Importing solutions from the rail sector

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Designing fluidity

Agenda

1. **Alstom's Infrastructure activity**
2. Alstom's Infrastructure solutions portfolio
3. Key takeaways

Infrastructure solutions within Alstom

TRAINS

- Tram, metro, suburban/regional, high speed, very high speed, locomotive
- Components: traction, bogie, motor

46%

SERVICES

- Maintenance
- Modernisation
- Spare parts, repairs & overhaul
- Support services

22%

SIGNALLING

- Signalling solutions portfolio for:
  - Main lines
  - Urban
  - Control and security
- Sold as products or solutions

17%

INFRASTRUCTURE & SYSTEMS

- Turnkey integrated solutions
- Infrastructure solutions for electrification, track, depot and E&M equipment

15%

A group with annual sales of 6.9 B€

Note: all figures including the signalling activity recently acquired from General Electric

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A complete offer

Electrification

Feeding Systems

Third rail, overhead line equipment and catenary systems
(600 V DC to 2x25 kV AC),
APS (750V DC), SRS

Power Supply Systems

Substations, feeder and cabling

Track

Concrete slab tracks
for steel and rubber-wheeled trains

Infrastructure equipment

Depot equipment, tunnel ventilation, escalators, ticketing, platform screen doors

New lines, extensions | Refurbishment | Maintenance

Tramway | **Metro** | **Main Line**

Covering all infrastructure needs

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Infrastructure solution portfolio

Strong innovation and in-house capabilities

Active in-house R&D programmes on infrastructure products and solutions improving:

- Urban **insertion** and construction **time**
- Energy **efficiency**, CO_2 **footprint** and **overall performance**

FEEDING SYSTEMS

- APS
- SRS
- Cariboni Feeding Systems

POWER SUPPLY SOLUTIONS

- HESOP

TRACK SOLUTIONS

- APPITRACK
- NBT
- HAS

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From Rail to Road
Electric vehicles feeding & charging solutions

Dynamic continuous feeding

APS

- Power supply delivery to traction for tramway
- REX based on APS installed in 10 cities worldwide with over 22 million km run

APS for Road

- Power supply delivery to traction for road vehicle on Highway
- 300m demonstrator in Sweden (Gothenburg)

Stationary charging

SRS for tramways

- Power supply delivery for stationary recharge for onboard energy storage (tramway)
- 11km under construction (Nice)

SRS for buses

- Power supply delivery for stationary recharge onboard energy storage (ebus).
- Innovation under deployment

