

USE-CASES – Smart and Resilient Energy Systems

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Table of Acronyms

AI	Artificial Intelligence
API	Application Programming Interface
APQ	Activity Pitch Questionnaire
CER	Critical Entities Resilience
DSO	Distribution System Operator
DTR	Dynamic Thermal Rating
EAM	Enterprise Asset Management
ENTSO-E	European Network of Transmission System Operators for Electricity
ESA	European Space Agency
EU	European Union
GIS	Geographic Information System
NIS2	Network and Information Security Directive 2
NWP	Numerical Weather Prediction
TSO	Transmission System Operator

INTRODUCTION

This document lists the use cases to be used as part of the “**Smart and Resilient Energy Systems**” thematic call. It aims at developing sustainable services leveraging space assets and technology to address key challenges and opportunities to develop operational solutions.

The use cases presented in this document have been derived from operational needs identified by ELES d.o.o., Slovenia's combined transmission and distribution system operator, and are intended to guide the development of innovative space-enabled solutions that improve the resilience, reliability, operational efficiency and situational awareness of electricity networks.

To support the development of integrated solutions and align with ELES's implementation priorities, the use cases have been grouped into three solution clusters:

- **Cluster A: Forecasting and Grid Operations**
Focusing on forecasting, balancing, optimisation, contingency planning, climate risk assessment and operational decision-making across electricity networks.
- **Cluster B: Dynamic Thermal Rating Enhancement**
Focusing on the enhancement of ELES's Dynamic Thermal Rating capability through improved environmental monitoring, forecasting and operational decision support.
- **Cluster C: Asset Intelligence, Digital Twin & Situational Awareness**
Focusing on asset intelligence, predictive maintenance, infrastructure monitoring, digital twin enhancement and situational awareness across electricity networks.

The use cases presented in this document are intended to illustrate key operational needs and opportunities rather than define an exhaustive set of solution areas.

The use cases within each cluster are complementary and may benefit from integrated solutions spanning multiple operational workflows.

Applicants are expected to develop integrated solutions addressing a complete solution cluster, while clearly identifying the individual use cases covered by the proposed solution. Proposals demonstrating broad applicability across transmission and distribution system operator activities and supporting end-to-end operational workflows are particularly encouraged.

When writing the initial proposal (APQ proposal), applicants shall identify the solution cluster addressed by the proposed solution and clearly indicate the associated use cases included within the proposed scope.

Table 1: Use Case Overview

Cluster	Use Case ID	Use Case
Forecasting and Grid Operations	A-01	Renewable Generation Forecasting
	A-02	Load Flow Prediction
	A-03	Contingency Planning for Unplanned Outages
	A-04	Cross-Border Scheduling & Balancing Coordination
	A-05	Seasonal & Long-Term Capacity Planning
	A-06	Climate & Weather Risk Mapping
	A-07	Strategic Outage Mitigation Planning
Dynamic Thermal Rating Enhancement	B-01	Dynamic Thermal Rating Enhancement
Asset Intelligence, Digital Twins, & Situational Awareness	C-01	Predictive Maintenance
	C-02	Asset Prioritisation
	C-03	Digital Twin Enrichment
	C-04	Natural Hazard Monitoring
	C-05	Infrastructure Condition Monitoring
	C-06	Emergency Situational Awareness
	C-07	Smart Grid Feasibility Study
	C-08	Cross-Domain Resilience Dashboards
	C-09	Obstacle & Encroachment Detection
	C-10	Vegetation & Corridor Monitoring

ELES

ELES is Slovenia's combined Transmission System Operator (TSO) and Distribution System Operator (DSO), responsible for the safe, reliable and uninterrupted transmission and distribution of electricity across Slovenia. ELES operates approximately 3,100 km of high-voltage transmission infrastructure, supports a distribution network exceeding 64,000 km, and manages electricity flows across multiple cross-border interconnections with neighbouring countries.

