

全球零排放非道路机械发展及政策概览

Global off-road equipment zero-emission progress and policy overview

邵臻颖

国际清洁交通委员会

The International Council on Clean Transportation (ICCT)

2023.10

关于国际清洁交通委员会(ICCT)

国际清洁交通委员会(ICCT)宗旨是改善包括轻、重型车、航空、船舶和非道路等所有交通部门及整个交通系统的环境和能耗影响，从而促进人类健康。

The mission of ICCT is to dramatically improve the environmental performance and efficiency of cars, trucks, buses and transportation systems in order to protect and improve public health, the environment, and quality of life.

- 非盈利独立研究组织
- 着眼于空气污染和气候变化影响
- 研究主要针对标准法规政策、辅助性政策
- 研究方向覆盖所有交通部门
- 项目涉及全球主要汽车市场、全球性视角
- 生态环境部为中国代表处主管单位

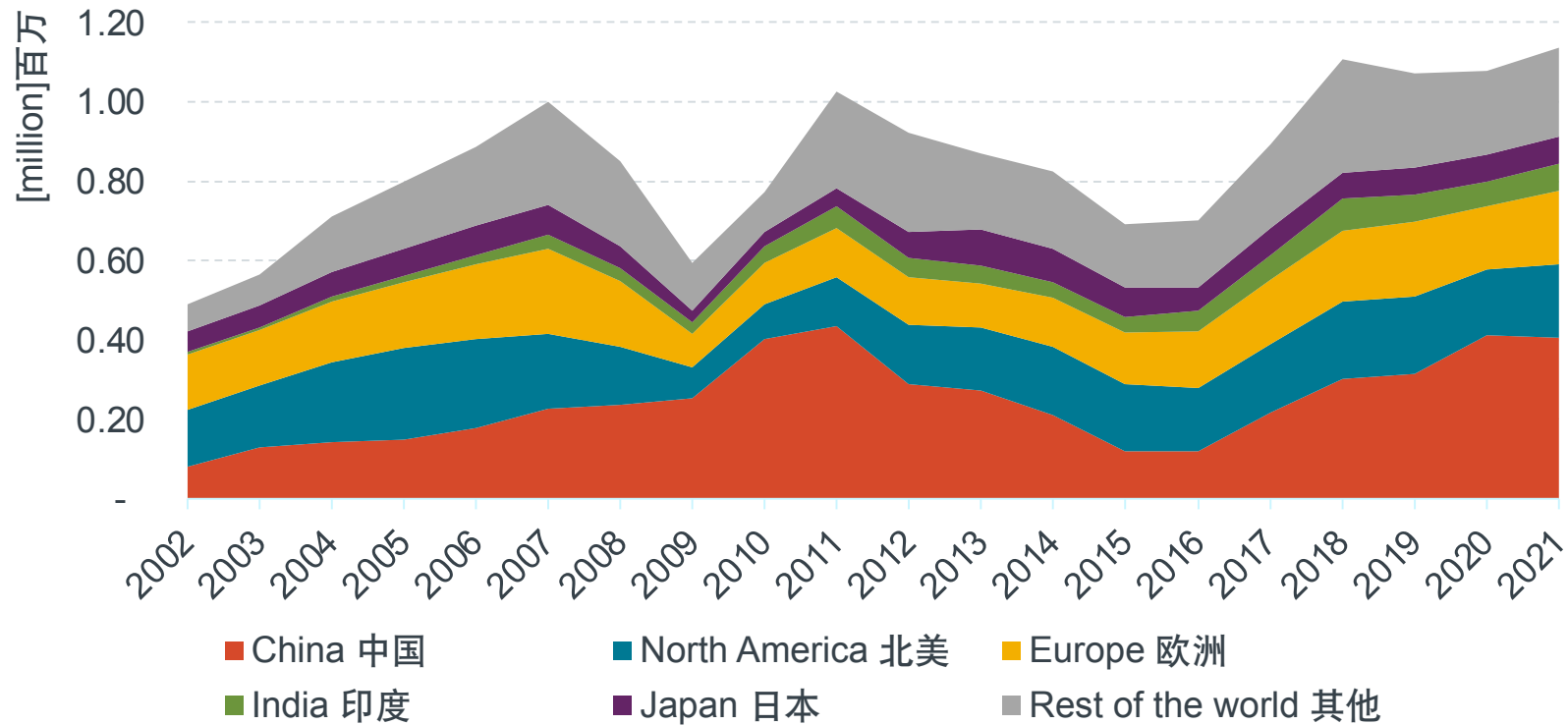
- Non-profit research organization
- Air Pollution and Climate Impacts
- Focus on regulatory policies and fiscal incentives
- Activity across modes in transportation system
- Global outreach, with special focus on largest markets
- Offices in Washington D.C., San Francisco, Berlin, Beijing

