ICCT activities supporting the harmonization of HDV CO_2 certification

Dr. Felipe Rodríguez
HDV Program Lead

HD CO_2 harmonization workshop
80th GRPE Meeting
Geneva, January 14, 2019

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Outline

1. G20 Transport Task Group

2. India
   a. Regulatory developments
   b. ICCT activities — VECTO proof-of-concept adaptation

3. South America
   a. Regulatory developments
   b. ICCT activities — Air drag testing support in Argentina

G20 Transport Task Group

What is the G20 Transport Task Group?

A voluntary platform for G20 countries to share respective experience and work together to improve the energy and environmental performance of motor vehicles, especially HDVs.

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GFEI GLOBAL FUEL ECONOMY INITIATIVE

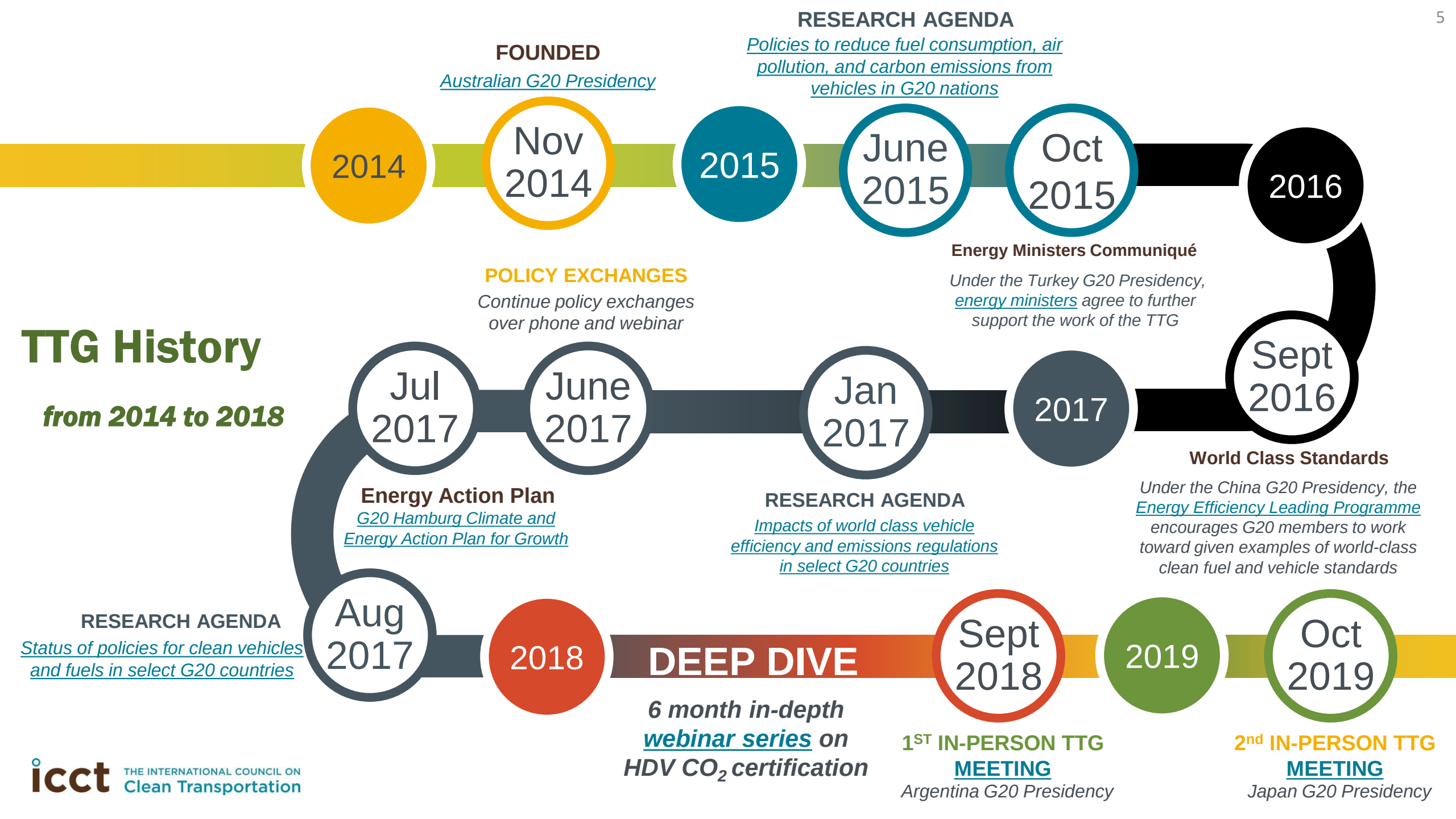
EPA

European Commission

ipeec International Partnership for Energy Efficiency Cooperation

TTG History

from 2014 to 2018



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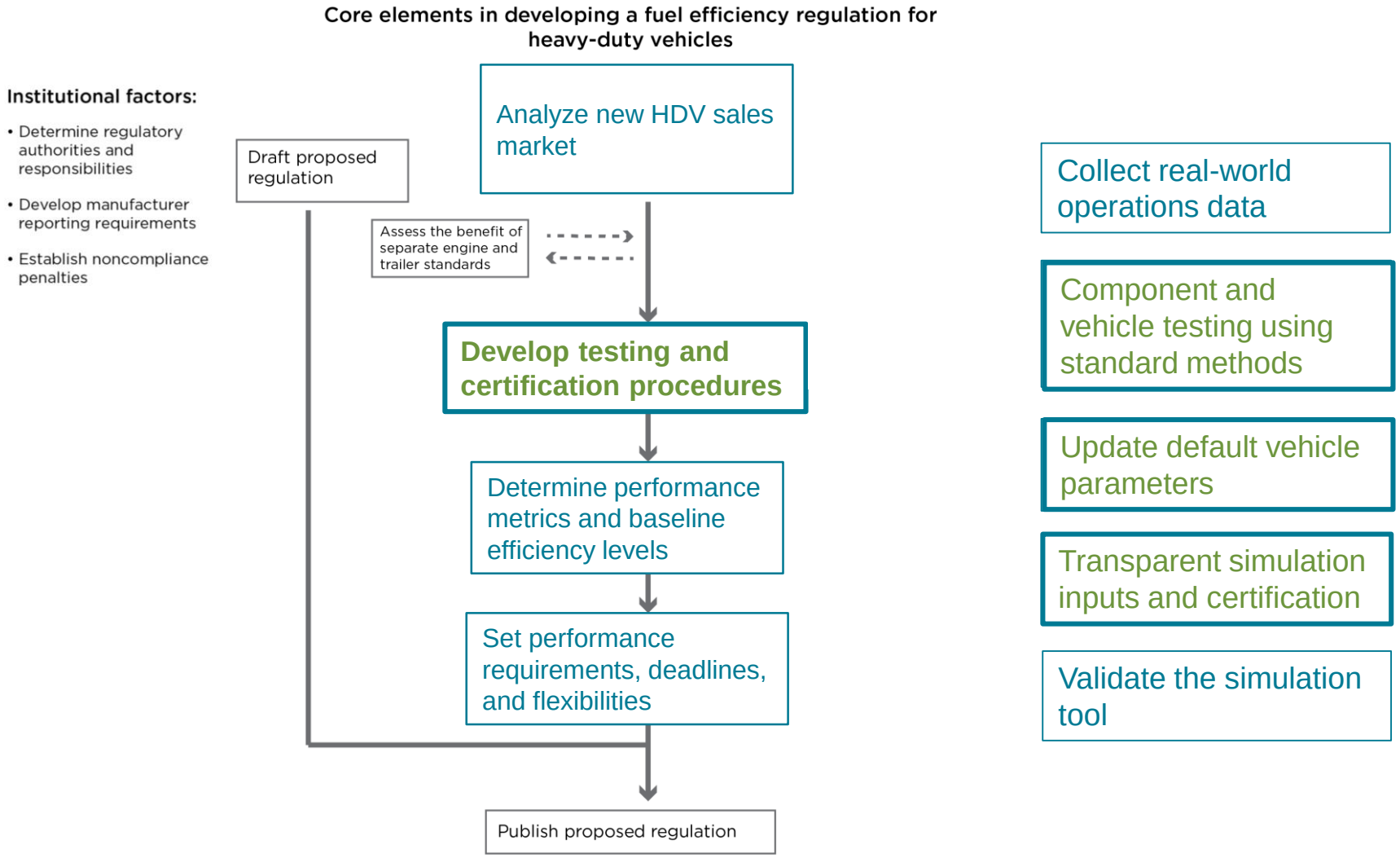
