Bombardier test project involves induction technology

BY FRANÇOIS SHALOM, THE GAZETTE JANUARY 10, 2013

An artist's conception of Bombardier's new electric bus which has its battery recharged through a capacitor under bus stops.

MONTREAL — There's no budget, no timeline, no proven technology, much less shovels in the ground or even a signed contract.

But it's substantially more than an idle dream.

Montreal's Île-Ste-Hélène is scheduled to be the North American test site this year for Bombardier Inc.'s Primove pilot project, a technology that is being tested at four sites in Germany, where the firm's rail division is based.

Primove's mandate is to develop electric mass-transit propulsion systems, but not the vehicles themselves.

Intended to bypass the conventional notion of electric buses and trolley buses powered by cumbersome batteries, Primove rests on an inductive transfer of power from ground-based electrical power sources to very small batteries placed under, not in, the bus.

Sensors on the vehicles would store the energy emitted by the electro-magnetic field, but only in small quantities, feeding the bus or trolley sufficiently to reach the next power source a short distance away. The system can charge while the vehicle is in motion or at rest.

“You bury power stations capable of charging rapidly, even instantly — we’re talking seconds — so that you don’t need to resort to (lengthier) conventional power boost systems currently on the market” like hybrid and electric vehicles, said Bombardier Transportation spokesperson Marc Laforge.

Burying the infrastructure underground eliminates not only long battery-recharging sessions but also the visual pollution of vast meshings of overhead cables that tramway catenaries and pantographs require, he added.

“It’s kind of the opposite principle — (Primove is designed to) store the energy source out of sight,” Laforge said.

To get there, though, Bombardier will need three partners; bus manufacturers, Hydro-Québec and mass transit agencies.

“The beauty of this project,” said Laforge, “is that the most interested party in North America is in Canada, in fact Montreal and the Société de transport de Montréal. For us at Bombardier, that’s perfect.”

But the STM’s enthusiasm was tempered, to say the least.

“Yes, absolutely there are discussions between us and Bombardier, but it’s very preliminary,” said spokesperson Isabelle Tremblay.

“There’s a general interest on our part concerning, in particular, rapid charging. But it’s at the exploratory stage right now, and our focus is on our long-term goal of buying only electric vehicles by 2025, whatever form that may take.”

“Bombardier is working on induction technology, which may be great, but we’re looking at everything available on the market, including a Chinese electric-charge technology that works very well.”

“But this is at the talking stage only — there is no budget dedicated to this, no deadline,” Tremblay said. “On the other hand, we’re listening and we’re interested.”

Laforge said that “if all goes well, we should do this pilot project this year on Île-Ste-Hélène,” and that Bombardier has approached Hydro-Québec and various bus manufacturers, including Quebec’s Nova Bus, which supplies the STM exclusively. The St-Eustache bus maker is selling 1,688 hybrid buses to the STM and Quebec’s eight other public transport agencies.

Gilles Dion, president and CEO of Nova Bus, said that he has discussed the Primove project with Bombardier “frequently for the last year or two.”

“It’s a fantastic initiative on Bombardier’s part, and I think there’s great potential for it.”

“We’re working to see how we could turn this trial technology into electric vehicles.”

“Are we going to be able to conduct tests this year? If not, it will be by next spring.”

But Dion noted that politics will play a role in its implementation.

Bombardier and Nova Bus had received financial commitments for the project after lengthy talks with the previous Liberal government led by Jean Charest. But discussions must now be restarted under Pauline Marois's Parti Québecois government to make sure the commitments conform to its policies and goals.

"I'm assuming that the (undisclosed) sums earmarked for this project will still be available, but everyone has to be on the same page once again, including Hydro-Québec, which will supply the electric system."

Hydro-Québec spokesperson Mathieu Rouy confirmed the utility has held some preliminary meetings with Bombardier and the STM to discuss the project, but said he could not comment further until the new government officially announces its policy for electric vehicles.

Between 2011 and 2020, Rouy said in an email, the Charest government had set aside "five envelopes of $100,000 each attributed by Hydro-Québec to projects linked to the electrification of transportation modes. To date, only one envelope has been attributed (to Laval)."

"As we speak, this program is maintained by the current government, so there remain four envelopes of $100,000 to be attributed."

Bombardier's Jérémie Desjardins, who heads the Primove project in Europe, told sources there that the technology has huge implications for Bombardier. If successful, it could lead to commercialization in related automotive fields, including cars and trucks.

But Bombardier's success in non-rail mass vehicles has been mitigated in recent years in Europe. Two French cities, for instance, Caen and Nancy, scrapped their Bombardier-provided tramways that suffered much higher than normal rates of breakdowns and failures after only a few years — three decades before their anticipated retirement.

But Dion said that the Primove technology is "very, very, very promising."

"That's why we're all looking at it so closely."

fshalom@montrealgazette.com

Primove induction powered tram trial proves a success

12 June 2012

GERMANY: Bombardier Transportation has successfully completed testing of its Primove catenary-free power system on a branch of the Augsburg tram network.

Primove uses cables between the rails to produce magnetic fields which induce electric current for traction power in pick-up coils mounted underneath the vehicle.

The tests were carried out using a modified Bombardier low-floor tram. The Primove 200 kHz induction loops were installed on an 800 m spur line which is only used in public service during events at the city's exhibition centre.

Augsburg transport operator AVG does not plan to deploy Primove, as it has a modern fleet of conventionally powered trams, but the federal government has awarded funding for Bombardier and Braunschweig transport operator BSVAG to undertake in-service trials with two electric buses which will run on a 12 km route.

- For more details of the Primove trials and Bombardier's vision for e-mobility, read the July 2012 issue of *Railway Gazette International*

Related News:

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Bombardier to test wireless trams in Augsburg - 26.05.10
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Above: Liberty Streetcar with three passenger compartments.

Left: Interior of Liberty Streetcar with customizable seating arrangements.

Right: Interior of Liberty Streetcar with just a single step to high-floor section.

Left: Exterior of Liberty Streetcar with sleek, modern design.

On Track for the ENVIRONMENT

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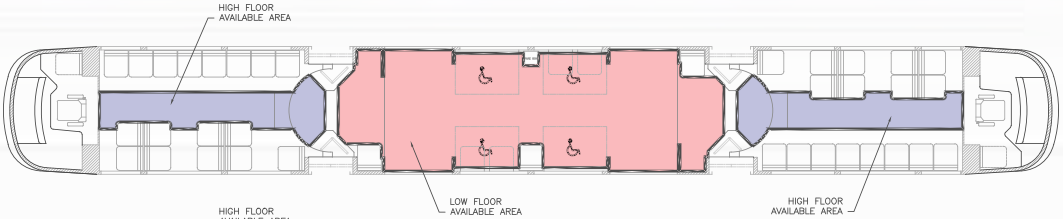

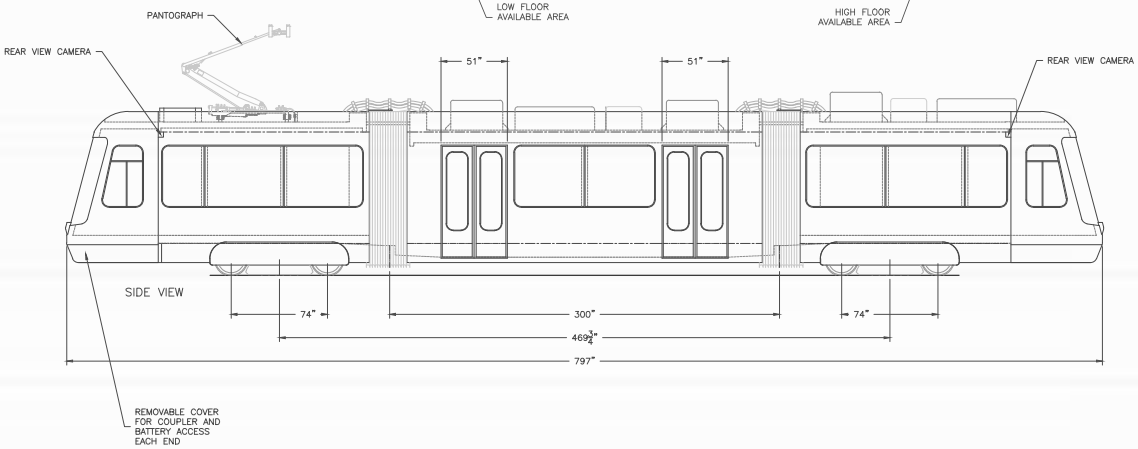

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Liberty Class Streetcar - Technical Specifications		
Track Gauge	Standard 4 Feet, 8.5 Inches	
Boarding Height	13.75 Inches (350mm)	
Power Supply	750 V DC (Max. 925 V DC, Min. 525 V DC)	
Low-Voltage Power Supply	24 V DC	
Motors	4 x 65 kW or 4 x 80 kW	
Maximum Speed	44 mph (70 km/h)	
Vehicle Length	66 Feet, 5 Inches	
Max. Height (w/o Pantograph)	10 Feet, 6 Inches	
Wheelbase	39 Feet	
Weight of Car Empty	63,960 lbs (without off-wire capability)	
Acceleration	3.0 mphps (1.3m/s2)	
Brake Deceleration	3.0 mphps	
Emergency Brake Deceleration	5.0 mphps	
Maximum Grade	9%	
Vehicle Width	8 Feet (2.46 m)	8 Feet, 8 Inches (2.65 m)
Percentage of Low-Floor Area	71%	73%
Total Seating Capacity	41 Passengers + 1 Operator	47 Passengers + 1 Operator
Maximum Capacity (AW3)	127 Standees + 41 Seated + 1 Operator = 169	135 Standees + 47 Seated + 1 Operator = 183
Maximum Capacity (AW4)	170 Standees + 41 Seated + 1 Operator = 212	181 Standees + 47 Seated + 1 Operator = 229

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Your first look at the streetcars to roll from Union Station to Oak Cliff come 2014

By ROBERT WILONSKY

Staff Writer

Published: 10 September 2012 11:07 AM

Editor's note: This item originally appeared on the Transportation blog.

New, 11:02 a.m.

When last we asked about the downtown-to-Oak Cliff streetcar project, scheduled to close the Houston Street Bridge sooner than later for construction, we were told there was a shortlist of would-be providers, and that the Dallas Area Rapid Transit board was *this close* to settling on a manufacturer. At last, we have a would-be winner: Brookville Equipment Corporation out of Brookville, PA, which DART's Committee-of-the-Whole is scheduled to okee-doke tomorrow before the full board gives its final stamp of approval later this month.

As you'll see below in the PowerPoint prepped for the August 28 rail committee meeting, there were three companies that bid on the project: Brookville Equipment Corporation, Inekon and CAF, with the 94-year-old Brookville coming up the winner by offering to build two streetcars for $9,422,837 (give or take a "5-percent supplemental work contingence"). Others were interested, but balked in part because of the small size of the order: two cars.

As you'll note, Brookville only makes one modern streetcar, the Liberty, which is what Brookville proposed to Dallas, says Joel McNeil, who heads up the company's sales division. He's not prepared to delve into further specifics — "because it's not official and the board still needs to vote on it" — but he does answer a few, ya know, general questions about the streetcar itself. Such as:

"The cars are customized to a city's needs, so a seating capacity can be altered on how they want to lay out the seats," he says when asked about seating capacity. "A typical 66-foot-long car has between 41 and 47 seated passengers depending on how the customer specifies it, then you have a capacity of between 120 and 130 standing."

And, no, it won't be green. "We build a vehicle for what the customer wants, so they get to pick the exterior color, the interior layout, the color scheme. It's all dependent on how the city wants to handle it." One car is due in May 2014; the second, by September 2014.

Tomorrow the DART committee-of-the-whole is also scheduled to forward to the board a contract for the design-build portion of the streetcar project, which will go to …

… a joint venture between Alameda, California-based Stacy and Witbeck, Inc. and Dallas-based CARCON Industries & Construction. The contract's worth $27,963,520 — $23 million, of course, coming from those federal Transportation Investment Generating Economic Recovery (TIGER) grant funds, with the rest coming from regional toll funds. Says the contract, "The term of
the contract is completion of the work by October 31, 2014." As for the route, for those who still have questions …

Did you see something wrong in this story, or something missing? Let us know.

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Kaohsiung picks CAF to build catenary-free trams

07 January 2013

TAIWAN: Kaohsiung City Government's Mass Rapid Transit Bureau announced on January 4 that it had selected a consortium of CAF and Evergreen Construction to build the first stage of the city's catenary-free circular light rail line.

Now expected to cost NT$15·6bn, the 22·1 km route with 36 stops will link the main station with business, shopping and residential areas, as well as major developments around the harbour that are due to open during 2014. It will incorporate portions of Taiwan Railway Administration's existing Lin Gang East and West freight railways, as well as roadside reservations, and will interchange with both of the city's metro lines.

After proposing a privately-funded BOT concession in 2011, the city decided last year to manage the project through conventional procurement. New bids were called in November, with two offers being received by the December 17 deadline. The other bid came from a consortium of Ansaldo STS, AnsaldoBreda and New Asia Construction & Development Co.

The NT$5·7bn turnkey contract for the 8·7 km phase one covers detail design and construction of all civil engineering works, including the 1 435 mm gauge track, power supplies and the rolling stock. With much of the land already acquired, construction of this section is due to be completed by October 2014. Phase two is being co-ordinated with the reconstruction in tunnel of TRA's existing cross-city main line, and is due to follow by December 2017.

CAF is to supply a fleet of Urbos low-floor cars 2 650 mm wide, equipped with an onboard energy storage system that will be recharged at intervals along the line. This will avoid the need for either overhead catenary or an underground inductive power supply. Traction voltage has been specified at 750 V DC.

Services are expected to operate from 06.00 to 23.00 each day, with headways ranging from 15 min off-peak to every 6 min at peak times. Ridership on the completed route is projected to reach 87 000 passengers/day in 2021.

Related News:

- Tamsui light rail approved - 15.01.13
- Zaragoza extends tram network - 20.12.12
- Kaohsiung tenders catenary-free light rail project - 08.10.12
- Cuiabá tramway turnkey contract signed - 10.07.12
- Kaohsiung Orange Line revenue service starts - 22.09.08
- Kaohsiung Red Line launched - 01.04.08

Zaragoza tram Line 1 enters service

26 April 2011

SPAIN: The first phase of Zaragoza tram Line 1 entered service at 04.52 on April 19, following successful completion of trials which started in November last year.

The initial 6·4 km section of the north-south route links Plaza Paraíso on Gran Vía with Valdespartera and has 13 stops. Work on Phase II connecting Gran Vía to Parque Goya in the north is due to start in July and will last for around 24 months (RG 10.10 p51).

The 12·8 km project with 25 stops is being implemented by the Traza consortium of Tuzsa, CAF, FCC Construcción, Acciona, Ibercaja and Concessia at a cost of €400m and should be completed in June 2013. Traza will operate the line for 35 years.

A fleet of 21 Urbos 3 trams has been supplied by CAF. The vehicles are 33 m long and 2 650 mm wide with capacity for 200 passengers, comprising 54 seats and 146 standees. The trams are equipped with CAF's onboard ACR ultracapacitor energy storage system for catenary-free operation, which will be used in the city centre once Phase II is completed.

Related News:
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Zaragoza extends tram network

20 December 2012

SPAIN: Line 1 of the Zaragoza tram network grew by a further 844 m on December 20, with the opening of the section from Plaza de España to César Augusto and Plaza del Pilar. Extension of the network into the heart of the old city has also seen a further addition to Spain's longest section of catenary-free tram route.

Opening to Plaza del Pilar is expected to increase weekday ridership by 4 000 to 50 000 passengers a day on Line 1, now running for a total of 7·56 km from Mago de Oz in the southern suburb of Valdespartera. Weekday ridership is forecast to double with the opening of the final section to Parque Goya north of the city centre, now expected to enter service in April 2013.

Extension of the tram route to Plaza del Pilar has involved an extensive programme of improvements to the urban fabric, including the creation of a total of 29 175 m^2 of pedestrian areas. Utilities such as water, gas and electricity are now housed in a new service tunnel running beneath Avenida César Augusto.

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Seville goes catenary free

THE Spanish city of Seville is to remove the catenary from its only light rail line because it interferes with religious processions through the streets - part of the 1.4km line runs alongside the cathedral. CAF, which supplied five LRVs to Seville, will install its rapid-charge accumulator (ACR) system on the line and in the vehicles (IR) June 2009 p24).

Short sections of catenary will remain at each stop to allow LRVs to be charged, which takes only 20 seconds. This will provide sufficient power to allow 600m of catenary-free operation between stops. Energy is also fully recovered during braking.

This is the first commercial application of ACR. However, about half of the light rail network being built in Zaragoza will be equipped with ACR.

THE first of 27 LRVs being supplied by CAF to Edinburgh was on show at BCN Rail. The 42.8m-long vehicles have a high-quality interior with leather seats, plenty of room for luggage as the 18.5km line will serve the airport, and a totally flat floor. Glass doors in the centre of the vehicle enable it to be split into two so that part of the vehicle can be shut off to passengers to improve security late at night.

Originally published October 26, 2011 at 6:36 PM | Page modified October 26, 2011 at 6:39 PM

Local firm wins bid to assemble streetcars

The First Hill streetcars in Seattle will be assembled here by 20 local workers at Pacifica Marine instead of being imported from Europe, as happened with the three South Lake Union streetcars.

By Mike Lindblom

Seattle Times transportation reporter

The next streetcars in Seattle will be assembled here by 20 local workers instead of being imported from Europe, as happened with the three South Lake Union (SLU) vehicles in 2007.

Seattle-based Pacifica Marine has been chosen to assemble six First Hill streetcars, to carry passengers starting in late 2013. The route goes from the International District/Chinatown light-rail station to Broadway, where the Capitol Hill station will be done in 2016.

The rail cars will be able to run 2 ½ miles on battery power and regenerative braking — so they draw electricity from overhead wires heading up to Capitol Hill and go wireless on the return to Chinatown.

