Interreg

Co-funded by the European Union

South Baltic

aqua loop

ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

Bremerhaven | 25.02.2026

Björn Suckow

The Need for a of Resource-Efficient Circular Economy

For Today's Challenges & Tomorrow's Legacy

HELMHOLTZ

Foto: AWI / U. Nettelmann

Today’s Challenges

My main concern at AWI's Sustainable Marine Bioeconomy Department:

making tomorrow’s aquatic food supply more sustainable.

Foto: AWI / H. Müller-Elsner

Why?

We are living on planet, with limited supply of resources and an ever growing population.

Foto: AWI / H. Müller-Elsner


the
AWI
HELMHOLTZ

leading institute for marine, polar and climate research.

We are in the midst of a climate crisis!

We are in the midst of a climate crisis!

- The Earth is heating up at an unnaturally rapid rate.


Where are we now?

Where are we now?

By the end of 2025 the globe has warmed by about:

+1.4°C

above the pre-industrial level

This number is based on **three separate methods** that use C3S data and calculations following those illustrated in the WMO Global State of the Climate 2024

We all have experienced the effects of the climate crisis.

Climate crisis: Not in a far away land, but here at our doorsteps.

Bremerhaven – Dec. 23 – 500 m from today's location

Bremen – Dec. 23

Image: Fabian Hoffmann (left) / Björn Suckow (right)

GER vs DK at the Euro 24 in June in Dortmund.

DEUTSCHLAND VS. DÄNEMARK: DIE „WAHREN“ HIGHLIGHTS

Pictures: Frederico Gambarini / dpa (links) / NJOY, Facebook (rechts)

The year before the last Aquaculture Europe Conference in Valencia 2024.

Foto: EPA

Geopolitics in the Arctic.

Picture: Alfred-Wegener-Institut / Mario Hoppmann

HELMHOLTZ

Where are we now?

By the end of 2025 the globe has warmed by about:

+1.4°C

above the pre-industrial level

This number is based on **three separate methods** that use C3S data and calculations following those illustrated in the WMO Global State of the Climate 2024

Latest report by Intergovernmental Panel on Climate Change (from 2023):

Bild: Tim Reckmann (CC BY 2.0)

HELMHOLTZ

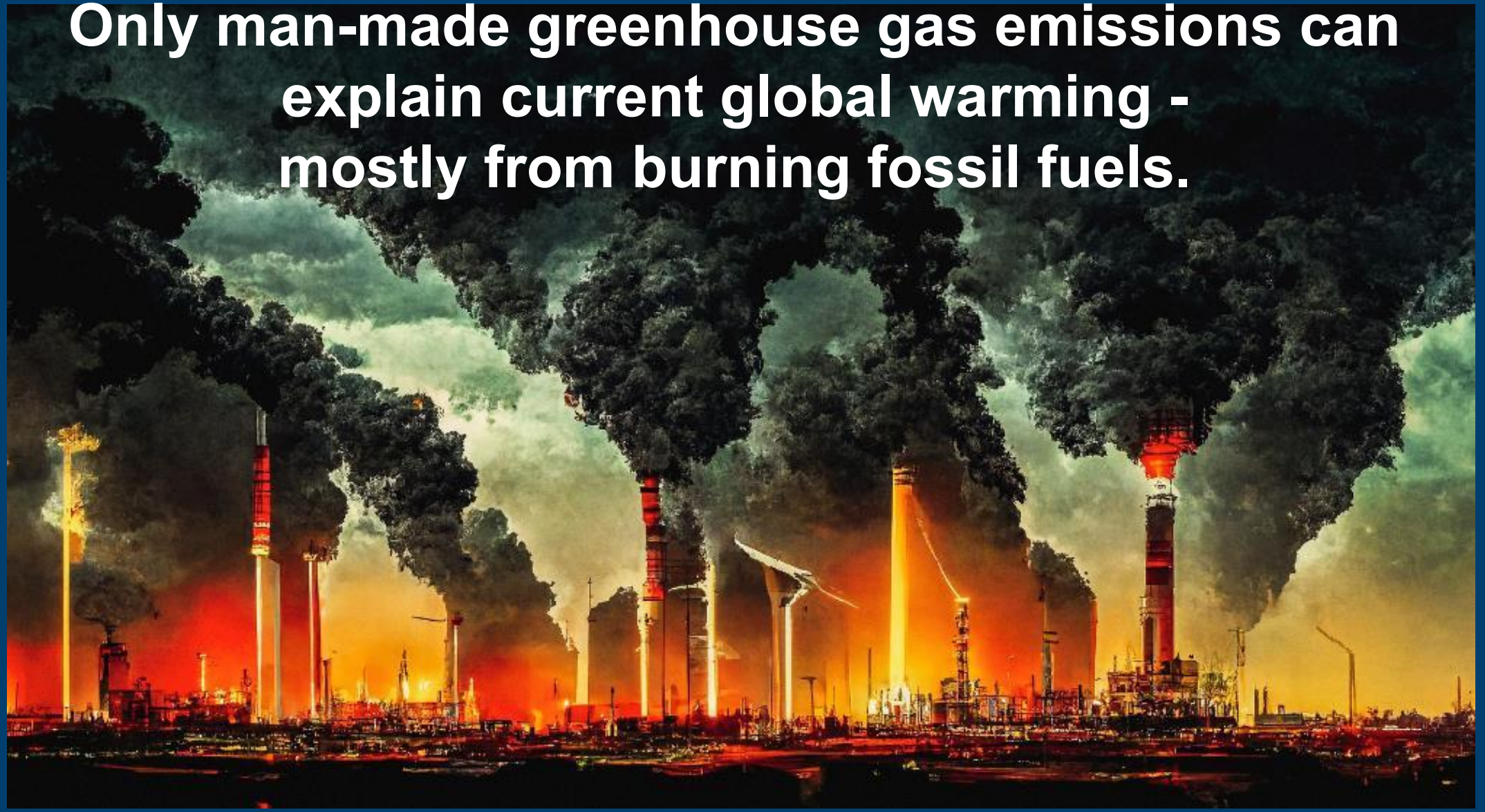


Image: AlanFrijns, AI generated. Free to use.

But the food system makes up for

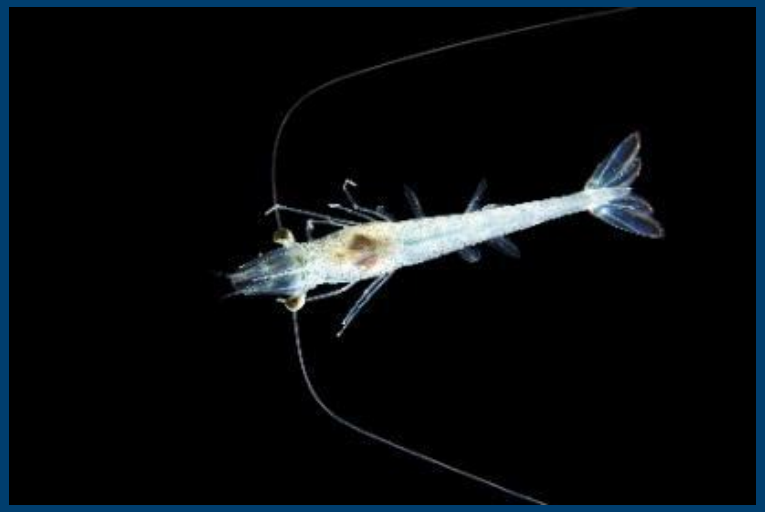
23% to 42%

of anthropogenic global greenhouse gas emissions.

