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THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

Methodological notes: global vehicle sales database

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Introduction

This paper describes the methods used to construct a global database of sales of new light- and heavy-duty vehicles and facilitate the development of metrics that track progress toward clean vehicle policies. Over the past decade, an increasing number of markets have adopted regulations to reduce fuel consumption and emissions of greenhouse gases (GHGs) and conventional pollutants from light-duty vehicles (LDVs) and heavy-duty vehicles (HDVs).

The International Council on Clean Transportation (ICCT) has undertaken several global studies to determine the impact and status of these standards in major vehicle markets (Façanha et al., 2012; Chambliss et al., 2013; Miller et al., 2014; Kodjak, 2015). In general, these studies have taken a market-specific[1] analytical approach, assessing the impacts of each regulation on the fuel consumption or emissions of regulated vehicle types (passenger cars, light trucks/light commercial vehicles[2], buses, medium- and heavy-duty trucks) in that market. These studies have taken into account the differences in regulatory definitions of passenger cars and light trucks across markets (Table 1). This approach has allowed the ICCT to estimate the impacts of these standards with a reasonably high degree of specificity.

Building on the findings of these comprehensive technical studies, the ICCT has identified the need for a set of transparent and accessible metrics that track global progress toward clean vehicle policies and technologies: for example, the share of light-duty vehicles subject to fuel economy standards, or the share of diesel vehicles with diesel particulate filters.

Table 1. Regulatory definition of passenger cars and light trucks in major markets

	PASSENGER CAR			LIGHT TRUCK/ LIGHT COMMERCIAL VEHICLE		
	MAX. GVW	MAX. SEATS	2012 FLEET AVG. CURB WEIGHT	CARGO VEHICLE MAX. GVW	OTHERS	2012 FLEET AVG. CURB WEIGHT
US and Canada	3856 kg	12	1579 kg	3856 kg	Medium-duty SUVs and passenger vans ≤ 4536 kg	2030 kg
Mexico	3856 kg	12	/	3856 kg	/	/
EU	3500 kg	9	1330 kg	3500 kg	/	1680 kg
China	3500 kg	9	1296 kg	3500 kg	PV with more than 9 seats and GVW ≤ 3500 kg	1437 kg
Japan	3500 kg	/	1193 kg (2011)	3500 kg	/	/
South Korea	3500 kg	10	1421 kg (2011)	3500 kg	PV with 11 to 15 seats and GVW ≤ 3500 kg	1848 kg
India	3500 kg	/	1059 kg	3500 kg	/	/
Brazil	3856 kg	12	1100 kg	3856 kg	/	1443 kg

/ indicates not applicable or no data

1 The term "market" may indicate sub-national states or provinces, countries, or regions consisting of multiple countries (for example, the European Union). In this paper, the term "region" is typically used to refer to a group of one or more national markets.

2 In this paper, the terms "light truck" and "light commercial vehicle" are used interchangeably.

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There are several challenges associated with developing robust, sales-based metrics with global coverage. First, policy definitions and regulated vehicle types vary from market to market — in particular, the differing applicability of regulations to light-commercial vehicles (LCVs) or passenger cars (PCs), both of which fall within the category of LDV, complicates estimation of the share of LDVs subject to certain regulations. Furthermore, data sources can be opaque with respect to the determination of vehicle categories, creating the need for extensive cross-checking to correct for potential misclassifications. **In this paper, we explain the methodology used to construct a global historical vehicle sales database that facilitates the development of sales-based policy and technology metrics.**

The rest of the document is organized as follows: first, we elaborate on the main challenges of developing a robust global database of historical new vehicle sales; second, we delineate the assumptions used to collect data and validate estimates across data sources; and lastly, we specify the steps taken to develop the final database.

Main challenges

The process for aggregating market-level information to the global level can lead to inaccurate estimations if the information being aggregated does not share the same definition. In order to develop robust global metrics, we required market-level sales of new PCs, LTs/LCVs, and HDVs. These sales estimates could be merged with the list of adopted national regulations for fuel consumption/GHGs or emissions of conventional pollutants in order to estimate the share of global sales subject to these policies. Nonetheless, there was no single database with enough information to facilitate a straightforward computation; namely, we needed to develop an appropriate classification of global LDV and HDV sales.

This classification process had two main technical challenges:

1. **Heterogeneity of regulatory definitions.** Most of the regulations adopted throughout the world differentiate between LDVs and HDVs; however, there are differences with respect to the specific vehicle types covered. For instance, some national regulations include separate limits for PCs and LCVs, even though both are categorized as LDV (which can include passenger cars, light trucks, sport utility vehicles, cargo vans, and small commercial trucks, among others). Moreover, the criteria for PCs and LCVs may differ from one market to another (Table 1). Additionally, while some LDV fuel consumption standards apply to PCs but not LCVs, other LDV regulations may include certain types of medium-duty vehicles.[3]
2. **Data source heterogeneity.** It is feasible to keep track of the regulatory criteria across major markets that have implemented the most stringent clean vehicle policies.[4] These vehicle classifications rely on factors such as vehicle weight, number of passenger seats, cargo capacity or even drive type (2wd, 4wd, AWD, etc.); however, this level of specificity tends to be present only in detailed, proprietary databases that may cover only a single year of sales for a given vehicle market. While the ICCT has purchased such databases for select large markets and years, the limited coverage of these databases precludes their use as the basis for a global analysis. As we will detail in the following section, the vehicle categories used in global sales databases do not necessarily match their regulatory definitions.

Since a key function of sales-based metrics is to track policy and technology progress over time, we aimed to develop a replicable methodology that can be updated easily as additional sales data become available. To this end, we sought to balance the merits of a consistent approach and categorization for all markets with select market-specific adjustments that can provide better specificity without unduly limiting the replicability of the analysis.