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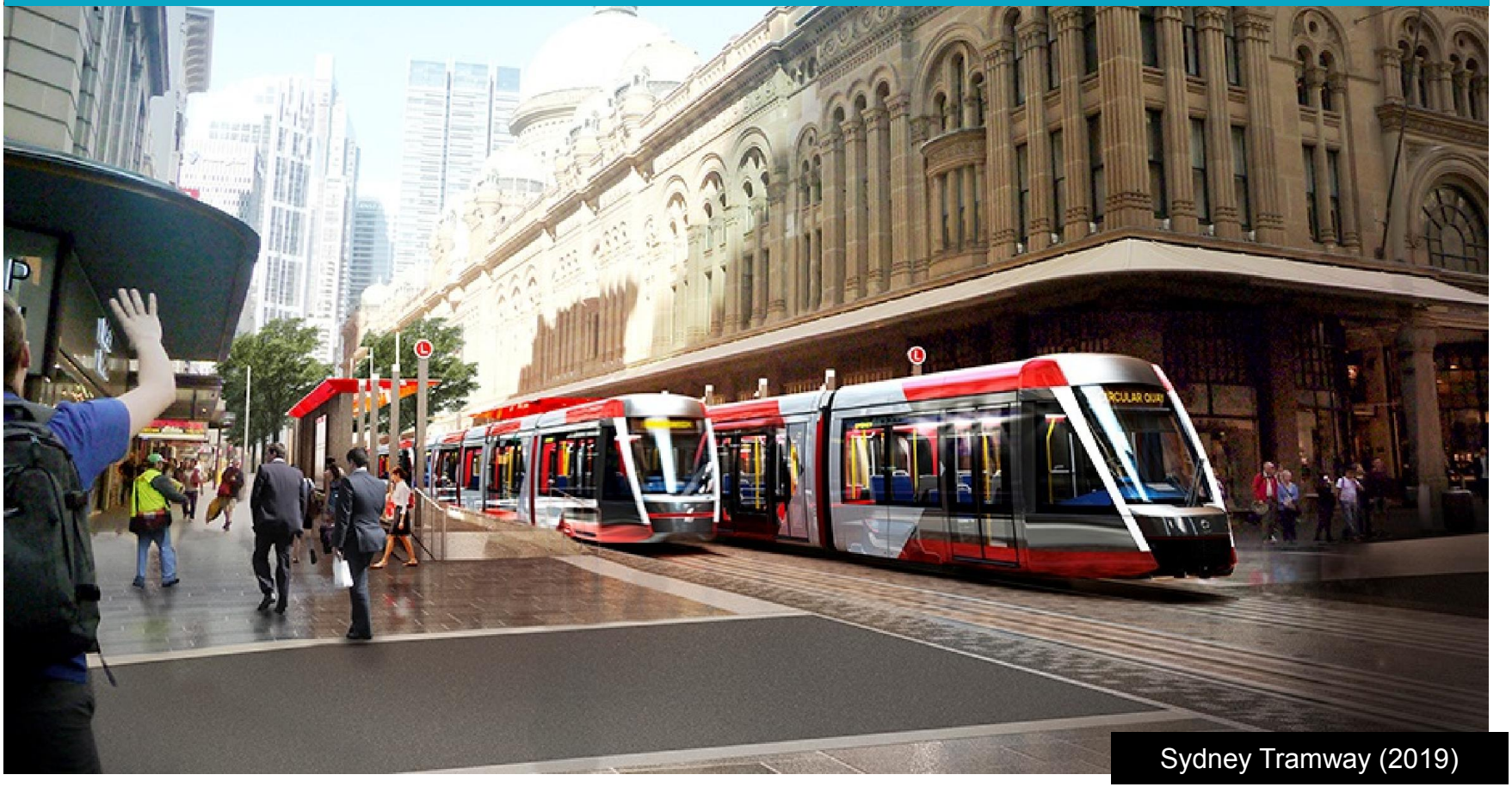
APS
Ground-level power supply



Sydney Tramway (2019)

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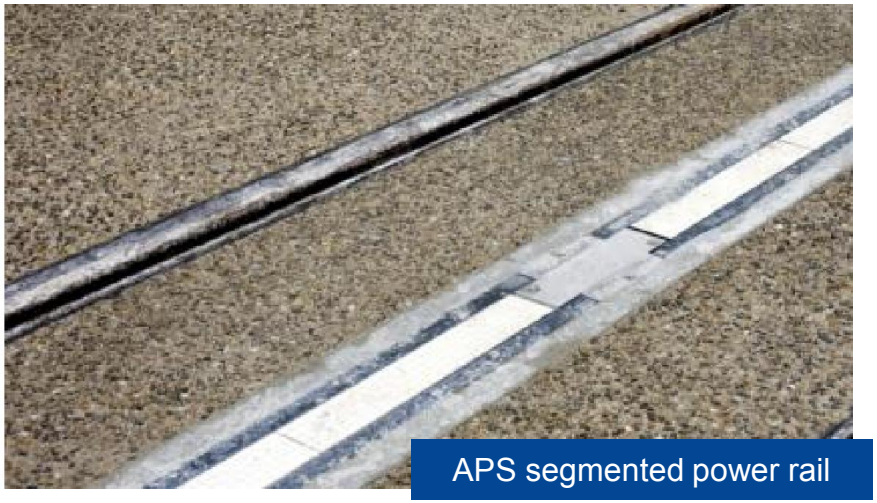
APS: key principles

- Power supplied to the tramway through a segmented street-level power rail
- Conductive segments are switched off/on/off as the tramway progresses, ensuring total safety for pedestrians and all road users
- Segmented power rail fed by buried power boxes
- Power picked up by contact shoes on tram central bogie

