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Fuel oil use in the Arctic in 2016

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www.astd.is

The main goals:

- Provide reliable data for different analyses performed under the realm of the Arctic council and its working groups, including EPPR and AMAP
- Promote Arctic research and development by offering high quality data
- Three access levels, contributing Arctic council member government have full access. To complicated to go into the details,but separate a document regulate access and payment

https://www.youtube.com/watch?v=MLOwVcr4Jr0

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# Content of the demo – to analyze fuel use in the Arctic by using ASTD

- Numbers and percentages of vessels using different grades of fuel in the Polar Code area in 2016
- Fuel consumption of different grades of fuel oil
- Sailed distance with different grade of fuel oil
- Ship routes for each fuel type
- Comparisons to a high traffic Area (The North Sea area)
- Analyze change

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Methodology

- The calculations are done at the individual ship level

- Correct engine and KW and speed over ground is used in the calculations

- Correct fuel type is used, but where fuel type was unknown, it was filled in by looking at a sister ship or similar ships (RPM engine)

- Unique ships is aggregated to 13 ship types

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Every dot counts
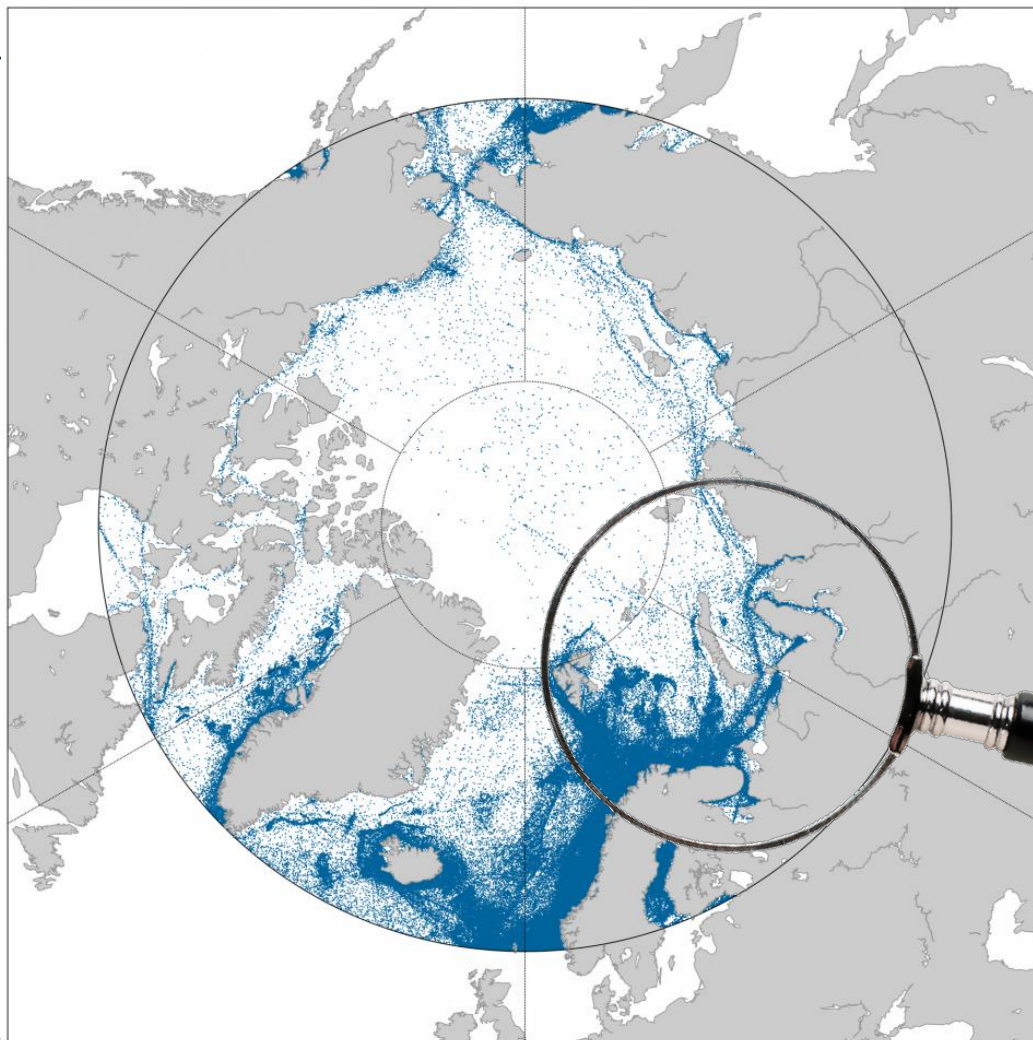
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Ship emission logarithm

$$E_{i,j} = \sum_{t=0}^{t=n} \left(\left(P_{ME_i} * \left(\frac{SOG_{i,t}}{V_{max_i}} \right)^3 * EF_{ME_{j,k,l,m}} + D_{AE_{p,i}} * EF_{AE_{j,k,l,m}} + D_{BO_{p,i}} * EF_{BO_{j,m}} \right) * 1\ hour \right)$$

