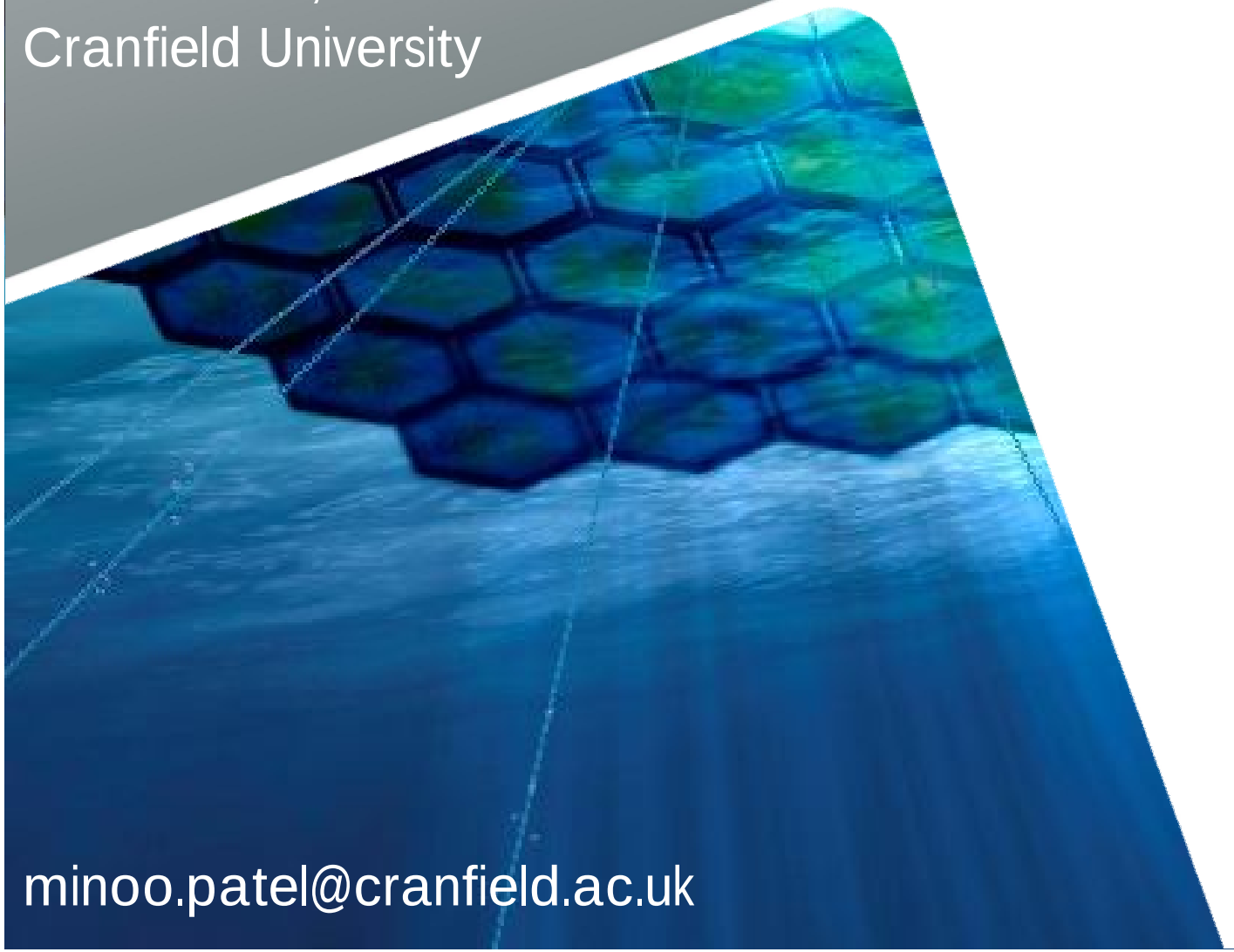
Sustainable Bio-fuels From Algae, the Sea Green Project

