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Inclusive and sustainable smart cities (CISI)

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# Towards the measurement of electromobility in international trade

An interactive online dashboard

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Ira Ronzheimer - José Durán Lima  
Cristóbal Budnevich - Matthew Gomies



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This document was prepared by Ira Nadine Ronzheimer, José Durán Lima and Matthew Gomies, staff of the Regional Integration Unit of the International Trade and Integration Division of the Economic Commission for Latin America and the Caribbean (ECLAC), and Cristóbal Budnevich, consultant with the same Division, as part of cluster 3 of the project "Inclusive and sustainable smart cities in the framework of the 2030 Agenda for Sustainable Development in Latin America and the Caribbean", implemented by ECLAC together with Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and financed by the Federal Ministry of Economic Cooperation and Development (BMZ) of Germany. The project is part of the ECLAC-BMZ/GIZ cooperation programme.

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## Objective and background

This document has been prepared in the context of the project “Inclusive, sustainable, and smart cities (CISI) within the framework of the 2030 Agenda for Sustainable Development in Latin America and the Caribbean”, implemented by ECLAC with the support of GIZ. The main objectives of this collaboration are: i) to estimate the demand for electromobility in Latin American and the Caribbean (LAC) cities and facilitate its implementation; ii) to promote regional supply to meet the potential demand for electromobility; and iii) to promote a dialogue between stakeholders of sustainable urban mobility in cities and suppliers of buses and providers of inputs of the regional industry.

The focus of this methodology is set on electric buses as a sustainable alternative to conventional diesel buses. Among the advantages of electric buses are that they are less technically complex, more reliable, and safer than all other types of buses. Also, some of the main inputs for their production (iron ore, aluminum, copper, lithium, and graphite) can be found in large quantities in LAC. Moreover, 95% of them can be reused or recycled (Alcover, 2021). The main disadvantages of electric buses are the high initial costs and the need for investments in charging infrastructure, which is much less developed in the region than is the case for conventional buses. Additionally, there are indications that the production of electric batteries generates high CO<sub>2</sub> emissions (overall carbon emissions range of 59-119 kg CO<sub>2</sub>-eq/kWh battery according to Emilsson and Dahllöf, (2019)). Another disadvantage is that the initial price of an electric bus is higher than that of a diesel-run bus. The electric battery technology is still maturing, and charging takes longer than refueling gas, diesel, and hydrogen. However, a well-planned infrastructure would likely ease this problem. Another point worth mentioning is the possibility of retrofitting, i.e., the conversion of conventional buses into electric buses by changing the necessary parts and installing an electric battery.

To estimate the productive capacity of the region in the context of electromobility, ECLAC’s International Trade and Integration Division developed a methodology that identifies the required inputs of electric and conventional buses (benchmark) in the Harmonized System (HS) Product Code Trade Classification. Therefore, the parts and pieces and their corresponding HS codes have been identified and grouped to clusters (e.g., battery cluster, engine, etc.). In the second step, these elaborated products have been disaggregated, firstly, into their semi-elaborated input parts and, in the third step, based on the semi-elaborated parts, in their raw materials.

These three product-levels are referred to as vectors. Therefore, the methodology includes multiple dimensions (cluster- and vector-level) for the two types of buses. Furthermore, the HS product codes are assigned to large economic sectors, allowing the analysis of inputs also on the industry-level. In summary, based on the product codes identified, the trade flows can be analyzed on the product level, cluster level or industry level to estimate the productive capacity of the region and to identify the main global players in the context of electromobility. In addition, the required products have also been assigned weights and prices, making it possible to estimate the cost structures of electric buses.

The previously referred methodology has been visualized in different graphics in an online Dashboard.<sup>1</sup> The underlying document explains in more detail the goals, setup, and methodology of the Dashboard. As sustainability and climate change represent the context of the project, and to provide a more complete analysis, the Dashboard also contains visualizations of the temperature trend and emissions.

The Dashboard is a reproducible product that can be of use not only within the region, but globally as the inputs for the buses are highly similar around the world. It provides a useful tool not only for policy makers but also for entrepreneurs to assess business opportunities in their countries.

