ANNUAL REPORT 2017

icct

THE INTERNATIONAL COUNCIL
ON CLEAN TRANSPORTATION

TABLE OF CONTENTS

ICCT's Year in Review 1

Emissions Standards 3

Efficiency 6

Compliance and Enforcement 9

The TRUE Initiative 10

Real-World Emissions 11

Electrification 14

Soot-Free Transport 16

Maritime Shipping 19

Low-Carbon Fuels and Biofuels 23

Staff 24

THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

Washington DC office: 1225 I Street NW, Suite 900, Washington DC 20005

San Francisco office: One Post Street, Suite 2700, San Francisco CA 94104

Berlin office: Neue Promenade 6, 10178 Berlin

Beijing office: Room 2505, No.19, Jianguomenwai St., CITIC Building, Beijing 100004

www.theicct.org | communications@theicct.org | @TheICCT

© 2018 International Council on Clean Transportation

ICCT'S YEAR IN REVIEW

The development of cleaner transportation options, from passenger vehicles to ships, is a global concern. Undeniably, the Trump Administration's proposed rollback of greenhouse gas emission standards for passenger cars is inconsistent with the global need to address climate change, and it is creating major uncertainly for the auto industry. The proposed regulation also seeks to deny California's authority to set its own emission standards, and by extension, the authority of 12 other states plus Washington DC. Those who follow this space closely will know that California—along with the U.S.—has been the world's pace setter for clean and efficient vehicles for decades. These actions create a massive vacuum for other nations, and cities, to fill.

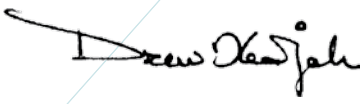
And indeed, that is what is happening, as progress on clean vehicle standards has continued apace across the globe. As you will read in the pages of this annual report, other major markets, such as Europe and China, have continued to press on. The European Union has moved ahead with a proposal to set CO_2 standards for passenger cars out to 2030, and first-ever CO_2 standards for heavy-duty vehicles. Both Europe and China have adopted variations on the California zero emission vehicle mandate, recognizing that electric vehicles will continue to need regulatory support for years to come. India has implemented the first fuel consumption standards for heavy-duty vehicles and is also considering pathways to electrification.

Beyond countries, cities are a new source of regulatory energy for cleaning up motor vehicles, with ideas ranging from bans to low emission zones to scrappage programs to clean bus procurement. As part of the newly created TRUE (The Real Urban Emissions) initiative, ICCT launched a remote emissions testing campaign in partnership with the cities of London and Paris. We also launched a Soot-Free, Clean Bus campaign to gather commitments from major bus manufacturers (Volvo, Scania, BYD, Cummins) to make available soot-free, clean buses to 20 global megacities. And we are building the evidentiary base for establishing best practices to support electric vehicle uptake through a series of global studies to identify innovative EV policies in major cities.

ICCT board members and staff in Washington, DC

ICCT Berlin office 5th anniversary

Institutionally, the ICCT's European office marked its 5th anniversary and celebrated an already substantial track record of work in European Union member states. The ICCT is also building a presence in China, having gained support from China's Ministry of Ecology and Environment to found a legal representative office in Beijing. Finally, we are hard at work on a five-year strategic plan, Vision 2025, that will guide our efforts over the next five years, so stay tuned. . .



Drew Kodjak
Executive Director

Road transportation is one of the leading sources of outdoor air pollution in Southern and Western Africa, where emissions from light- and heavy-duty vehicles, minibuses, buses, and two-and three-wheelers continue to negatively affect public health, making motor vehicles a central area for rapid policy response.

Developing a roadmap for the adoption of clean fuel and vehicle standards in Southern and Western Africa

EMISSIONS STANDARDS

In 2017, progress was made worldwide on strengthening vehicle emission standards. A roadmap for Euro 6/VI equivalent standards for light and heavy-duty vehicles was proposed in Brazil, and filter-forcing emission standards were proposed for non-road vehicles in India. There was also policy movement on real-driving emissions tests in Europe, and China proposed its first portable emissions testing standard for heavy-duty vehicles. In the European Union, ICCT worked to advance the implementation of increased emission standards, releasing an emission reduction technologies assessment for the European car and van fleet and offering a strategy to implement stronger standards for heavy-duty vehicles. The ICCT is also expanding its work to Africa, where countries have some of the most lenient emission standards in the world. In 2017, ICCT released a “roadmap” for establishing clean fuel and vehicle standards on the continent. Additional select activities are outlined below.

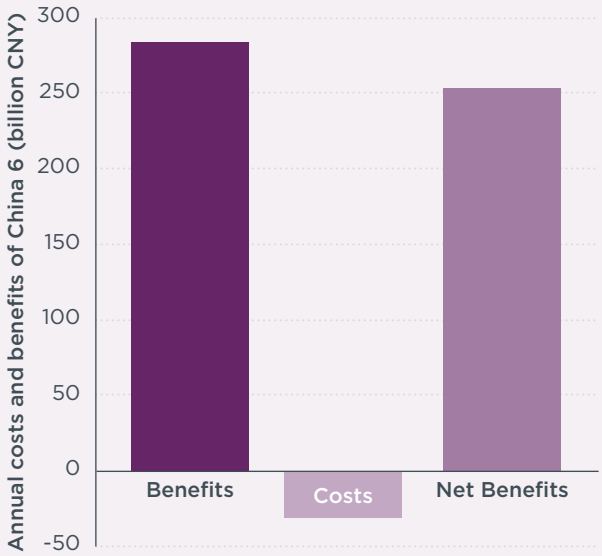
INFORMING GOVERNMENTS

In September, Drew Kodjak, ICCT's Executive Director, testified before the U.S. EPA on the agency's proposal to reconsider its final determination on the mid-term evaluation of the 2025 light-duty vehicle GHG standards. In March, Nic Lutsey, ICCT's electric vehicles program director and U.S. lead, testified before the California Air Resources Board with regards to California's midterm review of the U.S. 2025 passenger car standards. His testimony highlighted an ICCT report which provides a strong technical basis for maintaining the 2025 standards because of technological innovation and lower costs.

