European Conference of Defence and the Environment

ECDE 2024

CONSTANTINOS HADJISAVVAS
The European Defence Agency

EUROPEAN
CONFERENCE OF
DEFENCE AND THE
ENVIRONMENT

EUROPEAN DEFENCE AGENCY

Defence, climate and environment:
Coinciding, not conflicting possibilities.
12-13 June 2024, Oslo, Norway

EUROPEAN CONFERENCE OF DEFENCE AND THE ENVIRONMENT

EDA's Drive for Defence Energy Resilience in a Climate-Neutral European Union

Dr Constantinos HADJISAVVAS
EDA Project Officer Energy
Project Manager of EU-funded programmes
(CF SEDSS, Horizon 2020 and Symbiosis, Horizon Europe)
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EUROPEAN DEFENCE AGENCY | European Defence Energy Network

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 882171

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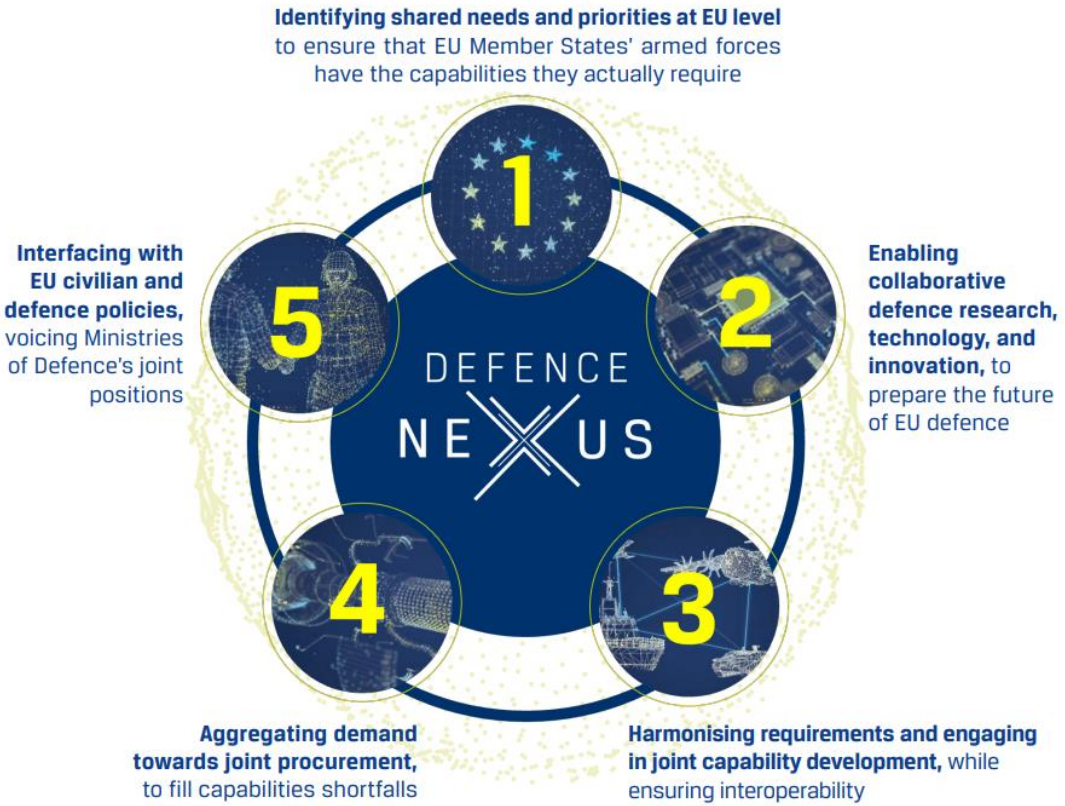
EUROPEAN DEFENCE AGENCY | European Defence Energy Network

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 882171

EU Defence Ministers approve reinforced mandate for EDA

EDA LONG-TERM REVIEW 2024



EDA's Administrative Arrangements

NORWAY MoD	SWITZERLAND MoD	SERBIA MoD	UKRAINE MoD	U.S. DoD
Since 2006	Since 2012	Since 2013	Since 2015	Since 2023

ESA	OCCAR
Since 2011	Since 2012

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2. EU climate-security nexus

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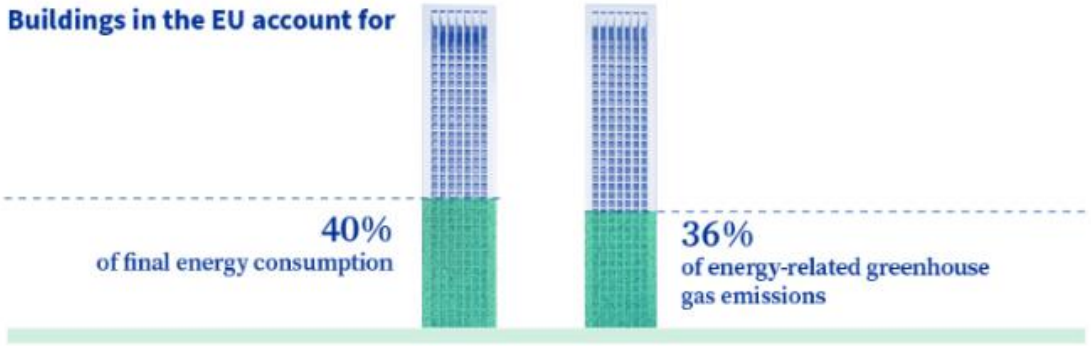
Make EU the first climate-neutral continent by 2050

…reduce EU greenhouse gas emissions by at least 55% by 2030 and reach climate neutrality by 2050…

New proposal – COM(2024) 63 final
90% reduction in greenhouse gas emissions….by 2040

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 882171

Paving the Way for Zero-Emission Buildings in the EU



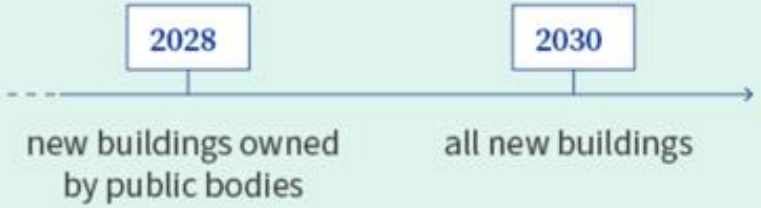
75% of existing buildings
are inefficient in terms of energy and will require energy renovation on a large scale

Existing buildings:

- should be **transformed into zero-emission buildings by 2050**

New constructions:

New buildings that will have to be zero-emission:



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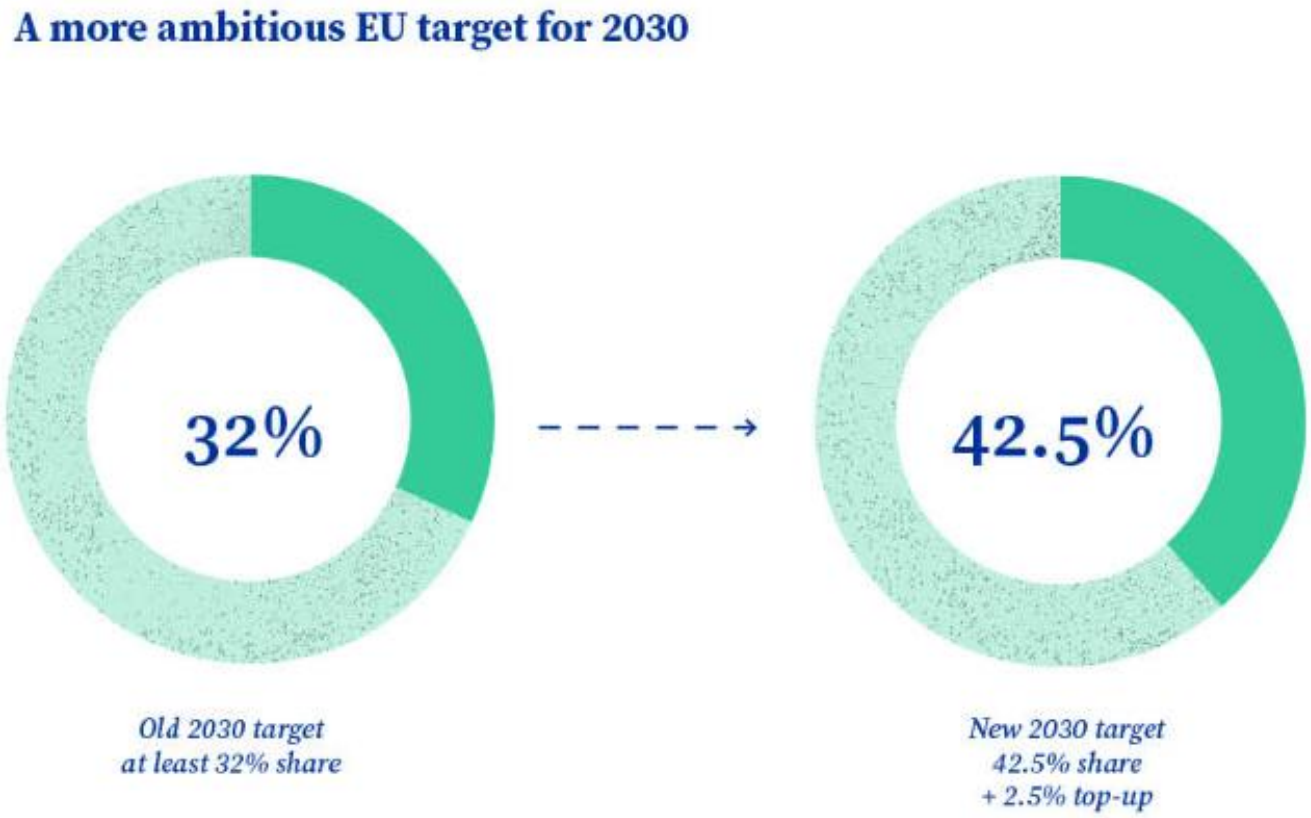
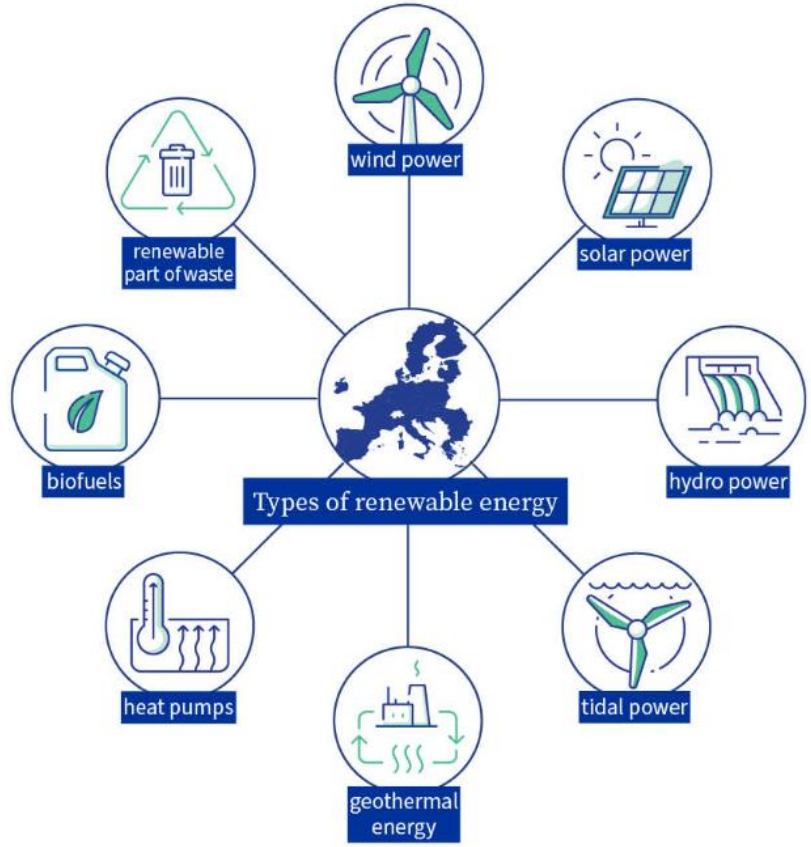
EU's Commitment to a Sustainable Future:
Scaling up renewable energy





This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 882171

EU Transport Sector:
Roadmap to 90% GHG reduction by 2050

Transport is responsible for almost 25% of greenhouse gas (GHG) emissions in the EU.

greenhouse gas emissions in transport by 2050

Making transport sustainable for all

Our transition to greener mobility will offer clean, accessible and affordable transport even in the most remote areas.

55%
reduction of emissions from cars by 2030

50%
reduction of emissions from vans by 2030

0
emissions from new cars by 2035

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 882171

3. Sustainable energy and climate change adaptation in defence

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EU Climate Change and Defence Roadmap

Council of the European Union

Brussels, 9 November 2020
(OR. en)

A European Green Deal

Striving to be the first climate-neutral continent

12741/20

COPS 389
CFSP/PESC 977
CSDP/PSDC 545
POLMIL 171
CLIMA 289
ENV 694
RELEX 870

COVER NOTE

From:	European External Action Service (EEAS)
To:	Delegations
Subject:	Climate Change and Defence Roadmap

Delegations will find attached document EEAS(2020)1251.

Encl.: EEAS(2020)1251

- … a set of concrete **actions** addressing the links between **climate change** and **defence...**
- **…address three interlinked work strands**
  - ✓**Operational dimension**
  - ✓**Capability development**
  - ✓**Partnerships and multilateralism**

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 882171

A Strategic Compass for Security and Defence

Council of the European Union

Brussels, 21 March 2022
(OR. en)

7371/22

COPS 130	PROCIV 36
POLMIL 72	ESPACE 27
EUMC 95	POLMAR 26
CSDP/PSDC 155	MARE 24
CFSP/PESC 394	COMAR 23
CIVCOM 50	COMPET 165
RELEX 373	IND 77
JAI 371	RECH 144
HYBRID 27	COTER 79
DISINFO 24	POLGEN 41
CYBER 87	CSC 111

OUTCOME OF PROCEEDINGS

From:	General Secretariat of the Council
To:	Delegations
Subject:	A Strategic Compass for Security and Defence - For a European Union that protects its citizens, values and interests and contributes to international peace and security

Delegations will find in the Annex the Strategic Compass for Security and Defence - For a European Union that protects its citizens, values and interests and contributes to international peace and security, as approved by the Council at its meeting held on 21 March 2022.

…the Compass calls upon Member States to:

develop

national strategies to prepare the armed forces for climate change

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 882171

ADDRESSING THE IMPACTS OF CLIMATE CHANGE AND ENVIRONMENTAL DEGRADATION ON PEACE, SECURITY AND DEFENCE

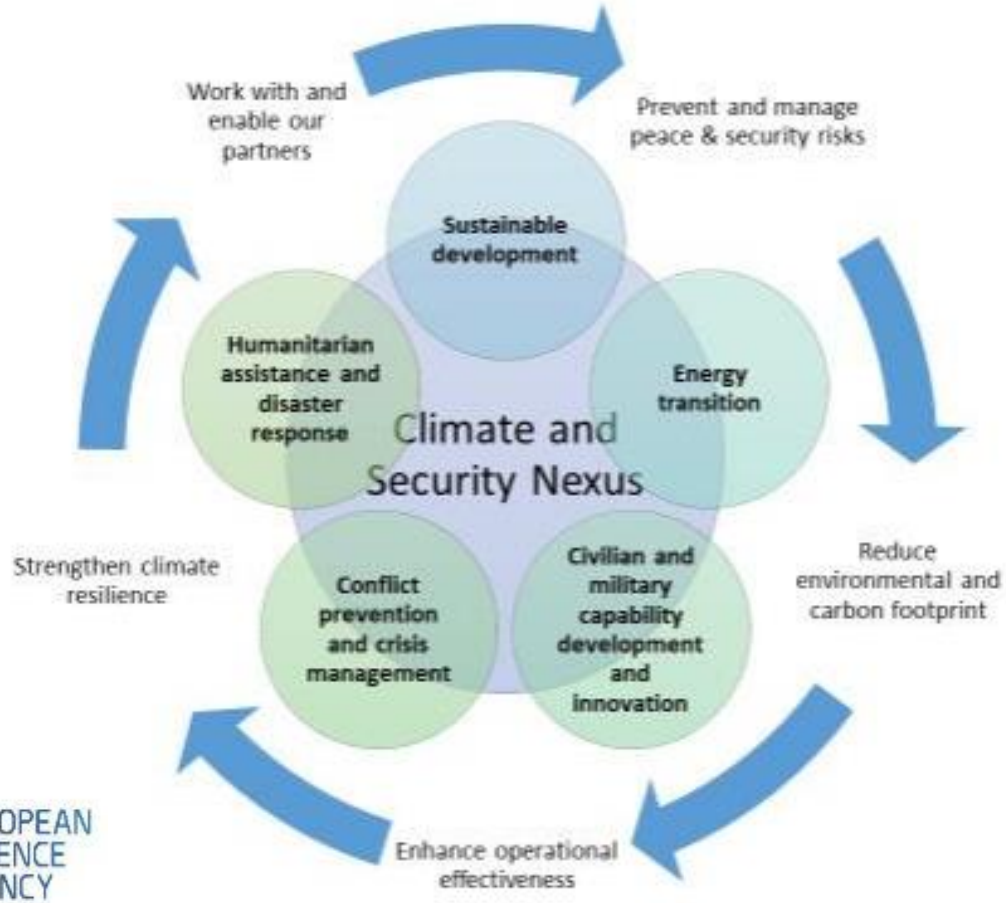
EUROPEAN COMMISSION

HIGH REPRESENTATIVE OF THE UNION FOR FOREIGN AFFAIRS AND SECURITY POLICY

Brussels, 28.6.2023
JOIN(2023) 19 final

JOINT COMMUNICATION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL

A new outlook on the climate and security nexus:
Addressing the impact of climate change and environmental degradation on peace, security and defence



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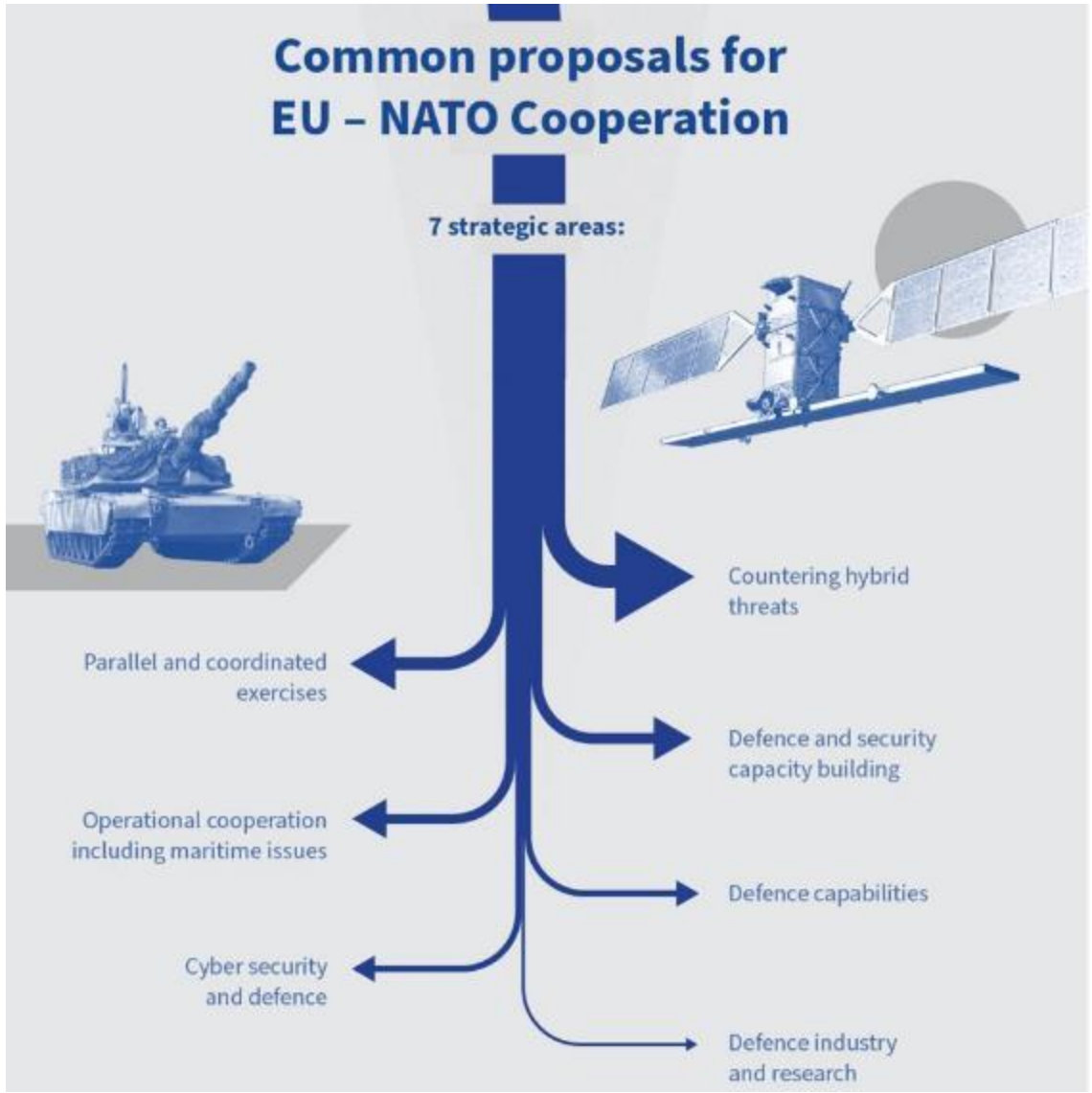
Of the **28 actions of the Joint Communication**, **EDA** is actively involved and will contribute to **10**, which constitutes **more than a third of the total actions.**

EU and NATO cooperation – Joint Declarations (2016, 2018 and 2023)



EU-NATO joint declaration 2018

- counter-terrorism
- women, peace and security
- military mobility

EU-NATO joint declaration 2023

- the growing geostrategic competition
- **resilience and the protection of critical infrastructure**
- emerging and disruptive technologies
- **the security implications of climate change**
- space
- foreign information manipulation and interference

EDA–U.S. Department of Defense Administrative Arrangement Signed

Initial activities of cooperation include, inter alia, the impact of climate change on defence.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 882171

A European Green Deal

Striving to be the first climate-neutral continent

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European Commission

EDA Energy and Environment Capability

Tecnology Group

EnE CapTech

Energy Defence Consultation Forum

CF SEDSS

H2020 funded

Offshore Renewable Energy in Defence

SYMBIOSIS

Horizon Europe funded

Incubation Forum for Circular Economy in European Defence

IF CEED

Co-funded LIFE programme and Luxembourg

cross-cutting

EU-funded defence energy-related projects run by EDA

Consultation Forum for Sustainable Energy in the Defence and Security Sector

(CF SEDSS)

- A European Commission initiative managed by EDA to assist the EU MoDs and relevant stakeholders to move towards green, resilient, and efficient energy models.
- Horizon 2020
- Phase III (Oct 2019 – Sept 2024)
- EUR 3.2 M

Symbiosis

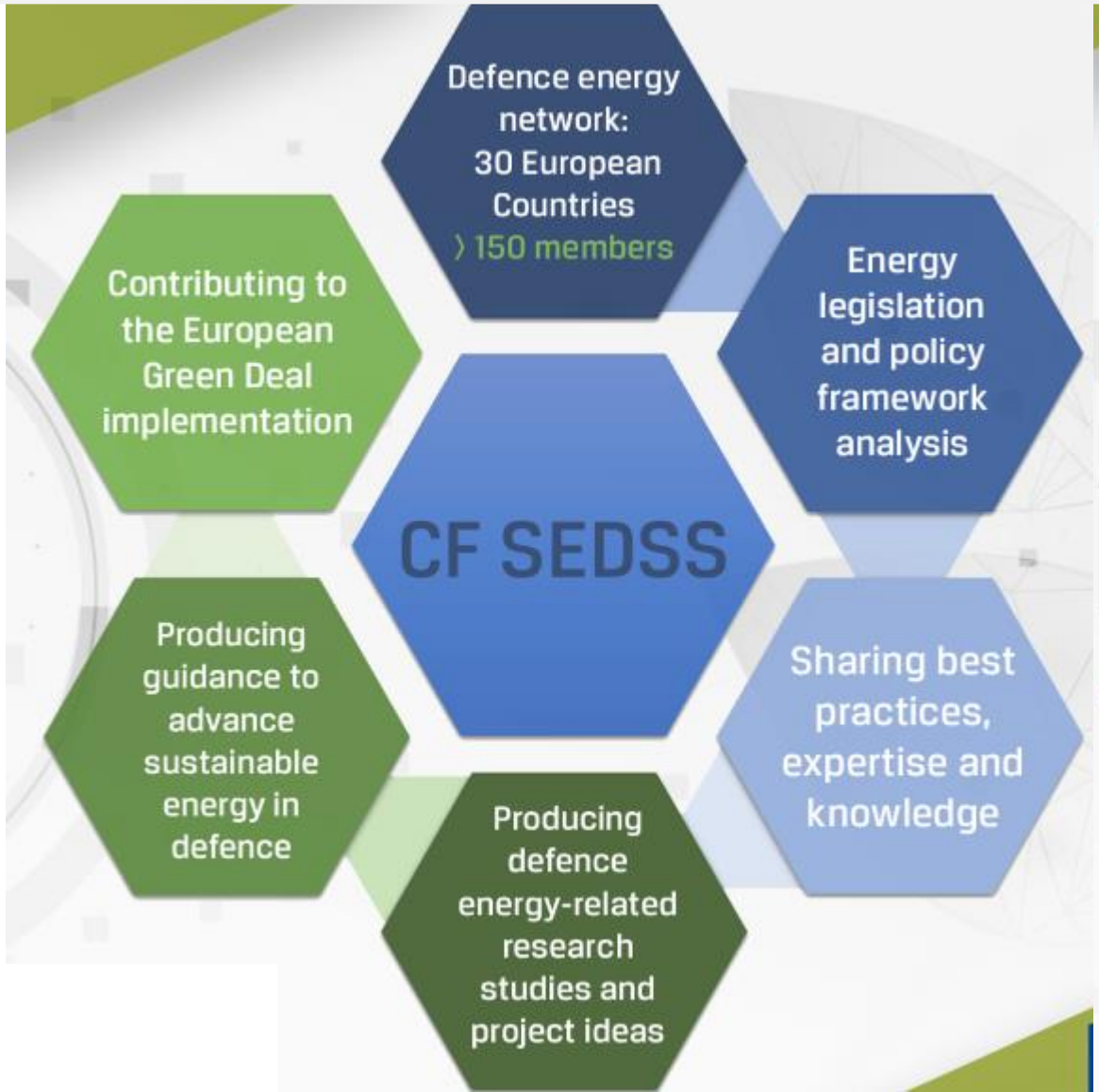
(Offshore Renewable Energy for Defence)

- Building on the EDA's Energy Consultation Forum's output, DG ENER and EDA developed the Symbiosis project with the aim to foster the co-existence between offshore renewable energy projects and defence operations and systems in European maritime spaces.
- Horizon Europe
- October 2022 – March 2025
- EUR 2 M

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 882171

Consultation Forum for Sustainable Energy in the Defence and Security Sector (CF SEDSS) – since 2015 (3.2 million Euro)

a European Commission initiative managed by EDA to assist the EU MoDs to move towards green, resilient, and efficient energy models



WORKING GROUP 1

Energy Efficiency & Buildings Performance

Improve the energy efficiency of military building stock and fixed infrastructure

WORKING GROUP 2

Renewable Energy Sources

Use renewable energy sources and technologies in the defence sector (generation, conversion, storage and use in transportation)

WORKING GROUP 3

Protection of Critical Energy Infrastructure

Increase the protection and resilience of defence-related critical energy infrastructure (tools, guidelines, methodologies)

TRANSVERSAL WORKING GROUP

Policy & Management Observatory

(Action plans, human factors, awareness, best practices, skills, etc.)

Technology, Research & Innovation Hub

(Energy management, networks, cyber, AI, digitalisation, sensors, micro-grids, etc.)

Financing & Funding Gateway Cell

(IdentiFunding methodology for defence energy projects, ad-hoc, SRSS, ECP, etc.)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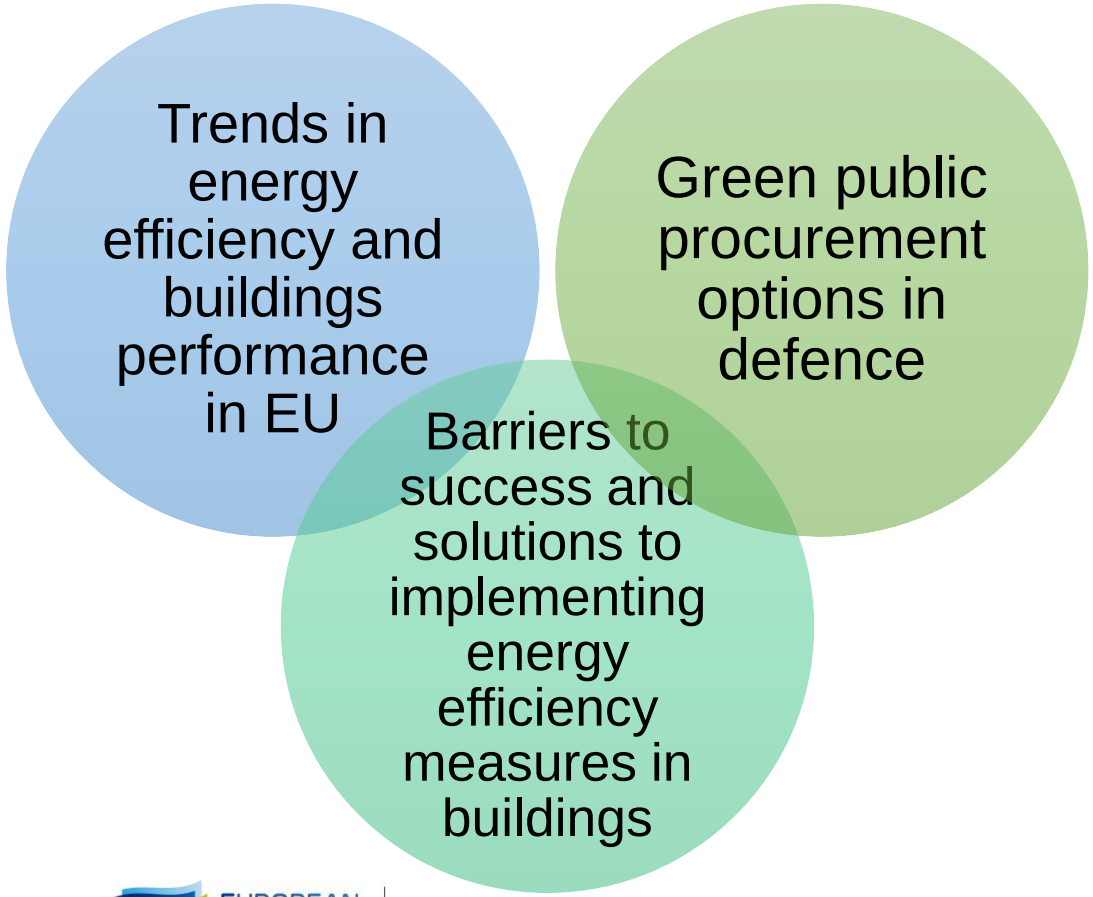
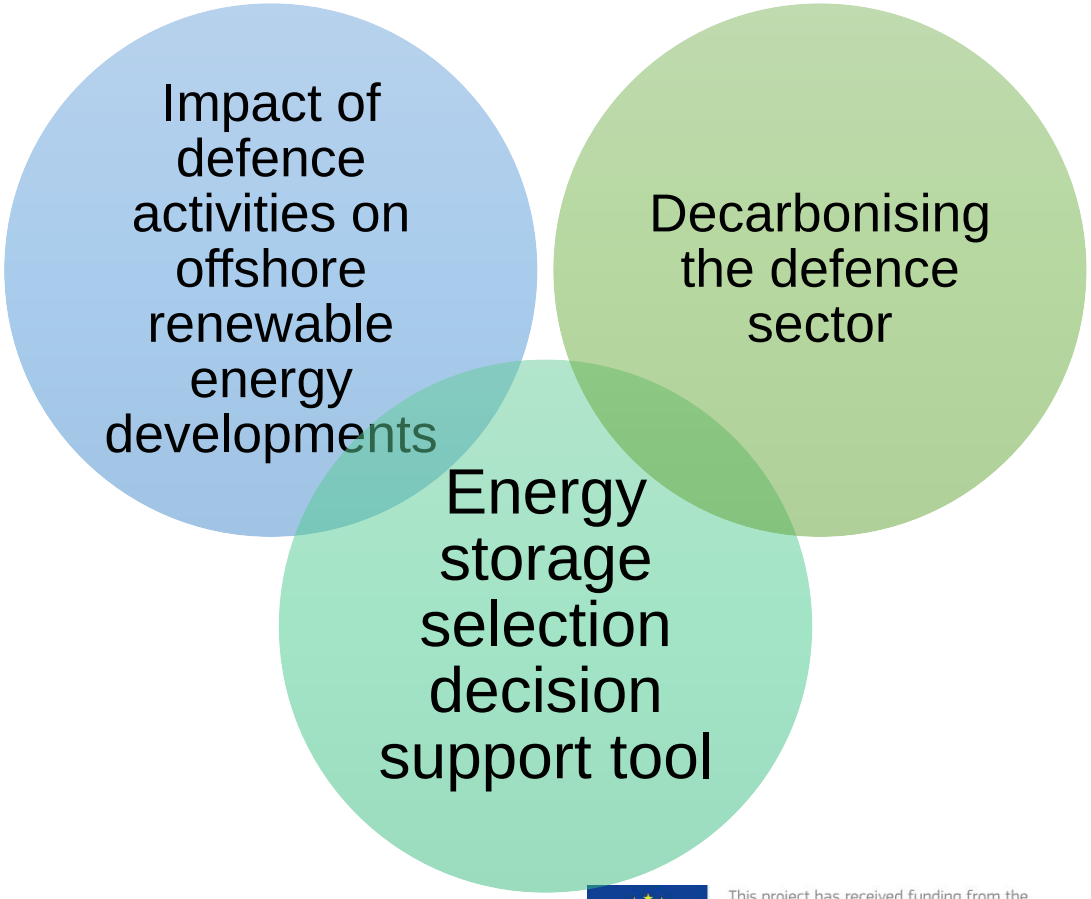
CF SEDSS III research focus (1/2)

