

European Conference of Defence and the Environment

# ECDE 2024

ANE OFSTAD PRESTERUD  
Norwegian Defense Research Establishment



EUROPEAN  
CONFERENCE OF  
**DEFENCE AND THE  
ENVIRONMENT**



**FFI** Norwegian Defence  
Research Establishment

# Sustainability in defence investment projects

Ane Ofstad Presterud







## RESEARCH ON DEFENCE INVESTMENTS

Research program:  
**Investment and logistics  
analysis (INLOG)**



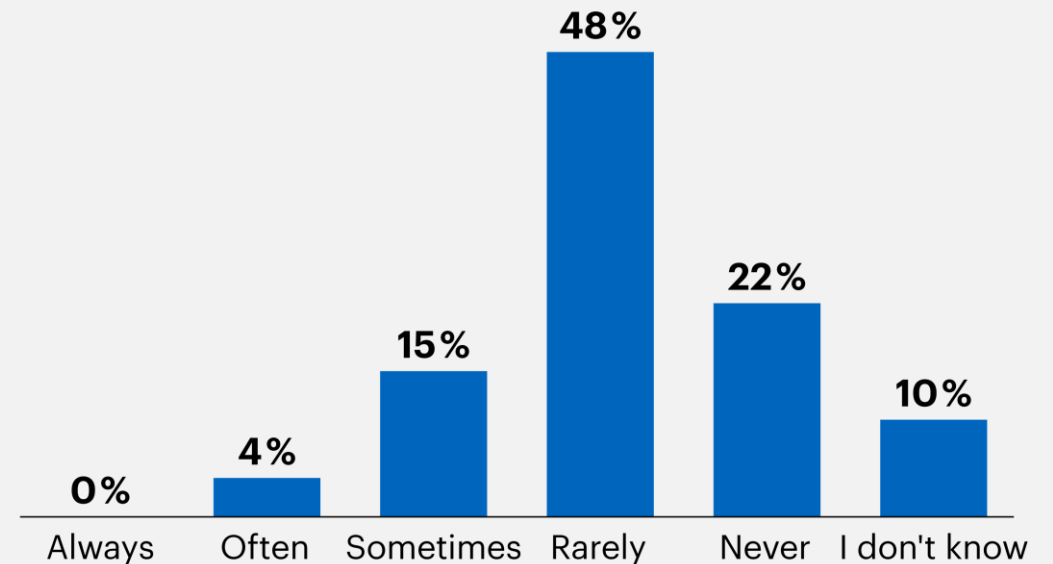


# **Sustainability in defence investment projects**

# Status: sustainability in Norwegian defence investment projects

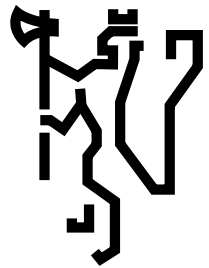
- There is a lack of consensus on what sustainability entails
- The sector is still immature in ensuring sustainability in investment decisions
- Good initiatives exist, but they are sporadic and often bottom-up

**In your experience, how often do considerations of environmental consequences play a role in investment decisions?**

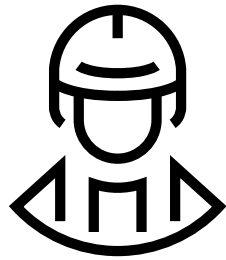




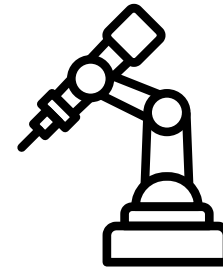
# Actors in the Norwegian defence investment process



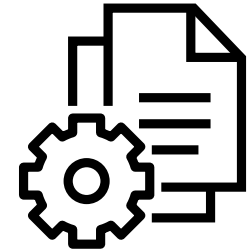
The Norwegian  
Ministry of Defence



The Norwegian  
Armed Forces

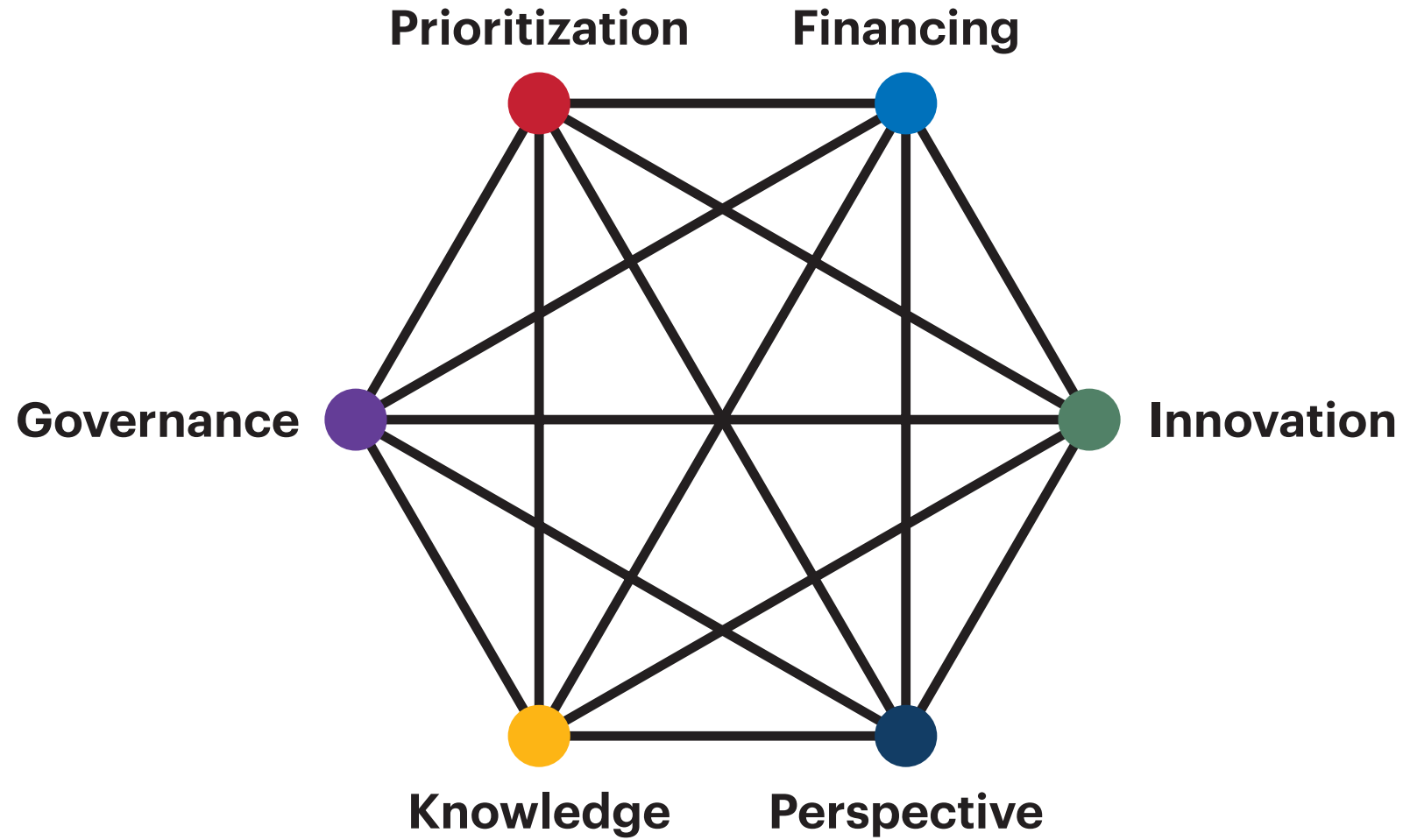


The industry



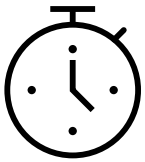
The Norwegian  
Defence Material/  
Estates Agency

# Challenges and enablers





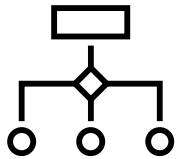
# Selected recommendations



Incorporate sustainability  
into front-end decisions



Supplement stated ambitions  
with clear guidelines



Evaluate sustainability  
objectives at the portfolio level



# Contact us for further information on our research



[ane-ofstad.presterud@ffi.no](mailto:ane-ofstad.presterud@ffi.no)



[ffi.no/forskning/prosjekter/investerings-  
og-logistikkanalyser-inlog](https://ffi.no/forskning/prosjekter/investerings-og-logistikkanalyser-inlog)



European Conference of Defence and the Environment

# ECDE 2024

MATHIEU SCHWANDER  
European Defence Agency



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# EMBEDDING CIRCULARITY IN PROCUREMENT: APPROACH AND TOOLS

## *AN IF CEED PERSPECTIVE*

**Mathieu SCHWANDER**

Project Officer Circular Economy

**Karina GLAPKA**

Policy Officer Industry Engagement

**Carolyn HENDRYS**

Project Officer Circular Economy

# CIRCULAR ECONOMY - “eda.europa.eu/ifceed” -

## Incubation Forum for Circular Economy in European Defence (IF CEED)



### AIM

**Implement circularity principles in European Defence by:**

- ▶ incubating collaborative project ideas;
- ▶ enabling transnational innovative solutions and revised business models.

*Contribute to:*

- ✓ EU Climate Change and Defence Roadmap
- ✓ Joint Communication on the climate and security nexus
- ✓ EU Green Deal



### WHOM FOR?

- ▶ Ministries of Defence
- ▶ Any pertinent EU / national / international public body/organisation
- ▶ Academia
- ▶ Industry
- ▶ Research-and-Technology-Organisations
- ▶ Financial institutions

### HOW?

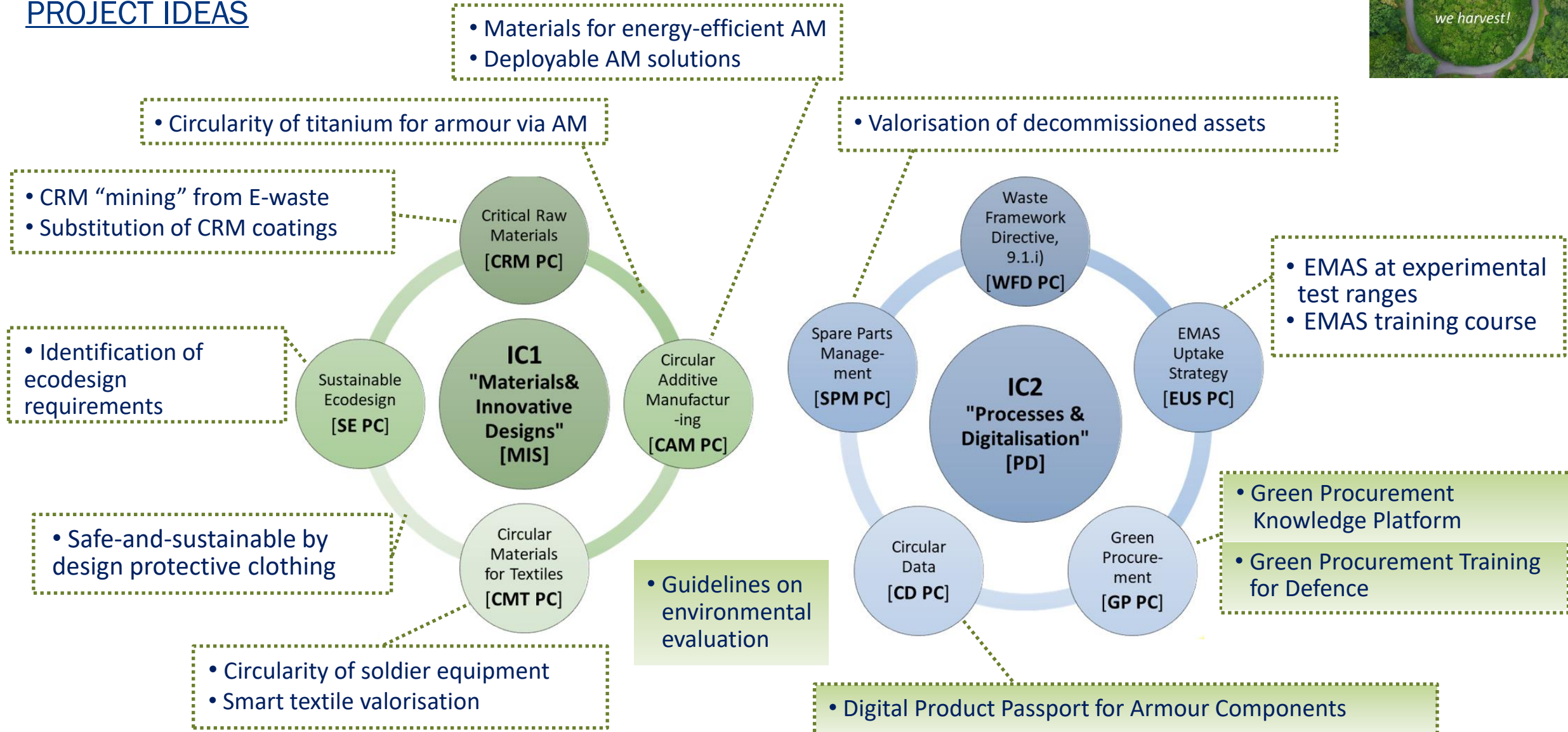
- ▶ Experts work within below 8 **"Project Circles"** (PC)

Incubation Clusters [ICs]							
PC Critical Raw Materials	PC Circular Additive Manufacturing	PC Circular Materials for Textiles	PC Sustainable Ecodesign	PC EMAS Uptake Strategy	PC Green Procurement	PC Circular Data	PC Spare Parts Management

**New topic: Post-conflict environmental remediation**

# INCUBATION FORUM FOR CIRCULAR ECONOMY IN EUROPEAN DEFENCE (IF CEED)

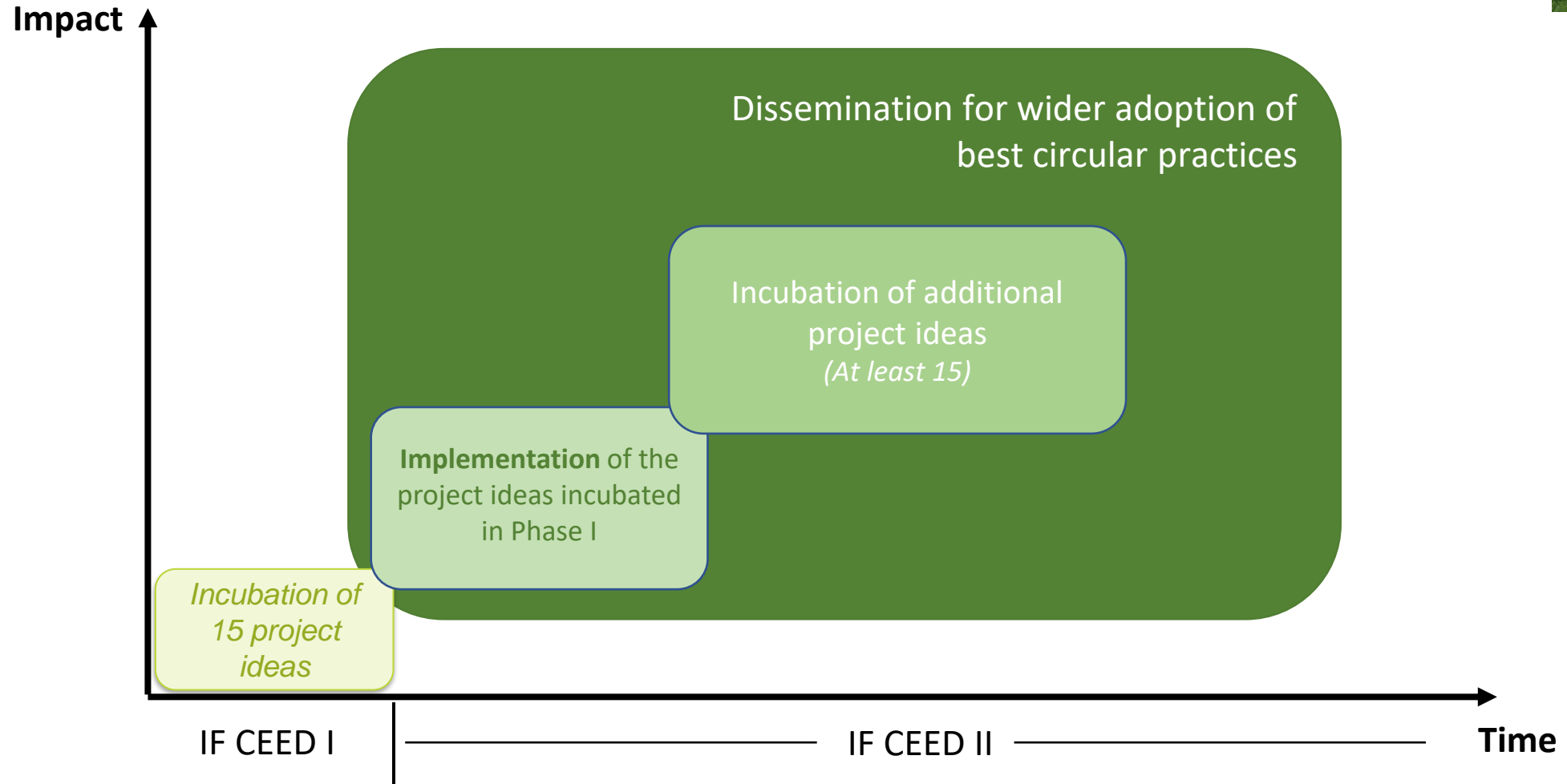
## PROJECT IDEAS





# INCUBATION FORUM FOR CIRCULAR ECONOMY IN EUROPEAN DEFENCE (IF CEED)

## PHASE 2 - OBJECTIVES





## GREEN PROCUREMENT IN DEFENCE



### ➤ **Reduce the environmental footprint of the armed forces by:**

- Fostering the uptake of resource-efficient products/capabilities.
- Supporting minimised impact
  - in use phase (scopes 1&2 emissions);
  - and from the supply chain (scope 3 emissions).
- Promoting extended (by design) lifetime of valuable products and materials.

### ➤ **Leverage associated benefits for operations.**

- Reduction of materials and energy consumption.
- Reduction of the Total Cost of Ownership.
- Improvement in the availability of assets/operational readiness.
- Security of supply.