The Dashboard development includes two steps:

- (i) The current Dashboard available contains visualizations from four main areas: a) temperature evolution, b) carbon emissions, c) production and operation of electric buses, and d) the decomposition of an electric bus including its price structure;
- (ii) In the next step, the Dashboard shall link input requirements for electric buses with trade data from the UN Comtrade data base for interactive visualization (e.g., by selecting steel as input for bus bodies shows the top 10 global steel exporting and importing nations including maps, etc.).

It is important to mention that the Dashboard may be even further extended in multiple ways e.g., it could be linked with tariff data, it could include different battery types for visualizing comparisons, include other types of buses (natural gas, hydrogen), information on retrofitting etc., overall representing a very promising tool.

Two publications within the CISI project context are related to the development of the Dashboard: firstly, a methodological document that explains in detail the development of the bus product vector based on the HS and, secondly, a document that applies the developed methodology to characterize trade in electromobility. The underlying document represents a short methodological description on the development of the Dashboard itself. It can be understood as a subproduct of the document describing the development of the methodology on decomposing a bus into its components. The novelty of this document lies in the fact that it measures the nature of climate change, based on identifying the trends of temperature and CO<sub>2</sub> emission at the country level; the status of conventional bus production and electric bus operation, and the practical application of the methodology developed to analyze the electromobility trade, especially in the case of electric buses. From there, it will be possible to analyze the traceability of the trade in parts and components related to the production of electric buses (electromobility), and also identify the status of each supplier/country/region in the value chain, depending on whether it is a producer of raw materials, semi-finished or elaborated products.

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<sup>1</sup> The Dashboard can be accessed via the following link: <https://electromobility.rj.r.appspot.com/home>.

# I. Methodology

## A. Climate change evolution

Annual temperature data were collected from the World Bank's Climate Change Knowledge Portal.<sup>2</sup> The timeseries data were collected for selected countries with a population larger than three million people with the following parameters:

- Collection: Climatic Research Unit, CRU (Observed)
- Variable: mean temperature
- Aggregation: annual
- Area type: country and subnational units
- Time period: historical reference period, 1901-2020.

With these data, a few map and graph visualizations were constructed to track the climate change specifically regarding the annual temperature (in degrees Celsius) and the average increase in the annual temperature between 2000 and 2020 for all the observed countries.

## B. Emissions

Annual CO<sub>2</sub> emissions data were collected from the CO<sub>2</sub> Emissions portal by Hannah Ritchie and Max Roser on the *Our World in Data* website.<sup>3</sup> The annual total and annual per-capita CO<sub>2</sub> emissions timeseries data were collected for all the available countries with a population size above three million. Utilizing these raw data, a few maps and graphs were generated to track the trend of annual total/per-capita CO<sub>2</sub> emissions

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<sup>2</sup> Source: <https://climateknowledgeportal.worldbank.org/download-data>.

<sup>3</sup> Source: <https://ourworldindata.org/co2-emissions#:~:text=In%201950%20the%20world%20emitted,34%20billion%20tonnes%20each%20year.>

emitted by each observed country between 2000 and 2020 and also to list the top 15 countries by annual total and/or per-capita CO<sub>2</sub> emissions. CO<sub>2</sub> emissions value is in tons.

### C. Production and operation of electric buses

This section shall provide a general overview of the current level of production of conventional and electric buses as well as the operation of electric buses in Latin America.

In 2019, the global vehicle production was estimated to be about 92 million vehicles, of which 80,813 are electric buses (see Table 1 or approximately one tenth of all buses produced).

**Table 1**  
**Number of vehicles produced by type, 2019 or latest year available**

Type	Units	Fraction
Vehicles	91 786 861	100%
Buses	829 296	0.9%
Electric buses	80 813	0.1%

Sources: OICA (n.d), ACEA (2022), Helgi Library (2021), INE (2022), Bureau of Transport Statistics (n.d), ADEFA (n.d), Placek (2022), Statista Research Department (2022), Textor (2022), Gorka (2021), Sun (2021), Seob Yoon (2020), Manakitsomboon (2022) & Portafolio (n.d).