ICCT's Peter Mock at a Global Fuel Economy Initiative event, ITF Annual Summit

ICCT'S IMPACT IN CHINA

In February, China's Ministry of Environmental Protection (MEP) recognized ICCT's "outstanding contribution" in supporting the development of China's sixth stage emission standard for light-duty vehicles. The standard, among the world's most stringent, is expected to substantially reduce emissions from four major ambient air pollutants by 2030. Over the last 2 years, the ICCT produced over a dozen research papers on technical aspects related to supporting the standard.



2030 annual costs and benefits of implementing China 6 LDV emission standards in Guangdong (Early Adoption scenario vs. BAU)

KEY PUBLICATIONS

- CO_2 reduction technologies for the European car and van fleet, a 2025–2030 assessment (white paper)
- A roadmap for heavy-duty engine CO_2 standards within the European Union framework (briefing)
- Developing a roadmap for the adoption of clean fuel and vehicle standards in Southern and Western Africa (report)
- Cost-benefit assessment of proposed China 6 emission standard for new light-duty vehicles (working paper)

The growth of CO_2 emissions from commercial vehicles has significantly outpaced those of passenger vehicles; from 1990 to 2014 CO_2 emissions of commercial vehicles increased by 25%, while the passenger car emissions did so by 12%.

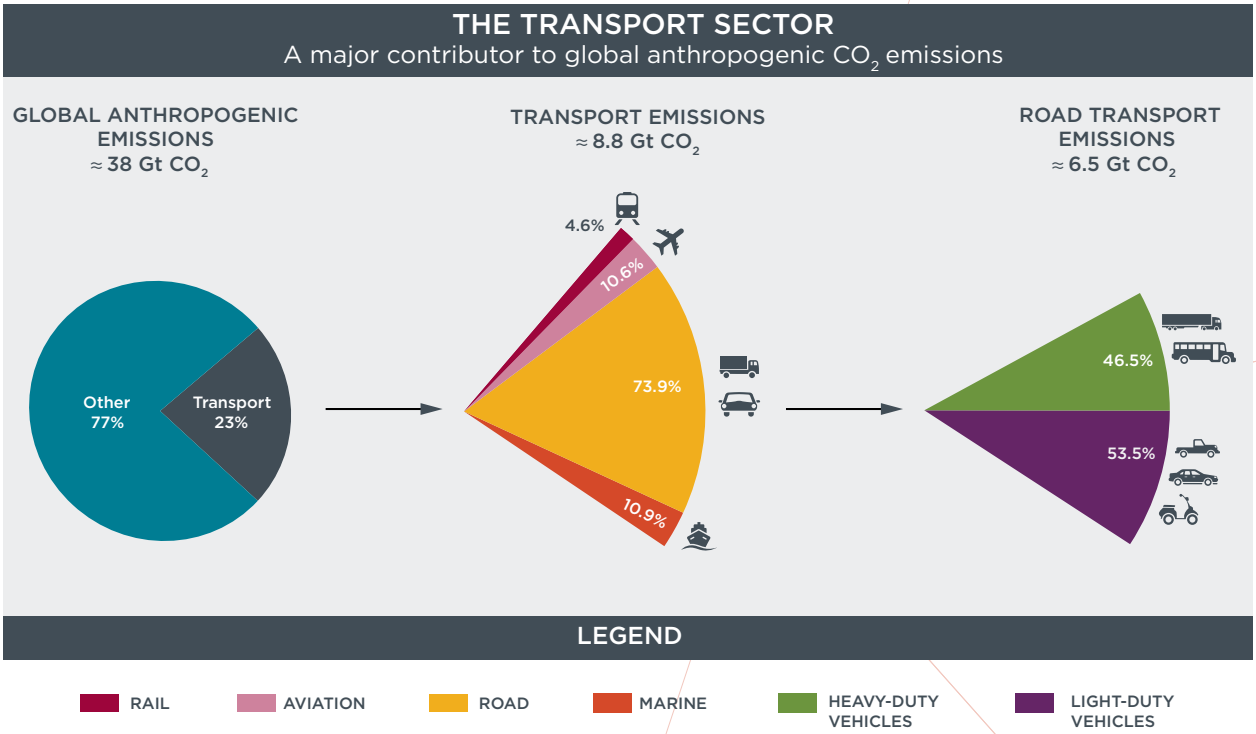
Fuel efficiency technology in European heavy-duty vehicles: Baseline and potential for the 2020–2030 timeframe

EFFICIENCY

Fuel efficiency standards are a key part of reducing greenhouse gas emissions from the transportation sector. ICCT analyzes innovative fuel technologies and policy incentives in Europe, India, and elsewhere around the globe. Select ICCT work on fuel efficiency in the aviation, heavy-duty vehicle, and passenger vehicle markets is highlighted below.

HEAVY-DUTY VEHICLES

While heavy-duty vehicles represent only 10% of the global vehicle fleet, they account for nearly half of on-road greenhouse gas emissions. Many countries are turning their attention to fuel efficiency and emission standards for HDVs. In 2017, ICCT preformed market analyses for heavy-duty vehicles in China and the EU, exploring the potential of fuel efficiency technologies to reach emissions targets.

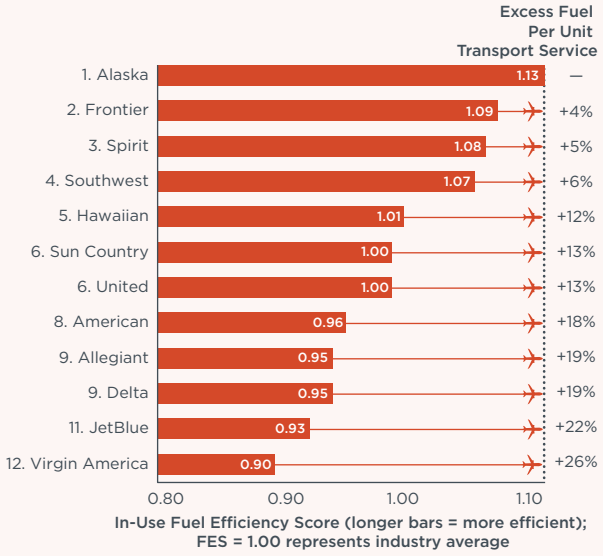


INDIA HDV

ICCT partnered with Lawrence Berkeley National Laboratory to examine the potential of fuel-efficient technologies for new heavy-duty vehicles in India over the next decade. The final report shows that India has a substantial opportunity to improve HDV fuel efficiency by 20% to 35% using low-cost technologies. This work was conducted under the U.S.-India technical cooperation on heavy-duty vehicles overseen by the U.S. Department of Energy and by the Petroleum Conservation Research Association in India.

