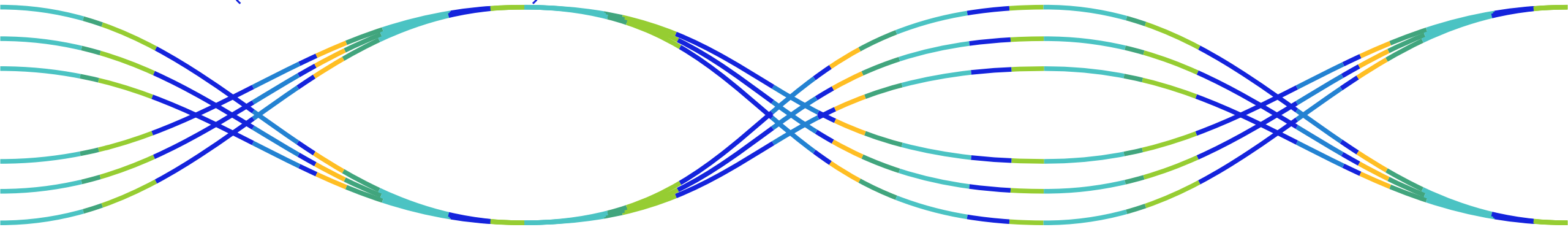
Flexibility & Demand Response

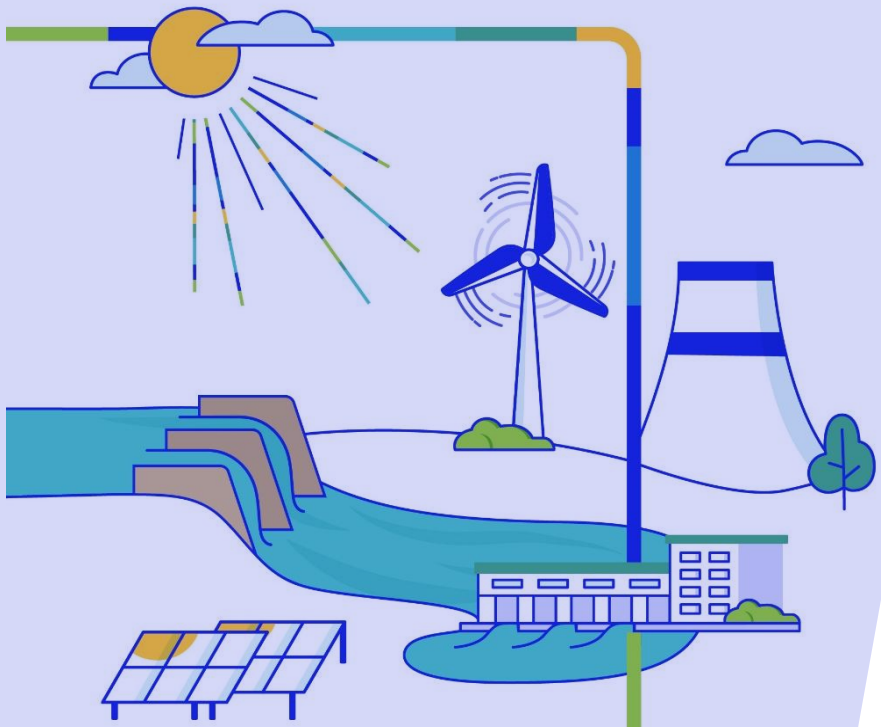
Smart metering interfacing with downstream uses to enable the development of the demand response mechanism for mass market (under 36 kVA).