Minoo Patel,
Cranfield University



minoo.patel@cranfield.ac.uk

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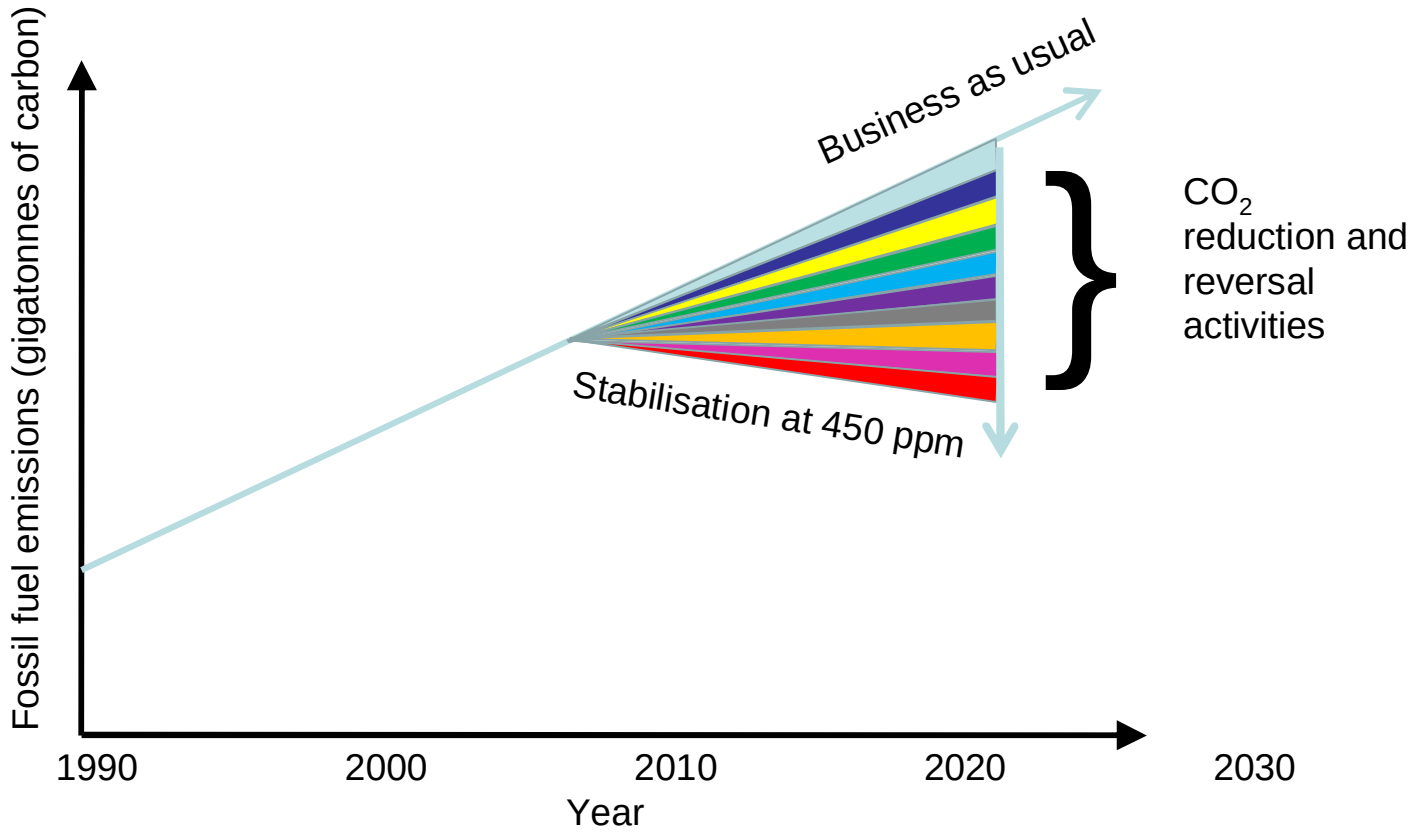
Overview

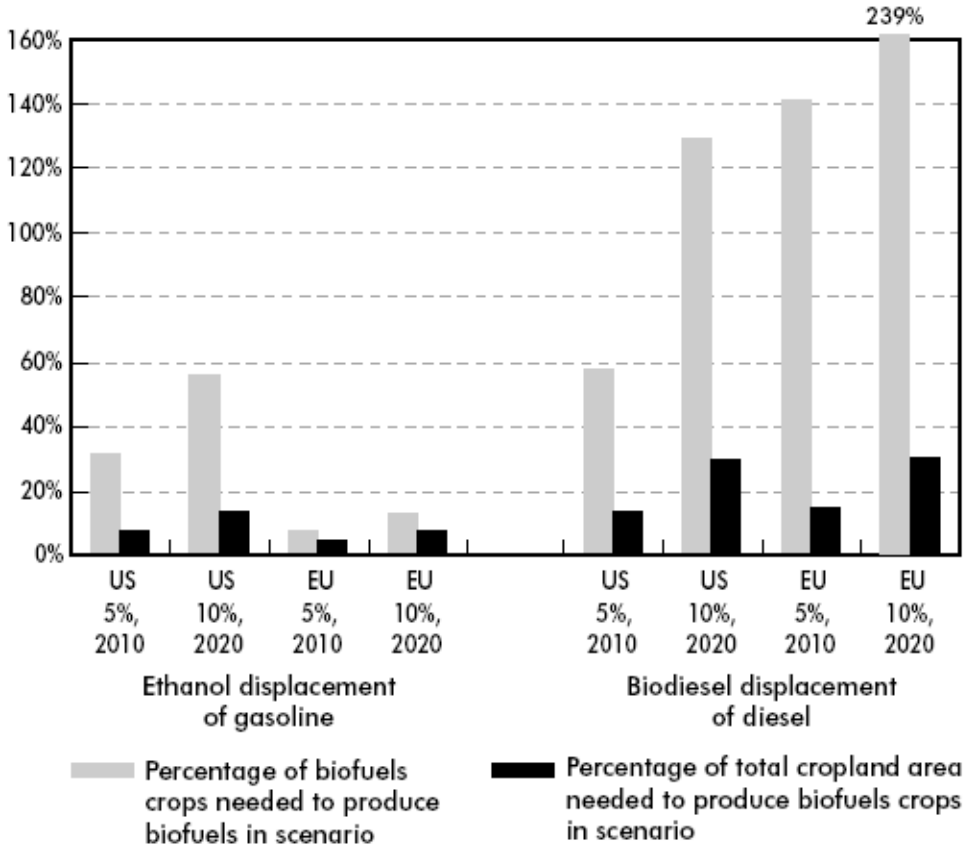
- The Energy Landscape
- Role of Bio-fuels
- Aquatic Sustainable Bio-mass for Large Scale Bio-fuel Production
- Status of Current Work

The Energy Landscape

cell technologies



Bio-fuel Resource Needs



Estimated required crops and cropland needed to produce biofuels under 2010/2020 scenarios

(IEA, http://www.iea.org/textbase/nppdf/free/2004/biofuels2004.pdf)