This reduces conflicts between overhead streetcar and electric trolley-bus wires and should save energy and maintenance costs in the long run, said Ethan Melone, city streetcar-project manager.

The new jobs would pay $15-$30 per hour, under contract with the International Association of Machinists and Aerospace Workers.

The trains are designed by Czech-based Inekon, which built the SLU fleet. Exact details of the partnership are being worked out, but probably the car bodies will be imported from the Czech Republic, for final assembly, testing and maintenance in Seattle, using mostly North American components, according to Bill Patz, president of Pacifica. He said the plant here would "evolve" so that eventually, as local crews gain expertise, rail cars could be built entirely in Seattle.

More jobs could be added if the partnership wins contracts in some of the 20 or so other U.S. cities adding streetcars, supporters said.

Mayor Mike McGinn and City Council President Richard Conlin announced the deal Wednesday. Transit is one reason the city continues to attract employers, including Amazon and the Brooks athletic-shoe company, McGinn said.

The $130 million First Hill line is already funded by Sound Transit sales taxes that voters approved in 2008.

Since the 1990s, Pacifica assembled and retrofitted more than 65 Spanish-designed Talgo rail cars for the Amtrak Cascades line, said Patz. The Talgos are distinctive because they tilt based on track curvatures, improving comfort on fast turns. But right now, the company has an "empty shop" in the Duwamish area, said Patz.

Bid prices weren't announced Wednesday, but modern streetcars and light-rail cars are worth roughly $4 million each.

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Czech trams repeat success in the USA

Prague, 20 February 2012 - As many as 26 new trams may be delivered from the Czech Republic to the USA over the course of the next three years. Czech manufacturer, Inekon Group, entered into a contract with the City of Seattle, which undertook to purchase six vehicles and reserved an option on the purchase of twenty more. The value of the currently signed contract amounts to USD 26.6 mil. (i.e. nearly CZK 600 mil.). In the second half of this year, Inekon will commence production of the trams in the manufacturing plant of Ostrava Transport (Dopravní podnik Ostrava a.s.). The first completed tram is scheduled to arrive in Seattle at the beginning of 2014.

Seattle has placed an order for six vehicles

It involves the supply of 20 additional trams; Texas shows interest as well

Prague, 20 February 2012 - As many as 26 new trams may be delivered from the Czech Republic to the USA over the course of the next three years. Czech manufacturer, Inekon Group, entered into a contract with the City of Seattle, which undertook to purchase six vehicles and reserved an option on the purchase of twenty more. The value of the currently signed contract amounts to USD 26.6 mil. (i.e. nearly CZK 600 mil.). In the second half of this year, Inekon will commence production of the trams in the manufacturing plant of Ostrava Transport (Dopravní podnik Ostrava a.s.). The first completed tram is scheduled to arrive in Seattle at the beginning of 2014.

"Our first trams were delivered to Seattle in 2007. Since then, the trams have operated at a reliability rate reaching almost 100%. It was this reference, in particular, that seemed to be the main reason for our success in the tender proceedings held by the city last year," said Ing. Jan Hušek, PhD, Vice Chairman of the Board of Directors at Inekon Group, a.s. "*Seattle has the right to transfer the option on 20 more trams to a different customer. This customer would therefore not be required to organize a new tender. This opens up a whole world of opportunities in America. The City of Dallas in Texas has expressed its interest in the supply of three trams under this option,"* said J. Hušek.

Inekon Group repeated its success in Seattle with the same type of tram (Inekon 12-Trio). The USA model is low-floor, two-way vehicle including a lounge for passengers that is fully air-conditioned. The trams will be redesigned to cover a distance of approx. 0.75 km uphill without traction power supply. This will mark the first solution of its kind in the entire North America.

"The trams are generally equipped with a battery for safety reasons in case of power supply failures on the road. The battery, however, is capable of covering a maximum distance of 100 to 200 meters. Our designers now face the issue of a distance several times longer,

moreover uphill and including power supply for the air-conditioning system," explained J. Hušek.

The first tram will be completed in Ostrava. The citizens of this Moravian-Silesian city will have the opportunity to see the tram during its testing in the neighborhood of the Martinov´s manufacturing plant at the turn of 2013 and 2014.

For the next five vehicles, the final assembly will be provided for Inekon Group in Seattle directly by partner company Pacifica Marine. Bill Patz, CEO of Pacifica Marine, commented on the aforementioned as follows: "*We are happy about the contract signed with Inekon. We believe that this is merely the beginning which will allow us to supply new trams to Seattle followed by otherr American cities."*

The comments provided by representatives of the City of Seattle, who wish to use the trams on a new line titled First Hill Streetcar, are positive in the same manner. The line should connect the administrative centers of municipal district First Hill with main traffic routes in the remaining parts of the city.

"This investment into traffic infrastructure improvements will bring new labor opportunities and return money to our local economy. The extension to the rail traffic network will support the development of neighboring municipal districts and will offer citizens new transportation options. I congratulate Inekon and Pacifica on a job well done," said Mike McGinn, the Mayor of the City of Seattle.

Supplementary facts:

- INEKON trams are original Czech products. Vehicles are manufactured in cooperation with Ostrava Transport (Dopravní podnik Ostrava a.s.) in the central manufacturing plant in Martinov.
- The first three low-floor INEKON 12-Trio vehicles were launched with great anticipation on 12 December 2007. The biggest city of the state of Washington and the American northwest is not the only place where you can see these trams. At the turn of 2006 and 2007, three vehicles were delivered to Portland as well. INEKON GROUP delivered the first Czech trams to this big city in the state of Oregon as well as to Tacoma in the state of Washington as early as the end of the 1990s. Even the capital city of the USA, Washington D.C., purchased three new INEKON 12-Trio vehicles.
- The Pacifica Marine company specializes in the manufacturing and refurbishment of public transportation means. The company was established by the International Association of Machinists and Aerospace Workers with a mission to create new labor opportunities and creating new jobs in the state of Washington.

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Seattle tramway to be electrified in only one direction

08 November 2011

USA: The City of Seattle has selected Czech firm Inekon and its local assembly partner Pacifica Marine to supply six cars for a short tram line planned to connect First Hill with the future Capitol Hill light rail stop and the Chinatown/International District. The Inekon-Pacifica partnership was one of three bidders and will maintain the cars for five years.

The 3·2 km route is planned to open in late 2013. It replaces a plan for a light rail stop at First Hill which was dropped because of engineering, geological and construction risks.

The line will be double track, but overhead electrification will only be installed on the track towards First Hill. The return trip will powered by batteries, which as well as reducing energy consumption and maintenance costs will avoid interfering with trolleybus wires.

Inekon has previously supplied six trams to Seattle and has also won orders in Portland and Washington DC. Those were delivered fully built, but the Seattle cars must comply with Buy America regulations requiring 60% domestic content and US assembly.

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Seattle

First-Hill Streetcar Line

Began operation: Under Construction (Opens 2014)
Route Miles: 2.4
Stops: 10
Org: transit agency
Schedule: daily
The First-Hill project is the second line of Seattle's planned modern streetcar network. It entered the construction phase in April 2012, with operations scheduled to begin in early 2014. The 2.4 mile long line will connect the First Hill employment/ activity center (one of the city's largest employment centers, including the Seattle University campus and the Seattle Medical Center) to the regional transit system as well as intercity passenger rail; provide local transit service; accommodate economic development; and contribute to neighborhood vitality. Like the existing South Lake Union streetcar line, First Hill will be operated by King County Metro as part of the city's transit system. Because the two lines do not connect, a separate maintenance facility / operations base is being constructed. At 5th and Jackson, the new line will also pass the now mothballed Waterfront Streetcar alignment, although there are presently no plans to connect to it.
The double-track alignment is located entirely on city streets and utilizes a combination of center and side (blub-out) platforms for the 10 stops. For the Broadway leg of the alignment, the existing street is being extensively reconfigured, incorporating a two-lane bike path (dubbed the "Broadway Bikeway") along the east side, with the shared streetcar/ traffic lanes shifted towards the west curb. The project website has graphics illustrating the entire alignment, as well as video fly-overs (one of which is included below).

The line has several other unique aspects- it will negotiate long stretches of moderate grades, as well as short stretches of steep grades (up to 9%). Much of the alignment will also be shared with Metro's trolley bus system. Most unique is the fact that the line will take advantage of its prevailing grade, and the inbound track (which moves in the downhill direction) will not have overhead wire. The line's five vehicles (being supplied by Inekon, with final assembly in Seattle) will each be equipped with an onboard energy storage system that allows "off-wire" operation. This mode of operation facilitated keeping the trolley bus and streetcar

overhead wire systems separate, and also simplified some of the project's interaction with other on-street and underground utilities. On an interesting historical note, sharing of overhead wire systems between trolley bus and streetcar was once common practice, albeit with trolley poles on the streetcar vehicles instead of pantographs.

Left- First-Hill Streetcar Map - click to enlarge
Middle- First-Hill in relation to South Lake Union Streetcar and Light Rail
Right- Broadway right-of-way illustration

Construction photos by Gordon Werner
News and Updates

8/29/12- Gordon Werner has a Flickr photostream with detailed photos of construction in progress.

Links

"Newest Streetcar to Remake First Hill", Seattle Times 4/11/12

Seattle Streetcar official website

Inekon Streetcar- Seattle page

ModernStreetcar.org website

This page was last updated on 8/29/12

Originally published April 10, 2012 at 9:24 PM | Page modified April 11, 2012 at 10:39 AM

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Newest streetcar to remake First Hill

Construction on the $134 million First Hill Streetcar line is to begin this month, with service expected to start in early 2014.

By Mike Lindblom
Seattle Times transportation reporter

ELLEN M. BANNER / THE SEATTLE TIMES

Along Broadway on the east side (left side of street in the frame), there will be a 10-foot-wide, two-way bike lane.

RELATED
Streetcar work expected to bring more noise and disruption
Animation of the streetcar on its route
LA looks to revive mythic past with streetcars
First Hill Streetcar
THE 2 ½-MILE streetcar line is projected to:
Connect two light-rail stations: International District/Chinatown and Capitol Hill.

Open in early 2014.

Cost $134 million.

Create a mile of 10-foot-wide, two-way bike lane on Broadway separate from cars.

Reduce automobile and bus lanes from four to two lanes in places.

Cut street parking by 40 percent.

Information
See animation of the First Hill Streetcar line: http://seati.ms/IpmUGn

Streetcar on Broadway

W. STENSRUD / THE SEATTLE TIMES

Click to zoom | When the First Hill Streetcar opens in 2014, car traffic and streetcars will share one lane each direction on Broadway, with pockets of parking or turn lanes alongside, plus a continuous two-way bike lane. This image shows a northbound streetcar stopped near Seattle Central Community College, at Broadway and Pine Street.

First Hill streetcar

MARK NOWLIN / THE SEATTLE TIMES

Click to zoom and expand | Construction on the $134 million line is to begin this month, with service expected to start in early 2014.

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Before Seattle-area politicians knew better, Sound Transit promised voters in 1996 an underground station at First Hill, where riders could take an elevator

200 feet down to catch a regional light-rail train.

Then after studying the sliding soils on nearby Beacon Hill, transit officials realized that despite the value of putting a train stop in one of the city's biggest employment centers, it would be prohibitively expensive and risky to mine a deep vertical shaft among the high-rises of First Hill.

Sound Transit apologetically canceled the station in 2005 and in its place proposed a streetcar line to serve First Hill, without securing the money.

Now that voters have approved the funds — a near footnote in the $18 billion Sound Transit 2 plan of 2008, funded by higher sales taxes — construction on the $134 million streetcar line is to begin this month. Service is expected to start in early 2014.

There will be fewer lanes for car traffic and a loss of parking. On the other hand, the line will mean more-frequent transit, and a huge gain for bicyclists. Along much of the route, the streetcar will share a traffic lane with cars, as in many cities.

Despite its origins as a consolation prize, the 2 ½-mile project has become a magnet for great expectations, beyond just moving people through the state's most densely populated corridor.

The First Hill Streetcar, running mainly down Broadway, Yesler Way and South Jackson Street, is expected to:

• Attract more cyclists by creating a mile of bike lane, called a cycle track, separate from cars.

• Launch a homegrown train-building industry, when Pacifica Marine in South Seattle assembles six Czech-designed trains and tries to sign streetcar deals with other cities.

• Promote new technology using rechargeable batteries, not overhead wires, to power its southbound downhill trip.

• Preserve retail and tourist commerce in historic Pioneer Square, by going a few extra blocks west.

• Reach thousands of new housing units proposed in a rebuild of Yesler Terrace.

• Connect to a possible future streetcar downtown.

State's densest neighborhood

Can a project work this many miracles?

Its main purpose is to move people — ultimately 3,000 to 3,500 a day in a 2007 Sound Transit estimate, and the Seattle Department of Transportation has conjectured the count could go twice that high. By comparison, the South Lake Union streetcar carried 2,500 average weekday riders last month.

The route will connect two light-rail stations: the existing International District/ Chinatown Station and the Capitol Hill Station, to open in 2016. Near the line are Swedish, Harborview and Virginia Mason medical centers, Seattle Central Community College, Seattle University and O'Dea High School.

Skeptics argue that these places can be served by existing or enhanced bus lines, which are less expensive and can tackle steep hills directly to downtown.

Jack Whisner, a King County Metro planner speaking only for himself, suggested in a 2010 letter to Mayor Mike McGinn, that a new trolley-bus route be created on Yesler Way to Harborview.

Trolley-buses, powered by overhead electrical wires, are better for short hops and hill-climbing, while rail should be deployed for longer routes at quicker speeds, he argued in the letter, published in Seattle Met magazine.

"Right now, Seattle's just building short, slow, ineffective streetcar lines that are not providing much transit advantage," Whisner said in an interview last week. Supporters say the streetcar will serve a new north-south corridor that is underserved by buses, and will attract tourists.

"There will be people who ride a streetcar who won't ride a bus," says Michael Wells, executive director of the Capitol Hill Chamber of Commerce.

Some of them work at Swedish, where close to half the 7,000 employees drive to

work. A streetcar will entice many out of their cars, said Sherry Williams, community-affairs director at Swedish.

She predicts that employees who live south of downtown will drop pricey First Hill garages, and instead find parking near a light-rail or Sounder station, hop the train, then transfer to the streetcar at King Street Station.

Bike-lane feature

The project's most novel feature is a 10-foot wide, two-way bike lane on Broadway, separated from cars by curbs and artistic bollards.

City-published animations underscore how this is a cycling project, as well as a transit project. Bicycles will often move faster than streetcars and motor vehicles. Seattle's policy of "complete streets" instructs the city to accommodate all modes of travel in road rebuilds.

Ethan Melone, streetcar project director for the Seattle Department of Transportation, says the bikeway is two feet wider than a pair of less safe 5-foot bike lanes that are often incorporated into road projects.

SDOT's efforts at bike-friendly design are partly a reaction to its early experience with the South Lake Union line, where bicyclists crashed by getting their tires stuck in the rails. Where bicyclists gain space, car drivers will lose some.

Street parking will be reduced 40 percent overall, said SDOT spokesman Rick Sheridan.

In several places, four car lanes of Broadway are being reduced to two lanes, for instance near Madison Street. Streetcars and automobiles will occupy the same lanes there, as well as on South Jackson Street, which will retain four lanes.

Streetcars are likely to get stuck in traffic, one reason the city predicts an 18-minute trip end to end. The city probably saved minutes by rejecting a route option on Boren Avenue, which, on many afternoons, is clogged by overflow traffic heading toward Interstate 5.

Streetcars and motorists alike could face delays where turning vehicles stop for cyclists and pedestrians at intersections, for instance near the community college.

But SDOT hopes to minimize the bottlenecks in other hot spots, such as Broadway to westbound James Street, with right-turn lanes that make room for drivers going straight.

Melone notes that very few passengers will ride the entire 18-minute length of the route — more likely they're going partway, from either of the two light-rail hubs.

Streetcars will arrive every 10 minutes, a frequency aimed at taking some edge off their slow pace.

Even backer Wells wonders how the mixture of sidewalks, bike tracks, parking spots, streetcars and automobiles will work: "Quite honestly, I'm still having a hard time seeing how all those will fit on the street."

In a short segment on 14th Avenue, trains will run behind Bailey Gatzert Elementary School, where parent Heather Ayres said the city needs to wage a huge, multilanguage safety campaign.

"It feels as though a very high-density traffic area is going to become more dense with traffic, unless they take certain measures," she said.

Another challenge, many years away, is a mixed-use redevelopment of Yesler Terrace, bringing eight-story buildings and up to 4,500 parking spaces, and related traffic, into an area already near saturation. On the other hand, thousands of newcomers would be next to a streetcar stop.

Aloha for streetcars

Backers say odds are improving for a $30 million extension a half-mile north to Aloha Street, so tracks can reach the entire Broadway small-business district, a few years after the initial line opens.

That's despite voter rejection of a car-tab fee last fall that included $18 million toward citywide streetcar design and possibly construction. The Federal Transit Administration shares the streetcar fervor of Seattle's elected officials, and even awarded $900,000 to plan a downtown line, alongside $2 million in Sound Transit funds to plan a Ballard line.

And a proposed federal rule change this year would increase the chances of small streetcar extensions to win FTA's multimillion-dollar construction grants — because, it is argued, streetcars can feed economic growth and add riders to a larger transit network.

Mike Lindblom: 206-515-5631 or mlindblom@seattletimes.com. On Twitter @mikelindblom.

Monday, July 30, 2012

Siemens to supply catenary-free LRVs for Qatar Education City line

Written by Keith Barrow

The Qatar Foundation has awarded Siemens a turnkey contract worth more than €100m to build and equip the 11.5km light rail line that will link Education City with the Doha Metro.

The contract includes signalling and communications systems, electrification, and depot equipment, as well as platform screen doors at four stations. Siemens also will supply a fleet of 19 Avenio low-floor LRVs, which will be equipped with the Sitras HES system for catenary-free operation.

