The End of fossil Fuels
ÖBB-Personenverkehr AG

13.11.2019

Martin Prießnitz
Thomas Gerstenmayer

Contents

Alternative Propulsion
General aspects

Cityjet ECO
Pilot-Project of ÖBB-Personenverkehrs AG

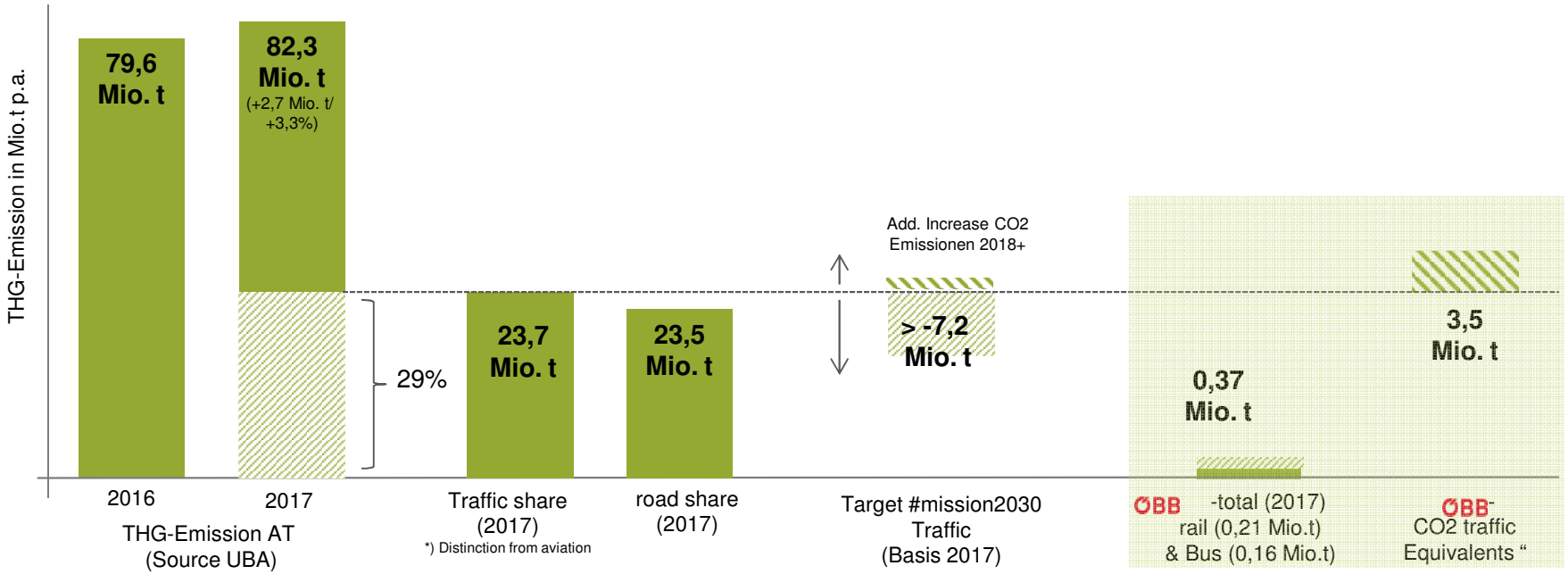
Discussion

Climate targets in Europe & Austria

Reduction of greenhouse gas emissions Development and share of transport and ÖBB

ÖBB #mission2030

	Target 2020	Target 2030	Ambition 2050
EU	-20 % greenhouse gas EU-weit (related to 1990)	-40 % greenhouse gas EU-weit (related to1990)	-80 bis 95 % greenhouse gas EU-weit (related to1990)
AT	-16 % GHG (related to 2005)	-36 % GHG (related 2005) #mission2030	



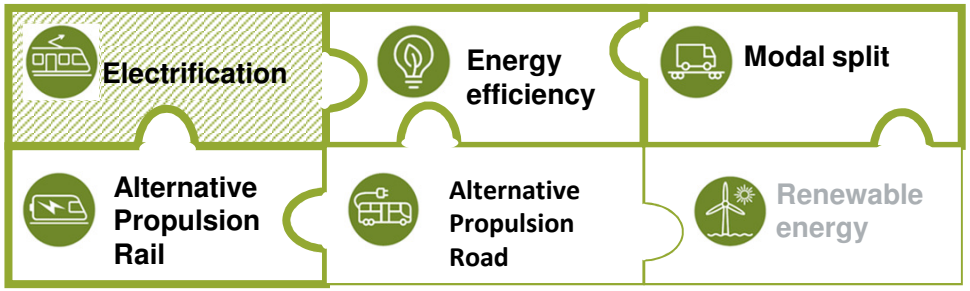
ÖBB climate strategy:
A major contribution to achieving climate goals

The 6 elements of the ÖBB climate strategy

The climate is changing...

The ÖBB Climate Protection Strategy 2030 makes a significant contribution
targets:

ÖBB climate protection strategy has 6 central levers



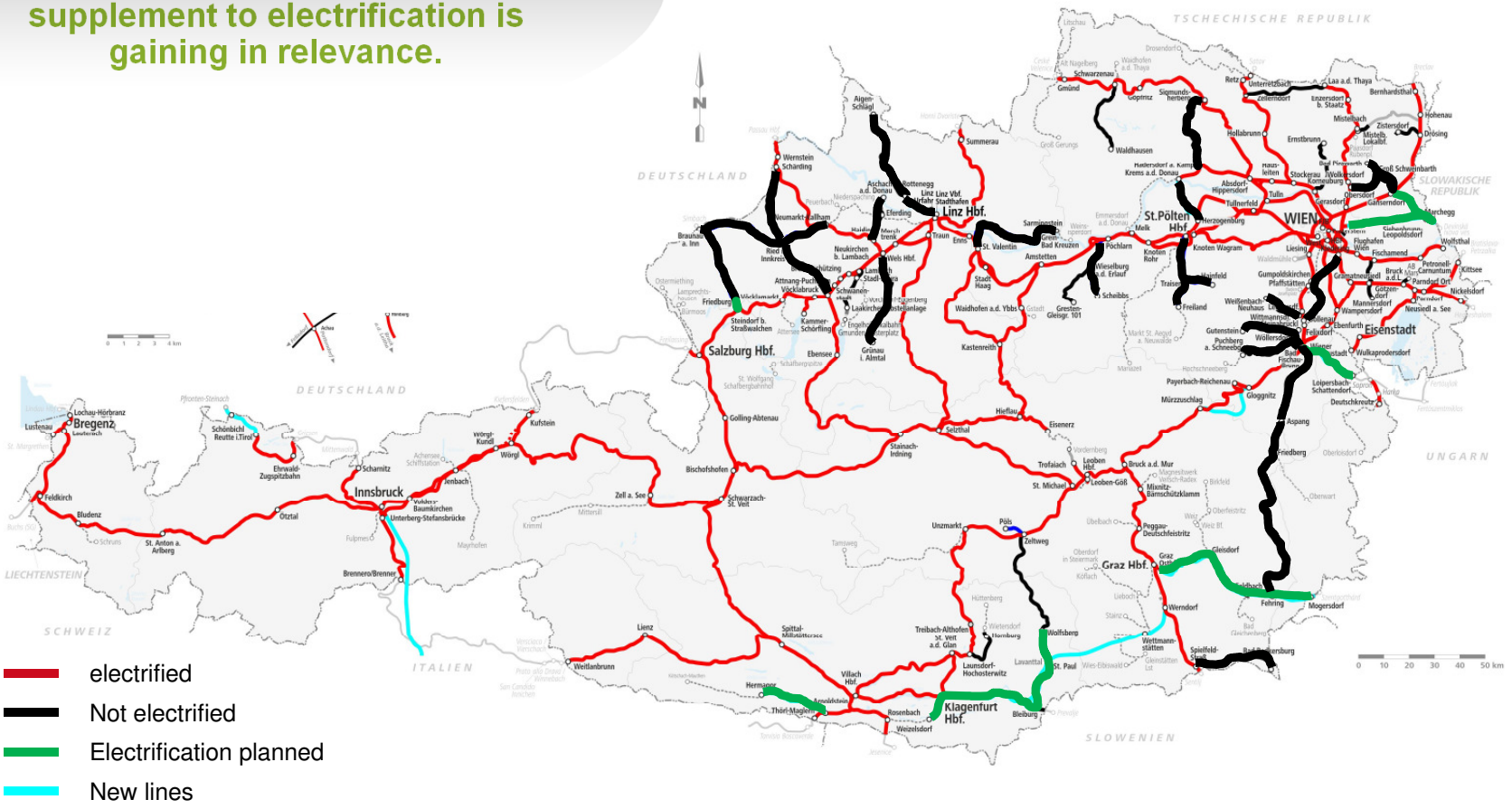
The ambition of the climate strategy, aligned with the government's climate and energy strategy (#mission 2030) is:

- CO2-neutral ÖBB mobility sector by 2030
- complete CO2 neutrality of ÖBB (incl. buildings) by 2050
- modal shift through system attractiveness and innovative capacity expansion
- Substitution diesel vehicles

Electrification of ÖBB lines:
cornerstone of climate protection strategy

Elektrifizierung

The use of alternative drives (H2, rechargeable battery) as a supplement to electrification is gaining in relevance.



Alternative drives:
What is available on the market?