Regarding the operation of electric buses in Latin America, only about 1.9% of the buses operating in 2022 are electric. If we include trolley buses, the penetration of electric vehicles in public transport increases to almost 3% (see Table 2). Clearly, public transport buses in Latin America are dominated by conventional diesel buses in 2022.

**Table 2**  
**Latin America and the Caribbean (11 countries): Fleet of urban transport buses as of April 2022**

Countries	Type of Bus (No of units)				Penetration		
	Total (1)=(2)+(3)+(4)	Diesel (2)	Electric (3)	Trolley (4)	Diesel (5)=(2/1)	Electric (6)=(3/1)	Trolley bus (7)=(4/1)
Argentina (4 cities) <sup>a</sup>	23 604	23 507	20	77	99.6	0.1	0.3
Barbados (Bridgetown)	283	250	33	0	88.3	11.7	0.0
Brazil (6 cities) <sup>b</sup>	19 010	18 662	46	302	98.2	0.2	1.6
Chile (2 cities) <sup>c</sup>	9 557	8 738	789	30	91.4	8.3	0.3
Colombia (3 cities) <sup>d</sup>	14 566	13 401	1 165	0	92.0	8.0	0.0
Ecuador (2 cities) <sup>e</sup>	8 430	8 240	21	85	97.7	0.2	1.0
Mexico (2 cities) <sup>f</sup>	17 347	16 791	48	508	96.8	0.3	2.9
Paraguay (Asunción)	2 249	2 247	2	0	99.9	0.1	0.0
Peru (Lima)	15 449	15 448	1	0	100.0	0.0	0.0
Uruguay (2 cities) <sup>g</sup>	3 246	3 212	36	0	99.0	1.0	0.0
Venezuela (R.B.)	3 000 <sup>h</sup>	2 955	0	45	98.5	0.0	1.5
Latin America and the Caribbean (11 countries)	116 741	113 451	2 161	1 047	97.2	1.9	0.9

Source: Authors, based on World Population Review (2022), E-Bus Radar (2021), Ministerio de Energía Chile (n.d) & Centro Tecnológico de Transporte, Tránsito y Seguridad Vial (2016).

<sup>a</sup> Includes information for Santa Fe, Mendoza, Córdoba, and the Buenos Aires Metropolitan Area (AMBA).

<sup>b</sup> Includes information for Campinas, São Paulo, Brasília, Maringá, Volta Redonda and Bauru.

<sup>c</sup> Includes information for Santiago and Valparaíso.

<sup>d</sup> Includes information for Bogotá, Medellín and Cali.

<sup>e</sup> Includes information for Guayaquil and Quito.

<sup>f</sup> Includes information for Mexico City and Guadalajara.

<sup>g</sup> Includes information for Montevideo and Canelones.

<sup>h</sup> Information circa 2019, obtained from: Paez-Pumar (2018).

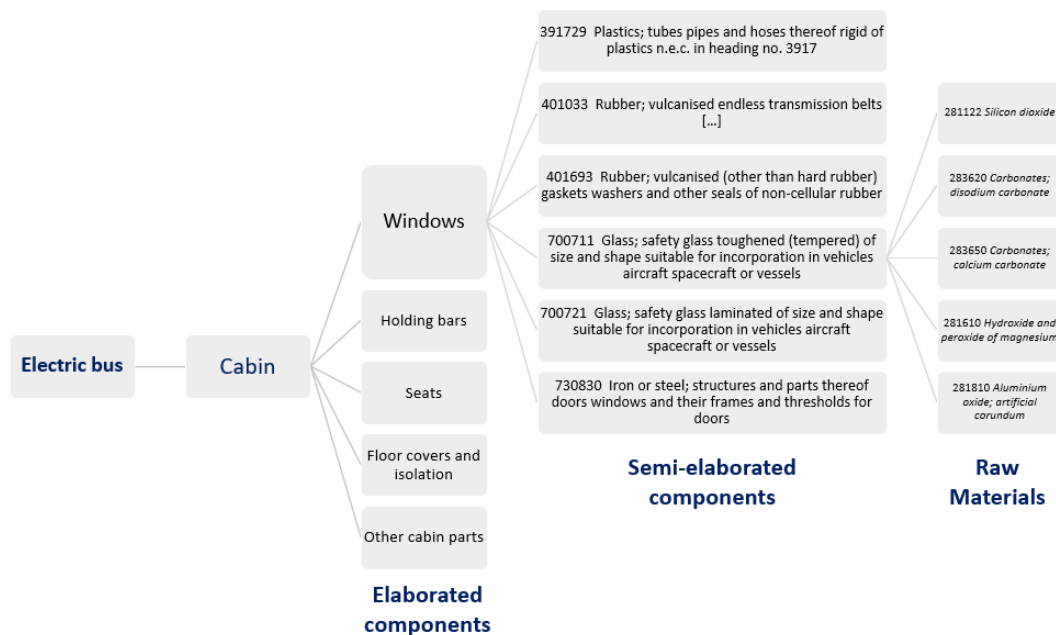
## D. Components of electric buses, its price structure and conversion factors

