THE VALUE PROPOSITION FOR LAND-BASED RAS AQUACULTURE

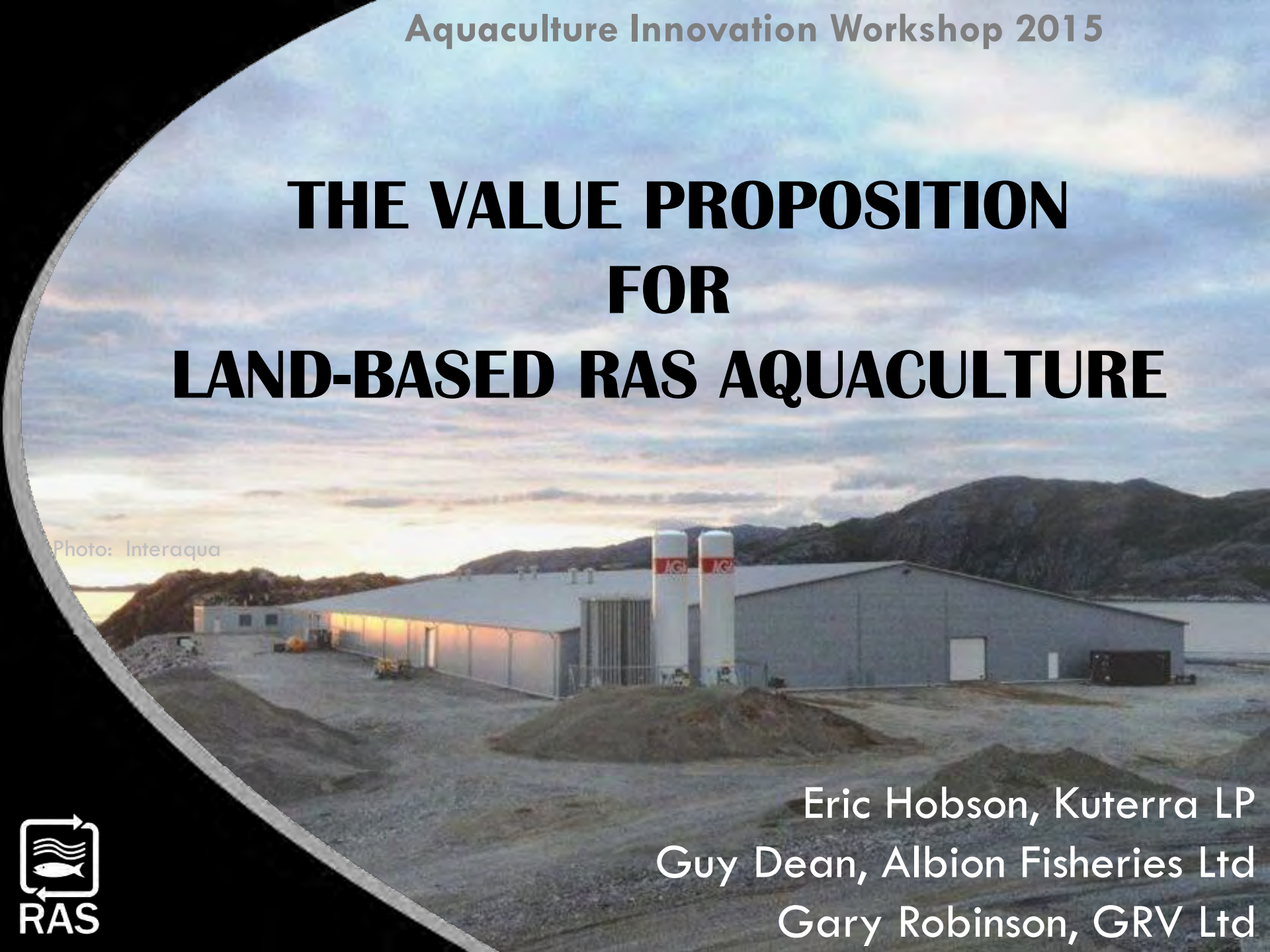

Photo: Interaqua

Eric Hobson, Kuterra LP
Guy Dean, Albion Fisheries Ltd
Gary Robinson, GRV Ltd

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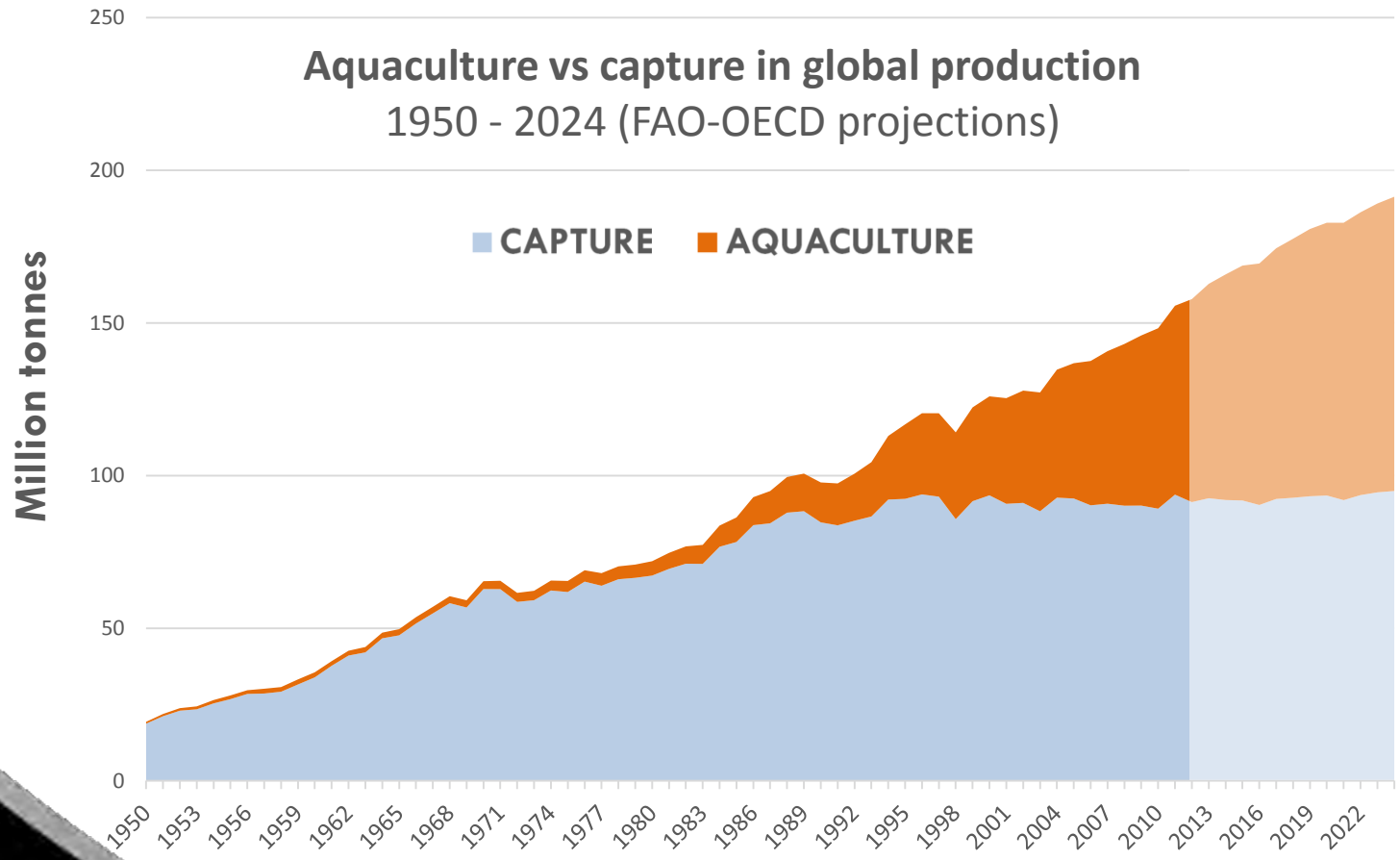
The opportunity

How to meet growing global seafood demand sustainably?



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The Trends

Supply → Demand

Consumer expectations

Traceability requirements

Willingness to pay premium

RAS technology advances

RAS production knowledge

RAS production risk

Feed costs

Local food production

Environmental compliance costs

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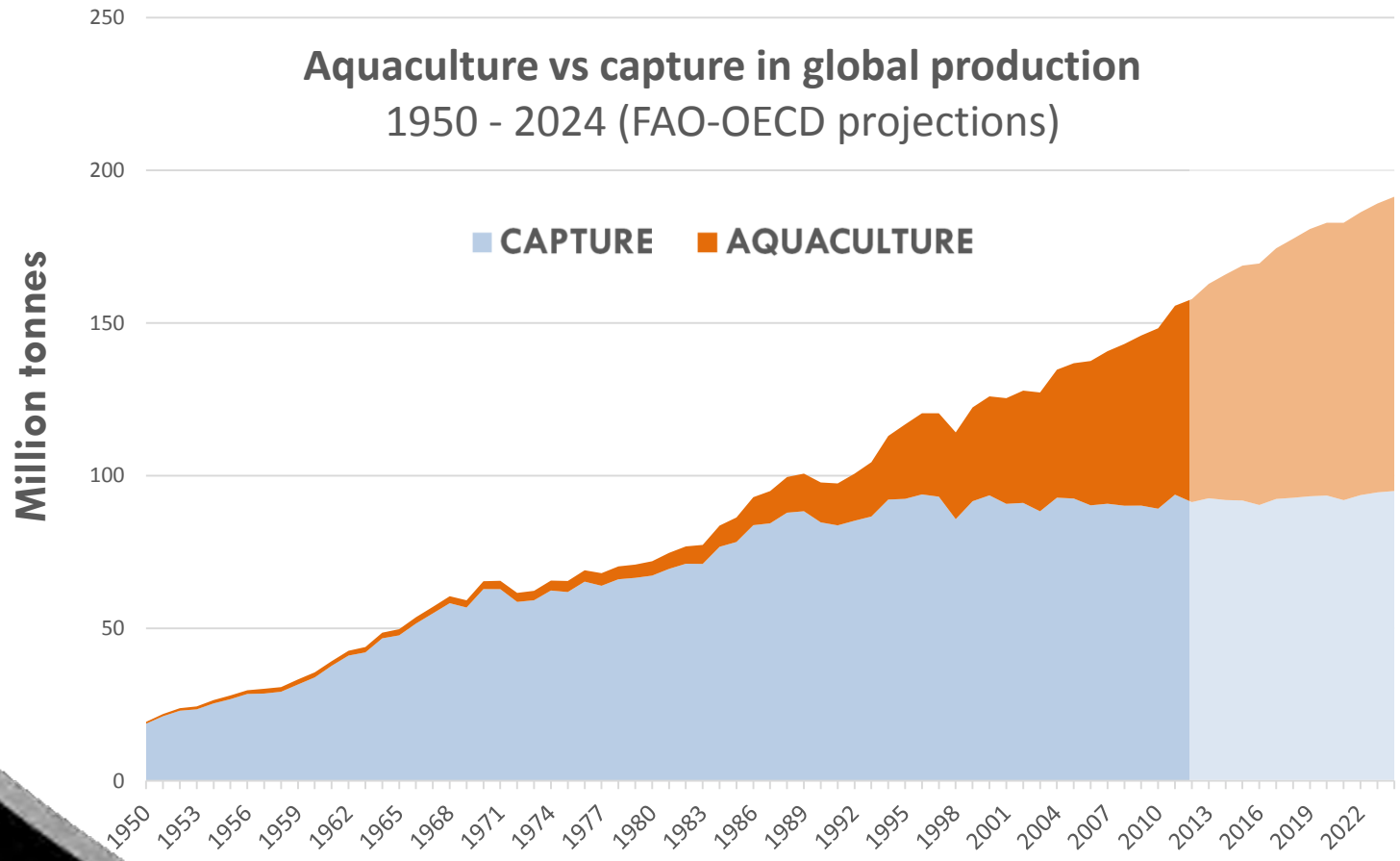
TREND 1 Growing seafood demand