WG-1 ENERGY EFFICIENCY & BUILDINGS PERFORMANCE



WG-2 RENEWABLE ENERGY SOURCES



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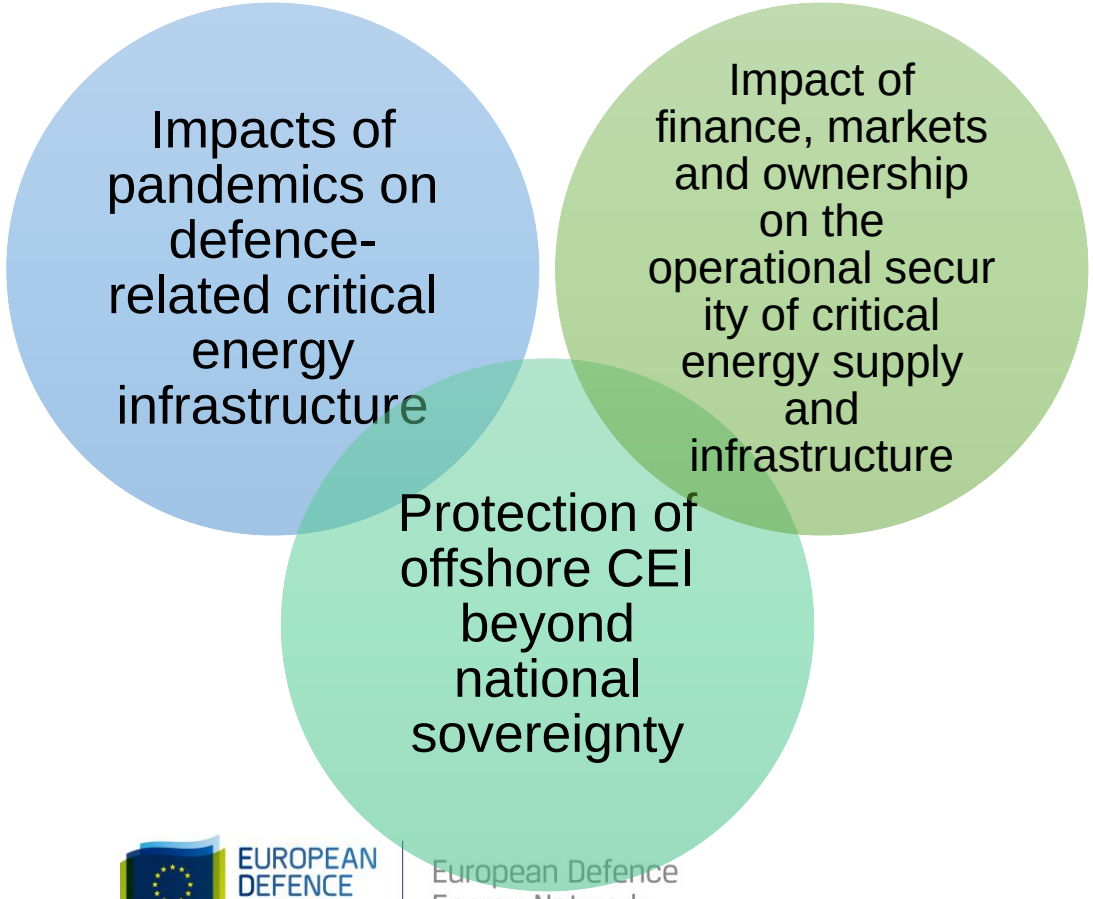
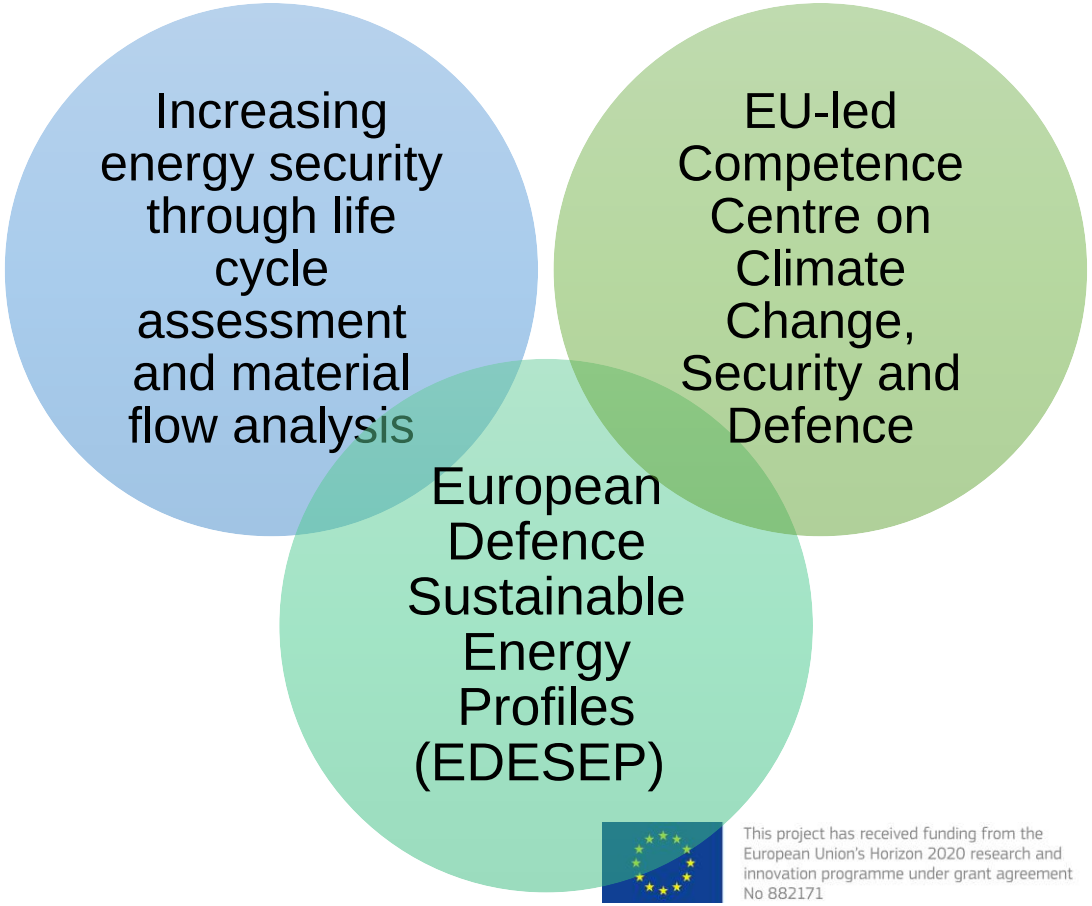
CF SEDSS III research focus (2/2)

WG-3 PROTECTION OF CRITICAL ENERGY INFRASTRUCTURE



WG-TRANSVERSAL WORKING GROUP



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EDA-JRC Climate Change Study: Key Recommendations

European Commission

EUROPEAN DEFENCE AGENCY

EUROPEAN DEFENCE AGENCY | European Defence Energy Network

MoDs

01 ✓ Develop National Defence Strategies on Climate Change

02 ✓ Deliver training in energy and climate mitigation and adaptation

03 ✓ Monitor energy performance and emissions

04 ✓ Implement climate risk management

EU

01 ✓ Develop an EU Defence Strategy on Climate Change

02 ✓ Develop guidance for managing climate risk, energy and carbon footprints

03 ✓ Establish an EU-led Competence Centre for defence, energy and climate

04 ✓ Establish a multi-stakeholder forum on defence, energy and climate

05 ✓ Establish a defence, energy and climate R&D programme

- investigate the **nature and development of hybrid threats**, including new **tactics** and **targets** to **strengthen the resilience of defence-related CEI**;
- address the **knowledge gap** in this area;
- provide the **EU and MoDs** with **recommendations** to **enhance the resilience of defence-related CEI against hybrid threats**.

Adopt	Conduct	Foster
a **whole-of-society approach** to resilience-building against hybrid threats, considering existing dependencies and interconnections in society.	periodic **vulnerability assessments** and identify interdependencies to address gaps that hostile actors could exploit.	international **collaboration and information sharing** to counter hybrid threats at operational and strategic levels effectively.

eda.europa.eu/docs/default-source/brochures/eda-jrc-study_web-version.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 882171

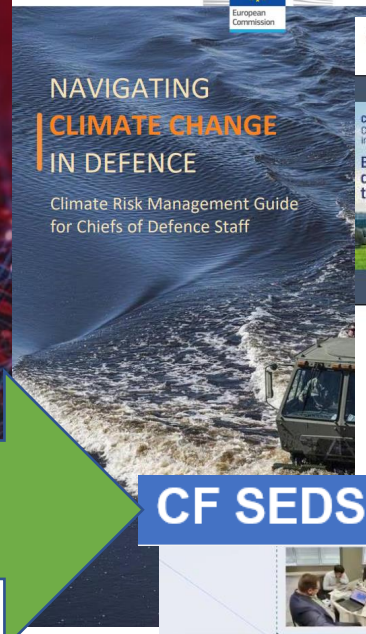
CF SEDSS: research focus and table-top exercise

CONSULTATION FORUM SUSTAINABLE ENERGY

WORKING GROUP 3

Protection of Critical Energy Infrastructure

Increase the protection and resilience of defence-related critical energy infrastructure (tools, guidelines, methodologies)



CF SEDSS Table top exercise (Sofia, May 2023)

CF SEDSS III – Table-top Exercise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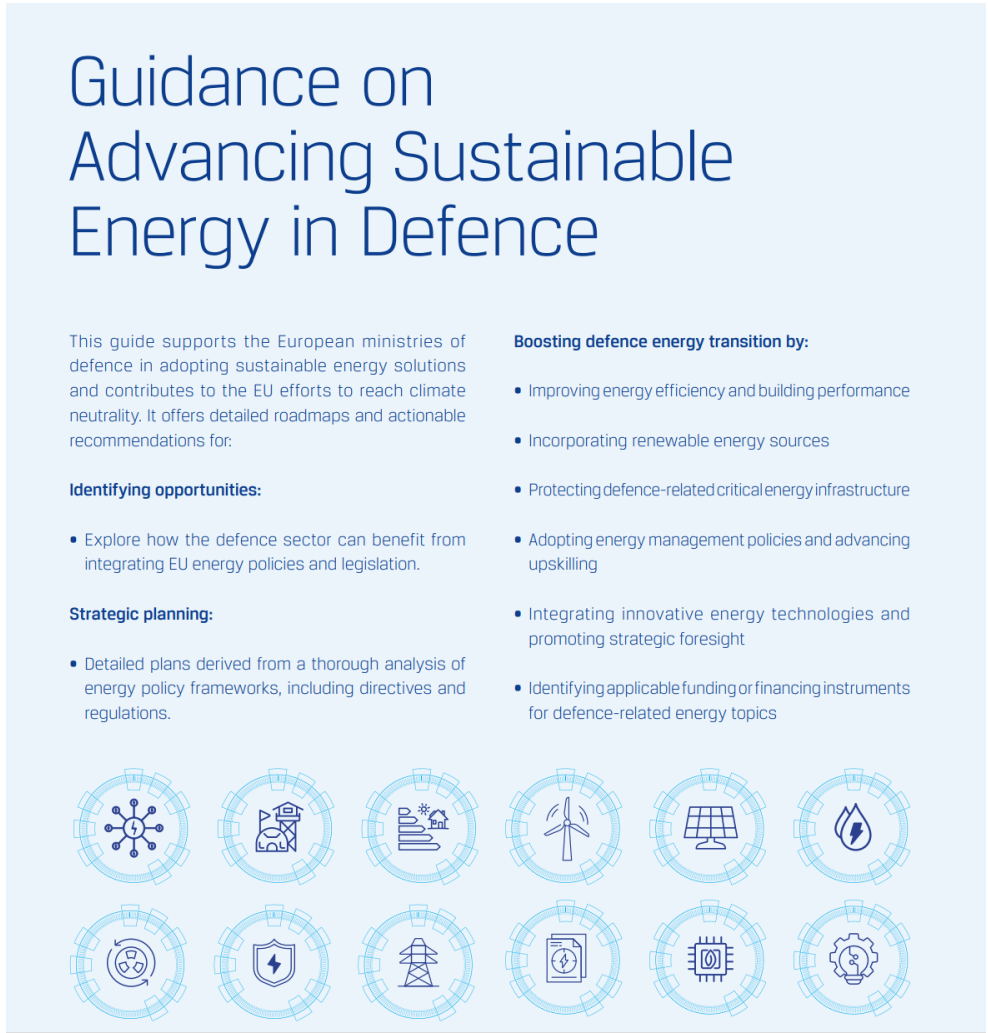
Guidance on Advancing Sustainable Energy in Defence

5 Chapters:

1. Strategic Context;
2. Implications of Energy Legislative Landscape on Defence;
3. Roadmaps for Advancing Sustainable Energy in Defence;
4. Guidance for the Implementation of the Roadmaps;
5. Cross-Cutting Support for the Implementation of the Defence Energy Roadmaps.



Guidance on Advancing Sustainable Energy in Defence

This guide supports the European ministries of defence in adopting sustainable energy solutions and contributes to the EU efforts to reach climate neutrality. It offers detailed roadmaps and actionable recommendations for:

Identifying opportunities:

- Explore how the defence sector can benefit from integrating EU energy policies and legislation.

Strategic planning:

- Detailed plans derived from a thorough analysis of energy policy frameworks, including directives and regulations.

Boosting defence energy transition by:

- Improving energy efficiency and building performance
- Incorporating renewable energy sources
- Protecting defence-related critical energy infrastructure
- Adopting energy management policies and advancing upskilling
- Integrating innovative energy technologies and promoting strategic foresight
- Identifying applicable funding or financing instruments for defence-related energy topics

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3. Reflections

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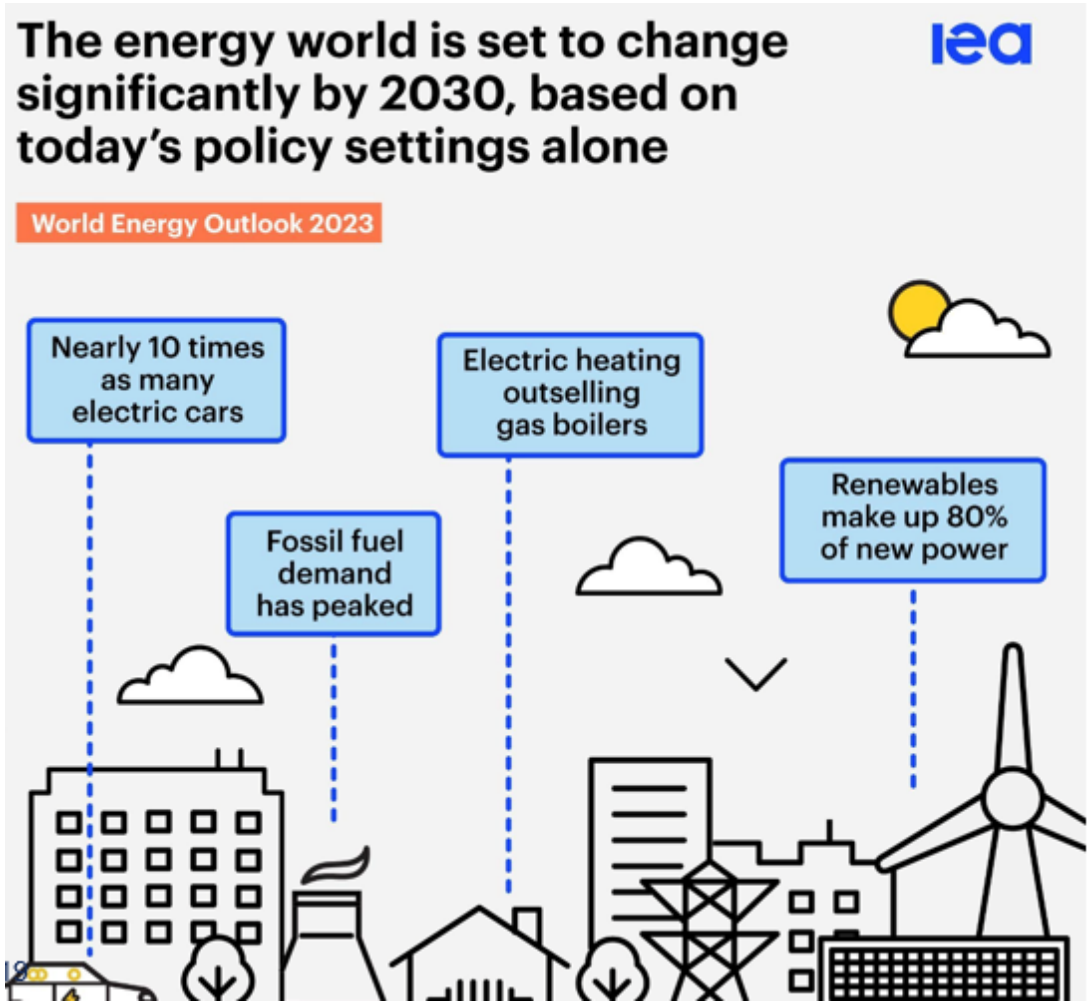
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 882171

Preparing defence for the post-2030 energy landscape



Prioritize **energy diversification**

Apply the "**energy efficiency first principle**"

Accelerate the **adoption of RES** and technologies.

Modernize infrastructure

Incorporate a **gender-focused** approach

Invest in **innovation, training and upskilling**

Foster multinational collaboration, including industry

Project implementation – funding

Learn more about us

Visit our webpage
link

Read our fact-sheets
link

Watch our video-clips
link

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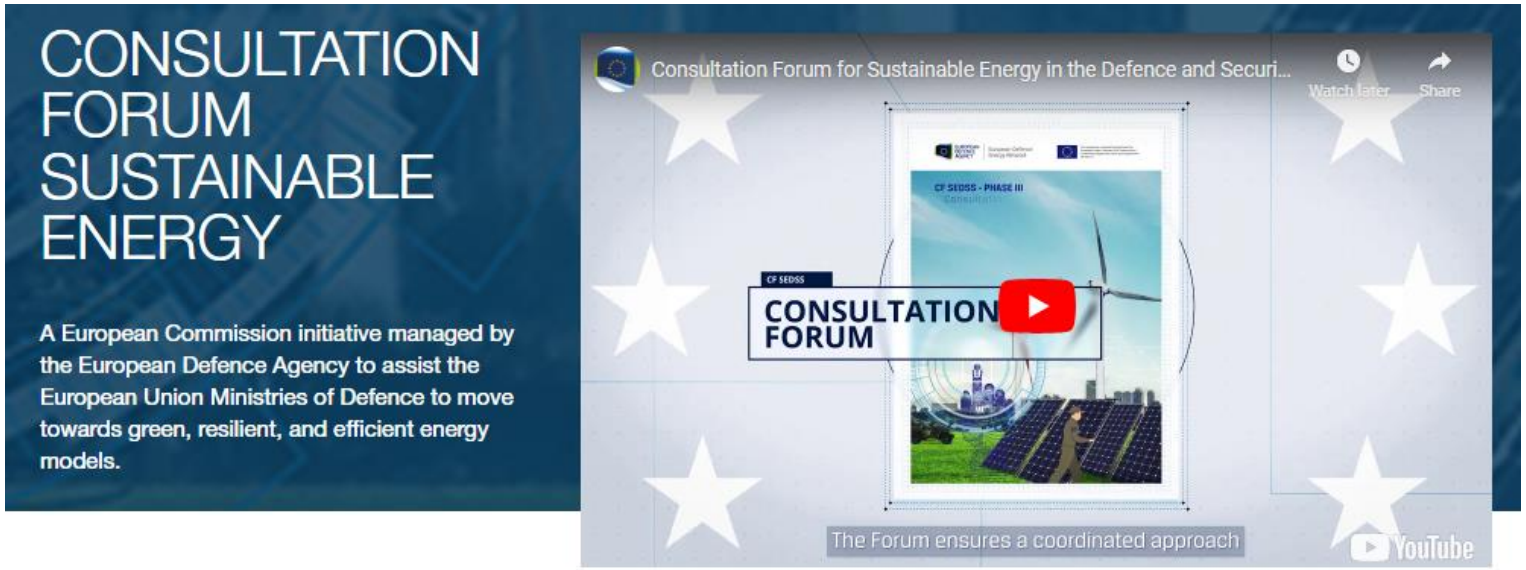
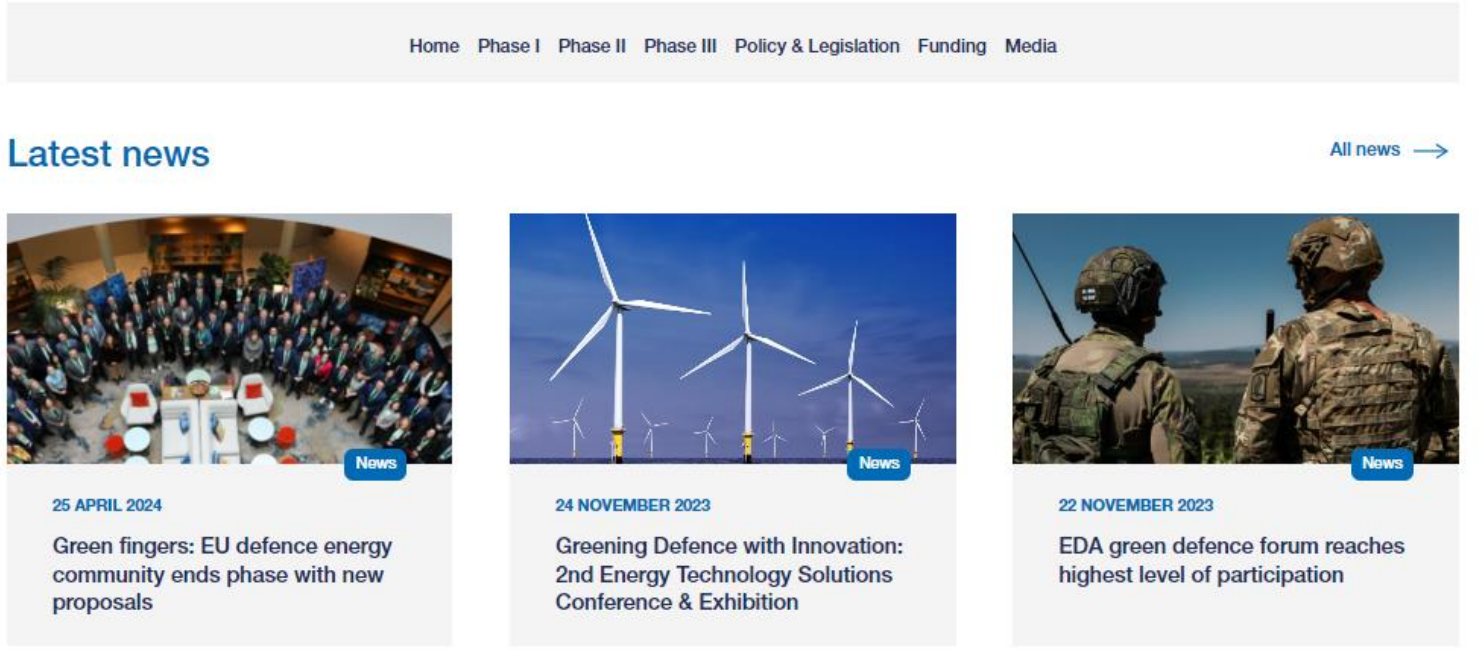
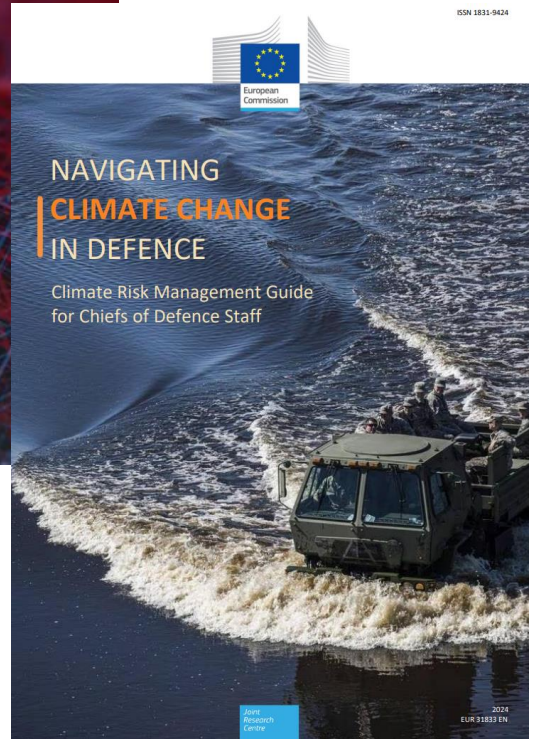
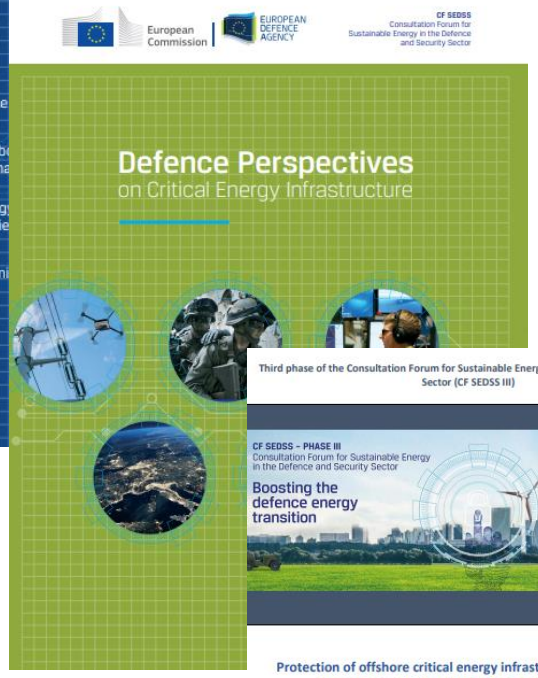




Publications



Upcoming publications



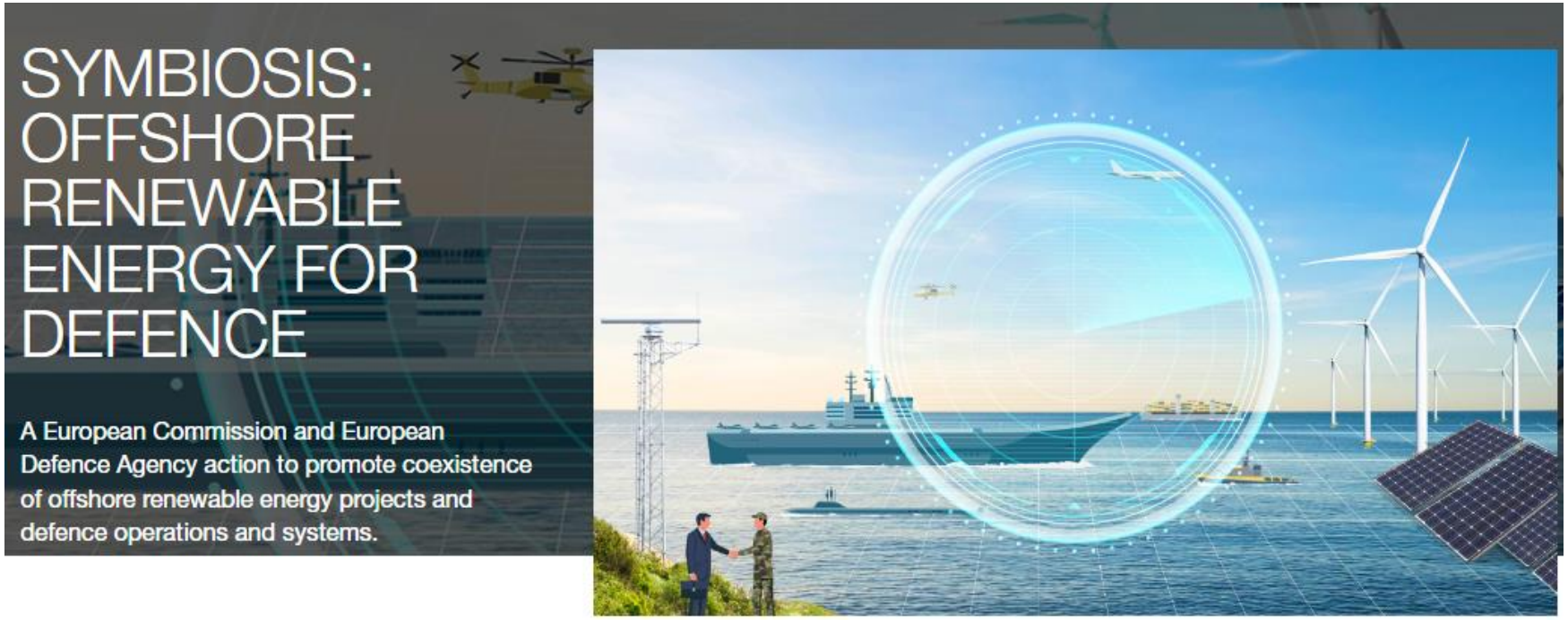
Protection of offshore critical energy infrastructure beyond national sovereignty: military rules of engagement and barriers

Working Group 3
Protection of Critical Energy Infrastructures

EUROPEAN DEFENCE AGENCY | European Defence Energy Network

Learn more about us

Visit our webpage link



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SUSTAINABLE ENERGY
FOR SUSTAINED DEFENCE

Thank you for your attention

Dr Constantinos HADJISAVVAS
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European Conference of Defence and the Environment

ECDE 2024

JEROEN ROTTINK
Chair NATO Environmental Protection Working Group

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NATO Environmental Protection governance and relations to Energy, Climate Change and Security

NATO MCJSB Environmental Protection Working Group (EP WG)

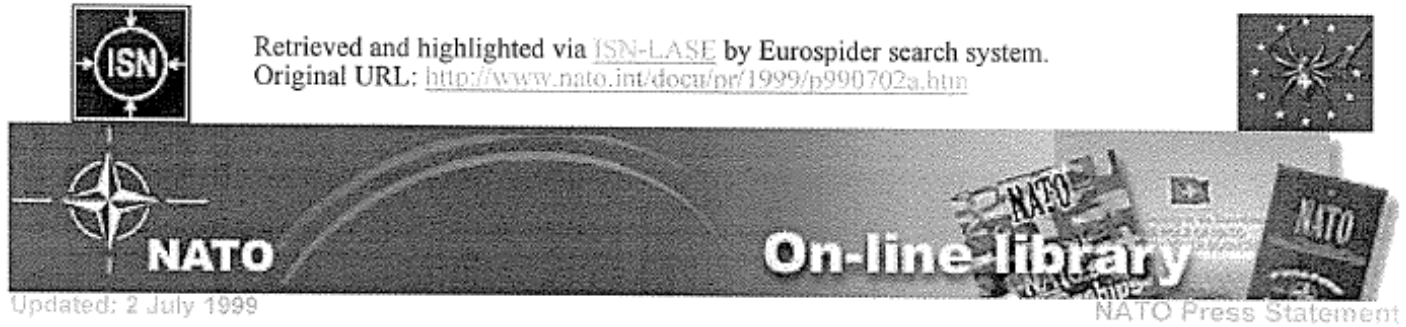
Mr Jeroen Rottink NLD (Civ)
Chair EP WG
jbh.rottink@mindef.nl

Capt Natalia LAIDOGLOU, GRC-N
Secretary EP WG
Laidoglou.Natalia@nso.nato.int

Presentation overview

- NATO EP Governance
  - Policy documents
  - Committees and Working Groups (WGs)
  - NATO ←→ Nations
- Relations to ENSEC and CCAS
  - Products - tools
  - Synergies
- How to achieve more?
  - NATO EP/ENSEC/CCAS related Courses
  - Future Outlook

NATO EP Governance - 1



Press Statement

2 July 1999

Protecting the Environment

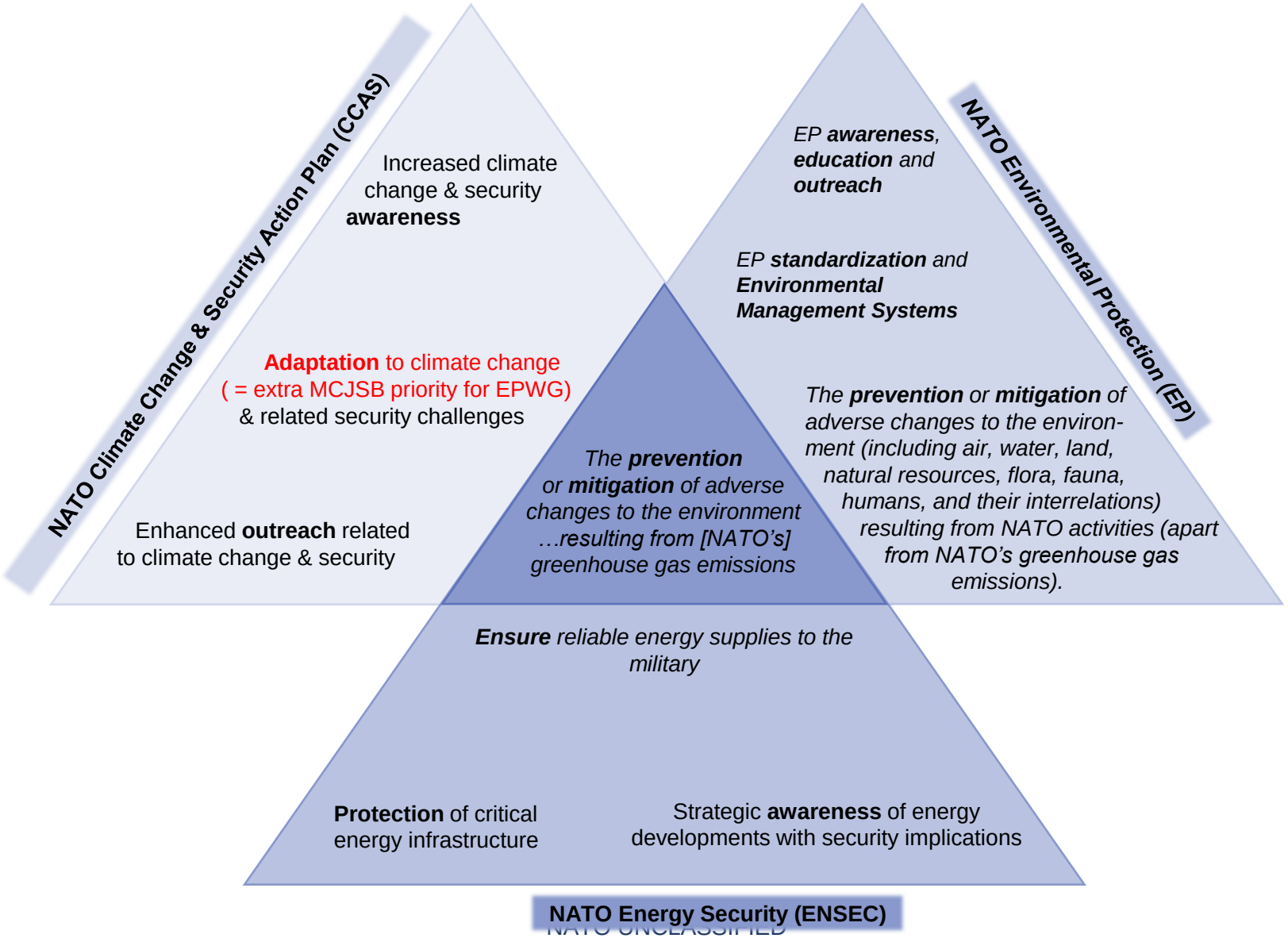
With environmental issues very much to forefront of the activities of Alliance members, NATO has begun the process of drawing from the wealth of existing national procedures, and the valuable work carried out by the International Staff Scientific Division Committee on the Challenges for Modern Society (CCMS) in order to develop common environmental policies and
itary action has an effect on the environment and
h nation possesses different environmental laws,
ocedures it must apply when forces of one
a standardized approach will certainly reduce the
in the Balkans where national environmental
a unified approach to protecting the environment;
Environmental Protection Working Group ([

99 at NATO Headquarters, the [EPWG] is under
the auspices of the Military Agency for Standardization (MAS) Joint Service Board. Chaired by Italy and attended by 12 nations, the group's initial focus has been to draft environmental policy, doctrine and guidance for NATO commanders and planners. The fruits of this work will be STANAG 7141-EP, which will be offered to nations for ratification during the coming months. Another topic the [EPWG] is tackling is an 'Alliance approach' to the handling and disposal of Hazardous Waste Materials.

