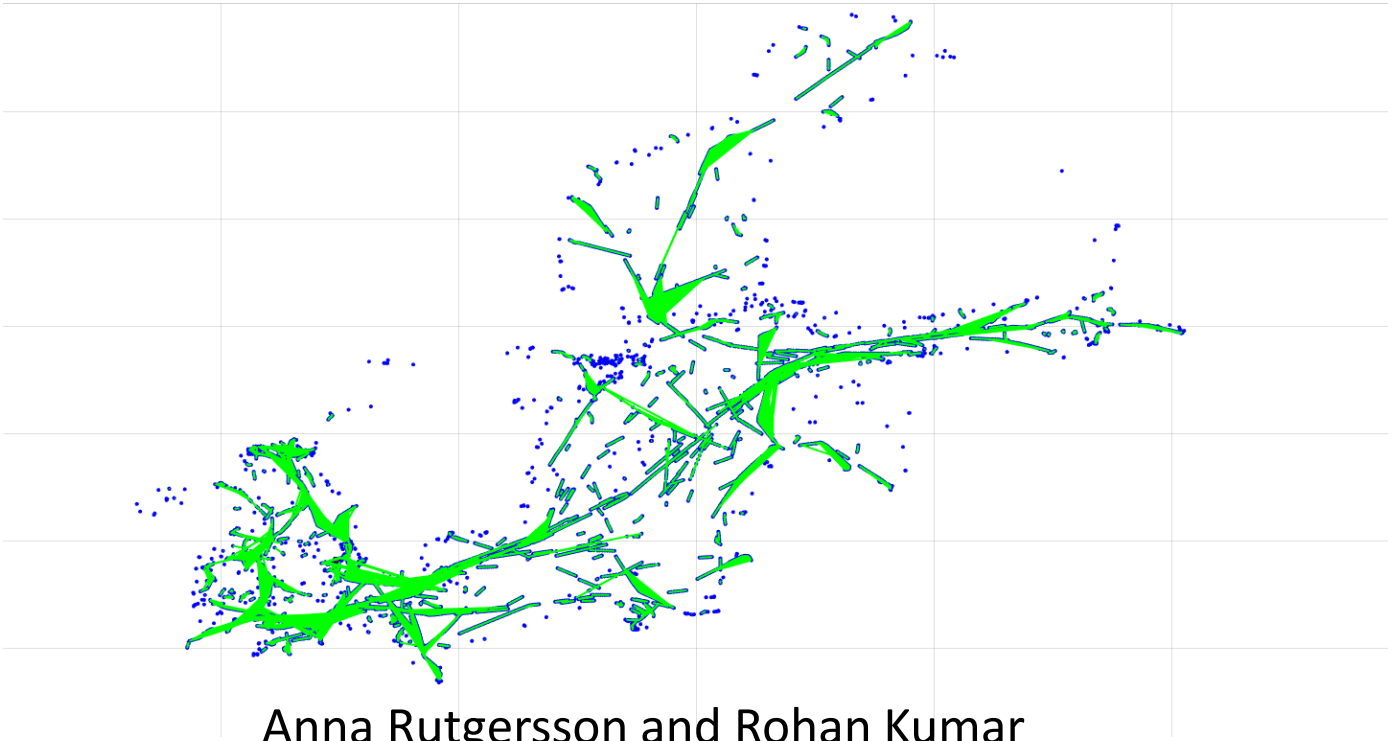
Assessing the Carbon Trade-off of Shipping Routes due to Offshore Wind Farm Development



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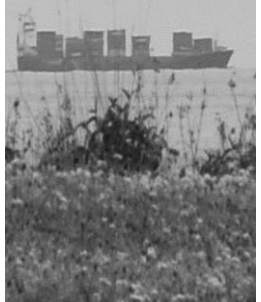
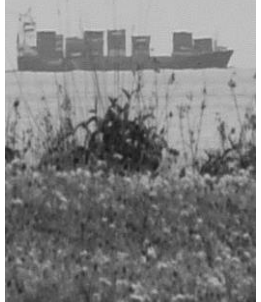


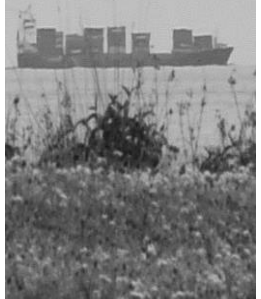
Background

- The IMO's revised GHG strategy commits global shipping to net-zero emissions by 2050, with key target for 2030 i.e. 50%.
- OWF can conflict with shipping, tourism, commercial fishing, and seabed resource exploitation (Virtanen et al., 2022).
- The United Nations Convention on the Law of the Sea (UNCLOS) does not confine shipping to predetermine routes.