Orléans L2 Tramway (2012)



APS segmented power rail

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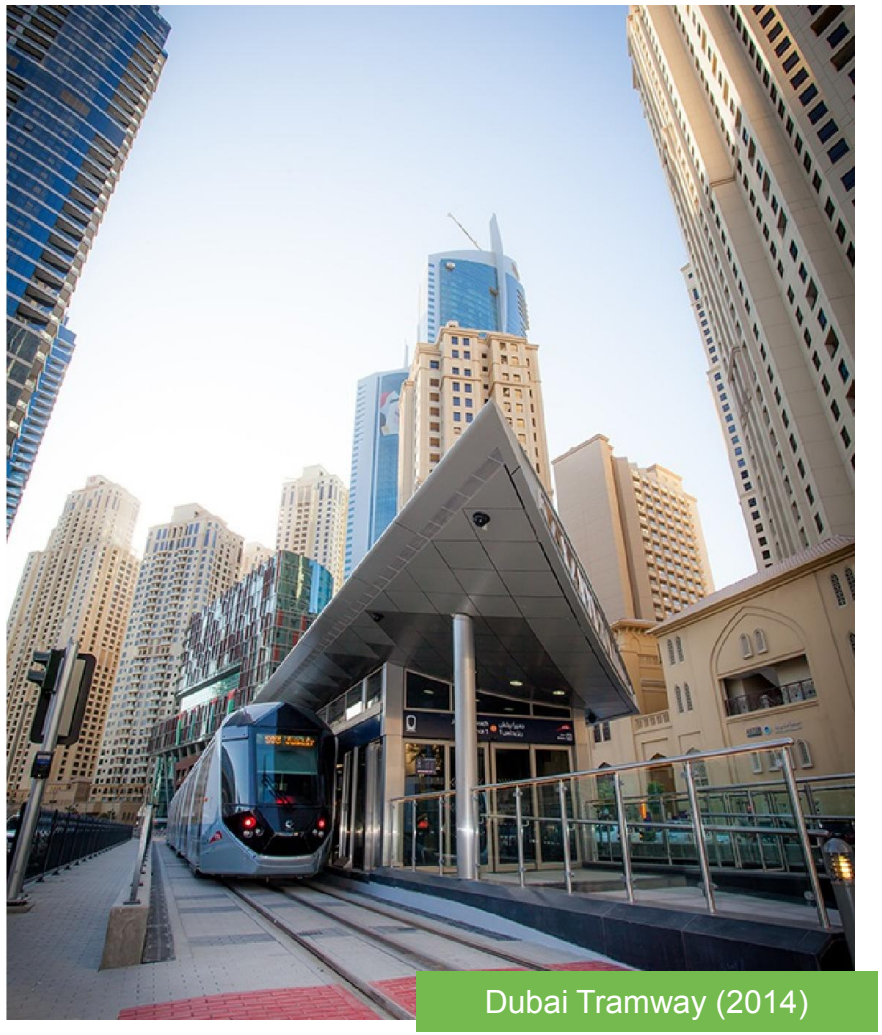
APS: customer benefits

- **Preserves the beauty of urban environments**
  - No obtrusive contact lines and masts
- **Same performance as catenary**
  - Up to 60 km/h regardless of slopes
- **Resistance to extreme conditions**
  - Humidity, hot temperatures, snow
- **Most service-proven catenary-free solution**
  - Over 12 years of operation
  - Over 20 million km run



Dubai Tramway (2014)

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APS: project references

- **7 projects in service**
  - **Bordeaux**, France
  - **Reims**, France
  - **Angers**, France
  - **Orléans Line 2**, France
  - **Tours**, France
  - **Dubai**, United Arab Emirates
  - **Rio Porto-Maravilha**, Brazil
- **3 projects in construction**
  - **Cuenca**, Ecuador
  - **Lusail**, Qatar
  - **Sydney**, Australia

Tours Tramway (2013)

Bordeaux Tramway (2003)

10 references: over 350 trams and 144 km of tracks with APS

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APS FOR ROAD
Dynamic feeding for road vehicles

