

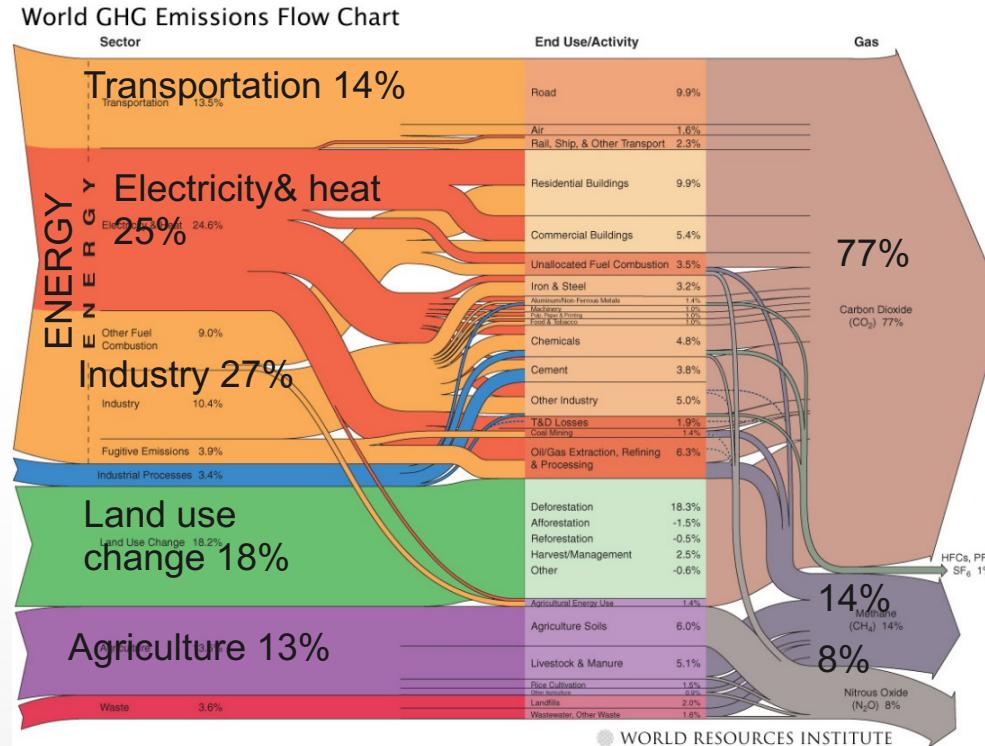
Power-to-X tulevaisuuden energiahärjestelmässä

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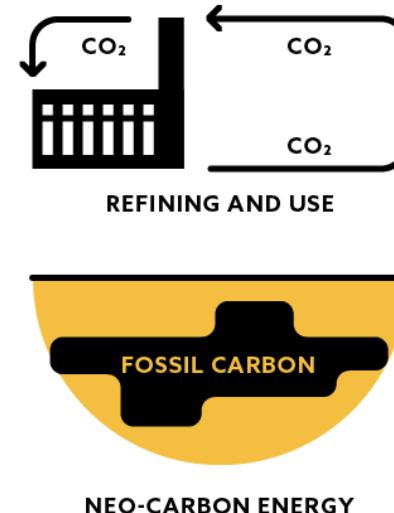
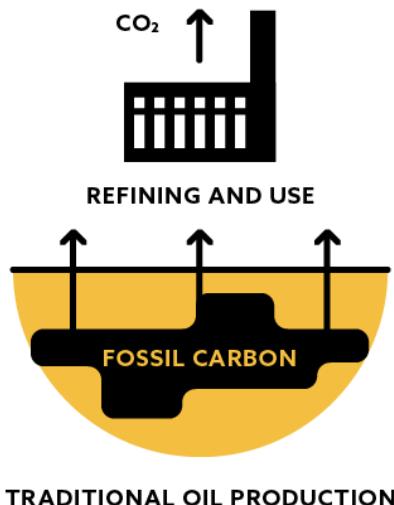
Tavoitteena on nollata globaalit kasvihuonekaasupäästöt 2050 mennessä



