The BSR electric Project in conjunction with the Clean Shipping Project Platform

E-Ferries & Urban E-Mobility

Local Workshop

Electric drives, alternative fuels, experiences and benefits from the automotive sector

Proceedings of the Workshop

Leipzig, March, 5 2020

Funded by the Interreg Baltic Sea Region Program

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Introduction

The future of mobility is electric.

This motto is heard by those who advocate clean urban mobility. Electric mobility also has a long history.

1832: Robert Anderson is said to have built an electric cart in Aberdeen around 1832. In November 1881, Gustave Trouvé presented an electric car at the International Power Fair in Paris (Wakefield, 1994) 1888: The 1888 Flocken electric car (Auto-Presse.de, 2012) from the Coburger Maschinenfabrik A. Flocken is regarded as the first four-wheel electrically powered automobile worldwide. From 1896 to 1939 there were around 565 brands of electric cars worldwide (Guinness, 1980). The decline of electric cars began from around 1910. The reasons are the greater range, the cheaper oil as fuel and the “highly sensitive batteries”. (Spiegel, 2016). The electric motor only remained as a starter in the automobile.

1834: As early as 1834, Moritz Hermann von Jacobi developed the first practical electric motor in Potsdam. In September 1839, 13 September, he installed a 220 watt DC motor he had developed and with paddle wheels in a rowboat and tested the first electric watercraft on the waters of the Neva River in St. Petersburg. The electrical energy came from galvanic elements with zinc-copper electrodes. This was the first application of an electric motor in practice as well as the first example of electromobility.

1909: The first electric motor boat in Germany was used on the Königssee in the Bavarian mountain town of the same name. The ship with the name "Accumulator" (100 years of electric motor shipping on the Königssee, 2009) was used as the first electric ship in Germany. Since then, electrically powered boats have had a long tradition on the Bavarian lakes.

1879, 1881: The first electric tram was put into operation in Berlin-Lichterfelde, 1881 after some resistance to previous projects. The world’s first usable electric locomotive was presented by Siemens in 1879. The attempt to obtain a concession for an electric elevated railway to Friedrichstrasse in Berlin failed due to resistance from local residents. The following project on Leipziger Strasse also failed due to fears of the devaluation of the houses of the residents.

1876: Internal combustion engines as drives in mobility later followed later than electric motors. In 1876, Nicolaus August Otto developed a so-called flying piston engine, also called an atmospheric engine, based on a Lenoir two-stroke gas engine patented in 1860, and in 1864 he founded the world's first engine factory in Cologne together with Eugen Langen. The "New Rational Heat Engine" was not registered until February 27, 1892 by Rudolf Diesel at the Imperial Patent Office in Berlin, which later became known as a diesel engine.
1886: The first car powered by an internal combustion engine was invented and createdby Carl Benz with his "Benz Patent Motor Car Number 1" in 1886.

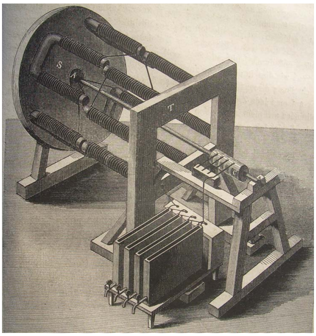


Illustration of the Jacobi (electric) motor with galvanic elements

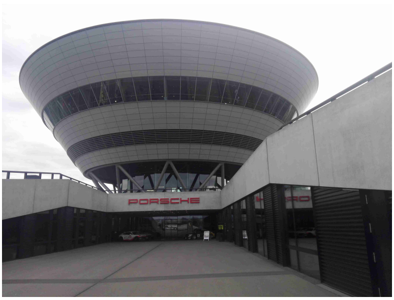
Technological advances

Not really essential has changed in the basic principles for 130 years (1888 - 2018). However, after intermittent ups and downs and a certain continuity of wired applications, electromobility prevails, especially in non-wired systems. Technological advances in design, materials and manufacturing methods have made energy sources in the form of better galvanic cells, e.g. lithium cells are now available and inexpensive, improved powertrains, better opportunities for expanding infrastructure and increased environmental awareness are driving factors of this development.

The BSR electric Workshop in conjunction with CSHIPP

The BSR electric project starts at the interface where currently available technology is being transferred to social use. The use of new technology is accepted in society when a benefit for the individual and for society becomes recognizable. Sometimes, new technologies are slow to gain acceptance, as history shows. The benefits of new technology can be understood both in avoiding damage and in providing benefits of various kinds. (Pull and push) Electric mobility is often associated with electric cars. There are also a number of other e-mobility solutions that are used for solutions for local public transport as well as for special transport tasks in companies. BSR electric focuses on promoting the implementation of electric vehicle solutions in urban areas. This applies to local public transport, municipal transport solutions, relieving the burden on inner cities and networking them with one another. In the project, the associated transformation processes are to be supported by information, exchange of experience, knowledge transfer and best practice examples.

The workshop is dedicated to the use cases of e-mobility on water (e-ferries and clean ships), electric buses and special vehicles. The aim of the event was to provide an overview of technical and energetic questions as well as relevant related topics of electromobility and to discuss and categorize the issues, contents and results that are essential for implementation with the stakeholders.



The workshop took place at the Porsche event centre and plant in Leipzig on March 5, 2020.

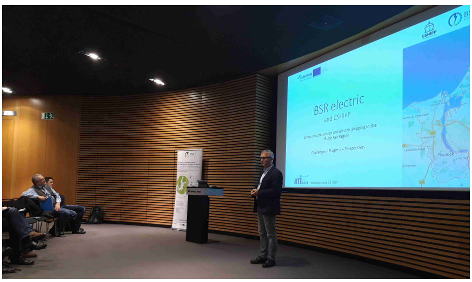
Electromobility on water (electric ferries, water taxis, ships)

According to information and discussion by the authors and stakeholders, electrically powered ferries on connections with short journeys as well as on protected waters or inland waters are well suited for electrification. In an urban environment, the infrastructure requirements are usually in place or can be implemented with little effort. Experience has shown that due to the relatively low drive power required for such e-ferries, solar energy can largely be used as an energy source.

It could also be shown that the electrification of ferry connections in inland waters has great potential for both the operation and the production of electric ferries. In principle, this fact can be transferred to ferry connections in the Baltic Sea region, and the first successful implementation of e-ferries in Denmark, Norway, Finland and Germany shows this.

Connection to the automotive sector

In addition to the questions mentioned, the expected effects of automobile production with its large numbers on electromobility on water with regard to technological progress, but above all the economic (price) advantages were discussed. This is one of the reasons why the location of the workshop was chosen accordingly.



Opening of the event

Clean shipping and electromobility

The connection to the platform project CSHIPP (Clean Shipping Project Platform) results directly and indirectly from electromobility and the question of how the success of e-ferries can be implemented on larger ships.

Therefore, it is about determining the current status of the game and defining future requirements for clean shipping. Electric drives can also make a significant contribution in this area.

Future requirements for clean shipping should be reflected in the studies and in the workshops.

Electric ferries for urban use and on inland waterways

- Electromobility and integration in multimodal transport systems
- Infrastructures and energy supply
- Experience in municipalities and transfer to other regions as the basis for planning, tendering and implementation
- Experience in the daily operation of e-ferries (technical, social, economic)
- Requirements and potential for electrical ferry connections in the Baltic Sea region and in Germany

Electrical energy systems, autonomous driving, "intelligent" systems

- Autonomous maritime systems - opportunities, risks, perspectives
- drives for autonomous ocean freight robots
- Autonomous electrical energy systems for more performance

Alternative fuels, energy converters for electric drives

- Hydrogen as a fuel alternative for inland and ferry shipping
- Ammonia as a fuel alternative
- Initiatives to use hydrogen in the maritime economy
- Best practice examples in the EU area on hydrogen and electromobility

History and current technological developments show the way that the future of mobility will be electric.

