Offshore Aquaculture Economics:

Implications for Seafood Market Growth

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06.27.19

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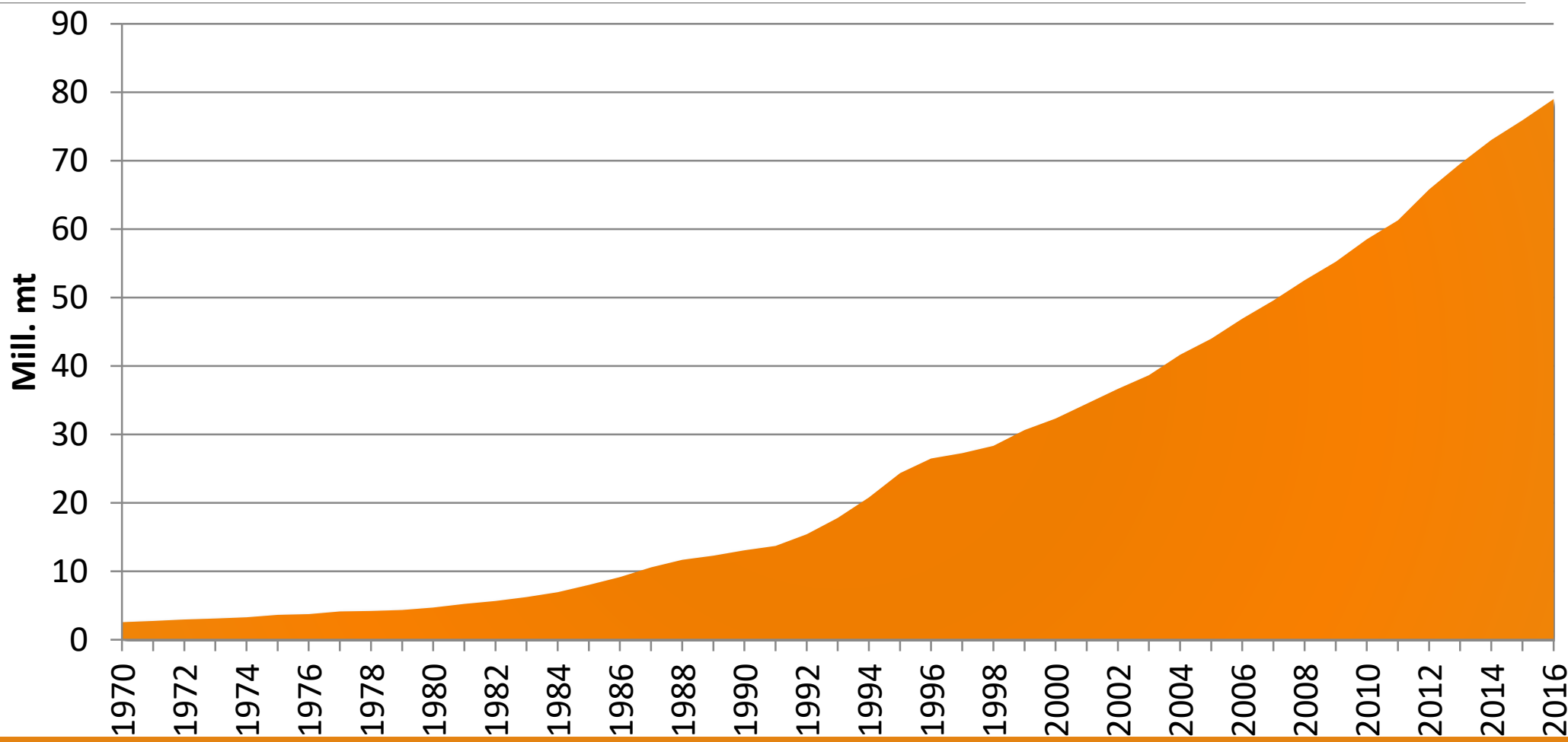
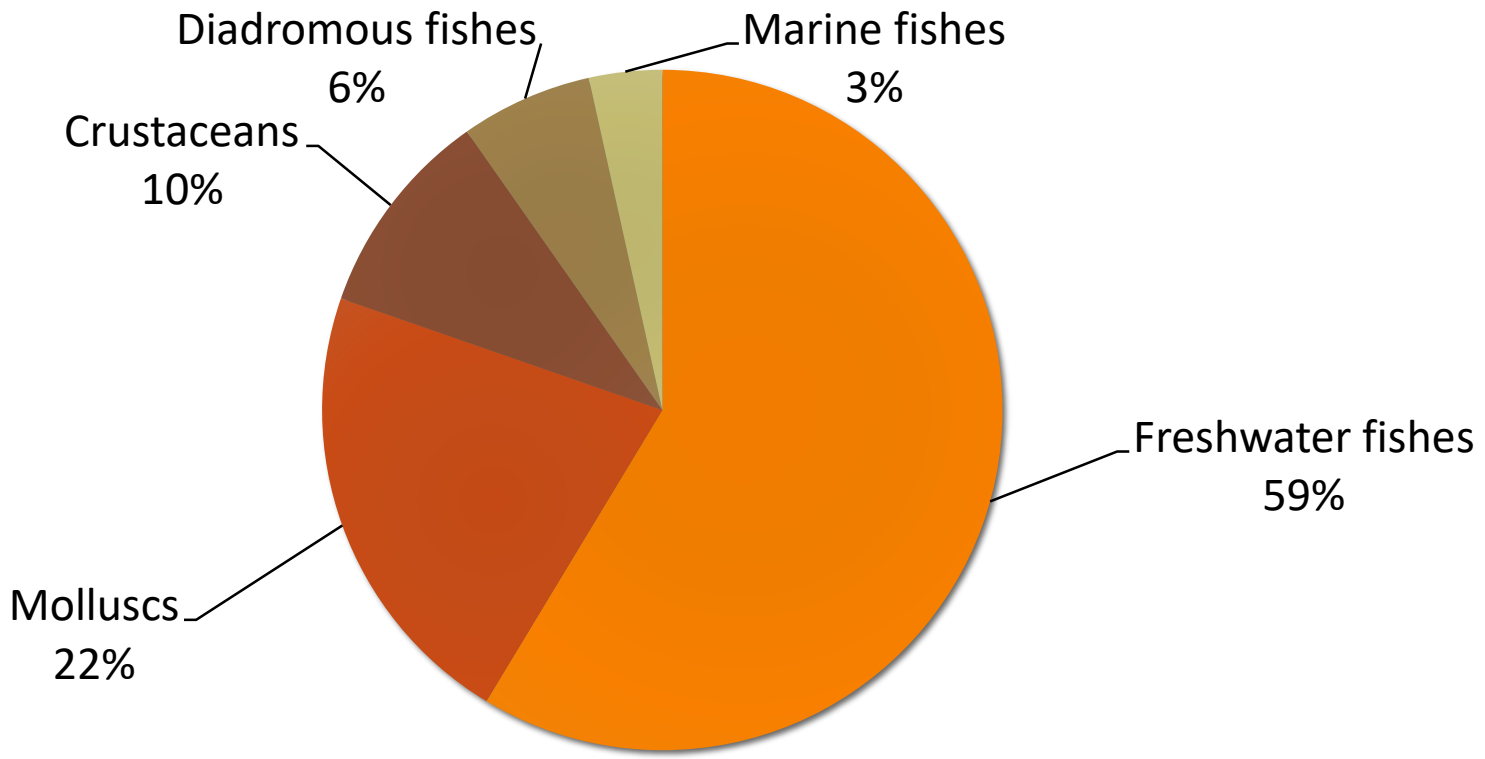
Global aquaculture production growth remains rapid, no apparent barriers: Global production 1970-2016