Where:

i = ship

j = pollutant

t = time (operating hour, h)

k = engine type

l = engine tier

m = fuel type

p = phase

$E_{i,j}$ = emissions (g) for ship i and pollutant j

P_{ME_i} = main engine power (kW) for ship i

$SOG_{i,t}$ = speed over ground (knots) for ship i at time t

V_{MAX_i} = maximum speed (knots) for ship i

$EF_{ME_{j,k,l,m}}$ = main engine emission facor (g/kWh) for pollutant j, engine type k, engine tier l, and fuel type m
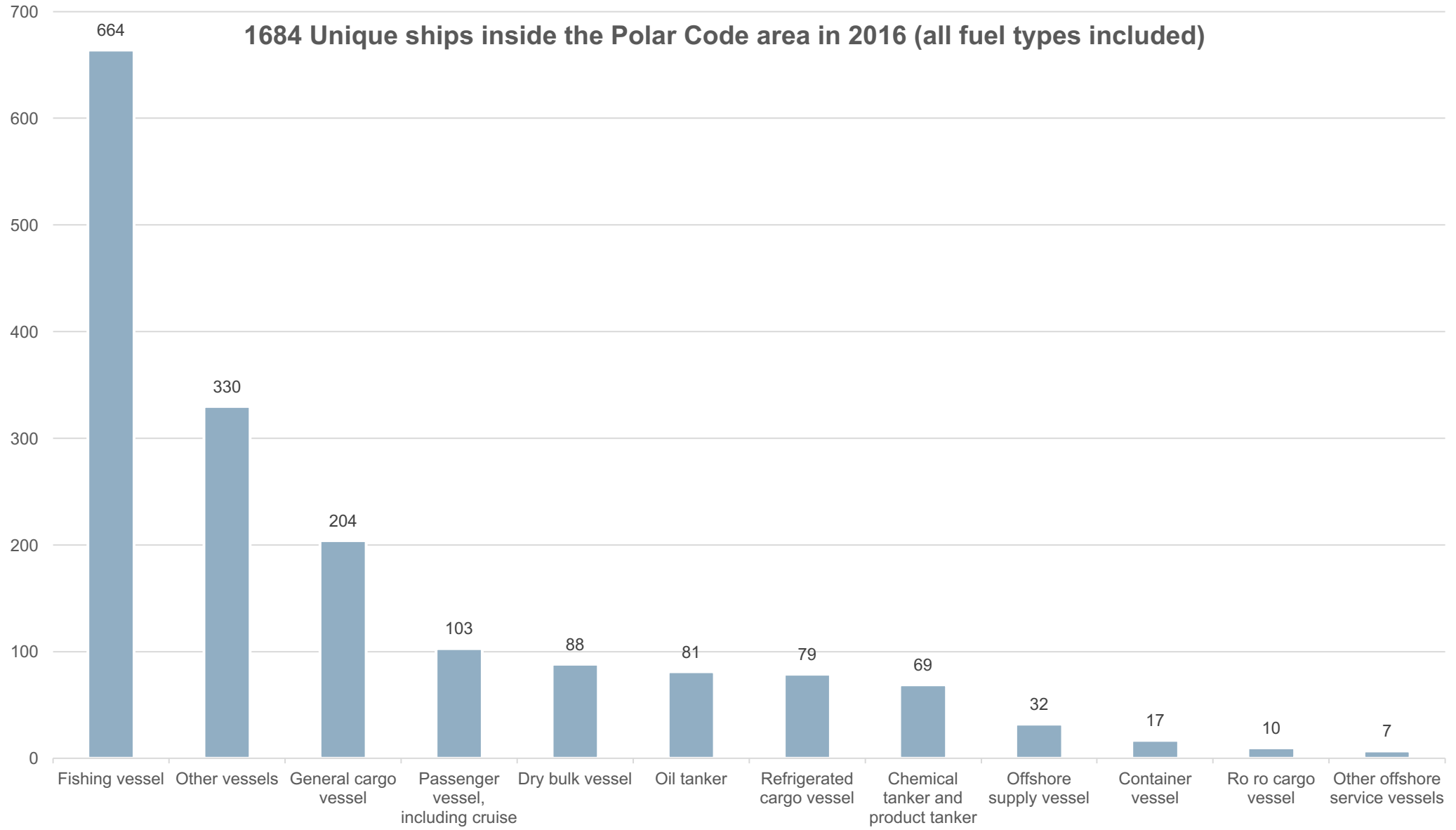
$D_{AE_{p,t}}$ = auxiliary engine power demand (kW) in phase p for ship i

