XXVIITH WORLD ROAD CONGRESS PRAGUE 2023

PIARC

BALANCING MISSED OPPORTUNITIES AND STRANDED ASSETS

GUIDING PRINCIPLES OF STRATEGY DEVELOPMENT AND IMPLEMENTATION FOR CLIMATE NEUTRAL ROAD FREIGHT TRANSPORT FROM AN ECONOMIC POINT OF VIEW

TSTF22: ELECTRIC ROAD SYSTEMS (ERS)

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RESEARCH OBJECT

THERE ARE TWO OPTIONS FOR AN E-ROAD FREIGHT TRANSPORT IN GERMANY

BET-System

- Battery electric trucks (BET) and …
- Charging points (CP)
- … including electricity grid connection
- Provision of electricity

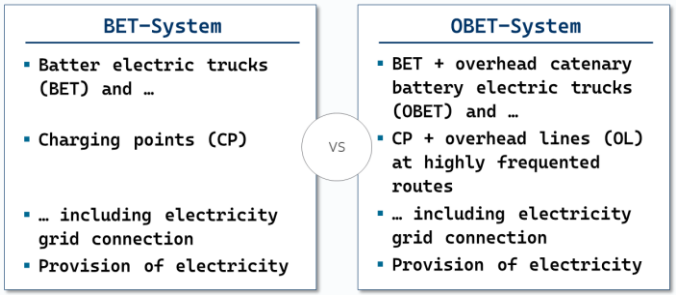
VS

OBET-System

- BET + overhead catenary battery electric trucks (OBET) and …
- CP + overhead lines (OL) at highly frequented routes
- … including electricity grid connection
- Provision of electricity

RESEARCH QUESTIONS

WE FIRST LOOK AT THE LONG TERM PERSPECTIVE IN ORDER TO DERIVE SHORT TERM RECOMMENDATIONS FOR ACTION

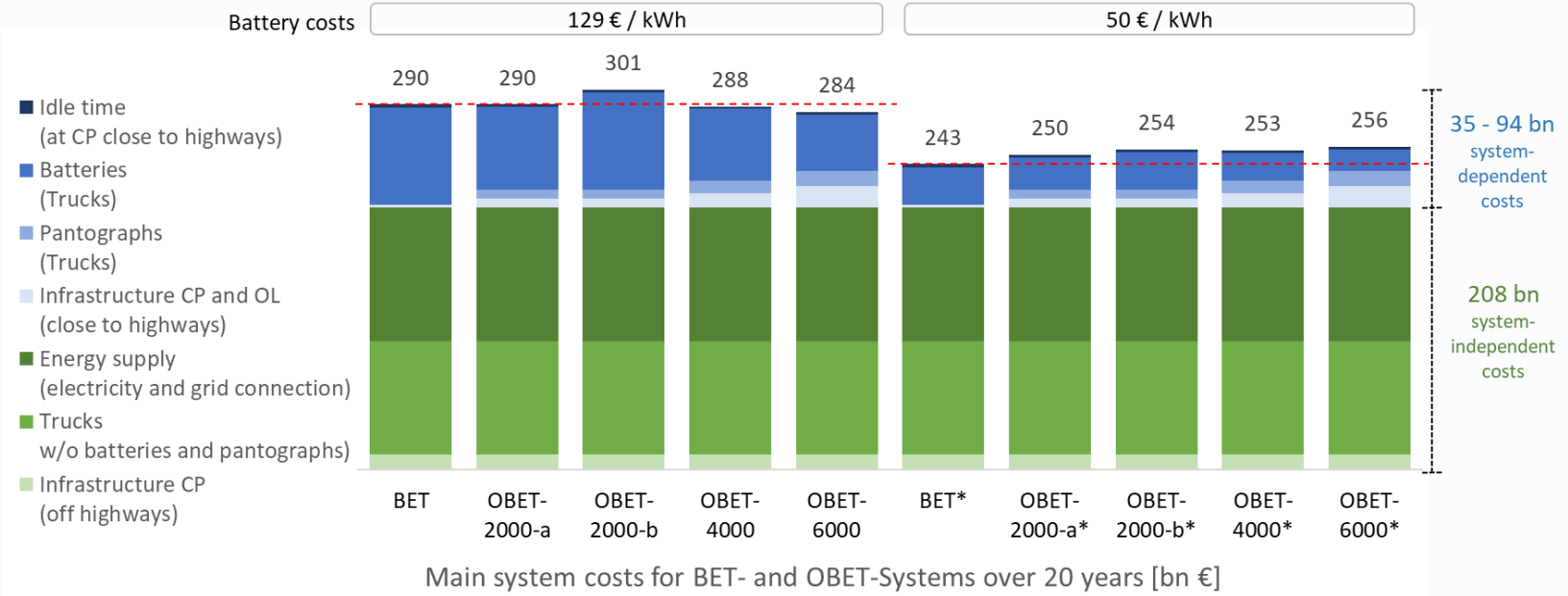


1 Which system is superior in the long term (final state)?

2 What short term recommendations for action can be derived, taking into account the existing uncertainties and the expected gain in knowledge?

