

APLICACIONES DE LOS SISTEMAS DE INFORMACIÓN GEOGRÁFICA (SIG) EN EL DESARROLLO DE LA ENERGÍA SOLAR: UNA REVISIÓN DEL ESTADO DEL ARTE

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INTRODUCCIÓN

- La óptima **integración en el territorio** de los proyectos de energía solar es crucial para una transición energética efectiva.
- Los Sistemas de Información Geográfica (**SIG**) se han consolidado como la herramienta clave para abordar este desafío.
- Se aborda una revisión del **estado del arte** sobre las aplicaciones de los SIG en el sector solar.
- El análisis, centrado en la literatura científica de la última década, identifica y categoriza las tendencias y metodologías predominantes. Los resultados destacan que la aplicación más extendida es la **evaluación del potencial y selección de ubicaciones** para grandes plantas fotovoltaicas, donde la integración de SIG con procesos de Análisis de Decisión Multicriterio (**AHP**) es un estándar. Se identifica, además, un rápido crecimiento en el uso de SIG acoplado a **Teledetección** e Inteligencia Artificial (**GeoAI**) para la cuantificación del potencial solar en **entornos urbanos**.
- Finalmente, la revisión subraya el papel crítico de los SIG en la planificación de la electrificación **rural** y el **acceso universal** a la energía, permitiendo identificar necesidades y optimizar soluciones fuera de la red.
- Se concluye que los SIG son un elemento indispensable para una transición energética espacialmente explícita, justa y eficiente, cuya evolución futura pasa por la integración de datos en tiempo real y modelos de planificación más **dinámicos**.
- Como ejemplo, la presentación aporta un análisis específico del periodo 2021 – 25.
- Adicionalmente, este artículo promueve la participación de los congresistas en el topic **"GIS-Driven Renewable Energy Solutions: Advancing Regional Development, Rural Electrification, and Universal Energy Access"** editado por los autores y que será presentado en el transcurso del congreso.

METODOLOGÍA

- A título de ejemplo, se ha realizado un análisis en Scopus de aquellas referencias que se ajustan a los siguientes criterios de búsqueda:



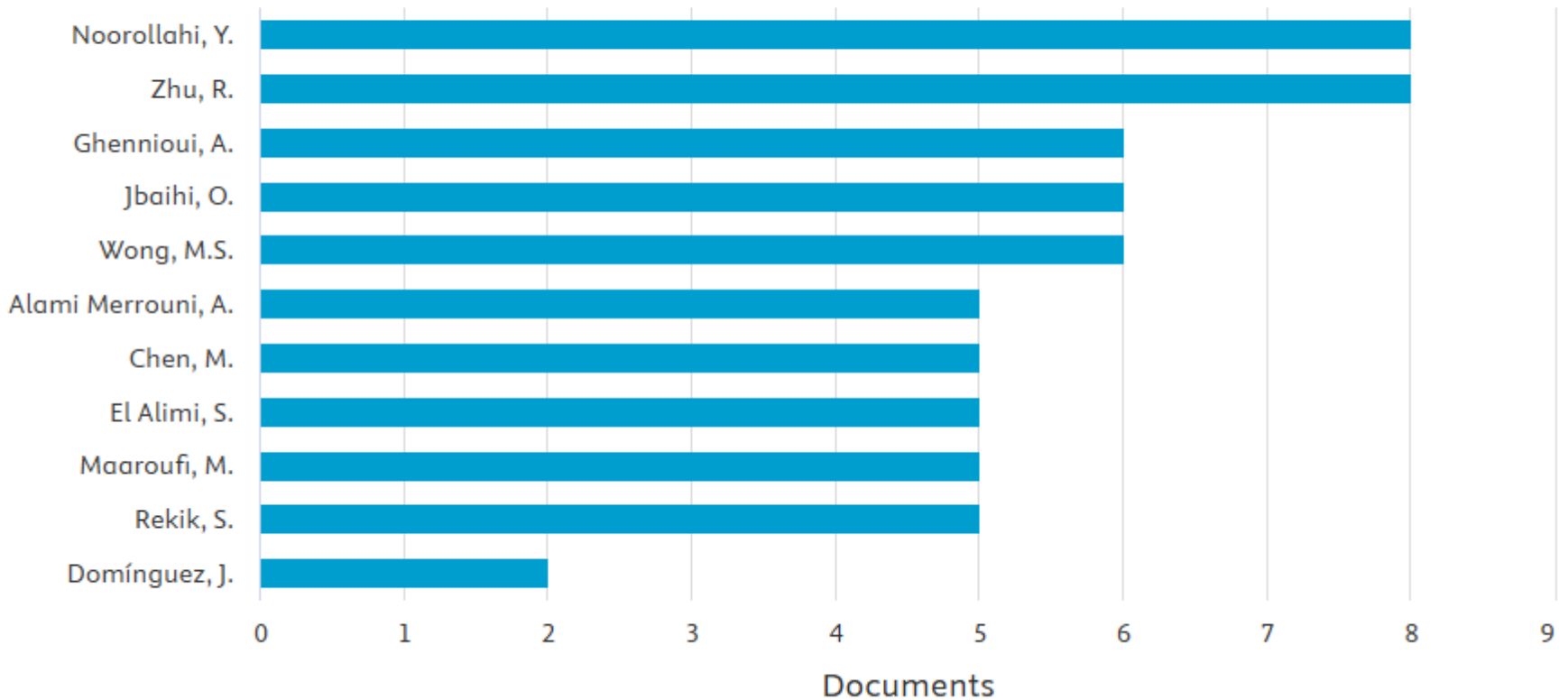
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366 document results

