

# Insights from a bottom-up approach to estimate shipping emissions and design mitigation measures

Susana López-Aparicio, Leonor Tarrason, Li Liu

NILU – Norwegian Institute for Air Research

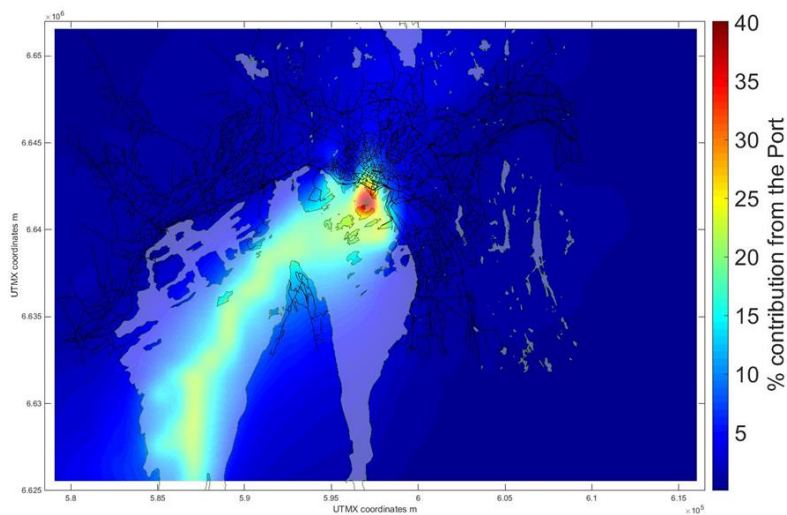
## Conclusions

- Our study shows the importance of comprehensive emission inventories to design effective measures to reduce emissions.
- International ferries and tourist cruises are the main contributors to total emissions from the Port of Oslo, and the highest emissions are obtained “at berth”.
- Different mitigation measures are designed and evaluated in closed cooperation with the Port Authorities; i) Sulphur content in marine fuel directive (<0.1%); ii) Shorepower; iii) Speed reduction zone; iv) Increase used of LNG.
- Shorepower and speed reduction zone are effective measure to reduce air pollutants and GHGs; The combination of measures is needed to develop effective mitigation strategy to reduce urban concentration levels.