COMPARISON OF MAIN COST ITEMS FOR A BET-SYSTEM AND 4 POSSIBLE OBET-SYSTEMS IN THE FINAL STATE

BET- SYSTEM IS SUPERIOR IN MOST CASES WE LOOK AT, BUT COST DIFFERENCES ARE MINOR



Main system costs for BET- and OBET-Systems over 20 years [bn €]

* Comparison was updated after the submission of the paper. Design of BET and OBET-Systems we look at is based on calculations by Fraunhofer ISI and own assumptions. More details in the appendix A and B.

OVERVIEW OF COMPARISON IN THE FINAL STATE

FIRST EVALUATION, WHICH IS STILL SUBJECT TO UNCERTAINTIES, LEADS TO A NECK-AND-NECK RACE BETWEEN BET- AND OBET-SYSTEM

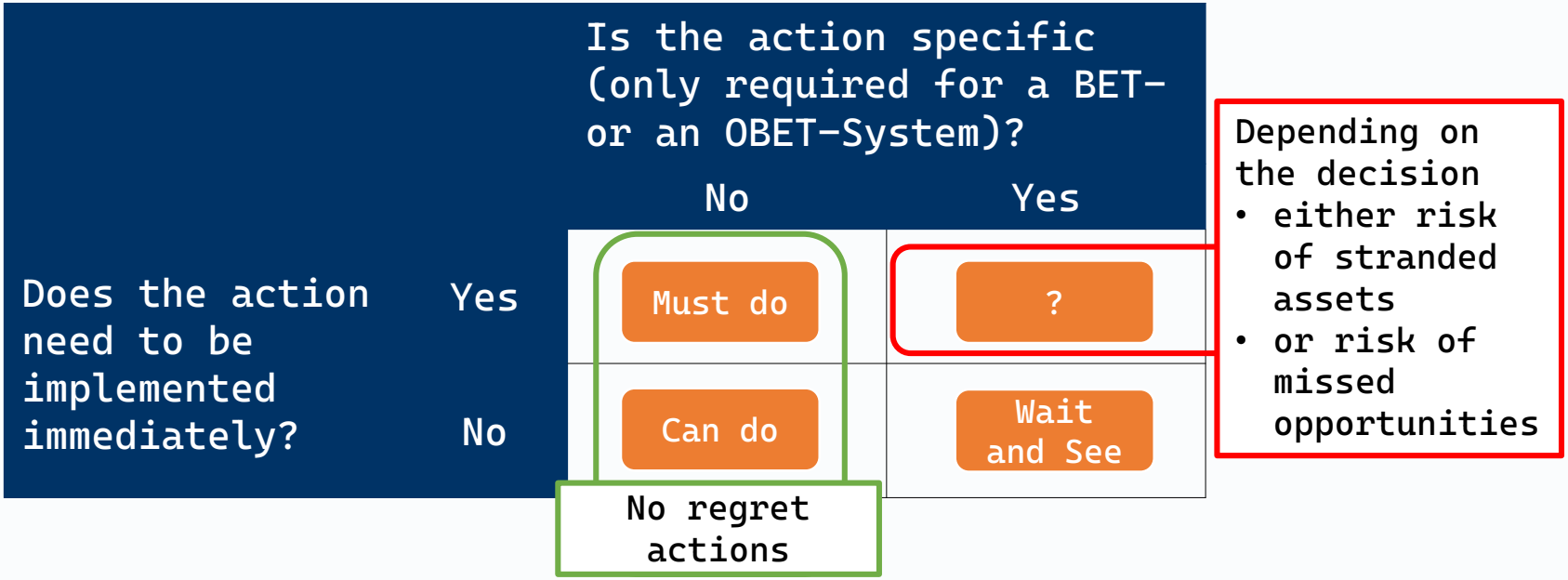
	Evaluation criteria	BET-System	OBET-System
A	**System costs**		
	System-dependent costs	+	
	System-independent costs	≈	≈
B	**Further aspects**		
	Parking and charging areas		+
	Quality and reliability		+
	Institutional issues		+

* More details on further aspects in the appendix C.

