

# **ELECTRIC BUS DEVELOPMENT in the Czech Republic and Slovakia**

**Jan SPOUSTA, CDV** (Transport Research Centre CZ)

[jan.spousta@cdv.cz](mailto:jan.spousta@cdv.cz)

# **ELECTRIC BUS DEVELOPMENT in the Czech Republic and Slovakia**

## **CONTENTS:**

- Trolleybus development in CZ/SK 3
- Current trolleybus status in CZ/SK 8
- Alternative power – Hybrid & Hydrogen 11
- Alternative power – Electric bus 12
- Trolleybus legislation in CZ/SK & other EU States 18

# TROLLEYBUS HISTORY in K+K STARTED IN 1904



## 4 out of 10 trolleybus systems in The Austro-Hungarian Empire

**CZ: České Budějovice 1909-1914**

## AT/CZ: Gmünd (Č.Velenice) 1907-1916

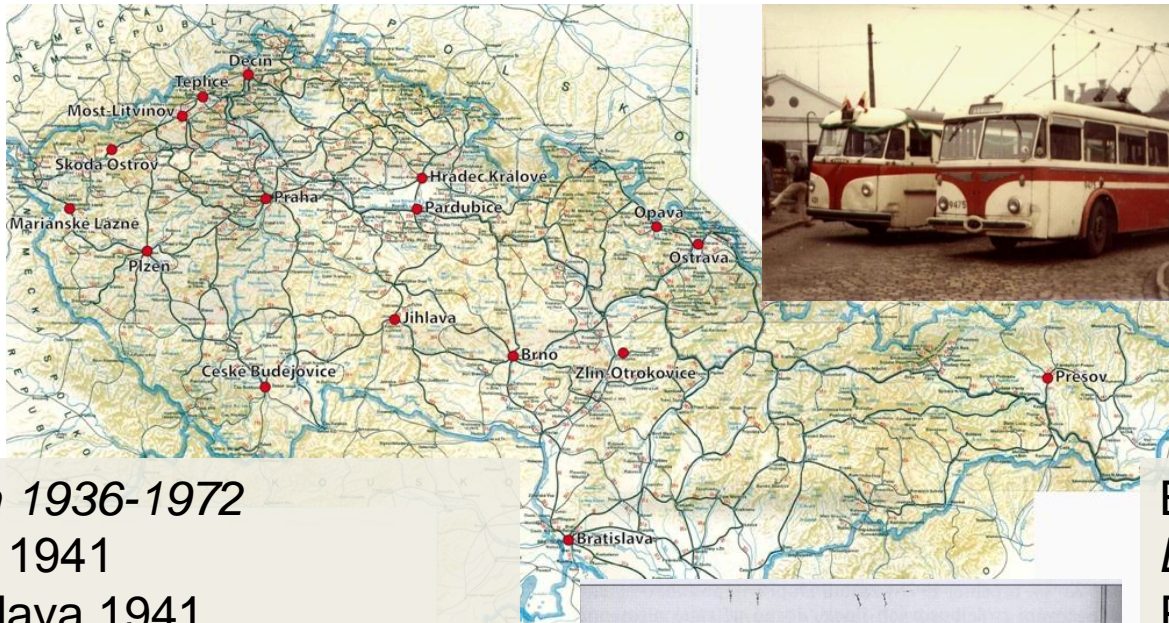
## SK: Bratislava 1909-1915

## High Tatras 1904-1906

# Electric Bus Development in the Czech Republic and Slovakia



## TROLLEYBUS BOOM in 1940s – 1950s



*Praha 1936-1972*

*Plzeň 1941*

*Bratislava 1941*

*Zlín 1944*

*Most-Litvínov 1946-1959*

*České Budějovice 1948-1971*

*Jihlava 1948*

*Hradec Králové 1949*

BW images: archive



*Brno 1949*

*Děčín 1950-1973*

*Pardubice 1952*

*Mariánské Lázně 1952*

*Teplice 1952*

*Ostrava 1952*

*Opava 1952*

*Prešov 1962*

## MASS PRODUCTION SINCE 1950s

First trolleys designed to operators' specifications