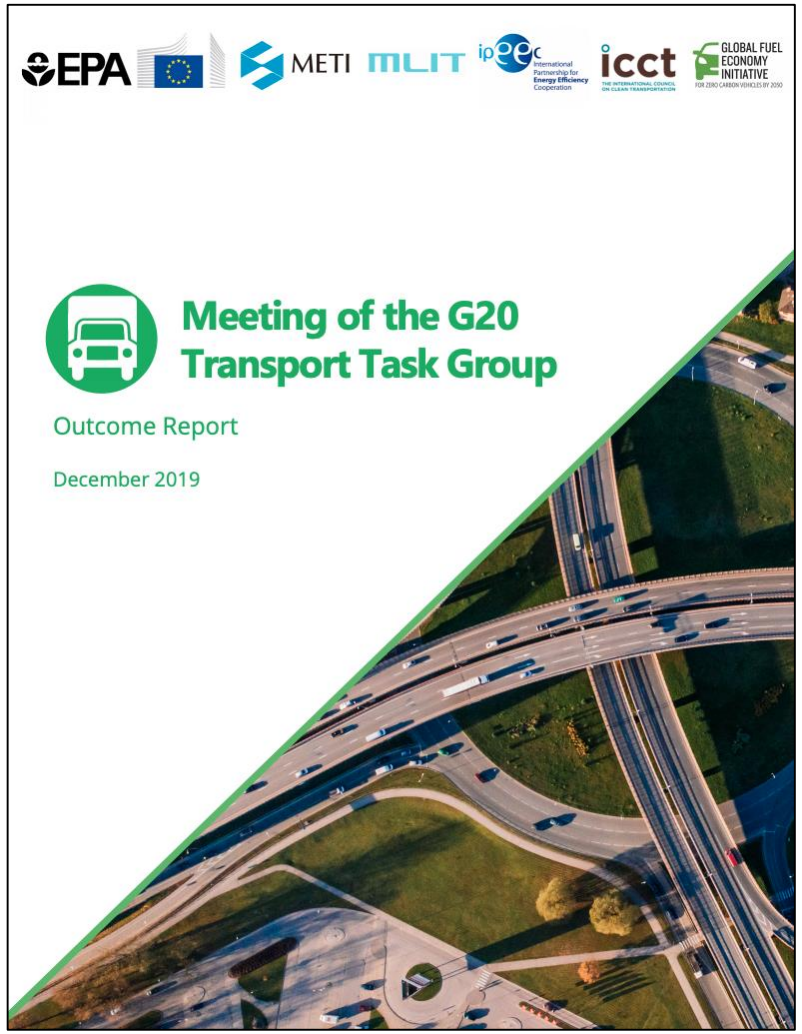
A stepwise guide to heavy-duty vehicle efficiency standards



https://theicct.org/cards/stack/stepwise-guide-heavy-duty-vehicle-efficiency-standards

Second in-person meeting of the G20 TTG



- Representatives from 11 G20 economies, 5 additional countries, and 10 intergovernmental and nongovernmental organizations.
- Agenda included a wider range of topics in addition of HDV efficiency and CO_2 emissions. They included pollutant emission standards for LDV and HDV, compliance and enforcement, air quality impacts of motor vehicles, and transition to zero-emission technologies.

https://ipeec.org/upload/publication_related_language/pdf/1681.pdf

India

HDV fuel economy standards in India — Phase 1 and 2

	
Type of standard	Not-to-exceed Fuel economy in L/100 km
Vehicle scope and segmentation	Diesel HDVs with GVW above12 tonnes Segmentation on GVW, number of axles, and truck type (rigid – tractor)
Standard limit	Function of vehicle group and of GVW
Certification	Track testing at 40 and 60km/h
Implementation	Phase 1 from April 2018 Phase 2 from April 2021