全球工程机械增长迅速

The market of construction equipment has grown rapidly

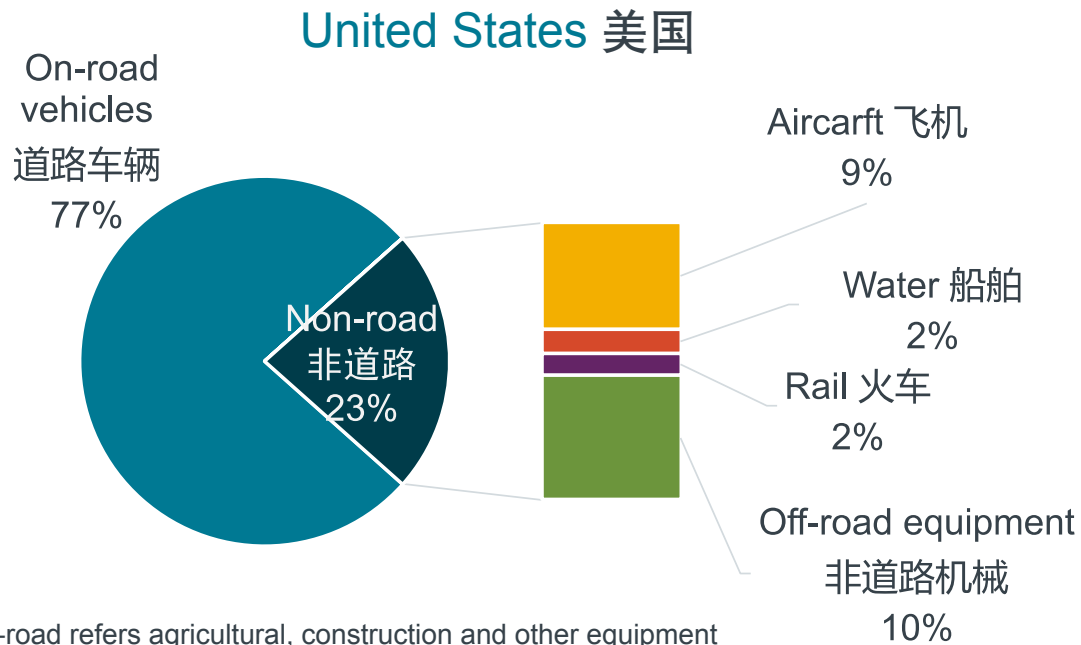
工程机械销量

Construction equipment sales trend



Non-road sector is a significant contributor to mobile source GHGs using United States and China as examples

