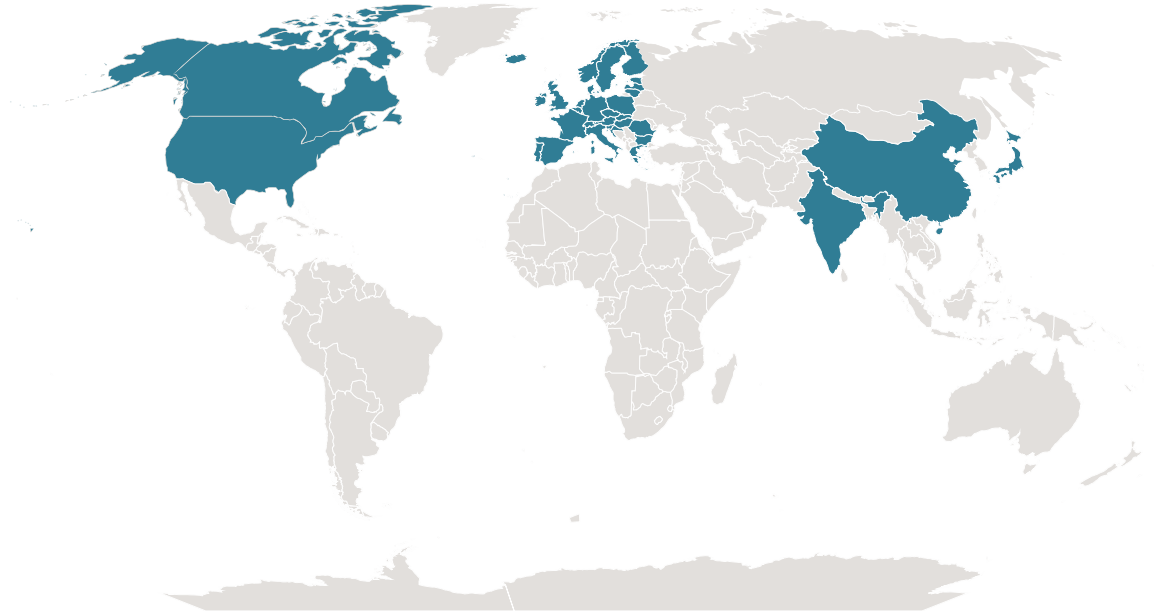
Global regulations governing CO_2 emissions from NRMMs

