

Integration of electric heavy-duty vehicles in emission standards

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EXPERT WORKSHOP

Mapping standards for low- and zero-emission electric heavy duty vehicles

17-18 February 2020 – Paris, France



The ICCT: mission and activities

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.

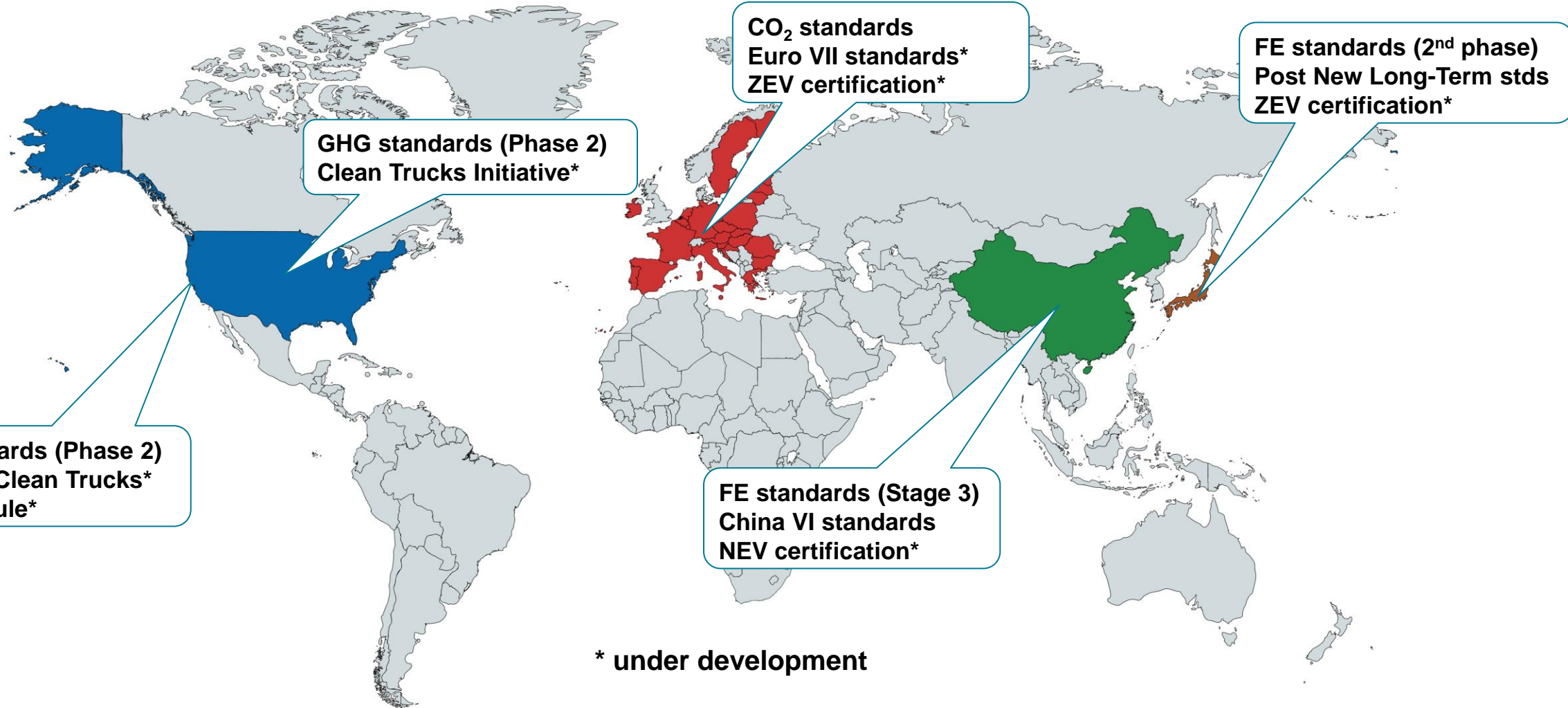
- Non-profit research organization
- Air pollution and climate impacts
- Focus on regulatory policies and fiscal incentives
- Activity across modes including aviation and marine
- Global outreach, with special focus on largest markets



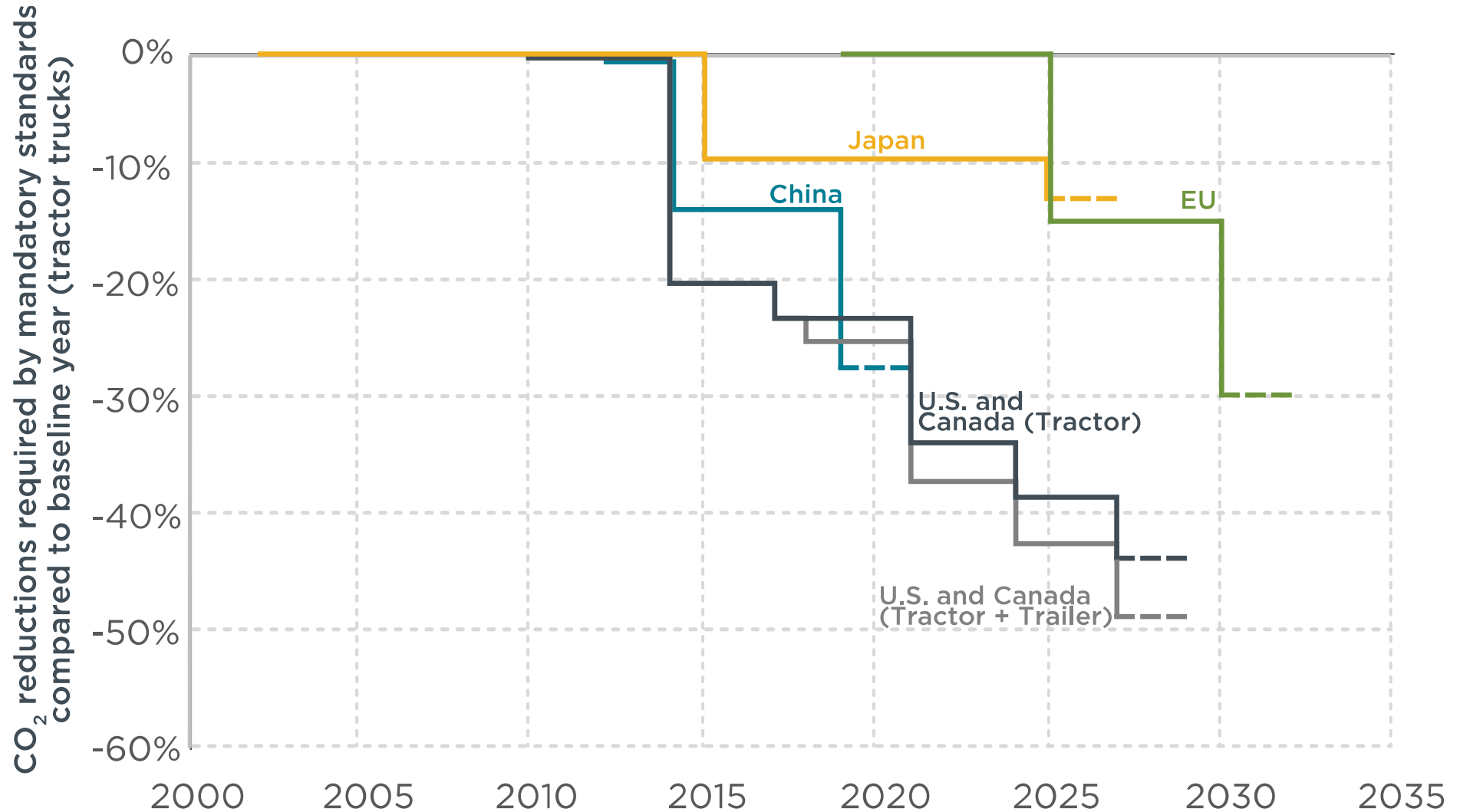
Scope of today's presentation

- Focus on CO₂ and pollutants emission standards
- Brief overview on the integration of ZE-HDVs into emission standards in the main markets
- Summary of available policy options
- Some guiding principles for integrating ZE-HDVs into emission standards

