Consultation Forum for Sustainable Energy in the Defence and Security Sector Phase II (CF SEDSS II)
2017-2019

GUIDANCE DOCUMENT
CF SEDSS II Results and Recommendations for Sustainable Energy in the Defence and Security Sector

European Defence Energy Network

EUROPEAN DEFENCE AGENCY

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CF SEDSS II

GUIDANCE DOCUMENT
CF SEDSS II RESULTS AND RECOMMENDATIONS FOR SUSTAINABLE ENERGY IN DEFENCE AND SECURITY SECTOR
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ACER	Agency for the Cooperation of Energy Regulators
AF	Armed Forces
ANSSI	National Cybersecurity Agency
APIC	Association for the Protection of Critical Infrastructures
BACS	Building Automation and Control Systems
BEVs	Battery Electric Vehicles
BMS	Building Management System
CEI	Critical Energy Infrastructure
CF	Consultation Forum
CFMT	Consultation Forum Management Team
CF SEDSS	Consultation Forum for Sustainable Energy in the Defence and Security Sector
CHP	Combined Heat and Power
CNPIC	National Centre for the Protection of Critical Infrastructure
COTS	Commercial Off the Shelf
CPNI	Centre for the Protection of National Infrastructure
CSD	Corporate Services Directorate
DEFNET	Defence Environmental Network
DG	Director General
DG ENER	Directorate General Energy
DPO	Data Protection Officer
EASME	Executive Agency for Small and Medium-sized Enterprises
EBRD	European Bank for Reconstruction and Development
EC	European Commission
ECI	European Critical Infrastructures
ECP	EDA Collaborative Platform
EDA	European Defence Agency
EDAP	European Defence Action Plan
EDEN	European Defence Energy Network
EDTIB	European Defence Technological and Industrial Base
EEAS	European External Action Service
EED	Energy Efficiency Directive
EEEF	European Energy Efficiency Fund
EE-ISAC	European Energy - Information Sharing & Analysis Centre
EFTA	European Free Trade Association
EIB	European Investment Bank
EISAC	European Infrastructure Simulation and Analysis Centre
EM-EE	Energy Management & Energy Efficiency
EMSs	Environmental Management Systems
EMT	Event Management Team
ENISA	European Union Agency for Network and Information Security
EnMS	Energy Management Systems
ESI	European Synergies & Innovation Directorate
EFSI	European Fund for Strategic Investments

EFTA	European Free Trade Association
EIB	European Investment Bank
EMAS	Eco-Management & Audit Scheme
EM-EE	Energy Management & Energy Efficiency
EMSs	Environmental Management Systems
EMT	Event Management Team
ENISA	European Union Agency for Network and Information Security
EnMS	Energy Management Systems
EnPIs	Energy Performance Indicators
ENTSOG	European Network of Transmission System Operators for Gas
ENTSO-E	European Network of Transmission System Operators for Electricity
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performance Contracting
EPCIP	European Programme for Critical Infrastructure Protection
ESCO	Energy Service Company
ESDC	European Security and Defence College
ESIF	European Structural and Investment Funds
ETP	Equities Technical Panel
EU	European Union
F4E	Fusion for Energy
GA	Grant Agreement
GHG	Green House Gas
GIS	Geographical Information Systems
HVAC	Heating, Ventilation, and Air Conditioning
ICEVs	Internal Combustion Engine Vehicles
ICS	Industrial Control Systems
INEA	Innovation and Networks Executive Agency
IoT	Internet of Things
JRC	Directorate-General Joint Research Centre
MCU	Media and Communication Unit
MoD	Ministry of Defence
MoDs	Ministries of Defence
MS	Member States
M&V	Measurement and Verification
NATO	North Atlantic Treaty Organization
NCPs	National Contact Points for CF SEDSS II
NCSC	National Cyber Security Centre
NECPs	National Energy & Climate Plans
NIS	Network and Information Systems Directive
NZEB	Near Zero Energy Building
OSCE	Organization for Security and Co-operation in Europe
PCEI	Protection of Critical Energy Infrastructure
PBD	Permanent Demountable Buildings
pMS	Participating Member States
PNPIC	National Plan for Critical Infrastructure Protection
PPD	Public Procurement Directive

PV	Photovoltaic
R&I	Research and Innovation
R&T	Research & Technology
RED	Renewable Energy Directive
REDB	Real Estate Data Base
RES	Renewable Energy Sources
ROI	Return on Investment
RTOs	Research and Technology Organizations
SCADA	Supervisory Control and Data Acquisition
SEDSS	Sustainable Energy in the Defence and Security Sector
SET-Plan	Strategic Energy Technology Plan
SGDSN	General Secretariat for Defence and National Security
SRSS	Structural Reform Support Service
Sub-WGs	Sub-Working Groups
SEDSS	Sustainable Energy in the Defence and Security Sector
SET-Plan	Strategic Energy Technology Plan
SEUs	Significant Energy Uses
SRI	Smart Readiness Indicator
SRSS	Structural Reform Support Service
Sub-WGs	Sub-Working Groups
TNCEIP	Thematic Network on Critical Energy Infrastructure Protection
TRL	Technology Readiness Level
TSOs	Transmission system Operators
WGs	Working Groups
WPs	Work Packages

EXECUTIVE SUMMARY

On 16 October 2017, the Grant Agreement between the Executive Agency for Small and Medium-sized Enterprises (EASME) and the European Defence Agency (EDA) was signed, launching phase II of the Consultation Forum for Sustainable Energy in the Defence and Security Sector (CF SEDSS II). This 22-month project, expiring on 15 August 2019, is funded by the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 789231. The present Guidance Document "CF SEDSS II Results and Recommendations for Sustainable Energy in the Defence and Security Sector" is the revised version of the Guidance Document "A Roadmap for Sustainable Energy Management in Defence and Security Sector" that was already initiated in phase I.

The Consultation Forum reviewed the Guidance Document considering the specificities of the defence sector, the revision of the energy-related legislation and directives, and the new developments in the European energy eco-system, including the European defence and security dimensions. The objective of the current version is to present the achievements of phase II (2017-2019) and, building upon such results, propose recommendations to the European Union (EU) Ministries of Defence (MoDs) to further enhance progress in energy management including energy efficiency, renewable energy sources and technologies as well as the protection of defence-related critical energy infrastructure. Taken into consideration such an objective, the three working groups of CF SEDSS II (working group 1 "Energy Management including Energy Efficiency", working group 2 "Renewable Energy Sources and Technologies" and working group 3 ""Protection of Critical Energy Infrastructure) revised and updated the related parts of the Guidance Document. Specifically, the working groups:

a) captured the current state of play of the EU MoDs and the armed forces regarding energy, particularly highlighting best practice on:
    - energy management;
    - energy efficiency;
    - renewable energy sources and technologies;
    - protection of defence-related critical energy infrastructure.

b) addressed the annotated articles of the energy-related legislation per thematic area:
    - Energy Efficiency Directive (EED);
    - Renewable Energy Directive (RED);
    - Energy Performance of Buildings Directive (EPBD);
    - Directive on European Critical Infrastructures (ECI); and,
    - whenever relevant, the overarching Regulation on the Governance of the Energy Union and Climate Action.

c) analysed the outcome of questionnaires and surveys concerning the evaluation of the energy-related legislation and directives and the identification of implications for the defence sector;

d) developed defence energy-related projects ideas (including dual-use synergies within the defence and civilian markets) that can act as enablers of military operational capabilities and support the MoDs to address common energy challenges and shortfalls at multi-national, regional and/or cross-border level; and,

e) provided guidance on how to facilitate performance improvement in the upcoming future and enable the MoDs to apply affordable, resilient and sustainable energy models in the defence sector.

As a European Union's Horizon 2020 Coordination and Supporting Action, the Consultation Forum facilitated and promoted over the last two years the exchange of good practice between the defence and energy communities with regard to the promotion of energy efficiency and buildings performance in the defence sector, the utility of renewable energy sources (RES), and the strengthening of the resilience of defence-related critical energy infrastructure. The Forum has successfully implemented its objectives with a positive impact on the efforts of the MoDs to address defence energy-related considerations and on the efforts of the EU to achieve its strategic goals on energy sustainability and energy security. Based on the feedback received from the MoDs, the Forum has enabled several ministries to develop national defence energy strategies, implement energy management systems, increase energy performance of defence building stocks, develop energy efficiency programmes and renewable energy sources projects, increase interest to address risks and vulnerabilities related to hybrid threats as well as stimulate investments in increasing energy efficiency in the armed forces. During Phase II, the Consultation Forum collected more than 30 project ideas, of which 18 were elaborated into comprehensive project proposals (see Appendix). To support their realisation, the Agency applied an internal methodology called "IdentiFunding for Energy" which matched such ideas with more than 30 eligible funding opportunities, enhancing the probability of their implementation through joint multinational collaborations. The emphasis provided by EDA in this activity demonstrates the commitment of the Agency to meet the expectation of the MoDs in producing tangible results.

The close cooperation with the European Commission and in particular with DG ENER and EASME proved beneficial to build a strong defence energy community and convince Member States (MS) to discuss and cooperate on relevant issues. Likewise, the extensive participation of on average 130 experts coming from 27 European countries and more than 20 different institutions and organisations, combined with the resulting high-quality of the deliverables, demonstrate that sustainable energy matters for defence and a greener defence energy matters for the EU. Overall, the Consultation Forum confirmed to be a model of how EDA performs simultaneously its triple mission of prioritisation, support platform to capability and technology projects and central operator and interface with the Commission and other Agencies in accordance with its mission statement updated by the Long-Term Review Conclusions and Recommendations endorsed by the Ministers of Defence. As a result, the successful work of the Consultation Forum is acknowledged in the June 2019 "Council Conclusions on Security and Defence in the context of the EU Global Strategy", where the EU Ministers of Foreign Affairs and Defence welcomed all the progress achieved in the context of the Consultation Forum and invited the EU Member States, the European External Action Service (EEAS), the European Commission and EDA "*to develop concrete solutions within the defence sector for safe and sustainable energy models leading to increased resilience and operational efficiency also in the context of climate change…*".

Following the approval of EDA participating Member States (pMS), this document is available to the EU MoDs and the related armed forces, and also Denmark, Norway, Switzerland and Serbia as well as targeted stakeholders with a view to share best practices and fill gaps in knowledge. As the field of energy sector evolves, this document may need to be attuned. Thus, it must be seen as a 'living' and non-binding document, up-to-date with lessons learned and experiences gained. In this regard, the present Guidance Document does not entail any future commitment for the participating MoDs, the EU institutions and agencies. However, it provides the framework for the formation of multi-national collaborations at the European level to help the MoDs addressing common considerations, applying energy improvements and interventions and moving towards a decarbonised defence future, while strengthening the EU energy security.

INTRODUCTION

As the EU is moving towards a resilient Energy Union aiming at enhancing its energy autonomy and security, the role of defence in this transition becomes vital. Improving energy efficiency and diversifying the energy supply will enhance European Union's resilience to security challenges, while enabling the defence sector to reduce both the energy footprint and costs. The defence sector demonstrated its willingness to transit to a cleaner, safer and more sustainable energy models and produce solutions, which will contribute to the European Union's strategic long-term vision for a prosperous, modern, competitive and climate neutral economy by 2050. The present Guidance Document supports the ongoing efforts of the MoDs to examine further how energy efficiency measures, renewable energy sources and technologies, as well as protection of critical energy infrastructure considerations might be better implemented or applied within the European defence and security sector. In this respect, the scope of the present Guidance Document is to both provide an overview of the results of the Phase II of CF SEDSS and introduce recommendations targeting the EU MoDs and relevant defence stakeholders which, building upon such results and the know-how gathered, will further support the transition towards sustainable and resilient energy models. While presenting past activities and setting future directions, the scope of the Guidance Document is to also fill previous gaps in knowledge while sharing best practice and innovative information.

Particularly, the first objective of the Guidance Document is to showcase the research and the activities of working group 1 "Energy Management including Energy Efficiency"; working group 2 "Renewable Energy Sources and Technologies (RES)"; and working group 3 "Protection of Critical Energy Infrastructure (PCEI)". Second, the Document presents recommendations to the EU MoDs through the identification of a series of proposed actions and recommendations in order to promote a greener defence. Such recommendations consider energy interventions in areas such as zero-emissions buildings, renewables for the defence sector, and the protection of defence-related critical energy infrastructures (CEI). To be successfully implemented, the roadmap will need to follow and be in line with the fast-paced developments of the energy-related legislation, policies, projects, and research in the European Union. Consequently, the Guidance Document, as a living document, is going to be reviewed, updated, and further improved during the upcoming years of Phase III (2019-2023).

The Guidance Document is structured as follows:

- **Section 1** analyses the context and strategic drivers through the examination of global trends in relation to energy security; the defence context of energy; the management of energy as a military capability; the energy strategy and policy; and the EU energy legislation;

- **Section 2** summaries the achievement of the three (3) working groups throughout the duration of Phase II with regard to energy management including energy efficiency, renewable energy sources and technologies, and protection of critical energy infrastructure;

- **Section 3** presents recommendations related to the specific energy activities of the three (3) working groups;

- **Section 4** describes the *IdentiFunding* methodology, the European Funding Gateway for Defence Energy, the Structural Reform Support Programme, and explores the opportunities for access to European funding. Moreover, it presents the defence energy-related projects ideas, which have been developed by the working groups. More information on the project ideas can be found in the Appendix of this document.

The content of the Guidance Document is the result of the combined efforts, knowledge, and experience of the participants of CF SEDSS II. Among the delegates of the MoDs, significant was the contribution of working groups' team leaders, moderators, and national contact points (NCPs) who, liaising with all MoDs' representatives, ensured a coherent, up-to-date and innovative input to the document. In addition to the 24 EDA pMS along with Denmark, essential collaboration came also from third countries such as Serbia and the members from the European Free Trade Association (EFTA), Switzerland and Norway. The interaction between the EU MS and the third countries enabled sharing of best practices and expertise to identify how to address common energy challenges while avoiding duplications. A strong support from the European Commission, and in particular from both DG ENER, EASME, the Joint Research Centre (JRC) and the Structural Reform Support Service (SRSS), ensured not only further exploration of the link between defence and energy, but also support to EDA in the contribution to an EU long-term perspective on EU energy legislation, policy and action plans. To be acknowledged is also the involvement of experts and professionals coming from academia, industry, and research and technology organisations (RTOs). The collaboration of such stakeholders helped EDA and the governmental professionals to keep track with the cutting-edge developments and good practices at the research, technological, and industrial level. Finally, to ensure coherence and avoid any duplication, the Agency has always invited representatives and experts from NATO in the CF SEDSS II activities.

Topics covered throughout the duration of CF SEDSS II from October 2017 to July 2019, including the four (4) plenary meetings and the activities that took place in between, are herein presented. Such topics include but are not limited to energy management, energy efficiency, RES, PCEI and financial considerations. Among these topics, the contributions in energy management and energy efficiency including policies, strategies, processes, roadmaps, methodologies and tools to improve energy performance constitute the framework for implementation of RES and PCEI, thus justifying their length in the document. On the basis of such topics, reference material was generated throughout the 22-month duration of CF SEDSS II, ranging from the global strategic context for energy as well as the defence context for energy, the purpose and scope of EU energy legislation, and a selection of available delivery tools and techniques.

With a view to implement the recommendations as drafted in this Guidance Document, transitions will need to take place at both the tactical and strategic level. Internationally agreed frameworks, adaptable to specific requirements of MoDs and armed forces in terms of regional needs or site-specific considerations, may be of interest for implementation. For example, the application of ISO 50001 on energy management systems (EnMS) is a relevant case as it has been increasingly adopted by a growing number of MoDs, after the civilian application. Such standardisation procedure is profitable in terms of energy performance, cost, and operational control performance. At the same time, there is also an omnipresent need to put in place a cultural shift so that energy is considered in all relevant aspects of military capability planning and operations (including defence infrastructure) to become the norm. Energy management has to be integrated within defence operational decision making. While the importance of implementing a structured approach through energy management system at the tactical level (i.e. building or site) is recognised, advancements will need to take place also at the strategic, policy, and educational levels through developments which will aim at raising expertise and awareness among all stakeholders involved. Such progress, covering both the strategic and tactical dimensions, will ultimately lay the foundations for a more sustainable energy future of the defence and security sector in the medium-to-long term.

The European Defence Agency and the Ministries of Defence acknowledge the momentum of the sustainable leap and are ready not only to welcome it but to steer it further. In June 2019, "*Council Conclusions on Security and Defence in the context of the EU Global Strategy*" (doc. 10048/19,

par. 49)[1] called "*for strengthening cooperation in tackling energy security challenges, including via energy efficiency, renewable energy solutions and the protection of critical energy infrastructure*". The Council of the EU, which adopted the Conclusions, welcomed "*all progress achieved in the context of the Consultation Forum on Sustainable Energy in the Defence and Security Sector (CF SEDSS) since its launch in 2016*" and expressed its expectation for the next phase. The Council also invited the EU Member States, the EEAS, the European Commission and EDA "*to develop concrete solutions within the defence sector for safe and sustainable energy models leading to increased resilience and operational efficiency also in the context of climate change…*". A few days after the Council Conclusions, the European Council adopted on 20 June 2019 *A New Strategic Agenda*[2] for the EU for the years 2019-2024, stressing that the "*EU will accelerate the transition to renewables, increase energy efficiency, reduce dependence on outside sources, diversify its supplies, and invest in solutions for the mobility of the future*."

The increased interest of the EU Member States for the energy domain and in particular of the EU Ministers of Foreign Affairs and Defence, who adopted for the first time Council Conclusions with specific reference to the work of the Agency in the CF SEDSS, already created the common ground for further actions. On 4 July 2019, the EU Member States' ambassadors in the Political and Security Committee (PSC) explored the linkage of the climate change with EU defence and acknowledged the substantial role of the CF SEDSS in enabling cooperation among different actors on relevant work strands in the defence-energy area[3]. Following the PSC, the permanent Military Representatives at the European Union Military Committee (EUMC) invited the Agency to present on 9 July 2019 its contribution in assisting the EU MoDs and the armed forces to reduce energy footprint and costs and increase their energy resilience and autonomy. Likewise, the EUMC welcomed the work of the Agency and in particular of CF SEDSS II and expressed interest for the future work of the Consultation Forum.

To address the emerging and future challenges in the field of energy as well as to meet the expectations of the Council of the EU, and consequently of the EU MoDs, the Agency in collaboration with DG ENER and EASME will further intensify its efforts to assist the relevant defence stakeholders to further advance the transition towards more affordable, sustainable and resilient energy models. In this regard, phase III of the Consultation Forum (2019-2023) will be developed in a way to contribute to the implementation of the EU's objectives in building a secure, competitive, and sustainable Energy Union and executing an Energy Security Strategy. Therefore, Phase III will continue pursuing the implementation of the EU legal framework on energy and will reaffirm the Consultation Forum as an appropriate vehicle to address at the European level common energy considerations in the defence and security sectors.

[1] Council Conclusions on Security and Defence in the context of the EU Global Strategy" (doc. 10048/19, par. 49).
[2] European Council - Council of the European Union, "A new strategic agenda 2019-2024", available at: https://www.consilium.europa.eu/en/press/press-releases/2019/06/20/a-new-strategic-agenda-2019-2024/
[3] Council of the European Union, European External Action Service WORKING PAPER Climate change and EU Defence: Guiding Questions WK 7951/2019 INIT, Brussels, 01 July 2019.

SECTION 1: CONTEXT AND STRATEGIC DRIVERS

Section 1 introduces the background that frames the developments in the defence energy domain. Particularly, it explores trends in the energy security field, including EU legislation, strategy, as well as the defence context for energy in terms of security of supply, cost and environmental impact, associated defence vulnerabilities and resilience opportunities.

1.1 Global trends in relation to energy

Until 2050, while hydrocarbons are likely to remain the most significant sources of energy, renewable sources will need to make an increasing contribution both to help to control costs but also to improve the security of supply and enhance energy independence and maintain economic prosperity and well-being. At the same time, economies will need to enhance energy efficiency to ensure that expensive and limited hydrocarbon resources are used in the most efficient manner. Such changes in megatrends are already having significant implications for economic and societal development, not least increasing the demand for equal access to housing and sanitation, but also to natural resources including raw materials, food, water, and energy. To manage human needs more sustainably, governments need to be able to understand and interpret the trends and to implement effective action. The defence sector is no different to any other sector of society in this respect. Therefore, it is becoming increasingly essential for defence to take into consideration existing and emerging megatrends in defence planning.

Energy security is a key element for Europe[4]. Member States support energy infrastructure projects to increase energy security and respond to the growing energy demand in the EU. As set out in the "Protection of Critical Energy Infrastructure (PCEI) Conceptual Paper",[5] the geopolitics of energy plays a key role in cementing better relationships with other countries and vice versa: smooth relations among states contribute positively to excellent cooperation in the energy sector. It is also obvious that geographical location is crucial in itself in meeting the above-mentioned needs of security in the energy sector, and prosperity and stability in a wider geographical area. An important feature of the energy sector is the interdependence of energy, as well as the dependence of other sectors on energy. This means that the energy sector as such is uniquely critical for a country and, consequently, an extremely attractive target for threats (terrorist attacks or cyberwarfare). This is not a new threat. Energy-transit countries also need to be well protected from threats from the countries supplying them with energy.

Countries' energy security may also be disrupted by terrorist attacks against critical energy infrastructures (internally and abroad), transit disruptions in key "chokepoints", cyber threats, as well as CBRNe[6] threats, both intentional and accidental. Such transnational risks to energy infrastructure, including cyber security threats, require not just national-level coordination and intelligence-sharing among governmental agencies, industrial players and local communities, but also harmonisation of procedures, in the form of a regional framework, among various countries.

Geopolitical considerations in the energy sector may also take the form of a country's *ability to contribute to the diversification of routes and sources*. Gas-transit countries fall into this category. The more pipelines that are installed in a country, or are interconnected with each other, the more diversified the route. However, an abundance of routes is not the only ingredient of energy security; the availability of a multitude of sources must also be taken into account. Multiple energy sources in combination are vital to energy security - and especially within volatile geopolitical contexts. This

[4] EUROPEAN COMMISSION (2014) "European Energy Security Strategy", (COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL, Brussels, 28.5.2014), http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0330&from=EN

[5] European Defence Agency, *Protection of Critical Energy Infrastructure (PCEI)*, Brussels, October 2017, available at: EDA, EDEN website, https://www.eda.europa.eu/european-defence-energy-network/phase-I/deliverables This document was developed during the CF SEDSS Phase I.

[6] Chemical, Biological, Radiological, Nuclear and Explosive.

implies that the EU energy market is not dependent on one primary source, or a single energy supplier. This diversification contributes to market stability.

Diversification of energy supply, however, requires sophisticated and complex infrastructure, with emphasis on cross-border infrastructure projects which meet international standards of energy security. For example, design specifications for natural disasters tolerance, technical and operational specifications which mitigate the threat of disastrous accidents, and security measures of the highest standards to deal with the threats of terrorist attacks or cyberwarfare. As a consequence, it is important that a country's relations with its neighbours enhance the stability of a wider region, thus becoming a bridge of nations with common interests in the energy sector. This could make specific countries' energy infrastructure more vulnerable (in the sense of it being critical), but robust bilateral relations and participation of those countries in multilateral mechanisms can reassure the energy community regarding the safety and security of energy supply across and within those countries' borders.

1.2 Defence context for energy

On 17 June 2019, the Council of the EU (ministers of foreign affairs and ministers of defence) adopted the *Council Conclusions on Security and Defence in the context of the EU Global Strategy*[7]. For the first time since the initiation of the CF SEDSS II, the ministers acknowledged the work and the results achieved by Consultation Forum. Under the section "Energy Challenges" in paragraph 49, the Council (ministers):

> *Calls for strengthening cooperation in tackling energy security challenges, including via energy efficiency, renewable energy solutions and the protection of critical energy infrastructure.*
>
> *Welcomes all progress achieved in the context of the Consultation Forum on Sustainable Energy in the Defence and Security Sector (CF SEDSS) since its launch in 2016 and looks forward to the next phase of the CF SEDSS as announced in Bucharest on 12 June 2019.*
>
> *Invites Member States, the EEAS, the Commission and the EDA to develop concrete solutions within the defence sector for safe and sustainable energy models leading to increased resilience and operational efficiency also in the context of climate change in line with relevant Council conclusions.*

With the adoption of the Council Conclusions and particularly the energy -related paragraph, the CF SEDSS have now an even greater opportunity to further deepening the work, the commitments, and the projects in line with the decision of the Council of the EU. Furthermore, the European Council has adopted on 20 June 2019 a new strategic agenda for the EU for the years 2019-2024 stressing that the "*EU will accelerate the transition to renewables, increase energy efficiency, reduce dependence on outside sources, diversify its supplies, and invest in solutions for the mobility of the future*." This momentum, as presented in the introduction, enabled relevant discussions at the PSC and EUMC which is expected to be further intensified in the next coming months.

It is important to recognise that the concept of international and national security is very different now from what it was ten or twenty years ago. There is a growing recognition that there are new and emerging threats to global stability and security at both international and national levels. New threats can emanate from states, but also from non-state actors such as terrorists (home-grown or overseas), insurgents and criminals, and from the limited access to natural resources, as the security of our energy supplies increasingly depends on fossil fuels located in some of the most unstable parts of the planet.

The EU Global Strategy, published in June 2016, sets out that amongst other threats climate change and energy insecurity endanger our people and territory, while wider environmental

[7] https://www.consilium.europa.eu/en/meetings/fac/2019/06/17

stresses could exacerbate potential conflict, in light of their impact on desertification, land degradation, and water and food scarcity.

> *The EU Global Strategy starts at home. Over the decades, our Union has enabled citizens to enjoy unprecedented security, democracy and prosperity. We will build on these achievements in the years ahead. Yet today terrorism, hybrid threats, climate change, economic volatility and energy insecurity endanger our people and territory.*
>
> *The Energy Union represents an integrated effort to work on the internal and external dimensions of European energy security. In line with the goals of the Energy Union, the EU will seek to diversify its energy sources, routes and suppliers.*
>
> *EU Global Strategy June 2016*

Whilst environmental pressures are unlikely to result in the need for new military capabilities, they are likely to impact on where armed forces are deployed and the way in which they operate now and in the future. Operating in increasingly hostile environments with potential energy and water shortages could increase energy demand and trigger the need for new advanced materials to cope with tougher conditions, shaping our capability requirements and budgets. It will be necessary for the defence sector to ensure that there are sufficient units at the appropriate availability, and the impact of climate change and resource security will need to be managed throughout the supply chain to ensure that risks to the secure supply of materials, energy, and labour are managed and military capabilities maintained. Therefore, it is essential to ensure that Europe's armed forces have the appropriate capabilities to deliver their missions and that they are able to operate in a sustainable and resilient manner. This means to integrate sustainability principles into defence acquisition and military planning and support the defence sector to gradually benefit from a move towards a low carbon and circular economy.

Finding innovative and sustainable solutions to improve the energy performance of military equipment can contribute to enhancing military capability while helping to manage through-life cost and other risks. For instance, by increasing the energy/fuel efficiency of military equipment, by integrating renewable and alternative energy/fuel systems into power source mixes, and by monitoring and managing energy requirements, the defence sector can reduce through-life cost risks. Increased energy efficiency and the integration of renewable energy sources will also result in enhanced mission endurance and freedom of action as increased capability can be achieved through using less energy to deliver the same military effect for extended periods of time. At the same time vulnerability to attrition and associated risk to life and equipment can also be reduced as a result of fewer fuel re-supply convoys moving across hostile environments. Consequently, there is a need for the defence sector to become more efficient with the energy resources which it consumes as well as to minimise its dependence on fossil fuels, through the implementation of energy efficiency and renewable energy production technologies, and policy and behavioural interventions. This requirement applies during peace time (homeland) as well as during deployments.

1.3 Managing Energy as a Military Capability

Often future energy demand is not properly factored into capability planning stages, and opportunities for efficient consumption are rarely investigated; *energy is treated as a commodity rather than as a capability in its own*. For infrastructure capability, this means setting requirements which are focused on delivering resilient defence infrastructure which is capable of continuing to provide the backbone of Europe's military forces now and in years to come. This will have

implications for how infrastructure is designed and managed as well as how that infrastructure is supplied with energy sustainably to meet the required demand. Therefore, it requires understanding energy demand by applying effective management systems both through procurement activities for new buildings, for refurbishment projects, and throughout the lifespan of the building and other infrastructure assets.

To achieve these strategic objectives requires having access to, and exploiting, appropriate knowledge, tools and techniques and applying them at the appropriate operational and tactical levels. As with all management change, such a transition to a sustainable energy future in the defence sector should be facilitated by adopting a systematic approach. For instance, through the application of recognised standards, such as the ISO 50001 energy management systems, the MoDs can put in place a series of required mechanisms in a more structured format. This includes having policies in place, ensuring commitment from senior management, and having appropriate monitoring, recording, and data analysis tools in order to define where efforts should be focused on and where the greatest return on investment can be achieved. This needs also to be underpinned by a proper management system and audit regime.

Obviously, results cannot be achieved purely through paper trails as having suitable qualified and experienced personnel employed is another critical factor. To address the energy challenges in the defence sector requires several actions such as the need to train the staff in all elements of energy management and to raise certain level of awareness amongst key staff across all of the functions of MoDs and armed forces in order to ensure that energy is managed alongside other key priorities for defence. As such, energy should be regarded as fundamental to the delivery of military needs as much as any other capability: ***it should be treated as a capability in its own and as a capability multiplier across the defence and security landscape.*** Likewise, energy provision should be seen as an enabler to any other key military capabilities, allowing armed forces to operate continuously at both the tactical, operational and strategic levels. It is therefore important to develop and implement a coherent defence energy policy as without it, energy supply could be subject to several hybrid threats, thereby negatively impacting operational capability at every level and reducing the effectiveness of any possible response.

1.4 EU Climate and Energy Framework: Energy Strategy and Policy – the Energy Union

The European Union's energy policies[8] are driven by three main objectives:

- Securing energy supplies to ensure the reliable provision of energy whenever and wherever it is needed;
- Ensuring that energy providers operate in a competitive environment that ensures affordable prices for homes, businesses, and industries;
- Expecting our energy consumption to be sustainable, through the lowering of greenhouse gas emissions, pollution, and fossil fuel dependence.

These goals will help the EU to tackle its most significant energy challenges. Among these, our dependence on energy imports is a particularly pressing issue, with the EU currently importing over half its energy at the cost of €350 billion per year. Other important challenges include rising global demand and the scarcity of fuels like crude oil, which contribute to higher prices. In addition, the continued use of fossil fuels in Europe is a cause of global warming and pollution.

Key policy areas that will help achieve such goals include:

- A European Energy Union that will ensure secure, affordable and clean energy for EU citizens and businesses by allowing a free flow of energy across national borders within the

[8] https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union

EU, and bringing new technologies and renewed infrastructure to cut household bills, create jobs and boost growth;

- A **European Energy Security Strategy** which presents short and long-term measures to shore up the EU's security of supply;
- A **resilient and integrated energy market** across the EU - the internal energy market. To this end, new pipelines and power lines are being built to develop EU-wide networks for gas and electricity, and common rules are being designed to increase competition between suppliers and to promote consumer choice;
- Boosting the **EU's domestic production of energy**, including the development of renewable energy sources;
- Promoting **energy efficiency**;
- **Safety across the EU's energy sectors** with strict rules on issues such as the disposal of nuclear waste and the operation of offshore oil and gas platforms;
- Enhance and augment **protection of critical energy infrastructure** as a strategic asset for EU security.

To pursue these goals within a coherent long-term strategy, the EU has formulated targets for 2020, 2030, and 2050.

2020 Energy Strategy

The 2020 Energy Strategy defines the EU's energy priorities between 2010 and 2020. It aims to:

- reduce greenhouse gases by at least 20%;
- increase the share of renewable energy in the EU's energy mix to at least 20% of consumption;

EU countries have agreed that the following objectives should be met by 2030:

- a binding EU target of at least a 40% reduction in greenhouse gas emissions by 2030, compared to 1990;
- a binding target of at least 27% of renewable energy in the EU;
- an energy efficiency increase of at least 27%, to be reviewed by 2020 with the potential to raise the target to 30% by 2030;
- the completion of the internal energy market by reaching an electricity interconnection target of 15% between EU countries by 2030, and pushing forward important infrastructure projects.

Together, these goals provide the EU with a stable policy framework on greenhouse gas emissions, renewables and energy efficiency, which gives investors more certainty and confirms the EU's lead in these fields on a global scale.

The EU aims to achieve an 80% to 95% reduction in greenhouse gases compared to 1990 levels by 2050. Its Energy Roadmap 2050 analyses a series of scenarios on how to meet this target.

The EU has already made important progress towards meeting its targets:

- The first 'state of the Energy Union' report from November 2015 showed that much progress had been made since the adoption of the Energy Union in February 2015, and 2016 was a key year of delivery;

- Between 1990 and 2012, the EU cut greenhouse gas emissions by 18% and was well on track to meet the 2020 target;
- In 2014, the projected share of renewable energy in the gross final energy consumption was 15.3%, up from 8.5% in 2005;
- The renewable energy progress report from 2015 states that 25 EU countries were expected to meet their 2013/2014 interim renewable energy targets;
- Energy efficiency is predicted to improve by 18% to 19% by 2020 – barely missing the 20% target. However, if countries implement all the necessary EU legislation, the target should be reached.

2050 Energy Strategy

The EU has set itself a long-term goal of reducing greenhouse gas emissions by 80-95%, when compared to 1990 levels, by 2050. The Energy Roadmap 2050 explores the transition of the energy system in ways that would be compatible with this greenhouse gas reductions target while also increasing competitiveness and security of supply. To achieve these goals, significant investments need to be made in new low-carbon technologies, renewable energy, energy efficiency, and grid infrastructure. Since investments are made for a period of 20 to 60 years, policies that promote a stable business climate which encourages low-carbon investments must start being made today.

Energy Roadmap

The European Commission's 2011 Energy Roadmap set out four main routes to a more sustainable, competitive and secure energy system in 2050: energy efficiency, renewable energy, nuclear energy, and carbon capture and storage. It combined these routes in different ways to create and analyse seven possible scenarios for 2050.

Conclusions of the analysis:

- Decarbonising the energy system is technically and economically feasible. In the long run, all scenarios that achieve the emissions reduction target are cheaper than the continuation of current policies;
- Increasing the share of renewable energy and using energy more efficiently are crucial, irrespective of the particular energy mix chosen;
- Early infrastructure investments cost less, and much of the infrastructure in the EU built 30 to 40 years ago needs to be replaced anyway. Immediately replacing it with low-carbon alternatives can avoid more costly changes in the future. According to the International Energy Agency, investments in the power sector made after 2020 would cost 4.3 times as much as those made before 2020;
- A European approach is expected to result in lower costs and more secure energy supplies when compared to individual national schemes. With a common energy market, energy can be produced where it is cheapest and delivered to where it is needed.

The EU produces market projection reports for 2030 and 2050 based on current trends and policies. They include information on possible energy demand, energy prices, greenhouse gas emissions and other potential developments.[9]

[9] Energy trends up to 2050

The Evolution of the Energy Security within the EU

The generally accepted definition of energy security, also operational at the level of the EU, is the one proposed by the International Energy Agency (IEA). The IEA[10] defines energy security as the uninterrupted availability of energy sources at an affordable price. It distinguishes between long-term energy security mainly dealing with timely investments to supply energy in line with economic developments and environmental needs, and short-term energy security focusing on the ability of the energy system to react promptly to sudden changes in the supply-demand balance. In line with the IEA, the EU sees the energy security as "diverse, affordable, and reliable energy".[11]

Energy framed as a security issue reached the EU agenda only in the 2000s. The previous years had been marked by a liberal understanding of energy mainly in terms of trade, interdependence, market logic and economics. With the beginning of the 2000s however, in the context of a change of self-perceptions regarding the EU's degree of dependence and vulnerability to energy imports, the EU enlargement, the occurrence of several energy supply disruptions, and the decrease in the EU's internal production, security of supply gained larger political acknowledgment and energy security entered the political agenda of the EU and of the Member States, albeit to a varying degree and submitted to different interpretations.

The EU's concern for its energy dependence and vulnerability is clearly reflected in the change of discourse with respect to energy. Thus, energy security and dependence as such have been specifically mentioned starting with the *Green Paper* of 2000[12] and reiterated in the following years in various EU documents, such as the *European Security Strategy* of 2003, the *Green Paper* of 2006[13], or the *Second Strategic Energy Review* of 2008[14]. Although energy has become a security component for the EU, nevertheless, the UE aim will have to focus on cooperation and interdependence, rather than energy dependence.

The evolution of energy as security for the EU has taken place in the context of the EU enlargement in 2004, with some of the new Member States, in Central and Eastern Europe, displaying both a very high dependence on hydrocarbons imports, as well as a more defensive tone in the relationship with Russia as single supplier. In this context, the political voice of the new Member States and their higher concerns for energy dependence and vulnerability have been soon reflected in the evolution of the EU's approach to energy security. The 2006 and 2009 gas disputes between Ukraine and Russia which led to temporary interruptions of gas supply to the EU consumers, further enhanced the call for a more security-oriented approach to energy on the part of the EU.

At the same time however, a global trend of expanding the security agenda to include new topics and actors has been taking place. As a consequence, in the recent years, the political action for providing a secure energy within the EU went beyond traditional concerns related to the security of supply and included preoccupations for clean and renewable sources of energy, climate change and environment protection.

The *Energy Union* aims at making energy more secure, affordable and sustainable, facilitating the free flow of energy across borders and a secure supply in every EU country, for every European citizen, while also leading to a sustainable, low carbon and environmentally friendly economy[15].

[10] https://www.iea.org/topics/energysecurity/

[11] https://ec.europa.eu/energy/en/topics/energy-security

[12] Green Paper on the security of energy supply, 29 November 2000, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM%3Al27037

[13] http://europa.eu/documents/comm/green_papers/pdf/com2006_105_en.pdf

[14] COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0781:FIN:EN:PDF

[15] https://ec.europa.eu/commission/priorities/energy-union-and-climate_en

The Energy Union is focused on five dimensions[16]:

- Security, solidarity and trust. This dimension in particular emphasises the importance of diversification of energy sources, suppliers and routes, cooperation among Member States, a stronger European role in global energy markets, and an increased transparency on gas supply contracts[17];
- A fully integrated internal energy market;
- Improved energy efficiency;
- Decarbonising the economy;
- Supporting breakthroughs in low-carbon and clean energy technologies by prioritising research and innovation.

The EU's Current Energy Strategy and Approach to Energy Security

At present, the EU imports 55% of all the energy it consumes, while energy represents around 15% of total EU imports. Specifically, the EU imports[18]:

- 87% of its crude oil
- 70% of its natural gas
- 40% of its solid fossil fuels
- 40% of enriched and manufactured nuclear fuels

Security of energy supply is therefore an integral part of the EU´s energy strategy. In 2015 the Commission adopted the Energy Union strategy.[19]

The EU approach to energy security takes into account risks that include disruption from countries from which the EU imports fuel, but also extreme weather, industrial hazards, cyberattacks, terrorism and hybrid threats. For the EU, increasing resilience is grounded on solidarity and regional cooperation, as well as speaking with one voice internationally when dealing with supplier countries.

The Energy Union builds on the *2030 Framework for Climate and Energy*[20] and *the European Energy Security Strategy*[21].

2030 Framework for Climate and Energy:

The Framework agreed upon in October 2014 by the European Council establishes targets and policy objectives for the period between 2020 and 2030, aiming at helping the EU achieve a more competitive, secure and sustainable energy system and meet its long-term 2050 greenhouse gas reductions target. It strives to encourage private investment in new pipelines, electricity networks, and low-carbon technology[22].

[16] https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/building-energy-union
[17] http://www.europarl.europa.eu/RegData/etudes/BRIE/2015/551310/EPRS_BRI(2015)551310_EN.pdf
[18] https://ec.europa.eu/energy/en/topics/energy-security
[19] https://ec.europa.eu/energy/en/topics/energy-security
[20] https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/2030-energy-strategy
[21] https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/energy-security-strategy
[22] https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/2030-energy-strategy

1.5 EU Energy Legislation relevant to Defence – the Clean Energy for All Europeans Package

The EU has agreed a comprehensive update of its energy policy framework to facilitate the transition away from fossil fuels towards cleaner energy and to deliver on the EU's Paris Agreement commitments for reducing greenhouse gas emissions. The completion of this new energy rulebook – called the Clean Energy for all Europeans package - marks a significant step towards the implementation of the energy union strategy, adopted in 2015. Based on Commission proposals published in November 2016, the Clean Energy for all Europeans package consists of eight legislative acts. After political agreement by the Council and the European Parliament in 2018 and early 2019, enabling all the new rules to be in force by mid-2019, EU countries have 1-2 years to transpose the new directives into national law. The changes will bring considerable benefits from a consumer perspective, from an environmental perspective, and from an economic perspective. It also underlines EU leadership in tackling global warming and provides an important contribution to the EU's long-term strategy of achieving carbon neutrality by 2050.[23]

This section provides an overview of the legislation covered in the Consultation Forum: the Energy Efficiency Directive (EED); the Energy Performance of Buildings Directive (EPBD); the Renewable Energy Directive (RED); and the European Critical Infrastructure (ECI) Directive. Since the new versions of the directives are fairly new and have not yet been adopted by the MS, they were not yet taken into account in the activities of Phase II. However, the Guidance Document already acknowledges and takes into consideration the revisions of the directives. The Consultation Forum will further work on and align with the respective activities in Phase III.

Energy Efficiency Directive (EED)

Putting energy efficiency first is a key objective in the Clean Energy for all Europeans package, as energy savings are the easiest way of saving money for consumers and for reducing greenhouse gas emissions. In 2012, under the *Energy Efficiency Directive 2012/27/EU*[24], the EU set a 20% energy savings target by 2020 (when compared to the projected use of energy in 2020) – this is roughly equivalent to turning off 400 power stations. In December 2018, the revised Energy Efficiency Directive entered into force (amending Directive EU (2018/2002) updating some specific provisions and introducing some new elements. Above all, it establishes a headline EU energy efficiency target for 2030 of at least 32.5% (compared to projections) with a clause for a possible upwards revision by 2023. Under the new Governance rules, Member States were required to draft by the end of 2018 their 10-year integrated National Energy & Climate Plans (NECPs) for 2021-2030, outlining how Member States will meet the 2030 targets for energy efficiency and for renewable energy.

In this context, the EU has adopted a number of measures to improve energy efficiency in Europe. They include[25]:

- an annual reduction of 1.5% in national energy sales;
- EU countries making energy efficient renovations to at least 3% of buildings owned and occupied by central governments per year;
- mandatory energy efficiency certificates accompanying the sale and rental of buildings;
- minimum energy efficiency standards and labelling for a variety of products such as boilers, household appliances, lighting and televisions (ecodesign);
- the preparation of National Energy Efficiency Action Plans every three years by EU countries;

[23] https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/clean-energy-all-europeans
[24] Energy Efficiency Directive: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1399375464230&uri=CELEX:32012L0027 Amending Energy Efficiency Directive (EU) 2018/2002: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2018.328.01.0210.01.ENG
[25] https://ec.europa.eu/energy/en/topics/energy-efficiency

- the planned rollout of close to 200 million smart meters for electricity and 45 million for gas by 2020;
- large companies conducting energy audits at least every four years;
- protecting the rights of consumers to receive easy and free access to data on real-time and historical energy consumption;
- guidelines on good practice in energy efficiency published by the Commission.

Snapshot of discussion during the CF SEDSS:

A number of key articles of EED were reviewed during the CF SEDSS. In particular, discussion among MoDs was on:

EED Article 4 – Building Renovation[26]: requiring MS to define long-term strategies for stimulating renovations (in particular, cost-effective deep renovations) in their building sector, in order to increase with immediate effect the historically low renovation rates, and ultimately reduce significantly the energy consumption of the building stock by 2050.

EED Article 5 – Exemplary role of Public Bodies' buildings complementing the Energy Performance of Buildings Directive (EPBD) by setting a specific renovation target of an annual 3% (calculated on the total floor area of heated/cooled buildings with a total useful floor area over 250 m2) for public buildings owned and occupied by its central government, which are required to be renovated to meet at least the national minimum energy performance requirements set in application of Article 4 of the EPBD, with exemptions applying to many of the MoD's typical building types or categories:

(a) buildings officially protected as part of a designated environment, or because of their special architectural or historical merit, in so far as compliance with certain minimum energy performance requirements would unacceptably alter their character or appearance;
(b) buildings owned by the armed forces or central government and serving national defence purposes, apart from single living quarters or office buildings for the armed forces and other staff employed by national defence authorities;
(c) buildings used as places of worship and for religious activities.

EED Article 20 – National Energy Efficiency Fund (NEEF), financing and technical support: which invites (non-binding) MS to establish dedicated financing facilities, such as National Energy Efficiency Funds (NEEFs), or use of existing ones, to support energy efficiency investment.

Energy Performance of Buildings Directive (EPBD)

The Energy performance of buildings directive (EPBD) is, together with the Energy efficiency directive, the main legislative instrument to promote the energy performance of buildings and to boost renovation within the EU. Together, the directives promote policies that will help achieve a highly energy efficient and decarbonised building stock by 2050 and create a stable environment for investment decisions to be taken and that will enable consumers and businesses to make more informed choices for saving energy and money. Buildings are responsible for approximately 40% of energy consumption and 36% of CO2 emissions in the EU, making them the single largest energy consumer in Europe. By improving energy performance in buildings, the EU can more readily achieve its energy and climate goals.

The energy performance in buildings directive (EPBD) outlines specific measures for the building sector to tackle challenges, updating and amending many provisions from the 2010 EPBD. The

[26] https://ec.europa.eu/energy/node/85

EPBD (2010/31/EU) has been in force since 2010 and helps consumers to make informed choices allowing them to save both energy and money. It has also resulted in a positive change of trends in the energy performance of buildings; following the EPBD introduction of energy efficiency requirements in national building codes, buildings of today consume only half as much as typical buildings from the 1980s.

The revised EPBD (2018/844/EU), which amends parts of the 2010 EPBD and introduces new elements, is an important part of the implementation of the EU priorities to build a resilient Energy Union and a forward-looking climate change policy. It was adopted on 9 July 2018 and constituted an important and concrete first delivery of the 'Clean energy for all Europeans' package and sent a strong political signal on the EU's commitment to the clean energy transition, as the building sector has a vast potential to contribute to a carbon-neutral and competitive economy. EU countries have until 10 March 2020 to write the new and revised provisions into national law.

The revised EPBD covers a broad range of policies and supportive measures that will help national governments in the EU boost energy performance of buildings and improve the existing building stock in both a short and long-term perspective. For example, taking both directives together:

- EU countries will have to establish stronger long-term renovation strategies, aiming at decarbonising the national building stocks by 2050, with indicative milestones for 2030, 2040 and 2050, measurable progress indicators and with a solid financial component. The strategy should clearly contribute to achieving the energy efficiency targets, as outlined in the National Energy & Climate Plan (NECP);
- a common European scheme for rating the smart readiness of buildings, optional for EU countries, will be introduced;
- smart technologies will be further promoted, for instance through requirements on the installation of building automation and control systems and on devices that regulate temperature at room level;
- e-mobility will be supported by introducing minimum requirements for car parks over a certain size and other minimum infrastructure for smaller buildings;
- EU countries will have to express their national energy performance requirements in ways that allow cross-national comparisons. These will have to be reviewed every five years and, if necessary, updated;
- health and well-being of building users will be promoted, for instance through an increased consideration of air quality and ventilation;
- all new buildings must be nearly zero-energy buildings (NZEB) from 31 December 2020. (Since 31 December 2018, all new public buildings already need to be NZEB);
- energy performance certificates must be issued when a building is sold or rented, and inspection schemes for heating and air conditioning systems must be established;
- EU countries must set cost-optimal minimum energy performance requirements for new buildings, for the major renovation of existing buildings, and for the replacement or retrofit of building elements (heating and cooling systems, roofs, walls and so on);
- EU countries must draw up lists of national financial measures to improve the energy efficiency of buildings.

In addition to these requirements, under the Energy efficiency directive (2012/27/EU), EU countries must make energy efficient renovations to at least 3% of the total floor area of buildings owned and occupied by central government, and national governments are recommended to only purchase buildings which are highly energy efficient.

To help EU countries properly implement the amendments to the EPBD and to achieve energy efficiency targets, the European Commission has established practical support initiatives called the energy performance of buildings standards (EPB standards), to be managed by the European Committee for Standardisation (CEN). The Commission has further published a recommendation on the building renovation aspects of the new rules.

Renewable Energy Directive (RED)

With a view to showing global leadership on renewables, the EU has set an ambitious, binding target of 32% for renewable energy sources in the EU's energy mix by 2030. The recast renewable energy directive entered into force in December 2018. This revision is not taken into account by the WG2 during Phase II. Applicability to defence will be analysed during Phase III. The original renewable energy directive (2009/28/EC) establishes an overall policy for the production and promotion of energy from renewable sources in the EU. It requires the EU to reach a share of at least 20% of renewable energy in final energy consumption by 2020 – which is to be achieved through the attainment of individual national targets. All EU countries must also ensure that at least 10% of their transport fuels come from renewable sources by 2020. In December 2018, the revised renewable energy directive 2018/2001/EU entered into force, as part of the Clean energy for all Europeans package, aimed at keeping the EU a global leader in renewables and, more broadly, helping the EU to meet its emissions reduction commitments under the Paris Agreement. The new directive establishes a new binding renewable energy target for the EU for 2030 of at least 32%, with a clause for a possible upwards revision by 2023. Since this new version of the Directive is fairly new and has not yet been adopted by the MS, it has not yet been taken into account in this Guidance Document.

National action plans and progress reports

The Directive 2009/28/EC specifies national renewable energy targets for 2020 for each country, taking into account its starting point and overall potential for renewables. These targets range from a low of 10% in Malta to a high of 49% in Sweden.

EU countries set out how they plan to meet these 2020 targets and the general course of their renewable energy policy in national renewable energy action plans.

Progress towards national targets is measured every two years when EU countries publish national renewable energy progress reports.

Cooperation mechanisms

The Directive 2009/28/EC promotes cooperation amongst EU countries (and with countries outside the EU) to help them meet their renewable energy targets. This cooperation can take the form of:

- statistical transfers of renewable energy,
- joint renewable energy projects,
- joint renewable energy support schemes.

Sustainable biofuels

Biofuels and bioliquids are instrumental in helping EU countries meet their 10% renewables target in transport. The Renewable Energy Directive sets out biofuels sustainability criteria for all biofuels produced or consumed in the EU to ensure that they are produced in a sustainable and environmentally friendly manner.

Companies can show they comply with the sustainability criteria through national systems or so-called voluntary schemes recognised by the European Commission.

European Critical Infrastructure (ECI) Directive

Overview

Directive 2008/114/EC aims to the identification and designation of ECI and the assessment of the need to improve their protection. ECI is applicable to MS and to the operators of European critical infrastructure (defined by the Directive as 'critical infrastructures the disruption or destruction of which would significantly affect two or more MS, or a single if the critical infrastructure is located in another MS. This includes effects resulting from cross-sector dependencies on other types of infrastructure')[27].

Relevant Provisions of the ECI Directive

Article 3 - Identification of European Critical Infrastructure

[...]

3. Each Member State shall identify the critical infrastructures located within its territory as well as critical infrastructures outside its territory that may have an impact on it, which satisfy the criteria adopted pursuant to paragraphs 1 and 2.

Each Member State shall notify the Commission of the critical infrastructures thus identified at the latest one year after the adoption of the relevant criteria and thereafter on an ongoing basis.

Article 4 - Designation of European Critical Infrastructure

1. On the basis of the notifications made pursuant to the second paragraph of Article 3(3) and any other information at its disposal, the Commission shall propose a list of critical infrastructures to be designated as European Critical Infrastructures.

[...]

Article 5 - Operator Security Plans

1. Each Member State (MS) shall require the owners/operators of each European Critical Infrastructure located on its territory to establish and update an Operator Security Plan and to review it at least every two years.

2. The Operator Security Plan shall identify the assets of the European Critical Infrastructure and establish relevant security solutions for their protection in accordance with Annex II. Sector specific requirements concerning the Operator Security Plan taking into account existing Community measures may be adopted in accordance with the procedure referred to in Article 11(3).

Acting in accordance with the procedure referred to in Article 11(2), the Commission may decide that compliance with measures applicable to specific sectors listed in Annex I satisfies the requirement to establish and update an Operator Security Plan.

3. The owner/operator of a European Critical Infrastructure shall submit the Operator Security Plan to the relevant MS authority within one year following designation of the critical infrastructure as a European Critical Infrastructure.

[27] ECI Directive in European Union Agency for Network and Information Security (ENISA) website: https://www.enisa.europa.eu/topics/threat-risk-management/risk-management/current-risk/laws-regulation/national-security/eci-directive

Where sector specific requirements concerning the Operator Security Plan are adopted based on paragraph 2, the operator security plan shall only be submitted to the relevant MS authority within 1 year following the adoption of the sector specific requirements.

4. Each MS shall set up a system ensuring adequate and regular supervision of the Operator Security Plans and their implementation based on the risk and threat assessments conducted pursuant to Article 7(1).

5. Compliance with Directive 2005/65/EC of the European Parliament and of the Council of 26 October 2005 on enhancing port security satisfies the requirement to establish an Operator Security Plan.

Article 6 Security Liaison Officers

1. Each MS shall require the owners/operators of European Critical Infrastructures on their territory to designate a Security Liaison Officer as the point of contact for security related issues between the owner/operator of the infrastructure and the relevant critical infrastructure protection authorities in the MS. The Security Liaison Officer shall be designated within one year following the designation of the critical infrastructure as a European Critical Infrastructure.

2. Each MS shall communicate relevant information concerning identified risks and threats to the Security Liaison Officers of the European Critical Infrastructure concerned.

Article 7 Reporting

1. Each MS shall conduct a risk and threat assessment in relation to ECI situated on their territory within one year following the designation of the critical infrastructure as an ECI.

