



Follow-up after 1 Dec meeting at CERN – state of play

**Electron beam treatment of marine diesel exhaust gases -
Consortium meeting**

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Genova, 1 March 2018

What we will be doing today?

The main **objective** of the meeting is to create strong Consortium **to bring electron accelerator on board of the ship.**

To achieve this objective, the following tasks are set:

- to involve all stakeholders
- to update partners on the current situation
- to agree on intellectual property (IP)
- to agree on financial aspects
- to agree on tasks and technical aspects
- to agree on the role of each partner
- to prepare good quality PoC proposal for the ARIES project

Current situation

Researchers have promising technology

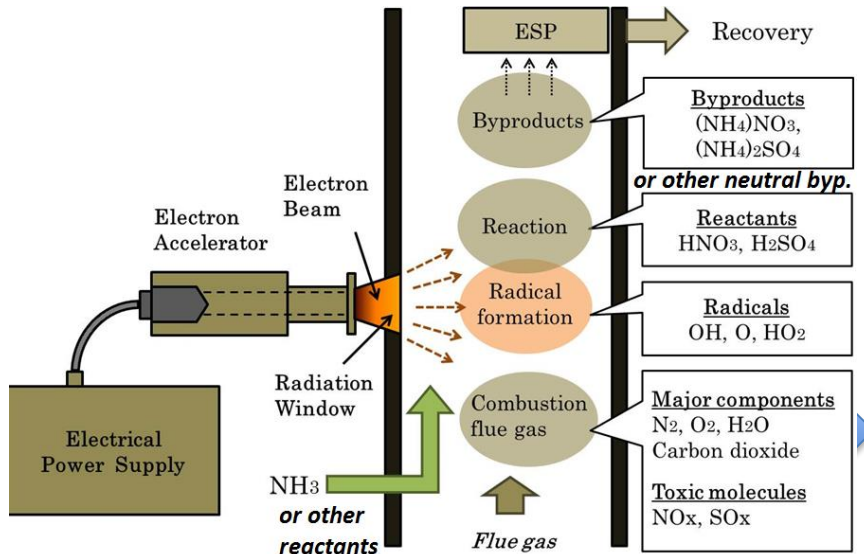
There is demand for better technical solution

The Sulphur Day is on 1 January 2020

MARPOL Annex VI - the global sulphur cap will be reduced from current 3.50% to 0.50%

Economically viable solution is still not there

There is no working technology which can effectively deal with SO_x and NO_x at the same time



1 Dec meeting at CERN

It was agreed that:

1. Accelerator application to the ship exhaust gases treatment is definitely good idea and we need to create tangible Consortium to move forwards with this idea
2. To proof this concept the next step will be development of the on-shore prototype, which will be installed on the marine diesel engine and will proof the technical and financial feasibility of this technology to all involved parties
3. In parallel we should start the technical analysis and technological developments for the full-scale on-board prototype



1 Dec meeting at CERN

It was agreed that:

4. We shall fully engage:
 - Leading Class Societies
 - accelerator manufacturers
 - scrubber manufacturers
 - engine manufacturers
5. We shall keep informed and liaise with:
 - European Commission
 - EMSA
 - IMO
 - IACS
6. We should look for appropriate funding for the above mentioned

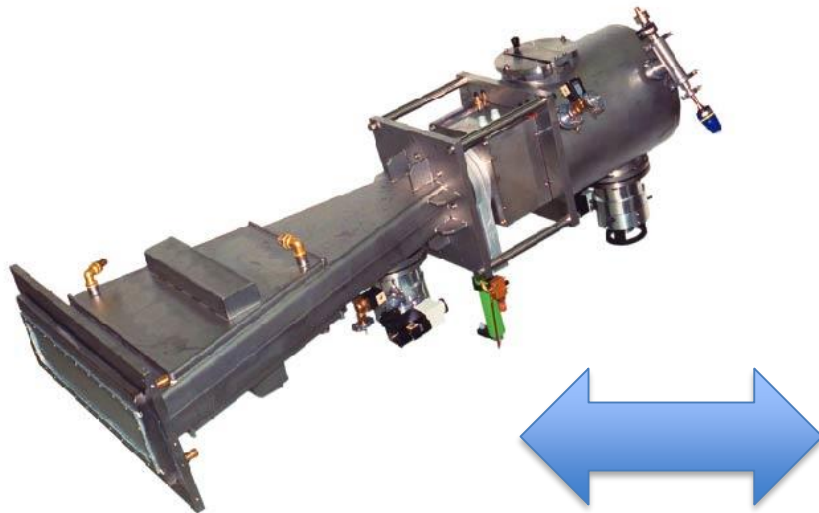
Objective

1. To proof that this technology can be applied to the marine diesel engine and provides for necessary results
2. To show technology in action – it works and it delivers
3. To create multi-disciplinary community