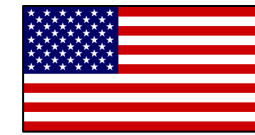
Focus in the following four regions: USA, EU, China, and Japan



Fuel efficiency, GHG and CO₂ standards for HDVs



US HDV Phase 2 GHG standards



The regulation includes 28 separate GHG standard

- 3 weight classes (LHD, MHD, HHD)
- 3 uses (urban, multi-purpose, regional)
- 2 fuel types (diesel, gasoline)
- 3 cabin types (low, mid, high roof)

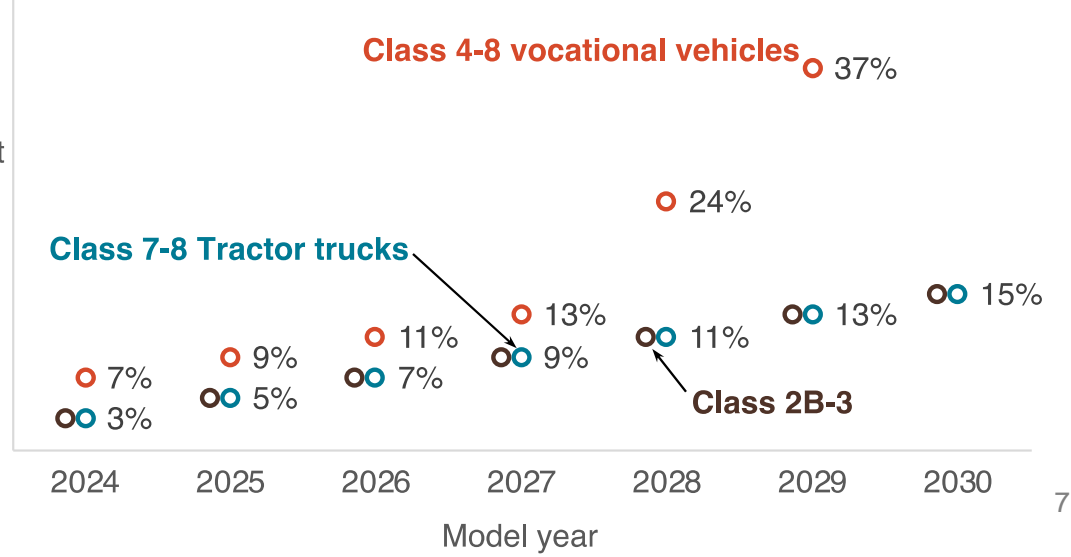
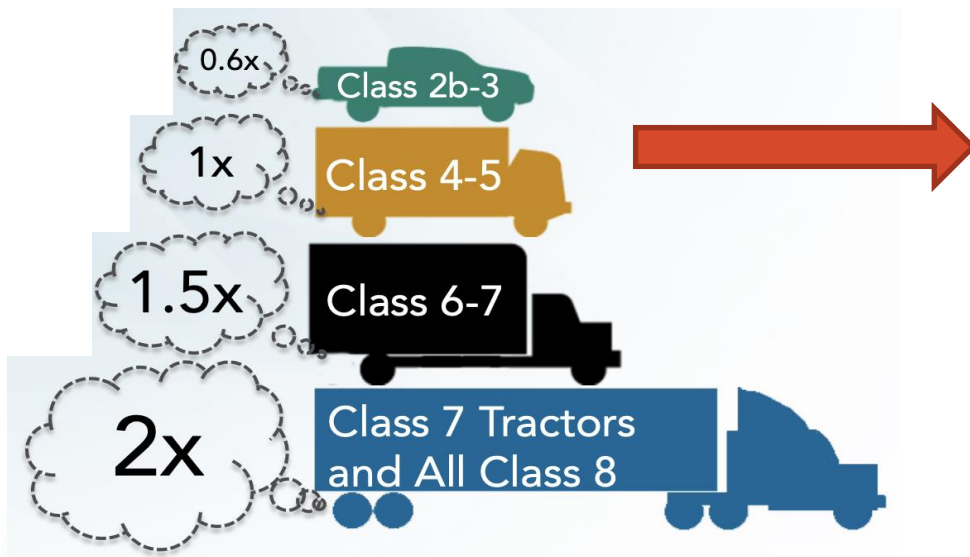
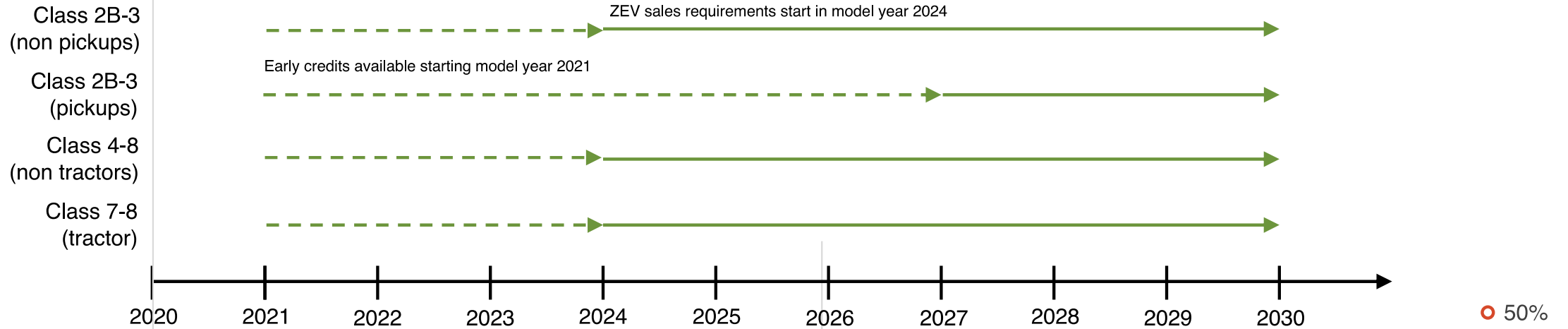
TABLE I-2—ADVANCED TECHNOLOGY MULTIPLIERS

Technology	Multiplier
Plug-in hybrid electric vehicles	3.5
All-electric vehicles	4.5
Fuel cell vehicles	5.5

