HVAC

Opportunities

Who we are

Iotinga is the company made of awards winning tech experts

European Commission
Horizon 2020
European Union funding
for Research & Innovation
SEAL OF EXCELLENCE

CES INNOVATION AWARDS 2019 HONOREE

CES INNOVATION AWARDS 2022 BEST OF INNOVATION

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What we do

We help other companies to design, develop and produce innovative products based upon IoT related technologies

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Some examples

- Micro Mobility Fleet Management
- Smart City garbage collection stats
- Master production schedule algorithm
- Edge computing applied to production systems

- Smart Thermostats / Comfort systems task-force and division

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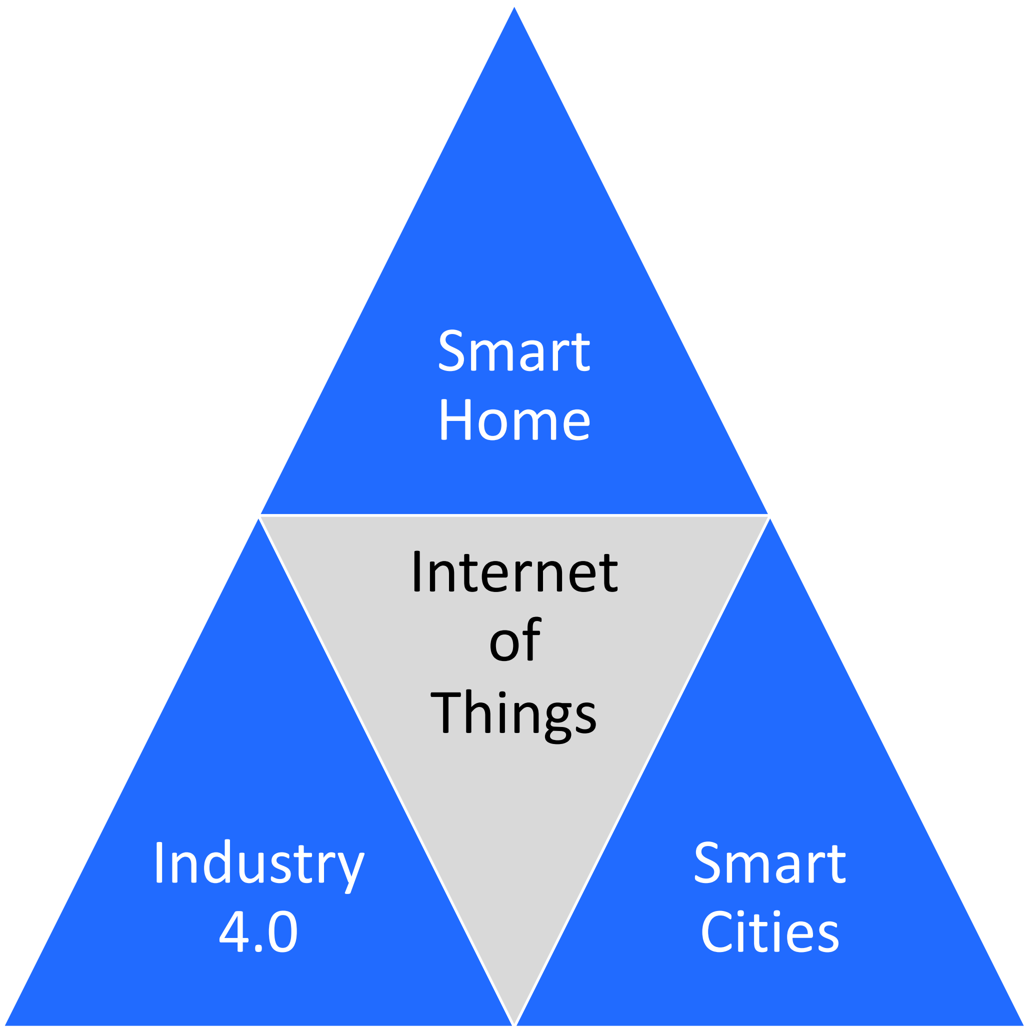

