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Copernicus for Energy Guidelines

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European Union Agency for the Space Programme

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FOREWORD

Europe's energy sector is changing fast. More solar, wind, hydro and other renewables are being built to cut carbon and meet climate goals. At the same time, energy companies must deal with risks from extreme weather, climate change, and growing demands on the grid. To succeed, the sector needs reliable environmental information that supports good decisions at every stage, from planning new projects to running existing assets.

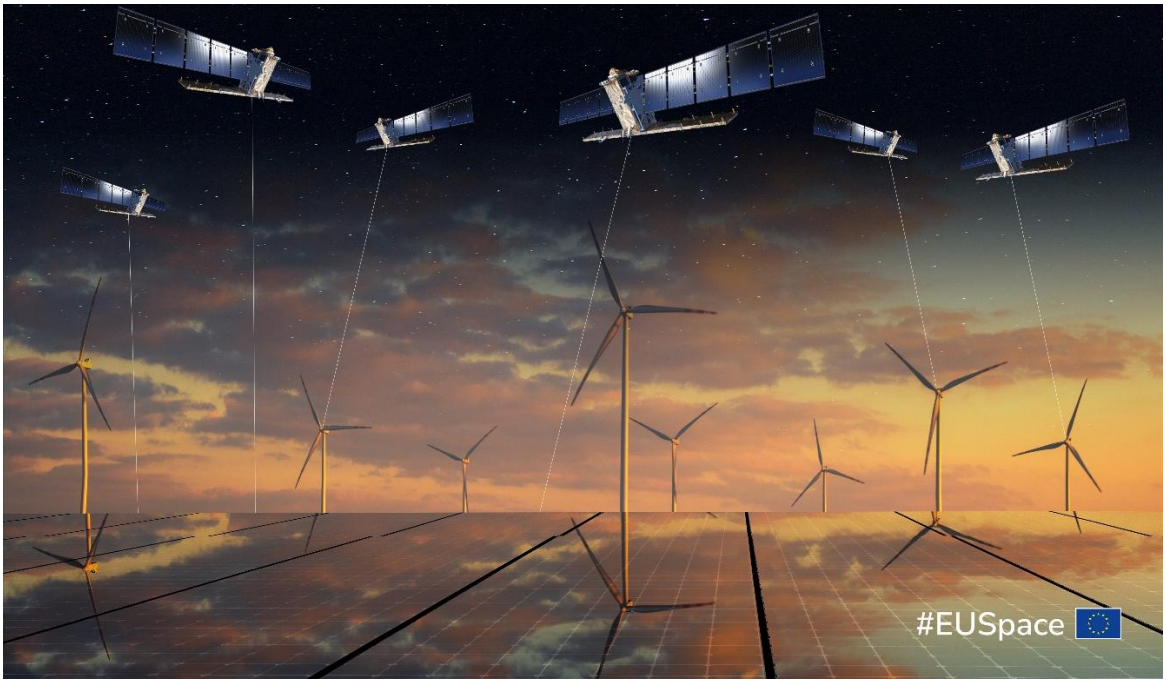
Copernicus, Europe's Earth Observation programme, provides exactly this. Through a combination of free satellite data (Sentinels) and specialised services (C3S, CAMS, CMEMS, CEMS, CLMS), Copernicus delivers consistent and trusted data on the atmosphere, land, oceans, and climate. This data is already used by energy companies to find the best locations for solar and wind farms, to forecast renewable energy production, to plan offshore maintenance, to protect infrastructure from floods and fires, and to meet environmental rules.

Key takeaways

- Practical value today: Copernicus is already helping energy operators, investors, and planners in real projects.
- Free and open: The datasets are freely available, making them cost-effective to use, especially for early assessments and planning.
- Wide coverage: Global, long-term data means that Copernicus can support both local site studies and large-scale planning.
- Better decisions: When combined with local measurements and commercial data, Copernicus improves forecasts, reduces risks, and supports compliance.
- Capacity to grow: Training, support networks, and service providers make it easier for energy users to start using Copernicus data and scale up over time.

Why Copernicus matters for the energy industry

The energy transition depends on smart, informed choices. Copernicus helps the industry reduce uncertainty, cut costs, and build confidence with regulators, investors, and the public. By using this free and reliable European resource, energy companies can improve performance today while also preparing for the climate and energy system of tomorrow.



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1 INTRODUCTION

1.1 EUSPA and the EU Space Programme

The European Union Agency for the Space Programme (EUSPA) is the agency in charge of implementing the European Union (EU) Space Programme with the aim of providing reliable, safe and secure space-related services to users. EUSPA's mission is to be the user-oriented operational Agency of the EU Space Programme, contributing to sustainable growth, security and safety of the European Union. In the execution of its mission, EUSPA counts on strong partnerships with the European Commission, European Parliament, Member States, European Space Agency, and private actors across the EU.

Figure 1: Overview of EU Space Programme.

The EU Space Programme consists of various components, including Earth Observation (EO - Copernicus), Global Navigation Satellite Systems (GNSS – Galileo and EGNOS), Space Situational Awareness (SSA) and (governmental) Satellite Communications / connectivity (SatCom – GOVSATCOM and soon IRIS2) as its main parts. All of these elements can provide extremely useful insights and applications, for example for regions where ground access can be difficult or impossible to achieve.

1.2 Copernicus and the Energy sector

The renewable energy sector is growing fast, with wind, solar, hydro, tidal and other clean sources playing a bigger role in meeting Europe's energy needs. At the same time, companies face new challenges: protecting infrastructure from increasing climate risks such as floods, droughts or wildfires, dealing with an overcrowded grid, planning the best sites for projects, or keeping assets running efficiently. To tackle these challenges, reliable information is needed, not only about today's conditions, but also about how they are likely to change in the future.

The Copernicus Programme, Europe's Earth Observation (EO) initiative, provides free and open data that can help. Its satellites and services deliver regular, consistent information on land, water, atmosphere and climate. For renewable energy, such data can:

- Map current physical climate risks,
- Plan new projects with risks in mind
- Optimize operations and maintenance activities
- Estimate resources more accurately
- Improve investment decisions with trusted environmental data
- Forecast energy production more reliably
- Monitor the environmental impact of energy projects

This guidelines document is written for renewable energy developers, utilities, investors, and other industry stakeholders who want to understand how Copernicus can support their work. It explains what Copernicus

is, shows how its data can be applied across the renewable energy value chain, and shares practical examples and lessons from past projects.

