CAPCONDO
best way to energy quality

Energy management system

Hardware and Software

Control and Monitoring

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Plan

1. Problematic, Objective, Solution
2. Composition/ Architecture of the energy management system
3. Energy management software CAP-VIEW
4. Conclusion

1

- Problématique, Objectif, Solution

Problematic

In the industry, the following problems are often faced :

- Frequent malfunction and/or damage of certain machines and electrical/electronic equipment..
- Increased frequency of maintenance shutdowns
- Premature aging of electrical equipment, such as circuit-breakers, contactors, etc..
- Abnormal heating of cables and transformers, etc..
- Waste of energy
- Important penalties in the electricity bills

Problematic

These problems are very costly for companies, and are the direct result of:

1. **The poor quality of the electrical network, due to:**

- Presence of voltage peaks
- Harmonic distortions in current and voltage
- Low power factor
- Presence of voltage drops
- Phase imbalance in current, etc.

2. The absence of monitoring of the energy consumption of the different equipment / production lines / departments, etc..

OBJECTIVE

The objective is to solve these problems:

- Improve the quality of the electric network.
- Eliminate/minimize maintenance shutdowns resulting from a bad electrical network quality
- Increase the life duration of electrical/electronic equipment
- Relieve cables and transformers
- Identify sources of energy waste, and eliminate/minimize this waste.
- Eliminate penalties in electricity bills

Our solution: An energy management system

To achieve this goal, you first **need to diagnose** the actual state of your electrical network and your energy consumption., This is the role of our **energy management system:**

- The remote and permanent monitoring of the state of the electrical network
- Remote and permanent monitoring of your electricity consumption
- Remote and permanent monitoring of your fuel, natural gas, compressed air and water consumption
- You will have a better understanding of your installation for a better management of the energy performance.

2

- Composition / Architecture of the energy management system

Composition of the Energy Management System

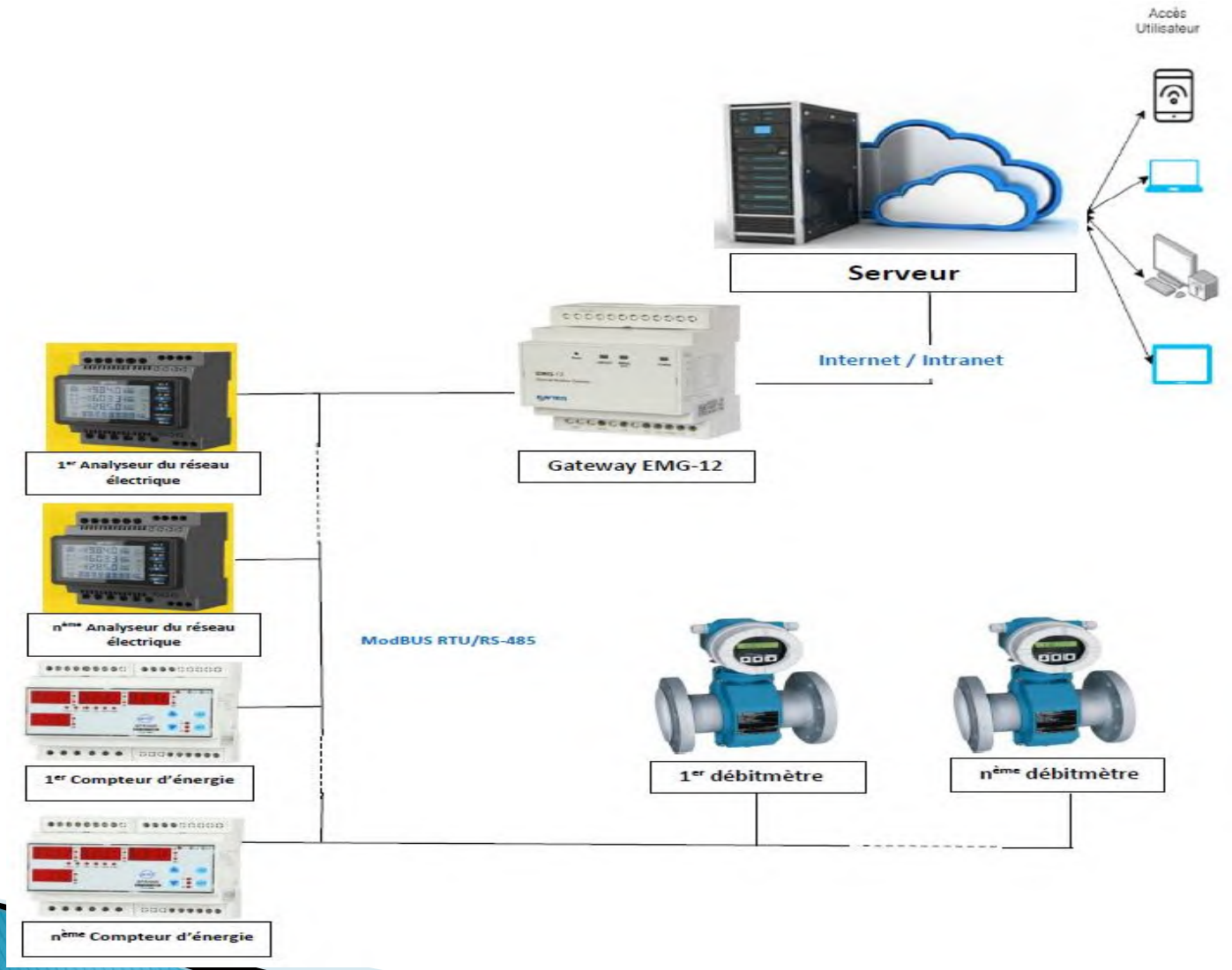
The energy management system is composed of measurement devices and a data processing software.

1. The measuring devices are essentially electrical network analysers, energy meters and flow meters (for compressed air, natural gas, fuel oil, etc.), with all the necessary accessories. These measuring devices are connected to a Gateway, which collects and sends the data to the server, to be recorded and further processed by the Software.
2. The energy management software: Its role is to exploit the data sent by the measuring devices, to process them, to draw up reports and periodic assessments, necessary for decision-making and corrective actions.

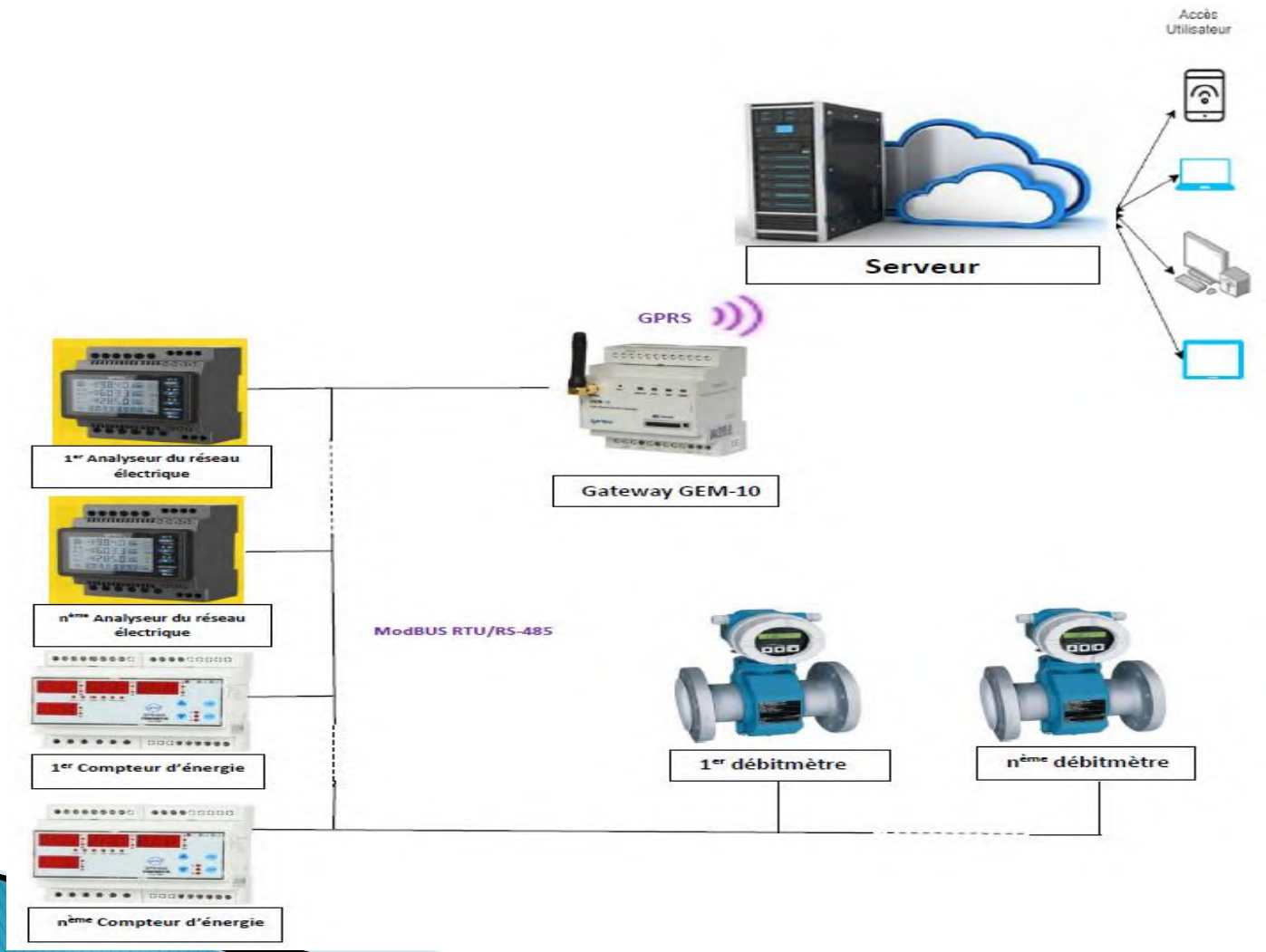
Architectures of an Energy Management System

- We have two types of architectures:
- **Wired architecture**: using an Ethernet / Modbus RS-485 Gateway (EMG-12): it collects data from measuring devices and transmits them to the server (private or public cloud) through the Intranet network or internet.
- **Wireless architecture:** using a GPRS/Modbus RS-485 Gateway (GEM-10): it allows to collect data from the measuring devices and transmit them to the server (private or public cloud) through the GPRS network.

Wired architectures: by using Gateway EMG-12



Wired architectures: by using Gateway GEM-10



Communication protocol between Gateway and measuring devices

- The communication protocol is MODBUS.
- It is a protocol based on a Master/Slave architecture
- In our application, the "Master" is the Gateway, and the measuring devices (power analyzers, energy meters, flow meters, etc.) are the slaves.
- This protocol is mainly intended to allow a simple, reliable and fast communication between the Gateway and the measuring devices.

Principal technical characteristics of Gateway EMG-12

- **Role:** Collect data from measuring devices and send them to the server (private or public cloud)
- **Communication protocols**: TCP/IP, APR, ICMP, HTTP, Modbus TCP
- **Ports**: Modbus (RS-485), USB (for configuration), Ethernet (RJ45)
- **Operation mode**: Modbus TCP/RTU
- **RS-485 serial communication**: Baud Rate from 1200bps to 115200bps
- **Ethernet communication**: Baud Rate from 10Mbps to 100Mbps

Principal technical characteristics of Gateway GEM-10

- **Role:** Collect data from measuring devices and send them to the server (private or public cloud)
- **Communication protocols:** TCP/IP, APR, ICMP, Modbus TCP, GPRS
- **Ports:** Modbus (RS-485), USB (for configuration), Ethernet (RJ45)
- **Operation mode:** Modbus TCP/RTU
- **RS-485 serial communication:** Baud Rate from 1200bps to 115200bps
- **Ethernet communication:** Baud Rate from 10Mbps to 100Mbps

Electrical network analyzers

Two types of electrical network analyzers can be used in our system:

MPR-26S-2: with a small display
(mounted on DIN rail)

MPR-47S: with a large display
(mounted on the door)

Principal technical characteristics of the electrical network analyzer : MPR-26S-21

- **Role:** Measure electrical parameters and send them to the Gateway
- **Precision:**

  0.5% **:** For voltage and current

  1% : For active power, apparent power, active energy and apparent energy

  2% : For power factor, reactive power and energy
- **Protocol/Communication Interface:** Modbus RTU/RS-485
- **RS-485 serial communication:** Baud rate from 2400bps to 115200bps
- **Internal Memory:** 4MB
- **Screen**: 2.1" LCD
- **Mounting:** On DIN rail

Principal technical characteristics of the MPR-47S electrical network analyzer

- **Role:** Measure electrical parameters and send them to the Gateway
- **Precision:**
  - **0.5% :** For voltage, current and active power
  - **1% :** For reactive power, apparent power, active energy and apparent energy
  - **2% :** For power factor, reactive power and energyProtocol/Communication

  Interface: Modbus RTU/RS-485
- **RS-485 serial communication:** Baud rate from 2400bps to 115200bps
- **Internal Memory:** 16MBScreen: 3.5" LCD
- **Mounting:** recessed (on panel)

Electrical network analyzers

Principal electrical parameters measured by these analyzers:

- Simple voltages
- Compound voltages
- Simple currents
- Compound currents
- Frequency
- Cos φ
- Active power
- Reactive power
- Apparent power
- Total active power
- Total reactive power
- Total apparent power
- Active energy
- Reactive energy
- Apparent energy
- Total harmonic distortions in voltage THDU
- Total harmonic distortions in current THDI
- Individual harmonic distortions in voltage Up to rank 51
- Individual harmonic distortions in current Up to rank 51
- Voltage unbalance
- Current unbalance etc.

Principal technical characteristics of the EPR-04S energy counter.

- **Role:** Measure electrical parameters and send them to the Gateway
- **Precision:** 1%.
- **Communication protocol/interface:** Modbus RTU/RS-485
- **RS-485 serial communication**: Baud Rate from 2400bps to 38400bps
- **Display: LED (red)**
- **Mounting:** On DIN rail

Energy meters

The electrical parameters measured by the EPR-04S type energy meters are:

- Active power
- Reactive power
- Apparent power
- Total active power
- Total reactive power
- Total apparent power
- Active energy
- Reactive energy
- Cos ϕ

Flowmeters

Flow meters are used to monitor the consumption of different types of fluids: compressed air, natural gas, fuel oil, water, etc.

The choice of the flow meter depends on several parameters:

Nature of the fluid (compressed air, natural gas, fuel oil, water...)

The process temperature

Process pressure

Flow rate range, etc.

Before a technical-commercial offer is given, a technical visit is necessary to determine the data required for a reliable dimensioning.

3

- Energy management software: CAP-VIEW

General Properties

Our software is based on IoT (Internet of Things) technology providing a SaaS (Service as a Software) solution.

This solution guarantees access to your energy data, historical and real time, from any machine connected to the internet, while ensuring the required level of security.

The SaaS solution has the following features:

- Plug & Play
- No configuration is required
- Quick deployment and easy maintenance
- Remote personalization of the solution
- Multiple access

CAP VIEW
allows you to:

- Permanent and detailed monitoring of the quality of the electrical network at any point
- Include data from other management systems (ERP, CMMS, etc.)
- Generate an energy performance report with graphs and curves, through an advanced report editor.

Versions of the Energy Management Software

Our software is available in 4 versions:

*** The free version**

**** CAP VIEW STANDARD**

***** CAP VIEW PLUS**

****** CAP VIEW PRO**

For the free version, only the real time values are displayed, in the form of tables.

For the other versions, they differ by the modules.

Remarks: All modules are configurable according to the customer's needs.

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Structure of each version

Free Version

MAIN

- Real time (Electrical and/or fluid)

CAP VIEW STANDARD

MAIN

- Real time (Electrical and/or fluid)
- History (Electrical and/or fluid)
- List of meters/analyzers
- Energy
- Gestion d'utilisateurs
- Configuration des alertes
- Liste des alertes etc.

CAP VIEW PLUS

MAIN

- Temps réel (Electrique et/ou fluide)
- Historique (Electrique et/ou fluide)
- Liste des compteurs/ Analyseurs
- Transformator
- Energie
- User management
- Alerts configuration
- List of alerts
- Uniform Regime Invoice / Hourly Positions
- Transformator, etc

CAP VIEW PRO

MAIN

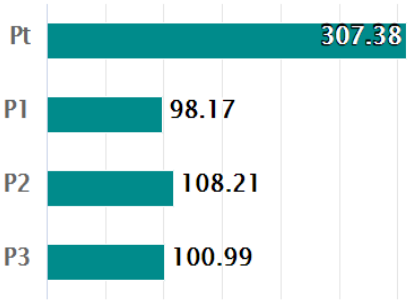
- Temps réel (Electrique et/ou fluide)
- Historique (Electrique et/ou fluide)
- Liste des compteurs/ Analyseurs
- Energie
- User management
- Alerts configuration
- List of alerts
- Uniform Regime Invoice / Hourly Positions
- Transformator
- Production declaration
- Production ratio, etc

Real time

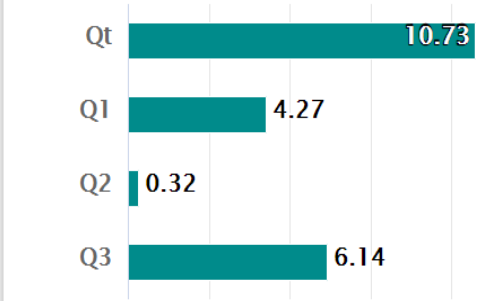
- Allows you to consult the data collected in real time. .

