Prosumer Energy Behaviour Report

(September 2021-May 2023)

Overview

In this report, we analysed the energy data from Enefit, a green-energy company in the Baltic Region between September 2021 and May 2023. The dataset was obtained from Kaggle. The data was analysed by investigating the performance of Enefit in the window under review and the behaviours of customers who both generate and consume their energy.

Analysis

Performance

- We look at the current total number of consumption points (customers) and capacity of solar panels installed in Estonia
- The total number of consumption points for businesses and non-businesses
- The capacity of solar panels and consumption points by regions
- Solar panel installation and consumption point performance in terms of contract type
- The month-to-month percentage change in solar panel installations and consumption points.
- We looked at the trend in the gas and electricity prices
- The adoption of green energy by Estonians in terms of the monthly number of consumption points and total capacity of solar panel installed

Subscriber Behaviours

- **Energy Consumption**
    a. Energy demand per hour of the day, holidays and weekends
    b. Trend and seasonal variation in energy demand
    c. Energy consumption by contract type, business type and at county level

- **Energy Production**
    a. Energy generation per hour of day
    b. Trend and seasonal variation in energy demand
    c. County solar panel performance and efficiency by measuring the average amount of energy generated by solar capacity per hour
    d. Production vs consumption ratio by county, business type and contract type

- **Energy Dependence**

Here, we looked at how businesses and non-businesses in counties depend on solar energy-generated electricity. We assume that the amount of energy generated the previous day would contribute to the energy demand of the next day. This was investigated in three terms:

a. **Energy sufficiency:** The fraction of last day's generated energy contributed to the next day's demand.
b. **Net energy balance (Energy deficit):** Difference between last day's generated energy and today's consumed energy
c. **Utilisation ratio:** Proportion of previous day's generated energy that was utilised in the current day.

Performance

Enefit

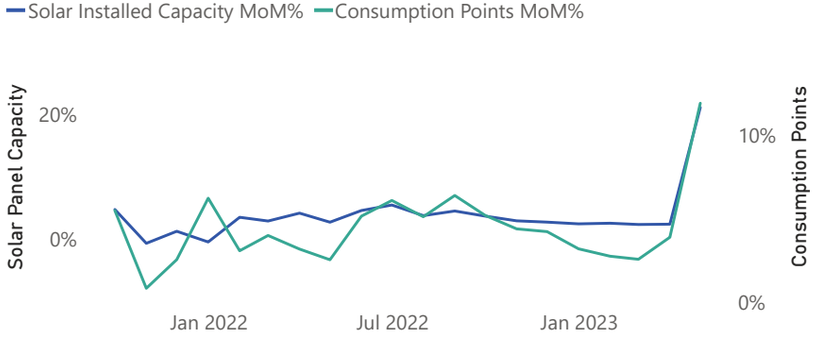
Product: All | County: All | Business Type: All

Consumption

Total Electricity consumption points	Total Solar Panel Capacity (kW)	Hourly Energy consumed (kW)	Hourly Energy Produced (kW)	Total Energy Consumed (kW)	Total Energy Produced (kW)
7472	148.51K	460.71	89.00	464.81M	89.80M

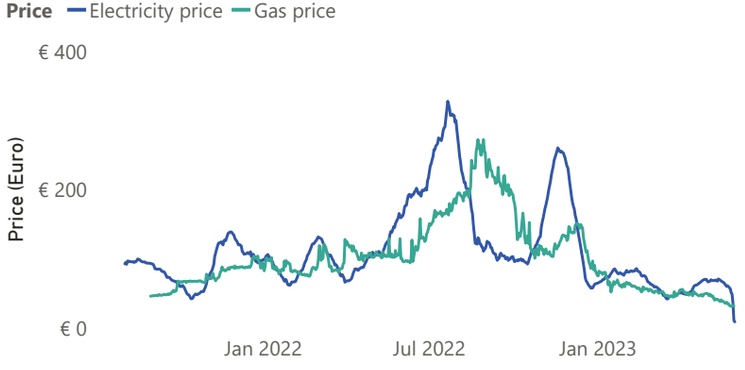
There's a sharp increase in the number of customers who subscribed to our service in May 2023

Solar panel capacity and number of consumption points increased by 21.1% and 11.9%, respectively compared to previous month.