非道路是移动源温室气体GHG的主要污染源

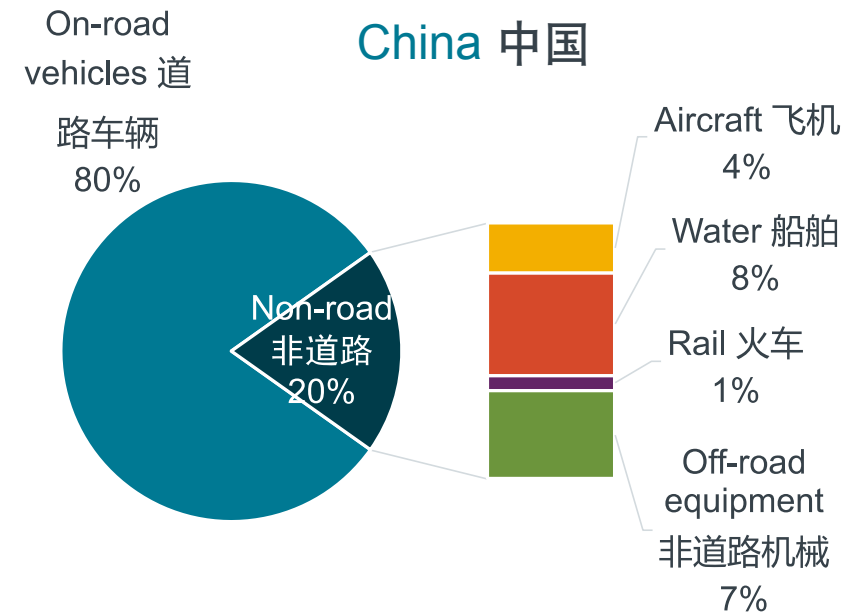


Off-road refers agricultural, construction and other equipment

2019 U.S. Transportation sector GHG emissions by source

US EPA: <https://www.epa.gov/greenvehicles/fast-facts-transportation-greenhouse-gas-emissions>

Aircraft and water exclude international bunkers



Off-road refers agricultural, construction and other equipment

2020 China transportation sector GHG emissions, internal

CO₂-equivalent includes black carbon, assuming GWP-20

Aircraft and water exclude international bunkers.

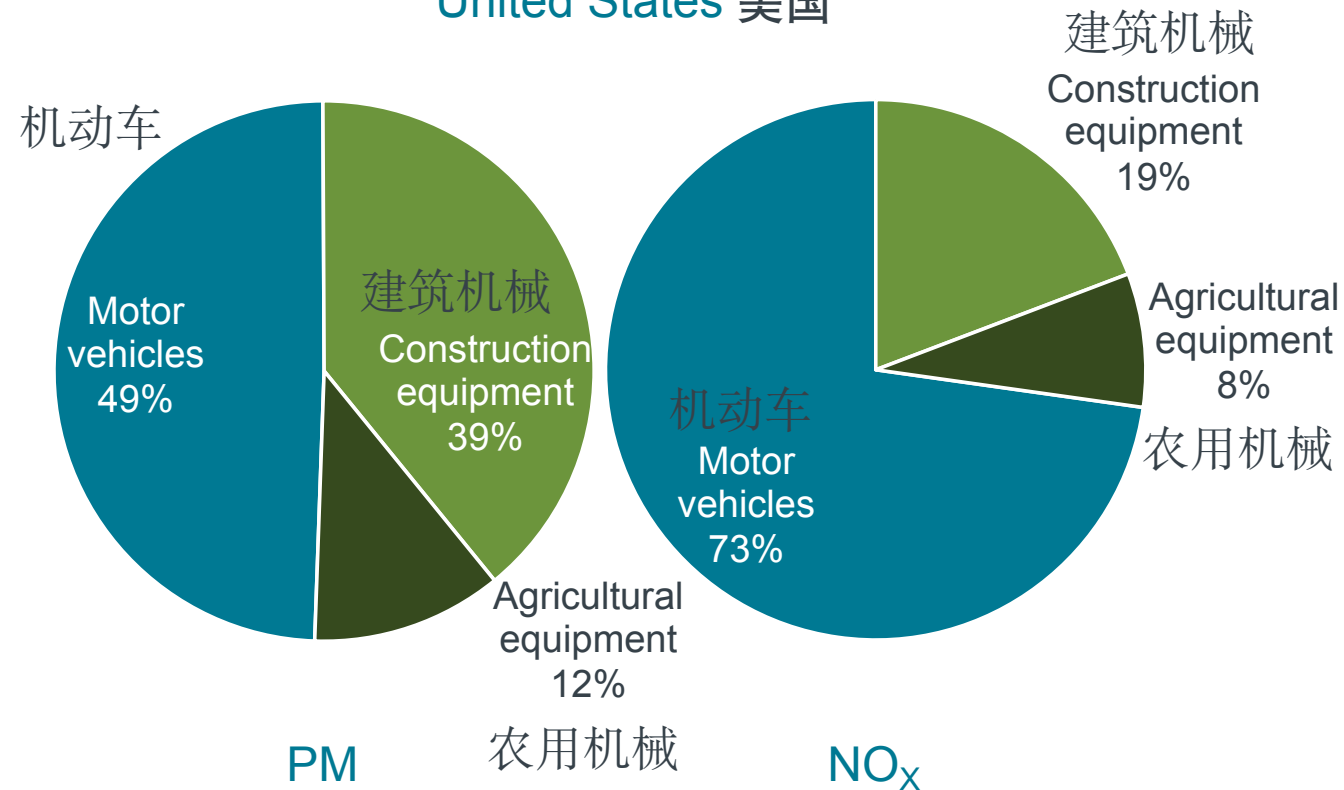
However, it remains unclear regarding the GHG contribution from off-road equipment for many other regions.