AIRLINE FUEL EFFICIENCY

ICCT published an update to its U.S. domestic airline fuel efficiency ranking, finding the gap between most efficient (Alaska, for the seventh year running) and least efficient airline (Virgin) widened to 26%. ICCT also performed its first transborder fuel-efficiency ranking of airlines flying between the U.S and Canada, finding fuel efficiency ranging from 12 to 32 passenger km per liter of fuel, depending on flight length. Both rankings demonstrate there is much room for improvement in the sector.



Average fuel efficiency of flights between the 10 Canada-U.S. transborder routes

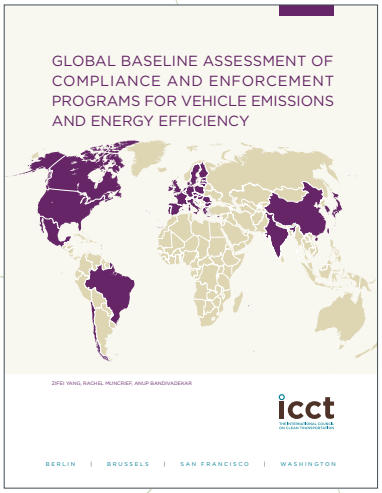
KEY PUBLICATIONS:

- Fuel-efficiency technology in European heavy-duty vehicles: Baseline and potential for the 2020–2030 timeframe [white paper]
- Improved heavy-duty vehicle fuel efficiency in India: Benefits, costs and environmental impacts [report]
- 2015-2016 Annual update to the domestic airline fuel-efficiency ranking [white paper]
- Canada-U.S. transborder airline fuel-efficiency ranking [working paper]
- Efficiency technology and cost assessment for U.S. 2025–2030 light-duty vehicles (white paper)

Not all regulatory agencies are sufficiently empowered to enforce compliance of the standards, including the authority to mandate recalls and impose punitive penalties.

Global baseline assessment of compliance and enforcement programs for vehicle emissions and energy efficiency

COMPLIANCE AND ENFORCEMENT



Strong compliance and enforcement programs are vital to ensuring emission and fuel standards are effective and the transportation sector continues to innovate and work towards a cleaner environment. In addition to research on real-world emissions, ICCT released a "Global baseline assessment of compliance and enforcement programs for vehicle emissions and energy efficiency." The study is the first to take stock of existing compliance and enforcement practices pertaining to emission and efficiency regulations in key vehicle markets. The baseline survey is intended to guide ICCT's future work on compliance efforts around the globe.

KEY FINDINGS:

- Not all regulatory agencies have sufficient legal authority to appropriately enforce compliance
- Budget and resource constraints frequently hamper compliance and enforcement programs
- Successful compliance and enforcement programs test vehicles at various stages of their useful life and put the testing burden on manufacturers
- Penalties for noncompliance vary significantly across regions
- Many programs lack transparency, making public monitoring and oversight difficult or impossible, and undermining public confidence

KEY PUBLICATIONS:

- Global baseline assessment of compliance and enforcement programs for vehicle emissions and energy efficiency (report)
- Shifting gears: The effects of a future decline in diesel market share on tailpipe CO_2 and NO_x emissions in Europe (white paper)
- Road tested: Comparative overview of real-world versus type-approval NO_x and CO_2 emissions from diesel cars in Europe (white paper)

THE TRUE INITIATIVE

Heavily impacted by emissions from traffic and passenger vehicles, cities are now taking the initiative to implement their own emissions programs above and beyond those established at the national level.

As a founding member of The Real Urban Emissions (TRUE) Initiative, ICCT is assisting a growing number of cities in gathering and publishing transparent real-world emissions data. This data will support insights into what policy measures could prove to be effective in curbing emissions from road transport.

In March 2017, ICCT executive director Drew Kodjak joined Mayor Anne Hidalgo of Paris and Mayor Sadiq Khan of London to announce their cities will be the first to use data from the TRUE project to help consumers make more informed choices about the environmental impact of the cars they drive.

THE REAL URBAN EMISSIONS INITIATIVE

Members of the TRUE initiative at AirVolution with London Mayor Sadiq Khan, Paris Mayor Anne Hidalgo, and Seoul Mayor Park Won-soon.

Table ES1. Evaluation of best practices for compliance and enforcement programs in major vehicle markets.

Region/country		Best Practices						
		Establish clear legal authority	Avoid conflicts of interest	Obtain the necessary resources	Conduct reliable testing and checks at all stages of production and use	Use corrective actions	Prioritize data and information transparency	Create a roadmap for program development
Asia	China	●++	●+	●+	●++	●+	●	●+
	India	●+	●+	●+	●+	●	●	●+
	Japan	●++	●++	●+	●++	●++	●	●+
	South Korea	●++	●++	●++	●++	●++	●+	●+
Europe	EU	●	●+	●+	●	●+	●	●+
	France	●+	●	●+	●+	●+	●	●+
	Germany	●+	●	●+	●+	●+	●	●+
	UK	●+	●	●+	●+	●+	●+	●+
North America	California	●++	●++	●++	●++	●++	●+	●+
	Canada	●+	●++	●+	●++	●	●	●+
	Mexico	●+	●+	●	●	●	●	●
	U.S.	●++	●++	●++	●++	●++	●+	●+
South America	Brazil	●++	●+	●+	●	●+	●	●
	Chile	●+	●+	●+	●+	●	●+	●+

● *The country does not sufficiently meet any criteria for this practice.*

● *+ The country meets some criteria for this practice.*

● *++ The country meets all criteria for this practice.*

REAL-WORLD EMISSIONS

Emissions testing by ICCT staff in China using a portable emissions measurement system

On-road emissions testing is a vital component of compliance and enforcement efforts needed to ensure emission standards are having their intended impact. Tests from the European Union reveal that for diesel Euro 6 vehicles tested, the average real-world level of nitrogen oxide emissions was 4.5 times above the Euro 6 limit and that the real-world vehicle fuel consumption gap in Europe is at all-time high. ICCT used real-world emissions data to compile a comparison of official and real-world fuel consumption and CO2 values for passenger cars in Europe, the United States, China, and Japan. ICCT plans to expand on this work in the future.

