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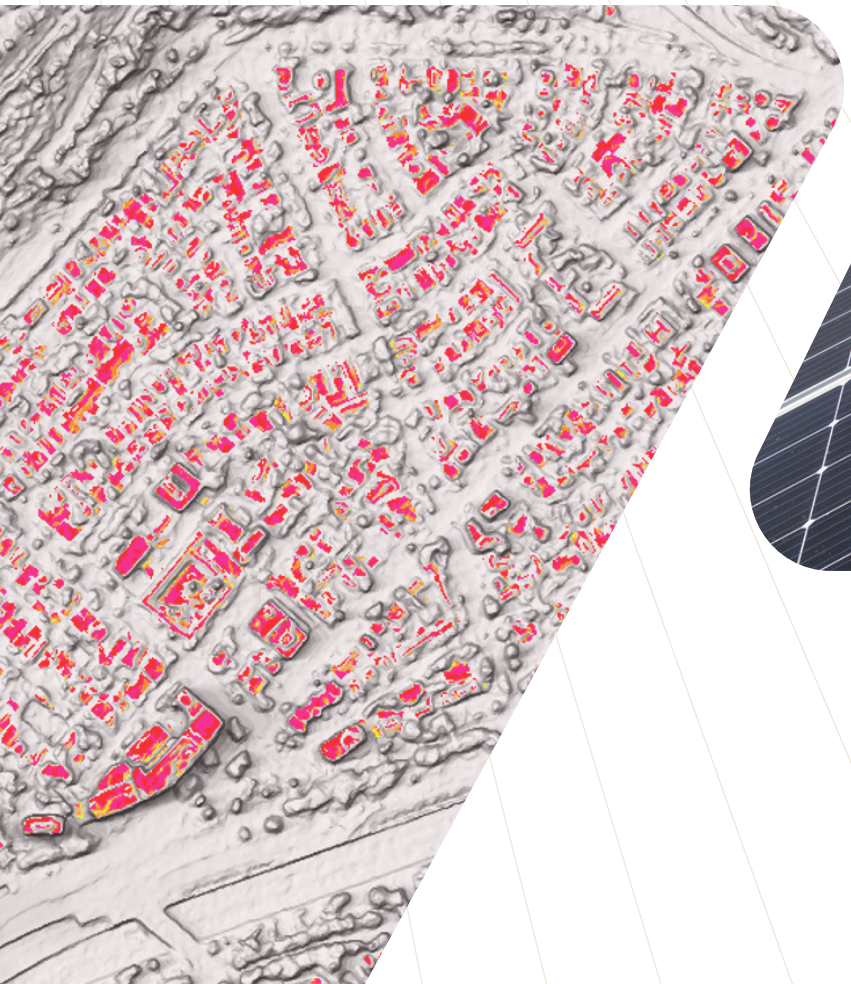
Solar Radiation Assessment for
Renewable Energy



White Paper 2023

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INTRODUCTION

As a result of the negative impact of fossil fuels on the environment and climate change, the need for sustainable energy sources has become increasingly urgent. Renewable energy is emerging as a viable alternative to meet the growing energy demands of the future while also achieving sustainable development goals. Solar energy is a clean, abundant, and free source of energy that has the potential to meet the increasing demand for electricity in many countries. Global Horizontal Irradiance (GHI) is used to measure solar energy, which is the total shortwave radiation received by a surface horizontal to the ground. This measurement includes both Direct Normal Irradiance (DNI) and Diffuse Horizontal Irradiance (DHF). To harness this energy into electricity, solar Photovoltaic (PV) systems can be used.

Installing solar PV systems is more favorable in areas with lower average temperatures, lower average relative humidity, and higher sunshine duration. Also, distribution of solar radiation on Earth's surface and the potential for electric energy production can be influenced by land topography, particularly slope and aspect. Therefore, for these spatial factors, Geographical Information Systems (GIS) in planning and implementing solar PV systems plays an important role. GIS has the capability to capture, handle, analyze, and visualize spatial data, making it an invaluable tool for these purposes.