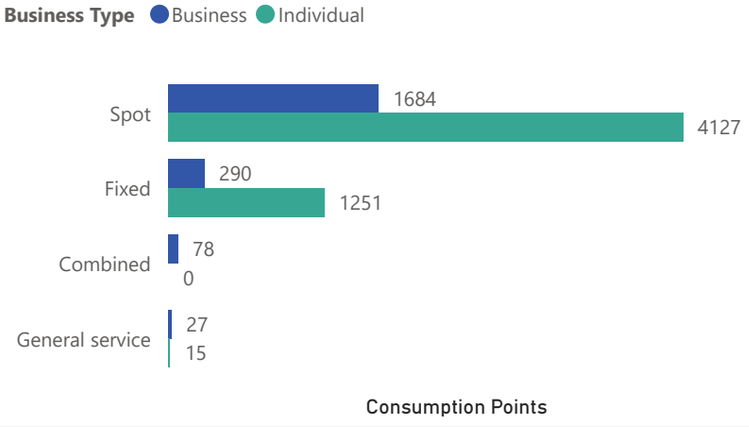


Gas and Electricity Prices

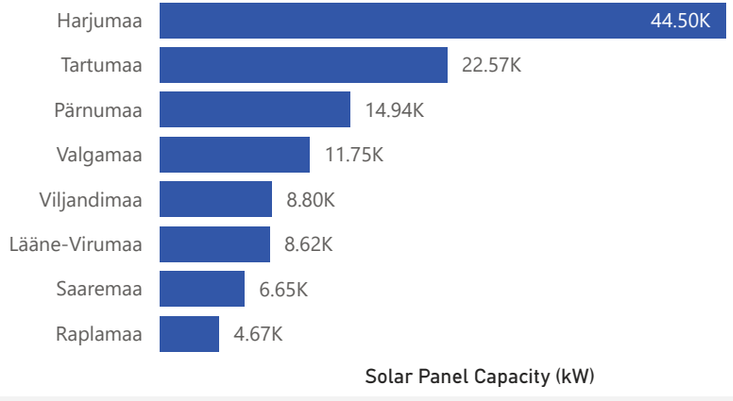
Sharp increase in solar panel patronage in May 2023 could be due to lower electricity and gas prices in 2023



There are more customers in the Spot product than any other product.

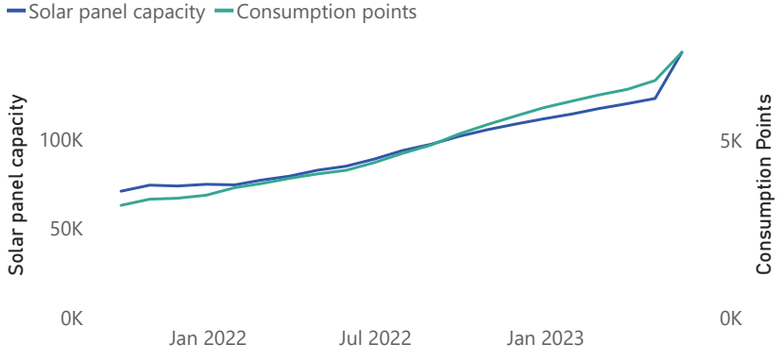


Harjumaa, Tartumaa and Parnumaa counties top the list with over 80,000 kW of solar panels installed.



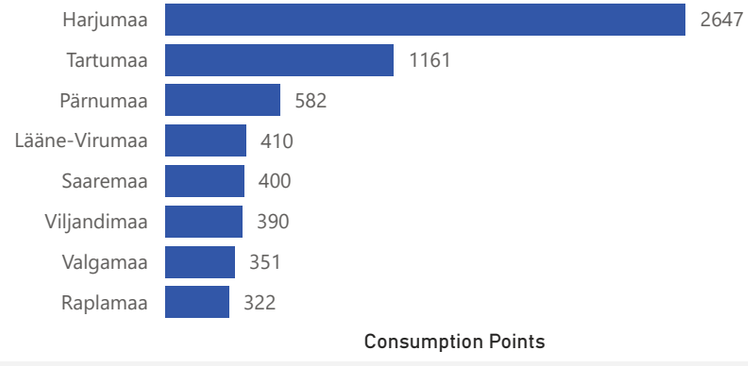
There's a monthly uptrend in the number of electricity consumption points and solar panel installations

Sharp increase in solar panel patronage in May 2023



County-level Current Electricity Consumption points

Harjumaa, Tartumaa and Parnumaa are the top counties with more customer subscription



