Saturn
Developing Solutions for Underwater Radiated Noise

SATURN has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006443.

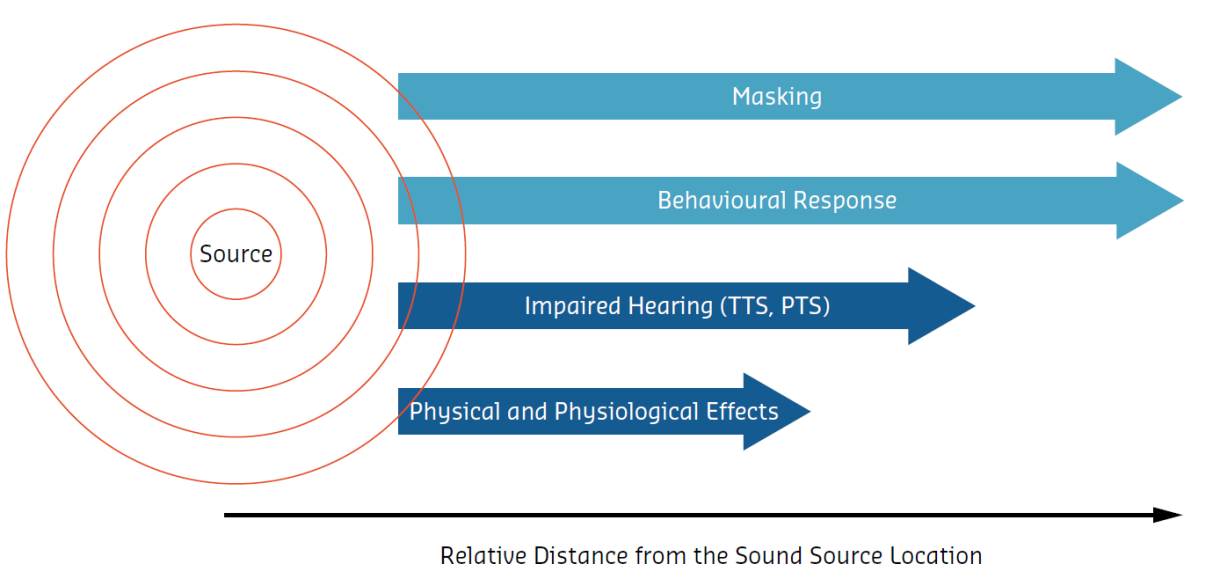
Technical solutions to mitigate ship noise in the EU SATURN project

Johan Bosschers (j.bosschers@marin.nl)
[SATURN WP4 research lead]

MARIN

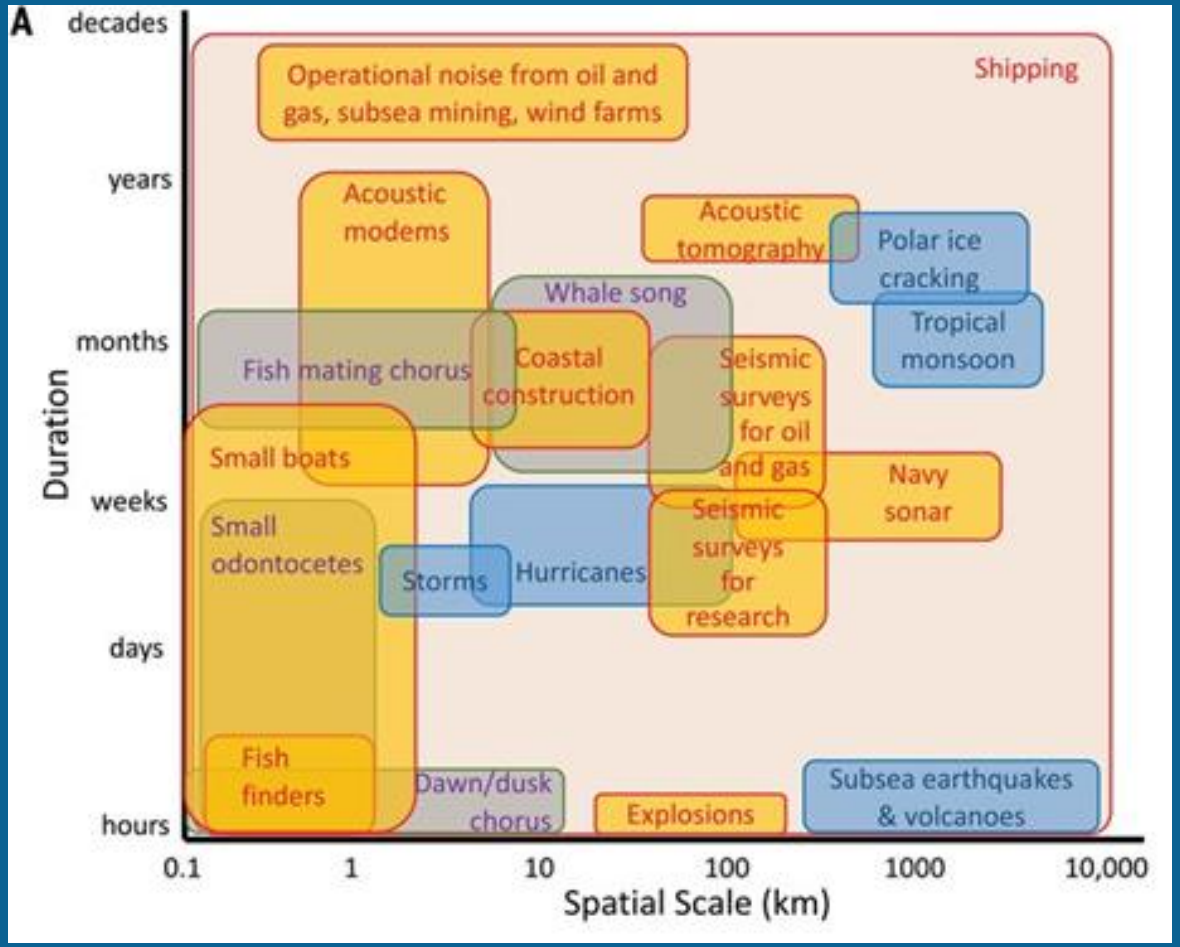
Transport Canada Underwater Noise Webinar, January 12, 2022