To maximize the use of Solar Radiance as received by the Earth's surface, IGiS offers its automated tool of Solar Potential Analysis. Some of the applications where IGiS offers the solution are,

Solar Potential Site Suitability Analysis

Sustainable Solution for Environment

Policy Development

Energy Yield Analysis

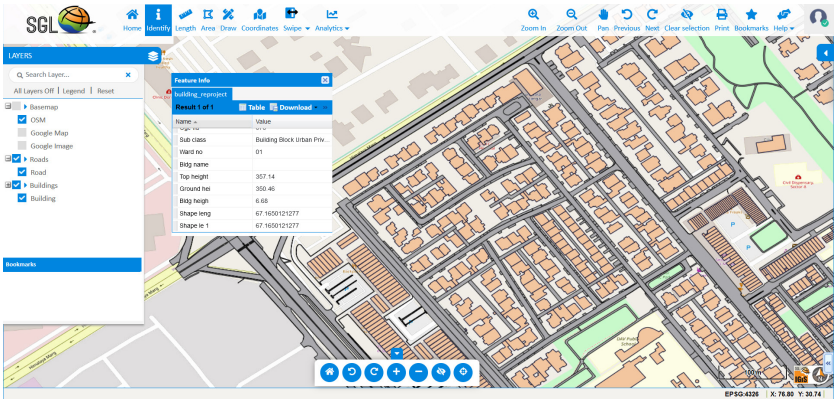
Rooftop Solar Radiation Potential

Sustainable Street Lighting: Optimizing Planning, Management, and Monitoring with Solar Power

Sustainable Water Solutions with Near Real-Time Monitoring of Solar-Powered Pumping Systems

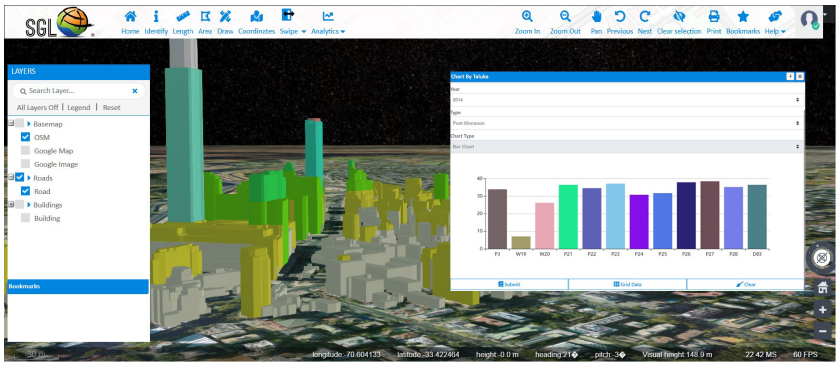
Solar Potential Site Suitability Analysis

Determining a suitable site for solar installations goes beyond considering solar radiation alone. These factors include local topography, the necessity to preserve protected areas, potential environmental impacts, water availability, and the impact on urban development. Hence, site selection is a complex process that requires the careful consideration of multiple variables. To address this issue, IGiS offers strategic solution for site suitability analysis with voluminous data handling capability. IGiS enhances the precision and effectiveness of decision-making processes pertaining to solar energy deployment.



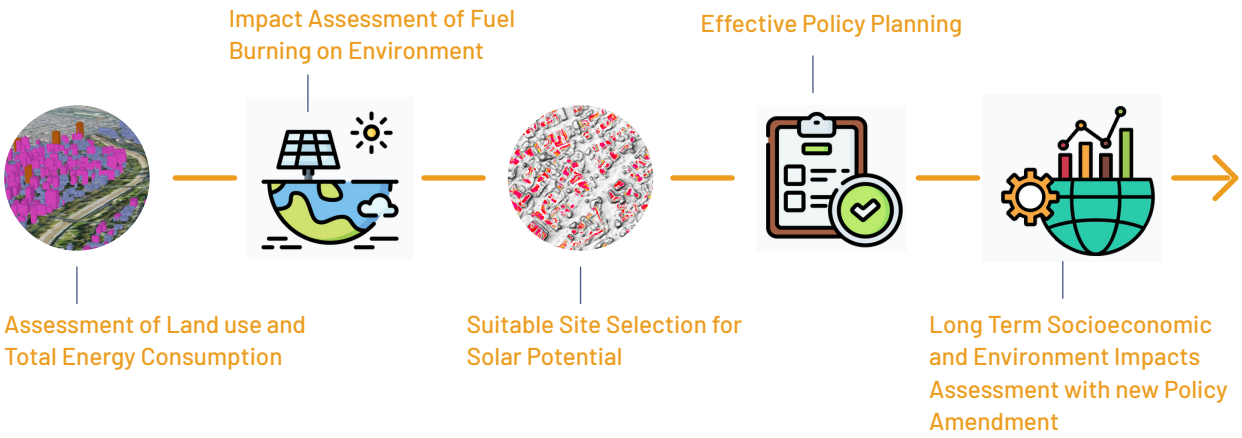
Sustainable Solution for Environment

Solar energy technologies play a vital role in shaping a sustainable energy future. While fossil fuels may currently offer cost advantages and assurances of abundant supply, it's important to recognize that these resources are finite and contribute significantly to greenhouse gas emissions. In contrast, solar energy provides a clean, renewable, and virtually limitless source of power. By embracing solar energy, we can reduce our reliance on fossil fuels, mitigate environmental impact, and work towards a more sustainable and greener energy future. IGiS allows sensitivity analysis by incorporating data on environmentally sensitive areas, such as habitats, biodiversity hotspots, and cultural heritage sites. By evaluating the spatial proximity between solar radiation potential areas and environmentally sensitive zones, potential conflicts can be identified, helping to minimize negative impacts on the environment.