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Resultados: cuando

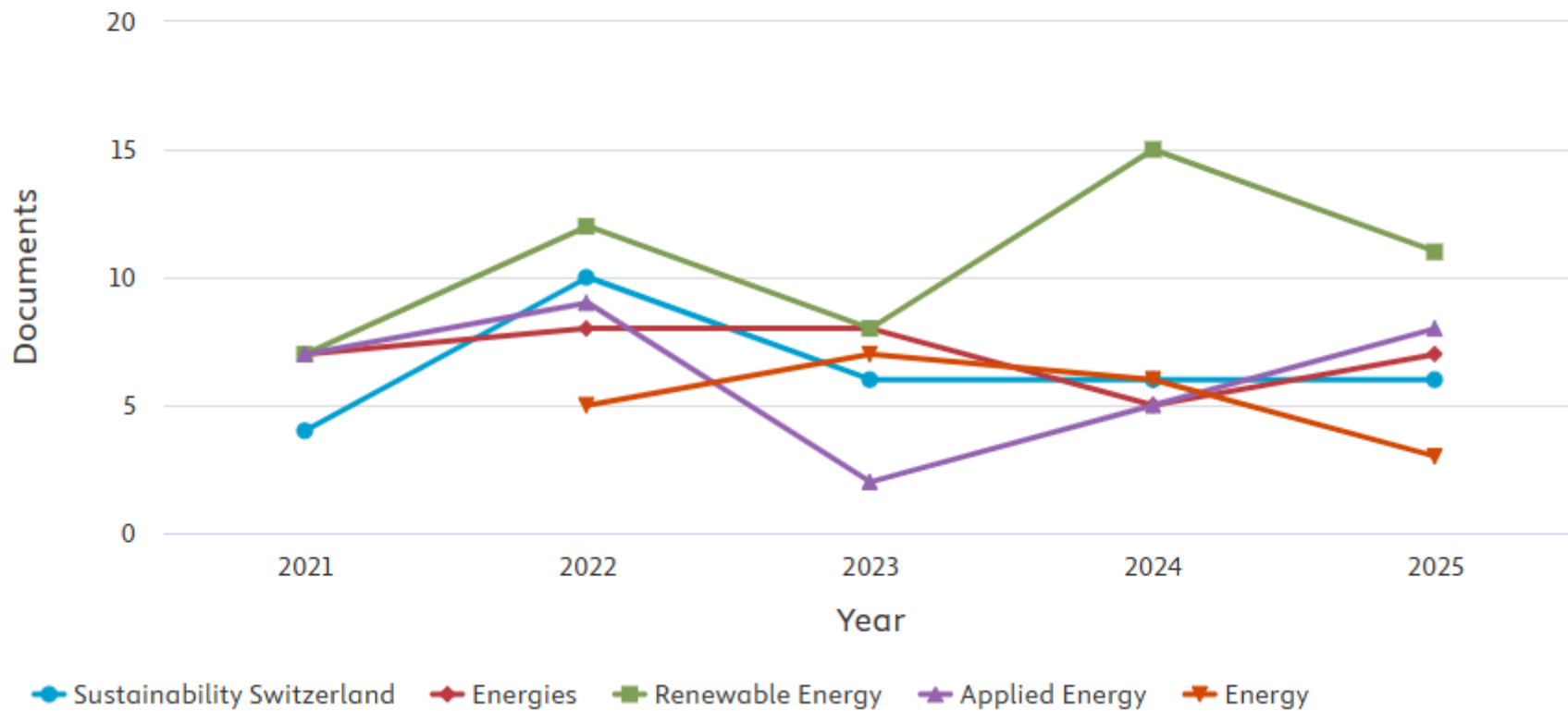
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Documents per year by source