[illegible] of the environment clearly features in the work [illegible] other groups within NATO and the [EPWG] expects to have widespread liaison and dialogue. Environmental protection is topical and its scope is vast; the [EPWG] is taking its first steps in pooling the knowledge of members and harmonizing environmental procedures which the Alliance will use in the next century.

EPWG 1999-2024 = 25 years!

CCAS – ENSEC – EP relations



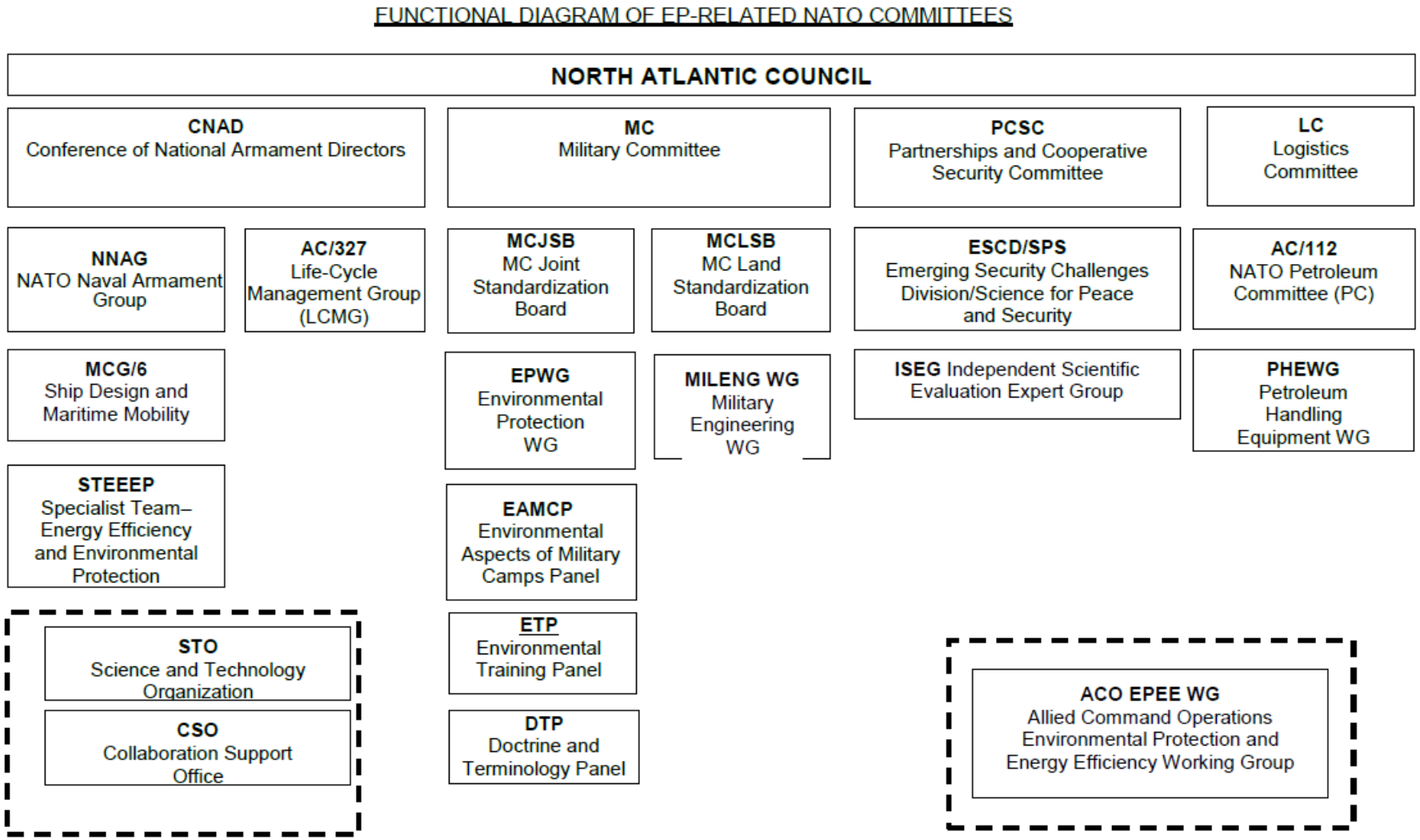
NATO EP Governance - 2

Policy & doctrine documents

- MC 469/2: NATO Principles and Policies for Environmental Protection (July 2023)
- MC 560/2: MC Policy for Military Engineering (Sept 2017)
- STANAG 7141 / AJEPP-4: Joint NATO Doctrine for Environmental Protection During NATO led Military Activities (March 2018 – under review)

MC = Military Committee
STANAG = STANdardization AGreement (covers an AP = Allied Publication)
AJEPP = Allied Joint Environmental Protection Publication

NATO EP Governance - 2
Committees and WGs



NATO EP Governance - 3
NATO ←→ nations

- EP in NATO Command Structure (NCS)
- Nations – ratify / implement (*) at national discretion
- NCS – must implement STANAGs
- Challenge

(*) 6 options: Ratify and [future] implement (with reservations) / Not ratify / Not participating

CCAS-ENSEC-EP

The prevention or mitigation of adverse changes to the environment …resulting from [NATO's] greenhouse gas emissions

Tools – products

1. EP STANAGS
2. CNAD Standards (review) (climate)
3. ENSEC Reports
4. HQ Energy Transition by Design

How to achieve more?

EP Courses

- Advanced Distance Learning 033, *Introduction to Environmental Awareness (under re-construction)*
- *M3-77 Environmental Management for Military Forces Course (2 weeks, NATO School)*
- *NATO Military Environmental Protection Practices and Procedures Course* (NMEPPPC) (one week, MILENG CoE)

EP Library

- at MILENGCOE website

ENSEC, MILENG and Operational Energy courses

Future Outlook

Involve more nations in EPWG and in work

Accelerate EP-work streams in NATO

Co-ordinate EP-work with ENSEC and CCAS (COE's)

1. Are there solutions that deal with both climate and security challenges?
2. And how will a changed climate affect military planning, activities and materiel in the future?

Thank you!

European Conference of Defence and the Environment

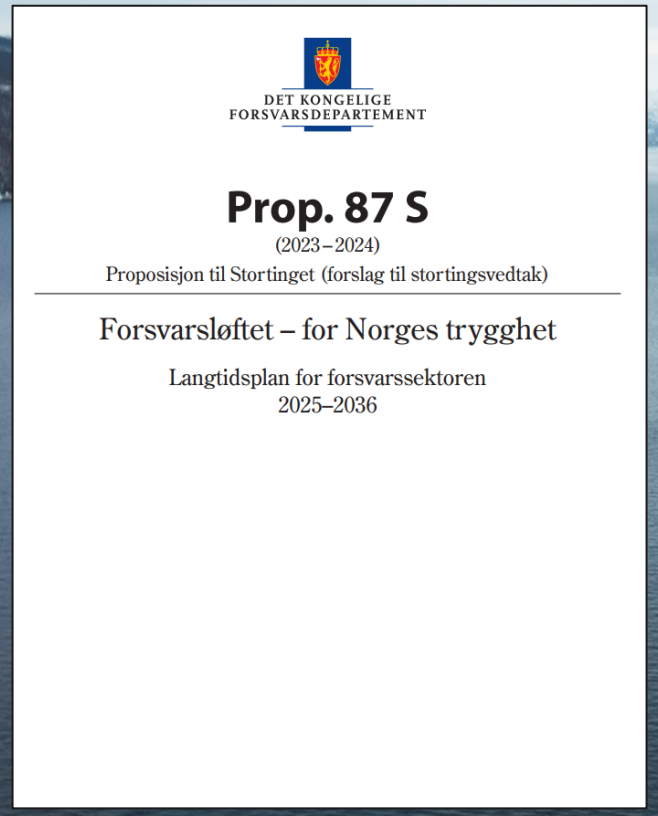
ECDE 2024

JULIE FOSSEM
Department of Defence Policy and Long Term Planning,
Ministry of Defense, Norway

EUROPEAN
CONFERENCE OF
DEFENCE AND THE
ENVIRONMENT

The Norwegian Defence Pledge

Long-term Defence Plan 2025-2036



DET KONGELIGE
FORSVARSDEPARTEMENT

Prop. 87 S

(2023–2024)

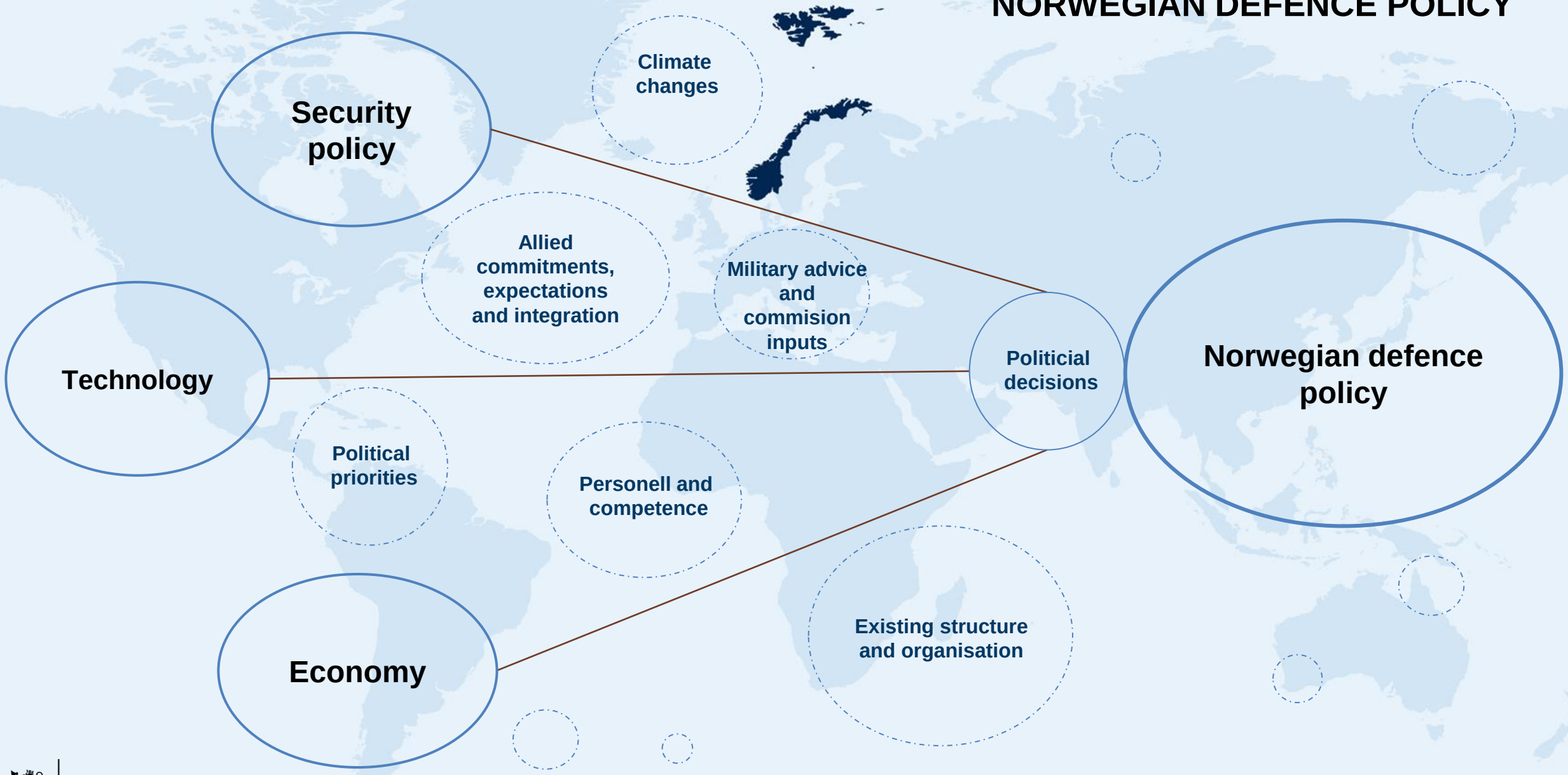
Proposisjon til Stortinget (forslag til stortingsvedtak)

Forsvarsløftet – for Norges trygghet

Langtidsplan for forsvarssektoren
2025–2036

Norwegian Ministry of Defence

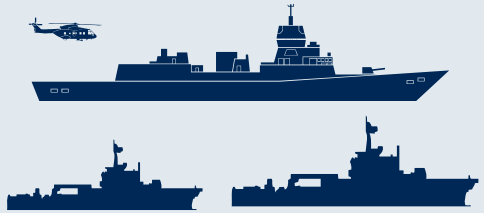
DRIVING FORCES OF NORWEGIAN DEFENCE POLICY



Main Priorities of the Defence Pledge

Situational Awareness

Enhancing situational awareness **in the High North**

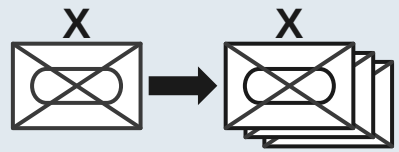


Fleet plan 2024

Strengthening and renewing the Navy with new **frigates**, new **submarines** and **standardized vessels**.

Air Defence

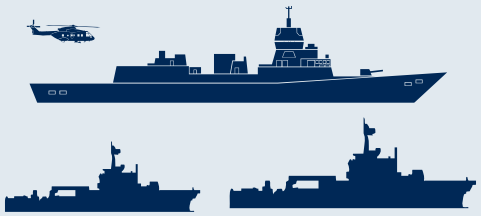
Increased volume and performance of **NASAMS-systems** and acquiring **Long-range Air Defence**



Land Forces

Expansion from one to **three combat brigades** in the Army and a more **robust Home Guard**

Addressing climate changes in the defence pledge



Capability development

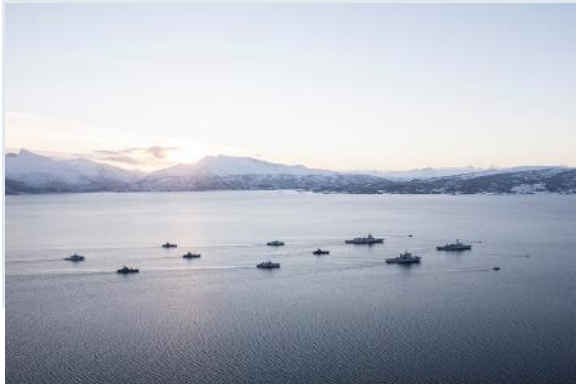
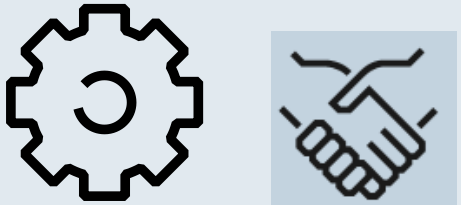
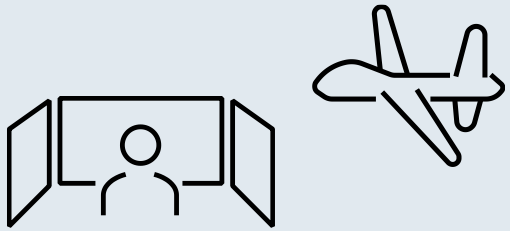


Photo: Elias Engevik / Forsvaret



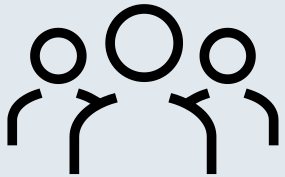
Procurements

Photo: Torgeir Haugaard/ Forsvaret



Simulators

Photo: Ole Vekve/Forsvaret



Research and development

Photo: Marius Villanger / Forsvaret

The Norwegian Defence Pledge

Long-term Defence Plan 2025-2036

Norwegian Ministry of Defence

European Conference of Defence and the Environment

ECDE 2024

SARA KAJANDER
Head of estate and environment, MoD Finland

EUROPEAN
CONFERENCE OF
DEFENCE AND THE
ENVIRONMENT

Puolustusministeriö
Försvarsministeriet
Ministry of Defence

A Comprehensive Approach to Climate and Security

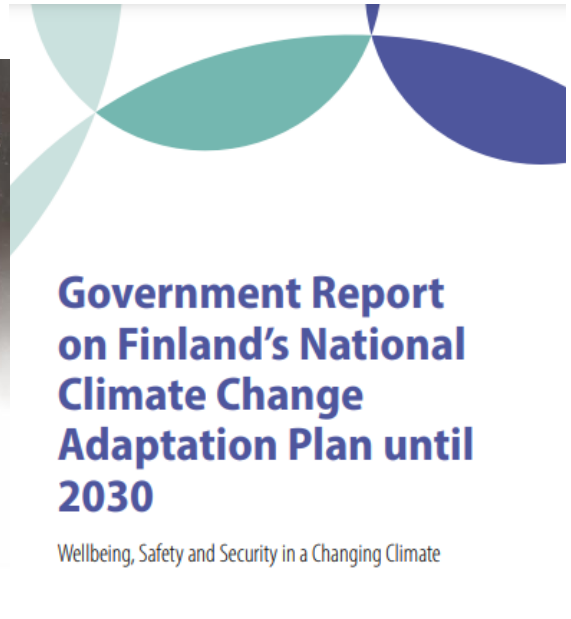
The 6th European Conference of Defence and the Environment

June 12th and 13th, 2024
Oslo, Norway

Sara Kajander
Director, Real Estate and Environment Unit

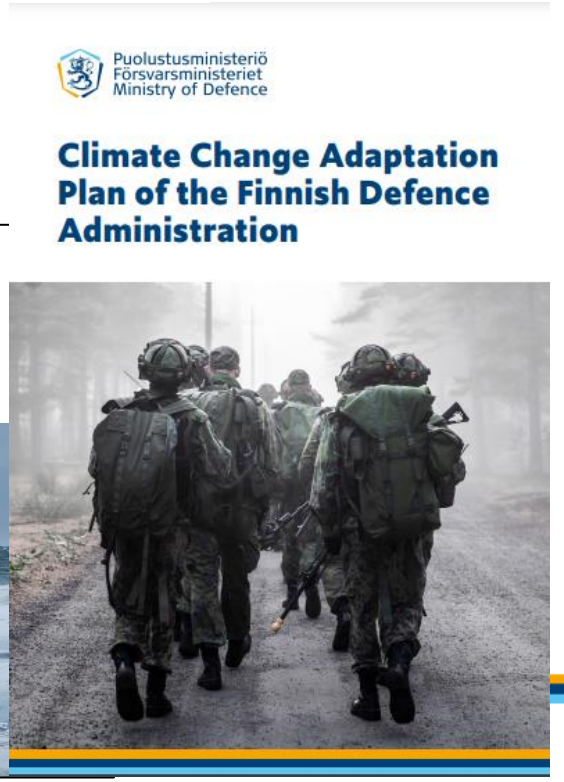

Publications of the Ministry of Economic Affairs and Employment
Energy • 2022:55
Carbon neutral Finland 2035 – national climate and energy strategy


CLIMATE RISKS IN FINLAND
CLIMATE RISKS ABROAD
DIRECT AND INDIRECT IMPACTS OF CLIMATE CHANGE
TRANSITIONAL EFFECTS
DIRECT AND INDIRECT IMPACTS OF CLIMATE CHANGE
CASCADING IMPACTS
SECURITY RISKS
CASCADING IMPACTS
CROSSBORDER EFFECTS
5

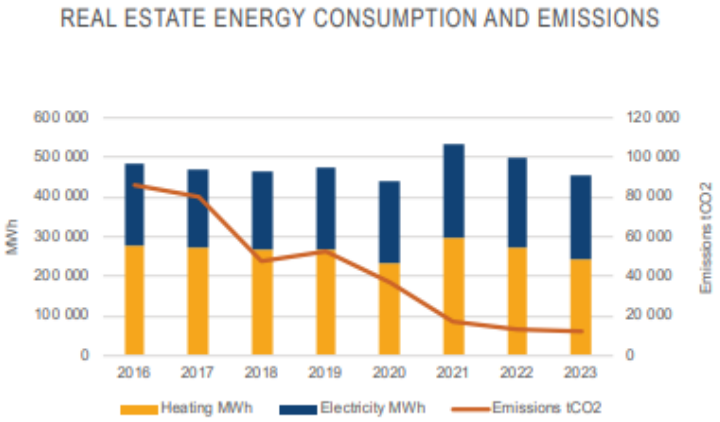

Government Report on Finland's National Climate Change Adaptation Plan until 2030
Wellbeing, Safety and Security in a Changing Climate

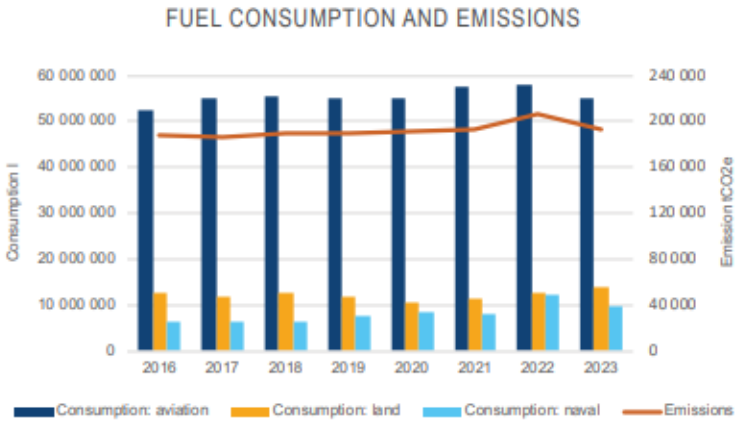

CLIMATE STRATEGY OF THE FINNISH DEFENCE

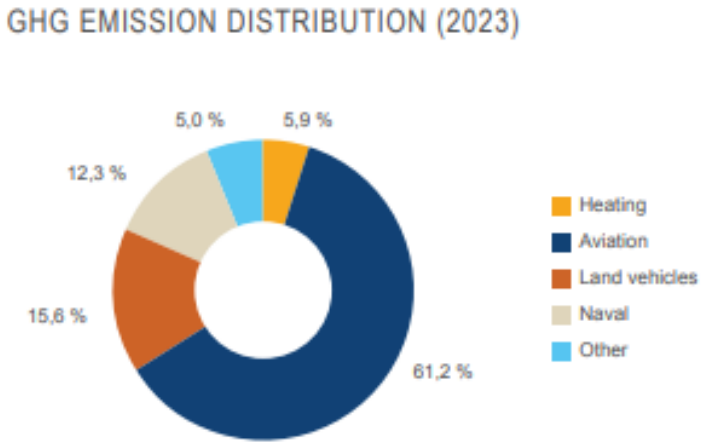

Puolustusvoimien energia- ja ilmasto-ohjelman 2022–2025 tavoitteet ja toimenpiteet


Puolustusministeriö
Försvarsministeriet
Ministry of Defence
FINNISH GOVERNMENT
Climate Change Adaptation Plan of the Finnish Defence Administration

GHG Emissions of the Finnish Defence







Goals

- Prepare for energy transition without compromising the defence capability
- To cut the emissions of land vehicles and naval vessels by half from 2020 to 2030
- To study possibilities and set emission targets for military aviation in 2025

Means

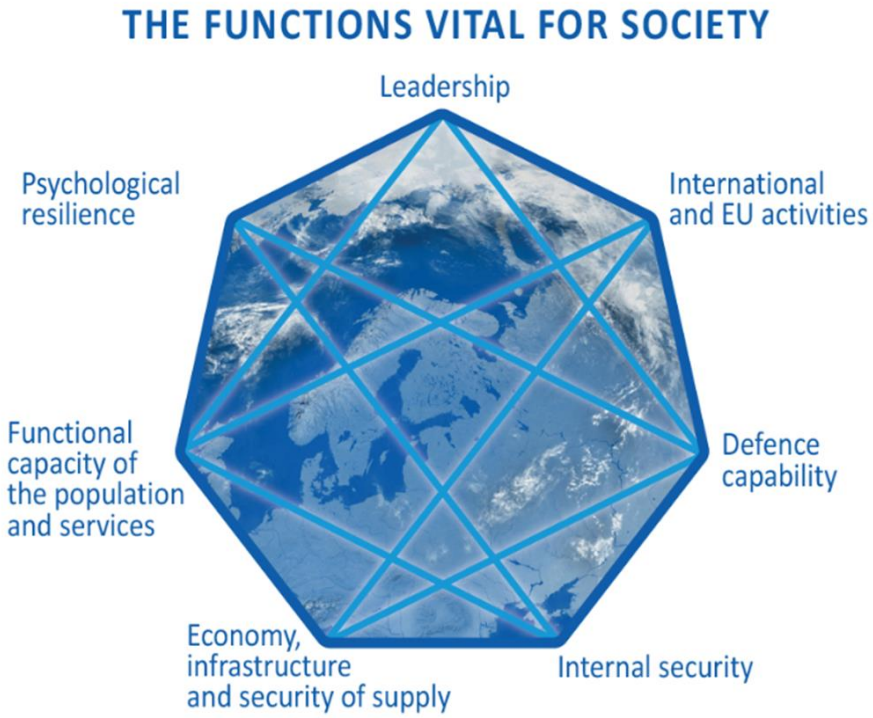
- Increased use of renewable fuels
- Use of electric vehicles in military passenger traffic
- Increased R&D and infrastructure development

Puolustusministeriö
Försvarsministeriet
Ministry of Defence


NATO
OTAN

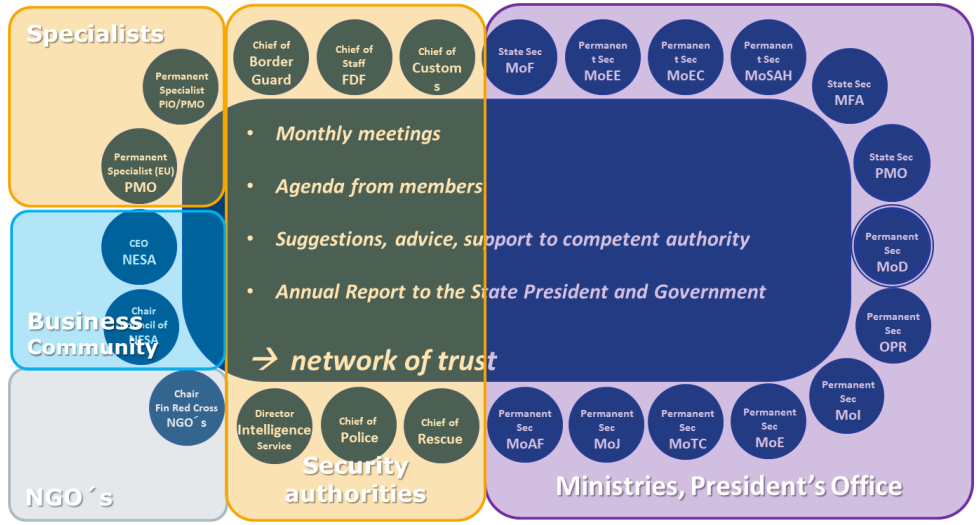
The concept of Comprehensive Security

A whole-of-society approach is necessary to combine security interests and climate change management



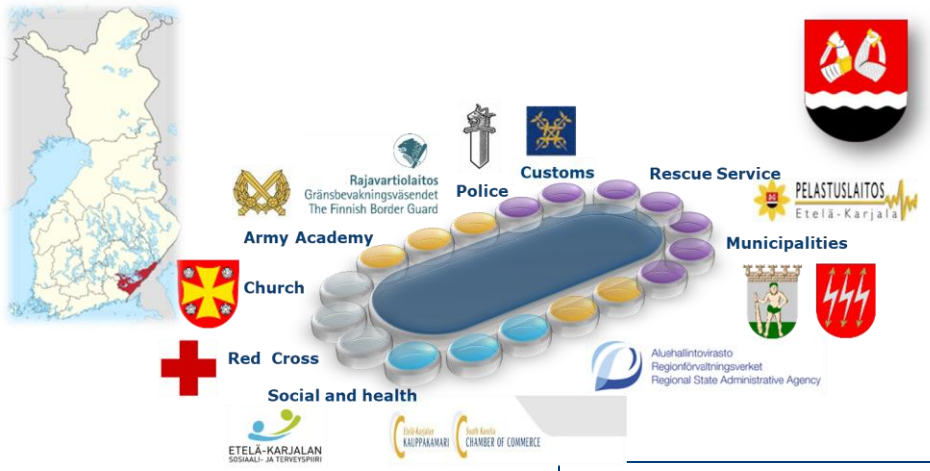
”Coinciding, not conflicting interests”
=
A network of trust for prioritizing and safeguarding the interests of the whole society

The Security Committee and Comprehensive Security Model



Top level

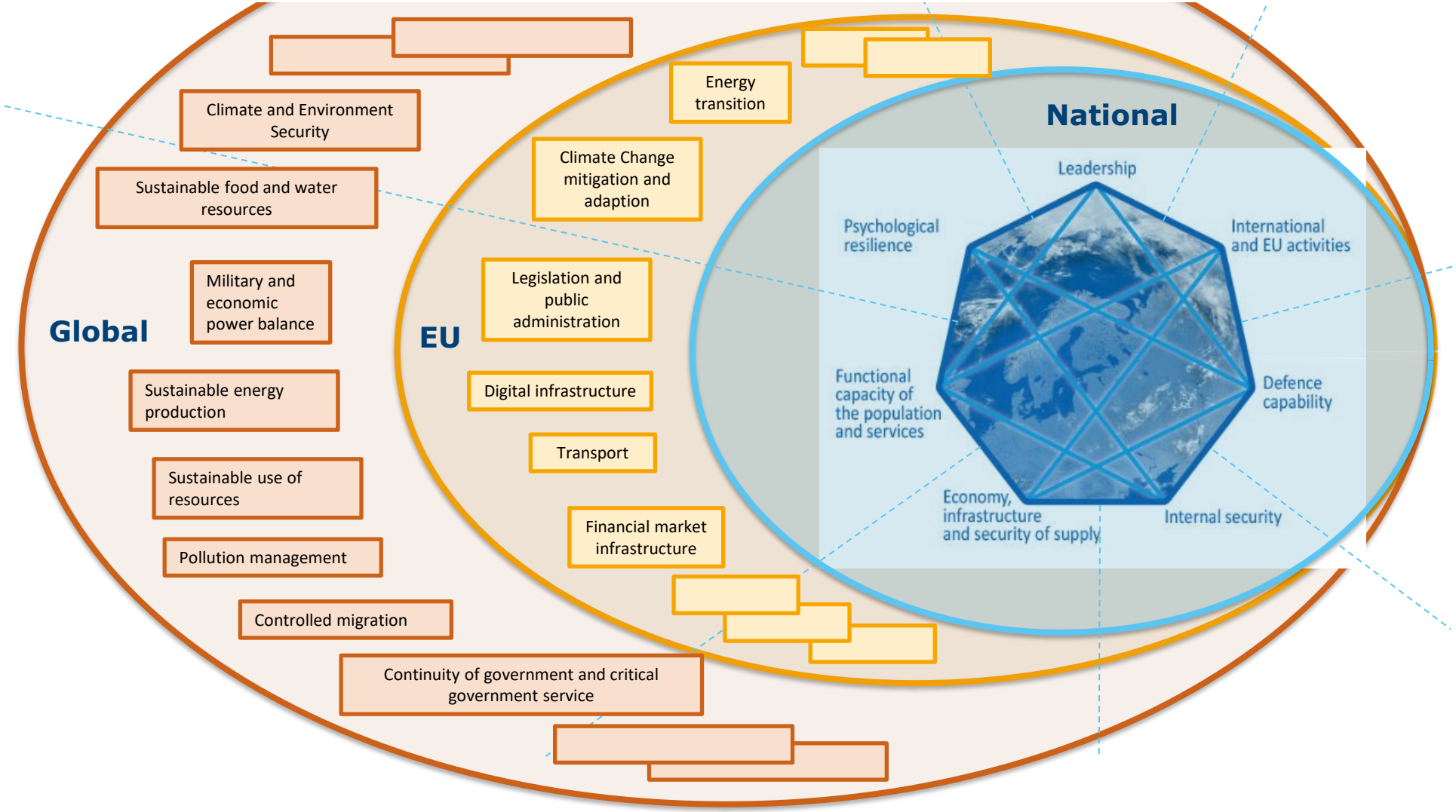
Regional level



Individual level

- National Defence Courses
- Every citizen as a security actor

In the bigger picture…




DEFNET

European Conference of Defence and the Environment

ECDE 2024

TOBIAS ETZOLD
The Norwegian Institute of International Affairs

EUROPEAN
CONFERENCE OF
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ENVIRONMENT

