UK Ship Emissions Inventory

Andriana Stavrakaki

Entec

Creating the environment for business

Introduction

- **Objectives**

- **Methodology**

- **Data Sources**

- **Refinements**
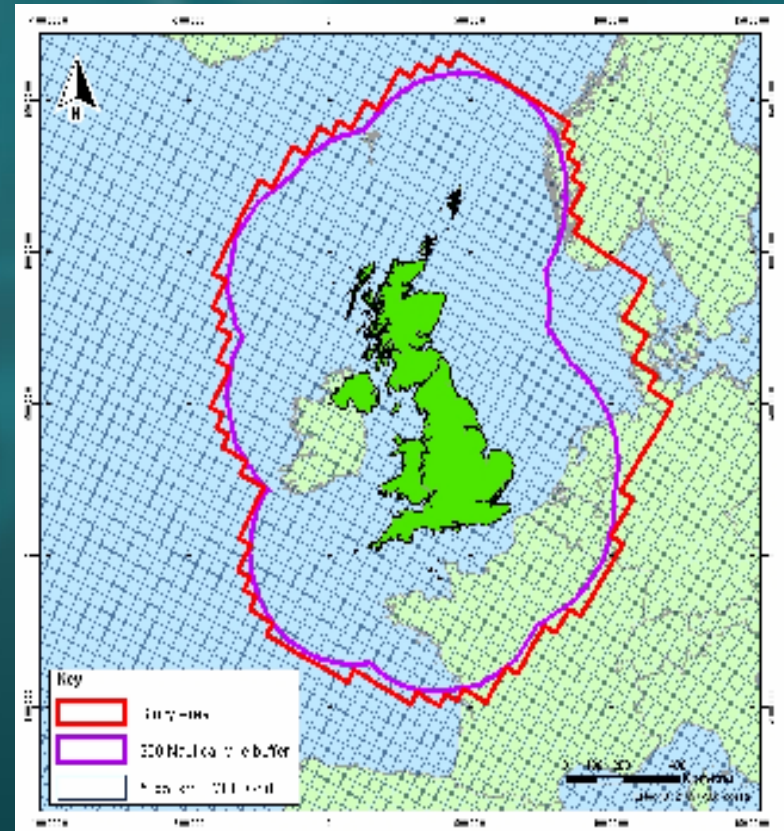
- **Uncertainties**

Entec

Creating the environment for business

Aims and Objectives

- **Quantification of emissions**

- **Pollutants:**
    - SO_2
    - NO_X
    - $PM_{2.5}$ & PM_{10}
    - VOCs
    - CO_2

- **Fuel consumption**

- **Years: 2007, 2010, 2015 & 2020**

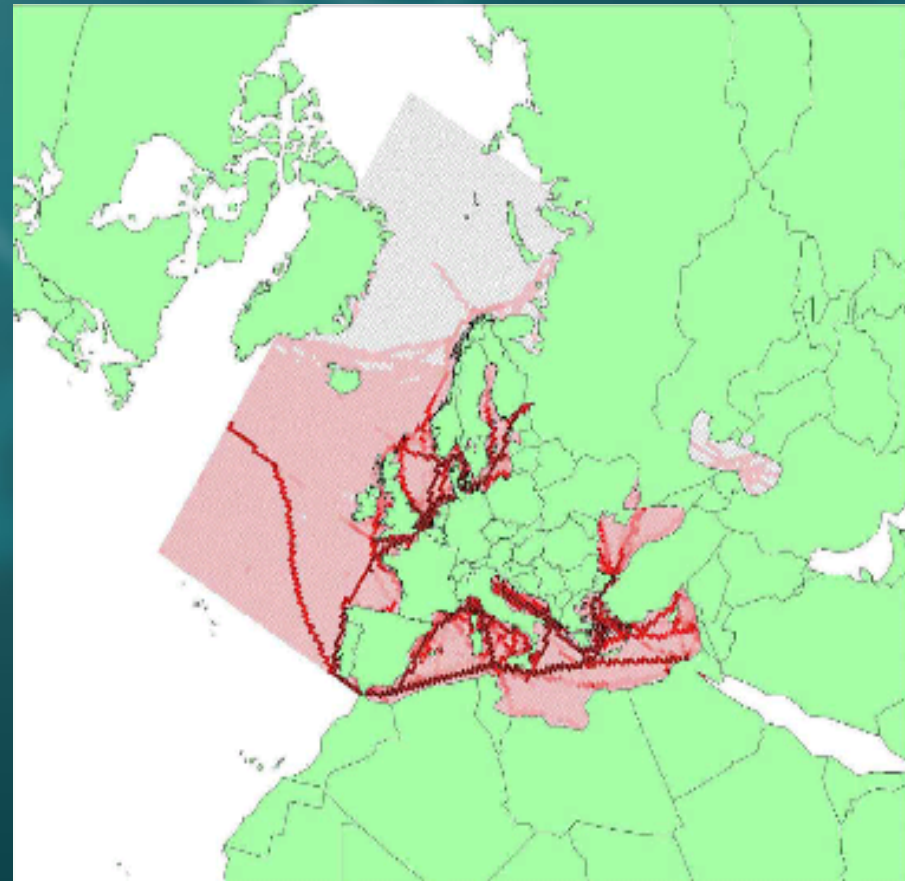- **Geographical Distribution of emissions (5 x 5 km²)**

