NOVASPACE

EO Market analysis and gap assessment for Carbon/GhG

Final report

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Table of Contents

Executive summary **7**

Methodology **9**

1. GHG/Carbon Market and Stakeholders (Demand) **10**

1.1. Introduction (trends, regulation, main use cases) 10

1.1.1. Regulatory roadmap 10

1.1.2. From regulation to Earth Observation use cases 12

1.2. Identification of main stakeholders 17

1.3. Market quantification (TAM, SAM) 19

1.3.1. Methodology for Total and Serviceable addressable markets 19

1.3.2. Market outlook: Total Addressable Market 21

1.3.3. Market outlook: Serviceable Addressable Market 22

2. Supply and performances for carbon direct emissions **24**

2.1. Map and roadmap of current and future systems 24

2.1.1. Key conclusions 24

2.1.2. Deep dive: Emission monitoring 25

2.1.3. Deep dive: Carbon management 26

3. Gap Analysis **28**

3.1. Gap assessment: do operators cover policy needs? 28

3.1.1. For emission monitoring 28

3.1.2. For carbon management 29

4. Recommendation **30**

4.1. Strategic conclusion 30

Annex A. Evolution and overview of Carbon Markets **31**

Annex B. Mapping the ecosystem **34**

Abbreviations and Acronyms

CAGR	Compound Annual Growth Rate
CAP	Common Agricultural Policy
CBAM	Carbon Border Adjustment Mechanism
CCM	Compliance Carbon Market
CDM	Clean Development Mechanism
CERT	CORSIA CO2 Estimation and Reporting Tool
CH4	Methane
CO2	Carbon dioxide
CO2M	Copernicus Anthropogenic Carbon Dioxide Monitoring mission
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CRCF	EU Carbon Removals and Carbon Farming Certification Framework
CSRD	Corporate Sustainability Reporting Directive
EO	Earth Observation
ESA	European Space Agency
ESR	Effort Sharing Regulation
ESRS	European Sustainability Reporting Standards
ETS2	EU Emissions Trading System 2
EU	European Union
EU ETS	European Union Emissions Trading System
GHG	Greenhouse Gas(es)
GSD	Ground Spatial Resolution
HAPS	High-Altitude Platform Systems
ICAO	International Civil Aviation Organization
LULUCF	Land Use, Land-Use Change and Forestry
LWIR	Long-Wave Infrared
MRV	Monitoring, Reporting and Verification
MWIR	Mid-Wave Infrared
NISAR	NASA-ISRO Synthetic Aperture Radar mission
REDD+	Reducing Emissions from Deforestation and Forest Degradation, plus conservation, sustainable management of forests and enhancement of forest carbon stocks
RISAT-2B	Radar Imaging Satellite-2B

SAM	Serviceable Addressable Market
SAR	Synthetic Aperture Radar
SWIR	Short-Wave Infrared
TAM	Total Addressable Market
UAV	Unmanned Aerial Vehicle
UNFCCC	United Nations Framework Convention on Climate Change
VCM	Voluntary Carbon Market

Executive summary

The report describes a European carbon-monitoring market in which **regulation is the primary engine of demand**, but where it does not automatically translate into a satellite market. The central strategic issue is the conversion of regulatory need into an EO-addressable, compliance-ready service. That conversion depends on three factors working together: technical performance, regulatory acceptance and adoption by the verification ecosystem. In this sense, the market opportunity for ESA is not defined only by the number or capability of satellites; it is defined by whether EO-derived information can enter the formal Monitoring, Reporting and Verification (MRV) chain with sufficient traceability, comparability and confidence.

The underlying market is sizeable and growing. The deck estimates the European Total Addressable Market (TAM) for carbon monitoring at $163 million in 2025 and $462 million in 2035, an 11% CAGR. The satellite-addressable Serviceable Addressable Market (SAM) is estimated at about $52 million in 2025 and $156 million in 2035, or roughly one-third of the total market by the end of the forecast period. **This gap between TAM and SAM seems structural rather than temporary** as EO cannot observe every greenhouse gas or every source type, current systems struggle with source attribution and regulatory-grade uncertainty, and many compliance frameworks still rely on bottom-up calculations, in-situ sensing and statistical methods.

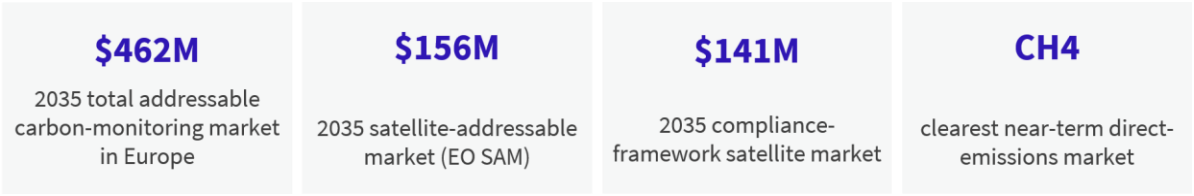


Figure 1 - Key findings

The most important near-term commercial conclusion is a two-speed market. Methane is the clearest satellite opportunity because point-source plumes are more observable, detection capabilities are validated, and buyer workflows are already emerging. CO2 is strategically larger but technically harder: background concentrations are higher, emissions are more diffuse, attribution is more complex, and detection thresholds remain concentrated on large emitters. The deck therefore points toward a dual strategy: monetize methane and other high-fit use cases now, while using public missions, pilots, model development and certification work to build the compliance case for CO2 over time.

A second conclusion is that downstream services matter as much as instrument performance. Satellite column concentration is not the same as an emission flux accepted by a regulator. Atmospheric inversion, uncertainty quantification, ancillary data, standardized evidence packages and compatibility with existing reporting workflows are decisive. For carbon removal, it seems that public and free data already dominate the data layer, so the commercial opportunity shifts toward integration, processing, visualization and audit-ready services rather than premium imagery alone.

The analysis identifies opportunities for ESA to support the technical development and uptake of EO capabilities relevant to carbon monitoring by:

- supporting the technical assessment of how EO-derived information could respond to existing and emerging MRV requirements.
- Supporting validation and inter-comparison activities that could facilitate assessment of EO-derived information by the relevant competent bodies.
- Supporting validation activities and technical pilots.
- contribute to strengthening the technical maturity and uptake of the EO service ecosystem
- supporting the technical maturation and demonstration of credible EO-based service concepts

Methodology

The study combines demand-side, supply-side and stakeholder evidence. Its logic is sequential: identify regulatory need, translate it into monitoring use cases, quantify the broad market, estimate the EO-addressable subset, test assumptions against operators and stakeholders, and then identify the remaining gaps. It draws on inputs from across the European value chain, including policymakers, verification bodies, end users and EO service providers.