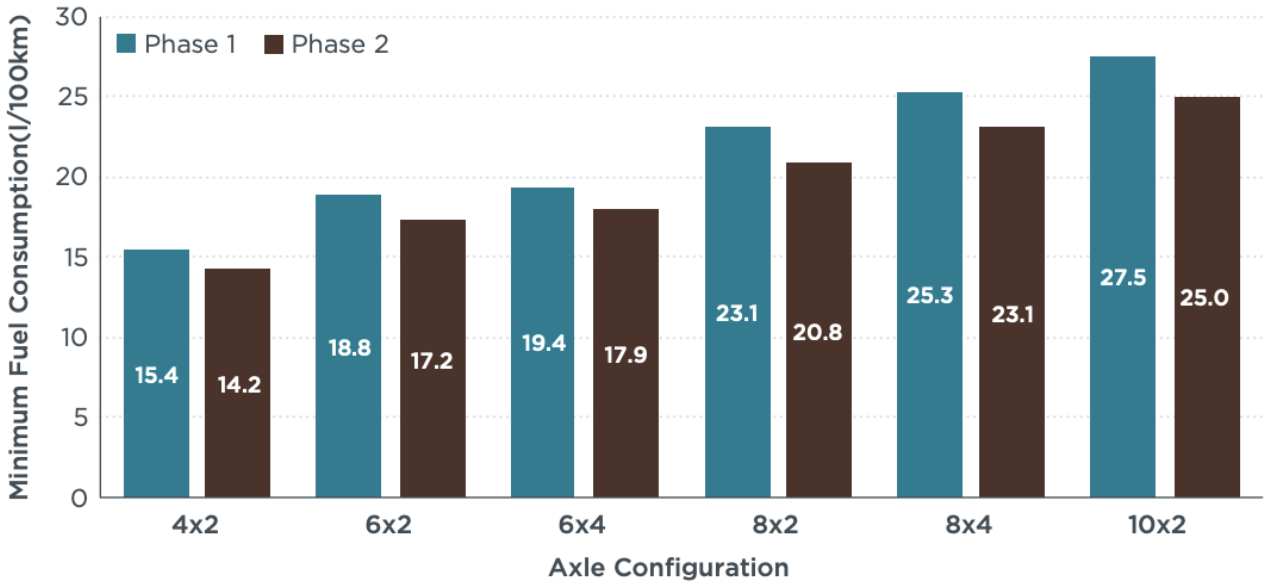


Figure 1. Phase 1 and Phase 2 fuel consumption limit values at 40 km/h for N3 rigid trucks by axle configuration

- The fuel-consumption reduction from Phase 1 to Phase 2 is estimated at 10.4%, calculated on a vehicle-population weighted average

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https://theicct.org/sites/default/files/publications/ICCT_India-HDV-fuel-consumption_policy-update_20171207.pdf

India intends to move to VECTO-like certification 1/2

Proposed Fuel Efficiency Standards for Commercial Vehicles in India

ARAI® Progress through Research

Phase 2 (Simulation)

- Drive Cycle based fuel consumption (Under discussions)

Axle Config.	Vehicle Config.	GVW (T)
4x2	Bus	3.5 - 7.5
	Rigid	
	Bus	7.5 - 12
	Rigid	
	Bus	12 - 18.5
	Rigid	
	Tractor	18.5 - 45.5
6x2	Bus	18.5 - 25.5
	Rigid	18.5 - 28
	Tractor	18.5 - 55
6x4	Rigid	18.5 - 28
	Tractor	28 - 55
8x2	Rigid	28 - 35
8x4	Rigid	
10x2	Rigid	35 - 42
10X4	Rigid	
12X2	Rigid	42 - 49

Based on application and vehicle categorization, the following mission profiles proposed for development,

- City bus
- Intercity bus
- Urban truck
- Intrastate truck
- Interstate truck
- Tipper (Mining)

A. A. Badusha, 2019. “India’s Fuel Efficiency Standards Today & Tomorrow.”. Presented at G20 TTG meeting. Tokyo.

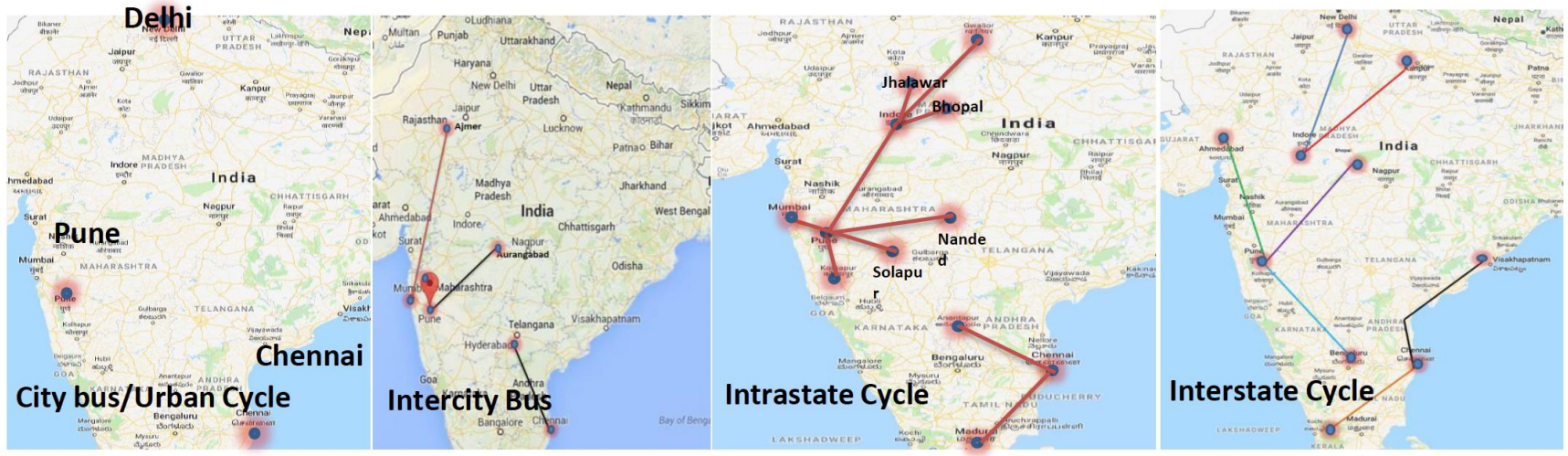
India intends to move to VECTO-like certification 2/2

Proposed Fuel Efficiency Standards for Commercial Vehicles in India

ARAI® Progress through Research

Phase 2 (Simulation)

- Drive Cycle based fuel consumption (Under discussions)