Before 2015 and the discovery of Volkswagen's use of an illegal defeat device in all of its diesel cars in the United States, few had systematically reviewed on-road NO_x emissions.

Road tested: Comparative overview of real-world versus type-approval NO_x and CO_2 emissions from diesel cars in Europe

KEY PUBLICATIONS:

- Impacts and mitigation of excess diesel NOx emissions in 11 major vehicle markets (report, fact sheet, press release, webinar YouTube link)
- Road tested: Comparative overview of real-world versus type-approval NO_x and CO_2 emissions from diesel cars in Europe (white paper)
- From laboratory to road international: A comparison of official and real-world fuel consumption and CO_2 values for passenger cars in Europe, the United States, China, and Japan (white paper)
- From laboratory to road: A 2017 update of official and "real-world" fuel consumption and CO_2 values for passenger cars in Europe (white paper)

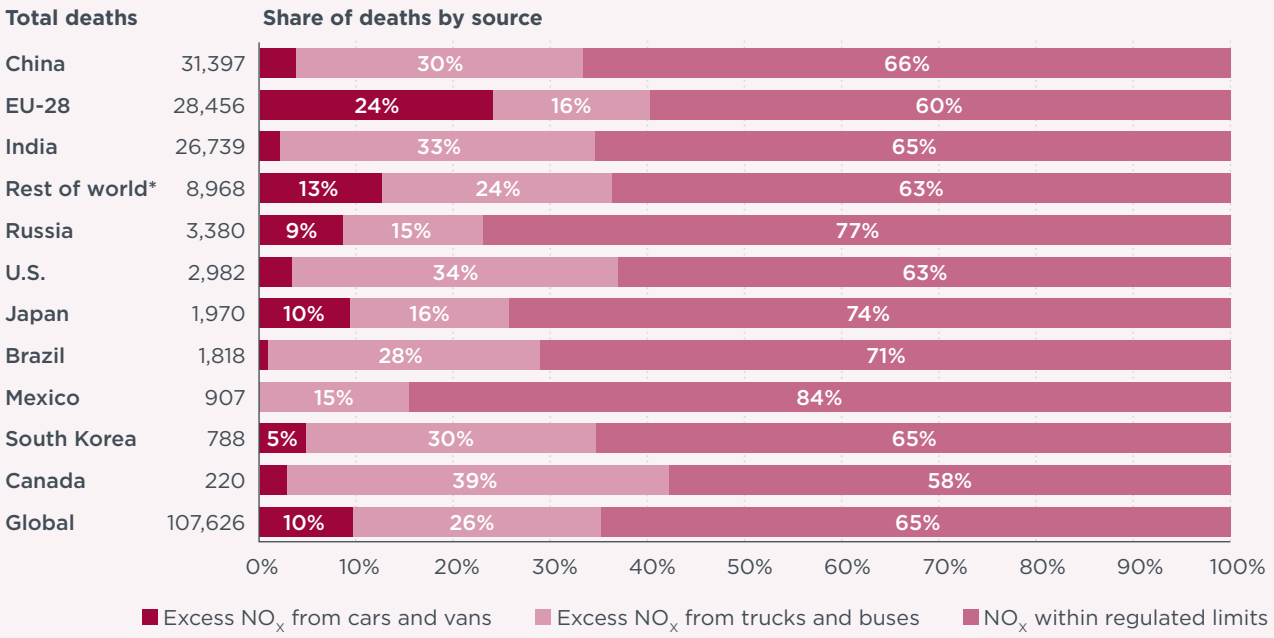
EUROPEAN PARLIAMENT EVENT ON REMOTE SENSING

At the end of September, the European Parliament hosted an event on the use of remote sensing of emissions. Rachel Muncrief, ICCT's program director, heavy-duty vehicles and enforcement, presented on The Real Urban Emissions (TRUE) Initiative and remote sensing projects planned for Paris and London.

EXCESS DIESEL NO_x EMISSIONS

Nitrogen oxide (NO_x) emissions from diesel cars, trucks, and buses are a major contributor to air pollution-related deaths worldwide. In May, an ICCT study quantifying the global health and environmental burden of real-world excess diesel NO_x emissions in 11 major vehicle markets was published in the journal *Nature*. The study found that more than 174,000 premature deaths from diesel vehicles could be avoided in 2040 with next generation vehicle emission standards.