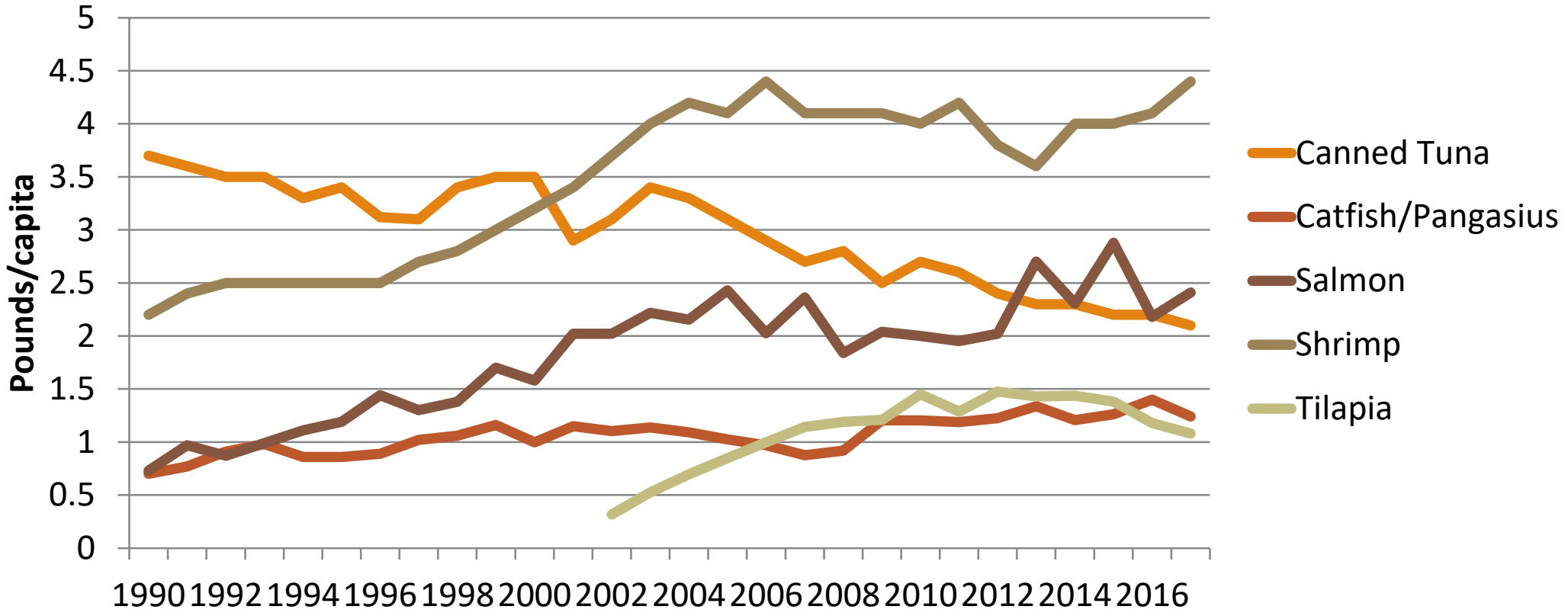


In contrast to fisheries, marine species are not very important in aquaculture, even if diadromous fish are counted as marine



This development strongly influence what is available at the U.S. Seafood market

U.S. Seafood consumption of top 5 species



Why are freshwater fish (and molluscs) so popular in aquaculture?

