WORLD DATA LEAGUE

Energy communities inclusive of residents vulnerable to energy poverty

Challenge Provider: City of Ghent

Ghent is the second largest city in Flanders, Belgium with a population of approximately 260'000. The City of Ghent has **huge ambitions in the fields of climate mitigation and adaptation**. Ghent has a climate plan 2020-2025 on climate mitigation, climate adaptation, food strategy and circular economy and in 2014 it signed the Covenant of Mayors as one of the first cities in Flanders.

The service for climate and environment has a team working specifically on **participation in transition, education and behavioral change**, in tight collaboration with its experts on climate and environment. The focus on applying insights from different theories and paradigms has resulted in specific actions with an impact on energy renovation, adaptation measures, sustainable food and mobility.

The **One Stop Shop for energy renovations** (Energiecentrale) is a good example of insights having been implemented successfully into a widely spread practice, together with a data driven evaluation. Further insights can for instance be used and tested in this practice and widened towards working more inclusively for migrant and vulnerable populations, promoting renewable energy and a just energy transition. The city of Ghent aspires to serve all SDG-goals.

In collaboration with numerous partners, the City and OCMW Ghent contribute to the recognition of the 17 Sustainable Development Goals, the Climate plan being one of many examples. Since 2017, the **City of Ghent has been one of the ambassadors** to help announce and implement the SDGs in Belgium. The challenge is not only to promote the SDGs, but also to encourage citizens, organizations, the business community and educational institutes to take sustainable action. Ghent launched a **successful campaign in 2018** and was internationally acclaimed for it.

In light of the current energy crisis, the urgent need to conserve energy and switch to renewables, Ghent has launched several initiatives aimed at increasing energy efficiency and promoting sustainable changes. One example being consultation services for citizens looking for green energy alternatives or the introduction of "renometers" - energy meters in houses recently renovated or due to be renovated.

With rising energy prices posing the risk of pushing more residents into energy poverty, the city of Ghent is looking for solutions that secure energy for those most in need. The city has mapped the solar potential of solar roofs and additionally started mapping the potential of green roofs as an energy saving measure for businesses.

Combining this information with street level data on energy consumption and information as to where the most vulnerable people are located within the city, Ghent would like to understand where would be best to establish new energy communities.

Context

Energy communities are an effective way to allocate and distribute energy in an equitable manner. Recently the EU launched the Energy Communities Repository defining different types of energy communities with the core tenant of their primary purpose being to generate social and environmental benefits rather than financial profits.

To form an energy community, first, opportunities for clean energy production, for example properties with roofs collecting large amounts of sunlight, need to be identified. The second step typically involves using data on energy usage and energy poverty to form local communities that can profit from the clean energy which is being produced.

While Belgium has no legal requirement for the size of energy communities and legally does not require geographical closeness, smaller and more local energy communities can offer additional benefits in terms of flexibility, grid-independence and a psychological incentive for energy demand reduction. To see the benefits of the nearby energy plant, can raise the awareness and faith in local renewable energy production.

After having gathered data on energy consumption, vulnerability and green energy production potential, the city of Ghent is looking for the best solution to form energy communities to propose to its citizens.

The output of this challenge is to be applied in further decision making processes on how to form energy communities in Ghent. The City has recently funded a study on how to form a cooperative entity with citizens as an energy community. It remains a challenge to enthuse people to join an energy community or to volunteer for governance or management tasks within the cooperatives. Proximity and visibility of power plants that can form the base for a community, could enthuse people to join. The City will support and enable these cooperatives.

Further Background Information

- Eurocities Stories:
    - Bringing the energy transition to people: https://eurocities.eu/stories/bringing-the-energy-transition-to-people/
    - Cities step up to mitigate energy poverty: https://eurocities.eu/latest/cities-step-up-to-mitigate-energy-poverty/
    - Valencia's local energy communities: https://eurocities.eu/stories/empowering-light/

- EU Rural Energy Community Advisory Hub - What is an Energy community?: https://rural-energy-community-hub.ec.europa.eu/energy-communities/what-energy-community_en
- EU Energy Communities Repository: https://energy-communities-repository.ec.europa.eu/index_en
- Energy communities as demand-side innovators? Assessing the potential of European cases to reduce demand and foster flexibility: https://www.sciencedirect.com/science/article/pii/S2214629622003516 (open access)

Goal

The goal of this challenge is to leverage the existing data to propose how energy communities could be formed in the city of Ghent with a special focus on including residents vulnerable to energy poverty.

Sustainable Development Goal

GOAL 7: Ensure access to affordable, reliable, sustainable and modern energy for all
Target 7.1: Ensure universal access to affordable, reliable and modern energy services
Target 7.2: Increase substantially the share of renewable energy in the global energy mix

Outcome

Create an optimization algorithm that proposes potential energy communities in the city of Ghent. The algorithm needs to take into consideration potential and existing sites for renewable energy production, energy consumption and inclusivity to residents vulnerable to energy poverty. The algorithm also should be scalable to account for potential future restrictions on the size of energy communities or geographical proximity between members. Ideally the solution would be scalable to other cities as well where similar data has been collected.