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Smart Thermostats & Comfort systems

Today our focus will be upon Smart Thermostats, Comfort Systems and Predictive Maintenance

We have some friends and collegues from Sime, a leader in the home comfort sector for fifty years

Michele Landini
R&D Technical Director

Alberto Tebaldi and **Tiziano Turra**
Electronic controls and regulation

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Some numbers from Sime website

Main manufacturing plant

- 51.000m^2
- 12 production lines
- R&D Laboratory
- Technical training center

Foundry

- 85.000m^2
- Capacity of 35.000 tons/year
- Serves Sime and other producers

Introduction

1. In the last decade, and even more so for the years to come, the need for efficient comfort systems will become increasingly pressing
2. The goal is to reduce the environmental impact and operating costs

Isolated, small and cheap improvements can produce real results when applied intelligently to complete systems

Comfort Systems Elements

In the last 2 decades there was a huge evolution for the following elements:

Building technologies and materials, doors, windows and thermal coating

Generators: boilers, heat pumps, thermal solar panels and photovoltaic panels

Terminals: radiators, fan coils, radiant floor, ducted systems

Control Systems: thermostats, chrono thermostats, smart thermostats

People: in particular how people interact and live in the environment

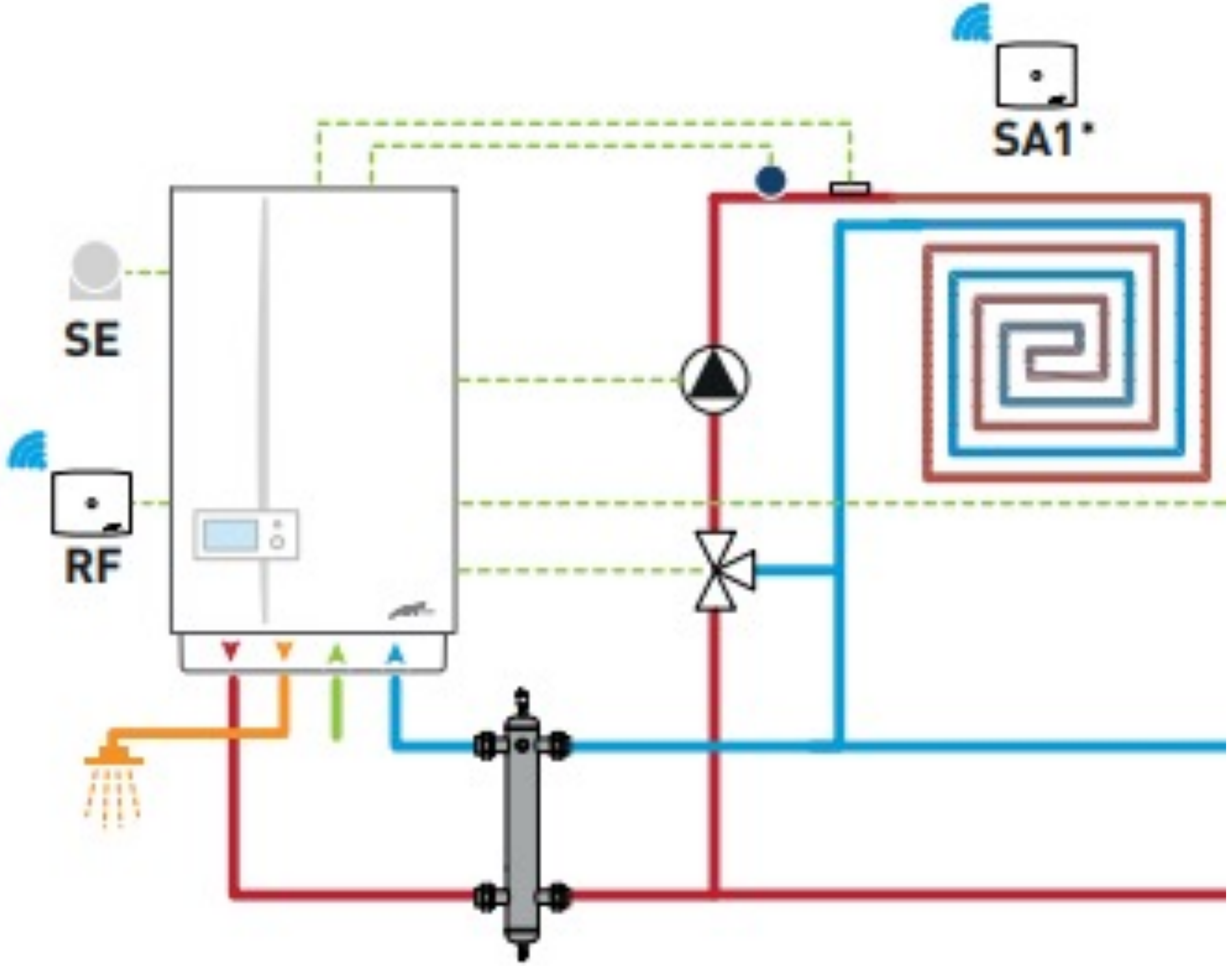
Minimal setup

The picture represents a minimal modern comfort system.

We can see:

- A generator
- A thermostat (SA1)
- A radio-frequency receiver (RF)
- An external temperature probe (SE)

For simplicity we can consider heating only, but the example is also valid for heat pumps and cooling



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Modulating Generators

Two main possibilities for the signal that the thermostat sends to the boiler

On/Off the generator can only be turned on or off (0 or 100% of energy consumption) by an electrical signal

Modulating – the generator can also receive a Control Set Point, a temperature value, which will set the ideal temperature of the water from the outlet (from 0 to 100% of energy consumption)