Energy Consumption

Back

Production

Business Type: All

Year: All

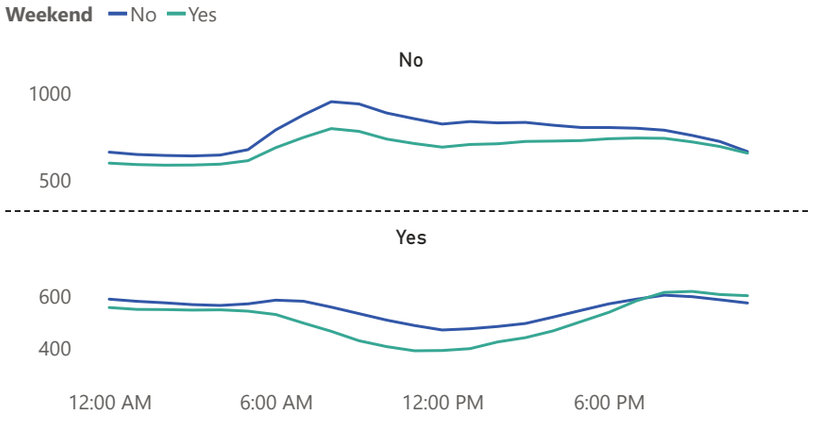
Month: All

County: All

Product Type: All

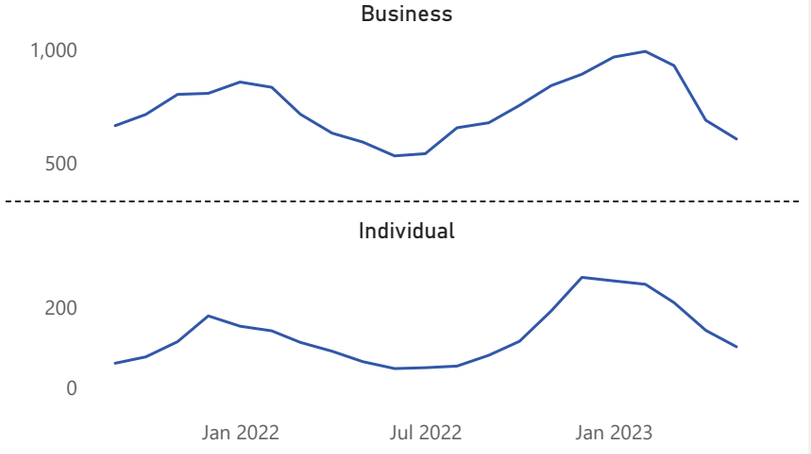
Hourly electricity consumption on and off-holidays are different with lower consumption on weekends for businesses

Consumption peaks twice, around 8AM and 8PM, off holidays while it declines to 300kW between 11AM and 12Noon before peaking toward the end of the day at about 8PM, on holidays



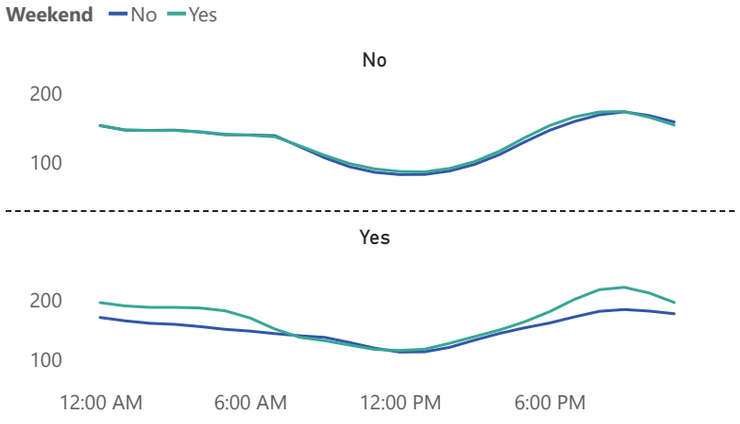
There's a seasonal variation of electricity consumption.

Electricity consumption peaks during Winter and declines in the Summer. Higher consumption in January and February and lower demand in June and July. Higher consumption in 2023 than in 2022.



