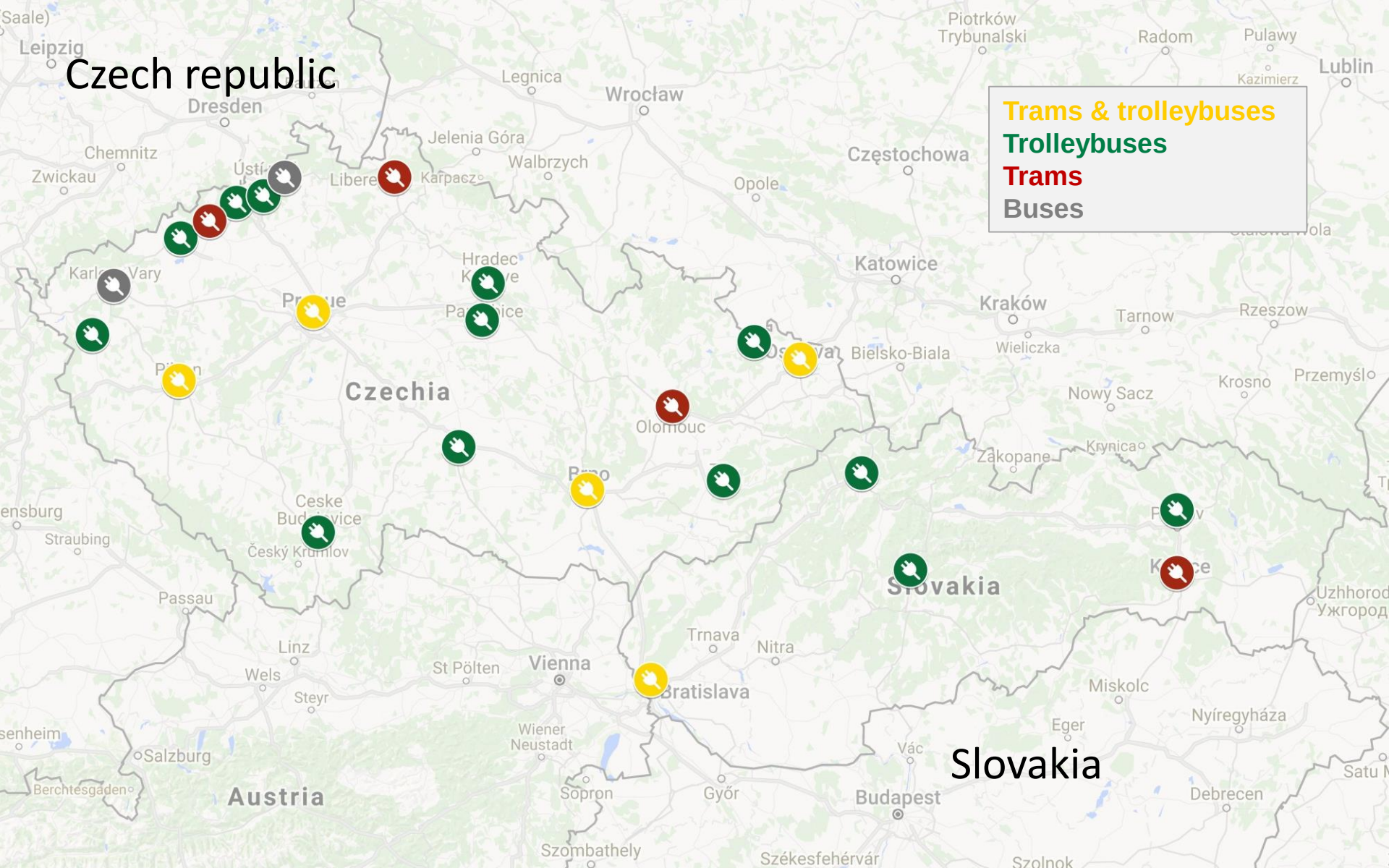
Growing e-mobility in Pilsen and other Czech cities

experiences, hopes and obstacles

22. 11. 2018

Jiří Kohout


Czech republic
Trams & trolleybuses
Trolleybuses
Trams
Buses
Czechia
Slovakia
Austria
Slovakia
Leipzig
Dresden
Chemnitz
Zwickau
Legnica
Wrocław
Jelenia Góra
Walbrzych
Karpacz
Opole
Częstochowa
Piotrków Trybunalski
Radom
Pulawy
Lublin
Kazimierz
Katowice
Kraków
Tarnow
Rzeszow
Wieliczka
Bielsko-Biala
Nowy Sacz
Krosno
Przemyśl
Zakopane
Krynica
Hradec
Olomouc
Brno
Ceske
Český Krumlov
Straubing
Passau
Linz
Wels
Steyr
St Pölten
Vienna
Wiener Neustadt
Salzburg
Berchtesgaden
Trnava
Nitra
Bratislava
Miskolc
Nyíregyháza
Eger
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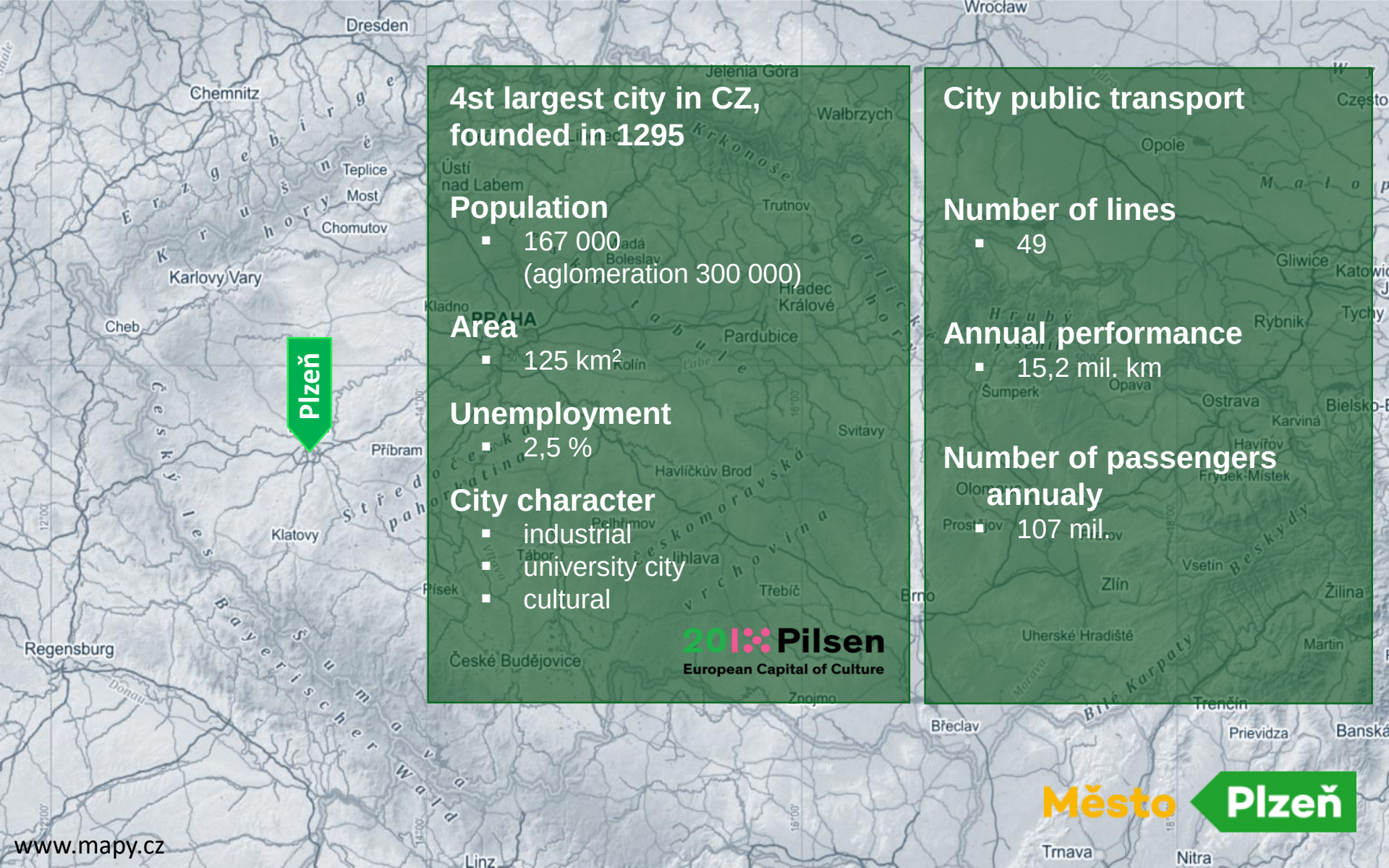
Budapest
Debrecen
Sopron
Győr
Szombathely
Székesfehérvár
Uzhhorod
Ужгород