# GREEN PROCUREMENT

## CONTEXT & STATUS QUO



### ➤ National defence environmental / sustainability strategies

- Existing in many Members States
- Including green / circular procurement
- Examples
  - ES MoD - Strategy on the challenge of Climate Change: “Increase the importance of environmental criteria in public procurement in the field of Defence.”
  - NL MoD sustainability agenda: “using government-wide sustainability criteria for the purchase of non-operational products”
  - PT MoD – National Defence Strategy for the Environment, Security, and Climate Change: « incorporate environmental and energy sustainability into (...) equipment procurement ».

### ➤ Implementation of specific green procurement solutions for defence remains limited.

- Some MS apply green procurement requirements for civilian-like products/services (often based on the EU Green Public Procurement criteria).



# GREEN PROCUREMENT IN DEFENCE

## EXAMPLES & LESSONS LEARNT



### ➤ Examples

- FR - procurement of uniforms for the navy → Criteria of limited toxicity and the use of organic material.
- NORDEFECO - Nordic Combat Uniform (NCU) System → Different green criteria.
- NL - Soldier equipment / Textiles → Requirement of minimum post-consumer recycled content for textile fibres.
- NL - Reuse/recycling of mobile phones
  - In case of reuse, Formatting the settings and safety procedures
  - Impact (for 1000 phones): reduction of waste (70 kg) and emissions (- 740 kg<sub>CO2</sub>).

### ➤ Lessons learned

- For the time being, GP in defence focuses on civilian type of products (e.g. textiles, electronics) → often a pilot-case for the MoDs; if considered successful, it is applied to new areas.
- Too many technical specifications are not effective; circular invitations to tender **must be described in much more functional terms** to give the market room to be more creative and thus innovate;
- Suppliers **need time for research and analysis of new or different production methods**;
- In such pilot projects, price should not be the decisive factor, as **tight budget ceilings may limit development potential**.

# GREEN PROCUREMENT IN IF CEED

## OBJECTIVES



- Map current national MoDs Green Procurement-related processes and activities;
- Assess relevant Green Procurement guidelines and practices from non-defence public procurement sectors;
- Assess potential needs and required actions for further improvement of Green Procurement in MoDs.

- Awareness and knowledge raising identified as a first need:
  - ❑ What? Exchange of experiences, case studies and lessons learned.
  - ❑ How? Knowledge platform & training

# GREEN PROCUREMENT IN IF CEED

## PROJECT IDEAS

For further information on these project ideas: [IF CEED Green procurement \(europa.eu\)](https://europea.eu/IFCEEDGreenprocurement)

### Green Procurement Knowledge Platform

- **Objective:** Develop a knowledge platform on circular and green procurement in defence.
- **Expected impacts:** Capacity building and increase of the use of Green Procurement, to ultimately reduce the environmental footprint.
- **Targeted audience:**
  1. National defence procurement authorities (“one-stop-shop” approach)
  2. Other stakeholders interested in green defence procurement
- **Implementation:**
  - Creation by EDA of an online platform on 'Circularity in Defence'
  - Dedicated section on green procurement.

**Green Defence  
Procurement**

Legal & Policy  
Framework

Standards &  
Labels

GPP Criteria

National Practices

### Green Defence Procurement Training

- **Objective:** Develop defence-specific training courses on green procurement for different profiles
- **Expected impacts:** Capacity building and increase of the use of Green Procurement, to ultimately reduce the environmental footprint.
- **Targeted audience:** National defence procurement authorities: Strategic level; practitioners; introduction for all related staff
- **Implementation:** To be decided



**GOING FURTHER - INTRODUCING COMPLEMENTARY ACTIVITIES**



## GOING FURTHER

# PROJECT IDEA “GUIDELINES FOR ENVIRONMENTAL EVALUATION IN DEFENCE”



### ➤ Why?

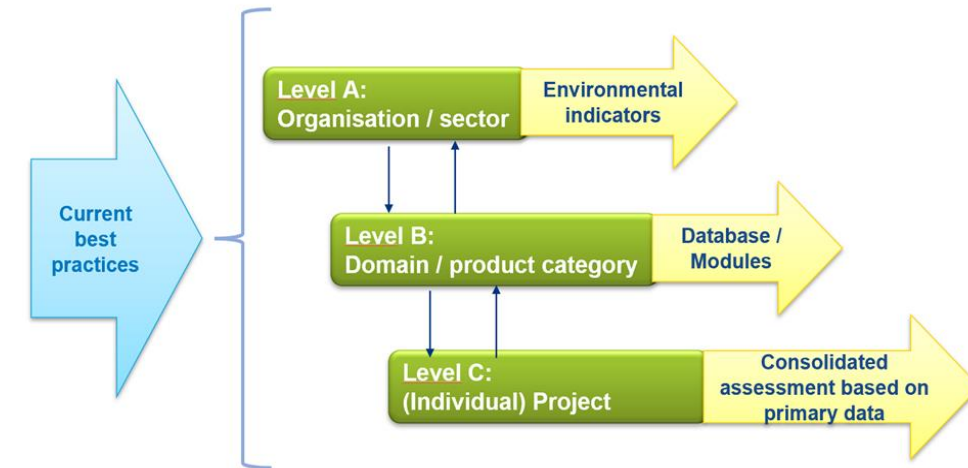
- Green procurement requires possibility to compare competing solutions/approaches.
- Awarding criteria need to be robust to avoid legal challenge.
- Avoid weak “green claims” and potential adverse effects.

### ➤ What do we want to achieve?

- Harmonisation of practice via...
- ... the establishment of guidelines for environmental evaluation in defence applications.

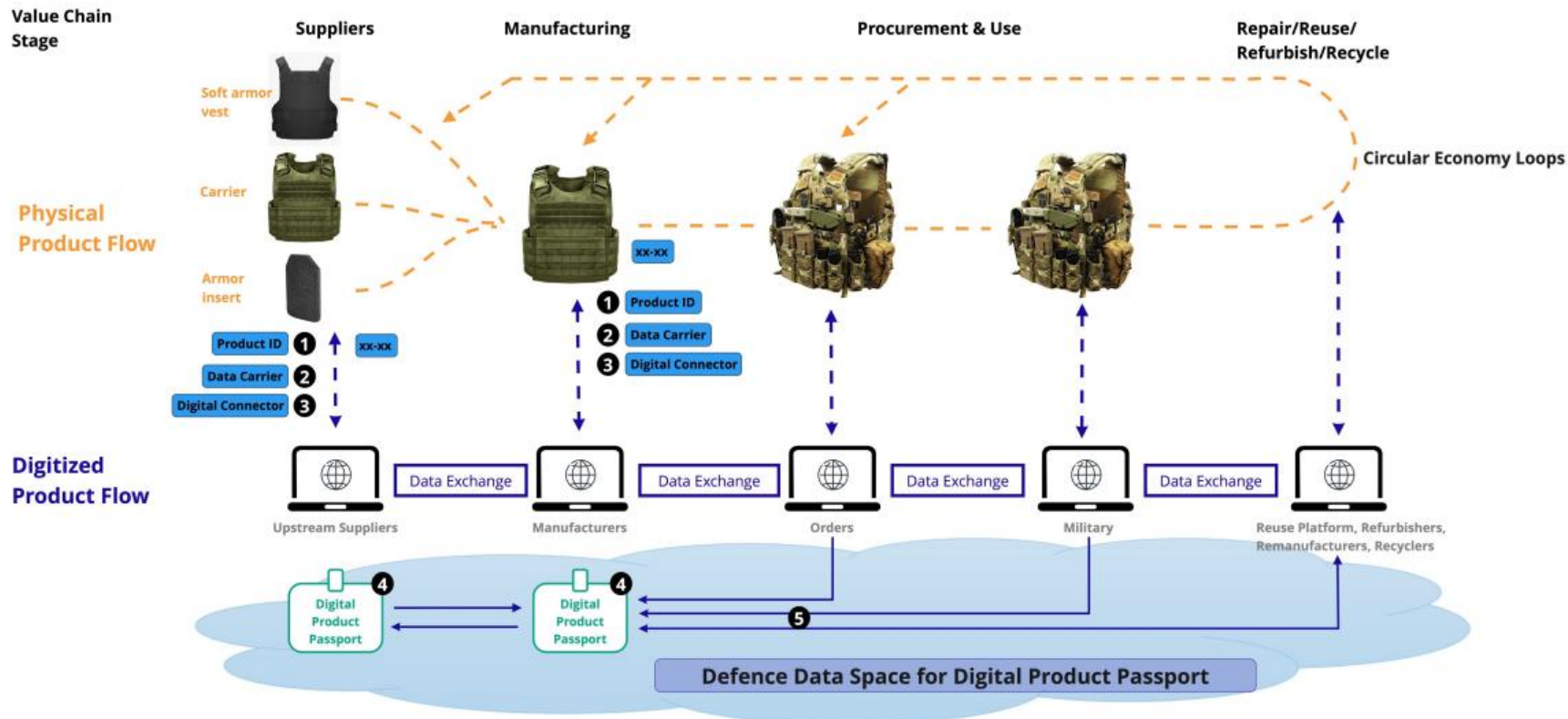
### ➤ How?

- Formalise detailed targets (e.g., in terms of scope, functional units) and diagnose current methodologies, tools and databases.
- Conceptualise an approach based on real data for environmental evaluation in defence applications.
- Implement a feedback loop via the implementation of project ideas.
- Establish guidelines for environmental evaluation in defence applications.
- Consolidate a defence LCA database based on primary data.



# GOING FURTHER

## DIGITAL PRODUCT PASSPORT (DPP) FOR BODY ARMOUR INSERTS (1)



Simplify access to the information on a product... along its whole lifecycle

for manufacturing, procurement, maintenance, recycling, etc.

# INCUBATION FORUM FOR CIRCULAR ECONOMY IN EUROPEAN DEFENCE (IF CEED)

## DIGITAL PRODUCT PASSPORT FOR BODY ARMOUR INSERTS (2)

### ➤ Objectives of the approach

- **Ease compliance checks** on composition, origin & properties of the product.
- Support **interoperability** across (complex) supply chains and among countries.  
→ Reduce the workload for procurement, logistics and maintenance functions.
- Enable **circular management** of products  
*(decision-making at end of first use, optimisation of sorting, repair, remanufacturing and/or recycling operations)*



### ➤ IOTA 2 project (January 2024 – January 2025)







## CONCLUSIONS



# CONCLUSION

## EMBEDDING CIRCULARITY IN PROCUREMENT

- **Green procurement requires to go beyond « business as usual ».**
- **IF CEED currently focuses on the primary need identified: awareness raising and knowledge.**
  - Knowledge platform to be launched Q3-2024.
  - Specific training for defence green procurement. → Under discussion.
- **Other tools can support green procurement.**
  - Harmonised guidelines for environmental evaluation.
  - Digital product passport.
    - Corresponding project (ideas) developed within IF CEED.
- **Further needs:**
  - Defining “green” criteria for the respective military product categories.



MANY THANKS  
FOR YOUR ATTENTION

*IF (we) 'CEED',  
we harvest!*

For questions or  
expression of interests,  
please email:  
[circular.economy@eda.europa.eu](mailto:circular.economy@eda.europa.eu)

**ACKNOWLEDGEMENT**

IF CEED 2 is currently co-funded by





European Conference of Defence and the Environment

# ECDE 2024

CARLOS FERREIRA  
University of Coimbra



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# **ENVIRONMENTAL PERSPECTIVE FOR DEFENCE PROCUREMENT:**

## **THE IMPORTANCE OF THE LIFE-CYCLE APPROACH**

Carlos Ferreira: [carlos.ferreira@dem.uc.pt](mailto:carlos.ferreira@dem.uc.pt)

José Baranda Ribeiro: [jose.baranda@dem.uc.pt](mailto:jose.baranda@dem.uc.pt)



**12<sup>TH</sup> JUNE, OSLO, NORWAY**

# ADAI research group capabilities

Provide conditions for the formulation and experimental characterization of energetic materials and expertise in ammunition technology:

- Explosives

Detonation velocity and pressure; Detonation front curvature; Critical diameter and detonation extinction phenomena; Features of the shock initiation of explosives; New formulations.

- Propellants

Combustion rates.

- Pyrotechnics

Initiation devices.

- Ammunition expertise

Long term collaboration with the Portuguese Armed Forces, NATO-STO AVT Technical groups, and demilitarization companies.





# ADAI research group capabilities

Develops and applies tools to enhance the sustainability of products and systems supported by life-cycle thinking. The team provides expertise in:

- Life-cycle management;
- Environmental life-cycle assessment (LCA);
- Life-Cycle Costing (LCC);
- Ecodesign;
- Urban metabolism;
- Circular Economy indicators;
- Other sustainability tools.





# Participation in NATO-STO AVT research groups and EDA projects

## Main NATO-AVT activities that we have been deeply involved:

- AVT-177 – Munition and propellant disposal and its impact on the environment
- AVT-179 – Design for disposal of present and future munitions and application of greener munition technology
- AVT-277 – Hazard assessment of exposure to ammunition-related constituents and combustion products
- AVT-293 – Effect of environmental regulation on energetic systems and the management of critical munitions materials and capability

## EDA Projects:

- ERM – Environmental responsible munitions (2011-2015);
- PREMIUM - Prediction models for implementation of munition health management (2021- 2025)

**Green Public Procurement (GPP)** aims at facilitating public authorities the purchase of products, services and works with reduced environmental impacts throughout its life-cycle (European Commission, 2006).

A voluntary tool that provides criteria developed for specific product groups (e.g. textiles, paints, furniture, electricity), with specific targets for:

- materials (e.g. materials used, hazardous substances, durability);
- refurbishment (e.g. increase service life, easy-to-disassemble, repairable and recyclable);
- end-of life management (e.g. design for dismantling to maximise the recovery of resources)



## Ecolabels

Ecolabels Type I is a voluntary qualitative scheme that helps consumers, retailers and business to make sustainable choices (e.g. EU Ecolabel).



Ecolabels Type II are self-declarations – low credibility.

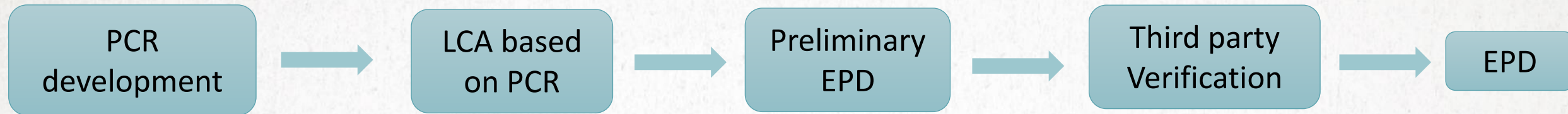
Ecolabels Type III provides quantitative environmental information of a product throughout the life-cycle. They are elaborated with the employment of Life-Cycle Assessment based on Product Category Rules (PCR) - Environmental Product Declaration (EPD).





## Ecolabels

Environmental Product Declaration process:

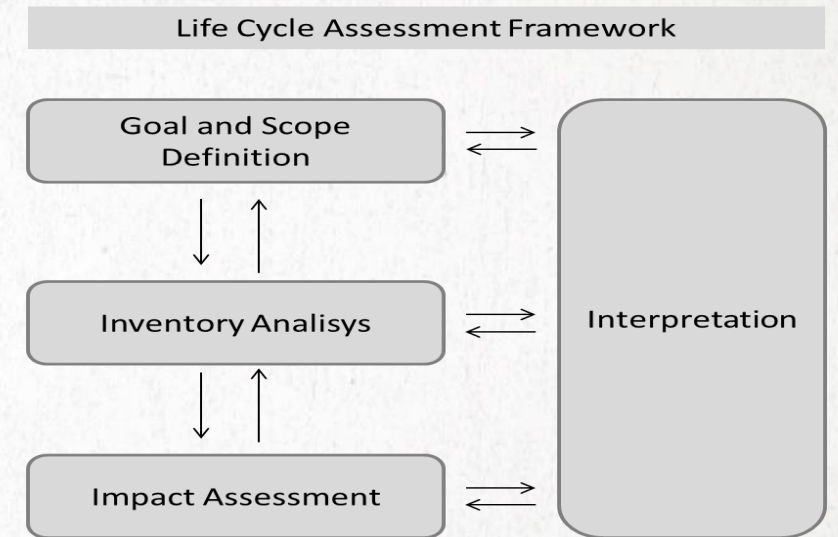


- Incentivise the environmental improvement
- Informative comparisons between products of the same function
- Environmental orientated acquisition

# LCA application for defence procurement

Life-Cycle Assessment is a tool that can be used to inform the public or stakeholders about the quantitative environmental impacts associated with products, platforms or activities.