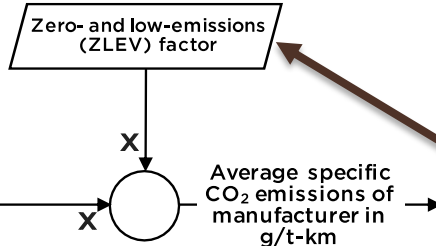
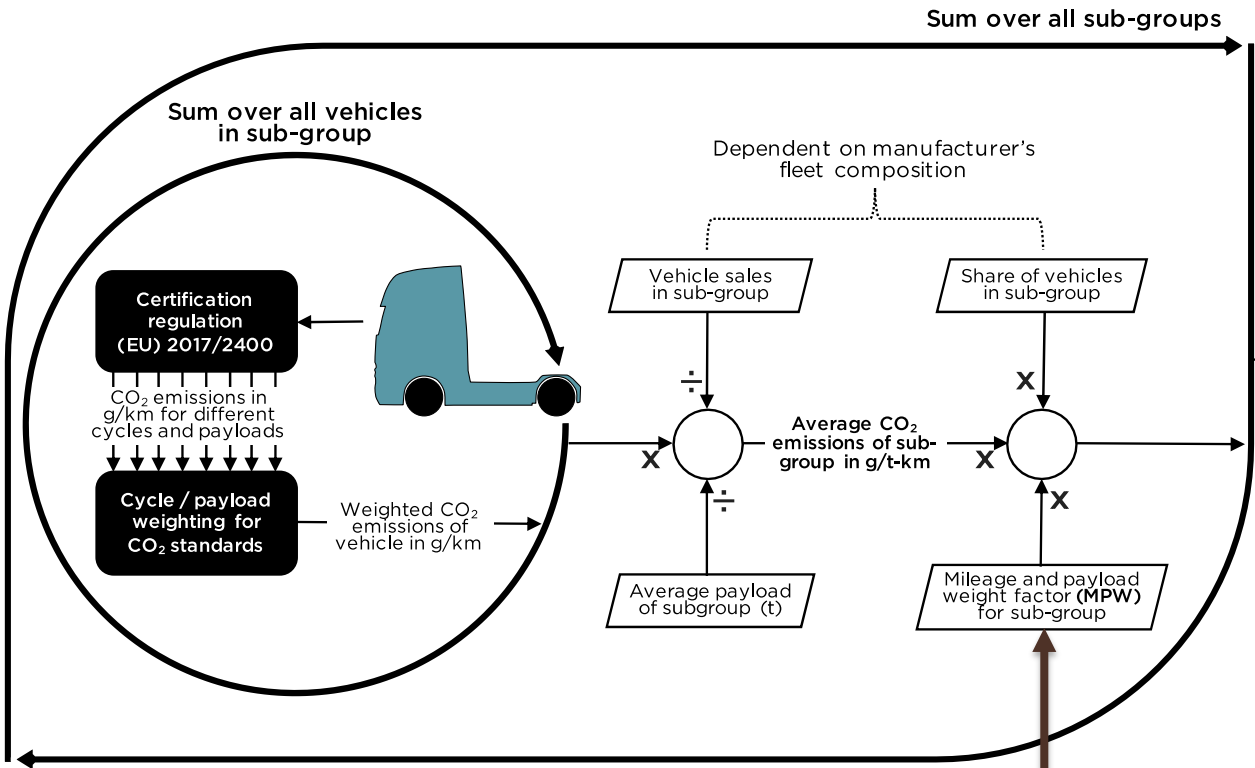
CARB's Advanced Clean Truck rule – under development



Sales requirements



EU's HDV CO₂ standards



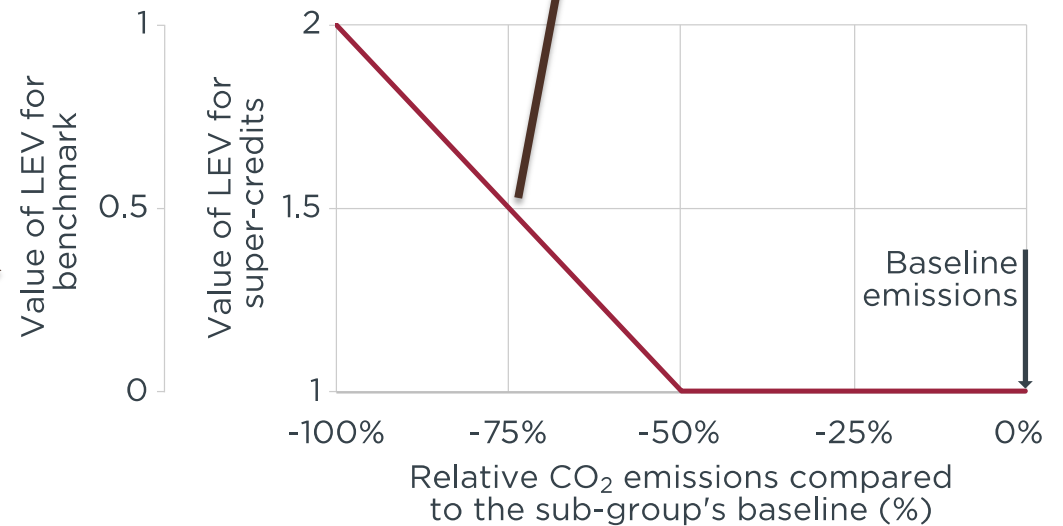
Super-credits (2019-2024)

$$\text{ZLEV factor} = \frac{V}{V_{\text{conv}} + \text{ZLEV}_{\text{in}} + \text{ZLEV}_{\text{out}}}$$

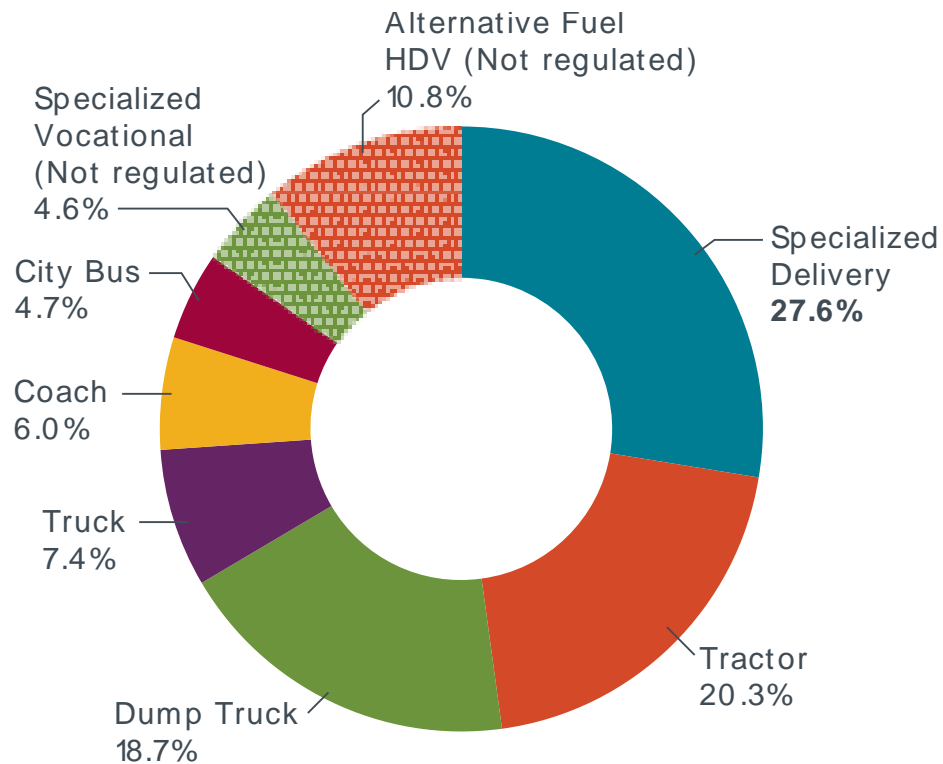
Benchmark (2025-onwards)

$$\text{ZLEV factor} = 1 - (\text{ZLEV}_{\text{sales share}} - 2\%)$$

Group description	Vehicle group	Vehicle sub-group ^a	Cabin type	Engine power	MPW ^b
Rigid, 4x2 axle, GVW > 16 t	4	4-UD	All	< 170 kW	0.099
		4-RD	Day cab	≥ 170 kW	0.154
			Sleeper cab	≥ 170 kW and < 265 kW	
		4-LH	Sleeper cab	≥ 265 kW	0.453
Tractor, 4x2 axle, GVW > 16 t	5	5-RD	Day cab	All	0.498
			Sleeper cab	< 265 kW	
		5-LH	Sleeper cab	≥ 265 kW	1.000
Rigid, 6x2 axle	9	9-RD	Day cab	All	0.286
		9-LH	Sleeper cab		0.901
Tractor, 6x2 axle	10	10-RD	Day cab	All	0.434
		10-LH	Sleeper cab		0.922



China and Japan fuel economy standards



ZE-HDVs are exempted from the fuel economy standards



Rigid freight trucks:

1		$PL \leq 1.5$
2	$3.5 < GVW \leq 7.5$	$1.5 < PL \leq 2$
3		$2 < PL \leq 3$
4		$3 < PL$
5	$7.5 < GVW \leq 8$	
6	$8 < GVW \leq 10$	
7	$10 < GVW \leq 12$	
8	$12 < GVW \leq 14$	
9	$14 < GVW \leq 16$	
10	$16 < GVW \leq 20$	
11	$20 < GVW$	