4st largest city in CZ, founded in 1295

Population

- 167 000 (aglomeration 300 000)

Area

- 125 km^2

Unemployment

- 2,5 %

City character

- industrial
- university city
- cultural

2015 Pilsen
European Capital of Culture

City public transport

Number of lines

- 49

Annual performance

- 15,2 mil. km

Number of passengers annualy

- 107 mil.

Město Plzeň

www.mapy.cz

1899

1929

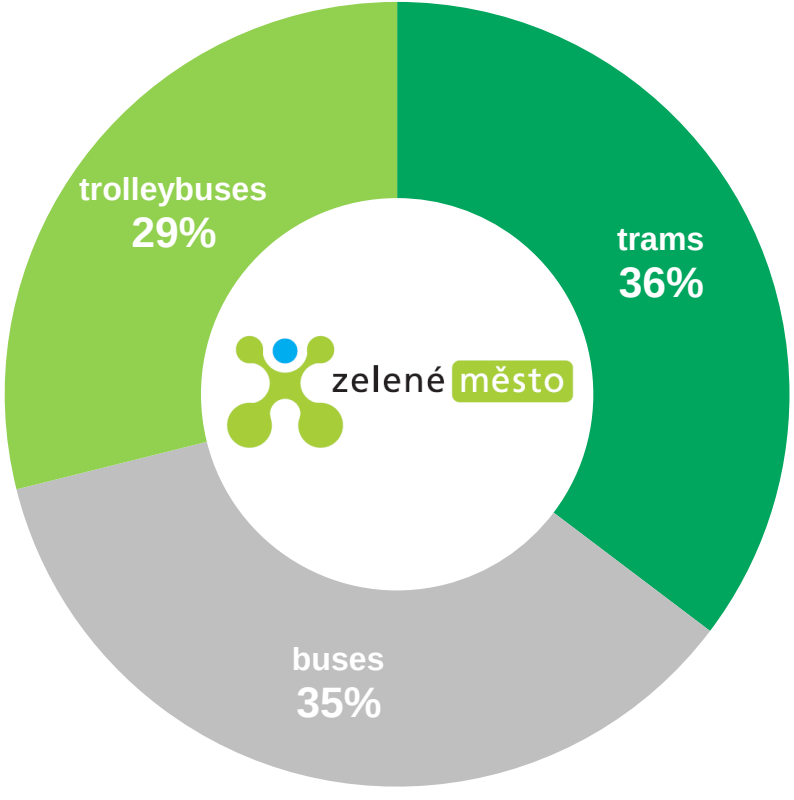
1941

Plzeňské městské dopravní podniky PMDP

65 % of Pilsner city public transport is electric!

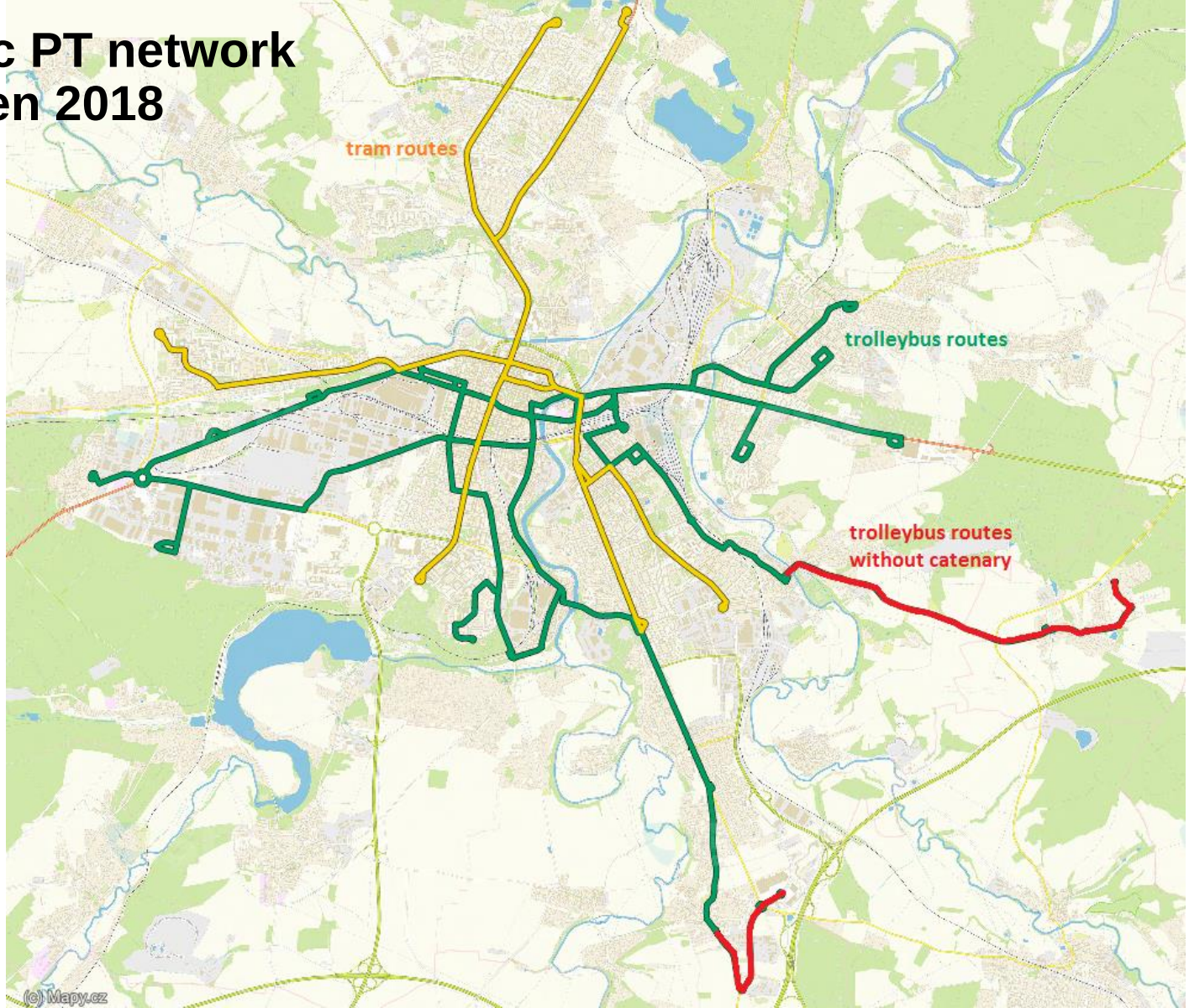
Annual vehicle km	
Trams	5,5 mil. km
Trolleybuses	4,5 mil. km
Buses	5,3 mil. km