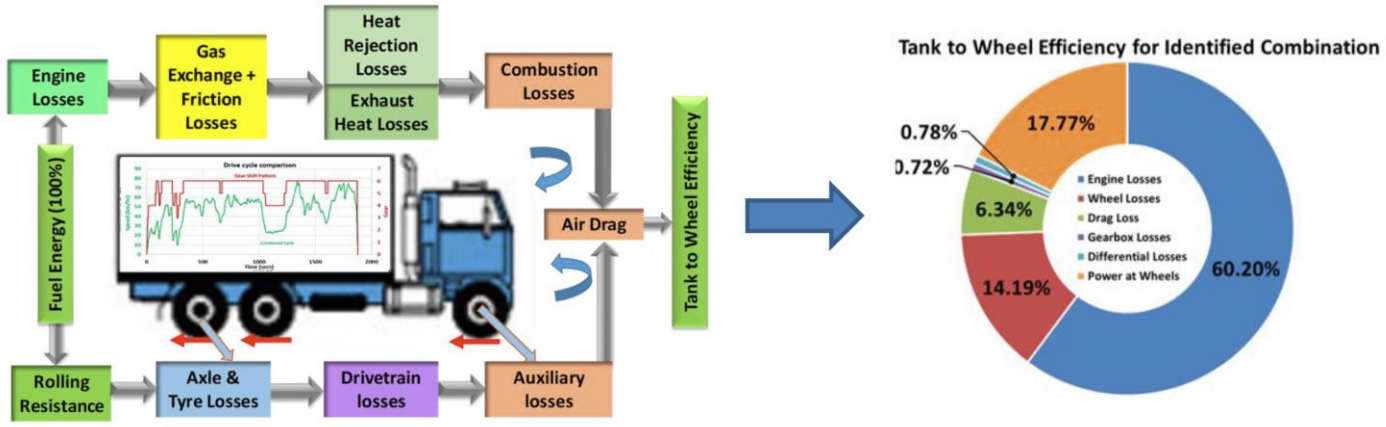
Identified Route Map for Mission Profile Development

Ashok Leyland, SMLI, Tata motors, Mahindra, Daimler, Volvo Eicher and FML support the development of test cycles

A. A. Badusha, 2019. “India’s Fuel Efficiency Standards Today & Tomorrow.”. Presented at G20 TTG meeting. Tokyo.

ARAI is leading the methodology development

- A technical committee for the development of the VECTO-like methodology has been set.
- Main players are ARAI, SIAM, BEE, and PCRA.
- Timeline for development of methodology: 18 months (April 2021).

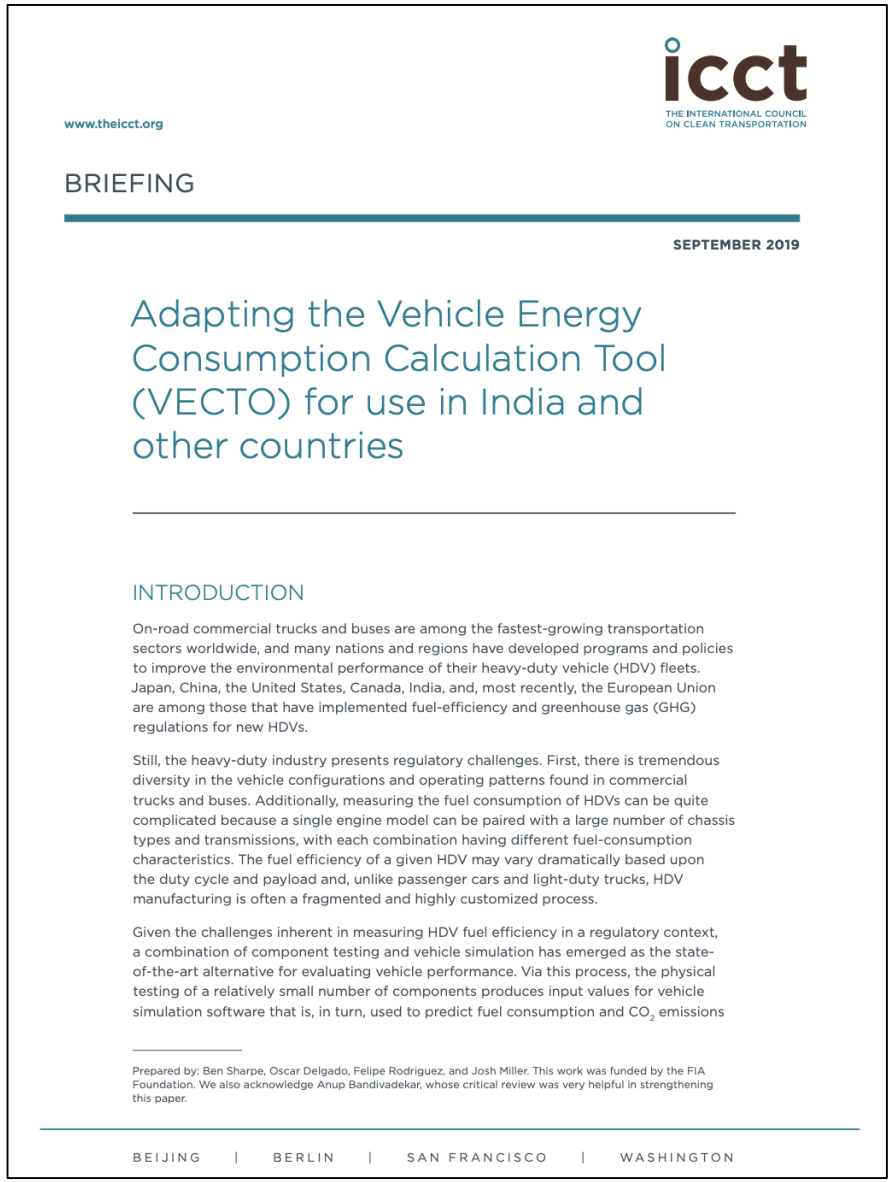


A. A. Badusha, 2019. “India’s Fuel Efficiency Standards Today & Tomorrow.”. Presented at G20 TTG meeting. Tokyo.

Several issues, deviating from the EU approach, have already been identified

- Fleet segmentation
- Duty cycles
- Standard and default values
- Auxiliaries
- Lower air drag losses
- Transition to BSVI
- VECTO adaptation

Proof-of-concept VECTO adaptation using India as an example



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BRIEFING

SEPTEMBER 2019

Adapting the Vehicle Energy Consumption Calculation Tool (VECTO) for use in India and other countries

INTRODUCTION

On-road commercial trucks and buses are among the fastest-growing transportation sectors worldwide, and many nations and regions have developed programs and policies to improve the environmental performance of their heavy-duty vehicle (HDV) fleets. Japan, China, the United States, Canada, India, and, most recently, the European Union are among those that have implemented fuel-efficiency and greenhouse gas (GHG) regulations for new HDVs.

Still, the heavy-duty industry presents regulatory challenges. First, there is tremendous diversity in the vehicle configurations and operating patterns found in commercial trucks and buses. Additionally, measuring the fuel consumption of HDVs can be quite complicated because a single engine model can be paired with a large number of chassis types and transmissions, with each combination having different fuel-consumption characteristics. The fuel efficiency of a given HDV may vary dramatically based upon the duty cycle and payload and, unlike passenger cars and light-duty trucks, HDV manufacturing is often a fragmented and highly customized process.