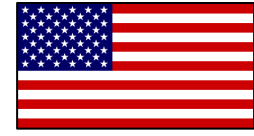
Tractor trucks:

1	$GVW \leq 20$
2	$20 < GVW$

Pollutant emission standards



US EPA' 10 – ABT mechanisms for HDVs



- Averaging (A): Targets are defined as a fleet-average, and not on an individual vehicle basis.
- Banking (B): Manufacturers can accumulate (bank) credits when over complying with the banking threshold
- Trading (T): Manufacturers can “trade” the credits to another manufacturer

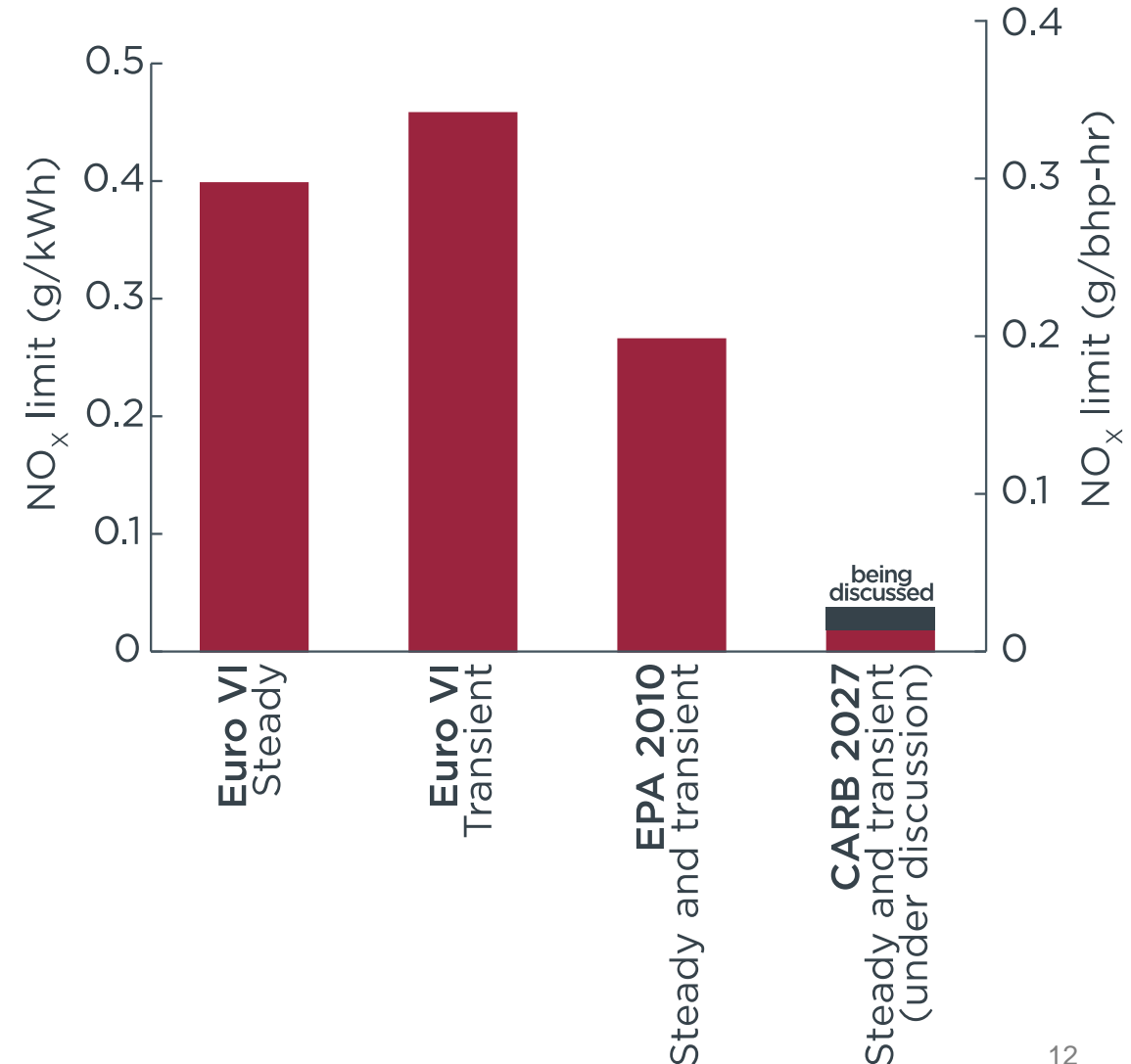
“Manufacturers are allowed to certify their engine families with various family emission limits (FELs), provided that in each model year the average of the FELs does not exceed the standard when weighted by the numbers of engines produced in each family for that model year.”

In the current regulation, OEMs do NOT get credit for ZE-HDV sales

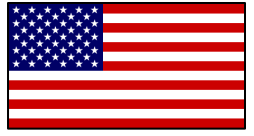
CARB's HD Low-NO_x regulation – under development



- California is considering a 90% reduction of NO_x limits in 2027
- Currently, only a national HD ABT program for credits, not capturing ZE-HDVs
- CARB is considering that ZE-HDVs would also be eligible to produce NO_x credits with a credit multiplier (2?)
 - Multiplier: Balance of incentives needed to advance with near-term air quality needs. A sunset multiplier is also being considered
 - Credits: Expiration 5 years after generation, and credit caps may be introduced



EPA's Clean Trucks Initiative – under development



- U.S. EPA released CTI's Advanced notice of proposed rulemaking
- One of the objectives of the consultation process is “To understand whether and how any incentives may be appropriate given the substantial tailpipe emission reduction potential of these [zero-emission] technologies.”

AUTHENTICATED U.S. GOVERNMENT INFORMATION GPO

3306 Federal Register / Vol. 85, No. 13 / Tuesday, January 21, 2020 / Proposed Rules

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 86 and 1036

[EPA-HQ-OAR-2019-0055; FRL-10004-16-OAR]

RIN 2060-AU41

Control of Air Pollution From New Motor Vehicles: Heavy-Duty Engine Standards

AGENCY: Environmental Protection Agency (EPA).

ACTION: Advanced notice of proposed rulemaking.

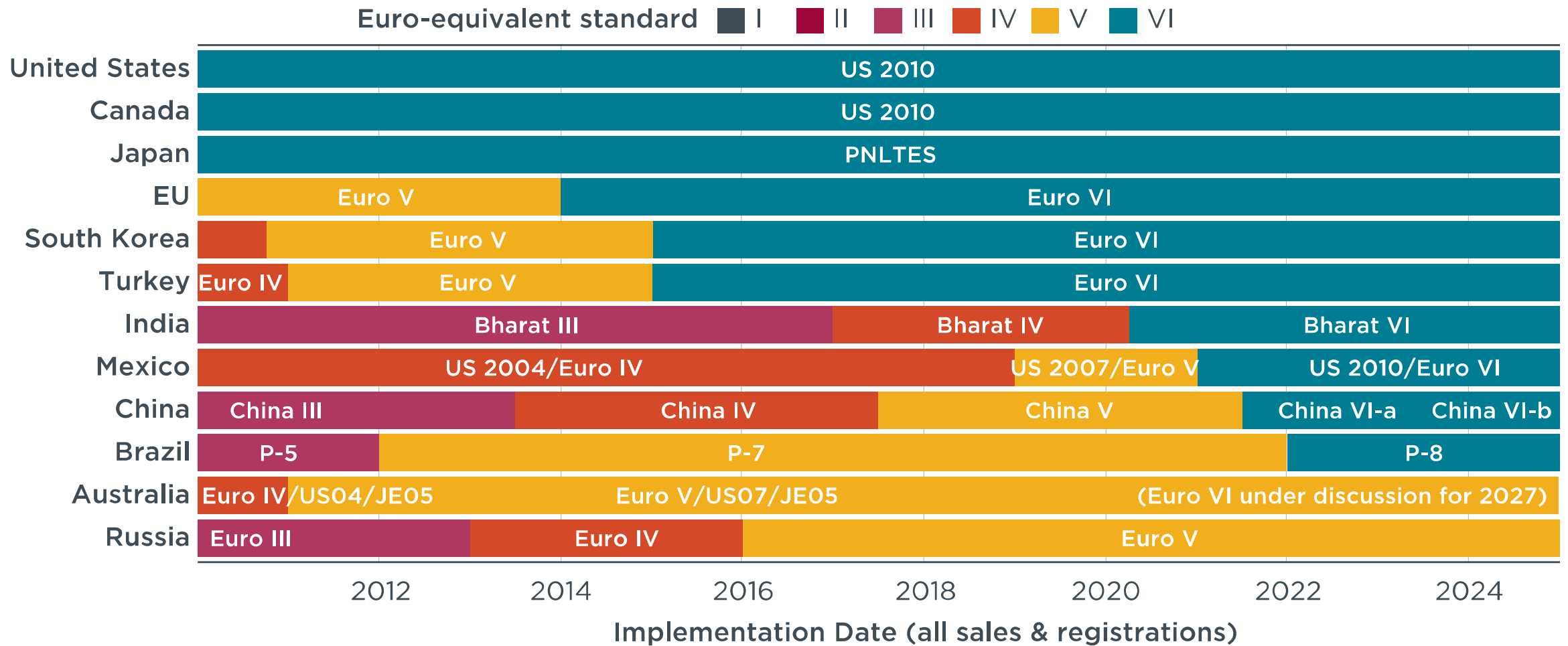
SUMMARY: The Environmental Protection Agency (EPA) is soliciting pre-proposal comments on a rulemaking effort known as the Cleaner Trucks Initiative (CTI).