### FIRST SERIALY PRODUCED TROLLEYS

Tatra T400 (1948-1955) 195 vehicles

Škoda 7Tr (1952-59) 173

ŠKODA OSTROV PRODUCTION LINE since 1960 –  
400 trolleybus per year

Škoda 8Tr (1955-61) 742

Škoda 9Tr (1961-1981) 7372 = Nr. 3 in the World  
*export to USSR, COMECON, India, Norway, Afghanistan*

Škoda 14Tr (1980-2004) 3854 + 15Tr (1983-2004) 623





## TROLLEYBUS RE-BIRTH in 1985-1995



Ústí nad Labem 1988  
České Budějovice 1991  
Chomutov-Jirkov 1995



Banská Bystrica 1989  
Košice 1993  
Žilina 1994



## TROLLEYBUS PRODUCTION AFTER 1990



LS



Collapse of the USSR market  
New customers – San Francisco, Dayton, Teheran  
CZ/SK Mobility pattern change –  
Production decreased below 100 trolleys/year  
Škoda 21Tr low floor since 1997, duobus since 1999  
New manufacturer: CEGELEC-Ekova  
Closure of Škoda Ostrov factory (2004) – re-launch  
of production in Plzeň (change of concept:  
electrification of bus bodies)





## CURRENT TROLLEYBUS PRODUCTION in CZ



**Škoda 24Tr:** 269+15

**Škoda 25Tr:** 74+4

**Škoda 26Tr:** 82+14

**Škoda 27Tr:** 19+11

**Škoda 28Tr:** 24

+ 48 under SOLARIS brand



**Škoda 30Tr:** 40

**Škoda 31Tr:** 24+2



Components & Assembly for various bus manufacturers e.g.  
BredaMenarini  
Belkomunmas  
Neoplan U.S.





