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LOW-COST SOLAR PHOTOVOLTAICS AS AN ACCELERATOR OF ENERGY TRANSITION

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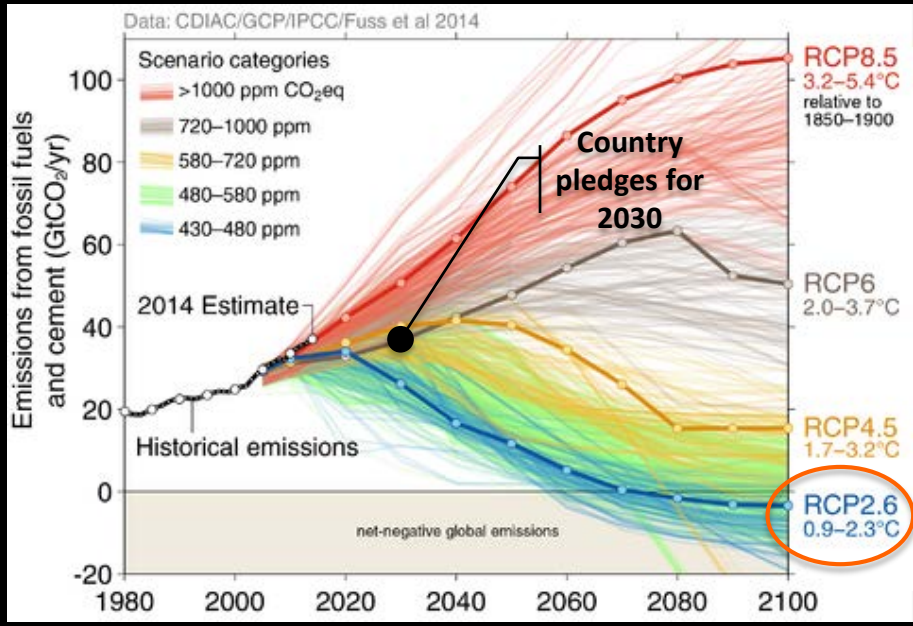
INTRODUCTION

CHALLENGE (1/2)

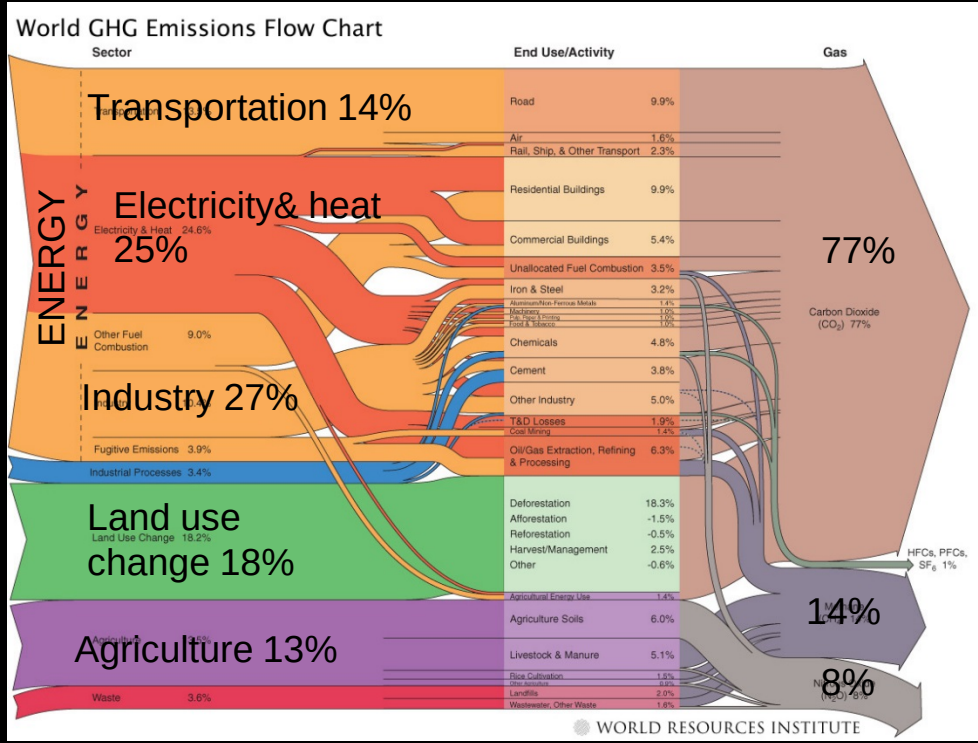
In Paris COP21 meeting the participating countries agreed on the target of 1.5 °C for global average temperature rise by 2100 from pre-industrial level. It requires net-Zero CO_2 emissions from energy sector by 2050. How to reach this in the given time window?



INTRODUCTION

CHALLENGE (2/2)

The main contributors to energy sector GHG emissions are the burning of coal and gas for electricity and heat, use of oil for mobility, and industrial use of fossil fuels.

