PARSEC

ACCELERATOR

D2.7 Market Trends Report

WP2 – Cross-border and cross-sectoral collaboration

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Executive Summary

PARSEC's Market Trend Observatory has been designed as a supporting activity that provides beneficiaries with market intelligence. It presents market developments and trends in the form of articles in an online environment. These point at new opportunities for Earth Observation (EO) companies arising from e.g. policies, innovative business models, funding and investment, or emerging EO capabilities.

This deliverable, the Market Trends Report, presents a comprehensive overview of the findings of the analysis of these market developments and trends. It shall serve as a resource for a number of stakeholders, in particular in the PARSEC sectors Food, Energy, and Environment to advocate on the benefits of EO for these sectors, as well as on the benefits of the cross-border/cross-sectoral collaboration for future market success of members of clusters and business networks.

Chapter 1 introduces the methodology and sources of the analysis.

Chapter 2 summarises market developments and trends and their analysis for the sectors of Food, Energy, Environment, and EO

Chapter 3 (Appendix) lists and links articles published under the Market Trends Observatory and matches them with sectors and thematic areas for further reference.

1 Introduction

1.1 Methodology

This Market Trends Report summarises findings from the activities of the Market Trends Observatory, which scanned for and monitored changes in underlying drivers that are defining and changing the sectors of Food, Energy, and Environment as well as the Earth Observation (EO) sector as such. Activities included **(i)** desk research across major sectorial publications, resources, and organisations, **(ii)** expert consultations across sectors for identification, validation and selection of trending topics and review of derived insights, **(iii)** analysis of the greater picture per each of the sectors of Food, Energy, Environment, and EO.

1.2 Market Trends Observatory

The Market Trends Observatory has been set up to provide knowledge to the PARSEC community of applicants, beneficiaries, and other stakeholders such as investors and the greater Earth Observation (EO) community. Knowledge is provided in the form of short articles about **(i)** developments and trends in the market, **(ii)** opportunities such as funding schemes, supporting programmes, or specific tenders, **(iii)** success stories of EO products and services, as well as **(iv)** information about relevant policies and regulation. These articles elaborate on implications for EO and are matched with both PARSEC sectors as well as Earth Observation application fields to ease access to relevant content for the users.

Market Trends Observatory articles have been published via the public website of the PARSEC Accelerator (https://parsec-accelerator.eu/insights/) alongside the articles of the Technology Watch. They were thus very accessible, allowing monitoring topics of interest (through web analytics), engaging users in further discussion (through comments, social media, polls), and utilising contents for generating awareness for the PARSEC Accelerator and for EO as an emerging field.

Table 1: Topics of interest: Market Trends Observatory articles sorted by number of views

Insight Article	Total number of views (Feb-20 – Apr-21)
InSAR Applications – Why industry is learning to “love” radar	475
Common Agricultural Policy	426
The rise of the EO Platform Ecosystem	225
In situ: Earth Observation is not only Space	164
Drones and HAPS bringing new opportunities closer to the Earth	140
Smart Specialisation (Strategy)	119
Copernicus Start-up Programme	103

Insight Article	Total number of views (Feb-20 – Apr-21)
How new satellite technologies are creating market opportunities	102
EU Funding: A wide Horizon of opportunities	57
EO for Developing Countries	46
High Performance Computing for Earth Observation	42
Innovation Hubs	40
With EO around Europe and beyond	40
Big Data, big opportunities, big challenges	33
European Green Deal	21
Bringing the benefits of EO in markets across the globe	19

Monitoring users' areas of interest over time allowed guiding directions of further analysis as well as PARSEC's arsenal of supporting activities.

1.3 User & Technology Talks

To complement desk research, experts have been engaged in discussions to learn about their challenges, their view on (market and technology) trends in their sector, and to derive requirements towards solutions enabled by EO. Representatives of the demand side from each of the sectors of Food, Energy, and Environment were invited to panel discussions, the so-called PARSEC User & Technology Talks.