As the operator of critical national energy infrastructure, ELES is facing increasing challenges driven by climate change, the growing penetration of renewable energy sources, increasing operational complexity, and rising cyber-physical security risks. Extreme weather events such as storms, floods, wildfires, snow, icing and landslides are becoming more frequent and severe, while increasing levels of distributed renewable generation require more accurate forecasting, greater operational flexibility and enhanced network visibility.

ELES has identified a range of operational challenges where innovative space-enabled capabilities may contribute to improving the resilience, reliability and operational efficiency of electricity networks. These challenges span forecasting and grid operations, dynamic thermal rating enhancement, asset intelligence, infrastructure monitoring, digital twin integration and situational awareness and form the basis of the solution clusters presented in this document.

ELES is formally designated as a critical entity under the national implementation of the EU CER Directive, with mandatory obligations relating to risk assessment, business continuity planning, incident response and the implementation of resilience-enhancing measures. Space-enabled services have the potential to support these objectives by providing improved monitoring, forecasting, asset intelligence and operational awareness capabilities across the electricity network.

The use cases presented in this document have been derived from operational needs identified by ELES and are intended to support the development of innovative and commercially sustainable space-enabled solutions applicable to electricity network operators. While based on ELES's specific operational context, many of the challenges addressed are common across transmission and distribution system operators and have broader applicability across the European energy sector. Applicants are therefore encouraged to consider solutions with the potential for wider deployment across electricity networks facing similar operational and resilience challenges.

Cluster A: Forecasting & Grid Operations

Operational Context

ELES is responsible for maintaining the balance between electricity generation and consumption across Slovenia while coordinating power flows with neighbouring countries. These activities require continuous forecasting, planning and operational decision-making to support network stability, renewable energy integration, cross-border coordination and efficient utilisation of transmission infrastructure.

Electricity networks are becoming increasingly complex as renewable generation, weather dependency and cross-border power exchanges continue to expand. Network operators require improved forecasting, planning and operational decision-support capabilities to maintain system stability, optimise network utilisation and ensure the reliable integration of renewable energy sources.

Key operational activities include renewable generation forecasting, load-flow prediction, contingency planning, cross-border balancing coordination, seasonal and long-term capacity planning, climate and weather risk assessment, and outage mitigation planning to support both day-to-day operations and longer-term network resilience.

Current Solutions and Limitations

ELES currently relies on numerical weather prediction (NWP) models, renewable generation forecasts provided by market participants, historical consumption data, weather-corrected demand forecasting and existing operational coordination platforms. Load-flow analysis and cross-border coordination are supported through established operational tools and ENTSO-E processes.

Whilst these capabilities support daily operations, forecasting accuracy remains constrained by limitations in the spatial and temporal resolution of available environmental data, particularly in Slovenia's complex Alpine terrain. Forecast errors can propagate into balancing decisions, congestion management, outage planning and operational coordination activities. Renewable generation forecasts may also be provided with insufficient granularity or timeliness for real-time operations, while weather and climate risk assessments may lack the resolution required to support corridor-level planning and resilience activities.

As renewable penetration increases and weather-related operational risks become more significant, these limitations can contribute to higher balancing costs, reduced operational efficiency, increased outage risk and reduced network resilience.

Cluster A Requirements

The following common requirements apply across the use cases within this cluster. They reflect ELES's need for operationally usable forecasting, planning and decision-support capabilities that improve grid operation, balancing, resilience planning and infrastructure utilisation.

Functional Requirements

- Renewable generation and operational forecasting capabilities.
- Load-flow prediction and congestion analysis.
- Scenario-based contingency planning and decision-support capabilities.
- Forecast uncertainty quantification and probabilistic forecasting.
- Cross-border operational planning, balancing and coordination support.
- Climate and weather risk assessment capabilities.
- Strategic outage mitigation and resilience-planning support.
- Support for seasonal, long-term and capacity-planning activities.
- Integration of forecasting outputs into operational decision-making processes.