Public Participation: Submit your comments, identified by Docket ID No. EPA-HQ-OAR-2019-0055, at <http://www.regulations.gov>. Follow the online instructions for submitting comments. Once submitted, comments cannot be edited or removed from *Regulations.gov*. The EPA may publish any comment received to its public docket. Do not submit electronically any information you consider to be Confidential Business Information (CBI) or other information whose disclosure is restricted by statute. Multimedia submissions (audio, video, etc.) must be accompanied by a written comment. The written comment is considered the official comment and should include discussion of all points you wish to make. EPA will generally not consider comments or comment contents located outside of the primary submission (*i.e.*,

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EU, China and Japan pollutant emission standards are not averaged



ZE-HDV certification: Energy consumption and range



A methodology for certifying ZE-HDVs is in the works



On-going technical development of VECTO

- **Continuous maintenance and helpdesk function**
- **Inclusion of new technologies, e.g.**
 - Review and update different types of transmissions
 - Predictive Cruise Control
 - Waste / Exhaust Heat Recovery Systems
- **Powertrains**
 - Electric and hybrid vehicles (including catenary)
 - Hydrogen (internal combustion engine/fuel cell electric vehicles)
- **Scope**
 - Small and medium lorries
 - Buses and coaches
 - Trailers and semi-trailers



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- The adopted HDV CO₂ standards opened windows for ZE-HDVs:
 - “By 31 December 2021, the Commission shall ... adopt ... a methodology for determining the zero-emission driving range and electricity consumption”
 - “By 31 December 2022, the Commission shall submit a report... towards a possible differentiation by zero-emission driving range and vehicle sub-group, combined with mileage payload weighting factors...”

China and Japan also are developing ZE-HDV certification

■ Energy Consumption and Range Test Procedure for Electric Vehicles

- The current standard applies for both LDV and HDV. Most of the requirements are based on LDVs and CATARC/MIIT will develop a revised standard for HDVs
- Expected to be implemented from 2024
- China cycle will be used
- To be submitted for approval in June 2020

标准号: GB/T 18386-2017

中文标准名称: 电动汽车 能量消耗率和续驶里程 试验方法

英文标准名称: Electric vehicles—Energy consumption and range—Test procedures

标准状态: 现行

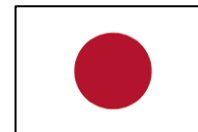


- In the Phase 2 regulatory document, MLIT said it would be developing a measurement method for ZE-HDVs and explore the possibility of creating efficiency standards for these and other types of advanced technology trucks and buses.

(5)電気自動車等の取扱い【別添7参照】

重量車における電気自動車については、現時点で販売台数比率が0.1%に満たない、また、同じく燃料電池自動車については、現時点で実験的な運行が進められている段階であること等を考慮し、省エネ法上の規制対象となる特定エネルギー消費機器に指定せず、基準値を策定しないこととする。ただし、重量車の省エネを着実に推進するためには、製造事業者等による電気自動車等（電気自動車、プラグインハイブリッド自動車及び燃料電池自動車）の導入への取組みについても評価する必要があることから、この取組みを燃費基準の達成判定において評価することとする。

これに向けて、来年度より電気自動車等の電費（電力量消費率）等の測定方法の検討を開始し、測定方法を確立させるとともに、電気自動車等の導入評価の具体的な方法等について審議を行う。



ICCT's guiding principles from international regulations

Principle 1: ZE-HDV certification enables targeted policy design

- The certification of the energy consumption and electric driving range enables establishing incentives targeted at deploying ZE-trucks in the highest emitting categories.
- Simulation based CO₂ certification is gaining ground in many regions
- The simulation of electric powertrains can be achieved using existing models



Principle 2: Advanced technology credits (ATC) must be carefully defined

- An advanced technology credits system can be useful to address the increased compliance cost associated with ZE-HDV technologies across the different categories.

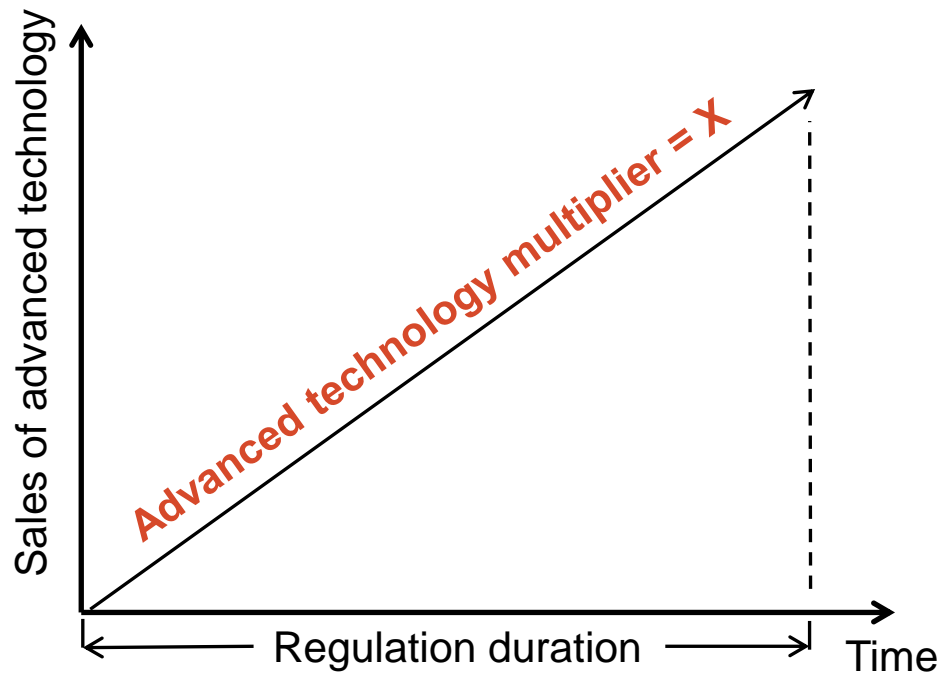
Multiplier

$$= \text{Adjustment Factor} \times \frac{\text{Advanced technology's incremental cost per emission benefit per vehicle}}{\text{Phase 2 compliance cost (conventional technology package) per emission benefit per vehicle}}$$

