Seaweed bioenergy developments

- Potentially promising, also in scale
  - DoE estimated that USA's petroleum demand could be met with 39,000 km^2, equal to 1/7 of the area used for corn production or 0.42% of the US map

- ExxonMobil committed 10 years research with $600m investment in 2009, but pulled back in 2013 (after $100m) due to slow progress
  - when it realized that algae fuel is "probably further" than 25 years away from commercial viability

- Current challenges and innovation pathways:
  - Seaweed harvest is seasonal except in the tropics, but tropics have low nutrients
  - High temperature variation in the sea is detrimental to yields
  - Nutrient and growth mapping is crucial, requiring high tech solutions
  - High tech solutions only viable after 5 years+ of established farming
  - Labour-intensive work, automation needed to make it economically viable
  - Competing sectors (food, pharmaceuticals) offer better revenue (which is why seaweed sector growth experiences more than 8% per year)

Peatlands: Wetter ways of farming

Wetlands International

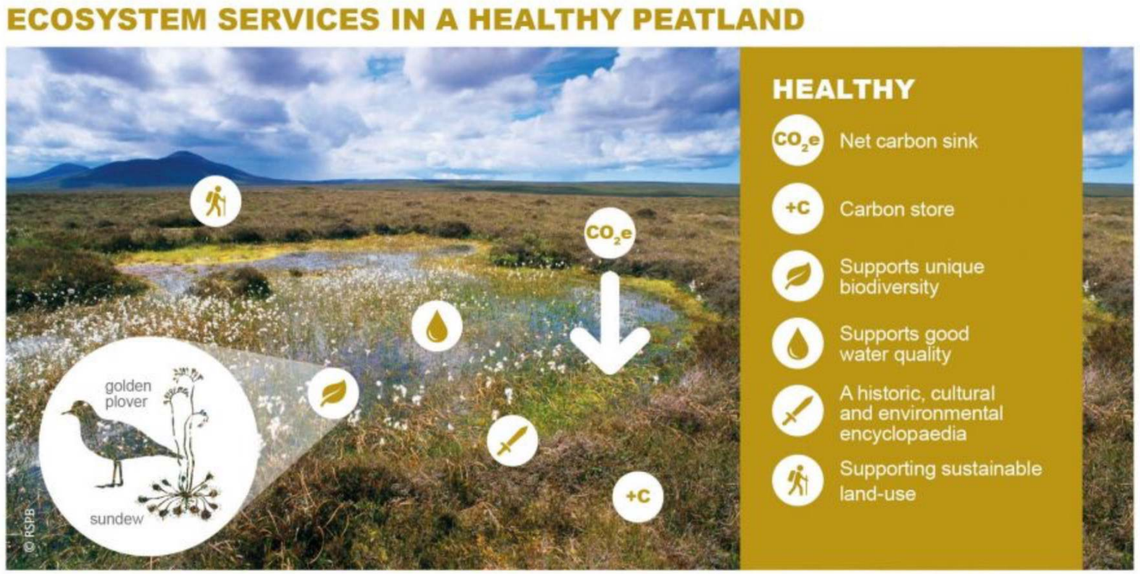
Platform Duurzame Biobrandstoffen

Driven by Nature.

Peatlands and how they function

- *"Terrestrial wetland ecosystem in which the production of organic matter exceeds its decomposition rate and a net accumulation of peat results"* (Wetlands International)

- Peatlands provides several ecosystem services e.g.:
  - Climate regulation
  - Water purification
  - Habitat for species
  - Bio feedstock
  - Recreational and educational opportunities