Key assumptions and data sources

In this section, we describe the main assumptions and data sources used to develop the global sales database. First, we assumed that the International Organization of Motor Vehicle Manufacturers (OICA) data set adequately represents total world sales of new vehicles (see Table 6 for a description of each data set consulted). The OICA data set includes annual total sales broken down by passenger vehicles and commercial vehicles. We chose this data set as a global reference for several reasons:

1. **Comprehensive geographic coverage.** The data set includes 144 individual markets, including all markets with a significant share of new vehicle sales.
2. **Data sources.** According to OICA, data is gathered from National Trade Organizations, OICA members or correspondents, National Offices of Statistics, and Ministries of Transport. These are likely to be the best sources for vehicle sales data; uncertainties regarding the accuracy of the data classification process can be explored by cross-checking against market-specific data sources that include more detail by vehicle type (e.g. MarkLines).
3. **Data availability.** The OICA data set is publicly available on the organization's webpage; it contains

3 For example, US EPA's Tier 3 standards apply not only to light-duty vehicles, but also to some vehicles weighing up to 14,000 pounds. Since the US has adopted standards for HDVs as well as LDVs, this distinction would not affect the resulting share of global vehicle sales subject to stringent emissions standards.

4 Transportpolicy.net, for example, provides up-to-date information on air quality, GHG and fuels regulations around the world. The information provided has a high level of detail for each market, including the classification of regulatory vehicle types and direct links to official sources.

complete data on vehicle sales in all 144 markets for calendar years (CY) 2005-2014.

The second assumption corresponds to vehicle classification. Since OICA does not provide enough information to categorize sales into LDVs and HDVs, we had to use complementary databases in order to reclassify the OICA data. We will describe the process for using such complementary databases in the next section; for now, it is relevant to mention that while OICA's PC category falls under LDVs, OICA's CV category includes some LCVs that belong to our LDV classification, as well as HCVs that should be classified as HDVs.

Figure 1 compares OICA's vehicle categories with the classification necessary to support the development of global sales-based policy metrics. We used secondary databases to estimate sales shares for PC, LCV and HCV, and used these shares to disaggregate OICA's categories (in particular, removing LCVs from the CV category). Then, we aggregated PC and LCV into LDV, and classified the remaining commercial vehicles as HCV/HDV. We will define which categories fall into PC, LCV, and HCV for each of the secondary databases used.

The third assumption is related to the markets with no secondary data to split OICA's CV category. For these markets, we assumed the same sales shares for PC, LCV, and HCV as those obtained from secondary databases for other markets in the same Roadmap model region (ICCT, 2012). This approach was taken to ensure that the sales share of each vehicle type in a given Roadmap region reflects the weighted average of shares for all individual markets in that region.

Sales database methodology

This section describes the process for aggregating vehicles sales into PC, LCV and HCV using secondary databases and the OICA database. We used two secondary databases: the first, MarkLines (ML), covered annual new vehicle sales in 59 markets at this time of this analysis. The second, the International Energy Agency database (IEA), covers new vehicle sales in 42 markets and aggregate regions.

ML is a private web portal that includes several vehicle indicators, including new vehicle sales. In ML, vehicle sales are disaggregated by market, brand and vehicle type. The IEA database is a product of the International Energy Agency's Mobility Model (MoMo). In particular, this database was produced as part of the IEA's Energy Technology Perspectives 2014 study. The IEA database provides estimates of annual vehicle sales disaggregated by vehicle type and fuel type.

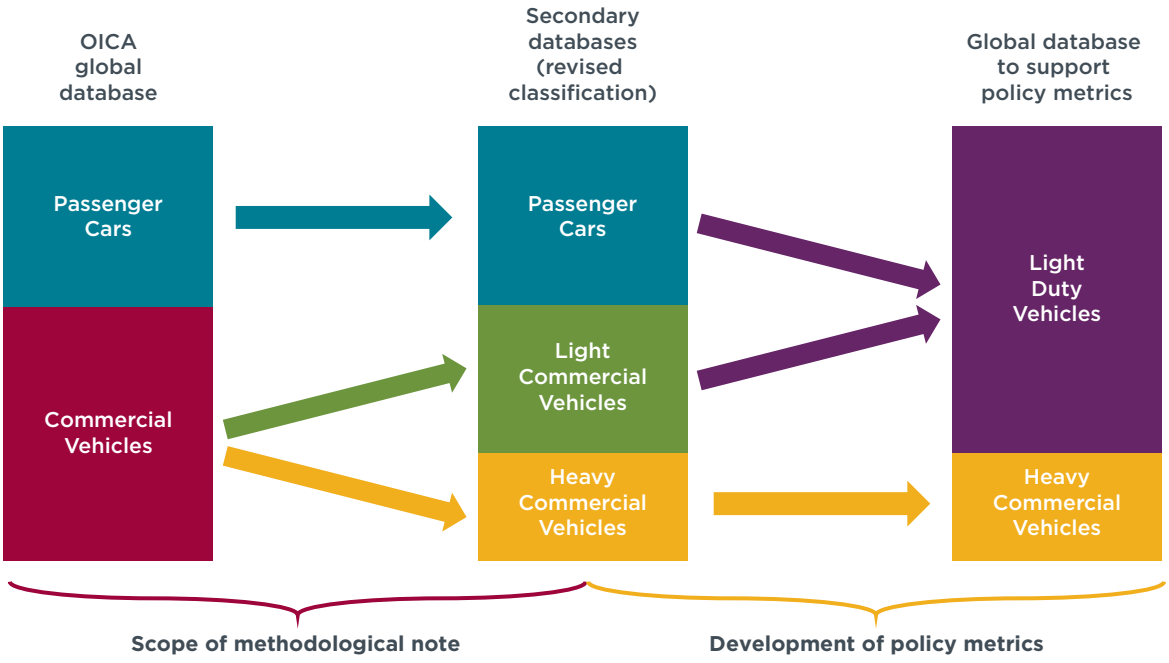

Figure 1. Overview of data manipulation and database usage

Figure 2 illustrates the four steps conducted to develop ICCT's estimates of historical vehicle sales according to regulatory categories:

- Step 1: Comparison of total sales across data sources.
- Step 2: Vehicle type definition for ML and IEA data sets.
- Step 3: Calculation of actual sales for markets with sufficient data.
- Step 4: Estimated sales for markets with insufficient or incomplete data.

