

# Enerbrain

## Wiki & Technical Appendix

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# 1. Profile

Enerbrain has been established in Turin in 2015 by a team of young entrepreneurs, engineers, technologists, scientists and building designers, with the goal of radically changing our buildings to make them more sustainable, comfortable and efficient. The company has developed and patented a end-to-end energy management solution that allows significant energy savings while improving indoor comfort. Enerbrain focus is on organisations who own or manage large portfolios of buildings such as retailers, supermarkets, shopping malls, airports, schools, hospitals, industries etc.

Enerbrain has been appointed by high profile clients in different industries such as Retailers (Carrefour, Immochan, Eataly, Al Futtaim etc), Airports (Ciampino Rome, Caselle Torino), Industries (FCA, Michelin, etc), Utility Companies (Iren, Engie, Edison, Enel X, A2A, Wien Energie etc), and many others.

Counting on 200+ installations (mar 2019) the company is rapidly growing in several countries, with offices in Torino (ITA), Barcelona (ESP), Tokyo (JAP) and Dubai (UAE) through an international team of over 50 professionals.

Enerbrain has been featured on national tv, radio and newspapers, including Financial Times, Forbes, Wired, Rai, La Stampa, Repubblica and attends several international events as speaker on a variety of topics including Smart Cities, IoT and Green Tech.

The technology has been scientifically validated by the Department of Energy of Politecnico di Torino. The Company has been awarded as the Best European Scaleup by the European Institute of Technology, is part of the Microsoft AI for Earth program, featured as Cool Vendor by Gartner, has been invited to speak at the European Parliament, is member of Endeavour, 1000 Solutions network, the Innovative Companies Incubator I3P, Polo ICT, Polo CleanTech, Torino Wireless, Smart Communities and Unione Industriale.

# 2. Value Proposition

In today's environment the responsibility for energy waste and incremental pollution arrives from big inefficient buildings and manufacturing sites.

The complex and expensive structures make it difficult to maintain and manage efficiently the energy process.

Enerbrain wants to improve the world in which we live and has therefore developed a system that allows you to monitor and manage the energy systems of large buildings and manufacturing sites to improve the environment and give greater efficiency and comfort to those who live buildings

## Main benefits

- improved indoor comfort while lowering energy usage
- smart retrofit: constant micro adjustments transform a static system in a highly dynamic and responsive one
- seamless integration with any existing HVAC system, improving performance without disrupting the infrastructure
- real time monitoring: air quality, energy and occupancy data allow a deeper understanding of the building and the business
- reduced tear and wear on HVAC systems and extension of their overall lifetime
- Increased property asset value by cca.7%

# Competitive advantages

- Easy and fast: Through an expert team Enerbrain system is installed in few days. The system is fail-proof and integrates with any existing brand or industrial system, improving performance and extending its lifetime.
- Turnkey: Enerbrain takes care of every step: design, manufacturing, consulting, installation, customer training, comfort, savings measurements and sustainability engagement.
- Worldwide standards: Enerbrain products are all designed and manufactured in Italy and comply with CE and many international certifications. All data and services comply with privacy standards.

# 3. How it works

Enerbrain turns buildings into strong environmental, economical and social assets. In one word: sustainable.

Thanks to new technologies that are noninvasive and easy to use we enable buildings to adapt in real time to people and climate, reducing energy usage by over 20% and radically improving indoor comfort.

Our IoT energy retrofit solution includes:

- Environmental sensors (wireless and battery powered)
- A cloud platform that receives environmental data and through algorithms sends instructions to the existing systems
- Wireless actuators installed in the heating and cooling systems
- An intuitive dashboard to manage and control all the buildings at once
- Our proprietary algorithms perform a fine tuning of HVAC systems in real time for maximum comfort and an average of 20% savings.