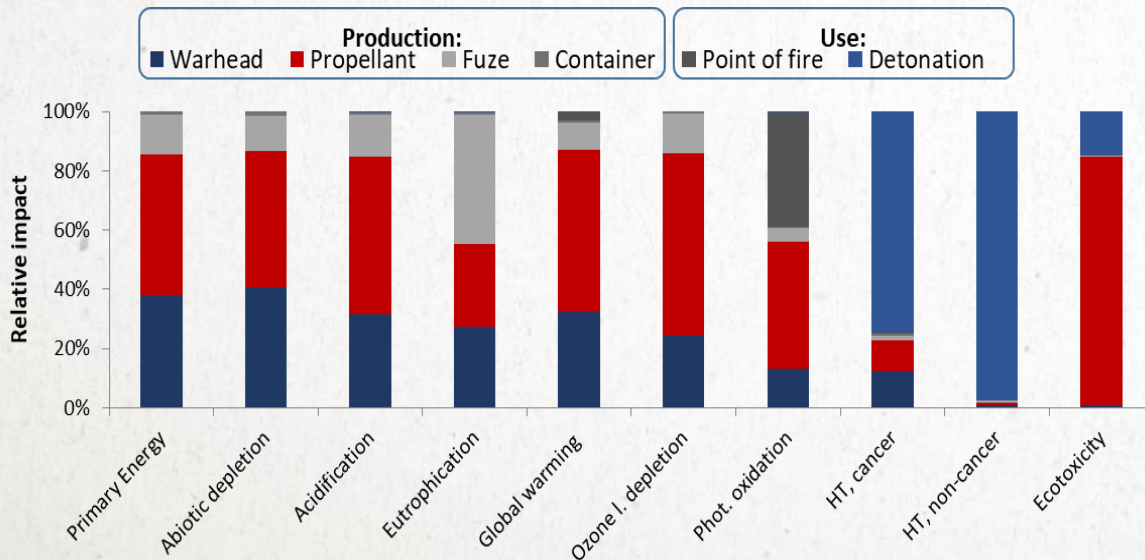
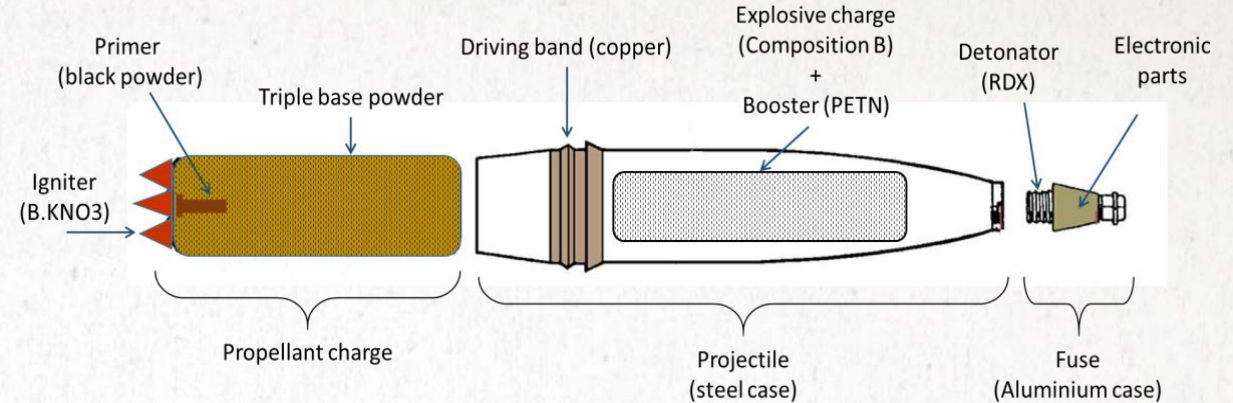
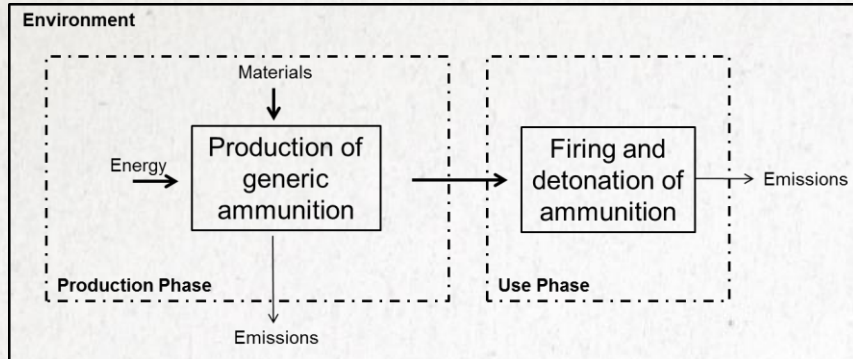
- Support ecodesign solutions;
- Identification of environmental hot-spots;
- Identification of improvements;
- Comparison of products or activities with the same function.





# LCA application for military systems

## AVT study – production and use of large caliber (155 mm caliber ammunition)



- Production presents a higher contribution to the environment impact categories;
- Use phase has a higher contribution to the toxicological impact categories;
- Exception for triple base powder production for ecotoxicity: emissions of insecticides into the soil (Profenofos, Cyfluthrin, Chlorpyrifos, and Aldicarb) used in the cultivation of cotton - nitrocellulose production.

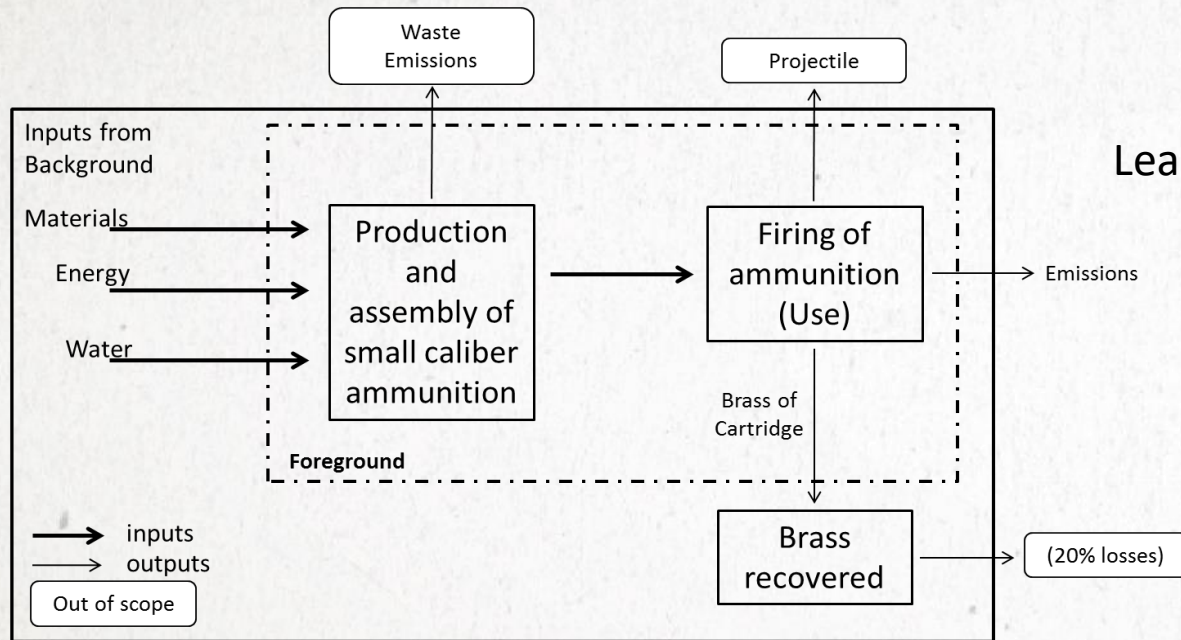


# LCA application for military systems

## EDA project - Ecodesign of small calibre ammunition



### 4 different small caliber munition:



Steel-lead projectile

Lead primer  
#1

Non-lead primer  
#2

Composite projectile

Lead primer  
#3

Non-lead primer  
#4

Ferreira C, Ribeiro J, Almada S, Rotariu T, Freire F (2016) Reducing impacts from ammunitions: A comparative life-cycle assessment of four types of 9 mm ammunitions, *Science of The Total Environment* 566-567, 1: 34 - 40

# LCA application for military systems

## EDA project - Ecodesign of small calibre ammunition



4 different small caliber munition:

### Primary data regarding the main components of the ammunition and the emissions

	#1		#2		#3		#4	
	Constitution	Amount (kg)	Constitution	Amount (kg)	Constitution	Amount (kg)	Constitution	Amount (kg)
Cartridge Projectile	Brass	4.9E-03	Brass	4.9E-03	Brass	4.9E-03	Brass	4.9E-03
	Steel	3.9E-03	Steel	3.9E-03	Nylon	4.1E-03	Nylon	4.1E-03
	Lead	6.1E-03	Lead	6.1E-03	Copper	1.0E-03	Copper	1.0E-03
Primer	Antimony powder	9.5E-05	Antimony powder	9.5E-05				
	Brass	2.4E-04	Brass	2.4E-04	Brass	2.4E-04	Brass	2.4E-04
	TNR-Pb	1.0E-05	DDNP	6.3E-06	TNR-Pb	1.0E-05	DDNP	6.3E-06
	Tetrazene	1.3E-06	Tetrazene	1.3E-06	Tetrazene	1.3E-06	Tetrazene	1.3E-06
	Barium nitrate	4.9E-06			Barium nitrate	4.9E-06		
	Antimony sulphide	1.3E-06	Zinc peroxide	1.4E-05	Antimony sulphide	1.3E-06	Zinc peroxide	1.4E-05
	Lead dioxide	1.3E-06	Titanium powder	3.7E-06	Lead dioxide	1.3E-06	Titanium powder	3.7E-06
	Calcium silicide	1.3E-06			Calcium silicide	1.3E-06		
Propellant	Single base powder	4.1E-04	Single base powder	4.1E-04	Single base powder	4.1E-04	Single base powder	4.1E-04
	Cardboard	3.2E-04	Cardboard	3.2E-04	Cardboard	3.2E-04	Cardboard	3.2E-04
Total weight		1.6E-02		1.6E-02		1.1E-02		1.1E-02

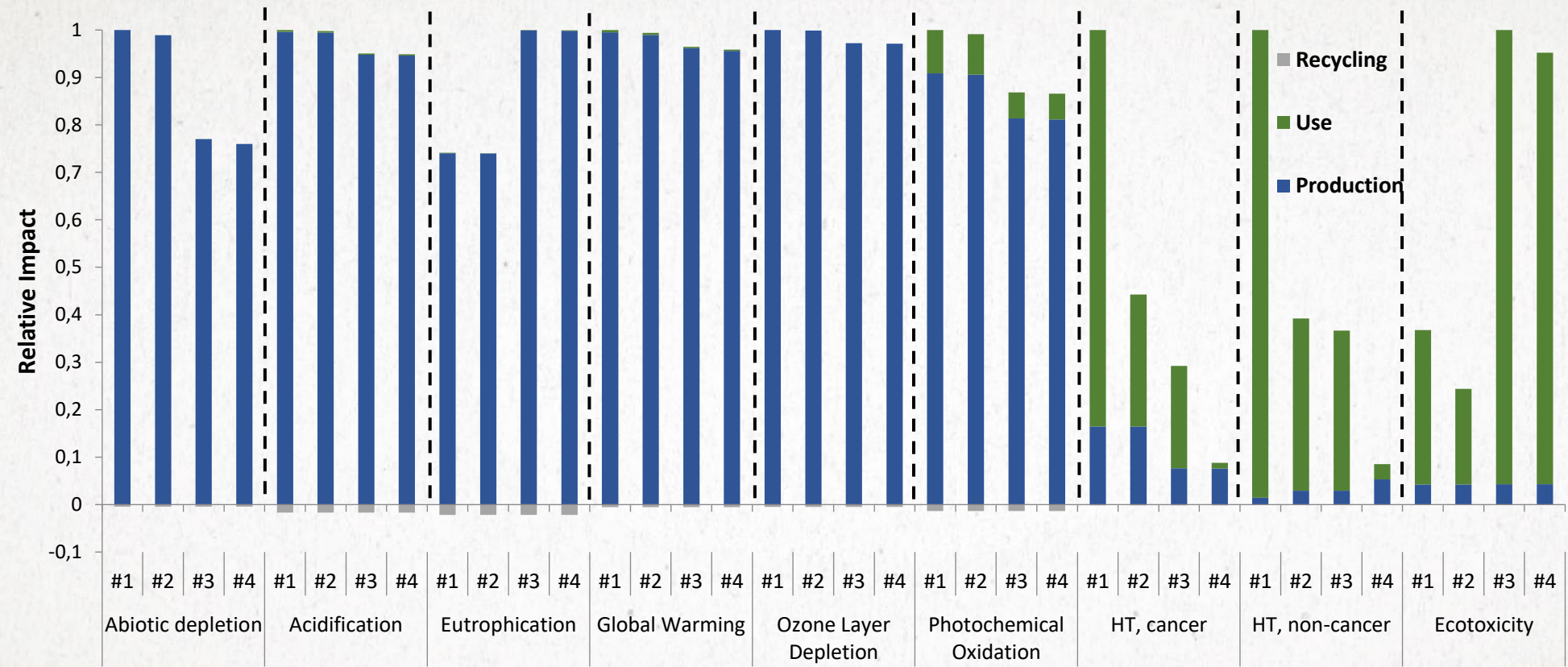
Substance	Emissions (mg/bullet)			
	#1	#2	#3	#4
CO	198.65	184.75	119.21	118.76
CO <sub>2</sub>	101.79	96.79	58.56	57.93
NO	3.80	3.22	3.85	4.41
NO <sub>2</sub>	0.64	0.62	0.49	0.52
NH <sub>3</sub>	3.10	2.46	1.67	1.84
HCN	1.77	1.22	0.18	0.13
CH <sub>4</sub>	1.10	0.96	0.61	0.59
Pb	3.14	1.04	0.81	0.04
Cu	0.55	0.41	4.85	5.21
Zn	0.12	0.11	0.19	0.03
Sb	0.37	0.20	0.15	ND

Electricity	0.046 kWh/bullet
Natural gas	0.240 MJ/bullet
Water	2.042 kg/bullet

Ferreira C, Ribeiro J, Almada S, Rotariu T, Freire F (2016) Reducing impacts from ammunitions: A comparative life-cycle assessment of four types of 9 mm ammunitions, *Science of The Total Environment* 566-567, 1: 34 - 40



## EDA project - Ecodesign of small calibre ammunition



The results show a trade-off: the “best” solution depends of the impact category

Ferreira C, Ribeiro J, Almada S, Rotariu T, Freire F (2016) Reducing impacts from ammunitions: A comparative life-cycle assessment of four types of 9 mm ammunitions, *Science of The Total Environment* 566-567, 1: 34 - 40



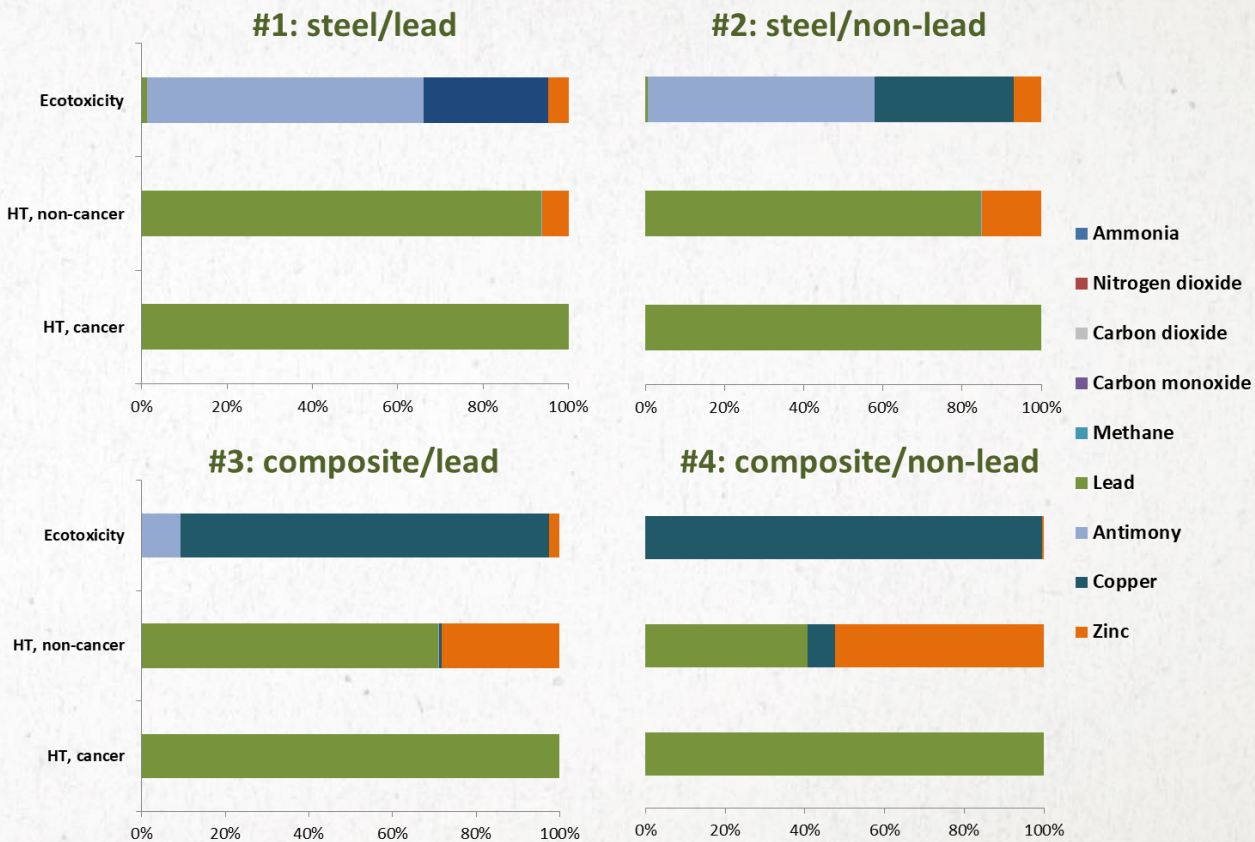
# LCA application for military systems

## EDA project - Ecodesign of small calibre ammunition

### Production Phase



### Use Phase



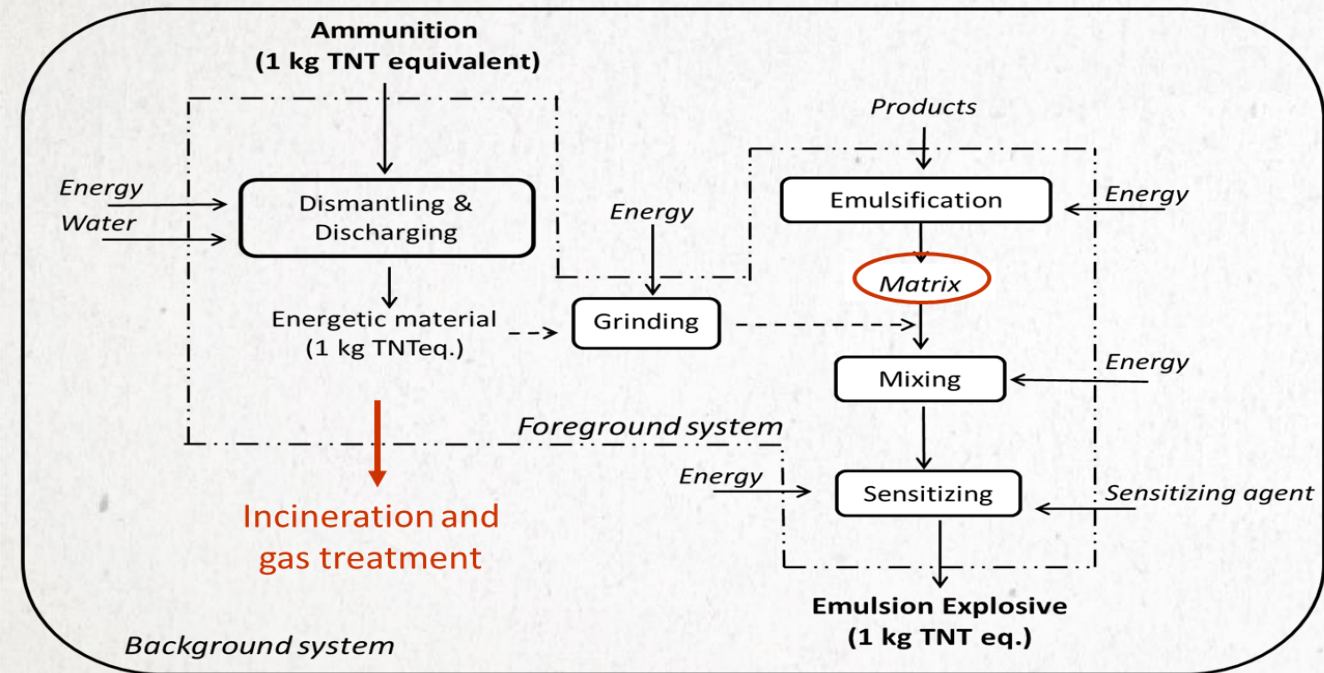
Ferreira C, Ribeiro J, Almada S, Rotariu T, Freire F (2016) Reducing impacts from ammunitions: A comparative life-cycle assessment of four types of 9 mm ammunitions, *Science of The Total Environment* 566-567, 1: 34 - 40

