European Conference of Defence and the Environment

ECDE 2024

ANE OFSTAD PRESTERUD
Norwegian Defense Research Establishment

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FFI Norwegian Defence Research Establishment

Sustainability in defence investment projects

Ane Ofstad Presterud

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RESEARCH ON DEFENCE INVESTMENTS

Research program:

Investment and logistics analysis (INLOG)

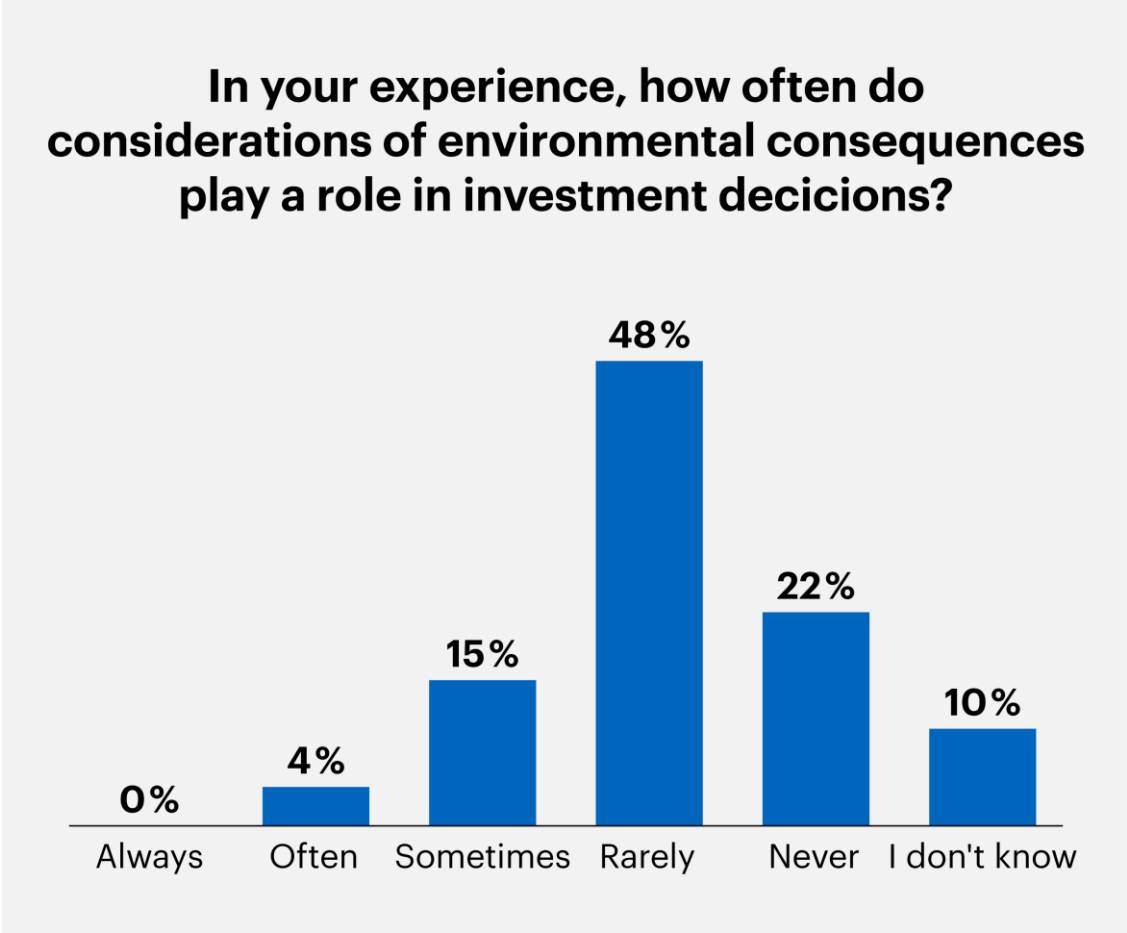
Foto: Forsvaret

FFI Norwegian Defence Research Establishment

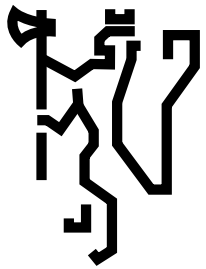
Sustainability in defence investment projects

Status: sustainability in Norwegian defence investment projects

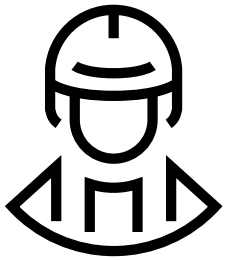
- There is a lack of consensus on what sustainability entails
- The sector is still immature in ensuring sustainability in investment decisions
- Good initiatives exist, but they are sporadic and often bottom-up



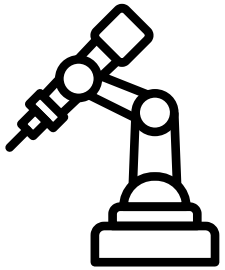
Actors in the Norwegian defence investment process



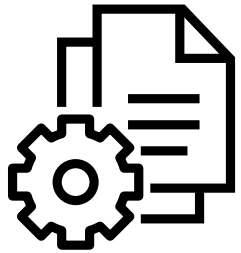
The Norwegian Ministry of Defence



The Norwegian Armed Forces

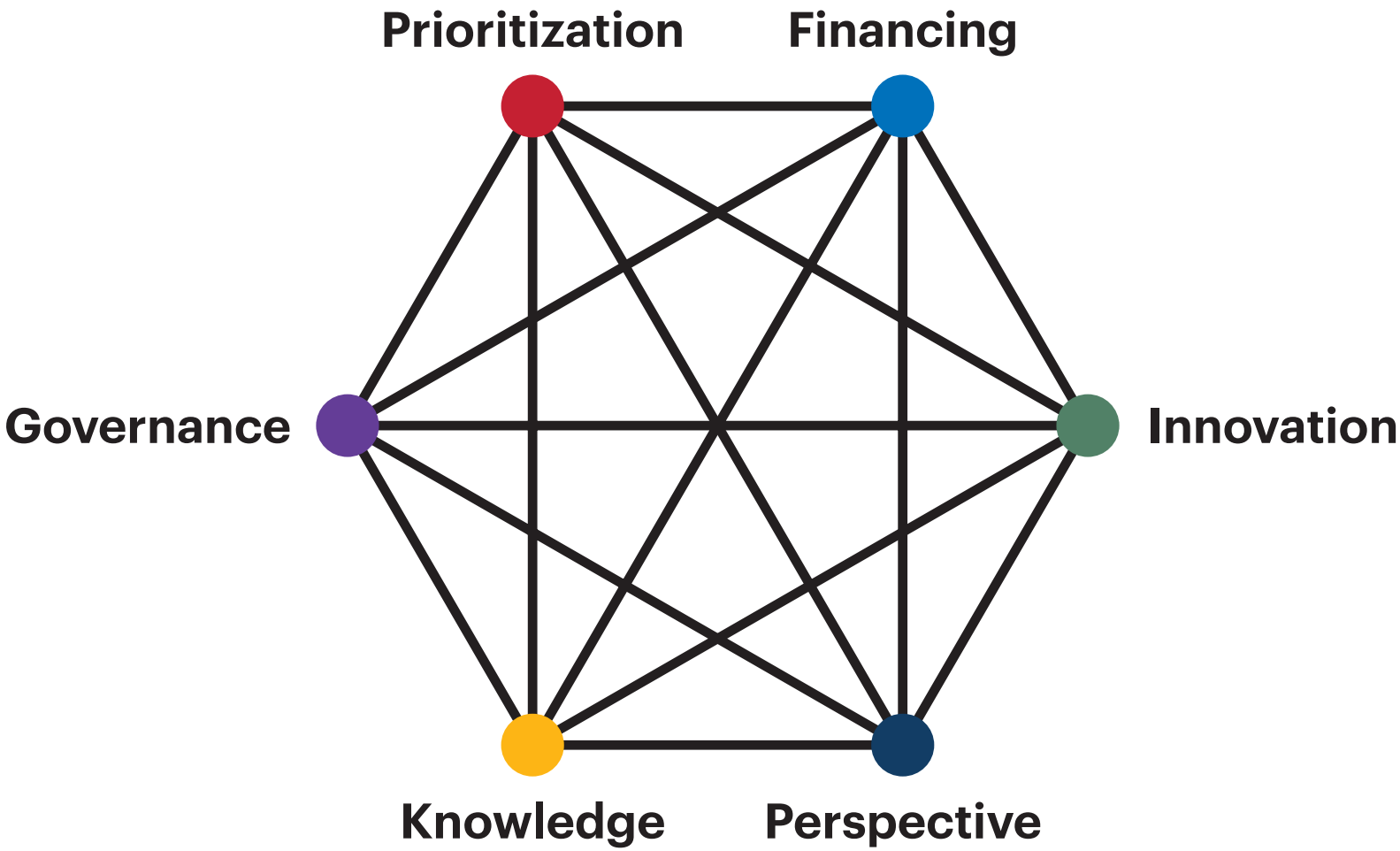


The industry



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

Foto: Forsvaret

Contact us for further information on our research

ane-ofstad.presterud@ffi.no

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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EUROPEAN DEFENCE AGENCY

European Conference of Defense and the Environment
12-13 June 2024 (Oslo)

EMBEDDING CIRCULARITY IN PROCUREMENT: APPROACH AND TOOLS

AN IF CEED PERSPECTIVE

Mathieu SCHWANDER
Project Officer Circular Economy

Karina GLAPKA
Policy Officer Industry Engagement

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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**

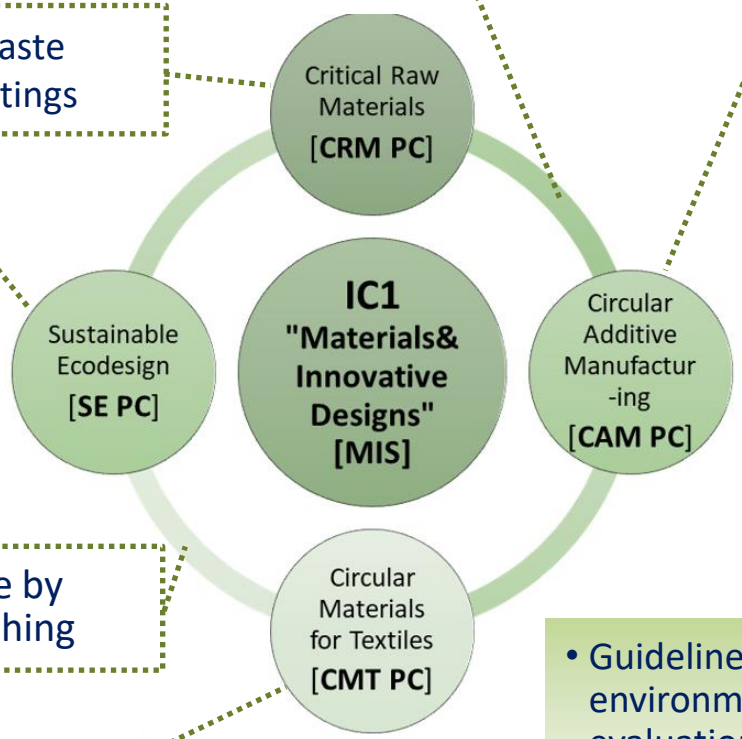
New topic: Post-conflict environmental remediation

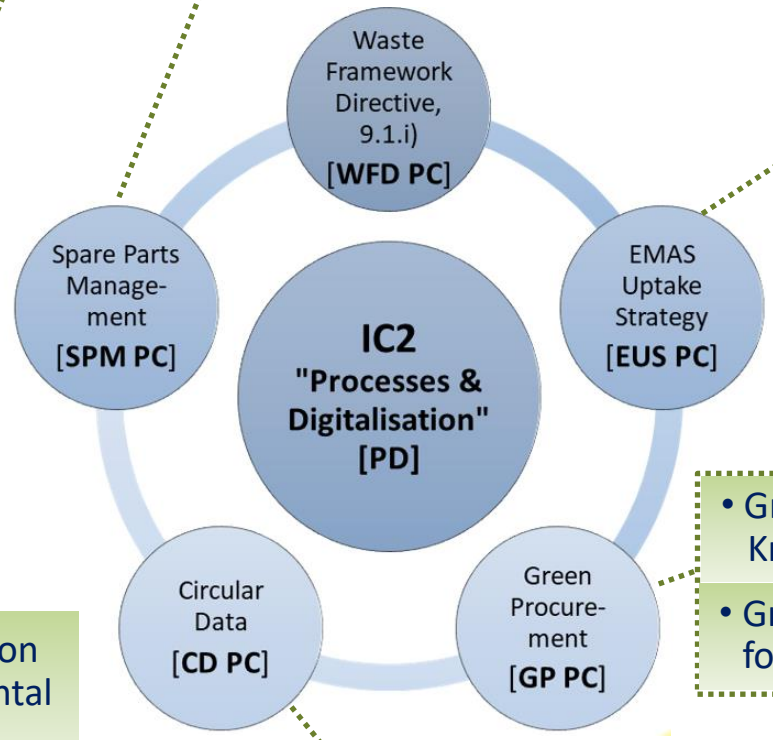
EUROPEAN DEFENCE AGENCY

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

PROJECT IDEAS

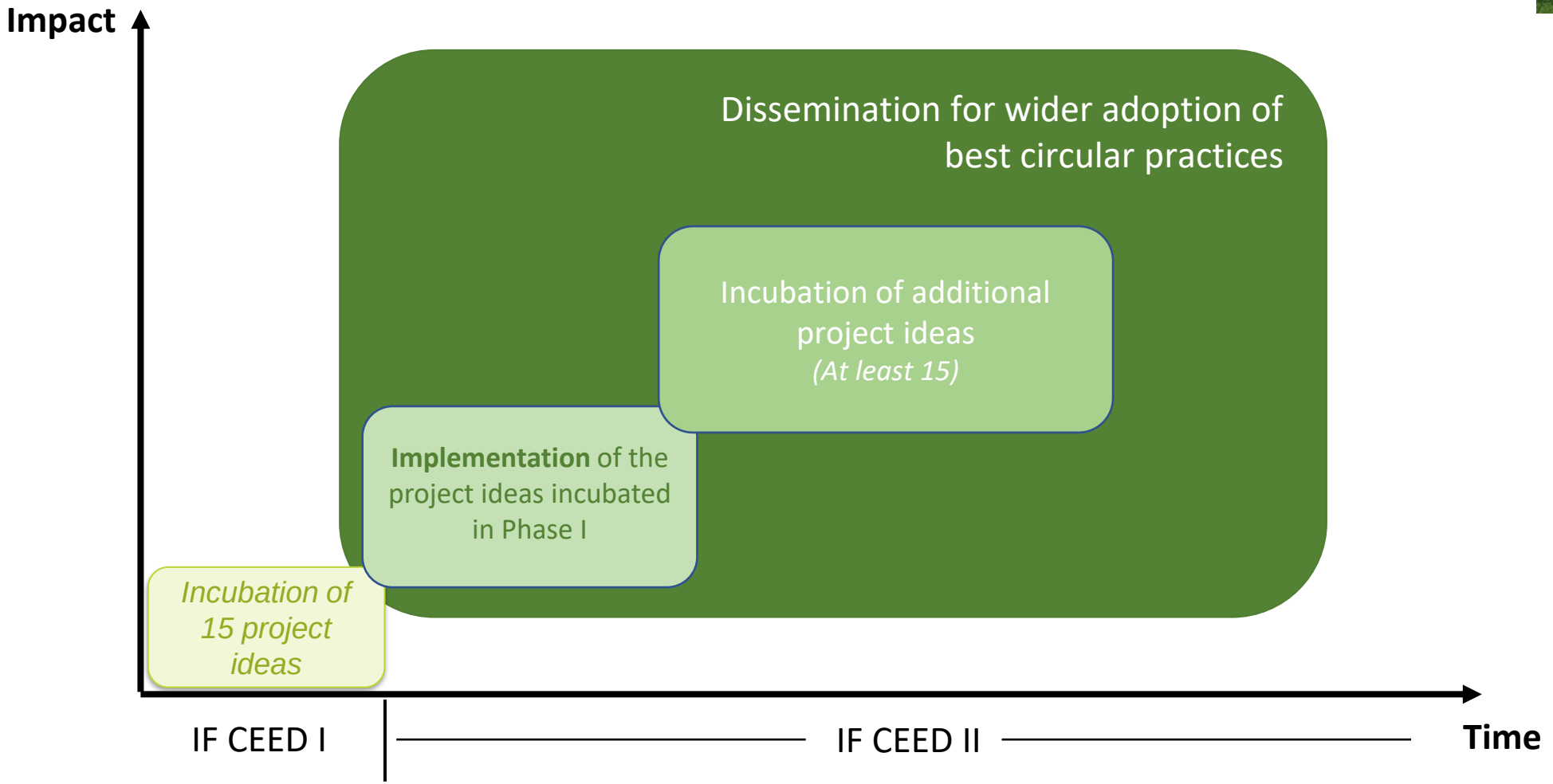
- Materials for energy-efficient AM
- Deployable AM solutions
- Circularity of titanium for armour via AM
- Valorisation of decommissioned assets
- CRM "mining" from E-waste
- Substitution of CRM coatings
- Identification of ecodesign requirements
- EMAS at experimental test ranges
- EMAS training course
- Safe-and-sustainable by design protective clothing
- Green Procurement Knowledge Platform
- Green Procurement Training for Defence
- Guidelines on environmental evaluation
- Circularity of soldier equipment
- Smart textile valorisation
- Digital Product Passport for Armour Components





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

PHASE 2 - OBJECTIVES



EUROPEAN DEFENCE AGENCY

European Conference of Defense and the Environment
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GREEN PROCUREMENT IN DEFENCE

GREEN PROCUREMENT

WHY?

- **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.
- NORDEFCO - 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_{CO_2}).

➢ 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)

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 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

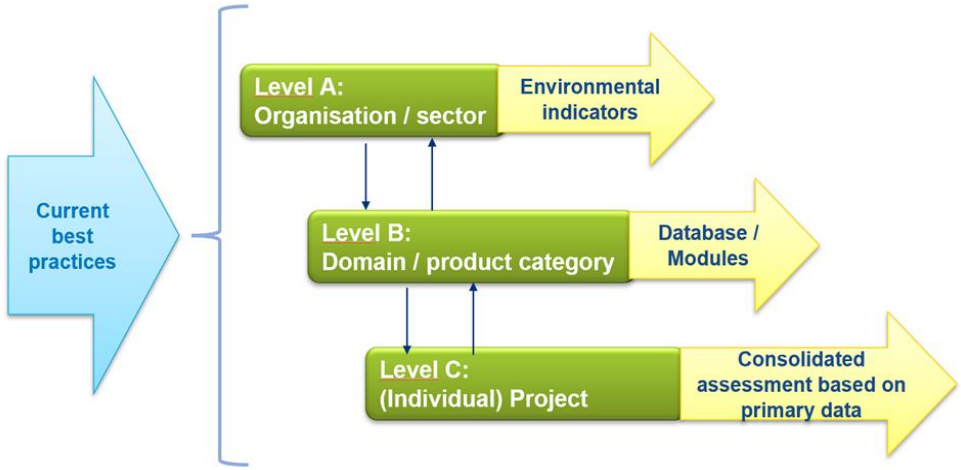
GOING FURTHER

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.