Entec

Creating the environment for business

Aims and Objectives
Outputs

- **Emissions reported by;**
  - fuel type
  - vessel type (i.e. cargo & passenger)
  - flag type
  - movement type
  - ~ 12 nm zone
- **Total emission estimates disaggregated by grid cells**

Entec

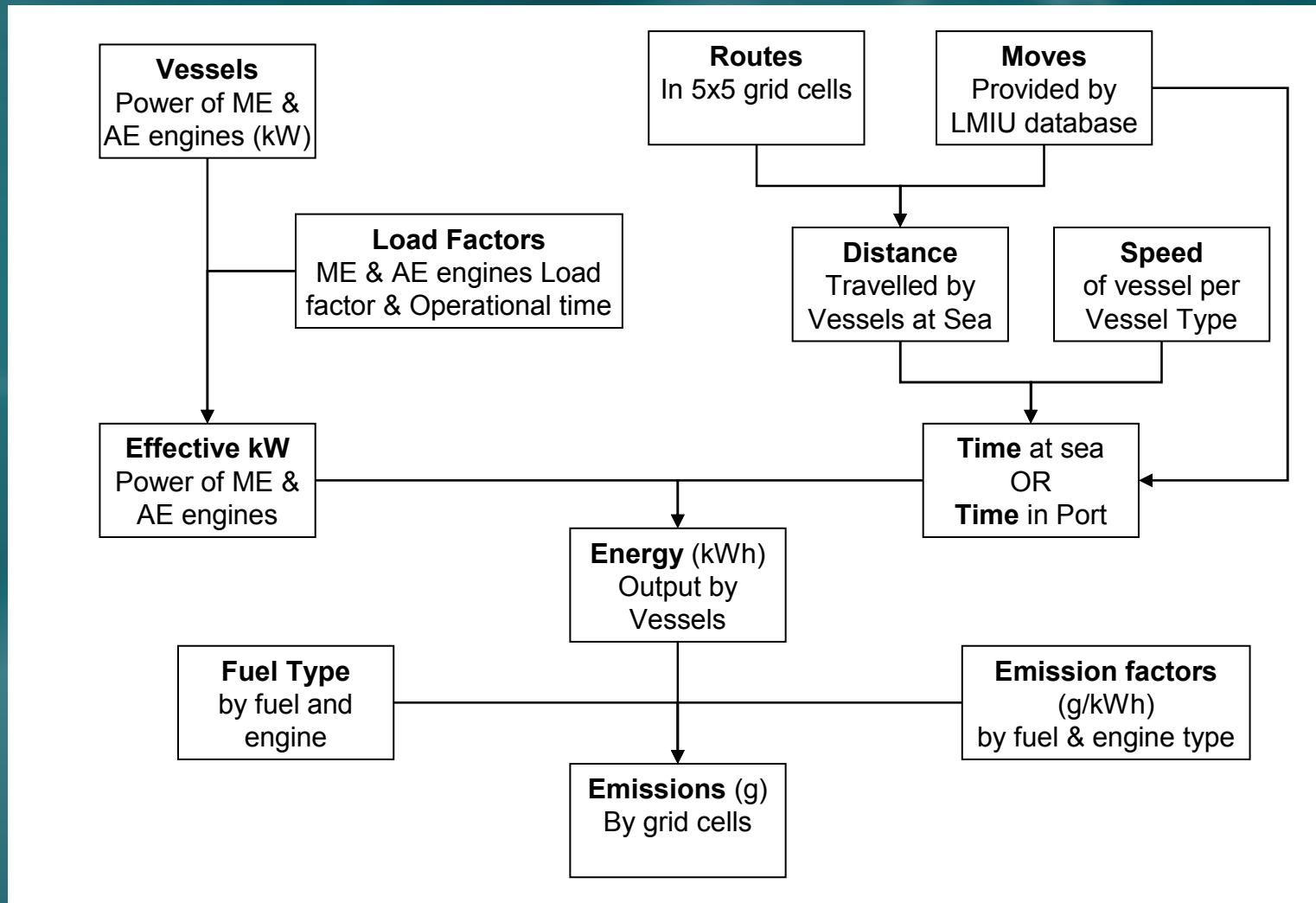*Creating the environment for business*

Methodology

- **Bottom-Up Approach**
  - Activity Based

- **Top-Down Approach**
  - Unknown destinations
  - Smaller vessels

Entec

Creating the environment for business
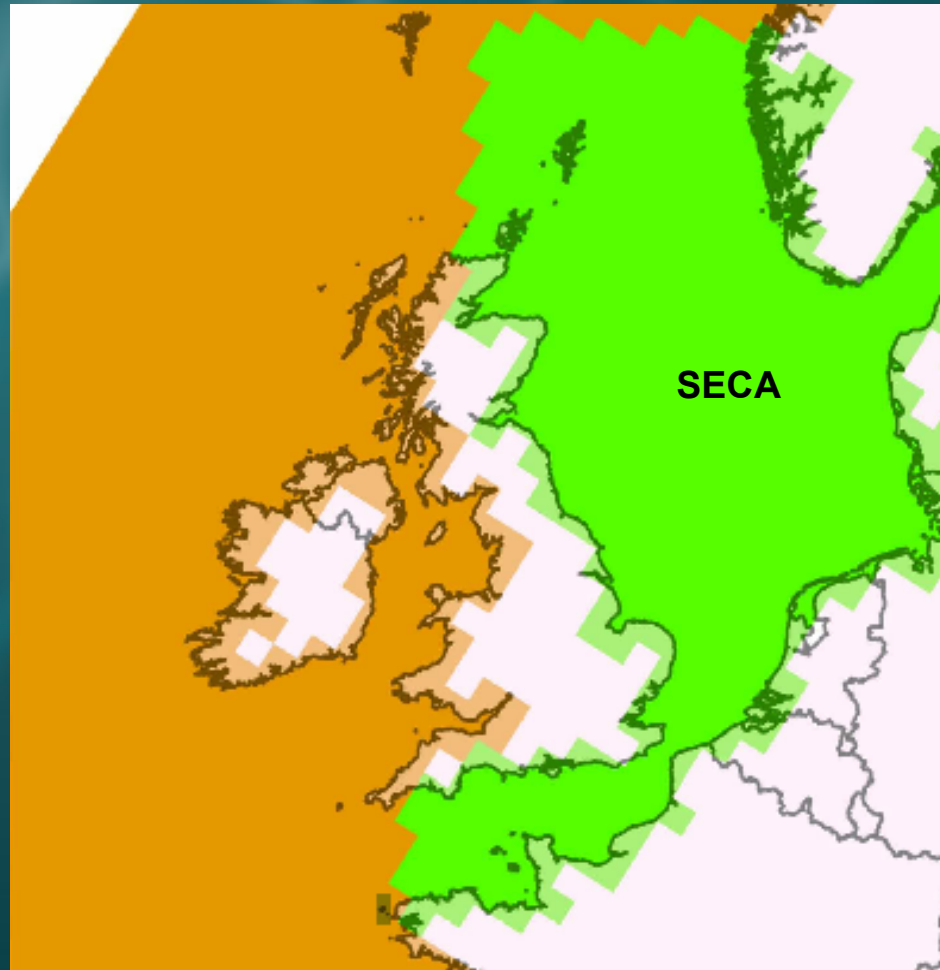
Methodology