$EF_{AE_{j,k,l,m}}$ = auxiliary engine emission factor (g/kWh) for pollutant j, engine type k, engine tier l, and fuel type m

$D_{BO_{p,i}}$ = boiler power demand (kW) in phase p for ship i

$EF_{BO_{j,m}}$ = boiler emission factor (g/kWh) for pollutant j and fuel type m

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1684 Unique ships inside the Polar Code area in 2016 (all fuel types included)

Vessel type	Count
Fishing vessel	664
Other vessels	330
General cargo vessel	204
Passenger vessel, including cruise	103
Dry bulk vessel	88
Oil tanker	81
Refrigerated cargo vessel	79
Chemical tanker and product tanker	69
Offshore supply vessel	32
Container vessel	17
Ro ro cargo vessel	10
Other offshore service vessels	7

Total fuel consumption (independent of fuel type) in metric tons and sailed distance in nautical miles in 2016 per ship type

Ship type	Sum fuel consumption in metric tons	Sum sailed distance in nautical miles
Fishing vessel	126708	4181120
General cargo vessel	90337	1203282
Other vessels	68863	1535955
Oil tanker	65819	610974
Passenger vessel, including cruise	40346	602930
Chemical tanker and product tanker	30407	385686
Dry bulk vessel	29031	284491
Container vessel	16466	176128
Offshore supply vessel	14747	155564
Refrigerated cargo vessel	12804	159482
Ro Ro cargo vessel	6192	52371
Other offshore service vessel	1881	19403
Total	503601	9367386

Number and percentage of vessels using different grades of fuel in the Polar Code area in 2016