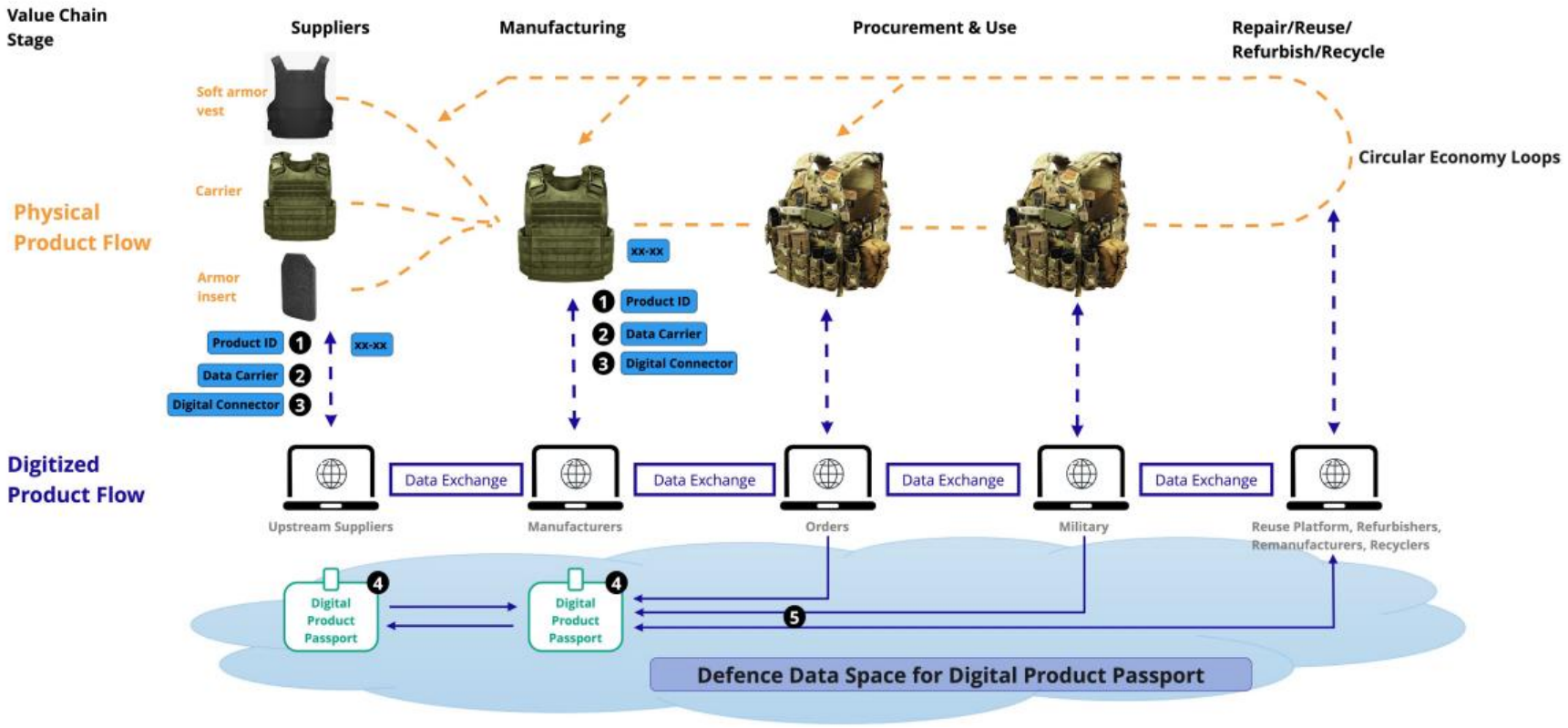
- **What do we want to achieve?**
  - Harmonisation of practice via…
  - … the establishment of guidelines for environmental evaluation in defence applications.

- **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.

For questions or expression of interests, please email:
circular.economy@eda.europa.eu

ACKNOWLEDGEMENT

IF CEED 2 is currently co-funded by

eda.europa.eu/ifceed

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ECDE 2024

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EUROPEAN CONFERENCE OF DEFENSE AND THE ENVIRONMENT

ENVIRONMENTAL PERSPECTIVE FOR DEFENCE PROCUREMENT:

THE IMPORTANCE OF THE LIFE-CYCLE APPROACH

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José Baranda Ribeiro: jose.baranda@dem.uc.pt

12TH 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 Procurement

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)

Green Procurement

Ecolabels

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

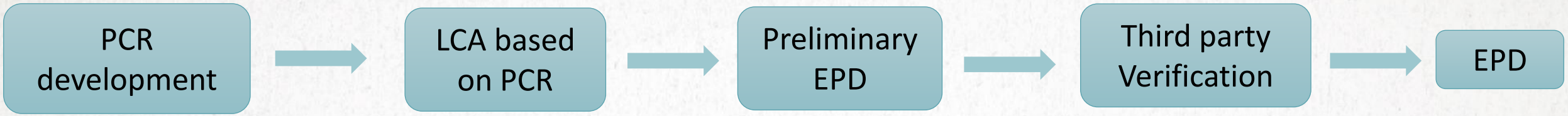
Ecolabels Type II are self-declarations – low credibility.

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).

Green Procurement

Ecolabels

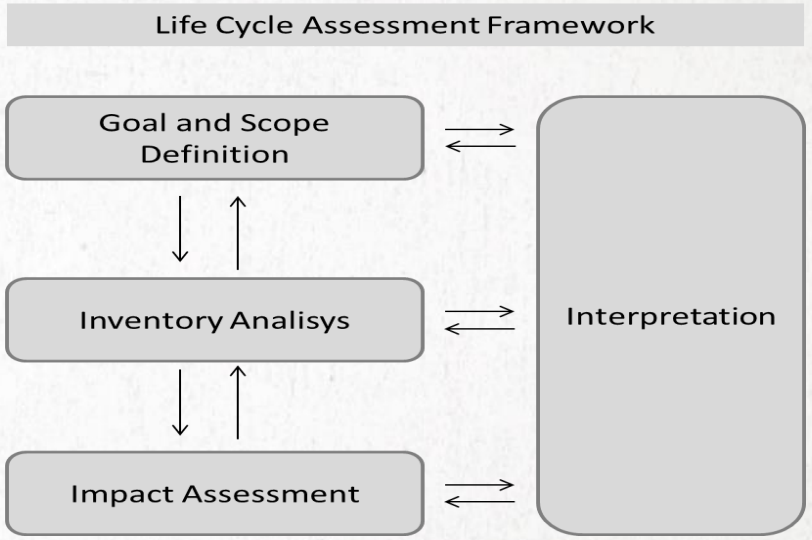
Environmental Product Declaration process:



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

LCA application for defence procurement

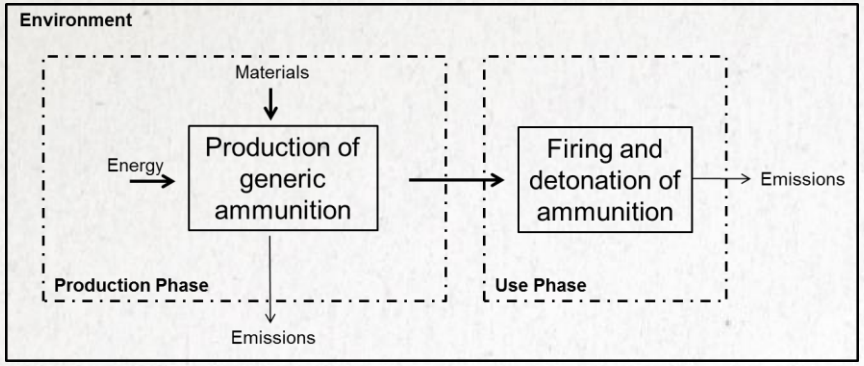
Life-Cycle Assessment is a tool that can be used to inform the public or stakeholders about the quantitative environmental impacts associated with products, platforms or activities.

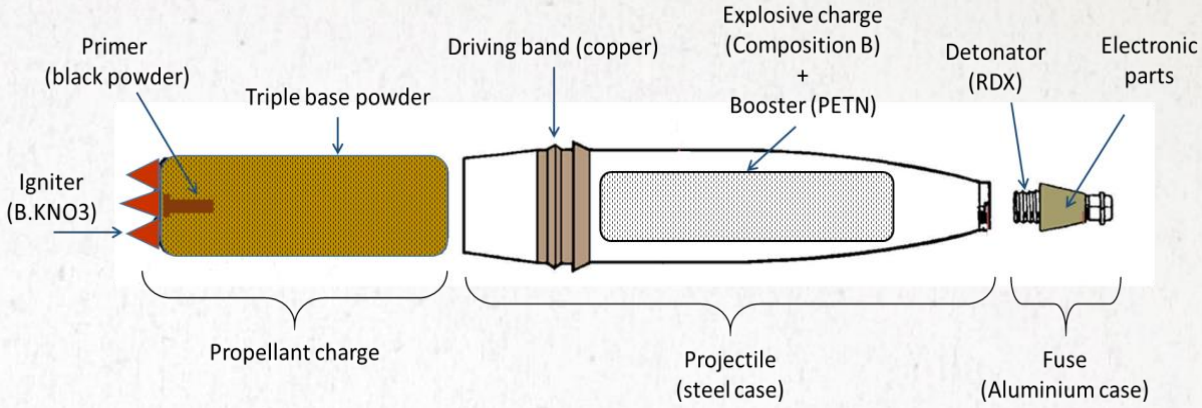


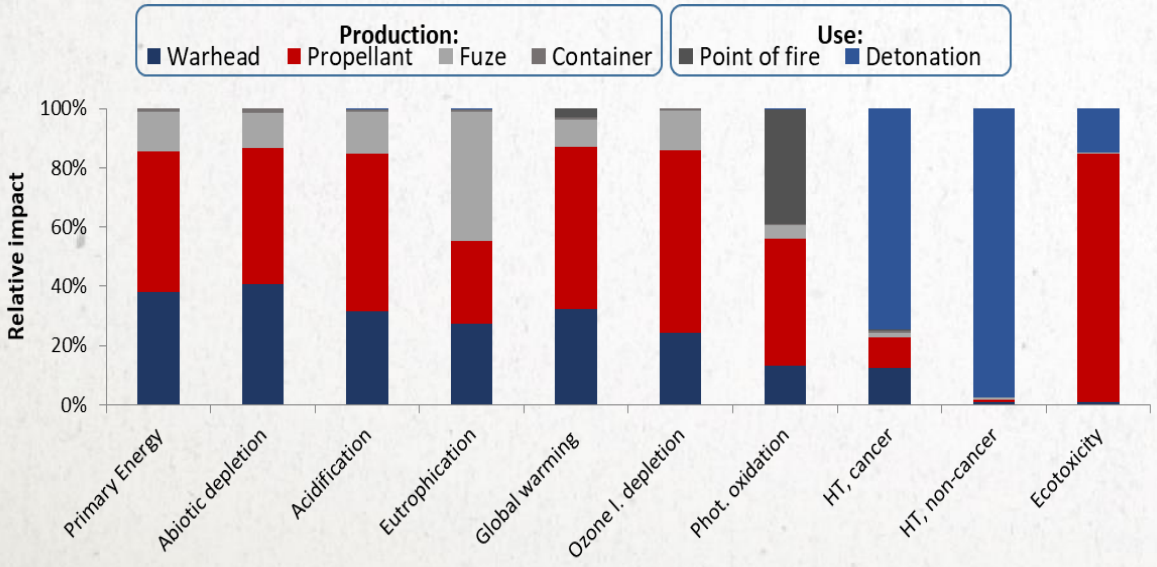
- Support ecodesign solutions;
- Identification of environmental hot-spots;
- Identification of improvements;
- Comparison of products or activities with the same function.

LCA application for military systems

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



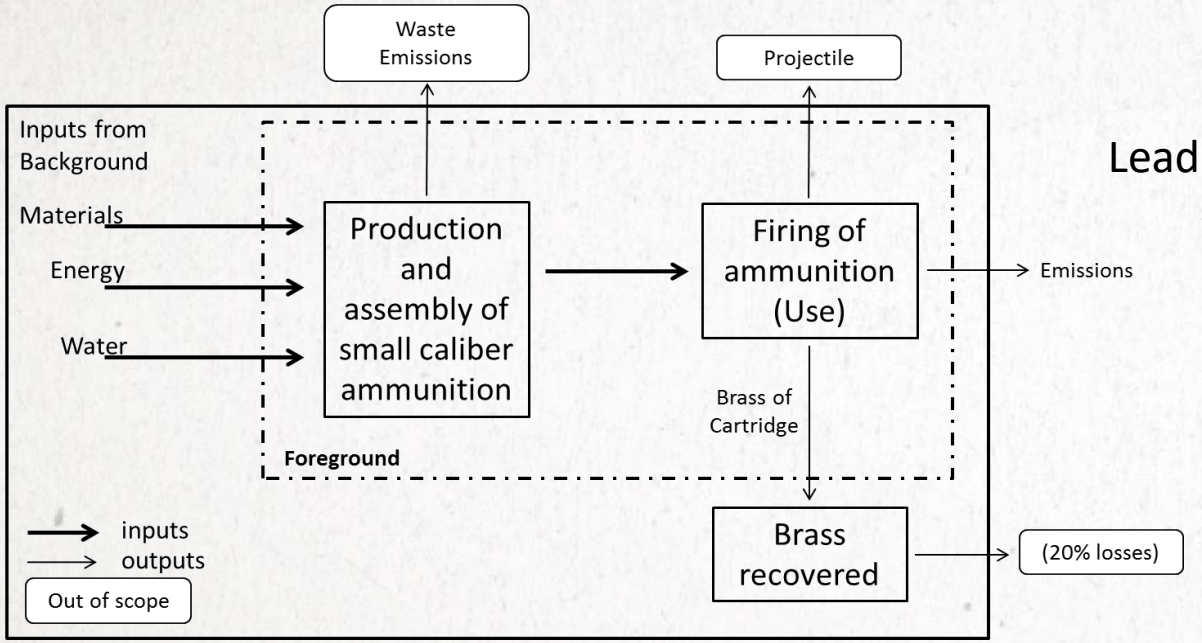




- Production presents a higher contribution to the environment impact categories;
- Use phase has a higher contribution to the toxicological impact categories;
- Exception for triple base powder production for ecotoxicity: emissions of insecticides into the soil (Profenofos, Cyfluthrin, Chlorpyrifos, 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	Brass	4.9E−03	Brass	4.9E−03	Brass	4.9E−03	Brass	4.9E−03
Projectile	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
	Antimony powder	9.5E−05	Antimony powder	9.5E−05				
Primer	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**

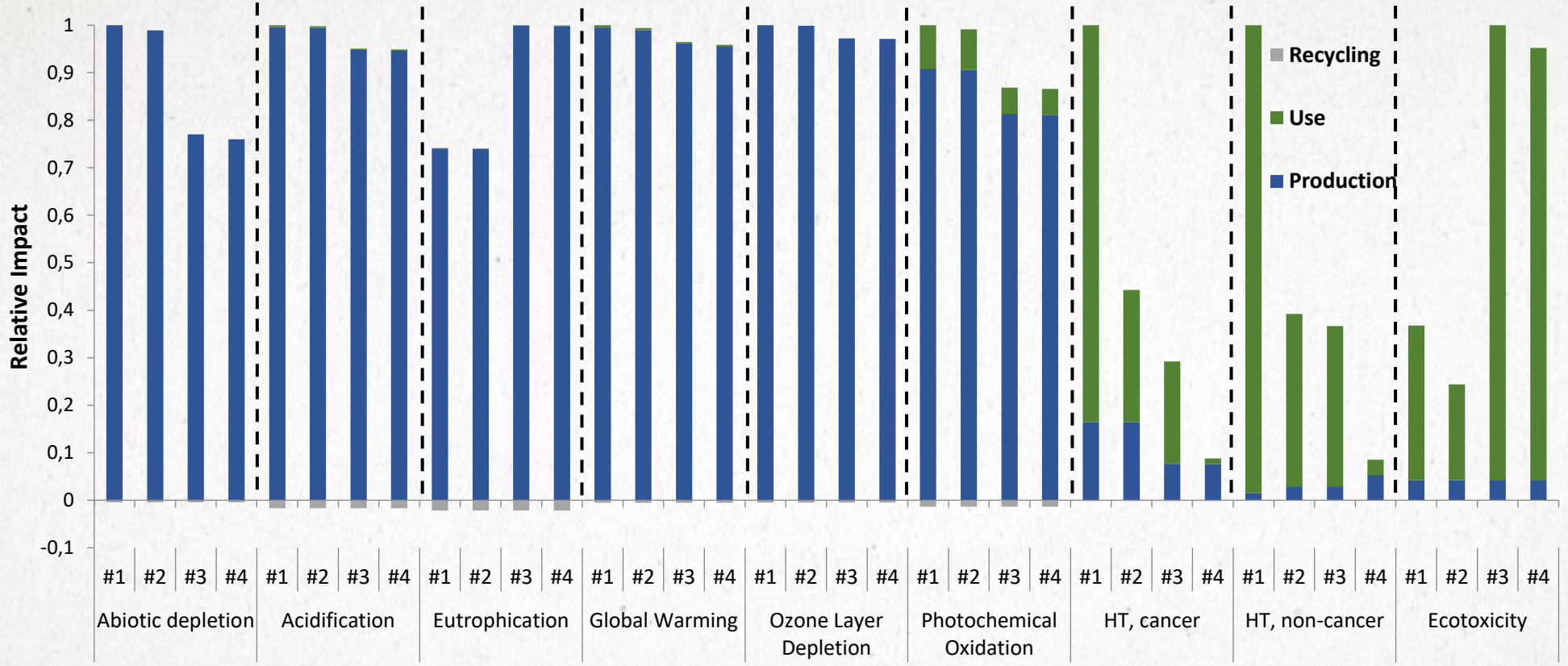
Substance	Emissions (mg/bullet)			
	#1	#2	#3	#4
CO	**198.65**	**184.75**	119.21	118.76
CO_2	**101.79**	**96.79**	58.56	57.93
NO	3.80	3.22	3.85	**4.41**
NO_2	**0.64**	**0.62**	0.49	0.52
NH_3	**3.10**	**2.46**	1.67	1.84
HCN	**1.77**	**1.22**	0.18	0.13
CH_4	**1.10**	**0.96**	0.61	0.59
Pb	**3.14**	**1.04**	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