Auditorium

Workshop

“E-Ferries & Urban E-Mobility – Electric drives, alternative fuels, experiences and benefits from the automotive sector”

March, 5 2020

Porsche Leipzig GmbH / Veranstaltungszentrum,
Porschestraße 1 – 04158 Leipzig

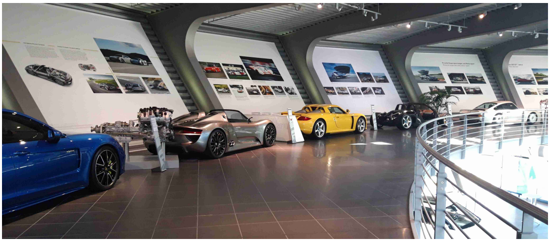
11:45	Arrival, Reception
12:00 - 13:00	Lunch
13:00 – 15:00	**Workshop**
15:00 – 16:30	Visit of the Porsche production facilities
16:30 – 17:00	Get together in the customer center
17:15	End of function

Themes and Presentations

Opening and Greetings	Thomas Kozian ATI Küste GmbH
BSR electric – Urbane Electric Ferries and Electric Shipping in the Baltic Sea Region– Challenges, Progress and Perspectives	Alexander John ATI Küste GmbH, Rostock BSR electric & CSHIPP
Urban Electric Mobility – an Example of the Verkehrsbetriebe Hamburg-Holstein (VHH)	Nicolas Restrepo Lopez, HAW Hamburg
Experiences from every day operation of E-Ferries – What implementers of urban E-Ferries should know	Knut Schäfer Weiße Flotte GmbH, Stralsund
Electric energy storages for mobile Applications – Hydrogen and Alternatives	Dr. Gerhard Buttkewitz IBB Rostock
Shipbuilding and Aspects for energy saving and clean Shipping	Dr. Detlef Andrich Baltic Engineering Flare Rostock
Electric Mobility with Special vehicles for disabled persons– Challenges in technological change	Hinrich Petersen ASP GmbH Hamburg
Afterwards: Visit of the Porsche-Fabrication	***

This event is partly financed by the EU Interreg program as part of the Interreg Project „BSR electric“.

Based on the availability of speakers, stakeholders, participants etc. the following agenda shows the course of the workshop. The workshop took place on March 5, 2020 in the event center of the Porsche factory in Leipzig.



Impressions of the exhibition

Presentations

BSR electric and CSHIPP - Urban Electric Ferries and Electric Shipping

Alexander John

ATI Küste GmbH
Gesellschaft für
Technologie und Innovation
Rostock

BSR electric –
Urbane Electric Ferries and Electric Shipping in the Baltic Sea Region– Challenges, Progress and Perspectives

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BSR electric

and CSHIPP

Urban electric Ferries and electric shipping in the Baltic Sea Region

Challenges – Progress – Perspectives

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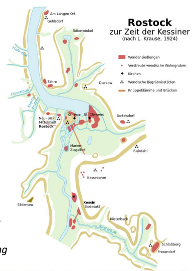
Agenda

- The project BSR electric
- The project platform CSHIPP
- Challenges
- Progress
- Perspectives



Rastocku *‚roz' – river and ‚tok_ – confluence, where the river flows together, also Raudstokk (Knýtlinga saga, 1260)*
Rostock, ***росток*** *(russ./ slav.), Stem of a plant at the very beginning … "Seeds sprouted."*
A sign of the beginning development of something

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BSR electric

"Fostering e-mobility solutions in urban areas in the Baltic Sea Region"

- Enhancing of e-mobility solutions in urban transport
- E-mobility beyond E-Cars: Alternatives
- Analysis, research and demonstration of diverse e-mobility solutions
- Transnational pilot activities, study visits
- Webinars, seminars, conferences for capacity building
- Roadmap white papers, recommendations

- No technical development - rather support and guidance for public authorities, companies, planners, transport providers

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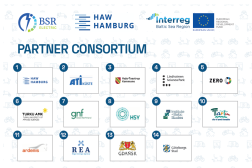
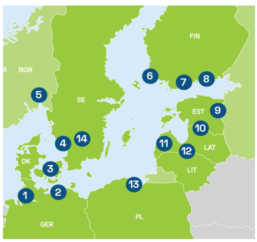
BSR electric

Aims

- Broadening of acceptance of e-mobility in the BSR
- Information and know-how transfer
- Initiation of technical innovations
- Use of regenerative energy sources
- Raising energy independence from fossil fuels
- Effective contribution for environmental protection
- Enhancing of infrastructure and special development
- Fostering societal change of behavior in mobility





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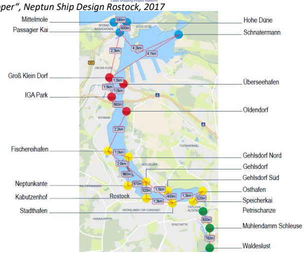
E-Ferry in Rostock

„Warnow Hopper", Neptun Ship Design Rostock, 2017



Starting point:
- ATI's dealing with maritime issues
- Continuation of these topics on electric mobility on waters
- Extension of the work from a technical perspective to a more social perspective

Motivation:
- Strengthening of ATI's competences
- Improvement of the position as a consultant countrywide and the region
- Synergy by linking activities

Revier Rostock – view to north. (Sascha Kilmer, panoramio.com)

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E-Ferries (Use case 7)

How can e-Ferries and e-Water taxies meaningful for urban transport?
- as a supplement of existing
- to fulfill environmental goals
- to make public transport more comfortable

How feasible is it? Necessary or nice to have? Affordable?

What potentials exist for urban transport and touristic?

What are challenges and obstacles? What are the perspectives?

What is it what a city really needs to have? Economical? Socioeconomical? What are FAQ?

How to deal with: Concurrent plans, pedestrian bridge, electric ferry, "Warnow-Hopper"-concept, existing traffics?

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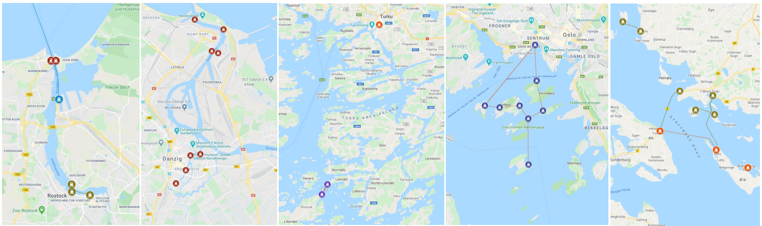
E-Ferries in the BSR - selected examples -

How other cities dealing with these issues?
How findings should be transferred and applied to other cities?



Rostock Gdansk Turku Archipelago Oslo Danish South Sea

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E-Ferries (Use case 7)

Methods & Outputs

- Workshops & Proceedings
- Roadmap for e-mobility (in cooperation)
- "Guideline for stakeholders"
  for knowledge transfer and recommendations
  based on findings and experiences of
  operation and best practices

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Clean Shipping Project Platform – CSHIPP
• brings together projects and organizations
• focused on enhancing and promoting clean shipping in the BSR
• The objective is to increase the impact of and connect the dots between the several projects working for clean shipping
• The projects involves in the platform shared topics and views of clean shipping from different angles
• CSHIPP synthesizes the projects' results into a more comprehensive whole.


