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#Space4Youth

Earth Observation, Renewable Energy and Space Influencers as tools to foster climate adaptation and mitigation

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ABSTRACT

Climate mitigation cannot happen without renewable energy. Using Earth Observation (EO) from Space as a tool, Europe's renewable energy surpassed fossil fuel energy in 2019. EO data played a critical role in this milestone and continues to aid the continent, as it pursues 100% renewable energy for the future. Good practises in Hydropower and Wind energy generation are highlighted. However, majority of activities and investments in the energy sector is still focused on fossil fuels. A 'Space Influencers' and 'Climate Communicators' programme is proposed to increase awareness and inspire young people to propel the shift towards cleaner and smarter energy.

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Introduction

Space is an indispensable tool to 'see' into our world. The field of Earth Observation (EO) uses satellites in space to collect geographic information on Earth's climate (the land, oceans and atmosphere). We understand the effect of human activity on Earth's climate through EO. In 2019, for the first time, more than half of Europe's energy was derived from renewable sources and fossil fuels have taken the back seat since then (Figure 1; IEA, 2020). The continent has successfully surpassed a critical milestone in the world's fight against climate change – EO from Space has been at the forefront of this change.

This essay discusses how EO is helping mitigate climate change through its contribution in the clean energy industry. Good practises are highlighted in the wind and hydropower sectors and finally, an idea for accelerating climate achievements is proposed.

Figure 1: Trends of fossil fuels and renewable energy sources in Europe for the last 5 years

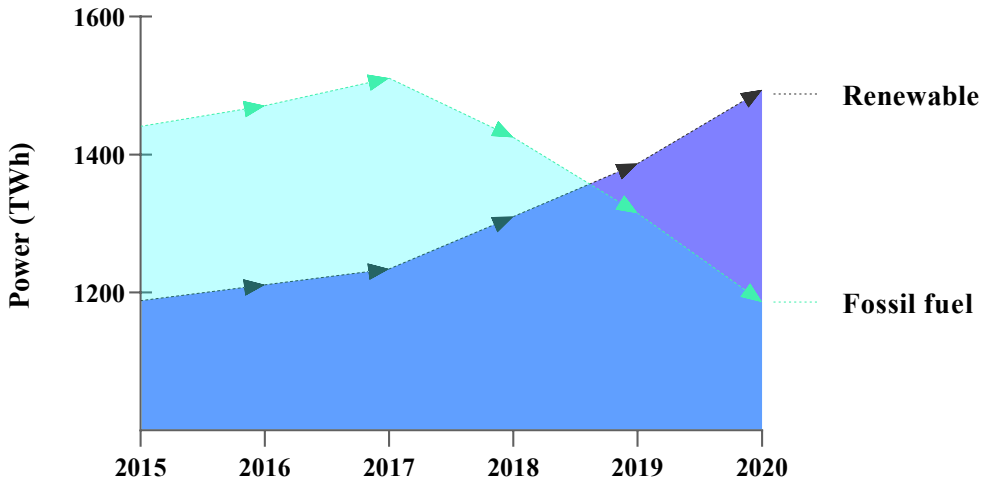

Figure 1: *A graph illustrating the trend of fossil fuel-derived and renewable source-derived energy for years 2015 to 2020 (year on the X-axis and power output in Terra-Watt hr^{-1} on the Y-axis). Blue trendline shows renewable sources and green trendline shows fossil fuels. Renewable energy successfully overtakes fossil fuels in 2019. Based on data from International Energy Agency 2015 to 2020 (IEA, 2020).*

Europe's eyes on Earth – Earth Observation through Copernicus

The European Commission and the European Space agency launched a constellation of satellites ('Sentinel') under the Copernicus programme in 2014 . EO data from the programme is analysed to understand effects of climate change. In addition to data from Space, Copernicus is also influenced by data gathered on Earth, *in situ*. Their combined analyses have helped maximise energy output, minimise risks and costs associated with renewable energy production (ESA, 2021; EEA, 2019). Whilst wind and hydropower generate the highest energy within the renewables in Europe, 44 in 100 people still use energy from fossil fuels (Figure 2; IEA, 2020).

Mapping new locations for renewable energy with EO

Renewable energy is one of the four conventional mitigation strategies for decarbonising our planet (Fawzy et al., 2020). The ultimate goal in climate adaptation is 100% energy from renewable sources such as solar, hydro, wind and geothermal power. EO data has helped scientists understand which locations have the greatest energy potential around the world. Numerous studies have identified and mapped locations containing wind energy potential across Europe, by drawing on data from Sentinel. One such study successfully mapped six locations surrounding the North-West coast of Sicily, by processing Sentinel data with existing geospatial software ArcGIS and Envi (Majidi Nezhad et al., 2019).