APS for Road

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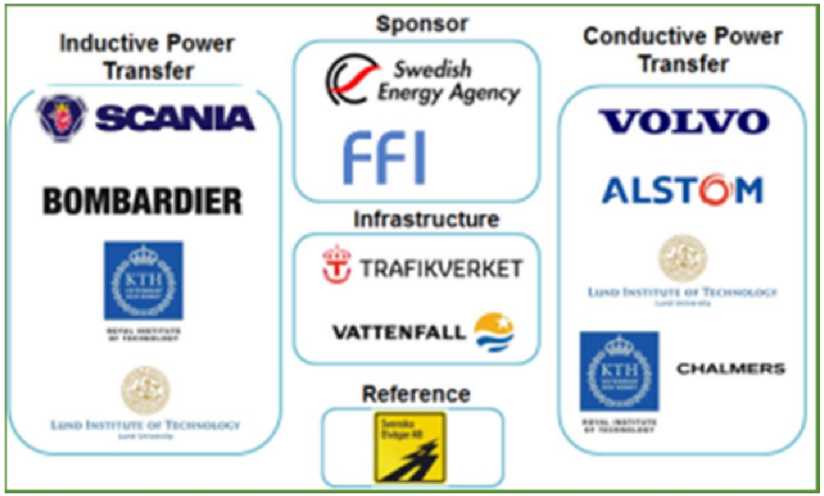
APS for Road: Slide-In Project in Sweden

- Strategic Vehicle Research and Innovation program launched by the Swedish Energy Agency in 2011



APS for Road: differences between rail and road

- Vehicles with different length

- Other differences:

Tramway	Road
1 tramway every 3 minutes	1 car every 3 seconds
2 tracks	Several tracks
Power 0,5MW / km	Power 2 to 10MW / km
Max power per segment : 1MW	Max power per segment : 130kW

APS for Road:
one of the answer to the need for electric road solution

- The future is to have road freight transport greener and electric road can answer to:
  - ➢Reduction of CO_2 emissions
  - ➢Reduction of other air pollutants (NOx, PM)

Conductive from the top

Inductive from the ground

Conductive from the ground

SRS
Ground-based static charging system

SRS for Buses

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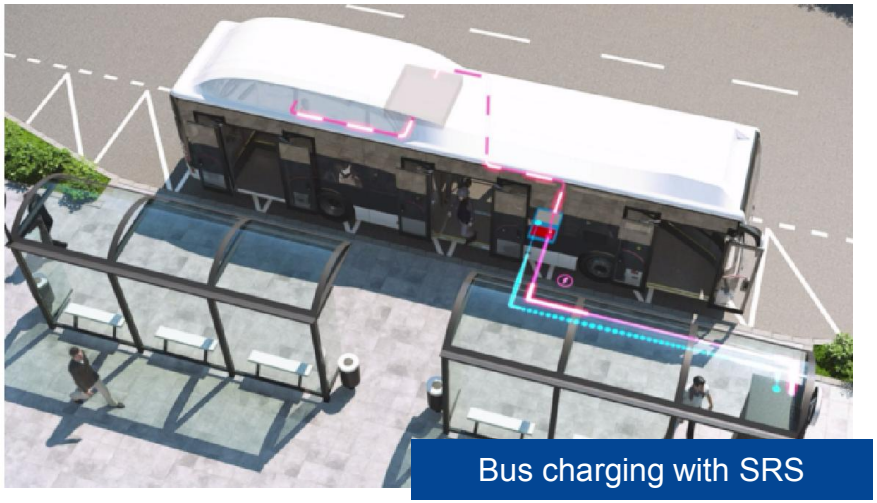
SRS: key principles

- Designed to recharge trams and electric buses equipped with on-board energy storage, at stations or in terminus
- Vehicle positions itself over in-street power rails (tram) or pads (bus)
- Power picked up by contact shoe located under tram or bus vehicle
- Solution derived from APS, with same functional and safety principles