Alternative Antriebe

Diesel- train

Battery train

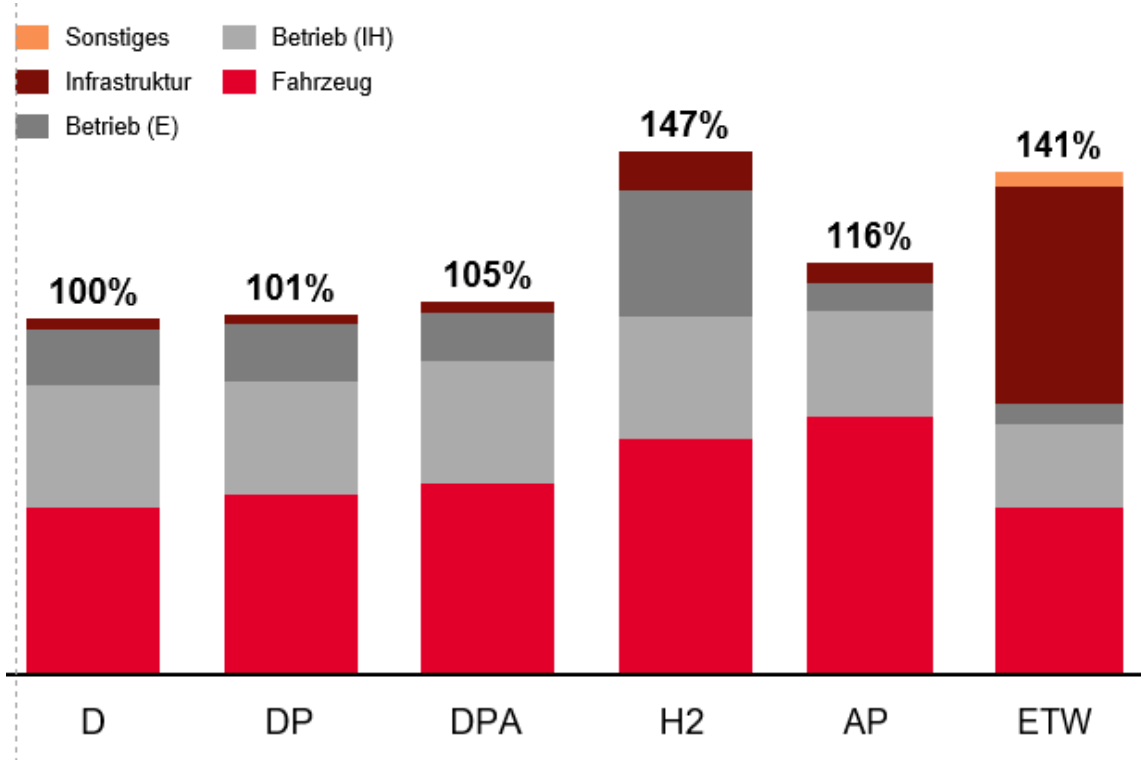
Hydrogen train

Electrification

Comparison of alternatives:
Total cost comparison of diesel routes in Austria

ÖBB

Alternative Antriebe

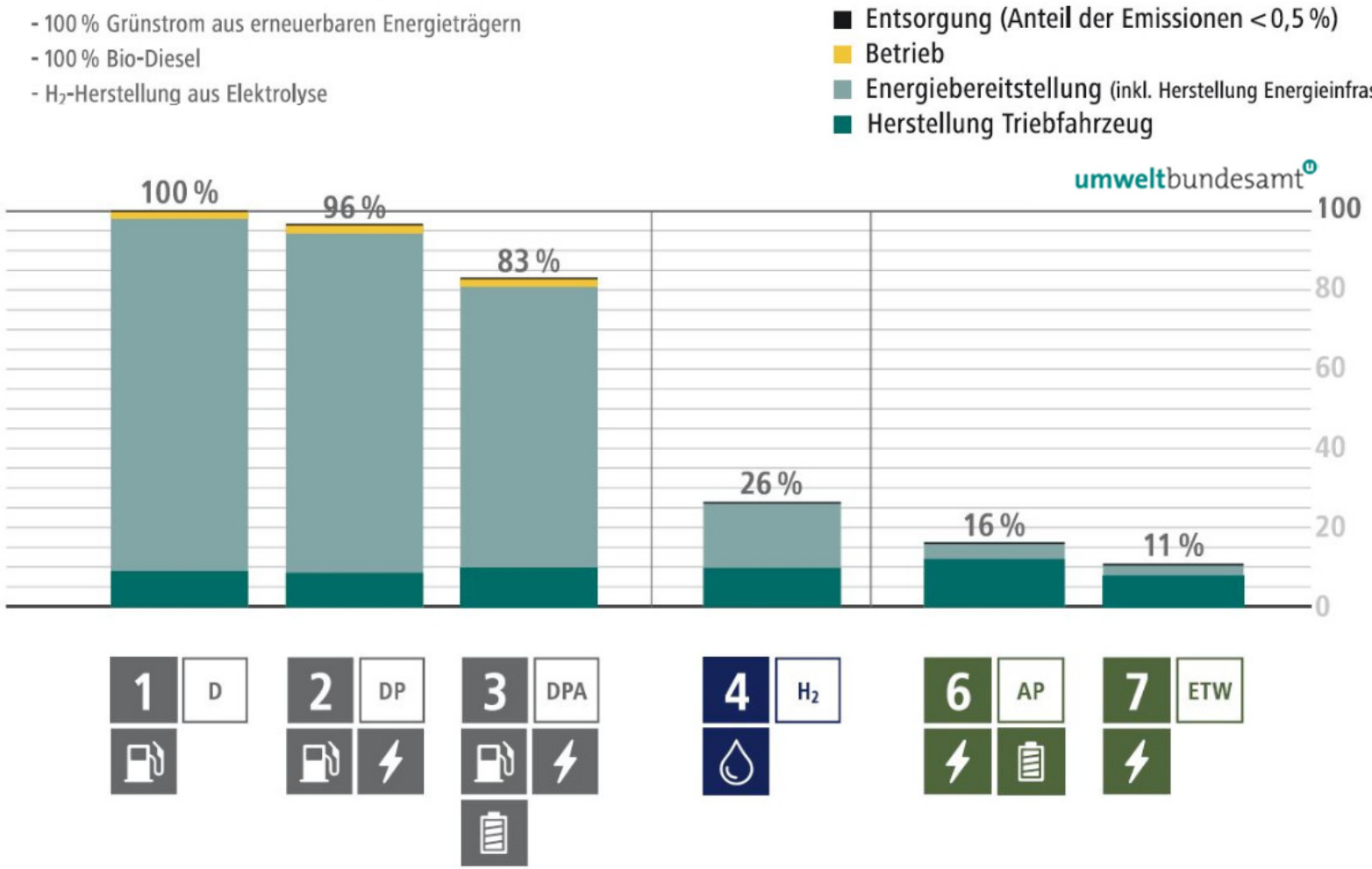


D	Diesel
DP	Diesel-Panthograf
DPA	Diesel-Panto-Battery
H_2	Hydrogen
AP	EMU with Battery
ETW	Electrification

Total Lifetime CO_2-Emissions:
Target 2030

Alternative Antriebe

- 100 % Grünstrom aus erneuerbaren Energieträgern
- 100 % Bio-Diesel
- H_2-Herstellung aus Elektrolyse