Real time

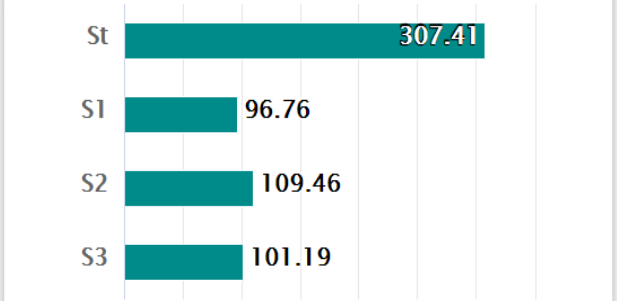
Puissance P [kW]



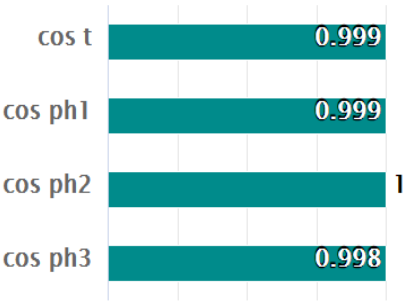
Puissance Q [kVar]



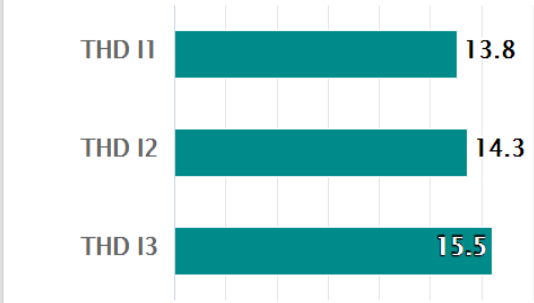
Puissance S [kva]



Facteur de Puissance



Distorsion harmonique [%]

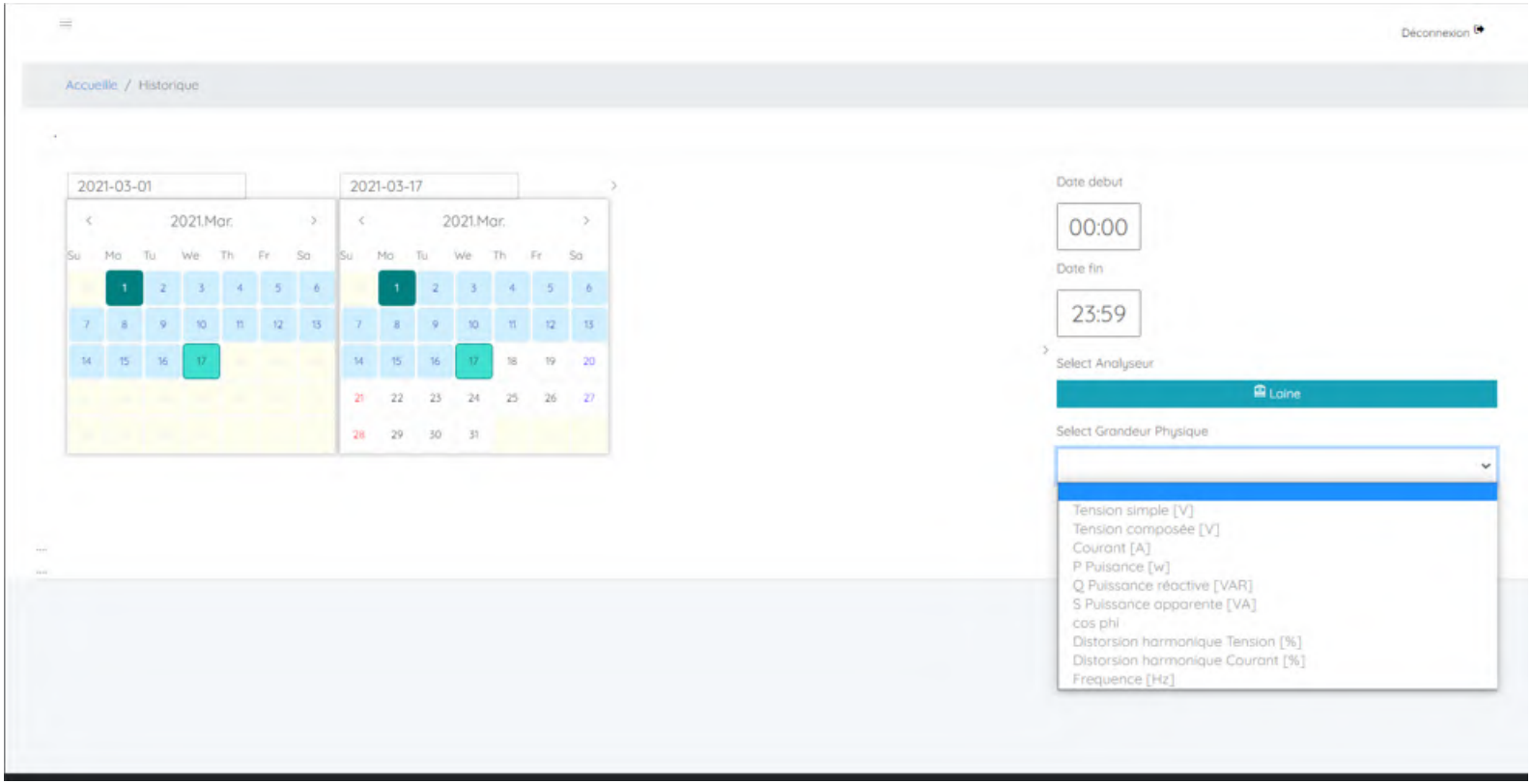


Energie [kwh]

825 393.23 *Kwh*

History

- Possibility to visualize the curves of the saved historical data.
- Choice of start/end dates/times at will.
- Easy parameterization of the choice and display of the data.



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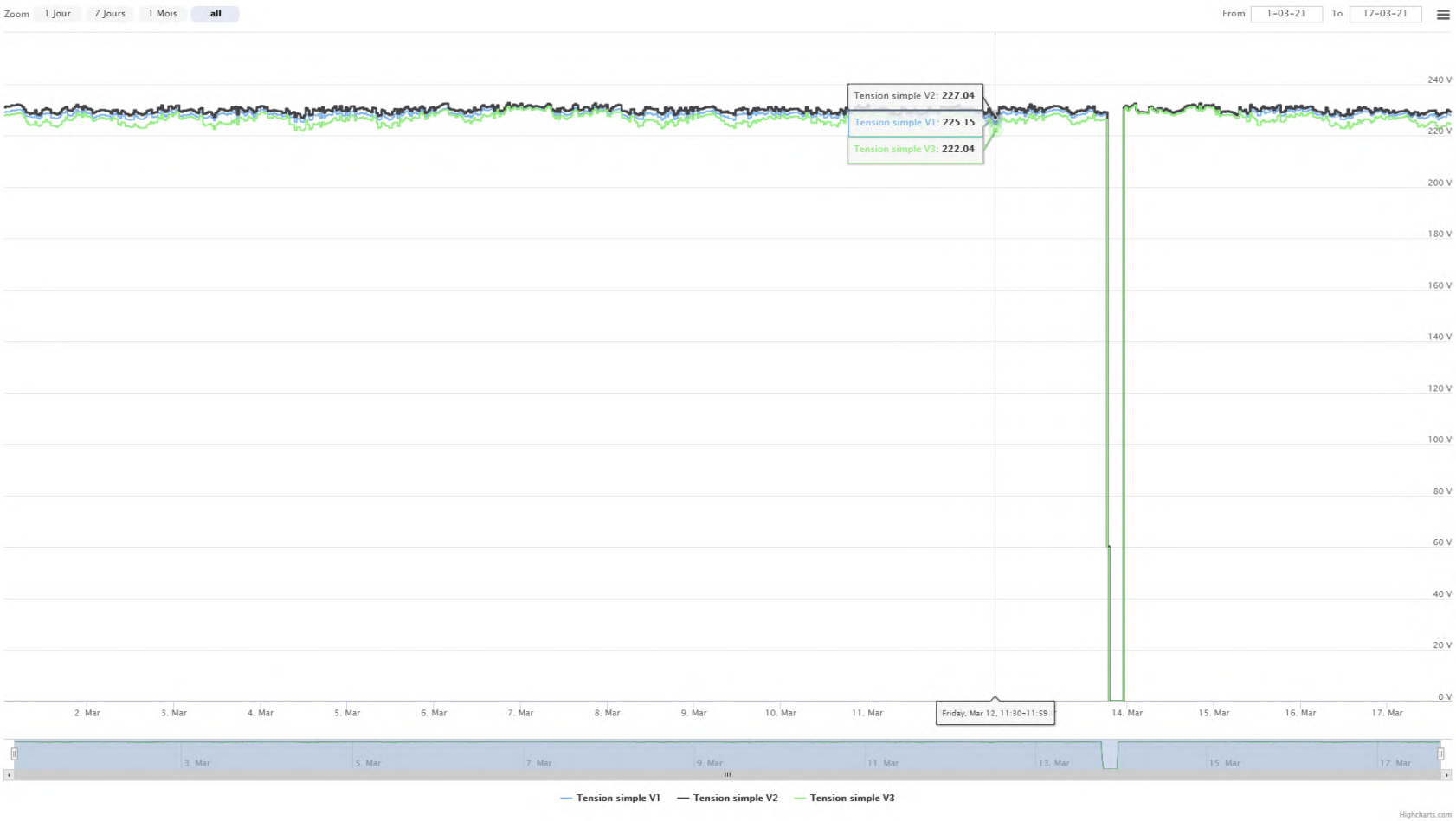
History: simple tensions



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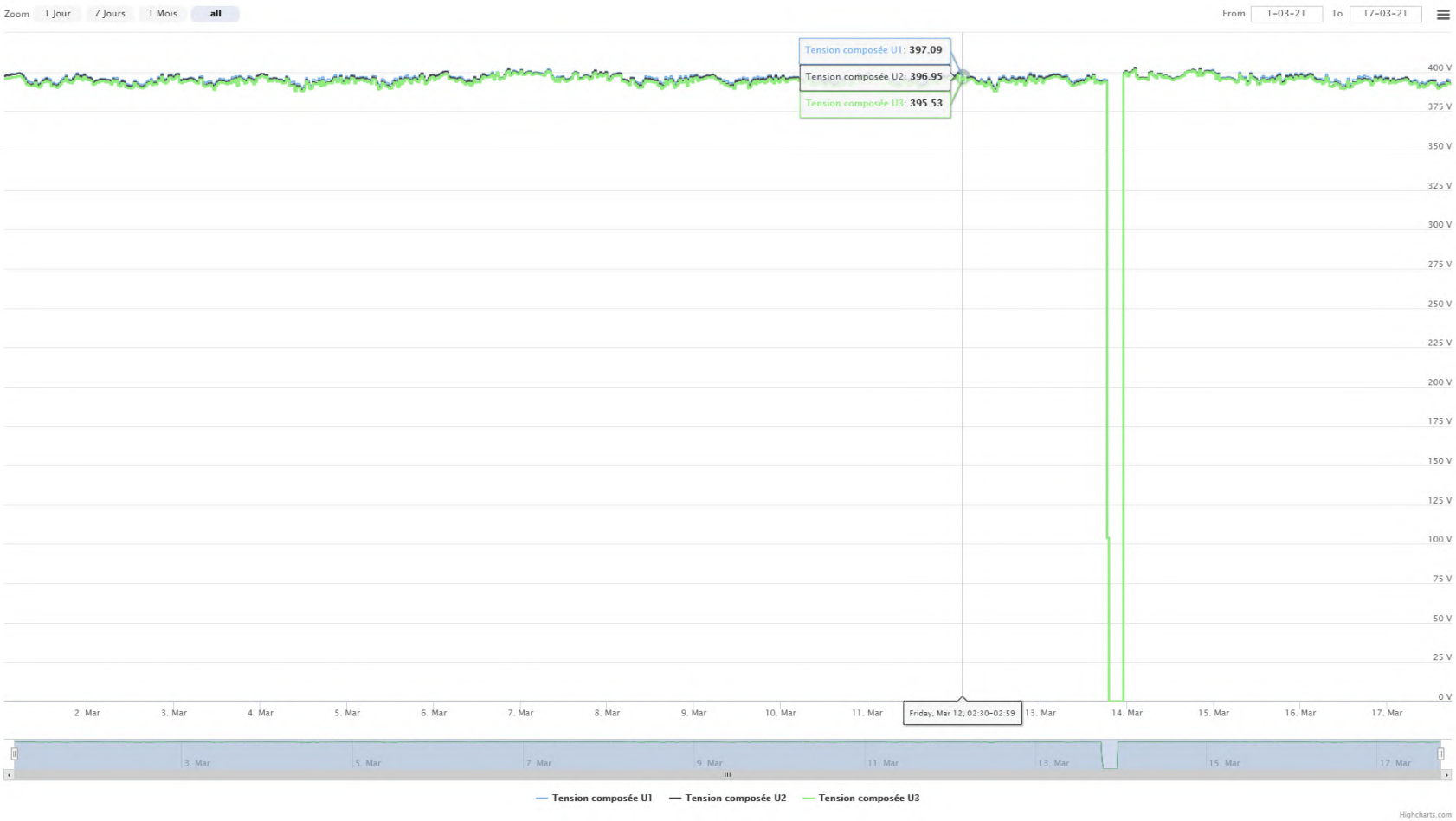
History: Compound Tensions



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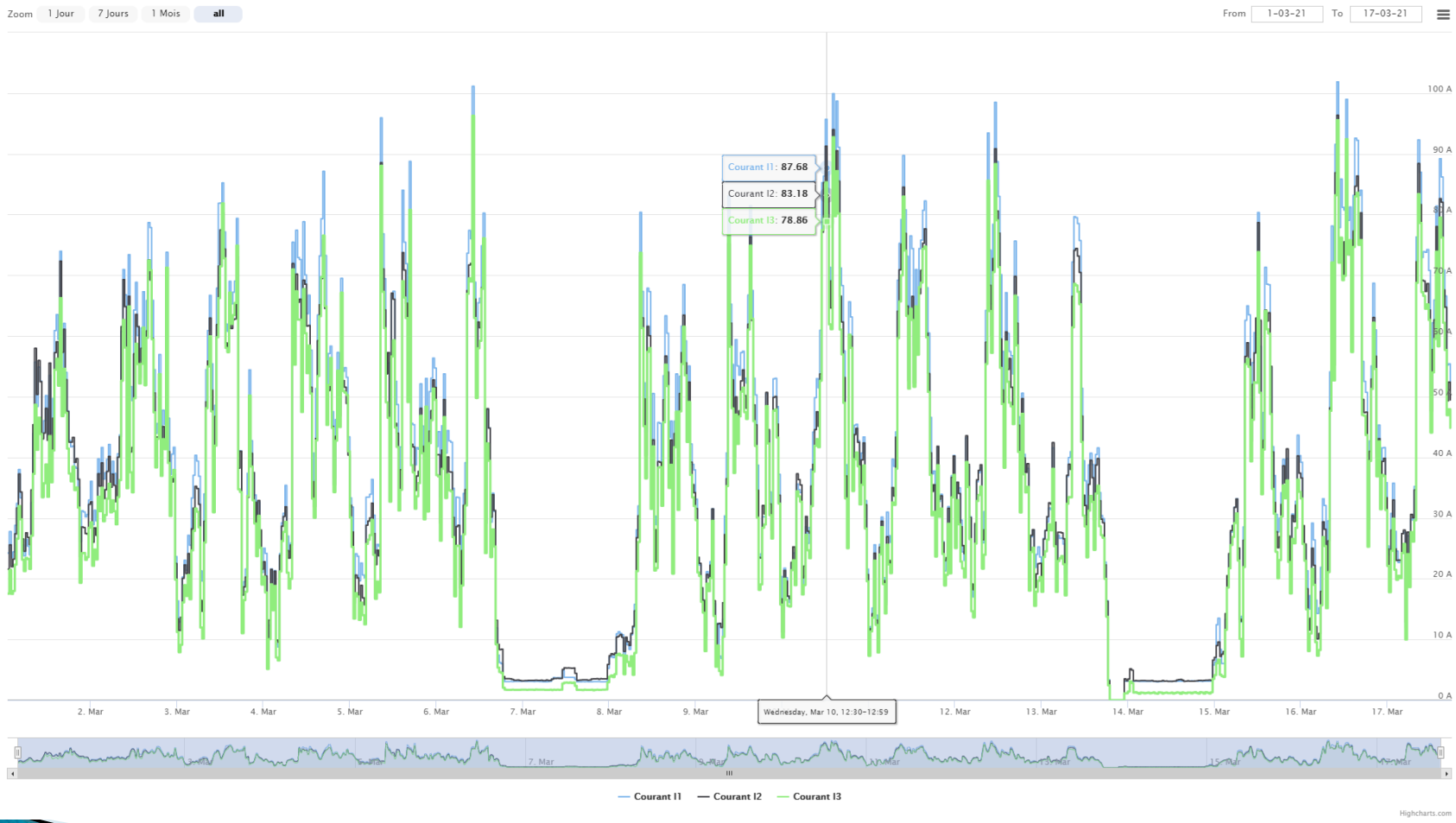
Current history