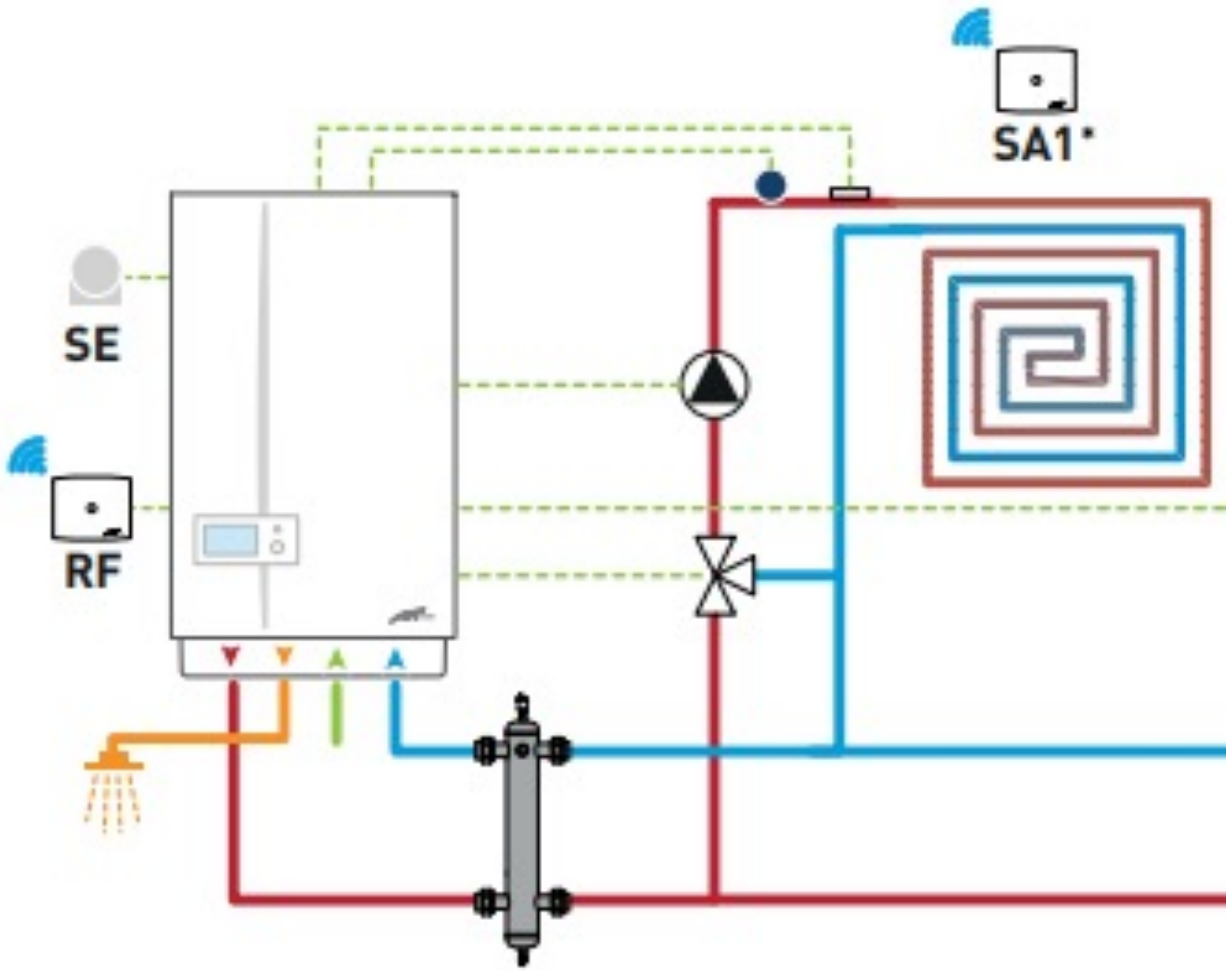
Control Set Point

Control Set Point is the delivery water temperature that the generator must supply to the system

Control Set Point is computed by the control system (thermostat)

In heating systems, lower Control Set Point implies lower energy consumption

