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THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

ANNUAL REPORT 2016

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FROM THE EXECUTIVE DIRECTOR

As 2016 fades in the rear view mirror, it becomes clearer that the year marked a turning point for the ICCT.

As it began, we were in the middle of thinking through fresh opportunities that the heightened public awareness and engagement from the still-breaking Dieselgate story created for our policy and research work. As it ended, we were in the middle of thinking through the fresh challenges of a changed political and business environment.

In between, the ICCT grew and transformed in important ways. We committed significant resources to expand our work on the compliance and enforcement side of vehicle regulations, the essential follow-up step to setting pollution and efficiency standards. We redoubled our research efforts supporting the transition to electric drive, and began to map out and execute a research agenda on new mobility. We deepened our longstanding expertise on advanced technologies, releasing not only an ambitious and comprehensive series of assessments of passenger-vehicle technology trends, done in collaboration with a dozen leading industry suppliers, but also a pathbreaking cost assessment of new aircraft fuel-efficiency technologies.

In 2016 we began to work in new ways with cities, laying groundwork for new collaborations on real-world vehicle emissions monitoring and, in ports, helping to identify strategies for reducing shipping emissions. We facilitated the technical cooperation that contributed to China's Stage 6 light-duty vehicle emissions standard, an innovative rule that pushes beyond the Euro 6 standards on which it was modeled. And we put in place an essential solid baseline of research for a long-term committment to tackle the problem of emissions from non-road engines, a major source of both local air pollution and carbon emissions.

The dynamic growth that 2016 saw reflects the dynamism of ICCT's staff and collaborators. We know the work we do is urgently important. It's a challenging time to be engaged in it—and for that reason an exciting time. Look for more on all these fronts, and more, in 2017.

Drew Kodjak
Executive Director

TRANSPORTATION TRENDS IN 2016

Events in 2016 continued to focus public attention on carbon emissions from the transportation sector, and on diesel NO_x emissions as well. Companies up and down the supply chain are innovating to design cleaner, more efficient vehicles, thanks in large part to the impetus provided by farsighted regulatory policies, and the ICCT has contributed its expertise to these ongoing efforts. A media spotlight remains focused on electric vehicles, with good reason, and ICCT's work in that area continues to gain momentum. But we also remain very active in lower profile, but still critical

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policy areas, such as compliance and enforcement; the untapped potential of advanced conventional technologies for on-road vehicles and aircraft; and emissions control in international aviation, shipping, and non-road agricultural and construction equipment.

NATE

ELECTRIC DRIVE

Electric vehicles (EVs) have emerged as a leading solution for policy makers to improve air quality, mitigate climate change, reduce oil imports, and support local industry. California, China, Germany, Norway, the Netherlands, and several other nations have made EVs central to their long-term vision of sustainable transport. With 2 million EVs now on the road around the world, major automakers keep promising additional models with lower cost, an increased electric range, and higher production volumes.

While many leading nations are using regulatory policy and consumer incentives, innovative policy now increasingly happens at the local level. Just 14 metropolitan areas around the world accounted for a third of global EV sales in 2015.