The following section explains the process how the electric bus has been disaggregated into its components. Furthermore, it details the derivation of the cost structure of this bus type and finally introduces the calculation of conversion factors that reflect the amount of each component globally that goes into the production of electric buses. This is the methodology that is visualized in the Dashboard.

The selection of components to produce an electric bus was based on the 2017 edition of the HS developed by the World Customs Organization. The HS is widely applied in the analysis of global trade data because it provides a common nomenclature for the classification of traded goods and its relatively high level of product detail. The suggested list of identified HS products will also be referred to as the *component vector*.

The proposed methodology was developed through an interactive and iterative process of reviewing studies and consulting experts, mainly mechanical engineers, engine technicians, and representatives of the design and development fields of automotive companies.

**Diagram 1**  
The three component vectors of a bus window



Source: Own elaboration.

Note: HS codes refer to HS 2017.

An integral part of the methodology is the definition of product clusters (for example, the battery cluster groups all the components required to build a battery). The components identified in the HS of each cluster include different elaboration levels (elaborated and semi-elaborated inputs, and raw materials). Diagram 1 visualizes the disaggregation of windows, which belong to the cabin cluster. While windows are assigned to the elaborated components, their inputs such as rubber and glass belong to the semi-elaborated components. These can then be disaggregated into their raw materials, as illustrated in the case of glass that is made of silicon dioxide and aluminum, among other inputs. Each HS code is uniquely assigned to one elaboration level.

The list of all products and their corresponding HS codes from all clusters that are classified as elaborated components is referred to as the elaborated component vector (the vectors for the remaining elaboration levels are referred to as the semi-elaborated components and raw materials vector).

The component vectors are based on the HS 2017 edition at the six-digit level.<sup>4</sup> This is the latest HS edition for which trade data are available, since the 2022 edition only entered into force in January 2022. Due to the changes made in the actualization of the HS 2017 (to HS 2022) in the subsection of vehicles, a new subheading 870822 was created to provide for windows for the motor vehicles of Chapter 87.<sup>5</sup>

HS section 17 (*Vehicles, Aircraft, Vessels and Associated Transport Equipment*) includes Chapter 87 (*Vehicles other than railway or tramway rolling stock, and parts and accessories thereof*). Chapter 87 covers both the final product (the buses) and the parts required for its production, such as clutches, engines, gearboxes etc. (see Table 3).

**Table 3**  
**Examples of inputs for vehicles in HS Chapter 87**

HS code	Product description
8708	Parts and accessories of the motor vehicles of headings 8701 to 8705:
870810	Bumpers and parts thereof
870821	Safety seat belts
870830	Brakes and servo-brakes; parts thereof
870840	Gear boxes and parts thereof
870850	Drive-axles with differential, whether or not provided with other transmission components, and non-driving axles; parts thereof

Source: World Customs Organization.

Note: HS codes refer to HS 2017.