Using a modern heat generator, we can consider energy consumption linearly related to Control Set Point value



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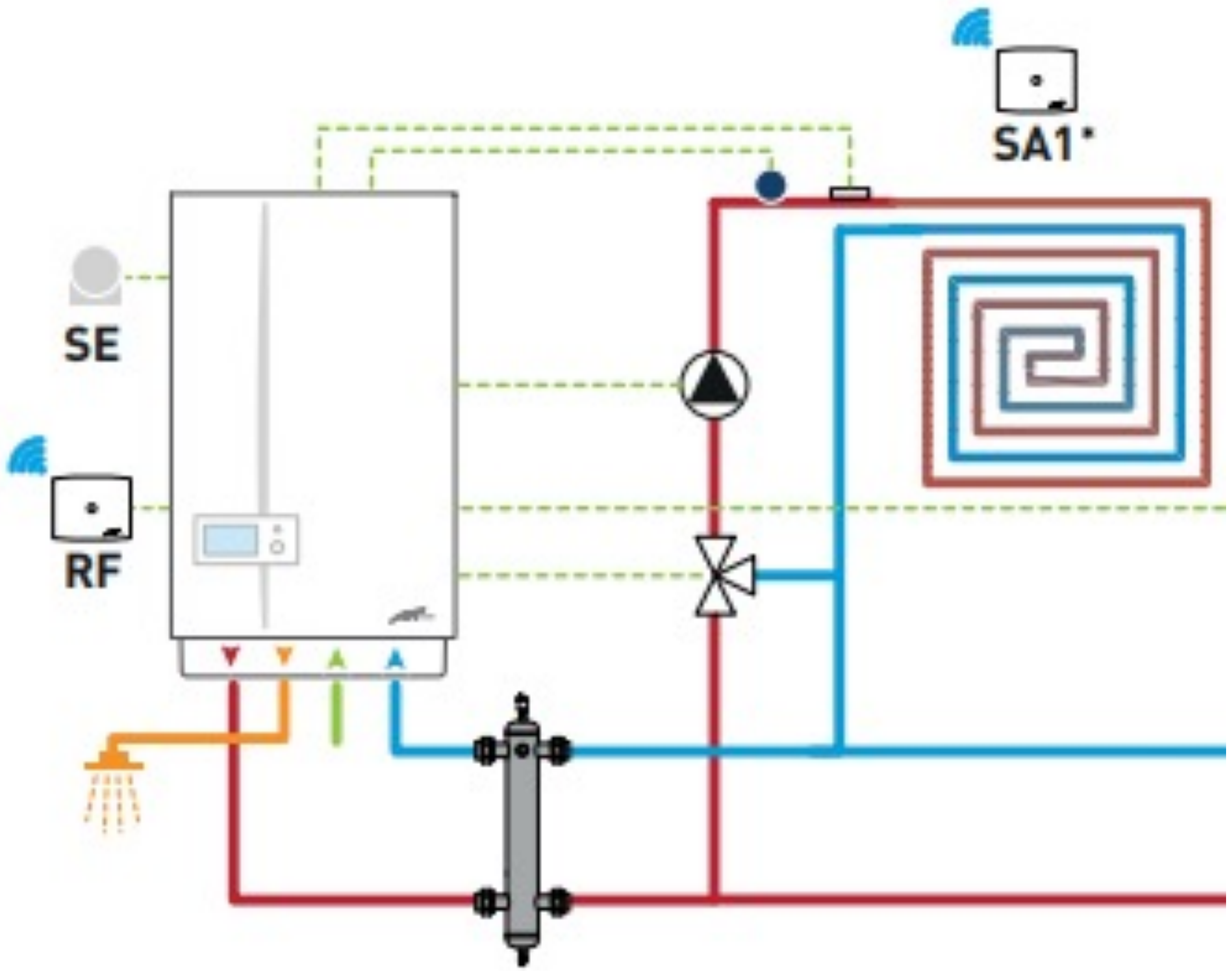
Control Set Point