Seafood consumption is growing.



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TREND 1 Growing seafood demand

Fishing is near its limits

Photo: 'Namgis First Nation

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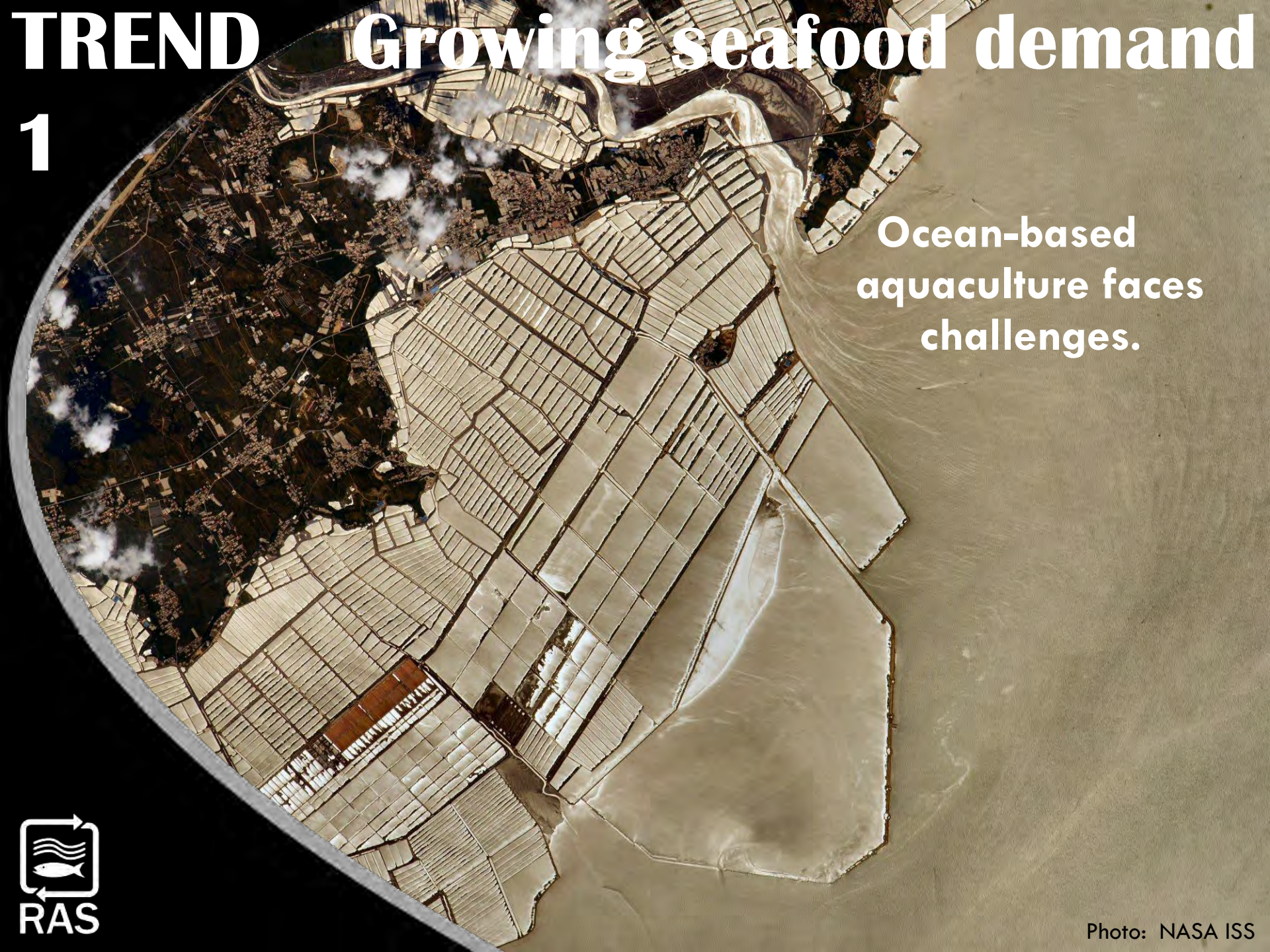
TREND 1 Growing seafood demand



Ocean-based aquaculture faces challenges.