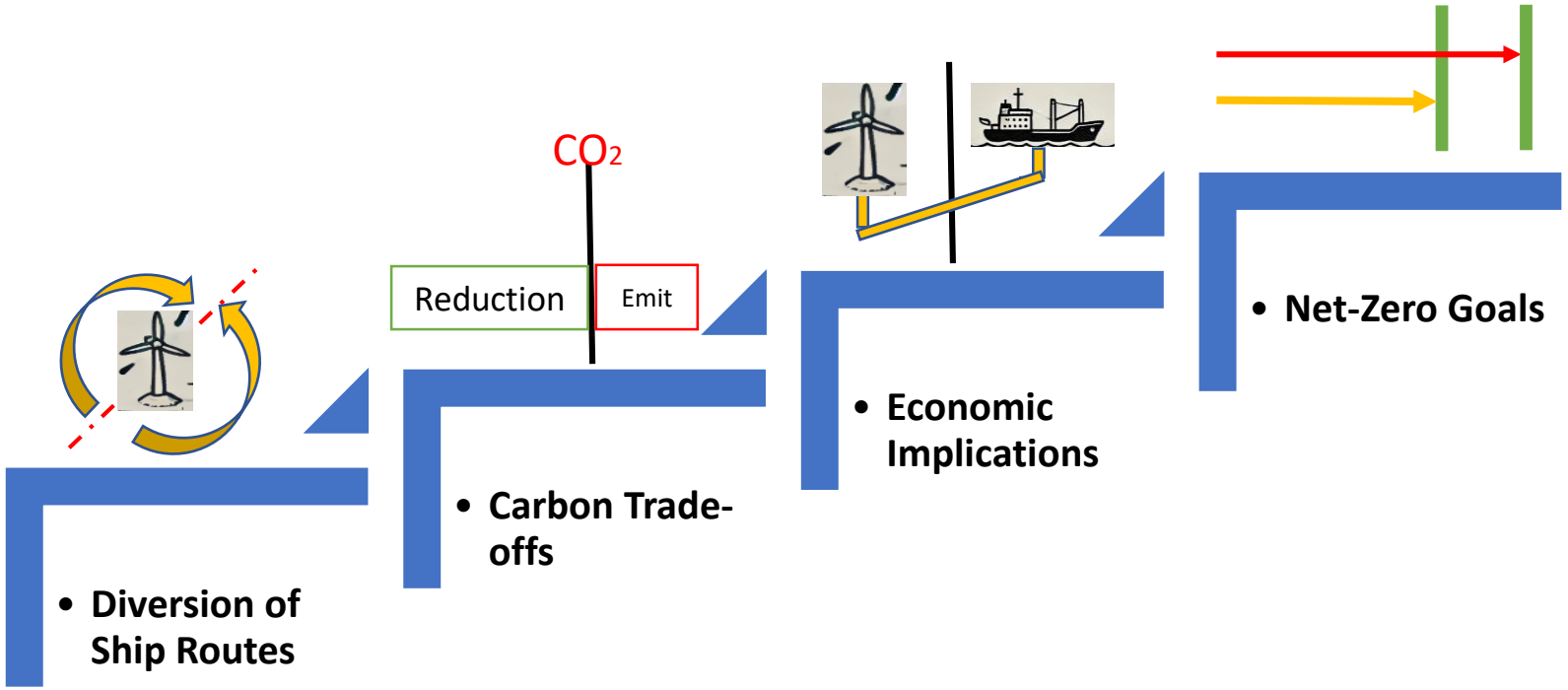
Background

- No clear standards for vessel dimensions for determining the appropriate separation distance for passing an OWF
- OWF installation could triples the collision risk compared to existing traffic flow(Son et al., 2024)
- Safe distance 6X the ship's length plus 500m: Permanent International Association of Navigation Congresses (PIANC, 2018)
- European MSP Platform (2018) recommends a minimum distance of 2 nautical miles (~ 3.7 km)



Focus

Carbon trade-offs from shipping route changes due to offshore wind farm and their impact on the maritime industry's net-zero goals.