Public transport vehicles	
Trams	116
Trolleybuses	90
Buses	117

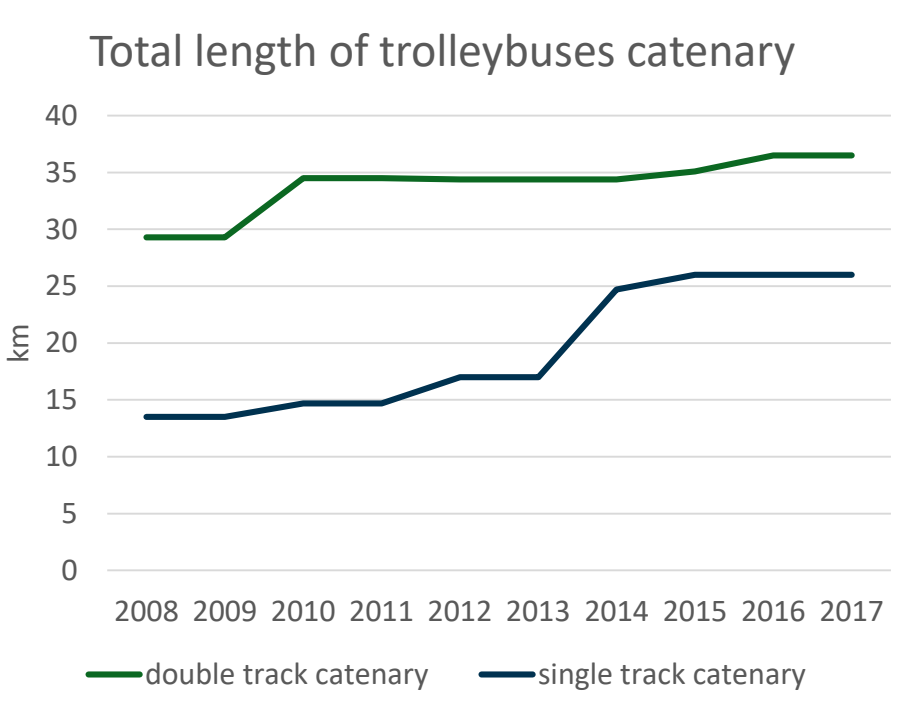


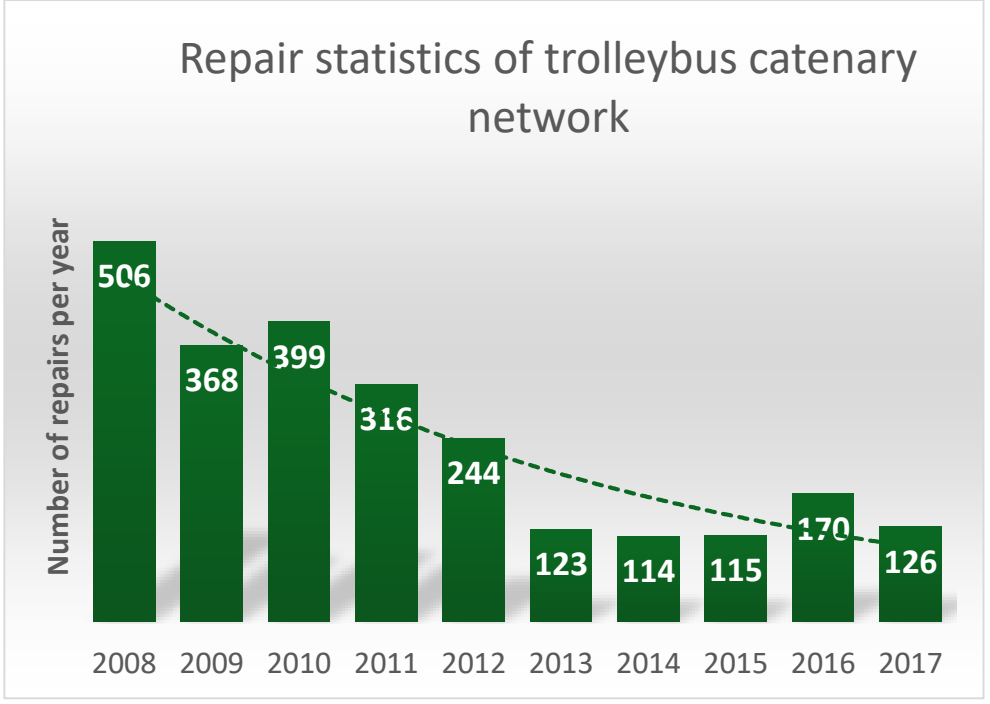
Plzeňské městské dopravní podniky PMDP

Electric PT network in Pilsen 2018



Overhead lines

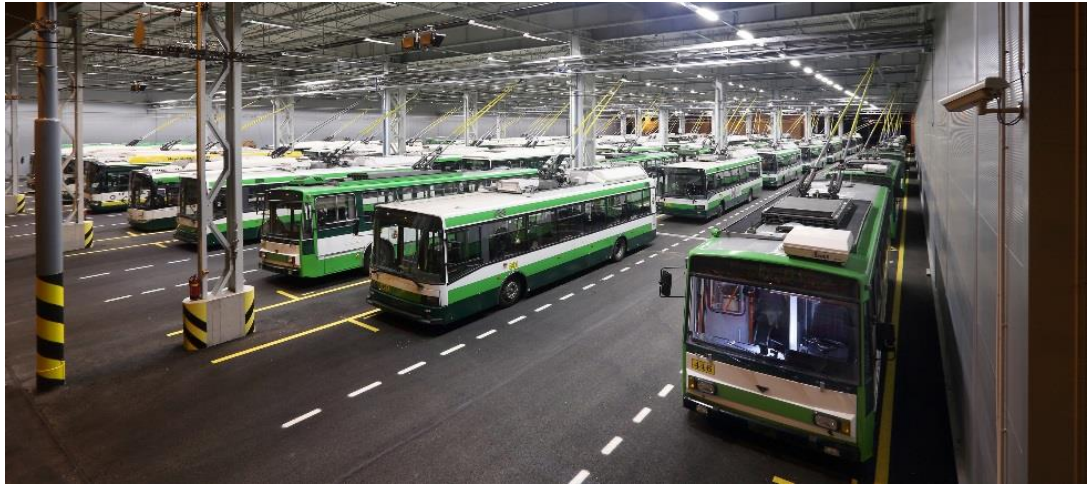




Plzeňské městské dopravní podniky PMDP

Trolleybus operation

Number of vehicles	87 pcs (66 standard, 21 articulated)
- operating vehicle types	Škoda 24 Tr, 25 Tr, 26 Tr, 27 Tr
- maximum in peak operation	69 pcs
Number of routes	10 (7 daily, 2 peak, 1 night)
Km per vehicle	47,000 km/year
Average speed	17.7 km/h (12 km/h with breaks etc.)



Plzeňské městské dopravní podniky PMDP

100 % low floor trolleybus rolling stock since April 10, 2018

Goodbye 14 Tr (April 9th 2018)

Plzeňské městské dopravní podniky PMDP

Pilsner Smart City Goal