Given the challenges inherent in measuring HDV fuel efficiency in a regulatory context, a combination of component testing and vehicle simulation has emerged as the state-of-the-art alternative for evaluating vehicle performance. Via this process, the physical testing of a relatively small number of components produces input values for vehicle simulation software that is, in turn, used to predict fuel consumption and CO_2 emissions

Prepared by: Ben Sharpe, Oscar Delgado, Felipe Rodriguez, and Josh Miller. This work was funded by the FIA Foundation. We also acknowledge Anup Bandivadekar, whose critical review was very helpful in strengthening this paper.

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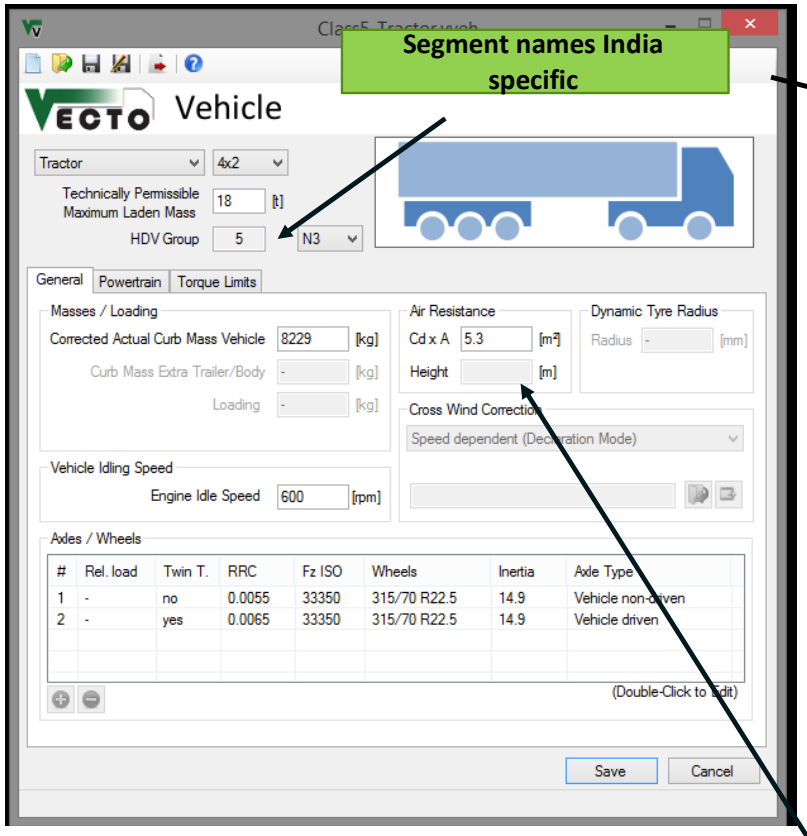
- **Objective**: Develop a proof-of-concept India-specific adaptation of VECTO using the tool's 'Declaration Mode'

- **4 main areas of modifications in VECTO-India**
  1. Introduced three new vehicle types
  2. Introduced WHVC-India cycle and its subparts
  3. Add weighted fuel consumption [g/km] and CO_2 [g/km] results for WHVC-India
  4. Remove and modify hard-coded and GUI details from EU's version of VECTO

https://theicct.org/publications/adapting-vecto-india-20190926

Vehicle (general tab) module changes



Original VECTO

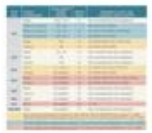
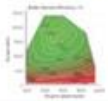
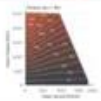
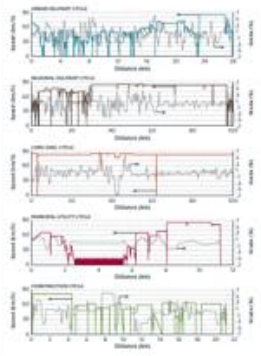
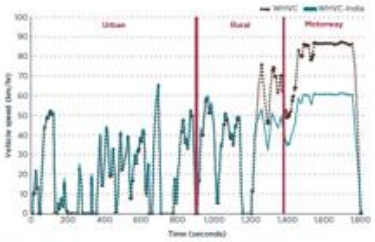
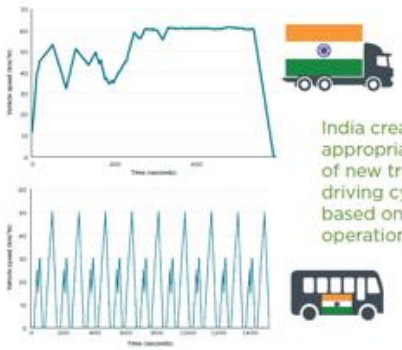
Segment names India specific

VECTO India

Cd x A is divided in two boxes.

1. Cd value is 0.6, not modifiable.
2. Frontal Area, modifiable.

Adapting VECTO for use in India and other countries

	VECTO European version	India VECTO Proof-of-concept India version	India VECTO Proposed India regulatory version
Vehicle types	 17 truck segments are included in VECTO. Segmentation is based on vehicle type (rigid truck, tractor truck, or bus), gross vehicle weight, and axle configuration.	Users can select from these 3 truck types  6x4 25-tonne rigid truck; 8x2 31-tonne rigid truck; 4x2 40-tonne tractor truck	 India creates 11 truck and 3 bus categories to match the segmentation approach in the existing fuel consumption regulations. See Sathiamoorthy and Sharpe (2019) for further discussion.
Input data	**Physical testing-based data**  Dynamometer-based engine fuel consumption maps	**Combination of user inputs and default values** User has the ability to input an engine fuel consumption map	**Physical testing-based data** VECTO ≈ India VECTO We propose that VECTO-India be identical to VECTO in terms of component testing and input data requirements. India should aim to require physical testing for all component inputs for which a certified test procedure already exists in the CO_2 certification process in the European Union. If this arrangement proves too burdensome, then certain technology modules in VECTO can be modified to be based on default values.
	 Testing-based torque loss maps for transmissions, axles, and auxiliaries	Default values auto-populate for transmission, axle, and auxiliary data. Users can modify the number of gear and/or the gear ratio values.	
	 Aerodynamic drag area (C_DA) → track testing Coeff. of rolling resistance (C_{RR}) → lab testing	Aerodynamic drag area (C_D) → default value Vehicle frontal area → modifiable input C_{RR} → modifiable input	
Drive cycles	 Unique drive cycles are assigned based on vehicle group	 WHVC-India cycle is used for all 3 vehicle types. Weighting factors are used for each of the 3 'mini cycles' in the WHVC to account for different mission profiles of the 3 vehicles.	 India creates an appropriate number of new truck and bus driving cycles that is based on real-world operations data.

https://theicct.org/publications/adapting-vecto-india-20190926

South America

Brazil's timeline for HDV CO_2 regulatory packages

PORTARIA Nº 2.200-SEI, DE 27 DE DEZEMBRO DE 2018

Define o cronograma de implementação do programa de eficiência energética para veículos pesados e de divulgação de resultados, em cumprimento ao disposto nos §§ 5º e 7º do art. 1º e no item 17 do Anexo III do Decreto nº 9.557, de 8 de novembro de 2018.