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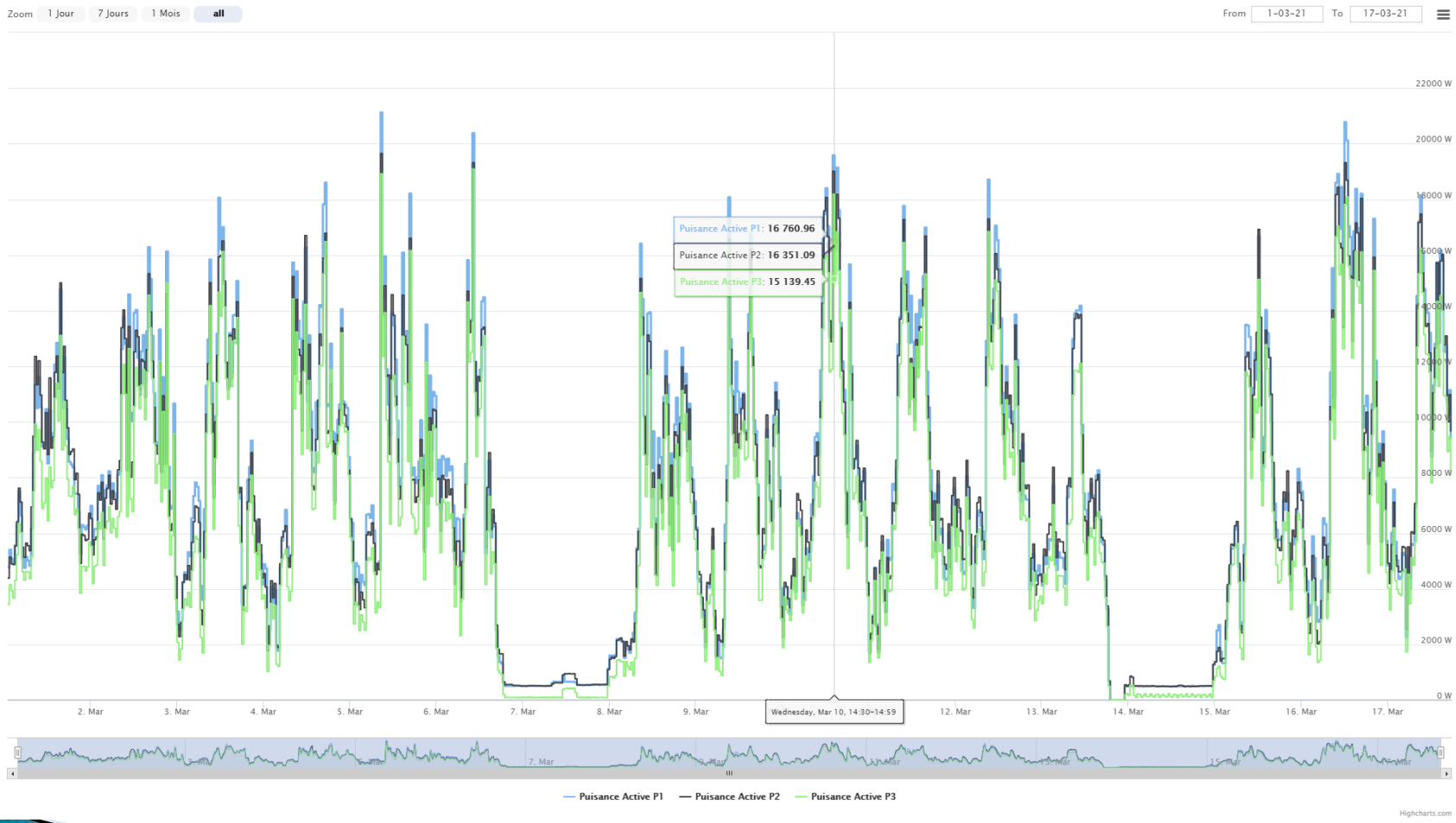
History: Active power



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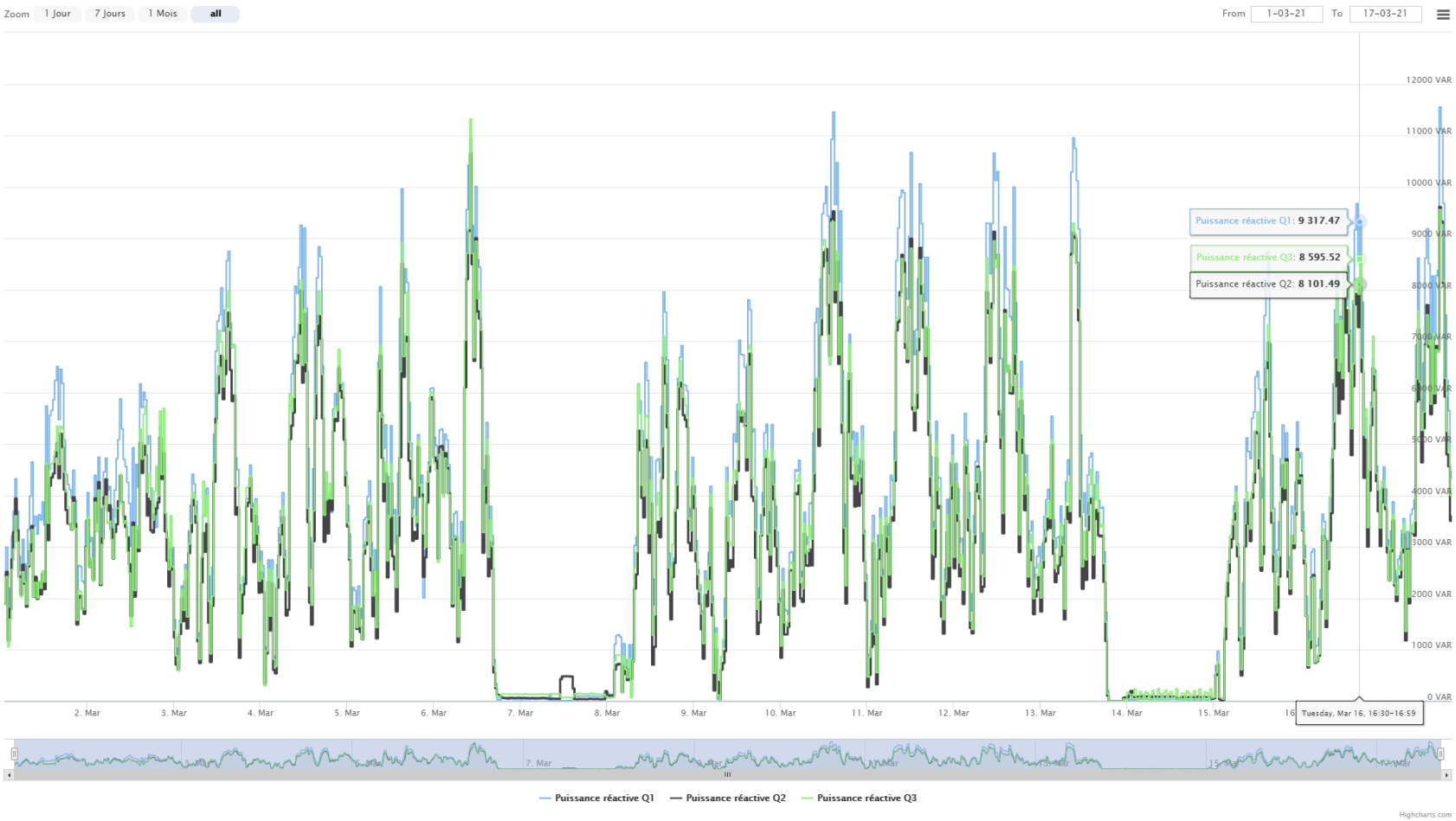
History : Reactive power



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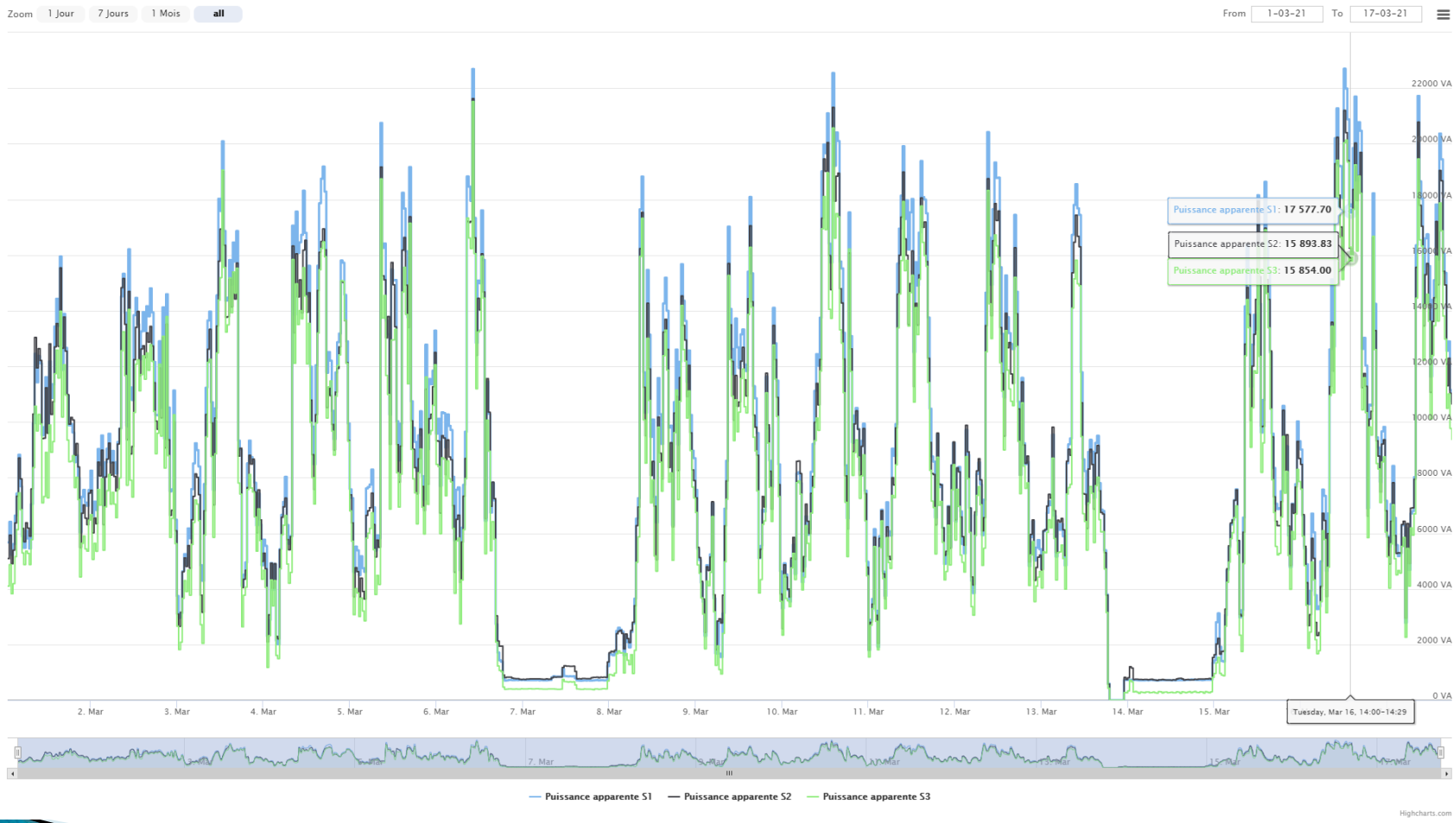
History : Apparent power



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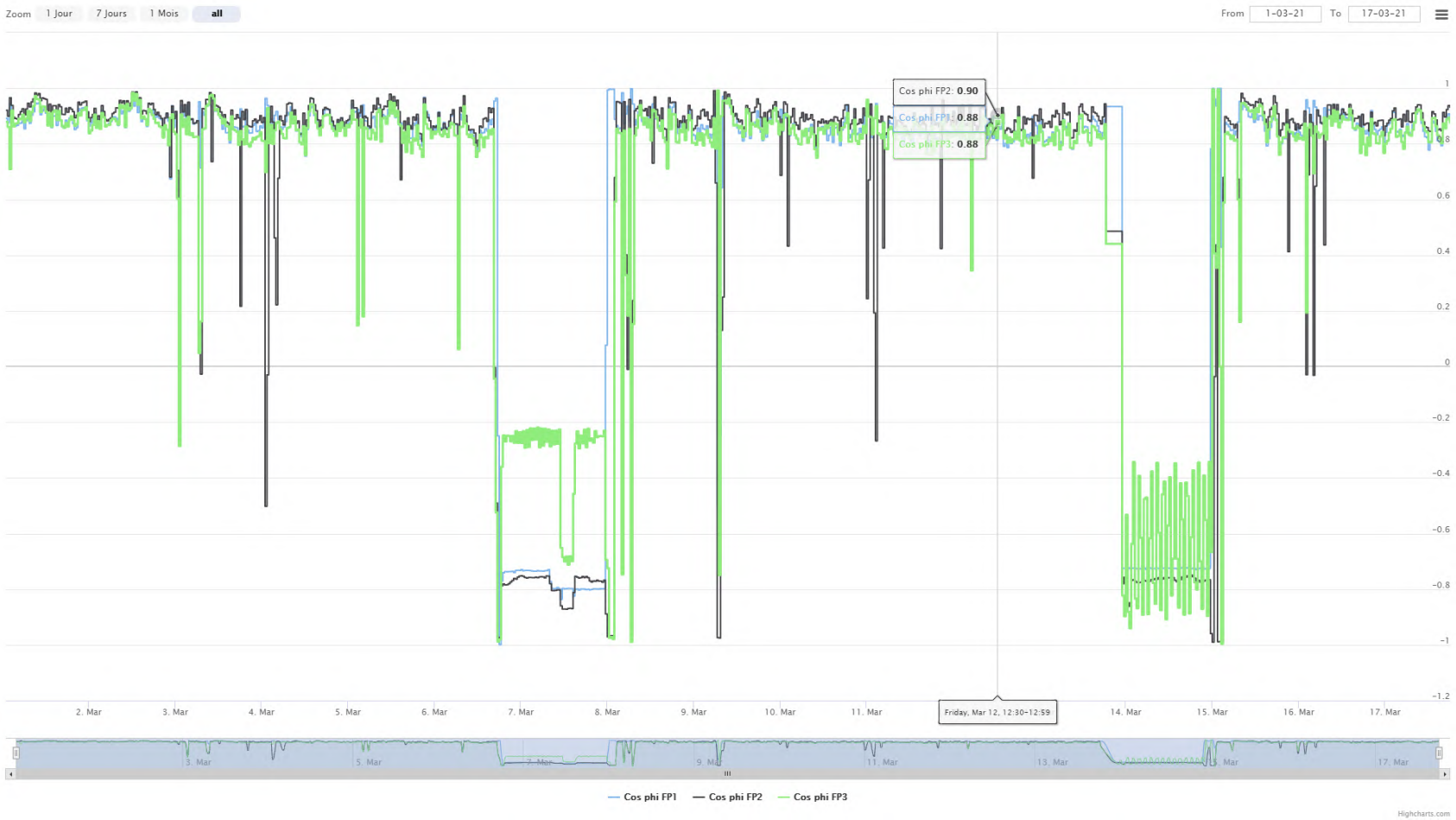
Cos φ history