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Photo: NASA ISS

TREND 2 Rising consumer expectations

Factors people care about in choosing food

38% Chemicals, toxins, pesticides

31% Non-GMO

23% All natural, not artificial

18% Organic

15% Additives, fillers

11% Preservatives

Source: Nutrition Business Journal

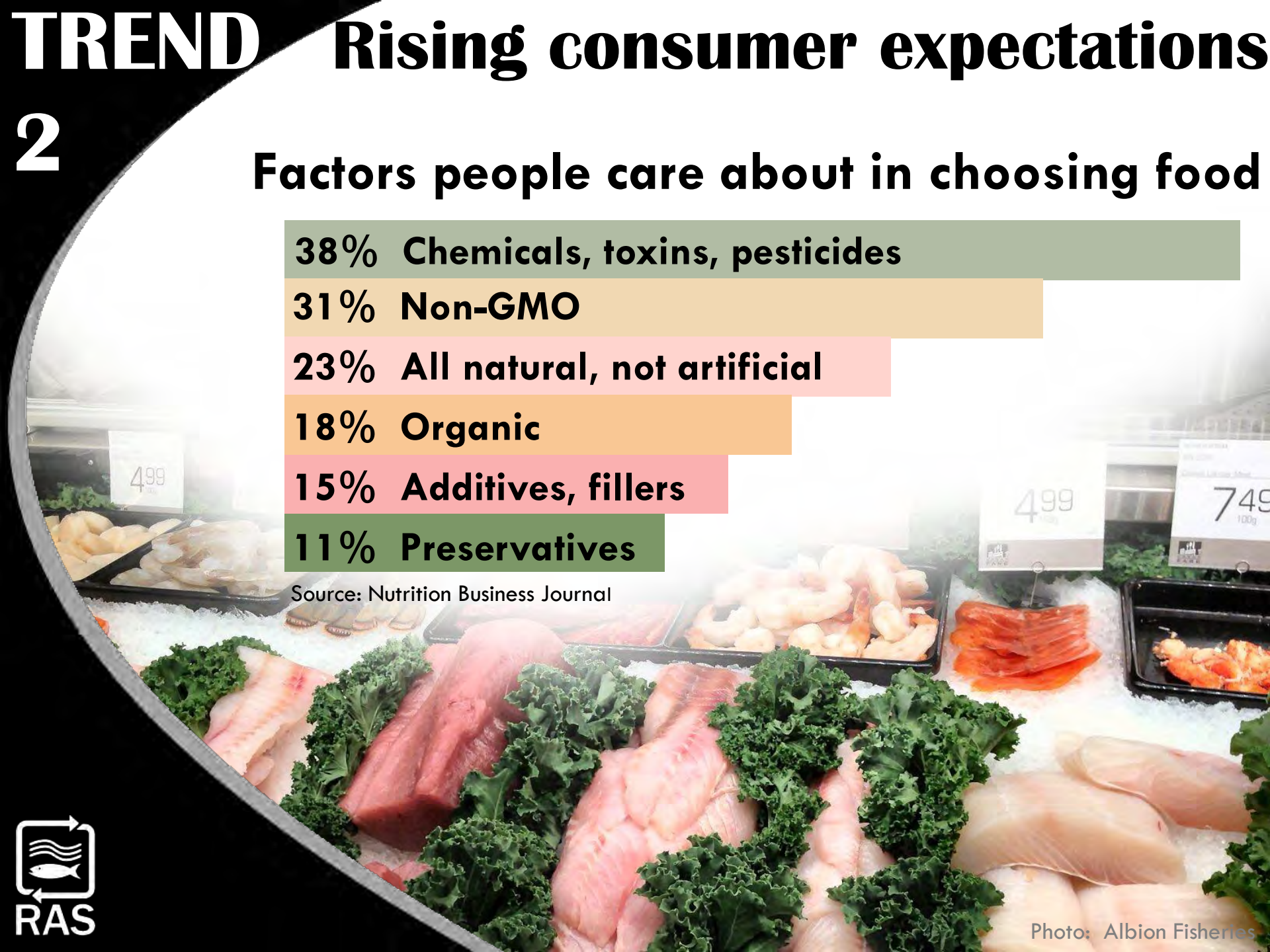

Photo: Albion Fisheries

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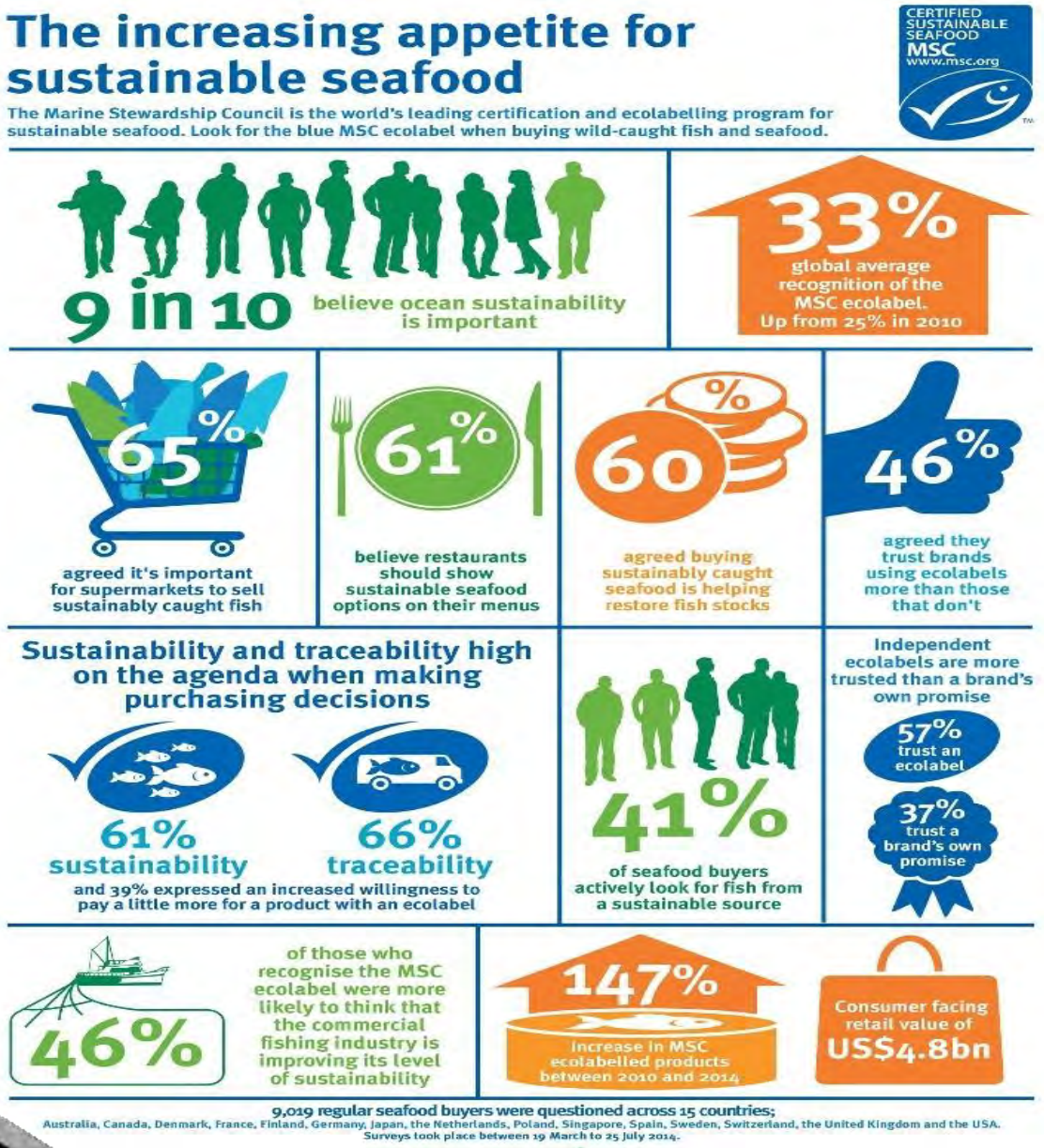
TREND 2 Rising consumer expectations



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TREND 2 Rising consumer expectations

MBA Seafood Watch assessment for

Recirculating Aquaculture Systems

for any species, grown anywhere

Criterion	Score (0-10)	Rank
C1 Data	7.00	GREEN
C2 Effluent	9.00	GREEN
C3 Habitat	6.83	GREEN
C4 Chemicals	6.00	YELLOW
C5 Feed	4.00	YELLOW
C6 Escapes	7.00	GREEN
C7 Disease	8.00	GREEN
C8 Source	10.00	GREEN
C9X Wildlife mortalities	-2.00	GREEN
C10X Introduced species escape	-2.00	GREEN
Total	**53.83**	
Final score	**6.73**	

Source: Seafood Watch

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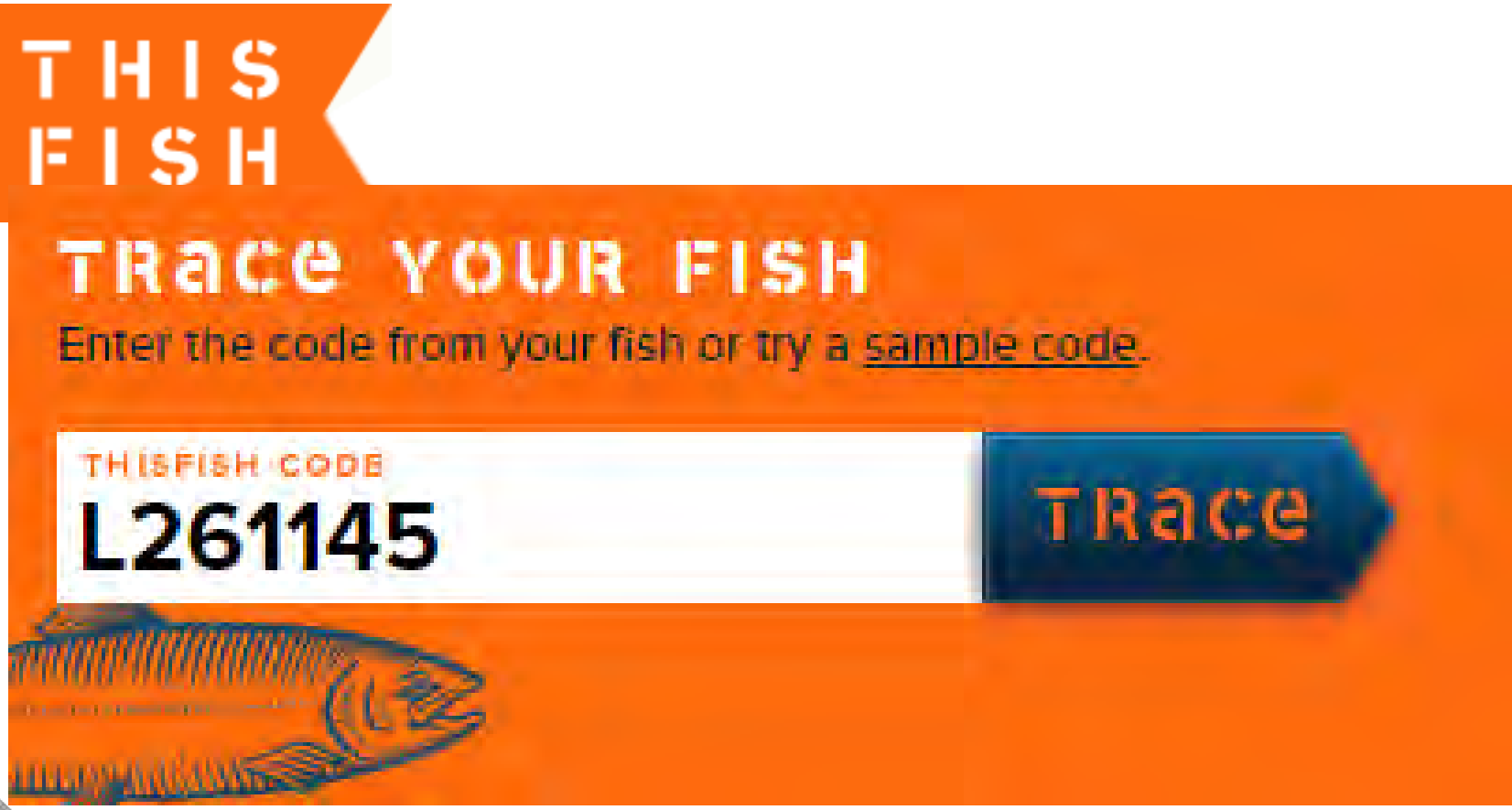
TREND 3

Increasing traceability



Source: ThisFish.info

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TREND 4

Willingness to pay more for seafood that meets expectations

Wegmans Fresh Farm-Raised Boneless Atlantic Salmon Fillets - 1 Fillet

3 / 5

Read all 2 reviews Write a review

$9.99 / lb.

Wegmans Food You Feel Good About Fresh Wild Alaska Sockeye Salmon Fillet

5 / 5

Read all 2 reviews Write a review

$14.99 / lb.

Wegmans Food You Feel Good About EU Organic Salmon - 1 Fillet

5 / 5

Read all 2 reviews Write a review

$16.99 / lb.

Source: Wegmans.com

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TREND 5 RAS technology advances