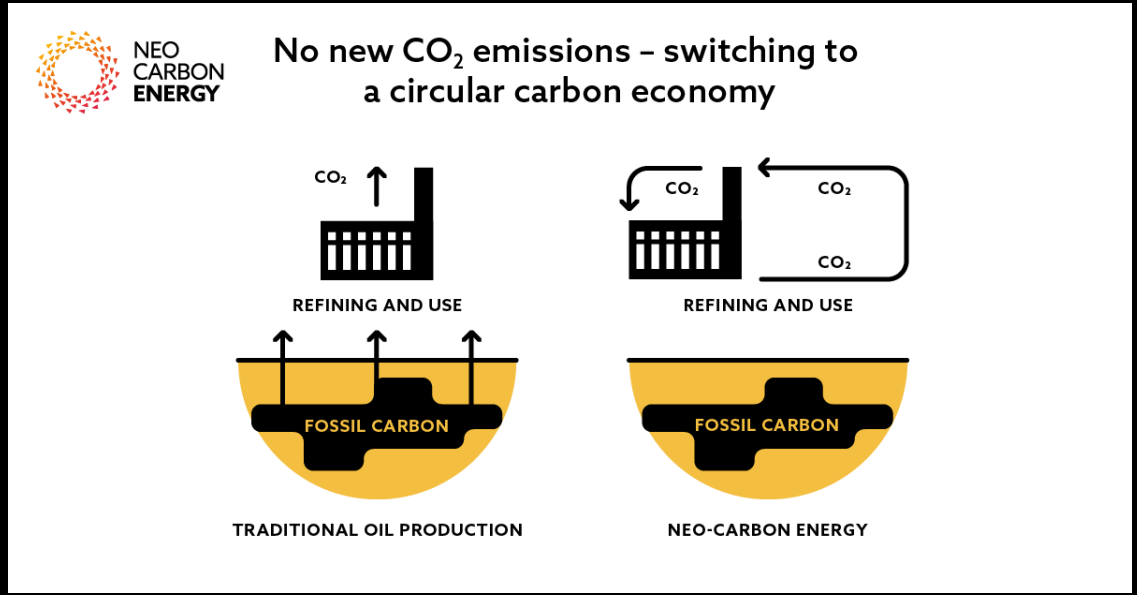


INTRODUCTION

SOLUTION

We have to transform the whole fossil energy and feedstock base of our industries to renewable one.

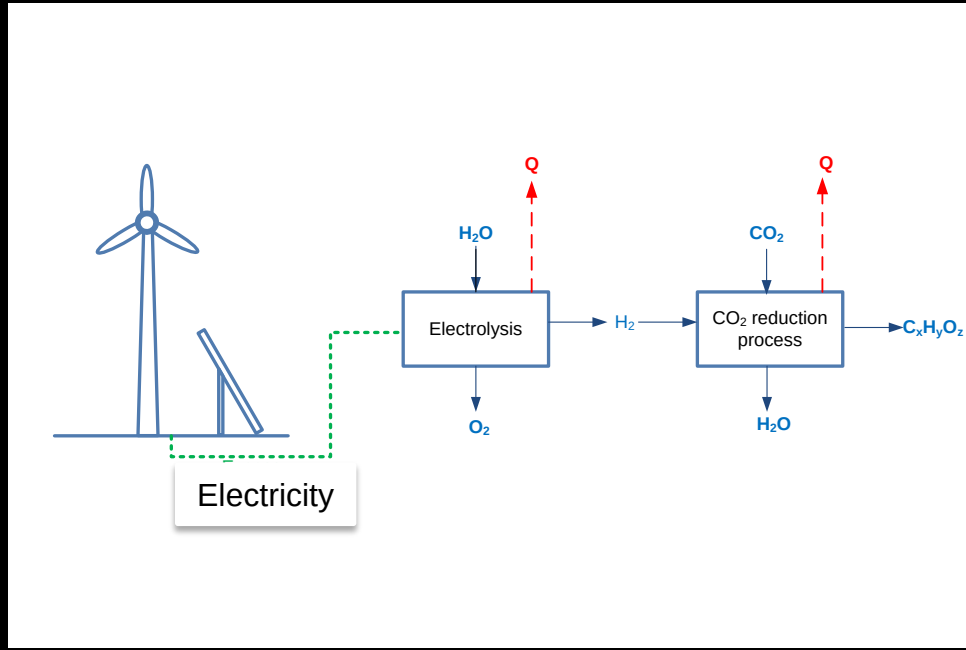
We have to implement circular carbon economy, which is scalable, net-CO2 emission free, is based on mass-produced technology (to be scalable fast enough) and is not tightly bound to the land use.