Alternative use of vehicles / electrification:
Advantages / disadvantages

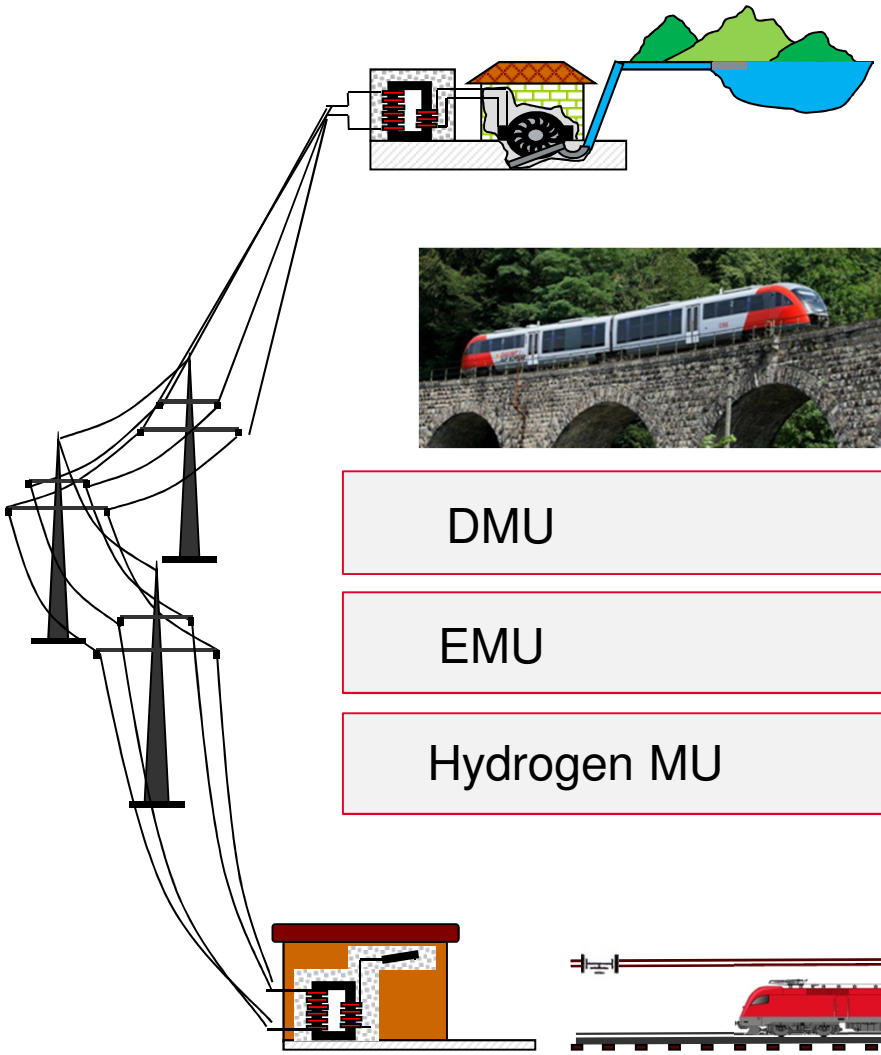
ÖBB

Alternative Antriebe

	Electrification	Battery Train	H_2 Train
advantages	environment-friendly, Communication		
	Low-cost operation (Energy / Maint.)	No need for line conversions	
	Energy-efficient operation		Range of vehicles
Neutral		Limited range	Adaptation of maintenance locations + equipment
	Fleet standardisation		
disadvantages	High investment for electrification	Development of charging infrastructure Power supply available	Development of tank infrastructure
	Maintenance costs line	Charging times Influences on circulation plan	High operation cost

Comparison of CO2 emissions:
DMU, EMU, HMU

Alternative Antriebe



DMU	3,08	3,08	$kgCO_2/km$
EMU	0,99	1,89	
Hydrogen MU	3,41	6,52	

Germany	currant av.	474g CO_2/kWh
Austria	currant av.	248g CO_2/kWh
Diesel		3,08kg CO_2/Liter

