ZEBRA

ZERO EMISSION BUS
RAPID-DEPLOYMENT ACCELERATOR

Medellín – Business Roundtable – Summary

Technology and financing options to deploy zero-emission fleets in the public transport bus system (TPC) in Medellín

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VENUE: GUAYACANES ROOM, AMVA, MEDELLÍN, COLOMBIA

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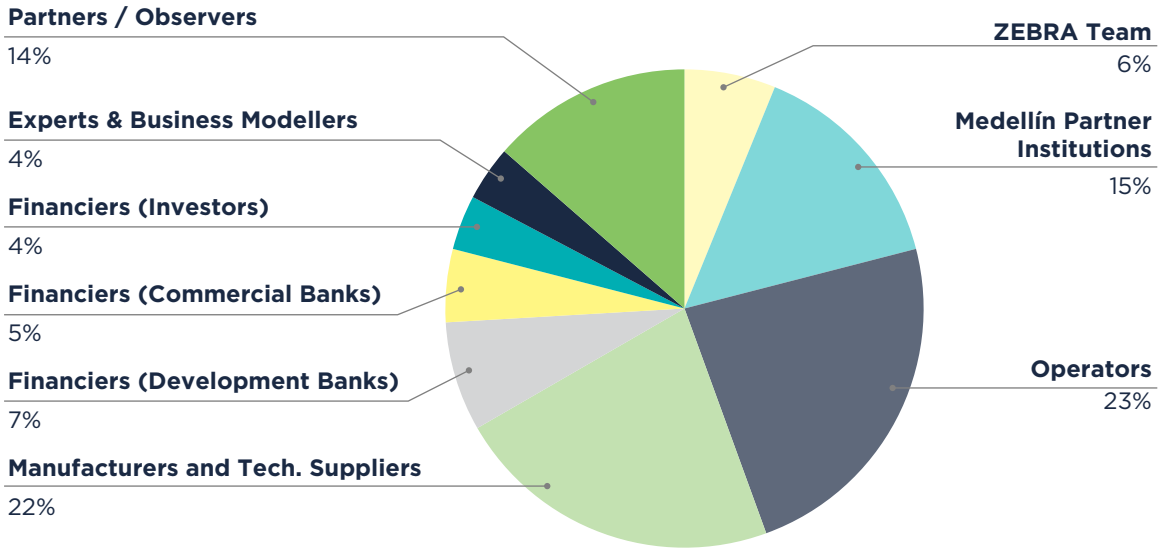
CONTENT

Medellín - Business Roundtable - Summary

Format and Objective: The business roundtable was held with local authorities, public transportation operators, bus manufacturers, and financial entities to discuss technology and financing options to deploy zero-emission fleets in Medellín and the Metropolitan Area of Valle de Aburra (AMVA). The event was designed to connect different actors with the goal of promoting business deals to modernize the bus fleets in Medellín and the AMVA to zero-emission fleets. In addition to sessions featuring informational presentations, **27 bilateral meetings** were held to spark and accelerate transactions between private operators and other stakeholders.

Participants: Participants were comprised of **81 stakeholders,** including Medellín's Secretary of Mobility and AMVA authorities, ZEBRA representatives, bus operators from Medellín and AMVA, bus manufacturers, financial institutions, investors, and other experts.

Roundtable Participants (81)



NEXT STEPS:

The operators found the opportunity to interact with bus manufacturers and financial institutions to be very valuable. Remaining issues identified and next steps to be taken the city include:

- The establishment of a **credit mechanism for small operators** so they can have access to financial resources.

- Assemble stakeholder support for the formation of associations or cooperatives of small bus owners in order to facilitate a wide-scale fleet modernization project.
- The need for the **restructuring of loans or leasing agreements**. Some operators have made investments to transition to Euro IV/V technologies and their buses still have plenty of useful life. It is difficult to find the capital to now invest on zero-emission fleet.
- Uncertainty about who will be responsible for **building and maintaining the necessary charging infrastructure**. One operator mentioned that, ideally, city or area authorities would supply the infrastructure.
- The need for legal stability to encourage the development of a functional economic model, such as assurances that operators can keep their routes for a set time period.