Technology advances through

- Optimization
- Standardization
- Scale

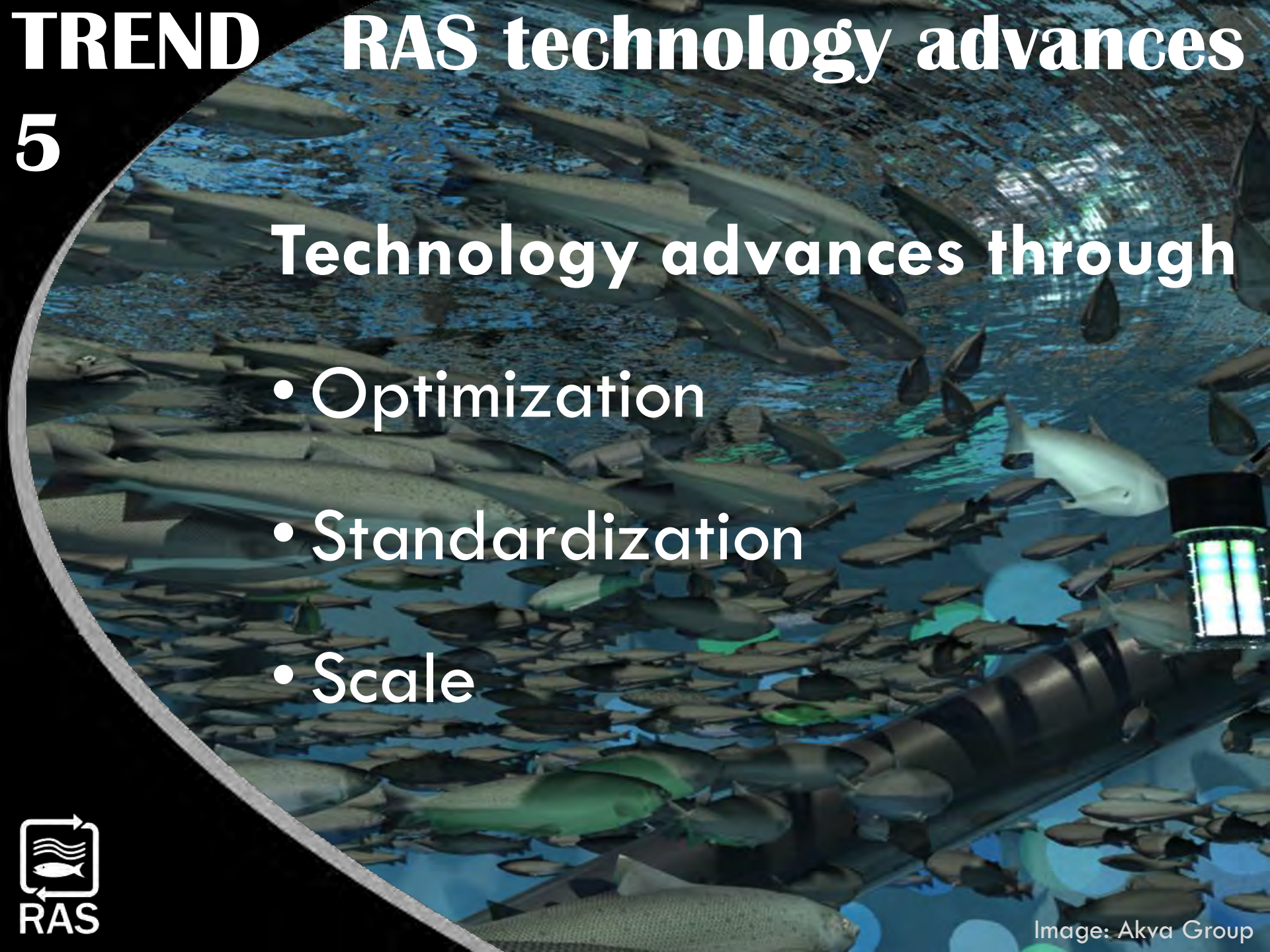
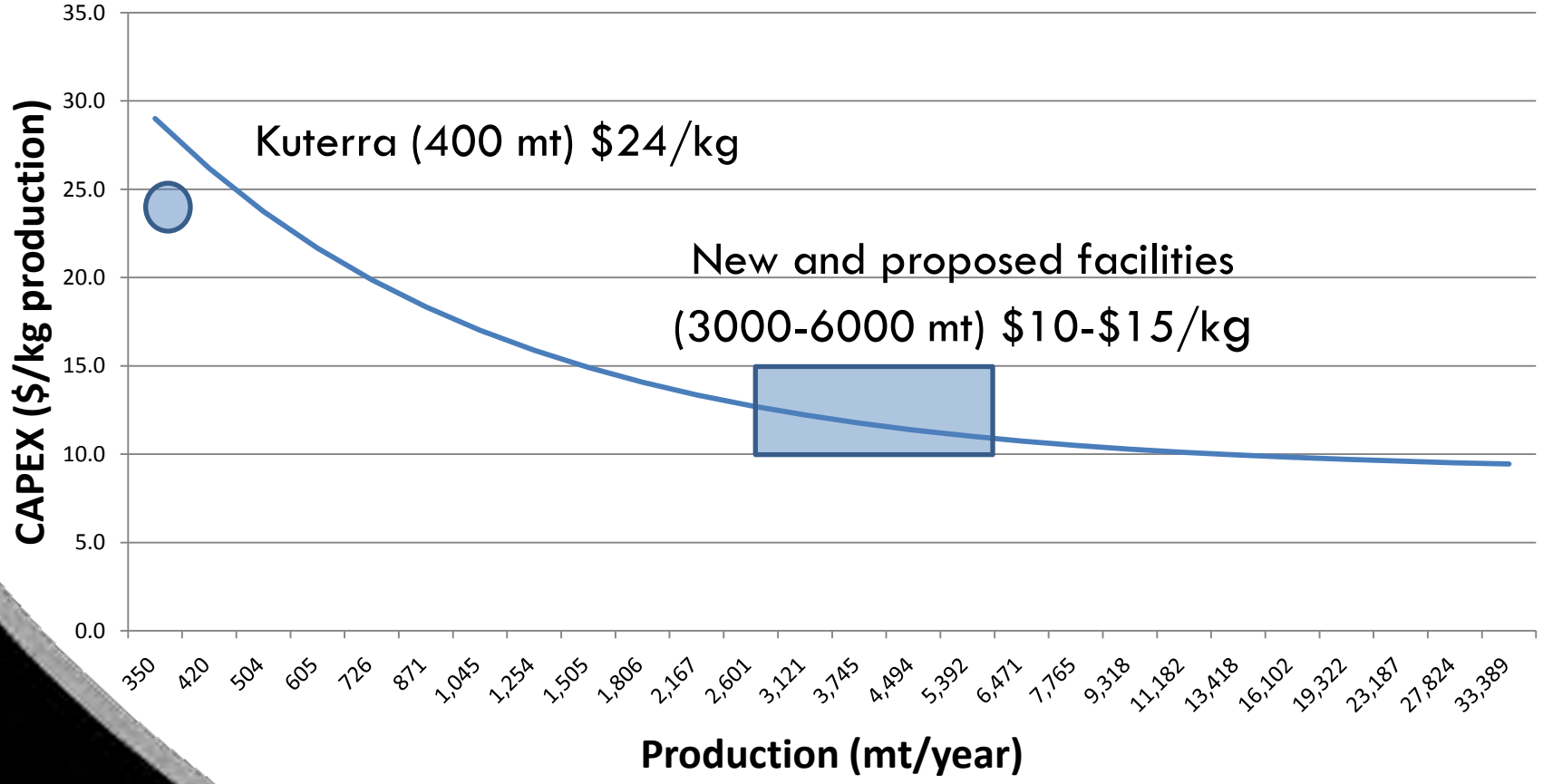


Image: Akva Group

TREND 5 RAS technology advances

Scale vs CAPEX



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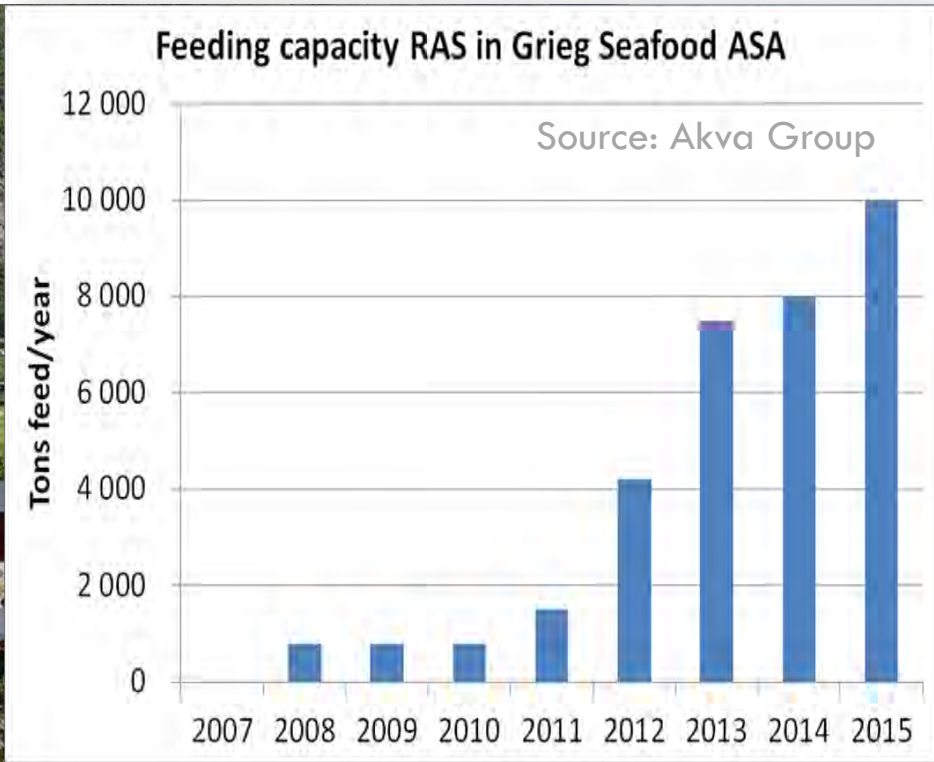
TREND 5 RAS technology advances

Key technology drivers

- Increasing use of RAS by primary production industries
- Changing economics of RAS production
- Incubation centres: Regions with active and connected industry, producer, supplier and research communities (eg. Denmark, Norway)
- Centres of aquaculture excellence (eg. Freshwater Institute)

Photo: Nofima



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TREND 5 RAS technology advances