## CURRENT TROLLEYBUS PRODUCTION in CZ



Cegelec



**TROLLINO12:** 155

**TROLLINO15:** 49

**TROLLINO18:** 79

**MetroStyle 18AC:** 10+26



Salzburg AG



**Cegelec/Bogdan (UA)**



EKOVA



Cegelec



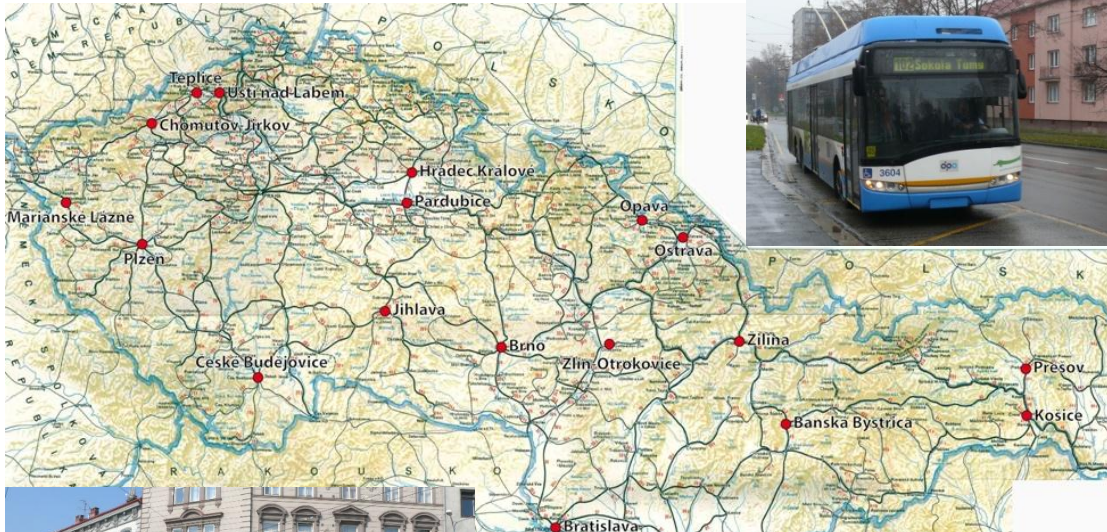
**SOR TNB12:** 3

**SOR TNB18:** 1



Components for several  
manufacturers  
Assembly (cooperation)  
for Škoda

# TROLLEYBUS SYSTEMS in CZ/SK 2012



	network [km]	fleet	% low floor
<b>CZ (13)</b>			
Brno	54	147	40
Č.Budějovice	29	53	40
Hradec Král.	23	45	100
Chomutov	23	22	25
Jihlava	17	32	100
Mar.Lázně	11	8	80
Opava	16	34	65
Ostrava	29	64	65
Pardubice	30	56	50
Plzeň	44	88	65
Teplice	21	42	50
Ústí n.L.	47	70	15
Zlín	39	56	40
<b>CZ total</b>	<b>391</b>	<b>717</b>	<b>ca 50</b>

**Slovakia (5):** 266 trolleys (LF 0-85 %)  
Banská Bystrica, Bratislava, Košice,  
Prešov, Žilina

Source (data 2011): MoT CZ, SDP CR, MoT SK

Trolleybuses carry 9 % of urban  
PT passengers in CZ, 13 % in SK  
ca 100 trolleys co-financed by EU Funds





## ALTERNATIVE POWER – HYBRID & HYDROGEN



**SOR NBH18 HYBRID**



**ŠKODA SOLARIS HYBRID**



**Tri-Hy Bus R&D Project**



Electric Bus Development in the Czech Republic and Slovakia

# ALTERNATIVE POWER – ELECTRIC BUS



Cegelec



**o.p.o.** DOPRAVNÍ  
PODNIK  
OSTRAVA

## SOR EBN 10.5



EKOVA

L = 10 370 mm  
W = 2 525 mm  
H = 2 800 mm  
Mass = 10 100 kg  
Max.permitted mass = 16500 kg  
Capacity: 85 (19 seats  
+66 standing) + driver  
Max. speed = 80 km/h  
Range = 120 kms  
Engine = 120kW/400V AC  
Traction Batteries  
180x 2.5-4.5V/300 Ah (1.7 t)



