Introduction brief

Customer Intelligence: Insights and Opportunities





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Summary

NET2GRID is an active member of the energy transition and ally of grid modernisation, offering services that turn underutilised Smart Meter data into valuable insights and opportunities. NET2GRID's Customer Intelligence solution provides energy companies with useful and actionable information about their customers to enable better marketing, improve customer loyalty and increase cross-selling opportunities. This introduction brief elaborates on NET2GRID's Customer Intelligence solution, and its key features.

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Renewable energy and electrification in grid modernization

Grid modernisation¹ applies as a catch-all phrase in the current energy landscape; the global push for decarbonisation, renewable energy, electrification, technological changes, and so on.

Renewable energy achieved a total of 29%² in the global electricity generation share in 2020, appearing an increasing tendency. **Electrification**³ is also making an establishment, addressing the net zero goals.

Energy companies have realised the need for a global shift to green energy and so appear individuals. Many **households** pulsate from passive to active, with consumers now having an active role as prosumers, too, with the aid of solar energy. **Digital Twins**⁴ have introduced themselves to better understand and represent the grid's assets. They can help utilities optimise their operational workload and planning, including the supply and demand of residential distributed energy resources (DER).



Figure 1: NET2GRID enables the Digital Twins model creation.

- 1 <u>Grid Modernization: Opportunities and Obstacles | T&D World (tdworld.com)</u>
- 2 Renewables Global Energy Review 2021 Analysis IEA
- 3 <u>Electrification Analysis IEA</u>
- 4 How digital twins are used in the energy sector | IEC



Challenges

Several difficulties have appeared in this modern energy infrastructure due to its high complexity. The new Digital Twin model can be overwhelming and often unmanageable. **Balancing supply and demand** can be a big challenge, along with maintaining an equilibrium between weather-dependent power generation and increased energy consumption that also avoids grid peaks.

The **fundamental issue** is that utilities and all other related companies that participate in the grid infrastructure **lack understanding of the consumers**. Thus, although they carry and retain a lot of consumer data, they often cannot realise the **value** they can unlock from it or even if they know the benefits they can gain, and they do not have the appropriate **know-how**.

Therefore, energy companies cannot **create awareness** among their clients and provide them with **detailed energy insights** and hence incorporate them into the adoption of residential green assets, and ultimately towards fulfilling the vision of the residential energy transition.

What if energy retailers could tackle these challenges by truly understanding their customers' households' energy profiles? And, what if, alongside the awareness, opportunities for upselling and new revenue streams could also be generated?



NET2GRID's AI solution

NET2GRID is an expert in providing the most accurate energy disaggregation services using AI and Machine Learning (ML) algorithms addressing the Non-Intrusive Load Monitoring (NILM) problem. Thus, with either Real-Time or Smart Meter data, NET2GRID can identify more than 10 different activities/ categories (electric-related) and approximately 20 different household appliances respectively.

Carrying such information for each household, NET2GRID can generate rich household energy insights and determine a whole-home energy overview. NET2GRID is able to identify consumers who own solar photovoltaic (PV) installations, Battery Energy Storage Systems (BESSs) or Electrical Vehicles (EVs) along with information about their production, consumption and usage. The key point here is that companies can use this information to enhance their intelligence and improve their marketing operations by offering recommendations or personalised advice. Recommending the most suitable appliance type or device for each particular household is only an example of the plethora of marketing actions available.

Let's discover together how NET2GRID's Customer Intelligence solution generates such insights.

Customer Profiles

At the core of the Customer Intelligence solution are the collected customer profiles that users have filled in themselves, indicating what kinds of heating, ventilation, air conditioning (HVAC) and appliances they have in their homes and how their home is built up in terms of size and occupancy.



Figure 2: Activity/category disaggregation in a household (Smart-Meter data-based).

Energy consumption insight reports

The same energy insights and reports that the end users see in their mobile app using the Customer Engagement solution are also available to utilities. This means that the utilities can access their customers' actual energy consumption insights, energy-saving recommendations, (self & peer) comparisons and energy efficiency benchmark data.

As indicated in the following example (Image 3), a support agent can access the energy insights along with additional information that is based on the NET2GRID Customer Intelligence services with regards to detected EV and PV appliances. They can also determine the Next Best Actions based on the Customer Intelligence candidate size estimations services in the DER category.

Utility Customer Care Agent View

Customer John Smith



Figure 3: Example of a customer support screen for call agents using NET2GRID's Customer Intelligence data sources.