# Introduction - Motivation

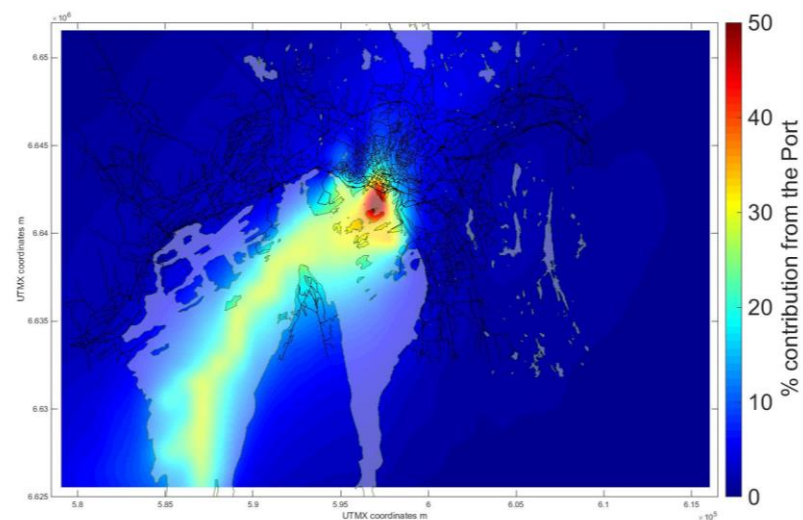
## 2013

% Port Contribution to NO<sub>2</sub> annual concentration

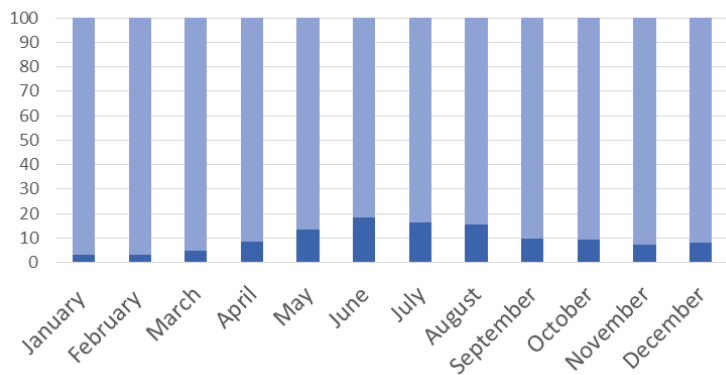


## 2020

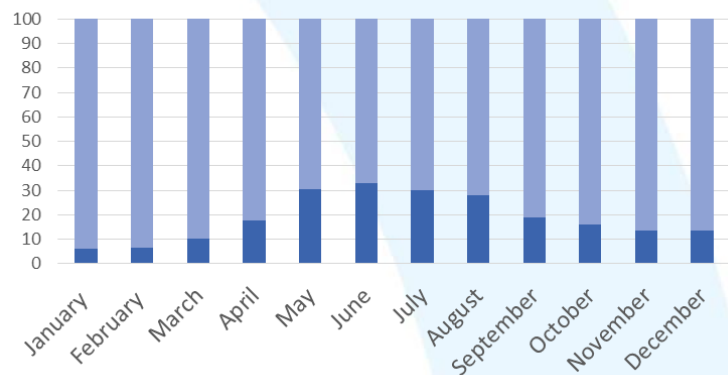
% Port Contribution to NO<sub>2</sub> annual concentration



Contribution from the Port at Hjortnes - 2013



Contribution from the Port at Hjortnes - 2020

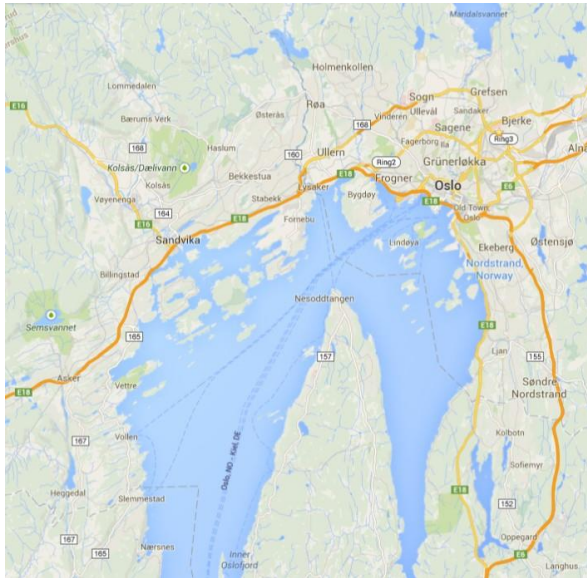


# Methodology

Emissions;  $\text{NO}_x$ ,  $\text{PM}_{10}$ ,  $\text{SO}_2$ , GHG ( $\text{CO}_2$ ,  $\text{CH}_4$ ,  $\text{N}_2\text{O}$ ,  $\text{CO}_2\text{-eq}$ ); Years: 2013 and 2020

Method: Activity call (Port of Oslo  $\approx$  3000 calls), EF, time, load factor, and engine power

(i) US EPA, 2009, Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories; (ii) European Commission and ENTEC UK Limited, 2002

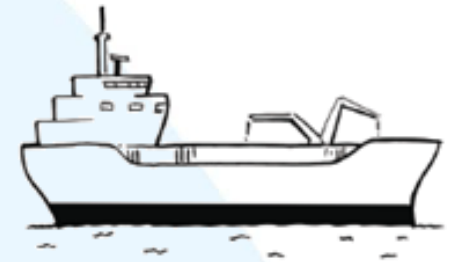


Emissions related with the activities in the Port of Oslo

## Shipping Emissions



Harbour Vessels



Oceangoing Vessels  
(cruising, manoeuvring, berth)