(includes: CO2, CH4, N2O, fluorinated gases)

(according to 6th assessment report the Intergovernmental Panel on Climate Change (IPCC)

→ Climate change mitigation and our nutrition are linked.



Our food system is comprised of four pillars.

23% to 42%

of anthropogenic global greenhouse gas emissions."

(includes: CO_2, CH_4, N_2O, fluorinated gases)

Pictures by Unsplash: Johny Goerend

HELMHOLTZ

Our food system is comprised of four pillars.

23% to 42%

of anthropogenic global greenhouse gas emissions."

(includes: CO2, CH4, N2O, fluorinated gases)

Pictures by Unsplash: Johny Goerend Shannon Murison

HELMHOLTZ

Our food system is comprised of four pillars.

23% to 42%

of anthropogenic global greenhouse gas emissions."

(includes: CO2, CH4, N2O, fluorinated gases)

Pictures by Unsplash: Johny Goerend Shannon Murison Mika Baumeister

Our food system is comprised of four pillars.

23% to 42%

of anthropogenic global greenhouse gas emissions."

(includes: CO2, CH4, N2O, fluorinated gases)

Pictures by Unsplash: Johny Goerend Shannon Murison Mika Baumeister Mike Gattorna

HELMHOLTZ

The most important factors for emissions are:

Land use

Production

~70% of greenhouse gas emissions

Supply chain

Post-trade

Pictures by Unsplash: Johny Goerend (upper) / Shannon Murison (lower)

The most important factors for emissions are:

Land use

Production

~70% of greenhouse gas emissions

Supply chain

Post-trade

Here, seafood offers ADVANTAGES over agricultural products!

Pictures by Unsplash: Johny Goerend (upper) / Shannon Murison (lower)

Why is that?

Marine animals (that we eat) = no energy required for temperature regulation

Marine animals (that we eat) = no energy required for temperature regulation

Hardly any energy required for an "upright" posture

Why is that?

Marine animals (that we eat) = no energy required for temperature regulation

Hardly any energy required for an "upright" posture

→ More efficient feed conversion than land animals

1 – Smil, V. (2000). Feeding the World: A Challenge for the Twenty-First Century. Cambridge, Massachusets, USA: MIT Press. // 2 - Smil, V. (2002). Nitrogen and food production: Proteins for human diets. AMBIO: A Journal of the Human Environment, 31(2), pp. 126-131. // 3 - Cowey, C., Mackie, A., & Bell, J. (1985). Nutrition and Feeding Fish. Academic Press London.

Lower freshwater demand

Lower freshwater demand

Less land-use

This is also evident when comparing animal products from agriculture with seafood.

Emissions from animal products: gCO_2 Equivalents per g Protein

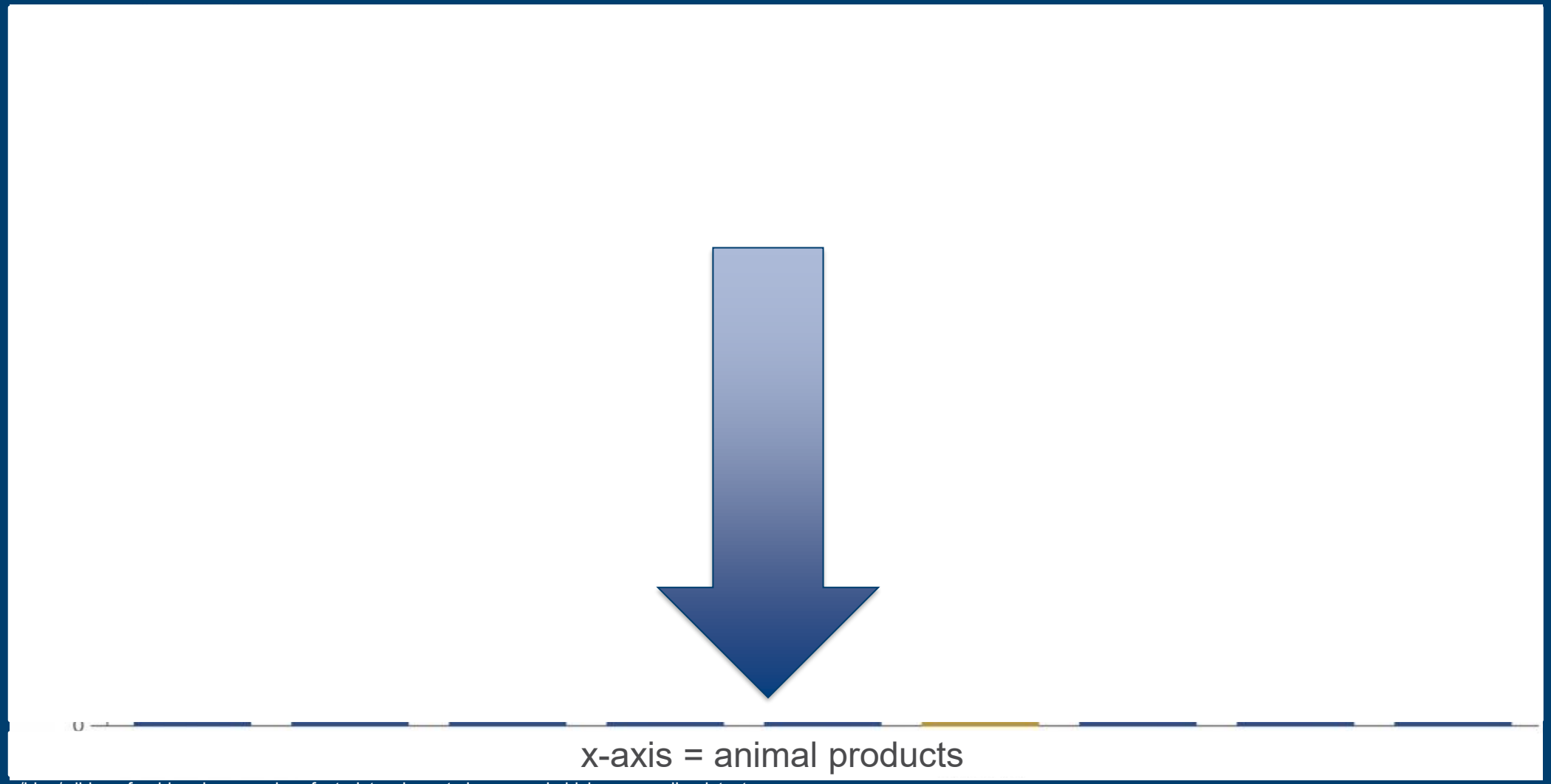


Bild: https://oceana.org/blog/wild-seafood-has-lower-carbon-footprint-red-meat-cheese-and-chicken-according-latest-data?ea.tracking.id=Twitter&utm_campaign=Engage&utm_content=20210916TWBlueFoodBlog&utm_source=Twitter&utm_medium=Social&utm_id=G51PZHMWFEsOmO