LCA application for military systems

EDA project - Ecodesign of small calibre ammunition



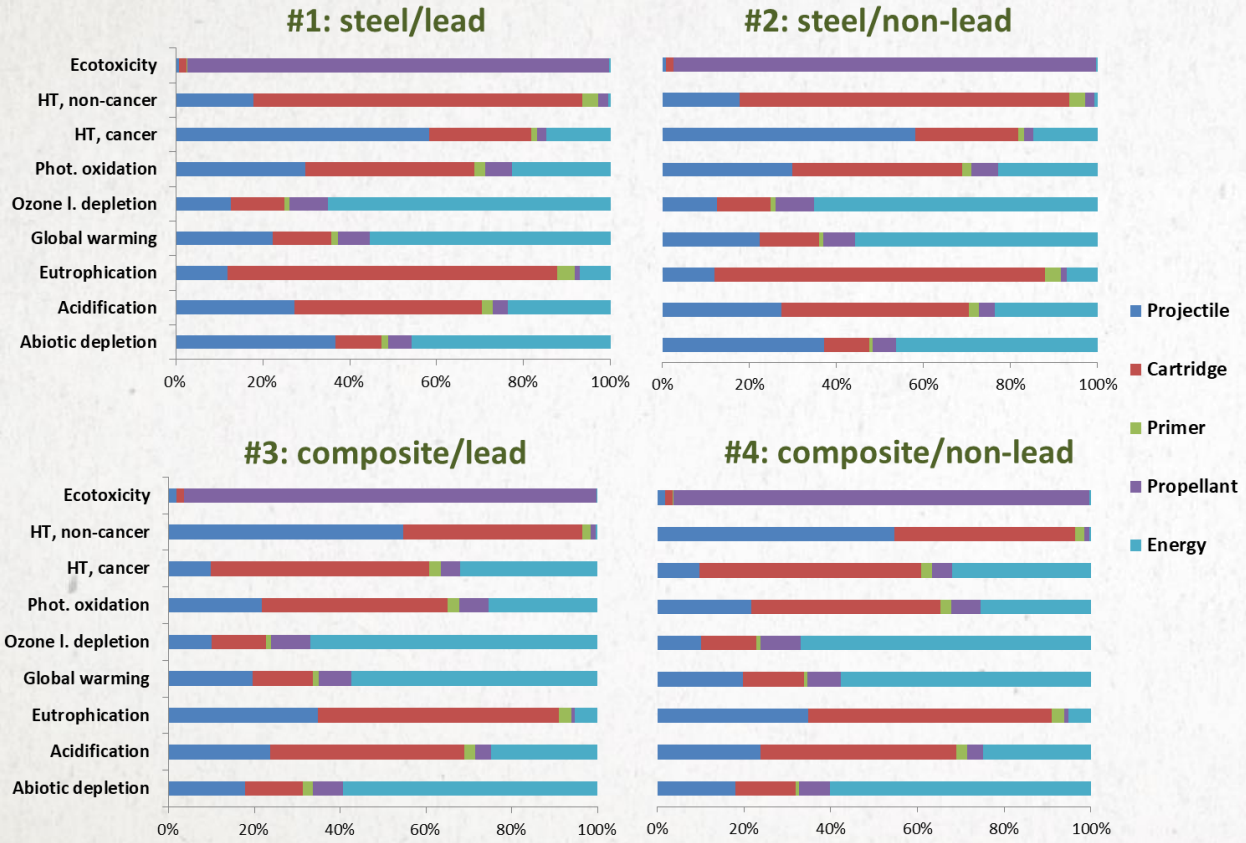
The results show a trade-off: the "best" solution depends of the impact category

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

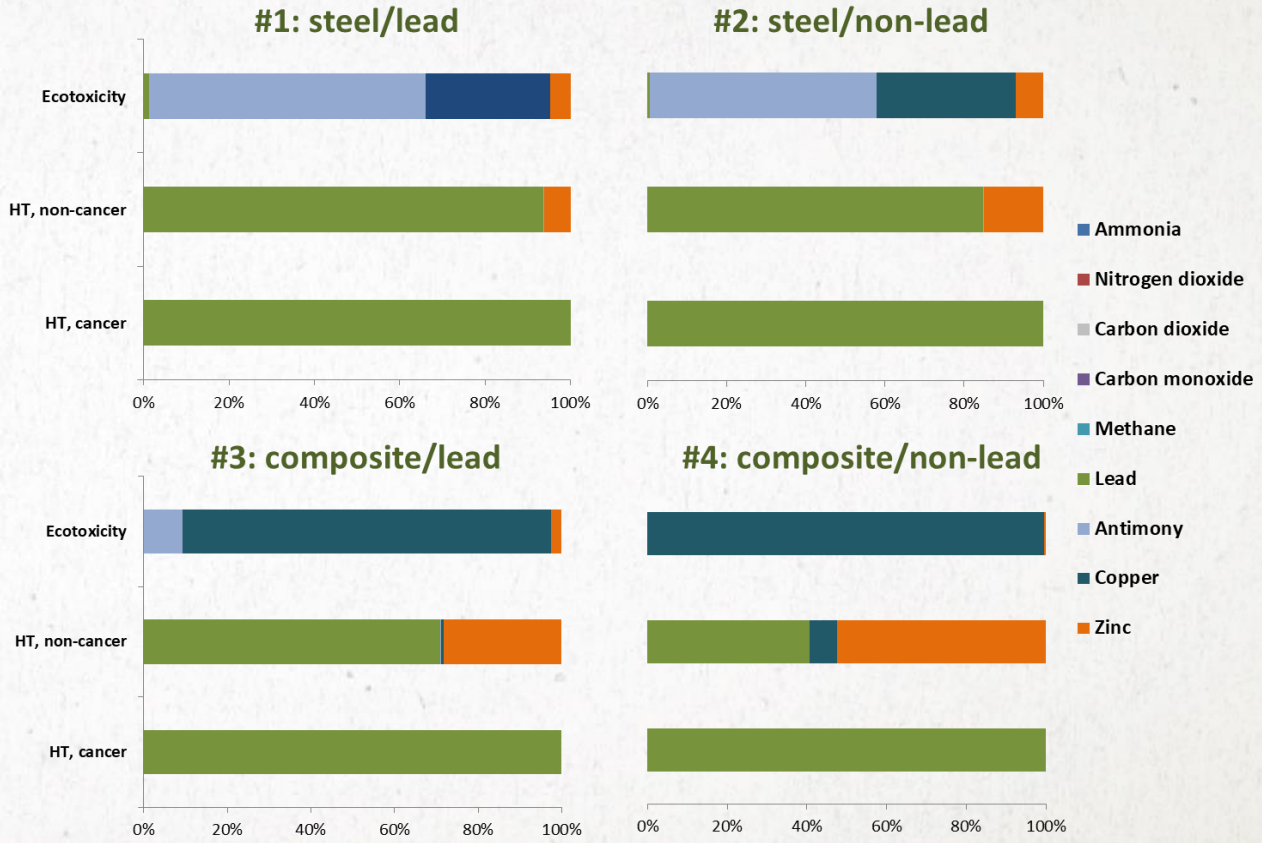
LCA application for military systems

EDA project - Ecodesign of small calibre ammunition

Production Phase



Use Phase



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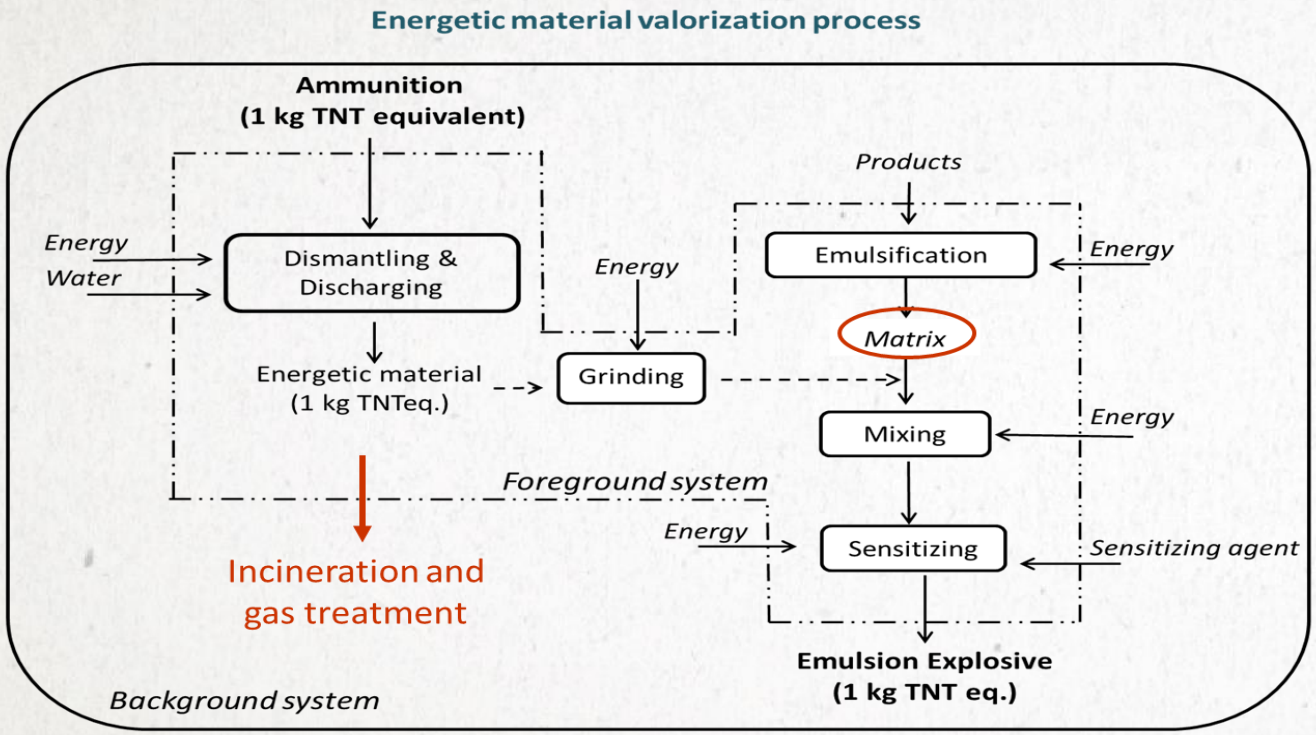
LCA application for military systems

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

A circular economy approach

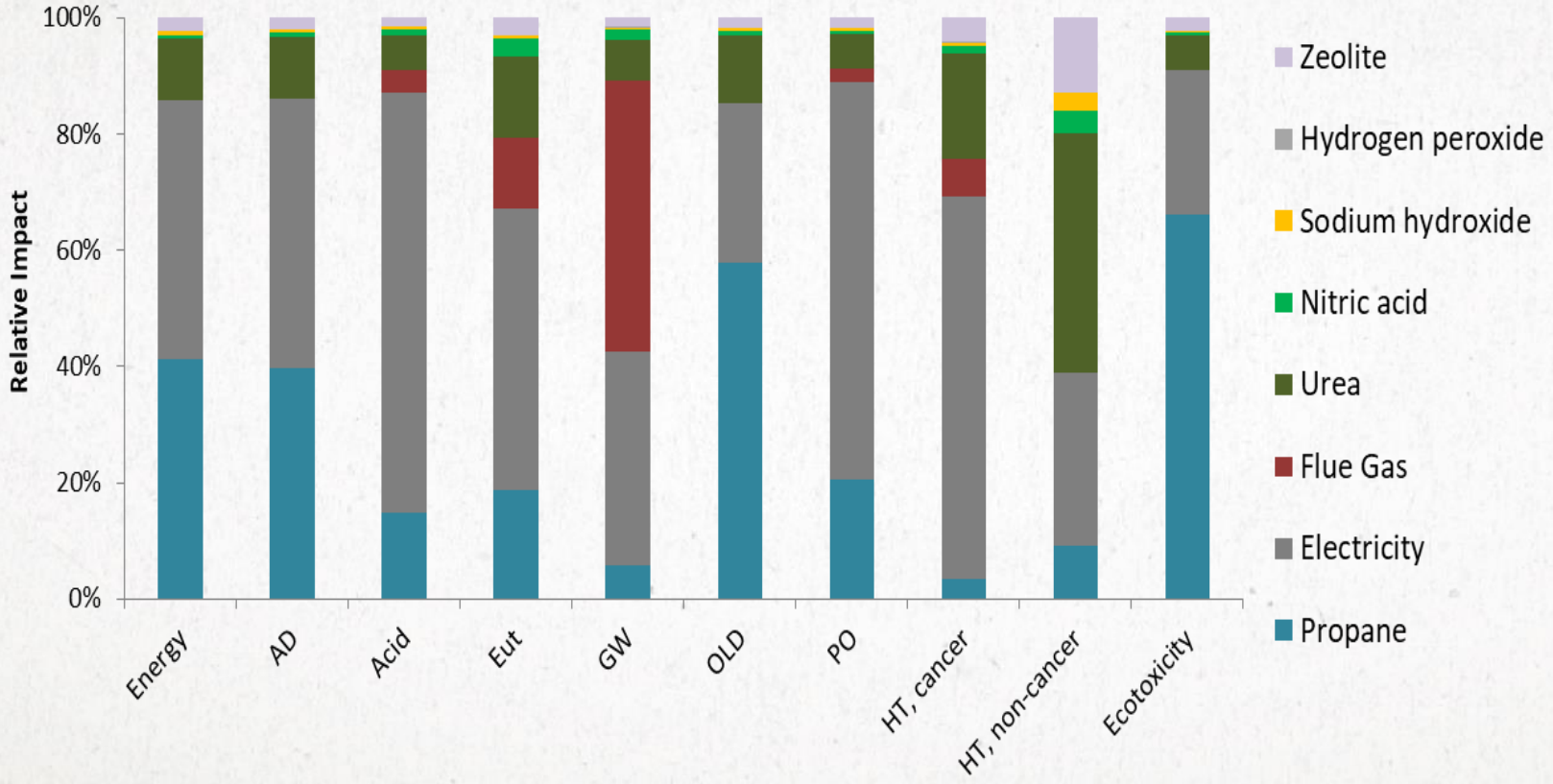


Source: C. Ferreira, F. Freire, J. Ribeiro, Life-cycle assessment of a civil explosive, Journal of Cleaner Production, 89, 2015, 159 – 164.

LCA application for military systems

Demilitarization of military ammunition

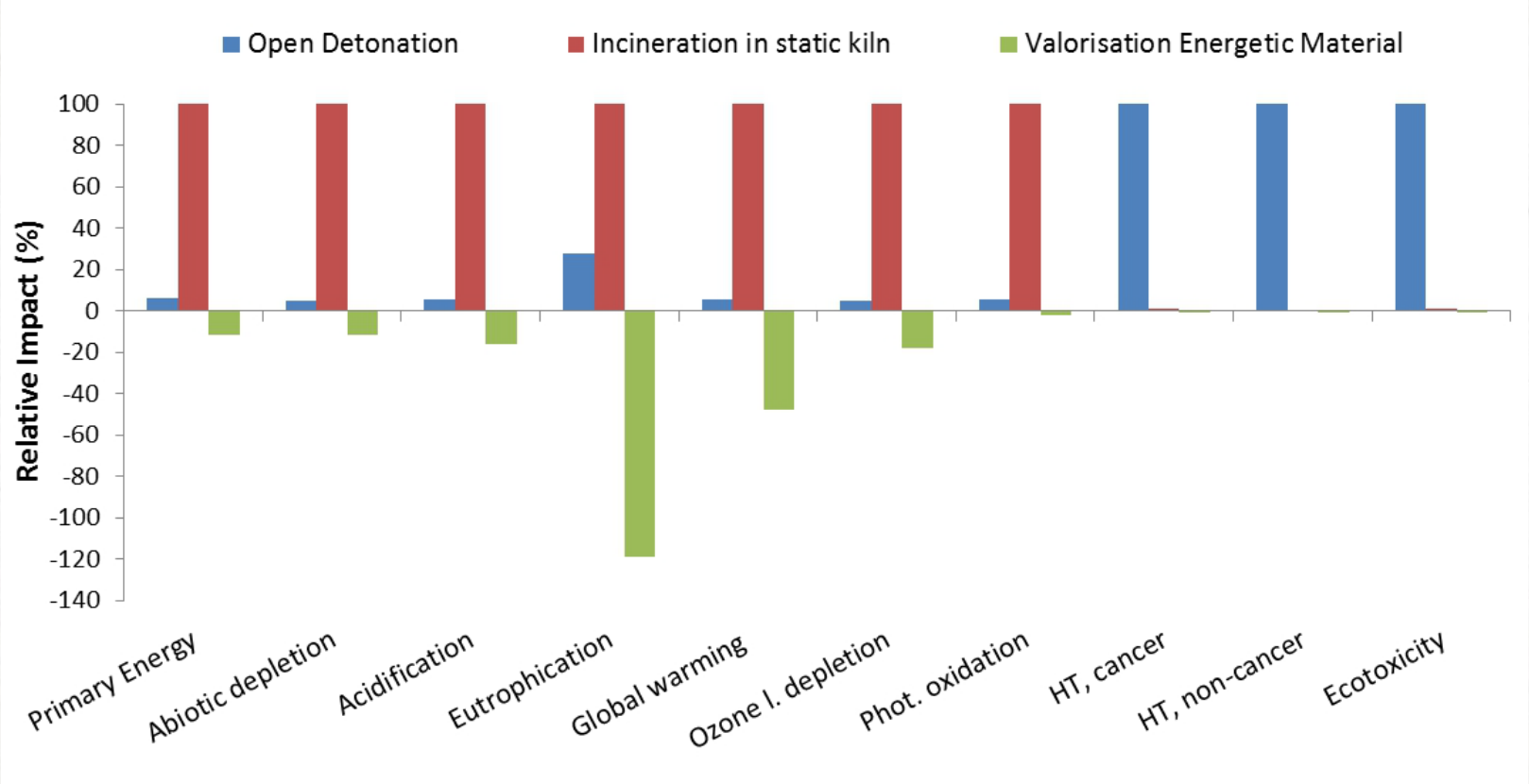
- Impacts associated with the incineration in a static kiln and flue gas treatment processes.



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

1 2  9 0 UNIVERSIDADE D COIMBRA

THANK YOU!