Climate Change in the Arctic: Security Implications and Consequences for Military Operations

ECDE Conference, Oslo, 12-13 June 2024

Dr. Tobias Etzold, Senior Research Fellow

Norwegian Institute of International Affairs (NUPI)

CLIMARCSEC: Basis facts

- Project within the 2023-24 project cycle of the **Multinational Capabilities Development Campaign (MCDC)**: US Joint Staff J7-led effort, in partnership with a community of 23 countries/int. organizations, to create non-material capabilities and solutions to support multinational force operations (MNFs) and exercises by solving or mitigating common military problems.
- **Norway (MoD/NUPI) has project lead**.
- **10 contributing nations**: AUT, CAN, DEU, FIN, FRA, GBR, POL, ROU, SWE, USA
- **7 observers**: AUS, BRA, ESP, NLD, ROK, NATO-ACT, EU-MS

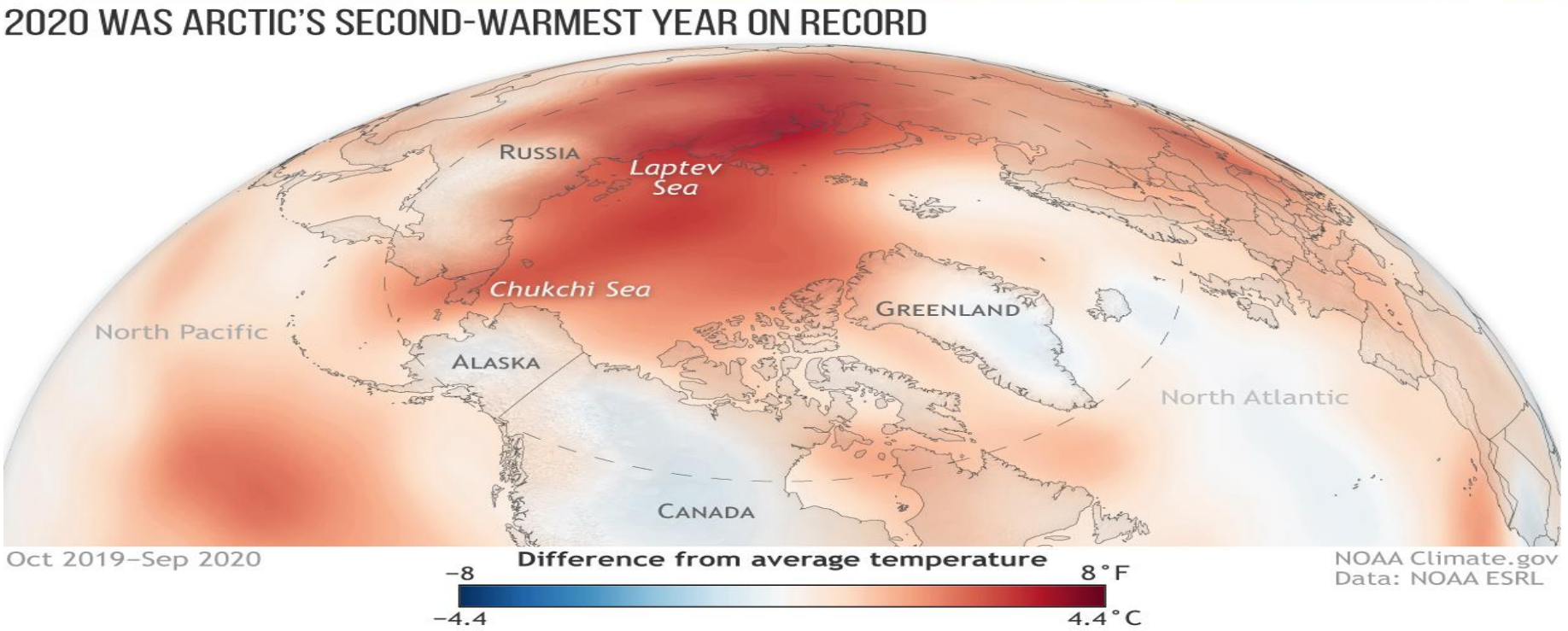
CLIMARCSEC: Background

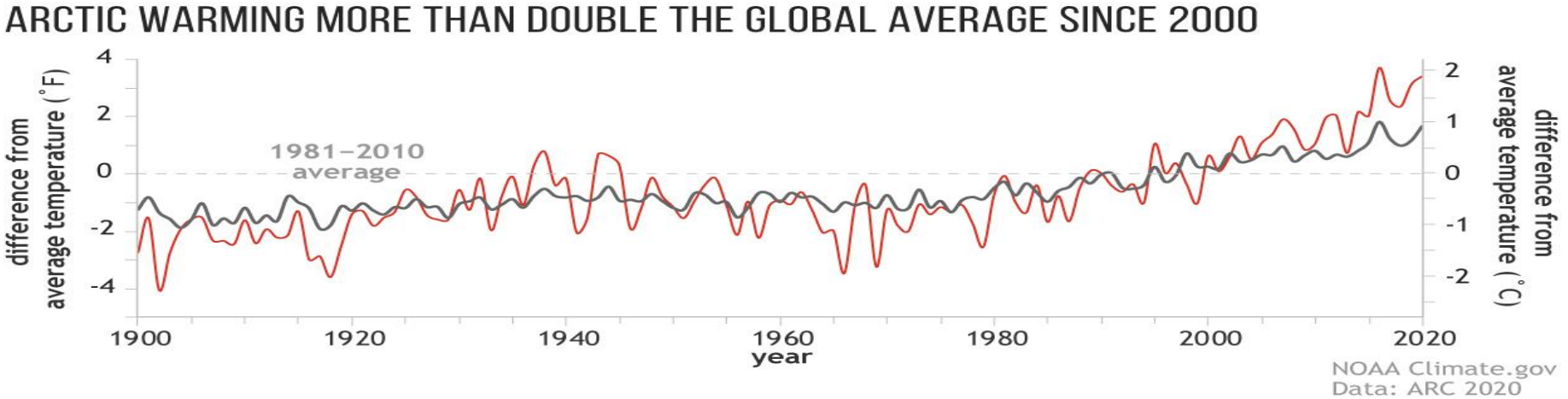
Figure 1. Arctic topographic map [1]

- Climate change is happening at high speed in the Arctic regions, three-four times faster than the global average, resulting in both new risks and new opportunities.
- Climate change opens up the Arctic and gives Arctic and non-Arctic actors easier access, facilitating navigation, resource extraction, fisheries and ecotourism including the risk of hybrid threats.

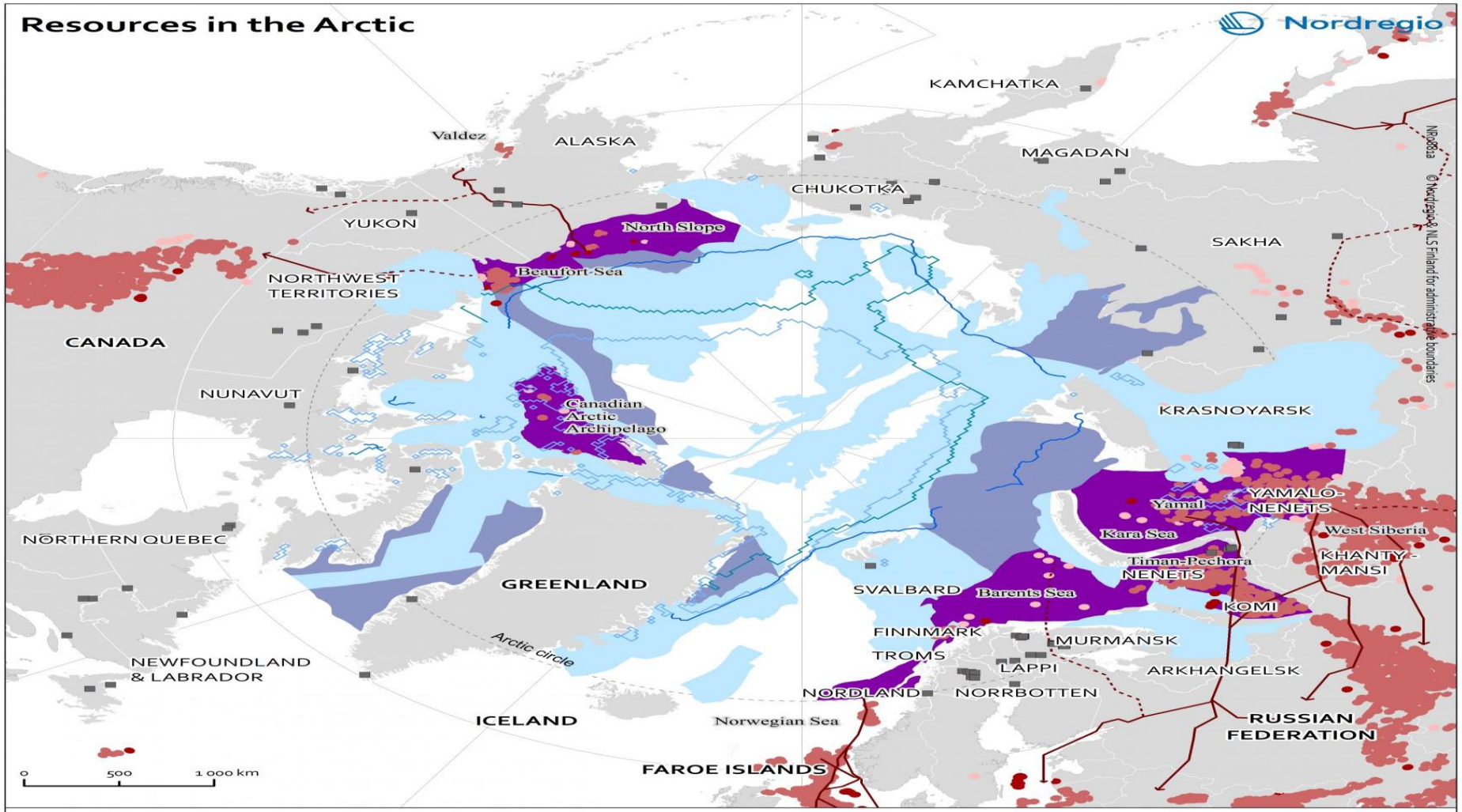
- The Arctic is presumably emerging as an arena of global rivalry over (political, military and economic) power among: Russia, USA and China.
- Rising temperatures are resulting in alarming reductions in sea ice cover and permafrost thawing as well as extreme weather conditions which directly affect among others also military operations.
- Lack of effective cooperation, security governance structures and coordination.

CLIMARCSEC Background: Arctic warming





D17 Arctic Area of Interest Traffic 2008-2022



Main oil and gas resources & mining activities in the Arctic

Oil/gas: exploration and production

- Gas
- Oil
- Oil and gas

Oil/gas: prospective areas and reserves

<50%	Probability that at least one accumulation of more than 50 million barrels of oil or oil-equivalent gas exists after USGS (including areas north of Arctic Circle)
50–99%	
100%	

- Main existing oil/gas pipeline (indicative direction)
- Main proposed oil/gas pipeline (indicative direction)
- Main mining site

- Sea ice extent in September 2012
- Sea ice extent in September 2018
- Average sea ice extent for September in 1981–2010

Regions included:

US - Alaska; CA - Yukon, Northwest Territories, Nunavut, Northern Quebec, Newfoundland & Labrador; GL; IS; FO; NO - Nordland, Troms, Finnmark, Svalbard; SE - Norrbotten; FI - Lappi; RU - Murmansk, Arkhangelsk, Komi, Nenets, Khanty-Mansi, Yamalo-Nenets, Krasnoyarsk, Sakha, Kamchatka, Magadan, Chukotka.

Data source: Nordregio, NSIDC, PRIO, United States Geological Survey USGS and several homepages for oil, gas and mining companies.

CLIMARCSEC: Background

- So far, climate change itself has not directly caused any conflicts in the Arctic and is not, and most likely will not be also in the near future, the main driver for emerging geopolitical tensions in the Arctic and beyond.
- But climate change makes military operations even more difficult and costly which however might become more necessary than before in order to meet tensions and potential conflicts from the outside spilling into the Arctic (Climate change as “threat multiplier”).
- Also, an increase of SAR (Search&Rescue) Operations with military involvement due to more shipping is likely.

CLIMARCSEC: Military problem

Climate change is opening the Arctic up to competition at a pace that challenges existing governance structures and national military capabilities and reveals capability gaps. The need for military MNF operations in the Arctic is increasing, but at the same time they are becoming more difficult. This increases the need for stronger situational awareness, operational capability, governance/coordination and policy changes.

Tendencies: what will be necessary in the future?

- More awareness and a better understanding of the sometimes somewhat vague problem of climate change's impact on security and military operations and related challenges.
- Adaptation to new requirements and environments needed.
- More cooperation and coordination:
- More pronounced role for NATO in the Arctic→ **"NATO and Allies will continue to undertake necessary, calibrated, and coordinated activities, including by exercising relevant plans"** (2023 NATO Vilnius Summit Communique)**.**

Tendencies: what will be necessary in future?

- Increasing awareness of climate change and climate security in NATO: NATO's Centre of Excellence for Climate Change and Security (CCASCOE) → key unit for expanding cooperative efforts to understand the climate threat, to learn how NATO can promote mitigation and adaptation efforts and how it will affect NATO's training and missions and to understand the strategic environment in which they operate.
- Thorough research through various research institutes in Europe, the USA and Canada and close cooperation between them.

European Conference of Defence and the Environment

ECDE 2024

BRYNJAR ARNFINNSSON
Norwegian Defence Research Establishment

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FFI Norwegian Defence Research Establishment

The Zero Emission Defence – a Review of Climate-Friendly Technology for the Norwegian Armed Forces

Brynjar Arnfinnsson
Senior Scientist, FFI

Foto: AdobeStock


AK
356 FS
AF 5356
LOCKHEED MARTIN

Agenda

1. Energy sources and carriers
2. Comparison of technologies
3. Potential applications
4. Can green technologies reduce logistics?
5. The way to net zero

Energy sources and carriers

Energy sources

Renewable energy

–

Hydro

Wind

Solar

Nuclear energy

–

Uranium

Thorium

Energy carriers

Carbon-free

–

Electricity

Hydrogen

Ammonia

Nuclear energy

Carbon-based

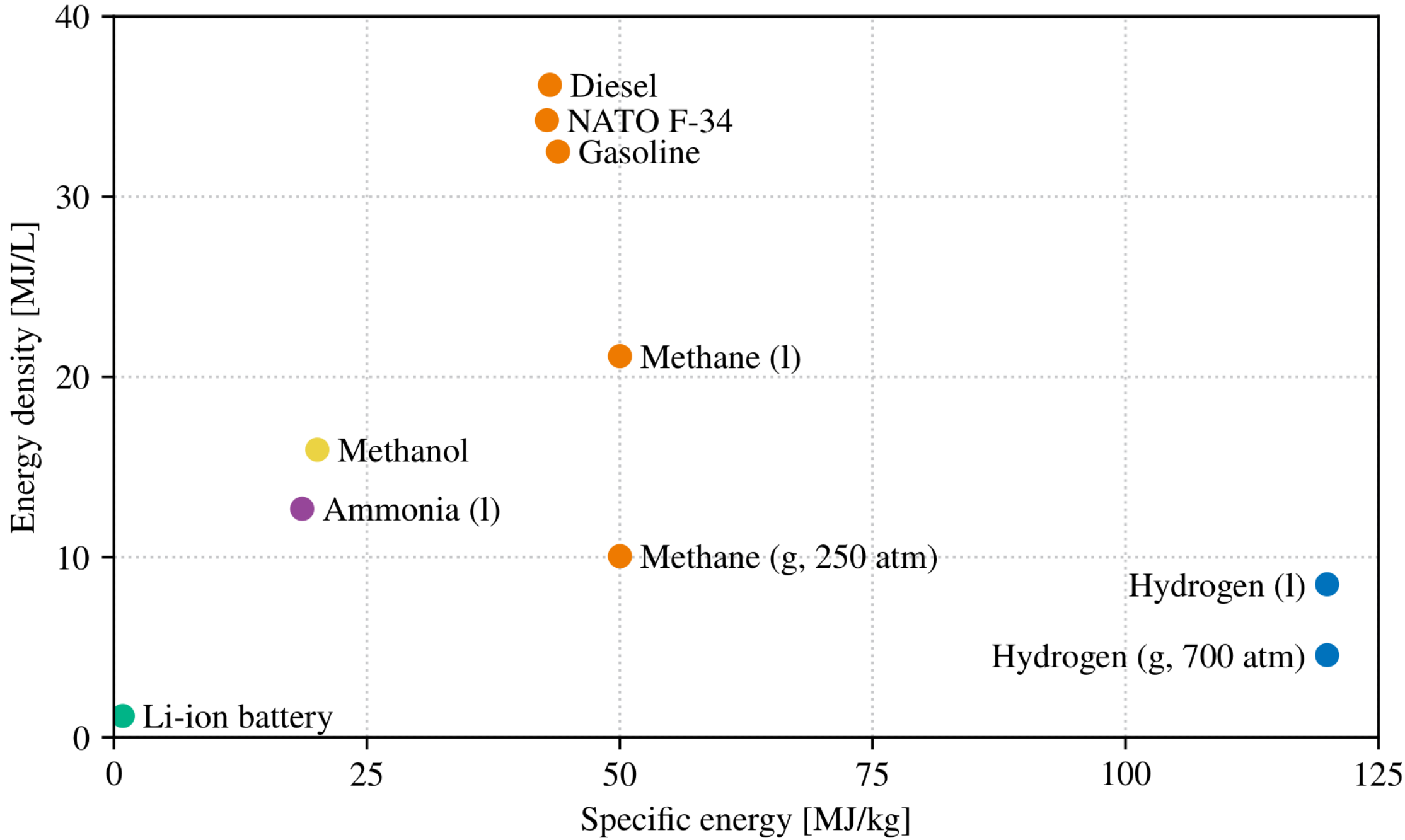
–

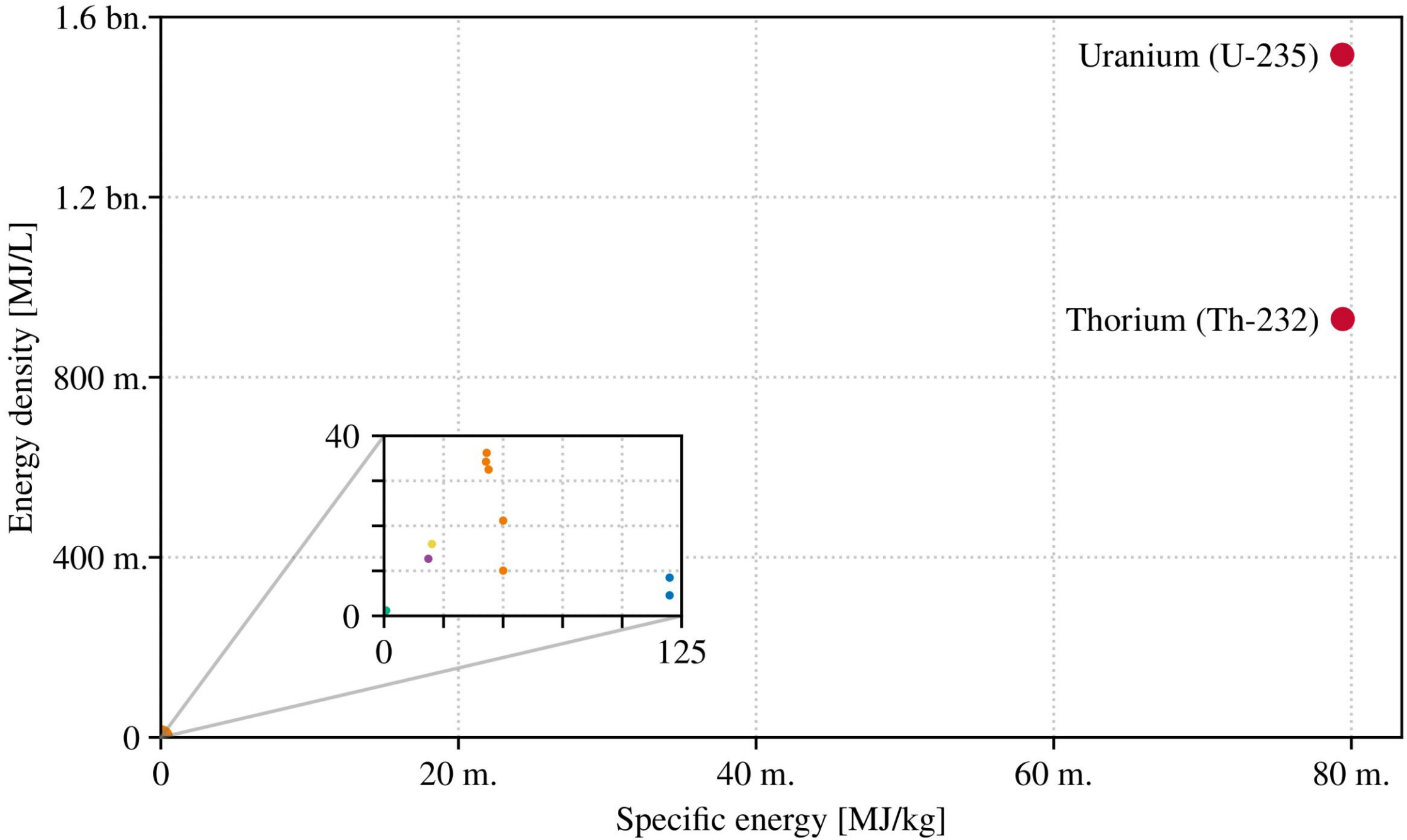
Hydrocarbons

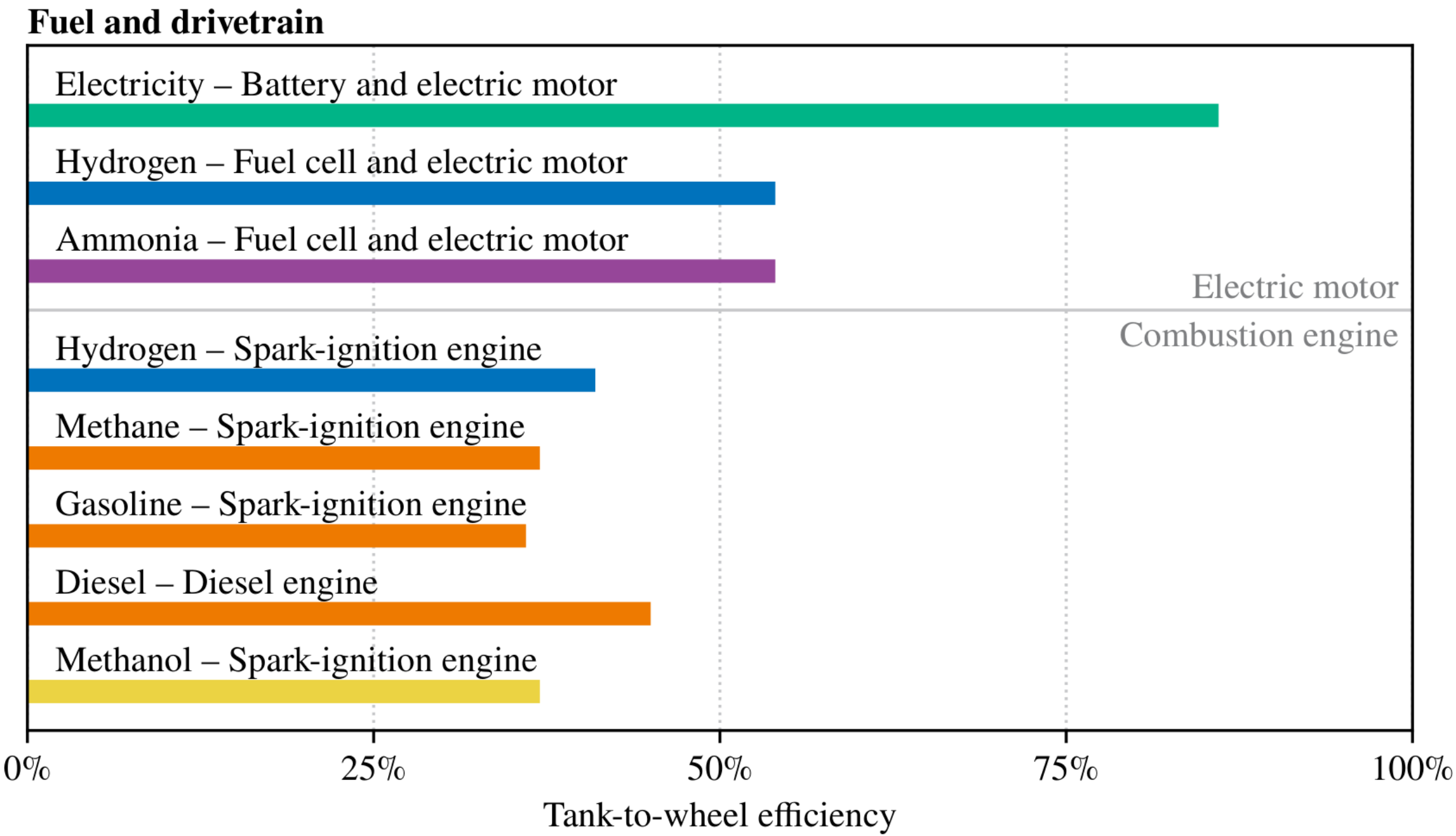
Alcohols

Images: Norwegian Armed Forces

Comparison of technologies


Diesel
NATO F-34
Gasoline
Methane (l)
Methanol
Ammonia (l)
Methane (g, 250 atm)
Hydrogen (l)
Hydrogen (g, 700 atm)
Li-ion battery
Energy density [MJ/L]
Specific energy [MJ/kg]
0
10
20
30
40
0
25
50
75
100
125


1.6 bn.
1.2 bn.
800 m.
400 m.
0
Energy density [MJ/L]
Uranium (U-235)
Thorium (Th-232)
40
0
0
125
0
20 m.
40 m.
60 m.
80 m.
Specific energy [MJ/kg]


Fuel and drivetrain
Electricity – Battery and electric motor
Hydrogen – Fuel cell and electric motor
Ammonia – Fuel cell and electric motor
Electric motor
Combustion engine
Hydrogen – Spark-ignition engine
Methane – Spark-ignition engine
Gasoline – Spark-ignition engine
Diesel – Diesel engine
Methanol – Spark-ignition engine
0%
25%
50%
75%
100%
Tank-to-wheel efficiency

	Energy content	Energy efficiency	Greenhouse gas emissions	Costs
Electricity Li-ion batteries				
Hydrogen E-hydrogen				
Ammonia E-ammonia				
Nuclear energy U-235				
Hydrocarbons Biomethane E-methane Biodiesel E-diesel				
Alcohols Biomethanol E-methanol				

Color indicators

- Better than fossil diesel
- Equal to fossil diesel
- Slightly worse than fossil diesel
- Much worse than fossil diesel

	Energy content	Energy efficiency	Greenhouse gas emissions	Costs
Electricity Li-ion batteries	🔴	🟢	🟢	🟢^{o} 🟡^{i}
Hydrogen E-hydrogen				
Ammonia E-ammonia				
Nuclear energy U-235				
Hydrocarbons Biomethane E-methane Biodiesel E-diesel				
Alcohols Biomethanol E-methanol				

Color indicators

- 🟢 Better than fossil diesel
- 🟢 Equal to fossil diesel
- 🟡 Slightly worse than fossil diesel
- 🔴 Much worse than fossil diesel

Comments

●^{o} Operating ●^{i} Investment

	Energy content	Energy efficiency	Greenhouse gas emissions	Costs
Electricity				
Li-ion batteries	🔴	🟢	🟢	🟢^{o} 🟡^{i}
Hydrogen				
E-hydrogen	🔴^{e} 🟢^{s}	🟢^{f} 🟡^{c}	🟢	❓^{o} 🔴^{i}
Ammonia				
E-ammonia	🟡	🟢^{f} ❓^{c}	🟢	🔴^{o} 🔴^{i}
Nuclear energy				
U-235	🟢	N/A	🟢	🟢^{o} ❓^{i}
Hydrocarbons				
Biomethane	🟡^{e} 🟢^{s}	🟡	🟢	❓^{o} 🟢^{i}
E-methane	🟡^{e} 🟢^{s}	🟡	🟢	🔴^{o} 🟢^{i}
Biodiesel	🟢	🟢	❓	❓^{o} 🟢^{i}
E-diesel	🟢	🟢	🟢	🔴^{o} 🟢^{i}
Alcohols				
Biomethanol	🟡	❓	🟢	🔴^{o} 🟢^{i}
E-methanol	🟡	❓	🟢	🔴^{o} 🟢^{i}

Color indicators

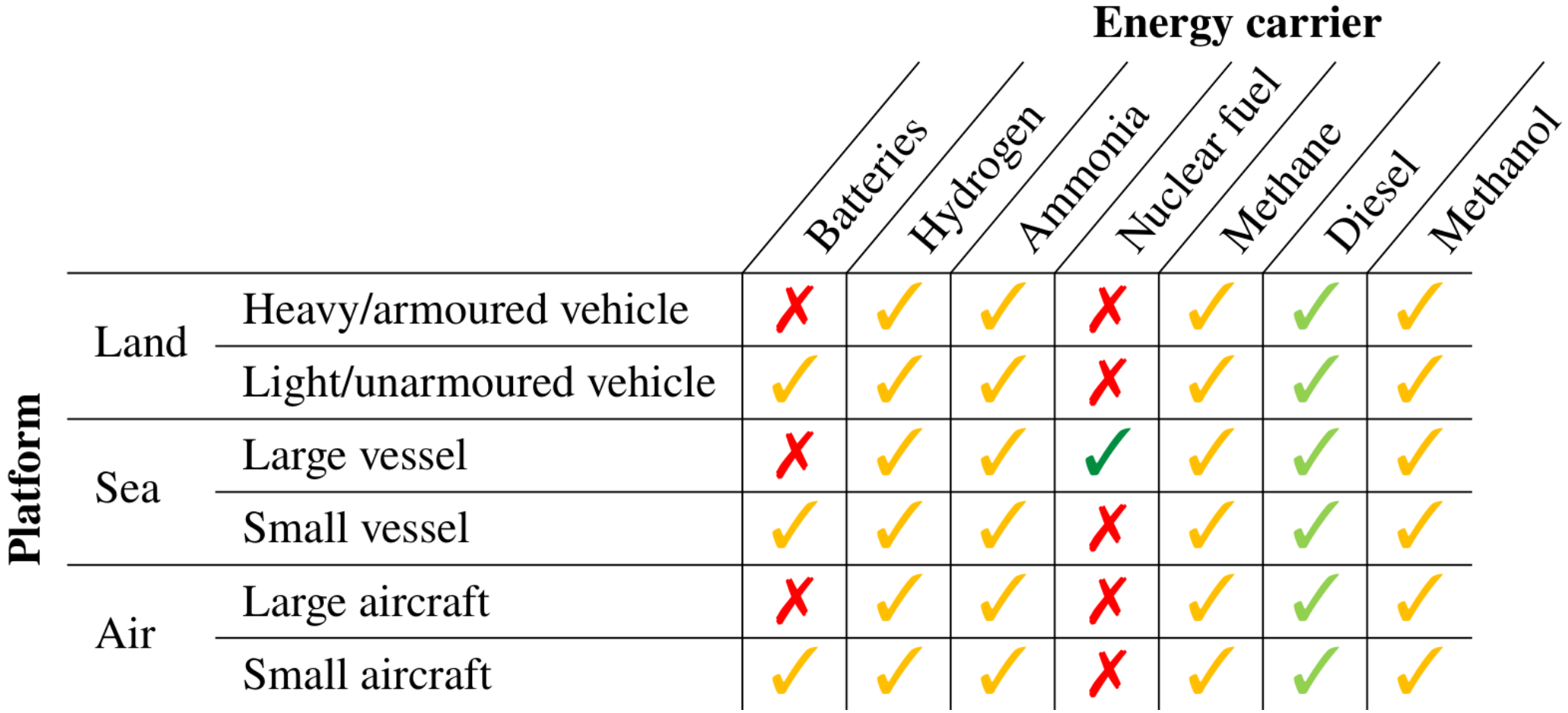
- 🟢 Better than fossil diesel
- 🟢 Equal to fossil diesel
- 🟡 Slightly worse than fossil diesel
- 🔴 Much worse than fossil diesel

Comments

- ^{e} Energy density
- ^{s} Specific energy
- ^{f} Fuel cell
- ^{c} Combustion
- ^{o} Operating
- ^{i} Investment
- ❓ High uncertainty assessment

Potential applications

Platform		Energy carrier: Batteries	Hydrogen	Ammonia	Nuclear fuel	Methane	Diesel	Methanol
Land	Heavy/armoured vehicle	✗	✓	✓	✗	✓	✓	✓
	Light/unarmoured vehicle	✓	✓	✓	✗	✓	✓	✓
Sea	Large vessel	✗	✓	✓	✓	✓	✓	✓
	Small vessel	✓	✓	✓	✗	✓	✓	✓
Air	Large aircraft	✗	✓	✓	✗	✓	✓	✓
	Small aircraft	✓	✓	✓	✗	✓	✓	✓



What about energy for operating bases and military infrastructure?