9; 1%

117; 7%

136; 8%

337; 20%

1085; 64%
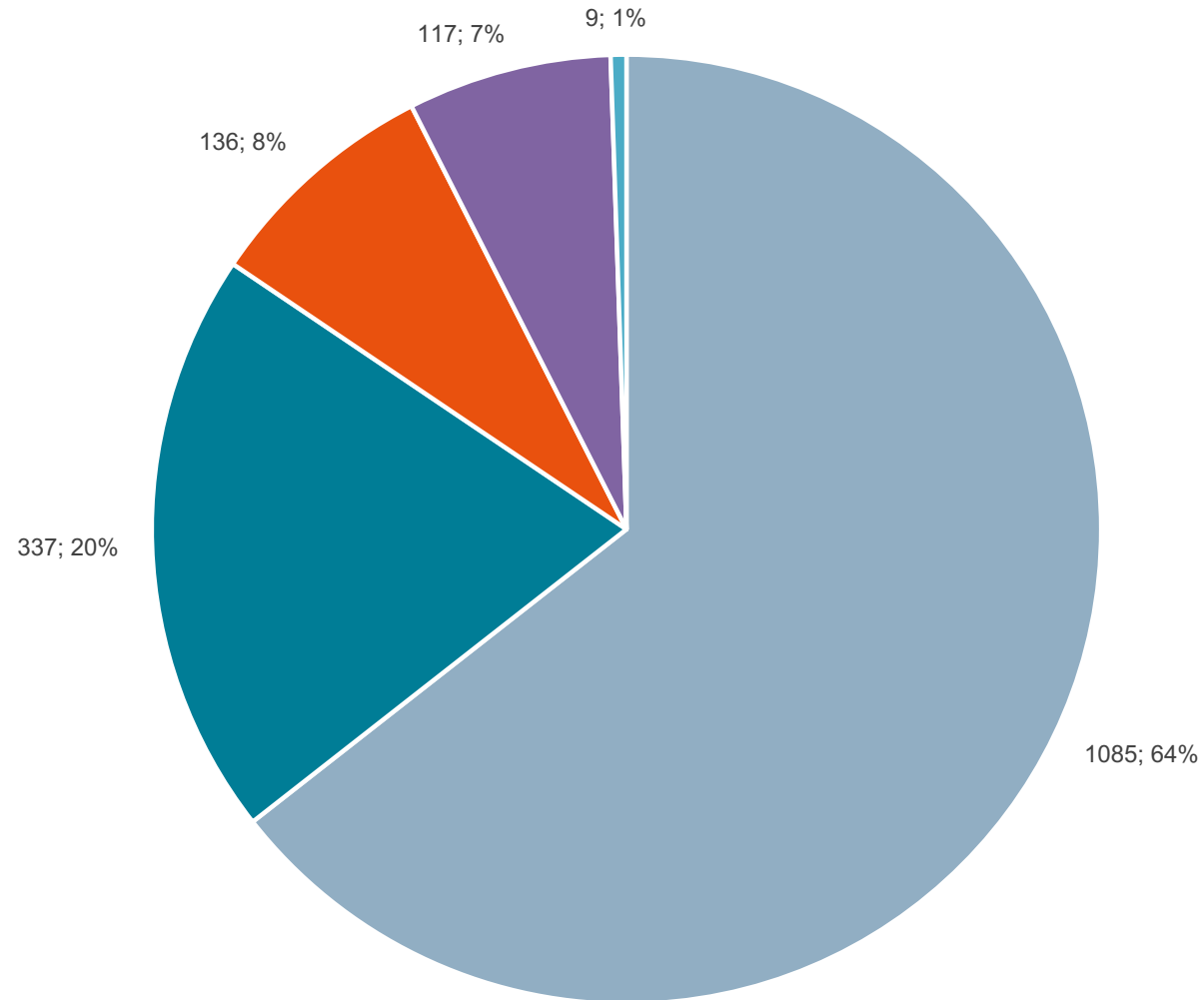
- Distillate marine fuel (MGO/MDO)
- Residual marine fuel and heavy distillate (ISO-F-10 - 80)
- Residual marine fuel (ISO-F-80 - 180) Heavy fuel oil
- Residual marine fuel (ISO-F-180 - 380 or above) Heavy fuel oil
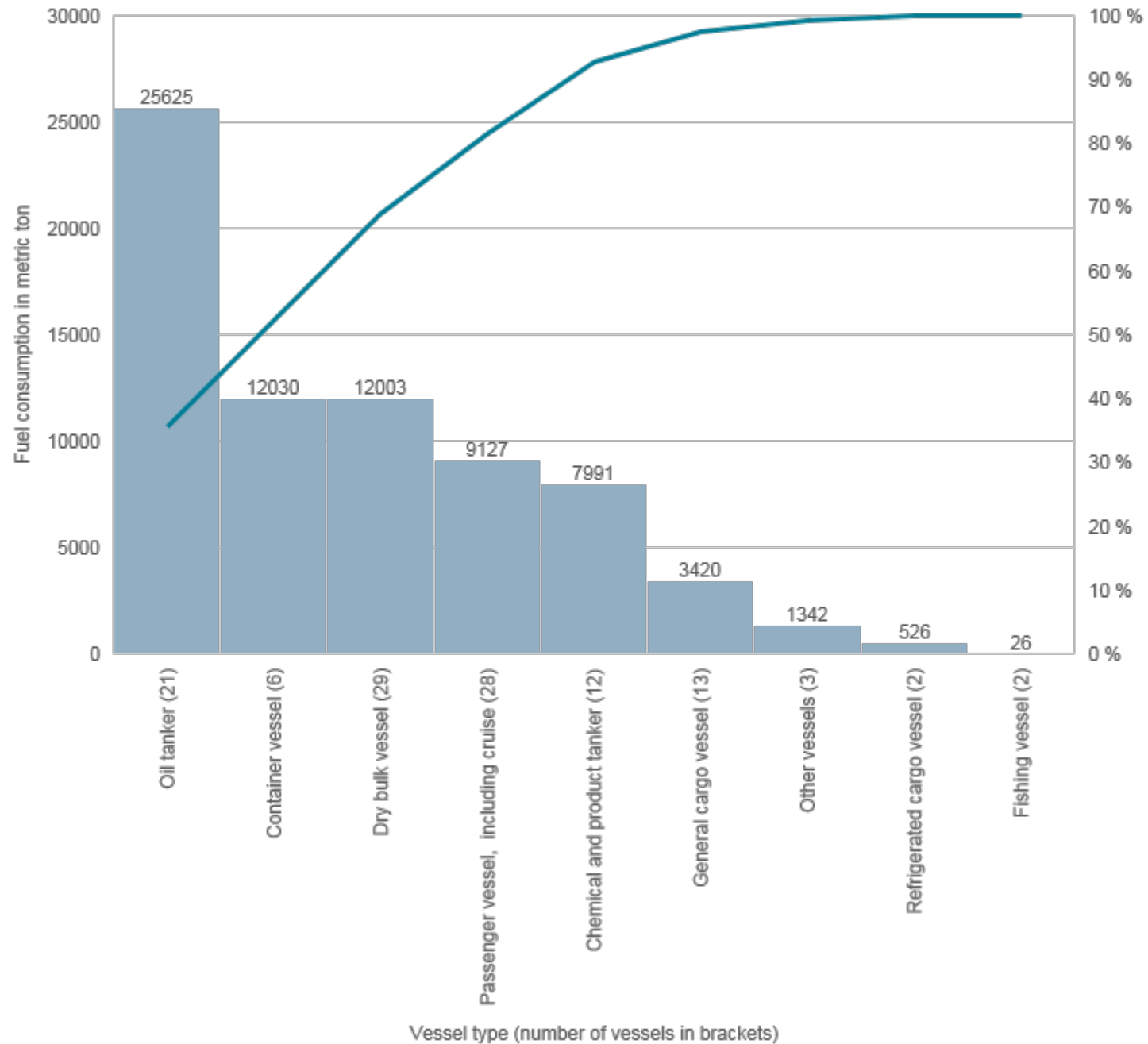- Liquide gas propelled (LNG) and nuclear powered ships