The goal is to make it easier for the renewable energy community to see where Earth Observation can add value, and how to get started with the tools, services and partners that are already available.

2 UNDERSTANDING EARTH OBSERVATION AND COPERNICUS

What is Earth Observation?

Earth Observation (EO) refers to the collection of information about our planet using satellites, airborne sensors, and ground-based systems. EO provides regular measurements of the Earth's surface, oceans, and atmosphere. For the renewable energy sector, EO is especially valuable because it delivers consistent, objective data across large areas, something that traditional surveys or local monitoring cannot always achieve.

The Copernicus Programme

Copernicus is the European Union's flagship EO programme. It was created to provide free and open access to reliable environmental data, supporting both public services and commercial applications. For energy stakeholders, Copernicus represents a powerful resource: it offers continuous coverage at European and global scale, high-quality datasets, and long-term archives for trend analysis.

Figure 1: Copernicus, with its network of satellites orbiting the Earth, acquires high resolution images and information about our planet. Credit: CNES

Sentinel Satellites

At the core of Copernicus are the Sentinel satellites. Each family of satellites has a specific role:

- **Sentinel-1** (radar imaging): useful for monitoring land movement, flooding, and infrastructure stability, providing high-resolution and frequent data every 6 days.
- **Sentinel-2** (optical imaging): provides high-resolution images every 5 days for land cover, vegetation, and solar project siting.
- **Sentinel-3** (ocean and land monitoring): delivers data on sea surface height, temperature, and water quality — relevant for offshore energy.

- **Sentinel-5** (atmosphere): measures air quality and atmospheric gases, important for solar energy modelling.
- **Sentinel-6** (altimetry): provides high-accuracy altimetry data for measuring global sea-surface height.
- **Future Sentinels** will expand coverage of CO_2 emissions, thermal observations, and other areas.

Copernicus Services

Beyond satellites, Copernicus includes six thematic services that process data into user-ready products. The most relevant for renewable energy are:

- **CAMS (Copernicus Atmosphere Monitoring Service):** provides solar radiation, aerosol, and atmospheric composition data and forecasts, essential for solar power projects.
- **C3S (Copernicus Climate Change Service):** offers climate projections and reanalysis (estimating weather conditions for each and every day over the past few decades as accurately as possible) datasets, supporting long-term planning and risk assessment. C3S also provides energy indicators derived from climate data. Thus, the products available for the energy sector include not only climate data but also derived energy products (e.g., capacity factors for wind, hydro, and solar, and proxy for energy demand in form of Energy Degree Days).
- **CMEMS (Copernicus Marine Service):** provides maritime information relevant for offshore energy developments and operations.
- **CEMS (Copernicus Emergency Management Service):** delivers flood and wildfire maps, useful for grid and hydropower risk management.
- **CLMS (Copernicus Land Monitoring Service):** provides land cover and land use data, supporting site selection and environmental assessments.
- **Security:** The Copernicus service for Security applications aims to support European Union policies by providing information in response to Europe's security challenges, including the mapping of strategic energy infrastructure.

Figure 2: Copernicus offers six thematic services. Credit: Copernicus

Why it matters for Renewable Energy

For renewable energy companies, Copernicus brings three key advantages:

1. **Cost savings**: the data is free, reducing the need for expensive commercial datasets.
2. **Consistency and Quality**: Copernicus data provides a standardised view across different regions and time periods, and is autonomously and independently quality controlled.
3. **Scalability**: companies can apply the same methods to local projects, national markets, or global portfolios.

In short, Copernicus delivers the environmental intelligence that renewable energy companies need to plan better, operate more efficiently, and manage risks with confidence. Take for example the Saharan dust phenomena: tracked by CAMS (**Figure 3**), allowing solar energy operators to anticipate drops in energy production and plan for maintenance/cleaning of assets. A more in-depth explanation of the EU Space Programme as a whole, including Copernicus, can be found here.