1. **Regulatory and market analysis:** Review of the key regulatory frameworks and market mechanisms shaping demand for carbon monitoring solutions across both compliance carbon markets (CCM) and voluntary carbon markets (VCM). The analysis identifies the relevant sectors, monitoring requirements, use cases and key market drivers, based on desk research.
2. **Stakeholder mapping and consultation:** Identification of the main actors across the value chain, including regulators, standard-setting and verification bodies, EO and service providers, and end users, followed by targeted interviews to validate assumptions, assess user needs and understand market adoption dynamics.
3. **Market quantification:** Estimation of the Total Addressable Market (TAM) and Serviceable Addressable Market (SAM) using two complementary approaches. A bottom-up approach quantifies demand based on regulatory scope, relevant use cases, monitored assets, technology adoption and implementation timelines. A top-down approach assesses the market from the supply side, based on the revenues, capabilities and regulatory addressability of relevant EO operators and service providers. The two approaches are cross-checked and recalibrated using insights from stakeholder interviews and the supply-side assessment.
4. **Supply-side assessment**: Assessment of existing and planned satellite operators and EO capabilities relevant to carbon monitoring, with a particular focus on CO_2 and CH_4, using proprietary databases and market reports. The assessment considers technical performance, market positioning, target applications and the ability of different solutions to address regulatory requirements.
5. **Gap analysis:** Cross-analysis of regulatory and user requirements against current and expected EO capabilities to identify where the market is already adequately served, where technical or service-layer gaps remain, and where future opportunities for EO-based solutions may emerge.
6. **Strategic implications:** Consolidation of demand-side, supply-side and stakeholder findings to identify the main market-development levers, barriers to adoption and potential areas of intervention, including opportunities to strengthen the EO service ecosystem and accelerate the development of trusted compliance-grade solutions.

1. GHG/Carbon Market and Stakeholders (Demand)

1.1. Introduction (trends, regulation, main use cases)

The first methodological layer establishes where demand for carbon-monitoring solutions originates. The study reviews the regulatory architecture shaping both compliance carbon markets (CCMs) and voluntary carbon markets (VCMs), and translates these frameworks into concrete monitoring requirements and EO-relevant use cases. Regulation is therefore considered not only as a policy signal, but as an operational specification: for each relevant framework, the analysis identifies its geographic and sectoral scope, the assets or activities subject to monitoring, the variables that must be measured, the required monitoring frequency, and the role of verification.

1.1.1. Regulatory roadmap

European efforts to strengthen its environmental policy landscape

Indeed, over the past two decades, **the European Union has progressively developed a denser and more operational climate-policy architecture**. This trajectory extends from the introduction of the EU Emissions Trading System (EU ETS) in the 2000s, through the Paris Agreement in 2015 and the European Green Deal in 2019, to the European Climate Law in 2021, which made the objective of climate neutrality by 2050 legally binding and established an intermediate target of reducing net greenhouse gas emissions by at least 55% by 2030.

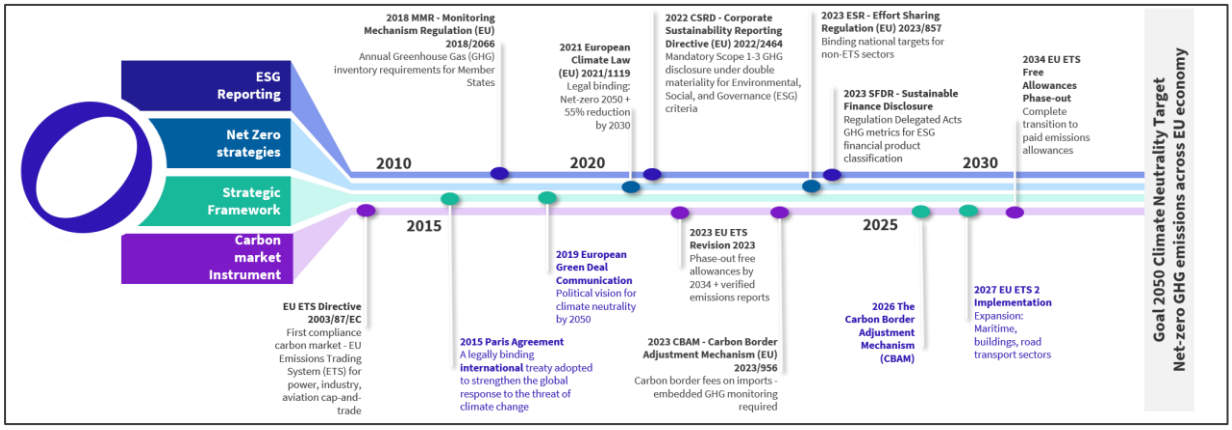


Figure 2 - Regulation Roadmap

More recent instruments have progressively broadened the scope and level of detail of carbon monitoring and reporting obligations. The Corporate Sustainability Reporting Directive (CSRD), adopted in 2022, expanded sustainability disclosure requirements, including greenhouse gas emissions reporting. In parallel, the Carbon Border Adjustment Mechanism (CBAM), the Effort Sharing Regulation (ESR), revisions to the EU ETS and sector-specific initiatives such as the EU Methane Regulation have extended carbon-related monitoring requirements across additional sectors, activities and value chains. Moreover, **this regulatory architecture continues to evolve:** CBAM enters its definitive phase from 2026, ETS2 is expected to extend carbon pricing to buildings

and road transport, and the progressive phase-out of free EU ETS allowances through 2034 will further strengthen the economic incentives associated with emissions reduction.

A shift from political objectives to operational monitoring

Taken together, these developments illustrate a structural shift from broad climate commitments toward more detailed, sector-specific MRV requirements. As regulatory coverage expands, demand for traceable, comparable and independently verifiable greenhouse gas information is expected to increase. **Regulatory implementation timing is therefore treated in this study as a dynamic input**, since the addressable demand for monitoring solutions evolves as individual frameworks enter into force or expand in scope (see Annex A. for roadmap)

Within this evolving ecosystem, compliance carbon markets represent the strongest structural source of demand because frameworks such as the EU ETS, ETS2, CBAM and the EU Methane Regulation impose mandatory monitoring, reporting and verification obligations on regulated actors. Voluntary carbon markets nevertheless remain complementary, particularly for project-level mitigation, nature-based solutions, forestry and emerging carbon-removal activities that are not yet fully integrated into compliance systems. VCMs also play an important role in methodological experimentation and in the development of monitoring and verification approaches that may subsequently inform regulated frameworks.

New opportunities for Earth Observation

For the EO market, **these opportunities are expected to materialise progressively rather than uniformly**. The extent to which regulatory demand translates into an addressable EO market will depend on the specific requirements of each framework, including the variables to be monitored, the level of accuracy required, the frequency of observation and the degree to which satellite-derived information can be integrated into recognised MRV methodologies.

The opportunity also differs between CCMs and VCMs. Within compliance markets, EO is particularly relevant where regulation requires independent verification, repeated observation over large areas or the detection of observable emission sources. In voluntary markets, satellite data already plays an important role in areas such as land-use monitoring, deforestation, biomass assessment and project-level verification. In both cases, EO is generally expected to operate as one component of a broader MRV chain, alongside in-situ measurements, modelling and certification processes.

This creates two complementary areas of opportunity for EO providers:

- **Supporting compliance-driven monitoring; and**
- **Verification.**

Regulation therefore acts as the primary structural driver of future demand, **while the size of the addressable EO market ultimately depends on the technical and methodological fit between satellite capabilities and individual MRV use cases**.

1.1.2. From regulation to Earth Observation use cases

The following mapping highlights potential use cases where Earth Observation can contribute relevant spatial, activity or emissions evidence within each regulatory framework. Inclusion does not imply that EO is mandated, nor that it represents the primary compliance or verification mechanism. The assessment is intentionally non-prioritised and is designed to identify potential applications rather than evaluate technical suitability, adoption likelihood or commercial attractiveness.

Compliance and MRV frameworks

The following frameworks create recurring emissions, activity or verification requirements. For each policy, we identify use cases where EO-derived evidence could contribute alongside the prescribed monitoring architecture.