O MINISTRO DE ESTADO DA INDÚSTRIA, COMÉRCIO EXTERIOR E SERVIÇOS, no uso da atribuição que lhe confere o art. 87, parágrafo único, inciso II, da Constituição Federal e tendo em vista o disposto na Lei nº 13.755, de 10 de dezembro de 2018, e nos §§ 5º e 7º do art. 1º e no item 17 do Anexo III do Decreto nº 9.557, de 8 de novembro de 2018, resolve:

Art. 1º Esta Portaria define o cronograma de implementação do programa de eficiência energética para veículos pesados e de divulgação de resultados, em cumprimento ao disposto nos §§ 5º e 7º do art. 1º e no item 17 do Anexo III do Decreto nº 9.557, de 8 de novembro de 2018.

§ 1º O cronograma de que trata o caput disporá também sobre as atividades para a adoção de metodologia de medição da eficiência energética de veículos pesados por intermédio do uso de ferramenta de simulação computacional.

§ 2º Para efeitos dessa Portaria, entende-se como veículo pesado, o veículo automotor para transporte de passageiros e/ou carga, com massa total máxima autorizada maior que 3.856 Kg e massa do veículo em ordem de marcha maior que 2.720 Kg, projetado para o transporte de passageiros e/ou carga, conforme disposto no § 4º do art. 1º da Resolução nº 15, de 13 de dezembro de 1995, do Conselho Nacional do Meio Ambiente.

Art. 2º As atividades do cronograma de implementação do programa de eficiência energética para veículos pesados e de divulgação de resultados, de que trata o art. 1º, serão divididas em três ciclos quinquenais, conforme disposto a seguir:

I - atividades para o primeiro ciclo - 2018 a 2022:

a) elaboração de Plano de Trabalho;

b) estudo das referências internacionais e escolha de ferramenta de simulação computacional; e

c) estabelecimento de padrões para os testes de eficiência energética (definição das classes de veículos, das rotas, entre outros), adequações na ferramenta escolhida e realização de testes.

II - atividades para o segundo ciclo - 2023 a 2027:

a) simulações e definição da linha de base de eficiência energética dos veículos comercializados no país;

b) análise e estudo acerca do estabelecimento no país de metas de eficiência energética para veículos pesados e para motores; e

c) divulgação dos resultados de eficiência energética de veículos pesados, a partir de 1º de agosto de 2023, conforme disposto no inciso II do § 2º e no § 7º do art. 1º do Decreto nº 9.557, de 2018.

III - atividades para o terceiro - ciclo 2028 a 2032: verificação do atendimento em 2032 das metas de eficiência energética para veículos pesados, vinculado ao resultado do estudo realizado no segundo ciclo.

Parágrafo único. O Plano de Trabalho de que trata a alínea a do inciso I do caput, elaborado pelo Comitê Gestor de Eficiência Energética de Pesados, a ser publicado em até seis meses do início da vigência desta Portaria, apresentará o detalhamento do cronograma de atividades de que trata este artigo.

Documento assinado digitalmente conforme MP nº 2.200-2 de 24/08/2001, que institui a Infraestrutura de Chaves Públicas Brasileira - ICP-Brasil.

- The timeline we have was defined by an Ordinance (PORTARIA Nº 2.200-SEI, DE 27 DE DEZEMBRO DE 2018)

- **2018-2022:** Definition of routes and vehicle segments
- **2023-2027:** Truck technology testing and modeling, monitoring and reporting
- **2028:** Set HDV efficiency standard targets
- **2032:** Full implementation

http://www.in.gov.br/materia/-/asset_publisher/Kujrw0TZC2Mb/content/id/57220399

Argentina's HDV efficiency regulatory framework

ARGENTINA: Development of the Regulatory Framework of Heavy-Duty Vehicles Efficiency (HDV-E)

- **Development of Technical Standards IRAM (ISO Chapter of Argentina) together with tests of freight trucks on the highway (Technical Group HDV-E Arg. with the participation of Government Ministeries and automotive and transportation services companies:**

✓ **1st STEP (2016): Smart Transportation Program Implementation Development of IRAM Standard 10290 (SAE1321) and tests of relative consumption of trucks on the highway**

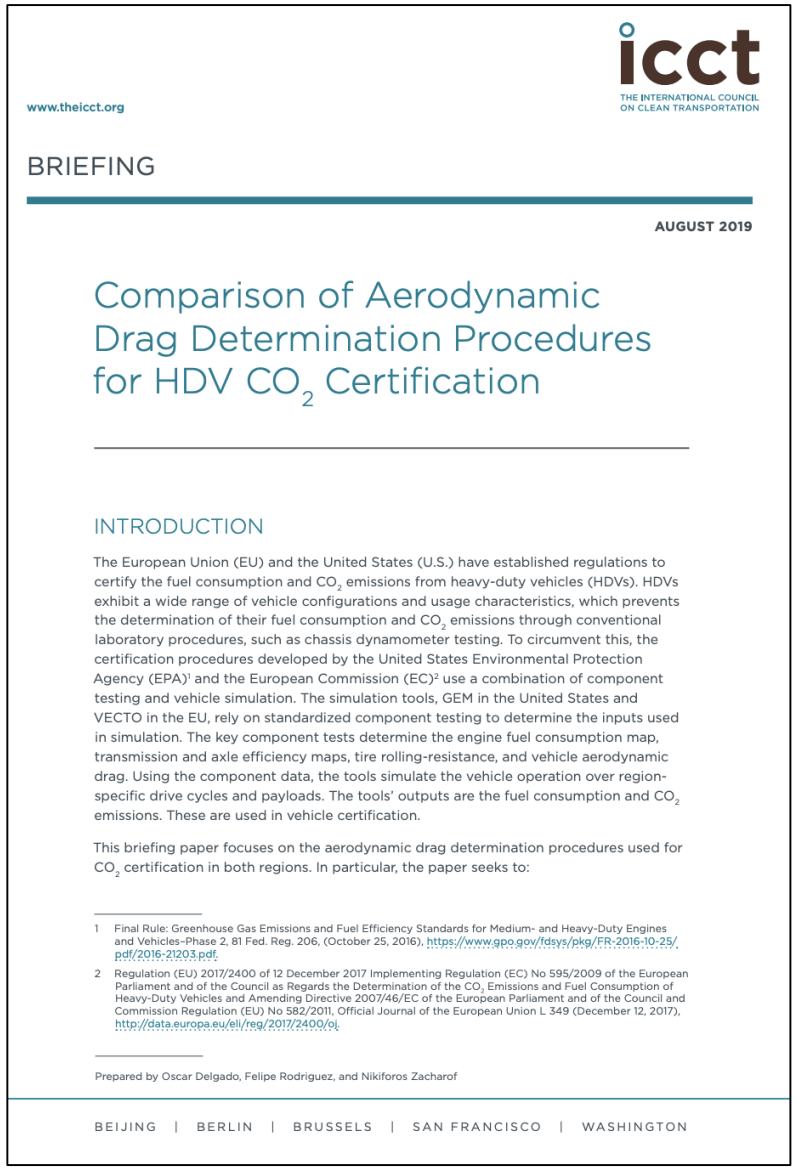
✓ **2nd STEP (2019): Development of Regulatory Framework to implement VECTO Software Development of Standard equivalent to SAE 2263 for coast down Coastdown truck tests in Highway and work program for new technical standards for VECTO certification and monitoring program.**