Emissions from animal products: gCO_2 Equivalents per g Protein

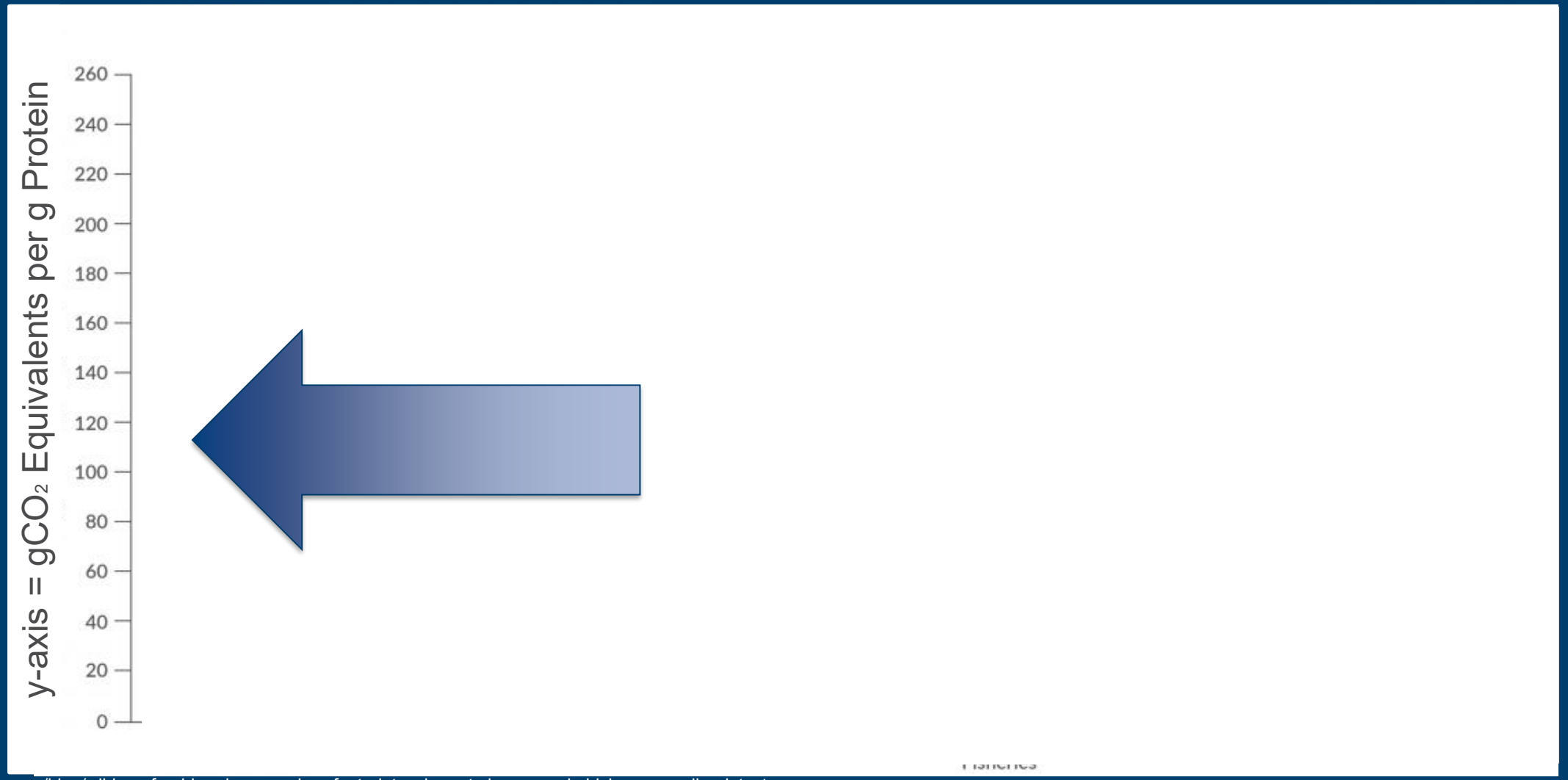


Bild: https://oceana.org/blog/wild-seafood-has-lower-carbon-footprint-red-meat-cheese-and-chicken-according-latest-data?ea.tracking.id=Twitter&utm_campaign=Engage&utm_content=20210916TWBlueFoodBlog&utm_source=Twitter&utm_medium=Social&utm_id=G51PZHMWFEsOmO

Emissions from animal products: gCO_2 Equivalents per g Protein

Bild: https://oceana.org/blog/wild-seafood-has-lower-carbon-footprint-red-meat-cheese-and-chicken-according-latest-data?ea.tracking.id=Twitter&utm_campaign=Engage&utm_content=20210916TWBlueFoodBlog&utm_source=Twitter&utm_medium=Social&utm_id=G51PZHMWFEsOmO

Emissions from animal products: gCO_2 Equivalents per g Protein

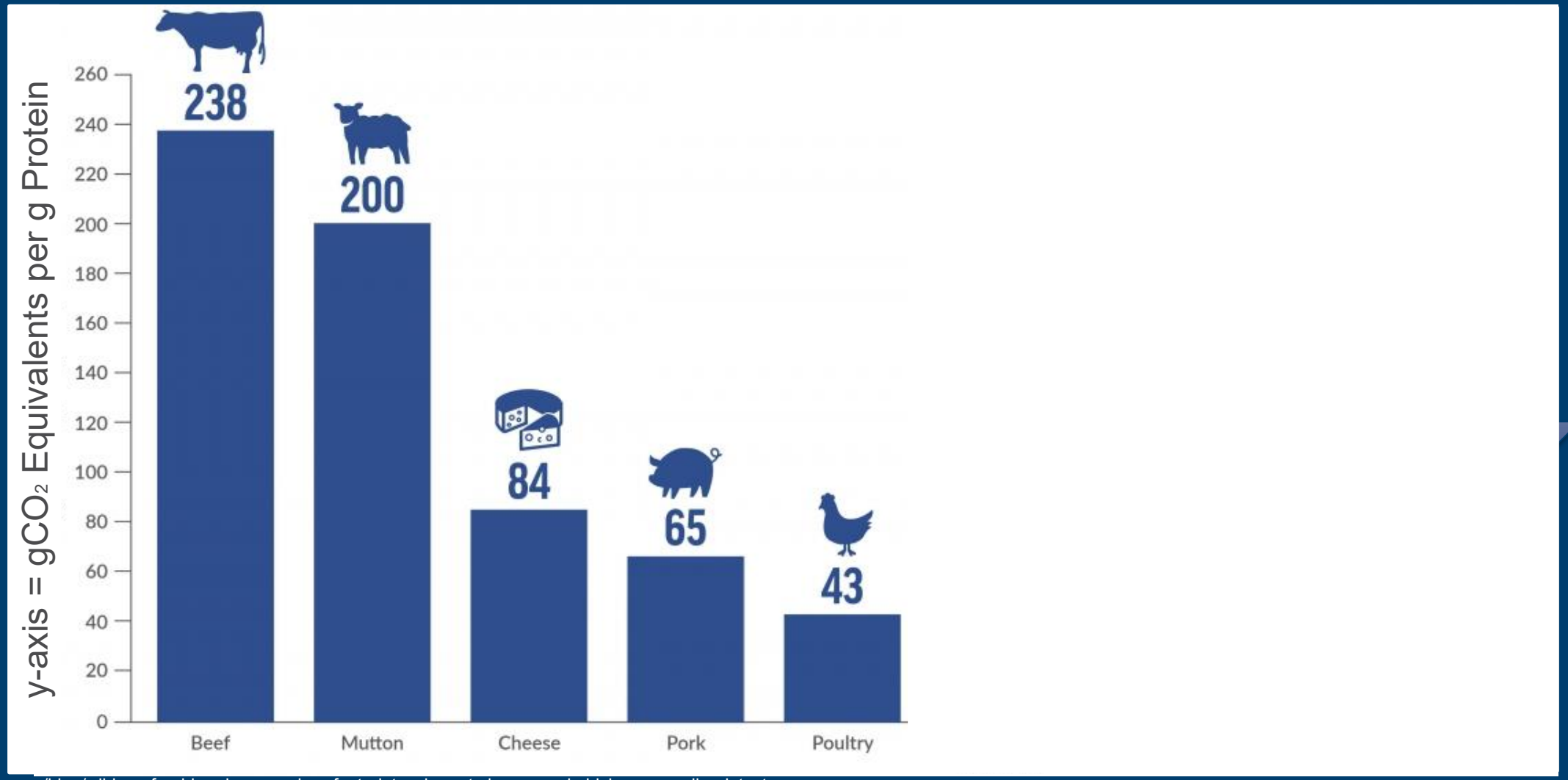


Bild: https://oceana.org/blog/wild-seafood-has-lower-carbon-footprint-red-meat-cheese-and-chicken-according-latest-data?ea.tracking.id=Twitter&utm_campaign=Engage&utm_content=20210916TWBlueFoodBlog&utm_source=Twitter&utm_medium=Social&utm_id=G51PZHMWFEsOmO