# LCA application for military systems

## Downcycling of energetic material from military ammunition via incorporation into civil explosives

### A circular economy approach

Energetic material valorization process

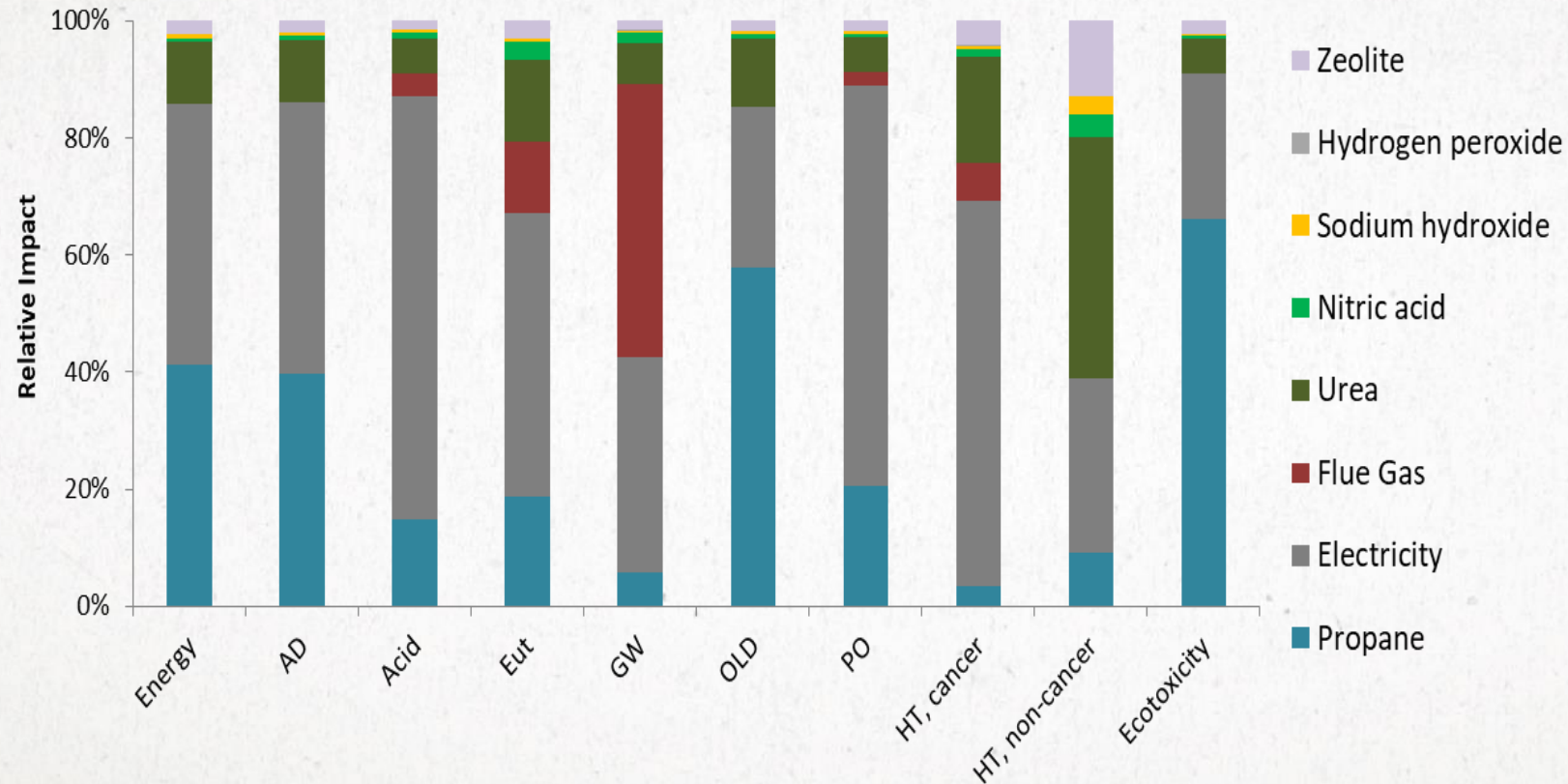


Source: C. Ferreira, F. Freire, J. Ribeiro, Life-cycle assessment of a civil explosive, Journal of Cleaner Production, 89, 2015, 159 – 164.



## Demilitarization of military ammunition

- Impacts associated with the incineration in a static kiln and flue gas treatment processes.

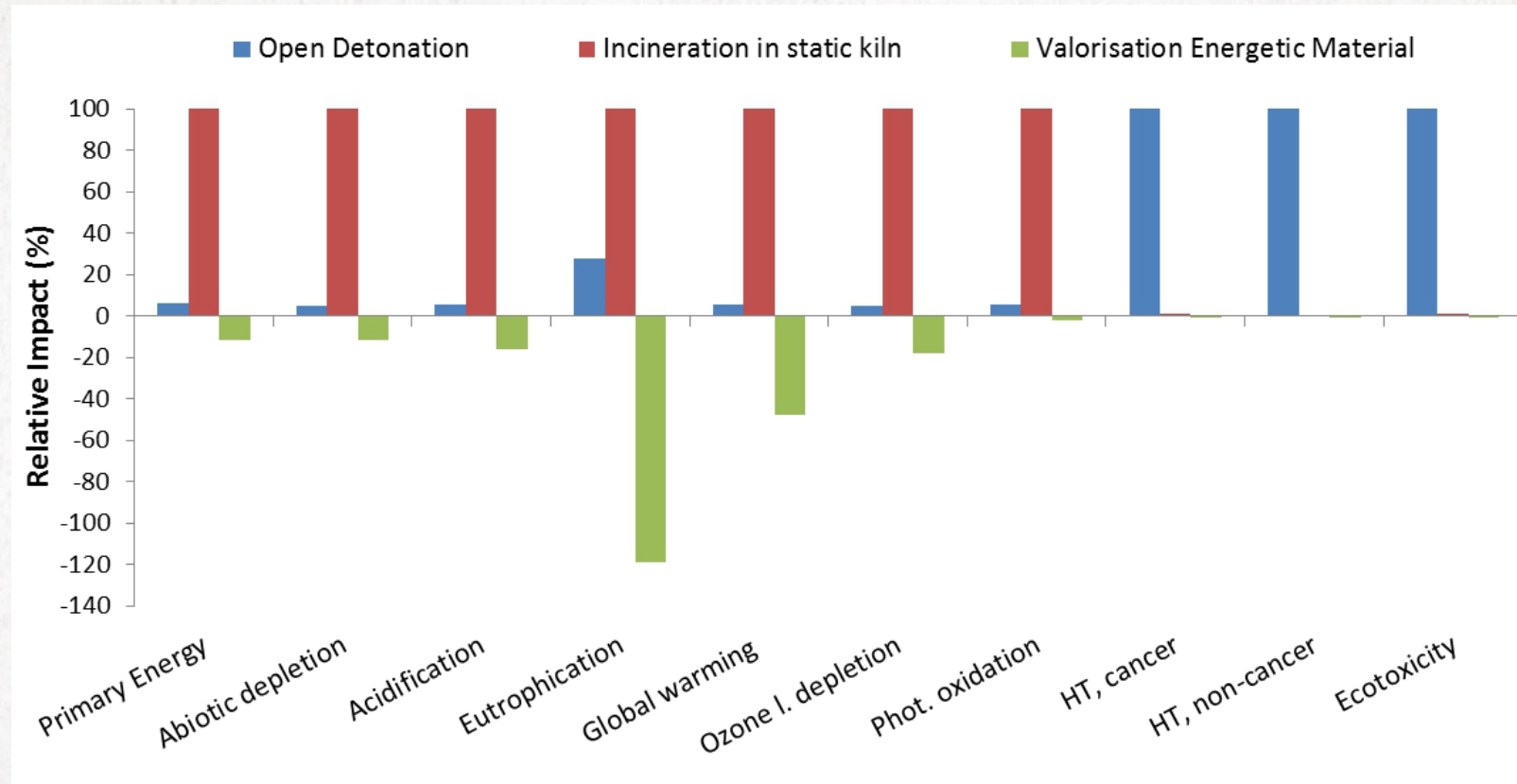


Source: Ferreira, C., Ribeiro, B., Mendes, R., Freire, F. (2013). "Life-Cycle Assessment of ammunition demilitarisation in a static kiln". Propellants, Explosives, Pyrotechnics, 2013, 38, 296 – 302.



# LCA application for military systems

Comparison between three methods of ammunition disposal: open detonation, incineration in a static kiln, recycling of energetic material.



Source: C. Ferreira, F. Freire, J. Ribeiro, Life-cycle assessment of a civil explosive, Journal of Cleaner Production, 89, 2015, 159 – 164.

# Green Procurement – way forward

## Harmonisation of rules for green procurement in defense

Definition of rules or procedures, such as PCR, referent to the procurement that all industry need (shall?) comply.

Who will define the rules?

- Nation level
- Organisations (European Commission; NATO)



Involvement of stakeholders:  
industry, academia, research  
institutes

# Preliminary Meeting Announcement and Call for Papers AVT-409 Research Specialists' Meeting (RSM)

## Life cycle analysis of sustainable technology for military platforms

To be held in Washington DC, USA  
20-21 May 2025

Organized by the Members of the  
Applied Vehicle Technology Panel  
AVT409 Programme Committee

**Members:** CAN, USA, FIN, NLD, NOR, POR, DEN

**Partners:** EOP, AUS





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**COIMBRA**

# THANK YOU!

Carlos Ferreira: [carlos.ferreira@dem.uc.pt](mailto:carlos.ferreira@dem.uc.pt)

José Baranda Ribeiro: [jose.baranda@dem.uc.pt](mailto:jose.baranda@dem.uc.pt)



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European Conference of Defence and the Environment

# ECDE 2024

PER ØIVIND BERG  
NATO Support and Procurement Agency



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# NATO SUPPORT AND PROCUREMENT AGENCY

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## AGENCE OTAN DE SOUTIEN ET D'ACQUISITION



## NSPA and environmental focus

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PREPARED FOR  
ECDE

12. June 2024

PRESENTED BY  
Major Per Øivind BERG







# NATO and climate change



NATO Strategic concept 2010 →



9 proposals for a future NATO  
No. 7: Proposal 7: Combat and Adapt to  
Climate Change

Governance and STANAG's



# OUR ORGANISATION \*

NATO NORTH ATLANTIC COUNCIL (NAC)

\* CIVILIAN

AGENCY SUPERVISORY BOARD (ASB)

NATO SUPPORT AND PROCUREMENT ORGANISATION (NSPO)

NSPA GENERAL MANAGER

NATO SUPPORT AND PROCUREMENT AGENCY (NSPA)

NSPA BUSINESS UNITS

SUPPORT TO  
OPERATIONS



LIFE CYCLE  
MANAGEMENT



ACQUISITION



CENTRAL  
EUROPE  
PIPELINE  
SYSTEM (CEPS)



NATO AIRLIFT  
MANAGEMENT  
(NAM)



# NSPA Clean energy vision & initiatives



To be an **environmentally responsible** Agency that customers choose to acquire **sustainable**, cutting edge capabilities that feature **clean energy solutions**