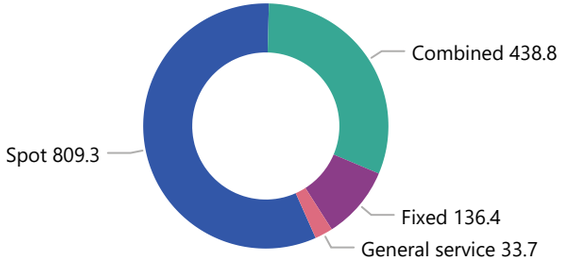
No difference in electricity consumption for non-businesses on weekdays or weekends

Unlike for businesses, consumption for non-businesses is lower. Stays relatively stable at the start of day, lowers till noon before peaking towards the end of the day. Also slightly higher when holidays are on weekends than on weekdays



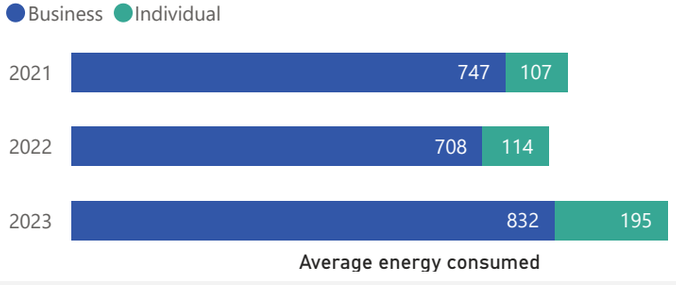
Spot subscribers consume almost twice electricity (in kilowatts) than combined subscribers

809.3 kW of electricity is consumed by spot customers per hour. This is followed by combined (438.8kW), fixed (136.4kW) and General service (33.7kW) .



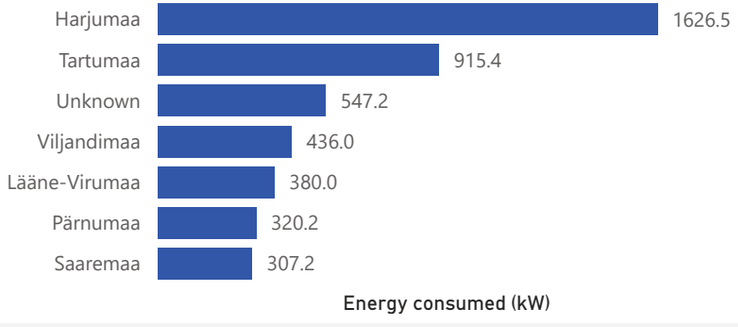
Hourly electricity consumption by businesses and non-businesses per year

Although businesses consume more energy than non-businesses, the hourly energy consumption for non-businesses has increased yearly. This could be due to more non-businesses adopting green energy.



Harjumaa county consumes the highest energy per hour

About 1.625 MW of electricity is consumed per hour by Harjumaa county. This is followed by Tartumaa



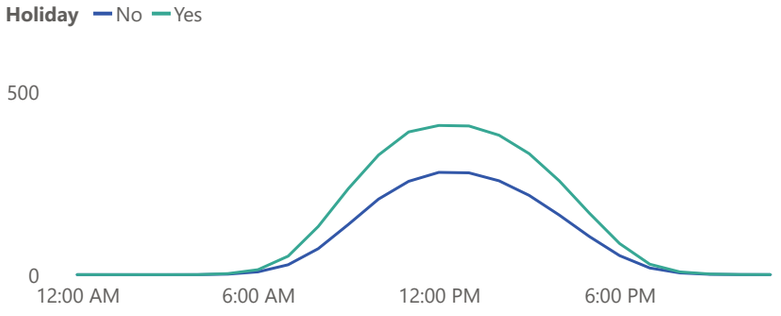
Energy Production

Back | Energy Dependence

Business Type: All | Year: All | Season: All | Month: All | County: All | Product Type: All

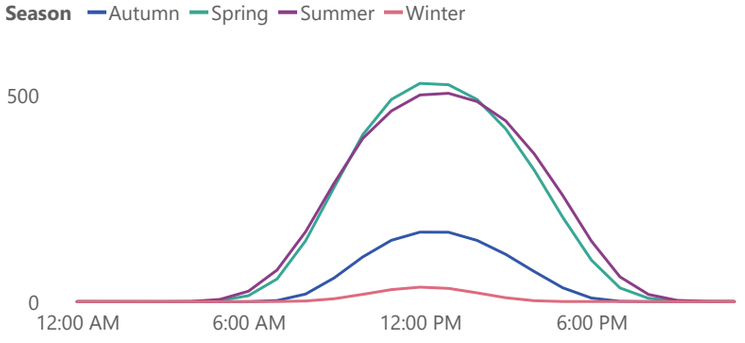
Electricity generation from solar panels peak at midday when the sun is directly overhead

Electricity is generated more on holidays than on weekdays. One reason would be because businesses are closed and may not rely on alternative energy source. Another would be that households tend to check if their solar panels are tuned on.



