Electrolysis assisted biomass gasification for biofuels production
- a technoeconomic perspective

Sennai Mesfun, RISE

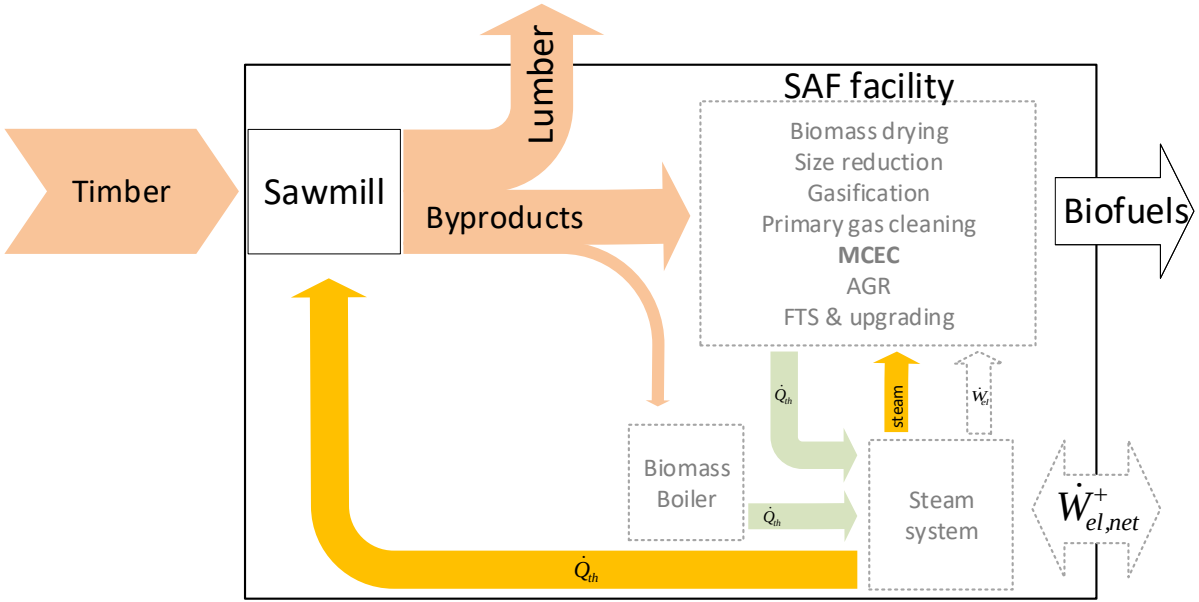
Objectives

investigate Molten Carbonate Electrolysis Cell (**MCEC**) for syngas conditioning

"To produce knowledge specific to the operating range, scale and feasibility of MCEC as an alternative pathway to a multiple-stage downstream conditioning of raw-syngas (from biomass gasification) prior to its synthesis to transport grade biofuel"

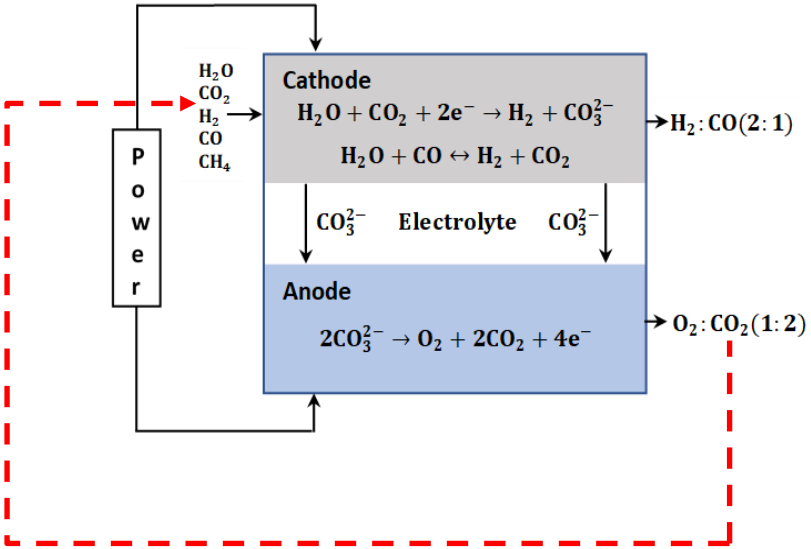
extent of linking electricity to liquid fuels