Each roof-mounted Sitras HES module combines a double-layer capacitor with a NiMH battery, allowing the vehicle to store both traction and braking energy. Power converters transform the three-phase current with a rated voltage of 11kV into the 750V direct current required for charging the energy storage unit. The system will complete its charging cycle in just 20 seconds, taking power from charging points installed at each of the line's 25 stations, which will be fed by centralised rectifier substations.

The LRVs will also be adapted to operations in high temperatures, with a powerful air conditioning system and sun shades to protect roof-mounted electrical equipment from radiant heat. The 27.7m-long vehicles will feature a 2.55m-wide bodyshell and will accommodate up to 239 passengers.

The line will open in autumn 2015, and is a core part of the Qatar Foundation's plan to develop a car-free site at Education City.

Tagged under Siemens Qatar Electrification Rolling stock News Middle East Light Rail

Supercapacitor light metro train unveiled

23 August 2012

CHINA: CSR Zhuzhou Electric Locomotive has unveiled a prototype light metro trainset which uses supercapacitor energy storage to operate without an external power supply.

Developed in conjunction with Chinese Academy of Engineering, the trainset has underfloor power pick-ups which are used to charge the roof-mounted supercapacitor unit from a fixed supply while the train is stood at a station. Charging takes 30 sec and can power the train for 2 km. Energy regenerated during braking is recovered for reuse.

The two-car articulated trainset which was rolled out on August 10 is designed for a maximum speed of 80 km/h, with an intended operating speed of 70 km/h. It is 2 650 mm wide, has a capacity of 320 passengers and is suitable for a minimum curve radius of 80 m.

The supercapacitor has a greater power density than lithium-ion batteries, and wireless operation is seen as a cheaper and less visually intrusive alternative to conventional electrification.

Commercial production is envisaged by 2014, with the manufacturer believing the technology could be viable for use in more than 100 smaller and medium-sized Chinese cities, as well as for the export market.

Related News:

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China Northern unveils 100% low-floor tram - 23.10.12
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Qatar Foundation awards €100m Doha tram contract - 30.07.12
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Rhein-Neckar Verkehr orders more supercapacitor trams - 05.04.11
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SuperCap tests complete - 18.03.08
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  Czech Railways finally takes over Railjet train order

Inside SWIMO, the Next-Generation Light Rail Vehicle

Rolling Smoothly with or without Overhead Wires

Electric trains are more energy efficient and generate fewer CO_2 emissions than other types of transportation systems. Next-generation light rail vehicles (LRVs) have been gaining momentum around the world, thanks to their low-floor design and low noise levels, as well as passenger- and earth-friendly features.

Kawasaki's SWIMO* is an LRV powered by the Gigacell®, Kawasaki's proprietary nickel metal-hydride battery, and can operate without overhead wires. The SWIMO test vehicle employs a three-carbody, three-bogie articulated design to enable smooth curving as well as flexibility in car combinations.

The 15 m long vehicle features floors that have been made as low as possible near the door. The aisle width is 800 mm at its narrowest section, allowing for ample wheelchair access. The SWIMO has 28 seats and can carry 62 passengers as standard capacity.

*SWIMO stands for "Smooth-WIn-Mover." It's the realization of Kawasaki's vision for a vehicle that would provide a smooth riding experience with a seamless transition to non-electrified sections, and a win-win green transportation solution via Kawasaki's innovative rail mover technology.

Five-carbody articulated unit.

Car structure
The three-carbody, three-bogie articulated tram has bogies at both ends and in the middle, allowing for smooth operation even on narrow curves. The tram layout can be changed to any configuration. A five-carbody articulated unit (20 to 30 m class), for example, can be arranged with two bogies at both ends and two bogies in the middle, as shown in the illustration.

Passenger cabin
The floor height in the cabin sections is only 360 mm. The passenger cabins at both ends have completely flat floors, providing maximum flexibility in seating arrangements.

Roof Mounting major electric devices on the roof makes SWIMO's low-floor design possible.

Charge/discharge control system
The control system, developed by Kawasaki, ensures a steady supply of power from the battery and effective use of regenerative power while controlling fluctuations in power consumption from overhead wires. On non-electrified sections the control system provides a steady supply of power from the battery when the tram is accelerating and returns regenerative power to the battery for maximum efficiency.

Braking system (regenerative brakes integrated with electronically controlled air brake system)
When braking, trains use their motor as a generator and return power to the overhead wires. This process, known as regenerative braking, is designed to enhance energy efficiency. Although power is returned to the overhead wires, transmission losses occur over long distances and if there are no other trains running nearby enough to use the regenerative power, it winds up being wasted. The SWIMO dramatically enhances energy efficiency by storing all regenerative power in its onboard Gigacell and then using it to power the motors when accelerating.

Illustration depicts the second SWIMO experimental prototype.

Door area
The car floors are only 330 mm off the ground at the door openings. SWIMO's 120 cm wide sliding double door is the widest LRV door in the world.

Middle bogie

Gigacell
The Gigacell battery installed under the seats has been downsized for railway car applications and upgraded for larger output. The Gigacell is an extremely safe nickel metal-hydride battery tailored to large-scale applications. It employs a unique structure developed by Kawasaki which prevents the battery from generating excessive heat or igniting, even after quickly charging and recharging a large amount of power.

Charging time
The Gigacell can be charged in only three to five minutes after the SWIMO has traveled 10 km. That's the same amount of time it takes to turn the LRV around at a terminal.

Testing at Kawasaki's Harima Works.

Trial run in Sapporo during winter.

Bogies at both ends
Kawasaki has developed compact bogies designed to fit under the driving cabs at both ends of the SWIMO in order to make the cabin floor flat. While this low-floor configuration would normally result in protruding wheels (conventional LRV wheels are generally 600 mm in diameter), the SWIMO circumvents this by reducing the size of the wheels on the second axle (the one farther from the operator's cab) to a diameter of 250 mm, as shown in the picture. The smaller diameter provides enough room for the flat-floor design and installation of doors over the wheels. The larger wheels have been placed under the operator's cabin along with the motor. While rail vehicles with wheels 360 mm in diameter or smaller have a history of derailing when switching tracks, Kawasaki has come up with a breakthrough development to keep SWIMO running safely on track. Kawasaki has conducted extensive testing on its state-of-the-art smaller wheeled bogie to ensure maximum safety.

Versatile operation
When operating in non-electrified sections, the SWIMO runs on its Gigacell batteries and returns regenerative power to the batteries when braking. Since the SWIMO is equipped with a pantograph, it charges the Gigacell while running on the power supplied from overhead wires in areas where they are available. There is no need for overhead wires when building new SWIMO lines or extending existing lines.

SWIMO blends in seamlessly with the cityscape
While overhead wires can mar the urban landscape, the SWIMO eliminates this concern and provides a more viable option for tourism planning.

KINKI SHARYO

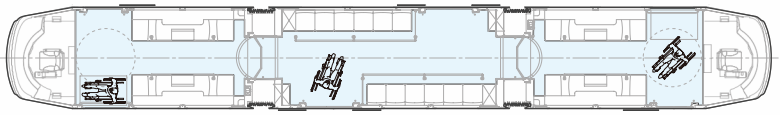
Vehicle Specification

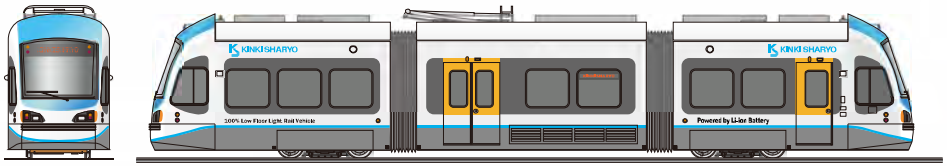
Tare weight (AW0)		32 t (70.5 klbs)
Capacity		106 (seated 28)
Dimensions	Carbody length	20000mm (65ft 7.4in)
	Carbody width	2650mm (8ft 8.3in)
	Carbody height	3800mm (12ft 5.6in)
	Truck center distance	10800mm (37ft 5.6in)
	Minimum aisle width	880mm (2ft 10.6in)
	Floor height (TOR)	360mm (1ft 2.2in)
	Ceiling height	2400mm (7ft 10.4in)
	Clear door opening Double door:	1220mm (4ft)
	Single door:	815mm (2ft 8.1in)
Track & Operating conditions	Maximum steep slope	6 %
	Horizontal curve radius (min)	18m (59ft)
	Vertical curve radius (min)	350m (1148ft)
	Catenary voltage (nominal)	DC750V
	Operating voltage range	525~900V
	Maximum service speed	8 0 km/h (50 mph)
	Acceleration	3.5 km/h/s (2.2 mph/s)
	Deceleration Normal:	4.8 km/h/s (3 mph/s)
	Emergency:	6.0 km/h/s (3.7 mph/s)

Propulsion control		VVVF inverter control (IGBT) with regenerative and rheostanic brake
Auxiliary power supply		AC440V-60Hz,DC24V
Battery equipment		Li-ion rechargeable battery 40kWh
Trucks	Wheel	Resilient wheel
	Wheel base	1800 mm (5.9ft 70.8in)
	Gear ratio	44/7 = 6.29
	Brake system	Spring applied hydraulic brake Electrical regenerative brake Track brake
	Motor	120kw x4, 550V, 2370rpm (self-cooling type)

LFX-300

100% Low-Floor Hybrid Streetcar
Powered by Li-ion Battery





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PHONE: 1-888-4-SHARYO (474-2796)
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LFX-300

100% Low-Floor Streetcar with Wireless Battery Power Propulsion System, the LFX-300 is user-friendly and environmentally responsible.

KINKI SHARYO

1 Wireless Hybrid System: Energy-Saving & Eco-Friendly

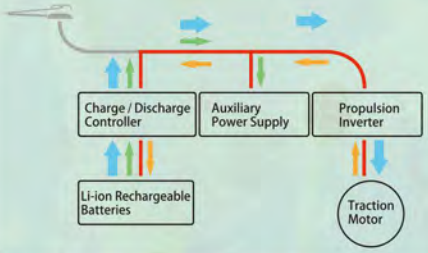
The LFX-300 operates using standard catenary electric power to recharge a set of Li-ion batteries. In a wireless operating segment, LFX-300 is powered by the batteries, which are then rapidly recharged when operating on catenary power and by regenerative braking.

Benefits: Downtown and historic landscapes remain beautiful and uncluttered by overhead catenary wires; vital in areas with aesthetic or historic preservation requirements. Clearances for overpasses, viaducts and city events are no longer hindered by overhead catenary wires. In addition, system developers can realize cost reductions by reducing wayside traction power equipment and maintenance.

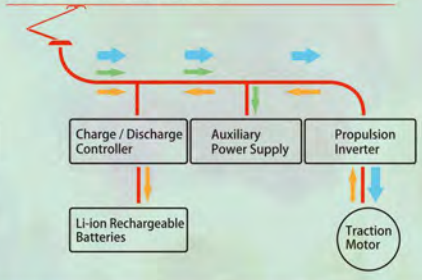
2 Designed for Customer's Needs

Designed from the ground up for compliance with ADA, Buy America, and NFPA-130 requirements, the LFX-300 will set a new standard for downtown surface rail operations with wireless battery power propulsion. LFX-300' s 100% Low-Floor configuration will maximize passenger loading and unloading allowing for higher frequency of operations. The whole floor is one level to allow all passengers (including wheelchairs, baby strollers, disabled, senior citizens and children) the ability to maneuver easily within the vehicle. Providing for level boarding without steps, the advanced Hydraulic Suspension System swiftly responds and adapts to floor height variations due to passenger load changes. The floor and platform always remain flush allowing passengers to board or exit swiftly and safely.

Battery Powered
Area Without Overhead Catenaries



Catenary Powered
Area With Overhead Catenaries



Eco-Friendly Sustainable Design

Meeting the highest standards for efficiency and quality, the LFX-300 offers safe zero emissions transportation and is built using materials and processes consistent with the latest international environmental standards.

ameriTRAM™

The 100% Low-Floor Streetcar Engineered for North America

KINKISHARYO
Engineering Sustainable Urban Transit

www.ameritram.com

ameriTRAM™

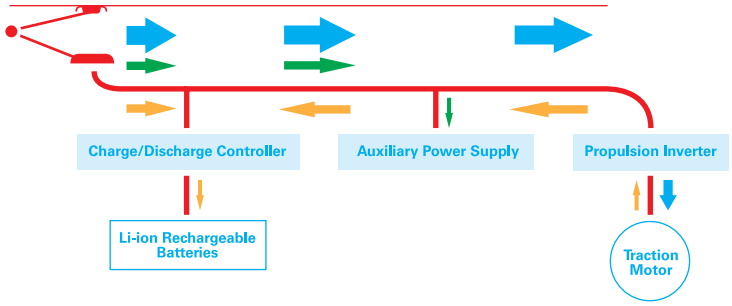
North America's 100% Low-Floor Streetcar

e-Brid™

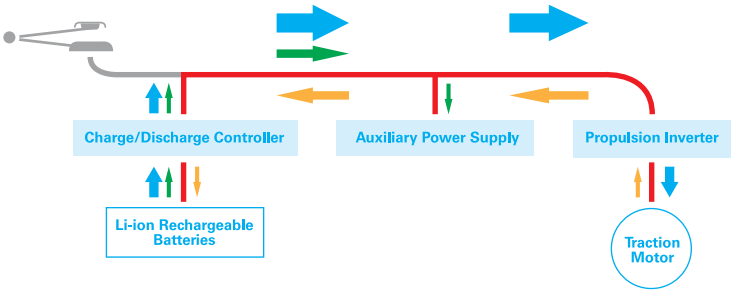
Electro-Hybrid Li-ion Battery Power Propulsion Technology

Through unique e-Brid ™ technology, *ameriTRAM ™* is propelled by overhead catenary or on-board lithium-ion batteries. e-Brid ™ charges the batteries while running on catenary power; and, when in battery mode, uses electricity stored from regenerative braking.

Powered by Catenary



Powered by Li-ion Batteries



Through e-Brid™ technology *ameriTRAM™* provides:

+ **Superior Versatility**
  Achieve propulsion where overhead contact wire cannot be installed

+ **Historic Preservation**
  Free downtown and historic areas of overhead wires

+ **Improved Aesthetics**
  Minimize environmental impact and improve visual aesthetics through wireless sections

+ **Reduced Energy Usage**
  Realize immediate savings though lower power consumption via "peak-shaving"

+ **Greater Value**
  Save millions in capital investment and operational costs with less electrification equipment and maintenance

+ **Enhanced Public Safety**
  Ensure safety of passengers in power outages or inclement weather

+ **Environmental Responsibility**
  Realize fewer greenhouse gas concerns through zero emissions and lower energy usage

Engineered For North America

ameriTRAM ™ is the only streetcar in North America that is compliant with ADA, Buy America, NFPA-130 and ASME RT-1

100% Low-Floor

With its 100% Low-Floor, *ameriTRAM* ™ offers:

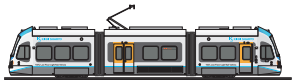
+ **Improved Passenger Safety**
  100% low-floor with no interior steps or ramps

+ **Superior Access**
  ameriTRAM ™ provides easier access and complies with all ADA requirements throughout the passenger area

+ **Greater Efficiency**
  Faster boarding means less dwell time at stations

Flexible Modularity

Expandable design allows for future system growth without increasing fleet size



ameriTRAM ™ 300

ameriTRAM ™ 500

ameriTRAM ™ 700

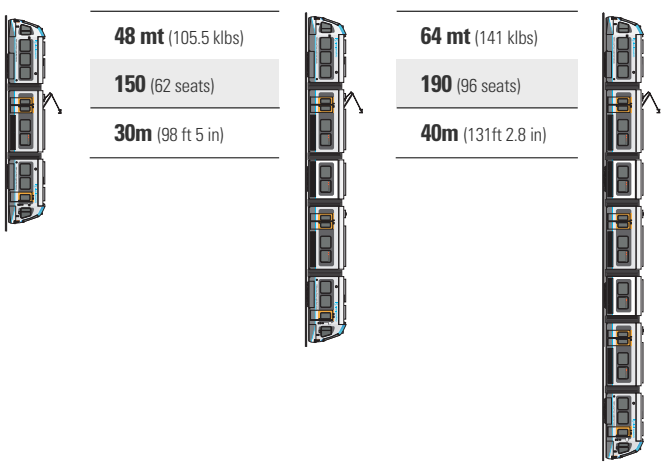
KINKISHARYO International, L.L.C. is the #1 supplier of low-floor light rail vehicles in North America.

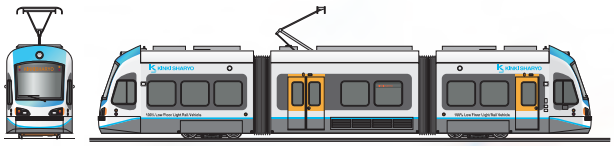
With the introduction of *ameriTRAM* ™, Kinkisharyo is the only light rail manufacturer to supply North America with a 100% low-floor, electro-hybrid, zero-emission streetcar powered by either overhead electric catenary or on-board lithium-ion batteries. Headquartered in Westwood, MA, KINKISHARYO has been redefining urban light rail transit systems throughout the U.S. for nearly three decades.