Annual premature deaths attributable to on-road diesel vehicle NO_x emissions, 2015



**Counts only those premature deaths resulting from NO_x emissions produced in the other regions shown here.*

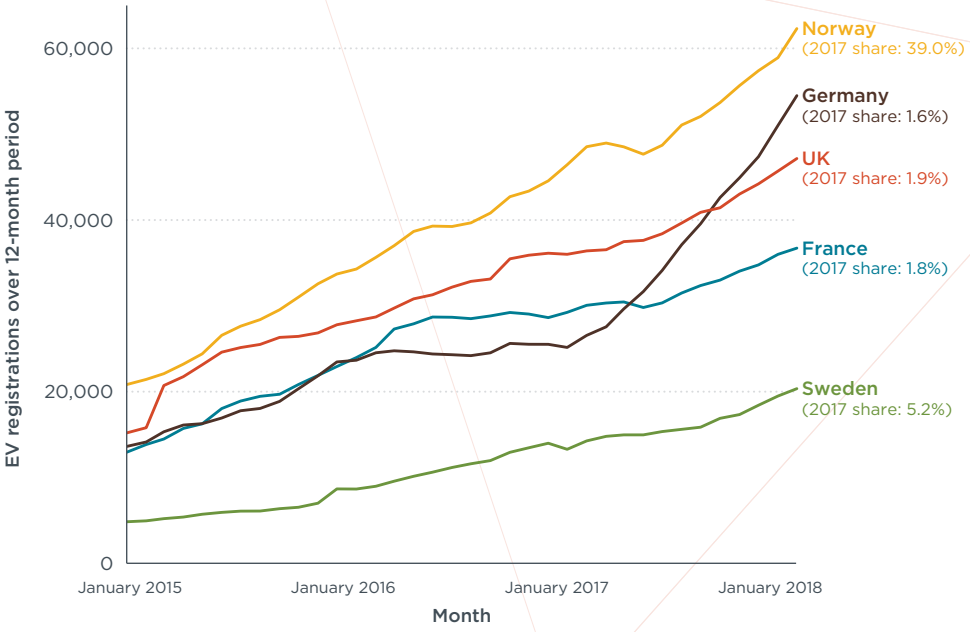
Electric vehicle sales are increasing across almost all markets, but are still disproportionately concentrated in a small number of major markets. In 2015, only 14 metropolitan areas accounted for almost a third of all electric vehicle sales.

Electric vehicle capitals of the world:
What markets are leading the transition to electric?

ELECTRIFICATION

The transition to electric vehicles has the potential to revolutionize the transportation industry.

ICCT's has taken an active role with the International Zero-Emission Vehicle Alliance (ZEV Alliance), a coalition of national, state and provincial governments who work to promote effective policies to expand ZEV deployment. The ZEV Alliance focused this year's work on assessing the infrastructure needs for electric vehicles and zero-emission technologies for commercial trucks. ICCT released a related white paper on emerging best practices for EV charging infrastructure, which highlights the importance of multifaceted and collaborative approaches to promote the buildout of early charging infrastructure. Additional select activities involving the electric vehicle market are listed below.

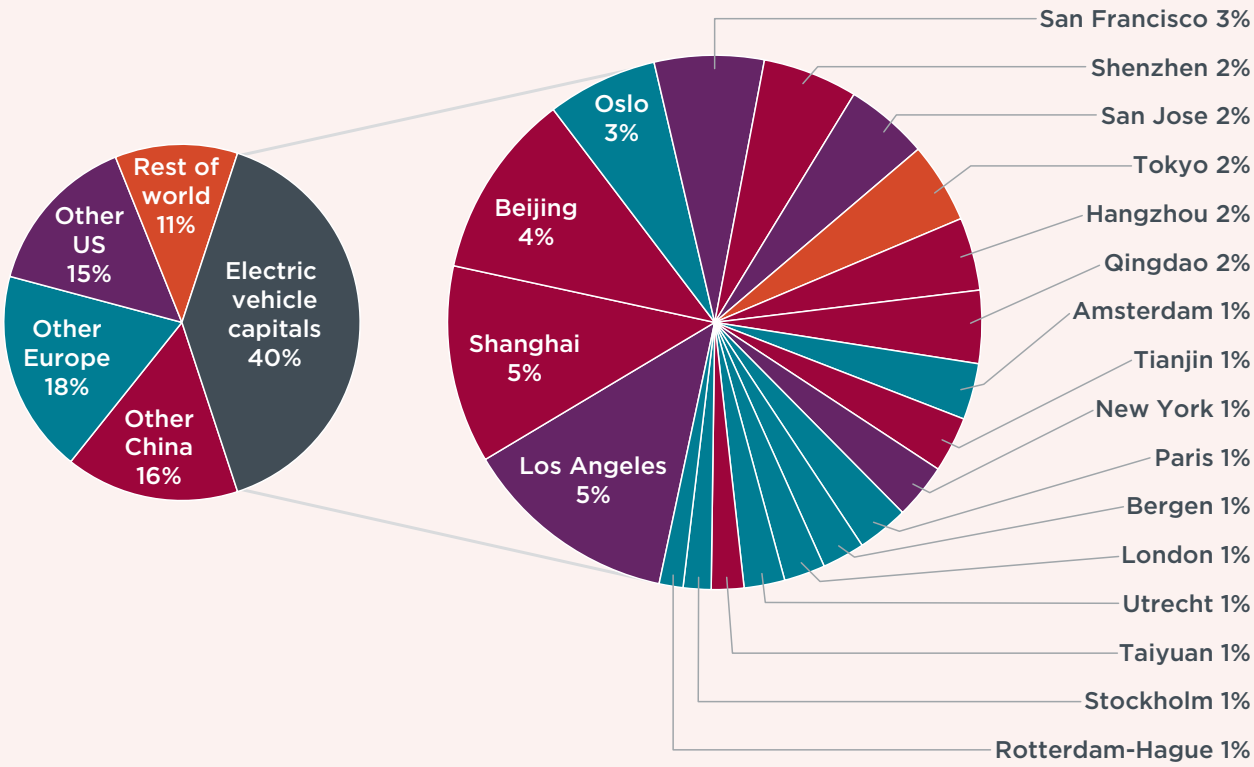


Electric passenger car registrations over 12-month period in France, Germany, Norway, Sweden, and the UK

GLOBAL EV USE

Although use of electric vehicles is growing and surpassed 1 million annual sales worldwide in 2017, just 20 cities account for 40% of the global electric market. ICCT undertook a study these "electric vehicle world capitals," to identify and highlight how these markets have effectively used fiscal, regulatory, infrastructure, local promotion policies together to encourage adoption of electric vehicles. This work reinforces and builds from ICCT's comprehensive study of city, state, and utility actions to overcome barriers in the U.S.

ICCT researcher Hongyang Cui presenting at an EV conference in Beijing



Estimated cumulative electric vehicle sales in electric vehicle capitals, expressed as percentages of the global electric vehicle stock through 2016.