Available Resources

All the data resources can be found here:
https://wdl-data.fra1.digitaloceanspaces.com/2023/Ghent/ghent_data.zip

As a reminder, you can also use any data that is open, free and legally available. It is also highly recommended to use the OpenStreetMaps data with regard to understanding residential areas, business areas and others.

The resources are provided by the city of Ghent and the energy company Fluvius.

The following list of resources is available for you to use:

- Geographical data on sun irradiation on a 3D model of Ghent (See the Appendix for background information).
- 3 Datasets from the Fluvius energy company on energy consumption in Ghent.
- 4 Datasets from Fluvius on energy production, storage devices and EV charging points.
- A dataset from Ghent in cijfers on average income per sector.
- A dataset on current rent prices in different locations in Ghent.

The description of the datasets can be found in the data dictionary.

You can also use the following resources:

- All 21 datasets available from the energy company Fluvius: https://opendata.fluvius.be/explore/?sort=title (website in Dutch)
- The Ghent in *cijfers* dashboard: https://gent.buurtmonitor.be/ (website in Dutch)
- Ghent Open Data Portal (210 datasets): https://data.stad.gent/explore (website in Dutch)
- Interactive Map of the Ghent Open Data Portal: https://data.stad.gent/map/ (website in Dutch)
- Interactive Map of the sunlight data: https://stad.gent/nl/energiecentrale/renovatiegids/zonnepanelen/de-gentse-zonnekaart (website in Dutch)

Tips

- Ghent encompasses the Zip codes: 9000, 9030, 9031, 9032, 9040, 9041, 9042, 9050, 9051, 9052.
- There is a common saying: “a Belgian has a brick in the stomach”, by which it is said that a lot of people (more than 70%) are owners of the property in which they live. Until now, the installation of solar energy is mostly a private investigation on a private roof. https://ec.europa.eu/eurostat/cache/digpub/housing/bloc-1a.html
- Be aware of the GDPR-restrictions that are also strictly applied in our city.
- The urban planning in Ghent is historically grown and is quite fragmented. The actual legislative framework allows us to build energy communities over a long distance, however, we think that the close proximity contributes to the creation of a community feeling and ownership.

Submissions

Deadline: 21 June 23H59 AoE

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gent:

Don’t forget that you will need to submit the solution report (notebook template with the link below) and executive summary (markdown template below) and a 3 minute pitch with a technical overview of your notebook. You also will need to present your solution as a **5 min** finals pitch to a non-technical grand jury live on June 30th at 17h00 CEST. The grand jury will also have access to your executive summary.

Solution report template: https://bit.ly/wdl2023-notebook
Executive summary template: https://bit.ly/wdl2023-summary

Appendix: Calculation method solar map

Irradiation:
The Digital Elevation Model of Flanders II is used as the basis for the calculation. In essence, it is a point cloud of 16 points per m² including height information. This measurement was done with a laser during a number of flights in the spring of 2013.

Based on this data, a map was made with cells of 0.5 by 0.5 m. It is on this map that we performed the calculation for solar potential. The amount of sunlight per year was calculated for each cell.
The orientation and shading of tall vegetation and buildings are the main factors influencing solar potential. The result of this exercise is an amount of potential solar energy per m² calculated for every 0.5 x 0.5 m cell.

This solar potential map is shown as background if you click on the layer "Zonne-instraling" next to the map here:
https://stad.gent/nl/energiecentrale/renovatiegids/zonnepanelen/de-gentse-zonnekaart
(website in Dutch)

Suitable roof surfaces:
The following steps were taken to determine suitable roof surfaces:

1. The cells were clipped onto buildings. All cells that are not on a building were disregarded. This exercise is limited to suitable roofs. This gives some errors because recent changes to buildings are not always mapped. Cells with an irradiance < 800 kWh/m² were also omitted. This concerns cells that received too little irradiation due to orientation or shading to allow placement of to generate solar panels.
2. Finally, the cells were grouped by roof surface. Roof surfaces < 5m² are considered too small for the installation of solar panels.

Average electricity yield per roof surface:
To arrive at an estimate of the electricity yield, the following calculation was performed:

For a flat ("plat") roof (0° - 15°):
Annual solar radiation per m² * suitable roof area * 0.15 (average efficiency factor of a solar panel to convert sunlight into electricity) * 0.7 (average correction factor because panels on a flat roof can be placed less efficiently) * 0.85 (average loss due to sub-optimal placement)

For an inclined ("hellend") roof (> 15°)
Annual solar radiation per m² * suitable roof area * 0.15 (average efficiency factor of a solar panel to convert sunlight into electricity) * 0.85 (average loss due to sub-optimal placement.