INTRODUCTION

POWER-TO-X

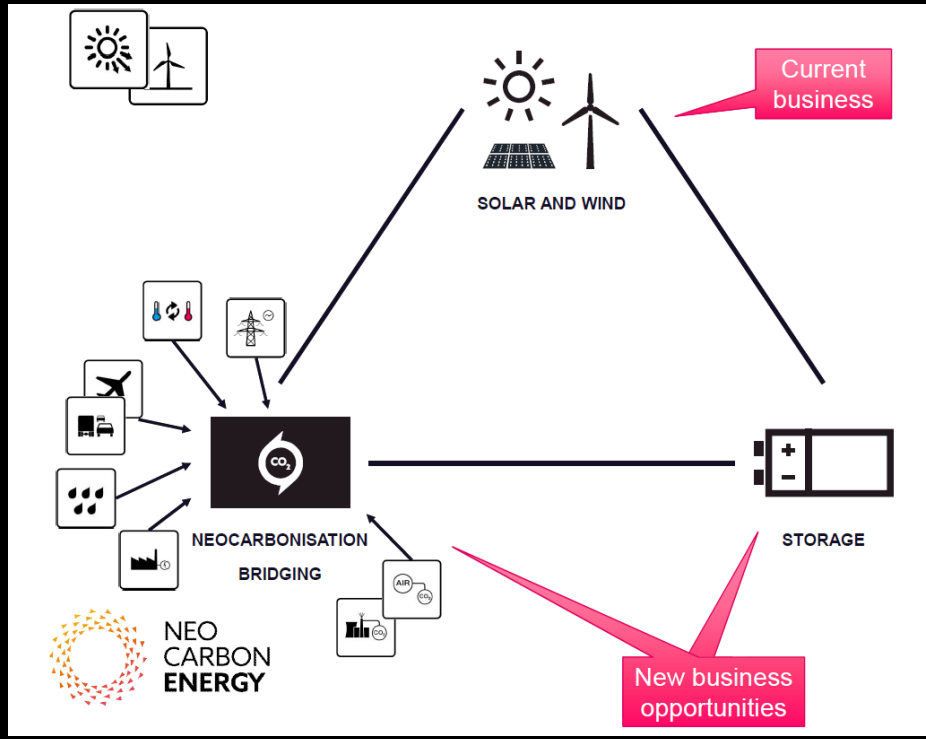
With P2X process hydrocarbons (e.g. fuels) can be synthesized from electrically produced hydrogen and captured CO_2 through thermochemical or biochemical route.



INTRODUCTION

FLEXIBLE FUTURE?

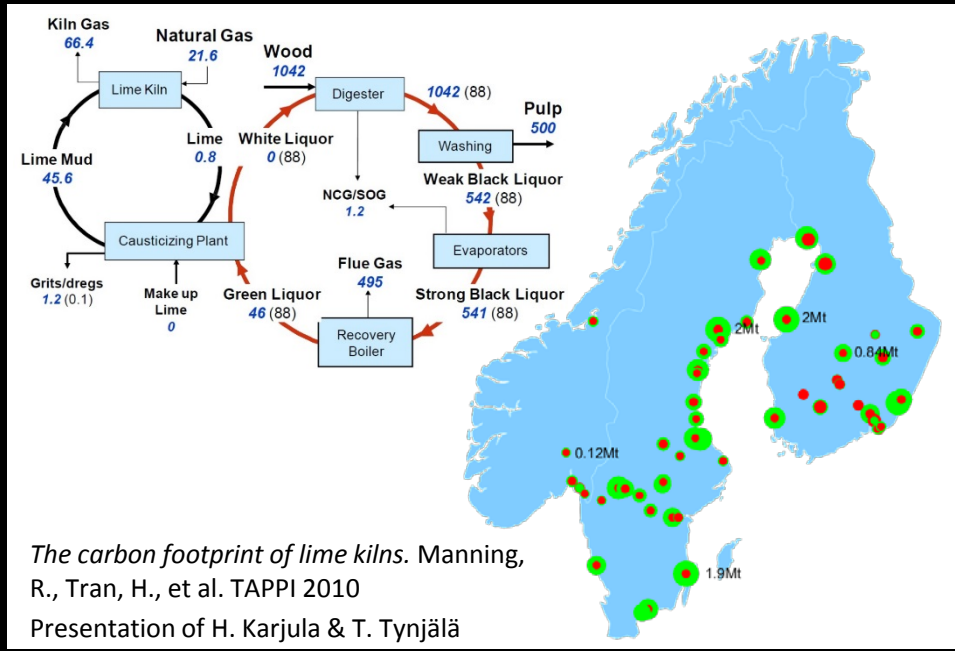
Future flexible energy system will be mainly based on the mass-produced solar and wind power. The whole energy use will be directly or indirectly electrified. Flexibility to the electricity system will be built with energy storages and demand response technologies.