Emissions from animal products: gCO_2 Equivalents per g Protein

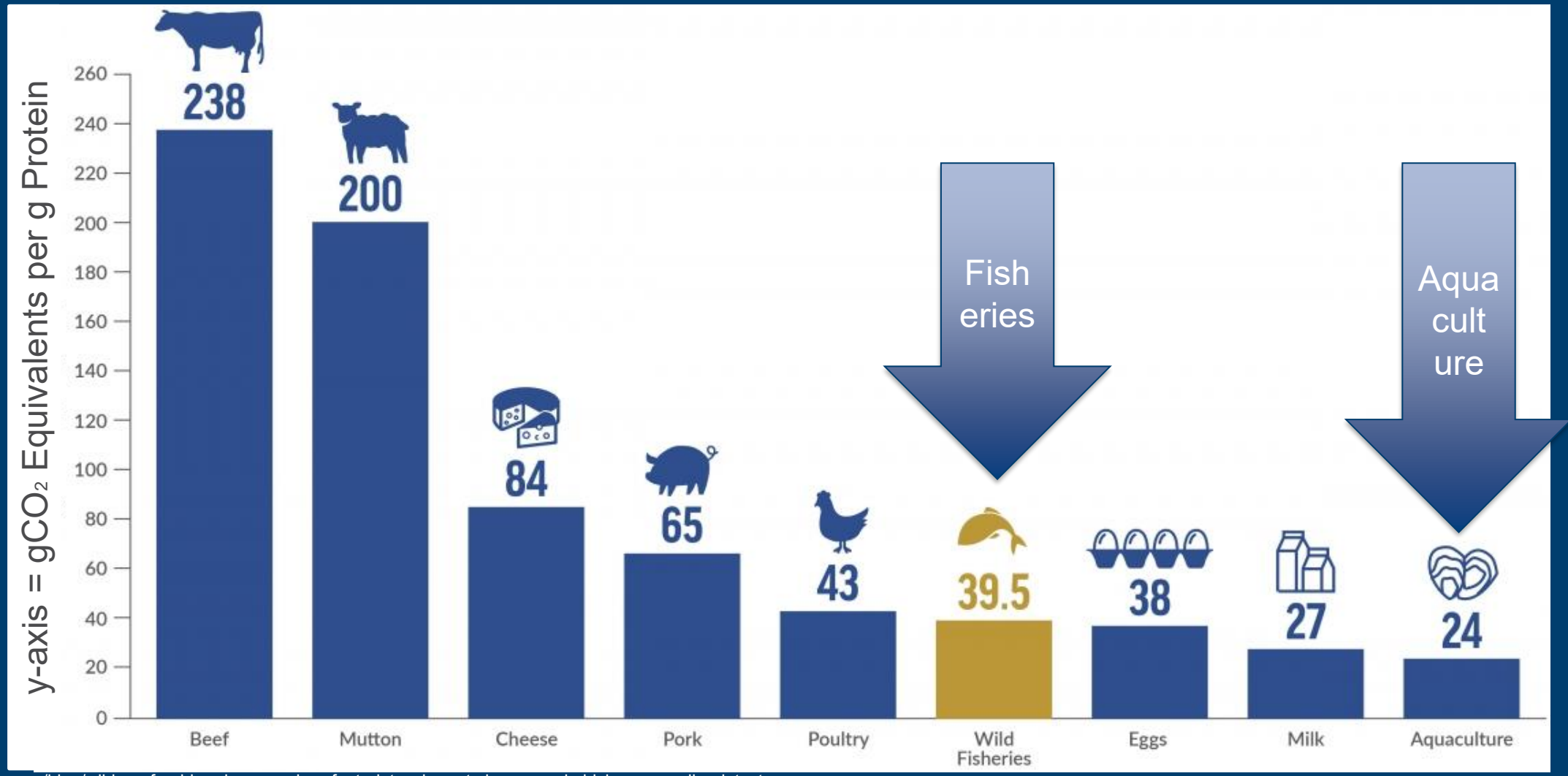
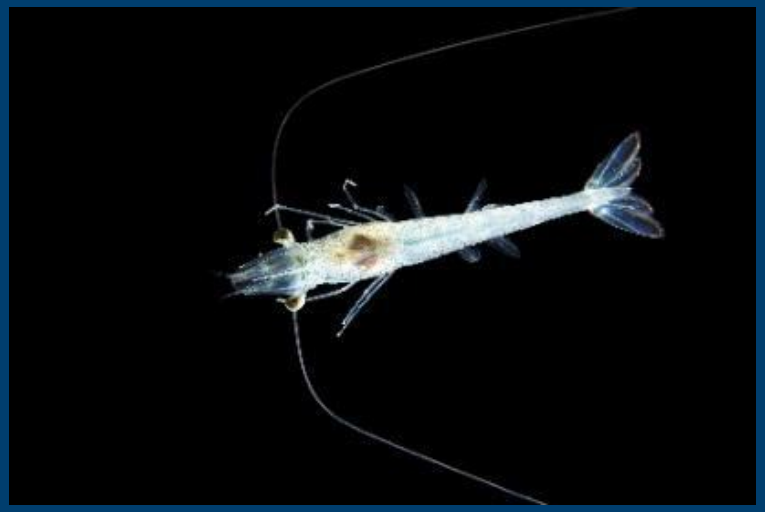


Bild: https://oceana.org/blog/wild-seafood-has-lower-carbon-footprint-red-meat-cheese-and-chicken-according-latest-data?ea.tracking.id=Twitter&utm_campaign=Engage&utm_content=20210916TWBlueFoodBlog&utm_source=Twitter&utm_medium=Social&utm_id=G51PZHMWFEsOmO

→ Seafood offers potential for sustainable diets



Sustainable expansion of aquaculture fully in line with current EU policy:

Sustainable expansion of aquaculture fully in line with current EU policy:

- **European Green Deal** currently the most influential incentive

Sustainable expansion of aquaculture fully in line with current EU policy:

- European **Green Deal**

- Its core = **"Farm to Fork" strategy**
  - wants to make food systems fair, healthy and environmentally friendly.

Picture: https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en

Sustainable expansion of aquaculture fully in line with current EU policy:

- European **Green Deal**

- Its core = **"Farm to Fork" strategy**
  - wants to make food systems fair, healthy and environmentally friendly.
  - explicitly states that "farmed fish and seafood have a lower carbon footprint than land-based animal production".