Effects of sound on marine life



European Marine Board (2021)

Natural and Anthropogenic sound



Duarte et al (2021)

Saturn
Developing Solutions for Underwater Radiated Noise

SATURN has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006443.

EU policy

- EU Maritime Strategic Framework Directive 2008/56 (MSFD), defines Good Environmental Status for marine waters. Descriptor 11: Underwater noise is at levels that do not adversely affect the marine environment

- Decision 2017/848 (2017): Noise levels should be monitored using measurements combined with modelling
  - Led to various noise measurement programs: JOMOPANS, JONAS, …

- EU Action Plan Towards Zero Pollution (2021): Review MSFD by 2023, work on EU threshold values for maximum levels of underwater noise stemming from maritime transport, construction, dredging, …

- But defining threshold values asks for quite some research questions to be answered

Saturn
Developing Solutions for Underwater Radiated Noise

SATURN has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006443.

SATURN Consortium

Research and Innovation Action under WATERBORNE Technology Platform (TP)

Call (part) identifier: H2020-MG-2020-SingleStage-INEA

Topic: MG-BG-03-2020 Under water noise mitigation and environmental impact

Start date: 1st February 2021

Duration: 48 months

Coordinator: UCC, MaREI

Partners: 20 (19 + 1 linked).

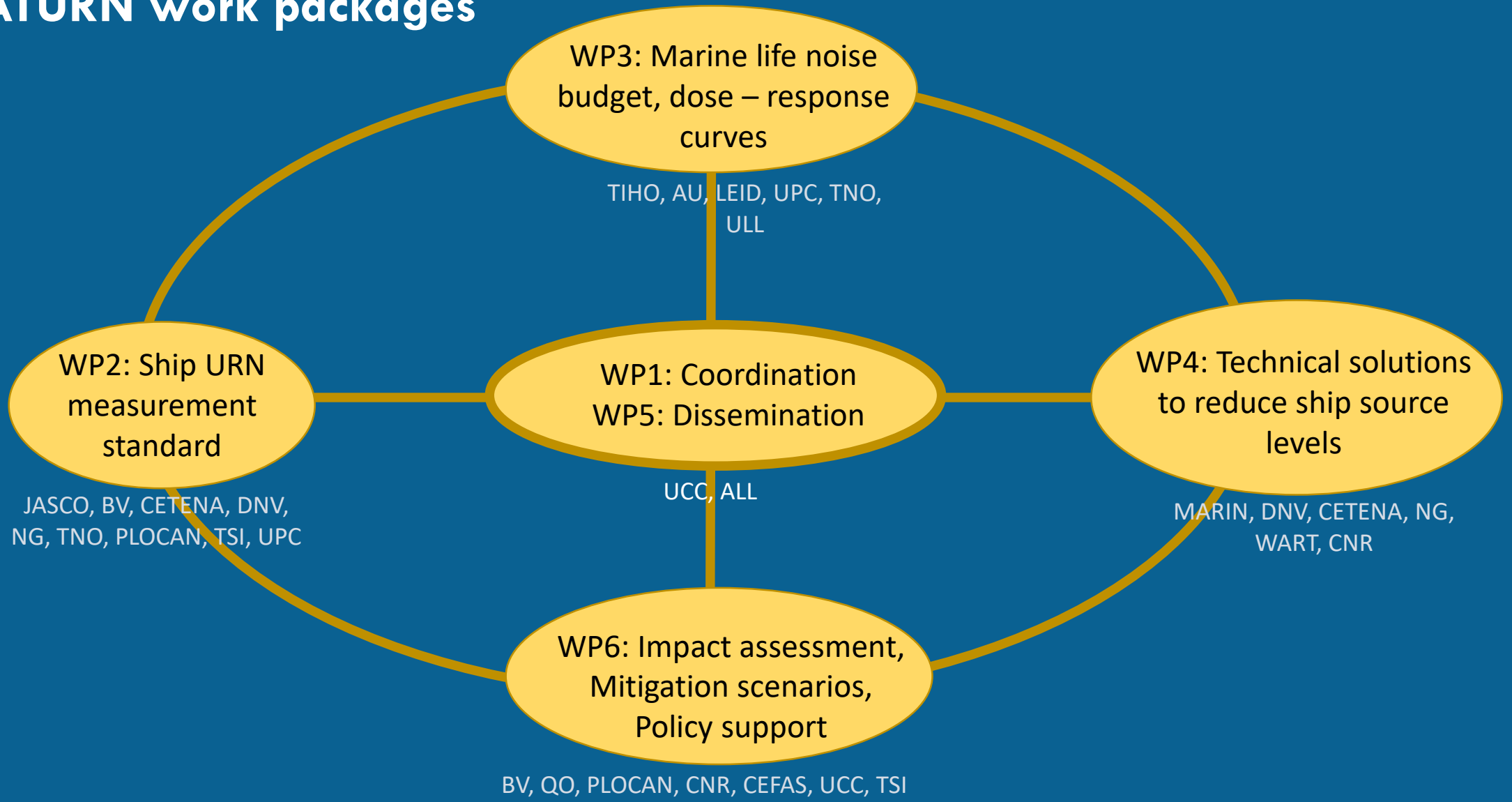
Countries: 9

Max EU contribution: €8.96 ME

Saturn Developing Solutions for Underwater Radiated Noise

SATURN has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006443.

SATURN work packages



Saturn
Developing Solutions for Underwater Radiated Noise

SATURN has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006443.

Challenges for the shipping industry

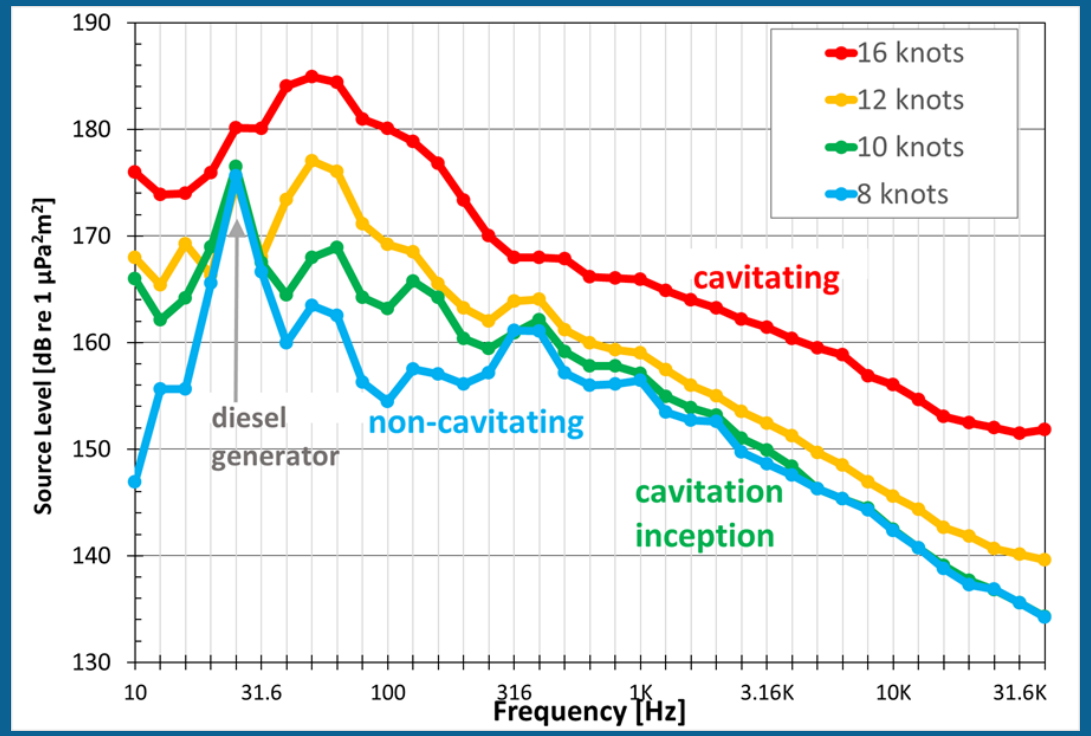
- IMO targets 50% reduction in Green House Gase emissions by 2050 compared to 2008
- Introduction of
  - Energy Efficiency Design Index (EEDI)
  - Ship energy Efficiency Management Plan (SEEMP)
  - Energy Efficiency Existing Ship index (EEXI)
  - Carbon Intensity Indicator (CII)

- Can we optimize ships for reduced GHG-emissions and URN ?

Saturn
Developing Solutions for Underwater Radiated Noise

SATURN has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006443.