Policy Development

Solar potential radiation is a critical factor in shaping policies and strategies for solar energy development. When combined with GIS, policymakers can harness the power of spatial analysis to make informed decisions and formulate effective policies. IGiS provides a framework for integrating and analyzing solar potential radiation data alongside various geographical layers. Policymakers can identify areas with high solar potential, suitable for solar installations. This aids in site selection for utility-scale solar farms, rooftop solar installations, and other solar projects. Furthermore, IGiS enables policymakers to evaluate the potential benefits and challenges associated with different policy options and assess the spatial impacts of solar energy development on land use and land cover. GIS also facilitates the monitoring and evaluation of policy outcomes. It enables policymakers to track the growth of solar installations, assess their contribution to renewable energy targets, and analyze the socioeconomic and environmental impacts over time.

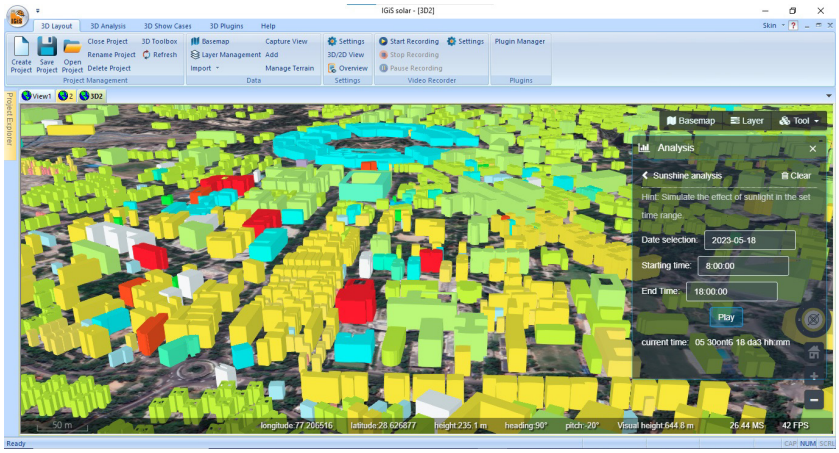


Energy Yield Analysis

Energy yield analysis involves assessing the expected energy output of a solar energy system based on solar radiation data and other relevant factors. By combining solar radiation data with GIS, energy yield analysis becomes a powerful tool for optimizing system design, evaluating potential energy generation, and efficient decision-making.

IGiS allows the overlay of solar radiation data with other geographical layers, such as terrain, shadow, and land use. By considering factors such as tilt and orientation of solar panels, shading from nearby objects, and land availability, GIS-based energy yield analysis can provide accurate estimations of the energy output of a solar energy system at different locations.

Furthermore, IGiS can be used for performance monitoring and comparison. By comparing the actual energy generation of installed systems with predicted values based on solar radiation data, the efficiency and performance of solar installations can be evaluated.