DER-related services

Solar PV installation

Solar PV panel detection

The first step in determining a solar PV installation is identifying solar PV panels in the household. NET2GRID can detect solar PV panels either via Real-Time or Smart Meter data based on the power curve's negative values which indicate produced energy injected into the grid.

Solar production estimation for PV owners

Having access to Smart Meter or Real-Time data, NET2GRID can efficiently estimate the solar PV energy production generated by the household's installed PV panels on a daily basis. To achieve this, an algorithm was developed whose goal is to detect any appliance usages in the time series and remove them from the original ones. As a result, the remaining time series will be the solar production ones. Specifically, the algorithm first subtracts the AlwaysON¹ values from the time series and calculates the start and the stop seconds of the solar production for the current day. It then filters out the pulses which belong to the larger appliances, to the smaller appliances and finally the pulses above zero. The estimated solar production is delivered.

NET2GRID recently applied the solar production estimation feature in the Australian market. Using one year's worth of 15 min and 30 min interval Smart Meter data from just over a total of 100 households and without the need for input weather data or profile information, NET2GRID estimated the solar production on a daily basis for each installation. These households were selected due to the presence of ground truth solar PV production data to which the feature's estimations could be compared. The estimation results were delivered on a daily and monthly basis. The following graph (Figure 4) shows the total active power measured by the smart meter (in blue) and the estimated solar production (in yellow) along with the load consumption (in black) as extracted by the solar production estimation feature for a household in Australia.



Figure 4: The total active power measured by the smart meter (in blue) and the estimated solar production (in yellow) along with the load consumption (in black).

¹ systems that are continuously available, plugged in, or connected to power sources and networks

Solar impact on house installation metrics for PV owners

Besides the solar PV panels detection, the following metrics are generated:

- 1. the original (no solar panel) energy delivered from the grid
- 2. the reduction in the energy delivered from the grid when a solar panel is installed
- 3. the energy that returns to the grid
- 4. the profit from not purchasing the power that the solar panel produces
- 5. the profit from selling the extra power to the grid



Figure 5: Household's aggregated solar energy production per hour for a whole year.

Solar production insight metrics for PV owners

The most important solar production metrics (in kW and kWh, respectively) are:

- **1. Daily production**: the value of the estimated daily solar production, for a specific day.
- **2. Peak value**: the value of the solar production time series at the peak timestamp. This value is positive since the solar production time series is always positive.
- **3. Overproduction percentage**: percentage of overproduction during the sunlight period of the day.
- **4. Efficiency monthly/annual percentage**: the value of the monthly/annual efficiency of the solar panel for a specific day in comparison to the maximum daily production for a specific month/year.
- **5. Per hour**: the values of the estimated solar energy production, for each hour of a specific day.

Figure 6 illustrates 1000 installations and their energy production and solar capacity distribution.



Figure 6: Mean monthly energy production and solar capacity distribution.

PV top candidates - installation capacity sizing

Based on the aforementioned solar PV panel metrics and, also, for non-PV households, NET2GRID has developed a recommendation system that **proposes the most suitable size (capacity)** for a solar panel array for an installation based on a list of solar panel types that have been determined. There have been implemented three different strategies based on the following pillars:

- Self-sufficiency¹ whole year: The goal is self-sufficiency, and the average metrics of a whole year are used. The average remaining energy delivered from the grid throughout the whole year is calculated for each solar panel. The solar panel with the smallest capacity which corresponds to the minimum remaining energy is selected.
- 2. Self-sufficiency summer and winter: The goal is to cover the winter energy demands up to a percentage and limit the surplus during summer to another percentage. Two score values, one for winter and one for summer, are calculated for each solar panel. The winter score represents how close the amount of energy that the solar panel covers is to the desired percentage. The summer score represents how close the amount of energy that returns to the grid is to the desired percentage. The total score of a solar panel is the sum of these two. The solar panel with the smallest capacity and the maximum score value is selected.

¹ how much of the initial energy consumption of the installation the solar panel can cover

3. Self-sufficiency spring and autumn: The goal is self-sufficiency, and the average metrics for the spring and autumn months are used. This alternative approach is used since metrics calculated during the winter and summer months may contain extreme values. After filtering out these extreme values, the average remaining energy delivered from the grid is calculated for each solar panel. The solar panel with the smallest capacity which corresponds to the minimum remaining energy is selected.