Ship source levels



Arveson & Vendittis (2000) 173 m cargo vessel

Propeller cavitation

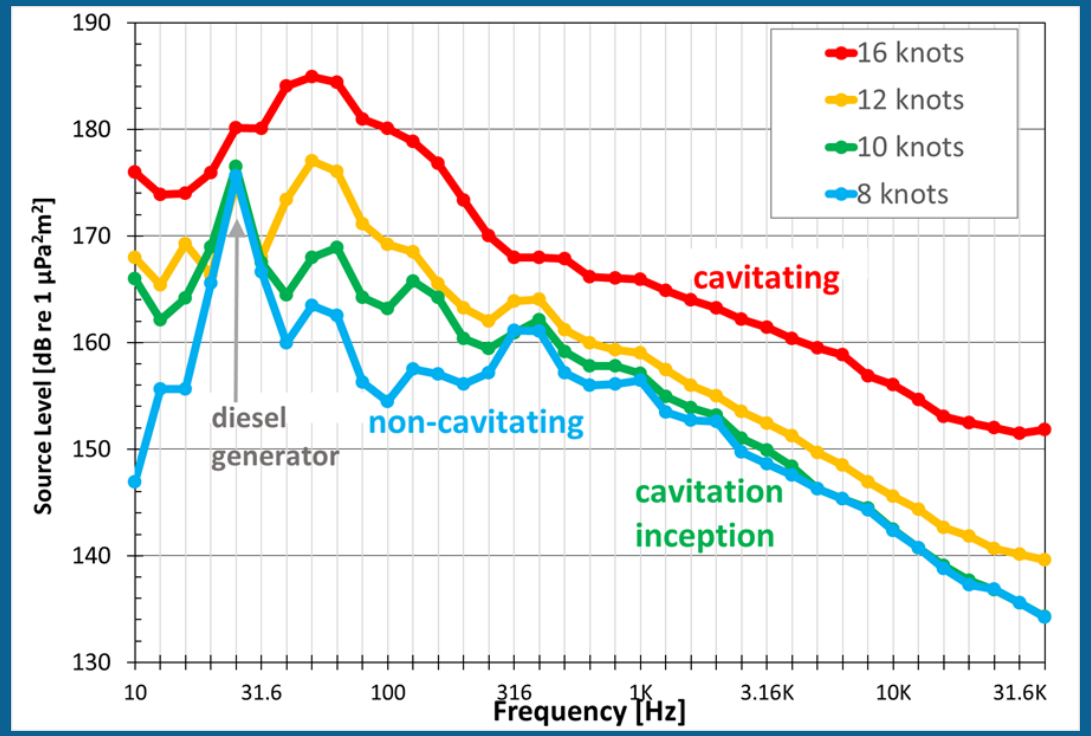
Sound sources:

- Propeller cavitation
- Main propulsor engine
- Auxiliary machinery

Saturn
Developing Solutions for Underwater Radiated Noise

SATURN has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006443.

Ship source levels

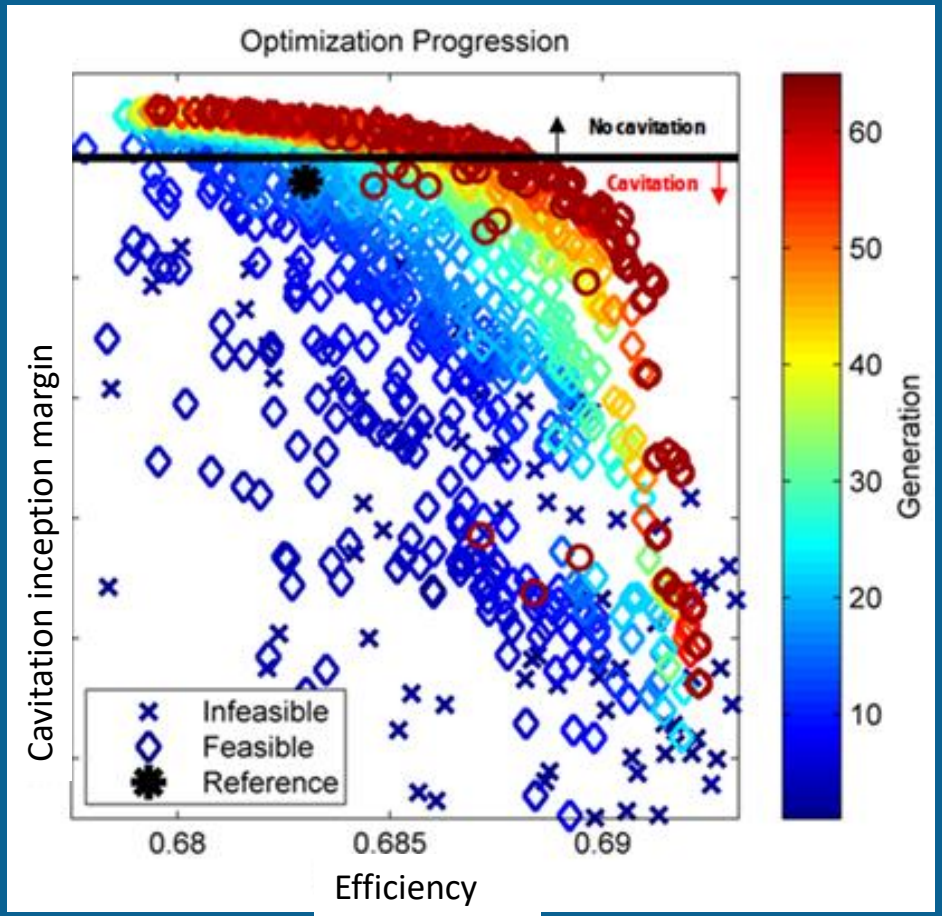


Arveson & Vendittis (2000) 173 m cargo vessel

Sound sources:

- Propeller cavitation
- Main propulsor engine
- Auxiliary machinery

Propeller design trade-off



Propeller optimization for efficiency and cavitation inception speed [MARIN]

Saturn
Developing Solutions for Underwater Radiated Noise

SATURN has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006443.