Relevance to the Risk Management/Risk Assessment

The cited articles require MS to identify critical infrastructures on their territories, and to designate them as ECIs. Following this designation, the owners/operators of ECIs are required to create Operator Security Plans (OSPs), which should establish relevant security solutions for their protection.

National authorities are predominantly responsible for the protection of critical infrastructure. However, disruptions to critical infrastructure can be felt across national borders. That is why an EU dimension to help manage these risks is needed. In 2007, the Council of the EU adopted conclusions on a European programme for critical infrastructure protection (EPCIF). This programme aims to improve the protection of critical infrastructures against all types of threats and hazards[28].

Following a review of Directive 2008/114/EC, the Commission, in 2013, set out a new approach towards implementing the European programme for critical infrastructure protection. This aims at building common tools and a common approach in the EU to critical infrastructure protection and resilience, taking better account of interdependencies between critical infrastructures, industry and state actors[29].

Currently Directive 2008/114/EC is undergoing a review following the 2017 Comprehensive Assessment of EU Security Policy[30] that specifically pointed at the need to prepare for attacks on critical infrastructure. The Commission launched an evaluation of Council Directive 2008/114/EC on the identification and designation of European critical infrastructures. The evaluation analyses to what extent the Directive objectives are achieved and assess its effectiveness, efficiency,

[28] Summary of ECI Directive (Directive 2008/114/EC) on EUR-Lex website: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM%3Ajl0013
[29] Summary of ECI Directive (Directive 2008/114/EC) on EUR-Lex website: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM%3Ajl0013
[30] SWD(2017) 278 final

relevance, coherence and EU added value.[31] Building on the outcomes of the 2012 review and in light of the conclusions of the 2017 Comprehensive Assessment of EU Security Policy, the evaluation takes account of the heightened threat from terrorism generally, the emergence of new threats in ways that threaten critical infrastructure, and ongoing efforts in response to possible hybrid activities orchestrated by state and non-state actors. With this public consultation, the Commission seeks to gather the views and concerns of all interested citizens and non-governmental/public/private organizations/entities on the ECI Directive. In doing so, the Commission will be able to gauge the relevance, effectiveness, efficiency, coherence and EU added value of the Directive in supporting the Member States working to protect critical energy and transport infrastructure throughout Europe.[32]

Network and Information Systems (NIS)

Overview

Directive 2016/1148 on security of network and information systems (the NIS Directive) was adopted by the European Parliament on 6 July 2016 and entered into force in August 2016. MS have to transpose the Directive into their national laws by 9 May 2018 and identify operators of essential services by 9 November 2018[33]. It expands the perimeter of recognition of the society's vital sectors that rely heavily on ICTs by including water, banking, financial market, healthcare and digital infrastructure.

The NIS Directive provides legal measures to boost the overall level of cybersecurity in the EU by ensuring:

- MS preparedness by requiring them to be appropriately equipped, e.g. via a Computer Security Incident Response Team (CSIRT) and a competent national NIS authority,
- Cooperation among all the MS, by setting up a cooperation group, in order to support and facilitate strategic cooperation and the exchange of information among MS. They will also need to set a CSIRT Network, in order to promote swift and effective operational cooperation on specific cybersecurity incidents and sharing information about risks,
- A culture of security across sectors which are vital for our economy and society and moreover rely heavily on ICTs, such as energy, transport, water, banking, financial market infrastructures, healthcare and digital infrastructure. Businesses in these sectors that are identified by the MS as operators of essential services will have to take appropriate security measures and to notify serious incidents to the relevant national authority. Also key digital service providers (search engines, cloud computing services and online marketplaces) will have to comply with the security and notification requirements under the new Directive.

1.6 European Strategic Energy Technology Plan

The European Strategic Energy Technology Plan (SET-Plan) aims to accelerate the development and deployment of low-carbon technologies. It seeks to improve new technologies and bring down costs by coordinating national research efforts and helping to finance projects.

The SET-Plan promotes research and innovation efforts across Europe by supporting the most impactful technologies in the EU's transformation to a low-carbon energy system. It promotes cooperation amongst EU countries, companies, research institutions, and the EU itself.

[31] https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2018-1378074_en; file:///C:/Users/gmorandi/AppData/Local/Packages/Microsoft.MicrosoftEdge_8wekyb3d8bbwe/TempState/Downloads/PART-2018-145142V1%20(1).pdf

[32] https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2018-1378074/public-consultation_en

[33] Summary of NIS Directive (Directive 2016/1148) on European Commission website: https://ec.europa.eu/digital-single-market/en/network-and-information-security-nis-directive

The SET-Plan comprises the SET-Plan Steering Group, the European Technology and Innovation Platforms, the European Energy Research Alliance, and the SET-Plan Information System (SETIS).[34]

Accelerating the transformation of Europe's energy system

Research, innovation and competitiveness are one of the five dimensions of the Commission's Energy Union strategy. The integrated SET-Plan is part of a new European energy research & innovation (R&I) approach designed to accelerate the transformation of the EU's energy system and to bring promising new zero-emissions energy technologies to market.

In September 2015, the Commission published a Communication defining the new European research and innovation strategy for the coming years. The Integrated SET Plan builds on the Energy Union strategy and highlights the areas where the EU needs to strengthen cooperation with SET Plan countries and stakeholders to bring new, efficient and cost-competitive low-carbon technologies to the market faster and in a cost-competitive way.

The Integrated SET-Plan:

- Identifies 10 actions for research and innovation, based on an assessment of the energy system's needs and on their importance for the energy system transformation and their potential to create growth and jobs in the EU;
- Addresses the whole innovation chain, from research to market uptake, and tackles both financing and the regulatory framework;
- Adapts the governance structures under the umbrella of the SET-Plan to ensure a more effective interaction with EU countries and stakeholders;
- Proposes to measure progress via overall key performance indicators (KPIs), such as the level of investment in research and innovation, or cost reductions.

The EU Steering Group on Strategic Energy Technologies (SET- Plan Steering Group) consists of high-level representatives from EU countries, as well as Iceland, Norway, Switzerland, and Turkey. It ensures better alignment between the different research and innovation programmes at EU and national level, as well as the SET Plan priorities. It also increases cooperation between national programmes to avoid duplication and heightens the impact of public investment.

European Technology and Innovation Platforms

The European Technology and Innovation Platforms (ETIPs) were created to support the implementation of the SET Plan by bringing together EU countries, industry, and researchers in key areas. They promote the market uptake of key energy technologies by pooling funding, skills, and research facilities.[35]

The platforms:

- ETIP Wind
- ETIP PV
- Ocean Energy Europe
- European Geothermal Energy Council
- The European Innovation Partnership on Smart Cities and Communities Marketplace
- Smart Networks for Energy Transition

[34] https://ec.europa.eu/energy/en/topics/technology-and-innovation/strategic-energy-technology-plan
[35] Ibid

- ETIP on Renewable Heating and Cooling
- European Biofuels Technology Platform
- CCS Platform
- Sustainable Nuclear Energy Technology Platform

European Energy Research Alliance

The European Energy Research Alliance (EERA) aims to accelerate new energy technology development by cooperation on pan-European programmes. It brings together more than 175 research organisations from 27 countries, involved in 17 joint programmes. It plays an important role in promoting coordination among energy researchers along the SET Plan objectives and in the technology transfer to the industry.

European Energy Research Alliance website

SET-Plan Information System

The EU's SET-Plan Information System (SETIS) provides information on the state of low-carbon technologies. It also assesses the impact of energy technology policies, reviews the costs and benefits of various technological options, and estimates implementation costs. This information is useful for the European Industrial Initiatives, private companies, trade associations, the European Energy Research Alliance, international organizations, and financial institutions.[36]

SETIS website

1.7 Impact of CF SEDSS II on MoDs National Energy Defence Strategies

In view of upcoming Phase III and as a result of actions of Phase II, EDA along with the pMS began to keep track of the activities in energy at the level of the MoDs particularly with the aim of understanding if, and to what extent, the CF SEDSS informed, impacted, and enabled the MoDs to move towards sustainable energy models. On such basis, the EDA CF SEDSS Management Team started to gather material as provided by pMS on energy-defence related activities. In line with the performance indicators of the project as set in the Grant Agreement, EDA initiated an activity to measure member states' progress towards sustainable energy models by determining the number of pMS with national defence energy policies/strategies/action plans and projects generated throughout and thanks to the CF. Also in consideration of the premature level of the status quo in defence-energy activities within the Ministries of Defence, input was not yet comprehensively provided by all pMS. However, EDA still deems valuable to include such results in this Guidance Document as part of the efforts of first monitoring the energy developments within the European defence sector, and second providing recommendations. Such information carries the added value of possibly being used as sample by all stakeholders involved, including EDA, the pMS, DG ENER, EASME, JRC, industry, academia, and the RTOs, by providing an up-to-date insight on the current national energy plans.

Particularly, pMS were required to address the following three (3) questions:

1. *Has Phase II influenced/enabled the Ministries of Defence (MoDs) to create or adapt any policy/strategy/action plan (or other energy-related activities) across the defence and security sector?*

2. *Has the MoD developed a national defence energy policy/plan which addresses energy considerations through the use of environmental or energy management systems (EMS or EnMS, PCEI)?*

[36] Ibid.

3. *Has the MoD made any investment for concrete defence-related energy infrastructure projects?*

From the feedback provided by MS, CF SEDSS II supported their efforts to apply sustainable energy to the defence sector and helped the MoDs both in the formulation or development of their energy strategies and implementation of EnMS. More information on such analysis can be found in Section 2.1.3. CF SEDSS II enabled to share experience with EPCs (directly within the CF SEDSS or through bilateral contacts, but initiated thanks to the Forum). This was an occasion for MS to also share inputs from other MoDs on their experience with ISO 50001, used to support EnMS approaches. Many projects related to energy performance were launched by pMS during the period of the CF. They benefited from the information, good practices and exchanges during the Forum.

In addition, increasing the energy performance of defence building stocks (fixed infrastructures) is the current priority of several pMS for strategy implementation. CF SEDSS discussions about energy performance of buildings and other requirements of the EPB directive have accelerated renovation of MoDs buildings to higher energy efficiency grades and energy performance certification. Phase II of the CF SEDSS enabled pMS to reconsider and double-check their projects with regard to energy-related considerations. Phase II has created a good information basis for adapting existing (national/internal) regulations in the energy sector. With regard to investments, some MS have launched renovations of buildings. There were some small projects in the MoDs and armed forces concerning LED lighting, solar panels for heating water and the installation of meters in some buildings. Refurbishment work has also usually included some specific energy efficiency optimization, with both primary energy savings, financial savings, and emissions savings.

For some MS, the Consultation Forum brought real and tangible results, such as monitoring and managing the energy accountabilities of MoD key activities through the application and implementation of an EMAS verified environmental management system at military camps in which include the energy management component in parallel with all the other environmental aspects; integration of ecologically sustainable development (ESD) into the built environment, including development of new facilities and refurbishment of older properties by establishing specific ESD principles and guidelines; energy efficiency programmes and development of renewable energy sources (PV) projects in military camps; dissemination activities to promote environmental and energy management among the MoDs management and personnel; integration of the principles of energy efficiency together with the environmental purchasing into MoD procurement activities in line with the relevant government green procurement policy.

Finally, the CF had a positive impact also in involving third countries including Norway, Switzerland and Serbia. This helped sharing of good practices and expertise while avoiding duplications. The third countries stated that they will certainly take into account any result which is congruent with their strategies and policies and to be supportive for cooperative measures and projects proposed by the CF SEDSS. With regard to implementation of project-ideas, pMS are seeking to gain detailed and promising results from the application of the different projects in order to establish a modern concept for raising energy efficiency in the armed forces. Thus, pMS expressed their firm support for Phase III of the CF SEDSS.

Overall, according to the evaluation provided by MS, the CF proved to be a unique platform which assisted the MoD to generate ideas for defence energy policies, strategies, action plans and defence energy-related project ideas. This process enabled MoD to move towards a more sustainable energy model bringing down energy bills that can be allocated to other military priorities. EDA will keep working on the assemblage of information in Phase III in order to make sure that this is overarchingly supplied by all Member States. Such tracking system will enable EDA to ensure a coherent approach of the initiative, in line with the main strategic directions of the Agency.

SECTION 2: RESULTS OF CF SEDSS II WORKING GROUPS

This section sheds light on the results achieved by the three (3) working groups during Phase II of the CF SEDSS:

- **Sub-section 2.1:** Energy Management including Energy Efficiency (Working Group 1);
- **Sub-section 2.2:** Renewable Energy Sources and Technologies (Working Group 2);
- **Sub-section 2.3:** Protection of Critical Energy Infrastructure (Working Group 3).

2.1: RESULTS IN ENERGY MANAGEMENT INCLUDING ENERGY EFFICIENCY

Sub-section 2.1 focuses on the outputs provided by CF SEDSS Working Group 1 – Energy Management including Energy Efficiency. After an initial insight on the scope of work, the methodology applied and the main differences from the civilian sector, analysis is given starting from section 2.1.3 onwards.

2.1.1 Scope of Work & Methodology Applied

There is a common understanding that the reduction of energy usage, along with the enhancement of energy efficiency, are important for reinforcing the military operational capabilities. Simultaneously, energy utility bills and resource-spending as well as greenhouse gas emissions will be reduced, to the benefit of the defence budgets and the national and EU targets for climate change. However, **the defence sector has not shifted significantly to more energy-sustainable defence models**.

The scope of WG 1 work lies in the area of energy management and energy efficiency in military installations, which, from the legislative perspective, are governed by the *Energy Efficiency Directive* (EED)[37], the *Energy Performance of Buildings Directive* (EPBD)[38], as well as the overarching *Regulation on the Governance of the Energy Union*[39].

In the sub-chapters to follow, a thorough analysis of the current status is carried out on the following aspects:

a) Energy strategies;

b) Long term renovation strategies and roadmaps;

c) Impact of the EED and the EPBD in the defence sector;

d) Energy management systems (EnMSs);

e) Energy data (including energy performance Indicators (EnPIs), measurement & verification, as well as modelling) & billing;

f) Human factors that affect energy in defence context;

g) Procurement with respect to energy efficiency;

h) Energy performance contracting;

i) Renovation of existing buildings and deep renovations to NZEB standards;

j) Energy audits and energy information requirements;

[37] Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, as amended by Directive (EU) 2018/2002 of the European Parliament and of the Council of 11 December 2018.
[38] Directive 2010/31/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, as amended by Directive (EU) 2018/2002 of the European Parliament and of the Council of 11 December 2018.
[39] Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2019 on the Governance of the Energy Union and Climate Action.

k) Energy performance certificates;

l) Inspection of HVAC systems and retrofitting of technical building systems;

m) Building automation and control systems (BACS) and metering

n) Funding energy projects;

The aforementioned topics were explored through discussions at roundtable formats during the Consultation Forum (CF) conferences as well as through 8 questionnaires that were developed and circulated around participating MS during both phases of the CF:

a) During the 1st phase:

i. Questionnaire on Energy Data Collection, Analysis and Sharing (*"Q-1"*, January 2016): the 23 MS that have replied to this Questionnaire constitute a significant sample, since they represent 95.1% of EU defence expenditure as well as 90.8% of EU defence personnel[40].

ii. Questionnaire on Energy Efficiency Awareness & Training (*"Q-2",* November 2016): the 22 MS that have replied to the questionnaire constitute a significant sample, since they represent 98.0% of the EU defence expenditure and 95.3% of EU Defence personnel[41].

iii. Questionnaire on Energy Management Systems – Public Procurement – Energy Services Companies & Energy Performance Contracting ("Q-3", May 2017): the 21 MS that have replied to the questionnaire constitute a significant sample, since they represent 93.6% of the EU defence expenditure and 85.6% of EU Defence personnel[42].

iv. Questionnaire on Energy Strategies in the Defence Sector (*"Q-4"*, May 2017): the 21 MS that have replied to the questionnaire constitute a significant sample, since they represent 93.8% of the EU defence expenditure and 86.0% of EU Defence personnel[43].

v. Questionnaire on the Impact of the EPBD in the Defence Sector ("Q-5", September 2017): the 15 MS that have replied to the questionnaire constitute a limited sample, since they represent 43.5% of the EU defence expenditure and 44.1% of EU defence personnel[44].

[40] Data for the year 2016, retrieved through the EDA Defence Data exercise. The EU MS MoDs that provided replies to Q-1 are AT, BE, BG, CY, CZ, DE, EE, EL, ES, FI, FR, HR, HU, IE, IT, LT, LV, NL, PT, RO, SE, UK. Additionally, CH contributed to Q-1.

[41] Data for the year 2016, retrieved through EDA Defence Data exercise. The EU MS MoDs that provided replies to Q-2 are AT, BE, BG, CY, DE, EE, EL, ES, FI, FR, HR, IE, IT, LT, LV, NL, PL, PT, SE, SI, UK. Apart from the latter MS, DK also provided a reply to Q-2. DK holds an opt-out from EU policies in relation to security and defence, hence does not provide defence data to EDA and is not included in the percentages presented above.

[42] Data for the year 2016, retrieved through EDA Defence Data exercise. The EU MS MoDs that provided replies to Q-3 are AT, BE, CY, DE, EE, EL, ES, FI, FR, HR, IE, IT, LT, LV, NL, PT, RO, SE, SI, UK. Apart from the latter MS, DK also provided a reply to Q-3. DK holds an opt-out from EU policies in relation to security and defence, hence does not provide defence data to EDA and is not included in the percentages presented above.

[43] Data for the year 2017, retrieved through EDA Defence Data exercise. The EU MS MoDs that provided replies to Q-4 are AT, BE, CY, DE, EE, EL, ES, FI, FR, HU, IE, IT, LT, LV, NL, PT, RO, SE, SI, UK. Apart from the latter MS, DK also provided a reply to Q-4. DK holds an opt-out from EU policies in relation to security and defence, hence does not provide defence data to EDA and is not included in the percentages presented above.

[44] Data for the year 2017, retrieved through the EDA Defence Data exercise. The EU MS MoDs that provided replies to Q-5 are CY, BE, EE, EL, ES, FI, HR, HU, LT, PT, PL, SE, SI, UK. Apart from the latter MS, DK also provided a reply to Q-5. DK holds an opt-out from EU policies in relation to security and defence, hence does not provide defence data to EDA and is not included in the percentages presented above.

b) During the 2nd phase:

i. Questionnaire on Funding Mechanisms for Energy Projects – Energy Data – Renovation Roadmaps (*"Q-6"*, October 2018): the 22 MS that have replied to this questionnaire constitute a significant sample, since they represent 96.8% of EU defence expenditure as well as 92.5% of EU defence personnel[45].

ii. Questionnaire on Energy Performance Contracting (*"Q-7"*, February 2019): the 22 MS that have replied to this questionnaire constitute a significant sample, since they represent 96.8% of EU defence expenditure as well as 92.5% of EU defence personnel[46].

iii. Questionnaire on Energy Strategies – Energy Management Systems – Energy Auditing (*"Q-8"*, May. 2019): the 21 MS that have replied to this questionnaire constitute a significant sample, since they represent 96.4% of EU defence expenditure as well as 90.4% of EU defence personnel[47].

2.1.2 Particulars of the Defence Sector and Differences Compared to the Civil Sector Concerning Energy

Common elements and particulars of defence sector building stock have been identified among MoDs as obstacles or hindrance to (a) the implementation of the EED and EPBD, (b) the creation of buildings stock inventory (only buildings that need energy for indoor heating/cooling count towards this inventory) and (c) implementation of energy efficiency measures in general, among them: a large portfolio of buildings (hundreds/thousands of buildings), a "campus" grouping of buildings, these hundreds/thousands of buildings are not individually metered and thus require a great amount of resources to collect information, a mixture of technical/storage/office/ leisure/living accommodation uses that may change with time, fixed operational energy consuming equipment, large variations in operational tempo, significant amount of cultural heritage buildings, security issues, difficulty to see or realise the Return on Investment (ROI), some buildings are not used or needed, use of some buildings may not be known, some of the buildings are not property of the MoD and belong to other public body (thus, MoD has not decision power), separate budgets for procuring energy and maintenance lead to no incentives to implementing energy efficiency measures.

These obstacles or difficulties are common to almost all MoDs in almost all cases. MoDs' building stock inventories do, generally, contain only basic information on buildings and floor area which is insufficient for MoDs to plan and prioritize implementation of energy efficiency measures. Even if MoDs were to renovate their building stock at a 3% a year refurbishment/replacement rate, as required by the *Article 5* of the EED, it would take over 33 years to bring the building stock up to current standard, let alone keep pace with technical developments over that time. A quick and inexpensive way to prioritise buildings for attention would be required. Relative benchmarks for defence buildings would be useful to identify where the greatest benefits can be realised from investment. Comparing actual energy consumption with a benchmark would allow for prioritisation.

[45] Data for the year 2017, retrieved through EDA Defence Data exercise. The EU MS MoDs that provided replies to Q-6 are AT, BE, BG, CY, DE, EE, EL, ES, FI, FR, HR, HU, IE, IT, LT, LV, NL, PL, PT, SE, SI, UK. Apart from the latter MS, DK also provided a reply to Q-5. DK holds an opt-out from EU policies in relation to security and defence, hence does not provide defence data to EDA and is not included in the percentages presented above.
[46] Data for the year 2017, retrieved through EDA Defence Data exercise. The EU MS MoDs that provided replies to Q-7 are AT, BE, BG, CY, DE, EE, EL, ES, FI, FR, HR, HU, IE, IT, LT, LV, NL, PL, PT, SE, SI, UK. Apart from the latter MS, DK also provided a reply to Q-6. DK holds an opt-out from EU policies in relation to security and defence, hence does not provide defence data to EDA and is not included in the percentages presented above.
[47] Data for the year 2017, retrieved through EDA Defence Data exercise. The EU MS MoDs that provided replies to Q-8 are AT, BE, CY, DE, EE, EL, ES, FI, FR, HR, HU, IE, IT, LT, LV, NL, PL, PT, SE, SI, UK. Apart from the latter MS, DK also provided a reply to Q-8. DK holds an opt-out from EU policies in relation to security and defence, hence does not provide defence data to EDA and is not included in the percentages presented above.

The following differences between the defence sector and the civil sector have been identified:

a) Priorities: The defence sector is operationally driven, with different purpose and priorities to the commercially driven civil sector, and thus, the defence sector is less ambitious as far as energy savings are concerned.

b) Building types: Non-operational buildings in the defence sector (offices, hospitals, schools, restaurants, etc.) show great amount of commonality with the civil sector; the standards of non-operational buildings in the defence sector are simpler than in the civil sector. It is operational buildings in the defence sector that are different, reflecting defence-specific particulars and a greater energy demand.

c) Approach to energy efficiency in buildings: defence sector requires a "cluster" or "campus" approach (groups of dependant buildings), as opposed to the single building approach in the civil sector, and also has different energy management requirements, depending on the type of "cluster" (runways, hangars, workshops, offices, laboratories, hospitals, canteens, etc.). Commonalities within clusters can be exploited by different buildings to obtain energy savings.

d) Occupation pattern: the defence sector shows wide variations in building occupation over time; buildings are designed for a specific capacity for specific requirements or needs under certain circumstances, and then the occupation changes widely over time when circumstances change, resulting in spare capacity during certain times in between operational periods.

e) Power network and metering infrastructure: the majority of the infrastructure is, in general, old, and the energy bills refer to a single meter at the gate. Bills come for an entire campus.

f) Economies of scale: the defence sector suffers from limitations to exploit economies of scale due to three reasons, mainly: a) unavailability of budget, or changes in planning and shifts of budget allocation, b) changes in priorities, normally in detriment of energy efficiency, and c) geographical spread of building stock.

g) Security of supply: at a local level, for defence sector, security of supply relies mainly on the use of generator sets; it is only at a national level that the diversity of energy sources is normally higher (for instance, nuclear + hydro + biomass + wind power + PV power). Defence remote operations tend to demand a higher amount of energy and a tighter security of supply than base operations. There is a diversity of backup solutions in comparison with a single type solution in the civil sector.

h) Cyber security: cyber security becomes a more critical issue in the defence sector, due to the sensitivity of the information; smart systems and remote metering, for instance, become critical issues for defence. In general, defence is a higher-level target than the civil sector and thus, security becomes a very high priority. The defence sector tends to adopt bespoke, rather than commercial standard systems.

These differences represent not only challenges to, but also some opportunities, for the defence sector:

a) Challenges:

   i) Procurement procedures are rather more complex in the public sector than in the private sector;

   ii) Defence sector, as part of the public sector, has to perform an "exemplary role", which does not necessarily pertain to the private sector;

   iii) Public administration budgeting cycles are shorter than payback periods;

iv) Re-investing money saved in energy consumption reductions is not permitted for most MS;

v) Rotation of military staff (often having to change positions once they get to understand the fundamentals of energy savings);

vi) Creation of adequate building stock inventories;

vii) Development of a multidisciplinary cross-government network for energy.

b) Opportunities for the defence sector:

i) To develop a dedicated defence energy funding programme;

ii) To clarify access to EU funding for defence energy-related projects;

iii) To develop a defence energy strategy within the context of the national energy strategy.

2.1.3 Energy Strategies

EU Framework

European Union is leading the global initiative to mitigate climate change. By 2020, the EU aims to reduce its greenhouse gas emissions by at least 20%, increase the share of renewable energy to at least 20% of consumption and achieve energy savings of 20% or more. All EU countries must also achieve a 10% share of renewable energy in their transport sector. Moreover, all EU Member States have agreed on a new 2030 framework for climate and energy, including EU-wide targets and policy objectives for the period between 2020 and 2030, which, in a nutshell, include a 40% cut in greenhouse gas emissions compared to 1990 levels, at least a 32% share of renewable energy consumption, and at least 32.5% energy savings compared with the business-as-usual scenario.

Through the attainment of these targets, the EU can help combat climate change and air pollution, decrease its dependence on foreign fossil fuels, and keep energy affordable for consumers and businesses.

EU MoDs Current Status on Energy Strategies

Two questionnaires were developed on this topic: the *Q-4* Questionnaire (CF I, May 2017), which mapped for the first time the landscape of energy strategies in the EU defence sector, followed by *Q-8* Questionnaire (CF II, May 2019), to mark the developments over the last two years:

a. 16 MoDs (73%, 16 out of the 22 that replied) indicated that they currently do have an energy strategy. Taking also into account that there is another MoD that has under staffing an energy strategy for the first time, it is evident that, when compared with the 2017 landscape, the visibility of energy in the defence sector has increased, leading to the adoption of relevant strategies by the hierarchy.

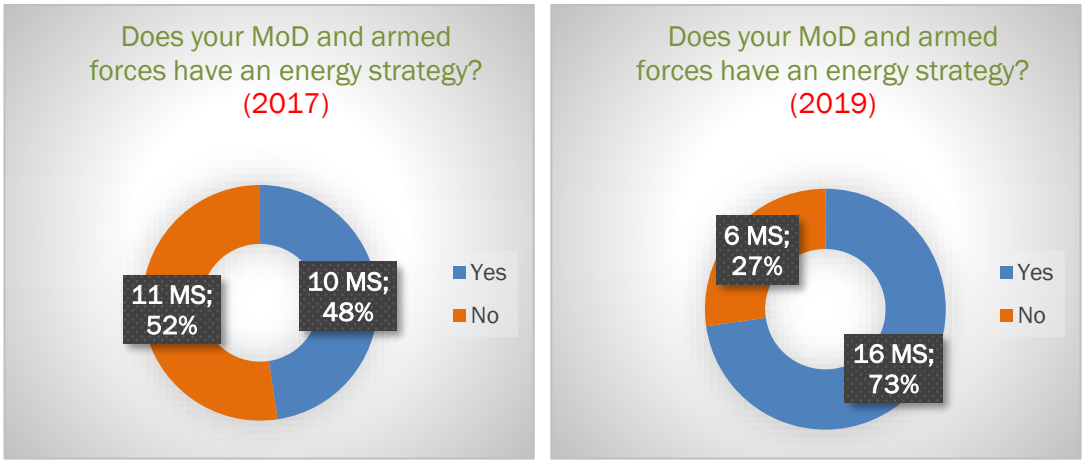


Figure 1: Incorporation of Energy Strategies in the Defence Sector (May 2017 & May 2019)

In more detail:

i. Half of the MoDs (50%, 8 out of the 16 that do have an energy strategy), have a stand-alone energy strategy, whereas the other half have consolidated their environmental protection or sustainable development strategy with their energy strategy into one document. There is also the case of one MS that has issued both a sustainable defence strategy (including energy) and a dedicated energy performance strategy.

ii. The majority of the MoDs (69%, 11 out of the 16 MoDs) that do have an Energy Strategy, their Energy Strategy is linked with the military operational capabilities. In the rest of the cases, the Energy Strategy deals only with infrastructure and support activities.

b. In the near future, 5 MoDs (83%, 5 out of the 6 MoDs that currently have not issued an Energy Strategy) are planning to develop one. This will result to 21 MS in total that will have an Energy Strategy (95%, 21 out of the 22 that replied) in the years to come.

Challenges and Barriers

The following challenges/ barriers have been identified:

a. The limited availability of funding and investments in many MoDs hinders the realisation of an energy strategy through the implementation of comprehensive action plans. EU and national competent authorities on energy have not necessarily been supportive in terms of providing the essential funding. This further weakens the support for and effectiveness of a MoD energy strategy.

b) The visibility of energy as one of the most critical operational capabilities' enabler is not clear in many cases, leading to the low commitment of all levels of command and personnel. This phenomenon is attributed to the following reasons:

i. The link between energy and operational capabilities is not adequately highlighted;

ii. In cases that an energy strategy is combined with an environmental protection or sustainable development strategy, the aforementioned link between energy and operational capabilities is downgraded in favour of the undeniable environmental protection benefits (i.e. CO_2 emissions, sustainability of resources, etc.);

c) A shortage of suitably qualified and experienced MoD professionals in the energy-related domain has been identified in some MoDs, leading to insufficient capacity

within the respective defence organisations to implement action plans in support of an energy strategy. In such cases, the development of an energy strategy provides little or no added value other than to satisfy a policy requirement.

c. A plethora of "strategies", "concepts" and "policies" abound within and overwhelm the military sector, diluting the actual commitment of all levels of command. This has a knock-on effect in terms of the engagement of personnel and the realisation of effective energy action plans deriving from the energy strategy.

d. Further to the above, the defence exemptions in EED (par. 2b of Article 5) are in some cases misinterpreted by national competent authorities on energy, resulting in unequal treatment in terms of national funding for the energy efficiency upgrade of the significant share of building stock of the MoDs / armed forces that are not exempted (i.e. living quarters and offices).

e. There are cases of MoDs / armed forces that have yet to establish a dependable energy data collection mechanism, which will enable them to partition energy consumption into significant energy uses. This issue may lead to the selection of inappropriate energy performance indicators (EnPIs) as well as to poor energy consumption forecasts (if any). Consequently, the developed energy strategies are coarse and very generic and are not supported by relevant action plans targeting specifically the significant energy uses. The aforementioned issues are justified by the following facts, captured by *Q-1* Questionnaire (January 2016):

   i. Less than half of the MoDs do project their future energy needs (in 10 out of the 22 MoDs that replied, 45%).

   ii. Just around one out of three MoDs do partition their electricity/gas consumption into relevant uses, such as offices, accommodation, production/maintenance, operations, etc. (in 7 out of the 20 MoDs that replied, 35%).

2.1.4 Long term Renovation Strategies

EU Framework

The concept of *"building renovation roadmaps"* at a national level has been introduced in *Article 2a* of the recently promulgated Directive (EU) 2018/844, through which all EU MS are called to establish a long-term renovation strategy to support the renovation of the national stock of residential and non-residential buildings, both public and private, into a highly energy efficient and decarbonised building stock by 2050, facilitating the cost-effective transformation of existing buildings into near zero energy buildings (NZEB).

Moreover, different approaches are provided for new buildings (*Article 6*), which have to comply at least with the minimum energy performance requirements, as well as for the major renovations of existing buildings (*Article 7*), taking into account not only high-efficiency alternative systems, but also healthy indoor climate conditions and fire safety.

EU MoDs Current Status on Energy Strategies

The use of renovation roadmaps was explored through a roundtable discussion on experiences within the defence sector and the economic benefit for deep renovations to NZEB / Net-Zero standards;

According to the MS replies to *Q-7* Questionnaire (CF II, February 2019):

a. More than ¾ of the MoDs (77%, 17 out of the 22 MS that replied) do plan for buildings renovation aimed at improvements of energy performance, but with wide differences in the time horizon and based on a combination of different standards, using both single building and cluster approaches, and both sole and staged renovations.

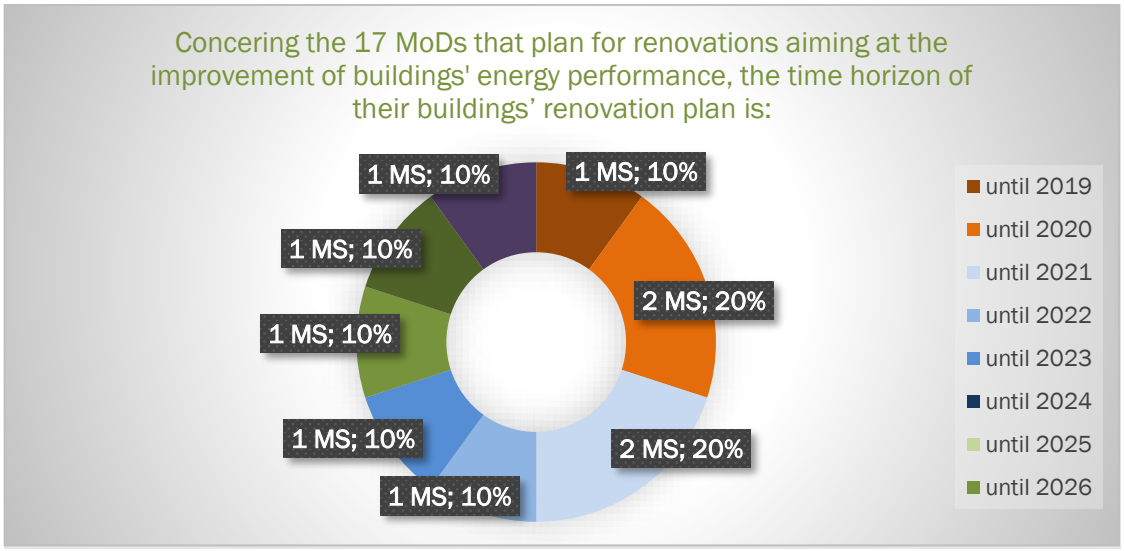


Figure 2: Time Horizon of Renovation Plans for the Defence Sector Building Stocks (February 2019)

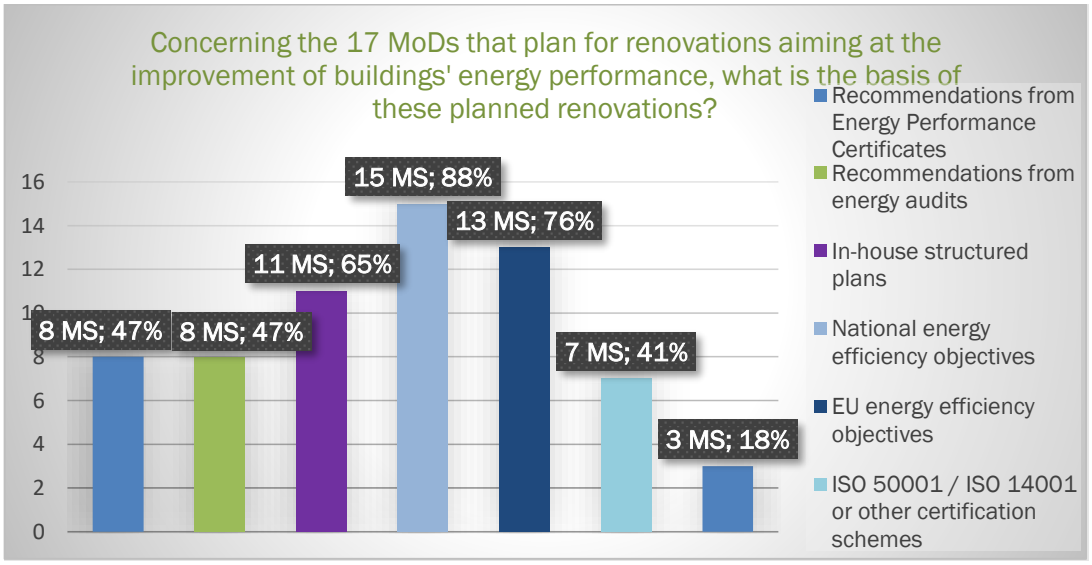


Figure 3: Renovation Drivers for the Building Stocks of the Defence Sector (February 2019)

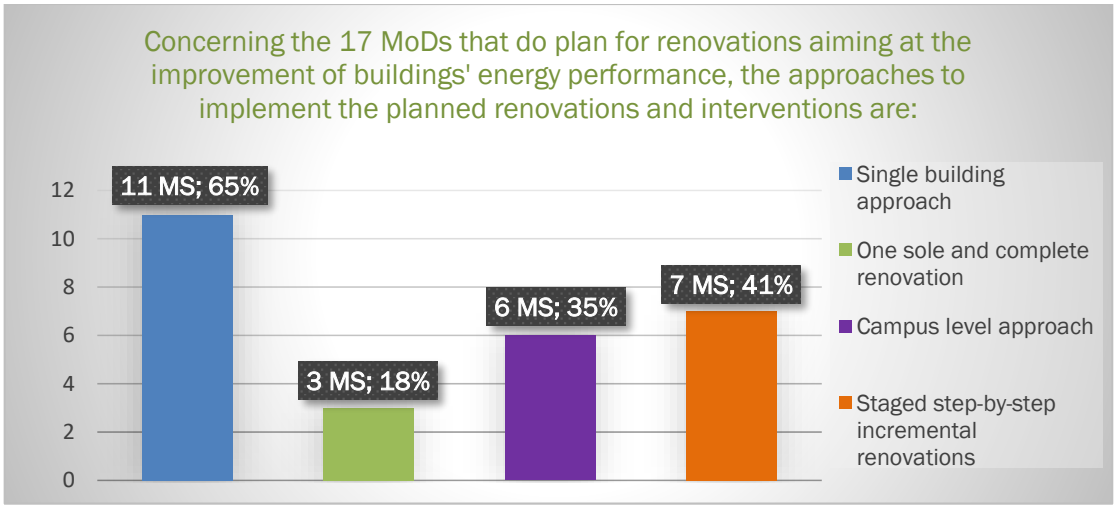


Figure 4: Renovation Approach for the Building Stocks of the Defence Sector (February 2019)

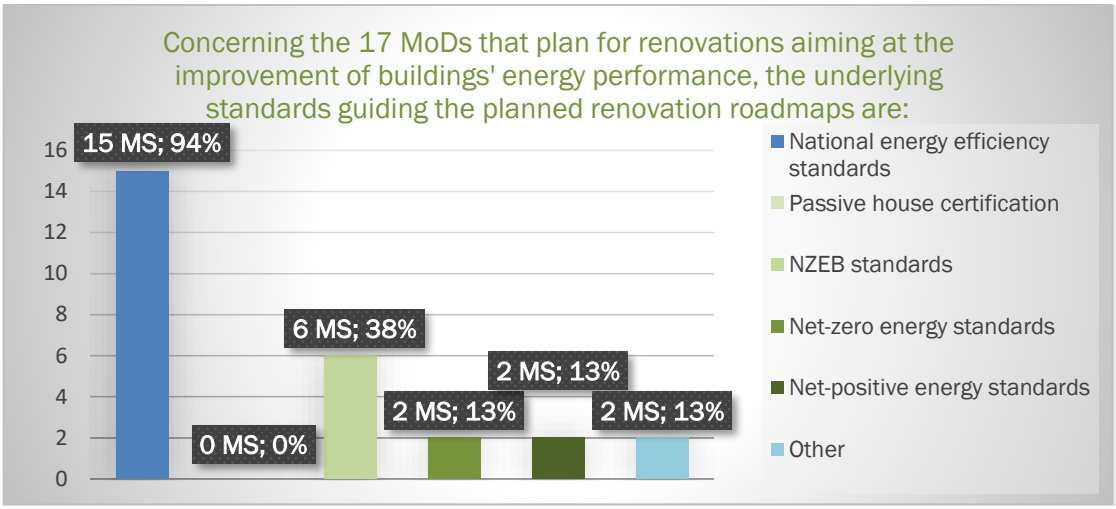


Figure 5: Renovation Requirements and Standards used for the Building Stocks of the Defence Sector (February 2019)

b. For the 5 remaining MoDs that do not plan strategically for renovations aiming at the improvement of the energy performance, energy efficiency is not among their highest priorities and the associated budgets are consequently not significant.

c. Concerning record keeping regarding infrastructure, according to the MS replies to the Questionnaire, less than half of the MoDs (45%, 10 out of the 22 MS that replied) maintain logbooks and databases that record different aspects of energy use. The parameters recorded are:

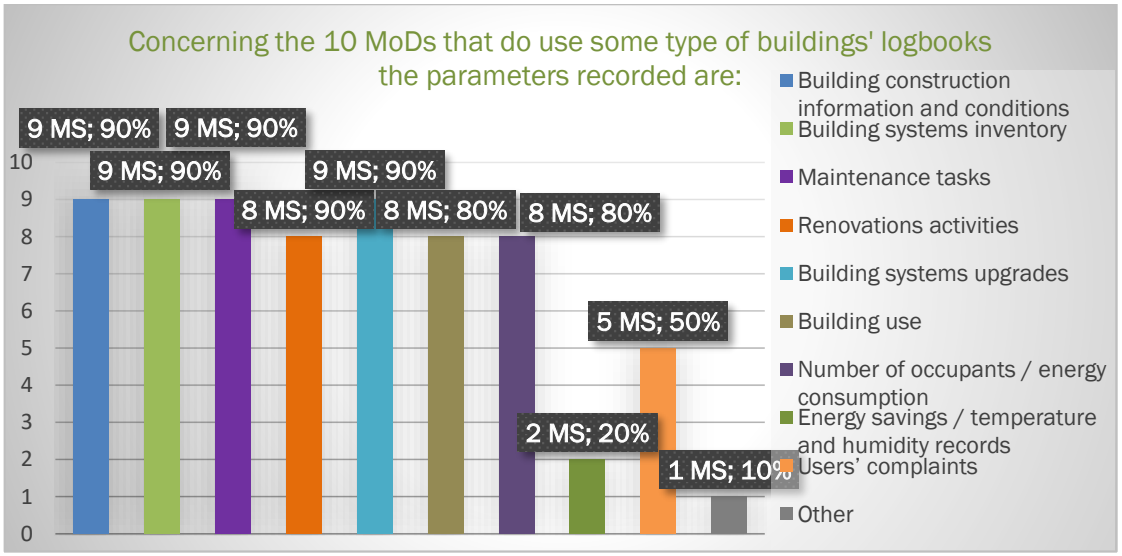


Figure 6: Types of Logbooks used for the Building Stocks of the Defence Sector (February 2019)

2.1.5 Impact of the EPBD in the Defence Sector

EU Framework

CF I covered EED and EPBD relevant articles, in particular:

a) Reviewing EED key articles:

i. *Article 4*: Building renovation strategies and plans

ii. *Article 5*: Exemplar role of public bodies buildings

iii. *Article 20*: Energy efficiency national fund, financing and technical support

b) Revision of EPBD key articles:

i. *Article 3*: Methodology for calculating the energy performance of buildings

ii. *Article 4*: Setting of minimum energy performance requirements

iii. *Article 5*: Cost-optimal methodology

iv. *Article 6* and *7*: New and existing buildings

v. *Article 8*: Technical building systems

vi. *Article 9*: Nearly zero energy buildings

vii. *Articles 11,12* and *13*: Energy performance certificates

viii. *Articles 14, 15* and *16*: Inspection of heating and a/c systems

EU MoDs Current Status on Energy Performance of Buildings

CF I:

The results from *Q-5* Questionnaire (CF I, September 2017) on the EPBD showed that the impact of this Directive has not been uniform across the EU defence sector. Moreover, a majority of EU MoD delegates (60%) observed that the overall impact of the EPBD was small. The reasons attributed to it were common across the EU fefence sector, the main reasons among others being:

a. Energy efficiency interventions and infrastructure maintenance are of lower priority to defence, with the bulk of the budgets being dedicated to armament and other operational purposes;

b. Lack of commitment, sensitivity and adequate mentality towards energy sustainability (especially at senior levels);

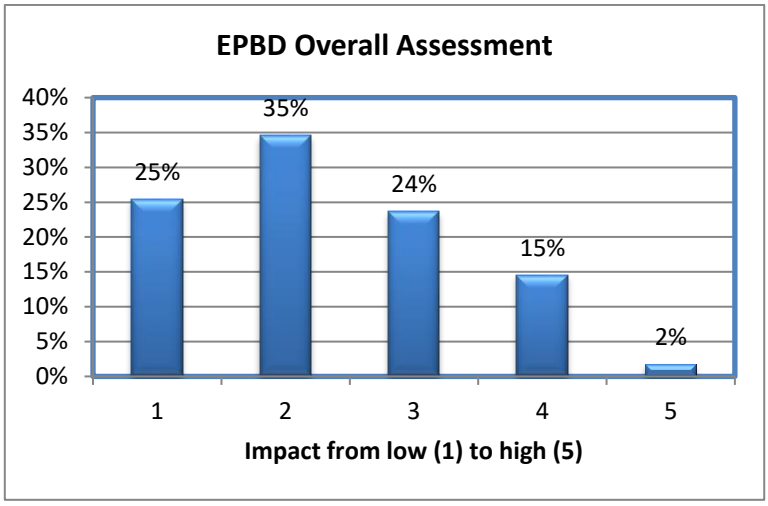
The progress achieved on monitoring of building information and data collection is small. Military bases and camps typically have limited (usually one) consumption meter, and the infrastructure is normally old, with very limited information about building fabric, installations or layouts of energy distribution networks. The implementation of the UK MoD's project proposal to establish benchmarks and databases for defence building stock was considered of importance to help MoDs gain this information through the appropriate tools, procedures and equipment.

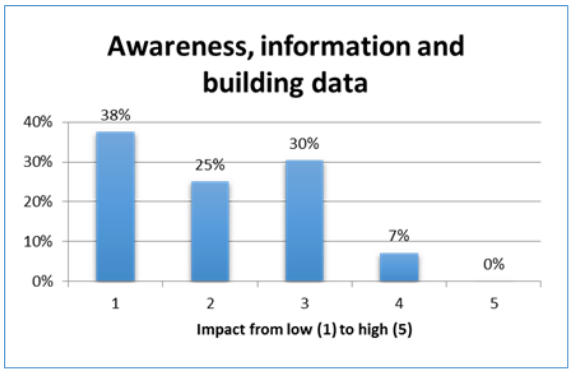
The majority of the MS also observed the limited impact of the technical building systems operational management and maintenance provisions, due to the lack of resources; ICT solutions, such as smart meters, or smart automation and control systems, are few and isolated.

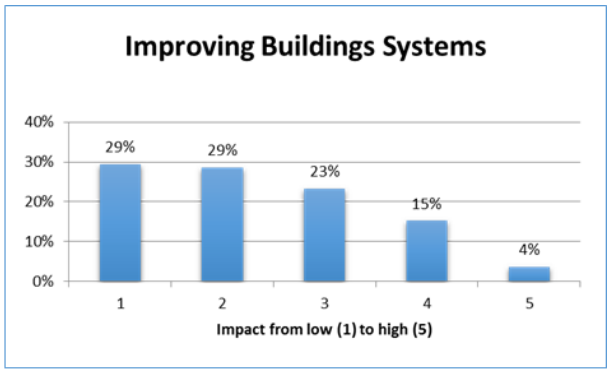
As concluded from previous meetings, there seemed to be a trend to deal with energy efficiency interventions on an ad-hoc basis through small-scale low-cost works with relatively limited impact, rather than as part of a plan, and a lack of base/compound level interventions. The EPBD on its own does not seem enough to highlight the importance of renovations, which is acknowledged by everyone. Ultimately, the renovation rate depends on the availability of funding.

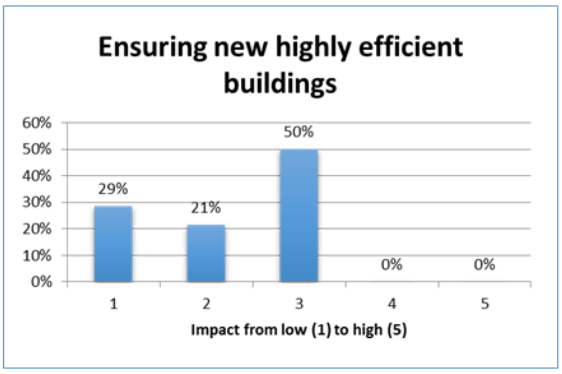
The lack of resources, commitment and tactical direction and the consideration of energy efficiency as a lower priority are still there despite the high degree of MoDs' accountability towards the achievement of their national energy efficiency objectives. The CF SEDSS was identified as the pivot point and key driver to overcome these obstacles and bridge the gap through the exchange of views, know-how and best practices among MoDs, the promotion of EU defence sector interests and direct involvement with the European Commission, and the identification of opportunities for materialisation of collaborative initiatives.

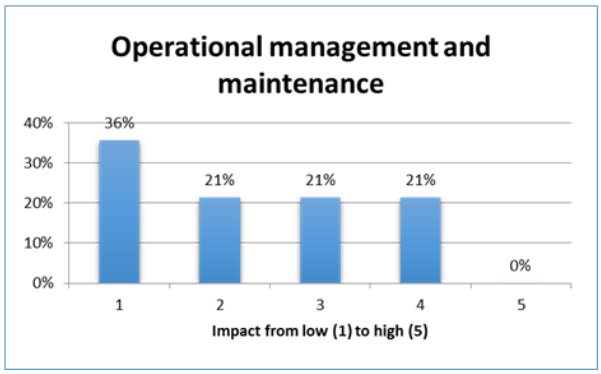
The following graphs show the impact of different aspects of the EPBD on the defence sector.


EPBD Overall Assessment
40%
35%
30%
25%
20%
15%
10%
5%
0%
25%
35%
24%
15%
2%
1
2
3
4
5
Impact from low (1) to high (5)


Awareness, information and building data
40%
30%
20%
10%
0%
38%
25%
30%
7%
0%
1
2
3
4
5
Impact from low (1) to high (5)


Improving Buildings Systems
40%
30%
20%
10%
0%
29%
29%
23%
15%
4%
1
2
3
4
5
Impact from low (1) to high (5)


Ensuring new highly efficient buildings
60%
50%
40%
30%
20%
10%
0%
29%
21%
50%
0%
0%
1
2
3
4
5
Impact from low (1) to high (5)


Operational management and maintenance
40%
30%
20%
10%
0%
36%
21%
21%
21%
0%
1
2
3
4
5
Impact from low (1) to high (5)

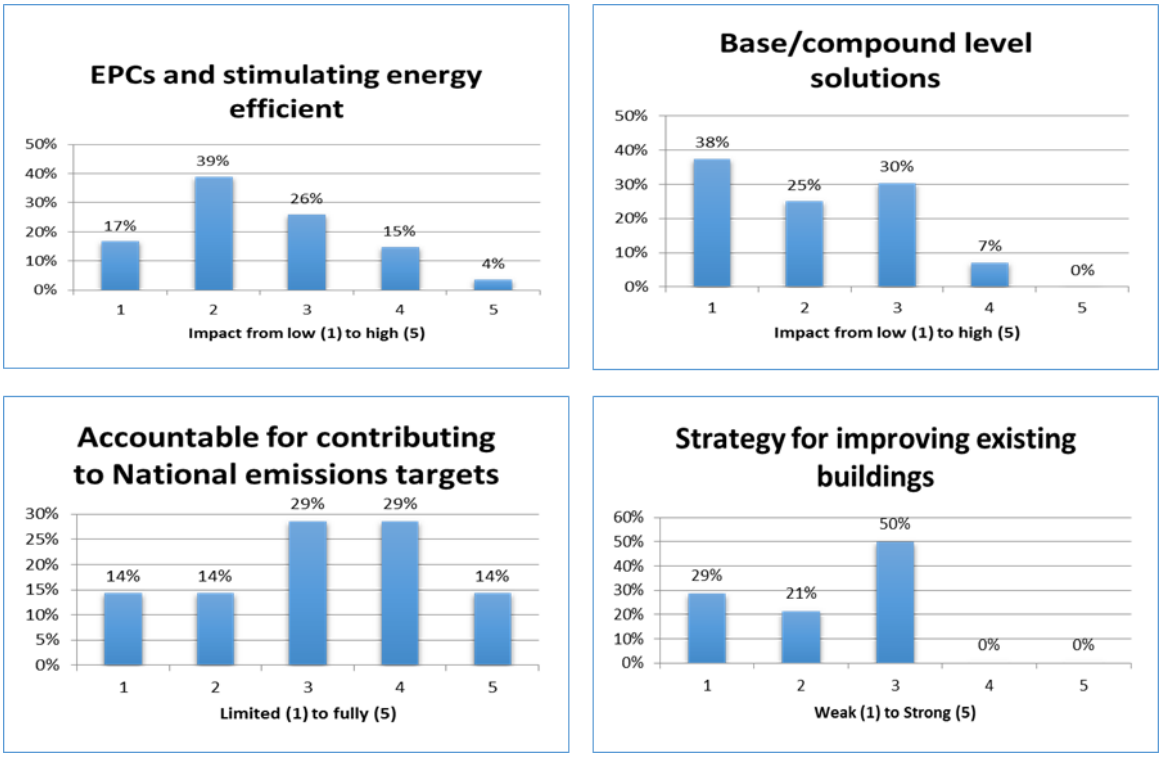


Figure 7: Different aspects of the EPBD on the defence sector.