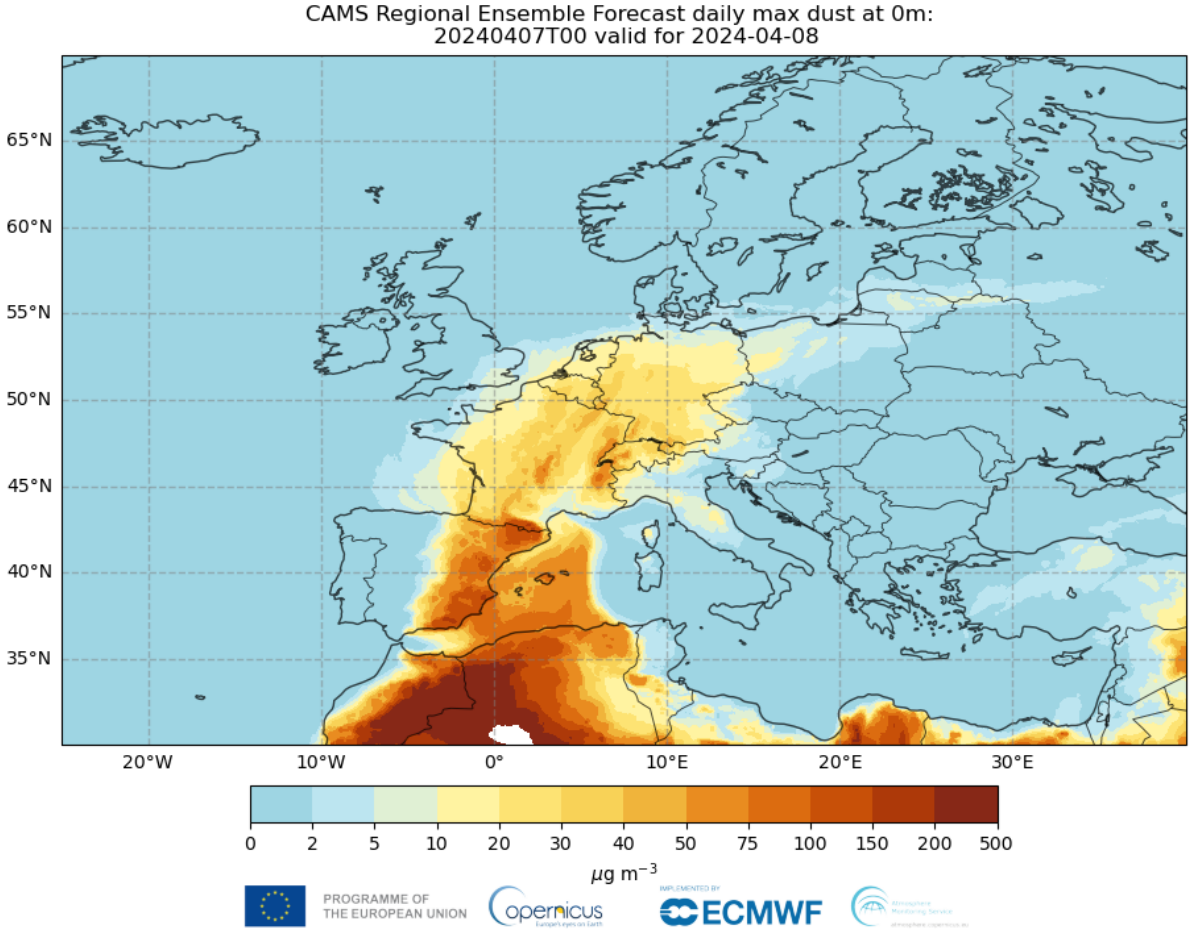


Figure 3: Saharan dust monitoring by the Copernicus Atmosphere Service

3 ENERGY PROCESSES THAT CAN LEVERAGE COPERNICUS

3.1 Energy Generation and Planning

Key processes supported by Copernicus

- Energy yield assessments and forecasts
- Site selection (including environmental assessments)

Site selection is one of the main challenges in energy infrastructure planning. Resource availability, grid accessibility and capacity, as well as environmental and regulatory constraints are key parameters impacting the development. These high impact processes usually fall on conservative approaches which utilise historical and often obsolete spatial datasets, many of which are unverifiable, or on extensive in-situ data gathering campaigns which are costly and time consuming. These processes add time to already lengthy process of site selection and infrastructure planning. The rising pressures on the commercial renewable energy sector and EU initiatives, such as REPowerEU, which defines Renewables Acceleration Areas for renewable energy deployment, as well as the Green Energy demonstrator by EUSPA, highlight the need to fast-track procedures. To meet this need, stakeholders in the energy sector are increasingly adopting Copernicus data and services to support faster and more robust decision making[1].

For solar, the Copernicus Atmosphere Monitoring Service (CAMS) provides information on solar irradiance, aerosols, and cloud cover, which is crucial for estimating plant output and for long-term resource assessment.

For wind, Sentinel-1 radar data can monitor offshore wind conditions, supporting both site selection and turbine layout design.

Offshore wind, tidal, and wave projects can leverage the information of the Copernicus Marine Service (CMEMS), which provides data on waves, currents, and sea surface temperature, key data points for site selection and yield assessments.

For biomass, Sentinel-1 and Sentinel-2 data, combined with ground truth information, support the estimation of fuel availability and strategic resource planning. They also enable planners to target specific invasive alien plant species, thereby simultaneously supporting biodiversity.

Hydropower operators can benefit from the Copernicus Climate Change Service (C3S) and Copernicus Emergency Management Service (CEMS), which offer information on snow cover, streamflow, drought, and floods, all key drivers of water availability.

With consistent long-term datasets and near-real-time updates, Copernicus reduces uncertainty in energy yield assessments, improving project bankability and investor confidence. Furthermore, the C3S ERA5 reanalysis provides valuable data for assessing climate resources across all renewable energy sources.

[1] European Union Agency for the Space Programme (EUSPA). 2024. *EO and GNSS Market Report, Issue 2*. Prague: EUSPA.

Copernicus is also increasingly useful for **meeting regulatory requirements**, including the assessment of environmental and biodiversity impacts, some of the key regulatory requirements faced by developers, which often add significant complexity to project deployment. Environmental consultancies combine traditional fieldwork with Copernicus data to improve both the efficiency and accuracy of their assessments. Typical applications include land use and land cover change monitoring, habitat suitability assessment and ecosystem health monitoring. By integrating Copernicus data and products, consultancies can deliver assessments that are both more robust and fully aligned with the regulatory framework.

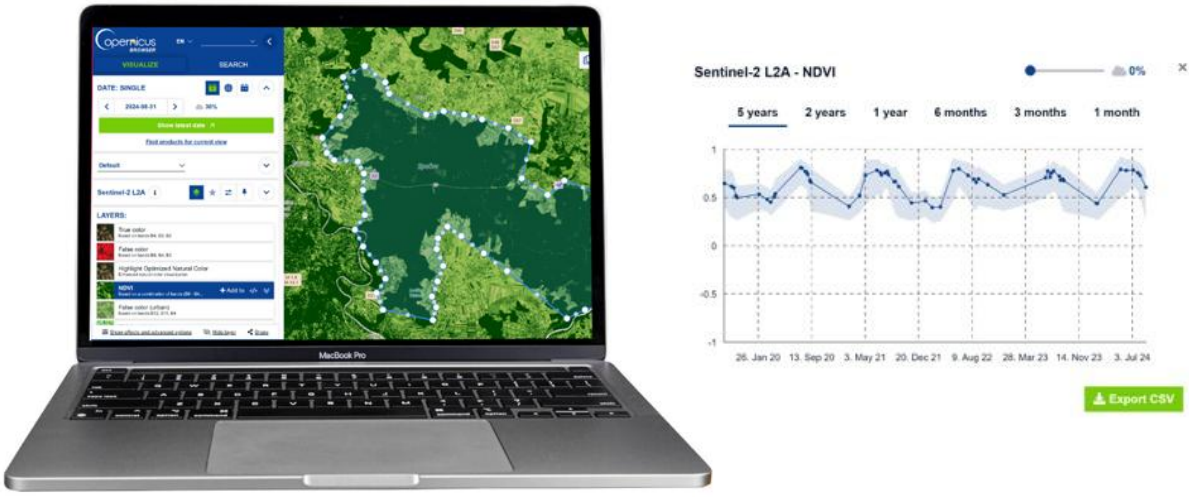


Figure 4: Sentinel-2 multispectral data derivative for forest ecosystem health monitoring – available through the Copernicus Data Space Ecosystem

3.2 Operations and Maintenance

Key processes supported by Copernicus

- Solar PV nowcasting (from the present to six hours ahead) for grid balancing/curtailment operations
- Identification of maintenance windows for offshore installations

Accurate weather and environmental data enable the efficient operations and maintenance of various energy assets.