然而，很多国家和地区非道路机械对于温室气体排放的贡献仍不清晰。

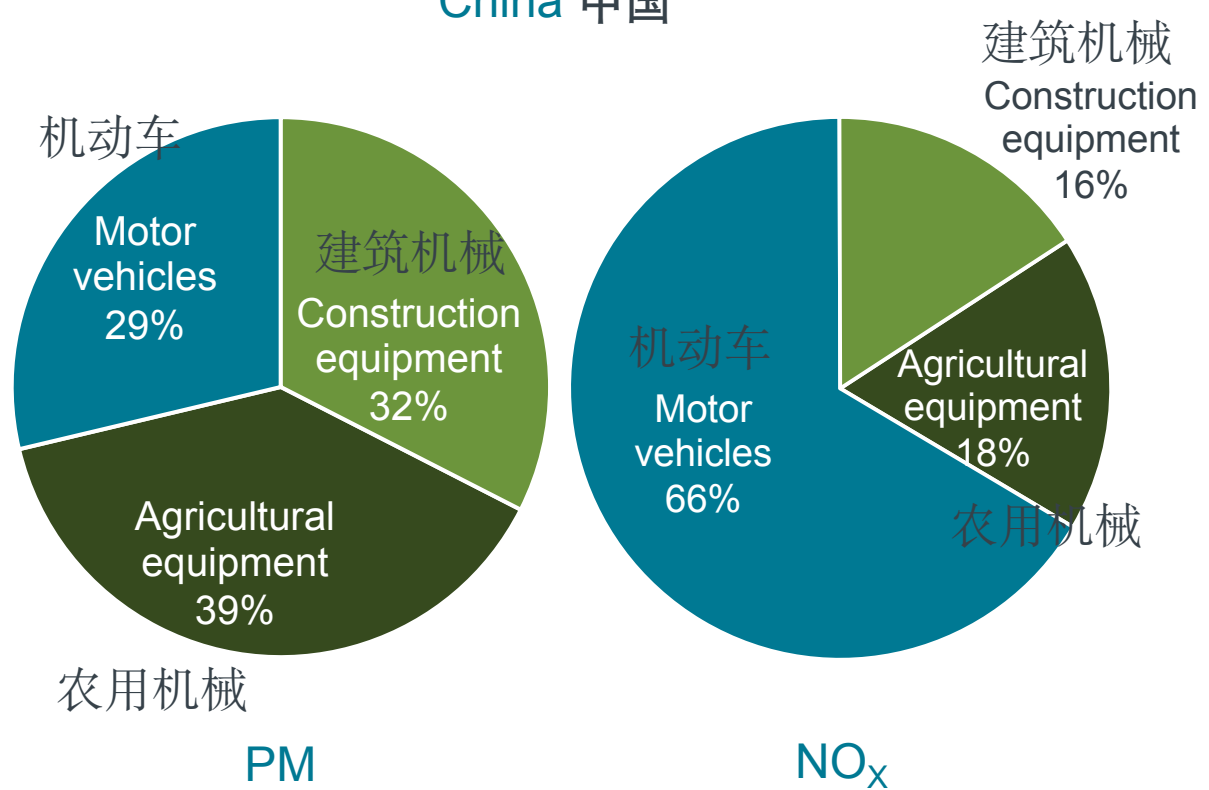
非道路机械已经超越或接近道路部门成为PM和NO_x的主要排放源

Off-road equipment has surpassed or approached the on-road sector to become the main emission source of PM and NO_x