Technology track and scope of work



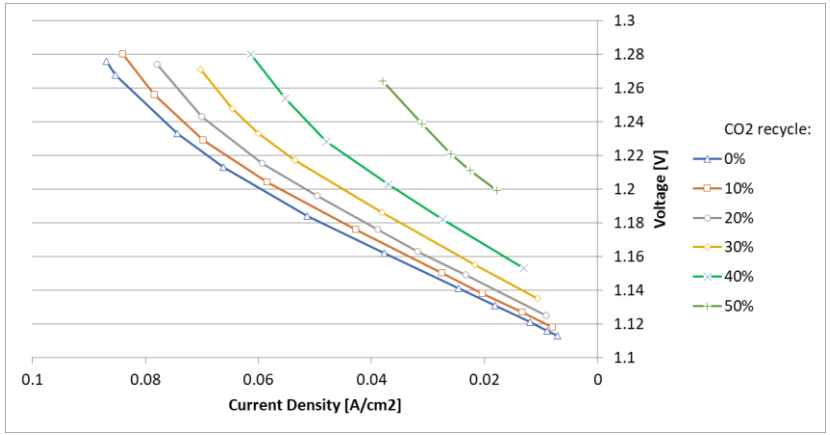
- **M**olten **C**arbonate **E**lectrolysis **C**ell (**MCEC**)
- Biomass gasification (x3)
- Fischer Tropsch to Jet fuel (FTJ)
- Evaluation type – technoeconomic assessment of sustainable aviation fuel (SAF) production at a typical Nordic sawmill
- Process configuration (x2)
- Host facility – sawmill (generic)

MCEC — operational window

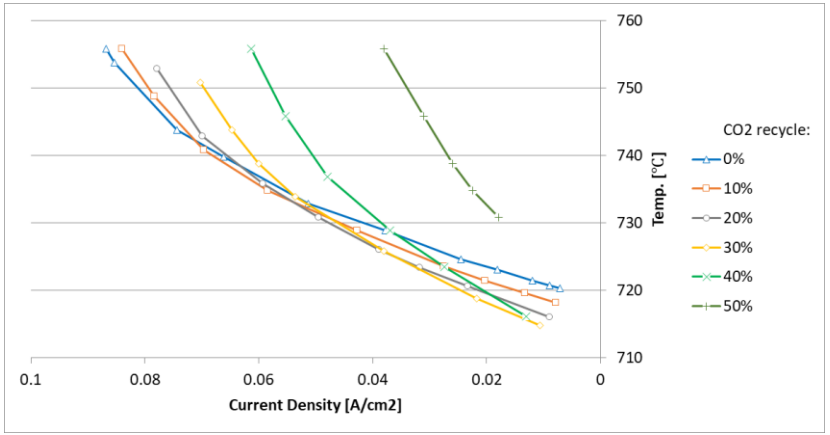


- polarization curve
- stack temperature
- methane behavior
- CO_2 recycle (anode)