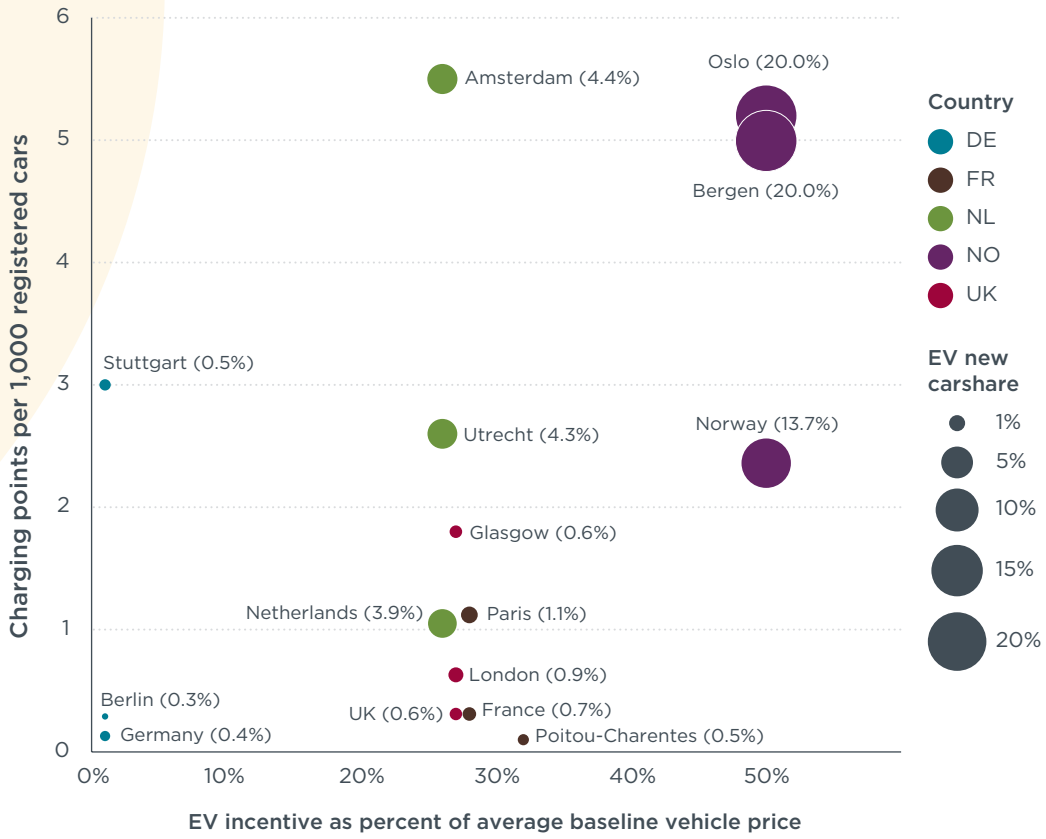
ZERO-EMISSION VEHICLE ALLIANCE

In December 2015, 14 governments in North America and Europe formed the International Zero-Emission Vehicle (ZEV) Alliance to accelerate the transition to ZEVs by enhancing government cooperation on policy. The ICCT serves as the ZEV Alliance's Secretariat and is responsible for managing the Alliance's publications and website, ZEVAlliance.org. Current members include the U.S. states of California, Connecticut, Maryland, Massachusetts, New York, Oregon, Rhode Island, and Vermont; the Canadian provinces of British Columbia and Québec; and Germany, the Netherlands, Norway, and the UK.

The Alliance's joint vision is that 100% of new passenger vehicle sales in their jurisdictions will be ZEVs by 2050. The ZEV Alliance held its first annual Assembly in Montréal, Québec in June 2016 to share policy experiences, strategies to accelerate ZEV technology, and challenges in implementing their ZEV action plans.

ZEV ALLIANCE MEMBERS AT THE INAUGURAL ANNUAL ASSEMBLY IN MONTRÉAL.

Well designed regulations, local registration, charging infrastructure, and outreach and education campaigns can help transition the market to electric drive, and ICCT work in 2016 showed how. The report "Sustaining electric vehicle market growth in U.S. cities" highlights and compares exemplary policies in all U.S. cities. "Comparison of leading electric vehicle policy and deployment in Europe" illustrates how leading markets in France, Germany, the Netherlands, Norway, and the UK have achieved higher shares of EVs.