Challenges and trends revealed in the context of **Food** included:

- Main sectorial challenges coming from policy (e.g. CAP, European Green Deal, Biodiversity, Farm to Fork), with major implications for operations and administrative requirements
- Means of optimising and minimising pesticide application for crop protection
- The need to support agricultural research on e.g. food production, plant protection, irrigation, harvest, agricultural engineering
- The need for technology-enabled quantification of ecological aspects

Challenges and trends revealed in the context of **Energy** included:

- The increasing market share of renewable energy
- The increasing demand for electricity
- Challenges for the electricity grid coming from the uptake of electric vehicles
- Digitalisation in the energy sector
- Decentralisation of grids

- New challenges arising with renewables infrastructure coming of age, including e.g. the need to recycle PV panels, blades of wind turbines, or batteries
- The need for energy storage to cope with peaks in availability of renewable energy

Challenges and trends revealed in the context of **Environment** included:

- Increasing demand across sectors for strategies and solutions to adapt to climate change
- A boost to the circular economy
- Sustainable agriculture as a large market for (also EO) solutions
- The mobility and transportation sector as an attractive target to eliminate pollution
- Biodiversity requirements affecting major sectors including e.g. agriculture, forestry, marine

The User & Technology Talks not only informed this report and the Technology Watch and Future Trends Plan, but also helped PARSEC beneficiaries to directly interact with the demand side and to shape their solutions in a market-oriented way.

2 Market Trends

2.1 Food

With a population of nearly 450 million to feed, food security is a crucial challenge for the European Union (EU). The agricultural sector plays a vital role in ensuring that needs for healthy and affordable food are met.

At the same time, the sector represents an economic pillar of the EU, having generated (gross) value added of EUR 181.5 billion in 2019, contributing 1.3 % to the EU's GDP in that year. The output value in 2019 produced by the sector was an estimated EUR 418.0 billion, about one half of which (52.8%, EUR 220.5 billion) came from crops. In 2018, the sector employed about 9.2 million people in the EU[1].

The food sector is faced with many challenges such as a growing population, globalisation, climate change, or an increasing number of policies related to its own environmental footprint. A sustainable EU food system is considered to be a cornerstone of the European Green Deal, and the associated farm-to-fork strategy and the biodiversity strategy target the agricultural sector in particular. Also the Common Agricultural Policy (CAP) – the overarching and most prominent policy in the EU agricultural sector, includes environmental care and preservation of landscapes and biodiversity as two of their nine specific objectives.

Means of Earth Observation (EO) enable solutions to cope with these challenges, as well as to implement policies such as the ones mentioned above. EO offers a large and cost-effective source of information for decisions to increase quality and/or quantity of yields while lowering costs and environmental footprints through e.g. generation of heterogenous fertilisation maps and automated fertilisation application, remote disease detection and warnings, fruit harvest scheduling, monitoring soil erosion, crop classification, or land usage information.

EO solutions are well established and extremely useful when it comes to the **classification and monitoring of crops**. Through the computation of vegetation indices from satellite data, the health, growth rate and projected yields of crops can be understood which can help decision making and

[1] EUROSTAT, 2020: Agriculture, forestry and fishery statistics — 2020 edition

optimisation of resource utilisation, such as application of fertiliser and pesticides, or irrigation. Multispectral imaging (MSI) and hyperspectral imaging (HSI) for instance enable **new value-added services** for applications such as monitoring vegetation growth, soil moisture, and fertilizer application rates.

Another uptake of EO solutions can be seen in **regulatory compliance monitoring**. Farms managed about 45 % of the total land area of the EU-27 in 2016, a large area to monitor. EO reduces the need for manual compliance checks, enabling authorities to detect and monitor violations of policies (e.g. in the context of area-based CAP payments), law (e.g. related to illegal land use, illegal crops, or other illegal activities), or regulation with increased automation, precision, and efficiency.