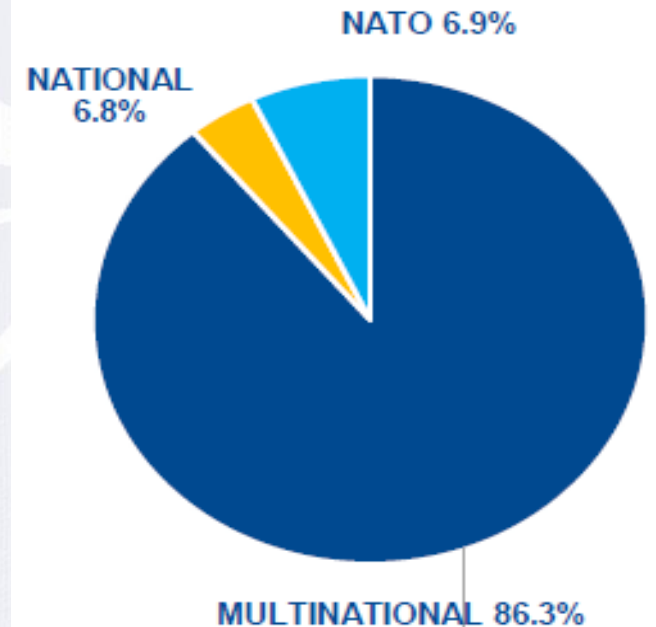


**CLEAN ENERGY  
INDUSTRY EVENT**  
7-8 JUNE 2023

**The Demilitarization, Dismantling and Disposal (D3) Support Partnership (SP)**



## BUSINESS DOMAINS

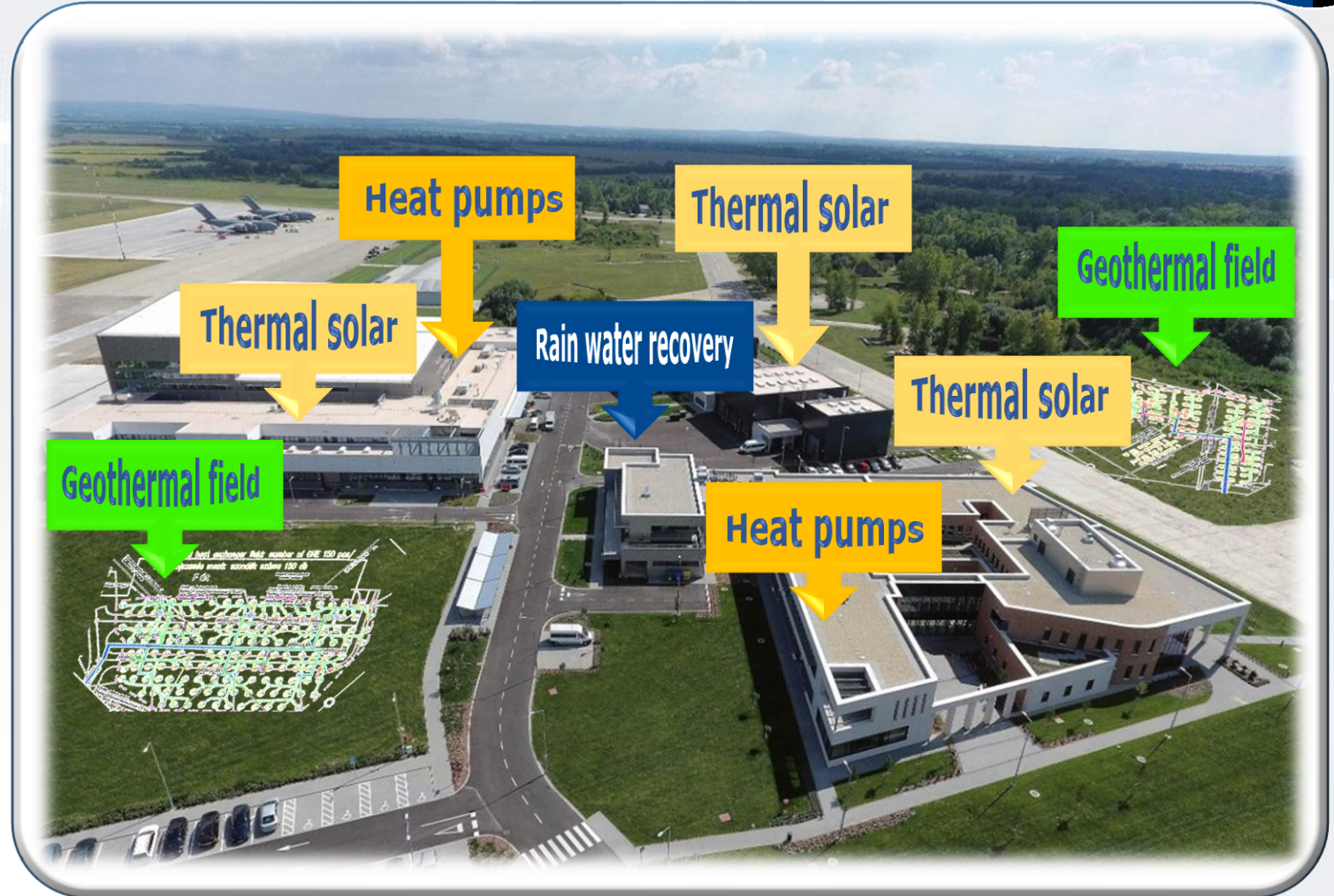




# NAM-Papa - Current Clean Energy Solutions - Example



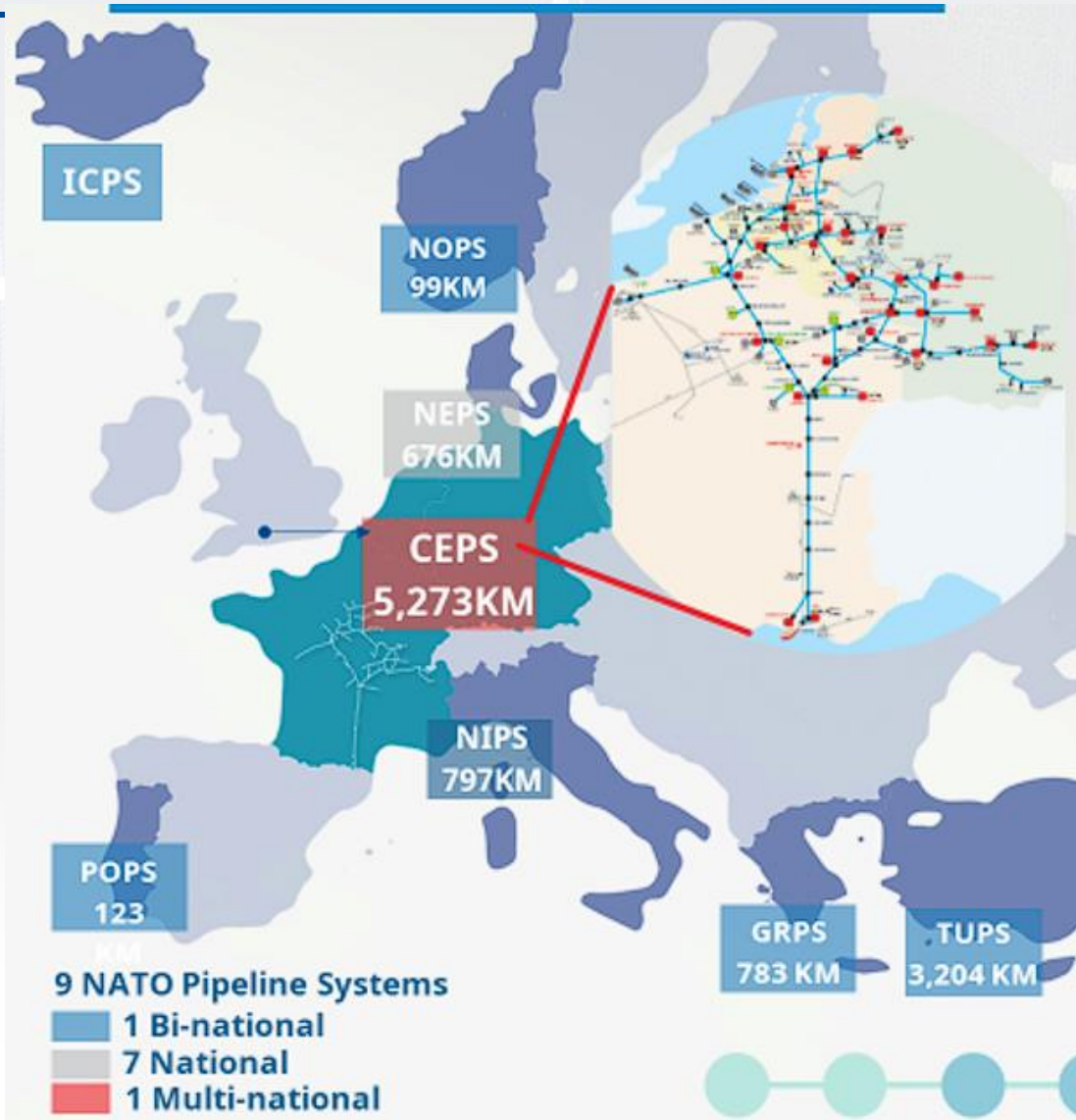
- Geothermal fields, 270pcs 100m probes 40mm diam.
- Heat pumps 1.5MW for Geothermal and >500KW air/liquid
- Thermal solar systems for domestic hot water
- Variable Refrigeration flow System with simultaneous heat-cool for Utilities building 100KW COP>4.8
- Rainwater recovery from ~3,000m<sup>2</sup> for gray water usage
- Collection of deicing liquids from apron



## NSPA and the use of SAF

### Sustainable Aviation Fuel (SAF)

- CEPS pipelines from 1.1.2023
- CargoLux 2023-





## Alliance Ground Surv. (AGS) base in Sigonella, Italy - example



### The Alliance Ground Surveillance (AGS) Main Operating Base

- 30.000m<sup>2</sup>
- Leadership in Energy & Environmental Design (LEED) protocols
- 160kW of electricity from renewable sources
- sustainable construction materials, coupled with rainwater and wastewater management techniques.









European Conference of Defence and the Environment

# ECDE 2024

ØYVIND JOHAN KVALVIK  
Norwegian Defence Materiel Agency (NDMA)



EUROPEAN  
CONFERENCE OF  
**DEFENCE AND THE  
ENVIRONMENT**





NORWEGIAN DEFENCE  
MATERIEL AGENCY

## **Integrating climate and environment in defence acquisition and procurement**

---

Major General Øyvind Johan Kvalvik  
**Deputy Director General**

WE EQUIP THE NORWEGIAN ARMED FORCES

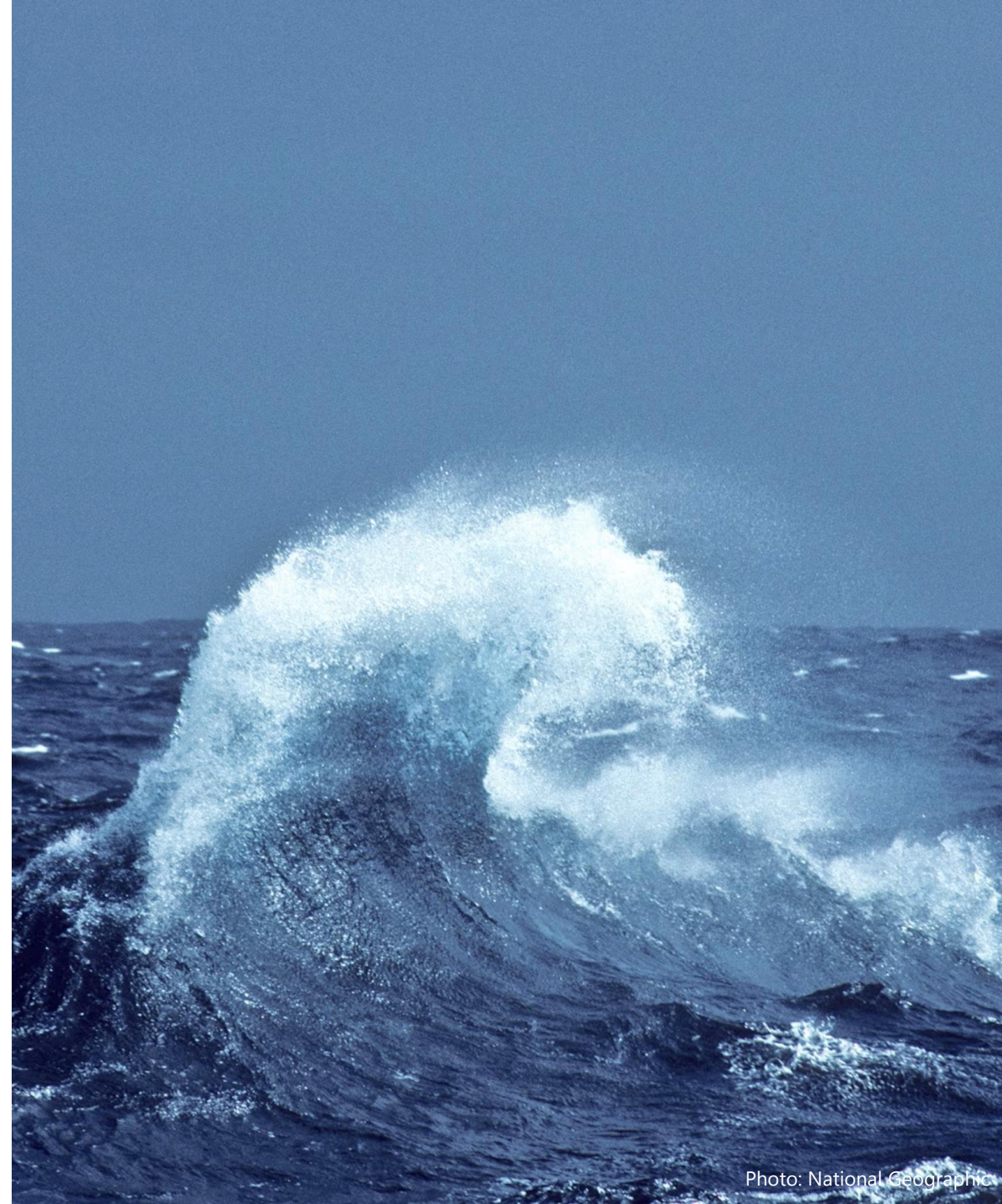


Photo: National Geographic





## **Agenda**

**01** Keys to achieving success

**02** Strategic framework and regulatory compliance

**03** Accomplishments



Photo: Norwegian Armed Forces

# 01

Keys to achieving success





# 02

Strategic framework and  
regulatory compliance



## New Norwegian Public Procurement Regulation







Photo: Norwegian Armed Forces

# 03

## Accomplishments

# Snowshoes







SAF – sustainable aviation fuel



Photos: Norwegian Armed Forces



# New coastguard vessels







# Use of simulators



European Conference of Defence and the Environment

# ECDE 2024

KERRY MARIE BOMMEN  
Kongsberg Defence and Aerospace



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KONGSBERG

# Protecting people and planet





KONGSBERG

# Linking innovation and circular economy

Arild Skoge and Kerry Bommen  
Kongsberg Defence & Aerospace



# European Environment

## EUROPE

### European Green Deal

Europe aims to be the first climate-neutral continent by 2050



## NORWAY

### 2030 Target:

Reducing GHG emissions at least 50% and towards 55% compared to 1990 levels by 2030

### Long-Term Strategy:

By 2050, aims to achieve climate neutrality



# Norway's Defence Sectors Commitment

## Specific Actions

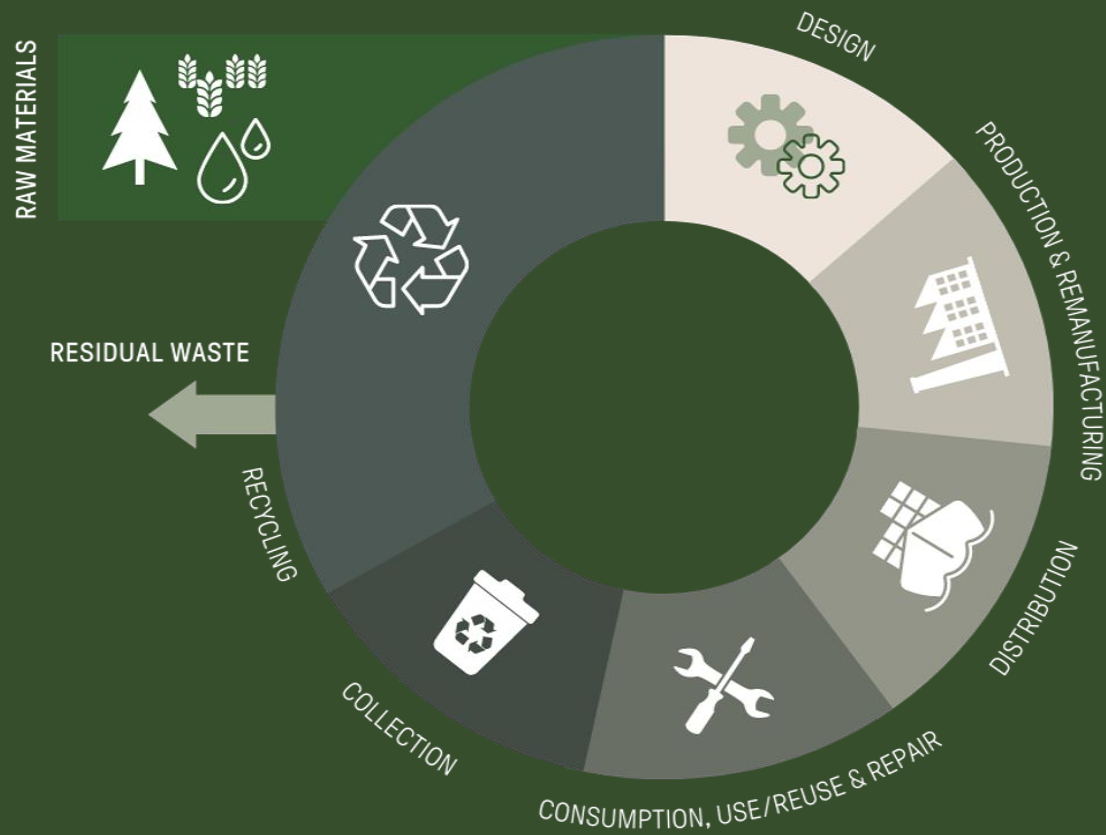
- Energy Efficiency
- Research and Innovation
- International Collaboration

## Challenges and Opportunities

- Operational Impact
- Technology Adoption
- Gamechanger



# CIRCULAR ECONOMY



The circular economy is based on three principles, driven by innovation and design



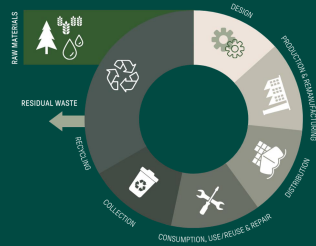
- Eliminate Waste and Pollution



- Circulate Products and Materials (at their highest value)