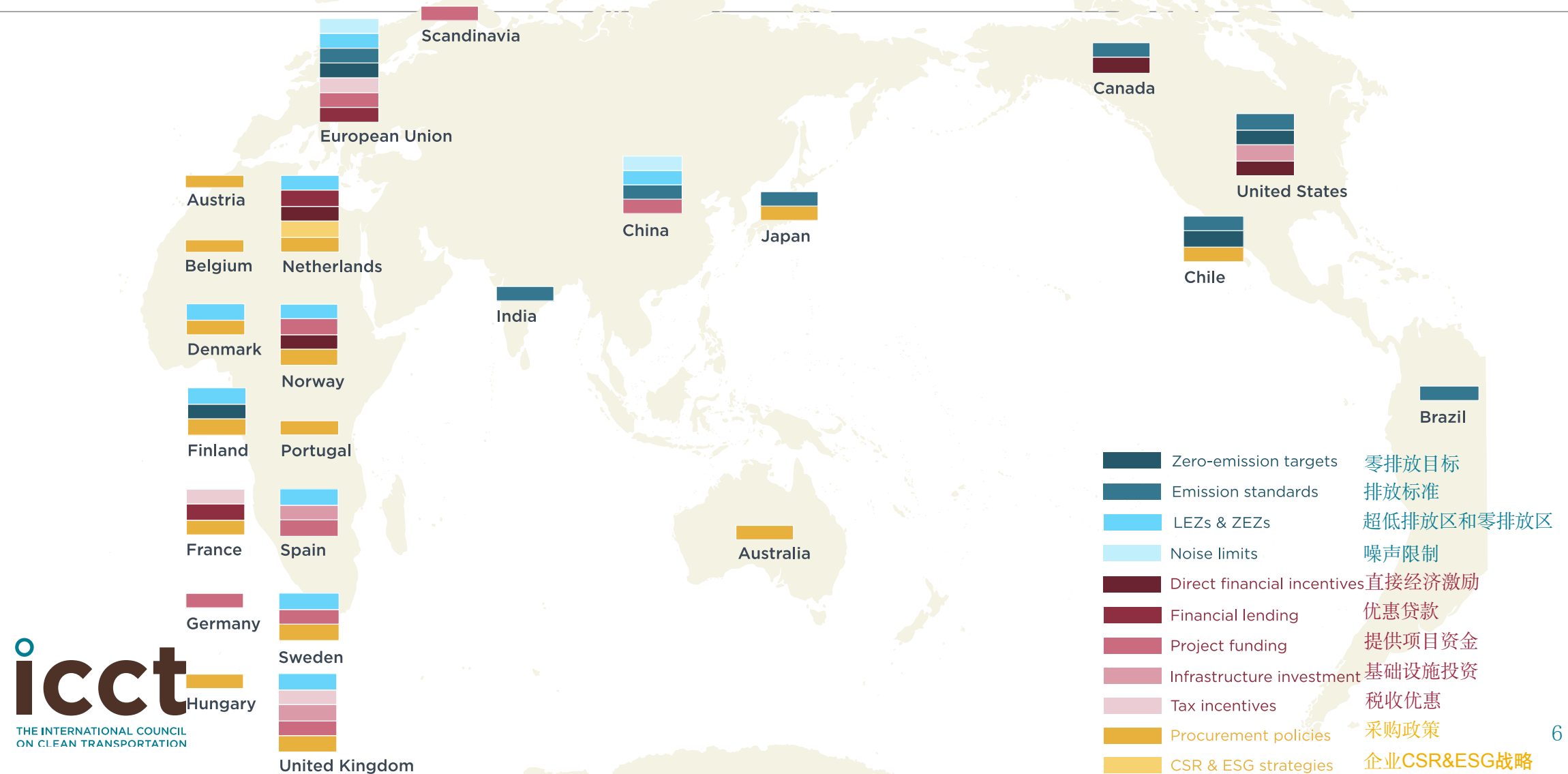
United States 美国



China 中国



越来越多的政府制定了非道路领域的零排放化转型目标，试点零排放机械，设立了零排放区，为工程机械设备全面零排放做准备。Growing governments have set ZE transformation goals in the off-road sector, launched ZE pilots, and established ZEZs