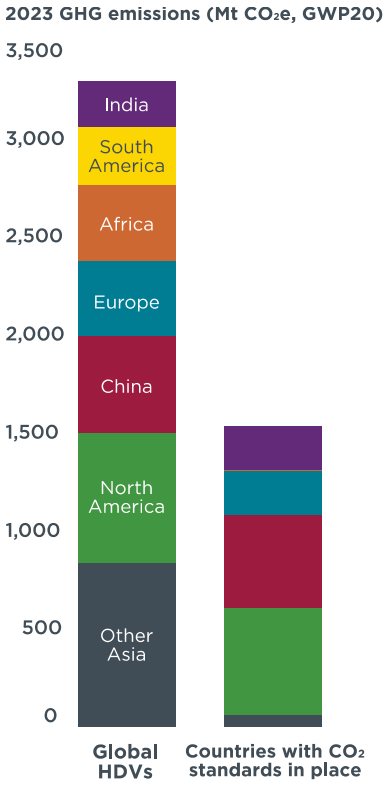
Eamonn Mulholland, Lingzhi Jin

2nd June 2025

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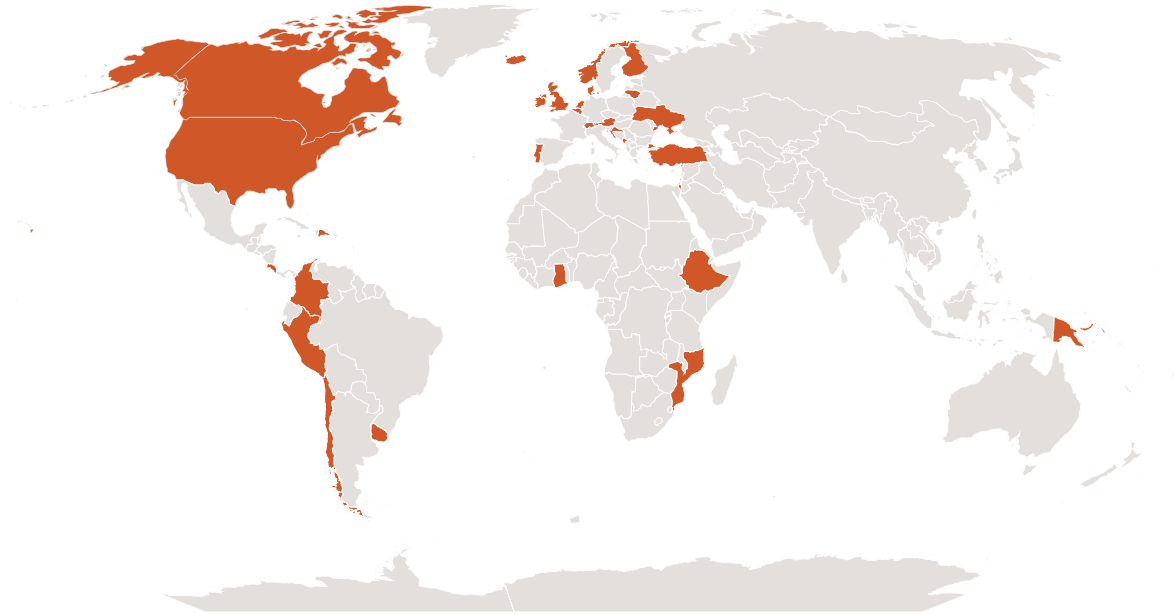
Countries with HDV GHG regulations