Picture: https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en

More policies that are in favor of sustainable aquaculture production

More policies that are in favor of sustainable aquaculture production

- **EU Bioeconomy Strategy** (potential of algae and mussels)

More policies that are in favor of sustainable aquaculture production

- **EU Bioeconomy Strategy** (potential of algae and mussels)
- **Circular Economy Action Plan**

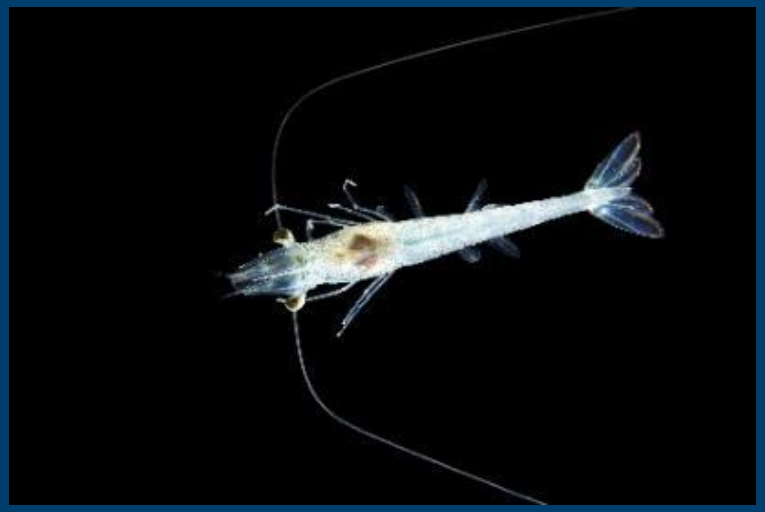
More policies that are in favor of sustainable aquaculture production

- **EU Bioeconomy Strategy** (potential of algae and mussels)
- **Circular Economy Action Plan**
- **Sustainable Blue Economy** (emphasises importance of responsible food systems, with a focus on sustainable AQ practices)

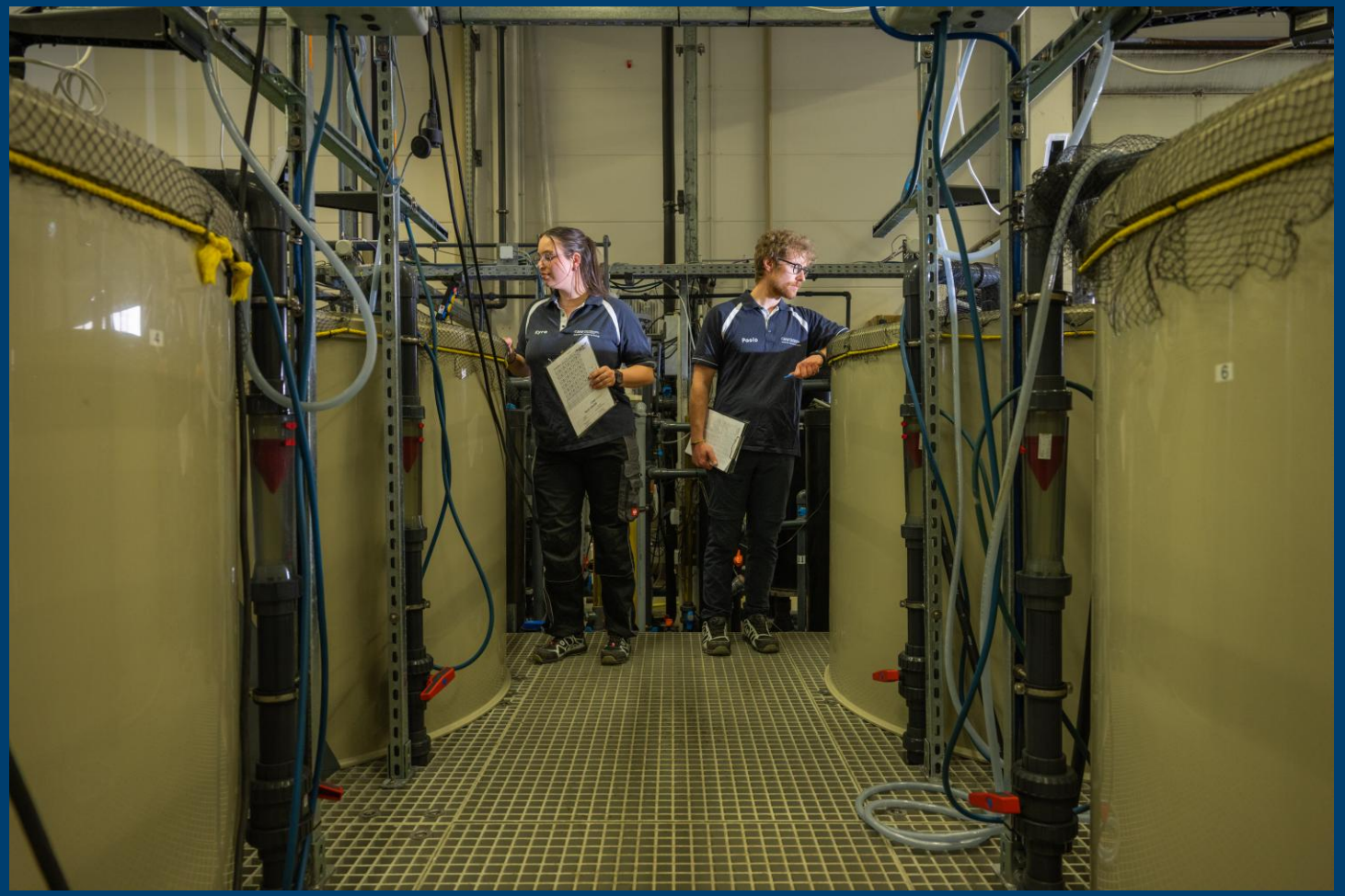
More policies that are in favor of sustainable aquaculture production

- **EU Bioeconomy Strategy** (potential of algae and mussels)
- **Circular Economy Action Plan**
- **Sustainable Blue Economy** (emphasises importance of responsible food systems, with a focus on sustainable AQ practices)
- and many more, including **SDG**s...

→ Seafood from AQ can be a response to various EU regulations



What do we need to take into account if we want to increase AQ production in a sustainable way here in Europe under a changing climate?



Picture: AWI / Esther Hovarth

We need to be wary of the impacts of climate change on AQ

We need to be wary of the impacts of climate change on AQ

- Changes in water temperature, pH, and oxygen levels can alter: growth, survival, and reproduction of cultured species

We need to be wary of the impacts of climate change on AQ

- Changes in water temperature, pH, and oxygen levels can alter: growth, survival, and reproduction of cultured species

→ leading to reduced productivity and increased vulnerability to disease & parasites.

We need to be wary of the impacts of climate change on AQ

- Changes in water temperature, pH, and oxygen levels can alter: growth, survival, and reproduction of cultured species

→ leading to reduced productivity and increased vulnerability to disease & parasites.

- Increased frequency of extreme weather events (hurricanes, floods & droughts), can damage or destroy AQ infrastructure, leading to significant economic losses.

Resources are limited! One key priority will be to:

Resources are limited! One key priority will be to:

Meet the demand for feed ingredients and decouple it from sources of food for human consumption.

Picture: AWI / Esther Hovarth

In both cases RAS production can offer a solution for a better tomorrow!

Picture: © Alfred-Wegener-Institute / Heiner Mueller-Elsner

Advantages of RAS production, e.g.