Two distinct and well developed communities

Accelerator community

Ships don't speak Accelerator



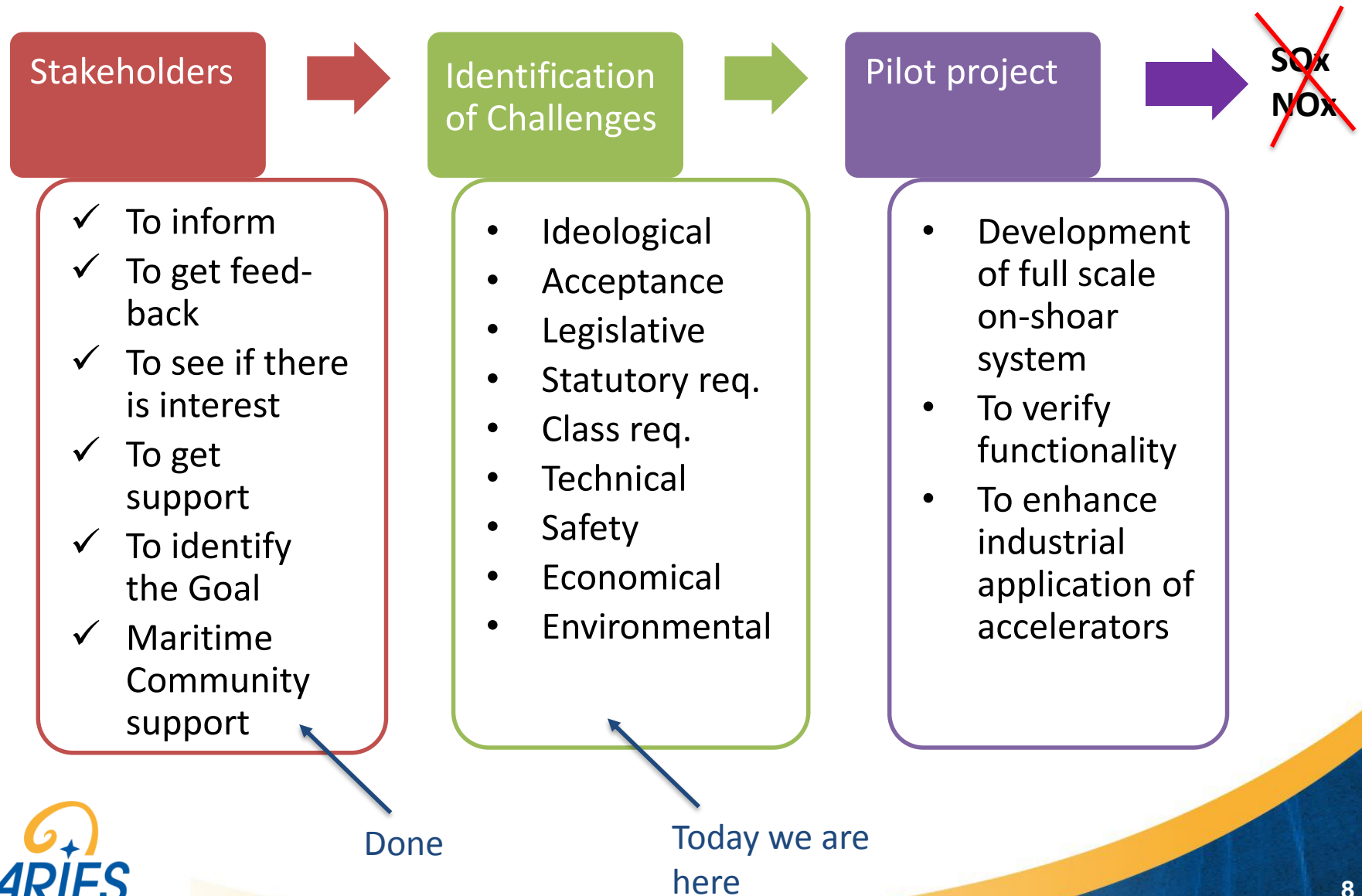
www.crosslinking.com/prod01.htm

Shipping community

Accelerators don't speak Ships



How to proceed?



Who are the main players?