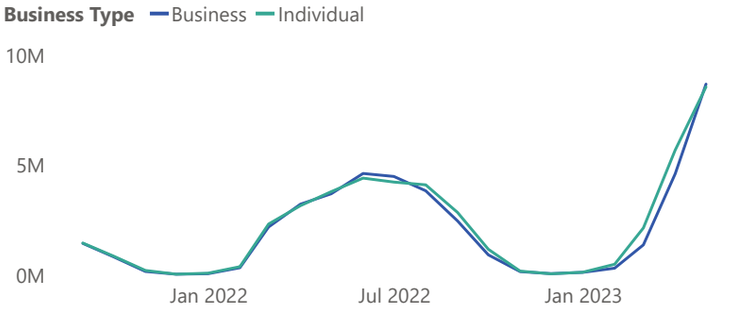
Electricity generation is more in Spring and Summer seasons than in Fall and Winter seasons when the sun appearance and intensity is relatively low

Over 600 kW of electricity is generated at midday during the Spring/Summer seasons.



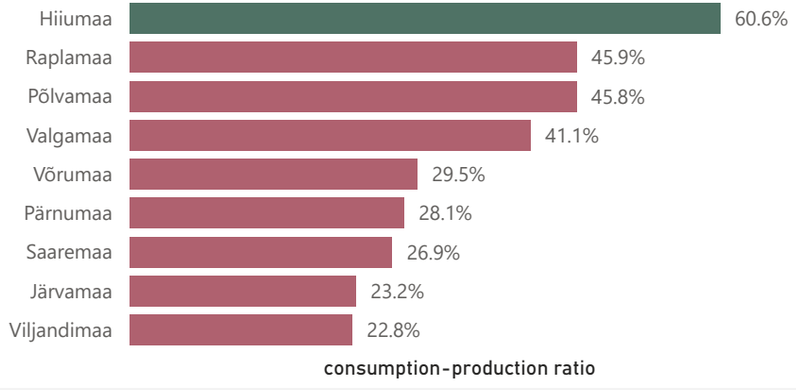
No difference in the total amount of electricity generated by businesses and non-businesses per month

The amount of energy generated per month of the year has increased. More electricity was generated before the Spring/Summer of 2023 than in 2022. Possibly due to more customers adopting to green energy to mitigate electricity costs.



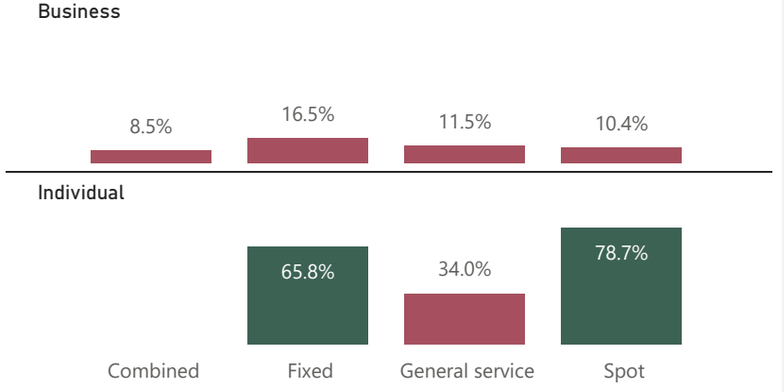
Smaller cities consume less energy than they generate.

Overall, Hiumaa county saves about 60.6% of their generated energy than any other city. Bigger cities like Harjumaa and Tartumaa depend heavily on alternative energy to run their businesses or power high-energy appliances.



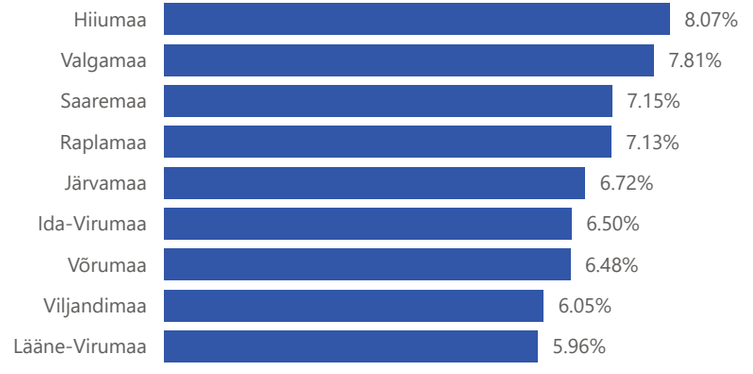
Individual subscribers save more energy than business organisations

Overall, individuals in the fixed or spot contracts save between 60 and 80% of their total generated energy. However, this differs by seasons.