Approach

Shiptype	Code
Passenger (Cruise) Ship	1
Passenger Ship	
Passenger/General Cargo Ship	
Passenger/Ro-Ro Cargo Ship	
Bitumen Tanker	2
Chemical Tanker	
Chemical/Oil Products Tanker	
CO2 Tanker	
Crude Oil Tanker	
Edible Oil Tanker	
LNG Tanker	
LPG Tanker	
Vegetable Oil Tanker	
Container Ship	3
Container/Ro-Ro Cargo Ship	
Deck Cargo Ship	4
General Cargo Ship	
Palletised Cargo Ship	
Refrigerated Cargo Ship	
Ro-Ro Cargo Ship	
Aggregates Carrier	5
Bulk Carrier	
Bulk/Oil Carrier	
Cement Carrier	
Heavy Load Carrier	
Landing Craft	
Limestone Carrier	
Livestock Carrier	
Ore/Oil Carrier	
Self Discharging Bulk Carrier	
Vehicles Carrier	
Vehicles Carrier	

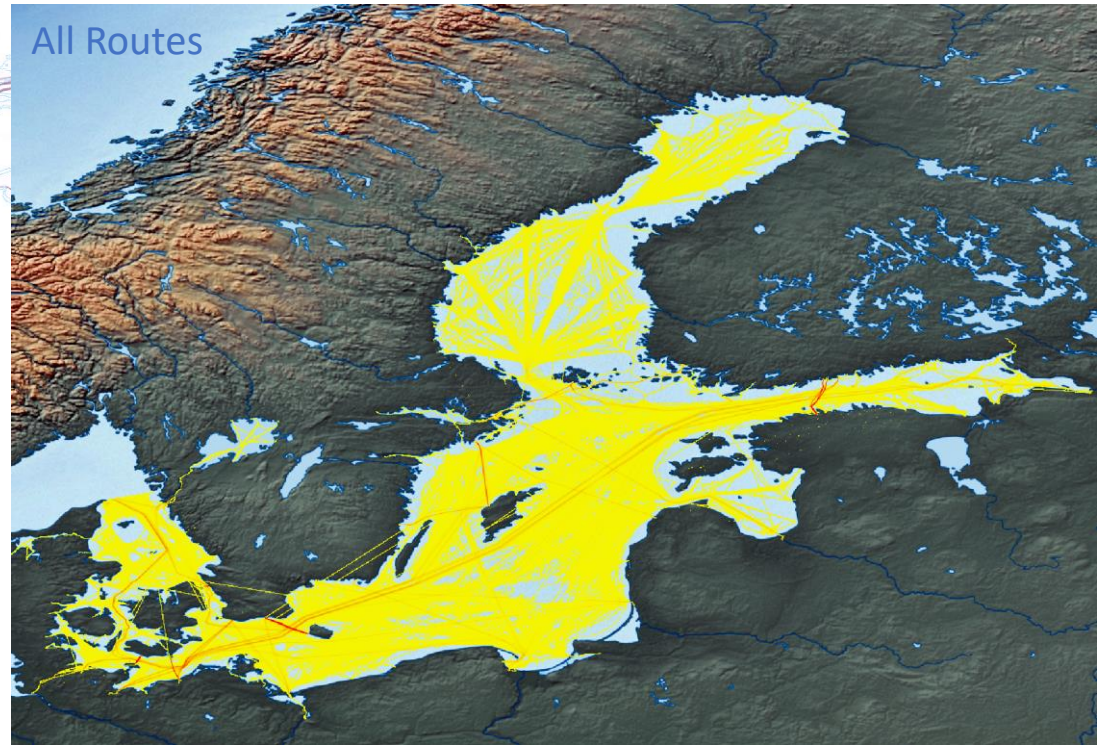
2019	Out of 8808	Percentage	Average Life Time (years)	Traffic Growth (%)
Passenger	804	9	27	1.5
Tanker	1617	18	26	1.5
Container	1476	17	25	3.5
Cargo	2581	29	26	1.5
Carrier	2330	26	27	1.5