CF II

The new provisions of the revised EPBD are deemed to have, in general terms, a limited impact on the defence sector. Further information is required on the specific content of the building renovation passports and the methodology to calculate the Smart Readiness Indicator (SRI), as well as time to assess the implications of the new requirements for electro-mobility to fully assess the impact. The MS view on the changes are:

a. The expanded definition of "technical building system" in Article 2 of revised EPBD has very limited, but positive nonetheless, impact on defence sector, as it only adds new trends and systems that are normally installed in buildings nowadays.

b. The inclusion of a requirement for temperature self-regulating devices in Article 8 of revised EPBD will have some impact on the defence sector, both positive and negative. The impact will mainly be for existing buildings where heat generators are to be replaced, as this requirement is already part of the technical standards for new buildings. The devices will deliver energy savings; however, the financial benefits will be partly offset by additional investment in equipment and additional resources to produce in-depth technical and financial feasibility studies with cost-benefit analyses. Additional training may be required if these studies are to be produced by defence personnel.

c. The requirement for installation of recharging points in *Article 8* of revised EPBD will have a limited impact on the defence sector, as it applies to new/deep renovated buildings only. There are questions over the detailed implementation of the requirement, such as:

   i. whether or not this requirement must be applied to all defence buildings, or only to non-operational buildings (e.g. administrative, accommodation, academies and schools, hospitals, etc.);

   ii. whether this recharging service should be provided for all vehicles (including private vehicles) or only for business vehicles;

iii. whether the service should be charged for and paid directly by the user or leased to a provider, or provided at no cost, in which case it could be understood as discrimination against other equally valid and clean technologies, such as H_2 fuel cell, etc.;

iv. whether further criteria, such as size and occupation of a military base or defence facility (e.g. barracks empty 50% of the year, etc.), should be introduced in the electro-mobility requirement;

On the positive side, MoDs believe this requirement will serve to incentivise people to use electric cars, even though this is clearly not within the scope and responsibilities of the MoDs.

On the negative side, the installation of recharging points will require significant capital investments.

d. Renovation passports may be very useful to help prioritise cost-effective investments and assist in the decision-making process, depending on the proposed template of such renovation passports. It may be beneficial to establish a building size threshold (m^2), as renovation passports may not be relevant for small buildings.

e. The shift in the metrics of the energy performance indicator to $kWh/m^2.y$ may complicate the comparison of buildings with similar consumption but with different energy sources. The use of $kWh/m^3.y$ measurement (instead of m^2) could be more relevant in the defence sector, as some buildings have high ceilings (e.g. hangars).

f. There is consensus that the defence sector should influence the methodology to calculate the SRI to account for the defence sector specificities, mainly for operational buildings, where a standard methodology may not be applicable or may impose too may constraints or unrepresentative results particularly for buildings containing numerous and varied (sometimes non-conventional and/or high consuming) equipment. Special attention must be paid to requirements for "smartness" which include sensitive information which could compromises security or other implications, such as the qualification and training of the personnel.

g. There is also consensus that a "cluster" approach to the calculation of the SRI may fit better for the defence sector, as opposed to a "single building" SRI.

h. Despite the general positive perception of the SRI as a tool for benchmarking and for internal assessment of the defence building stock, there is a general feeling that, if optional, it may fail to be implemented.

The following common features and positions were found during the discussions concerning energy efficiency and renovation strategies and plans:

a) Most MoDs have an energy efficiency plan and building renovation strategy plan.

b) There is uncertainty about how much MoDs are contributing to their national targets. The 3% renovation rate national target (EED Art. 5) is allocated to each MS public administration building stock as a whole; each MoD can negotiate a lower/higher rate of renovation with its central government or, in many cases, MoDs may be excluded from the targets. Also, MS may choose to implement alternative measures providing equivalent energy savings and not follow the 3% renovation rate. According to *Q-8* Questionnaire (CF II, May 2019):

i. Only 1 MoD is actually following an energy efficiency target defined by a renovation rate, which is set by the central government;

ii. The remaining 21 MoDs (95%, 21 out of the 22 MS that replied) are either implementing alternative measures (in most cases in coordination with their central governments) or have been exempted from relevant national targets and just follow their energy strategy (if any).

c) Not all MS have a clear definition of what a NZEB is, and where they have, they differ among MS.

d) MS have minimum energy performance requirements for new and renovated buildings, and for technical building systems that MoDs follow.

Through *Q-5* Questionnaire (CF I, May 2017) and *Q-8* Questionnaire (CF II, May 2019), the following information provides a mapping of the defence landscape with respect to the implementation of the EPBD:

a) 100% of respondent MoDs declared that their MS have transposed EED & EPBD into national legislation. No changes in Phase II.

b) 100% of respondent MoDs are classified as public bodies. No changes in Phase II.

c) 70% of respondent MoDs declared to be carrying out programme of refurbishments but Article 5 of EED is not the primary reason; no MoD has declared it is publishing a list of MoD buildings with energy performance data to meet requirement of Article 5 of EED; a slight increase up to 77% was reported during Phase II.

d) Most MoDs are carrying out some form of audit programme on selected buildings (mainly new buildings or deeply renovated buildings) and produce energy performance certificates. 4 MoDs conduct energy audits in all their buildings. Moreover, there is a mixture of internal and external personnel carrying out certification.

e) 54% of respondent MoDs are implementing energy efficiency (EE) measures recommended in the energy audit reports. No changes in Phase II.

f) 100% of respondent MoDs declared that their MS has a national energy efficiency action plan (NEEAP) in place, although not all of them have an approved definition of a NZEB. No changes in Phase II.

g) 92% of respondent MoDs have or are developing an asset data base of buildings (although it may not be adequate); most have site level energy consumption figures; a few declared to have building level energy consumption figures during Phase I; the majority do not have energy benchmarks for defence buildings. From the start to the end of the CF, 50% of MoDs declared to have energy consumption data for all buildings.

h) 100% of respondent MoDs are applying national building standards, with cost-optimal methodology for the calculation of minimum EP requirements embedded in their national building standards. No changes in Phase II.

i) 71% of respondent MoDs have identified barriers to the implementation of EE measures, such as:

   i) Internal funding

   ii) Expertise

   iii) Awareness of decision makers and defence personnel

   iv) Management information (buildings and energy consumption)

   v) Criteria for external funding

Challenges and Barriers

The challenges and barriers identified by MS concerning the implementation of the EPBD include the following:

a) Disconnection between energy procurement, energy efficiency, energy consumption awareness and maintenance plans, leading to no drivers for energy efficiency measures.

b) Disconnection between duty holder and budget holder, leading to lack of incentivization to save energy.

c) Lack of a single senior MoD energy management point of accountability.

d) Need to prioritise buildings on the basis of adequate building stock inventory and benchmarks.

e) Building stock inventories are inadequate.

f) Difficulties to create and update an adequate building stock inventory register: too many buildings, mixed or unknown use, property issues, lack of individualized metering, lack of resources, difficulties to collect data (externalization of maintenance), lack of human resources to collect data and monitor energy consumption.

g) Payback periods are too long for cost benefits to be realised.

h) Lack of funds for implementation of energy efficiency improvement measures.

i) Limited knowledge/awareness about financing mechanisms and available funds.

2.1.6 Energy Management Systems

EU Framework

Article 5 of the *EED* requires public bodies to play an exemplary role as far as their energy efficiency and energy consumption of their buildings are concerned. To that end, public bodies are encouraged to adopt specific energy efficiency action plans and, moreover, develop and implement energy management systems (EnMSs).

Energy auditing, which is a key element of every EnMS, is specifically addressed in *Article 8* and *Annex VI* of the *EED*, in order to emphasize the requirements for high quality as well as for safeguarding the impartiality of the auditors.

Apart from EnMSs, the European Parliament and Council have developed the Eco-Management & Audit Scheme (EMAS), a comprehensive tool for promoting continuous improvements in the environmental performance of organisations by the establishment and implementation of environmental management systems (EMSs), based on the international Standard ISO 14001:2015. Currently, EMAS has been promulgated as *Regulation (EC) 1211/2009* amended by *Regulation (EU) 2017/1505*. In the context of EMAS, energy is considered a significant environmental aspect and energy efficiency as one of the core environmental indicators.

EU MoDs Current Status on Energy Management Systems

According to relevant discussions held during the 2nd CF SEDSS I plenary meeting (June 2016) and *Q-3* and *Q-8* questionnaires that were circulated (CF I, April 2017 and CF II, May 2019), the majority of MoDs /armed forces do apply EnMSs and/or EMSs to some extent. Moreover, it is evident that during the last 2 years more MS are experimenting in the application of EnMSs in pilot scale to examine the potential benefits, with a view to broaden the scope in the near future.

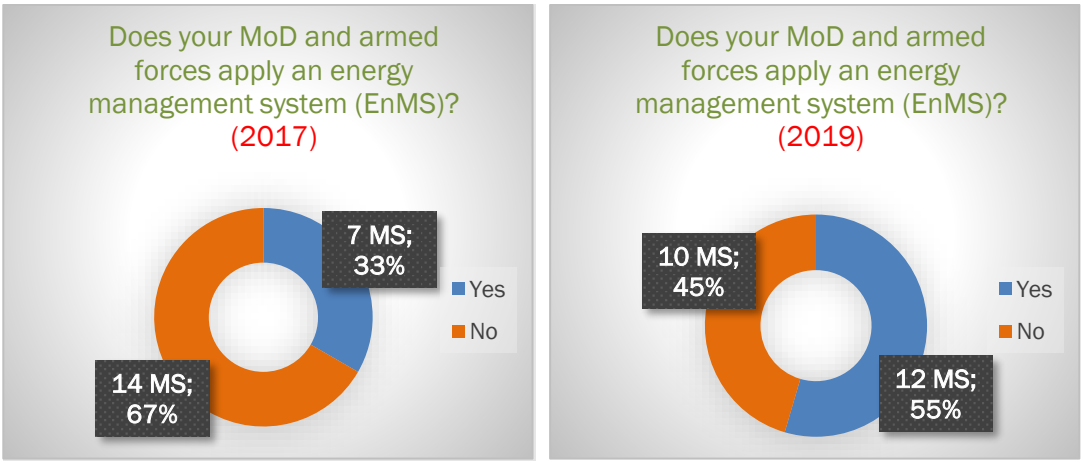


Figure 8: Implementation of Energy Management Systems in the Defence Sector (Apr 2017 & May 2019)

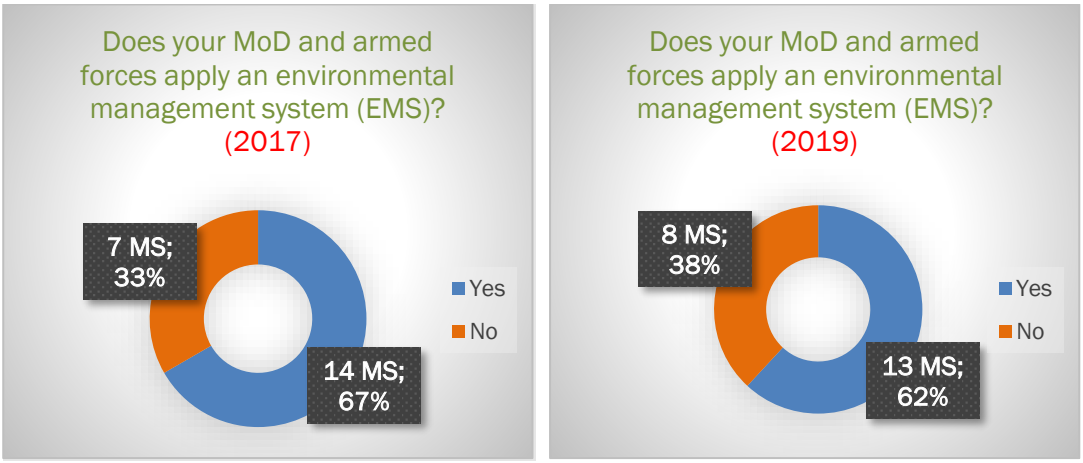


Figure 9: Implementation of Environmental Management Systems in the Defence Sector (Apr 2017 & May 2019)

However, there are different levels of maturity on the application of energy management among MoDs /armed forces. In more detail, the 2019 mapping is the following:

a) There are examples of comprehensive application of EnMSs within 2 MoDs/armed forces (9%, 2 out of the 22 MoDs that replied):

   i. 1 MoD applies a certified ISO 50001 with a wide-scale scope (i.e. covering almost or all military facilities) (since 2013);

   ii. 1 MoD applies a non-certified EnMS consisting of a combination of ISO 50001 and national requirements (since 2005), along with an EMAS-based EMS (since 2015) in all military facilities within national borders.

b) 10 MoDs (45%, 10 out of the 22 MS that replied) apply an EnMS in a pilot or small scale, either in a stand-alone format (3 cases) or in combination with an ISO 14001 / EMAS EMS (7 cases):

c) Moreover, there are 6 MoDs (27%, 6 out of the 22 Ms that replied) that implement only EMSs (based on either ISO 14001 or EMAS) which, in most cases, incorporate energy consumption as one of the significant environmental aspects and, thus, manage energy.

d) Additionally, 6 MoDs are planning to develop EnMSs in the near future.

e) Only in 6 cases, the MoDs that have developed and implemented EnMSs/EMSs, were granted relevant financial/technical assistance by national or EU funding mechanisms/competent authorities.

Challenges and Barriers

The challenges and barriers identified by MoDs that actually implement or are planning to implement an EnMS /EMS can be summarised as follows:

a) Human factors (i.e. commitment, awareness, motivation, communication and training); a topic which was extensively covered during the 3rd CF I conference (Rome, November 2016);

b) Availability of human resources to assume duties as energy managers/energy team members;

c) Financial resources:

   i. Taking into account the continuously reduced MoD budgets, funding the implementation of an EnMS and its accompanying action plans is not considered a priority, even though in many cases the ROI of such projects is very attractive and will have a long terms positive impact on budgets;

   ii. Within the financial procedures of most MoDs, various/different budget lines have to be used for the implementation of action plans (e.g. for training, infrastructure renovation, fuel monitoring, procurement of equipment, etc.). The owners of these budgets are different and there are challenges into coordinating such actions.

d) Organisational issues:

   i. Energy efficiency in general has been mentioned only as a broad responsibility of "all commanders". In most cases, energy was identified as a responsibility of the overall system, but no specific leader/commander has been assigned as owner/ manager. This is coupled with the fact that various internal stakeholders do exist (e.g. logistics support, infrastructure, human resources/training, operations, maintenance, etc.), without anyone taking the lead;

   ii. In most of the cases that energy efficiency improvement plans with broad objectives have been established at the top level, there are no corresponding, specific actions and targets assigned to every single military unit;

   iii. Multi-tier hierarchy chains [i.e. strategic level: Minister of Defence and Chiefs of General Staffs, operational level: commands/groups, tactical level: corps, divisions/stations, brigades/wings, battalions/squadrons (and equivalent civilian chains of command)]: to reach common agreements on EnMS/EMS issues around 7 tiers of command have to be involved;

   iv. Wide communication on energy-related issues among same level units and formations that would lead to dissemination of good practice has not been established yet.

   v. In general, energy management review meetings are not a common practice among defence organisations. Only annual progress reports supported with general EnPIs are submitted to the top level and, in most cases, these processes are isolated from other key functions of the defence sector. Only in the sites that an EnMS/EMS is applied, periodic energy efficiency meetings are held to review progress and capture actions towards stated objectives, since this is a requirement of the relevant standards.

vi. Energy managers in the operational/camp level are in most cases appointed with the responsibility for other time-consuming tasks, which actually slackens their engagement and effectiveness.

vii. Frequent turnover of military personnel.

e) Technical issues:

i. Data collection/metering: sufficient data granularity is key to ensure that action plans are effectively targeting on significant energy uses (SEUs) and the commitment of personnel and all levels of command is maintained. In some cases, evidence in the form of energy data and mainly on how energy consumption is partitioned is difficult to acquire.

ii. Definition of the EnMS/EMS scope: there is always the debate on whether to include operational activities within the scope and what will be the impact of such an action on the operational capabilities.

iii. In some MoDs/armed forces there are still grey zones in terms of whether certain legislative clauses actually exempt defence-related infrastructure and activities. This affects the progress of the works and slows down the investments, since additional efforts are required to investigate/interpret the statutory requirements, in cooperation with the competent authorities.

2.1.7 Energy Data

EU Framework

In *Article 3*, the EED stresses the necessity of setting national energy efficiency targets. In order to monitor the progress of achieving these targets, among others, there are requirements concerning metering of energy products – including submetering (*Article 9b*), remote reading (*Articles 9 and 9c*), billing information – including cybersecurity (*Articles 10, 10a* and *Annex VI*) and the relevant costs of access to both metering and billing (*Article 11*).

EU MoDs Current Status on Energy Data & Billing

According to the discussions during the 1st CF SEDSS I and the 2nd CF SEDSS II WG1 meetings and the relevant replies on *Q-1* Questionnaire (CFI, January 2016) and *Q-6* Questionnaire (CFII, October 2018):

a) All MoDs collect energy data and maintain relevant records. **The types and details of data, as well the competent bodies that are responsible for these tasks vary between MoDs**.

b) The granularity of data, the use of smart meters and the level of record keeping for infrastructure consumptions differs:

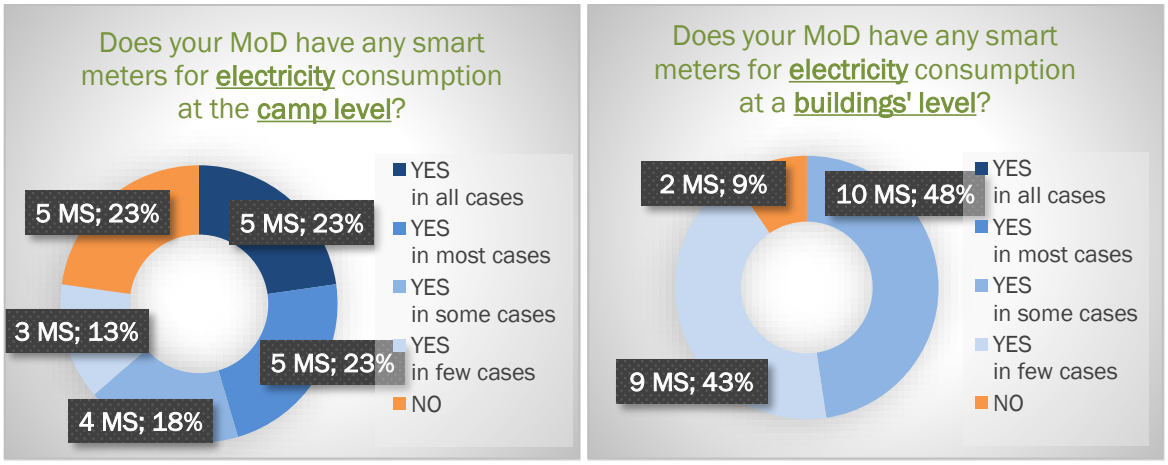


Figure 10: Utilisation of Smart Metering Devices in the Defence Sector (October 2019)

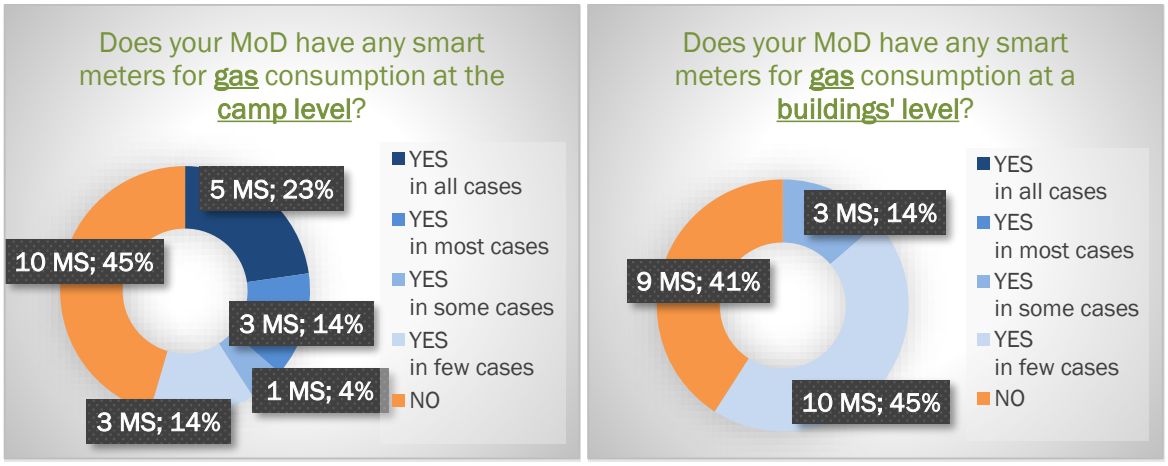


Figure 10: Utilisation of Smart Metering Devices in the Defence Sector (October 2019)

c) **MS do acknowledge that the use of smart metering may have to be extended at the buildings' level, to pinpoint rapidly any energy saving opportunities. A project of such a magnitude requires long-term planning and significant resources.**

d) With respect to the energy consumption bills (electricity/gas/heating oil):

i. The quality of information provided by energy retailers to the MoDs is in general according to the provisions of the EED in 19 out of 23 MoDs (83%). 4 MoDs (17%, 4 out of the 23 MoDs that replied) do not acquire the billing information in accordance with Annex VII of EED;

ii. As far as complimentary information on historical consumptions is concerned, it is available to most MoDs (87%, in 20 out of the 23 MoDs that replied);

iii. Electronic billing is provided by energy retailers to more than three-quarters of the MoDs (77%, in 17 out of the 22 MoDs that replied);

iv. In more than two-thirds of the EU countries (70%, in 16 out of the 23 MoDs that replied) the energy consumption bills are paid centrally, either by the MoD or by the relevant General Staff. In most of these cases, the energy-reduction action plans are launched and managed centrally. In the rest of the cases, the commanders of the camps are responsible for covering the relevant expenses.

e) Most MoDs keep records of the total useful floor area[48]:

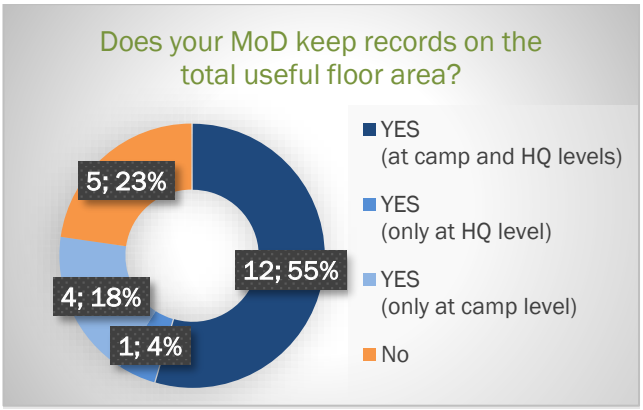


Figure 11: Record-keeping of Total Useful Floor Area in the Defence Sector (October 2019)

f) Energy performance indicators (EnPIs)[49] have been developed and used in only around 1/3 of the MoDs so far (36%, 8 MoDs out of the 22 that replied). Mainly they represent ratios of consumed energy per metric (m^2, number of personnel, distance driven) or emissions and are not normalised considering weather conditions or other independent variables that may affect consumptions. **MS acknowledged that the selection of appropriate EnPIs is critical, since unsuitable EnPIs can be misleading.**

g) More than half of the MoDs (55%, 12 out of the 22 MS that replied) project their future energy needs. Among them, 4 conduct some sort of modelling, which in all cases is a very simple one, just based on historic trends of consumptions and prices. **The use of more sophisticated modelling tools, in cooperation with institutions that possess relevant know-how, will allow MoDs to forecast more accurately their energy needs and plan proactively.**

h) Almost ¾ of the MoDs (73%, 16 out of the 22 MS that replied) submit their energy data to their national competent authority. This task is carried out on an annual basis, except from 1 MoD, which performs this exercise bi-annually. **All reporting (on annual consumptions and/or on future energy needs) has been proven until now time-consuming and of no added value to the MoDs, since this action does not serve as a basis for further cooperation between the MoDs and the competent authorities** (e.g. for inclusion of the armed forces into financial schemes or energy efficiency upgrade projects, as it is highlighted in *Chapter 5*).

Challenges and Barriers

With respect to the installation of smart meters, the following financial and technical burdens were identified:

a) The slow pace of the installation of such devices by the energy providers – there are cases where the MoDs had to purchase the equipment.

b) In most cases, the military installations have been founded many decades ago and expanded, in the years to follow, not in an orthodox way. This fact has led to complex internal distribution grids that require significant numbers of smart meters in order to partition energy consumptions per use.

[48] Total useful floor area is the floor area of a building or part of a building, where energy is used to condition the indoor climate (definition nr 10, Article 2 of Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, as amended.

[49] According to EN ISO 50001:2018, an *Energy Performance Indicator (EnPI)* is a measure or unit of energy performance, which can be expressed by using a simple metric, ratio or a model, depending on the nature of the activities being measured.

c) Lack of commitment from senior/middle level management to engage in such action plans (see more on this on the *Human Factors Affecting Energy Efficiency* sections).

d) Lack of financial resources, since the budgets of all MoDs are cut down. There was just one case (4% of MoDs that replied) where an MoD was benefited by national/EU funding in order to install smart meters (and this was just for a few installations).

e) The significant size of the building stock, which, in most cases, is scattered around the whole country.

f) In some cases, the state of ownership discourages such acts, since there are EU countries in which the armed forces are just occupants and the competent national authority – owner is not interested in investing in such schemes.

g) The age of buildings requires, in some cases, costly preparatory works to install smart meters.

h) There is a potential risk of cyber security compromise with respect to smart metering and remote monitoring.

2.1.8 Human Factors Affecting Energy Efficiency

EU Framework

With respect to the human factors affecting energy efficiency, the EED states that the EU Member States should:

a) encourage training programmes for the qualification of energy auditors in order to facilitate sufficient availability of experts (*Article 8*);

b) promote suitable information, awareness-raising, education/training initiatives and technical assistance in order to inform on the benefits and practicalities of taking energy efficiency improvement measures and, further onto building relevant capacities among the general public and specific sectors (*Articles 17* and *18*).

EU MoDs Current Status on Human Factors Affecting Energy Efficiency

MoDs acknowledge the importance of human factors on energy efficiency and the definition of relevant qualifications when personnel is involved in tasks related to energy usage. MoDs also stressed the **need to broaden the scope of energy efficiency plans and interventions to address both technology and cultural change together**, in order to exploit synergies and realise their full untapped potential. In spite of the fact that technology may result in energy savings (if money is available) in the short run and that cultural change may take longer to achieve and bring positive results, it was also recognised the latter is still essential for the former and that either of them leverage on the other. Technology was also identified as a driver that could bring cultural change as part of a comprehensive and holistic plan.

Despite the general agreement on the need to address behavioural aspects, it was found that **the vast majority of MoDs/armed forces do not have a comprehensive behavioural change programmes being implemented or running across their whole organization.** Some of the reasons why MoDs do not have a behavioural change programme in place are:

a) the reduction of energy consumption considered as a lower priority issue within their organisations;

b) difficulty to control variables: cultural change is not a laboratory experiment where all variables can be controlled;

c) difficulty to measure results: there are no, or at least a few, tangible indicators of where the impact of the behavioural change programme has been;

d) difficulty to quantify results, articulate benefits and translate them into monetary value;

e) difficulty to justify and request funding for implementation of a programme where benefits cannot be articulated and translated into monetary value;

Finally, no MoD has quantitative data on the impact of a comprehensive behavioural change programme implemented in their organization; only some MoDs have qualitative data, including surveys and historical records of behaviour within organisations.

In terms of the human factors in defence context, we have to accept the following:

a) MoDs'/armed forces' personnel are well-disciplined and have been accustomed to following procedures, more than personnel of any other sectors (public or private).

b) There is a direct link between operational capabilities and energy efficiency, which is to the interest of the defence institutions but it also affects, in certain cases (e.g. deployment, crisis), the welfare of personnel.

c) The core of military personnel has entered the armed forces at an early age, through military academies or recruiting that involves subsequent training. At these early stages, personnel is more adaptable to new mind-settings and to new approaches of work. To that end, the effort to secure the commitment of the future leaders and followers has to start at these very early stages.

The human factors on energy savings and energy efficiency improvements which are illustrated in the diagram below[50] were explored within the defence context.

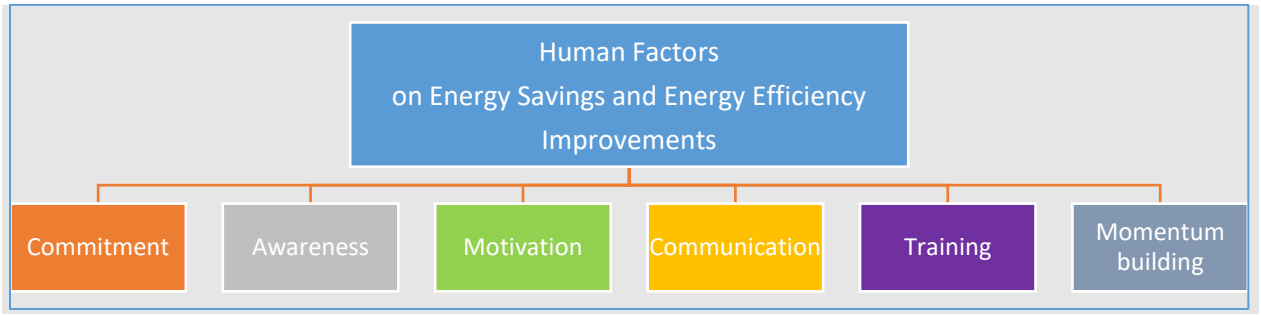


Figure 12: Human Factors on Energy Savings and Energy Efficiency Improvements

The concepts entailed within each of the aforementioned aspects, according to the discussions during the 3rd CF SEDSS I WG1 meeting and the relevant replies on the *Q-2* Questionnaire (November 2016) are the following:

a) Commitment (i.e. willingness to engage in energy efficiency improvement schemes, save energy and accomplish relevant targets):

i. The general, main objective of the MoDs/armed forces is to secure the sovereignty and serve the national interests of their country. Therefore, the objective of continuous improvement in energy management (as it is dictated by the ***plan-do-check-act cycle***) may be pursued systematically by defence decision-makers only in the cases where there are evident links between energy and operational requirements. In all cases, operational imperatives always prevail and determine the way of work in all the lines of command.

ii. A commitment for energy efficiency and energy savings from the strategic level of command is of paramount importance. However, in most cases this is not

[50] Adopted from *"Building Energy Manager's Resource Guide"*, written by NIFES Consulting Group on behalf of Sustainable Energy Ireland (SEI).

clearly defined and/or the mandate is not accompanied with the provision of the necessary resources.

iii. The lowest level (tactical) plays a key role, since at this level of command the implementation of all relevant projects and the mind-setting of personnel is actually taking place.

iv. There have been cases reported in which the operational/tactical levels of command have downgraded relevant mandates on energy efficiency due to the fact that these mandates were neither supported by adequate funding nor the actual resources available in that level were sufficient enough to support both the operational capabilities (as dictated by relevant procedures and plans) and any new schemes on energy efficiency.

v. In general, personnel as well as commanders are more committed during deployment and/or crisis, since in such operational environments energy resources are scarcer and any lack of them may well have adverse impacts on the operational capabilities or even human lives.

b) Awareness (i.e. understanding of energy issues and their impact on the defence sector):

i. Energy efficiency awareness schemes should aim to provide the necessary information to formulate cultural change in the direction of energy savings and energy efficiency improvements.

ii. The vast majority of MoDs have launched some forms of energy awareness campaigns (90.9%, in 20 out of the 22 MoDs that replied).

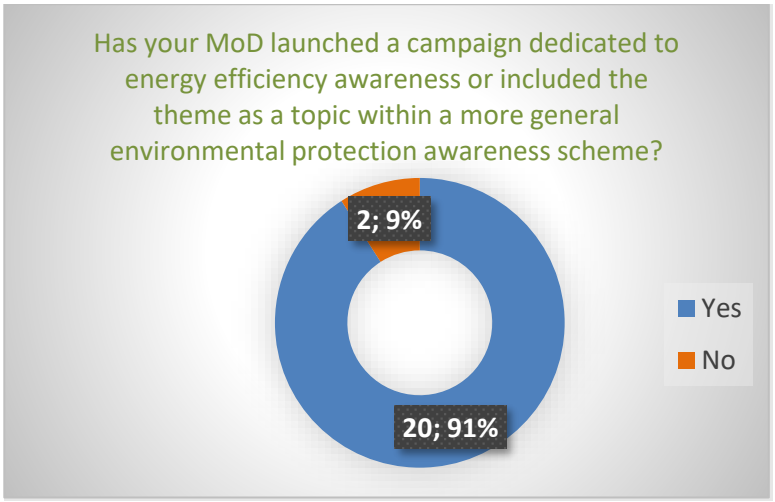


Figure 13: Implementation of Energy Efficiency Awareness Campaigns in the Defence Sector (November 2016)

In more detail:

a. 3 MoDs have had both dedicated energy efficiency awareness campaigns as well as environmental protection awareness schemes that included energy efficiency (13.6%).

b. 10 MoDs have launched dedicated energy efficiency awareness campaigns (45.5%).

c. 6 MoDs have not launched awareness campaigns dedicated to energy efficiency; however, they have integrated the topic into larger, environmental protection awareness schemes (27.3%).

d. 1 MoD was included in the scope of a broader governmental campaign on energy efficiency (4.6%).

e. Just 2 MoDs have not carried out any similar awareness campaigns (9.1%).

iii. Around one-third of the MoDs (36%, 8 out of the 22 MoDs that replied) were assisted by national competent authorities into their awareness schemes. In more detail:

a. 6 MoDs have received media material (i.e. leaflets, brochures etc.) (27%, 6 out of the 22 MoDs that replied).

b. 4 MoDs have received technical support (18%, 4 out of 22 MoDs that replied).

c. Not a single MoD has received national funding for awareness campaigns.

iv. Moreover, only just 1 MoD (5%, 1 out of the 21 MoDs that replied) has received some EU funding for awareness campaigns.

v. The shortage and/or low quality of energy data hinders energy-awareness campaigns.

c) Motivation (i.e. the factor or combination of factors and enthusiasm that drive hierarchy and personnel to save energy and increase efficiency). There are numerous factors that may influence the motivation of individuals and/or groups within MoDs'/ armed forces' personnel, such as:

i. Awareness; although there is a clear distinction between awareness and motivation, i.e. what people know vs why they take action, these two elements are interrelated, as it is depicted in the following grid [51]:

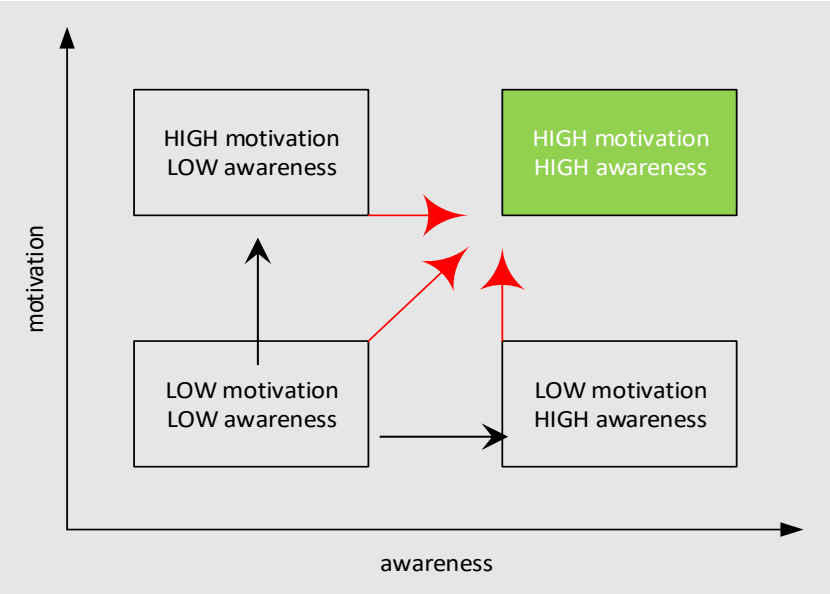


Figure 14: Awareness/Motivation Grid [5]

[51]Adopted from *"Building Energy manager's Resource Guide"*, written by NIFES Consulting Group on behalf of Sustainable Energy Ireland (SEI).

Within the MoDs/armed forces there is personnel that falls into all 4 categories of motivation/awareness presented in the aforementioned diagram.

ii. Operational imperatives; military personnel have a very high sense of duty. In operations, especially during deployment, the availability of energy resources is decisive on the success of the operations. This parameter affects all levels of hierarchy and personnel.

iii. Personnel safety; as many recent studies emphasize, energy savings and energy efficiency improvements during operations reduce the exposure of personnel to threats related to logistic support of energy resources.

iv. Exemplar behaviour/commitment from commanders; the paradigm of leadership of all levels paves the way for personnel to follow accordingly.

v. Legislation and internal orders; this is a typical top-down approach that military personnel, being well-disciplined, is accustomed to follow.

vi. Financial incentives; this is the main driver for higher levels of command to reduce energy consumption mainly in everyday activities but also during operations.

vii. Running competitions; internal competitions on energy savings among military units or individual personnel have been proven to boost motivation, especially when prizes and/or publicity are involved.

viii. Keeping modern; adopting new trends based on civil counterpart activities refreshes motivation.

ix. Social pressure; up until now the cases in which public opinion has focused on defence energy consumption and/or greenhouse gas (GHG) emissions are detrimental and sporadic. However, this parameter should not be undermined in the future.

d) Communication (i.e. various methods of delivering as well as receiving messages related to energy savings and increase of energy efficiency):

i. There is a need for communication streams that address energy issues internally as well as externally. As a first step, the relevant stakeholders in all levels should be identified, as seen in the diagram below.

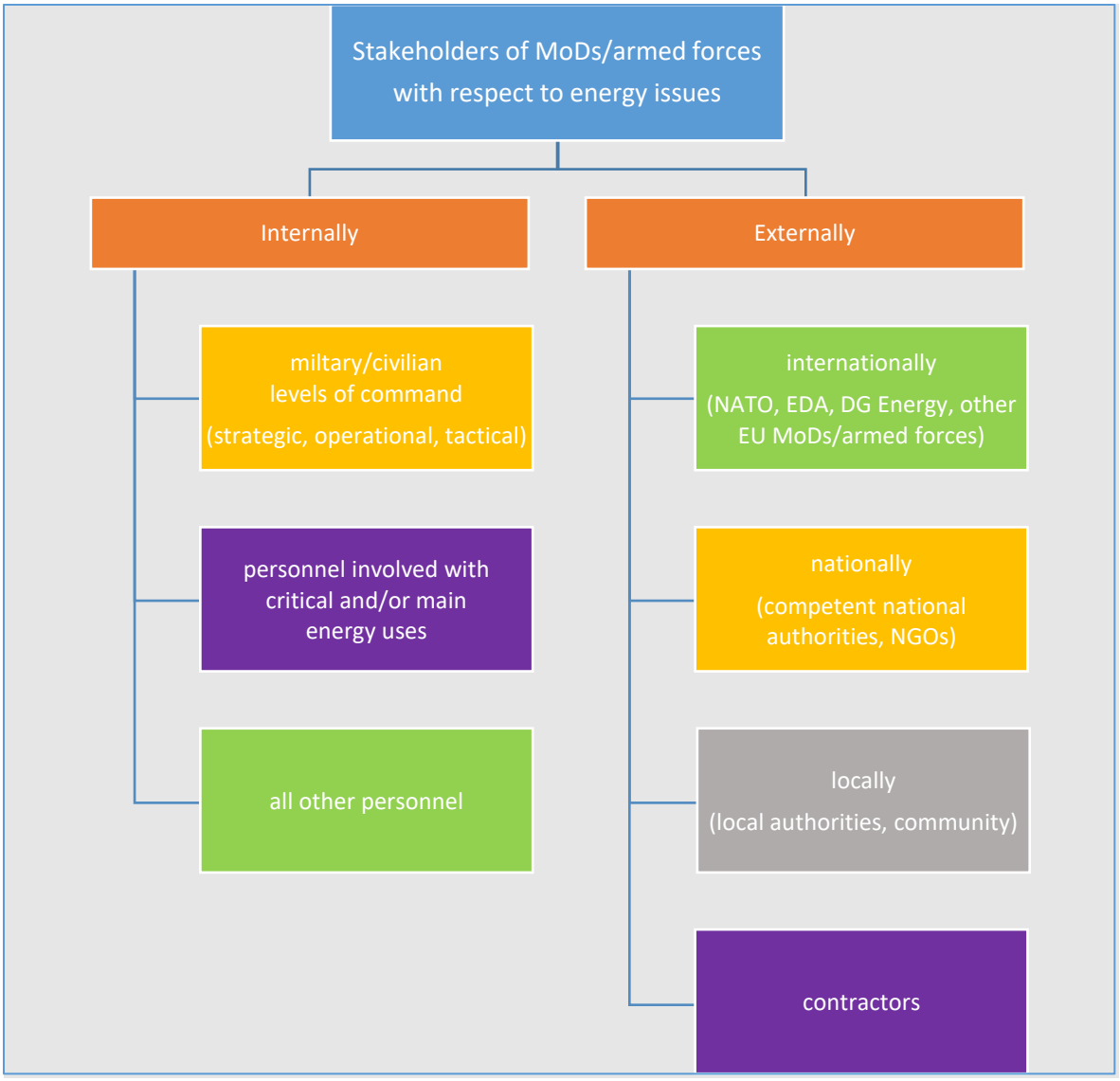


Figure 15: Stakeholders of MoDs/Armed Forces with Respect to Energy Issues

ii. So far, in most cases, the communication with respect to energy issues between all the aforementioned internal and external stakeholders is not consistent and is mainly focused on just reporting energy consumption and not on topics with more added value for the future, such as lessons-learnt, new initiatives, funding tools, etc.

e) Training (i.e. the process of imparting knowledge and skills which enable personnel to undertake their role and duties taking energy efficiency and energy saving into consideration):

i. Different levels and syllabus of training are applied, depending on the duties/job descriptions as well as the skills of personnel.

ii. MoDs/armed forces have initiated professional training schemes in the regimes of energy efficiency. To that end, according to the discussions during the 3nd CF SEDSS I meeting and the relevant replies on *Q-2* Questionnaire (November 2016):

a. Professional training of engineers and technical personnel has been provided on the following topics:

- Design and construction of energy efficient infrastructure: in around two-thirds of the MoDs (64%, 14 out of the 22 MoDs that replied).
- Renovation of existing infrastructure in order to comply with the new legal framework on energy efficiency: in more than three-quarters of the MoDs (77%, 17 out of the 22 MoDs that replied).
- Design and application of renewable energy sources (RES): in more than two-fifths of the MoDs (41%, 9 out of the 22 MoDs that replied).
- Design and application of smart grids: in almost a quarter of the MoDs (23%, 4 out of the 22 MoDs that replied).

b. However, there is an almost unanimous perception that the aforementioned training schemes have to be improved and deliver more concrete results (95%, 18 out of the 19 MoDs that replied).

c. Energy efficiency has been incorporated into the syllabus of professional training of many specialties, which, according to their duties and expertise use energy or have an impact on it. A non-exhaustive list includes:

- aircraft pilots (on efficient throttling of aircraft engines during taxiing and take-off):
- heating/air-conditioning technicians (on execution of relevant inspections and maintenance):
- vehicle drivers (on eco-driving);
- equipment operators (on operation under energy saving MoDes);
- fuel logistics personnel (on preserving the quality of POL and handling of waste/drainage fuels);
- procurement officers (on applying energy efficiency requirements and/or special terms on energy savings during tendering).

d. Training on energy auditing is of paramount importance both for implementation of the relevant legal framework and, more critically, for mapping the building stock and equipment and, consequently, assessing any opportunities and methods for improvement:

- Half of the MoDs (50%, 11 out of the 22 MoDs that replied) have, to some extent, competent personnel within their infrastructure domain that have attended training programmes for the qualification as energy auditors. However, in the majority of MoDs the numbers of qualified energy auditors are not sufficient.
- In around one-fifth of the cases (22.7%, 5 out of the 22 MoDs that replied) the national legislative frameworks do not foresee the registration of civil servants and/or defence personnel as energy auditors. To that end, any potential energy auditing schemes within defence may suffer from various implications, that in many cases stall such schemes (e.g. sets an extra financial burden to the MoDs).
- In one case, the MoD decided not to purse systematic training on energy audits and to outsource this task to the relevant facility management contractors not because of lack of expertise, but because of other reasons (fluctuating workload on energy audits,

registration processing fees, general government direction to outsource services, etc.)

- Only one MoD benefited, to some extent, by national funding in order to conduct trainings on energy audits.

f. Momentum (i.e. the force that maintains the continuous improvement on energy efficiency):

i. Once some energy-related awareness and training schemes are reaching their end, it is always a challenge to maintain the continuous improvement of energy management.

ii. Moreover, the high turnover of commanders and military personnel adds greatly to the challenge of keeping the momentum.

iii. In the cases where an EnMS/EMS is not established, keeping this momentum relies only in the personal commitment of the involved staff and it is not an established "procedure".

iv. Currently, within the defence sector there are no monitoring mechanisms of identifying behavioural trends and reacting accordingly by launching initiatives that affect the human factors on energy efficiency.

Challenges and Barriers

The challenges and barriers that are identified concerning the human factors that affect energy efficiency fall under 5 main categories:

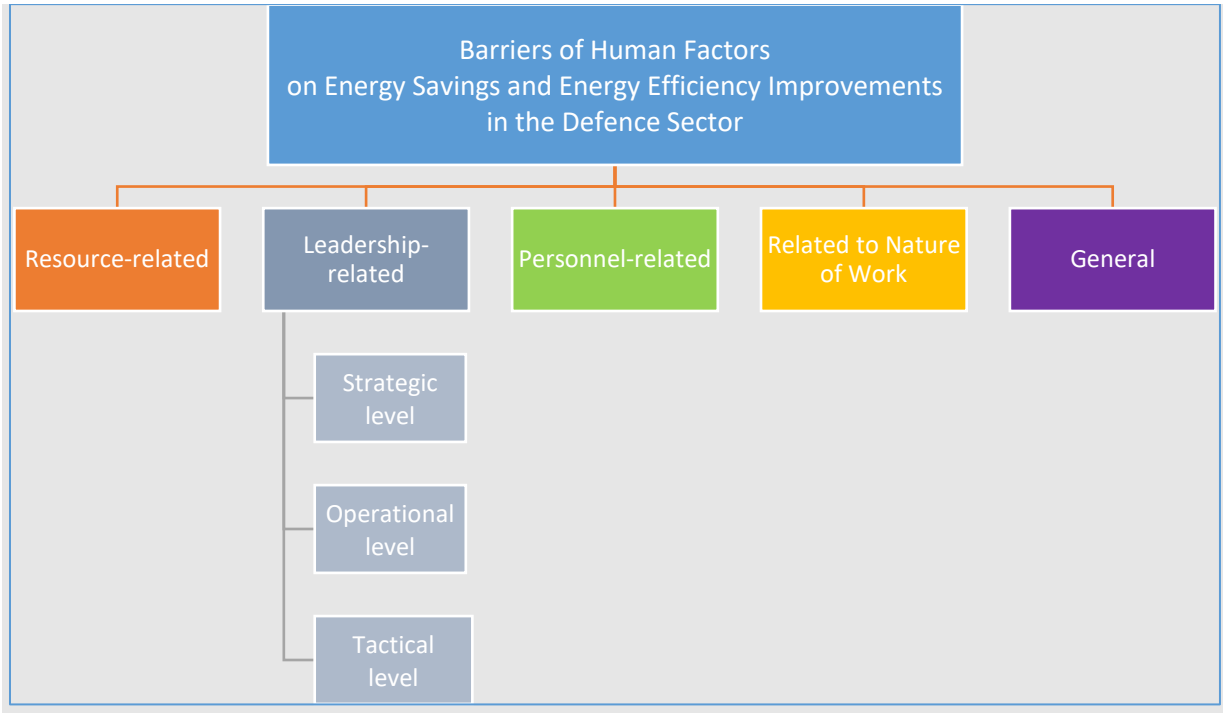


Figure 16: Barriers of Human factors on Energy Savings and Energy Efficiency Improvements in the Defence Sector

a) Resource-related barriers:

i. The lack of commitment of national competent authorities and central governments to assist the defence sector to undertake energy efficiency improvements.

ii. The general discomfort to commit to rules and requirements which have been enacted by the general government or EU and require changes that:

a. are perceived to require different approach to everyday work, already dictated by operational, imperative requirements;

b. are not being supported by relevant funding;

iii. The general scarcity of financial resources to implement large-scale energy efficiency projects that demonstrate vigorously the commitment of top management (strategic level);

iv. The general tendency (not limited to the defence sector) to neglect funding of training and awareness schemes and direct all available financial resources to more technical solutions, such as renovations and procurement of equipment.

b) Leadership-related barriers:

i. The levels of command within the defence sector are multi-tier:

a. strategic level: MoD and Chiefs of General Staffs;

b. operational level: Commands/Groups;

c. tactical level: corps, divisions/stations, brigades/wings, battalions/squadrons (and equivalent civilian chains of command).

To that end, in order for energy efficiency to excel, around 7 tiers of command have to commit to the cause.

ii. The turnover of top management (i.e. Ministers, Chiefs of Staff) and every 2-3 years stalls the launch of many long-term projects in non-operational domains.

iii. The turnover of operational and tactical commanders (as well as of most military personnel) every few years in duty stations, inland and abroad, that requires acclimatization periods in new main duties and operational objectives, results in slow/poor involvement with other aspects, such as energy efficiency, at least at the beginning. This has also a negative impact on the momentum that may have previously been built by previous commanders.

iv. The shortage of commitment of the middle and/or lower level of command that occurs from time to time, even in cases where the strategic level command has actually supported energy efficiency improvements (in the means of promulgation of energy policies and mandate for launching relevant projects).

v. The shortage of active involvement of middle and lower level commanders to undertake the task of customizing the messages to be marketed to various target groups of personnel in order to address practical and everyday situations.

vi. The different levels of awareness on energy issues among the levels of command, especially on the links between energy efficiency and the operational capabilities.

vii. The fact that in more than two-thirds of the MoDs (70%, in 16 out of the 23 MoDs that replied) the energy consumption bills (electricity/gas/heating oil) are paid centrally either by the MoDs or by the relevant general staff (in the rest of the cases, the commanders of the camps are responsible to cover the relevant expenses). In such cases there is a lack of motivation at camp/installation level and the energy-reduction initiatives and action plans, as well as the management, are launched centrally.

c) Personnel-related barriers:

i. The rotation of personnel every few years in various duty stations hinders their involvement with energy efficiency activities, since other, more imminent activities related to their new operational tasks have to be addressed. This has also a negative impact on the momentum that may have previously been built by or within former personnel.

ii. The different levels of awareness on energy issues among personnel.

iii. During competitions on energy savings among different military units, fair play has to be safeguarded, since there have been reported cases of rivalry and misbehaviour.

d) Barriers related to nature of work:

i. The imperative to operate in various environments, under a wide range of climatic characteristics and available energy resources, especially when it comes to deployed missions. This requires, in some cases, further awareness-raising and training.

ii. The general motto "train as you fight" that crosscuts all defence activities, in order to ensure operational readiness and full exploitation of the military capabilities, cannot always be applied in the case of energy efficiency. In other words, during training the energy-related issues can be taken into account, but there are cases in operations that the parameter of energy-saving has to be downgraded due to operational and/or personnel safety imperatives.

e) General barriers:

i. The tendency to emphasise potential financial benefits from energy savings and/or energy efficiency upgrades rather than focusing on indisputable benefits towards personnel (e.g. comfort).

ii. The portions of information that are disseminated through awareness schemes have to be balanced and targeted. Too much information may lead to fatigue and loss of enthusiasm.

2.1.9 Public Procurement and Energy Efficiency

EU Framework

According to Article 6 of the EED, EU Member States shall ensure that central governments, in which the MoDs /armed forces are included, purchase only products, services and buildings with high energy efficiency performance, insofar as that is consistent with cost-effectiveness, economic feasibility, wider sustainability, as well as sufficient competition.

A specific clause for the armed forces, under paragraph 2 of Article 6 of the EED, allows MoDs to apply the aforementioned requirements only to the extent that no conflict with the nature and the primary aim of the activities of defence is caused.

Annex III of EED provides guidance on the energy efficiency requirements for purchasing products, services and buildings by the central government, taking into account:

a) The Energy Labelling Regulation *[Regulation (EU) 2017/1369]* as well as the delegated acts on specific products.

b) The Eco-design implementing regulations (under *Directive 2009/125/EC on Energy labelling,* repealed by *Regulation (EU) 2017/1369*) adopted after the entry into force of the EED.

c) The EU-US Energy Star Agreement (expired on 20 February 2018).

d) The minimum energy efficiency requirements for buildings and building elements that the EPBD obliges EU Member States to set.

e) The Public Procurement Directive (PPD – *Directive 2014/18/EC*).