1. Because it is relatively easy to keep control with the production process
   - This also tends to make production cost low
   - Most freshwater fish being farmed is relatively small, but with fast growth
2. Because production can take place close to the market
   - The U.S. is the only of the world´s 4 most populated countries which is not in the top for when it comes to aquaculture production

Why bother with marine fish?

1. Because they grow bigger and are more valuable, and even more so if they can be marketed as fresh

2. Because, in principle, they can be farmed in countries where people do not want to see the production process

2.5 Because the oceans are poorly utilized as a source for food, and there are lots of potential locations available (Gentry et al. 2017)

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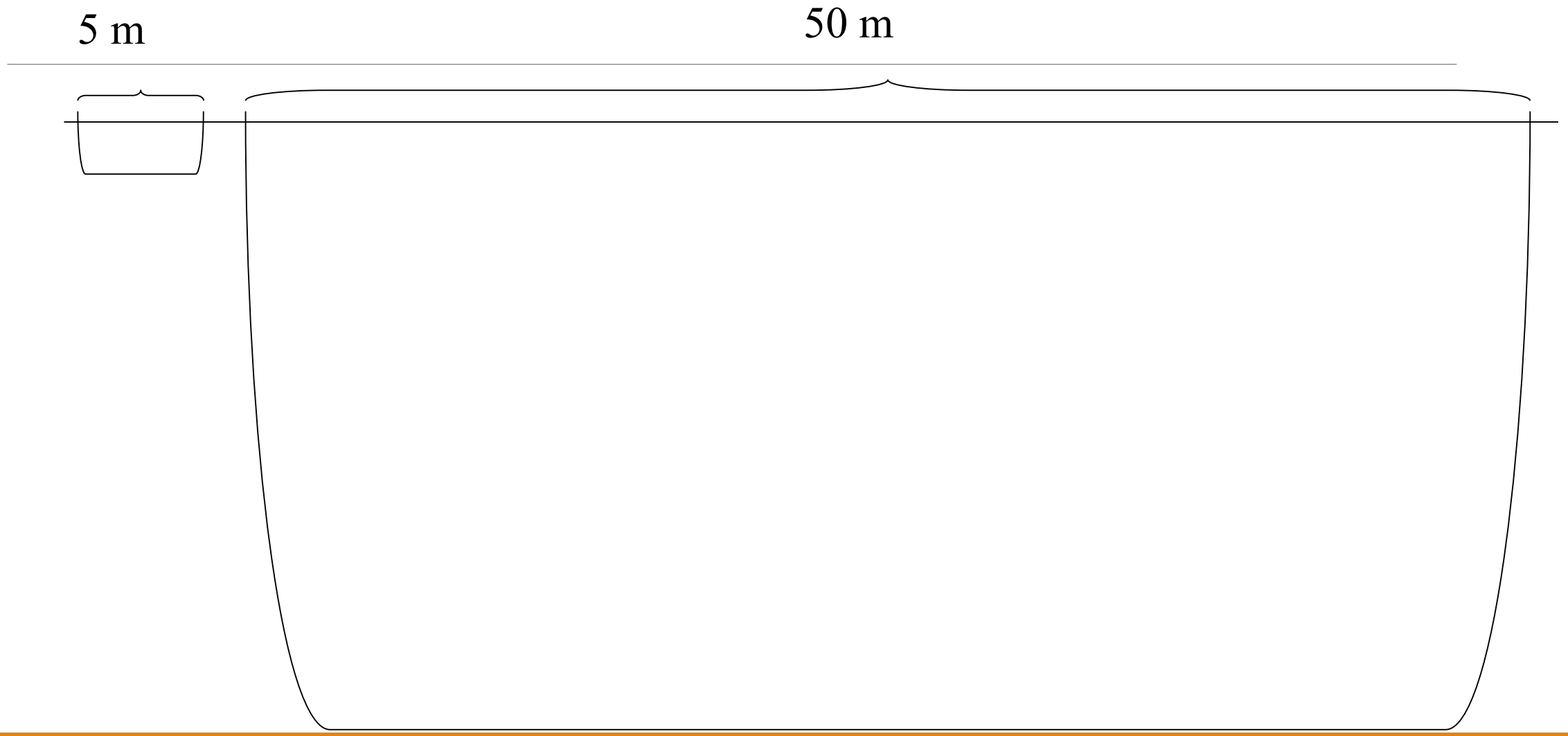
But it is challenging, and costly

Marine aquaculture is a child of the 1960s, and was made possible with the invention of the netpen