Regulation / status	Regulatory focus	Potential EO use cases
EU Methane Regulation *In force - Regulation (EU) 2024/1787*	Methane measurement, quantification, reporting and verification in the oil, gas and coal sectors; leak detection and repair; venting/flaring controls; import transparency and a satellite-based global methane monitoring tool.	• Detection and localisation of high methane-emitting events and super-emitters • Methane plume screening and magnitude estimation • Monitoring of oil & gas pipelines, production sites and related infrastructure • Monitoring of coal mines and mine-related methane sources • Offshore methane-source monitoring • Venting and flaring detection / activity screening • Screening of methane events linked to imported fossil-fuel supply chains
EU Emissions Trading System (EU ETS) *In force - maritime included since 2024*	Annual MRV and allowance surrender for covered stationary installations, aviation and maritime activities. Core compliance monitoring relies on approved calculation and/or direct-measurement methods.	• Facility location, operational-status and activity verification • Independent screening of large industrial point-source emissions • Atmospheric plume and anomaly detection around selected installations • Maritime vessel activity, route and port-call consistency checks • Cross-checking of reported activity data using geospatial evidence
ETS2 *Fully operational from 2028*	Upstream emissions trading system covering fuels released for combustion in buildings, road transport and additional sectors; regulated entities are fuel suppliers rather than individual buildings or vehicle users.	• Urban and building-stock activity mapping • Road-network and mobility activity proxies • Land-use and urban-form monitoring relevant to fuel-demand patterns • Macro-level consistency checks between reported fuel demand and observed activity • Geospatial analytics supporting sectoral emissions modelling

Regulation / status	Regulatory focus	Potential EO use cases
Carbon Border Adjustment Mechanism (CBAM) *Definitive regime from 2026*	Embedded emissions associated with covered imports of cement, iron and steel, aluminium, fertilisers, electricity and hydrogen, with verification requirements for actual emissions where applicable.	• Mapping and monitoring of third-country production installations • Facility operating-status and production-activity proxies • Independent screening of large industrial emission sources • Power-generation and electricity-production activity monitoring • Cross-checking of reported installation information across international supply chains • Anomaly screening to target further verification
CORSIA Global ICAO international-aviation scheme	Monitoring and reporting of international aviation CO2 emissions using fuel-use methods or ICAO CERT, alongside offsetting obligations using eligible emissions units.	• Project-area monitoring for CORSIA-eligible carbon credits where underlying methodologies use EO • Forest, land-cover and wetland monitoring for eligible nature-based projects • Project activity, permanence and land-use-change checks where required by the underlying crediting programme

Lands, removals and project mechanisms

The following frameworks are particularly relevant for EO-supported monitoring of land-based and project-level activities, including changes in land use, biomass, ecosystem condition and long-term permanence.

Regulation / status	Regulatory focus	Potential EO use cases
Common Agricultural Policy (CAP) *In force - Area Monitoring System mandatory*	Area-based agricultural support and controls through the Integrated Administration and Control System, including regular satellite observation under the Area Monitoring System.	• Agricultural parcel identification and area verification • Crop / land-cover classification • Monitoring of agricultural activities and selected management practices • Verification of area-based eligibility conditions • Detection of land-cover or land-use changes affecting subsidy eligibility • Monitoring of selected irrigation or water-management conditions where relevant to an intervention

Regulation / status	Regulatory focus	Potential EO use cases
LULUCF Regulation *In force - Regulation (EU) 2018/841, as amended*	Member-State accounting of GHG emissions, removals and carbon-stock changes across land-use categories and land-use conversions.	• Land-use / land-cover classification and change detection • Afforestation and deforestation monitoring • Forest condition, disturbance and biomass proxies • Cropland and grassland monitoring • Wetland and peatland extent / condition monitoring • Spatial support to carbon-stock and land-sector inventory activity data
Carbon Removals and Carbon Farming (CRCF) *In force - Regulation (EU) 2024/3012*	EU certification framework for permanent removals, carbon farming, soil-emission reductions and carbon storage in products, using activity-specific certification methodologies.	• Carbon-farming activity-area verification • Afforestation and agroforestry monitoring • Peatland / organic-soil rewetting and restoration monitoring • Vegetation, biomass and land-cover change monitoring • Practice persistence and project-continuity checks • Reversal / disturbance monitoring for land-based removal activities • Spatial verification of project boundaries and surrounding land-use change
REDD+ *Active UNFCCC framework*	National or subnational monitoring and reporting of forest-related emissions/removals, forest carbon stocks and forest-area changes in developing countries.	• Forest-cover and forest-area change monitoring • Deforestation and forest-degradation detection • Forest disturbance monitoring • Biomass and forest-carbon proxies • Mangrove forest change monitoring where included in the national forest definition • Spatial support to leakage / displacement analysis
Paris Agreement Article 6.4 *UNFCCC Paris Agreement Crediting Mechanism*	Crediting mechanism for mitigation activities and removals, with activity-specific methodologies, monitoring, validation and verification requirements.	• Project-boundary and project-activity verification • Land-use and land-cover monitoring for mitigation/removal activities • Biomass, vegetation and ecosystem-change monitoring where methodology-relevant • Leakage monitoring • Permanence and reversal surveillance • Methodology-specific remote evidence supporting monitoring reports

Regulation / status	Regulatory focus	Potential EO use cases
Clean Development Mechanism (CDM) *Legacy mechanism - phasing down through 2026-2027*	Kyoto Protocol project-credit mechanism. Remaining activities are being wound down or transitioned toward the Article 6.4 mechanism.	• Methodology-specific monitoring of remaining project activities • Project-area and land-use-change verification • Renewable-energy / infrastructure activity evidence where methodology-relevant • Forestry or land-based project monitoring where applicable • Historical time-series evidence for legacy project verification

Corporate, claims and policy frameworks

The following frameworks highlight where EO can potentially support disclosure, substantiation, inventory quality or policy-progress assessment through geospatial evidence.

Regulation / status	Regulatory focus	Potential EO use cases
CSRD / ESRS Binding framework - *revised ESRS adopted July 2026*	Corporate sustainability reporting for companies in scope, including climate-related and other material environmental disclosures.	• Corporate asset mapping and geolocation • Independent emissions or activity cross-checks for selected assets • Land-use, ecosystem and biodiversity evidence • Geospatial supply-chain and sourcing checks • Physical climate-risk and hazard exposure mapping • Portfolio-level monitoring of infrastructure, land and natural-resource assets
EmpCo *Directive (EU) 2024/825 - from 27 September 2026*	Consumer-protection rules addressing misleading environmental claims and certain sustainability representations.	• Verification of the geographic extent of projects or activities referenced in environmental claims • Land-use and forest-condition evidence supporting location-based claims • Asset / site activity checks where a claim depends on physical operations • Before-and-after monitoring for claims linked to restoration or land-management outcomes