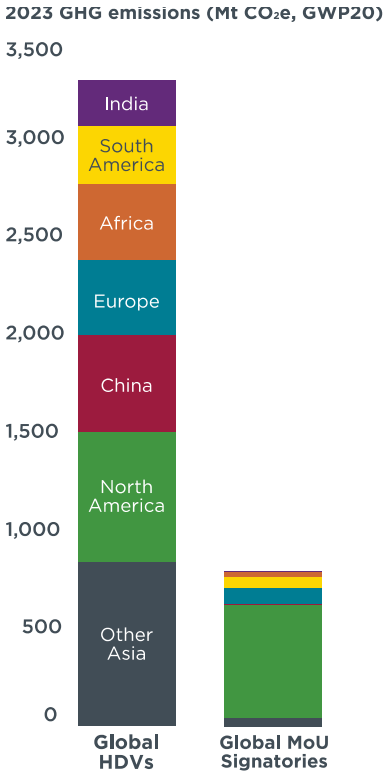




Source: ICCT Roadmap

Global MoU Signatories

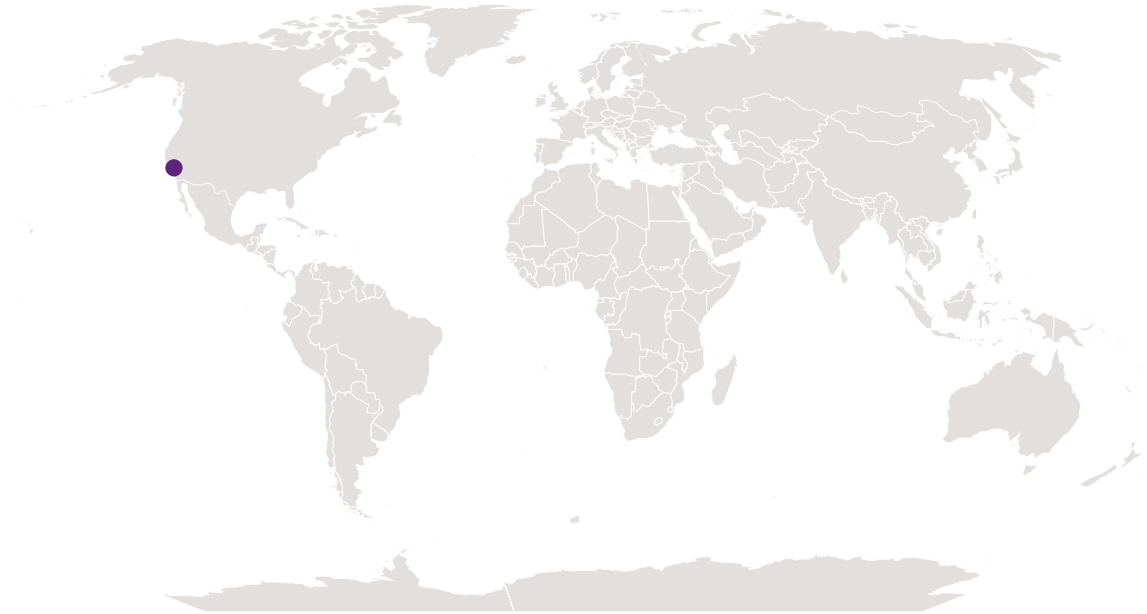


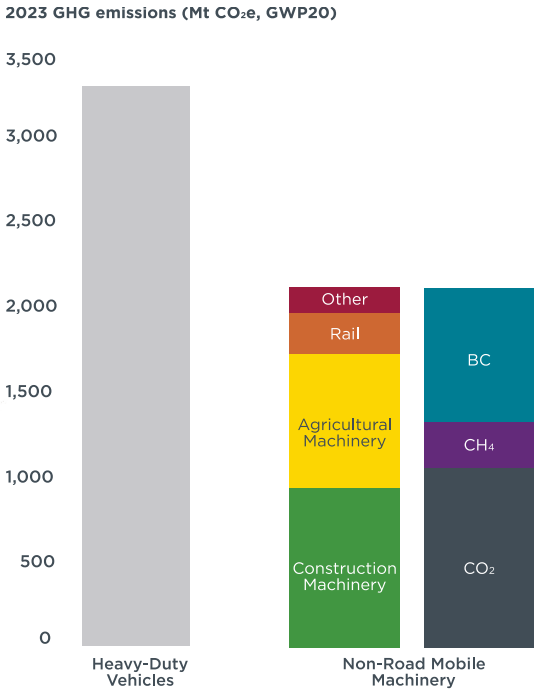


