SOLARIS

trolley

Industry Perspective on Ebus Future

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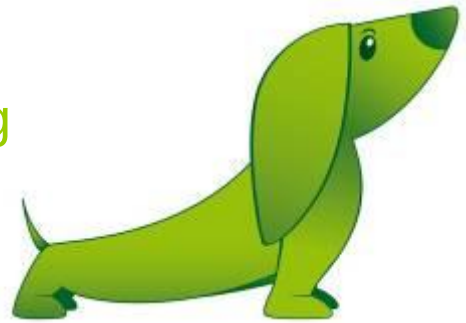


Agenda

Experience in trolleybuses

ŠKODA — Trollino 12, 15, 18

Cegelec — Trollino 12, 15, 18

MEDCOM — Trollino 12

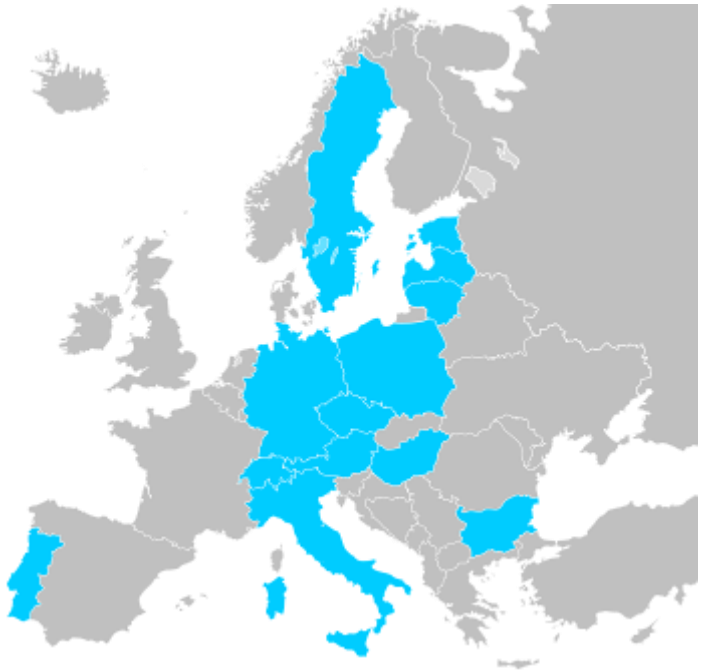
vossloh KIEPE — Trollino 12

611 Solaris Trollino

delivered since 2001

of which **358** Solaris Trollino 12 (two-axle)
67 Solaris Trollino 15 (three-axle)
186 Solaris Trollino 18 (articulated)

to **27** cities in **13** countries



References

Bologna (I), Budapest (H), La Chaux-de-Fonds (CH), Chomutov-Jirkov (CZ), Coimbra (P), Debrecen (H), Eberswalde (D), Gdynia (PL), Jihlava (CZ), Kaunas (LT), Landskrona (S), Lublin (PL), Napoli (I), Opava (CZ), Ostrava (CZ), Pardubice (CZ), Plzeň (CZ), Riga (LV), Roma (I), Salzburg (A), San Remo (I), Sofia (BG), Tallinn (EST), Teplice (CZ), Tychy (PL), Vilnius (LT), Winterthur (CH)

(as of 31.12.2012)

❶ Experience in trolleybuses

❷ Current status of ebus technology

❸ Next steps and ebus future

Urbino 12 electric

Standard-length electric bus

Modular powertrain and electric drive system for easy adaptation to individual operational requirements

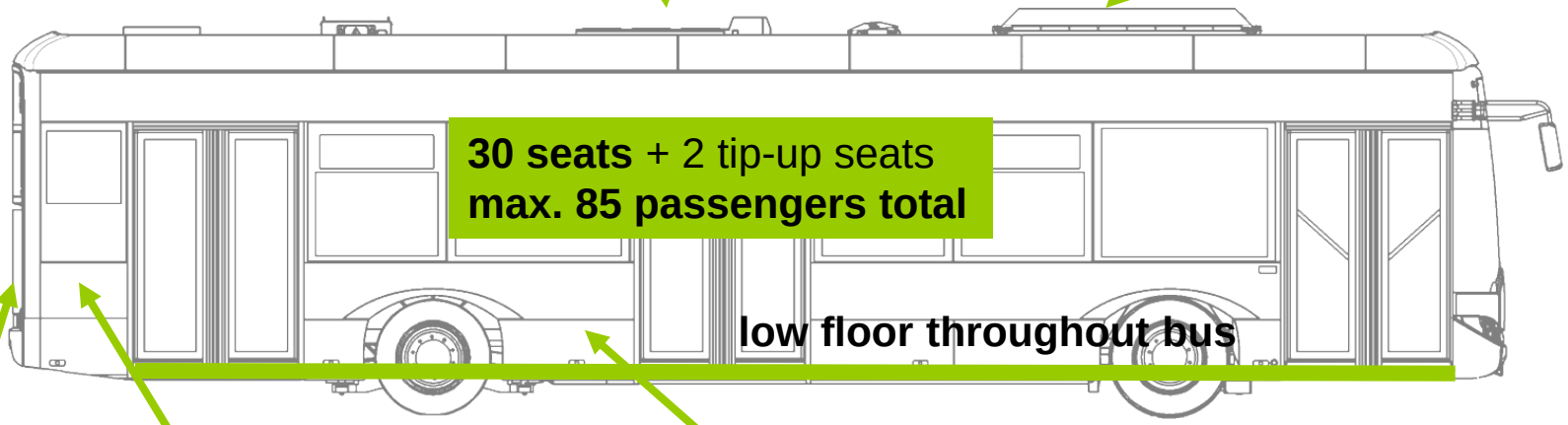
Fast plug-in charging in prototype, **prepared for opportunity charging systems** (e.g. inductive charging)