- Fully controlled and protected (e.g. against climate, parasites, …)

Picture: © Alfred-Wegener-Institute / Heiner Mueller-Elsner

Advantages of RAS production

- Fully controlled and protected (e.g. against climate, parasites, …)

- Potential for full circularity / zero waste

Picture: © Alfred-Wegener-Institute / Heiner Mueller-Elsner

Sustainable diets for fish and shrimp

Fricke et al. (2022)

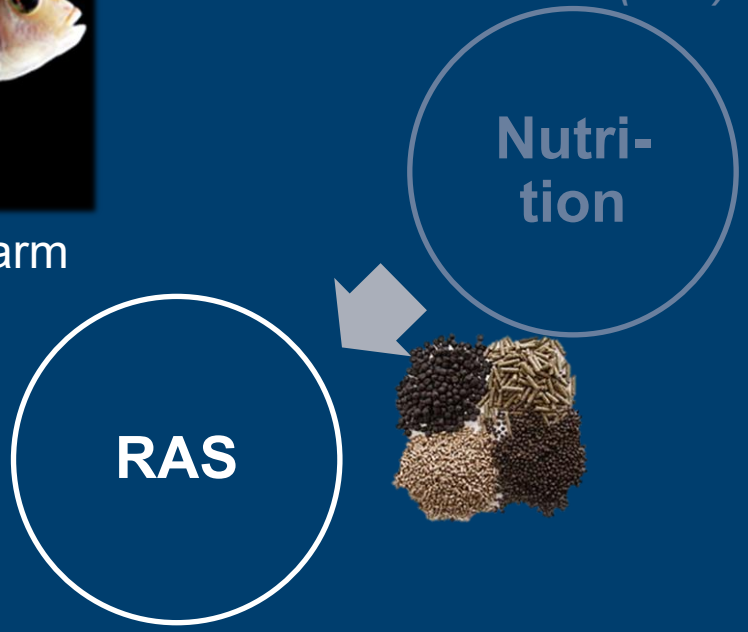
Nutri-tion

Optimal systems to farm fish and shrimp

Bögner et al. (2021)

Sustainable diets for fish and shrimp

Fricke et al. (2022)



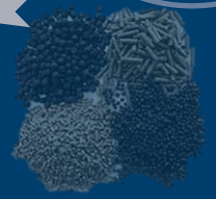
Optimal systems to farm fish and shrimp

Bögner et al. (2021)

Sustainable diets for fish and shrimp

Fricke et al. (2022)

Nutri-tion



RAS

Inverte-brates

Solid waste re-use / upcycling

Onomu et al. (2024)

HELMHOLTZ

Optimal systems to farm fish and shrimp

Bögner et al. (2021)

Sustainable diets for fish and shrimp

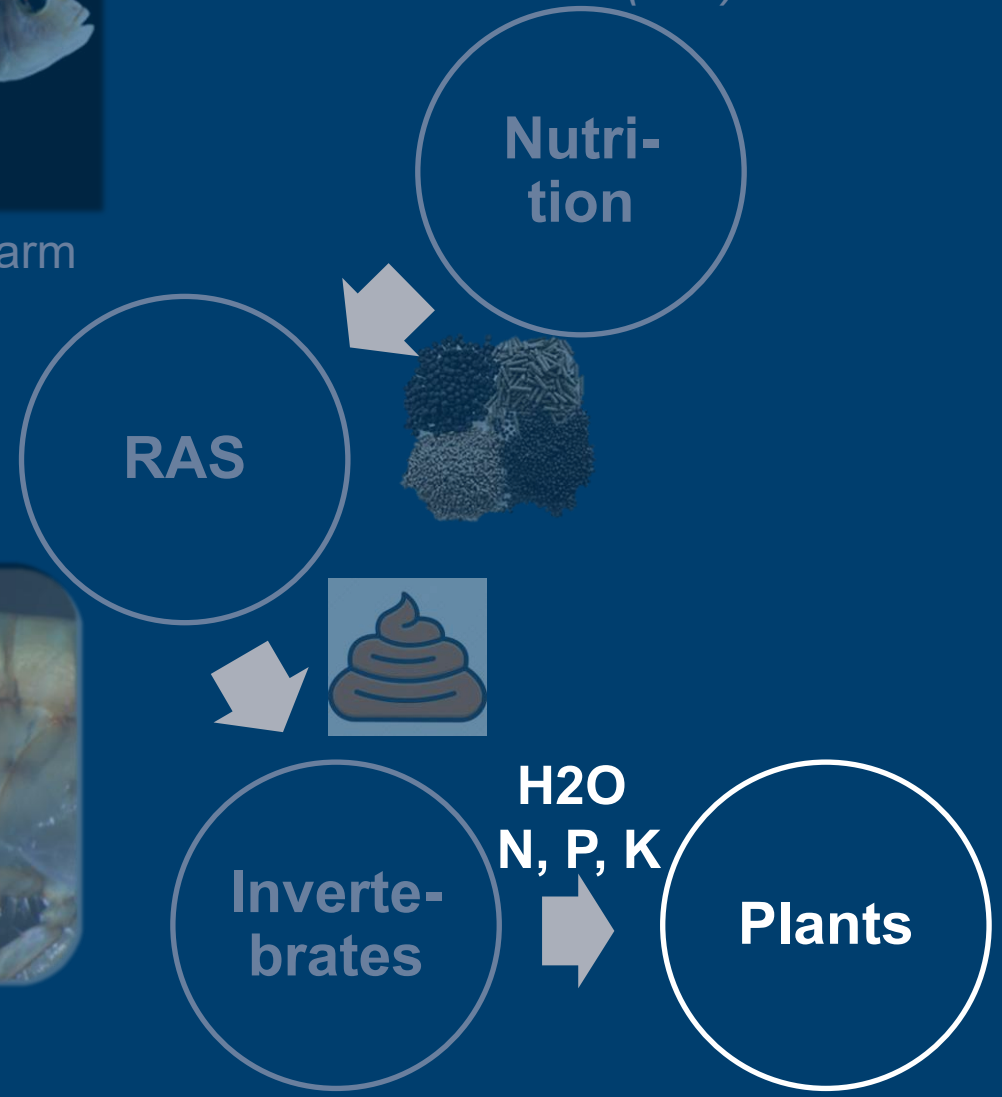
Fricke et al. (2022)

Solid waste re-use / upcycling

Onomu et al. (2024)

Dissolved waste re-use / upcycling

Beyer et al. (2023)



HELMHOLTZ

Optimal systems to farm fish and shrimp

Bögner et al. (2021)

Sustainable diets for fish and shrimp

Fricke et al. (2022)