With the recognition of agriculture being a key sector to achieve the targets of the European Green Deal and its associated policies, opportunities for EO lie as well in **environmental impact monitoring**. Satellite-based means of **atmospheric monitoring** (e.g. Sentinel-5p's TROPOMI instrument) enable detection and monitoring of greenhouse gas emissions related to agricultural practices. Other environmental impacts such as water pollution or soil erosion can be detected through satellite imagery. InSAR increasingly sees agricultural application enabling insights into the impact of agricultural practices on ground stability.

A further emerging field for EO in agriculture is the one for **risk monitoring and (parametric) insurance**. EO allows stakeholders such as banks or insurance companies to understand risks associated with the loss of yields (e.g. coming from impacts of human activities, climate change, or other natural). EO also provides precise information about the occurred impacts enabling accurate insurance coverage and investigations.

Other trends increasingly adopted in agriculture include e.g. the **Internet-of-Things**, where a number of devices (including e.g. farming machinery) and **in situ instruments** (e.g. soil sensors) can be interconnected. The latter are serving as observation instruments (e.g. for local weather, soil moisture, mineral contents) and enable validation and calibration of satellite-borne data. High-speed Internet connectivity of rural areas will support further uptake of IoT applications. The resulting increase in the amount of data and data sources further the need for **Big Data** integration und platforms enabling processing and utilisation of data and information. **Autonomous in-field machines** benefit from GNSS guidance and with the support of EO data are able to perform tasks of precision agriculture such as treatment (fertiliser, pesticides) or irrigation.

Overall, EO has the chance to bring agricultural practices to the next level in terms of efficiency and sustainability. The sheer size of the sector, its importance for the citizens, economy, and environment, and thus the number of stakeholders monitoring agricultural activities and impacts provide huge market opportunities for EO solution providers.

2.2 Energy

The United Nations' Sustainable Development Goal 7 aims at ensuring access to affordable, reliable, sustainable, and modern energy for all and calls for, among others, the transition towards renewable energy. In Europe, this transition is promoted among other through the revised Renewable Energy Directive, which includes a new binding renewable energy target of at least 32% for 2030, with a clause for a possible upwards revision by 2023, thereby helping the EU to meet its emissions reduction commitments under the Paris Agreement. The European Green Deal is also looking at renewables as one means to the decarbonisation strategy. It explicitly requires Europe to multiply its wind energy capacity five times by 2050 in to achieve 30% of the future electricity demand.

In 2019, renewable energy represented 19.7 % of energy consumed (gross final energy consumption) in the EU-27[2]. Renewable sources in 2019 included mainly wind (35%), hydro power (35%), and solar (18%). Solar power is the fastest growing renewable, largely thanks to the reduced production cost of highly efficient photovoltaics (PV) systems. PV is believed to become the cheapest way to generate electricity by 2030. The renewables sector employed 1.5 million people in the EU in 2018[3].

Renewables bring with it a number of challenges on top of policies, regulation, and global challenges of the energy sector. Forecasting of available wind or sunlight is of the essence to optimise output and to cope with peaks in demand and supply. Installations require proper site selection, including assessments of aspects such as social acceptance – a major issue for both wind and large photovoltaics installations.

Earth Observation (EO) solutions are crucial for planning, construction, and operating renewable energy installations. EO enables site selection for optimised exploitation of energy resources in line with regulation and law. It can provide estimates of energy generation and assess disaster risks. Infrastructure conditions of installations, e.g. power line, dams, or solar panels can be monitored by means of EO, enabling timely and cost-efficient maintenance.

For **site planning and operations of (offshore and onshore) wind energy installations**, EO data can reveal whether areas are susceptible for meteorological events (e.g. rain, lightning) that can cause operational problems. Especially offshore sites are exposed to severe environmental conditions, making construction, operations, and maintenance more difficult. Satellites provide accurate data on parameters related to metocean conditions, such as winds, waves, and sea surface height – even very close to a coastline. EO data is also used for forecasting applications and to predict extreme weather events. SAR data can provide wind maps with 1 km resolution and imagery down to 25 cm, and has proved to be more accurate than meteorological data and mesoscale model results.