Performance Requirements

- Forecast update frequency of at least 15 minutes for intra-day operational activities where applicable.
- Forecast horizons of at least 72 hours for operational planning activities, with longer planning horizons supported where relevant.
- Spatial resolution sufficient to support forecasting, planning, climate-risk assessment and resilience activities at generation asset, network and corridor level.
- System latency of less than five minutes from data acquisition to operational display for time-critical operational applications.
- Support for seasonal, quarterly, half-year and annual planning horizons where relevant.

Integration Requirements

- Integration with existing operational, balancing and control-room environments.
- Compatibility with relevant electricity-sector and data-exchange standards.
- Integration with forecasting, planning, risk-management and network-management systems.
- Support for the integration of multiple environmental, operational and geospatial data sources where relevant.

Non-Technical Requirements

- Compliance with relevant electricity-market, operational and regulatory requirements.
- Operational continuity and service reliability suitable for operational decision-making.
- Predictable and sustainable operational cost models.
- Clearly defined licensing and intellectual-property arrangements.
- Compliance with applicable cybersecurity requirements.
- Appropriate training, knowledge-transfer and capability-development activities supporting the long-term operation, maintenance and evolution of delivered capabilities.

Cluster A Use Cases

A-01: Renewable Generation Forecasting

Description:

The increasing penetration of weather-dependent renewable energy sources requires network operators to continuously balance electricity generation and demand while maintaining system stability. Accurate short-term forecasting of solar and wind generation is essential for operational planning and renewable integration.

Solutions should improve the ability of network operators to forecast renewable generation, reduce forecast uncertainty and support balancing activities across electricity networks.

Example Capabilities:

- Short-term solar and wind generation forecasting.
- Satellite-enhanced irradiance and weather forecasting.
- Renewable generation prediction with uncertainty estimation.
- Support for balancing and renewable integration activities.

A-02: Load Flow Prediction

Description:

Growing network complexity and increasing renewable penetration require improved visibility of future network conditions. Network operators need to anticipate congestion and stability risks before they impact system operations.

Solutions should improve the ability of network operators to forecast load flows, identify emerging constraints and support operational decision-making.

Example Capabilities:

- Network load-flow forecasting.
- Identification of congestion risks and network constraints.
- Stability and operational risk assessment.
- Support for operational planning and network optimisation.

A-03: Contingency Planning for Unplanned Outages

Description:

Weather-driven generation variability and changing operating conditions can increase the risk and impact of network disturbances. Network operators require improved forecasting capabilities to anticipate potential disruptions and prepare effective mitigation measures.

Solutions should improve operational preparedness through enhanced forecasting, risk assessment and scenario analysis capabilities.

Example Capabilities:

- Weather-driven contingency forecasting.
- Probabilistic scenario analysis.
- Operational risk assessment.
- Support for outage mitigation and continuity planning.

A-04: Cross-Border Scheduling and Balancing Coordination

Description:

Cross-border electricity exchanges play a critical role in maintaining system stability and balancing electricity supply and demand. Accurate forecasting is required to support coordination with neighbouring system operators and regional electricity markets.

Solutions should improve operational awareness and forecasting capabilities supporting cross-border scheduling, balancing and coordination activities.

Example Capabilities:

- Cross-border generation and demand forecasting.
- Balancing support across interconnected networks.
- Exchange capacity planning and optimisation.
- Support for regional operational coordination.

A-05: Seasonal and Long-Term Capacity Planning

Description:

Increasing renewable penetration and changing network utilisation patterns create new planning challenges for electricity network operators. Effective capacity planning is required to support maintenance scheduling, infrastructure utilisation and future network development.

Solutions should improve seasonal and long-term planning activities through enhanced forecasting and scenario analysis capabilities.

Example Capabilities:

- Seasonal and long-term forecasting.
- Maintenance outage planning support.
- Capacity planning and optimisation.
- Renewable integration scenario analysis.

A-06: Climate & Weather Risk Mapping

Description:

Floods, snow, icing and severe weather events can have significant impacts on electricity infrastructure and network operations. Current methods rely on meteorological information, GIS tools and resilience studies to assess these risks and support emergency preparedness activities.

Solutions should improve the generation of high-resolution risk maps and provide better visibility of weather-related risks affecting substations, transmission corridors and other critical infrastructure.