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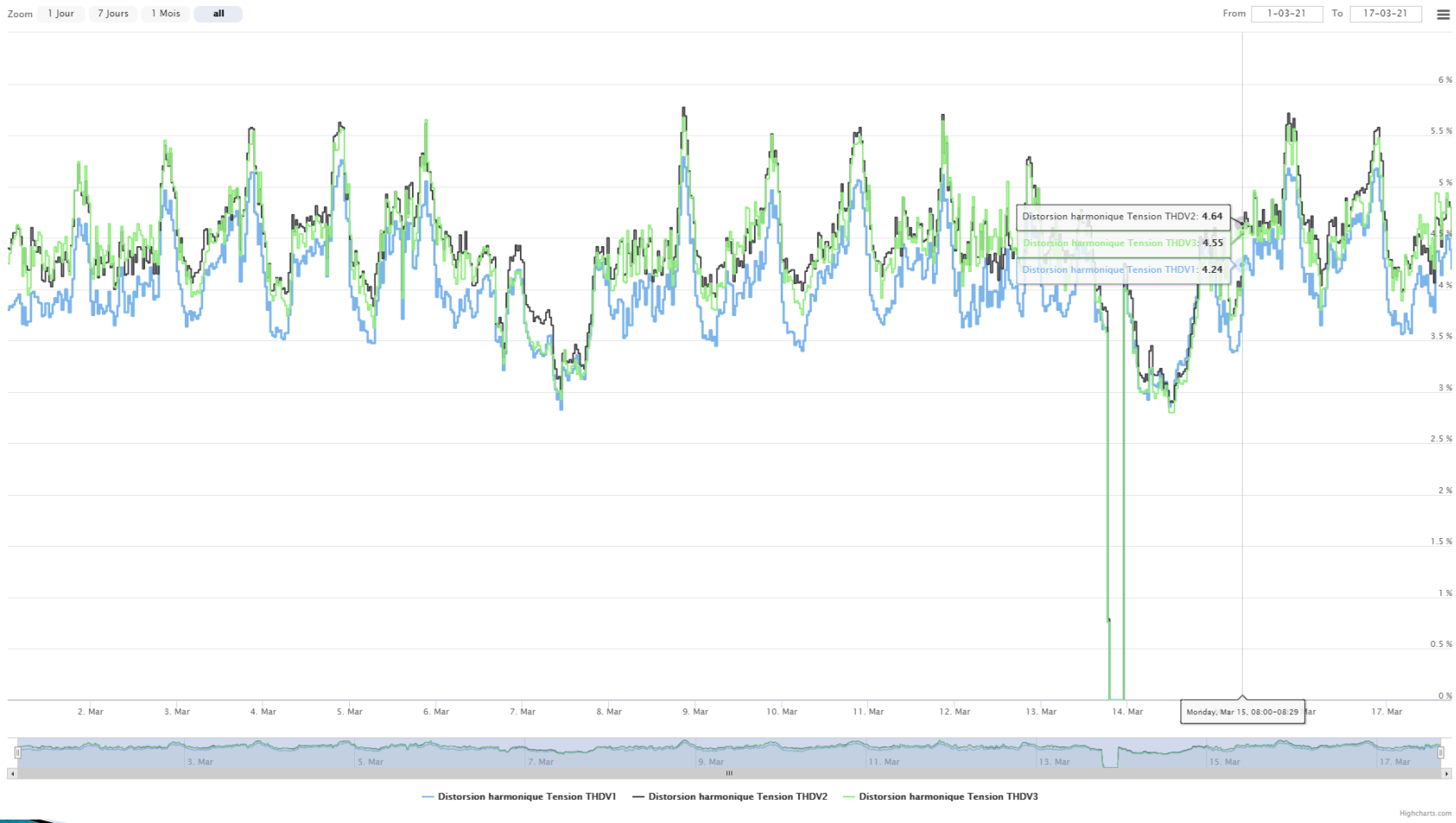
THD-V History



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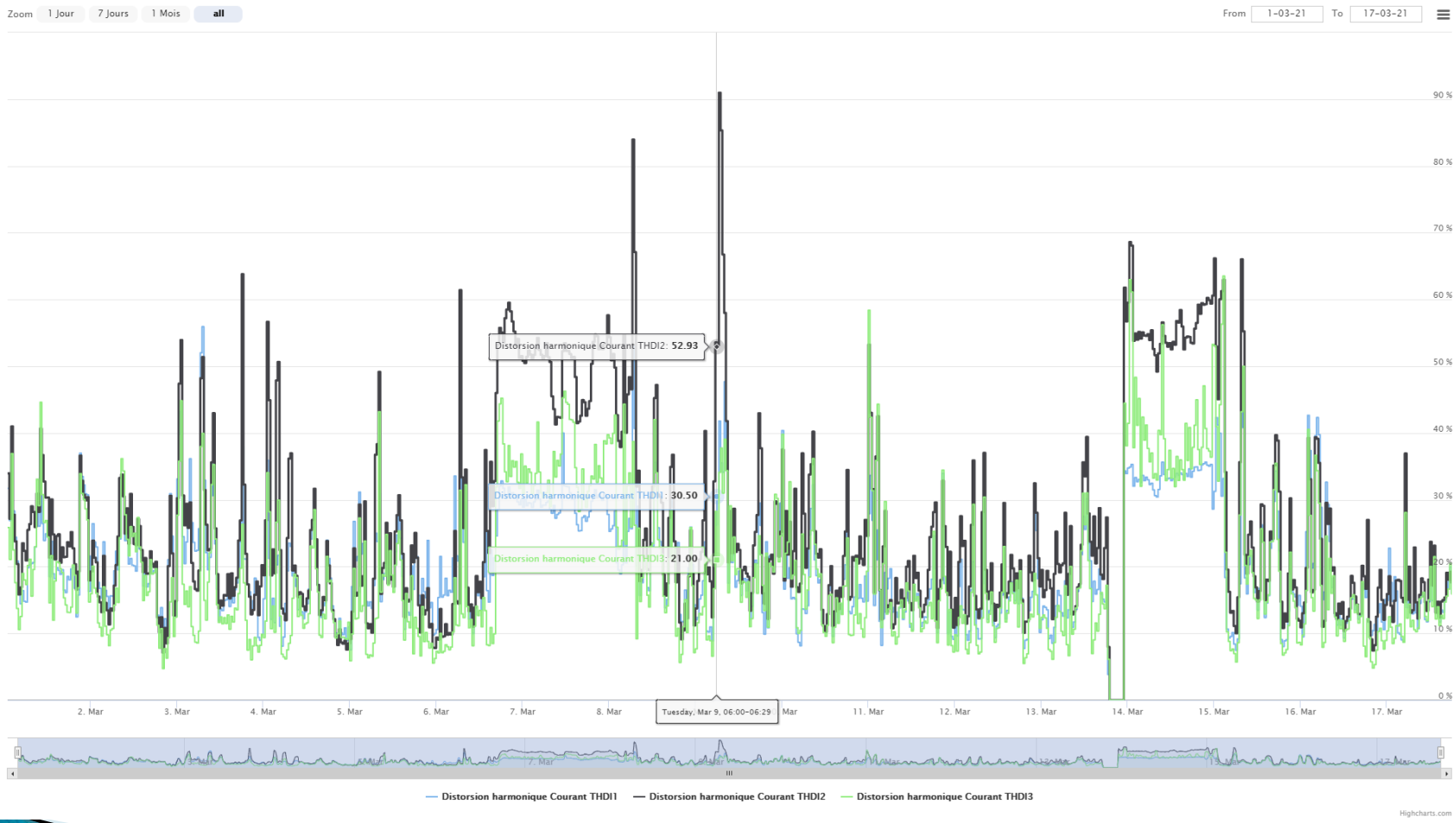
THD-I History



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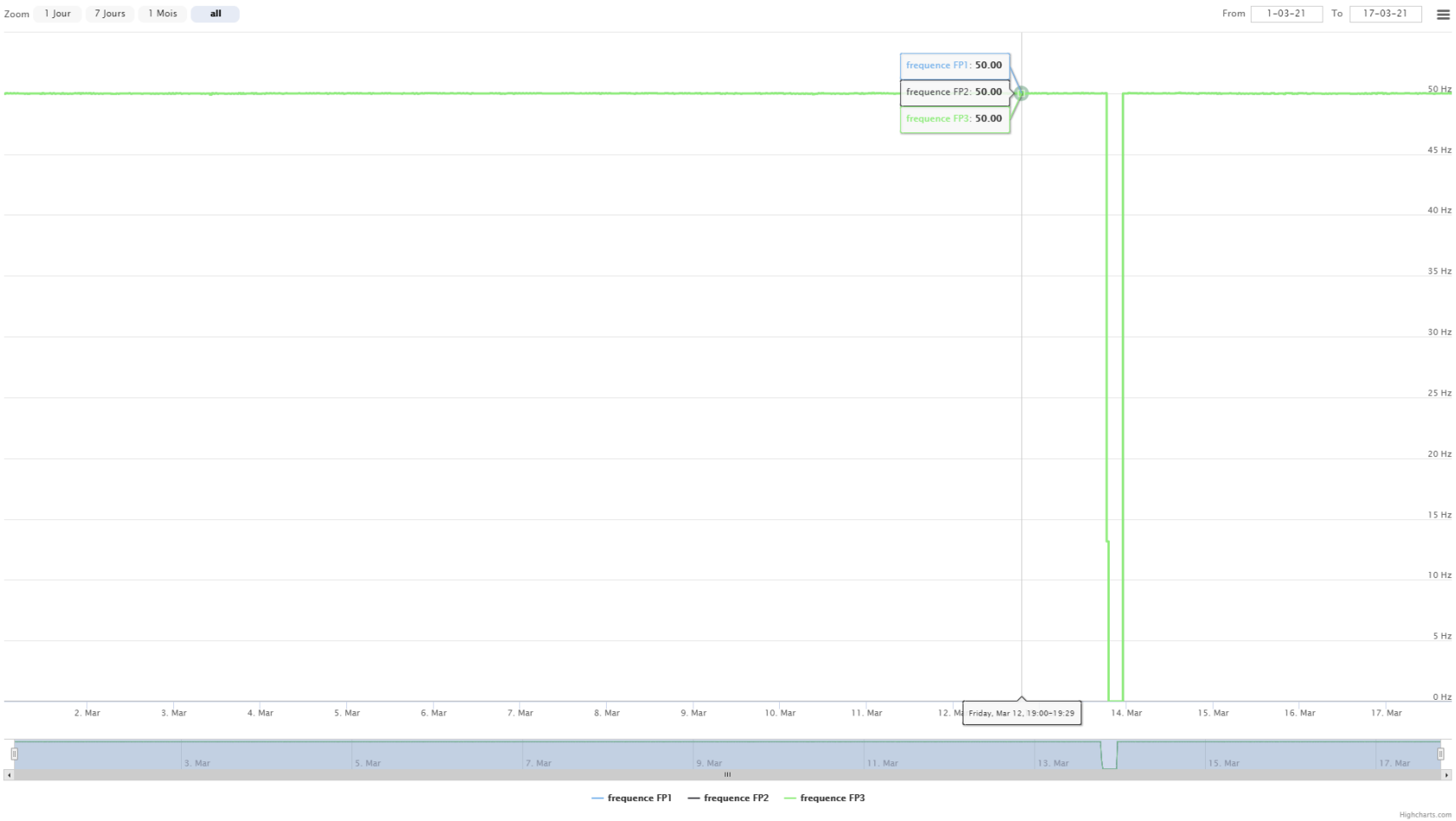
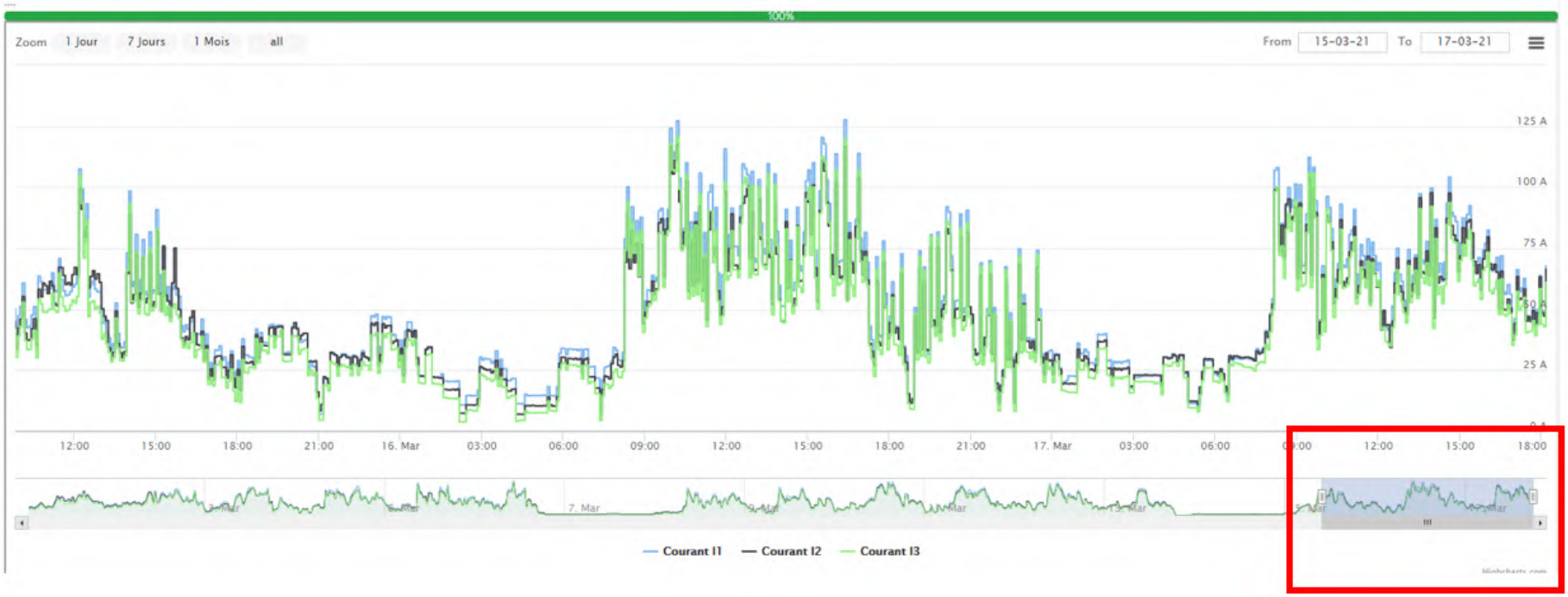
Frequency history



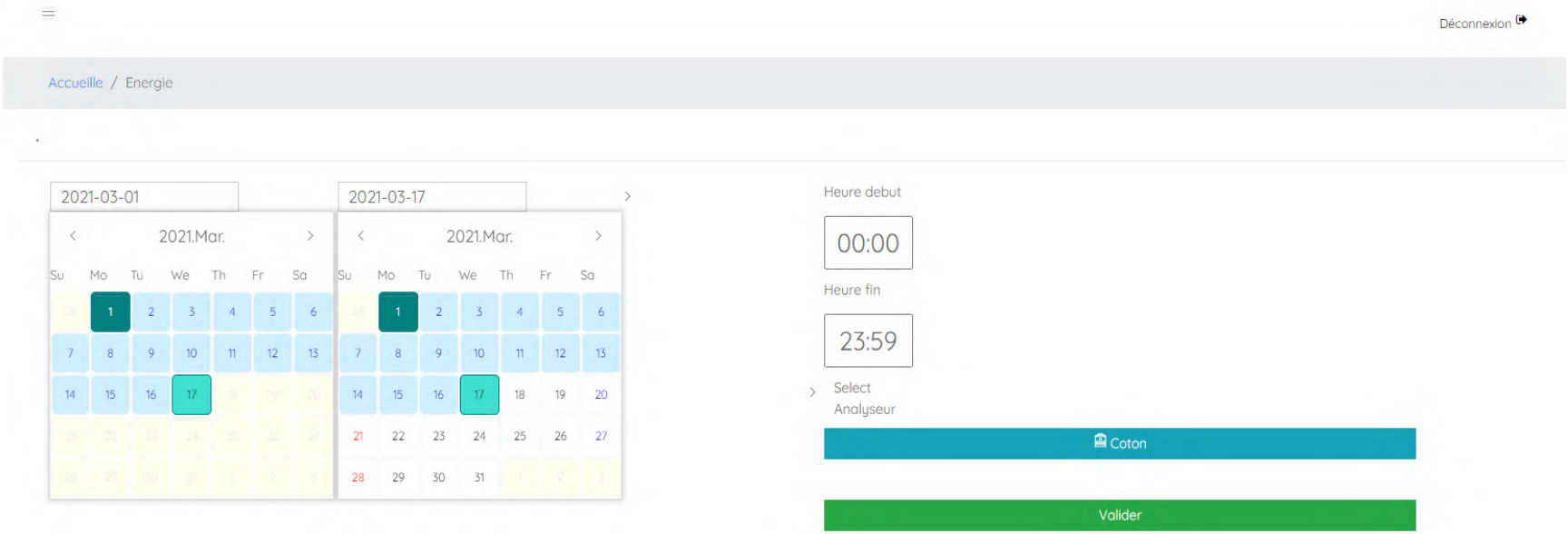
Zoom function

The possibility to zoom in is done by selecting the desired period. The selection is displayed in gray.