Solar PV installations rely on short-term forecasts (nowcasting) of the energy production using irradiance, aerosols, cloud cover, and water column data to optimise scheduling and support grid balancing (e.g. through curtailments). CAMS is a key source for such data[2], as illustrated in **Figure 5** a nowcasting model powered in part by CAMS.

[2] CAMS and NWP solar radiation forecasts are both freely available and there is a quarterly EQC report that looks at their performance. The previous annual reports can be found here

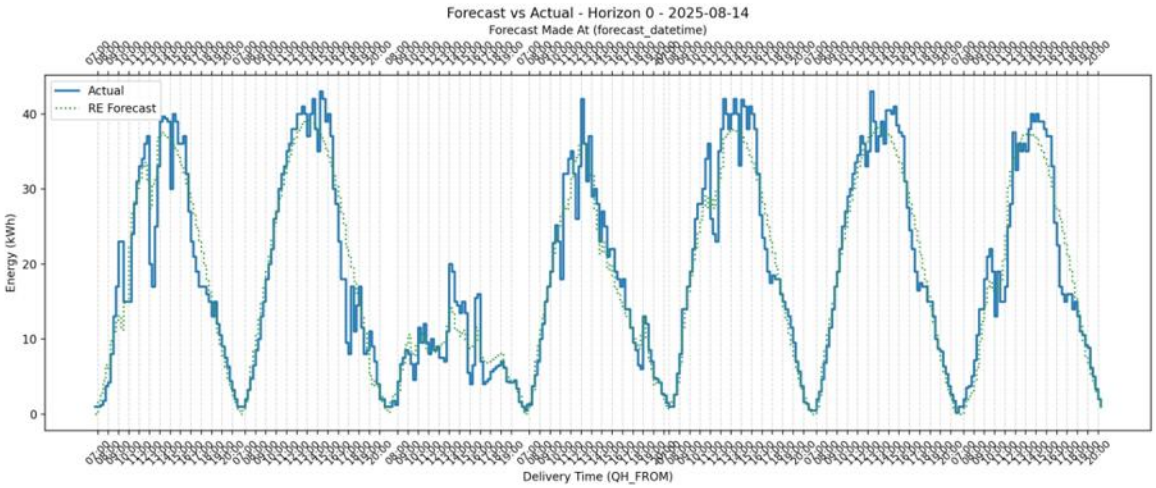


Figure 5: Nowcasting (every 15 min) of solar PV site power generation plays a major role in grid balancing operations through curtailment

Data from the Copernicus Marine Service help offshore wind park developers assess accessibility of potential sites, as both crew transport and heavy lift vessels have strict operating limits linked to wave height. Additionally, for wind parks in operation, Copernicus supports the planning maintenance activities based on sea state (wave height) and weather (including likelihood of lightning). This is highly critical information as there are great risks to crews and potential losses that can range from €2-3 million per hour. Choosing to send a maintenance crew (or not) needs to be based on highly accurate and reliable information.

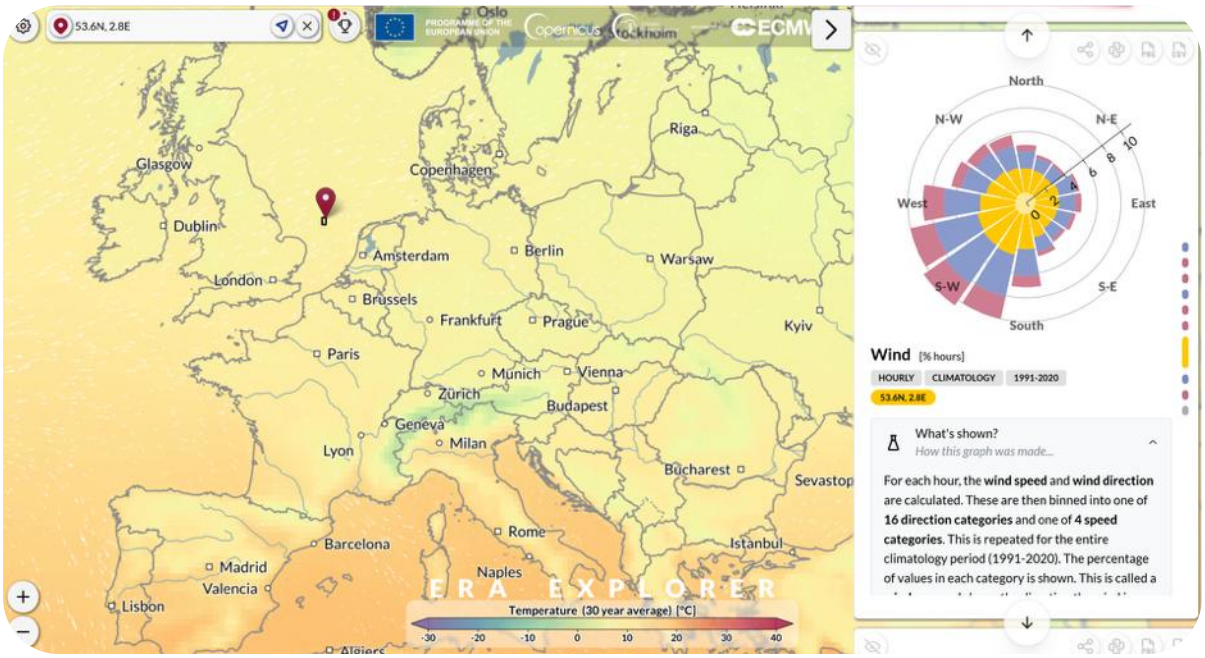


Figure 6: ERA5 data on the average wind speed and direction in the North Sea in the period 1991-2020 – Available through the C3S, Climate Data Store and the ERA5 Explorer

3.3 Distribution and Grid Management

Key processes supported by Copernicus

- Physical risk assessments (floods/fires)
- Grid balancing with decentralised PV generation
- Third party interference/construction detection
- Increase the resilience of energy systems and optimize their performance in response to climate change
- Improvements of solar energy park management

Electricity grids face challenges from decentralised generation (like rooftop PV), increasing extreme weather risks, climate change and third-party interferences (e.g. constructions). Copernicus can help in these areas.