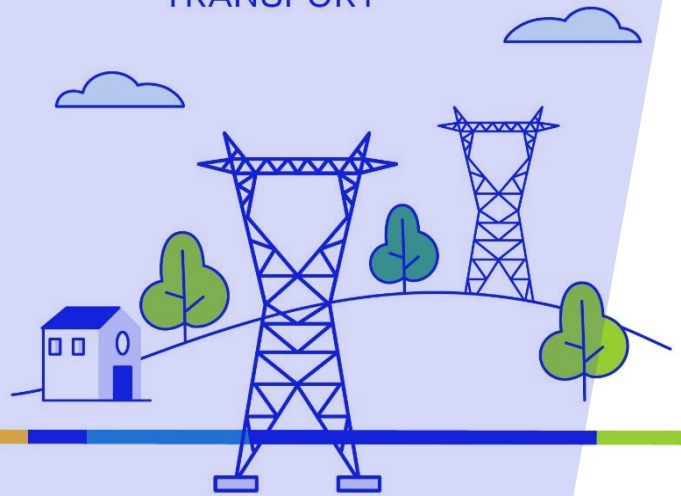
ENEDIS

28/04/2026

PRODUCTION

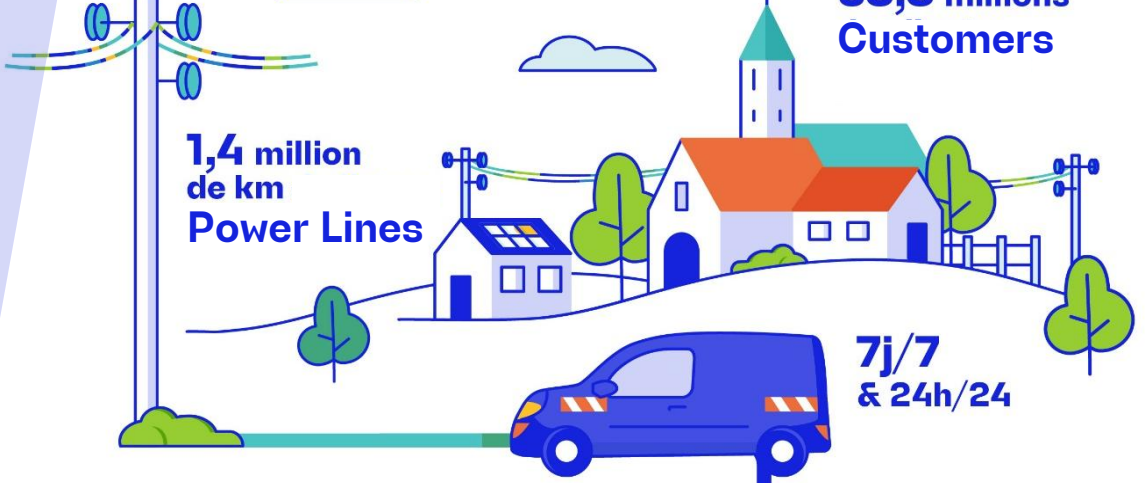


TRANSPORT



DISTRIBUTION

ENEDIS



38,8 millions
Customers

1,4 million
de km
Power Lines

7j/7
& 24h/24

41 000
employees

FIRE

Rapid
Intervention
Force
Electricity

Availability
99,99%

Key figures in France

38,8 million
clients

2,5 million
EV & PHEV
→ **2035: 18mn EV & PHEV**

1,3 million
renewable energy generation facilities in 2024

1.4 million
of kilometers of power lines

2,8 million
EV charging points

28 %
renewable electricity in the mix
→ 2030: > 40%

11 million
domestic hot water systems connected to the meter

Linky meter

1 meter, two versions : single phase and three phases

Comply with Cybersecurity, privacy and regulatory requirements

4,5 billions investment €

>3 billions data collected and stored per day

6 years roll out (2015-2021)

>98% tele-operation success rate
>98% daily collection success rate

4 suppliers, with assembly plants based in France

Flexible consumption (Demand Response):

Electric heating
Domestic hot water (DHW system)
EV charging infrastructure
Heat pumps
Cooling system (HVAC)

Controllable or adjustable production:

Hydropower
Adjustable nuclear power
Controllable/limitable renewable energy sources

Storage:

Battery Energy Storage System (BESS)
- Utility-scale BESS
- Residential BESS
- Hybrid PV + BESS systems

Pumped-Storage Hydropower - PSH
Electric vehicles (V2G)

→ **Balancing services**

– Consumption Flexibility –
– Production Flexibility –
– Storage Flexibility –

Challenges for 2030

The demand response mechanism will need to simultaneously integrate consumption, decentralized generation and storage.

Increasing variability in solar and wind power

→ need for rapid modulation.

Massive electrification (heat pumps, EV charging infrastructure, industry)

→ new consumption peaks.

Less dispatchable production

→ More reliance on flexibility.

Dynamic pricing

→ Cost-saving opportunity for the consumers.

Is the DSO involved in the system balance?

Enedis doesn’t request or implement balancing services.
It is a facilitator, not a market player.

However, DSO:
— manages the LV/MV networks,
— provides metering data,
— guarantees a stable and sure local network,
— facilitates the deployment of controllable equipment,
— secures and standardizes data exchange
— validates data (trusted third party for billing).