Energy module

To view the total energy consumption in the selected period



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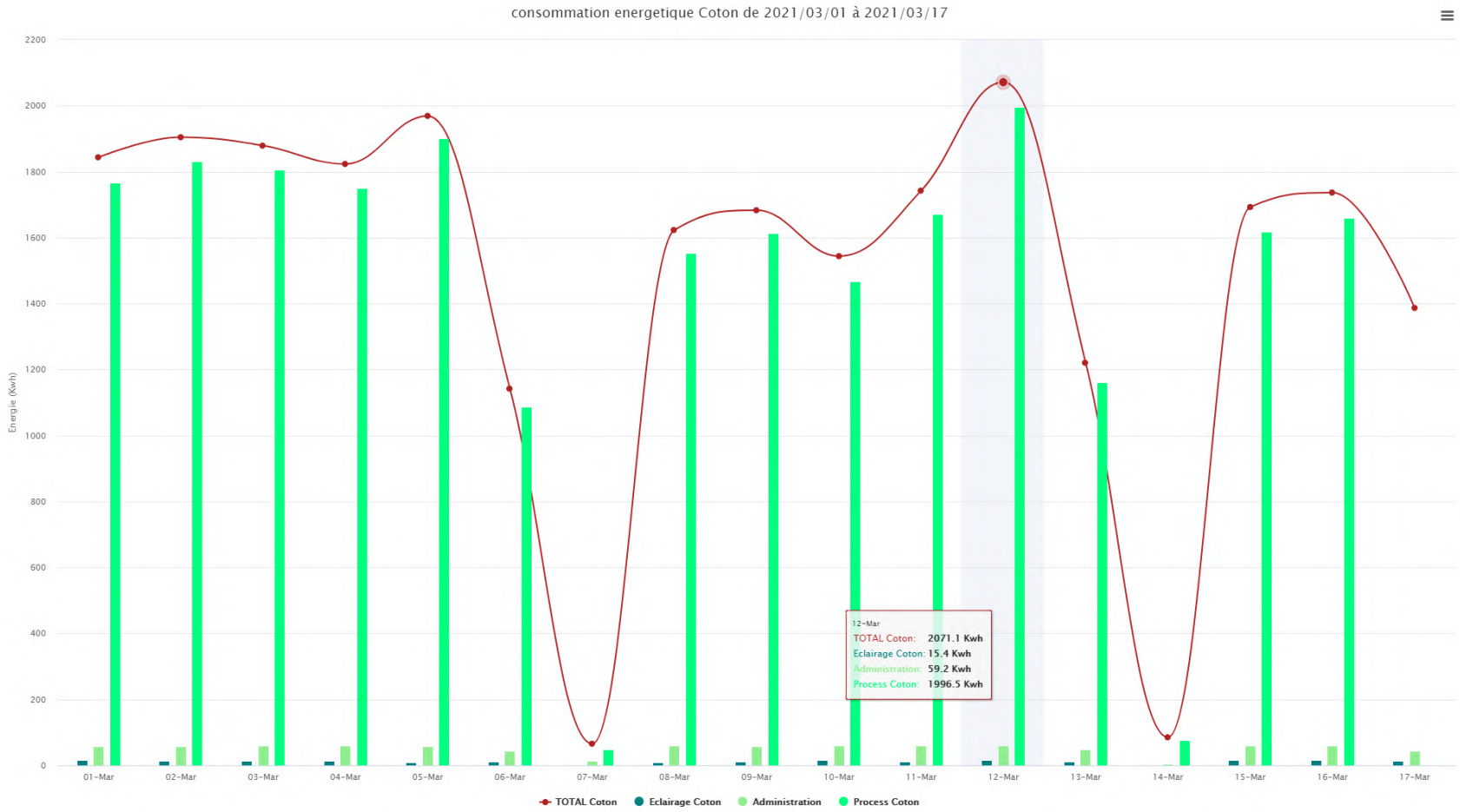
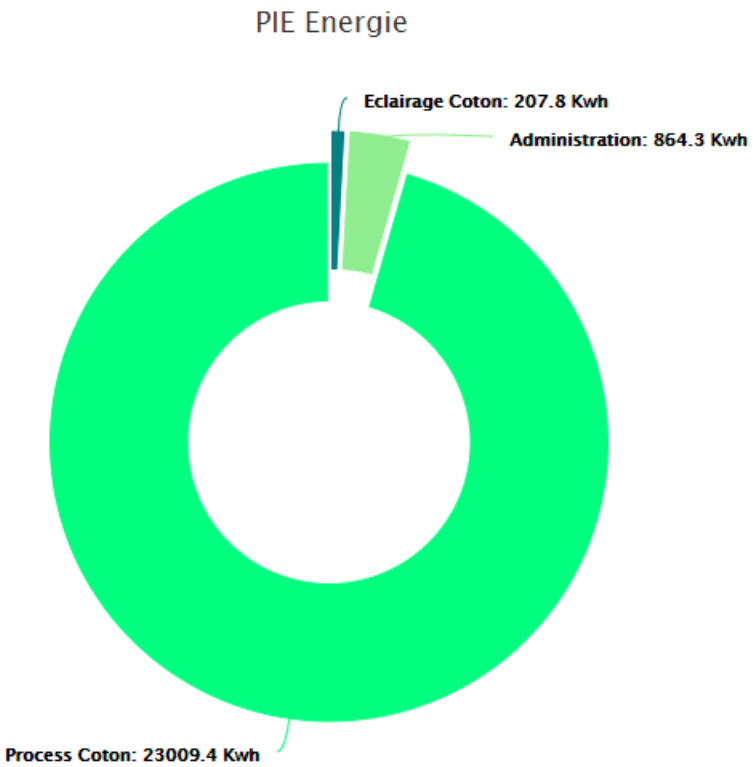
Energy module: Distribution of energy consumption over the selected period



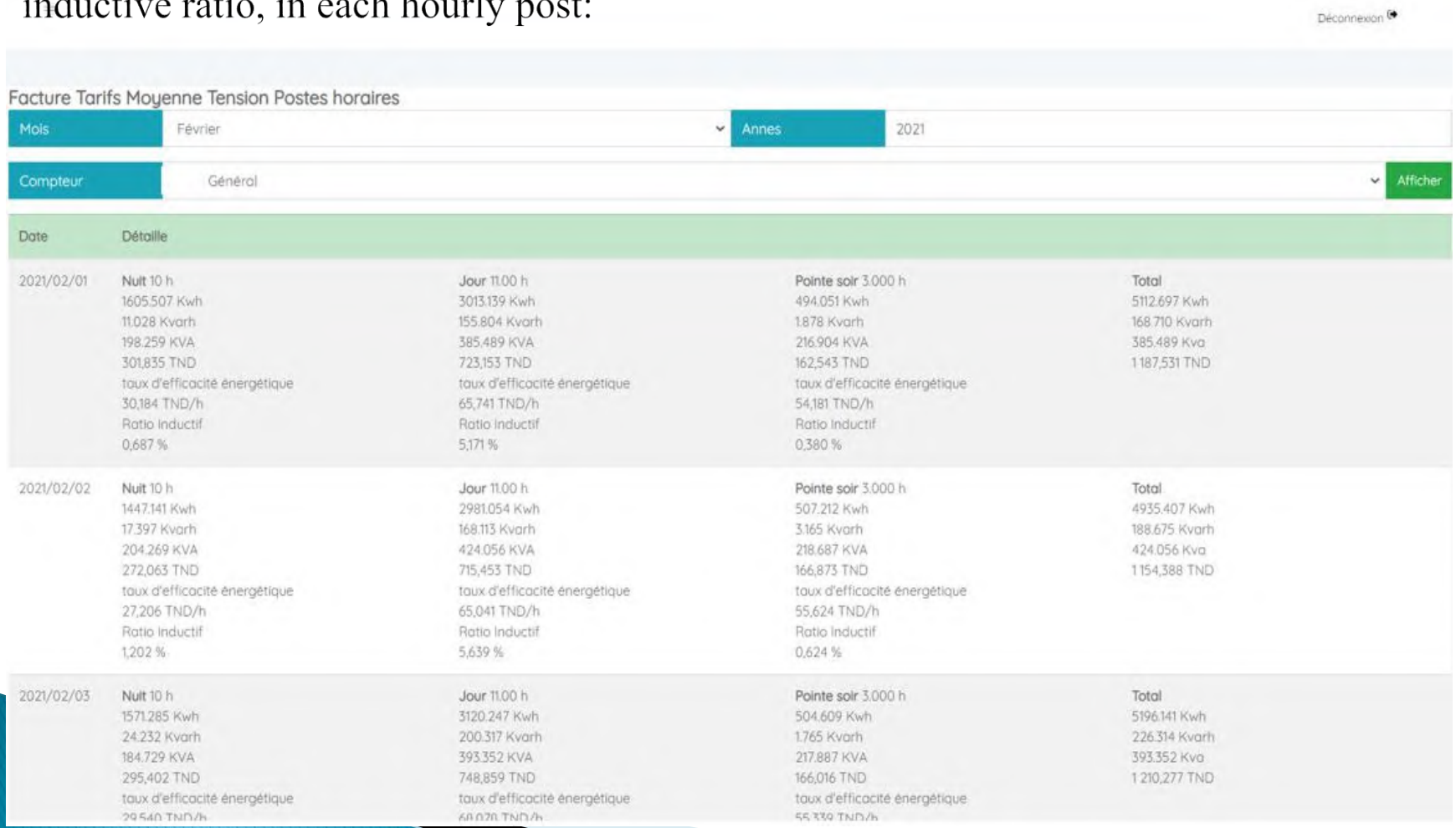
Energy module: Distribution of energy consumption, and total energy over the selected period



Totale : 25 410,841Kwh

Hourly post bill: daily consumption

You can choose the month, the year and the desired start, and view the active, reactive and apparent energy consumption, the energy cost, the energy efficiency rate and the inductive ratio, in each hourly post:



Déconnexion

Facture Tarifs Moyenne Tension Postes horaires

Mois: Février — Annes: 2021

Compteur: Général — Afficher

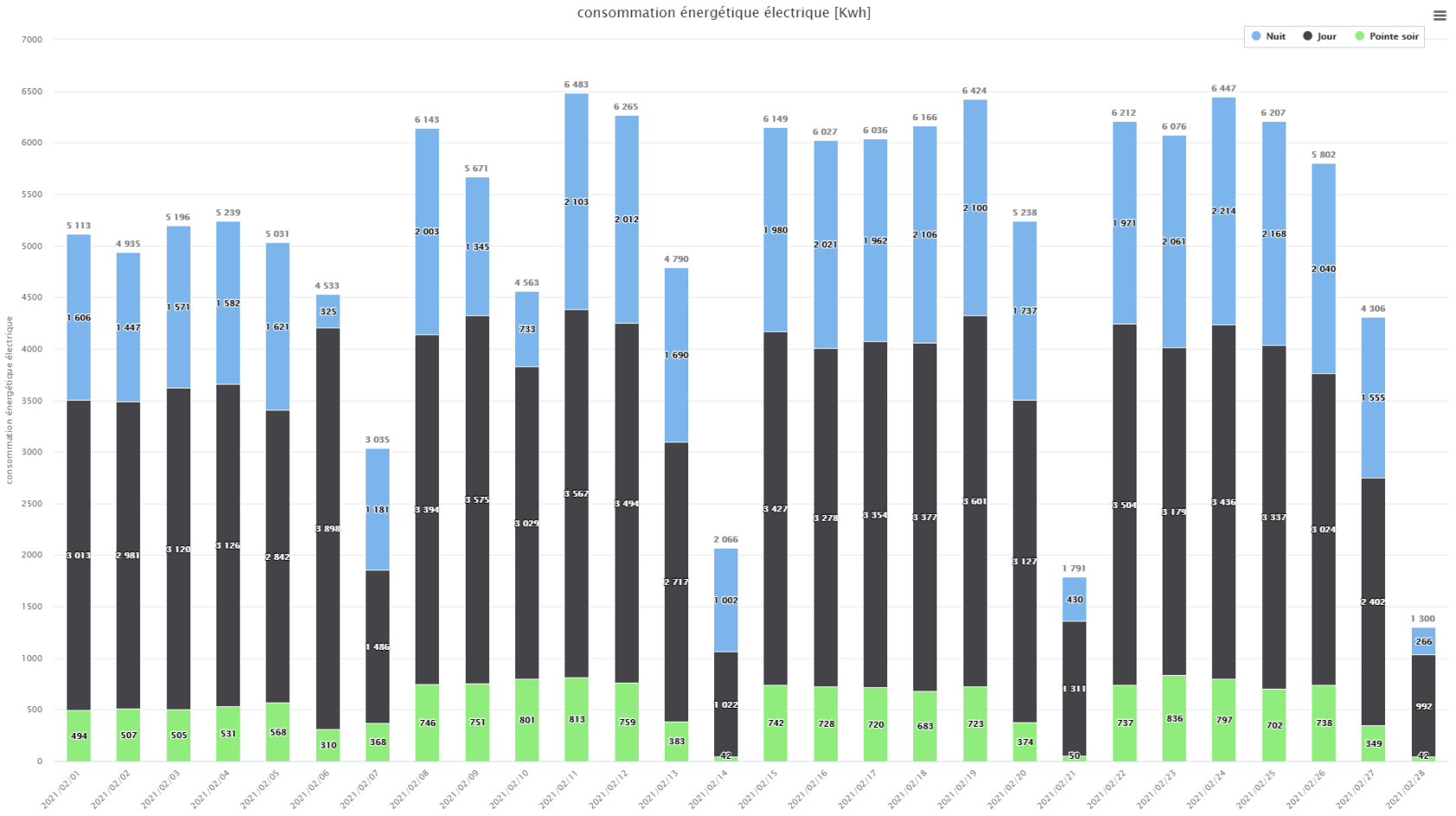
Date	Détaille			
2021/02/01	Nuit 10 h 1605.507 Kwh 11.028 Kvarh 198.259 KVA 301,835 TND taux d'efficacité énergétique 30,184 TND/h Ratio Inductif 0,687 %	Jour 11.00 h 3013.139 Kwh 155.804 Kvarh 385.489 KVA 723,153 TND taux d'efficacité énergétique 65,741 TND/h Ratio Inductif 5,171 %	Pointe soir 3.000 h 494.051 Kwh 1.878 Kvarh 216.904 KVA 162,543 TND taux d'efficacité énergétique 54,181 TND/h Ratio Inductif 0,380 %	Total 5112.697 Kwh 168.710 Kvarh 385.489 Kva 1 187,531 TND
2021/02/02	Nuit 10 h 1447.141 Kwh 17.397 Kvarh 204.269 KVA 272,063 TND taux d'efficacité énergétique 27,206 TND/h Ratio Inductif 1,202 %	Jour 11.00 h 2981.054 Kwh 168.113 Kvarh 424.056 KVA 715,453 TND taux d'efficacité énergétique 65,041 TND/h Ratio Inductif 5,639 %	Pointe soir 3.000 h 507.212 Kwh 3.165 Kvarh 218.687 KVA 166,873 TND taux d'efficacité énergétique 55,624 TND/h Ratio Inductif 0,624 %	Total 4935.407 Kwh 188.675 Kvarh 424.056 Kva 1 154,388 TND
2021/02/03	Nuit 10 h 1571.285 Kwh 24.232 Kvarh 184.729 KVA 295,402 TND taux d'efficacité énergétique 29,540 TND/h	Jour 11.00 h 3120.247 Kwh 200.317 Kvarh 393.352 KVA 748,859 TND taux d'efficacité énergétique 60,020 TND/h	Pointe soir 3.000 h 504.609 Kwh 1.765 Kvarh 217.887 KVA 166,016 TND taux d'efficacité énergétique 55,339 TND/h	Total 5196.141 Kwh 226.314 Kvarh 393.352 Kva 1 210,277 TND