SRS for Buses collector shoe



Bus charging with SRS

SRS: customer benefits

- **Ground-based solution** *vs. overhead solutions*
  - Unobtrusive and compact solution
  - No height constraint for vehicles
  - No mobile infrastructure: high availability of charging spot
  - Fixed infrastructure: facilitated maintenance
- **By contact** *vs. inductive solutions*
  - Fast and efficient energy transfer
  - Unlimited power
  - Lower vehicle and infrastructure cost/complexity
  - Better resistance to heavy loads
  - Fixed infrastructure: facilitated maintenance

SRS for Trams

Tramway charging with SRS

SRS: project references

- **Nice L2 & 3 (West-East)**, France
- Key Features:
  - Catenaryless : **SRS** at passenger stops
  - **19 Citadis X05 trams** (44-m long)
- Construction in progress


Nice tramway (Line 1)


Citadis X05 tram with SRS

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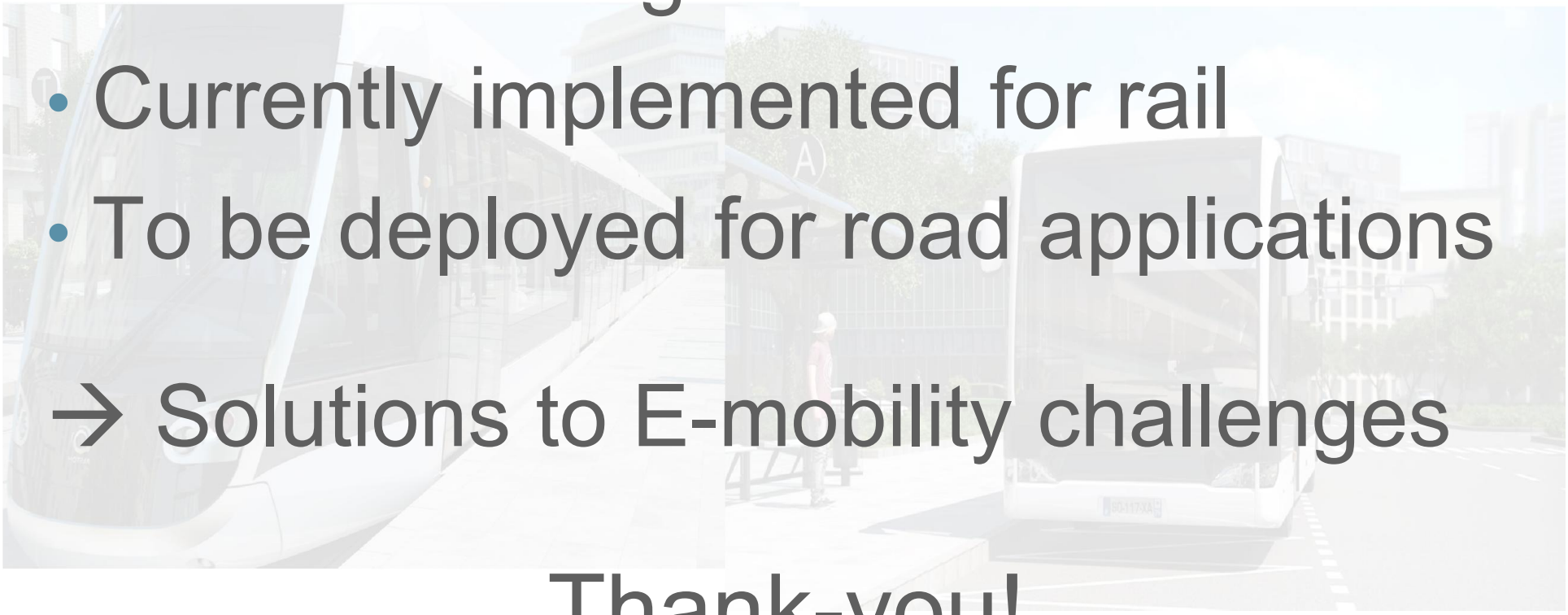
APS & SRS : from rail to road

Innovative energization solutions



- Currently implemented for rail
- To be deployed for road applications

→ Solutions to E-mobility challenges

Thank-you!

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