DETAILED DESCRIPTION:

1. INTRODUCTION

The event was opened by Manuel Olivera, Latin America Regional Director of C40, who discussed the need for climate action and highlighted the fact that Medellín is one of 24 of the 94 C40 members that have committed to buy only zero-emission buses from 2025 and create fossil-fuel free zones. Olivera mentioned that the event was not a traditional workshop but a business roundtable, with entities that sell electric buses, entities with experience in new business models to facilitate electric mobility, as well as financing institutions and investors interested in electric bus projects. He invited the bus operators to make use of the roundtable to explore business deals and that, ideally, the conversations will continue in follow-up bilateral meetings.

2. AUTHORITIES

Eugenio Prieto, Director of AMVA, and Humberto Iglesias, Secretary of Mobility of Medellín, outlined actions local authorities are taking to improve air quality in the region. Prieto described the Metropolitan Plan for Climate Change and Plan for Air Quality (PIGECA). He also outlined the AMVA/Medellin/Findeter/EPM project to provide fleet renovation financing and the creation of ZUAP (Zona Urbana Aire Protegido), or low emission zones. Prieto also declared that

electric mobility is here to stay and its application to public transportation is a huge opportunity. Iglesias thanked C40 for their support of the city of Medellín and explained the city is focused not only transport, but also on air quality and health, and stated the greatest mechanism for climate action in the region is the electric mobility in public transportation. As evidence that Medellín is posed to be the Latin American capital of electric mobility, Iglesias cited the new national law for electric mobility promotion, as well as the Colombian President's commitment to the advance of the model.

3. CASE-STUDIES IN LATIN AMERICA

SANTIAGO DE CHILE

Sebastian Galarza, from Centro Mario Molina Chile, and Hector Moya and Carlos Bueno, from Metbus, a bus operator in Santiago, presented a case study of Santiago, Chile. Galarza provided historic context on Chile's efforts beginning in the 1990's to adopt measures to reduce air pollutants from the transport sector, including efficiency labeling, the introduction of Euro VI standards, a "green tax", and the creation of a driving cycle for buses in Santiago. Electric bus deployment pilot programs began in 2013, and their success encouraged the expansion of electric bus deployment using new business models between private entities. For example, Engie, an electric utilities company, financed the acquisition of 100 Yutong buses and leased them to two private operators, Vule and STP, for 12 years. Another example using a similar model was discussed by Hector Moya in which Enel, an electric utility, BYD, a bus manufacturer, and Metbus, a bus operator, partnered to run 100 electric buses in 2018 in "Santiago's corredor Grecia" after a successful pilot program involving two buses. Enel built the electric depots and installed chargers, BYD provided the buses and included a maintenance contract and battery guarantee, and Metbus operated the vehicles. The 102 buses in the first six months of 2019 have mobilized 5.5 million passengers, traveled 1.8 million km, have had an operation availability of 99.6%, and have a driving range of 241km on average. The average energy consumption observed for each bus was 1.08kWh/km, and one charger could service two busses. The project was deemed financially viable mainly due to the lower cost of energy, which decreased from 0.42 $USD/km to 0.12$USD/km. As each bus was driven approximately 6,000km per month, the cost saved on energy was sufficient to pay for the cost differential of monthly payments between electric and diesel buses.