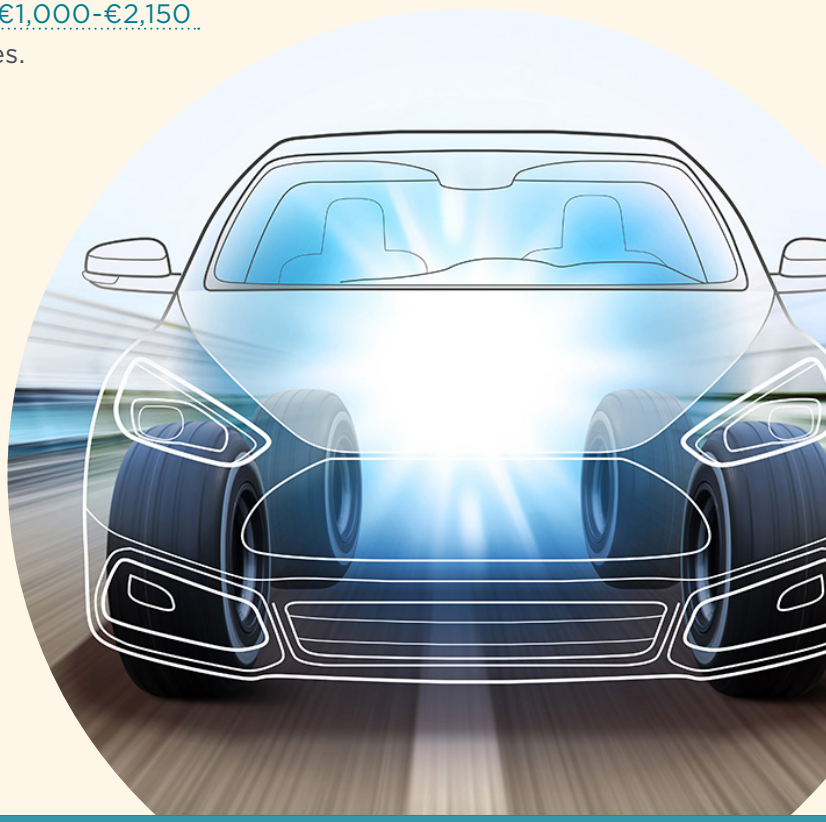
KEY PUBLICATIONS:

- Nic Lutsey, Peter Slowik, and Lingzhi Jin, "Sustaining electric vehicle market growth in U.S. cities."
- Peter Slowik and Nic Lutsey, "Evolution of incentives to sustain the transition to a global electric vehicle fleet."
- Siyou Kim and Zifei Yang, "Promoting electric vehicles in Korea."
- Uwe Tietge, Peter Mock, Nic Lutsey, and Alex Campestrini, "Comparison of leading electric vehicle policy and deployment in Europe."

ADVANCED TECHNOLOGIES

In the near term, advanced "conventional" technologies remain crucial tools in efforts to decarbonize the transportation sector. A series of technical briefs, products of a collaboration between the ICCT and a dozen automotive industry suppliers, highlighted trends in key fuel-saving technologies. As Europe began preparing a 70 g/km CO_2 standard for 2030, we leveraged our technical expertise to determine that automakers could meet that standard at only €1,000-€2,150 per vehicle, with few to no electric vehicle sales.

On-road vehicles are not the only stage for advanced conventional technologies. Aircraft contribute 10% of transportation CO_2 emissions, and **without further intervention commercial aviation's share of greenhouse gas emissions will triple by 2050.** On February 8, 2016, the International Civil Aviation Organization (ICAO) took a historic step by announcing the first ever efficiency (CO_2) standard for new aircraft. While not ambitious, the standard is an important first step in bringing awareness to the even greater efficiency improvements advanced technologies can deliver. Cost assessment of near- and mid-term technologies to improve new aircraft fuel efficiency, showed that emerging