INTRODUCTION

FINLAND & CO_2

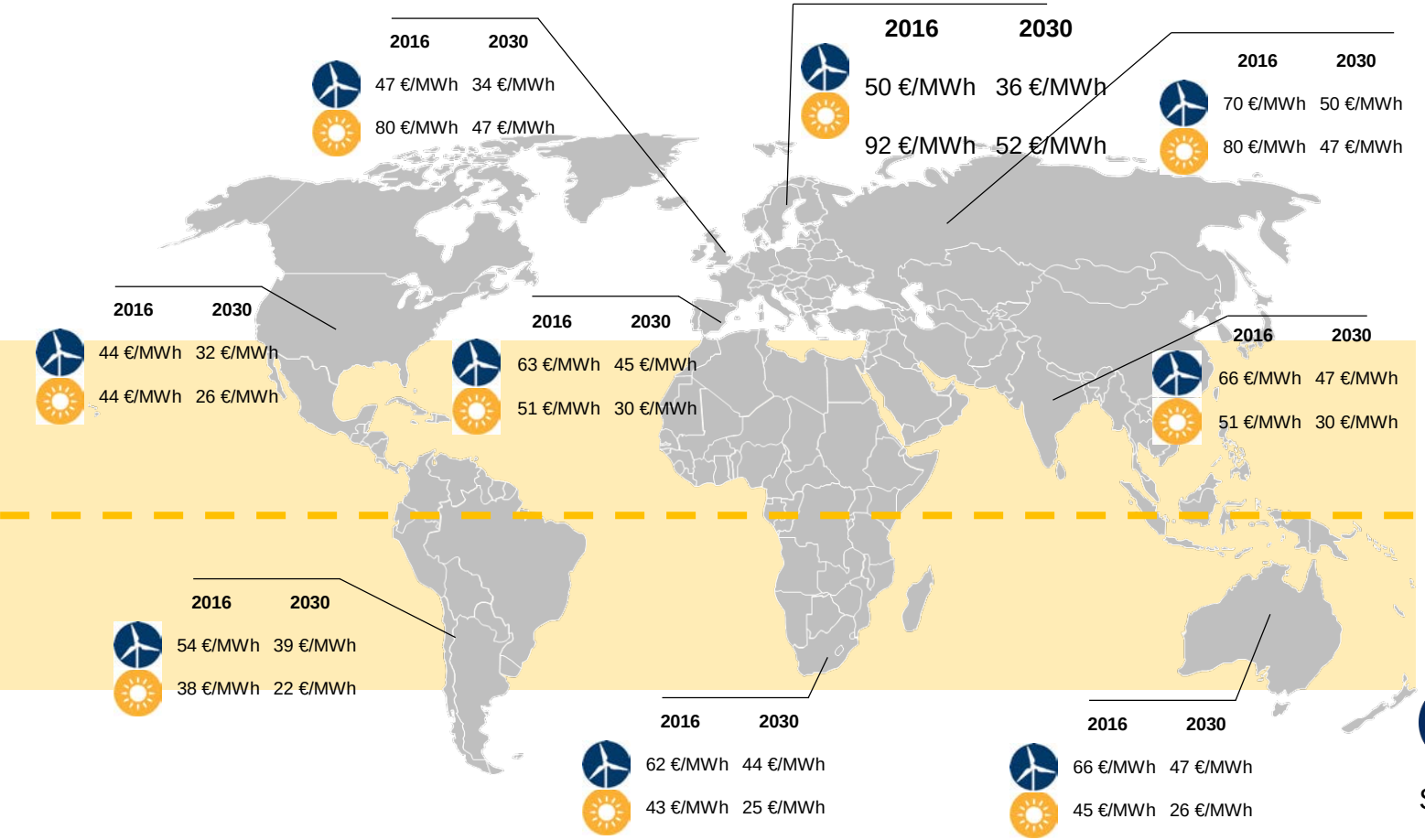
Finnish pulp and paper industry produces 36 Mt/a of CO_2, fossil fuel combustion is responsible of 60 Mt/a. By converting this bio-CO_2 to methane with P2G we would have ~170 TWh of gas. This equals the energy content of yearly oil & gas use in Finland, Estonia and Latvia. However, We will not have unlimited source or low-cost renewable electricity.