Solar panel efficiency and performance

On average, the overall efficiency and performance of installed solar panel systems is higher less than 10% in all regions. This can increase up to 15% during the Spring and Summer seasons.



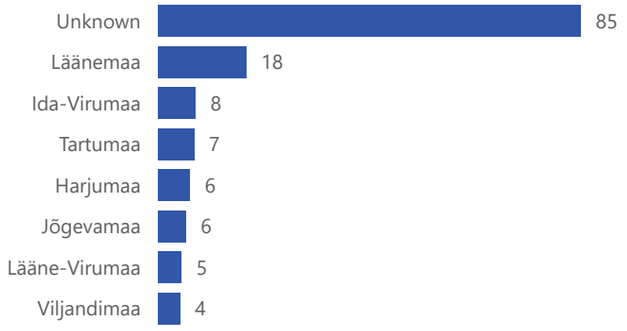
Energy Dependence

Back | Summary

Business Type: All | Year: All | County: All | Product Type: All

Energy utilisation ratio by county

Dependence of solar energy from previous day is high in counties with high business clusters. Solar panels installed in unknown areas do not meet the energy demand the next day. Businesses could be located there.

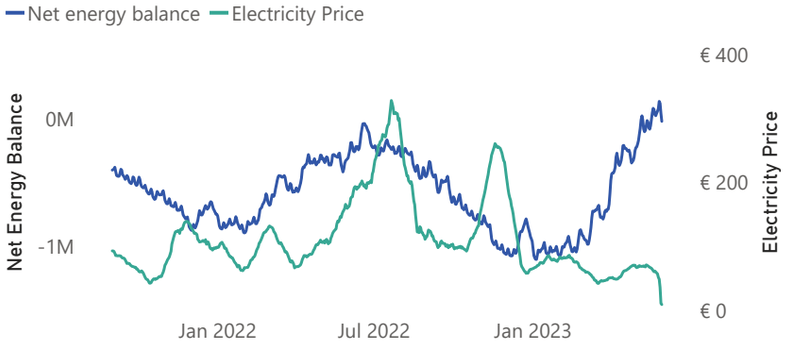


Seasonal events affect electricity sufficiency

Energy dependence on solar panels increases with seasons, with peak periods between April and July. In May 2023, we see solar panels generated all the consumed energy

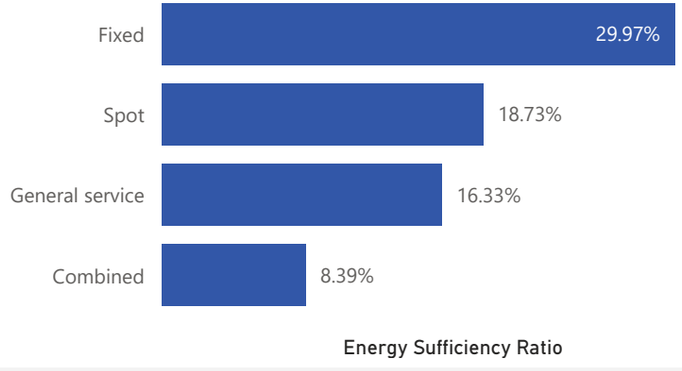
Energy deficit vs price

Reliance on solar energy by customers for energy demand during Summer could have caused higher electricity cost due to non-remittance to national grid. Other factors may have contributed to price fluctuations