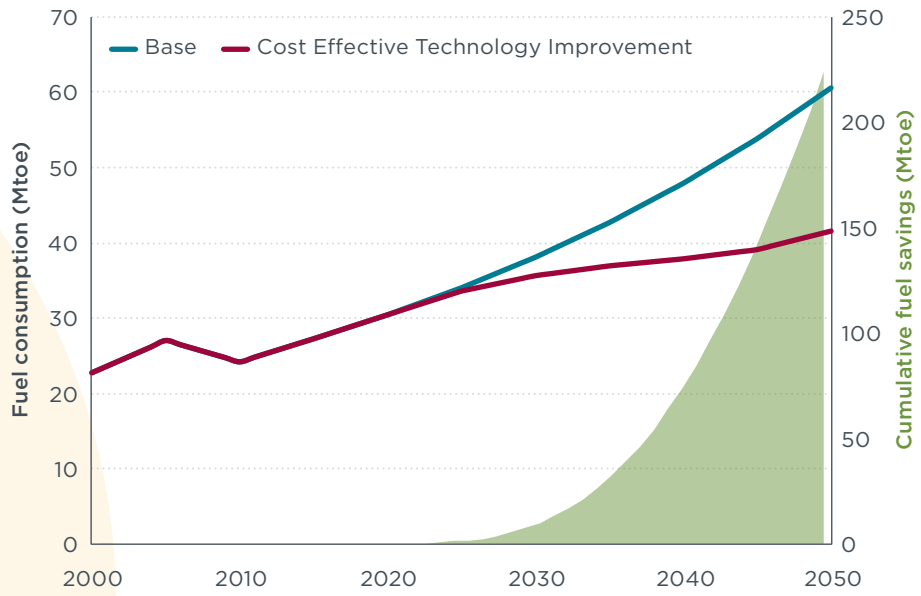


DRIVING AUTOMOTIVE INNOVATION

ICCT partnered with the Manufacturers of Emission Controls Association, the Advanced Engine Systems Institute, and the U.S. Coalition for Advanced Diesel Cars to host a September conference titled *Driving Automotive Innovation*. Senators Ed Markey of Massachusetts and Jeff Merkley of Oregon served as honorary co-hosts. Speakers from major supplier companies emphasized the economic, environmental, and energy security benefits of innovation in fuel efficiency.

EXECUTIVE DIRECTOR DREW KODJAK PRESENTING AT THE DRIVING AUTOMOTIVE INNOVATION EVENT

technologies could slash new aircraft fuel consumption by a quarter in 2024 and 40% in 2034. Airlines passing on cost savings to consumers would lower ticket prices by up to about $100.



> This study shows that aircraft manufacturers can literally redouble their efforts to reduce emissions, and they should. Deploying the full range of technologies under development—aerodynamic improvements and lightweight materials in addition to better engines—would provide significant benefits to airlines, consumers, and the environment.
>
> **Anastasia Kharina,**
> aviation researcher

CHINA 6 EMISSION STANDARDS

In December 2016, China instituted its Stage 6 light-duty vehicle emission standards. These limits require even lower emissions than the Euro 6 standards after which they were modeled. ICCT helped establish and maintain joint technical cooperation between the Chinese Ministry of Environmental Protection and the California Air Resources Board to integrate best practices from California into the final standard. As a result, this rule will produce cleaner vehicles in China sooner than in Europe.

CHINA'S NEW EMISSION STANDARD FOR LIGHT-DUTY VEHICLES WILL PREVENT **21,754 PREMATURE DEATHS** IN 2030.

KEY PUBLICATIONS:

- Aaron Isenstadt and John German, U.S. Passenger Vehicle Technology Trends.
- Anastasia Kharina, Dan Rutherford, and Mazyar Zeinali, "Cost assessment of near- and mid-term technologies to improve new aircraft fuel efficiency."
- Peter Mock, "2020–2030 CO_2 standards for new cars and light-commercial vehicles in the European Union."

COMPLIANCE AND ENFORCEMENT

2016 delivered a vivid reminder that, to achieve their goals, emission standards need effective compliance and enforcement (C&E) provisions. That's why last year ICCT formally launched a new program to inform and support governmental compliance and enforcement efforts worldwide.