Methodology
Fuel Type

- **Fuel Type based on**
  - Engine
  - Vessel type
  - Location

- **At Berth projections – MGO for vessels (exception passenger vessels)**
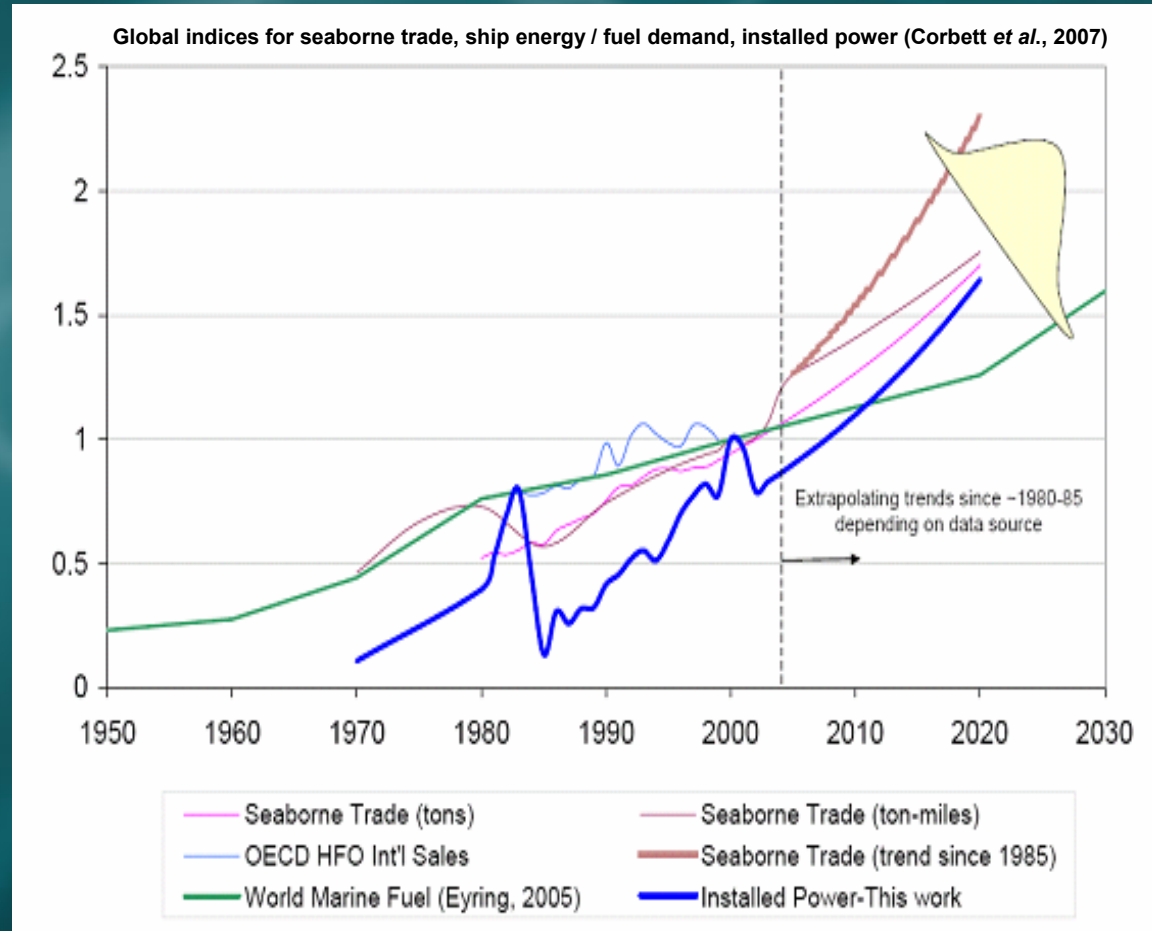

SECA

Entec

Creating the environment for business

Methodology
Emission projections

- **Forecasting future emissions on the basis of historical data and best future estimates does lead to high uncertainty**

- **Growth rates of 2%, 3% and 4% applied to future emission forecasts**

Global indices for seaborne trade, ship energy / fuel demand, installed power (Corbett *et al.*, 2007)

Extrapolating trends since ~1980-85 depending on data source

Legend:
- Seaborne Trade (tons)
- Seaborne Trade (ton-miles)
- OECD HFO Int'l Sales
- Seaborne Trade (trend since 1985)
- World Marine Fuel (Eyring, 2005)
- Installed Power-This work

Entec

Creating the environment for business

Data Sources

- **Movements Database**
- **Characteristics Database**
- **Emission Factors**
- **Routes**

Entec

Creating the environment for business

Data Sources
Movements Database

- **Provided by Lloyd's Marine Intelligence Unit (LMIU)**
  - *"aims to cover all merchant vessels over 100gt engaged in international trade"*

- **Lloyd's MIU extracted transits**
  - Between ports in the area;
  - From / to ports inside the area to / from ports outside the area; and
  - Through the area without calling at a port in the area

- **Information extracted**
  - Arrival/Departure Port;
  - Arrival/Departure Dates and where available Arrival/Departure Times; and
  - Port/Place details including: Port Name, Country, Latitude/Longitude

Entec

Creating the environment for business

Data Sources
Characteristics Database

- **Provided by Lloyd's MIU**

- **Vessel Characteristics**
  - Vessel Type
  - Flag type
  - Service Speed
  - Vessel size