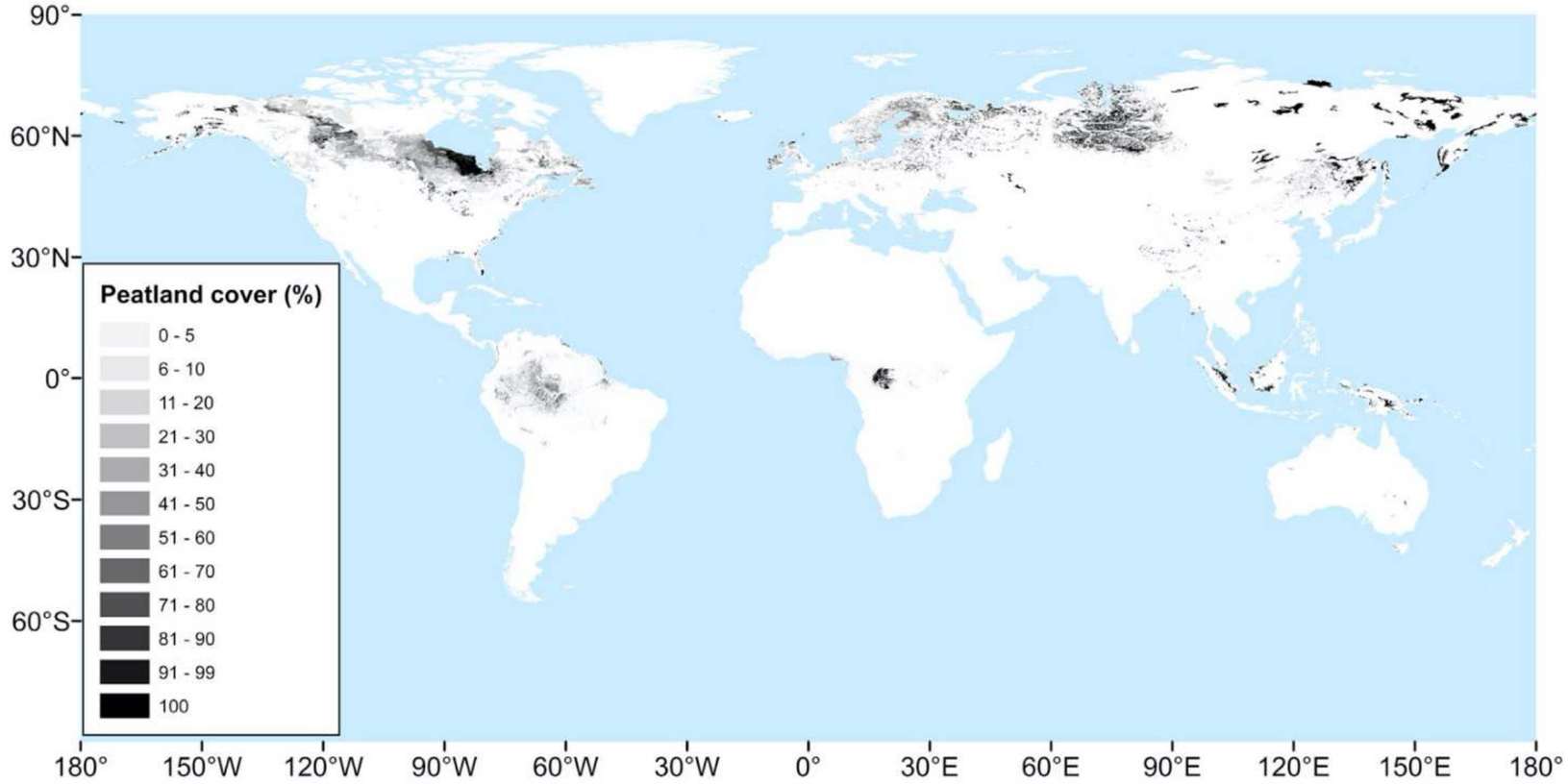


Source: IUCN

Platform Duurzame Biobrandstoffen

Driven by Nature.