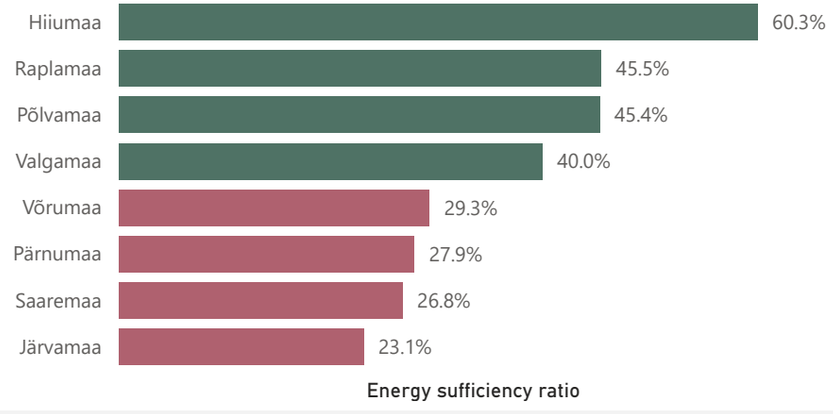
Energy sufficiency by contract type

Overall, about 30% of the energy consumed by customers in the fixed contract is met by solar energy generated the previous day. This is followed by Spot, General service and then combined contract types.



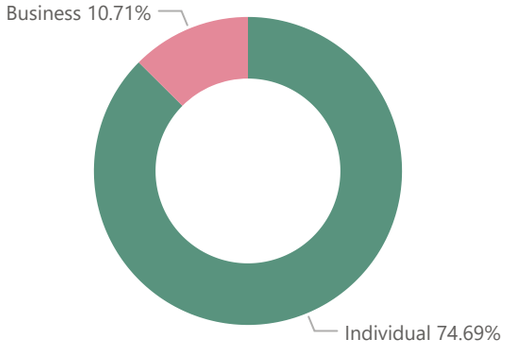
Energy sufficiency ratio by county

At the county level, the amount of solar energy generated the previous day is sufficient to meet at least 40% of the energy demand of customers in only 4 counties.



Non-businesses depend less on external energy than businesses

About 75% of the total energy demand by non-businesses the next day is met by the amount of energy generated the previous day. This is in contrast to the 10% by businesses.



Summary

- As at May 2023, Enefit has a total of 7,472 consumption points with solar panels worth over 148,000 kilowatts (KW) installed in Estonia.
- Harjumaa, Tartumaa and Parnumaa top the list with over 1,000 consumption points and over 80,000 MW of installed solar panels.
- There has been an uptrend in the capacity of installed solar panels and consumption points per month of the year. In May 2023, an increase of over 10% was recorded when compared with April 2023 where over 20% of that increase was as a result of more businesses subscribing to green energy.
- There's a difference in energy consumption between businesses and non-businesses. For businesses, energy consumption on working days peaks at 8 AM and slowly declines till the end of the day. However, energy consumption is lower on weekends. On the other hand, on holidays, energy demand declines sharply at noon and slowly increases toward the close of working hours before it remains constant at the end of day.
- Conversely, for non-businesses there's no difference in electricity consumption on weekdays or weekends. However, electricity demand slightly declines at the start of day till midday, slowly increases and peaks at 8-9 PM before declining slightly toward the end of day. Also, energy consumption on weekend holidays is slightly higher than on non-weekend holidays.
- Electricity generation increases at the start of the day and peaks at midday when the sun radiation is overhead. The amount of energy generated declines to toward the close of day.
- There's a seasonal variation in electricity generation and consumption. Consumption is highest in Winter seasons than in any other season and least in the Spring/Summer seasons. On the other hand, electricity generation is highest in the Spring/Summer seasons than in Fall/Winter seasons.
- By comparing the total electricity generation and usage by business and non-businesses and by contract type, non-businesses in the fixed and spot contracts consume little of the energy generated than businesses irrespective of the contract type. More than 50% of the generated energy is not utilised on average. This also changes by seasons where during Spring/Summer seasons, generated power provides over 100% of used energy, while in Autumn/Winter seasons, it falls by 50%.
- On the other hand, when we measure solar panel efficiency and performance by comparing total energy generation to solar panel capacity, we see that on average, the efficiency and performance of solar panels is less than 10% in all counties. This efficiency varies with seasons, with a higher performance of up to 15% during the Spring and Summer seasons.
- Businesses depend on external energy to meet electricity demand than non-businesses. On average, about 75% of energy generated is sufficient to meet the electricity demand of non-businesses over the 10% of businesses.
- In unknown solar panel locations and Laanemaa, energy need is more than 10-85 times the amount generated by solar panels in these areas.
- Energy generated by solar panels in four counties: Hiumaa, Raplamaa, Polvamaa, and Valgamaa can sufficiently meet at least 40% of their energy demand.
- External energy reliance by businesses or non-businesses depends on season and months of the year. In the Spring/Summer months, energy sufficiency increases