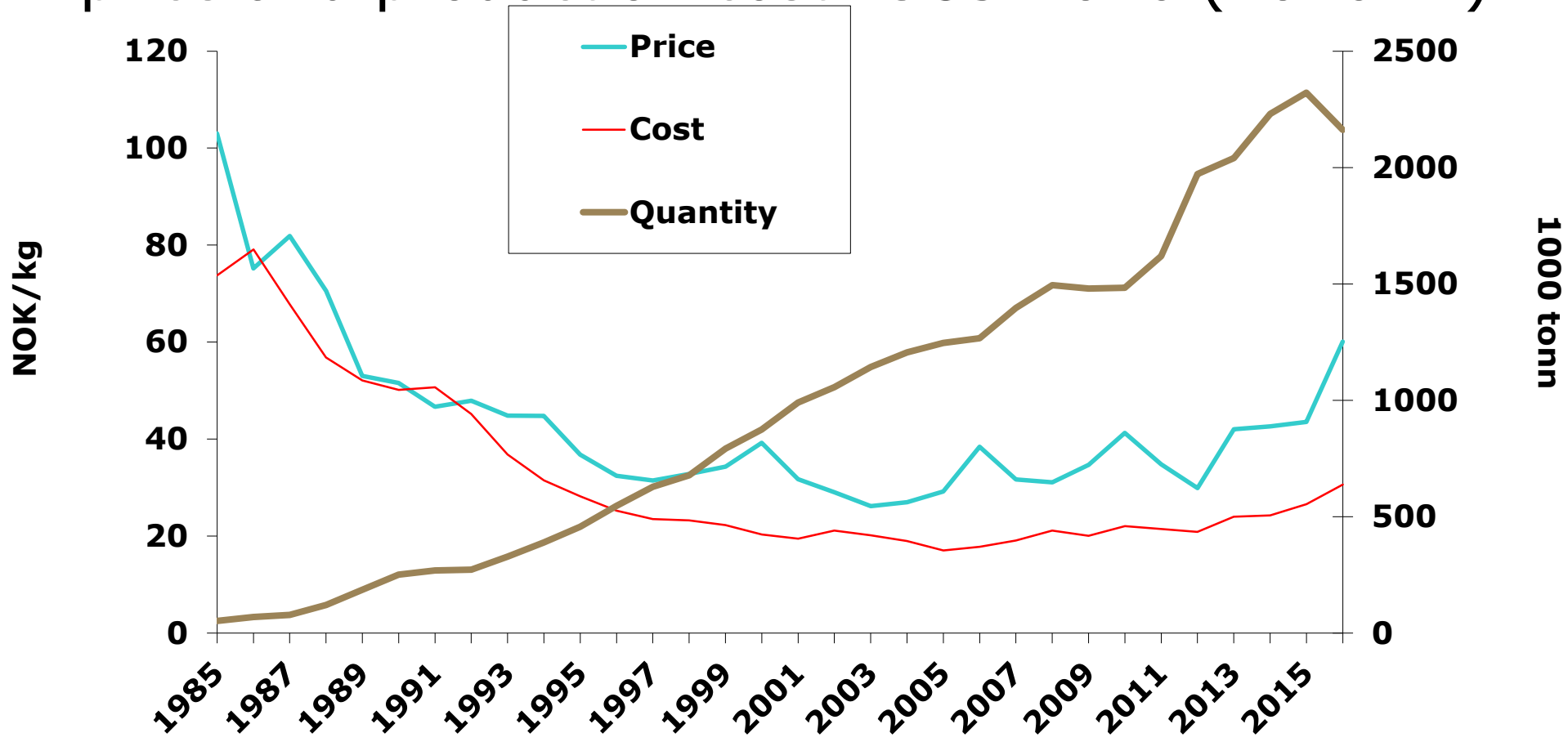
Technology developed rapidly, and the plants became larger…..

…… and larger

Innovations increase scale – a salmon pen from 1980 and one from 2015



And with increased knowledge and better technology, production cost came down: Global salmon production, price and production cost 1985-2016 (2016=1)



Netpens is a technology that require particular types of coastline, although they have become more robust

For salmon, demand is sufficiently strong that even though production has increased rapidly, prices have had an increasing trend for over ten years

Wild landings are stagnant for most species

- Increasing trend in prices in markets not dominated by aquaculture

This is largely due to lack of access to new production cites, which is partly a regulatory and partly a technology question

- A license to hold 780 mt of salmon in Norway is now worth more than 10 mill $

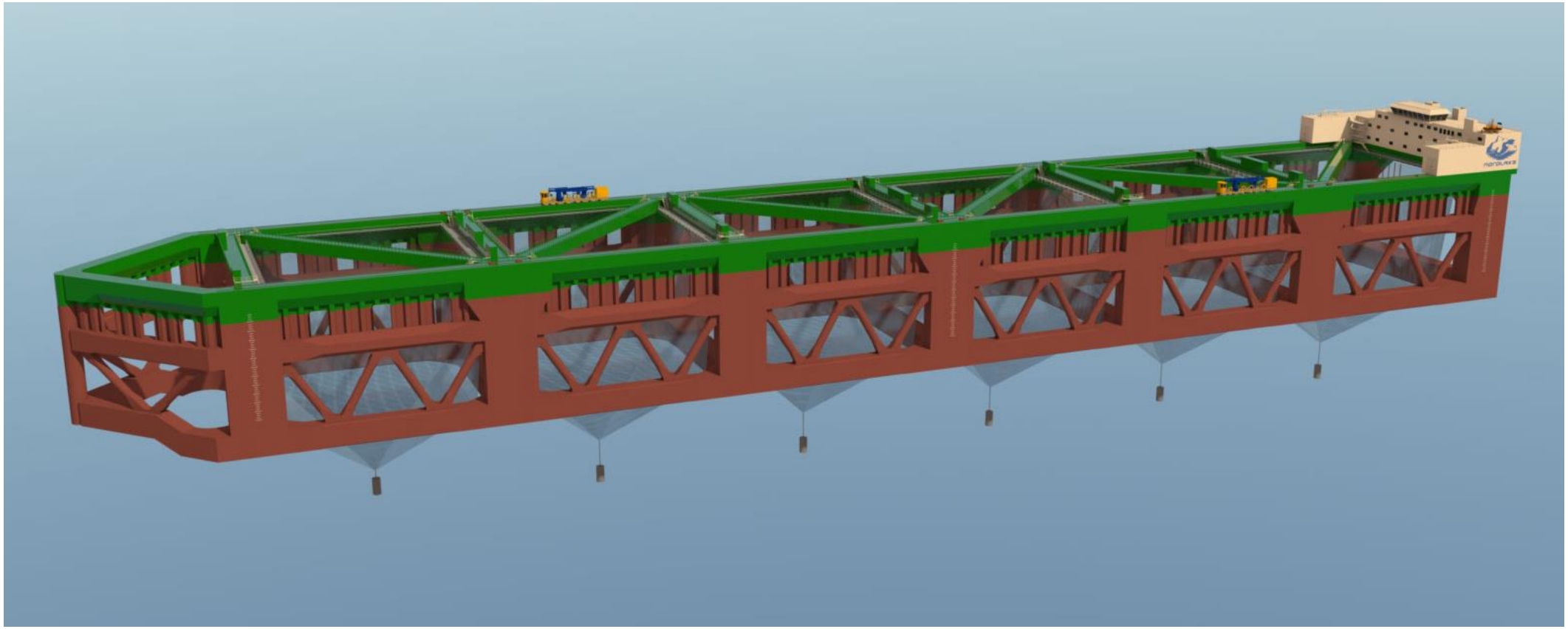
Two types of technologies are being tried: Offshore and land based