EU MoDs Current Status on Public Procurement and Energy Efficiency

According to the replies to *Q-3* Questionnaire (CF I, May 2017):

a) The majority of the MoDs/armed forces have incorporated the relevant specifications concerning energy efficiency into their procedures/requirements for the procurement of various products. In more detail:

b)

Type of Product	Compliance
Air conditioners [Regulations 626/2011/EU and 206/2012/EU]	**82%** of the MoDs / AF that replied (14 out of the 17)
Circulators [Regulations 641/2009/EU and 617/2013/EU]	**53%** of the MoDs / AF that replied (9 out of the 17)
Dishwashers [Regulation 1059/2010/EU]	**65%** of the MoDs / AF that replied (11 out of the 17)
Domestic ovens, hobs and range hoods [Regulations 66/2014/EU and 65/2014/EU]	**65%** of the MoDs / AF that replied (11 out of the 17)
Electric motors [Regulation 4/2014/EU]	**67%** of the MoDs / AF that replied (12 out of the 18)
Water heaters and hot water storage tanks [Regulations 812/2013/EU and 814/2013/EU]	**83%** of the MoDs / AF that replied (15 out of the 18)
Heaters [Regulations 811/2013/EU and 813/2013/EU]	**67%** of the MoDs / AF that replied (12 out of the 18)
Local space heaters, solid fuel local space heaters [Directives 2015/1185/EU, 2015/1186/EU and 2015/1188/EU]	**65%** of the MoDs / AF that replied (11 out of the 17)
Solid fuel boilers [Directives 2015/1187/EU and 2015/1189/EU]	**53%** of the MoDs / AF that replied (8 out of the 15)
Lamps, directional and LED [Regulations 874/2012/EU and 1194/2012/EU and Directive 2015/1428/EU]	**78%** of the MoDs / AF that replied (14 out of the 18)
Lamps, non-directional, fluorescent and professional [Regulation 874/2012/EU and Directive 2015/1428/EU]	**78%** of the MoDs / AF that replied (14 out of the 18)
Refrigerated storage cabinets [Directives 2015/1094/EU and 2015/1095/EU]	**65%** of the MoDs / AF that replied (11 out of the 17)
Household refrigerating appliances [Regulation 1060/2010/EC]	**75%** of the MoDs / AF that replied (12 out of the 18)
Electric power consumption standby and off MoDe of electrical and electronic household and office equipment [Regulation 801/2013/EC]	**76%** of the MoDs / AF that replied (13 out of the 17)
Television [Regulations 1062/2010/EU and 801/2013/EC]	**65%** of the MoDs / AF that replied (11 out of the 17)
Transformers [Regulation 548/2014/EU]	**65%** of the MoDs / AF that replied (11 out of the 17)
Household tumble driers [Regulations 392/2012/EU and 932/2012/EU]	**56%** of the MoDs / AF that replied (9 out of the 16)
Vacuum cleaners [Regulations 665/2013/EU and 666/2013/EU]	**69%** of the MoDs / AF that replied (11 out of the 16)

Ventilation units [Regulations 1253/2014/EU and 1254/2014/EU]	**78%** of the MoDs / AF that replied (14 out of the 18)
Household combined washer-driers [Directive 96/60/EC]	**65%** of the MoDs / AF that replied (11 out of the 17)
Household washing machines [Regulation 1061/2010/EU]	**71%** of the MoDs / AF that replied (12 out of the 17)
Tyres [Regulation 1222/2009/EC]	**62%** of the MoDs / AF that replied (10 out of the 16)
Computers [Regulations 617/2013 and 174/2013/EU, Commission Decision 2015/1402/EU along with EU-US Energy Star Agreement]	**84%** of the MoDs / AF that replied (16 out of the 19)
Electronic displays and imaging equipment [Commission Decision 2014/202/EU along with EU-US Energy Star Agreement]	**79%** of the MoDs / AF that replied (15 out of the 19)
Uninterruptible Power Supplies (UPS) [Commission Decision 2014/202/EU along with EU-US Energy Star Agreement]	**67%** of the MoDs / AF that replied (12 out of the 18)
Enterprise servers [Commission Decision 2014/202/EU along with EU-US Energy Star Agreement]	**71%** of the MoDs / AF that replied (12 out of the 17)

Table 1: MoDs replies to Q-3 Questionnaire (CF I, May 2017)

Some of the categories of products are procured by MoDs /armed forces in very small quantities, hence their energy footprint is relatively small.

b) As far as the tendering specifications for service contracts, as listed in Annex II of the PPD (maintenance-repair, transport, telecommunications, computer – IT, architectural, engineering, technical, building-cleaning, sewage/ disposal, education, etc.), they have been incorporated into the relevant MoD/armed forces contracting requirements in different levels. In more detail, according to the replies to a relevant question of *Q-3* Questionnaire (CFI, May 2017):

   i. 10 MoDs (50%, 10 out of the 20 MoDs that replied) stated that in few tendering cases they have actually included a clause for the service providers to use products that comply with the relevant energy efficiency requirements;

   ii. 4 MoDs (20%, 4 out of the 20 MoDs that replied) stated that in many tendering cases they have included such a clause;

   iii. 4 MoDs (20%, 4 out of the 20 MoDs that replied) stated that in all tendering cases they have included such a clause;

   iv. 2 MoDs (10%, 2 out of the 20 MoDs that replied) stated that they have never included such a clause into their tendering requirements.

c) In terms of purchase and/or rental agreements for buildings, there are also different levels of incorporation of requirements concerning compliance with the national minimum energy requirements set under the EPBD among the MoDs/armed forces. In more detail, according to the replies to a relevant question of *Q-3* Questionnaire (May 2017):

   i. 8 MoDs (40%, 8 out of the 20 MoDs that replied) stated that they have actually included a clause on compliance with EPBD national minimum energy efficiency requirements in all contracts for purchase/rental of buildings;

ii. 5 MoDs (25%, 5 out of the 20 MoDs that replied) stated that they have included such a clause in many contracting cases for buildings;

iii. 4 MoDs (20%, 4 out of the 20 MoDs that replied) stated that they have included such a clause in few contracting cases for buildings;

iv. 3 MoDs (15%, 3 out of the 20 MoDs that replied) stated that they have never included such a clause into contracting cases for buildings.

Challenges and Barriers

The challenges and barriers identified by MoDs that have incorporated, to some extent, relevant energy efficiency requirements in the tender specifications for products and services include the following:

a) Availability of energy efficient equipment in the market, especially in the cases that products are purchased in the local markets;

b) Availability of certified service providers in sufficient numbers throughout the country;

c) Excessive cost of procurement of energy efficient equipment/certified service providers, combined with the fact that the operational performance and/or the lowest price of purchase/life-cycle are the key or dominant criteria and (i) energy efficiency is valued less, or (ii) no justification through ROI is mandatory;

d) Absence of central mandate/guidelines within the internal procurement processes for incorporation of energy efficiency specifications in the tendering/contracting requirements;

e) Gaps in the training/motivation of procurement officers;

f) Some products are purchased in very small quantities locally by the camps' authorities and go unnoticed.

2.1.10 Energy Performance Contracting

EU Framework

According to *Article 18* of the EED, EU Member States shall promote the energy services market by supporting the public sector in taking up energy services offers, in particular for building refurbishment.

Energy performance contracting (EPC) is a form of financing for capital improvement which allows funding energy upgrades from cost reductions. Under an EPC arrangement, an external organisation (energy service company - ESCO) implements a project to deliver energy efficiency, or a renewable energy project, and uses the stream of income from the cost savings, or the renewable energy produced, to repay the costs of the project, including the costs of the investment. Essentially the ESCO will not receive its payment unless the project delivers energy savings as expected.

ESCOs, differently from the traditional energy consultants or equipment suppliers, can also finance or arrange financing for the operation and their remuneration is directly tied to the energy savings achieved. Therefore, ESCOs accept some degree of risk for the achievement of improved energy efficiency in a user's facility and have their payment for the services delivered based (either in whole or at least in part) on the achievement of those energy efficiency improvements.

EU MoDs Current Status on Energy Performance Contracting

Participants acknowledged the following potential benefits of pursuing EPC with ESCOs, although their experience on this topic so far is limited (see next paragraph):

a) Reduction of energy consumption and other agreed criteria, such as greenhouse gas (GHG) emissions and production of energy by RES;

b) Execution of energy efficiency upgrades, even without the necessity of initial capital investment from the side of the MoDs/armed forces (resulting to no increases to national budgets/debts);

c) Transfer of risk from the MoD to the contractor in terms of real performance obtained (i.e. guaranteed savings, provided all requirements of the contracts are met/followed), adaptation of innovative technologies and volatile prices of energy products (mainly oil);

d) Ownership of the equipment is passed to the MoD/armed forces after the end of the contract (in case it was originally procured by the ESCO);

e) Utilisation of the contractors' human resources and expertise to engineer and further maintain the technical interventions, coupled with the scarcity of relevant resources/expertise from the MoDs'/armed forces' side in many cases;

f) Parts of the savings can be agreed in the contract to be returned to the landowner (MoD/armed forces) during the contract;

g) Justification of the investments by a ROI considered on global cost (including future energy bills).

According to the MS replies to *Q-7* Questionnaire (CF II, February 2019), as combined/compared with the replies on the *Q-3* Questionnaire (CF I, May 2017), the EPC market in the defence sector is still very young but promising to some extent. In more detail:

a) 5 MS are already implementing or are in the process of signing EPCs (21%, 5 out of the 24 countries that replied). In more detail:
   i. In 3 MS the EPCs' scopes are only energy efficiency upgrades (heating, ventilation, and air conditioning – HVAC, upgrades to the buildings' envelope, building management system – BMS, etc.), whereas in the remaining two (FR and UK) the generation of energy from RES is also included;
   ii. In total, a comparatively small number of contracts have been signed so far;

b) 5 MS are facing either accounting rules or policies that prevent or make it challenging to implement an EPC (22%, 5 out of the 23 countries that replied). In more detail:
   i. In one MS there is a federal budget law situation that prohibits the implementation of EPCs;
   ii. In another MS there are some policies with regards to physical works/building on infrastructure that make the implementation of EPCs challenging;
   iii. In the existing public fiscal system of one MS (following a relative EU legislative provision), money from the infrastructure's utility bills saved by potential energy efficiency improvement measures is supposed to return to the national treasury. Moreover, according to specific consultation documents issued by the MS Independent Authority for Public Contracting, EPC contracts dealing with the application of deep renovation (e.g. interventions to the building envelope, to the HVAC equipment, etc.), are considered contracts of public works (not contracts for procurement of materials and services). Therefore, since the existing law for public procurement does not include provisions of such considerations (payments for contractors' compensation can only be made during the "work in progress" period, not after or before), EPC contracts can only be applied as

procurement contracts (e.g. for replacing existing lighting bulbs with LED bulbs), thus with limited energy performance improvement results;

iv. In one MoD case, specific operational equipment or facilities (command posts, bunkers, etc.) are serviced by military personnel only;

v. In one MS any contract that requires a multi-annual commitment (such as an EPC) must be approved by the Ministry of Finance, creating a significant bureaucratic burden;

c) 5 MS that have not yet applied EPCs are planning to follow this path in the near future (26%, 5 out of the 19 countries that have not applied EPCs so far).

Further to the MS replies to the aforementioned structured questionnaires, the following graph, prepared during the 4th CF SEDSS I meeting (May 2017), illustrates the MS perception of the implementation of EPCs:

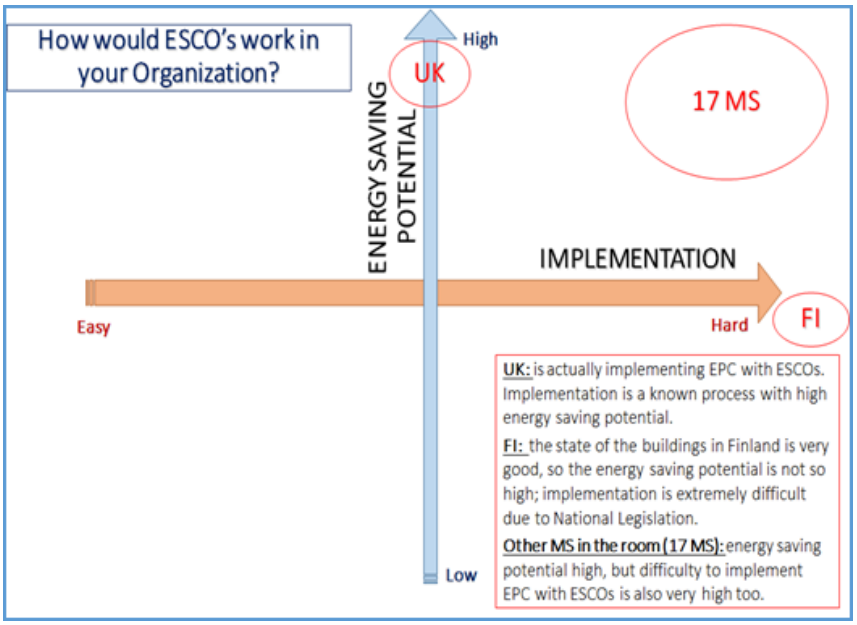


Figure 17: MS Perception on the Implementation of EPCs in the Defence Sector (May 2017)

Challenges and Barriers

The challenges and barriers identified by MS in the development and implementation of EPCs include the following:

a) Gaps in the national legal frameworks for the implementation/contracting of power purchase agreements (PPAs), including EPCs.

b) Internal procedures on budgeting that do not allow pay-back from existing budget lines for billing and/or to pay more than the actual consumption from the operational budget lines;

c) Uncertainties on the future uses/occupation of buildings and land usage in the long term, due to large scale re-organisations within the MoDs/armed forces.

d) Lack of baseline data (energy and its drivers), in combination with challenges to acquire the blueprints of buildings and their equipment that have been built several decades ago and in various phases;

e) MoD's/armed forces' liabilities towards the institutions that fund EPCs in the cases of ESCOs' bankruptcy and especially in terms of maintenance/ownership of equipment and, perhaps, loan instalments;

f) Reluctance of senior management to commit to long-term contracting with the private sector (ESCOs);

g) Several cases where most of the opportunities for reduction of energy consumption/increase of energy efficiency have already been harvested internally through other MoD/armed forces initiatives and the remaining potential for improvement constitutes less attractive business cases for ESCOs;

h) Potential challenges in the cooperation between the MoD technical personnel that is responsible for the maintenance of infrastructure and the ESCO's personnel, in terms of allocation of maintenance tasks and duties.

i) The practicalities and details of measurement and verification (M&V) may create friction between the contractors and the site owners, hence a lot of attention has to be paid during the development of the tender specifications.

j) Cases of limited expertise from the side of the involved MoD's/armed forces' personnel to:

   i. Perform preliminary energy audits, feasibility studies and setting the energy usage baseline;

   ii. Evaluate the technical proposals of the interested ESCOs during the tendering phase;

   iii. Verify the actual savings during the implementation of the EPCs;

   iv. Sustain the maintenance and support of the equipment after the end of the contract.

2.1.11 Renovation of Existing Buildings and Deep Renovations to NZEB Standards

EU MoDs Current Status on Renovation of Existing Buildings – Deep Renovations to NZEB

With respect to the renovation of existing buildings and deep renovations to near zero energy building (NZEB) standards, MoDs have no concerted programmes for implementation of energy efficiency measures, both applicable to technical systems and building envelope, and renovations take place on an opportunity basis.

The adoption of a solid comprehensive methodology and holistic approach to implementation of energy efficiency projects (preparation -> design -> pre-construction -> construction -> in use) has been identified as necessary for the success of such projects, with insufficient time and effort allocated to commissioning being one of the most common and critical mistakes that compromise the realization of the energy savings potential.

The adoption and pursue of different energy targets by different MS lead to different drivers (energy saving, cost saving, green energy production, CO_2 reduction, societal benefits, etc.) that affect the approach to and design of the energy efficiency projects, and ultimately define and outline the type and scale of the refurbishment interventions.

Moreover, the existing variability in the interpretations and requirements for NZEB standards established by different MS seems, at first sight, to act as a hindrance to the adoption of an EU common approach and framework for an EU NZEB definition. Belgium, with three different interpretations in its three different regions varying from no requirements in one region, to very strict requirements in other region and adoption of *"passivhauss"* standards in the other region,

was provided as a good example of this variability. However, considering the very different climatic conditions across the EU, it has also been questioned if a common definition of the NZEB concept would be practicable, or even possible, and whether it may be better to keep the definition of NZEB open for MS to decide on it on the basis of their national specific conditions.

Overall, MoD delegates declared that, even though the defence sector has some exemptions from complying with the EPBD, there may be opportunities to act on accommodation units, offices, schools, etc. Since defence sites are normally composed of multiple buildings with different uses and different characteristics and energy saving opportunities, a "cluster approach" to a NZEB concept that takes into account the aggregate effect of a combination of different interventions and solutions is considered more appropriate and applicable to the defence sector, than a single building approach. For example, within one military site, there may be one building that is apt for renovation and saving energy, another for installation of photovoltaic (PV) and producing energy, and another for any intervention. There may also be space on the site for installation of low carbon energy generation (e.g., combined heat and power (CHP), mini wind turbines, or geothermal exploitation). It is the net zero, or nearly zero energy sum of the cluster that should be accounted for.

Challenges and Barriers

During Phase I, MoDs' delegates identified the following obstacles, limitations and challenges to the implementation of a NZEB renovation programme:

a) Finance: funding is not accessible to the defence sector.

b) Cost savings attained in utilities are not translated into capital that can be reinvested in additional energy efficiency measures.

c) Lack of expertise/training.

In the main, deep NZEB renovations have not yet taken place in the defence sector.

Permanent Demountable Buildings

The traditional concept of temporary buildings being typically low-quality and energy inefficient was challenged with the disruptive concept of highly energy efficient permanent demountable buildings (PBD), which are designed to be demounted, containerized, stored, transported, and reused where and whenever needed to match evolving needs over time. Some non-EU norms on PBD, such as the US Army's regulations or the *"Pearl Building Rating System"* from the Emirate of Abu Dhabi, were highlighted.

It was noted that PBDs can attain high levels of energy performance and savings throughout their guaranteed life cycle of at least 20 years and that, with proper planning, PBDs could be used in replacement of traditional, low quality, temporary buildings, bringing about additional benefits such as assembly time, reduced maintenance costs, reusability and scalability.

All MoDs recognised that there is a lack of forward planning when it comes down to deciding on energy performance requirements for temporary buildings and that a potential service life extension that could justify energy investments is never factored in to the design aspects, in service life planning or procurement processes within their organizations. The benefits of longer-term planning and the utilisation of PBDs for temporary buildings was acknowledged.

2.1.12 Energy Audits and Energy Information Systems

EU Framework

According to *Article 8* of the EED, EU Member States shall promote the availability of high quality energy audits, which have to be cost-effective and carried out in an independent manner (even by in-house experts through a relevant scheme) by qualified and/or accredited experts according to

national criteria. Moreover, energy audits may stand alone or be part of a broader environmental audit.

EU MoDs Current Status on Energy Audits and Energy Information Requirements

According to *Q-8* Questionnaire (CF II, May 2019):

a) most MoDs carry out some form of audit programme on selected buildings (mainly new buildings or deeply renovated buildings) and prepare energy performance certificates;

b) 4 MoDs conduct energy audits in all their buildings;

c) there is a mixture of internal and external personnel carrying out certification.

Challenges and Barriers

Digital technology and artificial intelligence are starting to challenge conventional methods of maintaining equipment and machinery through creation of digital twins. This technology provides opportunities to ensure optimum energy performance of building and building systems. Blockchain technology is employed to protect the data and enhance cyber security.

2.1.13 Energy Performance Certificates

EU MoDs Current Status on Energy Performance Certificates

Different MoDs have different interpretations of the concept of a "public building", resulting in different understandings, policies and approaches to EPBD *Articles 11, 12* and *13* regarding the obligation to obtain and display an energy performance certificate on MoDs' buildings. Interpretation ranged from no obligation to full coverage. Some MoDs considered that a building is "public" when it serves a public service, leaving out defence buildings completely; the definition of being visited frequently by the public is not clear either, leaving room to define what "frequent" means, or if citizens visiting the building for business purposes (industry mainly) are considered as public, for example.

As with the energy audits, the implementation of energy performance certificate requirement was not found to be uniform across MoDs; some of them have programmes and some of them do not, and the personnel carrying them out were internal for some MoDs and external for others.

EU Framework

According to *Article 10* of the EPBD, EU Member States shall lay down the necessary measures to establish a system of certification of the energy performance of the buildings, including their actual performance as well as reference values (e.g. minimum energy performance requirements to compare and assess and recommendations for the cost-capital or cost-effective improvements). As far as the public authorities are concerned, subject to national rules, EU Member States shall encourage them to take into account the leading role which they should play in the energy performance of buildings, by implementing the recommendations included in the energy performance certificates. Practicalities concerning the energy performance certificates are provided in *Articles 12* and *13* of the EPBD.

Challenges and Barriers

The lack of resources and budget were the main obstacles to implementation. The lack of proper benchmarks for defence buildings was again highlighted, and the willingness to have universal minimum energy performance requirements for all weather conditions throughout the year put on the table as food for thought. The methodology may be appropriate for standard buildings, but may not apply for defence specific buildings. Finally, there was unanimous agreement on the fact that sometimes it is not cost effective to raise the performance of specific buildings. Also, raising the commercial value of a building is of limited impact to the defence sector. Overall, the objective of the displaying the EPCs was not obvious. The impression is that the defence sector is not obligated

to comply with these provisions, although benchmarking defence building energy performance was seen as a good idea. In general, each pMS has a legally binding methodology to calculate the minimum energy efficiency requirement based on EU directives, and in accordance with, or adapted nationally from EN 16247 standard.

The reasons for the energy performance gap, understood as the difference between the predicted energy performance at the design stage and actual operational energy performance of buildings, were studied and are mainly due to:

- the method of calculating energy use for the purposes of building code compliance does not take into account all the energy uses in a building; in particular, it does not address energy used by lifts and escalators, for catering facilities, or server rooms. This energy use can be substantial;
- site practice: the design is not built as intended, the engineering systems are not commissioned effectively and the operators and occupiers of the building do not understand how to operate and maintain the building so that it delivers the expected performance;

In principle, all MoDs agree that having a target design energy performance of a building has value, but with the observation that the building code estimations are normally much lower than the actual energy performance of the buildings. There is additional value in having a methodology to predict more accurately at design stage the in-use energy performance of a building. Comparing and validating building performance with more accurate design estimations against real performance of the building can help to identify the poorly commissioned or maintained technical systems or behavioural aspects of the building users. Thus, a more detailed approach to modelling energy performance at the design stage, such as the TM54, can more accurately predict the real energy performance of the building during its operational life.

2.1.14 Inspection of HVAC and Retrofitting of Technical Building Systems

EU Framework

Directive (EU) 2018/844 has set new requirements concerning heating, ventilation and air conditioning systems, provided in *Articles 14* and *15* with respect to the output thresholds for inspections.

Moreover, EU Member States shall lay down requirements to ensure that, where technically and economically feasible, non-residential buildings with an effective rated output for heating systems or systems for combined space heating and ventilation of over 290 kW are equipped with building automation and control systems by 2025. The building automation and control systems shall be capable of:

a. continuously monitoring, logging, analysing and allowing for adjusting energy use;

b. benchmarking the building's energy efficiency, detecting losses in efficiency of technical building systems, and informing the person responsible for the facilities or technical building management about opportunities for energy efficiency improvement; and

c. allowing communication with connected technical building systems and other appliances inside the building, and being interoperable with technical building systems across different types of proprietary technologies, devices and manufacturers.

As far as the residential buildings are concerned, EU Member States may lay down requirements to ensure that residential buildings are equipped with:

a. the functionality of continuous electronic monitoring that measures systems' efficiency and informs building owners or managers when it has fallen significantly and when system servicing is necessary, and

b. effective control functionalities to ensure optimum generation, distribution, storage and use of energy.

EU MoDs Current Status on Inspection of HVAC and Retrofitting of Technical Building Systems

The delegates supported the outcomes of the Concerted Action that EPBD provisions on building technical systems are not effective; the inspection reports are too complex to prepare and then to understand, requiring a level of knowledge that users may not have and, in addition to that, there is no obligation to act on the recommendations for replacement or upgrading technical building systems. Most MoDs declared that they do not act on the inspection report recommendations, and that replacements or upgrading take place on an opportunity basis. Those MoDs that act on the recommendations declared that they normally do it when calculations and payback periods are clearly given in the report.

Inspections of technical building systems in the defence sector normally take place within two wider inspection programmes at MoDs:

a. Inspections within maintenance plans.

b. Inspections through external service contractors.

Electronic monitoring and control systems in heating and a/c systems are normally implemented in buildings, although their implementation is not done to satisfy the provision for reduction of inspection frequencies in *Articles 14* and *15* of the EPBD. Moreover, even if an electronic monitoring and control system is installed, it becomes very difficult to keep the systems optimised when inspections and maintenance services are externalized to contractors.

Concerning the establishment of requirements for the procurement of new, replacement and upgrading of technical building systems (for new and renovated buildings), MoDs declared that some national guidelines exist, however, these guidelines are too general and need to be more precise and specific.

With regard to the requirement to purchase only products, services and buildings with high energy-efficiency performance, MoDs declared that the existing procurement plans provide only general guidelines that are open to different options.

It was also noted that in some MS, particularly in Nordic MS, the public sector has to act and lead by example for private sector.

2.1.15 Building Automation and Control Systems (BACS)

EU Framework

The EU legal framework covering this aspect is included in *Article 8* of the EPBD, in which Member States, shall, for the purpose of optimising the energy use of technical building systems, set system requirements in respect of, among others, the overall energy performance and control of the technical building systems.

EU MoDs Current Status on BACS

CF I

MoDs recognise that the installation or replacement of existing inefficient building systems, for new state-of-the-art highly efficient building systems is at the core of the energy efficiency measures.

The setting of requirements in respect of the appropriate control of the technical building systems, and the installation of active control systems such as automation, control and monitoring systems, aiming to save energy, are required by Article 8 of the EPBD.

MoDs have revised building automation and control systems (BACS) functionalities and building operation principles from a conceptual and holistic perspective, and discussed about what makes a building more efficient, and also about the contribution of BACS's functionality to the improvement in the energy performance of buildings and touching upon other aspects, such as the implementation of metering and building automation within an energy management system, impact on operations, interoperability, economic efficiency, the criticality of having an appropriate and updated building stock inventory data base, or the implementation of distributed intelligence that allows for sensitive, adaptive, responsive and interactive actions in response to different conditions.

MoDs agreed on the importance of installing BACS and metering in their real estate at site and building level as a means to monitor and control appropriate operation of technical building systems and maximize energy savings. However, they do not make use of the full range of BACS that are now available, and they have metering and site level only; only some of them have sub-meters at building level and then only in part of their real estate (ca. 10% - 40%). An increasing number of the meters are 'smart' meters which allow remote monitoring of energy consumption.

Only a few MoDs have integrated systems installed at site level covering a number of buildings and facilities which facilitates active energy management. Some of the reasons why MoDs/armed forces have not installed BACS are:

- high cost of installation;
- lack of technical leadership:

Some MoDs have some quantitative data on the impact of BACS installation, although they would have to dig in very carefully on a case by case basis to obtain this data, and there is no continuous automated reporting. Qualitative data is more common among MoDs, although this data is more a *"gut feeling"* than something that has been objectively monitored in detail and accounted for. Once again, the lack of a proper baseline that is suitable for comparison purposes was highlighted by most of the MoDs. Renovations, demolitions and selling buildings were also mentioned as alternatives to big BACS implementations when looking at the big picture, especially in budgetary terms.

CF II

MoDs explored how control and automation can assist in limiting energy demand, balancing the use of sustainable energy and making the use of fossil fuels as effective and clean as possible (practical examples, making smarter use of the data, optimising installation performance, demand prediction and control and improving the working environment). Most defence infrastructure has a limited amount of building automation and control and therefore MoDs are not currently able to utilise the more sophisticated data management tools that are available. Long term plans are required which allow investment in small steps towards full automation and control.

2.1.16 Low Emission Vehicles and Support Infrastructure

EU Framework

Article 8 of the EPBD foresees, with regard to new non-residential buildings and non-residential buildings undergoing major renovation, with more than 10 parking spaces, the installation of at least one recharging point (in accordance with Directive 2014/94/EC) and ducting infrastructure for at least one every five parking spaces to enable the installation at a later stage for electric vehicles.

EU MoDs Current Status on Low Emission Vehicles and Support Infrastructure

Focusing on the transformation of internal combustion engine vehicles (ICEVs) into battery electric vehicles (BEVs), the following topics were discussed:

- The importance of having detailed information about the vehicle fleet: data such as vehicle fleet size, mileage, frequency, time and moment of use, age, and vehicle fleet management procedures to develop a solid business case.
- In general, the business case is solid in terms of technical and environmental aspects, although the current cost of BEVs is higher than ICEVs requiring a reduction in fleet numbers and higher utilisation to keep the overall operating costs at the same level.
- The energy mix of the electricity supply influences heavily the carbon footprint of the electric vehicles, with cases where ICEVs may result in net lower carbon emissions than BEVs (such as electricity produced in high percentages of coal).
- Support infrastructure is an added cost which may impact heavily the financial health of the initiative; charging installation costs vary from 1/1,2k EUR for slow charging 3,7/7,4 KW (10/5 hours charge time), to 65k EUR for superfast charging 50/150 KW (40/15 minutes charge time); PV energy supply + storage platform for 2 car may cost 26k EUR.
- An efficient vehicle fleet management system is central to the success of the initiative.
- New procurement and utilisation models, such as leasing, or combined leasing and ownership, as well as sharing of vehicles between different bodies, may have to come into place to reduce the number of vehicles needed and maximize benefits.
- Italy's MoD has a business case to transform 60% of their city ICEVs in Rome, with particular focus on service costs, energy costs, endurance and life cycle, and using a large PV system mounted on building roofs for energy supply to optimise use and charging of vehicles. Implementation of this initiative is expected to take place during the present year.

Business cases are normally solid in terms of technical and environmental aspects; however, cost-benefit analysis is harder to justify on a like for like substitution and it will be sound only under specific circumstances; decisions relate ultimately to the budget available and it is critical to have a strong political direction. As stated before, detailed information about the vehicle fleet is key and paramount for designing and planning of a successful vehicles transformation initiative:

- Mileage:
    - Mileage must be below autonomy of the battery (normally around 200 Km/day), in order not to consume the capacity of battery and allow for cheaper slow charge of the vehicle at night,
    - Mileage must be above 80 Km/day (if only working days are considered) or 50 Km/day (if all weekdays are considered).
    - High dependency on the price of electricity.
- Support infrastructure:
    - Support infrastructure is an added cost which may impact heavily the financial health of the initiative. Overall cost may recommend the use of existing charging infrastructure from the grid.
    - Capacity of the electricity distribution grid may be a constraint (and a cost if it needs to be reinforced) and loading needs to be optimized. (PV storage platforms are, for now in general, too costly).

- Installation of slow charging infrastructure is much cheaper and serves the purpose providing that the fleet use and charging are managed adequately.

- Carbon footprint:
  - Manufacturing of batteries has a higher carbon footprint than manufacturing of internal combustion engines and is more expensive, so it is critical that cost and environmental savings are achieved during the vehicle operational life.
  - The energy mix influences heavily the carbon footprint of the electric vehicles, with cases where ICEVs may result in fewer carbon emissions than BEVs.

- Vehicle fleet management system:
  - An efficient management system is key to allow for cheaper slow charging infrastructure for charging when vehicles are not required (normally at night).
  - Solutions for car pool sharing are highly recommended to reduce the size of the vehicle fleet.
  - New procurement and vehicle utilisation models are also key to reduce the number of vehicles needed and maximize benefits.

BEV present an opportunity to be used as energy storage platforms locally, or even for general grid if adequate legislation is in place. With a few exceptions, such as Italy, MoDs have not embarked on any pilot project to demonstrate feasibility of full-scale initiatives for transformation of their vehicle fleets. This is due to a number of reasons including budget constraints, legal obstacles and limited political direction. Policies for installation of supporting infrastructure are, thus, not in place for now. Based on initial feedback from 5 MoDs, it can be observed that MoDs vehicle fleets are comprised of hundreds of different vehicle types, mainly motorbikes, utilitarian cars, and different sizes of busses and trucks, both petrol and diesel, normally fully owned, and a wide range of ages. A much more detailed survey on the types of MoDs vehicle fleet is recommended for the next phase of the CF.

Challenges and Barriers

Limited political direction, as well as lack of legal framework and financial incentives for public authorities to transform their vehicle fleets into low emission vehicles.

2.1.17 Funding Energy Management and Energy Efficiency Projects

EU MoDs Current Status on Funding Energy management and Energy Efficiency Projects

According to the replies to Q-7 Questionnaire (CF I, February 2017):

a. In most of the cases, **the MoDs' budget lines are inadequate to cover a satisfactory level of renovations** (67%, 14 out of the 21 MS that replied).

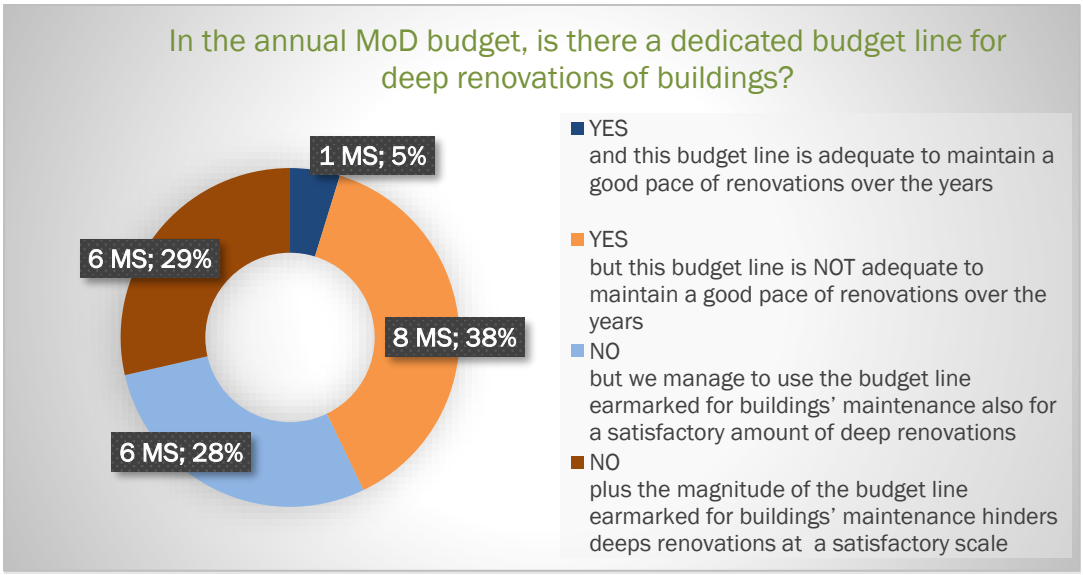


Figure 18: MoD Budgets with respect to Deep Renovations of Building Stocks (February 2019)

b. Under that light, **external/alternative financial resources must be explored and exploited**. However, only 41% of the MoDs (9 out of the 22 MS that replied) have already developed mechanisms (mainly processes to existing organisational structures and not dedicated teams) to apply for external funding (not limited to cover energy-related needs). These mechanisms are mainly applicable to grants; only 1 MS MoD has the option to apply (either directly or through the central government) for a loan.

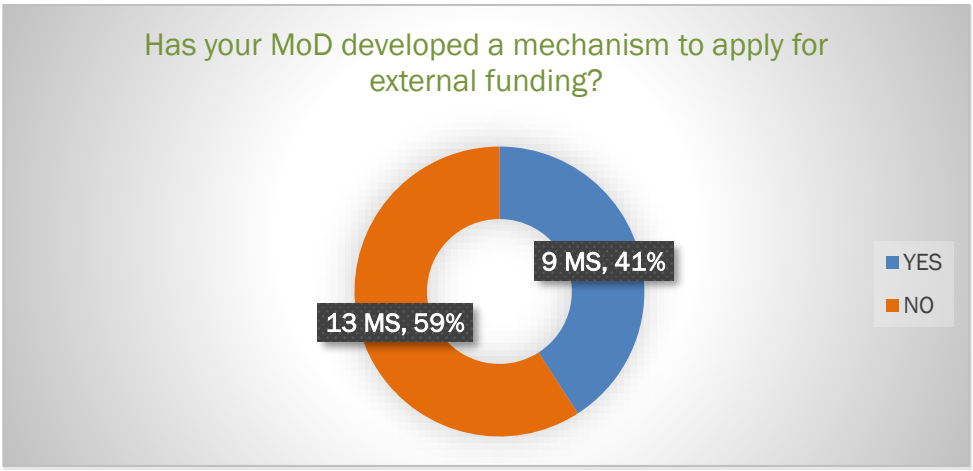


Figure 19: MoDs' Status on Internal Mechanisms to Uptake External Funding (February 2019)

c. So far, **the external funding collectively received over the last 10 years is extremely small**, in the area of 63 million euros (half of which provided to one MS only for combined environmental and energy projects). **National governments need to allocate reasonable external funding for deep renovations of the MoDs' large building stocks, in order the public sector to fulfil its exemplary role, as inscribed in the EED**.

The financial instruments managed nationally that were used are displayed below (*"other types of funding"* refer mainly to direct funding from the central governments).

Moreover, 3 MoDs have managed to acquire external funding through LIFE. No other financial instruments managed by EU authorities (e.g. FP7/H2020, Erasmus +, etc.) have been used so far.

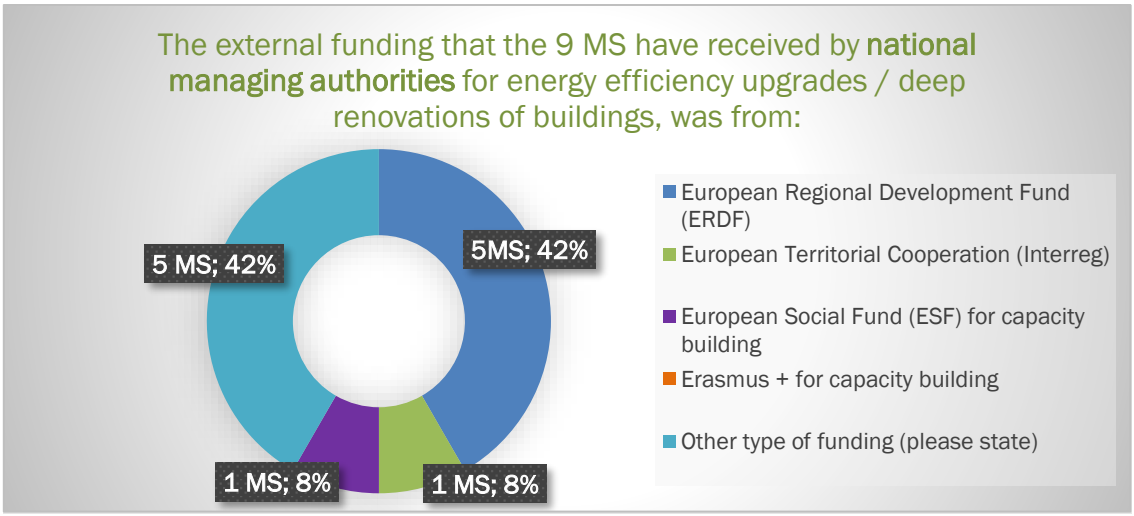


Figure 20: Types of External Funding MoDs have Received for Energy Efficiency Upgrades (February 2019)

Challenges and Barriers

From the mapping of the current status on external funding, it is evident that MS face many challenges on accessing external resources to perform interventions that would increase energy efficiency, including deep renovations.

Lessons learned from applying for external funding focus on:

a. the flexibility and speed necessary to comply with the calls' requirements;

b. the technical expertise required to draft sound proposals;

c. the commitment of the management to avail human resources and financial resources to complement the funding granted.

2.2: RESULTS IN RENEWABLE ENERGY SOURCES AND TECHNOLOGIES

During the Consultation Forum Phase I events, a number of technologies were reviewed and discussed in terms of the potential for exploitation by the defence sector within the remit of CF SEDSS (fixed infrastructure on European soil) and examples of these are set out below. Some of these technologies and their applicability were subject to greater scrutiny during Phase II with the intention of developing specific project ideas. This section deals with the feasibility of different technology options including defence specific challenges and benefits of renewable energy technologies and specific recommendations where applicable.

2.2.1 Wind energy

The terms 'wind energy' or 'wind power' describe the process by which wind is used to generate mechanical power or electricity.

Wind turbines convert the kinetic energy produced by wind into mechanical power. Wind turbines operate on a simple principle: the energy in the wind turns two or three propeller-like blades around a rotor. The rotor is connected to the main shaft, which spins a generator to create electricity. Wind turbines are mounted on a tower to capture the most energy possible. At around 30 meters or more above ground level, the turbine blades can capture the kinetic energy found in faster and less turbulent wind found at that altitude. Wind turbines can be used to produce electricity for a single building, or can be connected to an electricity grid from where the electricity can be distributed to greater effect.

Since wind is the result of a combination of the uneven heating of the atmosphere by the sun, the irregularities of the earth's surface, and the rotation of the earth, the distribution of wind patterns and speeds vary across the world and are further effected by vegetation density and height, bodies of water, differences in topography as well as buildings. Therefore, a range of physical factors need to be considered when planning for the installation of wind turbines and ultimately selecting the most appropriate sites, as not all locations will provide the best return on investment in terms of electricity generated. Other factors include national planning legislation and potential interference with military operations or civilian considerations, especially with respect to radar function.

<u>Wind turbine design and location</u>

Modern wind turbines fall into two basic categories:

- The horizontal-axis wind turbines typically have three blades. These three-bladed wind turbines operate with the blades facing into the wind. While these turbines produce adequate amounts of electricity, they produce a significant Doppler Effect, which interferes with radar function, and as such limits the suitability for military sites where radar is required;

- The vertical-axis design may operate in lower wind speeds than the horizontal-axis design and has a much-reduced impact on radar function, as the Doppler Effect is significantly less.

Wind turbines can range in size from 100 kilowatts to as large as several megawatts. The larger wind turbines can be more cost effective, especially in wind farms, providing larger quantities to an electrical grid. A further logistical challenge, which needs to be taken into consideration, is the transportation of the large components to the required location. Offshore wind turbines can be the largest, and can often generate even more power. They have the added advantage that the large components can be transported by ships rather than by road. However, in terms of direct utility for military installations, this could be more limited as the location of offshore wind farms cannot be

such that it would interfere with the operation of a naval dockyard or so far offshore that supplying power back to the shore at the required point of delivery becomes cost-prohibitive.

Single small turbines, below 100 kilowatts, are suitable for single buildings, telecommunication dishes, or water pumping. Smaller turbines can be combined with smart demand management technologies, diesel generators, batteries, and photovoltaic systems. These smart hybrid systems are more usually used in remote, off-grid locations, where connection to a main grid is unavailable.

2.2.2 Solar

Solar generation is part of a suite of technologies, which reduces dependence on fossil fuels, increases independence from national power grids and offers reductions in cost.

Solar energy can be converted into electrical power by using Photovoltaic (PV) technologies, the principle of which is based on the absorption of solar irradiation by a semiconductor material. The versatility of PV systems enables a high degree of compatibility with the requirements of the defence and security sector.

Technology solutions are already available for all of these applications but further work is required to enable the integration of appropriate renewable energy technologies into existing or new energy systems.

2.2.3 Smart grids

A smart grid is an electrical system, which can include a variety of power sources such as conventional electrical supply, supply from liquid fuel via diesel generators, and renewable energy sources, running in combination with energy storage technologies, and demand monitoring (smart metering) and management technologies.

Smart grids enable digital two-way communication between the supply and demand. Smart grids have the potential to improve the efficiency of energy distribution and usage, both through grid design and through consumer participation.

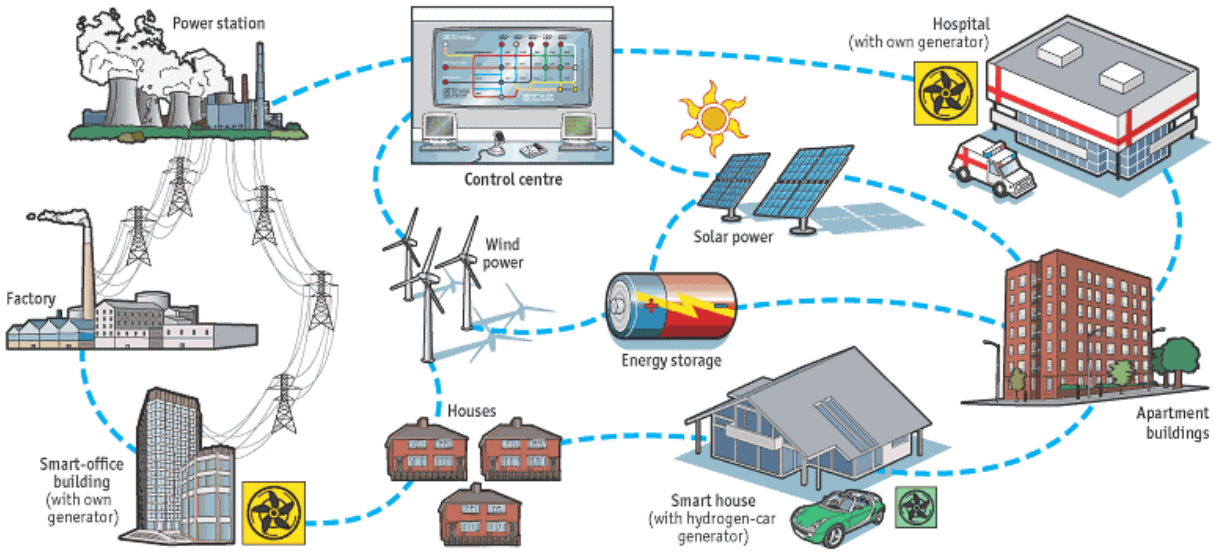


Figure 21: Smart grid

2.2.4 Energy Storage

Examining the utility of energy storage in military applications was a topic first identified during the CF SEDSS Phase I. Energy storage systems play a key role in enhancing the effectiveness of RES technologies and the overall resilience of energy systems. There are a number of different types of technology used in energy storage within four broad categories, as tabulated below:

Mechanical (Kinetic and Potential)	Electrochemical and Chemical	Electrical (Electromagnetic and Static fields)	Thermal
Pumped Hydro (PHS)	Secondary batteries • Alkaline • Lithium • Sodium-sulphur • Sodium-iron chloride • Redox flow	Super capacitors	Molten salt thermal storage
Compressed Air (CAES)	Hydrogen	Superconducting magnetics	Ice thermal storage
Flywheel (FES)			Heat thermal storage
			Chilled water thermal storage

Table 2: Types of technology used in energy storage

These efforts, however, must face economic realities such as investment costs, operation and maintenance, and expected lifetime. Moreover, specific technical parameters have to be taken into account:

- Start-up time / response time
- Ramp time
- Power capacity
- Energy capacity
- Cyclability / aging
- Efficiency (electricity out vs electricity in)

However, the need to provide energy solutions at existing or reduced costs to the consumer requires cheap, reliable energy storage as the key to transitioning to renewable power.

Given the range of different energy storage technologies, there is a need to assess which might be suitable for use in military applications. During Phase II this lead to the idea for a project: a study could be conducted based on potential use cases and a comparison with military requirements. This should include testing in a variety of operating environments – since Commercial Off the Shelf (COTS) technology may not be appropriate for military use or may need to be adapted.

This could be done as both desktop research and ultimately trials of systems. Initially, a feasibility study would need to be conducted including cost-benefits analysis, with recommendations made on which technologies could be suitable for which military systems.

While a range of these technologies already exists, the Coordinator for the Concerted Action for RES (CA-RES) suggested that there should be a particular focus on:

Mechanical;

- Electrochemical: a range of battery types and hydrogen;
- Electrical: a range of super-capacitors;
- Thermal: Heat and cold storage.

The project would focus on the use of energy storage as part of the drive for self-sufficiency rather than for back-up solutions. The project should tackle issues such as:

- How to calculate the desired storage capacity for a particular installation;
- Specific military installation circumstances;
- Identification of technologies at technology readiness level (TRL) 8 and 9, which could be used in military installations;
- Identification of use cases for remote and connected locations.

2.2.5 Alternative fuels

This includes biofuels, synthetic fuels, synthetic gas, hydrogen, oxygen, and gas (natural, methane, etc.) which can be used in various applications including automotive vehicles, vessels, aircrafts and many types of mobile machinery (e.g., generators and power tools).

The military, legal and policy frameworks under which such fuels are used are addressed by STANAGs/AFLPs in all three domains (land, maritime, aviation, taking note that different clearance and certification processes may be involved).

Case study: IT NAVY – FLOTTE VERDE

At the third CF SEDSS event of Phase 1 in Rome, IT presented Flotta Verde, a project aimed at finding an alternative ship fuel to petroleum, increasing national energy security and reducing polluting emissions.

Flotta Verde adopts three different strategies in order to achieve these goals: obtaining synthetic fuel from renewable sources, in line with the targets set by Directive 2009/29/EC (Horizon 2020); developing and using innovative "Eco Design" technologies on-board ships (such as LED lighting and silicone painting); and finally, reducing the fuel consumption of ships via the use of "Energy Saving" procedures (such as electric propulsion, propeller cleaning, appendages optimisation, low speed OPS optimisation and the use of single shafts).

IT also emphasised that its navy is a pioneer and leader in Europe on "green diesel", demonstrated by the desire to have their ships operating with a fuel that has a renewable origin component of 50%, which goes further than the European Commission's '10% by 2020' requirement. The presentation also emphasised the benefits of the HVO biofuel compared to FAME including: a higher power density, no hygroscopy, oxidation stability and no risk of fouling or clogged filters.

Moreover, it was stated that as an advocate of "green diesel", IT managed to have synthetic fuel derived from biomass included in NATO specifications, which followed from a Statement of Cooperation in April 2014 between the IT and US navies.

Case study: UK DEFENCE STRATEGIC FUELS AUTHORITY (DSFA)

The UK MoD's DSFA has a mandate to: provide the coordinated fuel requirement from defence users to buyers; to bring strategic coherence to the fuel supply chain; to act as a single point of contact for international engagement on fuel related matters; and to provide a single fuel technical authority for defence standards and UK-led STANAGs.

Concerning aviation, the DSFA presentation recognised the need for and value of alternative fuels, and welcomed the developments at NATO level. The DFSA also maintained that they are pushing to gain clearances for the use of synthetic fuels on all UK Ministry of Defence platforms, in order to improve European interoperability and in the interest of industrial and market flexibility. Most platforms have given the carte blanche in this regard, although there are discussions still ongoing with the remaining platforms.

Aside from the slow approval process, the challenges in the aviation field include costs and availability. However, the DSFA stresses that there are concerted efforts to maintain progress. In the land and maritime fields, the presentation reiterated concerns with FAME fuels, such as long-term storage issues and the risk of microbial growth. There is potential for alternative fuels in these areas, although similar challenges are present as in the aviation field, in addition to the limited experience of those in the land and maritime fields with regards to maintenance and the general operability of alternative fuels.

Future prospects for alternative fuels

During Phase I, the conclusions on aviation were that military certification of alternative fuels was a slow process with interchangeability and interoperability issues, whereas the navy did not encounter such issues meaning that certifications were ongoing. Insofar as land forces are concerned, alternative fuels can be used as long as blend requirements are met (EN50; ASTM D975) and as long as the process complements NATO's single fuel policy.

It was generally accepted during Phase I that there would be no obvious benefit for the European defence community to form a parallel structure to look at biofuels penetration and that as long as non-NATO MS could understand and react to NATO fuel policy then the NATO approach should maintain its long-held primacy.

Therefore, two of the main conclusions were that:

a. NATO fuel strategy and structural approach was sufficient to meet the EU armed forces' needs, including MS who were not part of NATO as the policy was widely distributed and unclassified;

b. Full biofuel adoption was technically feasible but economic and departmental policy within the MoDs would not allow further penetration without an overarching political policy framework.

During Phase II, the subject of fuels and mobility was discussed, but not fully addressed neither in the CF SEDSS II events, nor in the interactions with civilian counterparts in the concerted factions on RES. As such, it is recommended that this topic be investigated further in Phase III.

Biomass

Biomass can produce electricity, and at the same time, heat can be recovered and could potentially be used within a district heating system. There are different types of biomass sources including bark, coconut shells, corncobs, energy crops, food waste, sawdust, and wood chips, and there are different types of technologies that can be used for producing electricity from biomass:

- Combustion;
- Torrefaction;
- Pyrolysis;
- Gasification.

When selecting the technologies, it is important to consider a variety of factors including the associated costs, the relative efficiencies and the purpose for which it will be used. For instance, biomass gasification vs biomass combustion can result in:

a) Higher efficiency;
b) Lower temperatures than combustion, therefore longer lifetimes of gasifier;
c) Same construction costs but lower maintenance costs than combustion plants;
d) Lower air emissions.

2.2.7 Waste to energy

This technology group refers to any waste treatment process, which creates energy in the form of electricity, heat or transport fuels (e.g. diesel, biogas) from a waste source.

It could include thermal (direct combustion and incineration), thermo-chemical (torrefaction, plasma treatment, gasification, pyrolysis, thermal polymerization, catalytic depolymerisation) and biochemical (composting, ethanol fermentation, and anaerobic digestion). Future work could focus on the integration and militarisation of appropriate technologies.

2.3 RESULTS IN PROTECTION OF CRITICAL ENERGY INFRASTRUCTURE

This sub-section focuses on the topics covered by CF SEDSS Working Group 3 – Protection of Critical Energy Infrastructure (PCEI).

2.3.1 State of the art of CI in general and CEI in particular

The protection of energy infrastructure has been already issued with the Council Directive 2008/114/EC on the identification and designation of European critical infrastructures and the assessment of the need to improve their protection. Within this Directive, the energy sector was identified as a European critical infrastructure (ECI), together with the transport sector. The term "critical infrastructure" means an asset, system or part thereof located in Member States which is essential for the maintenance of vital societal functions, health, safety, security, economic or social well-being of people, and the disruption or destruction of which would have a significant impact in a MS as a result of the failure to maintain those functions[52].

The significance of impact shall be assessed in terms of cross-cutting criteria that are referred to:

a) Casualties criterion (potential number of fatalities or injuries);
b) Economic effects criterion (economic loss, degradation of products or services, environmental effects);
c) Public effects criterion (public confidence, physical suffering and disruption of daily life, loss of essential services).

In this regard, for example, the costs of damage to Europe's critical infrastructure by climate change will reach €34 billion per year by 2100 according to a recent report[53]. These events will impact energy, transport and industry infrastructure most and it is estimated that the investment of €25 billion will be needed by 2040 to make energy infrastructure resilient, stretching to €200 billion by 2100[54].

- Energy sector: The expected annual damage of €0.5 billion per year could be 400%, 860% and 1600% higher by the 2020s, 2050s, and 2080s, respectively. These results arise from the sector's sensitivity to droughts and heat waves (e.g. decrease in cooling system efficiency of power plants due to higher water/air temperature).

- Transport sector: an increase of current damage of €0.8 billion per year with 1500% by the end of this century. By the 2080s, 92% of total hazard damage will harm this sector mainly by affecting roads and railways (e.g. buckling of rails, melting of asphalt).