Geospatial cover of peatlands



- Majority of peatlands: Boreal and temperate areas

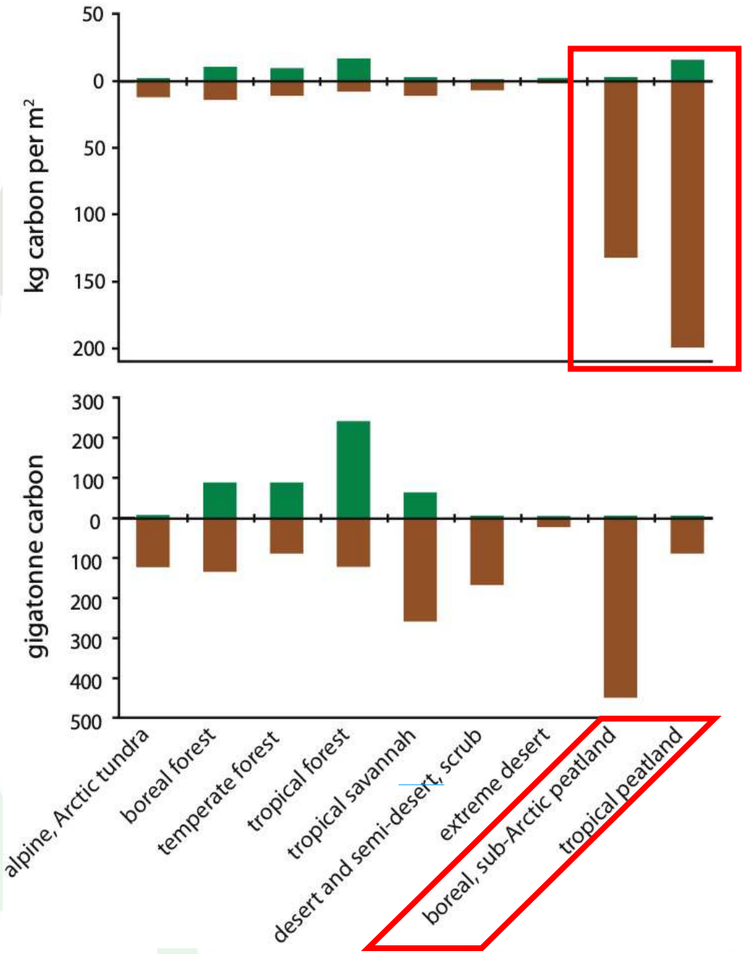
Source: Xu et al. (2018)

Platform Duurzame Biobrandstoffen

Driven by Nature.

Large carbon storage capacity of peatlands

- Peatlands have the highest carbon storage capacity per area of all land types, 30% of all land carbon stock
- Cover only ~ 3% of Earth's surface
- Compared to forests, more carbon in peatlands is stored in the soil
- Difference between boreal and tropical peatlands:
  - Largest carbon stock in boreal peatlands
  - Tropical peatlands have higher carbon storage capacity



Source: UNEP (2012), Yearbook Emerging Issues in our Global Environment

Platform Duurzame Biobrandstoffen

Driven by Nature.

Current use of peatlands causes CO_2-eq emissions

- Peatlands are drained for agriculture
  - S-E Asia: conversion to plantations (palm oil/pulp)
  - Europe/North America: vegetables, cereals and livestock pastures
- Land subsidence + decomposition of organic carbon → Net GHG emissions

Global

- Drained peatlands = 63 million ha
- Global emissions from drained peatlands = 2 Gtonne CO_2 annually