For more information on *ameriTRAM*™
www.ameritram.com

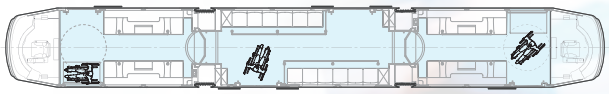
Vehicle Specification

ameriTRAM™		300	500	700
Empty Weight with e-Brid ™		**32 mt** (70.5 klbs)	**48 mt** (105.5 klbs)	**64 mt** (141 klbs)
Passengers (4/m2)		**115** (28 seats)	**150** (62 seats)	**190** (96 seats)
Primary Dimensions	Length over Anticlimbers	**20m** (65 ft 7.4 in)	**30m** (98 ft 5 in)	**40m** (131ft 2.8 in)
	Width of Carbody *	**2.65m/2.46m** (8 ft 8.3 in/8 ft 1 in)		
	Width of Thresholds *	**2.71m/2.52m** (8 ft 10.7 in/8 ft 3.2 in)		
	Height of Carbody	**3.8m** (12 ft 5.6 in)		
	Boarding Height	**350mm** (13.75 in)		
	Ceiling Height	**2472mm** (8 ft. 1.3 in.)		
	Clear door opening Double Door: Single Door:	**1220mm** (4 ft.) **815mm** (2 ft. 8.1 in.)		
Trucks	Truck Centers	**10.8m** (35 ft. 5.2 in.)		
	Wheel Diameter	**600mm** (23.6 in.)		
	Wheel Base	**1800mm** (70.9 in.)		
Operating Parameters	Maximum Grade **	**9%**		
	Minimum Horizontal Curve	**18m** (60 ft.)		
	Minimum Vertical Curve (+/-)	**350mm** (1150 ft.)		
	OCS Voltage (DC)	**750 nominal** (525-900 range)		
Performance	Maximum Service Speed	**80 kph** (50 mph)		
	Acceleration **	**1.3m/s²** (3.0 mphps)		
	Service Brake	**1.3m/s²** (3.0 mphps)		
	Emergency Brake	**2.3m/s²** (4.5 mphps)		
Primary Systems	Propulsion	**IGBT Inverter with VVVF Controls**		
	Friction Brake	**Hydraulic Disc**		
	Auxilary Power	**208vAC - 3phase - 60hz**		
	LVPS	**24vDC**		





***ameriTRAM*™** Streetcar, exterior



***ameriTRAM*™** Streetcar, interior

*Available in wide (LRV) or narrow (Streetcar) versions
**All axles powered

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E. businessdevelopment@kinkisharyo.com

For more information please visit
www.kinkisharyo.com
www.ameritram.com

KINKISHARYO
Engineering Sustainable Urban Transit

Genève tram trial assesses supercapacitor performance

07 August 2012

SWITZERLAND: Genève tram operator TPG is testing a prototype supercapacitor energy storage unit which allows braking energy to be recovered, and enables a tram to run for short distances without an external power supply.

The 1 tonne supercapacitor unit has been installed on the roof of one of a batch of 32 Tango trams being delivered to TPG by Stadler Rail. It can store the equivalent of the entire kinetic energy of an empty tram moving at 55 km/h, according to Stadler, and is more effective than batteries at absorbing and releasing the high short-term currents produced during braking.

Energy regenerated during braking is reused as the vehicle starts to move, when its power requirement is highest. The stored energy can also power the tram for at least 400 m if the overhead supply should fail. A distance of 1500 m has been achieved with careful driving under low-acceleration, low-speed test conditions.

The prototype is undergoing extensive testing by TPG, Stadler and traction equipment supplier ABB. Its energy consumption is being compared with the rest of the Tango fleet equipped for conventional regenerative braking which feeds current back into the overhead supply.

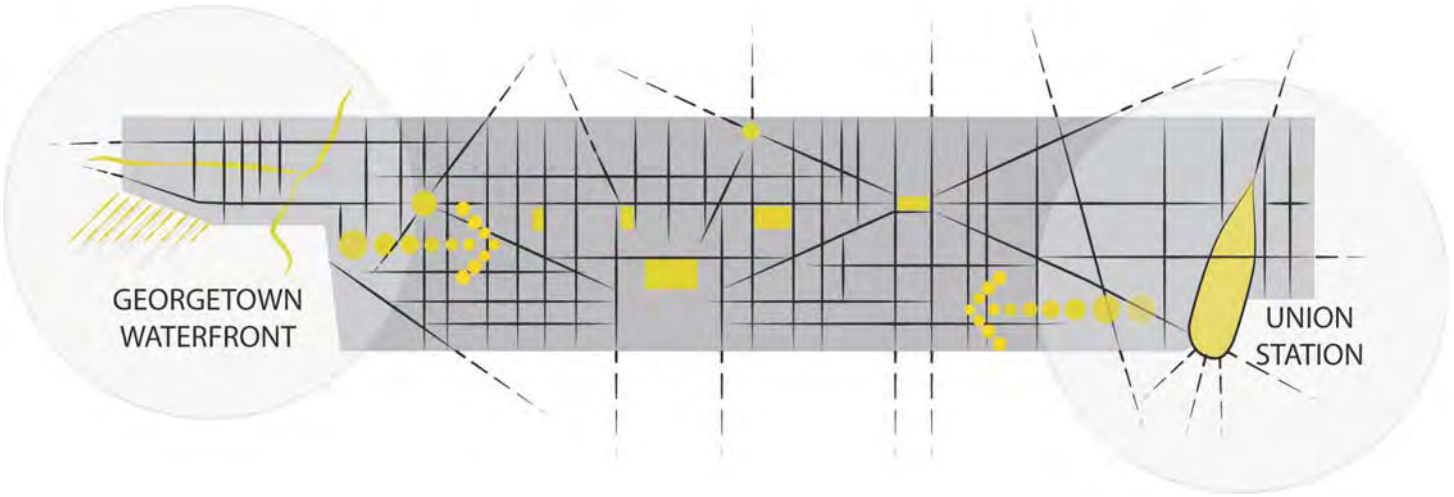
If the tests prove successful, the other 31 Tango vehicles for TPG could be equipped with supercapacitors 'relatively easily'.

Related News:

Alstom to test onboard flywheel energy storage - 18.01.13
European Commission backs regenerative braking R&D - 04.12.12
Supercapacitor light metro train unveiled - 23.08.12
Supercapacitor energy storage for South Island Line - 03.08.12
Zaragoza tram Line 1 enters service - 26.04.11
Rhein-Neckar Verkehr orders more supercapacitor trams - 05.04.11
Genève chooses the Tango - 26.01.10
Supercapacitors to be tested on Paris STEEM tram - 08.07.09
Ultracapacitors on test - 08.01.09
SuperCap tests complete - 18.03.08
Wayside and on-board storage can capture more regenerated energy - 02.07.07
Double-layer capacitors store surplus braking energy - 01.11.01

APPENDIX B

Technical / Informative Sessions with Car Builders



SIEMENS

SIEMENS

DC Streetcar Options for ESS

Richard Palmieri
Siemens Rail Systems – Regional Sales Director

Peter Tuschinski
Siemens Rail Systems - Strategy North America

Washington DC
April 3 2013

SIEMENS

Agenda

Confirm status of Streetcar Project DC
- Planning and timeline
- Status alignment
- Vehicles and options
- Critical Success Factors

Siemens S70 Streetcar
- Technology

Energy Storage for LRVs
- Baseline – options and technology
- Siemens References
- Energy Storage ‘made for the US’

SIEMENS

DC Streetcar Status

H Street / Benning and Anacostia Segments

- In construction with opening planned in 2014
- 2.75 miles
- Three Inekon T12 Streetcars
- Three additional Skoda T10 Streetcars on order
- Conventional overhead power

22 Mile Streetcar DBOMF

- Industry RFIs received
- Next action in segments or as P3?
- Requirements for off-wire operation – L'Enfant Plan

Georgetown Alternative Analysis

- Process and timeline discussion

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Siemens S70 Streetcar Technology
Specifications

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Siemens S70 Streetcar

Performance and Capacity

Maximum operational speed
35 mph
56 km/h

Passenger capacity:
60 seats
Approx. 195 total passengers @ 6 p/m²
4 wheelchair spaces

Catenary supply voltage:
750 Vdc

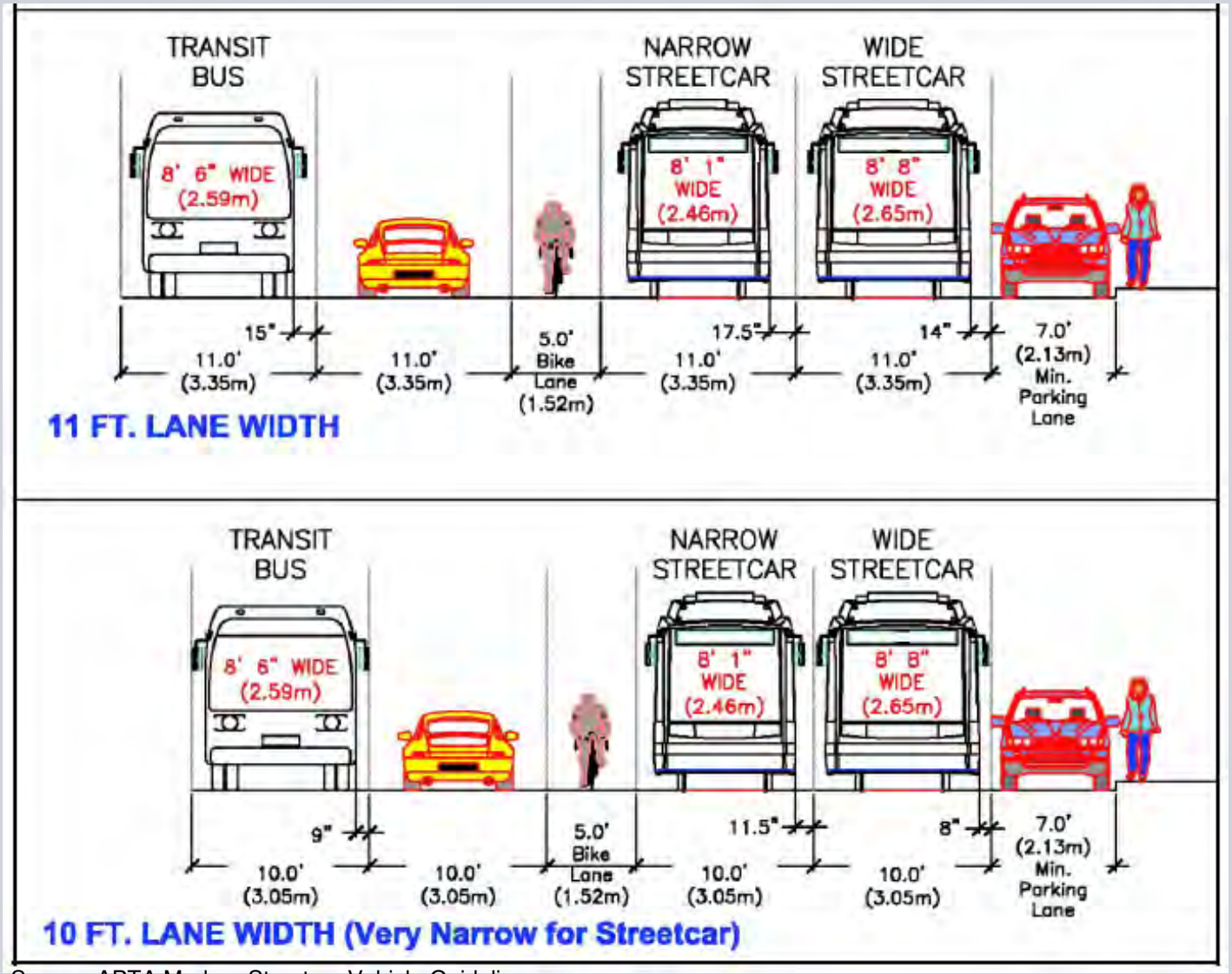
Length over anticlimbers:
79.1 ft
24110 mm

Width:
8.7 ft
2654 mm

Vehicle empty weight:
96,500 lbs (AW0)
43700 kg

Siemens S70 Streetcar
Urban Fit and Lane Width

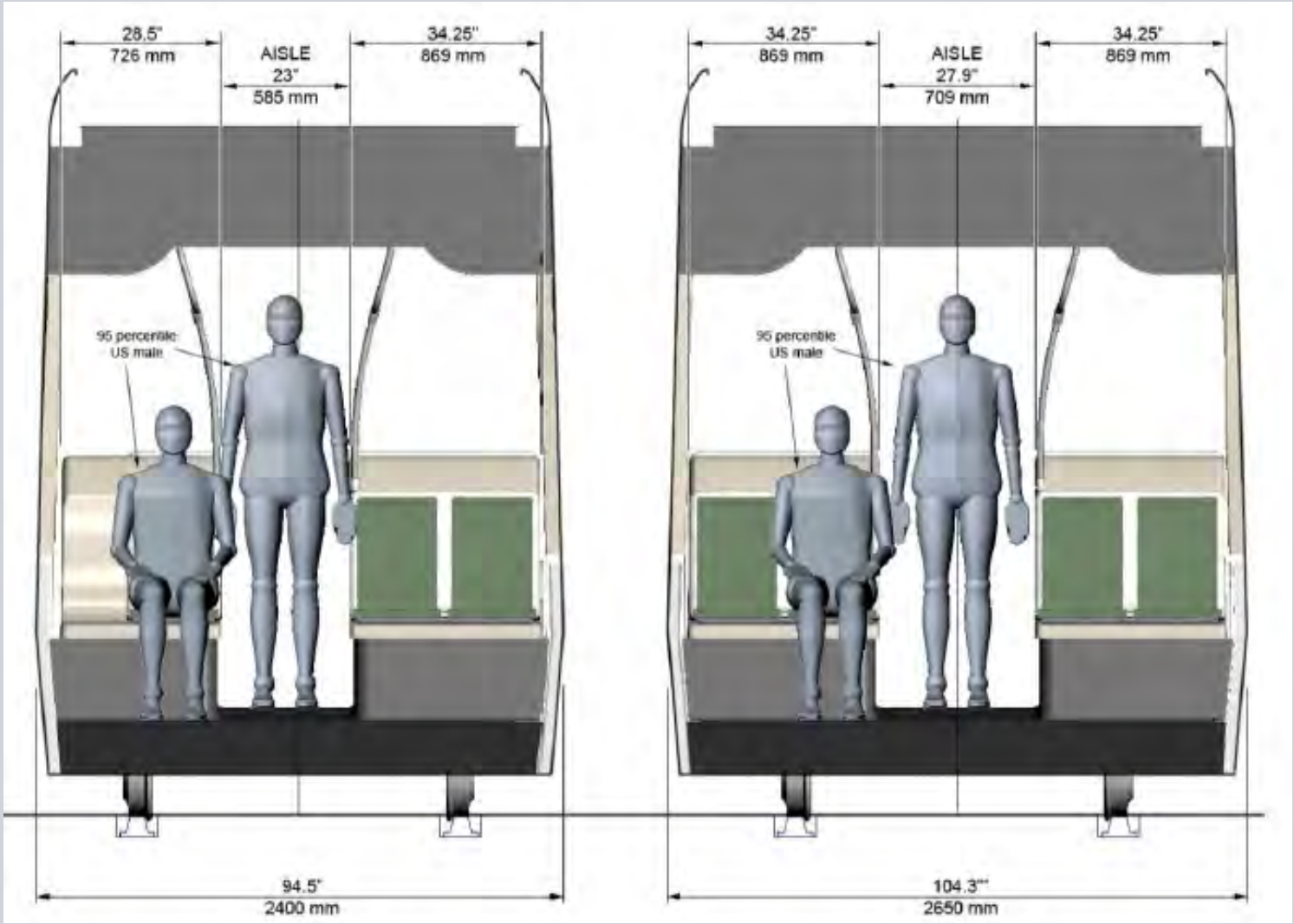
SIEMENS



Source: APTA Modern Streetcar Vehicle Guidelines

Siemens S70 Streetcar
Vehicle Width and Passenger Comfort

SIEMENS



Source: APTA Modern Streetcar Vehicle Guidelines

SIEMENS

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Electric cars
Recent breakthroughs leading to mass availability

SIEMENS

Timeline: The 100-Year History Of The Electric Car

November 21, 2011 4:31 AM

The electric car was just as popular as its gasoline counterpart when it first went into production around the turn of the 20th century. People loved it because it was much les advent of highways, they wanted to go farther than their battery life allowed, and the electric car fell out of use. Today, new electric cars in the market face a similar challenge range.

1890 1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010

hat was ...tia Air ...f of the ...2003, ...available ...in 2003, ...ject of ...s Car?

...ctric car

2006

A Luxury Market

In 2006, Tesla Motors (named after Nikola Tesla, an inventor who worked with Edison) unveiled the Tesla Roadster. Priced over $100,000, the car was meant for a high-income market and aimed to show off what an electric engine could accomplish. The company stopped taking orders for the car in 2011. A second-generation Tesla, with a starting driving range of 160 miles, will go on sale next year at around $58,000.

Enlarge

A Tesla Roadster at a flagship showroom in Los Angeles. (Mark J. Terrill/AP)

2010

The New Electric Generation

The all-electric Nissan Leaf went on the market in the fall of 2010. The Leaf can go up to 100 miles per charge and costs around $35,000. Nissan has sold more than 8,000 of the vehicles so far. Like other electric vehicles on the market (the Smart Fortwo, Chevy Volt and the coming electric Ford Focus), the Leaf faces similar problems to those that ailed electric cars at the turn of the last century: consumer desire for longer battery range and a less expensive product.