- Industry sector: current damage of €1.5 billion per year is estimated to increase 10-fold by 2080[55]. Floods and windstorms currently dominate hazard losses in the industry sector, mainly through structural damage to infrastructures, machinery, and equipment[56].

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[52] European Commission, *Council Directive 2008/114/Ec*, *on the identification and designation of European critical infrastructures and the assessment of the need to improve their protection*, Brussels,8 December 2008, https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32008L0114&from=IT

[53] EIT Climate-KIC, *Annual damage to Europe's critical infrastructure may increase tenfold this century*, 7 March 2018, https://www.climate-kic.org/news/annual-damage-europes-critical-infrastructure-may-increase-tenfold-century/

[54] EIT Climate-KIC, *Annual damage to Europe's critical infrastructure may increase tenfold this century*, 7 March 2018, https://www.climate-kic.org/news/annual-damage-europes-critical-infrastructure-may-increase-tenfold-century/

55G. Forzieri, A. Bianchi, F. Batista, , A.Marin Herrera, A. Leblois, C. Lavalle, J. C.J.H.Aerts, L. Feyen, *Escalating impacts of climate extremes on critical infrastructures in Europe*, Global Environmental Change, Volume 48, January 2018, Pages 97-107, https://www.sciencedirect.com/science/article/pii/S0959378017304077

[56] EIT Climate-KIC, *Annual damage to Europe's critical infrastructure may increase tenfold this century*, 7 March 2018, https://www.climate-kic.org/news/annual-damage-europes-critical-infrastructure-may-increase-tenfold-century/

With Directive 2016/1148 of the European Parliament and of the Council, the Directive on security of network and information systems (the NIS Directive)[57], the perimeter of recognition of the society's vital sectors that also rely heavily on ICTs is expanded by including water, banking, financial market infrastructures, healthcare and digital infrastructure. Businesses in these sectors that are identified by the Member States as operators of essential services, will have to take appropriate security measures and to notify serious incidents to the relevant national authority. Also key digital service providers (search engines, cloud computing services and online marketplaces) will have to comply with the security and notification requirements under the Directive. In this sense, operators of essential services and digital services, although not critical infrastructures strictly speaking, are identified as such, in relation to the possibility of provoking cascading effects (domino effect) on many other services and infrastructures, if attacked.

Therefore, these infrastructures refer to the networks of independent, man-made systems and processes to provide a continuous flow of goods and services for the public[58]. In this system, there is a set of sub-systems, referring to services deemed fundamental to the lives and operations of society and whose disruption could produce significant loss of life, financial cost, or physical damage. It is necessary to take into account that nations include different systems within their set of critical infrastructures, but most of them recognize the following as critical: energy, ICT, finance, healthcare, food, water, transport, and emergency services.

Critical infrastructures do not operate as isolated systems and the continuity of their services is quite dependent on the proper operations of other infrastructures. If one of their inputs fails, the critical infrastructure cannot optimally provide its own service. In addition, if these dependencies are bi-directional, meaning the services are mutually dependent on each other, these linkages are called interdependencies. These complex relationships mean that a disturbance in the normal operations of one critical infrastructure can impact other critical infrastructures.

The following incidents exemplify how infrastructures depend on each other. In 1998, in the USA, a computer failure aboard the Panamsat Galaxy IV telecommunications satellite shut down the transmission of television, radio, and data to organizations, businesses, hospitals and credit card transactions. In 2005, a power failure, in the St. Gotthard region of Switzerland, shut down the entire Swiss rail network for three hours. A short circuit in a power line led to the complete shutdown of a nation-wide critical infrastructure, which disrupted the transportation of the goods and personnel. In this regard, since 2000, 501 of 1749 incidents of critical infrastructure failure were caused by infrastructure failures in other sectors. Of those 501 events, 76 were the result of a domino effect, meaning that the failure in one service triggered a failure into a second service and so on[59]. The vulnerabilities of complex interdependence are not limited by national borders, but they do stretch across multiple critical services and shocks can ripple through first order, and even second order, connections[60]. The energy is the sector that causes the major of the total outages (60%)[61]. These events affect also the other sectors, for instance, since 2014 there have been several incidents:

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[57] European Parliament and Commission, *Directive (Eu) 2016/1148 of the European Parliament and of the Council, concerning measures for a high common level of security of network and information systems across the Union*, 6 July 2016,https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32016L1148&from=IT

[58] ERGEG "The Lessons to Be Learned from the Large Disturbance in the European Power System on the 4th of November 2006."

[59] *Good Neighbors Make Good Security: Coordinating EU Critical Infrastructure Protection Against Cyber Threats*, Globsec, 28 August 2017, https://www.globsec.org/publications/good-neighbors-make-good-security-coordinating-eu-critical-infrastructure-protection-cyber-threats/#XXfRWT1gqsRAGhaf.99

[60] *Good Neighbors Make Good Security: Coordinating EU Critical Infrastructure Protection Against Cyber Threats*, Globsec, 28 August 2017, https://www.globsec.org/publications/good-neighbors-make-good-security-coordinating-eu-critical-infrastructure-protection-cyber-threats/#XXfRWT1gqsRAGhaf.99

[61] Eric Luiijf, Albert Nieuwenhuijs, Marieke Klaver, Michel van Eeten and Edite Cruz, *Empirical findings on Critical Infrastructure Dependencies in Europe*, TNO Knowledge for Business, 6 October 2008

- 2014: German steel mill[62].
- October 2014 Bank of England computer glitch[63].
- December 2014 NATS computer glitch[64].
- March 2015 Netherlands power failure[65].
- March 2015 Turkey power failure nationwide power outage[66].
- April 2015 Rome / Lazio region power outage[67].
- April 2015 Washington DC power failure[68].
- April 2015 TV5Monde hack[69].
- May 2015 Brussels ATC failure[70].
- June 2015 LOT computer failure / cyber attack[71].
- July 2015 NYSE / United Airlines / Washington Post computer problems[72].
- 2014[73]/2015[74]: Drones above nuclear power plants in France.
- Summer 2014: DOEL 4 nuclear plant shut down[75].
- April 2015: Germanwings crash[76].
- Jun/Jul 2015: St. Quentin Fallavier gas plant[77].
- July 2015: Berre l'Etang refinery tanks blown up[78].
- Aug 2015: Thalys gunman[79].

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[62] Robert M. Lee Michael J. Assante Tim Conway, *(Cyber-to-Physical or Process Effects) case study paper – German Steel Mill Cyber Attack, ICS Defense Use Case (DUC)*, 30 December, 2014 https://ics.sans.org/media/ICS-CPPE-case-Study-2-German-Steelworks_Facility.pdf
[63] The Guardian, *Bank of England payment system crashes leaving homebuyers in limbo*, 20 October 2014, https://www.theguardian.com/business/2014/oct/20/bank-of-england-payment-system-crashes
[64] The Guardian, *Nats: computer failure behind London airport chaos was unprecedented,* 13 December 2014, https://www.theguardian.com/uk-news/2014/dec/13/london-airport-chaos-computer-failure-nats-heathrow-gatwick-airspace
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[66] *Turkey power outage shuts down public transportation and half of provinces*, The guardian, 31 March 2015, EDT https://www.theguardian.com/world/2015/mar/31/turkey-power-outage-shuts-down-transportation-provinces
[67] European Commission DG Migration & Home Affairs, *The European Programme for Critical Infrastructure Protection (EPCIP)*
[68] Jeremy Diamond, *Widespread power outages sweep Washington*, D.C, CNN April 7, 2015
[69] *How France's TV5 was almost destroyed by 'Russian hackers'*, BBC, 10 October 2016 https://www.bbc.com/news/technology-37590375
[70] Kurt Hofmann, *ATC technical failure closes Belgian airspace, ATW Air transport World*, Air Transport World, May 27 2015, https://atwonline.com/air-traffic-control/atc-technical-failure-closes-belgian-airspace
[71] Wiktor Szary, Eric Auchard, *Polish airline, hit by cyber attack, says all carriers are at risk*, Reuters, JUNE 22, 2015 https://www.reuters.com/article/us-poland-lot-cybercrime/polish-airline-hit-by-cyber-attack-says-all-carriers-are-at-risk-idUSKBN0P21DC20150622?mod=djemCIO_h
[72] Drew Harwell, Thad Moore and Jacob Bogage, *NYSE resumes trading after unprecedented shutdown*, The Wanshington Post, July 8, 2015, https://www.washingtonpost.com/business/economy/nyse-trading-has-been-halted/2015/07/08/46b51974-2588-11e5-b72c-2b7d516e1e0e_story.html?noredirect=on&utm_term=.ff12eee78705
[73] *More drones spotted over French nuclear power stations*, The Guardian, 31 Oct 2014 https://www.theguardian.com/environment/2014/oct/31/more-drones-spotted-over-french-nuclear-power-stations
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[76] *Germanwings crash: What happened in the final 30 minutes*, BBC, 23 March 2017, https://www.bbc.com/news/world-europe-32072218
[77] Nick Kostov, Inti Landauro, *French Gas Plant Attack Suspect Commits Suicide*, The wall street Journal, 23 December 2015, https://www.wsj.com/articles/french-gas-plant-attack-suspect-commits-suicide-1450862536
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[79] *Thalys train attack: Belgium charges two over foiled 2015 shooting*, BBC, 31 October 2017, https://www.bbc.com/news/world-europe-41825021

- Oct 2015: AVE sabotage Catalonia[80]
- March 2016 – two suicide bombings at Airport in Zaventem, and one at Maalbeek metro station. 32 people and three suicide bombers were killed, 340 were injured[81]
- April 2017 - a suicide bombing in the St Petersburg metro. 15 people were killed (plus the bomber), 64 were injured[82].
- June 2017 – at Brussels Central Station a terrorist was shot after trying to detonate a bomb[83].

ENISA (European Union Agency for Network and Information Security) has a major role in the implementation of the NIS Directive, and in supporting the MS to create their national strategy and to implement it. ENISA is supporting the EU Member States and EFTA (European Free Trade Association) countries since 2012 to develop, implement and evaluate their national cyber security strategies. With the NIS Directive in place, a lot of Member States are considering revising their strategies with the goal of creating new versions that will include the provisions of the NIS Directive into their strategic objectives. Critical information infrastructure protection is an integral part of a NCSS (national cyber security strategy)[84].

In addition to Directive 2008/114/EC and the NIS Directive other elements of the energy *acquis* also touch upon the protection and development of infrastructures relevant for the supply of gas and electricity and the security of their supplies, such as the Regulation 2017/1938 concerning measures to safeguard the security of gas supply[85], the Regulation on the risk-preparedness of the electricity sector[86] and certain provision of the so-called Third Energy Package[87].

Regulation 2017/1938 concerning measures to safeguard the security of gas supply requires Member States to carry out every 4 years an assessment of all risks relevant to the security of gas supply at national and regional level. The latter is prepared within groups of Member States defined in the Regulation and based on gas supply routes. Both types of risk assessments have to consider potential political, technological, commercial, social and natural risks, including terrorism, cyber attacks or the control of infrastructure by third-country entities. On the basis of the risk assessments, Member States have to prepare preventive action plans and emergency plans to ensure the maximum preparedness, so as to avoid a disruption of gas supply, and mitigate its effects should it nevertheless occur. Similarly to the gas sector, a new Regulation on the risk-preparedness of the electricity sector[88] will ensure that all Member States put in place appropriate tools to prevent, prepare for and manage electricity crisis on the basis of an assessment of risks and in cooperation with each other. A methodology for the identification of risks will be developed by the European Network of Transmission System Operators for Electricity (ENTSO-E) and the Agency for the Cooperation of Energy Regulators (ACER), including consequential hazards such as the consequences of malicious attacks or fuel shortages. Based on the identified risks, each Member State will have to establish a risk preparedness plan that should include, among others, risks stemming from cyber-attacks

[80] *Train network stalled in Catalonia in a suspected act of sabotage*, The Local ES, 8 October 2015, https://www.thelocal.es/20151008/trains-paralyzed-across-catalonia-after-cable-theft-from-ave-network
[81] Jennifer Rankin and Jon Henley in London, *Islamic State claims attacks at Brussels airport and metro station*, The Guardian, 22 Mar 2016, https://www.theguardian.com/world/2016/mar/22/brussels-airport-explosions-heard
[82] *St Petersburg attack: What we know*, BBC, 19 April 2017, https://www.bbc.com/news/world-europe-39481067
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[84] ENISA, *EU strategies to secure the EU cyber space and critical infrastructure against hackers*, Brussels, November 2017
[85] OJ L 280/1 of 28.10.2017
[86] Regulation on the risk-preparedness of the electricity sector and repealing Directive 2005/89/EC – still to be published in the OJ.
[87] https://ec.europa.eu/energy/en/topics/markets-and-consumers/market-legislation
[88] Regulation of the European Parliament and of the Council on risk-preparedness in the electricity sector and repealing Directive 2005/89/EC – still to be published in the OJ

To increase the resilience between EU MS, ENISA needs to cooperate with ENTSO-E and the European Network of Transmission System Operators for Gas (ENTSOG) to face cybersecurity challenge[89]. Under the gas and electricity Directives and Regulations of the Third Package, the ENTSOG and ENTSO-E respectively were created. All gas transmission system operators (TSOs) have to cooperate through ENTSOG and ENTSO-E respectively to promote the completion and functioning of the internal market in natural gas and electricity and cross-border trade and to ensure the optimal management, coordinated operation and sound technical evolution of the natural gas and electricity transmission network. As part of this work, both ENTSOG and ENTSO-E participate in the design of secondary legislation for the operation for the operation of the network (network codes). They also prepare ten-year network development plans and summer and winter generation adequacy outlooks (electricity) as well as summer and winter supply outlooks G-E

The role of cybersecurity grows exponentially in the defence context as it assumes endangerment of human lives, national security, and environment at the global level. At this time, the well-prepared malevolent actors could have access to corporate and industrial control networks or they could penetrate the military defence systems and be able to collect classified data.

In particular, a major part of Europe's critical infrastructures is managed and controlled by ICS (industrial control systems)/SCADA systems (SCADA is the supervisory control and data acquisition). These systems are evolving and have increased their connectivity capabilities using both private and public communication networks, which in turn results in a larger attack surface, which means that they are exposed to more risks. The most widespread implementations of conventional and SCADA ICS can be applied to the following functions and areas in the facility:

- Command and control – primarily SCADA systems in production, storage, and manage facilities;
- Staff working environment – ventilation and filtering systems, temperature and humidity controls, fire alarms, hazard alarms, power supply, etc;
- Laboratories and research centres – scientific equipment for hazardous materials;
- Communication – communication and data transfer equipment[90].

As ICS are usually controlling critical and sensitive installations (such as those from utilities or energy sectors), they have become very attractive targets for attackers, due to the potential impact that a successful attack can have, as well as due to cascade effects affecting different areas and even countries. However, cybersecurity strategies should not only depict the past, but should also pave the way for a cybersecure future: many MS have already started creating strategies on emerging technologies like big data, Internet of things (IoT- Industry 4.0), cloud computing as they could support critical systems. The national cybersecurity strategies should not only cover the existing landscape but also have a vision for a secure use of ICT in the borders of the country. Moreover, cybersecurity is not only a priority for the public or the private sector; start-ups and SMEs (small medium enterprise, the backbone of the EU economy) are also affected from the national strategy[91]. Thus, it would be beneficial to include this long-term vision and need for investment early on in the strategy. Cybersecurity is a shared responsibility and ENISA is stepping forward and is assuming its share of this responsibility[92]. Accordingly, ENISA is working towards making collaboration and information and knowledge sharing stronger and more reliable. The multi-faceted efforts of ENISA across the cybersecurity spectrum are supporting and empowering a more cyber secure and safe Europe.

89 ENTSO-E, Protecting Europe against cyber-attacks: The European Network for Cyber Security (ENCS) & ENTSO-E join forces, June 2017, https://docstore.entsoe.eu/news-events/announcements/announcements-archive/Pages/News/encs-entsoe-join-forces.aspx

90 ENISA, *Communication network dependencies for ICS/SCADA Systems*, Heraklion, December 2016

91 ENISA, *Communication network dependencies for ICS/SCADA Systems*, Heraklion, December 2016

92 ENISA, Communication network dependencies for ICS/SCADA Systems, Heraklion, December 2016

Moreover, the terrorist attacks on the twin towers and subways in London and Madrid and the tropical storm Katrina have shown that both natural disasters and human intentional events can seriously damage existing infrastructure. Natural or intentional events could severely hit a community and provoke economic, financial and human losses. In this scenario, political decisions can have similar effects: from 6-20 January 2009, gas flows were interrupted from Russia to the EU via Ukraine. A majority of Member States were affected directly and indirectly. Tensions between Russia and Ukraine and Russia and Belarus have been raised several times since the break-up of the Soviet Union due to the continuing difficulties to agree on the details of a new gas transit and supply regime[93].

The energy sector is a crucial issue that should be considered under the critical infrastructure protection. Globalization and liberalization of the market economy and privatization are two additional difficulties for a proper management and protection of critical infrastructures because national governments are no longer in full control of all sectors that are essential to society. Therefore, a close cooperation is necessary between public and private sectors in order to allow reaching at the same time national and supra-national interests and commercial interests of private companies.

Each country deals with critical infrastructure protection according to its rules, laws and policies; in this regard, in UK, Centre for the Protection of National Infrastructure – CPNI is the government authority for protective security advice to the UK national infrastructure. Their role is to protect national security by helping to reduce the vulnerability of the national infrastructure to terrorism and other threats. They are accountable to the Director General of MI5. CPNI identify 13 national infrastructure sectors: chemicals, civil nuclear communications, defence, emergency services, energy, finance, food, government, health, space, transport and water. Several sectors have defined 'sub-sectors'; emergency services for example can be split into police, ambulance, fire services and coast guard. Each sector has one or more lead government department(s) (LGD) responsible for the sector, and ensuring protective security is in place for critical assets. CPNI is focussed on providing advice and assistance to those who have responsibility for protecting these most crucial elements of the UK's national infrastructure from national security threats[94].

Effective protective security depends on the use of a variety of measures to detect, deter and delay any attack. Cybersecurity measures should form part of a multi-layered approach that includes physical and personnel/people security.

Information technology is increasingly integrated into everyday life – the world is a more open and connected place. The UK government has set up the National Cyber Security Centre (NCSC) to act as a unified source of advice and support on cyber security. The NCSC was officially opened on 14 February 2017. The NCSC is the single point of contact for the private and public sectors. It brings together the capabilities developed by CPNI and CESG (the information security arm of GCHQ[95]), CERT-UK and the Centre for Cyber Assessment"[96]. The National Cyber Security Centre (NCSC) is a part of GCHQ and is the UK's authority on cybersecurity. The main purpose of NCSC is to reduce the cybersecurity risk to the UK by improving its cybersecurity and cyber resilience. They recognise that, despite all the efforts to reduce risks and enhance security, incidents will happen. The NCSC will provide effective incident response to minimise harm to the UK, help with recovery and learn lessons for the future and so they will work together with UK organisations, businesses and

[93] COMMISSION STAFF WORKING DOCUMENT Accompanying document to the Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL concerning measures to safeguard security of gas supply and repealing Directive 2004/67/EC

[94] Centre for the Protection of National Infrastructure, *Critical National Infrastructure*, https://www.cpni.gov.uk/critical-national-infrastructure-0

[95] GCHQ is part of the team which protects the UK, along with law enforcement and the other intelligence agencies. Working with HMG and industry, they defend Government systems from cyber threat, provide support to the Armed Forces and strive to keep the public safe, in real life and online.

[96] Centre for the Protection of National Infrastructure, *Cyber Security*, https://www.cpni.gov.uk/cyber-security

individuals to provide authoritative and coherent cybersecurity advice and cyber incident management[97].

GCHQ aims to identify vulnerabilities in technology across UK facilities. These vulnerabilities may represent a risk to the security of systems in the UK and of our allies. These include Government departments, critical national infrastructure, companies and private citizens. In some cases, the same vulnerabilities might provide a means by which the UK intelligence community could obtain vital intelligence that could be used to protect the UK and its interests[98].

To carry out its mission, GCHQ is supported by the following entities:

- The Equities Technical Panel (ETP), made up of a panel of subject matter experts from across the UK Intelligence Community including the NCSC.

- The GCHQ Equity Board (EB), which includes representation from other Government agencies and Departments as required. The Chair of the Equity Board is a senior civil servant with appropriate experience and expertise, usually drawn from the NCSC, and answerable in this role to the Chief Executive Officer (CEO) of the NCSC.

- The Equities Oversight Committee, chaired by the CEO of the NCSC, which ensures the Equities Process is working appropriately and in accordance with specified procedures. This Committee also advises the CEO of the NCSC on equity decisions escalated from the Equity Board[99].

In France, the policy on the critical infrastructure protection (CIP) is developed and coordinated by the General Secretariat for Defence and National Security (SGDSN). The critical infrastructure protection (CIP) policy provides a framework in which public or private critical operators can assist in implementing the national security strategy in terms of protection against malicious acts (terrorism, sabotage) and natural, technological and health risks. As the linchpins of this system, critical operators must analyse the risks to which they are exposed and apply the protection measures within their remit – particularly the VIGIPIRATE plan. The 2013 White Paper on Defence and National Security establishes this policy as a means of strengthening the Nation's resilience[100].

By delegation of the Prime Minister, the SGDSN is responsible for the cross-government coordination and organisation of the system. It determines the scope of the CIP policy, particularly as regards method and doctrine. It approves the National Security Directive. It also lays down the cybersecurity rules that must be applied by critical operators.

France is partitioned into 13 defence and security zones (including over-sea territories). The zone prefect is the territorial stakeholder in charge of coordinating the CIP system. Its responsibilities include organisation, support for prefectures and informational liaison between the central and local levels. It also coordinates inspections of critical infrastructure within its area of jurisdiction. For each critical infrastructure, the department-level prefect approves the specific protection plan drawn up by the operator. He also drafts an external protection plan setting out the intervention and vigilance measures to take if this critical infrastructure should ever find itself under threat or attack[101].

[97] The launch of the National Cyber Security Centre A snapshot of the past, present and future of cyber security
[98] Government Communications Headquarters, *The Equities Process*, 29 November 2018, https://www.gchq.gov.uk/features/equities-process
[99] Government Communications Headquarters, *The Equities Process*, 29 November 2018, https://www.gchq.gov.uk/features/equities-process
[100] SGDSN, *The Critical Infrastructure Protection In France*, January 2017
[101] SGDSN, *The Critical Infrastructure Protection In France*, January 2017

As early as 2008, the White Paper on Defence and National Security identified cyber-attacks as one of the main threats to our defence and security. To tackle those new threats, Article 22 of the 2013 French Military Programming Law now requires critical operators to reinforce the security of their information systems[102]". These requirements apply to critical information systems identified by operators and involve reporting incidents, implementing a core set of security rules and making use of qualified detection service providers and products. The National Cybersecurity Agency (ANSSI) is in charge of implementing these provisions within the SGDSN and has worked closely with the ministries and operators to define rules that are at once effective, appropriate and sustainable for operators. In 2013, the SGDSN launched a process for revising the national security directive. One of its objectives is to adopt an all-hazards approach so as to encourage operators to make preparations for every critical eventuality that may affect their staff, premises, networks and production facilities by drawing up a business continuity plan (BCP). These documents are a requirement on the part of critical infrastructure. The SGDSN has produced a methodological guide to drawing up BCPs, which the general public has been able to access since 2013[103] [104].

After the European Council approved the European Programme for Critical Infrastructure Protection (EPCIP) in 2004, the Spanish Administration launched the National Plan for Critical Infrastructure Protection (PNPIC). Therefore, in 2007 the Spanish Cabinet decided then to create the National Centre for the Protection of Critical Infrastructure (CNPIC) and released the rule of law as Royal Decree 704/2011, which develops the Regulation on the Protection of Critical Infrastructures. The CNPIC, dependant from Secretariat of State for Security, of the Ministry of the Interior, is responsible for directing, coordinating and supervising the protection of national critical infrastructure[105].

In Spain, the action plan aims to optimise the security of critical infrastructure mainly in the field of the protection against deliberate attacks. This makes paramount the involvement of other agencies, both from the public administration, and from the private sector. Therefore, cooperation of every actor involved either in the regulation, planning or operation of the different infrastructures that provide essential public services to the country is mandatory, in order to achieve a public-private partnership beneficial to everyone[106].

To defend the Spanish society from the new risks, generated largely by globalization, and include international terrorism, the proliferation of weapons of mass destruction, or organized crime, on May 7, 2007, the Secretariat of State for security of the Ministry of the Interior defined a first National Plan for protection of the critical infrastructure and a first national catalogue of strategic infrastructure[107].

"With Law 8/2011, establishing measures for the protection of critical infrastructure, the National Centre for the protection of the critical infrastructure (CNPIC) was created as a ministerial body to impulse, coordinate and supervise all activities entrusted to it by the Secretariat of State for security in relation to the protection of the critical infrastructure in the country. CNPIC organically depends on the Secretary of State for security, and its functions are those according to the rules established"[108].

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[102] *SGDSN*, *The Critical Infrastructure Protection In France*, January 2017
[103] Defence Code – Articles L. 1332-1 to L. 1332-7, L. 2151-1 to L. 2151-5 and R. 1332-1 to R. 1332-42
[104] Instruction générale interministérielle n° 6600 relative à la sécurité desactivités d'importance vitale du 7 janvier 2014.
[105] TEMI GROUP, *Spain provides Legal Framework for Critical Infrastructure Protection*, 22 July 2011, https://temigroup.wordpress.com/2011/07/22/spain-provides-legal-framework-for-critical-infrastructure-protection/
[106] TEMI GROUP, *Spain provides Legal Framework for Critical Infrastructure Protection*, 22 July 2011, https://temigroup.wordpress.com/2011/07/22/spain-provides-legal-framework-for-critical-infrastructure-protection/
[107] TEMI GROUP, *Spain provides Legal Framework for Critical Infrastructure Protection*, 22 July 2011, https://temigroup.wordpress.com/2011/07/22/spain-provides-legal-framework-for-critical-infrastructure-protection/
[108] Global Regulation, *Law 8/2011, 28 April, By Which Establish Measures For The Protection Of Critical Infrastructure*, 28 April 2011, https://www.global-regulation.com/translation/spain/1437394/law-8-2011%252c-28-april%252c-by-which-establish-measures-for-the-protection-of-critical-infrastructure.html

Regarding this, in January 12, 2011 the "Association for the Protection of Critical Infrastructures (APIC)" was instituted as a non-profit entity. Aware of the importance of the exchange of knowledge and management techniques in the field of security at the regional, national and international levels, joint analysis of common problems, reflection on fundamental or new aspects of security management, this association has as essential purposes the following[109]:

- To be an open space for analysis and treatment of those risks and threats that occur around the activities and facilities of the critical and strategic infrastructures.
- To be a permanent discussion forum for security management professionals on the concerns of securities and insecurities in critical and strategic infrastructures.
- To be a permanent collaboration table with the different professionals of the critical infrastructures, as well as with the security forces, fire, civil protection, etc.
- To serve as a nexus for security professionals in matters of civil and patrimonial security, internal order, fire safety, protection of information and values, prevention of occupational risks, protection of the environment, etc.
- To promote the creation and strengthening of security management units or departments in critical and strategic infrastructures.
- To ensure the collaboration agreements with other associations or similar bodies in other regional, national and international spheres[110].

In October 2018, the European Infrastructure Simulation and Analysis Centre (EISAC) was born in Italy. "It is the first of four centres to be set in the European Union (Germany, France, Spain and the Netherlands)"[111]. It may support private sector and public administration to provide continuity to essential services (energy, water supply, communications and transport, terrorist actions, cyber-attacks and extreme weather events). *The new structure will work with the civil protection, local administrations and managers of critical networks providing advanced services of natural events simulation and their impact on services, stress tests of infrastructures and data collection and analysis as well. EISAC Italia will also provide territorial databases, infrastructure simulators, satellite data analysis and weather, climate and ocean forecasting systems to improve the resilience of critical infrastructures, i.e. their ability to withstand extreme events and quickly return to normal operating conditions*[112].

Therefore, it is clear that each country has its own approach to critical infrastructures protection but the interconnection existing between Member States requires the adoption of a common method. Standards and best practices are one of the means used to elevate information security levels and their implementation is increasingly requested, in various ways by governmental policies. In critical infrastructure protection, the benefits of technical standardisation are equally evident, in a multinational setting like the European Union the adoption of common standards for the management and assurance of information security in such important systems would certainly increase trust across borders, data exchange and interoperability[113].

Regarding this, ISO 27001 [ISO13] is a governance framework specifying the requirements for the security management of information systems. It aims to ensure a risk management system and a continuous cycle of risk assessment, then treatment reassessment. In any case, ISO 27001 define

[109] Asociación para la Protección de las Infraestructuras Críticas (APIC), *Sobre APIC Quiénes somos y cuáles son nuestros objetivos*, http://infraestructurascriticas.com/principal.asp?pag=que
[110] Asociación para la Protección de las Infraestructuras Críticas (APIC), *Sobre APIC Quiénes somos y cuáles son nuestros objetivos*, http://infraestructurascriticas.com/principal.asp?pag=que
[111] Working towards the improved safety and protection of citizens, KIOS Research and Innovation Center of Excellence, http://www.kios.ucy.ac.cy/index.php/component/content/article.html?id=214:ciprnet-
[112] ENEA Italian National Agency for New Technologies, Energy and Sustainable Economic Development, *Security: In Italy first European center for the critical infrastructure protection*, 11 October 2018, http://www.enea.it/en/news-enea/news/security-in-italy-first-european-center-for-the-critical-infrastructure-protection
[113] ENISA, *ENISA's contribution to the Critical Information Infrastructure protection (CIIP)*, May 2017, https://www.enisa.europa.eu/publications/ed-speeches/enisas-contribution-to-ciip

risk management and its implementation but the process and its requirements are not well-defined in the standard itself. Even if it is very flexible, adapting it to real cases requires a lot of work, especially in the case of industrial systems and infrastructures, with all their peculiarities and so the implementers can select the risk assessment method that suits best their use case. It must be remarked that no generally accepted risk management framework exists for ICSs and SCADA systems anyway, and that the ISO 31000 framework for risk management can be considered the natural complement of ISO 27001[114].

In ICT security sector there are two main certification types that are in use: ISO/IEC IS 15408 and BS7799 standard developed in Great Britain. The object of the ISO/IEC IS 15408 (Common Criteria) is an ITC system or product; while BS7799 standard certify the process used by an organization, be it a private company or a public structure, to internally manage ICT security. The BS7799 certification can be considered a corporate certification, like the more known ISO 9000 certification, but specialized in the field of ICT security[115].

On the one hand, an important feature of the energy sector is the interdependence of energy infrastructure, as well as the dependence of the other sectors on energy. This means that the energy sector as such is uniquely critical for a MS and consequently, an extremely attractive target for enemy attack (including terrorist attacks and cyberwarfare). On the other hand, the transit countries could be well protected from threats from the countries supplying them with energy.

Modern energy infrastructures provide essential fuel to all other sectors of defence CI including transport, ICT, water, etc. Without energy, all sectors cannot operate properly. The energy sector initiates more cascades than any other sector. A disruptive event on defence related CEI can create cascading effects on other infrastructures dependent on them with impacts on these different sectors. This is due to the nature of modern CIs (including energy) which are now increasingly complex and more interconnected than ever and often operate as a system of systems. This interconnection gives rise to dependencies or interdependencies, whereby the effective operation of a CI relies more and more on the normal operation of other CIs. For example, electric power provides energy to pumping and compressor stations, storage facilities and control equipment for oil and natural gas. Power outages can affect oil and natural gas production and transportation whereby refineries may be shut down and oil terminals, gas tanks and pipelines may become inoperable due to electric power loss[116].

An attack on energy critical infrastructure or a disruption can cause serious problems to the citizens and can jeopardize national security and so its protection is a key issue. In this context, public-private partnerships (PPPs), which are based on the cooperation between the public and the private sectors, are indispensable. The comprehensive definition of public-private partnership that this study applies is the one contained in Article 15.41 of the EU Regulation 549/2013, explicitly "*Public-Private Partnerships (PPPs) are long-term contracts between two units, whereby one unit acquires or builds an asset or set of assets, operates it for a period and then hands the asset over to a second unit. Such arrangements are usually between a private enterprise and government but other combinations are possible, with a public corporation as either party or a private non-profit institution as the second party*[117]".

In the last twenty years, there have been structural changes in societies, that are shaping a new world: a growing population with an increasing trend towards urbanization, a rising use of the web, hybrid threats, a slowdown in the growth of emerging economies, geopolitical instability, an

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[114] Alessandro Guarino, *Information Security Standards in Critical Infrastructure Protection*, ISSE, Berlin, 11 November 2015

[115] Istituto Superiore delle Comunicazioni e delle Tecnologie dell'Informazione ISCOM, *Network Security in Critical Infrastructures*, http://www.isticom.it/documenti/news/pub_003_eng.pdf

[116] European Defence Agency, *Protection of Critical Energy Infrastructure (PCEI)*, Brussels, October 2017.

[117] Alessandro Annoni, *Public Private Partnership: is this concept still valid?*, Joint Research Centre the European Commission's in-house science service, January 2017, https://geospatialworldforum.org/speaker/SpeakersImages/public-private-partnership-is-this-concept-still-valid.pdf

increasing demand for equal access to housing and sanitation, but also to natural resources including raw materials, food, water, and energy. To manage human needs more sustainably, governments need to be able to understand and interpret the trends and to implement effective action. The defence sector is no different to any other sector of society in this respect. Therefore, it is becoming very important for defence to take into consideration existing and emerging megatrends in defence planning.

2.3.2 Synergies between civil and military sectors

Global technologically advanced environmental, geopolitical and economic changes led to significant progress, at international as well as at national levels, in the general cyber risk profile. To ensure safety and security on the national level and in critical infrastructures, many states on this planet have a dedicated cybersecurity department (or agency). However, greater efforts should be undertaken to deal with every new offence and threat, also characterized by interconnected knowledge, techniques, and expertise. In many modern scenarios, the energy environment and the cyber space are the “easier vector” to hit or damage a community.

The changing security and energy environment make it necessary for CEI to serve both civilian and military operations and, in case of a severe crisis, be ready to switch from civilian to military modus operandi at short notice. Due to limited resources and the need to reduce operational costs we cannot afford critical infrastructures operating only for the defence sector and as a consequence closer collaboration between civil and military domains is paramount. The challenge is unprecedented since most often there are different procedures, regulations and modus operandi during a crisis. Apart from technological issues, the establishment of a common understanding between military and civilian staff is essential before, during and after an event. Terrorist attacks in EU capitals, huge refugee and migration flows, natural disasters, and a range of complex armed conflicts throughout the world have a significant impact on the defence and security sectors.

Armed forces have been asked to perform additional tasks to support police and civil protection, for instance by guarding strategic points, providing security and resources to refugee camps, or to contribute in search and rescue operations and in clearing and repairing damaged roads and other communications routes.

Although defence does have its own energy resources, it depends to a great extent on civilian resources. This could raise some serious issues: the compromising of civilian resources could heavily affect the whole society; in the event of a cyberattack, the relationship between civil power plants and the EU national defence sector would be paralyzed in the effective response capabilities; the lack of EU energy supply would weaken its ability to provide security; the ability of the EU to provide an effective response to hybrid threats, that could affect the civil society. It is expected that through collaboration each MS will enhance the protection and resilience of defence-related CEI, and consequently the resilience of the EU. While the defence sector’s own infrastructure may be well protected, the interface and dependency with civilian energy infrastructures is another challenge. The challenges for the defence sector increase further given that although defence has its own energy resources, it depends mostly on civilian resources (public or private).

The future security environment is expected to be increasingly affected by key environmental and resource constraints, including health risks and societal factors, climate change, water scarcity and energy needs. In addition to those constraints, natural hazards, physical and cyber threats, terrorism, criminal activity, hybrid and asymmetrical warfare are among the issues which may amplify vulnerabilities to CEI affecting negatively the defence and security sector.

In a Europe where MS armed forces are required to work more closely together the question of who supplies energy gains urgency and in particular in cases where the armed forces are engaged in civilian type operations such as search and rescue, fire-fighting etc.

While in previous decades energy companies used to belong to or be managed by national governments, nowadays the majority of those companies belong to the private sector. As an

example, during the Cold War, most of these energies producing companies, including railways, ports, airfields, grids and airspace were in state hands and easily transferred to NATO control for those MS concerned, in a crisis or wartime situation. Today, by contrast, 90 per cent of NATO's supplies and logistics are moved by private companies and 75 per cent of the host nation support for NATO forces forward deployed on the territory of the eastern Allies comes from private sector contracts.

Cyber-attacks on the energy infrastructure are the modern reality and the issue of the global concern. The leading international agencies, research institutions, and global experts in cybersecurity and defence raise the challenge high on the global agenda and indicate the necessity of the multi-disciplinary approach. The success of the solution is based on the assumption of interconnectivity and complexity of the cybersecurity development, deployment, and management for macro- and micro-critical infrastructures. After incidents in 2014-2015 (HAVEX, Black Energy malware), cybersecurity is recognized a pillar for CIs and EU reinforced the existing framework with the Directive on security network and information systems (NIS Directive) to ensure MS preparedness and cooperation. In 2016, an American study for homeland security found that 55% of all cyber-attacks in all sectors of industry were work of insiders. Often, these events occurred with malicious intentions but using unverified software of dubious provenance in work place; to deal with this threat, it is necessary to improve information sharing and to develop harmonized procedures.

Beyond the already existing EU cybersecurity initiatives, the Commission is proposing a new fundamental project, to further tighten the relationships between the various stakeholders (public and private) of cybersecurity on the critical infrastructures: the creation of a Network of Competence Centres and a European Cybersecurity Industrial, Technology and Research Competence Centre (European Centre) to develop and roll out the tools and technology needed to keep up with an ever-changing threat. The European Centre will be in charge of coordinating the funds foreseen for cybersecurity in the next long-term EU budget together with the MS in the most targeted way. This will help to create new European cyber capabilities. A wealth of expertise already exists in Europe, there are more than 660 cybersecurity competence centres spread across the EU.

The European Competence Centre will coordinate the use of the funds foreseen for cybersecurity under the next long-term EU budget for years 2021-2027 under the Digital Europe and Horizon Europe programmes. The centre will support the Network and Community to drive the cybersecurity research and innovation. It will also organise joint investments by the EU, MS, and industry. For example, under the Digital Europe programme €2 billion will be invested in safeguarding the EU's digital economy, society and democracies by boosting the EU's cybersecurity industry and financing state-of-the-art cybersecurity equipment and infrastructure.

Each MS will nominate one national coordination centre to lead the network, which will engage in the development of new cybersecurity capabilities and broader competence building. The network will help to identify and support the most relevant cybersecurity projects in the MS. This project has the aim to improve: better coordination of work; access to expertise; access to testing and experimental facilities; assessment of product cybersecurity; access to innovative cybersecurity products and solutions; support for market deployment of products and services; increased visibility towards potential investors and business partners; cost-saving by co-investment with other MS; EU capacity to autonomously secure its economy and democracy. The hope is that the EU will become a global leader in cybersecurity.

Defence organisations will need to follow a structured path which is often served by implementing internationally agreed frameworks which can be adapted according to the requirements of a particular MoD or armed force, taking into account regional needs and even site-specific considerations. One such mechanism is through the application of ISO 50001 on energy management systems (EMS), which has been increasingly adopted by civilian sectors and with a growing number of MoDs recognising the added value which the standard can bring to an organisation's energy performance, and, therefore, cost and operational control performance.

While the standard provides a systematic pathway to follow, there is also an overarching need to put in place a cultural shift so that energy is considered in all relevant aspects of military capability planning and operations, including on defence infrastructure, to become a way of working rather than something which is added-on as an after-thought and is only driven by a limited number of energy-conscious individuals.

The need to secure the integrity and maintain the robustness of existing and future defence relevant installations has to consider the diversity of hazards and threats (e.g. natural, physical, cyber, hybrid, multidimensional) and the presence of interdependent networks of infrastructures (telecommunications, internet, transportation, water, sewage, etc.) that are impacting the energy network which itself consists of many (sub-)networks (e.g. electric power, oil pipelines and logistic chains, gas pipelines and logistic chains).

2.3.3 Evolution of Energy Security with an impact on PCEI

EU Energy Security Strategy:

In response to the concerns related to the EU's potential vulnerability resulting from possible major supply disruptions, and in connection with the reliance on a single supplier, the European Commission released its *Energy Security Strategy* in May 2014 (accompanied by the *In-depth study of European Energy Security*)[118]. Through this document, the EU expresses its determination to adopt a strategy for energy security which promotes resilience to potential shocks and disruptions to energy supplies in the short term (similar to the gas disruptions in 2006 and 2009) and reduced dependency on particular fuels, energy suppliers and routes in the long-term. For this, the EU calls for the need to pursue a more collective approach through a functioning internal market and greater cooperation at regional and European levels.

The Strategy is based on eight key pillars promoting closer cooperation between all Member States while respecting national energy choices, and based on the principle of solidarity:

1. Immediate actions aimed at increasing the EU's capacity to overcome a major disruption during the winter 2014/2015. For this the European Commission in close cooperation with Member States carried out for the first time an energy security stress test[119], whose main results and proposed actions have served as a basis for the later adoption of legislative acts such as Regulation 2017/1938 on measures to safeguard the security of gas supplies, described in section 3.12.

2. Strengthening emergency/solidarity mechanisms including coordination of risk assessments and contingency plans, and protecting strategic infrastructure. The pillar includes four main provisions related to: the obligation of Member States to build up and maintain minimum reserves of crude oil and petroleum products; preventing and mitigating gas supply disruption risks; the need to develop solidarity mechanisms among Member States; and the **protection of critical infrastructure**.

   This last provision also takes into account the necessity to launch a wider debate on the protection of strategic energy infrastructure such as gas and electricity transmission systems, addressing the control of strategic infrastructure by non-EU entities, notably by state-companies, national banks or sovereign funds from key supplier countries that aim at penetrating the EU energy market or hampering diversification rather than the development of the EU network and infrastructure.

   The criticality thresholds used in determining ECI differ among MS, nevertheless the Directive has aided MS in increasing their awareness of the risks and vulnerabilities of their critical systems. A broad range of energy infrastructure protection issues must be addressed for which comprehensive and regular assessments are necessary. Infrastructure situational awareness

[118] https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/energy-security-strategy
[119] https://ec.europa.eu/energy/en/news/stress-tests-cooperation-key-coping-potential-gas-disruption

should be enhanced to the maximum extent possible and private owners and operators should regularly report to state authorities on the status of their infrastructures.

In this sense, different types of interdependency have to be considered, regarding to ENISA: Physical interdependency, which arises from a physical linkage between the inputs and outputs of two infrastructures; Cyber interdependency, if the state depends on information transmitted through the information infrastructure; Geographic interdependency, which occurs when elements of multiple infrastructures are in close spatial proximity; Logical interdependency, two infrastructures are logically interdependent if the state of each depends on the state of the other via a mechanism that is not a physical, cyber, or geographic connection.

3. Moderating energy demand;

4. Building a well-functioning and fully integrated internal market;

5. Increasing energy production in the European Union;

6. Further developing energy technologies;

7. Diversifying external supplies and related infrastructure, with a focus on natural gas, an on uranium and nuclear fuel supplies;

8. Improving coordination of national energy policies and speaking with one voice in external energy policy.

In-depth study of European Energy Security[120]

According to the study, the current European energy security strategy takes into account a trend of increasing import dependency, in the context of a significant decline of EU production of oil, gas and coal, linked to a gradual depletion of EU reserves and the closure of uncompetitive sources, on the one hand, and of growing amounts of imported oil, gas, and coal to compensate for declining domestic production, on the other hand. The conclusions of the study are also supported by the Fourth Report on the State of the Energy Union[121] , adopted in April 2019, which takes note that despite a gradual decrease between 2007 and 2014, energy consumption has started to increase in recent years, raising slightly above the 2020 targets, as a consequence of the weather variations, colder years 2015 and 2016, and also increased economic activity and low oil prices. The in-depth study of European Energy Security also acknowledges the contribution, since 2006, of the increasing share of renewables, as well as of the reduction of overall demand to a stabilisation of import dependency.

It analyses the EU's energy security strategy in relation with **six major sources of energy**:

1. Oil is the largest single primary energy source used in the EU, accounting for one of the highest shares of imports (almost 90%).

A report developed by Cambridge Econometrics in 2016, "A Study on Oil Dependency in the EU[122]", identifies three main types of risks in connection to the EU's dependency on oil imports: exposure to security of supply (the exclusive reliance of some European Member States on a single supplier and the various geopolitical insecurities affecting some of the oil suppliers); exposure to environmental risk (related to the carbon emissions associated with different sources of EU imports); and dependence on oil extraction and petroleum refining companies (over 80% of crude oil imports and 95% of refined oil imports to the EU are from non-European companies).

[120] https://ec.europa.eu/energy/sites/ener/files/documents/20140528_energy_security_study.pdf
[121] https://ec.europa.eu/commission/sites/beta-political/files/fourth-report-state-of-energy-union-april2019_en_0.pdf
[122] https://www.camecon.com/wp-content/uploads/2016/11/Study-on-EU-oil-dependency-v1.4_Final.pdf

From a security of supply point of view, however, being mostly imported by sea, oil offers more flexibility when it comes to changing suppliers in case of disruptions. Nevertheless, taking into account oil's history of supply and price shocks, the EU aims to adopt measures that would allow to diversify supplies and to prepare for short term shocks. Thus, in 2009, the European Commission adopted the *Minimum Stocks of Crude Oil and/or Petroleum Products Directive*[123] requiring the EU countries to maintain emergency stocks of oil equal to at least 90 days of their average daily consumption or 61 days of consumption, whichever is higher, in case there is a disruption to oil supply. In the case of a major supply disruption, the Commission shall authorise the release of some or all of the quantities of emergency stocks and specific stocks.

2. The EU imports over 60% of its **gas**, with two thirds of these imports coming from countries outside of the EEA.

The security of gas supply is understood by the EU as the ability to ensure an interrupted flow of gas across borders at any time to where it is most needed, with no undue physical or regulatory barriers. For this goal, an efficiently organised internal gas market is considered to be the key condition.

According to the Fourth Report on the State of the Energy Union (2019)[124], important progress has been made in order to ensure diversification of gas supply, aimed at ending dependency on a single supplier in certain Member States, increasing the resilience of the Member States' energy systems, enhancing competition, and decreasing prices. As a result, at present, with only one exception, all Member States have access to two independent sources of gas, and it is expected that all Member States except for Malta and Cyprus will have access to three sources of gas by 2022, while 23 Member States will also have access to the global LNG market. Access to LNG market and the expected completion of the Southern Gas Corridor are key diversification initiatives, especially important for those areas in Europe historically dependent on a single gas supplier, as the Eastern Baltic Sea region and Central South-Eastern Europe.

For the EU, there are three main mechanisms to help to boost EU gas supply resilience: a well-functioning EU internal market, the capacity to operate pipelines in two directions (reverse flow), and gas storage rules [125].

In March 2019, the IEA published an analysis on the current state of the natural gas security in the EU: *Commentary: A long-term view of natural gas security in the European Union*[126]. The report concludes that Russia is well placed to remain the primary source of gas into Europe. LNG imports are projected to grow, as new suppliers – notably the United States – increase their presence on international markets and more European countries build LNG regasification capacity. However, Russia is still projected to account for around one-third of the EU's supply requirements through to 2040.

The IEA analysis suggests that the EU internal market is already functioning reasonably well with around 75% of gas in the European Union being consumed within a competitive market, and with gas being able to be redirected across borders to areas confronted with an increase of demand or with shortages of supply. Reverse flow capacity has largely contributed to this purpose. However, the report takes notice of the fact that 40% of the EU's LNG regasification capacity cannot be accessed by neighbouring states, and that the access of some countries in Central and South-East Europe to alternative sources of supply is still limited.

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[123]https://eur-lex.europa.eu/legal-content/EN/ALL/;jsessionid=0g1BTRSFG7fv1TNKJvrNFLqnrfYl5nLWpxHSXp6gpK5JvvN9v516!2097610408?uri=CELEX:32009L0119

[124] https://ec.europa.eu/commission/sites/beta-political/files/fourth-report-state-of-energy-union-april2019_en_0.pdf

[125] https://ec.europa.eu/energy/sites/ener/files/documents/20140528_energy_security_study.pdf

[126] https://www.iea.org/newsroom/news/2019/march/a-long-term-view-of-natural-gas-security-in-the-european-union.html

An essential part of ensuring secure and affordable supplies of energy to Europeans involves diversifying sources and supply routes. In order to decrease the dependence of EU countries on a single supplier of natural gas and other energy resources and thus to limit the impact of potential disruptions, the EU envisages three main alternative supply routes and sources[127]:

- The Southern Gas Corridor aims to expand infrastructure that can bring gas to the EU from the Caspian Basin, Central Asia, the Middle East, and the Eastern Mediterranean Basin, in order to support countries in Central and South East Europe to diversify their supplies and reduce dependence on a single supplier of natural gas.
- Developing the Mediterranean hub in the South of Europe, with Israel, Egypt and Cyprus becoming strategic partners for the EU because of their significant offshore reserves of natural gas, which could be exported to the EU via pipelines or as LNG.
- Imports of liquefied natural gas (LNG): In February 2016, the European Commission presented an EU strategy for liquefied natural gas (LNG) and gas storage, as LNG supplies from North America, Australia, Qatar, and East Africa are increasingly being imported by the EU.
- The Fourth Report on the State of the Energy Union (2019)[128] takes note that significant progress has been made to increase the EU's energy security with respect to natural gas. and electricity, by adopting new rules on security of gas supply and electricity risk preparedness in order to organise operational cross-border regional cooperation to prevent and manage risk of gas disruptions, electricity shortage or black-out. The Report also highlights the progress made in the gas market, with the European Commission being now able to ensure that Member States' agreements with countries outside the EU comply with EU law before being concluded,

3. **Solid fuel** (hard coal, sub-bituminous coal, lignite/brown coal and peat) provides 17% of the EU's energy. Some of the EU Member States still score high levels of carbon use, due to a low degree of modernisation, obsolete state of power plants, low efficiency and lack of diversification.

4. **Nuclear** powered electricity accounts for 13% of the EU's energy consumption, and 27% of its electricity generation. There is a good variety of supplying countries, as up to 95% of the uranium is provided by countries including Kazakhstan, Canada, Russia, Niger and Australia. Storage of uranium is also easy. However, only a limited number of companies manages the final fuel assembly process.

5. **Renewable energy** is based on a large diversity of fuels, but is poses concerns related to reliability, requiring adaptation of the grid, as it depends on the changing nature of wind and solar power.

After EU countries have agreed in 2014 to reduce greenhouse gas emissions by at least 20%, increase the share of renewable energy to at least 20% of consumption and achieve energy savings of 20% or more by 2020; with the new 2030 framework for climate and energy they established a 40% cut in greenhouse gas emissions compared to 1990 levels, at least a 27% share of renewable energy consumption, and at least 27% energy savings compared with the business-as-usual scenario. Eventually, on 28 November 2018, the Commission presented its strategic long-term vision for a prosperous, modern, competitive and climate-neutral economy by 2050.

The Fourth Report on the State of the Energy Union (2019) notices that, since 2014, the share of renewable energy in the EU energy mix has significantly increased, reaching 17.5% in 2017. However, the increase has slowed down since 2014 and the deployment of renewable energy varies across sectors has been unequal, with renewable energy reaching 30.8 % in the electricity

[127] https://ec.europa.eu/energy/en/topics/energy-security/diversification-of-gas-supply-sources-and-routes
[128] https://ec.europa.eu/commission/sites/beta-political/files/fourth-report-state-of-energy-union-april2019_en_0.pdf

sector, but only 19.5% in the heating and cooling sector, and 7.6% in the transport sector. The pace of increase in the share of renewable energy has also slowed since 2014.

Through the attainment of the targets proposed, the EU can help combat climate change and air pollution, decrease its dependence on foreign fossil fuels, and keep energy affordable for consumers and businesses. But in this sense, it is necessary to consider the green and renewable energy as a critical infrastructure and vital necessity for the future. So, for example, also the wind power is exposed, as every infrastructure, to risks with consequences that can affect the individual operator, at the risks of economic losses due to the interruption of the activity. It is necessary to intensify the security systems of the IT devices linked to the management and maintenance systems of wind turbines, ICS/SCADA systems, which in most cases have not been created for the web and are therefore obsolete and more subject to infiltration of hacker.

A synergy between the electricity grid, the computer network and technologies for the production of electricity from renewable sources, it should be added greater attention to the management of the systems, so that the process of evolution of the energy system in the smart direction is completely perfected. New paradigm of smart cities must be taken into account in order guarantee energy security in an environment characterised by a huge number of automatised and distributed devices IOT based. Particular attention should be given to the vulnerabilities that such a scenario will present. Resilience will be a key element in achieving high energy security levels in smart cities and critical infrastructures.

A growing network connection of electrical systems and equipment (power plants), or of production plants, photovoltaic and wind power plants, transformer cabins, transmission infrastructures, which inevitably has them, and suddenly, exposed to threats so far unknown, highlighting its vulnerabilities. In fact, the operation of the systems and network equipment is often based on fairly old "operating" communication systems and protocols, which guarantee great reliability in an "isolated" and protected environment, but which easily become "vulnerable", once put in contact with the outside world.

The diffusion of renewable generation plants entails the entry of numerous new operators, many of whom with little or no experience in the sector, and, consequently, a reduced awareness of cybernetic risks. Two factors, the increase of the so-called "attack surface", i.e. the number of target subjects, together with the low level of preparation of these subjects, which could be combined in a dangerous way. This is associated with the phenomenon of "prosumer", companies (manufacturing, services) and consumers who are also transformed into energy producers, installing systems that are also renewable sources, in the vast majority of photovoltaic cases. These operators, although much smaller than the "pure players" of the generation, are connected to the network and therefore can cause instability, especially in the case of "widespread" attacks.