Figure 2: Share of energy sources in Europe, 2020

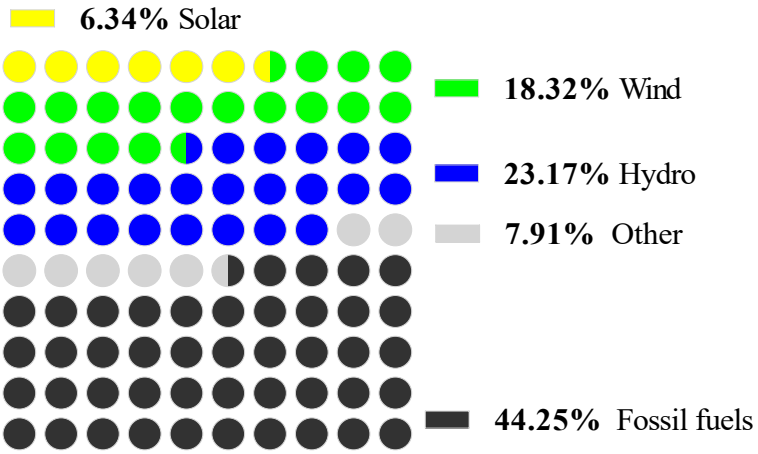

Figure 2: *100 colour-coded circles depict the shares of different energy sources in Europe last year (2020). Out of one hundred people, the lives of 44 people are still fuelled by fossils. Hydropower dominates the renewable sector (~23 in 100), followed by wind (~18 in 100) and then solar (~6 in 100). 'Other' includes geothermal and ocean derived energy (~8 in 100). Based on data from International Energy Agency 2020 (IEA, 2020).*

Furthermore, scientists have developed models for forecasting best-case scenarios using EO input. Accurate comparisons between energy generation sources can be drawn for a precise location. Argentiero and Marcello Falcone performed a case study analysis where they found that wind energy is both financially and environmentally friendlier compared to solar energy in Toronto (Argentiero and Falcone, 2020). This mode of pre-feasibility assessment could aid the government, private companies and investors to make informed choices, which otherwise remain invisible.

Safer renewable energy using EO data

Freely accessible sentinel data is used by many hydropower stations around the world to tackle different geological challenges. For instance, hydropower generated from snow reservoirs can be difficult to predict due to uncertainties in snow inflow and melting rate. Kemijoki, a hydropower company in Finland, rely on forecast models from Europe's contribution to Global Earth Observation, which in turn is used to determine the time and quantity of release on a daily basis (Hu et al., 2017, EuroGEO, 2021).

Although hydropower contains great potential, it is risky business. Often, plant locations are in both ecologically and geographically fragile regions. Himachal Pradesh is a northern state in India that is well known for its hydropower potential. However, this Himalayan belt is also highly prone to land displacement (earthquakes/landslides) and water displacement (floods/overflow). Hence, power generation here comes with significant environmental and financial risks. The Tidong Hydro Power Plant in Himachal Pradesh has been collaborating with *Tre Altamira*, a European company that uses Space as a tool to monitor ground deformation. By using EO data from Sentinel-1 and a tool called InSAR (Interferometric synthetic-aperture radar) technology, the company could effectively measure millimetre-scale changes in the ground surrounding the hydropower plant from Space (Tre-Altamira, 2021; Statkraft, 2021). EO can inform hydropower plants about such risks associated with production, thereby providing them with greater control over response and emergencies. This is especially true for remote areas such as the Tidong Valley, where gathering *in situ* data is impossible at millimetre scales.

The above are few of the many examples of EO's role in optimisation of existing renewable energy generation. Research using EO data has presented many more models and insights that help mitigate climate change in Europe (Argentiero and Falcone, 2020). The continent's milestone achievement was made possible due to Space technology and EO data contribution.

Ideas for a cleaner AND smarter world – getting more people involved

Although above examples show promising signs for climate adaptation, there is plenty yet to be achieved. Aforementioned applications need wide-spread recognition and implementation around the globe. The world requires 'clean energy', but also 'smart energy'. Sadly, the vast majority of people are not aware of how Space is propelling climate mitigation and adaptation—this needs to change. One solution is to increase visibility of efforts and opportunities in platforms that people most use, like social media. Lack of interest in space climate research is partially due to complicated science and daunting jargon ('faults', 'radiation') that are associated with negative understanding. In an effort to change this, I propose the launch of a 'Climate Influencers' and Space Influencers' programme. As of 26th April'21, there were less than one hundred posts with hashtags **#SpaceInfluencers** and **#ClimateCommunicators** combined, on Instagram.

When compared to **#Space** which has 18.4 Million posts, there is a clear need to address. Organisations involved in Space and climate research could work with influencers* to convey information in a laymen-friendly manner and promote their activities. The need for renewable energy is one such specialism influencers could focus on. Production of creative content will be required, in line with social media trends to reach wider and younger audiences. More students in education will be motivated to utilise freely available EO data, thus promoting and creating more innovation in the sector. This programme could provide inspiration for young people to pick up skills and new jobs generated in this sector. With adequate awareness and public interest, there is no doubt that climate mitigation and adaption will further accelerate in time to meet every nation's climate goals.

*Influencers can be part of an existing employees' role, in the form of collaboration or part of an organisation's outreach activities.

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