Consumption of different grades of marine fuel in metric tons in the Polar Code area in 2016 and in the North Sea in 2014 (7)
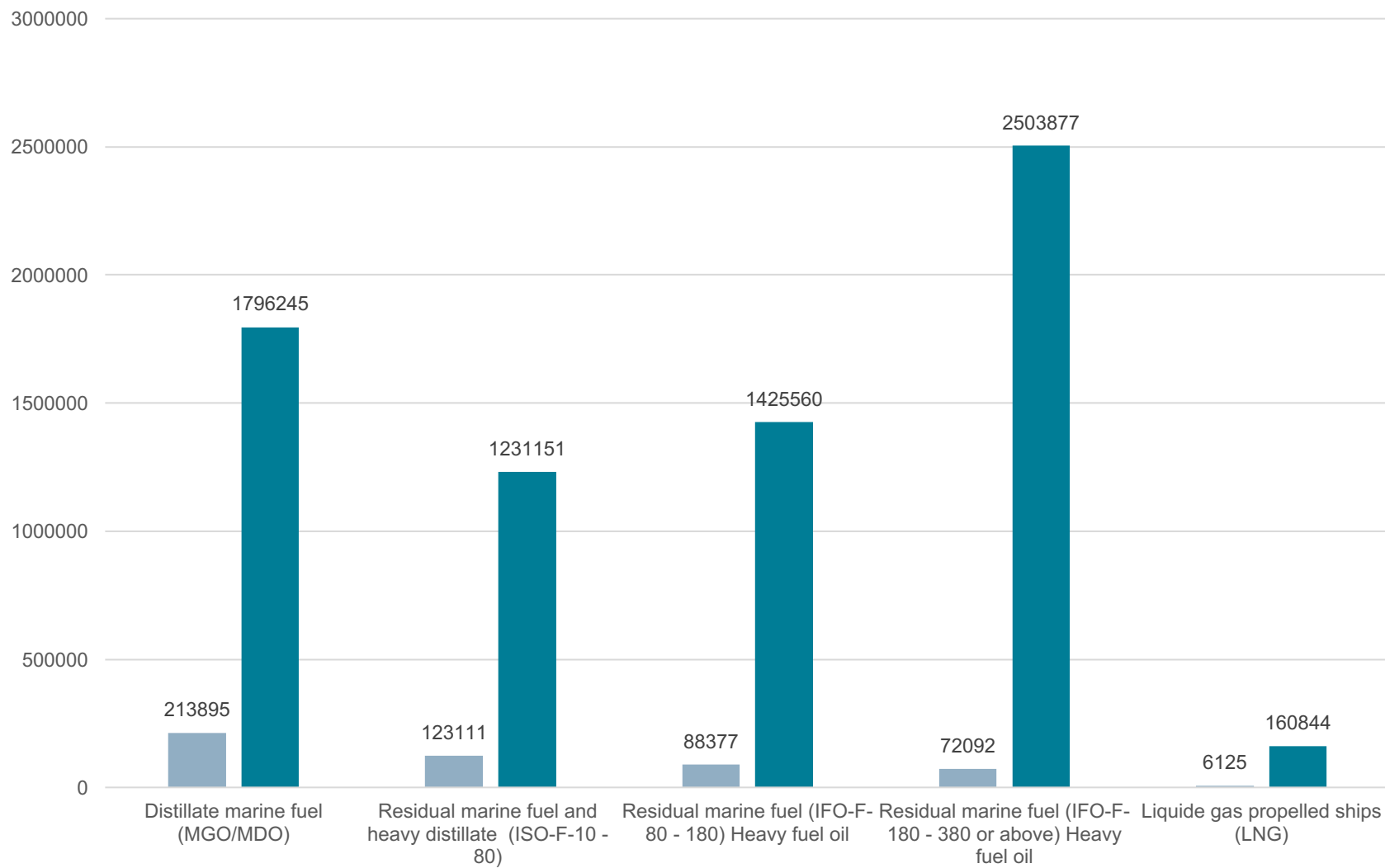
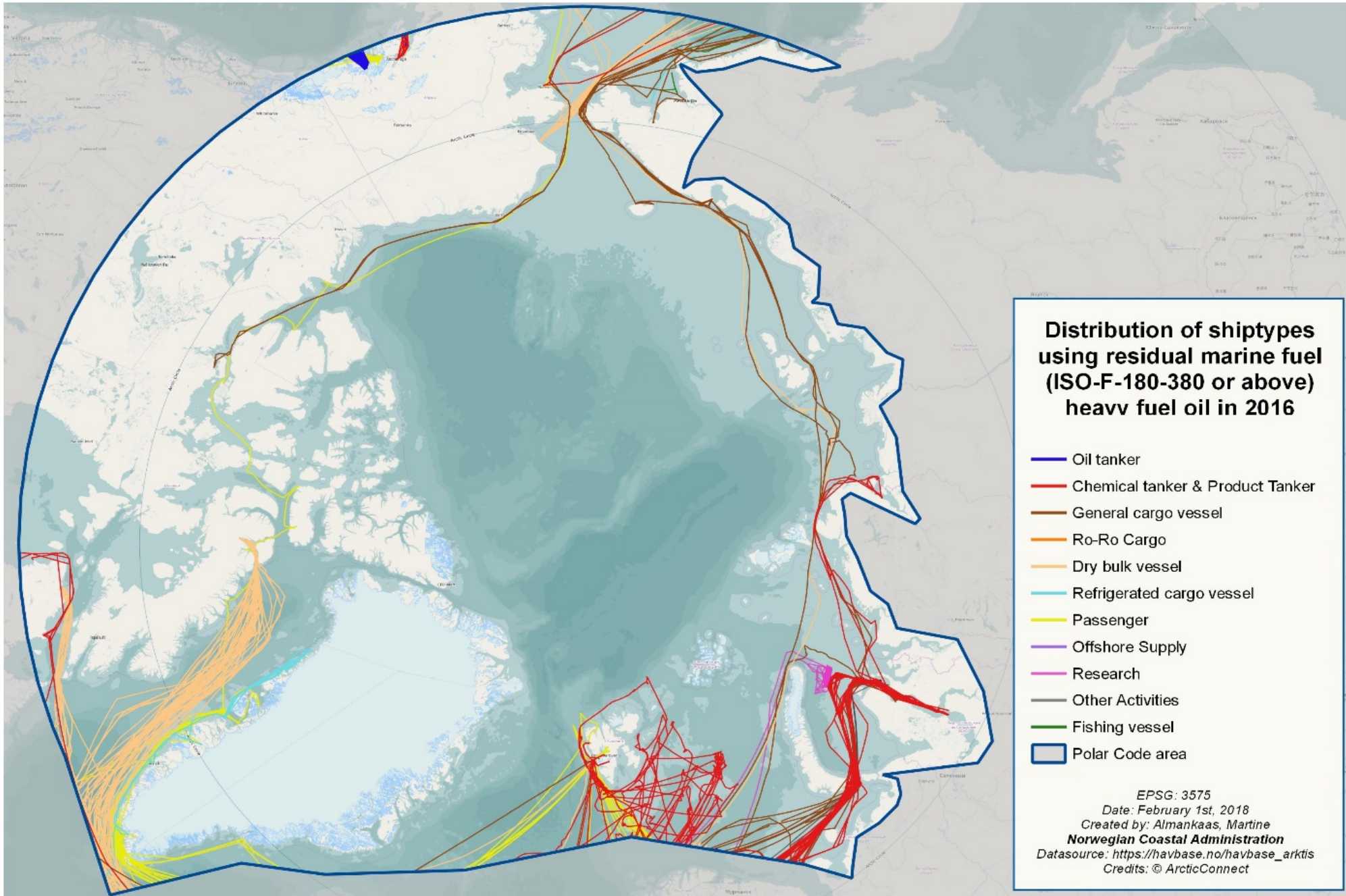- Fuel consumption in metric tons inside the bounderie of the Polar code
- Sum fuel consumption in the North Sea