6. **Electricity** constitutes the most fuel-diverse form of energy available and it offers the flexibility to switch fuels in case of price changes or supply disruptions. Moreover, the EU has taken significant steps to improve the resilience of its energy system by improving the integration of the European electricity grid and completion of key inter-connectors, and by reducing the import dependency through an increased use of renewable energy sources.

Nevertheless, the EU takes into account possible challenges to the security of electricity supply. First, there are large differences between Member States regarding the resilience of their energy systems. Second, the storage capabilities for electricity are very limited. Third, the potential overlap of unusual or extreme events (e.g.: an ongoing cold and dry winter coupled with a major external gas supply disruption) might inflict upon and cause disturbances in the functioning of the European electricity system and internal market.

In order to prevent and counter such disturbances, the EU emphasises the need for the Member States to cooperate and to exchange information on negotiations with external fossil suppliers, as disruptions in the supply of some fuel might also affect the production of electricity.

The Fourth Report on the State of the Energy Union (2019) addresses the need for investments on a much larger scale in electricity grids (both transmission and distribution), investments estimated at more than EUR 150 billion for the period 2021-2030, as well as the necessary update towards digitisation, smart grids, and the deployment of new storage facilities. In addition, the role of batteries is of strategic importance to the EU, in connection with its efforts for decarbonising the European economy, strengthening the EU's strategic autonomy in energy supply, and boosting the EU's industrial competitiveness. According to the Report, batteries are important for the management of the electricity grid to distribute and store power from renewable energy sources, while also contributing to low-emission and zero-emission mobility.

Considering the magnitude or rate of long-term climate change, focus should be put on green procurement methods and green military equipment with a lower carbon footprint that will provide increased operational, environmental and cost-effective reliability.

Energy management needs to become integrated with corporate decision making and behaviour. Although energy training, policy and leadership are all part of ISO 50001, such a shift in corporate culture will take time to be embedded in the defence sector, mainly because the Defence sector is just entering into this policy area.

To pursue the goals of the Energy sector and market security within a coherent long-term strategy, the EU has formulated targets for 2020 (short term), 2030 (medium term), and 2050 (long term).

2.3.4 CF SEDSS II WG3 's results and experiences

The main activities of the WG3, which was set up specifically for the Phase II of the CF SEDSS, refer to the protection of CEI. Since the raising of the debate throughout the international community, it became extremely relevant to cover this overarching issue which has cross cutting influence in many sectors of each MS. Given the fact that the MS MoDs in most of the cases do not own or have the responsibility (unless of critical situations) to protect CEI, the topic of PCEI is of high importance to the respective MoDs, as they recognise the increased dependency of MS armed forces to CEI.

During the conferences of CF SEDSS II Phase, all WG3 participants shared their thoughts and challenges on exploring the protection of CEI from a military point of view and assessing how the EU energy legislation on European critical (energy) infrastructures can be applied by the defence sector to ensure adequate level of military capabilities and to support civil sector as well. All this to guarantee the efficiency, modernity and resilience of MS MoDs infrastructures. Moreover, the connections between PCEI and hybrid threats were focussed and discussed during each sections of work.

Participants were delegates from EU MS MoDs, delegates from other ministries such as the Ministry of Economic Affairs and Communications and one MoD representative from Switzerland, experts from the European Commission (DG energy, DG JRC, European Security and Defence College - ESDC) and NATO. Moreover, meetings included participants from industry sphere, academia side and experts from international organizations/entities.

According to the principles and the aims of the CF SEDSS, WG3's objectives could be summarised by the following points:

- Raise awareness and increase knowledge of the significance of the PCEI in the EU defence and security sector;
- Contribute to the enhancement of CEI protection and resilience in defence sector;
- Identify common challenges; shortfalls, vulnerabilities, risks & opportunities, related to PCEI in the defence sector, even though analysing and depicting the current respective PCEI MS' state of play;
- Propose project ideas factsheets and detailed versions. As shown, concrete proposals have been developed and identified as part of the PCEI final deliverables, and the WG3 is close to have tangible positive results, in terms of funding some projects ideas mature enough;

- Identify potential scope and objectives related to CF-SEDSS Phase III to reinforce activities already in progress and increase a wider awareness.

Considering that MS armed forces are engaged and related to PCEI, as they are considerable consumers of energy within the public sector, during the conferences, general framework of the activities was defined and general common points were discussed. The delegates and the other participants shared consideration on the high dependency of the armed forces on CEI. Also, the importance of cooperation between "private sector-civil authorities and armed forces" to enhance PCEI was highlighted. During the meetings, all the participants also focused on common capabilities or shortfalls, and investigated on the existing EU legislation for the critical energy infrastructure and best practices in EU MoDs. A particular attention was given on arising and hybrid or other asymmetrical threats and risks. During the second Phase the participants discussed the following points:

- Critical infrastructure resilience and security management.
- European Critical Infrastructures Directive and other relevant legislation – implications for the defence sector.
- Military role in critical infrastructure protection in terms of opportunities and challenges.
- Best practices towards the protection of oil and gas storage facilities and towards the establishment of resilient CEI for European defence.

Regarding European Critical Infrastructures Directive and other relevant legislation, two exploratory questionnaires were developed. The aim of these questionnaires was to assess the state of play of the EU MoDs regarding the awareness/implementation of national/EU energy-related policies/legislation with regard to the protection of defence energy-related CI. This enables the WG to address gaps in this field as well as to share best practices.

The participants also worked in sub-groups to facilitate the elaboration of the deliverable documents and to focus on each item giving their contribution in relation to the background:

- contribution of the PCEI perspectives in CF SEDSS Phase II Guidance Document;
- development of a document concerning the protection of defence-related CEI against hybrid threats;
- development of a position paper on the PCEI.

In addition relevant potential project ideas aiming at enhancing the resilience and the protection of defence energy-related CEI were elaborated which are described later in this sub-section (see project proposal synthesis).

The key outcomes of the meetings were that the MS are highly interested and willing to explore and assess their contribution in enhancing the resilience and protection of defence energy-related critical infrastructures related to defence sector.

Outcomes and analysis of questionnaires on European Directive

During the CF SEDSS, P.II, two exploratory questionnaires were developed in order to assess the state of play of the EU Ministries of Defence regarding their awareness /implementation of national or EU energy-related practices/policies/legislation with regard to the protection of defence-related critical energy infrastructures.

The elaboration of the collected (unclassified) information enabled the WG 3 "Protection of Critical Energy Infrastructure" (PCEI) of the Consultation Forum for Sustainable Energy in the Defence and Security Sector-II (CF SEDSS II) to address defence energy-related considerations in the field of the PCEI, to share good practices among the EU MoDs, to generate collaborative projects as well as to recommend how EU/MoDs can increase the resilience of the defence-related CEI.

The provided answers did not commit the MoDs for any future activities or responsibilities and can be amended/revised at any time.

Moving towards the completion of Phase II and exploring the scope of Phase III of the CF SEDSS, we can draw some important conclusions regarding the MoDs interest on the impact of PCEI on defence, as extracted by their participation in the PCEI questionnaire.

Only half of the MS answered the questionnaire and this reluctance can be explained in image 1, where it is obvious that the PCEI is typically out the sphere of authority of MS MoDs.

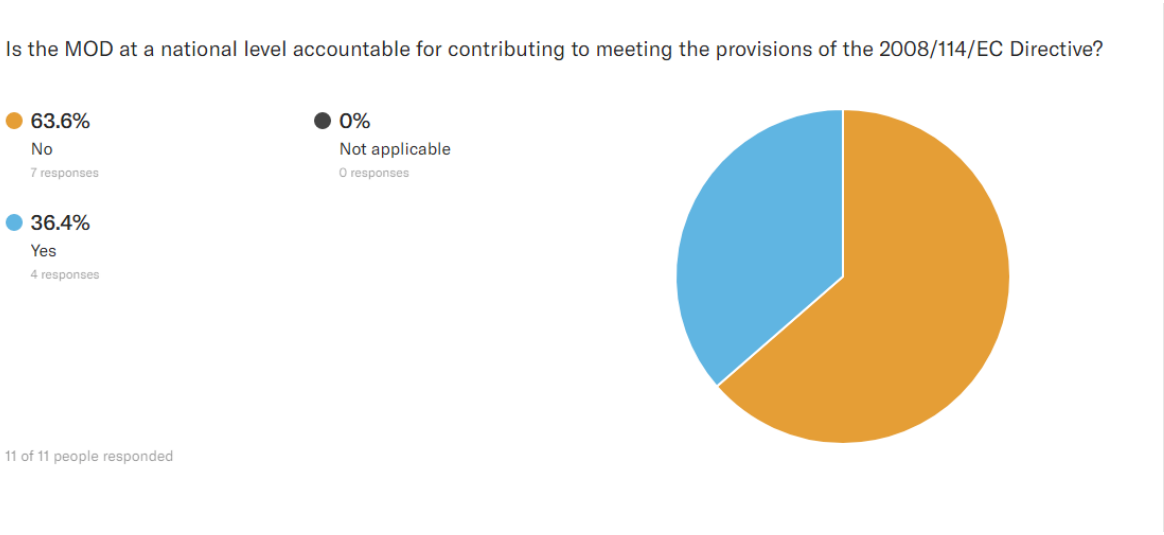


Figure 22: MoDs' Authority to PCEI

However, the MoDs, as indicated in Picture 2, are willing to explore their potential contribution to PCEI, even if they are not officially engaged to do so, as they recognize the high importance and effect of the CEI to the proper functioning and operational capabilities of their respective armed forces.

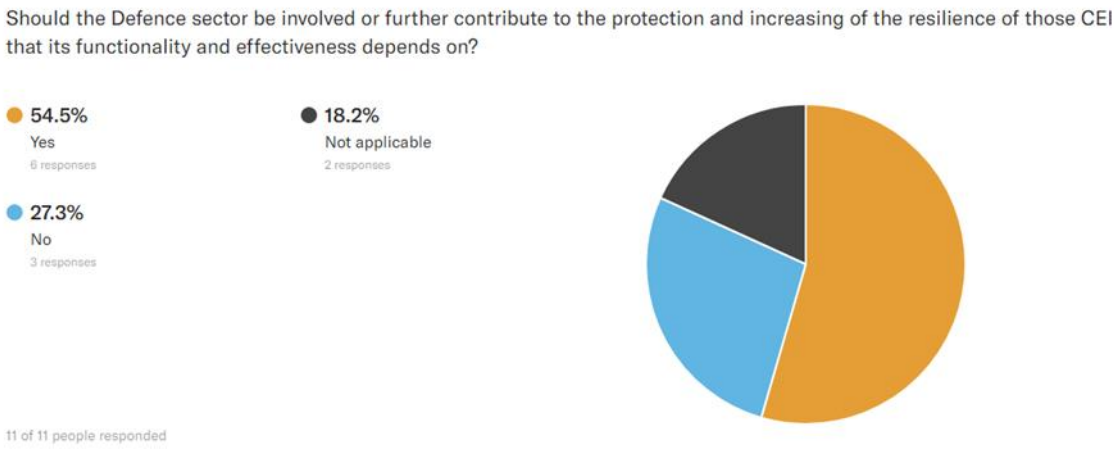


Figure 23: MoDs' Potential contribution

Therefore, one of our objectives during Phase III should be to find different ways to approach the MoDs and raise further awareness for the impact of PCEI on defence. It is imperative to stress out that the scope of this initiative is not to take responsibilities on the subject, but rather to contribute towards the PCEI in the light of its interaction with the defence sector.

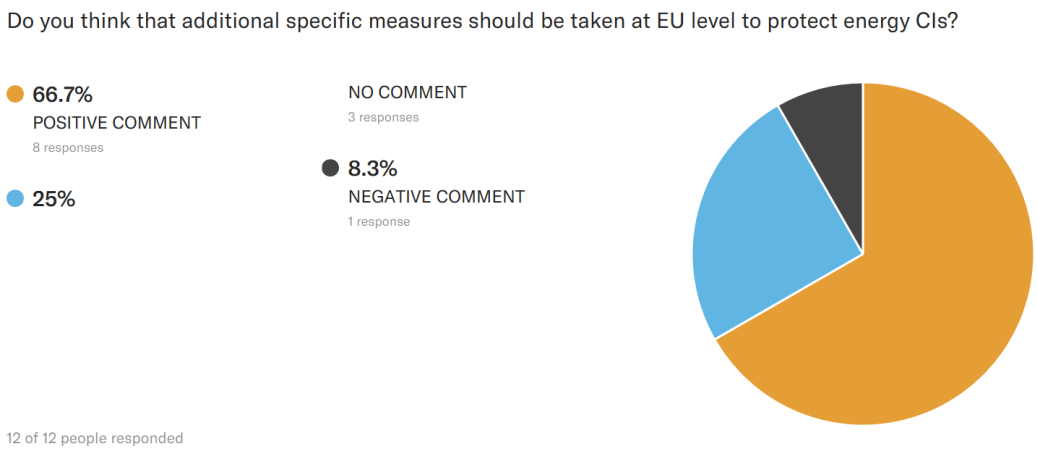


Figure 24: Additional measures

Reading the answers to the questionnaire relating to EU Directive 2008/114 - which is currently being updated - it is clear that the delegates believe that further measures are necessary to ensure the protection of critical infrastructures. This highlights the right level of awareness and maturity to approach the PCEI issue, considering the concerning role of defence sector.

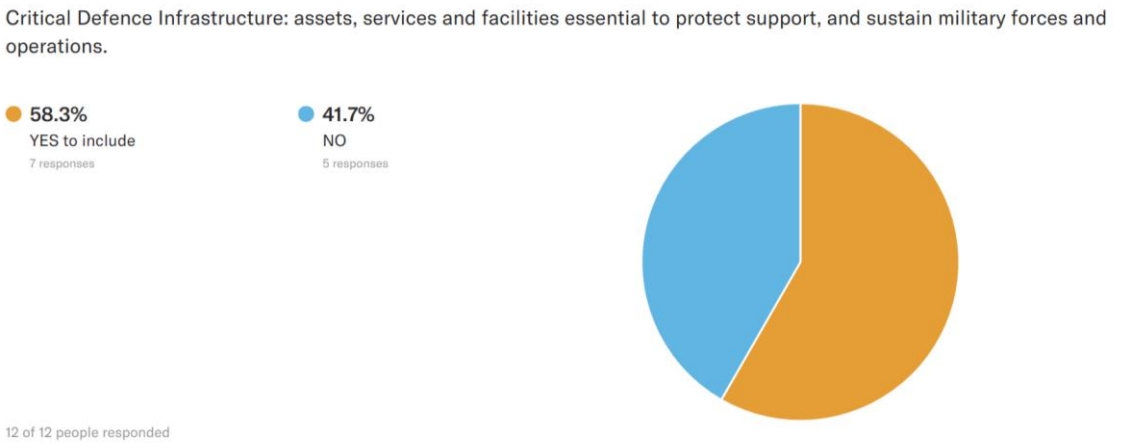


Figure 25: Critical Defence Infrastructure

Despite the dependency relationship between critical defence infrastructures is well defined, through the analysis of the replies of the questionnaire, it appears that there is not the extreme necessity to include the question of the critical infrastructures of the defence in a field of community treatment. Probably this evaluation is attributable to the perception of sensitivity that the defence sites potentially hold.

Project proposal synthesis

Exemplary projects involving experts from MoDs, academia, industry and governmental offices in order to illustrate the existing knowledge and provide ideas for new or continuing projects adjusted to account both for the defence and civilian sectors. These projects should act as part of the work on improving the resilience of the defence and security sector through the protection of critical energy infrastructure (PCEI) by exploring options for protecting defence related critical energy infrastructure (CEI) from existing and emerging risks and threats, including hybrid and asymmetrical warfare, climate change and natural hazards. The project ideas address the thematic areas of resilience, protection, observability, risk management aiming to enhance both prevention and preparedness but also response and recovery. A short description of each project idea can be found below.

I. SPEEDUS

Military and civilian functional infrastructures (i.e. hospitals, airports, operational and command and control centres and so on do depend, to a certain extent, on public critical infrastructure (CI) which deliver Critical Services (CS) such as electricity, telecommunication, water and gas, transport via routes and railways etc. The objectives of this project are to:

- design an appropriate protocol for identifying external dependencies (i.e. the specific vulnerability of a MI with respect to the reduction (or complete loss) of one or more CS (might be at the same time).
- create a system enabling to associate to a specific event (expected in a given area) the expected degree of disruption of critical infrastructure in that area and the consequent reduction of the CS that they transport.
- Use the system as a prediction tool, by knowing the level of specific vulnerabilities to outages, after having appropriately shaping the back up system, to enable military installations (MI) to face the predicted events. The system can be shared with the civilian emergency governance in a way to ensure a coherent set of data and information used during an emergency scenario.
- Perform two test cases of the whole predicted cycle of actions mentioned above.

II. REMARC

Nowadays military sites (MS) are tightly embedded in the "system of systems" (SoS) of critical infrastructure (CI) in a given area; external CI produce services which allow MS to perform their functions. This dependency raises problems related to the continuity of functions that MS must produce, with the further constraint of being provided above a given efficiency threshold. A further complexity comes from the level of internal dependencies among the systems within the SoS: a perturbation of a given CI can propagate also to other CI through cascading effects.

This project REMARC wants to achieve the following three main objectives:

- Identify a procedure (protocol) for the assessment of dependency of MS with respect to external services (limited to electricity, water, gas and telecommunication) to be eventually cast into an EU norm;
- Realize a decision support system (DSS) enabling a continuous monitoring of the environmental conditions (in an all hazard perspective), capable of predicting potential damages induced by adverse natural events on the regional SoS of CI and estimating the resulting impact on services;
- Design a new protocol for interaction with external operators with the aim of producing a coordinated emergency strategy for a more efficient emergency management and a more rapid and effective return to the standard operating conditions (resilience enhancement).

III. Situation awareness system (SAS)

The critical (energy) infrastructure system-of-systems is very fragmented. It has a large number and variety of assets, resources, actors etc. It requires a situational awareness watchdog system that can integrate various information flows as a backdrop to decision-making. A close example of this is the war room of the militaries, where decision makers collate and interpret data before making decisions.

The project objectives are to enable real time data flow integration. It must provide for an increasing level of pre-processing of data through the use of AI and machine learning to provide valuable inputs for decision-makers. The user may then decide on further processing or on making a decision. The data flow must eventually allow for coherent and rich data visualization techniques, including through the use of geographic information systems. The complexity which can be supported by the platform must be sufficient to enable its use by government regulators, the military, or emergency response coordinators. The platform should minimize the requirement for development of new hardware or software, utilizing off-the-shelf products, pre-existing standards.

IV. Military camp study

Armed forces have a high dependency on CEI belonging to, operated and supervised by the private sector and other government agencies. In the event that CEI becomes unavailable, how a military camp will function is not fully understood. What contingencies are in place amongst MSs to prepare for this problem and whether these contingencies can be shared, tested and standardized are issues that need to be addressed. This project proposes to create a generic and adjustable template for operation at reduced or no availability of imported energy to the isolated grid of a military camp. The objective of this project is to develop a generic and adjustable template with a tiered priority matrix and relevant metrics in order to (i) optimise use of available energy and (ii) inform those responsible about the limitations in the event of reduced or no availability of imported energy and futureproof military camps for the introduction of new technologies. The main activities of the project are to define the critical sites/operations/activities, determine the energy requirements of each site/operation/activity, create a template with a tiered priority matrix for the camp, test the applicability of the template at reduced power for a specified time, engage with all stakeholders (sites/operations/activities) before, during and after testing and revise the template after applicability testing complete.

V. Establishing Energy Autonomy

Inside a military camp different kinds of functions require electricity resilience. Usually electricity supply is sourced from public electricity network for one or several points and power continuity (if needed) is ensured with diesel generators, UPS-systems, batteries etc. Energy resilience for camps becomes an exercise in establishing a hierarchy of facilities by importance to concentrate scarce resources where the most gains in energy security can be ensured.

A 2050 EU energy strategy goal is to reduce 80-95% of greenhouse gas emission, so new energy sources are needed also in the defence sector, or to articulate how the energy needs of the defence sector require technologies whose environmental impact is offset by reductions in civilian sectors. By the same time, development of sustainable energy technologies may have brought new solutions and mixes of energy production to enhance energy resilience for military facilities.

In different military camps, energy resilience is fostered by different means, despite overt similarities between facility sites. The multitude of different approaches results in lack of standards and loss of time.

Building a strong energy architecture is one of the solutions to improve energy resilience. Since the investments in strengthening energy architecture are often high, it is important to make investments only when necessary. This requires understanding of different kind of functions and their criticality inside military camps.

This project has the following three main objectives:

- Propose European military standards for electrical installations for pre-identified key sectors where resilience must be improved.
- Propose different electrical architectures taking into account priority of end users inside a network,
- Find sustainable, robust and reliable power supply based on green technologies to replace within the next 30 years diesel generators as emergency power supply or use combinations of them to achieve better resilience and lower or stop fossil fuels use.
- This project will combine green energy, standardization and resilience to face the requirements of increasing resilience and decreasing greenhouse gases. Forming this project idea into a project, needs knowledge from (electrical) engineering, standardization, logistics, IT/control systems and military requirements.

2.3.5 Perspective of PCEI Position Paper

The PCEI Position Paper analyses the paradigm of critical infrastructure protection from the perspective of the defence sector. It illustrates the most important and relevant elements of this framework, including interdependencies, the risk of cascading disruptions and the fragmentation of the infrastructures in a complex array of organizations, with different cultures, regulatory regimes and incentive structures.

The topic is important because of the impact that potential disruptions may have on national defence and security and especially on critical defence infrastructures, which are their own domain in the various national frameworks of EU Member States. CEI and the defence sector face a challenging security environment, in which the increasing frequency and severity of natural phenomena is joined by new categories of threats (“hybrid”, “new generation” etc.) mediated by, among others, networked command, control and coordination systems exposed to very cost-effective cyber-attacks. The involvement of the defence sector in the protection of CEI emerges as a concrete possibility that is worthy of study.

Defence-related critical energy infrastructures are presented as a sub-domain, made up of the civilian infrastructures on which military facilities are reliant for normal functioning and the on-site back-up systems that provide a certain level of autonomous functioning. The significant interconnections between the defence sector and the civilian energy infrastructure system-of-systems generate challenges to defence involvement in this area. These challenges range from the operational to the legal, given the existing non-military frameworks for critical infrastructure protection. Civilian-military cooperation is an important concern for the CEIP Position Paper and it draws on the experience of the drafting group to illustrate best practices but also the challenges.

At the same time, the Position Paper traces the changes in geopolitical environment which will ultimately affect the security environment, but also the future development of the CEI system-of-systems at European level, given the greater cross-border interconnections and the tighter couplings through initiatives such as the Energy Union.

The conclusion of the Position Paper is that the defence sector has a compelling interest in the security of CEI and the possibility of contributing to it under the umbrella of existing CEIP frameworks at national and European levels, contingent on the identification of solutions to jurisdictional and organizational issues. Through its capabilities and even its own infrastructure, the defence sector can contribute to the improvement in the resilience of the CEI system-of-systems.

2.3.6 Perspective of the Hybrid threat

During the second phase of the CF SEDSS, the PCEI WG-3 has elaborated the document entitled “Conceptualising the Protection of Defence-Related Critical Energy Infrastructure against Hybrid Threats” (working title). This document aims at supporting the EU MoDs to increase the resilience of defence-related CEI against hybrid threats by raising awareness and enabling the MoDs to develop the appropriate measures to address respective vulnerabilities. In addition to

preparedness aspects, the document touches upon elements related to the swift recovery of the CEI in case they will be victims of a hybrid threat. One of the main characteristics of hybrid threats is their character as well as the fact that attribution is rather cumbersome. Consequently, a firm response is not always straightforward when a collective response is needed for those hybrid threats that expand across several jurisdictions. At the same time, the challenges with respect to preparedness and deterrence against hybrid threats are equally high.

Despite the fact that hybrid threats have been recognised as an essential threat to the EU and its MS, there is still not a common understanding or consensus on a specific conceptual framework, although the Communications on Hybrid Threats (2016 and 2018) have paved the way in order to raise awareness and help MS understand that they need to act urgently. The European Commission has recognised this gap, and the Joint Research Centre (JRC) has taken the initiative to develop a conceptual framework on hybrid threats to support common understanding, common language and support MS efforts undertaking the right measures to increase resilience against hybrid threats. This effort has taken place in close collaboration with the Centre of Excellence for Countering Hybrid Threats in Helsinki (Hybrid CoE). The conceptual framework developed has served as a conceptual basis for the development of the present document.

To this end and to ensure coherence at the European level, the present document follows the approach and terminology developed in the conceptual framework and aims to be a type of implementation of this document in the domain of energy with particular interest for the defence sector. Hence, the document does not intend to provide a concept for hybrid threats but rather to address a specific infrastructure related sub-domain with particular importance for the defence sector (energy infrastructure) and to investigate the tools that can be used by adversaries to undermine the performance of the infrastructure mentioned above. Undermining the performance of defence related to energy infrastructure has a detrimental effect on the capability of the defence sector to carry out its mission. While an open attack to energy infrastructure will lead to open warfare, hybrid threats may help adversaries to achieve their objectives without entering a lose-lose situation of open conflict.

Overall, the document "Conceptualising the Protection of Defence-Related Critical Energy Infrastructure against Hybrid Threats" seeks to provide a solid conceptual basis to facilitate the development of the necessary measures in the domain of preparedness and response for ensuring the resilience of those CEI that the defence sector depends on for their viability and effectiveness. It is expected that through civil-military collaboration, each MS will enhance the protection and resilience of defence-related CEI, and consequently, the resilience of the EU. For this reason, this document places emphasis on the cooperation between defence and public and private sectors and where and how defence can provide support. Beyond the conceptualisation, it is expected that this document could trigger the discussion for cross-border cooperation through the development of joint collaborative projects or common (table-top) exercises and training. As the field of hybrid threats evolve, the document may need to be adjusted, and, thus it must be seen as a 'living' and non-binding to be updated based on lessons learned and experiences gained.

SECTION 3: RECOMMENDATIONS FOR DEFENCE ENERGY TRANSITION

Section 3 focuses on the potential future direction of the topics covered during the 22 months of the second Phase of the CF SEDSS. It sets out realistic proposals given the current status towards a sustainable energy future. It also provides information on the potential to improve energy performance in the military sector through the selection of the most viable options to deliver sustainable energy in defence, the development of energy roadmaps and base-lining tools, risk management and mitigation measures, strategic planning for energy, and some technology options.

3.1: Energy Management & Energy Efficiency

Section 3.1 covers future prospects on the topics discussed during both phases of the CF with respect to energy management and energy efficiency. Desirable and feasible choices are presented along with best practices showcased in Info Boxes. Moreover, for most managerial subjects (i.e. energy strategies, EnMSs, energy data, human factors affecting energy, procurement and energy performance contracting) where a consensus was reached, relevant objectives and generic roadmaps are also included.

3.1.1 Energy Strategies

Desirable and Feasible Choices

MoDs acknowledge the necessity of an energy strategy as a significant enabler towards increasing energy efficiency and reducing energy consumption within the defence sector, provided that it is sustained by concrete action plans.

An energy strategy should be endorsed by the highest level within MoD. An energy strategy will:

a) Prove the commitment of the hierarchy;

b) Set specific objectives and SMART (Specific – Measurable – Achievable – Relevant – Time-bound) targets for critical energy performance indictors (EnPIs);

c) Allocate required resources;

d) Engage the appropriate internal and external stakeholders;

e) Prove the significant role of energy in both supporting and sustaining military operations;

f) Have to be linked to the national energy strategy;

g) Provide a solid basis for discussions/negotiations on funding opportunities with important national/EU stakeholders;

h) Include a monitoring mechanism to safeguard its implementation and the continuous improvement axiom.

In a holistic context, the energy strategy should not only focus on military components and facilities, but it should also include operational matters, even though the latter do not fall under the scope of the EED. A military energy strategy is suggested to link energy and sustainability with the mission and the military operational objectives. Therefore, it should cater not only for infrastructure and supporting activities, but also for military operational activities, since:

a) military operations and exercises represent a significant proportion of energy consumption;

b) energy efficiency in military activities deliver tangible benefits to the operational objectives in terms of sustainability and effectiveness.

All levels of command have to be involved in delivering an energy strategy.

To overcome the challenges/barriers described in Section 3, MoDs have to seek:

a) An internal champion (individual and operational unit) on energy within the MoD and armed forces organisational structures, in order, as a first step, to establish a dependable energy data collection system that will further enable the development of an Energy Strategy.

b) Close cooperation with:

i. the national competent authorities and be actively involved during consultations for the development of the integrated national energy & climate plans (NECPs);

ii. industry, in order to incorporate either off-the-shelf energy efficient products into the military domain or develop new, tailor-made solutions for energy efficient military activities (operations and support).

c) Guidance from EU (DG ENER) and the national central governments, to involve officially the defence sector in the achievement of national targets on energy efficiency and to make access to national funding available;

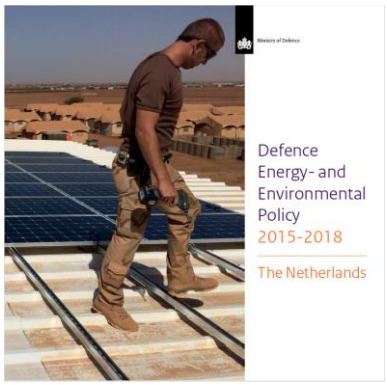
d) Re-investing a significant portion of the financial savings that will arise by the implementation of the energy strategy and the supporting action plans into new energy efficiency projects, and not to be returned to the central government budget or to be used for other purposes. Moreover, these newly generated action plans should aim to combine increased energy efficiency with increased comfort for the involved personnel;

e) Further exploration of the energy performance contracting (EPC) tool towards defence infrastructure (see further at the relevant paragraphs on EPC of this document).

Info Box: Energy Strategies - Defence Energy & Environmental Policy Plan (NL MoD)

Since 1989, the NL MoD has been developing and implementing energy and environmental policies.

The 2015 – 2018 Energy & Environmental Policy of the NL MoD has as a point of departure the legislative requirements and the precondition that the primary objective of defence, i.e. the operational deployability of the armed forces, remains guaranteed.



The pillars of the Policy are energy aspects, sustainable procurement and environmental management. With respect to energy, the *"Trias Energetica"* principle is adopted:

- Energy savings;
- Switching to sustainable energy.
- Using energy efficiently.

Energy objectives included:

- Energy savings for real estate and civil vehicles of 1.5% per year and consumption 14% from renewable energy by 2020;
- Cooperation with industry, research institutes and international partners to uptake civil market developments on energy and reduce fossil fuels;
- Purchasing 100% sustainable electricity and natural gas or generating it sustainably itself for real estate;
- Cooperation with third parties on realisation of sustainable energy projects in defence sites;
- Installation of smart metering devices;
- Reduction of dependence on fossil fuel in the operational domain with a simultaneous increase of the operational effectiveness.

The budget for the 2015 – 2018 period on energy was around 50 M Euros.

The 2019 – 2023 version is currently under development and will be based on the principles of compliance with legislation and central government policy combined with the demands / aspirations of personnel. With a foreseen budget of around 100 Million Euros, it will set action plans for the successful management of energy and climate change (energy management systems, 1.5% energy consumption reduction per year, 14% sustainable energy in 2020, 49% CO_2 emissions; reduction in 2030, NZEB, deep renovations, smart metering, etc.) along with environmental aspects (environmental management systems, hazardous substances, waste, water, air quality, nature and landscape).

Figure 26: Energy Strategies - Defence Energy & Environmental Policy Plan (NL MoD)

Objective

Based on the actual discussions during the CF SEDSS WG1 meetings and the submitted questionnaires, the MoDs'/armed forces' experts have concluded that an energy strategy should be issued by each MoD, in order to initiate and maintain actions for a more energy efficient, and less energy consuming, defence sector.

Roadmap

The development of a generic roadmap for the implementation of an energy strategy in a defence context may include the following stages:

a) Develop the energy strategy:

   i. Appoint a champion on energy within the defence organisational structure;

   ii. Gather indicative data on energy consumption and relative costs;

   iii. Perform a Strategic Analysis on Energy against legislation/national targets, cost, support activities, operational capabilities (e.g. SWOT (Strengths – Weaknesses – Opportunities – Threats), Scorecards, Gap Analysis, etc.)

b) Translate the energy strategy:

   i. Develop strategic objectives, derived from the aforementioned analysis and linked with the operational capabilities and the core role of defence;

   ii. Set appropriate energy performance indicators (EnPIs);

   iii. Determine SMART targets;

   iv. Construct and prioritize action plans, while foreseeing and allocating the required resources (human, financial, material);

   v. Assign accountability (i.e. define roles);

c) Align the MoD/armed forces:

   i. Pursue the commitment of all levels of hierarchy;

   ii. Communicate the energy strategy internally;

   iii. Cooperate closely with all the departments and especially with the ones that deal with strategic foresight, operations, support, finance, human resources, education/ training and public relations;

   iv. Increase the motivation of personnel (through awareness/training and provision of tangible results reflecting benefits on their well-being and on the common – 'broader than MoD' – interest);

d) Seek for allies:

   i. Identify regional and national stakeholders and pursue capacity building, technical support and funding;

   ii. Communicate the energy strategy towards the external stakeholders;

   iii. Participate regional/ national consultations and pursue cooperation, without compromising the operational capabilities and imperatives.

e) Set up internal mechanisms to make use of the influx of relevant technical support and external funding;

f) Realise the action plans;

g) Monitor the performance against the specified objectives and targets;

h) Conduct reviews and engage hierarchy in the de-briefing procedures;

i) Adapt with a vision to continuous improvement.

3.1.2 Long Term Renovation Strategies and Roadmaps

Desirable and Feasible Choices

MS elaborated on the topic of *"building renovation roadmaps"*:

a. How structured approaches, such as the use of "building renovation roadmaps" (individual building renovation roadmaps plus logbook) may be useful in the defence building context to limit energy demand and bring existing buildings to NZEB standards in a planned, staged and cost-effective manner over time; this step-by-step approach to renovation can be adapted to suite available funds, access to building stock and capacity of the building;

b. Through review of a case study and round table discussions, MS explored how structured approaches, such as the use of “building renovation roadmaps” (individual building renovation roadmaps plus logbooks) may be useful in the defence building context to limit energy demand and bring existing buildings to NZEB standards in a planned, staged and cost-effective manner over time; this step-by-step approach to renovation can be adapted to suit available funds, access to building stock and capacity of the building.

Non-intrusive affordable solutions were investigated together with the economic impact and benefit for deep renovations to NZEB/Net-Zero standards.

Through review of a case study and round table discussions, MS explored how to stimulate the market to deliver affordable net zero energy renovations at an affordable cost through industrialisation and off-site manufacture of innovative non-intrusive solutions. With sufficient scale of demand, it will allow providers to offer long term (30+ years) “home/rent and comfort bundle” energy performance contracting agreements with the owner/tenner on the basis of utility bills and maintenance costs savings.

These innovative refurbishment solutions, consisting mainly of prefabricated Modules for the façade and roof, plug-in technical building systems and roof solar panels which can be customised for different needs and can be assembled within one week without halting operations. This makes them very interesting to the defence sector.

Info Box: Example of Structured Deep Renovations in the Civil Sector (*iBroad* Project) - Replicable in the Defence Sector

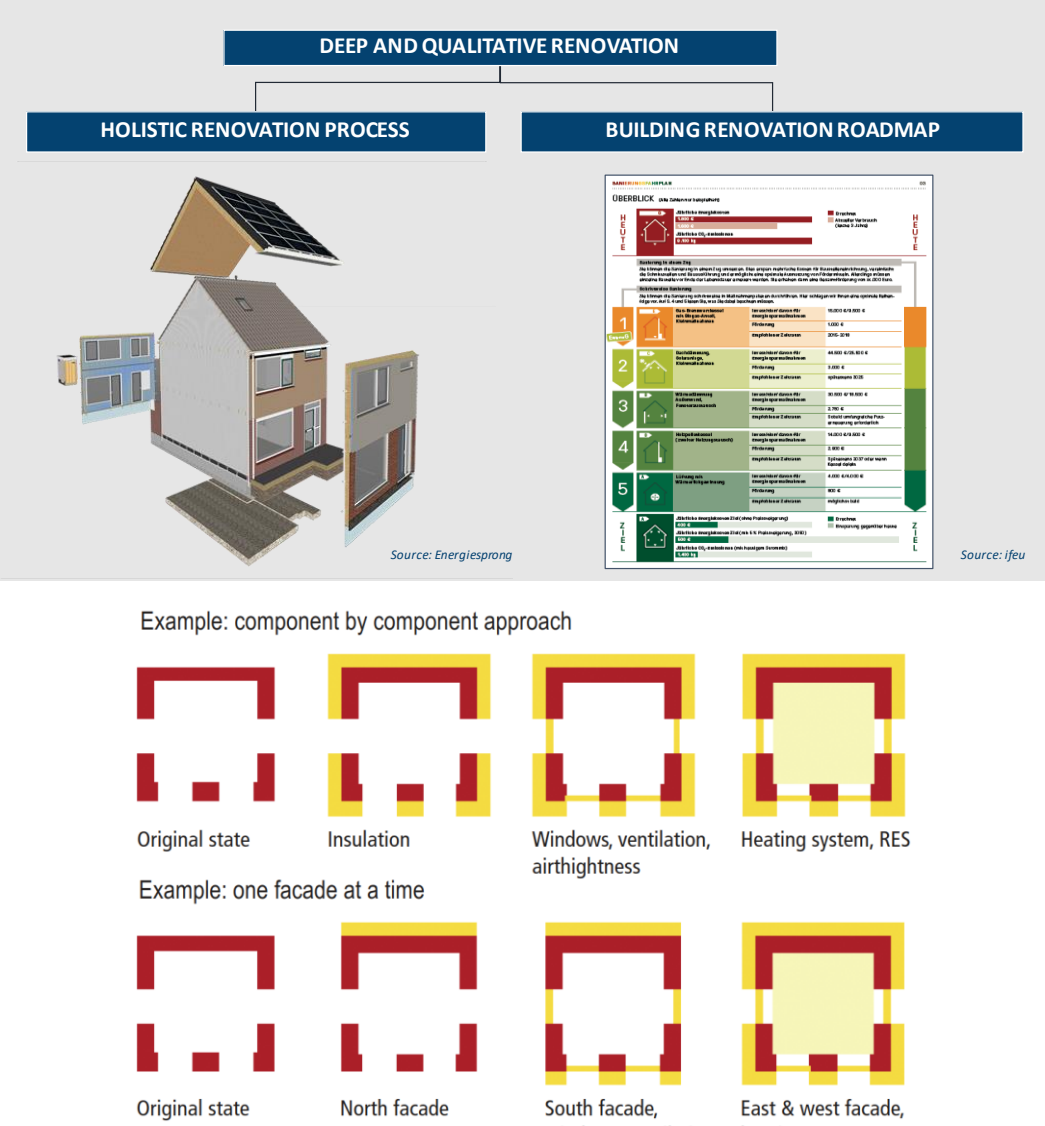


Figure 27: Example of Structured Deep Renovations in the Civil Sector (*iBroad* Project) - Replicable in the Defence Sector

Info Box: Example of Non-intrusive Solutions to Deep Renovations in the Civil Sector (*Tranzition Zero* Project) - Replicable in the Defence Sector

Figure 28: Example of Non-intrusive Solutions to Deep Renovations in the Civil Sector (*Transition Zero* Project) - Replicable in the Defence Sector

Roadmap

A generic roadmap for implementing energy efficiency measures to the building stocks of the defence sector may include the following activities:

a. Alignment with corporate objectives:

   - Align energy efficiency planning and objectives with your organization's planning and objectives.

b. Measure:

   - Measure and collect adequate sufficient accurate data through deployment of efficient smart (sub) metering infrastructure and performance of energy audits at building level to allow you to properly analyse and develop successful business cases.

   - Build adequate building stock inventory with appropriate and adequate data.

c. Planning:

   - Develop a solid comprehensive methodology and holistic staged structured approach to long term planning, design and implementation of energy efficiency projects (preparation -> design -> pre-construction -> construction -> in use -> end of operations -> disposal).

   - Adapt methodology to your specific defence related particularities.

   - Define and outline the type and scale of the refurbishment interventions.

- Choose the most suitable energy targets to your organization and the right indicators and metrics.
- Include energy efficiency in the design criteria for temporary buildings.

d. Implementation:

- Install the right technologies at the right level; consider disruptive but sound new affordable solutions to traditional problems.
- Allocate sufficient time and effort to commissioning.

e. Maintenance:

- Plan and execute a rigorous operations and maintenance programme to ensure equipment longevity, reliability, safety and energy efficiency.
- Monitor and control building systems to ensure they are operating at optimum efficiency.
- Inform building occupants and train building management staff on the operation of the building systems.

f. Disposal:

- Adjust the control systems to minimum operating setting when the building is vacated.
- In case of permeant demountable building, disassemble and store components for future deployment.

3.1.3 Energy Management Systems

Desirable and Feasible Choices

EnMS is a strong tool to assist MoDs in increasing their energy performance.

The implementation of the energy efficiency action plans required by the EnMSs will accelerate the MoDs' internal processes for improvement and will raise the voice towards the national energy authorities for funding.

Energy management is multi-tasking, affects most specialties within the defence sector and should not be restricted to the programme of work of engineers only.

Commitment of all levels of management is required:

a) Top–level managers initially agree on the necessity of improving energy efficiency. However, embracing the concept and support with required resources is not always sustained afterwards;

b) Middle–level managers (i.e. commanders) play the most crucial role in the tactical – operational level. The development of action plans requires the active engagement of middle-level management in terms of prioritisation and allocation of human and other resources. The implementation of the action plans necessitates the involvement of the low-level management and a critical mass of personnel.

Human factors (commitment, awareness, motivation, communication, training and momentum-building) play a significant role in the actual involvement of all tiers of management and personnel (refer to the *Human Factors Affecting Energy Efficiency* sections for more).

ISO 50001 is a generally acceptable energy management system (EnMS) and has an integrated approach based on life-cycle analysis. Environmental management systems (EMSs), such as ISO

14001 and EMAS III, to the extent they include the energy aspect, may be suitable for energy management.

Although certification of EnMSs/EMSs is required by EED when stand-alone energy audits are not carried out and certification by itself can also enhance the public image of the defence sector, it should not be the ultimate goal when applying an EnMS/EMS. However, the certification process has been proven to be beneficial to various types of organisations, including defence, since, among others, it:

a) Acts as a credible peer-review of the applied EnMS/EMS;

b) Provides an impartial proof of conformity with the implemented EnMS/EMS standard, which is more widely accepted to external stakeholders and public opinion;

c) Maintains the momentum to continue the implementation of the applied EnMS/EMS, through the initial certification – surveillance audits – re-certification cycle for ISO 50001 /ISO 14001, or the verification – registration cycle for EMAS.

Easy wins based on no/low cost actions can boost an EnMS EMS at the beginning. However, in order not to lose the momentum, allocation of adequate resources has to be secured.

The selection of appropriate energy performance indicators (EnPIs) is critical. Wrong EnPIs can be misleading. The establishment of EnPIs requires the involvement and commitment of senior level management, in terms of mandate and allocation of funding.

The execution of an energy review to analyse energy uses/consumptions and to identify, prioritise and record opportunities for improvement is very important. Furthermore, the establishment of an energy baseline, using the information in the initial energy review and taking into account variables that affect energy consumption (e.g. weather conditions, occupancies, activity cycles, etc.), coupled with the appropriate EnPIs, can provide a clear view of the progress of the applied EnMS/ EMS.

Info Box: Energy Management Systems - ISO 50001:2018 Conceptual MoDel

Figure 29: Energy Management Systems - ISO 50001:2018 Conceptual MoDel

Info Box: Energy Management Systems - ISO 50001:2018 Application in Defence Context

Irish Defence Forces

The development of an EnMS in the Irish Defence Forces (IE DF) began in 2009, under the Irish Standard IS 393:2005 and, later on, under the EN 16001:2009. Since 2012, the IE DF have been implementing an ISO 50001 EnMS covering the whole range of operational and support activities (around 9.000 personnel, 17 installations, over 1.200 buildings, various land vehicles and small numbers of aircrafts and vessels). In 2013 they were the first armed forces worldwide to receive ISO 50001 certification. So far, ***average an annual 3% reduction in total energy consumption has been achieved***, compared to baseline year 2009.

French MoD

In January 2015 the FR MoD started developing an EnMS for the *La Valbonne Army camp* (approx. 2.700 personnel, 200 buildings, military vehicles and transportation in general was excluded from the scope) following the successful implementation of an Energy Performance Contract in the camp. The camp was ISO 50001 certified in 2015. So far, ***a 31% reduction in energy consumption (HVAC), a 79% reduction in GHG emissions and a 38% Reduction in utility bills have been achieved***, compared to the baseline year 2013.

Hellenic MoD

Partially funded by EU LIFE tool, during 2012 - 2016 the EL MoD launched the LIFE11/ENV/GR/938 Military Energy & Carbon Management - MECM project, aiming at the continuous improvement of 3 military camps (*Triantafyllidi Army Camp*, *Larissa Air Force Base* and *Souda Naval Depot Station*) through the development and implementation of EnMSs for all non-operational activities (in total: around 3.500 personnel, 600 buildings and various support vehicles). The project lead to ISO 50001 certification of the 3 camps in 2015 and has resulted to ***an average 25% reduction in energy consumption*** (compared to baseline year 2011).

Figure 30: Energy Management Systems - ISO 50001:2018 Application in Defence Context

Objective

Based on the actual discussions during the CF SEDSS WG1 meetings and the submitted questionnaires, the MoDs'/armed forces' experts have concluded that the MoDs should move forward to the development and implementation of energy management systems or environmental management systems (that include energy as one of the significant environmental aspects) in order to pursue the continual improvement of energy performance to the benefit of the military capabilities and resilience.

Roadmap

A generic roadmap for developing and implementing an EnMS across MoDs and armed forces may include the following activities:

a) Appoint a champion on energy within the defence organisational structure;

b) Gather concrete energy data in order to:

   i. identify the significant energy uses and set a baseline;

   ii. support the necessity of developing an EnMS towards senior management;

c) Prepare a feasibility study to launch an EnMS pilot project (generic objectives, scope, internal actors, resources, milestones/ timelines, etc.);

d) Prepare an energy policy and an energy strategy for approval by the senior management (strategic level);

e) Raise the awareness of senior management (strategic level) towards energy (submit a SWAT analysis and some showcases) and secure their commitment by approval of the energy strategy and launch of the pilot project;

f) Secure, via the signed energy policy, the required initial resources for launching the project (i.e. select an energy manager/team, small budget for training/small interventions/awareness campaign, etc.);

g) Seek for allies internally and externally (EDA, Ministry of Energy, national authorities, energy providers, etc.) for technology transfer and potential financial support;

h) Train the core team (energy manager and team, advisable to include staff from organisational level);

i) Raise the awareness among personnel and the operational and tactical levels of management and encourage their engagement;

j) Develop the EnMS procedures and start implementing all the parts of the system (legislative & other requirements, energy review, energy baseline, EnPIs, objectives/targets/action plans, documentation/records, operational control, procurement/design, monitoring, auditing, review);

k) Disseminate loudly your first (quick) wins towards all stakeholders:

   i. all levels of management: to prove the validity of the concept and apply for more resources;

   ii. all personnel of the installation included in the scope: to reward their involvement and motivate further;

   iii. external stakeholders: to seek for assistance (technical/financial) and demonstrate your work;

l) Plan the next steps for continuous improvement within the pilot project having in mind to select the most appropriate timing to expand the scope of the EnMS to other installations as well.

Relevant Project Proposal:

Project idea "Implementation of Energy, Water and Waste Management Systems (Military Energy Stars)" covers the objectives:

i. to design and to install the energy – water – waste management systems in order to gain control over the energy management and to achieve energy savings in the range of 10-20 percent;

ii. to set an exemplary institution in energy management (quality of the systems, competent personnel, tangible and visible results in energy consumption reduction), and

iii. to prepare the dedicated military units for further energy transition (towards renewable energy generation) through long-term planning and high level of execution readiness.

3.1.4 Energy Data

Desirable and Feasible Choices

The axiom of all types of management systems that "only what is measured leads to a defined improvement" leads to the necessity of appropriate energy data collection and consequent analysis as the first step for a successful EnMS. This is also applicable to the defence sector as well.

The significant energy uses (SEUs) have to be identified and, to the best possible and economically feasible extent, to be monitored.

Geographical information systems (GIS) applications are considered as helpful tools to set up and maintain information on production/distribution of energy in link with the SEUs.

Smart metering technologies are evolving and relevant costs are continuously reducing. New innovations in non-intrusive smart energy metering technology enable a single meter to measure consumption of different types of equipment using algorithms to disaggregate electrical signatures. This can assist energy managers in the data monitoring and analysis by building, by zone or even by type of equipment, helping identifying inefficiencies and informing prioritization of improvement measures. This type of meter provides much more flexibility in terms of installation and data analysis than the traditional smart meters. Development of a non-cloud-based solution will be needed to meet defence cyber security protocols.

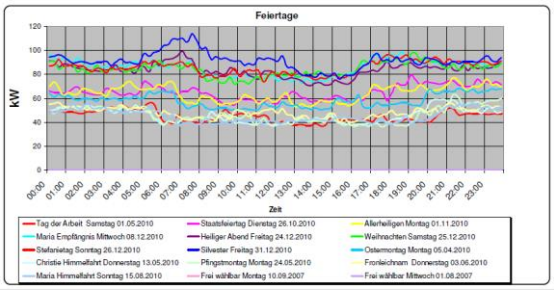
Through review of the AT MoD's Real Estate Data Base (REDB) project and round table discussions, participants explored how having the right level of energy consumption data can bring energy bills down by simply monitoring and analysing the data properly and identifying where energy is being used inefficiently and consequently where savings can be achieved. From results to date, AT armed forces calculate a payback period of around 5 to 7 years for their system.

All MoDs see the benefits of deploying metering and implementation of management systems in their military bases and buildings, especially when energy data can be cross-checked with appropriate information from their building stock (including state of building and technical building systems and building use, among other variables). It was agreed that metering and data analysis is the best way to start the transformation of existing conventional buildings into smart buildings. Nevertheless, MoDs agree it is difficult to make the business case to secure funding.

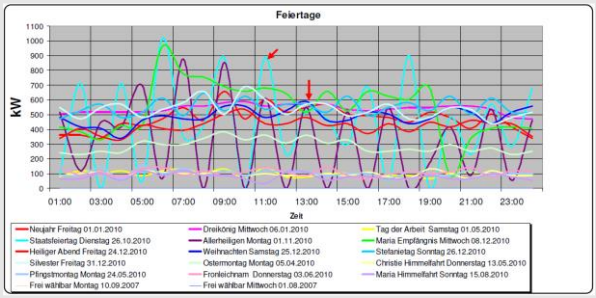
There are ongoing discussions across the defence sector as to how to appropriately deploy sub-metering in addition to the main base meter. Development of appropriate policies and estimation of costs and payback periods, whether metering is best done manually or automatically, whether or not extensive metering can assist in achieving energy savings through behavioural change, and if and how cyber security risks can be avoided or mitigated are all factors. Some MoDs are now in the process of implementing energy metering and management systems in their military bases and buildings.

Info Box: Energy Metering - Real Estate Energy Data Project (AT MoD)

Electricity Consumption DABSCH Barracks



Natural Gas Consumption DABSCH Barracks



Economic View

Estimated costs for implementation and operation of MDM and EMS:

Start-up investment	€
Software	120.000,00
Installation of 1000 meters	300.000,00
personnel costs	50.000,00
Network components	300.000,00
	770.000,00
Follow-up investment p.y.	
Installation of meters	100.000,00
Network components	100.000,00
	200.000,00
recurring costs p.y.	
Maintenance and improvement of software	10.000,00
Maintenance of meters	20.000,00
personnel costs (1 employee)	50.000,00
	80.000,00

Economic View

Estimated savings by MDM and EMS:

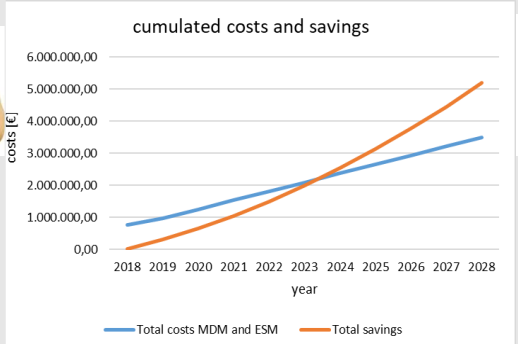
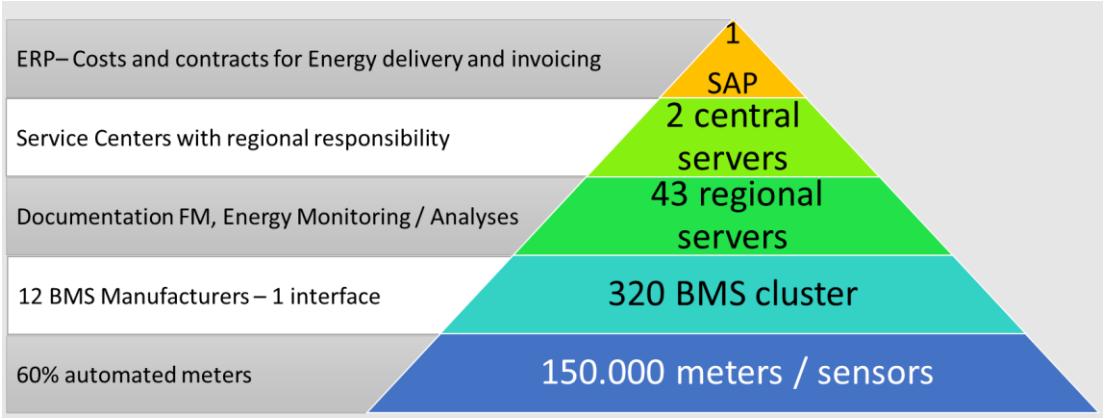


Figure 31: Energy Metering - Real Estate Energy Data Project (AT MoD)

Info Box: Energy Metering - Energy Monitoring System at Bundeswehr (DE MoD)



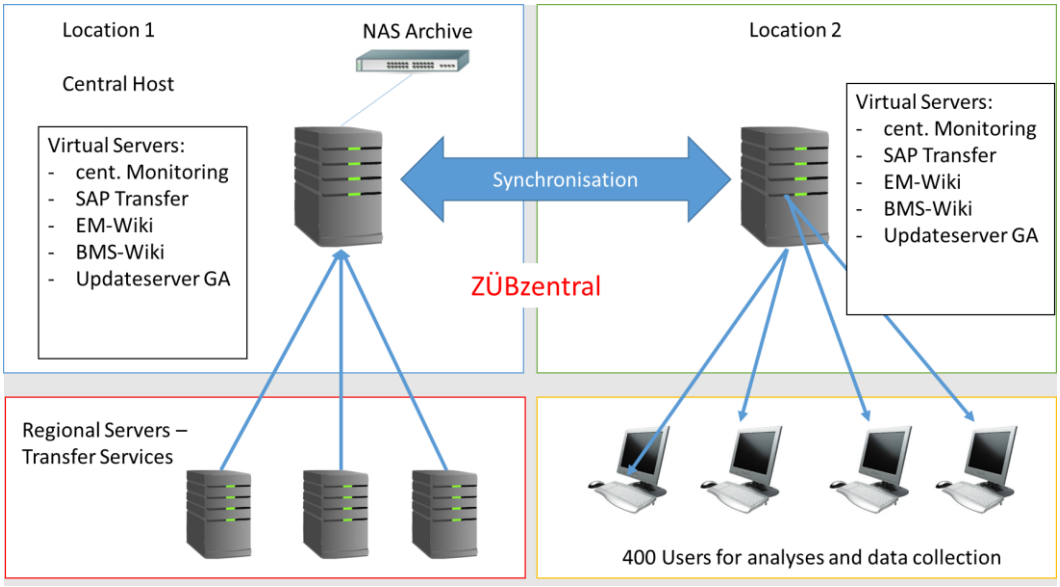


Figure 32: Energy Metering - Energy Monitoring System at Bundeswehr (DE MoD)

Close cooperation with the national competent authorities, research institutes as well as with the energy providers has to be further pursued for technology transfer, and exploitation of external funding on smart metering and data modelling. Absolute numbers on consumptions of energy products (electricity and fuels) and drivers can serve only as a first approach on data collection and cannot provide a clear picture on the trends (improvement or deterioration) of energy efficiency.