MCEC — operational window

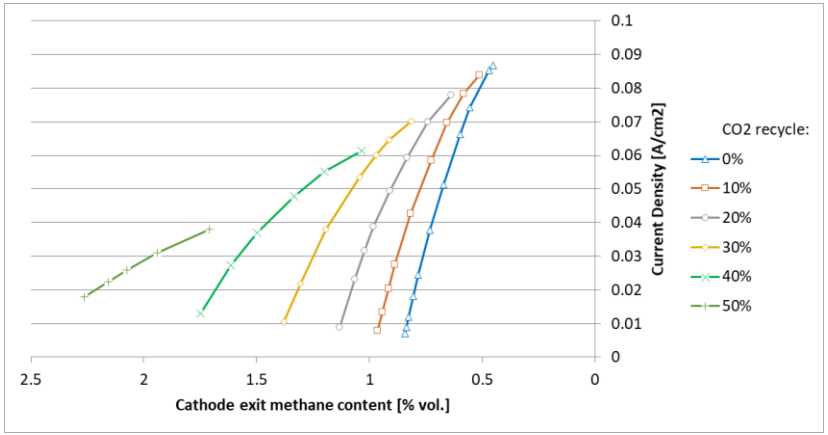


polarization curves

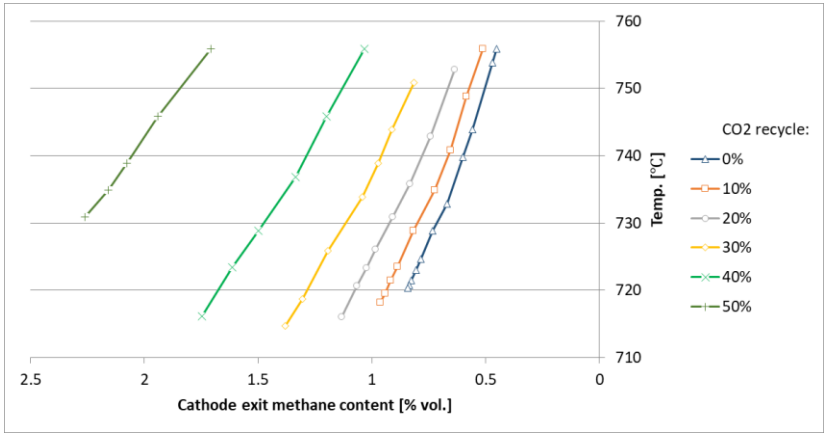


stack temperature

MCEC — operational window



methane vs current density

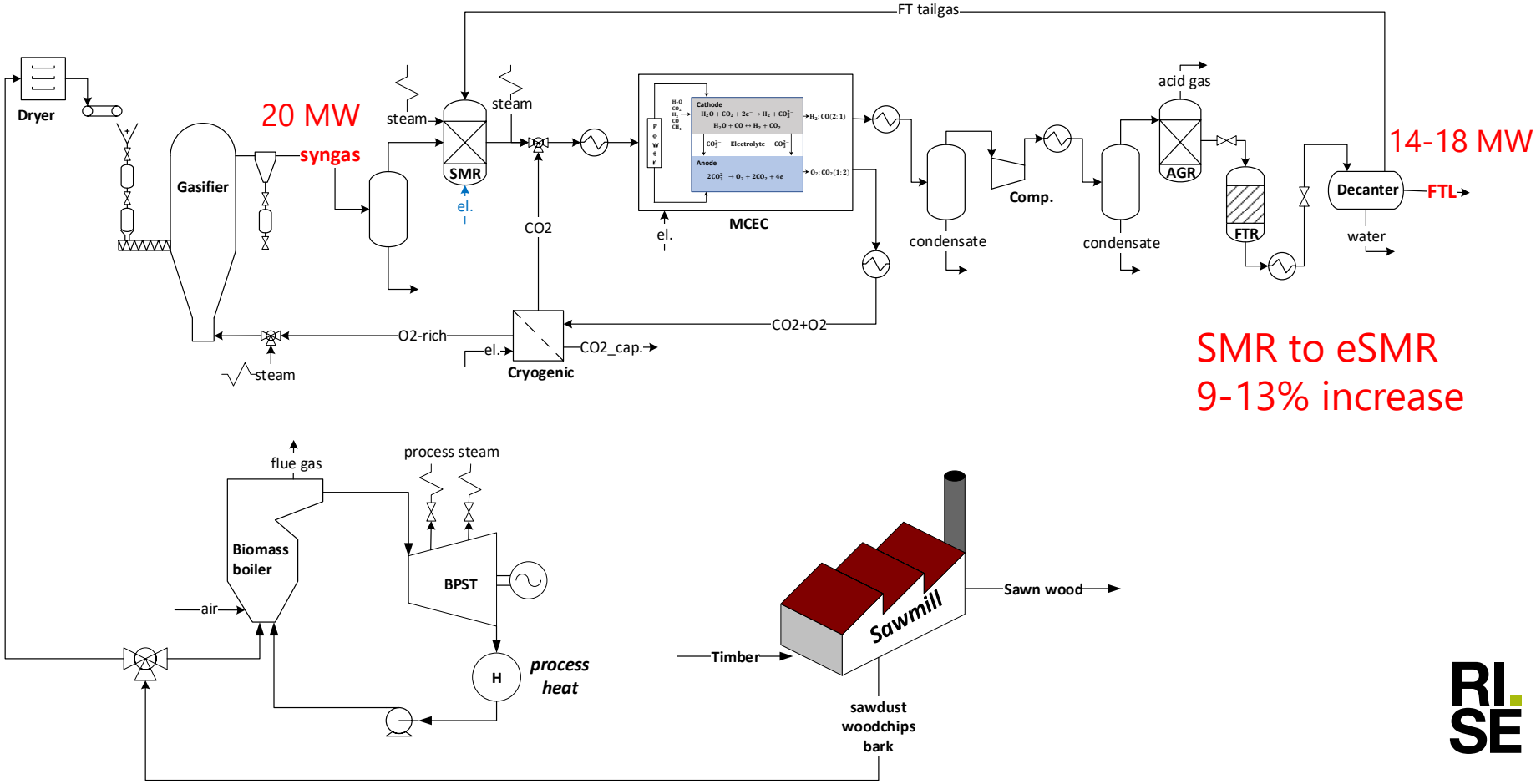


methane vs stack temperature

Cases evaluated

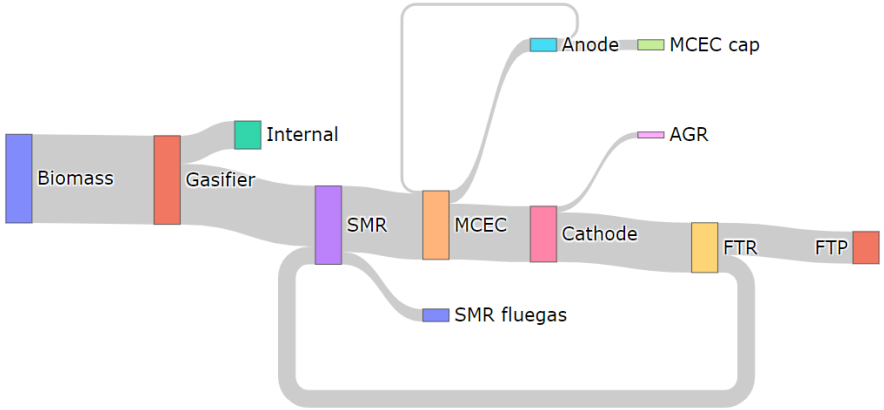
- MCEC integrated with 3 gasification technologies (20 MW LHV syngas)
  - WoodRoll (WR, Cortus Energy AB)
  - Dual Fluidized Bed (DFB, e.g. GoBiGas)
  - Bubbling Fluidized Bed direct heated (BFB, Andritz Carbona)
- 2 process configuration
  - side-fired steam reformer (SMR)
  - electric heated steam reformer (eSMR)
- Production perspective: investment and *production cost estimates* for the studied cases

Process configuration (20 MW LHV syngas)