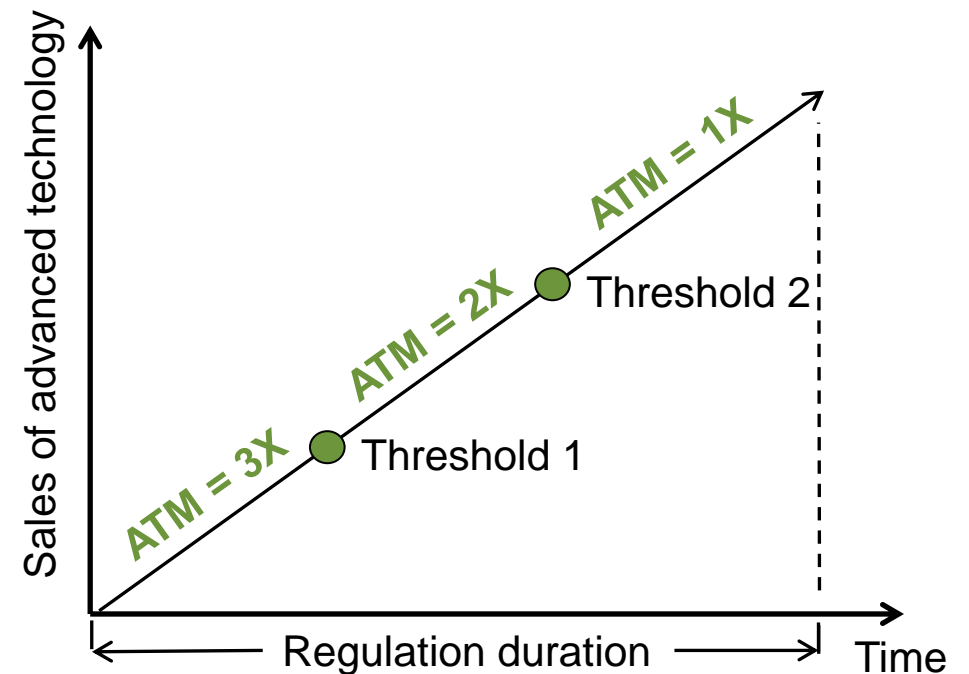
- Although advanced technology credits can help make fleet electrification more cost-effective, they erode the intended environmental benefits of the standards.
- It is a balancing act which requires a crystal ball

Principle 3: Advanced technology multiplier values should have sunsets

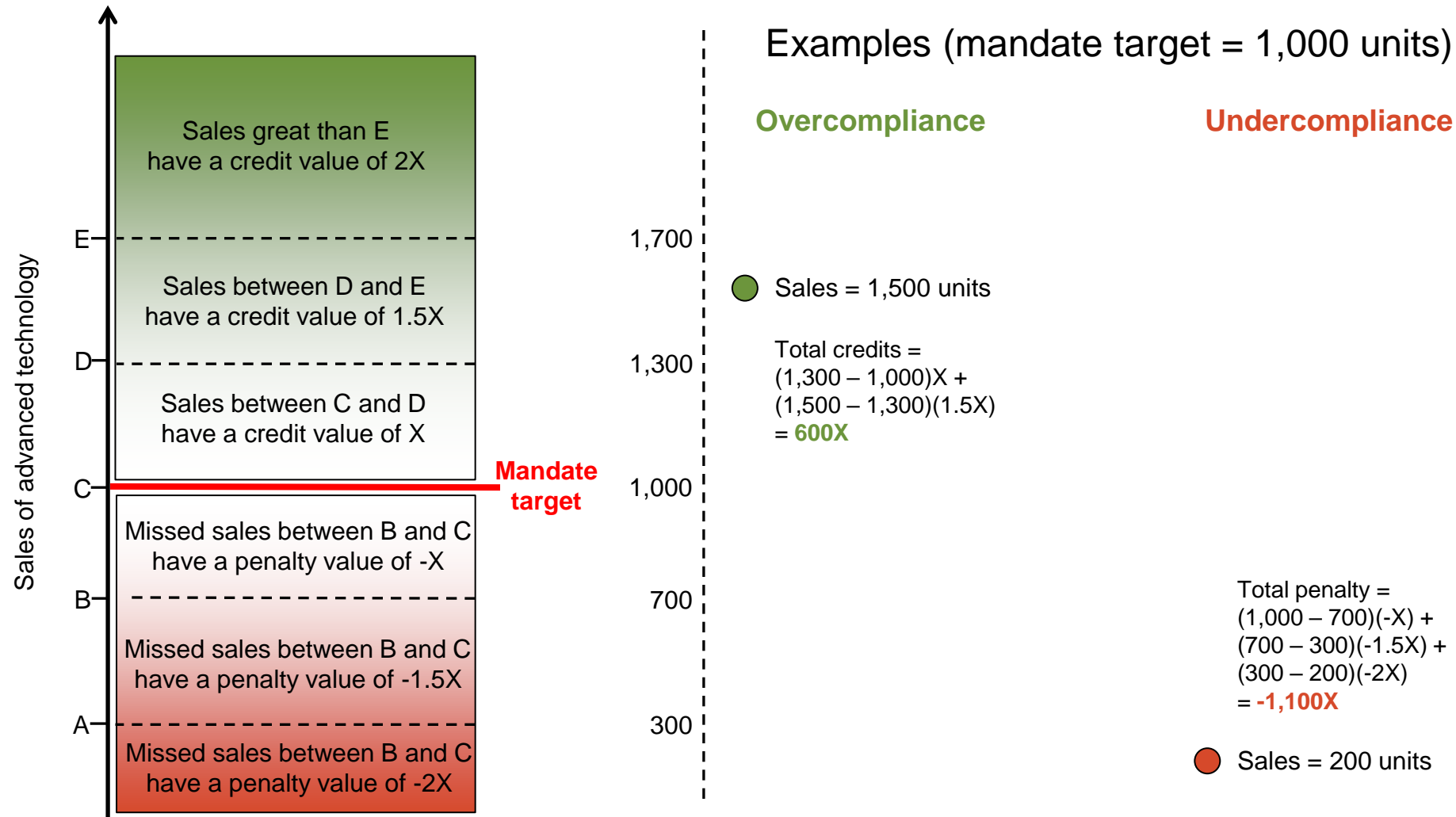
Scenario 1: advanced technology credits have constant value over life of the regulation