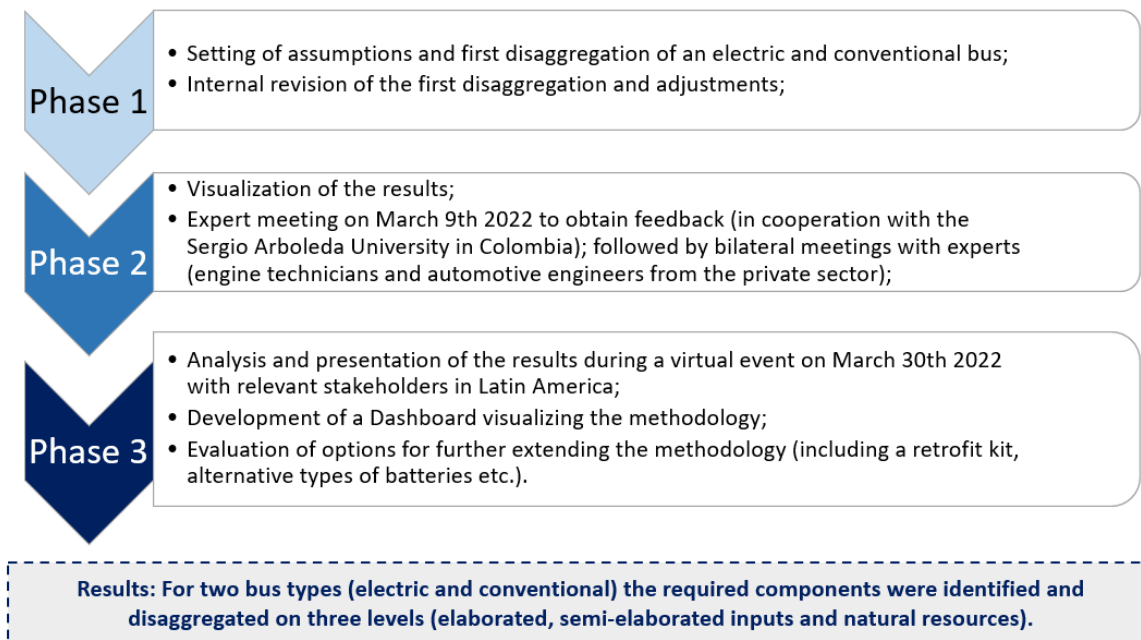
Other sections of the HS that contain parts and inputs required to produce a bus are *mineral products* (Section 5), *products of the chemical or allied industries* (Section 6), *plastics and articles thereof, rubber and articles thereof* (Section 7), and *base metals and articles of base metal* (Section 15). Sections of the HS that provide parts to a minor extent are *machinery and mechanical appliances, electrical equipment, parts thereof, sound recorders and reproducers, television image, and sound recorders and reproducers, and parts and accessories of such articles* (Section 16), and *optical, photographic, cinematographic, measuring, checking, precision, medical or surgical instruments and apparatus; [...] clocks and watches; musical instruments; parts and accessories thereof* (Section 18).

Diagram 2 sums up the different phases of the development of our proposed methodology. Those phases are explained in greater detail below.

<sup>4</sup> No changes were made in the codes of the identified components regarding the update from the HS 2012 to HS 2017. Therefore, all codes are identical in both editions.

<sup>5</sup> For further information see: [http://www.wcoomd.org/-/media/wco/public/global/pdf/topics/nomenclature/instruments-and-tools/hs-nomenclature-2022/table-1\\_en.pdf?la=en](http://www.wcoomd.org/-/media/wco/public/global/pdf/topics/nomenclature/instruments-and-tools/hs-nomenclature-2022/table-1_en.pdf?la=en).

**Diagram 2**  
**Steps of development of a methodology for trade in conventional and electric buses**



Source: Own elaboration.

The first phase required the development of a general approach, as the methodology had to be set up from the beginning. A top-down approach was adopted for the construction of the component vector. The first step was to break down each bus type into its main structures (bus body, motor etc.). All these elaborated components have been identified in the HS and used to construct the elaborated components vector. As a second step, elaborated components were in turn disaggregated into their own components (for example, magnets that form part of the motor) which were grouped in the semi-elaborated vector with their respective HS codes. Finally, semi-elaborated components were disaggregated into their raw materials. These have then been listed with their corresponding HS codes. The result consisted of a list of codes that ranged from elaborated products to raw materials.