Hourly post bill: Total consumption

	38,361 TND/h Ratio Inductif 0,362 %	65,987 TND/h Ratio Inductif 3,402 %	80,947 TND/h Ratio Inductif 0,362 %	
2021/02/27	**Nuit** 10 h 1554.500 Kwh 12.484 Kvarh 246.473 KVA 292,246 TND taux d'efficacité énergétique 29,225 TND/h Ratio Inductif 0,803 %	**Jour** 11.00 h 2401.940 Kwh 32.504 Kvarh 316.499 KVA 576,466 TND taux d'efficacité énergétique 52,406 TND/h Ratio Inductif 1,353 %	**Pointe soir** 3.000 h 348.852 Kwh 0.164 Kvarh 127.989 KVA 114,772 TND taux d'efficacité énergétique 38,257 TND/h Ratio Inductif 0,047 %	**Total** 4305.292 Kwh 45.152 Kvarh 316.499 Kva 983,484 TND
2021/02/28	**Nuit** 10 h 266.013 Kwh 38.655 Kvarh 25.758 KVA 50,010 TND taux d'efficacité énergétique 5,001 TND/h Ratio Inductif 14,531 %	**Jour** 11.00 h 992.036 Kwh 23.662 Kvarh 167.212 KVA 238,089 TND taux d'efficacité énergétique 21,644 TND/h Ratio Inductif 2,385 %	**Pointe soir** 3.000 h 42.048 Kwh 16.994 Kvarh 16.508 KVA 13,834 TND taux d'efficacité énergétique 4,611 TND/h Ratio Inductif 40,416 %	**Total** 1300.097 Kwh 79.311 Kvarh 191.231 Kva 301,933 TND
Totale	**Total Nuit**	**Total Jour**	**Total Pointe soir**	**Total Consomation**
	44 833,800 Kwh	82 614,073 Kwh	15 799,988 Kwh	143 247,861Kwh
	425,328 Kvarh	4 535,250 Kvarh	171,909 Kvarh	5 132,487Kvarh
	8 428,753 TND	19 827,377 TND	5 198,194 TND	**33 454,324TND**
	Ratio Ind : 0,949 %	Ratio Ind : 5,490 %	Ratio Ind : 1,088 %	Ratio Ind : 3,583 %

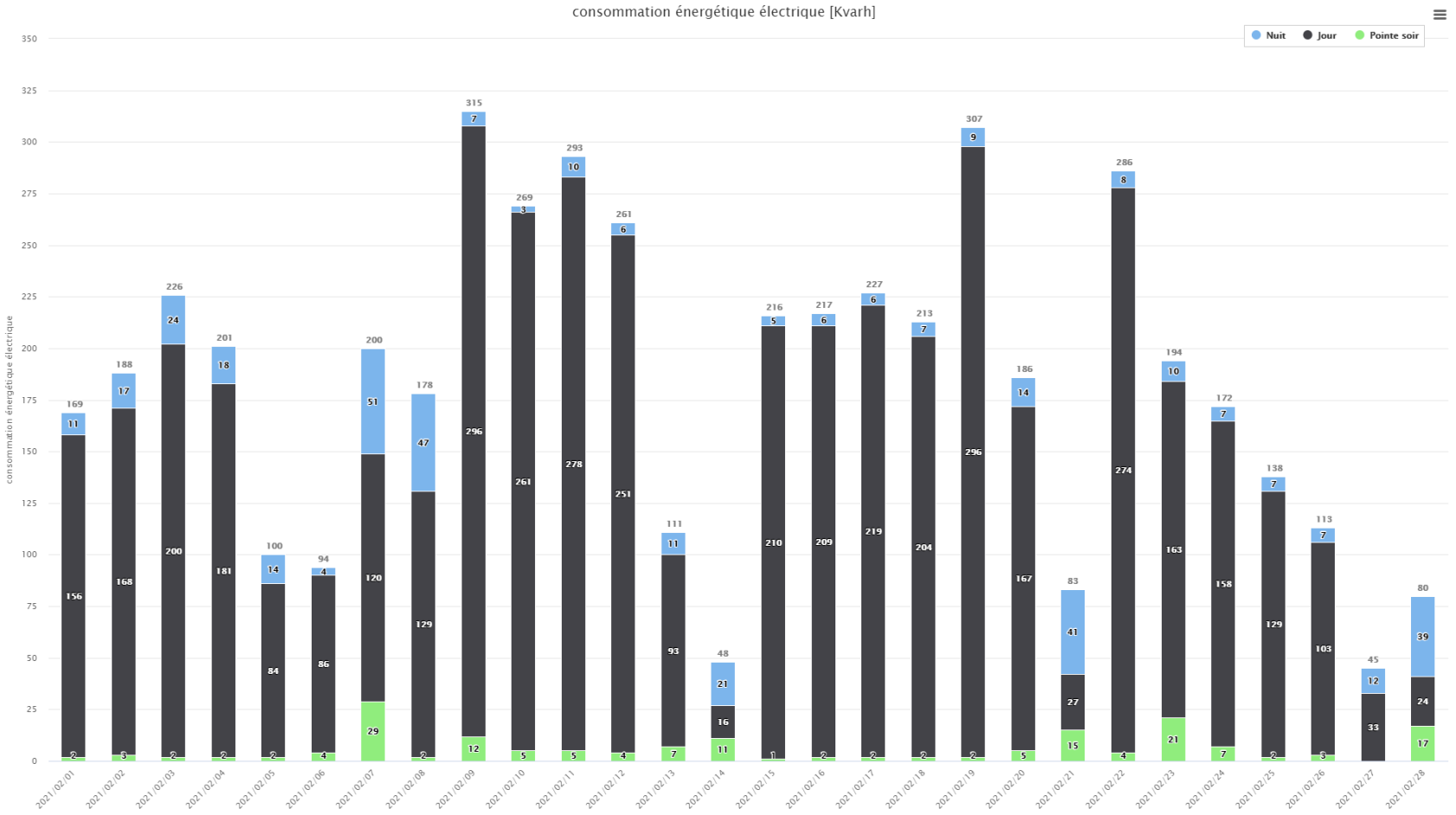
Hourly post bill: active energy consumption (kWh)

The energy consumption is displayed in the form of histograms, identifying the energy consumed in each hourly post:



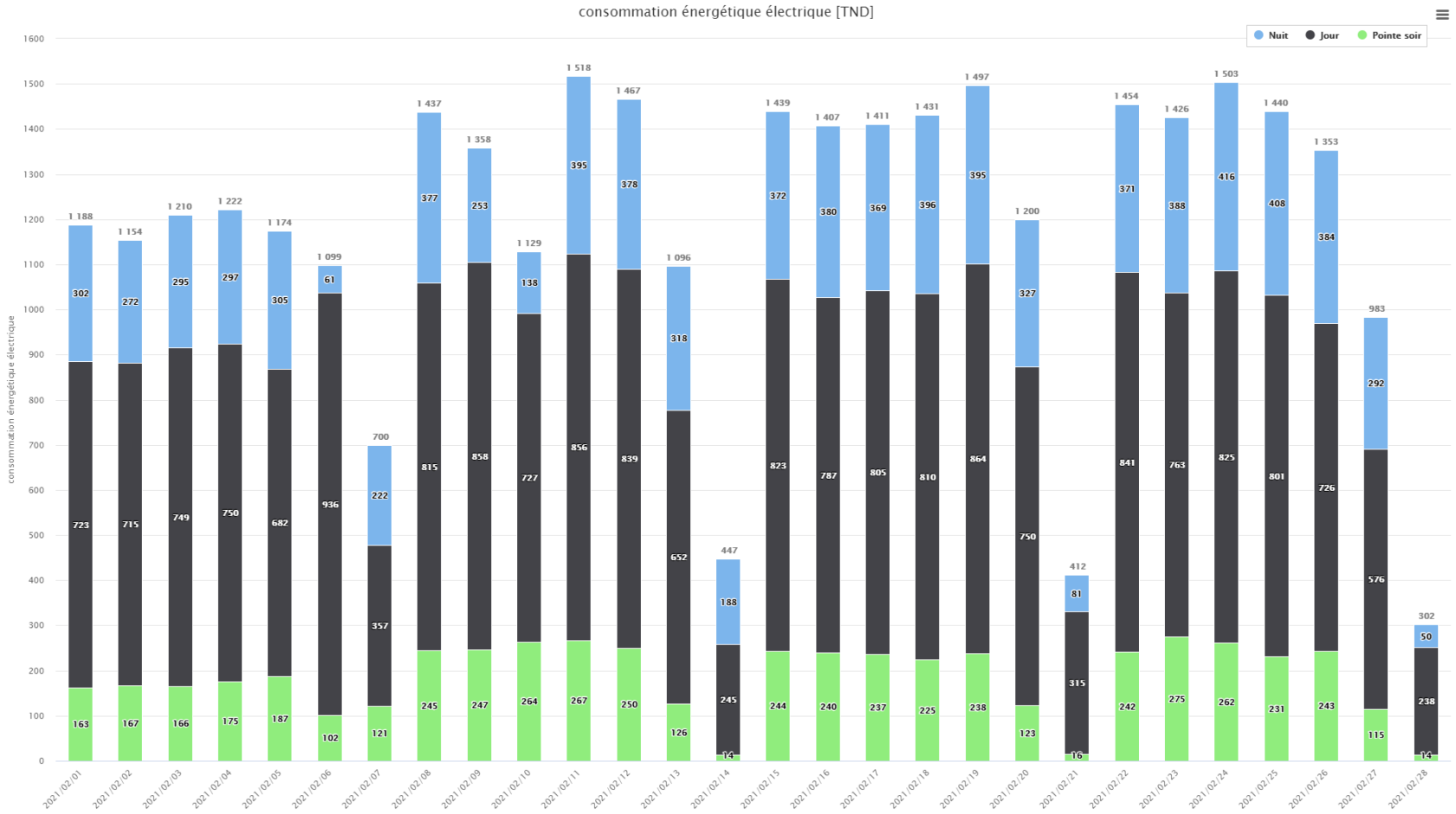
Hourly bill: reactive energy consumption (kVArh)

In the same way for the reactive energy, the energy consumption is displayed in the form of histograms, identifying the energy consumed in each hourly post.



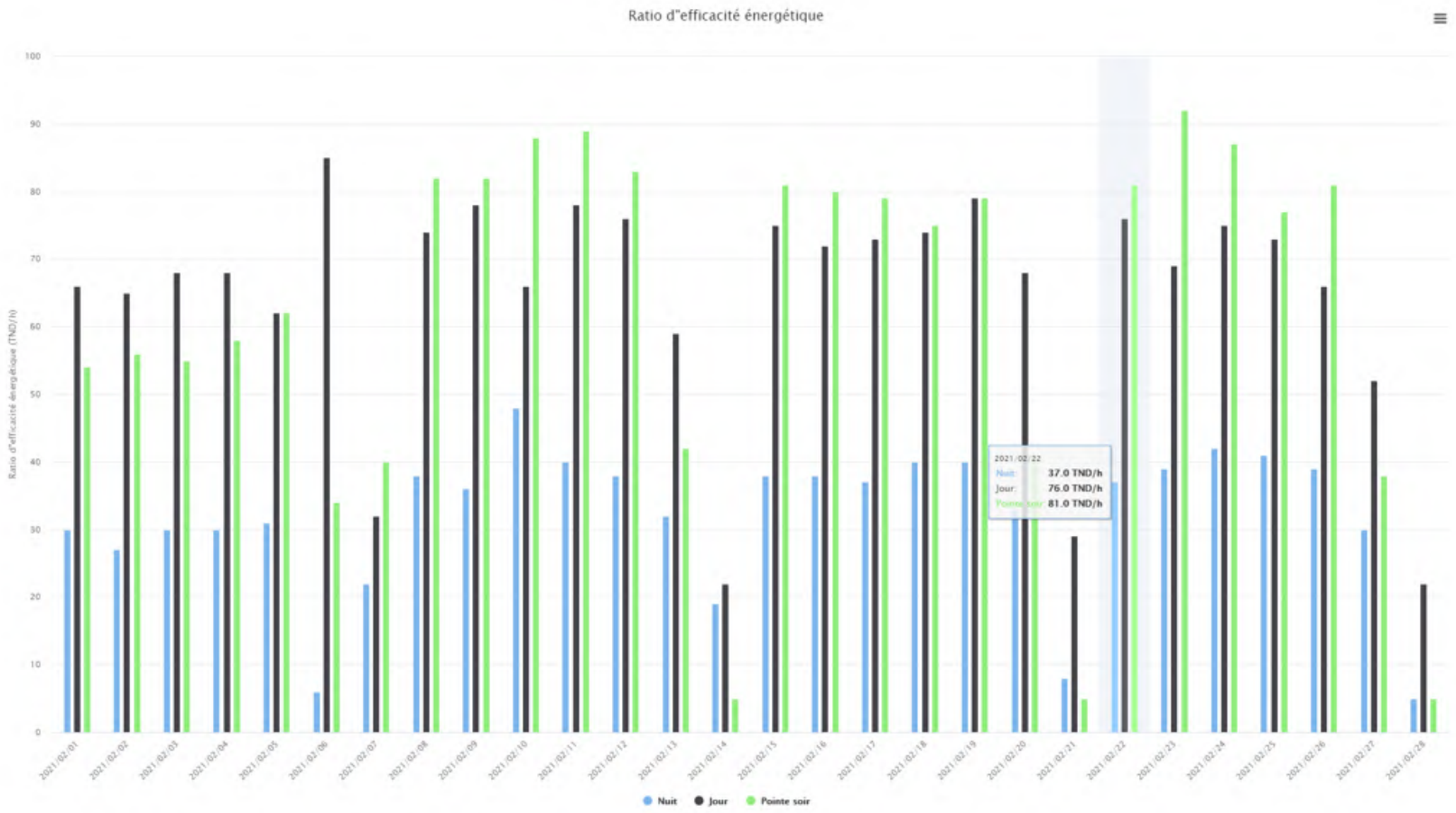
Hourly post bill: Price of electricity consumption

For each day, the price of the total electricity consumption is displayed at the top, with a repartition of the prices on the different hourly posts according to the consumption:



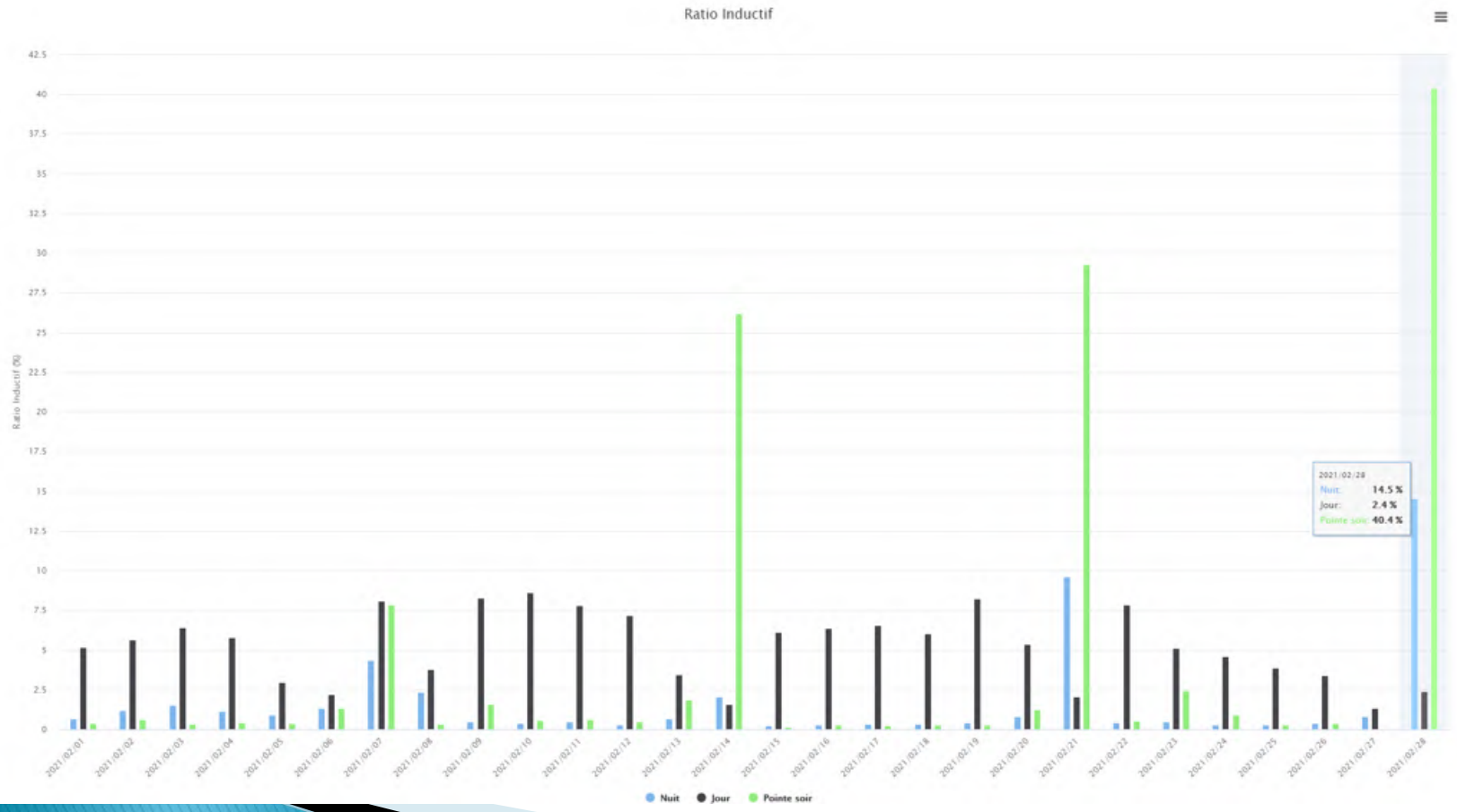
Hourly post bill: Energy efficiency ratio