## Prerequisites

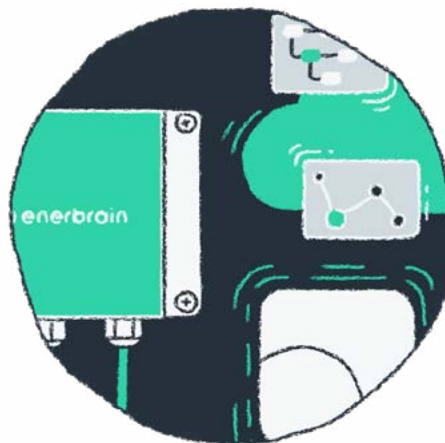
The system is compatible with the majority of Heating, Cooling, Ventilations (HVAC) systems, with or without a Building Management System (BMS). The main requirement is the presence of mechanical actuators (valves, inverters, pumps, dampers) in good working conditions and electrically connected to the BMS or a BACS (Building Automation Control System), even of the most basic ones.

The installation includes a preliminary technical survey to collect information on the building, critical areas, systems layout and type of actuators.

## Installation

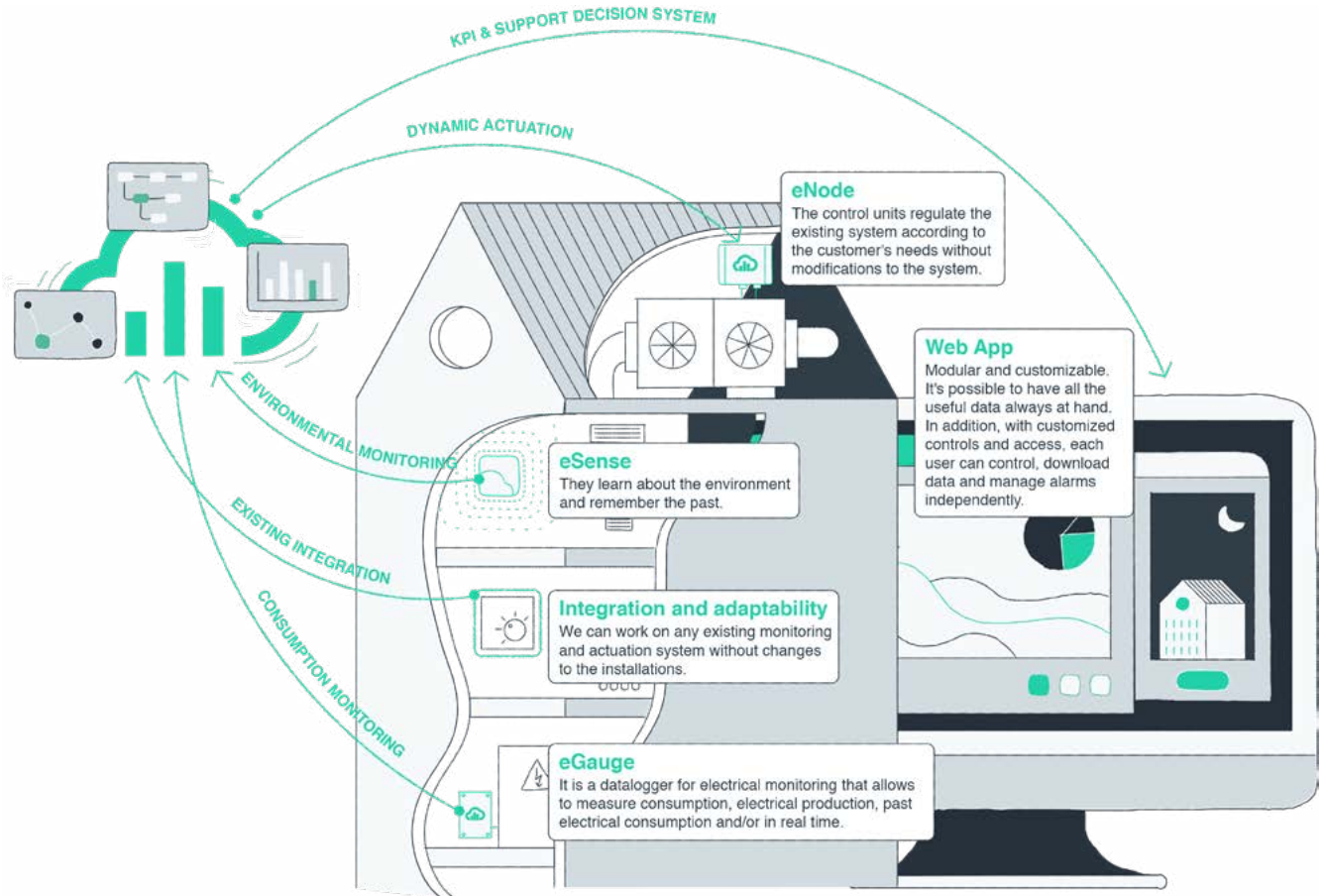
Installation is planned within a few weeks from contract signature. Enerbrain needs access to the technical rooms and support from the maintenance staff on site. Installation is non invasive and is typically performed on low 24V circuits (in some cases 220V) and depending on the number of devices it usually takes from a few hours up to 2 days to complete.