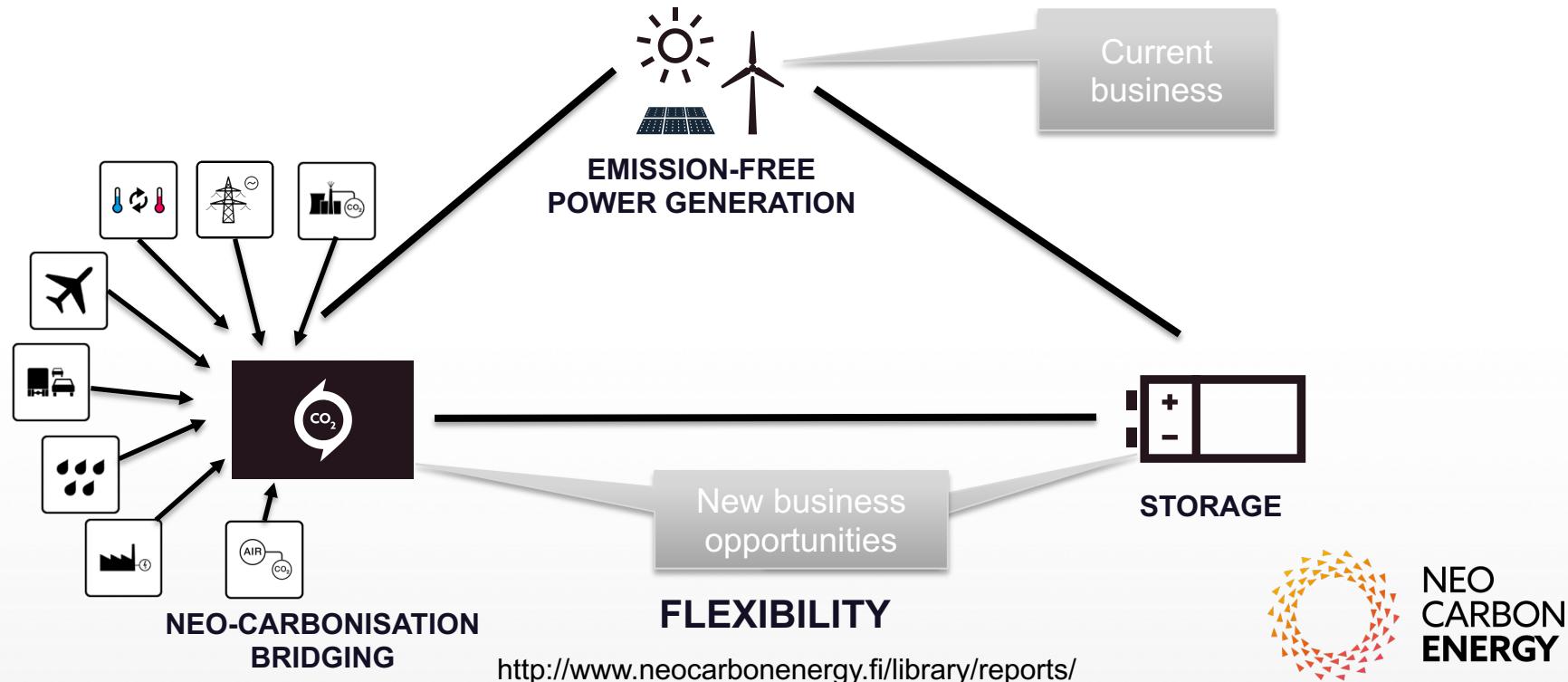
Tarvitsemme hiilidioksidin kiertotalouden



No new CO₂ emissions – switching to
a circular carbon economy

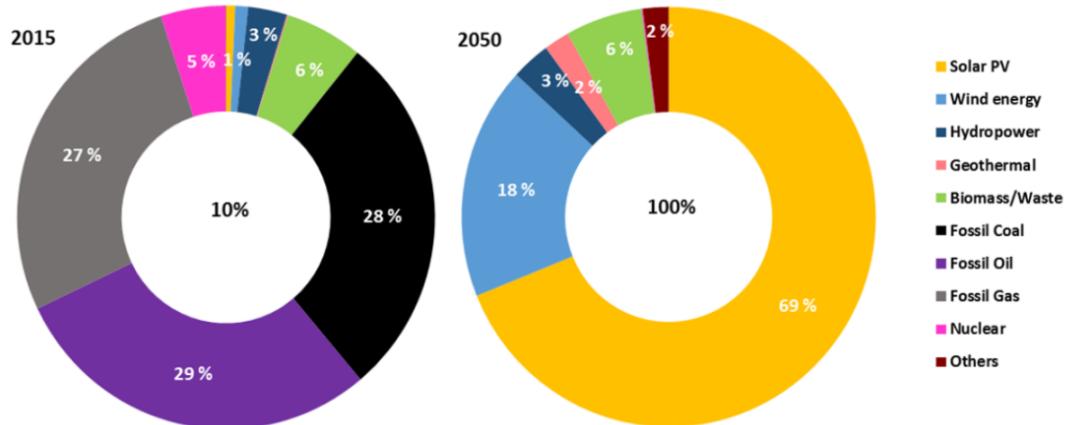


Sähköjärjestelmästä pääenergiajärjestelmä



Päästötön energiajärjestelmä on mahdollinen eikä nykyistä kalliimpi

Total Primary Energy Demand Shares



Key insights:

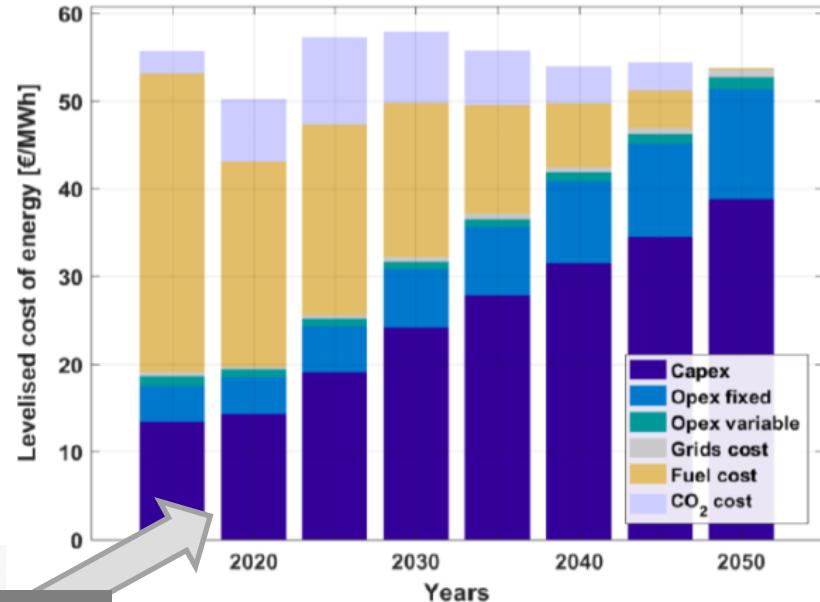
- TPED shifts from being dominated by coal, oil and gas in 2015 towards solar PV and wind energy by 2050
- Renewable sources of energy contribute just 22% of TPED in 2015, while in 2050 they supply 100% of TPED
- Solar PV drastically shifts from less than 1% in 2015 to around 69% of primary energy supply by 2050, as it becomes the least cost energy supply source

Source: <http://energywatchgroup.org/new-study-global-energy-system-based-100-renewable-energy>

Huge technology business opportunity

New Study: Global Energy System based on 100% Renewable Energy

The [new study](#) by the Energy Watch Group and LUT University is the first of its kind to outline a 1.5°C scenario with a cost-effective, cross-sectoral, technology-rich global 100% renewable energy system that does not build on negative CO₂ emission technologies. The scientific modelling study simulates a total global energy transition in the electricity, heat, transport and desalination sectors by 2050. It is based on four and a half years of research and analysis of data collection, as well as technical and financial modelling by 14 scientists. This proves that the transition to 100% renewable energy is economically competitive with the current fossil and nuclear-based system, and could reduce greenhouse gas emissions in the energy system to zero even before 2050.



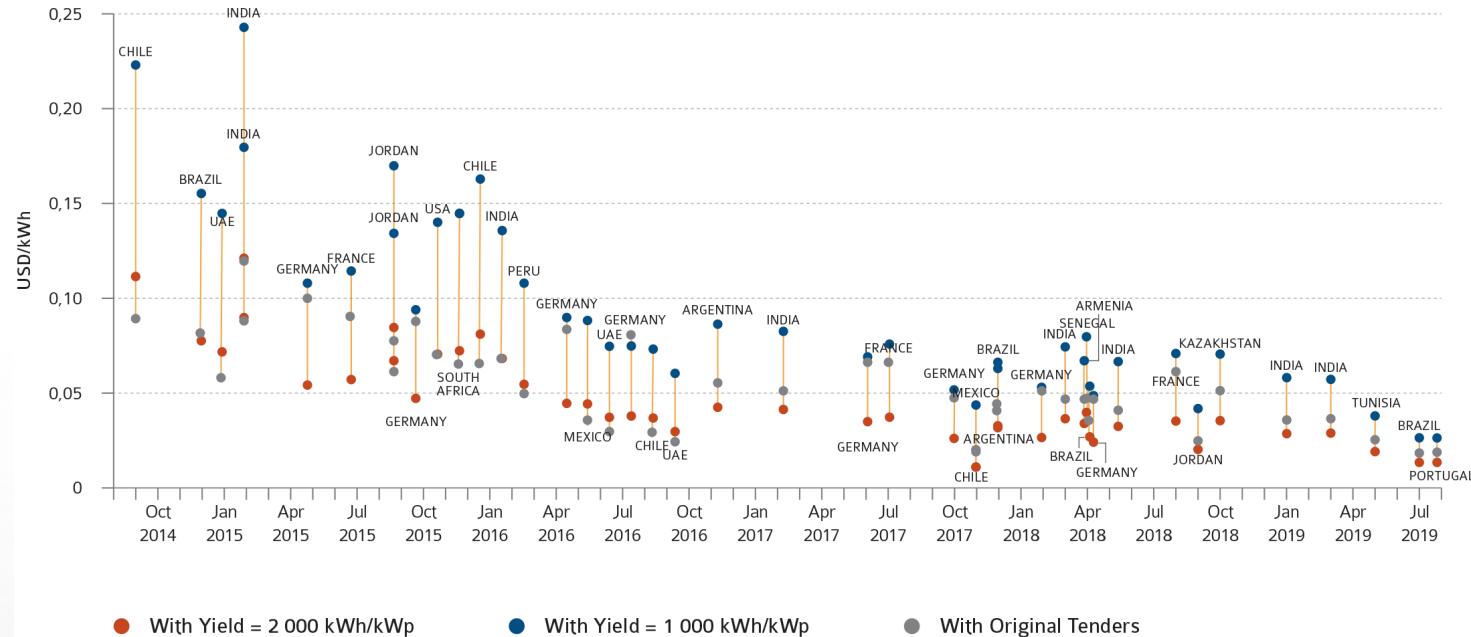
Fossiilisista polttoaineista päästöttömään sähköön ja massavalmistettavaan teknologiaan