Bio-fuels Road Map

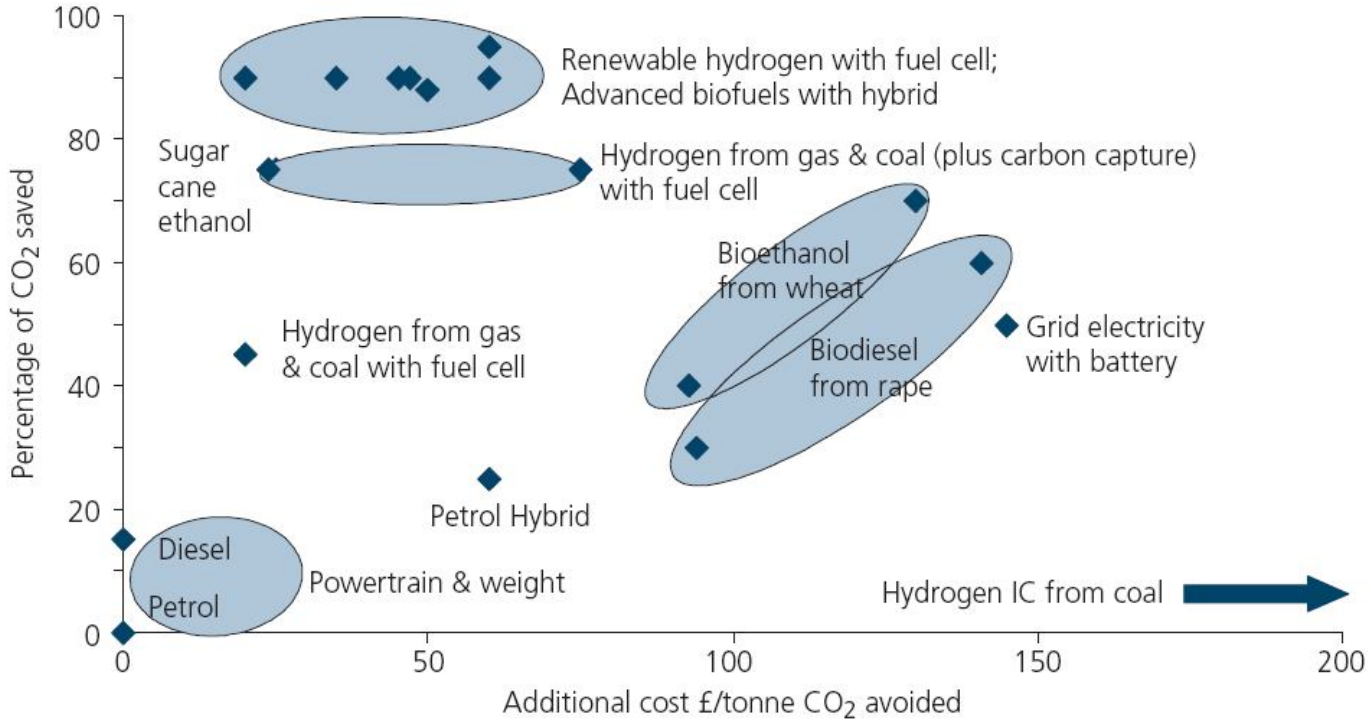


Figure 9: From "Sustainable biofuels: prospects and challenges", The Royal Society, Policy document 01/08, January 2008, ISBN 978 0 85403 662 2 http://royalsociety.org/displaypagedoc.asp?id=28914

Comparison of Oil Yield From Microalgae Vs Other Plant Sources

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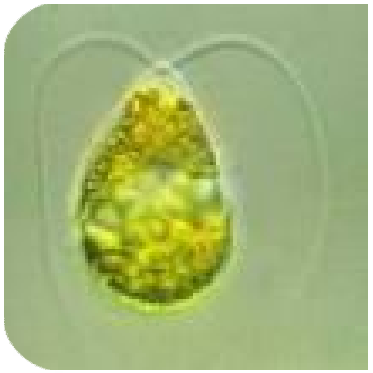

Plants	Oil yield ($Lha^{-1}yr^{-1}$)
Maize	172
Soybeans	446
Rapeseed	1190
Palm oil	5950
Microalgae	58,700 (30% oil by wt. biomass)
Microalgae	135,000 (70% oil by wt. biomass)

What Are Large Oil & Gas Companies Doing?

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Biopetroleum build facility to grow algae for biofuel

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Shell and HR Biopetroleum build facility to grow algae for biofuel

11/12/2007

Royal Dutch Shell plc and HR Biopetroleum today announced the construction of a pilot facility in Hawaii to grow marine algae and produce vegetable oil for conversion into biofuel.

What Are Large Oil & Gas Companies Doing?

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bp

BP and DuPont Announce Partnership to Develop Advanced Biofuels

Release date: 20 June 2006

DuPont bio-based science and BP fuels technology expertise will bring next generation biofuels to market

In this section

- BP Captures Coalbed Methane Resource in Indonesia

What Are Large Oil & Gas Companies Doing?

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Access

This article is part of Nature's premium content.

Please note this is News in Brief, and so will be a short article.

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News in Brief

ExxonMobil invests in algae for biofuel

What Are Large Oil & Gas Companies Doing?

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"Credible studies show that with plausible technology developments, biofuels could supply some 30% of global demand in an environmentally responsible manner without affecting food production. To realize that goal, so-called advanced biofuels must be developed from dedicated energy crops, separately and distinctly from food"

….. Steve Koonin, former Chief Scientist BP

Science Fiction?

Dunaliella Biotechnology

Intensive Plant, NBT Ltd., Eilat, Israel, 100,000 m² since 1990

Biofuels

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4th Generation Biofuels
Feedstock: Purpose designed energy crops
Bioconversion process: Fermentation, gasification, fast-pyrolysis
Carbon balance: Negative
Energy balance: High, waste heat used for CO_2 capture & storage

Incremental generational development of biofuels – each stage becoming progressively greener.