"To increase share of electric traction in public transport - trams and trolleybuses - in Pilsen ***from 64 % in 2015 to 85 % in 2030"***

Plzeňské městské dopravní podniky PMDP

Why go electric and mass?

Electric engine efficiency up to **95 %**

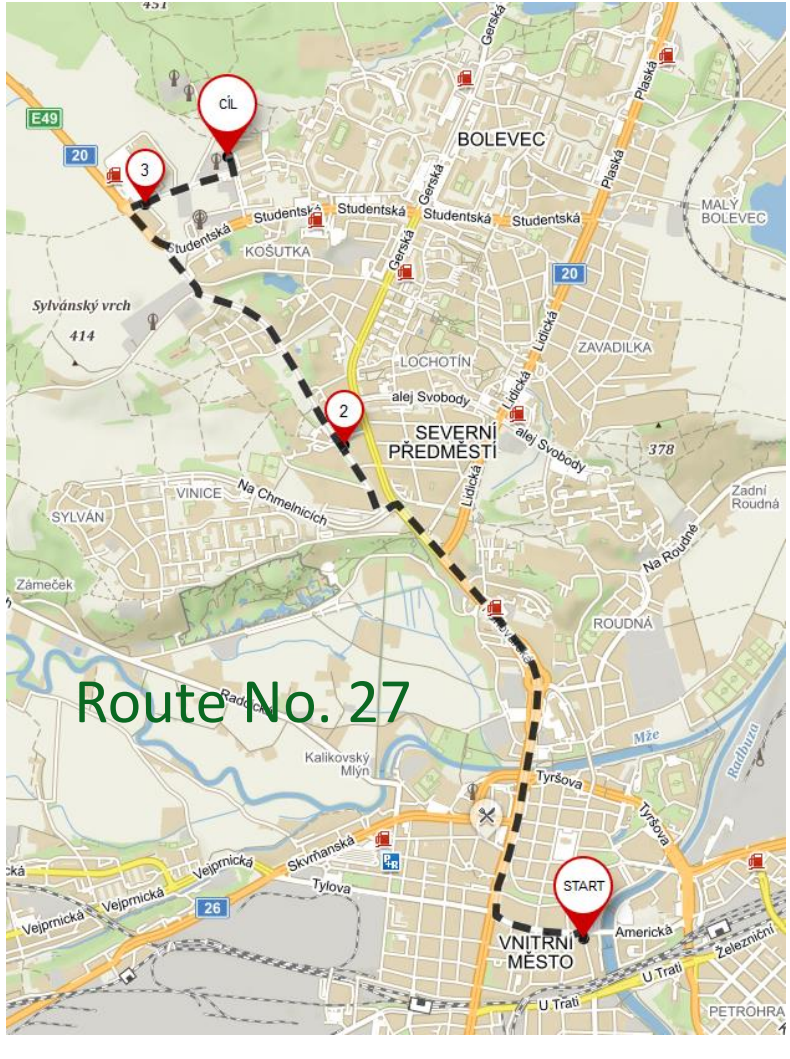
- Performance: 160 kW
- Max. 120 passengers (12 m length)
- Energy consumption: 5,98 MJ/km
  - By 50 passengers is **0,12 MJ/pkm**

Combustion engine efficiency up to **35 %**

- Performance: 160 kW
- Max. 5 passengers (4,3 m length)
- Energy consumption: 2,85 MJ/km
  - By 3 passengers is **0,95 MJ/pkm**

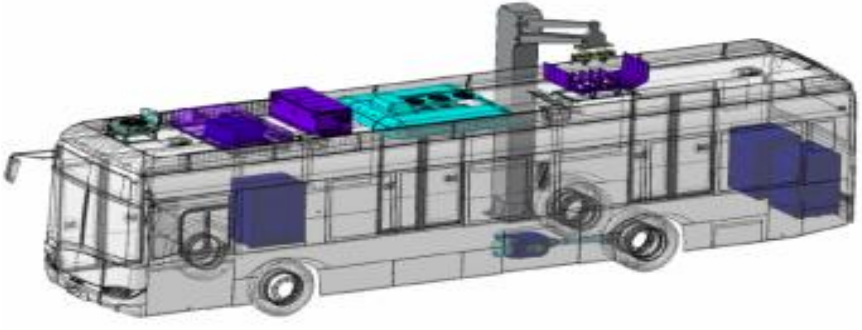
Lessons learned from ZeEUS project in Pilsen

Length of the bus line	6 km, in a hilly suburb
Total daily hours of operation (full electric)	7.5 - 18.5 h
Total km driven vehicle/day	80 – 200 km
Monthly avg. temperatures	Jun. 17.7°C / Jan. -2.2°C