The carbon footprint of lime kilns. Manning, R., Tran, H., et al. TAPPI 2010

Presentation of H. Karjula & T. Tynjälä

The wind power and solar PV electricity cost estimated in 2014



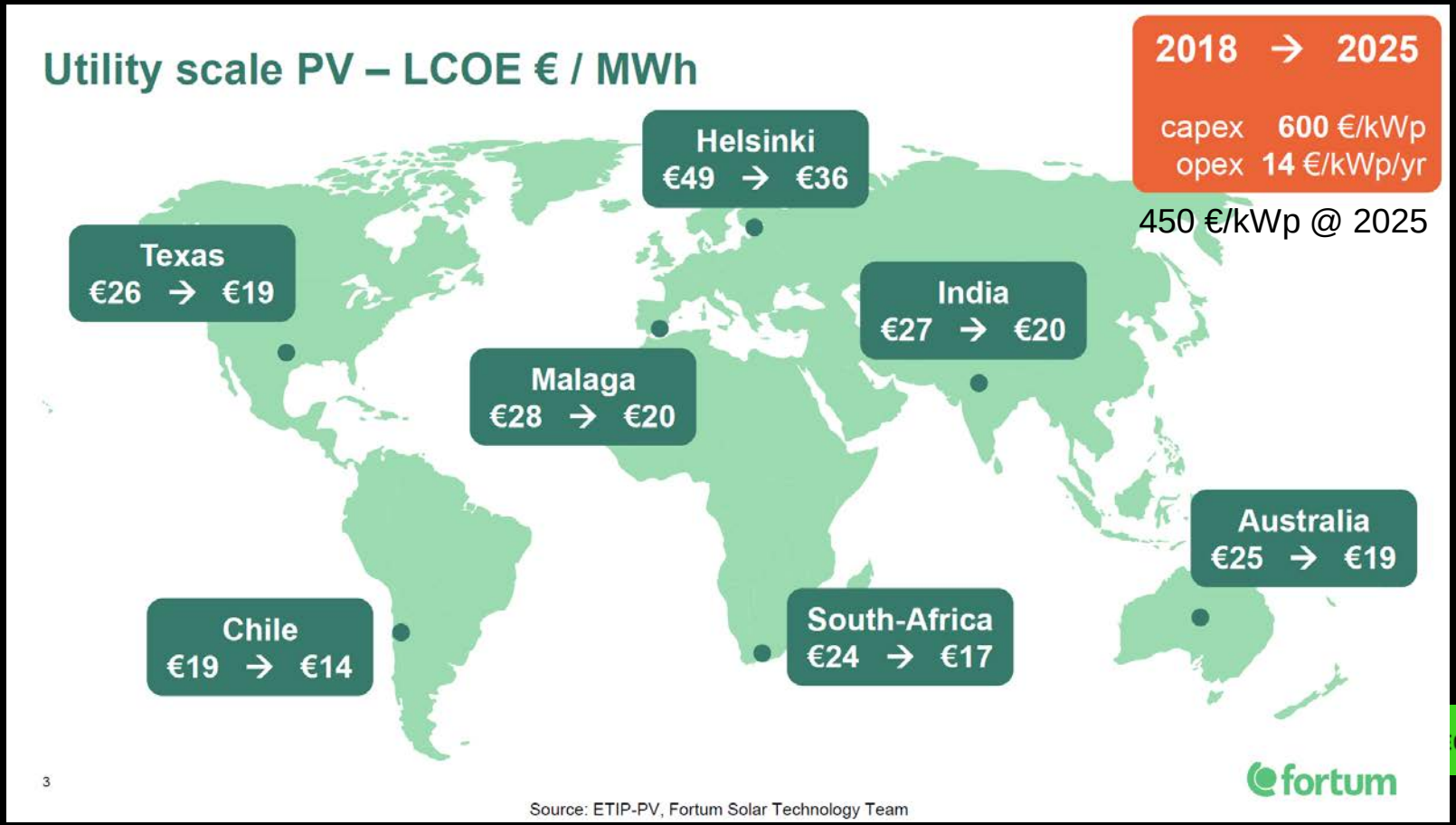
Clear Seasonality
Wind most competitive
Intermittent power

Low seasonality
PV most competitive
Intermittent power

Fortum

Source: Per Langer

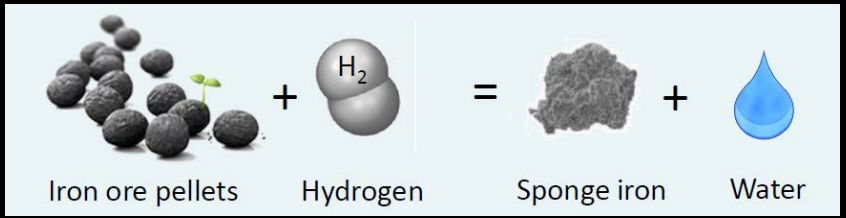
Solar PV electricity cost estimates in 2018 (2014 estimates already outdated)