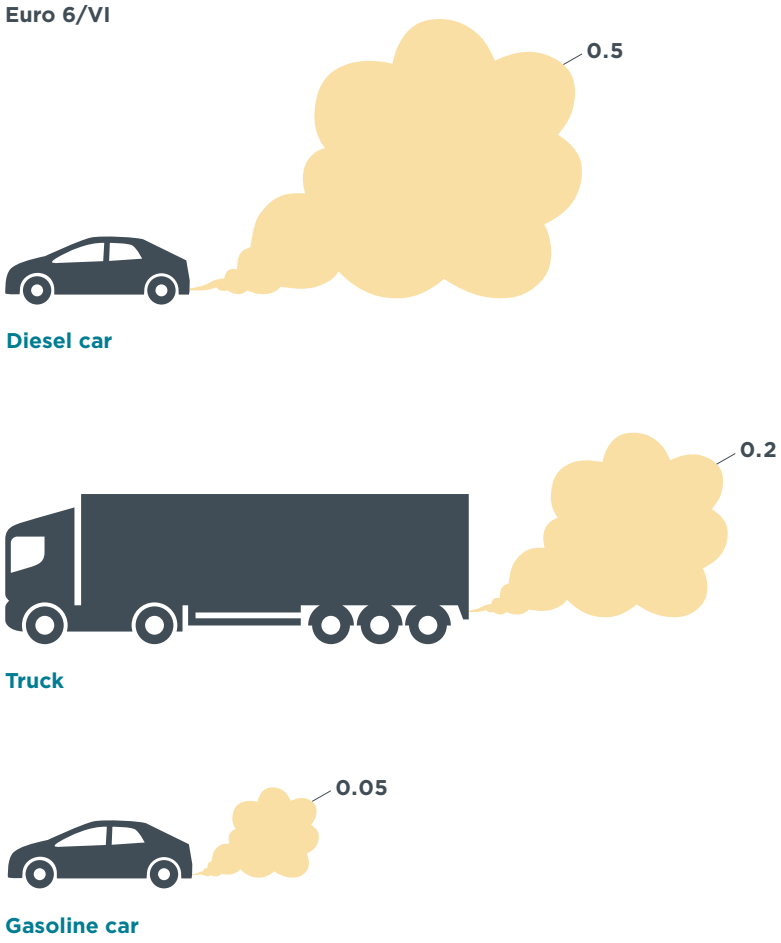
In its inaugural year, the C&E program work focused on accuracy in certification testing, the detection of defeat devices in passenger vehicles, and a comprehensive survey of the state of C&E-related regulatory practices in key markets around the world.

KEY PUBLICATIONS:

- Rachel Muncrief, "NO_x emissions from heavy-duty and light-duty diesel vehicles in the EU: Comparison of real-world performance and current type-approval requirements."
- Tom Cackette, "Improving emission standards compliance with a defect reporting system for in-use passenger vehicles."
- Rachel Muncrief, "Defeat device testing in the EU: So far, not so good."
- John German, "The emissions test defeat device problem in Europe is not about VW."

IMPROVING TEST PROCEDURES

Under the Euro V regulations, diesel trucks emitted 5 times more NO_x than diesel cars. Under current Euro VI regulations, trucks emit 2.5 times less than diesel cars. In "NO_x emissions from heavy-duty and light-duty diesel vehicles in the EU," ICCT researchers demonstrated that improved test procedures from Euro V to Euro VI, such as the addition of off-cycle tests, transient and high-load tests, and in-use conformity tests, reduced truck emissions and can do the same for diesel cars. The Worldwide Harmonized Light Vehicles Test Procedure (WLTP) and Real-Driving Emissions (RDE) test protocol, which will more accurately reflect real-world driving, are expected to incorporate all three additions.



Average NO_x emissions (in g/km) from diesel cars are 2.5 times higher than those from trucks (Source: European Vehicle Market Statistics, 2016/2017)

HEAVY-DUTY TRUCKS

2016 saw progress toward establishing new heavy-duty vehicle (HDV) air pollution standards in major markets. In China, which also approved new standards for light-duty vehicles in 2016, a proposal for HDV standards is being revised. India, meanwhile, adopted Bharat VI standards for both light-duty and heavy-duty vehicles—a culmination of ICCT's policy work there since our founding. Both China and India's standards will at least match the European and U.S. standards in stringency. Elsewhere, Mexico City committed to upgrading its bus fleet with soot-free buses. ICCT is providing policy and technical support through our soot-free bus project with the Climate and Clean Air Coalition.

On the greenhouse gas side, Europe, China, and the U.S. made progress on fuel efficiency standards. In Europe, the Commission announced it would propose its first HDV fuel efficiency standard. Further east, China proposed a new fuel consumption standard designed to close the gap in HDV efficiency between China and the U.S. and Europe.