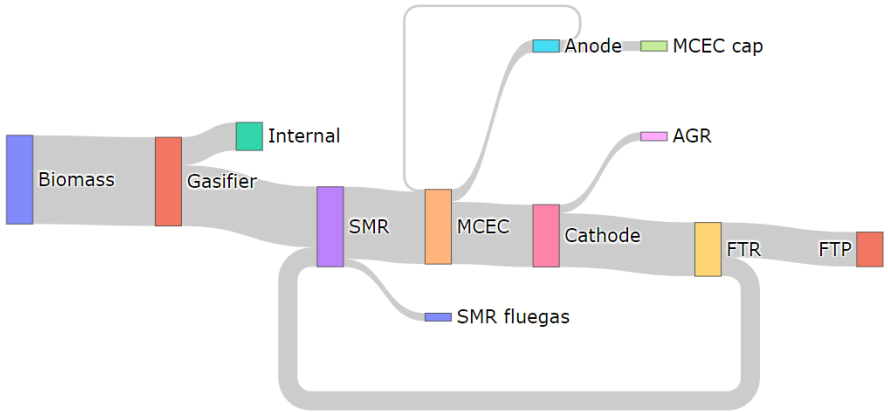


Carbon balance (Dual fluidized bed)

DFB_SMR [C-balance]



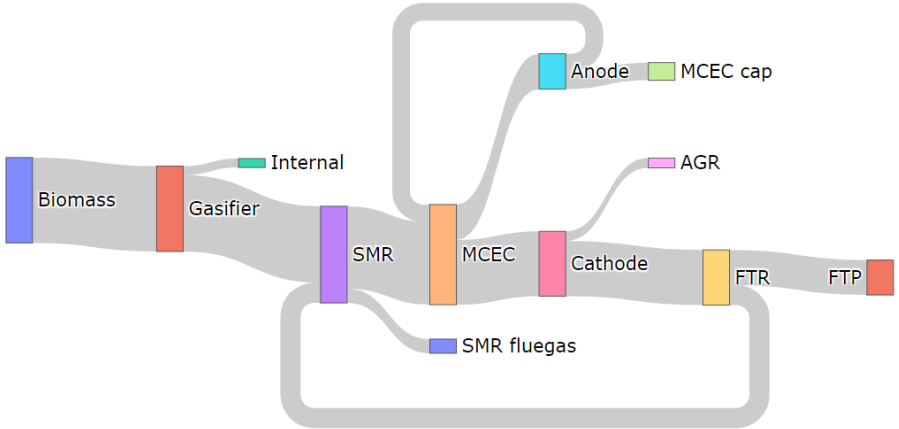
DFB_eSMR [C-balance]



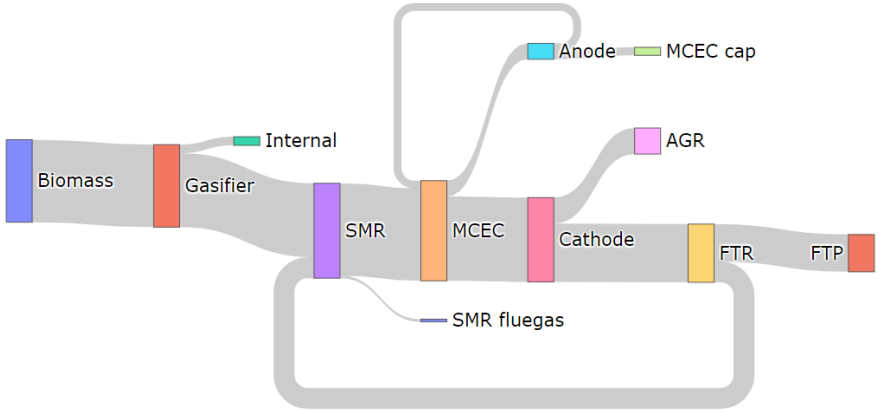
Normalized to carbon in syngas

Carbon balance (Bubbling fluidized bed)

BFBx_SMR [C-balance]



BFBx_eSMR [C-balance]