Installation requires simple electrical work to connect existing motors, valves and air gates to the actuators according to a project provided by Enerbrain. Environmental sensors are easily fixed to the walls through screws.



# Working diagram of the system and monitoring locations

The environmental sensors are battery powered, connected to Enerbrain's cloud and installed in the critical areas of the building. The actuators are installed by trained technicians in the technical rooms where heating and cooling are centrally distributed (air handling units, rooftops, burners and electric heaters).



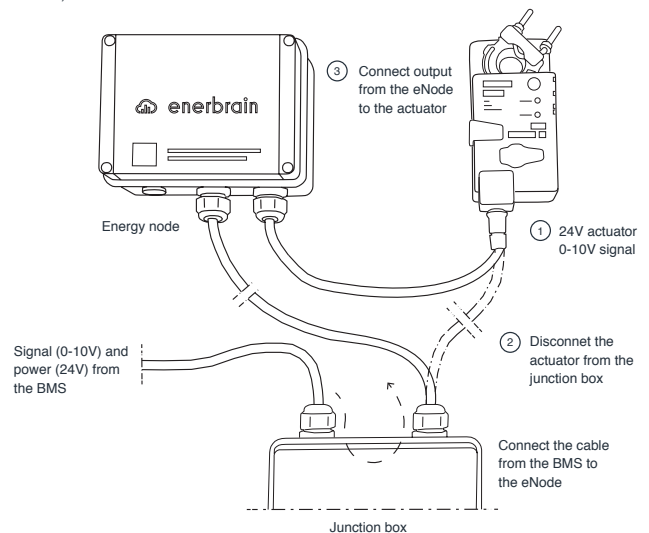
## Control and interaction with existing systems

Enerbrain devices are integrated with HVAC system, being installed between pre-existing BMS (if present) and the HVAC actuators. This allows Enerbrain to take control of the system, making it smarter and more adaptive, still leaving the visibility of the original BMS instructions. Enerbrain devices are designed and installed to be "fail-safe" and to allow building technicians to always being in control of the system: if needed, they can set Enerbrain devices in "bypass mode" via the Web App or by a physical button on the device.

Enerbrain devices can also automatically set themselves in "bypass mode" in case of communication failure to guarantee the functionality of the system (original BMS signal passing through).

In some installation a feedback signal is used by the BMS to verify the position of the valve, Enerbrain's devices are capable of sending to the BMS the expected signal in order to avoid false alerts.

below: example of the installation of the eNode, Enerbrain's actuator



# 4. Testing the system

Enerbrain performs a technical assessment as well as a bill audit to understand the feasibility and provide a preliminary estimation of the savings. Customers have the option to test the system to obtain an energy and comfort assessment of the impact of the system as well as become familiar with it.