Fuel Type	Number of Ships	Abatement
Distilled	7843	837 Scrubber(IMO)
Residual	44	
Not known	814	
LNG	103	na
LPG	2	na
Methanol	1	na
Nuclear	1	na
Hydrogen	0	na
Ammonia	0	na

Emissions									
GHGs		Particles				Reactive Gases			
CH4	CO2	SO4	EC(BC)	OC	ASH	SOX	NOx	CO	NMVOCs

Approach

Shipping Routes



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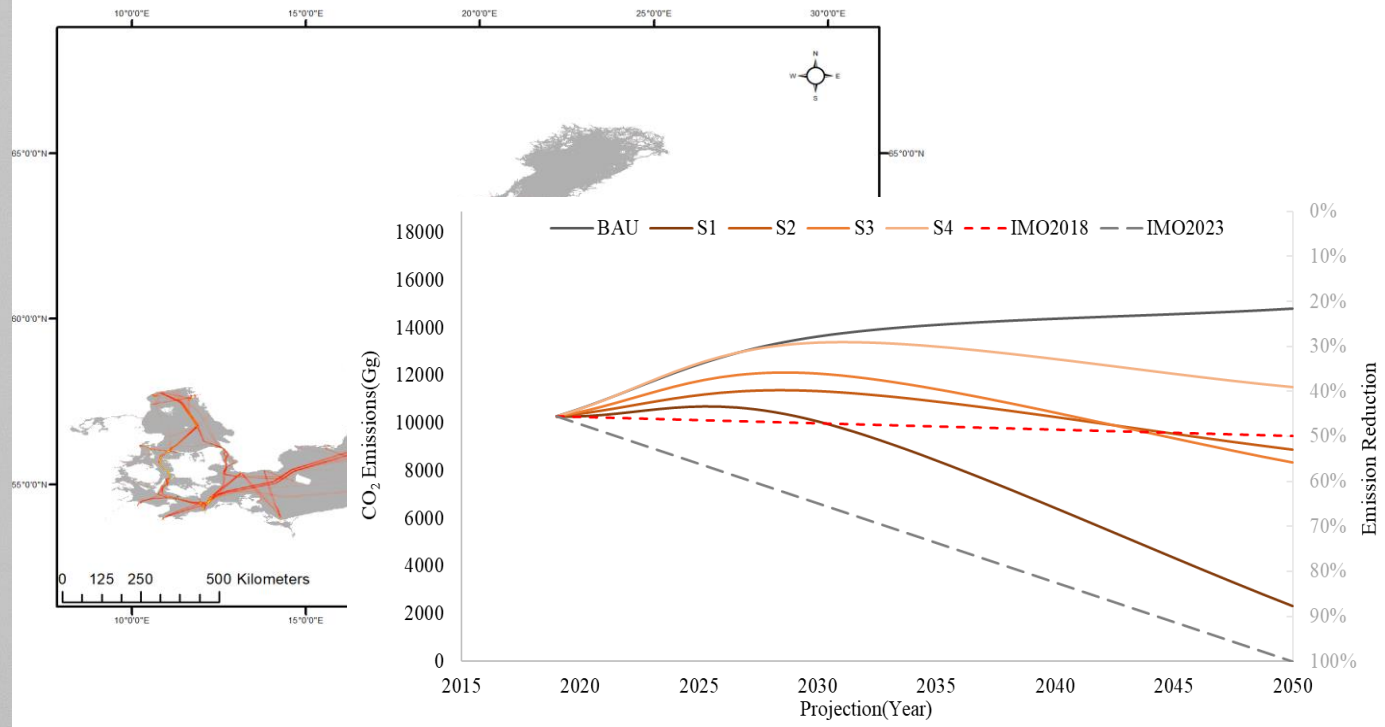