Calculation of the price of the energy consumed per hour, in each hourly post:



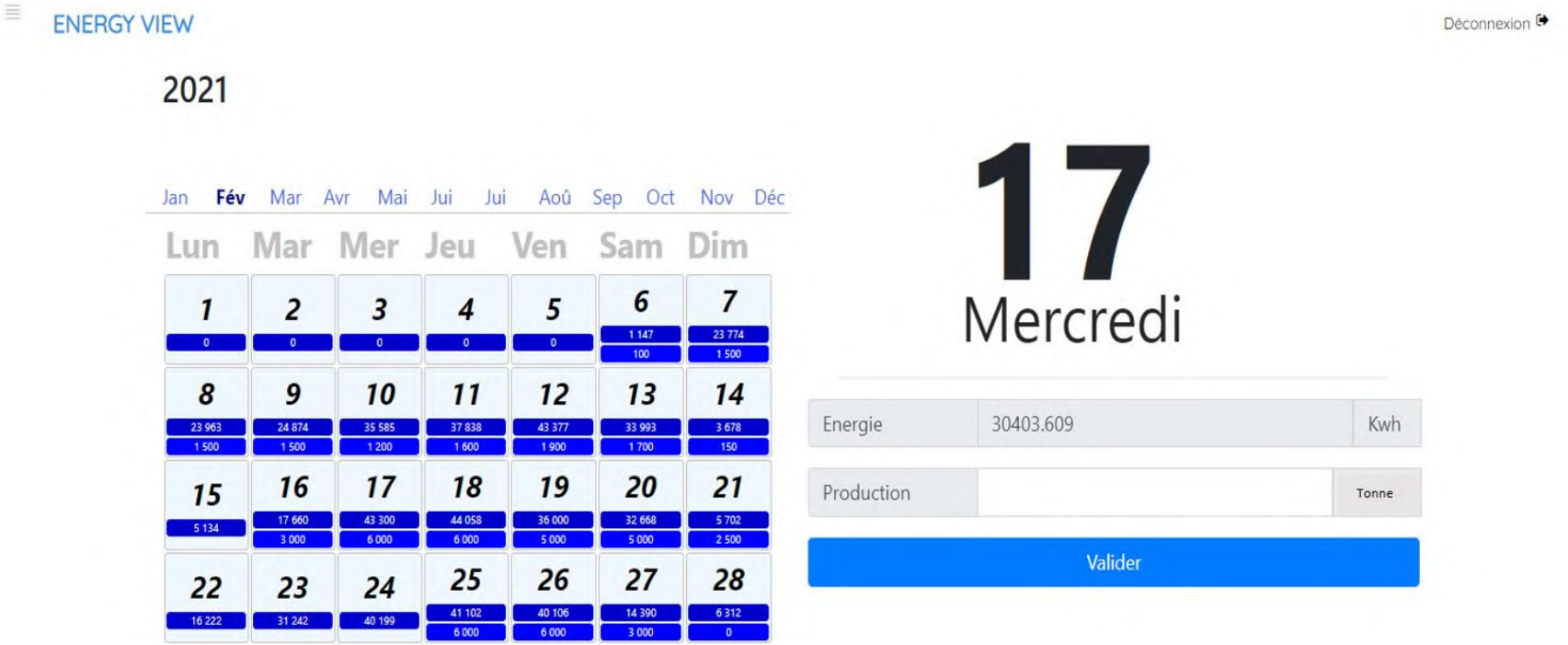
Facture postes horaires: Ratio inductif

- Calculation of the ratio of reactive energy to active energy:



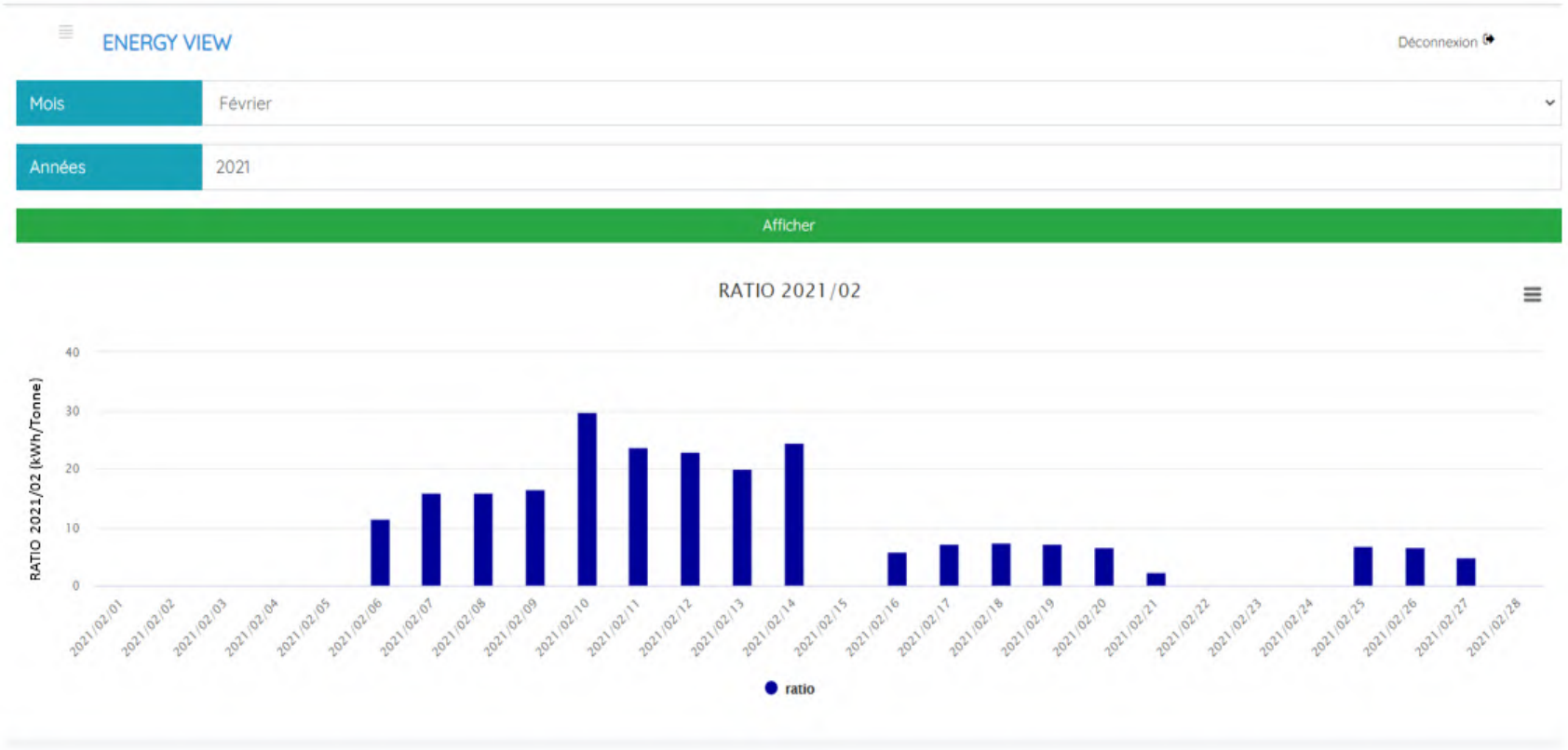
Declaration of production: to establish the production ratios

- For each day, the energy consumption is displayed, and the user must declare the production, to have the production ratio:

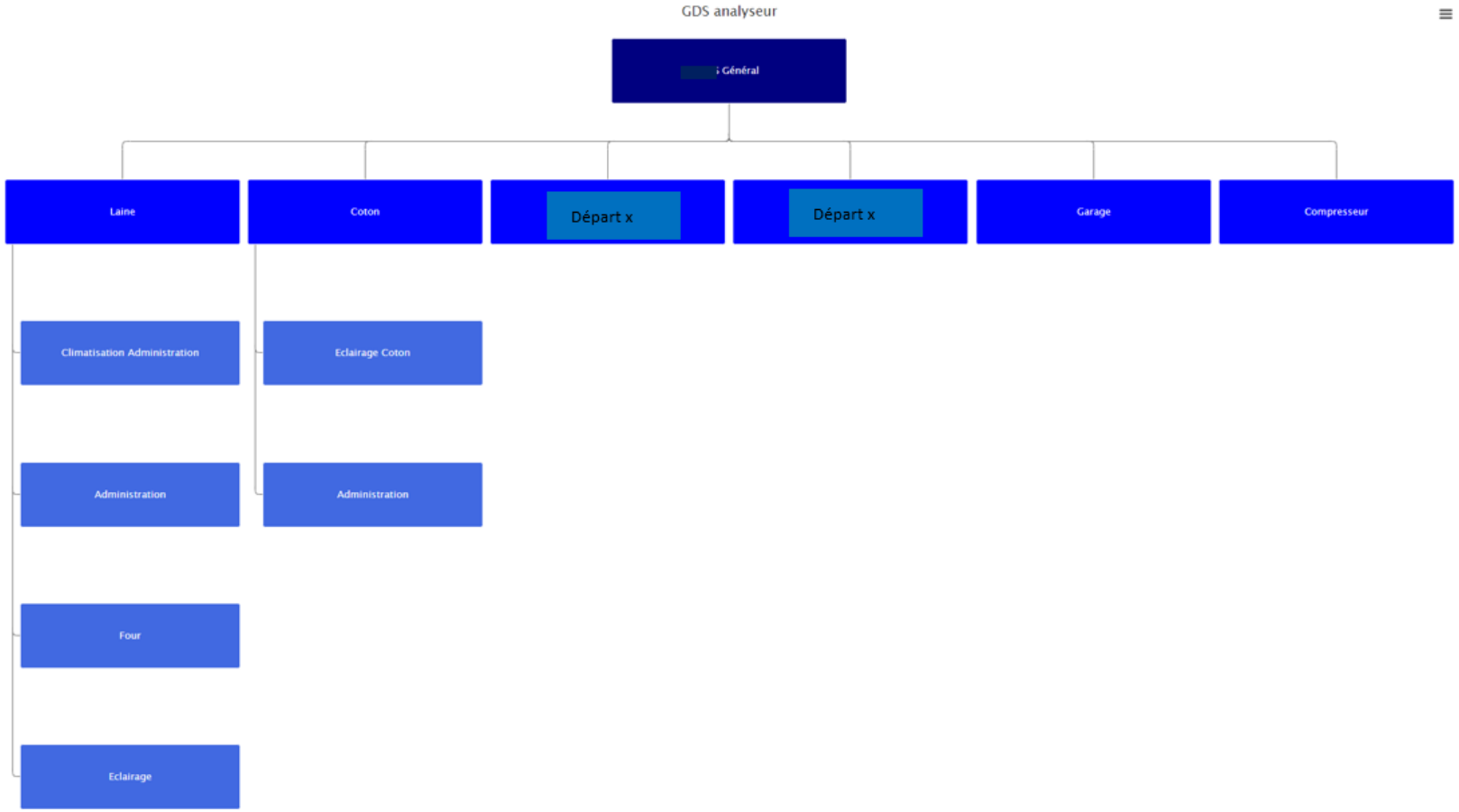


Ratio de production

- Depending on the production data entered by the user, the ratios are calculated and displayed:



List of analysers: gives the tree structure of the analysers/energy counters



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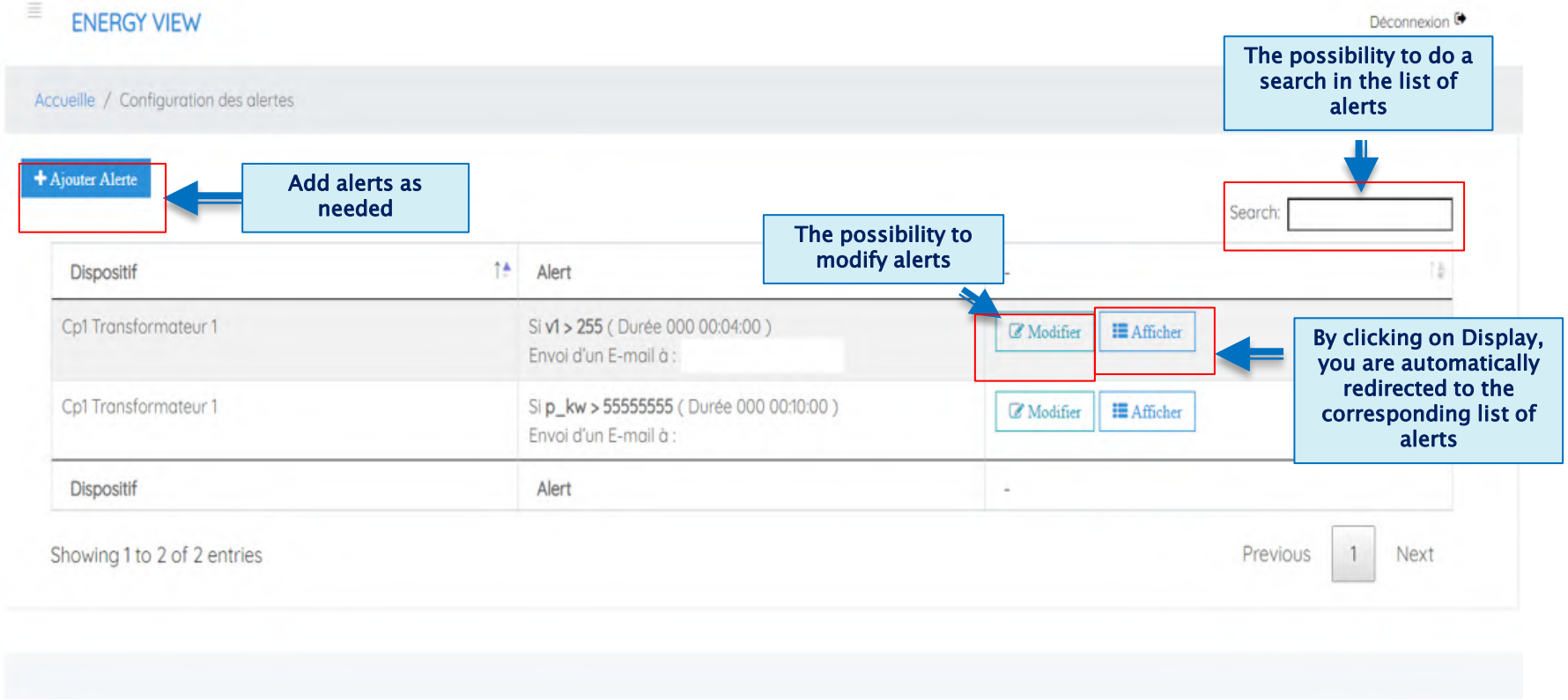
Configuration des alertes