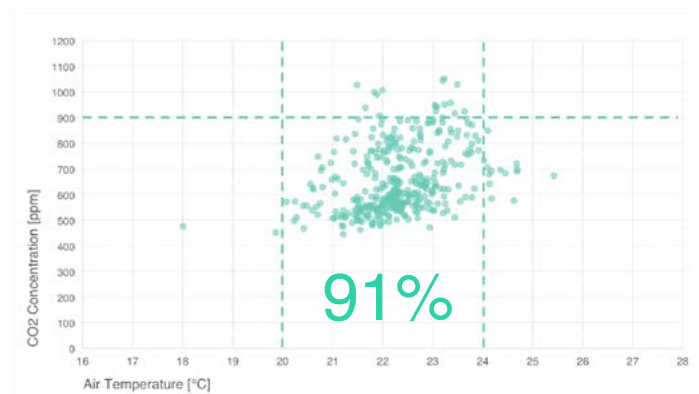
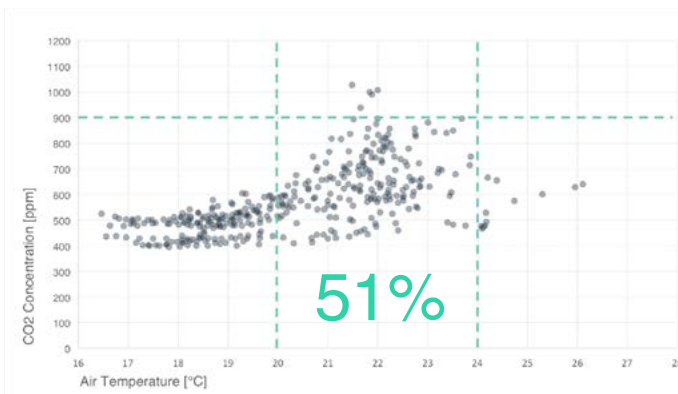
During the test, a study campaign is performed for a period of 8 weeks by alternating monitoring and automation (referred as ON/OFF test), this allows to get an accurate projection of the energy savings (fig. 20) and increased comfort levels (fig. 21 a-b) in the specific context of the customer.

↓ Fig.20 Test ON / OFF - Energy saving



↓ Fig.21 (a) Before Enerbrain time in comfort

↓ Fig.21 (b) After Enerbrain time in comfort



# 5. Savings calculation

According to UNI EN 15603 the baseline calculates using historical energy consumption data from the last 24 months as well as the outdoor temperatures. The formula determines the “Energy Signature” as a baseline, that is used to determine the expected energy usage to heat and cool the building. Savings are calculated as the difference in actual energy usage against the expected consumption without Enerbrain.

## Degree days: how outdoor temperature influences consumption



Outdoor temperature

> 20°C cooling needed  
 ~ 20°C cooling needed  
 < 20°C heating needed

Heating (or Cooling) Degree Days measure the temperature difference between the outdoor environment and the indoor target of 20°C. They are used to correctly compare energy usage in the past, by taking in consideration yearly and seasonal changes that have an impact on consumption.

## Savings calculated according to UNI EN 15603

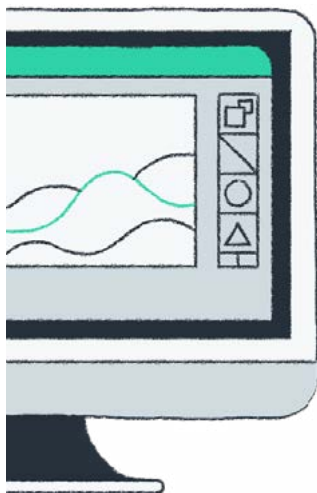
$$\text{Savings} = \frac{\text{Current Degree Day}}{\text{Past Degree Day}} \times \text{Past Consumption} - \text{Current Consumption}$$

Example (current winter colder than previous season)

$$\frac{2.500}{2.000} \times 100.000 \text{ kWh} - 85.000 \text{ kWh} = 40.000 \text{ kWh (32\%)}$$

The Energy Signature measures the typical consumption in relation to the outdoor temperature for the winter and summer season. The data for the calculation are provided by third parties: government agencies (weather) and the utility provider or the energy meters (energy usage).