Figure 7: High-, medium-, and low flood risk zones identified around grid infrastructure using Copernicus data

For grid operators, CEMS provides flood, wildfire, and drought monitoring, supporting physical risk assessments of existing infrastructure, as well as the planning of future expansions.

Furthermore, to address the issue of irregular electricity demand due to the production of local (often rooftop-mounted) PV installations, which are highly weather-dependent, grid operators can rely on production forecasts that (similar to the nowcasting case above) predict how much electricity will be generated in the next minutes/hours. This provides important insight into how much load their grid will be under, and how much additional spare capacity (or margins, i.e. electricity resources that can be deployed within 15 min, such as traditional gas plants) is required to keep up with sudden demand peaks. Understanding PV-induced demand peaks and drops enables the grid operator to more efficiently plan this spare capacity, potentially saving thousands of euros in spare capacity contracts.

Sentinel-2 imagery can also broadly detect potential construction activities near high voltage overhead lines, which can be validated by the operators to take the required steps to ensure compliance. Due to the global coverage of the Sentinel-2 satellites, and the frequent data (every 5 days), the satellites provide freely accessible data useful for early warnings/alerts

across entire infrastructures, which then can be further validated through in-situ inspections or very high-resolution commercial data.

To enhance the resilience of energy systems and optimize their performance in the face of climate change, the C3S has closely cooperated with the European Network of Transmission System Operators for Electricity (ENTSO-E) to develop relevant products and services. This collaboration led to the creation of the Pan-European Climate Database (PECD) — the first of its kind to incorporate climate change projections. The PECD provides energy analysts, planners, and decision-makers with essential information to support long-term energy planning and adaptation strategies. ENTSO-E uses this dataset as a key input to its European Resource Adequacy Assessment (ERAA). The downstream use of PECD by ENTSO-E is further detailed here.

Moreover, CAMS solar radiation data enables efficient management and monitoring of solar energy parks with diverse infrastructures. By integrating CAMS into the analytics platform, you can accurately benchmark energy production, detect and analyse outages, and reliably interpret performance issues—even for systems without local irradiation sensors.

3.4 Matching Energy Processes to Copernicus Data and Services

The below table helps understand at a glance, which Copernicus services and Sentinel data may be relevant for your use case.

	Energy Generation and Planning	Operations and Maintenance
Solar	CAMS, C3S, CLMS, Sentinel-5(P)	CAMS, C3S, CLMS, Sentinel-5(P)
Wind	C3S, CLMS, Sentinel-1, -2	C3S, Sentinel-1
Offshore	CMEMS, C3S, Sentinel-1, -3, -6,	CMEMS, C3S, Sentinel-1, -3, -6
Hydro	C3S, Sentinel-1, -2	Sentinel-1, -2
Grid	CAMS, C3S, CEMS, CLMS	CAMS, C3S, CEMS, CLMS
Biomass	Sentinel-1, -2	Sentinel-1, -2

Figure 8: Energy sources and processes linked to relevant Copernicus data and services

4 BEST PRACTICES AND CASE STUDIES

4.1 Energy Generation and Planning

Zadar County, Croatia	 	Land Monitoring
Challenge	Unrestricted renewables siting risks biodiversity loss, habitat fragmentation, landscape degradation, and land-use conflicts, leading to long permitting delays, public opposition, or project cancellation.	
Solution	• The Energy Institute Hrvoje Požar (EIHP) in partnership with The Nature Conservancy (TNC) provided integrated sensitivity mapping. • They combined solar/wind resource potential with environmental, social, and land-use data, including CORINE Land Cover, used to assess ground-mounted solar PV impacts on natural resources and the effects of land cover change.	
Impact	Copernicus CLMS provides key inputs to make the required trade-offs when siting new wind and solar assets. Integrated sensitivity mapping combining Copernicus data reduces permitting delays and help avoid costly project cancellations by enabling better biodiversity risk assessments.	
LEARN MORE		

mocean energy		Copernicus Marine Service
Challenge	Wave Energy Converters (WECs) must be optimised for specific wave climates, making site selection and survivability analysis critical.	
Solution	• Mocean Energy calculates average power production, power availability, and survivability. • Applies numerical modelling, prototyping, and testing to fine-tune WEC performance for real-world conditions.	
Impact	Copernicus Marine Service's wave reanalysis datasets are key inputs to make the required site selection analyses and optimize wave energy converter design, improving power production accuracy and device survivability.	
LEARN MORE		

Raiffeisen Bank		Atmosphere Monitoring Climate Change
Challenge	Unrestricted renewables siting risks biodiversity loss, habitat fragmentation, landscape degradation, and land-use conflicts, leading to long permitting delays, public opposition, or project cancellation.	
Solution	• CAMS and C3S data support a solar yield estimation tool developed by ARMINES and Evenflow in collaboration with EUSPA. • CAMS solar radiation data and C3S ERA5 reanalysis (temperature, wind speed) to forecast PV system output. • Financial model assesses ROI by combining CAPEX, OPEX, subsidies, financing options, and market variables.	
Impact	The accuracy and historical availability of the data made available by Copernicus help financial institutions trust solar PV assessments, supporting their bankability, resulting in better financial modelling.	
LEARN MORE		

4.2 Operations and Maintenance

luminus		Atmosphere Monitoring
Challenge	PV asset owners need to inform the utility company of their up- and downward production flexibility, so their assets can be remotely curtailed to support a balanced grid.	
Solution	• Reuniwatt provides a 15-minute nowcasting service for PV assets of Luminus' clients. • The technology considers solar irradiance, near-real-time cloud cover, water column data, and other variables.	
Impact	PV asset managers can provide accurate production estimations and be considered a 'reliable asset' on the grid. Providing 15-minute solar production forecasts enables utilities to improve grid stability and reduce penalty costs for energy imbalances.	

gruner		Climate Change
Challenge	Hydropower operators must assess and prepare for extreme flood events to ensure dam spillways are up to the task.	
Solution	• GECOsistema's platform, powered by C3S data, analyses flood probabilities and intensities. • Hydrological Insights: Compare the average daily discharge in m3/s of a flood event for different climate scenarios. • Flood mapping: the Copernicus-provided digital elevation model powers downstream flood maps.	
Impact	Copernicus provides insights on water discharge and allow hydropower operators to make flood impact assessments (especially useful in data-sparse regions). Flood risk mapping powered by C3S data allows hydropower operators to make informed spillway decisions, reducing potential downtime from extreme events.	
LEARN MORE		