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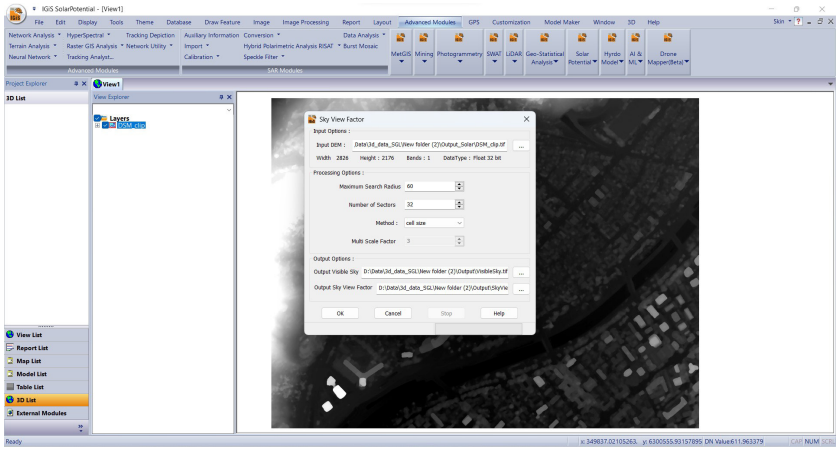
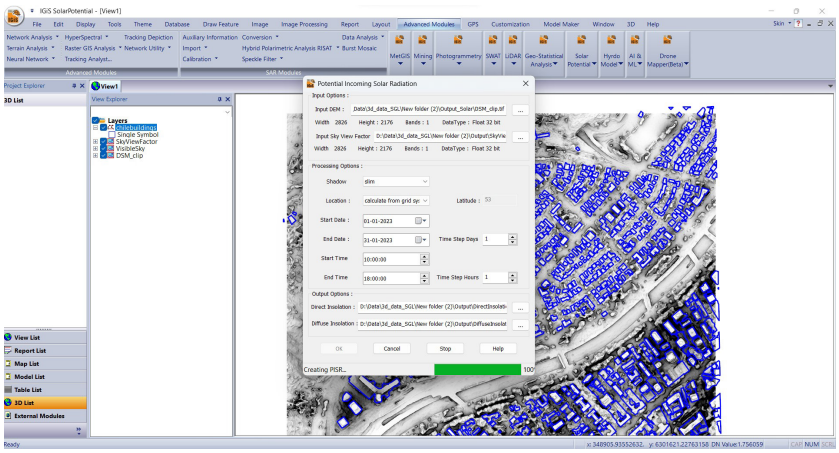
Rooftop Solar Radiation Potential

Ensuring accurate characterization of rooftop solar energy potential is of utmost importance to facilitate the widespread adoption of renewable energy in densely populated cities. Nevertheless, this has posed a persistent challenge owing to the intricate influence of building shading and the diverse availability of rooftops. To tackle this challenge, the visualization of Solar Potential Radiation in three dimensions (3D) offers a valuable solution. Using IGiS, rooftop solar potential analysis takes into account various factors such as building characteristics, nearby obstructions, shading effects, roof orientation, and solar radiation data. By integrating these spatial data layers, it enables the identification of rooftops that are most suitable for solar energy installations. IGiS also helps assess the feasibility and optimal placement of solar panels on rooftops.

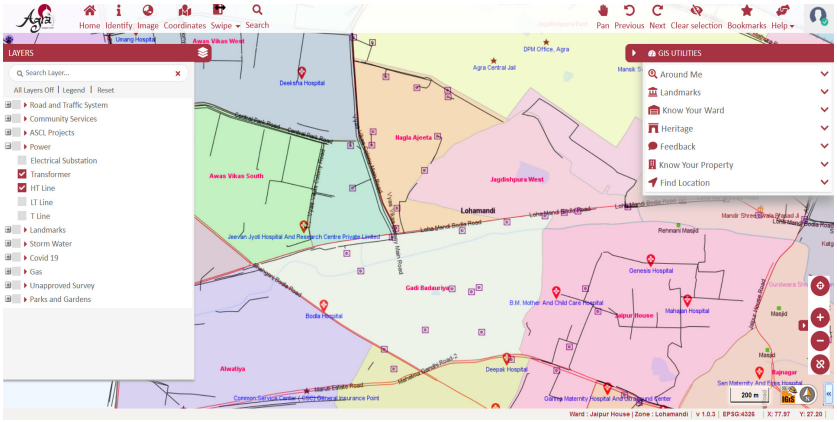
By leveraging IGiS technology, cities and communities can tap into the abundant solar potential of rooftops and accelerate the transition to a sustainable and renewable energy future.





Sustainable Street Lighting: Optimizing Planning, Management, and Monitoring with Solar Power

Solar-powered street lighting systems offer an eco-friendly and cost-effective alternative to traditional grid-connected streetlights. By harnessing solar energy, these systems reduce reliance on fossil fuels, resulting in lower electricity costs and contributing to sustainable urban development. The utilization of IGiS in the design and layout of solar-powered street lighting networks is advantageous. IGiS takes into account factors such as road geometry, pedestrian traffic, and safety requirements to determine the optimal number, placement, and spacing of streetlights. This ensures consistent and adequate lighting coverage, enhancing visibility and security in public spaces. Additionally, combining web & Mobile based IGiS solutions facilitate the monitoring and maintenance of solar-powered street lighting systems. With near real-time tracking of streetlight locations, operational status, and energy generation, authorities can promptly identify and address any issues that arise. This capability ensures the dependable functioning of the lighting infrastructure, promoting a safer and more efficient urban environment.