Can zero emission technology reduce logistics?

«The defense that first manages to crack the code – on how to become less dependent on fossil logistics – they have a great advantage.»

Eirik Kristoffersen

Norwegian Chief of Defence

25th Nov. 2022

Photo: FFI

Photo: Nathan Franco / U.S. Army

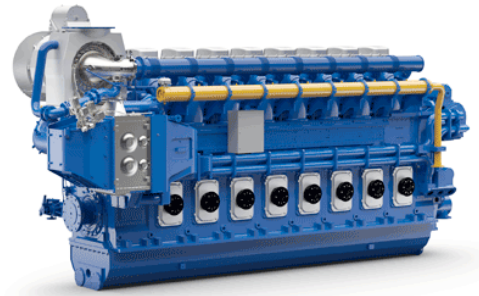
Photo: Darin Russell / Lockheed Martin

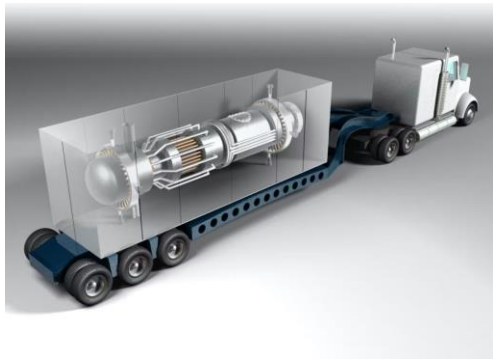
Photo: Johan Ludvig Holst / Forsvaret

The way to net zero

The way towards net zero for the Armed Forces

- Biofuels and e-fuels
- Dual-fuel
- Nuclear power
- Renewable energy
- Batteries





“The Armed Forces cannot be the only remaining fossil sector in a society which in the future will be fossil-free. We must reconcile the need to have a strong defense with a green defense.”

Jens Stoltenberg

Secretary General of NATO

26th June 2023

Photo: Stian Lysberg Solum / NTB

Questions?

Contact:

Brynjar.Arnfinnsson@ffi.no

European Conference of Defence and the Environment

ECDE 2024

MARIUS PEDERSEN
Norwegian Defence Research Establishment

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FFI Norwegian Defence Research Establishment

National and International Security in the Arctic

Norwegian Perspectives

Marius N. Pedersen

Foto: AdobeStock

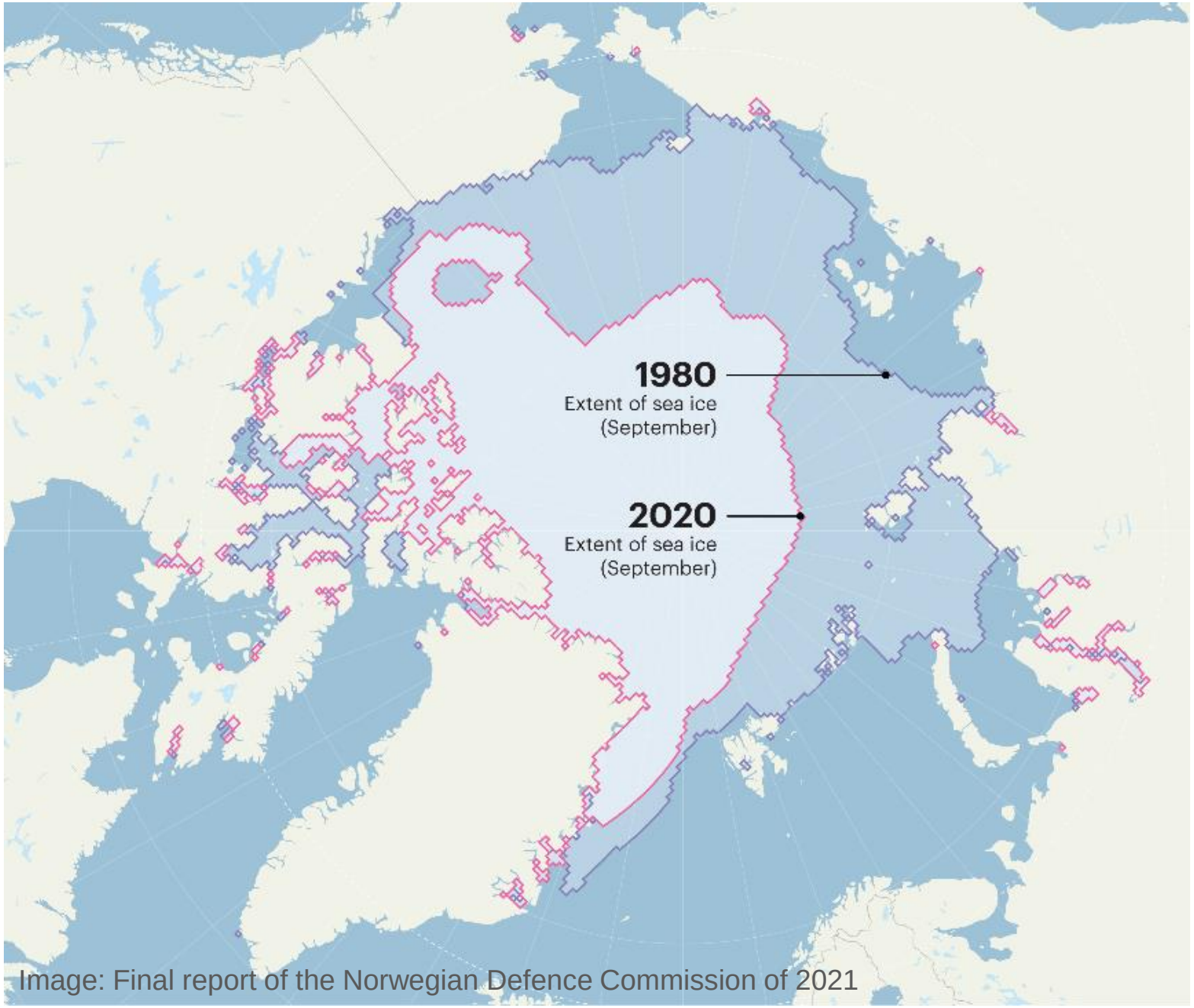


Image: Final report of the Norwegian Defence Commission of 2021

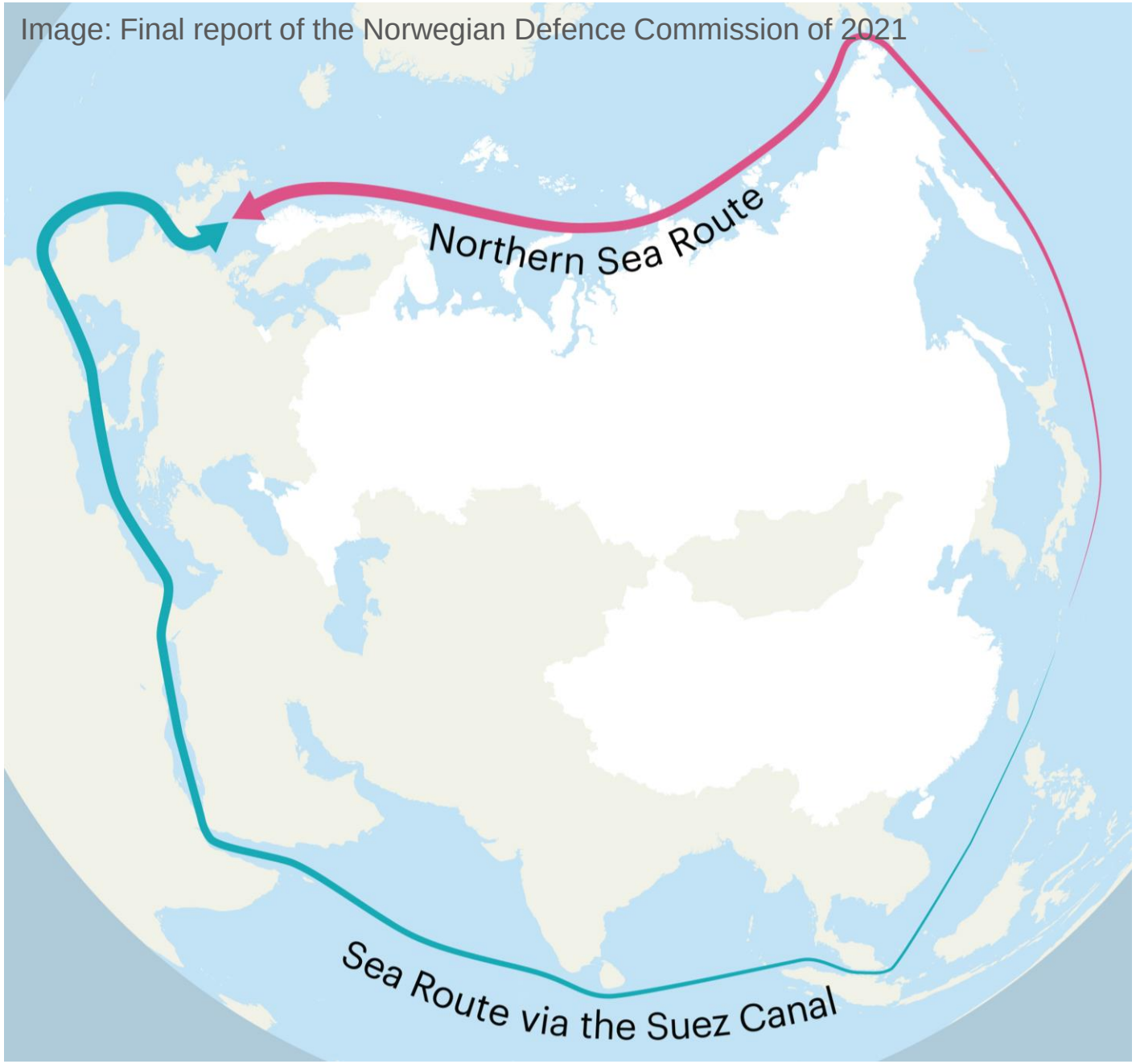


Image: Final report of the Norwegian Defence Commission of 2021
Northern Sea Route
Sea Route via the Suez Canal

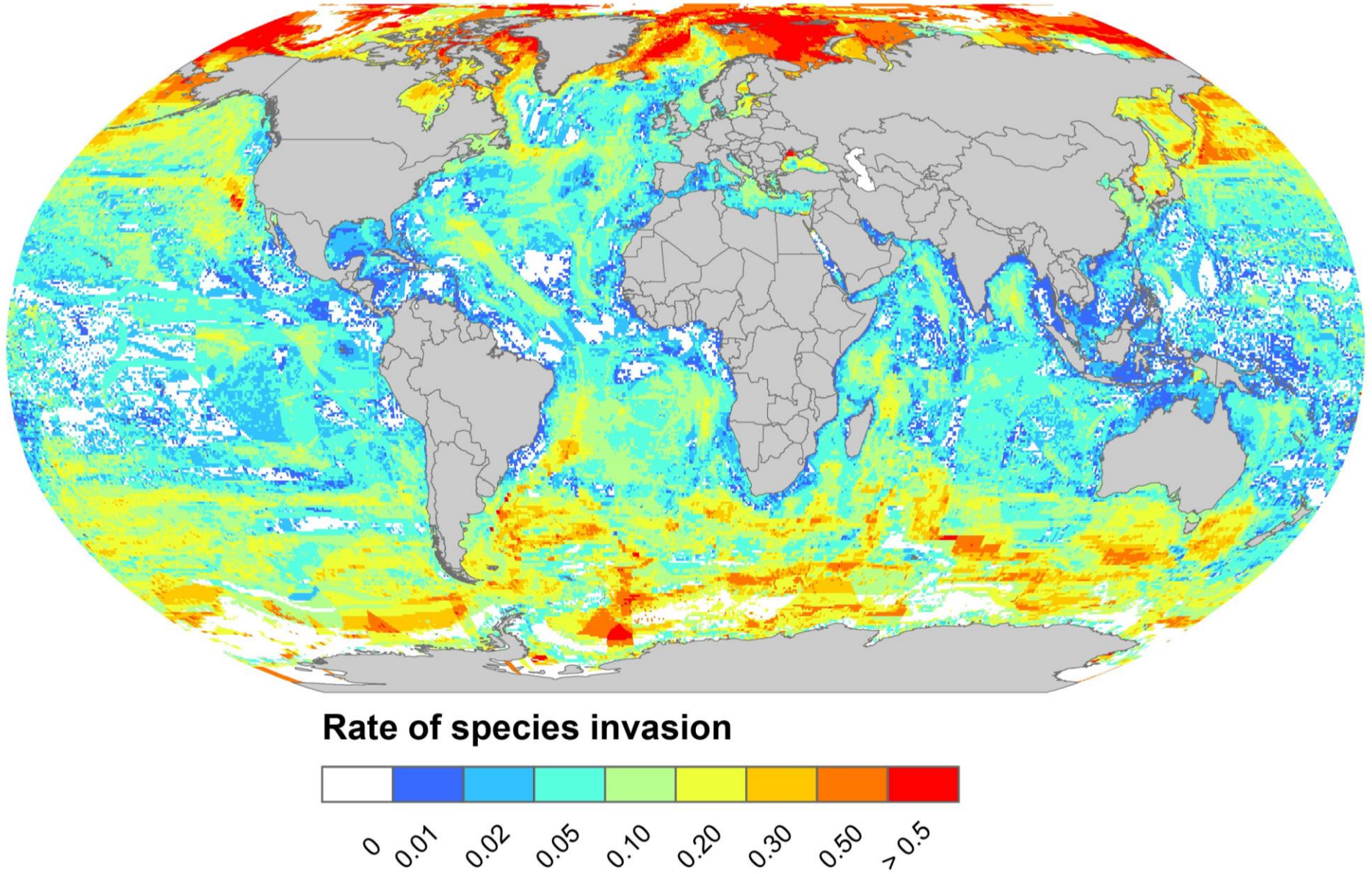


Image: William Chung et al., ICES Journal of Marine Sciences 72, 2016

Arctic Security Landscape

- Great deal of alarmism
- «Race for the Arctic»
  - Resources
  - Trade routes
  - Ice breakers
- Consequences of militarisation and securitisation
- Less cooperation and more uncertainty
  - Militarisation
  - Securitisation

Image: Vijdan Mohammad Kawoosa / High North News


Nervous?
Yes... Very.
First time?
No, I've been nervous lots of times.
made with mematic

Impacts on the Maritime Domain

- Greater maritime access
- More open sea
  - Often poorly charted
  - Even uncharted
- Increased human activity
  - Military and commercial
  - Cruise traffic is a particular challenge
- New actors with limited Arctic experience
- Uncertainty about treaties

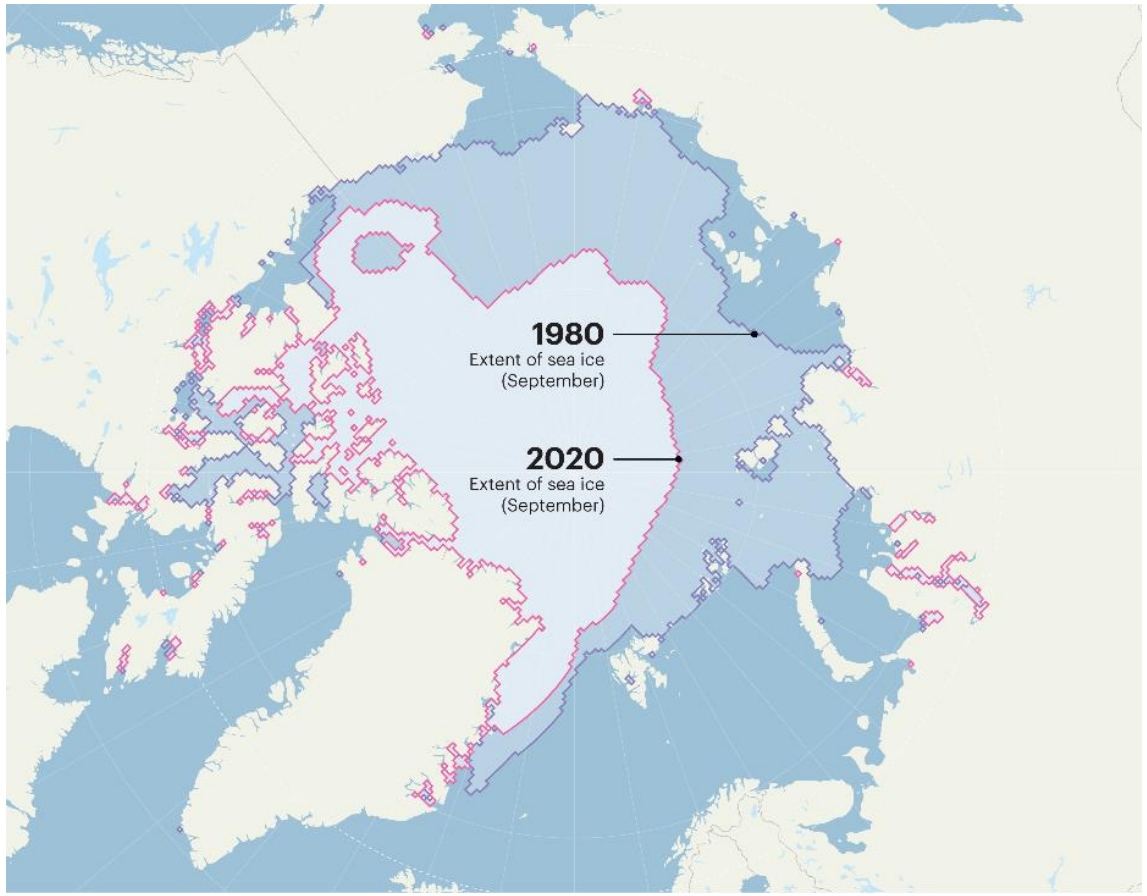


Image: Final report of the Norwegian Defence Commission of 2021

Impacts on the Maritime Domain

- The contentious Svalbard Treaty
- United Nations Convention on the Law of the Sea
  - Article 234:

"Coastal States have the **right to adopt and enforce non-discriminatory laws and regulations** for the prevention, reduction and control of marine pollution from vessels in ice-covered areas within the limits of the exclusive economic zone, where **particularly severe climatic conditions and the presence of ice covering such areas for most of the year** create obstructions or exceptional hazards to navigation, and pollution of the marine environment could cause major harm to or irreversible disturbance of the ecological balance. Such laws and regulations shall have due regard to navigation and the protection and preservation of the marine environment based on the best available scientific evidence."

Image: Archive of the Governor of Svalbard

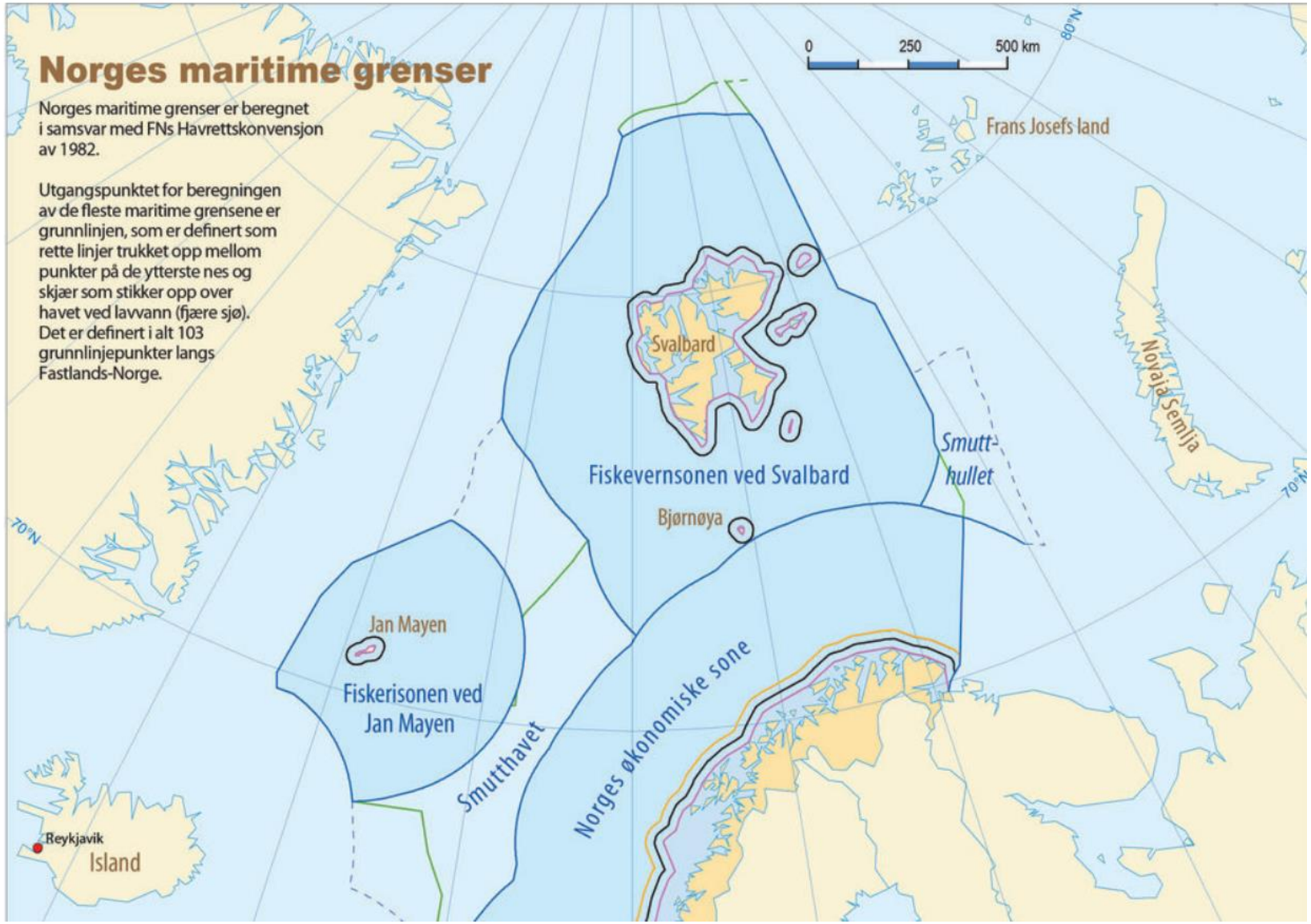


Image: The Norwegian Mapping Authority

Impacts on the Land Domain

“Weaponisation of migration seeks to use the destabilising potential in a high number of migrants in a short time period to provoke desired political change in a target state”

- Several recent examples
  - Russia against Finland and Norway in 2015
  - Belarus against Poland and Latvia during the winter of 2021/22
  - Russia against Finland and Norway 2023

- Climate refugees will offer Russia new opportunities to pressure hostile states

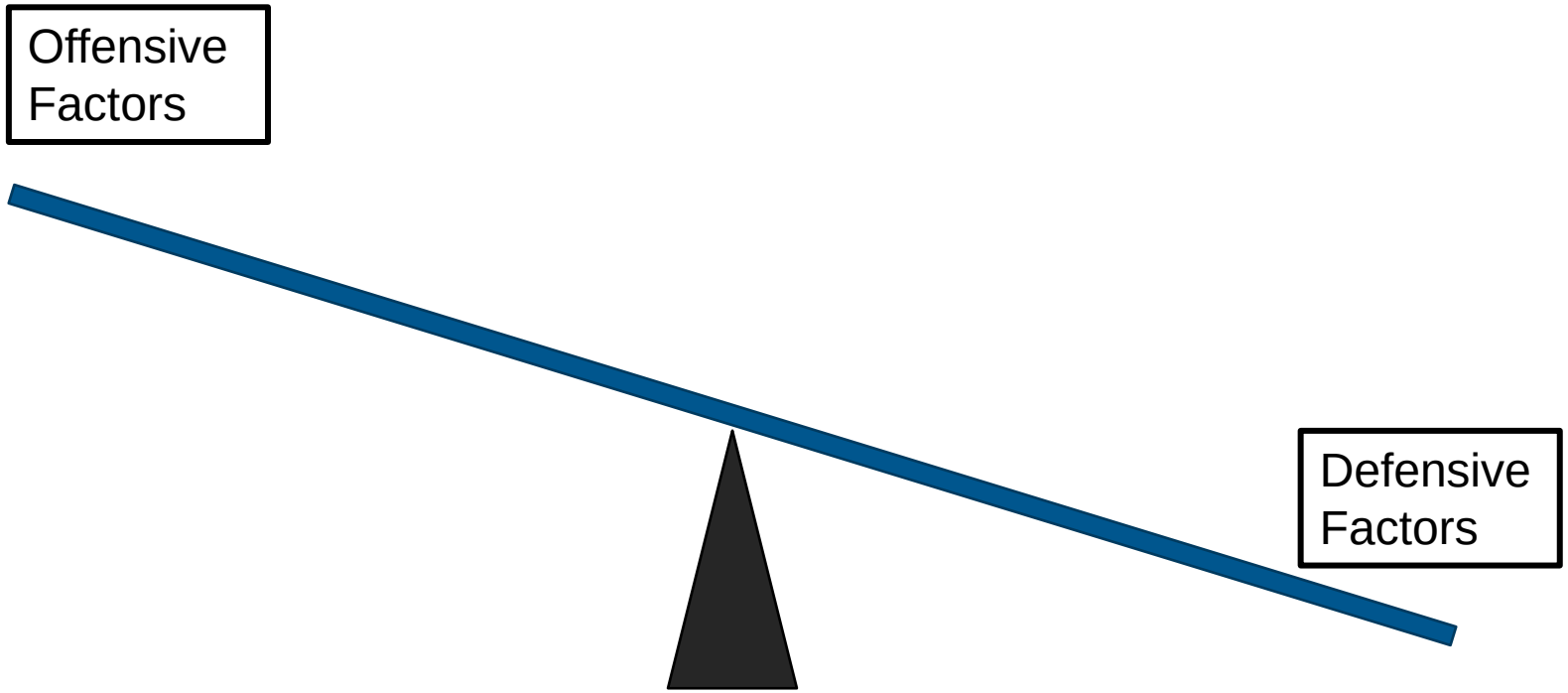
Image: Kancelaria Premiera (CC BY-NC-ND 2.0)

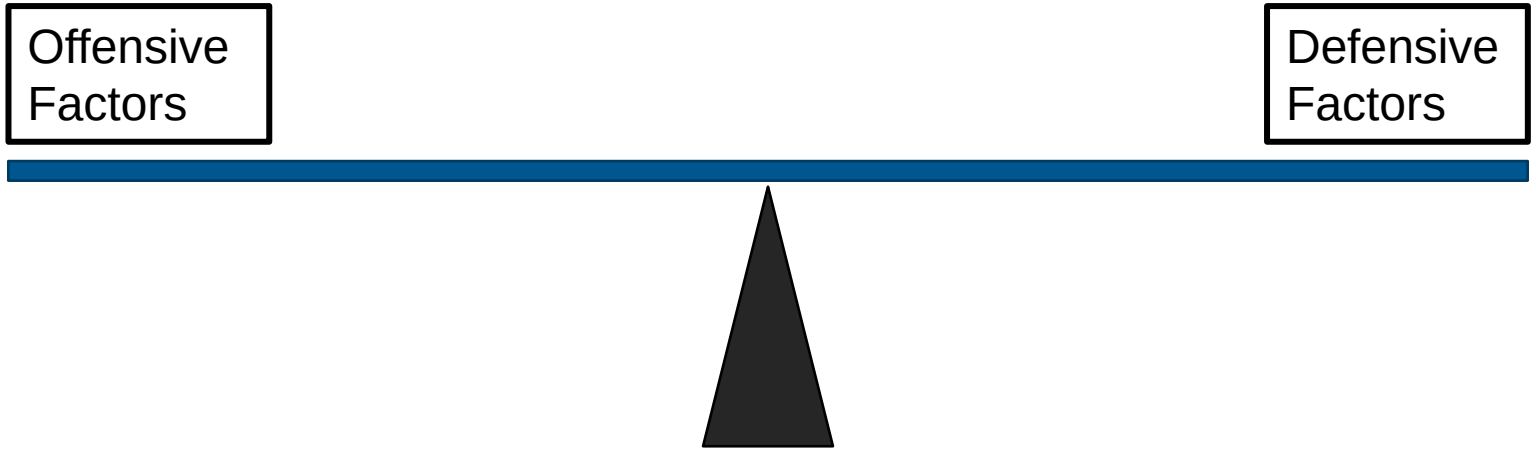
Security Consequences

- Increases risk of *security dilemmas*
- Tilting the offence-defence balance
- The Arctic has been a clearly defence-oriented region
- Climate change may tilt the scales towards balance

The Offence-Defence Balance

	Offensive advantage	Defensive advantage
Offensive posture not distinguishable from defensive posture	(1) Doubly dangerous	(2) Security dilemma, but security requirements may be compatible
Offensive posture distinguishable from defensive posture	(3) No security dilemma, but aggression possible. Status quo states may follow different strategies than aggressors. Warning given.	(4) Doubly safe


Offensive
Factors
Defensive
Factors


Offensive
Factors
Defensive
Factors

European Conference of Defence and the Environment

ECDE 2024

SONJA BERLIJN
KTH Royal Institute of Technology

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ENVIRONMENT

The future electricity system:
A problem solver or a problem creator?

Prof.dr.techn.ir. Sonja Monica Berlijn MBA
Tuesday 12 June 2024

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prof. Sonja Berlijn

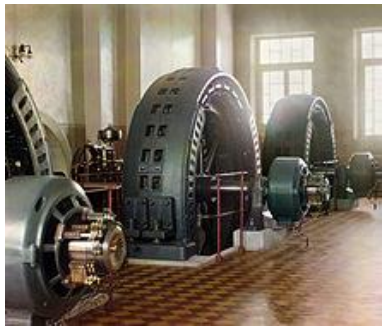
Electricity system is rapidly changing

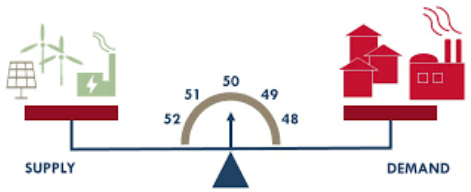
- Energy transition is going faster than expected
  - Electricity demand is increasing significant
  - New production is needed
  - Both new types of demand and production arise
  - Electricity becomes more and more relevant for society
- The electricity system needs to facilitate these changes
- The future electricity system solves climate challenges but
  introduces some new challenges

A simple Electricity System

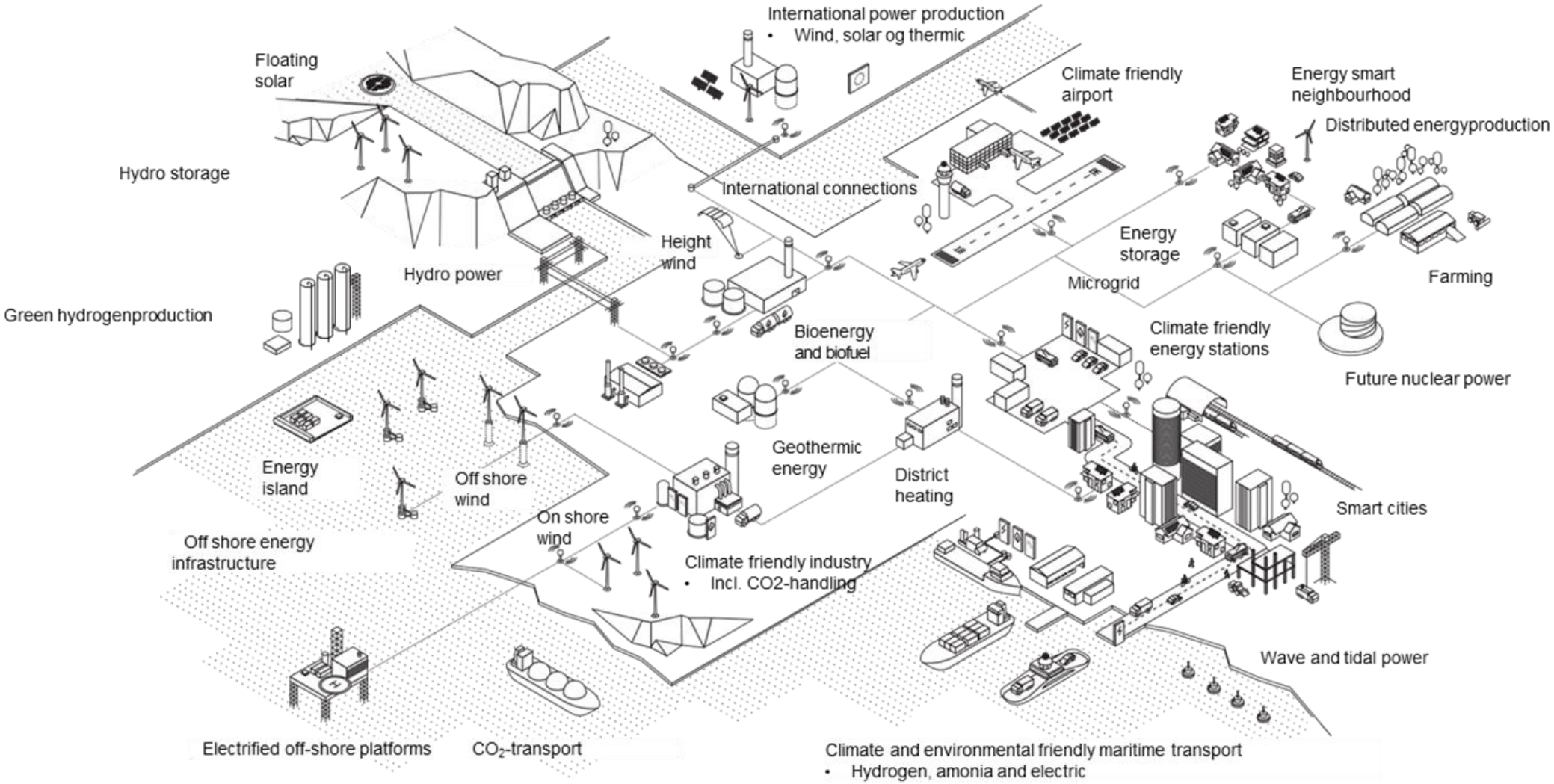
Every electrical power system has three major components

- generation: source of power, ideally with a specified voltage and frequency
- transmission system [transformers, lines, etc.]: transmits power; ideally as a perfect conductor
- load: consumes power; ideally with a constant resistive value





A glimpse of the future electricity system



Electricity will be the main energy source

- The future electricity system has a large impact on the functioning of society and total defence
  - Transport, communication, information, food, water, payment, is there anything left that does function without electricity?
- The electricity system is under pressure and its vulnerability is increasing
  - More digital solutions are needed to solve the challenges in the electricity system
  - The build-in redundancy might be decreasing
  - It is too complex for even insiders to understand

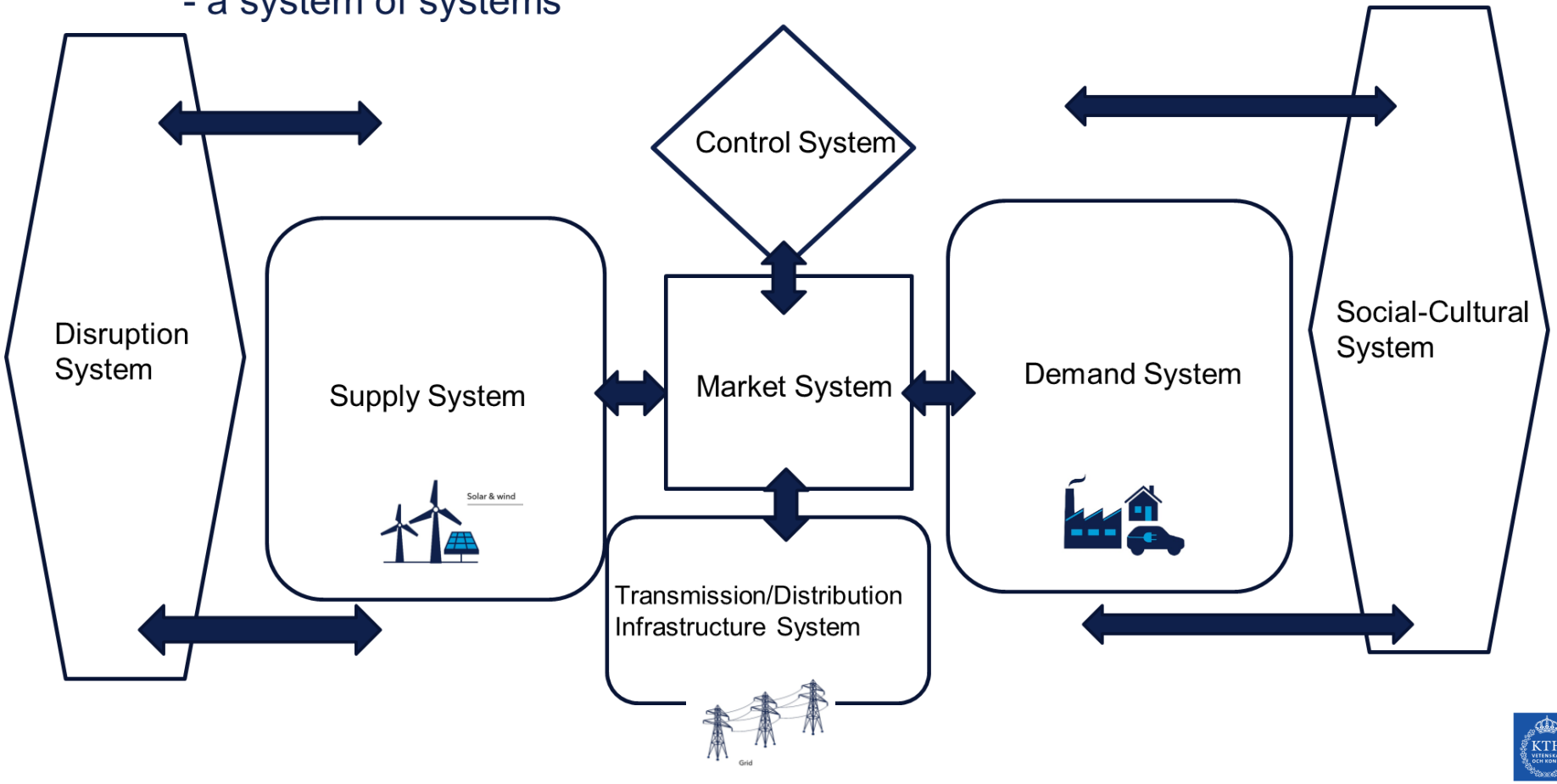
Source - www.rac.co.uk

How can we find weaknesses in a complex electricity system?