Scalable Bio-Fuel Production

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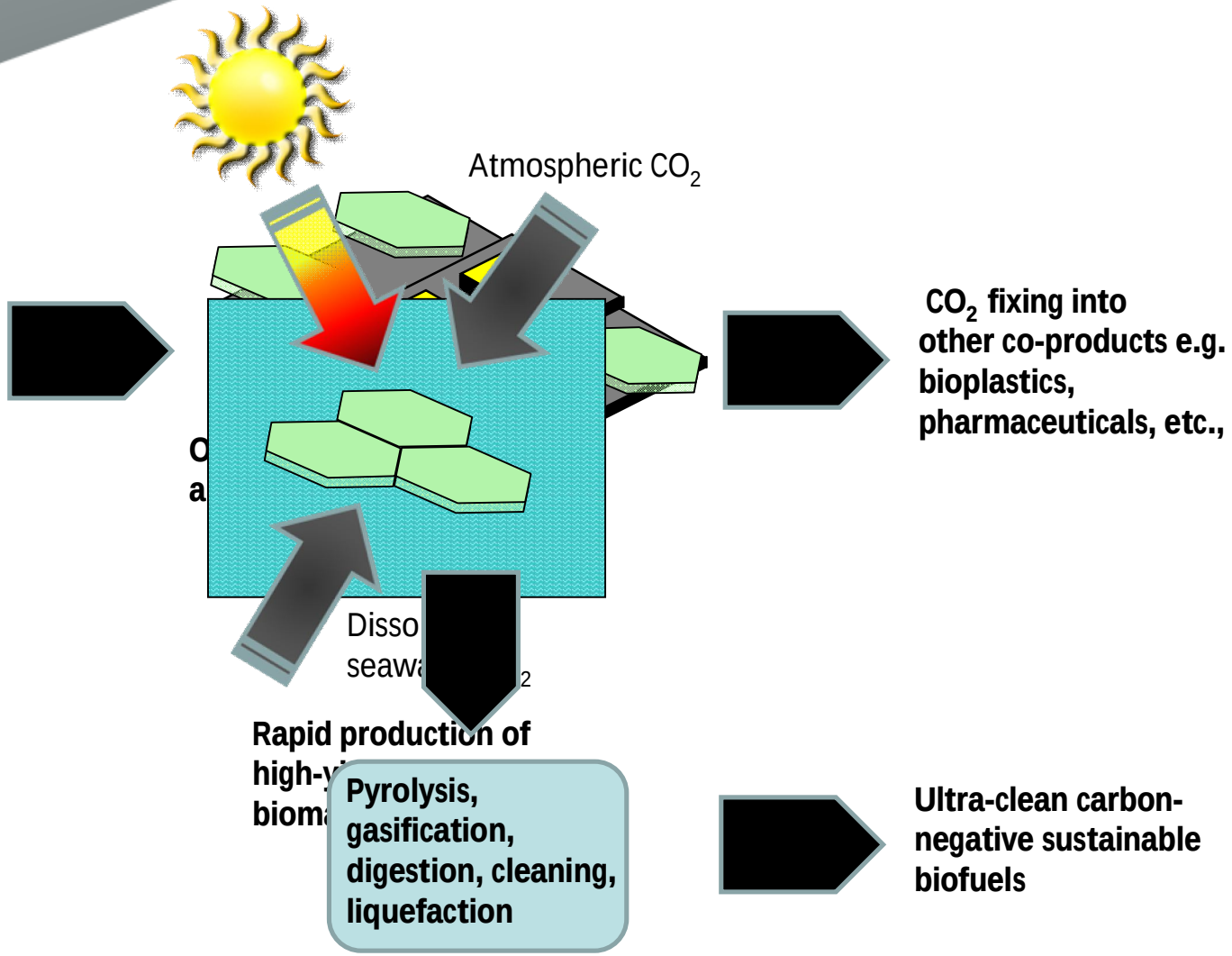
- Where will the bio-feedstock come from?
- What about land and water shortages?
- Will sufficient volumes be available to meet demand?
- Can bio-fuels be produced at a competitive price?
- Are GM based solutions commercially scalable?

Carbon-negative sustainable biofuels



Why Offshore?

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- Oceans and seas cover 72% percent of the earth's surface
- Over 96% of all water on earth is seawater
- Oceans play a fundamental role in maintaining the planet's atmosphere and temperature not least in the natural sequestration of CO_2.
- There is approximately 60 times more dissolved CO_2 in seawater than in the atmosphere and three-thousand times more CO_2 stored in sedimentary rocks.
- PEs of aquatic micro & macro algae are significantly greater than terrestrial plants.