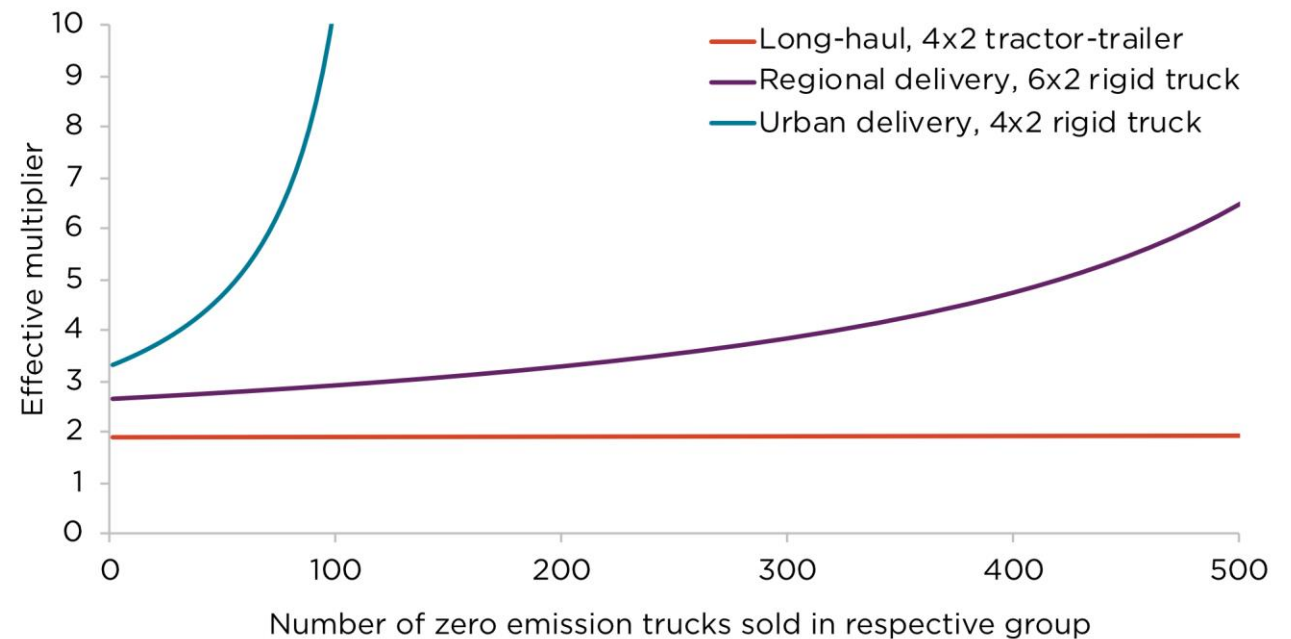
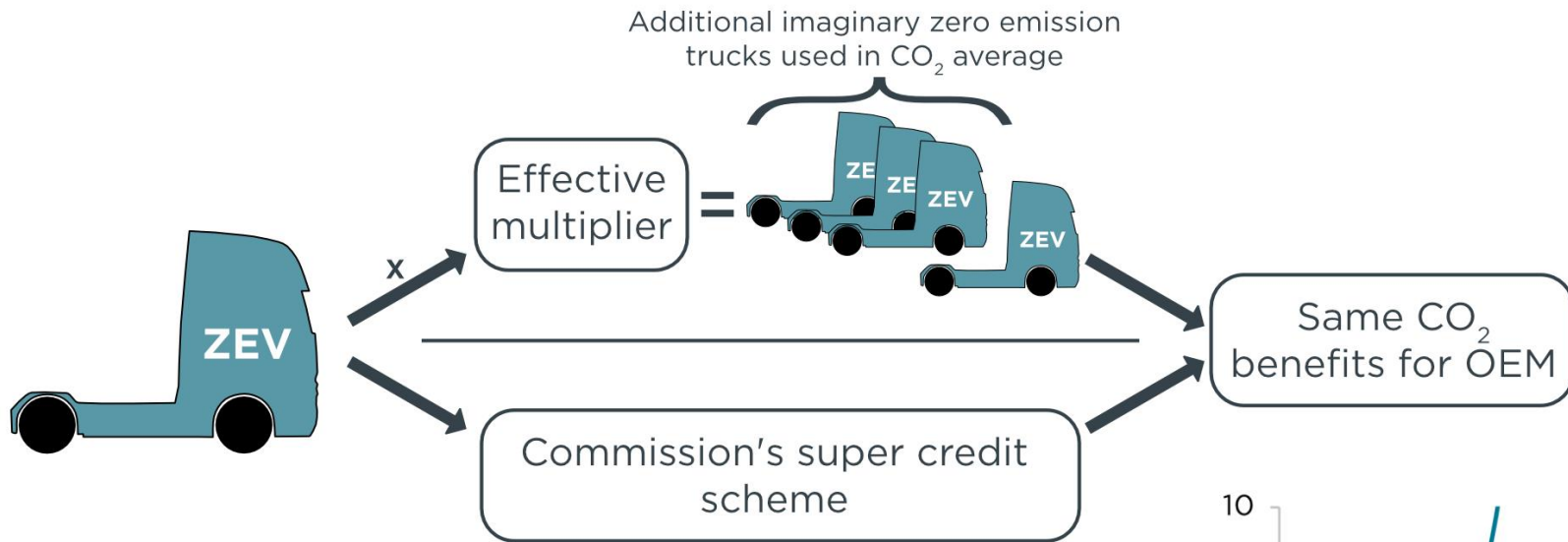
Scenario 2: value of advanced technology credits is linked to sales thresholds



Principle 4: Advanced technology credits (ATC) and benchmarks or mandates are not mutually exclusive