REDISET
Resilient Digital Sustainable Energy Transition

REDISET system model

- a system of systems

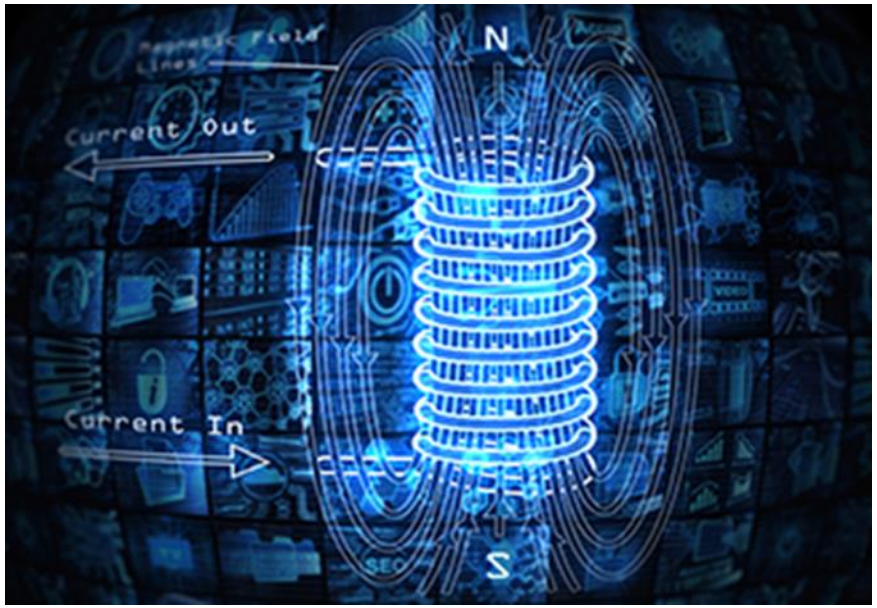


Creative ways to attack the future electricity system

- Market system
- Weather data
- False sensor data
- Disinformation via social media
- Attack a small player in the electricity system
- Certain components
- Off-shore grid connection

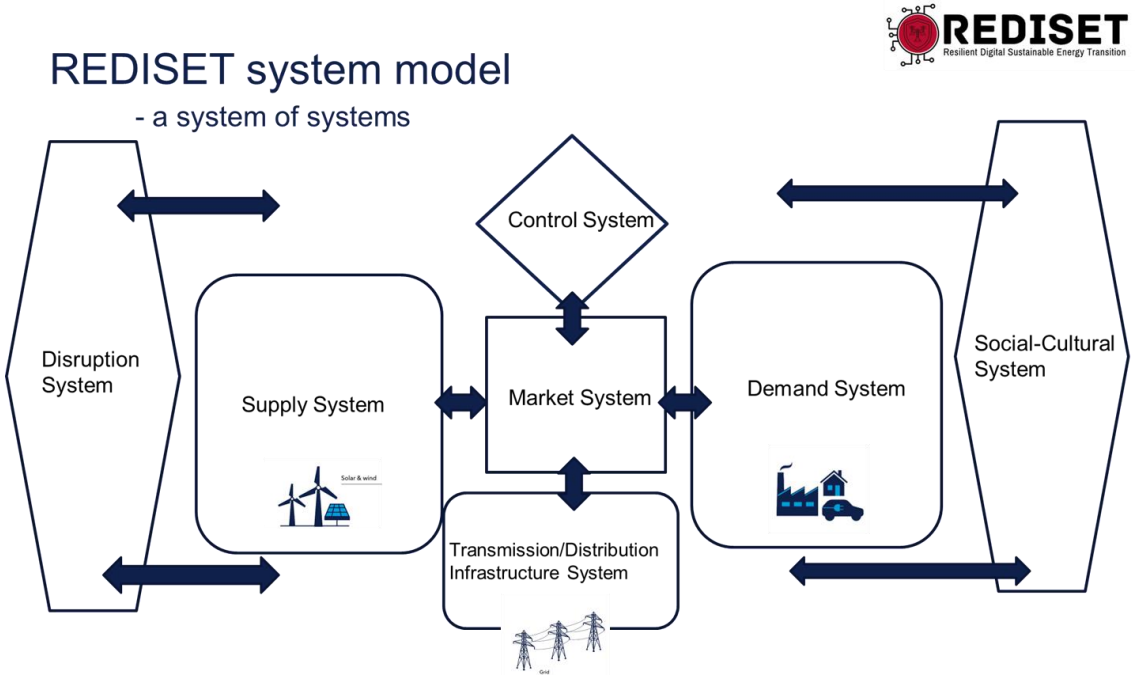
Electricity system has become a complex cyber-physical system and defending it becomes more complex and expensive

- Physical attacks
  - Right now there is a redundancy in the grid, this redundancy is shrinking
  - Longer lead times for new equipment (3-7 years)
- Cyber attacks
  - Indirect via administrative systems
  - Disrupting data
- Social attacks
  - Consumers, e.g. EV-users
  - Critical persons on critical positions



What are the highest risks and how to mitigate them?

- What are the highest risks?
  - Preliminary research has shown that there are some unexpected items
  - We can learn from on-going crisis
- How to mitigate the risks?
  - Can micro-grids be a solution?
  - Can decentralisation help?
  - Shall control in crisis be simplified?
- What are acceptable costs?
  - Redundant and resilient grid is maybe too expensive?



Problem solver or problem creator?

- The electricity system is the back-bone of the future energy system
- It is expected that the grid will more than double in length and the need for electricity will increase with a factor of 2-7
- The pace of the increase in need is higher than the increase of new grid capacity - congestion
- The congestion can be solved with digitalisation
- The new electricity system solves our dependence on gas and oil and reduces CO_2 emission

- ‘There is no transition without transmission’

Problem solver or problem creator?

- More and more is depending on electricity
- The electricity system will be connected to other systems (sector coupling)
- The electricity system is very complex and even for in-siders difficult to understand
- A lot of parties will be active contributors to the electricity system
- The future system will be highly digitalized
- There might be less margins available in the transition period
- The digitalization of the electricity system leads to new vulnerabilities

- Cyber – physical security and cyber - physical resilience are new areas of attention and research

Thank you for your attention

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Defence Zero

Modelling approach for Defence sector emissions and future evolution of Defence emissions

12 June 2024

Roland Berger

Content

A. Background of Roland Berger Defence Zero study

Roland Berger started the 'Defence Zero' study to understand the Defence industry sustainability challenge; we focus on emissions as the starting point

1. What is the source & magnitude of the challenge of emissions in Defence?
2. What are (potential) solutions to the challenge?
3. How to manage trade-offs (cost, timing, operational effectiveness, …)?
4. What is needed to fund the development and implementation of solutions?
5. What should MoDs and industry focus on? What roles should they play? How can we be more effective and move faster by working together?

B. Our modelling approach and results for 2019 Defence emissions

We use a bottom-up approach to estimate the contribution from platforms, considering emissions factors in the supply chain, and their utilisation

Main sources of emissions modelled in Defence Zero

Mobile platforms

- Supply chain
  - Annual platform deliveries
  - Emissions factors of component parts (cradle-to-gate)
- Operations
  - # of in-service platforms
  - Active % of in-service platforms
  - Utilisation of active platforms
  - Hourly emissions of platforms

Stationary assets

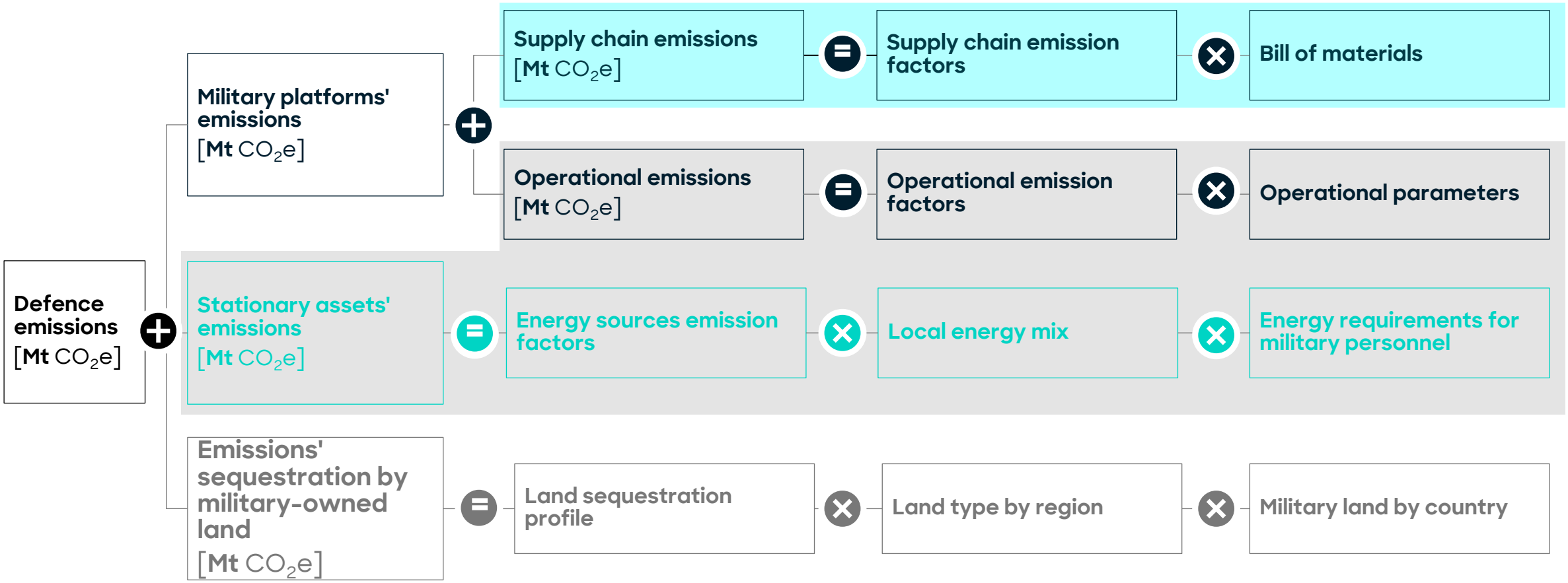
- Energy requirements for military personnel by country
- Energy emissions factors
- Sequestration/carbon sinking: land ownership, sequestration profiles, sequestration rates

We may underestimate contributions from some areas, e.g. we do not (yet) explicitly factor in emissions from production and use of missiles and ammunition

Source: Roland Berger

Our model aggregates emissions from military platforms, from stationary military assets, and emissions sequestered by the land owned by the Forces

Defence Zero model structure

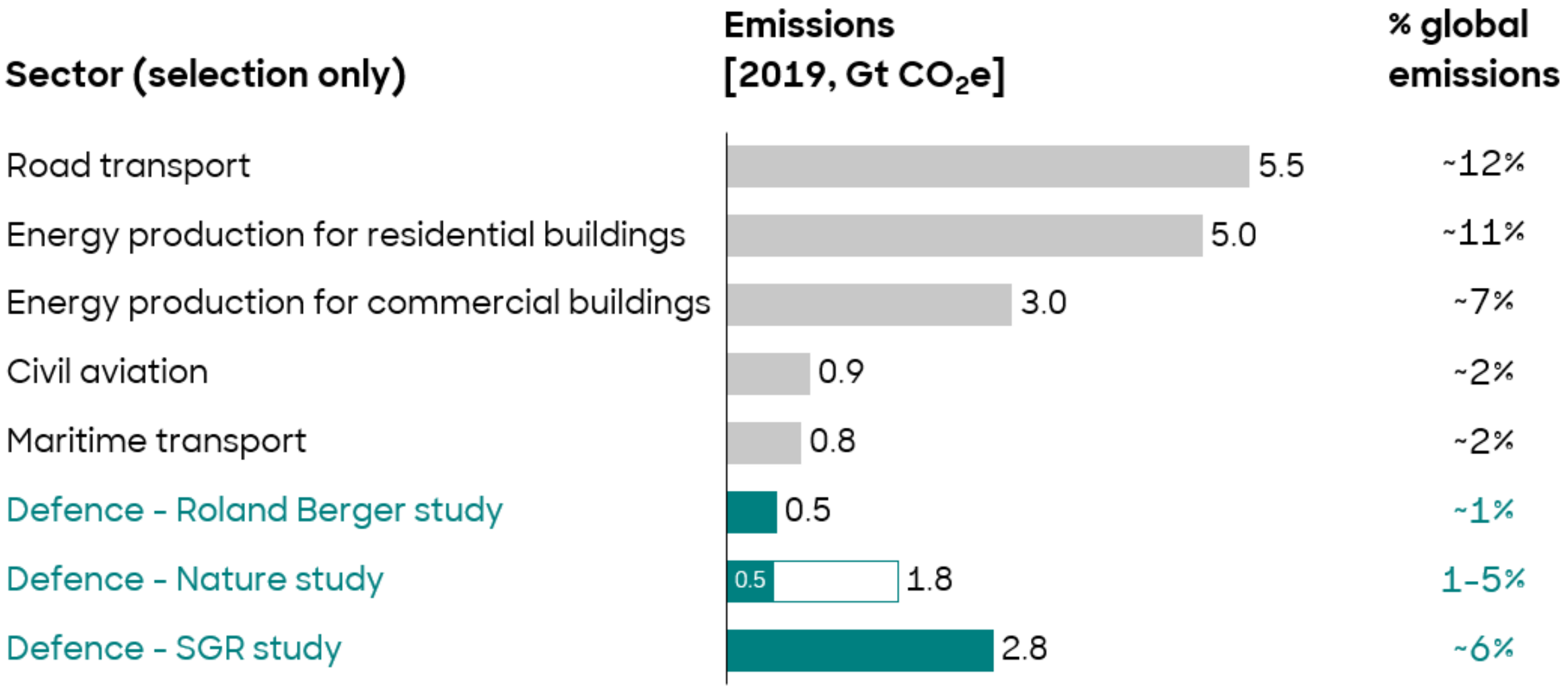


Armed Forces Scope 1+2

Armed Forces Scope 3 upstream / OEMs Scope 1+2 + Scope 3 upstream

Source: Roland Berger

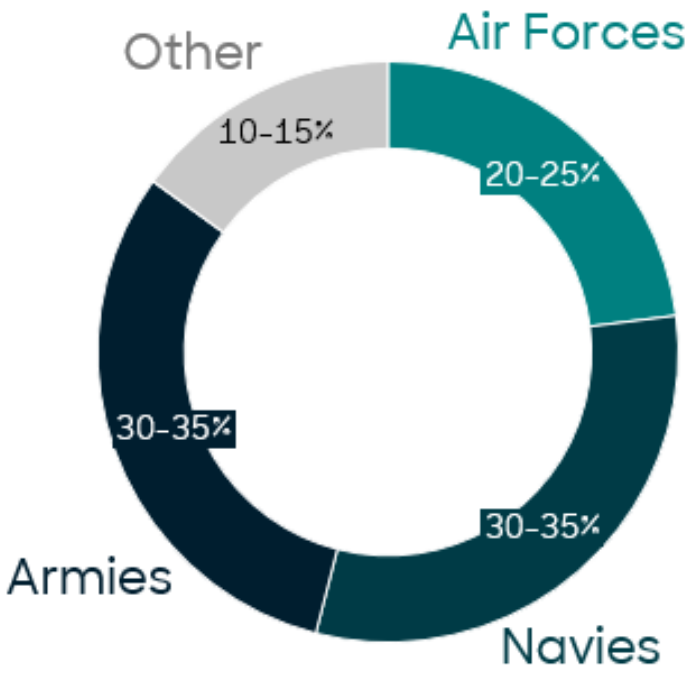
Our model estimates the contribution of Defence to be ~1% of global emissions



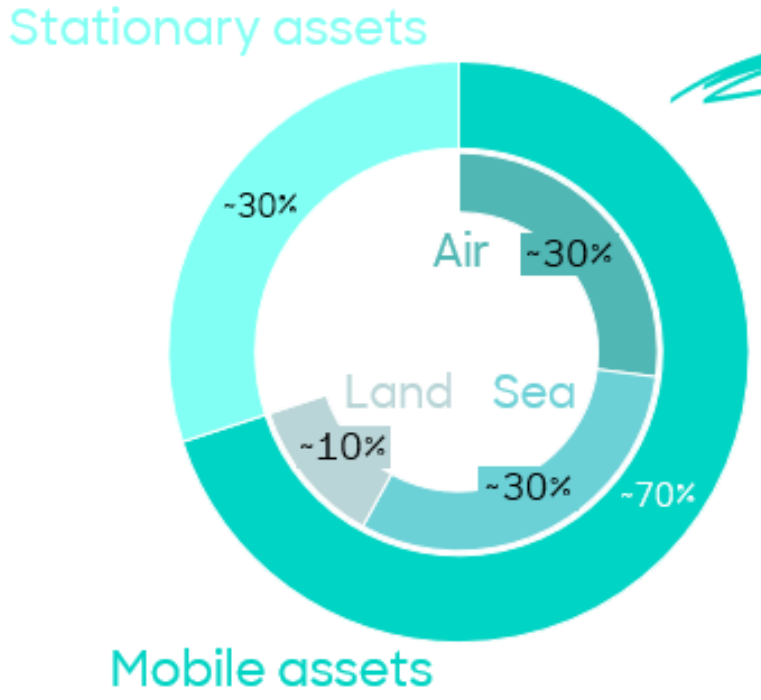
Source: World Bank, World Resources Institute, Nature, SGR, Teal, Roland Berger

Two-thirds of (2019) Defence emissions were from mobile assets, a small share of which was from production, with the majority arising from their operation

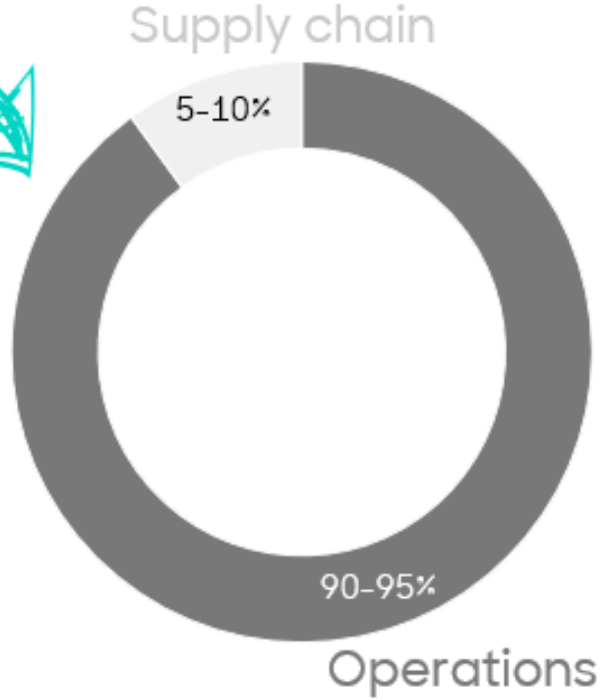
Emissions split by service



Emissions split by asset type and domain



Mobile assets emissions split



Source: Roland Berger

C. Preliminary conclusions

Defence contributes ~1% of manmade emissions, but will be heavily scrutinised. We must understand baselines, and balance sustainability & traditional priorities

Actions for Defence industry stakeholders

- **Measure:** Understand individual emissions baselines (Scopes 1, 2 and 3) and main drivers, including conforming with reporting requirements (TCFD, ISSB, EFRAG, SBTi, CDP, ….)
  - Scope 1 & 2 are relatively straightforward
  - Scope 3, particularly 3-1 (Purchased Goods & Services) & 3-11 (Use of Sold Products), is harder
- **Manage:** project the evolution of Defence emissions, devise (verified) methods to reduce emissions and define appropriate targets*
- Identify how sustainability (decarbonisation, supply chain transparency/reliability/security) & operational effectiveness can strengthen each other
- Understand the broader impact of ESG, given scrutiny from investors & other stakeholders

*** Prioritise actions that offer suppliers and end users the "best" return over the next 5-10 years and beyond**

Roland Berger

European Conference of Defence and the Environment

ECDE 2024

TOBIAS ETZOLD
The Norwegian Institute of International Affairs

EUROPEAN
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ENVIRONMENT

Climate Change in the Arctic: Security Implications and Consequences for Military Operations

ECDE Conference, Oslo, 12-13 June 2024

Dr. Tobias Etzold, Senior Research Fellow

Norwegian Institute of International Affairs (NUPI)

CLIMARCSEC: Basis facts

- Project within the 2023-24 project cycle of the **Multinational Capabilities Development Campaign (MCDC)**: US Joint Staff J7-led effort, in partnership with a community of 23 countries/int. organizations, to create non-material capabilities and solutions to support multinational force operations (MNFs) and exercises by solving or mitigating common military problems.
- **Norway (MoD/NUPI) has project lead**.
- **10 contributing nations**: AUT, CAN, DEU, FIN, FRA, GBR, POL, ROU, SWE, USA
- **7 observers**: AUS, BRA, ESP, NLD, ROK, NATO-ACT, EU-MS

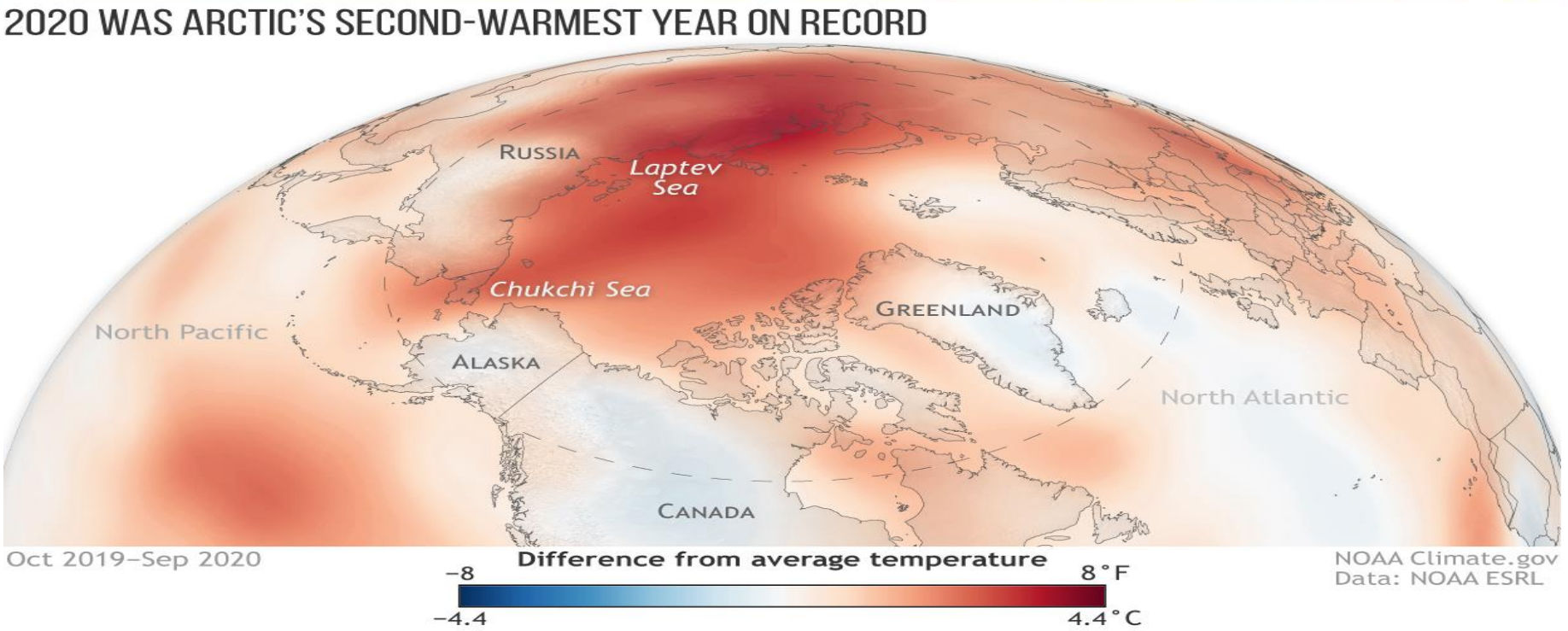
CLIMARCSEC: Background

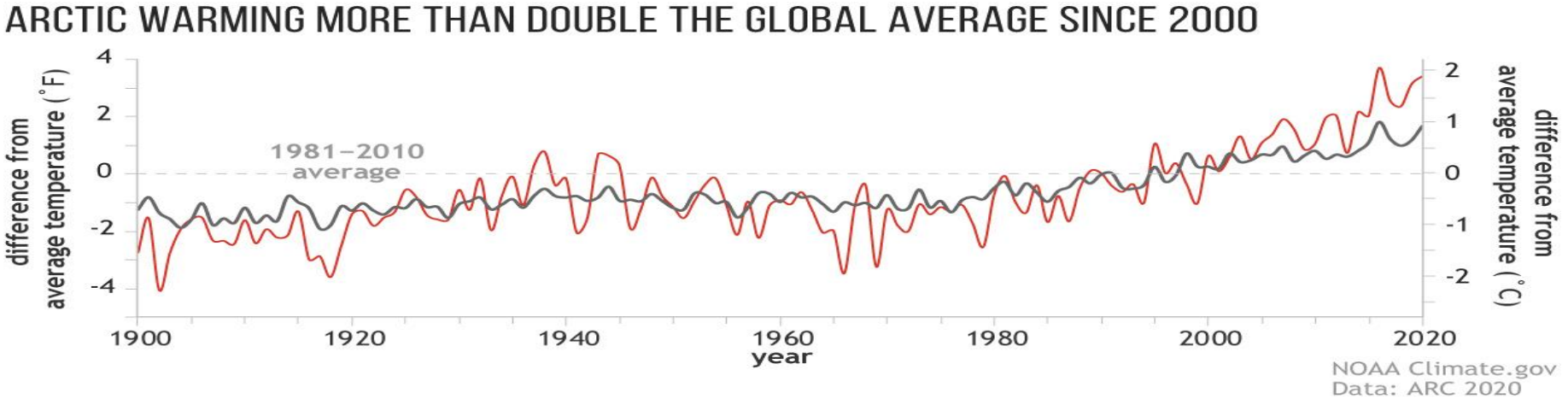
Figure 1. Arctic topographic map [1]

- Climate change is happening at high speed in the Arctic regions, three-four times faster than the global average, resulting in both new risks and new opportunities.
- Climate change opens up the Arctic and gives Arctic and non-Arctic actors easier access, facilitating navigation, resource extraction, fisheries and ecotourism including the risk of hybrid threats.

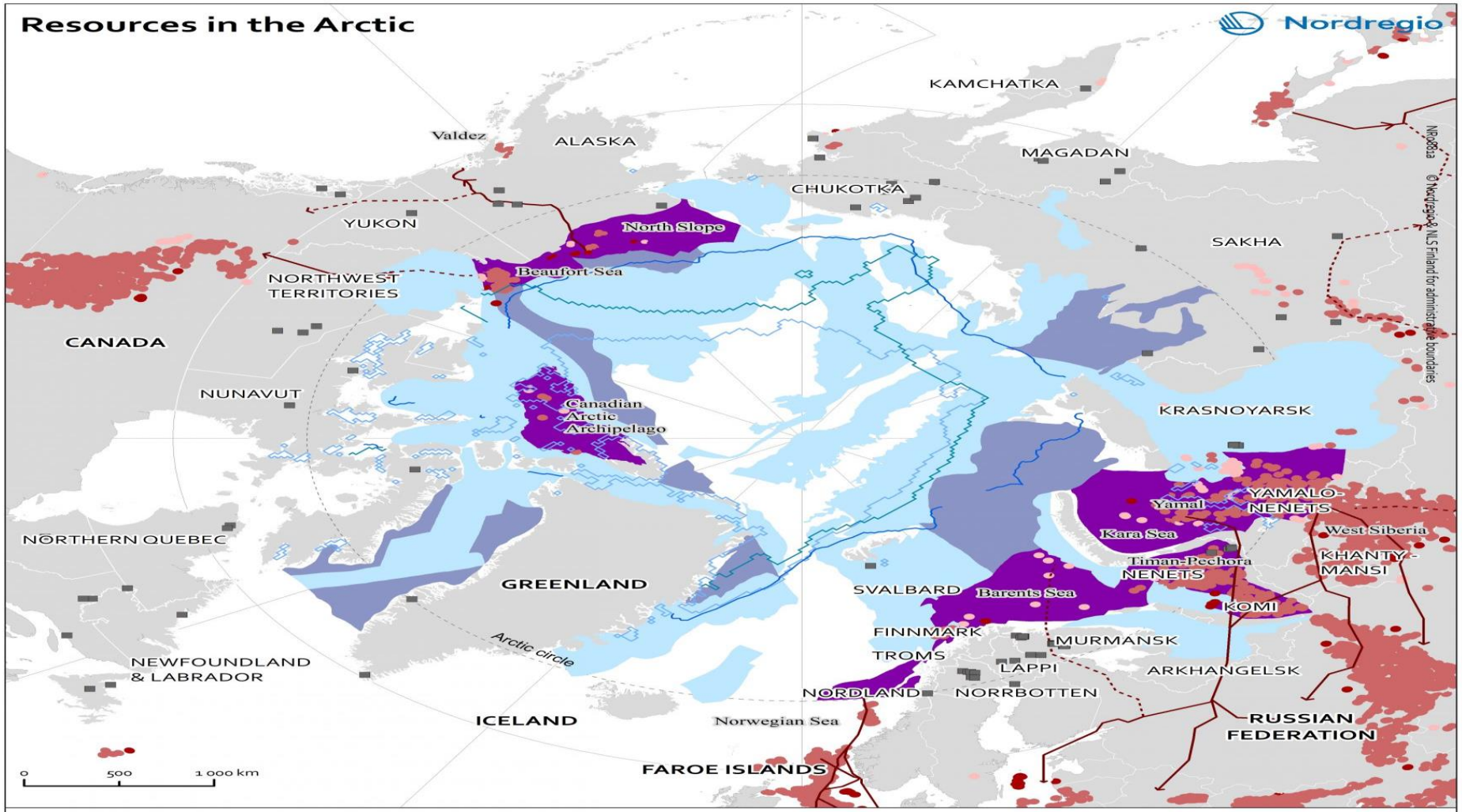
- The Arctic is presumably emerging as an arena of global rivalry over (political, military and economic) power among: Russia, USA and China.
- Rising temperatures are resulting in alarming reductions in sea ice cover and permafrost thawing as well as extreme weather conditions which directly affect among others also military operations.
- Lack of effective cooperation, security governance structures and coordination.