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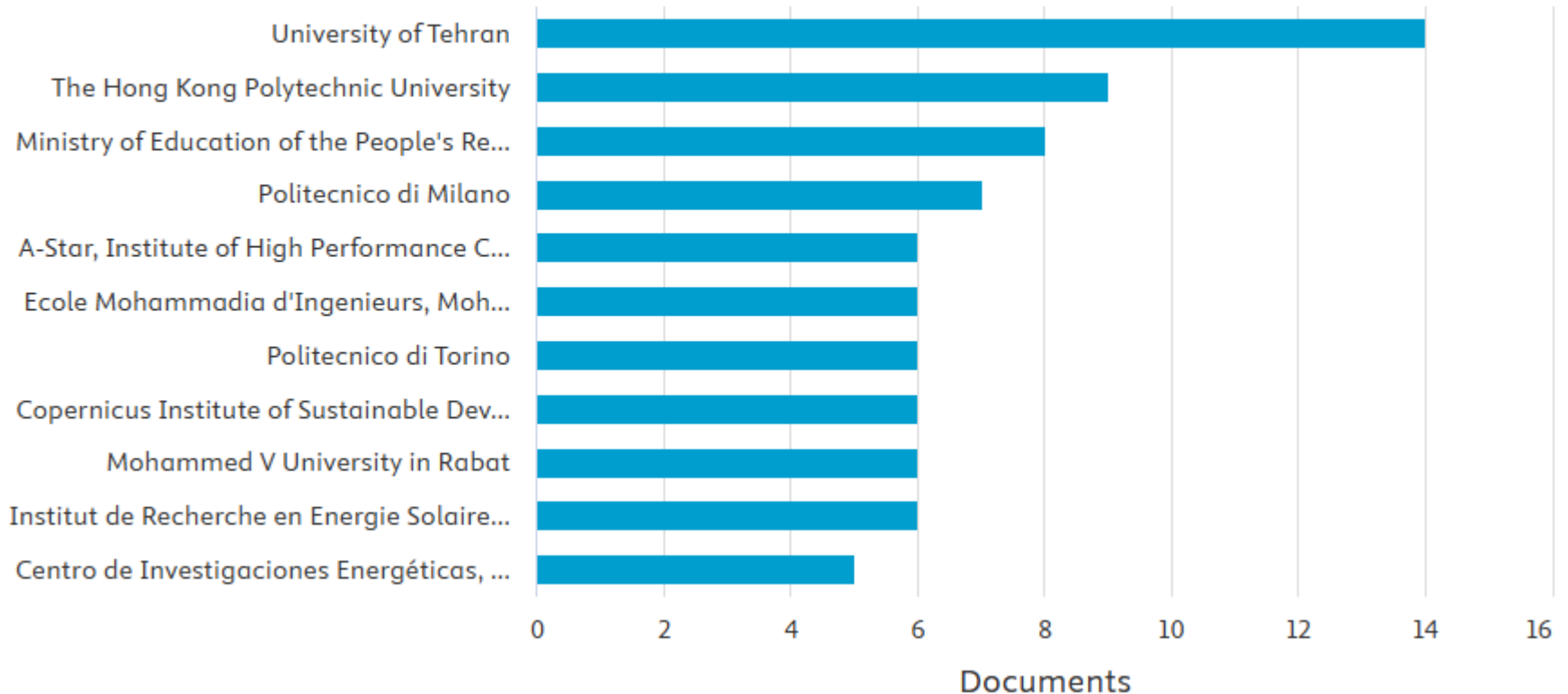
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Resultados: instituciones

Documents by affiliation

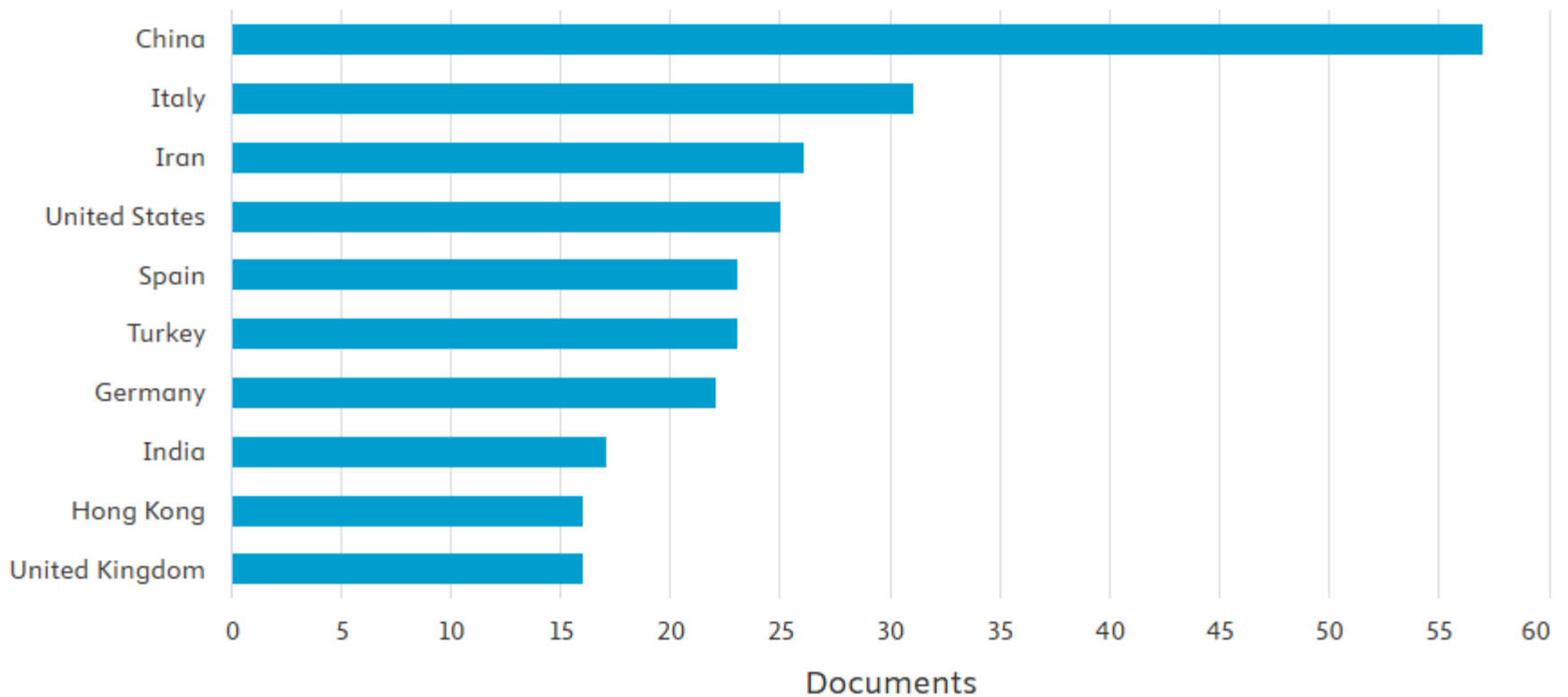
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Resultados: ¿donde?