# ALTERNATIVE POWER – ELECTRIC BUS



Cegelec



DOPRAVNÍ  
PODNIK  
OSTRAVA



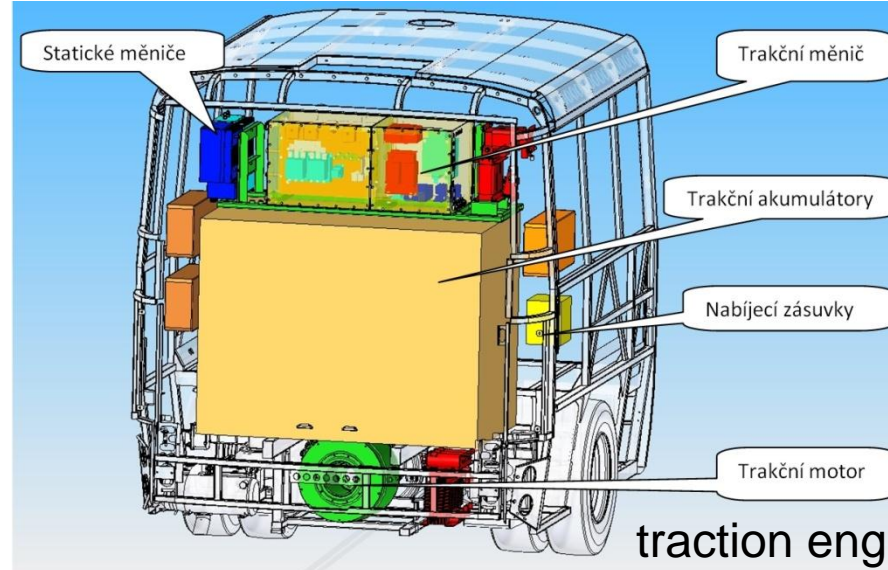
**CHARGING** from 30 % to 100 %

250A/400V    32A/400V

60 min        7 hours

Fast charging (3x 20 min.) increases range up to 220 kms

static converter



traction converter  
SBE10

batteries  
LiFeYPO4  
600V DC  
170 kWh  
(1.7 ton)

traction engine  
120 kW

All images: EKOVA

## ALTERNATIVE POWER – ELECTRIC BUS



Cegelec



**dpo** DOPRAVNÍ  
PODNIK  
OSTRAVA

### SOR EBN 10.5 - RESULTS AFTER 2 YEARS

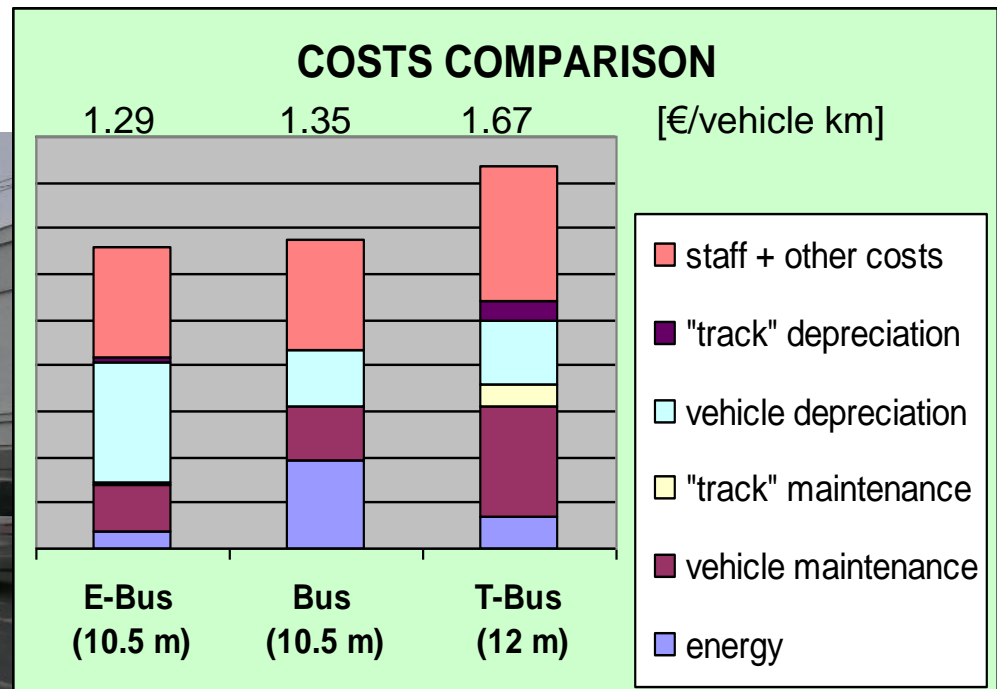


EKOVA

4 e-BUSES in service in Ostrava since 2011  
Total mileage: 200 000 km; first one 70 000 km  
In service on routes 32 & 38 (peak hours  
workdays): 75 km/morning >68 % battery capacity,  
fast recharge 100 Ah/1 hour > 95 %  
100 km afternoon > 48 %,   
slow recharge 32Ah/5 hours > 100 %  
Consumption = 0.89 kWh/km  
*No loss of capacity recognised after 2 years*