ZeEUS Demo description & Key Topic

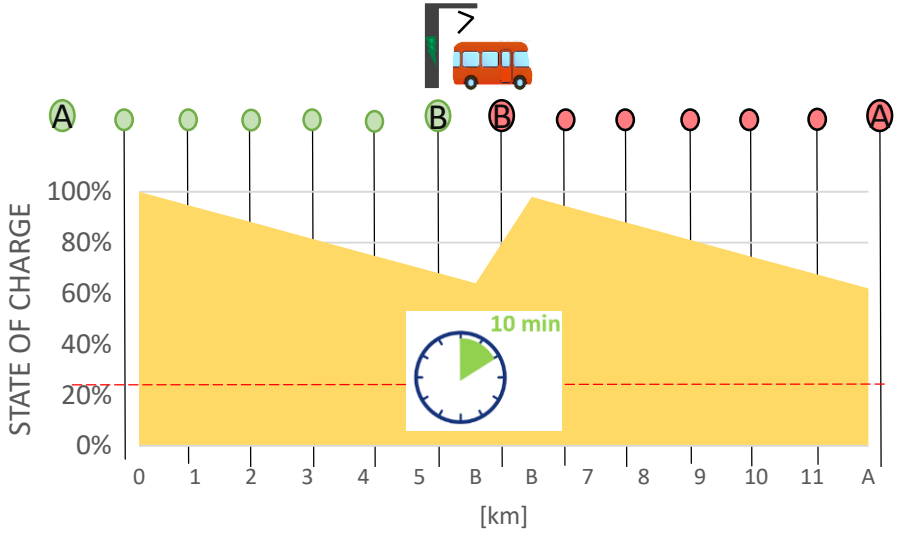
- Opportunity **fast charging solution** for 2 e-buses on **standard bus route**
- Full low-floor 12m long e-buses including **electrical heating and A/C**
- Capacity for 82 passengers
- Design of the batteries and charging station was for type of operation with short charging time at one of the end terminals; below 10 minutes for high power charging
- Conductive type of fast charging; **pantograph down** (on the station) connected with roof contacts on the e-buses
- Overnight **depot slow charging** and battery balancing

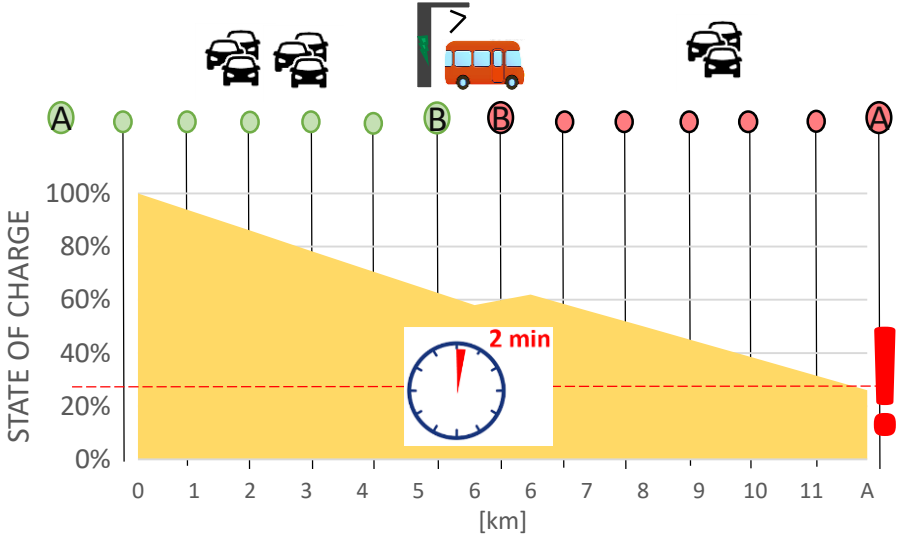


Results & Lessons learned (1)

- **Silent** vehicle motion, **smooth acceleration**, air-conditioned
- High failure rate of bus & fast charging station – **need further development**
- **Battery capacity** should be higher – especially for heating in winter
- For a real operation: **Charging should be faster**

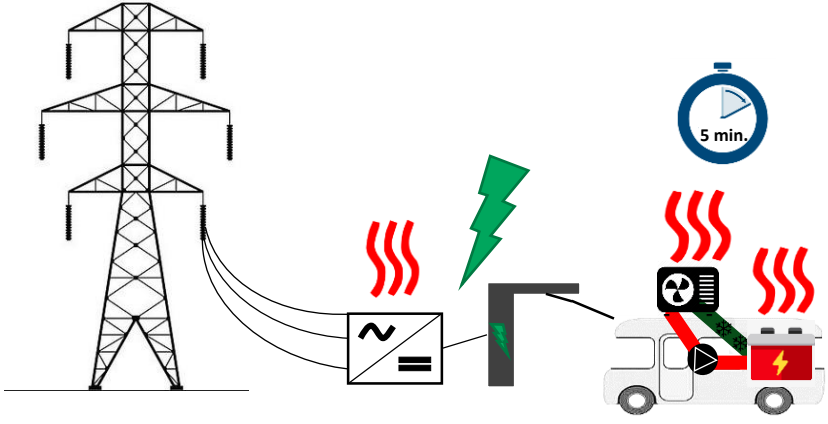
  or **more fast charging stations** would be needed

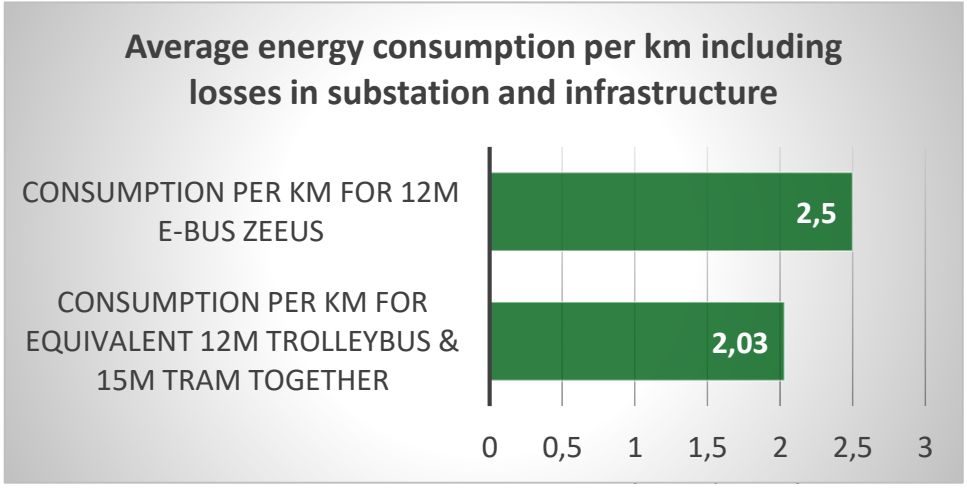




Results & Lessons learned (2)