To complement the top-down approach and ensure the completeness of the vectors, a bottom-up approach was used that included revising the entire HS to ensure all parts have been included.

As a first step in the construction of the vector for the bus types, a reference bus model was selected (as explained in the assumptions sections). Then, the complete list of HS codes at the six-digit level was reviewed and all the elaborated parts required have been selected and categorized into different clusters (for example, wheels belong to the bus cabin cluster, battery cells belong to the battery cluster, etc.). For large clusters, sub-clusters have been introduced to better organize the parts within one cluster (e.g., other cabin parts represent a sub-cluster of the cabin cluster including fire extinguishers, windscreen wipers, etc.).

The second step was to assign weights (in kilograms) to the identified parts. Using the weights of the components, it was possible to compute the cluster weights. The total weight of all clusters was double-checked against the total weight of the bus. This was followed by the identification of the semi-elaborated parts in the HS. All elaborated parts have been disaggregated into the semi-elaborated inputs (for example, the bus body as elaborated part has been disaggregated into steel structures,

aluminum plates, rubber, and other parts) and were assigned weights, too. Afterwards, the semi-elaborated parts were disaggregated into their raw materials, whereby the required raw materials were also assigned weights (e.g., the steel structures have been disaggregated into iron ores). As the product disaggregation process is very research-intensive and consequently, time-consuming, not all elaborated and semi-elaborated products have been disaggregated. The goal was set to disaggregate all components with a weight of more than 50 kg. Additionally, it is important to mention that some elaborated and semi-elaborated parts required were not included in the HS. For these products, *dummies* were introduced. For example, there is no code in the HS for battery cases.

In the third step, all the products in the HS that represent extremely small parts (screws, valves, steel alloys, lamps etc.) were identified, and these products could not be quantified as they are likely already included in the weights of the parts they belong to (such as screws in a motor). In order not to overestimate the weight, they were grouped in the generally necessary parts cluster without any weight assignments. The products belonging to the generally necessary parts cluster have not been disaggregated.

The main sources consulted were webpages of components' manufacturers (e.g., ZF Fahrzeugteile AG for the axles) and suppliers of spare parts for buses and trucks. Some parts are identical for buses and trucks (e.g., driver's seat, wheels, axles, brakes and steering systems); therefore, truck parts provide a good indication of the weight of bus parts. Moreover, there is more information available on truck spare parts.

The first version of the component vectors was subject to an internal analysis within the ECLAC team and was further discussed at an expert meeting convened to obtain feedback on the assumptions used for the disaggregation process. The expert meeting "Measuring electromobility in trade" took place on 9 March 2022, in cooperation with experts from the private sector and University Sergio Arboleda in Colombia.<sup>6</sup> The feedback obtained from participating experts and from further consultations with specialist engineers confirmed the initial disaggregation. The final version of the applied methodology was presented during an electromobility workshop held on 30 March 2022, that included actors from the private and public sectors.<sup>7</sup> This marked the successful conclusion of Phase 2.

Input requirements for the construction of a bus were defined using the Mercedes-Benz Citaro city bus as the reference (see Image 1). The Citaro has both diesel-run and battery-run versions (electric). It employs a Nickel-Manganese-Cobalt battery with an input relation of 1:1:1 and was assumed to have 10 battery modules installed which provides the bus with a capacity of 243 kWh. It has a length of 80 meters and can transport up to 80 passengers at a time.

Nowadays, the electric version is not operating in LAC cities, probably due to the cost difference with the Chinese manufacturers' models. However, the Citaro was selected due to the relatively high availability of technical information about its two versions compared to other models. Moreover, the variation in the components and materials used in different bus models is expected to be rather low, thus using a different reference model would likely have led to similar results. An exception might be the battery system, as the type of battery can vary with the bus model. Therefore, a battery type that is commonly used was chosen (for details see the battery cluster below).

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<sup>6</sup> For more information see <https://www.cepal.org/es/eventos/webinario-midiendo-la-electromovilidad-comercio-internacional-caso-buses-electricos>.

<sup>7</sup> For more information see <https://www.cepal.org/es/eventos/webinario-dialogo-publico-privado-electromovilidad-america-latina-asia>.