- ~10000(Gg) CO2 emission
- IMO ships 9850Gg and 150Gg non-IMO ships

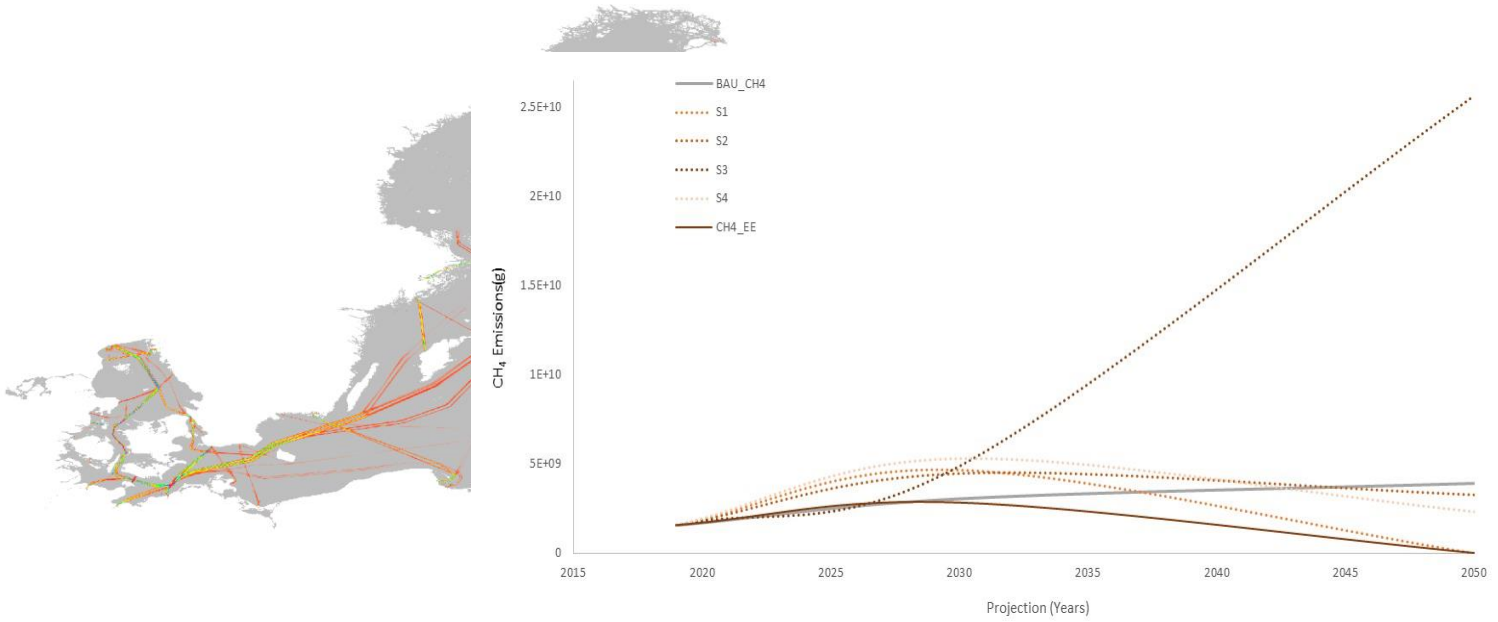
165,350,860 tree seedlings grown for 10 years

2,480,263

1,342,969 homes' energy use for one year

20,145

Approach

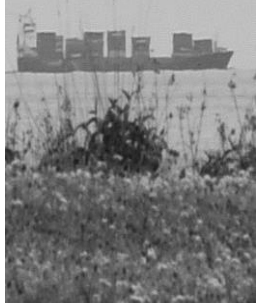


- LNG-ships could add 2.5Gg of CH4 or 70Gg of CO2 equivalent

1,157,456 tree seedlings grown for 10 years

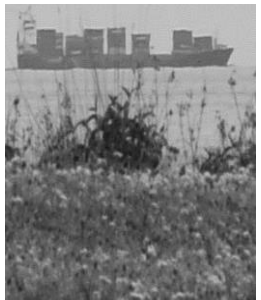
61,821 electric-powered passenger vehicles driven for one year