+ Superior ≈ On par

APPROACH IN CASE OF A NECK-AND-NECK RACE

IN ORDER TO DERIVE SHORT TERM RECOMMENDATIONS FOR ACTION WE DISTINGUISH 4 CATEGORIES



* Based on Vorwerk, L. / Beckers, T. / Westphal, M. / Bieschke, N. / Hermes, G. (2023): Energiewende, Sektorenkopplung und Infrastrukturen. Eine institutionenökonomische Analyse der zukünftigen (Infrastruktur-)Planung und Finanzierung unter Berücksichtigung juristischer Aspekte.

RECOMMENDATIONS FOR ACTION

WE RECOMMEND TO MAINTAIN BOTH OPTIONS IN THE SHORT TERM AS TODAY'S RISK OF MISSED OPPORTUNITIES IS HIGHER THAN TODAY'S RISK OF STRANDED ASSETS

No regret action	• Build up of CP, especially along highways • Develop institutional framework for CP
Actions to maintain and strengthen options and to prepare for decision	• Continue R & D activities for OBET-System in order to gain knowledge and ensure future availability of main components • Further investigate design questions regarding a BET- and an OBET-System • Explore risks and develop mitigation actions

OUTLOOK

FOLLOWING RESEARCH TOPICS SUPPORT FUTURE DECISION-MAKING AND THE TRANSFORMATION OF ROAD FREIGHT TRANSPORT

European interoperability and benefits of coordination	*Interdependencies with road transport based on hydrogen and synthetic fuels*
Detailed view on design of BET- and OBET-Systems in Germany and Europe	Organisational and institutional design for BET and OBET-Systems

APPENDIX A: DESIGN OF (O)BET-SYSTEMS WE LOOK AT

	BET-System	OBET-System 2000-a	OBET-System 2000-b	OBET-System 4000	OBET-System 6000
A.1) Infrastructure close to highways					
# of MCS-CP	5.941	5.203	5.203	4.834	2.500
Length of OL	-	2.000	2.000	4.000	6.000
B.1) Infrastructure off highways					
# of CCS-LP	150.000	150.000	150.000	150.000	150.000
A.2) Trucks					
# of BET	300.000	150.000	150.000	105.000	50.000
# of OBET	-	150.000	150.000	195.000	250.000
Battery capacity of BET (kWh)	500	500	500	500	500
Ø Battery capacity of OBET (kWh)	-	350	500	300	250
Ø Energy consumption of (O)BET(kWh/km)	1,3	1,3	1,3	1,3	1,3
Range of BET (km)	380	380	380	380	380
Ø Range of OBET(km)	-	270	380	230	190

*BET and OBET-System Design is based on
- calculations for the need of CP from Fraunhofer ISI
- and own assumptions

**Updates

Cf. Plötz, P./ Hacker, F./ Jöhrens, J./ Speth, D./ Gnann, T./ Scherrer, A./ Burghard, U. (2021): Infrastruktur für Elektro-Lkw im Fernverkehr. Hochleistungsschnelllader und Oberleitung im Vergleich. Ein Diskussionspapier.

APPENDIX B: ASSUMPTIONS ON FUTURE COSTS, SERVICE LIFE AND TOTAL MILEAGE IN THE LONG TERM

A.1 und B.1) Infrastructure	
CAPEX	
MCS-CP (€ / piece)	400.000
CCS-CP (€ / piece)	80.000
OL (both directions) (€ / km)	2.500.000
Service life (years)	20
A.2 und B.2) Trucks	
CAPEX	
Battery	
General assumption (€ / kWh)	129
Variation within sensitivity (€ / kWh)	50-250
Pantograph	12.000
Truck w/o batteries and pantograph (€ /piece)	75.000
Service life (years)	5
A.3) Ø time costs (€ / h)	35
B.3) Ø electricity costs incl. grid connection (ct / kWh)	10
Total mileage of BET & OBET in Germany (vehicle-km / year)	40,6 bn

**Updates

APPENDIX C: FURTHER ASPECTS TO THE EVALUATION IN THE FINAL STATE, WHICH ARE IN FAVOUR OF AN OBET-SYSTEM

(Temporal) shortages of parking and charging areas	Shortages of parking likely to impede and complicate development of Charging Stations. Due to reduced need for parking/charging areas related risks for the OBET-System are lower
Quality differences and reliability	OBET-System eliminates some coordination and transaction costs in the context of reservation systems for CP
Institutional issues	Institutional challenges of CP provision higher than of OL provision due to coordination and power issues

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