Quelle: Umweltbundesamt

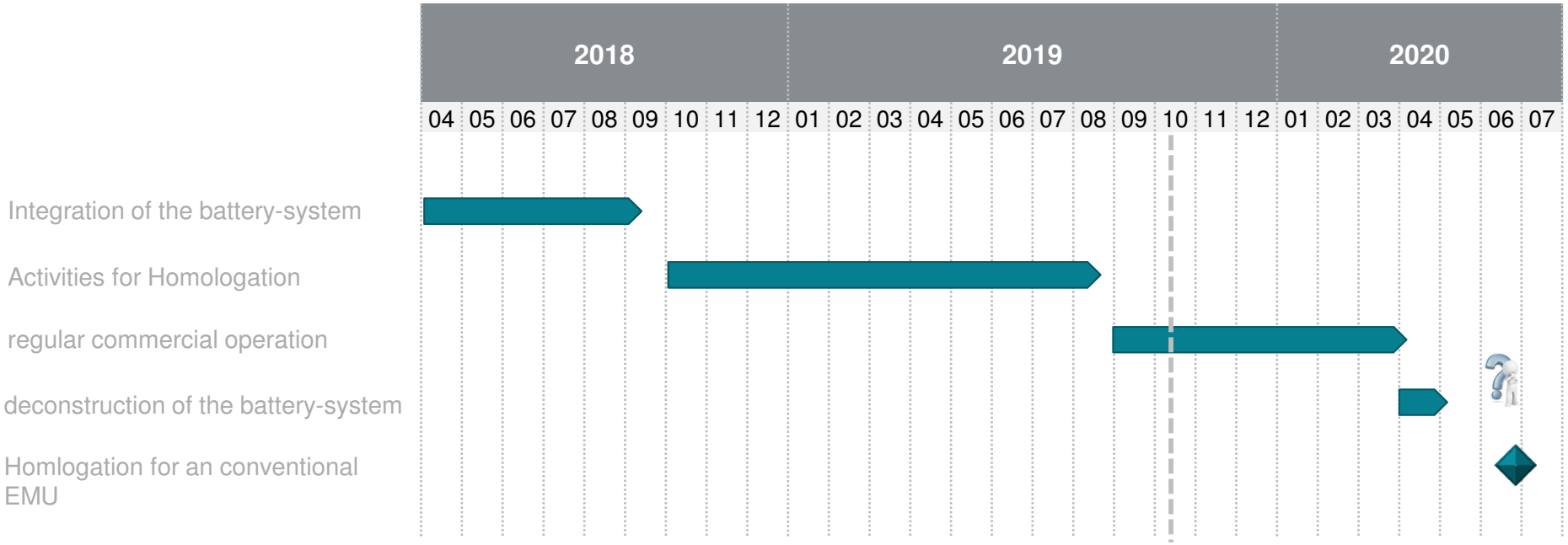
Contents

Alternative Propulsion
General aspects

Cityjet ECO
Pilot-Project of ÖBB-Personenverkehr AG

Discussion

Cityjet eco – Project timeline

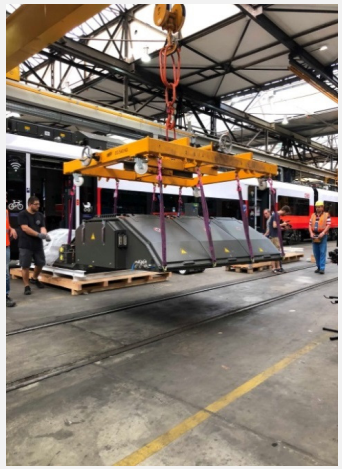


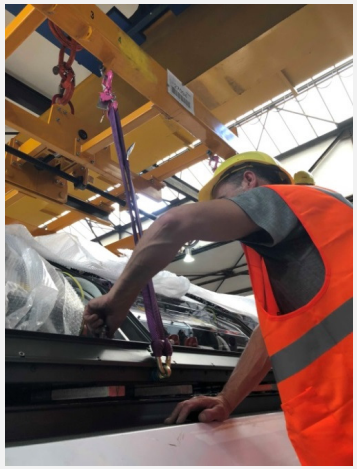
the Project is a cooperation between the ÖBB Personenverkehr und Siemens Mobility

Implementation of the battery components

The Desiro ML Cityjet vehicle concept is predestined for extension to a battery-powered vehicle

advantage: the complete battery equipment can be accommodated on the centre car

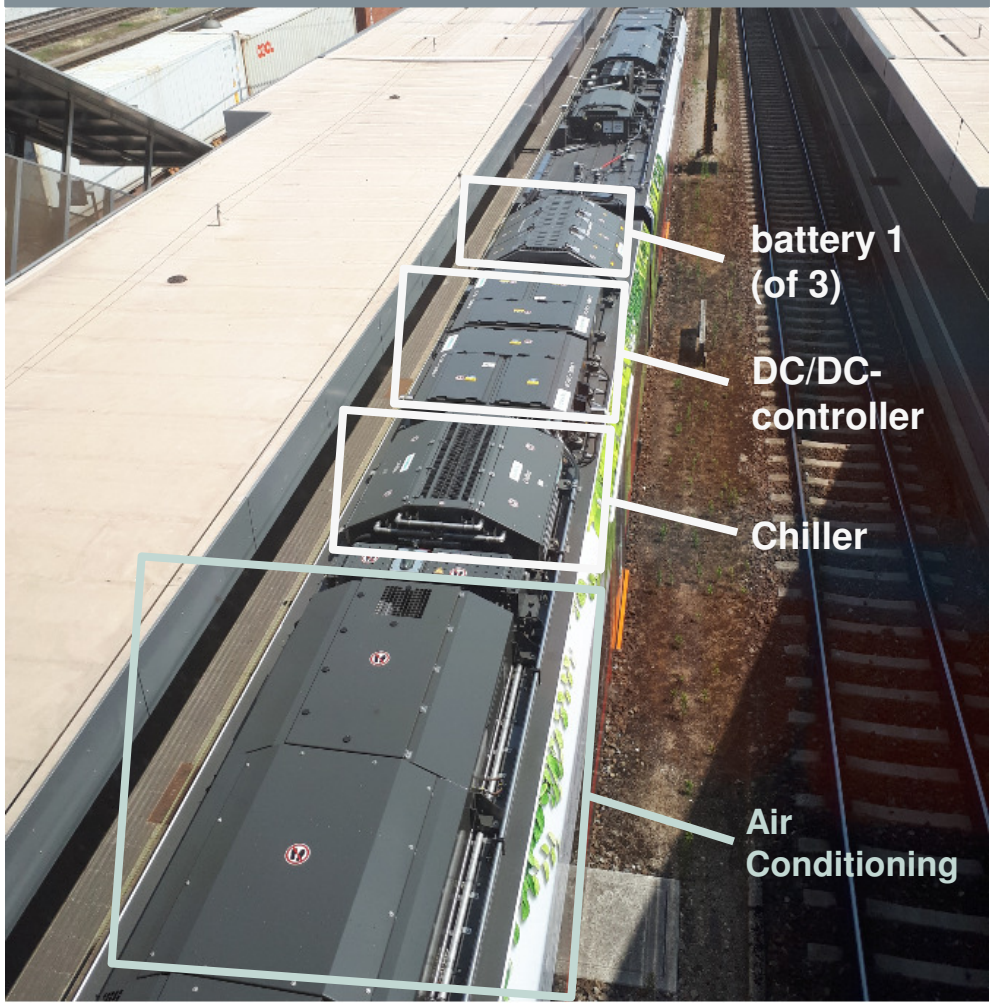




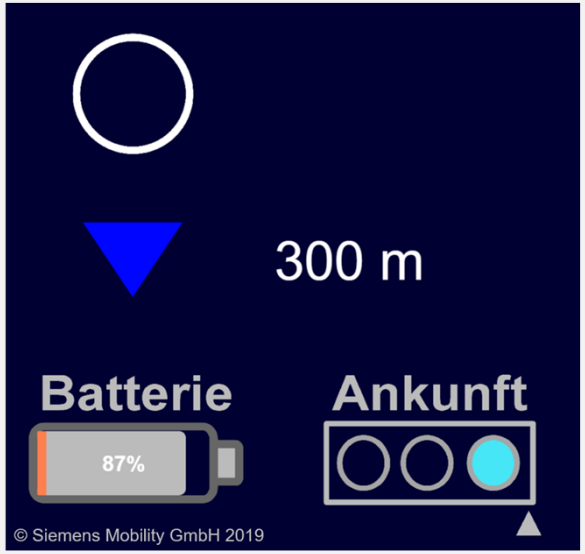
The **battery system** includes:

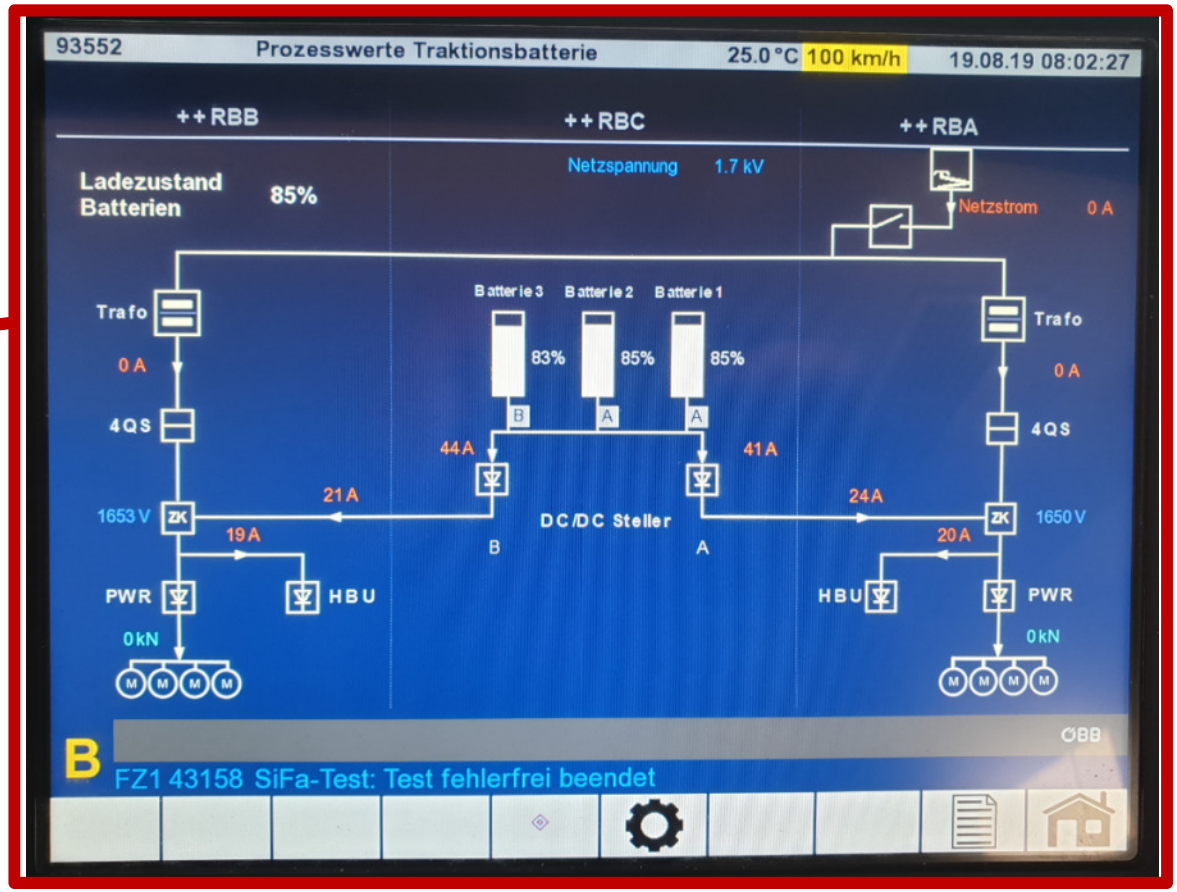
- 3 battery container
- 2 DC/DC controllers
- 1 chiller (for cooling/heating)

components of the cityjet eco



visualization of the battery-system





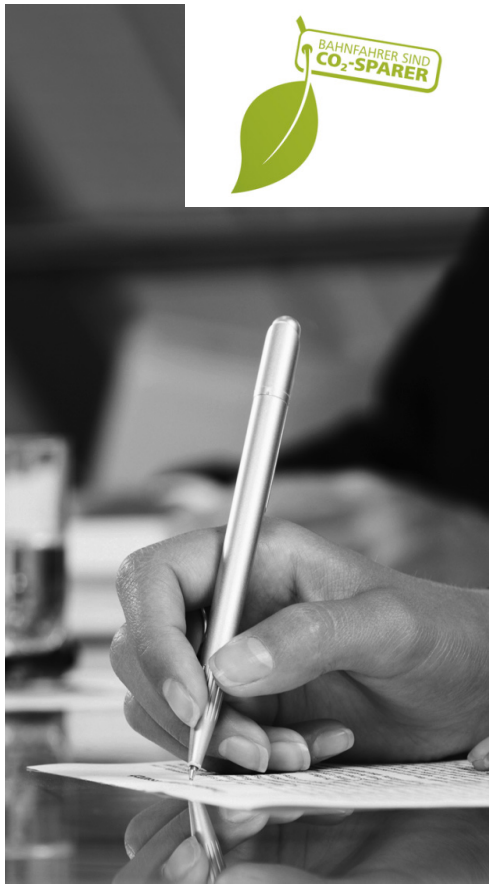
In the project, importance was attached to ease of use and little training effort.