SCOTTISHPOWER		Climate Change
Challenge	Offshore wind Operations and Maintenance (O&M) is hindered by unpredictable metocean (weather and ocean) conditions.	
Solution	• The ForeCoast® Marine product by JBA Consulting is a comprehensive metocean risk management tool, powered by ERA5 hindcast data. • Manage live metocean risks during the installation process (Wikinger offshore windfarm). • Explore the impacts of different installation and O&M strategies on project financials and health and safety considerations (East Anglia ONE site).	
Impact	Copernicus enables the retrieval of hourly meteorological and oceanographic data around the world, streamlining offshore weather downtime analysis. ERA5-driven metocean risk management cut offshore maintenance delays and health risks, saving millions in operational costs.	
LEARN MORE		

Challenge	Tracking the construction start and progress of dozens of large solar installations per year requires a lot of manpower.	
Solution	• Sentinel-2 data, with its high data frequency and resolution, can be used to detect the start and progress of large solar plants. Very high resolution (commercial) data can provide additional insights.	
Impact	Copernicus enables automated tracking of solar asset construction start and progress without manual intervention (on-site audits), lowering monitoring costs significantly.	

4.3 Distribution and Grid Management

Challenge	i-DE wants to identify non-compliant constructions near powerlines and get notified of new construction activity.	
Solution	• NEO's solution SignalEyes leverages a patented technology that automatically detects changes along powerlines. • Uses Sentinel-2 data to spot anomalies & triggers purchase of very high-resolution data only when needed.	
Impact	Highly cost-efficient infrastructure monitoring by leveraging free and open Copernicus data. Timely detection of unauthorized construction near powerlines using Sentinel-2 data improves regulatory compliance and avoid costly infrastructure damage.	
LEARN MORE		

Rte Le réseau de transport d'électricité		Atmosphere Monitoring, Climate Change
Challenge	Grid operators lack reliable production readings for a large part of the connected solar PV assets, impacting grid stability.	
Solution	• ARMINES provides a "Solar Radiation as a Service" solution powered by CAMS and C3S data • Platform provides on-the-fly computations of intra-day irradiation and PV output.	
Impact	Increased solar power forecast accuracy reduces reliance on reserve margins on the grid, resulting in significant cost savings.	
LEARN MORE		

enel		Emergency Management, Land Monitoring
Challenge	Enel Grids requires effective risk analysis to mitigate the growing threats of wildfires and floods to its electrical infrastructure.	
Solution	• Planetek's solution provides vulnerability and risk identification around electrical infrastructure. • Flood and fire risk (low, medium, high) maps generated around key infrastructure.	
Impact	Copernicus provides key inputs to map physical risks, enhancing infrastructure risk mitigation and planning activities, lowering outage risks and repair costs.	
LEARN MORE		

5 GETTING STARTED WITH COPERNICUS

For many companies in the energy sector, the first question is not **if** Earth Observation (EO) data could add value, but how to begin using it in practice. Copernicus offers a wealth of free and open resources but making the most of them requires clarity on objectives, an understanding of available support, and connections with the right service providers or tools to build in-house expertise.

Step 1. Visit the Copernicus Energy Hub

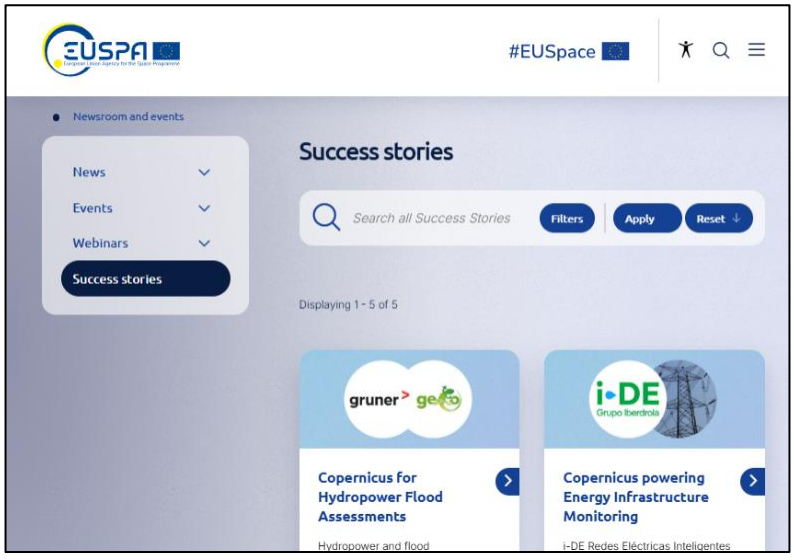
The first step for any energy stakeholder is to visit the [Copernicus Energy Hub](). This portal acts as the central entry point for information, datasets, and tools specifically tailored to the energy community.

Figure 9: The Copernicus Energy hub provides an overview of relevant Copernicus products

It provides an overview of available resources, explains the role of Earth Observation in the energy sector, and connects users directly with examples, data sources, and guidance documents.

Step 2. Explore use cases on the Energy Hub and EUSPA's website

Once familiar with the Hub, the next step is to **explore the use cases** showcased both there and on EUSPA's website. These real-world examples demonstrate how other companies, utilities, and agencies have already used Copernicus to improve energy planning, operations, and risk management. They cover applications across the value chain, such as renewable resource assessment, grid management, and climate adaptation planning.



By examining cases you can understand the **practical benefits** of Copernicus and avoid "reinventing the wheel." Many of the challenges described will resonate with your own experiences, while the documented solutions illustrate what kinds of insights and business value Copernicus can deliver.