Regulation / status	Regulatory focus	Potential EO use cases
Green Claims Directive Proposal - *pending / blocked as of September 2026*	Proposed framework for substantiation, communication and verification of explicit environmental claims.	• Potential project-area verification for location-based environmental claims • Potential forest, land-use and ecosystem evidence • Potential asset-level activity verification • Potential before-and-after monitoring supporting claims of environmental improvement
Effort Sharing Regulation (ESR) *Binding Member-State target framework*	Annual national emission targets covering domestic transport (excluding aviation), buildings, agriculture, small industry and waste.	• Landfill methane plume detection and waste-site monitoring • Agricultural land-use and activity monitoring • Building-stock and urban activity proxies • Road-transport and mobility activity proxies • Industrial-site activity screening for smaller installations • Spatial evidence supporting national / sectoral inventory quality assurance
European Climate Law Overarching EU climate framework - *amended in 2026*	Binding EU climate-neutrality objective, 2030 target and 2040 target, with assessment of progress at Union and Member-State level.	• Independent spatial evidence on land-sector emissions and removals • Forest and ecosystem change monitoring relevant to net-removal trends • Large-source atmospheric emissions observation for trend assessment • Cross-checking of national activity and land-use information • Long-term geospatial indicators supporting assessment of climate-policy progress

1.2. Identification of main stakeholders

The carbon-monitoring ecosystem spans the full value chain, from regulators and policy makers to technology providers, verification bodies and final users. Public institutions define the regulatory framework, allocate funding and set MRV requirements, while public and private space actors develop the infrastructure and data capabilities required to support emissions and carbon monitoring. Value-added service providers then translate EO data into operational products that can be integrated into reporting, verification and decision-making processes. See Annex B for detailed Value chain scan.

Demand ultimately comes from different types of users depending on the market structure. In Compliance Carbon Markets, final buyers are primarily regulated actors such as large emitters and public authorities. Their willingness to pay is largely compliance-driven, as monitoring and reporting are mandatory and non-compliance can generate direct financial exposure. In Voluntary Carbon Markets, demand is more project-driven: project developers typically bear the cost of data collection, MRV and certification, with willingness to pay linked to the expected value of the carbon credits generated.

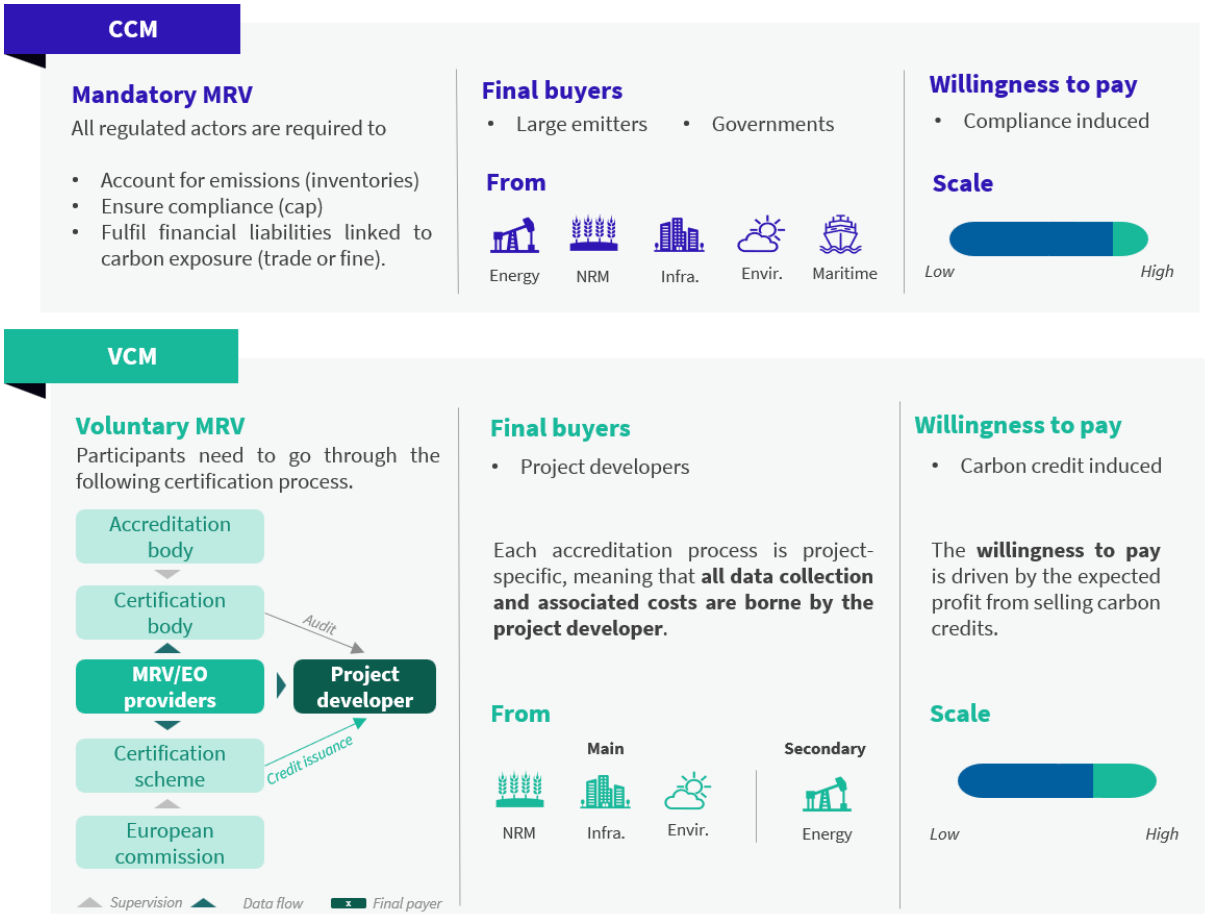


Figure 3 - Identification of main users and willingness to pay

A particularly relevant segment is finance, where carbon data is increasingly used not only for reporting but also for investment strategy and risk management. Financial institutions use carbon-related information to assess exposure to high-emission assets, identify transition risks and opportunities, and support portfolio allocation decisions. This creates demand for processed, comparable and decision-ready information rather than raw EO data alone.

Overall, the market opportunity for **EO sits increasingly at the intersection between data generation, verification and service provision**. The strongest value is therefore likely to accrue to actors able to combine satellite observations with analytics, certification requirements and user workflows, rather than to data providers operating in isolation.

1.3. Market quantification (TAM, SAM)

Executive snapshot

TAM 2025	TAM 2035	SAM 2025	SAM 2035
$163M	**$462M**	**$52M**	**$156M**
Carbon-monitoring market	11% CAGR	EO-addressable market	12% CAGR

Market framing

The study separates the broad carbon-monitoring opportunity from the part that can realistically be addressed by Earth observation. This distinction is central to the report: regulatory demand can be large while satellite addressability remains constrained by technology, methodology, adoption and competition from other measurement systems.

Throughout this study, we define:

- The **TAM** as the Total addressable market for sensing solutions, excluding ground surveys and purely statistical modelling; includes in-situ, aerial and drone approaches.
- The **SAM** as the Serviceable addressable market specifically addressable by satellite data and service operators.

1.3.1. Methodology for Total and Serviceable addressable markets

The market quantification was conducted through two complementary approaches. A **bottom-up approach** was used to estimate the Total Addressable Market for carbon monitoring across all sensor types, while a **top-down approach** was used to estimate the Serviceable Addressable Market specifically addressable by Earth Observation solutions. The two approaches were subsequently cross-checked and recalibrated using the findings from stakeholder interviews and the supply-side analysis.

Total Addressable Market (TAM) – Bottom-up approach

The TAM was estimated from the demand side by translating regulatory requirements into individual monitoring use cases and associated market opportunities. For each relevant regulation, the analysis first identified its geographical and sectoral scope, the assets or activities subject to monitoring, the variables to be measured and the required monitoring frequency.