Tuuli- ja aurinkovoima

Aurinkosähkön PPA-sopimushintojen kehitys

NORMALIZED LCOE FOR SOLAR PV BASED ON RECENT PPA PRICES DURING 2014 - Q3 2019

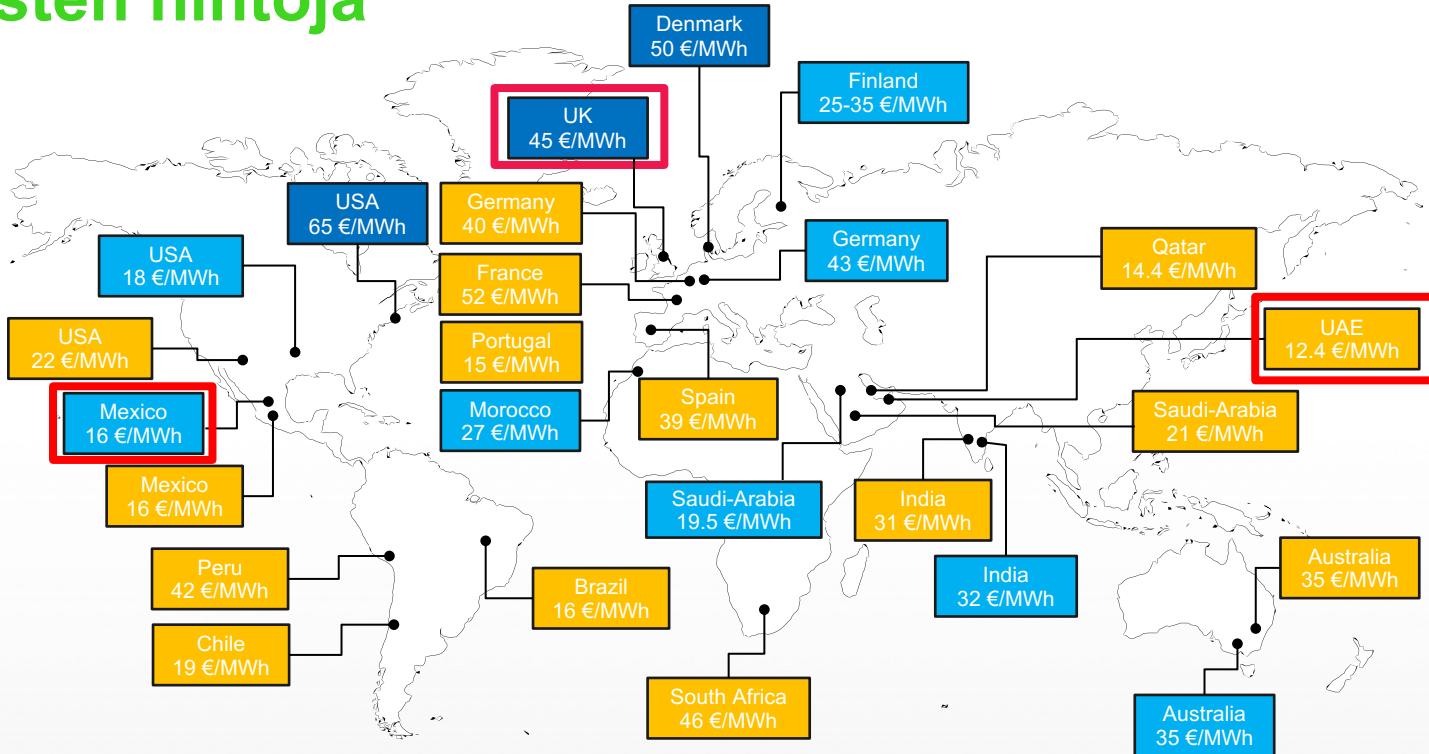


SOURCE IEA PVPS, BECQUEREL INSTITUTE.