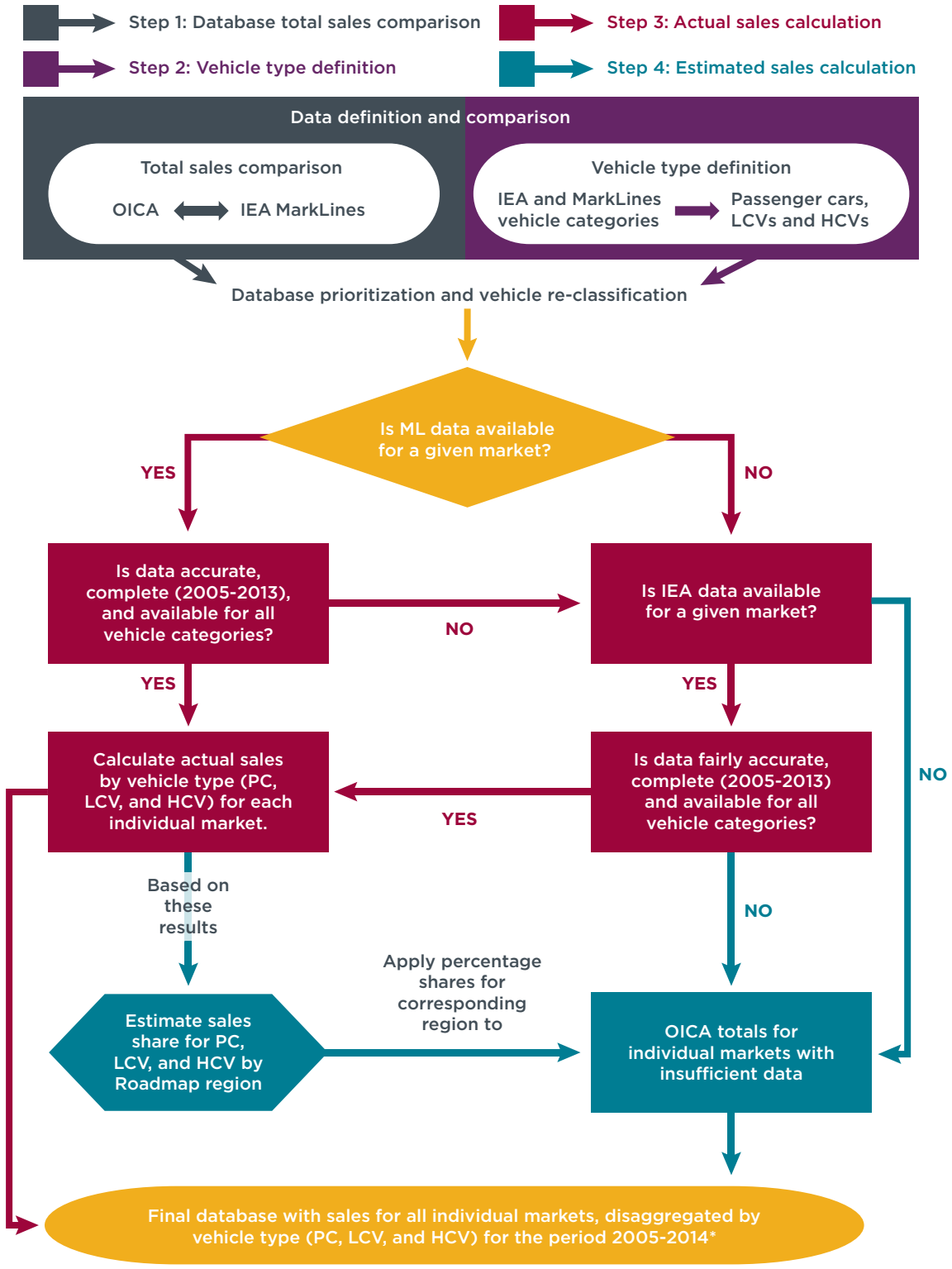

Figure 2. Sales database methodology

**For markets without 2014 ML data, 2014 CY sales by vehicle type were estimated by applying 2013 sales shares from ML or IEA to OICA 2014 sales totals.*

STEP 1: DATABASE TOTAL SALES COMPARISON

As a first step, we compared estimates of total sales across the three data sources. The objective of this comparison was to evaluate the consistency of ML and IEA with OICA sales totals and determine whether it is appropriate to disaggregate OICA data using sales shares from a secondary data source. The overall finding was that ML totals were largely identical to OICA's, whereas IEA totals were close but not as consistent. Figure 3 shows examples of this comparison for four major vehicle markets; in each of these markets, ML sales align with OICA's so closely that only one of the series is visible.[5]

Due to the consistency of total sales between ML and OICA, we favored ML data where available for the calculation of actual PC, LCV, and HCV sales (step 3).