Additional, a Driver-Assistance-System was developed in the project to signalize the range forecast and to give recommendations for the most energy-efficient driving style

Cityjet eco – Technical Data

Technical Data	AC mode	Battery mode
Wheel arrangement	Bo'Bo'+2'2'+Bo'Bo'	
Track gauge	1,435 mm	
Maximum speed	140 km/h	120 km/h
Traction power	up to 2,600 kW	
Installed battery capacity		528 kWh
Starting acceleration	1.0 m/s^2	0.77 m/s^2
Power supply	15 kV AC / 25 kV AC	
Length (over coupling)	75,152 mm	
Floor height	600 mm	
Entrance areas	6 on each urban train	
Capacity	244 seats on urban train	
Maximum axle load	< 17 t including traction battery pack	
Crashworthiness	TSI and EN 15227 conform	
Fire protection	CEN / TS 45545 and DIN 5510 Fire protection level 2	

Cityjet eco – Technical Data



Social benefits

1 Lower costs
The total cost of ownership (TCO) of a battery train is lower compared to conventional diesel trains

2 Reduced emissions
Reduction of CO2, NOx and particulate emissions

3 Noise reduction
Compared to diesel vehicles, the noise level is reduced. Especially in the station, for example in preheating mode

Benefits for operators and passengers

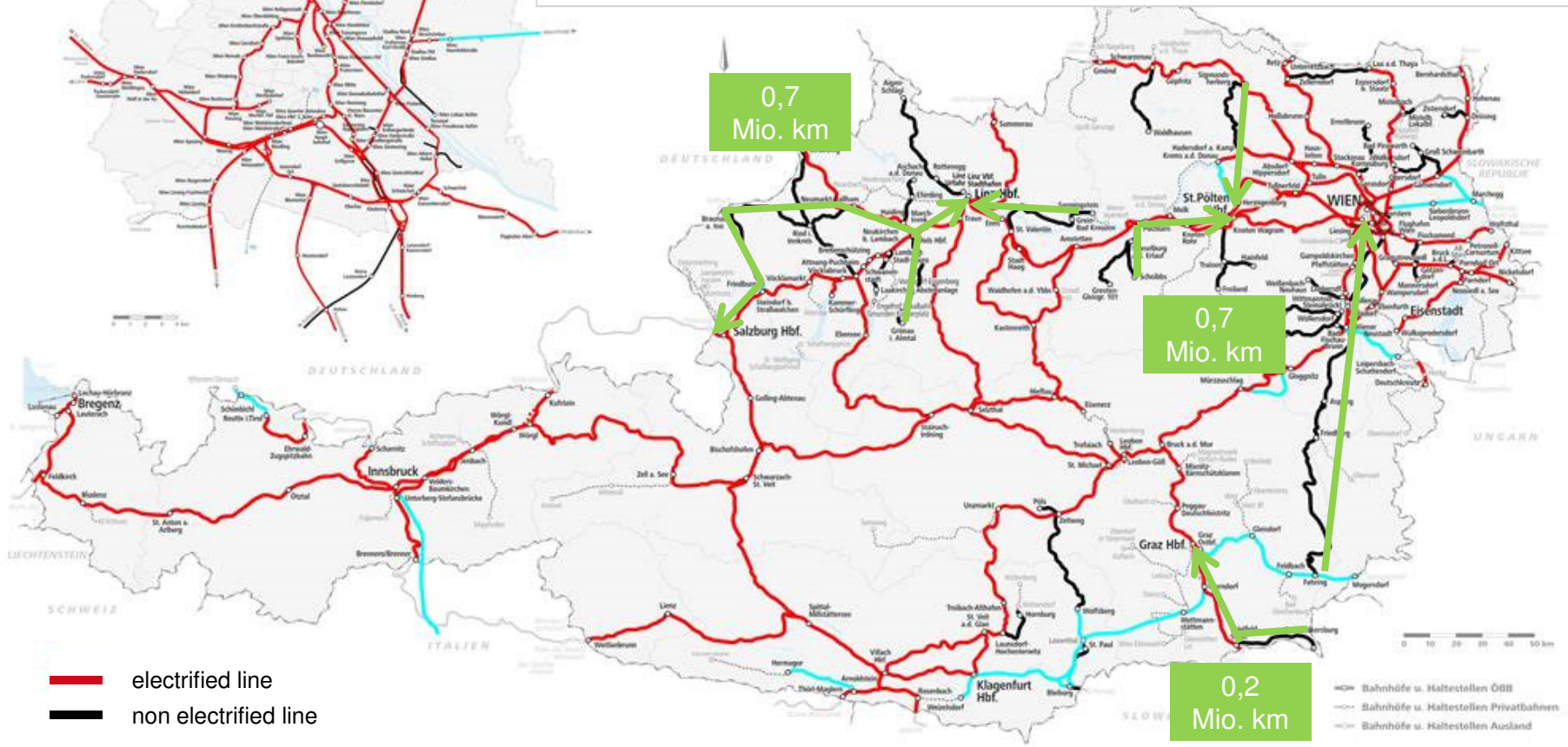
4 More flexible operation
through battery railcars and conventional EMUs, fleet standardization, new connections can be offered

5 Avoidance of infrastructure costs
Avoidance of expensive, uneconomical electrification projects through the use of battery trains

6 Greater comfort and fewer transfers
Direct connections, shorter travel times and greater comfort
→ increased passenger numbers