EO can also provide data for the assessments of demand profile, infrastructure, environmental conditions, social acceptance, co-existence and permitting of wind plants, as well as serve for **monitoring** purposes. Many monitoring applications, however, will require data from within the wind turbine or need to operate in very close proximity, e.g. for monitoring blade conditions. Here, drones are an appropriate tool for inspections, even autonomously. Further, multispectral and hyperspectral imagery can be applied to **vegetation monitoring** for overhead transmission line management.

In the context of solar energy, market opportunities emerge from the need to create **solar cadastres**. The right location of solar panels is crucial for their efficiency. EO-based solar cadastres map the urban environment and the shadows casted by buildings, in order to select the optimal location. Further, private installations of solar panels can be subject to regulation and tariffs to be paid for the generated energy. EO imagery can reveal **undeclared installations** as well as, through time series of images, determine installations date which is relevant for e.g. period of due payments, but also in the context of **green energy certificates** where their value is defined by the installation date.

Further EO applications enable the **selection of adequate PV modules**. Various conditions of the environment in which PV panels are to be installed define suitability, including e.g. aerosols, water vapor, ozone and other gases in the atmosphere. Such data is available e.g. from the Copernicus Atmospheric Service, weather services, and in situ sources.

It is recognised that EO can contribute to the optimisation of renewable energy systems for power production and optimal integration of traditional and renewable energy supply systems into electric power grids. As such, the estimated total addressable market for EO downstream services in the renewable energy sector amounts to approximately EUR 73 million and is key to achieving the EU 32% renewable energy target 2030. Given the size of the market, the variety of stakeholders, as well

[2] EUROSTAT, 2020: Renewable energy statistics

[3] JRC, 2020: Employment in the energy sector: trends and impact of the green energy transition

as variety of aspects to be covered by EO it remains an attractive and growing market for EO solution providers.

2.3 Environment

Climate change and environmental degradation are an existential threat to Europe and the world. To overcome these challenges, the European Green Deal is a plan to make the EU's economy sustainable. This will be done by turning climate and environmental challenges into opportunities and making the transition just and inclusive for all. The EU aims to be climate neutral by 2050, but reaching this target will require action by all sectors of our economy, including e.g. investing in environmentally-friendly technologies, supporting industry to innovate, and decarbonising the energy sector. One of the EU's five research and innovation mission areas focuses on the need to meet the goals and targets set out by international policy frameworks such as the COP21 Paris Agreement and the UN's Sustainable Development Goals (notably SDG11) by developing climate-neutral and smart cities. The deeptech capabilities of Artificial Intelligence (AI) and Big Data analytics can enhance the insights which Earth Observation (EO) data can provide our green and circular economies. Reaching climate neutrality will only be achieved through innovation in the efficiency of our energy generation, energy consumption, construction activity, transport and resource usage, or precision agriculture e.g. modelling accurate wind and solar energy generation, production of more efficient transport routes, planning of greener cities, enhancement of infrastructural greenhouse gas emission monitoring, or variable rate application of seeds, fertiliser, pesticides, and water.

Beyond **monitoring environmental impact** as already described for the sectors of agriculture (see 2.1) and energy (see 2.2), EO can serve this task across sectors. Mining activities for instance often fragment and degrade natural habitats, pollute water, and produce waste which can extend far beyond the actual boundary of a mining area. Many of these impacts can be detected using available high or very-high resolution satellite imagery. Means of atmospheric monitoring such as Sentinel-5p's TROPOMI instrument can detect greenhouse gas emissions associated with raw materials exploitation.

Reducing the net emissions of greenhouse gases is at the heart of the above-mentioned policies, as they are the primary cause of global warming. Creating national greenhouse gas emissions inventories is part of the agreements and an opportunity for EO to provide the required data. Public bodies like the European Space Agency (ESA) develop such datasets, e.g. under their Climate Change Initiative. ESA regularly seeks to improve capabilities, also through **procurement**, opening opportunities for EO service providers.