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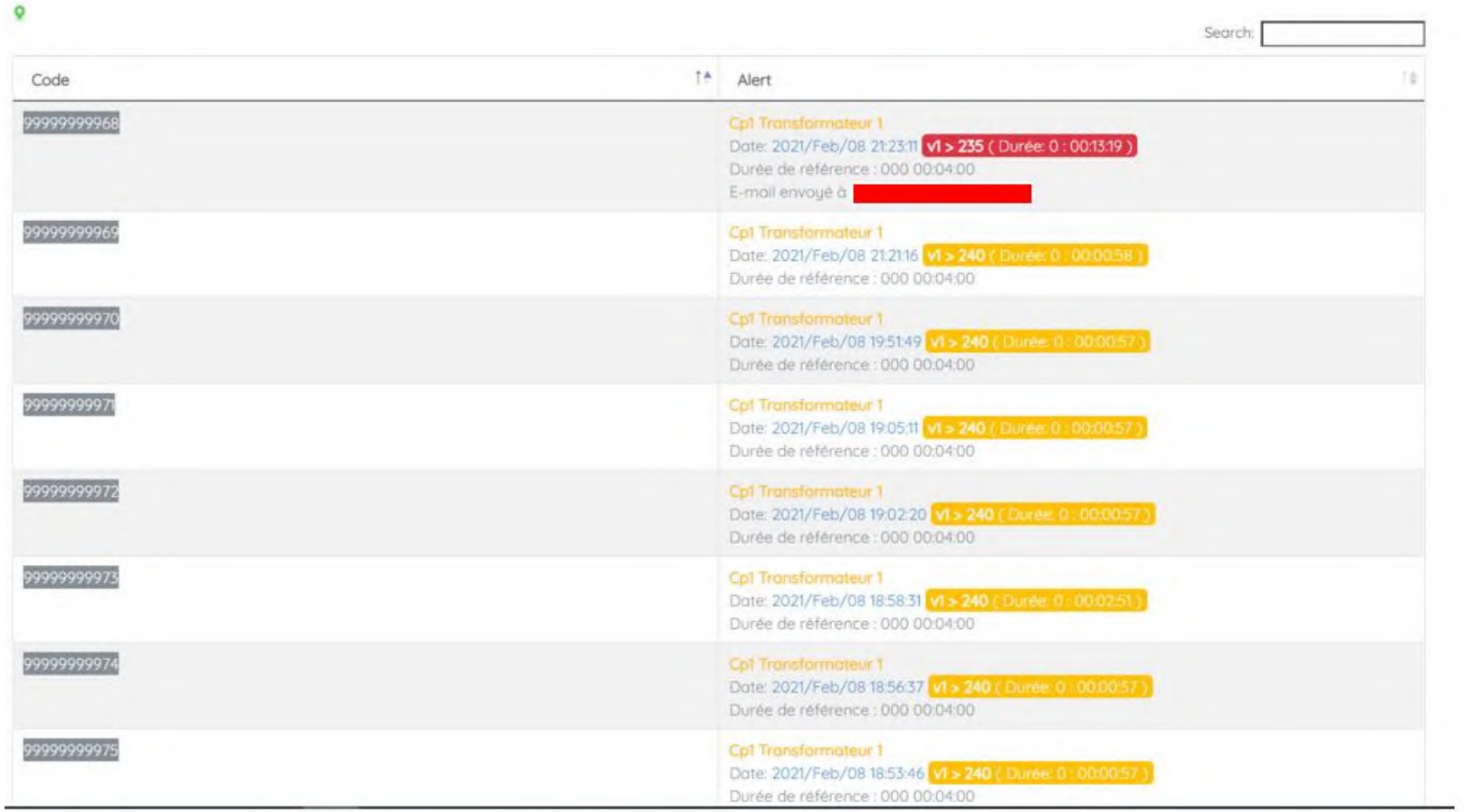
List of alerts

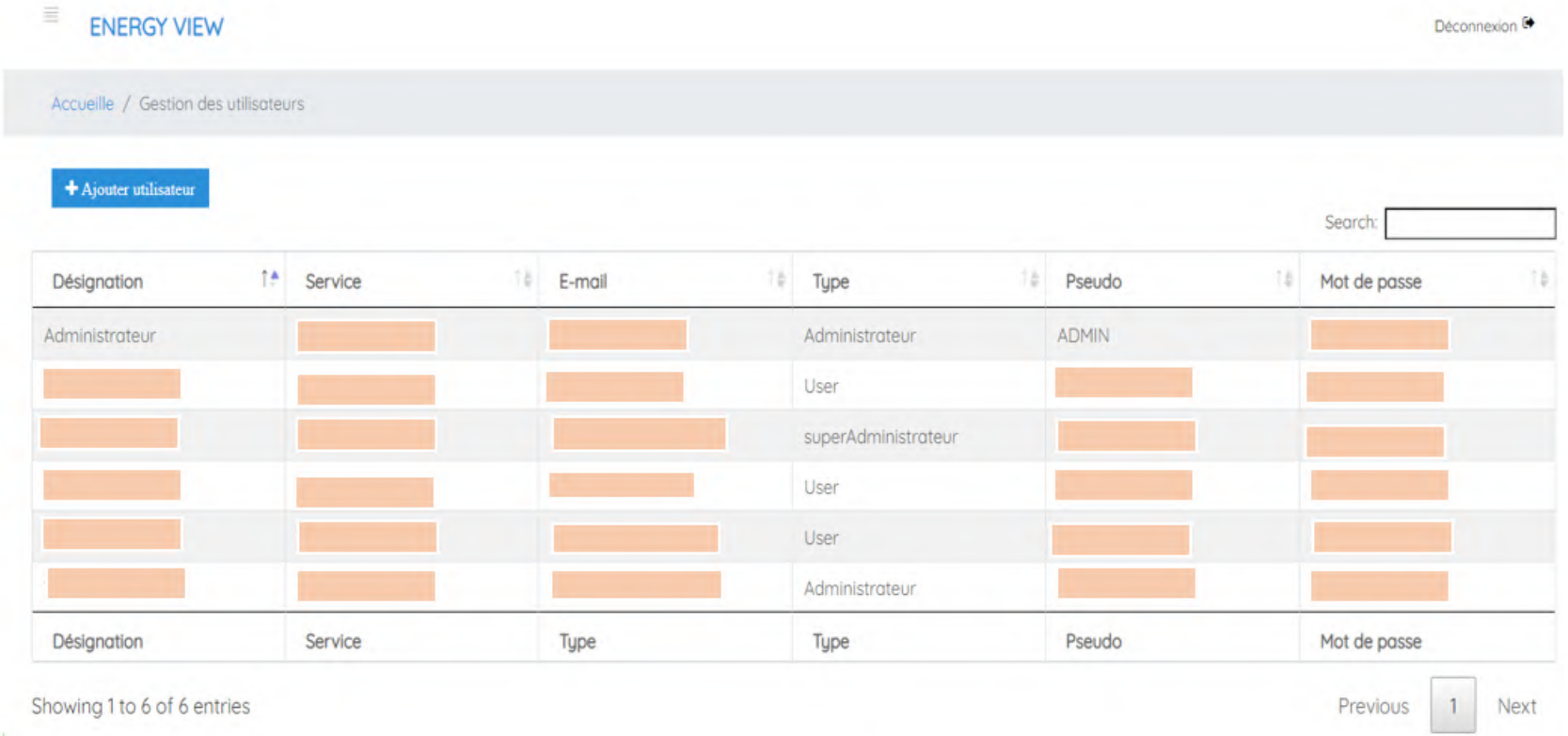


Search:

Code	Alert
99999999968	Cp1 Transformateur 1 Date: 2021/Feb/08 21:23:11 V1 > 235 (Durée: 0 : 00:13:19) Durée de référence : 000 00:04:00 E-mail envoyé à [redacted]
99999999969	Cp1 Transformateur 1 Date: 2021/Feb/08 21:21:16 V1 > 240 (Durée: 0 : 00:00:58) Durée de référence : 000 00:04:00
99999999970	Cp1 Transformateur 1 Date: 2021/Feb/08 19:51:49 V1 > 240 (Durée: 0 : 00:00:57) Durée de référence : 000 00:04:00
99999999971	Cp1 Transformateur 1 Date: 2021/Feb/08 19:05:11 V1 > 240 (Durée: 0 : 00:00:57) Durée de référence : 000 00:04:00
99999999972	Cp1 Transformateur 1 Date: 2021/Feb/08 19:02:20 V1 > 240 (Durée: 0 : 00:00:57) Durée de référence : 000 00:04:00
99999999973	Cp1 Transformateur 1 Date: 2021/Feb/08 18:58:31 V1 > 240 (Durée: 0 : 00:02:51) Durée de référence : 000 00:04:00
99999999974	Cp1 Transformateur 1 Date: 2021/Feb/08 18:56:37 V1 > 240 (Durée: 0 : 00:00:57) Durée de référence : 000 00:04:00
99999999975	Cp1 Transformateur 1 Date: 2021/Feb/08 18:53:46 V1 > 240 (Durée: 0 : 00:00:57) Durée de référence : 000 00:04:00

Users management

Users management allows you to assign the permissions you want to each team member.



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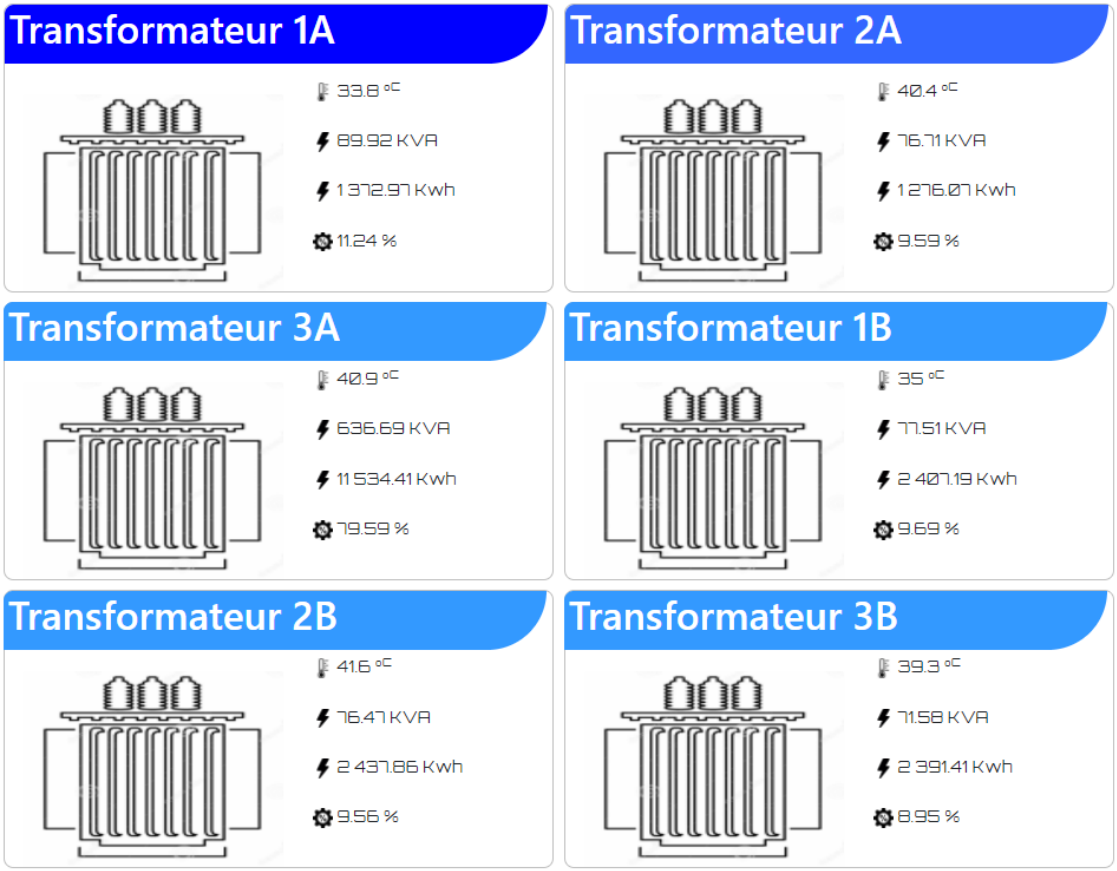
Transformers module: display of temperature and electrical data in real time.

ENERGY VIEW

2021/03/17 18:27



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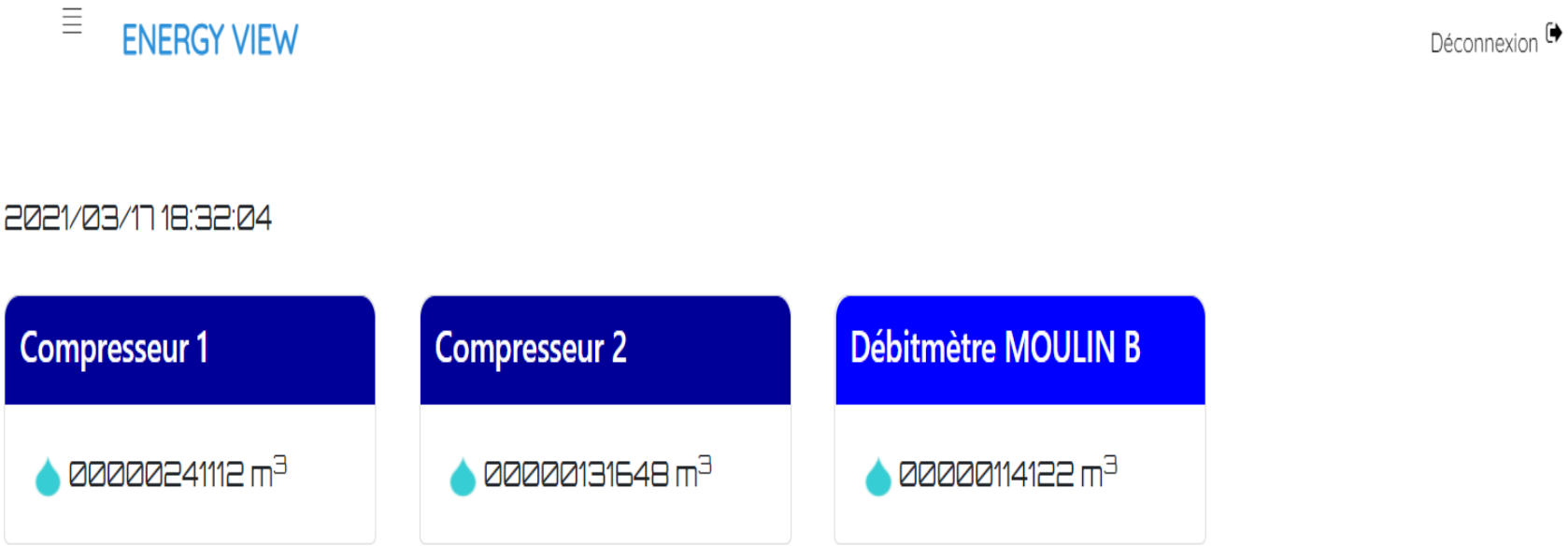
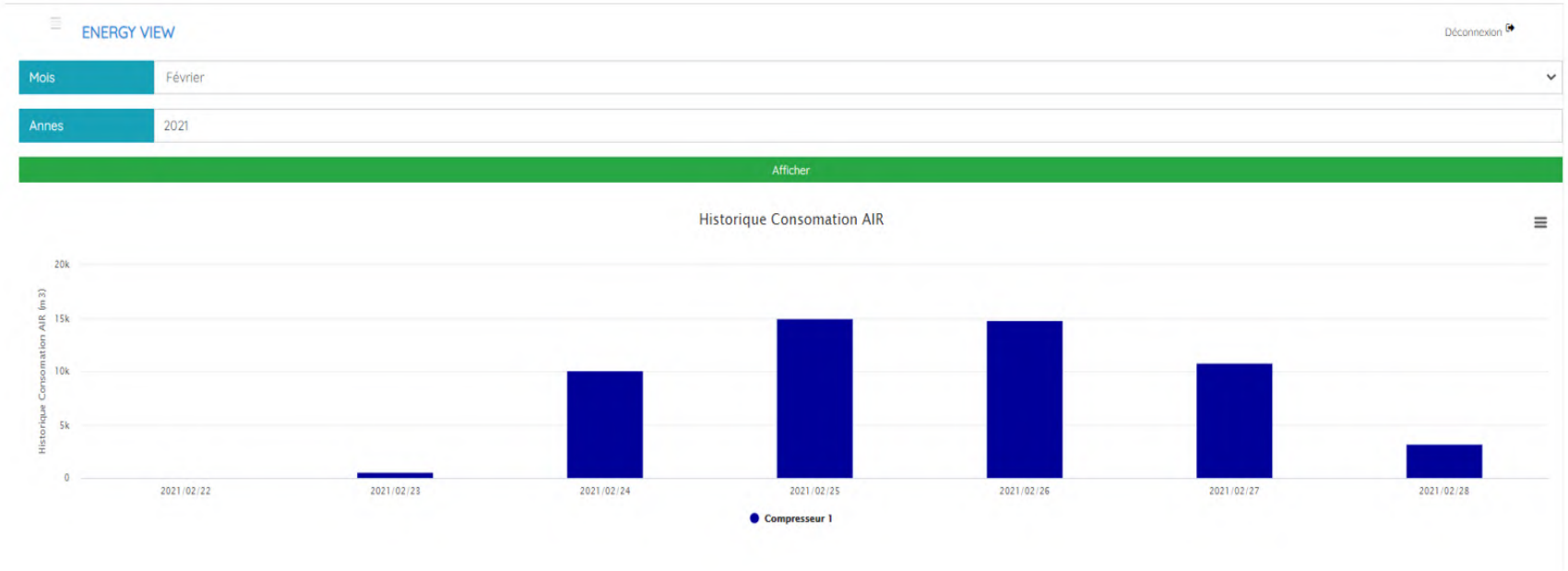
Real time Compressed air

- Real-time display of the values recorded by each flowmeter, since installation::



History Compressed air

- Display of the daily consumption / production of compressed air:



4

• Conclusion

With the energy management system, energy consumption and energy quality can be monitored remotely and continuously. This provides a better understanding of the customer's electrical network and energy consumption habits.

The customer can finally identify problems related to the quality of his electrical network, as well as problems related to his energy consumption, and take the necessary corrective actions.

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