CLIMARCSEC Background: Arctic warming





D17 Arctic Area of Interest Traffic 2008-2022



Main oil and gas resources & mining activities in the Arctic

Oil/gas: exploration and production

- Gas
- Oil
- Oil and gas

Oil/gas: prospective areas and reserves

<50%	Probability that at least one accumulation of more than 50 million barrels of oil or oil-equivalent gas exists after USGS (including areas north of Arctic Circle)
50–99%	
100%	

- Main existing oil/gas pipeline (indicative direction)
- Main proposed oil/gas pipeline (indicative direction)
- Main mining site

- Sea ice extent in September 2012
- Sea ice extent in September 2018
- Average sea ice extent for September in 1981–2010

Regions included:

US - Alaska; CA - Yukon, Northwest Territories, Nunavut, Northern Quebec, Newfoundland & Labrador; GL; IS; FO; NO - Nordland, Troms, Finnmark, Svalbard; SE - Norrbotten; FI - Lappi; RU - Murmansk, Arkhangelsk, Komi, Nenets, Khanty-Mansi, Yamalo-Nenets, Krasnoyarsk, Sakha, Kamchatka, Magadan, Chukotka.

Data source: Nordregio, NSIDC, PRIO, United States Geological Survey USGS and several homepages for oil, gas and mining companies.

CLIMARCSEC: Background

- So far, climate change itself has not directly caused any conflicts in the Arctic and is not, and most likely will not be also in the near future, the main driver for emerging geopolitical tensions in the Arctic and beyond.
- But climate change makes military operations even more difficult and costly which however might become more necessary than before in order to meet tensions and potential conflicts from the outside spilling into the Arctic (Climate change as “threat multiplier”).
- Also, an increase of SAR (Search&Rescue) Operations with military involvement due to more shipping is likely.

CLIMARCSEC: Military problem

Climate change is opening the Arctic up to competition at a pace that challenges existing governance structures and national military capabilities and reveals capability gaps. The need for military MNF operations in the Arctic is increasing, but at the same time they are becoming more difficult. This increases the need for stronger situational awareness, operational capability, governance/coordination and policy changes.

Tendencies: what will be necessary in the future?

- More awareness and a better understanding of the sometimes somewhat vague problem of climate change's impact on security and military operations and related challenges.
- Adaptation to new requirements and environments needed.
- More cooperation and coordination:
- More pronounced role for NATO in the Arctic→ **"NATO and Allies will continue to undertake necessary, calibrated, and coordinated activities, including by exercising relevant plans"** (2023 NATO Vilnius Summit Communique)**.**

Tendencies: what will be necessary in future?

- Increasing awareness of climate change and climate security in NATO: NATO's Centre of Excellence for Climate Change and Security (CCASCOE) → key unit for expanding cooperative efforts to understand the climate threat, to learn how NATO can promote mitigation and adaptation efforts and how it will affect NATO's training and missions and to understand the strategic environment in which they operate.
- Thorough research through various research institutes in Europe, the USA and Canada and close cooperation between them.

European Conference of Defence and the Environment

ECDE 2024

BRYNJAR ARNFINNSSON
Norwegian Defence Research Establishment

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FFI Norwegian Defence Research Establishment

The Zero Emission Defence – a Review of Climate-Friendly Technology for the Norwegian Armed Forces

Brynjar Arnfinnsson
Senior Scientist, FFI

Foto: AdobeStock


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LOCKHEED MARTIN

Agenda

1. Energy sources and carriers
2. Comparison of technologies
3. Potential applications
4. Can green technologies reduce logistics?
5. The way to net zero

Energy sources and carriers

Energy sources

Renewable energy

–

Hydro

Wind

Solar

Nuclear energy

–

Uranium

Thorium

Energy carriers

Carbon-free

–

Electricity

Hydrogen

Ammonia

Nuclear energy

Carbon-based

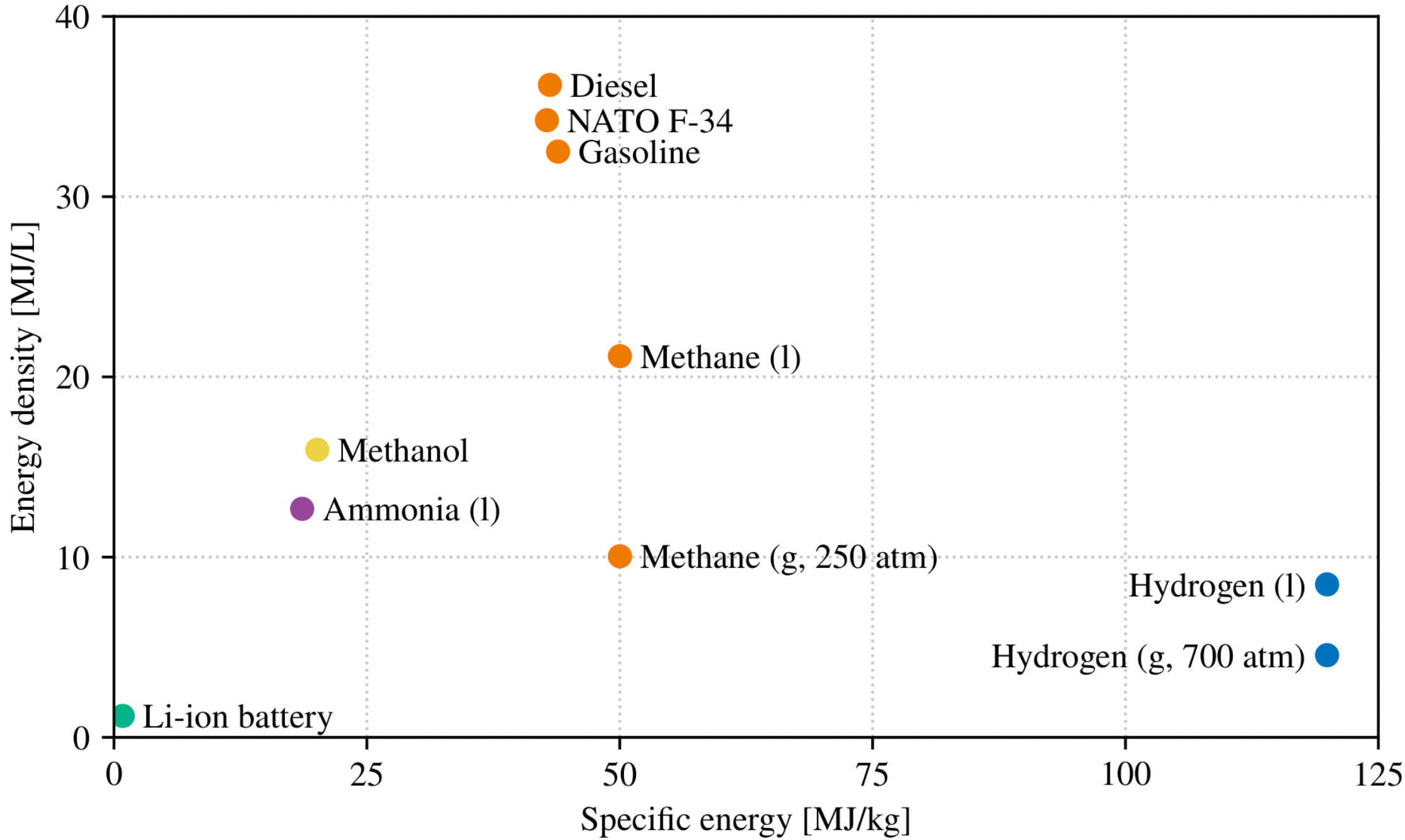
–

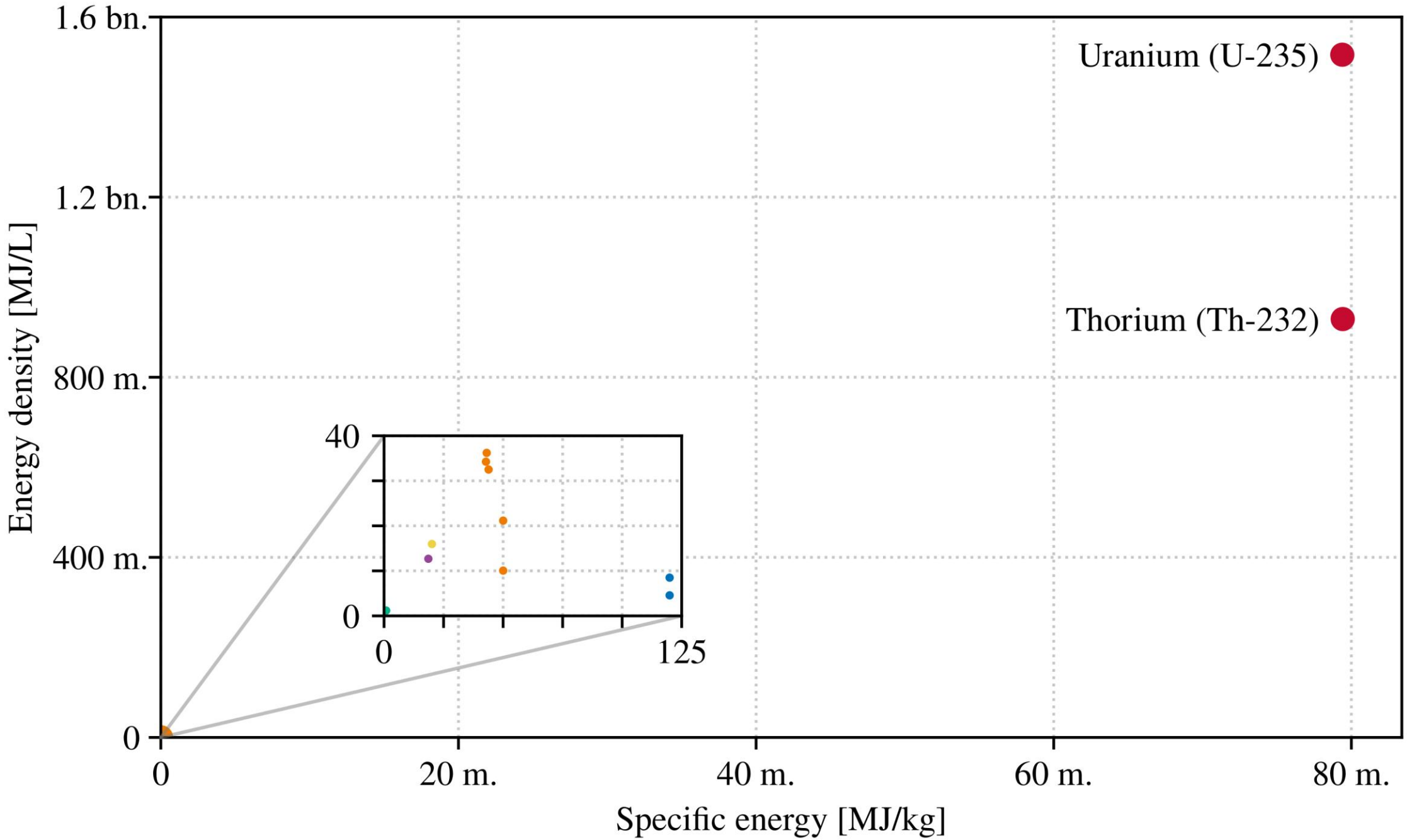
Hydrocarbons

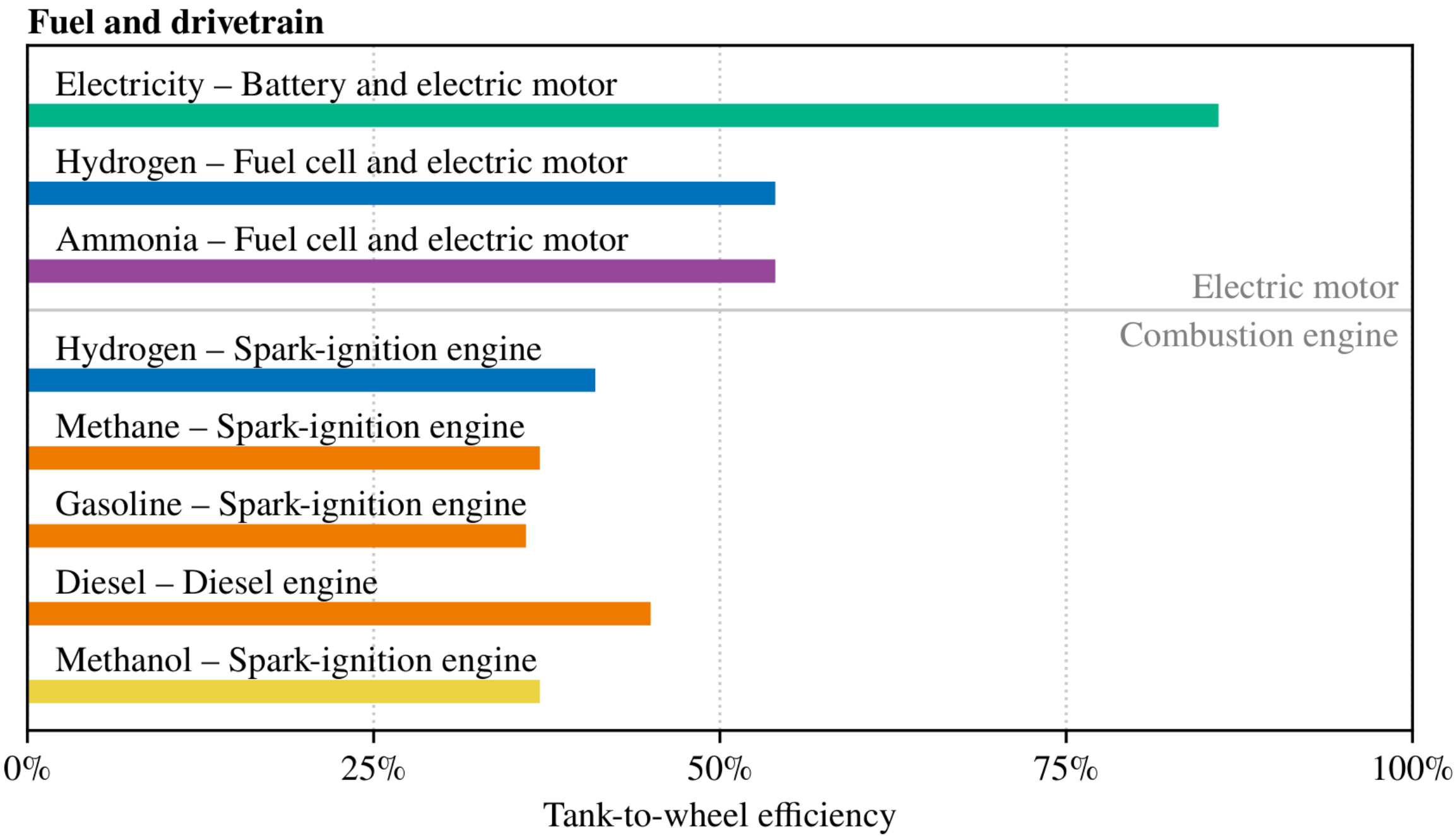
Alcohols

Images: Norwegian Armed Forces

Comparison of technologies


Diesel
NATO F-34
Gasoline
Methane (l)
Methanol
Ammonia (l)
Methane (g, 250 atm)
Hydrogen (l)
Hydrogen (g, 700 atm)
Li-ion battery
Energy density [MJ/L]
Specific energy [MJ/kg]
0
10
20
30
40
0
25
50
75
100
125


1.6 bn.
1.2 bn.
800 m.
400 m.
0
Energy density [MJ/L]
Uranium (U-235)
Thorium (Th-232)
40
0
0
125
0
20 m.
40 m.
60 m.
80 m.
Specific energy [MJ/kg]


Fuel and drivetrain
Electricity – Battery and electric motor
Hydrogen – Fuel cell and electric motor
Ammonia – Fuel cell and electric motor
Electric motor
Combustion engine
Hydrogen – Spark-ignition engine
Methane – Spark-ignition engine
Gasoline – Spark-ignition engine
Diesel – Diesel engine
Methanol – Spark-ignition engine
0%
25%
50%
75%
100%
Tank-to-wheel efficiency

	Energy content	Energy efficiency	Greenhouse gas emissions	Costs
Electricity Li-ion batteries				
Hydrogen E-hydrogen				
Ammonia E-ammonia				
Nuclear energy U-235				
Hydrocarbons Biomethane E-methane Biodiesel E-diesel				
Alcohols Biomethanol E-methanol				

Color indicators

- Better than fossil diesel
- Equal to fossil diesel
- Slightly worse than fossil diesel
- Much worse than fossil diesel

	Energy content	Energy efficiency	Greenhouse gas emissions	Costs
Electricity Li-ion batteries	🔴	🟢	🟢	🟢^{o} 🟡^{i}
Hydrogen E-hydrogen				
Ammonia E-ammonia				
Nuclear energy U-235				
Hydrocarbons Biomethane E-methane Biodiesel E-diesel				
Alcohols Biomethanol E-methanol				

Color indicators

- 🟢 Better than fossil diesel
- 🟢 Equal to fossil diesel
- 🟡 Slightly worse than fossil diesel
- 🔴 Much worse than fossil diesel

Comments

●^{o} Operating ●^{i} Investment

	Energy content	Energy efficiency	Greenhouse gas emissions	Costs
Electricity				
Li-ion batteries	🔴	🟢	🟢	🟢^{o} 🟡^{i}
Hydrogen				
E-hydrogen	🔴^{e} 🟢^{s}	🟢^{f} 🟡^{c}	🟢	❓^{o} 🔴^{i}
Ammonia				
E-ammonia	🟡	🟢^{f} ❓^{c}	🟢	🔴^{o} 🔴^{i}
Nuclear energy				
U-235	🟢	N/A	🟢	🟢^{o} ❓^{i}
Hydrocarbons				
Biomethane	🟡^{e} 🟢^{s}	🟡	🟢	❓^{o} 🟢^{i}
E-methane	🟡^{e} 🟢^{s}	🟡	🟢	🔴^{o} 🟢^{i}
Biodiesel	🟢	🟢	❓	❓^{o} 🟢^{i}
E-diesel	🟢	🟢	🟢	🔴^{o} 🟢^{i}
Alcohols				
Biomethanol	🟡	❓	🟢	🔴^{o} 🟢^{i}
E-methanol	🟡	❓	🟢	🔴^{o} 🟢^{i}

Color indicators

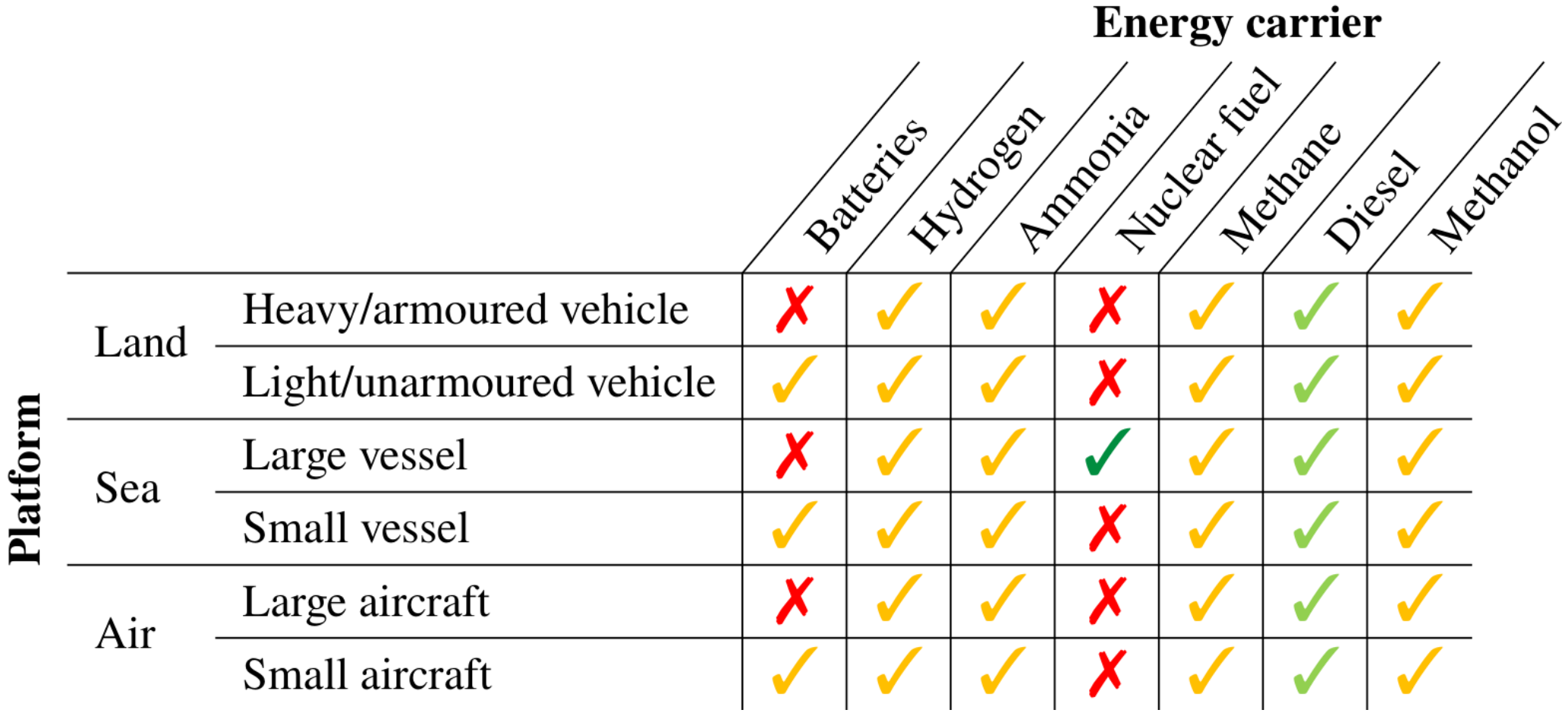
- 🟢 Better than fossil diesel
- 🟢 Equal to fossil diesel
- 🟡 Slightly worse than fossil diesel
- 🔴 Much worse than fossil diesel

Comments

- ^{e} Energy density
- ^{s} Specific energy
- ^{f} Fuel cell
- ^{c} Combustion
- ^{o} Operating
- ^{i} Investment
- ❓ High uncertainty assessment

Potential applications

Platform		Energy carrier: Batteries	Hydrogen	Ammonia	Nuclear fuel	Methane	Diesel	Methanol
Land	Heavy/armoured vehicle	✗	✓	✓	✗	✓	✓	✓
	Light/unarmoured vehicle	✓	✓	✓	✗	✓	✓	✓
Sea	Large vessel	✗	✓	✓	✓	✓	✓	✓
	Small vessel	✓	✓	✓	✗	✓	✓	✓
Air	Large aircraft	✗	✓	✓	✗	✓	✓	✓
	Small aircraft	✓	✓	✓	✗	✓	✓	✓



What about energy for operating bases and military infrastructure?

Can zero emission technology reduce logistics?

«The defense that first manages to crack the code – on how to become less dependent on fossil logistics – they have a great advantage.»

Eirik Kristoffersen

Norwegian Chief of Defence

25th Nov. 2022

Photo: FFI

Photo: Nathan Franco / U.S. Army

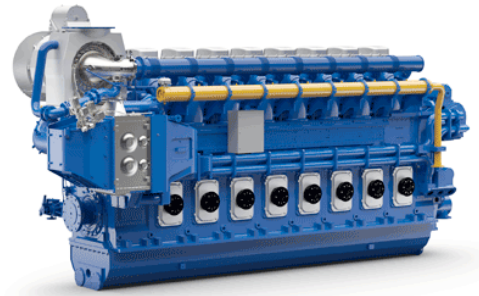
Photo: Darin Russell / Lockheed Martin

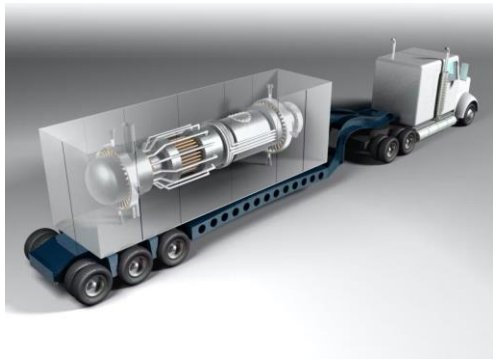
Photo: Johan Ludvig Holst / Forsvaret

The way to net zero

The way towards net zero for the Armed Forces

- Biofuels and e-fuels
- Dual-fuel
- Nuclear power
- Renewable energy
- Batteries





“The Armed Forces cannot be the only remaining fossil sector in a society which in the future will be fossil-free. We must reconcile the need to have a strong defense with a green defense.”

Jens Stoltenberg

Secretary General of NATO

26th June 2023

Photo: Stian Lysberg Solum / NTB

Questions?

Contact:

Brynjar.Arnfinnsson@ffi.no

European Conference of Defence and the Environment

ECDE 2024

MARIUS PEDERSEN
Norwegian Defence Research Establishment

EUROPEAN
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FFI Norwegian Defence Research Establishment

National and International Security in the Arctic

Norwegian Perspectives

Marius N. Pedersen

Foto: AdobeStock

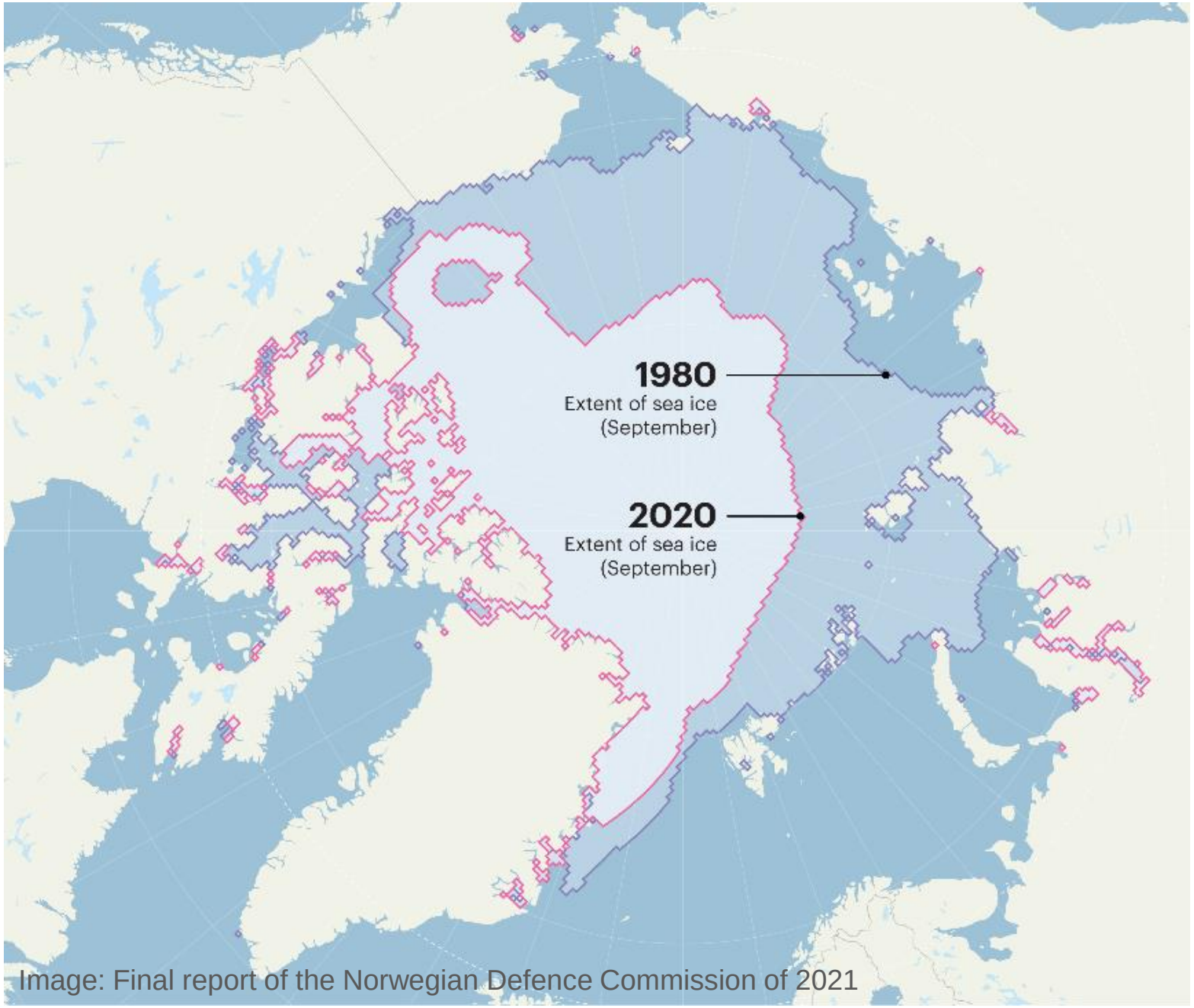


Image: Final report of the Norwegian Defence Commission of 2021

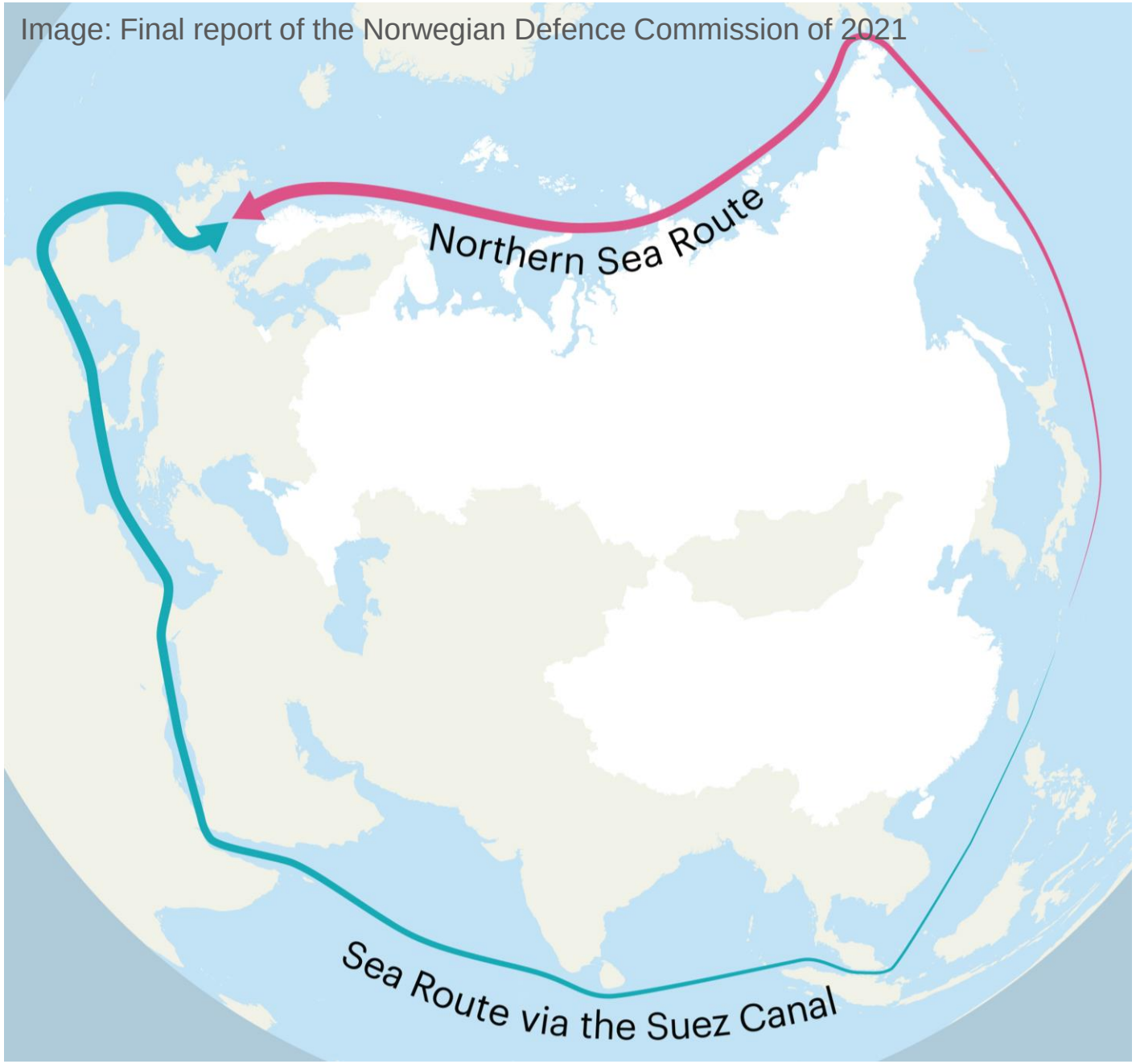


Image: Final report of the Norwegian Defence Commission of 2021
Northern Sea Route
Sea Route via the Suez Canal