Possible GHG-URN win-win situations

- Electric propulsion systems
- Wind propulsion
- Air bubbles / layers / chambers

- Speed reduction
- Alternative propulsors
- ….

ry ‘Basto Electric’

ship ‘Shin Aitoku Maru’

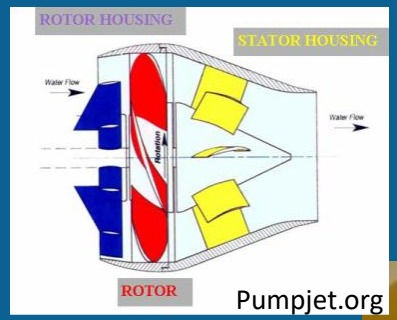

Various ship types (Silverstream)

Saturn
Developing Solutions for Underwater Radiated Noise

SATURN has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006443.

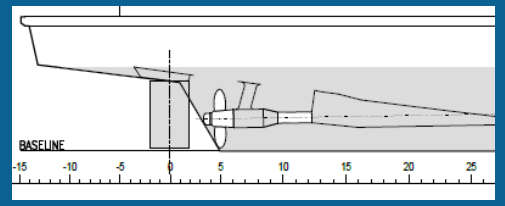
SATURN WP4 – Technical solutions

- T4.3: Pumpjet [CNR &CETENA]



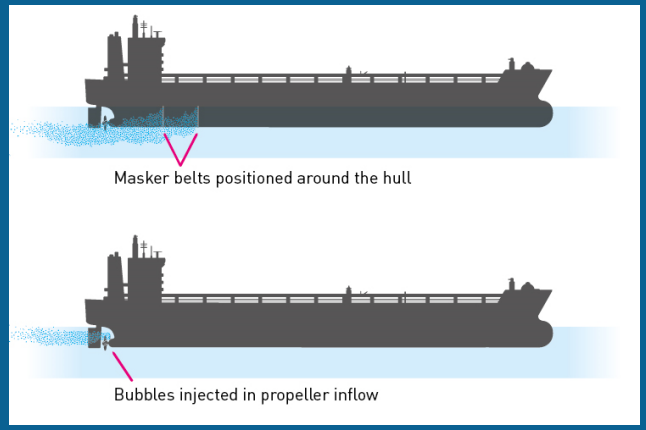
Pumpjet.org

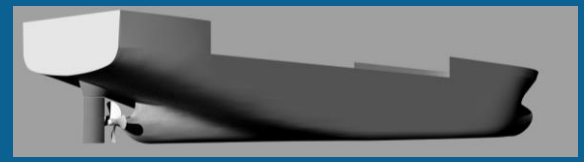
- T4.5: Trochoidal propulsor [NAVAL GROUP]



Twin-screw ferry, Loa= 168 m

- T4.4: Injection of air bubbles [MARIN]
  - Includes propeller design study with Wärtsilä NL