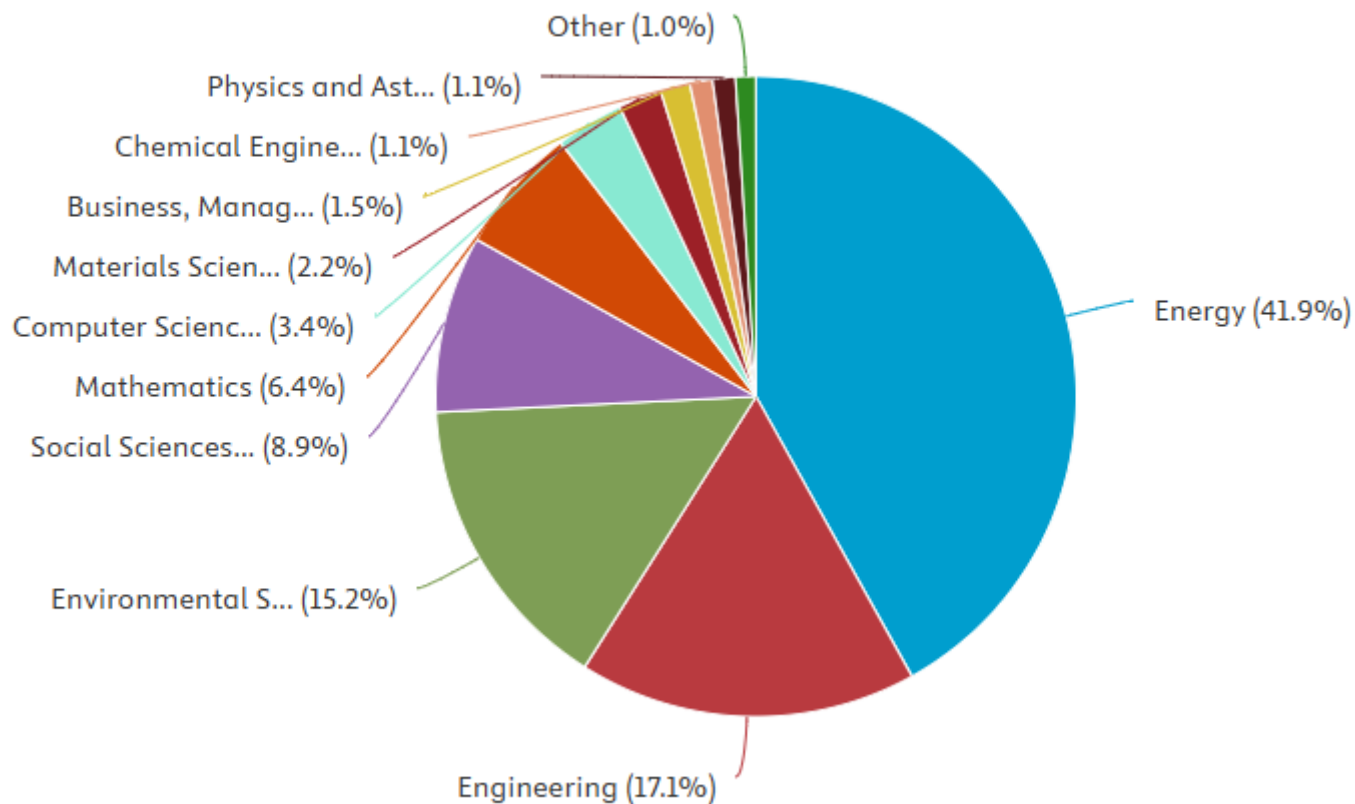
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Resultados: áreas temáticas