Offshore aquaculture is happening for salmon and other species (as is landbased aquaculture)

This farm started operation in 2018. It´s diameter is 110m and it will produce 8000 mt per year. Building cost: $100 mill.

This is 385m long and 65m wide with a capacity to produce 11000 mt. Has been built

Will become operative in 2019.
Construction cost is about $120 mill



Ocean aquaculture is expensive

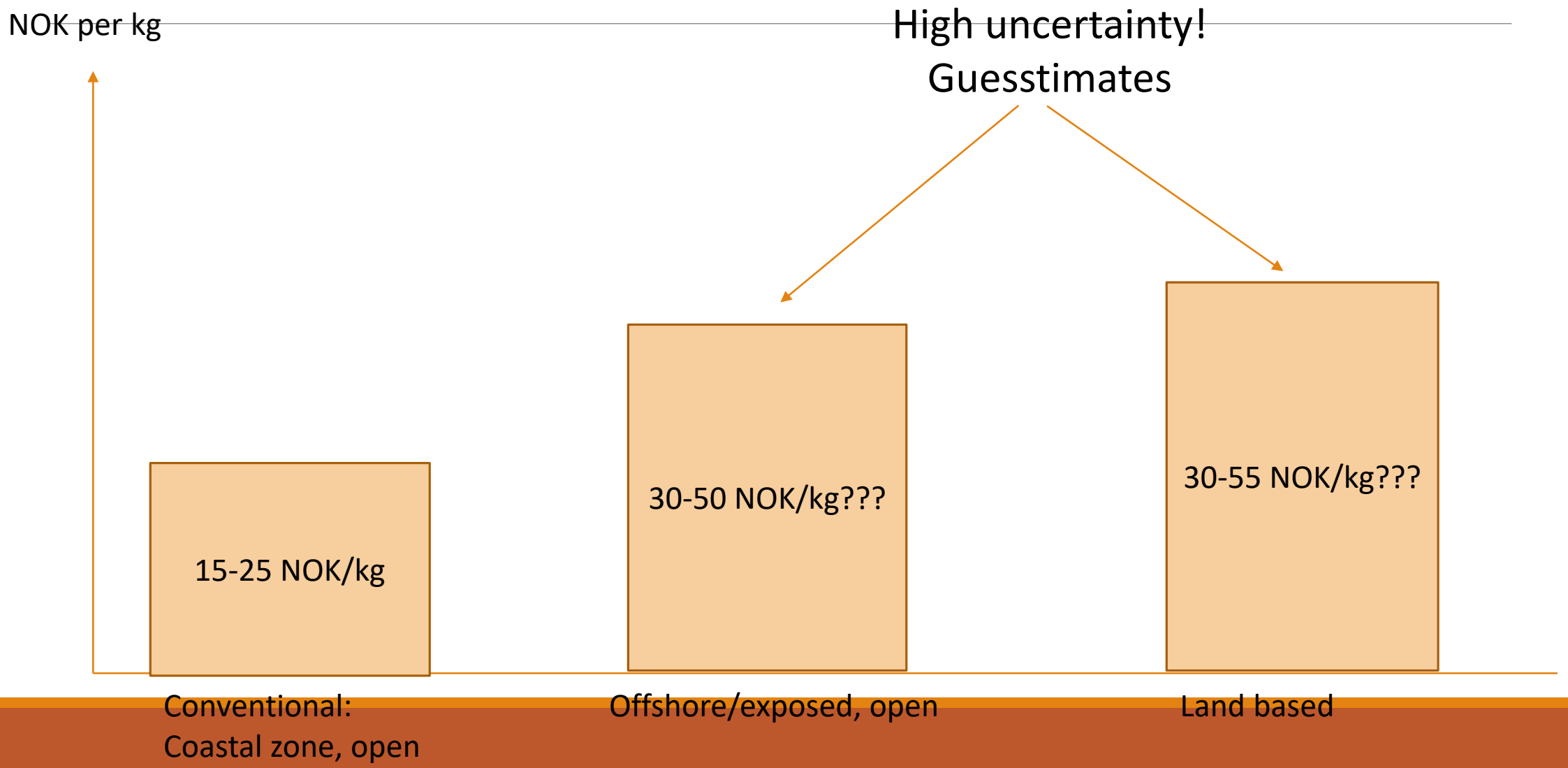
These facilities are much bigger than coastal farms