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CSHIPP – Inter-Project Platform
ATI Küste is partner of CSHIPP as being part of BSR electric
• Contributing the e-ferry theme as part of clean shipping
• State of play and future needs of clean shipping technologies
• Expanding the e-ferry issue to e-shipping and clean shipping
• 14 Partners, Work package coop with Aalborg University (DK) Szczecin Maritime University (PL) ATI Küste GmbH
Clean Shipping Project Platform
Dialogue and cooperation between:
BUSINESSES
RESEARCH ORGANISATIONS
POLICY MAKERS
Funded by:
European Regional Development Fund
Norwegian Funding
European Neighbourhood Instrument
Russian Funding
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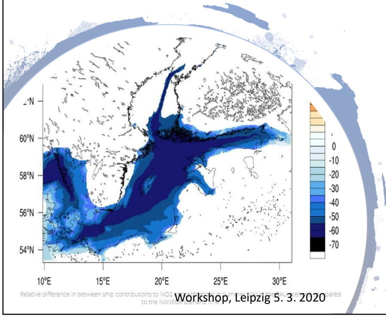
Implementation and outputs

Research, Exchange of experiences,
Partner Meetings and networking
Cooperation in a more scientific Circle

Policy recommendations
Anayses and Whit papers
Mapping of activities → Story Map



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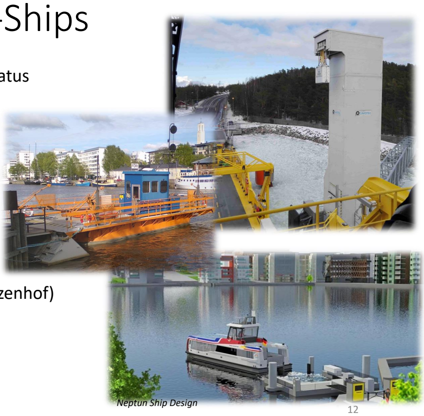
Progress – e-Ferries & e-Ships

When we started: e-ferries were mostly in project status

Today: e-ferries - hybrid ferries were put into service
New projects and studies,
New builds and transformations
→ Norway, Finland, Germany, Denmark …

Rostock (under way)
EU-wide tender for a new e-ferry (Gehlsdorf - Kabutzenhof)
Planned: vehicle is solar powered / grid charged,
similar to "Fährbär"



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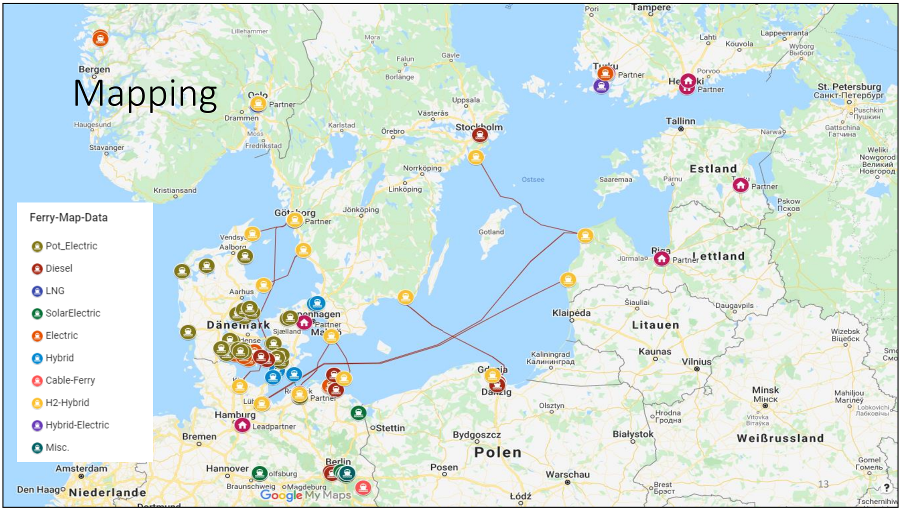

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Challenges – e-Ferries

Expectations, rules and **regulations** …

- Environmental / climate issues, saving emissions
- Improvement of urban environment
- Improvement of comfort for passengers
- Multimodality

Technical:

- Storages, energy densities,
- operation ranges
- categorization

Cat.	Propulsion Power Energy Storage	Ships length Travel duration	Type, Energy system Examples, Notes
1 Urban	20 kW 200 kWh	20 meters 10 minutes	Fully electric, Solar power, urban / river transport, inland waters E-Ferry „Fähr Bär“, BVB Berlin (Germany),
2 Car	500 kW 2000 kWh	75 meters 30 minutes	Fully electric, Battery, energy of one trip ~ 250 kWh, recharge in 15 minutes! E-Ferry „Ampere“, Sogne Fjord (Norway),
3 *Oversea*	*20,000 kW* *> ~3000 kWh*	*200 meters* *~120 minutes*	*HFO/MGO powered. Electric propulsion only for port maneuvers, recharging by onboard gen-sets..* *Hybrid-Ferry „Berlin“ (Scandlines, Danmark/Germany))*

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Challenges – Examples

Sogne Fjord: Ferry „Ampere“, Lavik – Oppedal (Norway)

Infrastructure: national grid too weak in that area, special charger infrastructure necessary

Additional battery buffer (250 kWh) each side

Redundant connectors: plug and pantograph

Oslo: Transforming of all LNG-driven ferry boats of „RUTER“ to e-ferries.

Reason: CO2-Policy of Oslo government, complete shift to electric in all municipal activities, exploitation of exisiting energy resources

Consequence: additional procurement of infrastructure, transformation of vessels, additional investments

Rostock: Concurrent traffic: Tram, Bus, Train and a planed pedestrean / bike bridge

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Perspectives – general

“The future of mobility is electric”

- The global market for e-ships is worth $2.6 B (2015)
- Estimation: $5.2 Mrd.$ (2024) → ~8.2%
- Battery market has doubled since 2015
- ~80% of all coastal vessels could be electrified, meaning for Scandinavia up to 200 ferries
- Estimated potential for Germany: up to 120 ferries (inland waters)

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Perspectives – technical


Use of renewables

Urban E-ferries: Solar, e-power from renewables

Bigger ferries: e-fuels, ammonia, hydrogen, derivates

Optimizations in shipbuilding

New designs, lightweight construction, new production methods

Drive trains and propulsion

Benefits

Benefits from automotive sector (prices)

Low noise, low vibrations (in and out of water)

More comfort

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Perspectives – societal

Autonomous systems for

- urban transport
- Deliveries
- Maritime and energy sector

Smart transportation smart cities

Regaining the inner cities

Sharing, multimodal

Political

Energy independence

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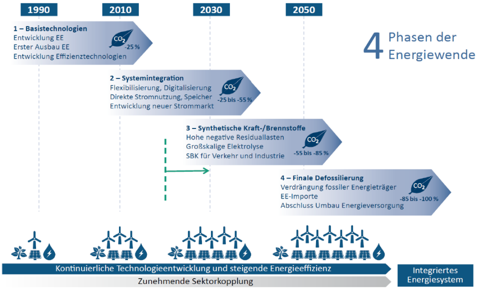
Perspectives – alternative fuels



Where does the fuel comes from?

Leopoldina Nationale Akademie der Wissenschaften
acatech DEUTSCHE AKADEMIE DER TECHNIKWISSENSCHAFTEN
UNION DER DEUTSCHEN AKADEMIEN DER WISSENSCHAFTEN

Quelle: »Sektorenkopplung - Optionen für die nächste Phase der Energiewende«. Veröffentlicht durch acatech, November 2017

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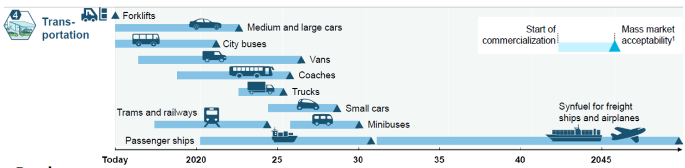
Perspectives – alternative fuels



Roadmap

Quelle: Hydrogen Council

- Korea: 2030 1,8 Mio. Fuel Cell Electric Vehicles FCEV
- Japan: 2030 0,8 Mio. FCEV
- China: 2030 1 Mio. FCEV
- Kalifornien: 2030 1 Mio. FCEV

8 Quelle: https://www.electrive.net/2019/09/04/china-will-eine-million-brennstoffzellenfahrzeuge-bis-2030/ (Download 05.09.2030)
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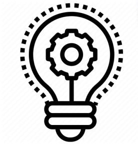
Outlook – Opportunities

Project opportunities – potential themes:

- Continuation in dealing with “maritime, mobility, energy, information”
- Hydrogen technologies and shipping
- Smart and multimodal mobility
- Autonomous maritime systems

Clean Shipping Technologies:

- Anti-Fouling, energy conversion, energy storages
- Waste-2-Energy, Waste-2-Product approaches
- Touristic solutions with electric vessels (E-Boot 4.0)
- Light weight and ship building tech



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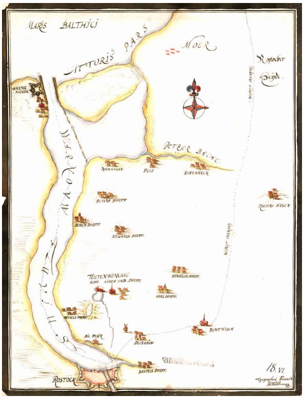
Thank you for your attention