KEY PUBLICATIONS:

- Electric vehicle capitals of the world: What markets are leading the transition to electric? (briefing)
- Emerging best practices for electric vehicle charging infrastructure (white paper)
- Electric vehicle capitals of the world: What markets are leading the transition to electric? (briefing)
- Expanding the electric vehicle market in U.S. cities (white paper).

SOOT-FREE TRANSPORT

Diesel exhaust is a human carcinogen and the source of 30 percent of global anthropogenic black carbon, a short-lived climate pollutant. Euro 6/VI emissions in cars, trucks, and buses when combined with diesel fuels containing no greater than 10 parts per million sulfur deliver "soot-free" emissions containing up to 99 percent fewer black carbon and particle number emissions. Soot-free transport is a critical step for all countries to eliminate up to 500,000 premature deaths by 2050 and 0.2 degrees warming in the next 25 years.

Major bus manufacturers sign a commitment to make soot-free buses available in 20 megacities

National-level policies affecting all heavy-duty diesel vehicles
National level proposals under development
Committed
Commitment under development
Not committed

Target cities supported by the soot-free urban bus initiative

The Soot-Free Urban Bus Fleets Project focuses on early introduction of these fuels and technologies to accelerate their introduction in 20 targeted megacities. Since 2015 the ICCT in partnership with UN Environment, Centro Mario Molina—Chile and C40 Cities have secured commitments in Mexico City, Santiago, Sao Paulo and Istanbul to shift their new bus procurements to soot-free engine technology.

In September, Scania, BYD, Volvo Buses and Cummins - four of the world's largest bus and engine manufacturers – joined at the request of the ICCT to commit to make their portfolio of soot-free engine technology available in the same 20 targeted megacities. The ICCT is working to expand the industry partnership and to seek new commitments from financing institutions.

The work continues with the support of the Climate and Clean Air Coalition and the German International Climate Initiative and is jointly implemented with UN Environment

SPOTLIGHT ON BRAZIL

New heavy-duty vehicle emissions standards taking effect in Brazil in 2019 creates an opportunity to significantly improve air quality in the country's major cities. ICCT staff supports efforts in the country to adopt more advanced vehicle emissions and fuel quality in the country, including the transition to soot-free buses.

KEY PUBLICATIONS

- Euro VI for Brazil: A clear path for cleaner skies (blog)
- Effect of P-8 standards on bus system costs in Brazil (briefing)
- Financing the transition to soot-free urban bus fleets in 20 megacities (report)

KEY RESOURCES

- Accelerating deployment of soot-free bus rapid transit fleets (webinar, YouTube recording)
- LinkedIn page: https://www.linkedin.com/groups/13563730
- Facebook group: https://www.facebook.com/groups/sootfree/

Roughly two thirds of 2015 black carbon emissions attributable to ships in the Arctic were the consequence of consuming heavy fuel oil.

Prevalence of heavy fuel oil and black carbon in Arctic shipping, 2015 to 2025

MARITIME SHIPPING

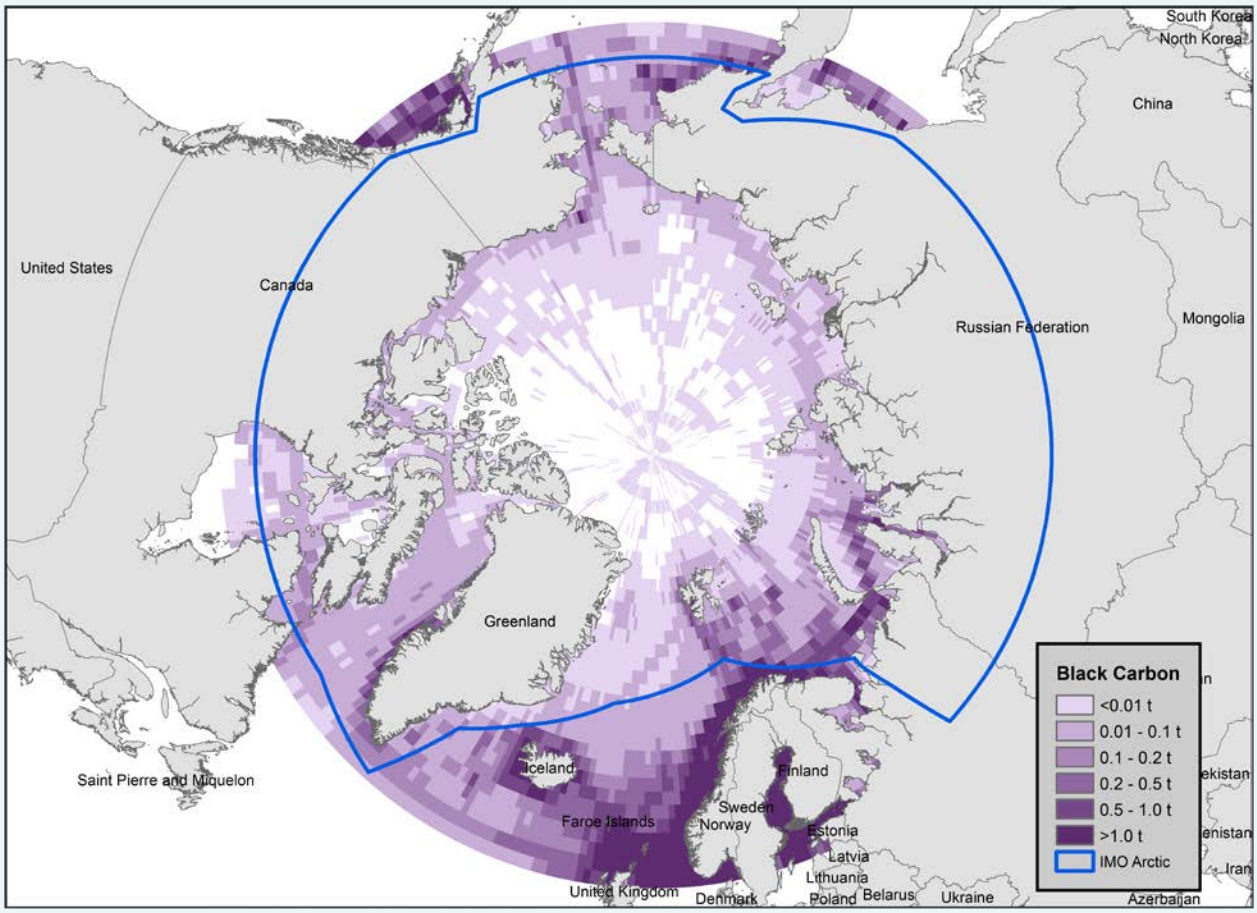
Maritime shipping is a vital to the global economy. However, while ships can move vast quantities of goods on relatively small amounts of fuel, they also use the world's dirtiest transportation fuels. Heavy fuel oil contains 2,600 times more sulfur than on-road diesel fuel, and also poses a unique spillage risk in fragile aquatic habitats like the Arctic. Ships and ports are already a significant contributor to local air pollution and associated health impacts, not to mention climate change; unfortunately, shipping emissions are on the rise. Greenhouse gas emissions from ships are projected to approximately double between 2015 and 2050 as international trade expands. Additionally, new trans-Arctic shipping routes are opening for longer periods of the year, a tantalizing proposition for countries looking for a shortcut to or from Asian, European, and North American markets. Although shipping's global regulator, the International Maritime Organization, recently agreed to an historic climate agreement for international shipping, its share of air pollution and GHGs will continue to grow unless additional, legally binding policies are agreed and implemented. Select activities and research conducted by ICCT on shipping emissions are listed below.

