BALTIC CLEAN TECHNOLOGY

conference for sustainable solutions

Conference proceedings

28 – 29 September 2017

HanseMesse Rostock, Germany

SOUTH BALTIC CLEANTECH INTERNATIONAL

www.baltic-clean-technology.com

South Baltic

Part-financed by the European Union (European Regional Development Fund)

BALTIC CLEAN TECHNOLOGY
conference for sustainable solutions

Documentation of the first Baltic Clean Technology 2017

Editor:

Rostocker Messe- und Stadthallengesellschaft mbH
Zur HanseMesse 1-2
18106 Rostock

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BALTIC CLEAN TECHNOLOGY
Conference for sustainable solutions

→ first conference
→ from 28 – 29 September 2017
→ in the conference Rotunda of the HanseMesse in Rostock
→ was implemented as a part of the project "Cleantech International"
→ with 152 participants
→ from 9 different countries
→ from various sectors e.g. ocean technology and resource management
→ 11 exhibitors presented their products in the foyer of the Rotunda
→ including special formats like the first Cleantech Talk, a project development workshop and two different outside events
→ the pictures of the graphic recording include all facts and results

Save the Date
BALTIC CLEAN TECHNOLOGY 2018
17 - 18 October 2018 in Szczecin, Poland

BALTIC CLEAN TECHNOLOGY 2017
Partners and sponsors

SOUTH BALTIC CLEANTECH NETWORK

ROSTOCK BUSINESS

Rostock Business and Technology Development GmbH

Rostocker Messe- und Stadthallengesellschaft mbH

enviMV e.V.

Fraunhofer IGD

Strategic Self-management Institute

UNIWERSYTET SZCZECIŃSKI

energikontor sydost

SMN subsea monitoring network

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Offshore WIND INDUSTRY

enterprise europe network

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CLEANTECH

NETZWERK MINI-ROV

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GERMANROV OFFSHORE SERVICE

Interreg South Baltic

EUROPEAN UNION

European Regional Development Fund

SOUTHBALTIC CLEANTECH NETWORK
European network for sustainable solutions

The South Baltic Cleantech Network was established in 2016 within the framework of the project "Cleantech International". It is a network of Cleantech SME and their cooperation partners and supports its members with activities on the international (European and even global) market.

Cleantech in the understanding of the South Baltic Cleantech Network describes all processes, products and services that improve operational performance, productivity, or efficiency while reducing costs, inputs energy consumption, waste, or environmental pollution through significant energy efficiency improvements, the sustainable use of resources, or environmental protection. Activities must also generate an economic benefit, be competitive and innovative.

PROJECT CLEANTECH INTERNATIONAL

Institution for business and technology development in Rostock, Germany.

The RMSG operates the two largest event venues in northeastern Germany.

Network for environmental protection in Mecklenburg-Vorpommern, Germany

NCC is the largest representation of the economic autonomy of West Pomerania.

Public institution of scientific research, founded in 1991 in Klaipeda, Lithuania.

One of the largest universities in Poland with 32.000 students. Founded in 1984.

Energy agency from Southeast Sweden. Was founded 1999 as an EU-project.

MEMBERS OF THE SOUTHBALTIC CLEANTECH NETWORK:

→ Germany:

Rostock Business and technology Development GmbH (Rostock)
enviMV, registered association (Rostock)
Rostocker Messe- und Stadthallengesellschaft mbH (Rostock)

→ Lithuania:

Public Institution Strategic Self-Management Institute (Klaipeda)
Expo Vakarai (Klaipeda)
Lithuanian Wind Energy Association (Klaipeda)

→ Poland:

Northern Chamber of Commerce (Szczecin)
University of Szczecin (Szczecin)
REMONDIS Szczecin Sp z. o. o. (Szczecin)

→ Denmark:

University of Roskilde

→ Sweden:

The Energy Agency for Southeast Sweden (Växjö)
Blekinge Business Incubator AB (Karlskrona)

BALTIC CLEAN TECHNOLOGY 2017
Impressions

Photos: Angelika Heim (http://angelikaheim.de)

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BALTIC CLEAN TECHNOLOGY 2017
Program

Conference program day 1

THURSDAY, 28 SEPTEMBER 2017	
8:00	Registration & welcome coffee → Foyer
9:00	Opening speech (The speech is held in German) → conference room: Rostock & Wismar *Dr. Stefan Rudolph / Ministry of Economics, Employment and Health of the State of Mecklenburg-Vorpommern*
9:30	**KEYNOTE 1 → conference room: Rostock & Wismar**
	Resources in a circular economy: regional, European and global view *Prof. Dr. Petter Jenssen / Norwegian University of Life Sciences*
10:00	**KEYNOTE → conference room: Rostock & Wismar**
	Matter and energy balance of resources and values for offshore wind – When old turbines give room for new technology within Vattenfall's portfolio. *Mario Hassel / Vattenfall AB*
10:30	Break
11:00	**KEYNOTE 3 → conference room: Rostock & Wismar**
	Data as resource and asset - Digital transformation with data driven services *Stefan Kranke / Microsoft Deutschland GmbH*
11:30	**KEYNOTE 4 → conference room: Rostock & Wismar**
	European Cooperation *Åsa Bjering / CPMR Baltic Sea Commisson*
12:00	Lunch → Foyer
13:15	**FORUM RESOURCE MANAGEMENT 1: Efficient waste, waste-to-energy and recovering management → conference room: Rostock**
	Waste management and urban mining: Germany, Europe and the World *Prof. Dr. Michael Nelles / Universität Rostock* On-/offshore waste management in Baltic cruise shipping *Jessica Hudde / Innovations- und Bildungszentrum Hohen Luckow e.V.* Strategies of phosphorus recovering from sewage sludge *Roland Ruscheweyh / REMONDIS Aqua GmbH & Co. KG* Potential for optimization by applied flexibility of decentral (renewable) waste-to-power generation equipment *Detlef Siebert / natGas AG*
13:15	**FORUM OCEANTECHNOLOGY 1: Environmental monitoring → conference room: Wismar**
	Marine sensor generation 4.0 from the surface to the ultra deep sea *Heinz Schelwat / Sea & Sun Technology GmbH* Upcoming technologies for efficient monitoring *Prof. Dr. Uwe Freiherr von Lukas / Fraunhofer IGD* Molecular monitoring of aquatic organisms *PD Dr. Matthias Labrenz / Leibniz-Institut für Ostseeforschung Warnemünde* Making marine monitoring affordable *Kari Vene / Hydrog Solutions OÜ*
13:15	**EUROPEAN FUNDING → conference room: Demmin & Greifswald**
	Cleantech in European funding sources for innovation – overview, current calls and interactive project discussions *Frank Graage & Antje Hiller / Enterprise Europe Network e.V., Steinbeis Team Northeast*
14:45	Break → Foyer

BALTIC CLEAN TECHNOLOGY 2017
Program

Conference program day 1

THURSDAY, 28 SEPTEMBER 2017	
15:15	FORUM RESOURCE MANAGEMENT 2: Innovation and integrated technologies for waste, water, sludge and recovering / degradation technologies → conference room: Rostock
	Supporting start ups for urban mining, resource managment and circular economy *Therese Bejgarn | EIT RawMaterials North AB* **Micro-pollutant degradation with pulsed plasmas** *Prof. Dr. Ronny Brandenburg | Leibniz-Institut für Plasmaforschung und Technologie e.V.* **Intensification of biosolids degradation due to application of high-power ultrasound** *Dr. Klaus Nickel | ULTRAWAVES Wasser & Umwelttechnologien GmbH* **Combined hydrolysis of biodegradable substrates** *Dr. Gerold Vollmer-Heuer | Power Recycling Energyservice GmbH*
15:15	FORUM RESOURCE MANAGEMENT 3: Innovation and integrated technologies for waste, water, sludge and recovering / integrated technologies for circular processing → conference room: Demmin & Greifswald
	Food2Waste2Food: decentral circular economy by greenhouse technology *Knut Hovland | Grønt Skifte AS* **Microalgae - innovative approach for waste water and air pollution treatment** *Gunnar Mühlstädt | MINT Engineering GmbH* **Drying, combustion and energy conversion technology for pasty wastes by example of dewatered sewage sludge** *Nico Timm | INTEC SMK GmbH* **Aquaponic system in a pre-commercial scale: fish and veggie-production by circulation of water and nutrients** *Björn Baßmann | Universität Rostock*
15:15	FORUM OCEANTECHNOLOGY 2: Technical monitoring of offshore structures → conference room: Wismar
	Hightech for subsea service and maintenance *Eyk-Uwe Pap | GERMAN ROV OFFSHORE Service GmbH & Co. KG* **Maintaining the Nord Stream pipeline – practical experiences and opportunities for innovation** *Ruurd Hoekstra | Nord Stream AG* **Resident robotic inspection system for offshore wind farm asset integrity** *Dr. Jakob Schwendner | Kraken Robotik GmbH* **Detecting burried objects using parametric subbottom profiler** *Dr. Jens Wunderlich | Innomar Technologie GmbH*
15:15	MATCHMAKING EVENT → conference room: Anklam & Stralsund
16:45	End of the first conference day
18:30	EVENING EVENT

BALTIC CLEAN TECHNOLOGY 2017
Program

Conference program day 2

FRIDAY, 29 SEPTEMBER 2017	
8:45	Welcome coffee → Foyer
9:00	CLEANTECH TALK → conference room: Rostock
9:00	PROJECT DEVELOPMENT WORKSHOP → conference room: Wismar
10:00	FORUM RESOURCE MANAGEMENT 4: Deconstruction, dismantling and reutilization of offshore power plants → conference room: Rostock
	Strategies and technologies for sustainable and efficient recycling of wind power plants *Michael Schneider | REMONDIS Assets & Service GmbH & Co. KG* **Sustainable decommissioning modelling of offshore wind farms** *PhD Eva Topham | University of Strathclyde* **Challenges due to contamination and underground construction for RES-plants** *Eberhard Casals | CDM Smith Consult GmbH*
10:00	FORUM BIG DATA: Supporting clean technology with digital data → conference room: Wismar
	Environmental decision support in space and time: the datacube paradigm *Prof. Dr. Peter Baumann | rasdaman GmbH* **EMODnet: unlocking the wealth of European marine data and observations** *Jan-Bart Calewaert | EMODnet Secretariat* **Geo-information systems as tool for resource management** *Prof. Dr. Ralf Bill | Universität Rostock* **Requirements for future distribution networks - operation of smart grid** *Philipp Kertscher | WEMAG Netz GmbH*
11:30	Break → Foyer
12:00	ON- AND OFFSHORE CONTAMINATION, UNEXPLODED ORDNANCE → conference room: Rostock & Wismar
	Research and innovation to address munitions in the sea by JPI oceans *Jens Sternheim | German program on underwater munition* **Special challenges in UXO recovery in the coastal areas of the Baltic Sea** *Oliver Geisler | Eggers Kampfmittelbergung* **Decision aid for marine munitions** *Prof. Matthias Reuter | Technische Universität Clausthal* **Exploration of sustainable rare earth elements by extraction from heavy mineral bearing sands from the German Baltic Sea floor** *Dr. Henrik Rother | Landesamt für Umwelt, Natur und Geologie Mecklenburg-Vorpommern*
13:30	Closing session → conference room: Rostock & Wismar
14:00	Lunch and end of the second conference day → Foyer
afterwards	OUTSIDE EVENT

Thursday, 28 September 2017

09:30 – 12:00

Keynotes

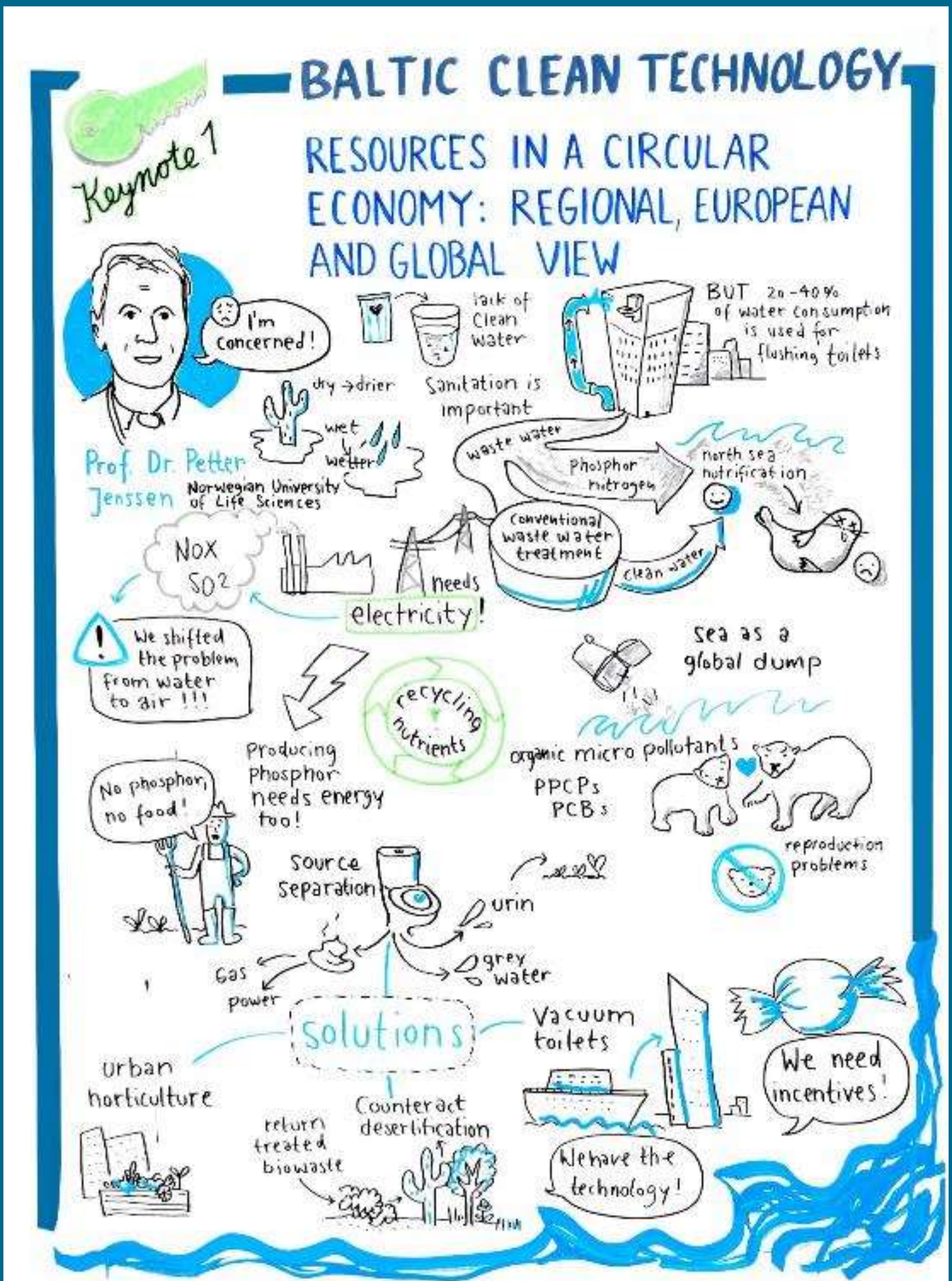
BALTIC CLEAN TECHNOLOGY 2017
Keynote 1

Prof. Dr. Petter Jenssen | Norwegian University of Life Sciences

Resources in a circular economy: regional, European and global view

The keynote will give a survey on circular economy, focussed on resources such as water, wastewater, sludge and their pollution and utilization potential. The lecture will be illustrated with his expertise and experience in Norway and third world, e.g. national research program entitled «Natural systems technology for wastewater treatment”. Several of these treatment alternatives are highly interesting in developing countries as well as for cold conditions.

BALTIC CLEAN TECHNOLOGY 2017
Keynote 1



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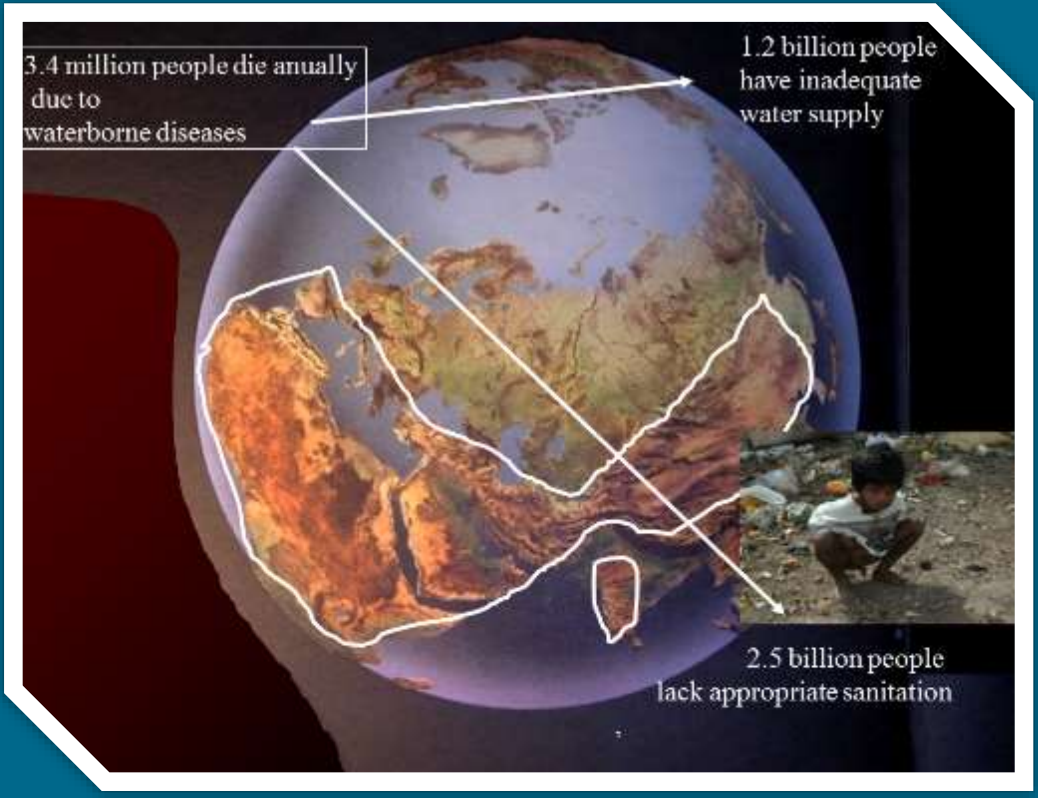
Keynote 1 - Presentation



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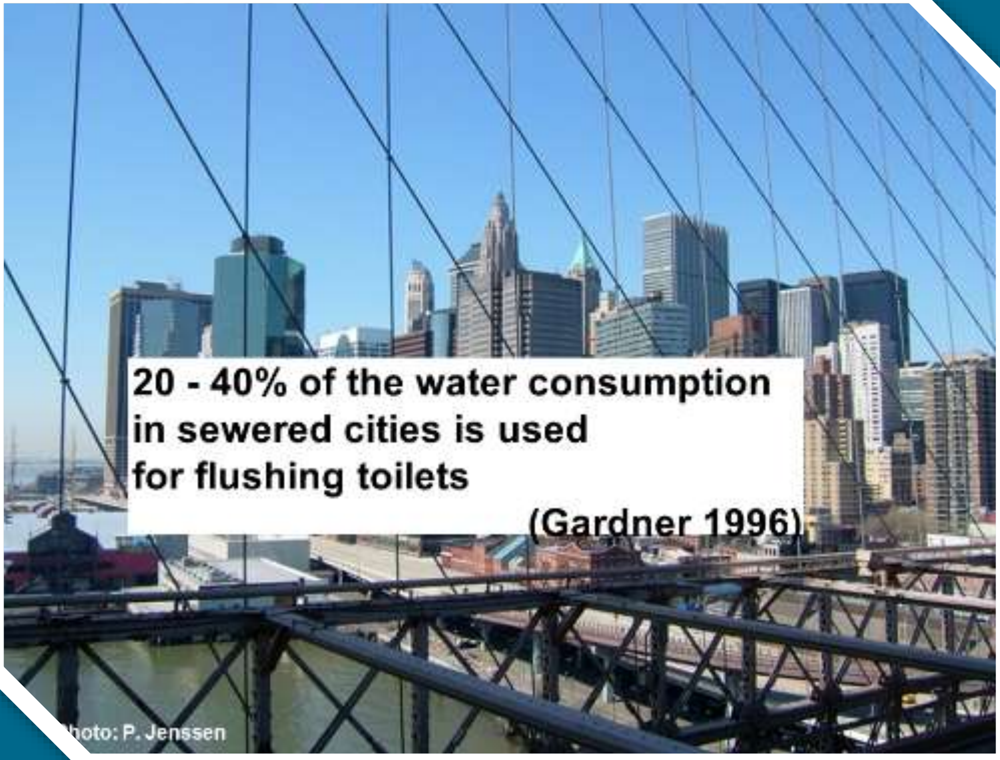
Keynote 1 - Presentation



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Keynote 1 - Presentation

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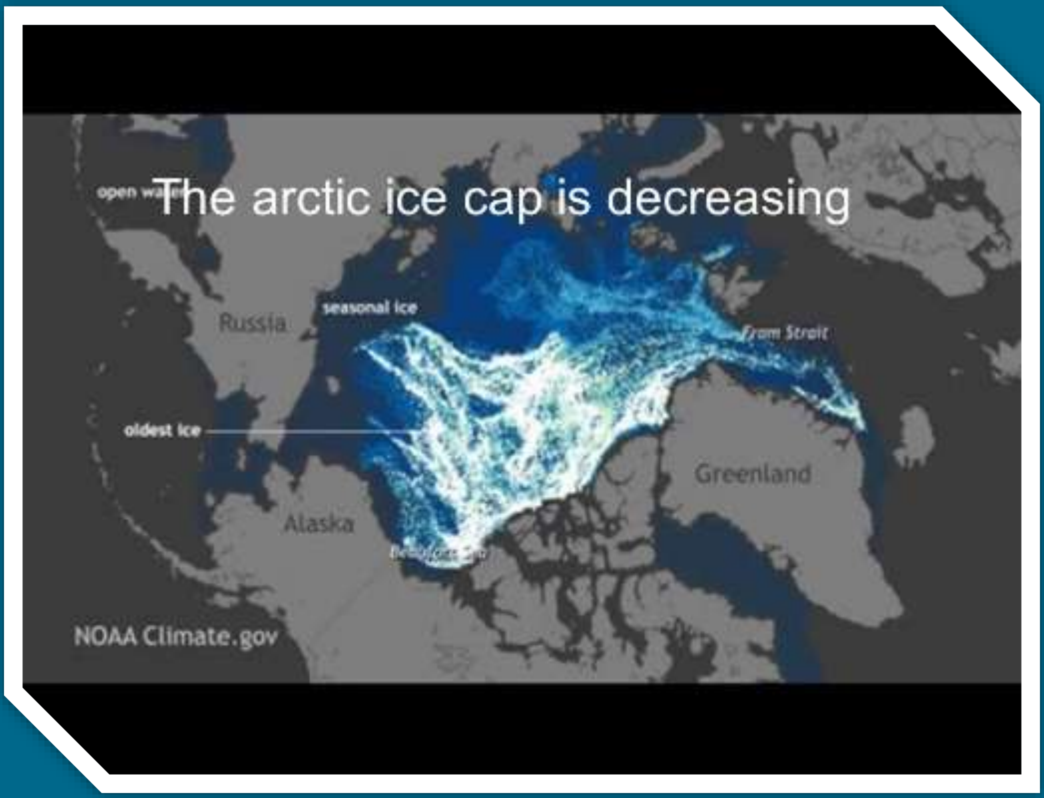

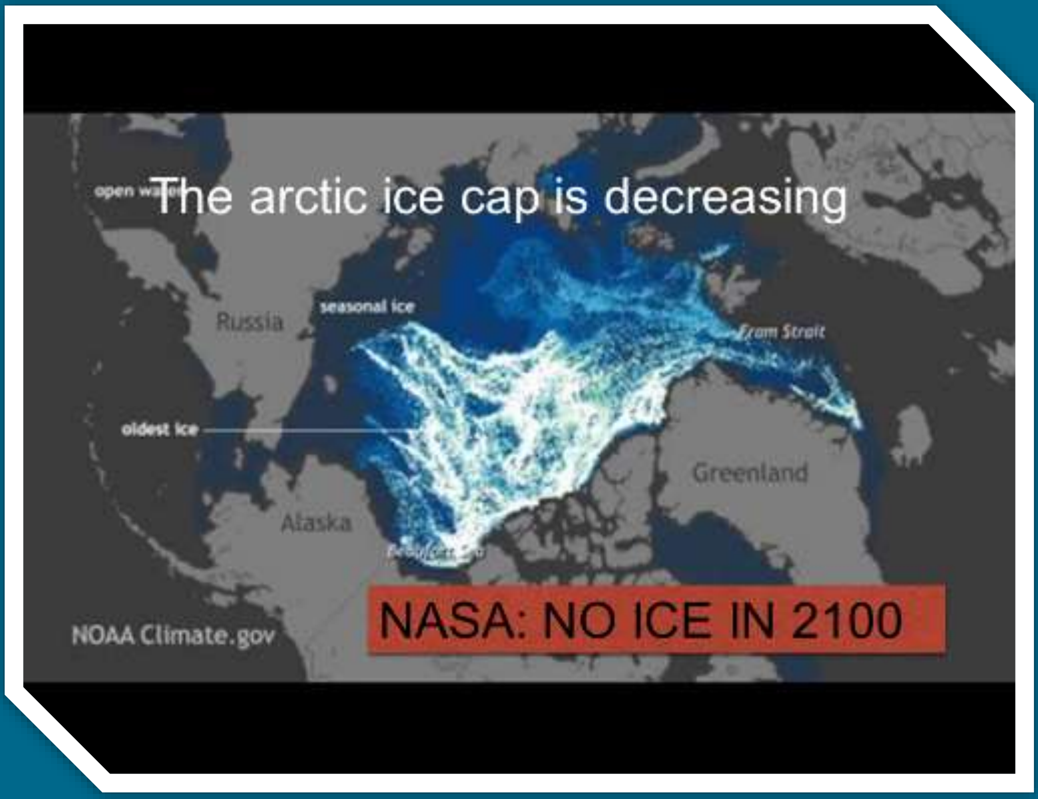

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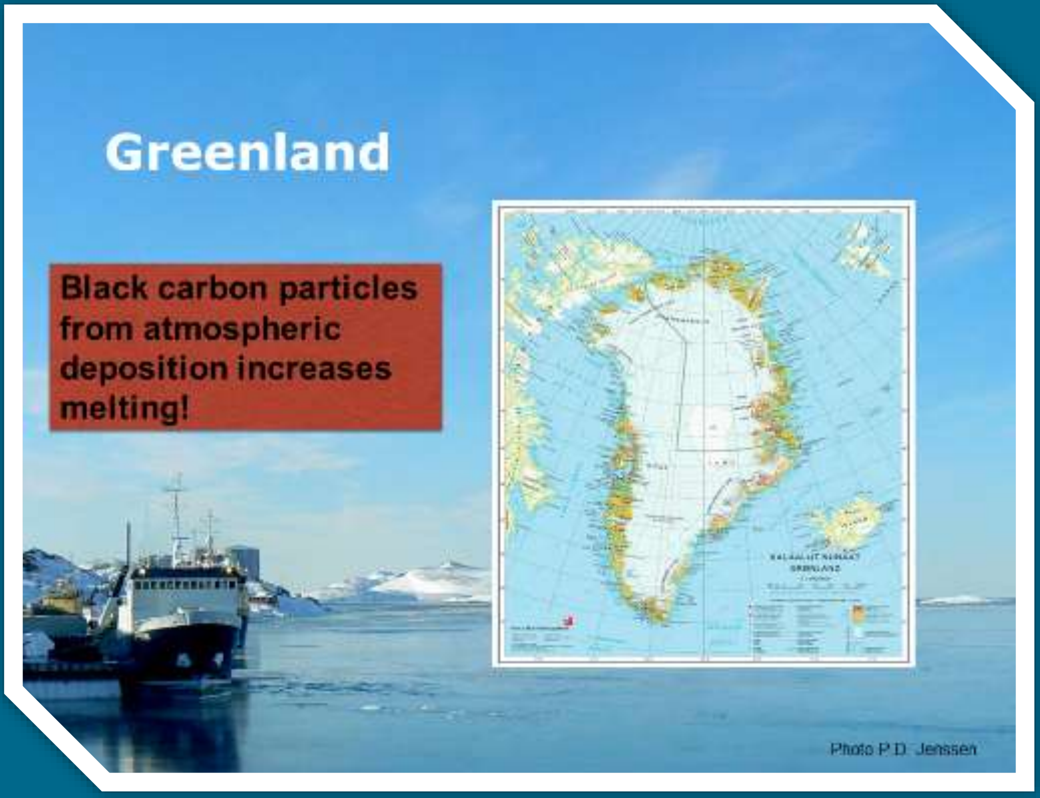
Keynote 1 - Presentation



BALTIC CLEAN TECHNOLOGY 2017
Keynote 1 - Presentation


Svolværpostei
Made from cod roe and cod liver
Popular on sandwiches
Stabburet
SVOLVÆRPOSTEI
Department of Environmental Sciences (IMV), P.D. Jensen
NORWEGIAN UNIVERSITY OF LIFE SCIENCES (NMBU)
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Svolværpostei
Made from cod roe and cod liver
Popular on sandwiches
WARNING: Not to be consumed
by pregnant women!
Stabburet
SVOLVÆRPOSTEI
Department of Environmental Sciences (IMV), P.D. Jensen
NORWEGIAN UNIVERSITY OF LIFE SCIENCES (NMBU)
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BALTIC CLEAN TECHNOLOGY 2017
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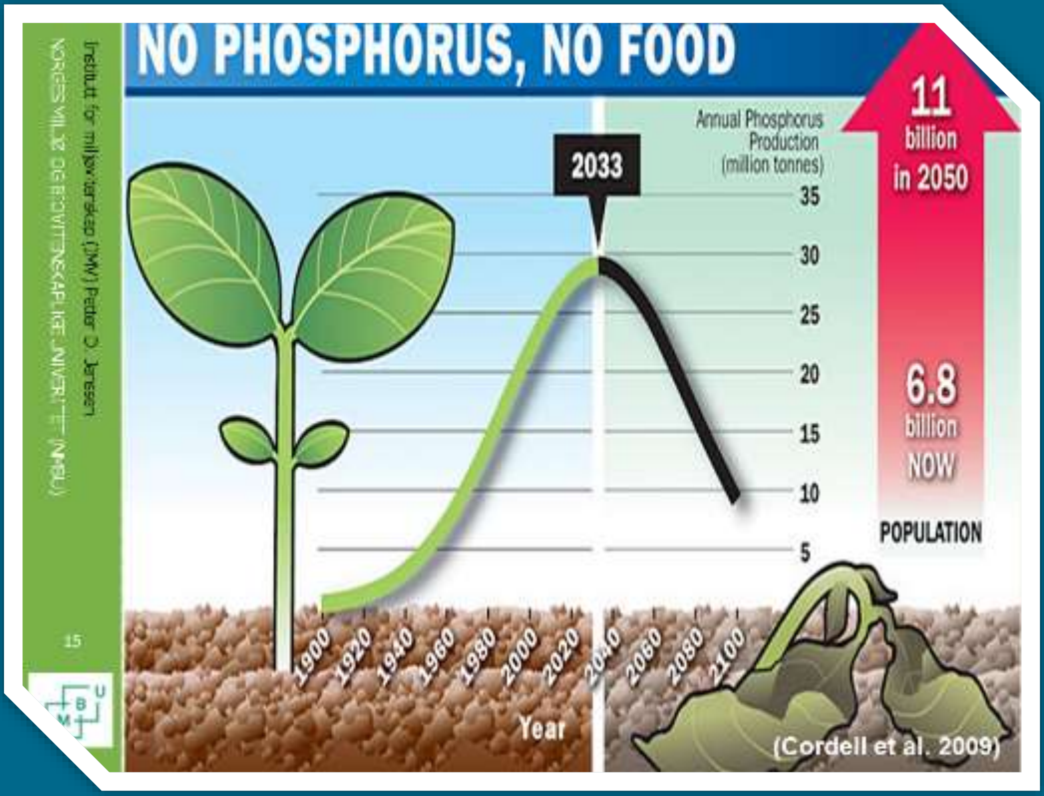

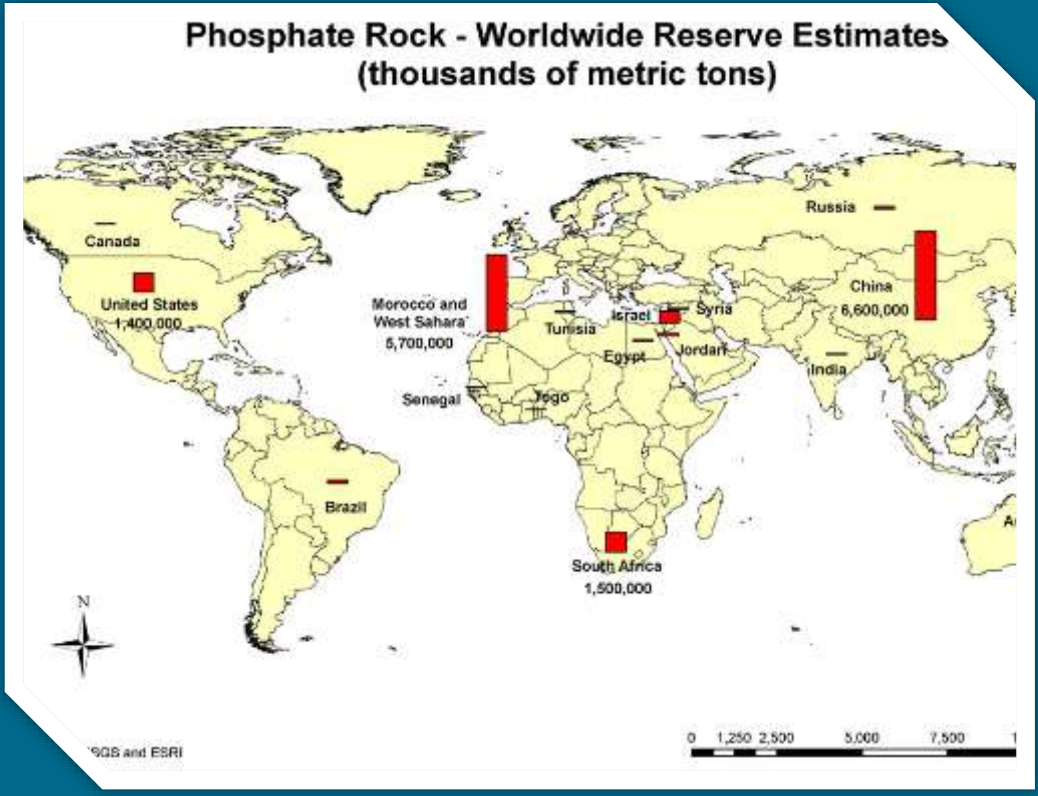

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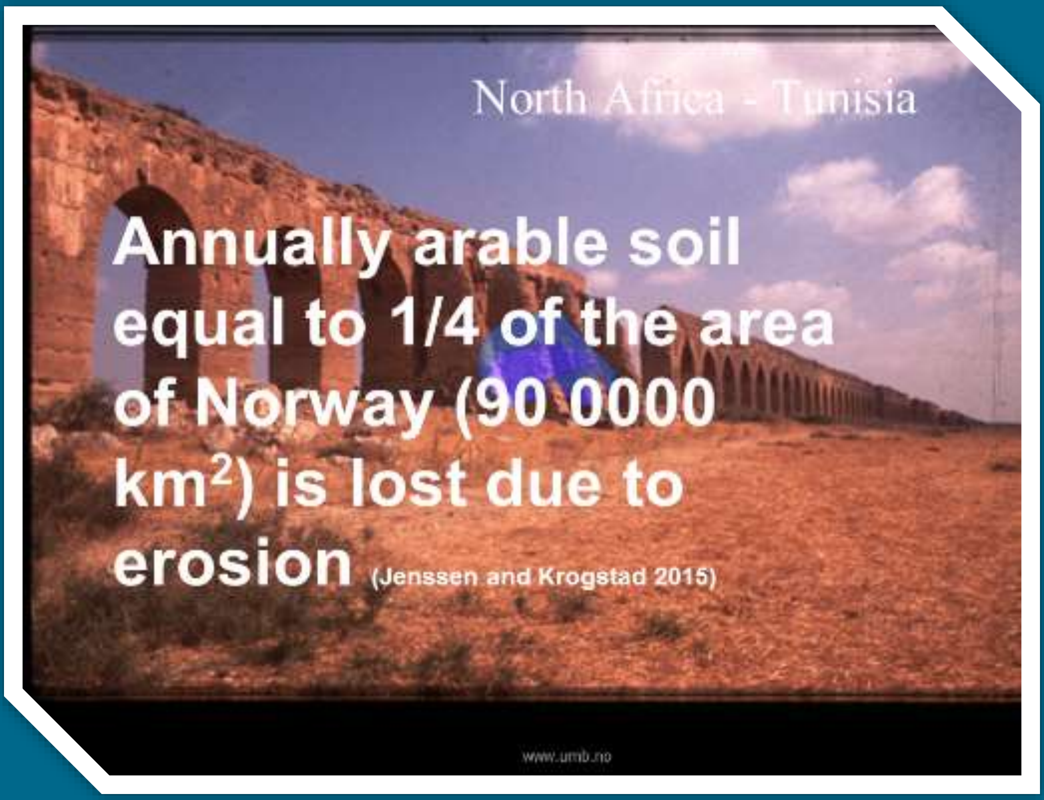

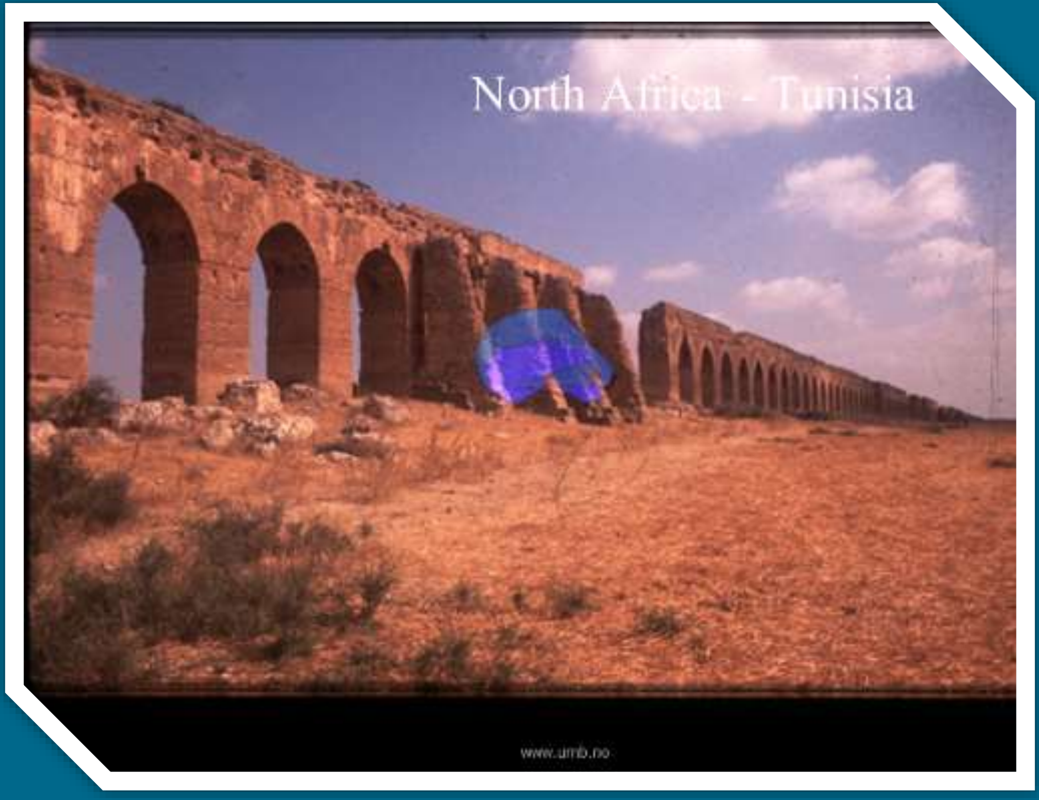

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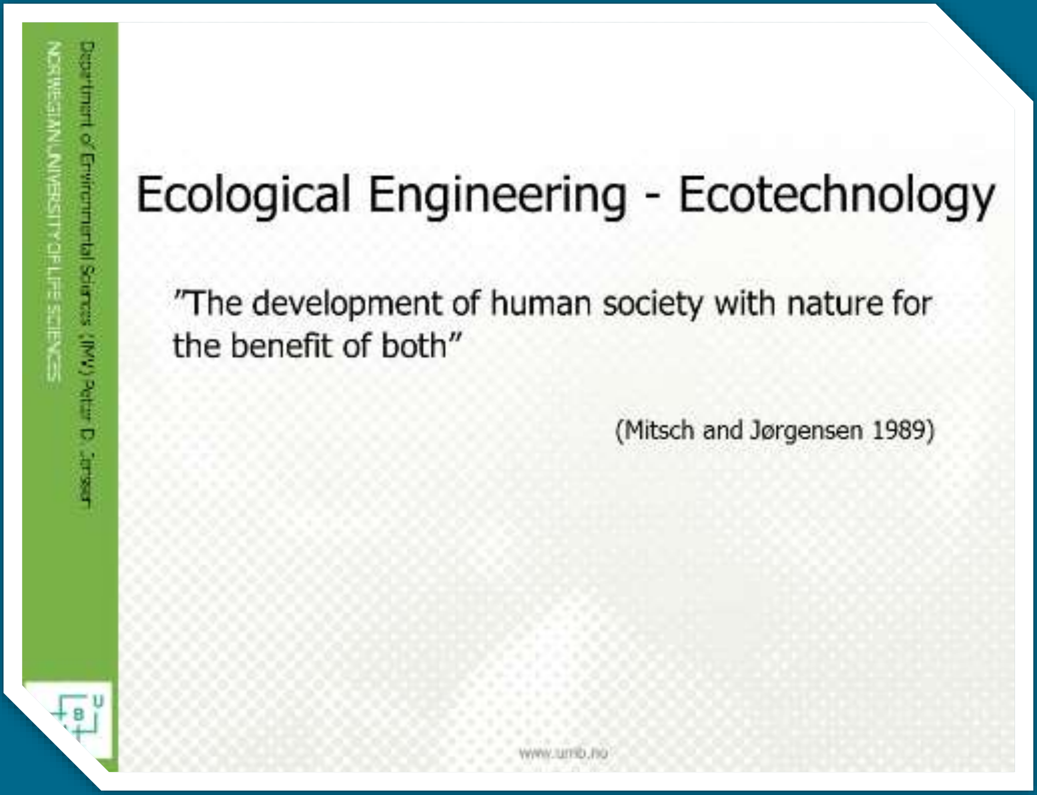

Department of Environmental Sciences (IMV) Petter D. Jenssen
NORWEGIAN UNIVERSITY OF LIFE SCIENCES
Ecological Engineering - Ecotechnology
"The development of human society with nature for the benefit of both"
(Mitsch and Jørgensen 1989)
www.umb.no

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Keynote 1 - Presentation

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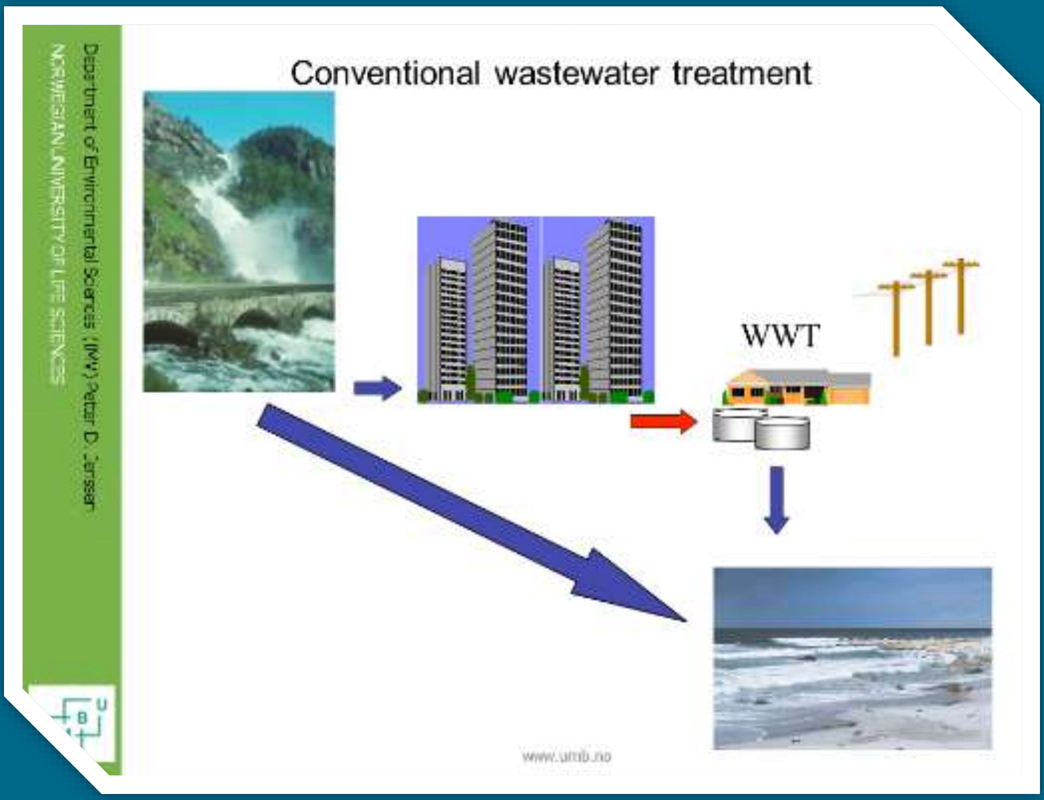

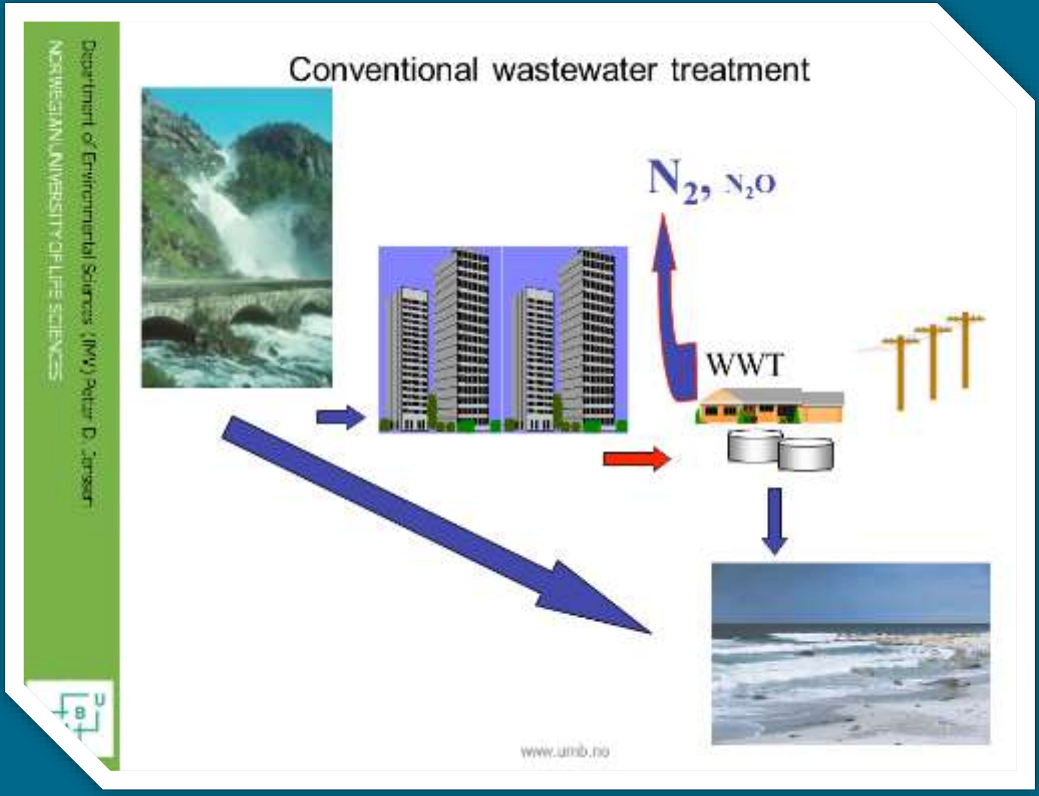

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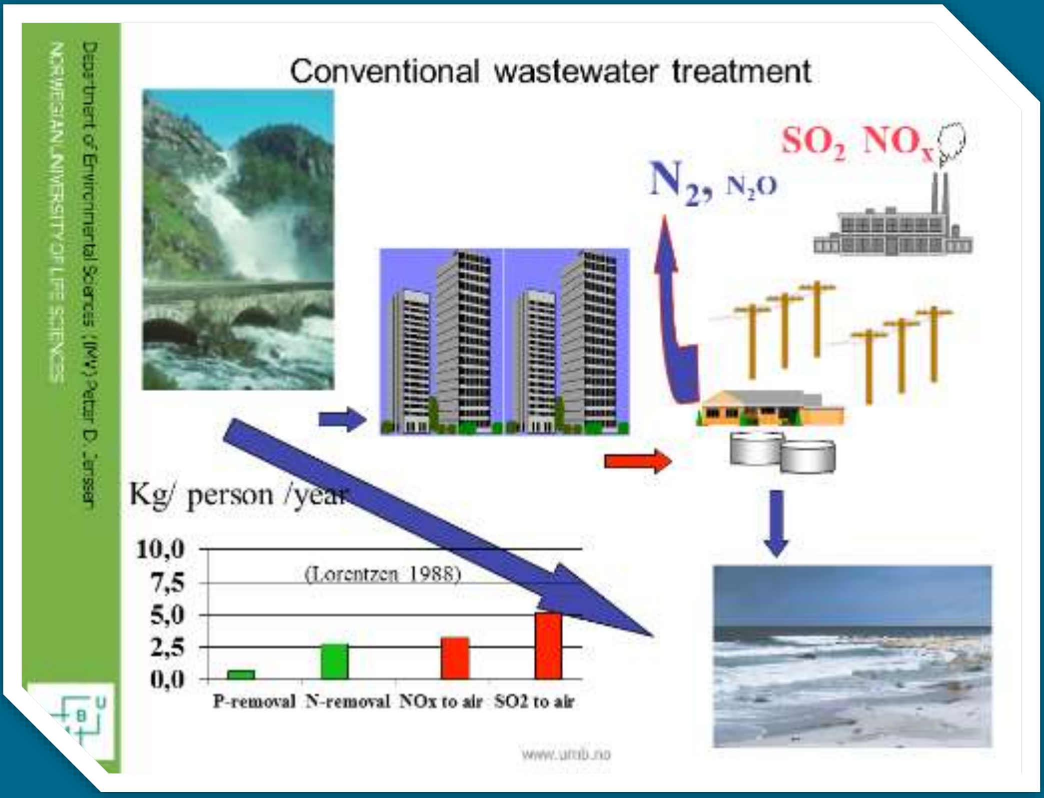

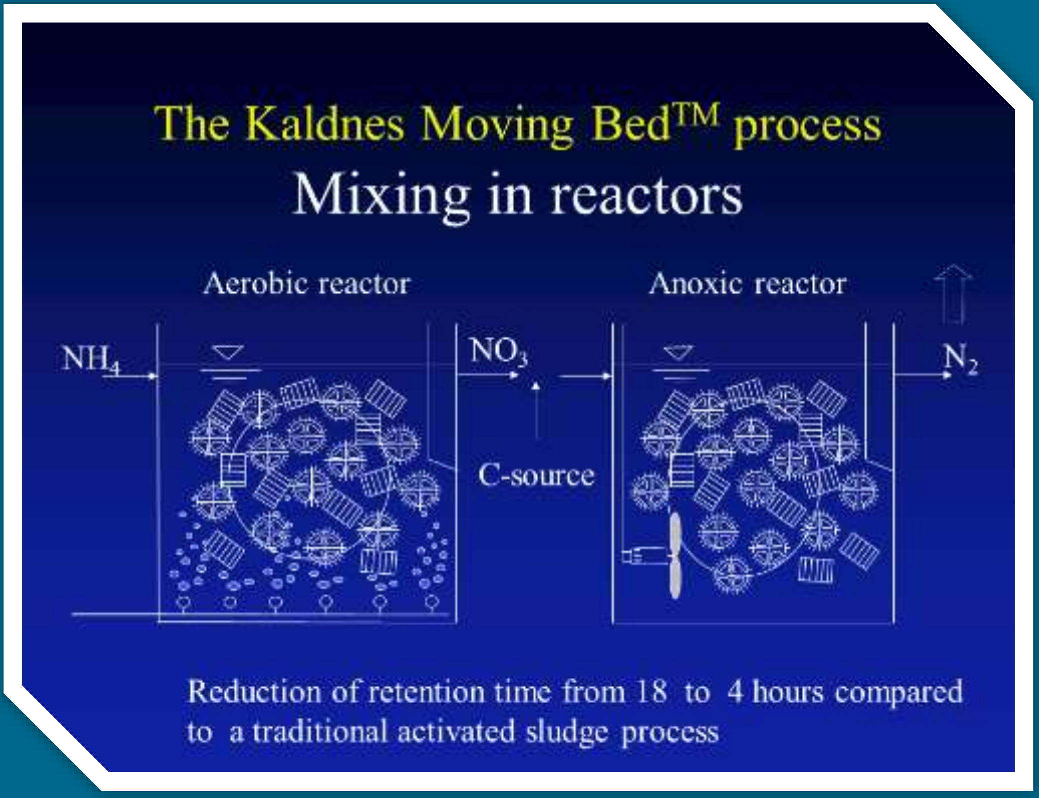

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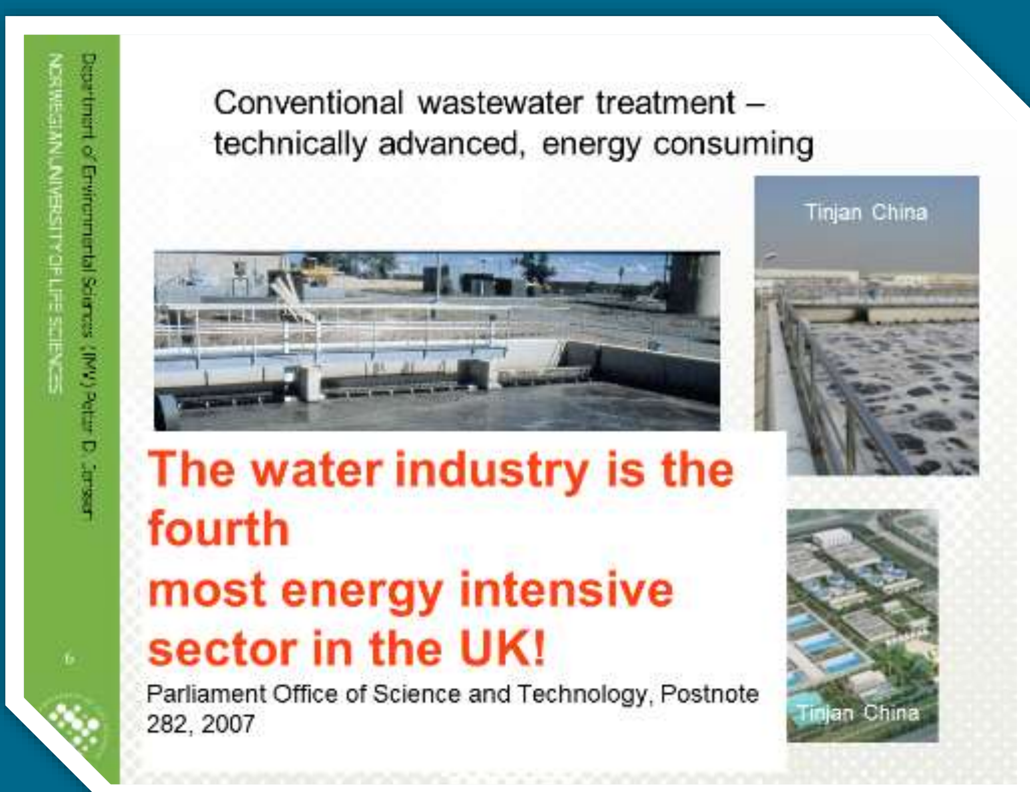

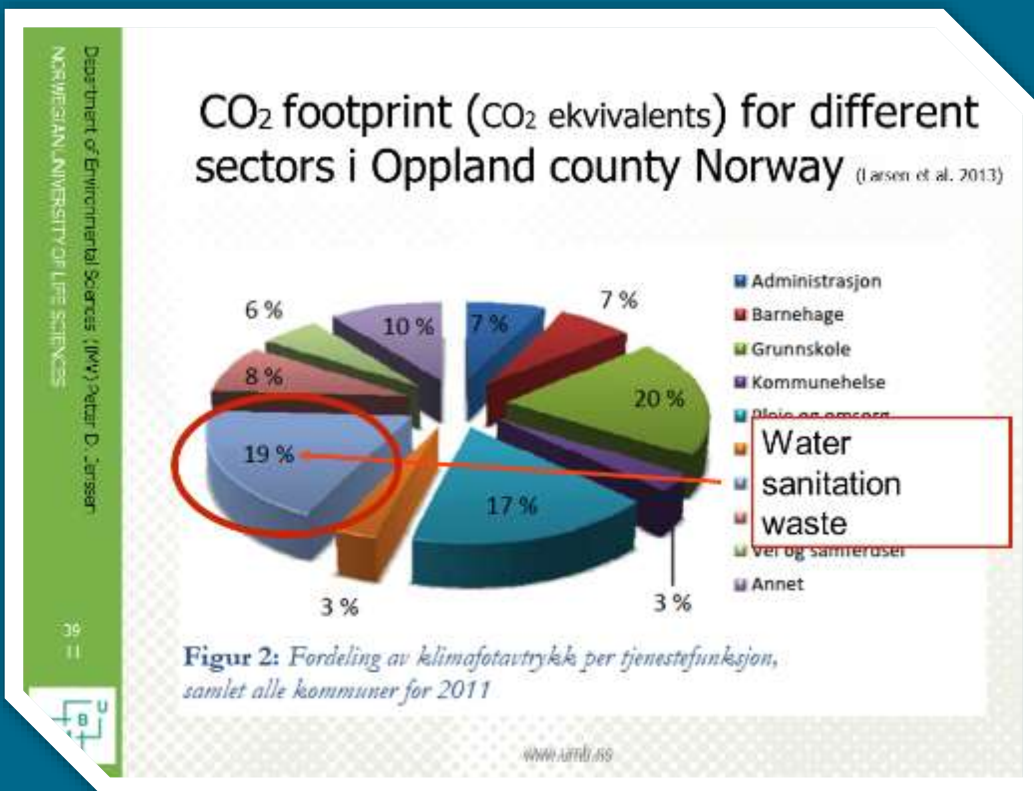

CO_2 footprint (CO_2 ekvivalents) for different sectors i Oppland county Norway (Larsen et al. 2013)
6 %
10 %
7 %
7 %
8 %
20 %
19 %
17 %
3 %
3 %
Administrasjon
Barnehage
Grunnskole
Kommunehelse
Water
sanitation
waste
Annet
Figur 2: Fordeling av klimafotavtrykk per tjenestefunksjon, samlet alle kommuner for 2011
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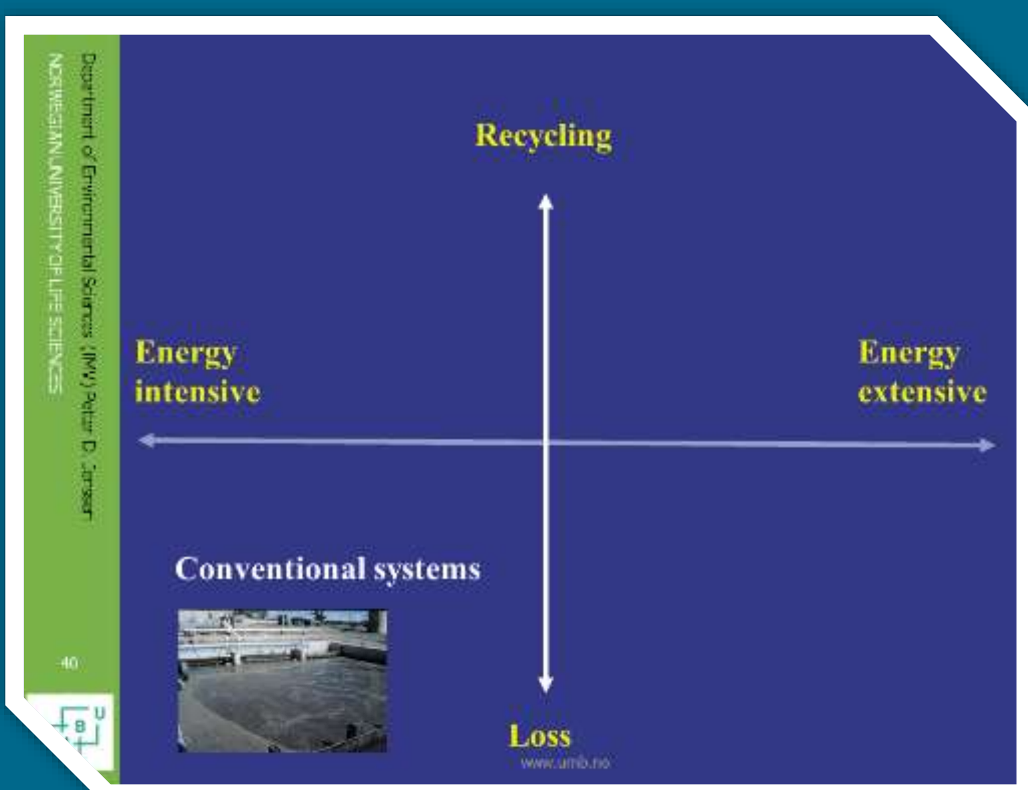

Recycling
Energy intensive
Energy extensive
Conventional systems
Loss
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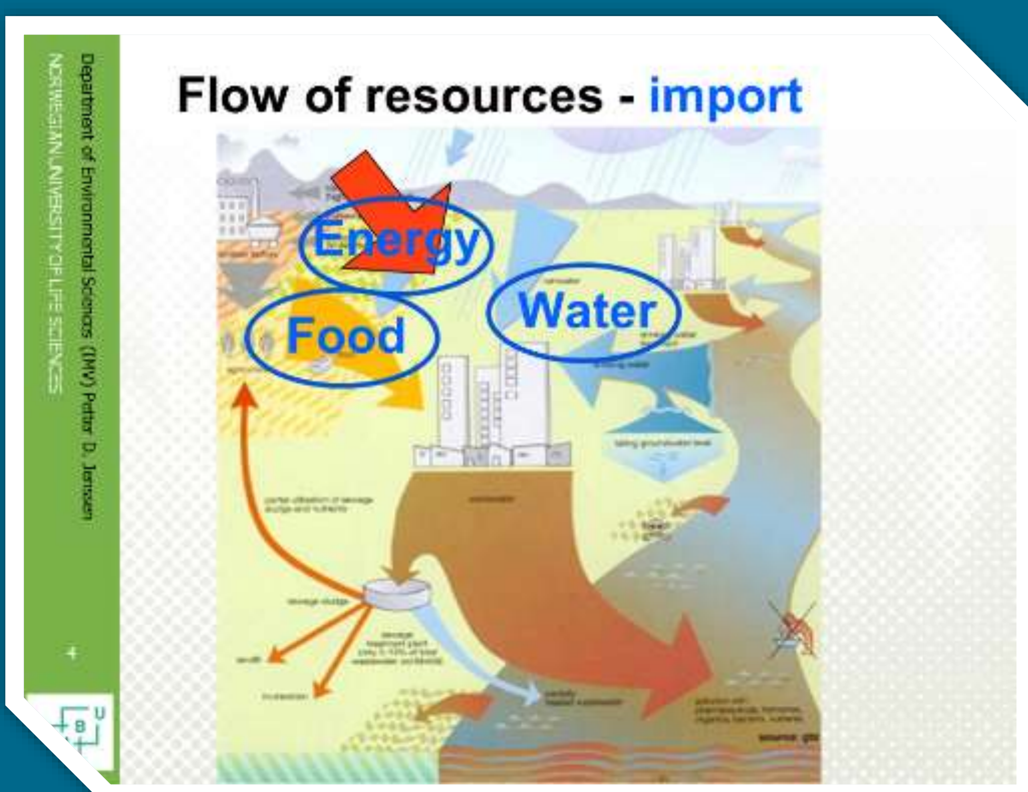

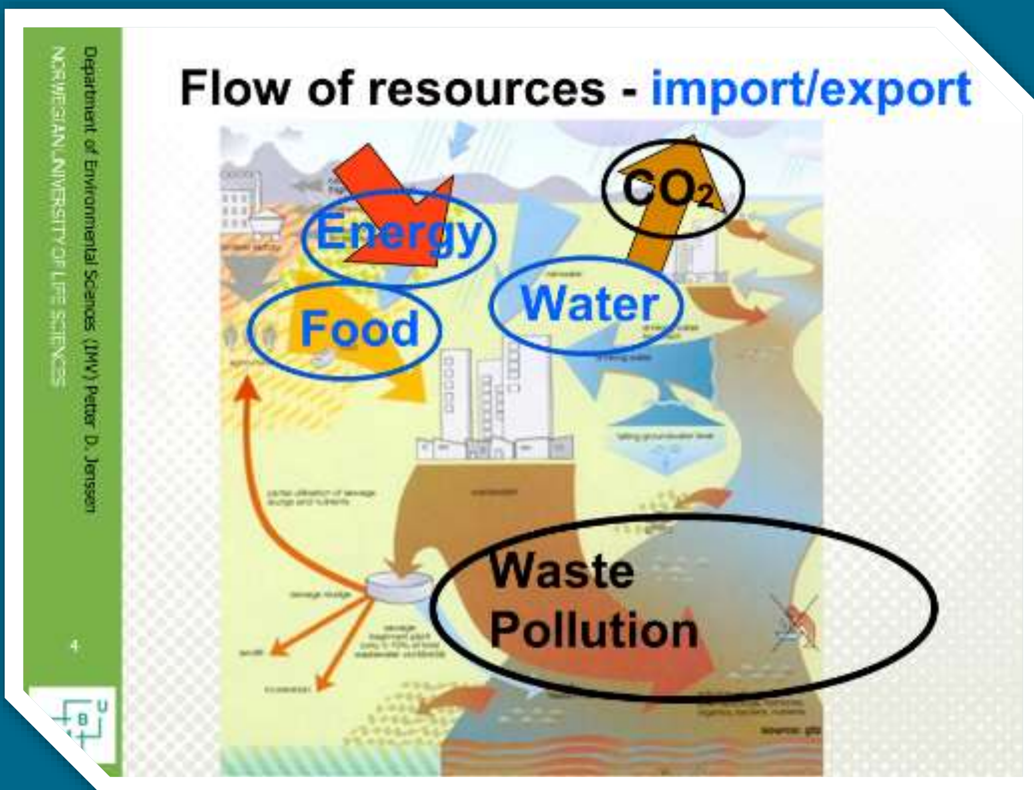
Flow of resources - import/export
Energy
Food
Water
CO_2
Waste
Pollution
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The wastewater resource
The value of nutrients discharged to sewer systems in Norway
30 million USD
per year
(Jenssen and Vatn 1991)
www.umb.no
Department of Environmental Sciences, P.D. Jenssen
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The wastewater resource
The fertilizer value of the blackwater from
900 Mio people in rural **China**
250 billion USD
per year
(UNESCO 2001)
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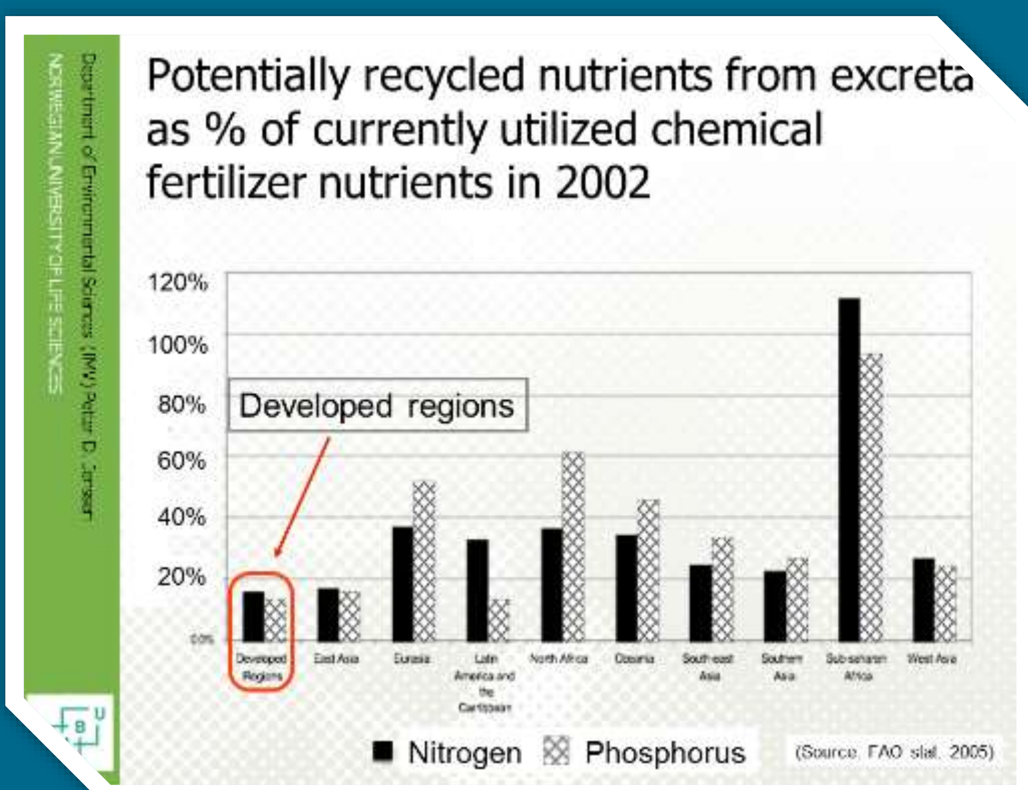
Potentially recycled nutrients from excreta
as % of currently utilized chemical
fertilizer nutrients in 2002
120%
100%
80%
60%
40%
20%
Developed regions
Developed Regions
East Asia
Eurasia
Latin America and the Caribbean
North Africa
Oceania
South-east Asia
Southern Asia
Sub-saharan Africa
West Asia
Nitrogen
Phosphorus
(Source: FAO stat. 2005)
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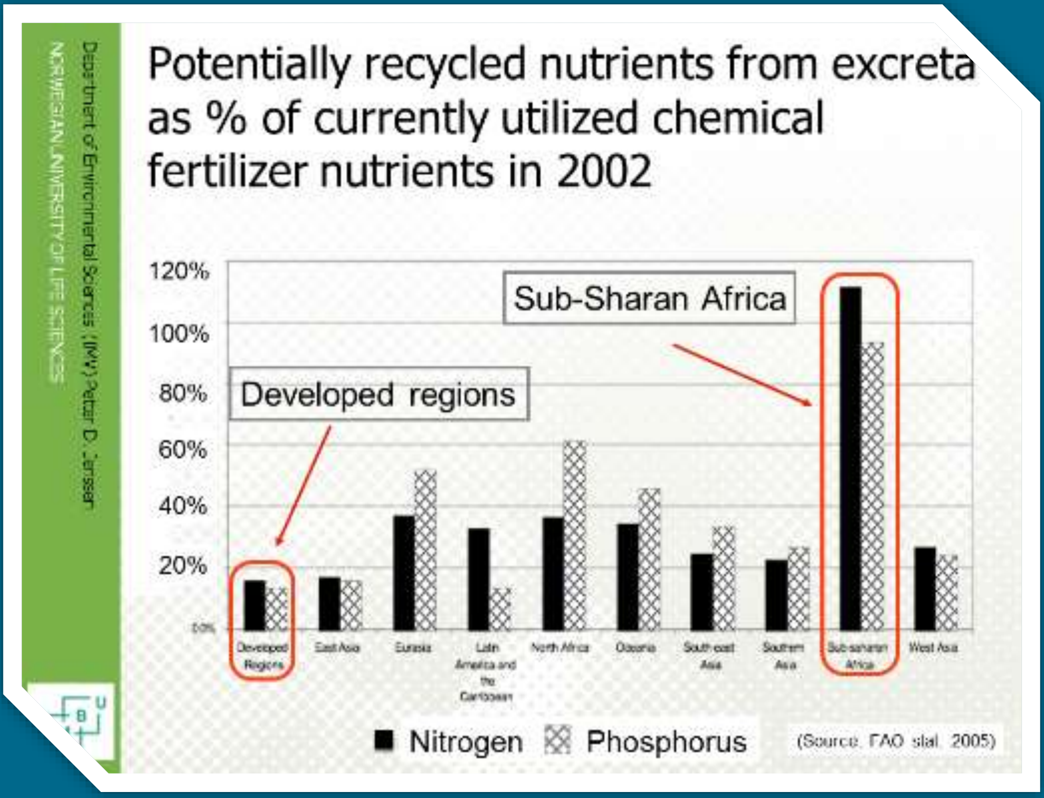

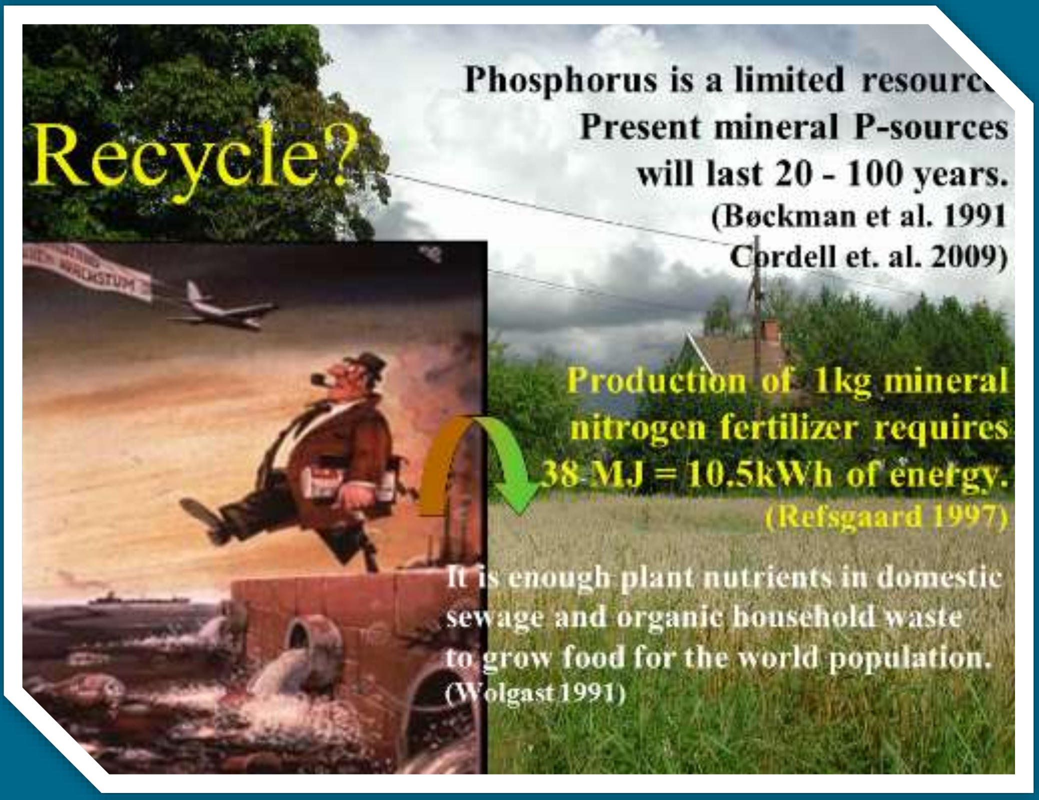

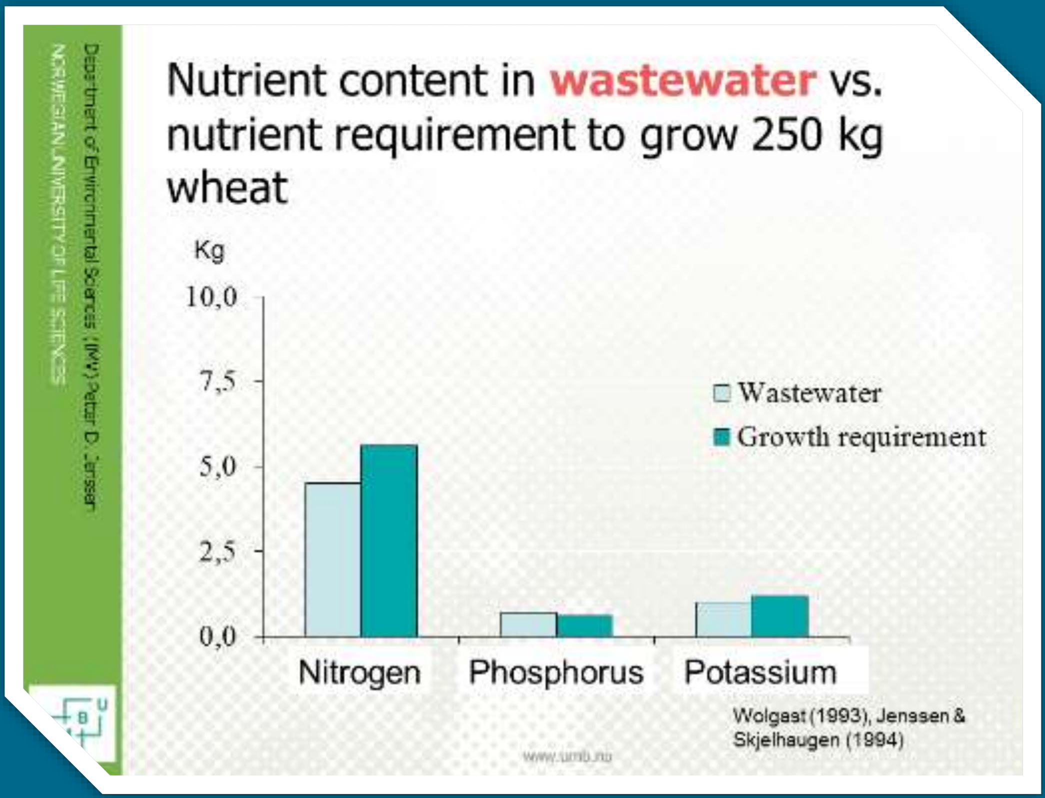
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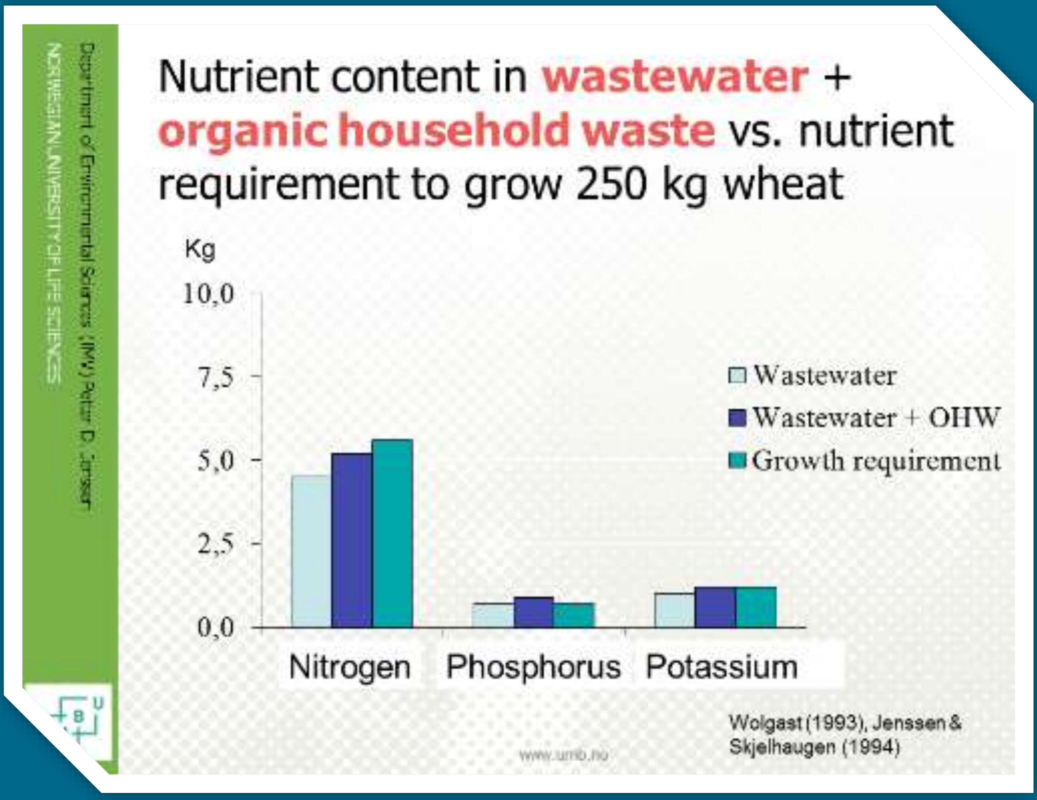
Nutrient content in wastewater vs. nutrient requirement to grow 250 kg wheat
Kg
10,0
7,5
5,0
2,5
0,0
Wastewater
Growth requirement
Nitrogen
Phosphorus
Potassium
Wolgast (1993), Jenssen & Skjelhaugen (1994)
www.umb.no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Nutrient content in wastewater + organic household waste vs. nutrient requirement to grow 250 kg wheat
Kg
10,0
7,5
5,0
2,5
0,0
Wastewater
Wastewater + OHW
Growth requirement
Nitrogen
Phosphorus
Potassium
Wolgast (1993), Jenssen & Skjelhaugen (1994)
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Resources in wastewater

Annual discharge from one person

• Nitrogen (N)	4.5 kg
• Phosphorus (P)	0.6 kg
• Potassium (K)	1.0 kg
• Organic matter (BOD)	35 kg

The nutrients discharged from one person can fertilize 0.1 hectar low intensity agriculture

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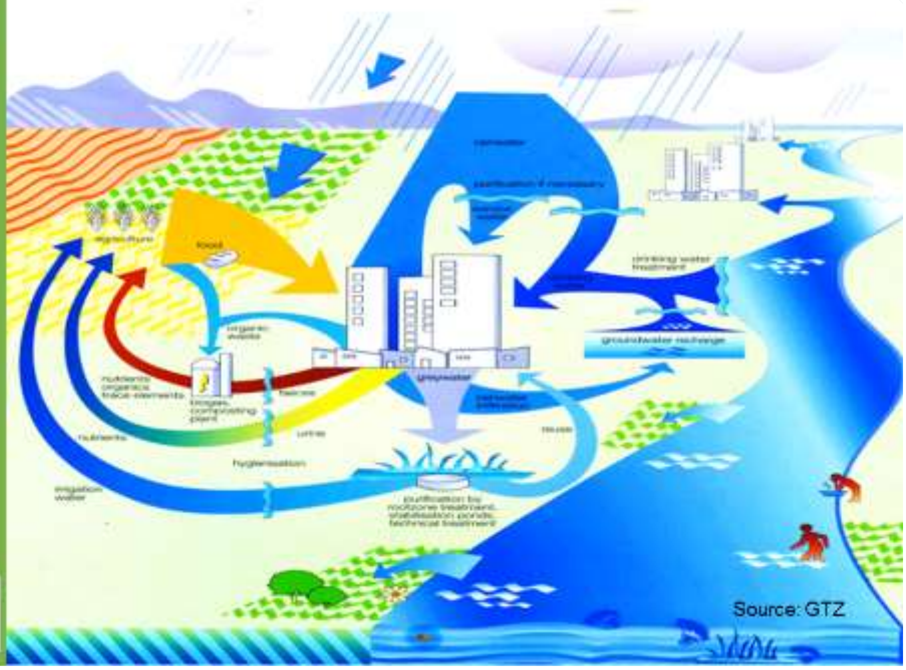
Sustainable water and sanitation - vision



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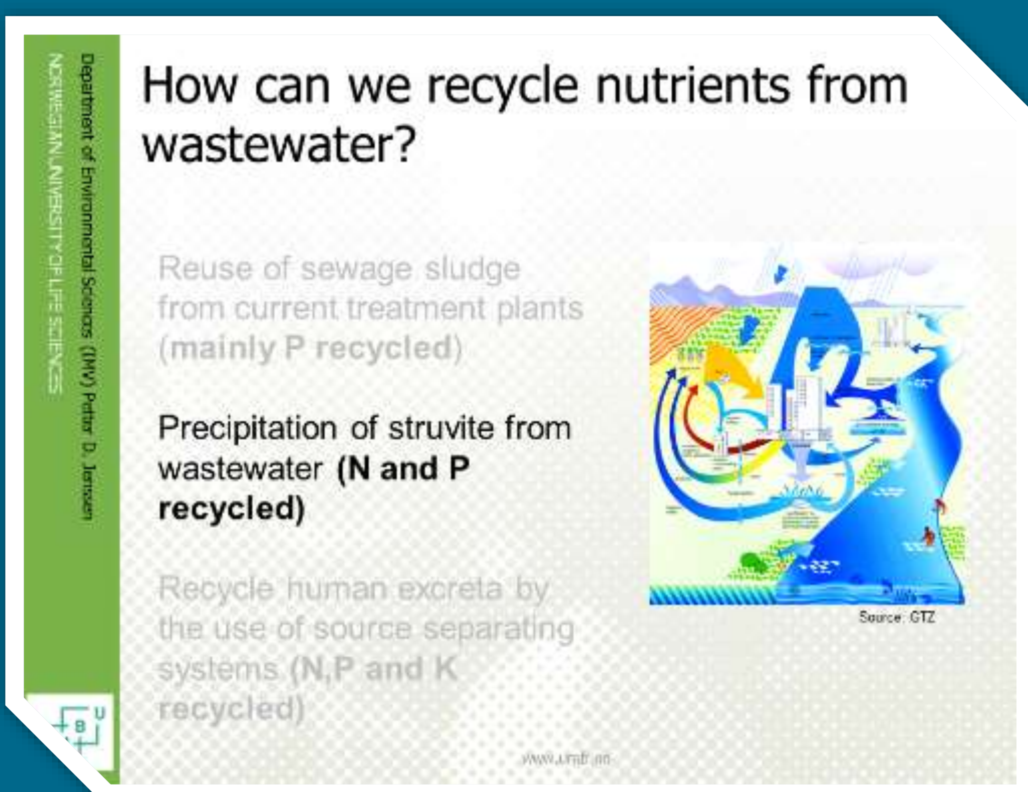

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How can we recycle nutrients from wastewater?

Reuse of sewage sludge from current treatment plants **(mainly P recycled)**

Precipitation of struvite from wastewater **(N and P recycled)**

Recycle human excreta by the use of source separating systems **(N,P and K recycled)**

Source: GTZ

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Source separation of wastewater

(Alsen and Jenssen2005)

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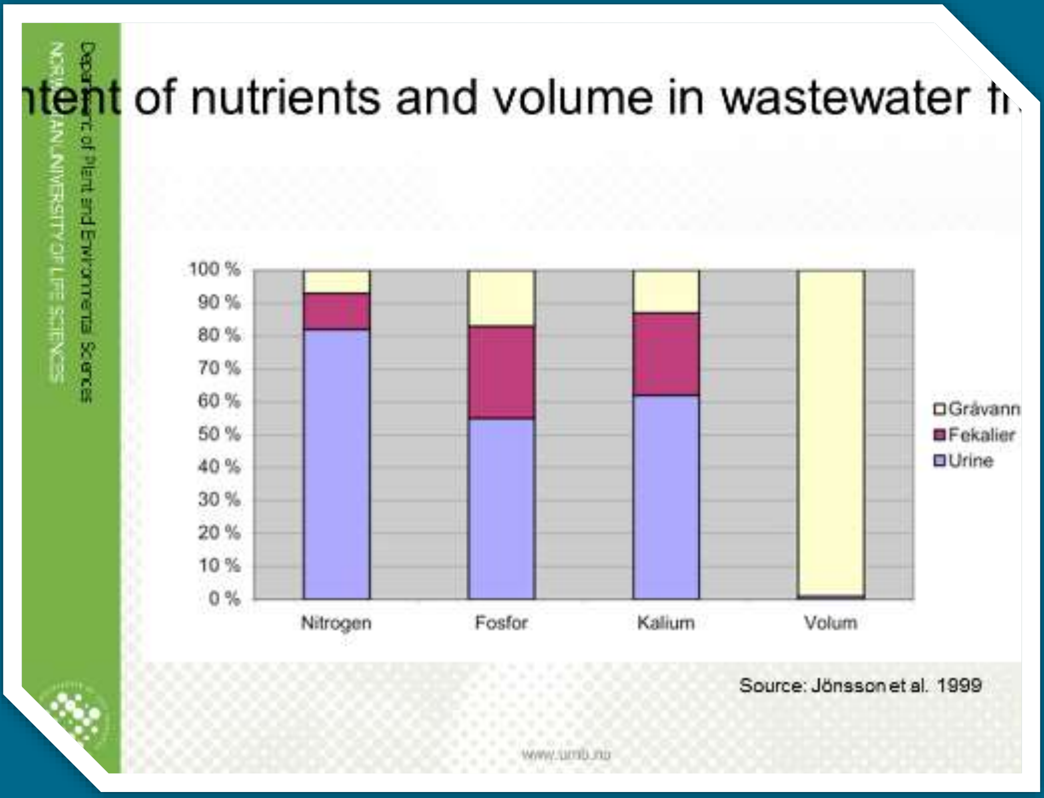
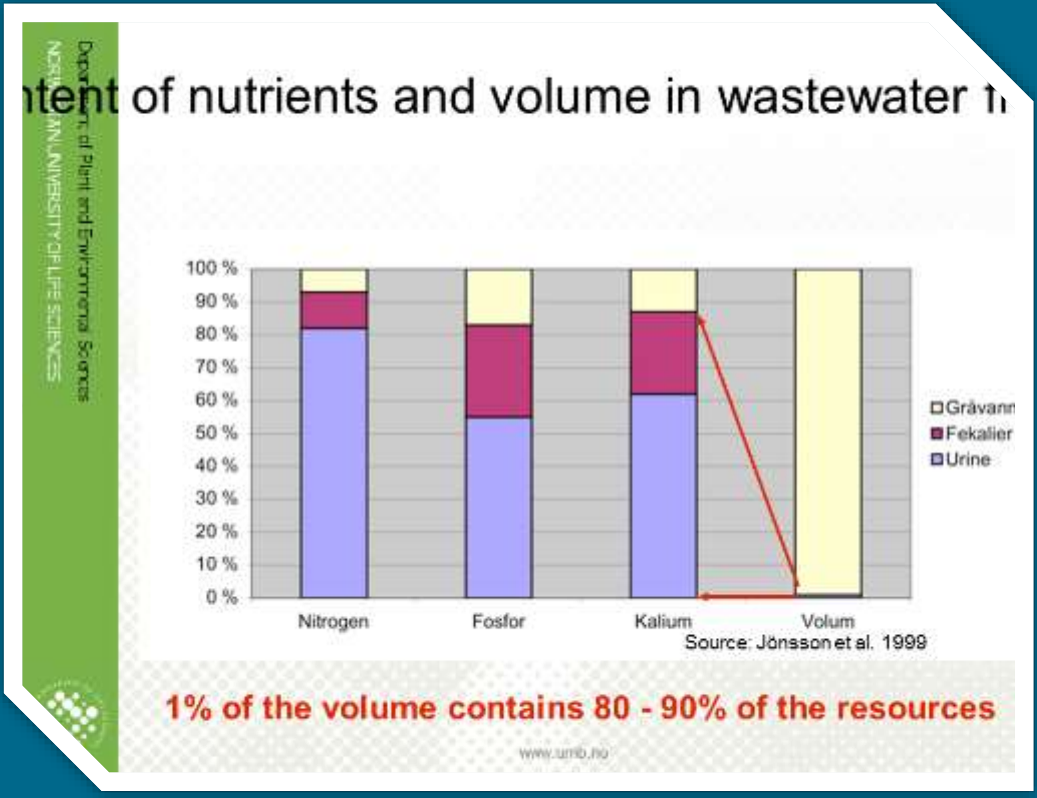
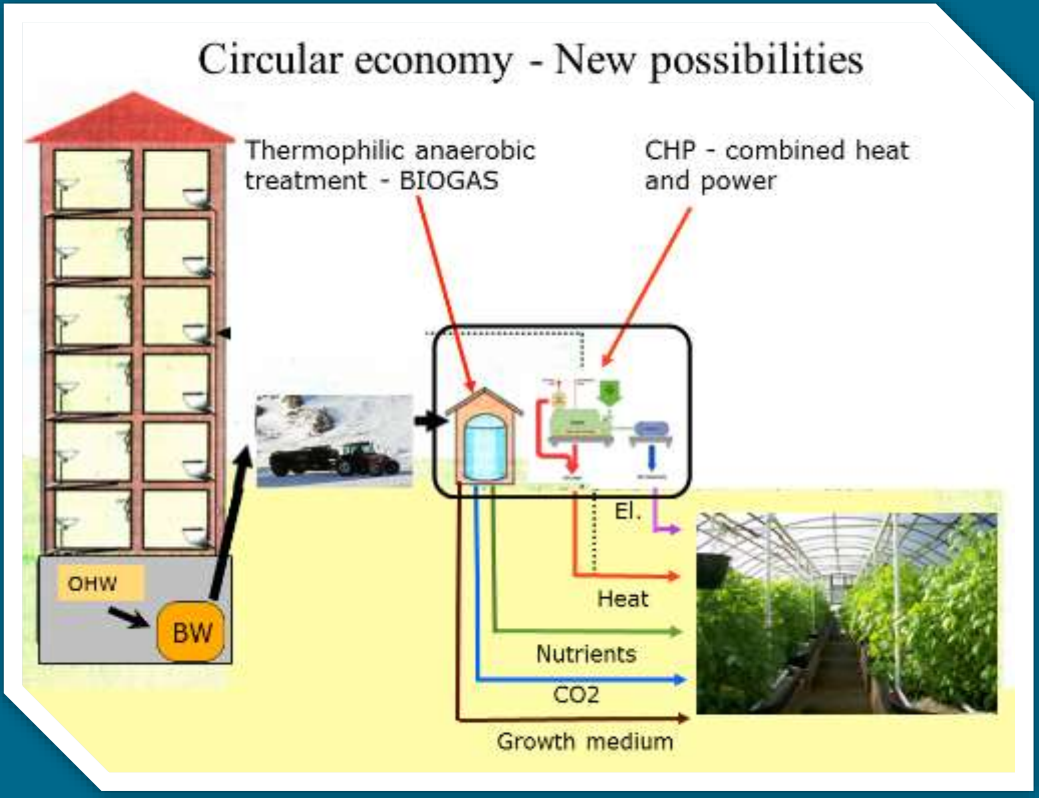
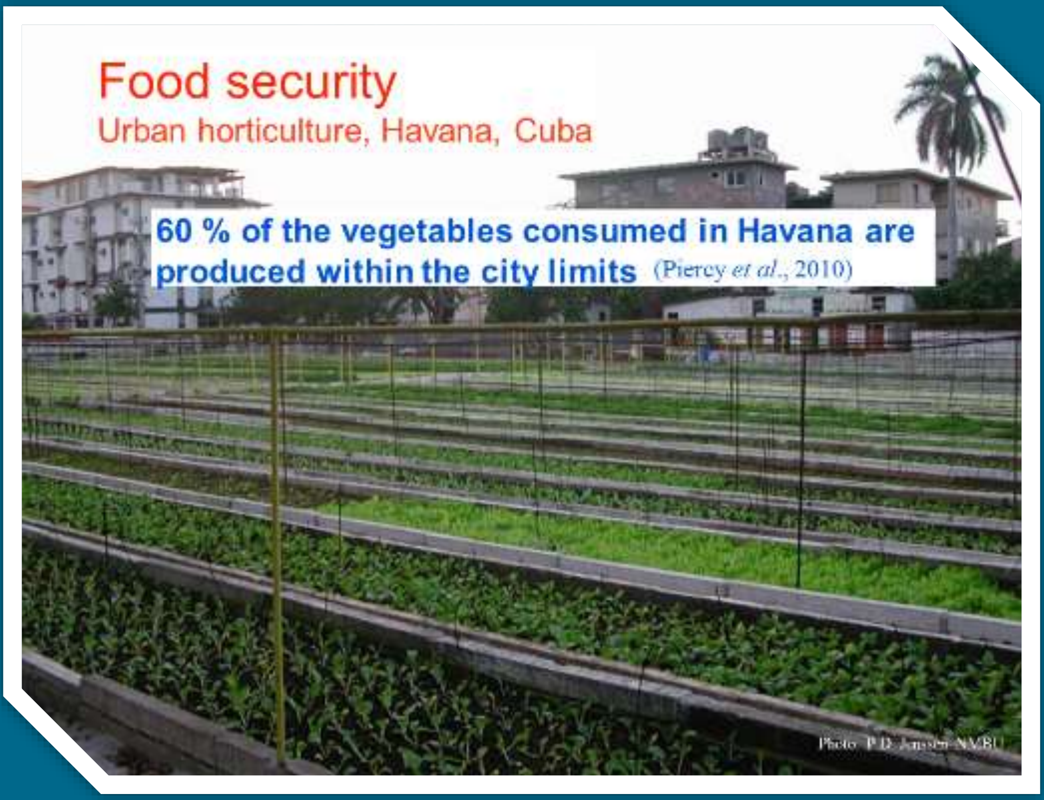





Vacuum technology Marine installations
• 1660 vacuum toilets
• > 2km of vacuum sewer line
(Jets TM)


Circular economy - New possibilities
Thermophilic anaerobic treatment - BIOGAS
CHP - combined heat and power
OHW
BW
El.
Heat
Nutrients
CO2
Growth medium

BALTIC CLEAN TECHNOLOGY 2017
Keynote 1 - Presentation


Food security
Urban horticulture, Havana, Cuba
60 % of the vegetables consumed in Havana are produced within the city limits (Piercy et al., 2010)


Water - A CHALLENGE!
How can we reduce the water footprint of a city to 1/10th without sacrificing comfort?
hoto: P. Jenssen

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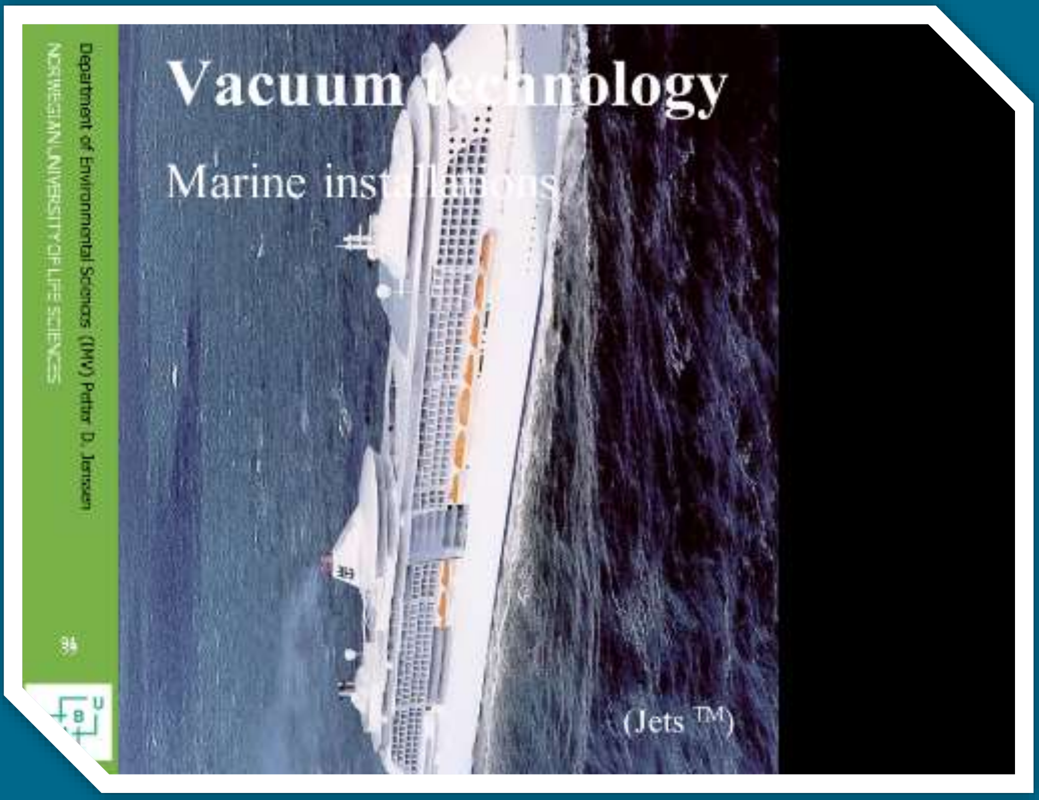
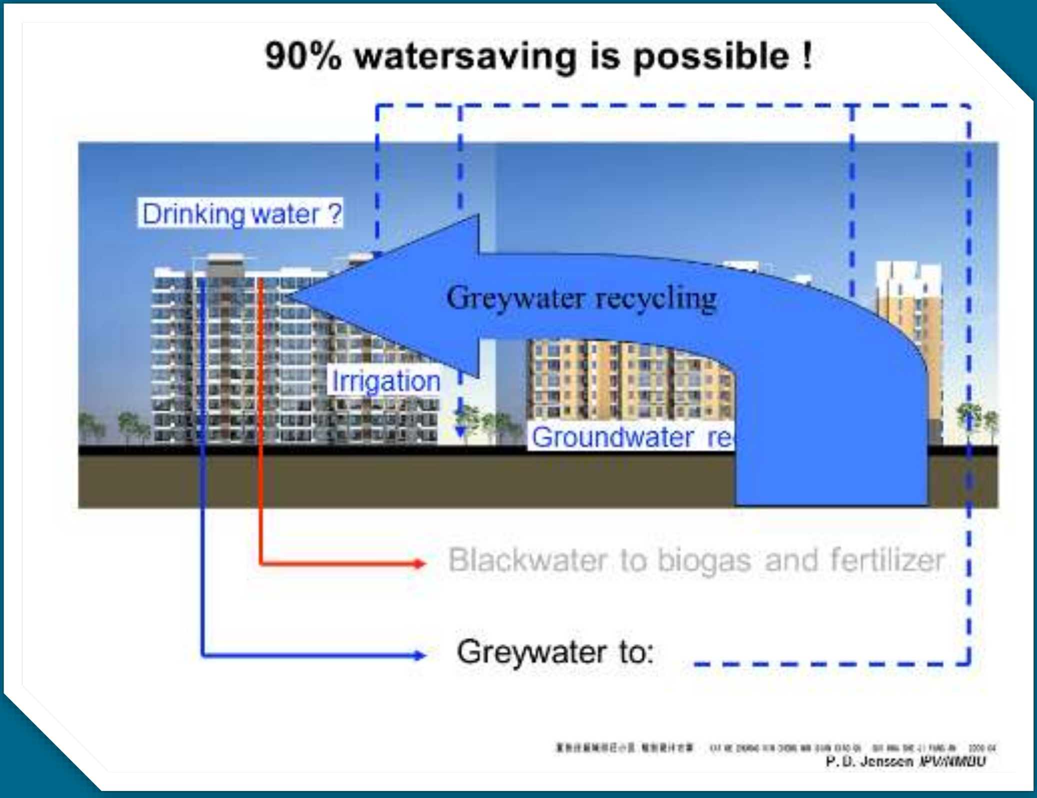
Keynote 1 - Presentation



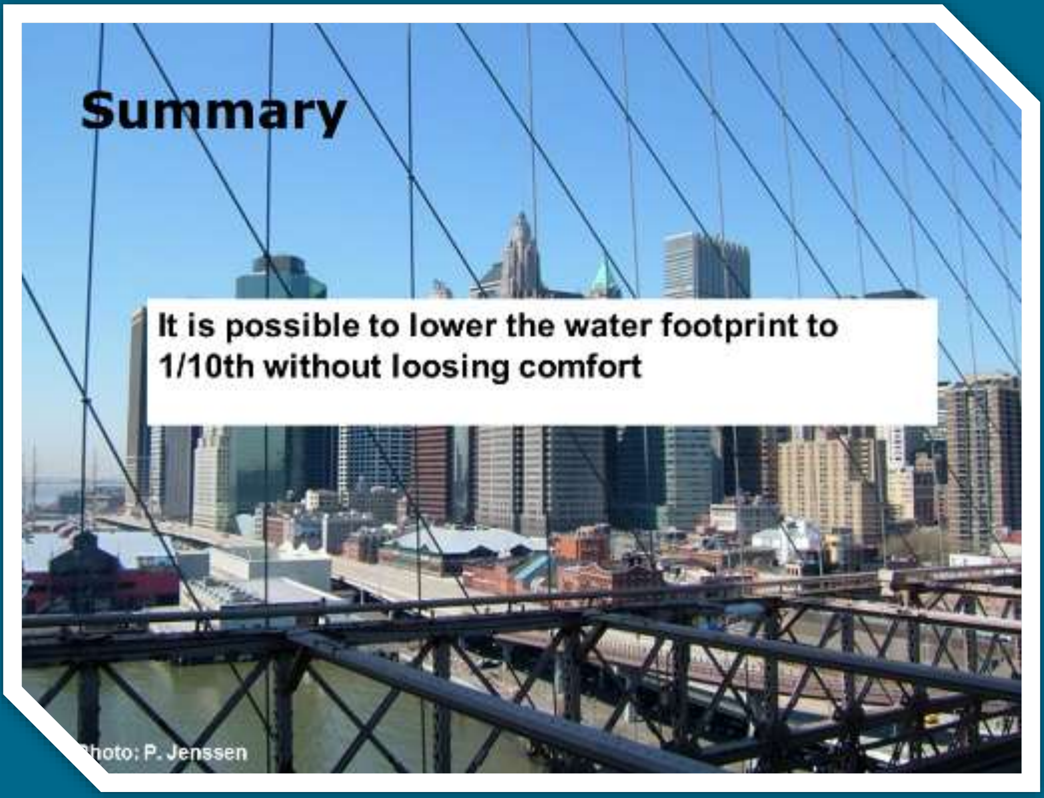
BALTIC CLEAN TECHNOLOGY 2017
Keynote 1 - Presentation

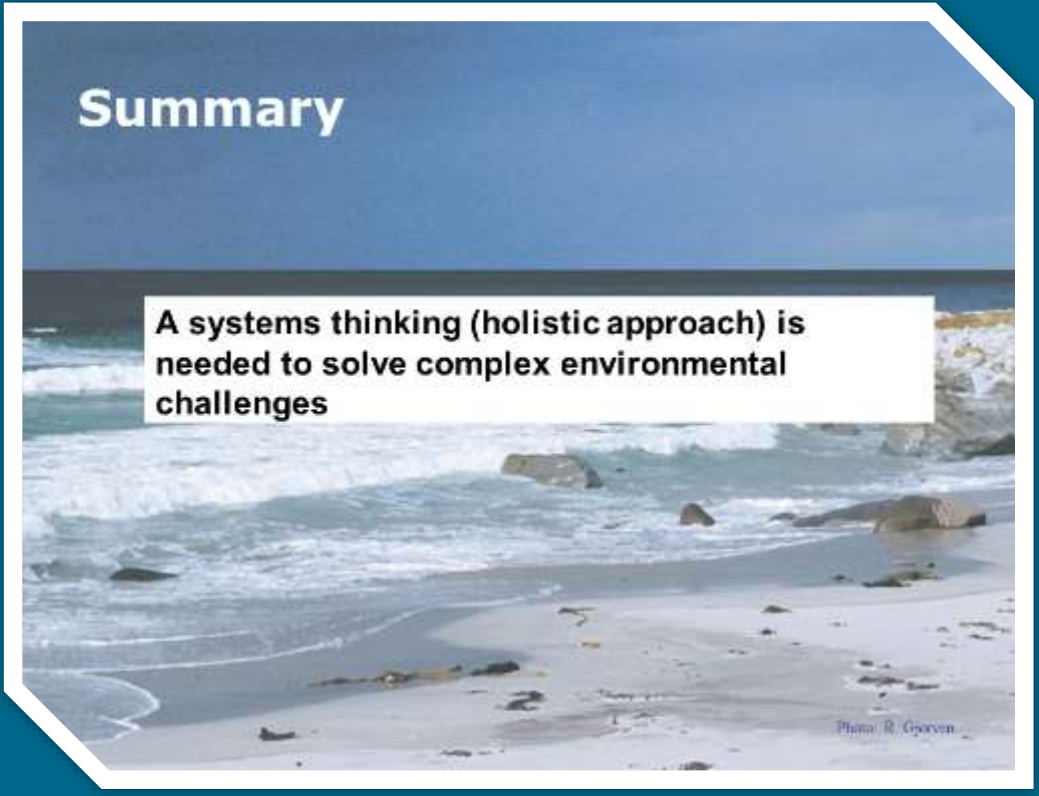
Department of Environmental Sciences (IMV) Petter D. Jenssen
NORWEGIAN UNIVERSITY OF LIFE SCIENCES
Inhouse use ?
Greywater treatment at
Klosterenga Oslo
Effluent values:
Fecal coliforms: <20
Total-N: 2,5 mg/l
Total-P: 0,03 mg/l
(Sagen 2014)



90% watersaving is possible !
Drinking water ?
Greywater recycling
Irrigation
Groundwater re
Blackwater to biogas and fertilizer
Greywater to:
P. D. Jenssen IPV/NMBU

Keynote 1 - Presentation





Summary
Upgrading of current treatment systems for wastewater and sludge need to focus on removal/decomposition of organic micro-pollutants

Summary
Recycling
Systems with source separation
Energy intensive
Energy extensive
Upgrading of current treatment systems for wastewater and sludge need to focus on minimizing use of fossil energy and maximizing recycling
Loss
Department of Environmental Sciences (IMV) Petter D. Jenssen
NORWEGIAN UNIVERSITY OF LIFE SCIENCES
76
www.umb.no


Summary
The future green cities will be hubs in a «circular (green) economy»
Source: GTZ
Department of Environmental Sciences (IMV) Petter D. Jenssen
NORWEGIAN UNIVERSITY OF LIFE SCIENCES
4


Summary
The future green cities will be hubs in a «circular (green) economy»
The future cities will be net exporters of soil amendment and fertilizer products
Source: GTZ
Department of Environmental Sciences (IMV) Petter D. Jenssen
NORWEGIAN UNIVERSITY OF LIFE SCIENCES
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Summary
Return og treated biowaste from urban areas we can counteract desertification
www.umb.no


Summary
Return og treated biowaste from urban areas we can counteract desertification
Recycling of phosphorus is necessary to obtain future food security
www.umb.no

BALTIC CLEAN TECHNOLOGY 2017
Keynote 1 - Presentation

BALTIC CLEAN TECHNOLOGY 2017
Keynote 2

Maria Hassel | Vattenfall AB

Matter and energy balance of resources and values for offshore wind

The lecture will be about the decommissioning of Yttre Stengrund, one of the first offshore wind farms in Sweden. Maria Hassel will talk about the process from decision to execution, lessons learned and experiences from Yttre Stengrund that can be implemented in new wind power projects.