Alexander John
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Electrifying Public Bus Transport - Use Case 3

Nicolas Restrepo Lopez

HAW Hamburg
Hochschule für
Angewandte
Wissenschaften Hamburg

HAW HAMBURG

Urban Electric Mobility - Electrifying Public Bus Transport - Use Case 3 - An Example of the Verkehrsbetriebe Hamburg-Holstein (VHH) as part of The INTERREG V project BSR electric

Electrifying Public Bus Transport

The INTERREG V project BSR electric - Use Case 3

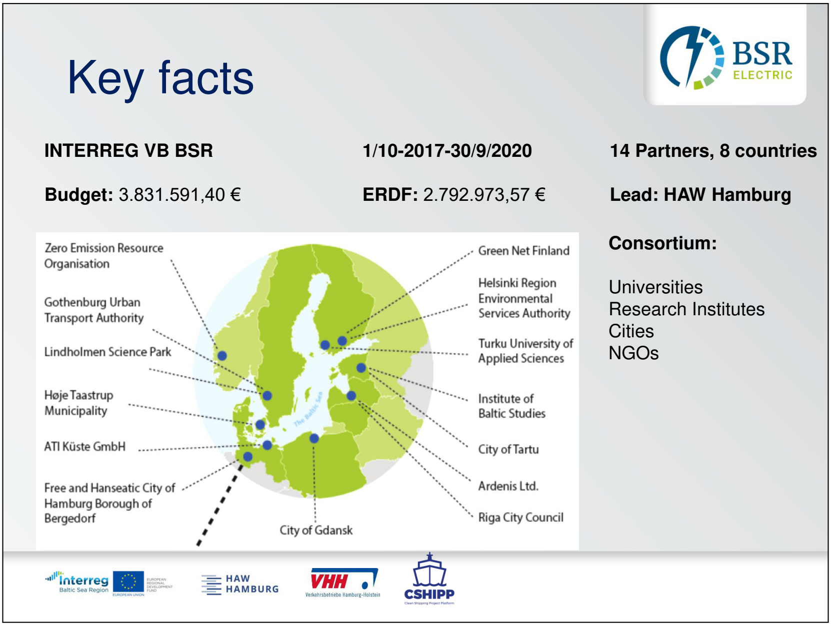
March 5th, 2020

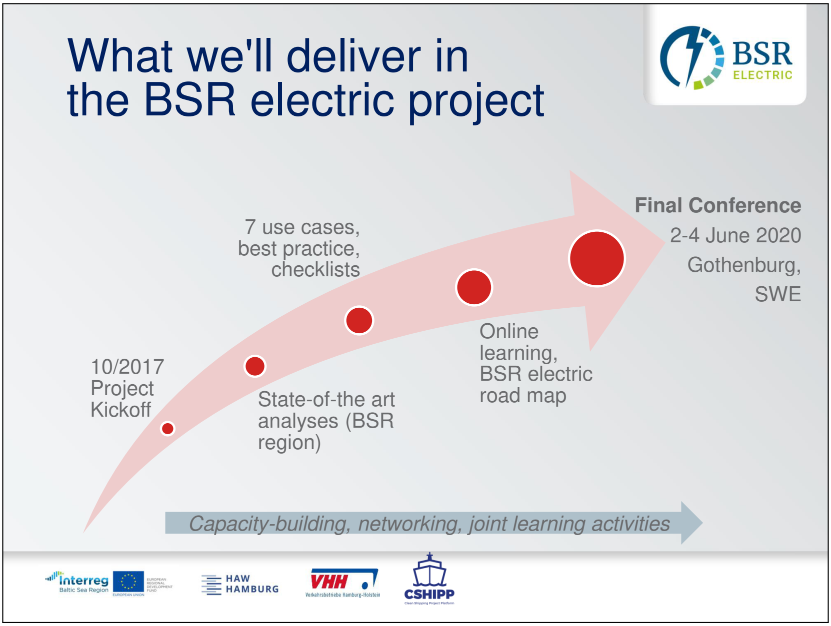
Nicolas Restrepo Lopez, Hamburg University of Applied Sciences

What is BSR-e all about?

- INSPIRE: enhance utilization of e-mobility in urban transport
- SHOWCASE: real-life use cases of new urban e-mobility
- CONTRIBUTE: achieve EU targets (reduction of transport sector emissions, climate-neutral urban transport by 2050)

E-Logistics (last mile) | E-Buses (public service) | E-Bikes + Cargo E-Bikes | E-Scooters (public facilities) | E-Ferries (Commuters)


Key facts
BSR ELECTRIC
INTERREG VB BSR
1/10-2017-30/9/2020
14 Partners, 8 countries
Budget: 3.831.591,40 €
ERDF: 2.792.973,57 €
Lead: HAW Hamburg
Consortium:
Universities
Research Institutes
Cities
NGOs
Zero Emission Resource Organisation
Gothenburg Urban Transport Authority
Lindholmen Science Park
Høje Taastrup Municipality
ATI Küste GmbH
Free and Hanseatic City of Hamburg Borough of Bergedorf
City of Gdansk
Green Net Finland
Helsinki Region Environmental Services Authority
Turku University of Applied Sciences
Institute of Baltic Studies
City of Tartu
Ardenis Ltd.
Riga City Council
Interreg Baltic Sea Region
HAW HAMBURG
VHH Verkehrsbetriebe Hamburg-Holstein
CSHIPP


What we'll deliver in the BSR electric project
BSR ELECTRIC
10/2017 Project Kickoff
State-of-the art analyses (BSR region)
7 use cases, best practice, checklists
Online learning, BSR electric road map
Final Conference
2-4 June 2020
Gothenburg, SWE
Capacity-building, networking, joint learning activities
Interreg Baltic Sea Region
HAW HAMBURG
VHH Verkehrsbetriebe Hamburg-Holstein
CSHIPP

Bus fleet electrification in Hamburg: The Framework

- Plan established in 2015 by the City of Hamburg: Transition towards zero-emission bus fleet
- From 2020 on procurement of e-busses only
- From 2030 on, whole bus fleet will be electrified
- Similar plans are being implemented in various cities all over europe

Bus fleet electrification in Hamburg: VHH Milestones

- Concept development started in 2016
- Modification of the bus depot in Bergedorf in 2018
- E-Buses procured from 2019 on
    - 2019: 16 Solo buses
    - 2020: 17 Articulated buses
    - 2021: tbd
- Modification of further depots is being planned

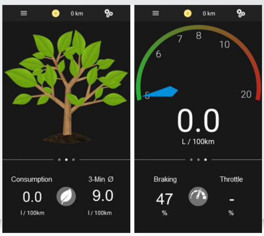
Bus fleet electrification in Hamburg

The contribution of BSR electric Use Case 3:

- Analysis of data from e-bus operation
- Dissemination of the findings and lessons learned (e.g. Checklist)
- Promotion and awareness-raising for sustainable transport modes
- Establishing a network of practitioners in the field of e-mobility and sustainable mobility

Lessons Learned & Findings

- Lessons learned: See list of recommendations / checklist
- Preliminary results from data analysis:
    - High temperature influence
    - High influence by driver´s behaviour
- Measuring and incentivation of driver´s behaviour is central!



(a) “Eco-Baum” (b) “Eco-Tacho”

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Join Us!

- Connect with professionals in the field and become part of the BSR electric community!