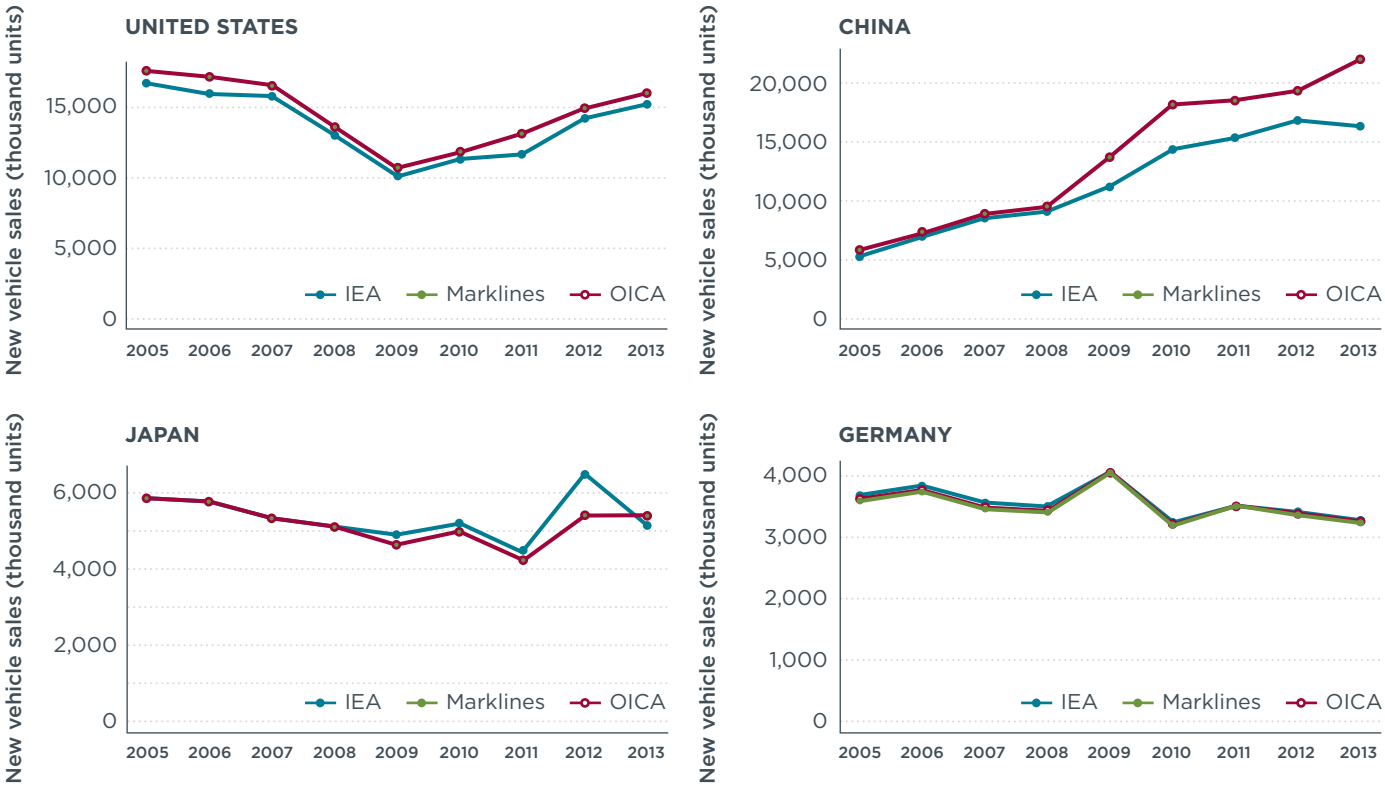

Figure 3. Total sales comparison by data source for four major markets[6]

Sources: IEA, MarkLines, and OICA.

5 Close alignment of total sales estimates from ML and OICA suggest that the two providers use the same primary data sources.

6 ML and OICA include sales data for CY 2014, and this data is incorporated into the ICCT's sales estimates; however, since the IEA data set only includes data through CY 2013, the comparisons of sales data provided in these figures do not show data for CY 2014.

STEP 2: VEHICLE TYPE DEFINITION FOR ML AND IEA DATABASES

After comparing total sales across data sources, we made detailed comparisons across data sets to determine which vehicle types should belong to the revised regulatory categories. The ML data contained more than 40 different vehicle types across the markets covered. Using the definitions of vehicle types provided by the ML website, we assigned these vehicle types to the categories as indicated in Table 2. The final two rows correspond to markets sourced

Table 2. Vehicle classification by market

Market	Passenger Cars	Light Commercial Vehicles	Heavy Commercial Vehicles	
Australia	Cars	Light Trucks SUV	Heavy Trucks	SUVs were excluded from the PC category in order to better match PC estimates for ML and OICA.
Brazil	Cars	Light Trucks	Buses Trucks	
Canada	Cars	Light Trucks	Medium Trucks Heavy Trucks	
China	Cars Sedan / Hatchback SUV Mini Van MPV	Light Trucks Light Trucks (Chassis) Mini Trucks Mini Trucks (Chassis) Small Buses Small Buses (Chassis)	Heavy Trucks Medium Trucks Heavy Trucks (Chassis) Large Buses Large Buses (Chassis) Medium Buses Medium Buses (Chassis) Medium Trucks (Chassis) Semi Trailer	For years 2005, 2006, and 2007, the data set included one consolidated variable as "Cars"; however, from 2008 onwards it disaggregated the "cars" category into Sedan/ Hatchback, MPV, SUV and Minivan. When we used this aggregation, the PC category was very consistent with OICA's PC figures.
France	Cars	Light Trucks	Heavy Trucks Buses Heavy Trucks/Buses	Heavy Trucks/Buses category only appears for 2008 and 2009. In other years, data are disaggregated to Heavy Trucks and Buses.
India	Cars UVs/MPVs	Light Trucks	Buses Medium/Heavy Trucks	
Japan	Cars Mini Cars Small Cars	Light Trucks Mini Trucks Mini Van	Buses Trucks	
Malaysia	Cars MPV 4x4/SUV Window Van	Light Trucks Pickup Panel Van	Trucks Heavy Trucks Buses Prime Mover	From 2009 onwards, some of the Cars category was reported as MPV. Hence, we considered MPV under PC.
Netherlands	Cars	Light Trucks Van	Trucks Heavy Trucks	Light Trucks category from 2005-2009 renamed Van from 2010-2014
Romania	Cars	Light Trucks	Buses Trucks	
Sweden	Cars	Light Trucks	Buses Medium Trucks Heavy Trucks	
United Kingdom	Cars	Light Trucks	Buses Medium/Heavy Trucks Heavy Trucks	After 2005-2009, Heavy Trucks were disaggregated into Buses and Medium/Heavy Trucks.
United States	Cars Cars/Light Trucks	Light Trucks	Medium Trucks Heavy trucks	Cars/Light Trucks category contains no data except for 12 units in 2009.
Vietnam	Cars MPV/SUV	Pickup Van SPV Minibus	Trucks Buses Trucks/Buses	Trucks/Buses category accounts for a very small share of HCVs.
Argentina **Chile** **Croatia** **Denmark** **Finland** **Germany** **Iceland** **Indonesia** **Middle East*** **New Zealand** **Norway** **Philippines** **South Africa** **Switzerland**	Passenger Cars Passenger Light Trucks	Light Commercial Vehicles (LCVs) Minibuses	Medium Trucks Heavy Trucks Buses	Sales in these markets were calculated using IEA data. When comparing with the PC category in OICA data, we found that the two data sources were more consistent when Passenger Light Trucks were included under PC.
Thailand	Passenger Cars	Passenger Light Trucks Light Commercial Vehicles (LCVs) Minibuses	Medium Trucks Heavy Trucks Buses	Sales in Thailand were sourced directly from the IEA data set.