**Image 1**  
**Citaro bus model**



Source: Sagar (2018).

The clusters that have been introduced and their corresponding subclusters as well as cluster-specific information and assumptions are exhibited in Table 4. For more detailed information on the disaggregation of each cluster, the methodological document may be consulted.

**Table 4**  
**Defined cluster of an electric bus and additional information**  
*(Weights in kilograms)*

Cluster Name	Sub-Clusters	Cluster weight	Additional explanations	Relevant literature
Bus body	No sub-cluster	5 600.0	The paint of the bus body has been neglected.	Goergler, 2014
Cabin	Floor covers; Holding bars; Windows; Seats; Other cabin parts	1 727.5	All windows are assumed to be made of soda-lime glass (are made of three main materials: Sand (about 75% of silicon dioxide or SiO <sub>2</sub> ), limestone (around 10% of calcium carbonate or CaCO <sub>3</sub> ) and roughly 15% of sodium carbonate (Na <sub>2</sub> CO <sub>3</sub> ). Glasses may also contain magnesium (magnesium oxide or MgO), and about 2 % aluminum (aluminum oxide or Al <sub>2</sub> O <sub>3</sub> ).	Britannica (n.d)
Battery	Battery parts: case; Battery parts: electronics; Battery parts: other parts of electronics; Battery cells; Battery cooling system; Battery parts	2 522.4	A Nickel, Manganese and Cobalt (NMC-111) battery with 10 modules was assumed. Total battery capacity is estimated to 243 kWh. Under perfect conditions, the eCitaro has a range of 280 km, which is reduced to 170 km when using air conditioning. There were two reasons for assuming this battery type: firstly, it is the most common battery currently in use and secondly, it is employed by the reference model. Each module weighs 254 kg which implies a total assumed weight for the battery cluster of 2,540 kg. As the battery modules include electronics that are accounted for in the electronics cluster (e.g. cables), the clusters total weight was reduced by 17.6 kg to 2,522.4 kg.	Forster, 2019; Olivetti et al., 2017; Mercedes-Benz, 2019a; AKASOL, 2021; Weyhe & Yang, 2018; Li et al., 2016; Research Interfaces, 2018; Fu et al., 2016
Electric engine	No sub-cluster	584.1	Disaggregation based on the electric engine ZF CeTrax with an output of 125 kW. The motors used are permanent magnet synchronous motors (PSM), which mounted directly on the wheel hubs of the portal axle. The total weight of the electric engine cluster is equal to 584.1 kg (instead of two times 295 kg) as 5.9 kg were assigned to an instrument for measuring or checking voltage current resistance (HS code 903039) that has been assigned to the electronics cluster.	ZF Friedrichshafen AG, 2021a
Drivetrain	Front Axle (ZF RL 75); Portal Axles (ZF AVE 130); Pressure air system; Steering system Wheel parts; Wheels	1 589.6	The front axle is a ZF 82 RL EC axle with a weight of 482 kg. The two electric motors are mounted on the portal axle, a ZF AVE 130, which is in the back of the bus. The entire portal axle unit with two electric motors, control arms, springs, and shock absorbers, weighs 1,220 kg. The motors with a total weight of 590 kg are not considered to be part of the drivetrain cluster but belong to the motor cluster. Therefore, the weight of the portal axles is assumed to be 630 kg. The bus is assumed to have six wheels, no additional spare wheel is included.	Mercedes-Benz, 2021; Mercedes-Benz, 2021; ZF Friedrichshafen AG, 2021a; ZF Friedrichshafen AG, 2021b
Electronics	Human control devices; Other parts; Internal control devices; Air conditioning; Cable harness; Display; Lights; Transformers	1 656.6	The electronics cluster includes, besides the air conditioning and heating system, many small and light-weighted inputs. One-quarter of the entire cluster is made of the cables (insulated electric conductors). In general, the selected electronic components were not disaggregated into their primary components. In some cases these are already part of other clusters. The estimated weight of the set of products selected from the cluster was 1656.6 Kg.	
General necessary parts	No sub-cluster	No weights assigned	Includes parts that are contained in most buses but which are hard to quantify, partly because they are already included in the weights of other, larger components (for example, screws and bolts in a motor).	