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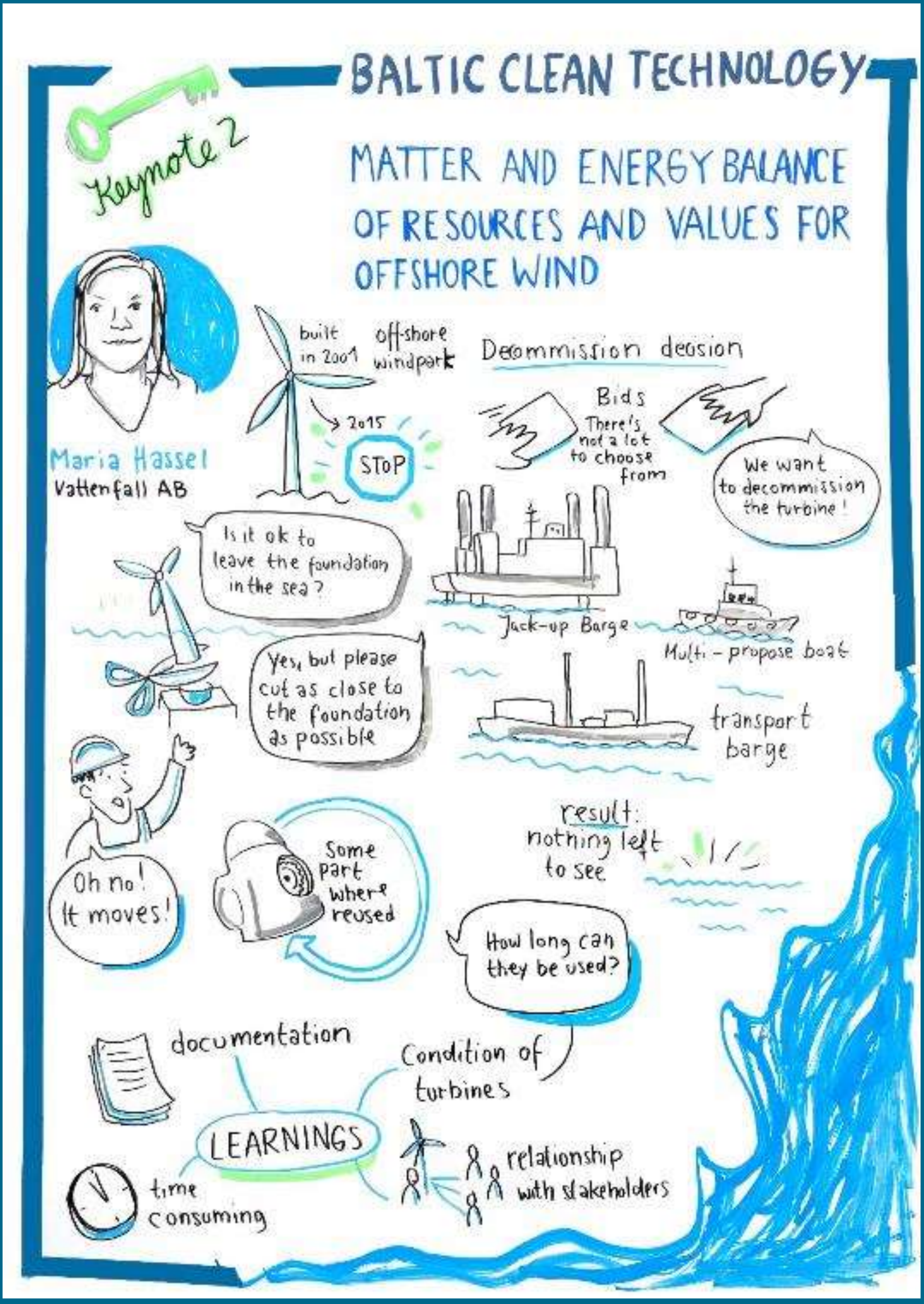
Keynote 2

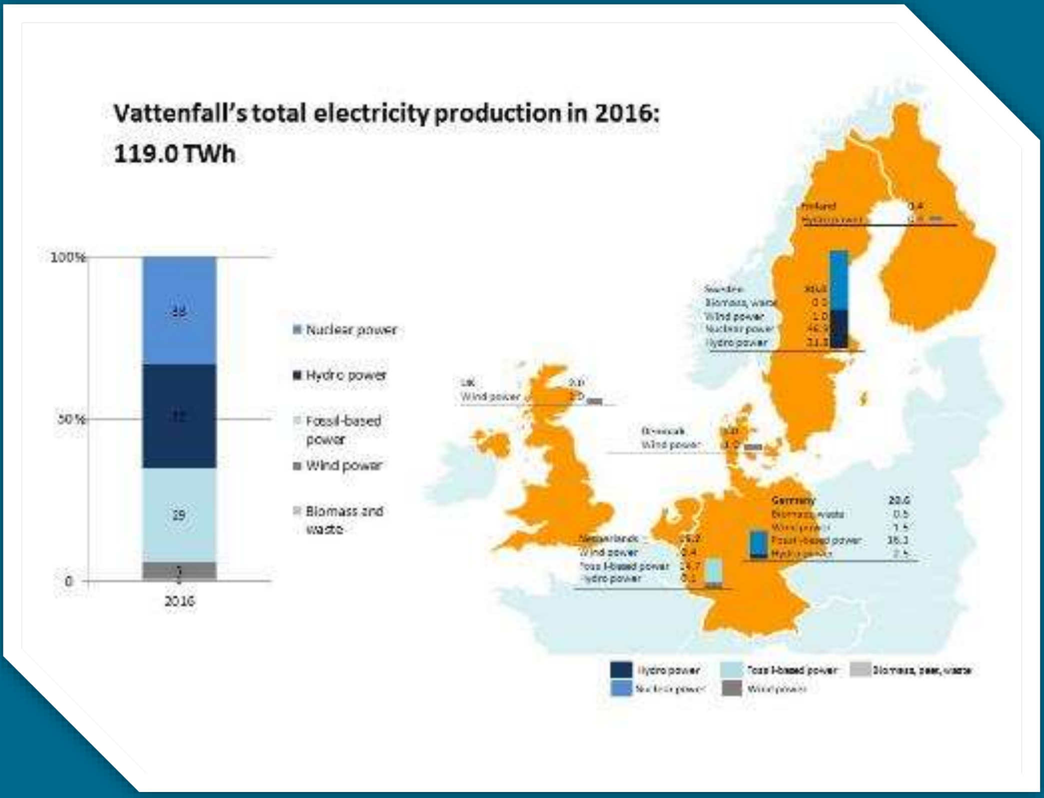


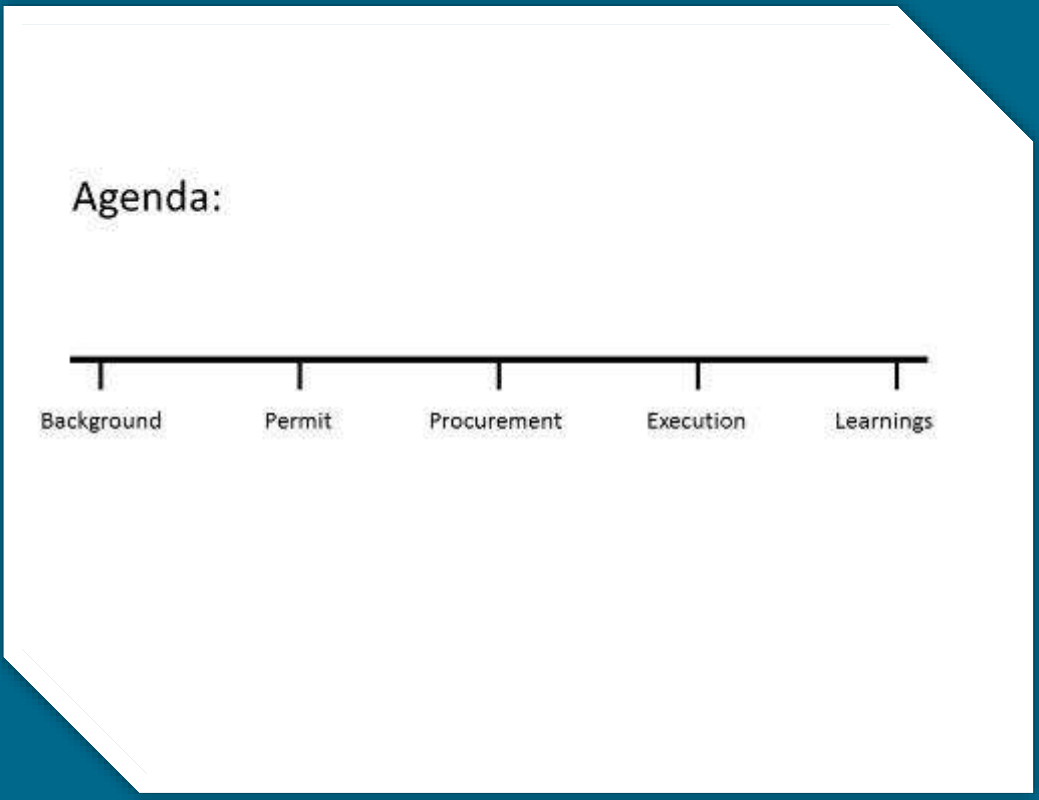
BALTIC CLEAN TECHNOLOGY 2017
Keynote 2 - Presentation

STOP

November 2, 2015
4:20 pm

BALTIC CLEAN TECHNOLOGY 2017
Keynote 2 - Presentation





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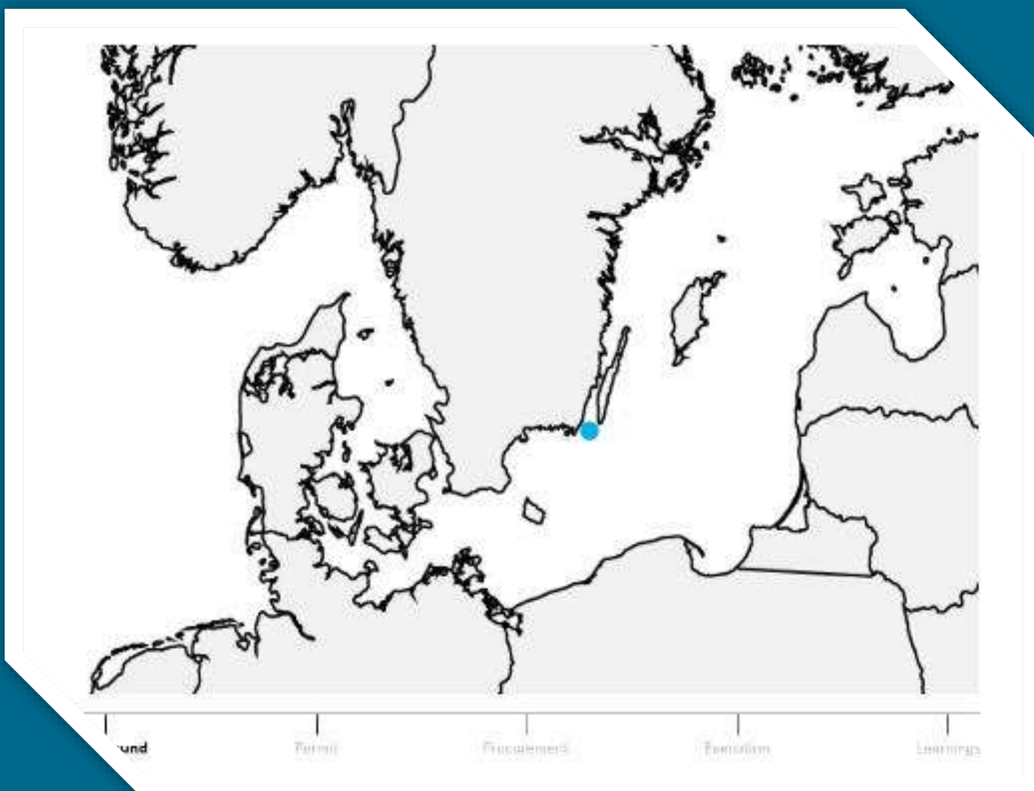
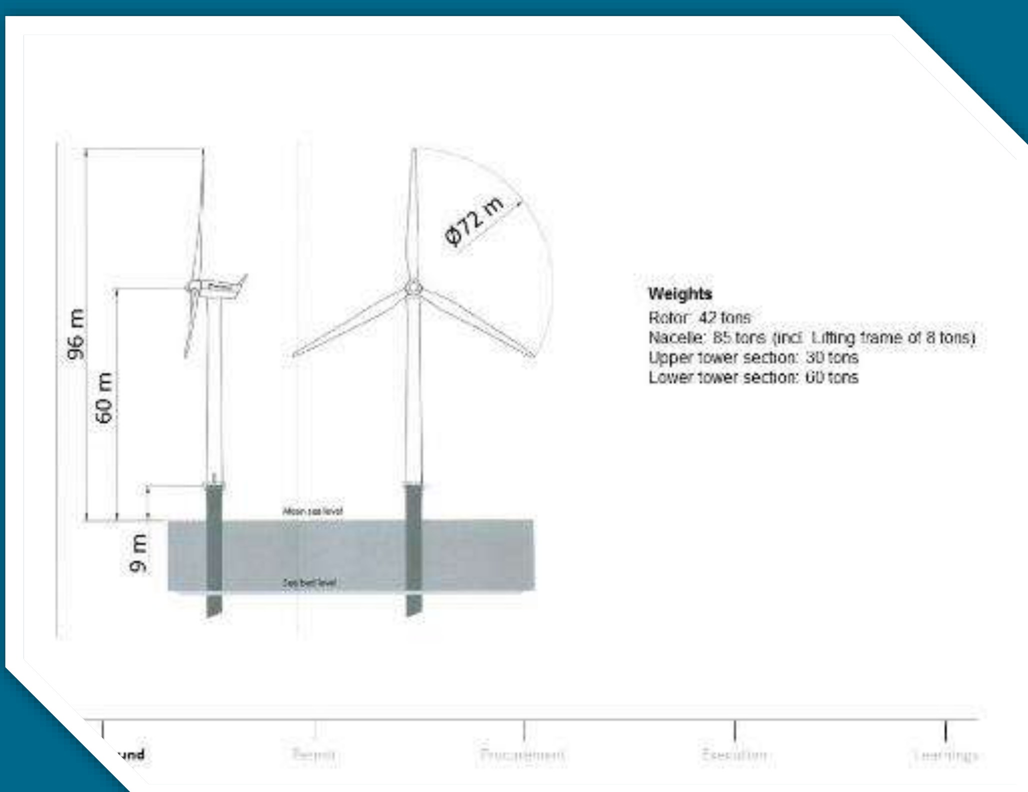
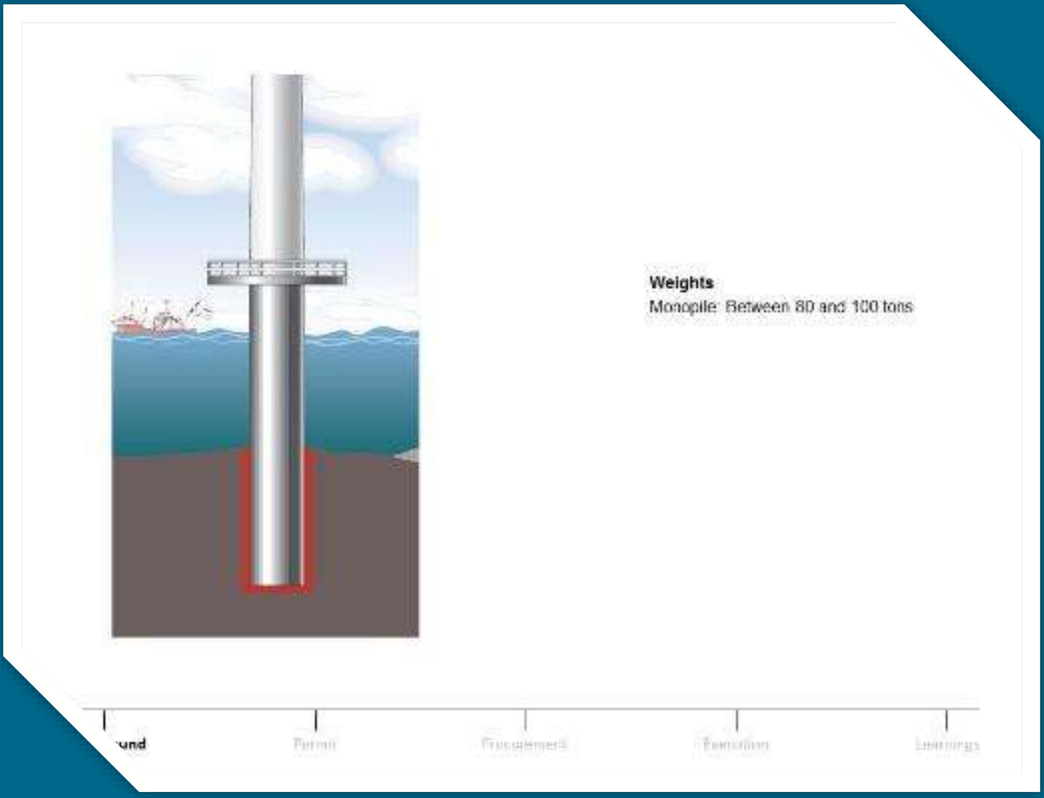
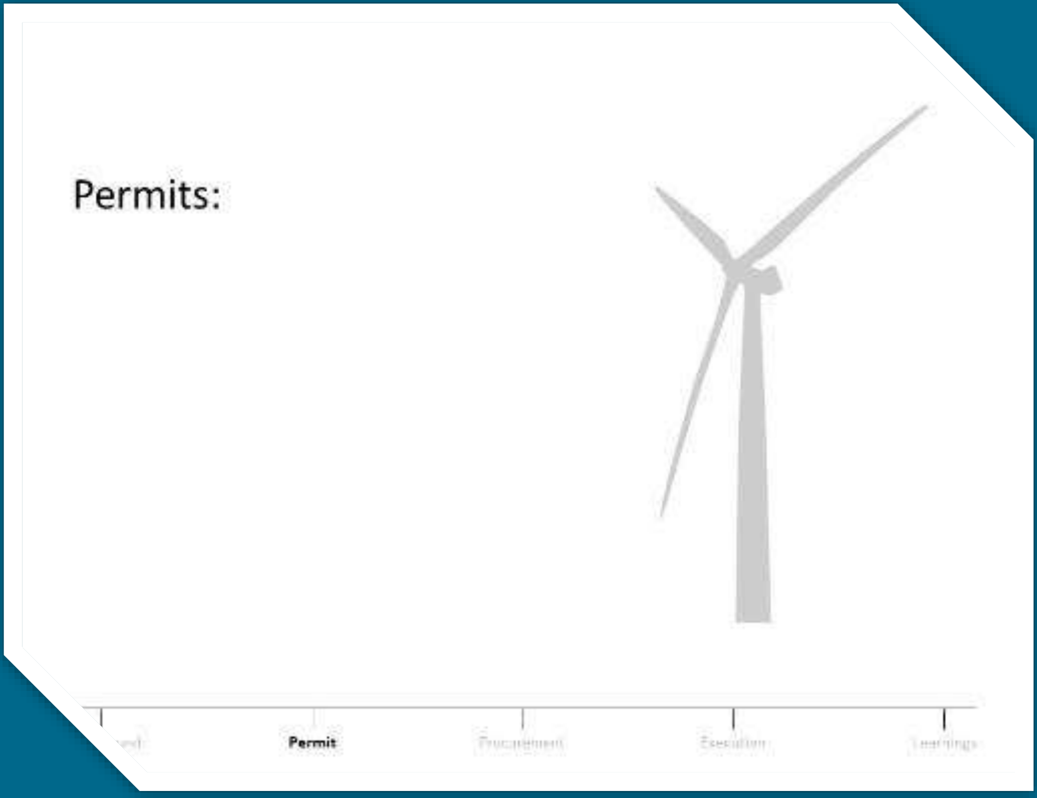
Keynote 2 - Presentation





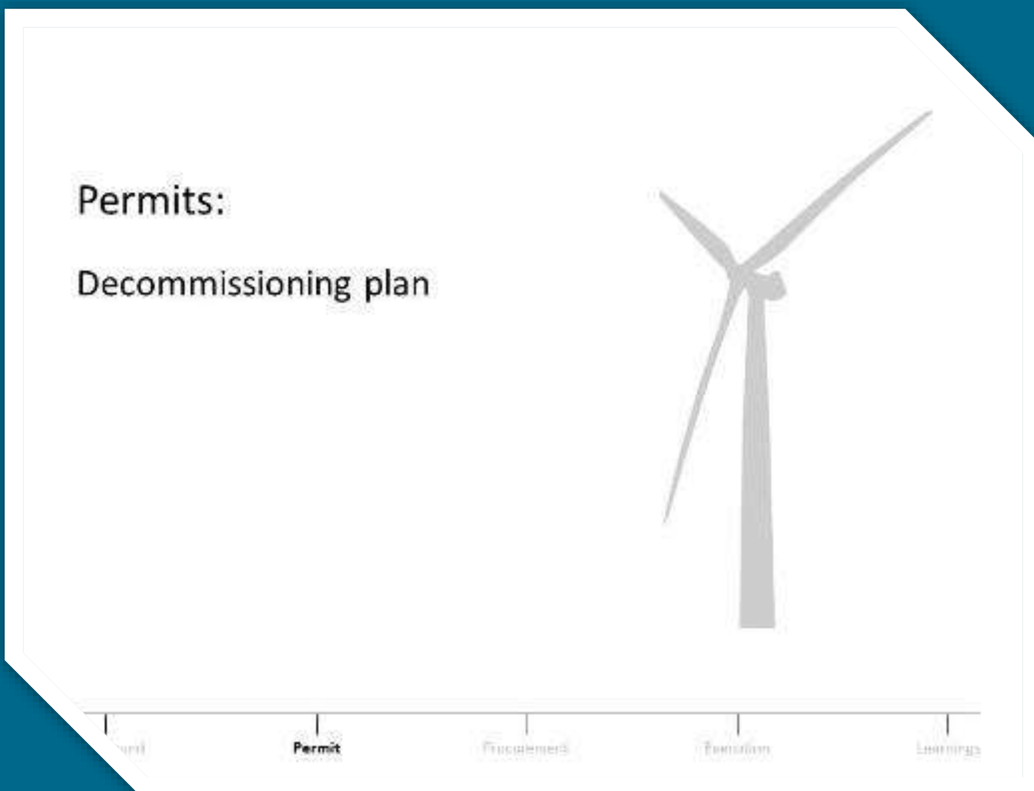


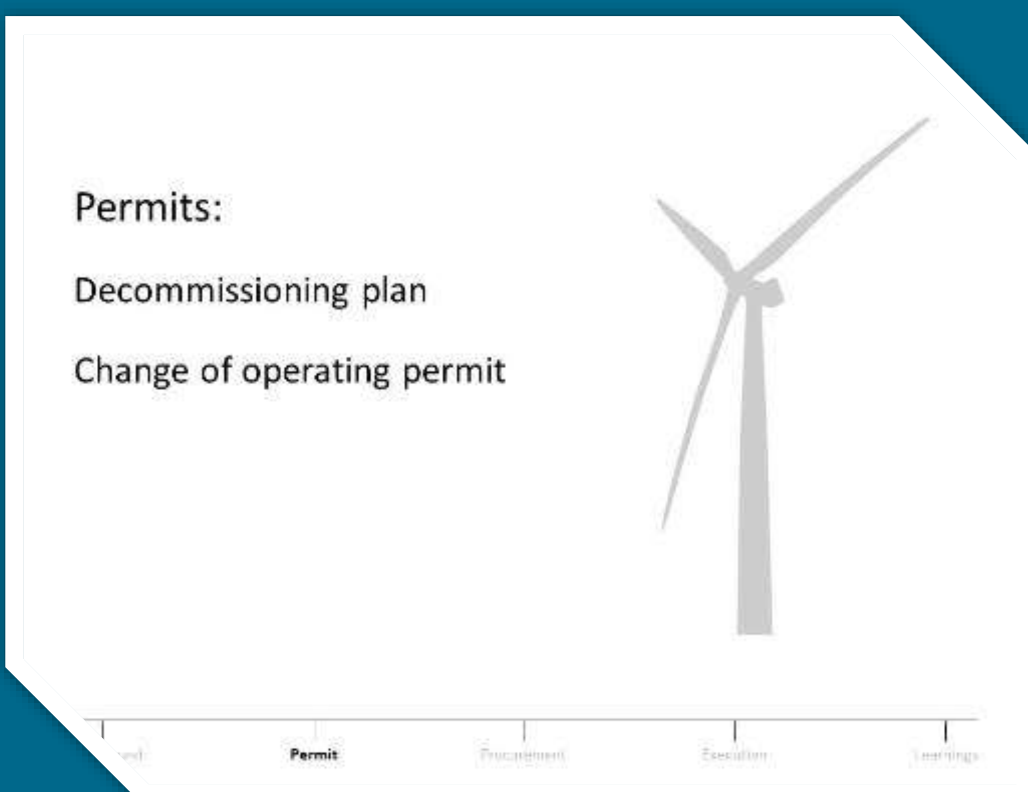
Weights
Monopile: Between 80 and 100 tons
Permit
Procurement
Execution
Learnings



Permits:
Permit
Procurement
Execution
Learnings

BALTIC CLEAN TECHNOLOGY 2017
Keynote 2 - Presentation





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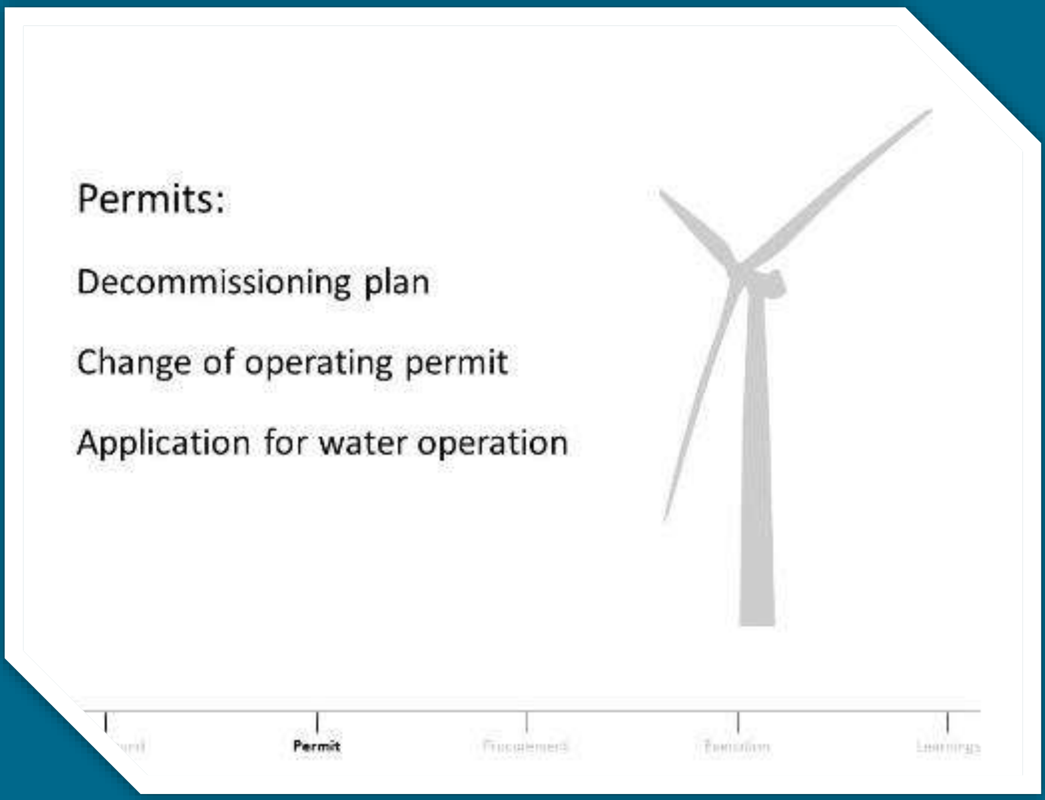
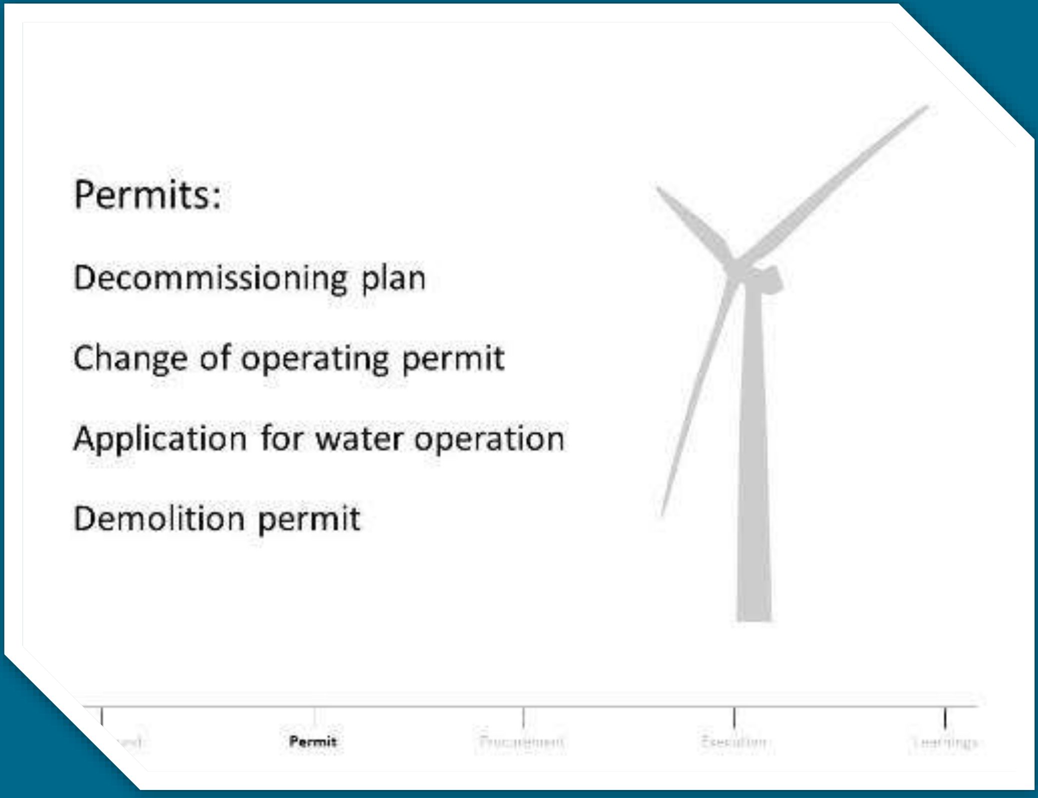
Keynote 2 - Presentation





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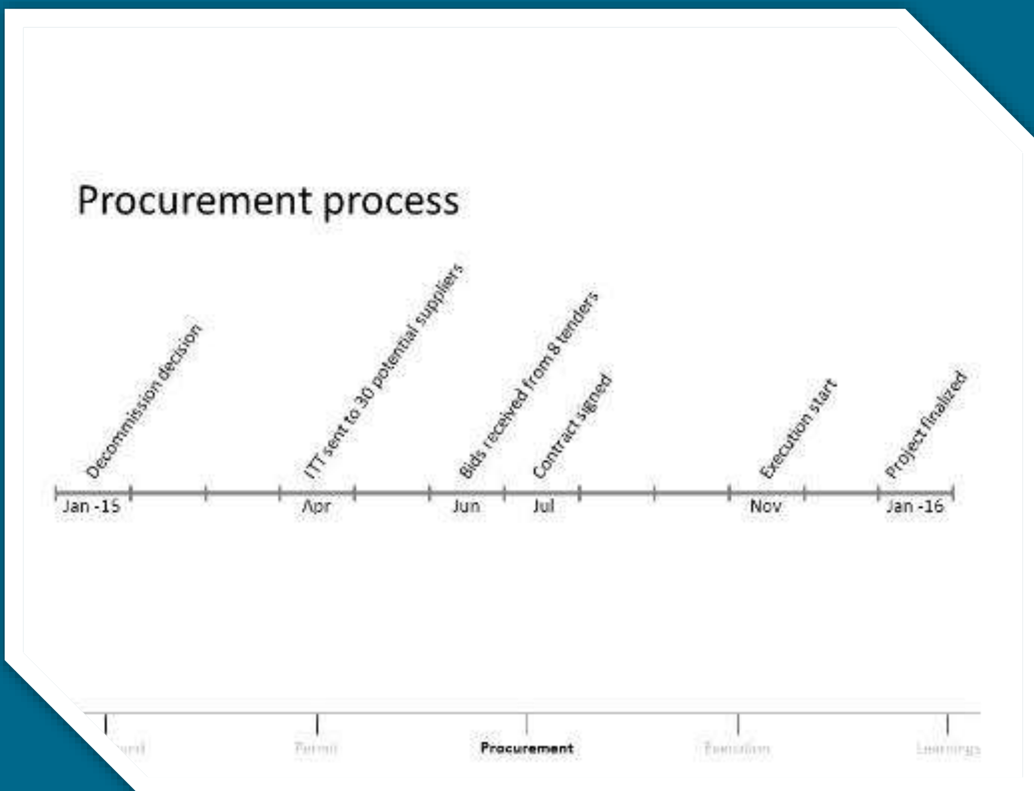

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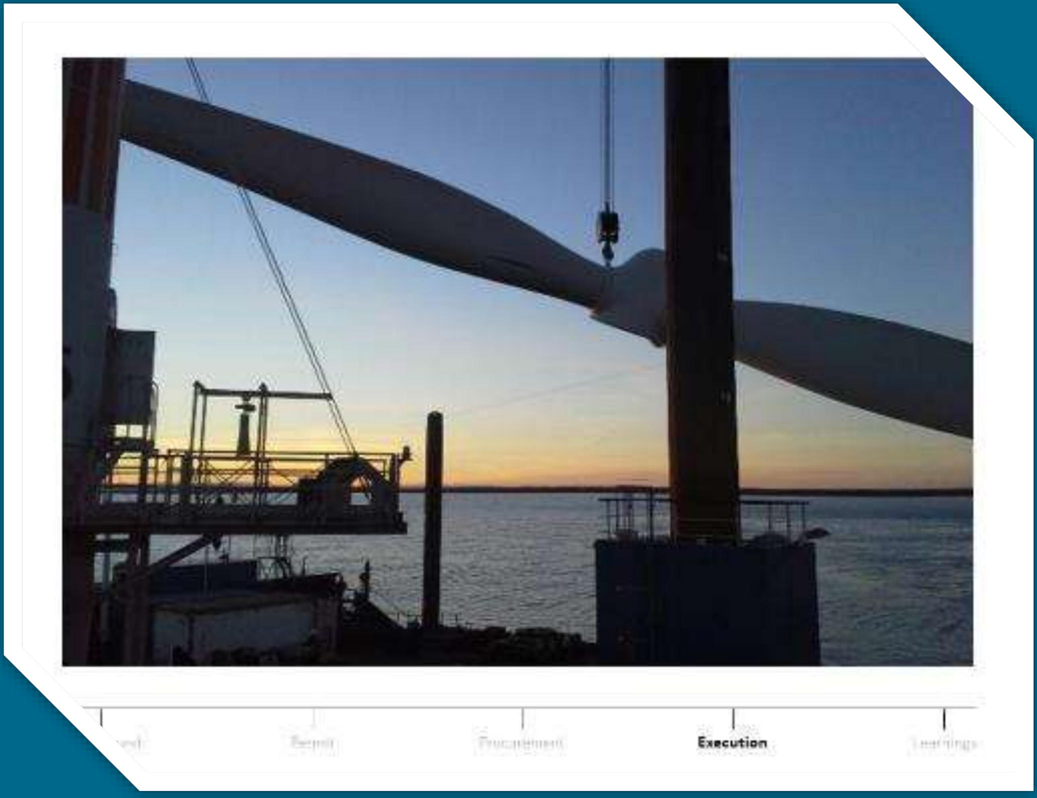
Keynote 2 - Presentation



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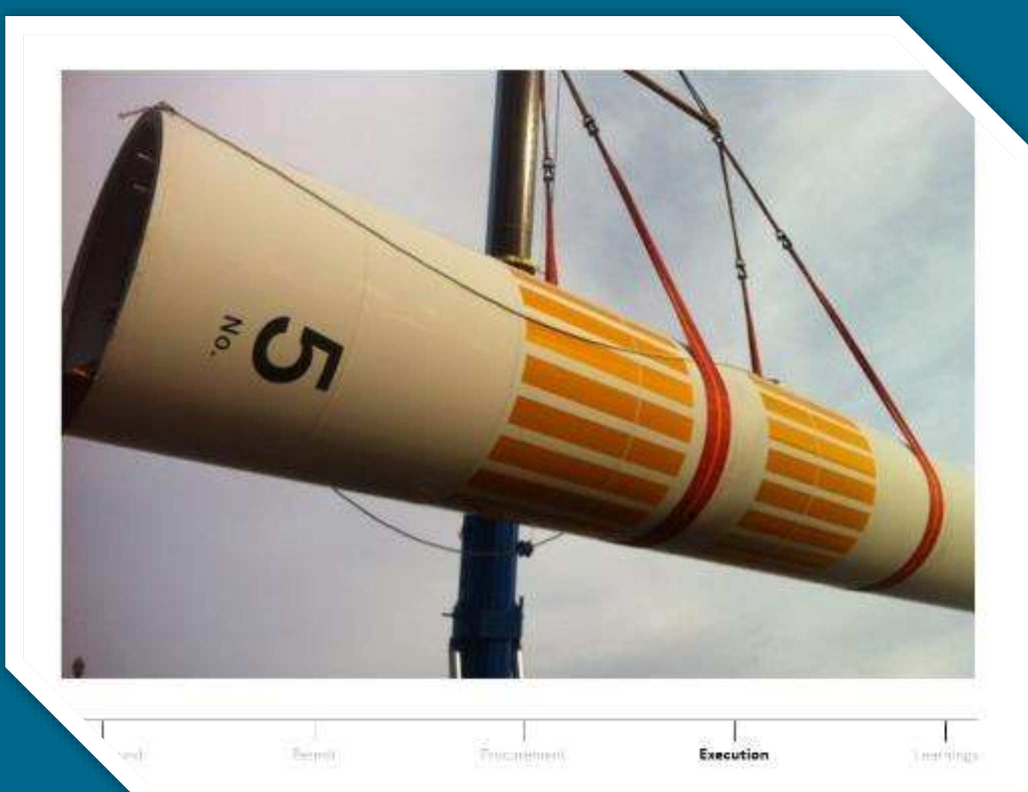
Keynote 2 - Presentation



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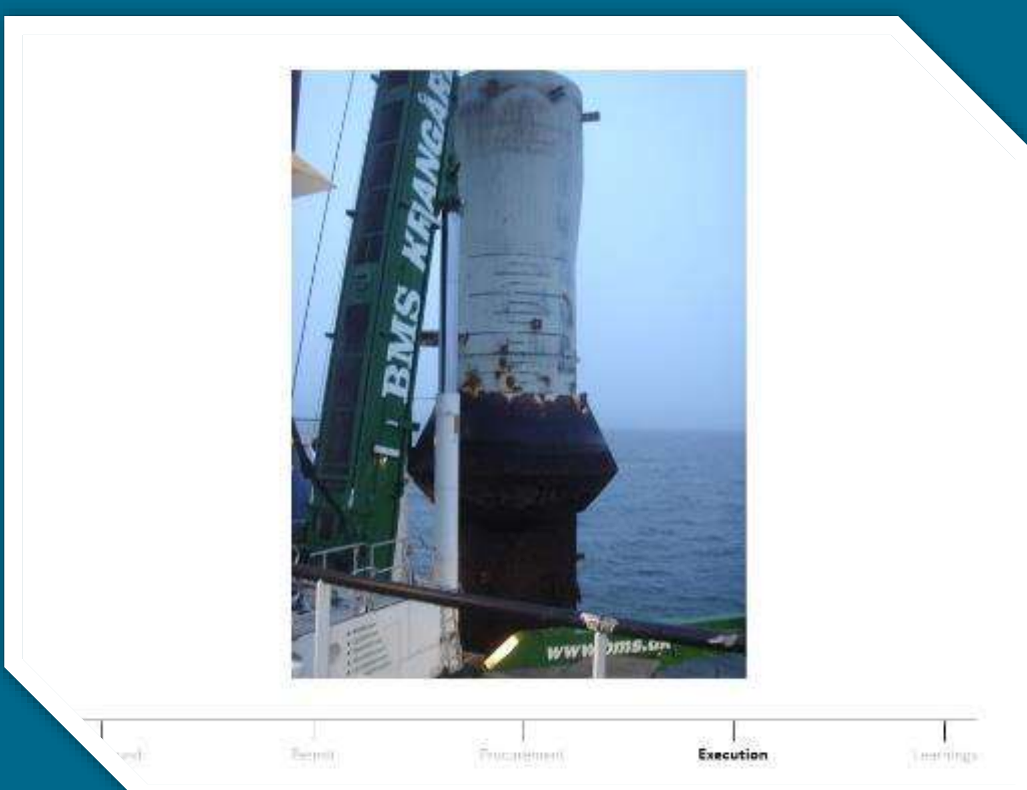
Keynote 2 - Presentation



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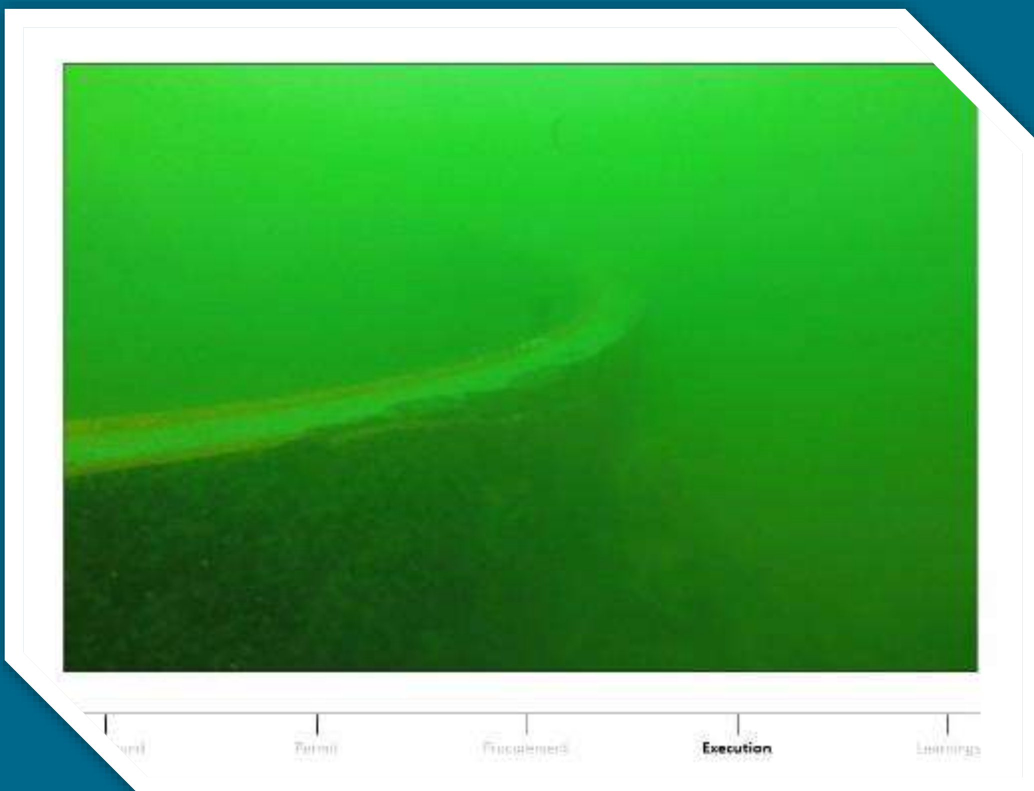
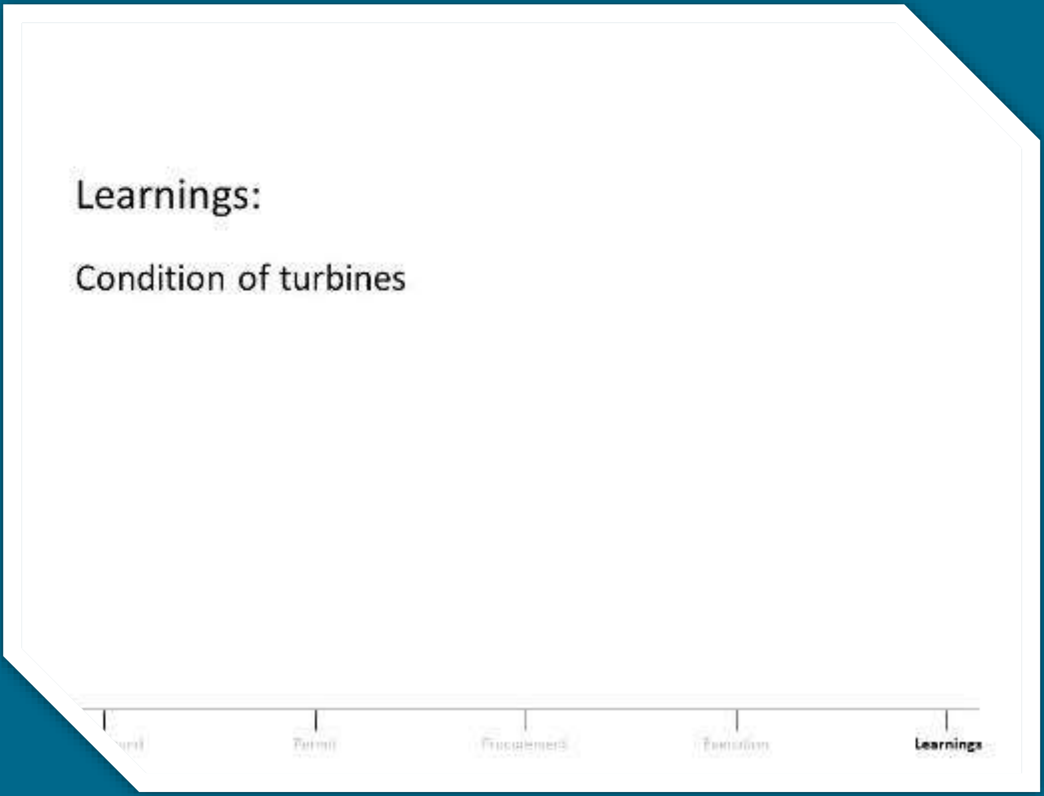
Keynote 2 - Presentation

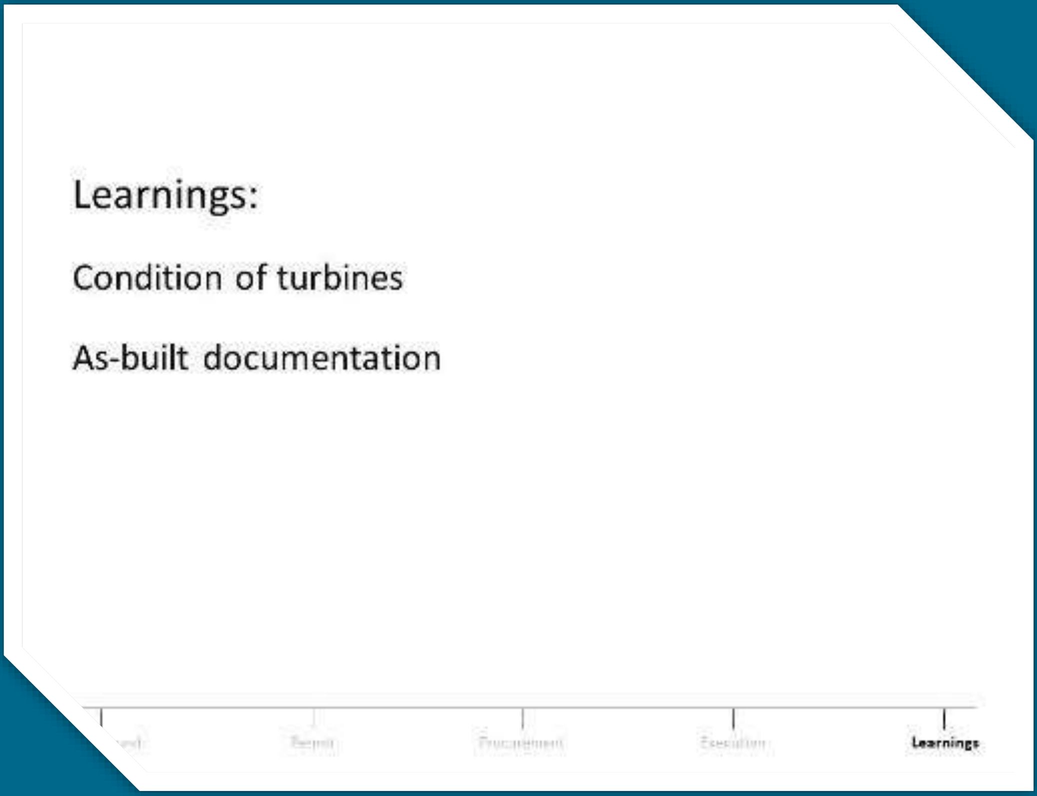


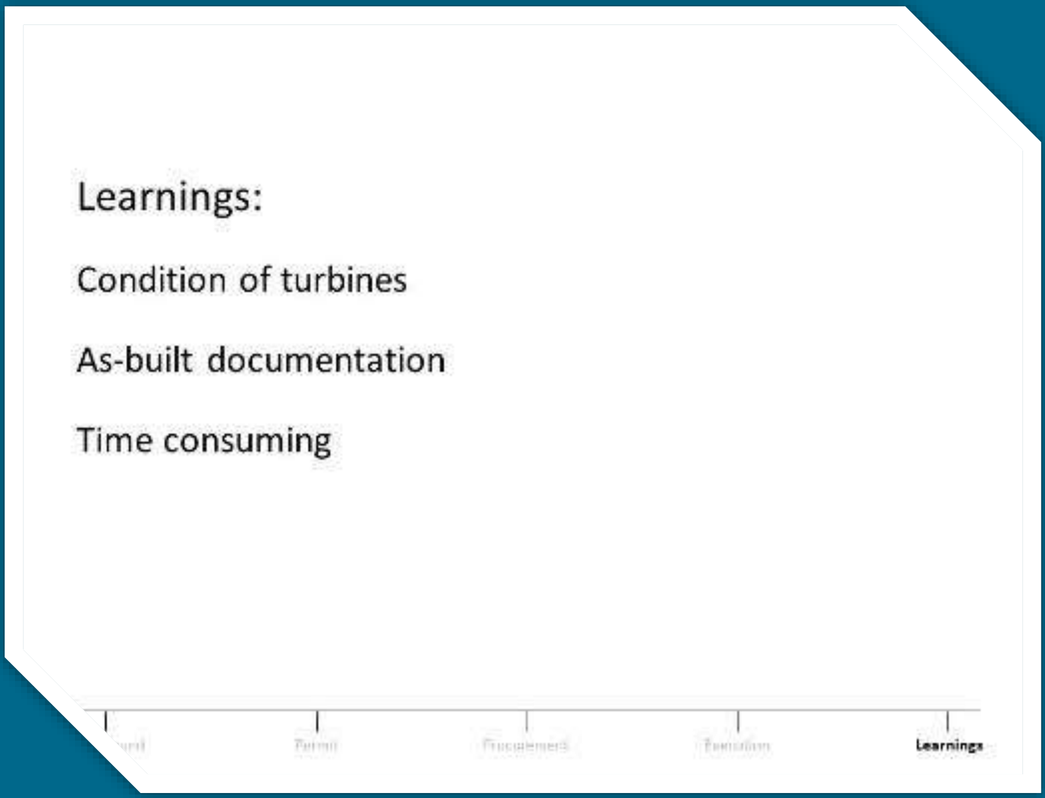
BALTIC CLEAN TECHNOLOGY 2017
Keynote 2 - Presentation

Learnings:

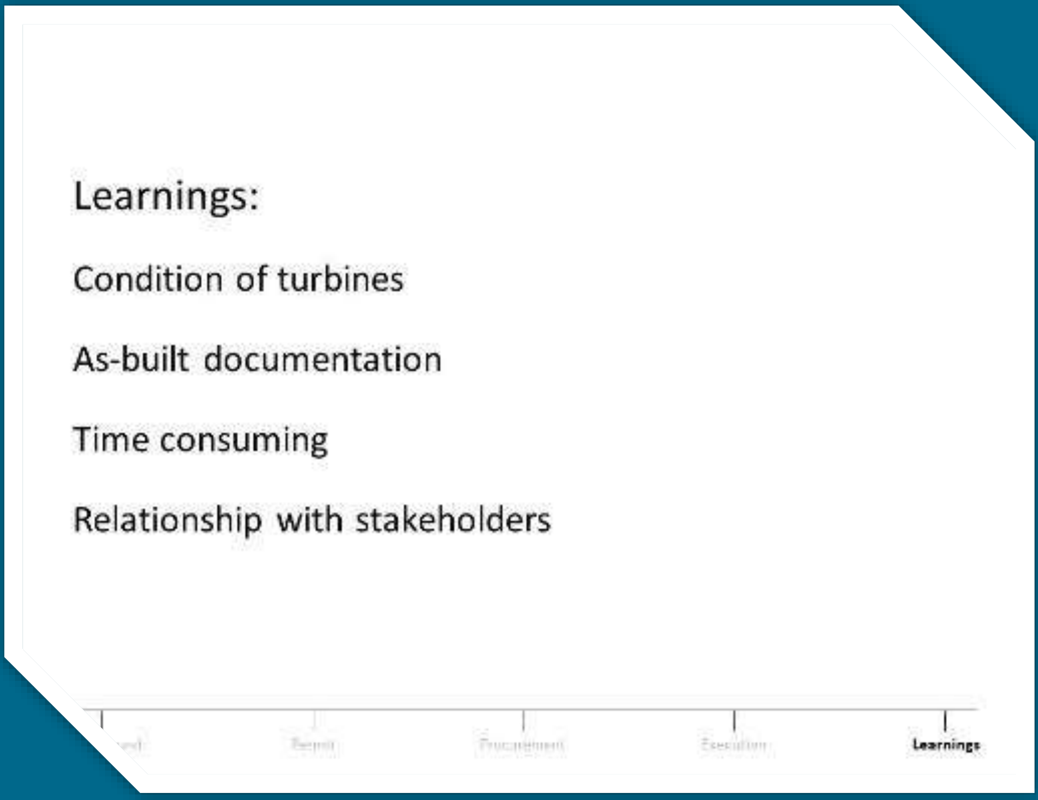
Permit | Procurement | Execution | **Learnings**


Learnings:
Condition of turbines
Permit
Procurement
Execution
Learnings


Learnings:
Condition of turbines
As-built documentation
Permit
Procurement
Execution
Learnings



Learnings:
Condition of turbines
As-built documentation
Time consuming
Learnings



Learnings:
Condition of turbines
As-built documentation
Time consuming
Relationship with stakeholders
Learnings

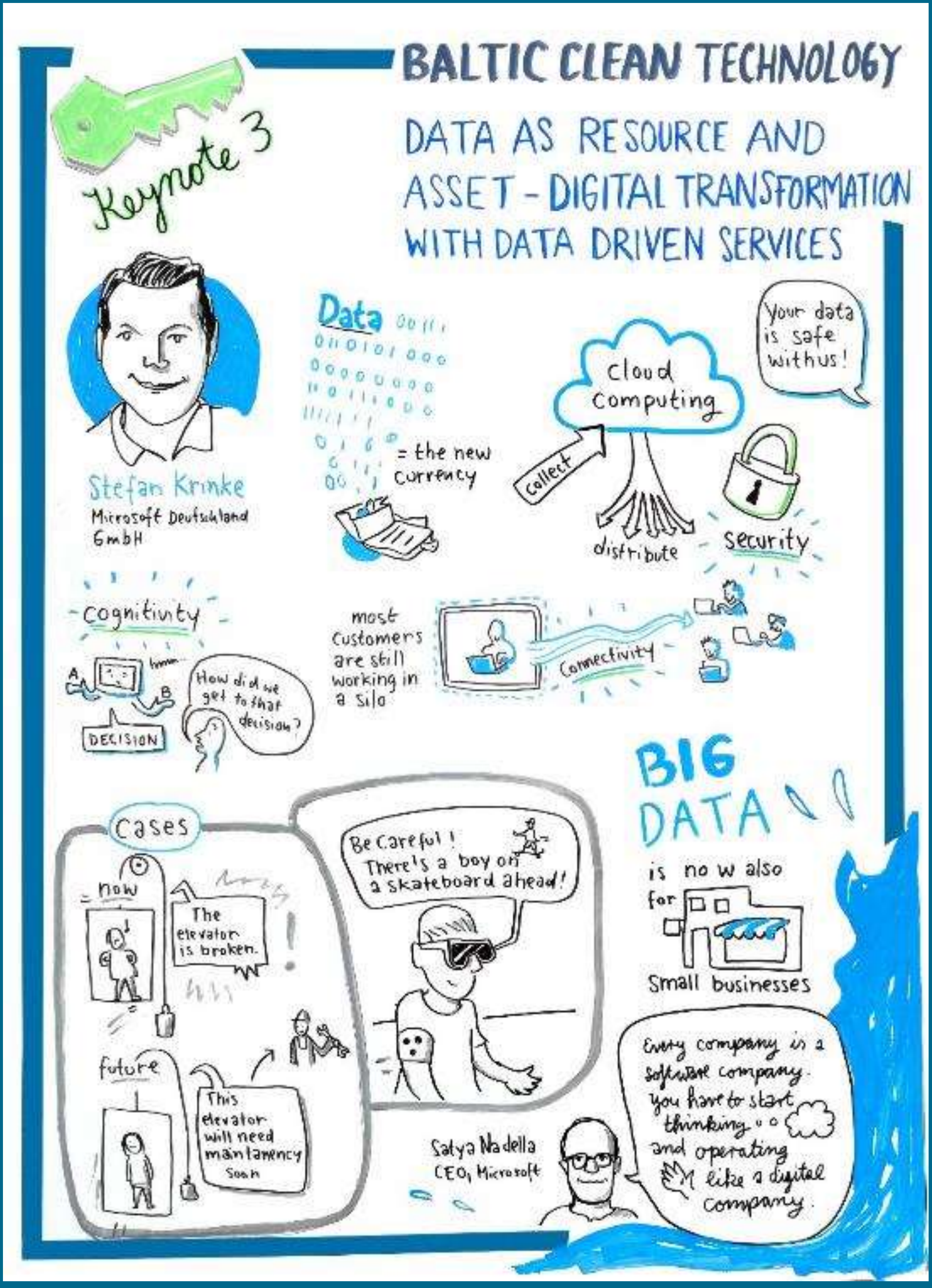
BALTIC CLEAN TECHNOLOGY 2017
Keynote 2 - Presentation

BALTIC CLEAN TECHNOLOGY 2017
Keynote 3

Stefan Krinke | Microsoft Deutschland GmbH

Digital transformation with data driven services

BALTIC CLEAN TECHNOLOGY 2017
Keynote 3



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Keynote 3 - Presentation

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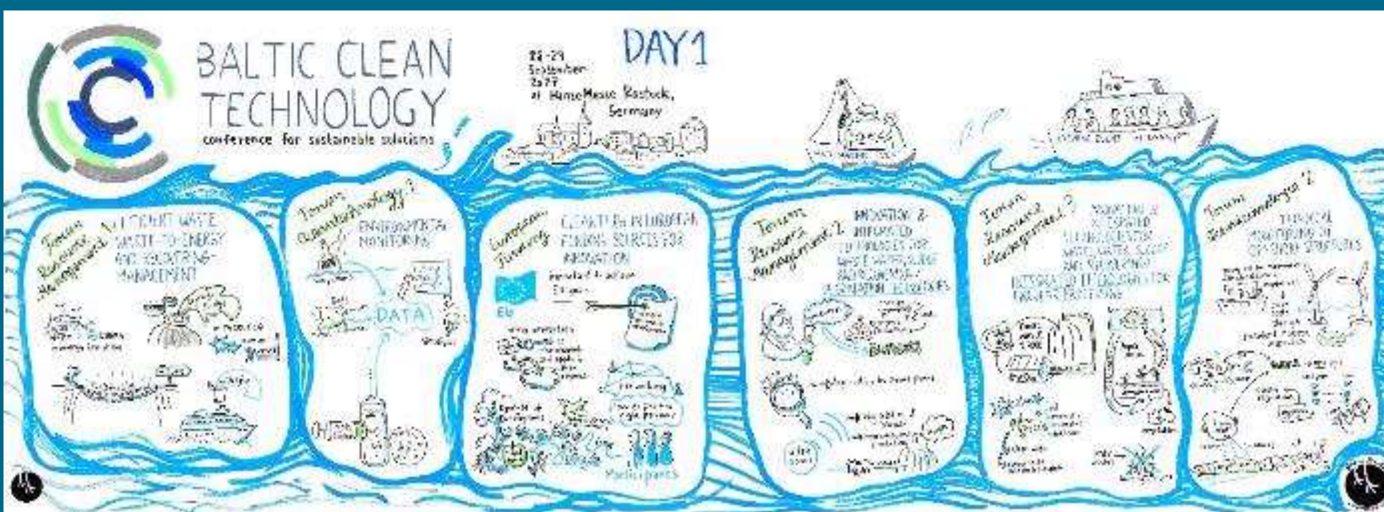
Keynote 3 - Presentation

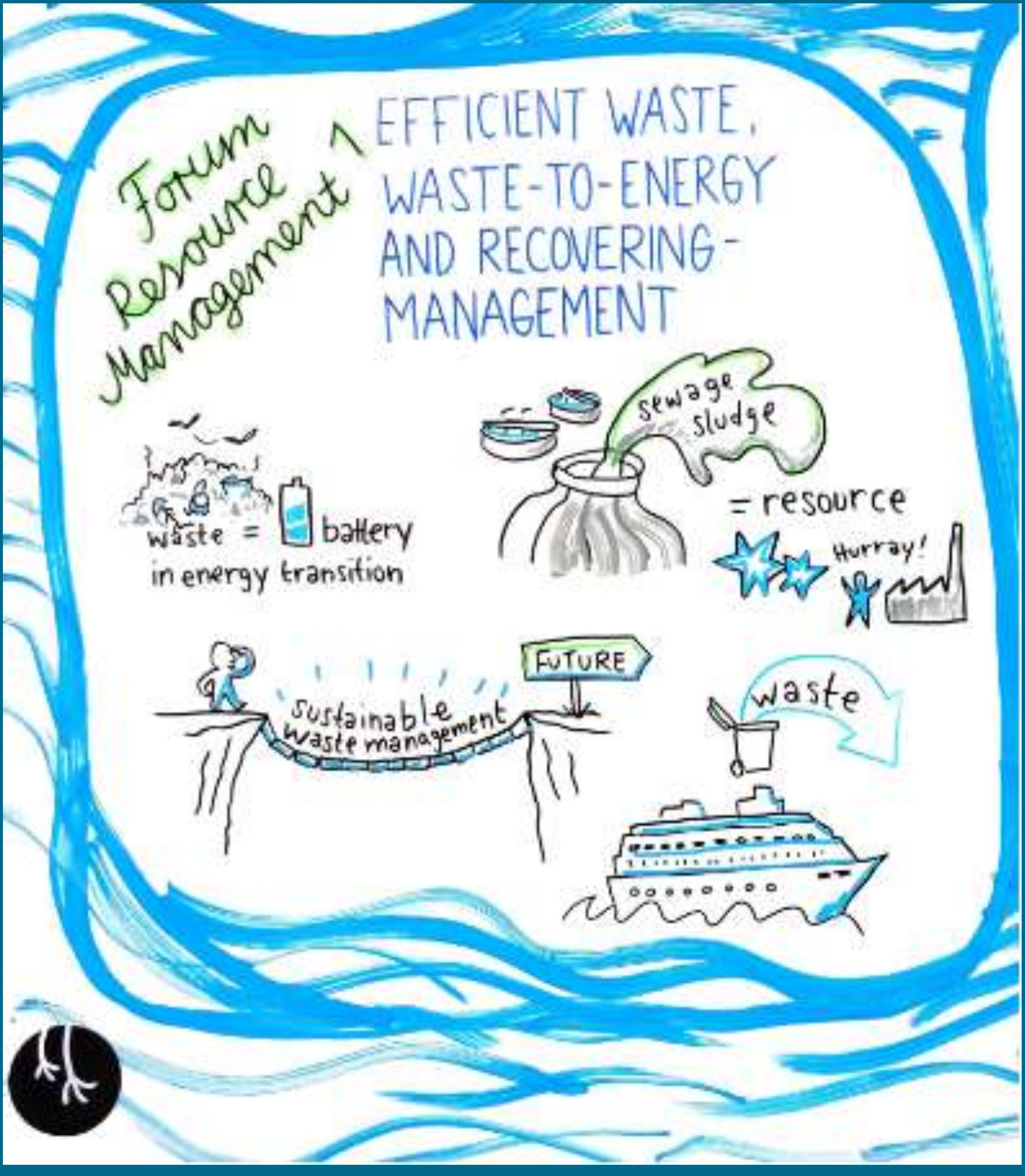
BALTIC CLEAN TECHNOLOGY 2017
Summary of results – day 1



Thursday, 28 September 2017

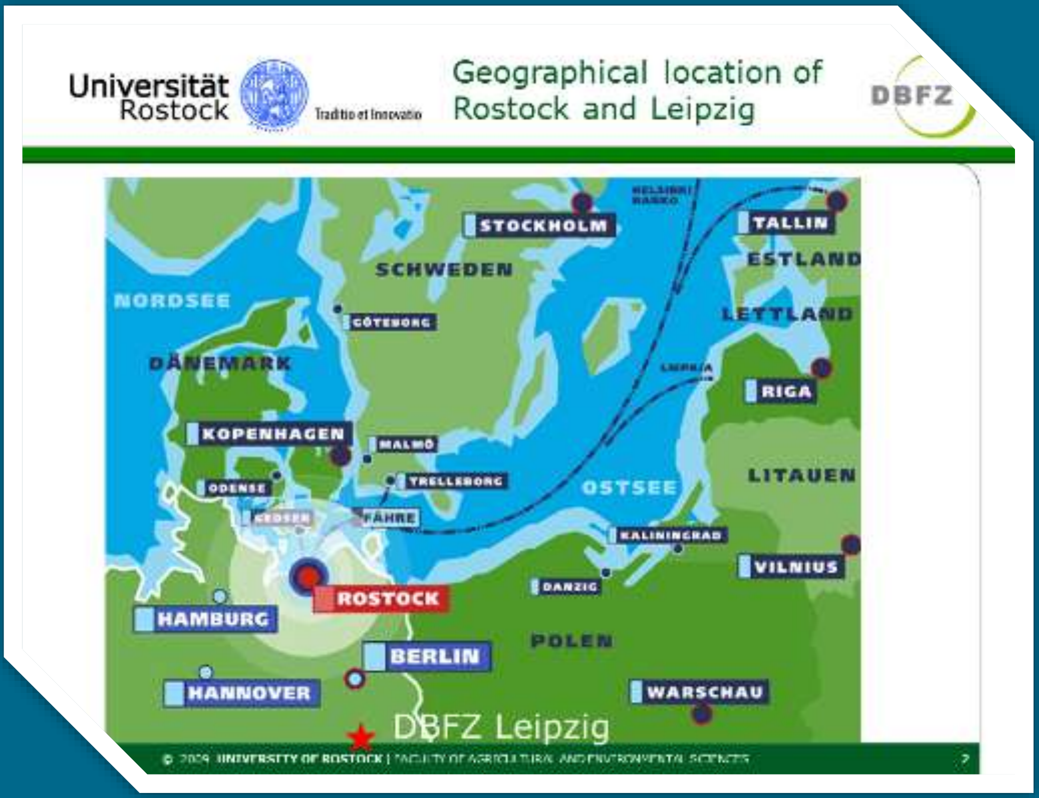
13:15 – 14:45

FORUM RESOURCE MANAGEMENT 1: Efficient waste, waste-to-energy and recovering management

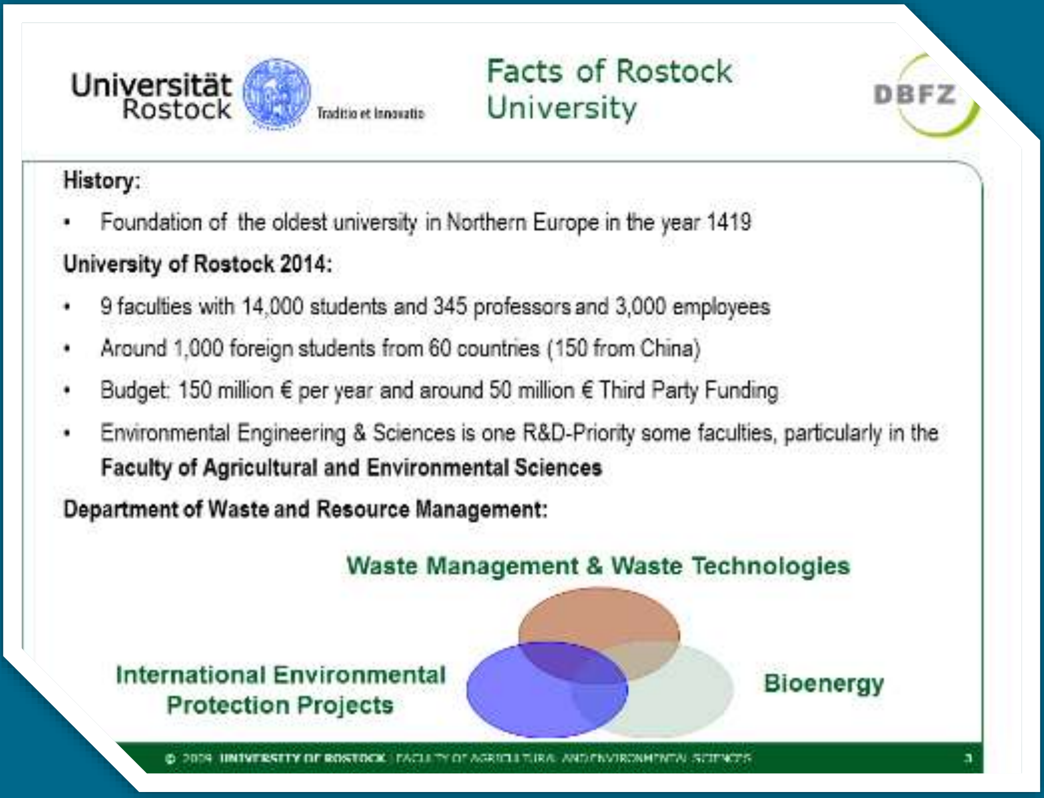


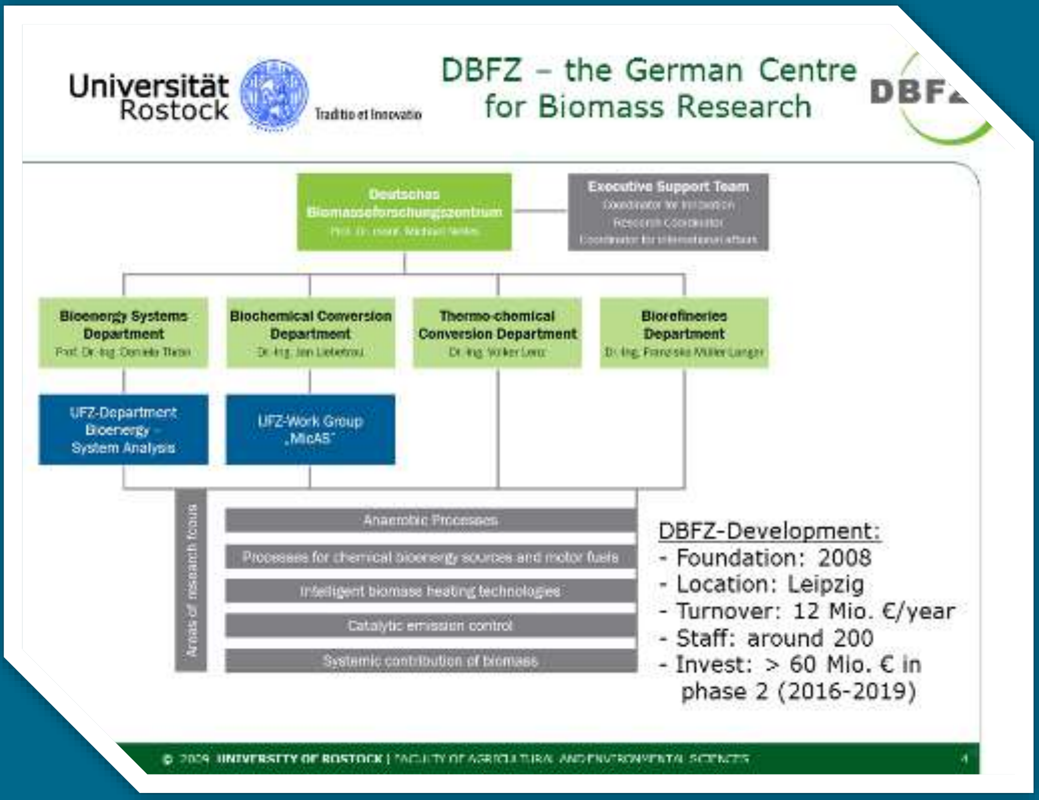
Forum Resource Management 1
EFFICIENT WASTE, WASTE-TO-ENERGY AND RECOVERING-MANAGEMENT
waste = battery in energy transition
sewage sludge
= resource
Hurray!
FUTURE
sustainable waste management
waste

BALTIC CLEAN TECHNOLOGY 2017
Forum RM 1 - Presentations



BALTIC CLEAN TECHNOLOGY 2017
Forum RM 1 - Presentations



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Traditio et Innovatio
Overview
DBFZ
Waste Management and urban mining: Germany, Europe and the World
1. Introduction: Global Challenges
2. Waste Management in Europe
3. Waste Management in Germany
4. Waste Management in China
5. Conclusion and Outlook
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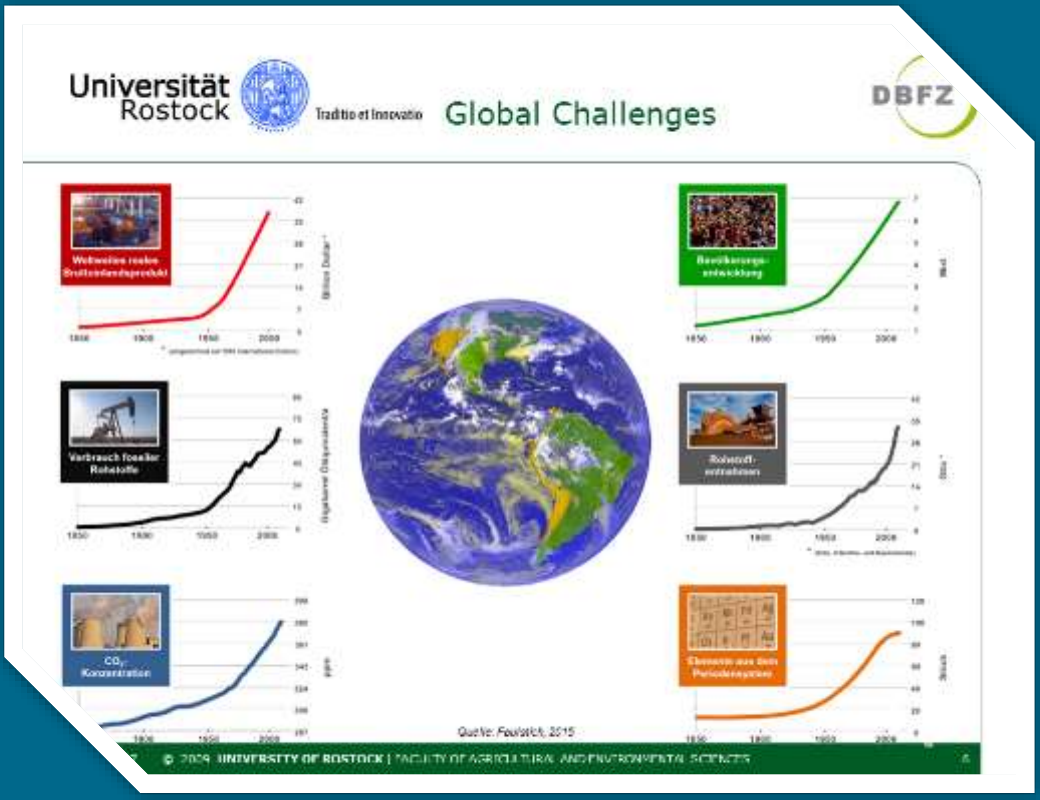
Universität Rostock
Traditio et Innovatio
Global Challenges
DBFZ
Quelle: Faulstich, 2015
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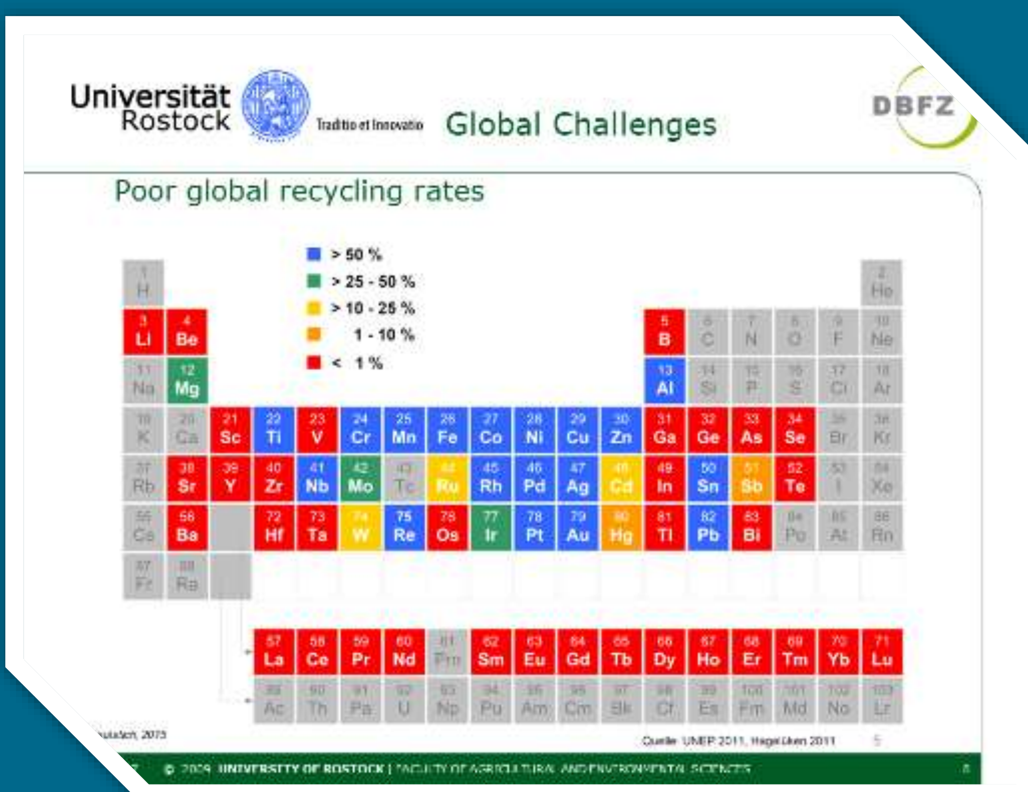
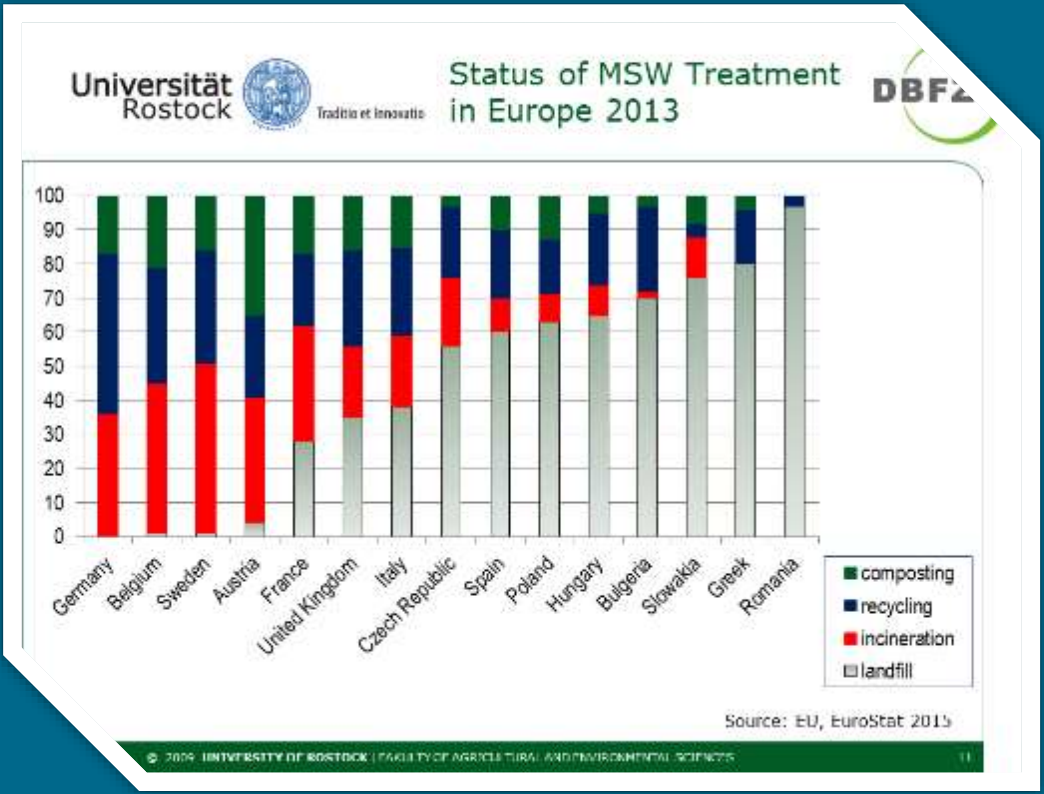
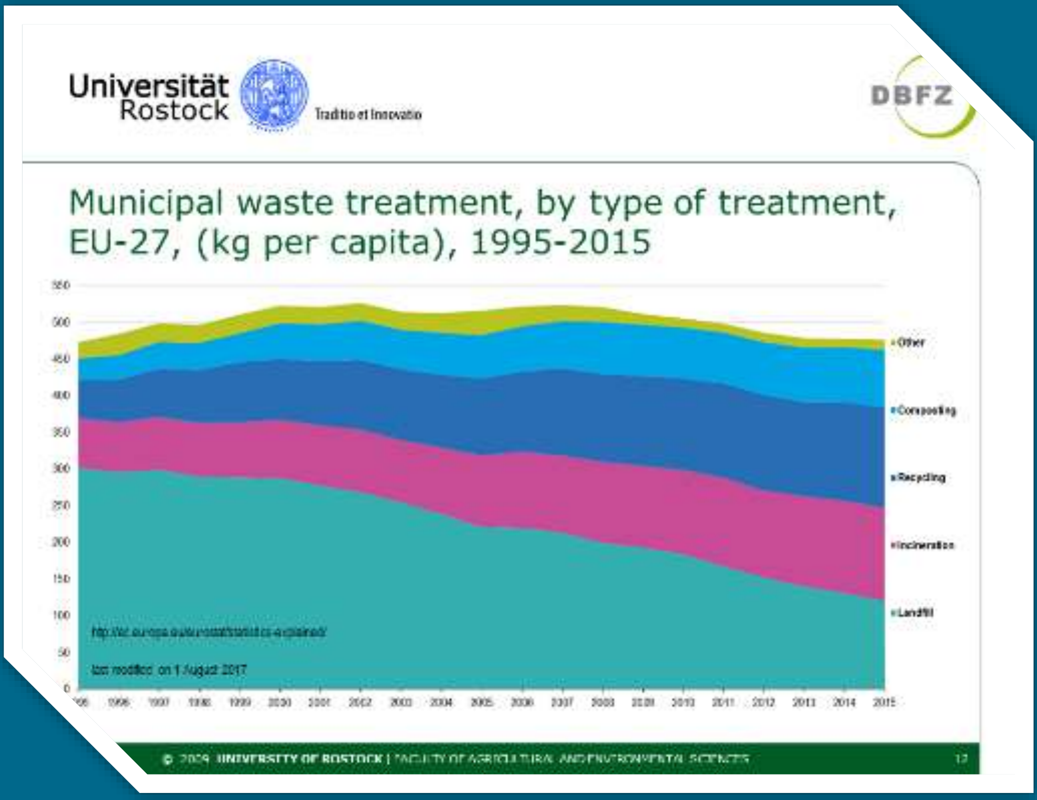
Forum RM 1 - Presentations



BALTIC CLEAN TECHNOLOGY 2017
Forum RM 1 - Presentations


Universität Rostock
Traditio et Innovatio
Status of MSW Treatment in Europe 2013
DBFZ
100
90
80
70
60
50
40
30
20
10
0
Germany
Belgium
Sweden
Austria
France
United Kingdom
Italy
Czech Republic
Spain
Poland
Hungary
Bulgaria
Slowakia
Greek
Romania
composting
recycling
incineration
landfill
Source: EU, EuroStat 2015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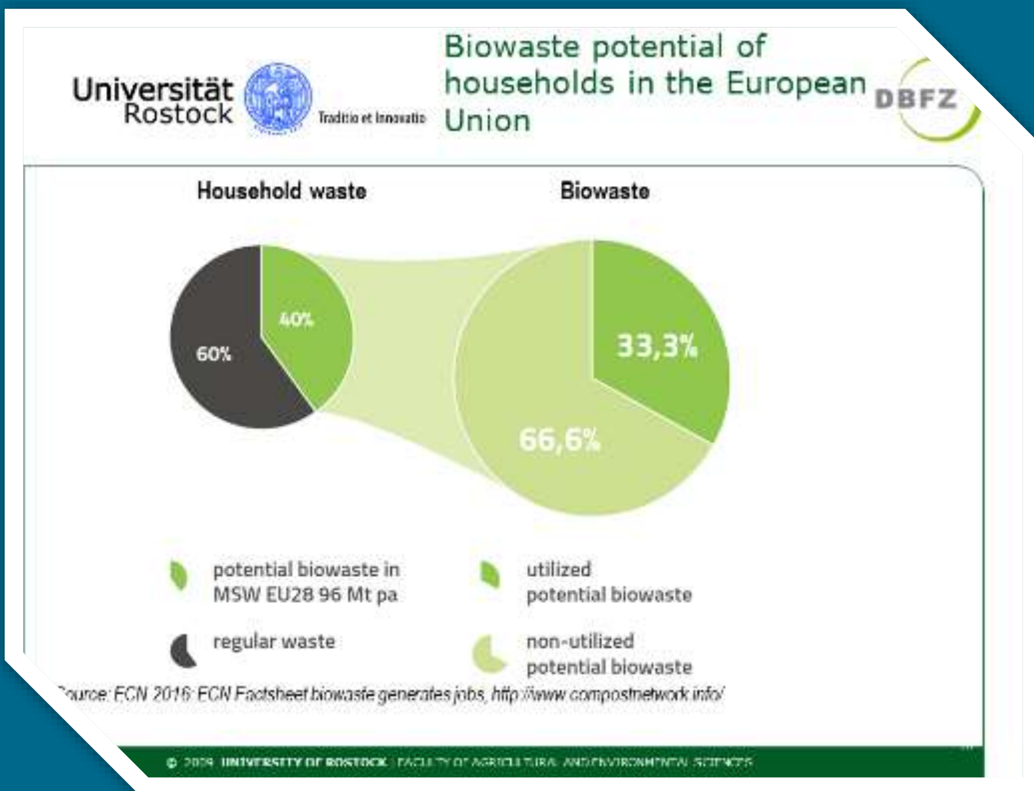
DBFZ
Municipal waste treatment, by type of treatment, EU-27, (kg per capita), 1995-2015
Other
Composting
Recycling
Incineration
Landfill
last modified on 1 August 2017

BALTIC CLEAN TECHNOLOGY 2017
Forum RM 1 - Presentations



Universität Rostock Traditio et Innovatio

Overview

DBFZ

Waste management and urban mining: Germany, Europe and the World

1. Introduction: Global Challenges
2. Waste Management in Europe
3. **Waste Management in Germany**
4. Waste Management in China
5. Conclusion and Outlook

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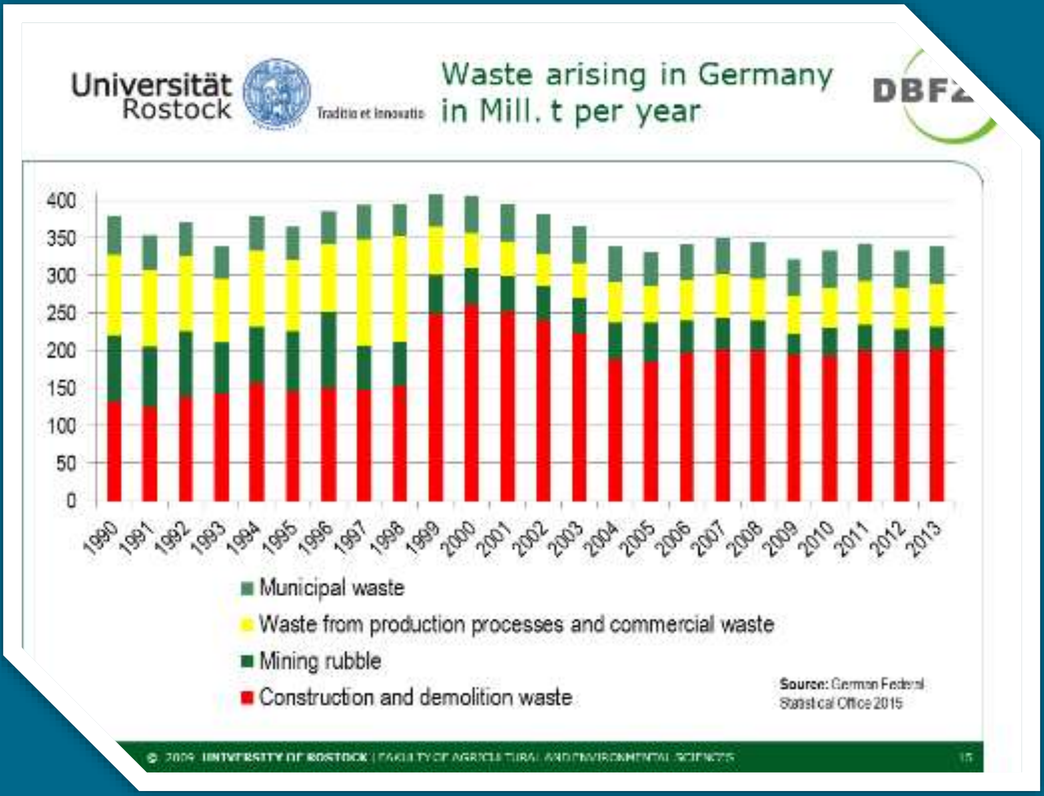
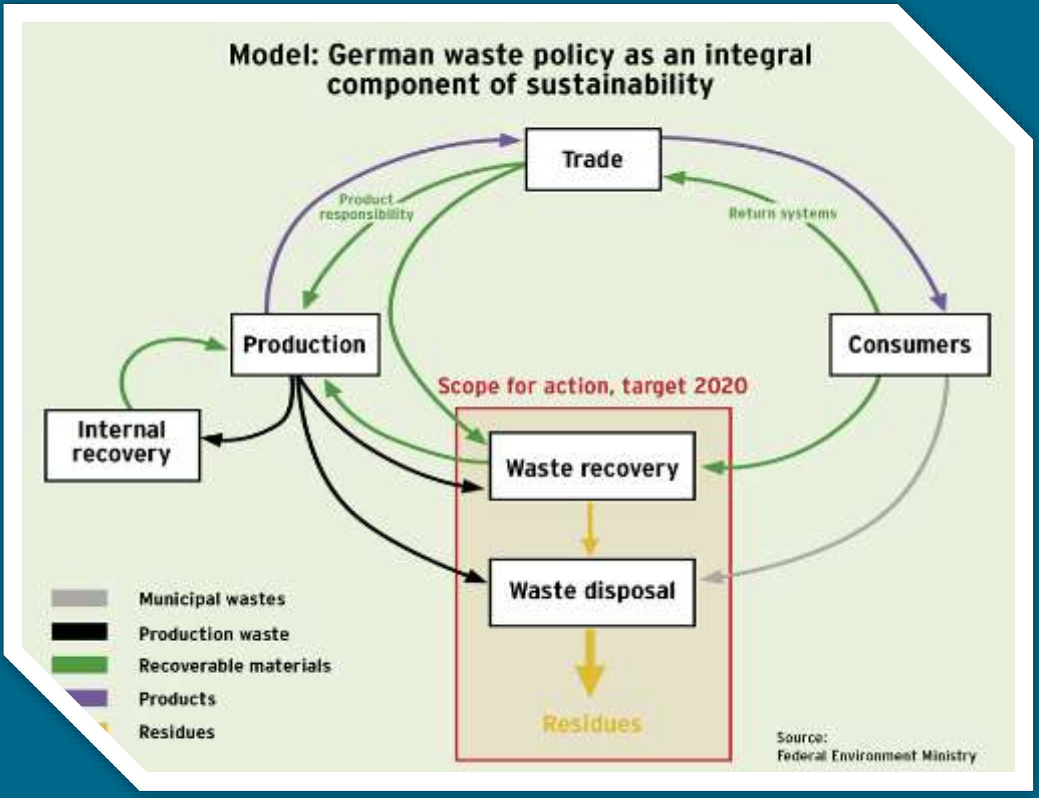
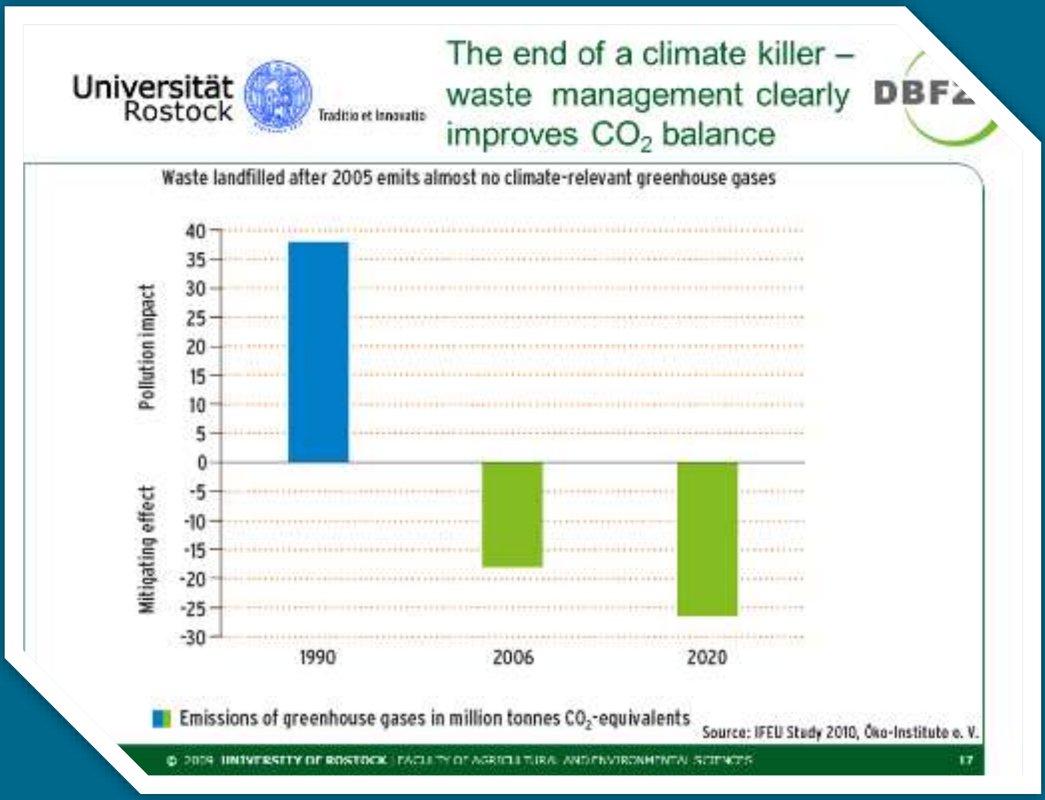

Universität Rostock
Traditio et Innovatio
Waste arising in Germany
in Mill. t per year
DBFZ
400
350
300
250
200
150
100
50
0
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Municipal waste
Waste from production processes and commercial waste
Mining rubble
Construction and demolition waste
Source: German Federal Statistical Office 2015


Model: German waste policy as an integral component of sustainability
Trade
Product responsibility
Return systems
Production
Consumers
Internal recovery
Scope for action, target 2020
Waste recovery
Waste disposal
Residues
Municipal wastes
Production waste
Recoverable materials
Products
Residues
Source: Federal Environment Ministry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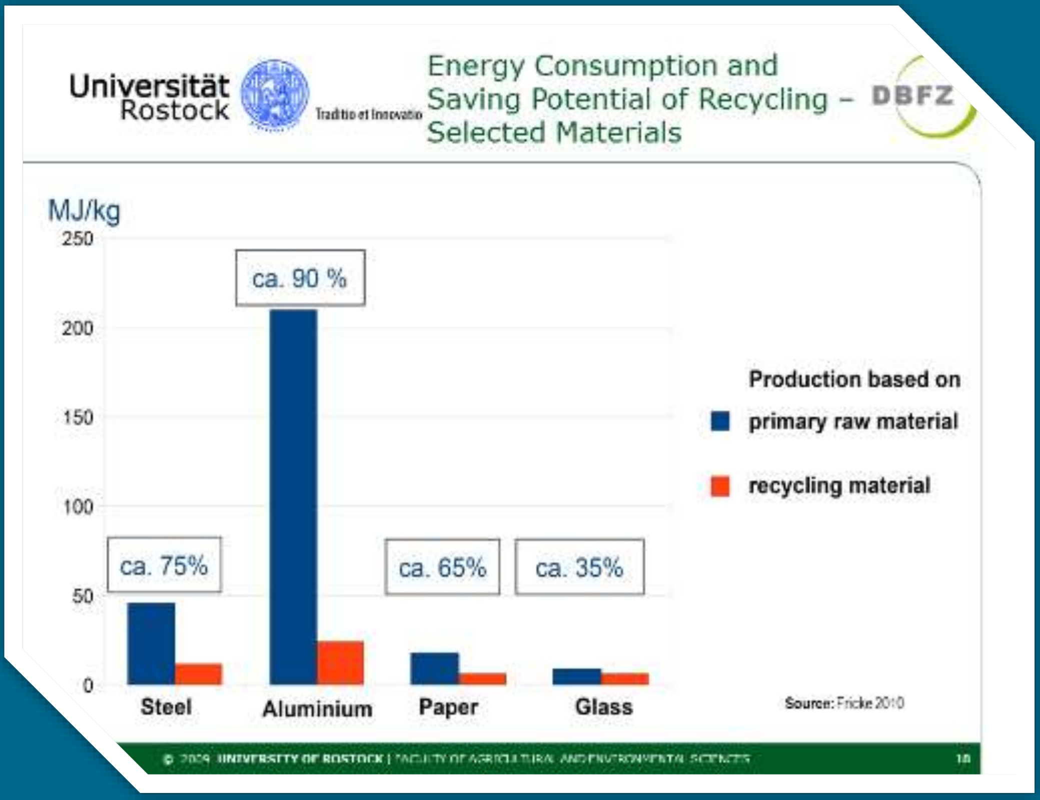
The end of a climate killer – waste management clearly improves CO_2 balance
DBFZ
Waste landfilled after 2005 emits almost no climate-relevant greenhouse gases
Pollution impact
Mitigating effect
40
35
30
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
1990
2006
2020
Emissions of greenhouse gases in million tonnes CO_2-equivalents
Source: IFEU Study 2010, Öko-Institute e. V.
17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Energy Consumption and Saving Potential of Recycling – Selected Materials
DBFZ
MJ/kg
250
200
150
100
50
0
ca. 90 %
ca. 75%
ca. 65%
ca. 35%
Steel
Aluminium
Paper
Glass
Production based on
primary raw material
recycling material
Source: Fricke 2010
18

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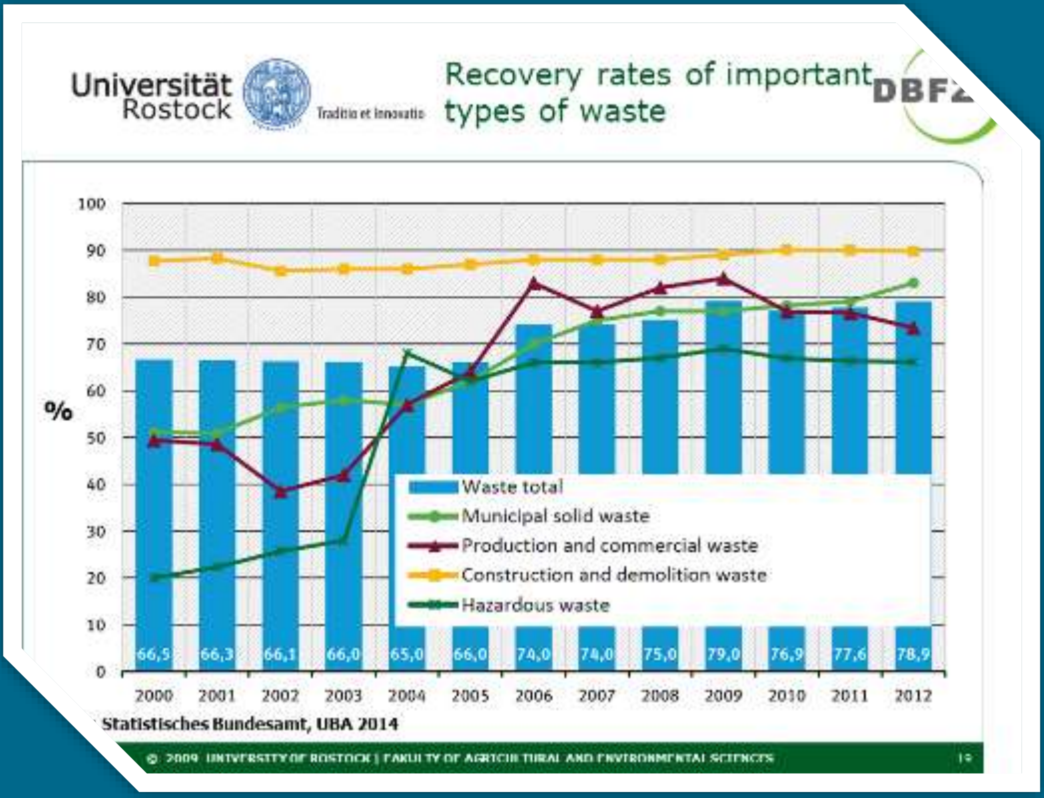
Forum RM 1 - Presentations



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Example
DBFZ
Biogenic waste and residues in Germany – amount, current utilisation and perspectives
Organic Waste and Residues in the Circular Economy and the Energy System
- Potential of organic waste and residues
- Separate Collection of Organic Waste
- Composting and Biogas Concepts
- Residues Waste Treatment Concepts
- Sewage Sludge Treatment

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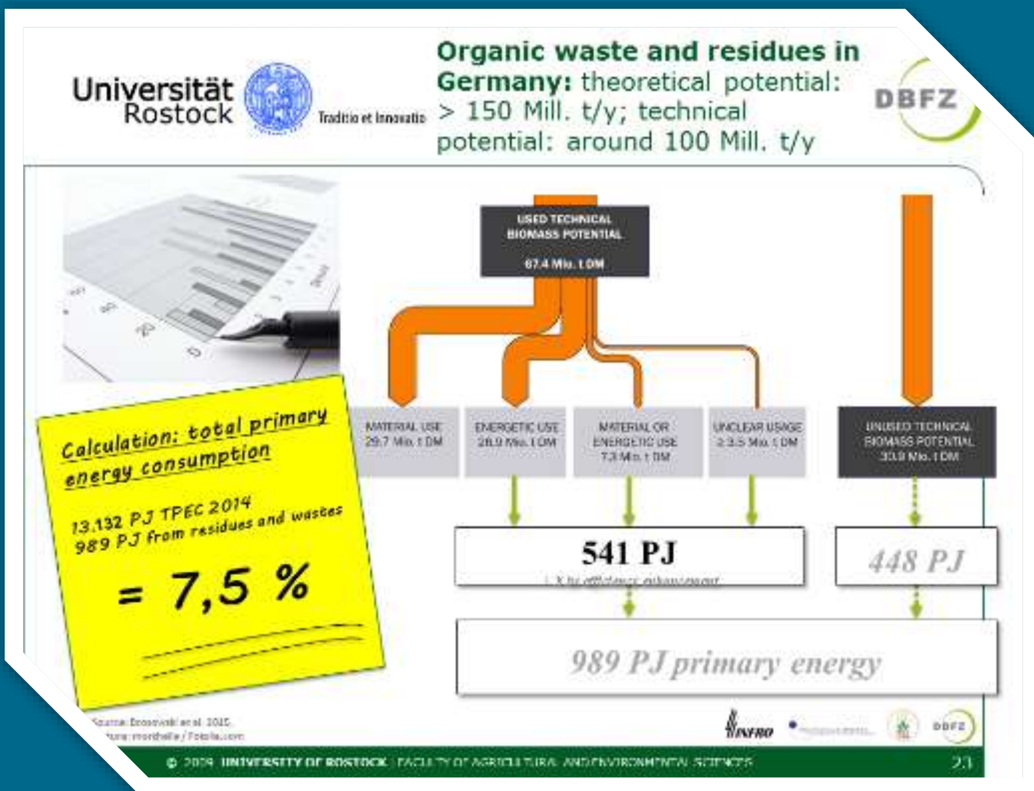
Biomass in the Energy System & the Circular Economy
DBFZ
Energy crops
By-products & Residues
Organic waste



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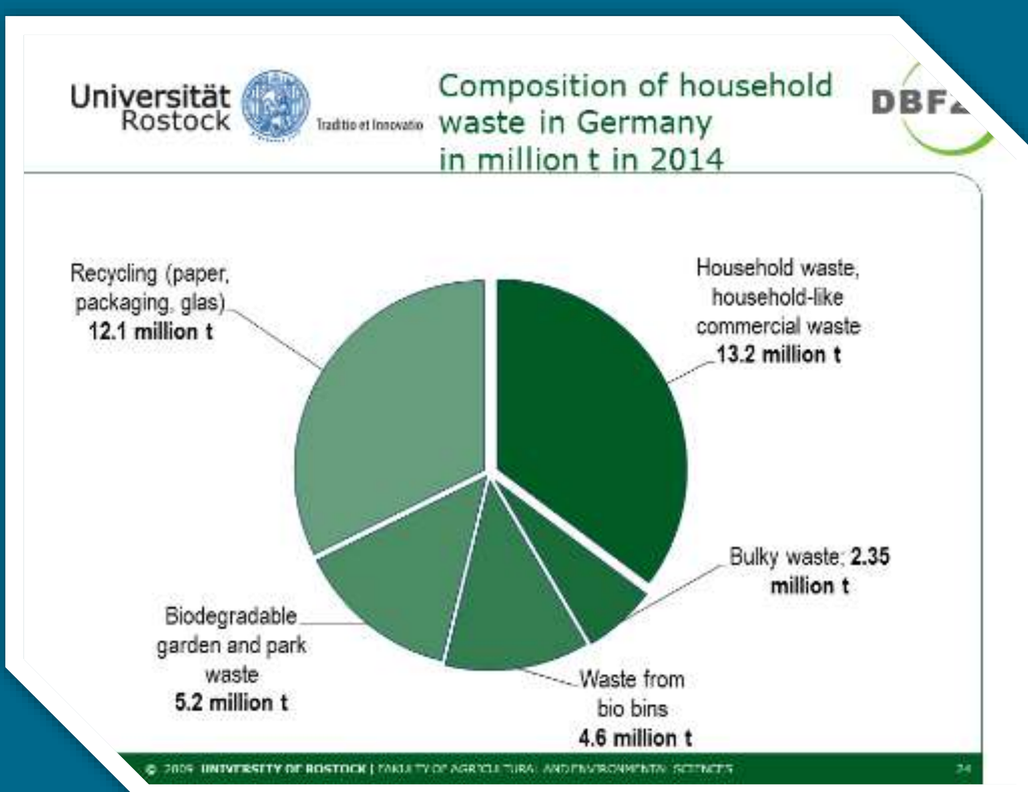
Organic waste and residues in Germany: theoretical potential: > 150 Mill. t/y; technical potential: around 100 Mill. t/y
DBFZ
USED TECHNICAL BIOMASS POTENTIAL
67.4 Mio. t DM
Calculation: total primary energy consumption
13.132 PJ TPEC 2014
989 PJ from residues and wastes
= 7,5 %
541 PJ
448 PJ
989 PJ primary energy
23



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Composition of household waste in Germany in million t in 2014
DBFZ
Recycling (paper, packaging, glas) 12.1 million t
Household waste, household-like commercial waste 13.2 million t
Bulky waste: 2.35 million t
Waste from bio bins 4.6 million t
Biodegradable garden and park waste 5.2 million t

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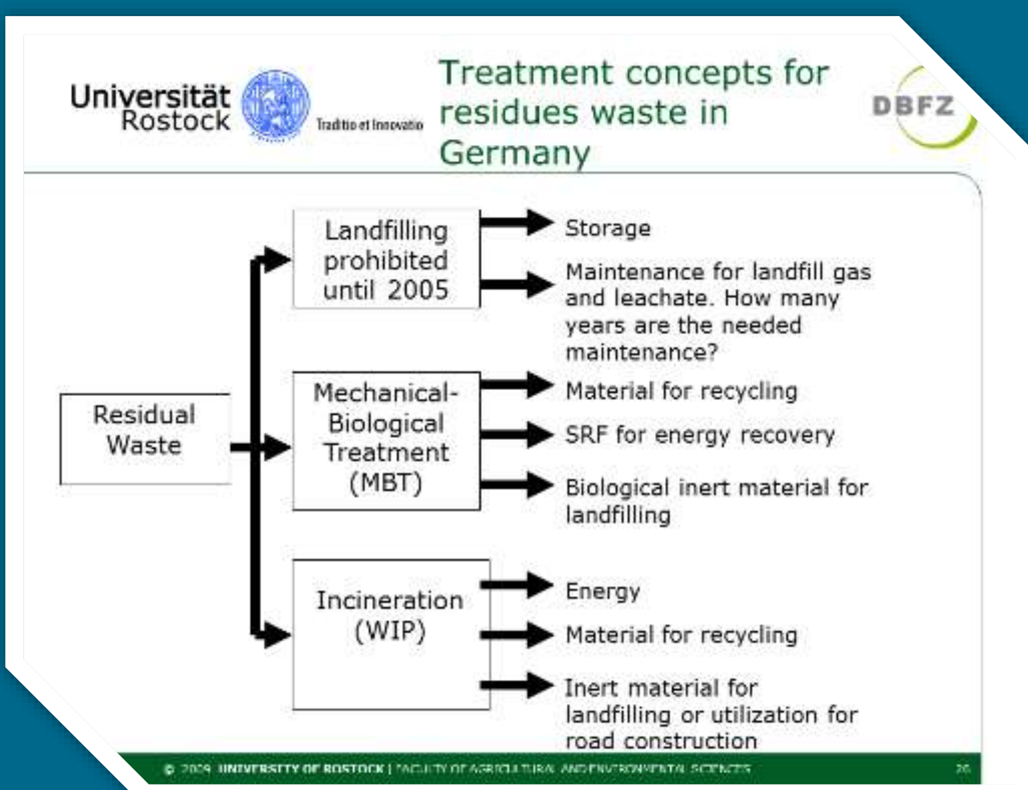
More recyclables than residues since 2010
1990
Residues
Bio-waste
Glass
Paper
87 %
34 million tonnes
13 %
5 million tonnes
2004
Residues
Biowaste
Packaging Materials
Glass
Paper
42 %
18 million tonnes
58 %
25 million tonnes
2010
Residues
Biowaste
Packaging Materials
Glass
Paper
37 %
15.9 million tonnes
63 %
27.6 million tonnes
Source: Federal Statistical Office (Statistisches Bundesamt) 2012, own calculations
25



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Treatment concepts for residues waste in Germany
DBFZ
Residual Waste
Landfilling prohibited until 2005
Storage
Maintenance for landfill gas and leachate. How many years are the needed maintenance?
Mechanical-Biological Treatment (MBT)
Material for recycling
SRF for energy recovery
Biological inert material for landfilling
Incineration (WIP)
Energy
Material for recycling
Inert material for landfilling or utilization for road construction

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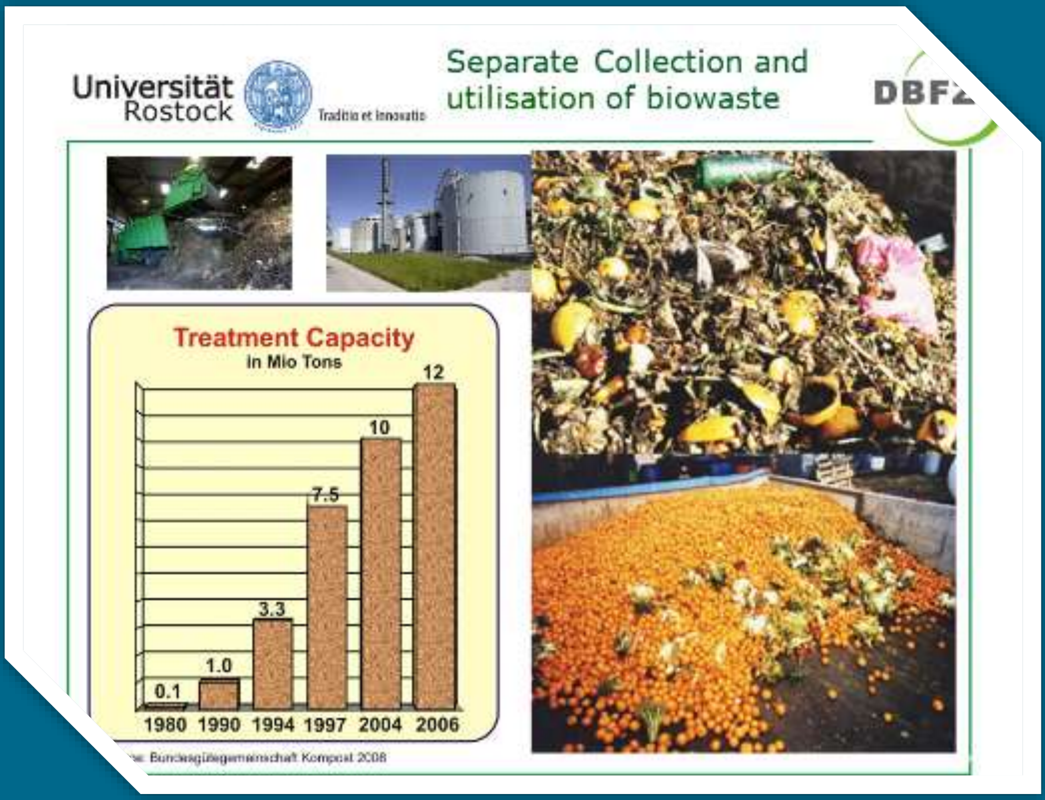

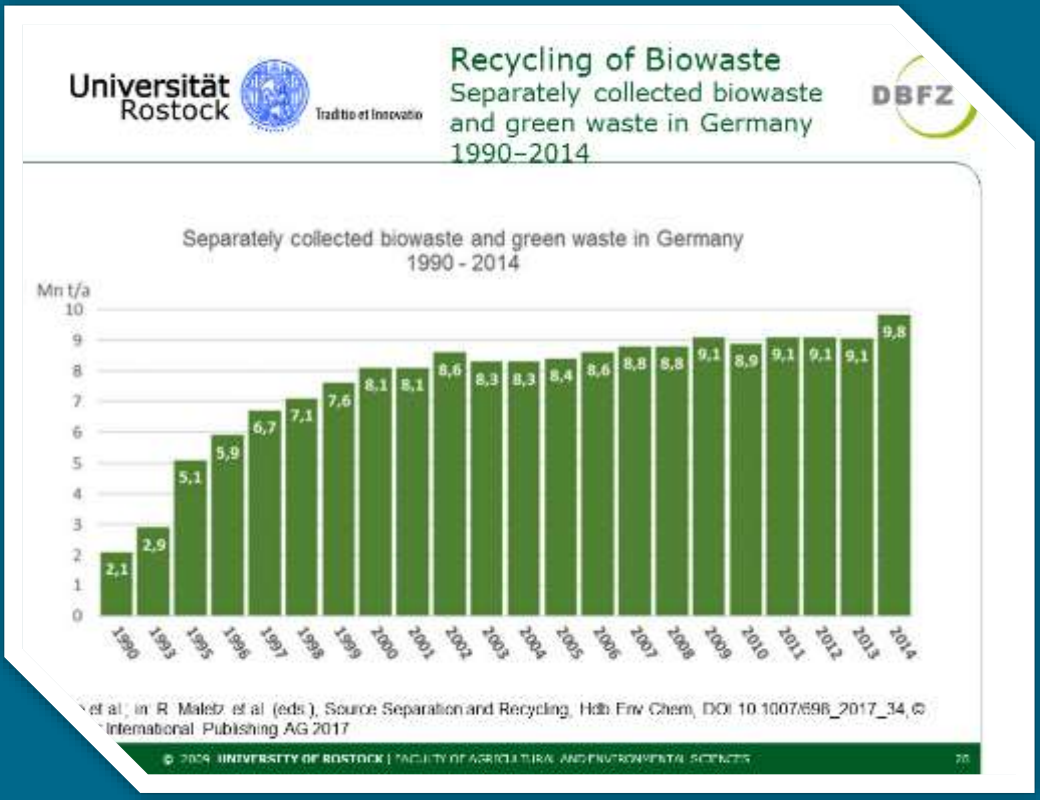


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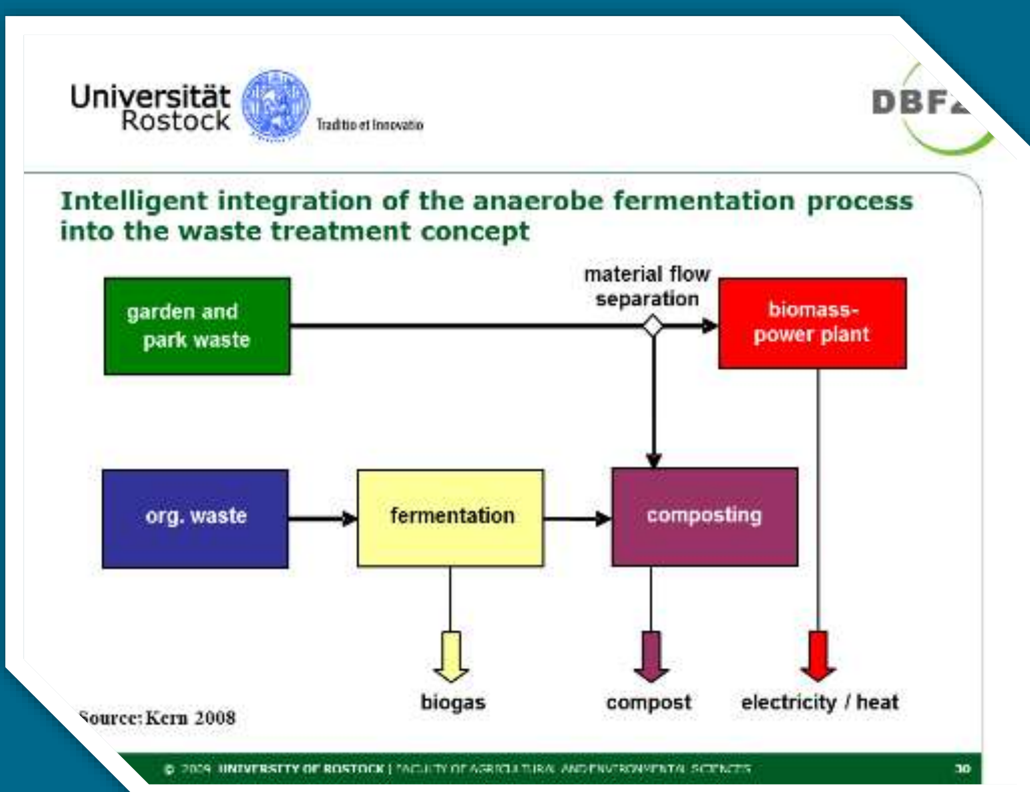
MSW-Recycling Quota in Germany 2013
DBFZ
electrical equipment
glass
paper, cardboard
bio-waste
packaging
metals, textiles ...
bulky waste
residual waste
collection rate 80%
100
collection rate 87%
100
collection rate 88%
99
collection rate 47%
99
collection rate 32 - 74%
81
collection rate 21 - 89%
69
collection rate 90%
54
9
collection rate 99,9%
0
20
40
60
80
100
Recycling Quota in %
statista
coverage quota = collection rate
© 2009 UNIVERSITY OF ROSTOCK | FACULTY OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES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DBFZ
Intelligent integration of the anaerobe fermentation process into the waste treatment concept
garden and park waste
material flow separation
biomass-power plant
org. waste
fermentation
composting
biogas
compost
electricity / heat
Source: Kern 2008
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30

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Overview

DBFZ

Waste management and urban mining: Germany, Europe and the World

1. Introduction: Global Challenges
2. Waste Management in Europe
3. Waste Management in Germany
4. **Waste Management in China**
5. Conclusion and Outlook

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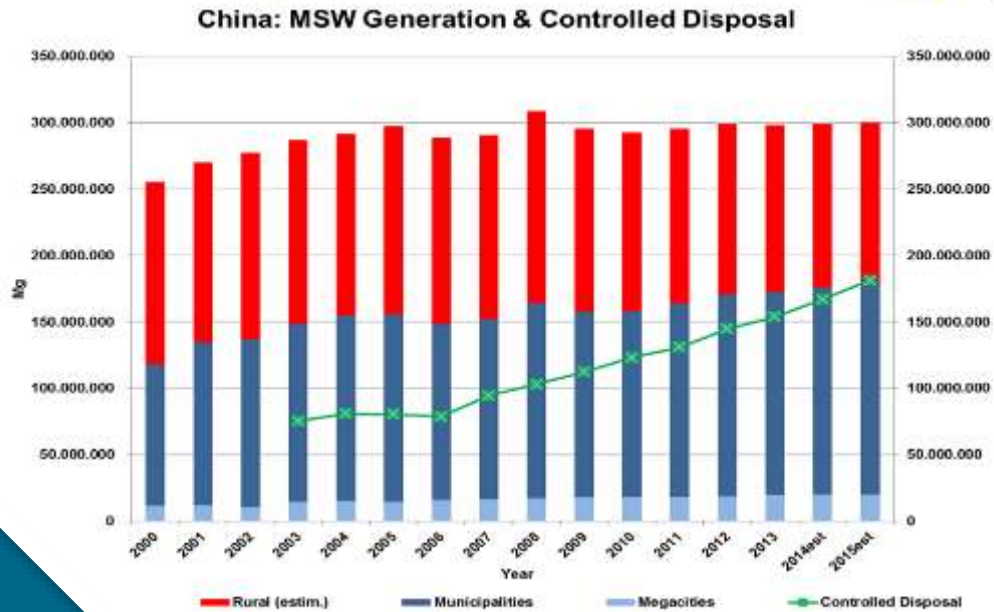
Treatment of solid waste in China (MOHURD 2016)

DBFZ



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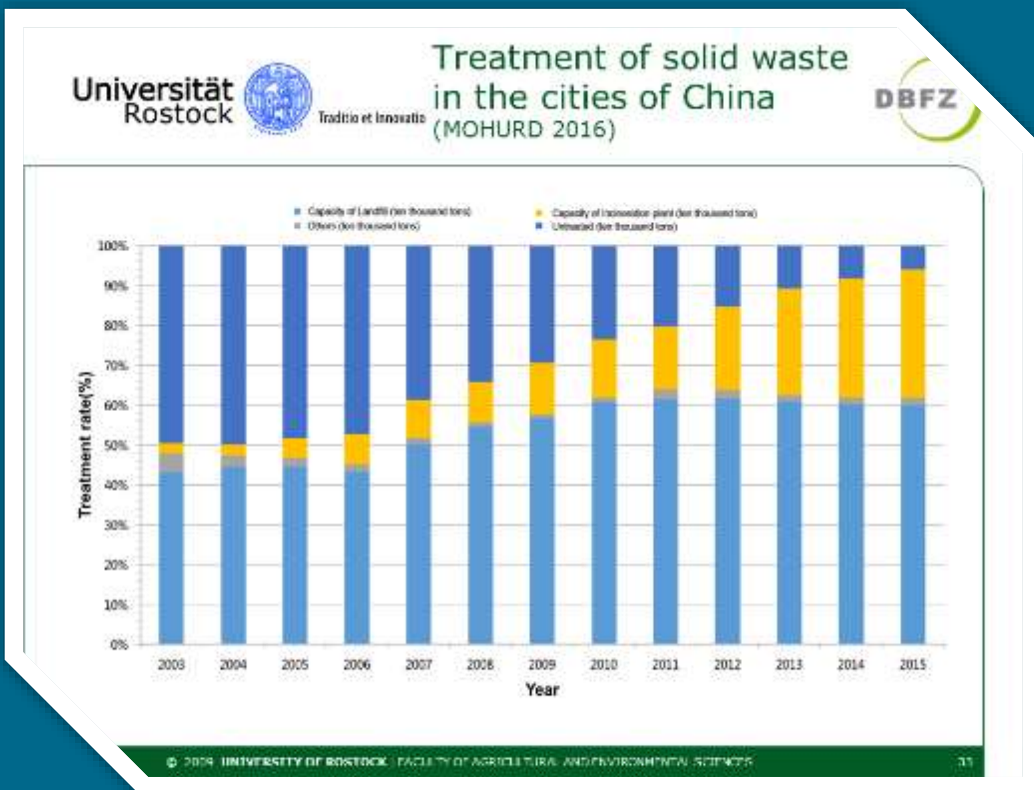

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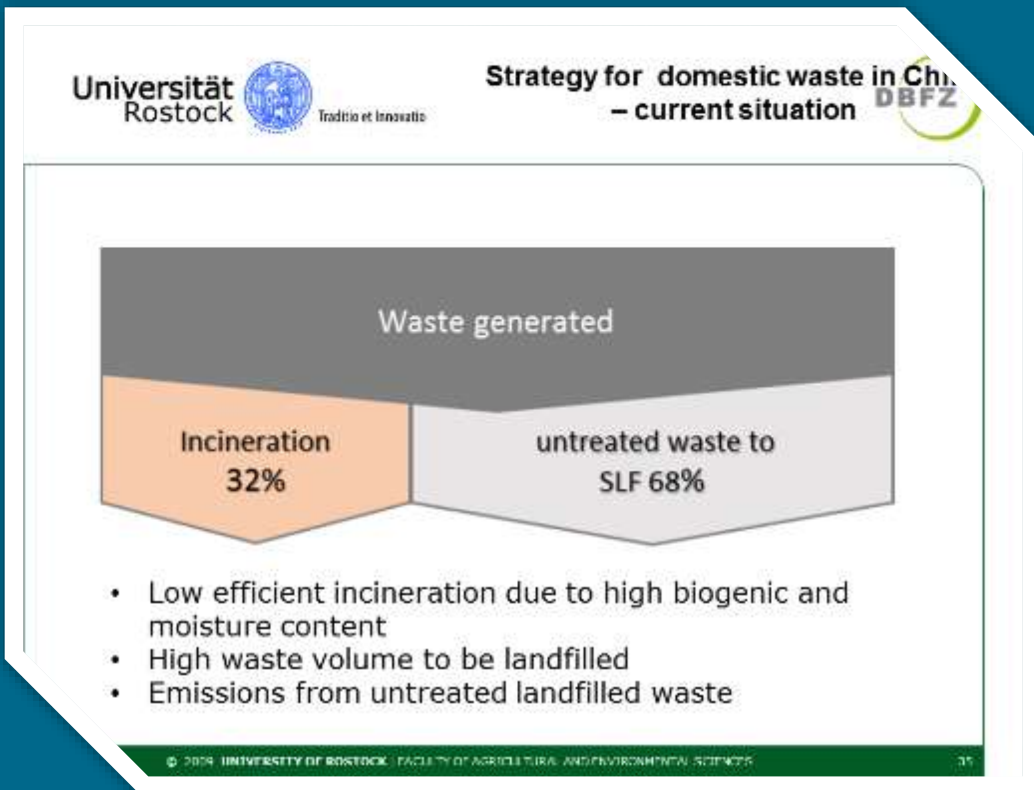

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Conclusion and Outlook

DBFZ

- The **worldwide** development of the current waste management systems to a Circular Economy is a key element for the global sustainable development.
- In **Europe** we have a very different standards of waste management systems
- We have a high level Waste Management System in **Germany** and is on track to a sustainable Circular Economy, but there is a long to go!
- The Waste Management System in **China** is developing very fast in the last 10 years. The positive development is going on and a main goal in the current 5-year plan of the Chinese Government.

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Thank you for your attention!

DBFZ

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IBZ Hohen Luckow e.V.

ovations- und Bildungszentrum Hohen Luckow e.V.