Carlos Ferreira: carlos.ferreira@dem.uc.pt
José Baranda Ribeiro: jose.baranda@dem.uc.pt

European Conference of Defence and the Environment

ECDE 2024

PER ØIVIND BERG
NATO Support and Procurement Agency

EUROPEAN
CONFERENCE OF
DEFENCE AND THE
ENVIRONMENT

NATO SUPPORT AND PROCUREMENT AGENCY

AGENCE OTAN DE SOUTIEN ET D'ACQUISITION

NSPA

OPERATIONAL ENERGY

NSPA and environmental focus

PREPARED FOR
ECDE
12. June 2024

PRESENTED BY
Major Per Øivind BERG

NSPA Clean energy video

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

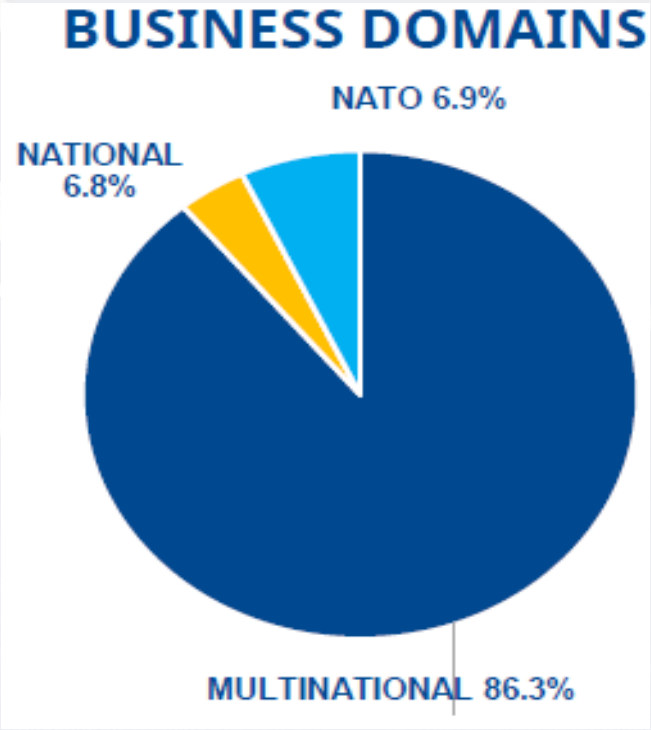
LIFE CYCLE MANAGEMENT

ACQUISITION

CENTRAL EUROPE PIPELINE SYSTEM (CEPS)

NATO AIRLIFT MANAGEMENT (NAM)

NSPA Clean energy vision & initiatives



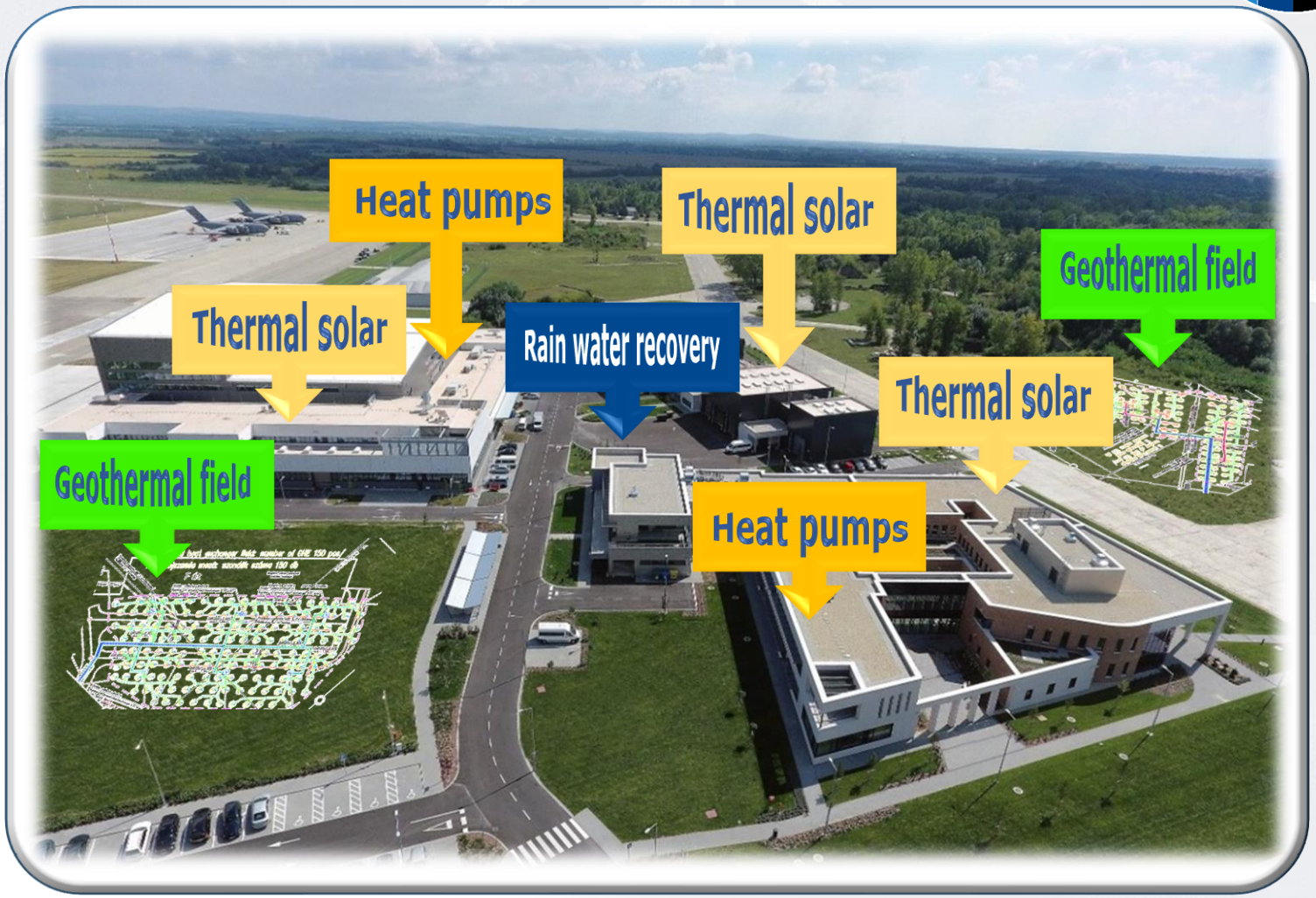
NSPA
NATO OTAN

CLEAN ENERGY INDUSTRY EVENT
7-8 JUNE 2023

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

NAM-Papa - Current Clean Energy Solutions - Example

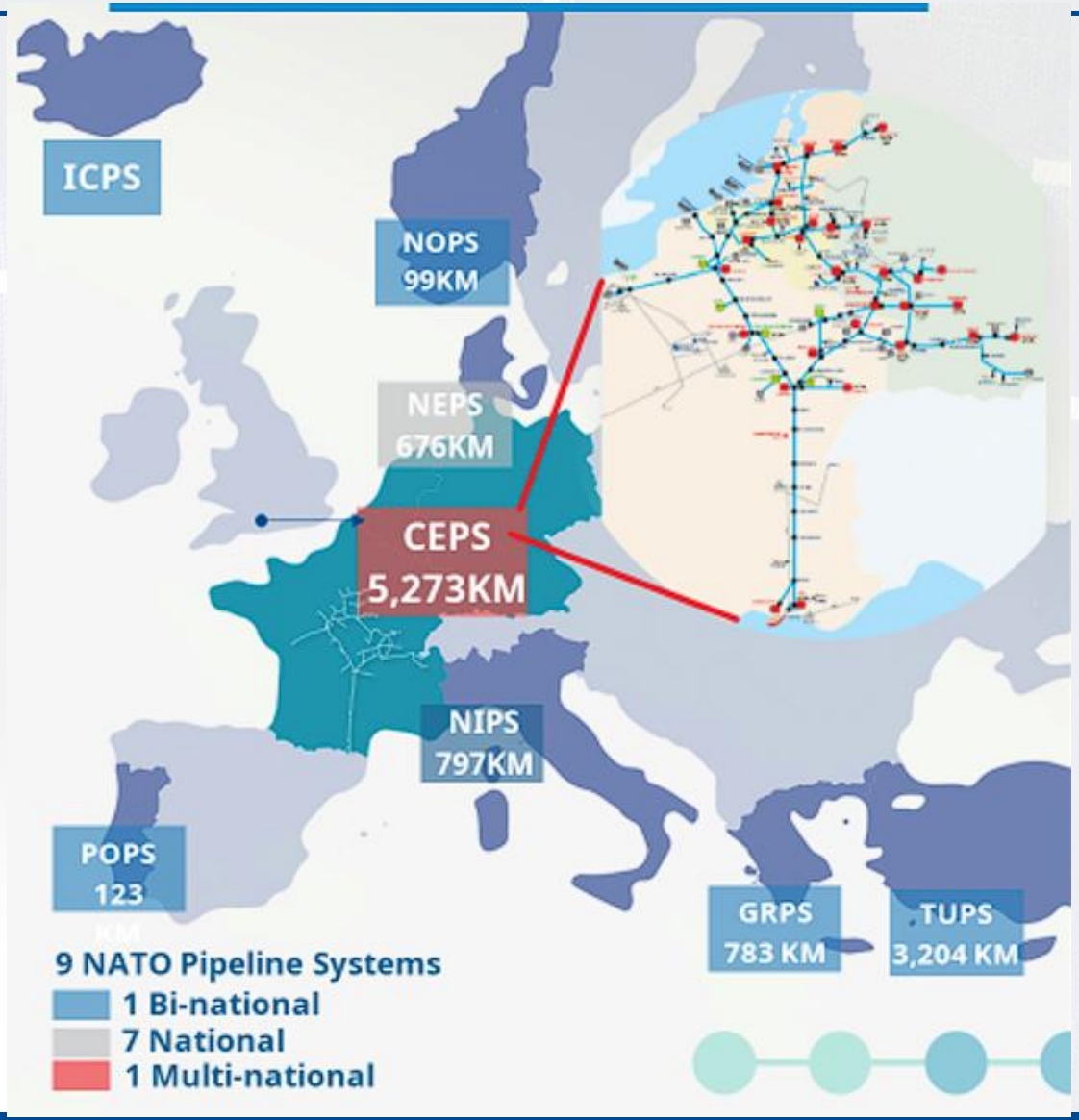
- Geothermal fields, 270pcs 100m probes 40mm diam.
- Heat pumps 1.5MW for Geothermal and >500KW air/liquid
- Thermal solar systems for domestic hot water
- Variable Refrigeration flow System with simultaneous heat-cool for Utilities building 100KW COP>4.8
- Rainwater recovery from ~3,000m2 for gray water 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

- 30.000m2
- Leadership in Energy & Environmental Design (LEED) protocols
- 160kW of electricity from renewable sources
- sustainable construction materials, coupled with rainwater and wastewater management techniques.

NSPA
NATO
OTAN

I ♥ Luxembourg

European Conference of Defence and the Environment

ECDE 2024

ØYVIND JOHAN KVALVIK
Norwegian Defence Materiel Agency (NDMA)

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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 Defence Materiel Agenc

Photo: Norwegian Armed Forces

03

Accomplishments

Snowshoes

Photo: Norwegian Defence Materiel Agency

SAF – sustainable aviation fue

Photos: Norwegian Armed Forces

New coastguard vessels

Photo: Norwegian Armed Force

Photo: Norwegian Armed Forces

Use of simulators

European Conference of Defence and the Environment

ECDE 2024

KERRY MARIE BOMMEN
Kongsberg Defence and Aerospace

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KONGSBERG

Protechting people and planet

KONGSBERG

Linking innovation and circular economy

Arild Skoge and Kerry Bommen
Kongsberg Defence & Aerospace

European Environment

EUROPE

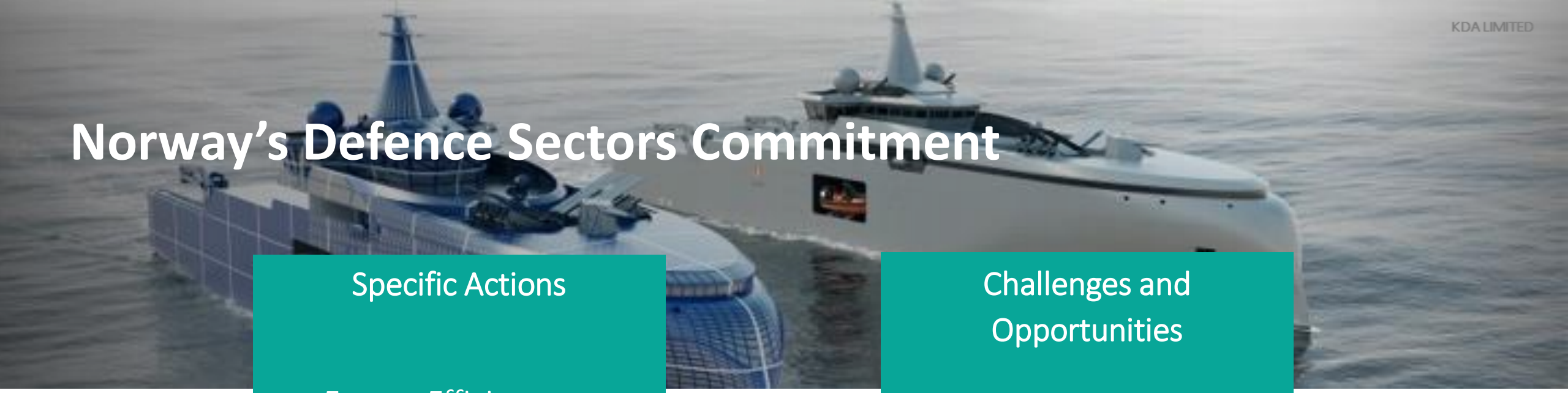
European Green Deal

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

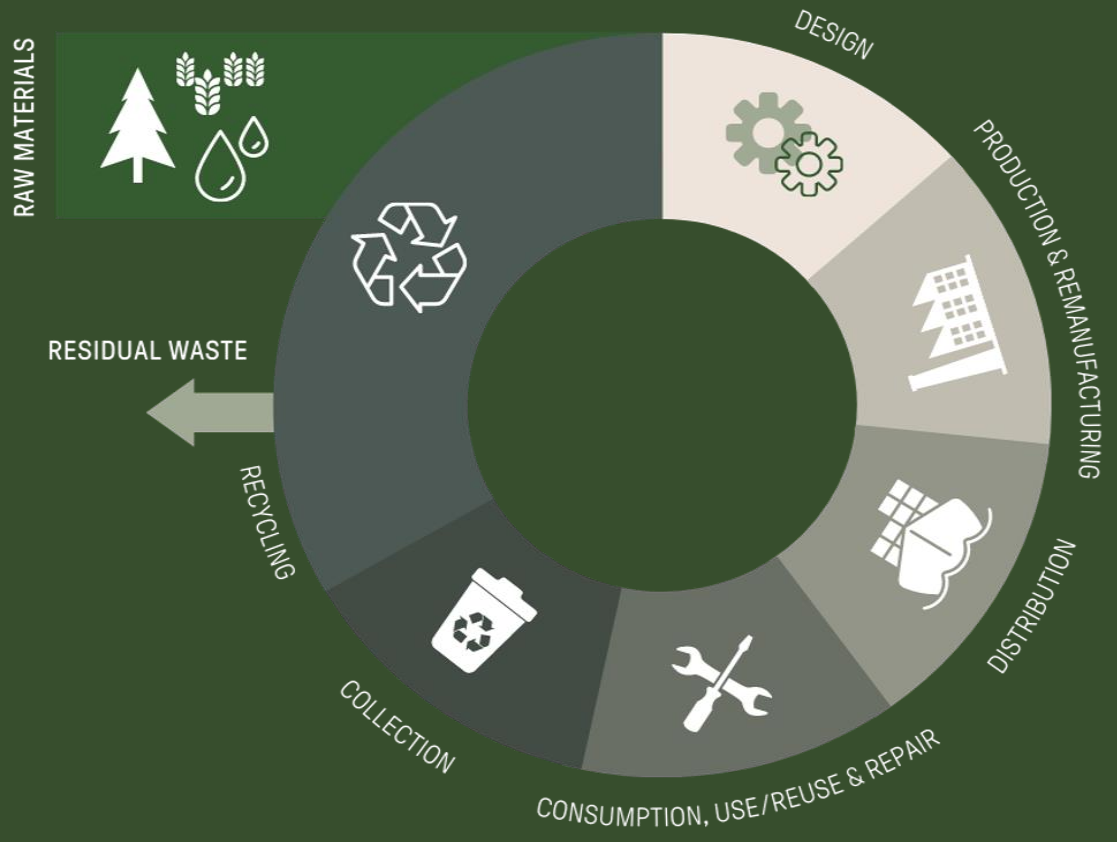
Specific Actions

- Energy Efficiency
- Research and Innovation
- International Collaboration

Challenges and Opportunities

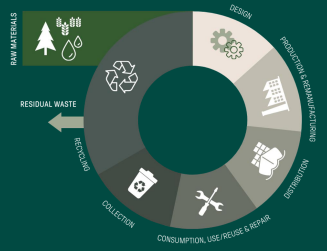
- Operational Impact
- Technology Adoption
- Gamechanger