## In case of major changes in the building



If the physical layout or usage changes dramatically it is necessary to perform a new assessment by switching on and off the system for a period of time in order to determine a new baseline.





# 6. Commercial options

Enerbrain can be delivered via 3 different contracts:



## Purchase Contract

Our client buys the hardware and then pays a yearly service fee that includes connectivity, license, support, etc. Usually, the ROI is under 24 months.



## Lease Contract

Similar to the above-mentioned proposition, the client pays a small monthly or quarterly fee that includes all the hardware and maintenance, connectivity, software license, etc. The leasing fee is smaller than the savings generated, therefore it is virtually free for the client without the need of any CAPEX investment. Additionally, this model can be financed by large financial institutions to guarantee large rollouts.



## EPC (Energy Performance Contract)

Hardware and software are provided with no capex investment, customers pay a portion of the savings generated. This is applicable only to certain buildings and in countries with a high energy cost.

## Terms and conditions

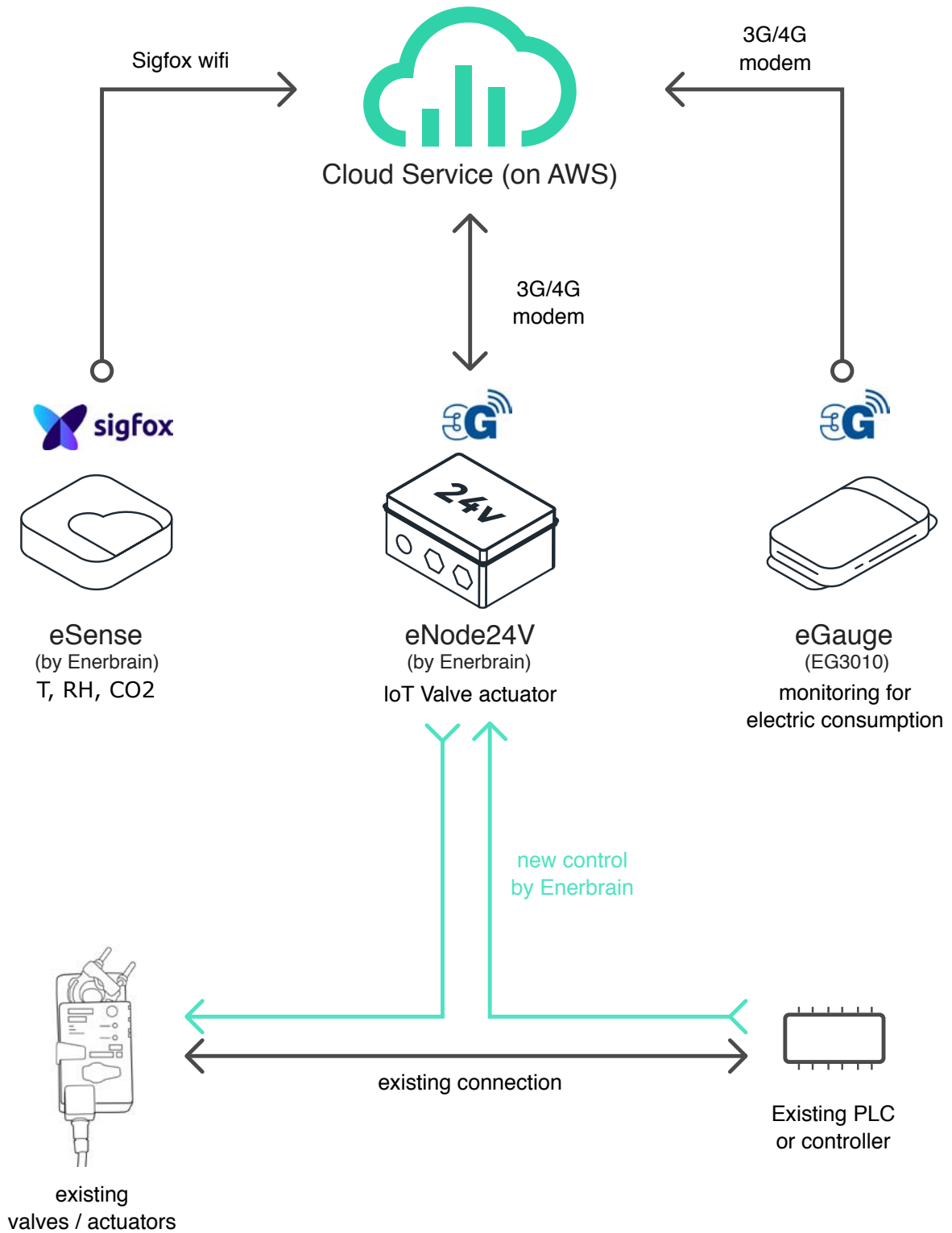
The Energy Performance Contract's fee is based uniquely on the savings without additional fees. It is 100% performance based: devices are provided under a rental license and installation, commissioning, remote management, data access, assistance and warranty are included for the whole duration of the agreement.