Example Capabilities:

- Flood risk mapping for substations and transmission corridors.
- Snow and icing exposure assessment.
- Severe weather and storm impact analysis.

A-07: Strategic Outage Mitigation Planning

Description:

Increasing climate variability and weather-related disruptions are creating new challenges for long-term network resilience and outage management. Network operators require improved understanding of future risks to support operational and infrastructure planning activities.

Solutions should improve the ability of network operators to anticipate, assess and mitigate seasonal and climate-driven outage risks.

Example Capabilities:

- Weather and climate risk forecasting.
- Assessment of infrastructure exposure to future hazards.
- Strategic outage mitigation planning.

Cluster B: Dynamic Thermal Rating Enhancement

Operational Context

ELES currently operates the SUMO Dynamic Thermal Rating (DTR) system as part of its daily network management activities. Dynamic Thermal Rating enables the thermal capacity of overhead transmission lines to be determined based on prevailing environmental conditions and is used to support transmission capacity management, congestion management and operational decision-making.

Improving the utilisation of existing transmission infrastructure is becoming increasingly important as renewable generation, cross-border electricity exchanges and network congestion continue to increase. Accurate environmental information is therefore critical to achieving reliable and operationally acceptable Dynamic Thermal Rating calculations.

Current Solutions and Limitations

Current Dynamic Thermal Rating calculations primarily rely on weather-model inputs augmented with on power line towers weather measurements with 5 minutes resolution for wind speed, wind direction, ambient temperature and solar irradiance. While these inputs provide valuable operational support as their spatial resolution follows centroids of individual spans, their accuracy may not adequately capture local environmental conditions along transmission corridors, particularly within Slovenia's complex Alpine and pre-Alpine terrain.

As a result, conservative operational margins may be required to ensure system security, potentially limiting the utilisation of available transmission capacity. ELES has therefore identified improved environmental monitoring, forecasting and historical analysis capabilities as a priority opportunity to enhance Dynamic Thermal Rating performance and support more effective network operation.

Cluster B Requirements

The following requirements apply to solutions addressing Dynamic Thermal Rating enhancement and related environmental monitoring and forecasting activities.

Solutions under this cluster shall provide satellite-derived environmental parameters, wind speed, wind direction, ambient temperature and solar irradiance, as inputs to the operational SUMO Dynamic Thermal Rating system. The thermal-rating calculation itself (conductor thermal balance in accordance with IEEE Std 738 / CIGRE Technical Brochure 601) remains within the SUMO DTR system; proposed solutions are expected to deliver the environmental input layer, associated forecasts and historical datasets rather than replace the existing DTR calculation engine.

Functional Requirements

- Environmental monitoring and forecasting capabilities supporting Dynamic Thermal Rating operations.
- Wind speed, wind direction, ambient temperature and solar irradiance information relevant to transmission assets.
- Historical environmental analysis and model-calibration capabilities.
- Support for congestion management and transmission capacity optimisation.
- Compatibility with existing Dynamic Thermal Rating workflows and operational planning activities.
- Delivered parameters shall be representative of conditions at conductor height (approximately 10–20 m above terrain), rather than at standard 2 m or 10 m meteorological reference heights.
- Wind speed and direction are the priority parameters, as a directional error of approximately 30° can reduce the effective perpendicular cooling component of a conductor by up to approximately 50 %.
- Nowcasting and forecasting of all four parameters supporting intra-day and day-ahead Dynamic Thermal Rating operation, with a forecast horizon of at least 48-56 hours.
- Optional: Per-parameter uncertainty or confidence information accompanying each delivered value.
- Hybrid and phased approaches are acceptable: solutions may combine satellite observations with numerical weather prediction, in-situ measurements and AI-based downscaling, and may deliver parameters in phases according to technological maturity, provided that each phase delivers standalone operational value.