MEDELLÍN

Fernando Montoya from Masivo de Occidente (MDO), a private bus operator of the integrated system (SITVA) in Medellín, discussed his company's "Nutibara Project". The City of Medellín issued an "acuerdo," or agreement, in 2017 outlining a path to electric mobility by 2029. MDO contract expires in 2029 and decided to start exploring electric mobility rather earlier than late. The pilot project involves the deployment of 12 electric buses, over two years. The transport authorities, AMVA, and Secretary of Mobility supported the project by granting faster permits (two months) and facilitating contacts with financial entities. The project is financed through a Findeter-compensated rate, which is 2-3% lower than the typical commercial rates. EPM provided the electric sub-station required at the depot, which supports charging of up to 20 electric buses. Based on Medellín topography and street design, MDO's routes required shorter buses, around 8m in length, with wheelbases below 4.5m to allow for the required turning radius and the capacity to climb inclinations up to 27%. The firm identified a suitable bus model manufactured by Zhongtong. Although the internal rate of return of the electric buses is lower than for diesel buses, the investment was deemed necessary to gain experience with the technology. The firm estimates 60% lower maintenance cost and 22% lower energy costs, which will be validated once the operation starts. However, the firm will incur higher financing costs due to the higher capital expenditure. The project is financed with 80% debt and 20% equity, with the use of two tax benefits, Article 255 ET (deduction for investments made for environmental benefit) and Article 258-1 ET (deduction for VAT paid on import, built, or acquisition of productive fixed assets). The manufacturer offered a battery warranty of 8 years, as well as technical support, maintenance service, spare parts availability, and other support.

4. NEW BUSINESS MODELS AND FINANCIAL RESULTS

Felipe Amaya from Dalberg presented potential financing models for the deployment of electric buses in Medellín. The focus of ZEBRA in Medellín is on the 60 private operators of the "Transporte Público Colectivo" (TPC), but other two business models exist: the 2 concessioned operators, Masivo de Occidente and Sistema Alimentador Oriental, and the BRT system, Metroplus. The respective number of buses are around 5,900 for TPC, 370 for concessioned operators, and 140 for Metroplus.

Most of TPC's revenues are from passenger fares with other minor revenues from, for example, advertising. About 30% of revenues are not integrated with the central fare collection system "Tarjeta Cívica." The buses are owned by private owners who oversee operation and maintenance, and the buses are paid with revenues from operation.

Two financing options were considered for TPC operators. The first is to facilitate their access to concessional financing with lower rates and better conditions. The Development Banks are expected to play a key role in the beginning of this process. One key issue is the availability of financial warranties to contain the risk of default. The second is to attract new players, similar to the case in Santiago, where a third party partially or completely acquires the system components (batteries, buses, and charging systems), and leases or rents to the operators. Dalberg is building a financial model tool to estimate cash flows and the potential impacts of the two proposed solutions. The firm asked for data that could help refine the input data for the tool.

Margarita Parra from Clean Energy Works presented the "pay as you save" (PAYS) business model. The model, similar to the second solution presented by Amaya, is a financial mechanism that reduces the initial cost of electric buses by leveraging investment by electric utilities in the batteries who recover their cost as a service charge in the monthly electricity bill. The operator only pays for the bus, not the batteries, reducing the initial cost, and as the operational costs are lowered, the savings allow them to pay utility service charge. This instrument could reduce the need for concessional financing.

Francisco Ramirez from BASE presented the financing modeling for the case of Lima, Peru, which was also applied in Bogota and is expected to be applicable for Medellín as well. Bus operators work on 10-year concessions where revenues are paid by kilometer traveled and passenger transported. Money is centrally collected and administered by a trust fund, who pays the to the operator's creditors first, and then to the operators, facilitating payment warranties. Finance modeling over different timeframes and with different battery size and replacement assumptions were performed showing that at a 10-year timeframe, the cost of electric buses is higher than the diesel or gas. At 12 years and without battery replacement, the gap is reduced but still electric buses have higher cost. At 14 years, the TCO curves start to converge. Once commercial financing is included, electric and diesel buses reach cost parity at approximately 12.5 years. The model also reveals the necessary

financing conditions so the electric bus TCO is lower. Finally, the analysis showed that the third-party acquisition solution, where the electric utility can benefit from better loan conditions than the operators, provides a higher return on investment.