* No individual market in the Middle East had sufficient data coverage in ML or IEA; however, the IEA data set included estimates for the Middle East as a region. To ensure consistency with the region total, we applied regional average sales shares to each individual market in the Middle East.

from the IEA data set, and the final column lists observations that may explain apparent anomalies in vehicle classification.

While the IEA data set contained relatively few vehicle categories compared to ML, we discovered some differences in these classifications across markets when compared to OICA's PC category. These differences were related to IEA's Passenger Light Truck (PLT) category, which for most markets seemed to fall under passenger cars; however, there were some exceptions. Although in the final database, only some markets were calculated using the IEA data set (see the last two rows in Table 2 for the vehicle classification), we will explain the process for assessing whether the PLT category should be included in the PC or LCV intermediate classification.

When we tested the relationship $PC_{(OICA)} = PC_{(IEA)} + PLT_{(IEA)}$, we found that the result was very close to OICA's PC category in some markets but significantly greater in others. Hence, we derived two classifications to aggregate these intermediate categories in the IEA data set: market type 1, where $PC_{(OICA)} = PC_{(IEA)} + PLT_{(IEA)}$, and market type 2, where $PC_{(OICA)} = PC_{(IEA)}$. Figure 4 illustrates the effect of this classification for a type 1 (Brazil) and type 2 market (U.S.).

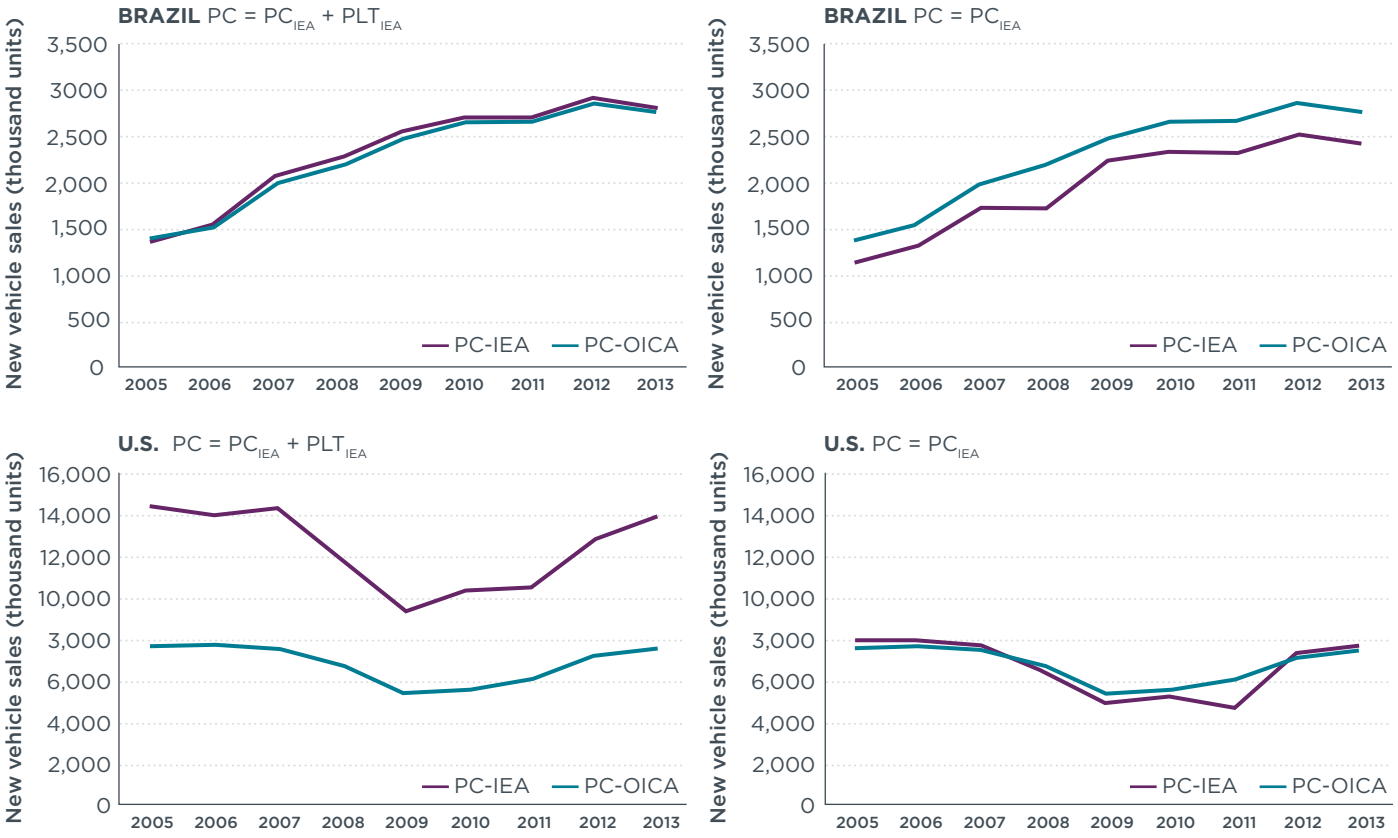

Figure 4. Classification of IEA's PLT category for a type 1 and type 2 market[7]

