# Data and Energy use of GGOs

## Summary

This paper presents an estimate of the orders of magnitude of energy and data if all the EU's electricity system was tracked with Granular GOs (i.e 1Wh Granular Certificates). Today's EACs systems involve **extremely small amounts of data storage.** For example, the **M-RETs** system in the US stores **1,200 TWh of 1 MWh certificates** in just 1 GB of data, which would easily fit **on a small USB stick.** This calculation is performed using assumption of standard data storage technologies, blockchain technologies are not considered. When selecting technologies for hourly tracking, energy consumption and sourcing should be built in by design.

Even in this **worst case scenario of GGOs tracking of all EU electricity is far from being a "big data" problem** when compared to other sectors:

- ➔ The estimated annual **data storage** volume of **~325 TB/a** is equivalent to the data generated by **1 autonomous vehicle** or ~0.5% of Netflix data.
- ➔ The estimated annual **electricity consumption** of **~1.5 GWh/a** is equivalent to consumption of ~**1 large school building** or ~17 days of normal production for one 10 MW offshore wind turbine.

## GGO Benefits

When considering a costs of GGO, we must also consider their benefits compared to the current GO that is not timestamped:

- Increased credibility of consumer disclosure.
- Allowing for hourly consumer choice and 24/7 sourcing.
- Enabling more accurate hourly carbon accounting (see here).
- Providing an additional market signal/premium for storage and flexibility.
- Hourly matching of supply/demand tackling oversupply/low-prices.
- Robust definition of electro-intensive products (e.g. Green Hydrogen).
- Enabling grid clean energy integration and grid decarbonisation (see here).

# GGO Data and Energy Costs

This section provides the methodology for the preliminary estimation of the overall energy and data use of GGOs.

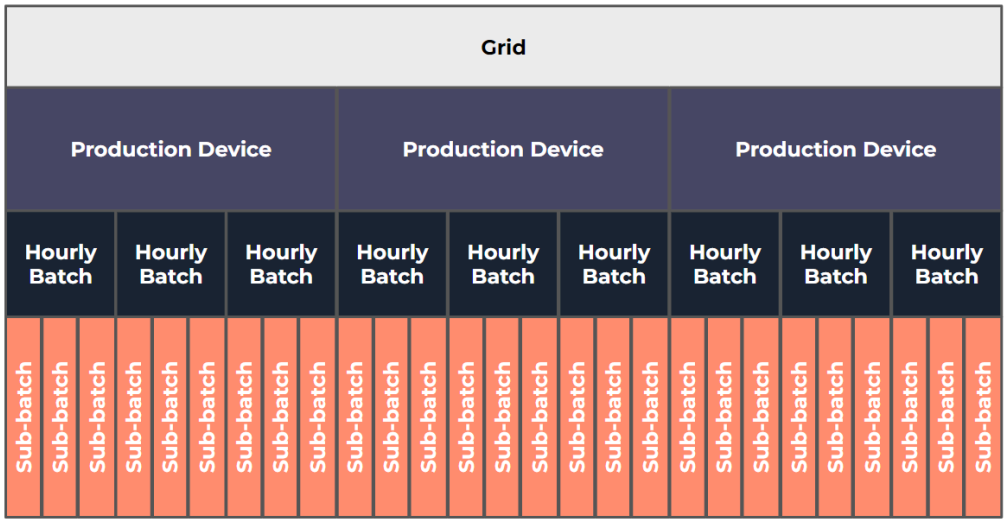
**Methodology**

The total data use depends on the grid, production device, trade and consumption (cancellation) data. Each of these has a certain data storage capacity requirement per unit and only needs to be stored once.

The basic calculation logic follows these steps:

1) The calculations are performed for 27 grids in the EU, 150 million production devices issuing certificates and 300 million consumers.
2) The number of issuances per hour is equal to the number of production devices in the grid (each device produces one batch of energy per hour, matched with one certificate batch).
3) The number of trades per issue is assumed to be 1.25, based on the current relation between the two as per figures from the association of issuing bodies.
4) The number of cancellations per hour is equal to the number of consumers in the grid (each consumer claims the use of a certain batch of energy every hour).

The structure of data storage is given in the graph below. Data for each of the blocks only needs to be stored once, irrespective of the size of the certificate of the energy volume generated. For example, even though one production device generates multiple batches, the data describing the production device is stored only once for all the generated energy batches, this is the same for grid data. It is crucial to understand that data storage quantities are more dependent on the number of hourly batches per production device than the size of the certificate itself.



**Data calculation**

The total data use estimation is presented in the table below:

| Item | No of items | Data storage per item | Total data requirement |
|---|---|---|---|
| **Grid** | 27 | 107 bytes | 0.000000003 TB |
| **Production device** | 150 mln | 184 bytes | 0.0251 TB |
| **Beneficiaries** | 300 mln | 184 bytes | 0.0502 TB |
| **Issuance data** | 150 mln issuances * 8760 h | 64 bytes | 76.48 TB |
| **Transfer data** | 150 mln issues * 1.25 transactions per issue * 8760 h | 64 bytes | 95.61 TB |
| **Cancellations data** | 300 mln beneficiaries * 8760 h | 64 bytes | 152.97 TB |
| | | **Total** | **325 TB** |

Total world data use is **59 ZB** (data for 2020). By dividing the two values we obtain a share of **0.0000006%.** The **estimated annual energy use** required for managing this data is **1.63 GWh (0.000006% of the total world energy use).**

**Key Assumptions**

In performing these calculations, a number of assumptions[1] were made. All assumptions are very conservative to help estimate a "worst case" scenario, with real data and energy storage predicted to be far less in reality. Fundamentally, the idea is to estimate orders of magnitude, not to arrive at a precise number:

- The data storage requirements per unit (i.e. grid, issuance data etc.) are based on EnergyTag Standard and Guidelines working group estimations.
- The number of production devices is based on a projected number of prosumers in the EU. Note: the current number of production devices in the EU is orders of magnitude smaller than the assumed 150 million.
- An average energy utilisation requirement is assumed to be 5 kWh per 1 GB of data (source). This figure is relatively old (source is 2012) and the final number would likely be significantly less today and in the future.
- These assumptions were gathered through interactions with a number of database experts to ensure the calculations are reasonable.

**Conclusions**

- Even in this extreme case where all EU electricity is tracked, GGOs do not constitute a big data or energy problem (~ one autonomous car or 1 large school building), with **potential benefits far outweighing data/energy costs in the very worst case.**

[1] Erring on the side of caution potentially leading to a number much higher than would be the case in reality.