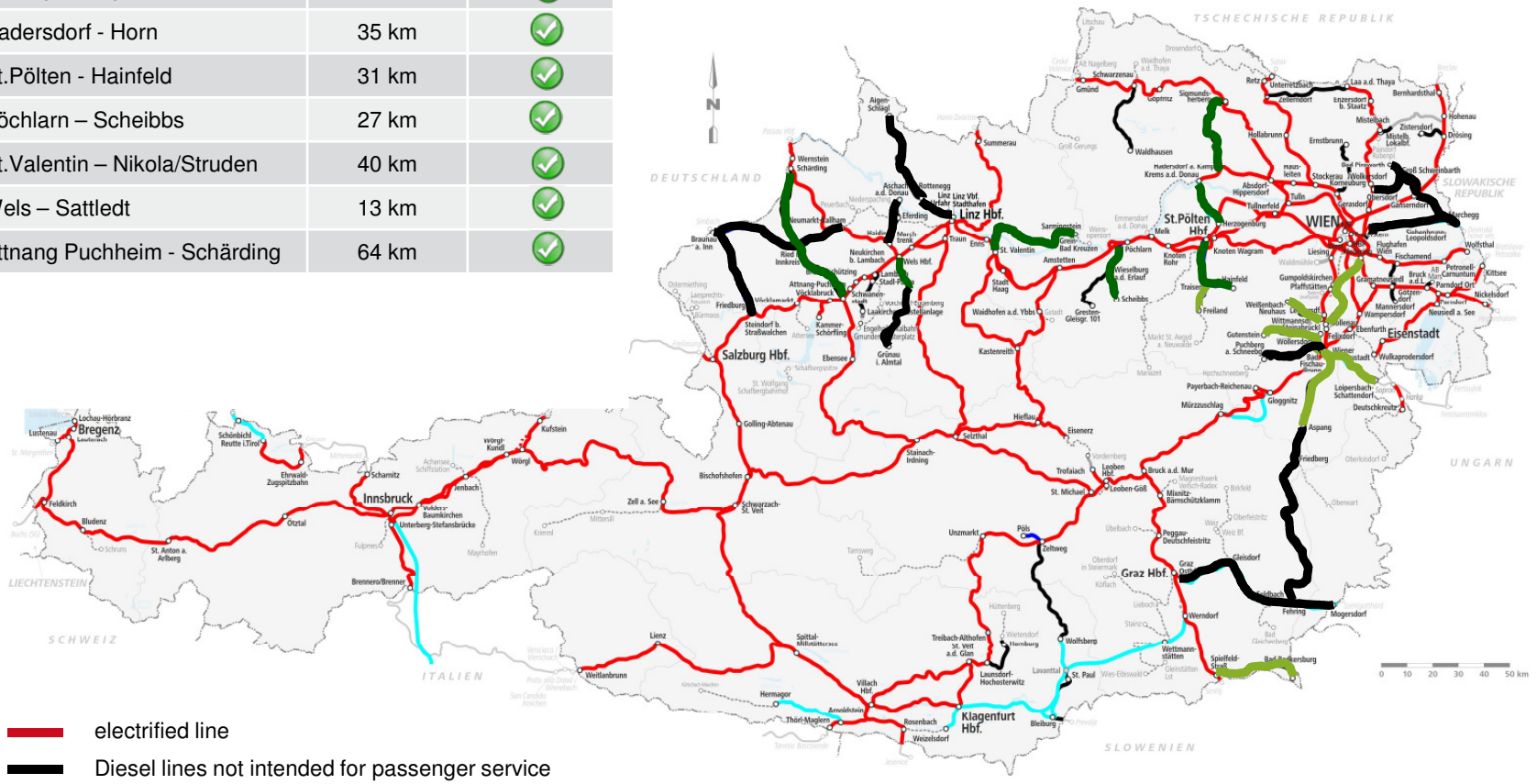
potentials of battery-electric trains in Austria

- Currently 2.1 million train-km in diesel traction "under contact wire".
- Reduction by 0.5 million km through electrification
- Remaining potential of 1.6 million km for battery trainsets (+ replacement of diesel traction on non-electrified lines)



Results of Operation

Route	Length (1 Direction)	Result
Herzogenburg - Krems	20 km	✓
Hadersdorf - Horn	35 km	✓
St.Pölten - Hainfeld	31 km	✓
Pöchlarn – Scheibbs	27 km	✓
St.Valentin – Nikola/Struden	40 km	✓
Wels – Sattledt	13 km	✓
Attnang Puchheim - Schärding	64 km	✓



- electrified line
- Diesel lines not intended for passenger service
- Diesel routes already in passenger service with Cityjet eco
- Diesel routes still in passenger service with Cityjet eco
- new electrified line

Outlook in the future

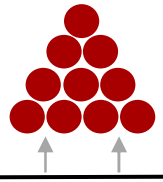
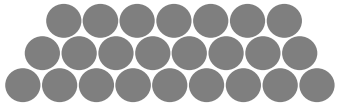
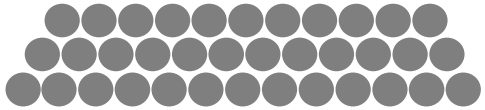
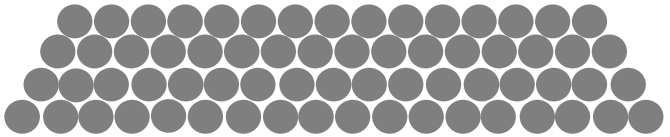
Implementation Desiro Mainline

- 1st ETCS Baseline 3.4 Implementation worldwide

- Power Systems 15kV/16.7Hz~ and 25kV/50Hz~

- Homologation for 4-fold traction

ERA-TV
Desiro ML cityjet **BL04.23**a
- Class 4744
- Class 4746

4th Railway Package	***Baseline 3.0*** **Homologation for the final concept for 24 (+11) battery trains**		Homologation AUT Class 4746 & 4744 PZB & ETCS Only the subject areas that have not yet been assessed for BL 1.0 and BL 2.0.
3rd Railway Package	***Baseline 2.0*** **Homologation for 24 (+11) pre-equipment battery trains**		Extension of Homologation AUT Class 4746 & 4744 PZB & ETCS
	Baseline 1.0 **Homologation for battery Prototype**		Homologation AUT Class 4746 PZB
	Baseline 4.23 **Homologation for conventional Desiro ML**		AUT & GER Class 4744 PZB & ETCS Class 4746 PZB & ETCS

Fullfillment of all TSI´s and NNTR´s

TSI = Technical specifications for interoperability

NNTR = notified national technical rules

Thank you for your attention

Alternative Propulsion
General aspects

Cityjet ECO
Pilot-Project of ÖBB-Personenverkehr AG

Discussion