✓ **3rd STEP (to be defined): Fuel Savings and CO2 Standard Targets in Transportation by 2030. Definition of CO2 and consumption standards, and reduction targets**

- **Communication and regional harmonization with Brazil and Chile (Technical Seminars) and other countries of the Americas that participate in the Pan American Commission of Technical Standards (COPANT)**
- **With TTG G20 Technical Support: Technical seminars and knowledge Incorporation via webinars (2018 Deep Dive to Support HDV-E Labeling and Standards Meeting). Technical support for coast down road trials (ICCT and US EPA)**

J. Vasallo, 2019. "Argentina. Energy efficiency and co2 emissions from heavy automotive transport". Presented at G20 TTG meeting. Tokyo.

Options for HDV aerodynamic drag testing



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BRIEFING

AUGUST 2019

Comparison of Aerodynamic Drag Determination Procedures for HDV CO_2 Certification

INTRODUCTION

The European Union (EU) and the United States (U.S.) have established regulations to certify the fuel consumption and CO_2 emissions from heavy-duty vehicles (HDVs). HDVs exhibit a wide range of vehicle configurations and usage characteristics, which prevents the determination of their fuel consumption and CO_2 emissions through conventional laboratory procedures, such as chassis dynamometer testing. To circumvent this, the certification procedures developed by the United States Environmental Protection Agency (EPA)[1] and the European Commission (EC)[2] use a combination of component testing and vehicle simulation. The simulation tools, GEM in the United States and VECTO in the EU, rely on standardized component testing to determine the inputs used in simulation. The key component tests determine the engine fuel consumption map, transmission and axle efficiency maps, tire rolling-resistance, and vehicle aerodynamic drag. Using the component data, the tools simulate the vehicle operation over region-specific drive cycles and payloads. The tools' outputs are the fuel consumption and CO_2 emissions. These are used in vehicle certification.

This briefing paper focuses on the aerodynamic drag determination procedures used for CO_2 certification in both regions. In particular, the paper seeks to:

1 Final Rule: Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles-Phase 2, 81 Fed. Reg. 206, (October 25, 2016), https://www.gpo.gov/fdsys/pkg/FR-2016-10-25/pdf/2016-21203.pdf.

2 Regulation (EU) 2017/2400 of 12 December 2017 Implementing Regulation (EC) No 595/2009 of the European Parliament and of the Council as Regards the Determination of the CO_2 Emissions and Fuel Consumption of Heavy-Duty Vehicles and Amending Directive 2007/46/EC of the European Parliament and of the Council and Commission Regulation (EU) No 582/2011, Official Journal of the European Union L 349 (December 12, 2017), http://data.europa.eu/eli/reg/2017/2400/oj.

Prepared by Oscar Delgado, Felipe Rodriguez, and Nikiforos Zacharof

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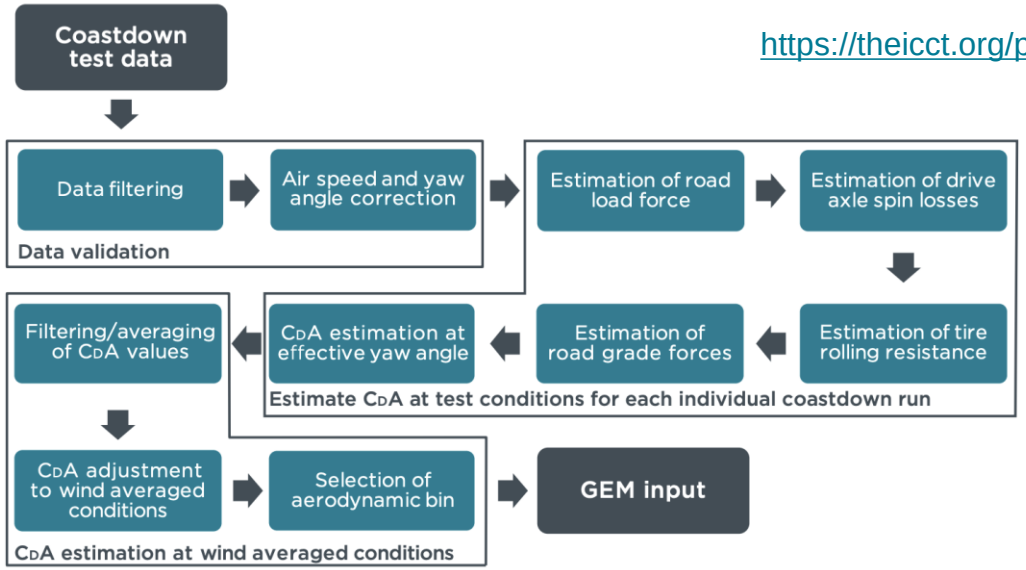
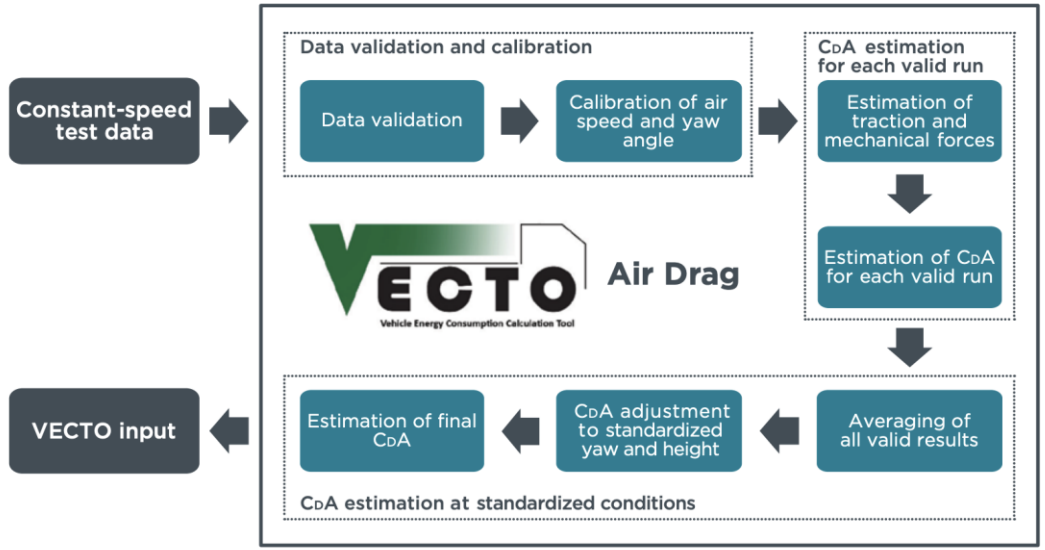
https://theicct.org/publications/aerodynamic-drag-HDV-EU