- **Engine Characteristics**
  - Main Engine (ME) & Auxiliary Engine (AE) kW Power
  - Engine Speed (RPM)

Entec

Creating the environment for business

Data Sources
Emission Factors

- **Originally Developed by IVL**
  - Based on Monitoring Data and Literature Survey
  - Presented as 15 Engine Type / Fuel Type Combinations
  - At Sea / Manoeuvring / At Berth
  - NO_X / SO_2 / CO_2 / HC / PM
  - Load factors for ME and AE operation

- **Updated for Policy Scenarios and Future Years**
  - Sulphur Content of Marine Fuels Directive (SO_2 & PM)
  - MARPOL Annex VI Regulations (NOx, SO_2 & PM)

Entec

Creating the environment for business

Data Sources
Route Network

- **AtoBviaC Plc**
  - Provided BP Shipping Marine Distance Tables
  - Routes respect all mandatory & recommended traffic separation schemes

- **Created using a GIS Based Methodology**
  - Shortest Straight Line Route (Avoiding Land)
  - Routes take into account passing places when possible

Entec

Creating the environment for business

Refinements
Managing Incomplete Data

- **Characteristics Data**

- **Movements Data**

Entec

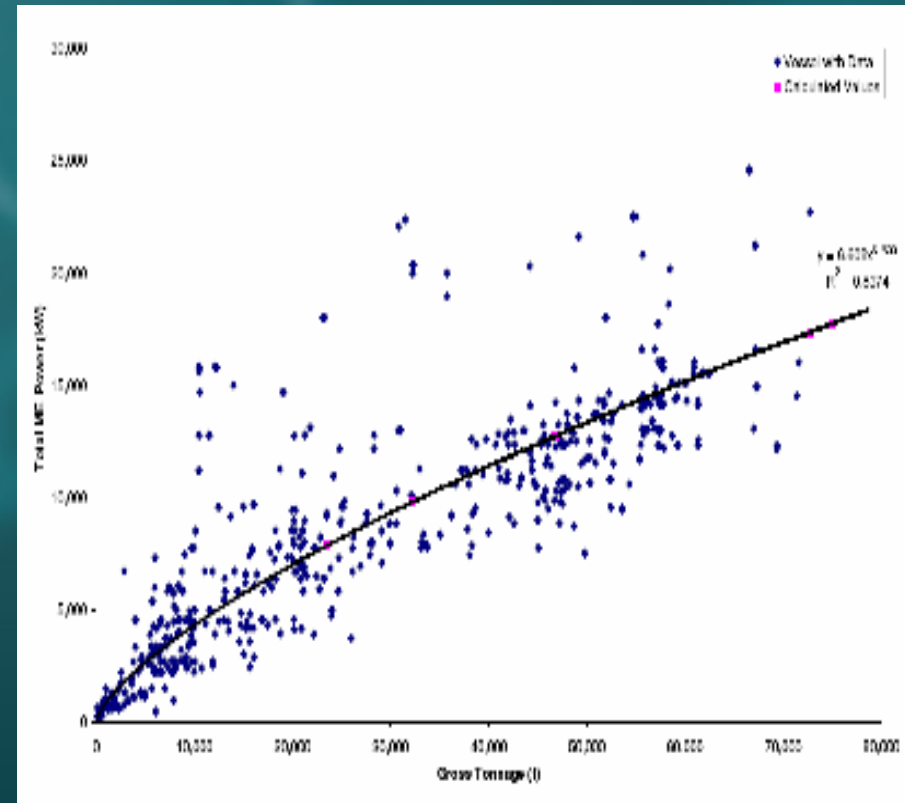*Creating the environment for business*

Refinements
Managing Incomplete Data

- **LMIU Characteristics Data**
  - Assumptions and Vessel Profiling to Account for Missing Data
    - Vessel speed
    - ME & AE Power
    - Engine speed

Refinements
Managing Incomplete Data

- **LMIU Movements Data**
  - Automatic Identification System (AIS) (Passenger)
  - Time of Arrival & Departure
  - Assumptions made for estimating emissions from missing / problematic movements (e.g. movements from and to the same port)

Entec

Creating the environment for business

Areas of Uncertainty

- **Accuracy and coverage of data**

- **Assumptions employed**

- **Uncertainty at All Stages**

Entec

Creating the environment for business

Conclusions

- **Emission estimates for UK waters**

- **Approach – Bottom up**
  - Emissions estimated based on:
    - Vessel movements; and
    - Vessel / Engine characteristics

Entec

Creating the environment for business

UK Ship Emissions Inventory

Thank you

Entec

Creating the environment for business