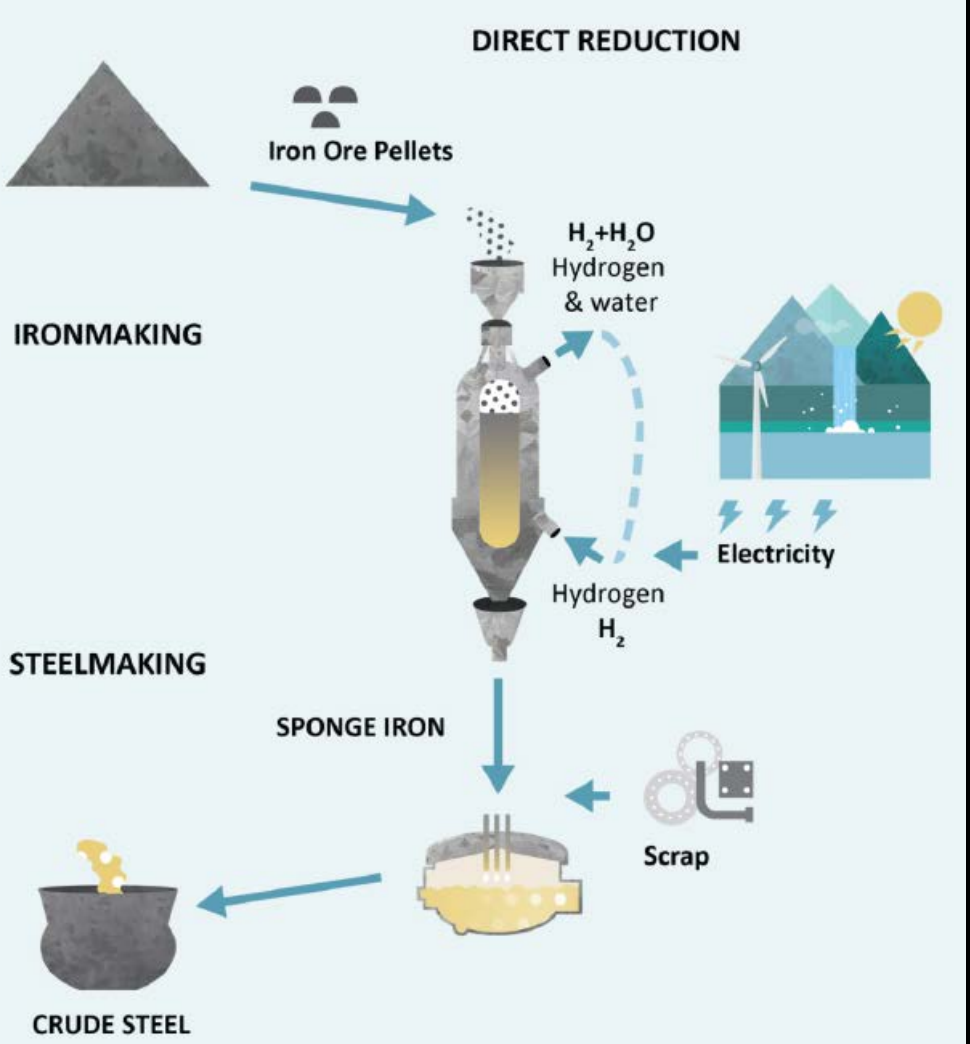


CHNOLOGY

Case 1: Hydrogen-based steel making

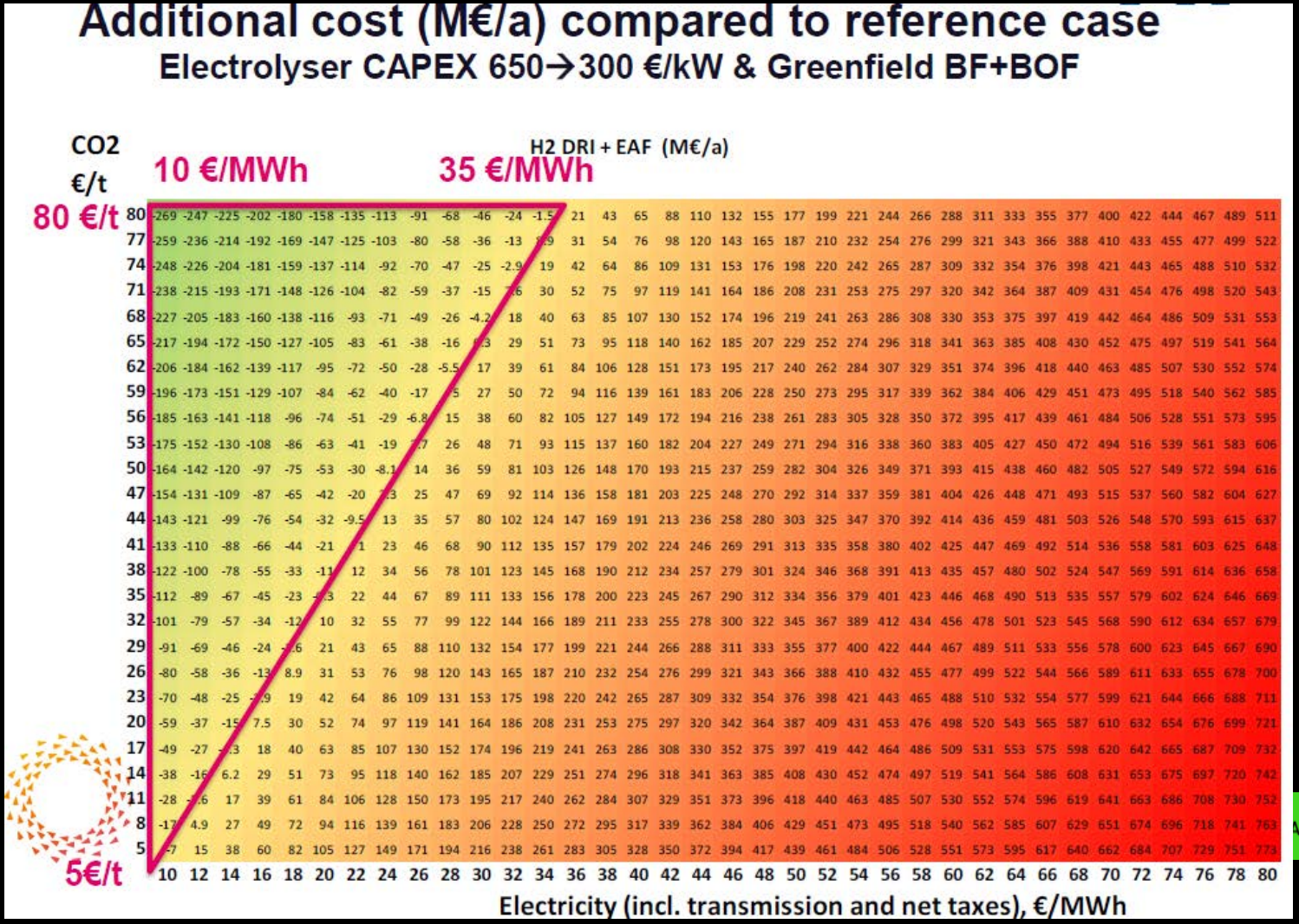
- Instead of coal, hydrogen will be used as a reducing agent in the prodtion of the iron
- The process can cut the CO_2 emissions more than 90 % when hydrogen is produced with renewable electrcity by water electrolysis
- HYBRIT project by LKAB, SSAB and Vattenfall: http://www.hybritdevelopment.com