Very Large Floating Structures – Potential Attributes

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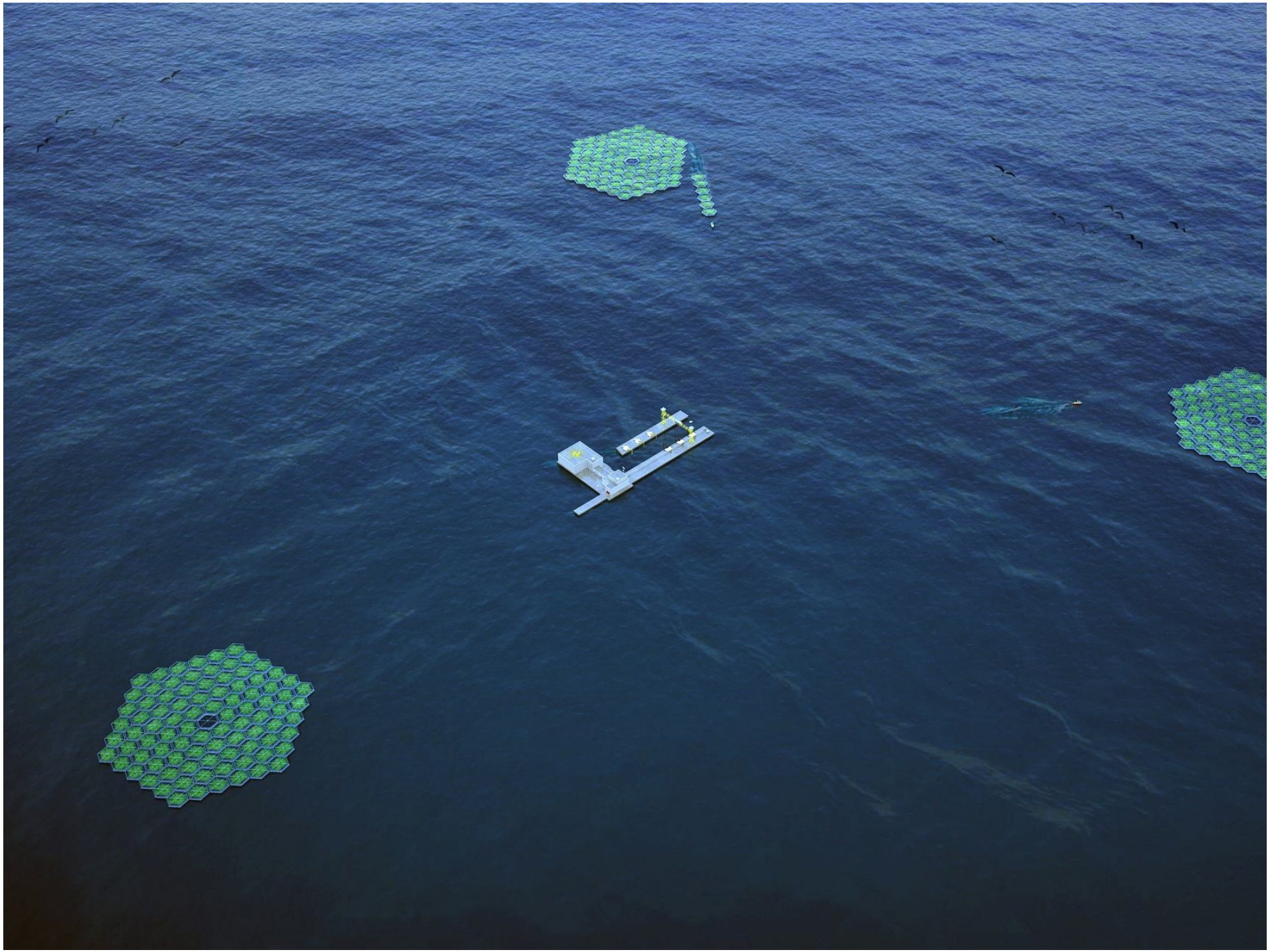
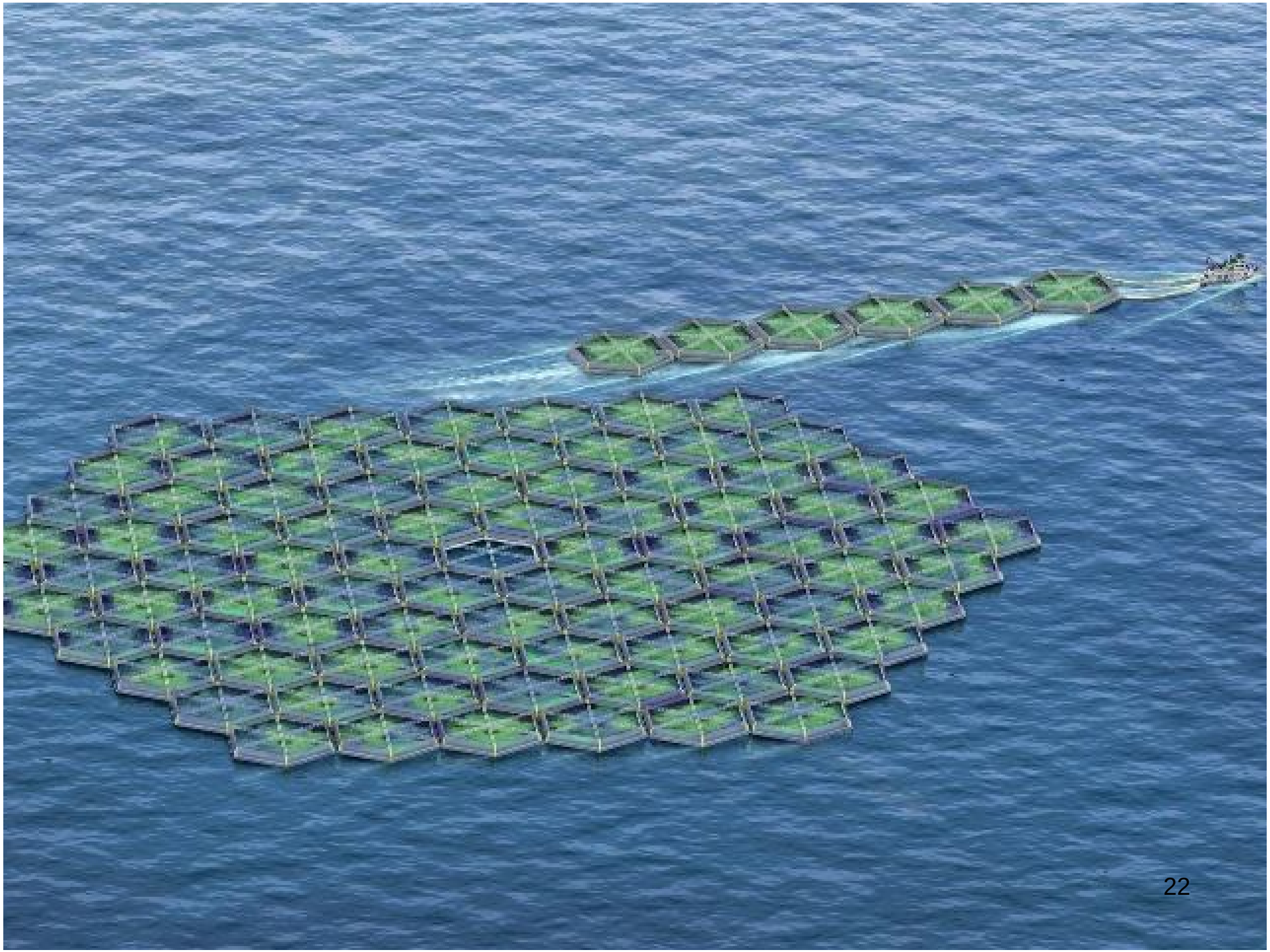