Gabriel Vizcaino from Celsia presented his firm's experience with electric mobility. Celsia builds electric charging stations, has designed a low-cost charging station solution for electric passenger vehicles, and are seeking to enter the public transportation segment. They have formed alliances with SURA to reduce the insurance premiums for electric buses and with Blanco y Negro, a private operator in Cali, Colombia, to structure the acquisition and operation of 26 electric buses.

5. BUS SUPPLIERS

Four bus manufacturers who currently do business in Colombia presented their technology options for electric buses. Juan Felipe Velasquez from BYD showed a video presenting their bus application in a diverse number of cities, highlighting how the firm adapts their models to the local markets. Select bus models were shown, such as the K9G(12.5m) used in the Metroplus BRT system, and the K7M (8.8m), which may be applicable for the TPC in Medellín. Velasquez mentioned the firm is currently structuring their products to adapt to specific Colombian conditions. The battery systems are expected to have a first life of up to 6,000 cycles or 16 years, and a second life in energy storage systems for 4,500 to 7,200 cycles or up to 25 years.

Alberto Beltran from Yutong, which builds buses from 5m to 18m in length with capacity to build up to 375 buses per day, presented specific electric bus models for use in Colombia. The "special services" (coach) ZK6119BEVQ has a length of 11m with a 40-passenger capacity and a range of 300km, one of which is owned and operated in Cali by Celsia. The firm plans to submit the transit bus ZK6125BEVG27, which has a length 12m with an 80-passenger capacity and range of 360km, to Bogota's bidding process. The one bus which is applicable for the TPC in Medellín is the "busetón" ZK6850BEVG57, which is 8.5m in length with a 50-passenger capacity and range of 330km. The buses are offered as a complete bus or as a chassis to be upfitted by local body builders. Local body building has the advantage of promoting local manufacturing as well as guaranteeing bus availability. Battery charging options include 150kW and 300kW. Kenworth de la Montaña, which has 16

locations across the country, is the exclusive distributor of Yutong for Colombia and provides the necessary aftermarket support and training for operators of their fleets.

Jorge Barrera, representing Zhongtong, presented three bus types specifically designed for Colombia which meet all regulatory requirements. The table below lists the technical details of the buses, including electric range, gradeability, battery capacities, warranties, electric consumption, and bus price (chassis). The 7.8m bus was selected by the operator MDO for use in Medellín. An analysis of the net present value of CAPEX plus "fuel" OPEX showed that price parity between diesel and electric buses was about 11-12 years, but could be as little as 5-6 years for one charging session per day and 3 years assuming two charging sessions per day.

Zhongtong models offered in Medellín

Characteristic	Bus length and type		
	7.8m	9.5m / 9.5m with AC	12m
Passenger capacity	40	50	80
Range (km)	250	300 / 250	300
Battery capacity (kWh)	167	269	350
Electric consumption (kWh	0.6	0.7 / 0.8	0.8
Curb weight (kg)	9,800	10,300 / 10,600	13,500
Gross weight (kg)	13,000	14,500	20,000
Grade ability (%)	27%	30%	30%
Battery useful life (years)	8 to 10	10 to 12	10 to 12
Battery warranty (years)	8	8	8
Battery extended warranty cost (USD/km)	0.09	0.10 / 0.12	0.14
Bus price (USD)	151,445	210,700 / 216,899	315,287

Ediltron Gomes from Sunwin showed a video which highlighted multiple bus models used around the world. The models range from 8m to 12m with CATL batteries and Siemens motors. Slow and fast charging options are available and no transmission is used as the motor is directly coupled with the rear axle. Sunwin buses, in their fifth generation, have reduced their weight by 2,500kg and consumption from 1.3kWh/km to 0.7kWh/km in the 2010 to 2019 period. Fuel energy savings are estimated to be 54% to 61% and maintenance savings are estimated to be up to 80%, based on experiences in China. Sunwin has delivered 26 buses to Cali, Colombia to date.

6. TECHNOLOGY SOLUTIONS SUPPLIERS

Andres Barentín from Dhemax, a provider of fleet and recharging management consulting services, presented an integrated system to manage fleet and recharging to optimize operations. Recharging management provides savings in energy cost and reduces the necessary infrastructure to guarantee operation. Telematics systems allow for tracking of driver performance, battery state of health, and other data.