STEP 3: ACTUAL SALES CALCULATION

The third step consisted of calculating actual sales according to the revised vehicle classification (PC, LCVs and HCVs) for those markets with accurate and complete data for CY 2005-2013. This process prioritized the ML data due to its consistency with OICA totals. If ML data were either unavailable or incomplete,[8] then IEA data were used to calculate sales shares. If there were insufficient data for a given market in both ML and IEA, then sales were estimated according to the process in step 4. In the example of the U.S., both databases contained complete data (no missing data for the 2005-2013 period, and vehicle type information according to Table 2). As illustrated in Figure 3, the ML sales totals were the same as OICA, while IEA estimates were lower; therefore, we opted to use ML data to calculate actual sales shares

7 ML and OICA include sales data for calendar year 2014, and this data is incorporated into the ICCT's sales database; however, since the IEA data set only includes data through calendar year 2013, the comparisons of sales data shown in these figures exclude data for calendar year 2014.

8 As an example of incomplete ML data, we found many regions where vehicle types were mixed into single categories called "all cars"; we also found regions where data for either LCV or HCV were not explicitly identified. Finally, for other regions, there was information for only a few sales years.

for the U.S. market. Meanwhile, Germany also had data in both the ML and IEA data sets; however, the ML data did not include the vehicle type information necessary to aggregate the HCV category. Since the IEA data for Germany were also available and fairly close to OICA totals, we used the IEA data to reaggregate OICA sales for Germany.

The second and third columns in Table 3 specify the database used to reaggregate vehicle categories for each market in our database. The remaining columns will be explained in step 4.

STEP 4: ESTIMATED SALES CALCULATION

The markets covered individually by either ML or IEA accounted for close to 85% of global vehicle sales in CY 2013. This high degree of individual market coverage allowed us to estimate sales in the remaining countries (rightmost column in Table 3) using ML and IEA data for other countries in the same region while retaining a high degree of confidence in the validity of our results.

This process consisted of adding up the sales in markets with ML and IEA data for each Roadmap model region (second and third columns in Table 3), then assuming the average sales shares of PC, LCV, and HCV are representative of the region. For instance, for the Latin America aggregate region (which excludes Mexico and Brazil), we used data for Chile and Argentina to calculate the average sales share of PC, LCV, and HCV, and applied these shares to the OICA totals for the remaining markets in Latin America (for which detailed ML or IEA data were not available). In the case of Africa, we used data for South Africa since it was the only market with sufficient data for PC, LCV, and HCV. This process allowed us to reaggregate sales to the regulatory categories while minimizing any distortions to the regional totals.

Table 3. Markets with actual sales and markets with sales estimated using regional average shares

Roadmap Region	Actual sales[9]		Estimated sales		
	ML	IEA	BASED ON SHARES FOR OTHER COUNTRIES (COLUMNS 2-3) IN ROADMAP REGION		
Africa		South Africa	Algeria Angola Botswana Burkina Faso Burundi Cameroon Congo Gabon Ghana	Ivory Coast Kenya Liberia Libya Madagascar Malawi Mauritius Morocco	Nigeria Senegal Sudan Tanzania Tunisia Uganda Zambia Zimbabwe
Asia-Pacific-40	Malaysia Vietnam	Indonesia New Zealand Philippines Thailand	Bangladesh Brunei Cambodia Kazakhstan Kyrgyzstan	Laos Mongolia Myanmar Nepal Pakistan	Singapore Sri Lanka Tadjikistan Turkmenistan Uzbekistan
EU-28	France Netherlands Sweden United Kingdom Romania	Denmark Finland Germany Croatia	Austria Belgium Greece Ireland Italy Luxembourg Portugal	Spain Bulgaria Cyprus Czech Republic Estonia Hungary	Latvia Lithuania Malta Poland Slovakia Slovenia
Latin America-31		Argentina Chile	Bahamas Belize Bolivia Colombia Costa Rica Cuba Dominican Republic	Ecuador El Salvador Guatemala Guyana Honduras Jamaica Nicaragua	Panama Paraguay Peru Trinidad and Tobago Uruguay Venezuela

9 For each Roadmap region, the markets with sufficient sales data (from either ML or IEA) were used to estimate the regional average sales share, which was then applied to the remaining markets in that region.

Roadmap Region	Actual sales[9]		Estimated sales		
	ML	IEA	BASED ON SHARES FOR OTHER COUNTRIES (COLUMNS 2-3) IN ROADMAP REGION		
Middle East		Middle East*	Turkey Bahrain Iraq Iran Israel Jordan	Kuwait Lebanon Oman Qatar Saudi Arabia	Syria United Arab Emirates Yemen Egypt
Non-EU Europe		Iceland Norway Switzerland	Albania Armenia Belarus Bosnia	Georgia Macedonia Moldavia	Serbia Ukraine Azerbaijan
Australia	X				
Brazil	X				
Canada	X				
China	X				
India	X				
Japan	X				
U.S.	X				
Russia**		X			
South Korea		X			
Mexico			***X		

X indicates there is only one country in a given Roadmap model region.
* No individual market in the Middle East had sufficient data coverage in ML or IEA; however, the IEA data set included estimates for the Middle East as a region. To ensure consistency with the region total, we applied regional average sales shares to each individual market in the Middle East.
** Russia did not have ML data for 2013, so 2013 was estimated using 2012 sales shares.
*** Mexico did not have sufficient data in either data set (IEA or ML). Instead, we applied sales shares for the Latin America-31 region to Mexico's OICA total.