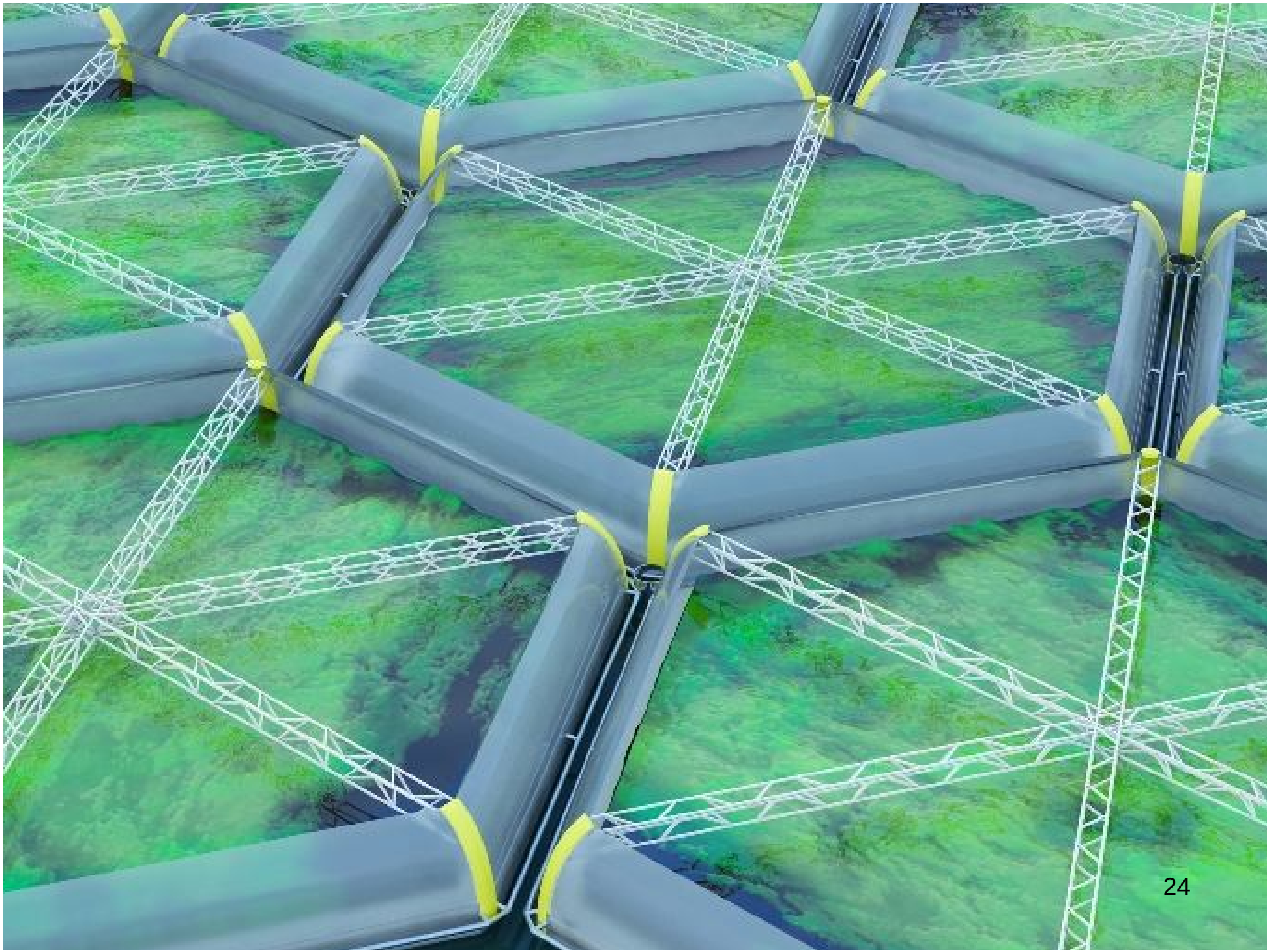
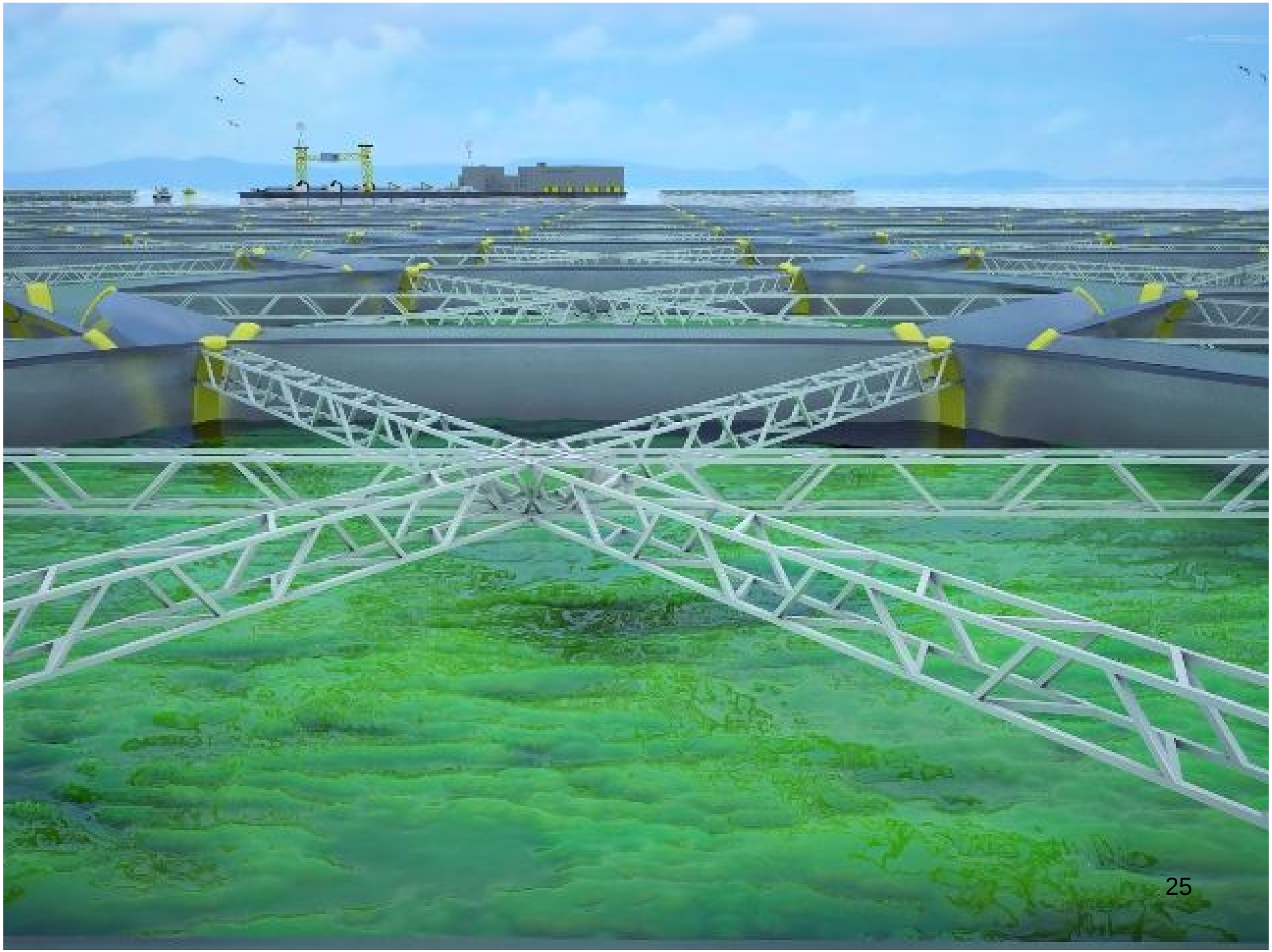
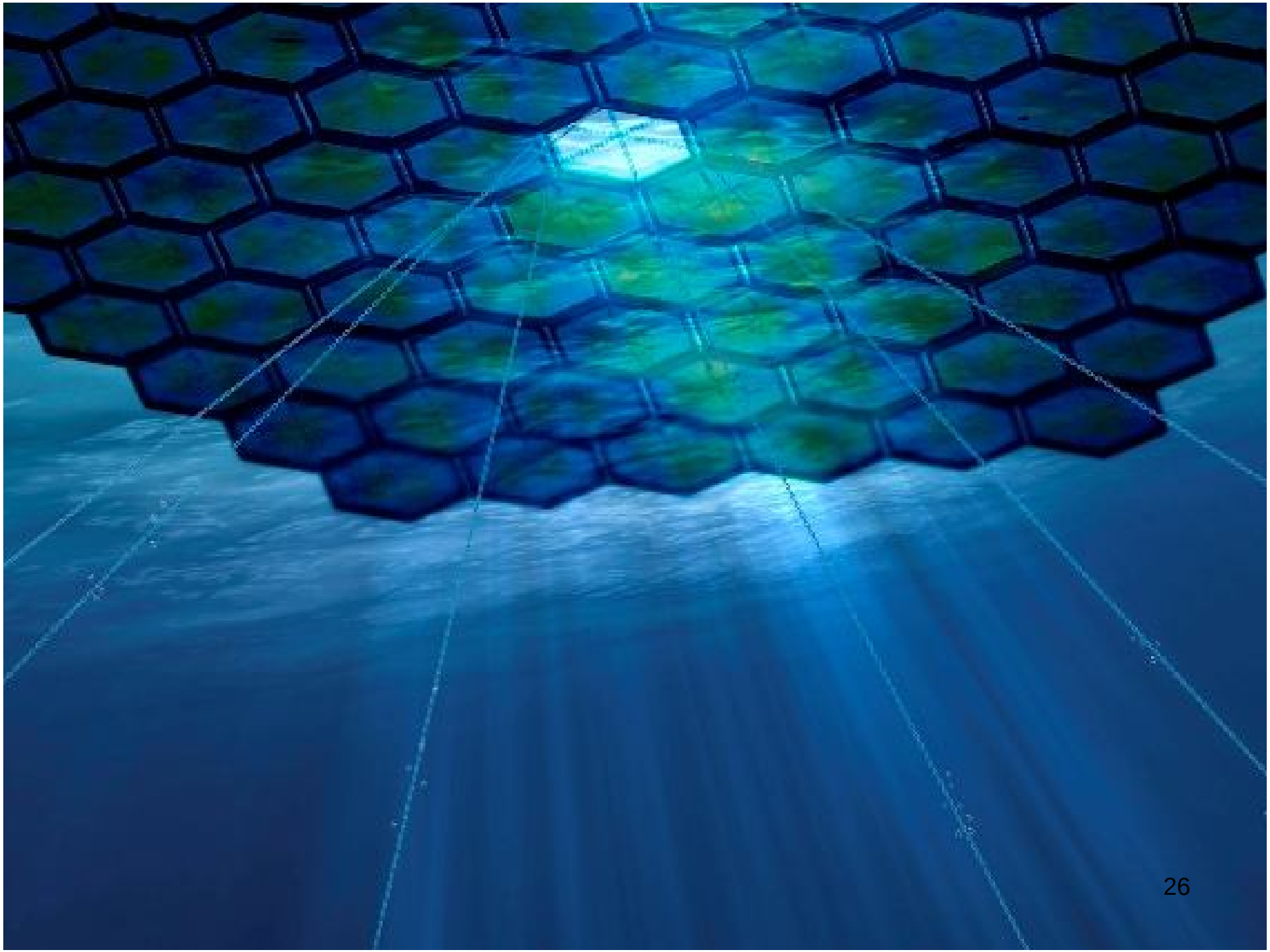
- Very large volumes of biomass can be relatively easily transported and handled
- Facilities could be self-powered and therefore self-contained
- Facilities could move to optimise photosynthetic conditions