Grade	Polar code	North Sea
Distillate marine fuel (MGO/MDO)	213895	1796245
Residual marine fuel and heavy distillate (ISO-F-10 - 80)	123111	1231151
Residual marine fuel (IFO-F-80 - 180) Heavy fuel oil	88377	1425560
Residual marine fuel (IFO-F-180 - 380 or above) Heavy fuel oil	72092	2503877
Liquide gas propelled ships (LNG)	6125	160844

Consumed ISO-F 180-380 broken down by vessel types in the Polar Code area in 2016

Fuel consumption in metric ton

Value	Percentage axis
25625	
12030	
12003	
9127	
7991	
3420	
1342	
526	
26	

Vessel type (number of vessels in brackets)

- Oil tanker (21)
- Container vessel (6)
- Dry bulk vessel (29)
- Passenger vessel, including cruise (28)
- Chemical and product tanker (12)
- General cargo vessel (13)
- Other vessels (3)
- Refrigerated cargo vessel (2)
- Fishing vessel (2)

Distribution of shiptypes using residual marine fuel (ISO-F-180-380 or above) heavy fuel oil in 2016

Legend:
- Oil tanker
- Chemical tanker & Product Tanker
- General cargo vessel
- Ro-Ro Cargo
- Dry bulk vessel
- Refrigerated cargo vessel
- Passenger
- Offshore Supply
- Research
- Other Activities
- Fishing vessel
- Polar Code area

EPSG: 3575
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Norwegian Coastal Administration
Datasource: https://havbase.no/havbase_arktis
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2014 and 2017 dry bulk shipping from Baffinland's Marry river mine