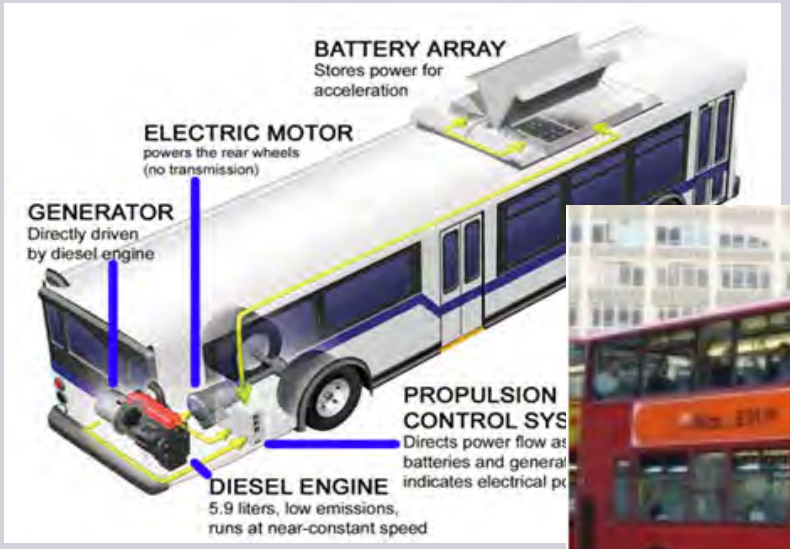
Enlarge

A Nissan Leaf charges at an electric vehicle charging station in Portland, Ore. (Rick Bowmer/AP)

Source : NPR.com

Transit : Hybrid Buses
Combining Diesel with electric propulsion

SIEMENS



Environmental

Innovation

Economic

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Key benefits of mobile Energy Storage Systems

Regenerative braking with ESS:

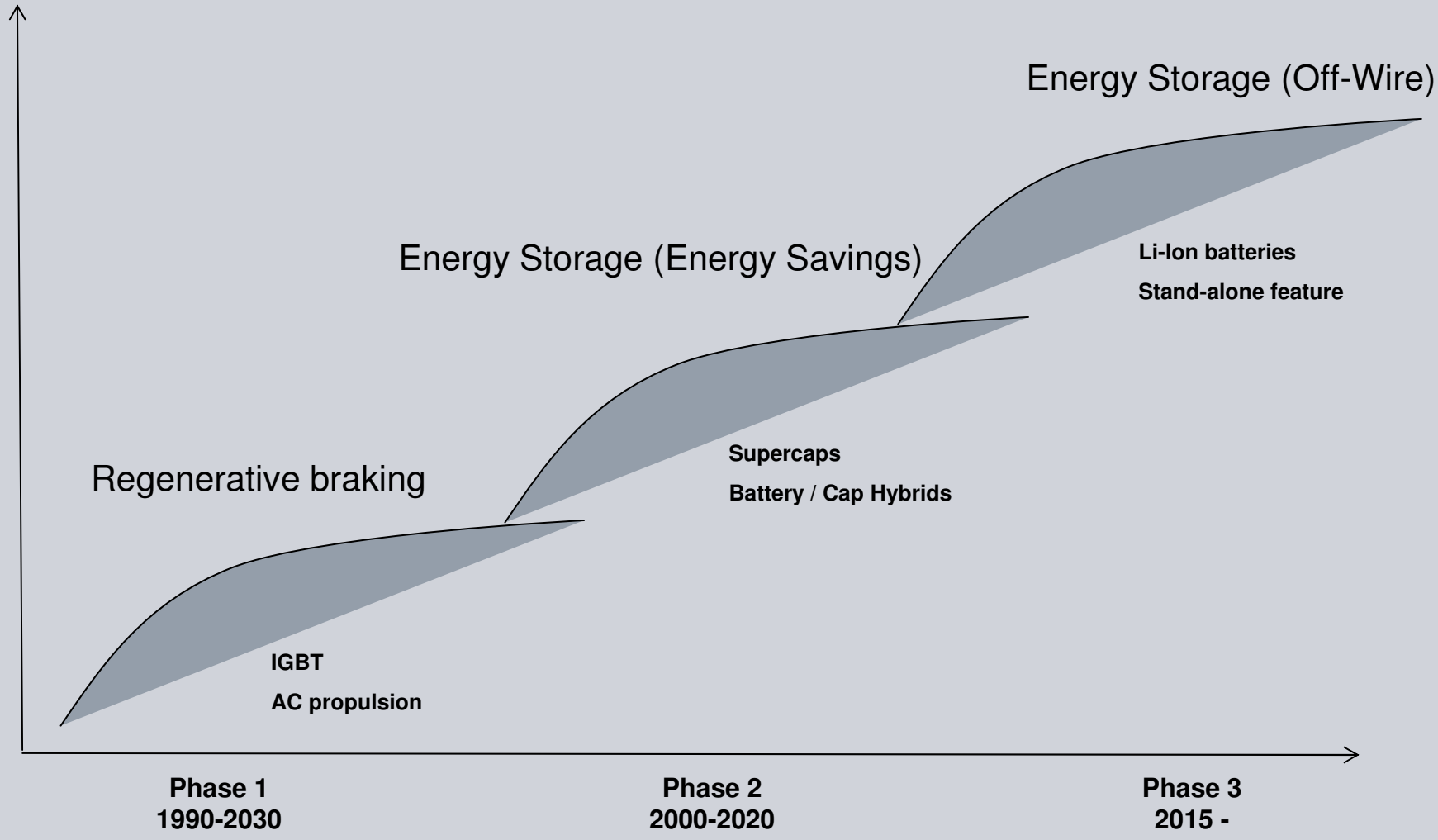
- Energy savings up to 30%
- Reduction of operating cost
- Reduction of CO_2 emissions
- Reduce use of expensive peak loads

Off-wire operating mode

- Short sections w/o need for electrification, i.e:
  - Tunnels or bridges
  - Intersections
- Aesthetic improvement in visually sensitive or historic neighborhoods

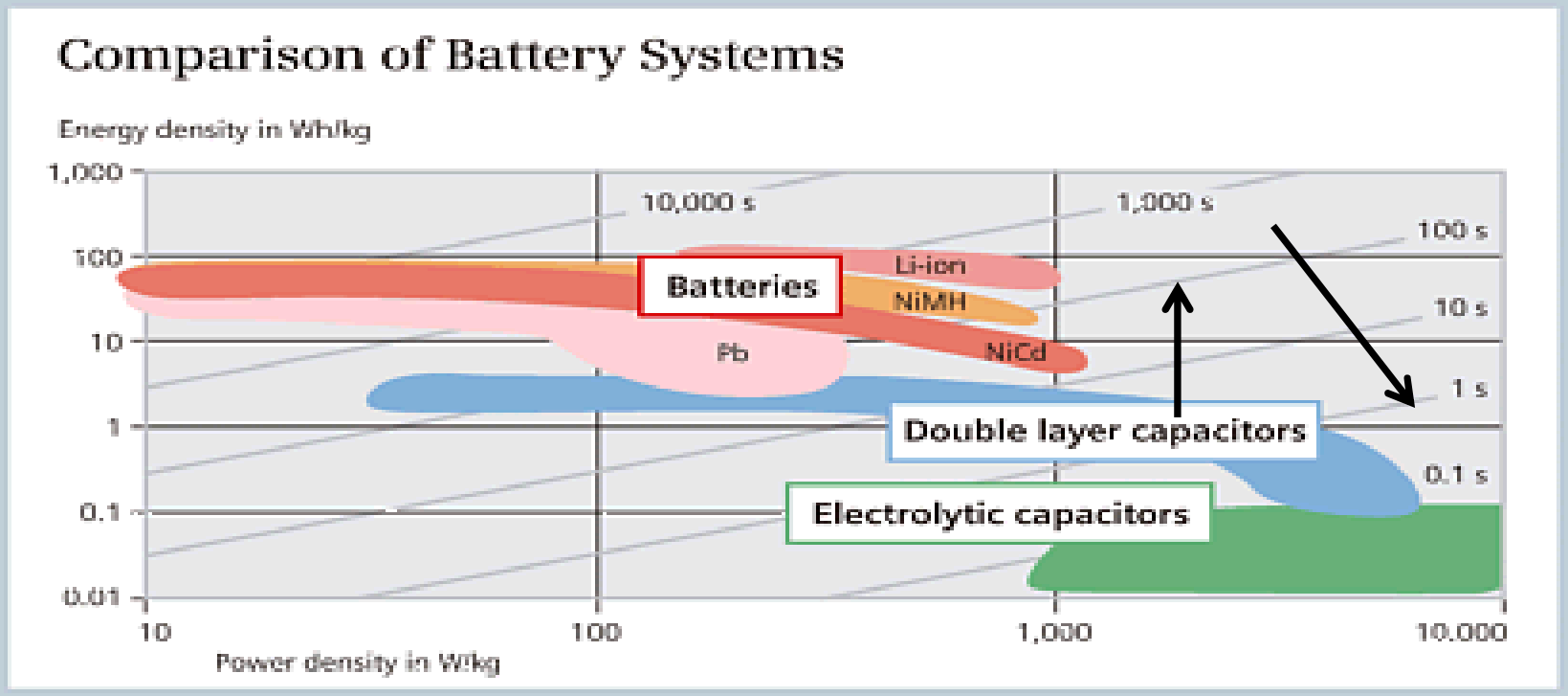
Electric Rail Vehicles: Energy SAVING Systems
Major Development Phases

SIEMENS



Batteries and Capacitors
Key technologies as enablers – view from 2007

SIEMENS



Battery type	Energy density Wh/kg	Power density W/kg	Service life in cycles / years
Lead-acid battery	30 – 50	150 – 300	300 –1,000 / 3 – 5
Nickel-metal hydride battery	60 – 80	200 – 300	>1,000 / >5
Lithium-ion battery	90 – 150	500 – >2,000	>2,000 / 5 – 10
Supercaps (double layer capac.)	3 – 5	2,000 – 10,000	1,000,000 / unlimited

SIEMENS

Availability and proven technology of storage modes for ESS

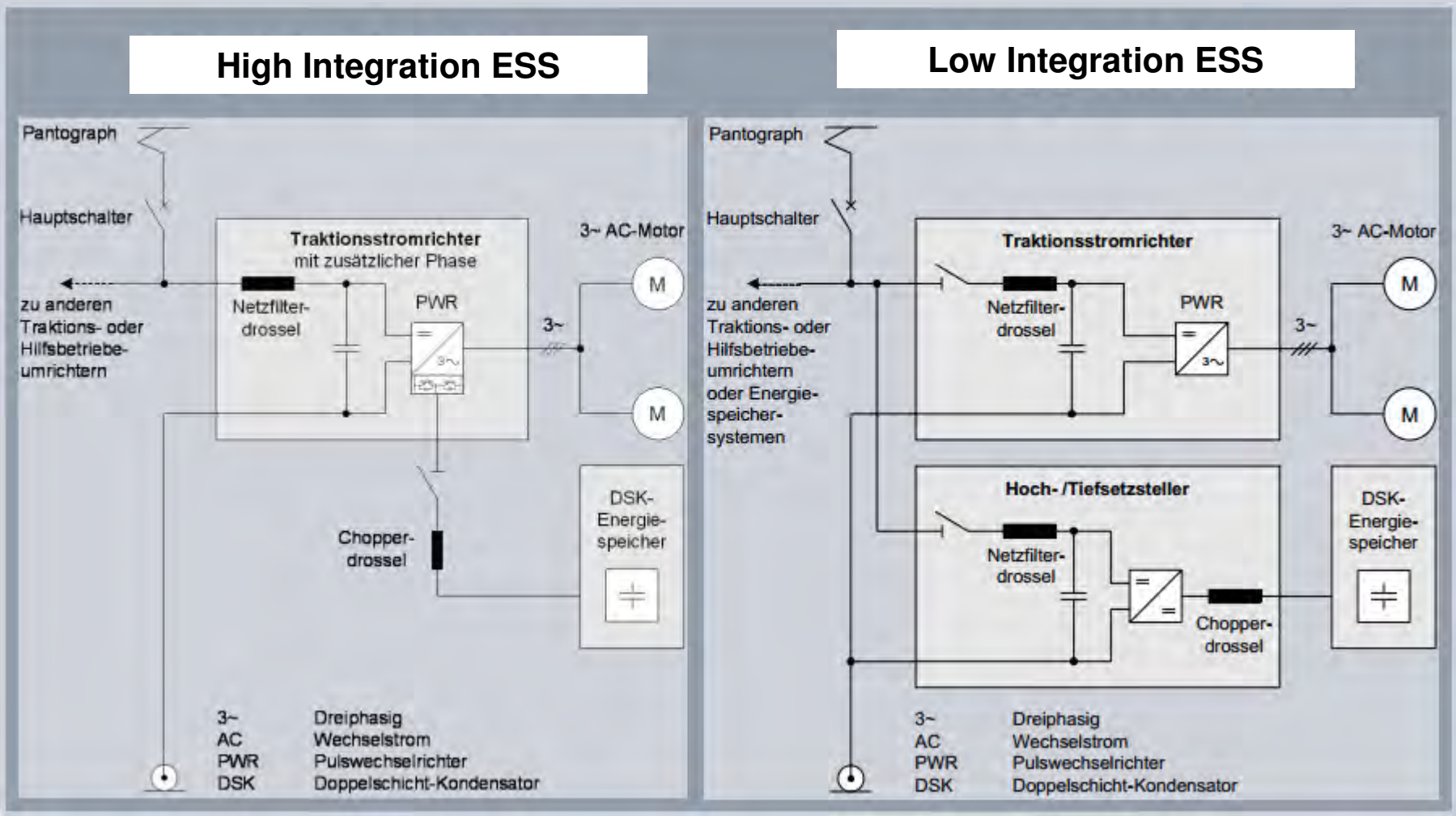
	Savings	Off-Wire	Tested	Cost
Supercaps	●●	○	●●	●
NiMH *(or other classic batteries)*	◖	◖	●	○
Hybrid	●●	●	●●	○○
Li Ion (assumed)	●●	●●	◖	●
Others *(off-wire only)*	*?*	●●	*?*	*?*

New development : Li Ion batteries for use in LRVs

- Demand through consumer goods, diesel hybrids and EVs
- Federal funding and recognition as green energy
- New chemistries

SIEMENS

High Level options for integration of ESS



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Berlin Lichterfelde 1881
The world's first electric tram

SIEMENS

- No overhead line
- Power supply via the rails

wg6

Slide 18

wg6 Fußzeile bitte nicht überdecken.
e09gunw0, 9/17/2012

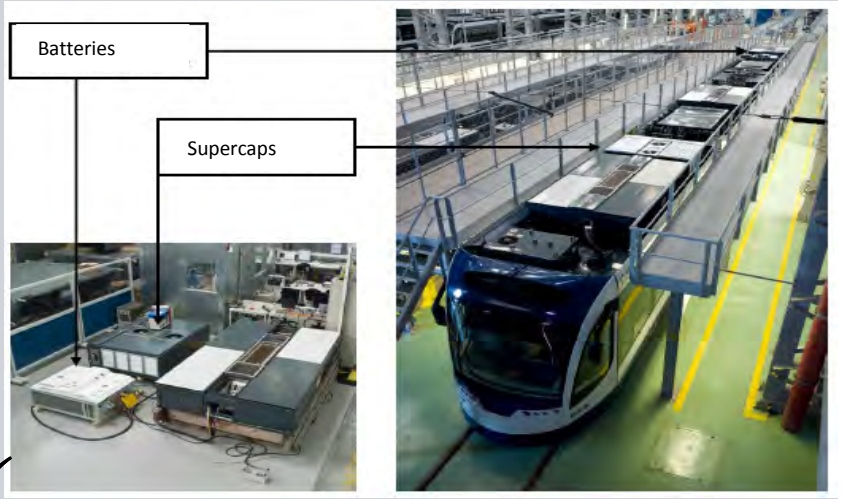
Hybrid ESS
Lisbon, Portugal

SIEMENS

Customer:	Metro Sul do Tejo, Almada, Portugal
Vehicle:	Combino Plus (2008)
Project:	24 100% low-floor , four-section trams
ESS:	Hybrid system (Caps and NiMH battery) Prototype with 2.8kWh energy content

Key benefits provided:

- Energy savings of more than 10%
- Reduced peak-demand
- Up to 1.5 miles of off-wire operation
- Availability >99.8%



Validated the engineering modeling assumptions ✓

Integrated Capacitor ESS
Innsbruck , Austria

SIEMENS

Customer: Innsbruck, Austria

Project: 32x ELIN EBG propulsion system (2010)

ESS: Capacitor based prototype with 0.4kWh
Highly integrated focus on Energy Savings

Key benefits provided:

- Energy savings of more than 10%
- Reduced peak-demand
- Reduced voltage drop along the overhead contact line
- Stabilized traction power supply

Validated the engineering modeling assumptions ✓

Qatar Education City 2015
The world's first completely catenary free tram system

SIEMENS

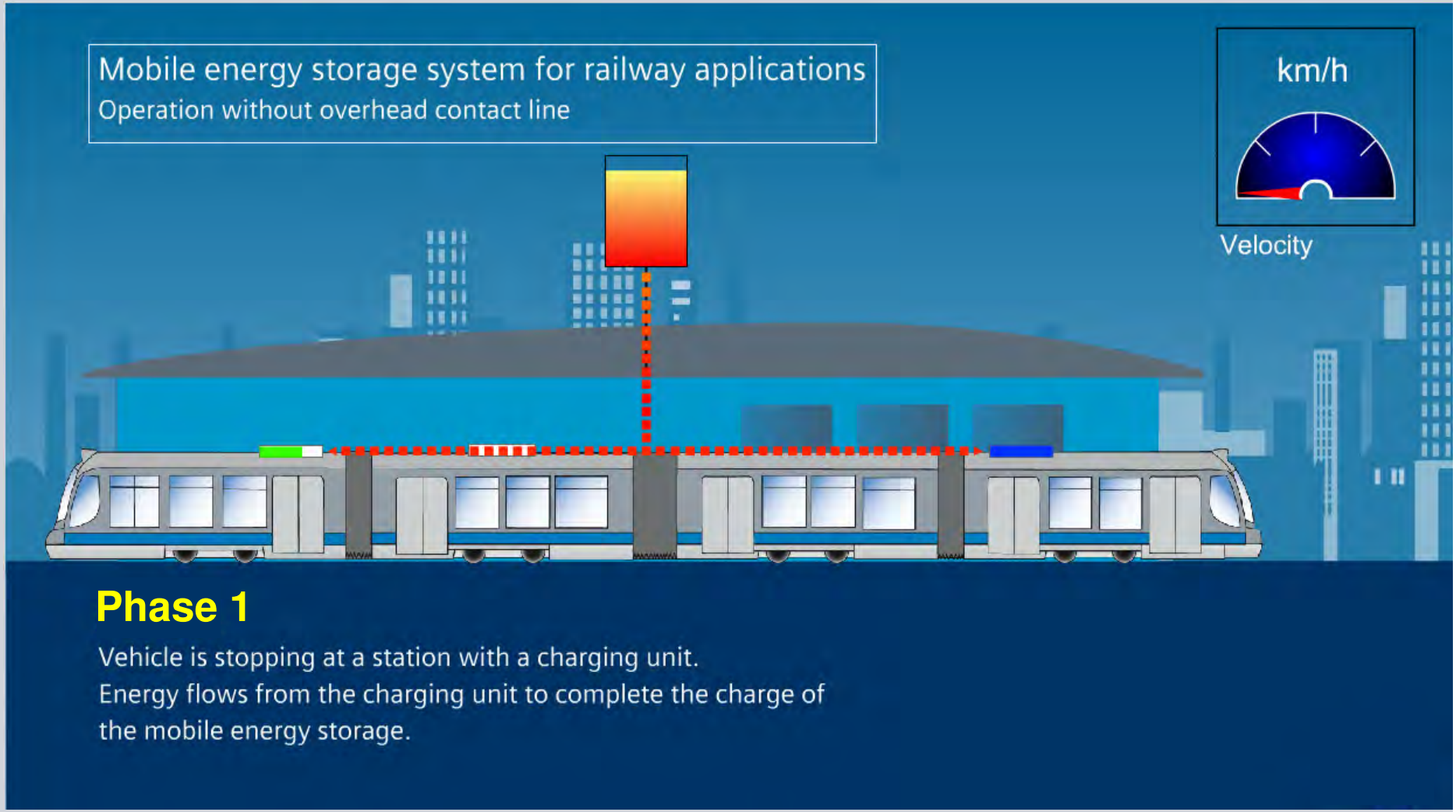
Education City: new university campus in Doha, Qatar, for 10,000 students.