The DSO objective is to enable the future of Demand Response without destabilizing the distribution network.

Demand-response principle in housing via aggregators

The controllable equipment is identified

Communication channel receives instructions.

The aggregator provides flexible power to TSO

Activations are performed automatically

Cancellation measures were set up for remuneration.

Service can be provided independently by an aggregator independent of the energy supplier and without considering the constraints of the network grid.

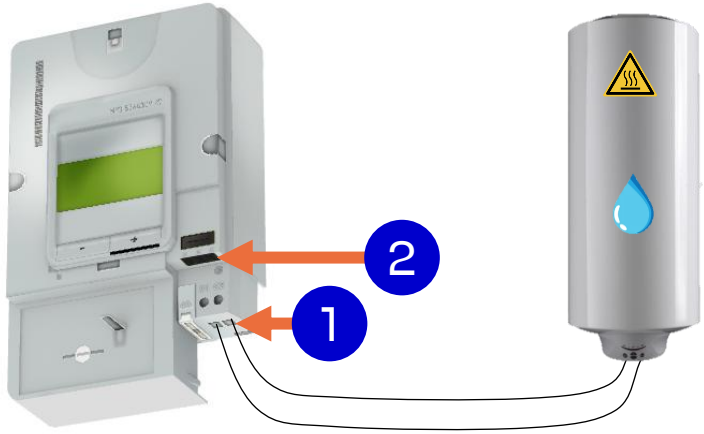
Another challenge remains : standardized communication protocols between the gateway and the equipment to ensure easy integration.

Meter data to improve the mechanism

Linky data enables:

1. Measurement of the instantaneous power consumption and production throughout the home/dwelling
   → measurement and correlation of load shedding
2. Production and consumption index
   → timetable peak hours off-peak hours, calculation of energy shed or carried forward
3. Timestamping
   → certification of load shedding value with the indices and load curve
4. Supplier calendar, contract constraints (e.g., Tempo red days, Peak/Off-Peak signal)
   → local prioritization optimization
5. Local stability in relation to non-controllable or non-relocatable uses
   → no exceeding of supply contract conditions
6. Consideration of distribution network orders (temporary backup limit)
   → secure energy operation for the home and grid

Linky meter : user's interfaces



1 on/off dry contact

- 11 millions hot sanitary water tanks are connected to it.
- They start only when electricity price is low (night and lunch time).