Trends 2019 in Photovoltaic Power Applications, IEA PVPS, www.iea-pvps.org

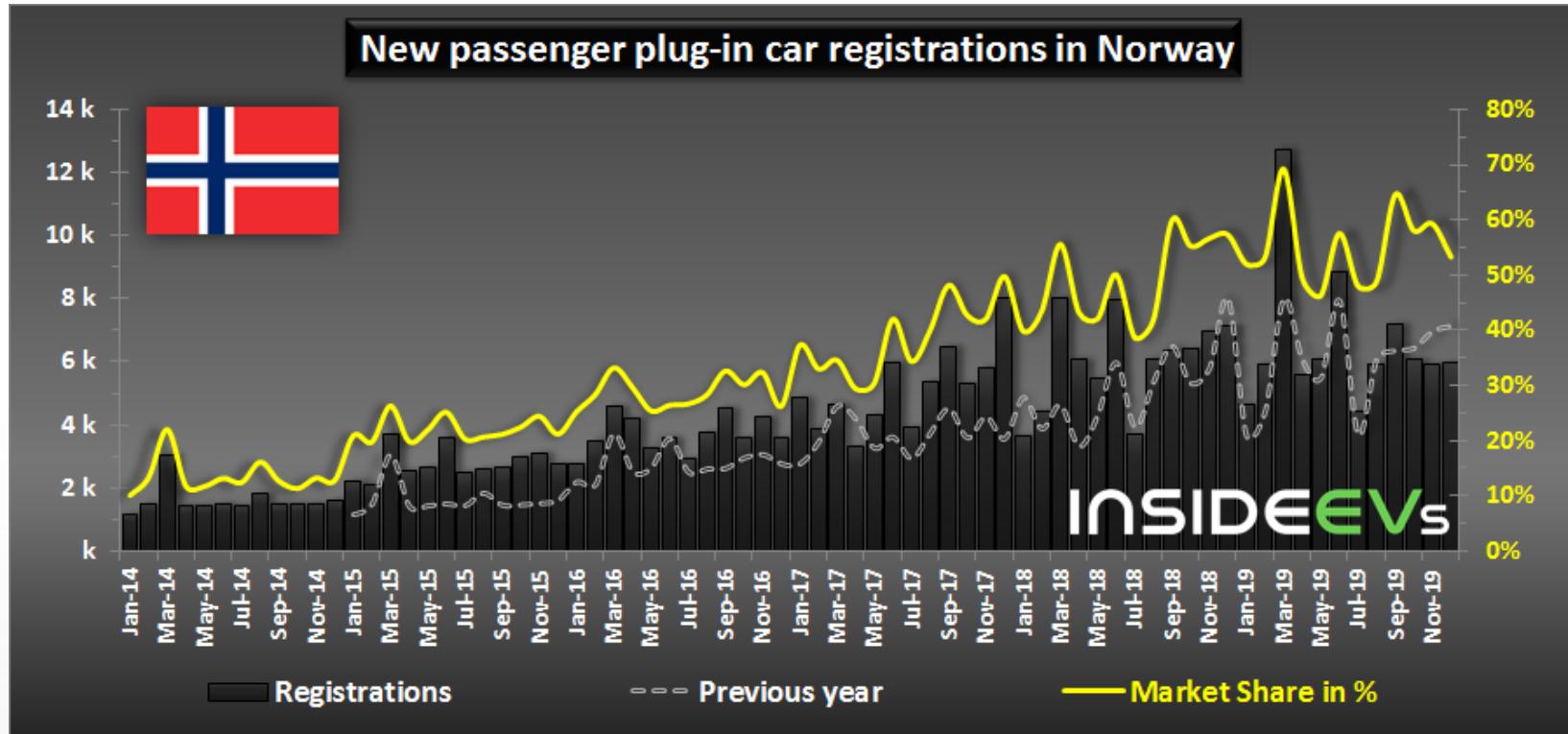
Viimeaikaisia tuuli- ja aurinkosähkön PPA-sopimusten hintoja