## Baseline

Enerbrain performs a technical assessment as well as a bill audit to understand the feasibility and a preliminary evaluation of the savings target. If necessary an energy audit with a monitoring campaign is performed. The baseline data, calculate as described in the specific section are integral part of the contract.

# Appendix A

## General Architecture



# Appendix B

## Security of data

As per the architecture indicated **above**, there is no sensible data stored in any of the steps from the eSense to the eNodes and then to the cloud.

Security is the primary focus in Enerbrain, therefore we have adopted several strategies to ensure data is always encrypted, safe and anonymous.

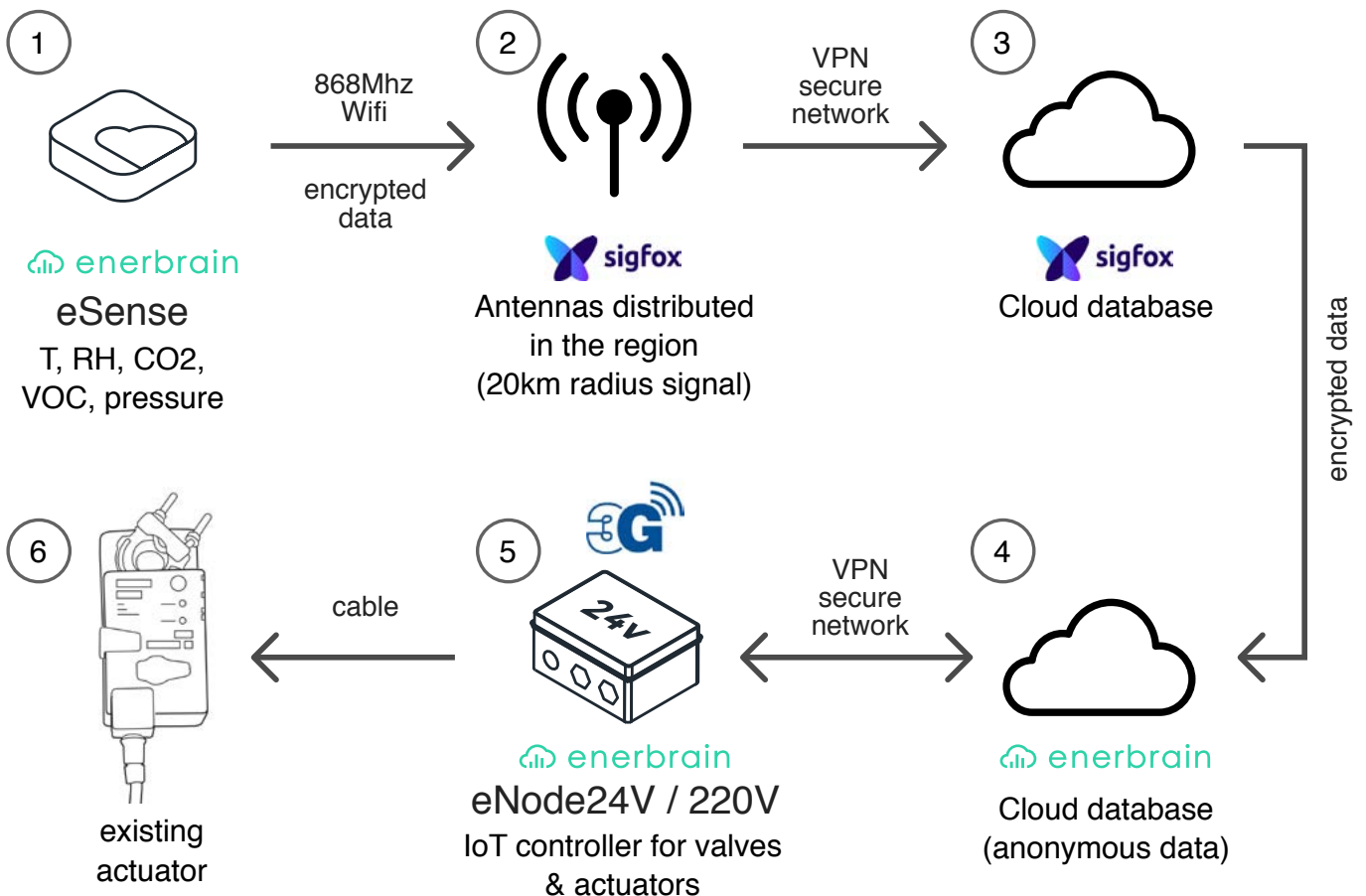
In the steps ①, ② and ③ the security layer is provided directly from SigFox, using a private key stored in a non accessible part of the hardware chipset to encrypt the message and send them to the gateway.