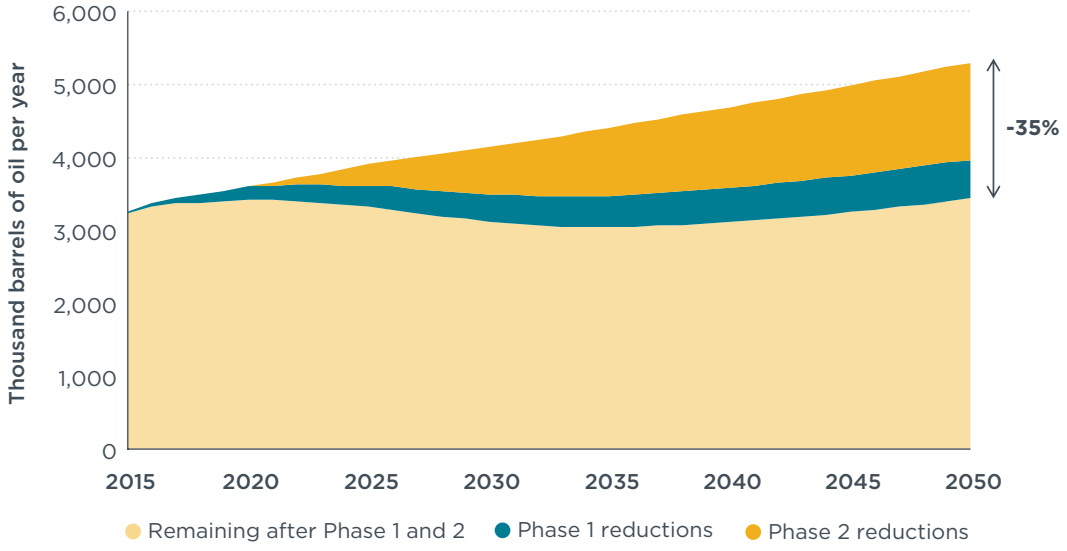
KEY PUBLICATIONS:

- Oscar Delgado, Josh Miller, Ben Sharpe, and Rachel Muncrief, "Estimating the fuel efficiency technology potential of heavy-duty trucks in major markets around the world."
- Zhenying Shao, Sarah Chambliss, and Anup Bandivadekar, "India heavy-duty fleet modernization program: A scrappage program combined with accelerated adoption of Bharat Stage VI emission standards."
- Ben Sharpe, "A big win-win on big trucks."

SAVING FUEL AND MONEY IN THE U.S.

The U.S. EPA and Department of Transportation announced their final rule for HDVs on August 16, 2016. Overall, the efficiency regulations now in place in the U.S. will cut fuel use by heavy trucks and buses by more than a third by 2050 and bring a net savings of over $200 billion.

> "This far-sighted regulation will continue to drive the development and deployment of cost-effective fuel-saving technologies."
>
> **Ben Sharpe, Canada lead**



(Source: "A big win-win on big trucks")

NON-ROAD ENGINES

In 2016, ICCT began establishing baselines and pathways for reducing emissions from non-road engines. Regulations for non-road engines have lagged behind those for on-road engines, yet non-road mobile machinery, such as agricultural and construction equipment, railroad engines, inland waterway vessels, and off-road recreational vehicles are becoming major sources of fine particulate matter and NO_x pollution.

Europe is leading the way in addressing this imbalance. The EU has enacted new Stage V non-road emission standards, the most stringent in the world, which will begin in 2018. This will simplify the current regulatory framework, require particulate filters for the first time, and help deliver major reductions in PM, NO_x, and hydrocarbons (HC) in Europe.

NON-ROAD EQUIPMENT FACES FEWER EMISSIONS REGULATIONS THAN ON-ROAD VEHICLES

COMBATING INDIA'S NON-ROAD ENGINE PROBLEM

Due to the quickly expanding market for agricultural tractors and construction equipment in India, emissions of NO_x and fine particulate matter from non-road engines are climbing and will soon exceed those from on-road vehicles. ICCT's 2016 study "An emissions inventory for agricultural tractors and construction equipment in India" builds a case that India could benefit from implementing emission standards equivalent to those in Europe and the U.S. along with maintenance requirements, and a registration program.

KEY PUBLICATIONS:

- Tim Dallmann and Aparna Menon, "Technology pathways for diesel engines used in non-road vehicles and equipment."
- Zhenying Shao, "Emissions inventory for agricultural tractors and construction equipment in India."
- Zhenying Shao and Tim Dallmann, "European Stage V non-road emission standards."
- Zhenying Shao, "Non-road emission inventory model methodology."