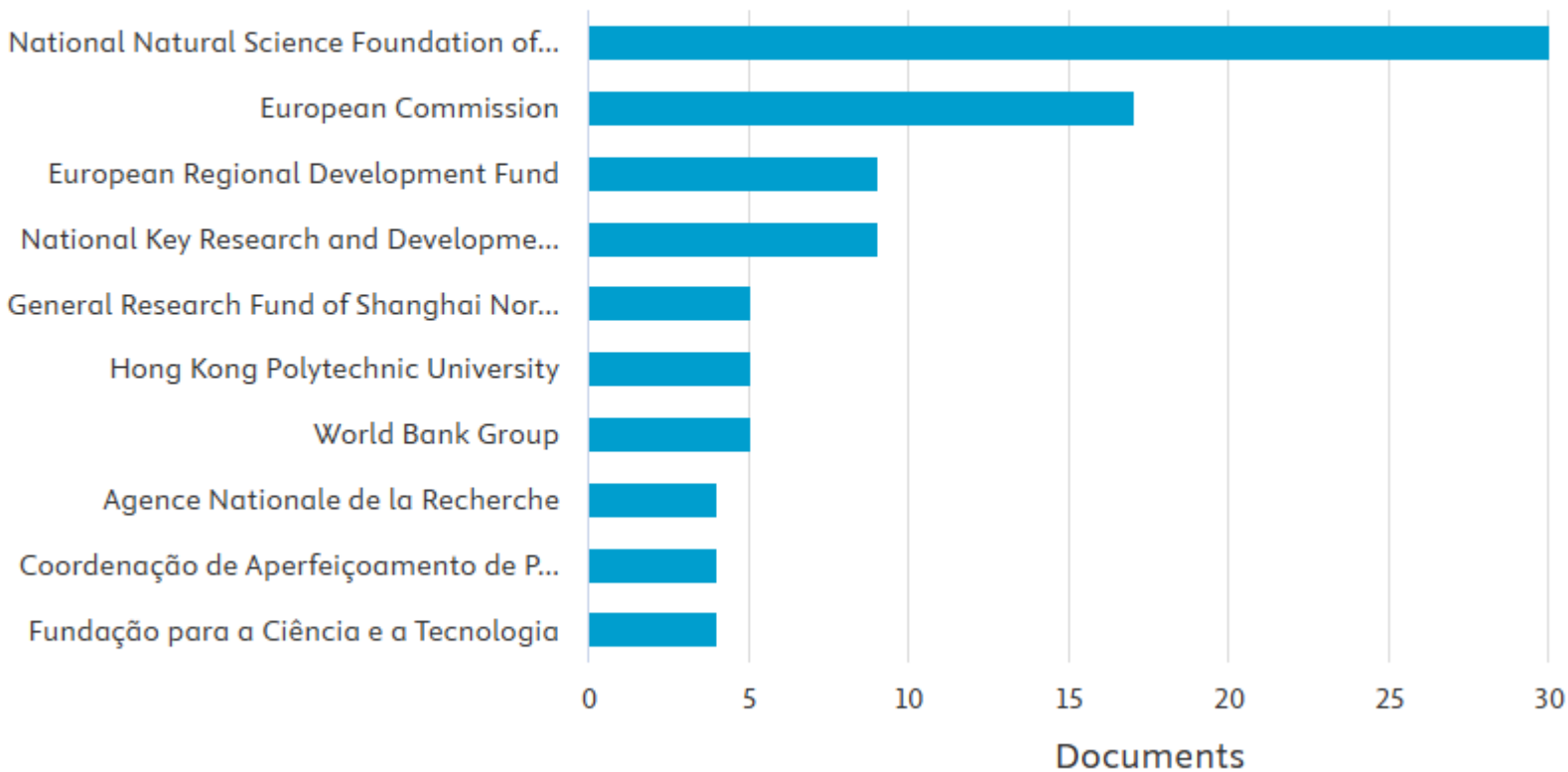
Documents by subject area



Resultados: ¿Quién financia la investigación?