The market size was then estimated using a set of use-case-specific assumptions and proxies, including:

- **Monitored surface or asset base**, derived from relevant sectoral and geographical databases;
- **Current technology adoption rate**, reflecting the extent to which technological monitoring solutions are already used for each use case;

- **Technology maturity by geography**, used to account for differences in the ability and willingness to adopt monitoring technologies across countries and regions;
- **Regulatory weighting factors**, introduced to limit double counting where the same asset or monitoring requirement falls under several regulatory frameworks;
- **Monitoring prices**, based on internal pricing benchmarks for the relevant variables and monitoring requirements.

A regulatory adoption curve was subsequently applied to reflect the progressive implementation of each framework. The model assumes successive adoption stages from initial activation to full implementation, allowing the market to ramp up progressively rather than assuming immediate full adoption. This approach results in an annual TAM by **regulation, vertical, use case and year**, representing the overall market opportunity for carbon monitoring solutions regardless of the sensor technology used.

Serviceable Addressable Market (SAM) – Top-down approach

The SAM was estimated from the supply side to determine the share of the overall carbon monitoring market that could realistically be addressed by EO-based solutions.

The analysis started with the identification of relevant EO operators and service providers, drawing on the supply-side assessment. For each operator, the analysis considered its activities, instrument capabilities, target customers, market positioning and estimated revenues. The share of revenues attributable to carbon-monitoring applications was then assessed, together with the regulations and use cases that each operator could potentially address.

Operator revenue trajectories were projected over time using growth assumptions and benchmarks from comparable companies. These estimates were then reconciled with the TAM results to distribute the EO-addressable opportunity across regulations, market segments and operators.

Recalibration based on stakeholder interviews and supply-side findings

A second, recalibrated scenario was developed to test the plausibility of the initial top-down assumptions. Rather than assuming that every technically relevant operator would address every potentially applicable regulation, the analysis assessed the likelihood of each **operator–regulation combination** in light of the evidence gathered during stakeholder interviews and the supply-side analysis.

The assumptions were therefore revised based on the study's updated understanding of **EO adoption rates, supply-side dynamics, regulatory factors and use-case fit**. In particular, market potential was reduced or excluded where stakeholder feedback indicated that EO was unlikely to be adopted for a given regulatory requirement, or where an operator was considered unlikely to develop the capabilities or commercial positioning required to address that market.

This recalibration provided a more grounded estimate of the **EO-addressable SAM**, reflecting not only theoretical technical potential but also the expected ability of the EO ecosystem to serve specific regulatory use cases.

Regulatory timing sensitivity

The model also incorporates a timing sensitivity mechanism to account for potential **delays or accelerations in regulatory enforcement**. Changes to the assumed regulation activation date automatically shift subsequent implementation phases and the associated market adoption curve. This makes it possible to assess the impact of changes in policy implementation timelines on both the TAM and SAM forecasts.

1.3.2. Market outlook: Total Addressable Market

The European carbon-monitoring TAM is estimated at approximately $163M in 2025 and $462M by 2035, representing an 11% CAGR. Growth is primarily regulation-led, driven by expanding monitoring, reporting, verification and carbon-accounting requirements, together with the increasing monetisation of verified emissions reductions, storage and removals.

Demand is concentrated in a limited number of verticals:

- **Environment -** largest segment, supported by environmental reporting, national inventories, ecosystem monitoring, restoration and land-use applications.
- **Finance -** significant demand for financed-emissions analysis, portfolio monitoring, risk assessment and green-finance verification.
- **Infrastructure and Natural Resources Monitoring -** supported by construction, embodied carbon, forestry, agriculture and land-use applications.
- **Energy and Maritime -** smaller today but benefiting from increasing regulatory momentum.

Growth remains exposed to regulatory delays and methodological uncertainty, particularly for carbon credits and removals where standardisation is less mature. Direct emissions and carbon-storage applications therefore represent a larger and more readily quantifiable share of market value.

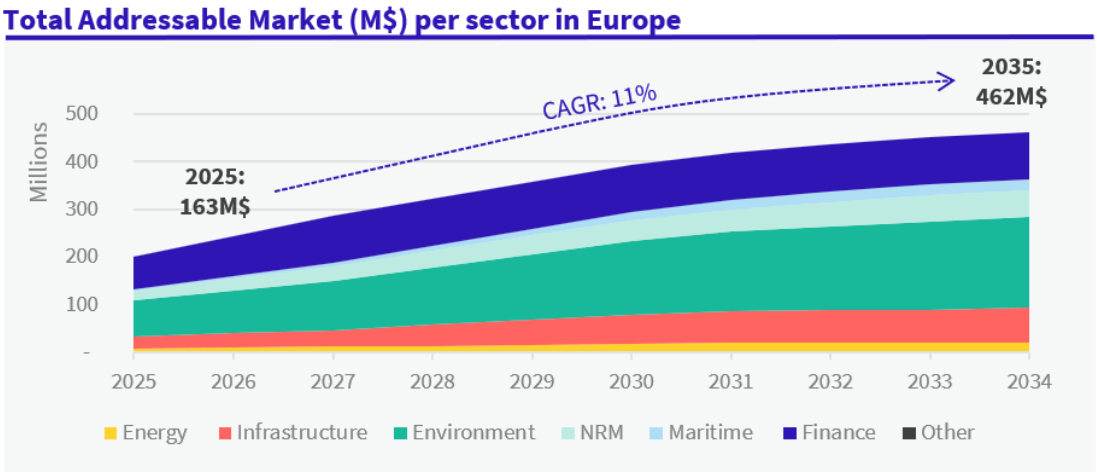


Figure 4 - TAM key findings

1.3.3. Market outlook: Serviceable Addressable Market

SAM outlook per vertical

The EO-addressable SAM is estimated at approximately $52M in 2025, increasing to $156M by 2035, corresponding to a 12% CAGR. The gap between TAM and SAM reflects that not every carbon-monitoring requirement can be served by satellite-based solutions: EO must be technically applicable, compatible with operational and MRV processes, and able to compete with established measurement approaches.

The SAM broadly follows the TAM by vertical, although EO penetration differs materially across sectors:

- **Environment -** largest EO-addressable segment, particularly for land-use, ecosystem and environmental monitoring.
- **Finance -** supported by demand for asset-level intelligence, portfolio analytics and externally derived carbon information.
- **Natural Resources Monitoring -** combines EO with field measurements for forestry, agriculture, biomass and soil-carbon applications.
- **Infrastructure -** potential around asset, activity and land-development monitoring.
- **Energy and Maritime -** supported by use cases requiring wide-area, repeated or remote observation, including methane and vessel-related activity monitoring.