ESTIMATION OF SALES BY FUEL TYPE

The final step to enabling a sales-based evaluation of global progress toward clean vehicle policies and technologies was to disaggregate the revised vehicle classification (PC, LCV, and HCV) by fuel type. We did not include this step explicitly in the process depicted in Figure 2, since the fuel type estimation was only conducted for a single year, and it used only the IEA data set. We were constrained to use IEA since it was the only global data set with sales broken out by fuel type. To reduce the incidence of missing data across markets, we aggregated the eight fuel types in IEA to four (Table 4).

Table 4. Fuel type aggregation

Database aggregation	IEA fuel types
Gasoline/Flex Fuel	Gasoline Flex Fuel CNG/Gasoline LPG/Gasoline
Diesel	Diesel CNG/Diesel
Pure CNG	Pure CNG
Pure Electric	Pure Electric

Even with this aggregation, a significant number of markets did not have complete data by fuel type: in most cases, this data was available for only a few years out of the CY 2005-2013 period. Similar to the approach for estimating sales shares by vehicle type, sales shares by fuel type for the available markets were used as a proxy for the remaining markets in each respective Roadmap region. The markets with available data by fuel type are listed in Table 5.

Sales shares by fuel type were applied to each of the 144 markets (that were already reaggregated into PC, LCV, and HCV categories using OICA totals). Since the IEA data set includes only CY 2005-2013, sales shares by fuel type in CY 2013 were imputed for CY 2014. Future improvements in data availability could increase the accuracy of these fuel share estimates.

Table 5. Markets used to estimate share of sales by fuel type

Roadmap region	Markets with fuel type data for CY 2013		
Africa	Algeria	South Africa	
Asia-Pacific-40	Indonesia Malaysia	New Zealand Philippines	Thailand Vietnam
EU-28	Croatia Denmark Finland	France Germany Italy	Sweden United Kingdom
Non-EU Europe	Iceland	Norway	Switzerland
Latin America-31	Argentina	Chile	
Middle East	Israel	Turkey	
Russia	Russia		
South Korea	South Korea		
U.S.	United States		
Australia	Australia		
Brazil	Brazil		
Canada	Canada		
China	China		
India	India		
Japan	Japan		
Mexico	Mexico		

Conclusions

Reclassifying new vehicle sales by regulatory category enables appropriate comparisons of the coverage of policies and technologies for LDVs and HDVs that would not be possible using OICA sales data alone. Figure 5 illustrates the impacts in the U.S. and China of classifying LT and LCV according to their regulatory definition as LDVs. For example, LDV efficiency regulations in the U.S. covered 16.5 million LDVs in 2014, nearly 20% of global LDV sales. If this comparison had been made using PC as a proxy for LDV, the U.S. would account for less than 12% of global PC sales. Similarly, HDV regulations in China covered 1.2 million HDVs (also called HCVs) in 2014, nearly a third of global HDV sales (3.8 million). If CVs (most of which are LCVs in terms of sales) had been used as a proxy for HDVs, then China would account for only 16% of global CV sales.

Considering the value added by this new vehicle sales database, there remain opportunities to improve the database in future work. First, information on the share of sales by fuel type is sparse among global data sets — the IEA data set is the only reviewed data source that includes sales by fuel type, and this information is not yet available for all markets or for all calendar years (e.g. 2014). Second, there are gaps in sales data for PC and LT/LCV in many small and medium-sized vehicle markets – as described earlier, these sales shares were estimated using regional averages that were determined by the markets with available data in a given region. Third, the database should be updated as data for additional years become available (especially CY 2014-2015).

Lastly, measures of policy progress that draw upon on this database of new vehicle sales also rely on accurate regulatory information for individual vehicle markets (for example, the information available on TransportPolicy.net). Comparisons of the share of vehicle sales subject to regulations will be especially robust to the extent that they relate to the regulations adopted in the top vehicle markets (for example, the share of sales in markets with Euro 6/VI-equivalent emissions standards); however, there remains a need to collect and validate policy information for small and medium-sized markets, including the specific vehicle types covered by such policies.

