

## SOLAR CADASTER - A SOLUTION FOR ROMANIA'S SOLAR ENERGY

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### Abstract

*Green energy is a topical issue as there is a move towards more and more energy consumption, be it in transport (through the development of electric cars and other mobility devices), for domestic use (heating and cooling homes) or in industry. There is a target in the Paris Agreement to increase renewable energy consumption by up to 65% by 2050. One solution for obtaining electricity in urban areas where space is limited is to install solar installations on the roofs of buildings. By implementing a solar cadaster, the potential of these areas can be highlighted and calculated. Geodetic engineers can be involved in all necessary steps of solar map development, implementation and updating.*

**Key words:** cadaster, GIS, Romania, solar cadaster

### INTRODUCTION

Green energy is an energy produced from renewable sources that doesn't generate contaminated substances or greenhouse gases, that help to protect biodiversity and the people as much as possible. Green energy, which is generated from natural resources and renewable sources, it is more looked into by a population that is preoccupied by the environment and to take part in protecting and to upkeep the planet. The nature has a set of characteristics that can be converted into electrical energy. Main sources of renewable energy are: **Sun** - solar energy is produced by using solar panels that are capable to convert sun's natural energy in two types of energy:

- Photovoltaic solar energy: the solar rays from the solar panels that are converted into electrical energy by the photovoltaic cells that compose them
- Thermic solar energy: the solar panels concentrate the light and the heat from the sun converting them into electricity. Solar energy is the most abundant energetic resource from Earth - 173.000 terawatts of solar energy hit the earth constantly. This

is 10.000 times greater than the total energy consumption on the entire world.

(source:<https://www.endesa.pt>)

Other sources of renewable energy are: wind, tides, water, biomass, earth's heat.

Advantages of green energy are very significant and they are:

- Renewable: unlike fossil fuel (coal or natural gases), the sun, wind and earth's heat are replenishable and durable that can be renewable in a natural and regular way. This fact dictates the ending of the worries about the deficit of resources.
- Sustainable: because it has a renewable and clean origin, green energy is a big contribution to protection of the environment, protection and durability of the planet Earth.
- 100% green: energy is generated from renewable source, which means that it doesn't have a negative impact on the environment, like greenhouse gases, soil, air and water contamination.
- Less electrical dependence from other countries: reducing the need to import fossil fuel, like coal or natural gases, exported from other countries.

- Reducing the up keeping and exploiting costs: Renewable energy continues to go towards a more efficient future from an economic standpoint. Nowadays the up keeping costs are smaller than the costs associated with the combustion of fossil fuel.
- Minor risks: The risk associated with the production of energy from renewable sources is significantly less than the unrenewable one.
- Improving the public health: fossil fuel energy production is responsible for a big part of the air, water and soil pollution, affecting the air we're breathing, the water we drink and the food we are growing, collecting and consuming. On a long term, the risks to live in polluted areas include respiratory problems, heart attacks, neuronal problems and other serious complications. An engagement towards green energy will eliminate all these problems and will contribute to improving the health of our community.

## MATERIALS AND METHODS

For the creation of solar maps it is necessary to acquire data from the field with Lidar measurements or from digital elevation models. From these 3D models we can extract the necessary data for the creation of solar maps such as: geometry and area of buildings, area and slope of roofs, geographical orientation etc. These elements can be entered into a GIS, then we can estimate the solar potential of the building. The important thing is the roof area of the building and its orientation.

A very important tool for solar cadastre is represented by 3D cadastre, namely by introducing the third dimension, different situations regarding the built areas can be better illustrated. Also, the introduction of the third dimension and the management of information in a GIS environment for both 3D cadastre and solar cadastre contributes to the clarification of energy consumption and for the development of photovoltaic panel infrastructure (Moscovici et al, 2019).

## RESULTS AND DISCUSSIONS

To a national and European level, in the past 20 to 25 years, the environment pollution problems were beginning to be taken more and more into consideration. Therefore, a series of measures have been taken, especially in maintaining the air quality department, the proper management of waste and the ways of obtaining electrical energy.