Biogas Expertise:

- Consulting of practice biogas plants
- Support of the biological process control
- R&D projects (applied research)
- Investigations to optimize the biogas process
- Batch-investigations to generate the gas potential of different substrates
- Analysis laboratory

Experimental plant for investigations in step with practice

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Cruise Shipping Market

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Market Situation:

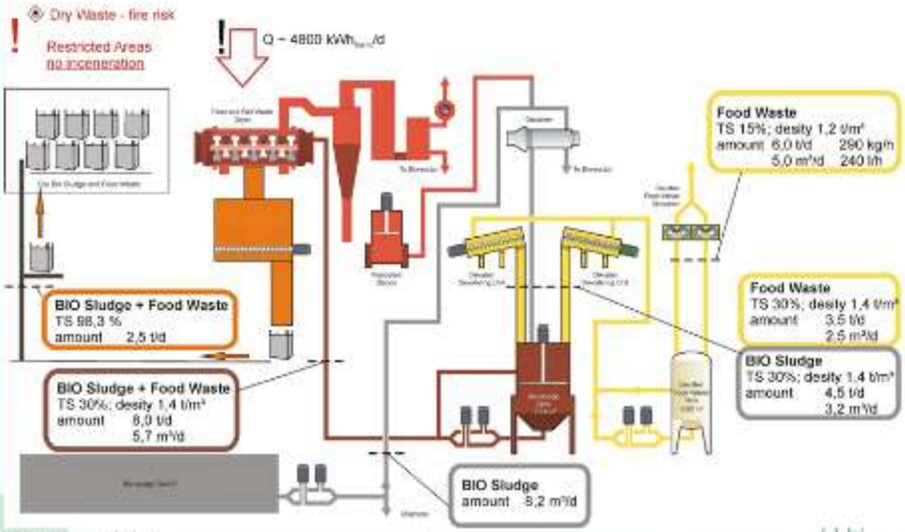
- German tourists 2016: 2,02 Mio. (increase of 11.3 %)
- Sales of German cruise shipping market 2016: 3,38 Bn. € (increase of 17.8 %)
- Passenger worldwide 2016: approx. 24 Mio.
- New buildings until 2020: approx. 55 cruise ships

Situation MV (Rostock/Warnemünde)

- Development of arrivals: 2002 – 62 arrivals
  2017 – 192 arrivals
  (approx. 800.000 passengers)
- Most important cruise shipping port of German Baltic
- Rank 6 of all cruise shipping ports in the Baltic

IBZ

Current Stand of Waste and Waste Water Treatment on Board



(Hudde & Orth 2012)

Biomass- and Energypotential

Feasibility study for biomass potential on a cruise ship

Kind of Waste	Description	Amount [t/a]	Methane-potential [m³/a]
Black water	Toilet flush (Vacuum systems)	20.075	4.979,4
Grey water	Laundries, showers, kitchen water	143.678,5	0
Food waste	Kitchen, restaurants	2.555	148.028,4
Flotate Fats	Fat separate material from grey water	12	9.603,6
Frying Fats	Kitchen	21,5	17.789,3
Dried BioSludge	Mix of surplus sludge and food waste	2.920	321.008,4

Energy potential of a ship with 2500 passengers plus crew (Hudde & Orth 2012)

Hudde, J., Orth, M (2012).: Anaerobe Abwasser- und Abfallbehandlung an Bord eines Kreuzfahrtschiffes der Reederei AIDA CRUISES - unpublished

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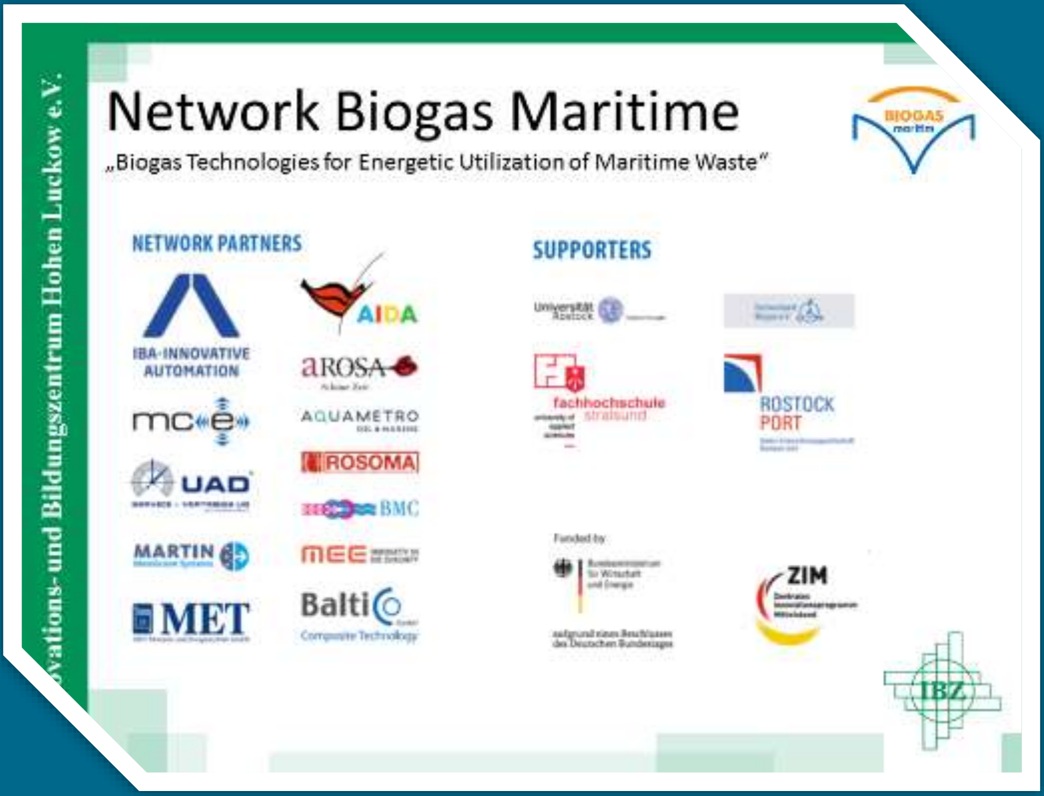
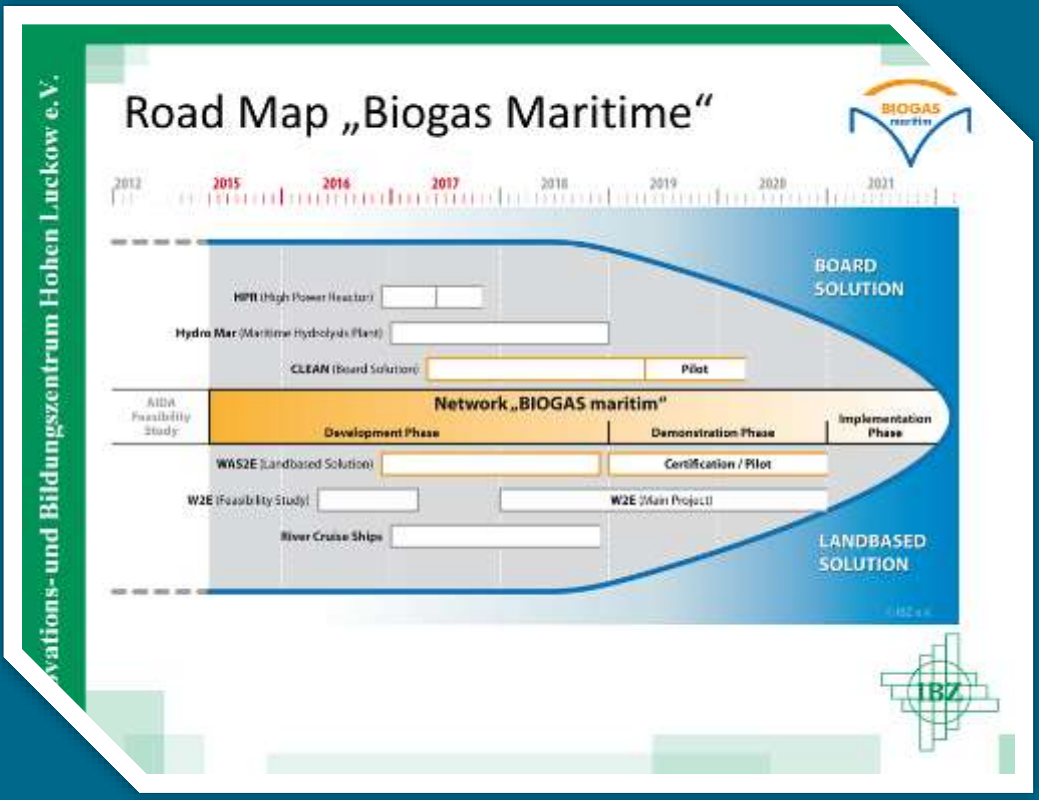
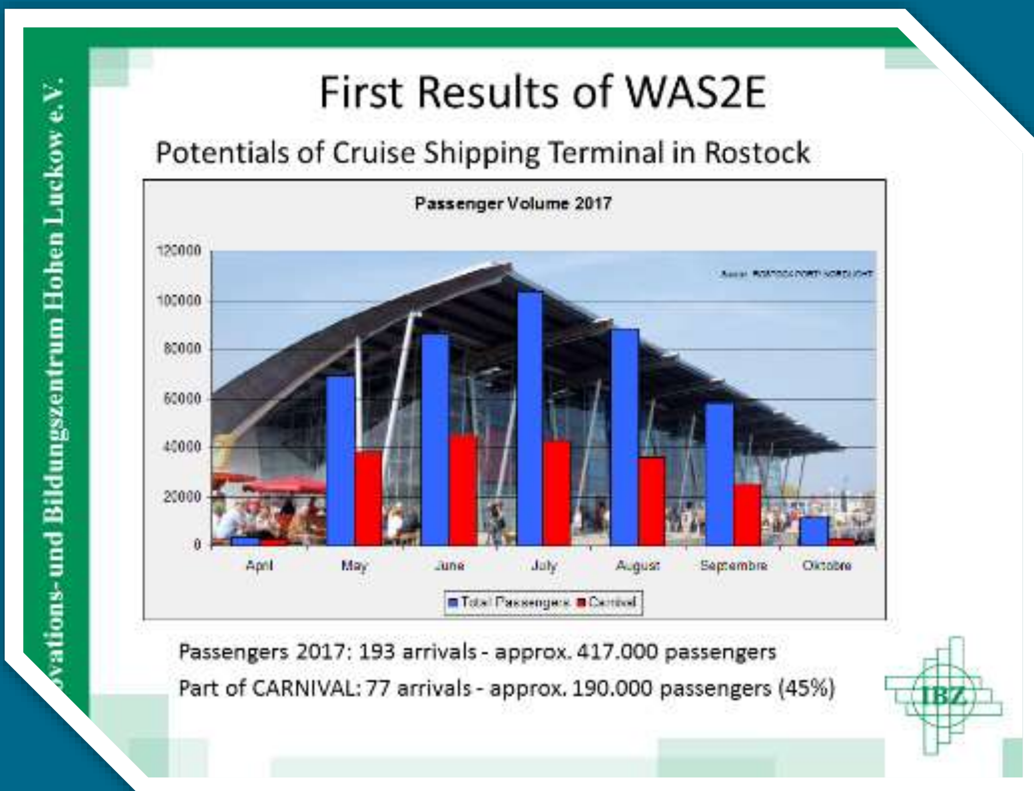


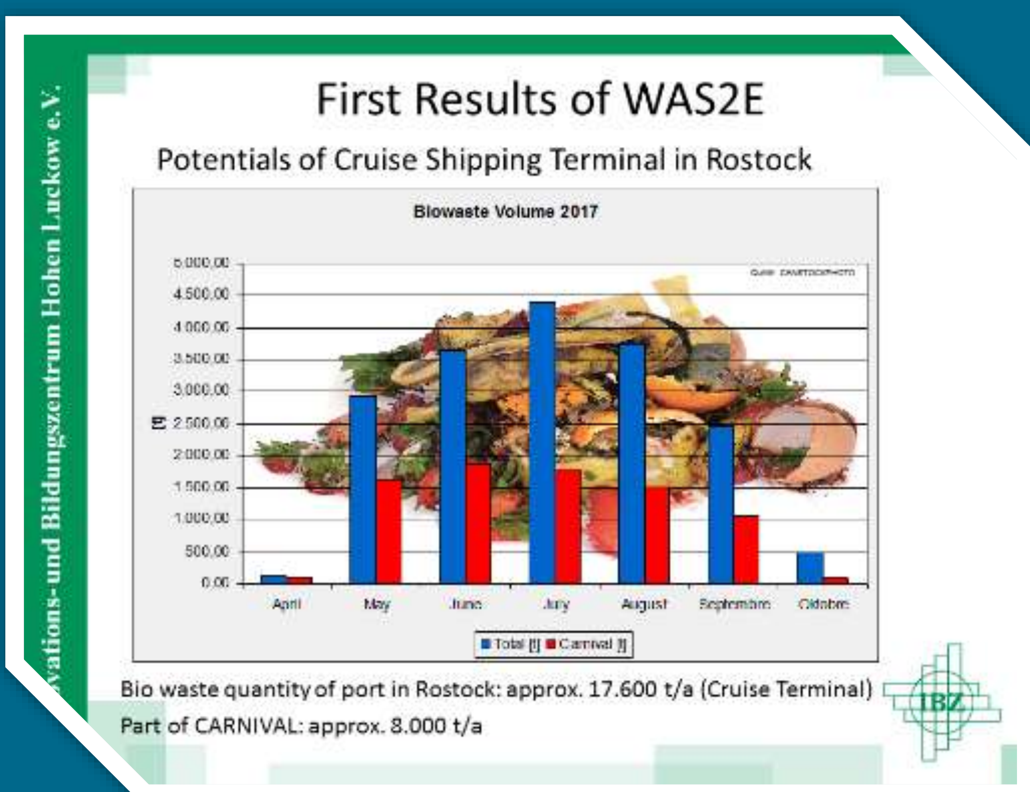


und Bildungszentrum Hohen Luckow e.V.
Waste and Sludge to Energy (WAS2E)
Waste Management Concept for Ship Waste of International Origin
Duration: 1.12.2016 - 30.11.2018
Funding Code: FKZ 03KB119A
Partnership:
IBZ
LMS AGRARBERATUNG
ROSOMA
Funded by
ZIM
Energetische Biomassenutzung
IBZ

und Bildungszentrum Hohen Luckow e.V.
Waste and Sludge to Energy (WAS2E)
Waste Management Concept for Ship Waste of International Origin
Cruise Terminal
Port
Transport
Electricity
Heat
Fuel
Fertilizer
Activated Coal
Energy
Biogas
Biochar
Storage
High Power Reactor
Carbonization



Innovations- und Bildungszentrum Hohen Luckow e.V.
First Results of WAS2E
Potentials of Cruise Shipping Terminal in Rostock
Passenger Volume 2017
120000
100000
80000
60000
40000
20000
0
April
May
June
July
August
Septembre
Oktobre
Total Passengers
Carnival
Passengers 2017: 193 arrivals - approx. 417.000 passengers
Part of CARNIVAL: 77 arrivals - approx. 190.000 passengers (45%)
IBZ



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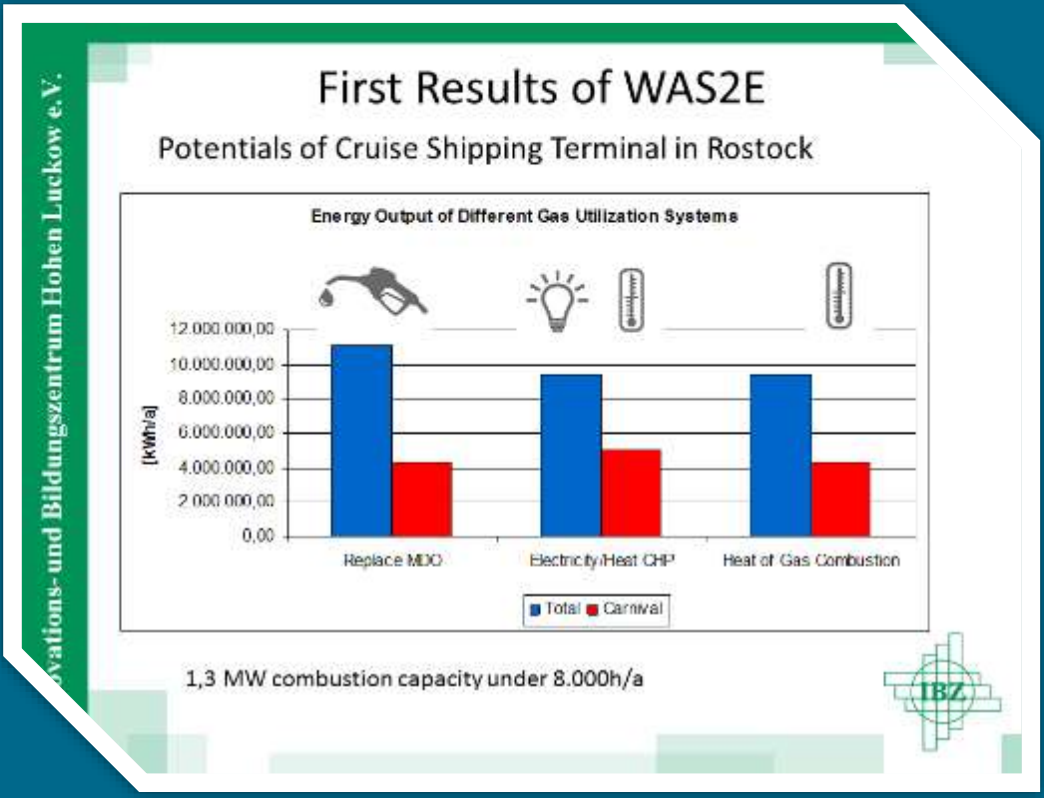
First Results of WAS2E
Potentials of Cruise Shipping Terminal in Rostock
Biowaste Volume 2017
5.000,00
4.500,00
4.000,00
3.500,00
3.000,00
2.500,00
2.000,00
1.500,00
1.000,00
500,00
0,00
April
May
June
July
August
Septembre
Oktobre
Total [t]
Carnival [t]
Bio waste quantity of port in Rostock: approx. 17.600 t/a (Cruise Terminal)
Part of CARNIVAL: approx. 8.000 t/a
IBZ


First Results of WAS2E
Potentials of Cruise Shipping Terminal in Rostock
Energy Output of Different Gas Utilization Systems
[kWh/a]
12.000.000,00
10.000.000,00
8.000.000,00
6.000.000,00
4.000.000,00
2.000.000,00
0,00
Replace MDO
Electricity/Heat CHP
Heat of Gas Combustion
Total
Carnival
1,3 MW combustion capacity under 8.000h/a
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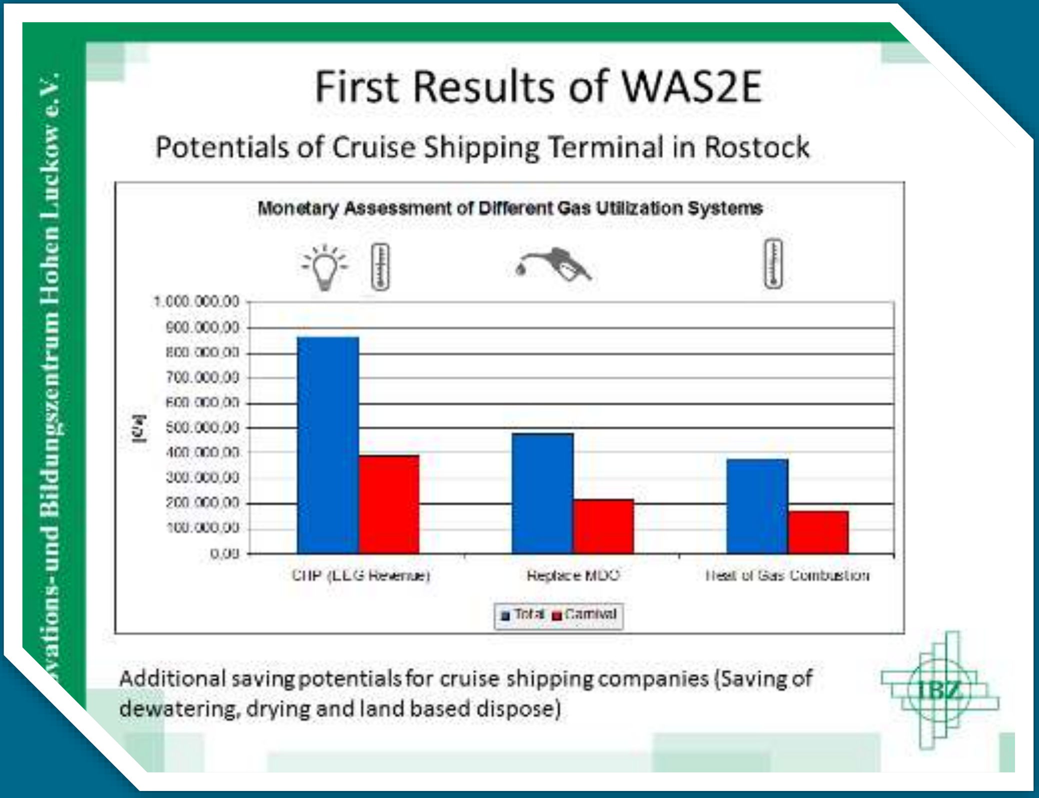
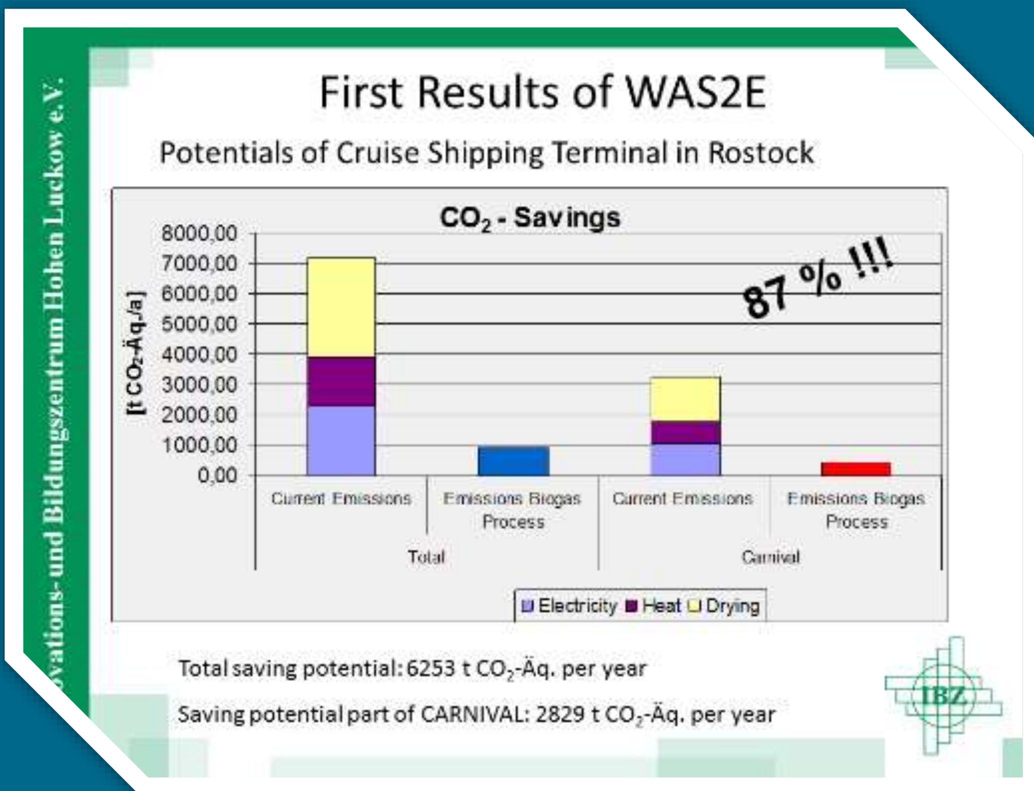
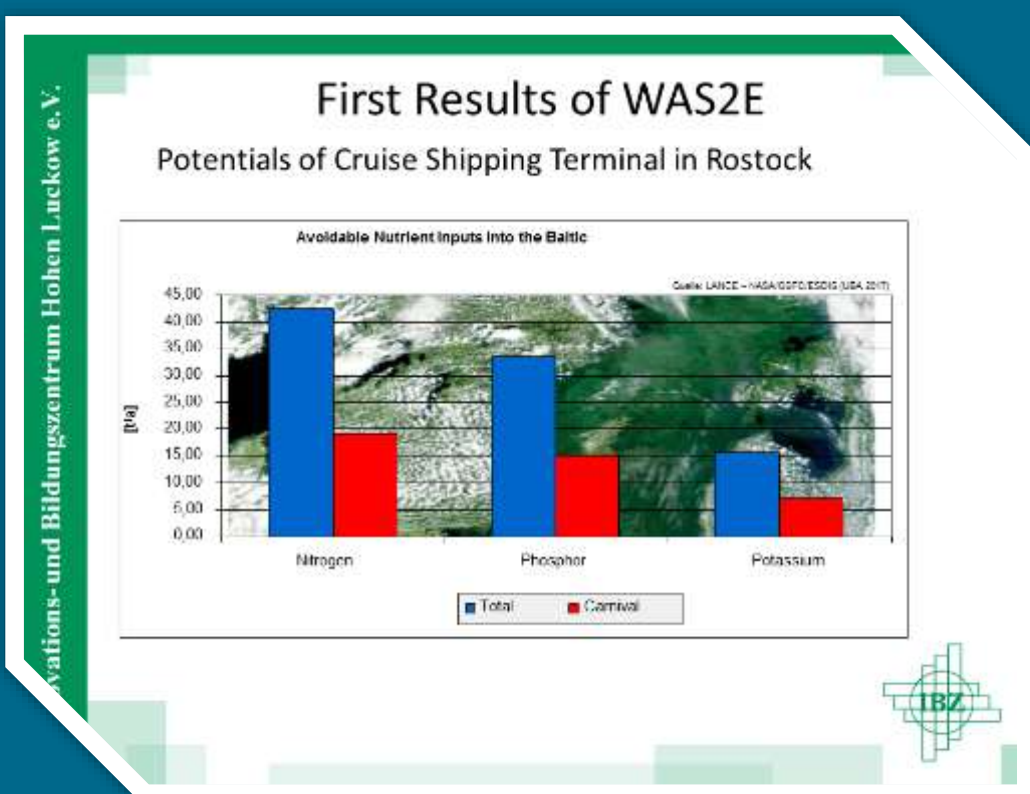
IBZ


First Results of WAS2E
Potentials of Cruise Shipping Terminal in Rostock
Monetary Assessment of Different Gas Utilization Systems
[€/a]
1.000.000,00
900.000,00
800.000,00
700.000,00
600.000,00
500.000,00
400.000,00
300.000,00
200.000,00
100.000,00
0,00
CHP (EEG Revenue)
Replace MDO
Heat of Gas Combustion
Total
Carnival
Additional saving potentials for cruise shipping companies (Saving of dewatering, drying and land based dispose)
Innovations- und Bildungszentrum Hohen Luckow e.V.
IBZ


First Results of WAS2E
Potentials of Cruise Shipping Terminal in Rostock
CO_2 - Savings
[t CO_2-Äq./a]
8000,00
7000,00
6000,00
5000,00
4000,00
3000,00
2000,00
1000,00
0,00
87 % !!!
Current Emissions
Emissions Biogas Process
Current Emissions
Emissions Biogas Process
Total
Carnival
Electricity
Heat
Drying
Total saving potential: 6253 t CO_2-Äq. per year
Saving potential part of CARNIVAL: 2829 t CO_2-Äq. per year
Innovations- und Bildungszentrum Hohen Luckow e.V.
IBZ


First Results of WAS2E
Potentials of Cruise Shipping Terminal in Rostock
Avoidable Nutrient Inputs into the Baltic
[t/a]
45,00
40,00
35,00
30,00
25,00
20,00
15,00
10,00
5,00
0,00
Nitrogen
Phosphor
Potassium
Total
Carnival
Innovations- und Bildungszentrum Hohen Luckow e.V.
IBZ

Cruise Liners: Efficient Onboard Anaerobic Digestion of Organic Wastes for Energy Recovery (CLEAN)
MARTIN
Membrane Systems
CARNIVAL
MARITIME
BIOGAS
AIDA
Duration:
01.08.2017-31.07.2020
Funding Code:
03SX437
IBZ
vations- und Bildungszentrum Hohen Luckow e.V.

CLEAN-Project - Aims
CLEAN
CH_4
Biogas
Utilization on Board
Food waste
Sewage sludge
Other organic residues
Anaerobic Plant
Process optimization
Digestate
• Combination of waste water treatment plant and an anaerobic step
• Small reactor with high flows for integration and operation on board
• Reach the new required limits for discharging permeate into the Baltic according IMO MEPC.227(64)
IBZ
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Forum RM 1 - Presentations

Outlook

EUSBSR
EU STRATEGY FOR THE BALTIC SEA REGION

- Appliance for a project in the framework of Interreg Baltic Sea Region Program
- Third call at the beginning of October
- Aims
  - To spread the idea of Biogas Maritime
  - To transfer the developed technologies of the network into the Baltic Sea Regions
  - To identify the total biogas potential of the BSR as well as economically and environmental benefits
  - Concepts of implementation
  - To sensitise stakeholders and actors of industry and administration
  - To build and enhance capacity and knowledge
  - To develop business models, concepts for operation and trainings of staff
  - Communication of the results to the public for positive image of this issue

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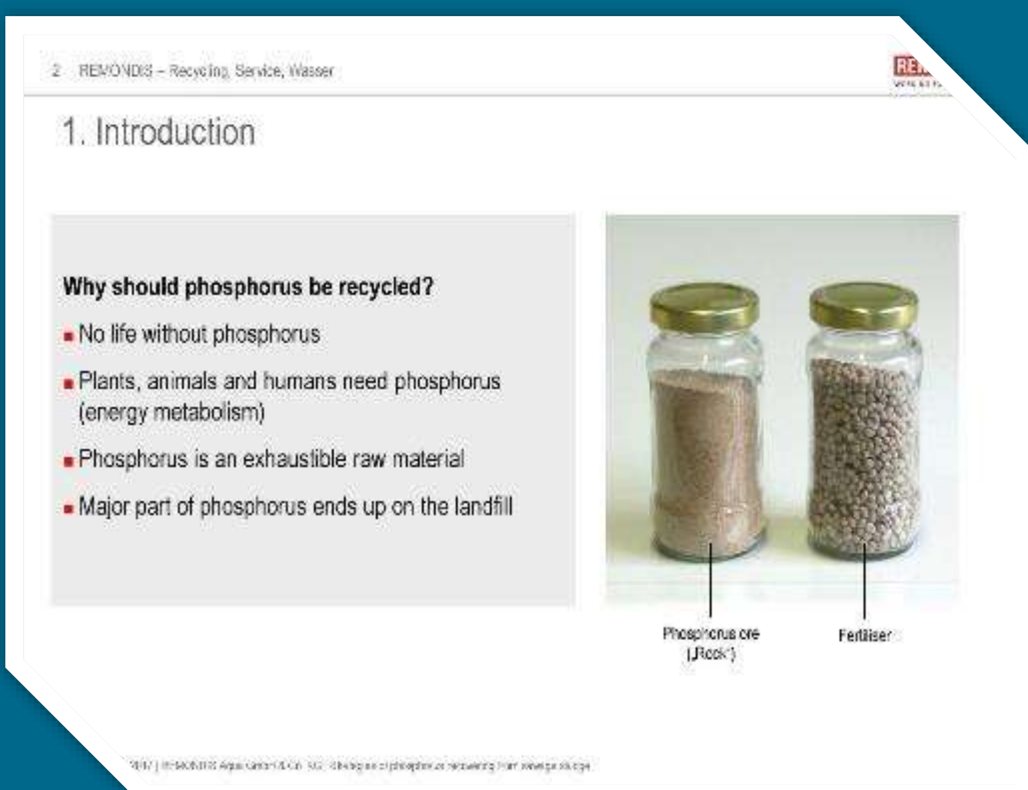

2. Thesis

NO mono incineration plant for thermal treatment of sewage sludge **WITHOUT** P-recycling plant.

sewage sludge

\+

Thermal utilisation by mono incineration

\+

P-recycling

= Sustainability

3. Legal background in Germany

Legal act is the Federal Sewage Sludge Ordinance ‚Abfallklärschlammverordnung'.
Amendment date is 18 January 2017:

- Use of sewage sludge for agricultural purposes is declining.
- Thermal utilisation of sludge is preferred.
- ¾ of sewage sludge in Germany is affected by legal P-recycling obligation.
- Deadline is 2029 (2032 smaller wwtp's).

12 years seems far away, but roll out of new technologies takes time.

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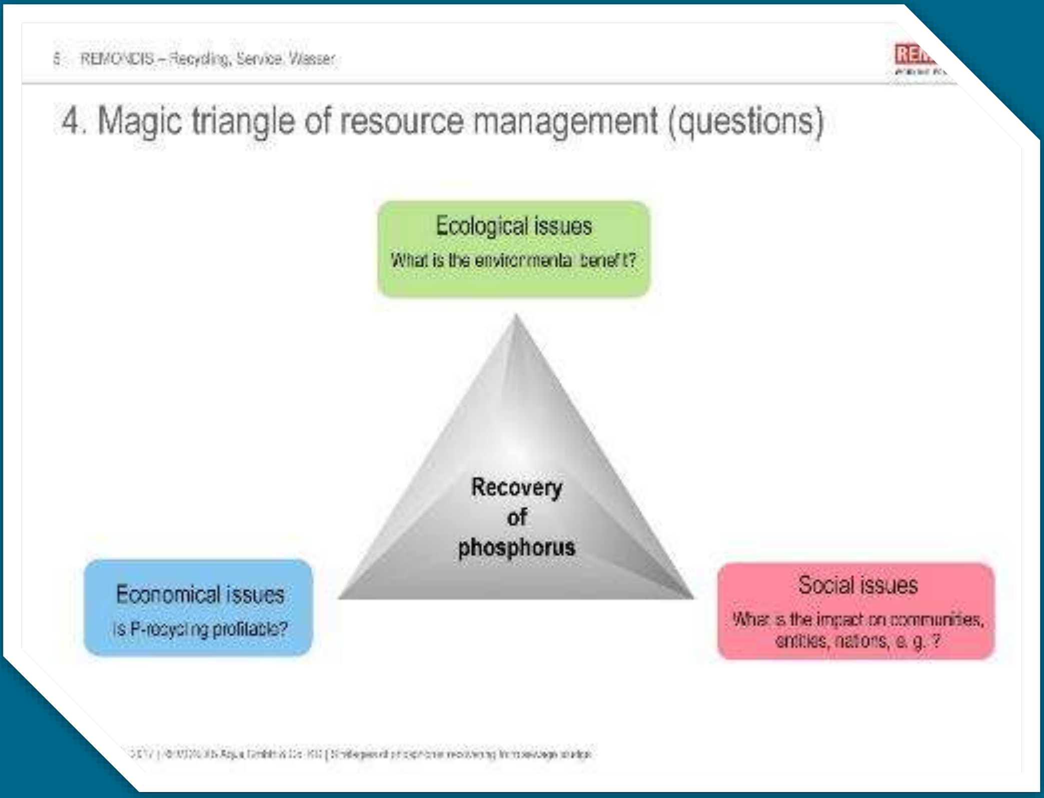
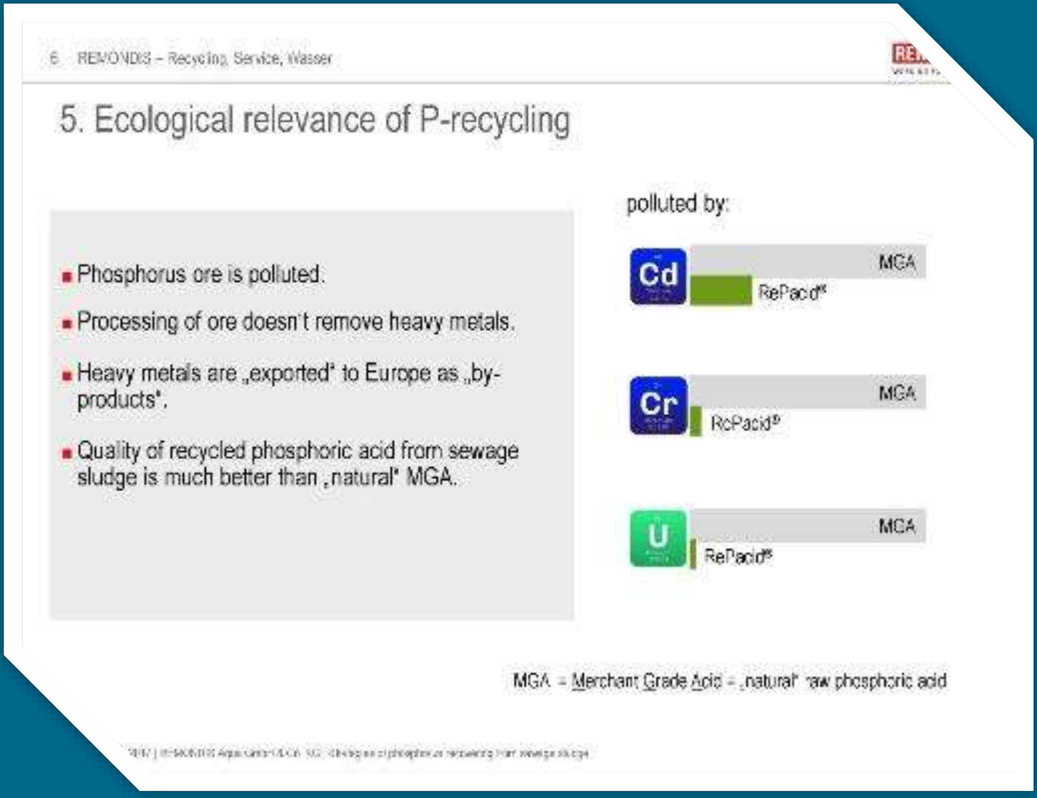
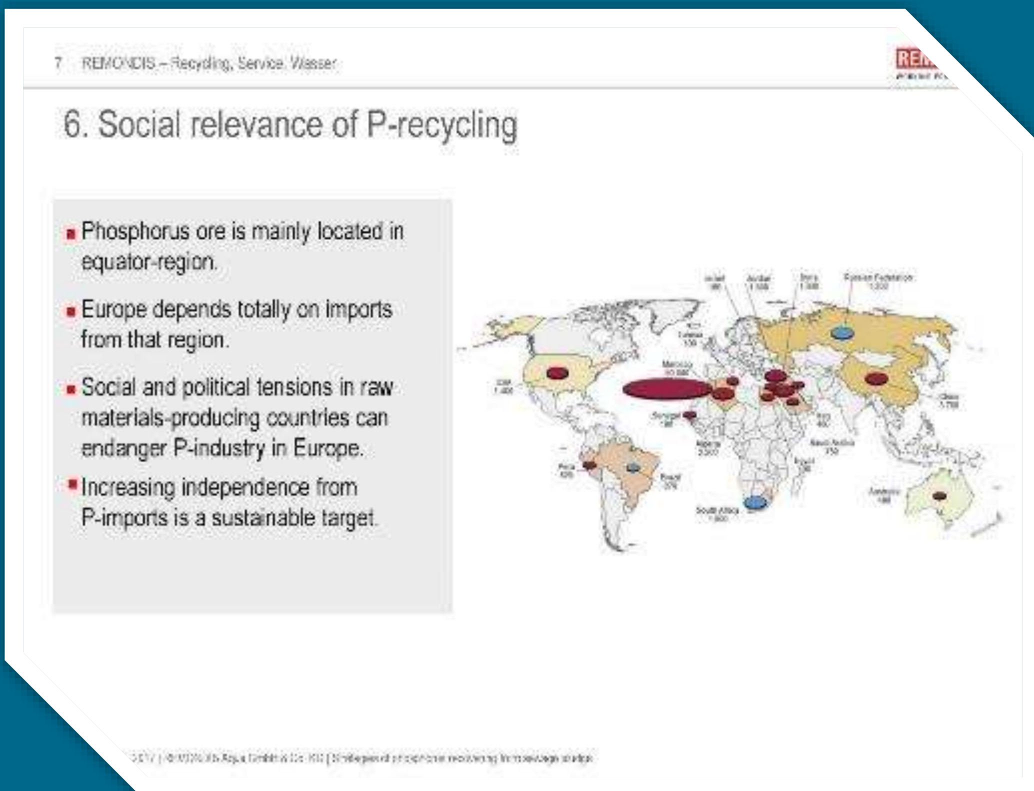
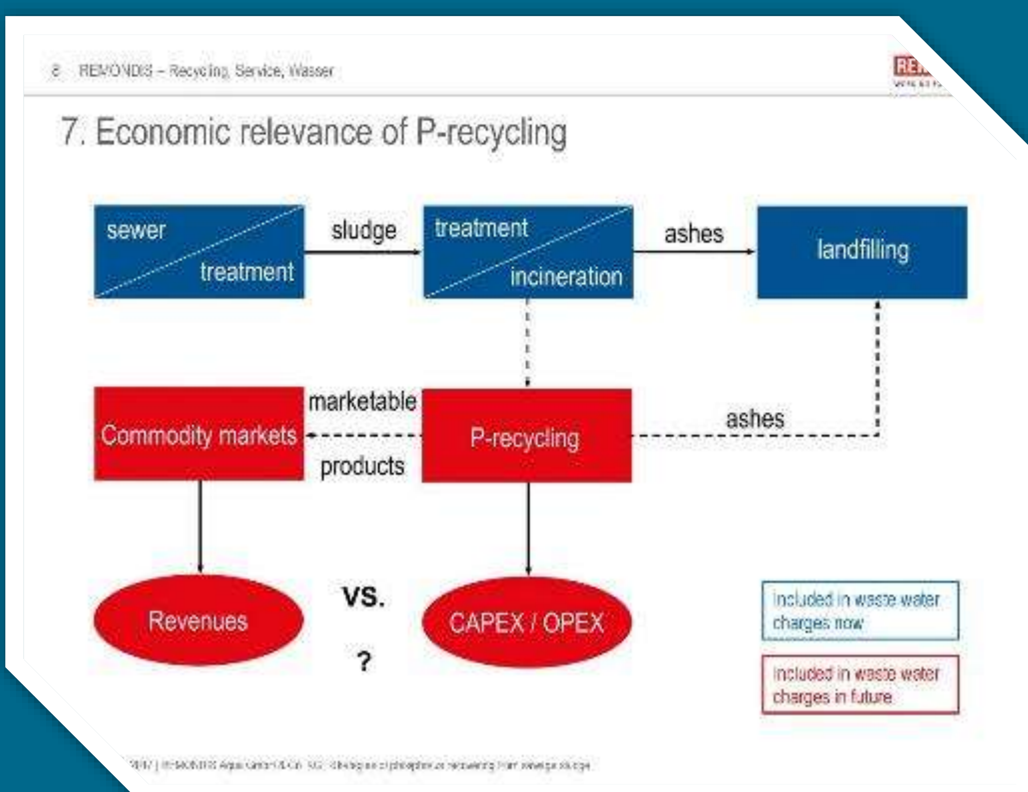





7 REMONDIS – Recycling, Service, Wasser
6. Social relevance of P-recycling
Phosphorus ore is mainly located in equator-region.
Europe depends totally on imports from that region.
Social and political tensions in raw materials-producing countries can endanger P-industry in Europe.
Increasing independence from P-imports is a sustainable target.


8 REMONDIS – Recycling, Service, Wasser
7. Economic relevance of P-recycling
sewer
treatment
sludge
treatment
incineration
ashes
landfilling
Commodity markets
marketable
products
P-recycling
ashes
Revenues
vs.
?
CAPEX / OPEX
included in waste water charges now
included in waste water charges in future

9 REMONDIS – Recycling, Service, Wasser

8. Development of P-recycling strategy (1/2)

Premises:

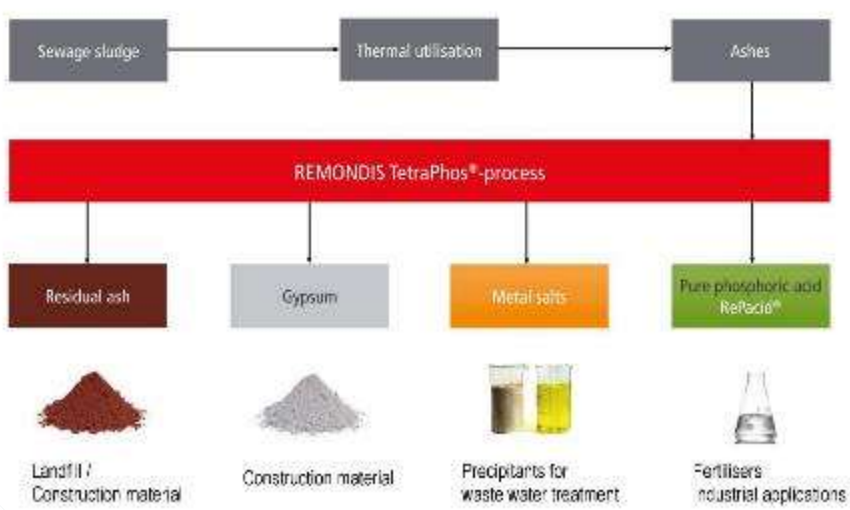
- Ash-based technology because sludge incineration will prevail.
- Maximum recovery of raw materials because P, Ca, Al, Fe - ingredients of ashes are valuable.
- Marketable products to reduce P-imports.
- No increase of waste water charges to attract recycling investments.

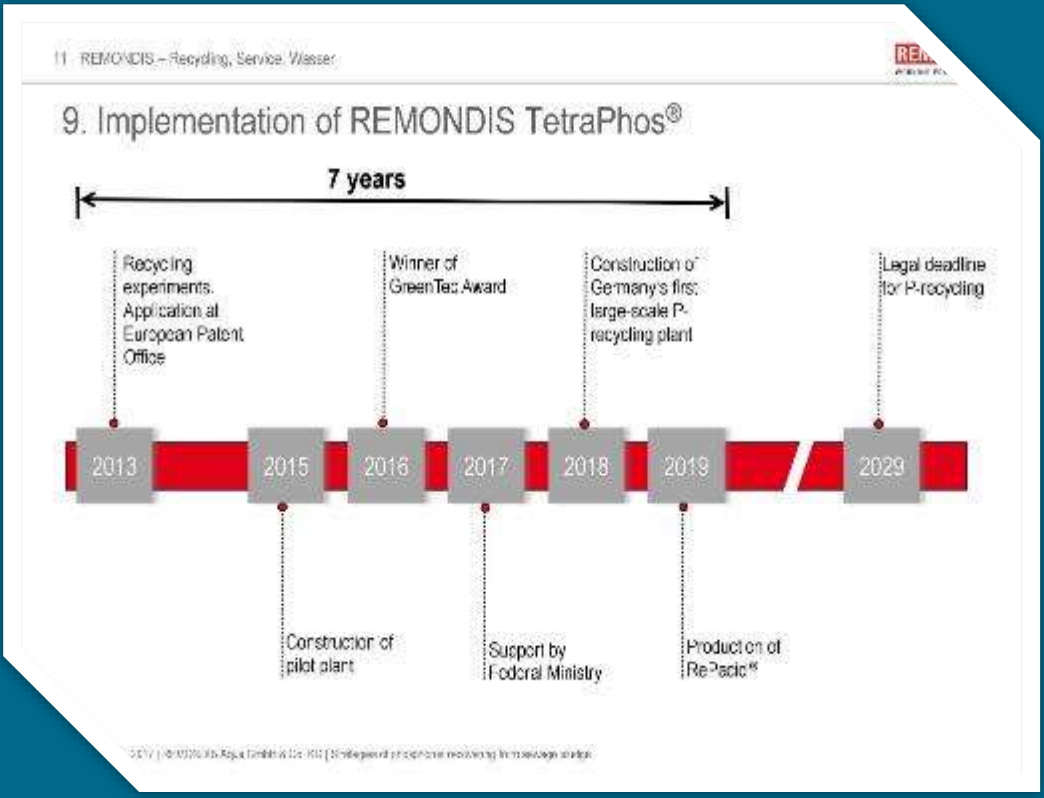
Solution:

Recovering phosphorus as **phosphoric acid** (H_3PO_4)

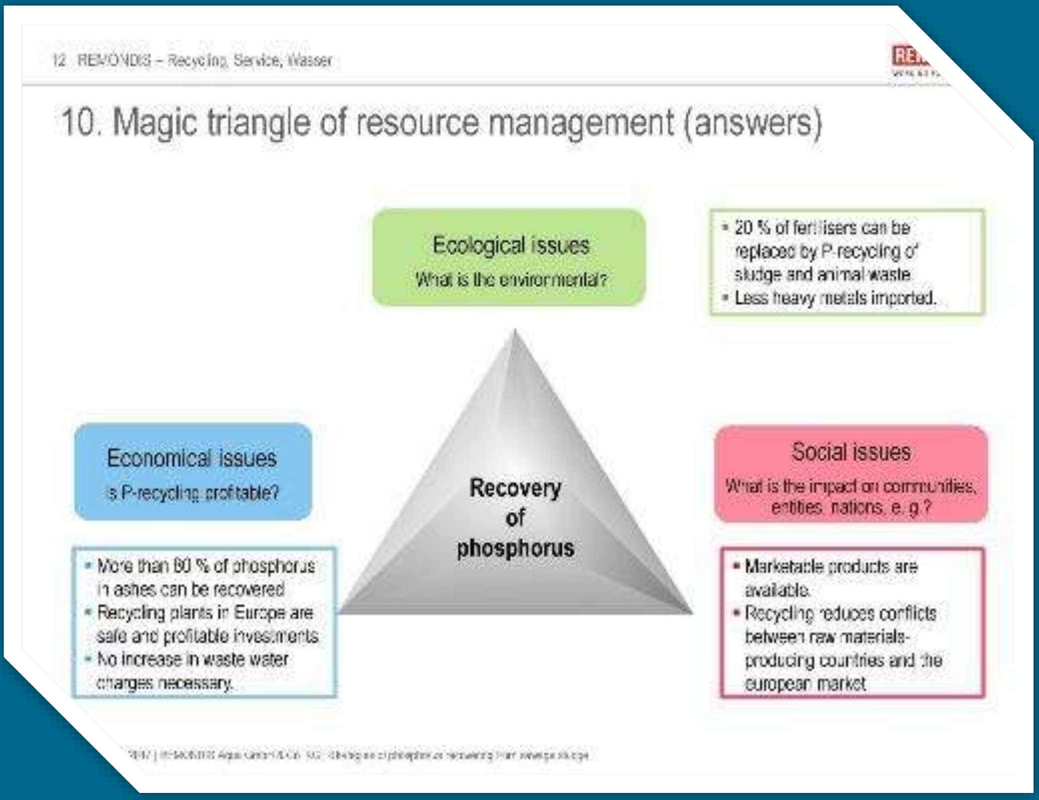
10 REMONDIS – Recycling, Service, Wasser

8. Development of R-recycling strategy (2/2)





11 REMONDIS – Recycling, Service, Wasser
9. Implementation of REMONDIS TetraPhos®
7 years
Recycling experiments. Application at European Patent Office
Winner of GreenTec Award
Construction of Germany's first large-scale P-recycling plant
Legal deadline for P-recycling
2013
2015
2016
2017
2018
2019
2029
Construction of pilot plant
Support by Federal Ministry
Production of RePacid®



12 REMONDIS – Recycling, Service, Wasser
10. Magic triangle of resource management (answers)
Ecological issues
What is the environmental?
• 20 % of fertilisers can be replaced by P-recycling of sludge and animal waste
• Less heavy metals imported.
Economical issues
Is P-recycling profitable?
Recovery of phosphorus
Social issues
What is the impact on communities, entities, nations, e. g.?
• More than 80 % of phosphorus in ashes can be recovered
• Recycling plants in Europe are safe and profitable investments
• No increase in waste water charges necessary.
• Marketable products are available.
• Recycling reduces conflicts between raw materials-producing countries and the european market


REMOND
WORKING FOR THE FUTU
RE

BALTIC CLEAN TECHNOLOGY 2017
Forum RM 1 - Presentations

BALTIC CLEAN TECHNOLOGY, 28.09.201
Detlef Siebert (COO),

Potential for optimization by applied flexibility of decentral (renewable) waste-to-power generation equipment

EnergieFlexWerk
vernetzen - gemeinsam profitieren

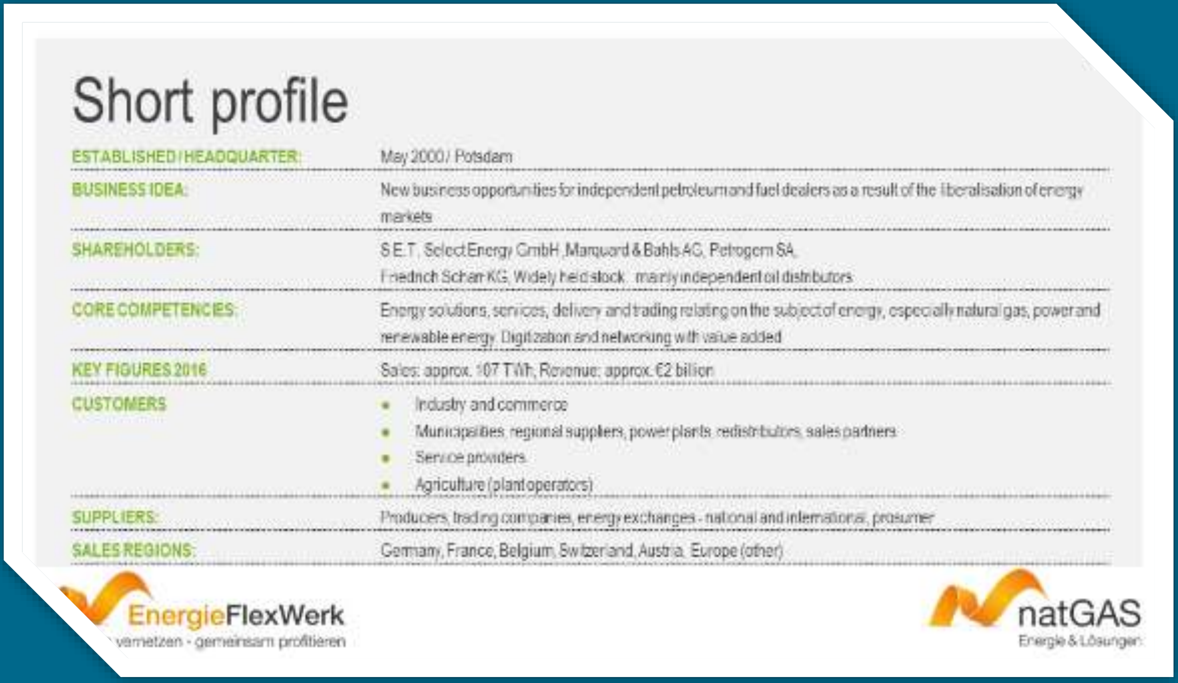
natGAS
Energie & Lösungen

Agenda

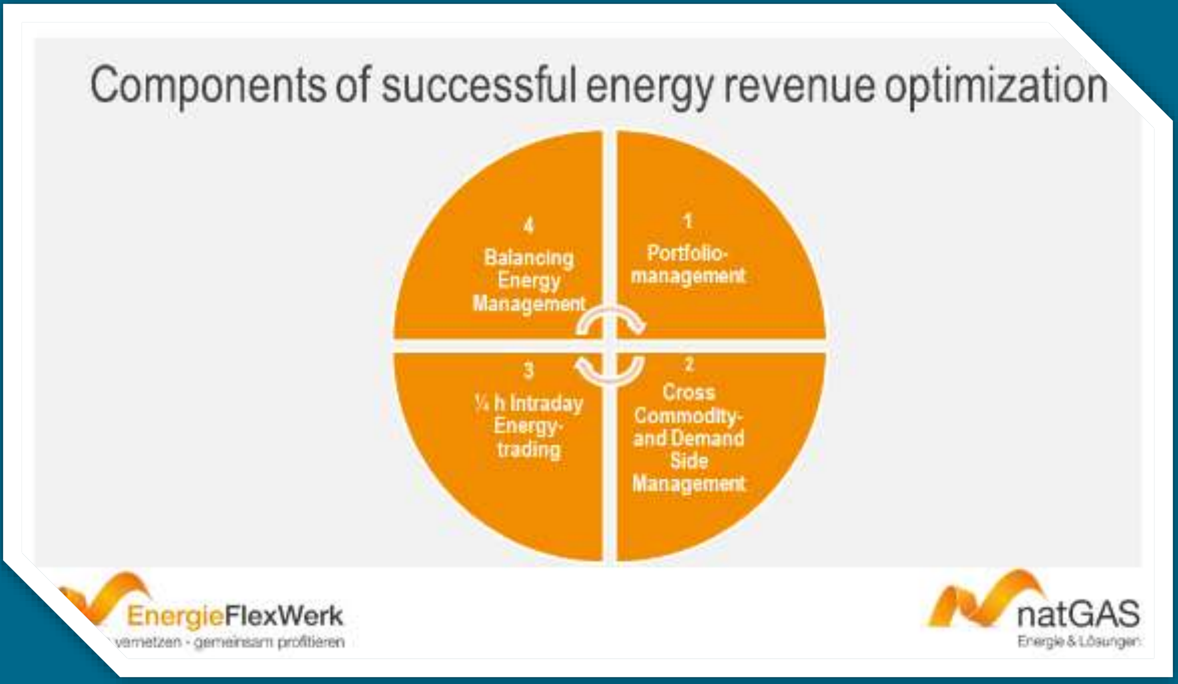
1. About natGAS / natGAS approach
2. How to become flexibel
3. The Energy Market
4. Cross Commodity and Demand Side Management

EnergieFlexWerk
vernetzen - gemeinsam profitieren

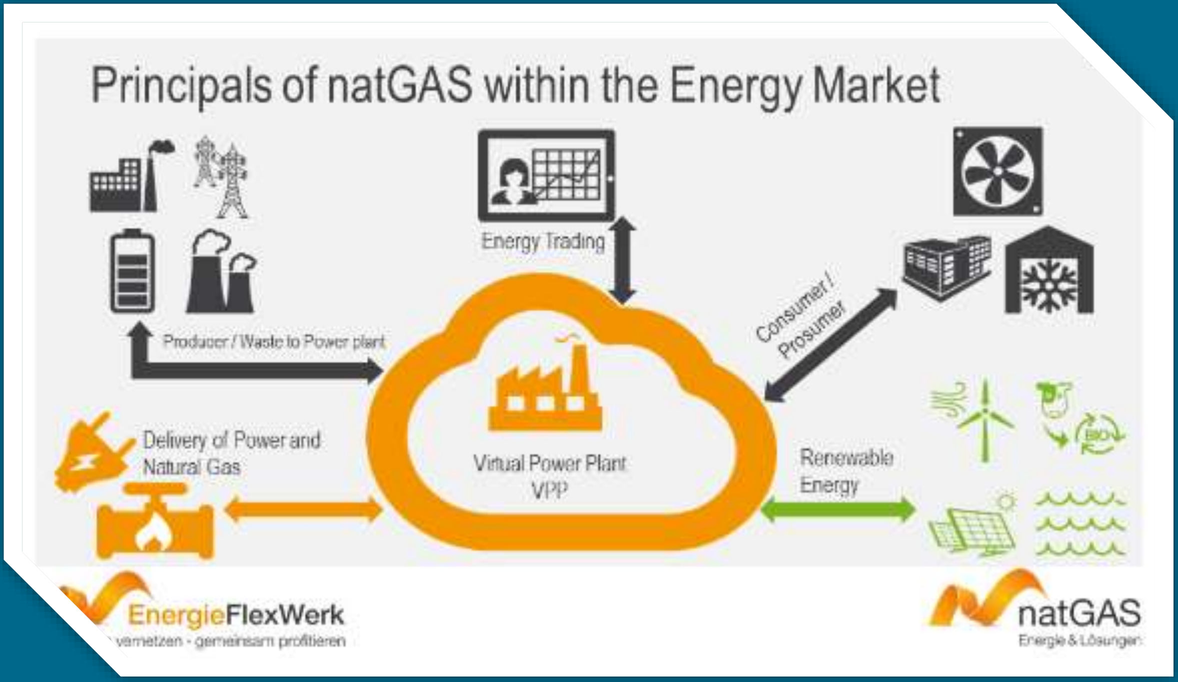
natGAS
Energie & Lösungen

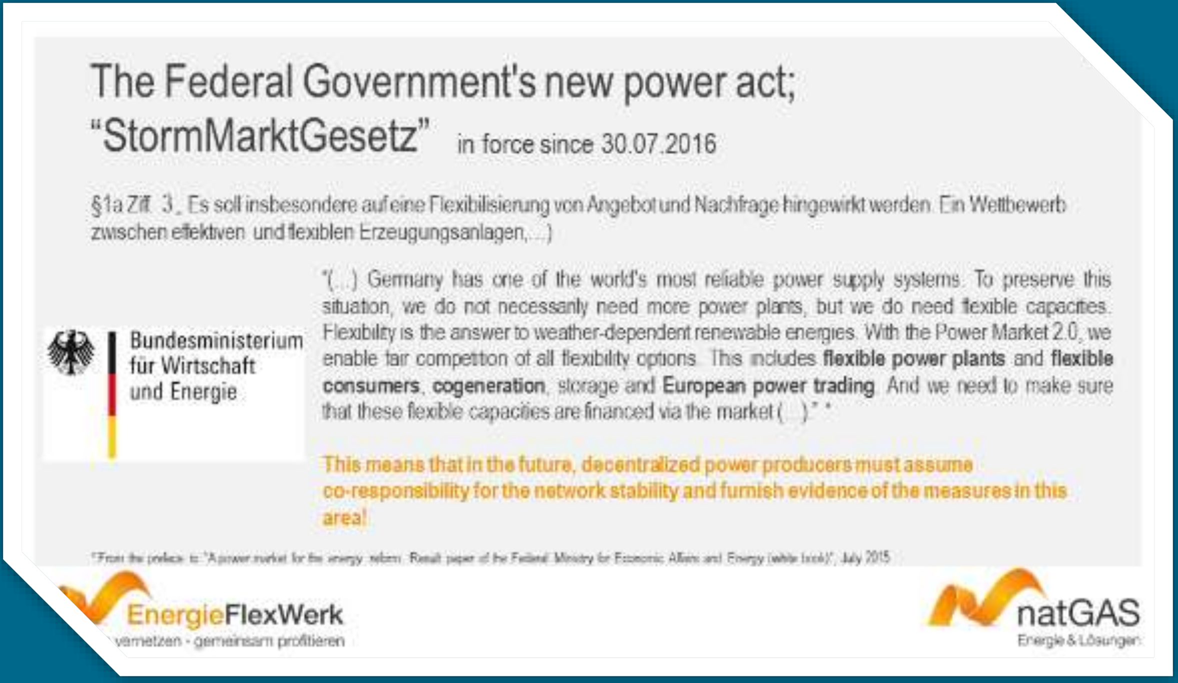


Short profile
ESTABLISHED / HEADQUARTER:
May 2000 / Potsdam
BUSINESS IDEA:
New business opportunities for independent petroleum and fuel dealers as a result of the liberalisation of energy markets
SHAREHOLDERS:
S.E.T. Select Energy GmbH, Marquard & Bahls AG, Petrogem SA, Friedrich Scharr KG, Widely held stock - mainly independent oil distributors
CORE COMPETENCIES:
Energy solutions, services, delivery and trading relating on the subject of energy, especially natural gas, power and renewable energy. Digitization and networking with value added
KEY FIGURES 2016
Sales: approx. 107 TWh, Revenue: approx. €2 billion
CUSTOMERS
Industry and commerce
Municipalities, regional suppliers, power plants, redistributors, sales partners
Service providers
Agriculture (plant operators)
SUPPLIERS:
Producers, trading companies, energy exchanges - national and international, prosumer
SALES REGIONS:
Germany, France, Belgium, Switzerland, Austria, Europe (other)
EnergieFlexWerk
vernetzen - gemeinsam profitieren
natGAS
Energie & Lösungen



Components of successful energy revenue optimization
4
Balancing Energy Management
1
Portfolio-management
3
¼ h Intraday Energy-trading
2
Cross Commodity- and Demand Side Management
EnergieFlexWerk
vernetzen - gemeinsam profitieren
natGAS
Energie & Lösungen


Principals of natGAS within the Energy Market
Energy Trading
Producer / Waste to Power plant
Consumer / Prosumer
Delivery of Power and Natural Gas
Virtual Power Plant VPP
Renewable Energy
BIO
EnergieFlexWerk
vernetzen - gemeinsam profitieren
natGAS
Energie & Lösungen


The Federal Government's new power act;
"StormMarktGesetz" in force since 30.07.2016
§1a Ziff. 3„ Es soll insbesondere auf eine Flexibilisierung von Angebot und Nachfrage hingewirkt werden. Ein Wettbewerb zwischen effektiven und flexiblen Erzeugungsanlagen,...)
Bundesministerium für Wirtschaft und Energie
"(...) Germany has one of the world's most reliable power supply systems. To preserve this situation, we do not necessarily need more power plants, but we do need flexible capacities. Flexibility is the answer to weather-dependent renewable energies. With the Power Market 2.0, we enable fair competition of all flexibility options. This includes flexible power plants and flexible consumers, cogeneration, storage and European power trading. And we need to make sure that these flexible capacities are financed via the market (...)." *
This means that in the future, decentralized power producers must assume co-responsibility for the network stability and furnish evidence of the measures in this area!
*From the preface to "A power market for the energy reform. Result paper of the Federal Ministry for Economic Affairs and Energy (white book)", July 2015
EnergieFlexWerk
vernetzen - gemeinsam profitieren
natGAS
Energie & Lösungen

Waste as a storage capacity, a future perspective

The most important technical challenge of "Energiewende" in Europe is providing enough storage capacity for balancing the huge fluctuations in energy production from Wind- and Solar Power Plants. The necessity of storage capacity does not only mean increasing battery capacities, it also means alternative storage capacity coming from input materials.
Waste can play an important role in this case! A few examples:

- Using waste bunkers as storage before burning in incineration plants. => Flexible power production
- Using liquid manure tanks as storage before fermentation in biomass plants;
- Using biogas-storage facilities before running a biomass CHP-Power Plant. => Flexible power production
- Using landfill gas plants as flexible power producers
- Using municipal CHP of sewage treatment plants as flexible power producers

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Forum RM 1 - Presentations

Concept of the Technical Network „EnergieFlexWerk“

Particularly developed for Energy Managers and Plant Responsible Technicians

- The target of this kind of networks is to share experiences around flexibilisation of industrial plant operators to reduce apprehensions of limitation in manufacturing processes
- One single network consists of 8 to 15 companies that are working over a three-year period
- Each company will be supported by an external consultant to define individual flexibility targets
- Per year three network meetings are scheduled, each network member will be host of the meeting at least once.
- All individual targets and the measures identified thereof will be published on an network individual platform. This platform will support the target positions.

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EnergieFlexWerk
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natGAS
Energie & Lösungen

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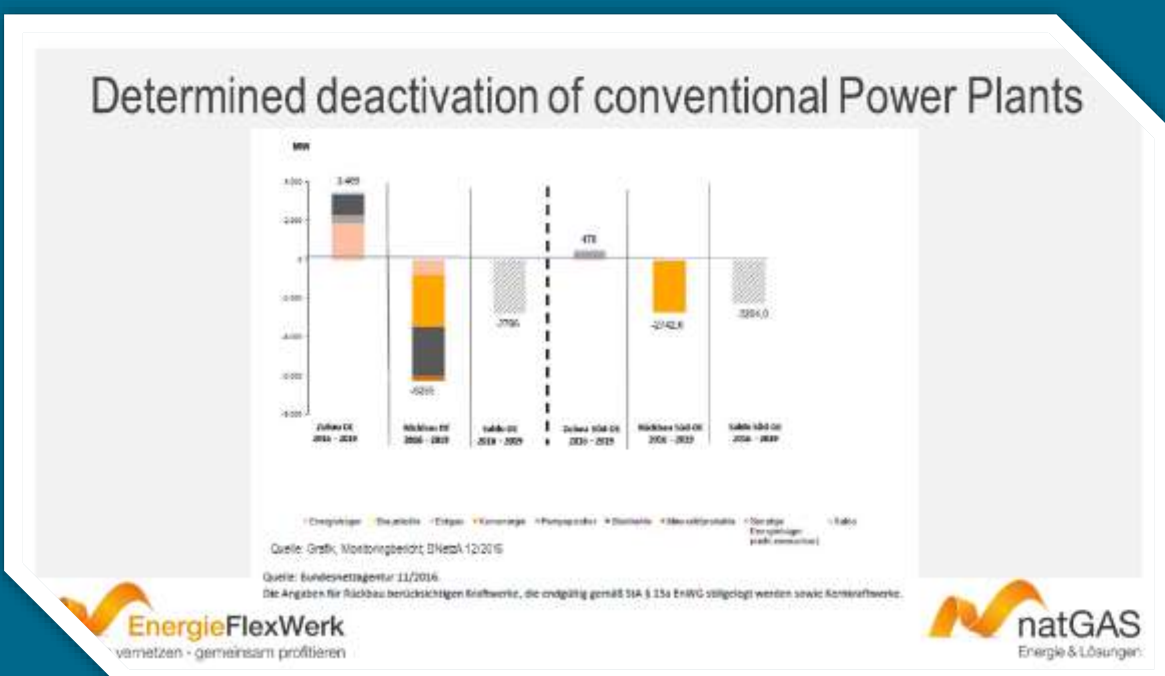
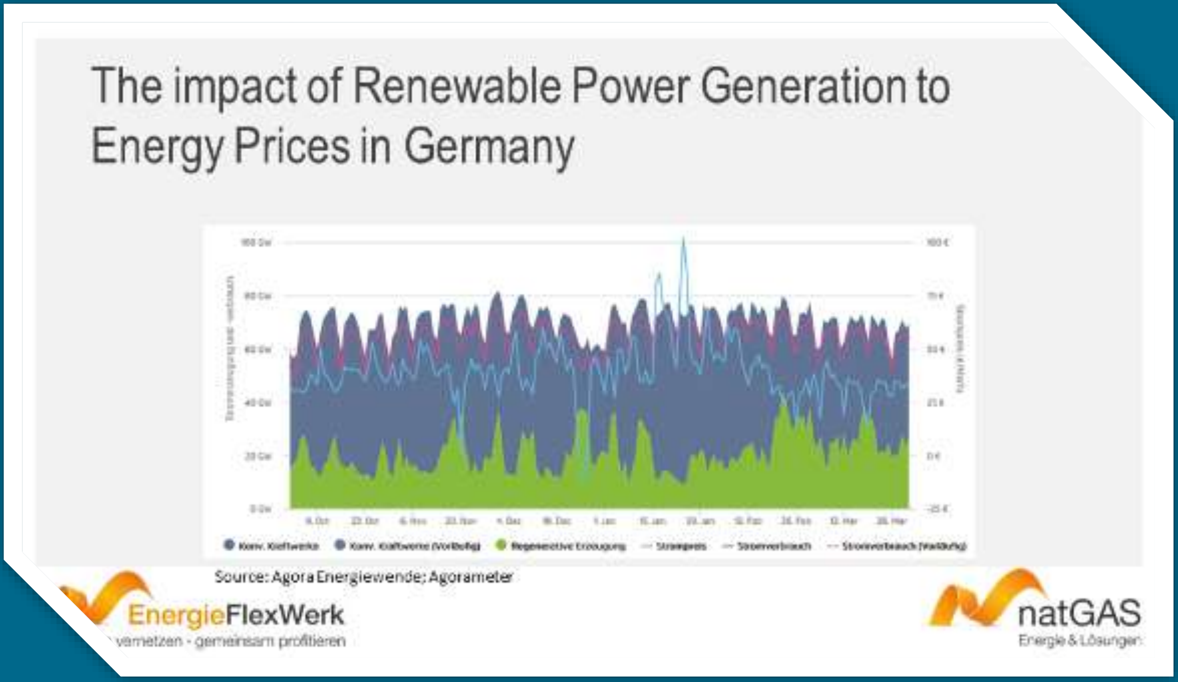
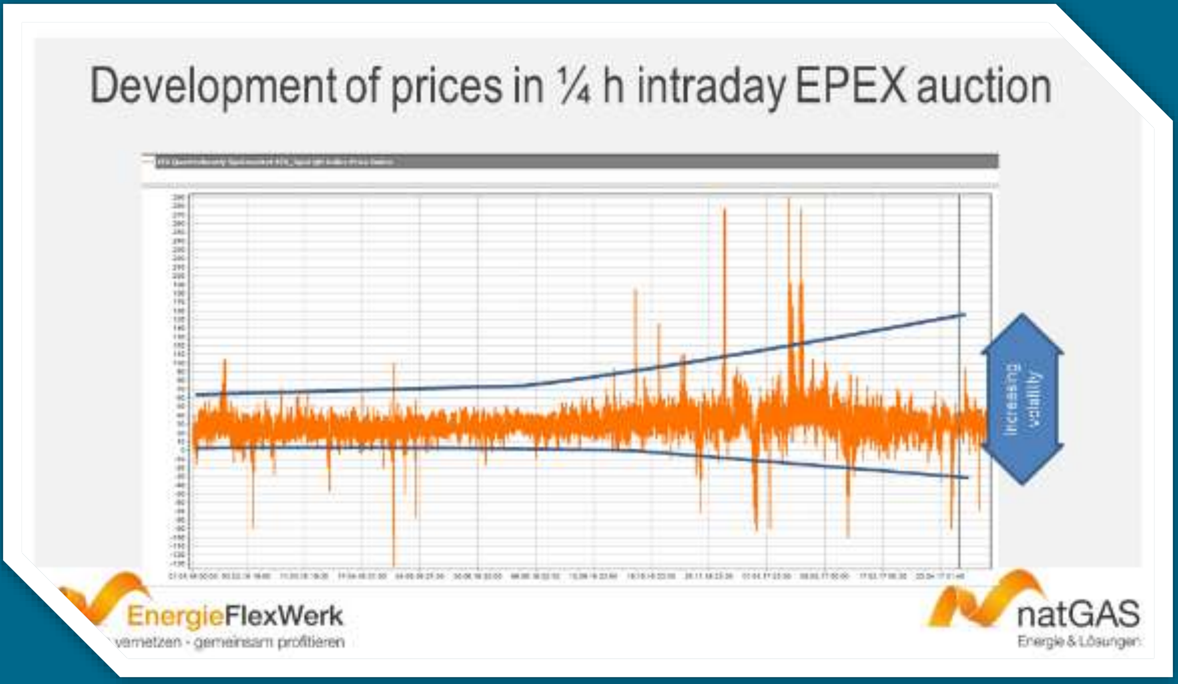



The impact of Renewable Power Generation to Energy Prices in Germany
Source: Agora Energiewende; Agorameter
EnergieFlexWerk
vernetzen - gemeinsam profitieren
natGAS
Energie & Lösungen


Development of prices in ¼ h intraday EPEX auction
Increasing volatility
EnergieFlexWerk
vernetzen - gemeinsam profitieren
natGAS
Energie & Lösungen

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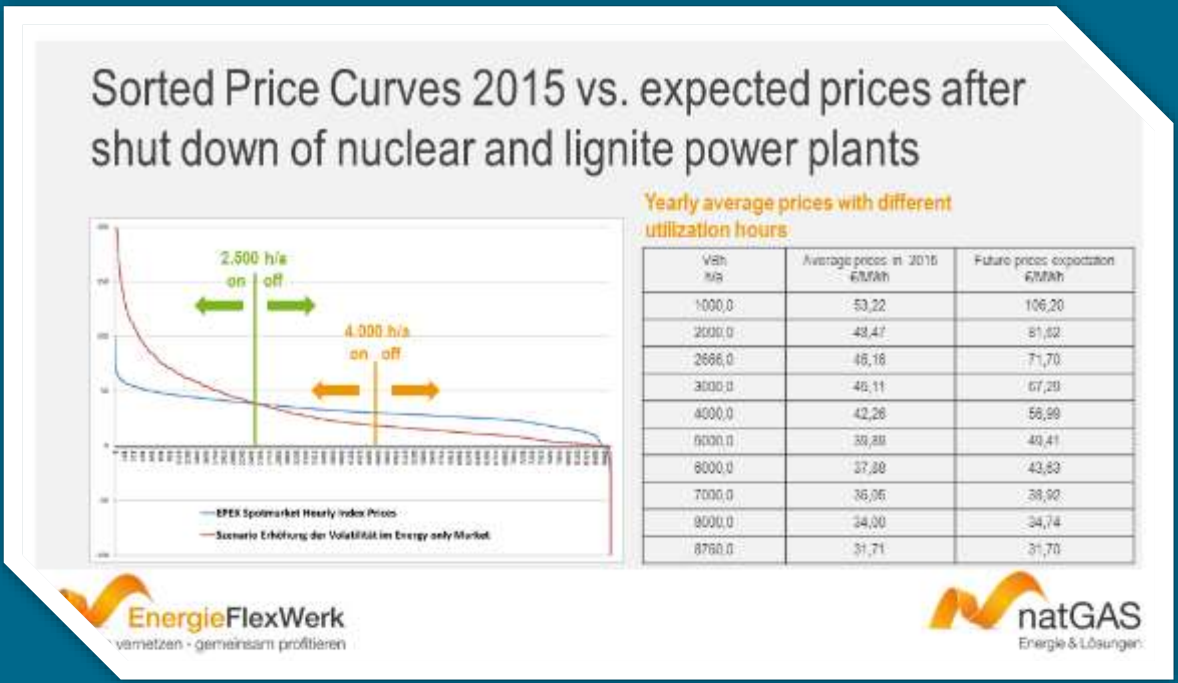
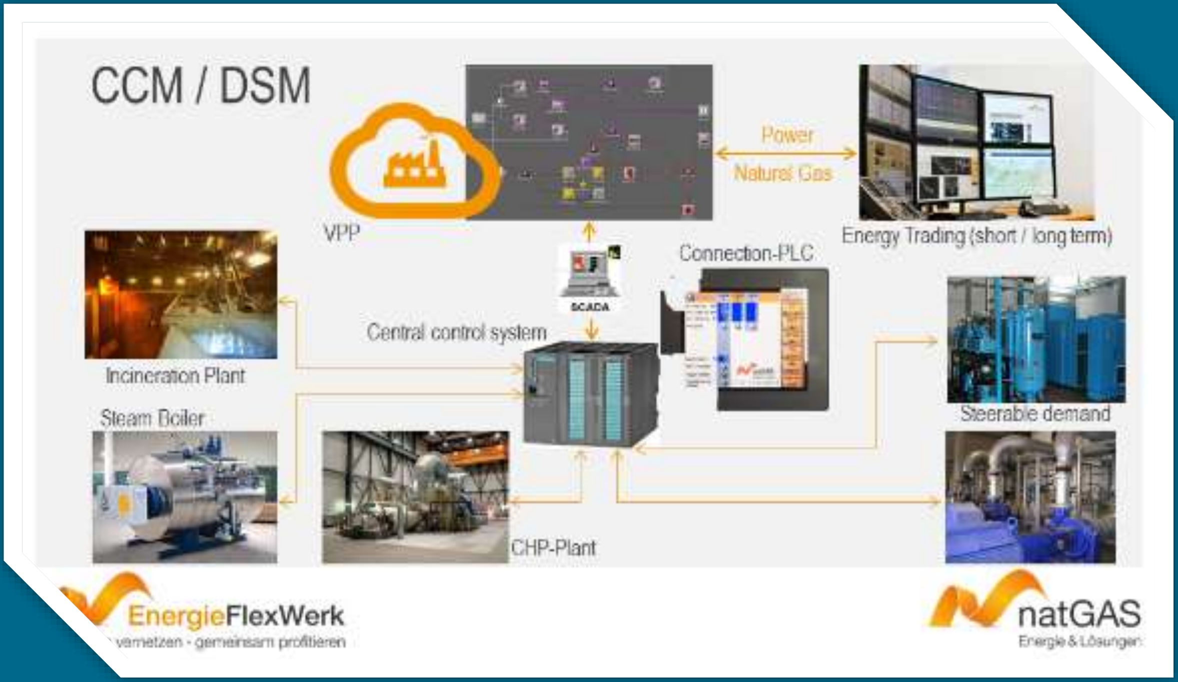
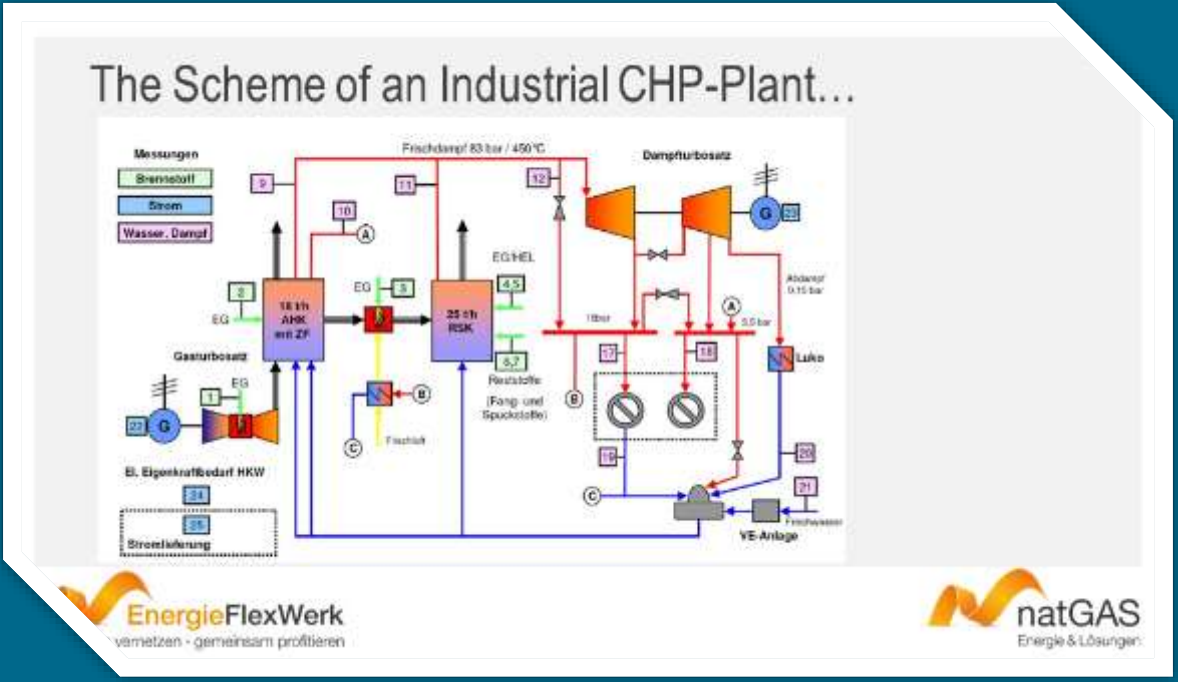


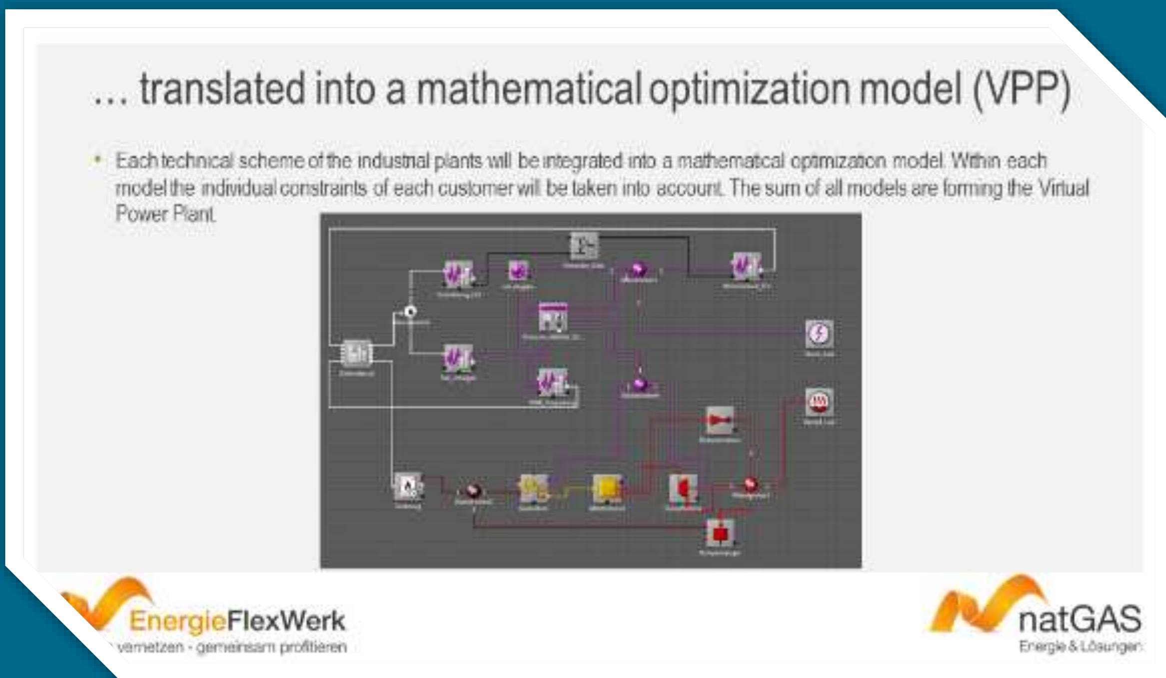
Vbh h/a	Average prices in 2015 €/MWh	Future prices expectation €/MWh
1000,0	53,22	106,20
2000,0	48,47	81,62
2666,0	46,18	71,70
3000,0	45,11	67,20
4000,0	42,26	56,99
5000,0	39,89	49,41
6000,0	37,88	43,63
7000,0	36,05	38,92
8000,0	34,00	34,74
8760,0	31,71	31,70



CCM / DSM
VPP
Power
Natural Gas
Energy Trading (short / long term)
Connection-PLC
SCADA
Central control system
Incineration Plant
Steam Boiler
Steerable demand
CHP-Plant
EnergieFlexWerk
vernetzen - gemeinsam profitieren
natGAS
Energie & Lösungen



The Scheme of an Industrial CHP-Plant…
Messungen
Brennstoff
Strom
Wasser, Dampf
Frischdampf 83 bar / 450 °C
Dampfturbosatz
EG/HEL
Abdampf 0,15 bar
18 t/h AHK mit ZF
25 t/h RSK
EG
Gasturbosatz
Reststoffe (Fang- und Spuckstoffe)
Frischluft
5,5 bar
Luko
VE-Anlage
El. Eigenkraftbedarf HKW
Stromlieferung
EnergieFlexWerk
vernetzen - gemeinsam profitieren
natGAS
Energie & Lösungen


… translated into a mathematical optimization model (VPP)
Each technical scheme of the industrial plants will be integrated into a mathematical optimization model. Within each model the individual constraints of each customer will be taken into account. The sum of all models are forming the Virtual Power Plant.
EnergieFlexWerk
vernetzen - gemeinsam profitieren
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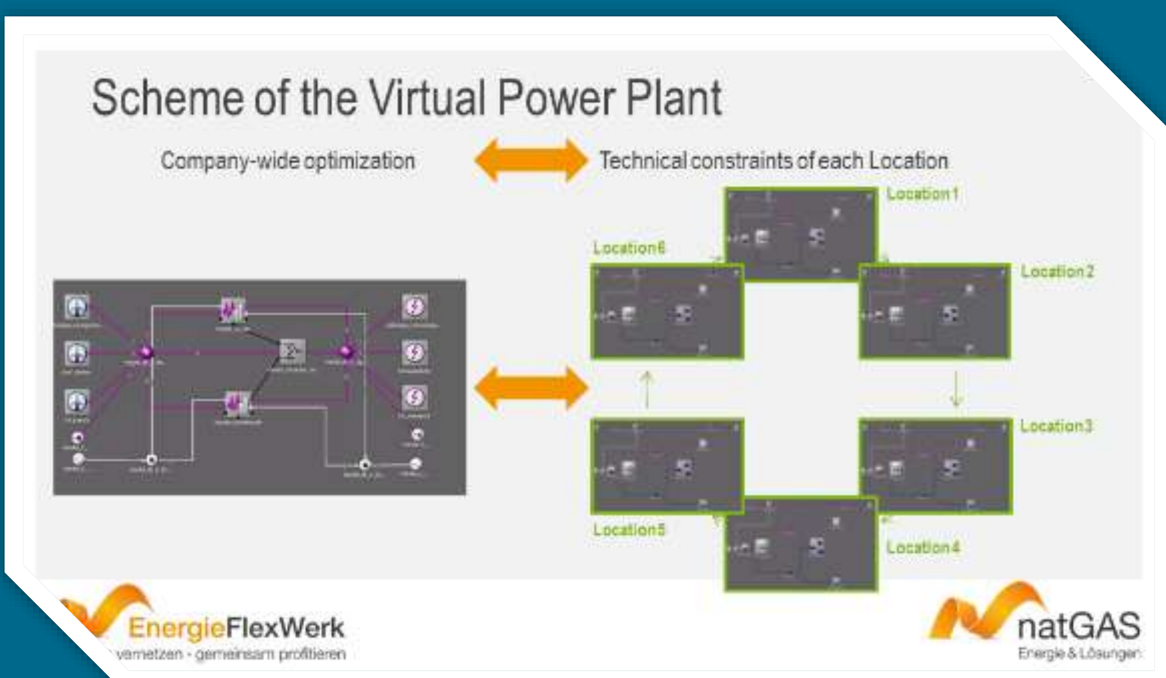
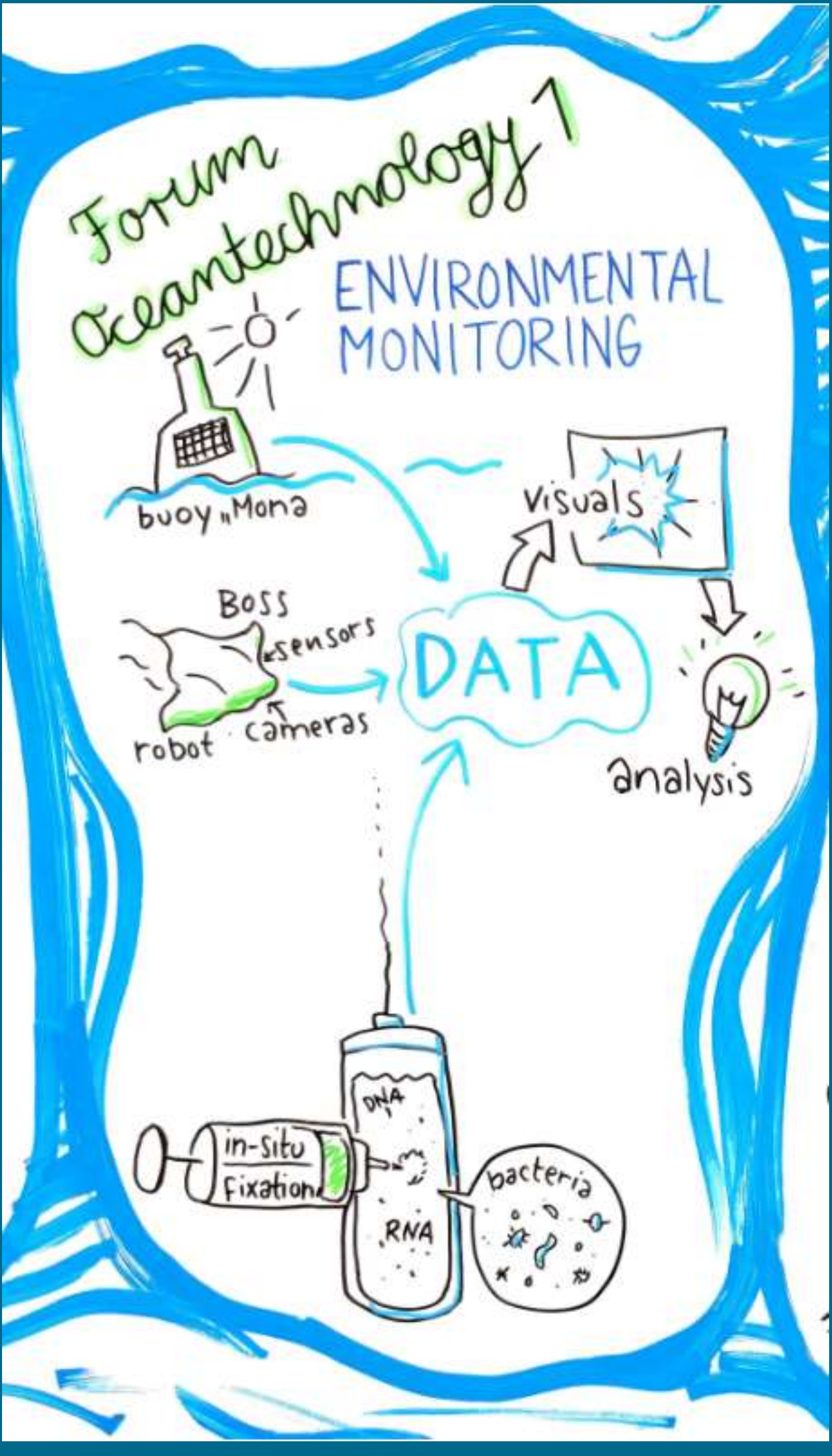

Scheme of the Virtual Power Plant
Company-wide optimization
Technical constraints of each Location
Location 1
Location 2
Location 3
Location 4
Location 5
Location 6
EnergieFlexWerk
vernetzen - gemeinsam profitieren
natGAS
Energie & Lösungen

BALTIC CLEAN TECHNOLOGY 2017
Forum RM 1 - Presentations

Thursday, 28 September 2017

13:15 – 14:45

FORUM OCEAN TECHNOLOGY 1: Environmental monitoring


Forum
Oceantechnology 1
ENVIRONMENTAL
MONITORING
buoy „Mona
visuals
Boss
sensors
DATA
robot
cameras
analysis
DNA
in-situ
Fixation
RNA
bacteria

BALTIC CLEAN TECHNOLOGY 2017
Forum OT 1 - Presentations

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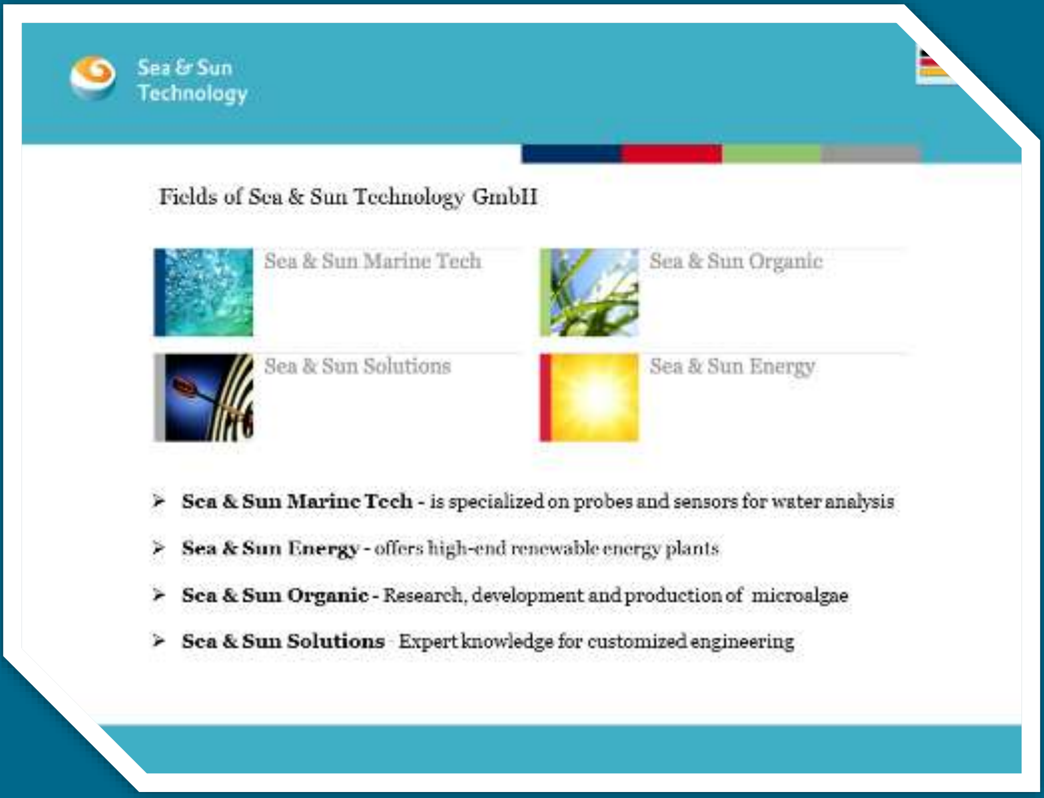
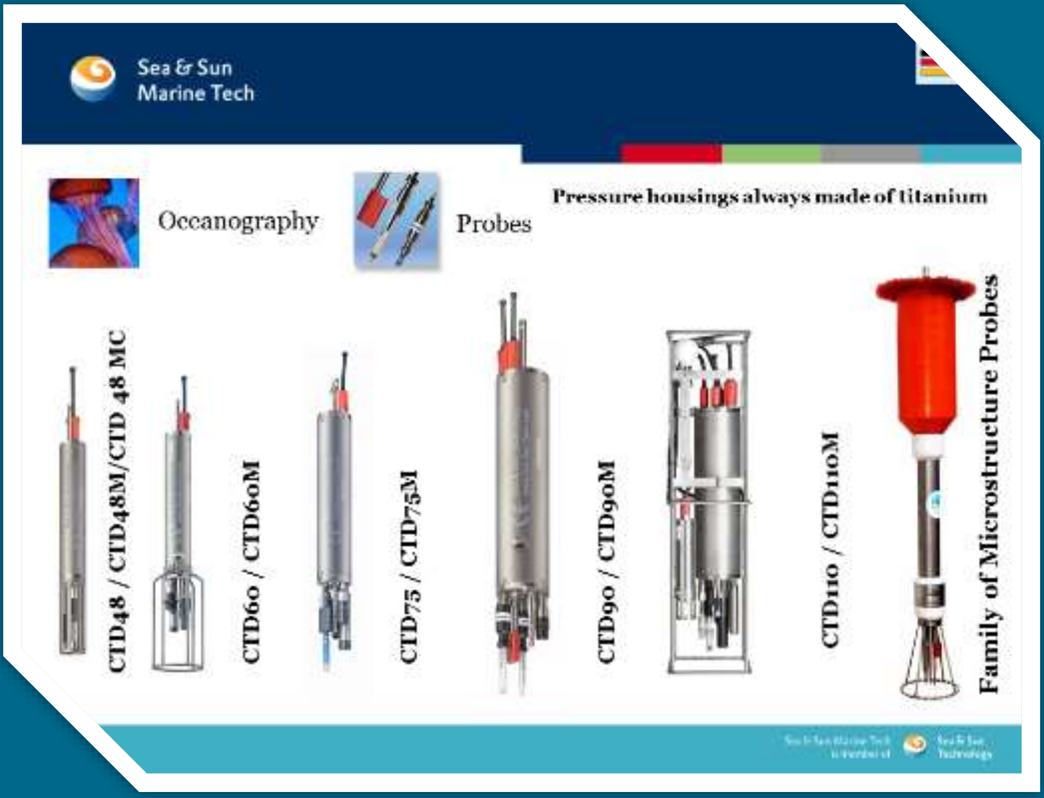



Sea & Sun
Marine Tech
Oceanography
Limnology
Offshore
Hydrology
Multiparameter Probes


Sea & Sun
Marine Tech
Oceanography
Limnology
Offshore
Hydrology
Sensors
Software
Equipment
Deep Sea Telemetry
Calibration Laboratory



Sea & Sun
Marine Tech
Oceanography
Probes
Pressure housings always made of titanium
CTD48 / CTD48M/CTD 48 MC
CTD60 / CTD60M
CTD75 / CTD75M
CTD90 / CTD90M
CTD110 / CTD110M
Family of Microstructure Probes

Sea & Sun
Marine Tech
Multi Parameter Memory Probe - CTD90M
(128 Mbyte/internal Battery)

BALTIC CLEAN TECHNOLOGY 2017
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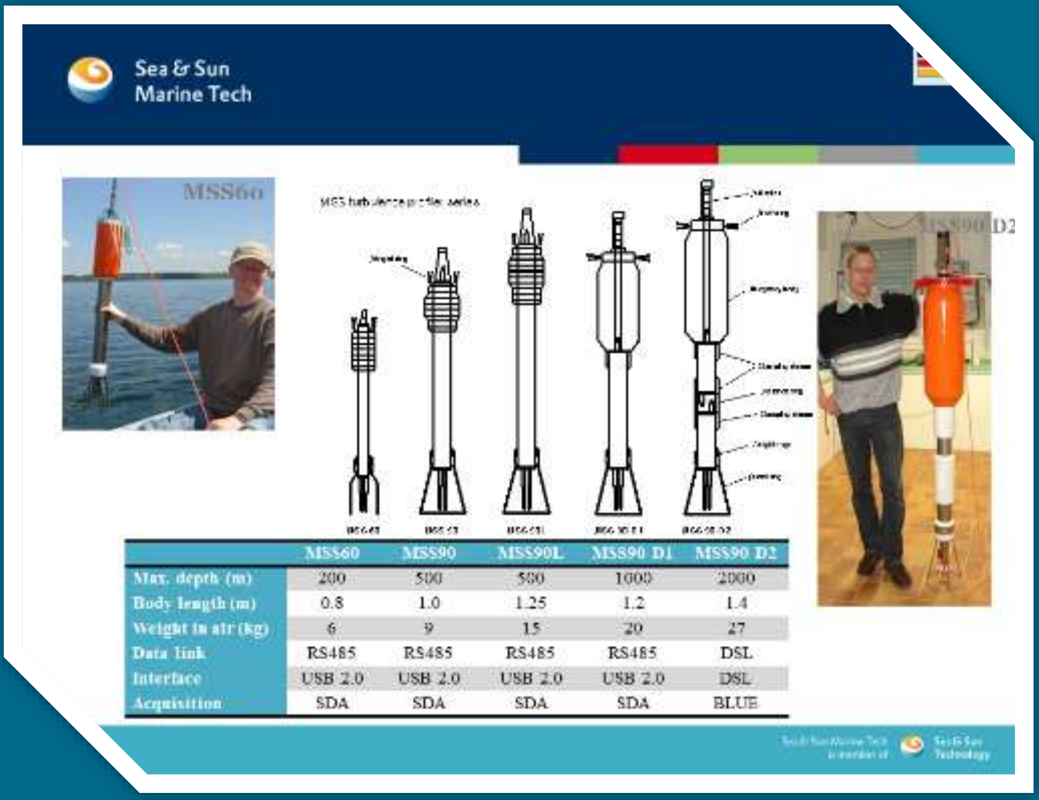

Sea & Sun
Marine Tech
Sensors for Multiparameter Probes

Sea & Sun
Marine Tech
Oceanography
Limnology
Hydrography
Groundwater
Examples of Sensors
Bottom view
Conductivity / 7 pol. Platinum cell
Temperature / PT100 4 Wire 150ms
Pressure Keller PA7-XX Progress
Turbidity sensor / Seapoint
pH sensor
pH sensor
pH sensor / H2S resistant

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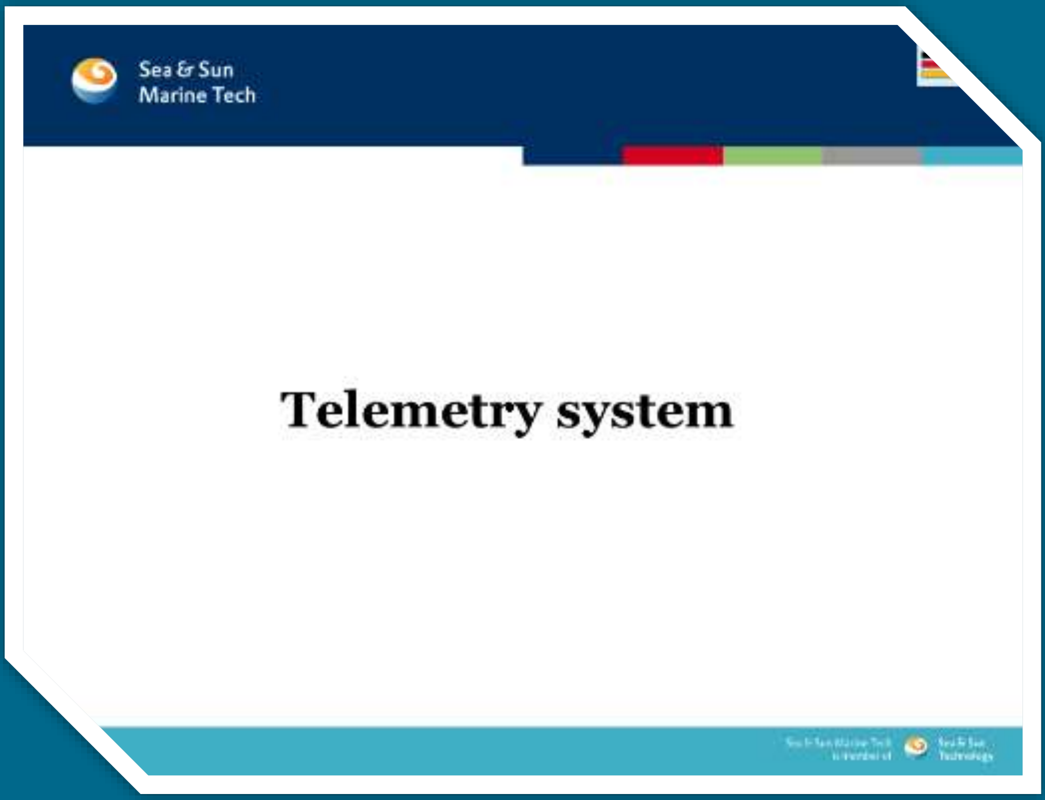
Forum OT 1 - Presentations


Sea & Sun
Marine Tech
Telemetry system


Sea & Sun
Marine Tech
High Speed Telemetry
Deck unit
input power supply 85 – 265 AC voltage
cable output up to 600 V 850 W (1.2kW opt.)
network interface LAN/Ethernet RJ45
Underwater unit
input voltage range 180 – 375DC voltage
standard output voltage 24V
output power max. 250W (600W opt.)
interfaces: 6 bidirectional ports
3*RS232, 3*RS422/485/232
max. baud rate 921.6k
LAN/Ethernet for video applications
e.g. IP cameras
HDCS 11 – High Definition Camera


Sea & Sun
Marine Tech
Deployment of Telemetry System
provided by GEOMAR, Kiel


Sea & Sun
Marine Tech
Services


Sea & Sun
Marine Tech
CTD- Calibration Labor – S1 Gentechnology Labor


Sea & Sun
Marine Tech
Shock test certificate (MIL)
CTD48M successfully performing vibration- and
shock and temperature test according
to Military Standard specifications.


Sea & Sun
Marine Tech
Special Customized
Applications


Sea & Sun
Marine Tech
Deployment of MSS probes


Sea & Sun
Marine Tech
Example configuration of CTD90M
CTD90M equipped with
an
integrating Watersampler
Acid Mine Drainage (South Africa)


Sea & Sun
Marine Tech
CTD profiling, north pole, French expedition

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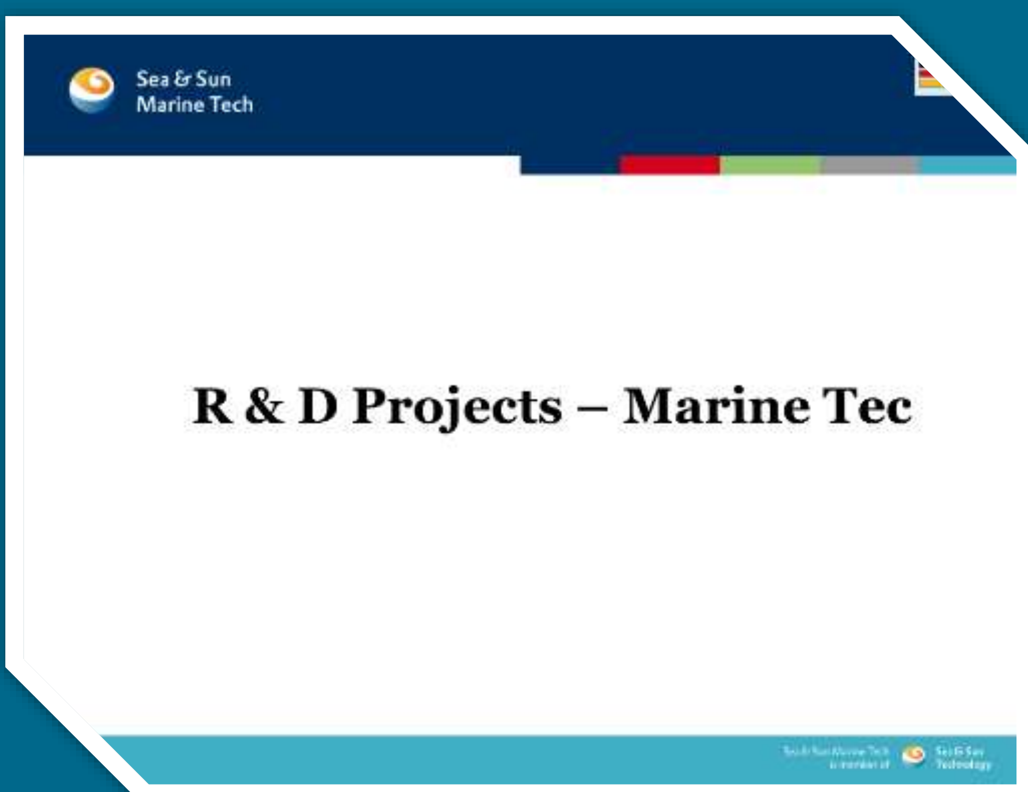

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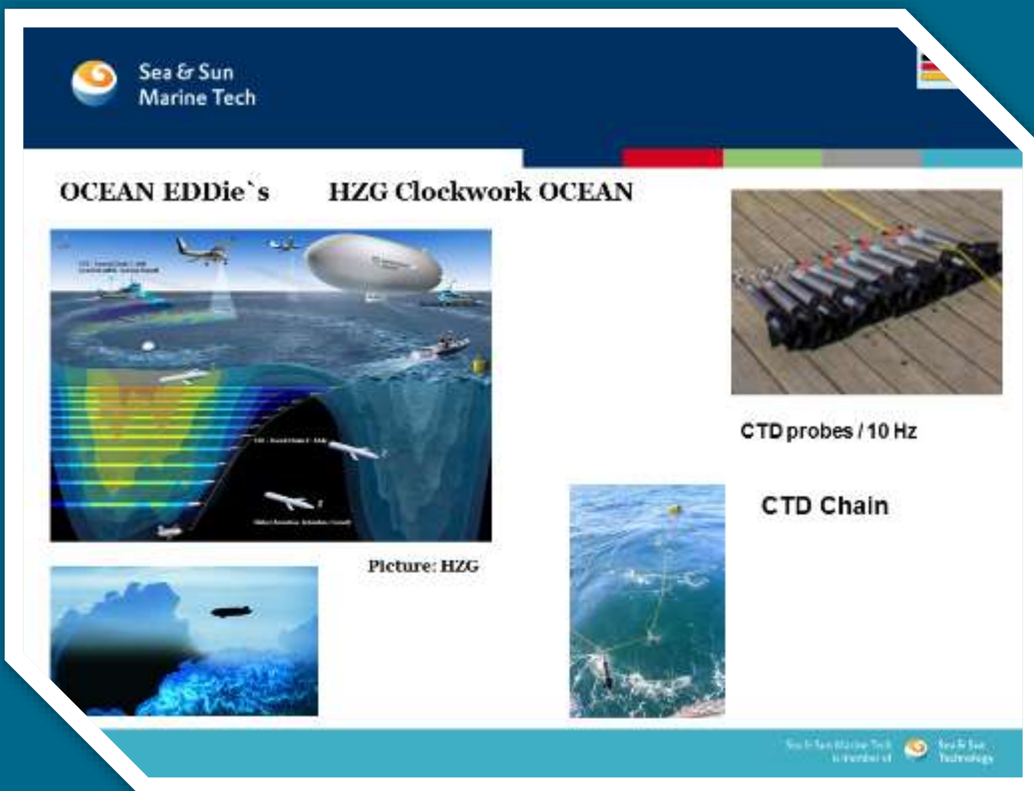
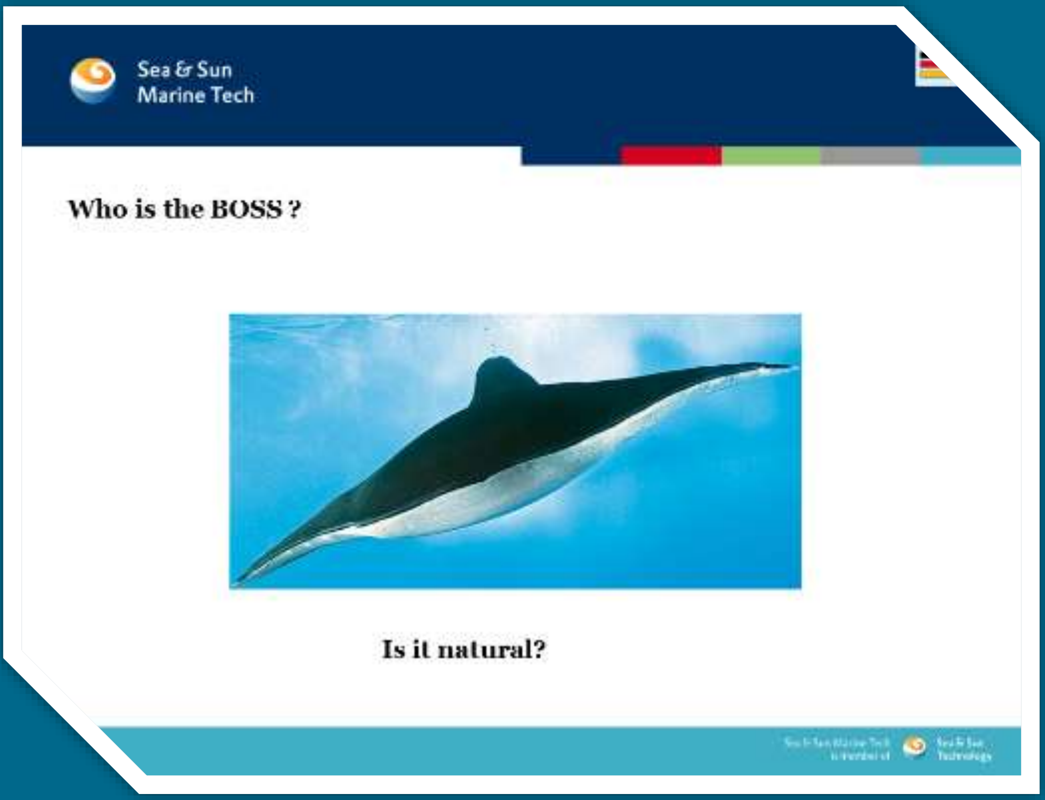
Forum OT 1 - Presentations




Sea & Sun
Marine Tech
Who is the BOSS ?
Is it natural?


Sea & Sun
Marine Tech
BMWi-Projekt BOSS
Bionic Observation and Survey System
BOSS (Bionic Observation and Survey System)
4 Cameras + 4 x LED Lights
(2 x front + 2 x bottom)
2 x Altimeters
2 x Sonar
2 x CTD
Autonomous data acquisition device for
measuring a wide range of water parameters.
Can be equipped with different measuring instruments
ike different kind of sensors (e.g.: CTD, DO, PH,
ro structure sensors,..), cameras and lightings, sonar, altimeters, ...

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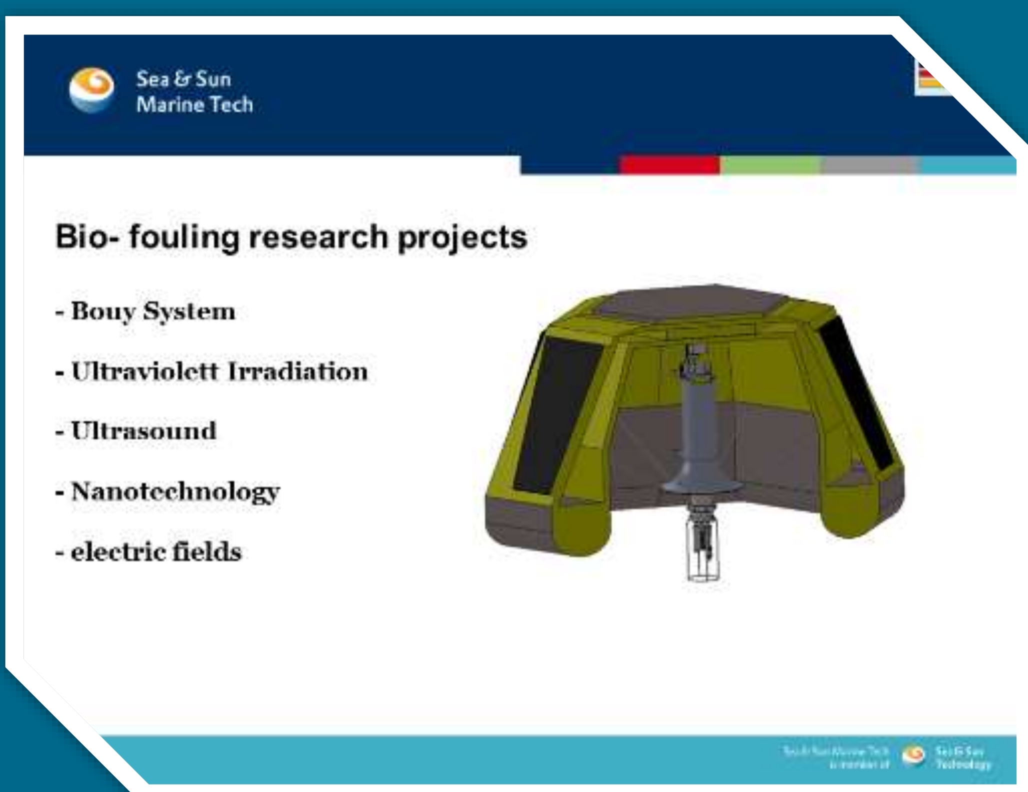
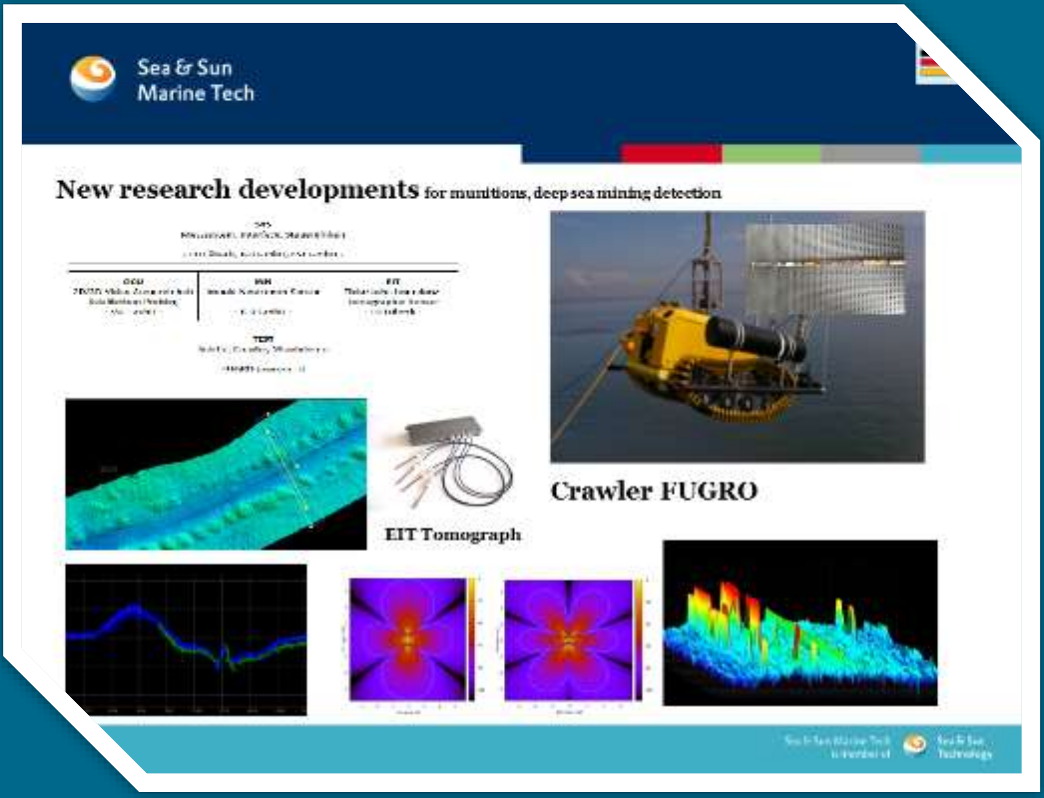
Forum OT 1 - Presentations



BALTIC CLEAN TECHNOLOGY 2017
Forum OT 1 - Presentations

BALTIC CLEAN TECHNOLOGY 2017
Forum OT 1 - Presentations



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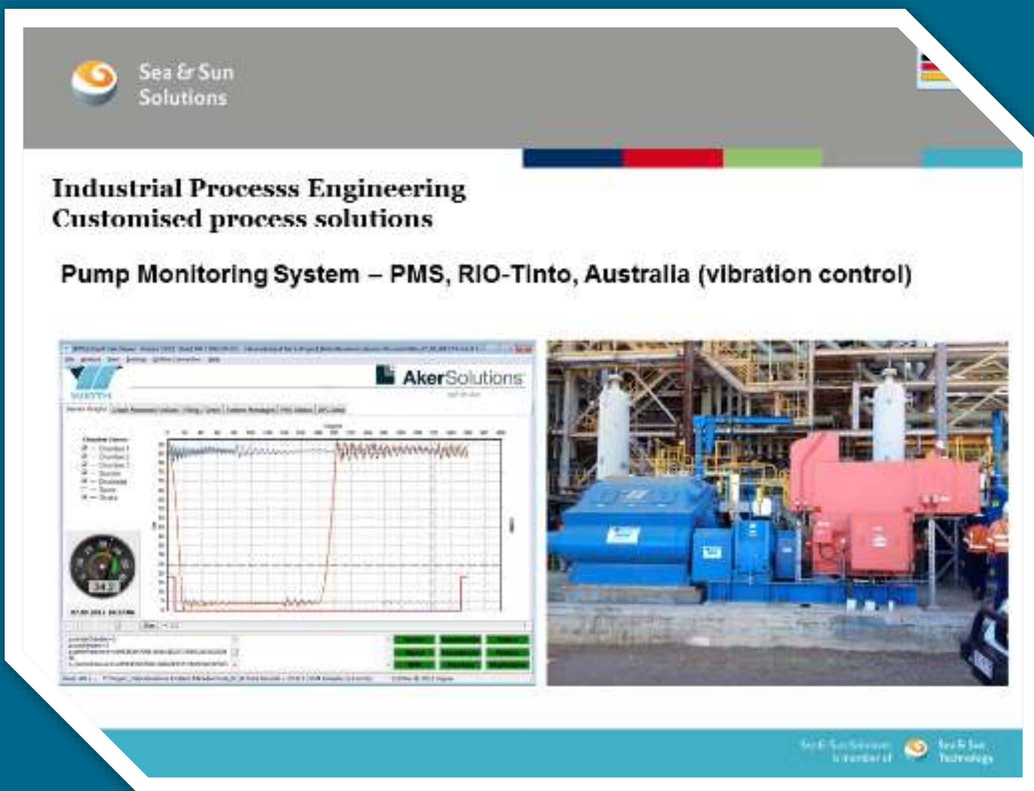
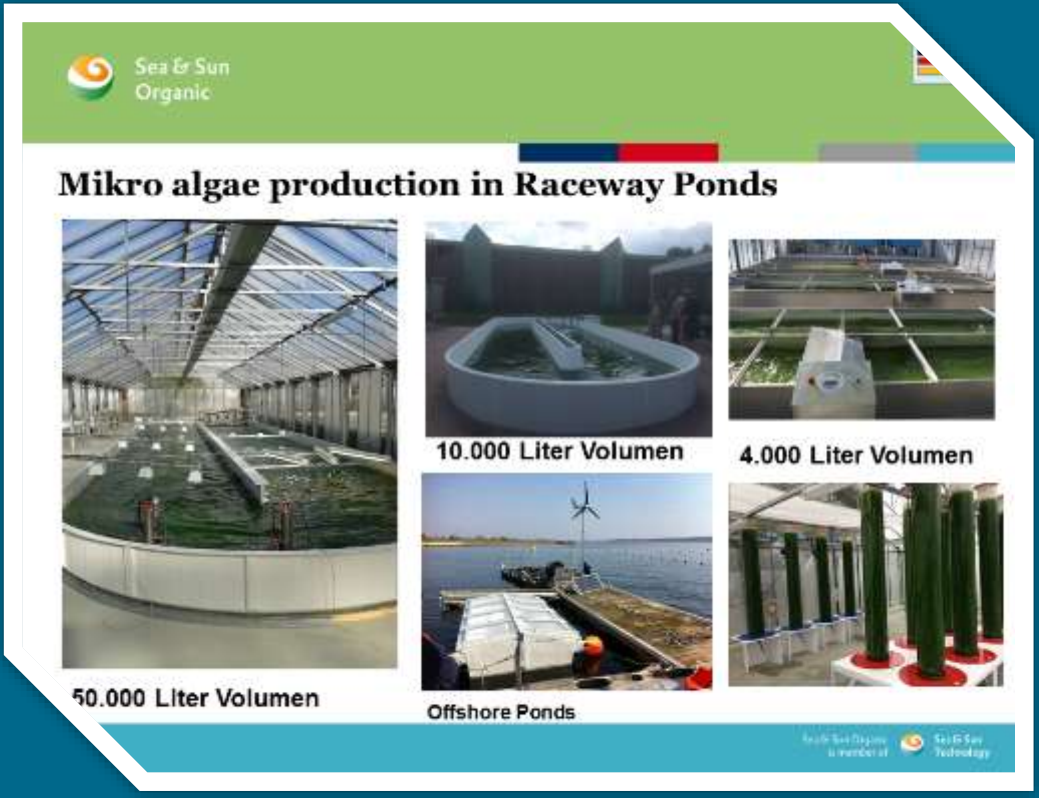


Sea & Sun Organic
Sea and Sun Organic
Microalgae production in greenhouses
Industrial scale winterfarming of kryophilic microalgae
Colourants for food and cosmetics
Fermentation of heterotrophic algae



Sea & Sun Organic
Mikro algae production in Raceway Ponds
10.000 Liter Volumen
4.000 Liter Volumen
50.000 Liter Volumen
Offshore Ponds

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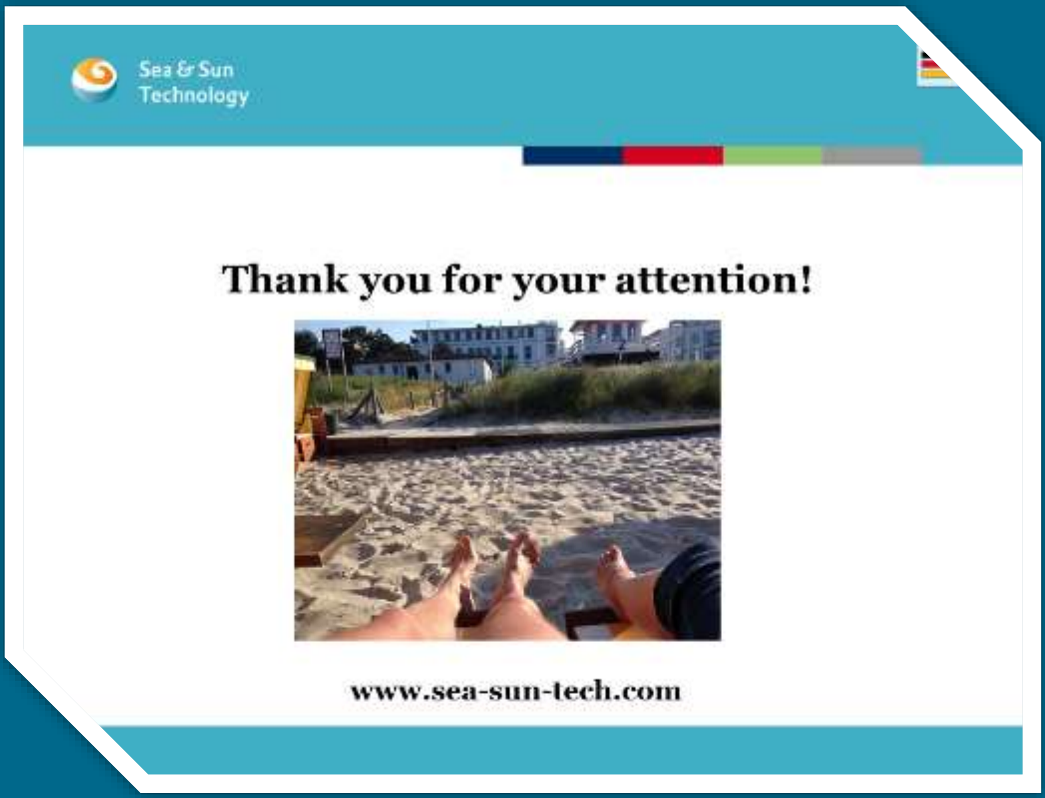
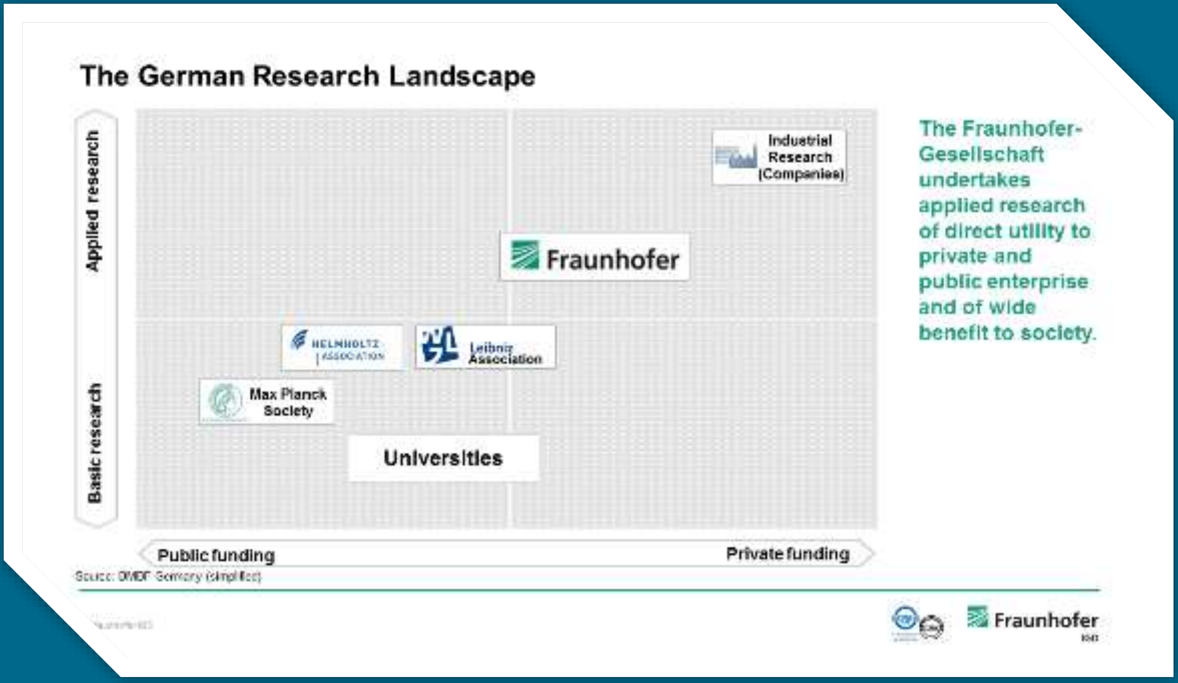
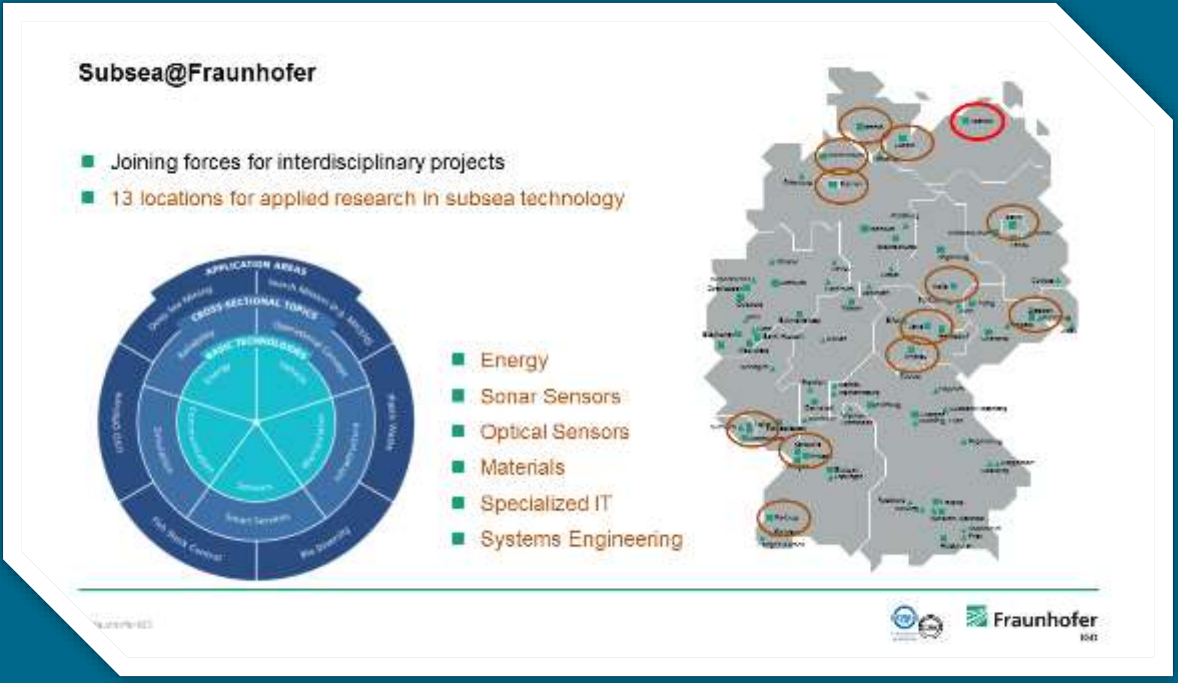
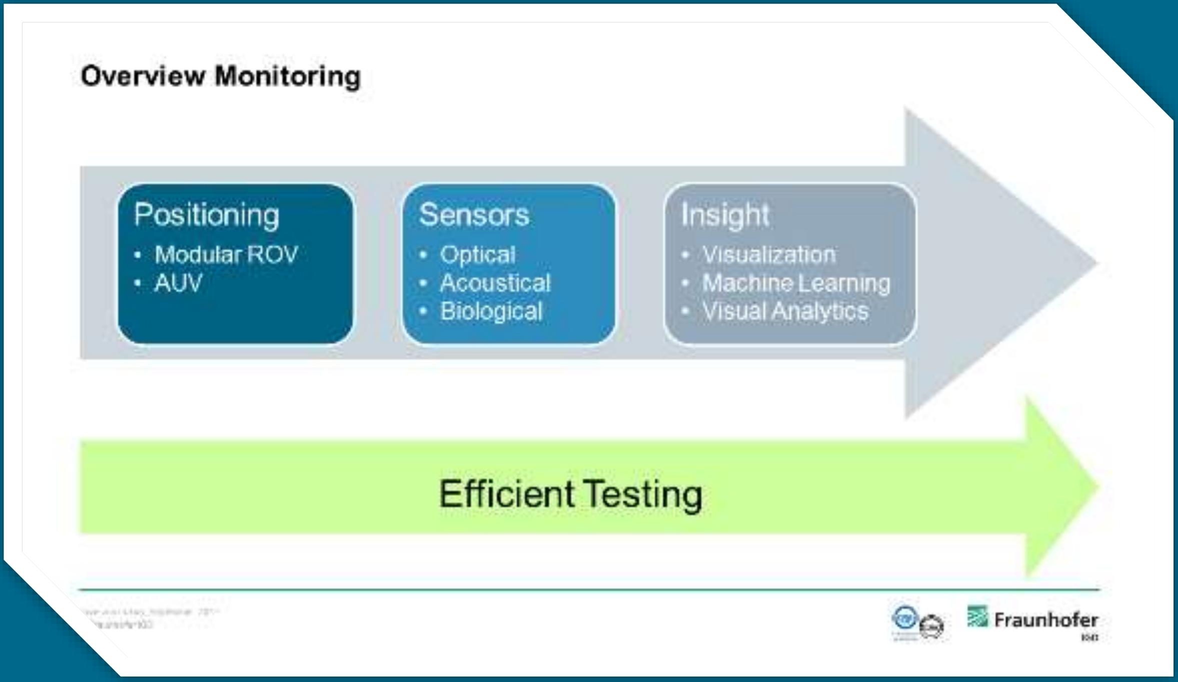
Forum OT 1 - Presentations


Sea & Sun
Technology
Thank you for your attention!
www.sea-sun-tech.com

BALTIC CLEAN TECHNOLOGY 2017
Forum OT 1 - Presentations


The German Research Landscape
Applied research
Basic research
Industrial Research (Companies)
Fraunhofer
HELMHOLTZ ASSOCIATION
Leibniz Association
Max Planck Society
Universities
Public funding
Private funding
The Fraunhofer-Gesellschaft undertakes applied research of direct utility to private and public enterprise and of wide benefit to society.
Fraunhofer


Subsea@Fraunhofer
Joining forces for interdisciplinary projects
13 locations for applied research in subsea technology
APPLICATION AREAS
CROSS-SECTIONAL TOPICS
BASIC TECHNOLOGIES
Energy
Sonar Sensors
Optical Sensors
Materials
Specialized IT
Systems Engineering
Fraunhofer


Overview Monitoring
Positioning
Modular ROV
AUV
Sensors
Optical
Acoustical
Biological
Insight
Visualization
Machine Learning
Visual Analytics
Efficient Testing
Fraunhofer


Positioning: Mini-ROV
We are shaping the ROV future
Competence Network for Mobile Underwater Inspection Vehicles
NETZWERK MINI-ROV
Fraunhofer

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Positioning: Autonomous Underwater Vehicles

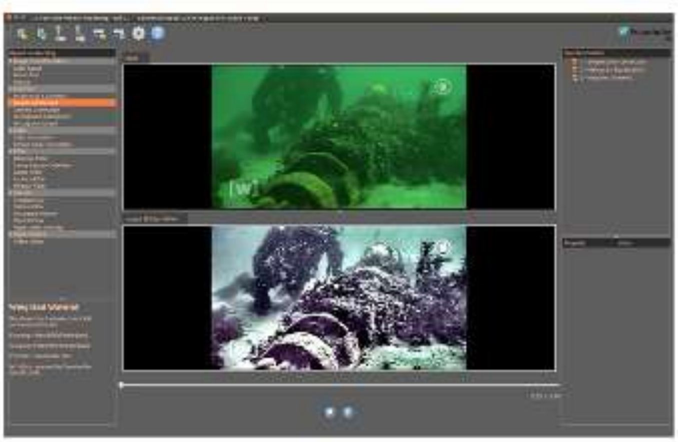
Source: Fraunhofer IOSB-AST

Shell OCEAN DISCOVERY XPRIZE

Source: Fraunhofer IOSB

Fraunhofer

Monitoring with Optical Sensors: Image Enhancement

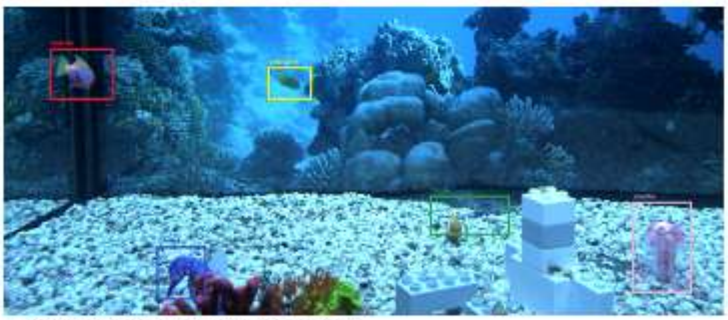


- Flexible combination of different algorithms for underwater image enhancement
- For online-processing of camera streams or post-processing of recorded videos
- Video up to 4k
- PC or embedded system
- Hardware acceleration

Source: Fraunhofer IGD

Fraunhofer

Monitoring with Optical Sensors: Convolutional Neuronal Networks for Object Detection



Source: Fraunhofer IGD

- Robust detection and classification
- Ca. 10 frames per second
- Challenge of efficient training of CNN

Fraunhofer

High-resolution 3D sonar imaging

- Visualization of objects and structures in zero-visibility conditions
- High-resolution images at short distances (up to 20 meters)
  → Centimeter-range spatial resolutions at imaging distances of few meters
- Different high-frequency multi-element systems for various imaging applications
- Real-time capability for dynamic process monitoring
- Integrated sonar systems with compact device dimensions for attachment on ROVs or AUVs

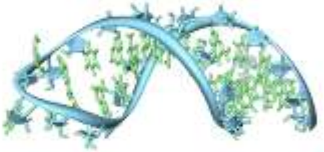
Source: Fraunhofer IBMT

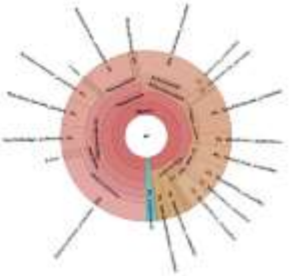
Fraunhofer

Detection of Substances using Mass Sequencing Data

Mass sequencing data:

- entire DNA or RNA of a sample
- huge amount of data
- unfavourable ratio of features to datapoints
- complex context





Machine support in the analysis process:

- automatic (Filtering, Alignment, Assignment, ...)
- visual (Principal Component Analysis, Non-Metric Multidimensional Scaling , Kronaplots, ...)