Source: Own elaboration based on González Cantú (2003) and HS 2017.

The disaggregation of the electric bus is visualized in the Dashboard in the form of an interactive pie chart that disaggregates the electronic bus clusters into subclusters, which are then disaggregated into the raw materials required. By clicking on the different clusters, the disaggregation opens. The top 10 required raw materials are presented in a bar chart.

To obtain the weighted average import price (per kg and per unit), the relevant import data for 2019 were collected for the following countries: China, Japan, United States, Canada, Turkey, Czech Republic, United Arab Emirates, Spain, Poland, and Hungary. The focus was set on these countries as collectively they represent 79% of global electric bus exports in 2019. The weighted price per kg was calculated by dividing the total import value for each input by its respective total import weight. Following the same method, we calculated the weighted price per unit for all the inputs for which unit quantity information was available. Data from countries that do not report import weight or quantity was excluded.

The conversion factors were calculated for all inputs required to produce an electric bus. The goal of the conversion factor is to capture the share of global trade in a particular input that goes into the production of electric buses. For example, a conversion factor of 1.88 for vehicle bodies means that 1.88% of world exports of this input go into the production of electric buses. Conversion factors were calculated at the product level using the HS 2017 edition and are based on the methodology already presented. They were calculated for all inputs for which required weights were estimated.

Two measures to estimate the conversion factor are presented below: the intra-industry conversion factor (which includes products primarily from the vehicle sector, subsection 87 of the HS, 5th Revision) and the conversion factor for components that also belong to other industries. The reason for this distinction is that components within the vehicle sector (for example, engines and safety belts) are used only for the production of vehicles, whereas other components such as iron ores, which are required to produce vehicle bodies- are also used in a range of industries (construction, aircraft, etc.). As the methodology should adequately capture the amounts traded that go into the production of electric and conventional buses, two distinct approaches are suggested. For both approaches, the year 2019 was used as baseline.

The products that belong to the general necessary cluster parts were excluded from the analysis as no weights have been assigned to these products because they are indirectly accounted for by larger inputs (e.g., valves in an engine). However, exceptions were made for products with a considerable share in global trade flows. For these products, the conversion factor was estimated based on the one applied for products of the same category.



## II. Conclusion

Introducing and expanding electro mobility in Latin American public transport represents a challenging endeavor, but it also entails many opportunities for the continent. Locally produced electric buses may facilitate the expansion of fleets and benefit local economies through employment creation. Local businesses may be able to base on their productive capacities of conventional buses and switch over to the more sustainable alternative of electric buses.

The Dashboard suggested here is a good starting point to develop a better understanding of what electromobility means from the point of view of trade. In addition, it provides a broad overview of the potential risk that the increase in temperature could pose to the world. At the same time, the information displayed on the Dashboard clearly illustrates the low incidence of the operation of electric buses in urban transport in the region.

In this respect, the Dashboard is an important tool for visualizing the complex methodology of disaggregating an electric bus into its components on the level of elaborated and semi-elaborated inputs and the raw materials required. It may serve academics, politicians, and entrepreneurs in evaluating how to raise their countries' or business' participation in the value chain of electric buses.

Furthermore, the Dashboard has a range of possible extensions for the future, making it an even more valuable tool for business and policy decisions. By linking the required components for example with tariff data, current tariff policy in the context of electromobility can be analyzed and improved to protect local production or to ease the imports of required inputs. The continuous development of the Dashboard will therefore be based on the feedback by stakeholders to be able to supply them with a tool that is of great use at the regional and global level.



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The dashboard presented here was developed in the framework of a collaboration project between ECLAC and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) on electromobility in Latin America. The dashboard represents the visualization of a methodology proposed for analysing trade flows in electric bus components in Latin America and worldwide in order to evaluate the productive capacity of Latin American countries in this area. The required components have accordingly been disaggregated into three levels: processed and semi-processed components and raw materials. The dashboard captures the complexity of this methodology and makes it accessible to policymakers and entrepreneurs, who can use it to evaluate their country's or business's potential to participate in the value chain of electric buses.