This may not be necessary, but economies of scale makes it more likely that it will be economically viable

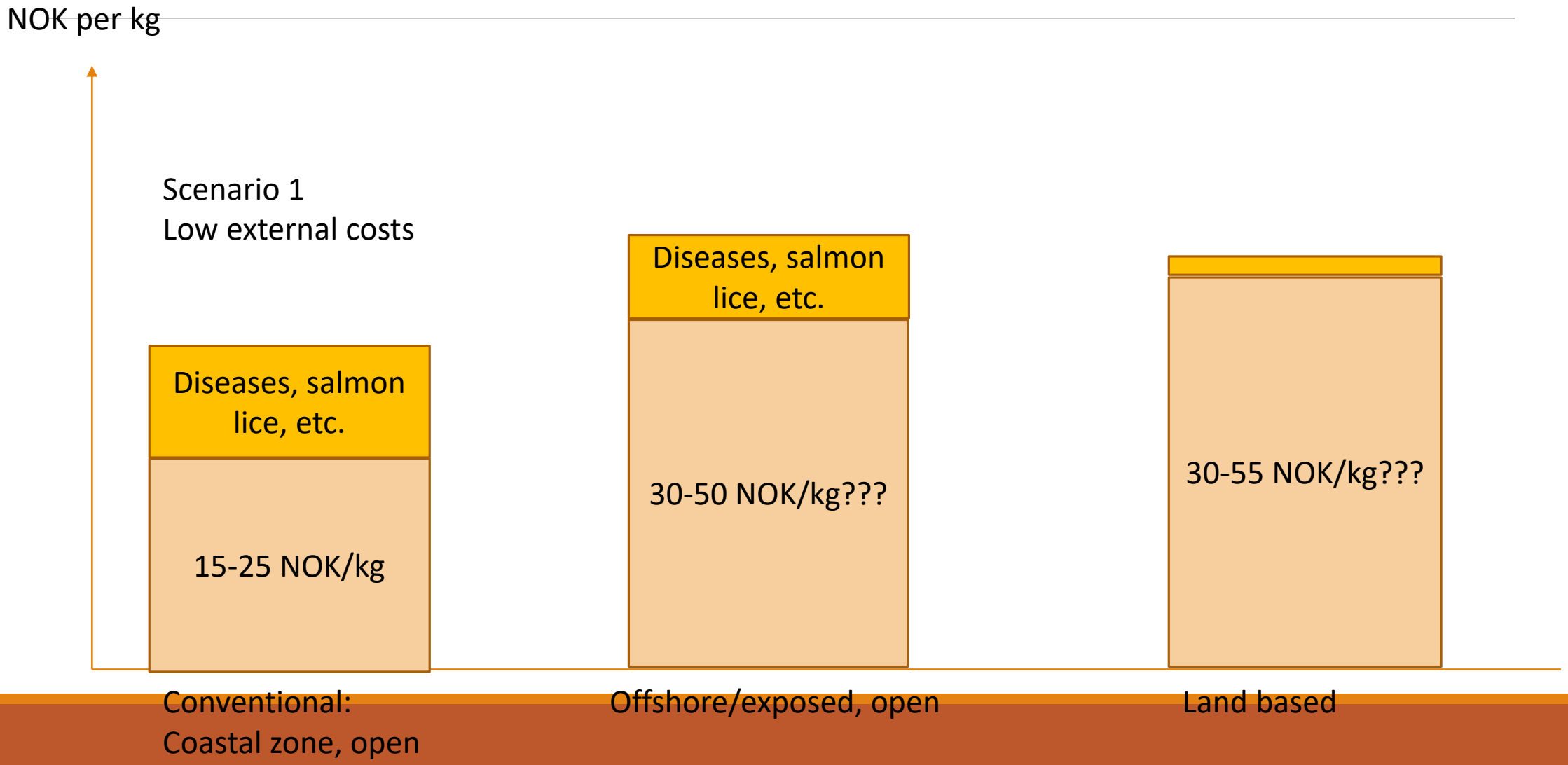
It also makes it easier to justify investments in supporting facilities

Depending on where you are in the world, it may also be necessary to handle weather issues

Production costs alternative technologies for salmon: Before environmental costs and license issues



Production costs alternative technologies: Costs due to disease and other environmental issues