Argentina's aerodynamic drag testing: Coastdown

Participants: Secretary of Environment and Sustainable Development, Energy Secretary, Transport Ministry, ICCT, US EPA, Argentinian Federation of Freight Transport Companies (FADEEAC), Argentina Automotive Factory Association (ADEFA), Scania, Mercedes Benz, Andreani, Michelin, YPF (Oil National Company), Drive Up, ITBA.

Objective:

- Build technical capacity, get familiar with this type of test, and select which standards to apply.
- Air drag testing is important for HDV simulation-based CO_2 certification (VECTO) and technology verification of aerodynamic devices.
- Collect air drag data for VECTO simulations.

Outcomes:

- Procedure to create an air drag standard with Argentina's ISO Chapter (IRAM) has begun.
- Air drag was measured at 6.1 m^2 (prelim.)

Argentina's fuel consumption test: Flowmeter evaluation

Participants: Secretary of Environment and Sustainable Development, Energy Secretary, Transport Ministry, ICCT, Argentinian Federation of Freight Transport Companies (FADEEAC), Argentina Automotive Factory Association (ADEFA), Scania, Horiba, Andreani, YPF (Oil National Company), Michelin, Drive Up, ITBA.

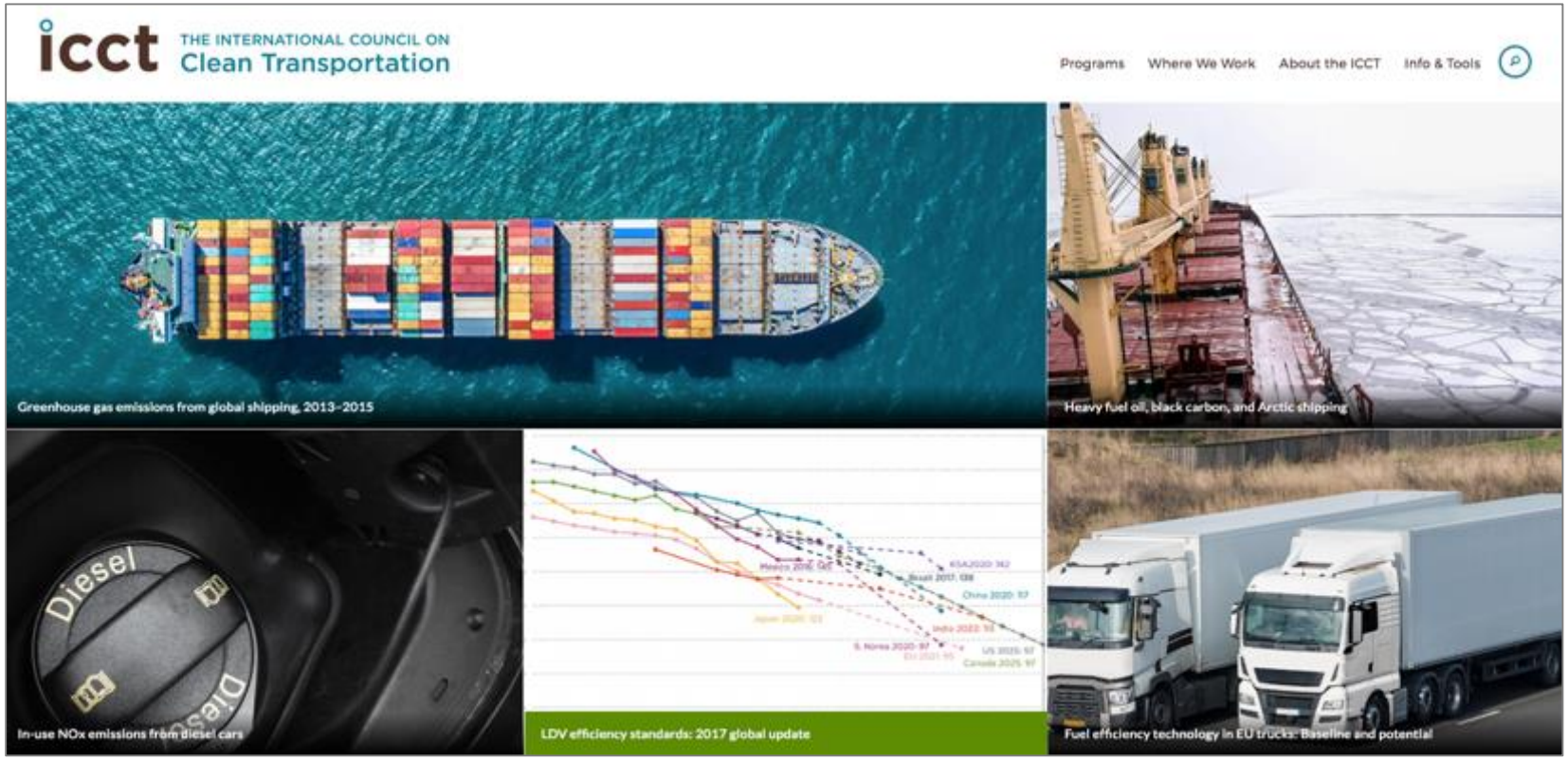
Objective:

- Build technical capacity and get familiar with fuel consumption measurement with fuel flow meters to develop relative consumption standards to support Argentina's Intelligent Transport Program.
- Collect FC data for comparing VECTO simulations against real-world measurement.

Outcomes:

- Data processing and analysis ongoing.

For more detail, please visit the ICCT website



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