Source: ICCT Roadmap

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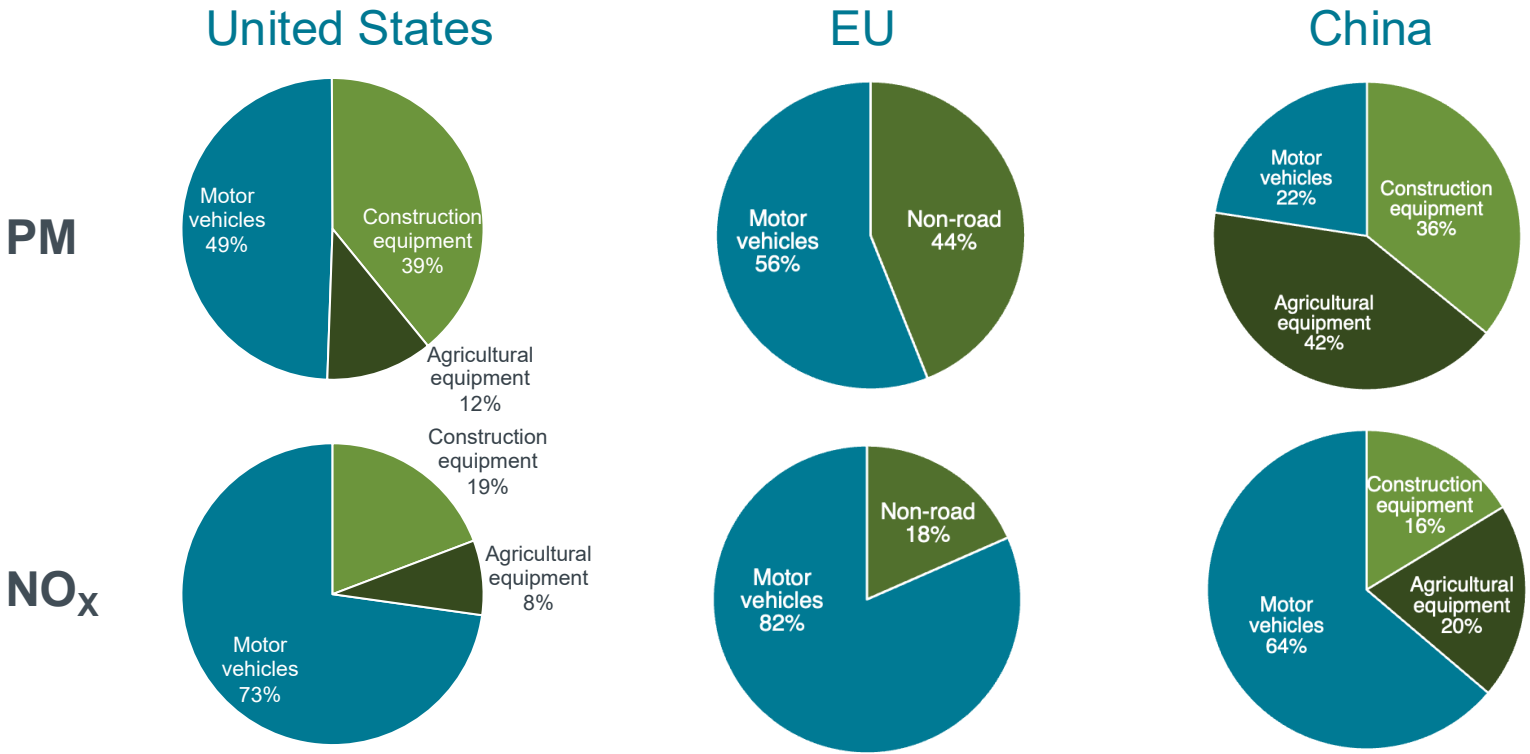
Countries with NRMM GHG regulations