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Solar Heat for Industrial Processes

36 87th percentile

Citations

1.97

FWCI



A GIS-AHP approach for determining the potential of solar energy to meet the thermal demand in southeastern Spain productive enclaves

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ARTICLE INFO

Keywords:
 GIS-AHP
 SHIP
 Solar potential
 SE
 Renewable energy generation
 Site selection
 Thermal demand

ABSTRACT

In this work, the potential of southeastern Spain to host solar thermal plants to meet industrial enclaves is assessed and presented. For this, the generation of thermal energy medium temperature range is estimated, with special emphasis on those areas not energy distribution networks. This region has been selected due to its high availability while forming a geographic area that presents numerous agrofood industries. Their temperature range heat demands for boiling, pasteurizing, and other food of the best-suited sectors for the application of medium-temperature solar collectors and linear Fresnel. A Geographic Information System and the Analytic Hierarchy Process (AHP) for information management and decision making, respectively. A geographic layers provided by different information sources on climate, land characteristics and energy infrastructures, including the distance to natural gas distribution pipelins for decision making. The final result translates into a geographic suitability scale, where 55(162 km²) of the total territory in southeastern Spain is highly suitable for its productive enclaves fed by solar thermal installations, where it is estimated that the met in 42%(9.3 TWh/y) with parabolic trough and 63%(14.7 TWh/y) linear Fresnel, score since 7 points.

1. Introduction

Access to energy is a key factor for the economic growth and social development of communities. Geographical areas where population and industries are concentrated usually have all the necessary services thanks to the corresponding regional energy distribution networks connected to utility scale plants. These type of power plants, so far mainly fed by fossil or nuclear fuels, are characterized by a large capacity, and they must be considered as individual entities would cause a noticeable change in the operation of a utility. This centralized scheme, in spite of warranting a in most cases- reliable overall access to energy, is far from being considered sustainable due to the environmental effects of carbon emissions resulting from the fossil fuels combustion. In addition, most of these utility scale plants are also affected by the uncertainty, complexity, and risks inherent to global energy markets [1–3]. In this context, Renewable Energies (REs) are emerging as an alternative to fossil fuel plants to centralized schemes due to their sustainable nature and the fact that they have reached

technological maturity and, in certain work a compared to conventional energy sources. They are beginning to reach a significant share of the energy mix, thanks, among other measures, to wind and solar power plants into their systems lower marginal costs, these plants can also a limiting factors found in conventional plants: even enlarge, the existing national becoming gas market, such as the regional or national energy the involvement in the project of medium- and users' communities or local industries. Further renewable plants introduce new limitations, a landscape and ecosystems [8–10], as well as variable and difficult-to-predict nature of the storage systems [11–13].

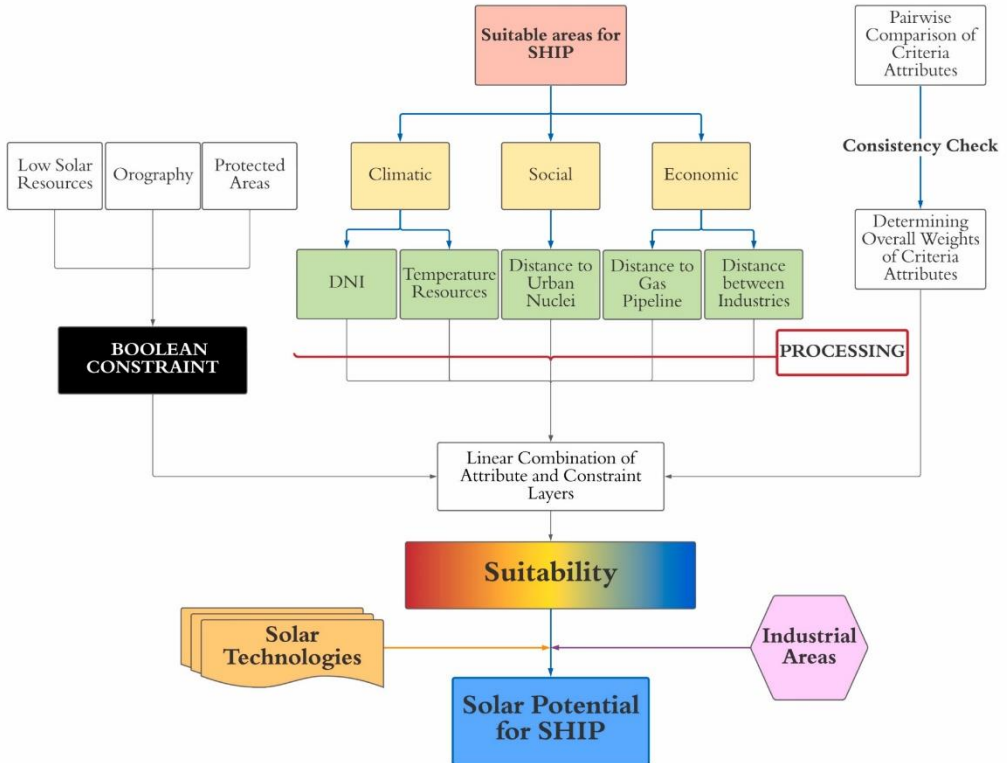
On the other hand, because of their dirtiness since they first appeared, also a relevant sit

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 1364-0321/© 2023 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY-NC license (<http://creativecommons.org/licenses/by-nc/4.0/>).