- Long term process of getting placing & **building permit** for fast charging station
- **High electricity pricing** for fast charging - needs a change of national electric energy regulations or continuous use of charging station (slower charging)
- **High energy consumption** – needs slower charging or battery development



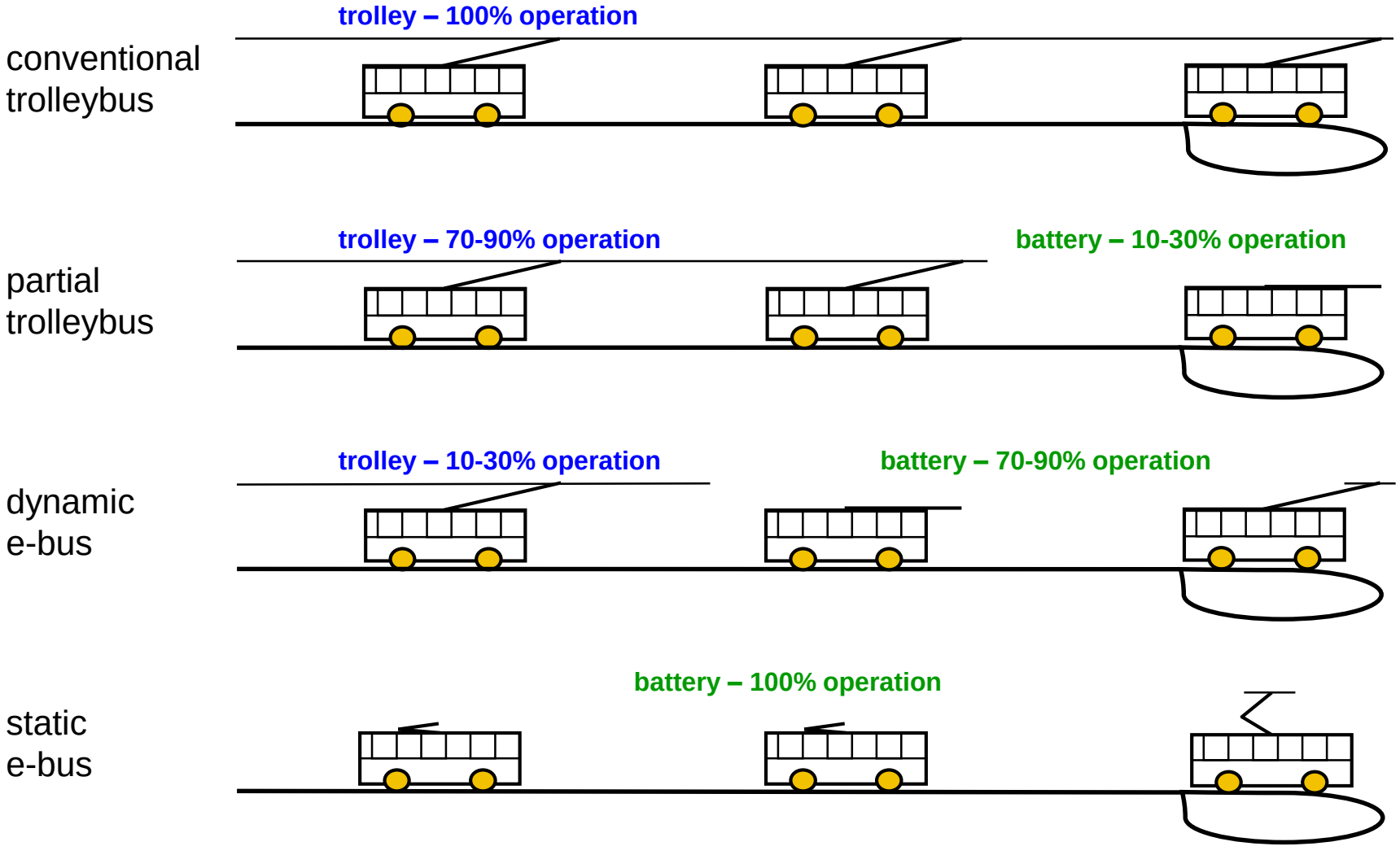


Plzeňské městské dopravní podniky

PMDP

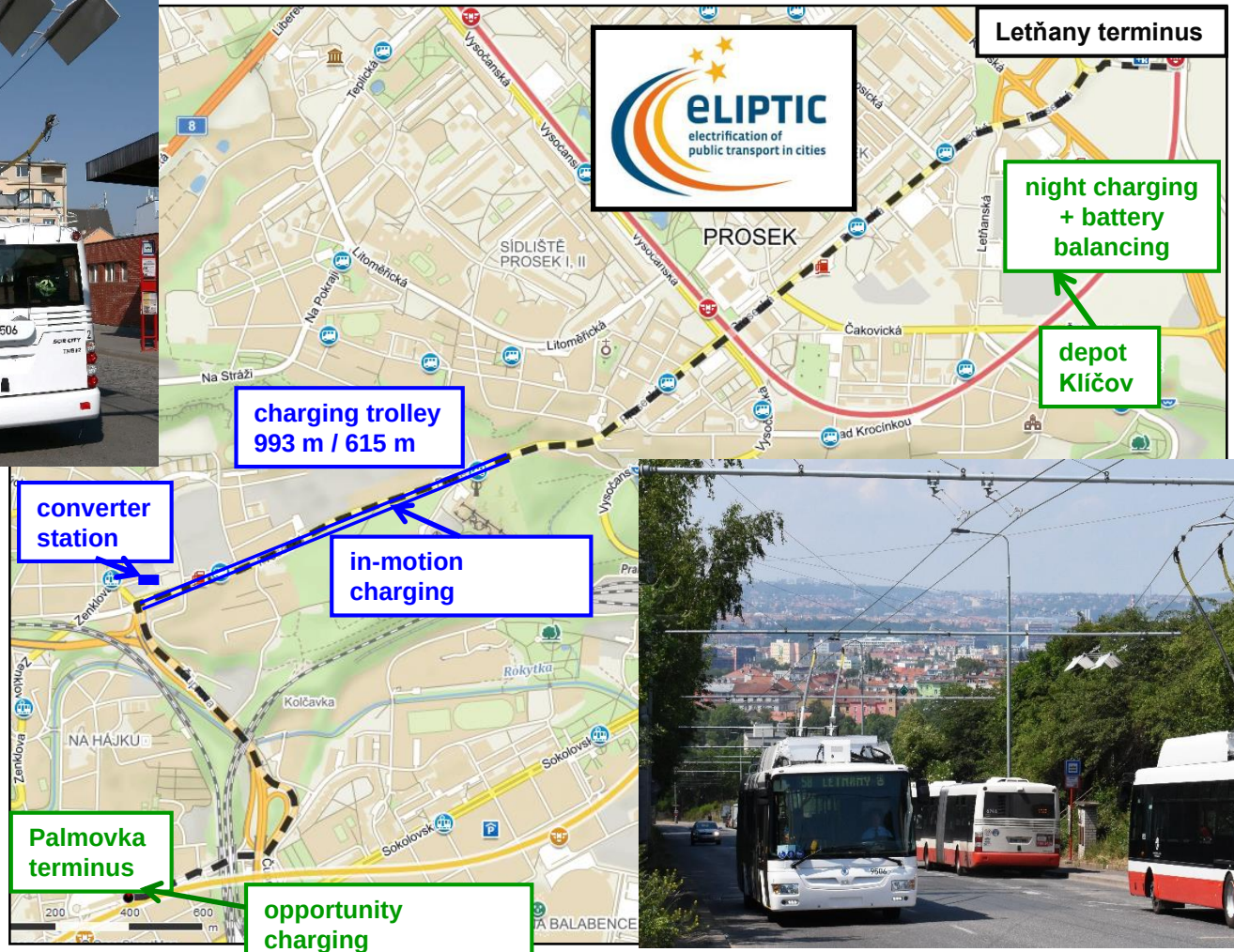
Growing e-mobility in CZ

In-motion charging concept in Czech cities



Prague, CZ: First new dynamic e-bus system in the world

Pilot operation since 10/2017



Hradec Králové

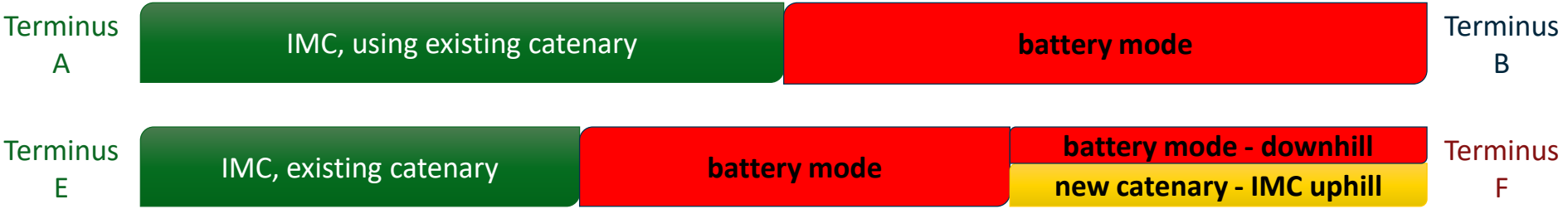
- 20 new e-buses (4-pole charging) „a new type of dependent traction“
- 9 new partial trolleybuses (IMC)

České Budějovice

- 11 new e-midi-buses 8,6 m (2-pole charging)
- 13 new partial articulated trolleybuses (IMC)