CHINA

In China, ICCT is strengthening the evidence base available to policymakers committed to reducing air pollution in coastal areas through international and domestic Emission Control Areas. In 2017, ICCT researchers produced a ship emissions inventory for China's Greater Pearl River Delta region to quantify the magnitude of major air pollutants from oceangoing vessels and identify the top contributing ship classes.

HEAVY FUEL OIL AND BLACK CARBON

The opening of new Arctic shipping routes has focused attention on the danger both heavy fuel oil (the dirtiest transport fuel) and black carbon (a potent climate pollutant) pose to the marine environment. Spills of heavy fuel oil and emissions of black carbon are of particular concern for the Arctic. Heavy fuel oil breaks down slowly in cold waters, sticks to floating ice, and emulsifies in the water, making it extremely difficult to recover once spilled. Burning HFO also emits more black carbon than other marine fuels.

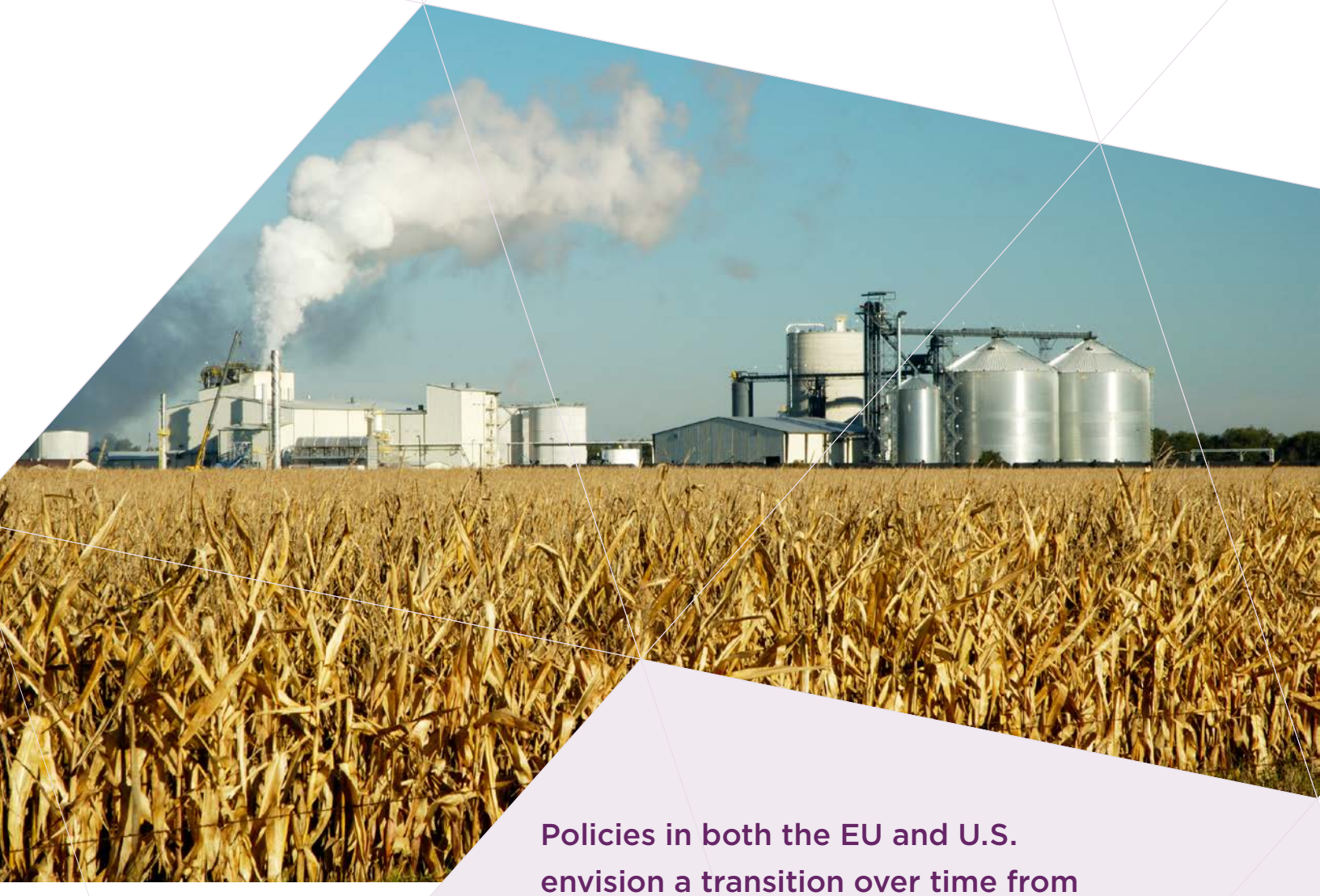


Black carbon emissions (tonnes) in the Arctic, 2015

KEY PUBLICATIONS

- Greenhouse gas emissions from global shipping, 2013–2015 [report]
- Black carbon emissions and fuel use in global shipping, 2015 [report]
- Prevalence of heavy fuel oil and black carbon in Arctic shipping, 2015 to 2025 [report]
- Distribution of air pollution from oceangoing vessels in the Greater Pearl River Delta, 2015 [working paper]

