Fuel oil use in the Arctic in 2016

Jon-Arve Røyset, Senior Advisor
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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
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
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
Every dot counts

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Ship emission logarithm

\[ E_{ij} = \sum_{t=0}^{t=n} \left( P_{ME_i} \cdot \left( \frac{SOG_{st}}{V_{max_i}} \right)^\gamma \cdot EF_{ME_{i,k,l,m}} + D_{AE_{p,t}} \cdot EF_{AE_{i,k,l,m}} + D_{BP_{p,t}} \cdot EF_{BP_{i,m}} \right) \text{ hour} \]

Where:

\( i \) = ship
\( j \) = pollutant
\( t \) = time (operating hour, h)
\( k \) = engine type
\( l \) = engine tier
\( m \) = fuel type
\( p \) = phase

\( E_{ij} \) = emissions (g) for ship \( i \) and pollutant \( j \)
\( P_{ME_i} \) = main engine power (kW) for ship \( i \)
\( SOG_{st} \) = speed over ground (knots) for ship \( i \) at time \( t \)
\( V_{MAX_i} \) = maximum speed (knots) for ship \( i \)

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

\( D_{BP_{p,t}} \) = boiler power demand (kW) in phase \( p \) for ship \( i \)
\( EF_{BP_{i,m}} \) = boiler emission factor (g/kWh) for pollutant \( j \) and fuel type \( m \)
1684 Unique ships inside the Polar Code area in 2016 (all fuel types included)

- 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
<table>
<thead>
<tr>
<th>Ship type</th>
<th>Sum fuel consumption in metric tons</th>
<th>Sum sailed distance in nautical miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fishing vessel</td>
<td>126708</td>
<td>4181120</td>
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<tr>
<td>General cargo vessel</td>
<td>90337</td>
<td>1203282</td>
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<tr>
<td>Other vessels</td>
<td>68863</td>
<td>1535955</td>
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<td>Oil tanker</td>
<td>65819</td>
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<tr>
<td>Passenger vessel, including cruise</td>
<td>40346</td>
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<tr>
<td>Chemical tanker and product tanker</td>
<td>30407</td>
<td>385686</td>
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<tr>
<td>Dry bulk vessel</td>
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<td>Container vessel</td>
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<td>Offshore supply vessel</td>
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<td>Refrigerated cargo vessel</td>
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<td>159482</td>
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<tr>
<td>Ro Ro cargo vessel</td>
<td>6192</td>
<td>52371</td>
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<tr>
<td>Other offshore service vessel</td>
<td>1881</td>
<td>19403</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>503601</strong></td>
<td><strong>9367386</strong></td>
</tr>
</tbody>
</table>
Number and percentage of vessels using different grades of fuel in the Polar Code area in 2016

- **Distillate marine fuel (MGO/MDO)**: 136; 8%
- **Residual marine fuel and heavy distillate (ISO-F-10-80)**: 117; 7%
- **Residual marine fuel (ISO-F-80-180) Heavy fuel oil**: 337; 20%
- **Residual marine fuel (ISO-F-180-380 or above) Heavy fuel oil**: 9; 1%
- **Liquefied gas propelled (LNG) and nuclear powered ships**: 1085; 64%
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)

- Distillate marine fuel (MGO/MDO): 1796245 metric tons
- Residual marine fuel and heavy distillate (ISO-F-10 - 80): 1231151 metric tons
- Residual marine fuel (IFO-F-80 - 180) Heavy fuel oil: 88377 metric tons
- Residual marine fuel (IFO-F-180 - 380 or above) Heavy fuel oil: 72092 metric tons
- Distillate marine fuel (MGO/MDO) in the North Sea: 2503877 metric tons
- Residual marine fuel and heavy distillate (ISO-F-10 - 80) Heavy fuel oil: 6125 metric tons
- Residual marine fuel (IFO-F-80 - 180) Heavy fuel oil: 160844 metric tons

Fuel consumption in metric tons inside the boundary of the Polar code
Sum fuel consumption in the North Sea
Consumed ISO-F 180-380 broken down by vessel types in the Polar Code area in 2016

- Oil tanker (21): 25625 metric ton
- Container vessel (5): 12030 metric ton
- Dry bulk vessel (29): 12033 metric ton
- Passenger vessel, including cruise (28): 9127 metric ton
- Chemical and product tanker (12): 7991 metric ton
- General cargo vessel (13): 3420 metric ton
- Other vessels (3): 1342 metric ton
- Refrigerated cargo vessel (2): 526 metric ton
- Fishing vessel (2): 26 metric ton

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

EPSG: 3035
Date: February 1st, 2018
Created by: Almorskaa, Marit
Norwegian Coastal Administration
Datasource: https://data.no/marit/data/arkiv
Credit: © ArcticConnect
2014 and 2017 dry bulk shipping from Baffinland’s Marry river mine

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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

Total increase: 179834 ton fuel – 46%
The end
Ono or two questions?
Thank you!