Source: Fraunhofer IGD/Universität Rostock

Fraunhofer

Visual integration of hetereogenous sensor data

Source: Fraunhofer IGD

Fraunhofer

Visual Analytics: Creating Value from Big Data

"The goal of visual analytics is to facilitate the analytical reasoning process through the creation of software that maximizes human capacity to perceive, understand, and reason about complex and dynamic data and situations."
Quelle : Thomas, Cook, IEEE 2005

Challenges of Big Data:

- Volume
- Velocity
- Variety
- Varecity

Fraunhofer

https://www.youtube.com/watch?v=

Outlook: Infrastructure for efficient testing of underwater technologies

SMN

Fraunhofer

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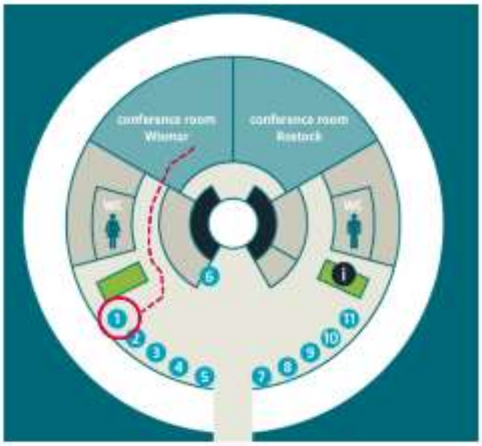
Ocean Technology Center Rostock as a nucleus for innovation

- Campus to cover the whole innovation pipeline from basic over applied research to commercial production and education/training
- Integrating several disciplines for subsea technology
  - Energy/propulsion
  - Sensors (optical, acoustic, …)
  - Automation/robotics
  - Data science
  - …
- Looking for collaboration
  - Your ideas for the test field in Rostock
  - Joint R&D projects
  - Shared access to testing infrastructure

Fraunhofer

Thank you for your attention!



Join us in the exhibition for more details…

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Forum OT 1 - Presentations

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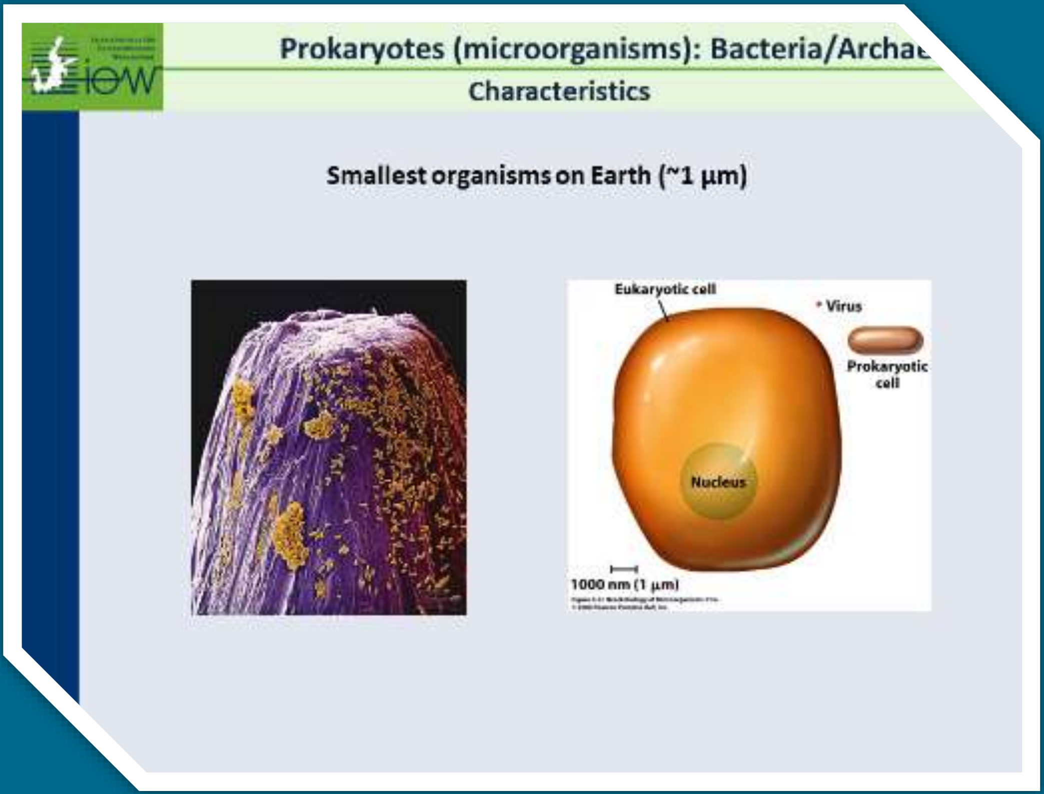
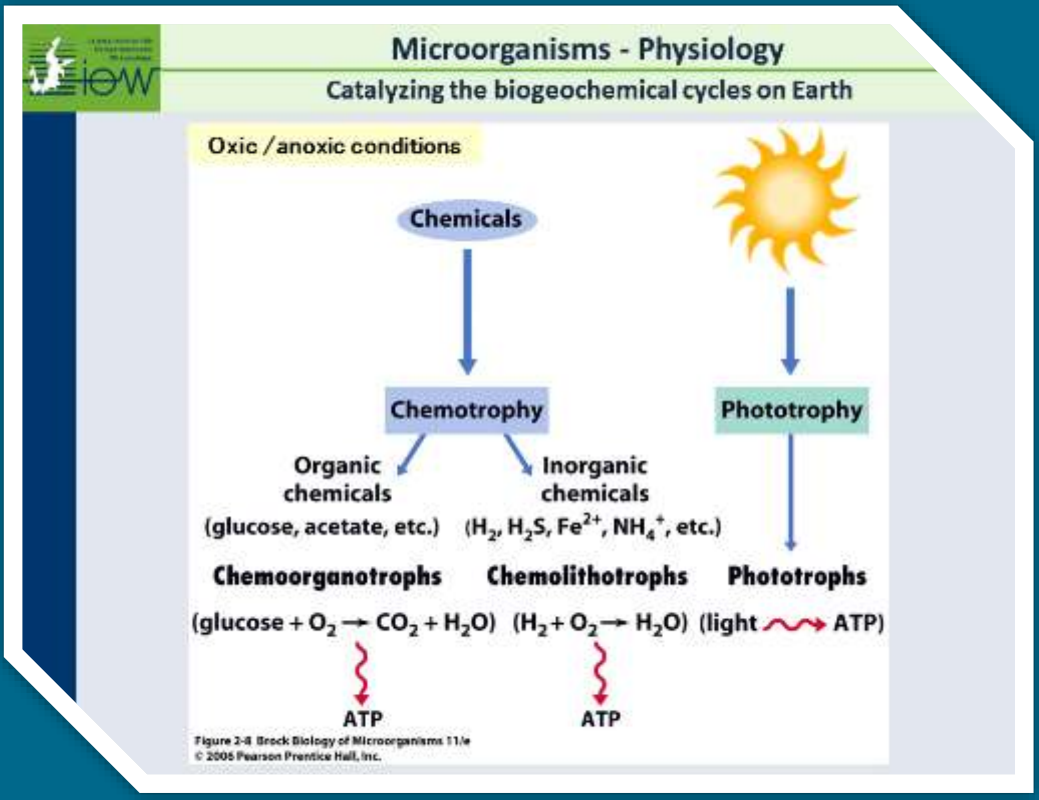




Microorganisms
Abundance

Microorganisms are small and different........

........but frequent

Habitats
(Whitman et al., Proc Natl Acad Sci USA 95:6578-6583, 1998)

- Digestive system	$0.05 \cdot 10^{29}$
- Oceans	10^{29}
- Soils	$2.6 \cdot 10^{29}$
- Freshwaters	$0.002 \cdot 10^{29}$
- Sediments	$0.2 \cdot 10^{29}$
- *Subsurface*	$40\text{-}60 \cdot 10^{29}$
Earth:	$\mathbf{5 \cdot 10^{30}}$

Microorganisms
Abundance

Whitman et al. (1988)

$1\ Mt = 10^6\ t$

Total abundance, biomass and surface area of heterotrophic microbes in the ocean

Plankton group	Abundance	Carbon	Surface area	
Viruses	7.5×10^{29}	150 Mt	$34 \times 10^9\ km^2$	
Bacteria	1.2×10^{29}	2400 Mt	$237 \times 10^3\ km^2$	
Protists	1.2×10^{26}	2.8 Mt	$1.5 \times 10^9\ km^2$	
Humans	5×10^9	*35 Mt*	$9 \times 10^3\ km^2$	

- Prokaryotic carbon: 60 – 100 % of total C in plants
- Prokaryotic N, P: 10–fold more than in plants
- Open Ocean, Soil, marine and terrestrial subsurfaces

The Baltic Sea

Knowledge regarding microbial abundances, diversities, and activities in the environment is fundamental for understanding globally important element cycles

→ Essential for environmental monitoring

→ Excluded from monitoring programs

Analysis of microbes and their activities

A challenge

(90) - 99% of all environmental prokaryotes are thus far non-cultivable

Photograph: P. Hirsch

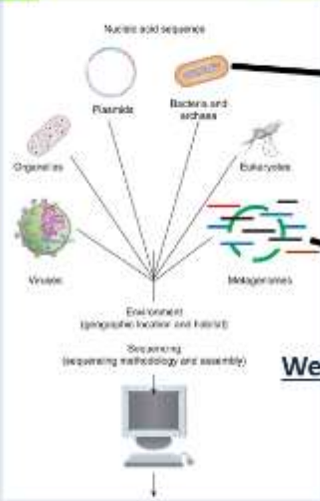
Baltic isolate

Turn of a disadvantage into an advantage:

Basic molecular technologies developed

Amann et al., 1995, Microbiol Rev; Pace, 1997, Science

Microbes and their activities
Cultivation-independent analysis



Bioinformatic processing of data

Well developed

16S rRNA/rRNA gene

- Identification by sequencing
- *In situ* detection of cells (gene probes)

Meta...OMICS:

Analysis of all environmental..

Genes (represent functions*)

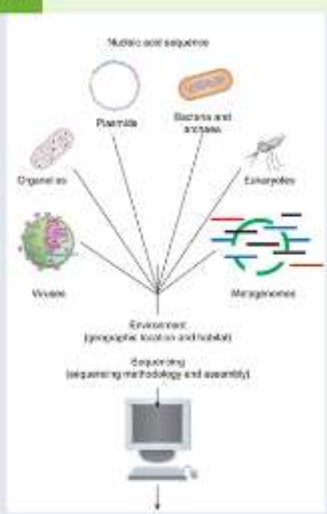
mRNA (activity indicator)

Proteins (activity indicator)

* around 500-7000 per species

Modified from Field et al., Nature Biotechnology 2008

Cultivation-independent sequence data analysis pip



Bioinformatic processing of data

Especially transcripts mirror contemporary environmental conditions and biogeochemical processes

BUT: mRNA can be degraded within 30 s

→ Challenge for sampling procedures

→ Basis for all downstream analyses

Modified from Field et al., Nature Biotechnology 2008

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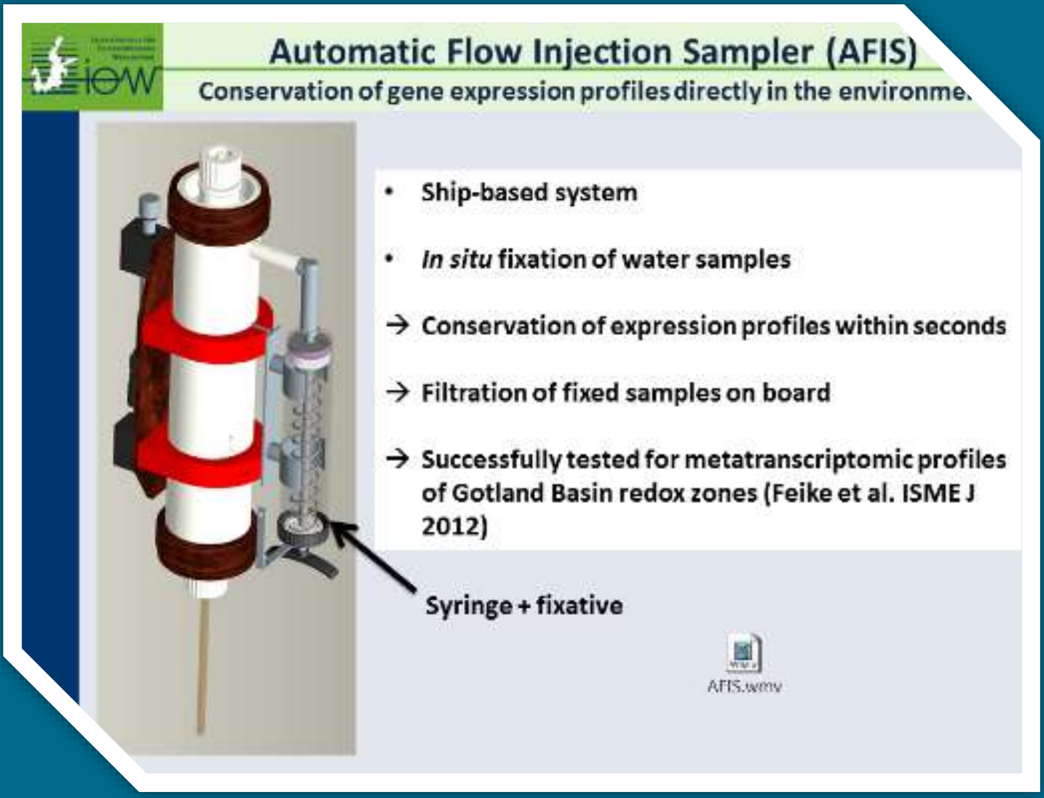

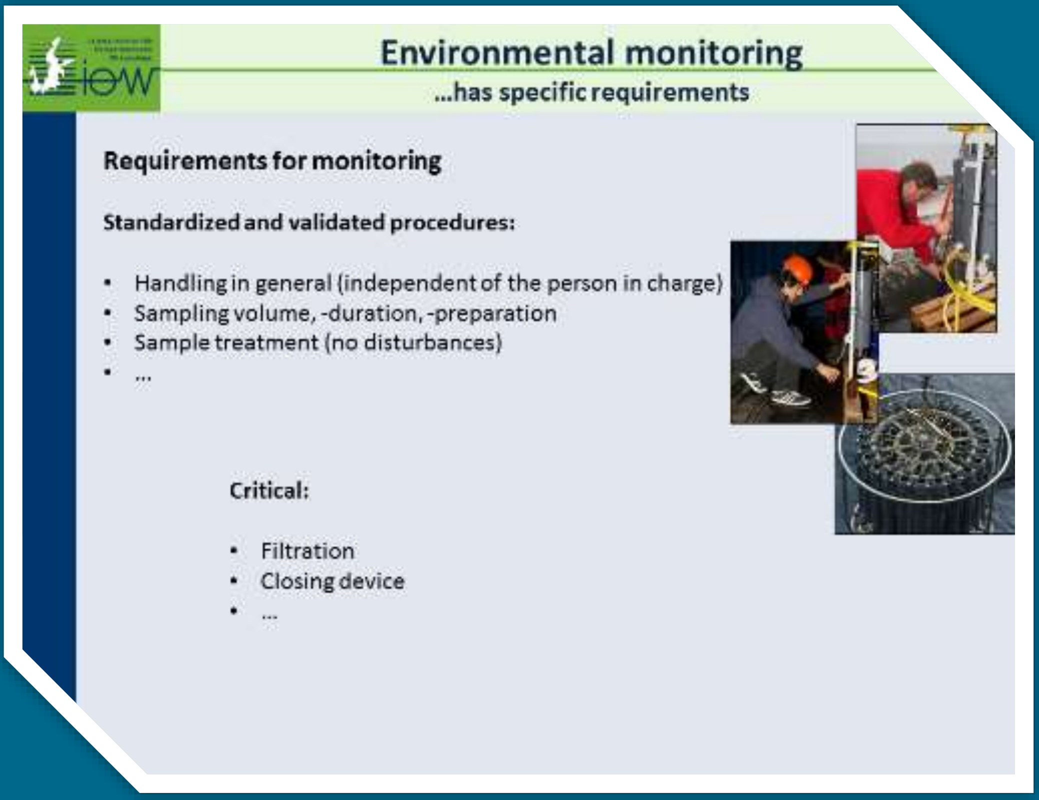

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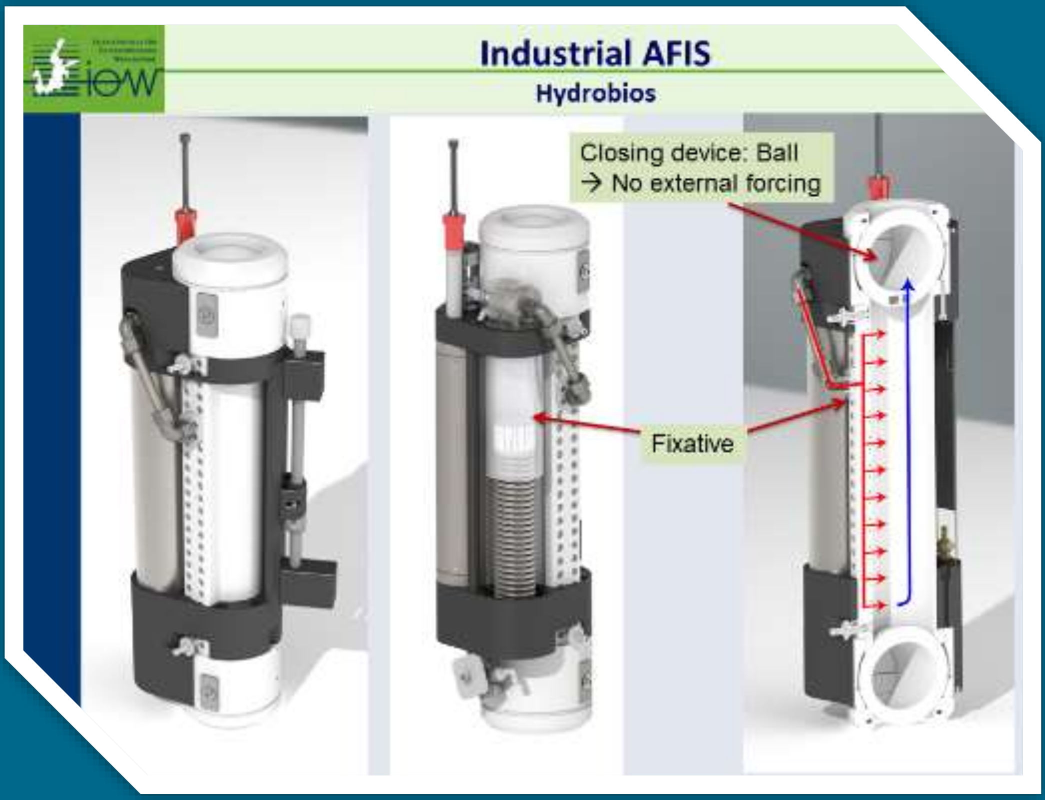

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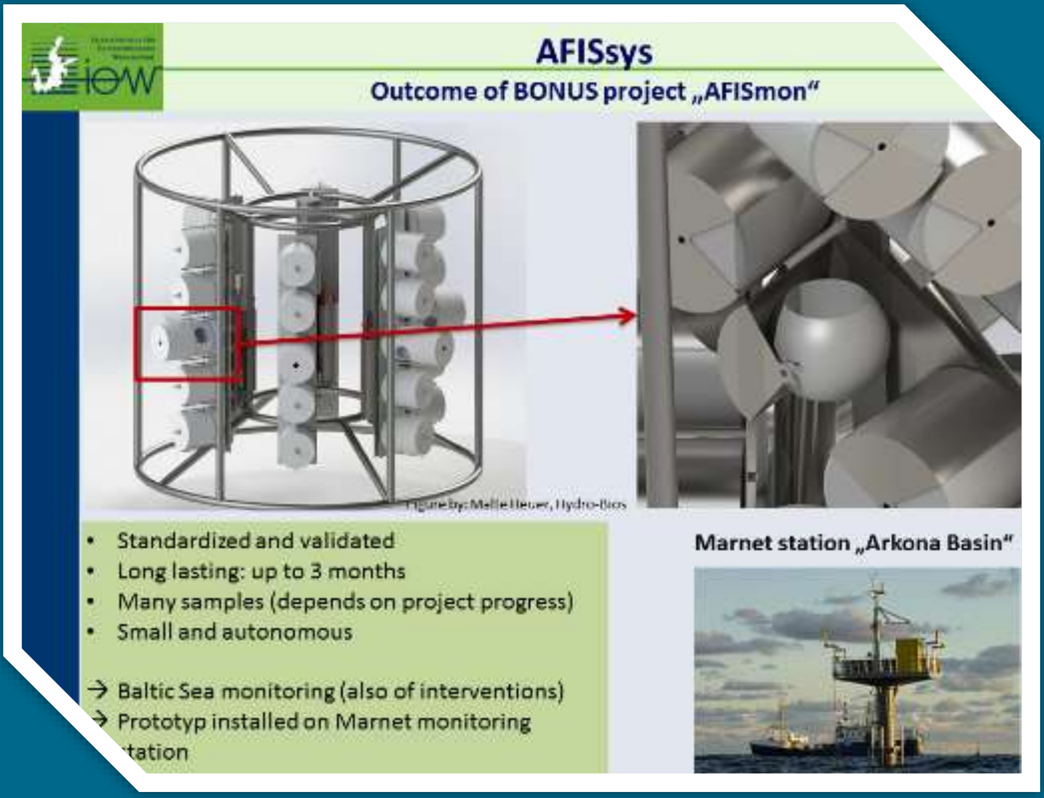
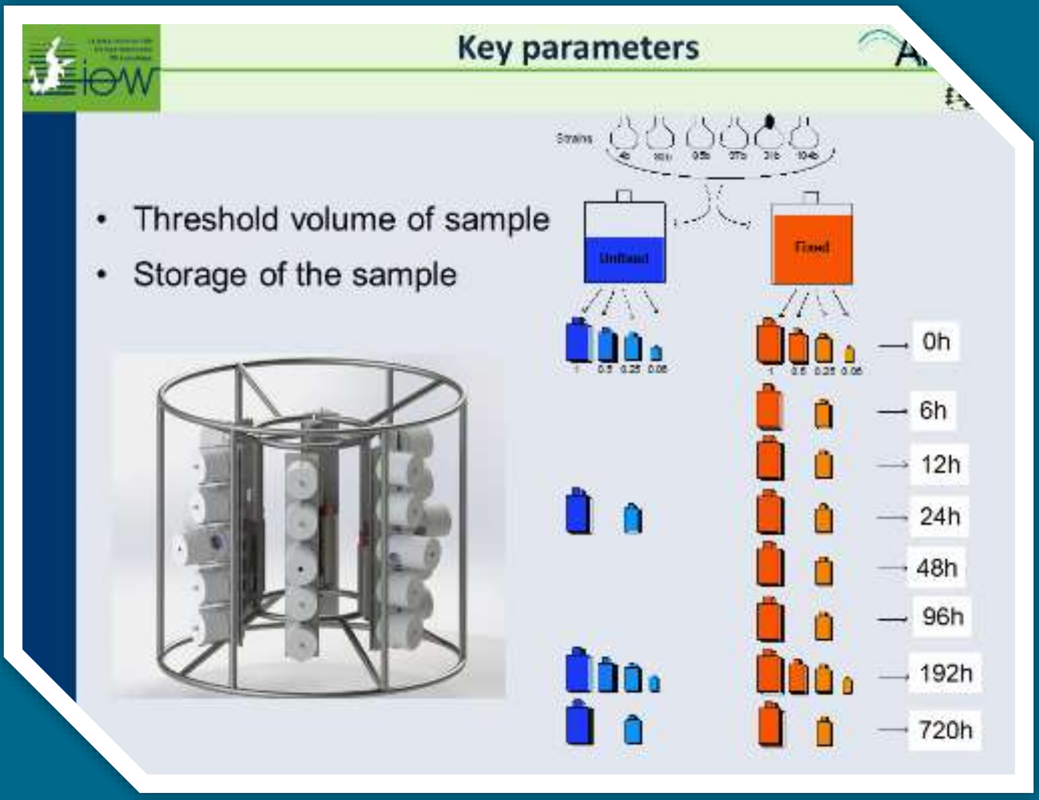
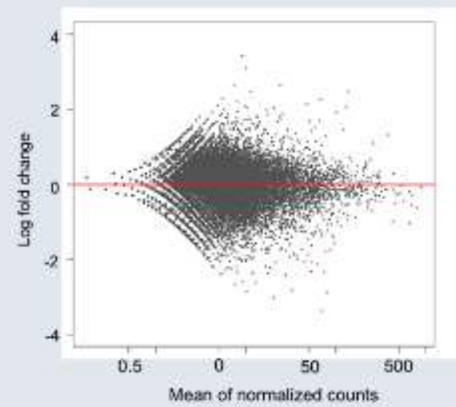




Fixatives

Effect of volume

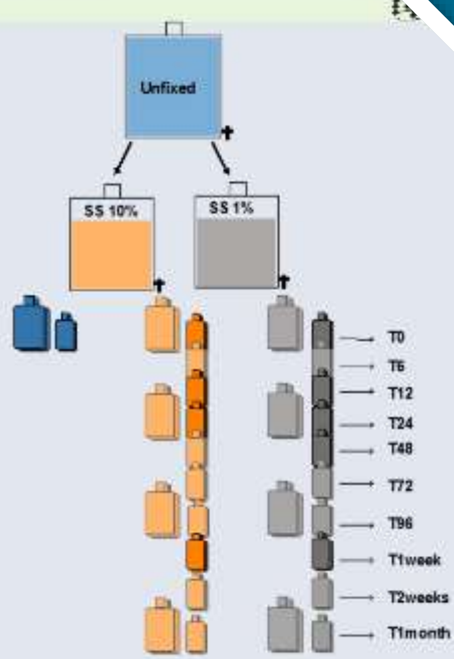


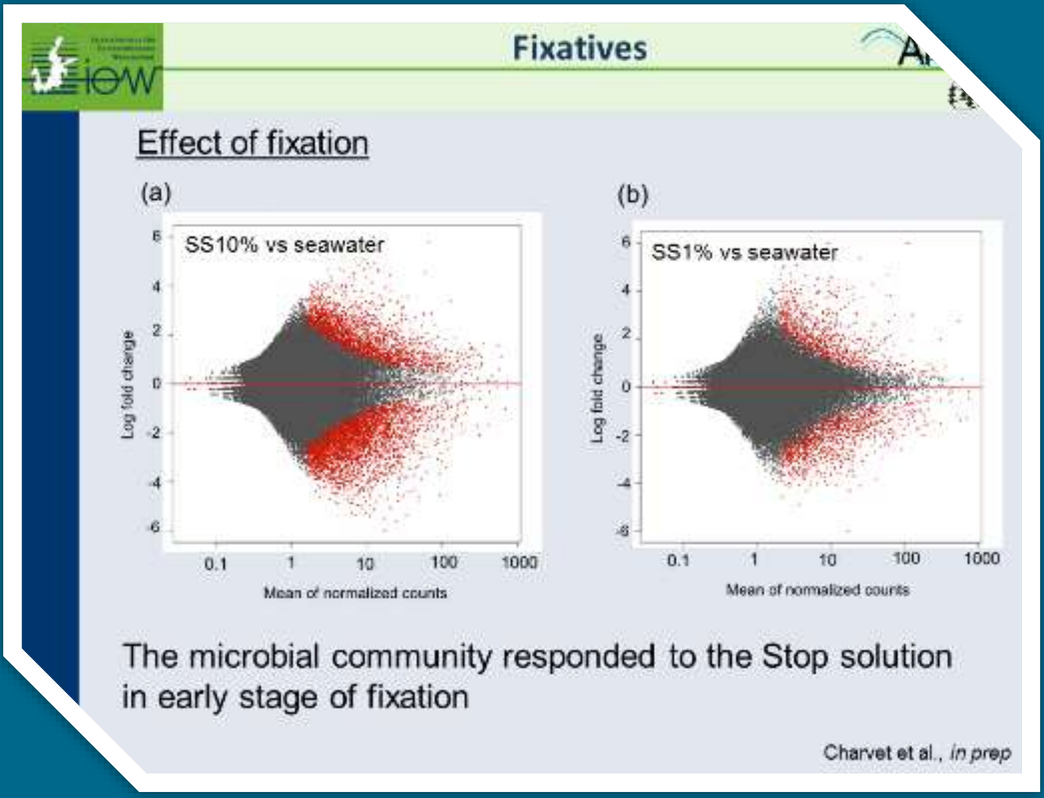
Volume of sample (250mL) does not reduce our capacity to profile the metatranscriptome

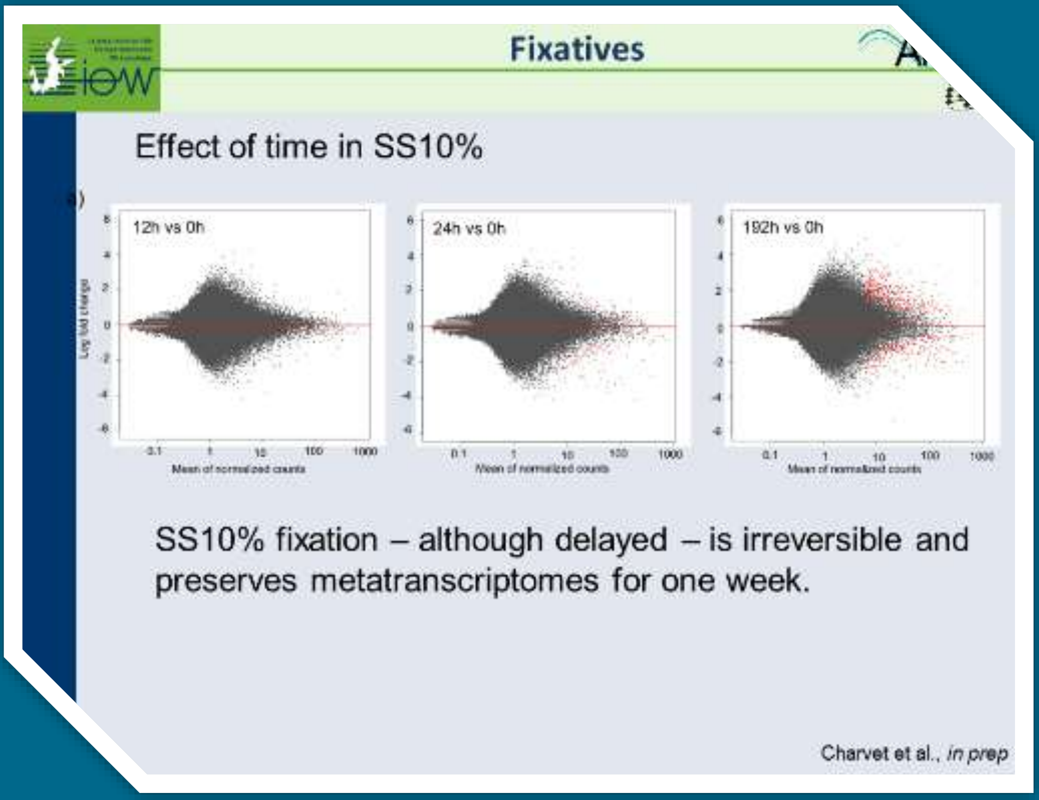
Charvet et al., *in prep*

Fixatives

Stop solution:
5% phenol + 95% ethanol



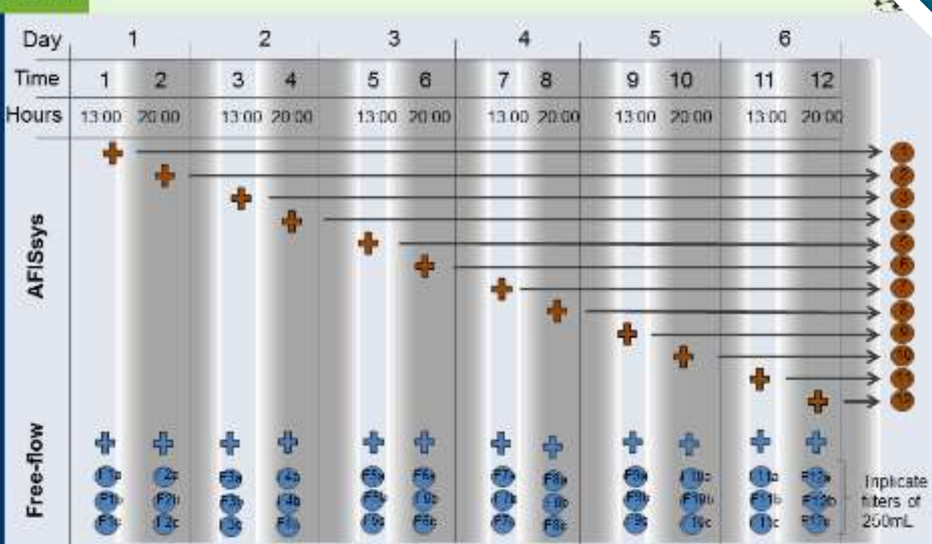

Fixatives
Effect of fixation
(a)
SS10% vs seawater
Log fold change
Mean of normalized counts
(b)
SS1% vs seawater
Log fold change
Mean of normalized counts
The microbial community responded to the Stop solution in early stage of fixation
Charvet et al., in prep


Fixatives
Effect of time in SS10%
12h vs 0h
24h vs 0h
192h vs 0h
SS10% fixation – although delayed – is irreversible and preserves metatranscriptomes for one week.
Charvet et al., in prep

Testing the prototype

- Conducted in Rostock (Marinehe)
  - Baltic Divers Rostock
- Constant access to the pier and floating dock.
- September 2016

Applying the prototype for a time-series



- Sampling time point
- Filtration time point
- Time between sampling and collection

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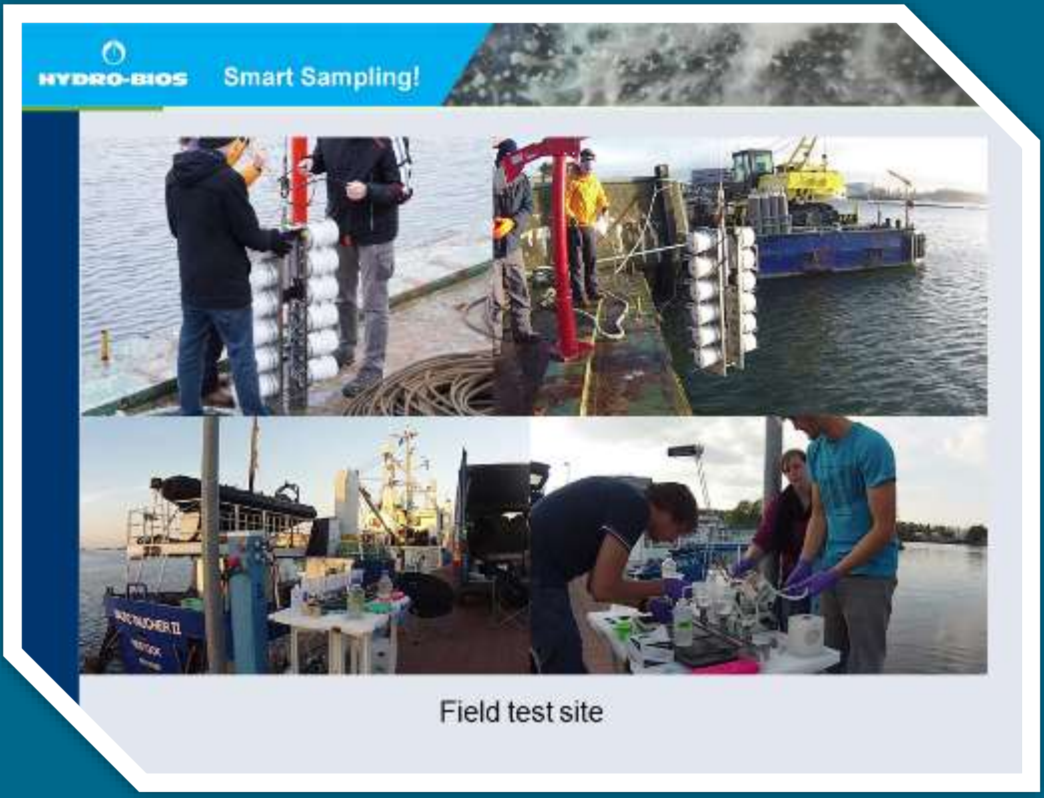
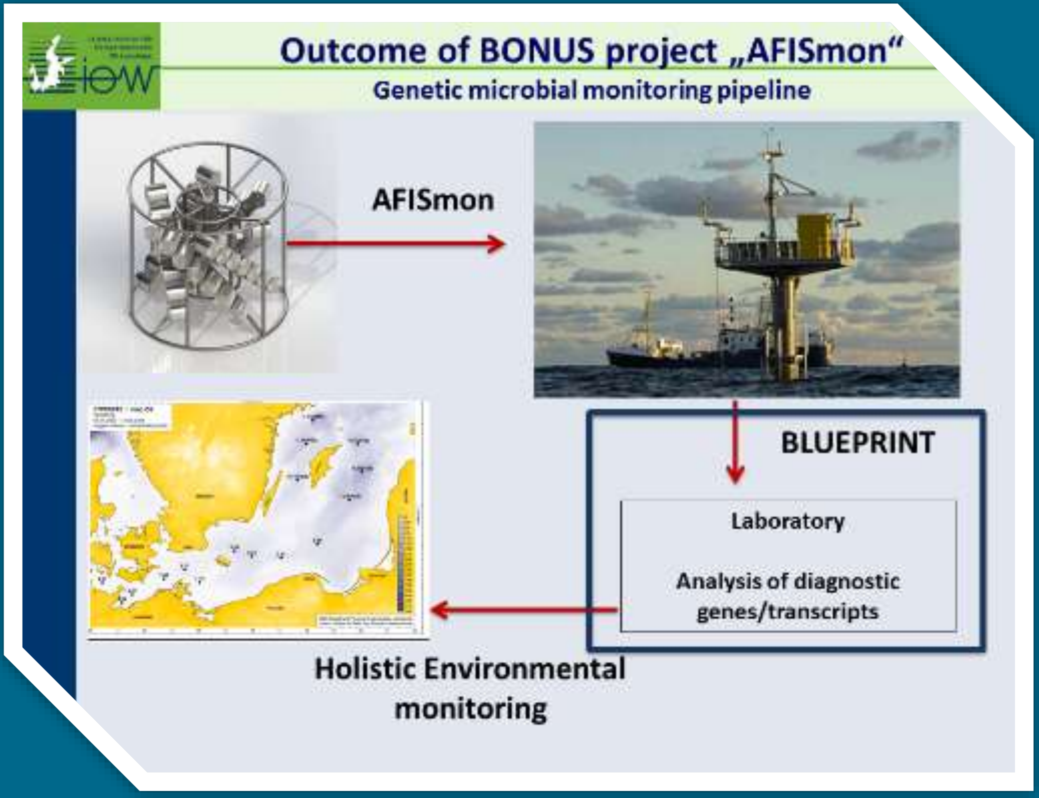
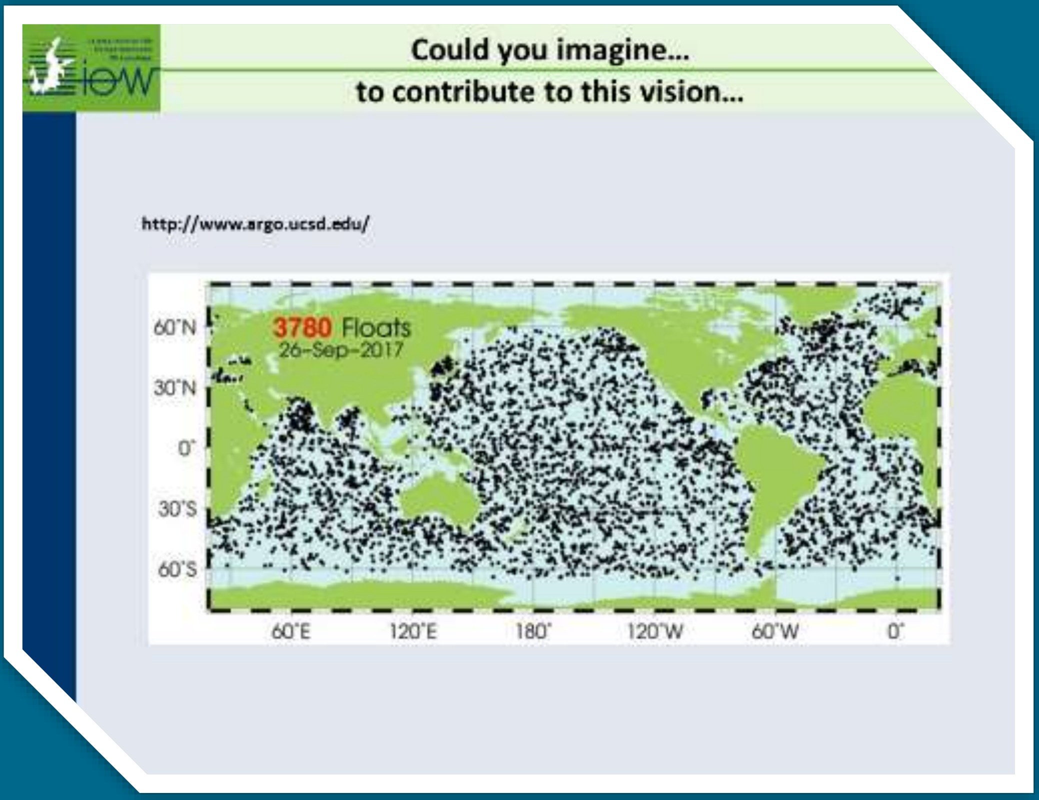




iow
Our vision: off shore technology
Ecogenomic sensor
Bacteria
Plankton
J. Delaney



iow
Could you imagine...
to contribute to this vision...
http://www.argo.ucsd.edu/
3780 Floats
26-Sep-2017
60°N
30°N
0°
30°S
60°S
60°E
120°E
180°
120°W
60°W
0°

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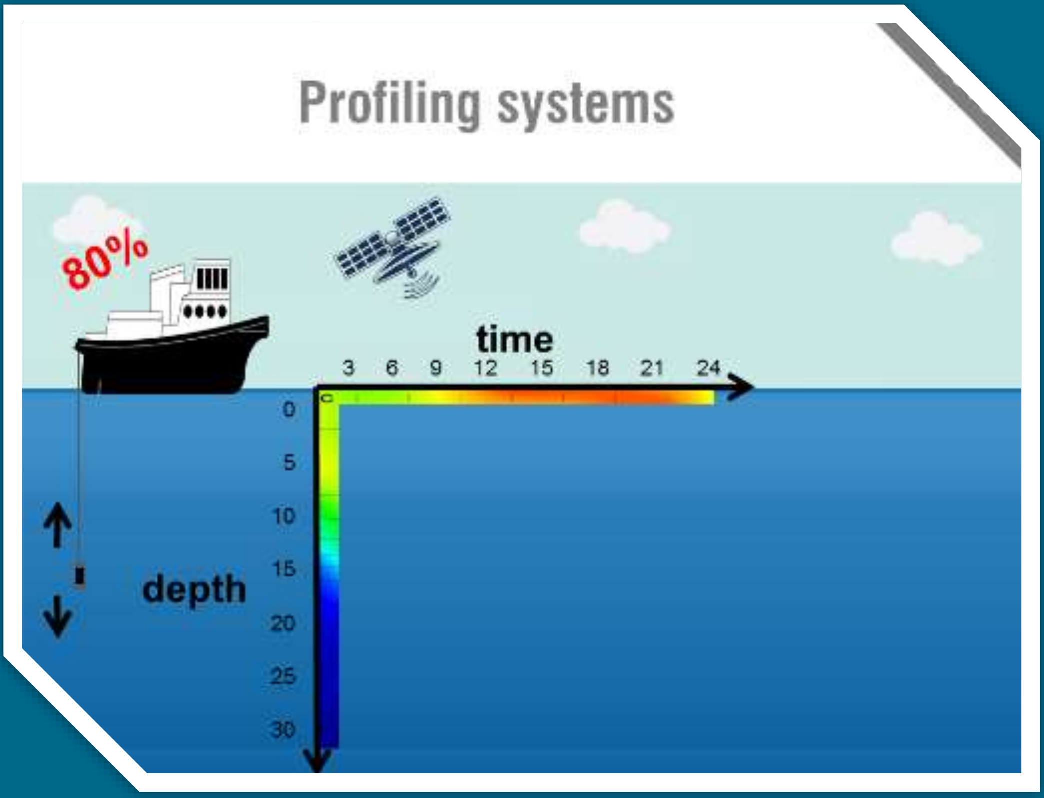
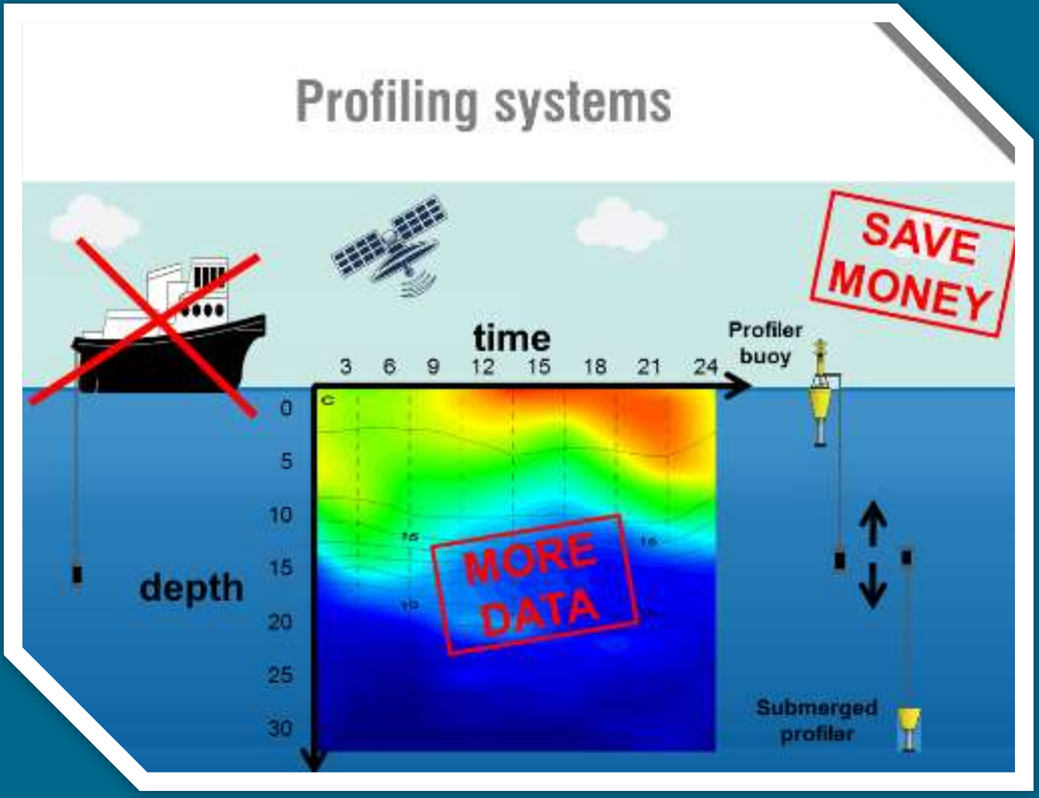

Profiling systems
80%
time
3 6 9 12 15 18 21 24
0
5
10
15
20
25
30
depth


Profiling systems
SAVE MONEY
time
3 6 9 12 15 18 21 24
Profiler buoy
0
5
10
15
20
25
30
depth
MORE DATA
Submerged profiler

Why we focused on marine research sector

- Old technology
  - Poor mechanics
  - Main controller production date 1998
  - User interface based on command lines
  - Originally designed for use on docs
  - Did not have floating body to go with
  - Battery powered, batteries not included
- Profiling system costing 50 + k€ in 2011
- Complete ignorance on client and end user needs
- Sell and forget attitude on the seller side
- Buy and regret emotions on buyers side

Business opportunity study

- Technology
  - Systems were often seen as sensor carriers rather than tools for data collection
  - Really poor user functionality and system metrics
  - vendor lock-in problems in most systems
  - Sector is full of expensive polished prototypes
- Data collection and management
  - Localized or shared amongst small groups
  - Custom solutions in each group
  - Public funding for obtaining public data that is not really accessible

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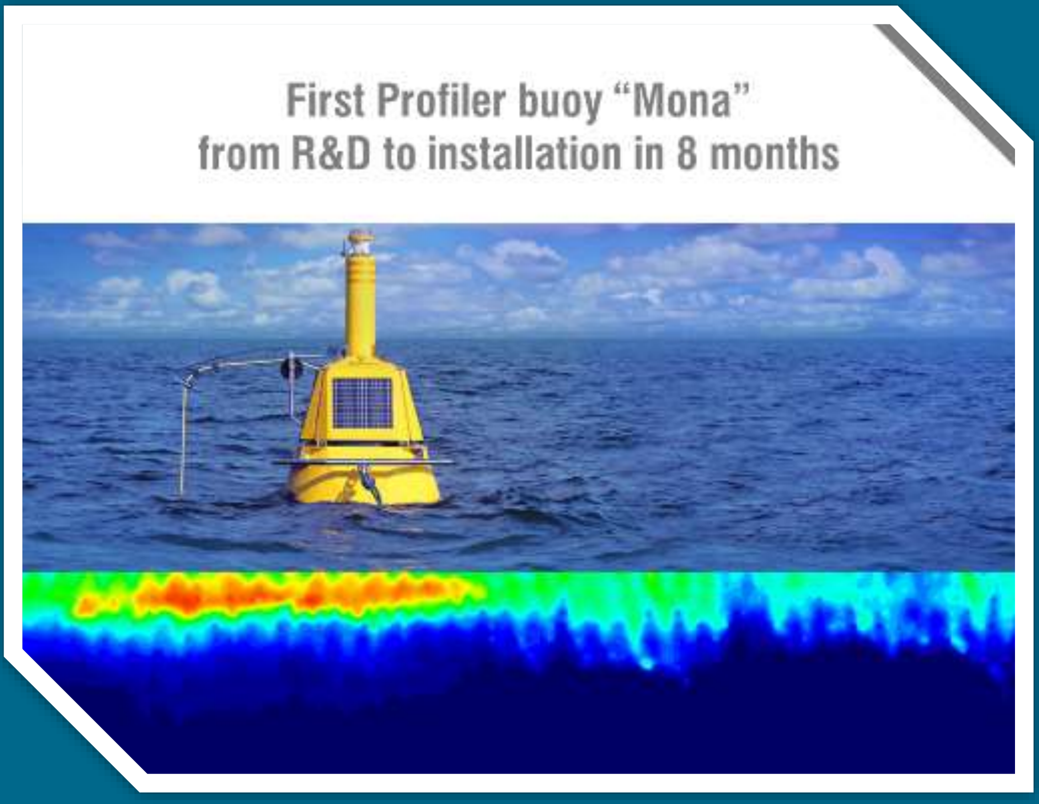

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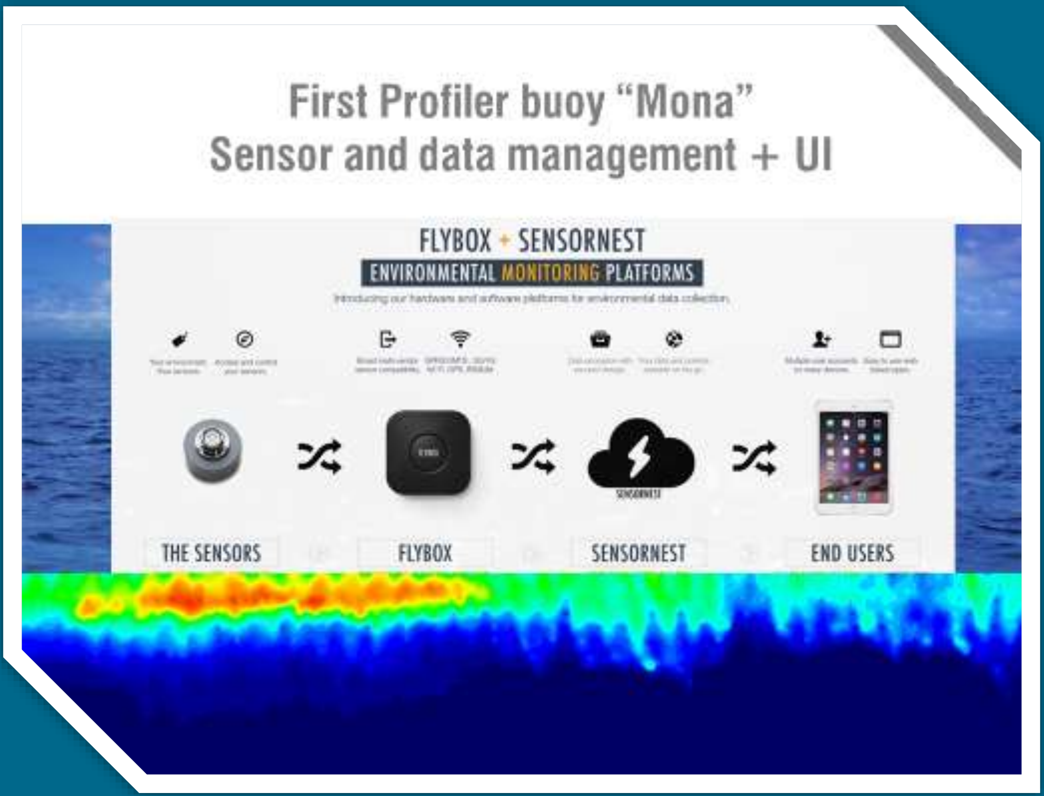

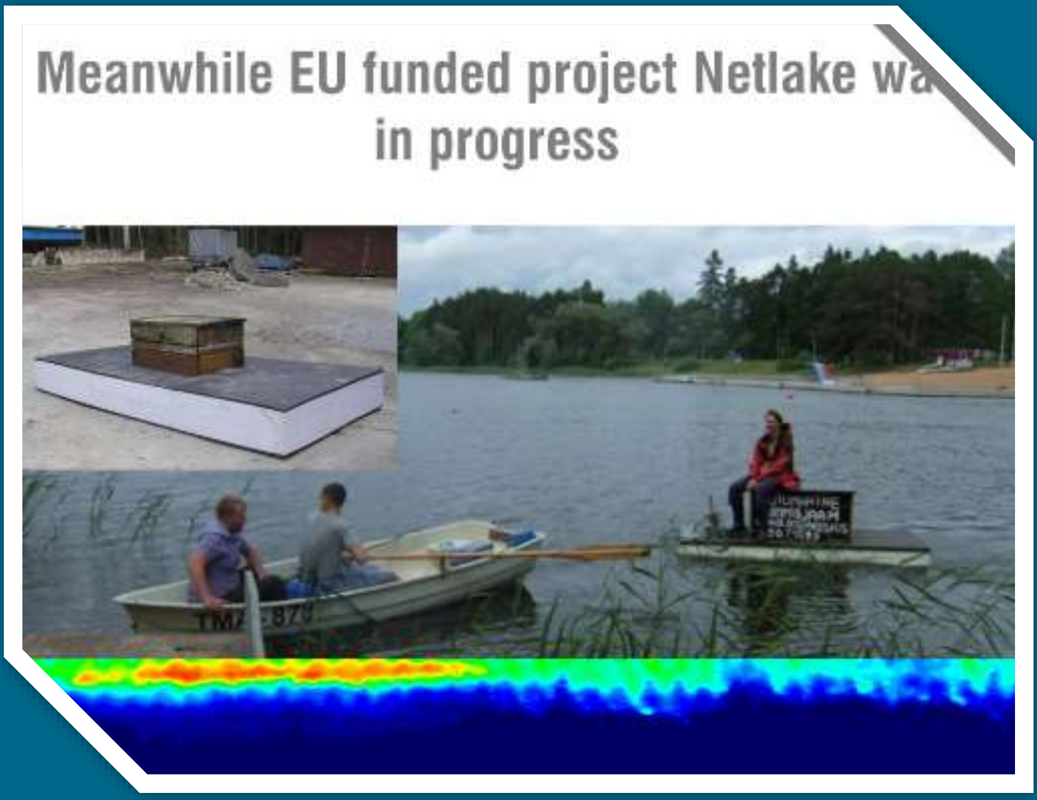

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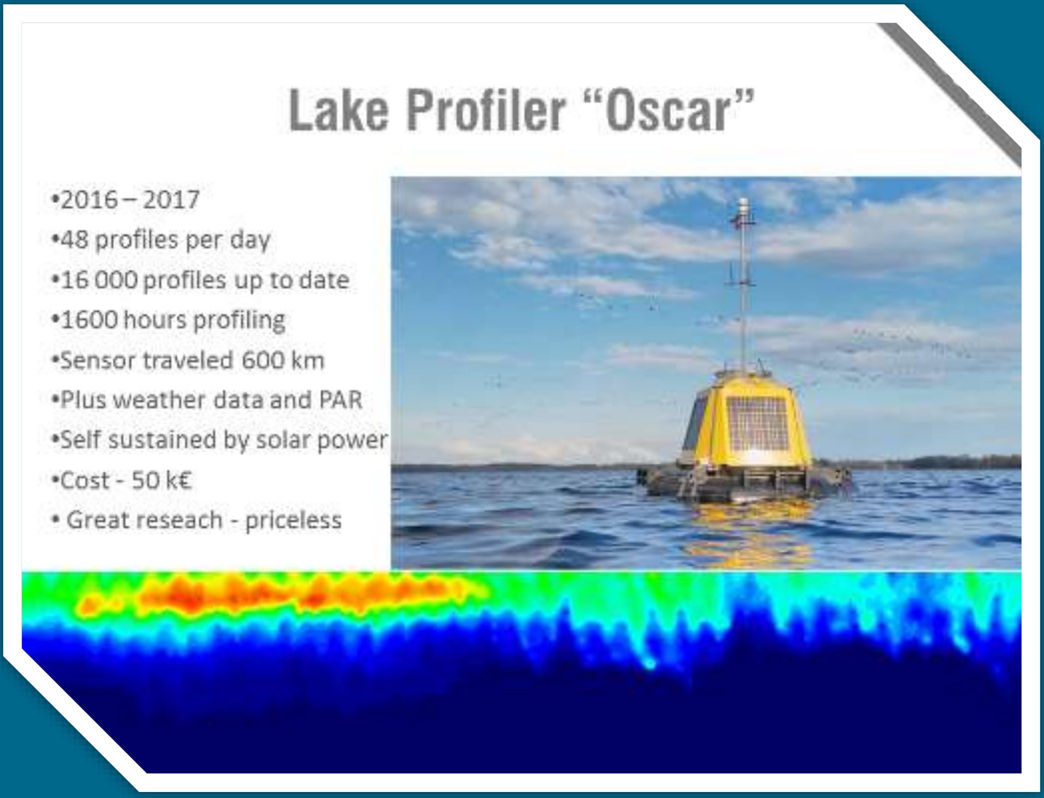
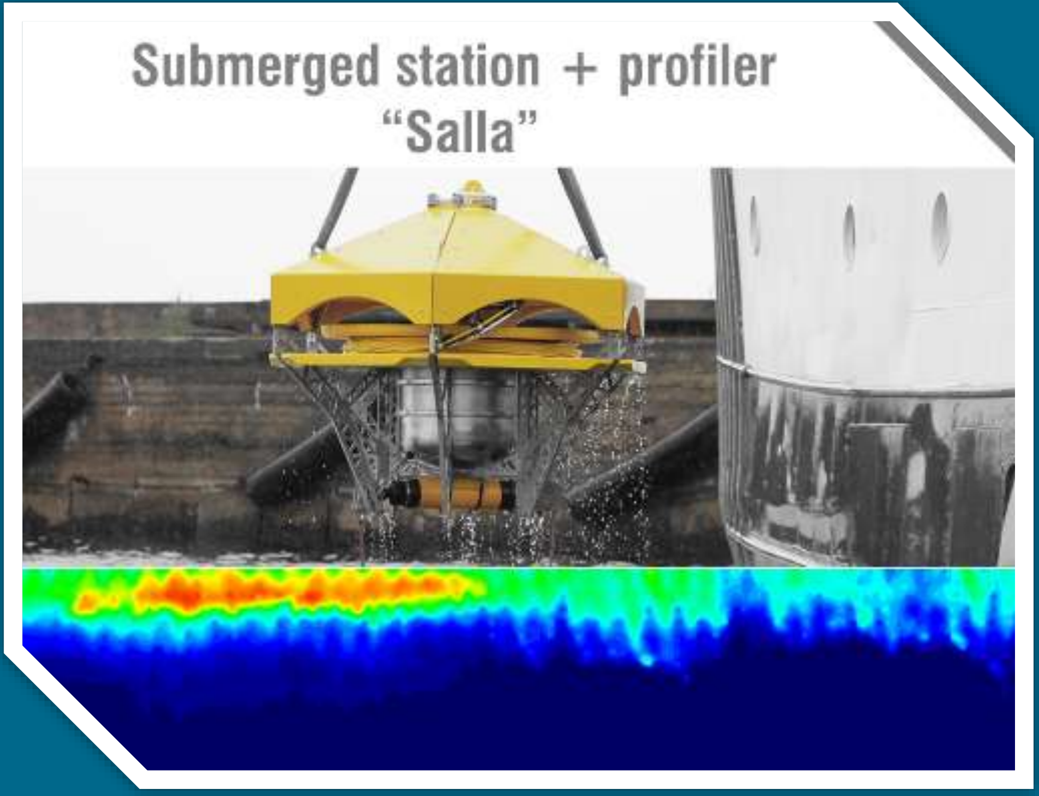
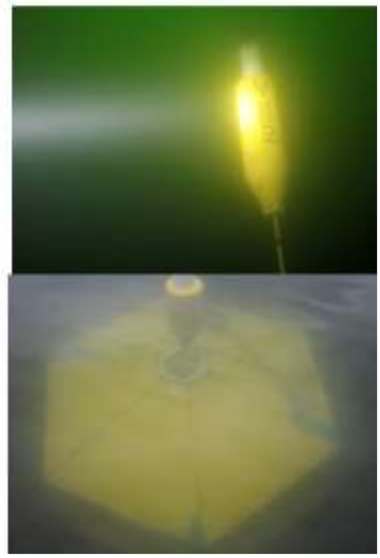


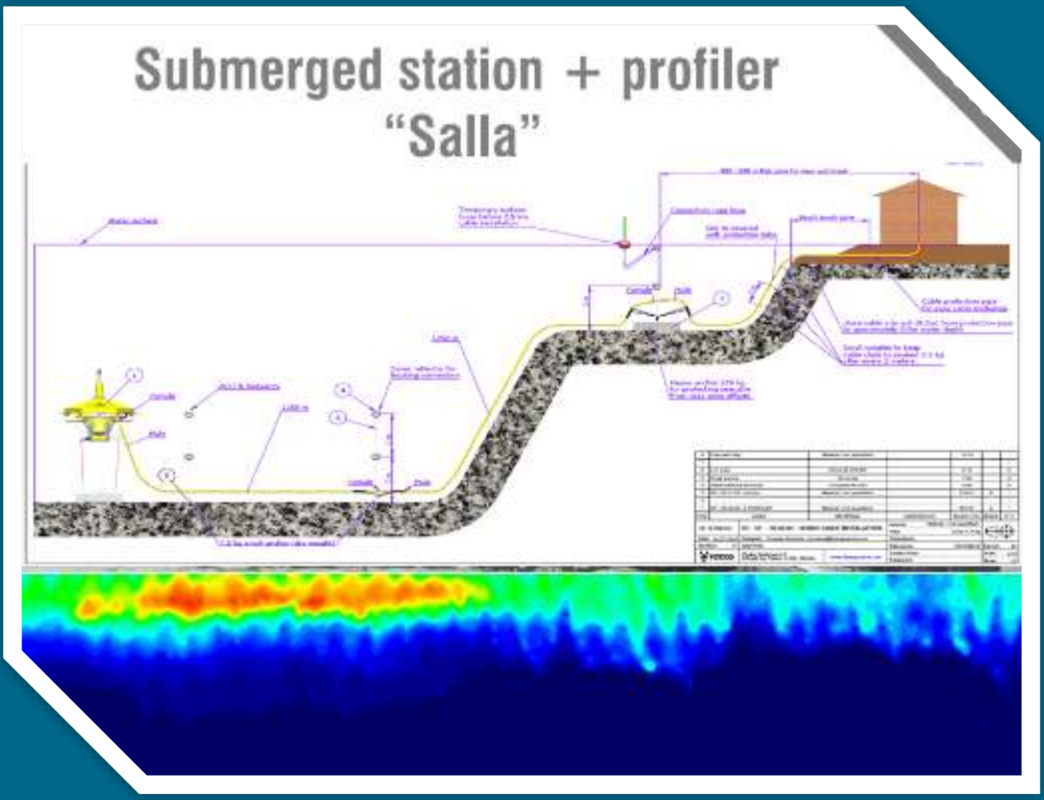


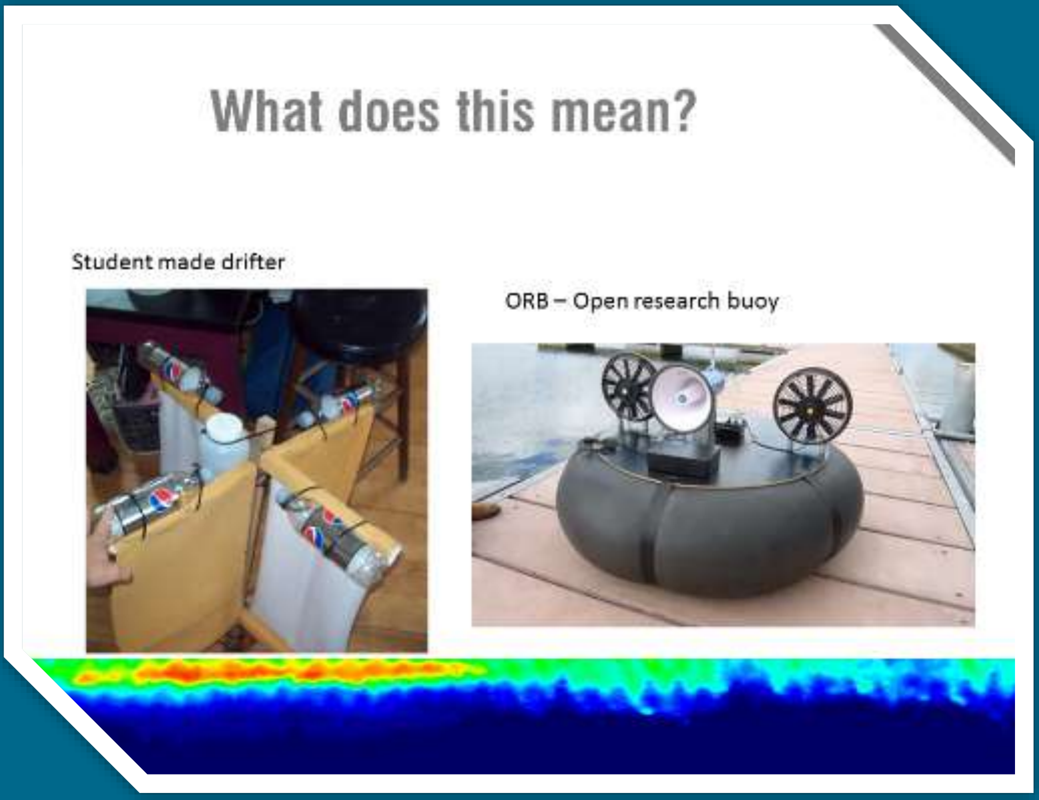
Submerged station + profiler "Salla"

- Deployment period one year
- Takes measures under ice
- Shore power and data through seabed cable
- Power and communication hub for add-on devices such as ADCP, hydrophone...
- Can be altered to subsea telemetry pop-up port

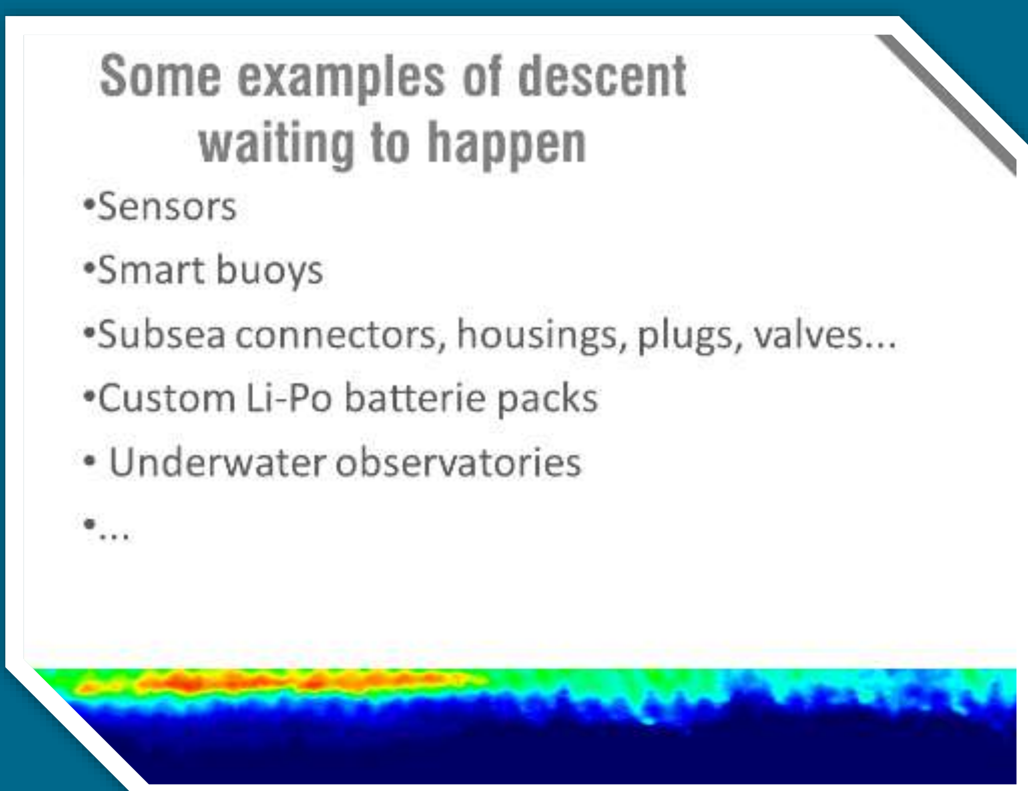


Submerged station + profiler "Salla" KERI Island


Submerged station + profiler
“Salla”


What does this mean?
Student made drifter
ORB – Open research buoy


Technology needs to descend
BlueRobotics
$$$
$ 3 108.00
?
$ 100
Be the one descending your own technology!


Some examples of descent waiting to happen
•Sensors
•Smart buoys
•Subsea connectors, housings, plugs, valves...
•Custom Li-Po batterie packs
• Underwater observatories
•...

Final thoughts!

- If the end goal is more environmental data
    - More and smarter systems are needed
    - Deploying and retrieving has to be fast, easy and cheap
    - Sensor fleet management tools need to be in place
    - Monitoring system has to have good lifesycle cost per data point

Small workboats should dominate as research vessels

BALTIC CLEAN TECHNOLOGY 2017
Forum OT 1 - Presentations

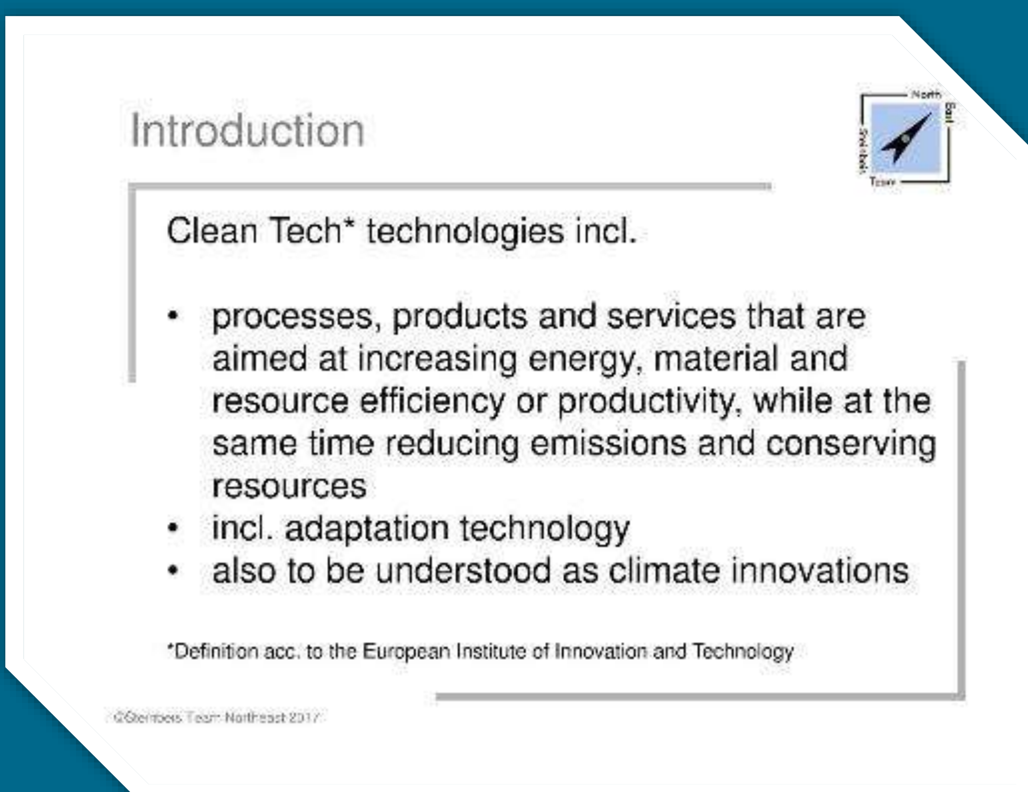
Thursday, 28 September 2017

13:15 – 14:45

FORUM EUROPEAN FUNDING


European Funding
CLEANTECH IN EUROPEAN FUNDING SOURCES FOR INNOVATION
EU
important to achieve EU goals
• Climate
• Sustainable development
bring innovation
new
to the market and apply in other regions
networking
How to find the right partner?
Djungle of EU-programs
good overview & summary
find
right topic
Participants


North
East
Steinbeis
Team
South Baltic
Part-financed by the European Union
(European Regional Development Fund)
enterprise
europe
network
Wir stehen Unternehmen zur Seite
Clean Tech in European funding sources
for innovation – overview, current calls
and interactive project discussions
Rostock, 28. September 2017
Frank Graage, Dr. Antje Hiller
Steinbeis Team Nordost


Introduction
Clean Tech* technologies incl.
• processes, products and services that are aimed at increasing energy, material and resource efficiency or productivity, while at the same time reducing emissions and conserving resources
• incl. adaptation technology
• also to be understood as climate innovations
*Definition acc. to the European Institute of Innovation and Technology

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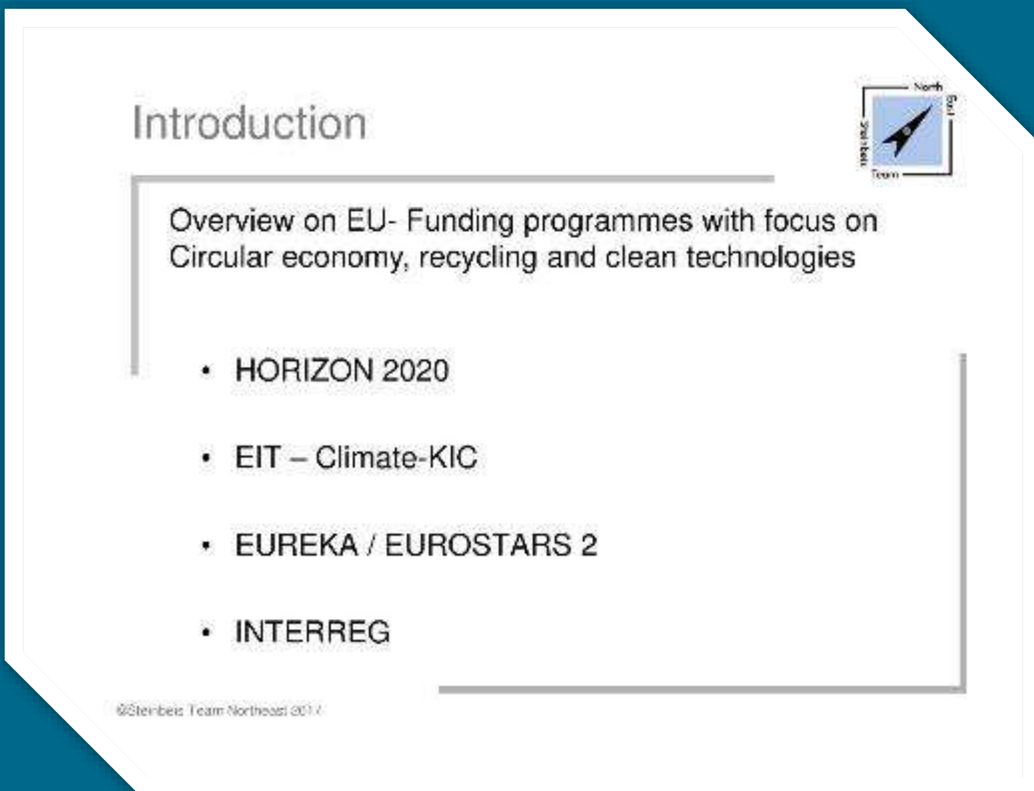

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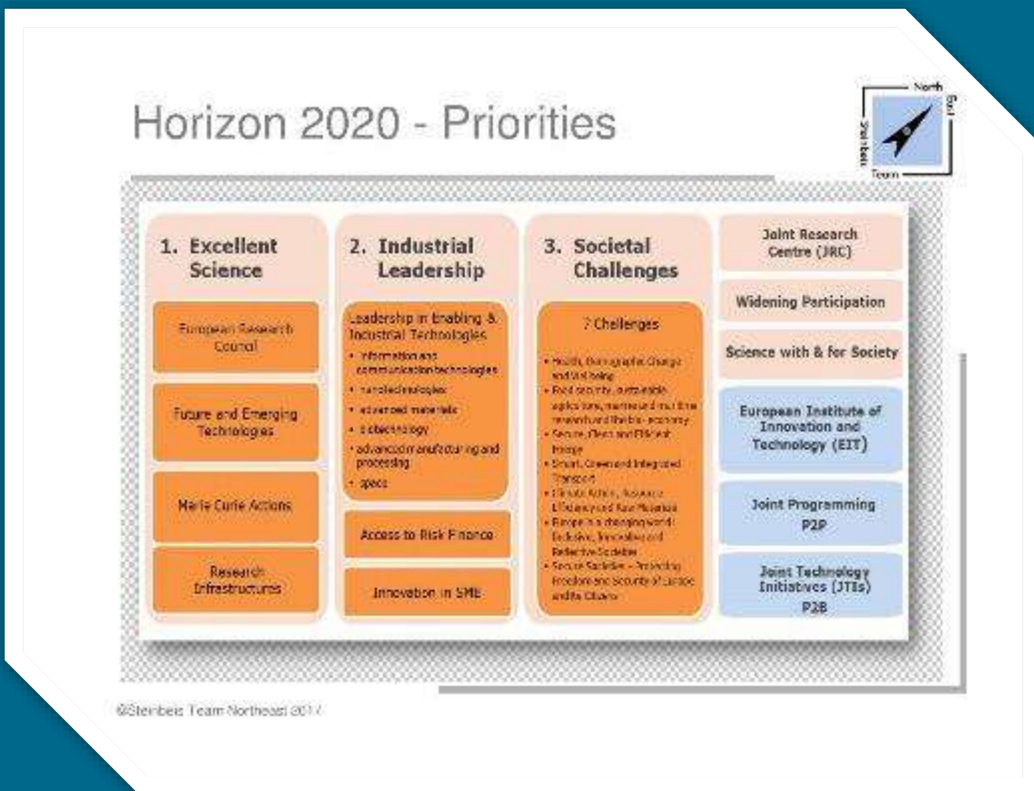

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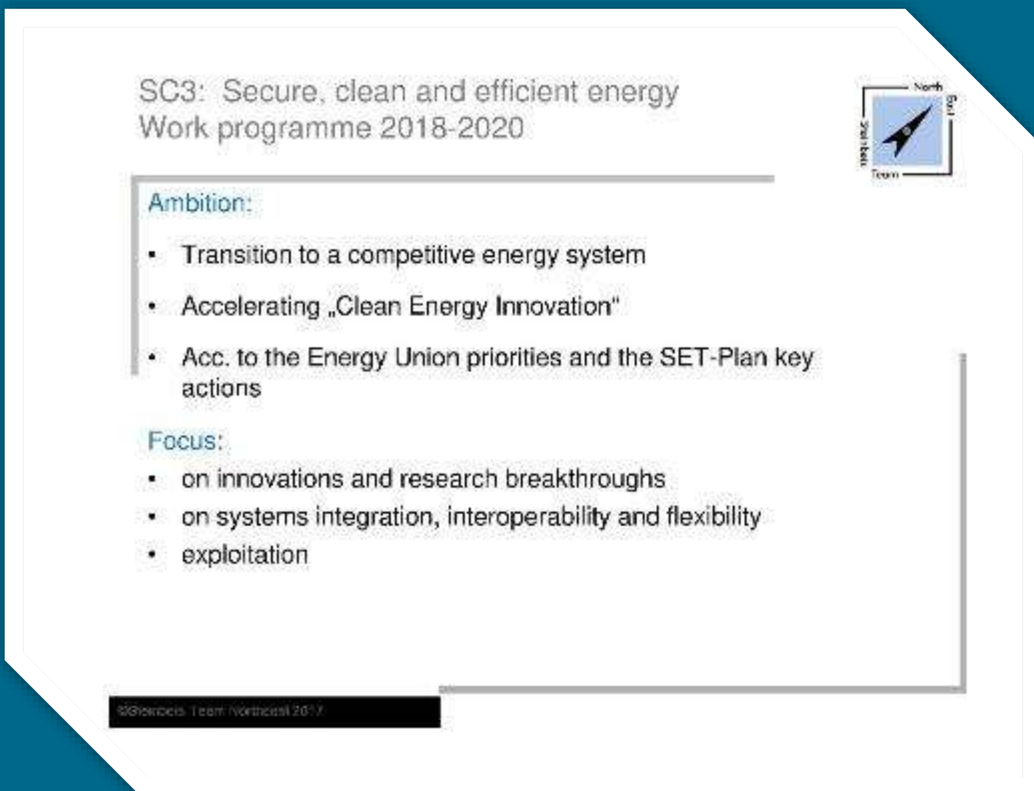

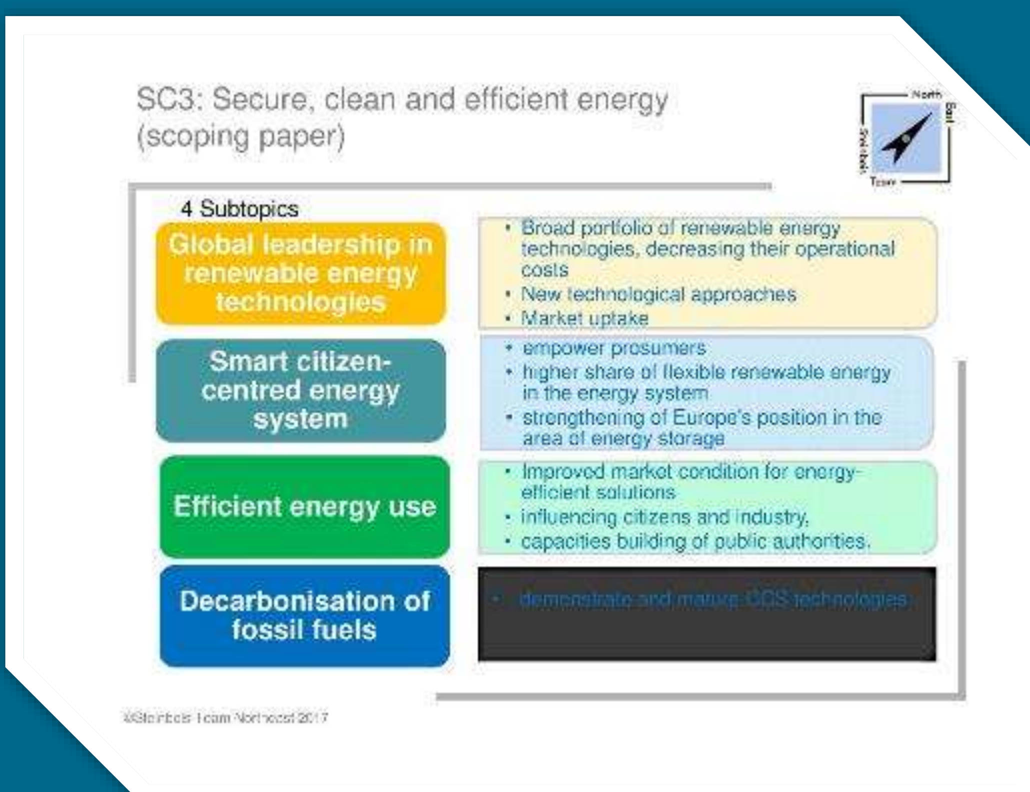

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SC3: Secure, clean and efficient energy (Examples 2018-2020)

- **RES-1-2019-2020: Developing the next generation of renewable energy technologies (RIA)**
  - *Feasibility of concept, to TRL 3 or TRL 4*
  - *with lower environmental impact and lower greenhouse gases emissions than the current renewable energy technologies*
  - *E.g. sustainable fuels other than hydrogen for energy and transport application, thin-film photovoltaics concepts*
  - *Submission date: 16 Oct. 2018 (first stage) and also in 2019-2020*
- **RES-13-2018: Demonstrate solutions that significantly reduce the cost of renewable power generation (IA)**
  - *offshore wind, deep geothermal, CSP, to TRL 5 to TRL 7*
  - *Submission date: 13 Feb 2018*

SC3: Secure, clean and efficient energy Further Information

- **EU Energy Info days** on Brussels on 23, 24 and 25 October 2017
- present you the Energy priorities of the H2020 Energy 2018-2020 calls for proposals
- offer you dedicated workshops for each funding areas
- Brokerage event for partner search and matchmaking
- Live stream and presentations will also be available for download
- https://ec.europa.eu/inea/en/news-events/events/energy-info-days-2017

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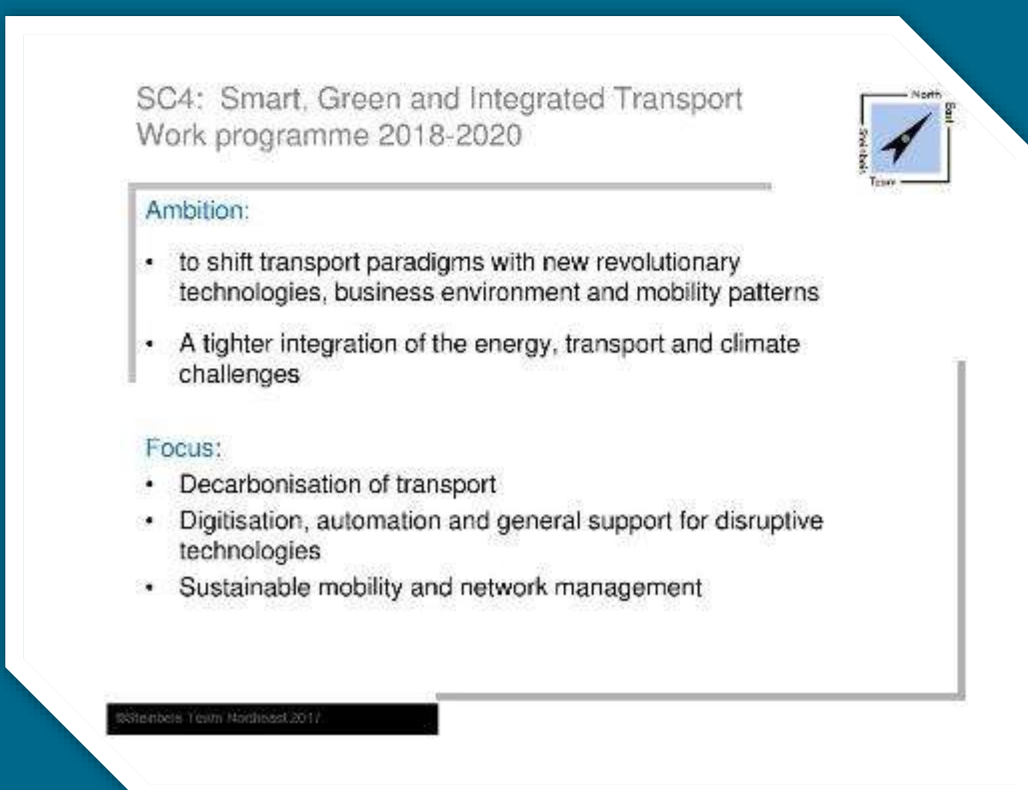

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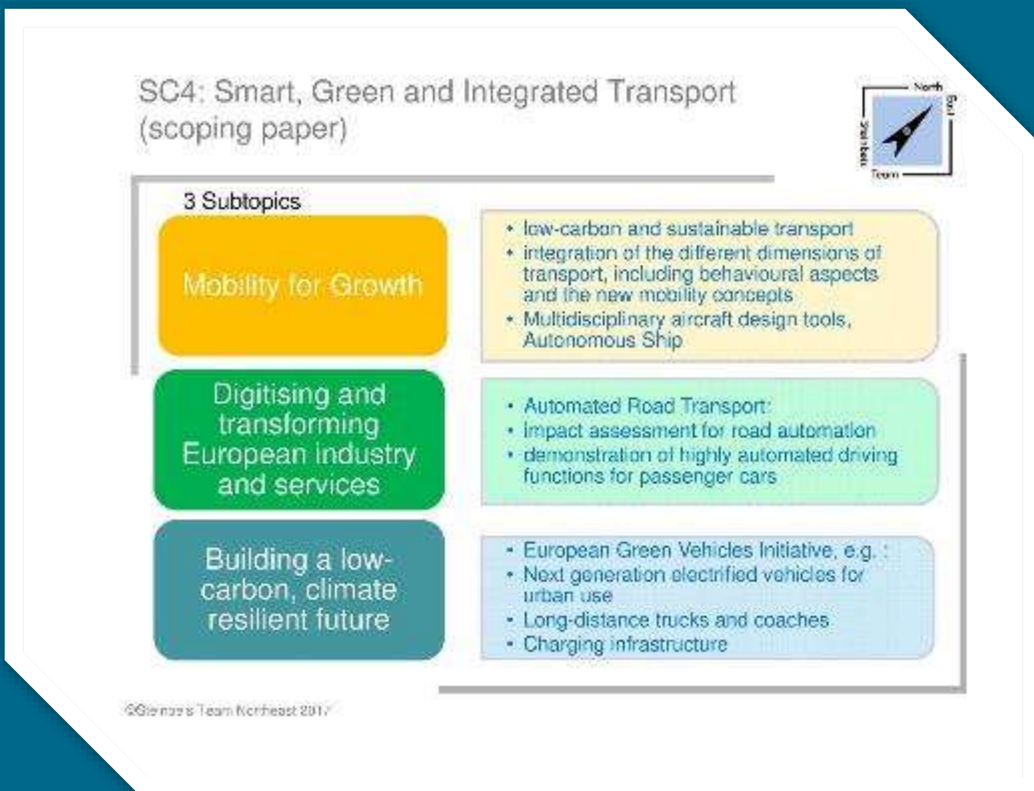

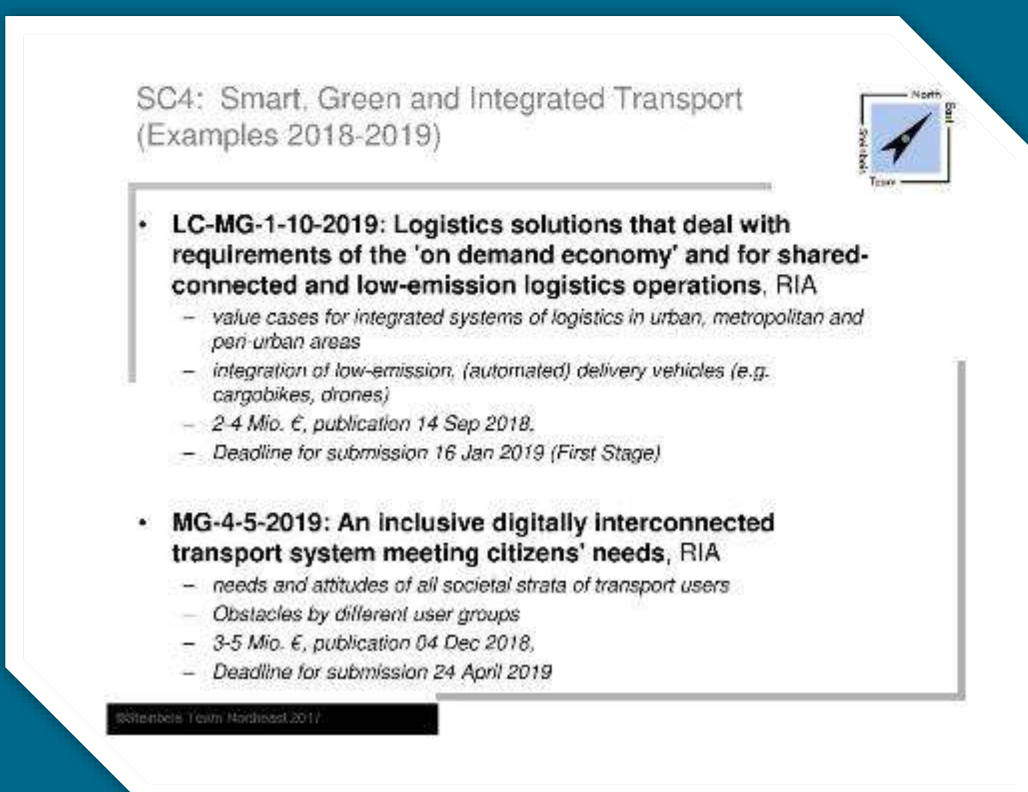

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SC5: Climate action, environment, resource efficiency and raw materials (scoping paper)

3 Subtopics

Building a low-carbon, climate resilient future
- Decarbonisation
- Climate adaptation, impacts and services
- Inter-relations between climate change, biodiversity and ecosystem services

Greening the economy in line with the Sustainable Development Goals
- The circular economy
- Raw materials
- Water for our environment, economy and society
- Innovating cities for sustainability and resilience
- Earth observation
- Heritage alive

Other actions
- H2020 Prizes
- Multi-stakeholder platforms and public-private-people partnerships for sustainable cities
- Policy support

SC5: Circular economy (Examples 2018-2019)

- CE-SC5-01-2018: Methods to remove hazardous substances and contaminants from secondary raw materials
- CE-SC5-03-2018: Demonstrating systemic urban development for circular and regenerative cities
- CE-SC5-04-2019: Building a water-smart economy and society
- **CE-SC5-05-2018: Coordinated approaches to funding and promotion of research and innovation for the circular economy (CSA)**
  - *Alignment and coordination of regional, national and European programming of R&I in the area of the circular economy*
  - *Accelerated diffusion of state-of-the-art circular economy solutions and best practices in circular economy R&I throughout Europe*
  - *Implementation of national and EU-level action plans including the Circular Economy Action Plan, the Green Action Plan for SMEs, and Eco-innovation Action Plan*
  - *Deadline 27 Feb 2018 (full application)*

SC5: Raw materials (Examples 2018-2019)

- CE-SC5-06-2018: New technologies for the enhanced recovery of by-products
- **CE-SC5-07-2018-2019-2020: Raw materials innovation for the circular economy: sustainable processing, reuse, recycling and recovery schemes** (Innovation action)
  - *development and demonstration of innovative pilots for the clean and sustainable production of non-energy, non-agricultural raw materials in the EU from primary/ secondary sources finishing at Technology Readiness Levels (TRL) 6-7; e.g.*
  - *Recycling of raw materials from end-of-life products*
  - *Recycling of raw materials from buildings*
  - *Advanced sorting systems for high-performance recycling of complex end-of-life products*
  - *Publication 14 Nov 2017; Submission Deadline 19 Feb 2018 (first stage) and 2019 again*
- CE-SC5-08-2018-2019-2020: Raw materials policy support actions for the circular economy
- SC5-09-2018-2019: New solutions for the sustainable production of raw materials
- SC5-10-2019-2020: Raw materials innovation actions: exploration and Earth observation in support of sustainable mining

SC5: WATER (Examples 2018-2019)

Water for our environment, economy and society

- **SC5-11-2018: Digital solutions for water: linking the physical and digital world for water solutions** (Innovation action)
  - *development and testing new, robust and cybersecure systems (TRLs 5-7)*
  - *to foster higher information transparency and accountability*
  - *integrated approach of all water resources and water bodies*
  - *The participation of social sciences and humanities disciplines and of market take-up partners from a wide range of different EU regions is crucial.*
  - *Deadline probably 27 Feb 2018 (first stage)*

SC5-12-2018: EU-India water co-operation (Research and Innovation action)
- *addresses wastewater treatment integrated with the reuse of reclaimed water and energy recovery from various sources and/or drinking water purification*
- *Real time monitoring and management of water quality*
- *at least three participants from India*
- *Deadline probably 27 Feb 2018 (first stage)*

BALTIC CLEAN TECHNOLOGY 2017
European Funding - Presentation

SC5: Climate action, environment, resource efficiency and raw materials - Information

- **EU Information days and brokerage event** on 8 and 9 November 2017 in Brussels
- Presentation of all topics published in the Work Programme 2018-2020
- Main steps for application / how to get help
- Finding partners (booking meetings in advance)
- Live stream and presentations will also be available for download
- https://ec.europa.eu/easme/en/2017-information-day

Horizon 2020 - Priorities

Horizon 2020 and partnering

- **Public-Private Partnerships (PPPs):**
  - Through Joint Technology Initiatives or other formal structures (§ 187) Via contractual arrangements, which provide inputs for work programmes e.g. Innovative Medicines Initiative 2 Joint Undertaking
- **Public-Public Partnerships (P2Ps):**
  - Through "ERA-Nets" for topping up individual calls/ actions (replacing current ERA-Net, ERA-Net Plus, Inco-Net, Inno-net)
  - Through participation in joint programs between Member States (§ 185.)
  - Supporting agendas of Joint Programming Initiatives when in line with Horizon 2020 e.g. Active and assisted living research and development
- **European Innovation Partnerships**
  - Not funding instruments, but for coordination with broader policies and programmes e.g. on Active and Healthy Ageing

Joint Technology Initiatives

PPP	EU (H2020) + EU MS	Industry	Total
Inovative Medicines Initiative 2	1,638 M€	1,638 M€	3,276 M€
Fuels Cells and Hydrogen 2	665 M€	665 M€	1,33 M€
Clean Sky 2	1,8 M€	2,2 M€	4 M€
Bio-based Industries	3,7 M€	975 M€	4,675 M€
Electronic Components and Systems	1,18 M€	2,83 M€	4,01 M€
Total JTIs	8,983 M€	8,308 M€	17.291 M€

JTI – Clean Sky

Ambition:
Reducing CO_2, gas emissions and noise levels produced by aircraft

Latest call (closed June 2017) - Examples for topics:
- Enhanced Low Cost Complex Composite Structures
- Low cost optical wave guides for damage detection
- Adjustable high loaded rod
- Prototype Tooling for subcomponents manufacturing for fuselage

New call expected for 2018
German Partners: Deutsches Zentrum für Luft - und Raumfahrt eV, Airbus, Liebherr Aerospace Lindenberg GmbH, Fraunhofer

ERA – Net Actions

Era-net Bioenergy: active since October 2004; since January 2011, a self-sustained network organised on a membership basis.

- Pre-annoucement for 12th call: 1 Oct 2017 – 1 Jan 2018
- "Biomass as an important pillar within energy systems and the circular economy"
- The joint call (8 EU countries) aims to support innovative, collaborative pan-European, R&D&I projects with TRL 2-7 (at the end of the funded project).

- Networking webinar to build a consortia November 2017
- Projects are expected to start in spring 2019.
- http://www.eranetbioenergy.net/file/download/52321632

Joint Calls

IraSME 2005 started as ERA-NET
- Since 2011 self-sustained
- (co-ordinated by AiF Projekt GmbH)

Participating countries:
- Austria, Belgium, Germany, CZ, France, Russia
- Open for all technologies, high risk R&D
- Deadline for Submission: 27 September 2017
- Expected again for March 2018
- http://www.ira-sme.net

IraSME

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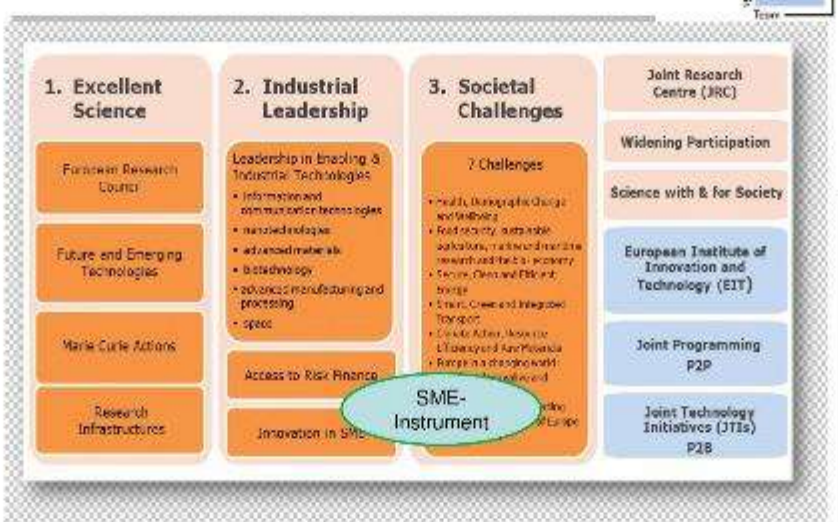
Horizon 2020 - Priorities



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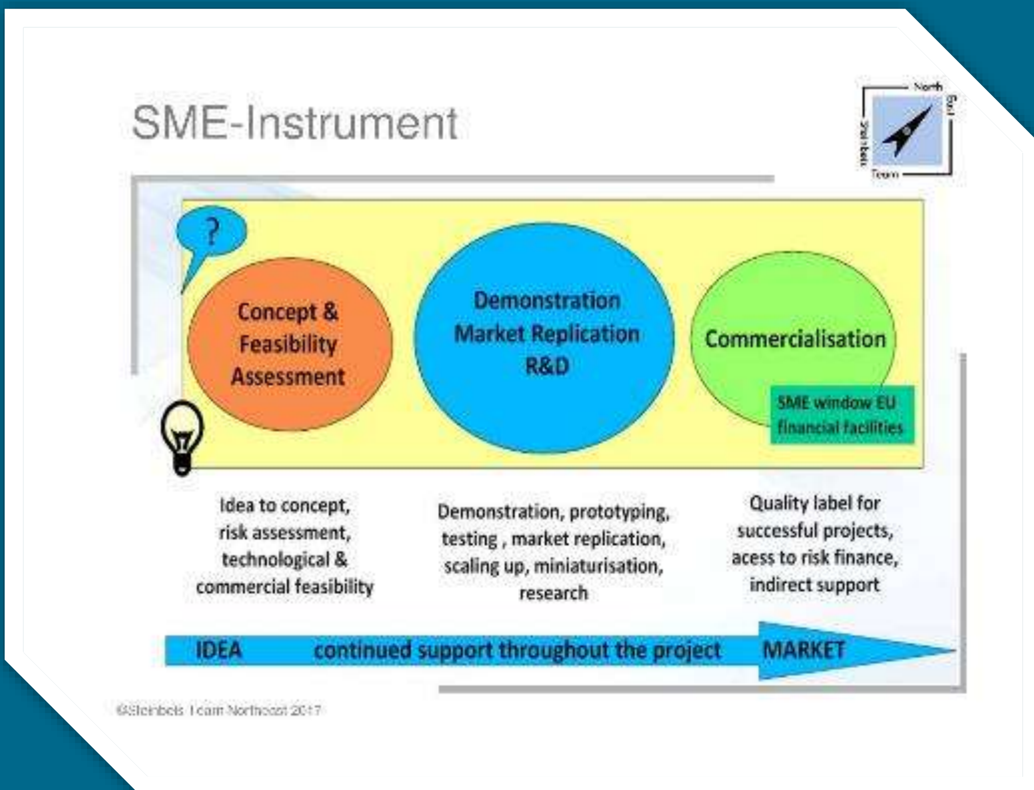

SME-Instrument 2017/2018-2020

- Only SME can apply, for disruptive ideas and high risk projects
- Single funding or with (research) partners
- Registered in EU or associated states
- One application or project in parallel, re-submissions possible
- Starting from 2018 not longer restricted to a topic
- New: Integration in „European Innovation Council"

Last submission dates 2017

- *phase 1* *07/11/17*
- *phase 2* *18/10/17*

Updates for 2018 later

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SME-Instrument/EIC 2018-2020 - Information

Information workshop for applicants SME instrument:
12 and 13 December 2017 in Bonn

European Innovation Council (EIC) and its funding programmes:
17 October 2017 in Bonn presenting:

- Fast Track to Innovation (FTI), with 2 research partners and 2 further industry partners
- FET Open
- 6 Inducement Prizes
- Perspectives EIC after 2020

European Institute of Innovation and Technology (EIT) - Knowledge and Innovation Communities

Climate-KIC

eit Climate-KIC

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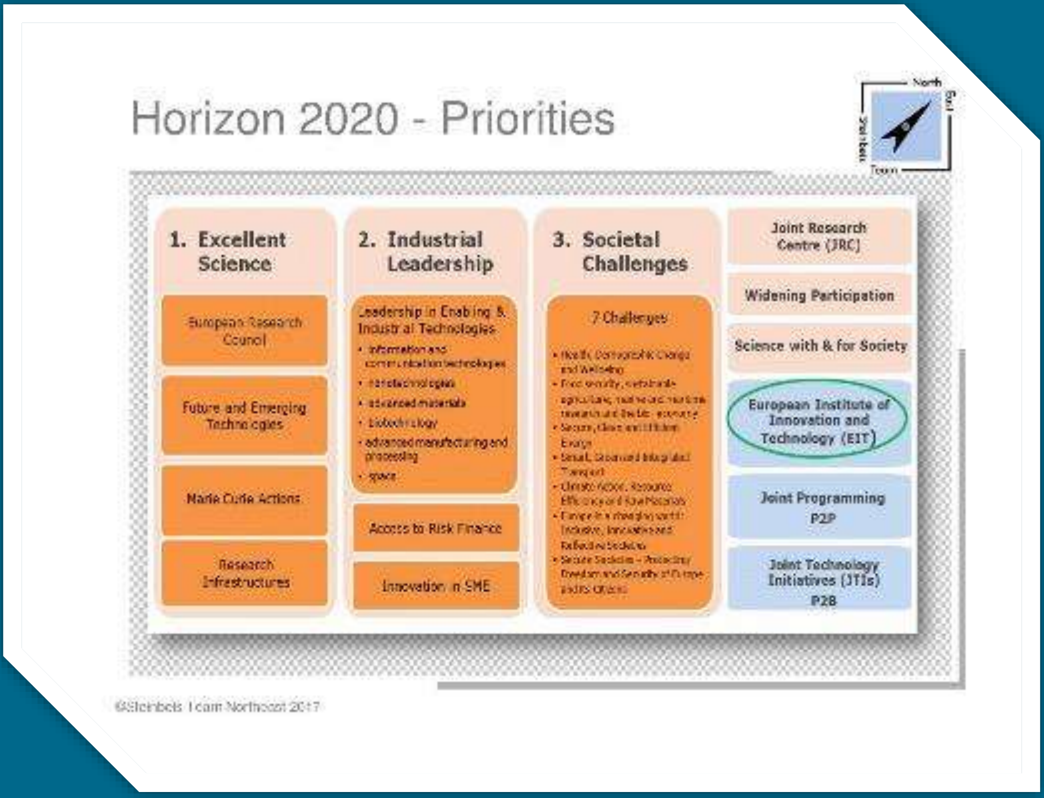

EIT- Climate-KIC (Example)

- Climate-KIC Accelerator

18-month program, coaching to cleantech start-ups, ~150 SMEs/year
http://www.climate-kic.org/start-up-accelerator/

- Demonstrator Programme

support KIC partners (and other stakeholders) with funding and services to de-risk the demonstration of innovations
http://www.climate-kic.org/demonstrator/

- Scaler Programme

for SMEs, to grow and achieve greater climate-relevant impact
http://www.climate-kic.org/scaler/

EUREKA programme initiative EUROSTARS 2

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EUROSTARS 2

- Joint Funding initiative from EUREKA members and EC
- Development of an innovative product, technology, service
- Open for all branches (70% of projects from IT, biology, manufacturing, transport, materials), at least 50% total costs to researching SMEs
- At least 2 partners from 2 Eurostars-countries
- Duration about 3 years, ready for market within 2 years after project end

eurostars™

EUROSTARS 2

Not eligible:
- Clinical studies
- Activities mainly addressed to investments and equipment
- Travel and marketing activities, at conferences and fairs

German Partners:
- Max. 500.000,- € Funding for all

Funding rates:
- SMEs up to 50%
- Research organisations 50-100%
- Industry with own budget

eurostars™


EUROSTARS 2
North
East
Steinbeis
Team
2 Cut off dates/year: **March and Sept. 2018**
Assessment criteria
• Degree of innovation
• Market opportunities & estimation of sales
• Additional value through collaboration
• Project structure: management, work plan, budget
Success rate for German participants ~30%
eurostars™
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North
East
Steinbeis
Team
Territorial Co-operation
INTERREG Programmes
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European Funding - Presentation

Territorial Co-operation
INTERREG B

6 INTERREG B programmes, 2 relevant for MV

Central Europe & Baltic Sea Region

- Public authorities or service providers, research institutions, chambers of commerce, associations, business support organisations, enterprises
- From EFRE: 247 Mio. / 263,8 Mio. Euro
- Co-financing EU for German participants: 80% / 75%
- Suggested Budget: 1 - 5 Mio. € Total
- Costs for personal, events, travels, external expertise, material, investments (limited)

Territorial Co-operation
INTERREG B – Open Calls

Central Europe

3rd call opened 21 Sept 2017; deadline 25 January 2018

Applying in four focus areas:
- Innovation and knowledge development
- Low carbon economy
- Natural and cultural resources
- Transport

Territorial Co-operation INTERREG B – Open Calls

BSR

3rd call planned for autumn 2017; deadline early April 2018

Applying in three focus areas:

- Innovation
- Natural resource management
- sustainable transport.