Source: Preliminary results. ICCT internal analysis. Supported by the GAINS model developed by the International Institute for Applied Systems Analysis

Non-road sector has surpassed or approached the on-road sector to become the main emission source of air pollution



Source (the U.S. and China): ICCT internal analyses and 2024 China Mobile Source Environmental Management Annual Report.

EU pollutant emissions is the average data of the Netherlands, Sweden, Finland, Denmark, Germany, and Switzerland: *Lončarević et al. (2022). Problems and Directions in Creating a National Non-Road Mobile Machinery Emission Inventory: A Critical Review. Sustainability.14(6), 3471*

Pollutant standards

California



Tier 4

Adopted 2004

Tier 5 concept introduced in 2021

Expected introduction in 2029

Possible inclusion of **GHG capping standards**

China



Stage IV

Updated in 2020

Consideration to include GHG limits Stage V

India



Stage IV

Adopted 2018

Stage V scheduled for 2025/2026

No special consideration for GHGs

United States



Tier 4

Adopted 2004

Europe



Stage V

Adopted 2016

Monitoring of CO_2 in place

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Sales requirements

IT IS HEREBY ORDERED THAT:

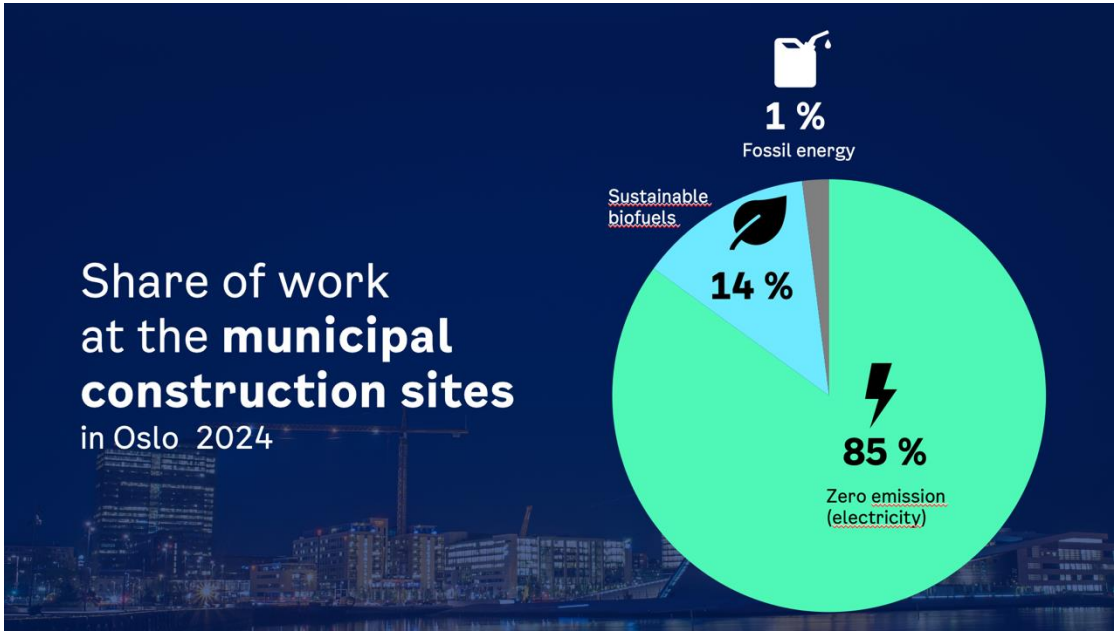
1. It shall be a goal of the State that 100 percent of in-state sales of new passenger cars and trucks will be zero-emission by 2035. It shall be a further goal of the State that 100 percent of medium- and heavy-duty vehicles in the State be zero-emission by 2045 for all operations where feasible and by 2035 for drayage trucks. It shall be further a goal of the State to transition to 100 percent zero-emission off-road vehicles and equipment by 2035 where feasible.

Source: Executive Department State of California: Executive Order N-79-20

ZE sales requirements

- ZE Forklift Rulemaking
  - From 2026: no new sales of spark ignition forklifts
  - 2028-2038: retiring existing spark ignition forklifts
- Generator Engines and Pressure Washers
  - From 2028: must be zero-emission
- Phased Advanced Clean Equipment (PACE)
  - Will set ZE sales requirements for manufacturers
  - Early stages; first workshop commenced in late 2024
  - Potential adoption in 2027 and implementation in 2031

