Title	**Earth Observation – A support for the distributed energy** sector (micro-/ mini-grids)
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Sustainable planning of affordable distributed energy installations considers many factors and requires draft but up-to-date analysis of the local environment and settlement structure potentially affected. It should provide a picture of the actual situation, its potential effect on local development, and with this analysis, it can support an enhancement of the electrification and therefore the implementation of the United Nations Millennium Development Goal agenda (i.e. SDG 7 - Affordable and Clean Energy).

The presented project “Integrated applications for micro grids in developing countries” (ESA 4000124252/18/UK/AD) reviews state of the art processes and addresses the potential of EO services towards supporting the site identification process within the Indian and African (selected countries) context. It will show, on how Earth Observation (EO) Services can support site identification and assessment by providing up-to-date information layer, such as urban extent, infrastructural and agricultural elements as well as information related to relief and potential hazards, among others. Overall aim is to provide ready-to-run cost-efficient, standardized solutions suitable for a scalable site identification process following different aspects, such as remoteness of a region, economic viability, vulnerability regarding natural hazards or other.

India and Sub-Saharan Africa

Electrification as well as availability of essential public services, such as health and education (SDG 3 and 4), can act as first steps towards realization of better life and sustainable development. However, fast population growth results in rapidly growing cities as well as widespread distribution of small settlements/ hamlets not connected to any main grid. The latter show disadvantage regarding their development potential towards higher sophisticated production methods.

Whereas India managed to connect 87.4% of its population to national grid power (2016), the situation especially within the Sub-Saharan Africa is far less convenient. Here, grid-connectivity was still well below 50% in 2016 [1]. Within the addressed project, both regions are taken into consideration, concentrating on identifying parallels and differences.

Micro grid developers and EO services

Essential element of the presented project is a comprehensive questioning of numerous micro/ mini grid developer regarding their needs and strategies. Within this process, EOservices are introduced and presented, based on Sentinel 1 and 2 data. The discussion leads to essential and case specific/ more complex EO information services, tailored by the feedback given by the users.

The site identification process underlies typical decision criteria’s which are often dependent on natural circumstances, and consider the developers intent. This will include parameter such as type of micro/mini grid (solar, wind, water, biomass or other), number of potential users, productivity and type of income, exposure to hazards (long and short term), and others. The better these elements can be described, the more precise the site identification process can be supported. EO data series of the Sentinel missions provide a suitable and very valuable base for highly automated medium scale applications. In combination with historic Landsat data, we can look back at the development of artificial structures and the natural environment at reasonable costs for the users in need.

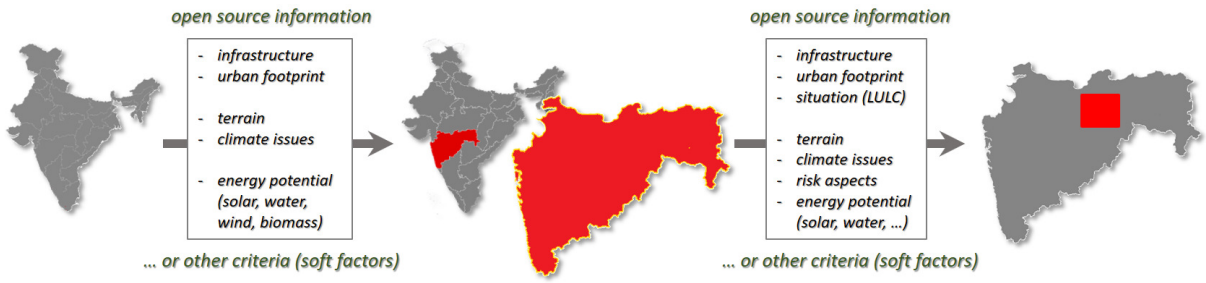

Figure 1: Multi-scale approach (national level, regional level, local level)

The site identification process gets applied following a multi-scale strategy. Draft site characterization gets done on national level, using open source information layer. Whereas this is suitable on national level, the fast development due to rapid population growth results in significant blurredness within regional scale, for data actuality becomes highly important. Here, Sentinel 1 and 2 information suits as highly suitable multi-temporal data source for more detailed analysis. On local level, just considering the area of a low number of villages/ limited extent, detailed information is also of interest to the users. However, here it became obvious that data costs (VHR satellite data) and the related services do not correspond to the requirements the developer has regarding cost and complexity of the results. Most of the missing information, identified within on-site investigations will not be solved by EO only and are therefore not of interest.