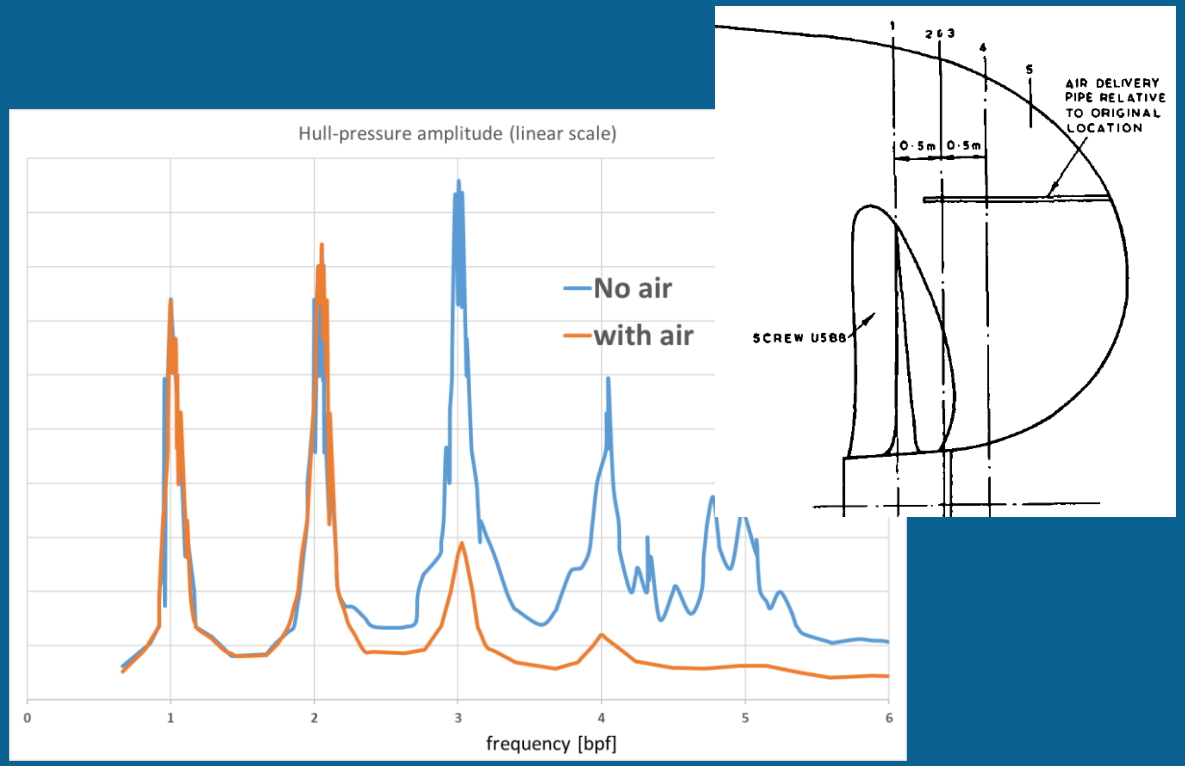

'Streamline' chemical tanker, Lpp= 94 m

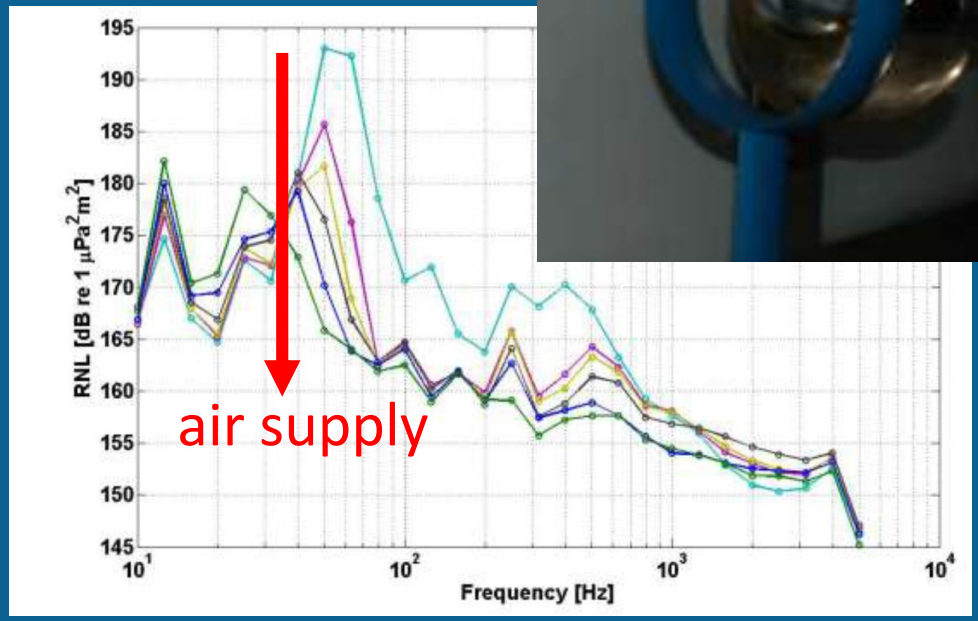
Saturn
Developing Solutions for Underwater Radiated Noise

SATURN has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006443.

Cavitation sound mitigation using air bubbles

- **Injecting air bubbles in propeller cavitation**





Hadler, English & Gupta (1984)

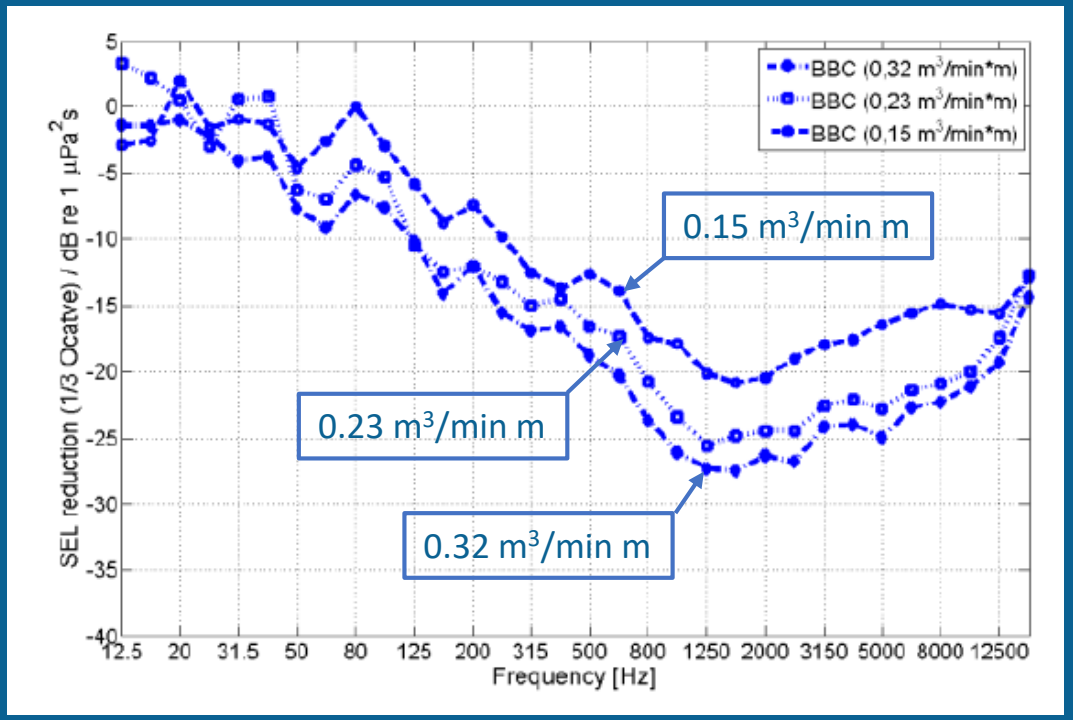
EU FP7 SONIC D3.3 (2015) Rolls-Royce measurements

Saturn
Developing Solutions for Underwater Radiated Noise

SATURN has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006443.