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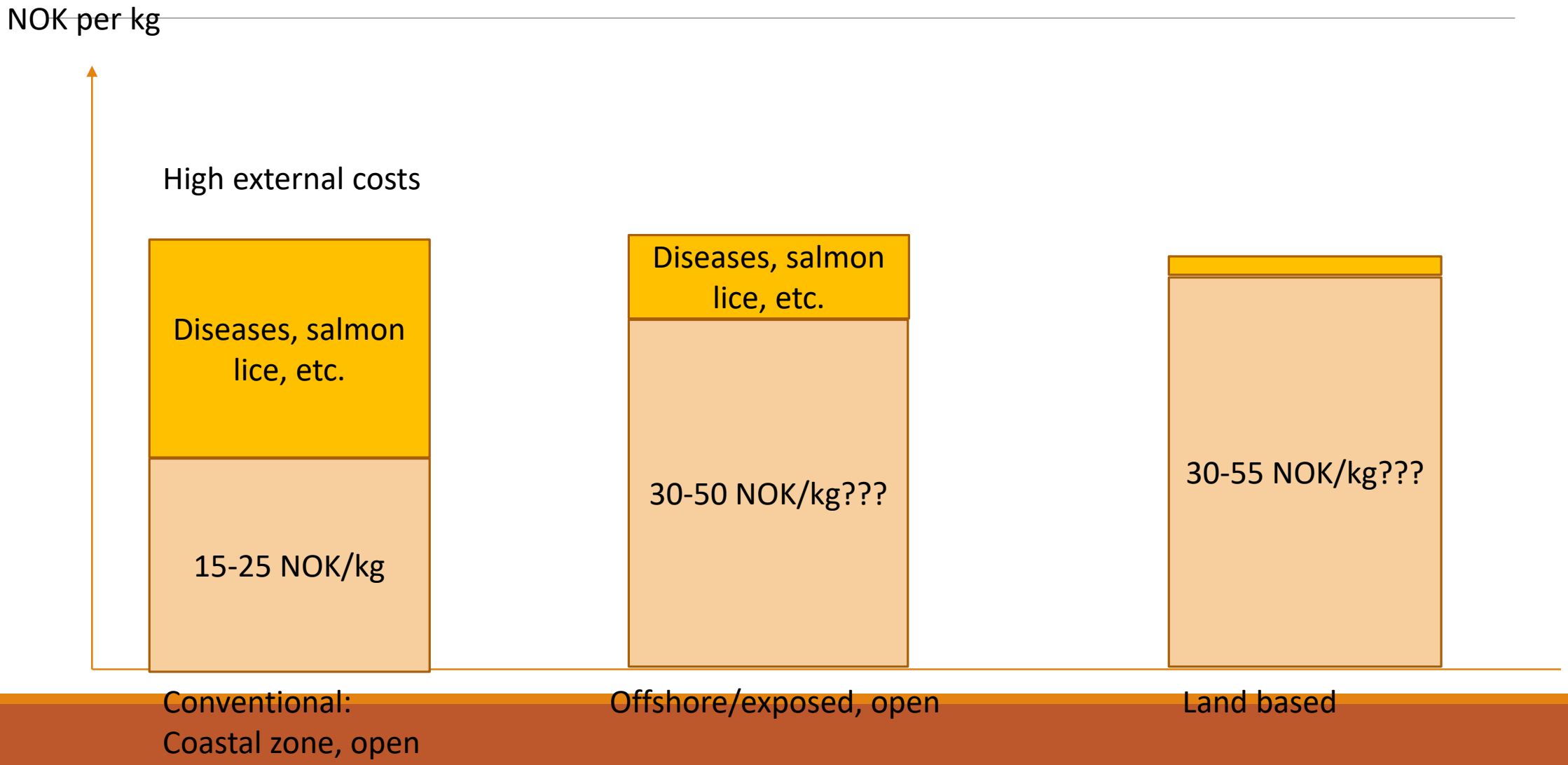
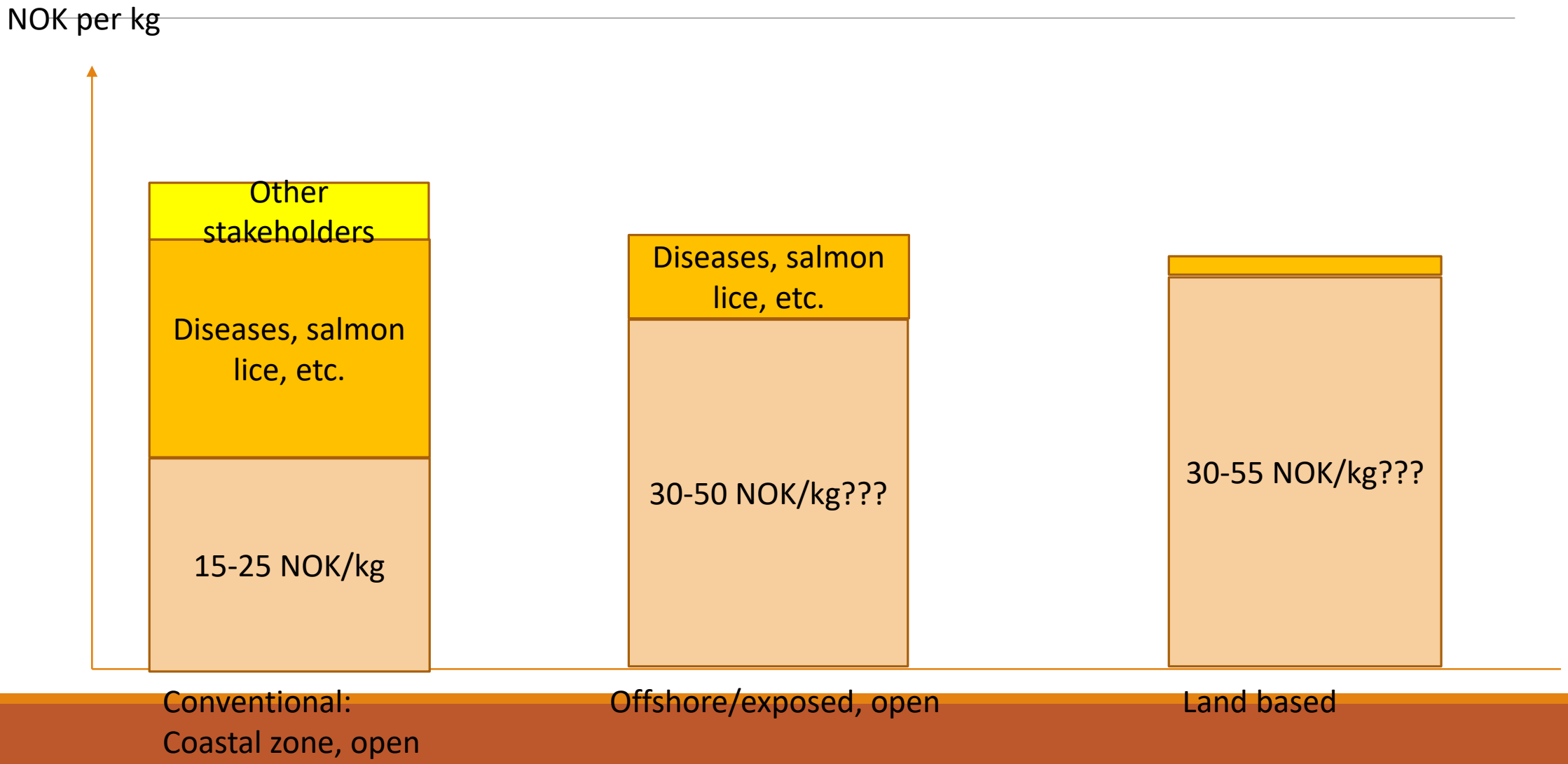