The gateway ② is connected to the Sigfox cloud ③ through a VPN, and once the message is received, it is then sent securely to Enerbrain's Cloud service ④.

The eNode by Enerbrain ⑤ is connected online using 3G VPN connectivity, and interrogates directly the cloud only when needed (to guarantee maximum security) and receives the result of the algorithm from an encrypted connection. The result is then transferred to the existing valves ⑥ via cable.

The eNodes ⑤ can be set to “bypass” status, and therefore the existing signal is maintained.

If an eSense or an eNode, for an unknown reason, is not registered in Enerbrain's CRM, the data is immediately deleted. Also, if there is any violation in Enerbrain Cloud service, the data is anonymous and encrypted.



# Appendix C

## Frequently Asked Question



### Where's the innovation?

Energy Cloud applies IoT technologies to civil HVAC systems, providing several benefits, lowering operational and maintenance costs and improving internal comfort. As a retrofit system it is compatible with any existing HVAC, with a non invasive solution and offered risk free with a Energy Performance Contract.

### How is it different from a thermostat?

A thermostat is an on/off switch to the heater or cooler. Large buildings usually don't have them and they only compensate for external temperature (in a cold winter day, using more gas) without monitoring the resulting indoor conditions. Energy Cloud realizes a closed loop system where constant micro adjustments are verified in a feedback loop, turning a static system in a highly dynamic one.

## What if my building has a brand new system?

Most civil HVAC systems for large buildings lack environmental sensors, or they measure air parameters in the wrong locations (for instance CO<sub>2</sub> readings in the air ducts rather than in the rooms). Energy Cloud takes into account all free energy sources (solar radiation, lights, people, machinery) and can sense and respond in real time to these changes.

## How many sensors are needed?

A typical installation requires 3 to 5 sensors per area or circuit. This depends on the way the distribution system was designed as well as the kind of building. The strategy is to place sensors in critical areas of the building according to the maintenance staff. Typically if these areas are in comfort the rest of the building is too.

## What if my building uses renewable energy or district heating and cooling?

The energy source is not important, the theory is that energy should be produced, distributed and used only where and when needed and in the amount needed. By taking control of the main valves it is possible to optimize the distribution dramatically while improving efficiency and comfort level.