UK Shipping Improvement Work
TFEIP Expert Panel – Transport
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Outline

• Why did we do this?
  – Background to current UK shipping emission inventory and the need to improve it
  – Aims and objectives of this ongoing shipping improvement work

• New methodology
  – New activity data: Using Automatic Identification System (AIS) data from the UK Maritime & Coastguard Agency

• What are the benefits and challenges
Current inventory good but had some limitations

- **Good**
  - Bottom-up tier 3 method based on Lloyd’s (LMIU) data
  - Domestic/international split by port origin/arrival listed by LMIU
  - Detailed consideration of vessel types, engines, fuels
  - Spatially distributed (5x5km) based on *estimated* routes
  - 2007 base year of activity data

- **BUT**
  - **Incomplete**: poor capture of vessels not engaged in international trade (smaller vessels, fishing vessels, offshore, service)
  - **Accuracy could be improved**: Blanket assumptions on vessel speeds (→ engine loads)
  - **Spatial accuracy could be improved**: No capture of *actual* vessel routes limits spatial granularity
  - Poor understanding of vessels starting/finishing at same port

What? – Aims and objectives

• Project for the UK Department for Business, Energy & Industrial Strategy (BEIS) under UK Inventory Improvement Programme

• Review and update the methodology for estimating emissions from UK shipping

• Try to improve upon previous methodology for known high uncertainties of
  – Vessels that move from and to the same port
  – Small vessels
  – Fishing vessels

• Backcasting annual emission estimates to 1990 + projections to 2035

• Led by Ricardo team, partners at University College London – emissions calculations
First stage in improvement work: review available options

- Review of **activity** data. Data samples from multiple providers critically assessed.
  - Automatic Identification System (AIS) data
    - Terrestrial
    - Terrestrial plus satellite
    - Commercial and Government
  - Non-AIS options – using Lloyd’s again

- Review of **emission factors**
  - Comparison of existing assumptions assessed against leading work by International Maritime Organization (IMO)

- **Outcome:** selected new methodology using terrestrial AIS data from the Maritime and Coastguard Agency
  - Best available data for the UK situation
  - More detailed activity data than the majority of national shipping emission inventories
New methodology

Our solution: develop new methodology using Automatic Identification System (AIS) data from Maritime & Coastguard Agency

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AIS NETWORK

SHORE BASED STATION

SHIP TO SHORE

SHIP TO SHIP

Class A AIS

VHF ANTENNA

12 VDC

GPS ANTENNA

CLASS B AIS DATA TRANSMITTED: MMSI, CALL SIGN, POSITION, LENGTH, BEAM, SOG, COG, HEADING, ETC.

Image source: www.HollandMarineHardware.nl
New methodology

AIS data – example resolution
New methodology

Overview of new methodology

• **Highly granular raw activity data**
  - Vessel positions up to every few seconds when in range of terrestrial network
  - Satellite AIS data not used
  - Unknown route (+destination) of vessels after leaving range of terrestrial AIS

• **Estimate emissions for every vessel position, after linking each vessel to Clarksons technical vessel characteristics database**, taking into account:
  - Vessel type
  - Engine power (main, auxiliary, boilers) of each vessel
  - Engine load, accounting for speed and draught at each position
  - Time until next position
  - Speed dependent emission factors
  - Location (at berth, at sea in a SECA/not in a SECA)
This is a big data project

- >2 billion data points were temporally thinned to a more manageable 100 million

- Large storage requirements

- Raw data are not clean data, many gaps and errors
  - → substantial time for data cleaning and algorithm development

- QA/QC of very large dataset is time consuming
  - Use visual inspection of mapped data to critically assess for spurious data
  - Long lead times to run queries
Improved data for UK energy statistics
Enhanced spatial resolution on key sources and AQ impacts in ports

• Enhanced vessel coverage compared to current estimates
  – Offshore, Fishing, Small service vessels, Passenger
Domestic class A position density
Benefits and wider applications

**Improved data for UK energy statistics**

**Enhanced spatial resolution on key sources and AQ impacts in ports**

- Enhanced vessel coverage compared to current estimates
  - Offshore, Fishing, Small service vessels, Passenger ferries

- Accounts for actual routes that vessels have taken

- Refined emission factors
  - Main engine load now speed and draught dependent, varying for each position report
  - Auxiliary engine loads now vary by vessel category, size and by mode
  - Auxiliary boiler fuel consumption and emissions now estimated

- …New activity data improves overall capture rate of vessel movements, but adds new challenge of distinguishing domestic shipping from international shipping

- Higher spatial resolution is valuable to local (port) authorities managing their understanding of local pollution sources
Spare slides
## Class A AIS requirements

<table>
<thead>
<tr>
<th>Vessel category</th>
<th>Requirement to fit AIS Class A</th>
</tr>
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<tbody>
<tr>
<td><strong>Cargo vessels</strong></td>
<td>All vessels over 300 GT on international voyages</td>
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<tr>
<td><strong>Passenger vessels</strong></td>
<td>All vessels. But Member States can exempt passenger vessels that are either &lt;15m length or &lt;300GT and which are engaged on non-international voyages from this requirement. It is unclear to what extent this exemption has been implemented and thus affecting vessels travelling in UK waters.</td>
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| **Fishing vessels** | All vessels with overall length >15m as follows:  
  - Existing vessels >24m should have been fitted by 31 May 2012  
  - Existing vessels 18m to 24m should have been fitted by 31 May 2013  
  - Existing vessels 15m to 18m should have been fitted by 31 May 2014  
  - new-built fishing vessels >15m should have been fitted from 30 November 2010 |
| **Other, naval** | No requirement. |
Backcasting / forecasting the base year inventory unchanged

• **Backcasting to 1990 – approach unchanged**
  – Scale base year according to indices set at base year = 1, accounting for changes in
    • Activity (DfT statistical time series)
    • Fuel type and/or emission factor (e.g. SECAs)
  – Updated vessel categorisation (was 8, now 19 vessel categories)
    • Updated separate more cargo types (previously all cargo split just into unitised and non-unitised)

• **Forecasting to 2035 – approach unchanged**
  – Accounts for projected changes in
    • Activity
    • Transport efficiency
    • Fuel type and/or emission factors
  – Cannot anticipate structural or route changes
  – Specific considerations for 4 ports (Southampton, Immingham, Liverpool Felixstowe)