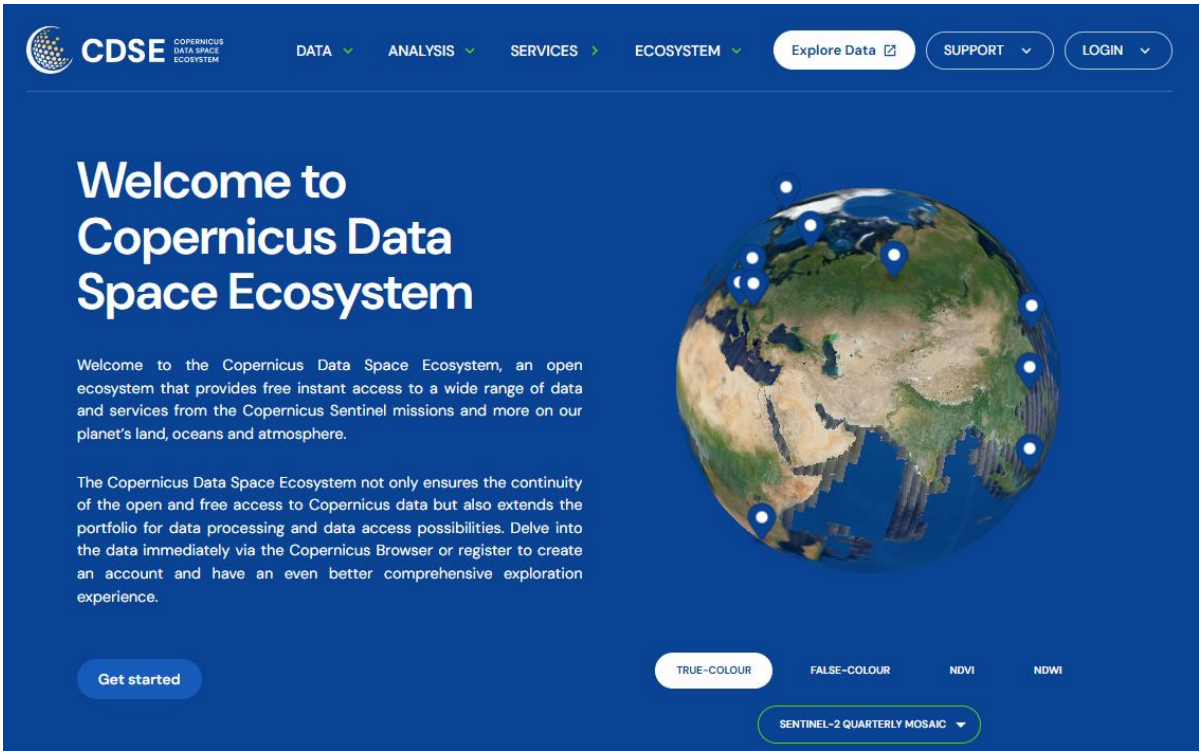
Step 3. Identify your objective business challenge

After gathering inspiration, you should clearly define your business challenge. This step is crucial: without a well-framed problem, the wide range of available data may seem overwhelming. Challenges could range from siting a new solar farm, improving offshore maintenance scheduling, forecasting renewable energy output, to managing wildfire risks for power lines.

A precise challenge statement allows you to match Copernicus resources to specific decision points. For example, an operator concerned about flood risk to substations will look to CEMS data, while a developer planning a new wind farm should explore C3S datasets or Sentinel-1 data for wake assessments. This step bridges the gap between abstract possibilities and concrete, operational needs, ensuring that subsequent engagement with data and partners is efficient and targeted.

Step 4. Identify and explore the relevant Copernicus data

With a challenge defined, the next step is to explore which Copernicus datasets and services are most relevant. Copernicus offers an extensive portfolio: satellite imagery from Sentinel missions, reanalysis and forecasts from C3S, atmospheric radiation data from CAMS, and hazard mapping from CEMS, among others. The Energy Hub and linked portals (e.g., Climate Data Store, Atmosphere Data Store, Marine Data Store) make these resources accessible.



At this stage, energy stakeholders should consider whether to access raw datasets directly or to work with intermediaries (such as service providers) that transform them into ready-to-use products. For many companies, starting with pre-processed information (like solar yield forecasts or flood risk maps) provides immediate value, while direct engagement with raw data may come later as in-house capacity grows.

Step 5. Engage with Copernicus

To move beyond exploration, you can consider actively engaging with Copernicus through organisations such as EUSPA or the "Entrusted Entities" which manage Copernicus Services such as ECMWF (climate and atmosphere), Mercator Ocean International (marine), or EEA (land) using their contact forms. Engagement can take many forms: joining pilot projects, applying for innovation funding, or participating in matchmaking activities that connect energy companies with Earth Observation service providers.

By engaging directly, companies also contribute to shaping Copernicus services for the energy sector. Feedback from real-world users helps refine products, making them more aligned with industry needs. In

addition, formal engagement ensures that energy stakeholders are aware of upcoming initiatives, datasets, or programmes, positioning them to benefit from new developments as they arise.

Step 6. Join dedicated capacity building programmes and trainings

Finally, you can invest in capacity building to embed Copernicus into your operations sustainably. Copernicus offers a wide range of training opportunities, including MOOCs, webinars, workshops, and e-learning resources provided by C3S, CAMS, CMEMS, and other services. These trainings cover both technical aspects (e.g., how to use the Climate Data Store) and applied topics (e.g., solar forecasting, climate risk assessment for infrastructure).

Figure 10: EU Space Academy Learning Platform

Some valuable resources include:

- **EU Space Academy** provides a customisable online development programme on using space data, tailored to your goals. Modules include trainings, workshops, and 1-1 mentoring.
- **Copernicus MOOC (Massive Open Online Course):** Free online course introducing EO concepts, applications, and business opportunities, with modules relevant to energy.
- **Copernicus Services Capacity Building Resources**
  - **CMEMS** E-Learning Materials and Trainings/Workshops: Throughout the year the Copernicus Marine Service organises training sessions, working in close collaboration with scientific partners to improve user learning services.
  - **C3S** User Learning Services offers free training on the use of the Climate Data Store platform and its content, relevant for various energy applications.
  - **CAMS** Training Resources offer data tutorials, MOOCs, and training events.
- **EO College:** a learning platform by ESA and DLR (incl. Youtube Channel) for various topics related to the use of EO, remote sensing and image processing to help you gain practical knowledge.
- **NASA Applied Remote Sensing Training Programme:** Free online webinars and self-paced courses on EO applications (including energy).

Coursera Remote Sensing Courses: Paid but often free-to-audit courses covering fundamentals and data analysis.