Photo: Akva Group

Where we came from


Photo: Inter Aqua Advance

RAS

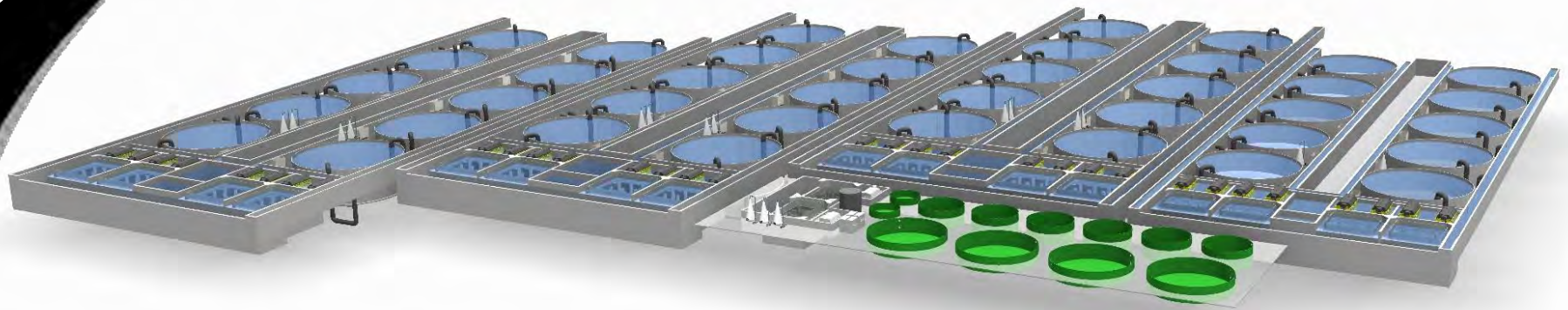
TREND 5

RAS technology advances

Today

Photo: Akva Group

TREND 5 RAS technology advances



© Inter Aqua Advance

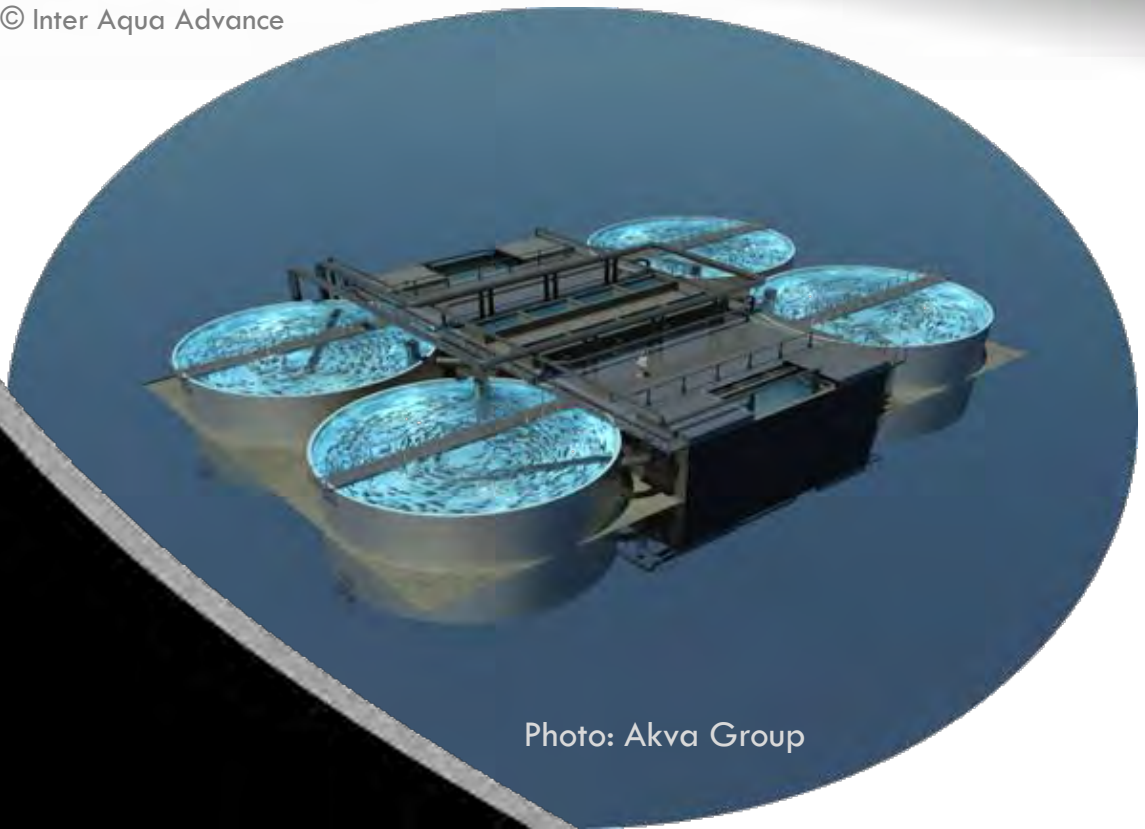


Photo: Akva Group

Where we are going

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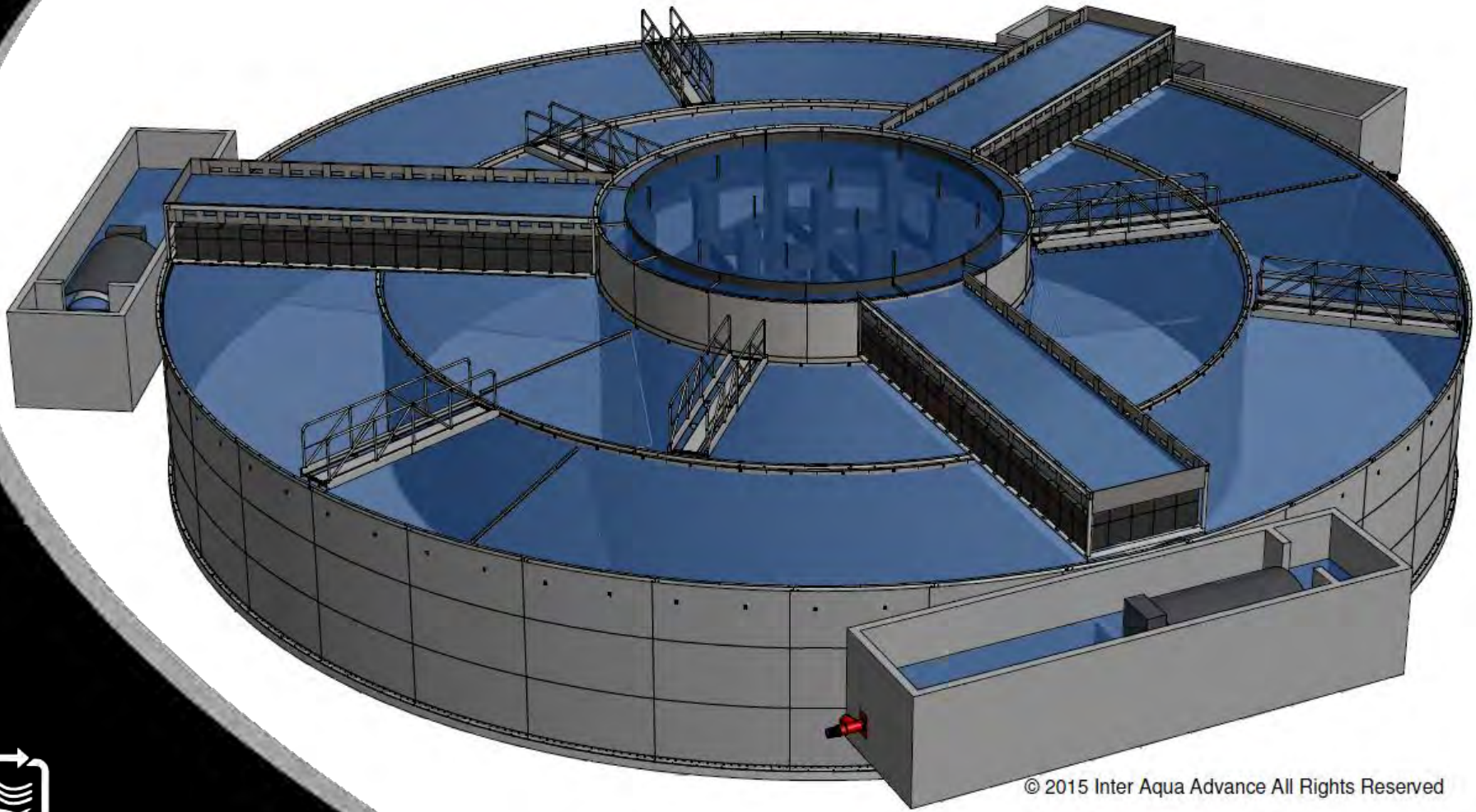
TREND 5

RAS technology advances

New directions



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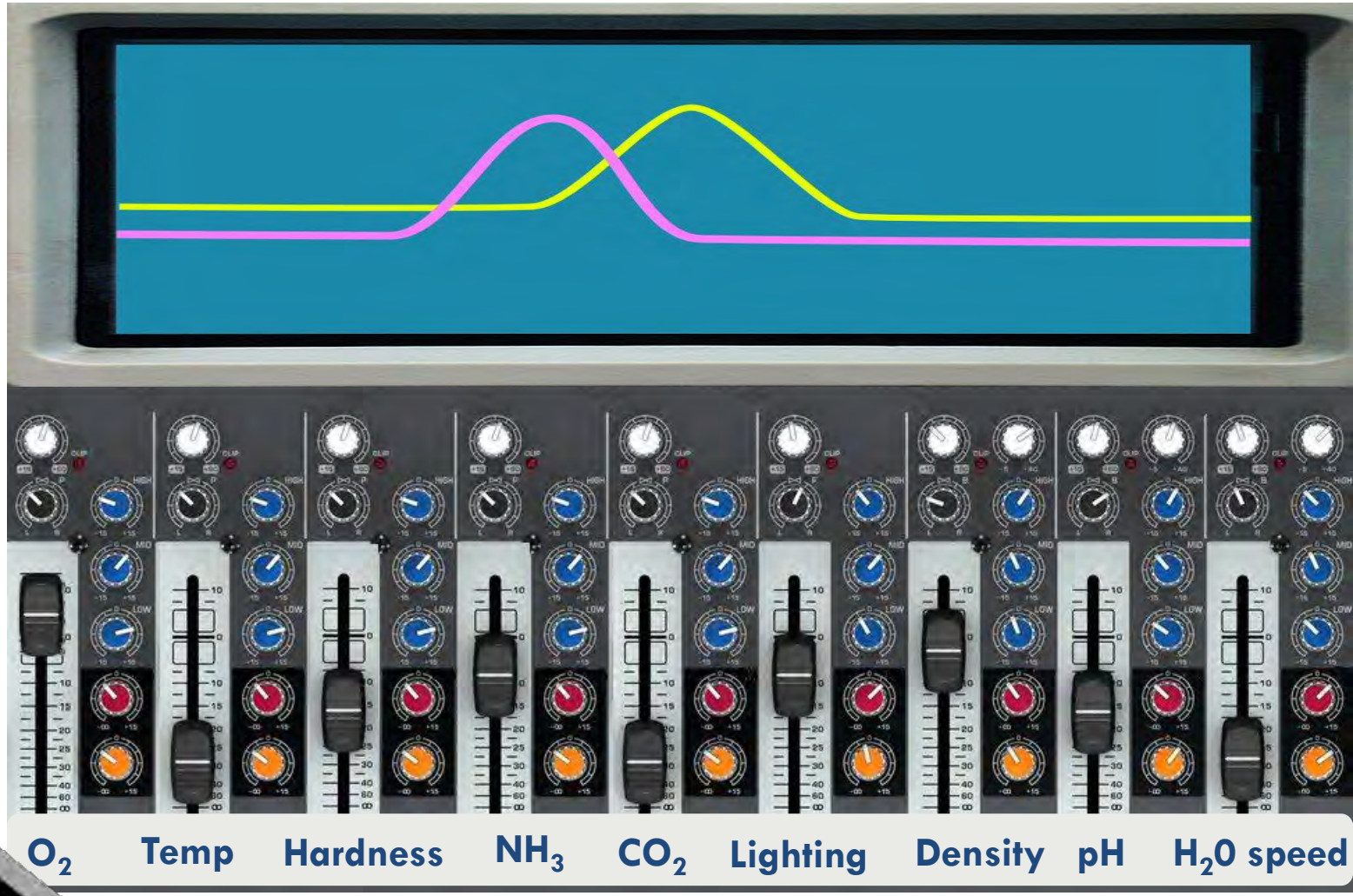
TREND 6