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Cross border co-operation INTERREG A

South Baltic Region

Germany, Poland, Sweden, Denmark, Lithuania

- Public authorities or service providers, research institutions, chambers of commerce, associations, business support organisations, enterprises (non-profit) with municipal order, e.g. energy management, public transport
- From EFRE: 60,7 Mill. Euro
- Co-financing rate for German partners: 85%

5th call will open 13 Nov 2017, deadline 15 Dec 2017

Only 1 Topic defined so far:

„Increased development of the South Baltic area's natural and cultural heritage assets into sustainable tourist destinations".

https://southbaltic.eu/call-for-proposals

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European Funding - Presentation

Thanks for attention!

Time for discussion of YOUR project ideas !

Frank Graage, Dr. Antje Hiller
Steinbeis Team Nordost
Partner of the Enterprise Europe Network

www.steinbeis-nordost.de

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Support by the Enterprise Europe Network M-V

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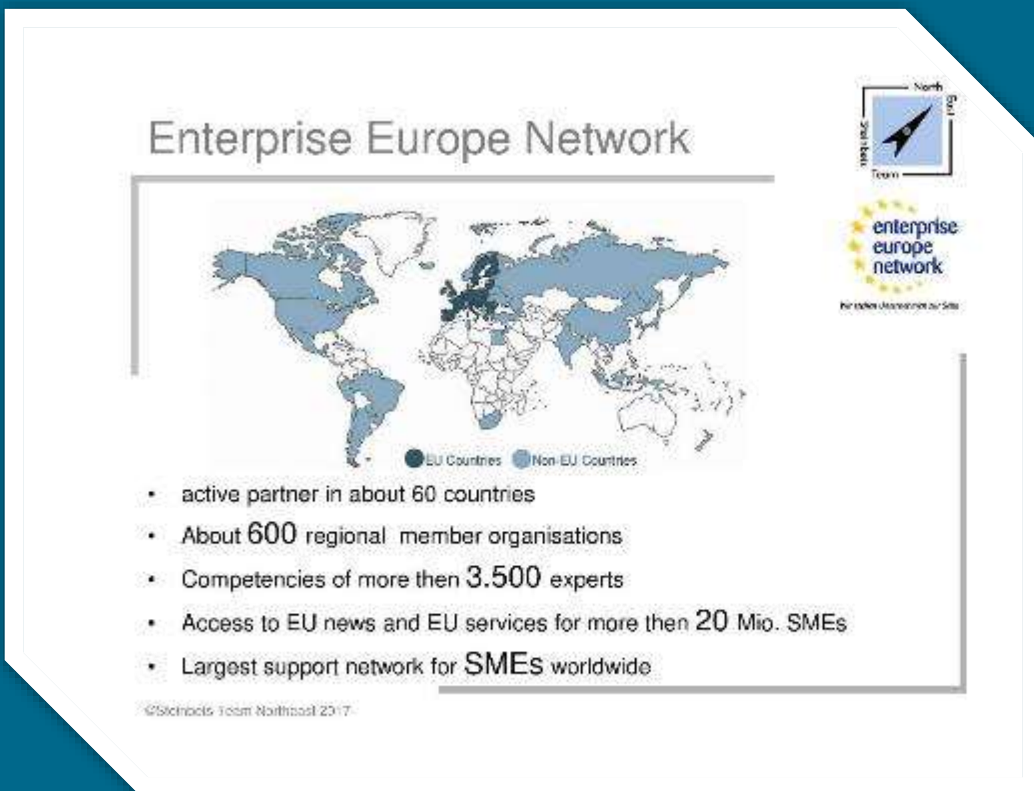

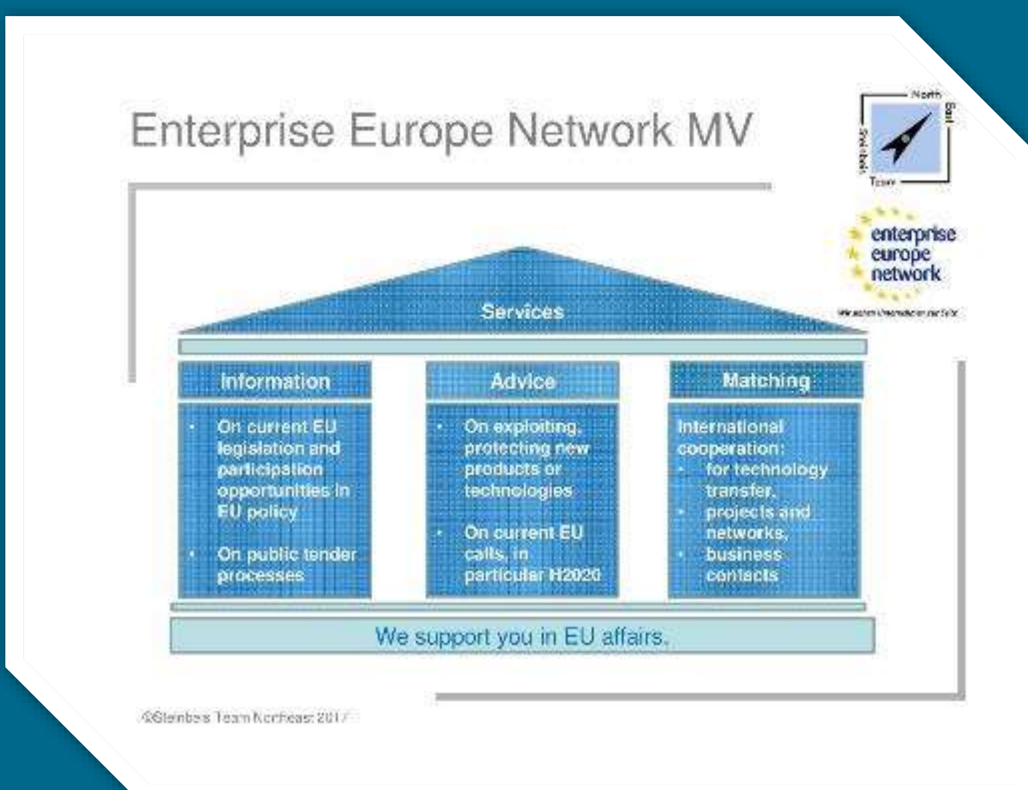

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European Funding - Presentation

Enterprise Europe Network MV

Information on EU- single market

- taxes,
- EU innovation strategy,
- EU legislation,
- public tender processes,
- EU financing instruments

EU Funding

We check out your project idea and identify suitable funding programmes.
We provide information, deadlines and procedure.

International contacts

We help you to find potential partners.

Brokerage events/ company missions

Examples:

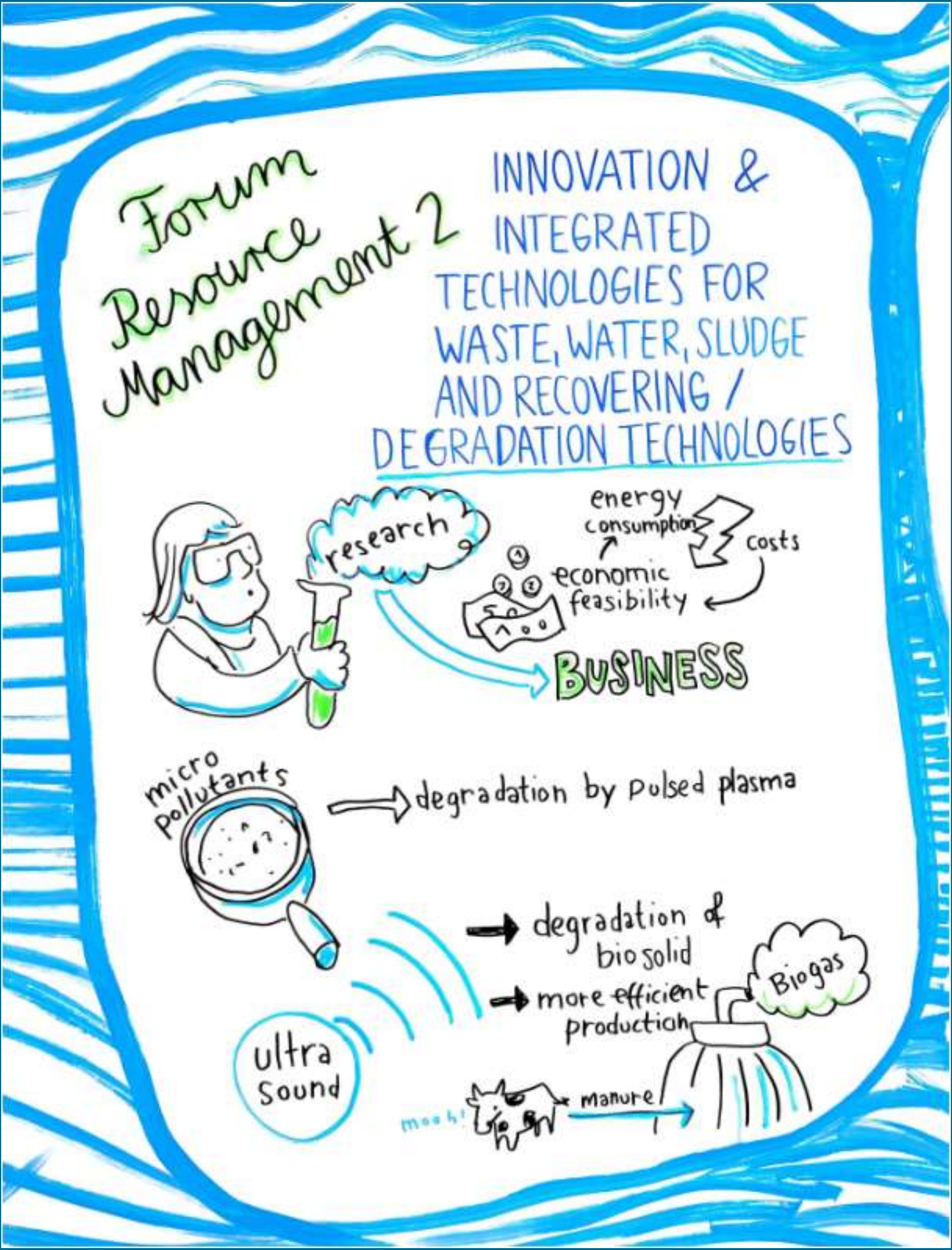
- International Business Matchmaking Mission on Renewable Energy: Solar Photovoltaic, Wind, Biomass
  2-3 Oct 2017 in Brasil
- About Japan! Cross-cultural workshop
  basic principles of Japanese business culture
  5 Oct 2017 in Krakow, Poland
- Offshore Energy match 2017
  9-11 October 2017 in Amsterdam, the Netherlands.
- Brokerage event in International Trade Fair of Renewable Energy Exposition "RENEXPO 2017"
  25-26 of October 2017, Warsaw, Poland

BALTIC CLEAN TECHNOLOGY 2017
European Funding - Presentation

Thursday, 28 September 2017

15:15 – 16:45

FORUM RESOURCE MANAGEMENT 2: Innovation and integretated technologies for waste, water, sludge and recovering / degradation technologies


Forum Resource Management 2
INNOVATION & INTEGRATED TECHNOLOGIES FOR WASTE, WATER, SLUDGE AND RECOVERING / DEGRADATION TECHNOLOGIES
research
energy consumption
costs
economic feasibility
BUSINESS
micro pollutants
degradation by pulsed plasma
degradation of bio solid
more efficient production
Biogas
ultra sound
mooh!
manure

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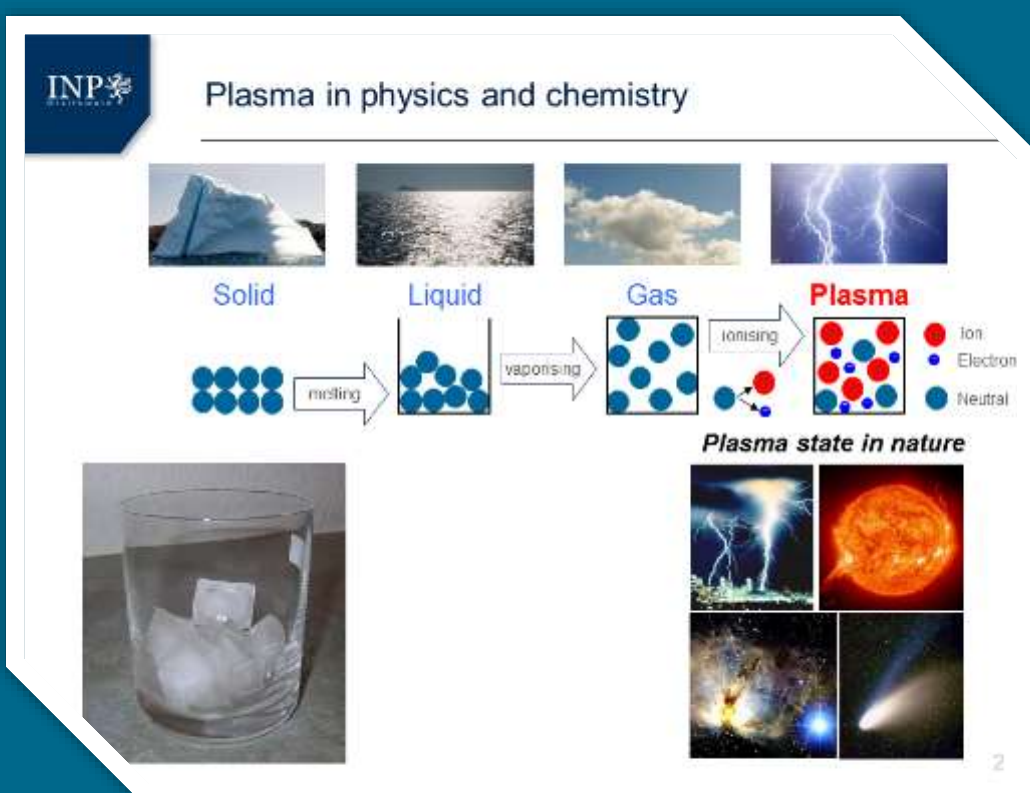
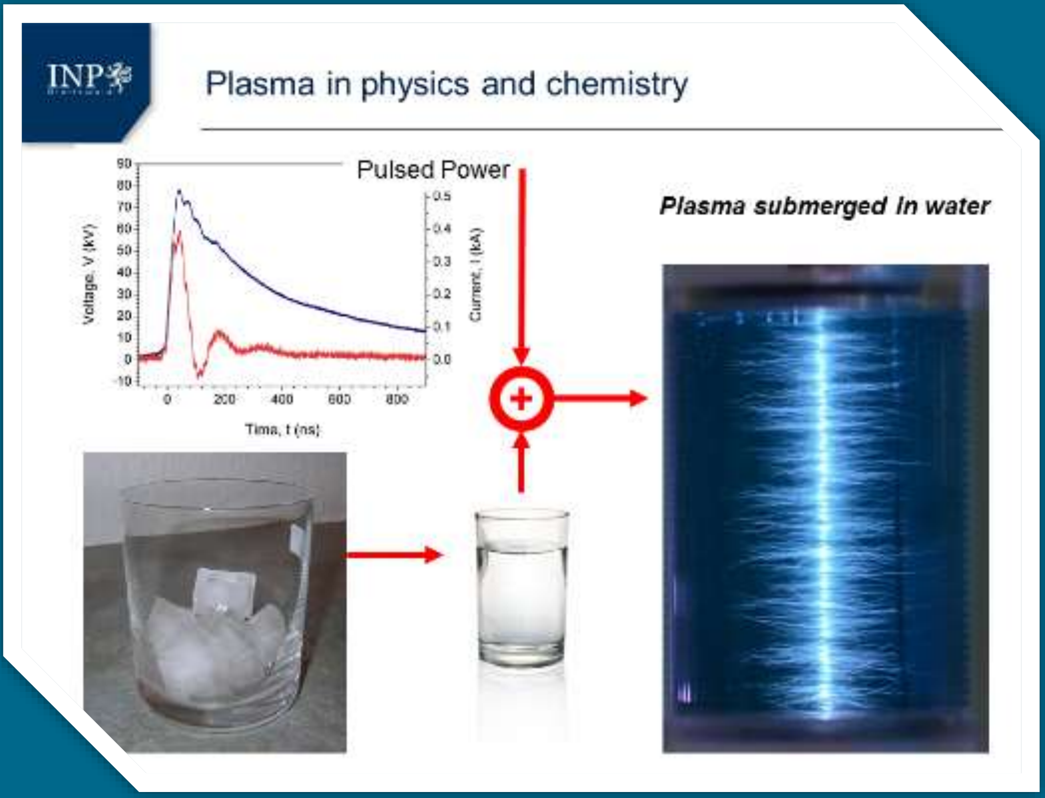
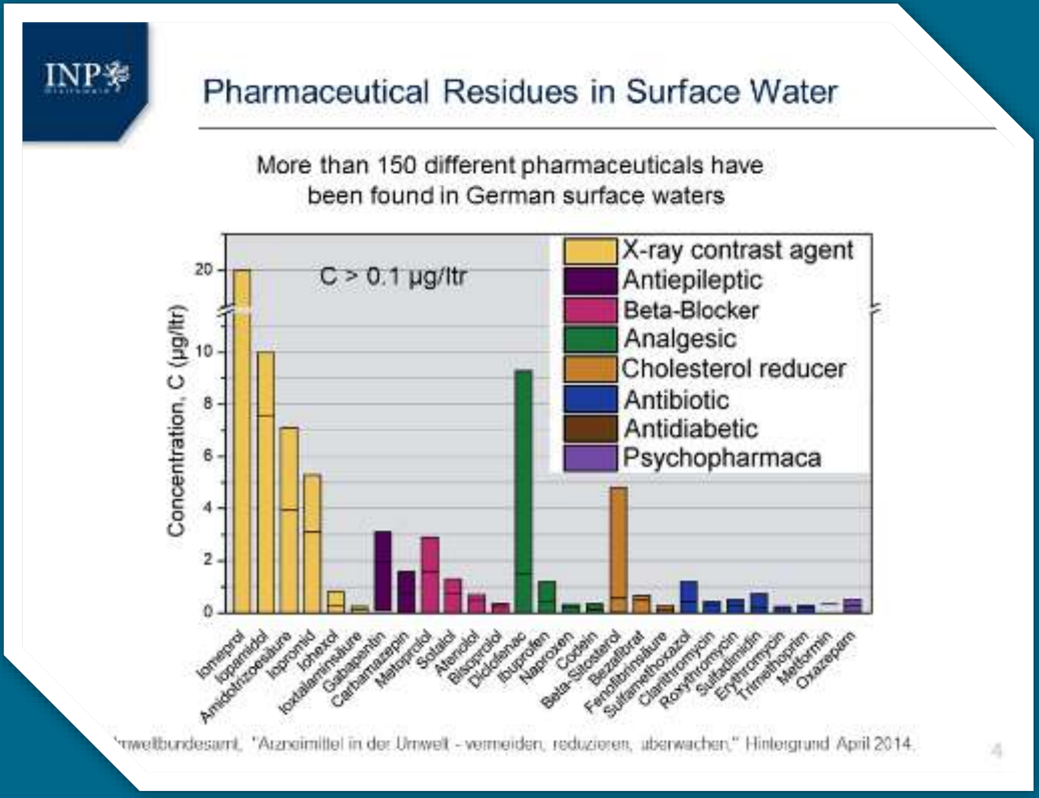
Forum RM 2 - Presentations





INP
Plasma in physics and chemistry
Pulsed Power
Voltage, V (kV)
Current, I (kA)
Time, t (ns)
Plasma submerged in water



INP
Pharmaceutical Residues in Surface Water
More than 150 different pharmaceuticals have been found in German surface waters
C > 0.1 µg/ltr
Concentration, C (µg/ltr)
X-ray contrast agent
Antiepileptic
Beta-Blocker
Analgesic
Cholesterol reducer
Antibiotic
Antidiabetic
Psychopharmaca
Iomeprol
Iopamidol
Amidotrizoesäure
Iopromid
Iohexol
Ioxtalaminsäure
Gabapentin
Carbamazepin
Metoprolol
Sotalol
Atenolol
Bisoprolol
Diclofenac
Ibuprofen
Naproxen
Codein
Beta-Sitosterol
Bezafibrat
Fenofibrinsäure
Sulfamethoxazol
Clarithromycin
Roxythromycin
Sulfadimidin
Erythromycin
Trimethoprim
Metformin
Oxazepam
Umweltbundesamt, "Arzneimittel in der Umwelt - vermeiden, reduzieren, überwachen," Hintergrund April 2014.
4

INP

Pharmaceutical Residues in Surface Water

EU-Directive
mandating actions to be taken by 2020

(EU Commission implementing decision (EU) 2015/495 of 20 March 2015 establishing a **watch list** of substances for Union-wide monitoring in the field of water policy pursuant to Directive 2008/105/EC of the European Parliament and of the Council. Off. J. Eur. Union L 78. ISSN: 1977-0677 58. 40e42.)

DECISIONS

www.theecologist.org/trial_investigations/268166/drugs_on_tap.html

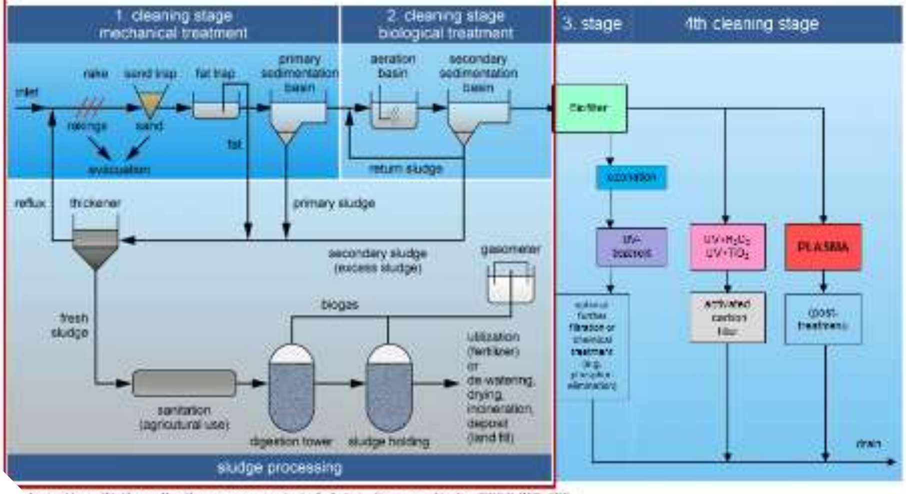
5

INP

Wastewater Treatment

most conventional water treatment plants

physio-chemical 4th-stage methods including plasma



...dapted from W. Gujer, Siedlungswasserwirtschaft, 3. Ed., Springer Berlin, (2007) 296-299

6

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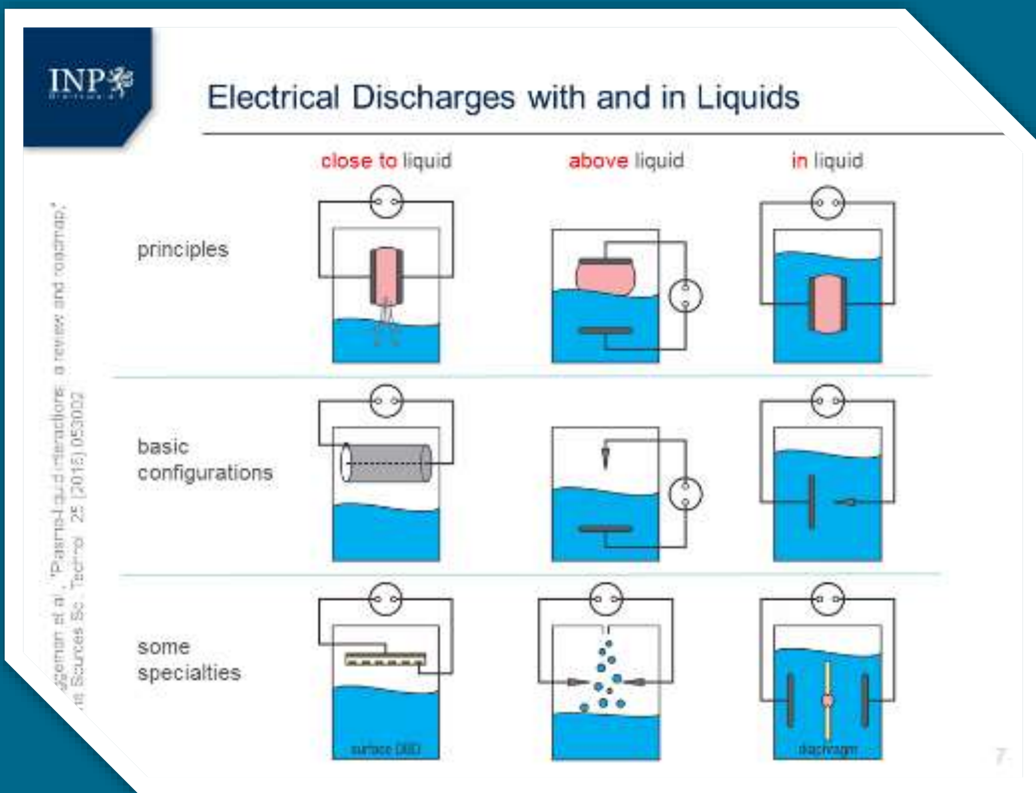
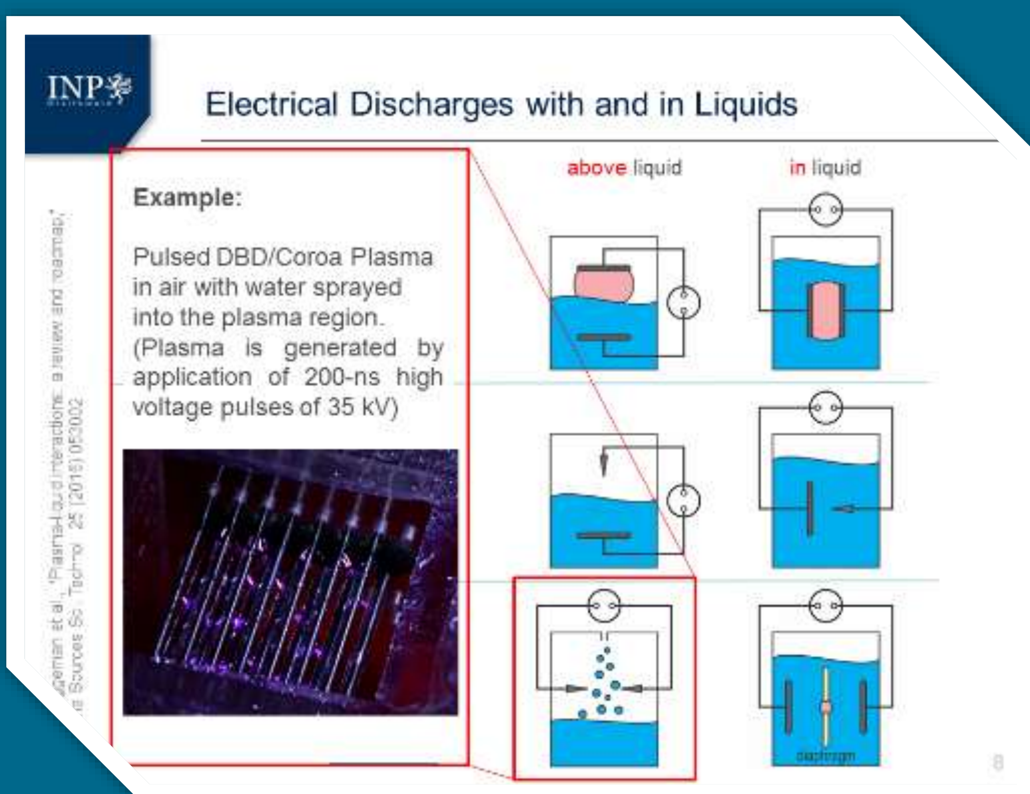
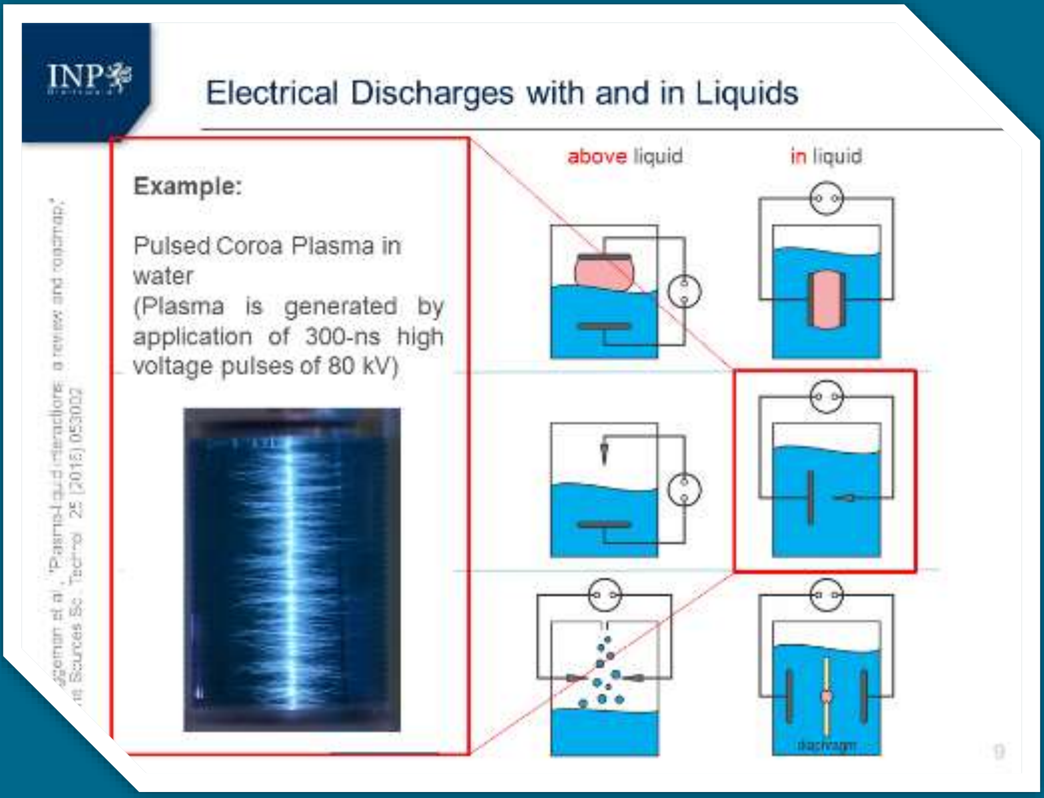
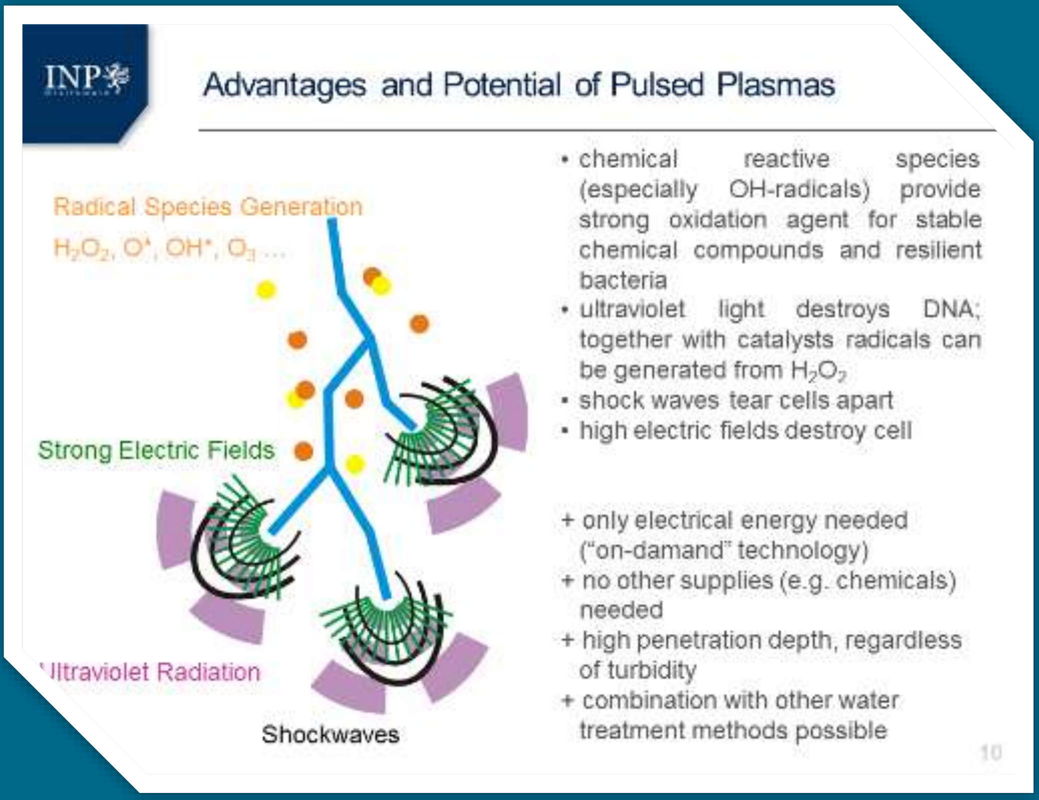
Forum RM 2 - Presentations



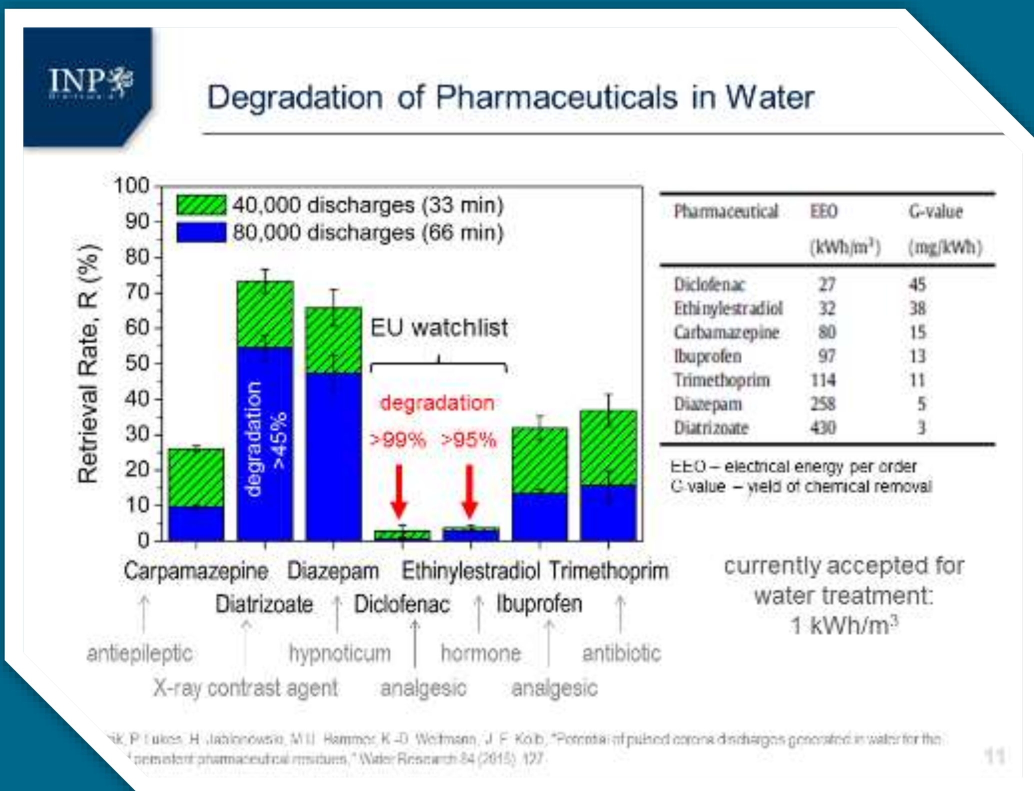




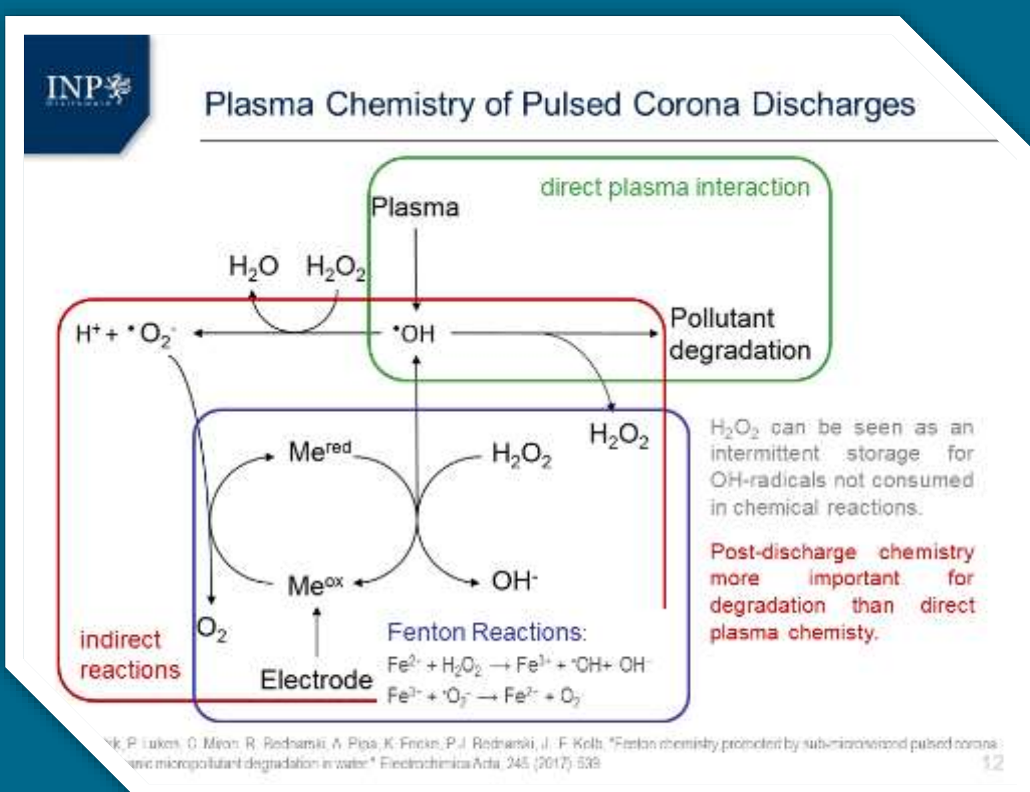
INP
Electrical Discharges with and in Liquids
above liquid
in liquid
Example:
Pulsed Coroa Plasma in water
(Plasma is generated by application of 300-ns high voltage pulses of 80 kV)
diaphragm
9



INP
Advantages and Potential of Pulsed Plasmas
Radical Species Generation
H_2O_2, O*, OH*, O_3 ...
Strong Electric Fields
Ultraviolet Radiation
Shockwaves
• chemical reactive species (especially OH-radicals) provide strong oxidation agent for stable chemical compounds and resilient bacteria
• ultraviolet light destroys DNA; together with catalysts radicals can be generated from H_2O_2
• shock waves tear cells apart
• high electric fields destroy cell
+ only electrical energy needed ("on-damand" technology)
+ no other supplies (e.g. chemicals) needed
+ high penetration depth, regardless of turbidity
+ combination with other water treatment methods possible
10



INP
Degradation of Pharmaceuticals in Water
Retrieval Rate, R (%)
40,000 discharges (33 min)
80,000 discharges (66 min)
EU watchlist
degradation >45%
degradation
>99% >95%
Carpamazepine Diazepam Ethinylestradiol Trimethoprim
Diatrizoate Diclofenac Ibuprofen
antiepileptic hypnoticum hormone antibiotic
X-ray contrast agent analgesic analgesic
Pharmaceutical EEO (kWh/m³) G-value (mg/kWh)
Diclofenac 27 45
Ethinylestradiol 32 38
Carbamazepine 80 15
Ibuprofen 97 13
Trimethoprim 114 11
Diazepam 258 5
Diatrizoate 430 3
EEO – electrical energy per order
G value – yield of chemical removal
currently accepted for water treatment: 1 kWh/m³
11



INP
Plasma Chemistry of Pulsed Corona Discharges
direct plasma interaction
Plasma
H2O H2O2
H+ + •O2-
•OH
Pollutant degradation
H2O2
Mered
H2O2
Meox
OH-
O2
Electrode
indirect reactions
Fenton Reactions:
Fe2+ + H2O2 → Fe3+ + •OH + OH-
Fe3+ + •O2- → Fe2+ + O2
H2O2 can be seen as an intermittent storage for OH-radicals not consumed in chemical reactions.
Post-discharge chemistry more important for degradation than direct plasma chemisty.
12

INP Greifswald

Summary

- Recalcitrant pharmaceuticals completely mineralized by application of pulsed corona discharges submerged in water
- Degradation attributed to OH-radical chemistry; Individual degradation rates and energy efficiencies depends on compound
- Negligible changes of pH-values and no significant increase of nitrate and nitrite concentrations
- Degradation of micropollutants by hydroxyl radicals: to take into account secondary mechanisms for OH-radical generation (metal released from electrodes important)

for publications: **www.pulsedpower.eu**

INP Greifswald

Contact

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www.pulsedpower.eu

14

Combined hydrolysis of biodegradable substrates and Wave-Box

Rostock, 28th September 2017

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PRE

Combined hydrolysis and Wave-Box

Developed by PRV and PRE – Neubrandenburg, Germany

1. Introduction
2. GHG emissions
3. Disintegration of organic structures
4. Hydrolysis
5. Wave-Box
6. Conclusion

ydrolysis and Wave Box – Dr. Gerald Vollmer Heuer

PRE

Combined hydrolysis and Wave-Box

Developed by PRV and PRE – Neubrandenburg, Germany

1. Who are PRV and PRE?

21 years experience in:

> Production and utilisation of energy from biomass
> Design and engineering of biogas plants
> Planning of heating, cooling and air conditioning systems
> District heating systems

Priority of work:

> Optimisation of production and utilisation of biogas
> Research and development (hydrolysis, ultrasound)

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Combined hydrolysis and Wave-Box

Developed by PRV and PRE – Neubrandenburg, Germany

2. GHG - Greenhouse gas emissions

Methane and CO_2 emissions from agriculture

> cattle
> manure
> digestate
> others

Anaerobic Digestion:

> Production of biogas/biomethane
> Production of organic fertilizer

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Combined hydrolysis and Wave-Box
Developed by PRV and PRE – Neubrandenburg, Germany

2. GHG - Greenhouse gas emissions

Methane and CO_2 emissions from manure and digestate

Recent studies showed a methane producing potential from digestate, resulting from remaining organics after digestion

Problems:
1. The biomethane production by AD process is less than possible
2. Methane emissions on fields are part of climate change

Reason:
Parts of organic solids are not available for microbial/enzymatic attack

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Combined hydrolysis and Wave-Box
Developed by PRV and PRE – Neubrandenburg, Germany

3. Disintegration of organic structures

Availability of organics
1. Some organic compounds are not degradable by AD: lignin is not usable for the biogas production, without strong alcalic polyol treatment
2. Some organic compounds are protected against mikrobial/enzymatic attack

Approach: Disintegration of structures

Basic principle: acceleration of speed-limiting step before digestion:

First step in AD process is „hydrolysis".

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Combined hydrolysis and Wave-Box
Developed by PRV and PRE – Neubrandenburg, Germany

3. Disintegration of organic structures

Some organic compounds are protected against mikrobial/enzymatic attack:
Increase of efficiency and biomethane as welll as reduction of methane emissions by better disintegration of substrates

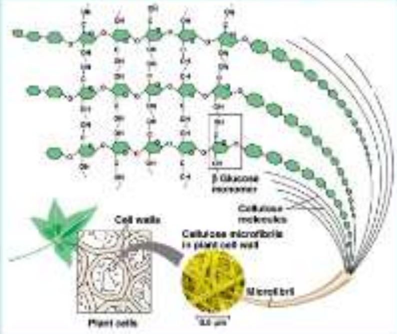

Fig. 1: structure of plant cell wall

Disintegration

I. Physical
   a) Mechanical
   b) Thermal
   c) Acoustical cavitation
II. Chemical
III: Biological/enzymatic
   (Hydrolysis)

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Combined hydrolysis and Wave-Box
Developed by PRV and PRE – Neubrandenburg, Germany

4. Hydrolysis
Biological-enzymatic hydrolysis

- Hydrolysis in AD process:
  - is limiting the speed of whole process

Reason: bacteria only can ingest small molecules

Effect:
- separate hydrolysis step dissolves substrate in watery medium (like digestion liquid)
- exoenzymes break polymere substrates as proteins, carbohydrats and fatty compounds
- water can infiltrate plant cells
- low pH-values and high temperature are benefical

But: protected substances need too much time

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Combined hydrolysis and Wave-Box
Developed by PRV and PRE – Neubrandenburg, Germany

4. Hydrolysis
Biological-enzymatic hydrolysis

- Aerobe Hydrolyse
- Anaerobe Hydrolyse
- Kombi-Hydrolyse mit Ultraschall

Hydrolysis and Wave Box – Dr. Gerald Vollmer Heuer

Combined hydrolysis and Wave-Box
Developed by PRV and PRE – Neubrandenburg, Germany

4. Hydrolysis

- Kombi-Hydrolysis with ultrasound:

Procedure: Kombi-Hydrolysis integrates substrate-feeding and disintegration in one step. Efficiacy is mechanical, biochemical as well as biological/enzymatic, supported by use of ultrasound (Wave-Box) and a Landia cutter pump.

Advantages:
- Low wear and tear,
- Cyclic mode effects multi-hydrolysis,
- Nutrients and micro-nutrients become available
- Viscosity decreases,
- 12-15-fold energy yield against energy demand

Disadvantages:
- Unknown

Hydrolysis and Wave Box – Dr. Gerald Vollmer Heuer

PRE Kombi-Hydrolysis

Efficient biogas production from manure and agriculture residues – easy to load

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PRE

PRE Kombi-Hydrolysis

Efficient biogas production from manure and agriculture residues – can be combined with Wave-Box

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PRE

The Wave-Box

Developed by PRV and PRE (Neubrandenburg, Germany)
supported by scientists of TU Hamburg

5. Wave-Box

Ultrasound system for the disintegration of biomass

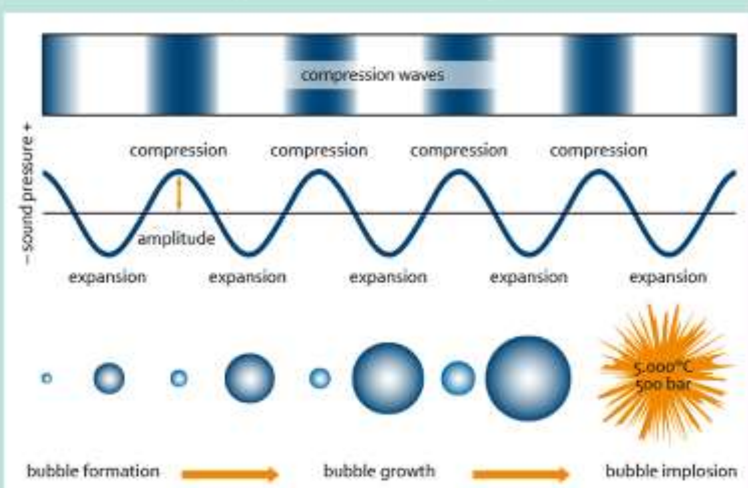
> Usable for different kinds of biomass and VS content
> Integrated High-Power-Ultrasound-Sonotrodes (HPUS)

Each sonotrode: 1 kW power output
Frequency: 20 kHz

- Hydraulic optimised piping
- Compact design – adaptable and scalable
- Self-regulating control unit

ydrolysis and Wave-Box – Dr. Gerald Vollmer-Heuer

Generating of cavitation by ultrasound



Physical process of cavitation
(Figure source: Sonotronic Nagel GmbH, Karlsbad)

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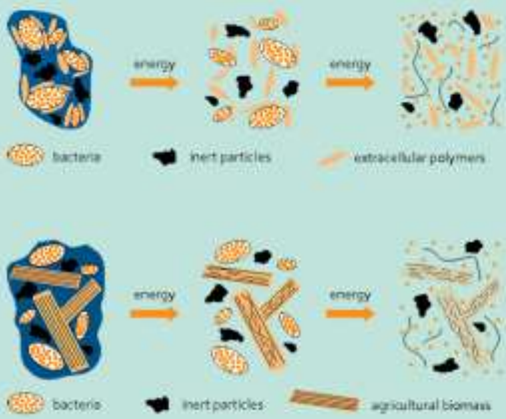
Effect of cavitation on organic structures



Upper line: effects on sewage sludge,
Lower line: effects on bacteria and agricultural biomass
(Figure source: Sonotronic Nagel GmbH, Karlsbad)

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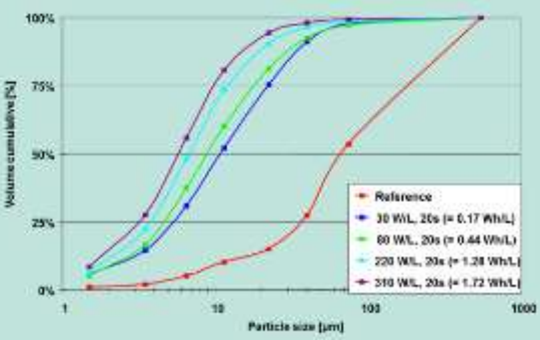
Hydrolysis and Wave Box – Dr. Gerald Vollmer Heuer

Effect of sonication on particle size distribution



Influence of increasing ultrasound energy input on particle size
(Figure source: TU Hamburg)

Physical effects:

- Lignin/hemicellulose-complexes destroyed
- Surplus of bacteria disintegrated: nutrients, enzymes and other organics become available
- Percentage of small particles increases
- Soluble COD increases
- Additional organic fraction available for methane production

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Hydrolysis and Wave-Box – Dr. Gerald Vollmer-Heuer

The Wave-Box - Biological and physical effects

Degradation enhancement:

- Significant higher CH_4 content
- Lower VS after whole process

Reduction of viscosity:

- Reduction of agitating time in digester and digestate storage
- Shorter pumping time, reduced wear and tear

Physical-chemical stability:

- No uncontrolled chemical reactions,
- (substances are not thermally modified)

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Case study: Zarrenthin Kombi-Hydrolysis and Wave-B

500 kW_{el} unit

Zarrenthin 1 (without Wave-Box)	Zarrenthin 2 (with Wave-Box)
20 m^3/d cattle slurry	20 m^3/d cattle slurry
20 t/d maize silage	17 t/d maize silage
5 t/d grass silage	3 t/d grass silage
CH_4-content 52%	CH_4-content 56%
VS in digestate 5.8 %	VS in digestate 3.2 %

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Case study: Zarrenthin

Wave-Box, treating second-step-digester medium, recirculating into Kombi-Hydrolysis

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Case study Göritz

Göritz biogas plant: Wave-Box, treating second-step-digester medium, recirculation back to digester

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New Wave-Box installation at Demmin

Demmin biogas plant: 716 kW_{el}
Wave-Box, treating digester medium, recirculation back to digester

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New Wave-Box installation at Rechlin

Rechlin Biogas Plant:
537 kW_{el}

Wave-Box,
treating digester medium,
recirculation back to digester

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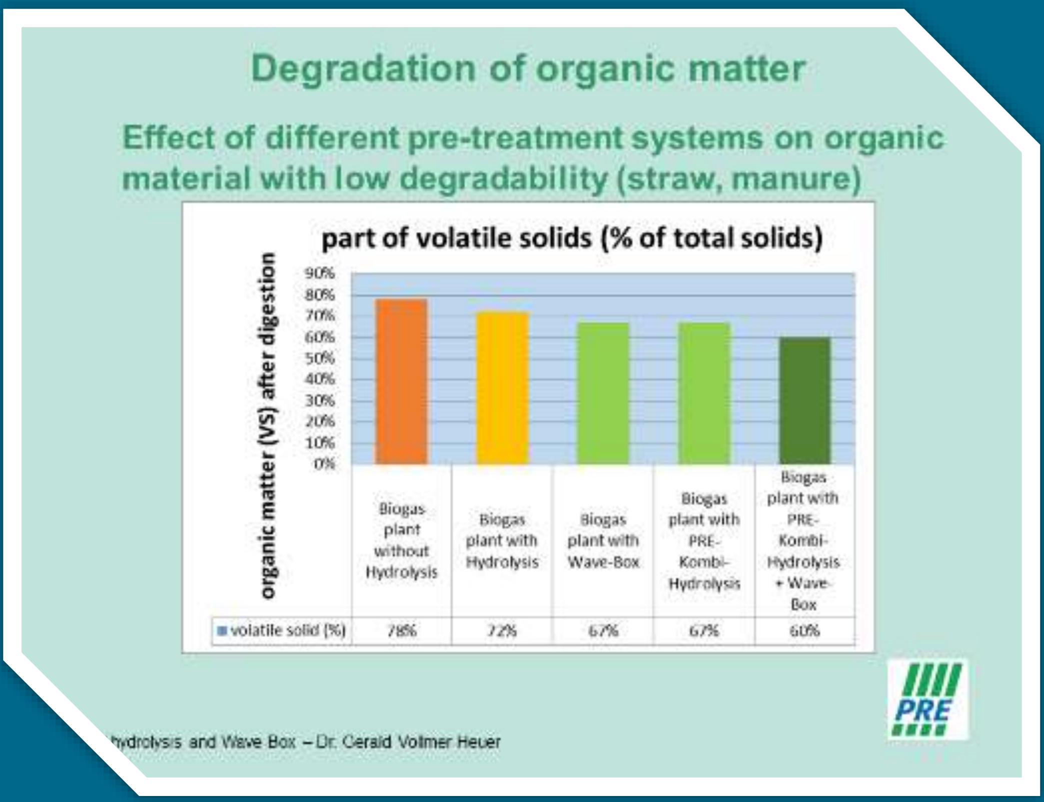

Degradation of organic matter
Effect of different pre-treatment systems on organic material with low degradability (straw, manure)
part of volatile solids (% of total solids)
organic matter (VS) after digestion
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Biogas plant without Hydrolysis
Biogas plant with Hydrolysis
Biogas plant with Wave-Box
Biogas plant with PRE-Kombi-Hydrolysis
Biogas plant with PRE-Kombi-Hydrolysis + Wave-Box
volatile solid (%)
78%
72%
67%
67%
60%
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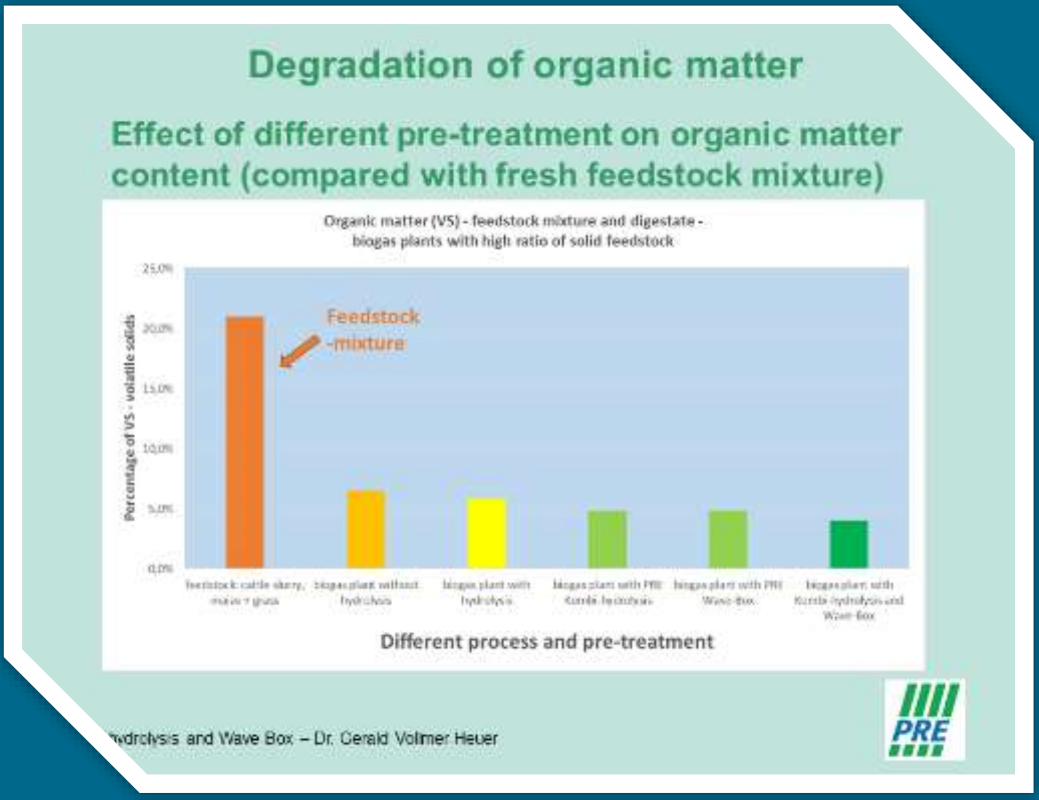

Degradation of organic matter
Effect of different pre-treatment on organic matter content (compared with fresh feedstock mixture)
Organic matter (VS) - feedstock mixture and digestate - biogas plants with high ratio of solid feedstock
Percentage of VS - volatile solids
Feedstock -mixture
Different process and pre-treatment
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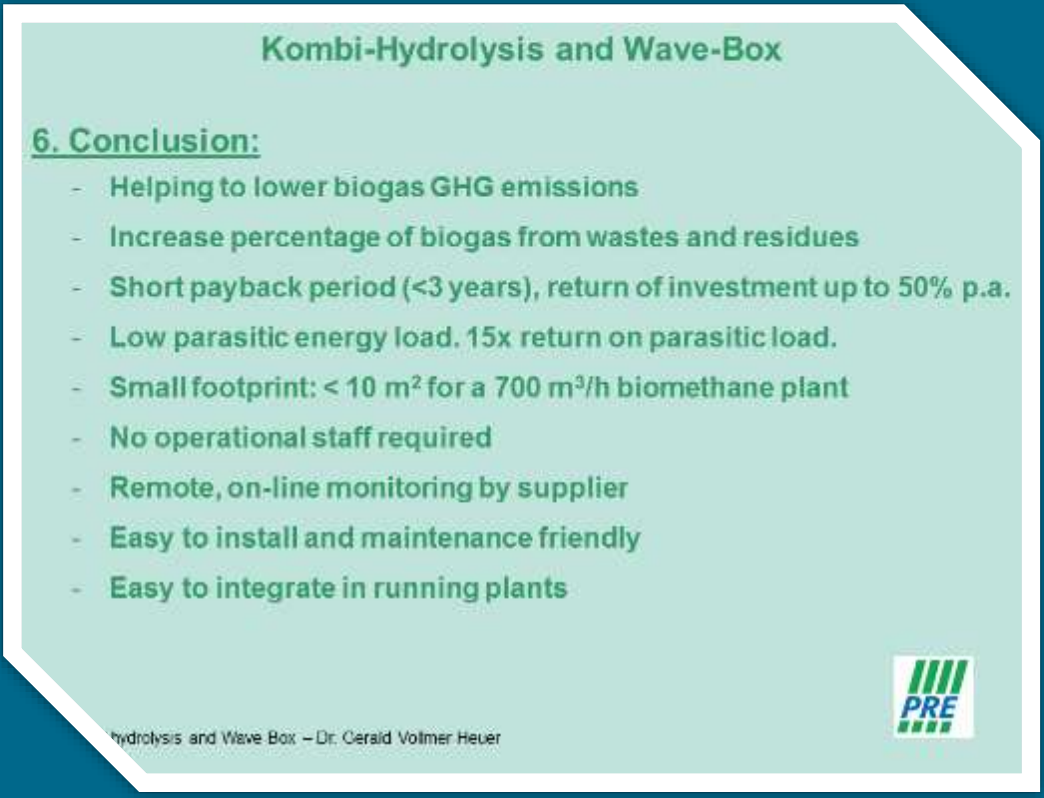
Kombi-Hydrolysis and Wave-Box
6. Conclusion:
- Helping to lower biogas GHG emissions
- Increase percentage of biogas from wastes and residues
- Short payback period (<3 years), return of investment up to 50% p.a.
- Low parasitic energy load. 15x return on parasitic load.
- Small footprint: < 10 m² for a 700 m³/h biomethane plant
- No operational staff required
- Remote, on-line monitoring by supplier
- Easy to install and maintenance friendly
- Easy to integrate in running plants
ydrolysis and Wave Box – Dr. Gerald Vollmer Heuer


PRE
Thank you for your attention!
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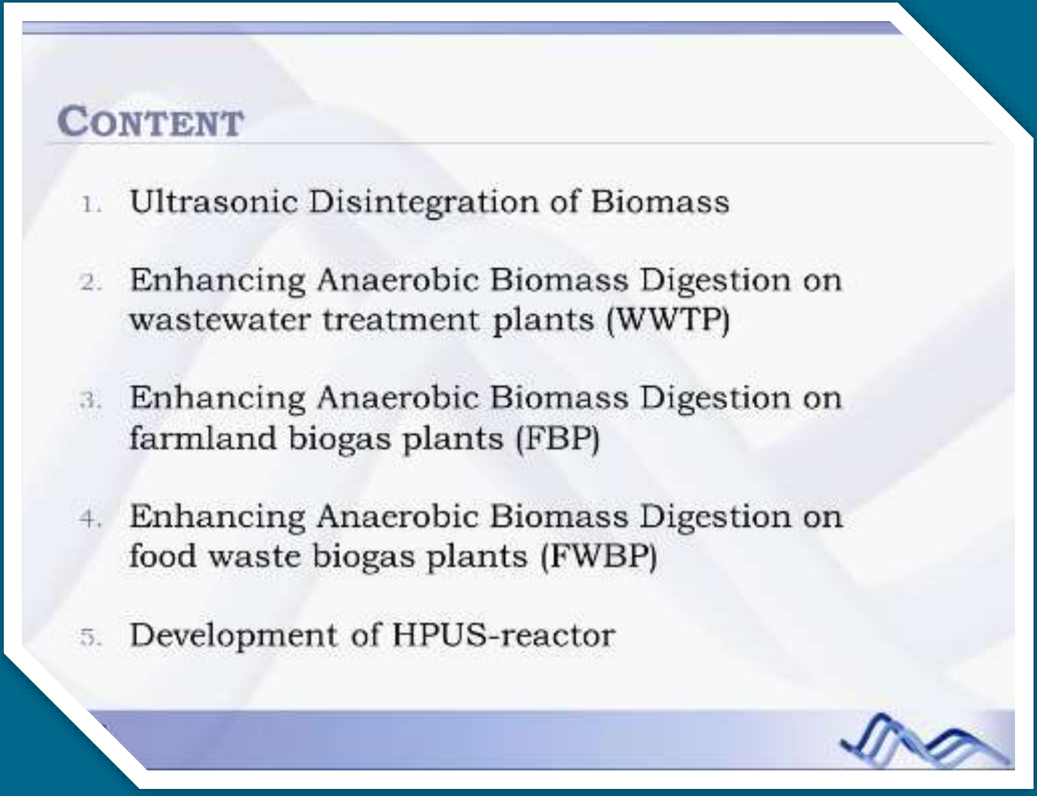
Phone: +49 395 7074709
Fax: +49 395 7782138
E-mail: info@pre-mv.de
Web: www.pre-mv.de
ydrolysis and Wave Box – Dr. Gerald Vollmer Heuer

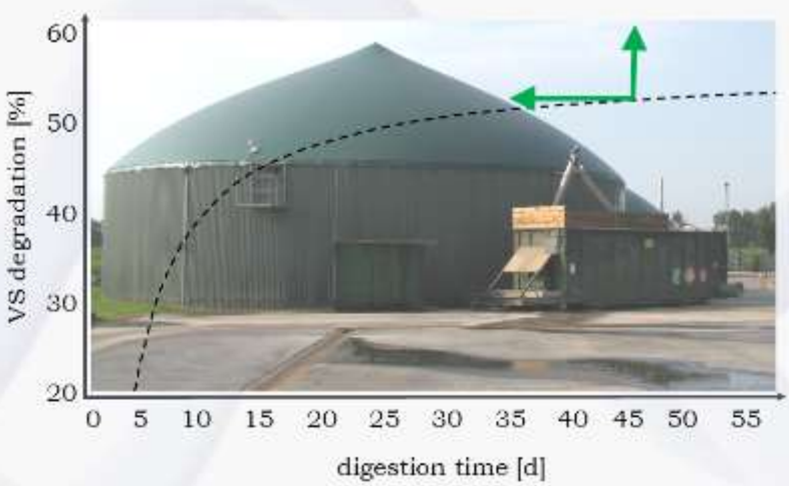
ULTRAWAVES
WASSER & UMWELTTECHNOLOGIEN GMBH
TUHH
Technische Universität Hamburg-Harburg
INTENSIFICATION OF BIOSOLIDS DEGRADATION DUE TO APPLICATION OF HIGH-POWER ULTRASOUND
Dr.-Ing. Klaus Nickel, Dipl.-Ing. Gunnar Klingspor, Prof. Dr.-Ing. Uwe Neis
ULTRAWAVES GmbH
Water & Environmental Technologies

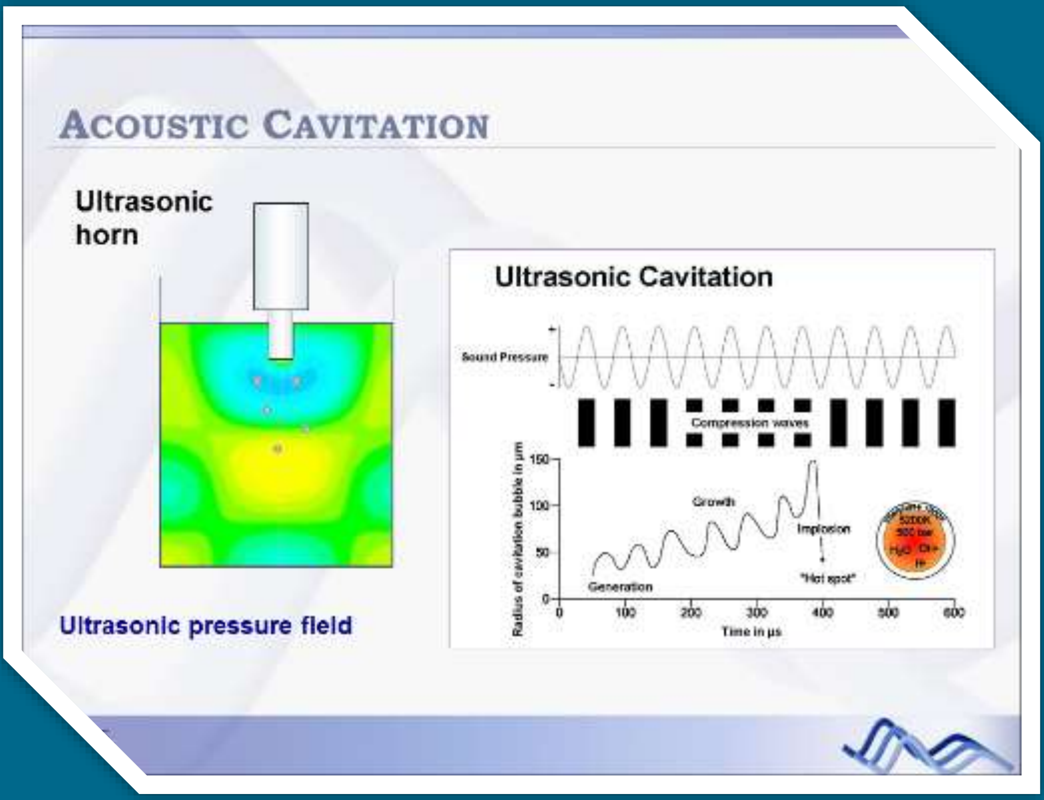


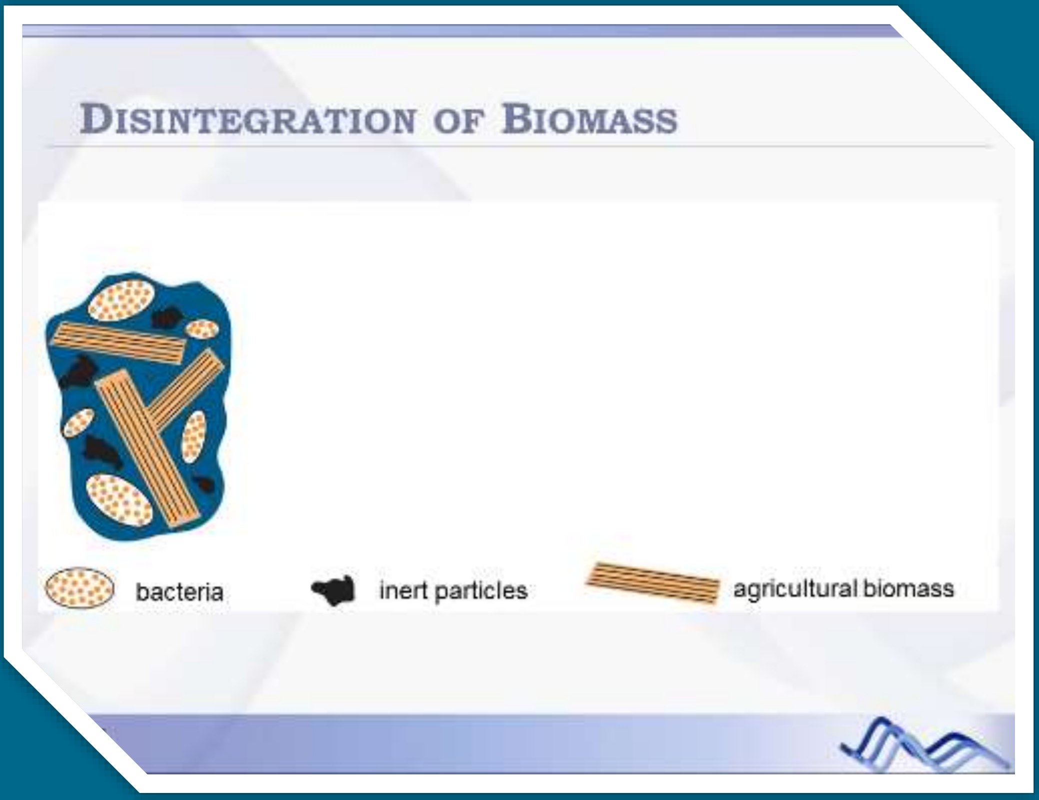
CONTENT
1. Ultrasonic Disintegration of Biomass
2. Enhancing Anaerobic Biomass Digestion on wastewater treatment plants (WWTP)
3. Enhancing Anaerobic Biomass Digestion on farmland biogas plants (FBP)
4. Enhancing Anaerobic Biomass Digestion on food waste biogas plants (FWBP)
5. Development of HPUS-reactor

ULTRASONIC DISINTEGRATION OF BIOMASS

ANAEROBIC DIGESTION – LIMIT OF DEGRADATION

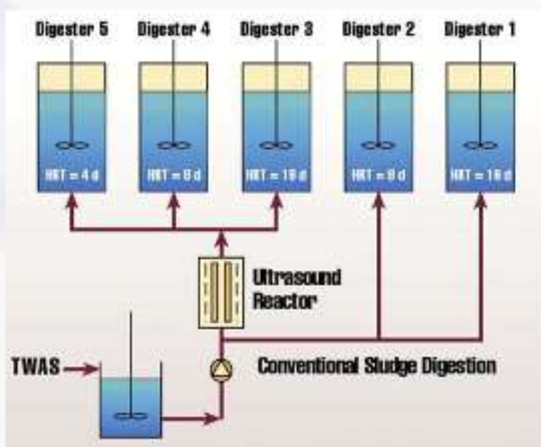


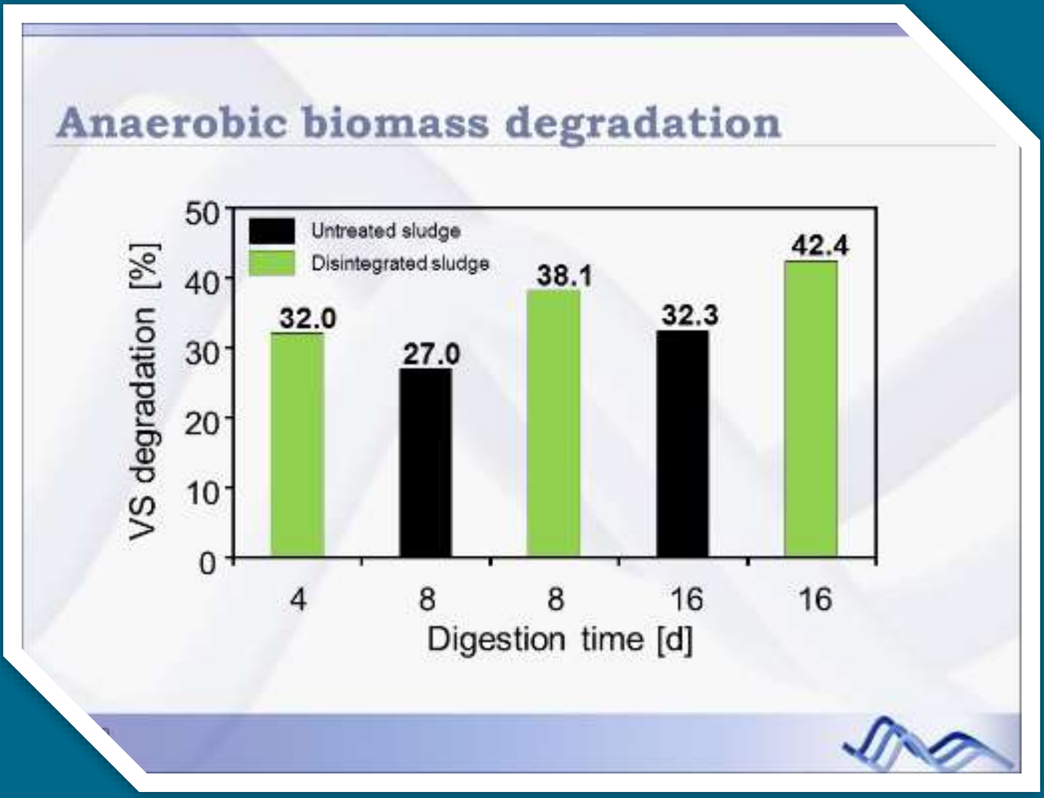

Acoustic Cavitation
Ultrasonic horn
Ultrasonic pressure field
Ultrasonic Cavitation
Sound Pressure
Compression waves
Radius of cavitation bubble in µm
150
100
50
0
Growth
Implosion
Generation
"Hot spot"
0
100
200
300
400
500
600
Time in µs


Disintegration of Biomass
bacteria
inert particles
agricultural biomass

ENHANCING ANAEROBIC BIOMASS DEGRADATION ON WASTEWATER TREATMENT PLANTS (WWTP)

Pilot scale plant set-up




Anaerobic biomass degradation
VS degradation [%]
Untreated sludge
Disintegrated sludge
32.0
27.0
38.1
32.3
42.4
0
10
20
30
40
50
4
8
8
16
16
Digestion time [d]


Bamberg WWTP, Germany

Bamberg WWTP, Germany

Initial conditions:

- Design capacity: 220,000 PE
- Actual Load: 330,000 PE
- 150 m^3/d primary sludge, 250 m^3/d WAS
- (3) egg shaped digesters with 18 d digestion time
- 35% average VS degradation

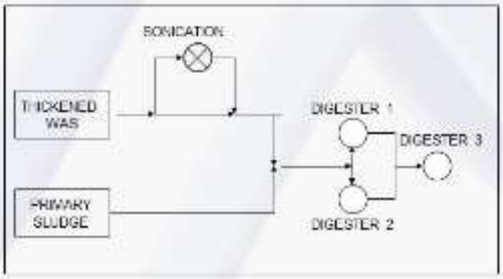
Goal:

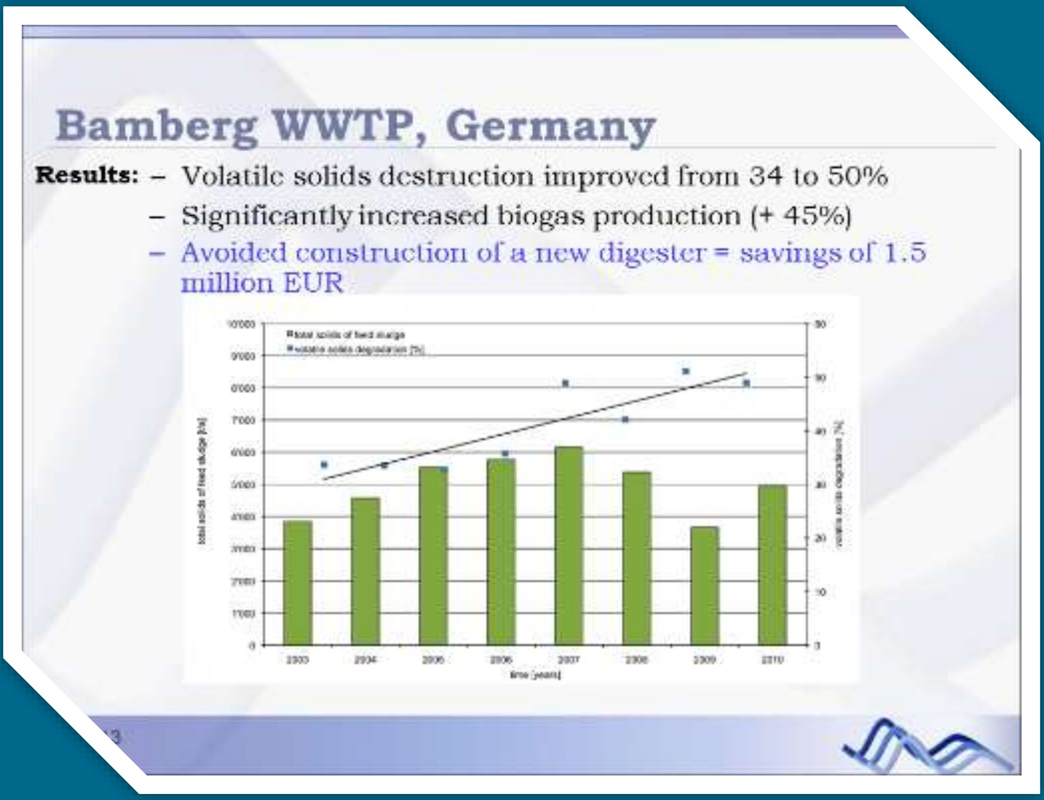
- Achieve a minimum of 40% VS degradation
  - Solution 1: Build another 3,000 m^3 egg shaped digester
  - Solution 2: Use of ultrasound to increase VS destruction

Bamberg WWTP, Germany

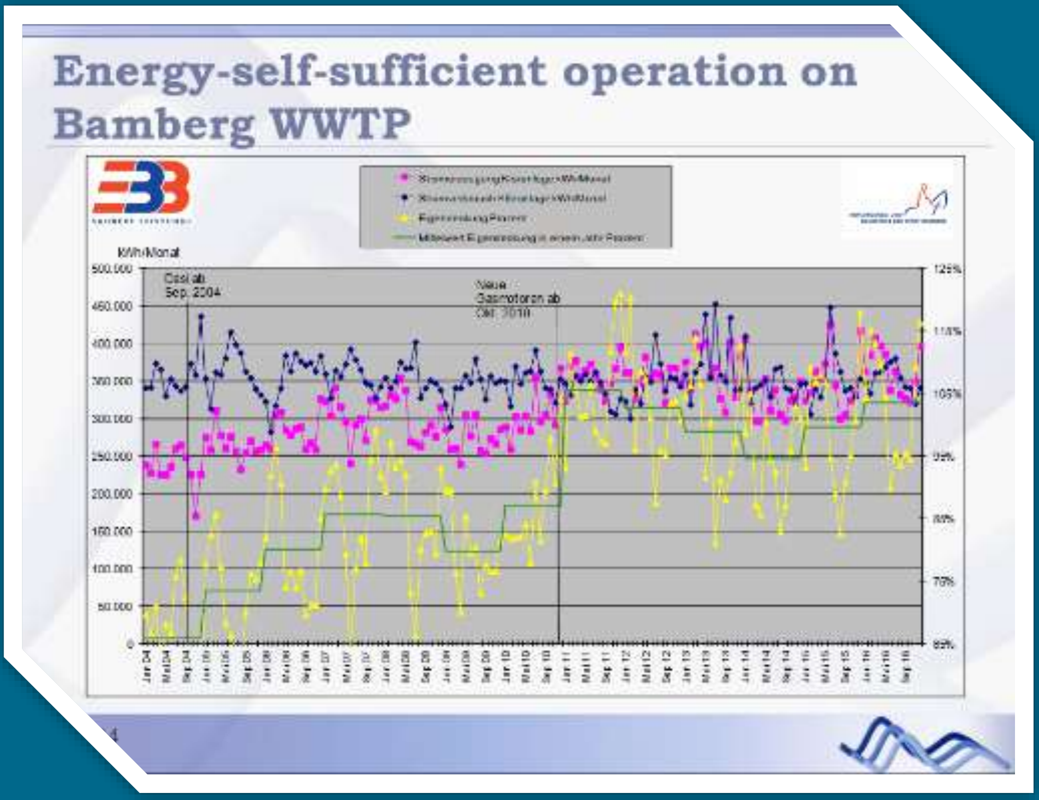
Ultrasound installation in 2004:

Sonication of 30% (in 2004) - 80% (in 2007) of the WAS (~ 70 – 100 m^3/d) @ 2 - 3 kWh/m^3

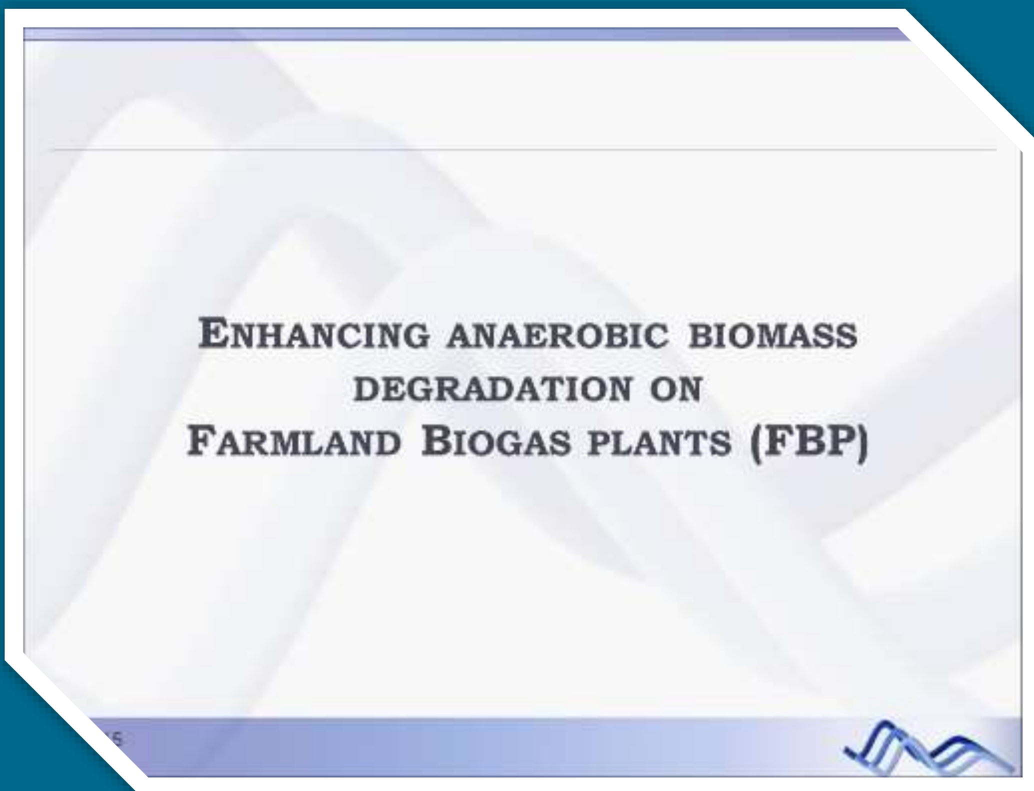




Bamberg WWTP, Germany
Results: – Volatile solids destruction improved from 34 to 50%
– Significantly increased biogas production (+ 45%)
– Avoided construction of a new digester = savings of 1.5 million EUR
total solids of feed sludge
volatile solids degradation [%]
2003
2004
2005
2006
2007
2008
2009
2010
time [years]



Energy-self-sufficient operation on Bamberg WWTP
kWh/Monat
Gas ab Sep. 2004
Neue Gasmotoren ab Okt. 2010


ENHANCING ANAEROBIC BIOMASS
DEGRADATION ON
FARMLAND BIOGAS PLANTS (FBP)


BORDESHOLMERLAND FBP, GERMANY

BALTIC CLEAN TECHNOLOGY 2017
Forum RM 2- Presentation

BORDESHOLMERLAND FBP, GERMANY

Initial conditions:

- 2 parallel lines
- size 2 x 537 kW
- 2 main digester à 2.500 m^3, 2 post digester à 2.500 m^3, 2 storage à 2.500 m^3
- input: 2 x 25 t/d maize
- retention time: 90 days/digester
- biogas production: 2 x 6150 m^3/d
- methane concentration ca. 50%

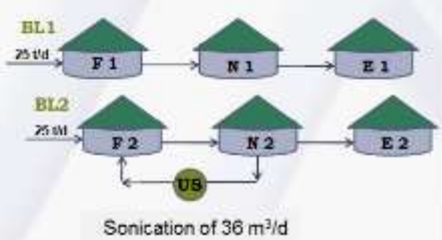
Goal:

- reduce amount of substrate

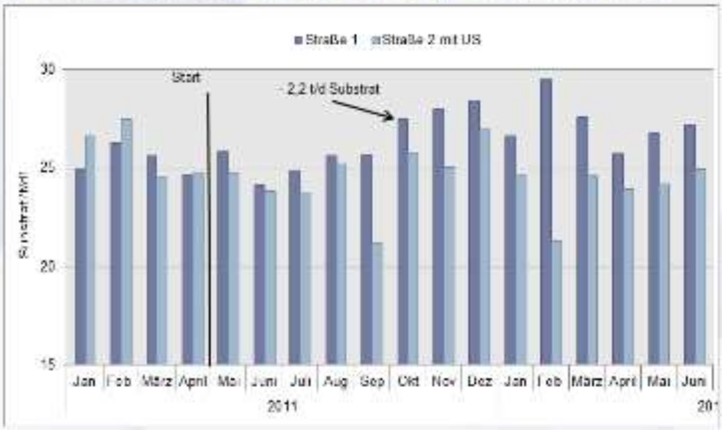
BORDESHOLMERLAND FBP, GERMANY

Ultrasound installation in 2011:

Sonication of partial flow (36 m^3/d) from post digester to main digester (@ 3.3 kWh/m^3) in line 2



BORDESHOLMERLAND FBP, GERMANY



Results: • 2,2 t/d less substrate on line 2 compared to line 1
• increase in methane content to 53% (+ 3%)
• increase in el. power production from 537 kW (line 1) to 570 kW (line 2)

Enhancing anaerobic biomass degradation on Food waste Biogas plants (FWBP)

Mariks FWBP, Germany

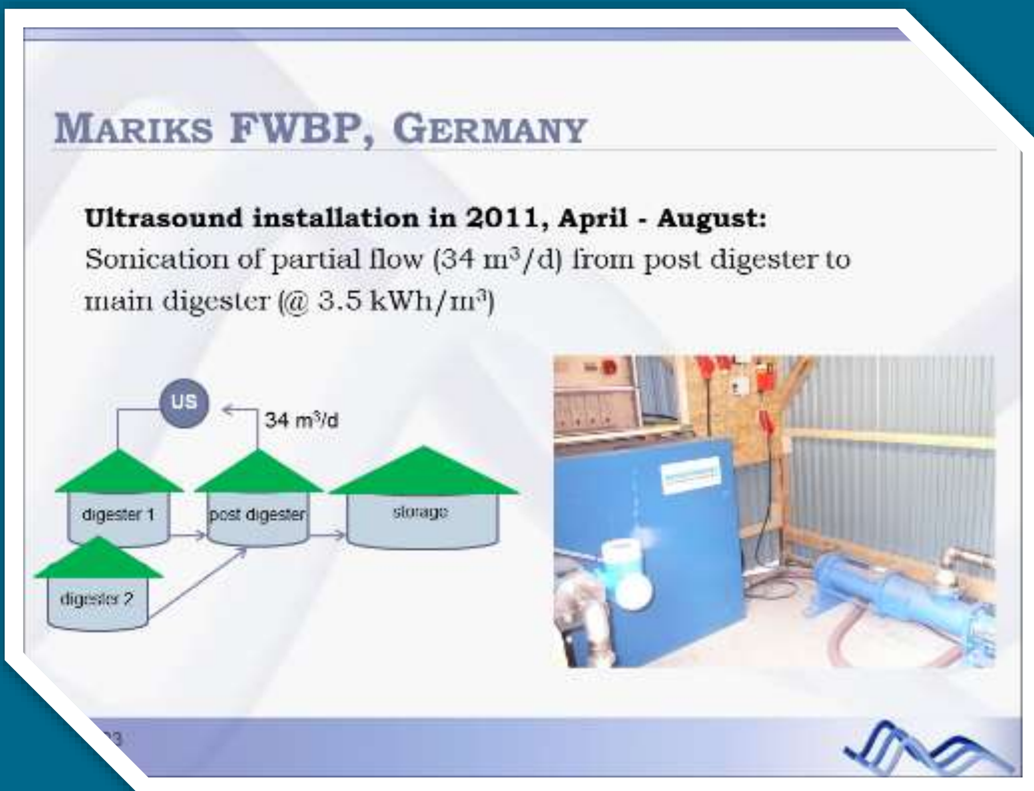
Mariks FWBP, Germany

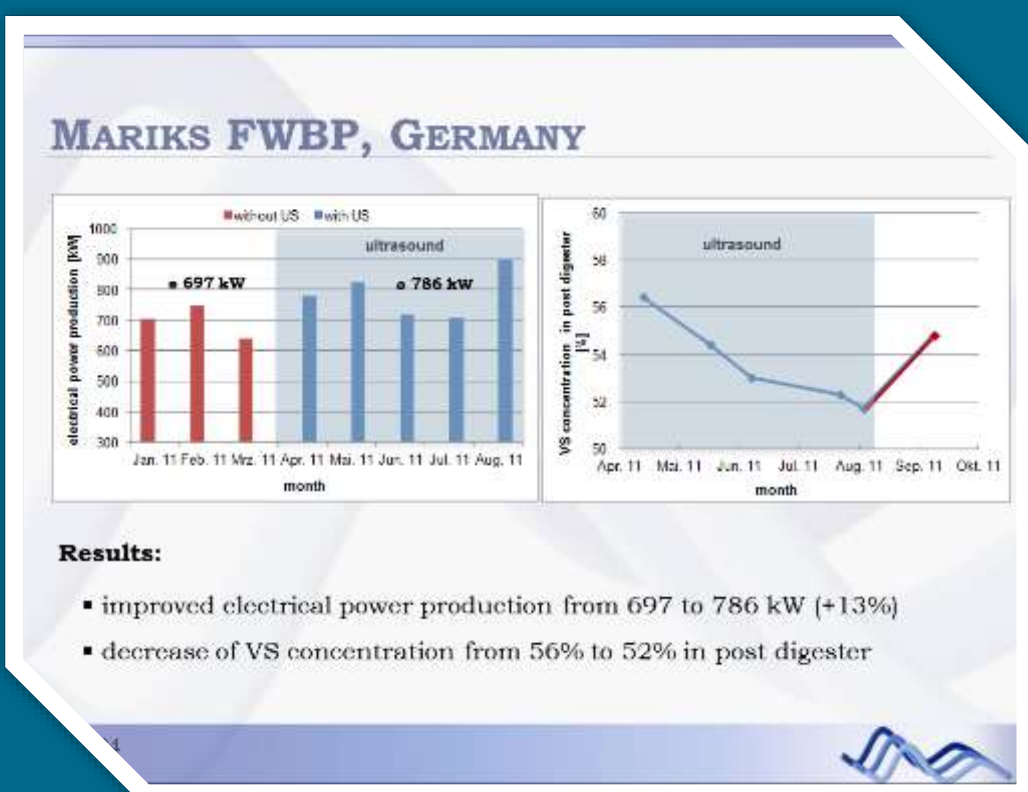
Initial conditions:

- 2 main digester à 1.800 m³, 1 post digester à 1.800 m³, storage tank à 5000 m³
- input: 73 t/d
- retention time: 40 days
- electrical power production: 700 kW
- methane concentration ca. 56-61%

Goal:

- increase in biogas production


MARIKS FWBP, GERMANY
Ultrasound installation in 2011, April - August:
Sonication of partial flow (34 m³/d) from post digester to main digester (@ 3.5 kWh/m³)
US
34 m³/d
digester 1
post digester
storage
digester 2

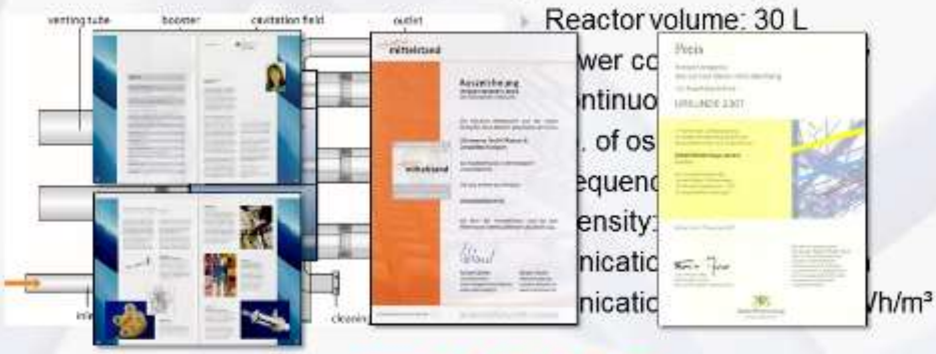

MARIKS FWBP, GERMANY
without US
with US
ultrasound
697 kW
786 kW
electrical power production [kW]
1000
900
800
700
600
500
400
300
Jan. 11 Feb. 11 Mrz. 11 Apr. 11 Mai. 11 Jun. 11 Jul. 11 Aug. 11
month
VS concentration in post digester [%]
60
58
56
54
52
50
Apr. 11 Mai. 11 Jun. 11 Jul. 11 Aug. 11 Sep. 11 Okt. 11
Results:
▪ improved electrical power production from 697 to 786 kW (+13%)
▪ decrease of VS concentration from 56% to 52% in post digester

US-reactor for biomass treatment
Requirements

- Treatment of large volumetric biomass streams
- High degree of biomass cell disintegration
- Continuous operation despite of varying biomass properties
- Resistant against reactor blockage (biomass impurities)
- Automatic system
- Low maintenance

Full-scale HP-Ultrasound System 2006

Technology Transfer Innovation 2002 *Innovation Award German Industry 2006* *Innovation Award Baden Württemberg 2007*



TUHH
Technische Universität Hamburg-Harburg

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Forum RM 2 - Presentations

WAVE-BOX: P&P-SYSTEM

- Components:
  - Modified Excentric Screw Pump
  - HPUS
  - Volumetric flowmeter
- Completely automated (24/7) & simple integration

AD ON FBP/FWBP: MORE CASES

- Beerlage FBP, GER (1,500 kW)
- Bispingen FBP, GER (1,100 kW)
- Demmin FBP, GER (716 kW)
- Ense FBP, GER (3,500 kW)
- Göritz FBP, GER (600 kW)
- Hellweg FBP, GER (500 kW)
- Haren FBP, GER (590 kW)
- Lindow FBP, GER (500 kW)
- Löhndorf FBP, GER (1,000 kW)
- Rechlin FBP, GER (537 kW)
- Wittenburg FBP, GER (716 kW)
- Wulkow FBP, GER (400 kW)
- Zarrenthin FBP, GER (537 kW)

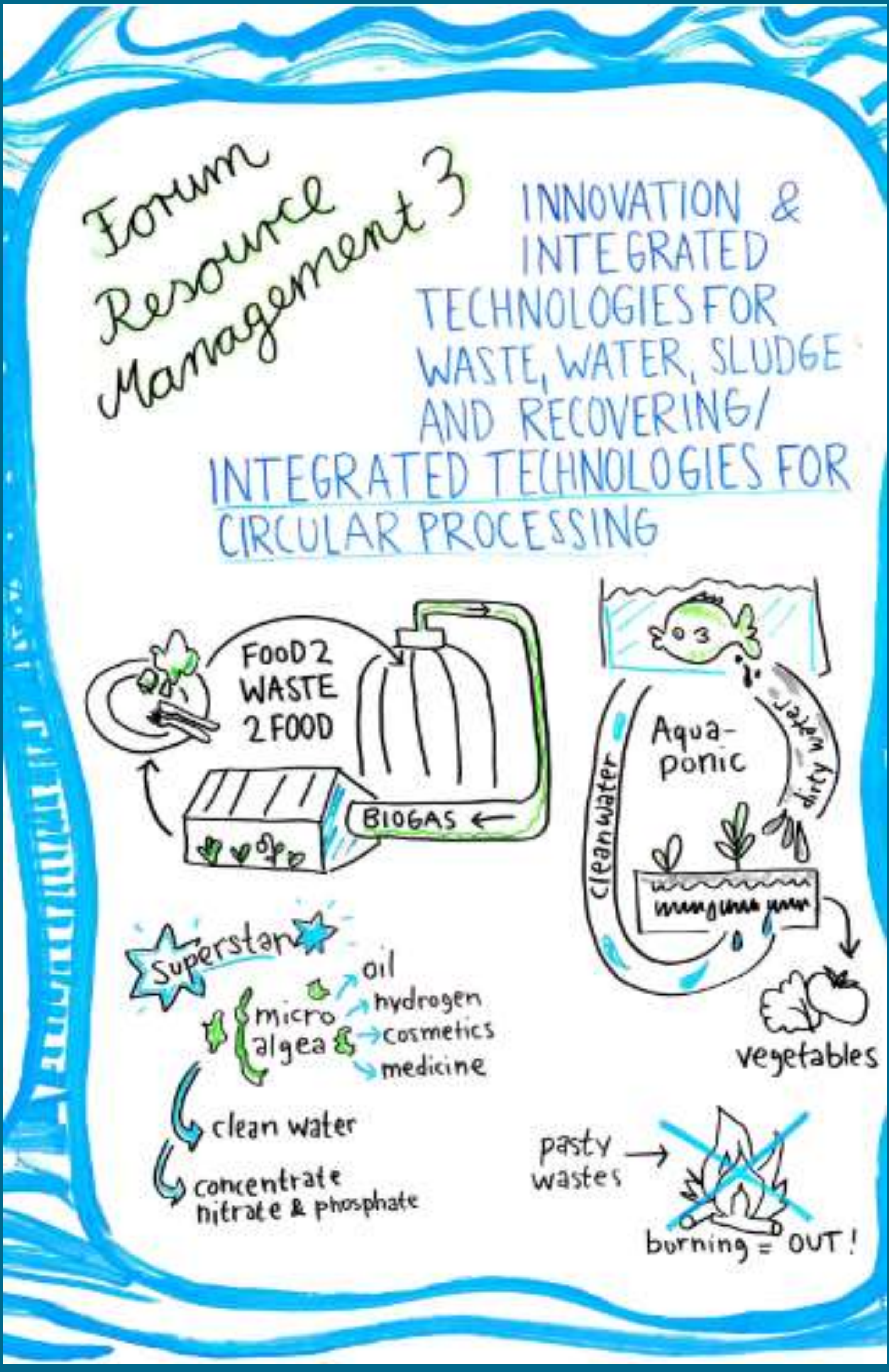
Conclusions

- Biomass treatment with ultrasound is an established technology
- Detailed studies have demonstrated the potential of ultrasound for enhanced biodegradation of biomass
- More than 80 Ultrawaves HPUS reference installations

Thursday, 28 September 2017

15:15 – 16:45

FORUM RESOURCE MANAGEMENT 3: Innovation and integretated technologies for waste, water, sludge and recovering / integrated technologies for circular processing


Forum Resource Management 3
INNOVATION & INTEGRATED TECHNOLOGIES FOR WASTE, WATER, SLUDGE AND RECOVERING/
INTEGRATED TECHNOLOGIES FOR CIRCULAR PROCESSING
FOOD 2 WASTE 2 FOOD
BIOGAS
Aqua-ponic
clean water
dirty water
vegetables
Superstar
micro algea
oil
hydrogen
cosmetics
medicine
clean water
concentrate nitrate & phosphate
pasty wastes
burning = OUT!

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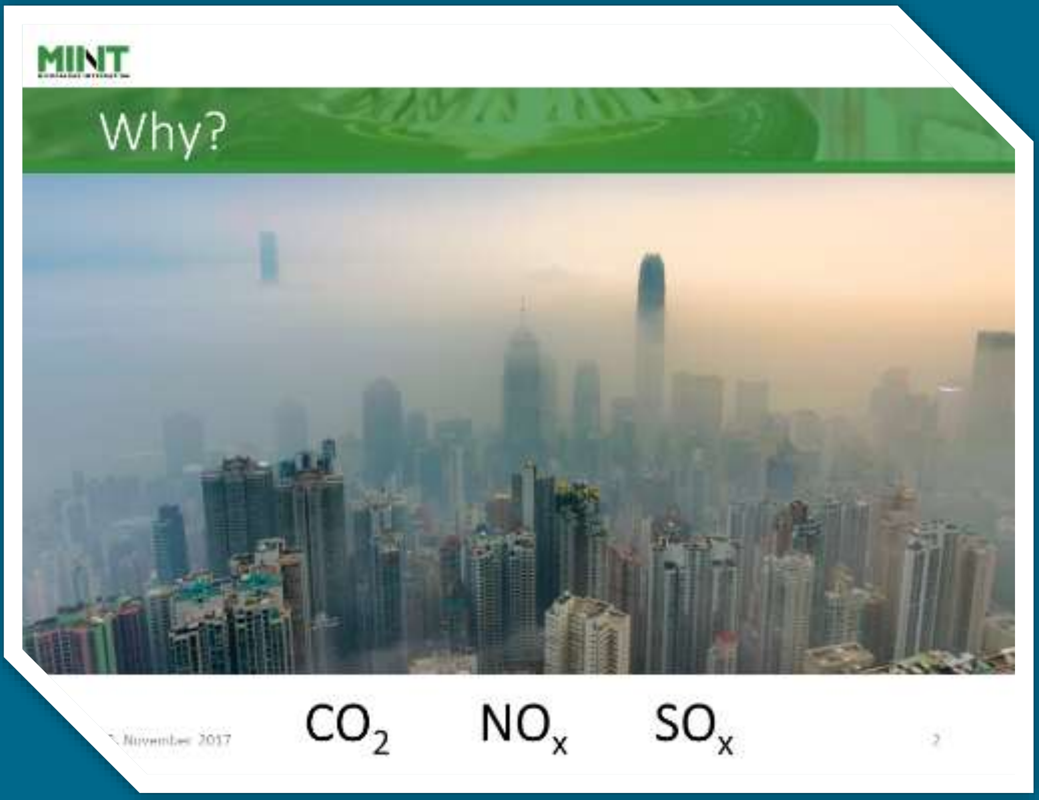
Forum RM 3 - Presentations



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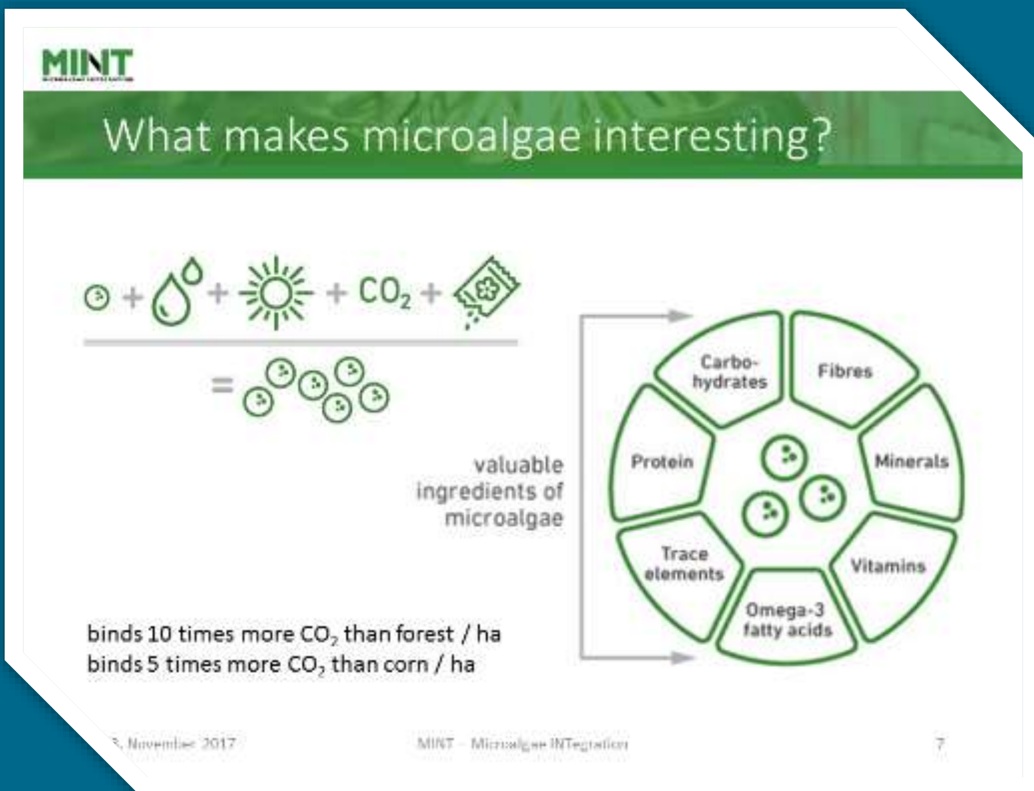

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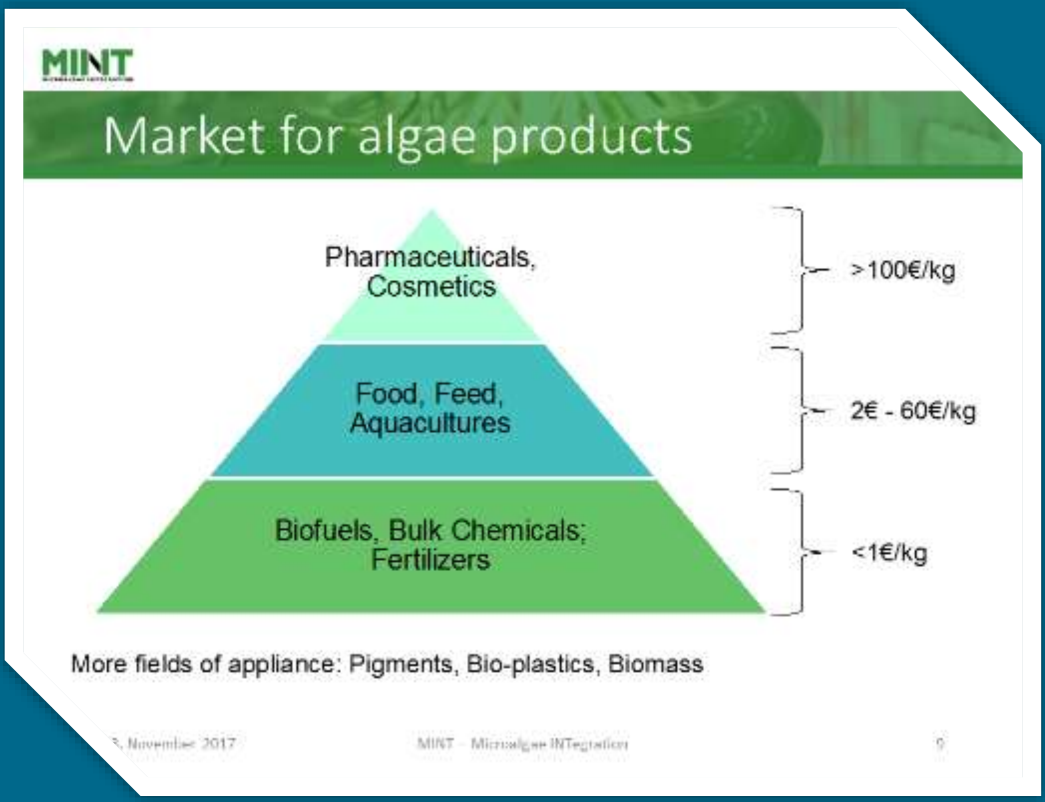
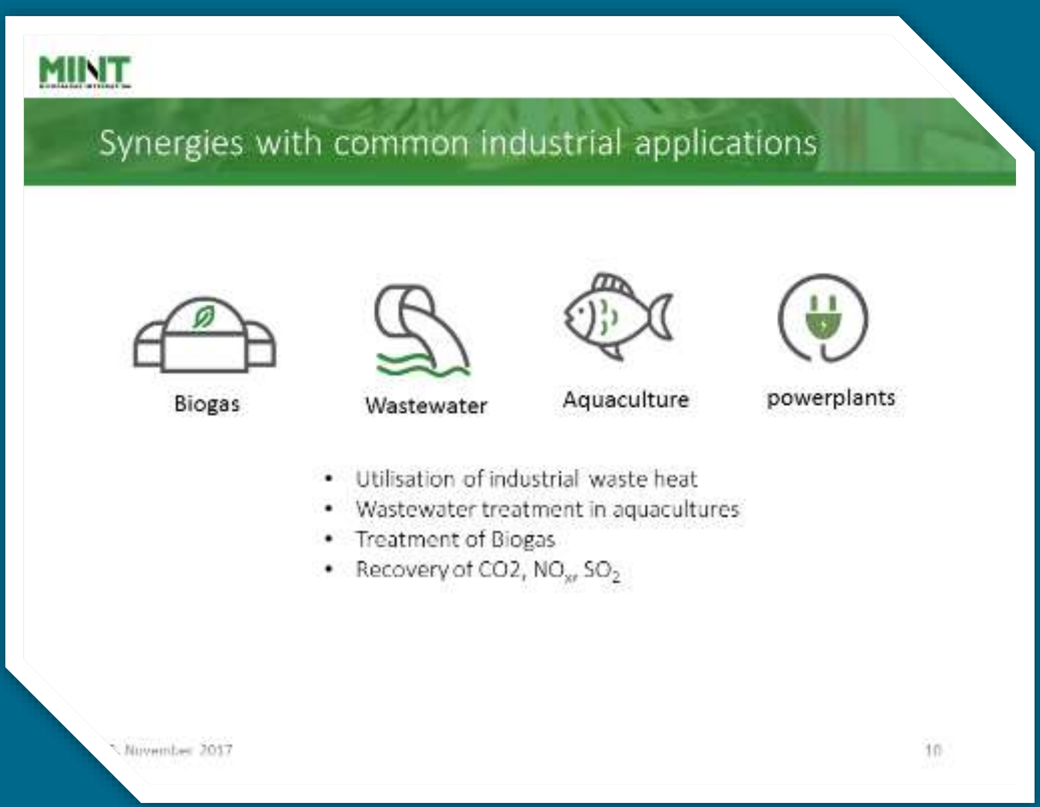
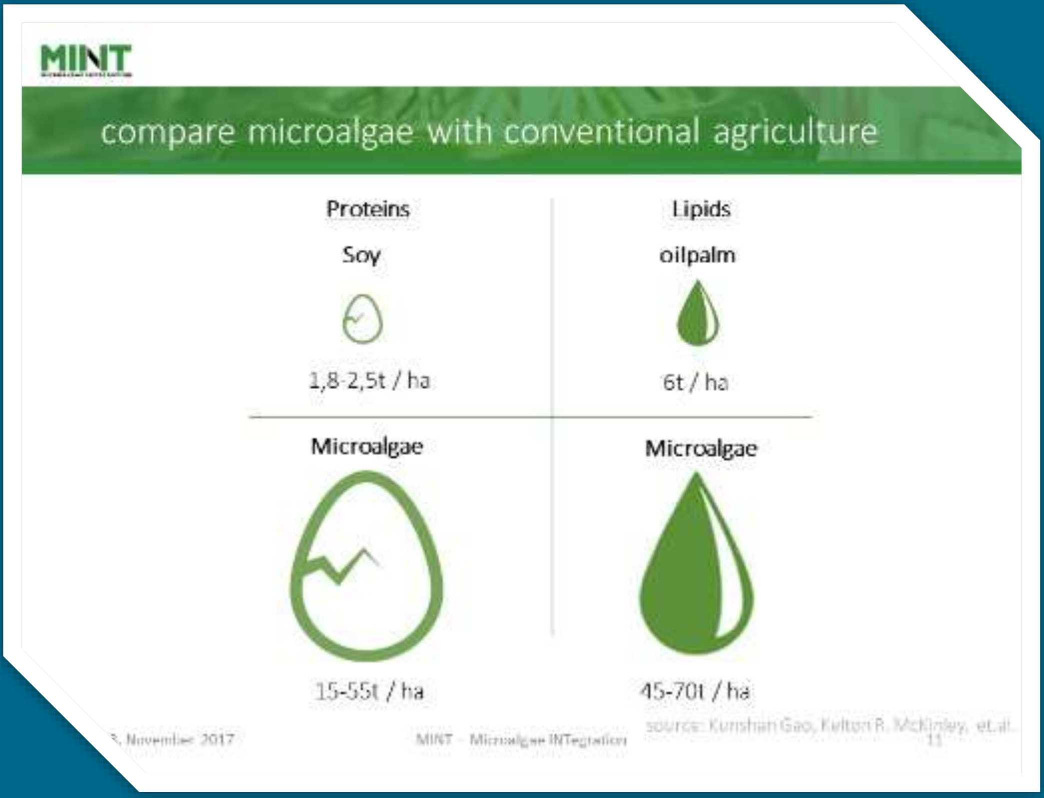
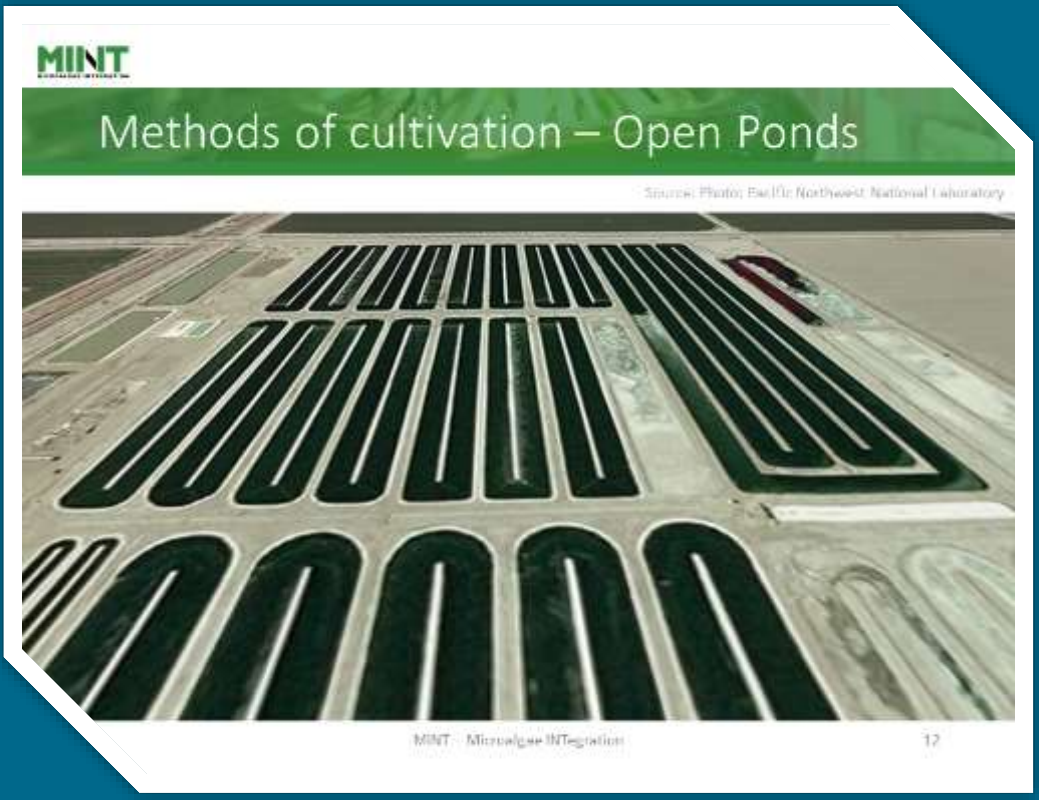






MINT
compare microalgae with conventional agriculture
Proteins
Soy
1,8-2,5t / ha
Lipids
oilpalm
6t / ha
Microalgae
15-55t / ha
Microalgae
45-70t / ha
November 2017
MINT - Microalgae INTegration
source: Kunshan Gao, Kelton R. McKinley, et al.
11



MINT
Methods of cultivation – Open Ponds
Source: Photo: Pacific Northwest National Laboratory
MINT - Microalgae INTegration
12

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Forum RM 3 - Presentations

MINT
MINT – Industrial Farming
▪ Large industrial plants for economic production.

MINT
MINT – Urban Farming
▪ Special plants for algae cultivation in urban areas.

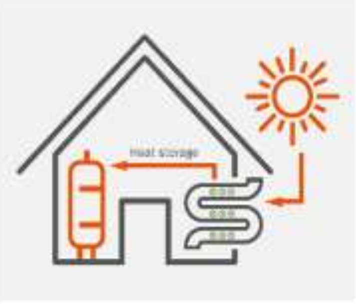
MINT

MINT – Technologies

Closing energy cycles

→The photobioreactor can parallel function as a thermal solar energy system. As hybrid operation it can be used both for extracting biomass as well as generating heat.

- Saving and using thermal solar energy inside the house (p.e. for heating or hot water)
- The algae medium acts as heat transfer media
- Favouring the bio-process by preventing overheating
- Possibility of using cryophilic algae in winter



3. November 2017 17

MINT

MINT – Technologies

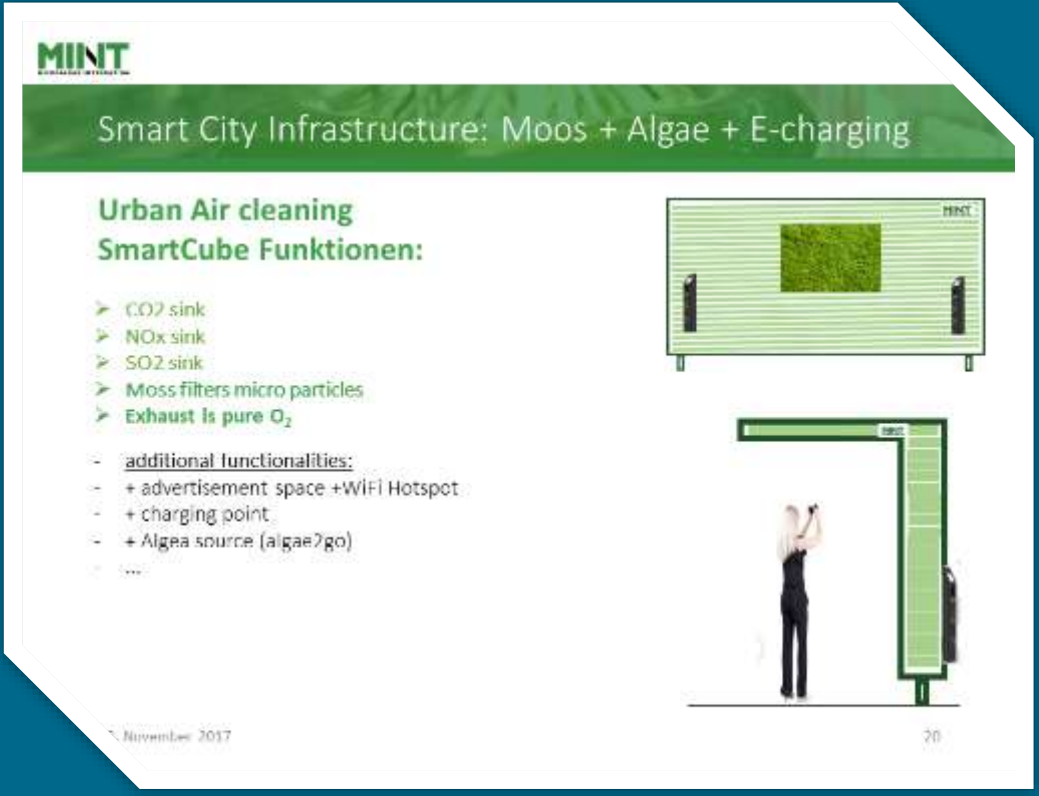
Closing nutrient cycles

→Accumulated nutrients in the building can be used as nutrient source for the biomass in the photobioreactor.

- Integral concept "farm-to-table" (proteins, lipids)
- No transport routes necessary
- Algae as infection barrier for xenobiotics in urine
- Possibility to use cryophilic algae in winter
- production of high value algae products

3. November 2017 18

BALTIC CLEAN TECHNOLOGY 2017
Forum RM 3 - Presentations




MINT
MINT – Waste Water Treatment
growing phototroph / heterotroph
→ Severall accumulated nutrients (N, P) can be used as nutrient source for the biomass in the photobioreactor, also different C-Sources
• COD reduction
• nutrient reduction
• CO_2 utilization
• waste => value product
November 2017
21


MINT
MINT – Business model
MINT
MICROALGAE INTEGRATION
We develop, manufacture and market systems
for cultivating microalgae in all sizes.
And for every location.
http://www.mint-engineering.de/english/
November 2017
22


MINT
MINT- Team. What sets us apart
Our
competitive edge
Algae technology
Biology /
qualitymanagement
Online monitored
process control


MINT
MINT - Solutions
INDUSTRIAL FARMING
Large industrial plants for economic production.
INDOOR FARMING
Innovative plant concepts for indoor cultivation.
URBAN FARMING
Special plants for algae cultivation in urban areas.