Link of university facilities, cultural places and residential areas on the campus:

- 11.5 km of track
- 25 stations
- 19 Avenio trams
- Innovative NVC system (Non-Visible Contact line) avoiding catenary
- Siemens supplies complete turnkey tram system (except for civil works)

How is the Siemens Catenary Free Solution working?

SIEMENS



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Key considerations for ESS

Sizing of an energy storage system (ESS)

- Targeted for off-wire duties is X
  → Sizing for ESS for more than X
- Mitigate possible interference in operation
  → thus over sizing the ESS
- Factor: separation of right-of-way.

Separation ↑ Interference ↓ ESS sizing ↓

Real-life project specific energy savings will vary :

- 30% entirely possible
- Vehicles are operated in a network of other vehicles and alignments.
- Modern vehicles all have the ability to regenerative braking

Network complexity , size ↑ Potential for Energy Savings ↓

- Biggest benefit for starter lines with few vehicles and interconnected lines

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ESS
Barriers to widespread commercial breakthrough

SIEMENS

- ✓ Established technology
- ✓ High availability
- ✓ Promising results

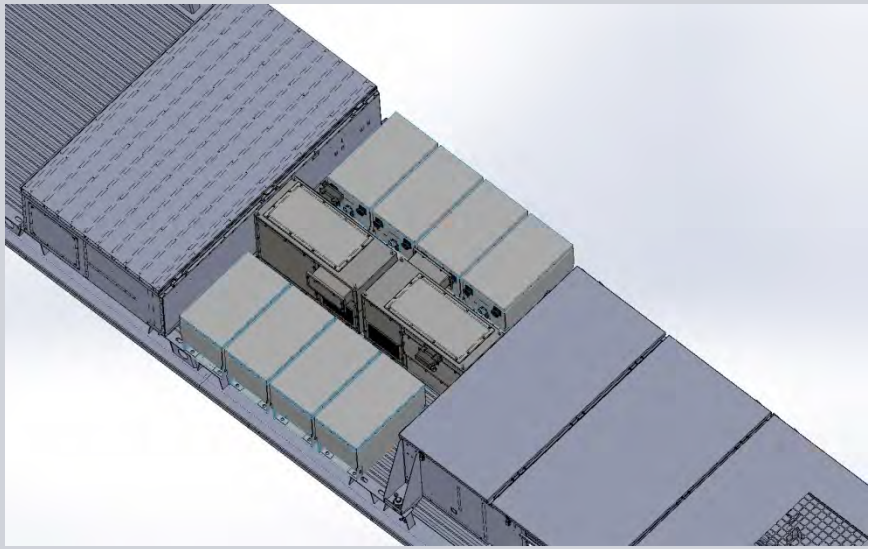
- Uneven technological readiness
  - •(Dis-) Charging parameters of batteries and capacitors
  - •Oversized and heavy batteries with concerning chemistries
- Return on Investment in large fleets unproven
- Lack of true ‘off-wire’ need in key transit markets

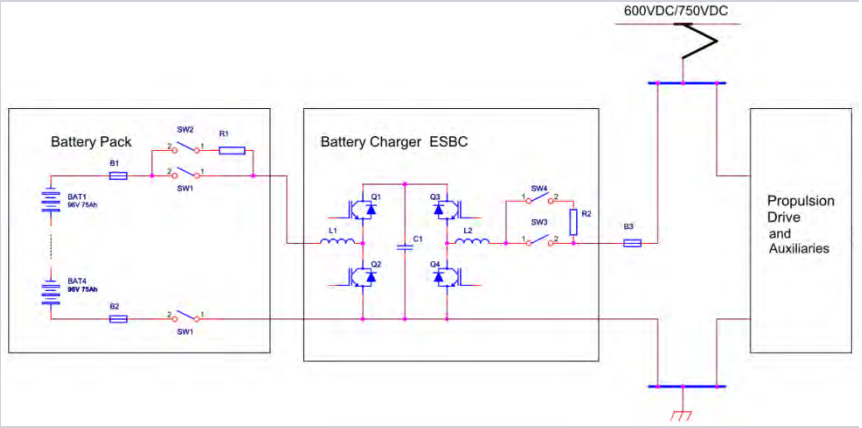
Early adopters accepting trade-offs in weight, functionality and ROI

SIEMENS

S70 Streetcar Energy Storage Concept

- Two energy saving battery (ESB) systems mounted on the roof connected to the vehicle 600/750 VDC power distribution.
- One ESB per traction container
- Batteries are away from the impacts of traffic accidents. The batteries far exceed LRV shock and vibration requirements
- Heating/cooling system will be provided to negotiate hot/cool and protecting batteries
- Estimated weight: 1170kg
- Estimated size: 52kWh
  The underlying sizing assumes a duty cycle of >2miles with multiple stops (target value)
  Real assessment of off-wire capabilities through proof of concept in summer 2013





Siemens Rail system
Creating a North American Energy Storage System

SIEMENS

Start-up systems
urban redevelopment

Ongoing improvement of
battery technology

Siemens
LRV market leader in North America
global portfolio
US specific requirements

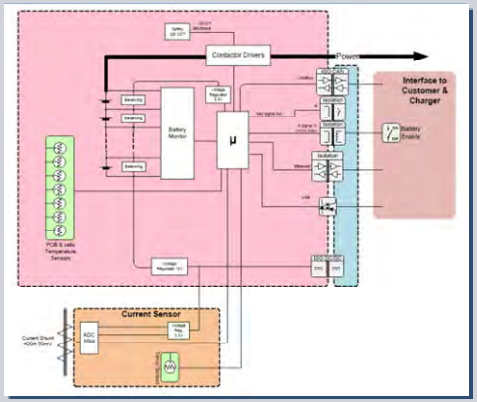
- Energy Storage System dedicated to the North American market:
  - Safe operation, low price point, ready for retrofits, targeted for US vehicles
  - Capable of energy savings and safely bridging alignment sections off-wire
- Proof of concept vehicle using the test track in the Siemens Sacramento facility : Summer ‘13
  - Energy saving mode
  - Off-wire operation

SIEMENS

Backup

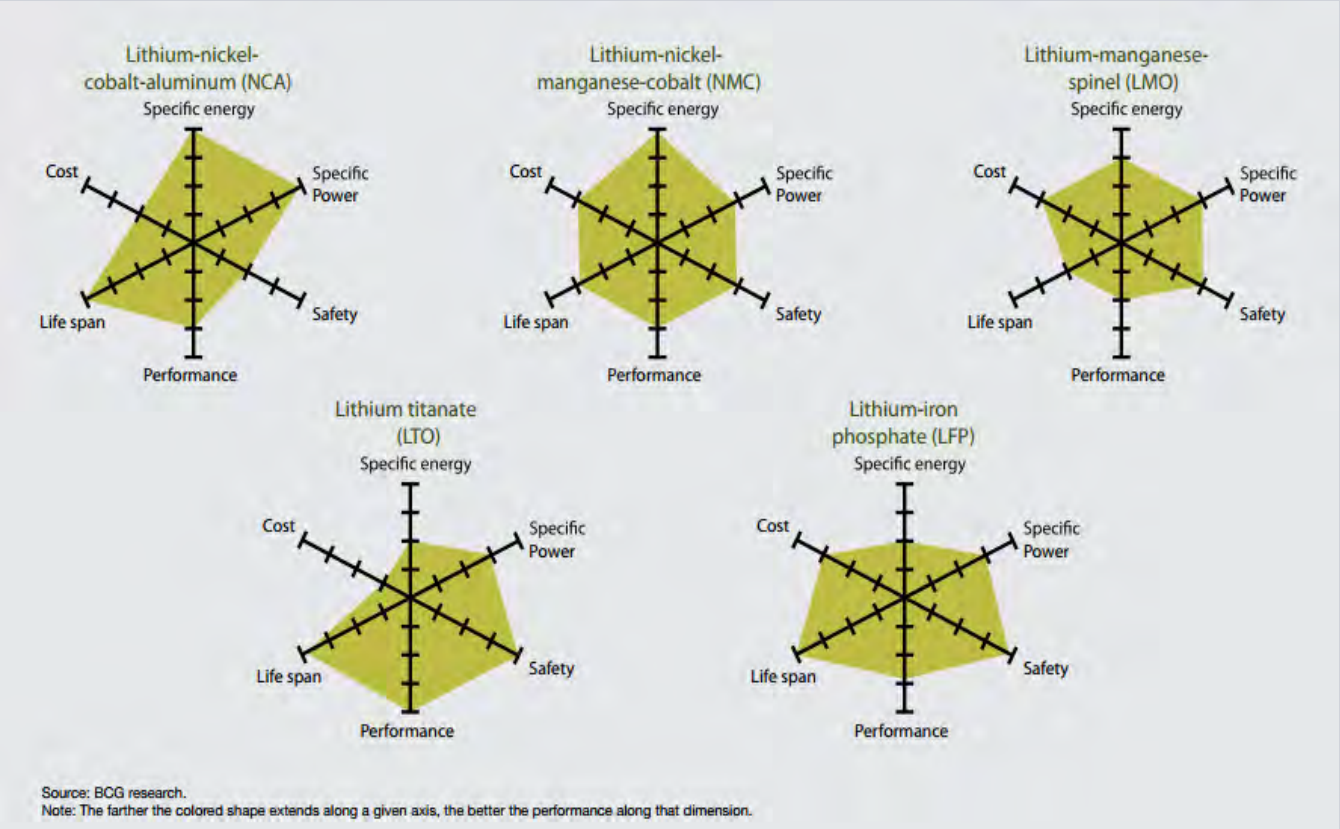
SIEMENS

Batteries : cells and BMS



SIEMENS

Battery Chemistries



Source: BCG research.
Note: The farther the colored shape extends along a given axis, the better the performance along that dimension.

Bombardier

WASHINGTON STREETCAR

JACQUES DROUIN
HAL LINDSEY
TIM DICKSON

BOMBARDIER
the evolution of mobility

AGENDA

1. OVERVIEW OF BOMBARDIER
2. GENERAL OVERVIEW OF THE FLEXITY FREEDOM LRV
3. FLEXITY FREEDOM OPTIONS PROCESS AND MOCK-UP
4. OVERVIEW OF BOMBARDIER SYSTEMS DIVISION
5. REVIEW OF THE SEM CONCERN
6. Q&A

BOMBARDIER

OVERVIEW

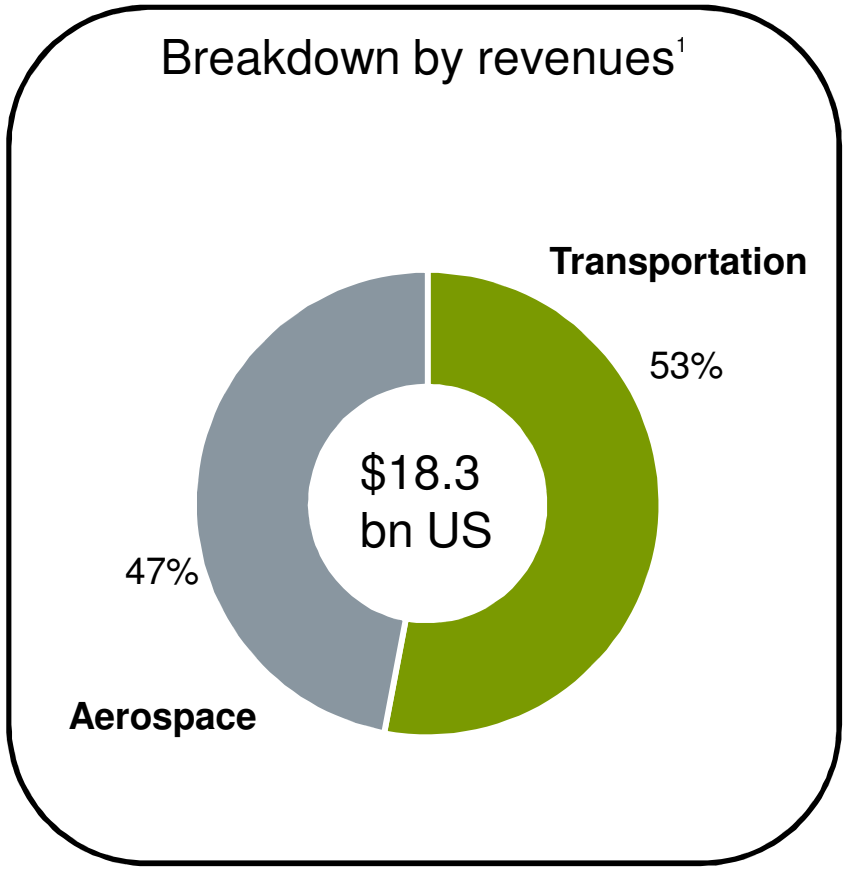
Bombardier is the world's only manufacturer of both planes and trains, with a worldwide workforce of 69,800 people.

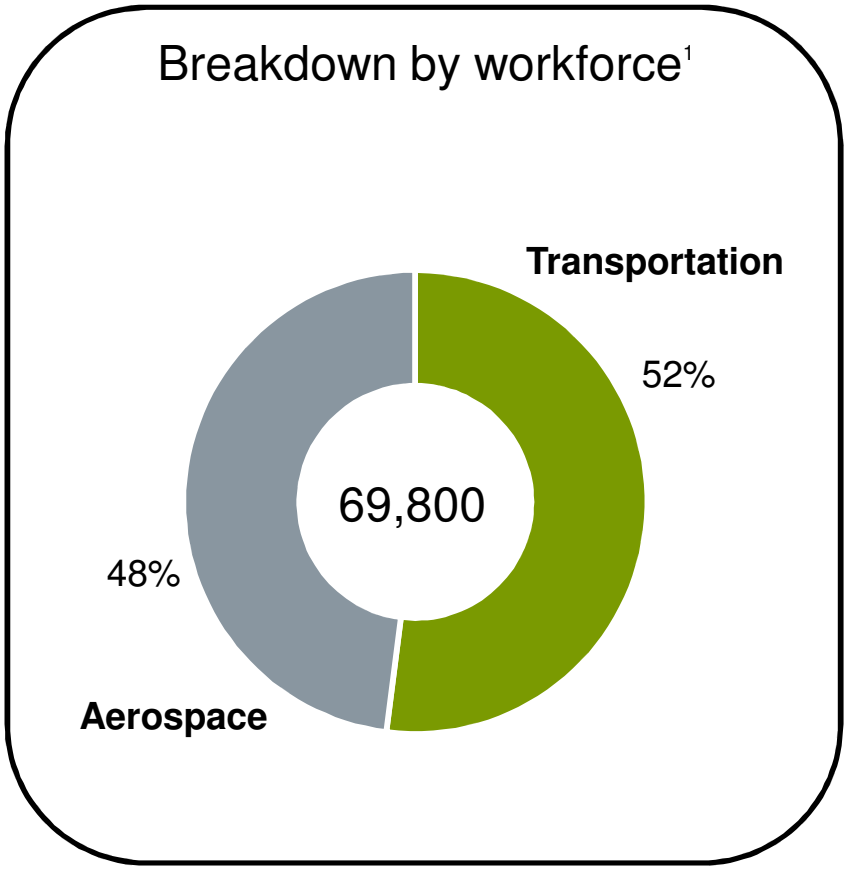
Bombardier is headquartered in Montréal, Canada. Our shares are traded on the Toronto Stock Exchange (BBD) and we are listed on the Dow Jones Sustainability World and North America indexes. In the fiscal year ended December 31, 2011, we posted revenues of $18.3 billion USD with 93% of revenues generated outside Canada.