PORTS

Air pollution from shipping poses significant challenges in port cities. The problem is particularly stark in China, which contains seven of the 10 busiest ports in the world. In Hong Kong, shipping emitted the largest proportion of NO_x and PM in 2010.

At the end of August, China's government announced inaugural national marine engine emission standards. China's Ministry of Environmental Protection estimates the first phase, implemented in 2018, will cut 70% of PM emissions and 20% of NO_x emissions from smaller marine engines. The second phase, implemented in 2021, is estimated to reduce an additional 40% of PM emissions and 20% of NO_x emissions.

At the tail end of 2015, China also issued an action plan to establish Ship Emission Control Zones in the Yangtze River Delta Region, the Pearl River Delta Region, and the Bo Sea Region that will require the use of higher quality, cleaner fuels and promote other technologies like liquefied natural gas engines and the use of shore power to clean up marine engines.

ICCT HAS PARTNERED WITH THE PORT OF SHENZHEN (PICTURED ABOVE) TO HELP IDENTIFY STRATEGIES FOR REDUCING EMISSIONS FROM SHIPPING.

KEY PUBLICATIONS:

- Haifeng Wang, Xiaoli Mao, and Dan Rutherford, "Costs and benefits of shore power at the Port of Shenzhen."
- Xiaoli Mao, "Action plan for establishing ship emission control zones in China."
- Xiaoli Mao, "Marine engine emission standards for China's domestic vessels."

SHORT-LIVED CLIMATE POLLUTANTS

Black carbon is a component of fine particulate matter—an air pollutant present in diesel engine exhaust—with a global warming potential up to 3,200 times that of CO_2 over a 20-year timeframe. It poses particular problems in the Arctic, because when it settles on otherwise reflective surfaces, like snow, it reduces its albedo and accelerates melting.

Maritime shipping in the Arctic is growing rapidly. ICCT predicts at least a 75% increase in activity from 2013 to 2025, but others have suggested it could grow as much as 500%. In the fall of 2016, the voyage of the luxury cruise ship *Crystal Serenity* through the Arctic from Alaska to New York illuminated the dangers of increased Arctic travel. Heavy fuel oil (HFO), a dirty, bottom-of-the-barrel residual byproduct of oil refining, powers the majority of marine vessels. While inexpensive, HFO releases high levels of black carbon and other air pollutants and poses unique spillage risks to sensitive regions like the Arctic.

> "Ongoing discussions at the Arctic Council and potential actions at the International Maritime Organization (IMO) to address the risks of HFO and black carbon are encouraging, and we're hopeful that common sense policy alternatives to limit these risks remain on the table."
>
> **Bryan Comer and Naya Olmer,**
> marine researchers

ICCT's 2016 study "Heavy fuel oil use in Arctic shipping in 2015" showed that while fewer ships operated on HFO than safer distillate fuel, ships carried 3 times more HFO onboard than distillate oil, posing additional risks like oil spills. Governments can address this problem by extending Emission Control Areas (ECAs) to the Arctic or banning HFO in the Arctic outright.

PARTICIPANTS IN THE BLACK CARBON WORKSHOP IN VANCOUVER, CANADA

MEASURING AND REDUCING BLACK CARBON EMISSIONS

In 2014, ICCT embarked on a 2-year effort, funded by the Climate and Clean Air Coalition (CCAC), aimed at understanding the nature and impacts of black carbon emissions from ships and how to lessen these impacts on the environment. In September 2016, ICCT and Environment and Climate Change Canada (ECCC) hosted the third and final CCAC workshop in Vancouver, Canada. The event focused on how to measure and control black carbon emissions from marine engines. Building on the groundwork laid by this project's two previous workshops, participants from 19 organizations worked to find consensus on strategies to measure and control marine black carbon emissions.

KEY PUBLICATIONS:

- Bryan Comer, Naya Olmer, and Xiaoli Mao, "Heavy fuel oil use in Arctic shipping in 2015."
- Bryan Comer and Naya Olmer, "End of Crystal Serenity's voyage spotlights way to ban toxic fuel in Arctic."
- 3rd Workshop on Marine Black Carbon Emissions: Measuring and Controlling BC from Marine Engines.

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