Performance Requirements

- Target spatial resolution of 50-200 m along transmission corridors, with 500 m as the minimum acceptable threshold.
- Target update frequency of 5 minutes, with 10 minutes as the minimum acceptable threshold.
- Target accuracies of approximately ± 0.5 m/s wind speed, $\pm 15^\circ$ wind direction, $\pm 1^\circ\text{C}$ ambient temperature and ± 20 W/m² solar irradiance. Minimum acceptable accuracies are ± 1.0 m/s wind speed, $\pm 30^\circ$ wind direction, $\pm 2^\circ\text{C}$ ambient temperature and ± 50 W/m² solar irradiance.
- Historical datasets supporting validation, seasonal studies and long-term planning activities. Multi-year historical coverage (indicatively at least five years) is expected.
- Data latency from acquisition to availability at the SUMO DTR interface of 5 minutes or less for nowcast products.
- Service availability suitable for continuous operational network management (99 % or higher).

- Accuracy shall be demonstrated against independent reference measurements representative of conductor height, covering both convective and stable atmospheric conditions and including complex Alpine terrain.
- Solutions shall include a validation phase on a priority Alpine 400 kV corridor segment (indicatively approximately 50 km) agreed with ELES, quantifying the resulting impact on Dynamic Thermal Rating accuracy and usable transmission capacity.

Integration Requirements

- Compatibility with SUMO Dynamic Thermal Rating and associated operational systems.
- Integration with GIS, asset-management and operational planning workflows.
- Support for the integration of environmental, geospatial and operational data sources.
- Georeferencing consistent with ELES GIS corridor geometries, with per-span or per-segment attribution of delivered parameters, and machine-to-machine delivery via a documented interface (e.g. JSON/REST, OGC services, GRIB2 or NetCDF).

Non-Technical Requirements

- Operational licensing suitable for real-time network-management applications.
- Clearly defined licensing and intellectual-property arrangements.
- Predictable and sustainable operational cost models.
- Compliance with applicable cybersecurity, operational and regulatory requirements.
- Appropriate training, knowledge-transfer and capability-development activities supporting the long-term operation, maintenance and evolution of delivered capabilities.

Cluster B Use Case

B-01: Dynamic Thermal Rating Enhancement

Description:

Dynamic Thermal Rating enables electricity network operators to optimise the utilisation of existing transmission infrastructure by continuously assessing thermal capacity under prevailing environmental conditions. ELES has identified improved environmental monitoring and forecasting as a priority operational challenge, particularly for Alpine and pre-Alpine transmission corridors where local weather conditions have a significant influence on network operations.

Example Capabilities

- Dynamic thermal rating forecasting and optimisation.
- Enhanced monitoring of wind speed and wind direction along transmission corridors.
- Enhanced monitoring of ambient temperature and solar irradiance relevant to thermal rating calculations.
- Historical environmental datasets supporting model calibration, validation and long-term planning.
- Improved congestion management and transmission capacity utilisation.
- Operational decision support for transmission system operations.

Cluster C: Asset Intelligence, Digital Twin & Situational Awareness

Operational Context

ELES is responsible for managing, monitoring and maintaining a large portfolio of transmission and distribution infrastructure while ensuring effective operational awareness across both routine and disruptive operating conditions. Key activities include predictive maintenance, asset prioritisation, digital twin enrichment, natural hazard monitoring, infrastructure condition assessment, vegetation and corridor management, emergency situational awareness and long-term infrastructure planning.

Electricity networks are increasingly exposed to environmental hazards, severe weather, vegetation encroachment and other external threats that can affect operational reliability, infrastructure integrity and network performance. At the same time, growing volumes of operational, environmental and asset data are creating opportunities to improve infrastructure management, automate monitoring activities and strengthen decision-making through greater situational awareness.

ELES is actively exploring the use of Earth Observation, artificial intelligence, advanced analytics and digital twin capabilities to improve asset intelligence, optimise maintenance activities and enhance visibility of infrastructure condition and strengthen operational awareness across the electricity network. As the operator of critical national infrastructure, ELES requires timely, reliable and actionable information drawn from multiple operational, environmental and infrastructure domains.