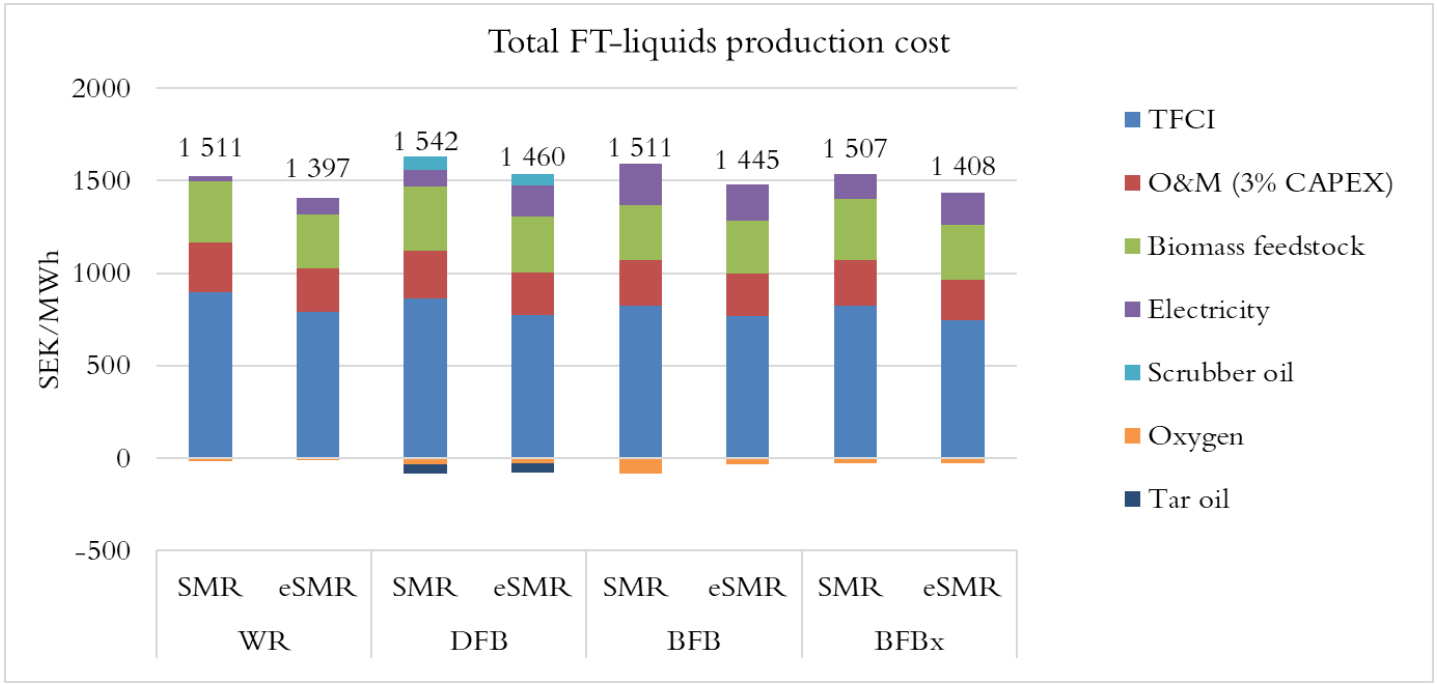


Normalized to carbon in syngas

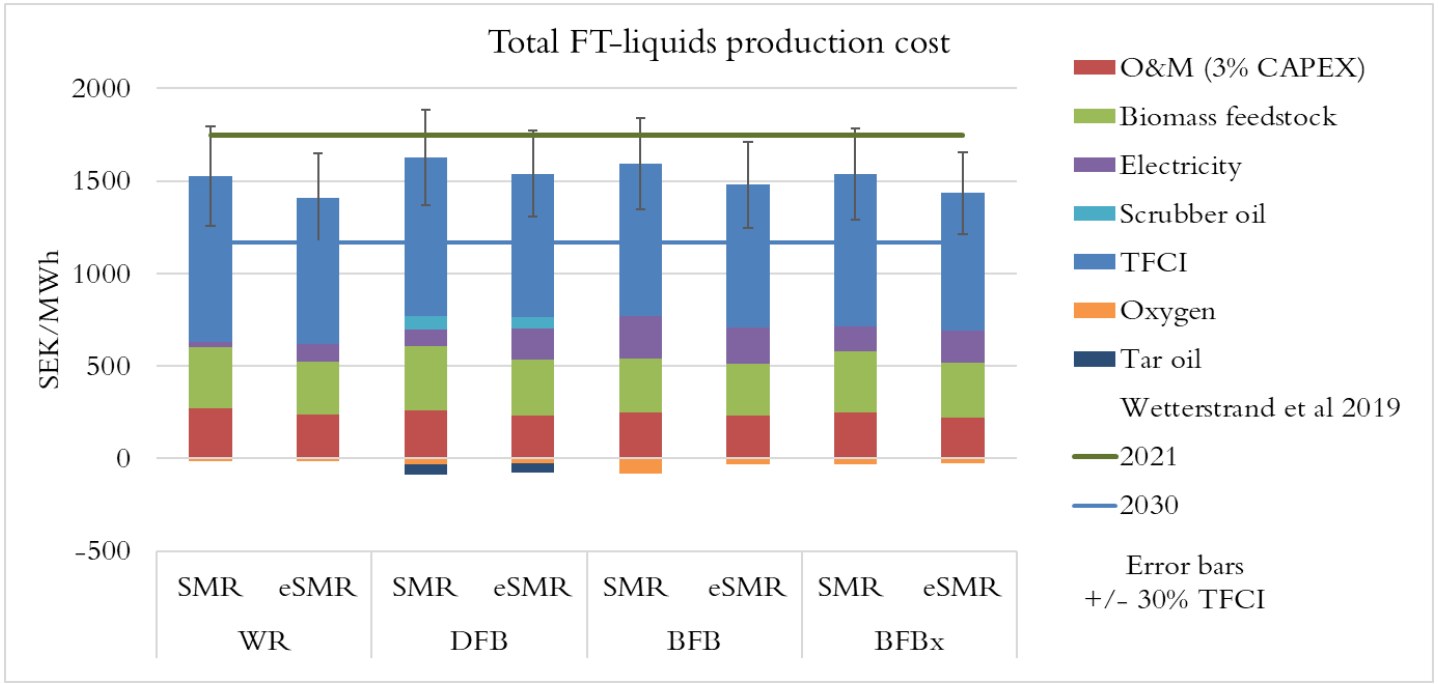
Economic parameters

Parameter	Unit	Value	Remark
Biomass	SEK/MWh	172.5	mixed bark, sawdust, woodchips
Electricity	SEK/MWh	400	
Oxygen	SEK/ton	600	
Scrubber oil	SEK/MWh	1060	DFB configuration
Annuity	-	0.1	~20 years, 8% interest
O&M	%	3	of Total Fixed Capital Inv. (TFCI)

Production cost



Production cost



Concluding remarks

- MCEC activity varies depending on syngas composition & requirements for downstream upgrading, WR<DFB<<BFB
- For a given MCEC size, lower current densities pronounce methane content of the syngas, e.g. suitable for SNG process
- Electrification of other process sections can boost carbon efficiency, worth checking electrical heating for the gasification process (DFB & WR)
- Process capital intensive (TFCI ~55% production cost), about 35% TFCI derives from gas conditioning section that include MCEC

Project partners:

Thank you for your attention!

Questions?

Det här projektet genomförs inom samverkansprogrammet *Förnybara drivmedel och system*
som finansieras av Energimyndigheten och f3 Svenskt kunskapscentrum för förnybara drivmedel.

www.f3centre.se/samverkansprogram

Energimyndigheten

SVENSKT KUNSKAPSCENTRUM FÖR FÖRNYBARA DRIVMEDEL