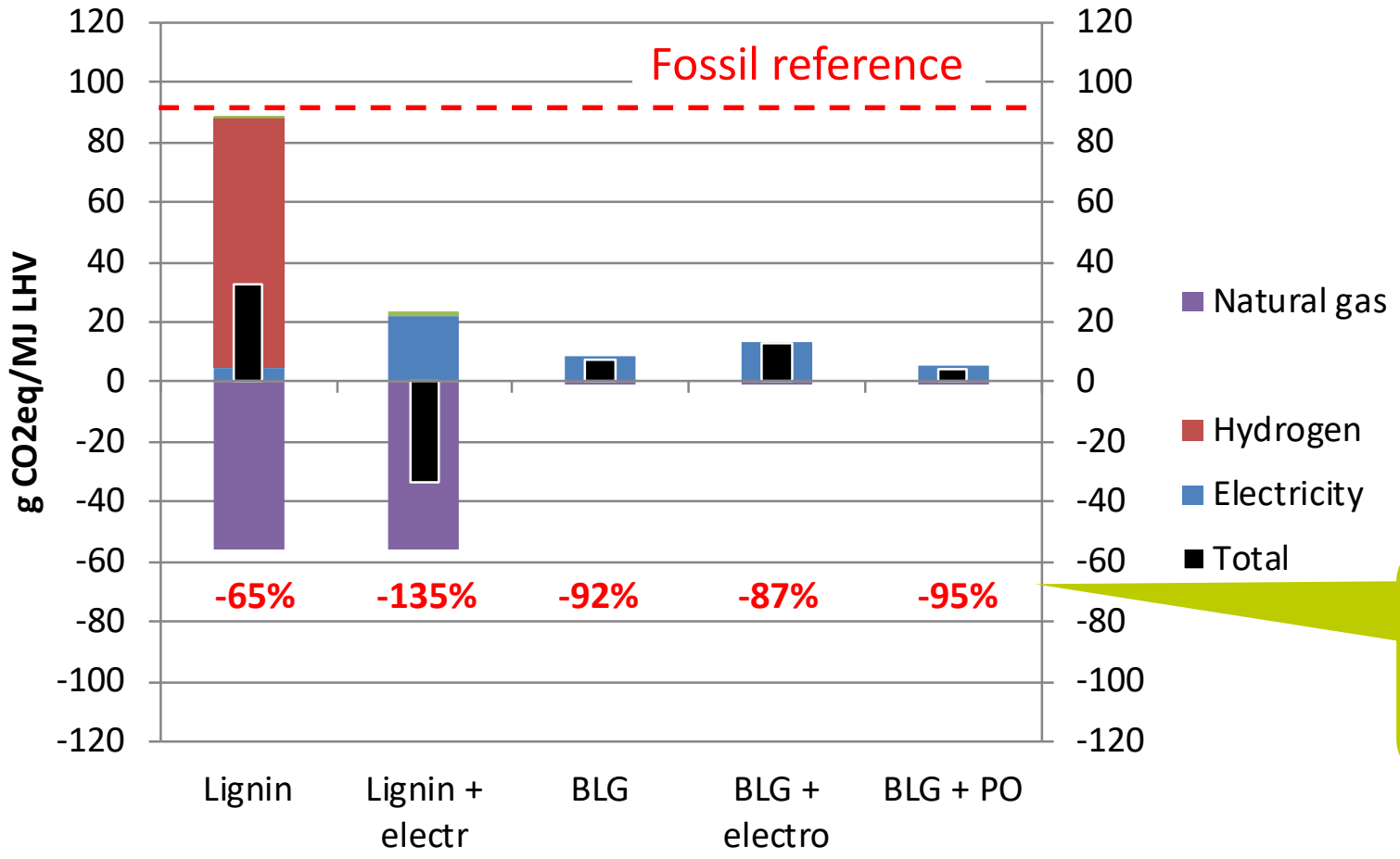
# Greenhouse gas performance (preliminary results)

## - Energy surplus mill (similar for balanced mill)




Results valid for low carbon electricity production!

RED II requires -65%

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# Conclusions

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This work has been carried out within the collaborative research program *Renewable transportation fuels and systems*, with funding from the Swedish Energy Agency and f3 Swedish Knowledge Centre for Renewable Transportation Fuels.

Thank you for listening!

Swedish Energy Agency

THE SWEDISH KNOWLEDGE CENTRE FOR RENEWABLE TRANSPORTATION FUELS

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