## Land Emissions

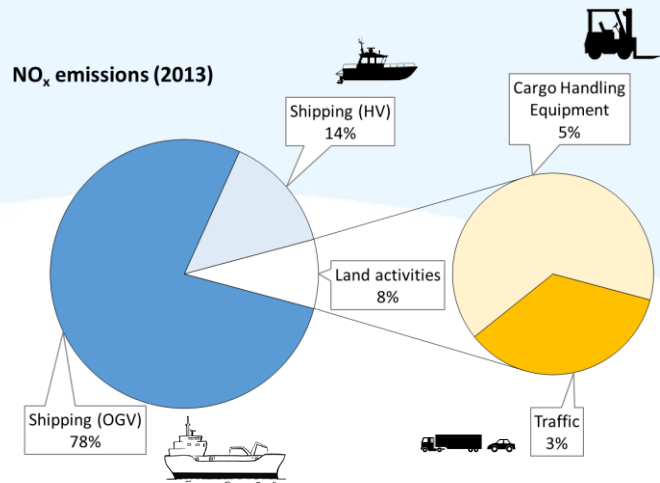


Cargo Handling Equipment

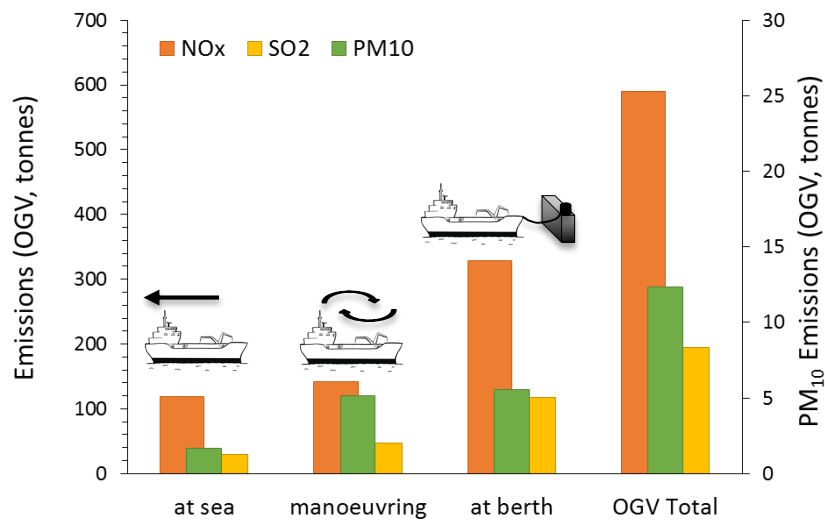
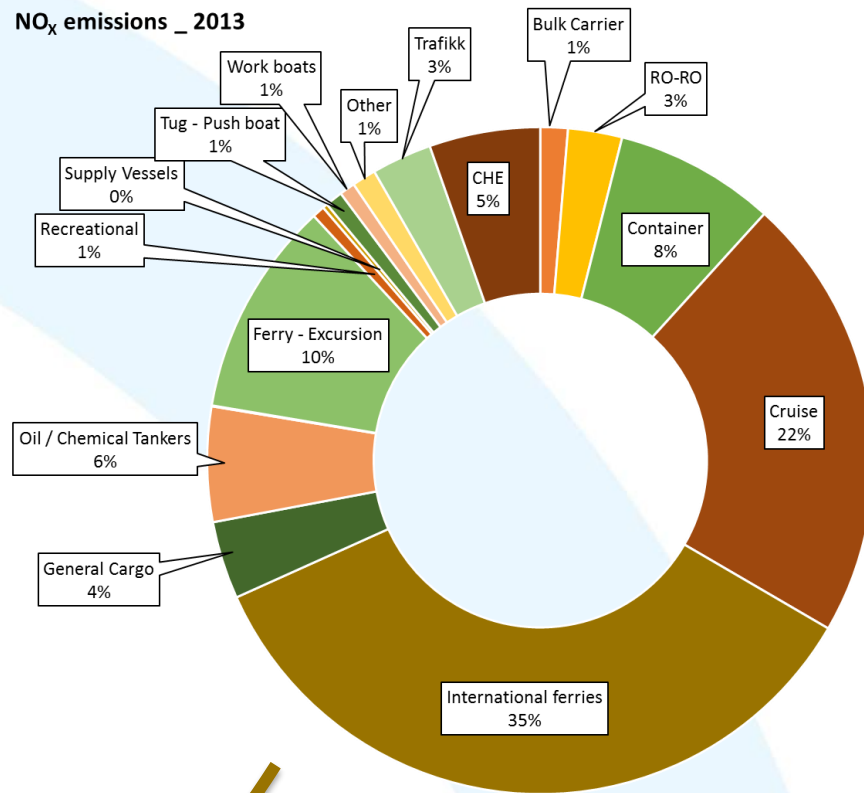