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



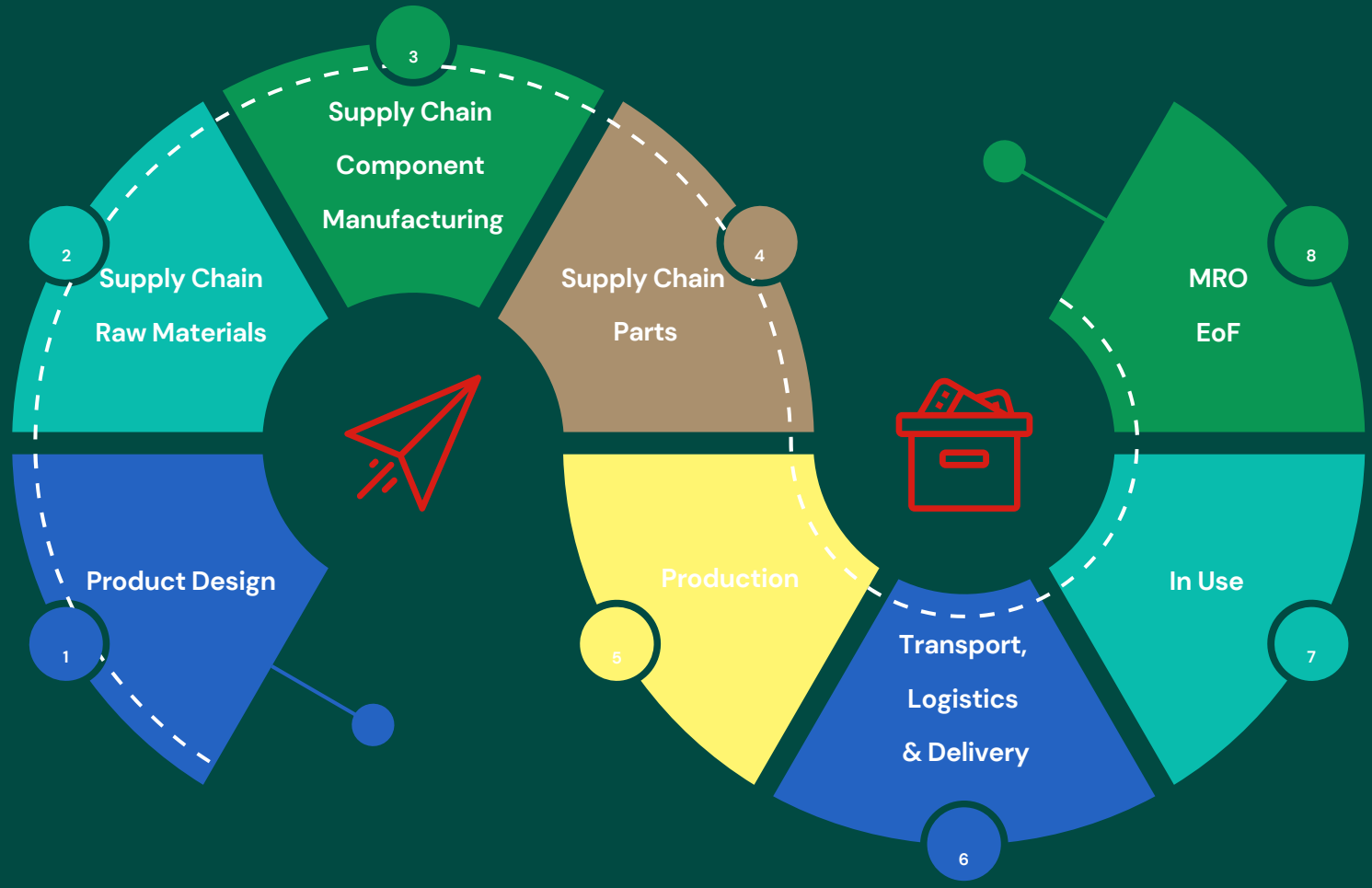
Value Chain & Eco System

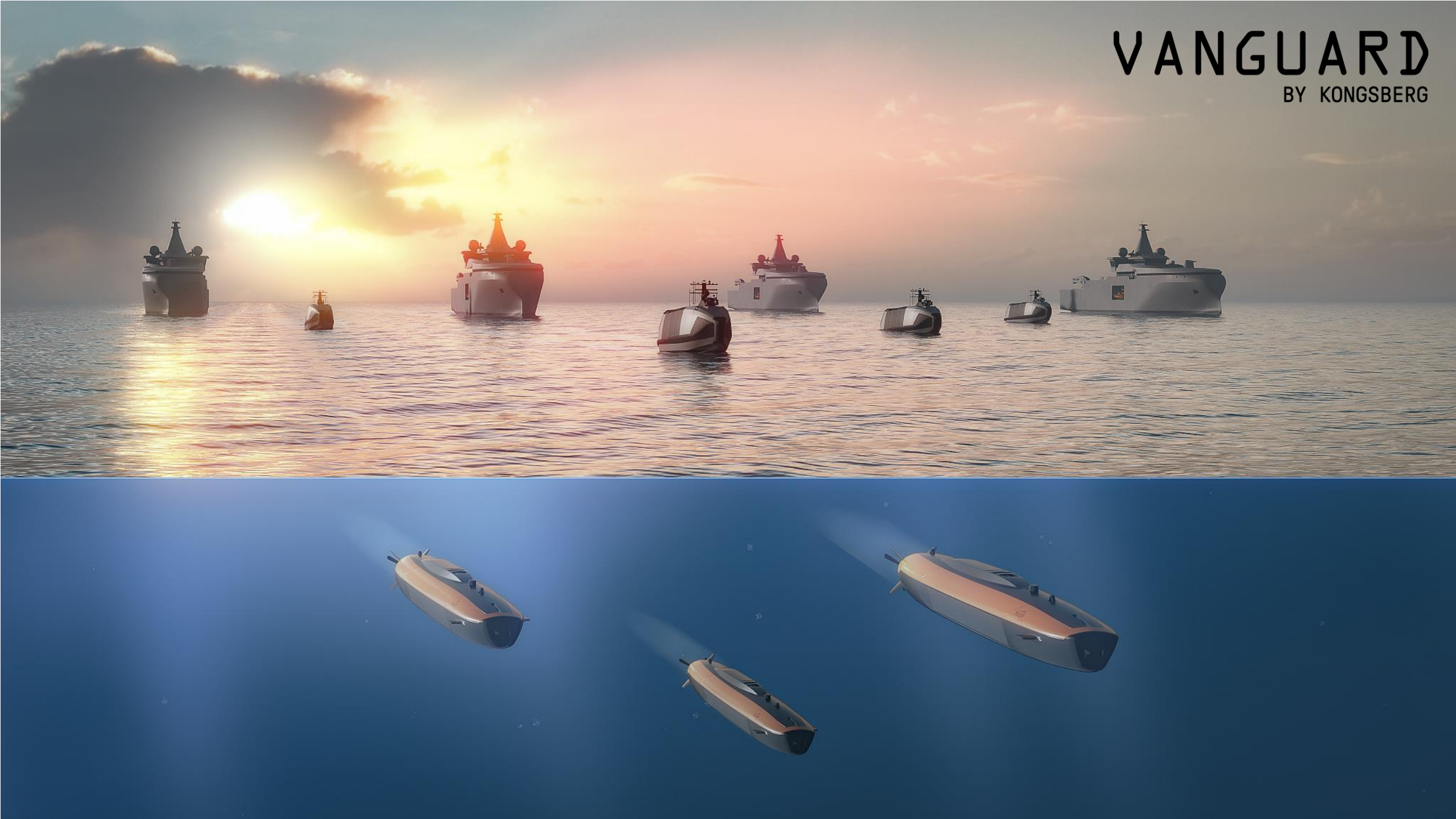
And apply principles of Circular Economy

KONGSBERG

Understanding the Value Chain

- Identify and Eliminate Waste
- Maximise Resource Circulation
- Enhance Environmental Stewardship
- Innovate Sustainably

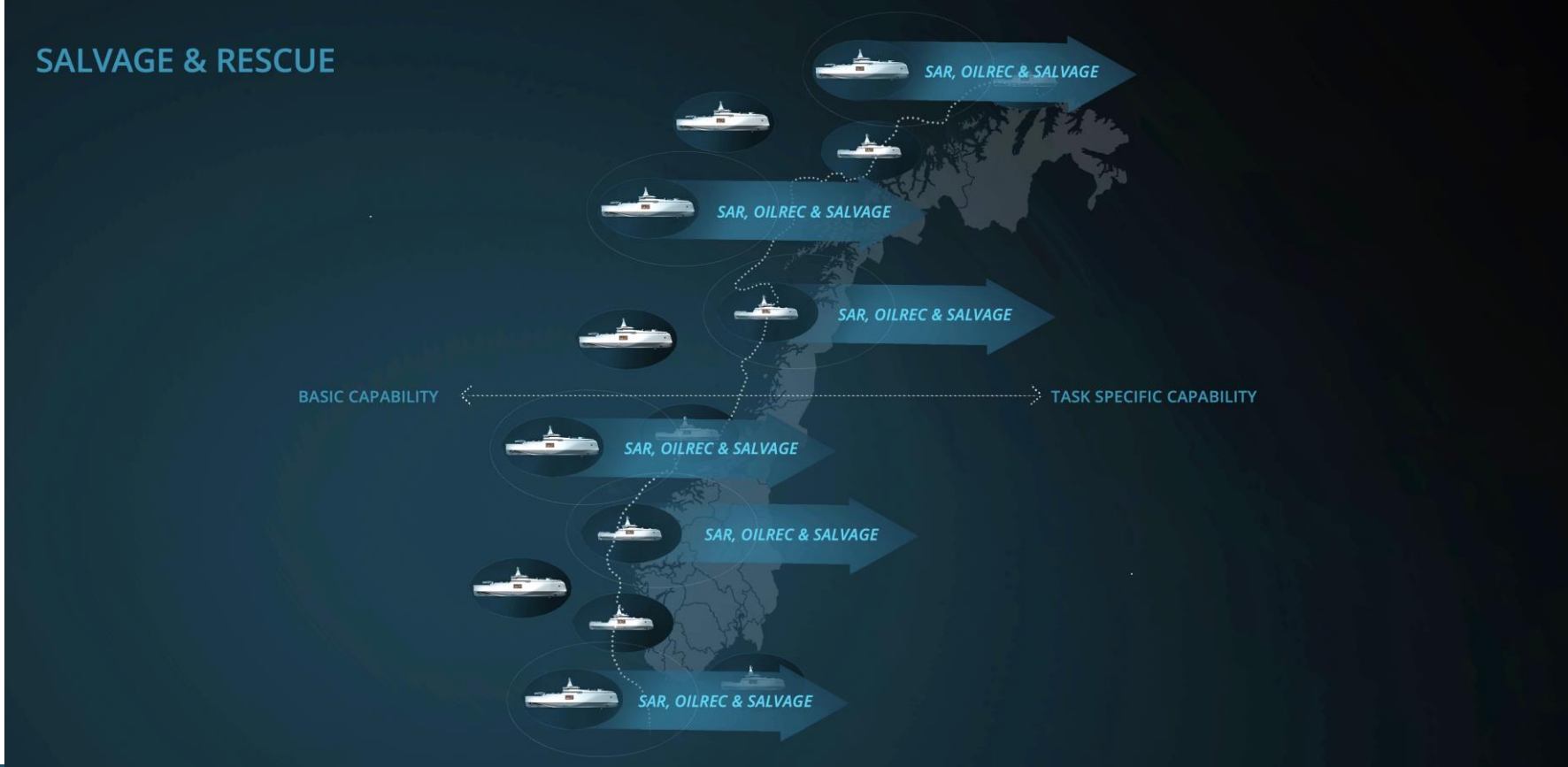



VANGUARD
BY KONGSBERG

Operational benefit

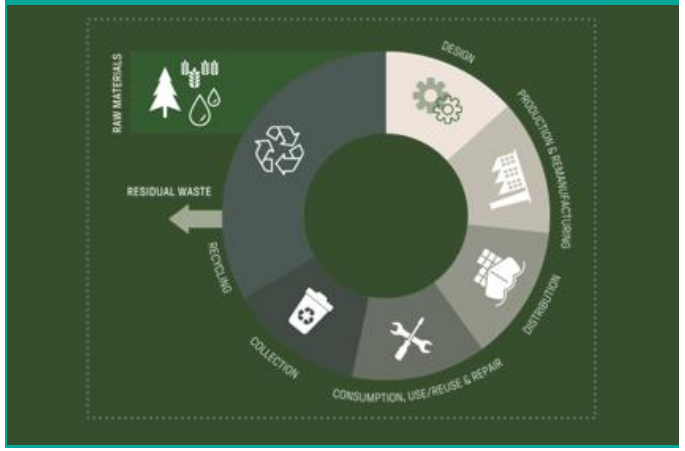
Enviromental benefit

Strategic benefits

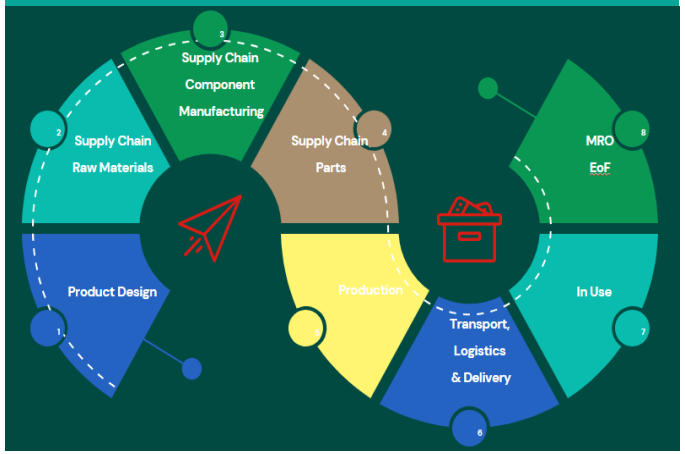


Key Takeaways – Linking innovation and Circular Economy

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
kerry.marie.bommen@kongsberg.com

European Conference of Defence and the Environment

ECDE 2024

CAROLINE GIBON
Thales

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THALES
Building a future we can all trust

Towards a common ecodesign approach in defence sector

June 2024

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

{OPEN}

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.

{OPEN}

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

{OPEN}

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

{OPEN}

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 ecodesign is not applied for a better environment, let's do it for better operations!

{OPEN}

Questions ?

{OPEN}

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ECDE 2024

TOR HENNING MOLSTAD
Nordic Additive Manufacturing

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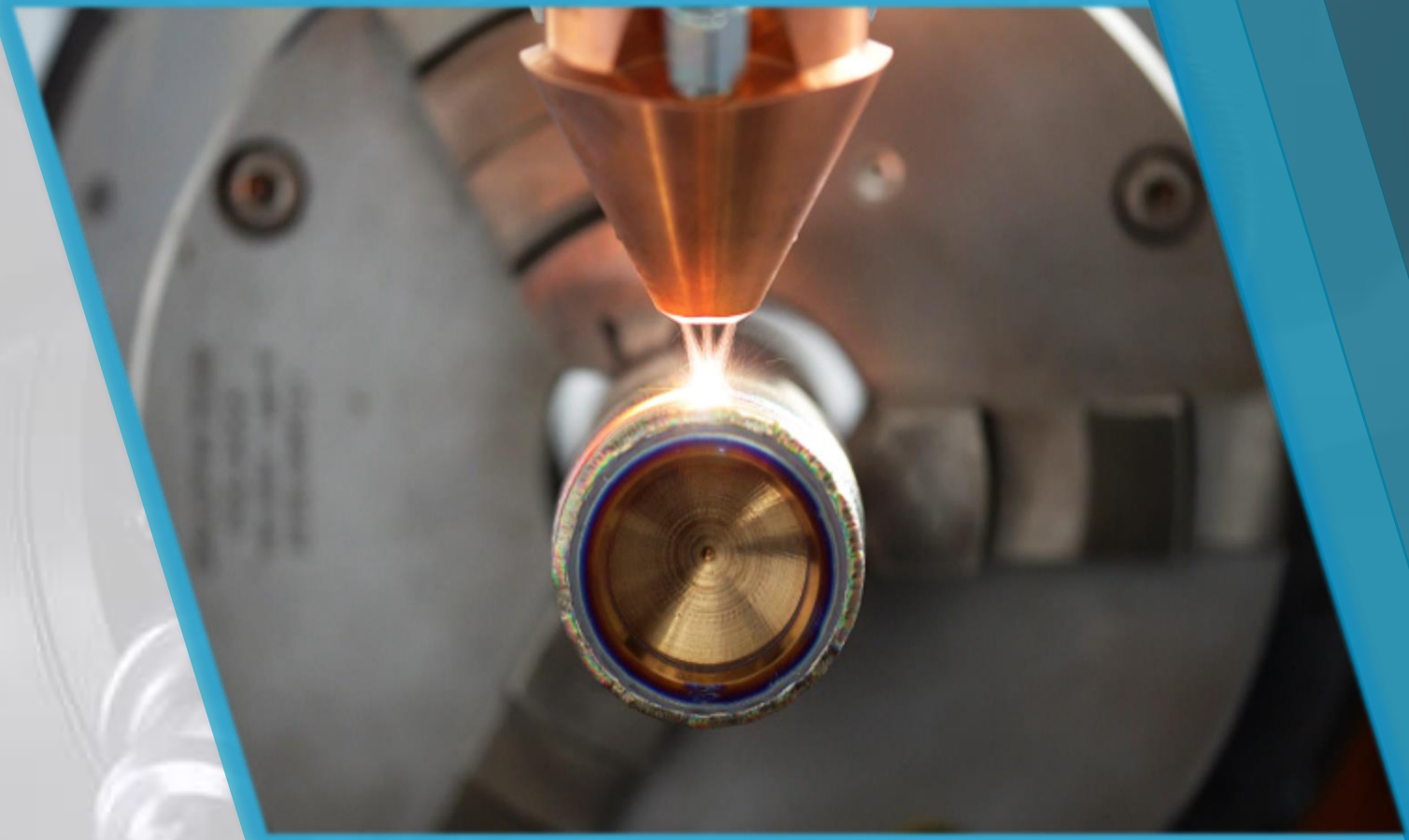
NORDIC ADDITIVE MANUFACTURING

World leading technology

Find us in social media!



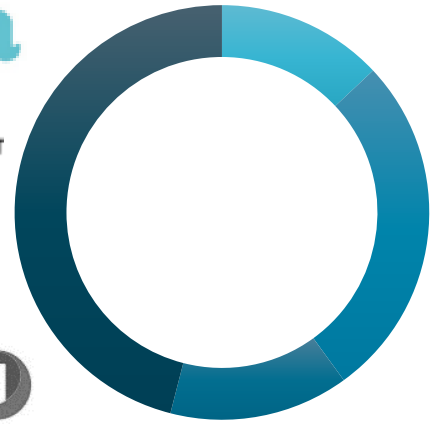
Repair vs Replace = Sustainability;
Practical use cases within AM/Metal Printing

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



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

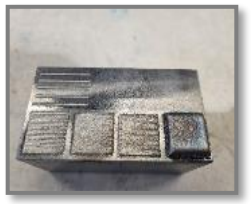
Kongsberg Maritime Propulsion Components

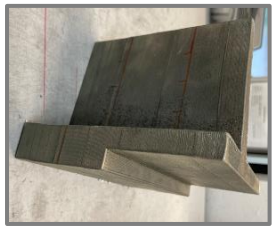
Manufactured using a qualified Laser Additive Manufacturing (LMD) process

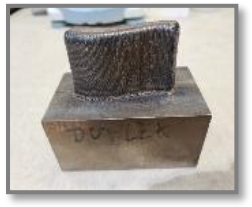
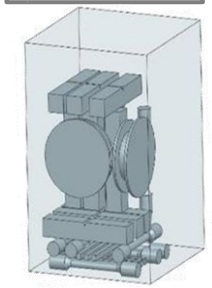
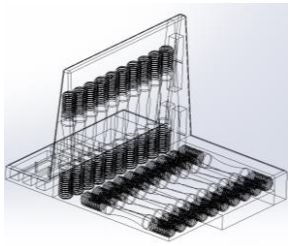
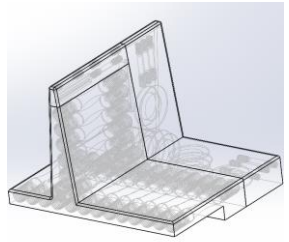
at Nordic Additive Manufacturing (NAM)

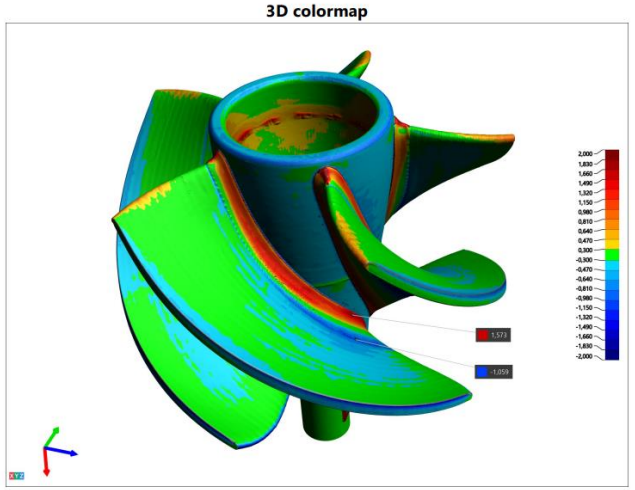
Mette Lokna Nedreberg – Kongsberg Maritime

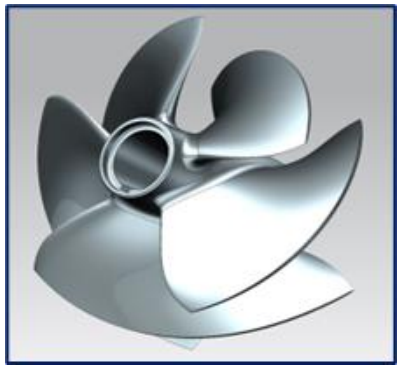
Manufacturing and qualification in according to DNV Guidelines DNV-ST-B203





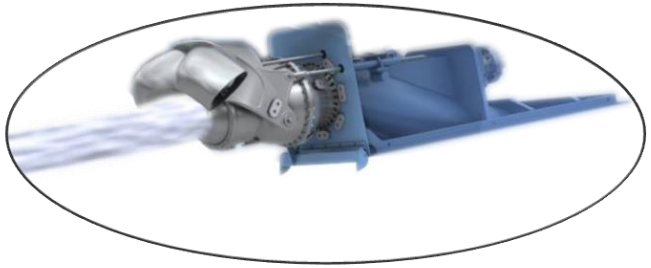





Initial process parameter ⇨ *Building Process optimization* ⇨ *Part Qualification* ⇨ *Part Manufacturing & Installation*

*Material testing and microstructure characterizations * of as built and after heat treatment* ⇔ *Field test & Part Test*