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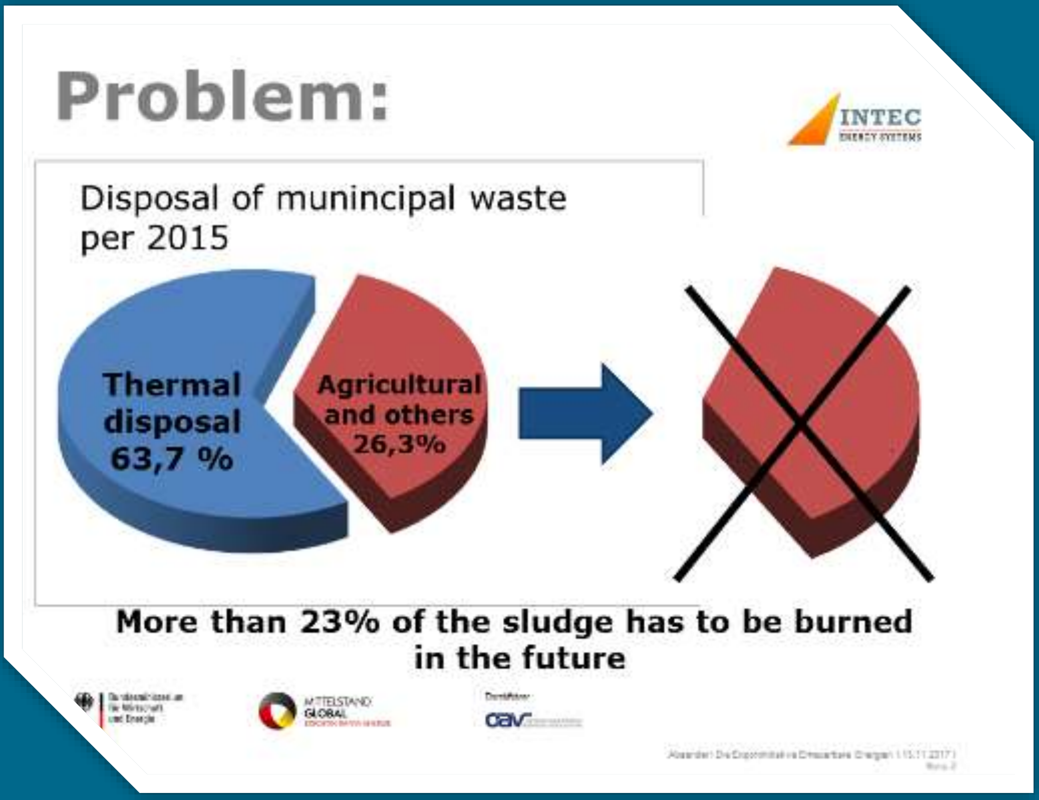
Forum RM 3 - Presentations


The INTEC GROUP
Heat and Power Generation
MITTELSTAND
GLOBAL
INTEC
ENERGY SYSTEMS


Problem:
INTEC
Disposal of munincipal waste per 2015
Thermal disposal 63,7 %
Agricultural and others 26,3%
More than 23% of the sludge has to be burned in the future
MITTELSTAND
GLOBAL

Solution:
INTEC
ENERGY SYSTEMS
INTEC self sufficient Sludge drying and combustions plants
MITTELSTAND GLOBAL

INTEC Group
INTEC
ENERGY SYSTEMS
A family of heat to power solutions
Status Quo
More than 2100 installations in 80 countries
More than 370 MW electrical energy installed
More than 5200 MW thermal energy installed
MITTELSTAND GLOBAL

BALTIC CLEAN TECHNOLOGY 2017
Forum RM 3 - Presentations

INTEC Engineering GmbH
Germany

- Established in 1995,
  INTEC is developing successfully and expanding the network of representations as well as own offices around the world.
  This gives our customers a good service and short reaction times.
- A turnover of 35-40 million Euro within the involved companies of the INTEC group, generated by approx. 100 employees.

INTEC Engineering GmbH
Germany

Product range:

- Thermal oil heaters
- Biomass firing systems
- Power Plants (ORC or Steam)
- Drying systems

BALTIC CLEAN TECHNOLOGY 2017
Forum RM 3 - Presentations

INTEC Engineering GmbH
Germany

Thermal Oil Heaters

Characteristics

- Thermal oil can be operated up until temperatures of 400 °C using synthetic oil.
- Optimized heat transfer and high efficiency design
- Tailor-made design to individual customer requirements
- Environmental friendly operation due to low emission values
- High operational reliability
- Low operating costs
- Long service life

INTEC Engineering GmbH
Germany

Solid Fuel Firing Systems

Step Grate

- Capacity up to 100 MW
- Reliable operation with high availability
- Low emission values for CO and NOx
- High efficiency
- Automatic fuel feeding and de-ashing
- **Operation with "low quality fuel" or high moisture up to 180 % o.d.b., no pre-drying of fuel is necessary!**
- Burning wastes like bark, chips, wood waste, off-cuts, trimmings, production waste, sanderdust and even critical fuels such as rice husks, cotton stalks, sunflower seeds, bagasse and all different kind of waste.

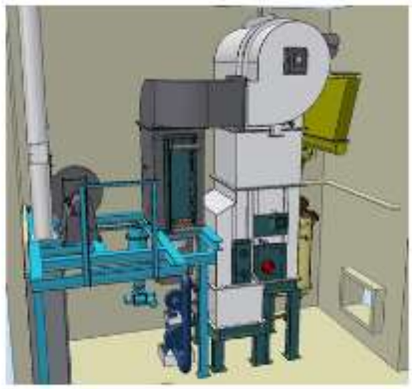
BALTIC CLEAN TECHNOLOGY 2017
Forum RM 3 - Presentations

INTEC Engineering GmbH
Germany

Solid Fuel Firing Systems

Fluidized Bed

- Capacity: 500 kW – 50,000 kW
- Fuels: Biomass, coal, sewer sludge
- Waste heat recovery media: Thermal oil, steam, hot water
- Fluidised bed combustion with controlled ash recirculation
- Ash cooling heat exchanger positioned outside of combustion area



INTEC GMK GmbH
Germany

- Since 2015 member of the INTEC Group located in Bargeshagen, Germany
- Power generation based on the Organic Rankine Cycle

INDUCAL®

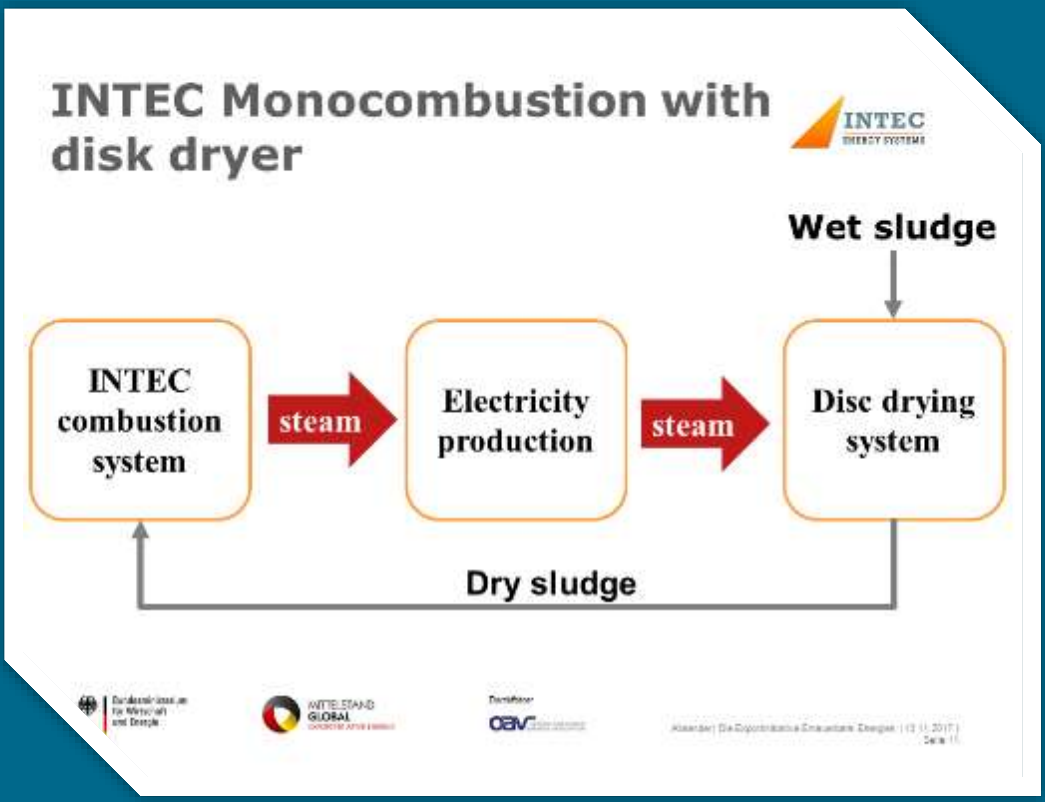
Waste heat recovery

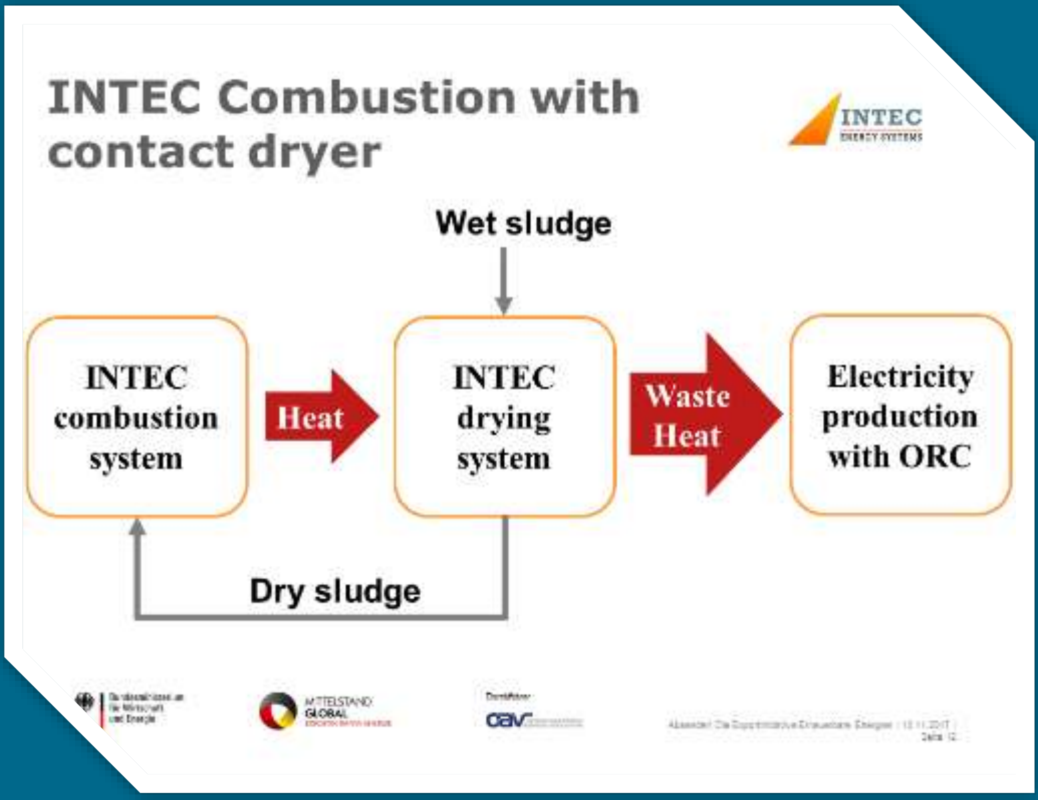
GEOCAL®

Geothermal

ECOCAL®

Biomass


INTEC Monocombustion with disk dryer
INTEC ENERGY SYSTEMS
Wet sludge
INTEC combustion system
steam
Electricity production
steam
Disc drying system
Dry sludge


INTEC Combustion with contact dryer
INTEC ENERGY SYSTEMS
Wet sludge
INTEC combustion system
Heat
INTEC drying system
Waste Heat
Electricity production with ORC
Dry sludge

BALTIC CLEAN TECHNOLOGY 2017
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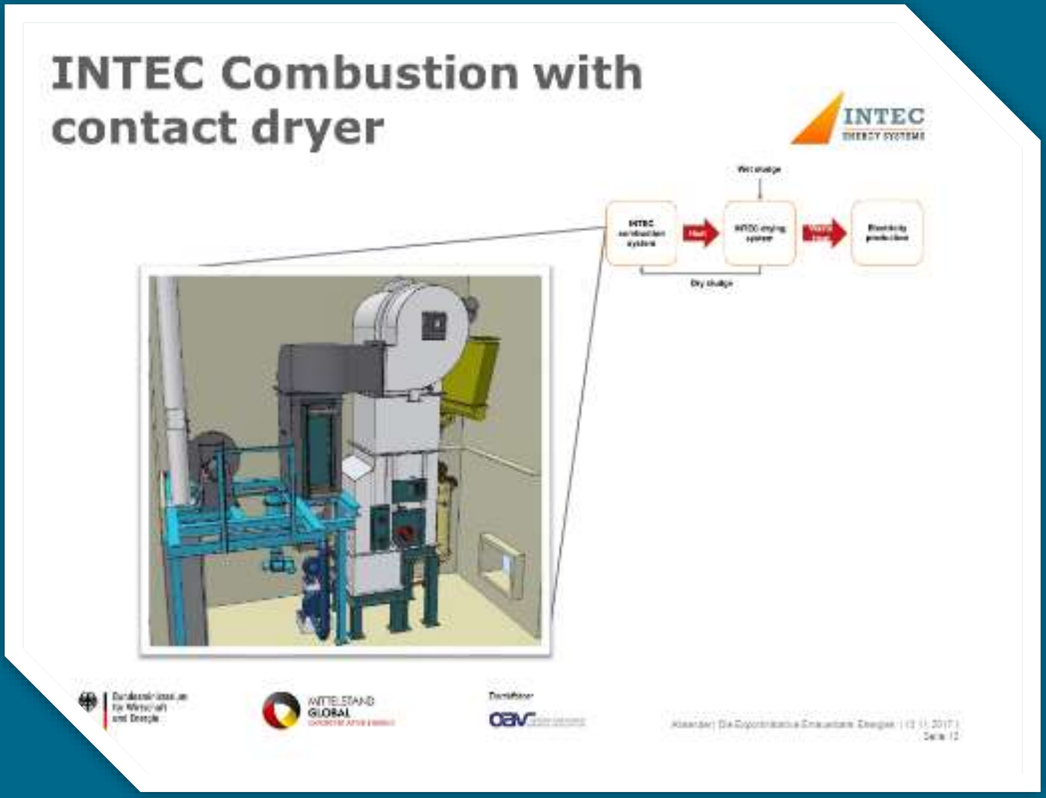
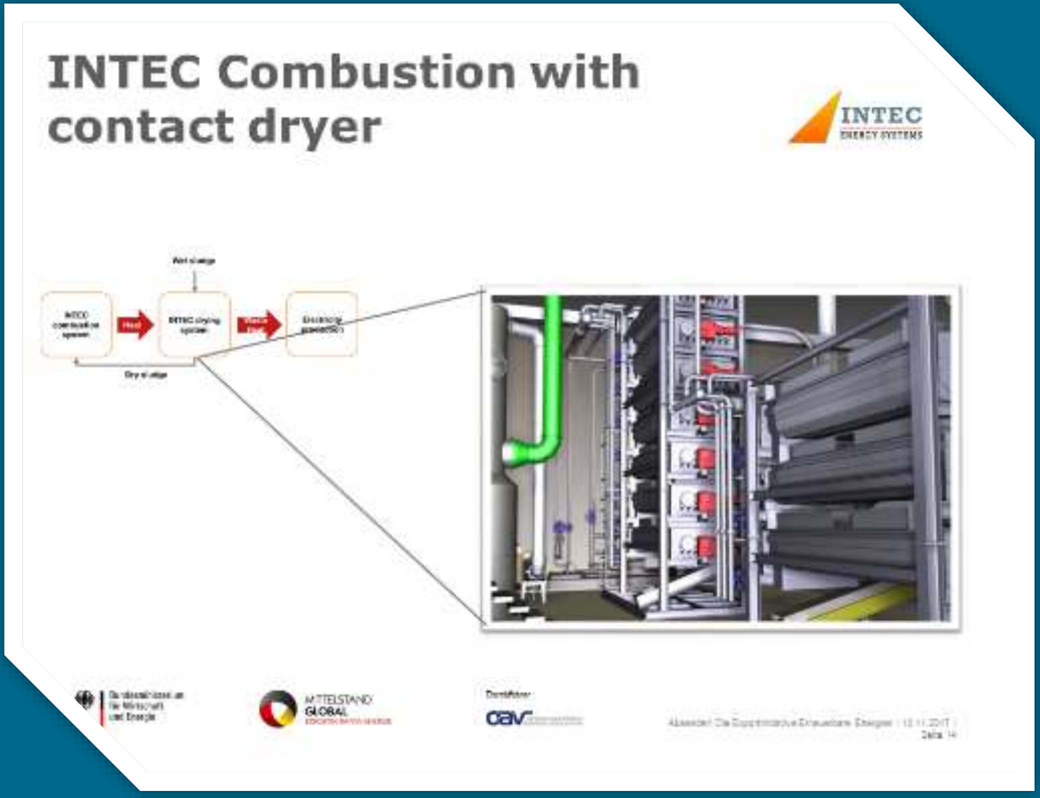
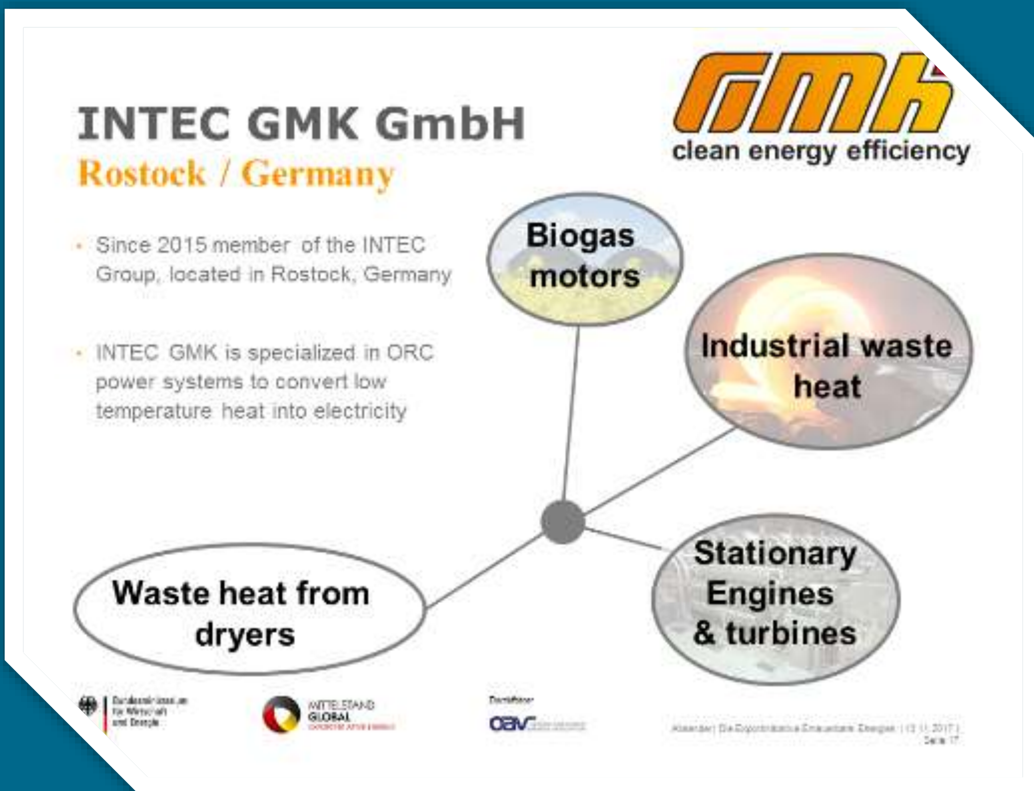




BALTIC CLEAN TECHNOLOGY 2017
Forum RM 3 - Presentations



INTEC GMK GmbH
Rostock / Germany
clean energy efficiency
Since 2015 member of the INTEC Group, located in Rostock, Germany
INTEC GMK is specialized in ORC power systems to convert low temperature heat into electricity
Biogas motors
Industrial waste heat
Stationary Engines & turbines
Waste heat from dryers

From the
Problem
INTEC
Over the
INTEC integrated drying system
To the
Solution


INTEC Group
REFERENCES
INTEC
ENERGY SYSTEMS
Karlsruhe
Appliaction: Sewage sludge dryer and incinerator for steam and power production
Firing Capacity: 5,7 MWth
1 Mwel Power Production
Fuel: Sewage Sludge
Installation: Karlsruhe, Germany
Customer: City of Karlsruhe
MITTELSTAND GLOBAL


INTEC Group
REFERENCES
INTEC
ENERGY SYSTEMS
Appliaction: Sewage sludge dryer and incinerator
Installation: Ruegen, Germany
MITTELSTAND GLOBAL

INTEC Group
REFERENCES

INTEC ENERGY SYSTEMS

Appliaction: Sewage sludge dryer and incinerator

Installation: Ruegen, Germany

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INTEC Group
REFERENCES

INTEC ENERGY SYSTEMS

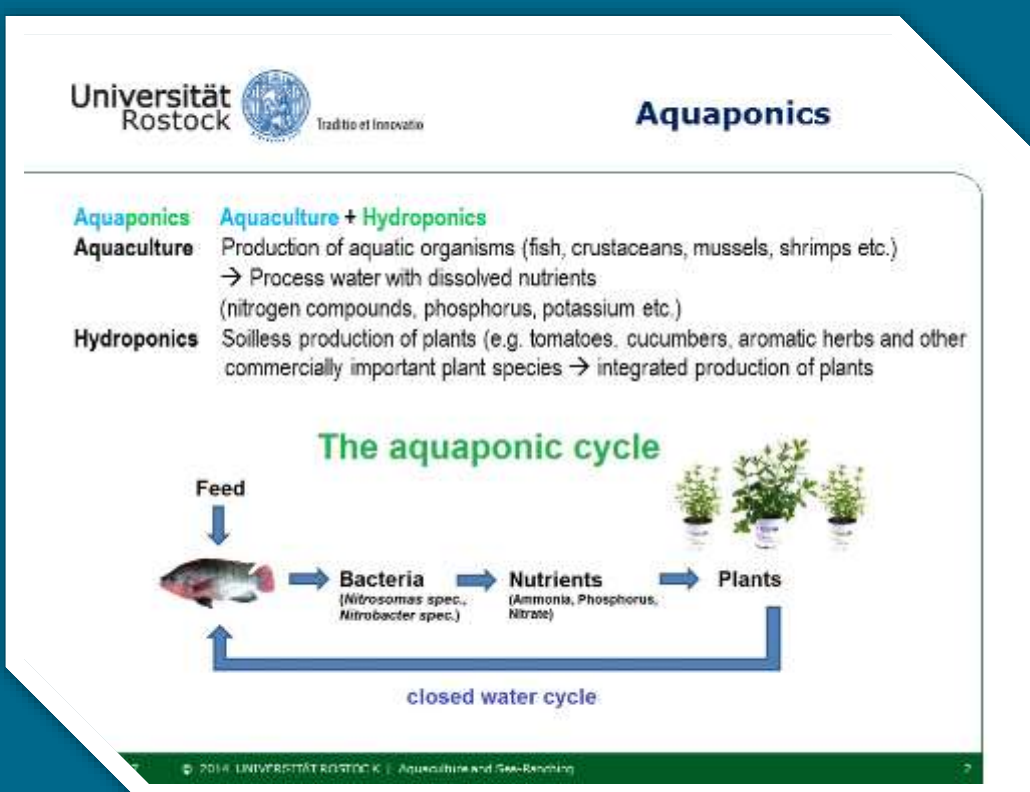
Appliaction: Fluidized bed firing

Installation: Taiwan

MITTELSTAND GLOBAL


INTEC
Thank you!


Universität Rostock
Traditio et Innovatio
Aquaponics On A Precommercial Scale:
Fish And Vegetable Production
By Recirculating Water And Nutrients
Dipl. Biol. Björn Baßmann,
Prof. Dr. Harry W. Palm


Universität Rostock
Traditio et Innovatio
Aquaponics
Aquaponics Aquaculture + Hydroponics
Aquaculture Production of aquatic organisms (fish, crustaceans, mussels, shrimps etc.)
→ Process water with dissolved nutrients
(nitrogen compounds, phosphorus, potassium etc.)
Hydroponics Soilless production of plants (e.g. tomatoes, cucumbers, aromatic herbs and other commercially important plant species → integrated production of plants
The aquaponic cycle
Feed
Bacteria
(Nitrosomas spec., Nitrobacter spec.)
Nutrients
(Ammonia, Phosphorus, Nitrate)
Plants
closed water cycle

Universität Rostock Traditio et Innovatio

Aquaponics

Established hydroponic techniques

- **Substrate system:** - gravel, clay, sand
  as mechanical filter and buffer
  → Ebb and flood systems
- **Floating raft system:** - plants grow on rafts above the water surface
- **Nutrient film technique (NFT):** - plant roots are in contact with a shallow nutrient film
- **Aeroponics:** - nutrients are sprayed directly onto the roots

Ebb- and flood system (Aquaculture and Sea-ranching, University of Rostock)

Raft system (Blaze, 2010)

NFT - System (Blaze, 2011)

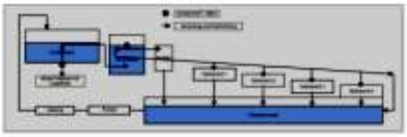
 3

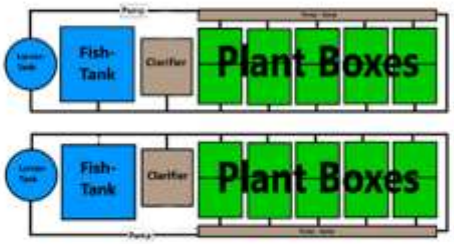
Universität Rostock Traditio et Innovatio

Aquaponics

Problems

- Scientific literature is scarse and often not publicly available
- The available literature is usually based on **small scale** experimental systems
- Data are often not comparable
- Data originate from non-commercial systems
- Cooperation with commercial systems is not easy
- General opinion about aquaponics in Germany: „It is not economically sustainable"
  (But how do you know that?)
- So how do you want to give investors and producers recommendations on aquaponics?





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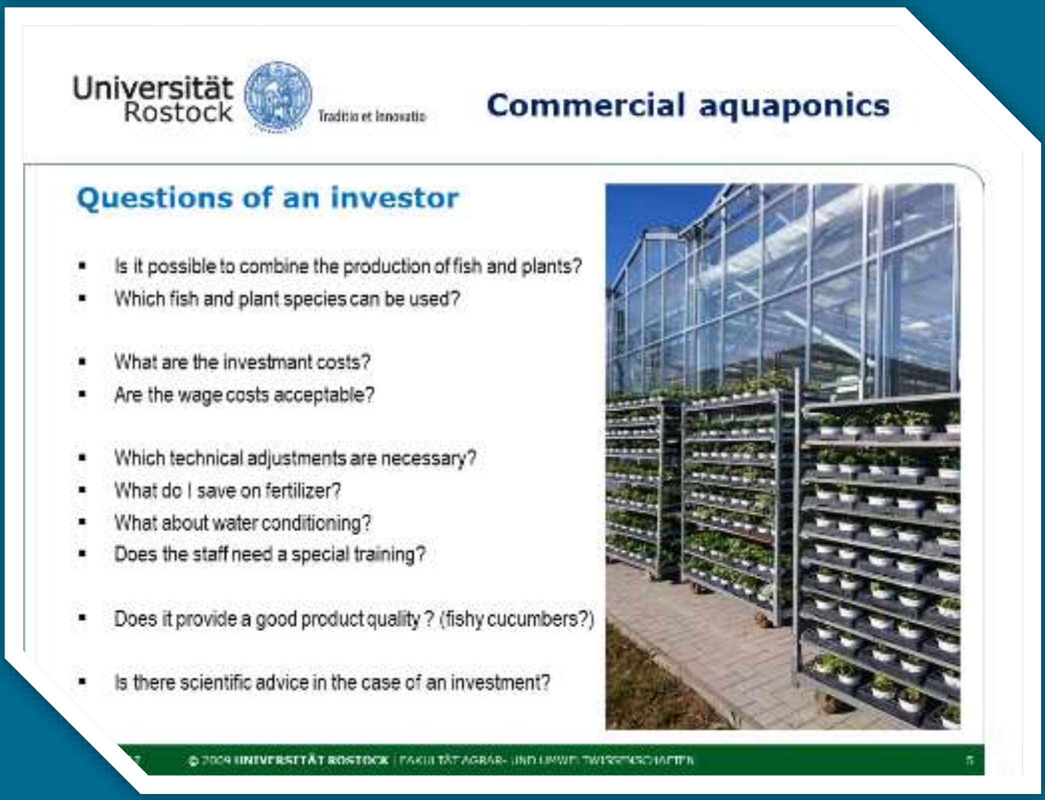

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Commercial aquaponics
Questions of an investor
Is it possible to combine the production of fish and plants?
Which fish and plant species can be used?
What are the investmant costs?
Are the wage costs acceptable?
Which technical adjustments are necessary?
What do I save on fertilizer?
What about water conditioning?
Does the staff need a special training?
Does it provide a good product quality ? (fishy cucumbers?)
Is there scientific advice in the case of an investment?

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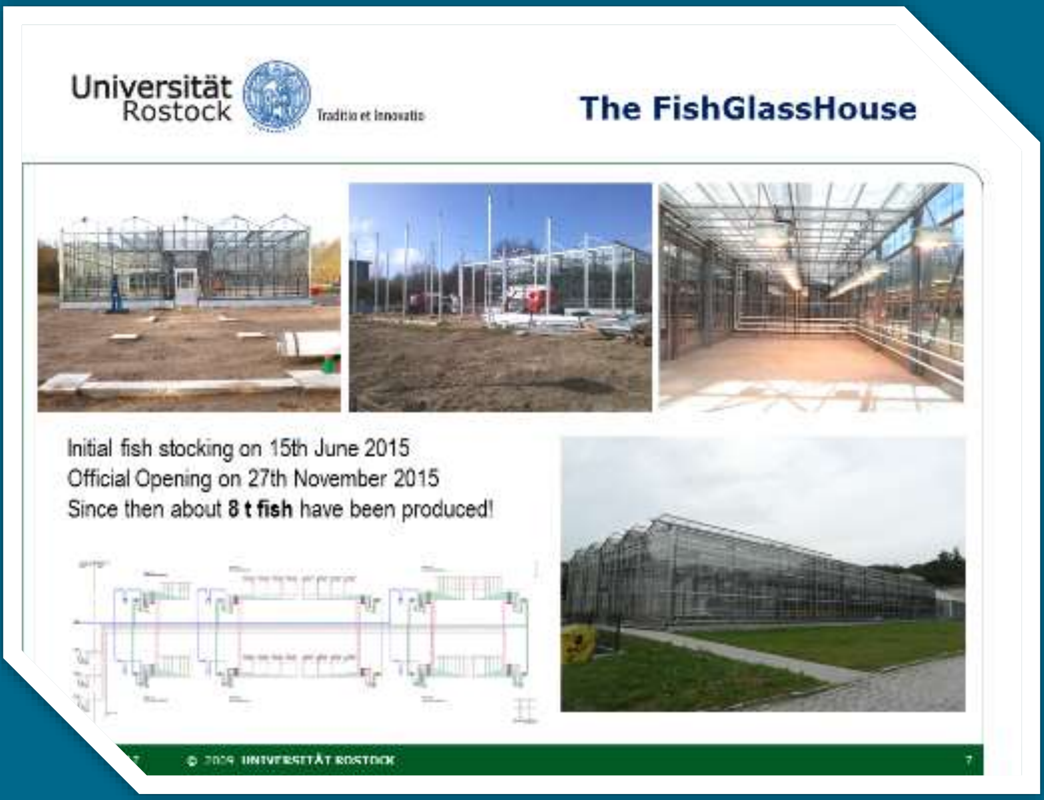
Prestudies
First experiments
Tilapia and cucumber after 70 days



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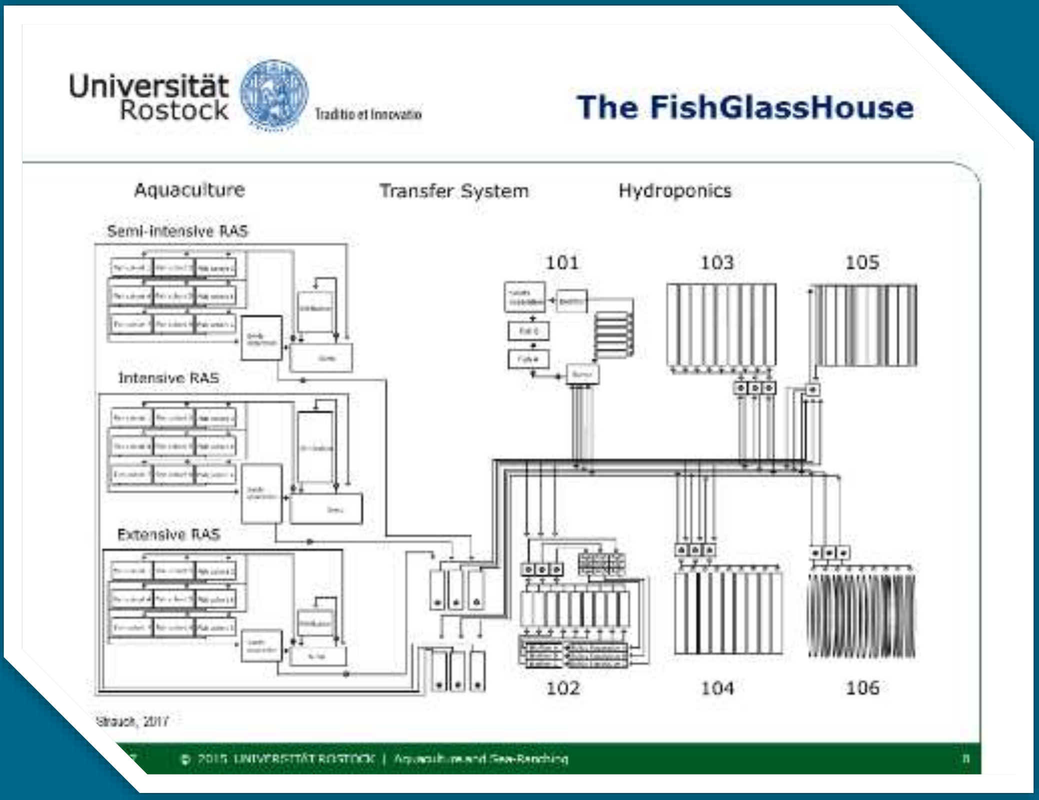
The FishGlassHouse
Initial fish stocking on 15th June 2015
Official Opening on 27th November 2015
Since then about 8 t fish have been produced!



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The FishGlassHouse
Aquaculture
Transfer System
Hydroponics
Semi-Intensive RAS
Intensive RAS
Extensive RAS
101
102
103
104
105
106
Strauch, 2017

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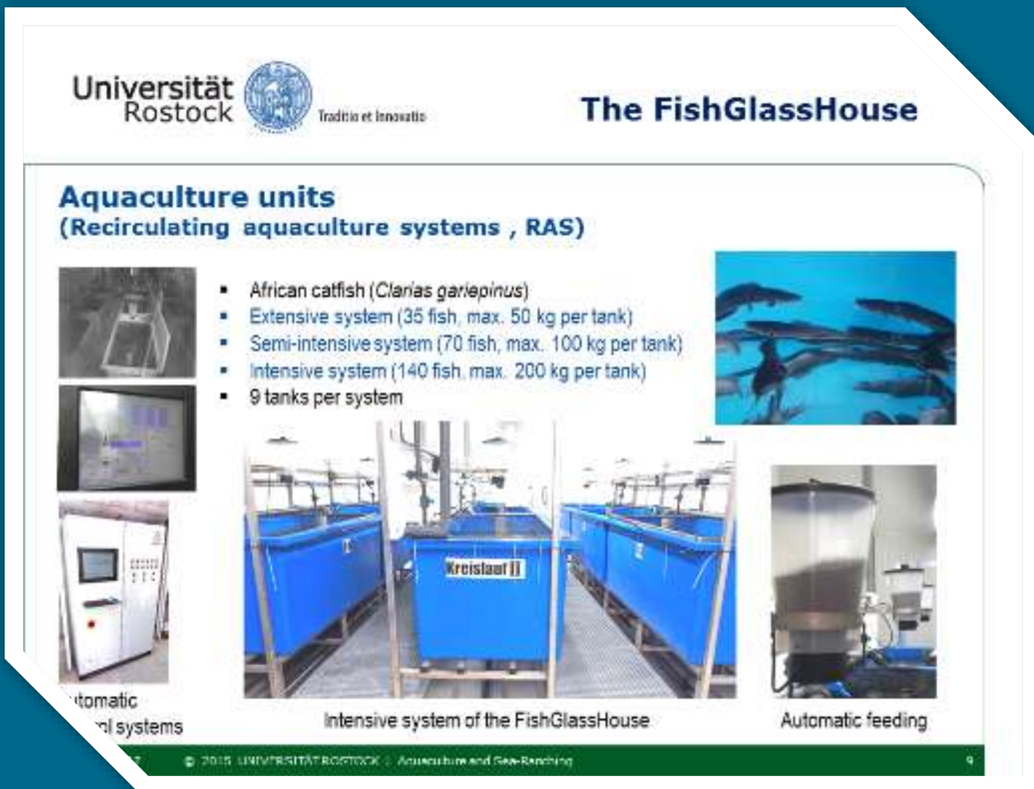

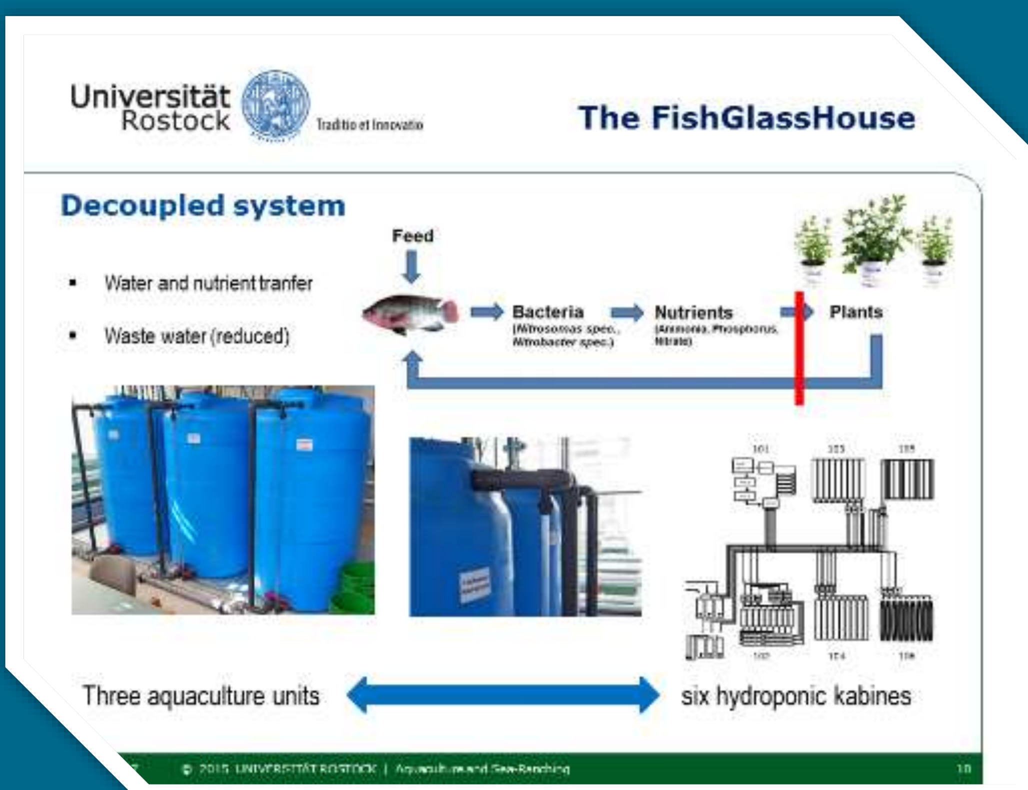

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The FishGlassHouse

Hydroponic units

- Automatic control of relevant parameters:
- Light Intensity [Lux]
  → automatic shading
- Temperature min-max
  → automatic heating/ventilation
- WLAN, Internet

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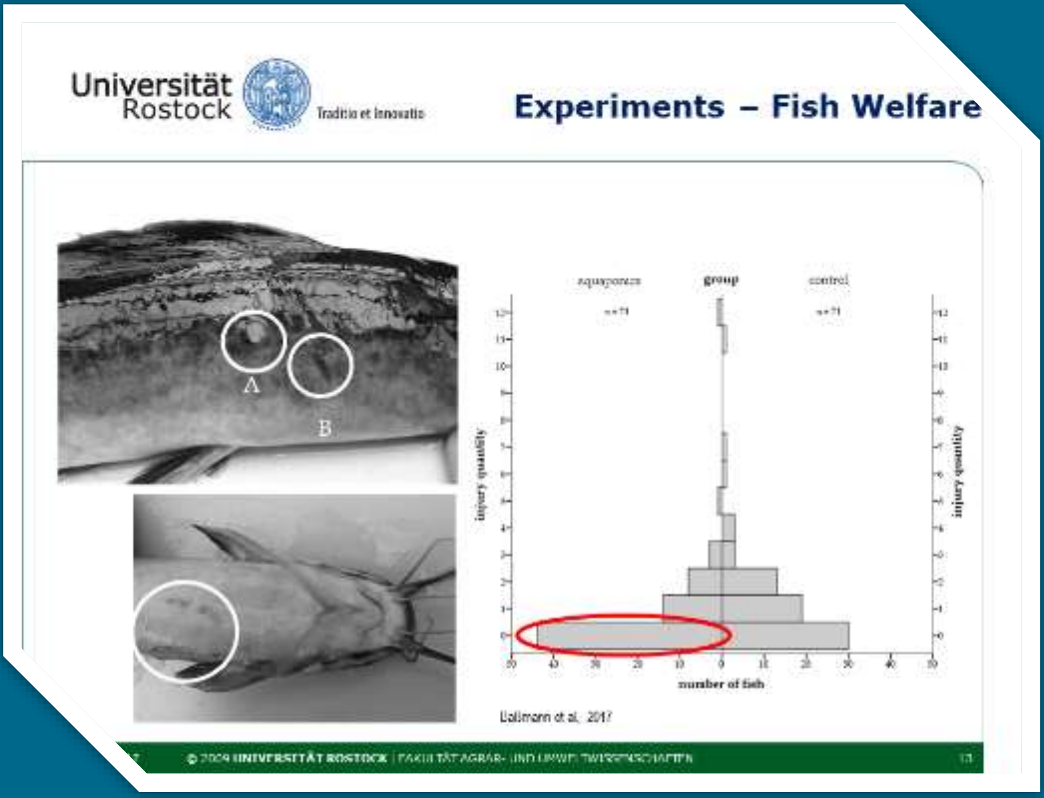
The FishGlassHouse

Fish cohorts	Production phase	Intensity	Initial weight	Final weight	Total growth	FCR	Survival
			mean fish⁻¹, in g n=9 tanks	mean fish⁻¹, in g n=9 tanks	mean tank⁻¹, in kg n=3 tanks	mean tank⁻¹ n=9 tanks	mean tank⁻¹, in % n=9 tanks
1, 2, 3	Run in/batch	Extensive	275	1527	41	0.94	96.2
		Semi intensive	275	1497	80	0.94	95.1
		Intensive	275	1459	146	0.96	89.8
			mean fish⁻¹, in g n=3 tanks	mean fish⁻¹, in g n=3 tanks	mean tank⁻¹, in kg n=3 tanks	mean tank⁻¹ n=3 tanks	mean tank⁻¹, in % n=3 tanks
4	Staggered 1	Extensive	51	1791	47	1.14	78.1
		Semi intensive	51	1781	109	1.01	93.0
		Intensive	51	1715	200	1.07	85.4
			mean fish⁻¹, in g n=3 tanks	mean fish⁻¹, in g n=3 tanks	mean tank⁻¹, in kg n=3 tanks	mean tank⁻¹ n=3 tanks	mean tank⁻¹, in % n=3 tanks
5	Staggered 2	Extensive	47	1607	52	0.89	95.2
		Semi intensive	47	1593	104	0.89	96.7
		Intensive	47	1628	199	0.94	93.2
			mean fish⁻¹, in g n=3 tanks	mean fish⁻¹, in g n=3 tanks	mean tank⁻¹, in kg n=3 tanks	mean tank⁻¹ n=3 tanks	mean tank⁻¹, in % n=3 tanks
6	Staggered 3	Extensive	40	1492	49	0.87	95.2
		Semi-intensive	40	1541	93	0.91	88.6
		Intensive	40	1561	172	0.97	81.4

 12



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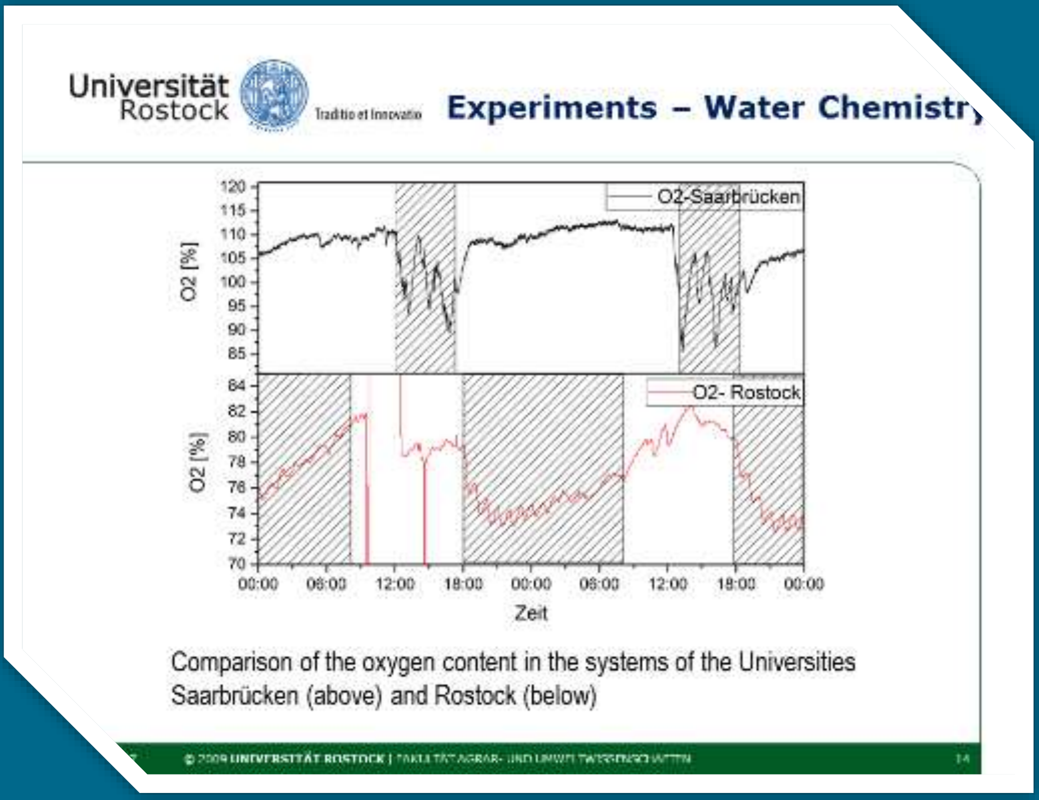
Experiments – Fish Welfare
A
B
group
control
injury quantity
number of fish



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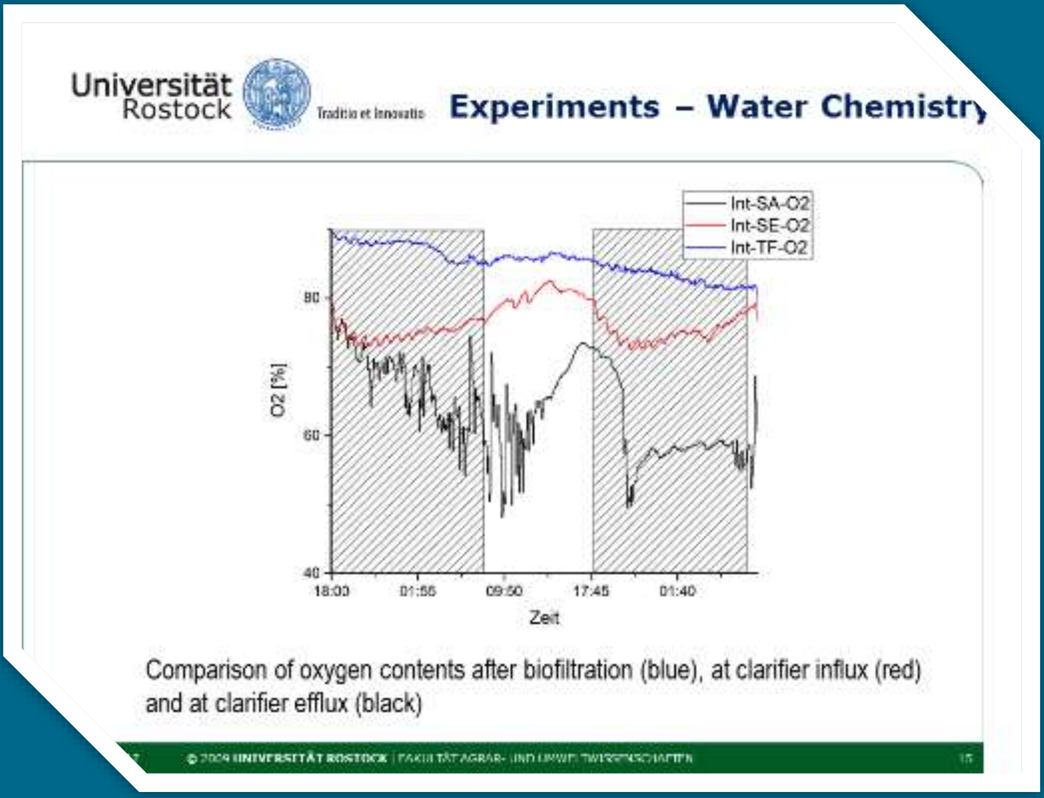
Experiments – Water Chemistry
O2-Saarbrücken
O2- Rostock
O2 [%]
Zeit
Comparison of the oxygen content in the systems of the Universities Saarbrücken (above) and Rostock (below)


Universität Rostock
Traditio et Innovatio
Experiments – Water Chemistry
Int-SA-O2
Int-SE-O2
Int-TF-O2
O2 [%]
80
60
40
18:00
01:55
09:50
17:45
01:40
Zeit
Comparison of oxygen contents after biofiltration (blue), at clarifier influx (red) and at clarifier efflux (black)
© 2009 UNIVERSITÄT ROSTOCK
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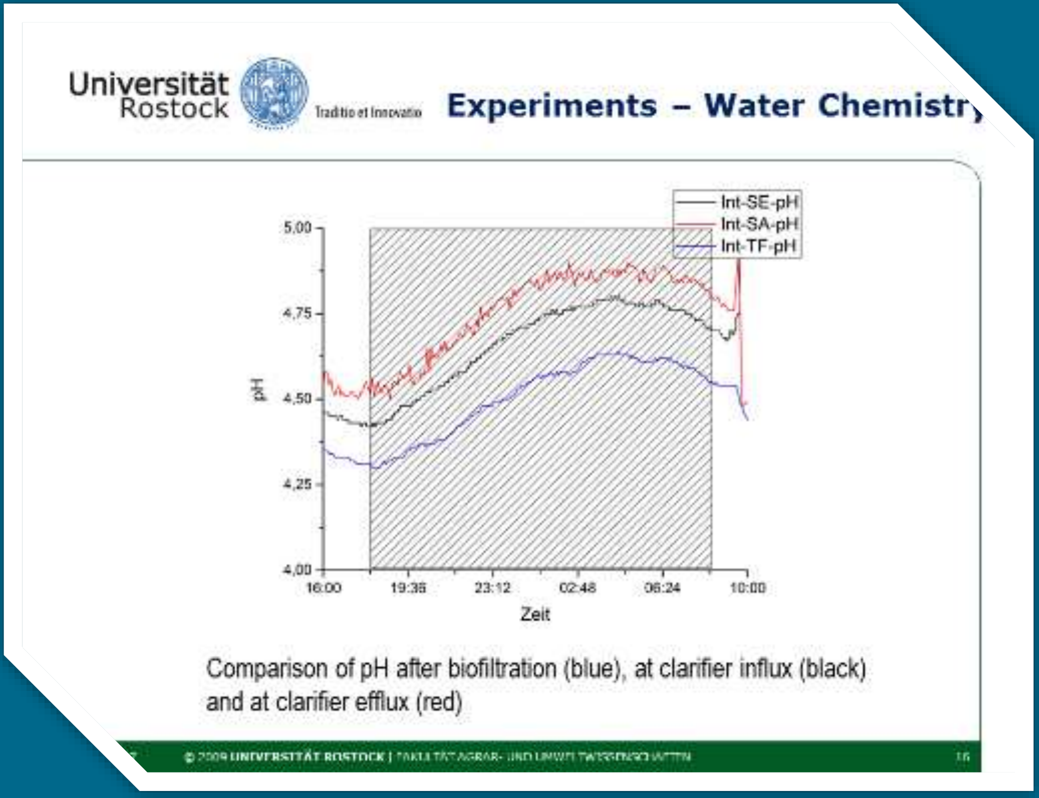
Universität Rostock
Traditio et Innovatio
Experiments – Water Chemistry
Int-SE-pH
Int-SA-pH
Int-TF-pH
pH
5,00
4,75
4,50
4,25
4,00
16:00
19:36
23:12
02:48
06:24
10:00
Zeit
Comparison of pH after biofiltration (blue), at clarifier influx (black) and at clarifier efflux (red)
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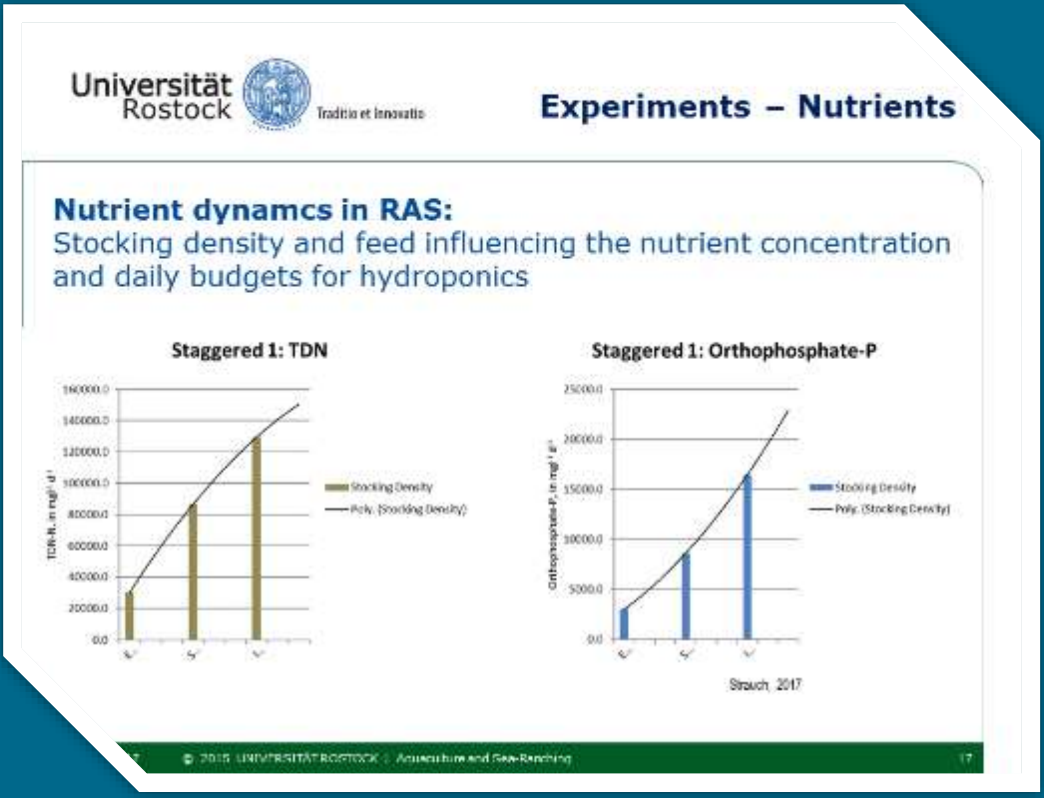

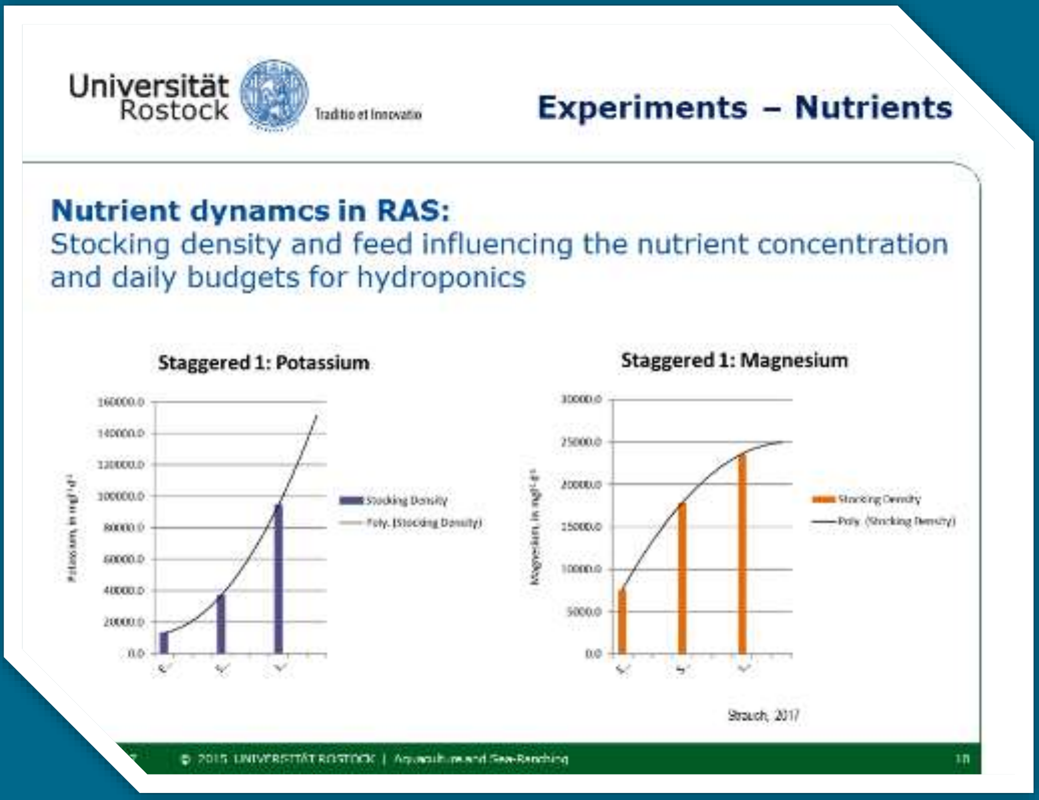

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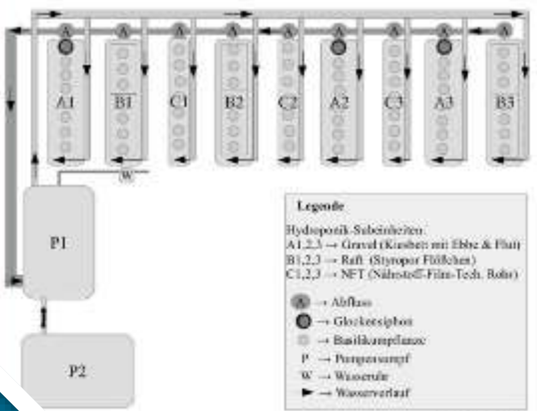
Experiments – Plant Growth

Why is that important?:
Which plant species can be cultivated in which subsystem?

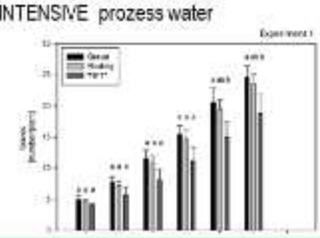


Pribbernow, 2016

Investiging different hydroponic subsystems
1. Gravel (Ebb - Flood)
2. Floating Raft
3. NFT

in combination with different plants:
1. Cucumber
2. Basil
3. Pak-Choi

with INTENSIVE prozess water



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Experiments – Plant Growth

Cucumber harvest in different subsystems

	Experiment I			Experiment II		
Parameter	Gravel	Floating	NFT	Gravel	Floating	NF
Fruit number*	26	23	9	33	32	8
Yield (g plant^{-1})	307^{a} ±49	312^{a} ±220	76^{a} ±89	415^{a} ±209	386^{a} ±256	99^{a} ±103
Fruit weight (g)	177^{a} ±5	204^{a} ±36	129^{a} ±7	186^{a} ±27	174^{a} ±7	179^{a} ±40
Fruit length (cm)	24.1^{a} ±0.2	24.6^{a} ±1.2	22.3^{a} ±0.7	24.8^{a} ±2.1	25.7^{a} ±2.7	20.8^{a} ±2.3
Fruit diameter (cm)	3.6^{a} ±0.1	3.8^{a} ±0.2	3.1^{b} ±0.2	3.2^{a} ±0.5	3.2^{a} ±0.7	3.8^{a} ±0.8

*sum per technique a,b: values showing the same letter are not significantly different ($p > 0.05$, $n = 3$) (ANOVA)

Werner, 2015

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Experiments – Plant Growth

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*sum per technique a,b: values showing the same letter are not significantly different ($p > 0.05$, $n = 3$) (ANOVA)

Werner, 2015

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Experiments – Plant Growth

Mint cultivation in an Ebb-Flood system:

Before and after the experiment - Comparison of the plant growth with *extensive* and *intensive* waters and control

Cooperation with the biggest plant producer in Rostock, Grönfingers

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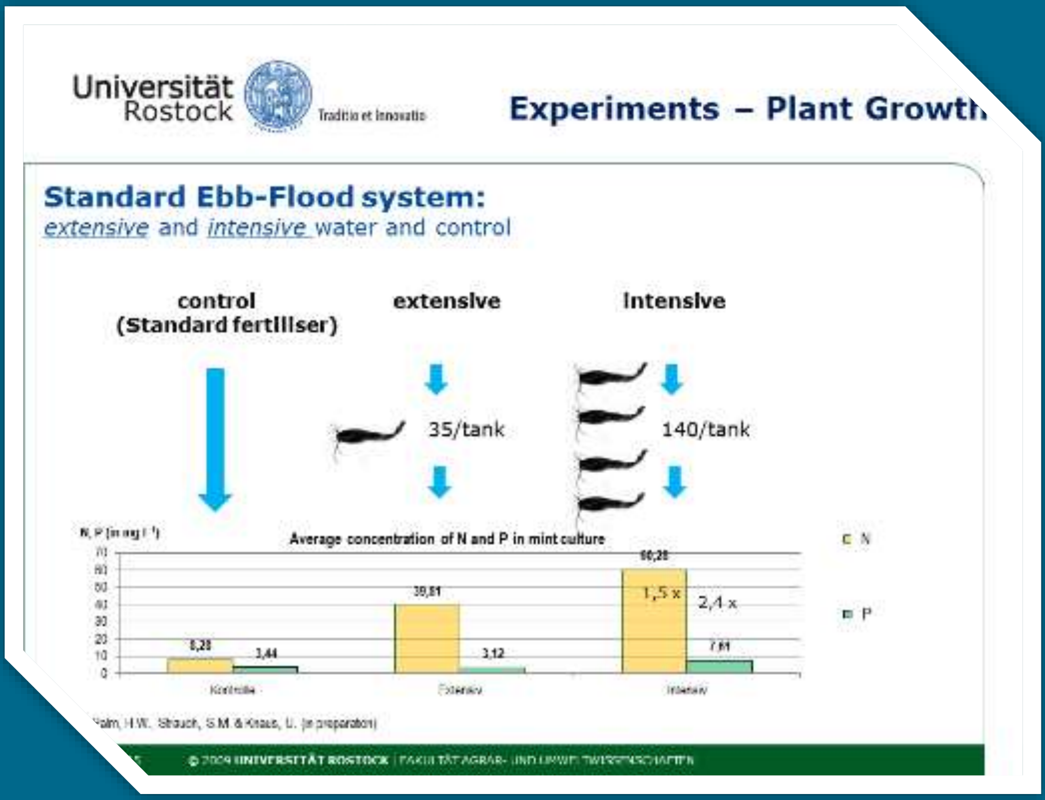

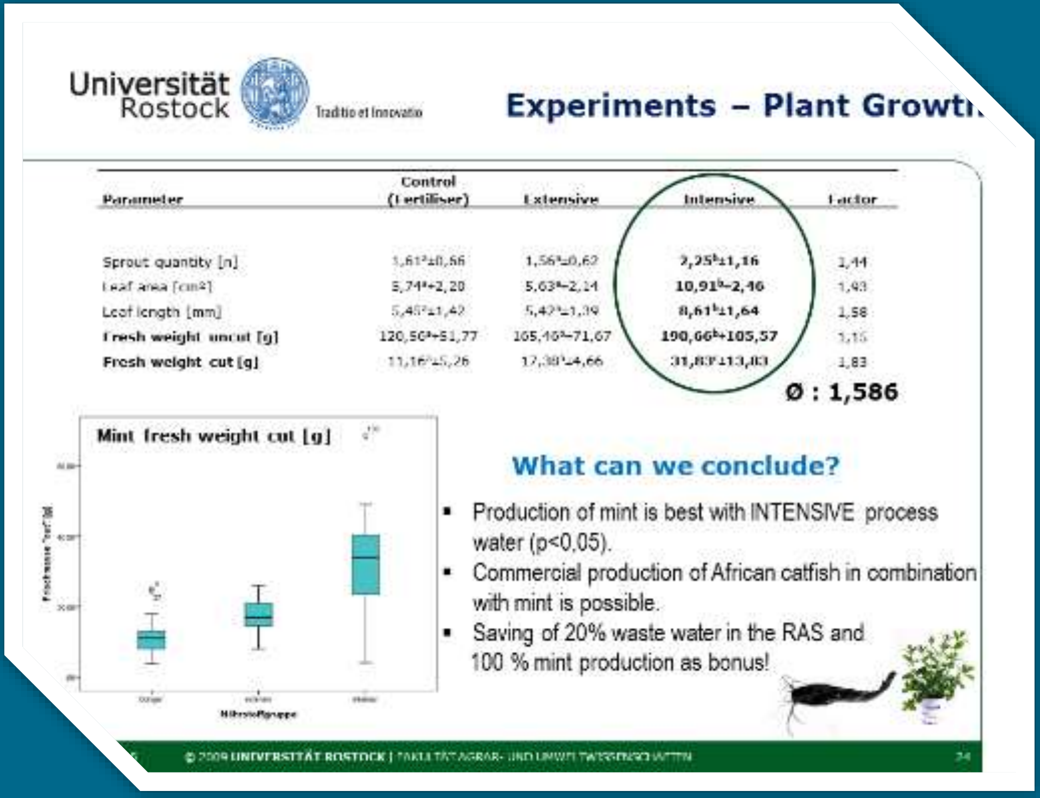

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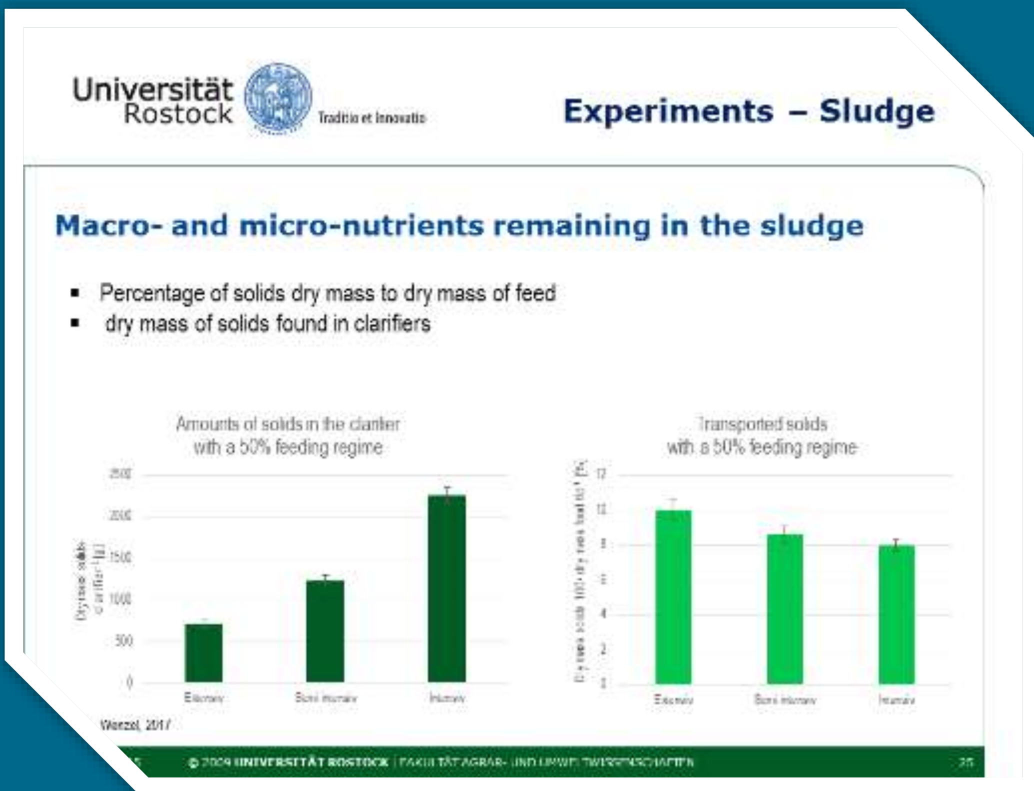

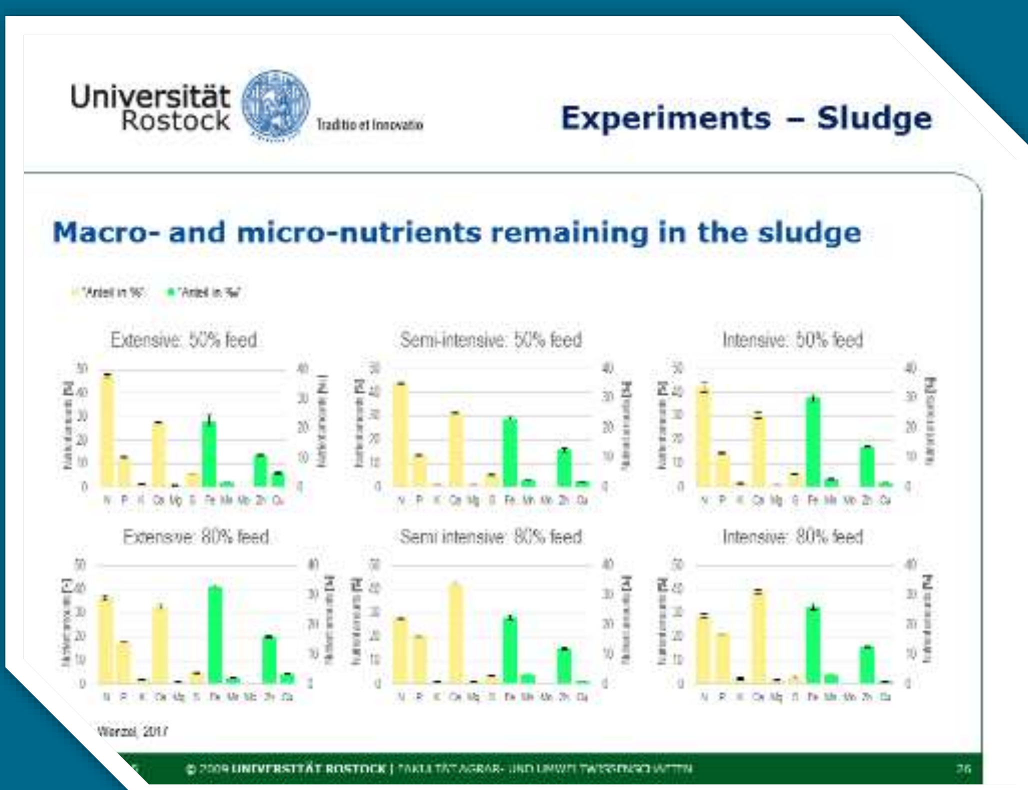


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Marketing
Standard Ebb-Flood system:
extensive und intensive water with control
Growth & quality of ornamental plants


Universität Rostock
Traditio et Innovatio
Marketing
50 % suitable for sale
Ivy (2 variations)
Garten & Wohnen.
Genießen.


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Public relations
Consumer survey at Grönfingers, 2016
Aquaponik in MV
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Public relations
Consumer survey at Grönfingers, 2016
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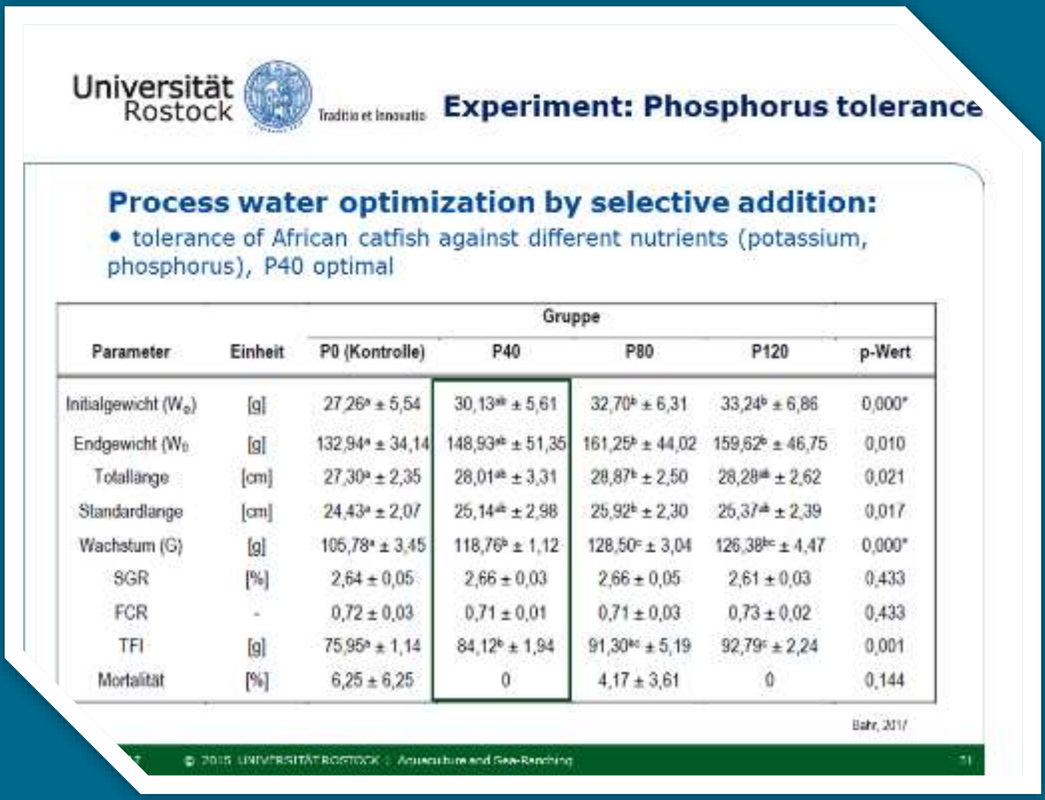
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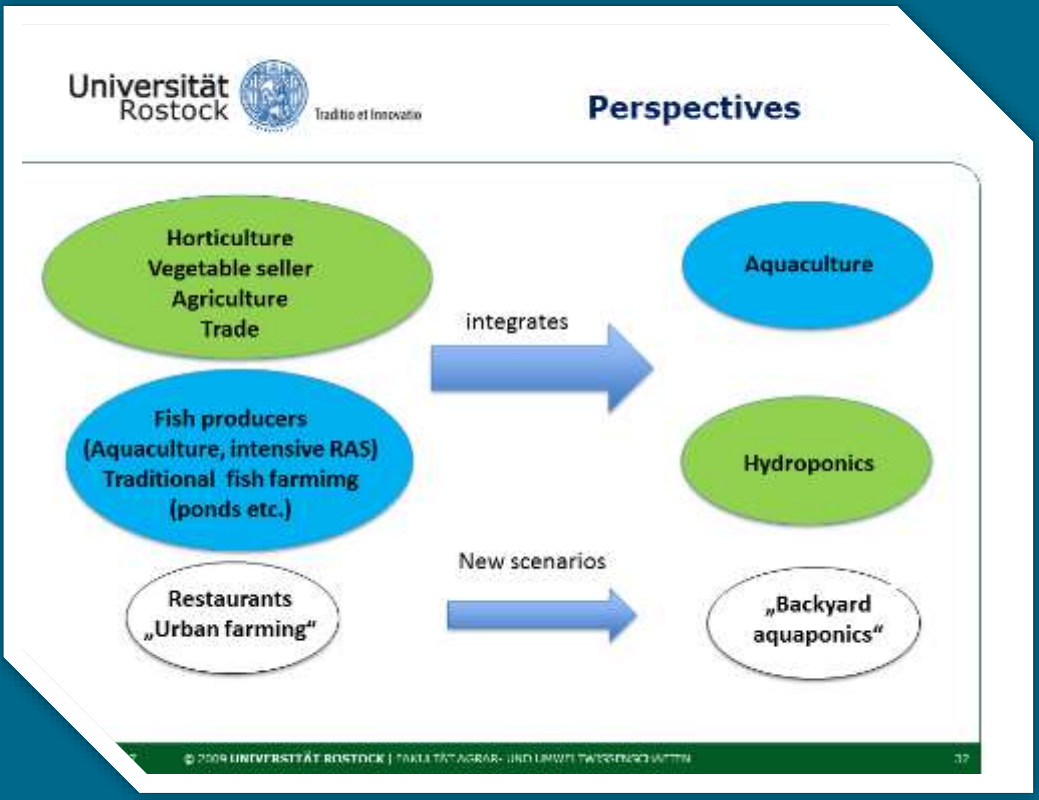
Experiment: Phosphorus tolerance

Process water optimization by selective addition:

- tolerance of African catfish against different nutrients (potassium, phosphorus), P40 optimal

Parameter	Einheit	Gruppe				
		P0 (Kontrolle)	P40	P80	P120	p-Wert
Initialgewicht (W_0)	[g]	$27,26^{a} \pm 5,54$	$30,13^{ab} \pm 5,61$	$32,70^{b} \pm 6,31$	$33,24^{b} \pm 6,86$	0,000*
Endgewicht (W_t)	[g]	$132,94^{a} \pm 34,14$	$148,93^{ab} \pm 51,35$	$161,25^{b} \pm 44,02$	$159,62^{b} \pm 46,75$	0,010
Totallange	[cm]	$27,30^{a} \pm 2,35$	$28,01^{ab} \pm 3,31$	$28,87^{b} \pm 2,50$	$28,28^{ab} \pm 2,62$	0,021
Standardlange	[cm]	$24,43^{a} \pm 2,07$	$25,14^{ab} \pm 2,98$	$25,92^{b} \pm 2,30$	$25,37^{ab} \pm 2,39$	0,017
Wachstum (G)	[g]	$105,78^{a} \pm 3,45$	$118,76^{b} \pm 1,12$	$128,50^{c} \pm 3,04$	$126,38^{bc} \pm 4,47$	0,000*
SGR	[%]	$2,64 \pm 0,05$	$2,66 \pm 0,03$	$2,66 \pm 0,05$	$2,61 \pm 0,03$	0,433
FCR	-	$0,72 \pm 0,03$	$0,71 \pm 0,01$	$0,71 \pm 0,03$	$0,73 \pm 0,02$	0,433
TFI	[g]	$75,95^{a} \pm 1,14$	$84,12^{b} \pm 1,94$	$91,30^{bc} \pm 5,19$	$92,79^{c} \pm 2,24$	0,001
Mortalität	[%]	$6,25 \pm 6,25$	0	$4,17 \pm 3,61$	0	0,144

Bahr, 2017



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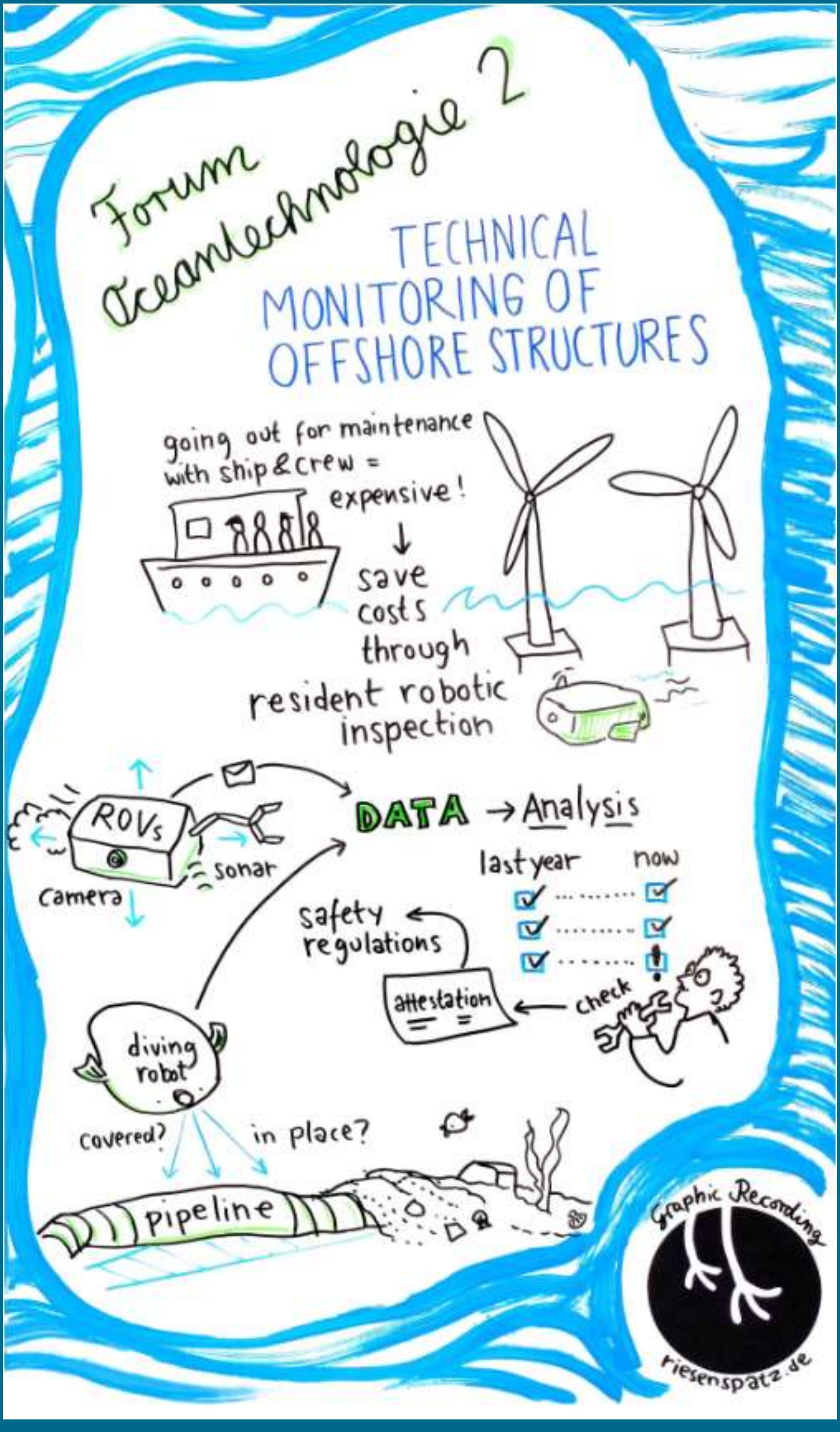
Thursday, 28 September 2017

15:15 – 16:45

FORUM OCEAN TECHNOLOGY 2: Technical monitoring of offshore structures



Forum Oceantechnologie 2
TECHNICAL MONITORING OF OFFSHORE STRUCTURES
going out for maintenance with ship & crew = expensive!
save costs through resident robotic inspection
ROVs
camera
sonar
DATA → Analysis
last year
now
safety regulations
attestation
check
diving robot
covered?
in place?
pipeline
Graphic Recording
riesenspatz.de

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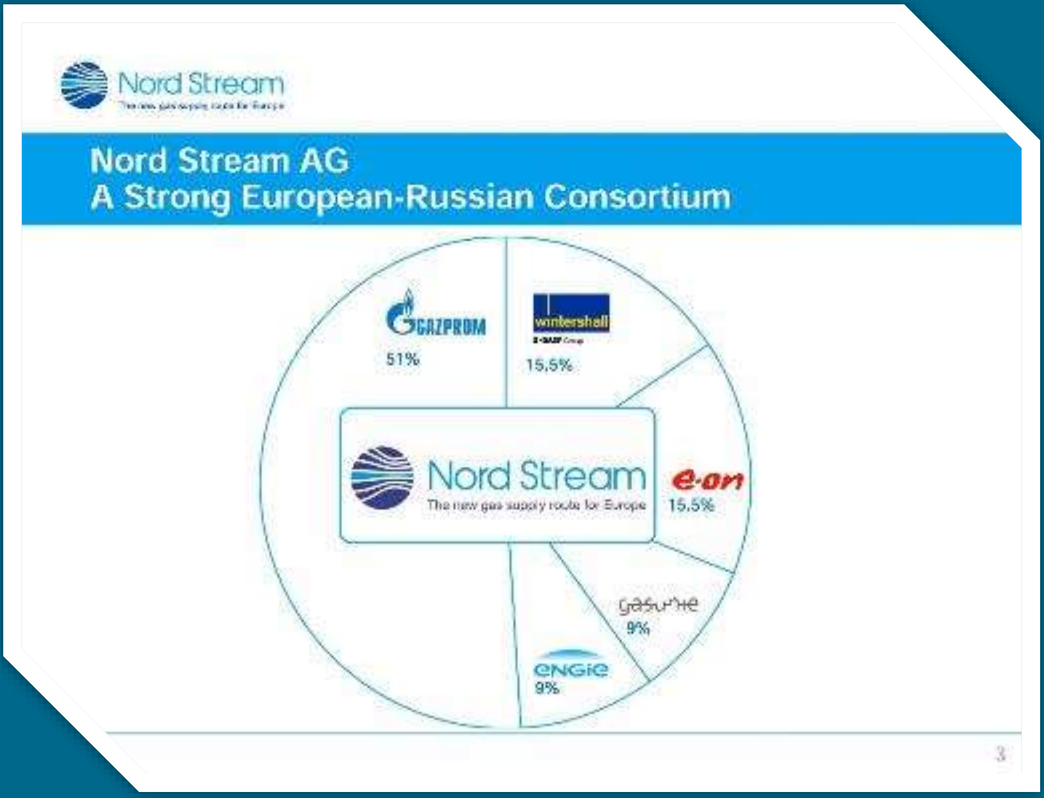

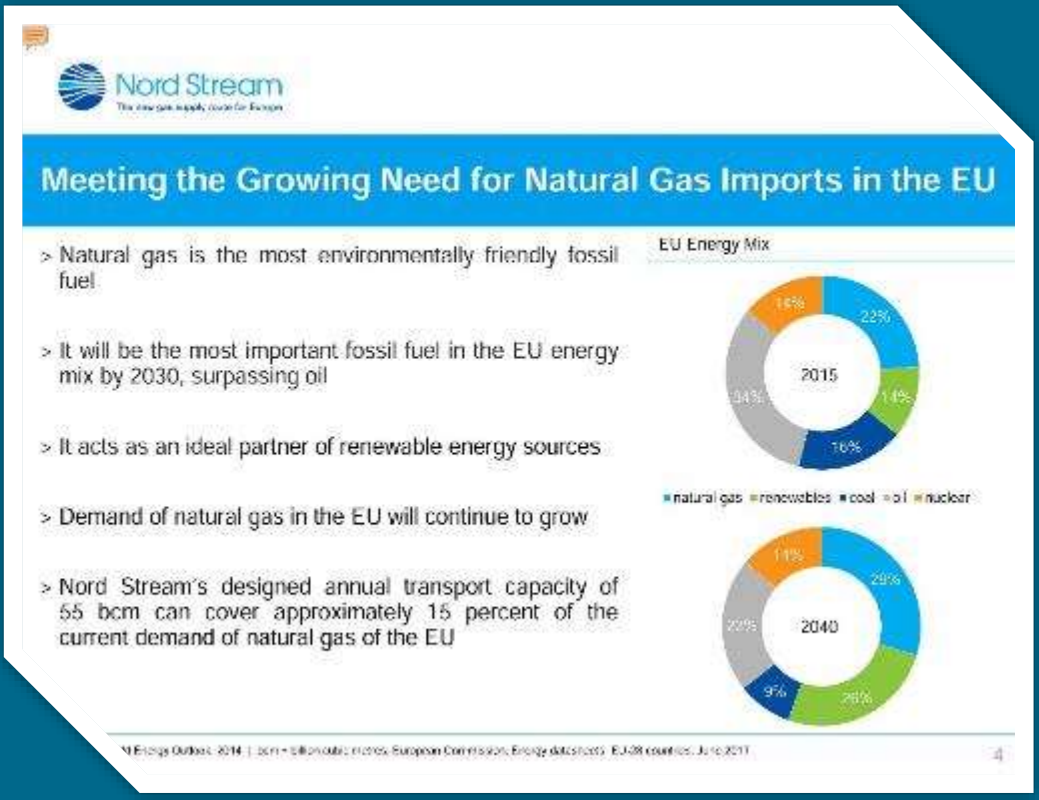

BALTIC CLEAN TECHNOLOGY 2017
Forum OT 2 - Presentations

Nord Stream
The new gas supply route for Europe

Nord Stream Milestones
Realisation of a Major Infrastructure Project on Schedule

Nord Stream contributes to the EU's energy security and climate change goals

- Key infrastructure project increases the EU's energy security for at least 50 years
- Safe and environmentally-friendly pipelines, constructed according to stringent international and national requirements
- A long-term benchmark project for EU-Russian cooperation

5

Nord Stream
The new gas supply route for Europe

Supplying Gas to Europe While Protecting the Environment - Project Phase History

Nord Stream

- Invested 100 million euros into environmental studies, planning and route design
- Devoted over 40 million euros to environmental monitoring: Monitoring confirms: impact in line with or below Environmental Impact Assessment (EIA)
- Surveyed 40,000 line kilometres of the Baltic Sea in geophysical investigations
- Concluded comprehensive EIA and environmental studies
- Cleared over 100 munitions successfully for safe routing
- Preserved cultural heritage and identified 100 wrecks in the pipeline corridor
- Shares the findings with scientists and others working on preserving and improving the Baltic Sea

6

BALTIC CLEAN TECHNOLOGY 2017
Forum OT 2 - Presentations

Nord Stream
The new gas supply route for Europe

Operations – Guaranteeing Safe and Reliable Gas Supply

- **Nord Stream facilities**
  - Landfall Russia: Connection to the Russian gas transmission system via the Gryazovets-Vyborg pipeline
  - Landfall Germany: Gas fed into European gas transmission system via the OPAL and NEL pipelines
  - Control Centre in Zug, Switzerland: Remote monitoring and control of the pipeline system 24/7, 365 days a year
- **Compliance and service agreements**
  - Adherence to international (DNV, ASME) and national (mainly Russian and German) legislation and codes
  - Gas transport agreement (Gazprom Export), grid connection agreements (operator of connecting pipelines in Russia, operators of connecting pipelines in Germany), site service agreements for landfalls
- **Dispatching**
  - Monitors process parameters for safe operation of pipelines
  - Robust performance provided since start of operations November 2011: U
  - Utilization August 83% in average, Utilization since 1.1.2017 81% in average

7

Nord Stream
The new gas supply route for Europe

Regular Maintenance and Inspection – The Basis for Safe Operation of the Pipeline

- Outstanding Technical Design according to the highest safety standards
  - High-tensile steel, type X70 with triple layer coating (interior epoxy coating enhances flow properties, exterior anti-corrosive coating, concrete weight coating to guarantee stability on the seabed)
  - Pipe wall thickness reduced in two steps as gas pressure drops during transport from Russia to landfall facility in Germany
- Entire system certified by Norwegian company Det Norske Veritas (DNV)
- Pipeline integrity Management System (PIMS) ensures that operation of the pipeline adheres to safety of the public, the environment and the pipeline installations
- Regular internal and external inspections of the pipeline system to make sure that integrity of the pipeline is maintained
- Preventive maintenance in both landfalls in accordance to vendors manuals and engineering practice

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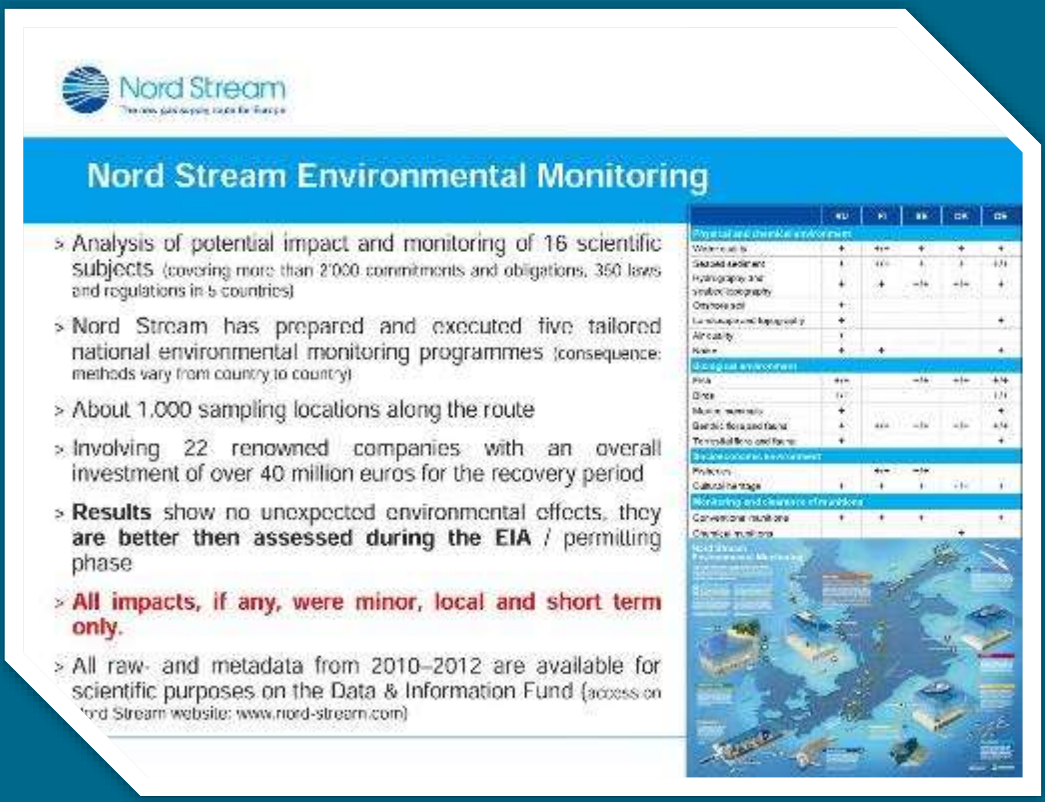
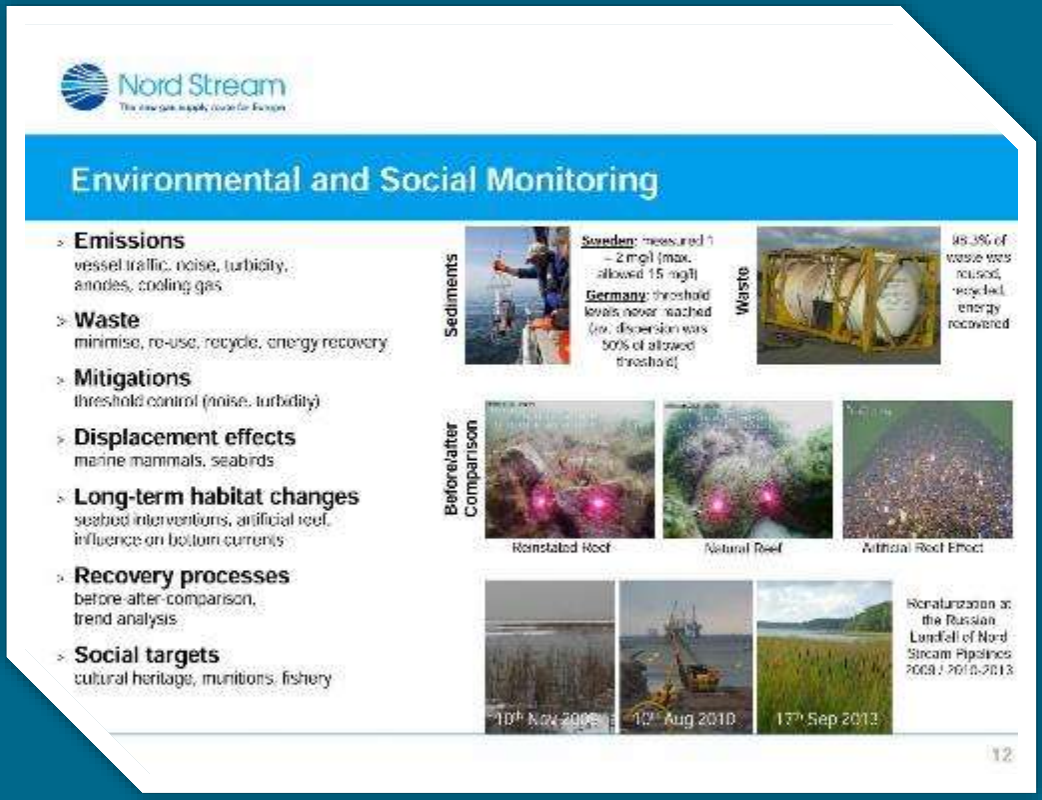

Nord Stream
Nord Stream Environmental Monitoring
Analysis of potential impact and monitoring of 16 scientific subjects (covering more than 2'000 commitments and obligations, 350 laws and regulations in 5 countries)
Nord Stream has prepared and executed five tailored national environmental monitoring programmes (consequence: methods vary from country to country)
About 1.000 sampling locations along the route
Involving 22 renowned companies with an overall investment of over 40 million euros for the recovery period
Results show no unexpected environmental effects, they are better then assessed during the EIA / permitting phase
All impacts, if any, were minor, local and short term only.
All raw- and metadata from 2010–2012 are available for scientific purposes on the Data & Information Fund (access on Nord Stream website: www.nord-stream.com)


Nord Stream
Environmental and Social Monitoring
Emissions
vessel traffic, noise, turbidity, anodes, cooling gas
Waste
minimise, re-use, recycle, energy recovery
Mitigations
threshold control (noise, turbidity)
Displacement effects
marine mammals, seabirds
Long-term habitat changes
seabed interventions, artificial reef, influence on bottom currents
Recovery processes
before-after-comparison, trend analysis
Social targets
cultural heritage, munitions, fishery
Sediments
Sweden: measured 1 – 2 mg/l (max. allowed 15 mg/l)
Germany: threshold levels never reached (av. dispersion was 50% of allowed threshold)
Waste
98.3% of waste was reused, recycled, energy recovered
Before/after Comparison
Reinstated Reef
Natural Reef
Artificial Reef Effect
Renaturation at the Russian Landfall of Nord Stream Pipelines 2009 / 2010-2013
10th Nov 2009
12th Aug 2010
17th Sep 2013
12

Forward Looking Statements

Some statements herein contain forward-looking information. The use of any of the words "anticipate," "believe," "continue," "could," "estimate," "expect," "intend," "may," "will," "plans," "project," "should," "target" and similar expressions are intended to identify forward-looking statements. These statements may include, but are not limited to, statements with respect to potential markets and contracts, the completion of a proposed transaction, sales and EBITDA projections or potential applications.

These statements address future events and conditions and, as such, involve known and unknown risks, uncertainties and other factors which may cause the actual results, performance or achievements to be materially different from any future results, performance or achievements expressed or implied by the statements. Such factors and assumptions include, among others, the effects of general economic conditions, the ability to project future sales and margins from current fundamentals and assumptions about market share, changing foreign exchange rates and actions by government authorities or cross-border authorities with jurisdiction over waterways, and negotiations and misjudgments in the course of preparing forward-looking information. Kraken believes the expectations reflected in those statements are reasonable but no assurance can be given that these expectations will prove to be correct and such forward-looking statements included in, or incorporated by reference into, this presentation should not be unduly relied upon. These statements speak only as of the date of this presentation.In addition, there are known and unknown risk factors which could cause the Company's actual results, performance or achievements to differ materially from any future results, performance or achievements expressed or implied by the forward-looking statements.

Known risk factors include risks associated with the ability to close contracts, working capital risk to be able to build inventory, loss of key personnel, lack of patents protecting intellectual property, changes in competing technology, continuing shrinkage of military budgets or other target customer budgets, risks associated with publicly traded company obligations, inability to raise required capital, and other potential risks that arise in the normal course of business. Forward-looking statements are made based on management's beliefs, estimates and opinions on the date that statements are made and the Company undertakes no obligation to update forward-looking statements if these beliefs, estimates and opinions or other circumstances should change, except as required by law.

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Synthetic Aperture Sonar Technology
Conventional Side Scan Sonar
Pixel Resolution: 20cm @ 80m range
Kraken AquaPix® SAS
Pixel Resolution: 3cm @ 80m range
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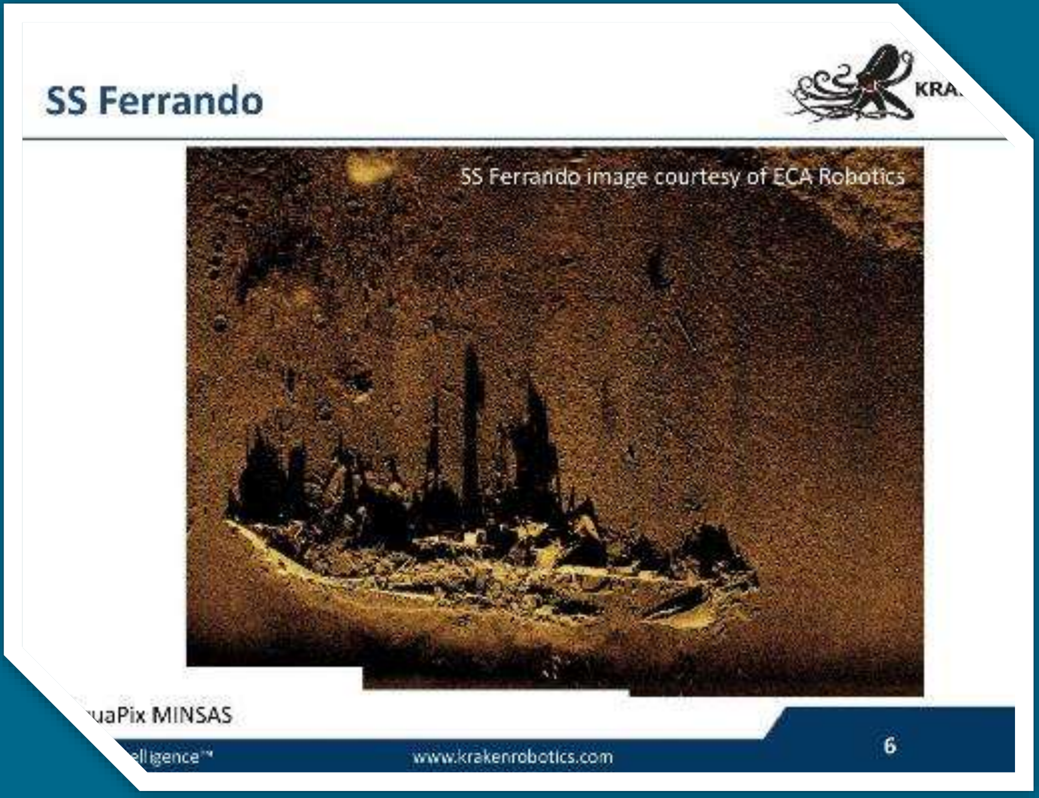
SS Ferrando
SS Ferrando image courtesy of ECA Robotics
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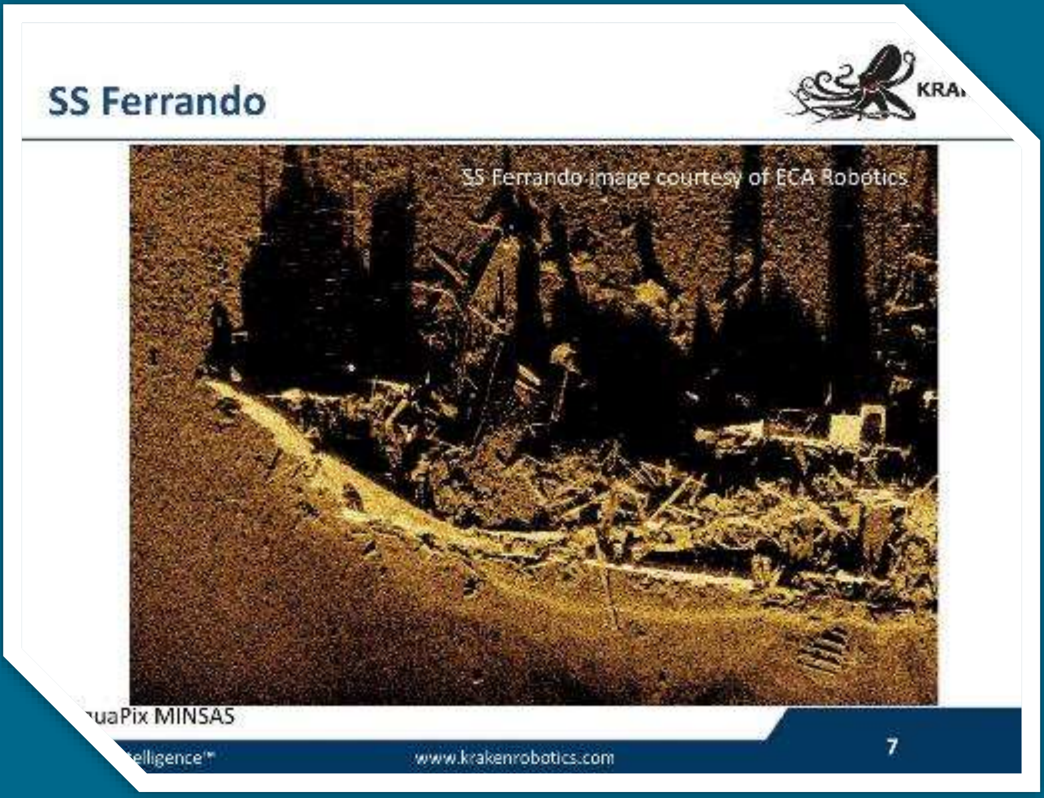

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Kraken Underwater Systems
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KatFish ®
ThunderFish®
LONG RANGE POSITIONING SYSTEM
QUADBAND SAS MF/HF
ACOUSTIC / RF COMMS
ACOUSTIC CAMERA
3D OPTIC LASER
QUADBAND SAS VLF/LF
MULTI-MISSION PAYLOAD BAY
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9


Offshore Wind Farm Market
KRA
Global offshore market
Europe
Capacity [MW p.a.]
Investment [EUR bn p.a.]
1,800 2,600 4,500
7.0 9.4 14.4
2013 2016 2020
2013 2016 2020
North America
Capacity [MW p.a.]
Investment [EUR bn p.a.]
0.0 300 500
0.0 1.1 1.6
2013 2016 2020
2013 2016 2020
Asia Pacific
Capacity [MW p.a.]
Investment [EUR bn p.a.]
400 900 1,500
1.6 3.2 4.8
2013 2016 2020
2013 2016 2020
Offshore projects
Plans for offshore
No activity
Rationale: Investment costs per MW: 2013: EUR 3.9 m, 2016: EUR 3.6 m, 2020: EUR 3.2 m
Source: EER; BTM; Global Data; Roland Berger
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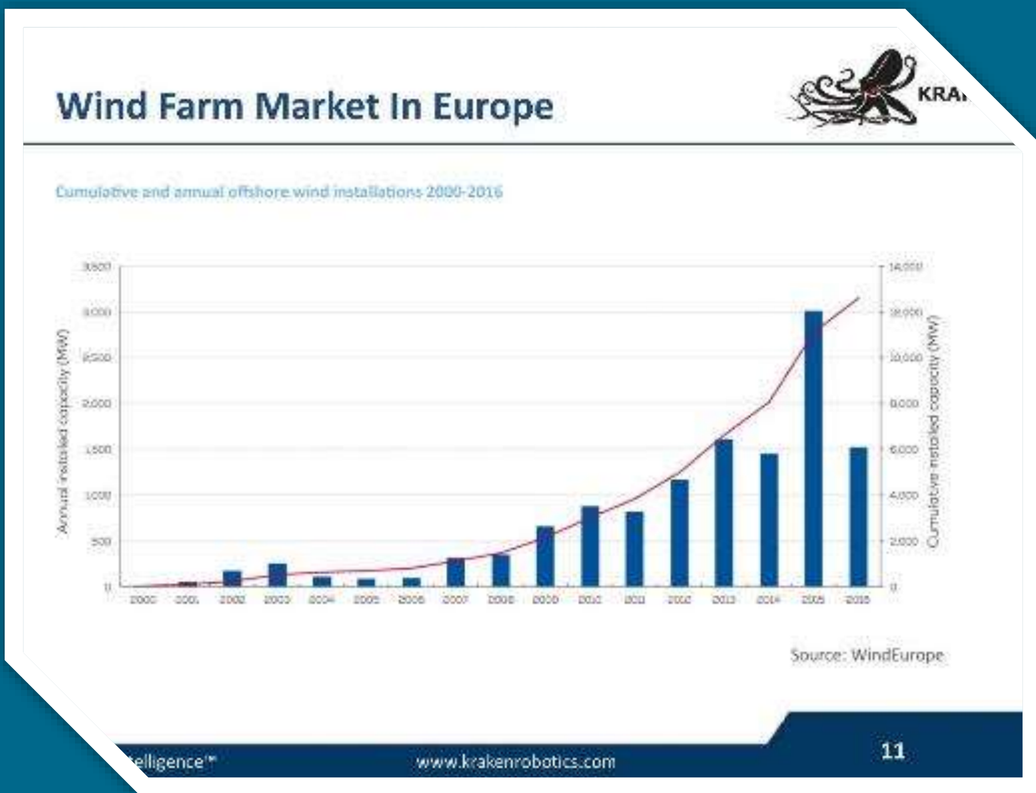

Wind Farm Market In Europe
KRA
Cumulative and annual offshore wind installations 2000-2016
Annual installed capacity (MW)
Cumulative installed capacity (MW)
Source: WindEurope
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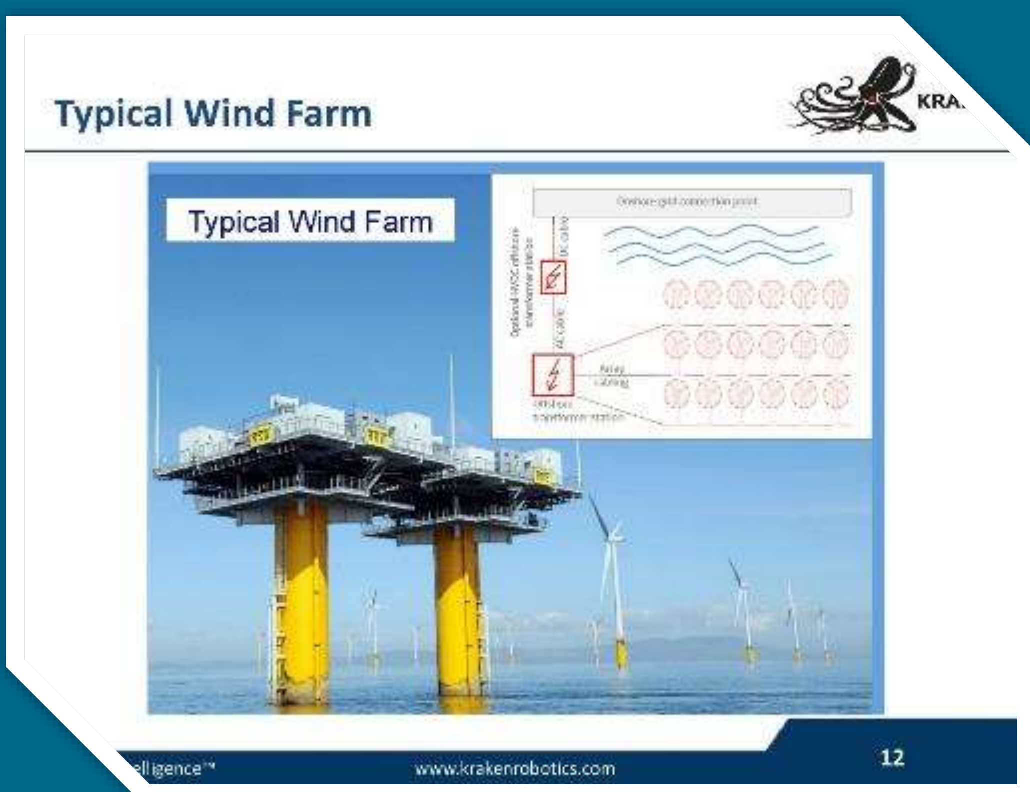

Typical Wind Farm
KRA
Typical Wind Farm
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Offshore Integrity Challenges
KRA
wake turbulence
gravity
tidal & storm surge depth variation
extreme wave
soil mechanics
scour
Source: US Department of Energy
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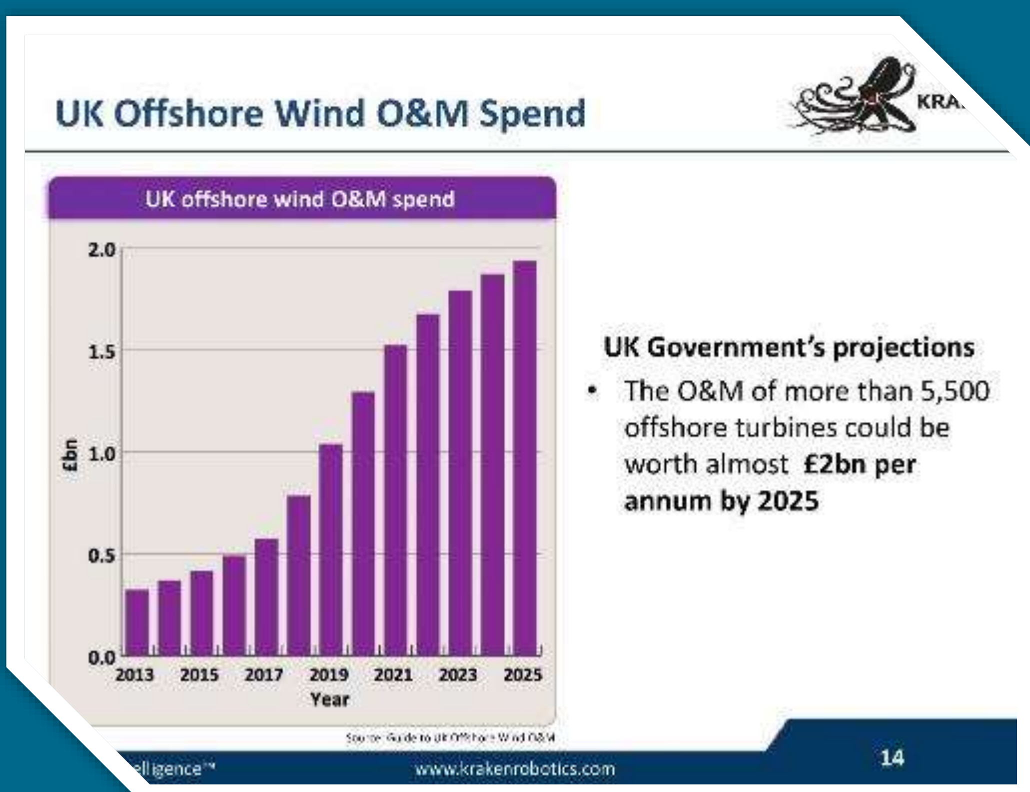
UK Offshore Wind O&M Spend
KRA
UK offshore wind O&M spend
2.0
1.5
1.0
0.5
0.0
£bn
2013
2015
2017
2019
2021
2023
2025
Year
Source: Guide to UK Offshore Wind O&M
UK Government's projections
• The O&M of more than 5,500 offshore turbines could be worth almost £2bn per annum by 2025
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Accessibility

KRA

Source: US Department of Energy

- O&M maximizes availability
- Least cost, by ensuring the best possible access to offshore plant
- Minimising the need for human intervention offshore, is a key route to maximising the potential, and **minimising the cost, for offshore low-carbon generation.**

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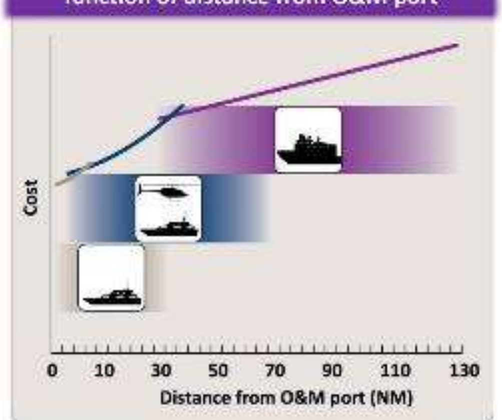
O&M Access Strategie Today

KRA

Illustration of lowest cost O&M strategy as a function of distance from O&M port



Source: Guide to UK Offshore Wind O&M

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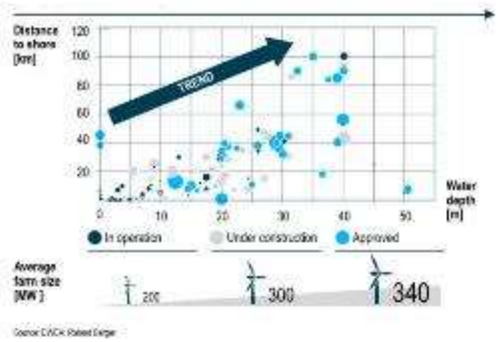
Offshore Wind Development



- Growth towards further distances from shore
- Higher relevance on reducing O&M costs.