6 RELEVANT COPERNICUS PORTALS

Portal / Service	Description
Copernicus Energy Hub	The **go-to resource** for understanding how Copernicus data and services can support the energy industry, outlining various relevant datasets and use cases.
Copernicus Data Space Ecosystem (formerly Copernicus Open Access Hub)	Main entry point for **Sentinel satellite data**, with cloud processing, APIs, and advanced search tools.
Climate Data Store **(CDS)**	Operated by **C3S**, providing **ERA5 reanalysis**, climate projections (CMIP5/6), and tailored sectoral applications (e.g. energy, water).
Atmosphere Data Store **(ADS)**	Portal for **CAMS datasets**, including solar radiation, aerosols, greenhouse gases, and air quality products.
Marine Data Store **(CMEMS)**	Access to **oceanographic data** (waves, currents, sea level, temperature, biogeochemistry) with ready-to-use services for offshore applications.
Emergency Management Data **(CEMS)**	On-demand maps and datasets for **floods, wildfires, and disasters**, supporting asset protection and resilience planning.
Land Monitoring Data **(CLMS)**	Provides **European and global land cover products**, vegetation indices, and thematic layers for site analysis and impact assessment.
EUMETCast Data	A **satellite-based dissemination service** offering continuous, near-real-time EO data, widely used by utilities and grid operators.

7 CHALLENGES AND CONSIDERATIONS

There are some key challenges that need to be considered by energy users looking to incorporate Copernicus in their workflows:

In-house development vs procurement

Energy companies must decide whether to build Copernicus-based solutions internally or procure them from specialised service providers. In-house development offers greater control and the ability to tailor tools to specific operational needs, but requires skilled staff, technical infrastructure, and higher upfront investment. Procurement, by contrast, allows for faster deployment and access to ready-made solutions, though it may limit flexibility and long-term ownership of methods.

Integration with existing energy modelling tools

A key challenge for energy users is integrating Copernicus data with their existing planning and operational tools. Many utilities and developers rely on established energy system models, grid operations software, or proprietary decision-support platforms. Copernicus datasets often come in scientific formats that require technical translation before they can be used within these workflows. Without dedicated integration efforts or customised interfaces, the potential of Copernicus may remain untapped.

Regulatory and bankability requirements in energy projects

In energy infrastructure, especially renewable generation and grid investments, regulatory approval and financing depend on robust, validated data. While Copernicus provides free and consistent datasets, investors and regulators often require high-resolution or site-specific measurements to certify “bankable” results. This means that Copernicus must usually be combined with ground-based (in-situ) data. For energy stakeholders, navigating these requirements is critical: failure to align Copernicus outputs with regulatory or financial standards can hinder project deployment.

Copernicus limitations

Copernicus data offers vital support for energy projects but has limitations including spatial resolution constraints that may miss fine-scale details, temporal latency affecting real-time decisions, and complexity in raw data processing. Atmospheric interferences like clouds can degrade data quality, and some specific datasets may be unavailable or delayed. To mitigate these issues, users should complement Copernicus data with high-resolution commercial sources, ground measurements, and integrated modelling. Utilizing pre-processed thematic products and investing in capacity building enhances usability and reliability, ensuring effective decision-making despite inherent constraints

Other considerations

Beyond technical and procurement choices, energy users should also consider the organisational aspects of Copernicus adoption. Large EO datasets demand adequate storage, cloud infrastructure, and staff trained in geospatial analysis. User training and awareness are essential so that outputs can be interpreted and integrated into business workflows. A common challenge is the operationalisation gap, where successful pilots fail to transition into routine processes without clear ROI or internal champions.

8 CONCLUSIONS

The renewable energy sector in Europe is expanding rapidly, but it faces significant challenges: planning new projects in a crowded landscape, ensuring resilience against climate risks, operating assets efficiently, and meeting regulatory requirements for environmental protection. Copernicus, with its combination of free Sentinel satellite data and specialised services (C3S, CAMS, CMEMS, CEMS, CLMS), provides a powerful toolkit to help address these challenges. By offering consistent, reliable, and openly accessible environmental intelligence, Copernicus supports energy stakeholders across the full value chain, from site selection and yield assessments, through operations and maintenance, to grid management and climate adaptation planning.

The case studies presented in this document illustrate how Copernicus data is already enabling real-world impact: supporting spatial planning to balance renewable deployment with biodiversity protection, providing accurate yield forecasts that underpin financial decisions, improving O&M strategies for offshore wind, enhancing flood and fire risk mapping for grid operators, and strengthening resilience in hydropower management. These examples demonstrate that Copernicus is not a theoretical tool, but a mature, operational resource delivering tangible value to commercial users today.

At the same time, adoption requires careful consideration. Companies must balance in-house development versus procurement from specialised service providers, integrate Copernicus data with in-situ measurements for validation, and evaluate trade-offs between free Copernicus datasets and higher-resolution commercial products. Organisational readiness (skills, infrastructure, and the ability to operationalise pilots) is just as important as technical capability.

Time for Copernicus!

Explore how Copernicus can strengthen your energy projects. Visit the Energy Hub, learn from existing use cases, and reach out to EUSPA to start a conversation about your specific needs. The sooner you engage, the sooner you can unlock the benefits of Europe's trusted Earth Observation programme!

CONTACT EUSPA

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EUSPA Mission Statement

The mission of the agency is defined by the EU Space Programme Regulation.

EUSPA's mission is to be the user-oriented operational Agency of the EU Space Programme, contributing to sustainable growth, security and safety of the EU. In the execution of its mission, EUSPA counts on strong partnerships with the European Commission, European Parliament, Member States, European Space Agency, and private actors across the EU.

The EU Agency for the Space Programme:

- Provides state-of-the-art, safe and secure positioning, navigation and timing services based on Galileo and EGNOS, cost-effective satellite communications services for EU GOVSATCOM and soon IRIS2, and Front Desk services of the EU Space Surveillance Tracking whilst ensuring the systems' service continuity and robustness;
- Promotes and maximises the use of data and services offered by Galileo, EGNOS, Copernicus, EU GOVSATCOM and soon IRIS2 across a broad range of domains.
- Fosters the development of a vibrant European space ecosystem by providing market intelligence, and technical know-how to innovators, academia, start-ups, and SMEs. The agency leverages Horizon Europe, other EU funding, and innovative procurement mechanisms.
- Implements and monitors the security of the EU Space Programme components in space and on the ground with the aim to enhance the security of the Union and its Member States. To do so, EUSPA operates the Galileo Security Monitoring Centre (GSMC).
- The EU Space Programme Security Accreditation Board is established within the Agency, representing the security accreditation authority for all of the EU Space Programme's components.

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