Water-jet Impeller

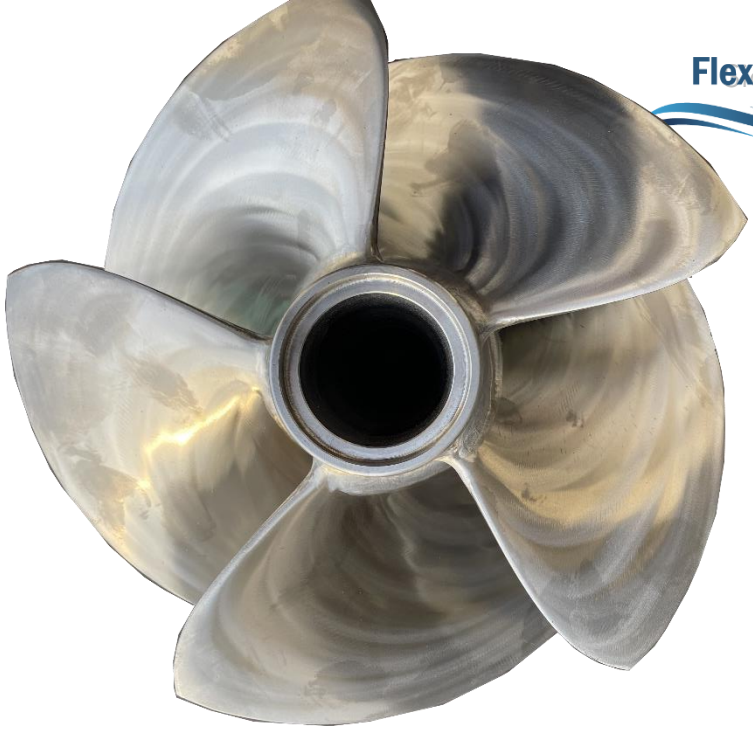


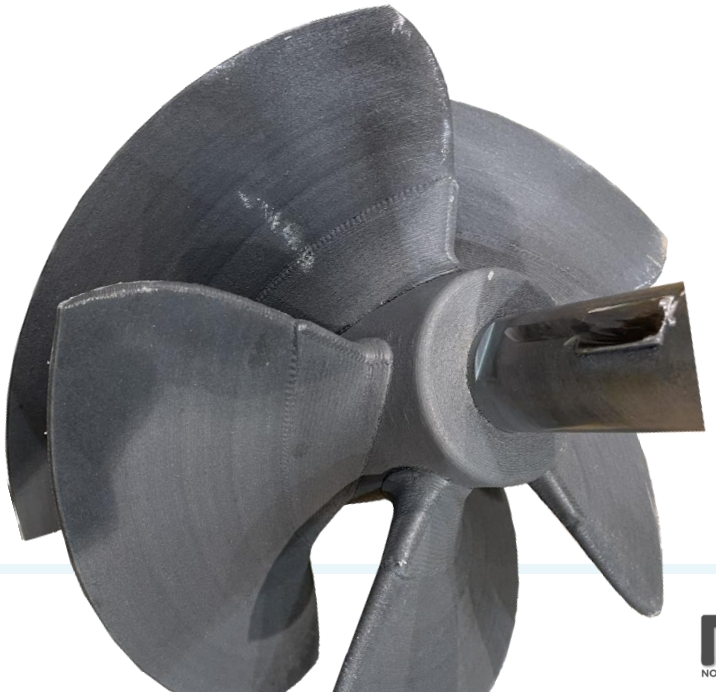
Scope:

Improve Lead time, quality and cost using AM / LMD

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 [º]	-	147	147	145





NORDIC ADDITIVE MANUFACTURING

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)

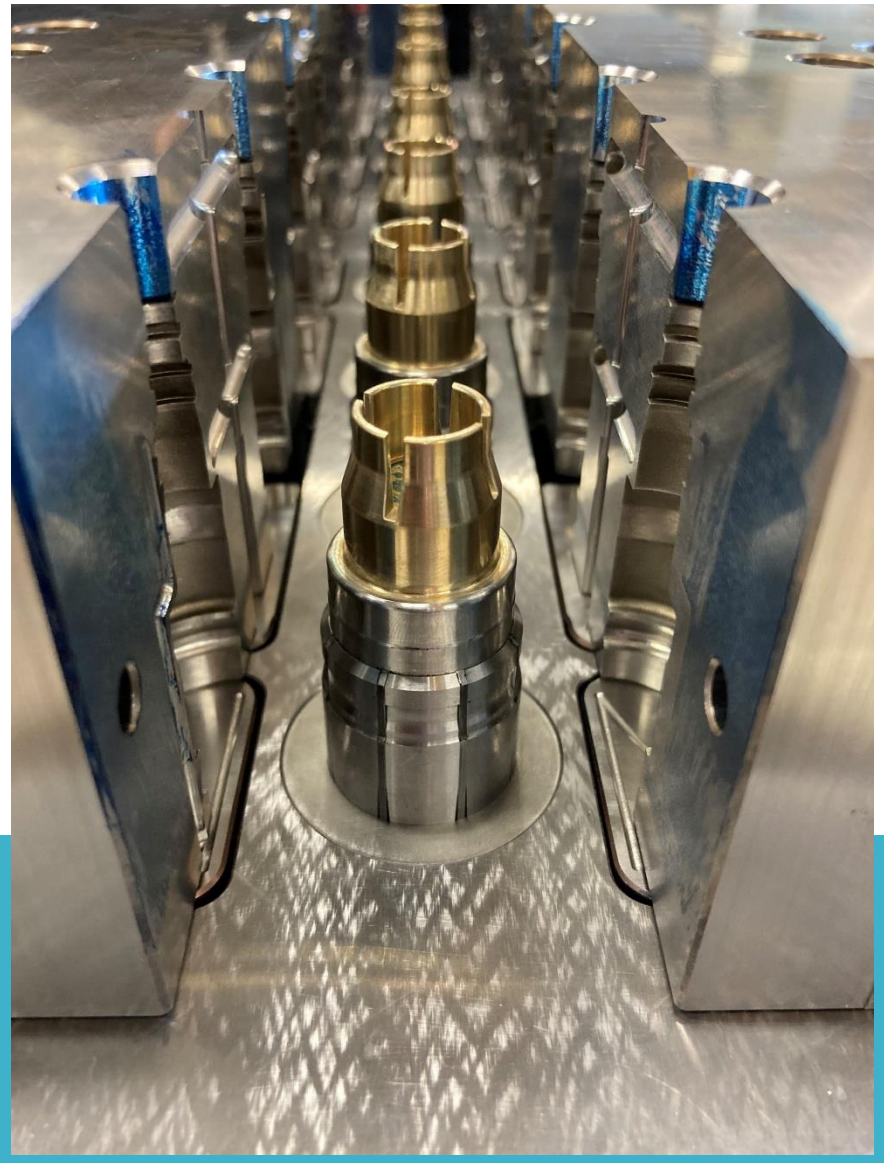
Manufacture and Final inspection – According to specification with good tolerances




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

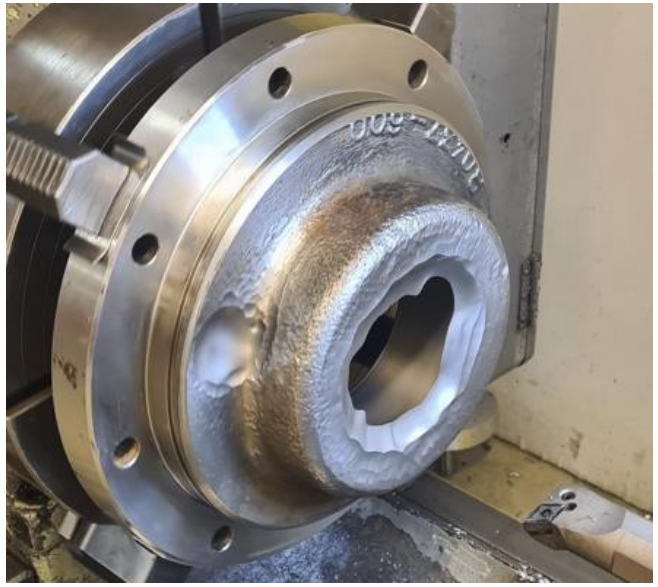
Rebuilt and added wear layer

Base material HRC35, hardened surface layer HRC58.

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

Repair vs replace

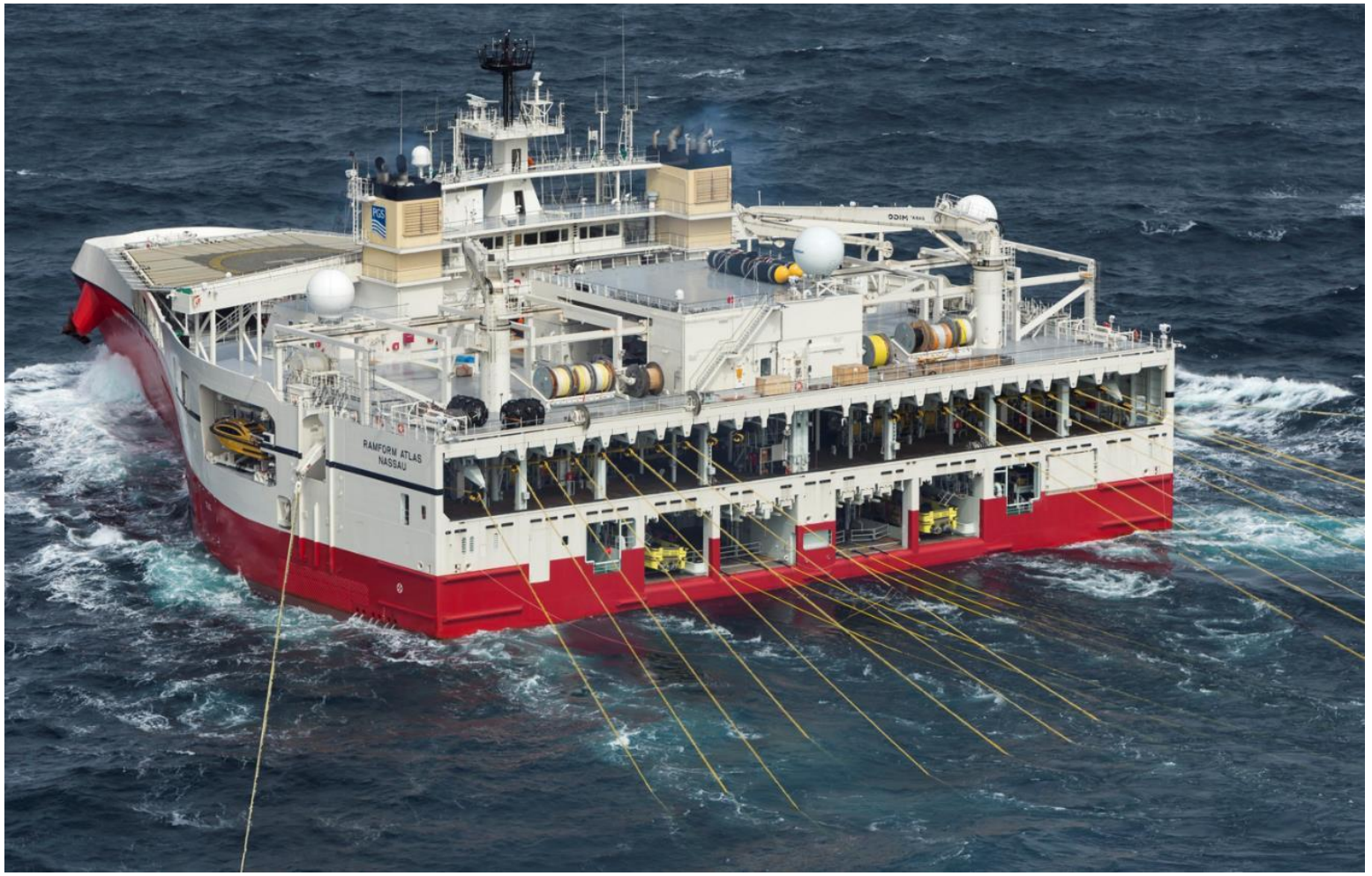
- Obsolete parts, duplex 22cr
- Short lead time with LMD repair
- Sustainability, repair vs new
- High potential in DED repairs



Potential in the Seismical Industry

Repair/Improvement Track Housing

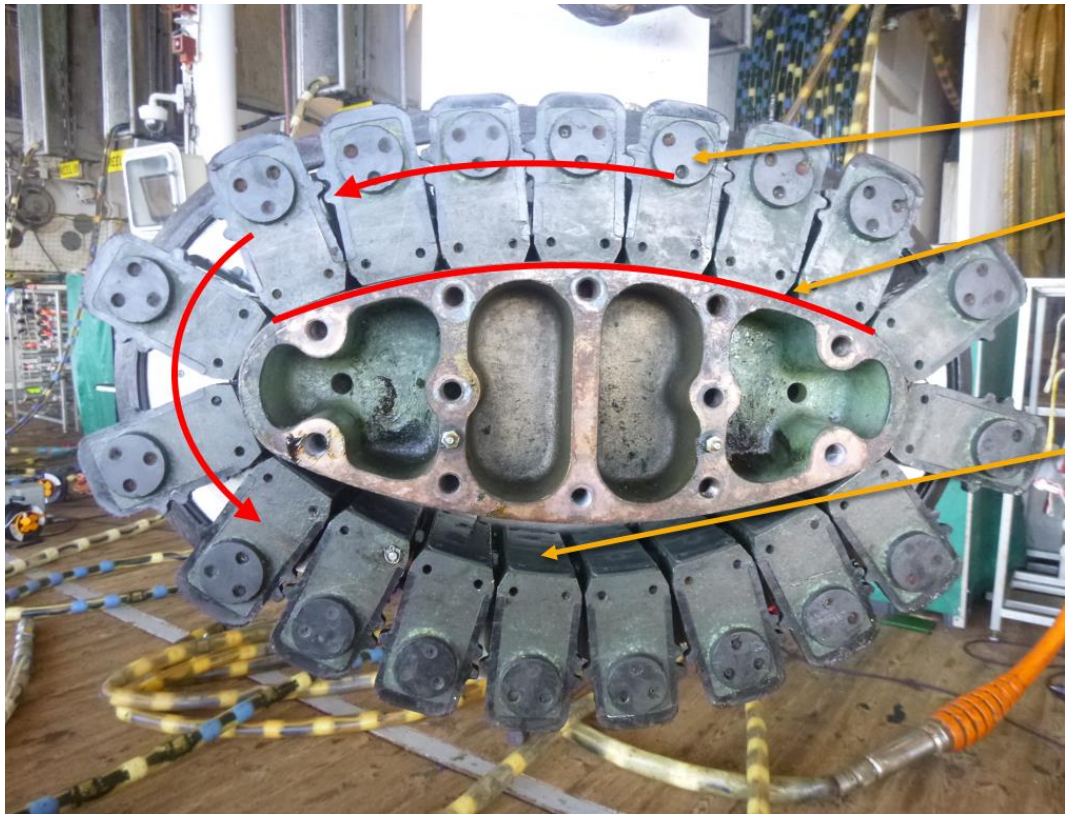
- NiAlBr with hardfacing
- Develop a process for improvement of the hardfacing
- Sustainibility repair vs new, improvement

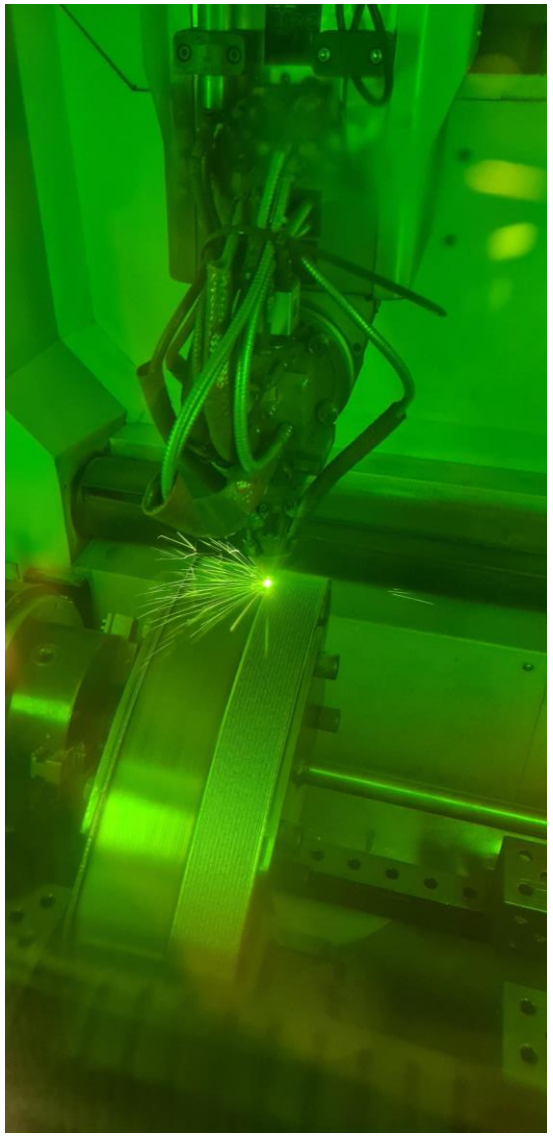


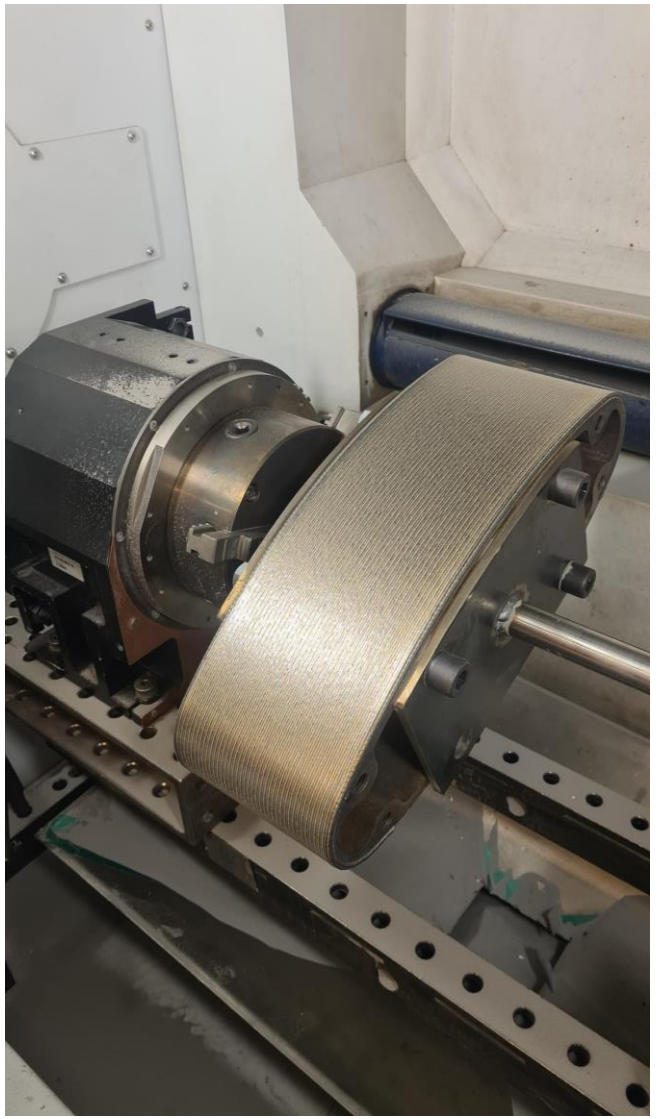
Potential in the Seismical Industry

Repair/Improvement Track Housing

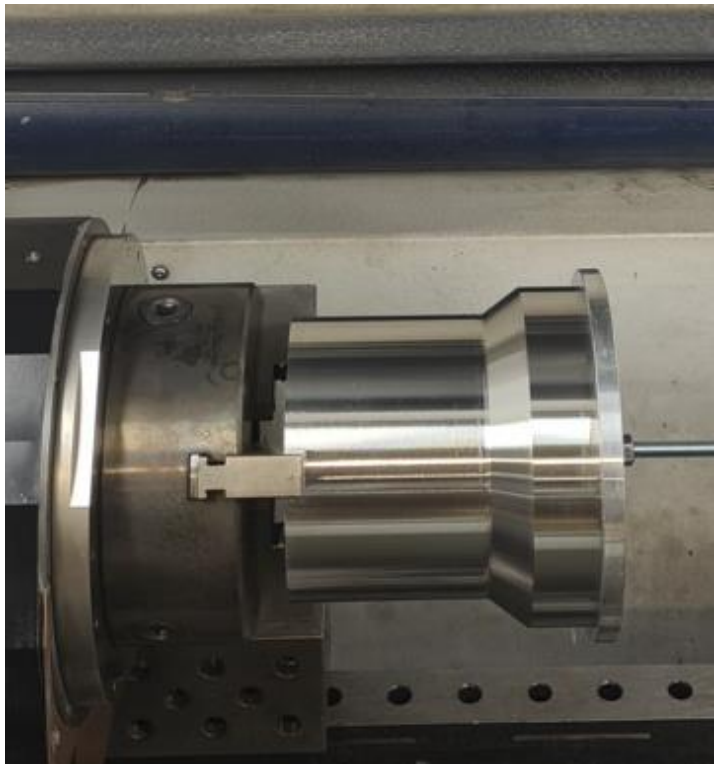
- Sustainability in repair/improvement of existing product.