Advancing production knowledge



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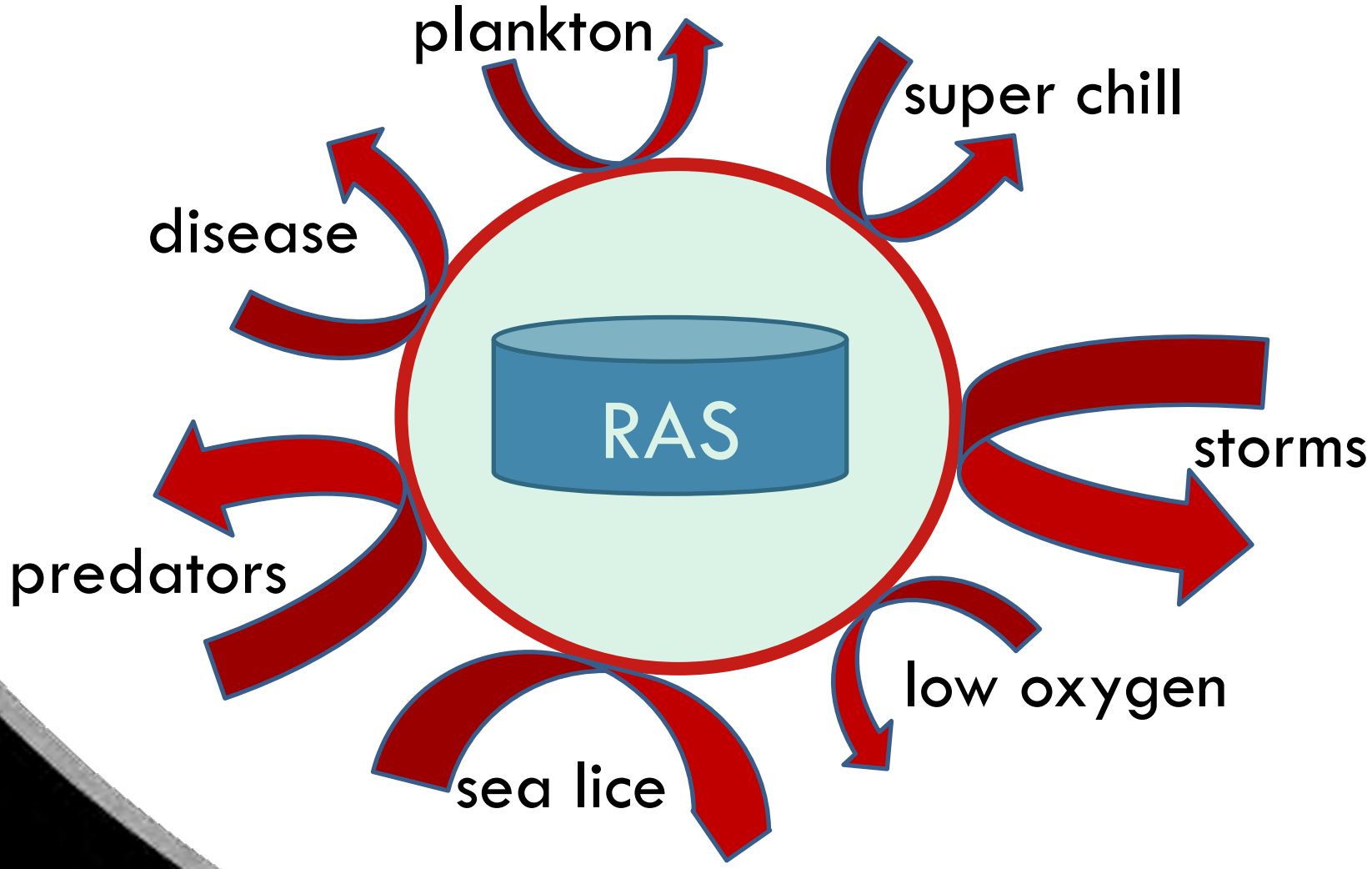
TREND 7

Falling production risk



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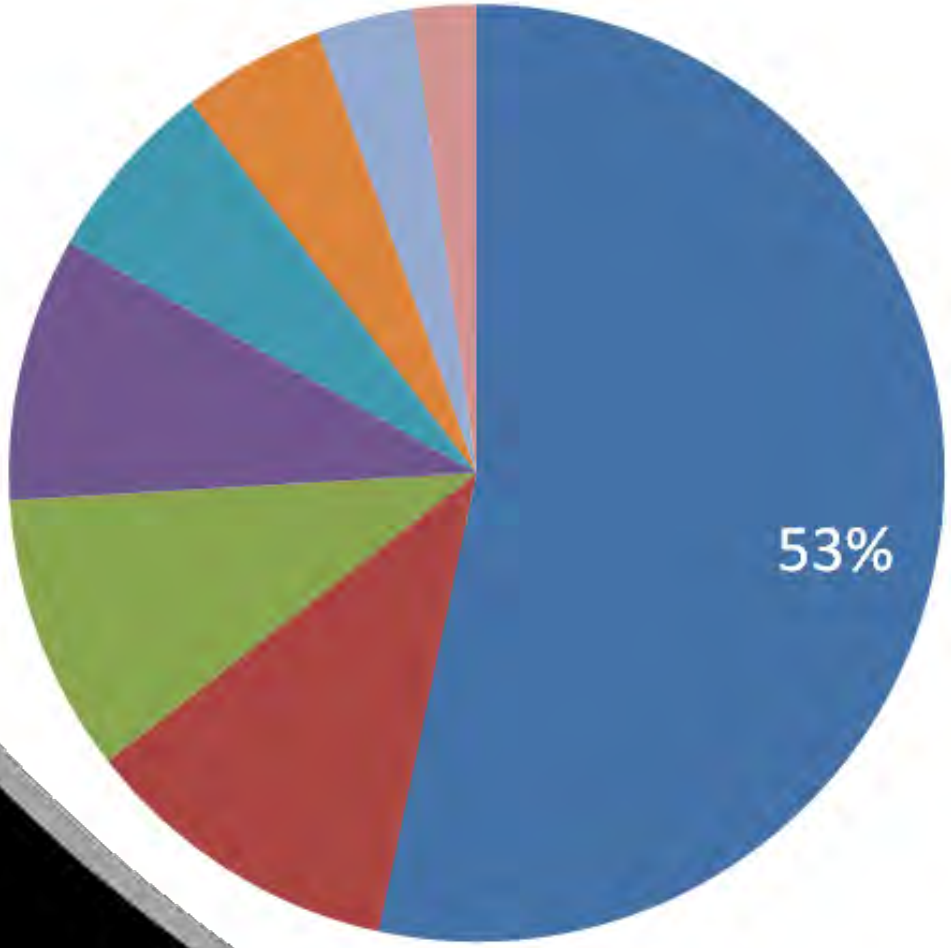
TREND 8

Rising feed costs

3000 mt/y RAS model farm



Production costs

- **Feed**
- Smolts (hatchery)
- Water treatments
- Energy
- Labour
- Insurance
- Maintenance

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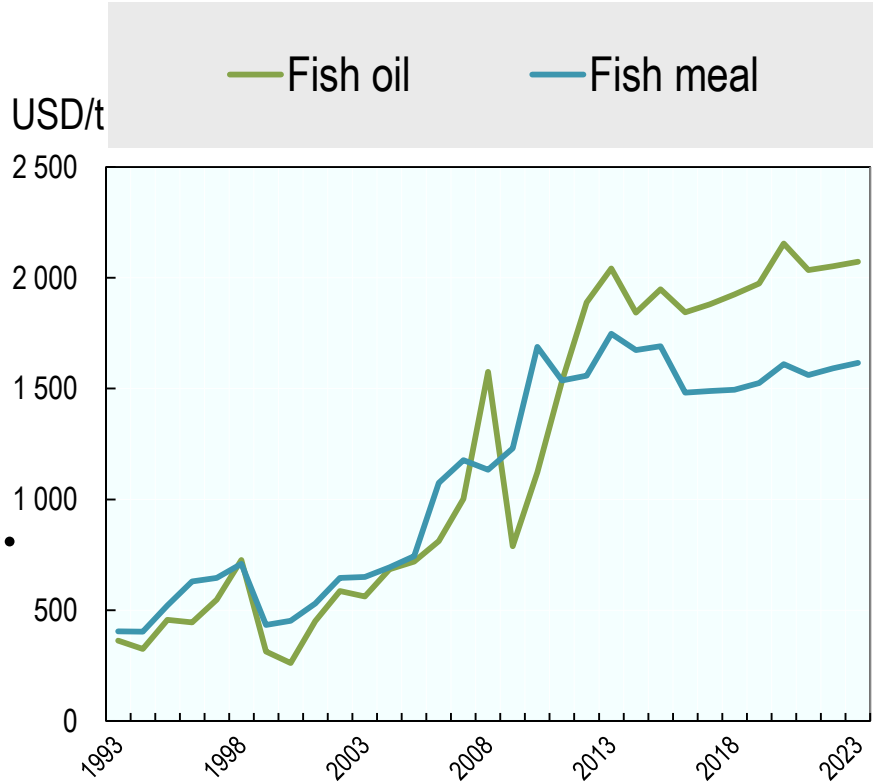
TREND 8

Rising feed costs

- RAS offers the potential for optimized fish performance, which = maximized feed conversion.
- Other forms of aquaculture have less capacity to do this.
- As feed costs increase, RAS competitiveness improves.