Figures 7 and 8 demonstrate the initial solar capacity distribution of households compared with the whole-year, summer-winter and spring-summer strategy recommendations.



Figure 7: Initial solar capacity distribution VS whole-year strategy recommendations.



Figure 8: Summer-winter VS spring-autumn strategy recommendations.

Battery Energy Storage System (BESS)

BESS detection in households

The goal of BESS detection in households (Image 9) is to indicate if a battery is used in a household. The main idea behind the BESS detection algorithm is to search for periods of time when the active power time series fluctuates around zero, given that the household has a solar PV installation. Thus, each day of the given month is split into equal-sized intervals. For each interval, the average, minimum and maximum of the active power are calculated. If the average is between a range around zero (e.g. -30 to 30) and the time series is not constant during this part, then this is an indication of BESS usage during this interval of the day.



Figure 9: Detection of BESS installation.

BESS top candidates - installation indexes pre- and post-installation

NET2GRID's services include the calculation of BESS-related indexes for solar installations for a specific time period. Specifically, the indexes are calculated separately for periods with BESS usage and periods without BESS usage, so that the utility or installer of BESS can compare the indexes pre-BESS and post-BESS. These indexes are:

- 1. The energy received from and returned to the grid.
- 2. The maximum instantaneous active power received from and returned to the grid.

- 3. The percentage of the time, during which the instantaneous active power received from and returned to the grid, was above a specified threshold.
- 4. The requested percentile of the active power received from and returned to the grid.



Figure 10: Energy imported from and returned to the grid by hour.

BESS top candidates - capacity sizing

NET2GRID has developed two approaches for the BESS recommender tool:

- 1. BESS capacity sizing from energy surplus. This approach estimates the suitable BESS size in Wh through the energy surplus that is returned to the grid. For a given period of time, it calculates for each day the maximum cumulative surplus of power between the first and last second when power is returned to the grid. Based on the surplus average value of the selected time periods, the algorithm recommends a size in Wh between different values, for example, 5000, 7500, 10000, 12500 and 15000.
- 2. BESS capacity sizing for load shifting¹. This method is not a traditional scenario but still applies to markets that support load shifting, viz to households that do not have a solar PV installation but can benefit from dynamic tariff billing. For a given period of time, it calculates the average amount of energy that was consumed during the most expensive time slots of the day. Finally, depending on the list of available BESS and their capacity, it provides the potential amount of savings the customer can earn for each respective option.

¹ Load shifting means the act of charging a BESS with power from the grid during hours when the kWh tariffs are low and discharging the BESS during hours when the tariffs are high.

The following figure (Figure 11) displays the number of households with BESS installed among 1000 ones, as well as the candidate households suitable for a BESS recommendation.



Bess candidates distribution according to solar capacity

Figure 11: BESS detection in households and candidate ones according to solar capacity.

The graph below (Figure 12) depicts the energy consumption and solar production in a household, specifically:

- During the morning, when there is plenty of sunlight, it equates to solar energy production. Because there is an energy surplus, the BESS is also charging, affecting the smart meter curve which is near zero.
- During the afternoon (around 15:00), the BESS is fully charged (the battery curve is near zero). Since there is still solar energy production and surplus, the energy returns back to the grid affecting the smart meter curve which is now negative.
- During the evening when there is not any sunlight anymore, solar energy is no longer produced. Thus, the BESS is discharged (the battery curve is positive) to supply the household with energy.



Figure 12: Energy distributed in a household 1.

EV Charging

EV (Charging) detection of EV owners

The EV detection algorithm deployed is based on identifying EV charging events. These events are divided into two charging categories: Level 1 (less than 3kW) and Level 2 (3-8.5kW or more than 8.5kW). The algorithm is based on pattern recognition of rising and reducing Points Of Interest (POI) that are used as indications of the start and end of a potential EV charging pattern in time series. More can be found in the dedicated EV (charging) detection white paper <u>here</u>.

The following figure (Figure 13) shows the EV detections among a thousand households and how they are distributed depending on the charging type.



EVs distribution according to charging type





Integrating with Customer Intelligence

NET2GRID's Customer Intelligence service is simply designed to easily integrate with most companies' systems. Therefore, NET2GRID processes either Real-Time data via its own hardware and firmware or Smart Meter data directly via batch file importing, usually by integrating with the respective datahub. After applying AI and ML algorithms in the cloud-based, AWS SaaS platform, NET2GRID deploys hourly, daily or monthly reports in JSON format that can be easily transferred to the energy company via file exchange.