- Regenerate nature



# Value Chain & Eco System

And apply principles of Circular Economy



KONGSBERG

## Understanding the Value Chain

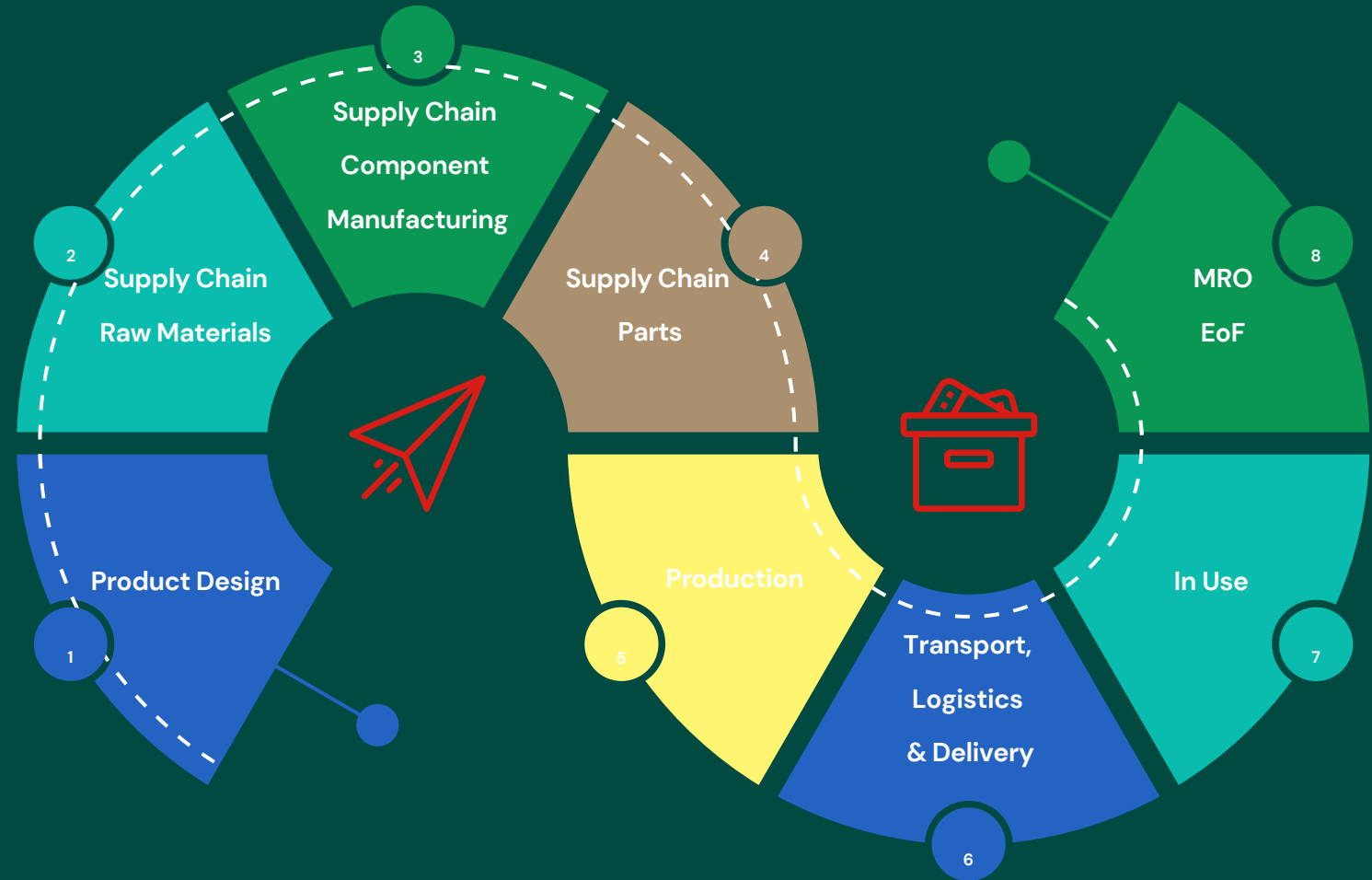


Identify and Eliminate Waste

Maximise Resource Circulation

Enhance Environmental Stewardship

Innovate Sustainably





# VANGUARD

BY KONGSBERG





# Operational benefit



See Statement of Proprietary Information



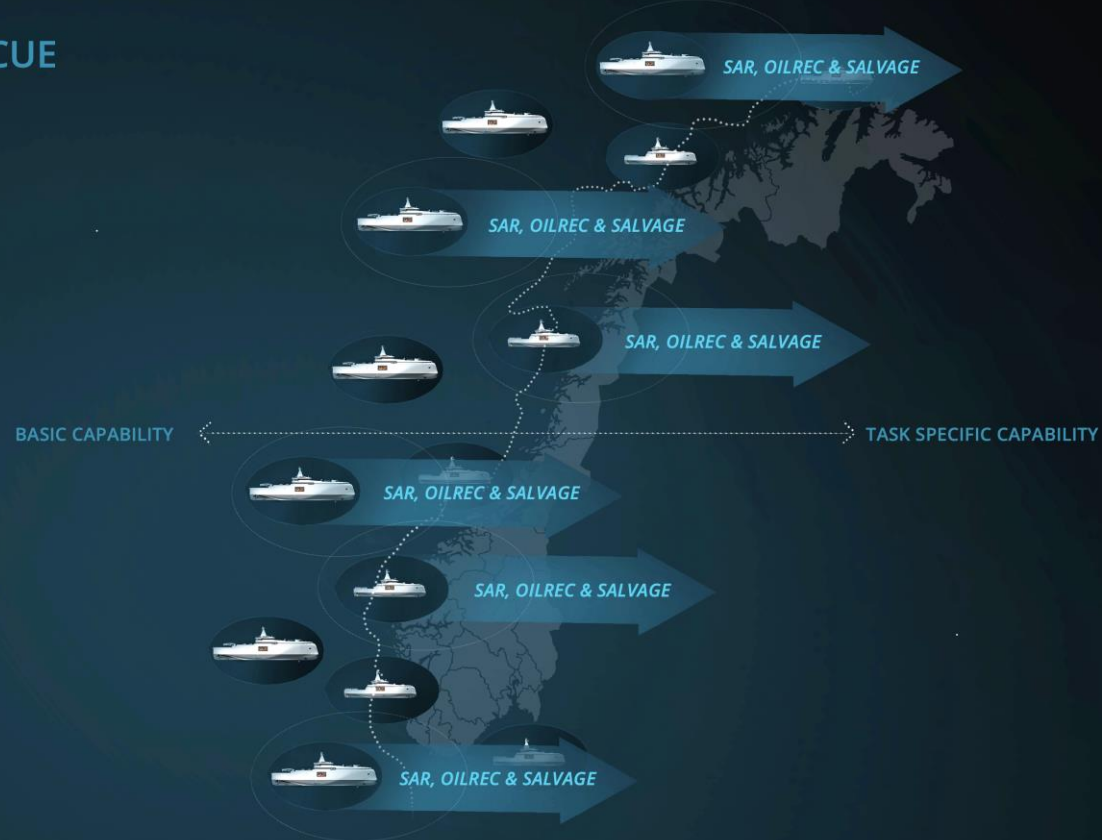
# Enviromental benefit



See Statement of Proprietary information

# Strategic benefits

## SALVAGE & RESCUE



Blue Water Platform



Toolboxes:  
SAR, OILREC & SALVAGE

Task Specific  
Capabilities

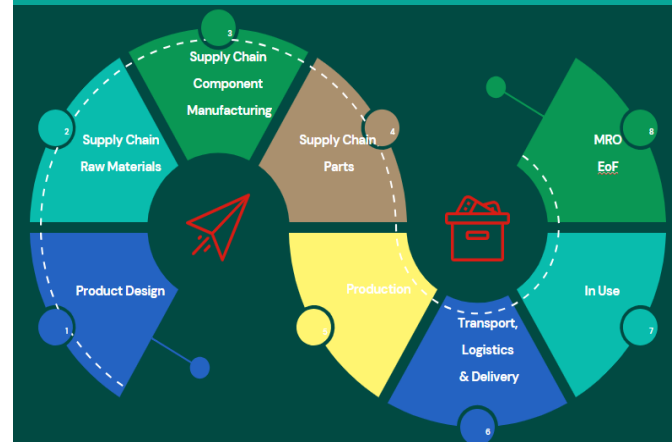
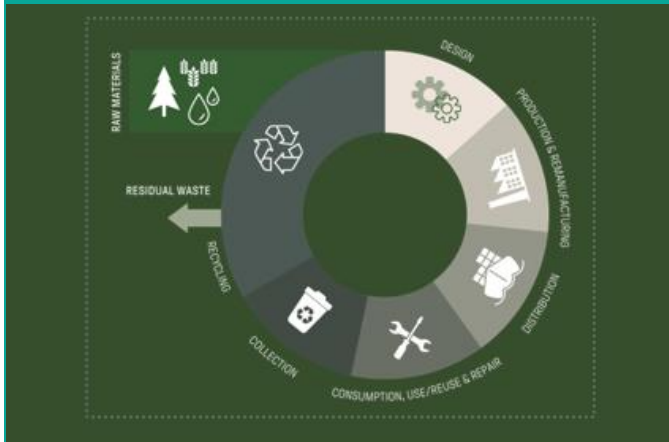


# Key Takeaways – Linking innovation and Circular Economy

Circular economy is a **key enabler** to more sustainable innovation

Infrastructure needs to cover **Shore-sea connection** – not only about the vessel  
**Understand the entire value chain and eco system**

**Collaboration** crucial with the **User, Industry and Research**  
how can we have these 3 elements **working together**





KONGSBERG

# Thank you!

[arild.skoge@kongsberg.com](mailto:arild.skoge@kongsberg.com)

[kerry.marie.bommen@kongsberg.com](mailto:kerry.marie.bommen@kongsberg.com)



European Conference of Defence and the Environment

# ECDE 2024

CAROLINE GIBON  
Thales



EUROPEAN  
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# Towards a common ecodesign approach in defence sector

June 2024

[www.thalesgroup.com](http://www.thalesgroup.com)





## Why a common approach?

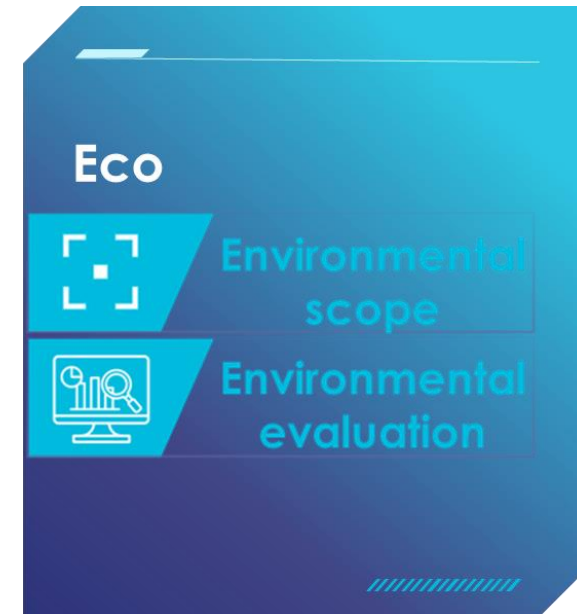
- > Limits of going it alone for an ASD manufacturer:  
matter of relevance, credibility and efficiency
- > Limits of going it alone for a MoD:  
matter of relevance, credibility too!

**A strong asset for the sector**

# What is the approach?



## 6 key principles





# An approach adapted to the defence sector to be relevant



## PITFALL

No Ecodesign in theory

No universal, autonomous  
Ecodesign

## RIGHT PRACTICE

Defence product Ecodesign

Mission critical products / systems with  
specificities to be respected

**Not constraints AGAINST the product.  
SUPPORT to the product value proposition.**

# An environmentally extended approach to deliver significant improvements



## SCOPE

Impacts not limited to the product manufacturing

Products own impacts in use

Indirect impacts related to the overall operational system

## APPLICATION

Adaptation of environmental impact evaluation practices to the development maturity

Tools and methods to cover such an extended scope

**No dazzling LCAs anywhere at anytime**



# A collaborative approach to let design and Ecodesign be effective



## OPEN

**Reinforce collaboration with the supply chain and customers/users**

**Leverage good ideas and optimize the overall complex systems**

## REVIEW

**Important to review user's needs, not to question them, but to better serve them**

**Stop just adding requirements on top of legacy solution: discrepancies or even contradictions in operational contexts**

**Over-engineering is the first reason of resources wastes and useless impacts**

## Caring for the environment is optionnal

- > Ecodesign could be detrimental to solutions performance ?
- > Priority to adaptation to climate change over trying to mitigate climate change?
- > Environment impact vs business impact:  
if eco-design is not applied for a better environment,  
let's do it for better operations!



# Questions ?

European Conference of Defence and the Environment

# ECDE 2024

TOR HENNING MOLSTAD  
Nordic Additive Manufacturing



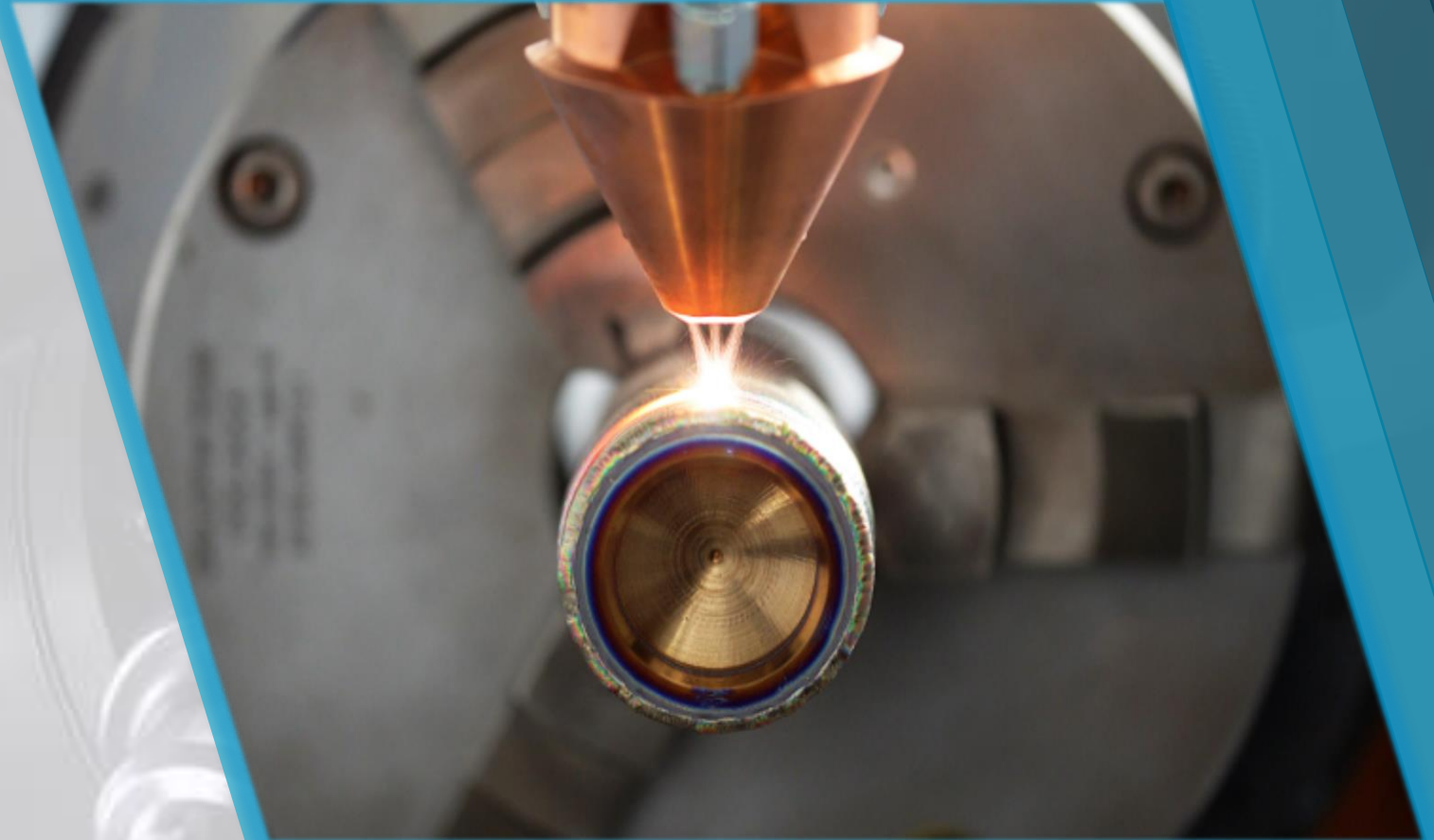
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**World leading technology**

Find us in social media!



**Repair vs Replace = Sustainability;**  
Practical use cases within AM/Metal Printing

Tor Henning Molstad; Head of Business development,  
marketing/sales at Nordic Additive Manufacturing

# About us, NAM

- AM, Laser Metal Deposition since 2017
- Close ties to SINTEF, NTNU and the industrial cluster NCE-Manufacturing; Raufoss Ind.-Park, NORWAY
- Industry and laboratories with a wide material & production technology expertise



## Ownership structure

**kormin**



**SpareBank 1**

**Nammo**



**NORSE**  
Metal



- Research
- Investment fund / Partners
- Industrial group
- SME companies



# Core Technology

## LMD

### ***Laser Metal Deposition (LMD),***

With LMD we can repair, build new parts, make changes to and improve existing parts.

Additive production in a multitude of materials and material combinations.

Both powder and wire.

### ***Examples of our materials:***

Duplex, Super Duplex, Stealite 6, Inconel 718, Inconel 625 , H13 tool steel, H11 tool steel, 316L, 6Mo, Titanium Gr5, Wolfram Carbide/Nickel, Wolfram Carbide/Cobalt, Vecaloy 600 (65 HRC), Nickel, AluBronze, Aluminum/Silisium (Silicone), Aluminum



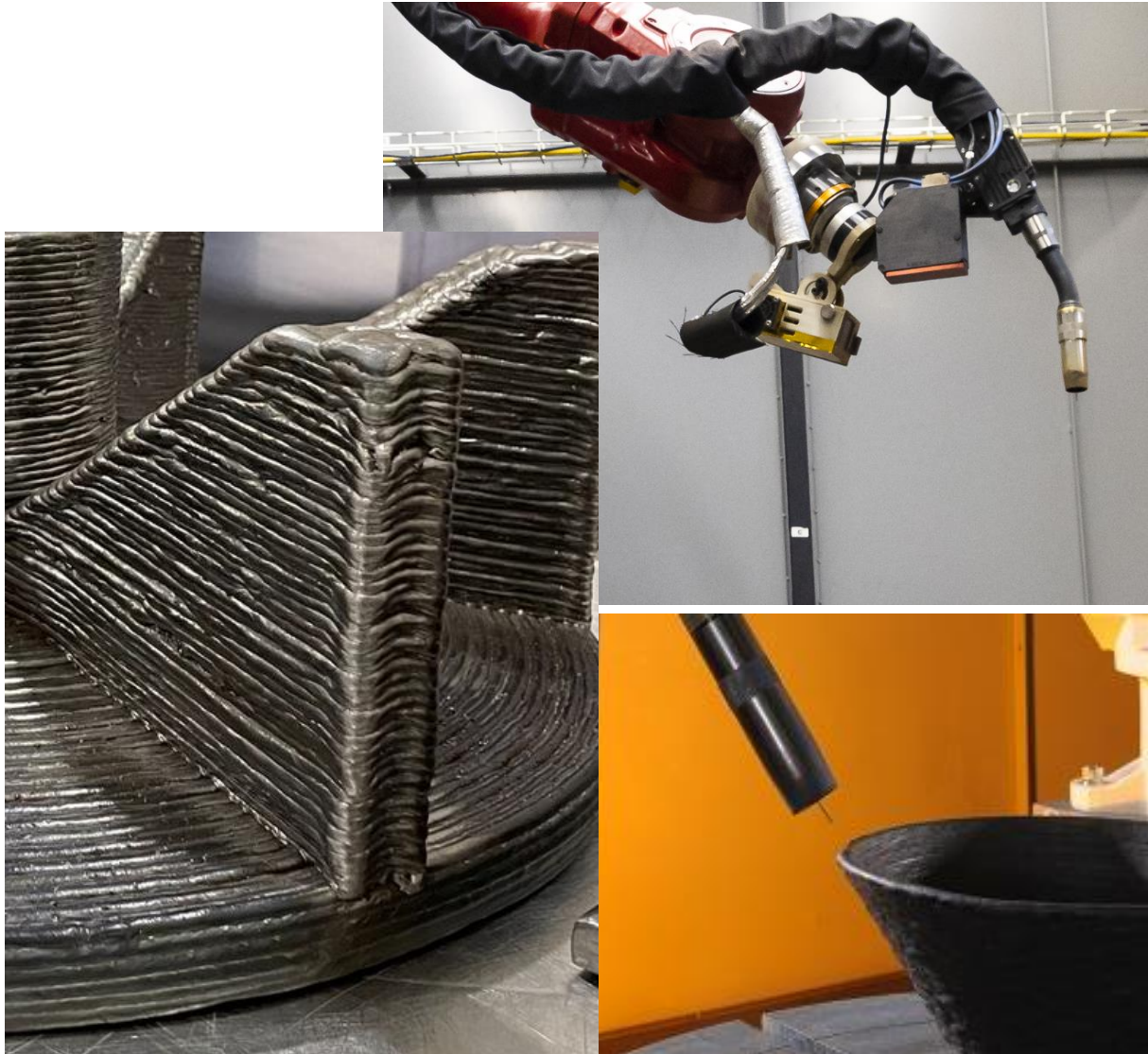
# Technology

## WAAM

### ***Wire Arc Additive Manufacturing (WAAM)***

With WAAM you can deploy materials faster compared to LMD, gives a rougher surface finish,

- Large size components, heavy components
- Wide material range, welding wire
- Start up cost, welding robot vs machine investment
- Pros & Cons each technology