- www.bsr-electric.eu
- linkedin.com/groups/13561920/
- #@BSR_electric

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Thank you!

www.bsr-electric.eu

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Research and Transfer Centre „Sustainability and Climate Change Management“
Ulmenliet 20, D-21033 Hamburg / Germany
E-Mail: **bsr-e@ls.haw-hamburg.de**

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Experience from daily operation with Urban Electric Ferries

Knut Schäfer

Weiße Flotte GmbH
Stralsund

Experiences from every day operation of E-Ferries –
What implementers of urban E-Ferries should know

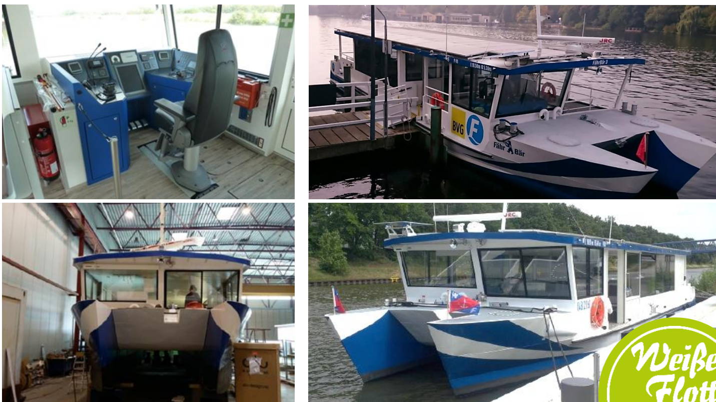
Weiße Flotte

Innovation leader in the area of solar-powered vessels

Solar-powered vessels

emission-free • innovativ • economical
E- ferry
made in Mecklenburg-Vorpommern

✓emission-free ✓silent ✓economical



Weiße Flotte

emission-free • innovativ • economical
E- ferry
made in Mecklenburg-Vorpommern

Solar-powered vessels
- Berlin

- Established in 2014
- Operating **4 different innovative solar-powered ferries** and a rowing boat ferry
- 2 year-round routes plus 2 seasonal lines on the river Spree and around the lakes of Berlin
- Passenger volume: approx. 400.000 per year
- Shuttle traffic up to **15 hours service per day**

Solar-powered ferry

Weiße Flotte

emission-free • innovativ • economical
E- ferry
made in Mecklenburg-Vorpommern

Solar-powered vessels
- Berlin

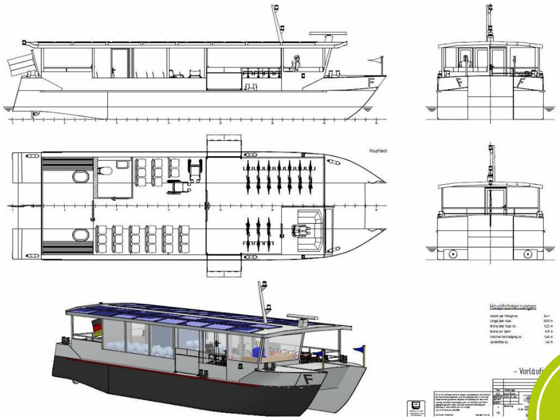
- Length over all 18,5 m
- Moulded breadth 5,22 m
- Moulded depth 3,46 m (excluding mast)
- Maximum draft 0,60 m
- Weight 20,0 t
- Top Speed 12 km/h
- Seats 35 - 49, 2 wheelchairs, 10 bikes
- Solar system 60 m² with 10,6 kw
- External power in 365 days and ~14 h service per day: 22 T kw/h = ***approx. 0,83 € per hour***

Made in Stralsund

Weiße Flotte

emission-free • innovativ • economical
E-ferry
made in Mecklenburg-Vorpommern

Solar-powered vessels
- Berlin



Weiße Flotte

emission-free • innovativ • economical
E-ferry
made in Mecklenburg-Vorpommern

Solar-powered vessels
- Wolfsburg

- Length over all 18,5 m
- Moulded breadth 5,22 m
- Moulded depth 3,46 m (excluding mast)
- Maximum draft 0,6 m
- Weight 18,0 t
- Top Speed 15 km/h
- Seats 60, two wheelchairs
- Solar system 66 m² with 10,6 kw

Made in Stralsund

Weiße Flotte

emission-free • innovativ • economical
E- ferry
made in Mecklenburg-Vorpommern

Solar-powered vessels
- Known issues: propeller

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E- ferry
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Solar-powered vessels
- Known issues: battery charger

Weiße Flotte

Solar-powered vessels
- Known issues: winch

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Weiße Flotte

Solar-powered vessels
- Known issues: high current screw connections

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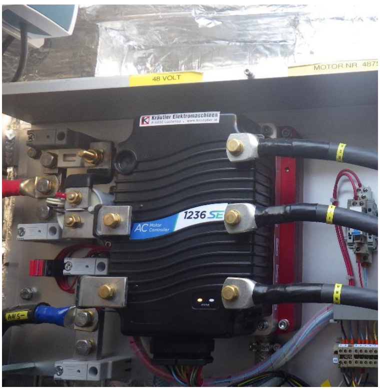

Weiße Flotte

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E- ferry
made in Mecklenburg-Vorpommern

Solar-powered vessels
- Advantages: magnets

Weiße Flotte

emission-free • innovativ • economical
E- ferry
made in Mecklenburg-Vorpommern

Solar-powered vessels
- Advantages: corrosion-free

Weiße Flotte

Solar-powered vessels
- Advantages: reliability

emission-free • innovativ • economical
E- ferry
made in Mecklenburg-Vorpommern

Weiße Flotte

Solar-powered vessels
- Advantages: weight

emission-free • innovativ • economical
E- ferry
made in Mecklenburg-Vorpommern

Weiße Flotte

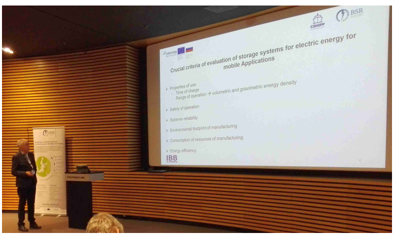
Thank you for your attention!

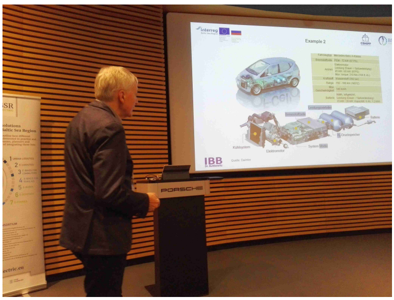
Electric energy storages for mobile Applications – Hydrogen and Alternatives

Dr. Gerhard Buttkewitz

IBB Ingenieurbüro Dr. Buttkewitz
Rostock

IBB
Dr. Buttkewitz





Electric energy storages for mobile Applications –
Hydrogen and Alternatives for E-Ferries and electctric Shipping

Storage of electrical energy for mobile applications with hydrogen

Dr. Gerhard Buttkewitz

Crucial criteria of evaluation of storage systems for electric energy for mobile Applications

- Properties of use
  - Time of charge
  - Range of operation → volumetric and gravimetric energy density
- Safety of operation
- Systems reliability
- Environmental footprint of manufacturing
- Consumption of resources of manufacturing
- Energy efficiency

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Schematic Diagram of a Hydrogen Energy storage system

Hydrogen energy storage (crucial components)

stationary:
- **Energy source** E_Q → **Electrolyser** E_{H2} →

$\eta_{el} = E_{H2} / E_Q = 75\ \%$

stationary or mobile:
- **Hydrogen storage** (direct or indirect) E_{H21} → **Fuel cell system** E_{BZel} ↔ **Battery system** E_{Bael} ↔

$\eta_{el} = E_{BZel} / E_{H21} = 50\ \%$

$\eta_{gesel} = E_{Vel} / E_Q = 37{,}5\ \%$

High temperature electrolysis (800 -1.000 °C) → $\eta_{el} = E_{H2} / E_Q > 85\ \%$

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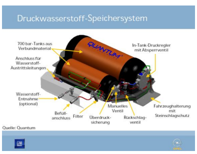
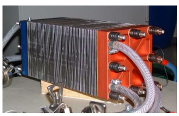
Example 1

Hydrogen storage	Fuel cell system	Battery system	
Pressure tank 700 bar ca. 1,1 $kWhH_2/kg$ 4 kg H_2 for ca. 500 km range Weight ca. 120 kg	ca. 100 kW Efficiency ca. 50 % ca. 50 kg	ca. 5 kWh ca. 30 kg	Drive + Onboard energy supply






Cruicial parameters

- **Overall Energy desnsity: ca. 0,3 kWh/kg**
- **Charging: analogue to refuelling of to natural gas < 5 Minuten**