Current Solutions and Limitations

ELES currently operates a range of tools supporting asset management, maintenance planning, infrastructure monitoring, vegetation management, digital twin development, anomaly detection and operational planning activities. Earth Observation data and artificial intelligence are also being evaluated through operational and pilot activities supporting infrastructure monitoring and resilience management.

Whilst these capabilities provide valuable operational support, monitoring, asset-management and analytical functions remain distributed across multiple systems and workflows. Existing approaches often rely on manual inspections, drone surveys, periodic updates and fragmented data sources, limiting scalability and reducing the ability to identify emerging risks across large infrastructure networks. Digital twin environments are also primarily dependent on periodic updates rather than continuous integration of operational observations.

As a result, opportunities exist to improve automation, strengthen asset intelligence, enrich digital twin capabilities and develop a more integrated operational picture across infrastructure, environmental and operational domains. Improved situational awareness would support more effective maintenance planning, infrastructure monitoring, emergency response and long-term decision-making.

Cluster C Requirements

The following common requirements apply across the use cases within this cluster. They reflect ELES's need for integrated asset intelligence, infrastructure monitoring, digital twin and situational-awareness capabilities that support operational decision-making and infrastructure management activities.

Functional Requirements

- AI-enabled anomaly, defect and asset-condition detection capabilities.
- Infrastructure vulnerability assessment and risk-based asset prioritisation.
- Automated integration of operational observations into digital twin environments.
- Natural hazard monitoring and environmental risk-assessment capabilities.
- Infrastructure condition monitoring and change-detection capabilities.
- Obstacle, encroachment and vegetation-monitoring capabilities.
- Emergency situational-awareness and operational decision-support capabilities.
- Integrated visualisation, reporting and dashboard capabilities.
- Support for smart-grid assessment and future operational planning activities.

Performance Requirements

- Scalability across the ELES transmission and distribution network.
- Availability suitable for operational monitoring and situational-awareness applications.
- Timely processing and delivery of monitoring outputs supporting operational decision-making.
- Ability to incorporate new observations, datasets and analytical models as they become available.
- Performance suitable for operational asset-management, monitoring and maintenance activities.

Integration Requirements

- Integration with digital twin, GIS, Enterprise Asset Management (EAM) and operational systems.
- Compatibility with existing monitoring, inspection and asset-management workflows.
- Support for standard interfaces and data-exchange mechanisms.
- Integration of Earth Observation, environmental, infrastructure and operational datasets.
- Deployment within environments that meet relevant cybersecurity requirements.

Non-Technical Requirements

- Operational licensing suitable for long-term deployment and use.
- Clearly defined licensing and intellectual-property arrangements.
- Compliance with applicable cybersecurity, critical-infrastructure and regulatory requirements, including CER and NIS2 obligations.
- Predictable and sustainable operational cost models.
- Appropriate training, knowledge-transfer and capability-development activities supporting the long-term operation, maintenance and evolution of delivered capabilities.
- Transparency, explainability and auditability of analytical outputs where relevant to operational decision-making.

Cluster C Use Cases

C-01: Predictive Maintenance

Description:

Electricity infrastructure requires regular inspection and maintenance to ensure safe and reliable operation. ELES is exploring the use of satellite imagery and artificial intelligence to identify anomalies and support the transition from reactive maintenance activities towards more predictive and risk-based approaches.

Solutions should improve the ability of network operators to identify emerging asset issues, prioritise inspections and support proactive maintenance planning.

Example Capabilities:

- AI-enabled anomaly detection using Earth Observation data.
- Identification of emerging infrastructure defects.
- Automated screening of assets requiring inspection.

C-02: Asset Prioritisation

Description:

Network operators must continuously prioritise maintenance and reinvestment activities across large portfolios of infrastructure assets. Improved visibility of asset condition, environmental exposure and operational risk can support more effective decision-making and resource allocation.

Solutions should improve the ability of network operators to assess risk, prioritise assets and support long-term infrastructure investment planning.

Example Capabilities:

- Satellite-enabled asset vulnerability analysis.
- Asset risk scoring and prioritisation.
- Infrastructure exposure assessment.