BOMBARDIER
the evolution of mobility

BOMBARDIER

A DIVERSIFIED COMPANY





[1] for fiscal year ended December 31, 2011

BOMBARDIER
the evolution of mobility

Bombardier Transportation in North America

Manufacturing Capacity and Centers of Competence

Thunder Bay
Ontario, Canada

La Pocatière
Québec, Canada

St-Bruno
Québec, Canada

Mississauga
Ontario, Canada

Plattsburgh
New York, United States

Pittsburgh
Pennsylvania, United States

Kingston
Ontario, Canada

Sahagun and Huehuetoca
Mexico

Washington Streetcar

16 April 2013

BOMBARDIER
the evolution of mobility

2 Vehicles

8 ft 8 ½ x 99 ft (2.65 m x 30.3 m)
Bi directional
Status: **in final design**

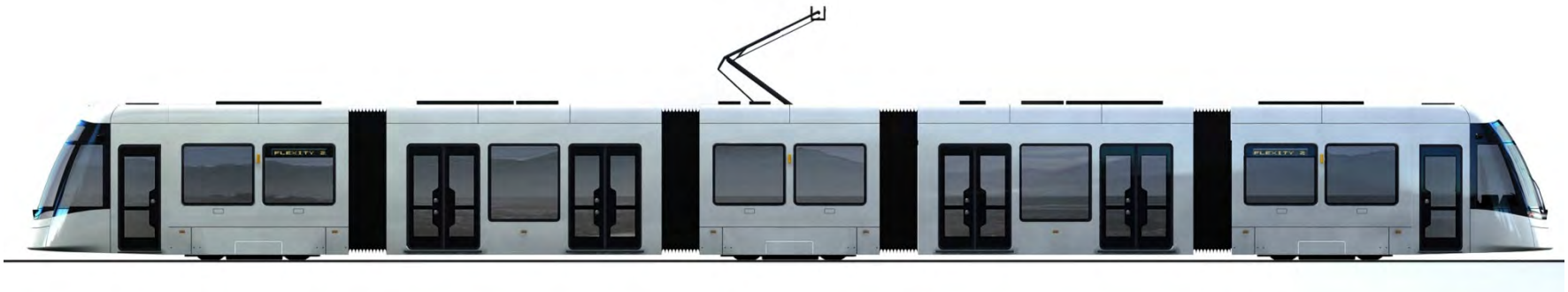
Above is the Flexity Freedom (NAFTA version of the Flexity 2)

BOMBARDIER
the evolution of mobility

BOMBARDIER *FLEXITY* 100% Low-floor trams

Main characteristics

Characteristic	Standardized platform vehicle for new and existing infrastructure
Vehicle concept	Multi-articulated vehicle
Width	2,3 m; 2,4 m and 2,65 m **(2.65 preferred for CFO)**
Bogie concept	Proven axle wheel set bogie with primary suspension and low unsprung mass
Gauges	1000 and 1435 mm
Motor technology	Water cooled asynchronous motors
Buffer load	400 kN
Carbody concept	Welded steel carbody
Bogie area – floor layout	6% longitudinal ramps over bogie, small platforms above bogie, 5% transversal ramps



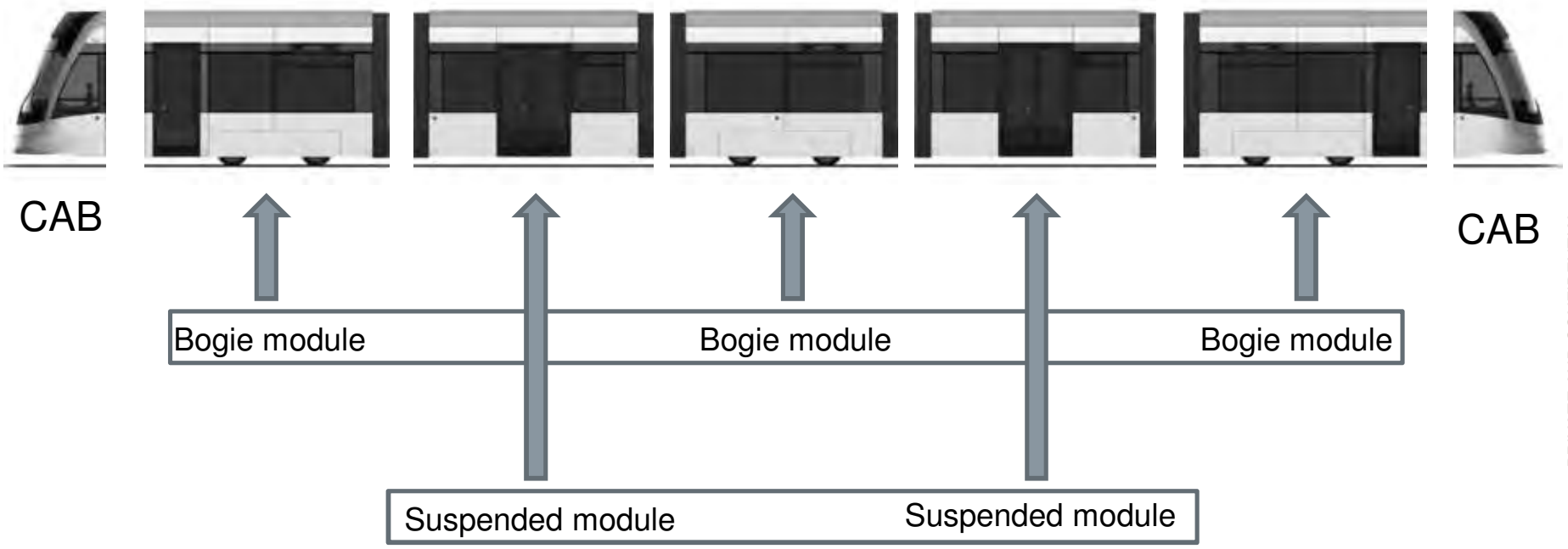
European Flexity 2, very similar design

BOMBARDIER
the evolution of mobility

2 Vehicle Features

- ✓ Modular design
- ✓100% low floor
- ✓Conventional axle bogies
- ✓Accessibility
- ✓ Vehicle dimensions
- ✓ Peformance
- ✓ Operation
- ✓Winter Operation
- ✓ Safety and CEM

2 Vehicle Features – Modular design



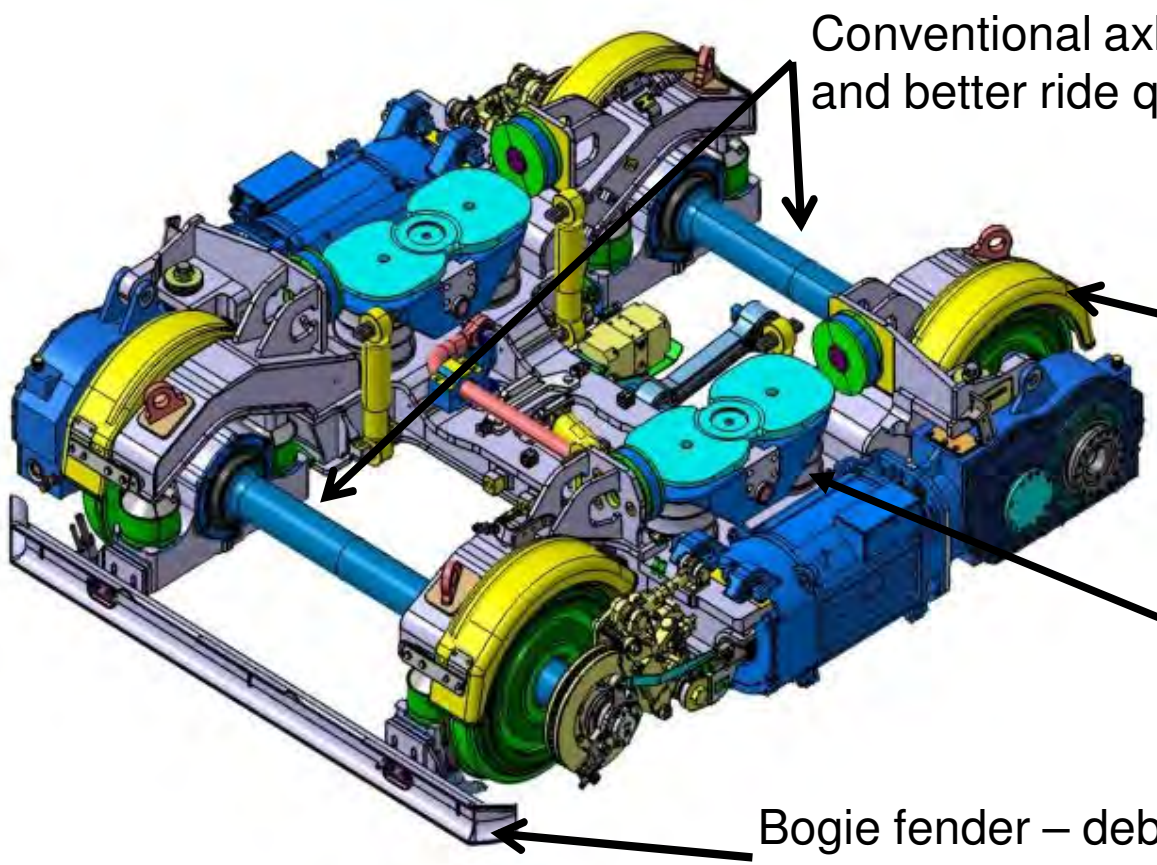
2 Vehicle Features – 100 % low floor

2 Vehicle Features – 100 % low floor

Easy boarding
through wide double doors

Minimal dwell time, more
efficient line

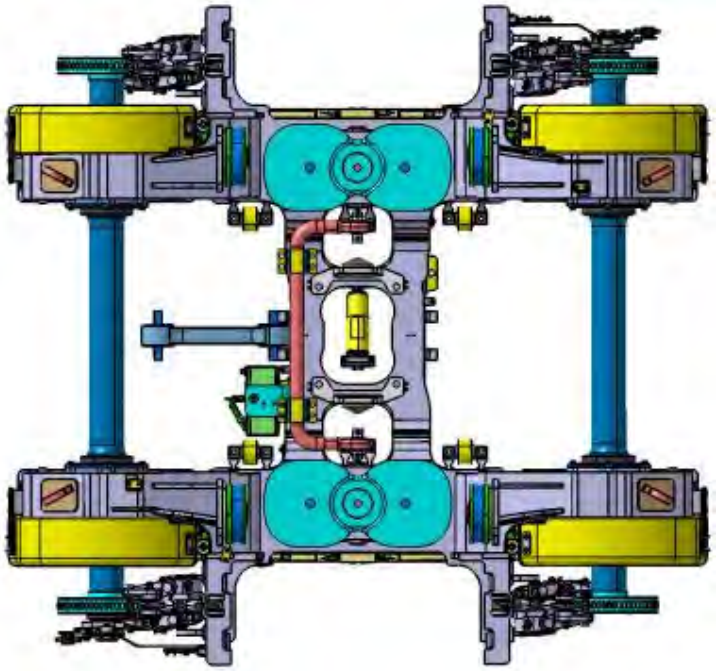
2 Vehicle Features – Conventional axle bogies



Motorized bogie

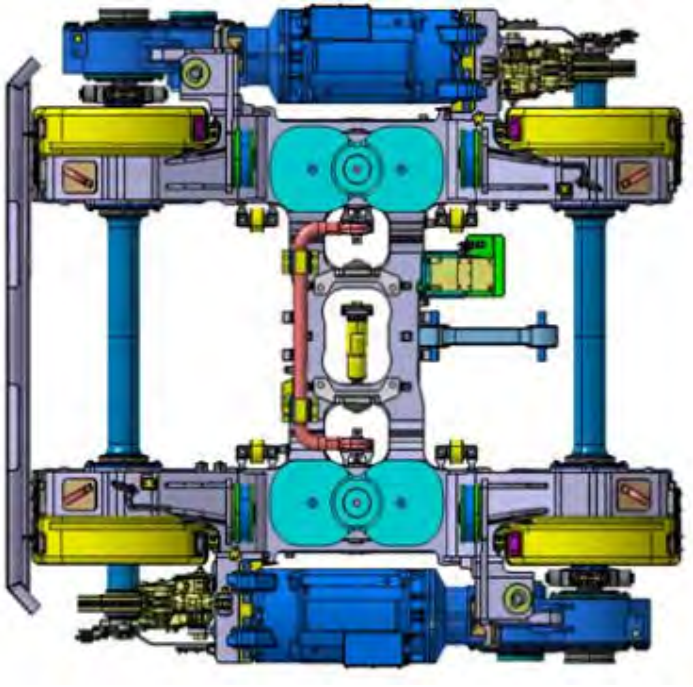
2 Vehicle Features – Conventional axle bogies

Four discs per truck
(2 per axle)



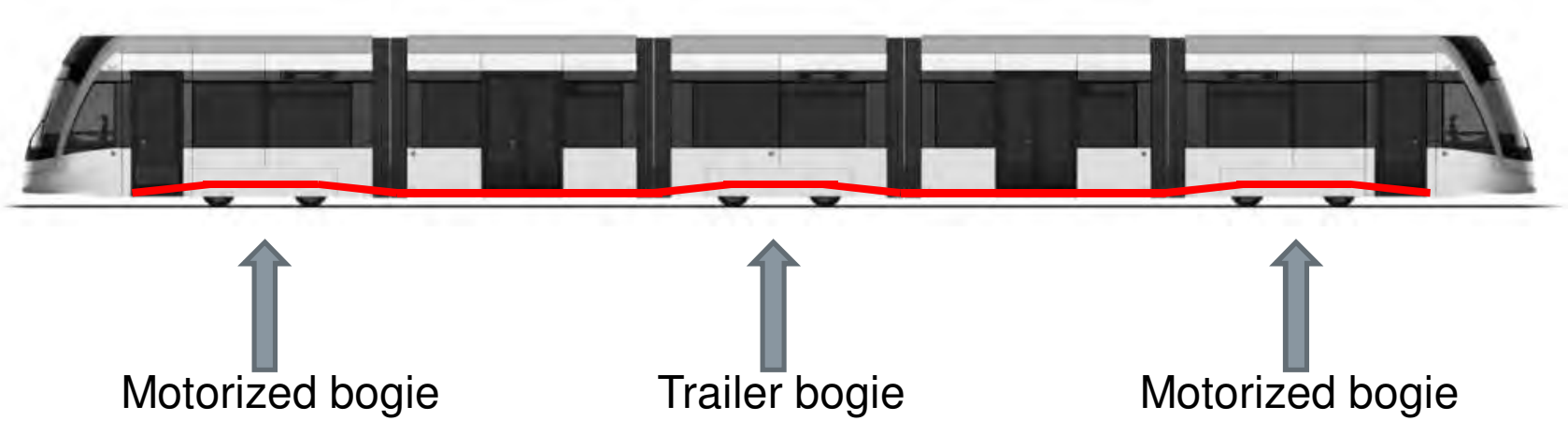
Trailer bogie

2 motors/2 gearboxes
2 discs per truck



Motor bogie

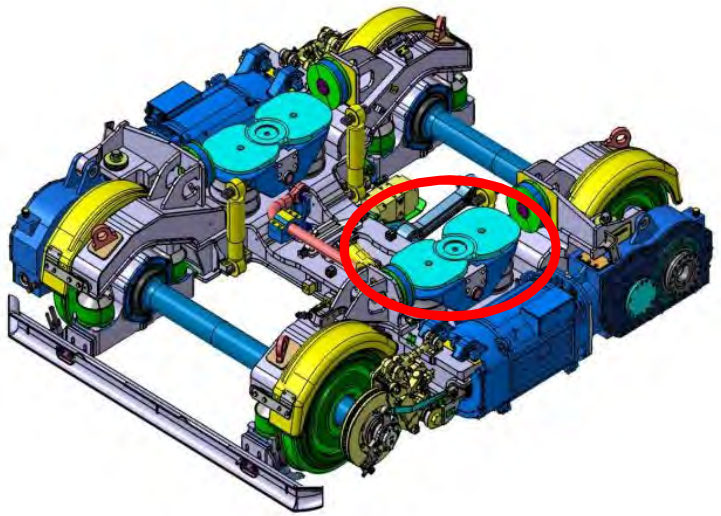
2 Vehicle Features – Conventional axle bogies



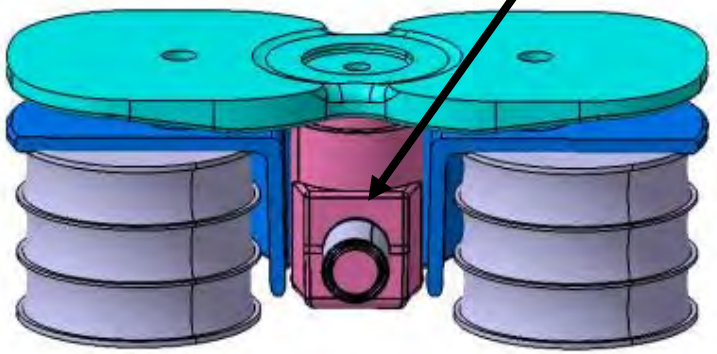
The floor is slightly raised to clear the bogie axles

The slopes remain within the prescribed limits of mobility impaired passenger requirements (ADA)

2 Vehicle Features – Accessibility – Car leveling



Hydraulic load leveling



2 Vehicle Features – Accessibility – Passenger doors

Opening inches	**31.5**	**51**	**51**	**31.5**

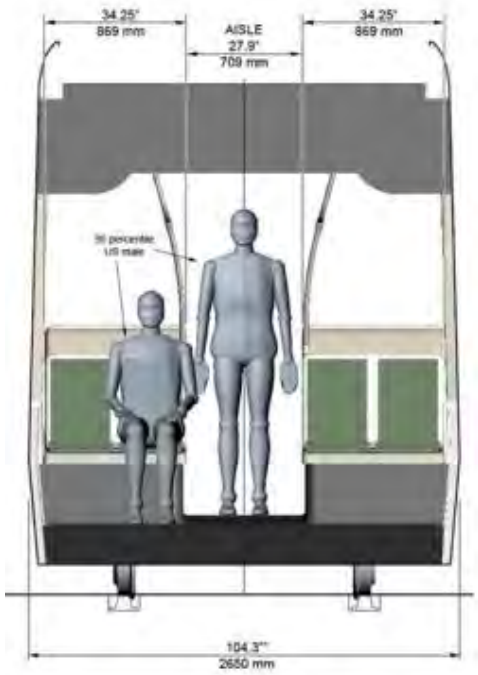
2 wider doors for the mobility impaired area
2 doors at the end to mimimize dwell time and ensure passenger flow
Configuration is suited for minimum dwell time while maximizing comfort

Doors are electrically operated slide and plug motion with obstruction detection:
-Better noise reduction inside
-Better climate control
-Aesthetically pleasing: flush with carbody