Additional cost (M€/a) compared to reference case

Electrolyser CAPEX 650→300 €/kW & Greenfield BF+BOF



Source: Eemeli Tsupari, VTT, Neo-Carbon Energy, www.neocarbonenergy.fi

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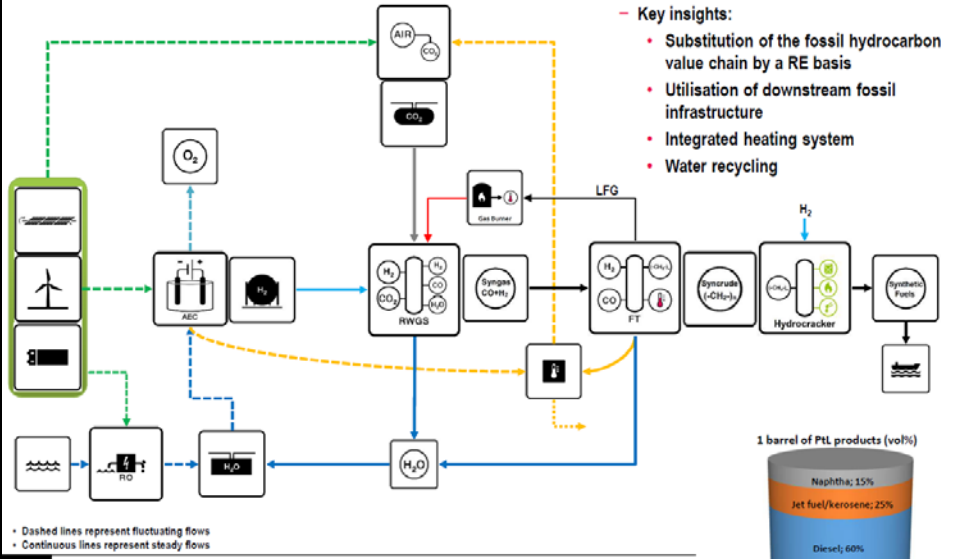
Case 2: Power-to-Liquids (solar+wind)

Methodology
RE-PtL Value Chain

Open your mind. LUT. Lappeenranta University of Technology



- Key insights:
  - Substitution of the fossil hydrocarbon value chain by a RE basis
  - Utilisation of downstream fossil infrastructure
  - Integrated heating system
  - Water recycling