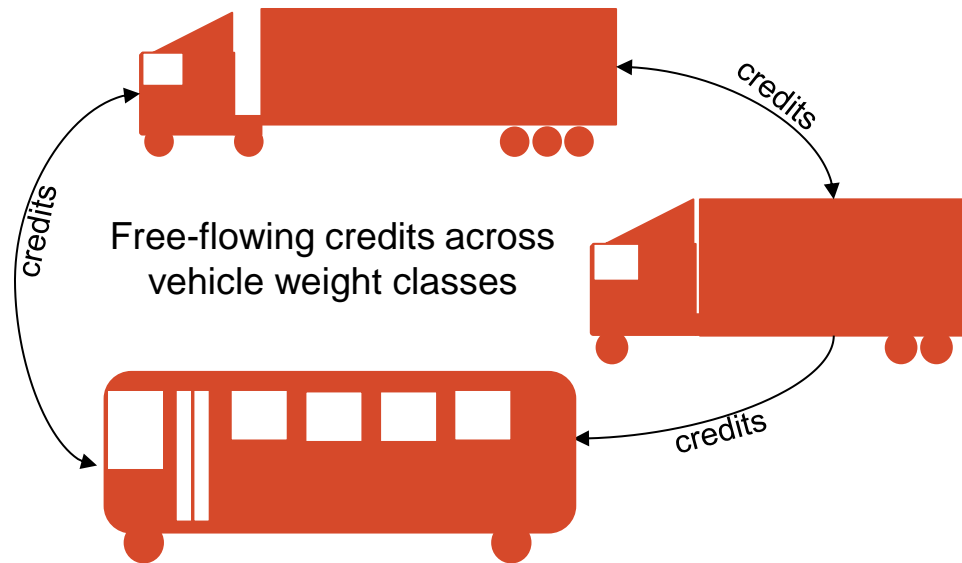


Principle 5: Short-term and long-term incentives have different designs

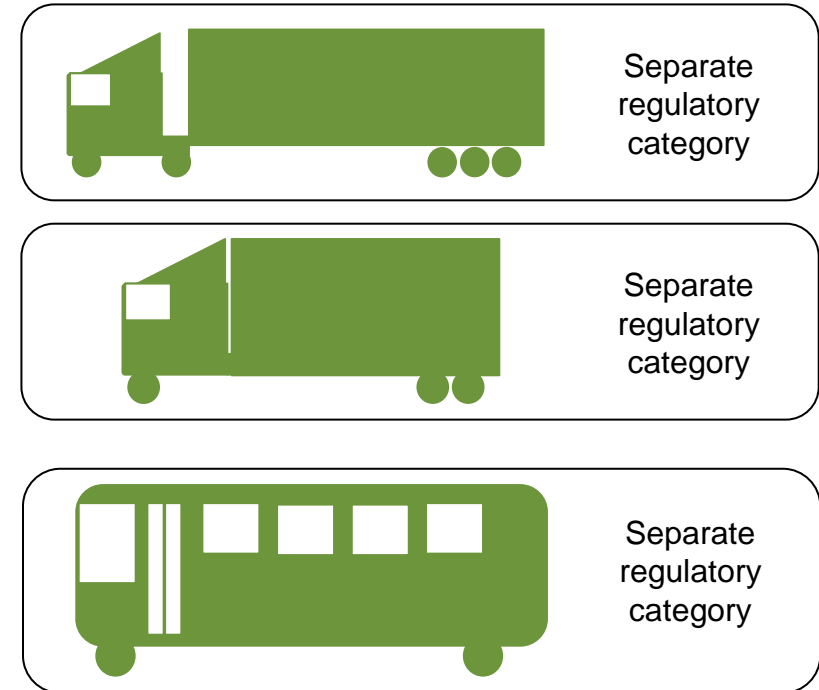


Principle 6: Averaging, Banking and Trading can be useful tool

Scenario 1: credit trading allowed across various vehicle weight classes

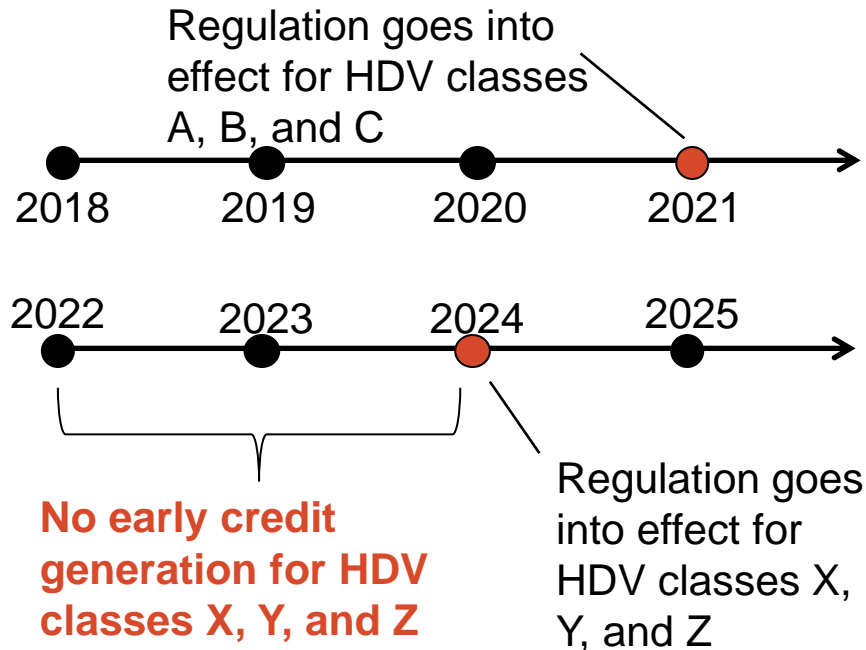


Scenario 2: no credit trading across various vehicle weight classes

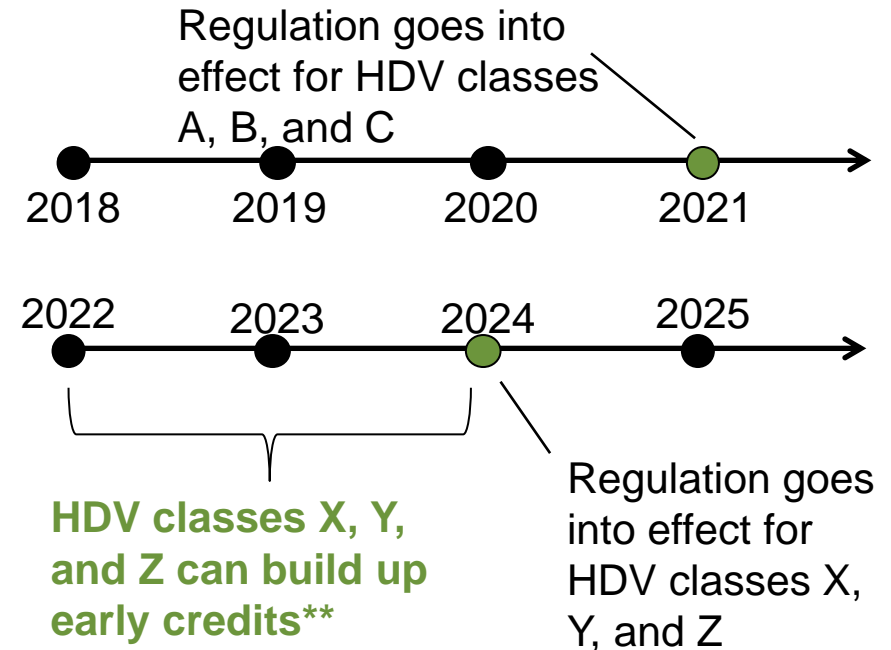


Principle 6: Averaging, Banking and Trading can be useful tool

Scenario 1: no opportunity for non-regulated vehicle classes to generate early credits

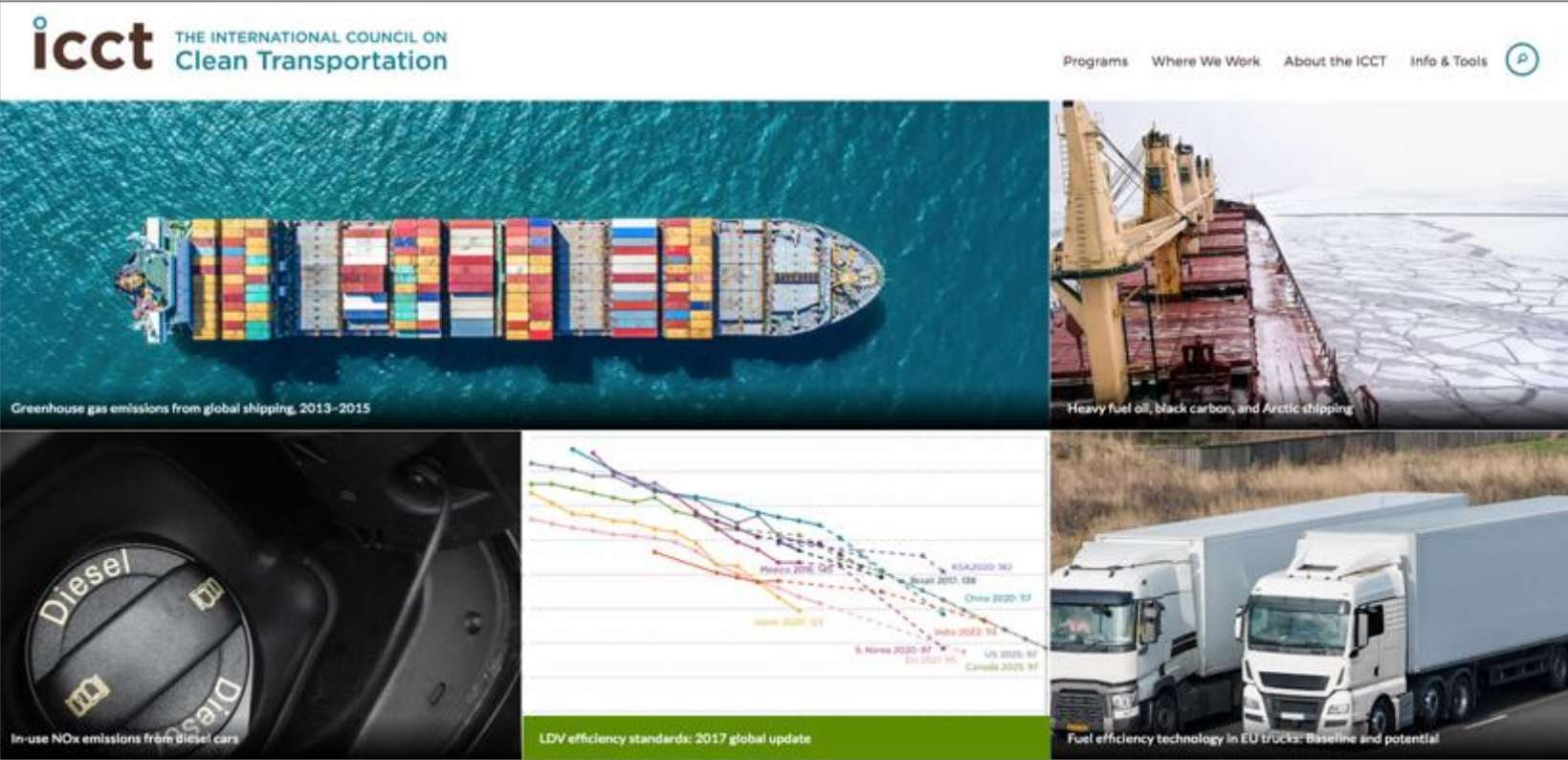


Scenario 2: non-regulated vehicle classes have opportunity to build up early credits with sales of advanced technologies



** Early credits for classes X, Y, and Z cannot be applied to classes A, B, and C

For more detail, please visit the ICCT website



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