Another challenging opportunity for EO lies in **ecosystem monitoring**. Human activities and natural disasters, climate, and the use of land, oceans, and airspace can disturb the balance of these systems. Policy makers need reliable information to understand their status, their functioning and importance, as well as impacts on ecosystems. Such information can come from various datasets and information products for monitoring e.g. marine zones, coastal habitats, inland water, grassland, forests, or artificial habitats. **Artificial reefs** for example offer a new role for EO in the support of marine ecosystems. With natural reefs in rapid decline due to climate change, Rigs-to-Reefs programmes aim to provide refuge for affected marine life in decommissioned structures such as oil and gas platforms (rigs). ESA has recently tendered a feasibility study on monitoring of environmental impact of decommissioning of energy assets using space-based data. EO is already proving its capabilities in monitoring natural reefs, e.g. through mapping and change detection of habitat, bathymetry, and water quality for health assessment and monitoring of coral reefs. Applying these to the vast number of rigs to be decommissioned as well as EO tasks in monitoring the decommissioning process as such provides new business opportunities for EO service providers.

Further tasks for EO emerge in **emergency management**, as climate change also brings with it an increase in disasters, such as wildfires. Wildfires themselves have a significant environmental impact,

leading to environmental degradation and air quality deterioration. They also impact economy with the destruction of property, crops, and other valuable resources. EO has already entered the market of wildfire management; solutions are in use that detect, count, and estimate the size and spread speed of fires as well as the burnt area. Given the nature of fire, near-real-time information in high resolution is required to act fast. With the emergence of private satellite constellations that allow for higher frequency revisit times and very high resolution such data is increasingly available. This enables innovative solutions, which are in high demand as demonstrated e.g. by a recent H2020 call funded with EUR 3 million.

Finally, with large parts of the population living in urban areas, **urban development** has a huge impact on environment at it is there where it also affects the health of citizens. EO data (satellite-based, in situ) provides information about air quality and, through integration in e.g. consumer solutions or **urban planning** applications enables citizens and public authorities to act. EO also enables new applications in the identification of urban heat islands, which occur as a result of human activities. EO-enabled solutions can support mapping temperatures and temperature variations across urban areas, and to assess the related risks for the health of citizens. Another impact on health and wellbeing is the availability of **green spaces**. Business opportunities emerge for solutions that enable mapping urban green and its condition, and to support planning to provide sufficient green spaces in the proximity of citizens.

Political pressure from Paris Agreement or European Green Deal as well as the unfolding climate emergency are forcing governments to act. Private businesses have developed market entry points in specific areas of environmental impact monitoring, including e.g. atmospheric monitoring. The current gap in access to and interpretation of necessary data holds great opportunities for commercial activity in this area.

2.4 Earth Observation

The European Earth Observation (EO) sector has seen significant developments in recent years. The deployment of the Copernicus Sentinels that provide a wealth of EO data, the establishment of the six operational core services of Copernicus, and the development of the downstream sector enabled by such data and services are transforming not only EO, but also a number of key sectors applying EO to their challenges. The importance of the European Space Programme is recognised und underlined by public investment (e.g. EUR 5.5 billion for Copernicus for the next seven years), the take-off of the EU Space Regulation which aims to modernise the flagship programmes (Copernicus, Galileo, and EGNOS), and the establishment of EUSPA (EU Agency for the Space Programme) which will govern the European Space Programme.