Solar PV
Onshore wind
Offshore wind

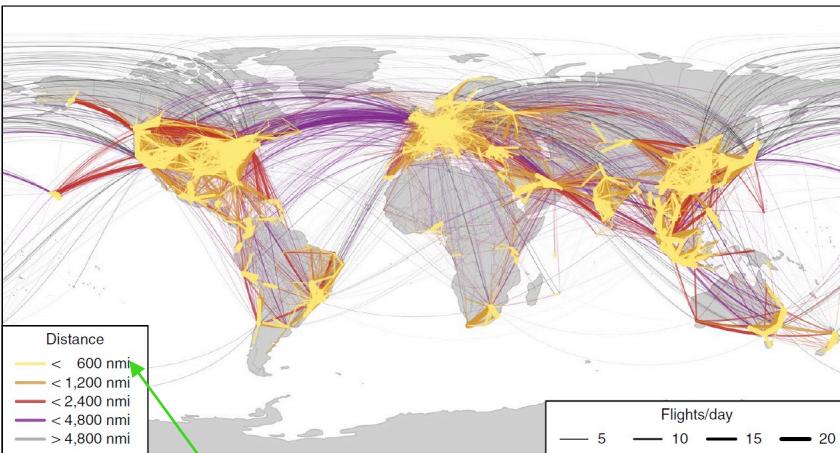


Liikenteen energiamurros

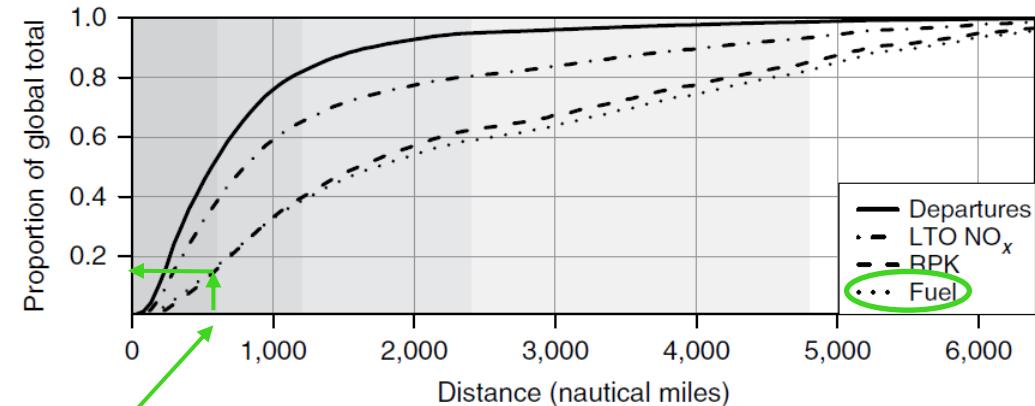
Norja on sähköautojen edelläkävijämarkkina



Mannertenvälisiin lentoihin ja meriliikenteeseen tarvitaan jatkossakin kemiallisia polttoaineita