Sound isolation using air bubbles

- **Bubble screens are used to mitigate pile driving noise**

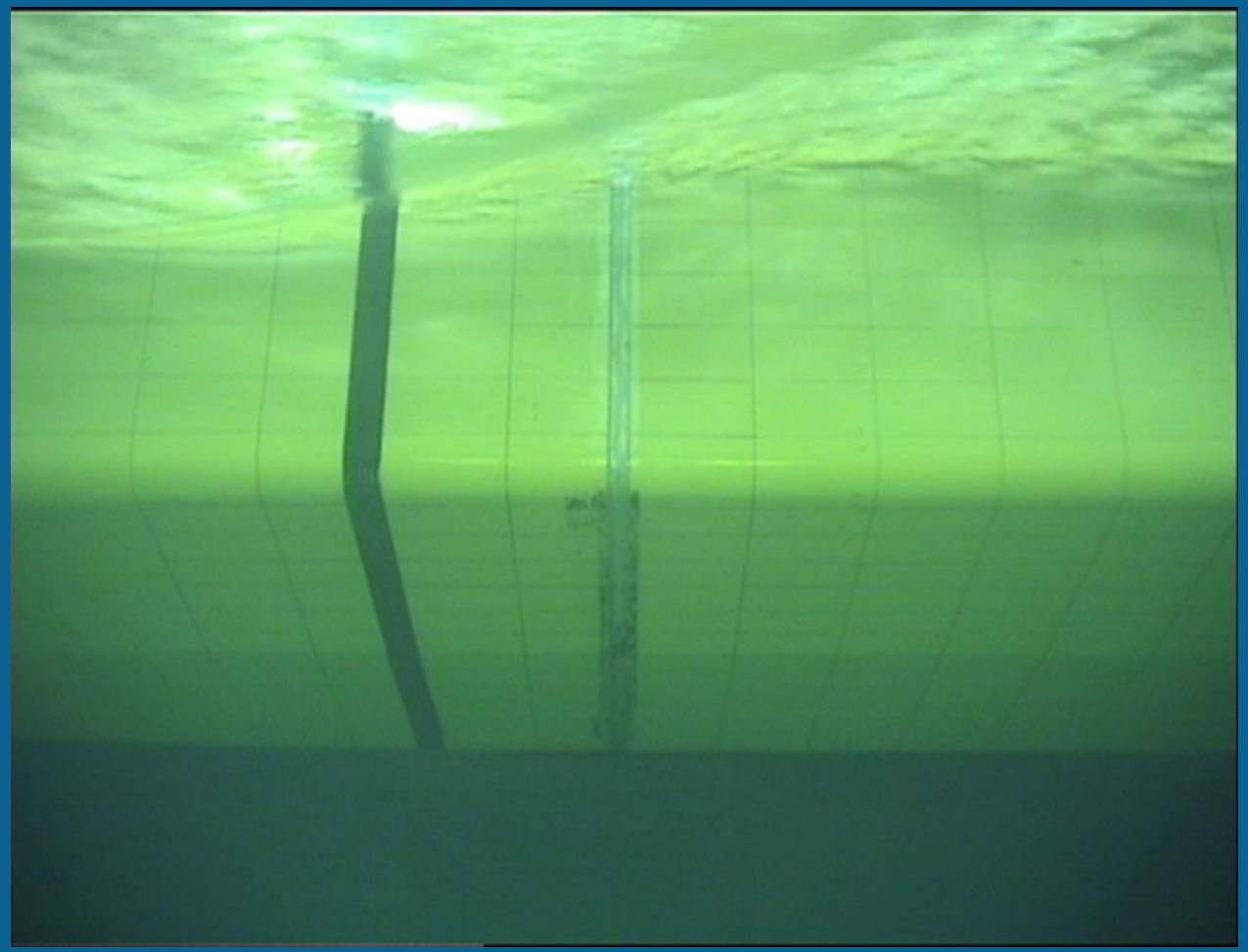


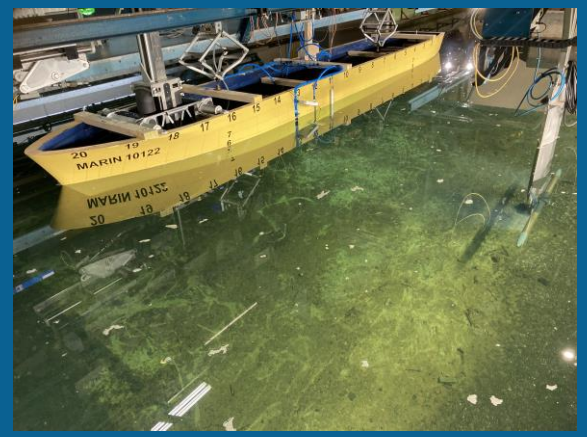
Insertion loss by bubble screen, Bellman (2014)

Saturn
Developing Solutions for Underwater Radiated Noise

SATURN has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006443.

T4.4 First tests on bubble injection below ship hull





Effect on propeller performance:

- Thrust reduction by 4%
- Efficiency reduction by 1%

Saturn
Developing Solutions for Underwater Radiated Noise

SATURN has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006443.