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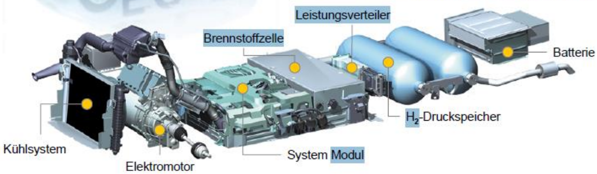
Example 2

Fahrzeugtyp	Mercedes-Benz A-Klasse
Brennstoffzelle	PEM - 72 kW (97 PS)
Antrieb	Elektromotor Leistung (Dauer- / Spitzenleistung): 45 kW / 65 kW (87PS) Max. torque: 210 Nm (156 ft.-lb.)
Kraftstoff	Wasserstoff (350 bar)
Range	150 - 180 km (NEFZ)
Max Geschwindigkeit	140 km/h
Batterie	NiMh, luftgekühlt, Leistung (Dauer- / Spitzenleistung): 15 kW / 20 kW; Kapazität: 6 Ah, 1.2 kWh



Quelle: Daimler

Principle Depiction of a Battery storage system

Battery storage system

stationary

Energy source

E_Q →

Stationary or mobile

Battery system

E_{Ba} →

$\eta_{gesel} = E_{Ba} / E_Q = 90\ \%$

Energy storage densities

Gravimetric electric energy density kWhel / kg overall mass	**ca. 0,2**
Volumetric electric energy density kWhel / Liter	**ca. 0,4**

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Example

Quelle: Elektroauto Plattform MEB © Fotoquelle und Bildrechte: Volkswagen AG

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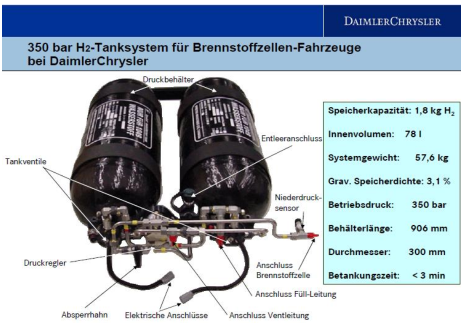
Pressure tank storage

Example 1



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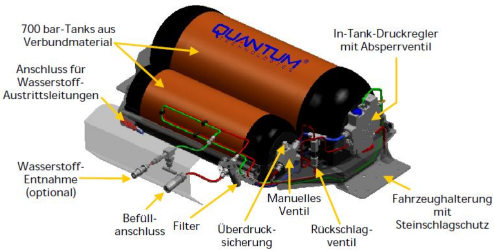
Example 2

700 bar CFK-Pressure tank



Energiedichten bei 700 bar mit CFK-Druckbehälter

Gravimetric electric energy density at η_{BZel} = 50 % kWhel / kg overall mass (H_2+CFK-Druckbehälter)	**ca. 0,9**
Volumetric electric energy density at η_{BZel} = 50 %kWhel / Liter	**ca. 0,7**

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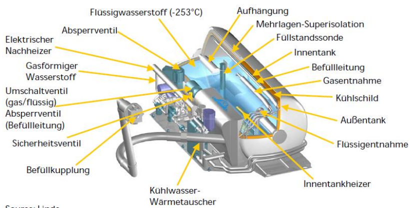
Liquified gas storage

Example



Quelle: Linde

Energy densities

Gravimetric electric energy density at η_{BZel} = 50 % kWhel/kg overall mass	**ca. 0,7**
Volumetric electric energy density at η_{BZel} = 50 %kWhel / Liter	**ca. 0,6**

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Metal hydride storage

- Metal + Hydrogen → Metal hydride + heat
- Charging time: 15 to 20 minutes
- Pressure: > 10 bar

Example

Speicherkapazität:	4,1 kg H_2
Systemgewicht:	320 kg
Außenvolumen:	170 l
Hydridvolumen:	75 l
Hydrid-Basis:	$TiV_{0.5}Mn_{1.5}$
Grav. Speicherdichte:	1,3 %
Vol. Speicherdichte:	2,4 kg H_2/100 l
Betriebsdruck:	50 bar
Kühlwasserwärmetauscher	

Energy densities of NT-Metallhydrides

Gravimetric electric Energy density at η_{BZel} = 50 % kWhel / kg overall mass	**ca. 0,25**
Volumetric electric Energy density at η_{BZel} = 50 % kWhel / Liter	**ca. 0,4**

Quelle: Daimler

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Storage of Hydrogen by means of Adsorption

- MOF‘s (Metal Organic Framework) Metal-organic Frameworks are well strucured porous chrystalline materials.
- Zeolithe are Alumosilicate with definined porous structures of very large inner surface.

Both materials did not come to application yet.

- A special configuration of MnH_2 (Kubas Mangan Hydride-1 – University of Lancaster) is promising (at an pressure of adsorption of 120 bar).

Density of Storage with MnH_2 ***Under development!***

Gravimetric storage density g H_2 / kg overall mass	105
Gravimetric energy density kWhH_2 / kg overall mass	3,5
Gravimetric electric energy density at η_{BZel} = 50 % kWhel / kg overall mass	**1,8**
Volumetric storage density g H_2 / Liter	197
Volumetric energy density at kWhH_2 / Liter	6,6
Volumetric electric energy density at η_{BZel} = 50 % kWhel / Liter	**3,3**

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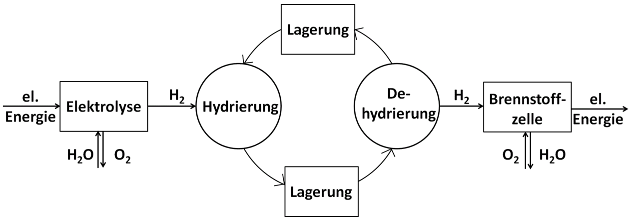
Chemical Hydrogen storage



Especially interesting for mobile applications are LOHC (Liquid Organic Hydrogen Carrier) und Methanol.

- **LOHC**
  - Temperatures ca. 200 °C for Hydration and Dehydration necassary.
  - Pressures of 30 bis 50 bar for Hydration necassary.

Energiedichten

Gravimetric electric energy density at η_{BZel} = 50 % kWhel/kg overall mass	**ca. 0,9**
Volumetric electric energy density at η_{BZel} = 50 %kWhel / Liter	**ca. 0,9**

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Methanol

- Temperatures ca. 100 to 150 °C for Hydration and Dehydration necessary.
- Pressures of ca. 30 bar for Hydration necessary.
- CO-issue

Energy densities

Gravimetric electric Energy density at η_{BZel} = 50 % kWhel / kg overall mass	**ca. 1,2**
volumetric electric Energy density at η_{BZel} = 50 % kWhel / Liter	**ca. 1,4**

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Comparison – Efficiency vs. Energy densitiy

Nr.	Storage system	Electric overall Efficiency η_{gesel} / %	Gravimetric elektric Energy density at η_{BZel} = 50 % e_{gel} / kWhel/kg	Volumetric elektric Energy density at η_{BZel} = 50 % e_{gel} / kWhel/L	Remarks
			direct Hydrogen storage		
1	**Pressured gas storage 700 bar**	33	0,9	0,7	State oft he art
2	**Adsorption MnH_2 120 bar**	37	1,8	3,3	Under development
			indirect Hydrogen storage		
3	**LOHC**	27	0,9	0,9	– Under development – Temperatures ca. 200 °C for Hydration and De-hydrattion necessary. – Pressures of 30 bar for Hydra-tion necessary.
4	**$CH_3OH + H_2O$**	25	1,2	1,4	– Under development – Temperatures ca. 100 bis 150 °C for Hydra-tion and Dehydrattion neces-sary. – Pressures of ca. 30 bar for Hy-dration necessary. – CO-issue
			Battery systems – State oft he art		
5	**Li-Ion**	90	0,2	0,4	State oft he art
			Theoretical potential of battery systems		
6	**Li-S**	90	2,6	2,8	Basic research
7	**Al-Ion**	90	1	1	Basic research
8	**Li-Air**	90	11,4	6	Basic research

All values are approximate.