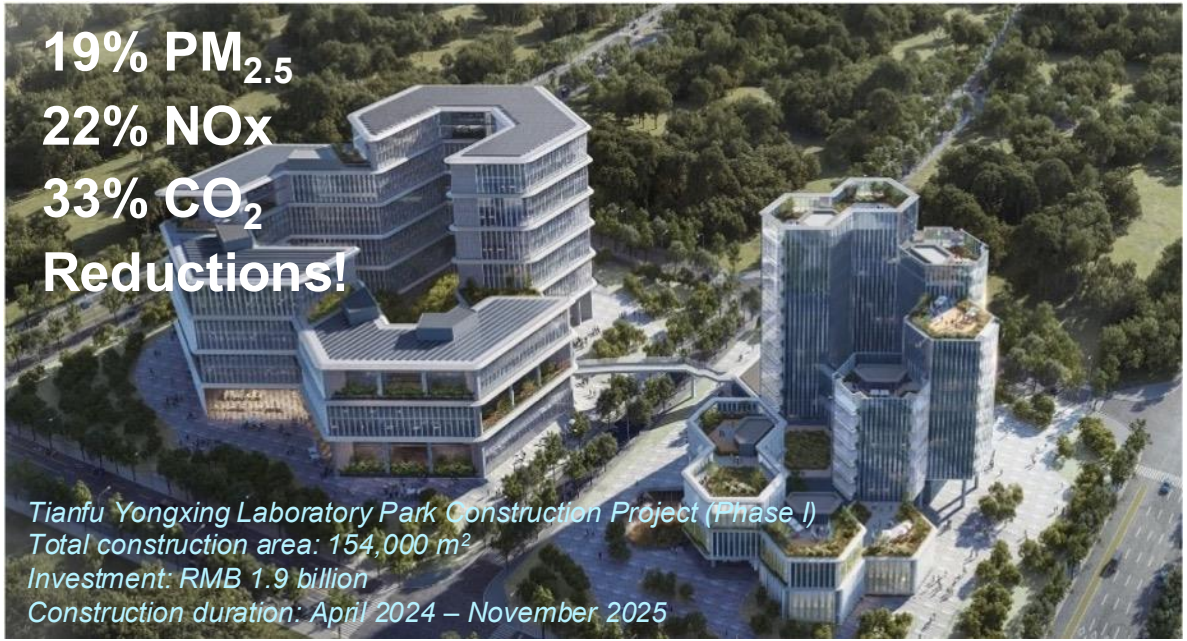
Case: City of Oslo



- **GHG** reduction target:
  95% reduction by **2030** compared to 2009 levels.
- Oslo's ZE goals:
  - **2025:** all **municipal** construction projects to be ZE
  - **2030: all** construction projects citywide to be ZE
- Public procurement standards (since 2019):
  - Fossil fuel-free operations as a baseline requirement
  - ZE adoption incentivized through **evaluation criteria**
- Progress as of 2023 (municipal construction projects): **77% ZE machinery**, 21% sustainable biofuels, 2% fossil fuels.