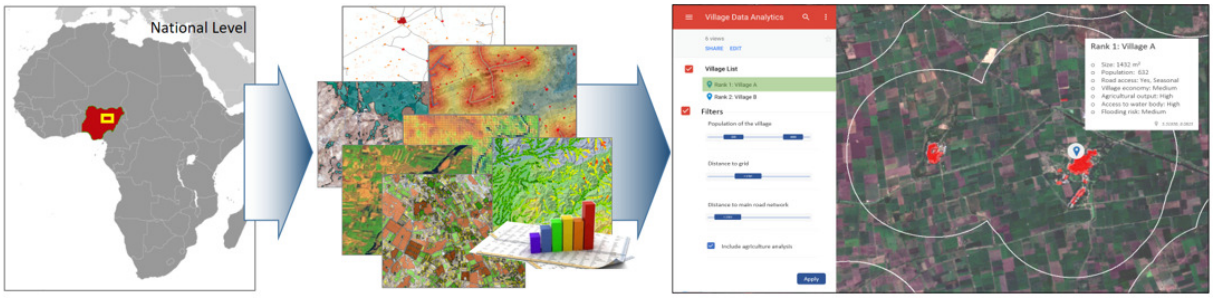

Figure 2: EO services towards a suitable site identification process

Dense interaction with micro-grid practitioner, providing valuable input regarding decision strategies and criteria, and is an essential element of identifying and forming the right services. Overall aim lays in providing EO information layer at a reasonable cost-benefit structure, appropriate for the users addressed (thematic and geometric accuracy, extent, spontaneous availability …).

The services proposed go beyond pure data analysis, but deliver advanced geo-spatial analysis as well as are implementation ready for the environment set-up by the developer itself. This includes technical support, maintenance of the service platform as well as efforts to expand the service to new geographies.

Impact assessment

At later stage, it is envisaged to implement EO data analysis to monitor newly electrified villages over several years in order to detect changes which can be attributed to the electrification effort, e.g. increased agricultural and economic activity, growth of settlements or the development of new public infrastructure could be performed using satellite imagery. This can establish a valuable feedback loop for development agencies and can thus lead to more impactful investments.

Present findings and actions towards financing

Global investments, such as of World Bank (WB) or the African Development Bank (AFDB) see micro grids playing bigger role in Africa's electrification as solar costs fall. This means that this will "incorporate interconnected or stand-alone 'mini grids' and 'microgrids' serving small concentrations of electricity users, and off-grid home-scale systems," WB states in its latest Africa's Pulse publication, regarding the sub-Saharan Africa (SSA).

Micro grids represent an interesting middle ground between home-scale systems and the extension of national grids in accelerating electrification in many SSA countries. In several SSA countries, administration is already revising their power-sector regulations to reduce barriers to micro grid development, mainly in solar systems.

So far, the need for supporting the increase the number of well-designed and soundly operated private mini grid investments in sub-Saharan Africa is identified by World Bank and other development partners as very valuable in shedding light on the benefits they can provide and the costs incurred. Within the The Africa's Pulse [2] report points out, that "over time, as incomes rise and populations agglomerate in higher-productivity locations, the national grid can spread out. In the meantime, household and community quality of life in off-grid areas can be substantially improved at relatively low cost through the provision of basic electricity services using solar home systems."

Summary

Within the presentation, the project and some of its major outcomes will be addressed. EO service set-up is done in close reconciliation with the affected micro/ mini grid developers. Spatial modelling results, based on the multi-thematic and temporal EO information layer will be presented and its qualitative impact on the site identification process worked out.