Growing e-mobility in Pilsen

- Increasing the share of electric modes up to 85 % till 2030 means **converting 3.2 mil. km annually from diesel to electric mode**
- The clean transformation will be based on:
  - opening one new tram extension to West Bohemia university
  - using **battery-hybrid trolleybus technology** (in-motion charging)
  - partial widening of trolleybus infrastructure



Plzeňské městské dopravní podniky PMDP

Why choose battery-hybrid trolleybus technology?

It is about flexibility and efficiency!

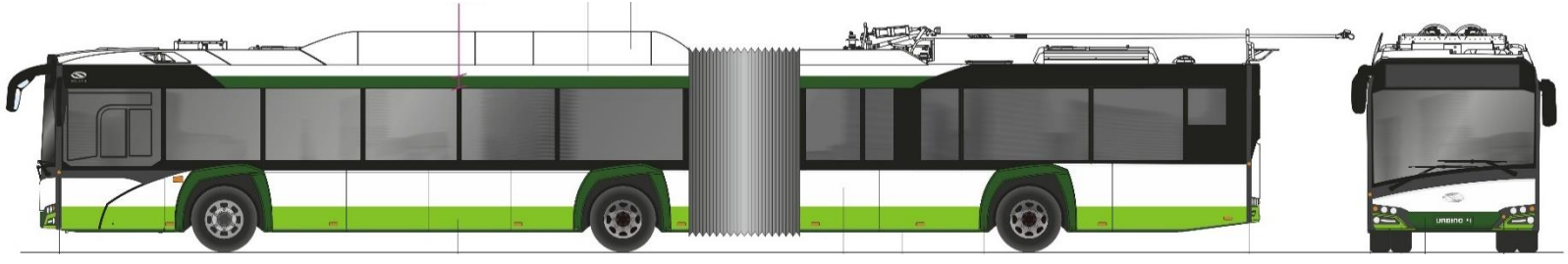
- charging not only during moving but standing in traffic jam
- differently long breaks on terminals, depending on delays and other conditions
- allowing route changes and different terminal stations on one route
- using existing infrastructure
- maintain light battery & longer lifetime

...