Stakeholders

- Ship owners
- Ship management companies
- Flag States
- Class Societies/IACS
- IMO
- European Commission
- EMSA
- US CG
- Engine manufacturers
- Scrubber manufacturers
- Shipyards and ship repair companies



- Accelerator designers, like
- Research institutes
- Universities
- Big labs
- Accelerator producers
- Controlling and monitoring devices producers
- Funding agencies

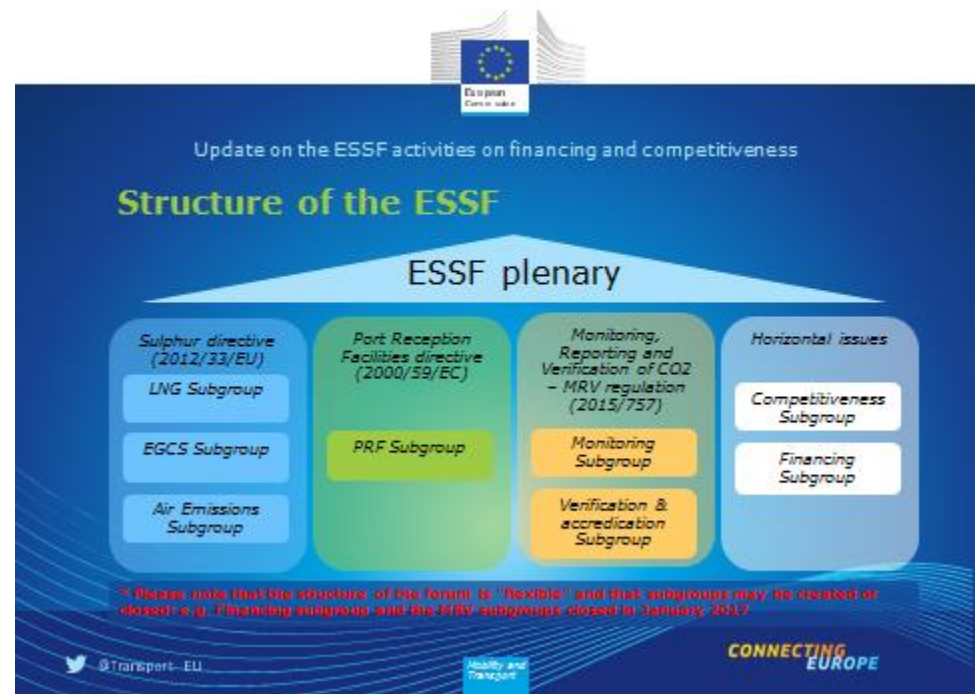
- NGO's and environmentalists

Who are the main players?

Stakeholders

- Ship owners
- Associations and NGO's
- Flag States
- Class Societies/IACS
- European Commission
- Engine manufacturers
- Scrubber manufacturers
- Shipyards and ship repair companies

European Sustainable Shipping Forum has dedicated Sub-group dealing with Exhaust Gas Cleaning Systems - EGCS



IMO - Marine Environment Protection Committee (MEPC) and its subgroups

To be aware of

Challenges

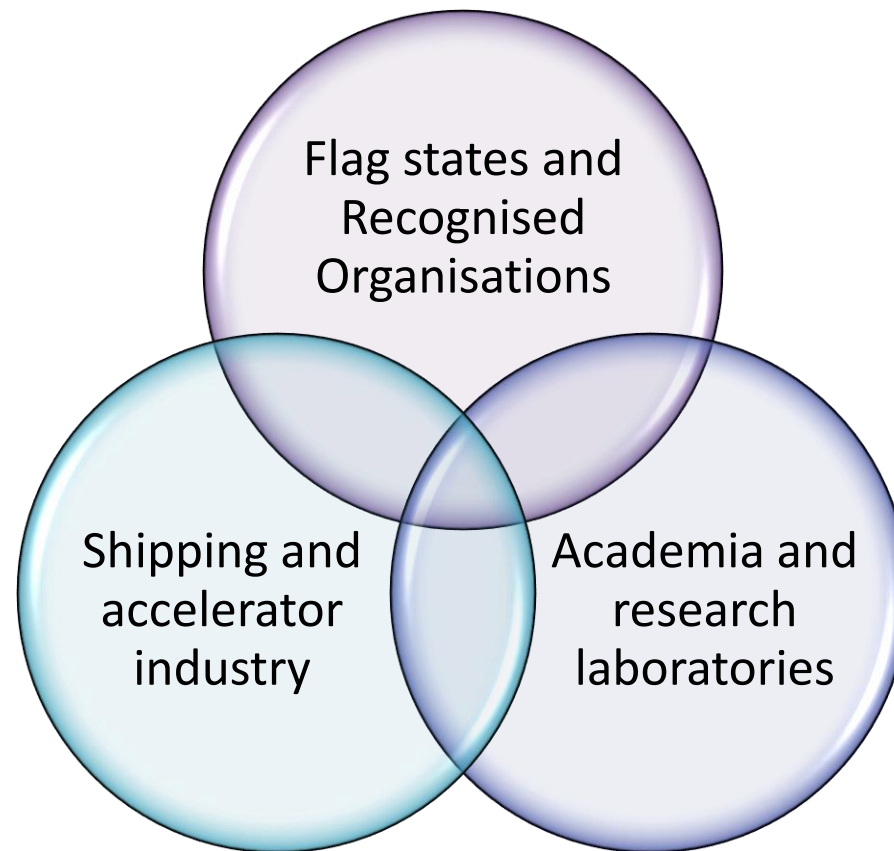
- **Ideological**
 - **Acceptance**
 - Legislative
 - Statutory req.
 - Class req.
 - Technical
 - **Safety**
 - Economical
- IMO - acceptance
 - European Commission – marine equipment certification
 - Flag States – set the rules
 - Class Societies – RO's
 - Engine manufacturers – particular requirements for each engine type
 - Accelerators manufacturers – to build
 - Shipyards and ship repair companies – somebody has to install all this