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Evaluation of relevant Storage systems for electric Mobility

Lfd. Nr.	Storage system	essential characteristics of use		Energiy effi-ciency (over all stages)	Additional parameters	
		Energy density / Range	Charging time		positive	negative
1	**H_2-Pressure tank systems 700 bar**	+	++	+	No CO	– Acceptance – Low reliability of the system
2	**H_2-Adsorption MnH_2 120 bar**	+++	++	+	– No CO – Acceptance hig-her than 1 – Reliability of the system higher than 1	
3	**$CH_3OH + H_2O$**	++	++	–	Experience of hand-ling	– traces of CO – toxic
4	**LOHC**	++	++	–	No CO	– toxic – fossile base of LOHC
5	**Li-Ione-Accumulators**	–	–	+++	High reliability oft he system	– environmental im-pact of produc-tion – consumption of resources

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Comparison: Efficiency / Energy density of Ammonia and Methanol as hydrogen carrier

Lfd. Nr.	Storage sys-tems	Electric overall efficiency η_{gesel} / %	gravimetric electric Energy density at η_{BZel} = 50 % e_{gel} / kWhel/kg	Volumetric electric Energy density at η_{BZel} = 50 % e_{gel} / kWhel/l	Remarks
			indirect Hydrogen storage methods		
	NH_3	< 25 %	1,5	< 2,0	– Under development – Temperatures ca. 400 bis 500 °C for Hydration – Pressure of 150 to 250 bar for Hydration. – Dehydration ca. 700 °C – 10 bar – Steel tank – Evt. energetic improvements by new generation catalysts – No CO-issue – toxic
	$CH_3OH + H_2O$	25	1,2	1,4	– Under development – Temperatures ca. 100 bis 150 °C for Hydra-tion and Dehydrattion – Pressure of ca. 30 bar for Hydrattio necessary. – CO-issue – toxic

Values are „cirka's".

Thank you !

Shipbuilding aspects for energy saving and Clean Shipping

Dr. Detlef Andrich

Baltic Engineering Flare GmbH
Rostock

Aspects of Shipbuilding for energy saving and clean Shipping
Baltic Engineering Flare Rostock

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Shipbuilding aspects for an energy-saving and clean shipping (green shipping) for inland and coastal people / motor vehicle ferry traffic

BSRelectric_CSHIPP Workshop
(E-Ferries & Urban E-Mobility - Electric drives, alternative fuels, experiences and benefits from the automotive sector)

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What is BEF?

Baltic Engineering Flare GmbH - Wing in Ground Craft - Maritime High-Speed Craft

The company was founded in summer 2005 by a group of experienced and young Rostock engineers for a variety of engineering services and product developments from Mecklenburg-Western Pomerania, a cradle of shipbuilding engineering, aviation pioneers and engineers. The team's strengths lie in the development and implementation of innovative interdisciplinary system solutions from the field of shipbuilding and maritime mechanical engineering.

BSRelectric_CSHIPP Workshop
(E-Ferries & Urban E-Mobility - Electric drives, alternative fuels, experiences and benefits from the automotive sector)

Baltic Engineering Flare

What is BEF?

Baltic Engineering Flare **GmbH – Wing in Ground Craft – Maritime High-Speed Craft**

Our priority business areas of activity include:

- from development to project planning, construction and manufacturing technology to technical documentation and certification documents for mechanical and shipbuilding products, especially in lightweight, ultra-light construction in composite construction of various materials
- Development services in the field of mechanical engineering, shipbuilding and construction
- one of our specialties is maritime high speed craft
- Support our partners with our know-how on the way to the digital data and information world.

BSRelectric_CSHIPP Workshop

(E-Ferries & Urban E-Mobility – Electric drives, alternative fuels, experiences and benefits from the automotive sector)

What is BEF?

Baltic Engineering Flare **GmbH – Wing in Ground Craft – Maritime High-Speed Craft**

Examples of our activities

BSRelectric_CSHIPP Workshop

(E-Ferries & Urban E-Mobility – Electric drives, alternative fuels, experiences and benefits from the automotive sector)

Aspects Theses Visions

- State of the art of modern, alternative IMO-compatible drives
- Ferry traffic infrastructure regional conditions
  - Use of adapted, energy-efficient ship shapes
  - Ferry traffic vs. Propulsion & propulsion concept
  - Underwater / surface ship taking into account existing infrastructure
- Ship hydrodynamics New ship construction innovative materials & manufacturing technologies for small seagoing ships
- Maritime high speed vehicles?
- Ferry traffic tourist excursions vs. Urban public transport / infrastructure

State of the art of modern, alternative IMO-compatible drives

- Substitution of primary energy source heavy oil by marine fuel not only in the area of port and national maritime borders in general
- Substitution, use of cryogenic fluid methanized energy sources
  - LNG / LBG use for drives (engine combustion)
  - Use for various secondary energy applications (heating purposes, electrical energy supply)
  - Maintaining existing engine systems or adapting gas engines (problem of methane slip)
- Use of previously known ship shapes for underwater / surface ship design without significant optimization of ship resistance pragmatic reduction in service speed

BSRelectric_CSHIPP Workshop
(E-Ferries & Urban E-Mobility - Electric drives, alternative fuels, experiences and benefits from the automotive sector)

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State of the art of modern, alternative IMO-compatible drives

- Substitution of combustion engine drives by electric motor drives usually while maintaining the propulsion concepts
- Use of technologies for regenerative primary energy conversion
  - Renaissance of sailing techniques
  - Solar techniques for generating electricity
  - Fuel cell technologies using hydrogen, LNG / LBG / SEE gas, alcohols
- Use of various storage systems for the direct storage of electrical energy

Only a few "successful" ship-hydrodynamic hulls and over-water ship designs considering "electrical propulsion"

BSRelectric_CSHIPP Workshop
(E-Ferries & Urban E-Mobility – Electric drives, alternative fuels, experiences and benefits from the automotive sector)

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State of the art of modern, alternative IMO-compatible drives

HSC Francisco
with Wave Piercer properties building number 69 INCAT Tasmania Australia
LÜA 99m, BÜA 26.94m 7.1 GT gross load capacity, 51 kn
Gas turbine LM2500 25 MW 5.6 t marine fuel consumption per hour
thermal efficiency 36%
Tank 70 Tl, LNG 40 m³

Examples of previous developments

BSRelectric_CSHIPP Workshop
(E-Ferries & Urban E-Mobility – Electric drives, alternative fuels, experiences and benefits from the automotive sector)

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State of the art of modern, alternative IMO-compatible drives

Silver Cloud SWATH
Abeking & Rasmussen, Lemwerder, Germany
LÜA: 41, BÜA: 17.8m 600t gross load capacity, 14 kn, range: 3,500 nm @ 10 knots
2x 1000 kW, turbo-charged Caterpillar C32 diesel engines
Tank: 79 Tl, Steel hull, Aluminum superstructure

Examples of previous developments

BSRelectric_CSHIPP Workshop
(E-Ferries & Urban E-Mobility – Electric drives, alternative fuels, experiences and benefits from the automotive sector)

State of the art of modern, alternative IMO-compatible drives

Electric ferry Future of The Fjords
Shipyard Brødrene Aa Norway 2017 Universal Design Transport Award
LÜA: 42, BÜA: 15m, 14 kn, Range: 30 nm @ 16 knots
Electric motor: 2 x 450 kW; Propeller: CPP propeller; Battery pack: 1800 kWh / 20 min.
Seats: 400, Materials: Carbon fiber sandwich; Seats: 400

Examples of previous developments

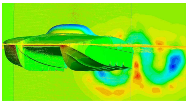
BSRelectric_CSHIPP Workshop
(E-Ferries & Urban E-Mobility – Electric drives, alternative fuels, experiences and benefits from the automotive sector)

Ferry traffic infrastructure regional conditions

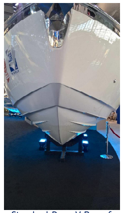
- Use of adapted, energy-efficient ship shapes
  - Halved standard Deep-V hull as a CAT solution
  - few applications of energy-efficient multi-stage hulls
  - SWATH Abeking & Rasmussen
  - Optimization speed, sea area, wave
  - Consideration of dynamic buoyancy and friction effects

FRS Solarfähre "Aluna"

Transport CAT 40x10 m, 50 kn, 2x 500 kW



Class One Race CAT



Standard Deep-V Rumpf

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(E-Ferries & Urban E-Mobility - Electric drives, alternative fuels, experiences and benefits from the automotive sector)

Ferry traffic infrastructure regional conditions

- Ferry traffic vs. Propulsion & propulsion concept
  - energy-efficient "four quadrant frequency converters"
  - Speed-torque characteristic curve of electric motors adapted to propulsor   overall efficiency
  - High-performance propellers, jet drives (propellers that pierce the surface and adapt hydrodynamic loads)
  - Novel propulsors (inline thrusters, wing flaps, ...)