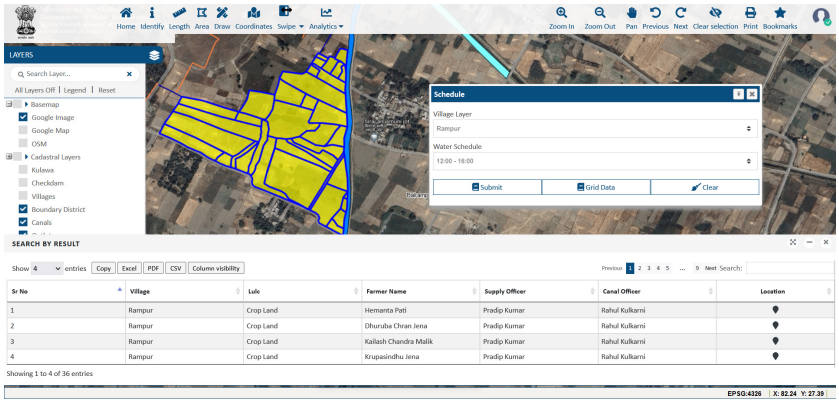


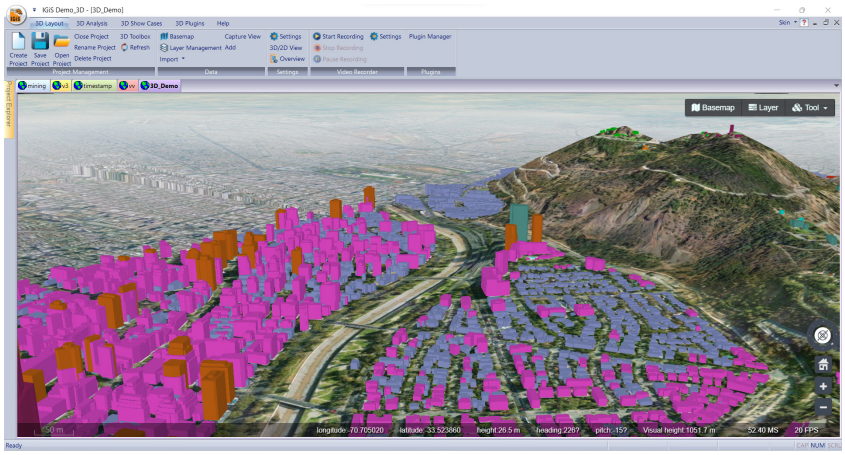
Sustainable Water Solutions with Near Real-Time Monitoring of Solar-Powered Pumping Systems

In several villages, the shortage of electricity has led to the prevalent use of fossil fuel-based water pumping systems for irrigation purposes. However, these systems have a detrimental impact on the environment as they emit harmful greenhouse gases. Therefore, automated water pumping system harnesses the power of solar energy and can be implemented, serving as a sustainable and eco-friendly replacement for the fossil fuel-based water pumping systems.

Combining Web & Mobile based solution complements solar-powered water pumping systems by providing remote monitoring, control, and data visualization capabilities. It enables near real-time tracking of pump performance, water flow rates, energy production, and system status. Through a web & mobile based interface, users can access and analyze data from anywhere, facilitating efficient management and timely decision-making.

Web & Mobile based IGiS solution allows the integration of spatial data such as geolocation, terrain elevation, water source locations, and water demand areas. It also enables near real-time monitoring of system faults, performance degradation, and maintenance needs. Alarms and notifications can be set up to alert operators about any issues, enabling timely maintenance and minimizing downtime. Remote access and control capabilities allow for prompt troubleshooting and adjustments, improving overall system reliability and uptime.





CONCLUSION

Solar radiation potential analysis using GIS is an indispensable tool for evaluating, mapping, and leveraging solar energy resources. By harnessing the power of GIS technology, governments, energy planners, and project developers can effectively identify appropriate locations, estimate energy generation potential, and make well-informed decisions to facilitate the widespread adoption of solar power. With its exceptional capability to integrate spatial data and offer valuable insights, GIS plays a pivotal role in expediting the transition towards a cleaner and more sustainable energy future.

ABOUT

Scanpoint Geomatics Limited

Scanpoint Geomatics Ltd. is the leader in the Indian Geomatics Industry. We pioneer the nation's geospatial domain through IGiS. An indigenous technology that brings GIS, Image Processing, and Photogrammetry together on the same platform under the Make in India Initiative. We are proud of our partnership with the Indian Space Research Organisation (ISRO). With an innovative approach and over two decades of rigorous research and development, the duo developed the IGiS platform. Backed by ISRO's domain expertise, we aim to push forth innovation and uplift the global geospatial domain.

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