SEA GREEN
Project Path

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Stage 0	Conceptual definition, front end engineering design (FEED) and intellectual property protection – being completed by Cranfield University
Stage 1	Technical, economic and environmental modelling, generic detailed design and generic environmental and regulatory certification and approvals
Stage 2	Site specific: detailed engineering, environmental and regulatory approvals followed by detailed engineering, large scale laboratory trials and cost estimation
Stage 3	Construction, deployment, commissioning and operation of a pilot offshore demonstration facility

Note – Pilot demonstrator facility could possibly be extended and expanded to become first commercial production facility

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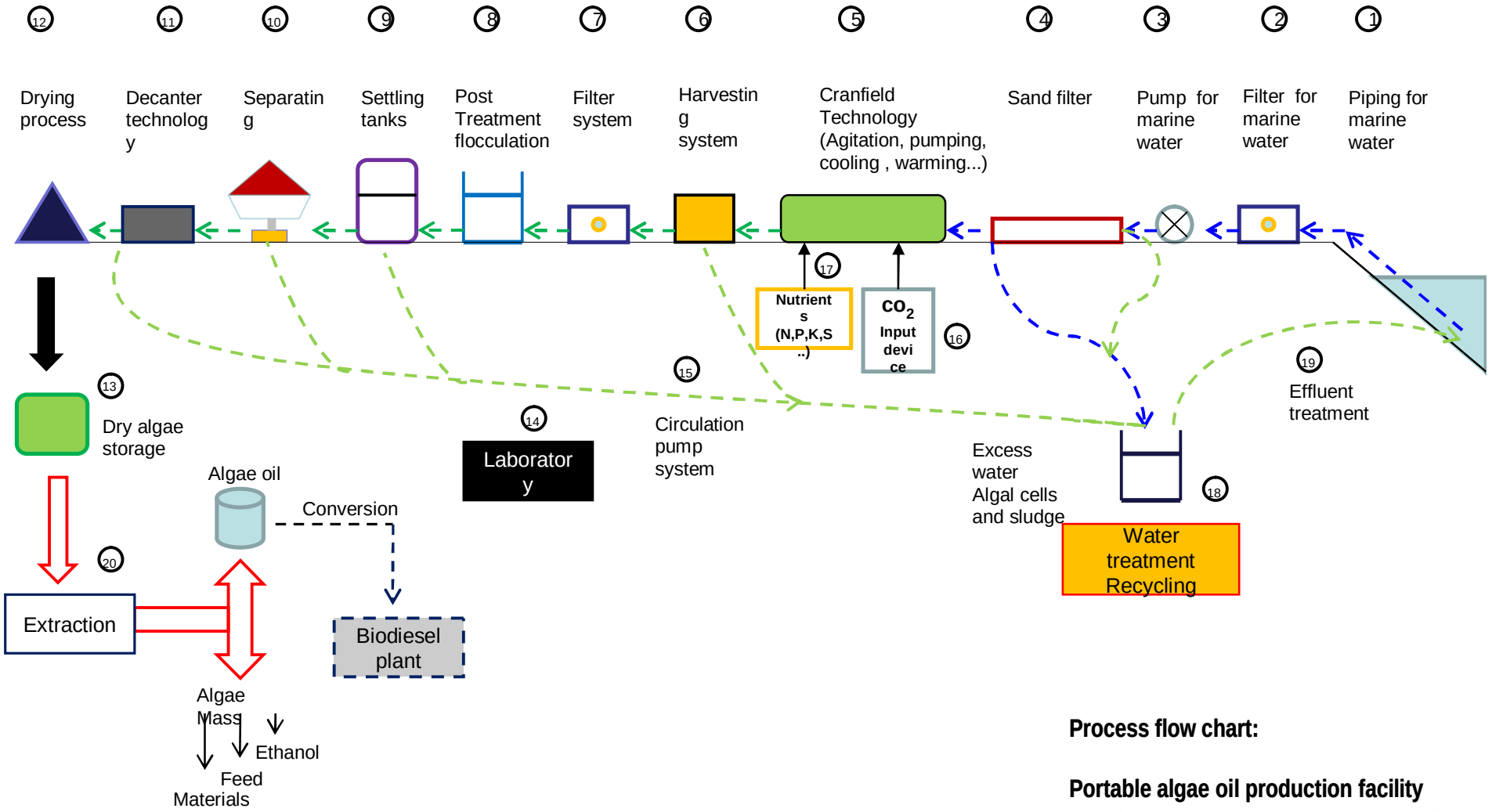

Process flow chart:

Portable algae oil production facility

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Summary

- All industries are experiencing radical change in the energy landscape;
- Limited supply base across all renewable energy technologies is and will continue to be a problem;
- Sustainable biofuel systems have the potential to be carbon negative – is the sea the answer?