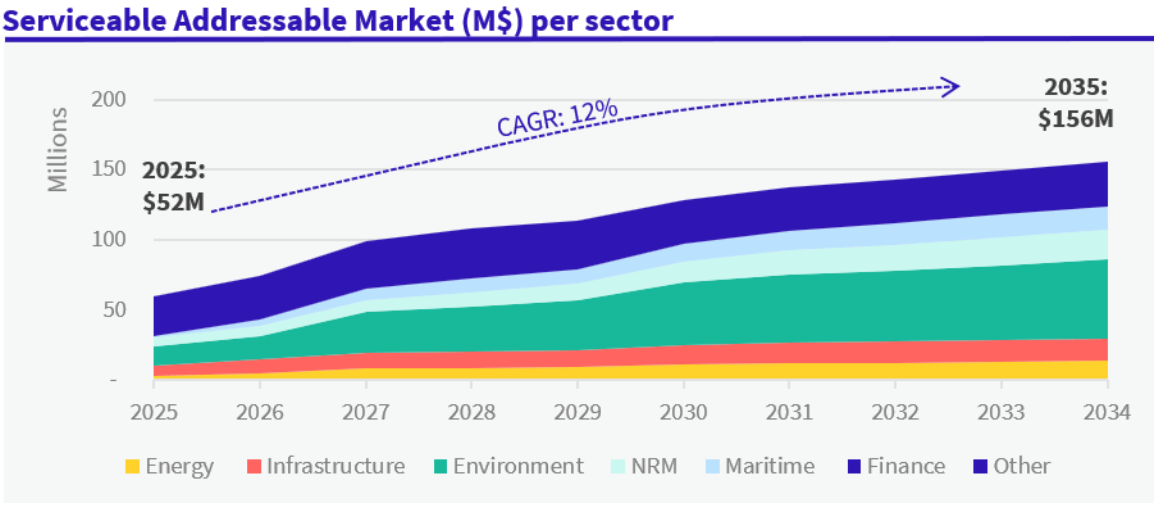


Figure 5 - SAM key finding

SAM outlook per regulation

The addressable opportunity depends on the technical fit between regulatory requirements and EO capabilities, the role given to independent verification within each framework, and the extent to which satellite-derived information becomes accepted within recognised monitoring and reporting processes.

- **EU Methane Regulation** emerges as the largest individual driver of EO-based GHG monitoring. Its requirements are particularly well aligned with satellite capabilities, as methane has a strong atmospheric signature and major point sources can be detected from space. This creates opportunities across oil and gas infrastructure, coal mines and landfills, where repeated observation and independent verification can complement conventional monitoring systems.
- **CSRD** also represents a significant market opportunity, although the role of EO is more indirect. The regulation considerably broadens demand for emissions-related information, including through financial institutions and corporate value chains. In this context, EO is less likely to serve as the primary reporting source and is instead expected to provide a scalable and independent verification layer.
- **EU ETS** architecture relies predominantly on bottom-up calculations and direct measurements. Satellite data can therefore contribute to selected supplementary or verification use cases but is unlikely to replace the core reporting mechanisms in the near term.
- **CBAM** presents a different profile, with stronger long-term potential for EO as an independent verification tool. The mechanism relies on reported embedded emissions from non-EU producers, creating a need to assess the credibility and consistency of information across complex global supply chains. EO could contribute by providing top-down emissions estimates, particularly in regions where local monitoring infrastructure is limited.

2. Supply and performances for carbon direct emissions

The supply-side analysis narrows a long list of more than 50 profiles to approximately 15 missions/operators considered most relevant for direct CO2 and CH4 monitoring. The selection combines technological compatibility, state-of-the-art performance and strategic/regulatory fit.

Step	Question	Filter
1. Compatibility	Can the operator detect the emissions?	Spectral coverage and sensor concept compatible with CH4 / CO2.
2. Performance	Is the operator at the forefront of emission detection?	Accuracy, spectral resolution, spatial resolution, detection threshold, revisit.
3. Strategic fit	Should the operator participate?	Business model, regulatory alignment, programme objectives and interest in GHG services.

2.1. Map and roadmap of current and future systems

The mapping of current and future systems is structured around two complementary categories: **Emission Monitoring** and **Carbon Management**.

2.1.1. Key conclusions

Throughout the supply study, it appeared that:

- **SWIR is the primary region for high-resolution near-surface CO2 and CH4 detection**, using bands around 1.61 / 2.06 µm for CO2 and 1.65 / 2.3 µm for CH4.
- **MWIR and LWIR provide complementary capability**. Spectral and sensor choices must balance sensitivity, spatial resolution, day/night capability, complexity, cost and atmospheric interference.
- **The market is moving toward a hybrid public-commercial model**: institutional missions provide precision, baselines and standards; commercial systems add resolution, flexible tasking and revisit.
- Carbon management requires wide-swath, repeat and long-term coverage**. Public missions are likely to remain the baseline infrastructure**, with commercial services focused on analytics, validation and project-specific monitoring.

2.1.2. Deep dive: Emission monitoring

Suitable bands

Atmospheric gases have characteristic absorption signatures. For CO2 and CH4, spectral selection is therefore a direct trade-off between measurement sensitivity, robustness and instrument feasibility.

Region	Strategic relevance	Key bands	Executive implication
SWIR	Primary region for high-resolution near-surface detection	CO2: ~1.61 and ~2.06 µm CH4: ~1.65 and ~2.3 µm	Best aligned with direct source detection; design must balance absorption strength, interference, resolution and cost.
MWIR / LWIR	Complementary capability	Alternative gas-sensitive regions	Relevant where different sensitivity or operating requirements justify the associated instrument trade-offs.

Suitable sensors and system design

Sensor selection follows the measurement objective. The core criteria are spectral sensitivity, spatial resolution, revisit, day/night capability, technological maturity, complexity and cost. No configuration maximises all dimensions simultaneously, so the appropriate choice is the one that best matches the intended regulatory or commercial use case.

Global roadmap and market structure

The global roadmap shows a diversifying GHG-monitoring supply landscape. Government missions tend to provide high-precision, science-grade observations and large-scale baselines; commercial constellations tend to provide higher spatial resolution, flexible tasking and faster revisit. These roles are complementary: interoperable public reference datasets and commercial responsiveness could form the basis of a scalable European MRV ecosystem.

2.1.3. Deep dive: Carbon management

General perspective on carbon mangament

Carbon-management applications require a fundamentally different monitoring architecture from point-source emissions detection. The priority shifts from spectral sensitivity to persistent, systematic observation**,** with wide swath, repeat coverage, data continuity and wall-to-wall monitoring becoming critical for projects spanning large areas and multi-year time horizons.

Therefore, we estimate that:

- **Public missions are likely to remain the backbone of the market**, providing consistent, large-scale baselines and long-term continuity. Sentinel, NISAR and future L-band missions are particularly well suited to this role.
- **Commercial SAR adds value where greater granularity and responsiveness are required**, including higher-resolution project monitoring, more frequent observations and targeted validation.
- **The commercial opportunity is therefore concentrated above the data layer**. Rather than replacing public infrastructure, private providers are positioned to differentiate through advanced analytics, higher-resolution validation, project-specific monitoring and decision-ready products.

Strategic implications

The emerging market is likely to follow a hybrid model in which publicly funded Earth-observation infrastructure provides the scalable baseline, while commercial players capture value through differentiated data, analytics and application-specific services. Rather than converging on a single dominant technology or provider model, competitive advantage will come from combining fit-for-purpose sensor performance with interoperable data, trusted reference observations and solutions tailored to specific MRV and carbon-management requirements.

Objective	Primary design priority	Best-fit architecture
Direct CO2 / CH4 monitoring	Spectral sensitivity and source-level resolution	SWIR-led monitoring, with complementary spectral approaches where they improve operational fit.
Regulatory / commercial MRV	Accuracy, traceability, revisit and interoperability	Public reference missions plus commercial tasking, resolution and responsiveness.

Objective	Primary design priority	Best-fit architecture
Land / biomass carbon	Repeat coverage, continuity and wall-to-wall observation	Institutional baseline infrastructure plus commercial SAR, analytics and validation.