Source: OECD - FAO Agricultural Outlook 2014 - 2023

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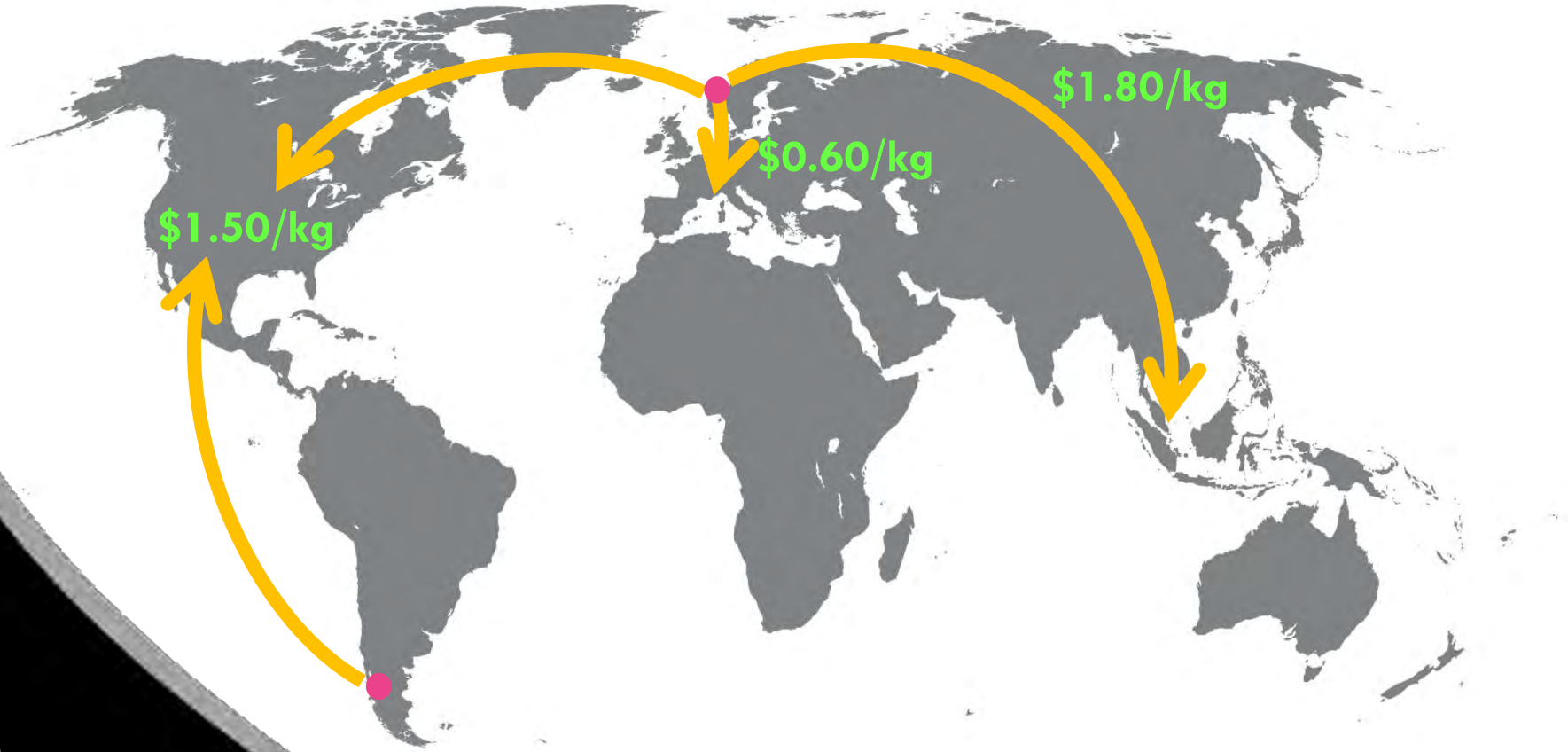
TREND 9

Local food production

Sample freight savings from local production (USD)



Sources: Anders Gjendemsjø, Deloitte AS for Akva Group
Marine Harvest Yearbook

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TREND 9

Local food production

or

Photo: Interaqua

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TREND 10

Rising environmental compliance costs

- Site productivity limits
- Sea lice treatments
- Net strength limits
- Monitoring and reporting
- Licence and tenure fees

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Photo: BC Salmon Farmers Association

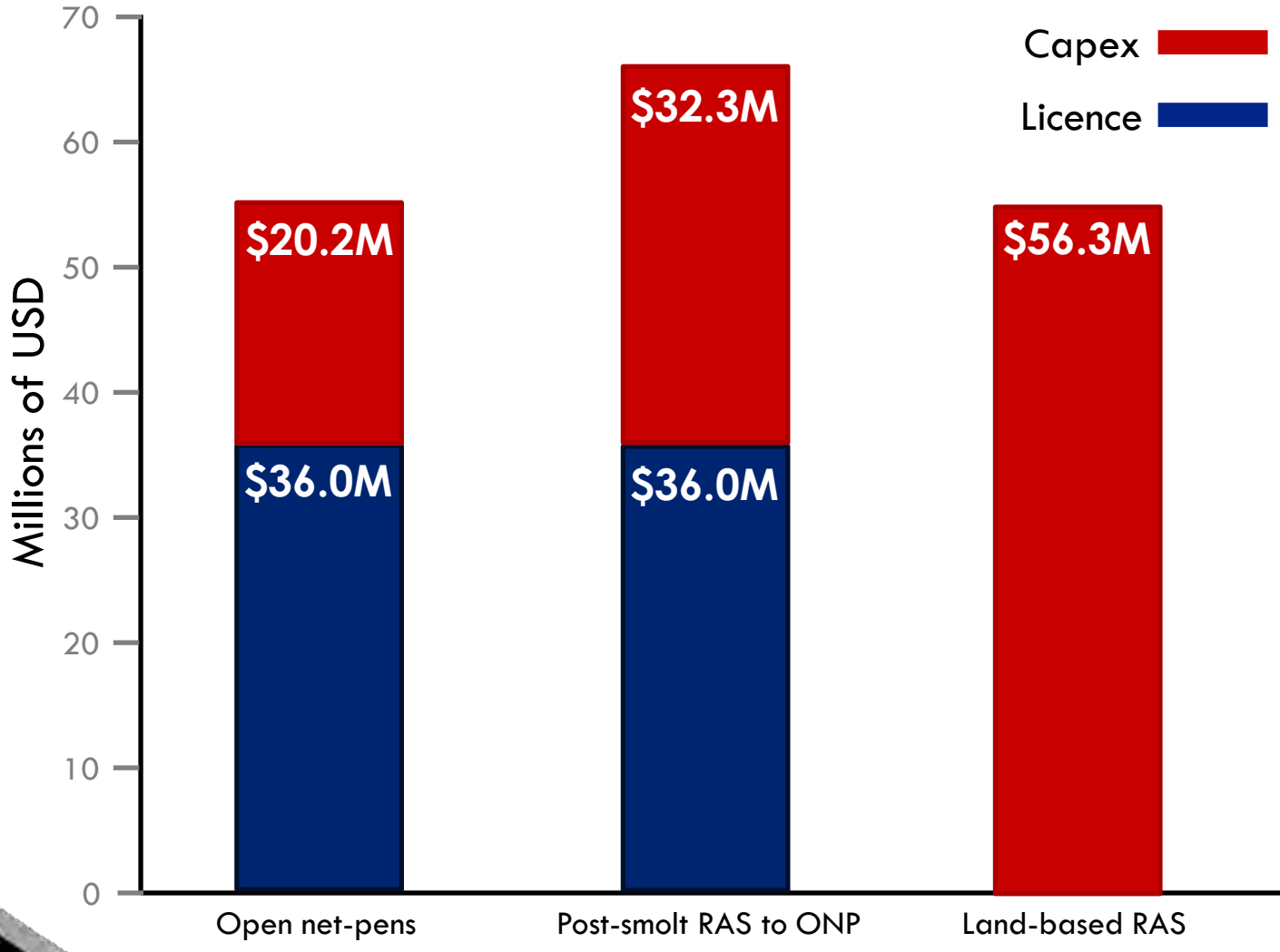
What does all this mean for the RAS industry?

Photo: Akva Group

Capital costs

5000 MT in Norway

- Hatchery included in each scenario
- 1NOK = 0.15 USD
- Licence cost = $12m per 1250-1667 MT



Source: Anders Gjendemsjø, Deloitte AS, commissioned by Akva Group

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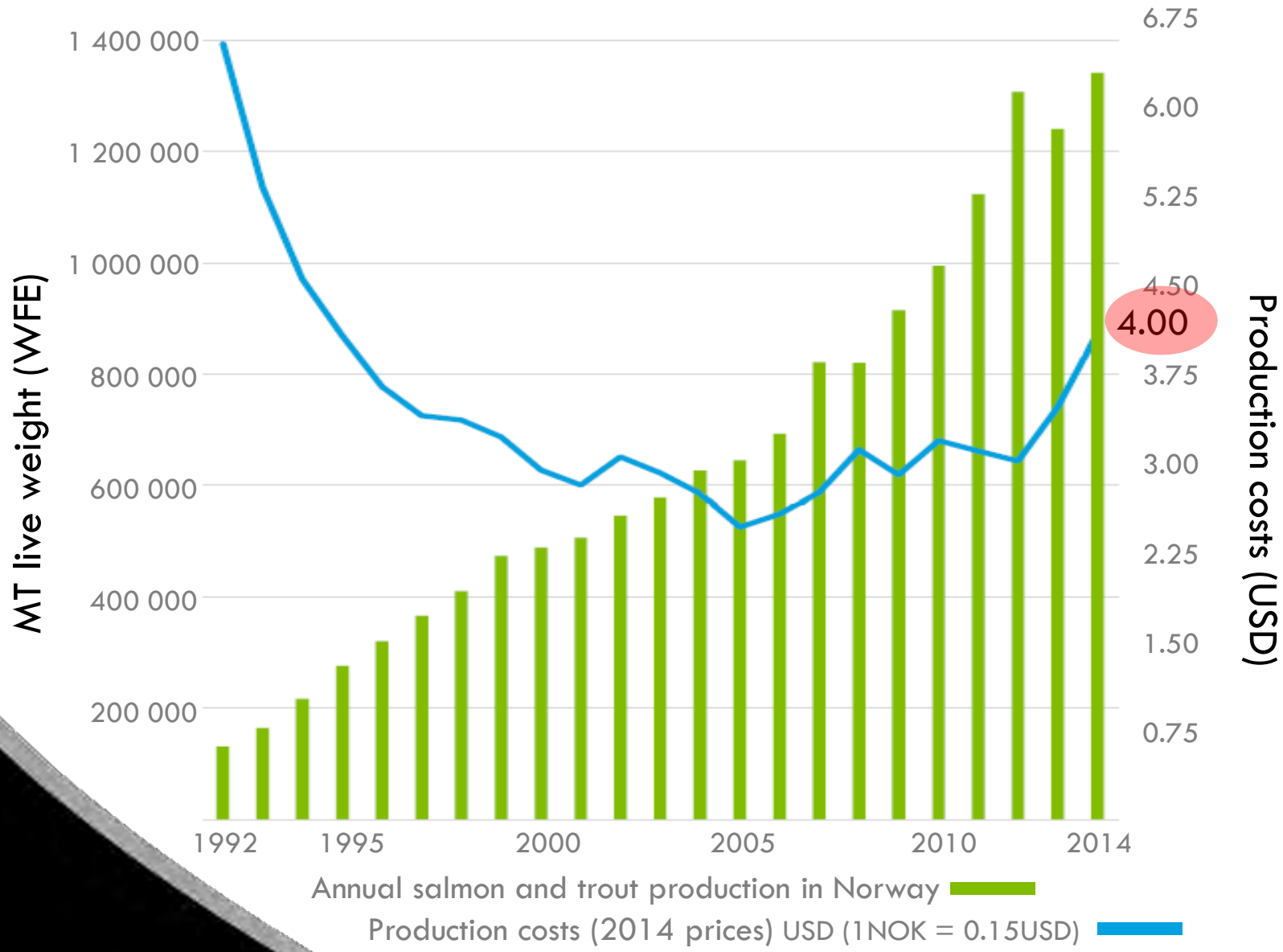
Production costs