Figure 14: NET2GRID's 360° view of the customer.



Business capabilities enabled with Customer Intelligence

NET2GRID's Customer Intelligence solution helps energy companies to gain a better understanding of their customers' home energy profile overview, unlocking new upsell and revenue opportunities. More specifically:

Energy Retailer/Utility

Utilities maintain large amounts of energy data, especially for their household customers. The ability to turn this data into insights about their customers' home energy profiles is of great value.

The utilities can now identify the type of customers they have and they can cluster them based on behavioural attributes and habits. Marketing campaigns can be more efficient and personalised. Offering a dynamic tariff plan based on the customer's routine can empower them, thus providing energy-efficient solutions. Simultaneously, upsell opportunities can be activated, enabling new revenue streams and increased profit margins.

For example, the energy retailer can promote a new EV charger to customers who already own an EV rather than targeting the whole customer base, making marketing campaigns less expensive and complicated. Offering new solar PV panels or BESS are a few more examples among the plethora of different recommendations that could be determined. The same offerings can be provided via renting or leasing solutions.

Bank

Banks could yield multiple advantages from the Customer Intelligence solution. Banking organisations can invest in Energy-as-a-Service in order to profile and segment their customers and offer them better and more personalised services. Banks can utilise Smart Meter data to understand their customers' behaviour, analyse their energy consumption habits and determine the homes' energy labels by tracking their energy performance.

Banks can offer new recommended products, for example, via a third party organisation, either directly or via offering a green loan, improving the household's efficiency. Additionally, banks can offer rental or leasing opportunities, for instance, a solar PV installation. Lastly, banks can simultaneously aid their customers to meet their mortgage CO2 reduction target, a great benefit to the former as they could access lower interest rates on the global finance market.

Solar Company

Solar companies, whether they are solar service, solar PV systems, inverter or BESS providers, can benefit from NET2GRID's Customer Intelligence offering. Even without access to the inverter's data, NET2GRID's algorithms perform rigorously.

Having an overview of the customer's whole home energy profile rather than just of the solar system can better determine the Next Best Actions. Configuring knowledge from multiple sources can play a significant role when it comes to upselling and offering new products and services whether these are selling, renting or leasing. Lastly, Customer Intelligence can be a key driver when engaging with customers, offering a high-end customer experience.

Home Energy Management (HEM) Provider

HEM companies are capable of utilising data, to provide the best recommendations for an efficient household. With just Smart Meter data and the Customer Intelligence solution, HEM companies can have a holistic view of the home's energy distribution and thus a better overview of the consumer's behaviour. They will be able to promote more targeted offerings either through their own product portfolio or from companies they collaborate with. Therefore, they can provide a complete customer experience, from purchasing the most suitable home devices to managing them in the most efficient way for each user.

Original Equipment Manufacturer (OEM)

OEMs can provide a plethora of different home appliances and devices to their consumers, but determining the most suitable purchase can be quite challenging. However, with NET2GRID's Customer Intelligence, they can effectively promote the best-suited appliance to each consumer. In parallel, OEMs can be updated and alerted when new types of activities or appliances are being used, which gives the OEM the ability to benchmark and comprehend the consumers better, thus making upsells more targeted.

Energy retailers, banks, HEMs, OEMs and solar companies can benefit from the Customer Intelligence solution on both Smart Meter or Real-Time data, depending on the data hub integration availability and the desired accuracy. NET2GRID takes pride in owning and developing an extensive hardware whitelabelled portfolio, which unlocks data availability and accuracy globally. Check NET2GRID's hardware <u>here</u>.



Figure 15: Benefits of using NET2GRID's Customer Intelligence solution.

Why to choose NET2GRID?



More than 10-year experience in the energy market, deploying innovative solutions based on machine learning algorithms.



A one-stop-shop providing both software and hardware solutions. NET2GRID's white-labeled mobile application and hardware devices aid leading energy companies worldwide to fulfill their needs and succeed in their business goals.



Minimised complexity by integrating API connectivity.



Easy onboarding and deployment based on NET2GRID's AWS cloud infrastructure.

Would you like to learn more about how NET2GRID empower energy retailers to become energy transition leaders by unlocking value from Smart Meter data?

Contact NET2GRID at sales@net2grid.com or request a demo.

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