And it becomes harder when there is additional fees associated with traditional technologies



In Norway, real offshore fish farming is happening

It is largely caused by difficulties in getting traditional production sites

Capital costs are high, but while it is not obvious that they will come down to the level of a traditional set of pens, they are likely to come down

Distance to shore makes operation costs somewhat higher, but it does not make too much of a difference

- Also for traditional plants, the distance to the harvesting plant is significant

Variable costs, mostly feed, are basically the same

There are trails and a few operations other places in the world, but generally with smaller scale systems

In not too many years, there will be suppliers providing this kind of systems off-the-shelf

The development internationally increase the likelihood that aquaculture in the gulf will succeed

But it is still impeded by:

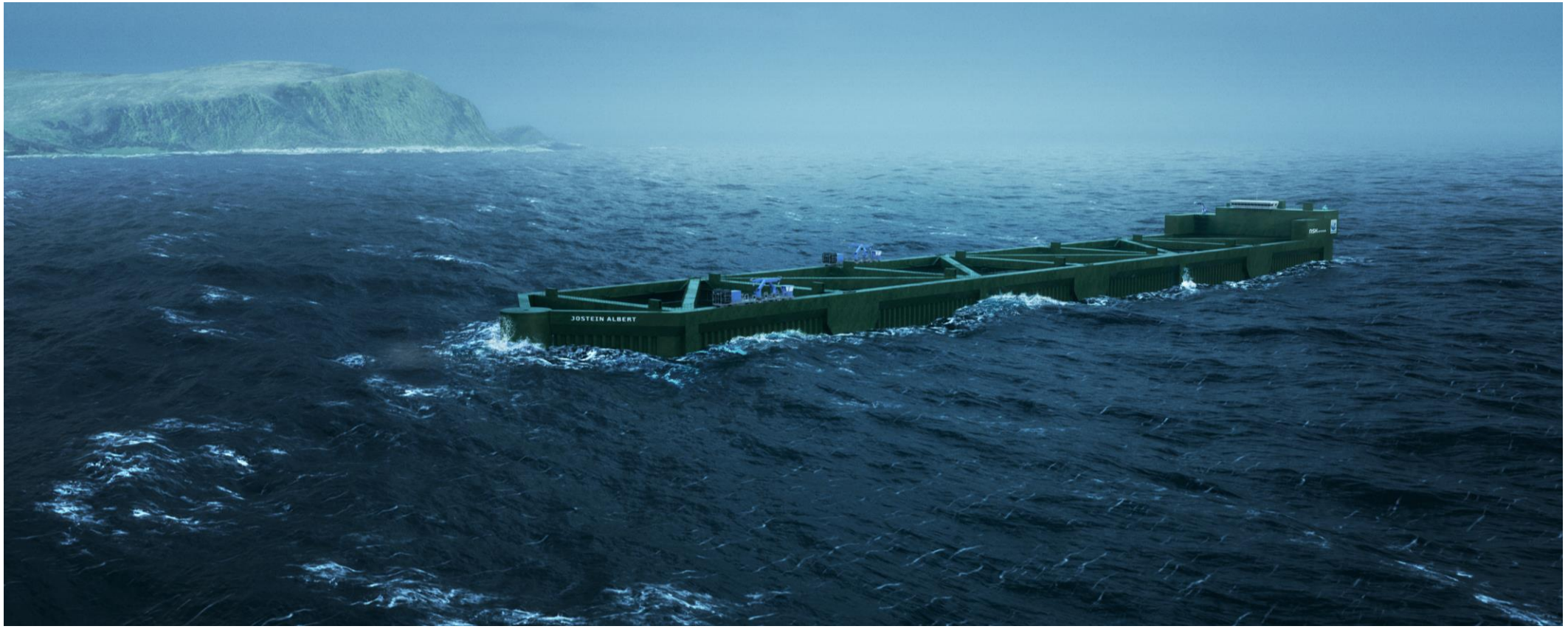
Not being able to buy fish of-the-shelf, and not to utilize existing breeding programs

Not being able to buy feed, vaccines etc. of the shelf

And the cost will be higher because one also have to invest in the infrastructure to serve the facilities since there does not exist an industry of well boats, feed producers etc.

But competition will be keen if one are producing species that are exposed to import competition, as globally, seafood availability continue to increase

So is this the future?



Will one move to a more controlled environment?