推动零排放机械的主要政策手段

Policy measures that promote ZE machines

零排放目标 Zero-emission targets

排放标准 Emission standards

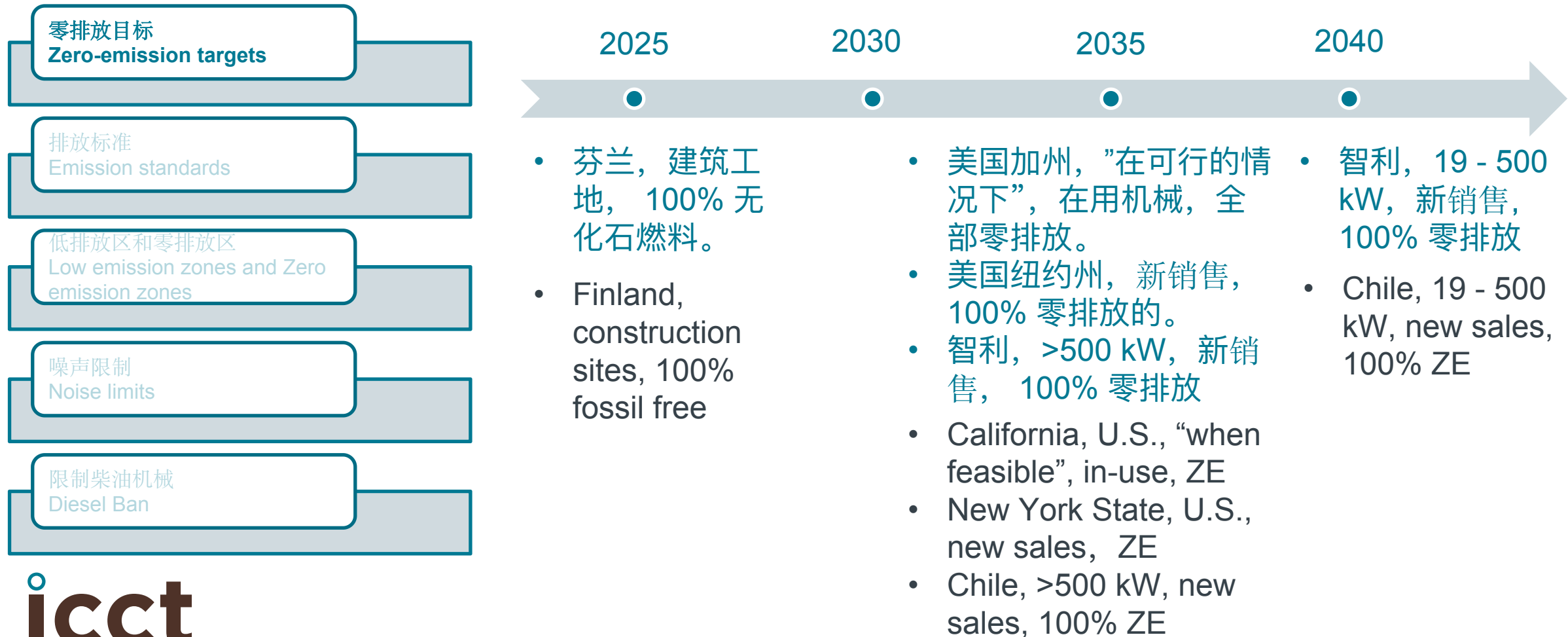
低排放区和零排放区 Low emission zones and Zero emission zones

噪声限制 Noise limits

限制柴油机械 Diesel Ban

明确的、强制性的减排或脱碳目标可以推动出台强有力的政策措施和推进先进技术的应用

A clear emissions reduction or decarbonization goal that is mandatory could force robust policy efforts and the adoption of advanced technologies



对道路车辆的管理经验表明，如果标准足够严格且管理结构合理，可以有效促进零排放技术的应用。 Experience in regulating cars, buses, and trucks shows that such standards can be effective in promoting the adoption of zero-emission technology if they are stringent and well structured.