The development of appropriate energy performance indicators (EnPIs) is imperative.

EnPIs offer a measure of energy intensity used to calculate the effectiveness of energy management efforts. An appropriate choice of an EnPI is one that, at the minimum cost and effort necessary, provides direction and feedback on how much progress is being made and if the energy plan is on track to meeting its goals. Inappropriate EnPIs could provide misleading or confusing information. **MS experts agreed on the necessity to increase the level of knowledge of infrastructure / energy Smanagers on developing appropriate EnPIs.**

Info Box: Energy Performance Indicators

EnPIs may vary from simple ones (that result from the division of total energy consumption to an activity metric), to more comprehensive ones that include regression analysis, estimating the dependence of a variable (typically energy consumption for energy use) on one or more independent variables (such as weather conditions, production volumes, activity cycles, occupancy, useful area, etc.) And this is while controlling for the influence of other variables at the same time.

Different EnPIs may be required to monitor and evaluate the performance of different levels of military command and control. In more detail:

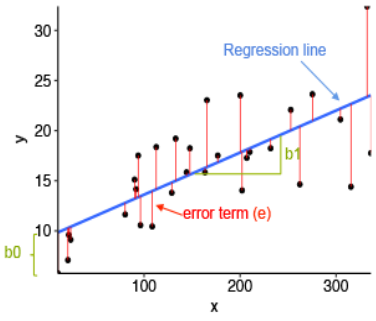
- more general, coarse EnPIs for strategic and operational level, such as energy consumed for various activities (electricity/m^2, thermal heating/m^2, total infrastructure energy/person, use of RES, fuels for each means of transport/distance travelled or flight hours, etc.). It has to be noted that the aforementioned EnPIs take into account only one independent variable.
- more sophisticated, multivariate and normalised EnPIs may be developed for the tactical level of an installation / battalion. In more detail, such EnPIs may also incorporate weather conditions (in Heating Degree Days / Cooling Degree Days), occupancy of buildings, product volumes / numbers, volumes of cargo transferred, operating / working hours, etc.
- additional or different EnPIs may be developed for military exercises / deployments, focusing on mission objectives with respect to usage of fuels for operations, engagement of personnel and energy mixtures for infrastructure needs (electricity generators, RES, power for grid).

Energy consumption models based on regression analysis may be developed, which serve as a forecasting tool for future energy consumptions as well as for evaluating historic energy consumptions using normalised EnPIs. Energy modelling involves the development of a mathematical relationship between energy consumption (i.e. the dependent variable) and the independent variables, in order to interpret the variation in energy resulting from variations in the individual independent variables. This type of modelling is called regression analysis. The most common models are linear regressions:

$$Y = b_0 + b_1 \cdot X_1 + b_2 \cdot X_2 + \cdots + b_p \cdot X_p + e$$

where:

- *Y* is the dependent variable, in our case the annual energy consumption;
- *Xi* (i = 1, 2, …, p) represents the "p" independent variables, such as weather conditions, numbers of personnel, total useful floor area, etc.;
- *bi* (i = 0, 1, 2, …, p) represents the coefficients derived for each independent variable and one fixed coefficient (b0) unrelated to the independent variables, serving as intercept to the Y axis (energy consumption) and showing the baseload;
- *e* represents the residual errors that remain unexplained / not included in the model, after accounting for the impact of the various independent variables. Regression analysis develops the set of *bi* values that minimises the sum of squared residual-error terms.



By all means, regression models cannot include all independent variables; even if this was feasible, then the model would become too complex and, in our case, would require excessive and confidential data. The practical approach is to pursue the inclusion of the independent variables thought to significantly impact the energy consumptions.

Figure 33: Energy Performance Indicators

Energy efficiency measures are expected to make a significant contribution to sustainable energy, where measurement and verification (M&V) of actual energy savings will be needed to demonstrate their short- and long-term impact. M&V is an inseparable part of an EnMS and also plays crucial role in energy performance contracts (EPC). In general, M&V: confirms expected savings; improves trust in results; gets backing for further similar projects; helps to detect deviations in performance.

Info Box: Measurement & Verification

Currently the following two international approaches on M&V are applied:

- The *International Performance Measurement & Verification Protocol (IPMVP)* of the Efficiency Valuation Organisation (EVO);
- *ISO 50015 Energy Management Systems – Measurement and Verification of Energy Performance of Organisations – General Principles and Guidance* of the International Organisation for Standardisation (ISO).

Monitoring, measurement and analysis process can be based on the following principles:

- Energy objectives are monitored as appropriate. Such monitoring is conducted at defined intervals and records all significant energy consumption.
- An energy monitoring plan is established, maintained, documented and kept up to date.
- Measuring equipment utilised for such monitoring needs to be accurate and the measurements repeatable. Such equipment is calibrated as appropriate and controlled in accordance with an appropriate documented calibration procedure.
- Correlation of energy consumption with organisation activity is calculated as well as actual versus expected consumption.
- The actual energy performance and the factors affecting such energy use are reviewed at defined periods and updated as necessary. Where significant deviations are identified then records of the reasons and remedies are maintained. The energy performance is compared to the baseline where necessary to identify improvements.
- If appropriate, benchmarking of energy use with similar organisations either internally or externally is conducted.

The risks that may be anticipated in a M&V process are presented in the following table:

Risk	Cause	Impact	Mitigation
Poor data quality	• Low resolution of operating data; • Missing data	Increase in uncertainty on energy saving calculation	• Agreement on the expected quality of data; • Investment grade energy audit
Modeling errors	Incorrect assumptions on technical aspects	Invalid model for estimating baseline energy use after retrofitting – Disputes over actual energy savings	Agreement on the use of modeling method and assumptions
Inconsistency of data	Improper M&V design	Disputes over actual energy savings	Proper M&V Plan
Imprecise / inaccurate metering	Measurement error	Increase in uncertainty in energy saving calculation	• Regular calibration; • Sub metering

Figure: 34 Measurement & Verification

Since 2016 EDA has developed and deployed a mechanism to collect annually and analyse defence energy data at MS level. The aim is to gain a better overview and understanding of the types and volumes of energy resources used by the armed forces on an annual basis. The analysis allows to identify energy consumptions and potential dependencies of Member States' armed forces. At the same time, it supports decision-making and enhances European cooperation on research and development in the fields of energy efficiency and procurement.

Objective

Based on the actual discussions during the CF SEDSS WG1 meetings and the submitted questionnaires, the MoDs'/armed forces' experts have concluded that the defence sector should move forward to gather and analyse energy data in a more systematic approach to:

a) Forecast energy consumption for budgetary reasons (billing and planning);

b) Plan more accurately new interventions in terms of energy resilience to support future requirements and activities;

c) Launch action plans for increasing energy efficiency and reducing consumption/costs while supporting or even enhancing the military operational capabilities and requirements.

Roadmap

A generic roadmap for collecting and analysing energy data may include the following activities:

a) Appoint a champion on energy within the defence organisational structure;

b) Establish a mechanism of collecting coarse data (on electricity/fuels consumptions and drivers) at the beginning;

c) Include the installation of smart metering in the construction specifications of all future buildings and in the contracting requirements for procurement/leasing/rental of buildings;

d) Strengthen the quality of your energy database with the use of smart metering;

e) Pursue continuous cooperation with:

   i. energy providers and national competent authorities in order to obtain more metering devices;

   ii. expert institutions in order to acquire the appropriate level of capacity on energy data processing;

f) Train your energy team in the use of more sophisticated EnPIs that are based on regression analysis;

g) Utilise appropriate EnPIs;

h) Process your energy data in various ways for the purposes of presenting results to:

   i. the top management, in a simplified way, in order to demonstrate the general trends of energy consumption and to justify the implementation costs of action plans;

   ii. the personnel managing the SEUs, in a more detailed manner, in order to identify improvement opportunities and abnormal situations and motivate them to work diligently on increasing energy efficiency and reducing energy consumption;

i) Keep being updated on the innovative solutions on data collection and processing.

Relevant Project Proposals:

The project idea "Normalising factors for Data related to Defence Energy Efficiency" is to commission a consultancy service to review, in conjunction with participating Member States, the breadth of defence outputs to identify a small number of core energy performance indicators (EnPIs) that can be used in isolation or aggregated for the whole of defence infrastructure to meet the standard set by ISO 50001. The focus will be on command and defence level performance reporting.

The project idea "Energy Data Analysis" is to define a uniform minimum data set, collecting energy data in fixed infrastructure as well as in operations with a high temporal resolution (<1h). Standardised analyses will be developed to monitor the energy data flow in the buildings and to optimize energy consumption.

3.1.5 Human Factors Affecting Energy Efficiency

Desirable and Feasible Choices

All participating MoDs' delegates acknowledged the **paramount importance of human factors as enablers to improve energy efficiency**.

As far as the differences between military and civil concepts of human resources related to energy savings and efficiency are concerned, they focus on the following:

a) the scope of energy efficiency and savings within the military has two pillars: facilities and military activities (exercises and operations). Within those two pillars, different messages have to be emphasised and communicated internally and externally. In more detail:

   i. Energy savings and improvement on energy efficiency in facilities have positive impacts on financial costs (key message to leadership and central government) and, consequently, may lead to investments that will improve the standards of the workplace (a key message to personnel and lower level management);

   ii. Energy savings and improvement of energy efficiency in military activities have positive impacts on military operational capabilities and, moreover, reduce risks related to logistic support (personnel exposure to the enemy, availability of energy sources and financial costs), which is a key message to all stakeholders.

b) the turnover of personnel from one duty station to another is significant within the armed forces. In more detail, every 2-3 years military commanders and personnel are transferred to different locations, and, in many cases, with different tasks appointed. To that end, all the elements of human factors that are analysed later on in this report have to be pursued consistently.

Commitment

All levels of command (strategic, operational and tactical) have to be involved and express their commitment. In more detail:

a) senior management commitment has to be portrayed by both the provision of resources (funds, appointment of energy manager and campaign team, availability of personnel to attend training sessions, etc.) and by personal involvement (personal briefs to middle level management, exemplary behaviour, site walk-overs, etc.);

b) middle and lower level management have to embrace the energy saving concept in terms of tailoring the awareness messages to the needs and specificities of their groups, overseeing the execution of best practices and, also setting the role model.

Subcontractors have to at least acknowledge and follow the energy policies of the MoD/armed forces, in order to enhance the energy-efficient lifecycle of products and services, with a special focus on the armaments industry.

Awareness

Since energy is a cross-cutting domain that affects all defence work strands (operational and support), all levels of command and specialties of personnel should be aware of the impact of energy on their course of business.

Energy data as well as data related to the implications of energy shortage to defence operations/support provides concrete evidence on the role of energy as capability multiplier and has to be the backbone of energy awareness schemes. To that end, energy data collection and analysis from the MoDs/armed forces is required. The format of energy data presented to the various stakeholders, in order to raise their awareness, needs to:

a) address issues that they encounter during the execution of their duties and present relevant examples;

b) make emphasis on drivers for energy efficiency other than the cost-saving effect (e.g. reduced energy footprint, better working conditions, sustainability of operations, etc.);

c) focus on more practical data, avoid plain reproduction of energy amounts in kWh and send clear messages that any energy savings will (also) have a positive impact on their duties and everyday work.

The higher levels of command (strategic) have to embrace the idea of launching energy efficiency awareness campaigns on a large scale and provide means accordingly. Consequently, the middle and lower levels of command (operational and tactical, respectively) have to be actively recruited to tailor the quality and quantity of information that should be provided to relevant personnel, depending on the addressees' specialties and duties.

The energy awareness campaigns have to be well designed and to address the following aspects:

a) Raising a campaign team: involving people that hold key positions to boost the campaign. The team has to have a clear mandate from the hierarchy, well-defined roles/authorities and meet regularly in order to respond to the challenges that will arise;

b) Funding: although funding is in all cases inadequate for awareness campaigns, any available financial resources have to be secured from the beginning, to enable the campaign team to plan and develop the campaign;

c) Communication strategy: following a clear path for internal and external communication [incl. appropriate timing to launch the campaign, target groups, selective and tailored information to every single group, use of suitable communication methods (e.g. presentations, workshops, leaflets, newsletters, posters, banners, stickers, promotional merchandise, competitions, recognition to significant contributors among personnel, rewards, exhibitions, participation to conferences/ fora, response to inputs from personnel and/ or other stakeholders, etc.)];

d) Monitoring; in every step of the campaign, measure the savings achieved that are attributed to changes in mind-set and avoid confusion with the changes that were achieved because of other factors (e.g. technical measures, climatic conditions, number of personnel, etc.).

MoDs'/armed forces' contractors have to be aware of energy issues related to the defence organisation they are working with in order to align their programme and code of work accordingly, especially in cases where energy/environmental management systems are implemented.

Motivation

The key objective is to raise the motivation of all personnel, especially groups of significant importance in decision-making and energy usage, i.e. to the top-right state (green) of the figure on the Implementation of Energy Efficiency Awareness Campaigns in the Defence Sector*: Awarenes*s – *Motivation Grid* (high motivation and high awareness). A survey in order to determine the mass of each one of the above quadrants, in terms of a simple questionnaire, can provide valuable inputs for developing an awareness/motivation campaign and identifying potential assistants among personnel (among those who are already highly aware and motivated).

Straightforward orders and guidelines on application of legislation have to be provided, in order to set the internal framework and provide the means for energy savings and energy efficiency improvements.

As soon as the internal framework is paved, clear messages have to be circulated internally to:

a) all levels of management on the benefits of improving energy efficiency and reducing energy consumption (operational effectiveness, cost reductions and public image, etc.);

b) all personnel on how energy savings can have a positive impact on other areas, apart from cost savings. These may include:

   i. Reinvestment of cost savings from energy savings on projects that can improve even more working place conditions;

   ii. Improvements on their working place standards (through better regulation of working environment conditions);

   iii. Avoidance of unnecessary exposure to risks. In more detail, by enhancing energy efficiency, fuel supply activities during deployments may be reduced in volumes and frequency, leading to less exposure of personnel that is involved into such logistic operations taking place in hostile environments;

   iv. Improved productivity and/or simplification of procedures to the benefit of personnel;

   v. Environmental consciousness and social responsibility.

Contractors have to be motivated to pursue energy savings and comply with defence energy policy and regulations during their course of cooperation with MoDs/armed forces. To that end, relevant specifications on tenders and contracts have to be foreseen.

Communication

Communication should be tailor-made, according to the addressees. In more detail:

a) An appropriate code of contact/language should be adopted, depending on the addresses (e.g. comic strips/simplified charts for personnel, formal letters enriched with relevant but unclassified data to external stakeholders, etc.);

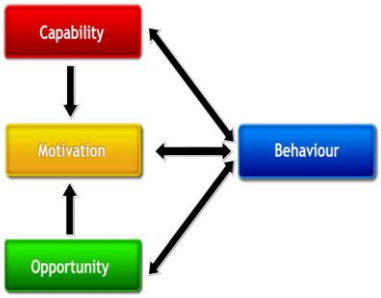
b) Information that is relevant and has an impact on the specific addresses should be provided, avoiding general and undocumented statements.

The outreach has to be reciprocal, i.e., MoDs/armed forces should have mechanisms not only to send messages related to energy issues, but also to receive, interpret and respond accordingly to the messages of relevant stakeholders and interested parties internally (i.e. adopt top-down and bottom-up approaches of communication) and externally (e.g. international, national and local competent authorities, community, NGOs, contractors etc.).

Monitoring of the responses to the messages sent internally and externally enables optimum evaluation and a timely response, and, to that end, it should be pursued.

Info Box: Behavioural Changes - FISH Approach (UK MoD)

The need has also been identified to simplify the existing wide variety of behavioural models and behavioural change process methodologies and come up with a suitable and effective methodology for defence. The UK MoD shared the principles and progress of its initiative "Maximisation of Energy Efficiency Behaviours Project" on behavioural change, which is based on the **COM-B Model** (**B**ehaviour underpinned by **C**apability, **O**pportunity, and **M**otivation), and the application of a systematic and guided methodology for identifying what needs to change in the person and/or the environment in order to achieve the desired behaviour change and the types of interventions that would be expected to be effective (**FISH approach**).



Phase	Focus	Activities
1	Understand Energy Behaviours and Baseline Across MoD	• Define energy behaviours. • Obtain energy behaviour data. • Analyse data to establish the status quo of energy behaviours across MoD. • Identify lessons learned from previous and current initiatives.
2	Identify Opportunities for Behaviour Change Interventions	• Collect primary data – survey and workshops. • Generate ideas based on Phase 1 findings. • Consider the need for bespoke interventions.
3	Deep Dives	• Conduct deep dives.
4	Assessment and Recommendations	• Assess the deep dives. • Evaluate the costs and benefits. • Present recommendations for wider roll out.
5	Acquisition Energy Behaviours	• Determine how to embed recommendations into MoD-wide capability planning and delivery.

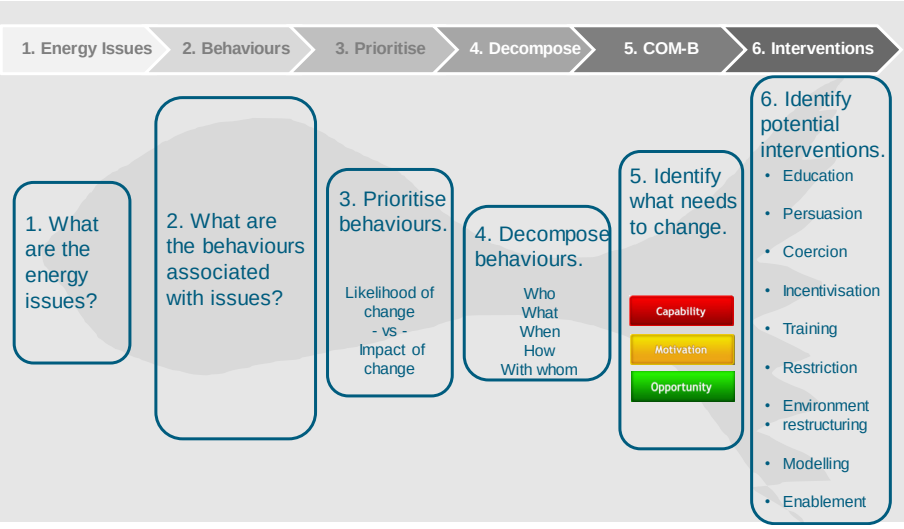


Figure 35: Behavioural Changes - FISH Approach (UK MoD)

Training

Different levels and a syllabus of training has to be applied, depending on the duties/job descriptions, as well as the skills of personnel. To that end:

a) Engineers and technical personnel have to be trained on energy auditing, application of EPBD requirements on new and existing installations, design and application of RES, development and implementation of EnMSs/EMSs, smart grids, HVAC maintenance, etc.;

b) Personnel of various specialties has to be also trained [(military) platforms/equipment operators, logisticians, procurement officers, etc.], according to their duties and expertise, on:

1) the energy efficient operation of military platforms (aircrafts, naval ships, land vehicles) and supporting equipment;

2) appropriate storage of fuels, energy efficient logistics and public procurement of energy efficient products, services and buildings.

Info Box: Capacity Building on Energy - EDA Defence Energy Managers 'Course

Since 2017 EDA has been launching a series of developmental courses entitled *"Defence Energy Managers' Course (DEMC)"*, aiming to enhance the MoDs' capabilities through reinforcing their understanding of the complexities of managing energy within defence and acquiring the capacity to structure, implement and improve an effective EnMS with a view of increasing energy efficiency and reducing energy consumptions.

Each course comprises of 3 classroom modules (10 days of training in total) alternating with 2 modules of relevant mentoring (webinars, on-line support and site visits that include training and auditing) of total duration of 12 months for developing and implementing an EnMS at home, MoD organisations.

The trial run of DEMC (April 2017 until April 2018), during which participants from 8 Member States (BE, DE, EL, IT, NL, PT, RO, SE) developed and applied effective EnMSs in 10 military installations, resulted in normalised annual savings of 2,916 MWh, which are almost equal to the amount of energy required to drive a Leopard 2 MBT around the Earth twice.

Moreover, other beneficial results stemming out of the EnMS implementation include:

- Water savings;
- Improved operational control of buildings;
- Improved comfort for personnel;
- Improved internal communication between the camps, the commands and the MoDs.

Figure 36: Capacity Building on Energy - EDA Defence Energy Managers 'Course

Momentum

To maintain momentum, a proper monitoring mechanism has to be set, with the main objective to evaluate the behavioural trends related to energy among personnel and respond accordingly, injecting portions of awareness, communication and training to enhance commitment and motivation.

Objective

Based on the actual discussions during the CF SEDSS WG1 meetings and the submitted questionnaires, the MoDs'/armed forces' experts have concluded that the application of EnMSs and the implementation energy efficiency improvement schemes can be achieved and sustained only through a systematic and constant approach on the aspects of human factors that involve building commitment, raising awareness, nurturing motivation, maintaining internal and external communication and providing appropriate training.

Roadmap

A generic roadmap on triggering the human factors related to energy efficiency improvement may include the following stages:

a) Appoint a champion on energy within the defence organisational structure;

b) Pursue close cooperation:

   i. internally with the champions that deal with human resources, education/training and public relations;

   ii. externally with the national competent authorities on energy, by inviting them to bilateral meetings in order to include the MoDs into their tank of stakeholders, when it comes to consultations and to provide economical funds as well as technical support/capacity building to the MoDs/armed forces in the regime of energy efficiency;

c) Raise the MoDs'/armed forces' external visibility on the topic of energy efficiency by actively participating to relevant initiatives, consultations, events and fora;

d) Set the internal framework on how to improve energy efficiency, i.e. start realising the first steps of an EnMS and provide explicit guidance, suitable to all internal addressees;

e) Identify gaps in professional training of engineers and technical personnel as well as personnel of various specialties, which, according to their duties and expertise, use/regulate significant amounts of energy and, further on, work closely with other internal and external stakeholders to bridge these training gaps;

f) Launch awareness campaigns on energy related issues (increase of energy efficiency, rational use of energy resources);

g) Inject energy efficiency awareness and motivation right from the start of personnel's career paths: from the military academies and the basic training of recruits/conscripts;

h) Establish a mechanism of rewarding the units and individuals on exemplary performance for using efficiently the energy resources;

i) Monitor the energy performance of target activities [e.g. accommodation, building management, levels of maintenance (organisational, intermediate and depot), transportation, etc.], in order to react promptly to behavioural changes.

3.1.6 Public Procurement with respect to Energy Efficiency

Desirable and Feasible Choices

There are parameters of higher value that define the specifications on procurement of equipment and services rather than energy efficiency, such as military operational requirements (including technical suitability and availability) and personnel safety (as top priority), as well as cost-effectiveness. Provided all the latter are followed, energy efficiency specifications should be integrated into the procurement process of the MoDs.

Objective

Based on the actual discussions during the CF SEDSS WG1 meetings and the submitted questionnaires, the MoDs'/armed forces' experts have concluded that the procurement of energy efficient products/equipment, services and buildings, in accordance with the relevant EU and national legal frameworks, has to be further pursued, but not to the detriment of military operational requirements and/or personnel safety.

Roadmap

A generic roadmap for incorporating energy efficiency specifications in the tendering/contracting requirements of the MoDs/armed forces for common products, services and buildings may include the following stages:

a) Liaise internally with the procurement departments;

b) Liaise with the national competent authorities to clarify the national legislative requirements on green/energy efficient public procurement;

c) Prepare a feasibility study on procurement of indicative, common types equipment of high energy efficiency class, in order to showcase the added value of purchasing energy efficient products (less operational costs, higher life-cycles in most cases – which also may impact positively military operational objectives);

d) Prepare an energy strategy/policy (strategic level) and a handbook (operational level) on procurement (or amend the existing one) for approval by the MoDs'/armed forces' administration;

e) Raise the awareness of administration/senior management (strategic level) towards energy and secure their commitment by approval of the energy strategy/policy on procurement;

f) Pursue central procurement (in order to monitor the adaptation of energy efficiency requirements more easily and benefit from economies of scale) instead of fragmented, smaller contracts executed locally;

g) Raise the awareness of all personnel on the benefits of procuring energy efficient equipment, services and buildings, since some personnel will be responsible for drafting technical specifications;

h) Train the procurement officers;

i) Monitor the actual progress of procuring energy efficient products, services and buildings, and compare the actual relative energy consumptions and running costs in order to validate the concept and further motivate the involved personnel.

Relevant Project Proposals:

The project proposal "Energy Awareness Campaigns for Defence" aims to the execution of awareness campaigns regarding energy sustainability in the defence sector that should take place at participating Member States territory, while specific promotional actions could take place during multi-national events (i.e. seminars, decision makers meetings, conferences, etc.).

The aim of the project "Capacity Building on Energy Aspects" is to shift the defence sector towards a more energy efficient modus operandi through the capacity building on related energy aspects, while considering the specificities and the core business of the armed forces, through (i) the identification of knowledge gaps on energy-related aspects of the defence sector; (ii) transfer of well-established best practices and/or generation of knowledge, tailor-made for the defence sector on energy efficiency; (iii) amendment of existing MoDs' procedures and requirements to incorporate energy efficiency as one of the operational parameters.

3.1.7 Energy Performance Contracting

Desirable and Feasible Choices

So far, MoDs/armed forces have limited experience on EPC and cooperation with ESCOs due to the challenges identified.

Besides the alignment of internal procedures that is required in most of the MoDs in order to subscribe to EPCs, close cooperation with the national competent authorities will bridge potential legislative gaps and facilitate the implementation of EPCs.

Training of personnel is critical, hence participation to relevant national schemes is advised, in addition to experience – sharing / lessons learnt with other public bodies that have implemented or are in the phase of launching EPCs.

Objective

Based on the actual discussions during the CF SEDSS WG1 meetings and the submitted questionnaires, the MoDs'/armed forces experts have concluded the utilisation of the EPC funding mechanism has to be further explored, taking into account the specificities of the defence sector.

Roadmap

A generic roadmap for implementing EPCs with ESCOs may include the following stages:

a) Liaise with the national competent authorities for capacity building/technical assistance (potentially including the development of a standardised EPC template);

b) Identify any potential national legislative gaps in EPCs involving the public sector and consult with national competent authorities;

c) Identify any potential internal (MoDs/armed forces') framework gaps (budgeting; long-term contracting; pay-back from billing budget lines);

d) Determine a suitable site for pilot-scale EPC project and prepare a feasibility study (types of interventions, return on investment, framework requirements, payment mechanisms to the contractors, involved actors, gaps in training of involved personnel, etc.);

e) Raise the awareness of senior management (strategic level) towards EPC and secure their commitment by approval of a pilot case;

f) Raise the awareness of all personnel on the benefits of EPCs (all will be using the facilities and some will be responsible for operating HVAC equipment);

g) Launch the pilot-scale EPC project and monitor its progress in the light of expanding the utilisation of this mechanism to larger scopes.

Relevant Project Proposal:

The aim of the “Energy Performance Contracting Concept for Camp Lighting” project is to test (i.e. develop and implement) EPCs in selected installations of the pMS with a view, upon successful outcomes, to apply the relevant business model in a larger scale in the future.

3.1.8 Renovation of Existing Buildings and Deep Renovations to NZEB standards

Desirable and Feasible Choices

EPBD and EED may act as a catalyst for renovation of existing defence building stock. A “cluster approach” to a NZEB concept that takes into account the aggregate effect of a combination of different interventions and solutions is considered more appropriate and applicable to the defence sector, than a single building approach.

Objective

Develop a solid comprehensive methodology and holistic staged structured approach to long term planning, design and implementation of building renovation projects appropriate to the specific defence related particulars, by:

- adapting the methodology,
- defining and outlining the type and scale of the refurbishment interventions,
- choosing the most suitable energy targets, right indicators and metrics.

Relevant Project Proposal:

The overall aim of the initiative to "Build on the NZEB Concept in the EU Defence Sector" is to demonstrate the feasibility of, and benefits from, the transformation of existing non-efficient military buildings/site into nearly zero energy buildings/site through the design, evaluation and implementation of effective refurbishment interventions, satisfying realistic ROI and payback period requirements, and contributing at the same time to the energy efficiency, renewable energy and reduction of CO2 emissions EU and national objectives.

Info Box: Example of Deep Renovation in the Defence Sector

An example of a cost-effective deep renovation of the ES MoD's Agency headquarters was presented and explained to the audience. Through this renovation, an obsolete building was transformed in to a highly efficient smart building which can be easily and quickly adapted to varying numbers of occupants and uses, through interventions in the building envelope, building interior fabric and structures, and installation of highly efficient technical building systems, including solar PV, solar thermal, and cogeneration technologies.

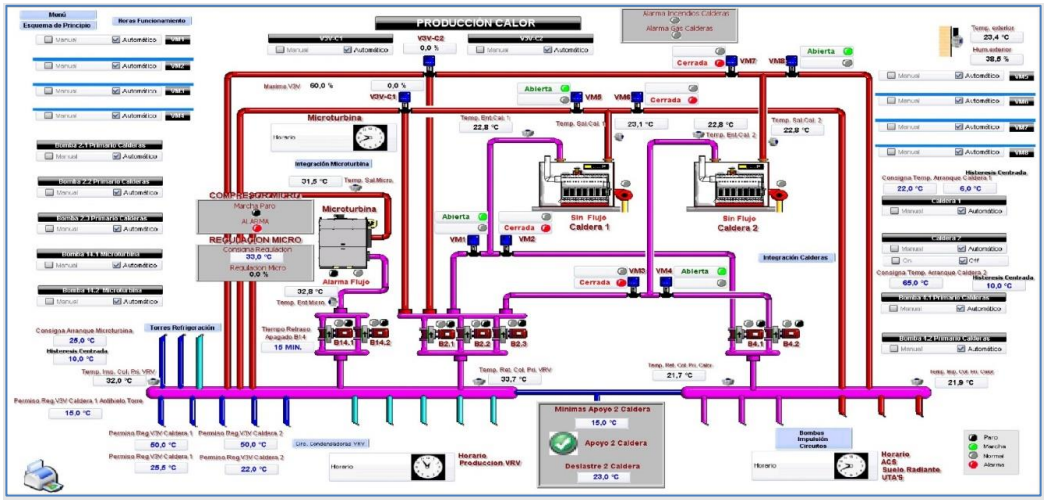
The renovation project was done in accordance with the current ES construction and environmental legislation and energy performance requirements, in order to achieve the highest achievable energy performance rating (A or B) and energy production for self-consumption, and to comply with the most stringent security measures required in the Defence sector, among others:

- Security in access points, zoning according to security levels (ZAR).
- Security in the classified projects development:
  - Classified Documentation: NATIONAL / NATO / EU / ESA.
  - TEMPEST Room
  - OTAN / UE / ESA / SLP Control Point
- Security systems.

The requirements for the distribution of spaces were also common to those identified generally in the defence sector, such as:

- Facilitate collaboration between multidisciplinary work teams.
- Provide flexibility in the reconfiguration of teams / spaces (in 2 days).
- Cooperation between different departments.
- Facilitate communication and exchange of information.
- Facilitate staff mobility.
- Productive and comfortable work environment.

All technical building systems are monitored and controlled in real time with a centralized SCADA system which keeps the whole building at the required levels of comfort with the most efficient consumption of energy.



Evidence was provided on significant energy and cost savings realized until now, with updated payback periods of 3,92 years for the light system (LUXMATE lighting control system and DALI electronic ballasts), or 11 years for the VRV system condensed by water (expected to be shortened upon realization of further savings before reaching 11 years).

Figure 37: Example of Deep Renovation in the Defence sector

3.1.9 Energy Audits and Energy Information Systems

Desirable and Feasible Choices

An energy audit is a key tool for providing sufficient accurate and relevant data to inform a robust detailed cost-benefit analyses to justify cost efficient investments in energy efficiency and energy production measures. Specific cases of energy audits and the resulting energy saving measures carried out in civil airports and health centres have demonstrated energy savings of up to 30% and return periods of 5 to 7 years seem perfectly replicable in the defence sector.

Having the correct level of information and using it effectively is important for asset management and energy efficiency and to underpin decision making:

a. For effective asset management it is key to set out information requirements at organisational, asset, project and building user level.

b. For whole life asset performance analysis, the design life, economic life and technological life of the building and its services need to be considered.

c. Operational costs have a major impact on the whole life costs and significant financial benefits can be obtained by targeting them at the design stage.

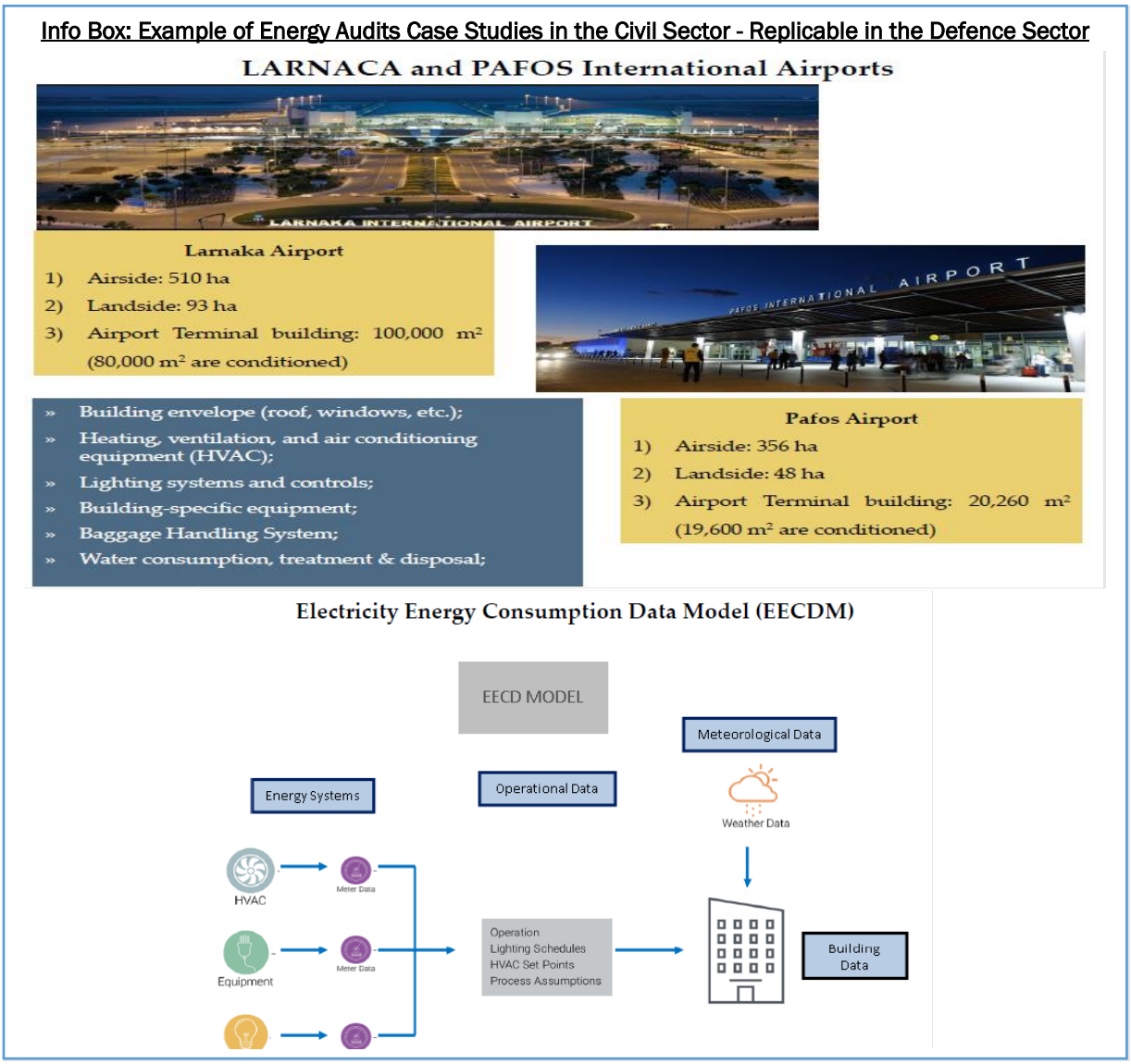


Figure 38: Example of Energy Audits Case Studies in the Civil Sector - Replicable in the Defence Sector

3.1.10 Energy Performance Certificates

Desirable and Feasible Choices

There is value in knowing the energy performance of the building at the design stage. However, a different approach to modelling energy performance is necessary to adjust the model results and reflect more accurately the real energy performance of the building during its operational life.

There is a need to define military buildings operational benchmarks (to the detriment of national benchmarks) to obtain a more realistic energy performance certification of military buildings.

Relevant Project Proposal:

The proposal "Military Building Stock Assessment: Energy Performance Certificates for Defence Buildings" aims to develop a methodology/model to calculate the design energy performance of in-use defence buildings compared with actual energy consumption. The results of the assessment will be presented visually in the form of a defence-specific energy performance certificate, providing the defence building owners with a realistic assessment of energy performance of their buildings and a tool to target energy efficiency interventions and investments to achieve the maximum reduction of energy consumption.

3.1.11 Inspection of HVAC and Retrofitting of Technical Building Systems

Info Box: Approach to Inspection of HVAC Systems (*iservcmb* project) - Applicable to Defence Sector

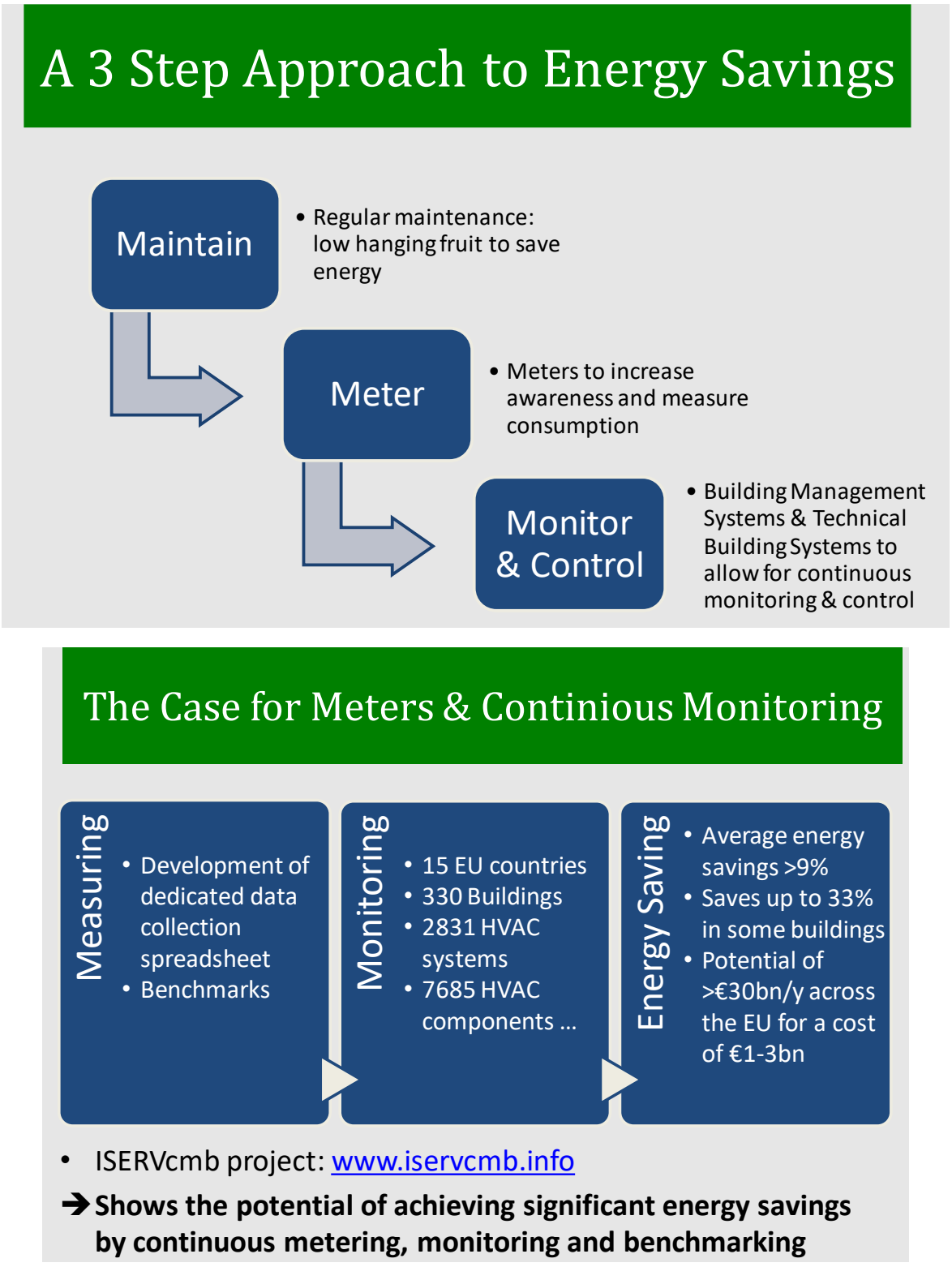


Figure 39: Approach to Inspection of HVAC Systems (iservcmb project) - Applicable to Defence Sector

3.1.12 Low Emission Vehicles and Support Infrastructure

Desirable and Feasible Choices

Full scale transformation of MoDs vehicle fleets has not started yet, mainly due to budget constraints, legal obstacles and limited political direction. A much more detailed survey on the types of MoDs vehicle fleet, as well as of existing legislation and potential financial incentives and financing mechanisms at the time, is recommended for the next phase of the CF.

Info Box: Approach to transformation of ICEV into BEV (NOEMIX project) - Applicable to Defence Sector

State of the art of the PA fleet in Friuli Venezia Giulia

Age	N	%
0-4 years	270	13,1%
5-9 years	573	27,8%
10-15 years	676	32,8%
15+ years	543	26,3%
TOTAL	2.062	100%

Mileage	N	%
25- km/day	830	40,3%
26-50 km/day	750	36,4%
50-99 km/day	400	19,4%
100+ km/day	79	3,8%
TOTAL	2.059	100%
Average	36 km/day	

noemix

Charging infrastructure

	Power	Average charging time	Cost *** (+installation)
Slow	3,7 kW (AC)	10 h ca.*	600 € / 800 € (+ 400 €)
	7,4 kW (AC)	5 h ca.*	
Fast	11 kW (AC)	3 30' ca.*	2500 € (+ 5000 €)
	22 kW (AC)	2 h ca.*	
Superfast	43 kW (AC)	1 h ca.*	30000 € (+ 5000 €)
	50 kW (DC)	40 min ca.**	
	150 kW (DC)	15 min ca.**	60000 € (+5000 €)
Ultra-fast	350 kW (DC)	10 min ca.**	120000 € (+5000 €)

* Full charge (0 - 100%)
** Charge till 80% of battery capacity
Estimated car battery capacity: 35 kWh
(average car battery capacity is between 30 and 40 kWh)

Charging time depends on several factors (temperature, % of residual charge,...) and the battery manage system (BMS) of the car controls the charging process in order to protect the battery and preserve its lifetime.

The majority of the EVs available on the market can be charged at a maximum power of 7,4 kW, very few models accept 11 or 22 KW (sometimes optional). However a significant number can be charged rapidly (>50 kW DC).

City cars don't need fast charging usually (little daily distances).

*** Source: Fueling Europe's Future, Cambridge Econometrics, 2018

3.2 Renewable Energy

3.2.1 Recommendations for further work on RES in Defence

Many renewable energy technologies were presented and discussed at CF SEDSS during Phase I and II. Overall, it was found that the MS had differing perspectives of the utility of RES to defence and, although a significant body of work had been completed on deployed hybrid systems, there was generally less activity at home, where limited budgets, understanding of opportunity and a lack of objective data (both benchmarking and within business cases) blocked progress on RES penetration. MoDs did not consider RES to be defence responsibility, but were open to improve understanding and to explore cost effective options both nationally or in collaboration with other states. In Phase II, this has led to the development of concrete collaborative project ideas.

Innovative processes such as energy performance contracting (EPC) offer an opportunity to decrease cost and transfer risk, but some cultural issues still exist within the defence sector. Moreover, there are contractual and legal considerations which need to be further explored. These costs, opportunities and risks should be included in any proposed business case.

The conclusions from the technology based sessions in the Phase I and Phase II events were as follows:

- In general the focus should be on higher technology readiness levels, although not exclusively in all cases.
- Solar PV systems are appropriate in many installations where there are extensive areas of roof-space and un-shaded open areas suitable for installation of PV.
- For wind, the current technologies could be integrated into military sites in a functional way to augment mains supply. Because of its intermittent nature, it would always require either a grid- based, local storage, or other RES solution to serve as back-up. Additional empirical data was needed on wind performance versus cost. Many MS have an understanding of the problems of radar interference from wind turbines and this might be a good area for collaboration accepting that national vulnerabilities would exist in the classified domain.
- The use of hybrid systems with integral RES at remote military sites was a realistic alternative and could offer high degrees of resilience to critical systems.
- The use of biomass could provide considerable renewable electricity and thermal energy.
- Geothermal applications present an attractive option for defence installations and sharing of data/business cases in this area would be beneficial to improve benchmarking and confidence.
- The use of heat pump technologies should be investigated for potential use in the defence sector.
- Small hydro-generation was considered and is an area worthy of further investigation for potential application in the defence sector.
- The work on renewable energy converters (e.g., fuel cells, electrolysers, and cogeneration) has been captured in a number of fact sheets and consideration of these should continue.
- The work on energy storage has also been captured in a number of fact sheets and should continue in greater detail.
- Waste to energy was an area worthy of further consideration and further investigation for the future.
- A technology watch should be maintained in the RES domain including systems simplification and technology integration.

From the discussions and the evidence received, it had become evident that the initial 24 month period was quite ambitious to move MoDs into the RES space. However, a capacity building approach could realise significant benefits downstream towards the attainment of the 2020 and 2030 EU renewable energy targets. The cultural makeup of the MoDs did not naturally align itself

with RES technology deployment based purely on sustainability arguments and hard-edged business cases would remain an essential criterion for successful RE implementation.

The review of the situation during Phase I was based on Member States' responses to questionnaires issued by the WG moderators and by the responses of participating delegates during WG sessions in event 4 (Lisbon) and event 5 (Thessaloniki). Only a minority of Member States had a separate energy strategy or policy for defence and only a minority had implemented an energy management structure. Very few Member States were implementing the RES directive in the defence sector. Not surprisingly very few states had a RES strategy. Nevertheless, many states had pilot studies and research projects in place particularly on Solar PV with smaller numbers on Bio-mass and Bio-fuels. A significant number of states expressed frustration with national procurement rules and also with certification and compliance issues which they felt were impeding RES implementation. Overall work was required to facilitate defence sector adoption of investment programmes which include RES.

3.2.2 Objective setting for RES in the Defence sector

There was a considerable divergence of views on what the RES objectives or end state should be for the defence sector. The following are the aspects on which consensus was achieved:

- **Contribute to national/EU RES effort.** In line with the recent EU communication on the National Energy and Climate Plans (COM (2019) 285), the Defence Ministries, as well as other ministries, can make a significant contribution to the completion of the national plans.
- **Increase resilience of the defence sector.** Most delegations agreed on the value of RES in increasing resilience within the defence sector. However, one delegation strongly argued that there were other measures such as generators which would ensure resilience more effectively that RES. Most delegations would support expanding the scope to include the role of RES on operational deployments while realising that this is not within the current scope of the CF.
- **Make financial savings in defence budgets.** There was general agreement on this objective. However, there was some scepticism expressed on whether such savings would benefit the defence sector or would be absorbed back by central government.
- **Make the defence sector an 'exemplar' for national and EU RES effort**. Delegates agreed that armed forces had a special role in society and therefore were in a unique position to display leadership in promoting the use of renewable energy, reducing carbon footprint and improving energy efficiency within MS.
- **Increase RES awareness and skills within armed forces to enhance operational effectiveness.** All delegations agreed that RES awareness and skills can help improve operational effectiveness especially on deployed operations.
- **Contribute to European and national energy security by reducing dependence on fossil fuels**. It was accepted that RES within the defence sector would reduce dependence on fossil fuel imports.

3.2.3 Roadmap for RES

There was a general agreement that buy-in at strategic level within states was essential if substantive progress is to be made in the defence and security sector.

A top-down/bottom–up approach was agreed. CF SEDSS can have a significant impact in fostering the BOTTOM-UP element. However, it should be supported by a TOP-DOWN component which sets agendas both at EU and national levels.

States can help achieve progress through developing an energy policy and management framework including the following;

- Increase awareness of energy matters and especially RES in the defence sector at national level.
- Develop and maintain a national defence energy strategy/policy with a RES component.
- Develop and maintain an energy management structure for the defence sector at national level.

Having established a strong energy policy and management framework states either individually or collectively could consider the following initiatives:

- Develop and/or review frameworks for delivery of RES projects in both national and EU contexts including appropriate procurement procedures, collaborative processes, funding mechanisms and consideration of energy performance contracts.
- Examine feasibility of applying existing and emerging RES technologies across national defence sectors, including by implementing pilot projects where relevant.
- Develop an implementation plan for RES in the defence sector, consistent with NATO approaches to RES where applicable.
- Pool findings and share experiences at EDA level.

3.2.4 Potential RES project development

The CF SEDSS II working group on RES also considered the scope for future work on RES in Phase II of the CF including the following possible projects:

- **Develop a RES feasibility tool-kit.** This could encompass all viable RES technologies and assist states in selecting the most appropriate technologies in particular applicable circumstances.
- **Further examine energy storage systems.** Energy storage was identified as a significant obstacle to wider deployment of RES. More efficient and cost effective storage options would significant enhance the viability of RES technologies.
- **Monitor new and emerging technologies.** The RES technology sector is undergoing rapid development and innovation and the CF should ensure that it remains appraised of technological developments.
- **Examine viability of mixed RES technologies in one installation.** This proposal was made by one state and supported by others. The intention in general is to assess the advantages and disadvantages of such mixes e.g. wind and solar.
- **Investigate role of energy performance contracts in delivering RES projects in defence sector.** The WG agreed that energy performance contracts could play a significant role in developing and implementing RES capacity in the defence sector particularly where significant capital investment was required.

3.2.5 Progress on project development in Phase II

During Phase II a total of five project ideas emerged during discussions in the context of WG2 – RES (see Appendix). These include:

1. RES-HUB project idea based on hydrogen storage;
2. ENSSURE project idea promoting RES as an element in ensuring energy resilience along with enhanced energy management and efficiency;
3. The examination of energy performance contracting as a tool for installing capital RES projects;

4. The development of a RES suitability tool to identify the most appropriate RES configuration for specific installations;
5. The development of an energy storage selection tool to maximise value of RES.

3.2.6 Recommendations on method of work of WG within Phase II of CF

- **Enhance intersessional work component.** It was agreed that much more work could be achieved through intersessional working. This would require greater consistency by MS representatives in providing the necessary inputs to the Moderators. The response during Phase II, e.g. to questionnaires, was disappointing and will have to improve.
- **Develop and agree clear objectives for each task within the WG.** The development and agreement of clear targets is an essential prerequisite for an efficient system of work. It was felt that initial work could be done through intersessional work to facilitate decisions being finalised at the first meeting of Phase II.
- **Develop and agree intermediate milestones for each task within WG to maintain momentum and to manage workload**. Once the targets and goals are finalised there is a need for milestones to measure and confirm progress towards achievement of the identified goals.

3.2.7 Recommendations on method of work of WG within Phase III of CF

In Phase III the WG should build on the recommendations for Phase II and add the following elements:

- Improve coordination in RES matters between national energy authorities and defence organisations including through joint workshops;
- Improve participation of, and coordination with, experts from industry and academia;
- Examine opportunities for collaboration with CF SEDSS WG 1 and 3 and other relevant groups, such as CA-RES. In phase III, also the transversal WG of the CF SEDSS will come into play which is expected to support the working group on RES to identify the relevant cutting-edge technologies that can be applied in the defence and security sector;
- Organise separate meetings on specific themes to focus attention on areas where progress could be achieved if greater attention were to be given to a specific issue.