Possibility of overhead power supply with trolleybus catenary

Solaris Urbino electric

Air-conditioning (passengers & batteries)
Konvekta UL500EM
with CO_2 heat pump

Power electronics
Vossloh Kiepe



Plug-in connection

Batteries (lithium-ion)
Solaris
210 kWh

Traction motor
Vossloh Kiepe
160 kW, 1,400 Nm

Awards

First **EBUS Award** for Battery Buses of Forums für Verkehr und Logistik e.V. under patronage of German Federal Minister of Transport **Dr Peter Ramsauer**

Busplaner Innovation Prize 2012
in Public Transport category

International Busplaner Sustainability Prize 2013

Demonstrations and Tests (selection)

Solaris Urbino electric buses have been demonstrated and tested in **more than 30 cities**, including:

- Aachen
- Berlin
- Braunschweig
- Düsseldorf
- Gdańsk
- Hannover
- Jena
- Kassel
- Kraków
- Leipzig

- Luzern
- Mönchengladbach
- Montafon
- Munich
- Nürnberg
- Poznań
- Reutlingen
- Tübingen
- Warsaw
- Zielona Góra

First order in Germany

1x Solaris Urbino 12 electric
for **Braunschweiger Verkehrs-AG**

- Delivery in summer 2013
- Will be used in „Emil“ demonstration project (electric mobilty with inductive charging) supported by German Federal Ministry of Transport, Building and Urban Development
- **60 kWh battery** releases space for more passengers
- **Bombardier Primove** inductive charging

First order in Austria

1x Solaris Urbino 8,9 LE electric
for **Stadtwerke Klagenfurt**

- Delivery in spring 2013

- Will be used in e-mobility project **CEMOBIL**

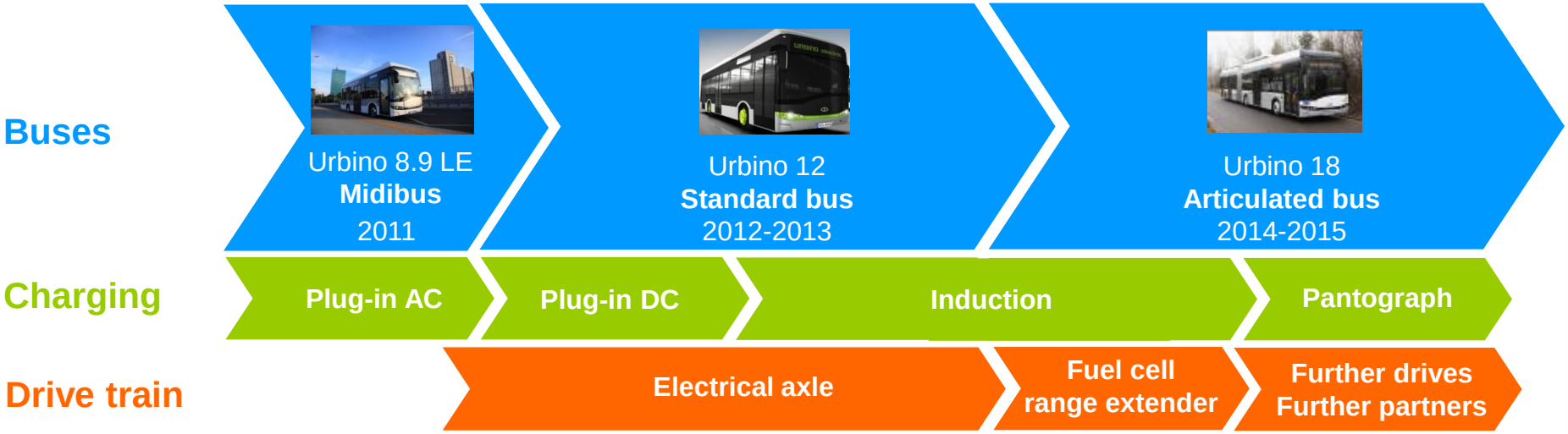
❶ Experience in trolleybuses

❷ Current status of ebus technology

❸ Next steps and ebus future

Next steps

- **Implement experience and lessons learned** in demonstrations and tests
- **Increase number of options** for powertrain and energy supply
- Make use of **improving battery technology** to further increase range
- Add **articulated buses** to electric bus range



Proven trolleybus technology works best

- Best possibility to supply energy to electric buses is **trolleybus catenary**
  - Large amount of energy can be reliably supplied
  - Technology is proven and works well in all conditions
- With current and future batteries, catenary can be restricted to core sections
  - Successfully implemented in Rome since 2004

New technology reduces infrastructure costs

- In future, trolley poles need to be **raised automatically** while bus is moving
  - No need for expensive and visually intrusive crossings and points
  - Fully flexible operation and possibility of route extensions
- "**Hybrid trolleybus**" with batteries and supercaps already available today

Hybrid trolleybus with batteries and supercaps

- Demonstrator in Eberswalde (Germany) funded by EU in **TROLLEY project**
  - Battery system (72 kWh) designed to cover 4 km on round trip of 18 km and to fit existing space on bus – other sizes are possible
- First results from operation alongside other trolleybuses (with supercaps and diesel auxiliary power unit) are available
  - Tested in winter (temperatures -1 to -3°C) with normal heating for passengers
  - Over whole day, **40 km of 240 km (17%) without overhead power supply**
  - **Energy cost per km 32% lower with hybrid trolleybus**

Thank you for your attention!