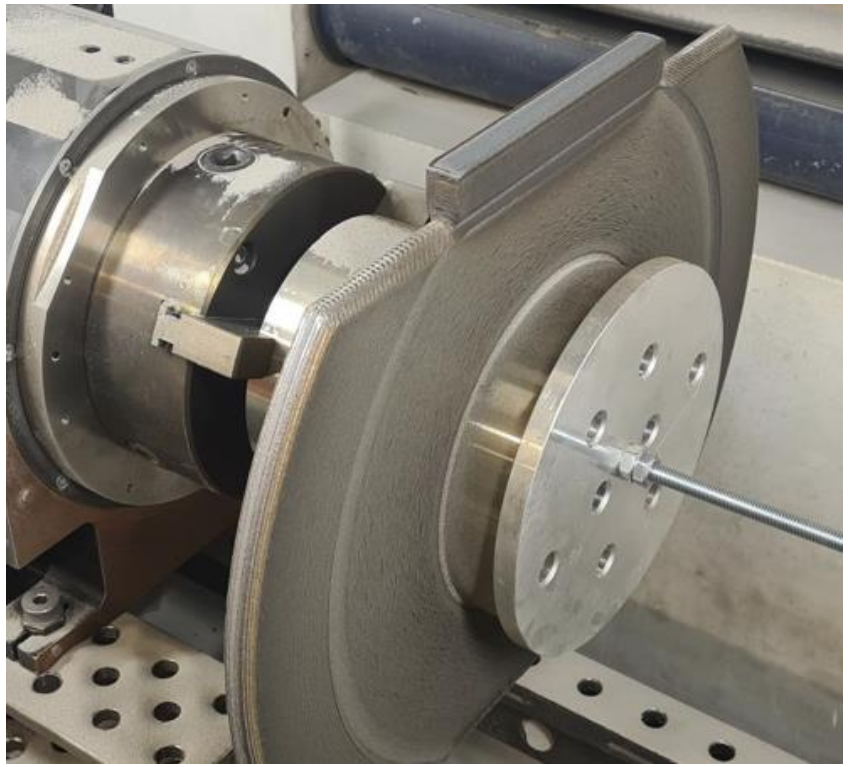




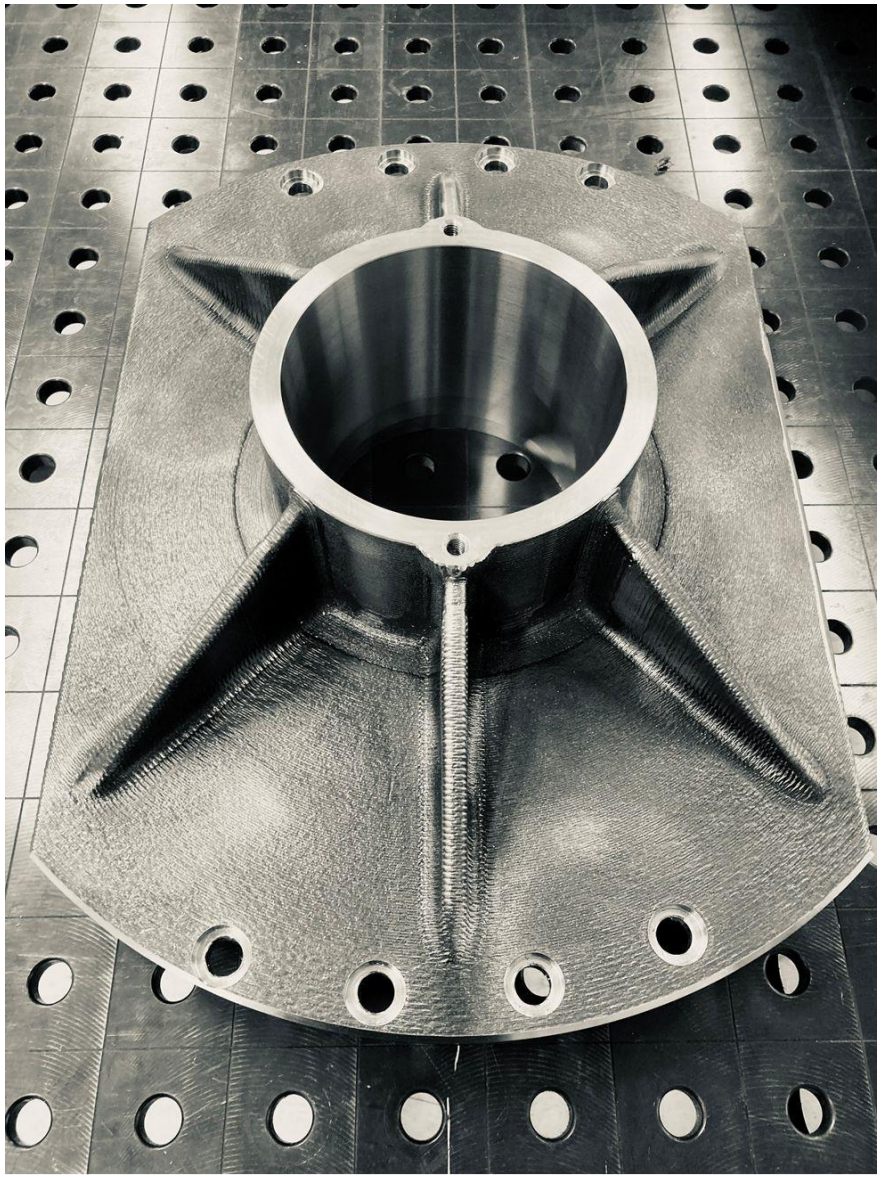


Hybrid Manufacturing, 316L; combination of machining & LMD





Hybrid Manufacturing, 316L



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

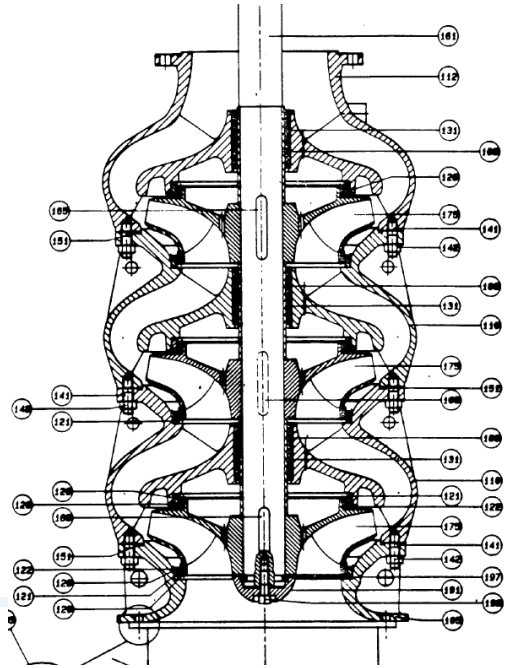
Energy optimizing a 45 meters line-shaft seawater lift pump with additive manufacturing

Scope of work

- Equinor contacted Eureka regarding the need to energy optimize a 3stage line-shaft seawater lift pump.
- The pump delivered 1950m3/h of water, but was dumping 1000m3/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

NORDIC ADDITIVE MANUFACTURING

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

equinor

EUREKA

Contact

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Fabrikkvegen 11
2830 Raufoss

Phone
(+47) 91 70 25 76

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IF CEED Project Proposal

Additive Manufacture of Armor components by WAAM using Titanium wire drawn from Titanium scrap

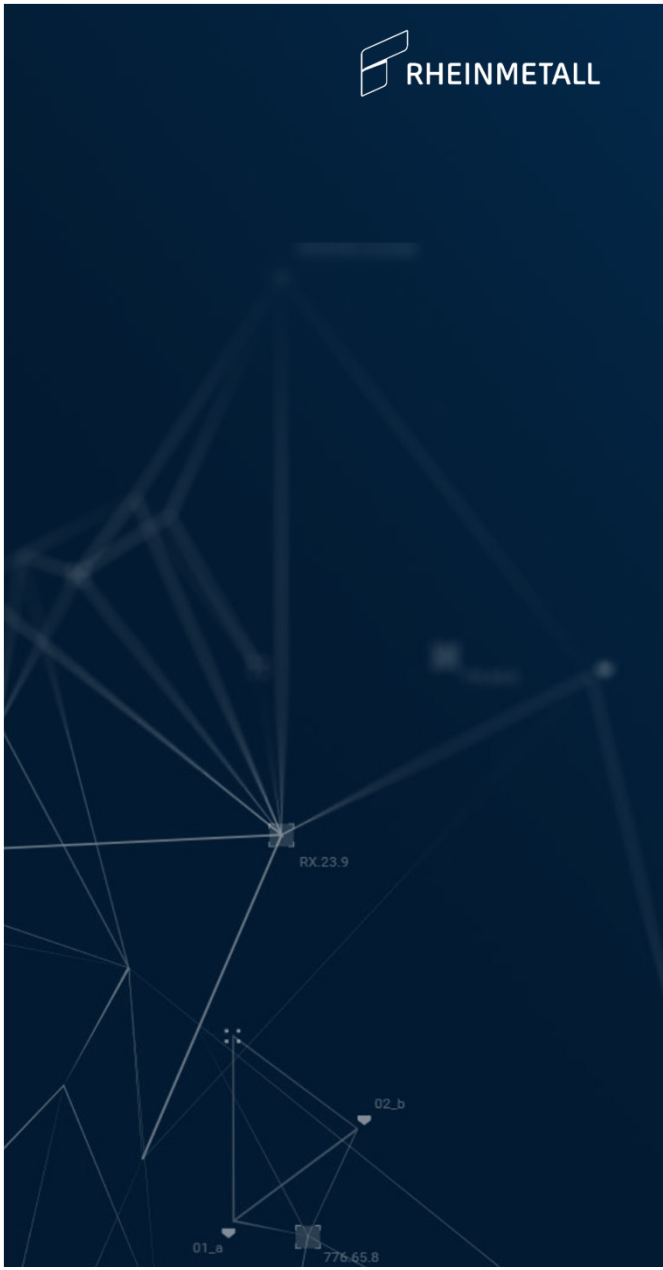
European Conference of Defence and the Environment, Oslo, Norway, 12th – 13th June 2024

Dr. Roland Niefanger, Rheinmetall Weapon Ammunition GmbH, **Business Unit Protection Systems**

2024-C5FTT-028

Agenda

- **Short Introduction to Rheinmetall / Protection Systems**
- **IF CEED Project Circles**
- **Titanium Production**
- **Objectives of Proposal**
- **Challanges**
- **Summary**



RHEINMETALL

Rheinmetall corporate structure

RHEINMETALL GROUP

Vehicle Systems Europe	**Vehicle Systems** International	**Weapon and Ammunition**	**Electronic Solutions**	**Power Systems***	**Central Division**
Business Units					
Tactical Vehicles	United Kingdom	Direct Fire	Integrated Electronic Systems	Air Management	Purchasing
Logistic Vehicles	Asia Pacific	Indirect Fire	Air Defence and Radar Systems	Thermal Management	Corporate Social Responsibility (CSR)
	North America	Propulsion Systems	Product and Airborne Solutions	Electrification / Digitalization	Project Management/ Business Excellence
		Protection Systems	International Projects and Services	Castings	Divestment Projects
		Projects & Services	Aeronautical Systems	Bearings	
				Trade	
				Hydrogen (Business Area)	
				Invent (Business Area)	

* New division since 01/2024: Previously divisions Sensors and Actuators + Materials and Trade

Business Unit **Protection Systems**

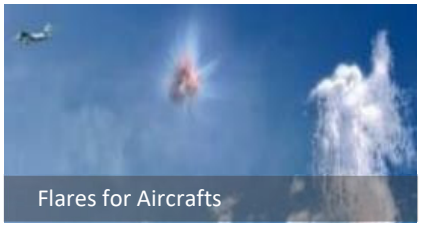
SOFTKILL

Systems / Ammunition for
Land , Air, Naval Platforms

SOFTKILL


Multi ammunition softkill system – MASS


Rapid obscuring system – ROSY


Flares for Aircrafts

ACTIVE PROTECTION

Light, Medium and Heavy
Tactical Vehicles, Logistical Vehicles

HARDKILL

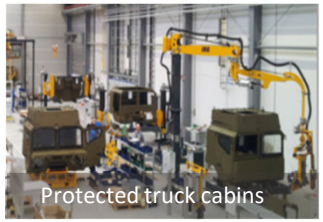

Strikeshield – Wheeled platforms


Strikeshield – Tracked platforms

PASSIVE PROTECTION

Light, Medium, Heavy Caliber Passive Protection,
Body Armour, Monocoque Armour, Civil Platforms

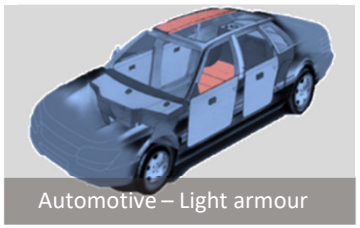
PASSIVE PROTECTION

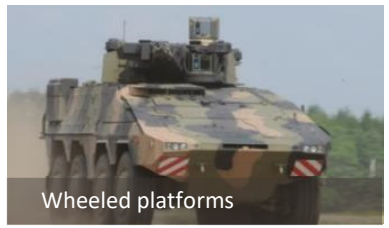

Protected truck cabins


Medium and Heavy armour


Marine application


Body armour


Automotive – Light armour

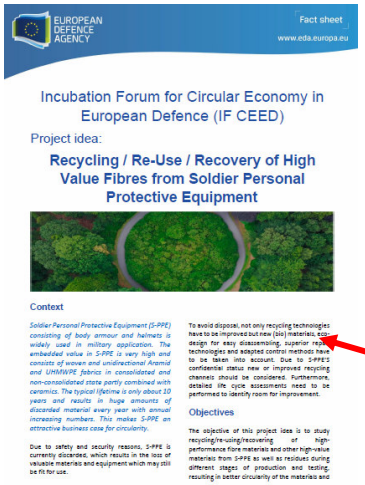

Wheeled platforms

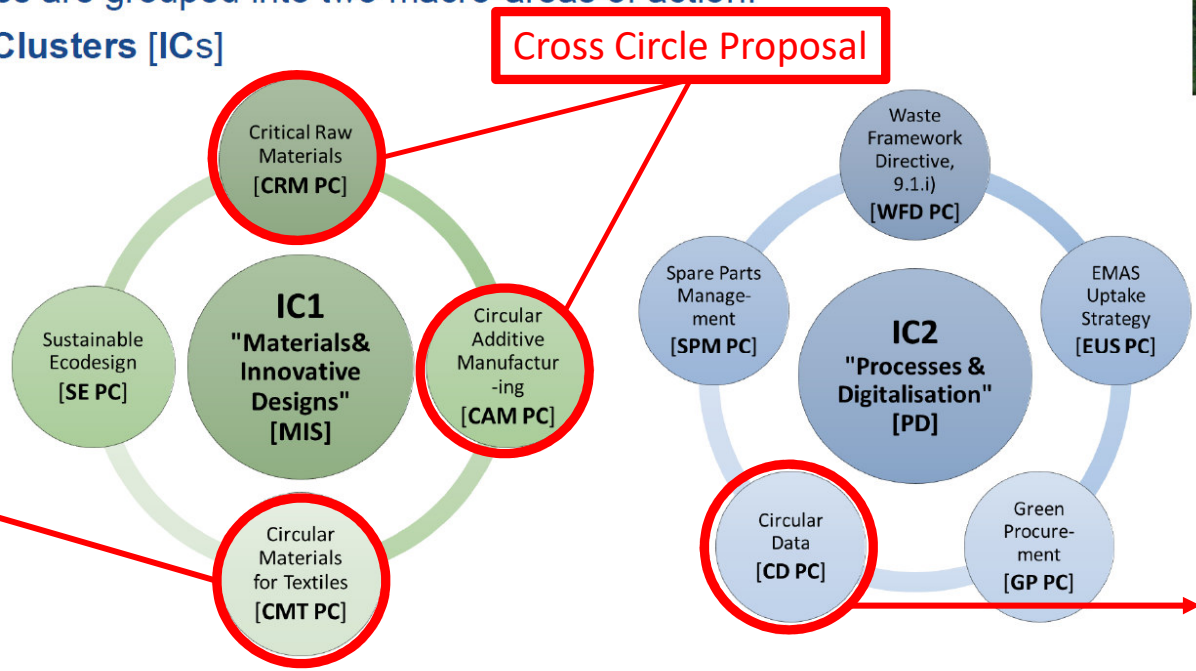
IF-CEED Project Titanium Recycling & ALM → Cross Circle Projekt

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

Project Circles are grouped into two macro-areas of action:

Incubation Clusters [ICs]

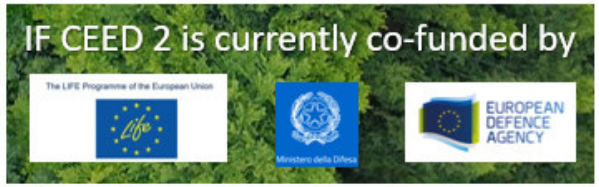




➢ PCs work in synergy with EDA's existing fora, e.g. CapTechs, Project Teams.