C-03: Digital Twin Enrichment

Description:

Digital twins can provide valuable support for infrastructure planning, maintenance and operational decision-making. ELES has established a digital twin of its transmission network and is seeking opportunities to enrich it with real-world observations derived from Earth Observation and other space-enabled data sources.

Solutions should improve the accuracy, timeliness and operational value of digital twins through the integration of space-data and automated update mechanisms.

Example Capabilities:

- Automated space-data ingestion.
- Integration of real-world observations into digital twin environments.
- Infrastructure monitoring and change detection.

C-04: Natural Hazard Monitoring

Description:

Natural hazards such as forest fires, landslides, earthquakes, floods and severe weather events can affect transmission and distribution infrastructure, creating operational, safety and resilience risks for electricity network operators.

Solutions should improve the ability of network operators to monitor hazards affecting electricity assets, assess potential impacts on infrastructure and support operational decision-making before, during and after disruptive events.

Example Capabilities:

- Near-real-time monitoring of natural hazards affecting electricity infrastructure
- Detection and assessment of wildfire, flood, landslide and severe weather impacts.
- Identification of network assets exposed to elevated risk.
- Support for emergency preparedness and response planning.

C-05: Infrastructure Condition Monitoring

Description:

Substations, overhead lines and other critical electricity assets require continuous monitoring to identify deterioration, anomalies and external threats that may affect operational performance or reliability. Current inspection approaches rely heavily on field activities and targeted drone surveys.

Solutions should improve the ability of network operators to monitor infrastructure condition at scale and provide earlier visibility of emerging risks affecting critical grid assets.

Example Capabilities:

- Monitoring the condition of substations and overhead line infrastructure.
- Detection of physical deterioration and infrastructure anomalies.
- Identification of external threats affecting critical assets.

C-06: Emergency Situational Awareness

Description:

Major incidents such as storms, floods, wildfires and other disruptive events can affect large portions of the electricity network and require rapid coordination across transmission and distribution operations. Network operators require timely and actionable information to support response and recovery activities.

Solutions should improve situational awareness during emergency events through integrated monitoring, assessment and decision-support capabilities.

Example Capabilities:

- Near-real-time monitoring of disruptive events affecting infrastructure.
- Infrastructure impact assessment during emergencies.
- Operational awareness across transmission and distribution networks.

C-07: Smart Grid Feasibility Study

Description:

Electricity networks are evolving towards increasingly digital, data-driven and interconnected operating environments. Network operators require improved understanding of how emerging technologies can support future grid resilience and operational performance.

Solutions should explore innovative smart-grid concepts and assess how space-enabled capabilities can support future electricity network operations.

Example Capabilities:

- Assessment of smart-grid concepts and architectures.
- Evaluation of space-enabled operational capabilities.
- Future network resilience analysis.
- Technology adoption roadmaps and planning support.

C-08: Cross-Domain Resilience Dashboards

Description:

Operational resilience requires information from multiple domains including infrastructure monitoring, forecasting, asset intelligence and operational systems. Network operators require integrated visibility across these domains to support effective decision-making during normal and crisis situations.

Solutions should provide a unified operational picture by integrating information from multiple resilience-related data sources.

Example Capabilities:

- Integrated resilience dashboards.
- Combined EO, forecasting and AI-enabled asset intelligence.
- Multi-domain operational awareness.
- Decision-support capabilities for control room operators.

C-09: Obstacle and Encroachment Detection

Description:

Transmission corridors may be affected by vegetation growth, third-party activities and other obstacles that create operational, safety and reliability risks.

Example Capabilities:

- Detection of obstacles affecting transmission infrastructure.
- Monitoring of corridor encroachment risks.
- Automated change detection along transmission routes.

C-10: Vegetation and Corridor Monitoring

Description:

Vegetation growth and encroachment within transmission corridors can create operational, safety and reliability risks while increasing maintenance costs across large electricity networks.

Example Capabilities:

- Monitoring vegetation growth along transmission corridors.
- Detection of vegetation encroachment affecting overhead lines.
- Corridor-wide change detection and risk prioritisation.