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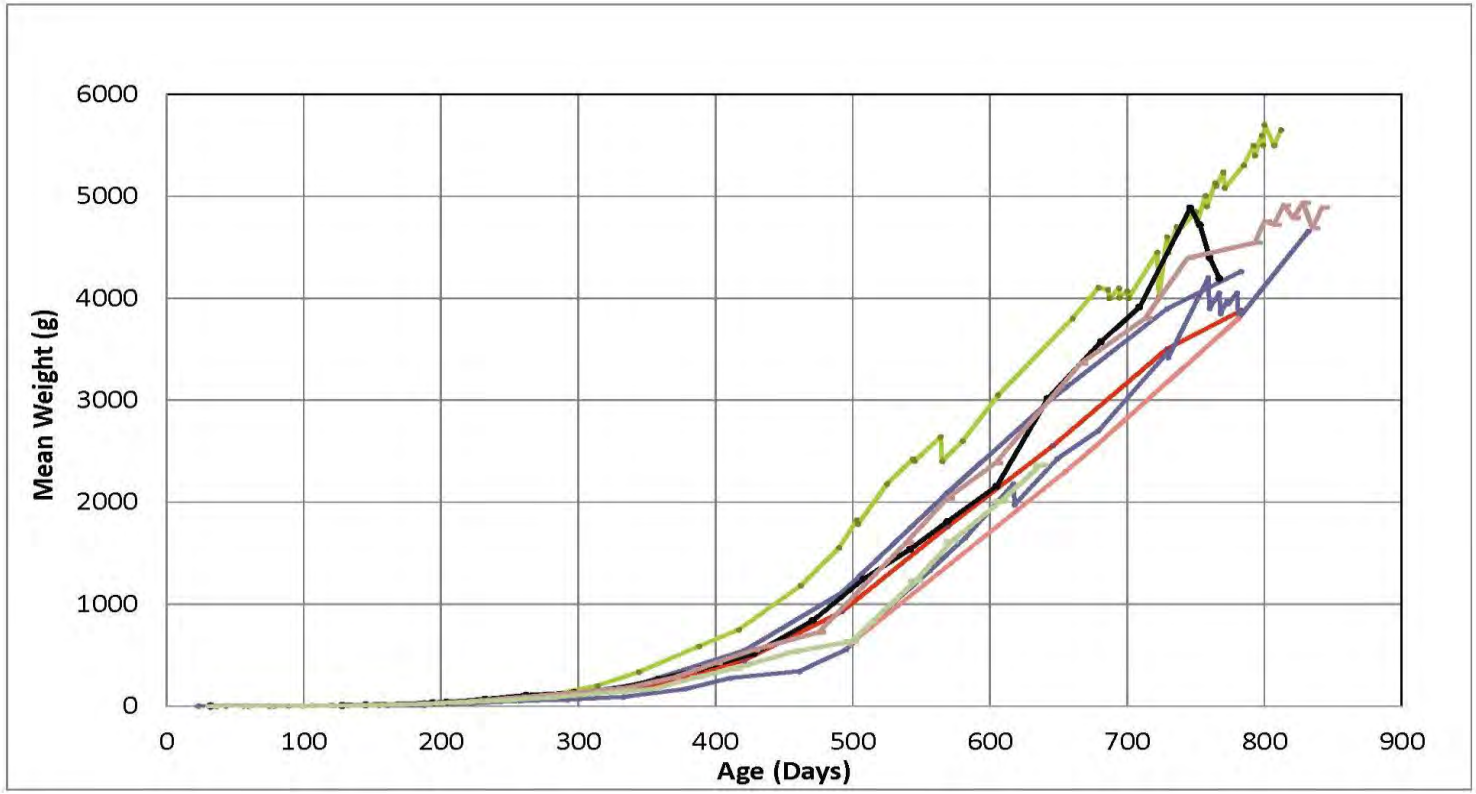
Source: Norway Directorate of Fisheries via Anders Gjendemsjø, Deloitte AS, commissioned by Akva Group

Growth

Freshwater Institute growout trials 1-8



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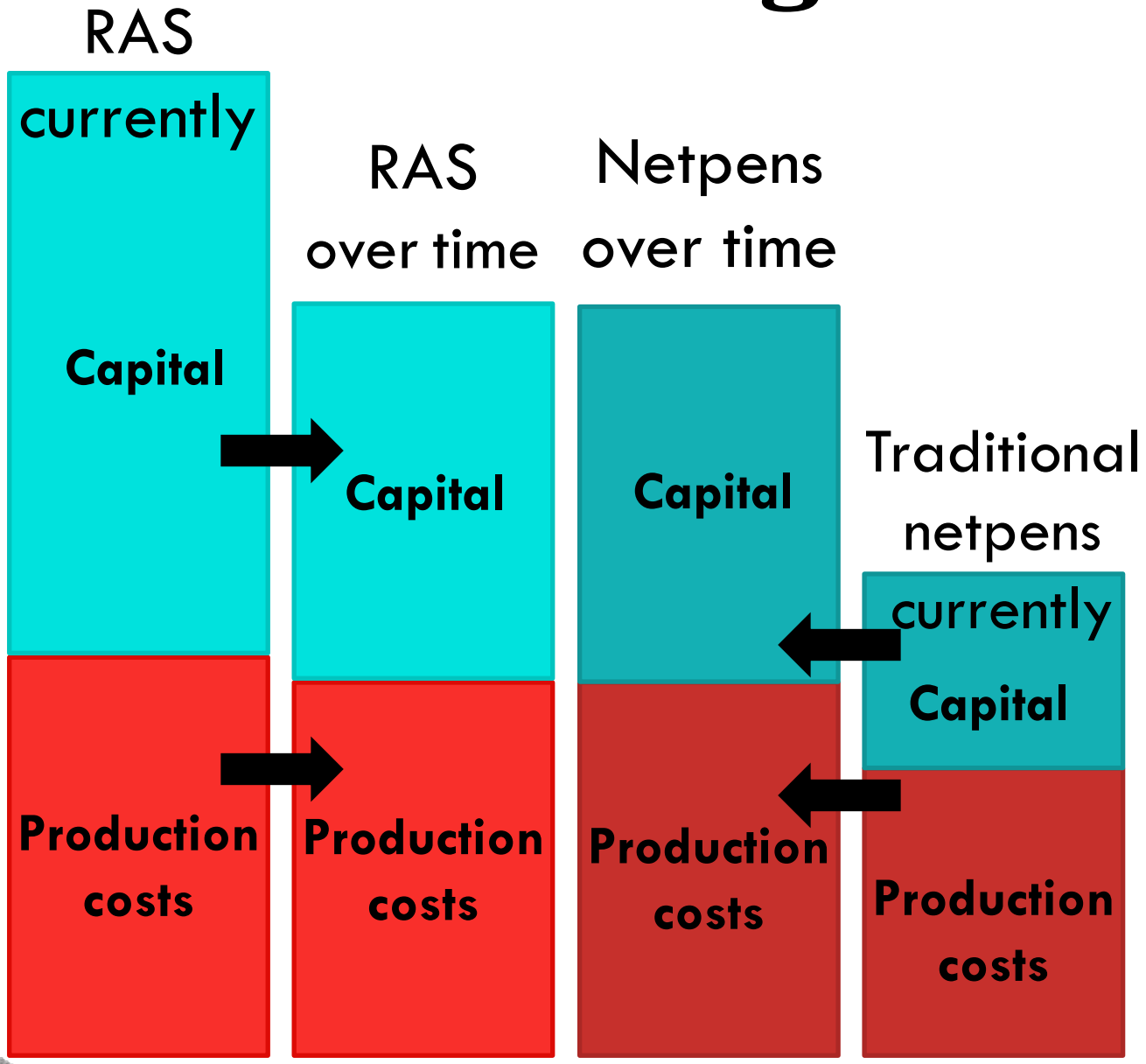
Leads to convergence



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THE VALUE PROPOSITION FOR LAND-BASED RAS AQUACULTURE

RAS is the future of the Aquaculture Industry despite being more **capital intensive** than traditional approaches. RAS has major advantages such as **lower water** and **area requirements**, **year-round production**, **temperature control** and **mitigation of environmental effects**. RAS is **species adaptable**, allowing operators to **follow market trends** for seafood preference. RAS is also a **"point"** pollution source, enabling efficient solids waste treatment and nutrients removal, which allows **reducing the impact on the environment at a reasonable cost**.

- Youri Gendel, Ori Lahav, Technion - Israel

RAS

Thank you

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