Source: City of Oslo, CCAC Webinar, 2025

Chengdu launches first Near-Zero Carbon Emission Construction Site Pilot



Electric share of various offroad machinery



Sprinkler Truck



Dump Truck



Cement Truck



Excavator



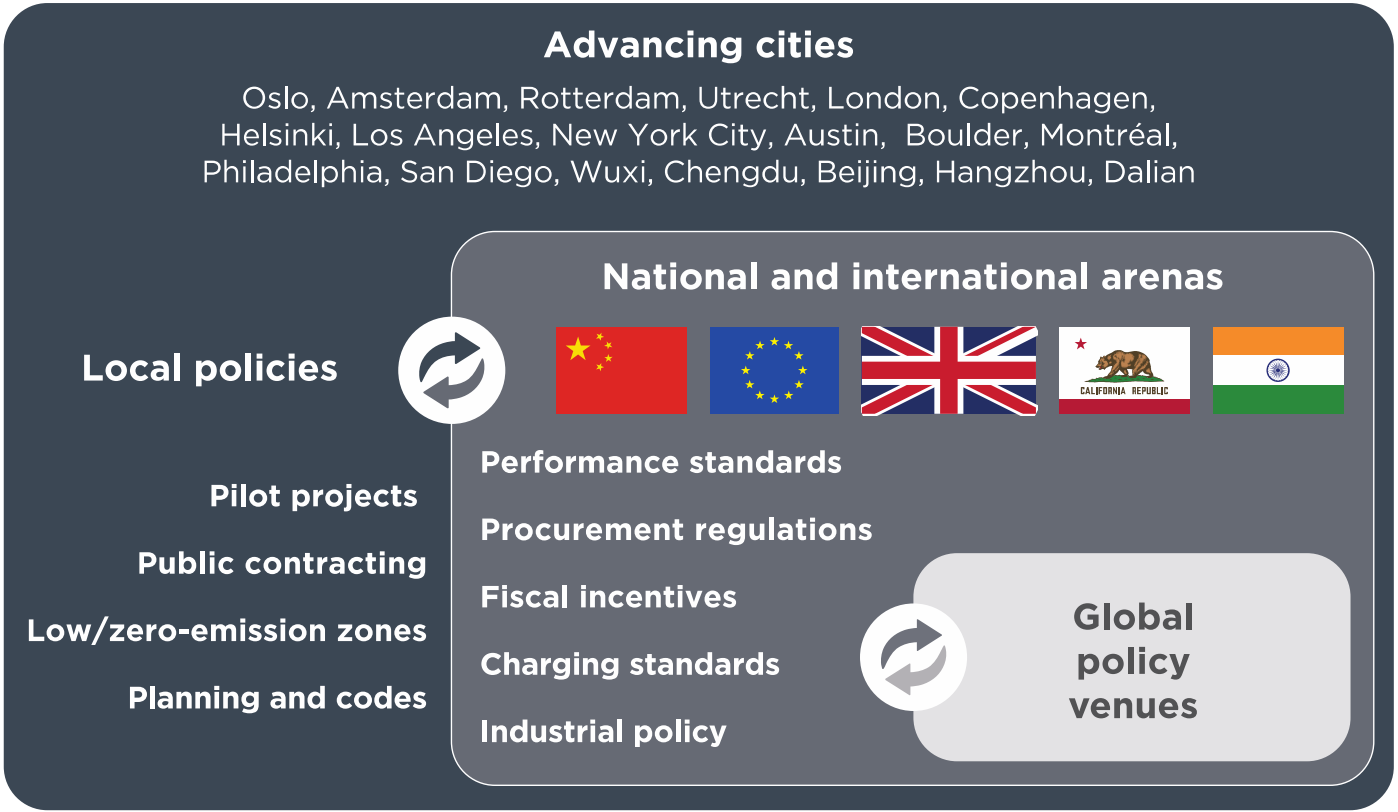
Drilling Rig



Aerial work platform

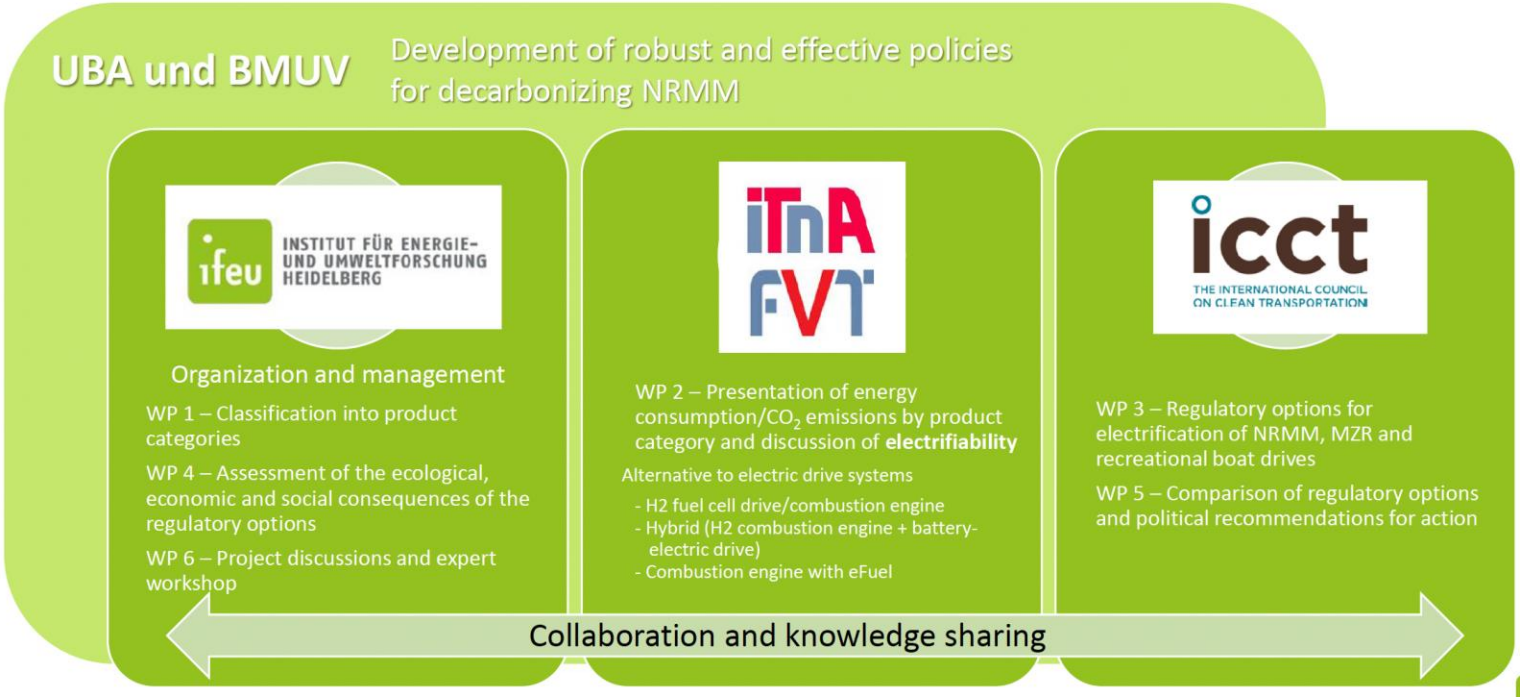
Source: Chengdu Bureau of Ecology and Environment

Policy venues, at all levels, will be fundamental for ZEM



Source: ICCT

Ongoing project: Regulatory options for the decarbonization of NRMM



Questions?

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