Excluding Unsuitable Areas
 Identifying Exclusion Criteria

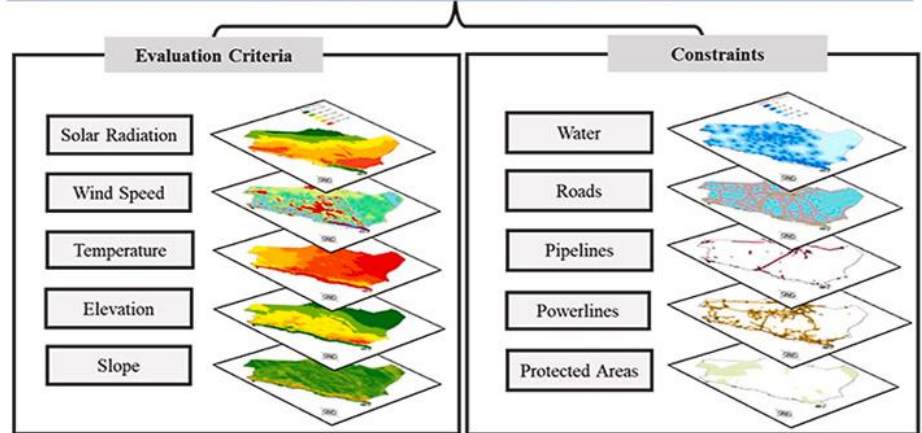
Hierarchy Structure of AHP
 Identifying Criteria Objectives and Attributes

Analytic Hierarchy Process
 Establishment of the criteria weights

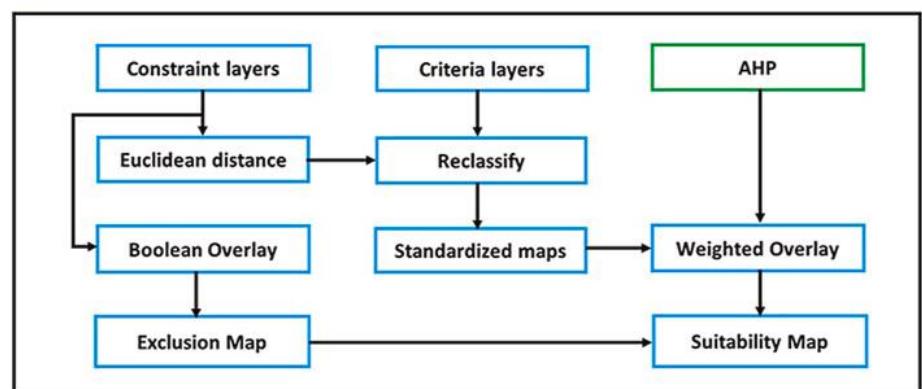


Hybrid for H2

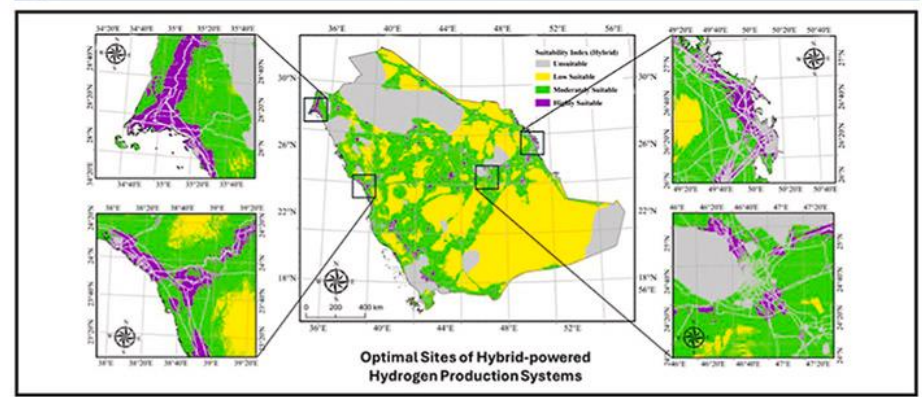
1 Spatial data collection and pre-processing



2 GIS-AHP Methodology



3 Model Output



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HYDROGEN ENERGY

ELSEVIER

A strategic GIS-AHP framework for optimal site selection of solar, wind and hybrid renewable energy systems for green hydrogen production in Saudi Arabia

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ARTICLE INFO

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Keywords:
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 Green hydrogen
 Site selection
 MCDM
 GIS-AHP