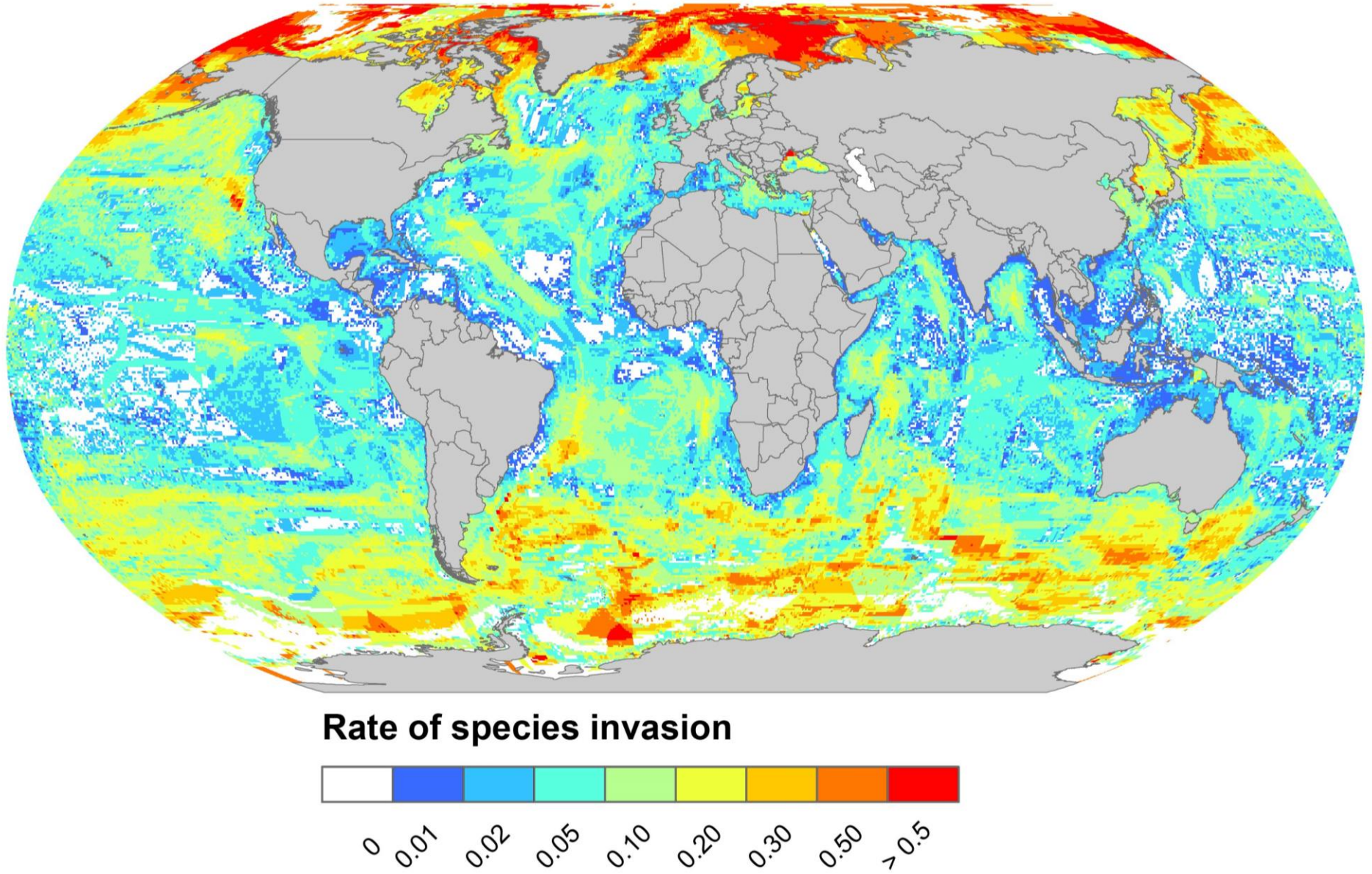


Image: William Chung et al., ICES Journal of Marine Sciences 72, 2016

Arctic Security Landscape

- Great deal of alarmism
- «Race for the Arctic»
  - Resources
  - Trade routes
  - Ice breakers
- Consequences of militarisation and securitisation
- Less cooperation and more uncertainty
  - Militarisation
  - Securitisation

Image: Vijdan Mohammad Kawoosa / High North News


Nervous?
Yes... Very.
First time?
No, I've been nervous lots of times.
made with mematic

Impacts on the Maritime Domain

- Greater maritime access
- More open sea
  - Often poorly charted
  - Even uncharted
- Increased human activity
  - Military and commercial
  - Cruise traffic is a particular challenge
- New actors with limited Arctic experience
- Uncertainty about treaties

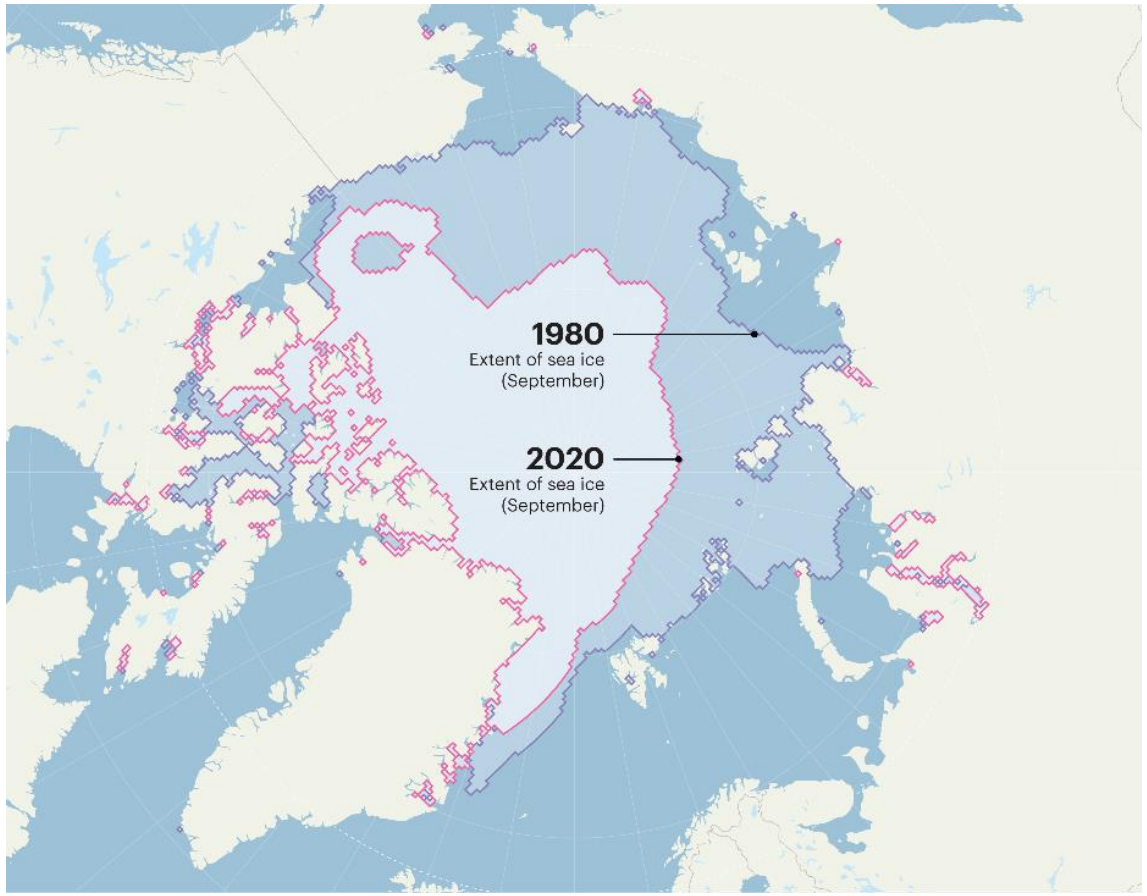


Image: Final report of the Norwegian Defence Commission of 2021

Impacts on the Maritime Domain

- The contentious Svalbard Treaty
- United Nations Convention on the Law of the Sea
  - Article 234:

"Coastal States have the **right to adopt and enforce non-discriminatory laws and regulations** for the prevention, reduction and control of marine pollution from vessels in ice-covered areas within the limits of the exclusive economic zone, where **particularly severe climatic conditions and the presence of ice covering such areas for most of the year** create obstructions or exceptional hazards to navigation, and pollution of the marine environment could cause major harm to or irreversible disturbance of the ecological balance. Such laws and regulations shall have due regard to navigation and the protection and preservation of the marine environment based on the best available scientific evidence."

Image: Archive of the Governor of Svalbard

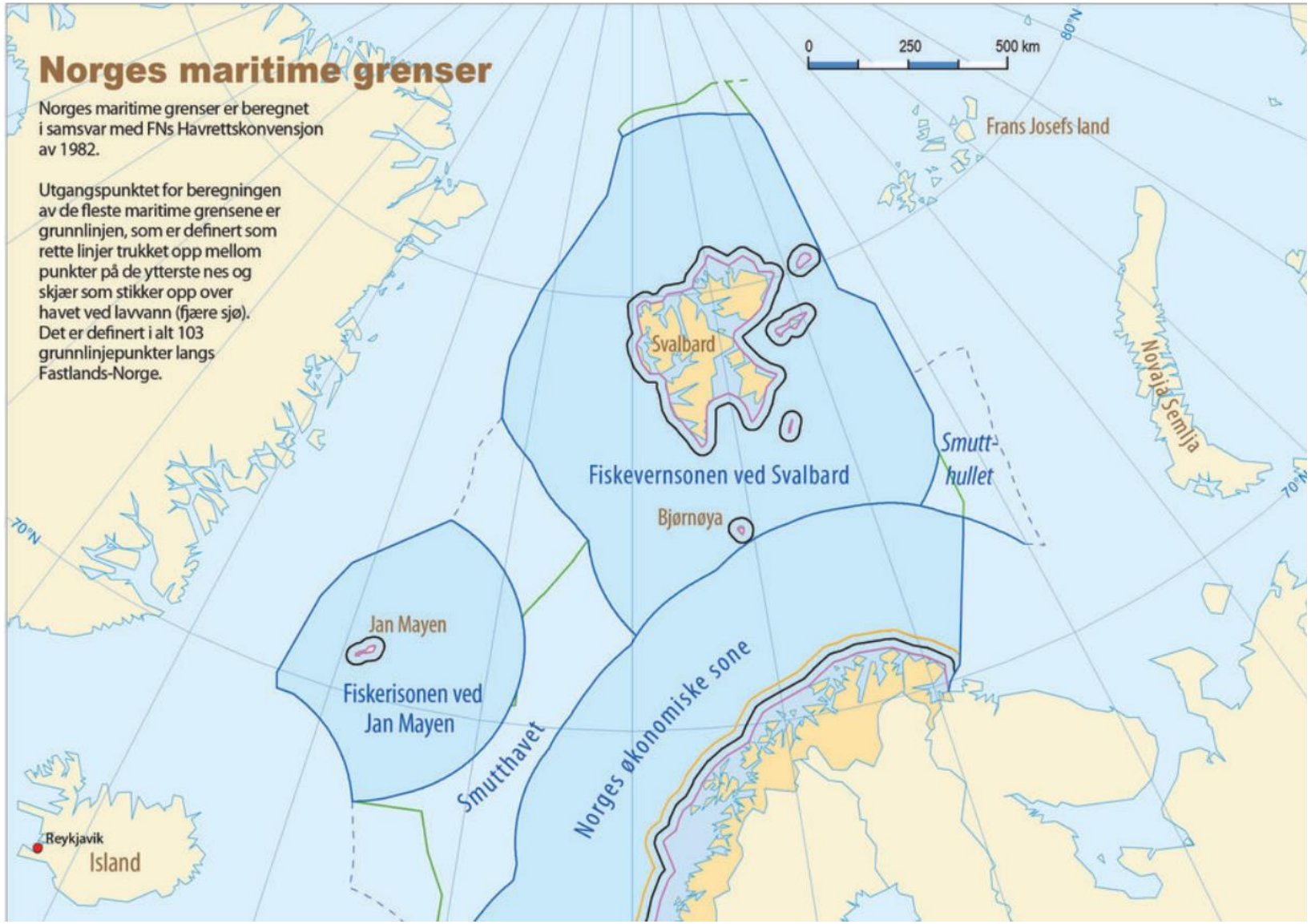


Image: The Norwegian Mapping Authority

Impacts on the Land Domain

“Weaponisation of migration seeks to use the destabilising potential in a high number of migrants in a short time period to provoke desired political change in a target state”

- Several recent examples
  - Russia against Finland and Norway in 2015
  - Belarus against Poland and Latvia during the winter of 2021/22
  - Russia against Finland and Norway 2023

- Climate refugees will offer Russia new opportunities to pressure hostile states

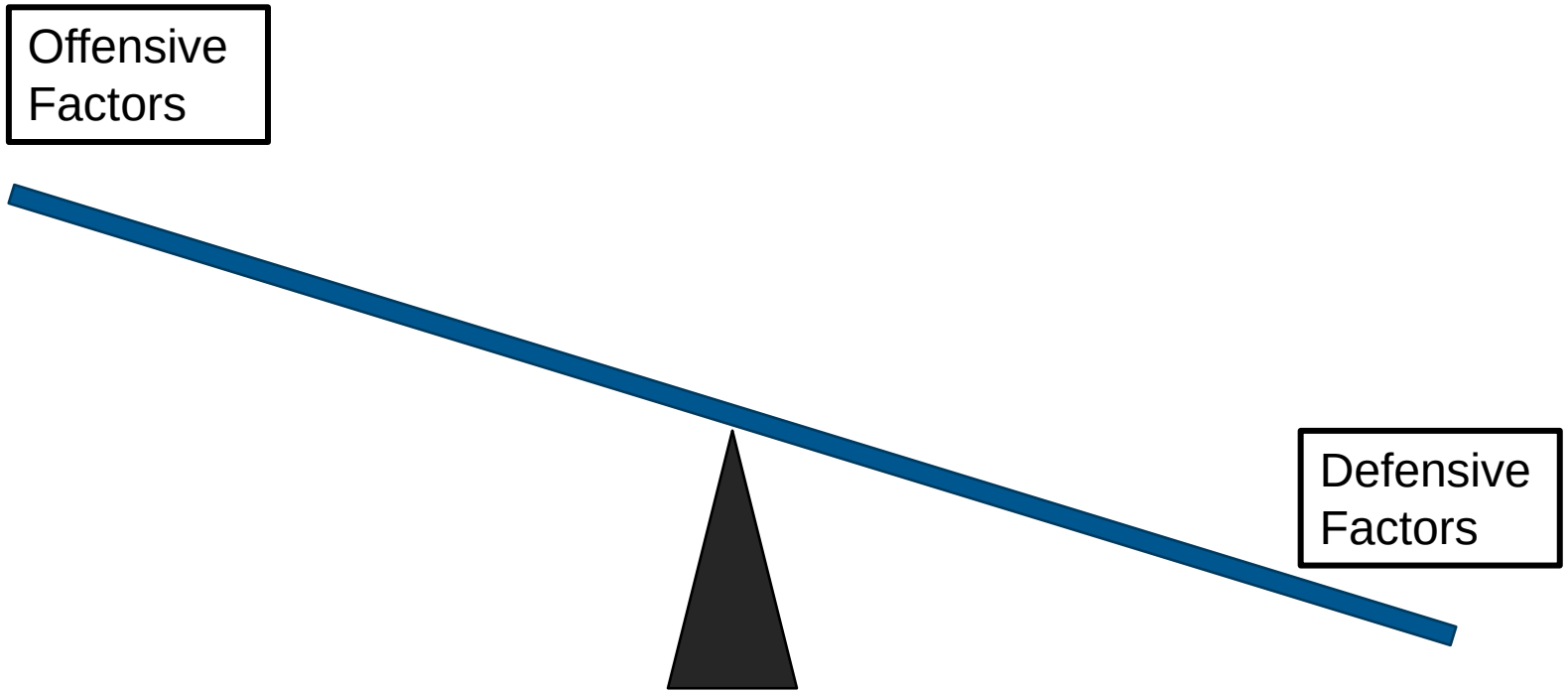
Image: Kancelaria Premiera (CC BY-NC-ND 2.0)

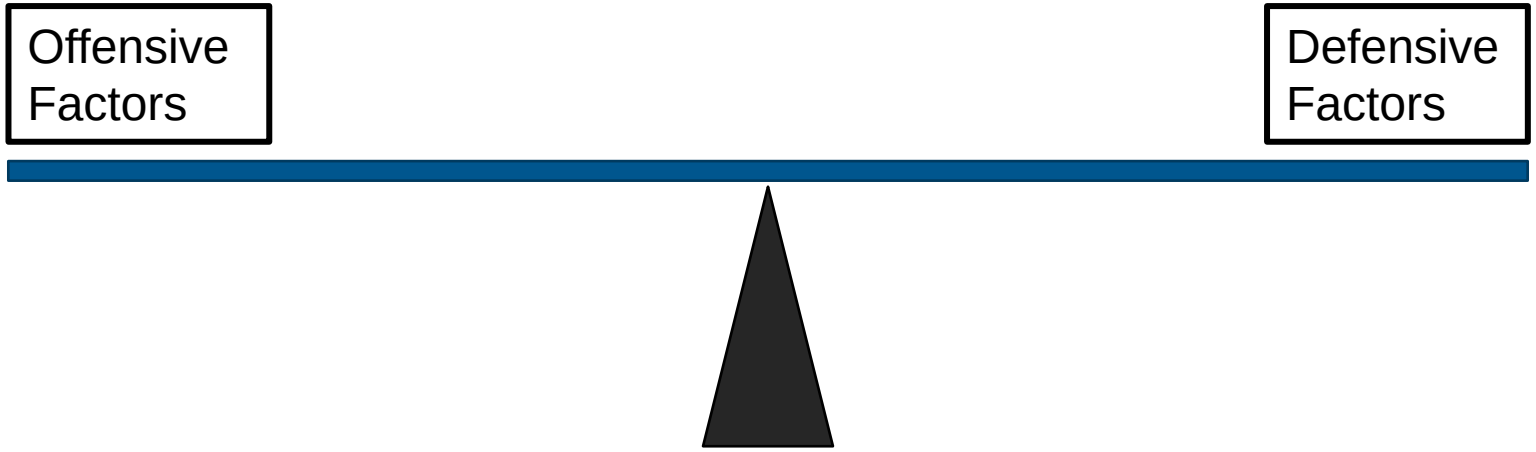
Security Consequences

- Increases risk of *security dilemmas*
- Tilting the offence-defence balance
- The Arctic has been a clearly defence-oriented region
- Climate change may tilt the scales towards balance

The Offence-Defence Balance

	Offensive advantage	Defensive advantage
Offensive posture not distinguishable from defensive posture	(1) Doubly dangerous	(2) Security dilemma, but security requirements may be compatible
Offensive posture distinguishable from defensive posture	(3) No security dilemma, but aggression possible. Status quo states may follow different strategies than aggressors. Warning given.	(4) Doubly safe


Offensive
Factors
Defensive
Factors


Offensive
Factors
Defensive
Factors

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The future electricity system:
A problem solver or a problem creator?

Prof.dr.techn.ir. Sonja Monica Berlijn MBA
Tuesday 12 June 2024

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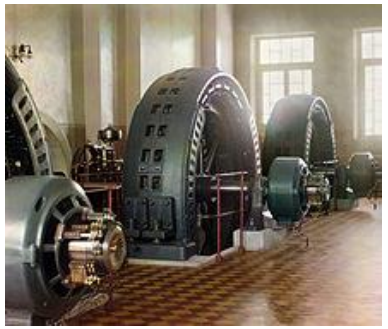
Electricity system is rapidly changing

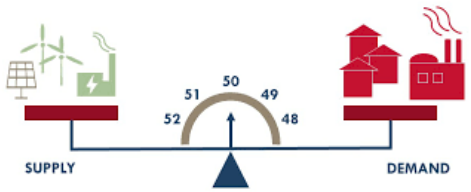
- Energy transition is going faster than expected
  - Electricity demand is increasing significant
  - New production is needed
  - Both new types of demand and production arise
  - Electricity becomes more and more relevant for society
- The electricity system needs to facilitate these changes
- The future electricity system solves climate challenges but
  introduces some new challenges

A simple Electricity System

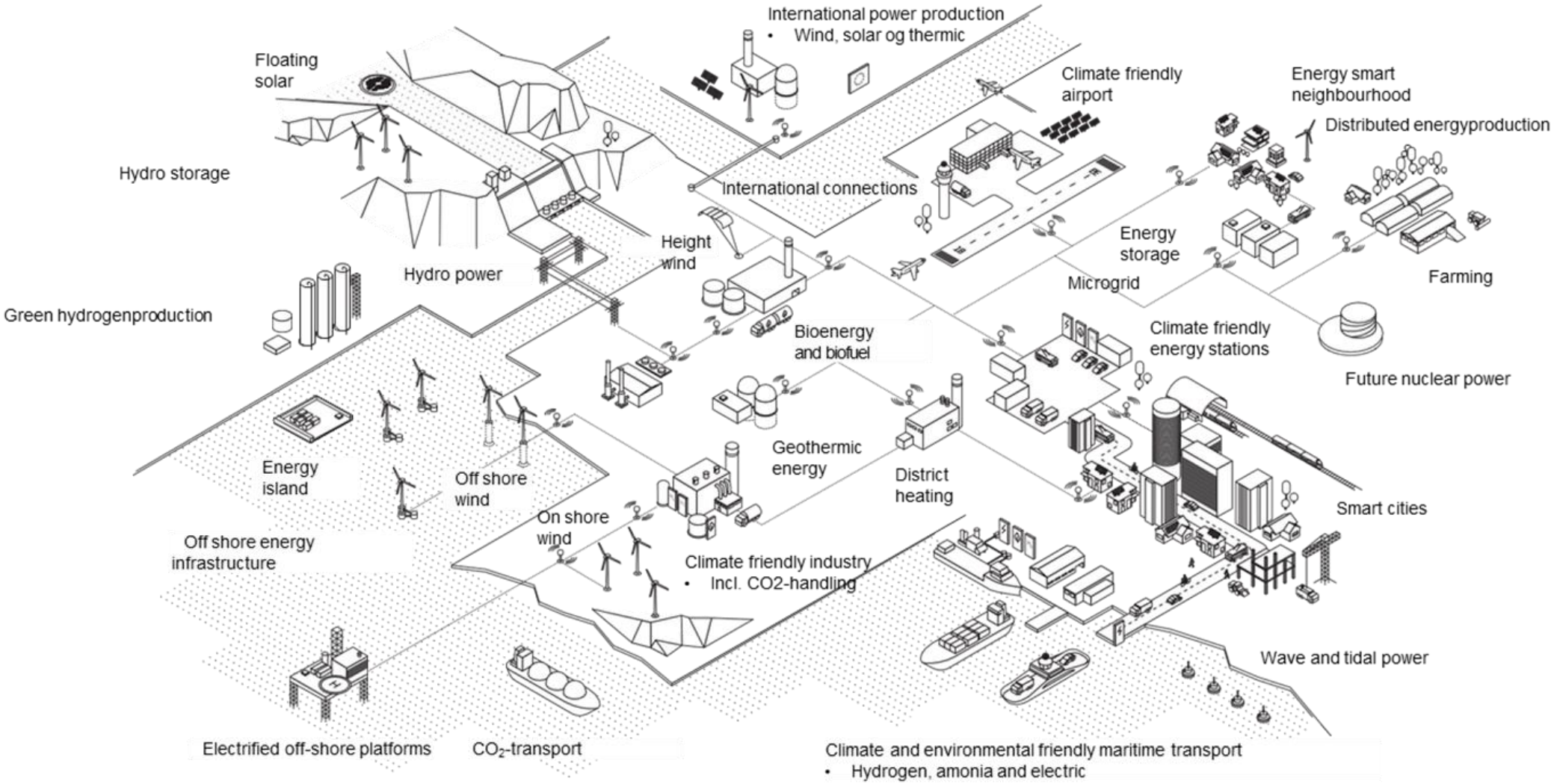
Every electrical power system has three major components

- generation: source of power, ideally with a specified voltage and frequency
- transmission system [transformers, lines, etc.]: transmits power; ideally as a perfect conductor
- load: consumes power; ideally with a constant resistive value





A glimpse of the future electricity system



Electricity will be the main energy source

- The future electricity system has a large impact on the functioning of society and total defence
  - Transport, communication, information, food, water, payment, is there anything left that does function without electricity?
- The electricity system is under pressure and its vulnerability is increasing
  - More digital solutions are needed to solve the challenges in the electricity system
  - The build-in redundancy might be decreasing
  - It is too complex for even insiders to understand

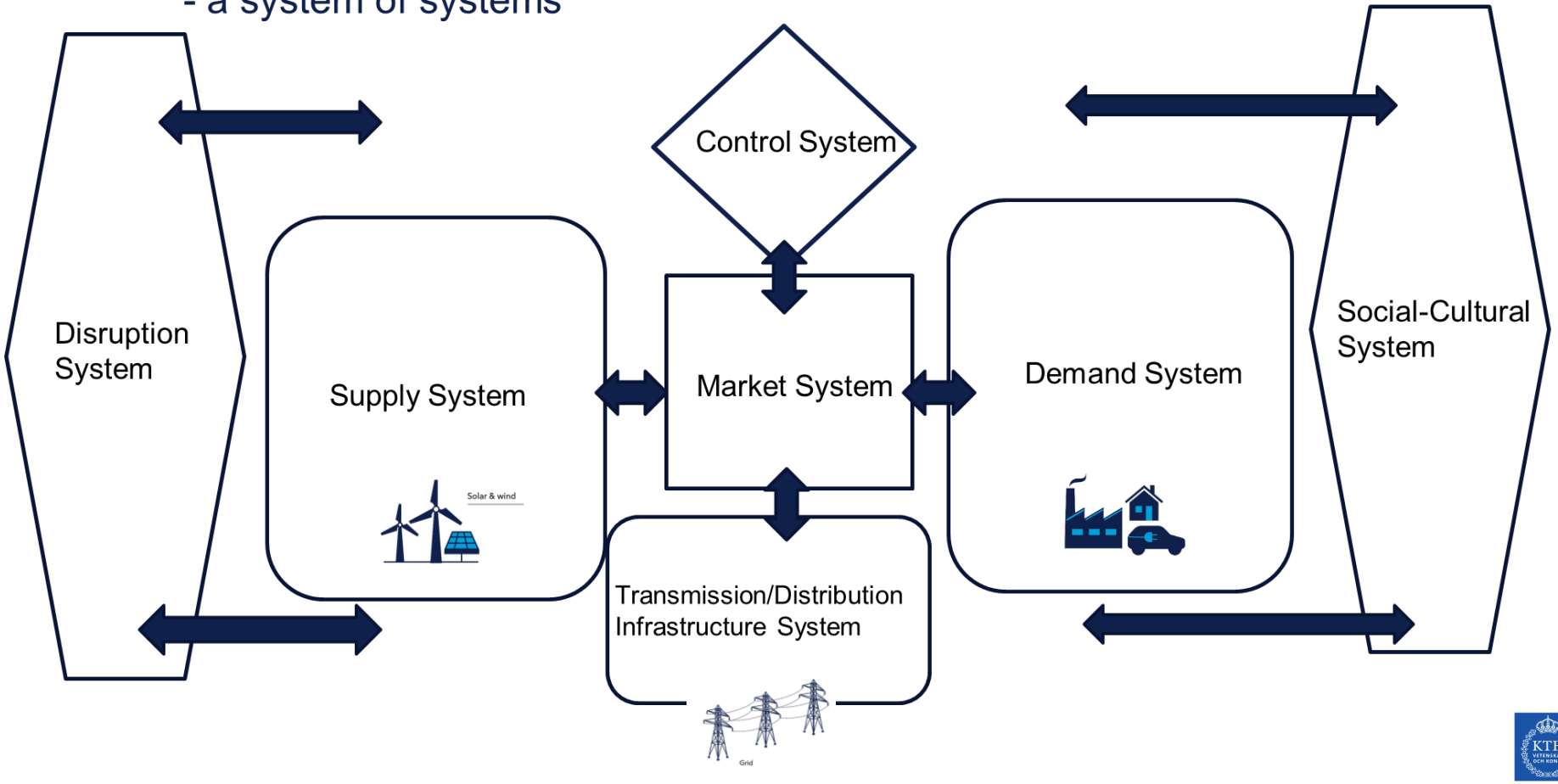
Source - www.rac.co.uk

How can we find weaknesses in a complex electricity system?

REDISET
Resilient Digital Sustainable Energy Transition

REDISET system model

- a system of systems

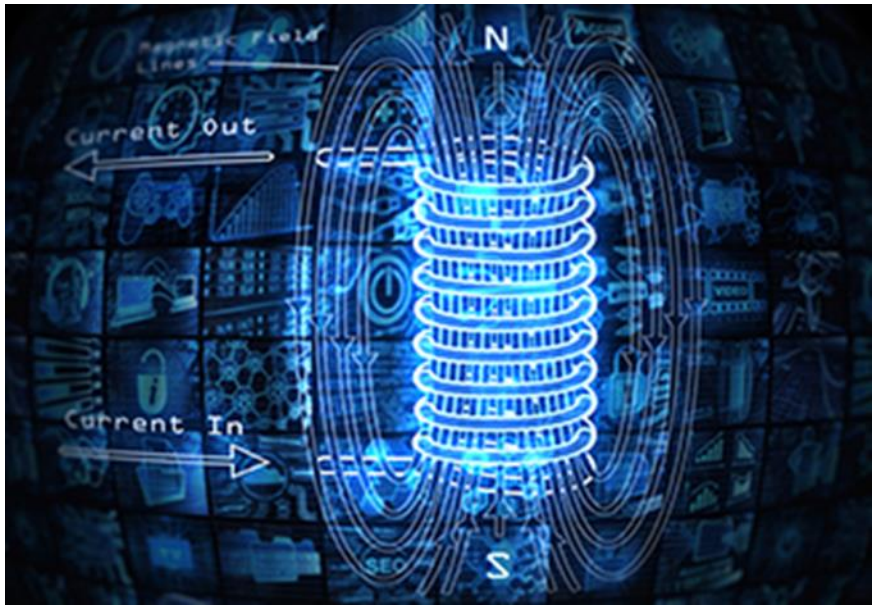


Creative ways to attack the future electricity system

- Market system
- Weather data
- False sensor data
- Disinformation via social media
- Attack a small player in the electricity system
- Certain components
- Off-shore grid connection

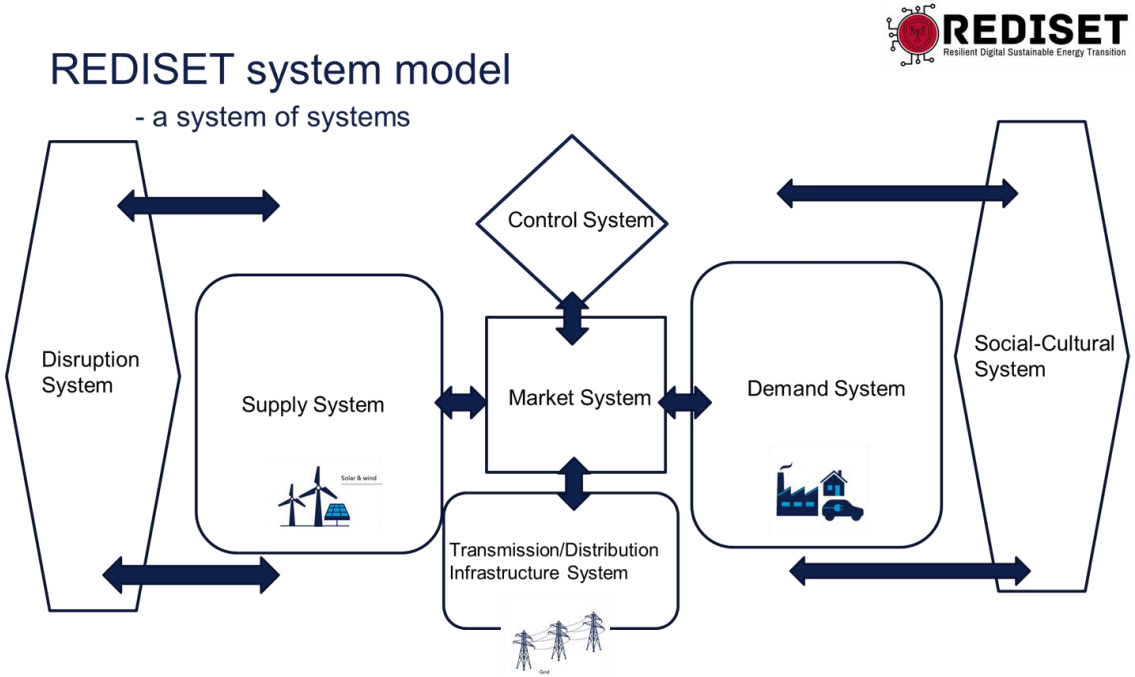
Electricity system has become a complex cyber-physical system and defending it becomes more complex and expensive

- Physical attacks
  - Right now there is a redundancy in the grid, this redundancy is shrinking
  - Longer lead times for new equipment (3-7 years)
- Cyber attacks
  - Indirect via administrative systems
  - Disrupting data
- Social attacks
  - Consumers, e.g. EV-users
  - Critical persons on critical positions



What are the highest risks and how to mitigate them?

- What are the highest risks?
  - Preliminary research has shown that there are some unexpected items
  - We can learn from on-going crisis
- How to mitigate the risks?
  - Can micro-grids be a solution?
  - Can decentralisation help?
  - Shall control in crisis be simplified?
- What are acceptable costs?
  - Redundant and resilient grid is maybe too expensive?



Problem solver or problem creator?

- The electricity system is the back-bone of the future energy system
- It is expected that the grid will more than double in length and the need for electricity will increase with a factor of 2-7
- The pace of the increase in need is higher than the increase of new grid capacity - congestion
- The congestion can be solved with digitalisation
- The new electricity system solves our dependence on gas and oil and reduces CO_2 emission

- ‘There is no transition without transmission’

Problem solver or problem creator?

- More and more is depending on electricity
- The electricity system will be connected to other systems (sector coupling)
- The electricity system is very complex and even for in-siders difficult to understand
- A lot of parties will be active contributors to the electricity system
- The future system will be highly digitalized
- There might be less margins available in the transition period
- The digitalization of the electricity system leads to new vulnerabilities

- Cyber – physical security and cyber - physical resilience are new areas of attention and research

Thank you for your attention

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