Shipping in The Arctic and resent Changs – Shuttle tankers
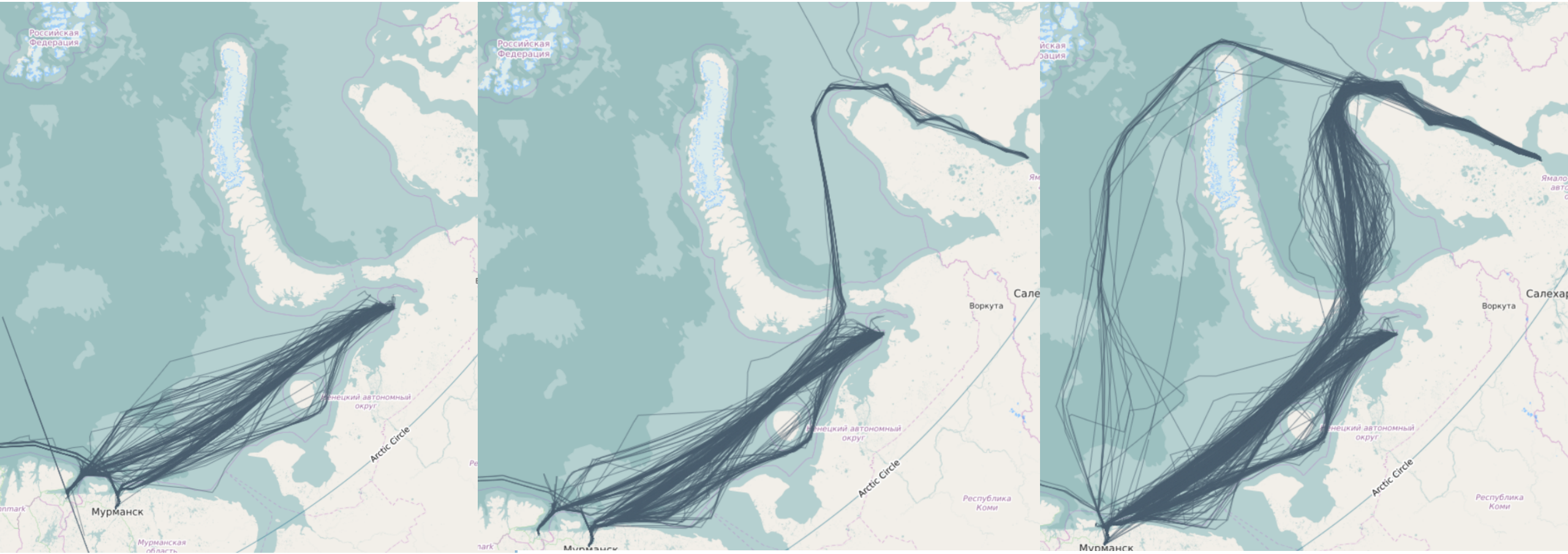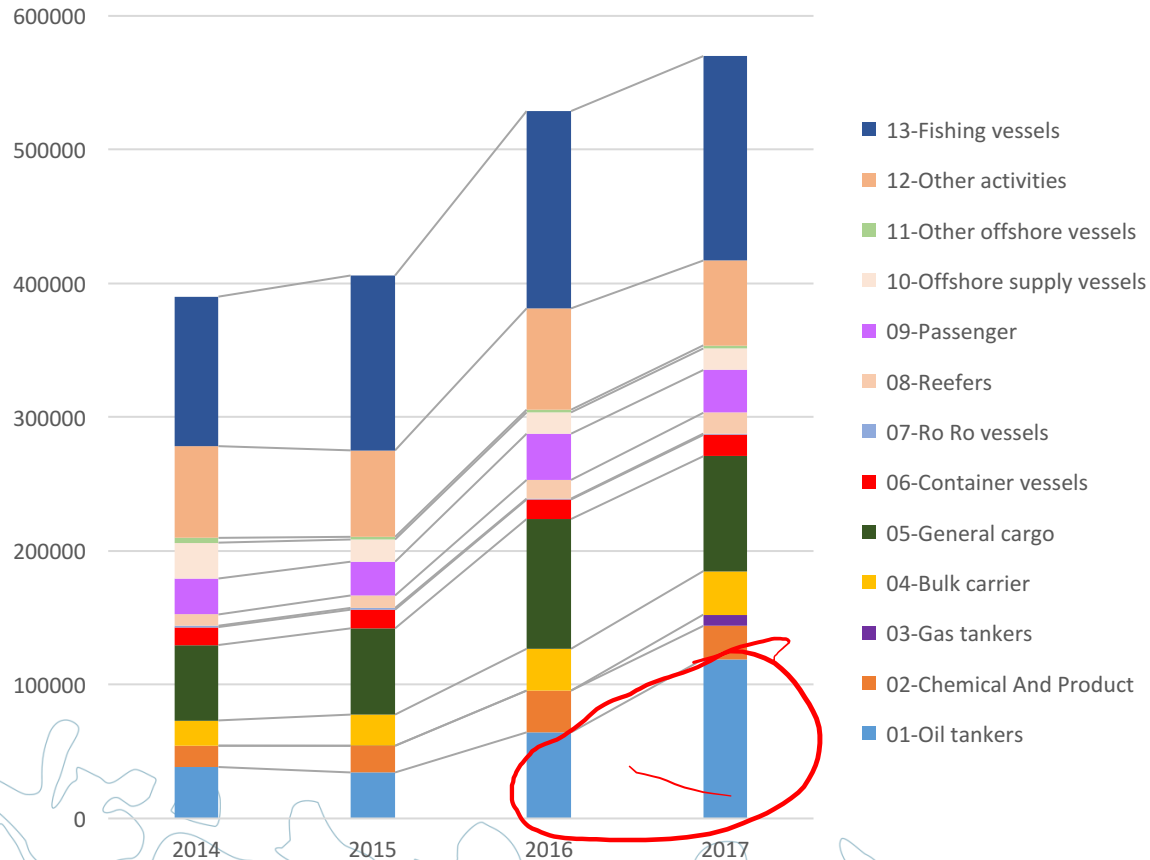
Year-round shipments of Yamal oil from the Arctic Gate (Vorota Arktiki), an Arctic oil loading terminal, (Yamal Peninsula, Yamal-Nenets Autonomous Area).