EU

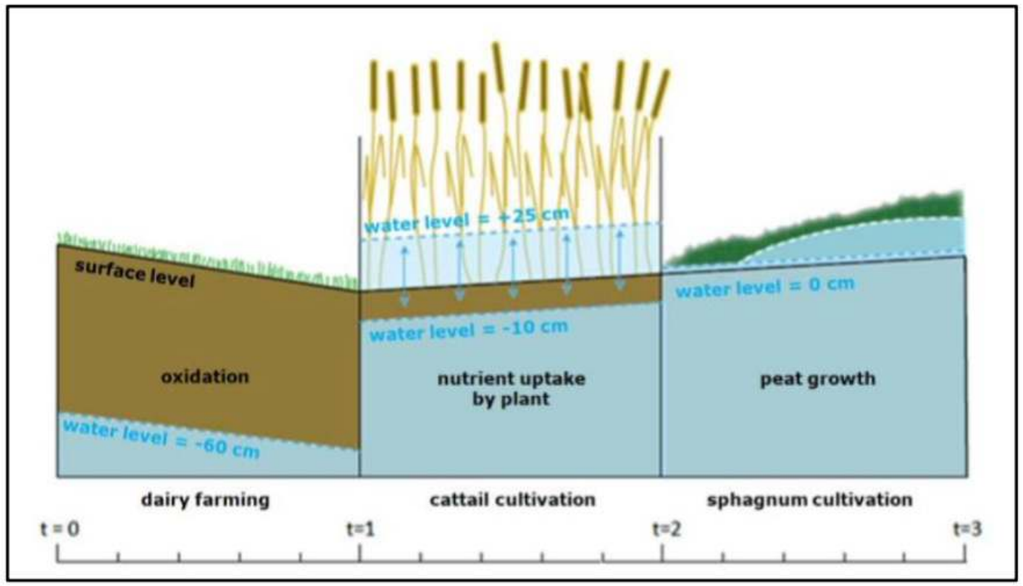
- Annual emissions from drained peatlands in EU = 220 Mtonne CO_2 annually
  - Equals 5% of annual EU emissions

Platform Duurzame Biobrandstoffen

Driven by Nature.

Paludiculture: Restoration with socio-economic benefits

- Paludiculture is the practice of crop production on wet soils, predominantly occurring on peatlands
  - Preservation and restoration of peatlands
  - Production of sustainable biomass
- Drained agricultural peatland as a first rewetting target
- Rewetting 30% globally of the most vulnerable drained peatlands could **save 1 Gtonne CO_2 per year!** (University of Greifswald)
- Requires different agricultural practices



Source: Van de Riet et al. (2014)

Platform Duurzame Biobrandstoffen

Driven by Nature.

Exploring paludiculture bioenergy potential

- Chosen potential paludicrops:
  - Reed canary grass
  - Common reed
  - Tall sedges
  - Cattail
  - Black elder
- Choice depends on local circumstances (water level, economic interest, end use)
- Other potential crops (e.g. berries) not taken into account
- Only focusses on bioenergy of paludicrops, not GHGe savings from rewetting peatlands (another potential win-win!)

Platform Duurzame Biobrandstoffen

Driven by Nature.

Exploring paludiculture bioenergy potential in Europe

- Assumption: use drained peatland for conventional agriculture and rewet it for paludiculture crops
- Peatlands used for agricultural practices in Europe: **7.7 million ha**
  - Excluded: European Russia (1.9 million ha) and Belarus (1.4 million ha)
- Biomass yields of paludicrops: 2 – 25 t DM/ha/a (large range due to crop type and environmental external factors)
- Lower heating values: 16.5 – 18.6 GJ/t DM
- Assumed energy conversion factor 50%