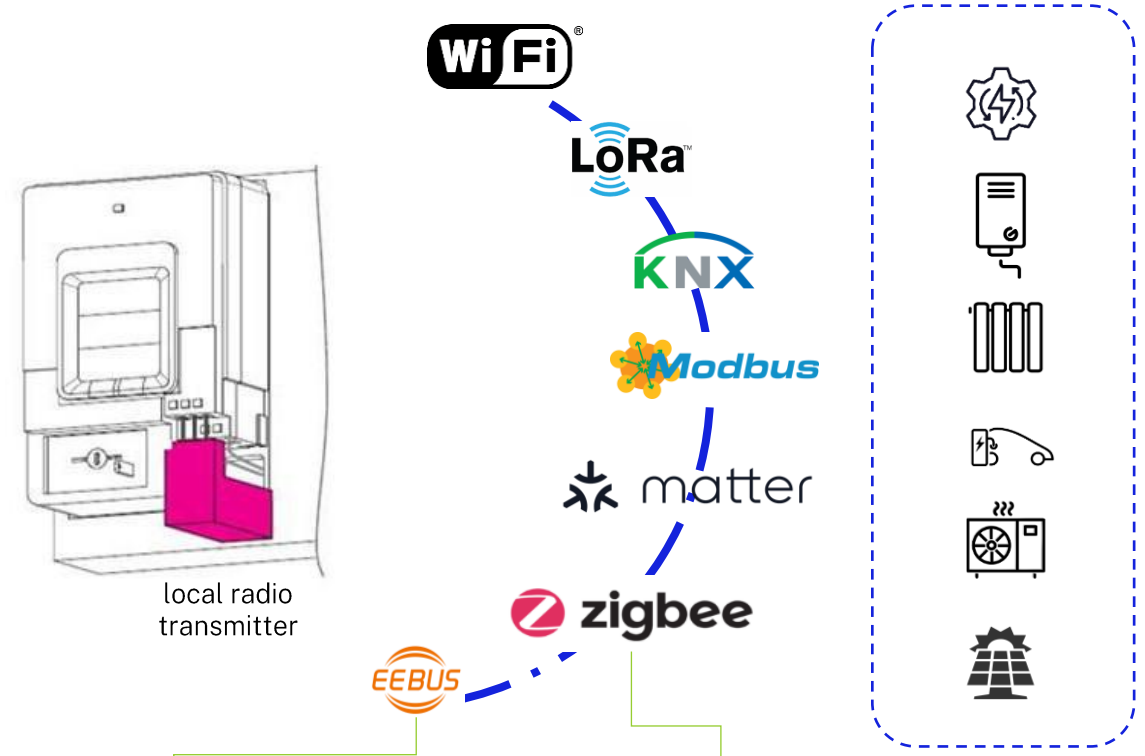
2 One data interface

- To give a local access to near real-time metering and consumption data:
  - Tariff period
  - Instantaneous power
  - Max Power available (contact)
  - Energy production (If solar panel is connected)
  - Dry contact position
  - 7 virtual switches positions
  - ...
- Data can be broadcasted with a small piece of equipment : a Smart Meter Dongle or ERL (Local Radio Emitter)

« The TIC »
Tele Information for Customer

Several plug-in wired or wireless module for downstream

Enedis enable multiple protocols with industrial partners and standard organizations



White paper co-authored with EEBUS and adaptation of an open-source stack (eebus go) for using the TIC with eebus devices

Publication of TICtoZigbee mapping note in accordance with the CSA

Our vision: standardize Smart Meter interface

to ensure easy integration, regardless of the brand, and to facilitate development for manufacturers and reduce costs.

Target architecture

System balance

Market, price / Adjustment Mechanism

Intelligent aggregation platform (Cloud)

- Renewable energy forecasts & prices
- Aggregated flexibility forecasts
- Upward and downward calls
- TSO reporting

Local Grid stability

Local network constraints (signal)

Delivery point / Smart Meter

- Electrical Measurement
- Supplier calendar, contract constraints
- Distribution network orders
- Timestamping
- Index and load curve

HEMS functionality

- Local *optimization* (comfort, billing)
- Real-time usage prioritization
- Autonomous failover in case of network outage
- Execution of aggregator instructions

HEMS could be only a software integrated into home router, access point, or any usage device with edge computing capabilities.

Electric heating, Domestic Hot Water, EV charger, Heat Pump, HVAC, PV, Residential BESS

Interoperability standard for home aera network between Smart meter, HEMS, Usages

The key challenge is to standardize the interface with downstream smart meters to facilitate the integration into the industrial downstream ecosystem for energy management development...

...not only in France.

Right now, the Connectivity Standards Alliance develops standards and protocols to ensure the interoperability of equipment regardless of brand and energy efficiency of homes.

- **A standard designed for home automation based on the IP protocol:** connection available via wire (Ethernet) or via radio standards (Wi-Fi, Thread, 6LowPAN, Bluetooth Low Energy) and Zigbee via bridge.
- **An exponential increase in Matter-certified products since 2022:**

8047 certified products by 2025

Light bulbs, switches, EV charging infrastructure, heat pump

→ Forcast : **5,5 billion devices by 2030**

- **Energy management** has become a **priority topic since version Matter 1.3** (2024).

csa connectivity standards alliance

matter

+ 850
companies in 49 countries, including the players in our ecosystem

matter 1.5 : A major update, in which Enedis actively took part, was published on November 20, 2025 and incorporates new features, including integrated energy management in homes.

3 validated clusters

for the provision of data and the improvement of functionalities related to smart metering

- **Meter Identification**
- **Commodity Metering**
- **Commodity Tariff (include Supplier Calendar from smart meter and Tariff from energy supplier cloud)**

Matter 1.5 creates a secure and uniform foundation for integrated energy management in smart and connected homes

- **Advanced energy management** that takes into account **complex tariffs, peak consumption,** and **CO_2 emissions**
- **Standardized transmission** of **real-time consumption, price**, and **tariff data**
- **Sharing of price forecasts** from **utilities, network operators**, and **energy suppliers**
- **Integration of predictive data** from **energy-producing systems** (home solar systems)
- **Monitoring of appliance operating costs** and scheduling their operation during favorable periods (**savings**)

Thank you for attention!