Plzeňské městské dopravní podniky PMDP

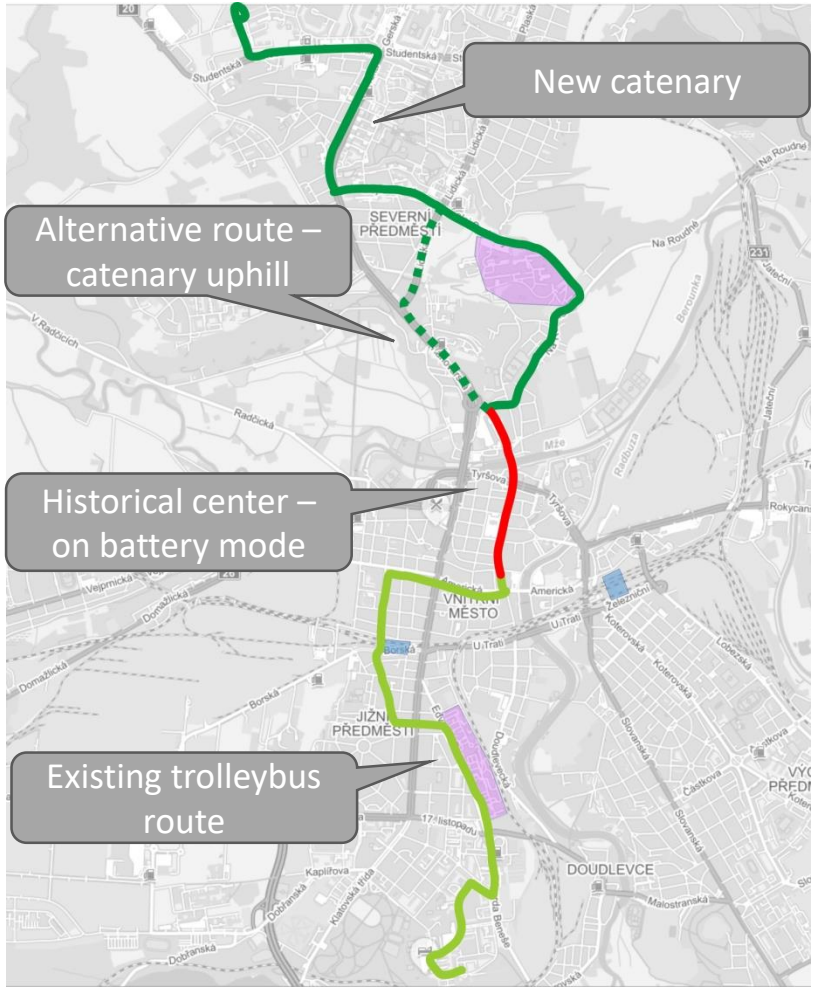
First steps and future plans

- ✓ *done:* 18 standard battery-hybrid trolleybuses purchased in 2017-2018 – replacing older with auxiliary diesel power unit for existing lines 12 and 13
- ✓ *done:* Sustainable urban mobility plan for Plzeň (till 2025)
- Plan to purchase in next 7 years:
  - next 25 standard battery-hybrid trolleybuses
  - 14 articulated battery-hybrid trolleybuses



- Study of a new trolleybus route to the Northern Suburb

Trolleybus project to the hospital and Northern Suburb



- Extension length 6,7 km
- Height difference 108 m
- Peak/off-peak frequency 15/10 min
- articulated battery trolleys 14 pcs

Plzeňské městské dopravní podniky PMDP

Possible trolleybus development

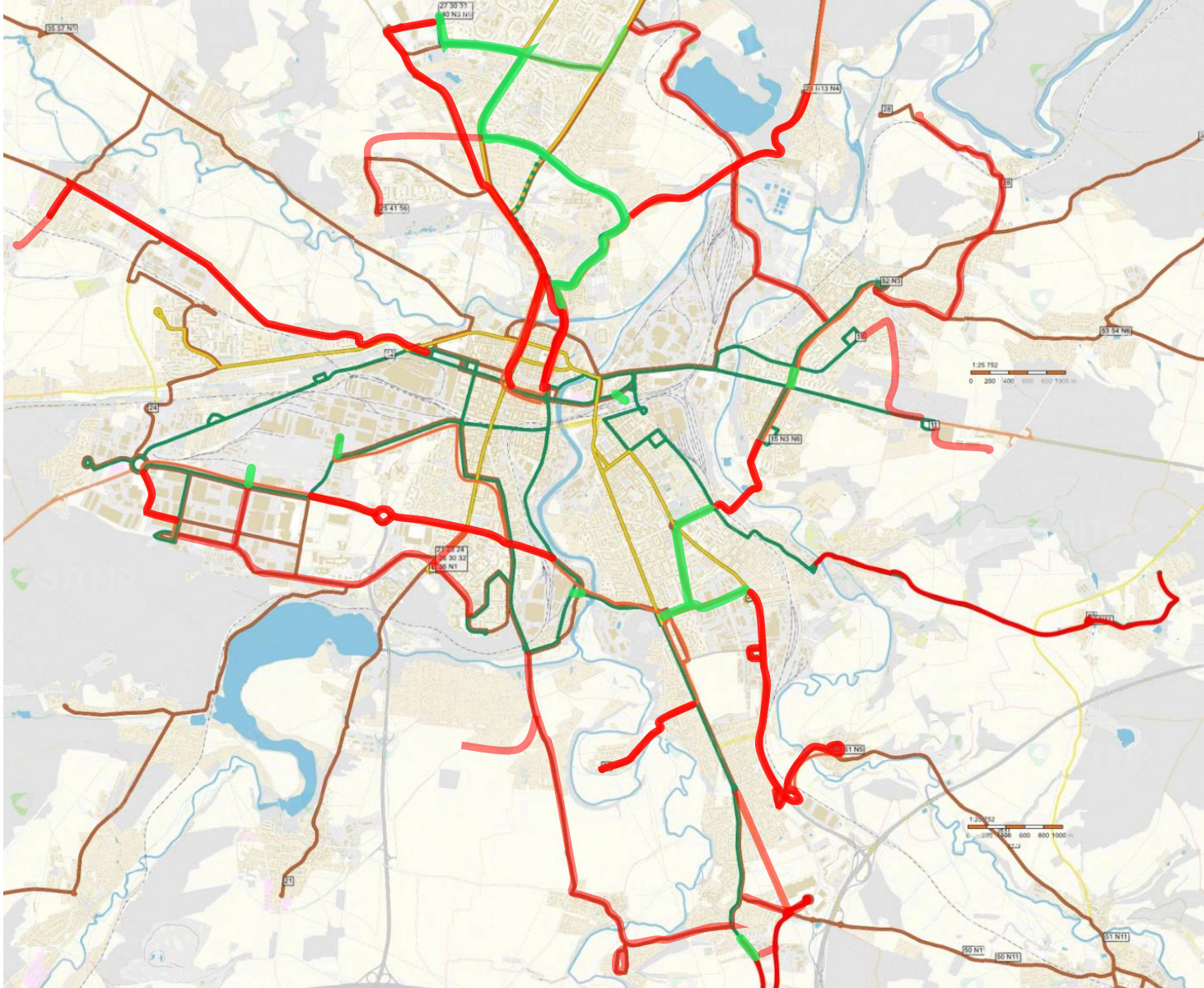
Existing overhead lines

Planned and prospective overhead lines

Battery mode sections

Prospective battery mode extensions

Other diesel bus routes



Challenges & obstacles to solve

- Czech railway legislation

  ... trolleybuses are in the same category like trains, but it does not help them

- Critical lack of drivers, esp. trolleybus drivers

  ... it also depends on legislation

- Long term process of getting placing & building permit
- Need of dedicated bus lanes on critical road sections & car restrictions in centers
- Financing

  ... still remaining more than 10 years fleet and infrastructure investment gap

  ... Czech government has always other interest and funding priorities in its transport strategy

Plzeňské městské dopravní podniky

PMDP

Conclusion

Conclusion

- We have a **great starting point** for e-mobility development
- Most of Czech cities still need to **overcome the investment gap**
- City PT has great performance but we need to **keep existing passengers** and attract others - requires **political courage**
- **In-motion charging trolleybuses are clean and efficient solution** not only for existing operators but as well for big cities like Prague
- **Electric city PT and especially IMC trolleybuses** need simplification of Czech legislation and continuous interest and support from the Czech government ... *or at least to not create new obstacles*

Plzeňské městské dopravní podniky PMDP

Thank you for your attention!

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