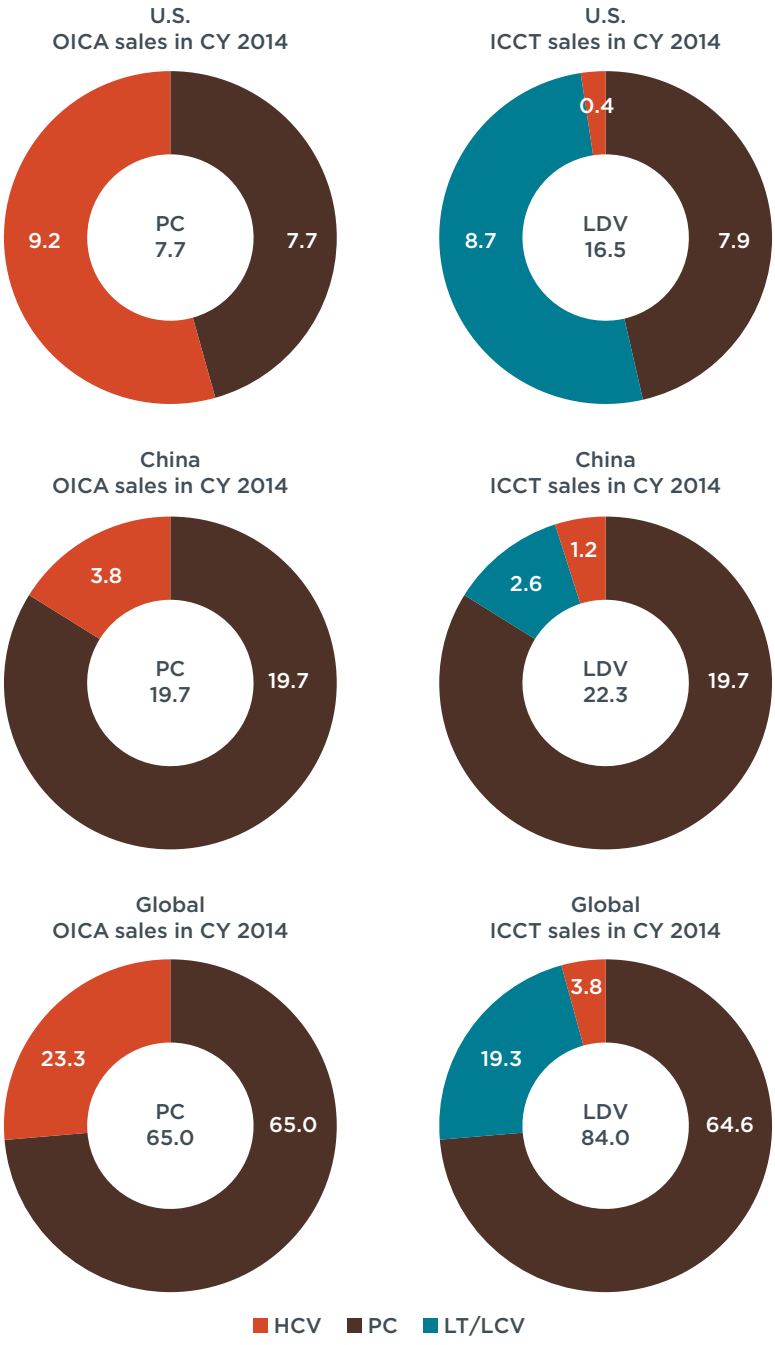

Figure 5. Comparison of OICA sales (millions) with ICCT analysis for U.S. and China in CY 2014

Glossary

2wd	two-wheel drive
4wd	four-wheel drive
AWD	all-wheel drive
CV	commercial vehicle (includes light and heavy commercial)
GHG	greenhouse gas
HCV	heavy commercial vehicle (CV excluding LCV)
HDV	heavy-duty vehicle
IEA	International Energy Agency
LCV	light commercial vehicle
LDV	light-duty vehicle (includes PC and LT/LCV)
LT	light truck
ML	MarkLines
MoMo	Mobility model (IEA)
MPV	multi-purpose vehicle
MUV	multi utility vehicle
OICA	Organization of Motor Vehicle Manufacturers
PC	passenger car
PLT	passenger light truck
PV	passenger vehicle
SUV	sport utility vehicle
SPV	special purpose vehicle
UV	utility vehicle

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Appendix

The following table provides a comparison of data sources used in this analysis.

Table 6. Overview of vehicle sales data sources

	OICA	MarkLines	IEA
Name of Database	International Organization of Motor Vehicle Manufacturers, total sales database.	MarkLines sales by brand and vehicle type; individual data set for each market.	International Energy Agency, MoMo database for ETP2014.
Citation	The International Organization of Motor Vehicle Manufacturers (2015). Passenger cars sales [pc-sales-2014-2.xlsx] Commercial Vehicles Sales [cv-sales-2014-2.xlsx]. Retrieved from http://www.oica.net/category/sales-statistics/	MarkLines Automotive Industry Portal (2015). Sales by vehicle type for selected countries. Retrieved from http://www.MarkLines.com/en/vehicle_sales/	OECD/IEA (2015). [DataBaseFinal-2013-update.xlsx]. Energy Technology Perspectives 2014. April 2015. Available from https://www.iea.org/delegates/mobility/
Markets	144 non-overlapping markets. Considered as total world sales.	For this analysis, we had access to 59 non-overlapping individual market.	42 individual markets and some aggregate regions. There is no data overlap across markets.
Indicators	Total annual sales.	Total annual sales.	Vehicle sales; also fuel type, stock, energy use, mileage, load factors, and activity data.
Years	Complete sales data for CY 2005-2014.	Mostly CY 2005-2014, although several countries have missing years.	Some markets have data for CY 1970-2013; better coverage from 1980 to 2013. Missing sales data for some markets.
Comments	High accuracy of the data since it is directly gathered from OICA members or correspondents, National Offices of Statistics or Ministries of Transport.	High resolution of data by vehicle type.	Since IEA applies the ASIF framework (Activity, Structure, Intensity and Fuel use), many of the indicators are estimated.
Use in this analysis	This data was used as the basis for total world sales by market, as well as to validate the accuracy of the IEA and ML data sets.	Used to calculate PC, LCV, and HCV sales shares for most markets that account for a large share of world sales.	Used as a secondary option to calculate PC, LCV, and HCV sales shares for several markets with insufficient ML data.

The following table illustrates the difference between two types of vehicle market found in the IEA data set. In type 1 markets, passenger light trucks are considered passenger cars, whereas in type 2 markets, they are considered light commercial vehicles.

Table 7. Vehicle classification for type 1 and type 2 markets in IEA data set

Market type	OICA equivalency	Database revised categories	Classification in IEA MoMo Database
Type 1	Passenger Cars	Passenger Cars	Passenger Cars
			Passenger Light Trucks
	Commercial Vehicles	Light Commercial Vehicles	Light Commercial Vehicles (LCVs)
			Minibuses
		Heavy Commercial Vehicles	Medium Trucks
			Heavy Trucks
			Buses
Type 2	Passenger Cars	Passenger Cars	Passenger Cars
	Commercial Vehicles	Light Commercial Vehicles	Passenger Light Trucks
			Light Commercial Vehicles (LCVs)
			Minibuses
		Heavy Commercial Vehicles	Medium Trucks
			Heavy Trucks
			Buses