Vehicles

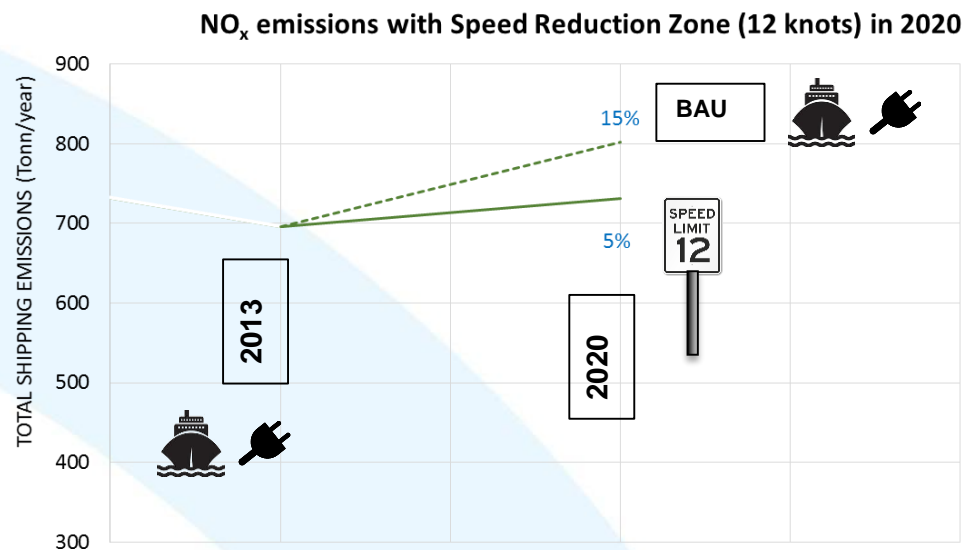
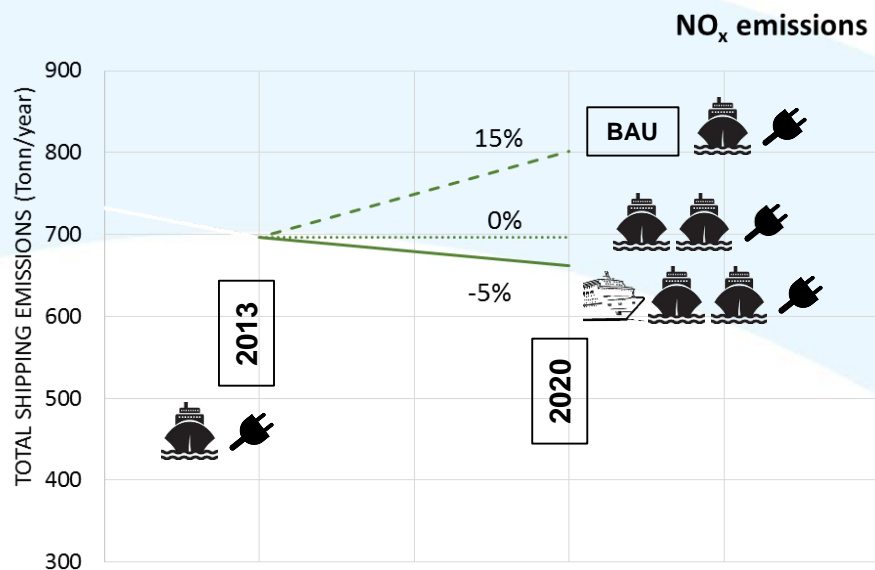
# Results \_ Emission Inventory (e.g. NO<sub>x</sub>)



**NO<sub>x</sub> emissions \_ 2013**

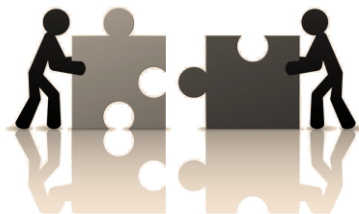


# Results \_ Mitigation Measures (e.g. NO<sub>x</sub>)



SHOREPOWER

SPEED REDUCTION ZONE



-15% NO<sub>x</sub>; -29% CO<sub>2</sub>

## References

- ENTEK UK 2005. Ship Emissions: Assignment, Abatement and Market-based Instruments. Task 1 - Preliminary Assignment of Ship Emissions to European Countries. European Commission Directorate General Environment ([http://ec.europa.eu/environment/archives/air/pdf/task1\\_asign\\_report.pdf](http://ec.europa.eu/environment/archives/air/pdf/task1_asign_report.pdf)).
- European Commission and ENTEC UK Limited, 2005. Quantification of Emissions from Ships Associated with Ship Movements between Ports in the European Community. European Commission. DG ENV.C1, Rue de la Loi, 200, B-1049: Brussels, Belgium.
- US EPA, 2009. Current methodologies in Preparing Mobile Source Port-Related Emission Inventories, Final Report, US Environmental Protection Agency (<http://archive.epa.gov/sectors/web/pdf/ports-emission-inv-april09.pdf>)

## Acknowledgement

*The Port of Oslo:* Neilson H., Sørensen T.O., Svendsen T., Hatteland C.J.

*NILU:* Tønnesen D., Vogt M., Sundvor I.

*PortsEYE AS:* Nguyen Thanh T.

## Contact Information:

Susana López-Aparicio,

NILU – Norwegian Institute for Air Research,

Instituttveien 18, NO-2027 Kjeller, Norway

email: [sla@nilu.no](mailto:sla@nilu.no)

Phone: (+47) 63 89 80 74