Ship is very specific environment:
safety first!

It is not «clean room», it is engine room



Multidisciplinary and multi-industry project



Idea is to have at least two representatives from each competence/segment

To be aware of

Challenges

- Ideological
- Acceptance
- **Legislative**
- **Statutory req.**
- **Class req.**
- Technical
- Safety
- Economical

- Flag States
- RO's - Class Societies
- IMO
- European Commission
- EMSA
- US CG
- Engine manufacturers

There are many rules to comply with and there many rule makers – so, to succeed, we have to involve rule makers in the prototype development process

In the same time we need to comply with physics rules - these are not so easy to change

MEPC 68/21/Add.1
Annex 1, page 1

ANNEX 1

RESOLUTION MEPC.259(68)
(adopted on 15 May 2015)

2015 GUIDELINES FOR EXHAUST GAS CLEANING SYSTEMS

Regulation 14 of MARPOL Annex VI

RELEVANT LEGISLATION

Regulation 2015/757
Directive (EU) 2016/802
Directive 2012/33/EU
Directive 2005/33/EC
Directive 1999/32/EC

To be aware of

Challenges

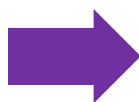
- Ideological
- Acceptance
- Legislative
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- **Technical**
- **Safety**
- **Economical**

- System is not directly related with ship seaworthiness?
- What is impact to normal ship operations?
- **Should be cheaper** than to run on marine gasoline or other dual / hybrid systems

- High energy consumption
- Electrical installations and power balance
- Exhaust back-pressure?
- Integration with on-board systems
- Reliability
- Control and monitoring
- Vibration
- Maintenance and service
- Crew training
- Radiation control and shielding
- Redundancy
- Efficiency
- Functionality
- Flexibility
- Waste and by-products

Further steps

Pilot project



~~SOx
NOx~~

How to turn these challenges to opportunities?

- Development of full scale on-board system
- To verify functionality
- To enhance industrial application of accelerators

- To establish Collaboration among interested parties
- To test on real engine in workshop, before going on-board
- Test requirements shall be set by the Flag and controlled by Class
- To obtain and put together funding
- Marine testing Reg 3.2 of Annex VI – permit for trials + similar instrument under EU Directive
- IMO Guidelines for scrubbers

To evaluate

- Economical feasibility
- Electrical load analysis
- Interface and interference with other ship systems with other
- SOx & NOx v.s. trading areas / fuel strategy
- SOx – more for retrofit?
- New buildings?

Where are we today?

Partners who **confirmed** their willingness to participate in the project (to be in the Consortium):

1. Institute of Nuclear Chemistry and Technology (Warsaw, Poland)
2. CERN (Geneva, Switzerland)
3. Riga Technical University (Riga, Latvia)
4. Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP (Dresden, Germany)
5. Remontowa Marine Design (Gdansk, Poland)
6. Riga Ship Yard (Riga, Latvia)
7. Accelerator Science Group, Particle Physics Department, STFC Rutherford Appleton Laboratory (UK)

Where are we today?

Stakeholders who **expressed** potential interest in the project:

1. European Commission – DG MOVE
2. Italian Coast Guard
3. Mediterranean Shipping Company – MSC
4. Grimaldi Group
5. American Bureau of Shipping (ABS)
6. DNV GL
7. ebeam Technologies

+ other contacts

Looking forward to the truly beneficial collaboration and fruitful day:

- to involve all stakeholders
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