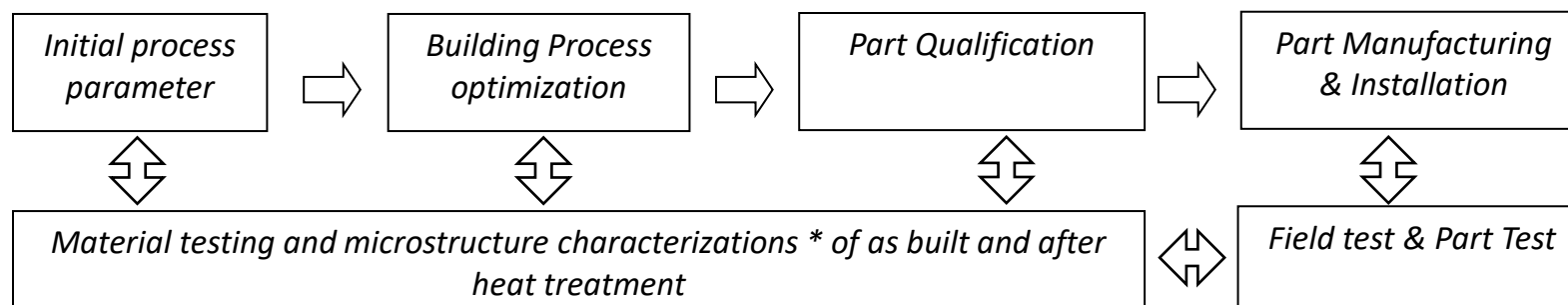
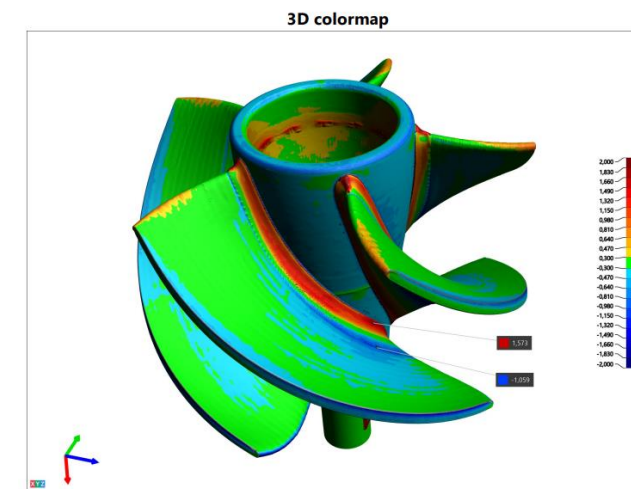
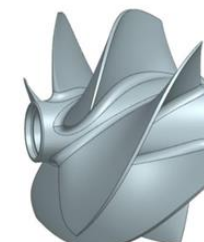
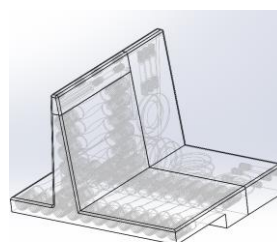
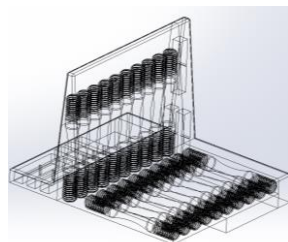
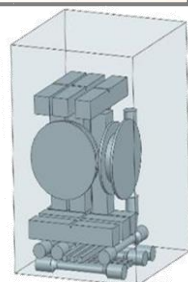
# Kongsberg Maritime Propulsion Components<sup>KONGSBERG</sup>

Manufactured using a qualified Laser Additive Manufacturing (LMD) process

at Nordic Additive Manufacturing (NAM)

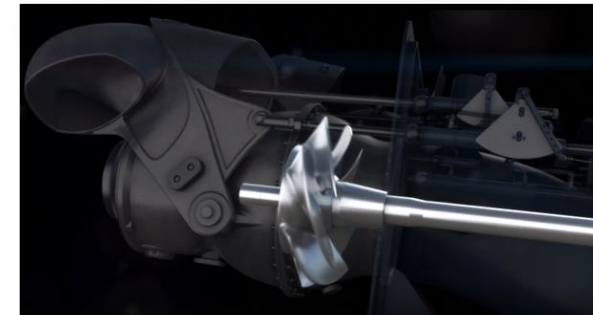
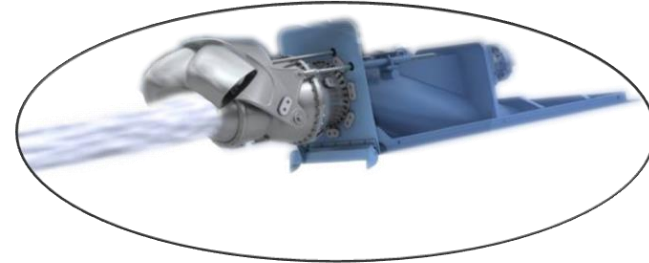
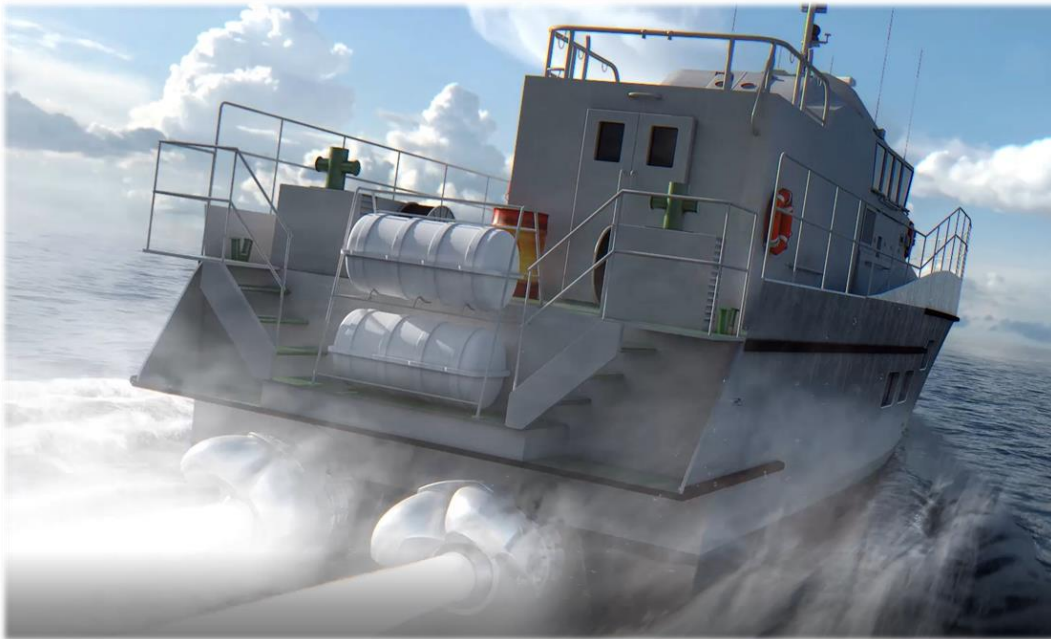
Mette Lokna Nedreberg – Kongsberg Maritime

# Manufacturing and qualification in according to DNV Guidelines DNV-ST-B203





# Water-jet Impeller



Scope:  
Improve Lead time, quality and cost using AM / LMD

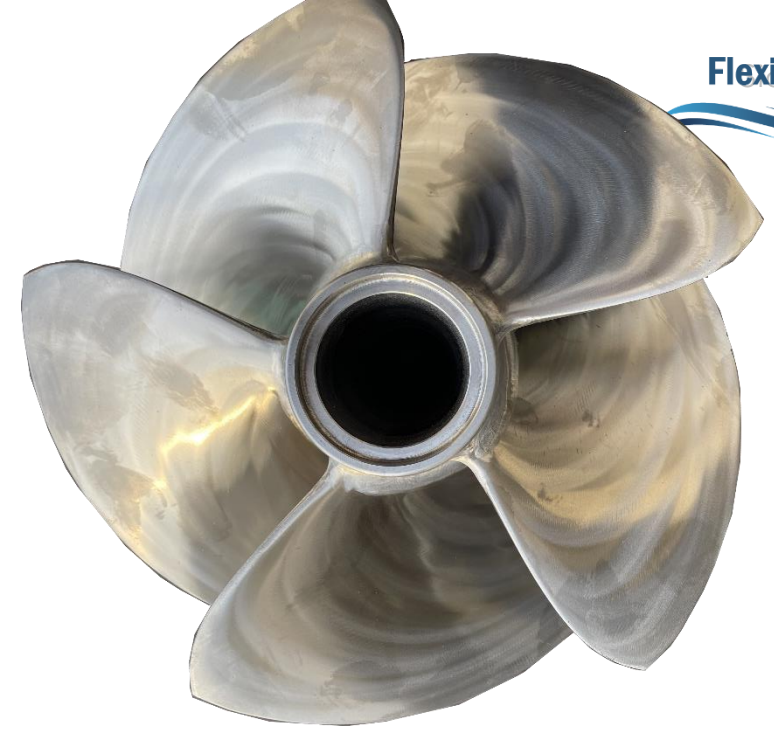
**NAM**

KONGSBERG

 **SINTEF**

## Manufactured material fulfil all requirements

Properties	Requirement	DED Material, results		
		X	Y	Z
Ferrite Fraction [%]	40-60	52	52	52
Tensile YS [MPa]	420	487	484	497
Tensile UT [MPa]	600	755	740	750
Elongation [%]	20	32	30	27
Charpy V [J]	30	66	47	56
Bending Angle [°]	-	147	147	145





# USV Sounder Propeller

(8 meter Unmanned Surface Vessel – Kongsberg Discovery)



## TECHNICAL SPECIFICATIONS

- Length: 8m
- Beam: 2.2m
- Height: 2.3 / 4.4m (mast down/up)
- Draft: 0.7m
- Weight: 4,200kg – ready to operate
- Propulsion: 125hp Steyr diesel engine with fixed pitch propeller
- Speed: 12 knots (max)
- Endurance: Up to 20 days @ 4 knots
- Payload power: > 4 kW @ 4 knots
- Control: K-MATE autonomy engine for direct, supervised and autonomous operation
- Communication: Maritime Broadband Radio/Iridium (VSAT optional)

## Manufacture and Final inspection – According to specification with good tolerances



Installed in the 8m USV Sounder vessel in December -23  
Order for 3 more in 2024

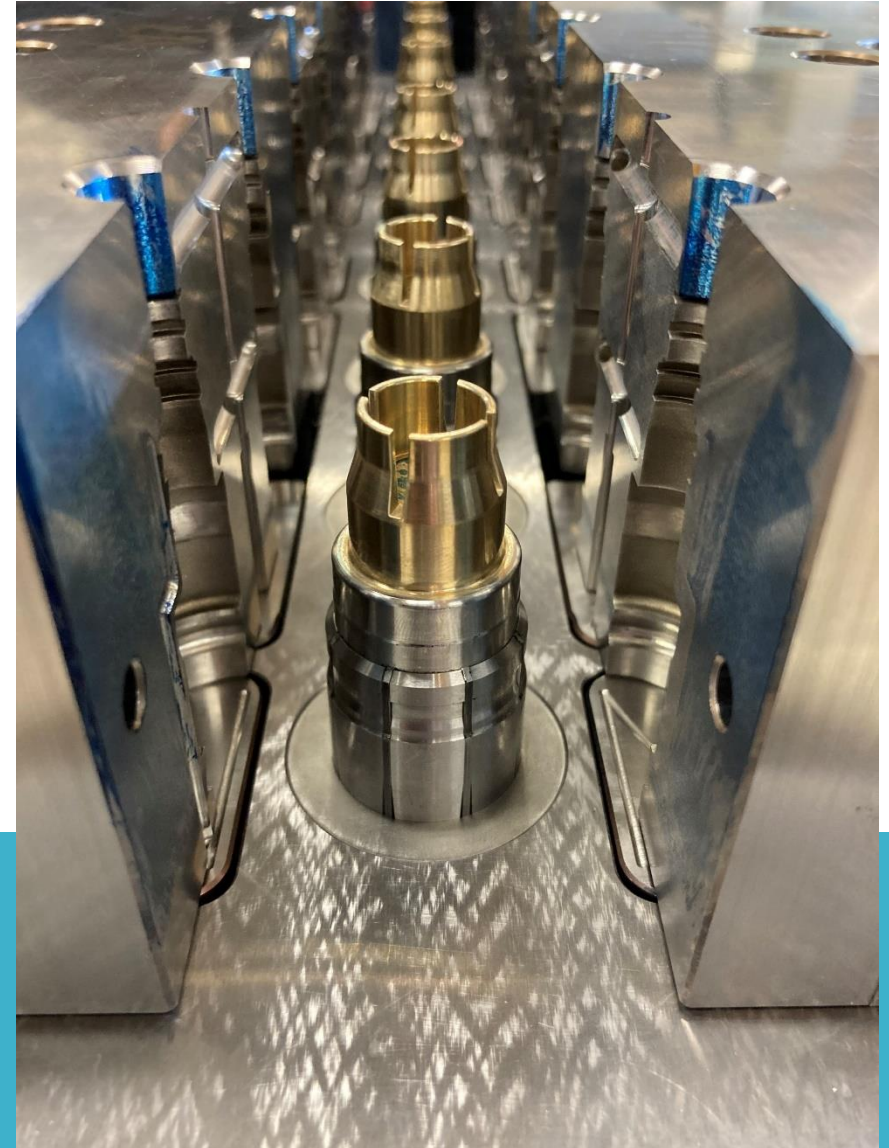


# Tooling repair





# Material combinations





# Repair, obsolete parts

## Gear sprockets

- Base material: Cast Steel
- LMD material: 17-4PH and HeatVar

Rebuilt and added wear layer

Base material HRC35, hardened surface layer HRC58.

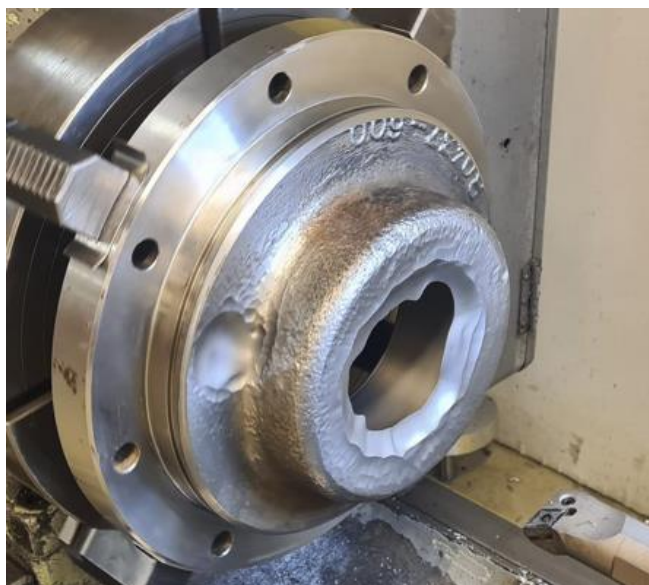
17-4PH to match the ductility in the center, Heatvar matched the surface layer.





## Repair vs replace

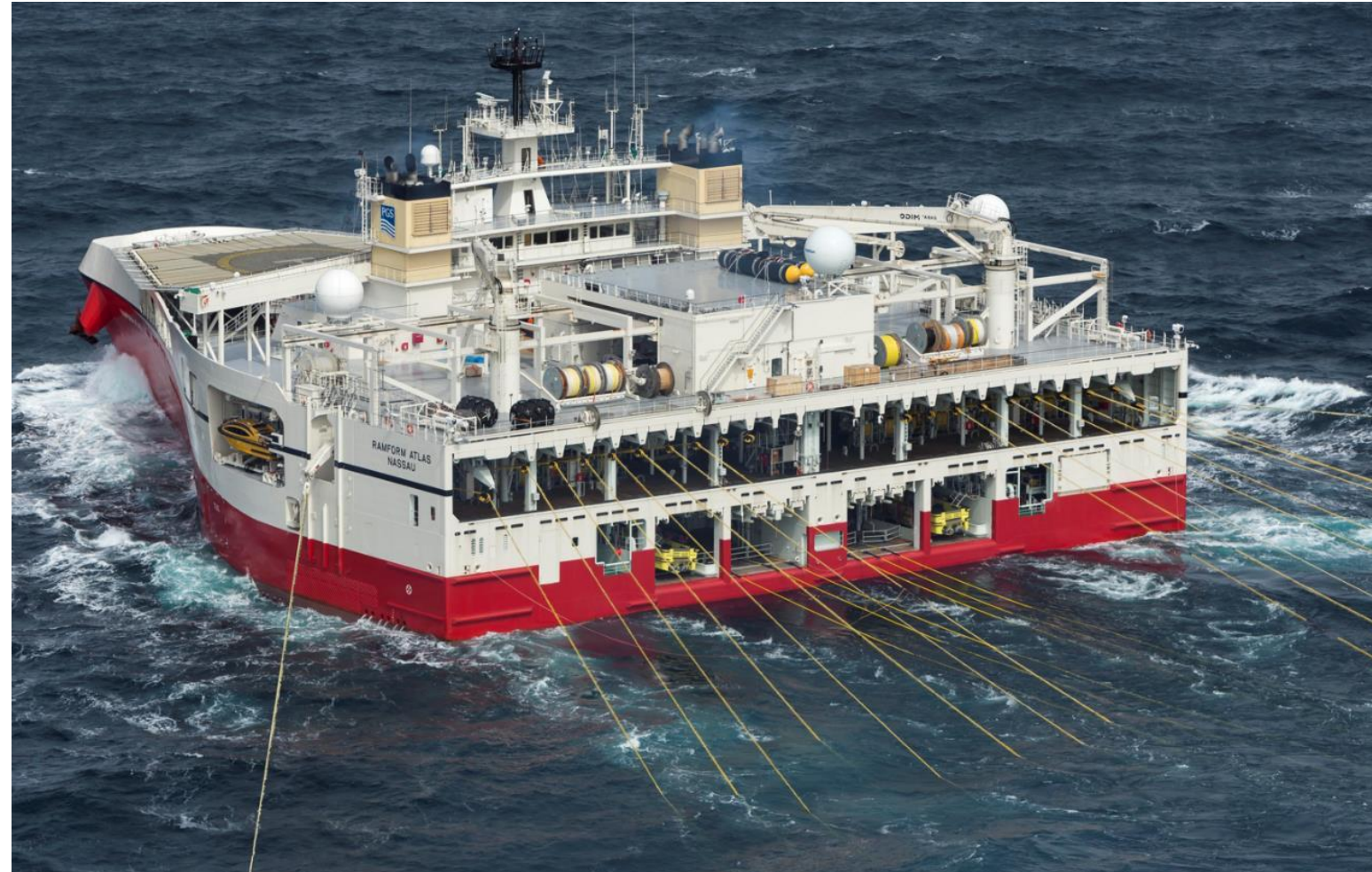
- Obsolete parts, duplex 22cr
- Short lead time with LMD repair
- Sustainability, repair vs new
- High potential in DED repairs