Results
PtL Energy Flow & Mass Balance

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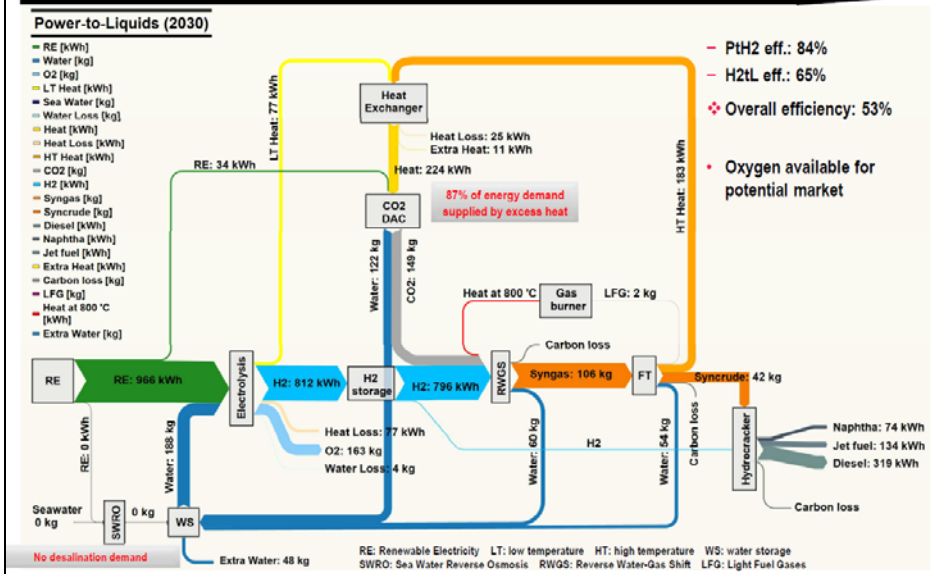

- PtH2 eff.: 84%
- H2tL eff.: 65%
- Overall efficiency: 53%
- Oxygen available for potential market

http://www.neocarbonenergy.fi/wp-content/uploads/2016/02/13_Fasihi.pdf

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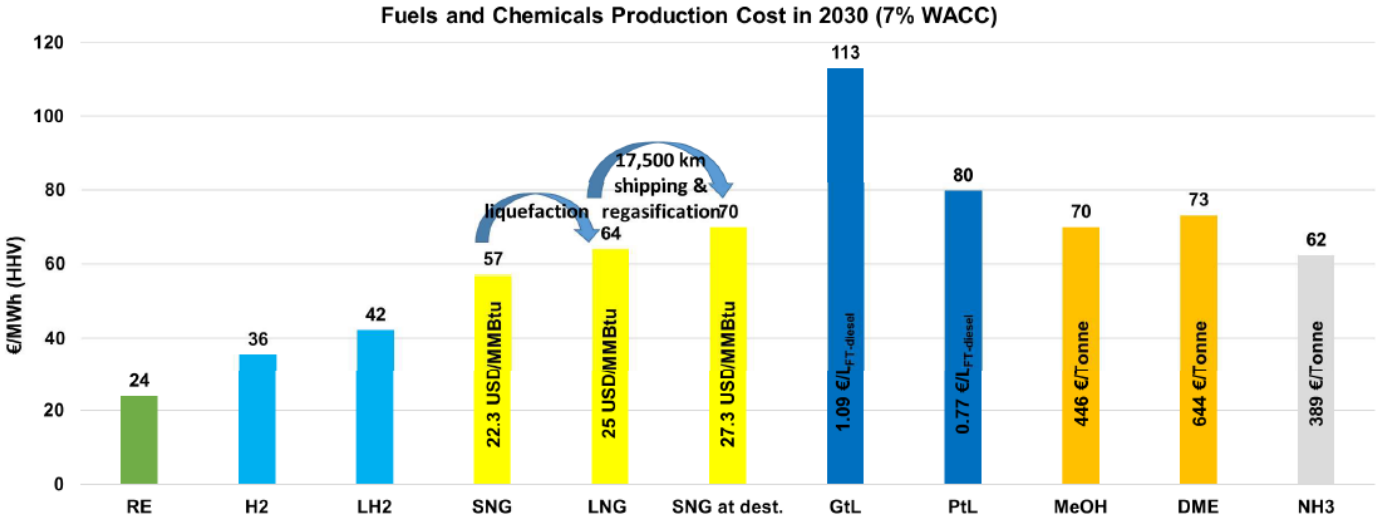
Results

Cost of Power-to-Fuel/Chemical Options



- SNG and PtG-GtL are the cheapest and the most expensive synthetic fuel, respectively.
- the production cost of RE-diesel, RE-methanol and RE-DME are close to each other, however the fuel-parity (cost competitiveness) depends on their respective market price and CO_2 emission cost.

http://www.neocarbonenergy.fi/wp-content/uploads/2016/02/13_Fasihi.pdf

How Bill Gates aims to clean up the planet

▲ An artists impression of what Carbon Engineering's ambitious direct air capture project would look like when completed. Photograph: Carbon Engineering

It's a simple idea: strip CO_2 from the air and use it to produce carbon-neutral fuel. But can it work on an industrial scale?

It's nothing much to look at, but the tangle of pipes, pumps, tanks, reactors, chimneys and ducts on a messy industrial estate outside the logging town of Squamish in western Canada could just provide the fix to stop the world tipping into runaway climate change and substitute dwindling supplies of conventional fuel.

https://www.theguardian.com/environment/2018/feb/04/carbon-emissions-negative-emissions-technologies-capture-storage-bill-gates

REFLEX

SOLETAIR LAUNCH DATE 14.6.2017

Site: www.soletair.fi, so far at least 35 Finnish media hits and more than 100 international media hits

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