零排放目标
Zero-emission target

排放标准
Emission standards

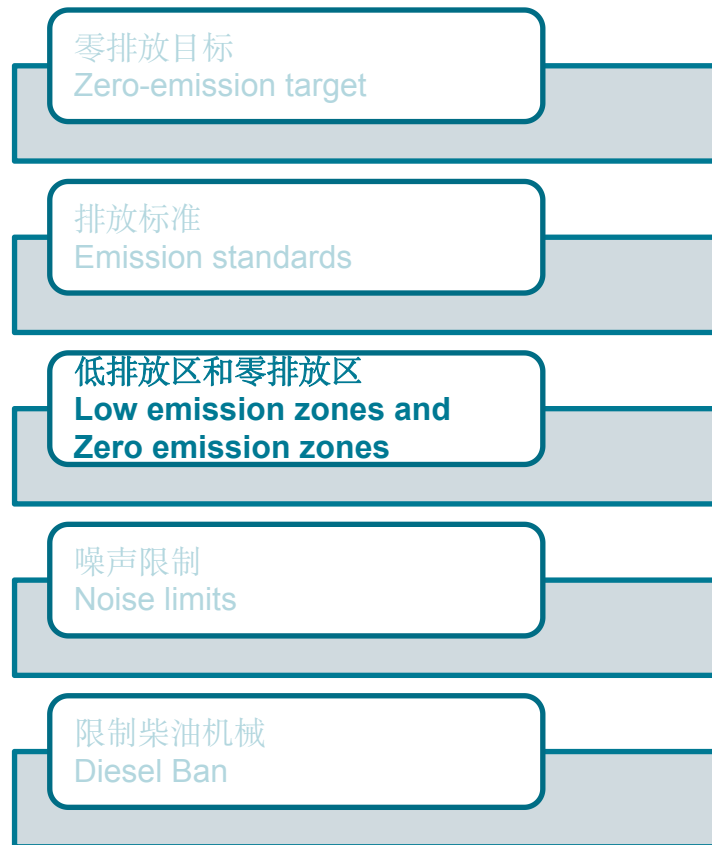
低排放区和零排放区
Low emission zones and Zero
emission zones

噪声限制
Noise limits

限制柴油机械
Diesel Ban

- 欧盟五阶段标准或强制使用颗粒物捕集器
 - **欧盟、印度和中国**均采用了类似标准。
- **加州**正在考虑提议更严格的Tier 5标准，或将第一次包括GHG减排目标。
- 基于道路车辆的管理经验，非道路移动机械可以借助于燃料消耗量、二氧化碳（CO₂）或温室气体（GHG）排放标准来促进零排放技术的应用
- The Stage V emission standard or filter-forcing regulation.
 - The **European Union, India, and China** have adopted this standard.
- **California** is considering proposing Tier 5, which has more stringent limits and a GHG reduction goal for the very first time.
- Experience in regulating on-road vehicles indicates that fuel consumption, carbon dioxide (CO₂), or greenhouse gas (GHG) emission standards can boost ZE technology penetration.

设立超低排放区和零排放区如今已扩展至城市地区的建筑工地。 Ultra Low-emission zones (ULEZs) and zero-emission zones (ZEZs) started with on-road vehicles and now have been extended to construction sites in urban areas



- 英国伦敦推出了世界上第一个非道路低排区，并将于 2040 年将低排区升级为零排放区。
- 挪威奥斯陆试点了世界上第一个零排放建筑工地。
- 哥本哈根（丹麦），赫尔辛基（芬兰）、万塔（芬兰）、鹿特丹（荷兰）、阿姆斯特丹（荷兰），巴塞罗那（西班牙）和维也纳（奥地利）等欧洲其他城市也在计划推动或已经开展零排放建筑工地示范项目。
- 中国已有300多个城市设立了非道路移动机械低排放区，其中有领先城市正在考虑将低排区升级为零排放区。
- London introduced the first off-road LEZ in the world and it is expected to shift to a ZEZ by 2040.
- The city of Oslo, Norway conducted the world's first zero-emission construction site pilot.
- Copenhagen (Denmark), Helsinki (Finland), Vantaa (Finland), Rotterdam (Netherlands), Amsterdam (Netherlands), Barcelona (Spain) and Vienna (Austria) have planned or implemented to spur zero-emission construction sites with demonstration projects.
- Over 300 cities in China introduced construction ULEZs in urban areas and leading cities are considering upgrading to ZEZs.

基于健康和安全管理要求可以有效的限制柴油机械，推动零排放技术的使用。

Some health and safety regulations or guidelines restrict diesel machines and promote zero-emission technology.