3. Gap Analysis

The gap analysis assesses two questions: **whether current satellite operators cover policy-driven monitoring needs**, and **where satellite missions are put in competition with other credible alternatives or complements**.

The assessment points to a differentiated market. Specialist commercial systems are increasingly capable of facility-scale greenhouse-gas observation, particularly for methane, while carbon-management frameworks depend on a broader mix of land, biomass, ecosystem and activity proxies. Across both segments, **no single satellite system simultaneously optimises spatial resolution, revisit, detection sensitivity, coverage and continuity.**

3.1. Gap assessment: do operators cover policy needs?

Policy needs fall into two distinct categories. **Direct emissions monitoring** requires sensitivity to atmospheric plumes, source localisation and sufficient revisit to capture intermittent events. **Carbon management** relies more heavily on repeated observation of land use, forest condition, biomass, project boundaries, ecosystem change and permanence. This distinction is important because the two categories are served by different sensor architectures and therefore present different supply gaps.

3.1.1. For emission monitoring

Commercial emission-monitoring systems show differentiated strengths. Currently available emission-monitoring systems provide complementary capabilities, but no single solution fully addresses all policy-driven monitoring requirements. Coverage remains constrained by trade-offs among spatial resolution, detection sensitivity, revisit frequency, geographic coverage and continuity. Some currently available systems provide strong spatial detail for source localisation, while others prioritise revisit frequency and monitoring cadence. These capabilities are complementary but may not individually provide the complete performance needed across policy use cases.

Moreover, methane is currently the more mature satellite monitoring case. Available methane-monitoring capabilities can support plume screening, source localisation and recurring observation of selected assets; however, performance and coverage vary, and current capabilities may not fully satisfy all policy requirements or the complete monitoring chain. This aligns well with policy needs around methane plume screening, source localisation, recurring observation of oil and gas assets, coal-related methane and venting or flaring events

On the other hand, CO2 remains a more constrained monitoring case. Current space-based CO2 monitoring remains mainly applicable to larger emission sources because of detection, attribution and atmospheric-background constraints. Available capabilities can provide targeted cross-checking, anomaly detection and independent evidence, but do not yet fully cover all policy and MRV requirements

Overall, currently available EO capabilities can address selected detection, localisation and wide-area monitoring needs, but may not fully cover the complete set of policy-driven requirements. Important gaps remain in sensitivity, spatial and temporal coverage, continuity,

source attribution, uncertainty characterisation and integration into established monitoring and verification processes.

3.1.2. For carbon management

Carbon-management requirements are broader and more heterogeneous than direct emissions monitoring. Frameworks such as LULUCF, CRCF, REDD+, the Common Agricultural Policy and project-based crediting mechanisms can require evidence on land-use change, forest cover, biomass, agricultural activity, wetlands and peatlands, project boundaries, disturbance, leakage or permanence. These variables are observable from space, but they are not captured by a single sensor type or mission.

A substantial base of institutional and commercial observation capacity is available, but coverage is distributed across different sensor types and missions. No single system captures all land, biomass, ecosystem and activity variables required by the relevant policy frameworks. REDD+ and LULUCF benefit from relatively broad mission coverage, while CRCF presents a more mixed profile because carbon-farming and removal activities span several land and ecosystem variables.

The remaining gap concerns both capability and orchestration. Although relevant observations are currently available, they do not yet fully cover all policy requirements, and complete solutions often require multi-mission integration, consistent methodologies, historical time series, field validation and traceable processing.

4. Recommendation

4.1. Strategic conclusion

The study converges on four major conclusions.

Regulation is the primary demand catalyst

EU regulation is increasingly shaping reporting obligations, technical requirements and the economics of GHG monitoring. Existing and planned satellite missions can address a meaningful share of regulatory needs, particularly for direct-emission monitoring, but coverage remains partial because frameworks differ materially in gas scope, source type, reporting frequency, precision and uncertainty requirements. Voluntary frameworks may support early use cases and market learning, but they are unlikely to substitute for the stronger demand signal created by formal compliance obligations.

The largest value pool sits in compliance-ready services, not raw observations

Scaling EO within MRV will require harmonised methodologies and products that can move from detection to compliance. The commercial opportunity therefore extends beyond satellite data acquisition into the downstream service layer: uncertainty quantification, source attribution, flux estimation, traceable processing, validation and integration with existing reporting workflows. The arrival of CO2M and other next-generation missions should expand the available observation base, but monetisation will depend on whether service providers can translate those measurements into accepted, auditable outputs.

A technology and methodology gap remains

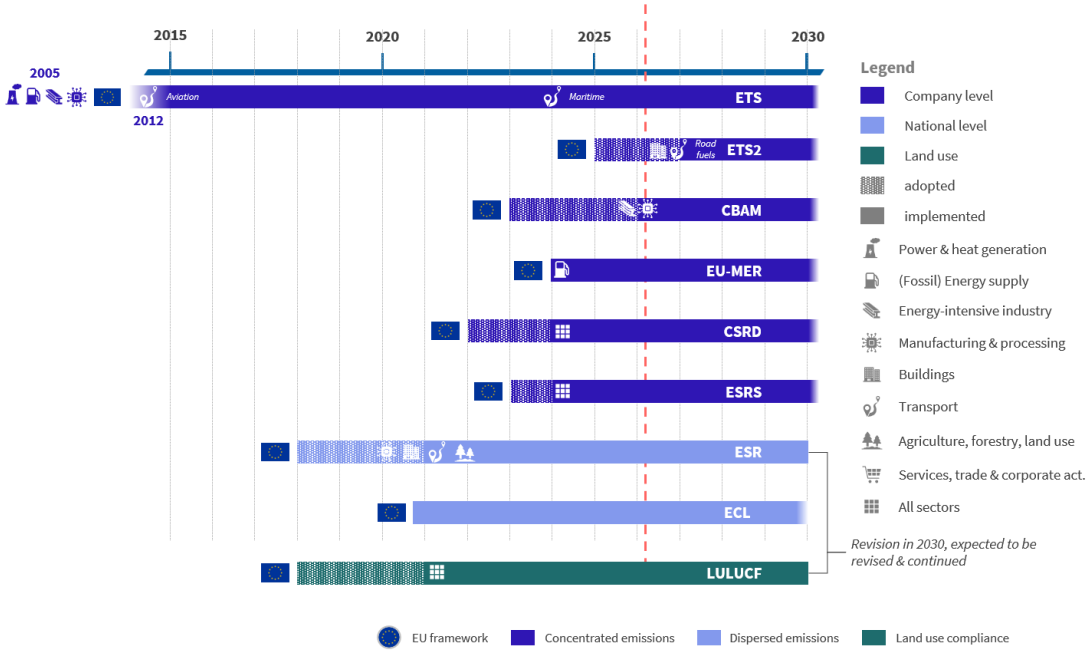
Satellite data alone is not sufficient for end-to-end MRV. Some emissions remain difficult or impossible to observe from space, source attribution can be ambiguous, and column concentration measurements do not directly provide the emission flux required for many compliance use cases. Flux inversion depends on atmospheric models and ancillary information such as wind fields and boundary conditions, while carbon-removal methodologies are still evolving. These constraints make standardisation, validation and integration with non-space data central to regulatory acceptance.