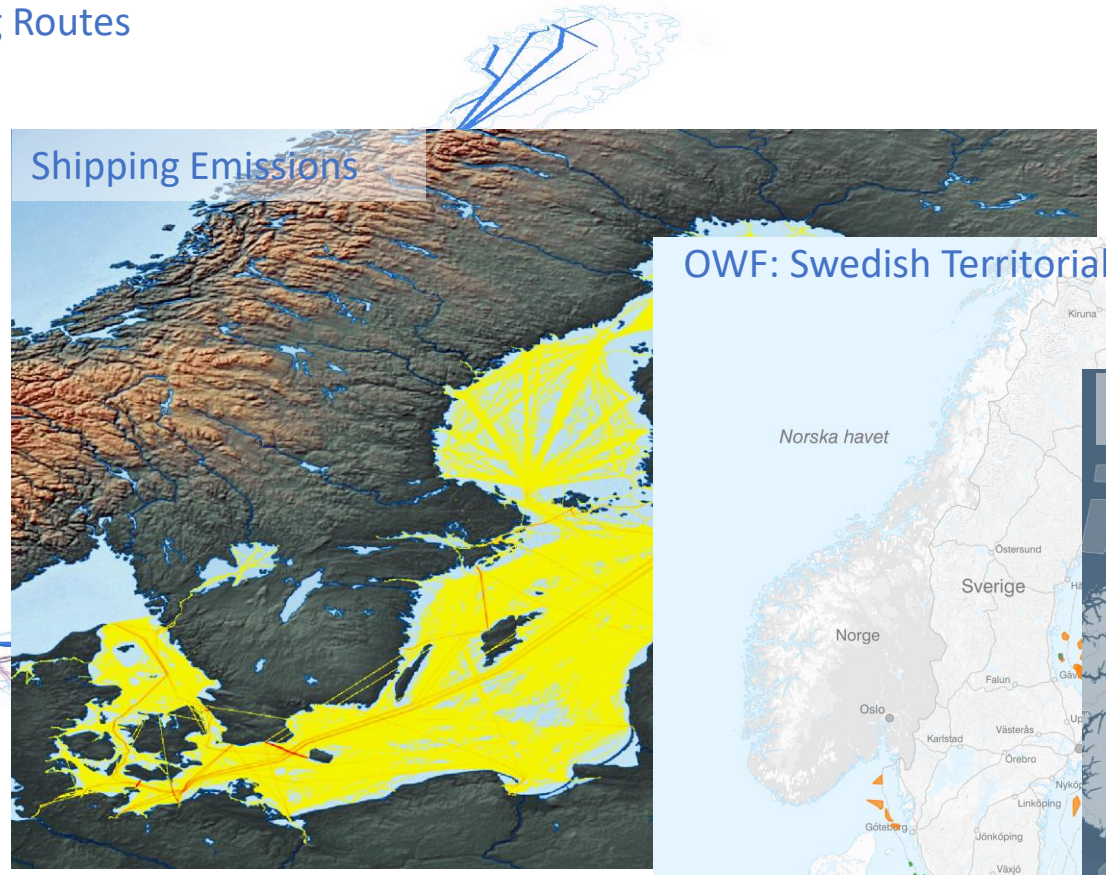
9,401 homes' energy use for one year

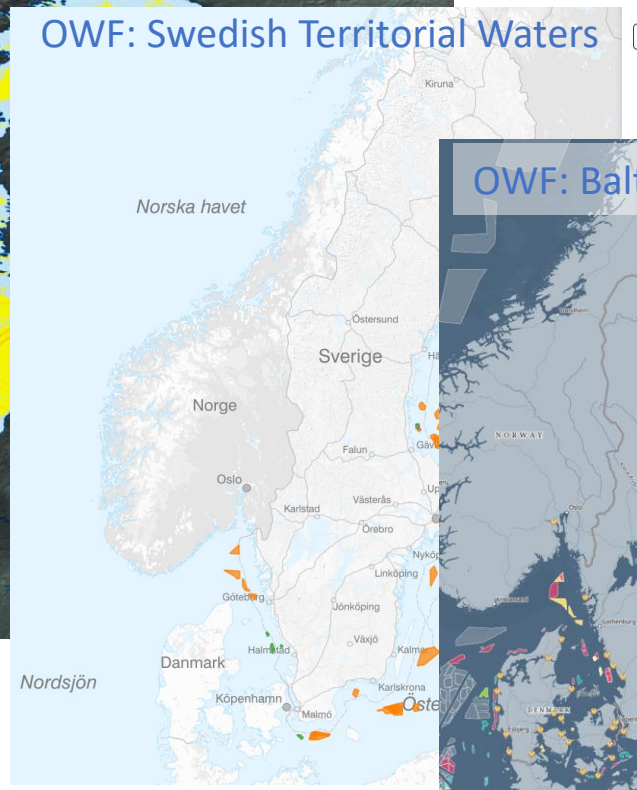


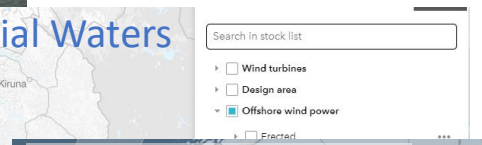
Approach

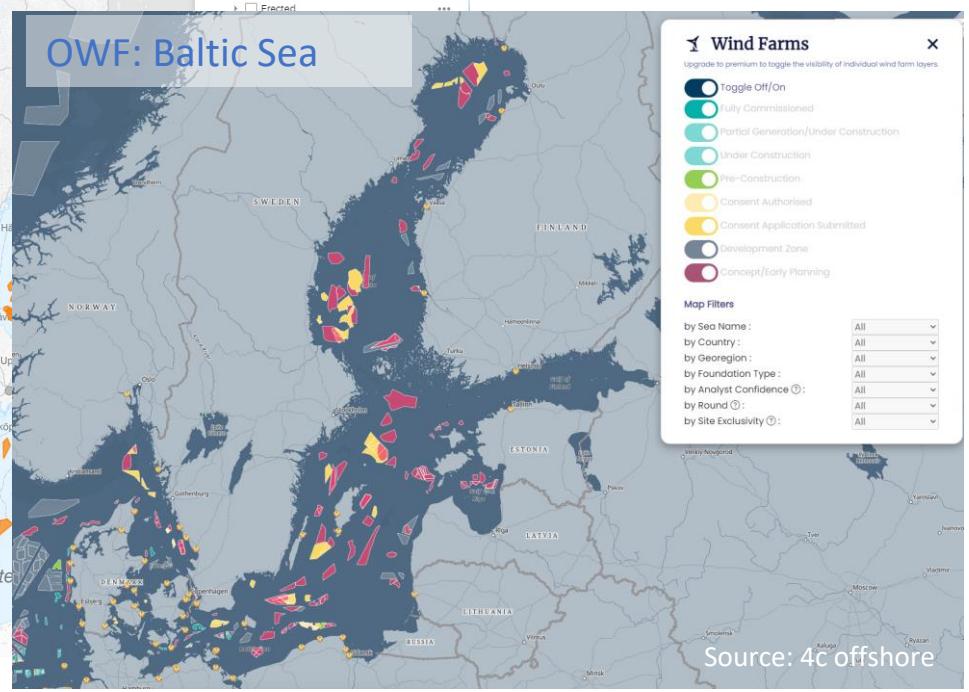
Existing Shipping Routes











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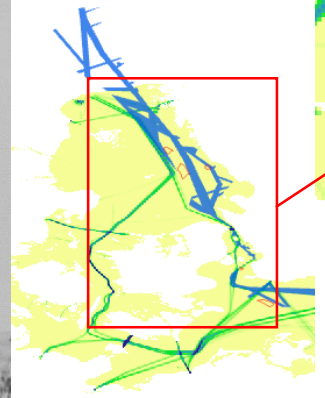
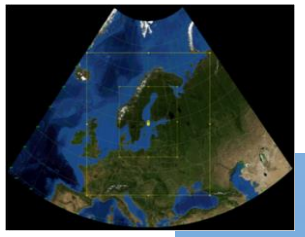


OWF: Expected energy and CO_2 equivalent reduction

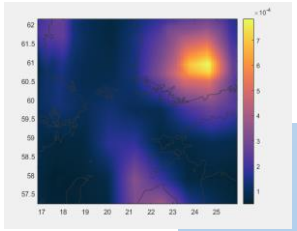
Shipping: Route deviation and CO_2 equivalent addition

Future



Inventory

- Estimation of gridded CO_2 emissions for different fuel types
- Assessing the possible CO_2 due to route deviation



Atmospheric Modelling

- Impact of CO_2 emissions
- Alternate fuels for long run and possible combination of HFOs and Alternate Fuels (Transition)

Scenarios

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Collaboration with:

Mistra C2B2 Co-Creating Better Blue

ShipTRASE

SAAC SWEDISH WIND CENTRE Research centre within wind power

Funded by:

TRAFIKVERKET