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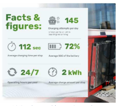
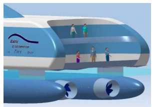
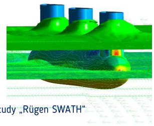
Ferry traffic infrastructure regional conditions

- Underwater / surface ship taking into account existing infrastructure
  - Ferry traffic with vehicle or load transfer (ramps on both sides, weather-protected superstructures, wind forces, ...)
  - Landside investor structures (mooring systems, free banks)
  - Waves influence investors in pool traffic
  - Bow, stern, side wall, upper deck design (solar, shore power, ...)


FRS Motor ferry "Glewitz"



IPT Wireless Charging System



Design study „Rügen SWATH"

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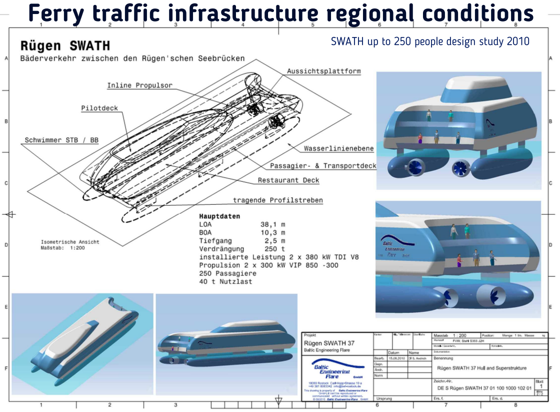
Ferry traffic infrastructure regional conditions



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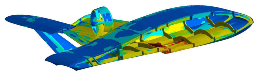
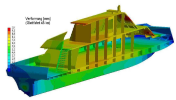
Ship hydrodynamics New ship construction innovative materials

- Ship hydrodynamics New ship construction innovative materials & manufacturing technologies for small seagoing ships
  - Hybrids & composite structures (metal FVW)
  - Light metals, sandwich (high-performance core materials)
  - Surface qualities, foliation
  - long-lasting self-polish antifouling systems
- ➢ Analogous to ship hydrodynamics, complete load simulations of the ship structures can be realized (strength, operational and vibration behavior under environmental and sea conditions)





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Maritime High Speed Crafts?

- water-bound maritime high-speed crafts can significantly reduce transfer times
- From a speed range of> 25 kn, sustainable profitability for vehicles with a load capacity of more than 100 t is questionable
  - ➢ Almost all previous shipping companies have reduced service speeds and discontinued ferry services
- Multi-hull (Cat / Tri) or Hydrofoil crafts can be operated economically due to the developments in the hull design, maneuverability, composite materials, electric drives and propulsion for vehicles up to 100 people and driving ranges up to 20 nm with minimal onshore infrastructure

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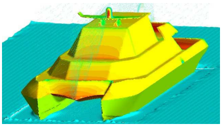
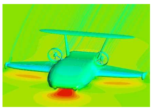
Maritime High Speed Crafts?





Examples from MHSC up to 100 people

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Ferry traffic tourist excursions vs. Urban public transport

- Ferry traffic tourist excursions vs. Urban public transport / infrastructure
  - Crafts for inland and coastal waters use in conjunction with bus, urban railway, tram, cargo transport
  - Approx. 50 people ("busload") with management
  - "City-Hoping "as a supplement to existing traffic systems
  - Small ferries for possible manual / electric bicycle, scooter, cargo bikes
  - Movable platforms (work, event, swimming, technical)
  - Classic excursion and tourist traffic
- ➢ Vehicles up to max. LÜA: 30 m, BÜA: 10 m, 10 kn, 100kW

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CONCLUSION

- A large number of existing technical and economical solutions for people and loads Ferries with alternative drive concepts are being tested
- Optimizations with regard to technical and economic efficiency include a lot of development potential
- Water-bound, amphibious and maritime high-speed vehicles can & must be included in the development of urban traffic structures

➢ Rivers, lakes and coastal waters are becoming urban living spaces with innovative ships and boats

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Thank you for your attention!

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Mobility with Electric Special Vehicles - Challenges in technological change

Hinrich Petersen

ASP GmbH
Hamburg

Electric Mobility with Special vehicles for disabled persons – Challenges in technological change

Interreg Baltic Sea Region — European Union, European Regional Development Fund — CSHIPP — BSR Electric

Electric special vehicle for disabled

Challenges in technological changes

Hinrich Petersen – ASP GmbH Hamburg

ASP MOBILITY SOLUTIONS

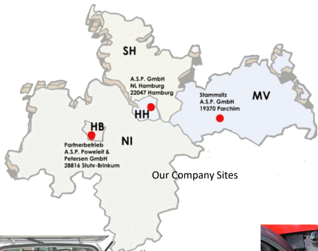
Interreg Baltic Sea Region — European Union, European Regional Development Fund — CSHIPP — BSR Electric

Company Profile

- Member of VFMP
  Association of vehicle retrofitters for people with reduced mobility

Retrofit

- Cars
- Group transport vehicles
- Tractors
- Machines
- Etc.



VFMP
Verband der Fahrzeugumrüster für mobilitätseingeschränkte Personen

ASP MOBILITY SOLUTIONS

Challenges

in the transition to electric mobility

- Ranges and power supply for electric auxiliaries
- Space for arranging and storing batteries
- Space for arranging of Folding ramp and electric steps
- Electric security
- Heating
- Changed operation

MOBILITY SOLUTIONS

Pros and cons – Facit

Desired benefits

- Quieter
- Cleaner
- Easier operation
- Easier maintenance and repair

Necessary environment

- Charging infrastructure needed (now come little by little)
- A little more expensive

MOBILITY SOLUTIONS


Thank you for your attention
Memberships and Certificates
DIN EN ISO 9001:2015
REG.-NR. Q1 0114047
Jährlich qualitätszertifiziert für die Herstellung, Vertrieb und Service von Behindertenfahrzeugen
Werkstattprüfung für Lackier- und Karosseriebetriebe
Mitglied im Verband der Fahrzeugumrüster für mobilitätseinge-schränkte Personen
Nutzfahrzeuge
IntegratedPartner
MOBILITY SOLUTIONS

References

100 Jahre Elektro-Motorschifffahrt auf dem Königssee. (Jahrgang 2009 Nummer 22 2009). www.traunsteiner-tagblatt.de

Auto-Presse.de. (2012). 130 Jahre Elektroautos: Kurze Blüte, langer Flopp. . (Memento vom 13. Juni 2013 im Internet Archive).

Guinness. (1980). The Guinness Books Of Cars, Facts & Feats. Third Edition. Norwich: ISBN 0-85112-207-8.

Spiegel. (2016). Elektroauto-Revolution vor 100 Jahren: Summ-summ statt Brummbrumm. spiegel.de, September 2016.

Wakefield, E. H. (1994). History of the Electric Automobile. Society of Automotive Engineers, Inc. (ISBN 1-5609-1299-5).

Wikipedia. Wikipedia. wikipedia.org

Imprint

Auditorium

The workshop was reported on the project website. The following picture shows a screenshot of the publication.

Screenshot
(`https://www.bsr-electric.eu/news/bsr-electric-participates-in-workshop-with-porsche`)

Workshop Organization

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CSHIPP	https://cshipp.eu/
ATI Küste	www.ati-kueste.de

ATI KÜSTE ®

Interreg Baltic Sea Region

EUROPEAN UNION

EUROPEAN REGIONAL DEVELOPMENT FUND

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