Felipe Cevallos from Reborn Electric presented a retrofitting alternative that could convert the existing diesel fleet to electric powertrains. In the conversion, components associated to the diesel powertrain are removed, and electric motors, batteries, and electric systems are installed. The cost of a retrofit is about 50% of the cost of a new electric bus.

Santiago Rodriguez introduced QEV Technologies, an electric mobility R&D company with a joint venture with a Chinese production company, who are offering bus development in Colombia and Latin America. The firm is working with Busscar, a local body builder in Colombia, to offer products which are adapted to local needs. Jorge Rodriguez from Aedive Peru mentioned that Modasa, a local bus manufacturer, has allied with QEV Tech to develop a custom-made product for Peru. The E-Titan transit bus has a VW chassis body built by Modasa, an e-motor of 175kW, and a battery pack of 200kWh. Similar efforts could be pursued to develop a bus for the TPC of Medellín.

7. INVESTORS

Andres Jaramillo from Transfondo explained that in other transportation sectors, airplanes, trains, and ships are not owned by the operators, and bus operators should adopt the same business model. Previously, operators bought the cheapest bus without any consideration of operation and maintenance costs. The business model is changing, now separating bus provision and their operation and maintenance.

Juan Carlos Diaz from Sumatoria spoke about their new fund “SGA Alternativo,” which is intended to be used to finance electric fleets. Currently, banks are not lending money for fleet renovations. New policies, such as Ley 1964 which requires 100% of new buses to be zero emissions by 2025, raises the question of how operators and banks will finance the ~2 billion USD that are needed to comply. Sumatoria’s strategy is based on contractual conditions

as well as the potential co-financing of national and local governments. The government also has a role to support the goals that they are imposing. For the TPC, subsidies and loan guarantees could be used. Diaz presented a case study for the procurement of 594 electric buses to be operated by Transmilenio Bogota, in which the contract separates fleet provision and operation, the timeframe was adjusted to 15 years, and linked the bus manufacturer within the guarantee structure.

8. DEVELOPMENT BANKS

Juan Manuel Robledo from the development bank Findeter discussed how his firm is generating finance and business models to illustrate that electric mobility is starting to be financially viable for bus operators. Findeter is promoting compensated rates, where funds are obtained from the Treasury to offer financing at lower interest rates with a commercial bank acting as intermediary. The MDO case study described above was financed using Findeter's "Línea 3 Reactiva" credit line, which offers up to 12 years terms, with 2 years grace periods, at a re-discount rate of IBR (Indicador Bancario de Referencia), and a + 0.4% monthly rate. The credit line has 300,000 million pesos and is open for all public transport systems. Findeter is open for other public or private entities to generate compensated rate financial mechanisms. They are currently working with the AMVA to promote fleet renovation in the Metropolitan Area.

Jorge Osorio described the financing options offered by his firm Bancoldex, a development bank that also finances enterprise initiatives through commercial banks. They have a credit line for sustainable development and energy efficiency, which opens every year between July and August with terms of up to 10 years with 3-year grace periods. They recently financed 180 hybrid buses for Bogota.

Lucia de Narvaez from BID Invest, the private arm of BID (Banco Interamericano de Desarrollo), discussed how in addition to offering financing, they also offer advice on how policymakers can revise policy frameworks and financial incentives, perform feasibility studies for charging infrastructure, and suggest steps for operational optimization. The firm is interested in trying to help to solve market failures in the sector and has funds available from donating countries to support electric mobility.

9. COMMERCIAL BANKS

Carlos E. Restrepo and Marlen Echeverry from Davivienda expressed that, in addition to presenting a possible financial structure, they came to gather input from stakeholders and are prepared to finance new projects. Davivienda was involved with the electric taxis project in Medellín and financed the operator MDO's "Nutibara Project." Restrepo and Echeverry outlined the two financing options, credit and leasing, available to bus operators.