HYUNDAI
HYUNDAI
APL
APL

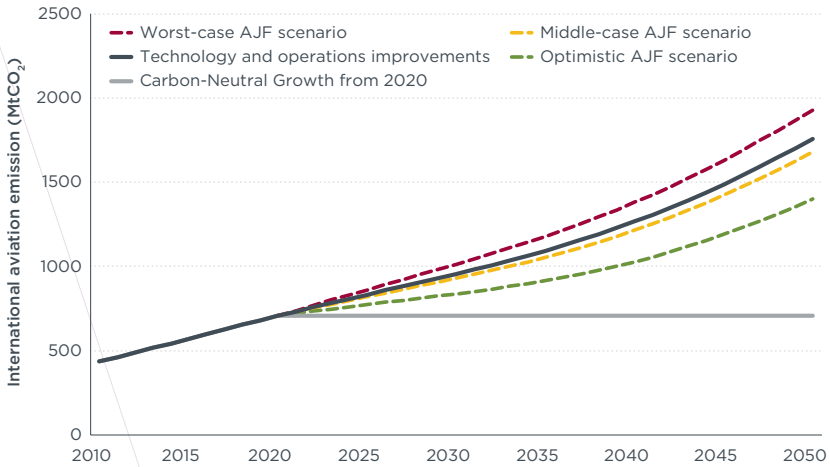


Policies in both the EU and U.S. envision a transition over time from first-generation, food-based biofuels to alternative fuels using non-food feedstocks and emerging technologies that offer greater GHG savings.

Effective policy design for promoting investment in advanced alternative fuels

LOW-CARBON FUELS AND BIOFUELS

Biofuels and other low-carbon alternatives have the potential to revolutionize the transportation sector. ICCT's research into the impact of alternative fuels is informing the next-generation of policy. Specific research topics in 2017 included indirect emissions of advanced biofuel feedstocks and policy measures needed to support a transition to advanced low-carbon fuels.



Potential contribution of alternative jet fuels to GHG emission reductions in international aviation

KEY PUBLICATIONS

- How rapeseed and soy biodiesel drive oil palm expansion [briefing]
- Potential greenhouse gas savings from a 2030 greenhouse gas reduction target with indirect emissions accounting for the European Union [working paper]
- Effective policy design for promoting investment in advanced alternative fuels [white paper]
- Mitigating international aviation emissions: Risks and opportunities for alternative jet fuels [white paper]

STAFF

Drew Kodjak, Executive Director

Fanta Kamakaté, Chief Program Officer

Anup Bandivadekar, Ph.D., program director, passenger vehicles and India lead

Brigitte Bernal, Washington office manager and assistant to the executive director

Yoann Bernard, researcher, real-world emissions

Kristine Bitnere, researcher, fuels

Kate Blumberg, senior fellow and Mexico lead

Kamrin Brown, AP accountant

Keri Browning, grants manager

Jessica Chu, San Francisco office manager and assistant to the chief program officer

Bryan Comer, Ph.D., researcher, marine

Anne Costello, controller

Hongyang Cui, researcher, China

Tim Dallmann, Ph.D., researcher, clean air

Oscar Delgado, Ph.D., researcher, heavy-duty vehicles

Jan Dornoff, senior researcher, vehicle emissions

Li Du, researcher, clean air

Cristiano Façanha, Ph.D., lead, roadmap, green freight, and Brazil

Jen Fela, managing editor

John German, senior fellow

Brandon Graver, researcher, aviation

Hui He, senior researcher and China lead

Ulises Hernández, researcher, green freight

Aaron Isenstadt, program associate, passenger vehicles

Lingzhi Jin, program associate, clean air

Omirzak Kadirbergenov, accounting manager

Anastasia Kharina, researcher, aviation

Sarah Keller, senior associate, strategic communications

Nic Lutsey, Ph.D., program director, fuels, heavy-duty vehicles, and electric vehicles

Xiaoli Mao, program associate, marine

Josh Miller, researcher, roadmap

Ray Minjares, lead, clean air

Peter Mock, Ph.D., managing director, European Union

Rachel Muncrief, Ph.D., program director, heavy-duty vehicles and compliance and enforcement

Mike Nicholas, senior researcher, electric vehicles

Naya Olmer, program associate, marine

Tana Papinova, manager, financial operations and reporting

Nikita Pavlenko, researcher, fuels

Clint Petty, senior financial analyst

Francisco Posada, Ph.D., senior researcher, passenger vehicles

Felipe Rodriguez, Ph.D., researcher, heavy-duty vehicles

Dan Rutherford, Ph.D., program director, aviation and marine

Joe Schultz, communications director

Stephanie Searle, Ph.D., lead, fuels

Zhenying Shao, researcher, roadmap

Ben Sharpe, Ph.D., senior researcher, heavy-duty vehicles and Canada lead

Peter Slowik, program associate, electric vehicles

Brianna Thompson, grants and international collaborations coordinator

Uwe Tietge, researcher, passenger vehicles

Diane Tworog, development and operations manager

Sandra Wappelhorst, researcher, passenger and electric vehicles

Liuhanzi Yang, researcher, china

Zifei Yang, researcher, passenger vehicles

icct

THE INTERNATIONAL COUNCIL
ON CLEAN TRANSPORTATION