Water filtration / desalination for re-use

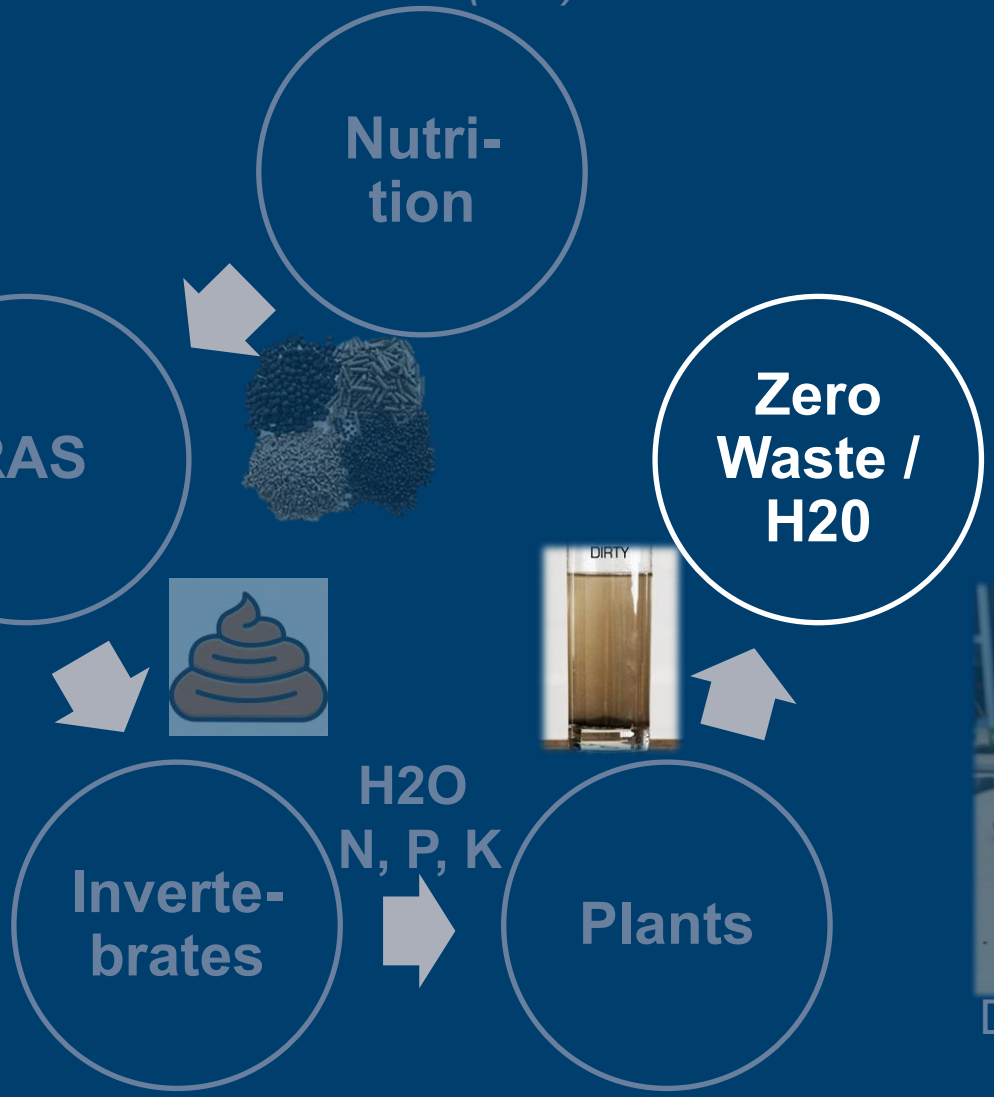
Ende et al. (2024)

Solid waste re-use / upcycling

Onomu et al. (2024)

Dissolved waste re-use / Upcycling

Beyer et al. (2023)



HELMHOLTZ

Sustainable diets
for fish and shrimp

Fricke et al. (2022)

Optimal systems to farm fish and shrimp

Bögner et al. (2021)

Water filtration / desali-nation for re-use

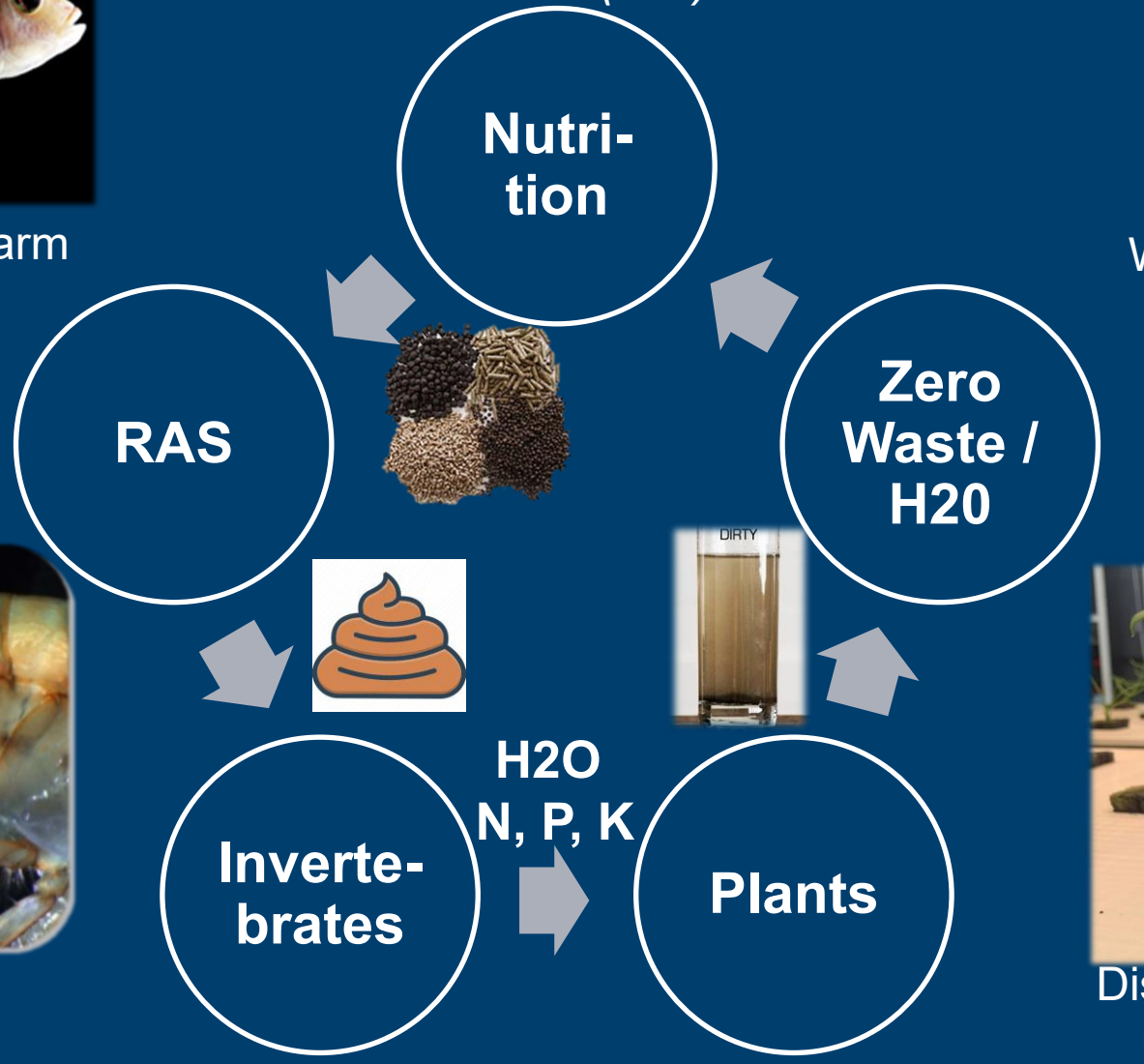
Ende et al. (2024)

Solid waste re-use / upcycling

Onomu et al. (2024)

Dissolved waste re-use / Upcycling

Beyer et al. (2023)