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Offshore IMR

Shipboard Personnel: 40 - 60 people
Daily Opex: €150,000 per day
Offshore Vessel: €10 million to €20 million/yr for 500MW

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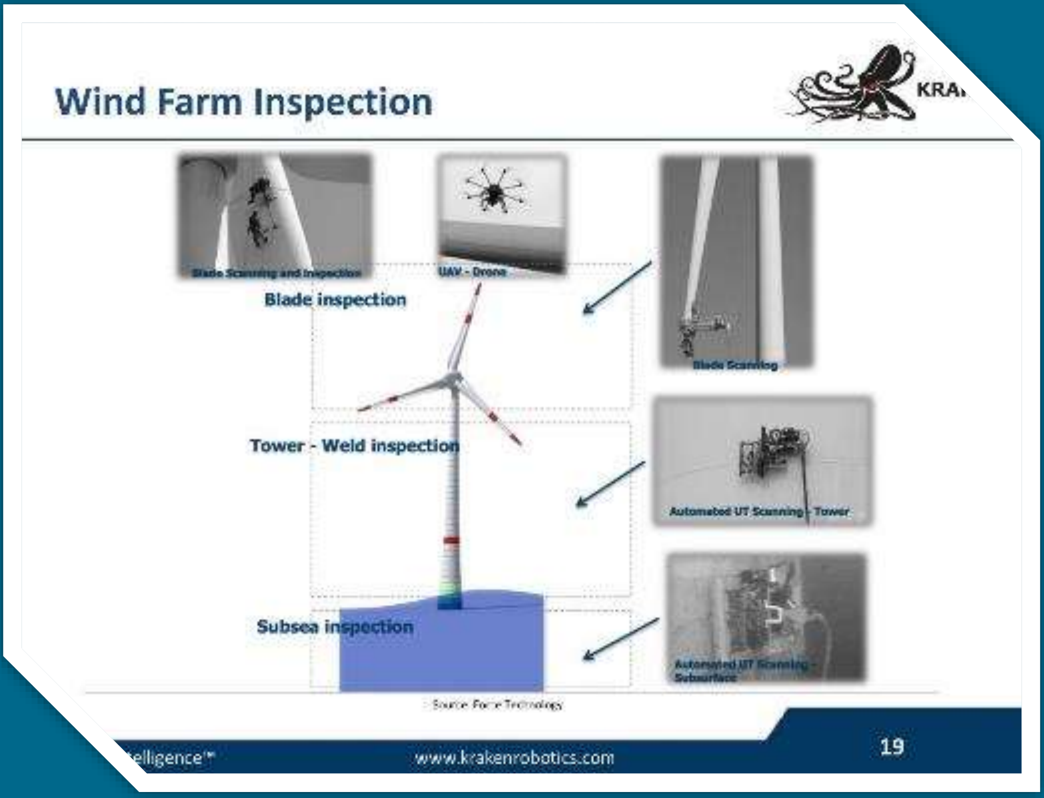
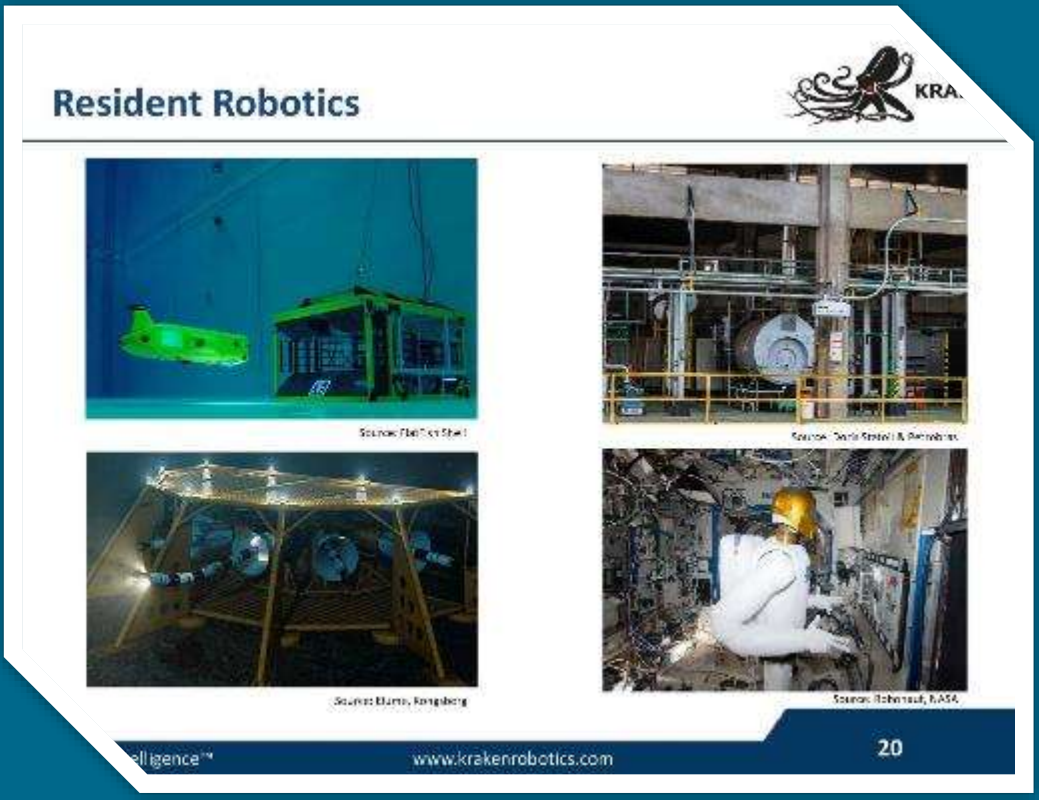
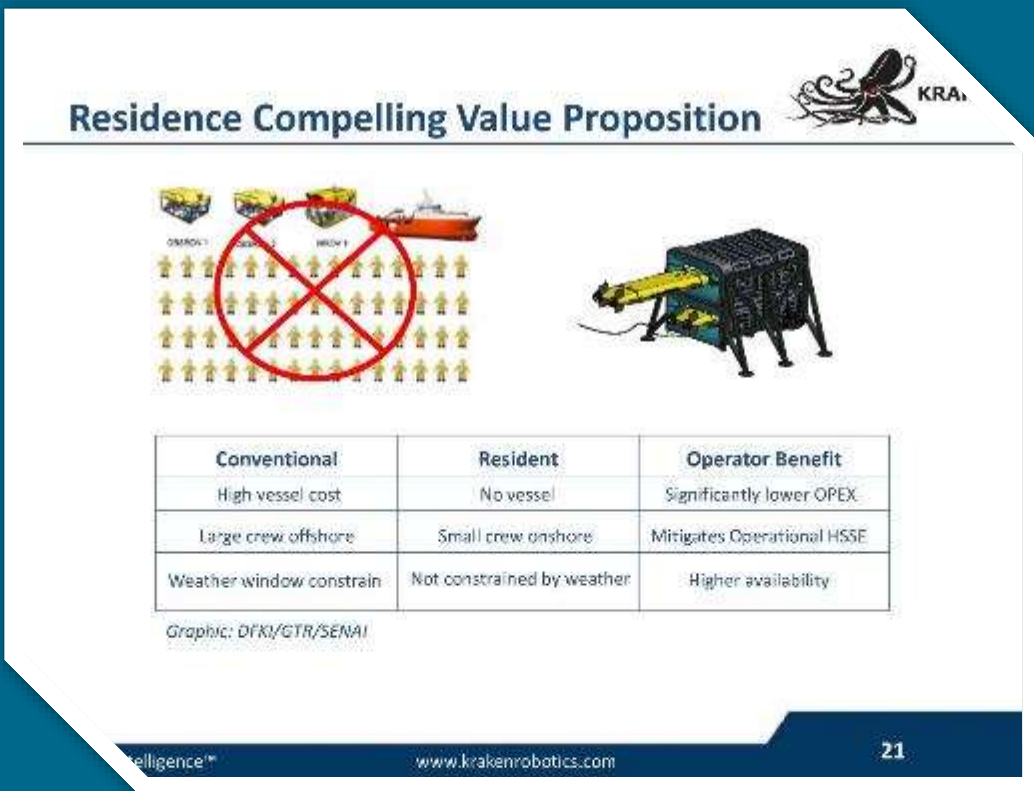
Forum OT 2 - Presentations







Residence Compelling Value Proposition
KRA
Conventional | Resident | Operator Benefit
High vessel cost | No vessel | Significantly lower OPEX
Large crew offshore | Small crew onshore | Mitigates Operational HSSE
Weather window constrain | Not constrained by weather | Higher availability
Graphic: DFKI/GTR/SENAI
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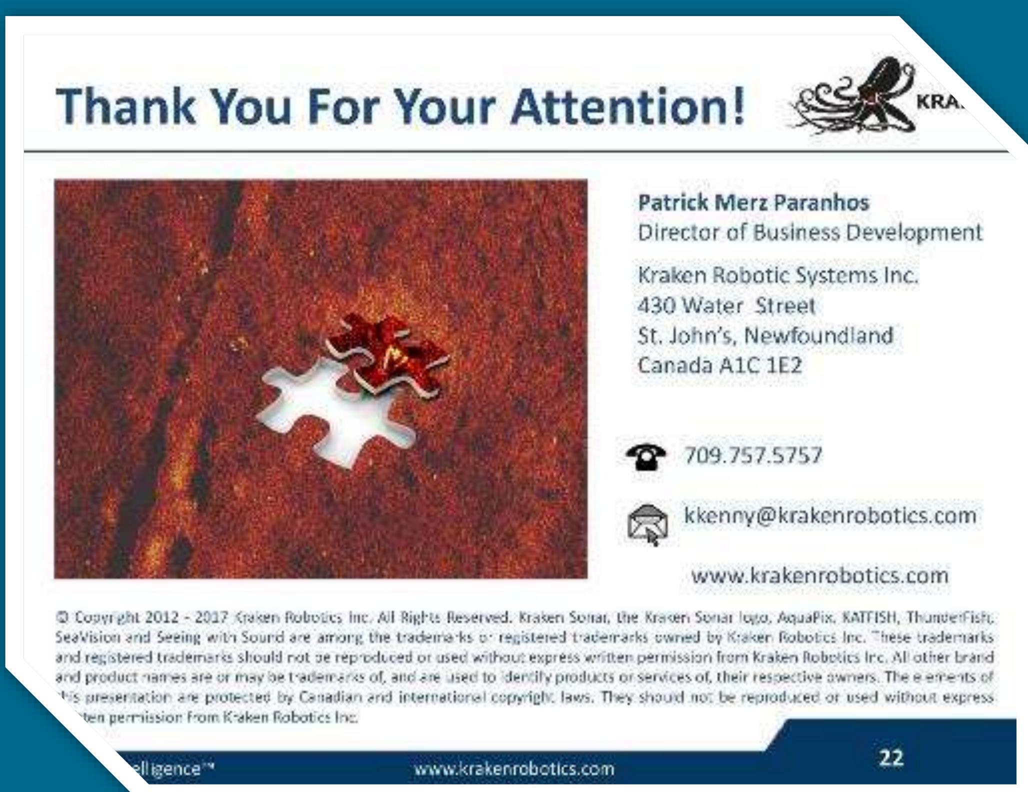

Thank You For Your Attention!
KRA
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BALTIC CLEAN TECHNOLOGY 2017
Summary of results – day 2

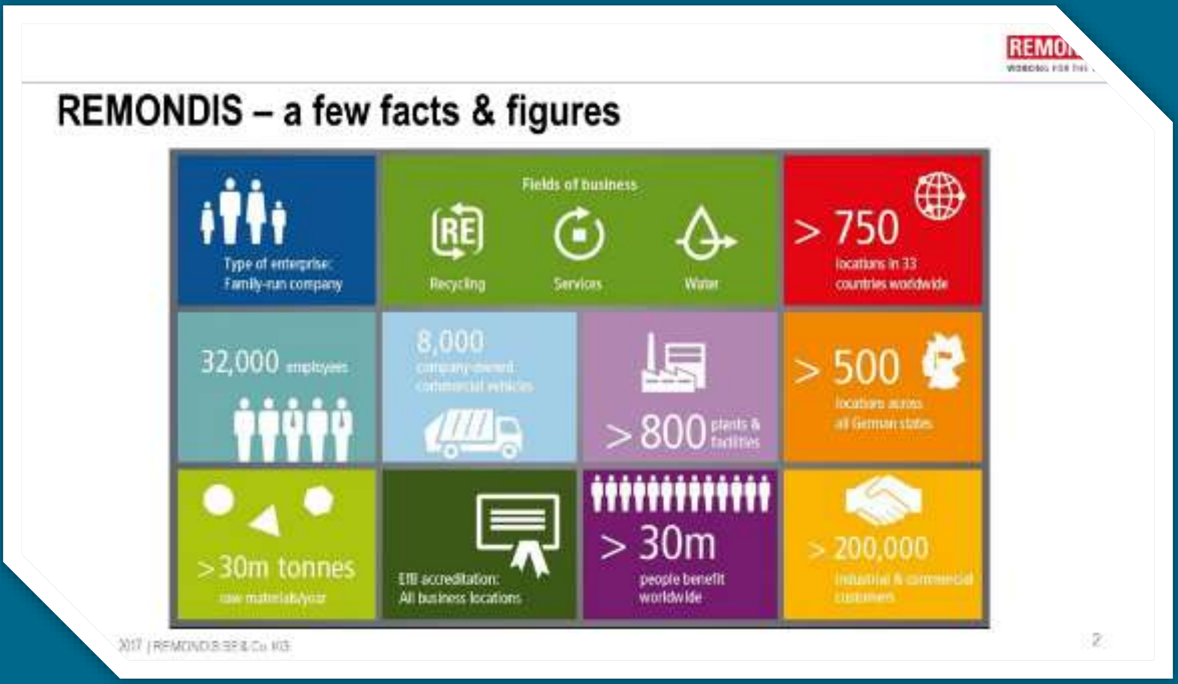
Friday, 29 September 2017

10:00 – 11:30

FORUM RESOURCE MANAGEMENT 4: Deconstruction, dismantling and reutilization of offshore power plants

Forum Resource Management 4
DECONSTRUCTION, DISMANTELING AND REUTILIZATION OF OFFSHORE POWER PLANTS
recycling parts
80%
of the weight can be recycled
BUT
rotor blades can't!
composites
DESIGN
for degradation
PLAN
from cradle to crade!
on shore
NO!
Problems may occur here
munition
contamination
lack of stability
potential area = limited!
Can you please clean up behind yourself?!
Degradation
↳ Leave site as it was!
remove foundation
What about the organisms living here?


REMONDIS®
WORKING FOR THE FUTURE


REMONDIS – a few facts & figures
Type of enterprise:
Family-run company
Fields of business
Recycling
Services
Water
> 750
locations in 33
countries worldwide
32,000 employees
8,000
> 800 plants & facilities
> 500
> 30m tonnes
Efb accreditation:
All business locations
> 30m
people benefit
worldwide
> 200,000
2

REMONDIS

Working for the future - today

- Our claim:
  - **Recycling before disposal!**
  - Collection and treatment of over 30 million tons of recyclables, which are re-distributed to the industry as raw materials
  - Cutting edge recycling processes developed and patented by REMONDIS are recognized within the business as state-of-the-art technology
  - Annual saving potential by REMONDIS (2016):

7,316,000 to of scrap metal saves 10,242,000 to of iron ore	1,675,000 to of recycling paper saves 4,506,000 to of wood
145,000 to of WEEE saves 4,868,000 to of copper ore	2,900,000 to of construction material saved through recycling
885,000 to of recovered glas saves 1,062,000 to of minerals	300,000 to less sulphur emissions through DESOX gypsum

2017 | REMONDIS SE & Co. KG 3

REMONDIS

The future

10 billion people by 2050

up to 75 % living in megacities

140 billion tons of raw materials needed annually by 2050

One question: Can we handle it?

6.5 billion tons of waste produced daily worldwide by 2030

¾ of the world's energy production consumed in megacities

Challenges & Solutions

2017 | REMONDIS SE & Co. KG 4

Global raw materials demand

- Up to this day, the global demand in raw materials has grown exponentially and it will continue to do so in the future:

1900:	10 billion to
1958:	20 billion to
1975:	30 billion to
2005:	62 billion to
2016:	70 billion to

- However, the annual per-capita consumption varies considerably:
  - in Germany around 22 to — in China around 12 to
  - in India around 4 to — in Malawi around 0.3 to
- A global population of 10 billion people with increasing wealth will ultimately consume more raw materials per capita and also in absolute numbers!

What has all that got to do with wind turbines?

Recycling of wind turbines

- Wind energy is the oldest form of energy used by mankind.
- Originally as a means of propulsion, it is now used mainly to produce electricity.
- Total number of wind turbines installed in Germany (2016) onshore and offshore = 28.217
- The German renewable energy act (EEG) insures that wind turbine installations are subsidized. When subsidization runs out installations are usually taken off the grid and dismantled.

Recycling of wind turbines - experience

- Complete dismantling of wind turbines (tower, housing, foundation, cables, etc.) as joint projects of REMONDIS Olpe GmbH, TSR and REMEX
- Experience in rotor blade disposal:
  - REMONDIS Olpe GmbH
    - since May 2009 about 20.000 tons
  - REMONDIS Nord
    - Thermal incineration by Bremerhavener Entsorgungsgesellschaft BEG, limited to a maximum of 1.000 tons/a
- Deconstruction of submarine cables and transport of off-/ onshore rotor blades through Rhenus Offshore Logistics

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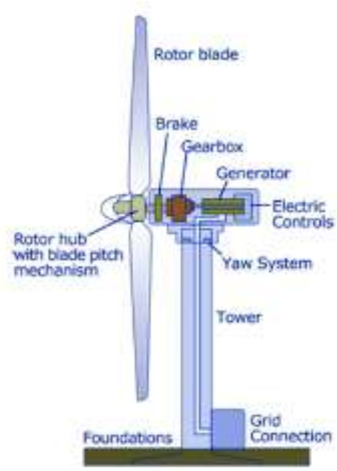
Wind turbine components

- Wind turbines consist of various materials incl. composites
- The three main functional groups are:
- Rotor
  - hub, mostly made of **metal**
  - rotor blades, made of **fibre glass/wood composite** or **carbon composites** (in new generation turbines)
- Housing
  - gear box and break
  - generator
  - yaw system
- Tower and foundations
  - grid connection



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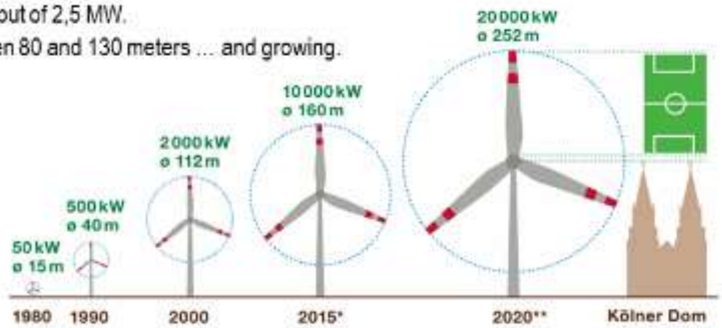
Wind turbines – technical development

- Rapid technological advancement of wind turbines in the last 10 years
- Improved energy efficiency and output correlates with the size of installations
- Today's wind turbines in Germany have an average rotor diameter of about 90 meters and a nominal electricity output of 2,5 MW.
  The tower height lies between 80 and 130 meters … and growing.



* Industry trends & source: EWEA Upwind
** EWEA Upwind 2011: eine Studie der europäischen Wind Energy Association

© Infografik BASF

Wind turbines – recycling challenges

- **The good news is:**
  Between 80 and 90 % of the weight percentage of a wind turbine can be recycled, mainly construction materials and metal components.

- **The bad news is:**
  Rotor blades with an average weight of 25 tons per blade (75 tons per installation) are the most voluminous part of the turbine and cannot be recycled according to modern ecodesign standards. They are merely disposed of.
  Current means of disposal: shredder and incinerate / shredder and add to concrete
  This has little or nothing to do with material recycling!

Wind turbines – recycling challenges

- Rotor blades are composites made of glass fibre mats, wood and epoxy or polyester resin. Separating these components is extremely elaborate and currently subject to bench tests only.
- REMONDIS dismantles and shredders the rotor blades.
- The shreddered material is shipped to cement works or incineration plants.
  - Because of its relatively high silicon content the material can substitute some of the sand needed for cement production.
  - In waste incineration plants it is simply used as additional fuel.

The problem: Thermal treatment of silicon results in increased slagging.

Therefore, if at all, most plants do not accept charges of more than 2 to 4 tons of shreddered rotor blades per day!

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Wind turbines – recycling challenges

- According to a study issued by Fraunhofer ICT and Technische Universität Dresden, the total weight of rotor blades to be recycled annually will amount to over 40.000 tons per year by 2045.
- At the same time, incineration capacities will decrease in accordance with the European waste management directive. Landfilling is not an option either (TaSi 2005 / EuroTasi 2xxx).

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Wind turbines - smart recycling solutions – eco design

- In order to maximize the material recycling quota of all recovered waste including rotor blades, strict eco-design regulations must be put into effect. Producers need to take the end-of-life treatment of their products into account when designing new products.
- Everything needs to be 100% recyclable! Remember, we only have 1 planet to share.

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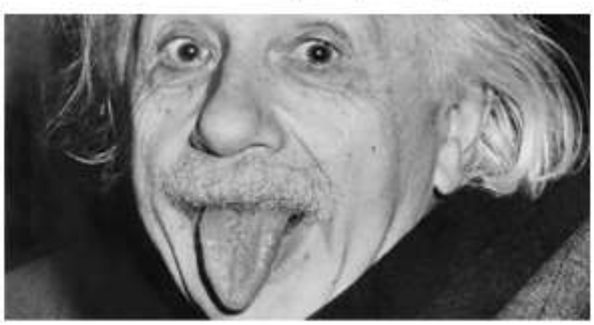
"A new kind of thinking is necessary if mankind wants to survive."

Albert Einstein (*1879, †1955),
German-American physicist, nobel prize 1921



Thank you for your attention.

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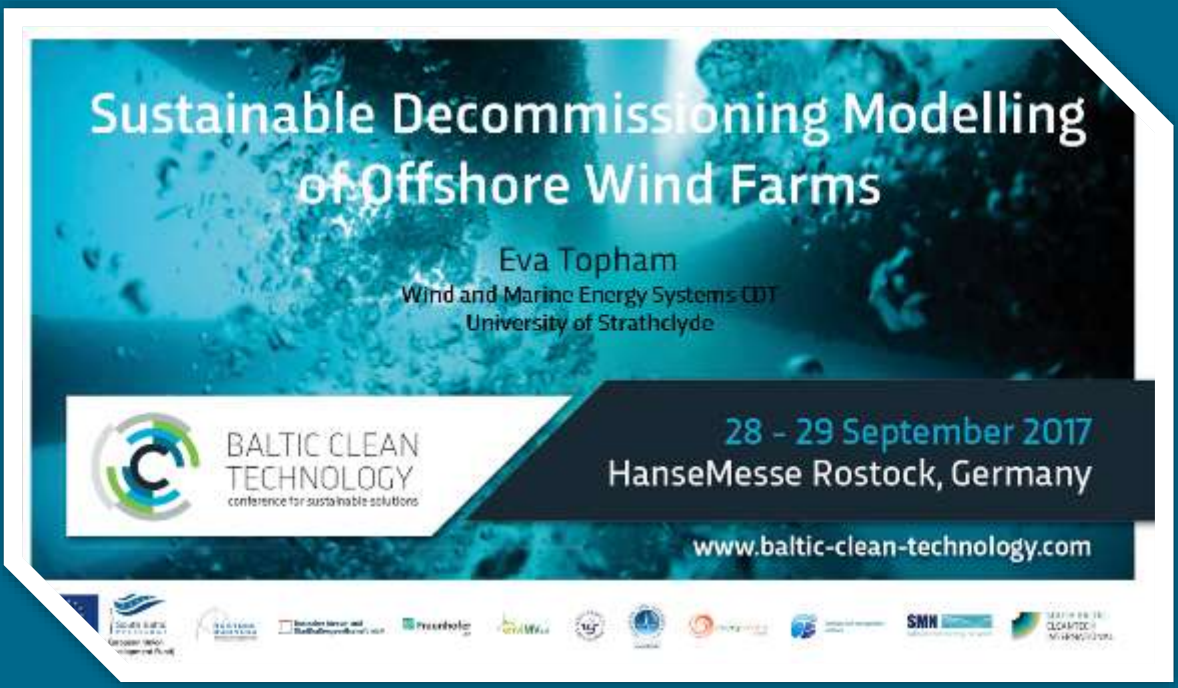

OBJECTIVES

1. Understand the process of decommissioning
2. Identify the elements to remove and the existing methods available
3. Simple estimation of costs and time
4. Assign sustainable final destinations to components

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WHAT IS DECOMMISSIONING?

- Last phase in project's lifecycle
- Considered to be the opposite of installation phase
- The principle: "the polluter pays" applies
- Ensures sites are left as they were before the project was deployed
- No regulations - UNCLOS

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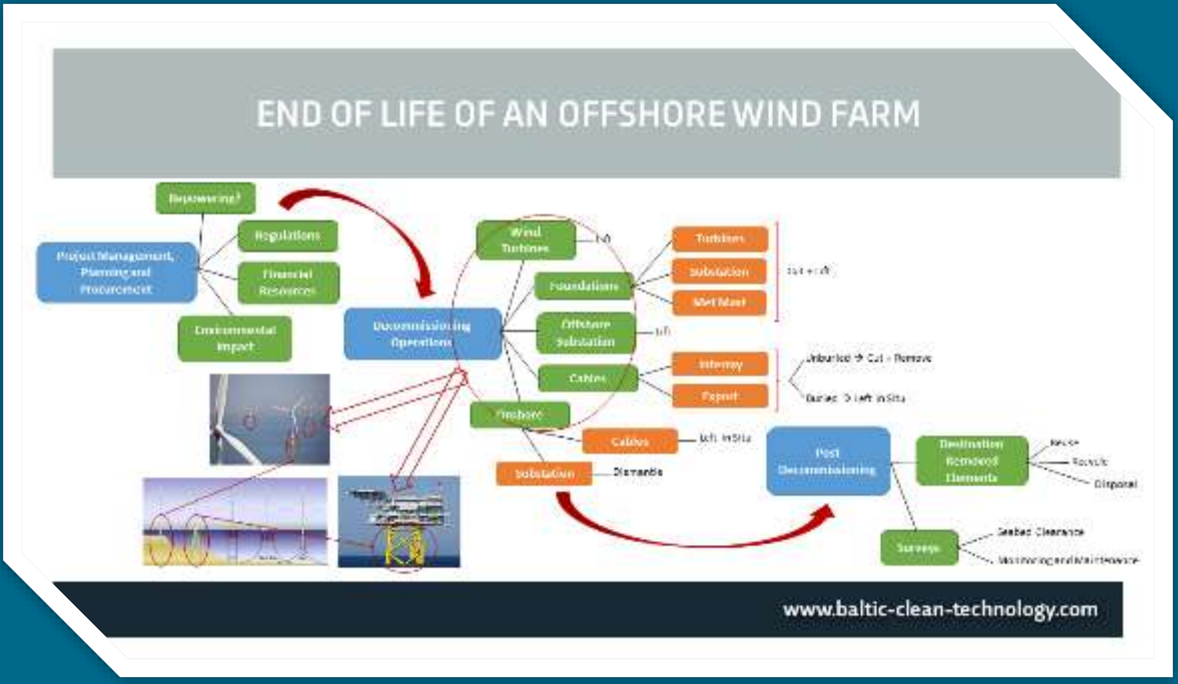


END OF LIFE OF AN OFFSHORE WIND FARM
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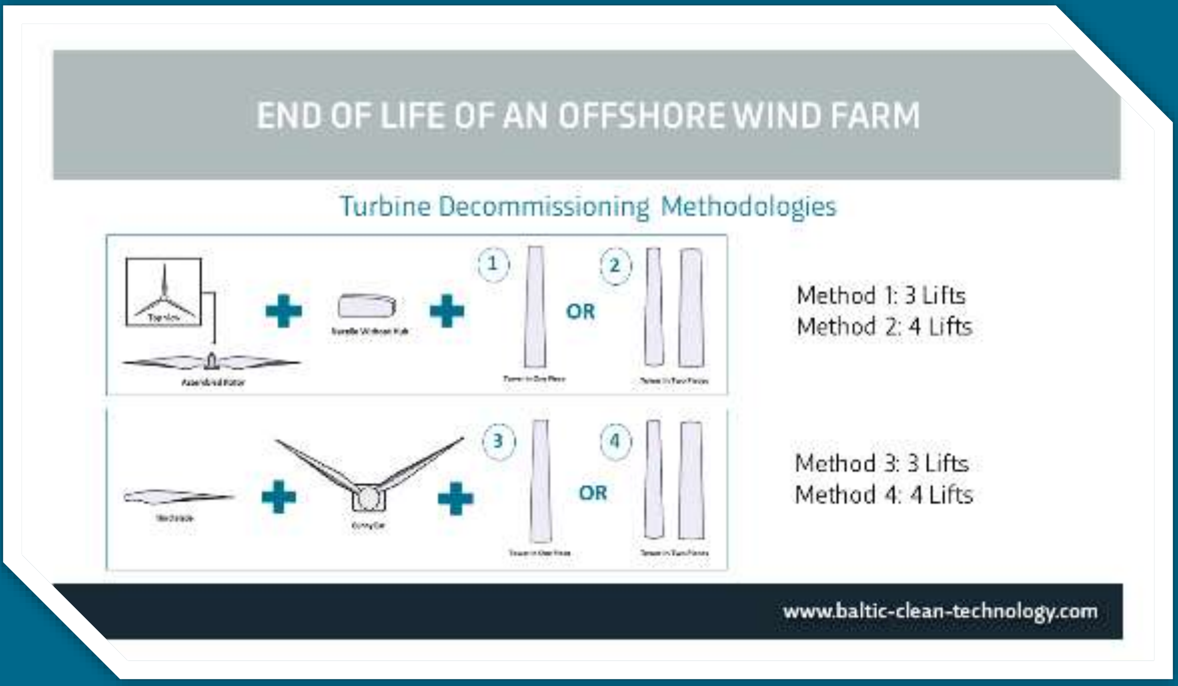
END OF LIFE OF AN OFFSHORE WIND FARM
Turbine Decommissioning Methodologies
1
OR
2
3
OR
4
Method 1: 3 Lifts
Method 2: 4 Lifts
Method 3: 3 Lifts
Method 4: 4 Lifts
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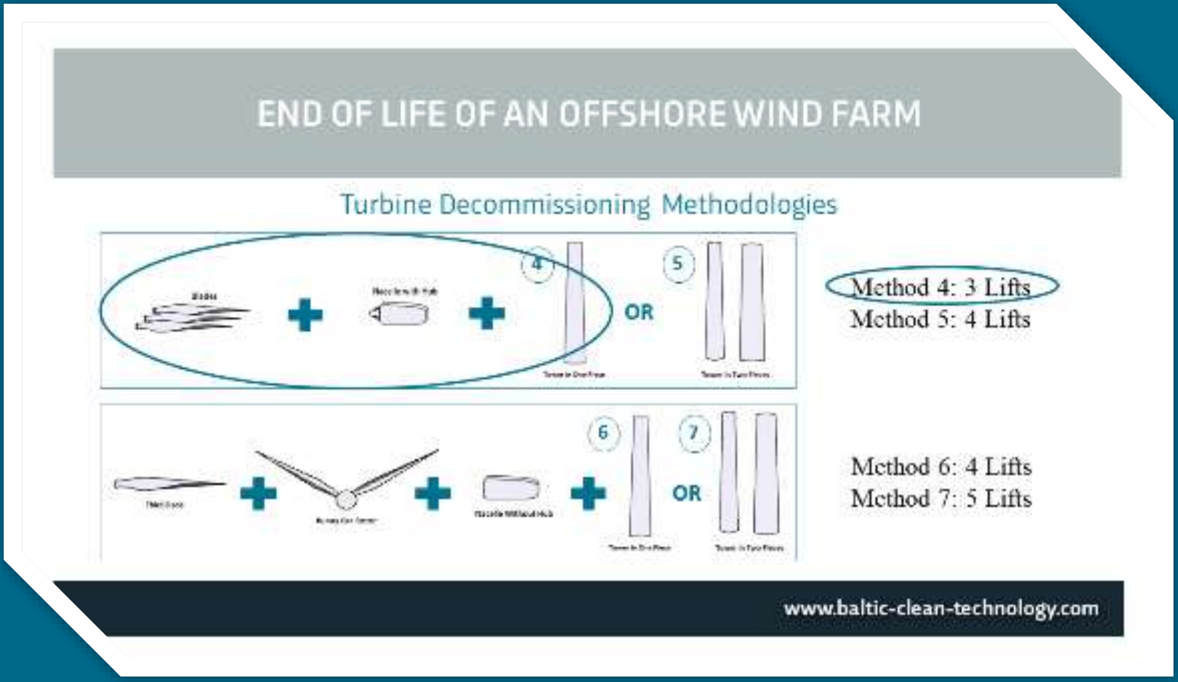

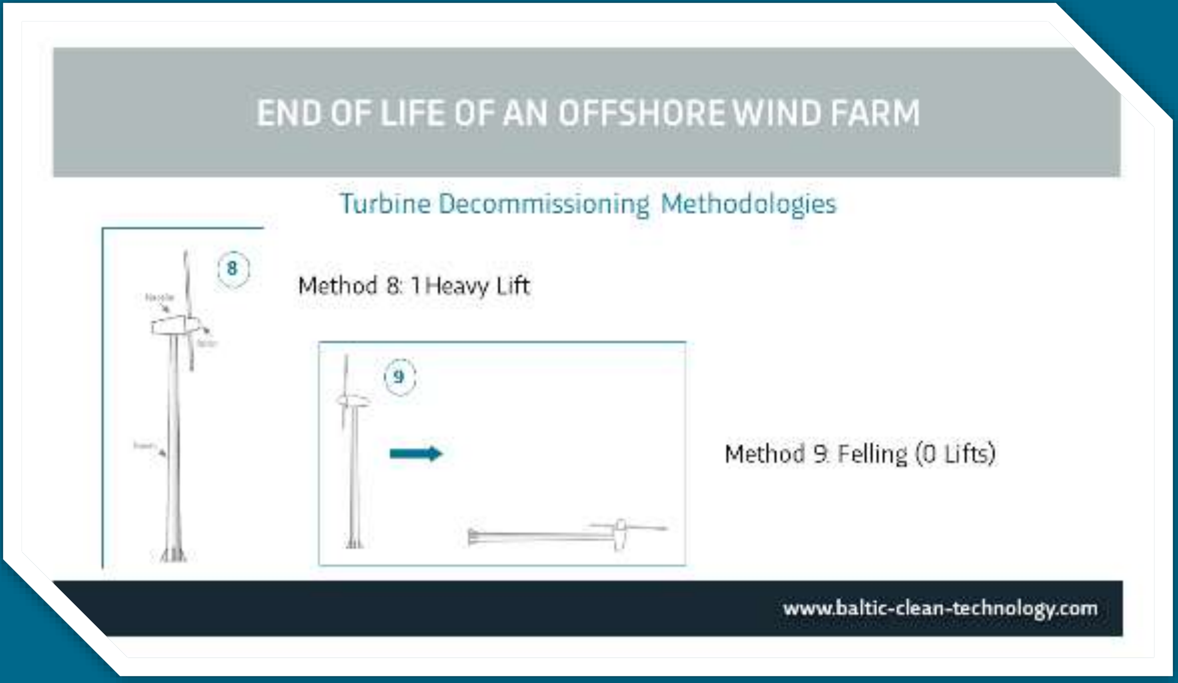

END OF LIFE OF AN OFFSHORE WIND FARM

Cutting Techniques

Method	Description	Merits	Drawbacks
Diamond Wire Cutting	The cut is a consequence of the friction produced by the wire against the structure	- Less pollutant, no vibrations - Can be wrapped around almost any size/shape - Cost effective solution	- Requires a good access to the cutting area
Water Jetting	A jet of water and an abrasive substance released at high pressure	- Can cut any material - Can be easily automated	- Components fly off - Environment is affected more - High costs
Explosives	A lined or unlined cavity in the explosive produces a high energy cutting jet	- Low time necessary - Controlled demolition of structures using explosives well established	- Non explosives methods preferred - Increased risks, requires a lot of planning - Disruption of the marine environment

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MODELLING COSTS AND TIME

Vessels

Vessels	Description	Crane Capacity (tonnes)	Deck Load (tonnes)	Deck Space (m^2)	Max Velocity (knots)	Operational Water Depth (m)	Turbine Capacity	Foundation Capacity	Estimated Day rate (£/day)	Merits	Drawbacks
Jack-up and leg stabilised vessels	Self-propelled and dynamically positioned vessels	30–400	492–2588	493–1020	6–8	24–45	1–2	0	50,000	- Good stabilising features	- Jack-up/down time required so slows operations
Non Propelled Jack Up	Jack up barge that needs towing	300–1000	110–2500	750–2500	–	30–40	2–6	2–4	75,000	- Cost effective vessel; good relationship between capacities and price	- Slow mobilisation - Only operates in "shallow" waters
Self-Propelled Multirole Vessel	Heavy lifting crane ships, self-propelled DP2 ship-shaped jack-up or jack up barge, fitted with helideck	300–1500	600–8400	403–4100	6–13	40–75	6–8	5–6	120,000	- Highest lifting capacity - Largest deck loading	- High demand on oil & gas industry - Port entrance limitation due to size - Daily charter very high
Wind Turbine Installation Vessel (WTIV)	Self-propelled with jack up legs and high crane capacities. They have been designed for the purposes of the industry sector	500–1500	2000–6541	2000–3600	7.5–12.5	35–60	10	8	155,000	- High crane and deck capacities - Rapid mobilisation	- Vessel designed for the offshore wind energy industry and so high demanded, availability might become a problem

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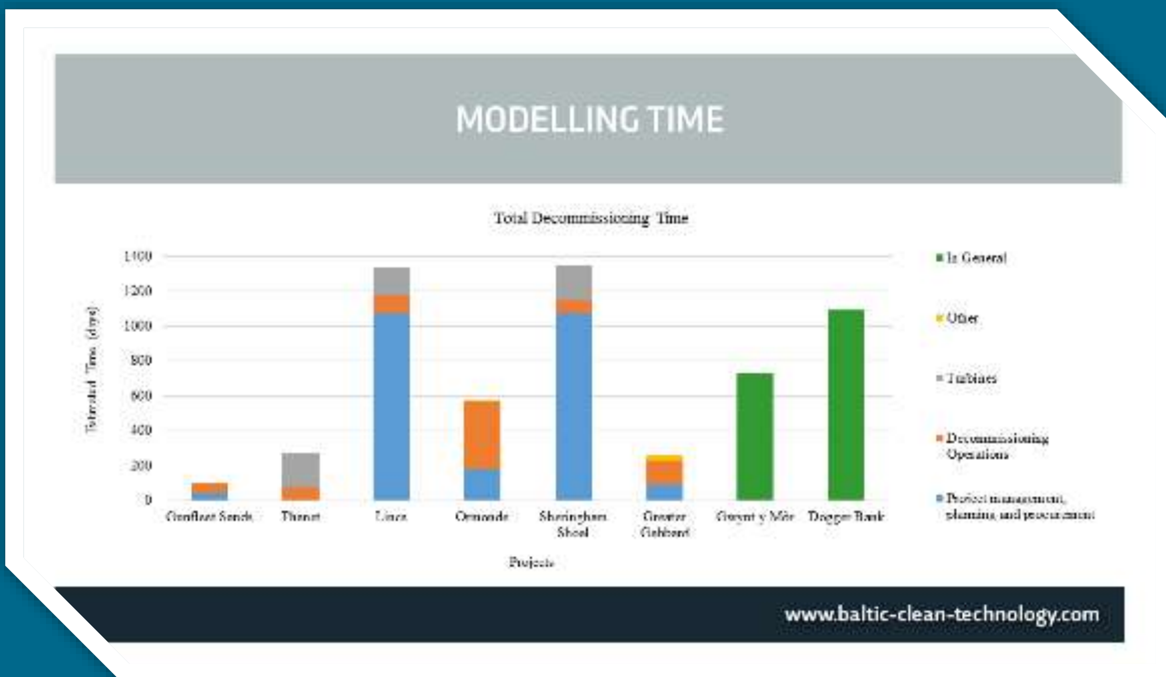

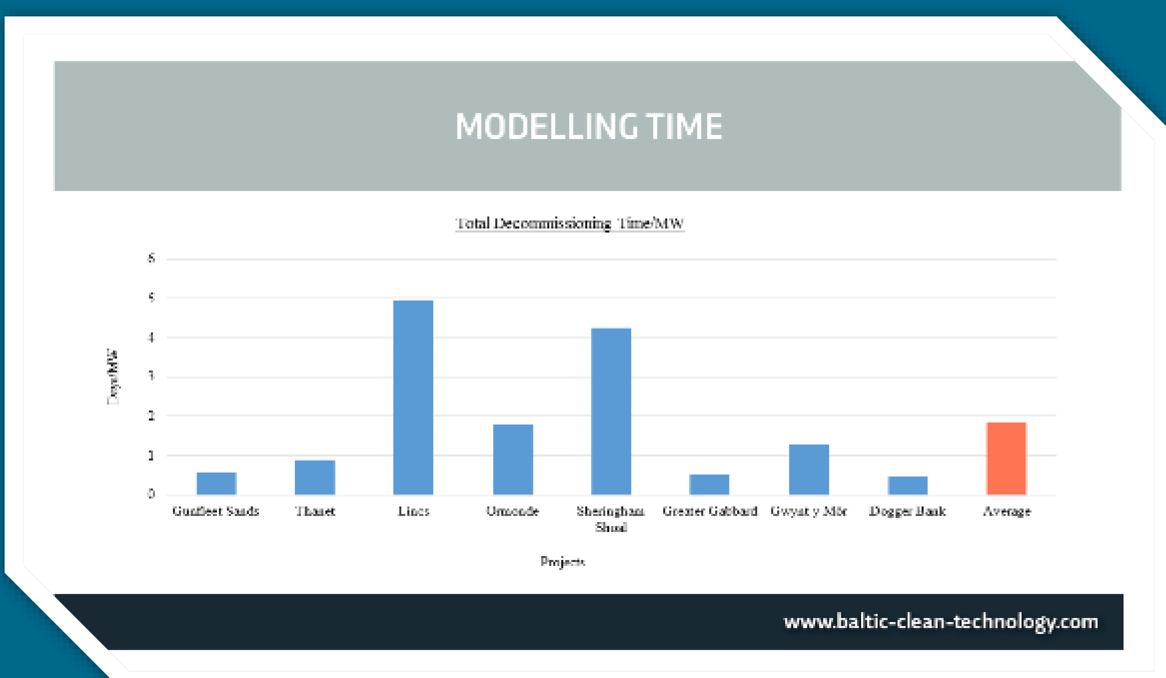

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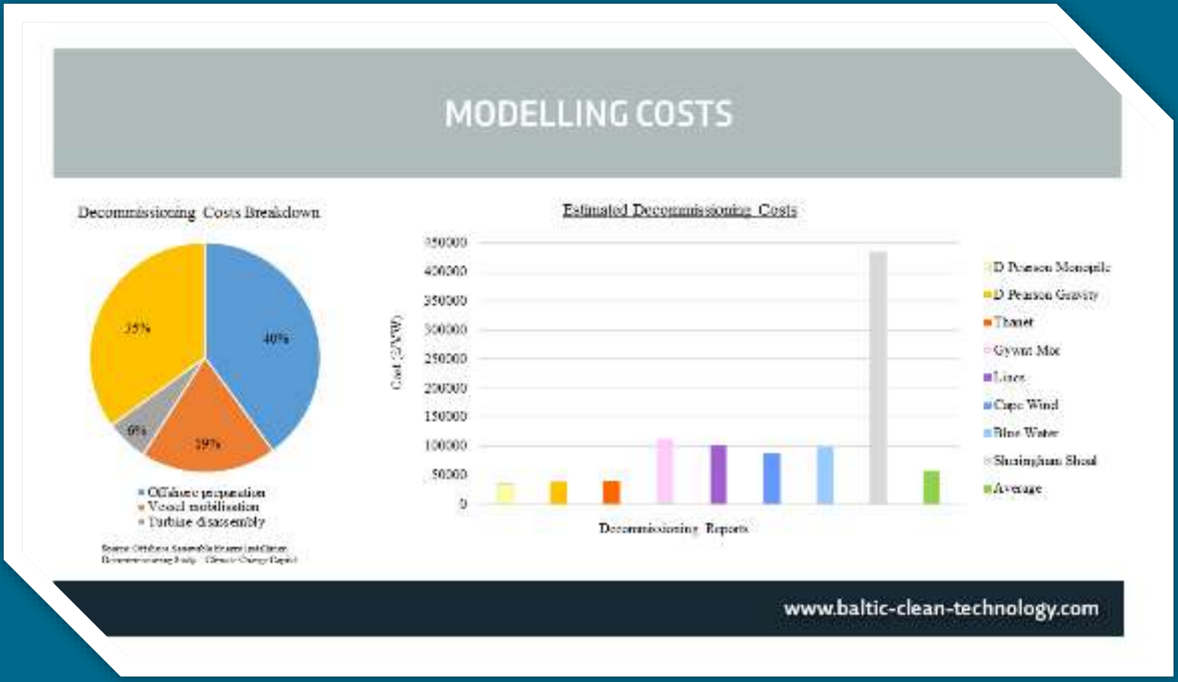

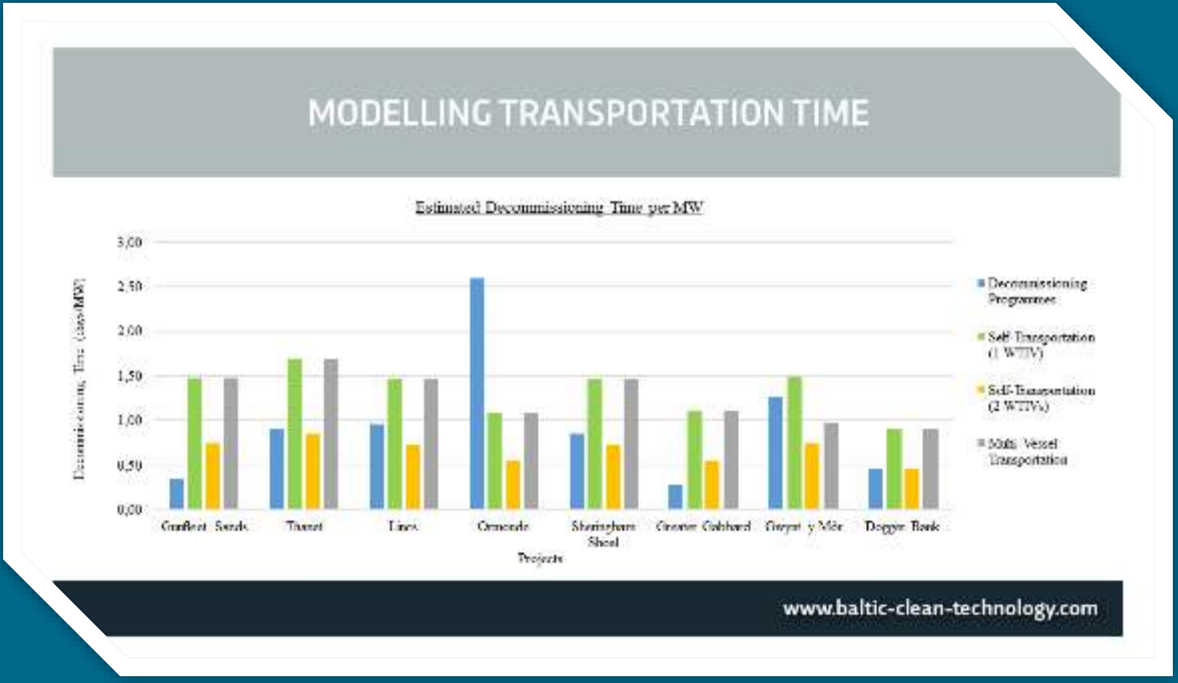

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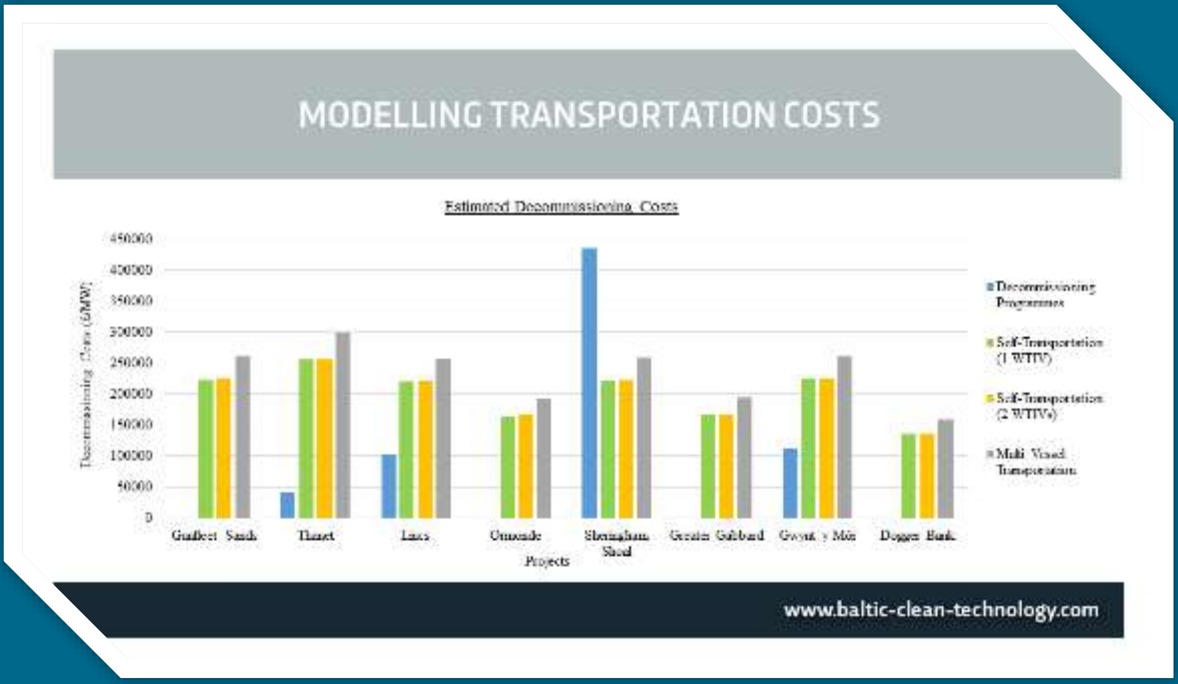

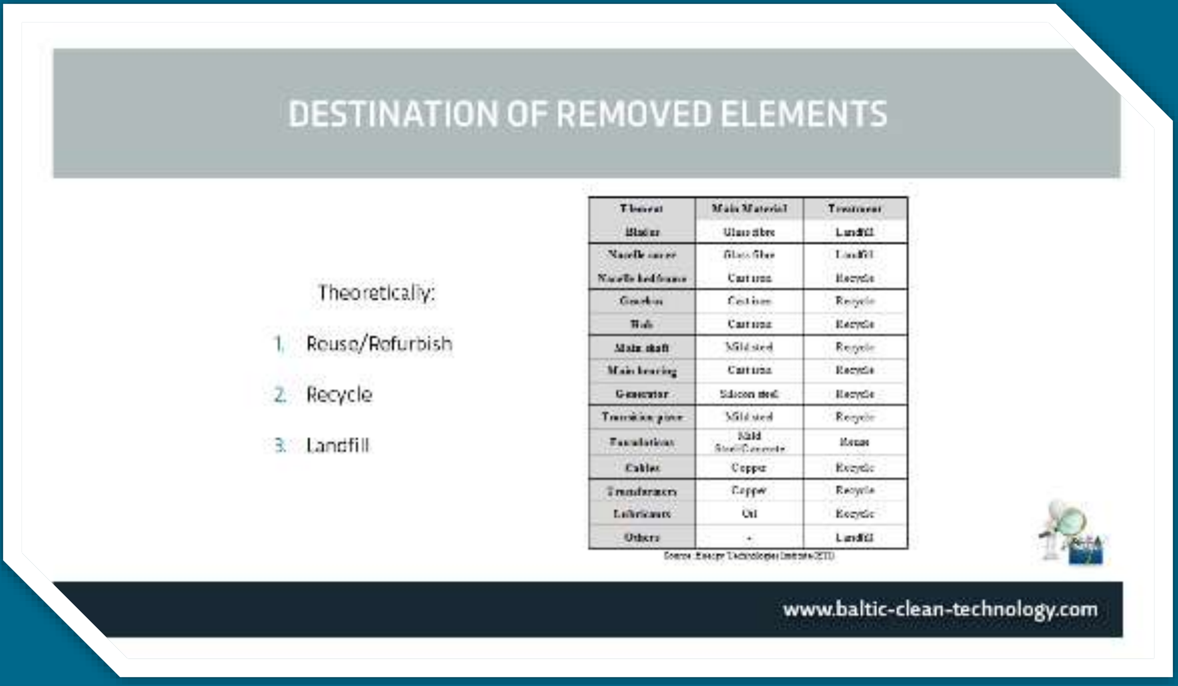

Element	Main Material	Treatment
Blades	Glass fibre	Landfill
Nacelle cover	Glass fibre	Landfill
Nacelle bedframe	Cast iron	Recycle
Gearbox	Cast iron	Recycle
Hub	Cast iron	Recycle
Main shaft	Mild steel	Recycle
Main bearing	Cast iron	Recycle
Generator	Silicon steel	Recycle
Transition piece	Mild steel	Recycle
Foundations	Mild Steel/Concrete	Reuse
Cables	Copper	Recycle
Transformers	Copper	Recycle
Lubricants	Oil	Recycle
Others	-	Landfill

Source: Energy Technologies Institute (ETI)

KEY RESULTS

- Less turbine disassembly offshore would imply less risk and time
- Reversing installation methods is said to be done, but lack of proof
- Requirement of foundations to be cut at depths of minimum 5m
- Offshore substations heaviest lift (>2000t), delicate operation
- Foundations could be lifted together with transition piece
- Buried cables can be left in situ if well buried but require monitoring

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CONCLUSIONS

- The entire removal of elements implies extreme costs and environmental impacts
- There still is too much uncertainty and project's life expectancy is a big factor
- The availability and costs of vessels have a significant influence on this stage
- Decommissioning time predictions could have been underestimated
- Decommissioning costs are estimated to be £40,000/MW, but this study suggests they could be over £ 200,000/MW
- The recycling of removed components could potentially reduce LCoE

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THANK YOU!
QUESTIONS?
University of Strathclyde Engineering
Wind & Marine Energy Systems CDT
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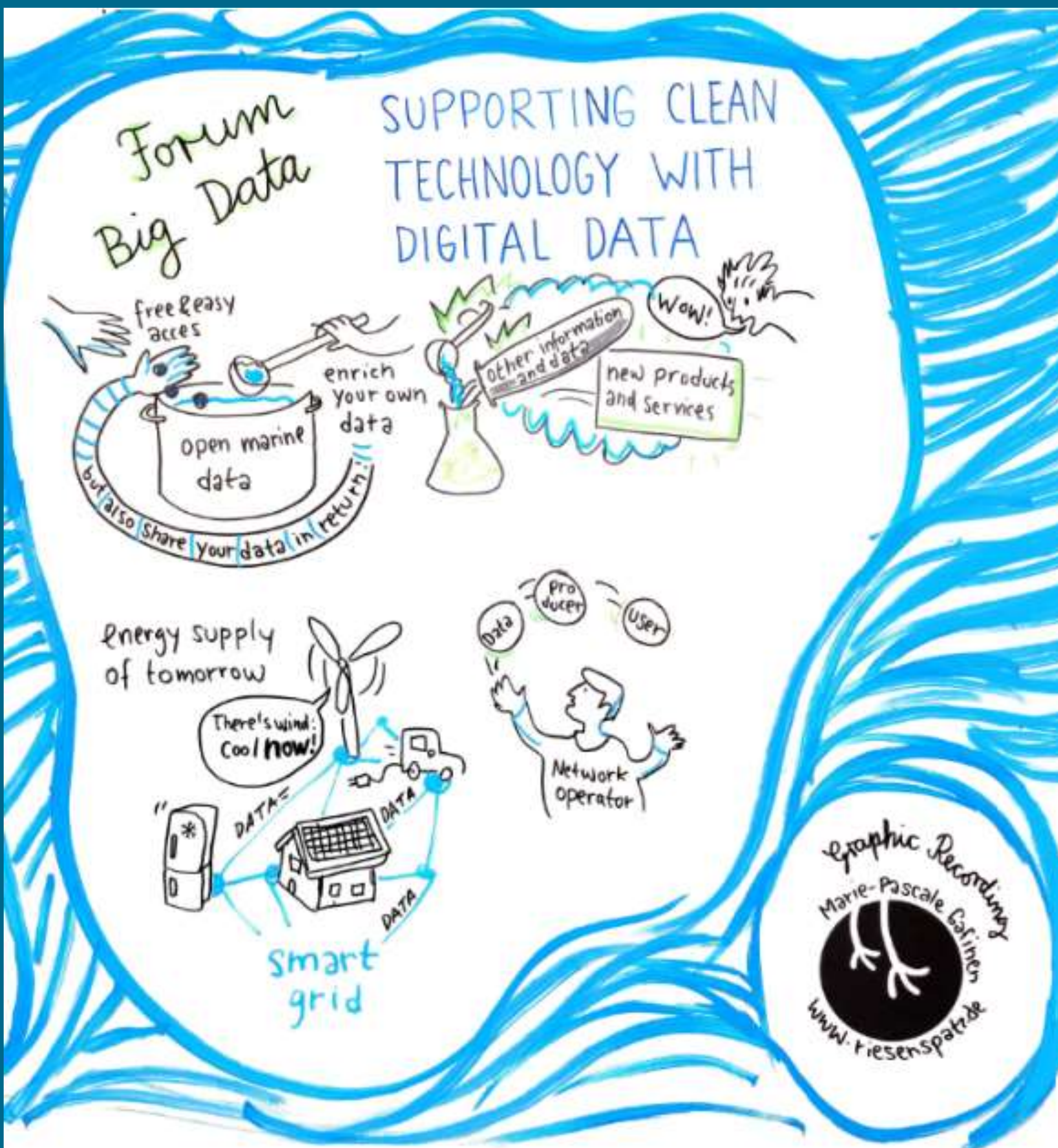
Friday, 29 September 2017

10:00 – 11:30

FORUM BIG DATA: Supporting clean technology with digital data


Forum
Big Data
SUPPORTING CLEAN TECHNOLOGY WITH DIGITAL DATA
free & easy acces
enrich your own data
open marine data
but also share your data in return!
other information and data
Wow!
new products and services
energy supply of tomorrow
There's wind: Cool now!
DATA
DATA
DATA
smart grid
Data
pro ducer
User
Network operator
Graphic Recording
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www.riesenspatz.de

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Forum Big Data - Presentations

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Forum Big Data - Presentations

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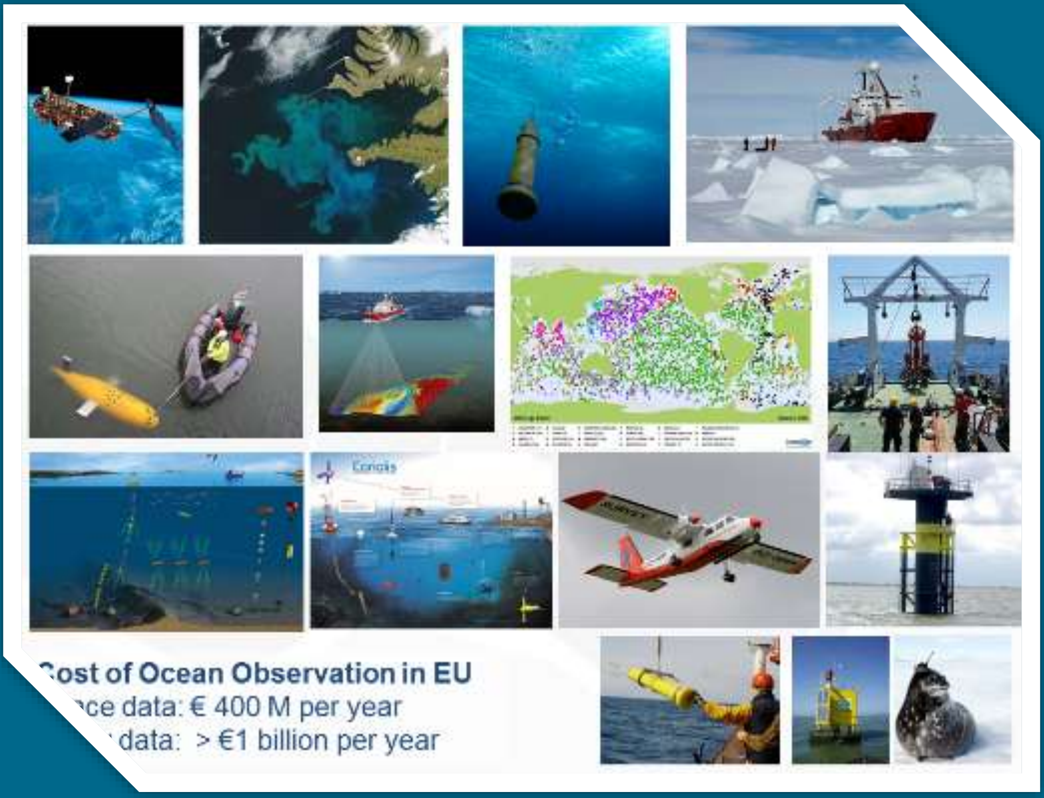

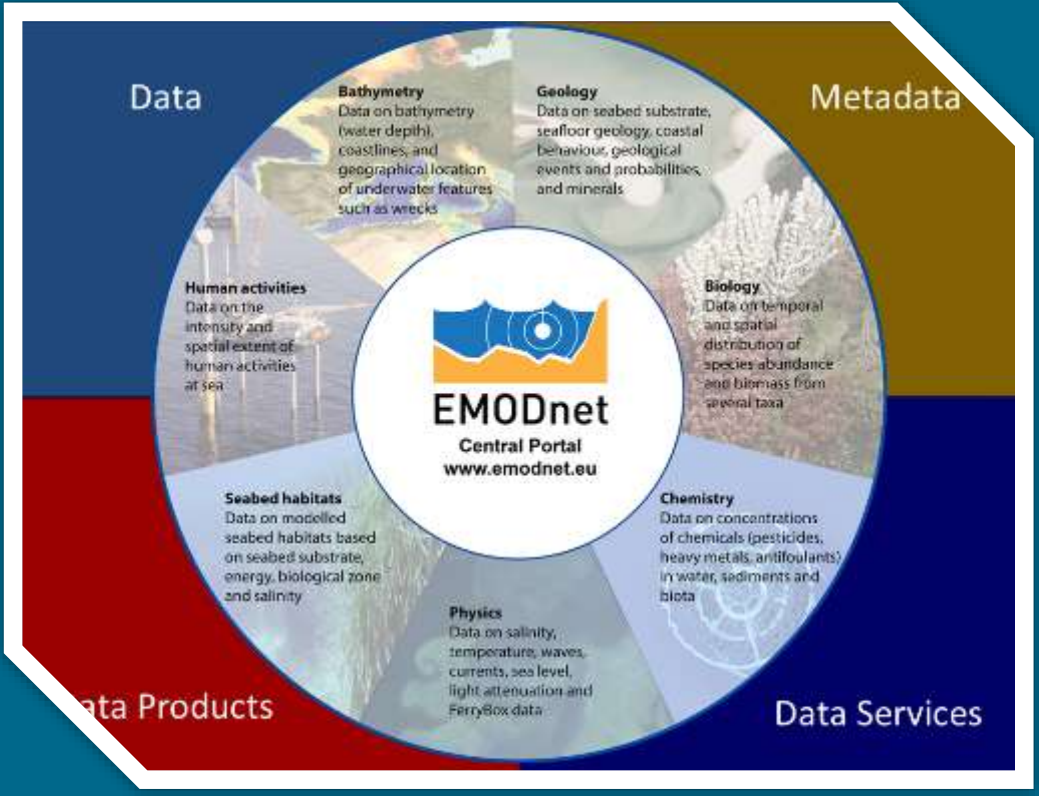

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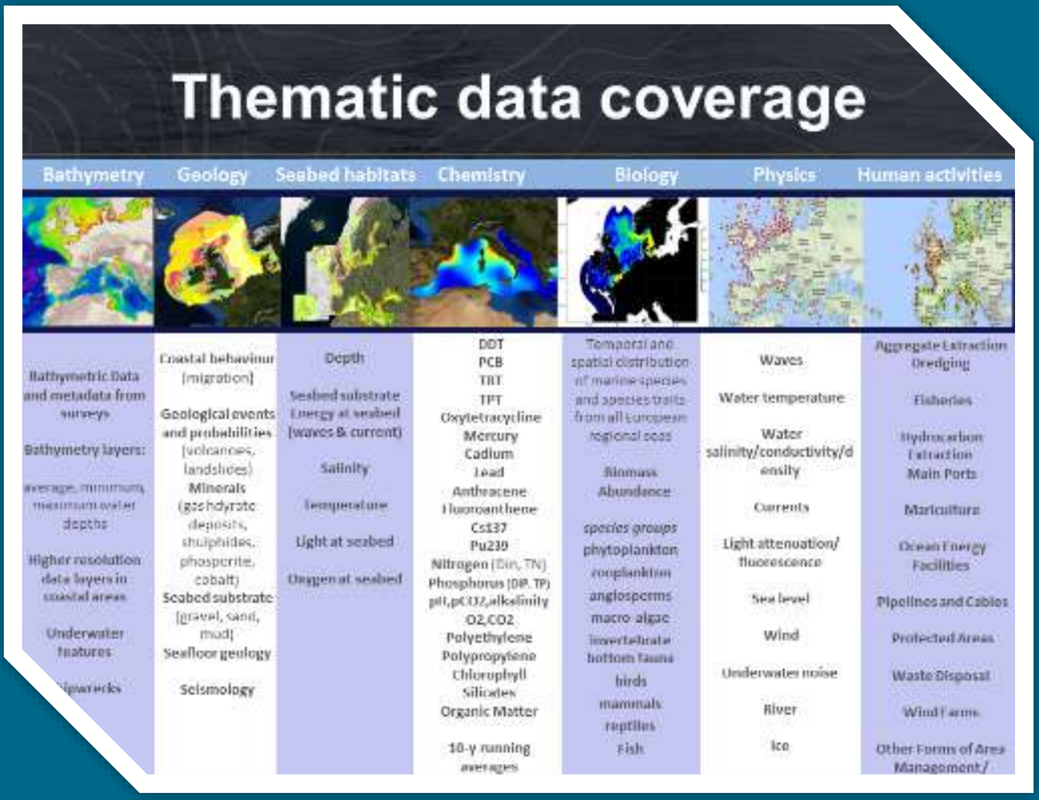
Forum Big Data - Presentations



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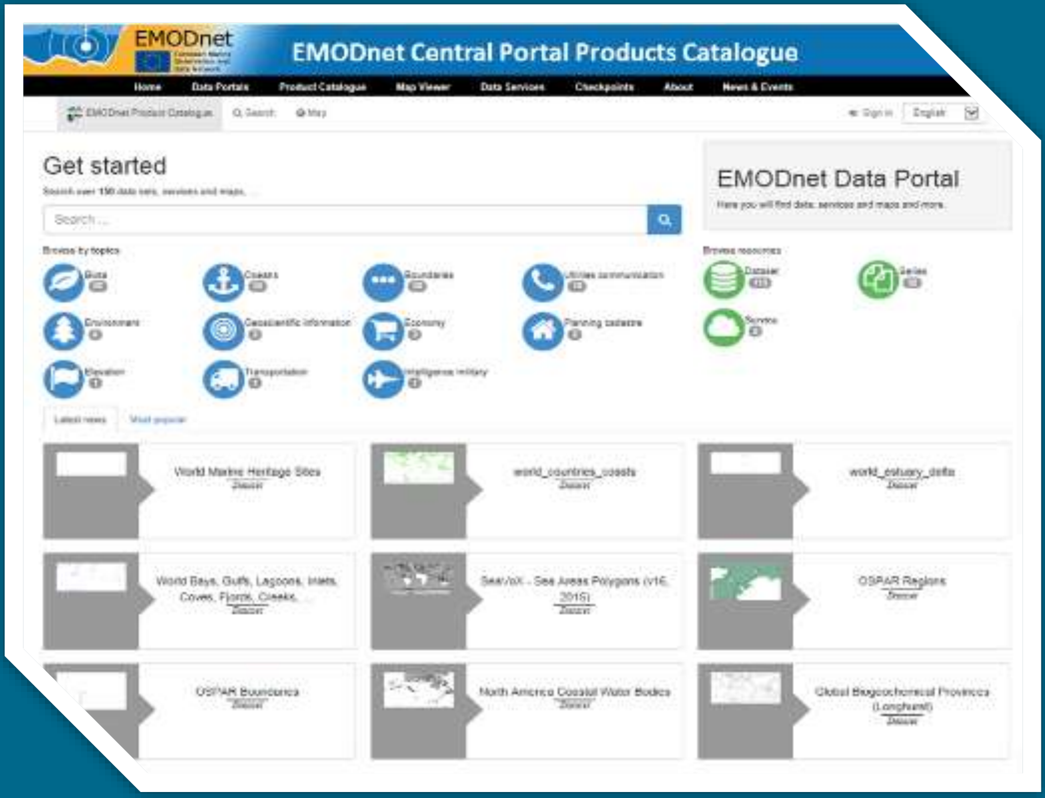
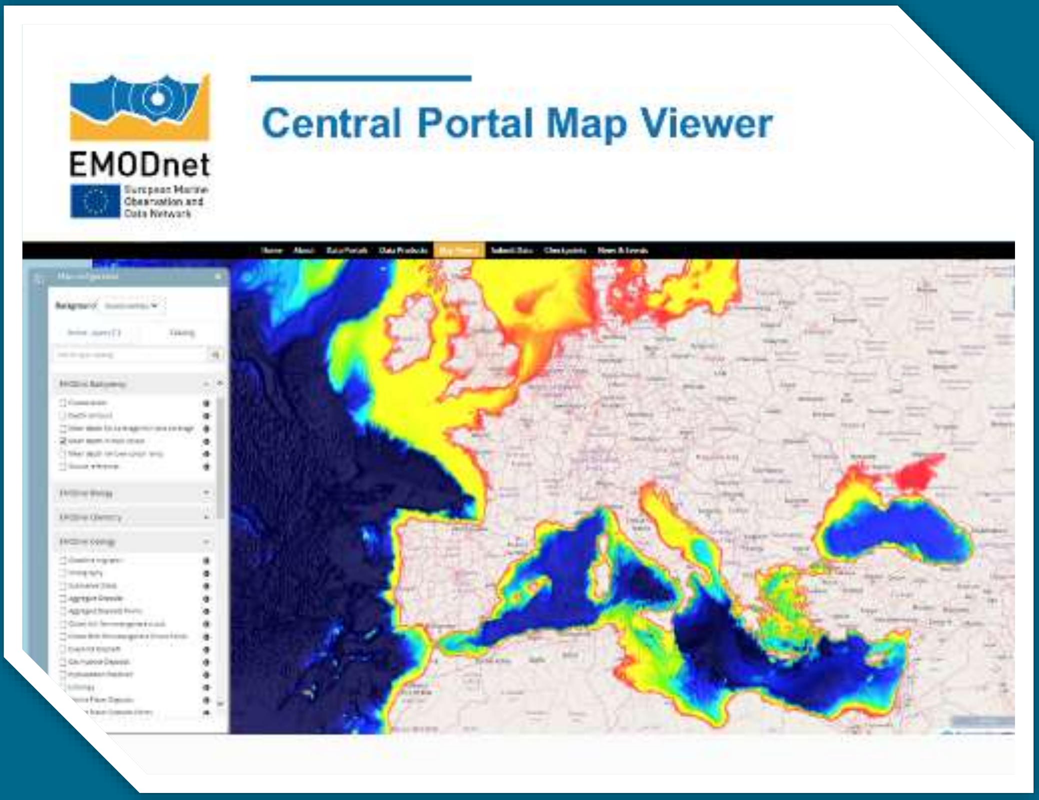




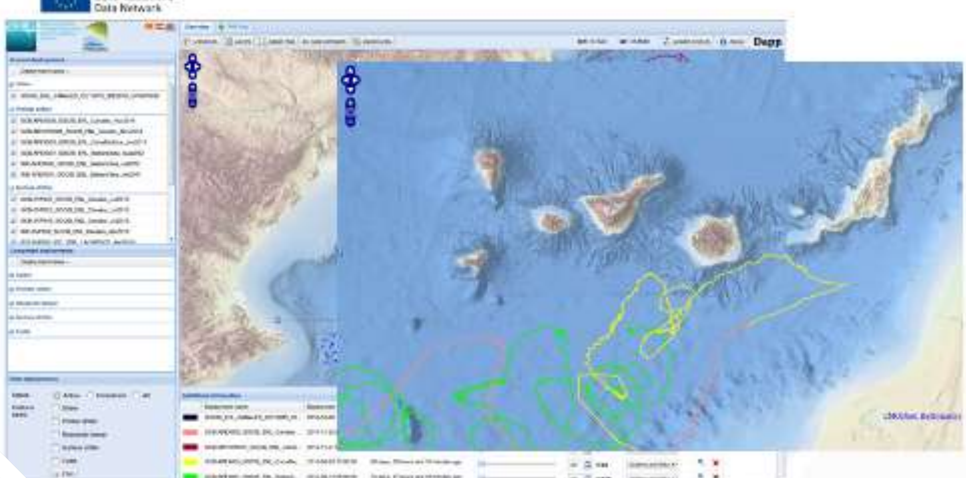
EMODnet
European Marine Observation and Data Network

Examples of use/application

- Electronic charts for recreational users
- Improved storm surge warning – Metoffice
- Tourism & Ecology
  - Inform interested tourists
  - Citizen science
- Oil and Gas Industry – map of offshore installations

EMODnet
European Marine Observation and Data Network

EMODnet Bathymetry



…mple of usage: SOCIB (Baleares – Spain) use WMS as baselayer for …v where marine observation instruments are deployed

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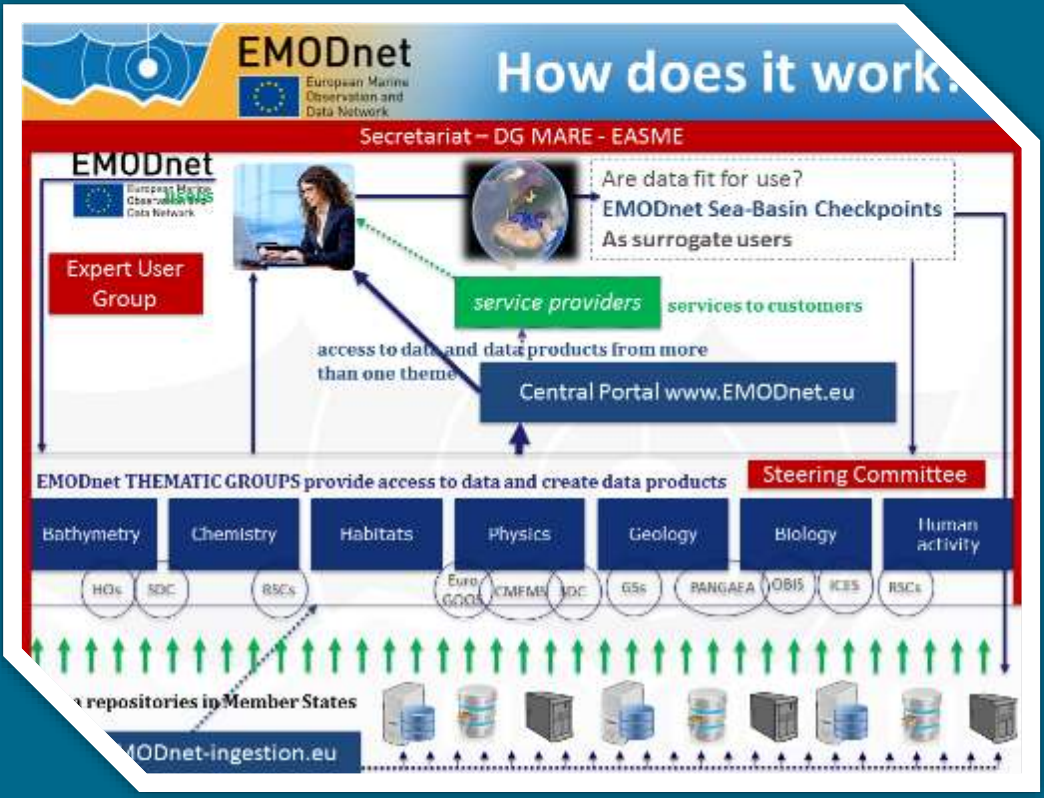
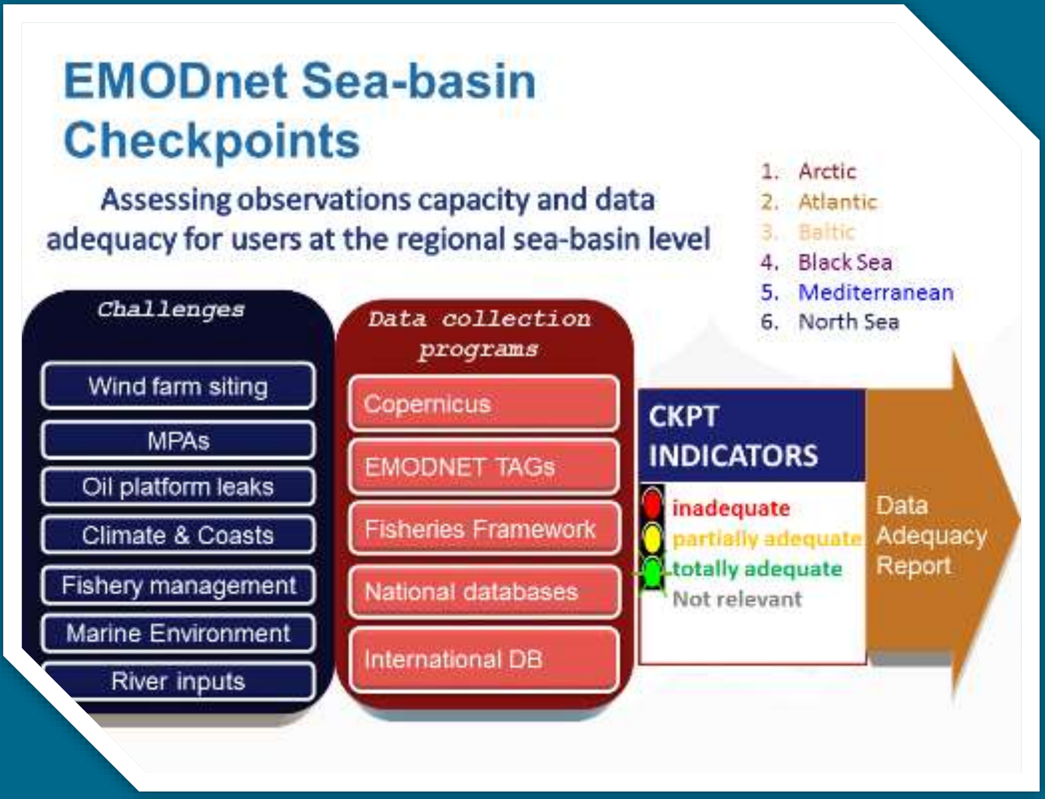
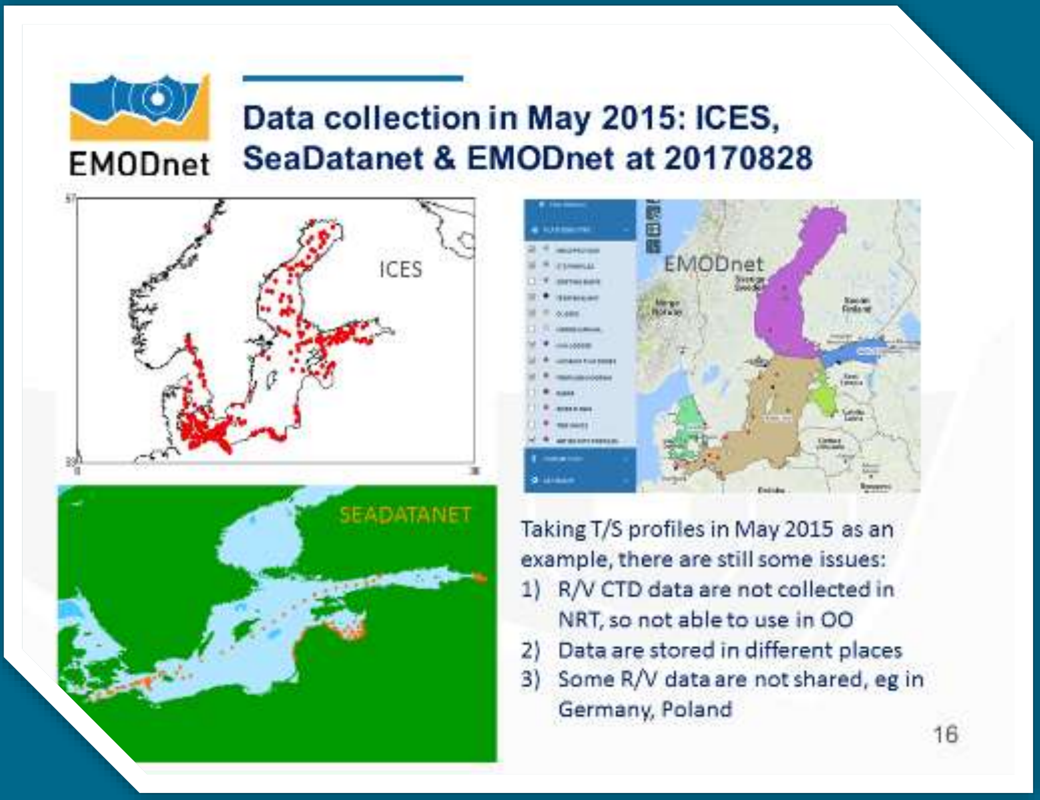


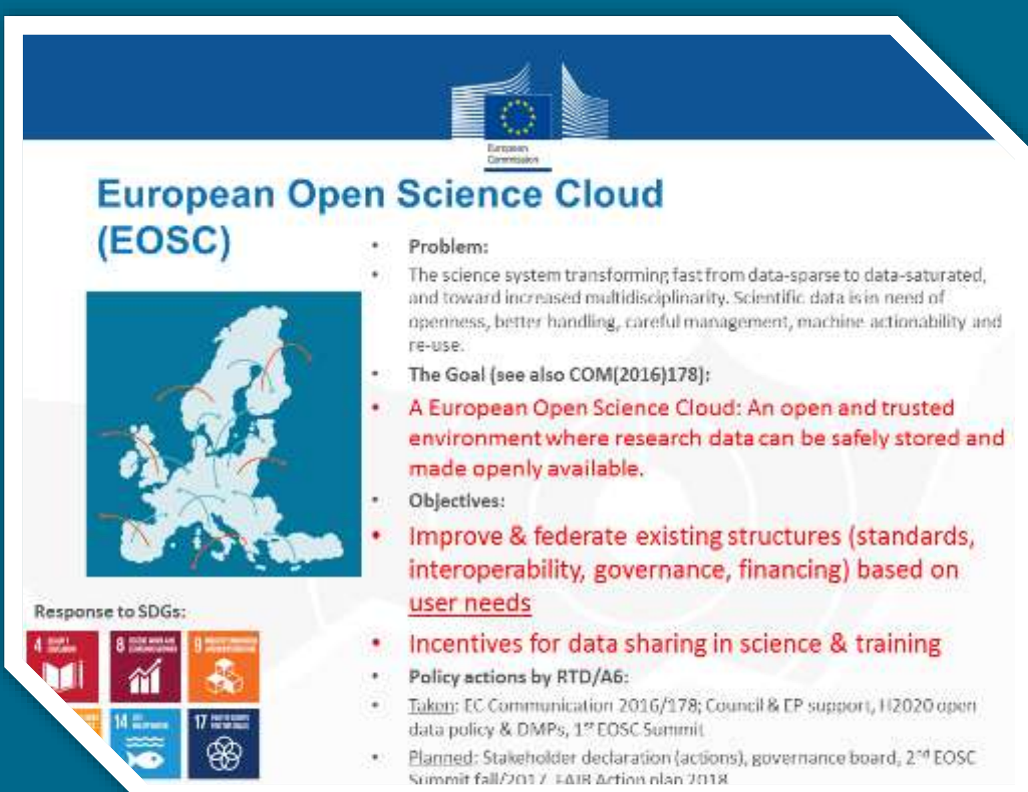

EMODnet Sea-basin Checkpoints
Assessing observations capacity and data adequacy for users at the regional sea-basin level
1. Arctic
2. Atlantic
3. Baltic
4. Black Sea
5. Mediterranean
6. North Sea
Challenges
Wind farm siting
MPAs
Oil platform leaks
Climate & Coasts
Fishery management
Marine Environment
River inputs
Data collection programs
Copernicus
EMODNET TAGs
Fisheries Framework
National databases
International DB
CKPT INDICATORS
inadequate
partially adequate
totally adequate
Not relevant
Data Adequacy Report


EMODnet
Data collection in May 2015: ICES, SeaDatanet & EMODnet at 20170828
ICES
EMODnet
SEADATANET
Taking T/S profiles in May 2015 as an example, there are still some issues:
1) R/V CTD data are not collected in NRT, so not able to use in OO
2) Data are stored in different places
3) Some R/V data are not shared, eg in Germany, Poland
16


EMODnet
www.opensealab.eu
15-16-17th November,
Antwerp
Workshops & Data Competition
EMODnet
OPEN
SEA
LAB
INNOVATION
CO-CREATION
IDEATION
HACKATHON
OPEN-DATA
15-17 November 2017 De Serre, Antwerp, Belgium
VLIZ
imec
EMODnet


EMODnet
OpenSeaLab Three Thematic Areas
Marine Environment
(management/monitoring)
Maritime Activities
The Blue Economy
Public knowledge
/services
marine litter,
coastal change,
invasive species,
tools to support MSFD/MSPD
???
aquaculture - reduce costs?
wave/wind energy - where is potential?
site selection surveys
coastal tourism – new services?
???
informed public leads to better ocean governance
citizen science / citizens sensors
educational tools/apps?
???
/14/2017
18


EMODnet
European Marine Observation and Data Network
Other resources?
https://ec.europa.eu/maritimeaffairs/atlas/maritime_atlas/
http://marine.copernicus.eu/
EUROPEAN ATLAS OF THE SEAS


European Commission
European Open Science Cloud (EOSC)
Problem:
The science system transforming fast from data-sparse to data-saturated, and toward increased multidisciplinarity. Scientific data is in need of openness, better handling, careful management, machine actionability and re-use.
The Goal (see also COM(2016)178):
A European Open Science Cloud: An open and trusted environment where research data can be safely stored and made openly available.
Objectives:
Improve & federate existing structures (standards, interoperability, governance, financing) based on user needs
Incentives for data sharing in science & training
Policy actions by RTD/A6:
Taken: EC Communication 2016/178; Council & EP support, H2020 open data policy & DMPs, 1st EOSC Summit
Planned: Stakeholder declaration (actions), governance board, 2nd EOSC Summit fall/2017, FAIR Action plan 2018
Response to SDGs:

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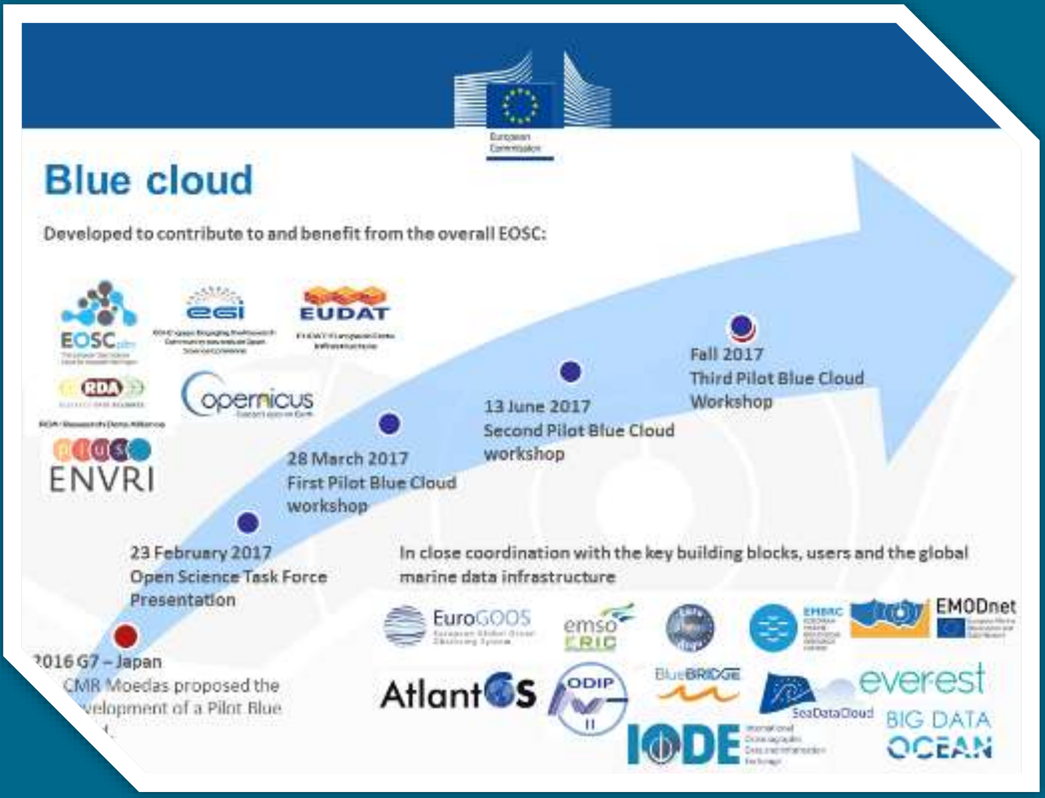

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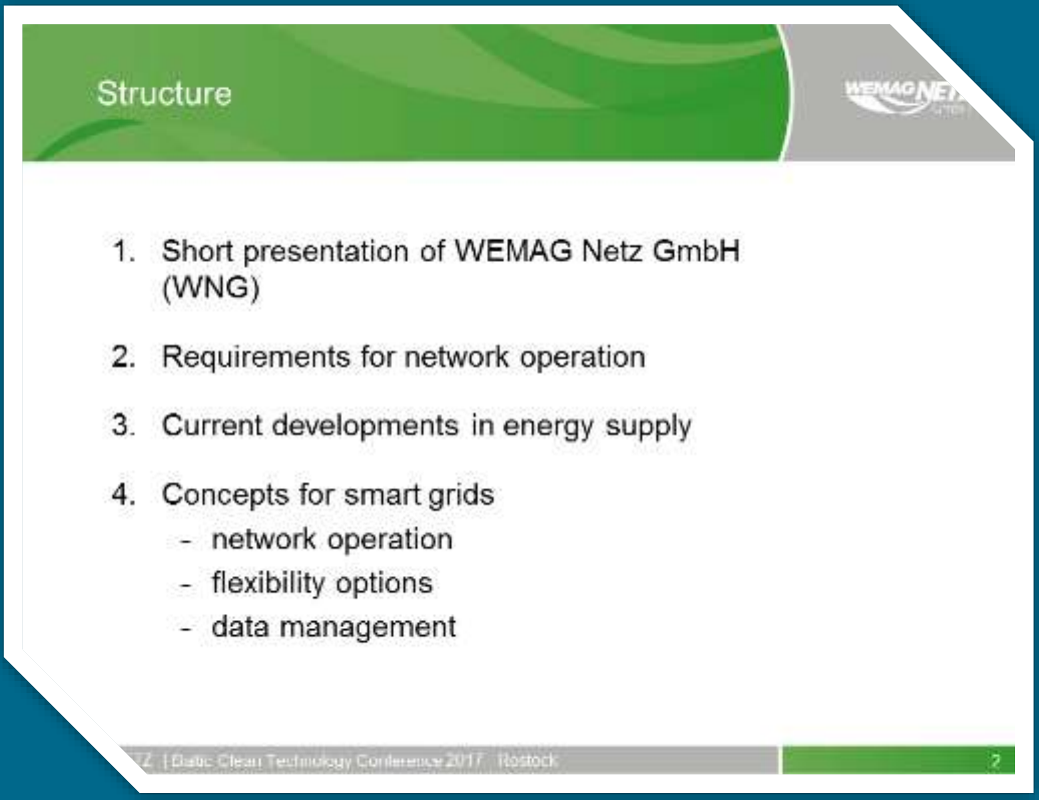
Forum Big Data - Presentations



1. Introduction - WEMAG AG / WEMAG Netz GmbH

- the WEMAG AG is based in the northeastern part of Germany
- the WEMAG AG is engaged in the fields of production, distribution and sale of electrical energy
- WEMAG Netz GmbH is part of the WEMAG company group with its headquarter located in Schwerin
- as a German distribution network operator (DSO), WEMAG Netz GmbH supplies parts of the federal states Mecklenburg-Western Pomerania, Brandenburg and Lower Saxony
- the distribution network includes high, medium and low voltage networks (HV, MV, LV) and is connected to the transmission network of the 50Hertz Transmission GmbH
- key data WEMAG Netz GmbH (Relationship with Germany)
  - covered area: 8.060 km² (~2 %)
  - netlength: 15.413 km (<1 %)
  - demographic density: 34 inhabitants/km² (15 %)

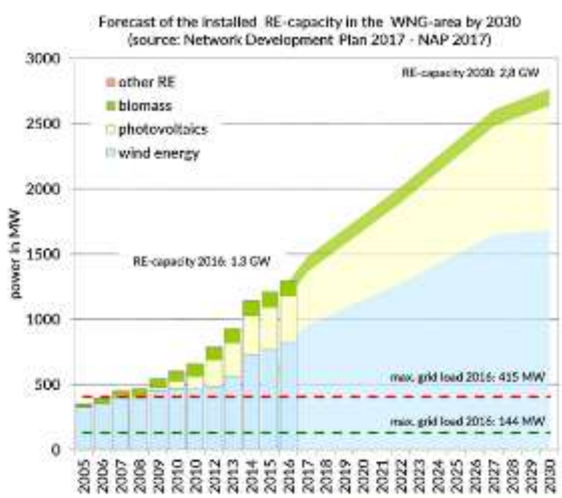
supply area of WEMAG Netz GmbH

1. Introduction - Installed capacity of the WNG-grid

The installed power of renewable energies in the WNG-grid area exceeds the maximum consumption power by a multiple.

- condition 12/2016:
  - ➢ consumer load
    - min 144 MW
    - max 415 MW
  - ➢ installed RE-capacity
    - wind 838 MW
    - solar 359 MW
    - biomass 113 MW
    - other RE 3 MW

    Σ = 1.313 MW (~320 %)
- forecast WNG-area for 2030:
  - installed RE-capacity 2.8 GW (+115 %)



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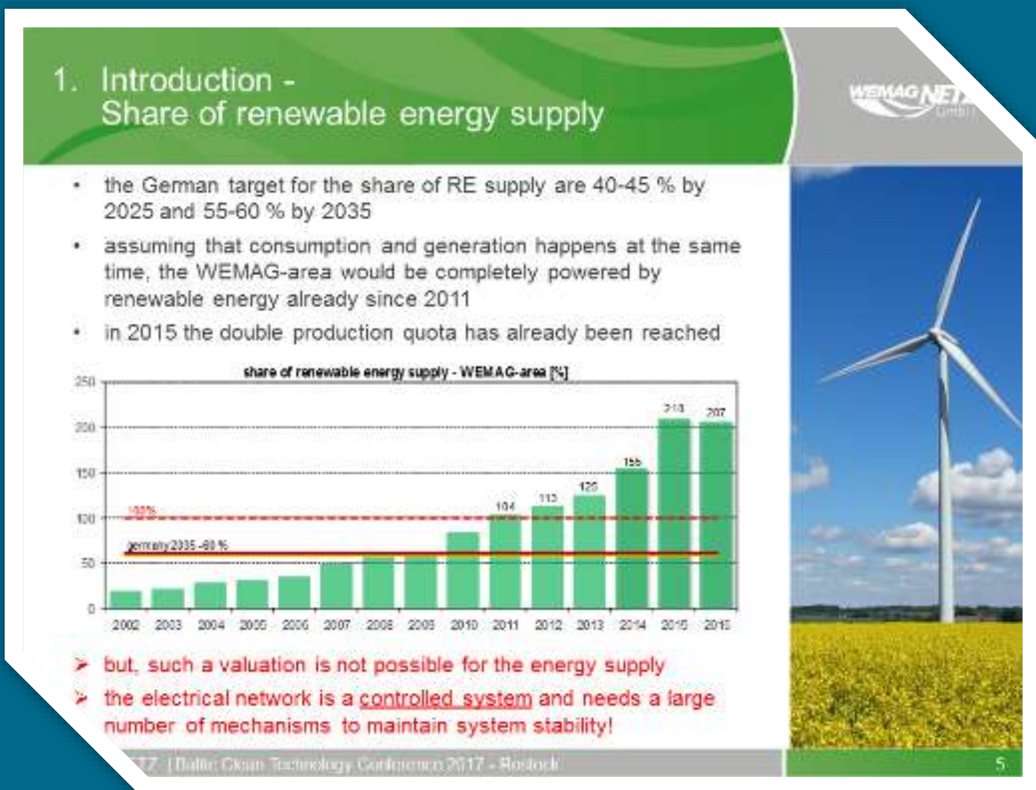

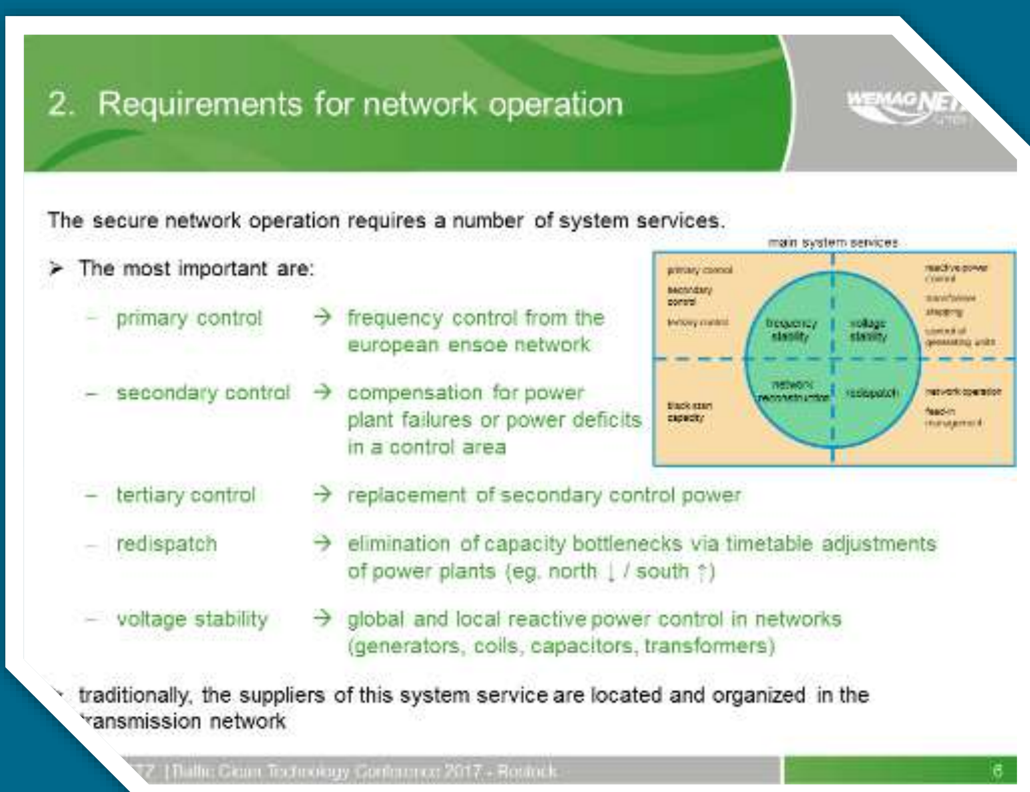

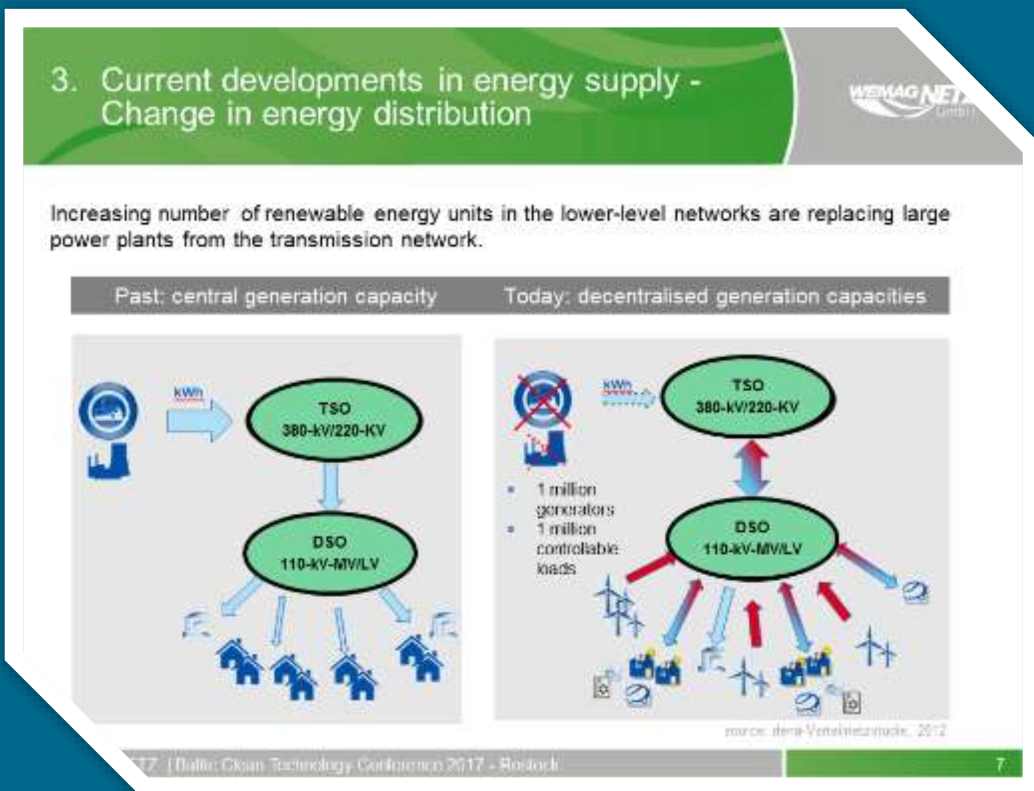

3. Current developments in energy supply - Change in energy distribution
WEMAG NETZ GmbH
Increasing number of renewable energy units in the lower-level networks are replacing large power plants from the transmission network.
Past: central generation capacity
Today: decentralised generation capacities
kWh
TSO
380-kV/220-KV
DSO
110-kV-MV/LV
1 million generators
1 million controllable loads
source: dena-Verteilnetzstudie, 2012
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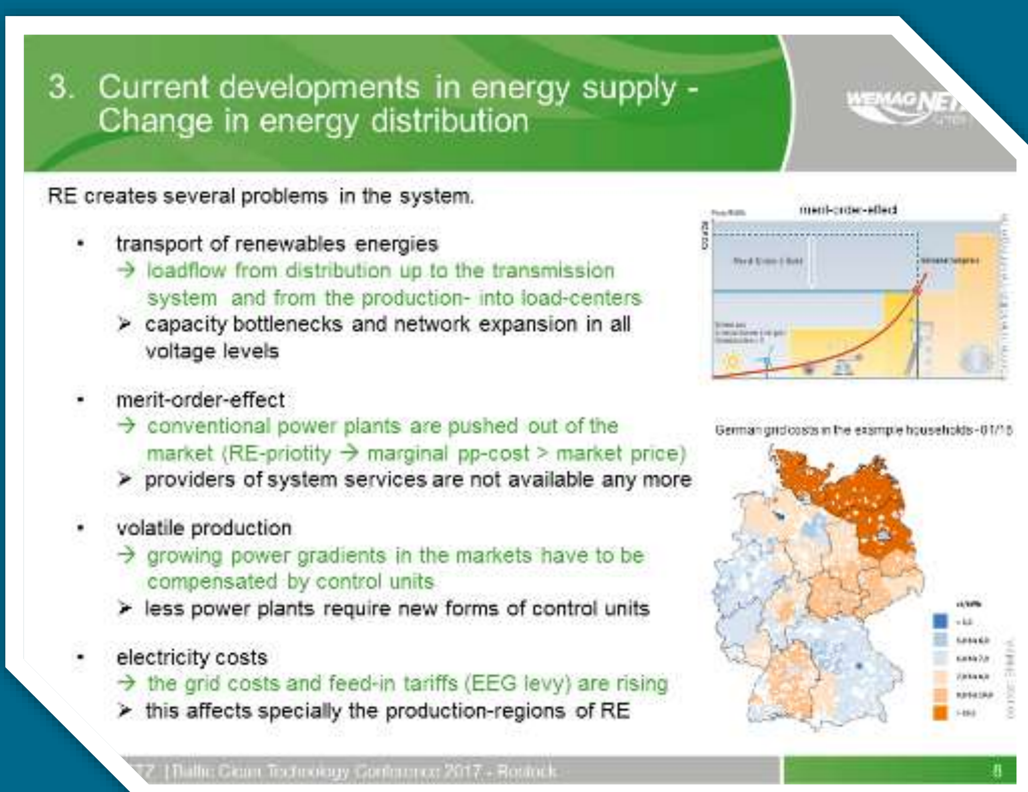

3. Current developments in energy supply - Change in energy distribution
WEMAG NETZ GmbH
RE creates several problems in the system.
• transport of renewables energies
→ loadflow from distribution up to the transmission system and from the production- into load-centers
➢ capacity bottlenecks and network expansion in all voltage levels
• merit-order-effect
→ conventional power plants are pushed out of the market (RE-priotity → marginal pp-cost > market price)
➢ providers of system services are not available any more
• volatile production
→ growing power gradients in the markets have to be compensated by control units
➢ less power plants require new forms of control units
• electricity costs
→ the grid costs and feed-in tariffs (EEG levy) are rising
➢ this affects specially the production-regions of RE
merit-order-effect
German grid costs in the example households - 01/16
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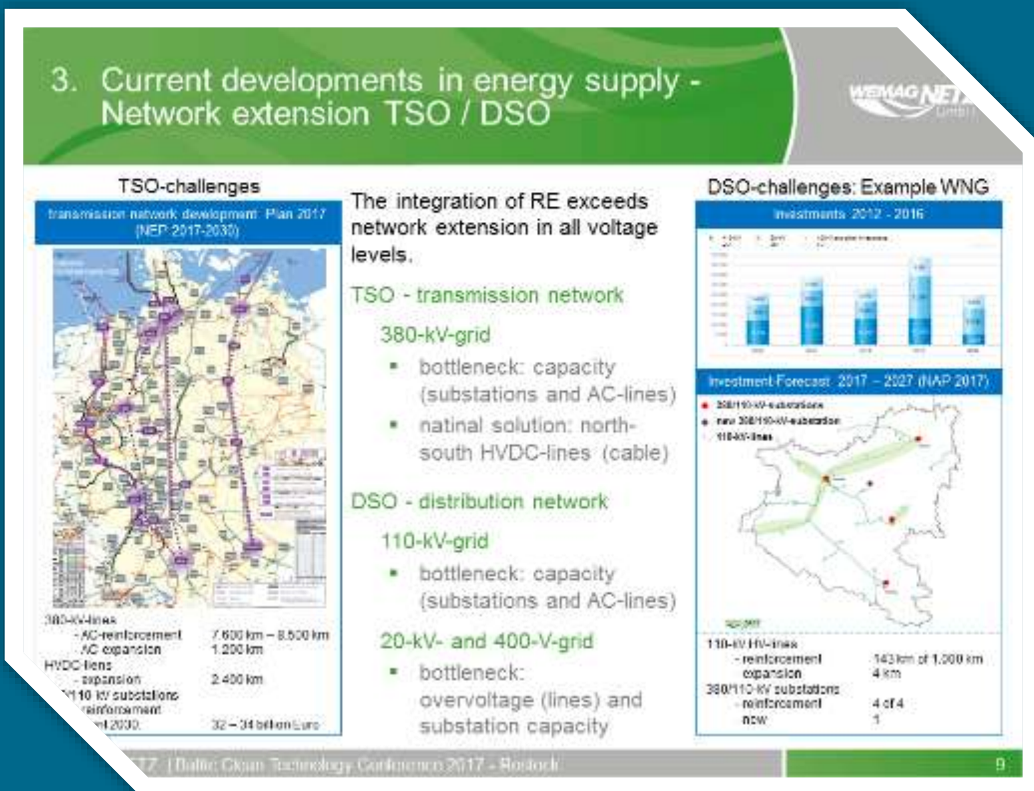
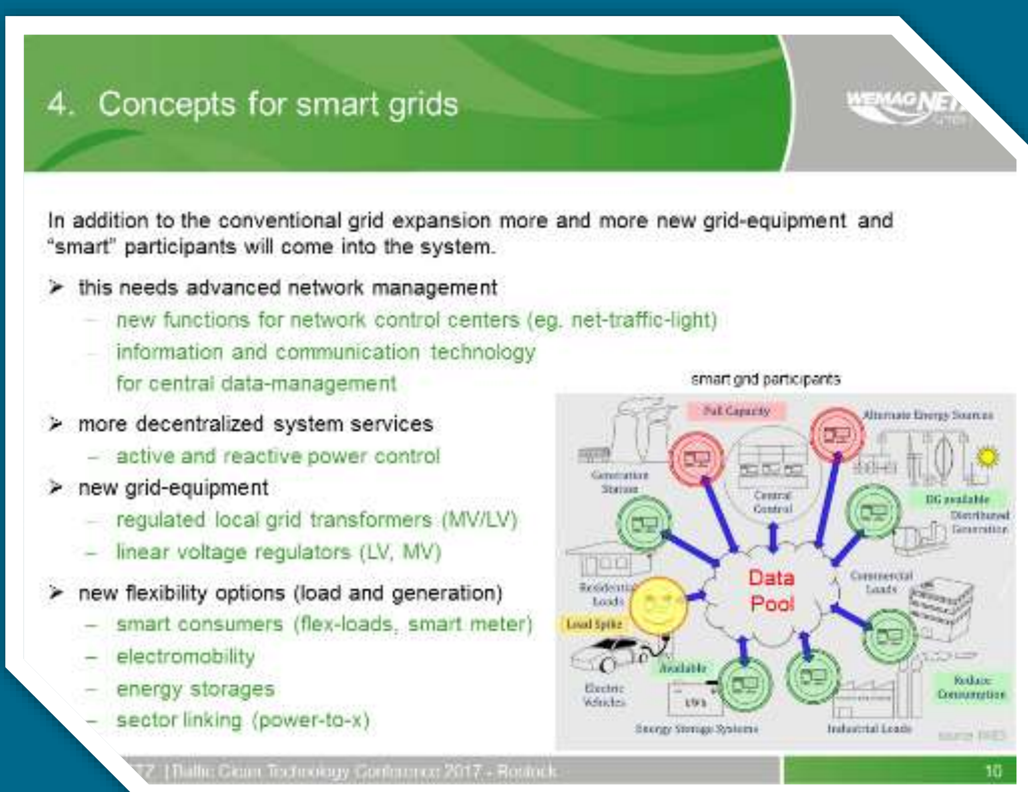
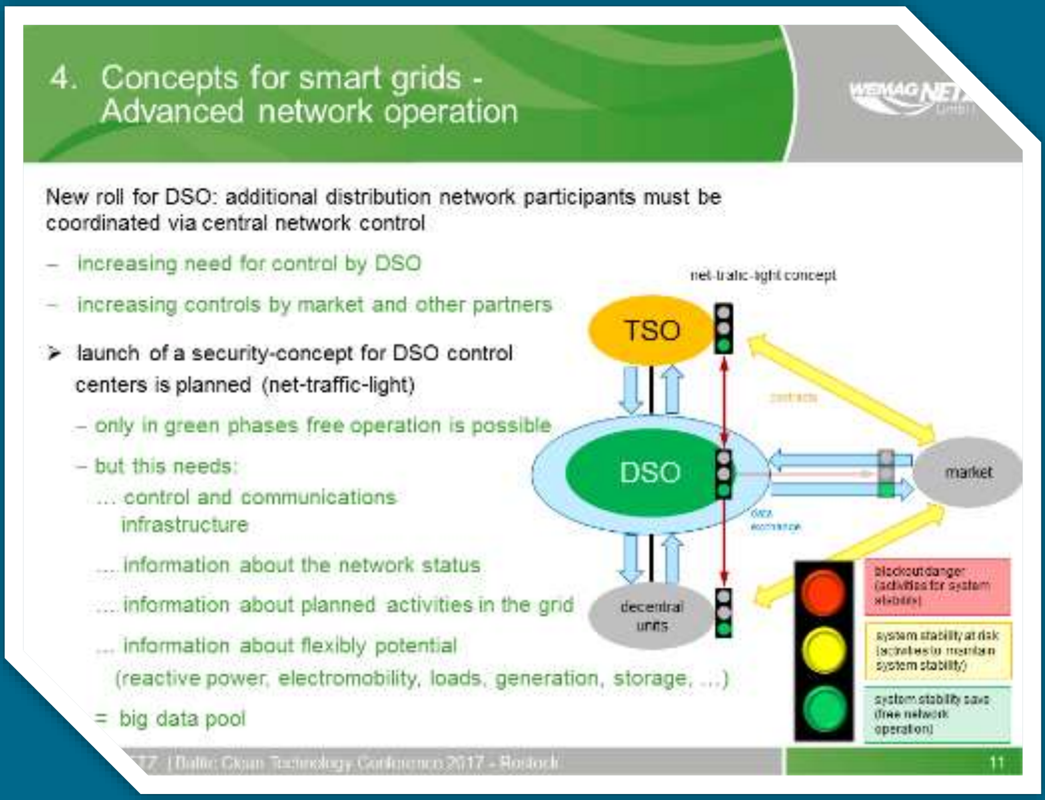
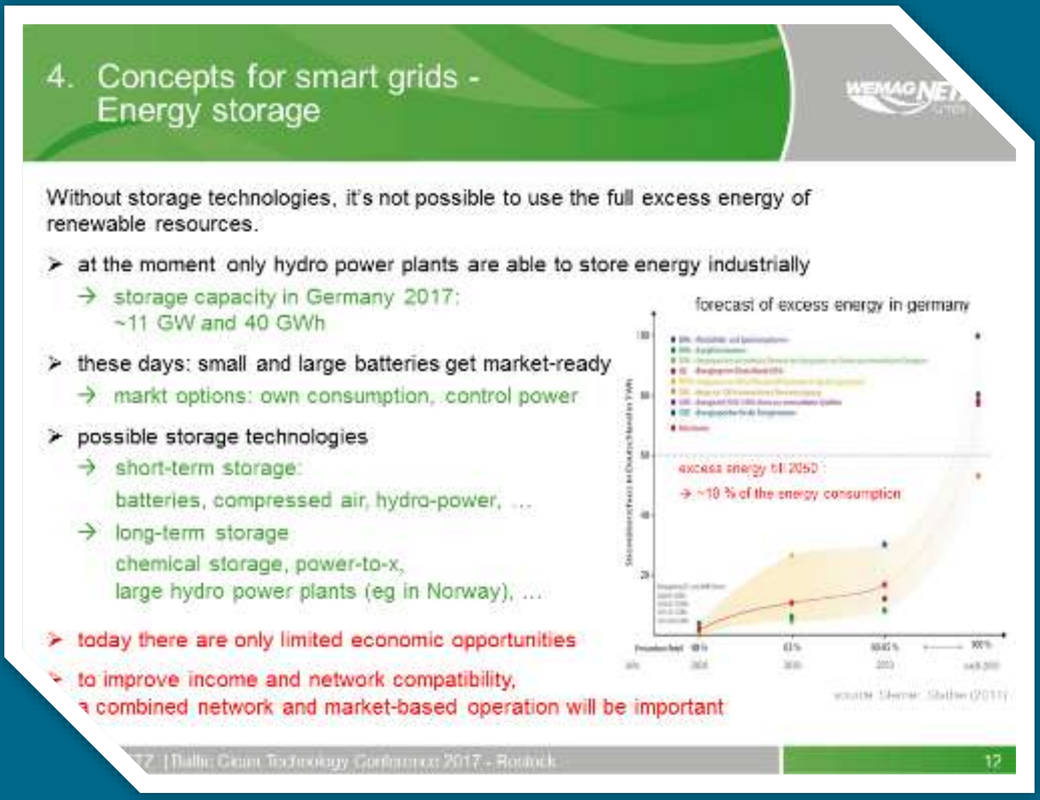





4. Concepts for smart grids - Advanced network operation
WEMAG NETZ
New roll for DSO: additional distribution network participants must be coordinated via central network control
– increasing need for control by DSO
– increasing controls by market and other partners
➢ launch of a security-concept for DSO control centers is planned (net-traffic-light)
– only in green phases free operation is possible
– but this needs:
… control and communications infrastructure
… information about the network status
… information about planned activities in the grid
… information about flexibly potential
(reactive power, electromobility, loads, generation, storage, …)
= big data pool
net-traffic-light concept
TSO
DSO
market
decentral units
system stability at risk (activities to maintain system stability)
system stability save (free network operation)
ETZ | Baltic Clean Technology Conference 2017 - Rostock
11


4. Concepts for smart grids - Energy storage
WEMAG NETZ
Without storage technologies, it's not possible to use the full excess energy of renewable resources.
➢ at the moment only hydro power plants are able to store energy industrially
→ storage capacity in Germany 2017: ~11 GW and 40 GWh
➢ these days: small and large batteries get market-ready
→ markt options: own consumption, control power
➢ possible storage technologies
→ short-term storage: batteries, compressed air, hydro-power, …
→ long-term storage chemical storage, power-to-x, large hydro power plants (eg in Norway), …
➢ today there are only limited economic opportunities
➢ to improve income and network compatibility, a combined network and market-based operation will be important
forecast of excess energy in germany
excess energy till 2050 :
→ ~10 % of the energy consumption
ETZ | Baltic Clean Technology Conference 2017 - Rostock
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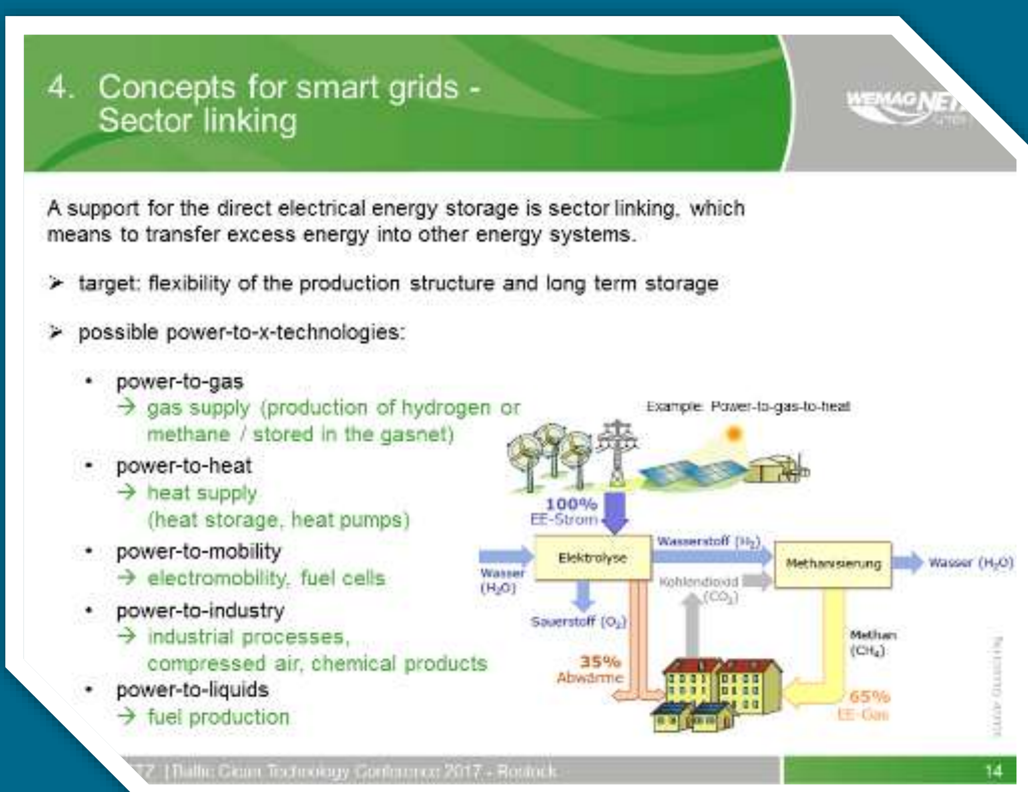
4. New concepts for smart grids - Energy storage
possible markt options
for large battery power plants:
primary and secundary control
peak shaving
ramping power plants
ramping RE-production
volatage stability
black start / grid reconstruction
example:
WEMAG battery power plant - Schwerin
WEMAG
Younicos
built: 2014 (extension 2017)
nominal power: 14 MW
nominal capacity: 15 MWh
number of batteries: 53.444 (Lithium manganese oxide)
market model: primary control (prequalification 10 MW)
operator: WEMAG AG, Schwerin
manufacturer: Younicos AG, Berlin
13



4. Concepts for smart grids - Sector linking
A support for the direct electrical energy storage is sector linking, which means to transfer excess energy into other energy systems.
target: flexibility of the production structure and long term storage
possible power-to-x-technologies:
power-to-gas
→ gas supply (production of hydrogen or methane / stored in the gasnet)
power-to-heat
→ heat supply
(heat storage, heat pumps)
power-to-mobility
→ electromobility, fuel cells
power-to-industry
→ industrial processes, compressed air, chemical products
power-to-liquids
→ fuel production
Example: Power-to-gas-to-heat
100%
EE-Strom
Elektrolyse
Wasserstoff (H_2)
Methanisierung
Wasser (H_2O)
Wasser (H_2O)
Kohlendioxid (CO_2)
Sauerstoff (O_2)
35%
Abwärme
Methan (CH_4)
65%
EE-Gas
14

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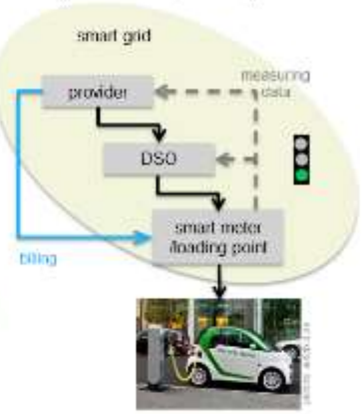
4. Concepts for smart grids - Electromobility

The transport sector is in the process of changing the drive systems.