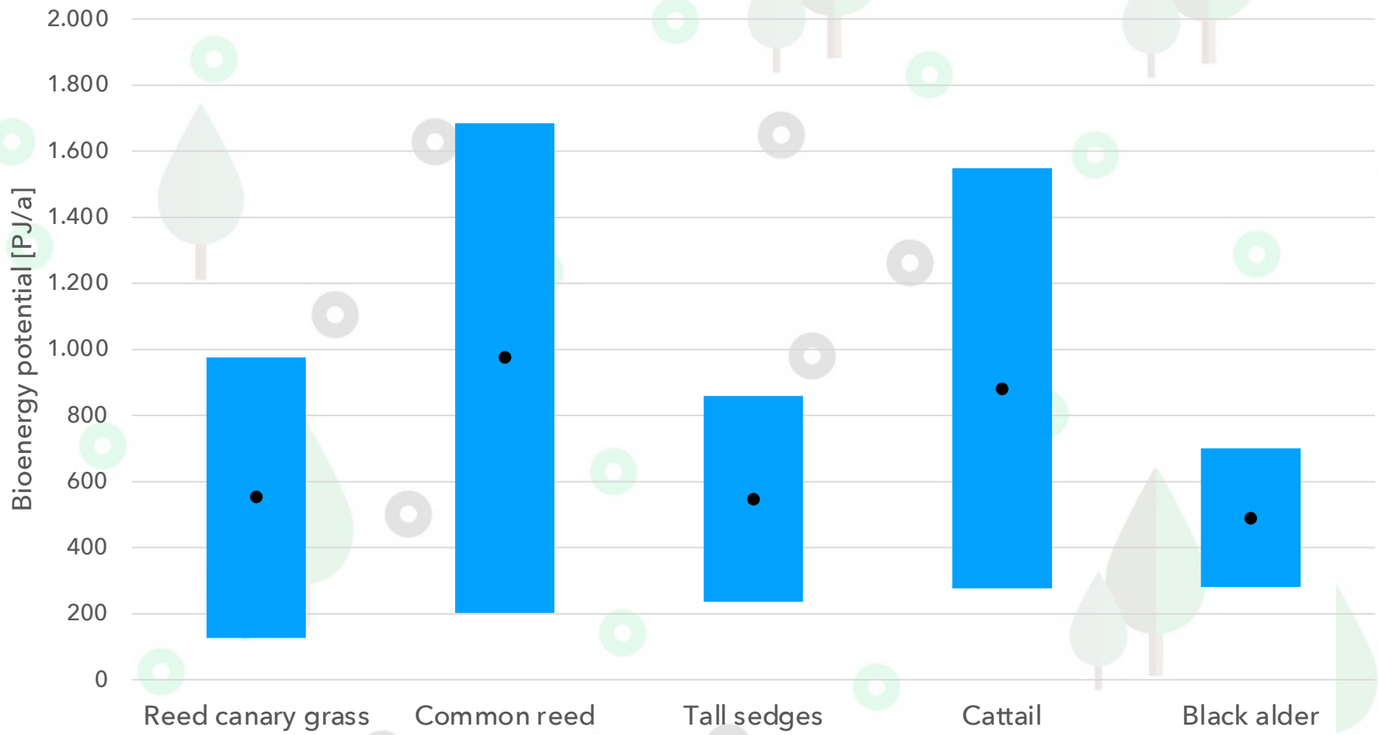
Source: FAO cited in IPS (2019), Agriculture on Peatlands

Platform Duurzame Biobrandstoffen

Driven by Nature.

Significant bioenergy potentials from paludiculture

- Total bioenergy potential: **130 – 1,680 PJ/a**
- Corresponds to **1 – 15%** of EU road transport energy consumption
- This is the **absolute maximum potential** in Europe if all drained peatland (currently used or abandoned) were used for bioenergy paludiculture



Platform Duurzame Biobrandstoffen

Driven by Nature.

Side notes on this analysis

- Rewetting of agricultural peatlands would entail a loss of existing food crops and pasture lands
  - Compensation elsewhere needed

- Biogeographical factors:
  - Different yields of the same paludicrop in different regions
  - Not every paludicrop suitable for every terrain

- Different paludicrops used for different applications, not only bioenergy purposes but also for building material, fodder, food, etc.

Platform Duurzame Biobrandstoffen

Driven by Nature.

www.platformduurzamebiobrandstoffen.nl

@PlatfDuurzBiobr

Platform Duurzame Biobrandstoffen

Driven by Nature.