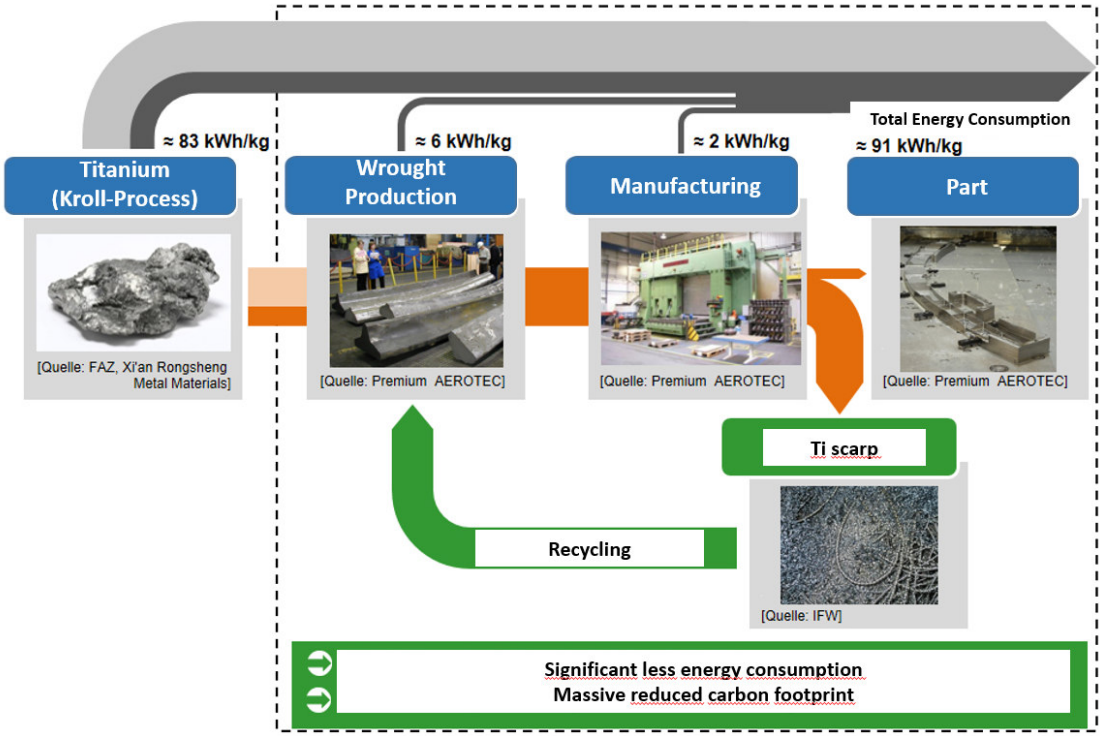
EUROPEAN DEFENCE AGENCY

circular.economy@eda.europa.eu
www.eda.europa.eu/ifceed



Energy consumption along the production process

- **The production of titanium is characterized by:**
- Environmental impact due to mining
- High energy consumption (high CO_2-footprint), especially at the start of production (Kroll Process)
- **Manufacturing of titanium parts is characterized by:**
- Huge amount of (contaminated) scrap!



[https://phi-hannover.de/titan-recycling-vom-span-zum-hochleistungsbauteil/]

Use Case: Titanium for Armor

[www.military.com]

Protection of pilots and parts of
the flight-control system

- **Very high protection effiency → lightweight armour!**
- **Ballistic / Blast / IED-Protection**
- **<u>Today's usage mainly:</u>**
- **Tanks (IFV / MBT)**
- **Aircraft / Helicopters**

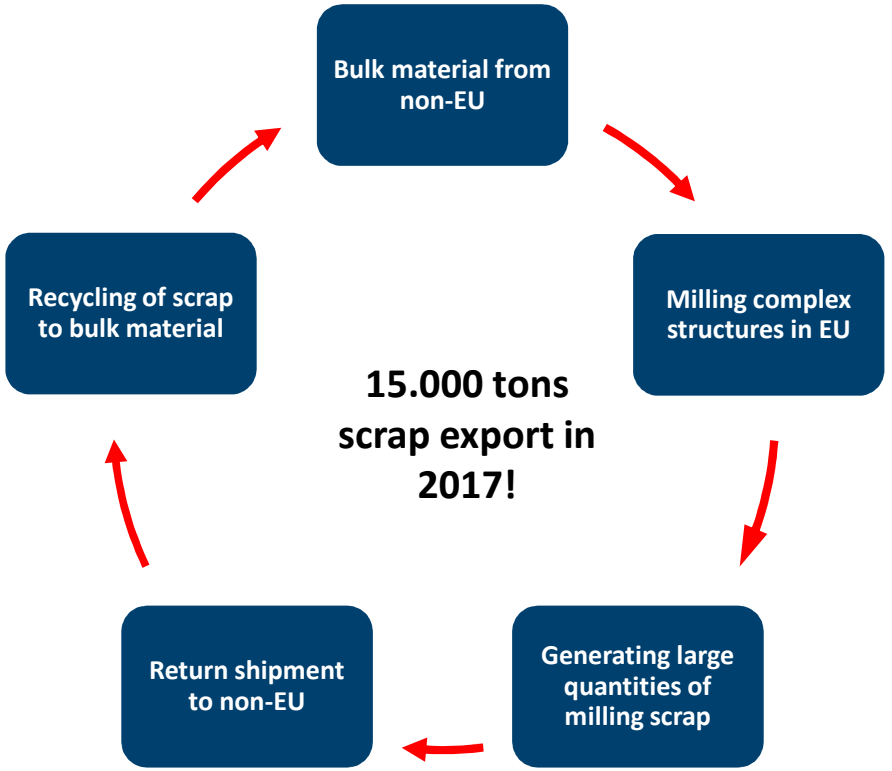
- **Expensive → price limits the use**
- **…**

[Rheinmetall]

[Rheinmetall]

Challange: Critical Supply Chain

- Titanium is a critical raw material
- Sourced mainly outside EU (China, Russia, Japan, USA, …)
- Price is an issue even in millitary application!
- Milling final shape out of bulk material → huge amount of contaminated scrap
- Titanium is recycled almost exclusively outside of the EU



Does that really make sense for the future?

Do not forget!

Potential: WAAM with recycled Titanium Grade 5 wire

- **AM for armour application leads to following mandatory requirements:**
  - Relevant componet size
  - Production time and costs
  - Suitable material avialable as wire
  - Suitable Materials to defeat ballistic / blast threats

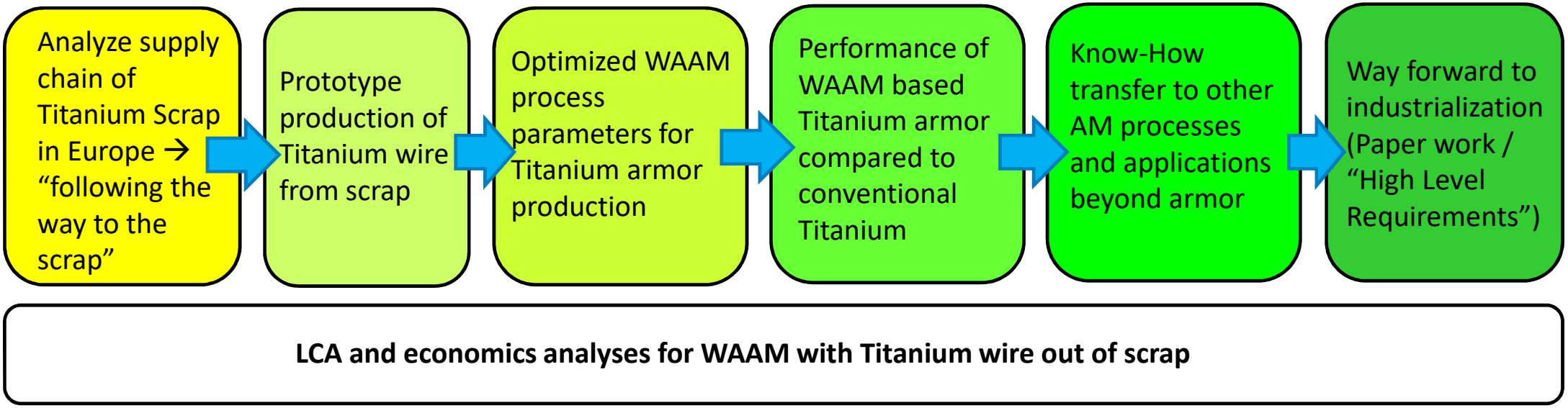
⇨ **Wire-Arc-Additive-Manufacturing**

⇨ **Titanium Grade 5**

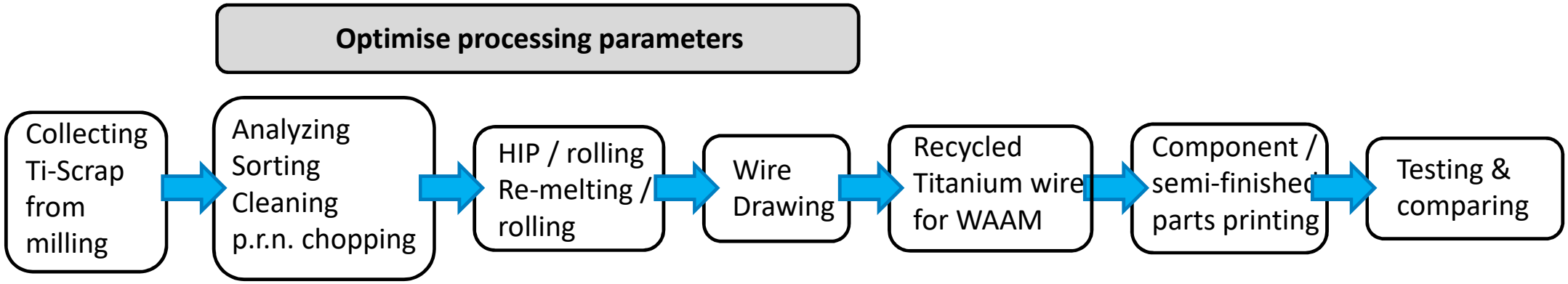
- **Benefits:**
- **Near net shape production**
  - Less raw material
  - Less scrap
- **Only one AM feedstock (wire) → simplyfied supply chain → cheaper**
  - Production on demand
  - Production of spare parts
  - No need of multiple semi-finished parts
  - Improved circularity & lower carbon footprint

Objective / sub-objectives of the proposal

- **Validate and demonstrate armor made by WAAM using Titanium wire based on scrap in military environment**



Proposed Processing for Recycling of Titanium Grade 5 wire used for WAAM



…. in principle, a straight-forward approach, but….

Proposed Processing for Recycling of Titanium Grade 5 wire used for WAAM

Challenges!

Optimise processing parameters

Collecting Ti-Scrap from milling → Analyzing Sorting Cleaning p.r.n. chopping → HIP / rolling Re-melting / rolling → Wire Drawing → Recycled Titanium wire for WAAM → Comp semi- parts

Typical EoL materials

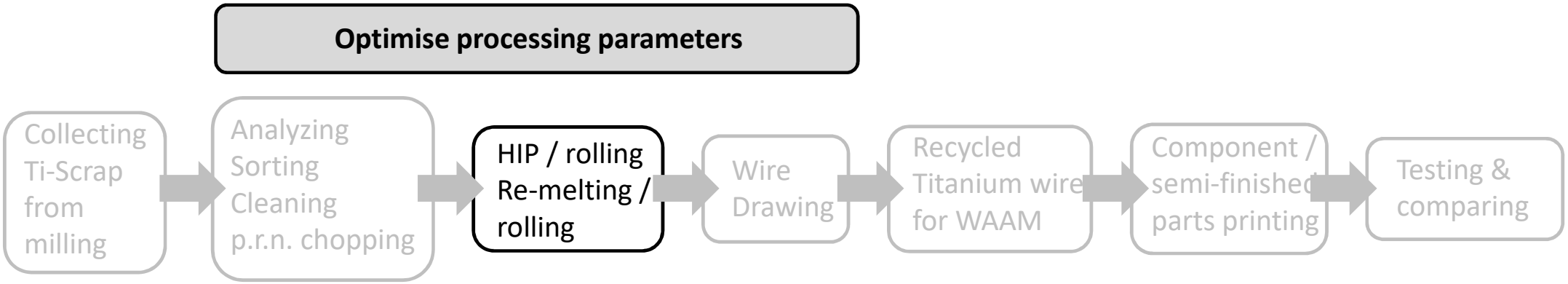
[Airbus]

[WWW.NDR.DE]

- **Recycling of end-of-life material very low (1% in EU!)**
- **Milling scrap contaminated with e.g. lubricants, tungsten carbides, metals, …**
- **High oxygen content in Titanium chips! Challange to decrease the content to an acceptable level!**
- **Production of titanium from 100% titanium chips has not yet taken place**
- **Controlled addition in the production of new titanium**

Proposed Processing for Recycling of Titanium Grade 5 wire used for WAAM

Challenges!

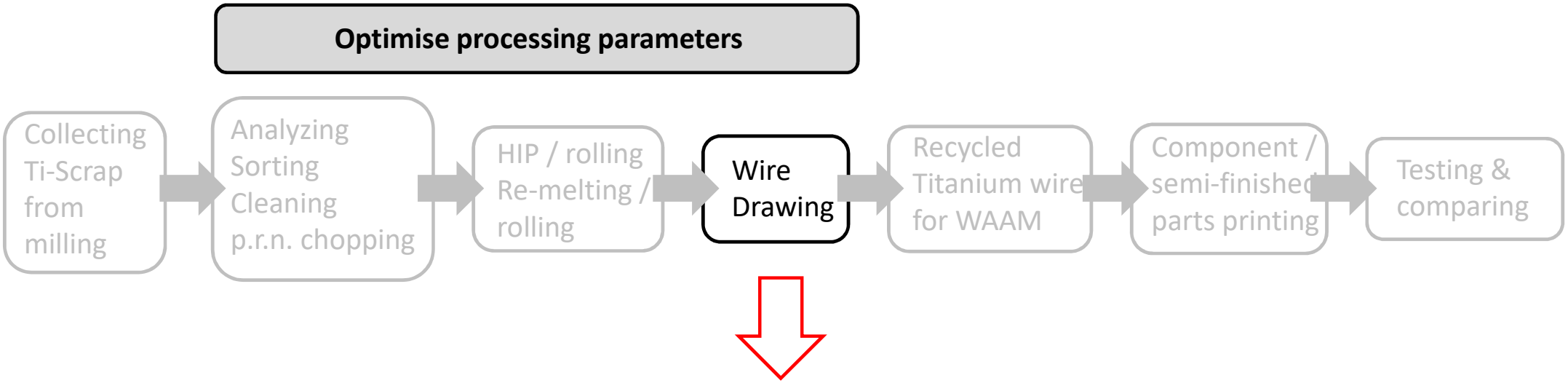


- **No experience with 100% Chips**
- **Mechanical properties?**
- **Using as armor?**
- **Using for wire drawing possible?**

Furthermore:
There is only one company in the EU with the technical capability to recycle Titanium.

Proposed Processing for Recycling of Titanium Grade 5 wire used for WAAM

Challenges!



To our knowledge there is no company in the EU that has the technical capability to produce grade 5 titanium wire from bulk material.

RHEINMETALL

Summary of the project proposal

- **Titanium Grade 5 exhibit a very high ballistic efficiency and is therefore used in IFV / MBT and in aircrafts / helicopters**
- **The production of titanium from ore requires very large amounts of energy, resulting in a high CO_2 footprint**
- **Production of complex parts results in huge amounts of contaminated Titanium scrap**
- **→ Foster scrap recycling to Titanium wire combined with additive manufacturing (WAAM) results in significant decreasing of needed material accompanied by decreasing scrap amount due to near net shape production**

<u>However, there are some major challenges to overcome</u>

- **virtually no EoL material available → scrap has to be used → difficult to reduce high oxygen content → utilisation as wire unclear**
- **Overall recycling capacity in the EU is very low (one company in France)**
- **No company within the EU which is able to draw a Titanium wire out of bulk material**

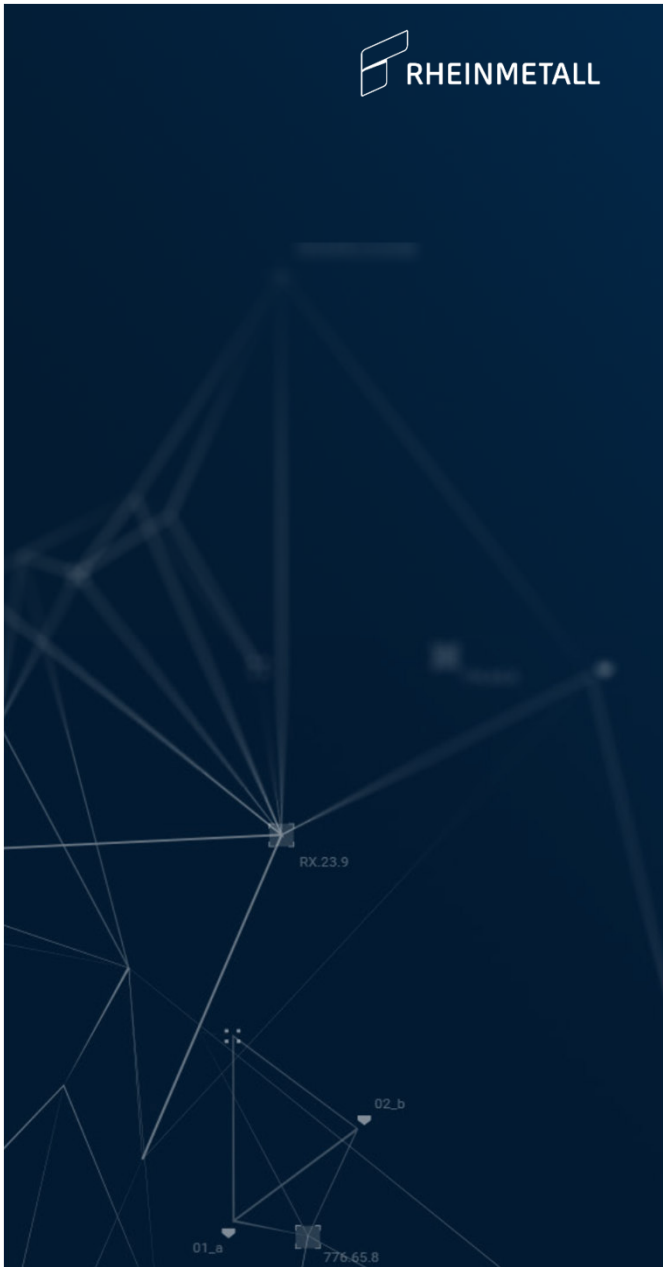
⇨ **The benefit with respect to sustainability aspect in combination with decreasing dependency on this CRM makes this proposal very attractive!**

- **"… funding remains a challenge…"**

Thank you for your attention!

Contact
Rheinmetall Business Unit Protection Systems

Dr. Roland Niefanger
roland.niefanger@rheinmetall.com



TAKING RESPONSIBILITY IN A CHANGING WORLD

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