ABSTRACT

The current study employs an integrated geospatial and Multi-Criteria Decision-Making (MCDM) approach to produce suitability maps for the deployment of the Green Hydrogen Production Systems (GHPS) in Saudi Arabia (SA). For optimal site selection, three different scenarios for the renewable-powered GHPS deployment are considered: solar, wind, and hybrid solar/wind. Ten different climate, topography, and proximity criteria are utilized. The Analytical Hierarchy Process (AHP) is used to allocate weights to the considered criteria. The results indicate that 75.7% of Saudi Arabia's land is suitable for renewable-powered GHPS, while 24.3% is excluded due to constraints and buffer zones. In this case, the land is classified into Highly, Moderately, and Low Suitable Classes. The findings show that for solar-powered GHPS, the land is classified as 2.43% is Highly Suitable, 25.1% is Moderately Suitable, and 44.2% is Low Suitable. For wind-powered GHPS, land is classified as 2.36% is Highly Suitable, 24.1% is Moderately Suitable, and 69.5% is Low Suitable. For hybrid solar/wind-powered GHPS, land is classified as 1.49% is Highly Suitable, 31.8% is Moderately Suitable, and 42.4% is Low Suitable. Moreover, techno-economic assessment shows that solar-powered GHPS perform better in the western region, whereas wind-powered systems perform better in the eastern region. The annual hydrogen yield ranges from 18 to 26, 21 to 46, and 23 to 52 ton/yr, and the corresponding LCOH values range from 4.52 to 6, 2.55 to 5.23, and 3.73 to 4.76 \$/kg for solar, wind, and hybrid-powered scenarios, respectively. The findings provide valuable insights for GHPS deployment in SA.

1. Introduction

The adverse environmental impacts of fossil fuel utilization necessitate an accelerated transition to Renewable Energy Systems (RESs). To mitigate this, hydrogen is considered one of the most promising alternative energy carriers and it is expected to play a significant role in the global energy mix by 2050 [1,2]. This recognition is attributed to hydrogen's natural abundance, high energy density, and diversity of production pathways from various feedstocks, including water, biomass, and hydrocarbons. Furthermore, hydrogen can be used as an energy storage medium, a transportation fuel, and an energy carrier for power applications, thereby strengthening its role in decarbonization pathways [3].

Although several hydrogen production methods exist [4], growing interest has been directed toward green hydrogen production via water electrolysis [5]. In this process, water is split to hydrogen and oxygen using electricity from the grid [6], solar photovoltaics (PV) systems [7], wind turbine systems [8], solar thermal power plants [9], or hybrid solar/wind systems [10]. However, green hydrogen production using renewable electricity is not yet economically viable compared to grey hydrogen, which is produced from hydrocarbons (such as natural gas) through steam methane reforming [11]. For example, about 97 million tons of hydrogen were produced globally in 2020, of which less than 1%

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LÍNEAS FUTURAS Y CONCLUSIONES

- ▶ El desarrollo de la investigación y análisis bibliométrico se va a plasmar en una publicación posterior
- ▶ Importancia de los SIG
- ▶ Invitación a participar...

Topic

GIS-Driven Renewable Energy Solutions: Advancing Regional Development, Rural Electrification, and Universal Energy Access

Topic Editors

Prof. Dr. Javier Domínguez Bravo
Dr. Luis F. Zarzalejo
Dr. Markus Biberacher

Deadline

Abstract Submission
30.04.2027
Manuscript Submission:
30/7/2027

Participating Journals

Clean Technologies, Energies, Sustainability, Applied Sciences, Sci

GIS-Driven Renewable Energy Solutions: Advancing Regional Development, Rural Electrification, and Universal Energy Access

- The aim of this Topic is to share insights into the importance of Geographic Information Systems (GIS) in the development of renewable energy.
- This Topic aims to include studies, reviews, research, and projects related to the implementation of Geographic Information Systems and other associated technologies, which are focused on improving the integration of renewable energies as an alternative to the current energy models, thereby promoting a fair energy transition that facilitates universal access to energy, prevents energy poverty, improves regional development, and contributes to mitigating the effects of climate change.
- We are pleased to invite you to contribute to this Topic, which aims to foster the exchange of knowledge regarding the critical role that Geographic Information Systems (GIS) play in advancing renewable energy development. The Topic will address regional development, rural electrification, energy access, and energy poverty, while also acknowledging the broader applications of GIS in the renewable energy sector. Over the past three decades, GIS has become indispensable in the planning and integration of renewable energy projects. Their ability to incorporate geographic, technical, economic, and environmental variables, coupled with the growing availability of geographic data sources, including remote sensing, has solidified GIS as a cornerstone of energy transition strategies. This Topic welcomes studies, reviews, research, and projects that explore the implementation of GIS and geographic information technologies in promoting renewable energy integration. We hope to highlight their potential in driving a justified energy transition, ensuring universal energy access, combating energy poverty, fostering regional development, and mitigating climate change impacts. Given its multidisciplinary nature, this Topic invites contributions from experts in geography, energy engineering, environmental sciences, earth sciences, agronomy, economics, social sciences, and other related fields.

Participating Journals



Applied Sciences

86,302 Articles | Launched in 2011

2.5

Impact Factor

5.5

CiteScore

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Ranking

Clean Technologies

494 Articles | Launched in 2019

4.7

Impact Factor

8.3

CiteScore

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Decision**Q2**Highest JCR Category
Ranking

Energies

61,504 Articles | Launched in 2008

3.2

Impact Factor

7.3

CiteScore

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Decision**Q3**Highest JCR Category
Ranking

Sci

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5.2

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