# ALTERNATIVE POWER – ELECTRIC BUS



Diesel EURO3 emissions 24.7 t/lifetime  
T-track maint. + deprec > +€ 0.25

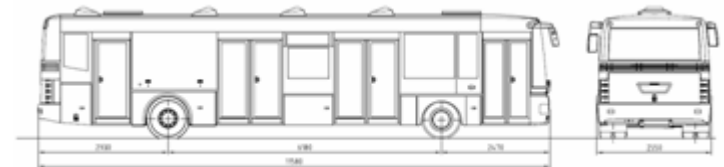
# ALTERNATIVE POWER – ELECTRIC BUS



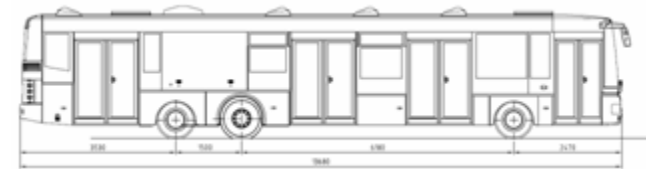
## CONCEPTS



EBN8  
(in production)



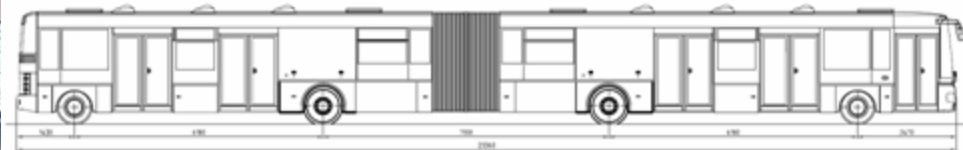
ENB 11.5



ENB 13.5



EBN9 (formal project)



ENB 23.5 m

All images: SOR



# ELECTRIC BUS EN-ROUTE CHARGING



MV

	PLUG	PLUG	PANTOGRAPH	PANTOGRAPH	INDUCTION	PANTOGRAPH REMOTE CONTR. CONTACTS
LOCATION	TERMINUS	TERMINUS	TERMINUS	TERMINUS	TERMINUS	EACH 2nd STOP
POWER SOURCE	3x400V 250A	600V DC (Tram)	3x400V 250A	600V DC (Tram)	3x400V 125A	750V 32Ah
ENERGY STORAGE						supercondensor
ENERGY TRANSFER	25kWh/ 10 min	17kWh/ 10 min	30kWh/ 10 min	30kWh/10 min	10kWh/ 10 min	1.23kWh/ 26 sec
PRICE [€]	9 000	15 000	125 000	32 000	55 000	92 000

## BARRIER: LEGISLATION in CZ/SK and other EU States



Despite the high number of T-bus systems and biggest fleet, Czech and Slovak legislation is not trolleybus supportive ... some changes in discussion but **we need your support and practice**...questionnaire will be distributed and incorporated into Compendium

	<b>Trolleybus</b>	<b>Duo-bus</b> (overhead connected)	<b>Diesel &amp; CNG bus</b>	<b>Electric bus</b> (not overhead connected)
DRIVER	"D" license + Rail driver license + CPC		"D" license + CPC	
VEHICLE (new type) HOMOLOGATION	Rail authority (body certification accepted from bus certification) - national only		EU Directive (EU-wide valid)	
VEHICLE (in service) ROADWORTHINESS	Rail authority – "rail" standards		EU Directive	
TRACTION OVERHEAD	Rail building authority – "rail" standards			
OVERHEAD MAINTENANCE	Rail building authority			
TRACTION CATENARY	Rail building authority		Building authority	
SERVICE LICENSE	Rail authority – even for diversion (accident, road engineering works)		Transport authority	



# Thank you for your attention!

Contacts:

**Jan Spousta**

**[jan.spousta@cdv.cz](mailto:jan.spousta@cdv.cz)**

+420 725 708 085



**Transport Research Centre,**

public research institution  
Líšeňská 33a, 636 00 Brno

**Office Prague**

Thamova 7, 186 00 Praha 8  
Czech Republic

**[www.cdv.cz](http://www.cdv.cz)**