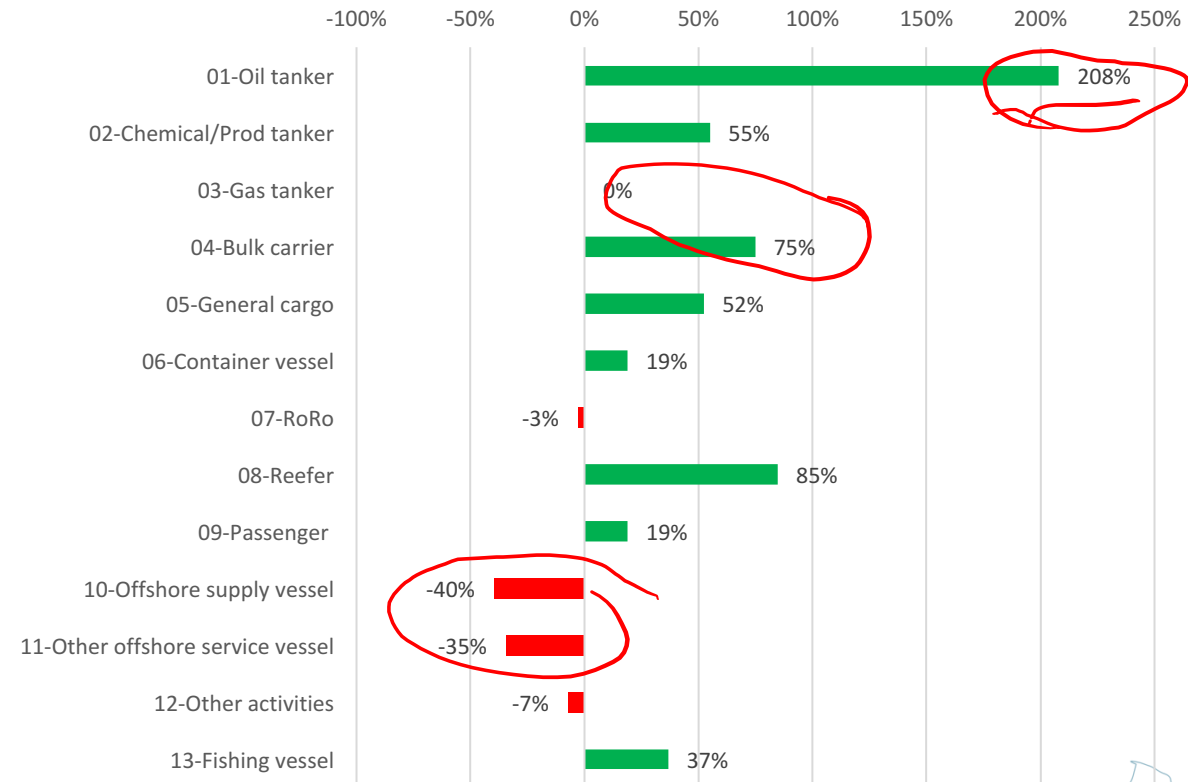
Fuel consumption (ton) in the Arctic

Fuel Consumtion (ton) in the Arctic -02014-2017

% change in fuel consumption in the Arctic - 2014-2017

Total increase: 179834 ton fuel – 46%

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The end
Ono or two questions?
Thank you!