HELMHOLTZ

Interreg North Sea

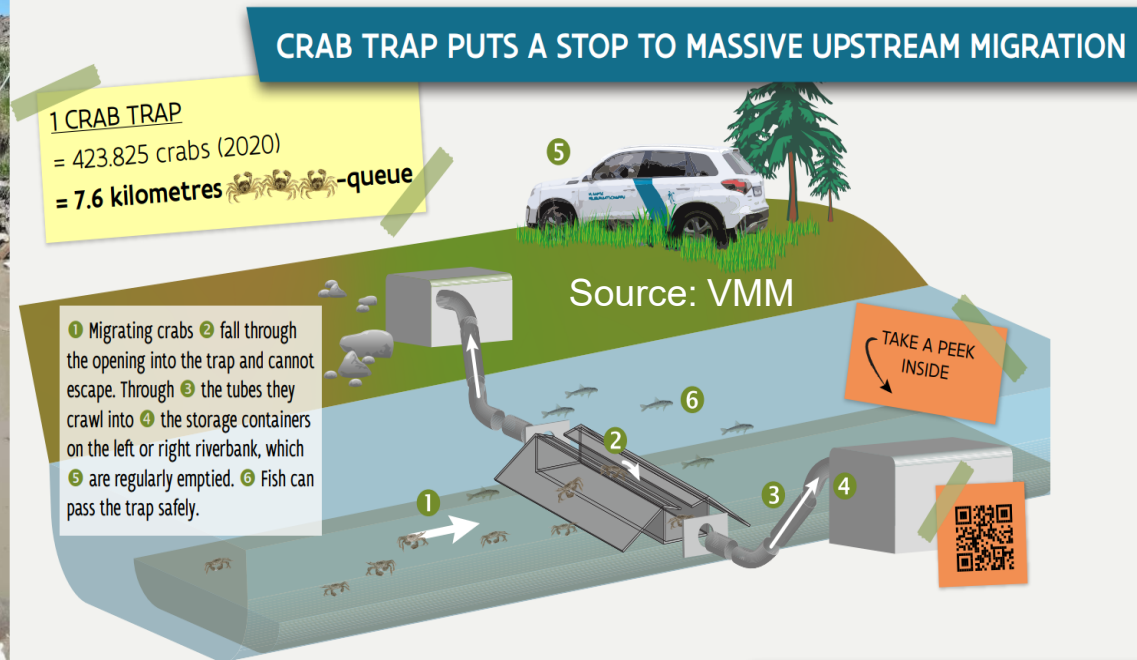
Co-funded by the European Union

- Testing trap concept for Chinese mitten crabsacross North Sea Region
- Utilisation of biomass in AQ feed

Source AWI / Esther Hovarth

Source: AWI / Björn Suckow

Source: VMM



→ AQ needs to apply resource-efficient circular economy principles to live up to its full potential

CONCLUSION

Picture by Irham Setyaki by Unsplash

CONCLUSION

- ✓ Climate change mitigation and our nutrition are linked.

Picture by Irham Setyaki by Unsplash

CONCLUSION

- ✓ Climate change mitigation and our nutrition are linked.
- ✓ Seafood offers potential for sustainable diets.

Picture by Irham Setyaki by Unsplash

CONCLUSION

- ✓ Climate change mitigation and our nutrition are linked.
- ✓ Seafood offers potential for sustainable diets.
- ✓ AQ can be a response to various EU regulations.

Picture by Irham Setyaki by Unsplash

CONCLUSION

- ✓ Climate change mitigation and our nutrition are linked.
- ✓ Seafood offers potential for sustainable diets.
- ✓ AQ can be a response to various EU regulations.
- ✓ To live up to its full potential AQ production needs to apply resource-efficient circular economy principles.

Picture by Irham Setyaki by Unsplash

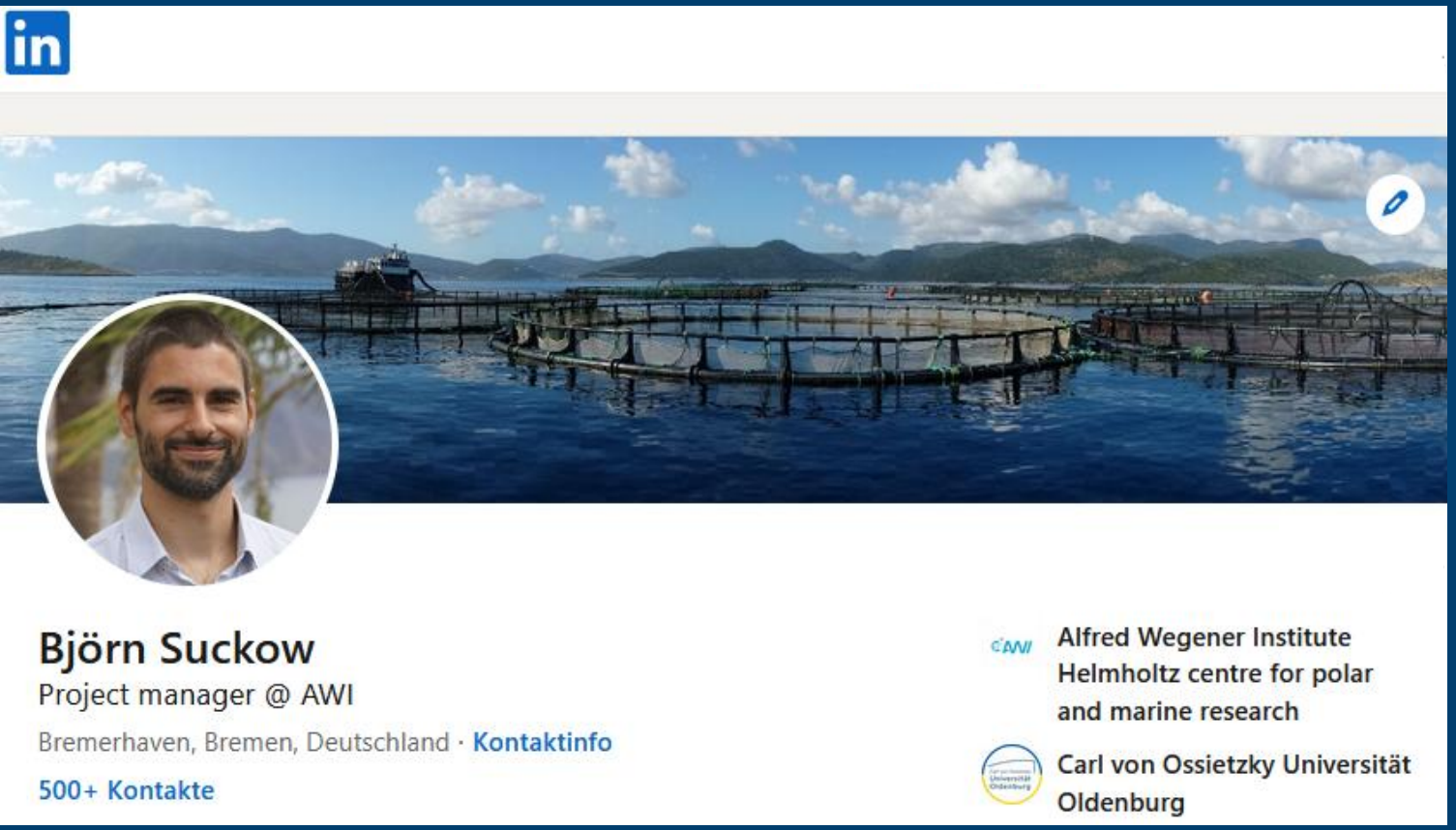
Interreg
South Baltic
Co-funded by the European Union
aqua loop
AWI

Let’s work on our legacy for a better tomorrow - together!

Image: truthseeker08 on pixabay

HELMHOLTZ

Thank you for your attention!



Bjoern.Suckow@awi.de

www.linkedin.com/in/bjoern-suckow