3.3 Protection of Critical Energy infrastructure

Identifying the protection of critical infrastructures as a core issue for the Consultation Forum, is the basis for succeeding in developing an effective improvement of the synergies between the energy and defence sectors. Only thanks to the development of coherent policy pertaining to protected critical infrastructures is it possible to ensure correct communication between private and public stakeholders: *specifically, between the civilian and military sectors*.

The energy efficiency of MS MoD/armed forces can only be guaranteed with the awareness of capabilities of the critical infrastructure. To do so, MS armed forces should proceed with implementing the following actions, without any compromise to military operational objectives and capabilities:

- develop, promulgate and support through relevant resources (human and economic) an energy policy and an energy strategy;

- engage more with industry in terms of research and technology for the provision of sustainable and energy efficient solutions;

- develop and implement energy management systems or environmental management systems, which should include energy protection as one of the most significant aspects, in order to guarantee the continuity of energy supply, thereby enabling all the other military operational capabilities.

These efforts must also necessarily take a look into the future, trying to identify those sectors in which criticalities can be more vulnerable. In this sense, anticipating the times and providing guarantees of protection to renewable and green energy (which as stated will constitute the future for the energy sector) will avoid risks in making critical infrastructures exposed and uncovered. Even more, cybersecurity will have to be the flagship of a new generation energy sector, guaranteeing protection to the defence and critical European infrastructures. While referring to cyber security, it is important to take into consideration the fast-paced development of new technologies. The recommendation is to increase the defence of the widest range of energy supply technologies.

Sharing of the best practices, legal norms, and standards is also a critical component to guarantee stability and security. This also refers to cybersecurity in critical infrastructure. The current cyber threats are recognised at both national and international levels and the best practices piloted and approved in one country could be further replicated in the other MS. In this challenging security environment, to ensure a safe and secure system for populations, territory and forces, it is necessary to encourage MS, partners and other nations to fully develop and implement their international obligations. In implementing the cyber and energy security policies, EU should continuously improve collaboration, as appropriate, with partners, as well as relevant international and regional organisations, and national authorities in MS.

The working group 3 on PCEI concludes that there is a need to ensure the protection and resilience of defence and security sectors in times of crisis. In this respect, during phase II, the group has developed a position paper on PCEI which provides the framework which could lead to the identification of best management practices, including an EU policy based on sustainable energy and environmental security priorities, to support MS further in strengthening the protection of all defence related CEI from threats, risks or vulnerabilities. To address these challenges, the PCEI position paper proposes to secure energy strategic autonomy for European defence through cooperation and practical assistance amongst MS. The paper also recommends a number of steps that will help the EU MS MoDs to identify concrete actions for developing appropriate methodologies and tools, and initiating projects of mutual interest with the support of the EU. It is

expected that the PCEI paper will support the efforts of the EU and MS in enhancing the resilience of defence related CEI, and provide an impetus for future work on the issue.

3.3.1 Recommendations on method of work of WG within Phase III of CF

The PCEI working group 3 identify that the application to critical energy infrastructure, "Digital Twin" technology could be used to increase protection and resilience by simulating infrastructure behaviour during crisis inflicted by both physical and cyber impacts. Characteristics such as robustness of the model, the link to the real world, the application of advanced big data analytics and the ability to evaluate "what if" scenarios are perfectly suitable for the purpose to detect future disruptive events and identify the proper measures to be implemented to reduce both risk and impact effects.

"Digital Twin" refers to a computer model which mirrors and simulates an asset or a system of assets and their surrounding environment. Digital twin models can help organising data and pull it into interoperable formats so that it can be used to optimise infrastructure use[129]. "Digital Twin" has been included in both 2018 and 2019 top 10 strategic technology trends by Gartner[130], the world's leading research and advisory company.

As reported on the Gartner top 10 strategic technology trends for 2019 webpage[131]:

> *a digital twin is a digital representation that mirrors a real-life object, process or system. Digital twins can also be linked to create twins of larger systems, such as a power plant or city. The idea of a digital twin is not new. It goes back to computer-aided design representations of things or online profiles of customers, but today's digital twins are different in four ways:*

- *The robustness of the models, with a focus on how they support specific business outcomes;*
- *The link to the real world, potentially in real time for monitoring and control;*
- *The application of advanced big data analytics and AI to drive new business opportunities*
- *The ability to interact with them and evaluate "what if" scenarios.*

In the third phase the PCEI working group will further explore the above application as the focus today is on digital twins in the IoT, which could improve enterprise decision making by providing information on maintenance and reliability, insight into how a product could perform more effectively, data about new products and increased efficiency. Digital twins of an organisation are emerging to create models of organizational process to enable real time monitoring and drive improved process efficiencies.

The PCEI working group considers that it is important for the MS to undertake actions which will enable each to assess their level of energy autonomy. While the defence sector's own infrastructure may be well protected, the interface and dependency with civilian energy infrastructures is another challenge. In a Europe where MS' armed forces are required to work more closely together, the question of who supplies energy gains urgency particularly in cases where the armed forces are engaged in civilian type operations such as search and rescue, fire-fighting etc. As such, the following challenges need to be further addressed in the context of phase III and proposed actions to be identified:

- the degree of energy independence of the armed forces;

[129] https://www.ifm.eng.cam.ac.uk/research/asset-management/research-projects/infrastructure-digital-twins/
[130] See, https://www.gartner.com/en/newsroom/press-releases/2017-10-04-gartner-identifies-the-top-10-strategic-technology-trends-for-2018 and https://www.gartner.com/smarterwithgartner/gartner-top-10-strategic-technology-trends-for-2019/
[131] https://www.gartner.com/smarterwithgartner/gartner-top-10-strategic-technology-trends-for-2019/

- the civil-military interface in terms of agreements and arrangements that need to be performed during preparedness;

- security and interoperability requirements that defence places on civilian energy infrastructure and the projection of future needs;

- introducing into civil energy infrastructure the risk assessment and security plans related to defence threat scenarios, in the framework of civil – military cooperation;

- development of joint training and exercises throughout the whole prevention, preparedness and response cycle;

  support of national activities which improve engagement by MS in investing in enhanced security and resilience of civil CEI relevant to defence.

Overall, the PCEI working group 3 will continue in phase 3 relevant work in order to address identified shortfalls in critical energy infrastructure protection and resilience by developing projects of mutual interest for the defence and security sector. It will also develop a roadmap which will enable the development of short-, medium- and long-term strategy for the PCEI Initiative. One of the key objectives will be the establish a network of experts as a platform for enabling broader collaboration across EU MS MoDs and relevant civil sectors.

3.3.2 Reflections for the future of the work strand on PCEI

Throughout the last 22 months of the CF SEDSS II project the working group on PCEI concluded that it is both desirable and opportune for the defence sector to contribute to the protection of CEI and that there are also potential benefits from cross-border cooperation between MoDs to explore how best to achieve this involvement, given the potential Europeanisation of the energy system-of-systems. The geopolitical and systemic development of the CEI generate new risks, vulnerabilities and threats that challenge both the national competent authorities, as well as the European Union's mechanisms for critical infrastructure protection (CIP). In this context, the involvement of the defence sector in the protection of defence-related CEI, the cooperation with NATO, the development of a defence-related energy union to complement the existing Energy Union, as well as an agenda of security-conscious and resilience enhancing innovation must all be considered as possibilities for collective action.

As identified by the position paper on the PCEI, there is an urgent need for promoting safety and security standards to increase the resilience of CEI related to the defence domain. Securing strategic energy autonomy for the MS and the EU as a whole is becoming more vital. Therefore there is also a need to develop the mechanisms for stronger collaboration between defence and civilian CEI and between the defence sector and the civilian owners and operators of most CEI. Such collaboration can take place at different levels which could include:

- the strategic level to work on a common understanding:
- the operational level to develop common threat scenarios and security plans; and,
- the tactical level to provide the resources needed for crisis management and asset recovery.

Similarly, investment plans could be agreed and the commitment of both MS and EU funds could be considered. In order to provide a comprehensive response to these challenges at MS level, a defence strategy related to PCEI needs to be put in place in order to develop capacity, to make the necessary investments as well as research plans, to tackle gaps in knowledge and to prepare common threat scenarios for joint activities and training. The objective is to ensure proper functioning of the critical path of the whole energy supply chain and life cycle, in the EU defence and security sector, by maintaining and improving energy security and sustainability within the EU.

SECTION 4: "IDENTIFUNDING" AND ACCESS TO EUROPEAN FUNDING

4.1 Objective

One of the main concerns of the Forum has been the transition from the conceptual to the realisation phase. The latter builds on the potential access to European funding in order to actualise energy-related projects in defence. Therefore, both in preparing and holding Warsaw and Nicosia conferences, the Forum has addressed the required steps aimed at targeting a number of eligible funding source.

For the above, a multi-dimensional plan has been developing to increase the possibility of the implementation of the CF SEDSS II project ideas through access to funding at European level. This plan, which is under implementation, consists of several stages, as follows.

4.2 European Funding Gateway for Defence Energy

EDA has first provided Member States with a dedicated 'European Funding Gateway for Defence Energy" [EFGDE - eda.europa.eu/what-we-do/our-current-priorities/eu-funding-gateway-for-energy-in-defence] to raise awareness and transfer know-how about the spectrum of funding opportunities for energy in defence available at European level. The EFGDE is a synopsis based on multiple comparative views, enabling to compare each relevant dimension, one-by-one, e.g. *what* can be funded, *who* has access, *which* type of funding), across the many funding opportunities that are potentially eligible, i.e.:

Figure 40: The EFGDE

EFGDE can be explored under the following criteria/dimensions:

Select a criterion: SCOPE WHAT WHO WHEN WHICH WHERE QUANTUM HOW

As an example, the "WHAT" selection delivers instantly the typology of projects that can be funded, as follows

Figure 41: The "WHAT" selection of the EFGDE

Similarly, the tool enables to switch swiftly to another dimension by choosing a different criterion of comparison, e.g. the “QUANTUM”, that is how much can be funded:

Figure 42: The “QUANTUM” selection of the EFGDE

Since some EU funding programmes are under so-called “indirect management”, further facilitation might be needed. “Indirect management” means that EU funding is re-allocated nationally/regionally/locally: hundreds of (managing) authorities and other (intermediate) bodies are in charge to publish relevant calls for proposals. To address such a highly fragmented landscape, EDA provides its stakeholders with dedicated analytical platforms and video tutorials:

- ESIF web-platform (eda.europa.eu/esif)

Figure 43: ESIF web-platform

- COSME web-platform (eda.europa.eu/cosme)

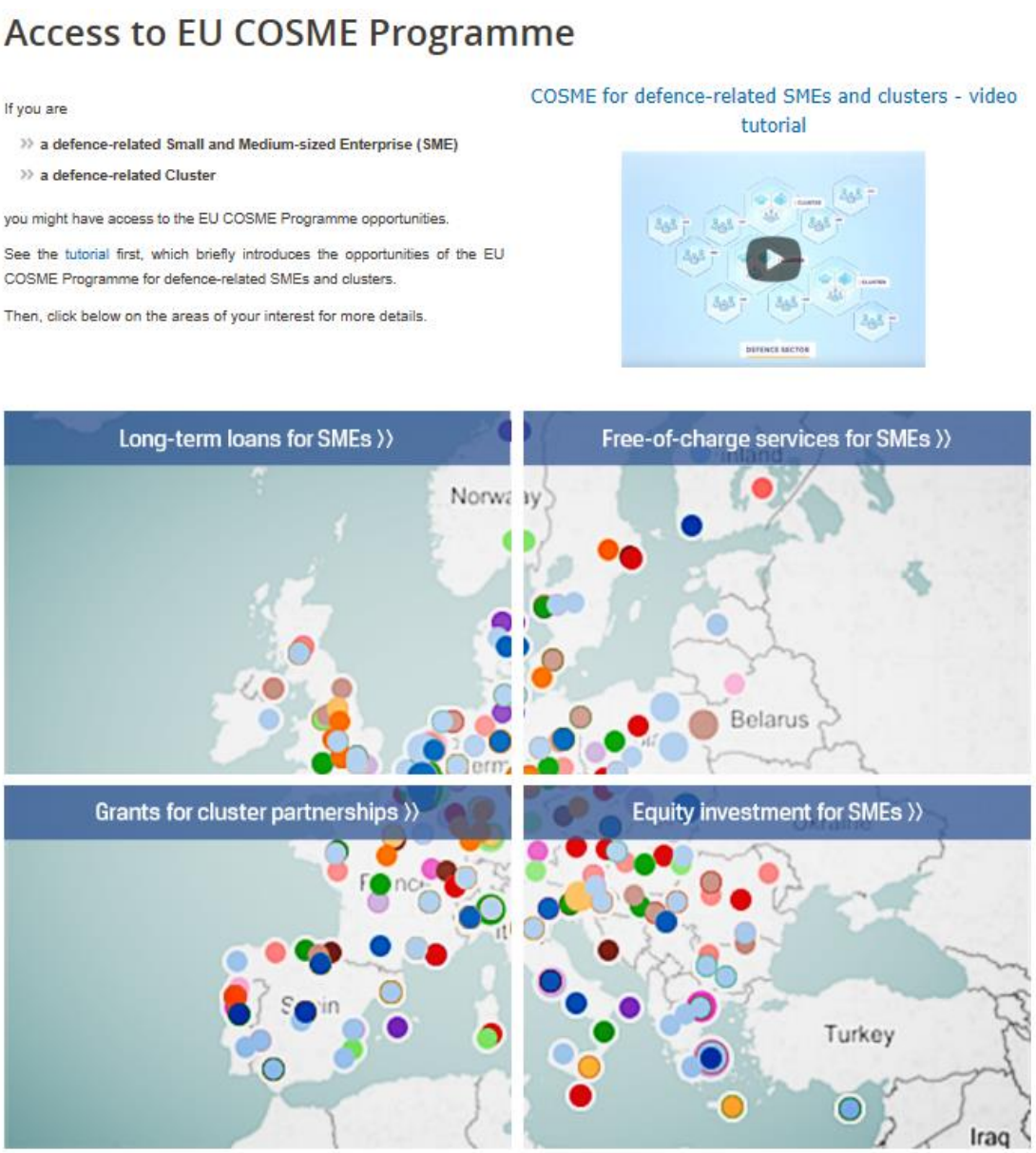


Figure 44: COSME web-platform

- ERASMUS+ web-platform (eda.europa.eu/erasmus)

Figure 45: ERASMUS+ web-platform

As part of the CF SEDSS II working group programmes, EDA also organised parallel sessions with dedicated experts providing guidance on how to improve further the project ideas, recommendations on how to get funding, guidance for an EDA-driven ad-hoc project generation, hands-on training, as well further information on several funding opportunities with a dedicated focus on e.g. the European Investment Bank (EIB).

4.3 Focus on the Structural Reform Support Programme

Aside to above introduced funding opportunities, EDA has addressed the Structural Reform Support Programme (SRSP) by developing the engagement within the CF SEDSS II of the related European Commission's service: the Structural Reform Support Service (SRSS).

SRSP is a funding programme for governmental bodies only, with grants covering 100% of a project cost. EDA analysis has delivered the following tailored assessment (excerpts are from the 2019 SRSP work programme):

- a leading MoD may be the ultimate "beneficiary" alone, as well as lead a national consortium; however,
- an MoD will not be directly the official applicant to the SRSP, as an SRSS Member State (national coordinating authority (NCA) applies on behalf of the MoD (and is actually compelled to apply all projects from national governmental bodies to SRSP/SRSS);
- when applying national projects to SRSS, an [N]CA submits them according to a very relevant national prioritisation and ranking. For the above, the competition is mostly an intra-national one;
- SRSS in Brussels might potentially revert/change the national ranking as provided by the respective [N]CA, though this is not likely to happen;
- a beneficiary is not directly funded by SRSP but a "provider" (contractor implementing the actions of the project for the benefit of the final beneficiary) is eventually funded. The provider may also be a private entity and the MoD may indicate its favourite one under specific conditions;
- the provider may partially use sub-contractors to implement non-core actions of the project;
- the beneficiary MoD will share the results with the other MoDs interested in the same project and a project may be implemented also in other MSs' military sites (when functional to the specific project);
- if a project is awarded under the 2019 SRSP call, the same project may be replicated in another relevant MS and eventually funded under the 2020 SRSP call;
- feasibility studies are eligible;
- defence energy-related projects would fall under the SRSP Thematic Area [T.A.] «Growth, Business Environment and Sectoral Issues» [art. 5(2)], particularly within its key priority [KP] "Energy Union". This KP can support "… the achievement of renewable energy targets, the promotion of energy efficiency, strengthening the security of supply and the proper functioning of energy markets, and supporting the low-carbon transition of national energy systems. Objectives must include "contributing to the national authorities' efforts to promote energy efficiency in buildings … and increasing the security of supply"; expected results must "inter alia, contribute to increasing the penetration of energy efficiency and renewable energy sources, increasing public sector energy efficiency investment, improving the accuracy of energy … forecasting, modelling and planning, strengthening energy infrastructures and low-carbon modernisation of energy systems";

- as to the typology of funding, it makes sense to target direct grants (2019 total for T.A. "Growth, business environment and sectoral issues" is € 2.7 million), public procurement (study / technical assistance / evaluation / survey / it / communication services / etc. - 2019 total for the above-mentioned T.A. is € 10.7 million) and indirect management (2019 total for the same T.A. is € 6.6 mn.

The need to develop such a specific focus on SRSP has been related to the fact that this source is earmarked for governments only, to the above-mentioned 100% coverage, to the relevant interest showed by SRSS in respect of extending the programme to the defence sector and the convenient annual deadline (October 31) matching the degree of maturity of the most advanced project discussed within the CF SEDSS II.

4.4 The "IdentiFunding" for Energy

In the meantime, EDA has developed a tailored methodology, the "IdentiFunding for Energy", able to match each project idea resulting from the CF SEDDS II with the range of their potentially eligible funding sources at European level.

This methodology has addressed about 30 project ideas based on the following ad-hoc light questionnaire:

For Government use only

"IdentiFunding for Energy in Defence"

Project: "..... *(name)* ....." [201...]
[CF SEDSS II - WG no. .... - ..... *(name)* .....]

Member State (MS) in the lead: .....
Contributing MS(s): .....

	Answer may simply be: "Yes" / "Partially" [1] / "No" [2] ⇩
***I)* "What" must be funded?**	
1. Does the project benefit / contribute at least to one of the followings? *Environment, climate change adaptation, resource efficiency, resilience, public administration efficiency and capacity*	
2. Does the project develop a high performing, sustainable and interconnected trans-European network in the field of energy? *Comments/additional information, if any: .....*	
3. Is the project an innovative pilot concerning "natural capital management"? *Comments/additional information, if any: .....*	
4. Is the project idea a(n): *a)* **pilot**, and/or *b)* **demonstration**, and/or *c)* **best-practice**, and/or *d)* **information / raising-awareness / dissemination** *e)* **capacity-building** project?	*a)* *b)* *c)* *d)* *e)*
5. What **Technology Readiness Levels (TRLs)[3]** is(are) addressed? *Comments/additional information, if any: .....*	(from) TRL ... (to ...)
6. Is the project (or part of it) **"dual" use** (civilian-military)? **If yes** or **partially**, then:	
a) is the **"civilian"** percentage of the **expected costs** of the project **≥50%?**	
b) is the **"civilian"** percentage of the **final value of the result** of the project **≥50%?**	
7. Does the project relate to the **industrial development of technologies** or **assets** increasing **efficiency** across the **life-cycle** of **defence products and technologies**? *Comments/additional information, if any: .....*	
8. Does any MS intend to procure the final product or use the technology in a coordinated way, including through joint procurement (with other MS)? *If yes, which MS(s): .....*	
9. Does the project trigger the need for dedicated **training** to develop / enhance any related **skills / competences**? **If yes / partially,** *please, provide a brief description of the required skill(s) / competence(s): .....*	

II) **"Who" is seeking access to funding?**

A. Enterprise(s)?
If yes, are they:

1. **Small-and-Medium-sized (SMEs)** [<250 staff[4] in whole Group]?
If yes/partially, please name it (them) if available:
a) .....
b) .....

2. **Intermediate/Mid-Cap(s)** [250-3000 staff]?
If yes/partially, please name it(them) if available:
a) .....
b) .....

3. **Larger(s)** [>3000 staff]/Prime(s)?
If yes/partially, please name it(them) if available:
a) .....
b) .....

Comments/additional information, if any: .....

B. Other(s)?

4. **Research-and-Technology Organisation(s)** (RTOs)?

5. **University(ies)?**

6. **Ministry(ies) of Defence?**

7. (other) Public body(ies) *[specify]?*
a) .....
b) .....

8. (other) Private body(ies) *[specify]?*
a) .....
b) .....

C. Location?

9. In which MS(s) do you consider the project may take place? .....

III) **"How much"/ "Which" funding?**

1. What is the **estimated total budget** of the project (in million €)? € .....

2. **Is it possible to split the project into self-standing**
a) cooperative sub-projects, or
b) national/local sub-projects,
in order to be able to apply them separately for funding?
a)
b)
Comments/additional information, if any: .....

3. **Aside from potential grants** (*i.e. money not to be repaid back*), is(are) the project holder(s) also **interested in a loan** (*i.e. money to be repaid back with interest*)?
If yes/partially,
please, provide an **indicative percentage** of the **total cost** of the project that **can be financed by a loan**: ..... **%**
Comments/additional information, if any: .....

Figure 46: IdentiFunding for Energy in Defence

This methodology has been applied in a tailored manner to all 17 project ideas that the working groups have decided to elaborate further. So far, this methodology has delivered the following outcome:

- 15 project ideas are potentially relevant for European Structural Funds;
- 11 are eligible also under the EU LIFE Programme;
- 4 are relevant for the Commission's SRSP;
- 2 could be covered by the EDIDP;
- one by EIB's loans, and
- one by the financial instruments of the EU COSME Programme.

4.5 From project ideas to official applications for funding

Based on the above outcome, the deadlines of related calls, the most mature project ideas within the CF SEDSS II and the expressed interest of the MoDs, **EDA has identified SRSP as the 2019 target for the application of the first 3 projects***:*

1) "Building on the Nearly Zero-Energy Buildings (NZEBs) Concept in the EU Defence Sector" - WG-1;
2) "Defence RESilience Hub Network in Europe" (RESHUB) - WG-2;
3) "Standard Procedure to estimate the dependency of large and complex civilian and military assets with respect to public services" (SPEEDUS) - WG-3.

With the support of an international consultancy company, EDA has been supporting the structuring, drafting and submission process of these 3 projects in view of 31st October's deadline for the 2019 SRSP call for proposals. As an actual follow-up, relevant ad-hoc meetings have taken place at EDA premises with the Member States interested in the 3 projects (n.b.: this activity takes please outside of the Consultation Forum).

The overall process identified by EDA to target and exploit at most SRSP is summarised as follows:

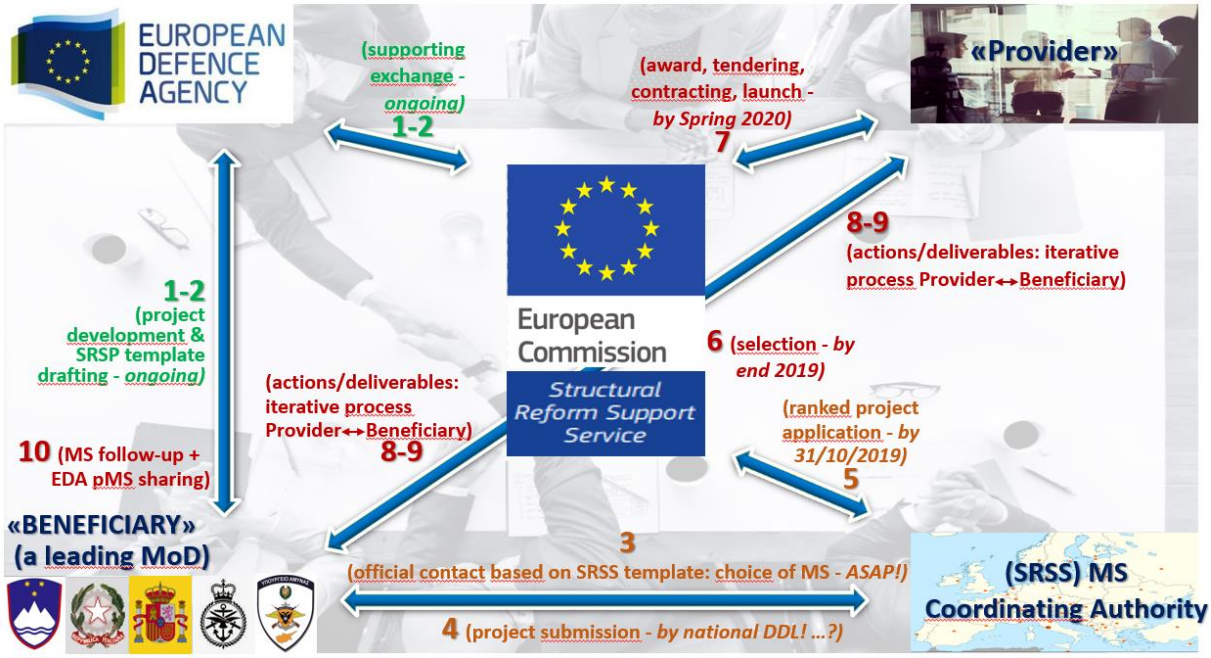


Figure 47: Process identified by EDA to target SRSP

In parallel, EDA is supporting the preparation of other projects with a view to apply for other eligible EU funding opportunities as of 2020. In this respect, EDA is ready to allocate additional budget to support at least five other applications. demonstrating the commitment of the Agency to meet the expectation of the Ministries of Defence in producing tangible results. To encourage the process, in both Nicosia and Bucharest Conferences work was done to identify and initiate these additional five projects application.

4.6 Wrapping-up on the funding dimension at European level

Hence, it can be said that in about one year there has been a leap forward: *from the generation of cooperative project ideas in defence to the concrete drafting of energy projects, from the identification of eligible funding at European level to the upcoming official application of first projects.* Finally, EDA is currently reviewing the five additional projects for providing them with the necessary technical assistance for the drafting of the new applications for funding in 2020.

CONCLUSION

Observations for Future Work

The Consultation Forum for Sustainable Energy in the Defence and Security Sector has provided a unique opportunity to increase the momentum on developing a sustainable energy pathway for the defence sector. Through the CF SEDSS, the defence sector demonstrated its willingness to engage in tackling tough challenges and produce solutions to its advantage, while also contributing to the overall and greater objective of the decarbonisation of the EU economy by 2050. Although progress on improving energy performance is evident, it can be concluded that the CF SEDSS initiative highlighted that there are specific bottlenecks that the defence sector needs to tackle with the support of national and EU stakeholders. This requirement is also acknowledged in the June 2019 "Council Conclusions on Security and Defence in the context of the EU Global Strategy" which call "*for strengthening cooperation in tackling energy security challenges, including via energy efficiency, renewable energy solutions and the protection of critical energy infrastructure*". Responding to the wider concerns, the Council of the EU invited the EU Member States, the EEAS, the European Commission and EDA "*to develop concrete solutions within the defence sector for safe and sustainable energy models leading to increased resilience and operational efficiency also in the context of climate change…*".

As such, there is a strong business case for the Consultation Forum to continue its work. EDA welcomes the opportunity to continue collaborating with the European Commission (DG ENER and EASME) on the third phase of the Consultation Forum and to facilitate the needs of the expanding network of stakeholders, which came as a result of this initiative. To further support the continuation of the CF SEDSS, it is useful to take into account some lessons learned, stakeholder observations, and proposals regarding format and organization, which includes:

A. Format and organisational aspects

- The balance between the number, duration, and format of meetings of CF SEDSS was correct;

- Enhanced level of stakeholder engagement with participants (for instance, through questionnaires or sharing of other documentation) was proposed n between meetings, which could facilitate stakeholder-led research and preparation of the meeting;

- There was a request for broadening stakeholders' engagement to include:
  - other government departments, specifically ministries of energy, interior, environment, industry, or economy and tax revenue representatives;
  - other national and EU relevant authorities;
  - institutions key to defence and finance; and,
  - research and technology organisations, industry and other suppliers.

- Closer collaboration between the working groups may help tap and leverage on each WG's outcomes and results as well as to better address cross-cutting considerations;

- Consideration of alternative structures to the CF SEDSS working groups: rather than the present model, there could be structures around high-level policies and methodologies; project identification, development and implementation, technology focus and financing. Particularly, a **Transversal Working Group** with a primary focus on addressing cross-cutting defence energy-related areas which are of interest to the other three working groups. To address these transversal areas better, the following sub-themes will be established: a **Technology, Research & Innovation Hub** to address issues, coordinate activities, collect best practices and raise awareness on innovative and smart energy technologies such as

intelligent metering system, blockchain, artificial intelligence, digitalisation, big data, sensors, energy management networks, cybersecurity, etc.; a **Policy & Management Observatory** to focus primarily on the energy management policy dimension aiming at helping the MoDs to assist the defence sector in establishing policies, strategies, processes, roadmaps, methodologies and tools to improve energy management and performance as well as cultivating green defence energy culture; a **Financing & Funding Gateway Cell** where the Agency will apply its internal methodology **"IdentiFunding for Energy in Defence"**, to review or identify existing and new financing mechanisms or other funding instruments to support the implementation of defence-energy related topics.

B. Proposed topics

- Empowering MoDs to identify, develop and implement collaborative projects through the exploration and provision of knowledge and training on financial tools and mechanisms. Rather than being on financial support to specific projects, this would assist with the identification of suitable financial mechanism or other relevant funding instruments and a greater understanding of how such tools work in practice;

- Striving towards the identification of tools and instruments that would help Member States/MoDs to develop tangible projects, which are linked to objectives of the relevant energy directives;

- Financing/funding of defence energy-related projects through the new European Defence Research Programme, or through the next EU Multiannual Financial Framework (MFF) 2021-2027;

- Further exploration of financing / funding dual use defence energy projects through EU Structural Funds or the SRSP;

- Interpretation of and compliance with public sector procurement rules where this is justified and applicable;

- Capacity building towards the development and implementation of: energy performance contracting; energy management systems, including appropriate energy performance indicators; setting energy targets, energy monitoring and modelling which could incorporate exploring the scope for defining separate targets for energy consumption (owing to lower use) and for energy efficiency (owing to more efficiency);

- Through-life cost approaches regarding specific issues such as technical building systems;

- Using evidence to build energy considerations in to budget cycle planning in public administrations;

- Development of energy policies and strategies at a high level in MoD/armed forces organisations;

- Enhancing awareness on the security systems of the IT devices linked to the management and maintenance systems of wind turbines, ICS/SCADA systems, in order to increase protection against hacker's infiltration;

- New paradigm of smart cities must be taken into account in order to guarantee energy security in an environment characterized by a huge number of automatized and distributed devices IoT based;

- Resilience must be considered as a key element in achieving high energy security levels in smart cities and critical infrastructures;

- Develop a roadmap which will enable the development of short-, medium- and long-term strategy for the protection of defence energy-related CEI;

- "Digital Twin" technology should be considered as a valid solution in order to increase protection and resilience by simulating infrastructure behaviour during crisis inflicted by both physical and cyber impacts.

C. Reflections

- Even though energy is not the core business of the defence sector, its role as a military capability multiplier is widely acknowledged. Using energy efficiently can contribute to sustaining military operations for longer periods and reducing the needs and the corresponding logistic risks of fuel supplies in hostile environments.

- Within the national borders, collectively saving energy in defence context results in saving financial resources directly (through lower utility bills) and indirectly (through lower maintenance costs), assuming also the exemplary role assigned to public sector towards mitigating climate change.

- The defence sector is operationally driven, with purpose and priorities different from the commercially driven civil sector, and thus, it is less ambitious as far as energy savings are concerned. However, the MoDs acknowledge the necessity of an energy strategy as a significant enabler towards increasing energy efficiency and reducing energy consumption within the defence sector, provided that it is sustained by concrete action plans. In this context, an energy strategy should be issued by each MoD, in order to initiate and maintain actions for a more energy efficient, and less energy consuming, defence sector. Likewise, MoDs should move forward to the development and implementation of energy management systems or environmental management systems to pursue continuous improvement of energy performance to the benefit of the military capabilities and resilience.

- The wide disparity in the approaches to use RES across EU MS demonstrates a need for greater sharing of information in this field. There is a need to examine how RES can contribute to a lowering of the carbon footprint of the defence and security sector. There should also be a closer focus on the obstacles to major RES projects and how these might be overcome (e.g., planning constraints, excess production, storage and coordination with other public bodies and the private sector). Building the business case for RES technology integration into defence infrastructure should be a priority.

- The increasing demand for energy by both the defence and the civilian sectors as well as the new threats that will arise from emerging technologies, natural hazards and the impact of climate change are sources of concern and alarm. Although defence does have its own energy resources it depends to a great extent on civilian resources. Therefore, there is a need for the defence to be ready to respond and recover in case these civilian resources are compromised.

- A phase III of the Consultation Forum should be developed in a way which identifies specific bottlenecks of the defence sector while offering possible solutions to address them as well as anticipates future needs, by balancing defined stakeholder requirements with the joint leadership of EDA and DG ENER. Specific concepts could be factored in agreements upfront, while recognising the need to be flexible with the content as Phase III matures. In this way, concepts could be readjusted, should these be determined to have limited scope

for improving a sustainable energy future for the defence sector, whereas those that show the greatest potential could be further developed. In addition, potential new concepts, which were neither articulated nor known during the initiation of the phase II, could also be taken into consideration at a later stage.

Key Recommendations

What is done on energy should contribute to maintaining military capability in a safety driven way. Energy efficiency can serve as a capability multiplier. MoDs can play a leading role within the public sector on the energy improvements, provided that relevant funds are secured and that this is accompanied by a strong political will. MS experts agreed that energy improvements will lead to reduced cost risks and to improvement of capability development and delivery. Also, the military expectations included that the sustainable energy transition will lead to cost-control through technologies, behavioural change, to reduced vulnerability, and reduced environmental impact. In relation to this, yet, there was an explicit view from MoDs that the existing defence exemptions within the EU legal framework on energy efficiency may have to be maintained.

In this regard, the following were proposed as next steps:

a) **MoDs /armed forces should proceed with implementing the following actions, without any compromise to military operational objectives and capabilities:**

i. Identifying knowledge gaps on energy-related aspects of the defence sector;

ii. Developing, promulgating and supporting through relevant resources (human and economic) an energy policy and an energy strategy, initiate and sustain action plans for a more energy efficient and less fossil fuel dependent defence sector with a greater diversity of energy sources;

iii. Engaging more with industry in terms of research and technology for the provision of sustainable and energy efficient solutions, either by the incorporation of off-the-shelf products in the military environment or by the development of tailor-made, new products;

iv. Developing and implementing energy management systems or environmental management systems, which includes energy as one of the significant environmental aspects, to pursue the continual improvement of energy performance in a way which benefits military capabilities;

v. Utilising smart metering technologies to provide sufficiently accurate data to the required granularity, taking into account cybersecurity, to enable effective energy management:

- Forecasting energy consumption for budgetary purposes (billing and planning);
- Planning more accurately new interventions to address future energy trends;
- Launching action plans for increasing energy efficiency and reducing fossil fuel consumption/costs while supporting or even enhancing the military operational capabilities and requirements;

vi. Triggering human factors which are related to energy efficiency improvement, renewable energy sources and technologies penetration focused on building commitment, raising awareness, nurturing motivation, maintaining internal and external communication, and providing appropriate training. This is important to help gain commitment at a high level to invest in energy efficiency and renewable energy.

vii. Creating new and/or amending existing procurement procedures and practice to enable the selection of energy efficient and renewable energy products/equipment, services

and buildings in accordance with relevant EU and national legal frameworks, but not to the detriment of military operational capabilities.

viii. Exploring further the feasibility of the EPC funding mechanism, taking into account the specificities of the defence sector.

ix. Developing renovation roadmaps and utilising technological developments to aid the transition to NZEB (including through the use of off-site manufacture of modular units for retrofitting building upgrades, building automation control systems or replacement with energy efficient permanent demountable structures);

x. Improving coordination in RES matters between national energy authorities and defence organisations including through joint workshops;

xi. Increasing awareness of energy matters and especially RES in the defence sector at national level;

xii. Developing and maintaining a national defence energy S+strategy/policy with a RES component.

xiii. Developing and/or reviewing frameworks for delivery of RES projects in both national and EU contexts including appropriate procurement procedures, collaborative processes, funding mechanisms and consideration of energy performance contracts.

xiv. Examining feasibility of applying existing and emerging RES technologies across national defence sectors, including by implementing pilot projects where relevant.

xv. Developing an Implementation Plan for RES in the Defence Sector, consistent with NATO approaches to RES where applicable.

xvi. Increasing policy and operational focus on resilience and preparedness both at EU and national level concerning the protection of defence energy-related CEI;

xvii. Integrating PCEI into EU policy-making processes; develop policy validation methodologies and methodologies to stress-test existing policies through public funding of ad hoc research projects;

xviii. Addressing identified shortfalls in critical energy infrastructure protection and resilience by developing projects of mutual interest for the defence and security sector;

xix. Developing short-, medium- and long-term strategy for the PCEI Initiative;

xx. Establishing a network of experts as a platform for enabling broader collaboration across EU MS MoDs and relevant civil sectors.

b) MS national competent authorities on energy and sustainability should:

i. Remove the barriers that exist in some MS with respect to the involvement of civil servants (MoD personnel included) in energy auditing schemes and at the same time strengthen the procedures that safeguard impartiality;

ii. Include competent MoD personnel in the national training schemes on energy;

iii. Not discriminate against MoDs when funding for energy efficiency upgrades are available for the public sector (through the national energy & climate plans, the ESIF, Horizon 2020 / Europe, the LIFE Programme, as well as other financing mechanisms or funding instruments), to enable MoDs to contribute to national energy efficiency and renewable energy sources targets.

c) The European Commission should:

i. Provide guidance to the national competent authorities on energy to acknowledge the defence sector as a significant stakeholder in terms of energy usage and to enable MoDs to gain access to national funding and technical assistance;

ii. Assist EDA and MoDs in capacity building and realisation of projects related with increase of energy efficiency and reduction of energy consumptions, the use of RES and the enhancing of the resilience of defence-related CEI;

iii. Look for synergies with other energy efficiency-related European Commission's activities and bring relevant communities together to exchange good practices.

d) EDA should:

i. Continue raising awareness of the importance for the defence sector to move toward defence sustainable, affordable and resilient energy models;

ii. Continue enabling the transferring of well-established best practices and / or generate knowledge, tailor-made for the defence sector on energy efficiency;

iii. Promote further cooperation among MoDs in the regime of energy and sustainability;

iv. Act as an interface between MoDs and the European Commission on energy in defence context (framework, funding instruments, etc.);

v. Provide capacity building on defence energy-related topics;

vi. Provide technical support to the MoDs for developing joint projects to address common energy considerations:

vii. Continue providing with the support of the European Commission the CF SEDSS as a platform for enabling the sharing of best practices, experiences and knowledge on sustainable energy across the EU MoDs and other relevant defence stakeholders.

Reflection for the future

To address the emerging and future challenges in the field of energy as well as to meet the expectations of the Council of the EU, and consequently of the EU MoDs, the Consultation Forum will continue pursuing in Phase III the implementation of the EU legal framework on energy and will reaffirm the CF SEDSS as an appropriate vehicle for addressing at the European level common energy considerations in the defence and security sectors. Building on the achievements of the previous phases (CF SEDSS phase I and II), the Agency with the support of the European Commission (DG ENER and EASME), looks forward to continuing assisting the MoDs to move towards more affordable, greener, sustainable and secure energy models. In this context, Phase III will contribute in preparing the defence sector to welcome and accommodate new trends in technology and related equipment such as digitalisation, automation, artificial intelligence, e-mobility, innovative energy technologies in battery storage, smart buildings, sensors, solar and wind power, and energy management systems or networks. Moreover, the examination of cross-cutting thematic areas through a novel transversal working groups is expected to underpin the decision-making of the MoDs to better plan their energy activities and to address challenges ranging from technological, technical and human factors to hybrid threats, terrorist and cyber-attacks or other man-made or natural disasters. Overall, Phase III is expected to present the defence and security sectors with an economic, operational, and strategic opportunity to reduce reliance on fossil fuel and natural gas, to progressively minimise energy costs and carbon footprint and to enhance the operational effectiveness and energy resilience of their functions.

APPENDIX

APPENDIX

Consultation Forum for Sustainable Energy in the Defence and Security Sector Phase II (CF SEDSS II)
Project Ideas

CF SEDSS II (2017-2019) - Project Ideas					
WG 1: Energy Management including Energy Efficiency					
Selected projects to be developed by May 2019					
	Title of the Project Ideas	Short description of projects	Interested MS/Entities[132]	IdentiFunding[133] outcome[134]	Remarks
1.	Energy data analysis	The objective of the potential project is the implementation of practicable tools for the analysis and optimisation of the energy management of buildings and its timely monitoring in order to identify saving potentials as effectively and economically as possible and to permanently maintain them.	AT, BG, DE, EE, LV, PT, SI	ERDF, ESF, Erasmus+, LIFE	
2.	Implementation of energy, water and waste management systems (military energy stars)	The objective of the potential project is to gain control over the energy consumption at armed forces, specifically – at the selected sites of the project implementation through	DE, EE, PL, SI, UK	TBD	

[132] The MS herein listed include the experts that collaborated in the development of project ideas during Phase II. The interest expressed does not entail any commitment for the MoDs or the EU institutions and agencies. However, it provides the framework for the future formation of multi-national collaborations at the European level to help the MoDs to address common considerations.
[133] "IdentiFunding for Energy": an EDA internal and dedicated methodology aimed at matching - in a tailored manner - available funding programmes/opportunities at European level with the features of each specific energy-related project idea. N.B.: other different methodologies under the same "IdentiFunding" concept are covering respectively OSRA-TBBs, KSAs, industry projects.
[134] One of the objectives of CF SEDSS II is to explore funding available at European level in a tailored manner for each energy-related project in Defence. To this end, the "IdentiFunding for Energy" has been applied to all projects for which required data have been sent to EDA by June 2019. The results are shown in the respective column.

		i. better energy planning, ii. better energy plans execution, iii. better energy data collection and energy data analysis (meters, sub-meters, meter data management and analysis systems), iv. better energy competences building, v. better people management, and vi. efficient knowledge and experience sharing among local and international stakeholders.			
3.	Camp lighting -ESCO Contract	Installation of LED lighting and automations to military facilities under the energy services companies' framework / funding mechanism.	BE, CY (lead), EL, SI.	ERDF, ESF[135]	
4.	Normalising factors for data related to defence energy efficiency	Development of a standard methodology to aggregate energy consumed across whole defence systems (air, land, maritime) to create defence-specific energy performance indicators (EnPIs).	AT, BG, FI, FR, IT, PT, UK (lead).	No funding route has been identified to take the project forward	Following BREXIT a new project lead will be required for the next stage.
5.	Capacity building on various aspect (auditing, measurement & verification, drafting EPCs, etc.)	Capacity building on various aspects related to energy (energy auditing, measurement & verification, drafting energy performance contracts, etc.)	BE, FR, NL.	ERDF, ESF, Erasmus+	
6.	Awareness campaigns	Launching awareness campaigns to motivate defence personnel (various subcategories of targeted audiences) in order to reduce energy consumptions.	LV, FR, PT (lead).	Erasmus+ LIFE	

[135] ESF: European Social Fund (ESF), funding training.

7.	Military building stock assessment: energy performance certificates for defence buildings	Development of a methodology/model to assess the energy performance of defence buildings, based on both base building performance and occupier activity.	CY, IE, UK (lead), DK.	LIFE, SRSP, ELENA	Following BREXIT a new project lead will be required for the next stage. May be applicable by 2020 to access EU funding
8.	Renovation to NZEB standards	Deep renovation of selected military installations in order to meet near zero emissions standards.	AT, CY, EL (lead), ES, HR, IE, LT, LV, PL, PT; HU, RO (observers). External: RS	SRSP, ERDF, Interreg, ESF, CF, LIFE (incl. PF4EE[136])	Applying to SRSP by Oct. 2019
Projects to be elaborated during the Third Phase					
9.	Passive air conditioning systems	Utilisation of passive air conditioning techniques and systems in military installations.	AT, LT.		
10.	Energy recovery systems	Utilisation of dissipated energy for use in cogeneration / tri-generation systems within military installations.	AT, IT.		
11.	Tools to evaluate energy vulnerabilities to military installations –implementation in the EnMS context	Development of tools and methodologies to define and evaluate energy vulnerabilities (e.g. energy shortage, dependencies on the national grid, etc.) of military installations.	FI (lead), SE.		

[136] Commission's loans entrusted to EIB.

WG 2: Renewable Energy Sources and Technologies					
Selected projects to be developed by May 2019					
	Title of the Project Ideas	Short description of projects	Interested MS/Entities	IdentiFunding outcome	Remarks
12.	RES feasibility toolkit	Toolkit to assist MoDs in selecting the most appropriate RES technologies in specific circumstances. Outputs would inform investment prioritization on technology aspects which commercial producers might not usually address such as ruggedization, integration into existing and complex power systems, and testing. Results could help with the business case (CF Phase I identified barrier) for increased up-take of renewable energy in defence infrastructure.	BE, BG, CY, EL, ES, FI, FR, HR, IE, IT, PT, SI, SE (lead TBC), UK.	EDA's Cat.B, EDA's OB, EDIDP, ERDF, Interreg, ESF, CF, Erasmus+, LIFE, CEF[137]	Not addressing EU funding but EDA's opportunities
13.	Energy storage selection tool	Energy storage was identified during CF SEDSS phase I as a significant obstacle to wider deployment of RES. More efficient and cost-effective storage options would significantly enhance the viability of RES technologies.	BE, BG, CY, EL, ES, FI, FR, HR, HU, IT, PT, SI. **Externals:** Hydrogen and Fuel Cells Joint Undertaking (European Commission funded initiative).		
14.	Defence RESilience Hub Network in Europe – RESHUB	Step by step building renewable energy harvesting and hydrogen energy storage capability within EU providing a source of energy for domestic forces and host nation support to other EU forces. At the same time the hybrid and electrical mobility solution can be implemented thus supporting EU objectives on lowering the carbon footprint.	AT, SI (lead with support from SI MoD, SI Ministry of the Environment and Spatial Planning, SI and Prime Minister's Office). External: NO	SRSP, EDIDP, ERDF, ESF, CF, Erasmus+, COSME[138], EIB[139], LIFE, CEF, SRSP[140]	Applying to SRSP by Oct. 2019

[137] CEF: Connection Europe Facility (energy share), ensuring security of supply or support large-scale deployment of energy from renewable sources.
[138] COSME: EU Programme for the COmpetitiveness of SMEs. Loans and risk capital for SME (through EIFs), plus grants for cross-border clusters partnerships.
[139] EIB: major direct loans.
[140] Structural Reform Support Programme.

			HU TBC, BE TBD		
15.	Energy performance contracts and renewable energy systems	To investigate the significant role which energy performance contracts could play in developing and implementing RES capacity in the defence sector particularly where significant capital investment would be required.	BE, CY, EL, ES, FI, FR, HR, IE, IT, PT, SI, UK.	LIFE, SRSP	
16.	ENergy Self-SUfficient REsilient military base (ENSSURE) - Examine feasibility of energy self-sufficiency in a small military base through combined use of RES, energy management and energy efficiency	An investigation in to the extent to which already existing heat and electricity renewable energy sources, heat and electricity storage technologies, load-shedding/peak shifting technologies, energy efficient loads and energy management - including human behaviour - could be combined in a representative military base in Europe in order to achieve energy self-sufficiency.	FR (lead), SI, BG. BE, NO, UK TBC FR has proposed this as a **cross-cutting** renewable energy and energy management / efficiency project.	LIFE Potentially ERDF	May be applicable by 2020 to access EU funding
Projects to be elaborated during the Third Phase					
17.	Solar panels on buildings / airfields / camps	Installation of PV panels to buildings and open spaces within camps. (links with WG 2)	BE/NL (lead), BG, CY, DE, HU, IE, LT, LV, NL, SE.	ERDF[141], Interreg[142], CF[143], LIFE[144]	Moved from WG-1
18.	i.e. intelligent energy to gas	Combination of RES technologies (energy generation) with energy storage technologies (links with WG 2)	AT, DE, IT, SE.	ERDF, LIFE	WG-1 propose to merge it with RESHUB
19.	Monitor new and emerging technologies	The renewable energy technology sector is undergoing rapid development and innovation. CF SEDSS should ensure that it remains appraised of technological developments.	BE, BG, CY, EL, ES, FI, FR, HR, IT, PT, SI, UK.		
20.	Examine viability of mixed RES technologies in one installation	The intention in general is to assess the advantages and disadvantages of mixes of	BG, CY, EL, ES, FI, FR, HR, IT, PT, SI, UK.		

[141] ERDF: European Regional Development Fund (the main ESIF).
[142] Interreg: Cross-border and transnational share of athe ERDF.
[143] CF: Cohesion Fund (ESIF). Only for BG, CY, CZ, EE, HL, HR, HU, LT, LV, MA, PL, PT, RO, SI, SL.
[144] LIFE: EU Programme for projects related to water, waste, energy, circular economy, chemicals (incl. REACH), noise, emissions, etc.

		renewable energy sources and technologies, e.g. wind and solar, at a specific installation.			
21.	Examine feasibility of back up RES options for isolated locations	An investigation in to the extent to which renewable energy sources and technologies could be used as a back-up whole energy solution in isolated locations in the event that the main fossil fuel-based energy source would be unavailable.	BG, CY, EL, ES, FI, FR, HR, PT, SI. Observer[145]: IT		
22.	Development of communication standards for smart grids in military installations	An investigation in to developing a European defence standard for smart grids in military installations to ensure interoperability is achieved between equipment manufacturers and military users.	FR, SI.		
WG 3: Protection of Critical Energy Infrastructure					
Selected projects to be developed by May 2019					
	Title of the Project Ideas	**Short description of projects**	**Interested MS/Entities**	**IdentiFunding outcome**	**Remarks**
23.	SPEEDUS Formulation of standard procedure to estimate the dependency of large and complex civilian and military assets with regard to public services	Establish the dependencies between military assets and public services. The objective is to develop a methodology for estimating the level of dependency through metrics. It is expected that high dependencies will be identified and treated.	CY, FR, EL, FI, IT (Lead), SI. **Externals:** ENEA Casaccia Research Centre, University of Cyprus (UCY) Observer: PT	SRSP, ERDF, CF, LIFE	
24.	Establishing energy resilience for military sites through standardization and sustainable development - Establishing the energy autonomy and resilience of the defence sector through the sustainable development	Establish camp energy autonomy and resilience. The objective is to develop a micro-system for optimized use on energy. This will enable the smart use of energy as part of camp management.	CY, IT, FI & FR (Lead TBC). **Observers:** SI. **External:** CH	ERDF, CF, LIFE	May be applicable by 2020 to access EU funding

[145] Observer means that the MoD experts would like to follow the project development but without any commitment for contribution.

	and collaboration with the civilian sector				
25.	REMARC: Resilience enhancement of military sites through a continuous risk analysis of regional critical infrastructure: decision support systems (DDS) for resilience enhancement and risk forecast of large scale (urban, regional) critical infrastructures systems (defence, civilian) with an "all hazard" perspective, by considering new systemic and societal vulnerabilities	Development of a decision support system based on constant monitoring and data collection. The objective is to collect data through monitoring related to environmental effects and simulate scenarios. Simulations will produce the critical scenario and will update it based on monitoring.	BG, IT (Lead). **Observer** IT, SI. **Externals:** CH, ENEA	Funding is based on follow-up of SPEEDUS	
26.	Situation awareness system for systemic decision support - Enhanced situation awareness based on behaviour analysis, machine learning, advanced sensing techniques and platforms. Interoperability, reuse of existing systems –common operational picture for all stakeholders (defence, civil)	Utilise GPS and remote sensing data for near real time monitoring. The objective is to develop a platform for real time data recording and processing related to behaviour analysis, machine learning etc. The added value will be the use of GPS and remote sensing data for near real time data collection, which is very limited at the moment.	MS in lead TBD. RO, UK **External** CH	SRSP	May be a work package within SPEEDUS application to SRSP
27.	Military camp study (energy production and consumption onsite, micro grid/closed system, defence focus, combine with other smart technology)	Develop a micro-grid for optimized camp management of energy resources and thus enhancement of camp resilience. The objective is to develop the micro-grid/closed system with highly optimized facilities which is a demanding technological objective. Added value: Ensuring energy autonomy of military camps or bases through optimisation. (Possible links with WG 1 and WG 2)	CY, FR, IE (Lead). **Observers:** AT, EL, PL, PT, SI **External** CH	ERDF, ESF, Erasmus+, LIFE SRSP	May be applicable by 2020 to access EU funding

Projects to be elaborated during the third Phase					
28.	Risk management through enhanced situation awareness for the detection and mitigation of combined cyber- physical – hybrid threats	Examine the applicability of scenario-based and resource-based approach for risk management of hybrid threats. The objectives are a) to identify scenarios with specific probability of occurrence based on historic data and b) identify critical resources as pillars and examine the impacts from their losses. This project is expected to enable the development of an innovative approach for resource-loss risk assessment for critical energy infrastructure against hybrid threats.	BG, CY (Lead), SI. **Observer:** EL **Externals** Cyprus University of Technology -CUT, EDP	ERDF, Interreg, CF, LIFE	Will be covered in the paper for the Hybrid threats

Note: In addition to these project ideas, the CY MoD proposed the development of Military Energy Communities (MEC) to Combat Power Security Risks in Critical Energy Infrastructure as a cross-cutting idea. This idea will be further explored during Phase III.

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EUROPEAN DEFENCE AGENCY

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