零排放目标
Zero-emission target

排放标准
Emission standards

低排放区和零排放区
Low emission zones and Zero emission zones⁷

噪声限制
Noise limits

限制柴油机械
Diesel Ban

- 在欧洲，《户外机械法令》要求无论采用何种机械动力，都需降低机械噪声。
- 近日，工业和信息化部、生态环境部、住房和城乡建设部、市场监督管理总局公布《低噪声施工设备指导名录（第一批）》
- In Europe, the Outdoor Machinery Directive is reducing machinery noise.
- China encourages to implement policies that support the adoption of low-noise equipment, and many of the recommended models are electric.
- 许多国家和地区，包括欧洲国家、加州、加拿大、日本和中国，均已对道路车辆采取了此类限制，但在非道路领域尚未见到类似管理要求。
- Many jurisdictions, including countries in Europe and California, Canada, Japan, and China ban certain diesel road vehicles, but similar bans are not seen yet in the off-road sector

推动零排放机械的主要经济财政手段

Fiscal measures that promote ZE machines

直接经济激励 Direct financial incentives

优惠贷款 Preferential lending

提供项目资金（包括试点项目） Project funding, including pilot projects

基础设施投资 Infrastructure investment

税收优惠 Tax incentives

优化价格差能加速零排放机械的购买

Incentivizing ZE technologies could accelerate the purchase

直接经济激励

Direct financial incentives

加州，CORE补贴计划，提供每台机械高达50万美元的补贴。California's CORE incentive program, offering up to \$500,000 to ZE equipment.
荷兰，SSEB国家级激励方案，为每台机械设备提供高达50%的采购价格补贴。Netherlands has a national incentive program, called SSEB, offering up to 50% of the purchase price of each piece of equipment

优惠贷款

Preferential lending

奥斯陆，为零排放机械提供的低息融资。Oslo has low-cost financing for ZE machinery.
欧盟层面，在新的 InvestEU计划的支持下，欧洲投资银行为法国、荷兰租赁公司提供贷款，用于购买电动化机械设备。At the EU level, the European Investment Bank has invested in purchasing ZE equipment for the fleet of French and Netherlands rental companies, supported by the EU's new InvestEU program.

税收优惠 Tax incentives

英国、法国自2019年起逐步取消了非道路机械柴油减税税率。The United Kingdom and France began gradually eliminating its reduced tax rate for off-road diesel from 2019.

未来碳税政策可能会扩大到涵盖工程机械排放。Emissions credits can be traded across the European Union and the system may be expanded to cover construction machinery emissions in future.

需要各方的资金投入

Fiscal incentives at all levels can help

提供项目资金（包括
试点项目）

Project funding,
including pilot
projects

由斯堪斯卡和沃尔沃资助的试点项目在采石场试点应用了零排放和低排放机械。A pilot program funded by Skanska and Volvo tested zero- and low-emission machinery in a quarry. 领先的小型设备供应商威克诺森在斯图加特和巴塞罗那的开展了零排放机械试点应用。Leading smaller equipment supplier Wacker-Neuson piloted its machines at test sites in Stuttgart and Barcelona.

基础设施投资

Infrastructure
investment

奥斯陆在其零排放区试点项目中包括了基础设施投资。Oslo's ZEZ pilot included investment in infrastructure. 一些港口项目中，为包括码头牵引车、正面吊和集装箱装卸机等非道路移动机械提供了基础设施投资。In some port projects, infrastructure investment is being provided for off-road machines including terminal tractors, reach stackers, and container handlers.

推动零排放机械的其他手段

Other measures that promote ZE machines

采购政策 Procurement policies

企业社会责任 (CSR) 以及环境、社会和治理 (ESG) 战略

Corporation social responsibility (CSR) and environmental, social and governance (ESG) strategies

零排放机械试点的一些先期国际经验

Early international experiences in piloting ZE equipment

- 建立非道路移动机械数据库和排放清单。 Establish an off-road equipment database and emission inventory.
- 制定与气候变化缓解目标相一致的长期减排或脱碳目标。 Establish long-term emissions reduction or decarbonization targets that are consistent with climate change mitigation goals.
- 制定标准和法规，要求实现中期目标。 Develop standards and regulations that require the achievement of mid-term goals.
- 财税激励措施可以加速市场发展。 Fiscal and tax incentives can accelerate market development.
- 通过政-企-学-研-用多方合作以推动一揽子解决方案。 Build a multi-stakeholder platform to engage policymakers, industry, end-users, and research entities in order to develop integrated solutions.



zhenying@theicct.org

icct
THE INTERNATIONAL COUNCIL
ON CLEAN TRANSPORTATION