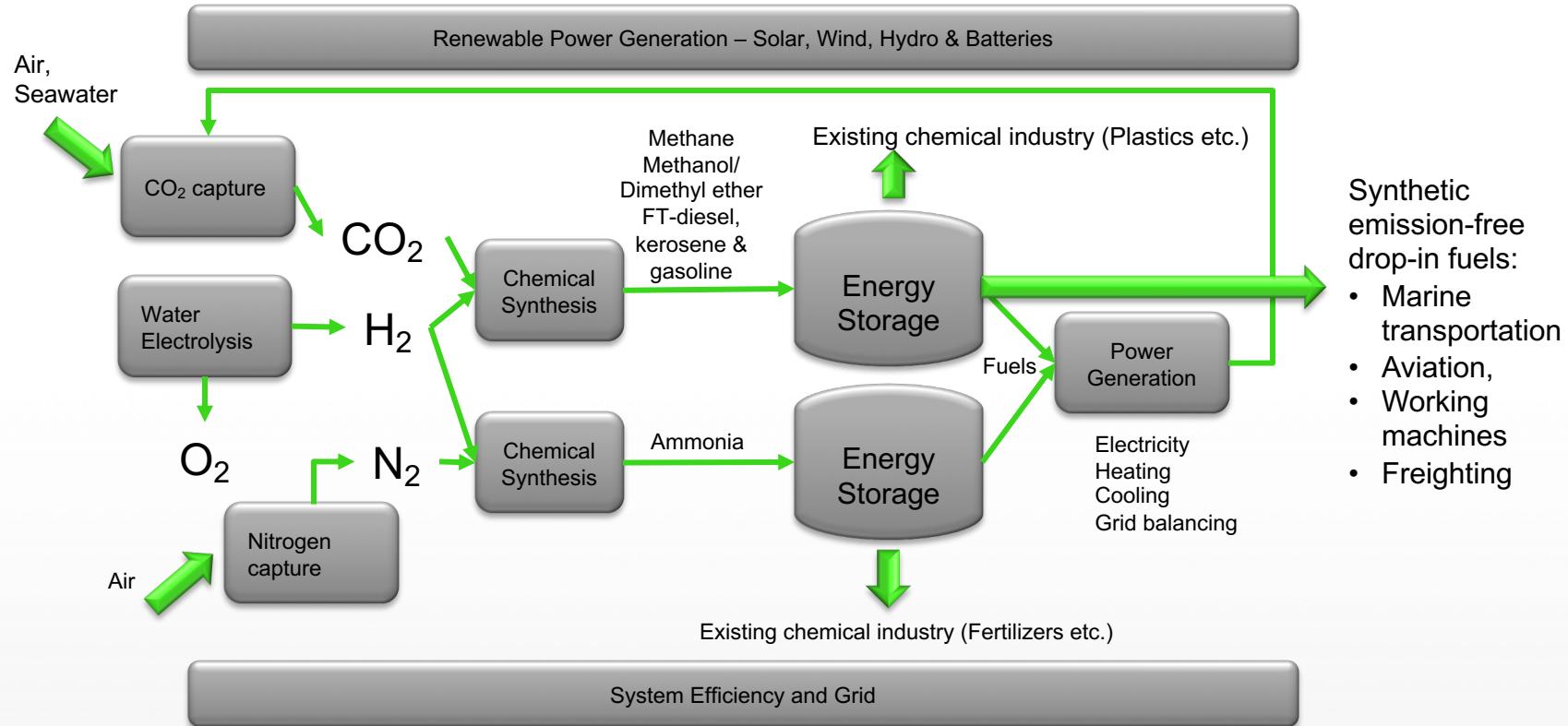


Electric flights at distances < 600 nmil (1100 km)
 ~15 % of total fuel consumption of battery energy
 density 800 Wh/kg will be reached



Source: Andreas W. Schäfer, et. Al., Technological, economic and environmental prospects of all electric aircraft, Nature Energy, Vol. 4, February 2019, pp. 160-166.

Mitä ovat P2X-polttoaineet ja kemikaalit?



Power-to-H₂ in Kokkola, Finland



Summary:

- Located in Kokkola, Finland
- Power-to-Hydrogen: 1800 Nm³/h (H₂)
- 3x3 MW pressurized alkaline water electrolyzers, 3x600 Nm³/h, 16 bar (H₂)
- The main use of H₂ plant is at nearby Cobal plant, delivery with a pipeline
- The rest of H₂ compressed to 200-300 bar and stored in bottles for delivery with trucks

How to improve significantly the energy efficiency of water electrolysis -> Koponen, J., Ruuskanen, V., Ahola, J., et. al., Effect of Converter Topology on the Specific Energy Consumption of Alkaline Water Electrolyzers, IEEE Trans. Power Electron., 34, pp. 6171-6182.

SOLETAIR – Polttoaineita ilmasta

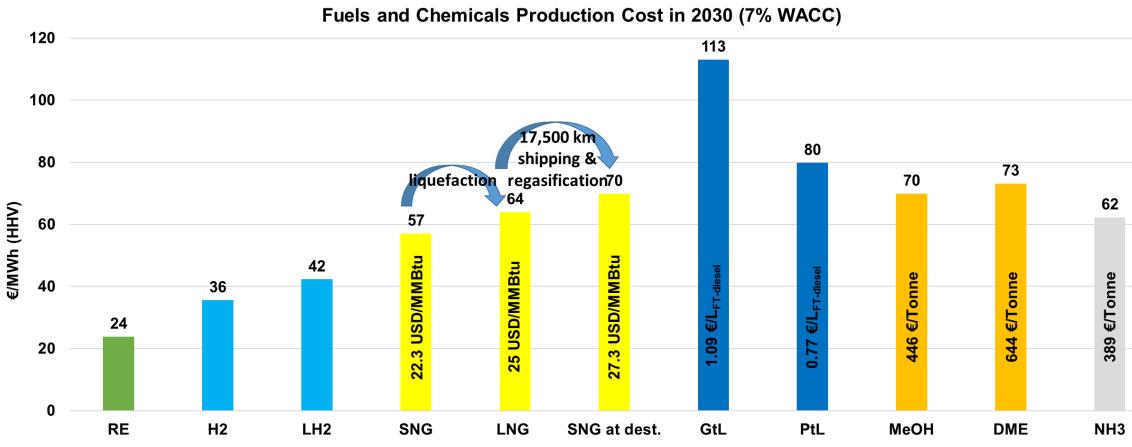


Projekti P2X Joutseno, 10/2019->: Teollisen skaalan PtMeOH-demonstraatio – Kannattavuustutkimus ja kehitys