Bi-parting plug sliding door (double door) and door actuator

2 Vehicle Features – Dimensions

Length: 98 ft



Width is 8ft 8 in ½ (2.65 m), allowing for comfortable 2 x 2 seating

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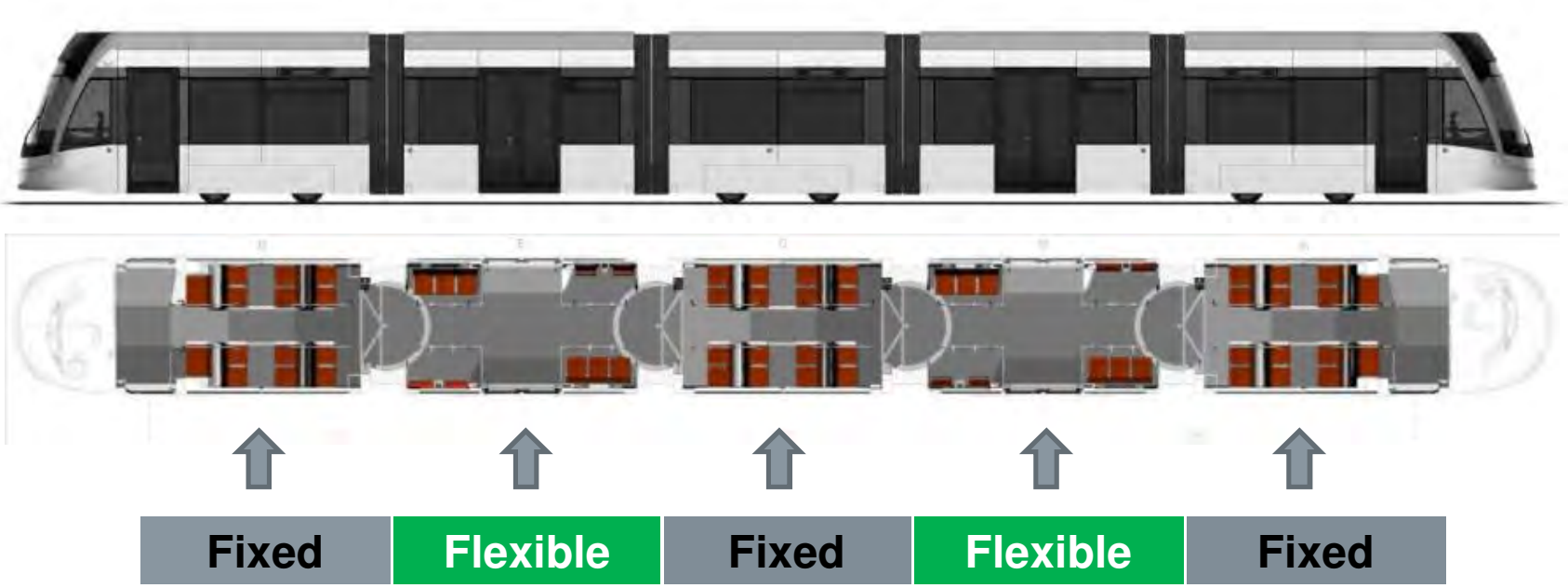
2 Vehicle Features – Dimensions



Fixed	Flexible	Fixed	Flexible	Fixed

Seating arrangement

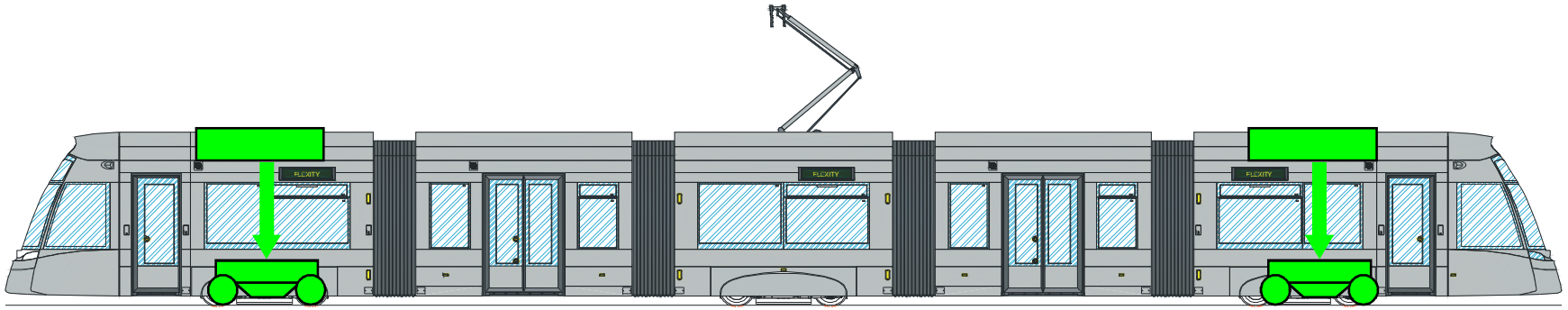
Seated	56
Flip up seats	8
Wheelchair areas	4
Standees	130 (4 pass/m²)

2 Vehicle Features – Peformance

Maximum service speed	80 km/hr	50 mph
Maximum acceleration	1.2 m/s²	2.7 mphps
Service deceleration	1.2 m/s²	2.7 mphps
Emergency brake rate	2.77 m/s²	6.2 mphps
Grade capability	6 % (250 m)	6% (820 ft)

Using Bombardier's service proven Mitrac propulsion package

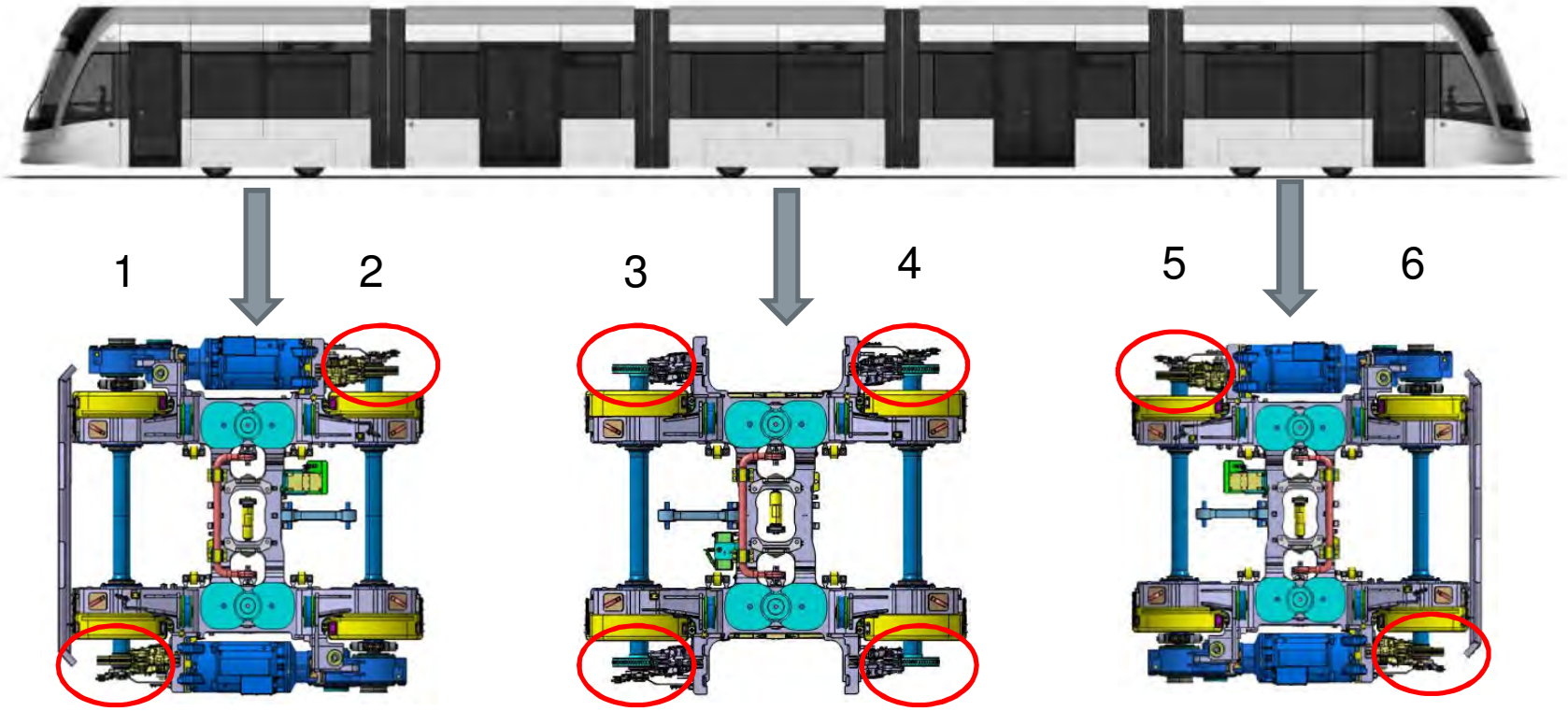
2 Vehicle Features – Performance - Propulsion



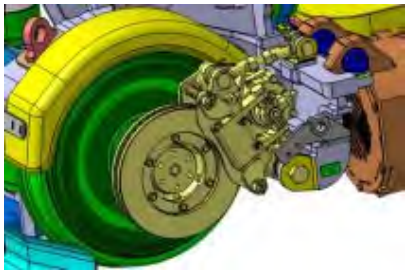
Mono Converter *MITRAC* TC 530 (13SG65)

- With one power module
  (one CM-H module)
- Capable to drive one bogie
  (2 motors)

2 Vehicle Features – Performance - Brakes



Hydraulic disc brakes – no susceptibility to humidity infiltration (winter)
Lighter and more compact



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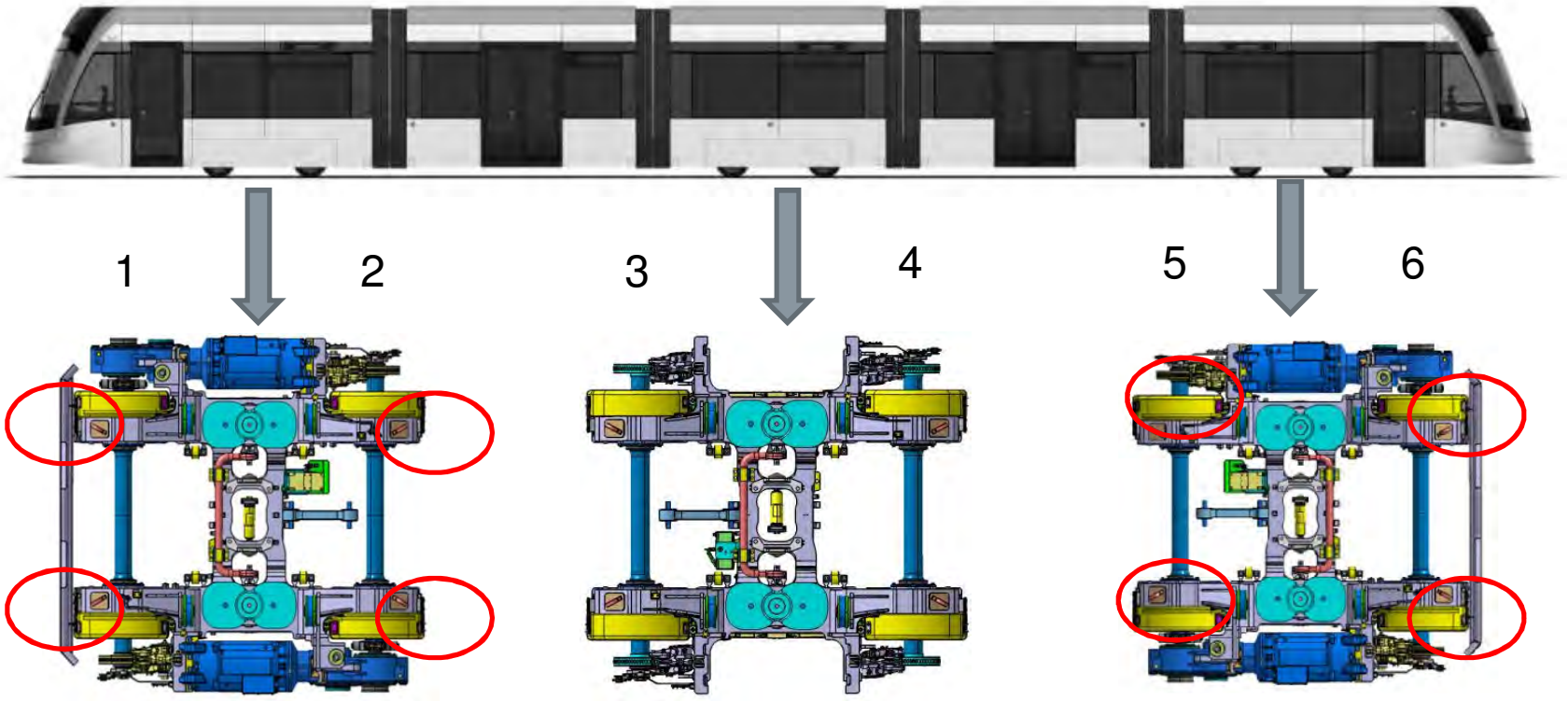
2 Vehicle Features – Performance - Brakes



Sanding nozzles are provided on axles 1, 2, 5 and 6
The sander itself is installed in the car and is pressurized

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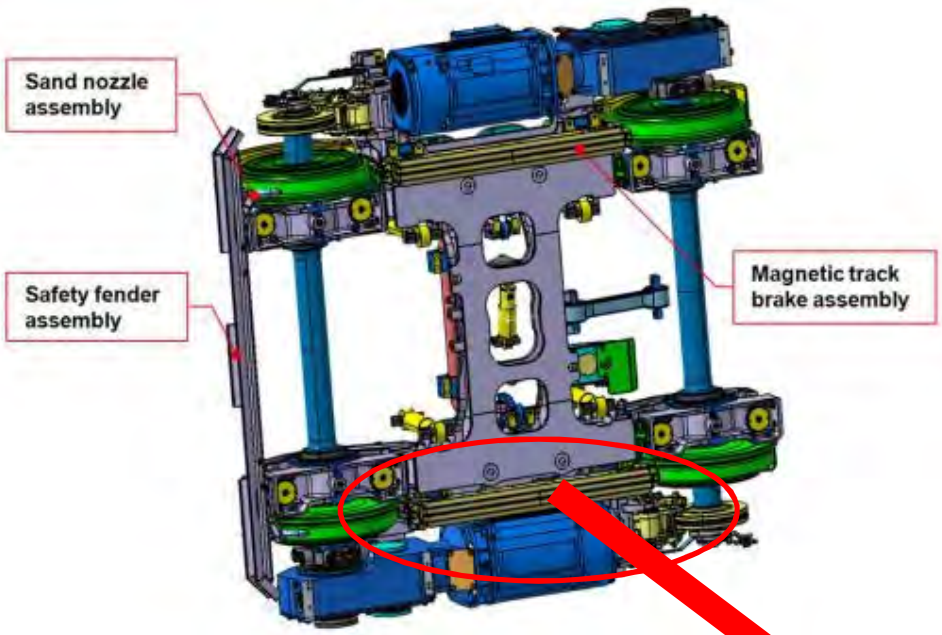
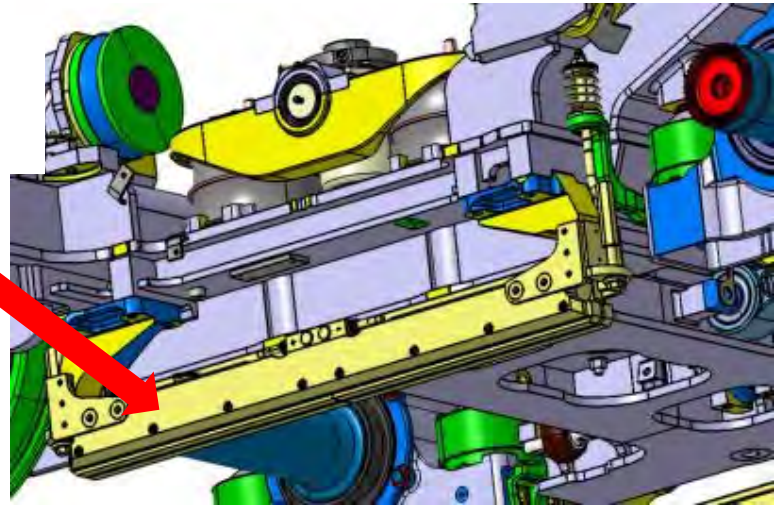
2 Vehicle Features – Performance – Track Brakes



Track brakes ensure an emergency stop should adhesion be lost



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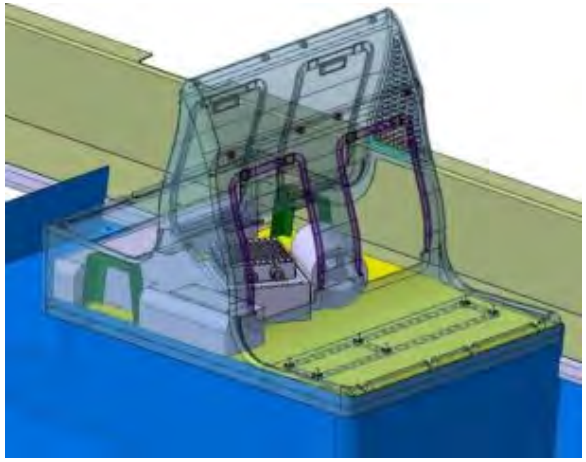
Full cab width at both ends, the vehicle is bi-directional

2 Vehicle Features – Operation - Winter

- Load cases for the vehicle structure allow for snow accumulation on the roof (14” or 355mm).
- Heated surfaces: door thresholds, coupler heads (mechanical and electrical), windshield, sanding ejectors.
- 28 KW of forced air floor heater (passenger area).
- Independent sanders are provided.
- Snow/debris fender on the leading axle of motor trucks.
- Bogies equipped with mud/snow guards.
- Stainless steel side and underframe structures



2 Visibility

The cab ergonomic study ensured maximum visibility for the driver while still allowing for the necessary structural strength to be built in.

Content

BOMBARDIER solution for CFO (Catenary Free Operation)

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Thank you

Washington

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