In Romania, for production and promoting the production of renewable electrical energy, starting with 2003, the primal laws that represent the base of this activity had begun to be created. Green energy regulation to a European level tally with the entry of environmental problems to a larger scale in public debates. First laws were adopted in 1997, when it was settled that until the year of 2010, 22.1% of the consumption of electricity has to come from renewable sources. In 2001, the objective specific to each country of the European union have been settled. Because through these measures the wanted results weren't obtained, subsequently a much better define legislative framework has been crated. (source: <https://stratos.ro>)

**At european level in the future**, one of the most recent developments in this domain is the one that came after the Paris Conference in 2015 regarding the climate, through which it has been settled that the percentage of energy from renewable sources need to be 27% from the total consumption until 2030 in the European union. It was pursued that until 2030, 32% of Europe's energy to become green, with the mention that until 2023, the percentage will be revised, depending on the progress made until then.

In 2020, the percentage it has gone up once again to 55%, even 60%, a very big number, but it was considered fitting after signing the Pact for Green Europe and the announcement of the strategy plan by the European Commission von der Leyen.

To a European level one of the most important perspectives is the creation of an Energy Union, that will reassure the total integration of the national markets in energy.

Cities that host more than half of the population of the earth, consume the biggest majority of energy from the entire world. To become more resilient for the future, cities have to start to make their own energy not just to reduce the necessary of it. One way to generate renewable energy in an urban environment is to utilize the solar energy. It is important to obtain a bigger image, more detailed, of the quantity of energy that we can produce with solar panels on the roofs of existing buildings. One way to analyze the potential of the existing environment is through solar maps.

**A solar map or a solar cadaster** it's a GIS system that shows the annual solar radiations on the surface of the existing buildings, most of the times it comes with the solar energy production, thermic or photovoltaic systems and connection to a website. Many municipal administrations already have solar maps and they serve mainly two purposes: as a frontal platform to inform citizens for the potential of their own roof and as a back-end instrument for city administration that they can depend on for energy related decisions.

The actual solar maps have different levels: the delivered information quality can differ a lot for each user. Sometimes, solar maps are a component of bigger programs to obtain more renewable energy productions in cities and to offer users direct access to information about solar system providers. Other solar maps offer the users just the solar radiations, without any other information. Plus, all the solar maps until now only cover the solar radiations to the roofs and not to other walls.

The principal accent of all solar cadaster applications is based on the following aspects:

- Annual solar radiations (KWh/m)
- Applications considered
- (photovoltaic, thermic)
- Total power per roof (KWh/area)
- Assumed efficiency of technologies
- Patrimony limitations (buildings with cultural patrimony are marked)
- Step value per category (KWA/m)
- Minimal surface of the solar system (m).
- Solar Maps can generate data about:
- The potential of building photovoltaic panels
- Solar-thermic potential
- Solar radiation potential analyses



Figure 1. Solar potential map for the city of Schwerin from Germany – Data about address and annual solar radiation per surface (source: <http://solar.geocontent.de/schwerin/>)

Different types of solar maps are already developed in cities across Europe.



Figure 2. Solar radiation potential map for the city of Schwerin from Germany (source: <http://solar.geocontent.de/schwerin/>)

## CONCLUSIONS

- Romania, at the current moment doesn't have any solar map and this concept is not developed or proposed for implementation;
- There is a target to increase renewable energy consumption by up to 65% by 2050;
- It is our duty to bring this new concept into the attention of the public, because engineers are directly involved in every step of the developing of solar maps, from the field data purchase, which can be done through LIDAR, or through digital model generations of the terrain, and data manufacturing in the coordinate system with dedicated programs and creations of

a GIS. Also the updating of the maps it's an important element

- The implementation of the solar cadaster and creations of solar maps for urban zones as fast as possible is strictly important, considering that the Romanian Government finances the 'Green House' program for installing photovoltaic systems
- Through the implementing of the solar cadaster program 'Green House' it could finance with priority being the areas with the most solar potential, and with the help of the data delivered by the application it could request a selection criteria.

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