Public investment not only goes into the space programme itself, but a large number of calls (e.g. from **Horizon 2020 / Horizon Europe**) explicitly call for applying space-based data (e.g. the recent Green Deal calls). Through CASSINI, the new initiative to boost upstream and downstream space innovation, an EUR 1 billion fund will support businesses and entrepreneurs in developing space-related products and services – from idea to market entry and growth. CASSINI will be the umbrella also for the different components of the Copernicus Start-up Programme, through which already a large number of successful EO business have been developed. The New Industrial Strategy for Europe explicitly calls for “Space technologies, data and services [...]” to “[...]strengthen Europe’s industrial base by supporting the development of innovative products and services”. The SME strategy, the launch of CASSINI being one of its actions, also recognises that “SMEs do not yet fully benefit from data [...]” and that “advanced disruptive technologies, such as blockchain and Artificial Intelligence (AI), Cloud and High-Performance Computing (HPC) can dramatically boost their competitiveness”. Through implementation of these strategies the launch of further activities in support of commercialising also EO solutions is to be expected and demand for such should increase with the attention that the EO sector receives.

But also (global) **private investment** into space and EO is picking up, indicating growing awareness and appreciation. Most investments come from Venture Capital firms and Angel investors, though largely going into upstream solutions. There are few investors specialising in space, yet an increasing number of incumbent investors start having EO companies in their portfolio. Moreover, investors with a focus on specific sectors may not specifically invest in EO companies, but companies with solutions for these sectors (which might happen to be EO-based). Also, major investors have started to prioritise environment and climate change in their strategies, making EO companies in these domains more attractive for investments.

Another notable market development is the increasing number of companies launching large constellations of **small satellites**. Some of these expand traditional satellite capabilities to higher resolution and revisit times, others deploy new instruments and methods including e.g. video capture or Radio Frequency analytics. The resulting mix of capabilities creates opportunities for new EO-based applications. And with the increasing number of satellites in (low) orbit, also new **business opportunities on the ground** arise. Ground-Segment-as-a-Service models for instance offer solutions for communication with satellites and for receiving and processing their data.

With the ecosystem and capabilities of EO further evolving, increased public and private funding and investment, and the pressure arising from key policies that explicitly require EO support, there is a positive outlook for companies developing and offering EO-based solutions, companies developing and implementing enabling technologies and infrastructure, as well as for actors across sectors to benefit from crucial information provided. The beneficiaries of the PARSEC Accelerator have proven that for the sectors of Food, Energy, and Environment. Initiatives such as CASSINI and INNOSUP are well equipped to bring EO innovation to other sectors as well.

3 Appendix: Market Insights

The following table lists the published articles of the Market Trends Observatory matched with sectors addressed and thematic area of the described developments and trends.

Table 2: Market Trends Observatory articles matched by sector and thematic area

Title / Link	Sector	Thematic Area
European Green Deal	• Cross-sectorial	• Policy & Regulation
EU Funding: A wide Horizon of opportunities	• Cross-sectorial	• Opportunities
Common Agricultural Policy	• Food • Environment	• Policy & Regulation
Big Data, big opportunities, big challenges	• EO	• Market Trends • Technology
The rise of the EO Platform Ecosystem	• Cross-sectorial • EO	• Market Trends
High Performance Computing for Earth Observation	• EO	• Market Trends • Technology
Bringing the benefits of EO in markets across the globe	• Cross-sectorial • EO	• Market Trends
How new satellite technologies are creating market opportunities	• Cross-sectorial • EO	• Market Trends • Technology
Copernicus Start-up Programme	• EO	• Opportunities
EO for Developing Countries	• Cross-sectorial • EO	• Market Trends
Innovation Hubs	• Cross-sectorial	• Opportunities • Policy & Regulation
Drones and HAPS bringing new opportunities closer	• Cross-sectorial	• Market Trends • Technology

Title / Link	Sector	Thematic Area
to the Earth		
With EO around Europe and beyond	• Cross-sectorial • EO	• Market Trends • Success Stories
In situ: Earth Observation is not only Space	• Cross-sectorial • EO	• Market Trends • Technology
Smart Specialisation (Strategy)	• Cross-sectorial	• Market Trends • Opportunities • Policy & Regulation
InSAR Applications – Why industry is learning to "love" radar	• Food • EO	• Market Trends • Technology

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