Juan Pablo Acosta, from Bancolombia. Leasing Bancolombia promotes electric delivery trucks in Colombia. Fifty are already operating. They offer financing options that include credit, leasing, and renting (with and without services). The financial leasing for buses offers financing of up to 80% of the asset cost, terms of up to 72 months, a grace period of up to 2 years, and a purchase option of 1% to 10%. They have a "sustainable financing line" with 10-year terms and a grace period of 2 years to support mobility projects, including charging infrastructure.

10. MATCHMAKING

Olivera from C40 explained the methodology for the session, emphasized the need to learn from experiences in other countries and cities, and urged all parties to ask for all the necessary guarantees before signing any contract. Each operator selected a list of entities to ask questions and discuss details, numbers, and possible next steps to close potential deals. Each operator had up to seven meetings of 15 minutes each, which are summarized in the table below.

Reuniones Bilaterales

Operator's Table			
1	Santra + Sotrames	4	Cooptransnor
2	Rápido San Cristobal	5	Coopetransa
3	Expreso Campo Valdes	6	Masivo de Occ.

		Operator's table to visit in each round						
Category	**Institution**	**Round 1**	**Round 2**	**Round 3**	**Round 4**	**Round 5**	**Round 6**	**Round 7**
Bus Manufacturers	BYD	3	4	5	-	-	-	-
	Sunwin	4	-	-	-	-	-	-
	Yutong	1	5	6	-	-	-	-
	Zhontgtong	5	1	2	-	-	-	-
Investors	Assymetric Return Capital	6	3	-	-	-	-	-
	Sumatoria	2	-	-	-	-	-	-
Development Banks	Bancoldex	-	-	-	5	-	-	-
	FINDETER	-	2	1	3	-	-	-
	BID Invest	-	6	-	-	-	-	-
Commercial Banks	Bancolombia	-	-	3		5	-	-
	Davivienda	-	-	-	1	3	5	-
Experts	Clean Energy Works	-	-	-	-	-	-	-
	Dalberg	-	-	-	2	-	-	-
Technology Suppliers	Dhemax	-	-	-	-	-	3	-
	QEV Tech	-	-	-	-	1	-	-
	Reborn Electric	-	-	-	-	-	-	5

11. NEXT STEPS

The operators in attendance expressed that they found the opportunity to interact with bus manufacturers and financial institutions to be very valuable. When asked what was still needed to advance the adoption of zero-emission fleets, they mentioned the following points:

- The need for a credit mechanism for small operators so they could have access to financial resources. They view current financial products as not applicable to small and medium sized bus operators. There is the need for better collective organization to transition from small bus owner to a larger, collective operation in which a larger group can offer the required guarantees to better structure a fleet modernization project.
- The need for the restructuring of loans or leasing agreements. Some operators have already made investments to transition to Euro IV/V technologies. For example, one operator invested $250M pesos per bus.

These buses still have plenty of useful life, and it is difficult to find the capital to now invest close to $800M pesos per bus in order transition the fleet to zero-emissions.

- Uncertainty about who is going to be responsible for building and maintaining the necessary charging infrastructure. One operator mentioned that, ideally, the city and area authorities would supply the infrastructure.
- The need for legal stability to encourage the development of a functional economic model, such as assurances that operators can keep their routes for a set time period.

Manuel Olivera of C40 and Oscar Delgado from ICCT offered closing remarks at the roundtable. Delgado mentioned that ZEBRA's strategy in Medellín started from the problems, not the solutions, and that the roundtable arose from the need to assess the actual and perceived barriers that were identified at a previous workshop with private bus operators. The bus models are available, the technical needs in terms of grade ability, turning radius, etc., are taken into account and more models, some adapted specifically for Medellín conditions, will be available in the near future. Also, financial entities have expressed an interest in the transition to zero-emission buses and new financing models would allow for lowering of costs to achieve financial closure. The ZEBRA team offered to provide support to help operators in any potential next steps.

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