- if the electromobility will be victorious, the network load will be strongly affected
- and if the loading points are installed uncoordinated, load-dependent grid expansion is to be expected
- studies show, that controlled charging strategies can mainly prevent grid expansion (eg. dena netzflex)
  - → but in this case the availability of the vehicles is limited (not always 100% charge-power possible)
- requirement: intelligent system control (smart grid components, information- and communication technology)
  - → then electromobility is available as controllable load or storage

integration of e-mobility in smart grids



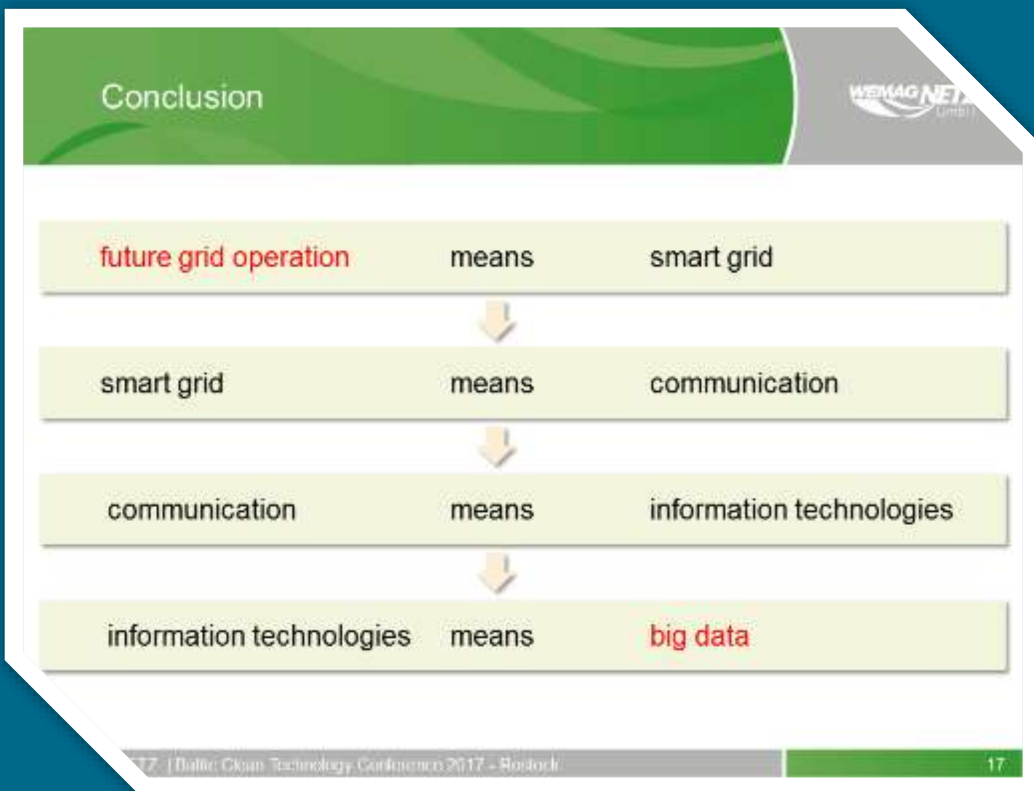
target 2017:
40 new loading points in the WEMAG area

4. Concepts for smart grids - Local network reconstruction

status quo:
- network reconstruction should normally start in the transmission network
- using black-start-units or power plants that have survived in island mode
- in north-east-germany only the coal-fired power plant in Rostock (500 MW) can start the reconstruction
- but: with heavy RE-production, hard coal is often not in the energy market
- then its not possible to start with this units
- means: network reconstruction in M-V may need 1 day to 1 week

possible solution:
- local network reconstruction with smaller units
- WEMAG is operating a promising research project in the Schwerin area:
  - battery storage Schwerin (10 MW) starts CHP plant Schwerin Süd (50 MW)
  - **target:** continued operation of the district heating supply (strong winter) and step-by-step reconstruction of the distribution network

research project Kickstarter


Conclusion
future grid operation means smart grid
smart grid means communication
communication means information technologies
information technologies means big data
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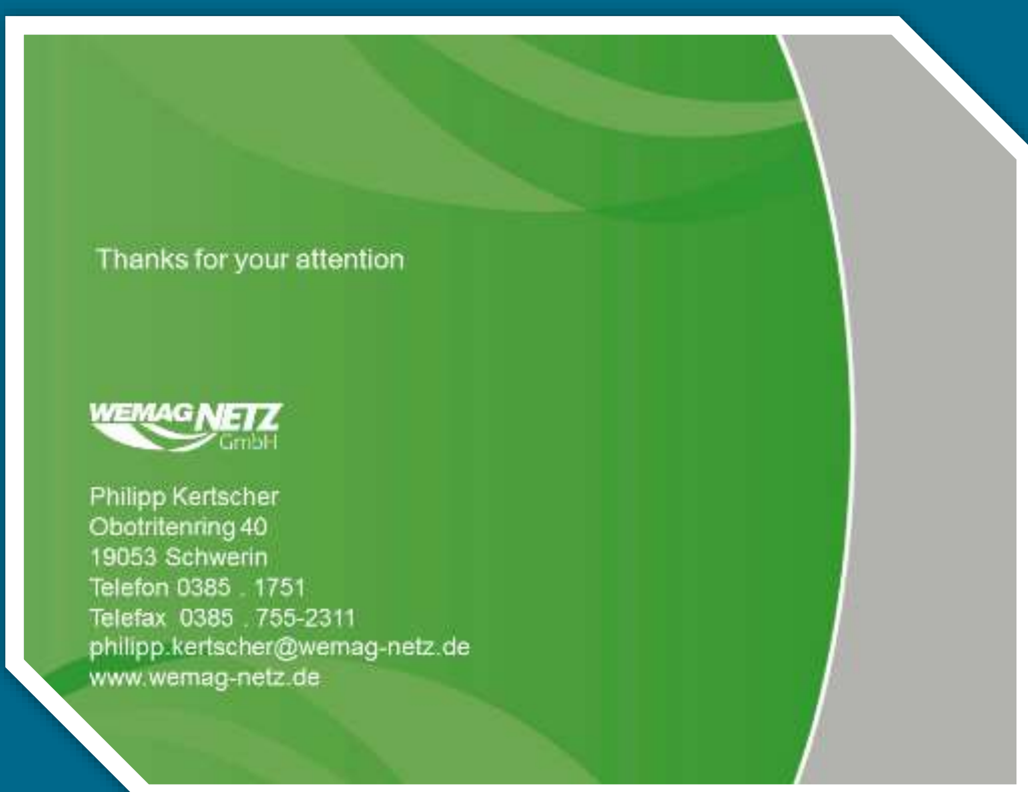
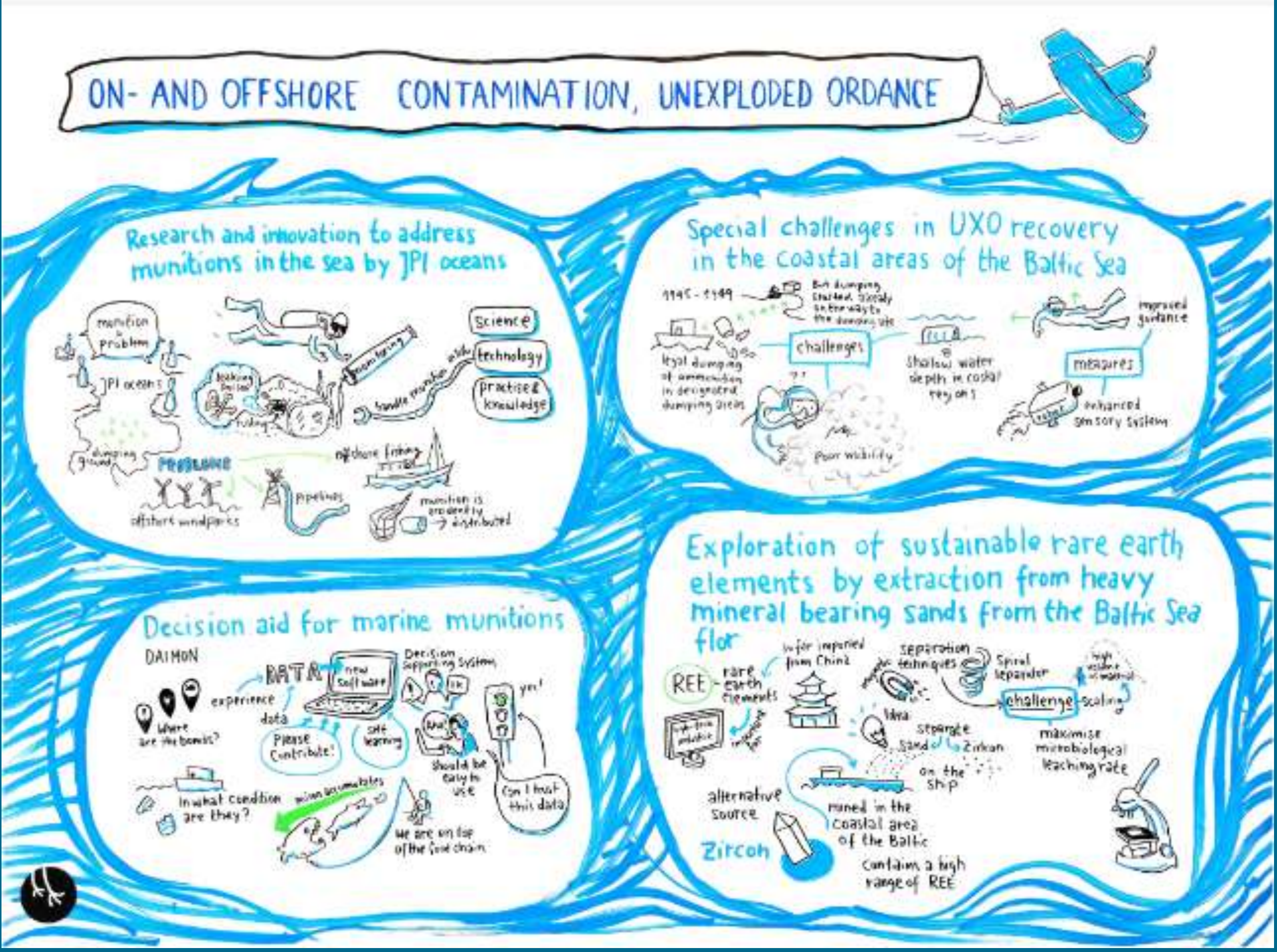

Thanks for your attention
Philipp Kertscher
Obotritenring 40
19053 Schwerin
Telefon 0385 . 1751
Telefax 0385 . 755-2311
philipp.kertscher@wemag-netz.de
www.wemag-netz.de

Friday, 29 September 2017

12:00 – 13:30

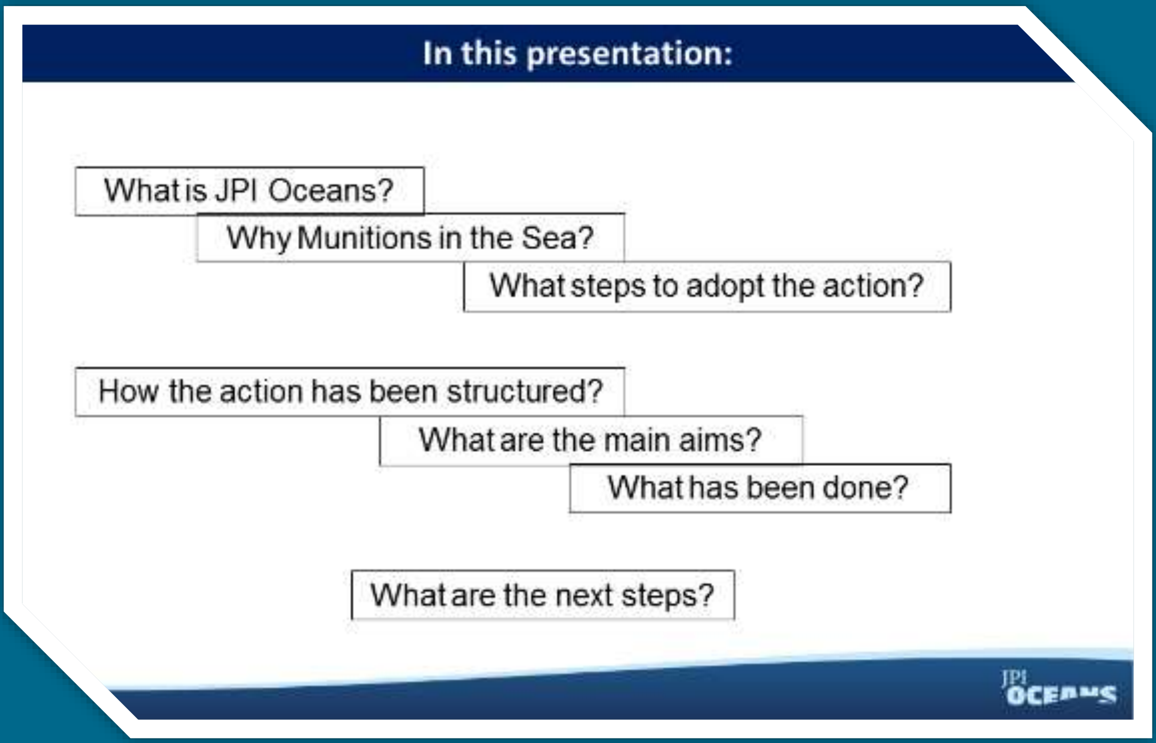
On- and offshore contamination, unexploded ordnance



ON- AND OFFSHORE CONTAMINATION, UNEXPLODED ORDANCE
Research and innovation to address munitions in the sea by JPI oceans
munition problem
JPI oceans
dumping ground
science
technology
practise & knowledge
handle munition
offshore fishing
pipelines
offshore windparks
munition is
distributed
Special challenges in UXO recovery in the coastal areas of the Baltic Sea
1945 - 1949
challenges
legal dumping of ammunition in designated dumping areas
shallow water depth in costal regions
poor visibility
improved guidance
measures
enhanced sensory system
Decision aid for marine munitions
DAIMON
DATA
new software
Decision supporting system
experience
data
where are the bombs?
Please contribute!
self learning
yes!
should be easy to use
Can I trust this data
In what condition are they?
We are on top of the food chain
Exploration of sustainable rare earth elements by extraction from heavy mineral bearing sands from the Baltic Sea flor
REE - rare earth elements
from China
separation techniques
spiral separator
challenge
scaling
Idea
separate
sand
Zircon
on the ship
maximise microbiological leaching rate
alternative source
Zircon
mined in the coastal area of the Baltic
contain a high range of REE


Research and innovation to address munitions in the sea by JPI oceans
29 September 2017
Baltic Clean Technology
Conference for sustainable solutions
JPI Oceans
JPI OCEANS


Who is speaking
GEOMAR
State Government of Schleswig-Holstein
(Ministry for Energy, Agriculture, the Environment and Rural Areas)
Chairman
German Program on underwater munitions www.underwatermunitions.de
CO-chair
expert group on environmental risks of hazardous submerged objects - http://www.helcom.fi
Jens Sternheim
JPI OCEANS


In this presentation:
What is JPI Oceans?
Why Munitions in the Sea?
What steps to adopt the action?
How the action has been structured?
What are the main aims?
What has been done?
What are the next steps?


What is Joint
Programming?


A concept to tackle
challenges that can not
be solved solely at
national level


Research funding in Europe
Intergovernmental and
European Commission
12%
88%
Member
States


JPI Oceans?


A coordinating and integrating platform for marine and maritime research

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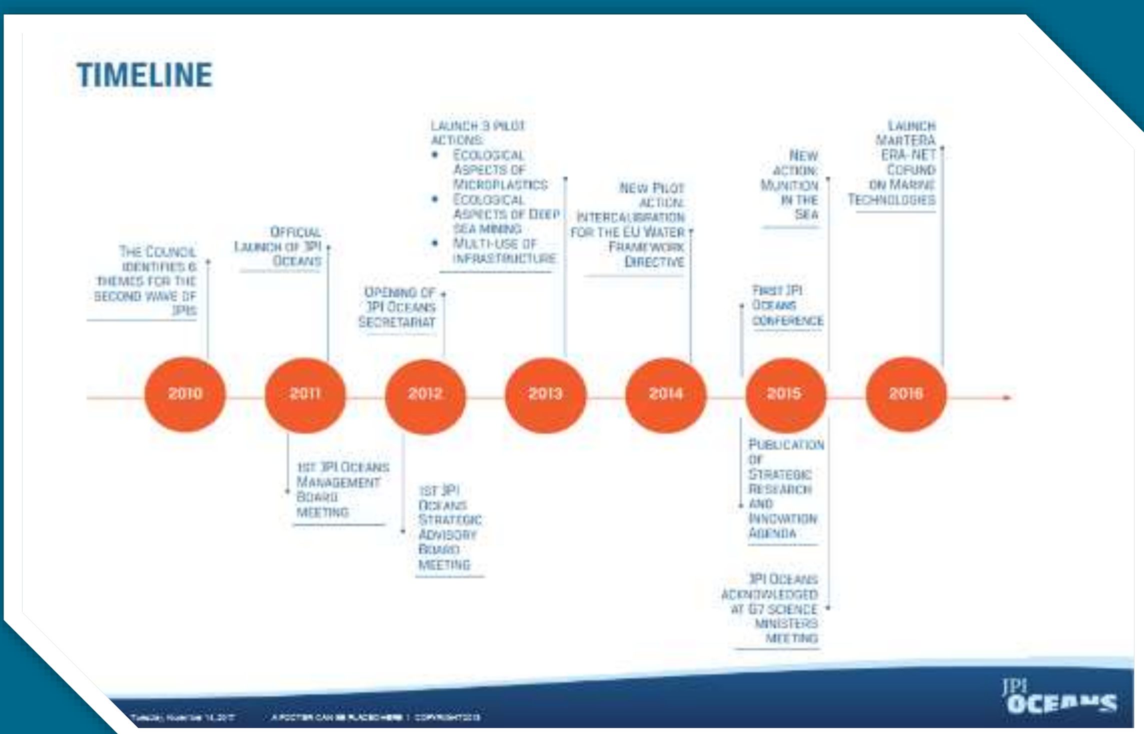
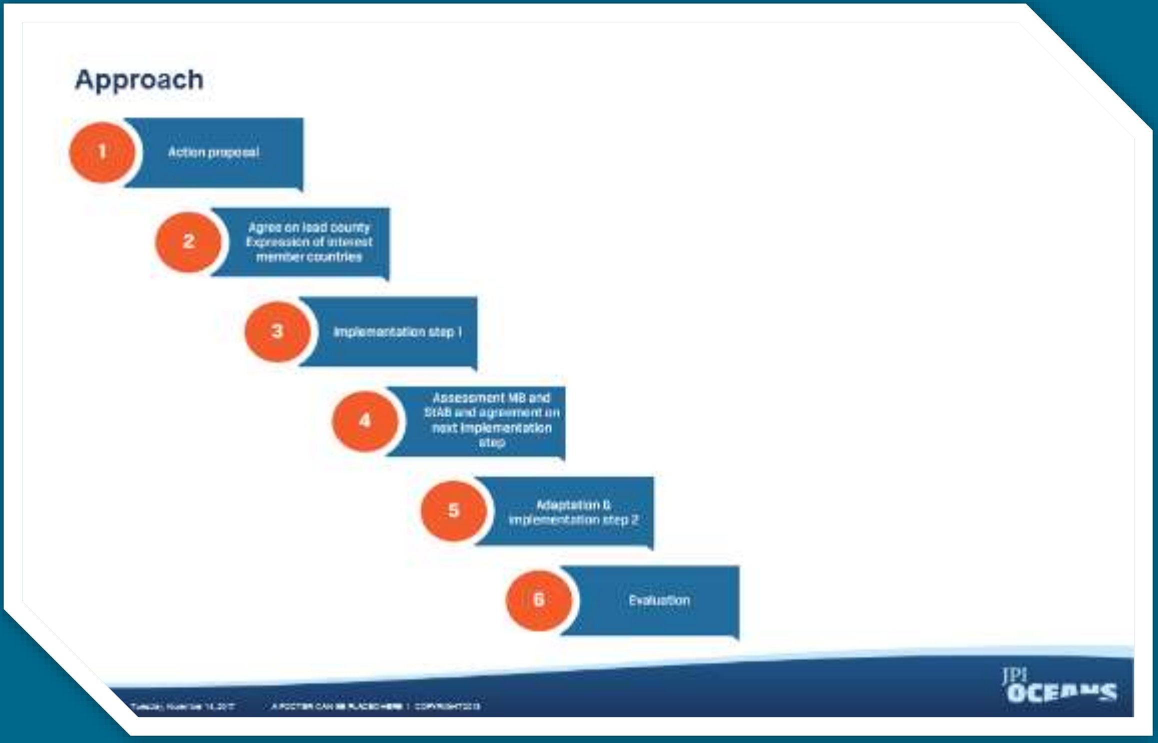
Forum UXO - Presentations




Strategic Research and Innovation Agenda
Exploring deep sea resources
Technology and sensor developments
Science support to coastal and maritime planning and management
Linking oceans, human health and wellbeing
Interdiscipli-nary research for GES
Observing, modeling and predicting oceans state and process-es
Climate change impact on physical and biological ocean processes - Oceans circulation
Effects of ocean acidification on marine ecosystems
Food security and safety driving innovation in a changing world
Use of marine biological resources through development and application of biotechnology
SCIENCE – POLICY INTERFACE
HUMAN CAPACITY BUILDING
INFRASTRUCTURE: SHARED USE AND MANAGEMENT
JPI OCEANS


Approach
1
Action proposal
2
Agree on lead county Expression of interest member countries
3
Implementation step 1
4
Assessment MB and StAB and agreement on next implementation step
5
Adaptation & implementation step 2
6
Evaluation
JPI OCEANS

BALTIC CLEAN TECHNOLOGY 2017

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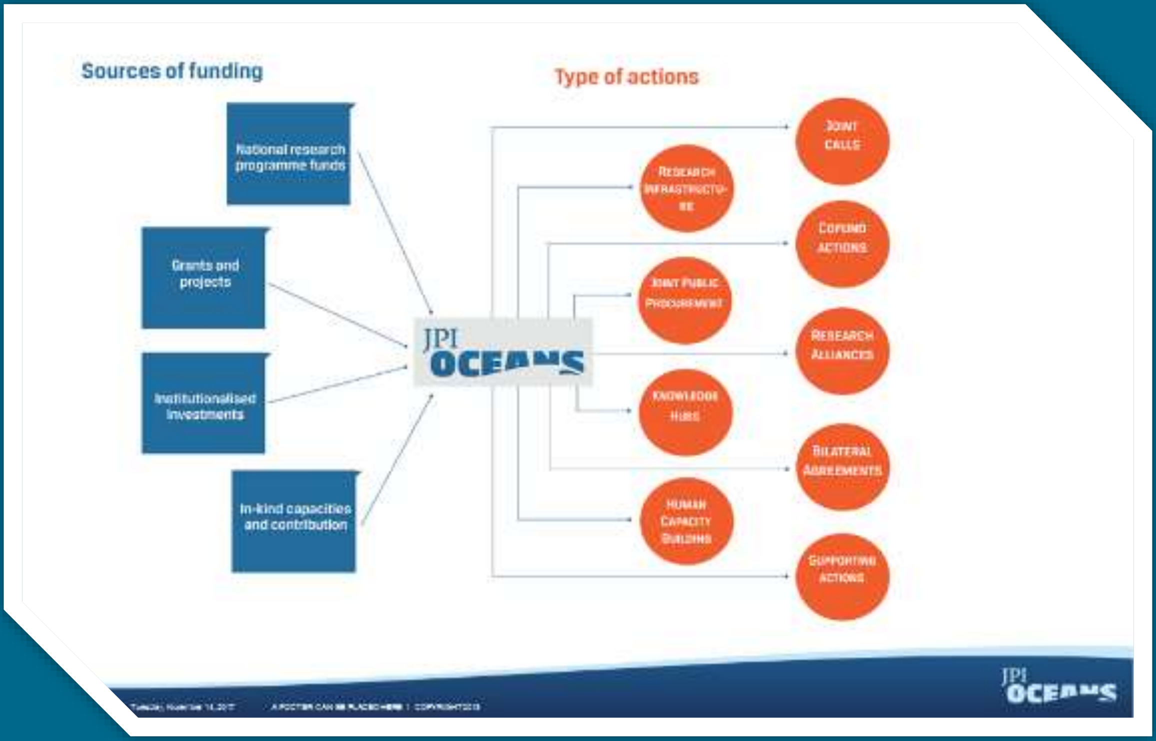
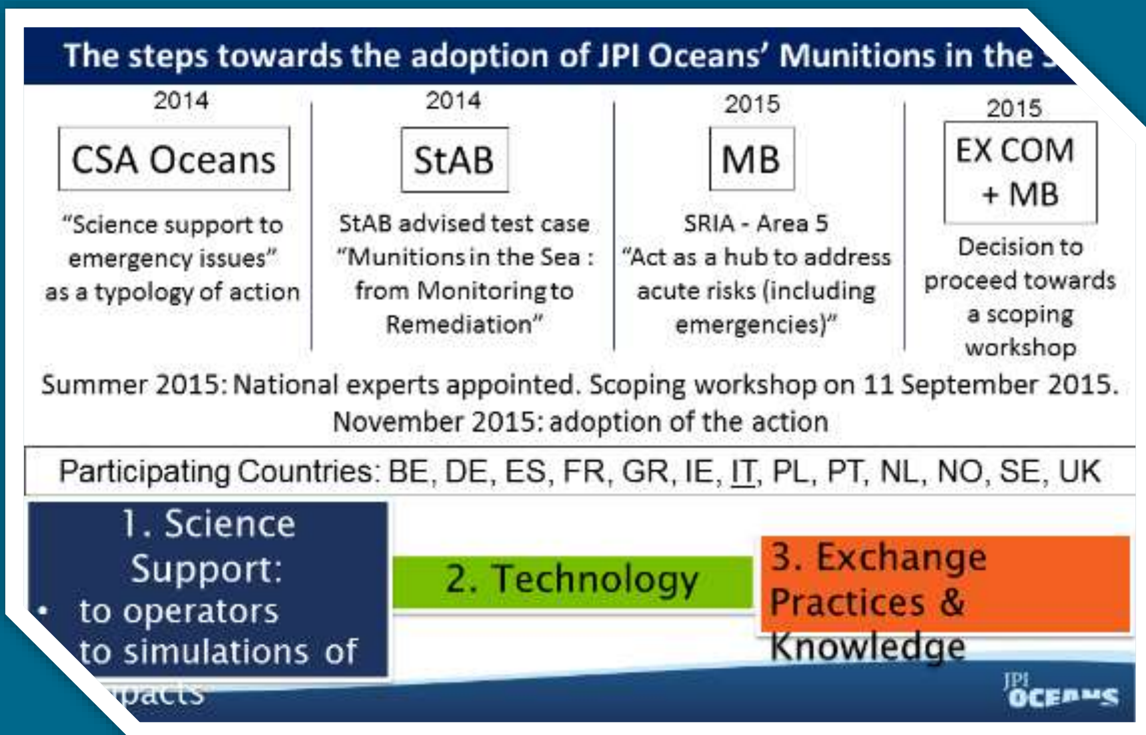
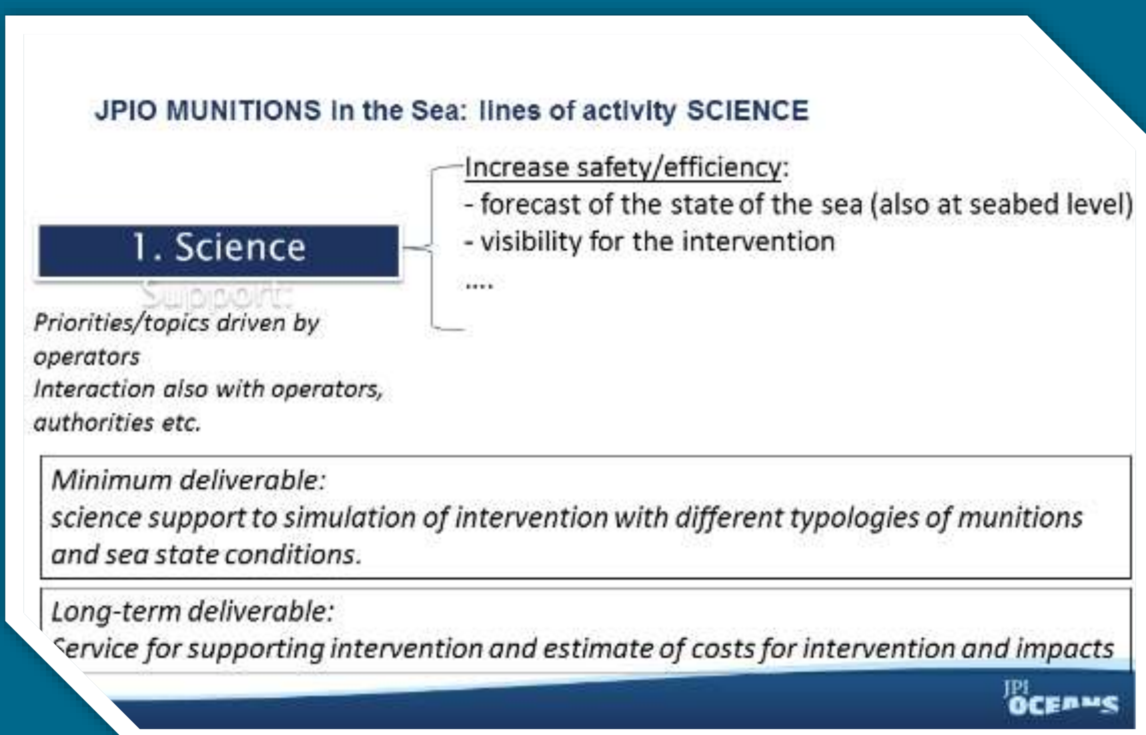


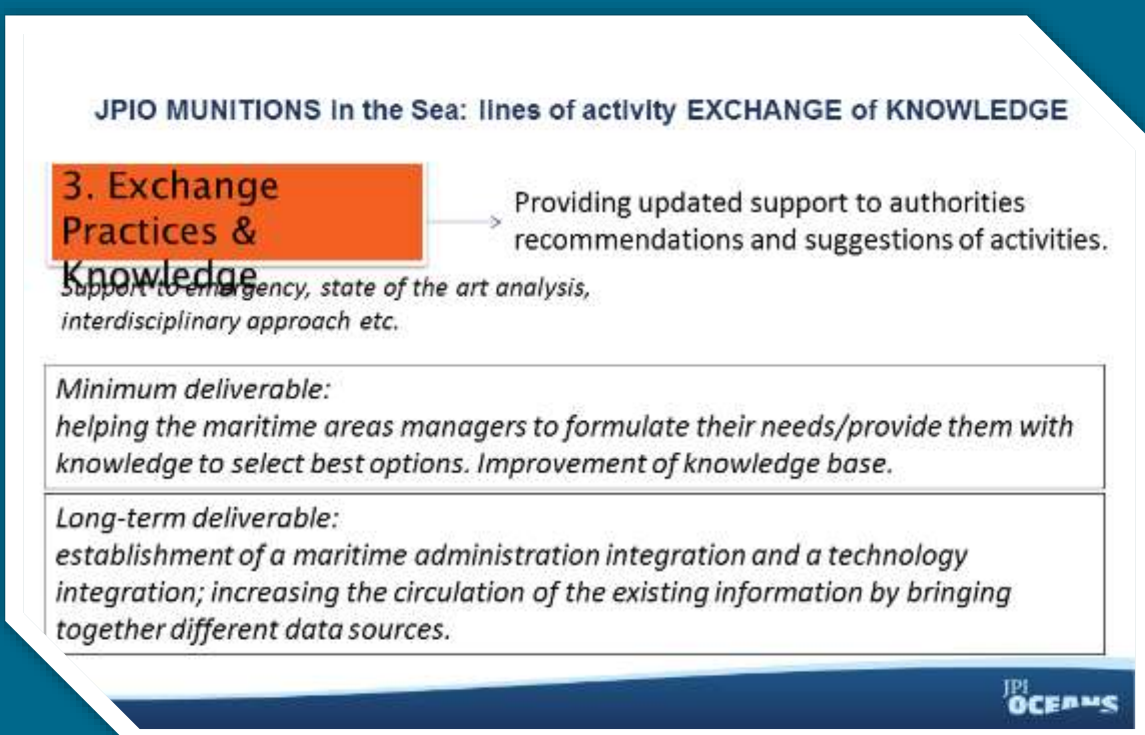

MUNITIONS in the SEA
Unexploded Ordnance (UXO) in the oceans (conventional explosive and chemical weapons (CW, dumped at sea during /after conflicts) are not only an undesirable legacy of the past but
RISKS calling for an urgent STRATEGY
• EXPLOSIONS
• LEAKING toxic constituents (CWA & explosives)
• INTERVENTION (safe and efficient)
• MONITORING, FORECASTING, REMEDIATING
➢SOCIETAL CHALLENGE for Good Environmental Status... but a cross-cutting issue
➢PRODUCTIVE CHALLENGE, remove MUNITIONS in the SEA means fostering activities:
▪ oil and gas operations
▪ placing pipelines and cables on the seabed
▪ offshore fish-farming and demersal fisheries
▪ wind farm installation
JPI OCEANS

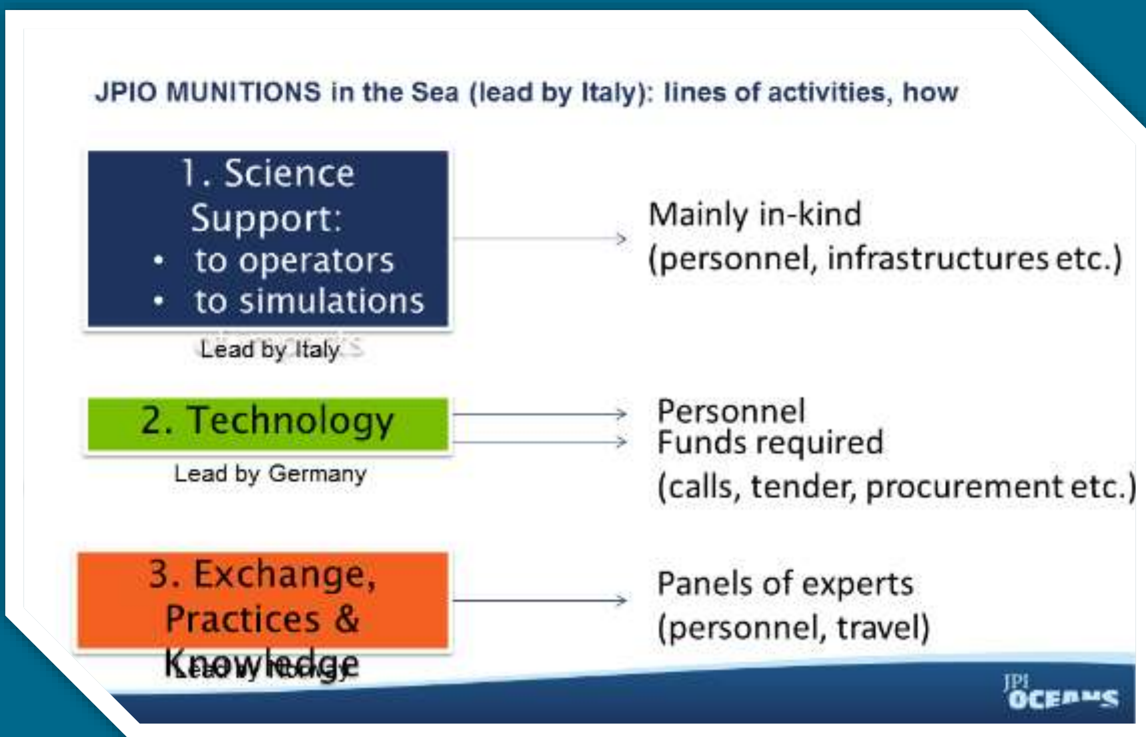

JPIO Munitions in the Sea in a nutshell
12 participating countries: BE, DE, ES, GR, IE, IT, PL, PT, NL, NO, SE, UK
Aim: SUPPORT TO POLICY/ANTICIPATE EMERGENCIES through a MAP OF THE RISKS, including time-scales for intervention, impacts (people, environment, human activities), options (before and after emergencies).
Safety of people (operators/citizens)
Support to policy (integrated risk-assessments)
Scouting/ Testing/Providing solutions
For further information: http://www.jpi-oceans.eu/munitions-sea
JPI OCEANS


The steps towards the adoption of JPI Oceans' Munitions in the S
2014
CSA Oceans
"Science support to emergency issues" as a typology of action
2014
StAB
StAB advised test case "Munitions in the Sea : from Monitoring to Remediation"
2015
MB
SRIA - Area 5
"Act as a hub to address acute risks (including emergencies)"
2015
EX COM + MB
Decision to proceed towards a scoping workshop
Summer 2015: National experts appointed. Scoping workshop on 11 September 2015.
November 2015: adoption of the action
Participating Countries: BE, DE, ES, FR, GR, IE, IT, PL, PT, NL, NO, SE, UK
1. Science Support:
• to operators
to simulations of
2. Technology
3. Exchange Practices & Knowledge
JPI OCEANS


JPIO MUNITIONS in the Sea: lines of activity SCIENCE
1. Science
Increase safety/efficiency:
- forecast of the state of the sea (also at seabed level)
- visibility for the intervention
....
Priorities/topics driven by operators
Interaction also with operators, authorities etc.
Minimum deliverable:
science support to simulation of intervention with different typologies of munitions and sea state conditions.
Long-term deliverable:
Service for supporting intervention and estimate of costs for intervention and impacts
JPI OCEANS


JPIO MUNITIONS in the Sea: lines of activity TECHNOLOGY
2. Technology
Also from other sectors
Industrial/operators' involvement
Scouting available technologies also from other sectors:
•Update of Munitions response technologies
•Environmental remediation technologies
Test of new/adapted technologies, in collaboration with industries and operators (aqua farmig, oil& gas, power lines, ...), to reduce costs and/or increase efficiency/safety
Minimum deliverable:
Survey of technologies (response and remediation)
Long-term deliverable:
Development of new technologies or sharing costs


JPIO MUNITIONS in the Sea: lines of activity EXCHANGE of KNOWLEDGE
3. Exchange Practices & Knowledge
Providing updated support to authorities recommendations and suggestions of activities.
Support to emergency, state of the art analysis, interdisciplinary approach etc.
Minimum deliverable:
helping the maritime areas managers to formulate their needs/provide them with knowledge to select best options. Improvement of knowledge base.
Long-term deliverable:
establishment of a maritime administration integration and a technology integration; increasing the circulation of the existing information by bringing together different data sources.


JPIO MUNITIONS in the Sea (lead by Italy): lines of activities, how
1. Science Support:
• to operators
• to simulations
Lead by Italy
Mainly in-kind
(personnel, infrastructures etc.)
2. Technology
Lead by Germany
Personnel
Funds required
(calls, tender, procurement etc.)
3. Exchange, Practices & Knowledge
Panels of experts
(personnel, travel)
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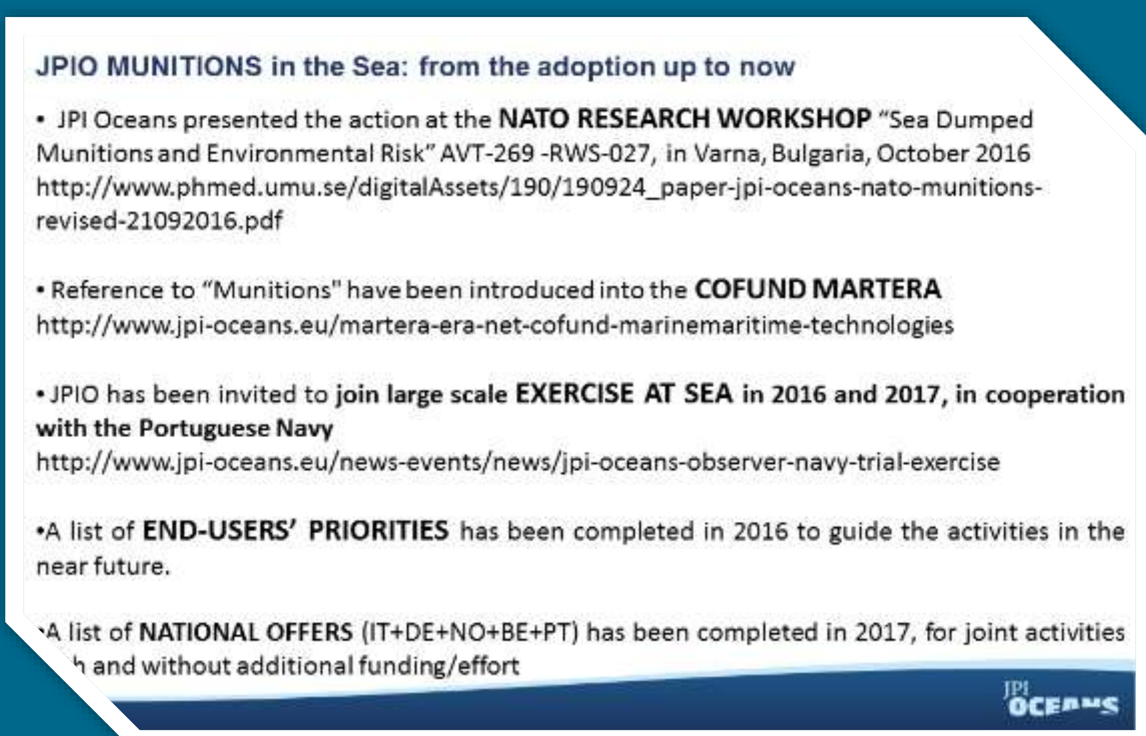
JPIO MUNITIONS in the Sea: from the adoption up to now
• JPI Oceans presented the action at the NATO RESEARCH WORKSHOP "Sea Dumped Munitions and Environmental Risk" AVT-269 -RWS-027, in Varna, Bulgaria, October 2016
http://www.phmed.umu.se/digitalAssets/190/190924_paper-jpi-oceans-nato-munitions-revised-21092016.pdf
• Reference to "Munitions" have been introduced into the COFUND MARTERA
http://www.jpi-oceans.eu/martera-era-net-cofund-marinemaritime-technologies
• JPIO has been invited to join large scale EXERCISE AT SEA in 2016 and 2017, in cooperation with the Portuguese Navy
http://www.jpi-oceans.eu/news-events/news/jpi-oceans-observer-navy-trial-exercise
•A list of END-USERS' PRIORITIES has been completed in 2016 to guide the activities in the near future.
•A list of NATIONAL OFFERS (IT+DE+NO+BE+PT) has been completed in 2017, for joint activities
and without additional funding/effort
JPI OCEANS

END-USERS priorities - AREAS of interventions

- Detection of new sites/validation of known sites, recognition/identification
- Monitoring (at large and small scales)
- Detonation, removal, capping, treatment of material
- Risk assessment (environmental, economic activities, social alert, human food chain etc.)
- Environmental mitigation

END-USERS priorities - ISSUES

3D Forecast of currents at surface and sea bed, hydrodynamic transportation, 3D particle-tracking-tools
Visibility at sea bed
Multi-spectral Imaging/high-res sonar images/magneto-electro-acoustic-optical sensors/chemical sniffers
ROV/AUV
Interoperable data provision and integration
Data communication
Remoted manipulation
State of corrosion/leakage, prediction of failure and release rates of contents.
Diffusion and impacts of toxic agents/bio-monitoring
Environmental risk assessment for underwater detonations
Risk assessment (tools, best practices)
Mitigation techniques

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National Offers (at the moment from IT+DE+NO+BE+PT), in brief:

Without additional external contribution

Access to projects' results, data and sites
Simulations and modeling
Organization of sea exercises
Scouting of technologies

On October 6th 2017, an operation plan for joint activities to be implemented in 2018, will be discussed

With additional external contribution

Innovation
Development of technologies
Operational services
Site characterization
...

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Thank you for your attention!
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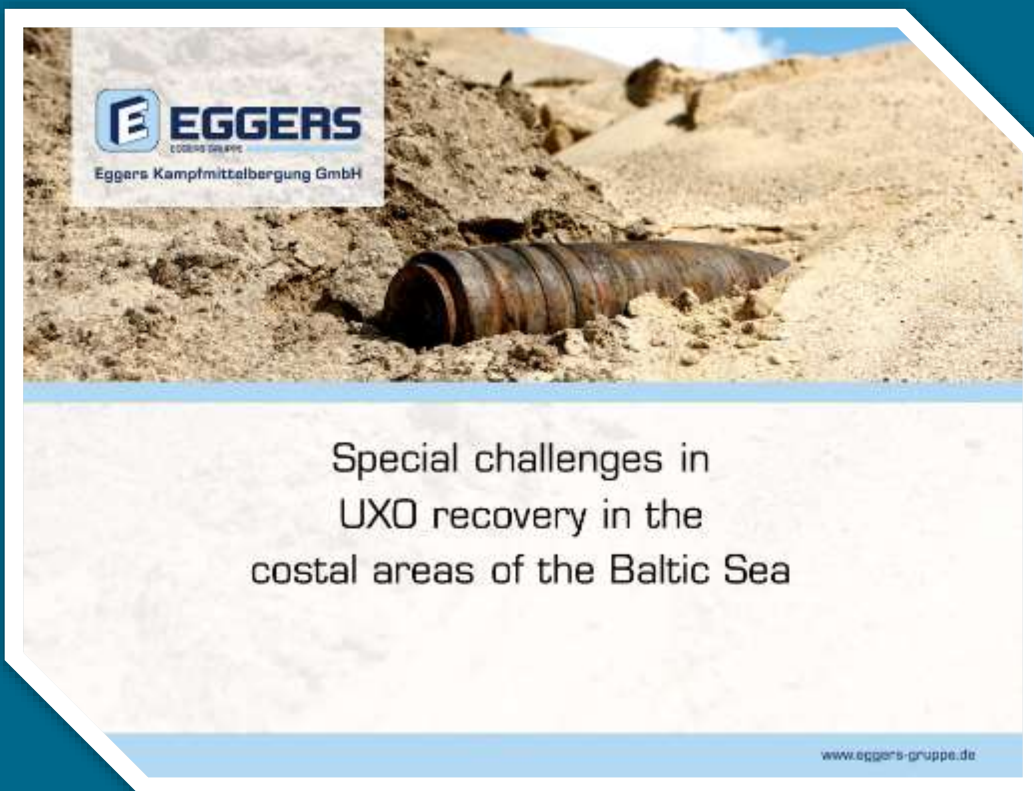
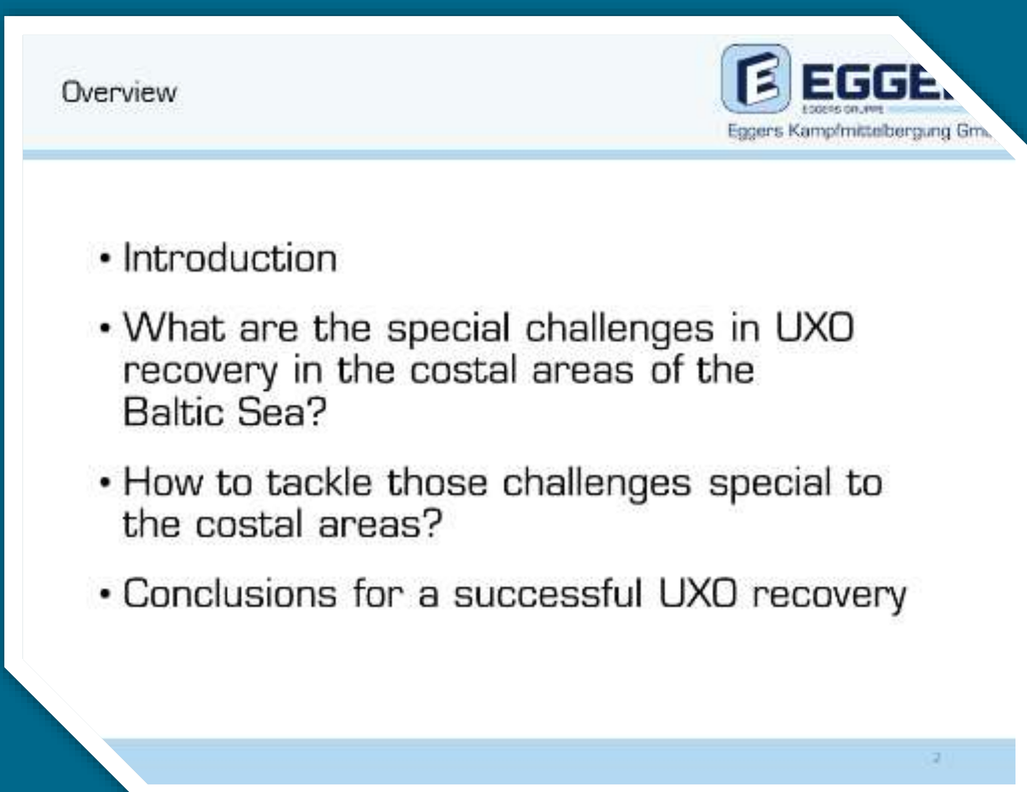
OCEANS
Questions?


EGGERS
Eggers Kampfmittelbergung GmbH
Special challenges in
UXO recovery in the
costal areas of the Baltic Sea
www.eggers-gruppe.de


Overview
Eggers Kampfmittelbergung Gm
• Introduction
• What are the special challenges in UXO recovery in the costal areas of the Baltic Sea?
• How to tackle those challenges special to the costal areas?
• Conclusions for a successful UXO recovery

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Introduction

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UXO deposition in the Baltic Sea by:

- Military developments along the coastlines, including test and training sites off-shore
- Combat operations in two world wars
- Post war deposits

3

Special challenges in UXO recovery in the costal areas of the Baltic Sea

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- Post war dumping of all different kinds of ammunition

4

Post war dumping of ammunition

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- Between 1945 and 1948 legal dumping of ammunition was performed in the North and Baltic Sea under allied control.
- About 1.6 million tons of conventional ammunition are verified to be deposited in the seas, approximately 1.3 million tons in the North Sea
- Additional 170000 tons of chemical ammunition are deposited in North and Baltic Sea

Post war dumping of ammunition

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- In result, a clustering of objects of different size, kind and condition is to be expected within a relatively small area
- The recovery of large calibre individually occurring ammunition is quantitatively in a markedly smaller proportion compared to the massed clogged ammunition with many small calibres down to 2 cm

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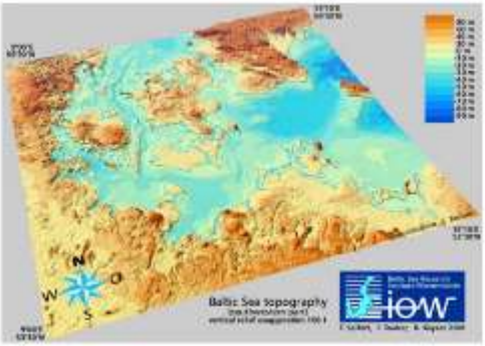
Post war dumping of ammunition

- The example of the dumping site "Kolberger Heide" demonstrates the dynamic suspected UXO sites
- The initially zone of contaminated area was successively enlarged after surveys initiated by the German authorities proved massive UXO clusters in conjected spaces
- Though special depositing areas were declared by the allies, dumping of ammunition began immediately after leaving the harbour

Shallow water depths in the costal region

- Wide areas of the coastal region are within depths of 10-20 m
- Wave heights may limit surveying
- Currents may impose additional positioning issues



Urban environment

- Along the coastline harbours and industrial sites were prominent targets for allied strikes, airborne or marine.
- Today port facilities with ongoing traffic and steel made installations influence the success of UXO recovery missions.

9

Poor visibility

- Poor visibility caused esp. by jetting and sediment transportation

10

Special challenges in UXO recovery in the costal areas of the Baltic Sea

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- Post war dumping of all different kinds of ammunition
- Shallow water depths in the costal region
- Urban environment, e.g. port facilities
- Poor visibility

11

ROV for UXO recovery

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- 24/7 operations minimize execution time
- Systematic visual inspection
- Pre-recovery jetting
- Recovery of large caliber single munitions
- Minimizing risks

© Saab Seaeye ROV systems

12

Diver for UXO recovery

- Operates with his fine motor skills, even in poor vision. The risk of damage is minimized.
- Hazard assessment on the spot by specially trained divers. Appropriate measures can be initiated.
- Preferred over ROV in recovery of clustered ammunition areas

13

Special challenges in UXO recovery in the costal areas of the Baltic Sea

How to assist the UXO recovery operation with the special challenges imposed in the costal areas of the Baltic Sea?

14

Special challenges in UXO recovery in the costal areas of the Baltic Sea

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How to assist the UXO recovery operation with the special challenges imposed in the costal areas of the Baltic Sea?

- Geophysical Prospecting

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Geophysical Prospecting
Geomagnetic

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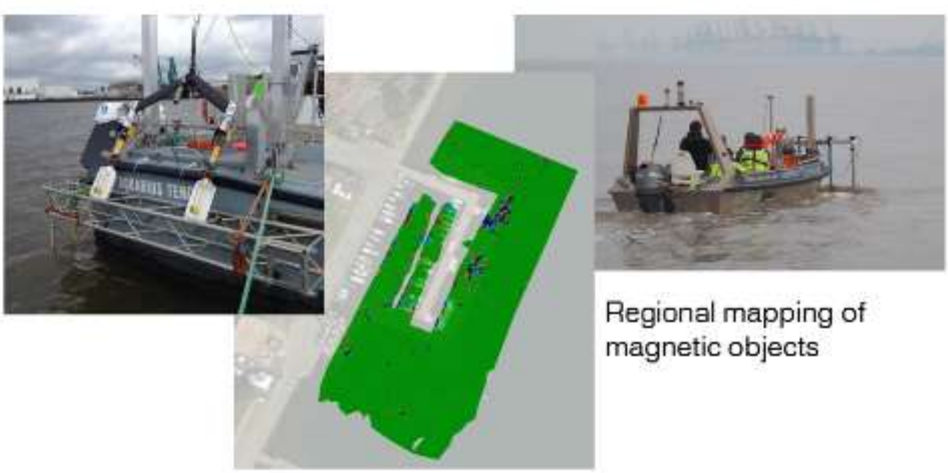

Regional mapping of magnetic objects

16

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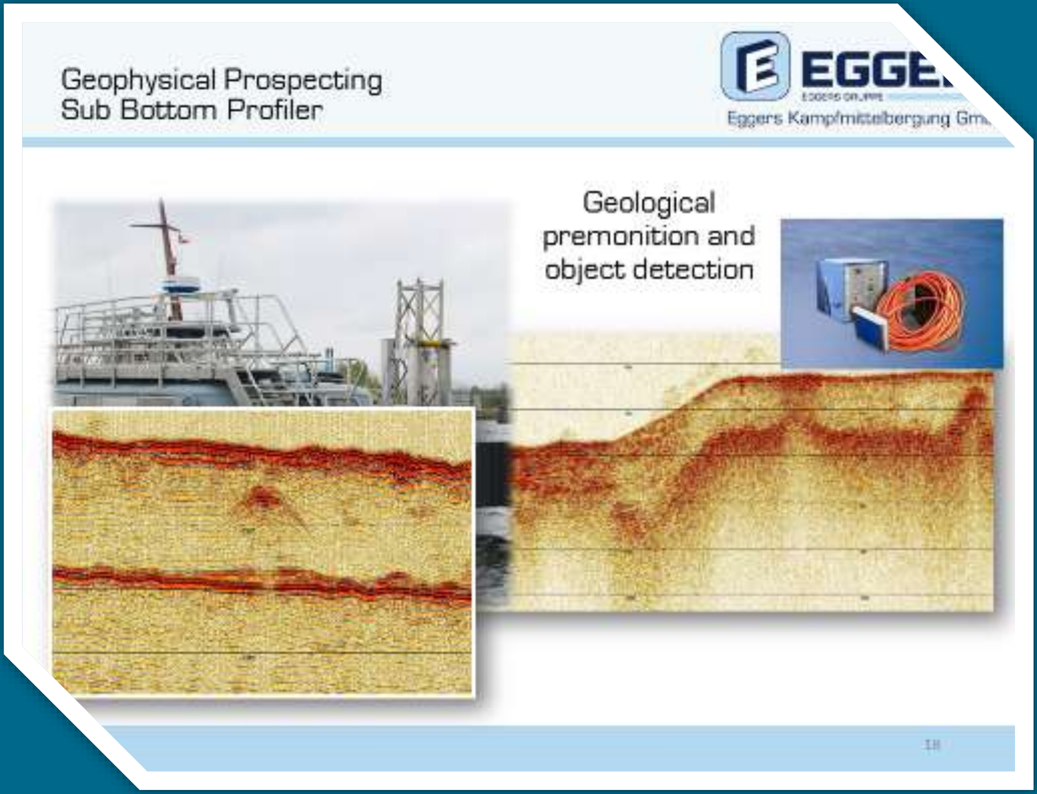
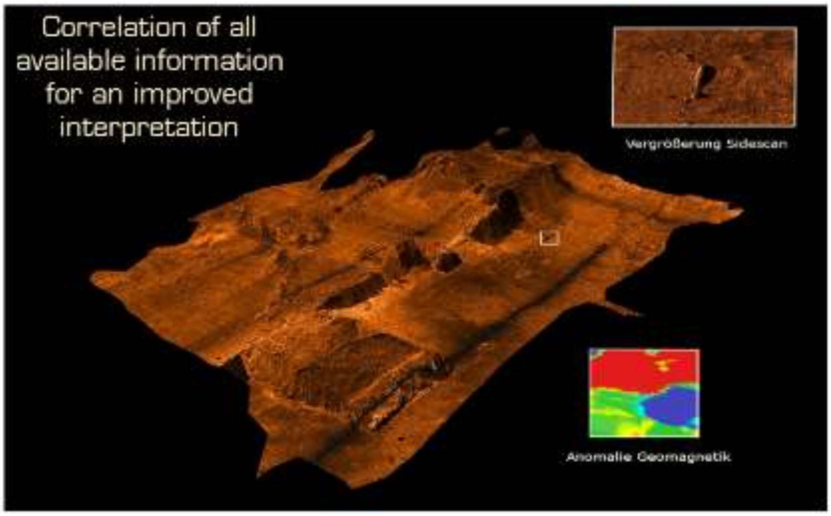


Geophysical Prospecting
Geomagnetic & SideScan



19

Special challenges in UXO recovery in the costal areas of the Baltic Sea

How to assist the UXO recovery operation with the special challenges imposed in the costal areas of the Baltic Sea?

- Geophysical Prospecting
- Improved guidance

20

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Improved guidance

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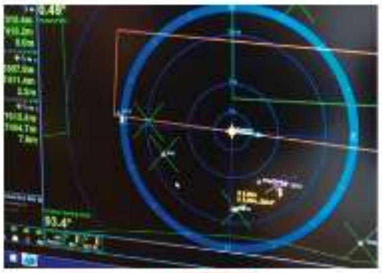

USBL systems for precise underwater positioning and supervision

21

Special challenges in UXO recovery in the costal areas of the Baltic Sea

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How to assist the UXO recovery operation with the special challenges imposed in the costal areas of the Baltic Sea?

- Geophysical Prospecting
- Improved guidance
- Enhanced sensory systems

22

Enhanced sensory systems

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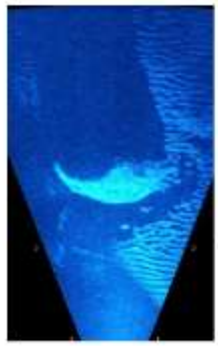
- Recent developments in sensory systems can enhance efficiency and reduce risk of diving operations
- High frequency sonar systems enable object identification in a live view, even in black waters

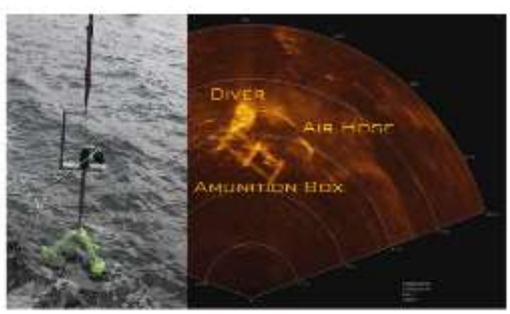


23

Enhanced sensory systems

Eggers Kampfmittelbergung Gm

- Tools for workspace monitoring increase the work safety
- Sonar view systems may enhance the divers efficiency by support from the work platform



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Summary & Conclusion

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Eggers Kampfmittelbergung GmbH

Special challenges in UXO recovery in the costal areas of the Baltic Sea:

- Post war dumping of all different kinds of ammunition
- Shallow water depths in the costal region
- Urban environment, e.g. port facilities
- Poor visibility

25

Summary & Conclusion

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The special challenges imposed on the UXO recovery in the costal areas of the Baltic Sea may be overcome by the application of

- Geophysical Prospecting
- Improved guidance
- Enhanced sensory systems

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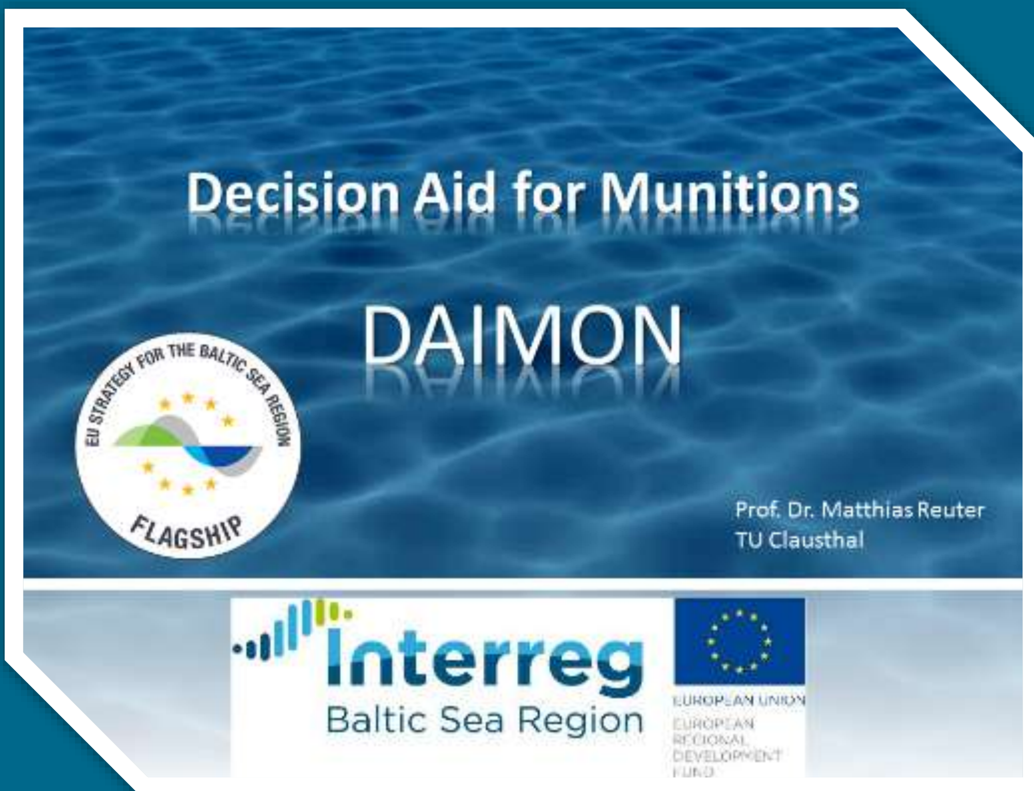
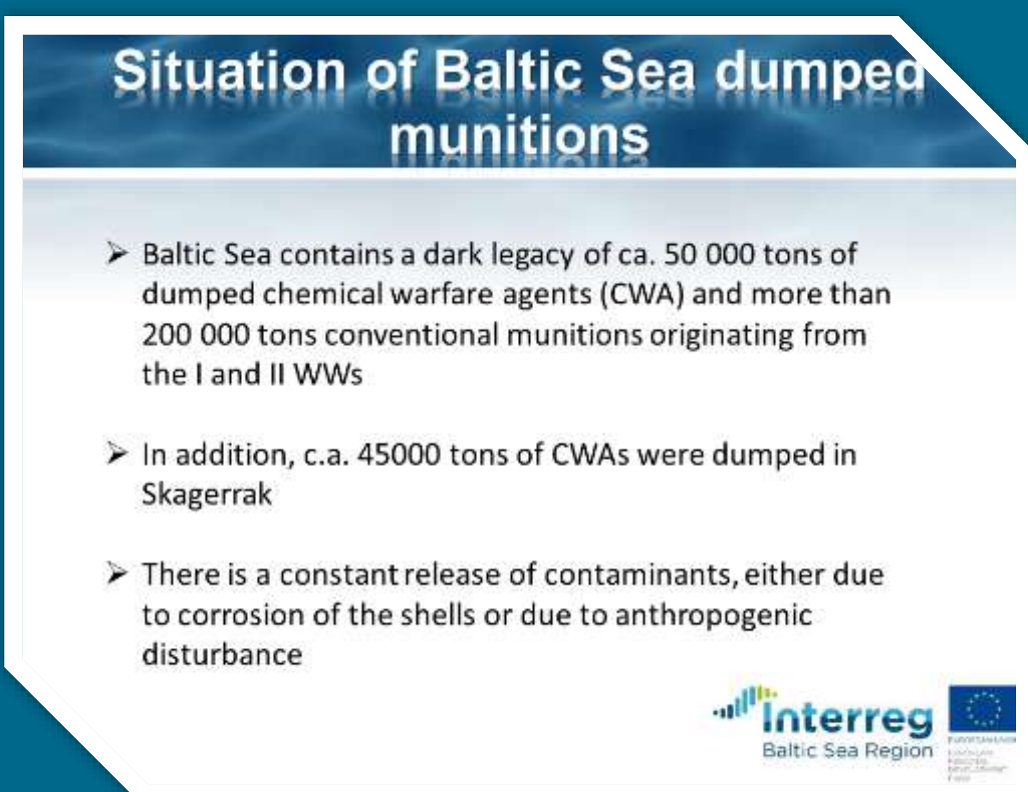
Thank you for your attention!



Decision Aid for Munitions
DAIMON
EU STRATEGY FOR THE BALTIC SEA REGION
FLAGSHIP
Prof. Dr. Matthias Reuter
TU Clausthal
Interreg
Baltic Sea Region
EUROPEAN UNION



Situation of Baltic Sea dumped munitions
➢ Baltic Sea contains a dark legacy of ca. 50 000 tons of dumped chemical warfare agents (CWA) and more than 200 000 tons conventional munitions originating from the I and II WWs
➢ In addition, c.a. 45000 tons of CWAs were dumped in Skagerrak
➢ There is a constant release of contaminants, either due to corrosion of the shells or due to anthropogenic disturbance
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Baltic Sea Region

Situation of Baltic Sea dumped munitions

CHEMSEA
CHEMICAL MUNITIONS SEARCH & ASSESSMENT

MODUM
TOWARDS THE MONITORING OF DUMPED MUNITIONS THREAT

daimon
Decision Aid for Marine Munitions

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Baltic Sea Region

DAIMON – Decision Aid for Marine Munitions

The question which DAIMON takes up is how to proceed with the identified and mapped warfare objects.

Remediation or no action are subject to heated disputes among the decision-making bodies.

Since there cannot be a general answer to this question, DAIMON will develop tools to support the Baltic Sea Region governments and companies in case-to-case decision-making.

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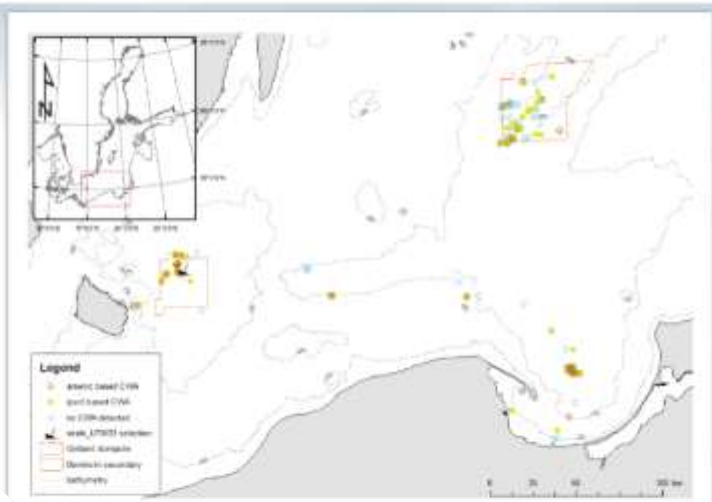
DAIMON – Decision Aid for Marine Munitions

DAIMON (Decision Aid for Marine Munitions) is an international project consisting of partners from Poland, Germany, Sweden, Finland, Norway, Lithuania and Russia, and cooperating experts worldwide, united by the goal to solve the problem of underwater munitions.

This project is part-financed by the EU INTERREG Baltic Sea Region Programme 2014-2020.

Interreg Baltic Sea Region

History and Current Status



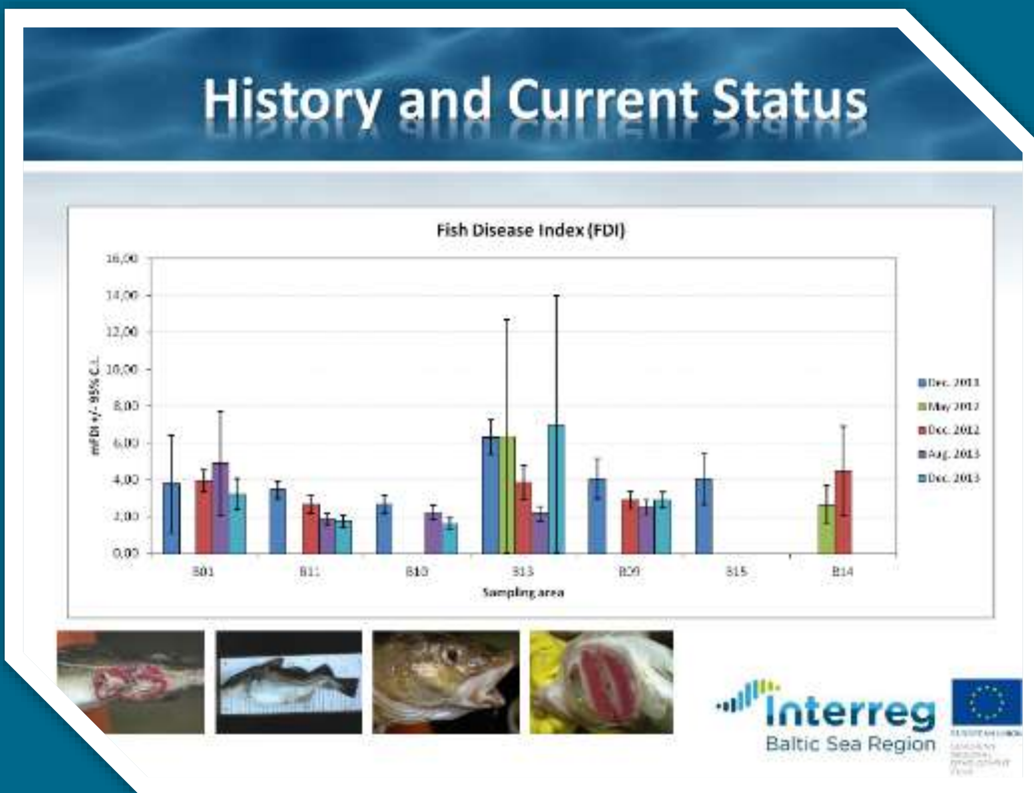
Results from the Chemsea Project:

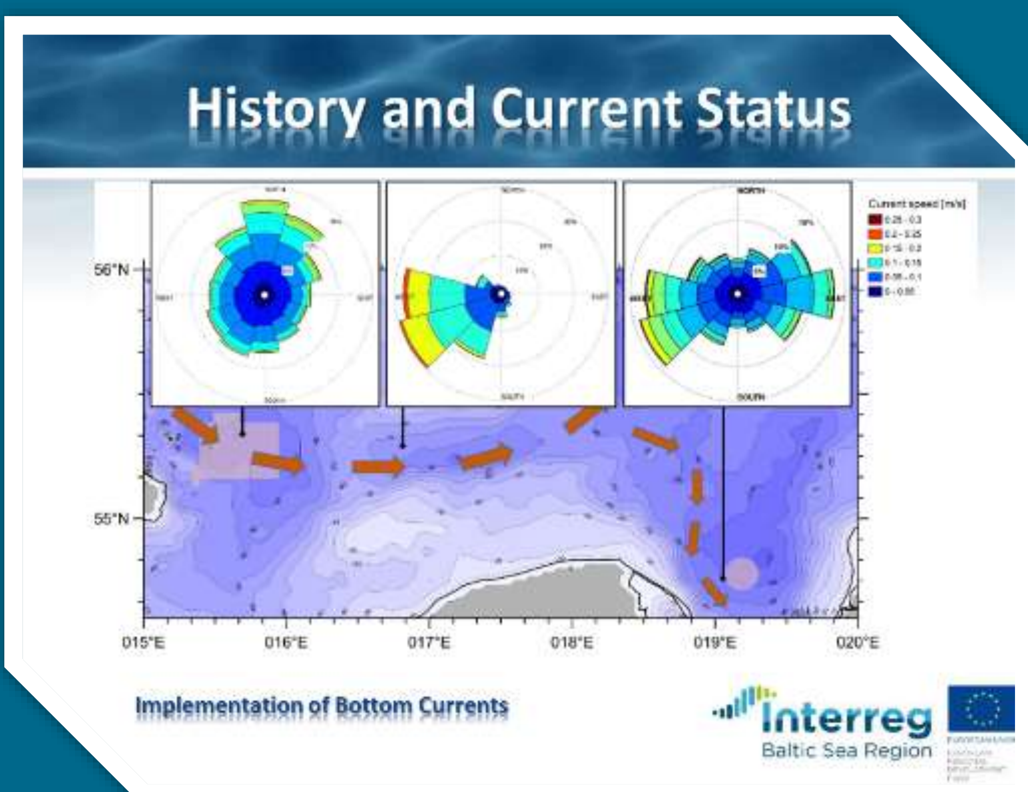
Interactive Map with dump sides

Documentation of CWA found by former measure-ments and historical Data

Implementation of Fish Disease Index (FDI)

Interreg Baltic Sea Region


History and Current Status
Fish Disease Index (FDI)
Sampling area
B01
B11
B13
B29
B15
B14
Interreg
Baltic Sea Region


History and Current Status
56°N
55°N
015°E
016°E
017°E
018°E
019°E
020°E
Implementation of Bottom Currents
Interreg
Baltic Sea Region

DAIMON - Methods

Case studies on conventional munitions

DAIMON will examine two locations of known dumped conventional munitions: in Gulf of Finland and in German coastal waters (12smz and parts of EEZ)

Working steps are:

- Photography and photometry of underwater objects by ROV,
- Sampling of sediments and biota,
- Analysis of collected material,
- Modelling of potential leakage,
- Risk categorization,
- Securing the operation to prevent possible contamination.

Interreg Baltic Sea Region

DAIMON - Methods

Case studies on chemical munitions

DAIMON will have a closer look on two locations identified by the CHEMSEA project: Gdańsk Deep (Kolberger Heide) and Bornholm Deep.

Working Steps are:

- Measure singular objects with side scan sonars (SSS) supplemented by Magnetic Anomaly Detector (MAD), using both towed arrays and Autonomous Underwater Vehicles (AUV).
- Inspection of detected objects by Remotely Operated Vehicles (ROV), and identified based on visual data, archive inventory and other in situ methods.
- Test of laboratory methods for corrosion estimation
- Collection of sediment and water samples to assess the spreading of toxic compounds.
- Development of passive samplers in vicinity of identified objects.
- Analyzation of collected samples in regard to their impact on biota including infauna communities and fish.

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Methods
Munition Status Examination
Modelling of possible release
Risk categorization procedure and decision support
Risk categorization procedure and decision support
Interreg
Baltic Sea Region

Outline
Methods
Risk Assessment Tool
Risk Categorization Tool
Decision Support
Interreg
Baltic Sea Region

DAIMON – Decision Support

The DAIMON tool for risk categorization & decision support will be developed by Clausthal University of Technology in cooperation with other DAIMON partners and the Advisory Board.

For each detected munition object, the software will formulate risk analysis documents, involving facts about the localization and overall state of the ammunition, the surrounding environment and state of biological pollution/damage.

Furthermore, it will recommend possible actions, such as recovery & destruction, accumulation, encapsulation, capping, blasting or non-action, including monitoring and costs thereof.

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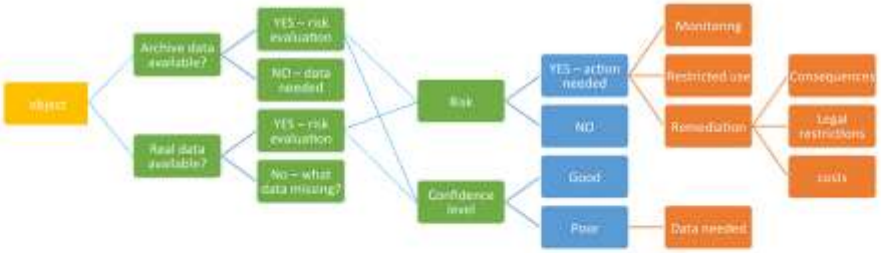
DAIMON – Decision Support



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DAIMON – Decision Support

Use Cases for the Decision Support System

Interreg Baltic Sea Region

Example "Reasonable weapon removal

- A new location of dumped munition was discovered.
- The responsible institution wants support in deciding about the further treatment.
- For that, a member of the institution submits the known properties of the munition find: type, origin, content, age, state of corrosion, leaks, chemical/ecological hazardousness ...
- Regarding this information base, the munition will be classified by the DSS, if no manual classification was given.
- Afterwards, the DSS makes an assumption about a reasonable removal: recover, encapsulate, blast, monitor ...

Interreg Baltic Sea Region

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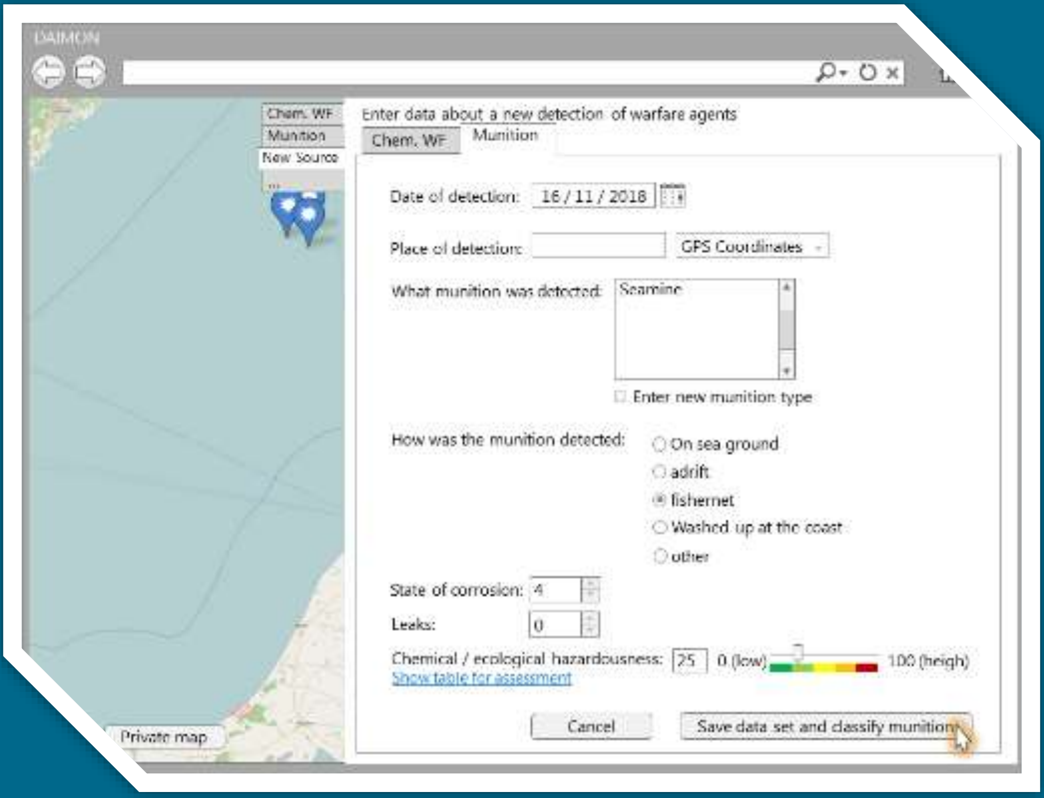

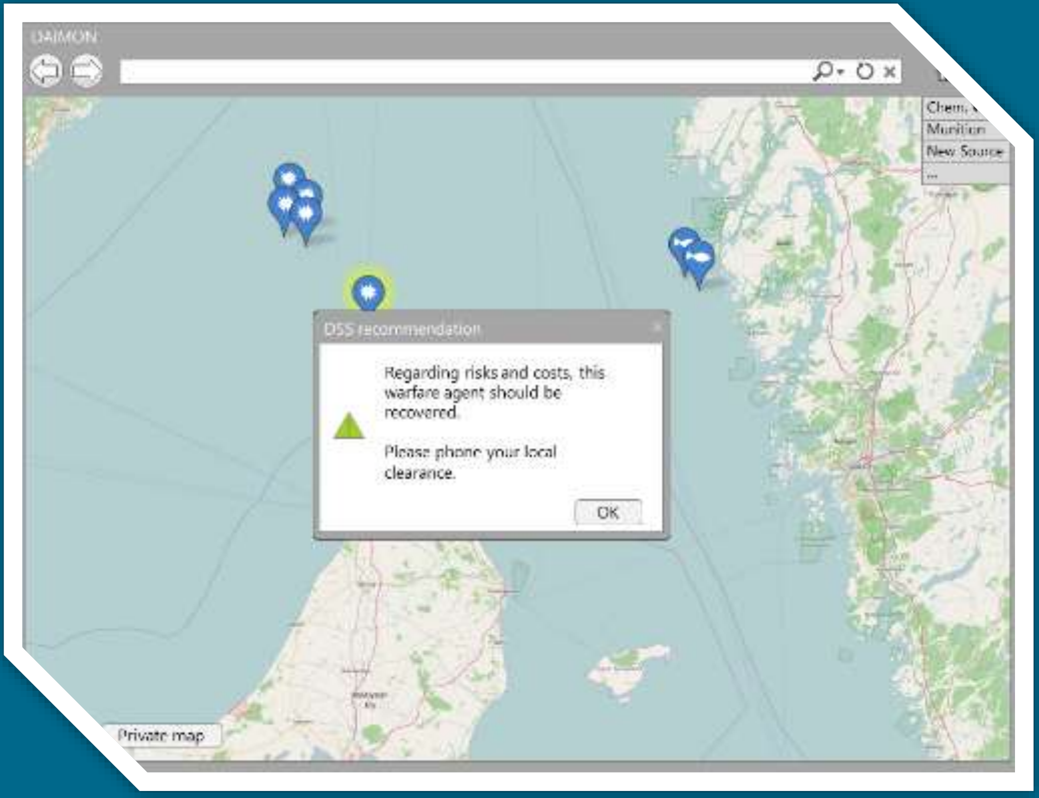

Example "Occurrences in a Certain Area"

- A staff member of a maritime institute wants to know if chemical warfare agents (CWA) were found in a certain area.
- For that, the employee points at a dedicated region on the displayed map.
- Afterwards, all references of CWA are listed beside.

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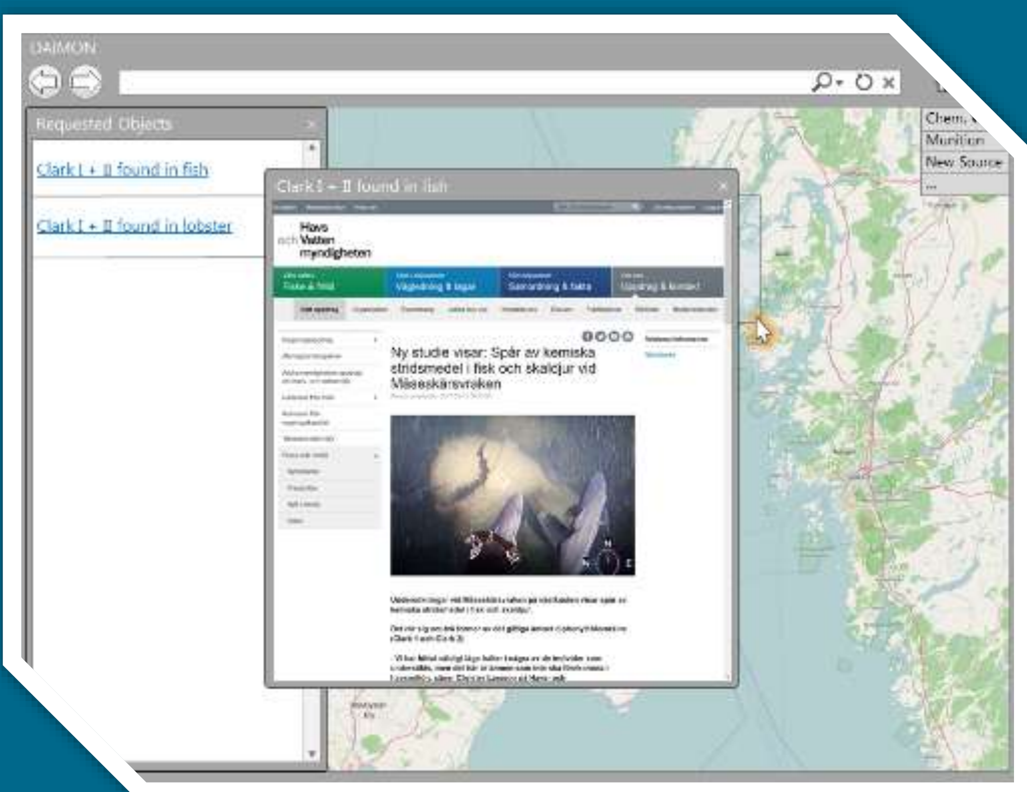

Example “Show Occurrences of Clark I + II”

- A staff member of a maritime institute wants to see all occurrences of Clark I and II in the BSR.
- For that, he/she chooses the appropriate tab of the chemical selection.
- The displayed map is now pointing out the relevant locations.
- The employee also wants to gain further information about a selected occurrence (e.g. if a selected occurrence is munition or was found in fish).

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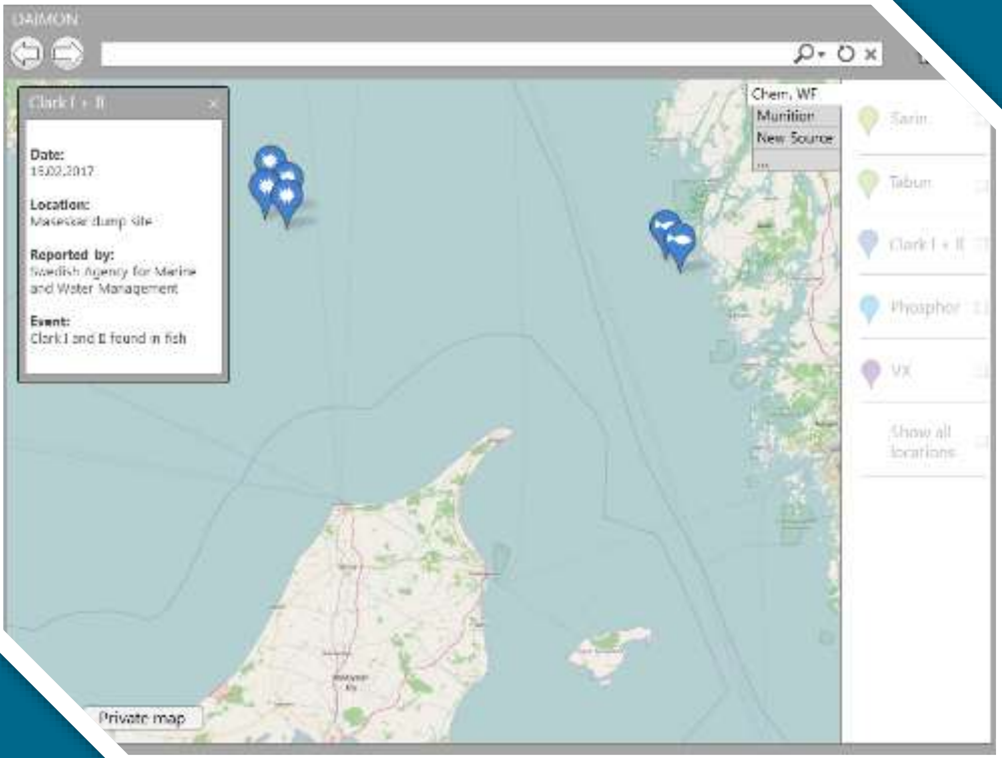

Example "CWA metabolite absorbing"

- During a new survey about CWA metabolites in fish, a new occurrence of Clark I was found.
- The staff member of the surveying institution adds this new data set to the Decision Support Software (database).
- Afterwards, the employee wants to know where the fish could have ingested the chemical.
- The DSS considers the known data about the fish, its location, its metabolism of Clark I and the oceanic current.
- Based on this, the DSS makes an assumption where the original source of the Clark I could be located.

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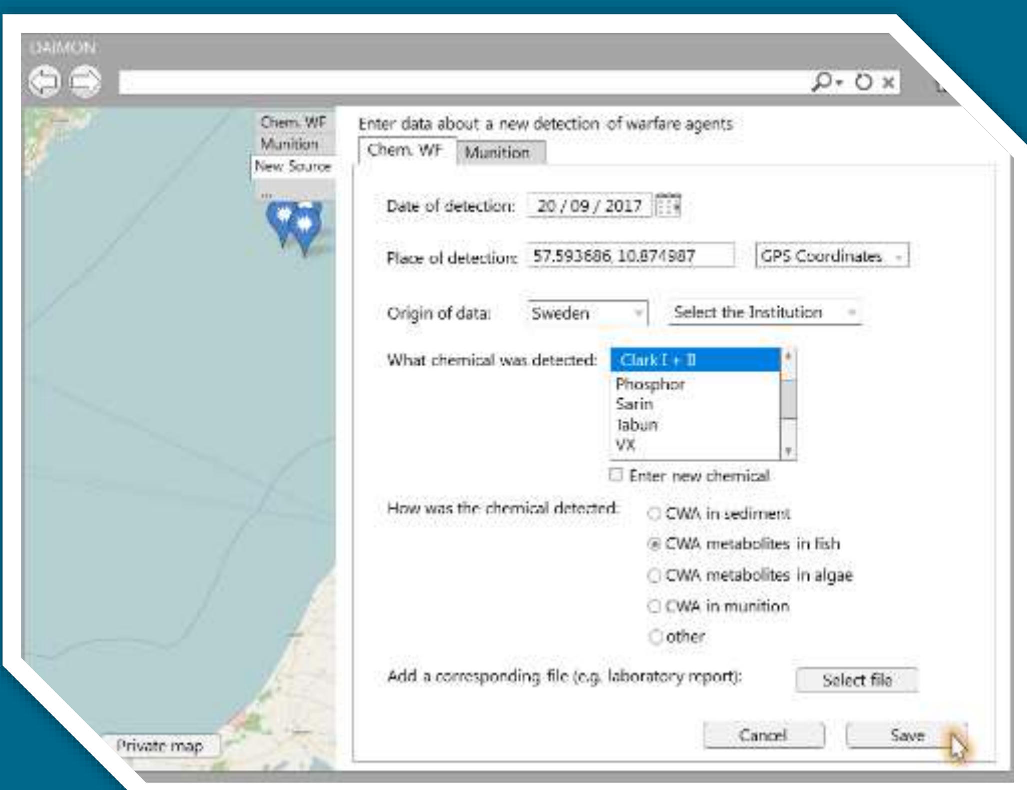

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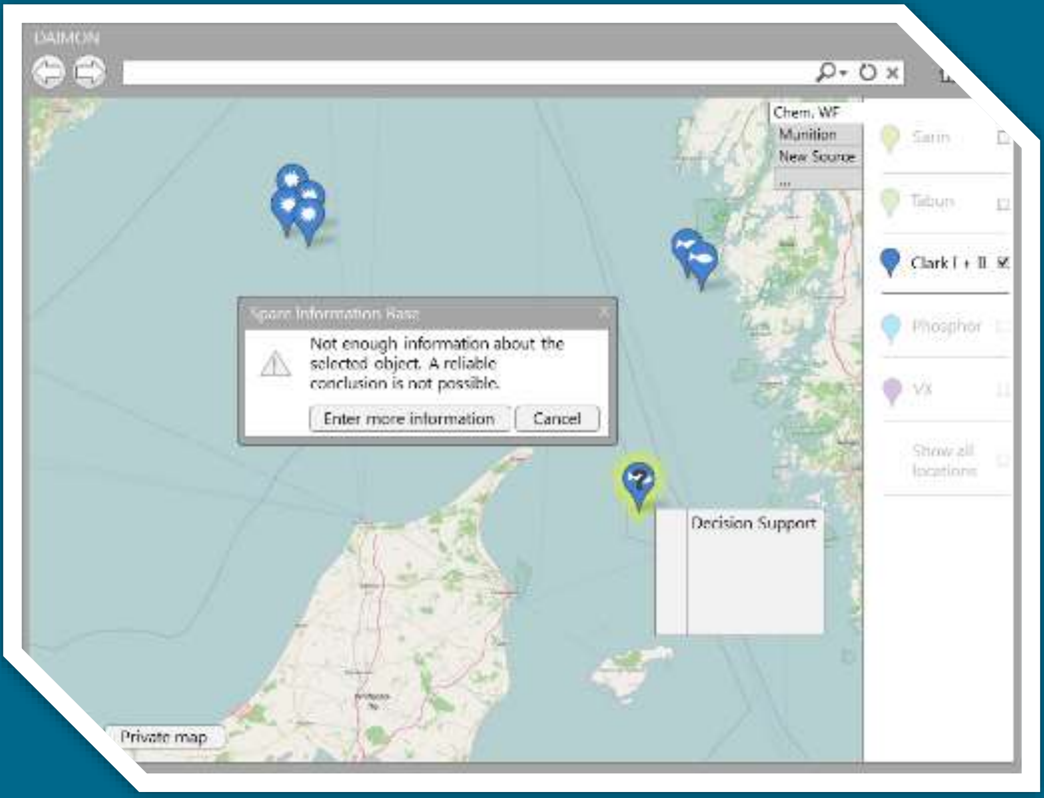

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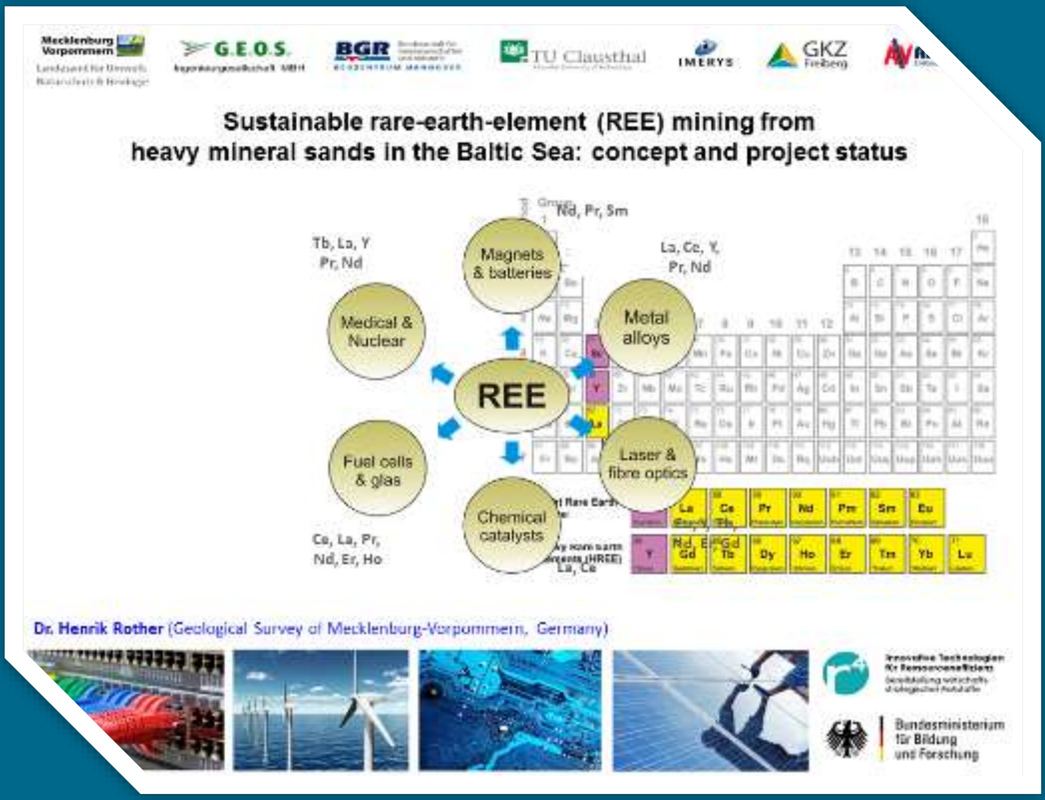
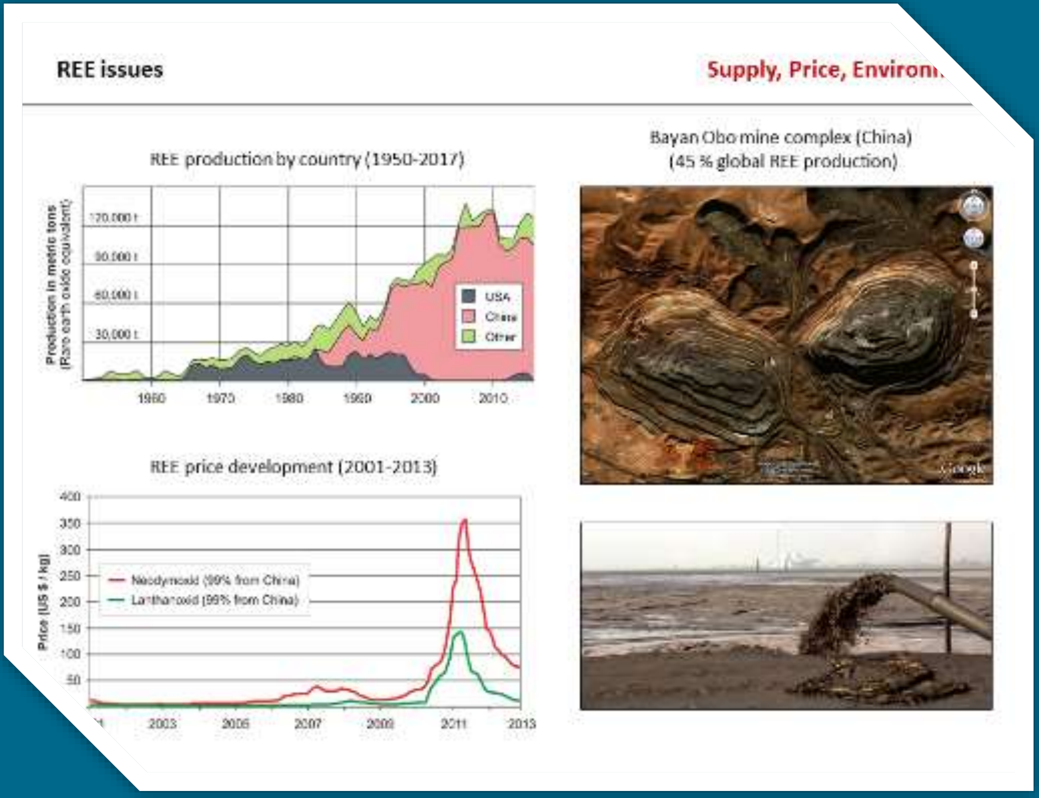
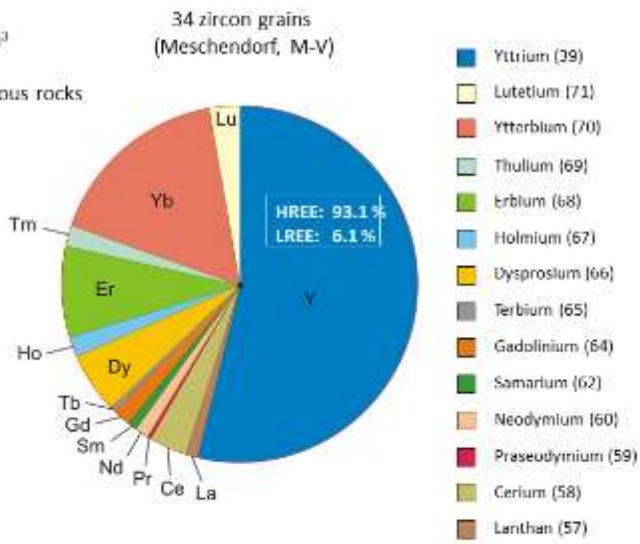




Zircon - an alternative source of REE?

- **Zirconium silicate:** $ZrSiO_4$
- **Density:** 4.65 g/cm^3
- **Mohs hardness:** 7.5
- **Occurrence:** felsic igneous rocks



Heavy mineral sands

Minerale		Dichte (g/cm^3)
Monazit	$(La,Ce,Nd)(PO_4)$	4,9 - 5,3
Magnetit	Fe_3O_4	4,9 - 5,2
Zirkon	$ZrSiO_4$	4,6 - 4,7
Ilmenit	$FeTiO_3$	4,5 - 5,0
Rutil	TiO_2	4,2
Almandin	$Fe_3Al_2(SiO_4)_3$	4,3
Pyrop	$Mg_3Al_2(SiO_4)_3$	3,2 - 3,5

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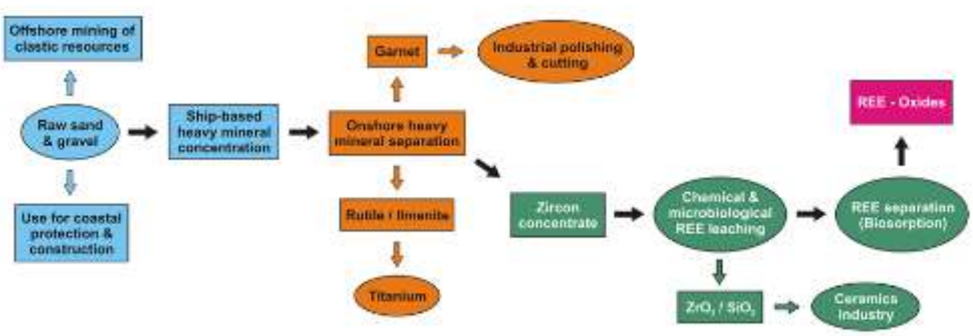
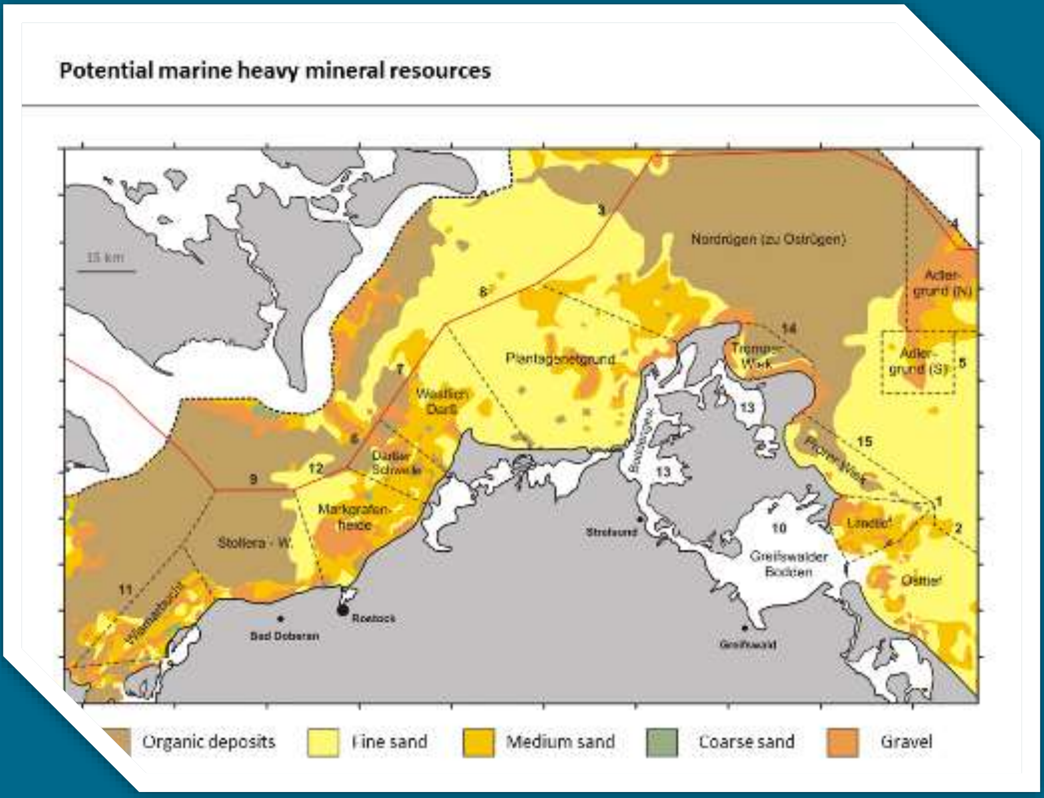
Offshore mining of marine sand

Coastal protection / Construction ind...

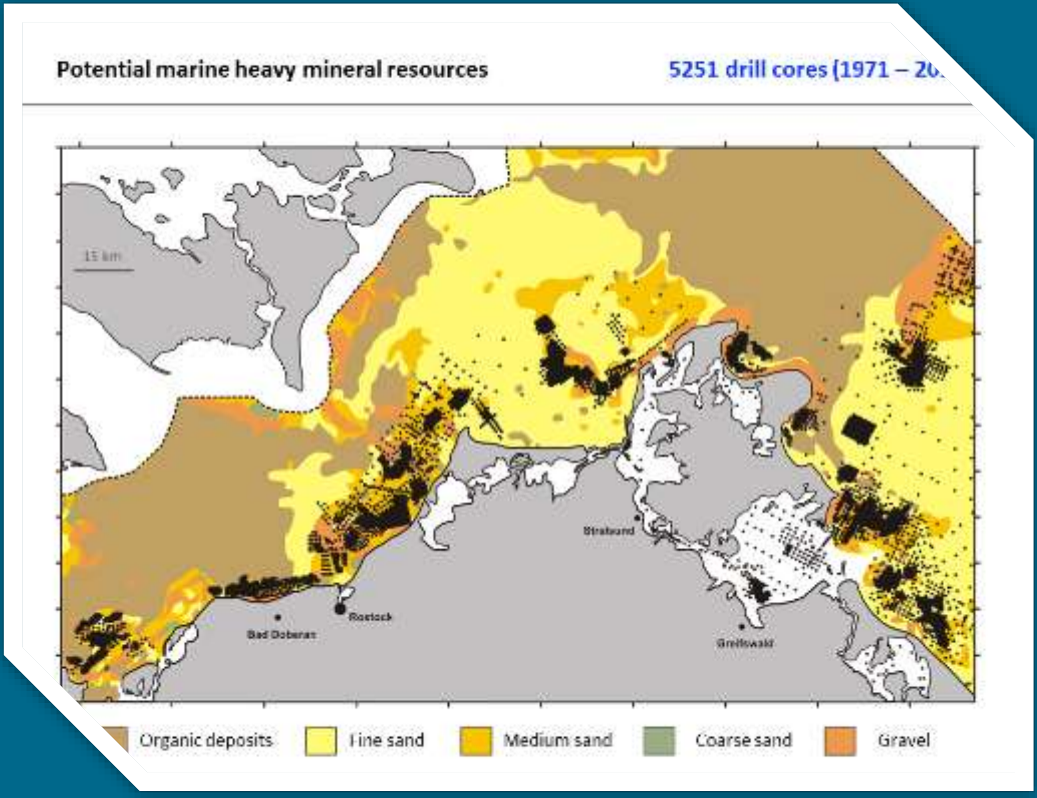
Zircon as an alternative REE source

Project conc...



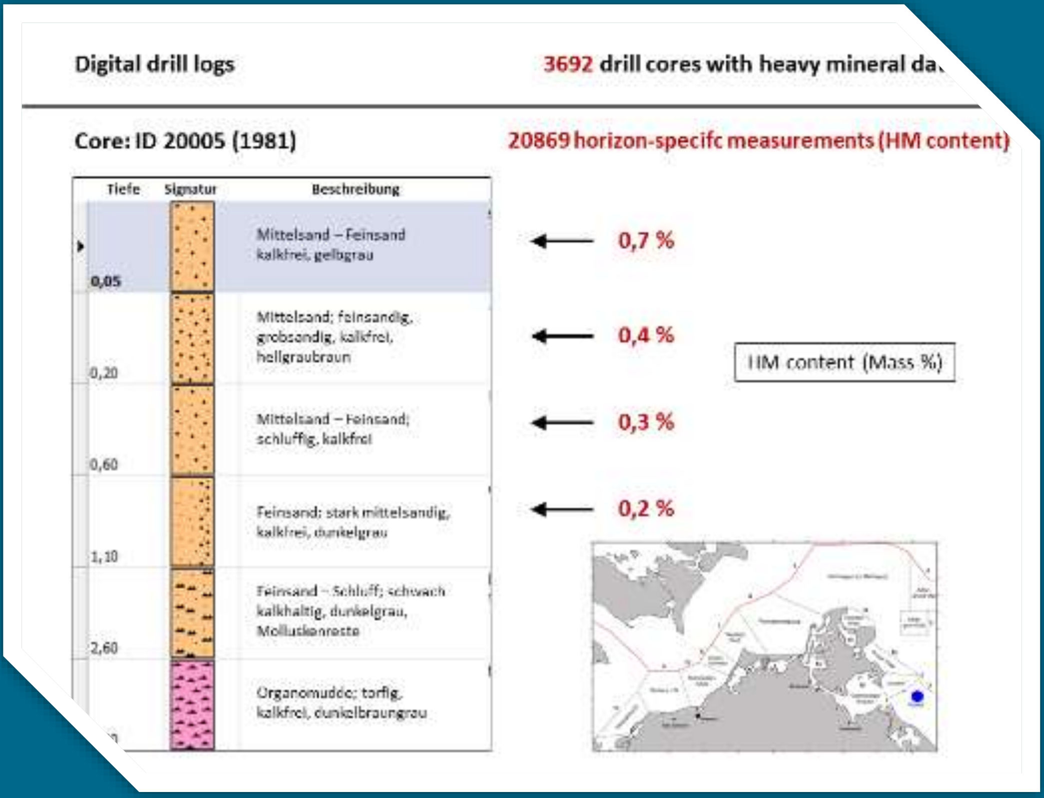


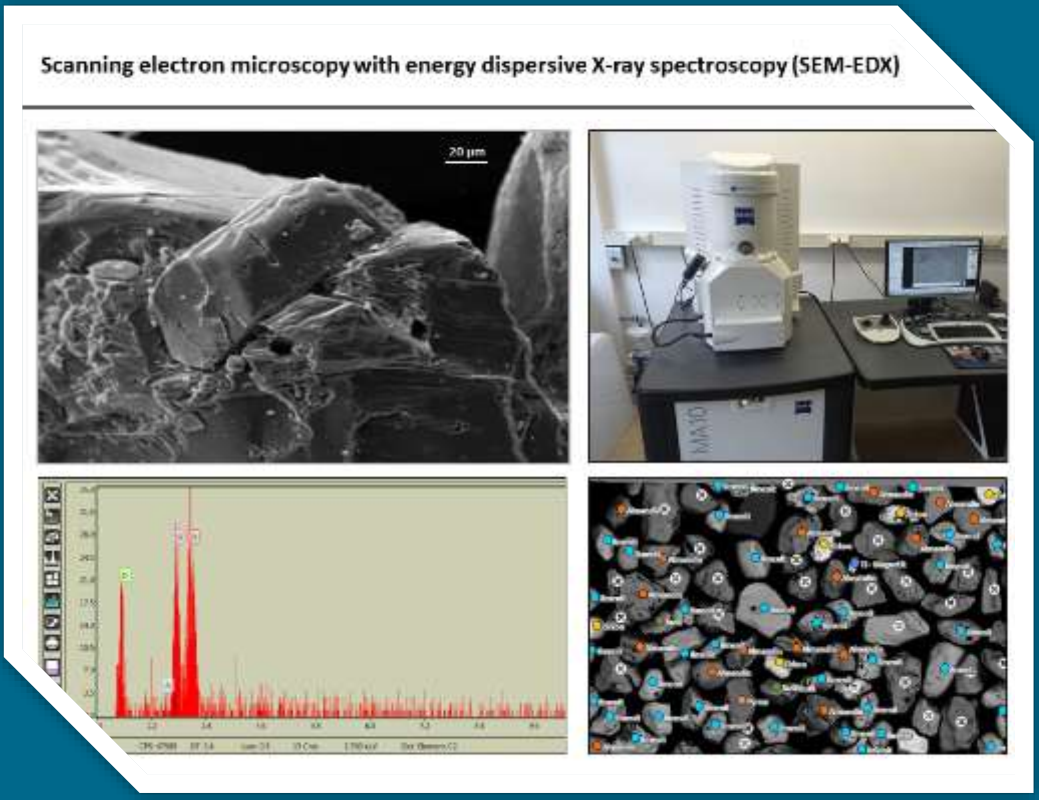
Potential marine heavy mineral resources
15 km
Nordrügen (zu Ostrügen)
Adlergrund (N)
Adlergrund (S)
Plantagenetgrund
Tromper Wiek
Westlich Darß
Darßer Schwelle
Markgrafenheide
Stoltera - W.
Wismarbucht
Stralsund
Greifswalder Bodden
Landtief
Osttief
Rostock
Bad Doberan
Greifswald
Organic deposits
Fine sand
Medium sand
Coarse sand
Gravel

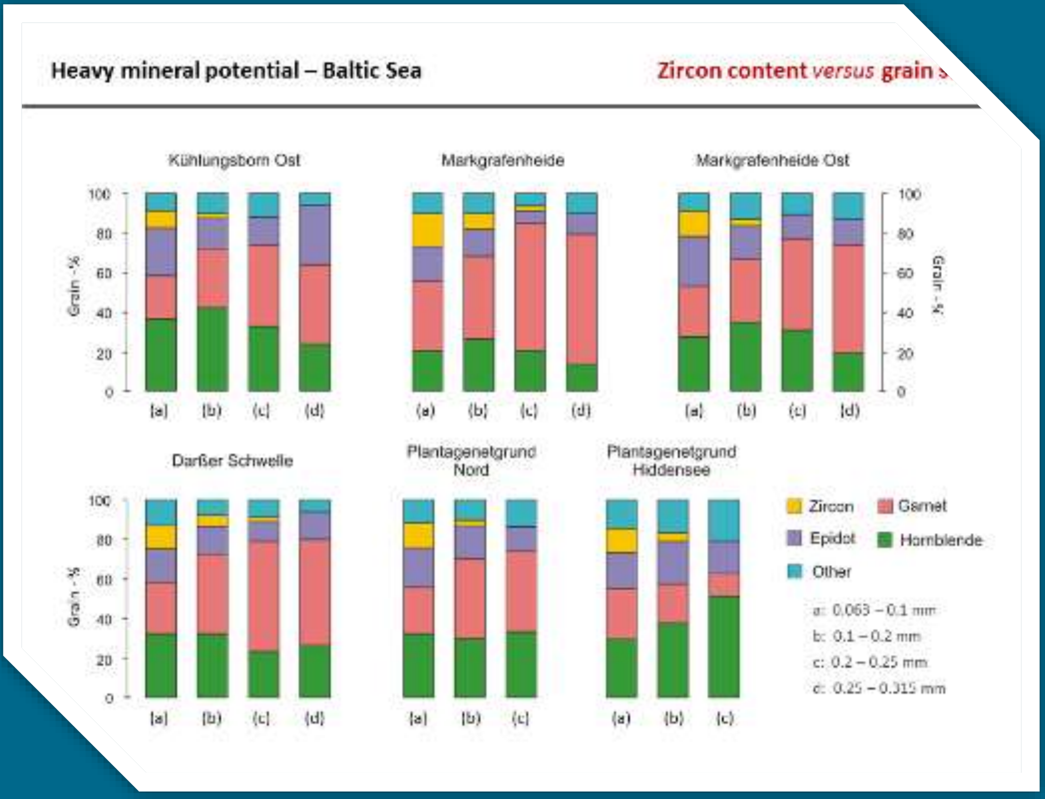


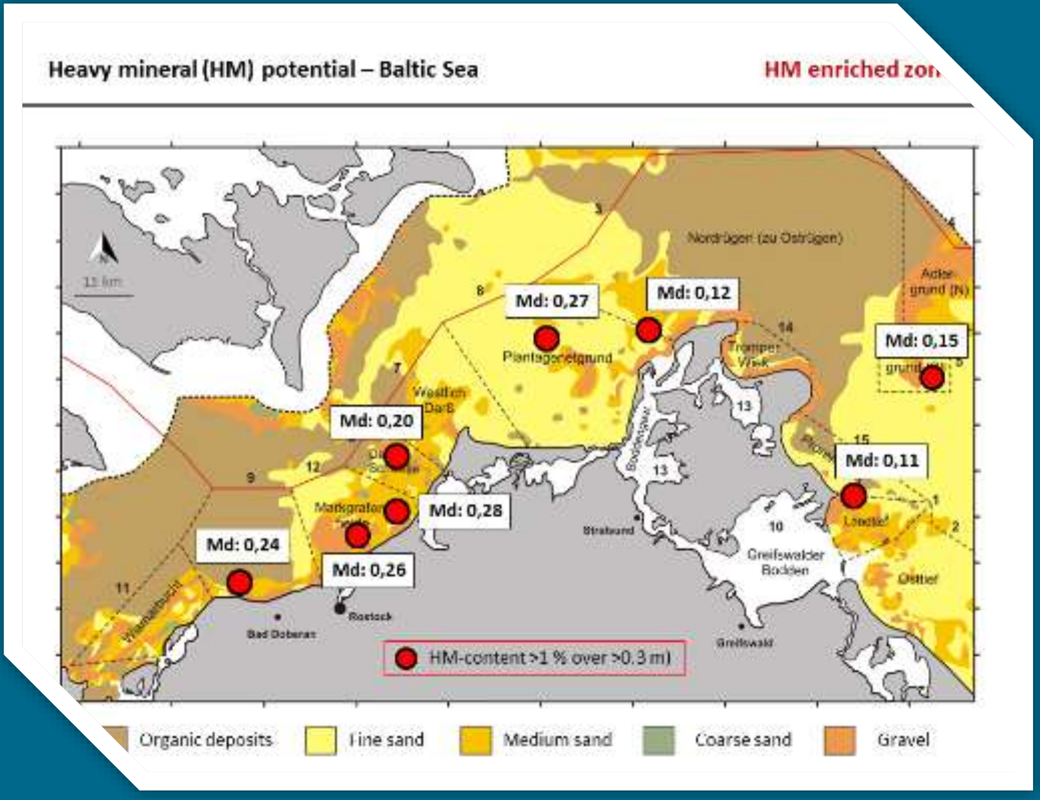
Potential marine heavy mineral resources
5251 drill cores (1971 – 20
15 km
Stralsund
Rostock
Bad Doberan
Greifswald
Organic deposits
Fine sand
Medium sand
Coarse sand
Gravel

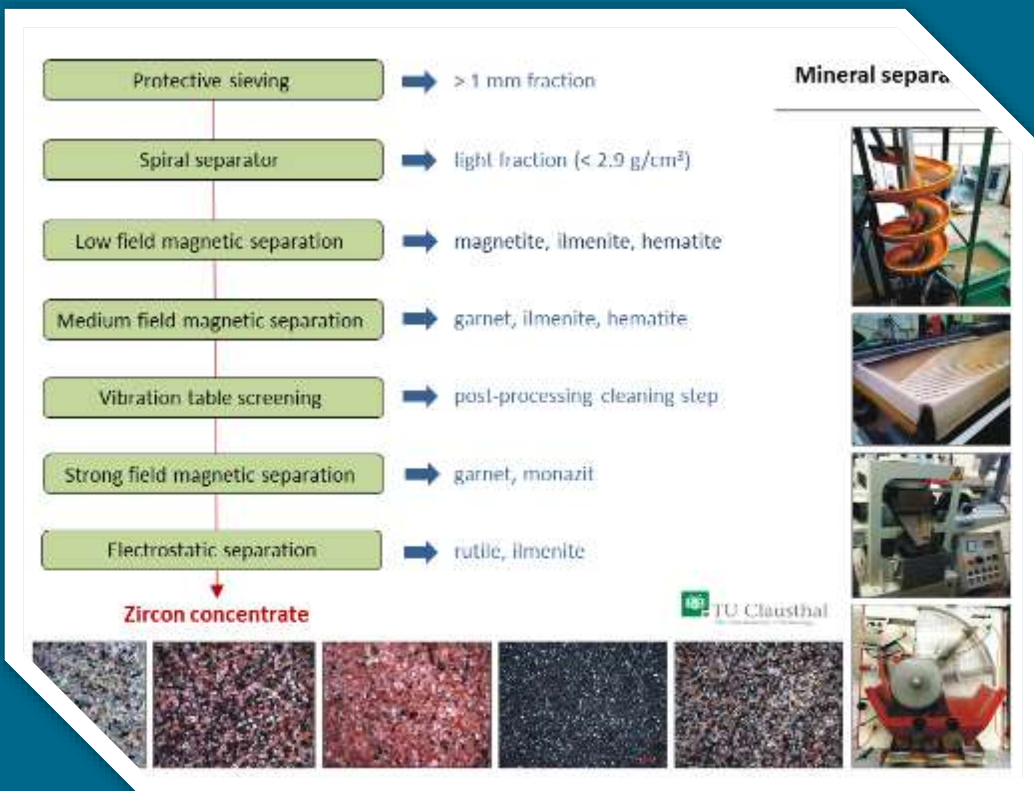
BALTIC CLEAN TECHNOLOGY 2017
Forum UXO - Presentations



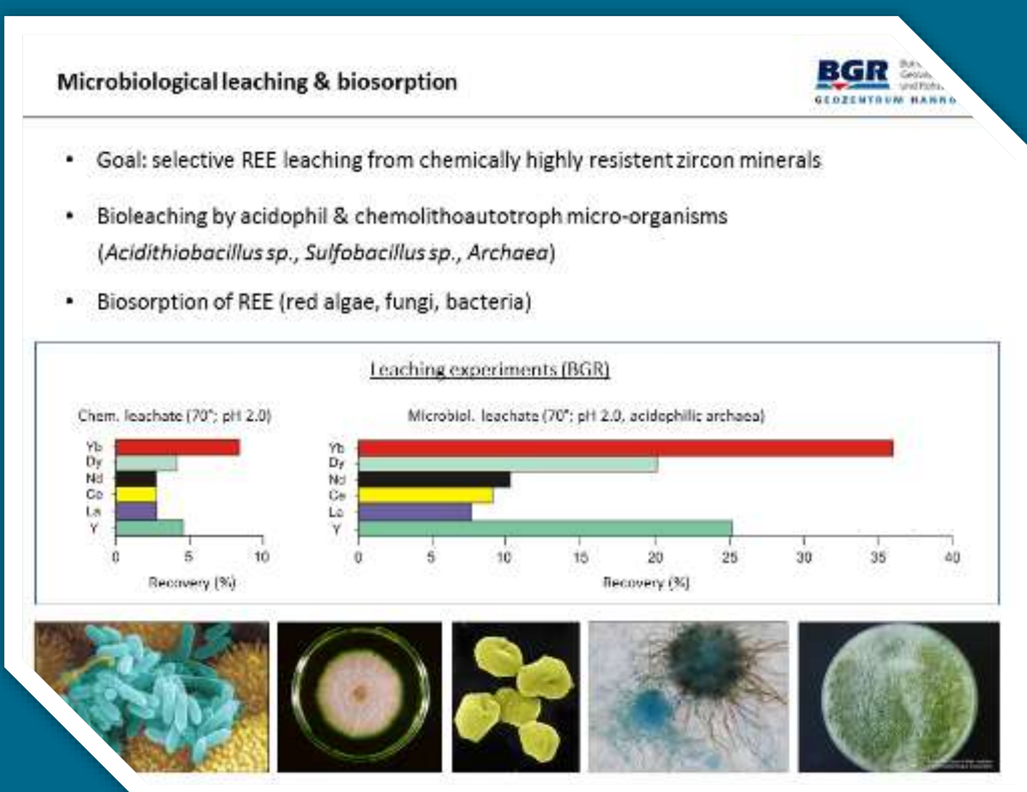



Heavy mineral potential – Baltic Sea
Zircon content versus grain s
Kühlungsborn Ost
Markgrafenheide
Markgrafenheide Ost
Darßer Schwelle
Plantagenetgrund Nord
Plantagenetgrund Hiddensee
Grain - %
Zircon
Garnet
Epidot
Hornblende
Other
a: 0.063 – 0.1 mm
b: 0.1 – 0.2 mm
c: 0.2 – 0.25 mm
d: 0.25 – 0.315 mm

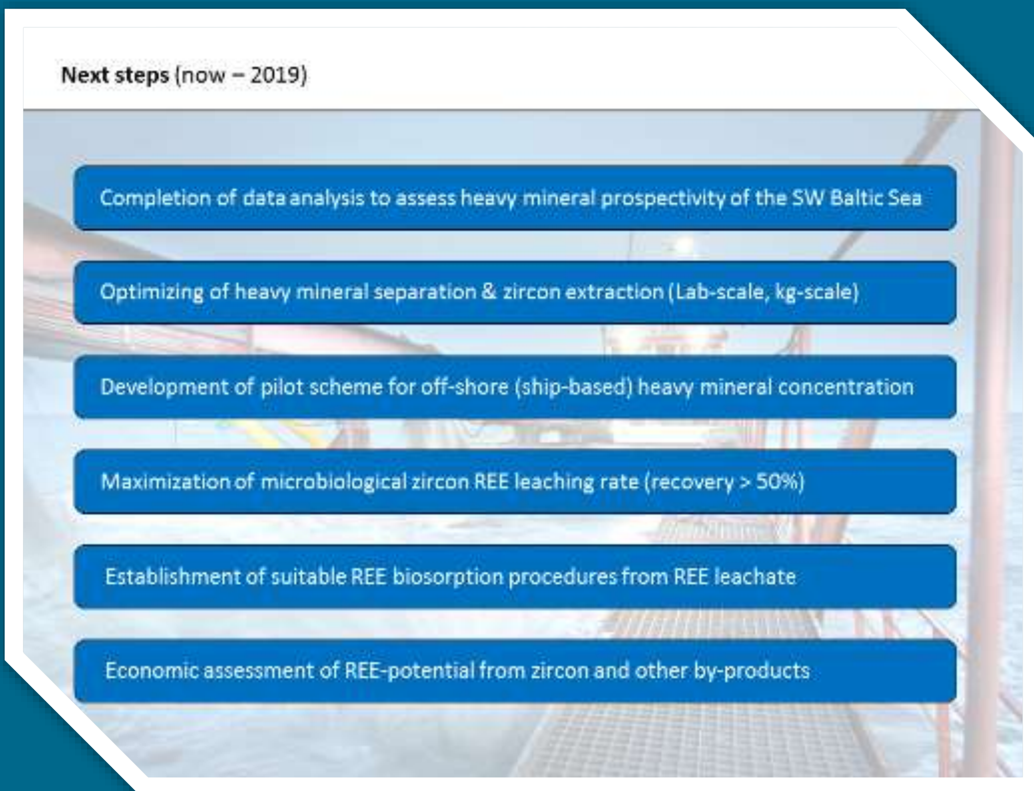

Heavy mineral (HM) potential – Baltic Sea
HM enriched zon
Nordrügen (zu Ostrügen)
Md: 0,27
Md: 0,12
Md: 0,15
Md: 0,20
Md: 0,11
Md: 0,28
Md: 0,24
Md: 0,26
Plantagenetgrund
Stralsund
Greifswalder Bodden
Rostock
Bad Doberan
Greifswald
HM-content >1 % over >0.3 m)
Organic deposits
Fine sand
Medium sand
Coarse sand
Gravel



Mineral separa
Protective sieving
> 1 mm fraction
Spiral separator
light fraction (< 2.9 g/cm³)
Low field magnetic separation
magnetite, ilmenite, hematite
Medium field magnetic separation
garnet, ilmenite, hematite
Vibration table screening
post-processing cleaning step
Strong field magnetic separation
garnet, monazit
Electrostatic separation
rutile, ilmenite
Zircon concentrate
TU Clausthal



Microbiological leaching & biosorption
BGR
• Goal: selective REE leaching from chemically highly resistent zircon minerals
• Bioleaching by acidophil & chemolithoautotroph micro-organisms (Acidithiobacillus sp., Sulfobacillus sp., Archaea)
• Biosorption of REE (red algae, fungi, bacteria)
Leaching experiments (BGR)
Chem. leachate (70°; pH 2.0)
Microbiol. leachate (70°; pH 2.0, acidophilic archaea)
Yb
Dy
Nd
Ce
La
Y
Recovery (%)


Next steps (now – 2019)
Completion of data analysis to assess heavy mineral prospectivity of the SW Baltic Sea
Optimizing of heavy mineral separation & zircon extraction (Lab-scale, kg-scale)
Development of pilot scheme for off-shore (ship-based) heavy mineral concentration
Maximization of microbiological zircon REE leaching rate (recovery > 50%)
Establishment of suitable REE biosorption procedures from REE leachate
Economic assessment of REE-potential from zircon and other by-products