WP4 – Task descriptions

- Improvement of Knowledge, Design tools, and Design evaluation tools
  - T4.1: Extend knowledge of mechanisms [CNR, CETENA]
  - T4.2: Improve numerical and experimental prediction tools [CNR, CETENA, MARIN, NG]
- Design and evaluate technical solutions (scale models)
  - T4.3: Pumpjet [CNR, CETENA]
  - T4.4: Propeller design and air bubbles [MARIN, Wärtsilä NL]
  - T4.5: Trochoidal propulsor [NAVAL GROUP]
- Analyse costs and benefits of technical solutions and review other solutions

  (use dose-response from WP3, provide input for WP6)
  - T4.6: Costs and benefits of new technical solutions (in T4.3, T4.4 and T4.5) [CETENA, DNV]
  - T4.7: Establish source level assessment matrix of different propulsors and solutions [CNR, CETENA, DNV, MARIN, NG]

Saturn
Developing Solutions for Underwater Radiated Noise

SATURN has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006443.

WP4 – Timeline

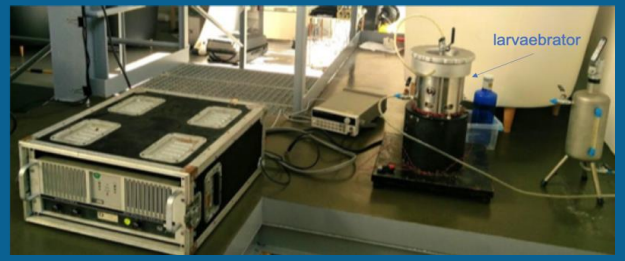
Task	Description	Participant	Y1: feb 2021- jan 2022	Y2: feb 2022- jan 2023	Y3: feb 2023- jan 2024	Y4: feb 2024- jan 2025
4.1	Mechanisms of URN	CNR+ CETENA		D4.1		
4.2	Improve computational and experimental tools	Naval Group				D4.5
4.3	SL reduction twin screw vessel (pumpjet)	CNR + CETENA			D4.2	
4.4	SL reduction single-screw vessel (air bubbles)	MARIN + Wartsila			D4.3	
4.5	SL reduction non-conventional propulsor	Naval Group			D4.4	
4.6	Cost-benefit analysis of solutions	CETENA + DNV-GL				D4.6
4.7	SL assessment matrix	CETENA + ALL				D4.7

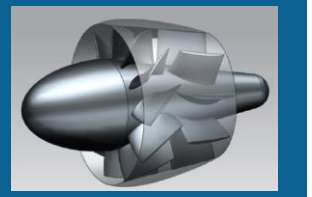
Saturn
Developing Solutions for Underwater Radiated Noise

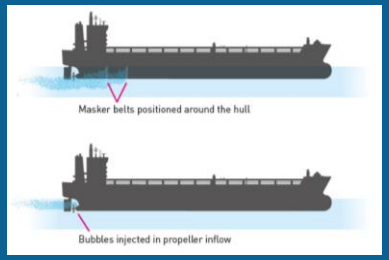
SATURN has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006443.

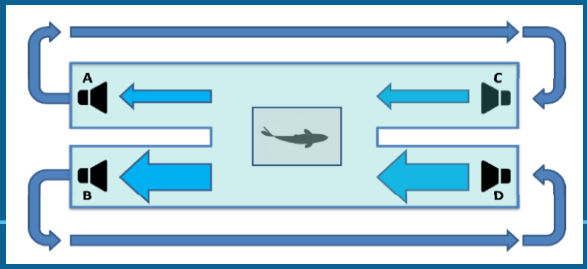
Innovative solutions being developed

WP	SATURN Project Output	TRL 1	TRL 2	TRL 3	TRL 4	TRL 5	TRL 6	TRL 7	TRL 8	TRL 9
2	Harmonised test signal package									
2	Shallow water source level measurement technique									
2	On board source level measurement system									
2	Particle motion modelling & mapping methodology									
3	Larvaebrator									
3	Dosimeter analysis tool									
3	Migradrome									
3	Novel combination of biomarkers for stress detection									
3	Updated DEPONS model									
4	Trochoidal Propulsor (acoustic and efficiency performance)									
4	Air bubble masker system									
4	Using air bubbles to mitigate cavitation									
4	Pump jet propulsor for noise reduction									
5	App for science communication									
6	Decision support tool – URN in Marine Spatial Planning									
6	Virtual Research Environment for URN									









Saturn
Developing Solutions for Underwater Radiated Noise

SATURN has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006443.

Saturn

Developing Solutions for Underwater Radiated Noise

SATURN has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006443.

Thank you!

www.SaturnH2020.eu

@Saturn_H2020

@SaturnH2020

Linkedin.com/company/SaturnH2020

UCC University College Cork, Ireland Coláiste na hOllscoile Corcaigh
MaREI Energy · Climate · Marine
AARHUS UNIVERSITET
BUREAU VERITAS
Centre for Environment Fisheries & Aquaculture Science
CETENA
DNV
Italian National Research Council
JASCO APPLIED SCIENCES
MARIN
NAVAL GROUP
PLOCAN Plataforma Oceánica de Canarias
Quiet oceans
SIREHNA NAVAL GROUP
TSI
TNO innovation for life
Universidad de La Laguna
Universiteit Leiden The Netherlands
UPC UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH
WÄRTSILÄ