The market is developing at two speeds: methane first, CO2 later

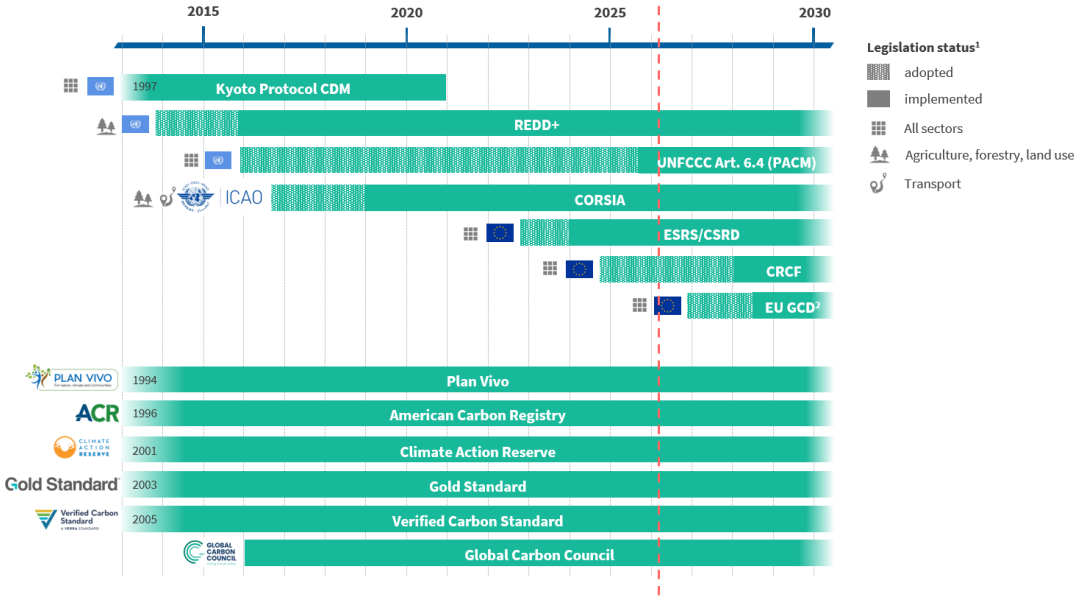
Methane represents the clearest near-term commercial market because detection capabilities are more mature, buyer demand is established and operational workflows are already developing around leak detection and source-level monitoring. CO2 is structurally more difficult: emissions are often more diffuse, background concentrations are higher and attribution to individual assets is more complex. As a result, CO2 demand is likely to remain more fragmented in the near term and will require stronger modelling, validation and regulatory integration before satellite-based services can scale at the same pace as methane.

Annex A. Evolution and overview of Carbon Markets

A comprehensive mapping of regulations and sectors enables modelling of current and future market opportunities, based on use cases, and aligned with client types.



Evolution of CCM



Evolution of VCM

Framework	GHG scope	Framework sectors covered	MRV use cases	Link to EO market verticals
EU ETS/ETS2	**CO2** **CH4** **Other**	**Power & heat** **Manufacturing** **Fossil energy** **Buildings** **Energy-intensive industry** **Transport** Land-use, agriculture, forestry Service & trade	• Activity-based emission monitoring • GHG emissions monitoring	Energy, Maritime, Environment, Infrastructure, LBS
CBAM	**CO2** CH4 Other	Power & heat **Manufacturing** Fossil energy Buildings **Energy-intensive industry** Transport Land-use, agriculture, forestry Service & trade	• Aluminium/iron ore/cement utilisation • Fertiliser production monitoring • Hydrogen production monitoring • Refinery emissions verification	NRM, Infrastructure, Energy
EU-MER	CO2 **CH4** Other	Power & heat Manufacturing **Fossil energy** Buildings Energy-intensive industry Transport Land-use, agriculture, forestry Service & trade	• Methane leak detection (O&G, Mining) • Offshore platform methane monitoring • Flaring stack monitoring • Landfill methane monitoring	Energy, Environment
CSRD/ESRS	**CO2** **CH4** **Other**	**Power & heat** **Manufacturing** Fossil energy **Buildings** Energy-intensive industry **Transport** **Land-use, agriculture, forestry** Service & trade	• Corporate supply chain reporting • Buildings monitoring • Agricultural carbon monitoring	Finance, NRM, Infrastructure, Environment, Maritime, Energy
ECL	**CO2** **CH4** **Other**	**Power & heat** **Manufacturing** **Fossil energy** **Buildings** **Energy-intensive industry** **Transport** **Land-use, agriculture, forestry** **Service & trade**	• National greenhouse gas inventories • Clean energy activity monitoring • Estimation of carbon removals	Environment, Energy, Infrastructure
CAP	**CO2** **CH4** **Other**	Power & heat Manufacturing Fossil energy Buildings Energy-intensive industry Transport **Land-use, agriculture, forestry** Service & trade	• Subsidy eligibility verification • Land-use/land-cover monitoring of agricultural land • Livestock activity monitoring	Environment, NRM
LULUCF	**CO2** **CH4** **Other**	Power & heat Manufacturing Fossil energy Buildings Energy-intensive industry Transport **Land-use, agriculture, forestry** Service & trade	• Land-use/land-cover monitoring of agricultural land • Land-use/land-cover monitoring of peatlands	NRM, Finance, Environment

Sector covered **Yes** No

EU framework

Concentrated emissions
Dispersed emissions

Land use compliance
Voluntary land-use credits

Overview of key Compliance carbon markets (CCMs) regulations

Framework	GHG scope	Framework sectors covered	MRV use cases	Link to EO market verticals
GCD	CO2, CH4, Other	**Power & heat**, **Manufacturing**, **Fossil energy**, **Buildings**, **Energy-intensive industry**, **Transport**, **Land-use, agriculture, forestry**, **Service & trade**	• GHG emissions monitoring • Agricultural commodity carbon tracking • Mining emissions monitoring	Energy, Natural Resources Monitoring, Finance
EmpCo	CO2, CH4, Other	**Power & heat**, **Manufacturing**, **Fossil energy**, **Buildings**, **Energy-intensive industry**, **Transport**, **Land-use, agriculture, forestry**, **Service & trade**	• Lifecycle-based evidence • Project area verification	Energy, Natural Resources Monitoring, Infrastructure
REDD+	CO2	Power & heat, Manufacturing, Fossil energy, Buildings, Energy-intensive industry, Transport, **Land-use, agriculture, forestry**, Service & trade	• Forest carbon monitoring • Deforestation tracking • Biomass burning detection	Energy, Environment, Natural Resources Monitoring
CRCF	CO2	Power & heat, Manufacturing, Fossil energy, Buildings, Energy-intensive industry, Transport, **Land-use, agriculture, forestry**, Service & trade	• Carbon storage in long-lasting products • Carbon removal and carbon farming	Infrastructure, Environment, Natural Resources Monitoring
CORSIA	CO2	Power & heat, Manufacturing, Fossil energy, Buildings, Energy-intensive industry, **Transport**, Land-use, agriculture, forestry, Service & trade	• Carbon project area verification • Aircraft CO_2 combustion verification	Infrastructure, Natural Resources Monitoring, Environment

Sector covered **Yes** No | EU framework | Concentrated emissions | Dispersed emissions | Land use compliance | Voluntary land-use credits

Overview of key Voluntary carbon markets (VCMs) regulation

Annex B. Mapping the ecosystem

Non-exhaustive overview of actors along the value chain