### Repair/Improvement Track Housing

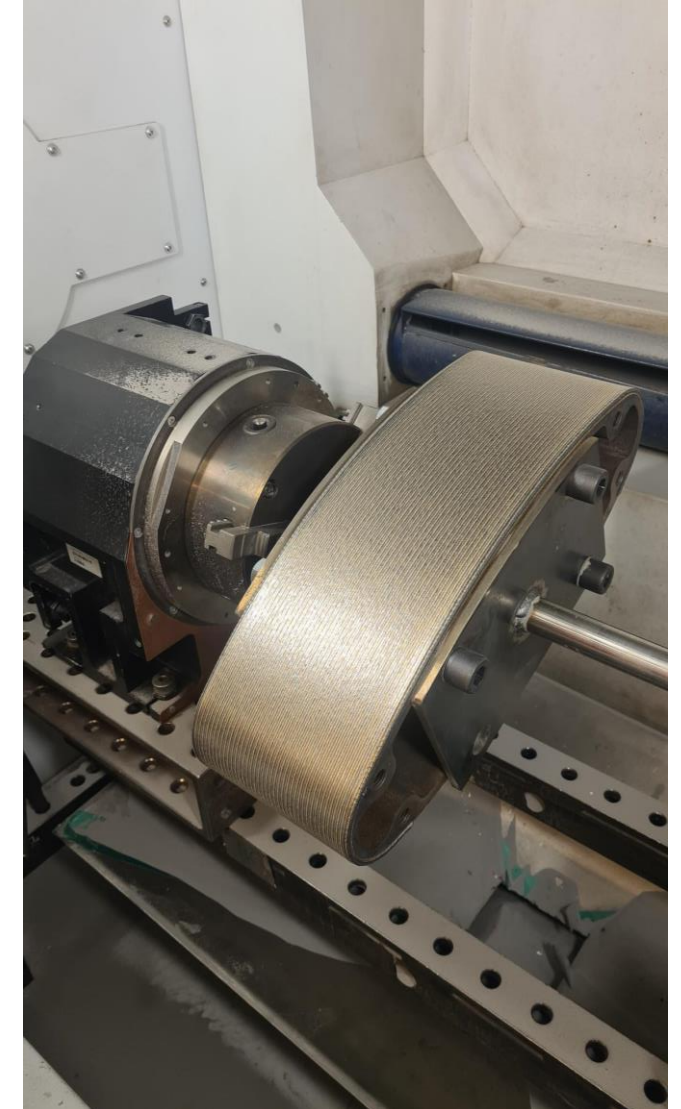
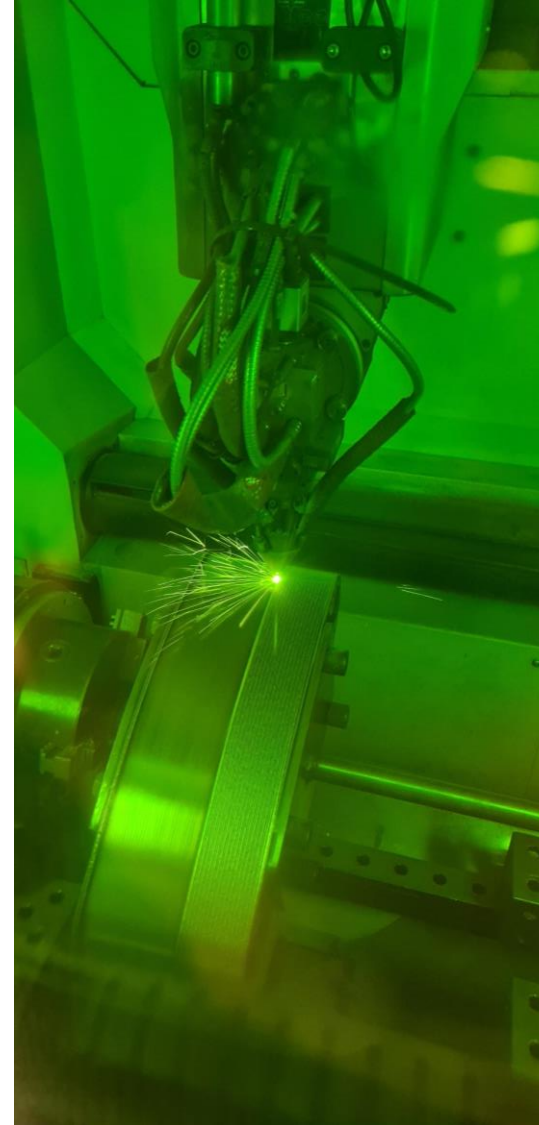
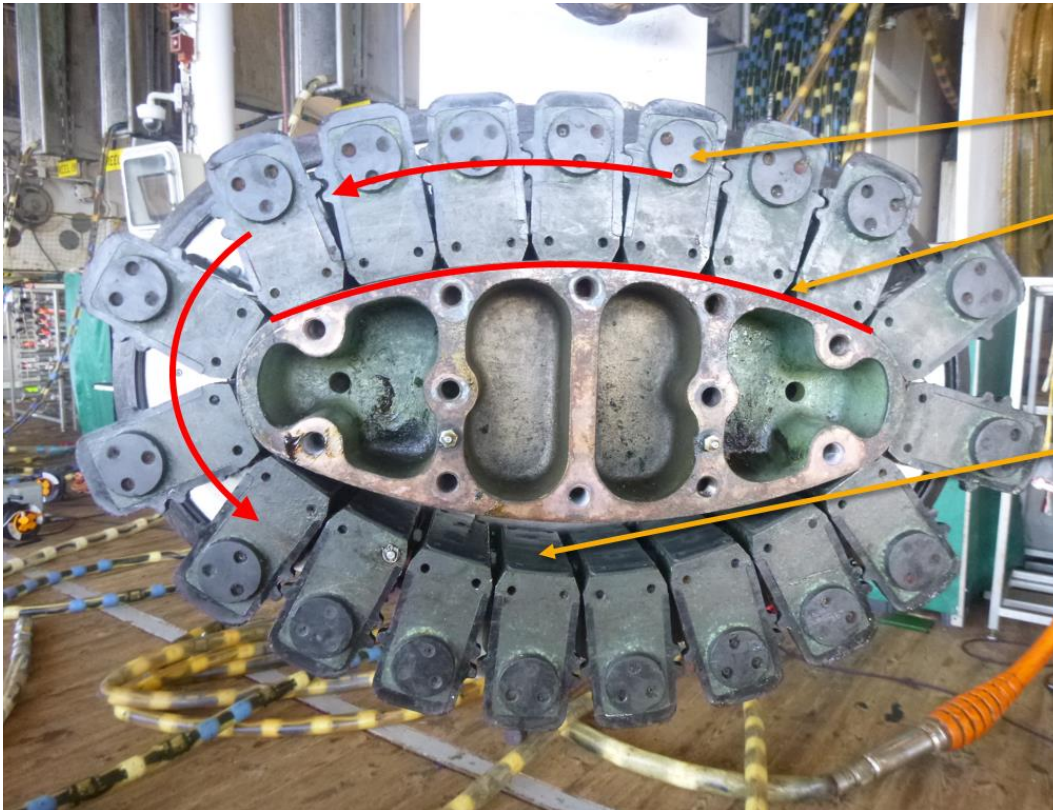
- NiAlBr with hardfacing
- Develop a process for improvement of the hardfacing
- Sustainability repair vs new, improvement





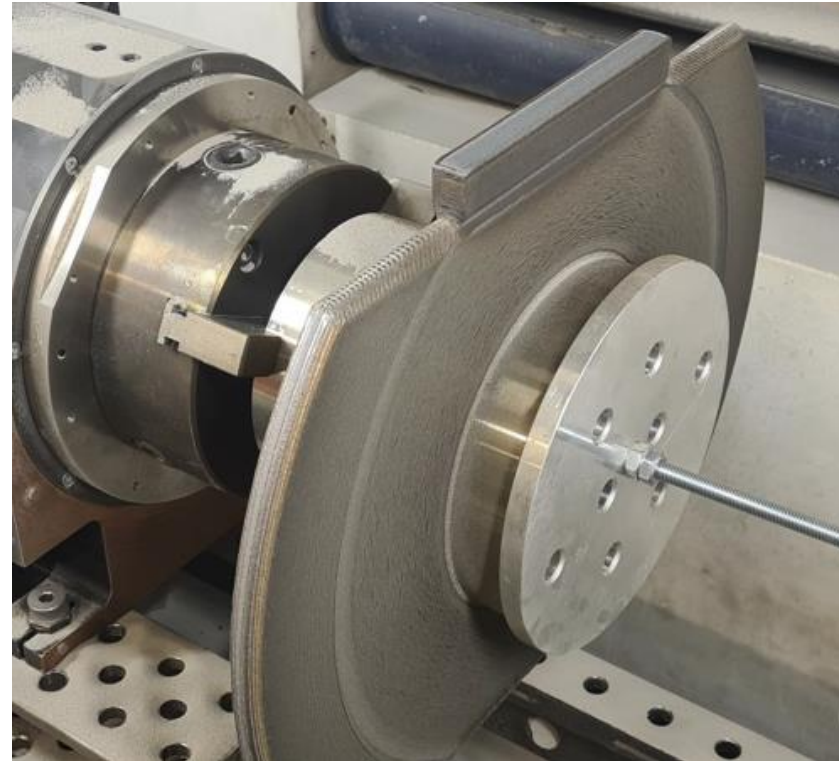
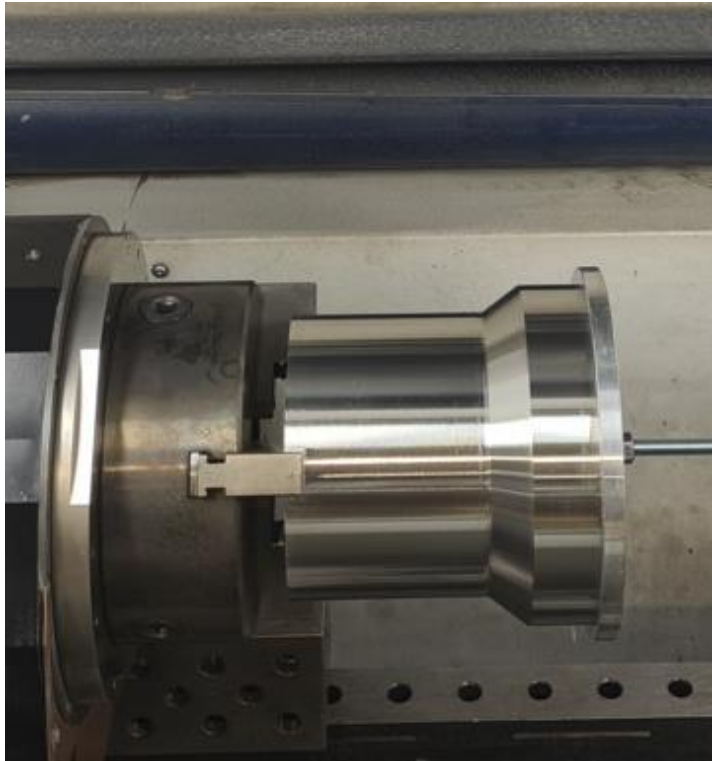
### Repair/Improvement Track Housing

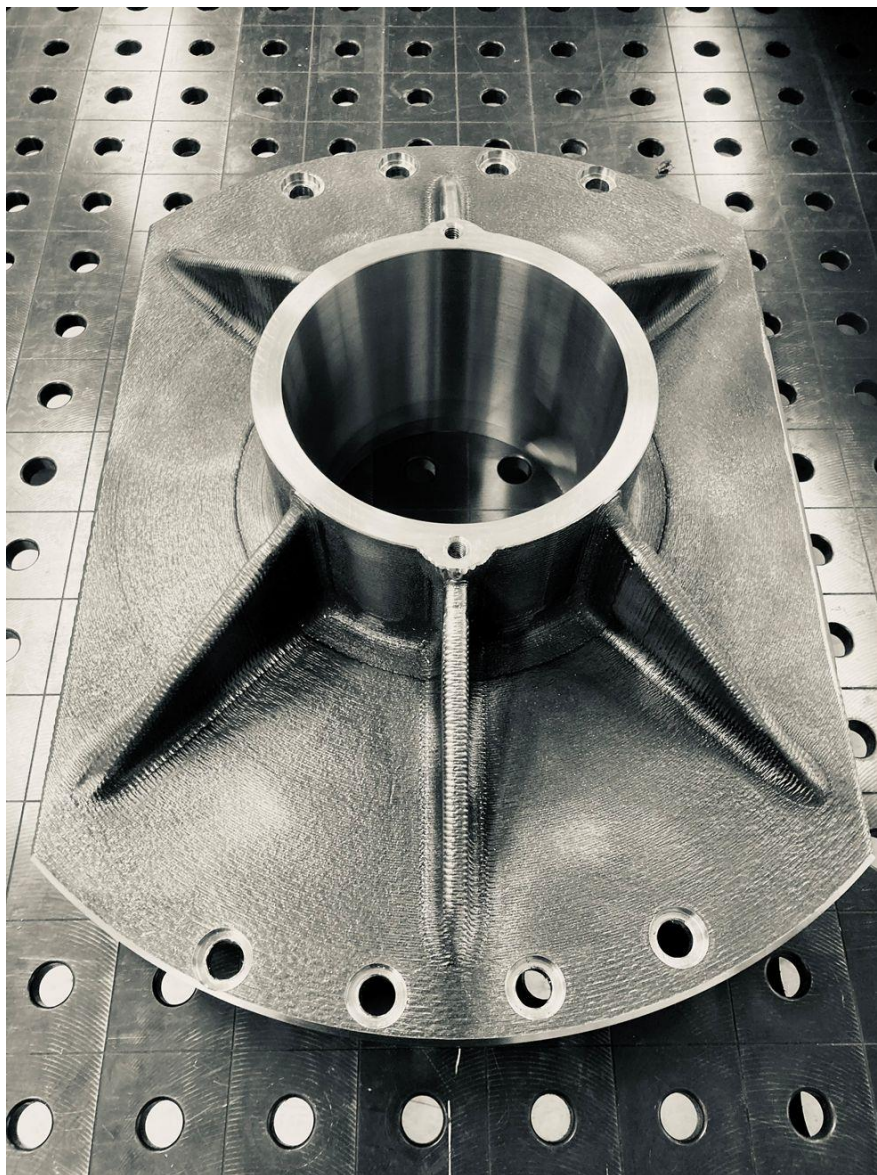
- Sustainability in repair/improvement of existing product.





## Hybrid Manufacturing, 316L; combination of machining & LMD





**Sastry Y Kandukuri, Ph.D.** • 1st

Global Practice Lead - Additive Manufacturing @DNV Norway Senior Pri...

1w • Edited •

Congratulations 🎉 to **Nordic Additive Manufacturing** based in Raufoss, Norway the first AM company to qualify according to the DNV-ST-B203 standard for Hybrid Manufacturing. 🌟 **Sture Henning Sørli Jone Haugvaldstad**

at **DNV**, we're thrilled to announce that NAM, working in collaboration with their OEM partner **Eureka Pumps** and other confidential OEM partners has successfully extended their DNV facility certification to new material grade i.e. both. . 🚀 AM 316L Austenitic Stainless Steel (UNS S31603) to AM 316L for DED-LB and the qualification of the transition zone with substrate 316L (1.4404) and AM 316L.

🔍 About NAM: NAM, a dynamic Norwegian start-up, is at the forefront of innovation. Their mission to blend classical manufacturing with cutting-edge Additive Manufacturing (AM). With Laser Metal Deposition (LMD) technology unlocking new possibilities in product design and production. 🛠️

🔍 About Eureka Pumps: NAM' partnered with Eureka Pumps, a renowned Norwegian pump supplier with over 40 years of experience in the oil & gas and marine industry. Eureka Pumps offers an impressive range of pumps and generator sets, covering a wide spectrum of applications. 🚢 🏠

**Sondre Løken Stian Gurrik Geir Egil Eie DNV - Energy Systems Gustav Heiberg Hans Axel Bratfos Daqin Xu Gisle Rørvik Thomas Bøe Jevnaker Tor Henning Molstad**





**NAM**

NORDIC ADDITIVE MANUFACTURING

**EUREKA**



**equinor**

**PROJECT**

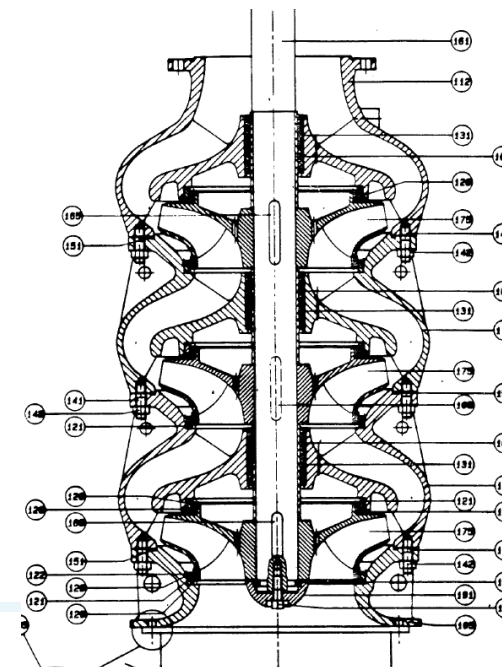
Energy optimizing a 45 meters line-shaft seawater lift pump with additive manufacturing

## Scope of work

- Equinor contacted Eureka regarding the need to energy optimize a 3stage line-shaft seawater lift pump.
- The pump delivered 1950m<sup>3</sup>/h of water, but was dumping 1000m<sup>3</sup>/h overboard resulting in a large waste of energy

## Estimated Co2 and Energy reduction

- 300kW, 36% Savings  
1314-ton Co2 annually
- Total savings in energy, Co2 permits and sales of gas - 5.4mill NOK/annually. (Data from 20.03.23)





# Duplex 22Cr Impeller, qualified products

- FAT Performed in full scale 100 kilo duplex impeller
- Low vibrations
- Slightly lower power consumption than calculated
- AM-built impellers a great success 😊



# Contact



Website  
[www.nordicadditive.no](http://www.nordicadditive.no)



Office  
Fabrikkvegen 11  
2830 Raufoss



Phone  
(+47) 91 70 25 76



E-post  
[post@nordicadditive.no](mailto:post@nordicadditive.no)