- Industrial scale pilot plant in Joutseno, Lappeenranta
 - CAPEX: 40-50 M€
- Raw materials:
 - Hydrogen (H_2) 5 000 t/a, (Chlor-Alkali electrolysis), Kemira Chemicals
 - Carbon dioxide (CO_2) 36 667 t/a from Finnsementti
- End products:
 - Methanol 26 667 t/a (appr. 1 000 truck loads)
 - Can be further processed to e.g. gasoline, kerosene (aviation), diesel (to be studied)
- Partners with LUT:
 - St1 Oy, Kemira Oy, Wärtsilä, Finnsementti Oy, Shell Long term research, Neste Oyj, Finnair Oyj.
 - City of Lappeenranta
 - Local SME engineering workshops



PtX-polttoaineet ovat skaalattavia eivätkä tarvitse viljelykelpoista maata



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

How Bill Gates aims to clean up the planet



An artist's 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 CO₂ 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>

PtFood - Ruokaa ilman maataloutta ja viljelymaan käyttöä



Why food from electricity, water and CO₂?

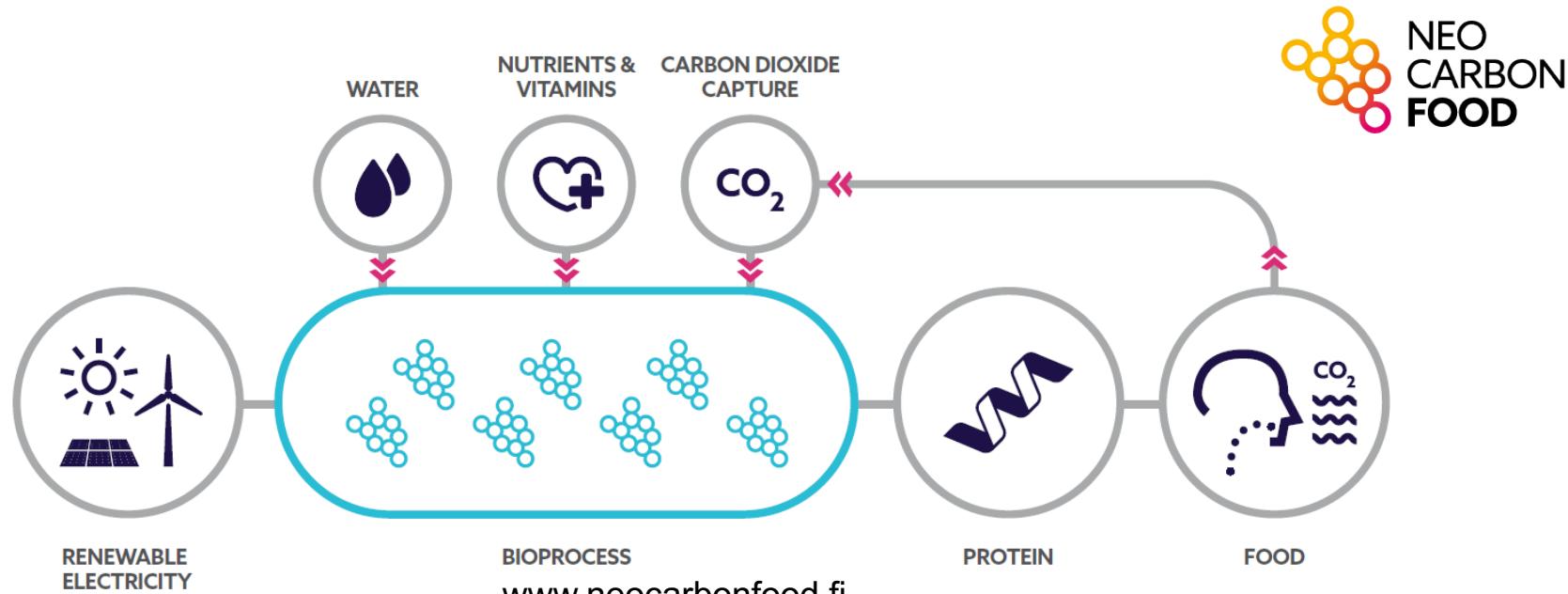
- 1) ~1/5 of human caused GHG emissions connected to food production.
- 2) World population 7 → 9 billion by 2050.
- 3) Climate change and will reduce food yields.
- 4) Global over-fishing: peak annual catch in 1996.





THE PRINCIPLE

Neo-Carbon Food is a microbial process. Protein production takes place in a reactor suitable for microorganisms to grow and divide. The energy of the process is electricity, and carbon dioxide is the carbon source.





J&AE

Teknologiateollisuuden
100-vuotisjäätiö

JANE AND AATOS
ERKKO FOUNDATION



Neo-Carbon Food – Food from electricity pilot
at LUT Lappeenranta campus in 2019
<https://www.youtube.com/watch?v=KTEEmRcShBw>

AIR INTO GRAPHENE



NEO
CARBON
MATERIALS

Materiaalit - Hiilidioksidista päästöttömällä sähköllä grafeenia ja nanoputkia