Example:

In our room we have 17°C but our SA1 is set to reach 20°C, the Control Set Point (computed by SA1) will initially be high, but it will be lower as the room temperature approaches 20°C

Similarly when the room is at 20°C and the boiler is off, we can decide when and with wich Control Set Point the generator will be turned on



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Control Setpoint
State of the art

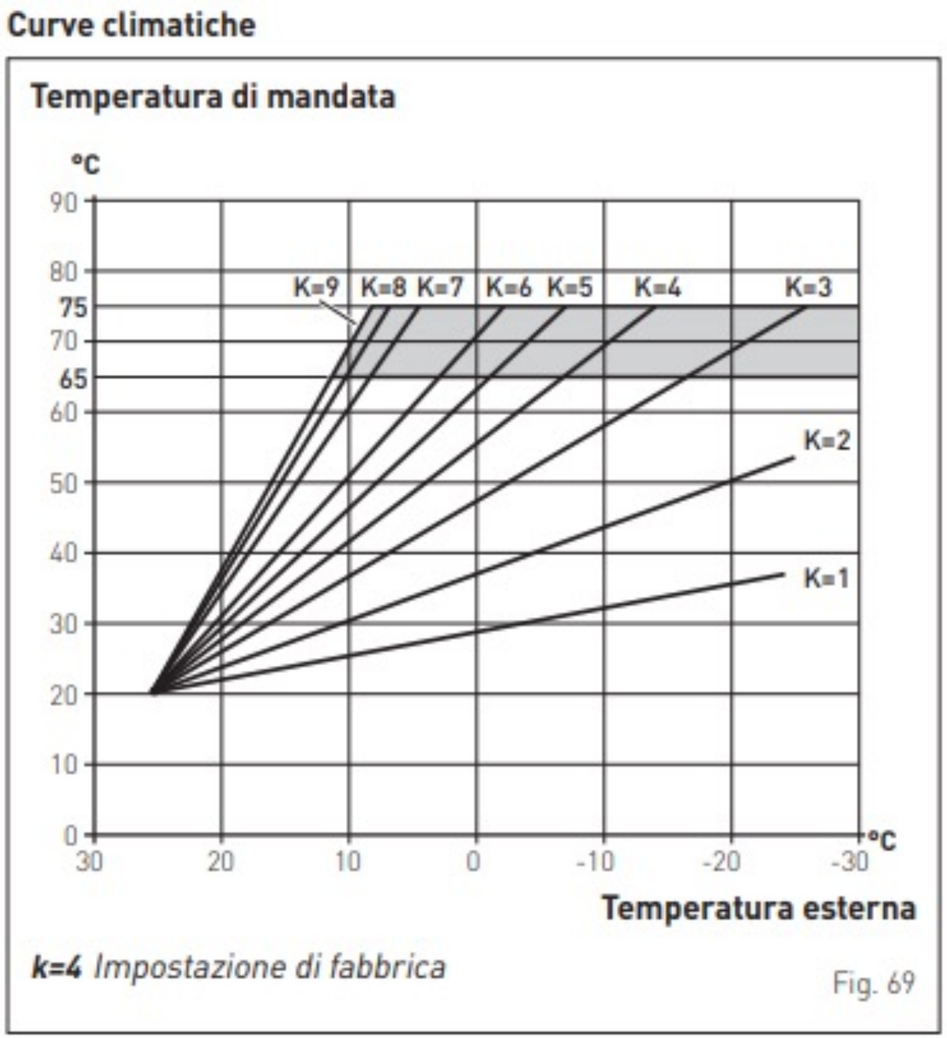
Different vendors have slightly different ways to calculate the control setpoint, but they are all based upon the following parameters:

R = Temperature of the room

E = External temperature

K = Summarizes the building efficiency (manually selected)

O = Offset which adjusts temperatures (manually selected)



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Summarizing

Roughly we can summarize the ideal Control SetPoint (cs) as Function of Date, Site, Building, Terminals, Generators, Control System, People and Weather

$$cs = f(D, S, B, T, G, C, P, W)$$

Currently, Control SetPoints are function of

$$cs = f(K, R, E, O)$$

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Remarks

Date, Site and Weather are over-simplified from the External temperature

The impact of Building and its Terminals is over-simplified from K, an angular coefficient

Generators capabilities are not considered (time needed to reach the control setpoint, temperature stability, actual modulation steps, ...)

Control System (thermostat) gives only the actual room temperature. Errors on temperature detection are manually compensated through Offset

People can influence the control setpoint by manually setting a weekly program

$$cs = f(D, S, B, T, G, C, P, W)$$

$$cs = f(K, R, E, O)$$

Open issue one

Can we improve comfort and energy efficiency considering actual People presence and behaviour forecasts?

Can we improve comfort and energy efficiency considering actual Weather and weather forecasts?

If no, why? If yes, with what assumptions?

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Further remarks

The Generators are transformers of energy from form A to form B, therefore they are analog devices, but their internal management system is digital. They can control the reaction from 0 to 100% of power through discrete steps (4 steps, 10 steps or even more)

Thermostats digitize analog values (temperature, humidity, ...) for processing using techniques such as sampling, hysteresis and compensation

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Open issue two

How numeric errors in this chain impact comfort and energy efficiency?

Which elements of the chain, if slightly improved, can improve a lot comfort and/or energy efficiency?

Final remark

End Users are not experts or technicians. Parameters like the K constant (building energy efficiency) are set incorrectly or simply ignored

Open issue three

Can we use thermostats to create an energy efficiency profile of the building / terminals?

If no, why? If yes, with what assumptions?

Predictive Maintenance

1. Ensuring continuity of service is essential for comfort and energy efficiency
2. If the generator stops working, the whole system becomes useless.
3. Keeping the generator healthy also guarantees maximum energy efficiency
4. A damaged component can damage the others (more expensive repairs)

The enabling factor for predictive maintenance is
data collection / data storage costs reduction

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State of the art

Sime started data collection in 2018 and today they have:

+300 monitored units

150 monitored parameters

Some monitored params

Temperatures, pressures, flows, working hours, user settings

sime®

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Open issue four

Can we use this data to prevent generators shutdowns?

How can we slightly improve our data collection in order to greatly improve the accuracy of our forecasts?

Open issue five

Can we use this data to improve our products?

How can we slightly improve our product in order to greatly improve reliability and fault tolerance?

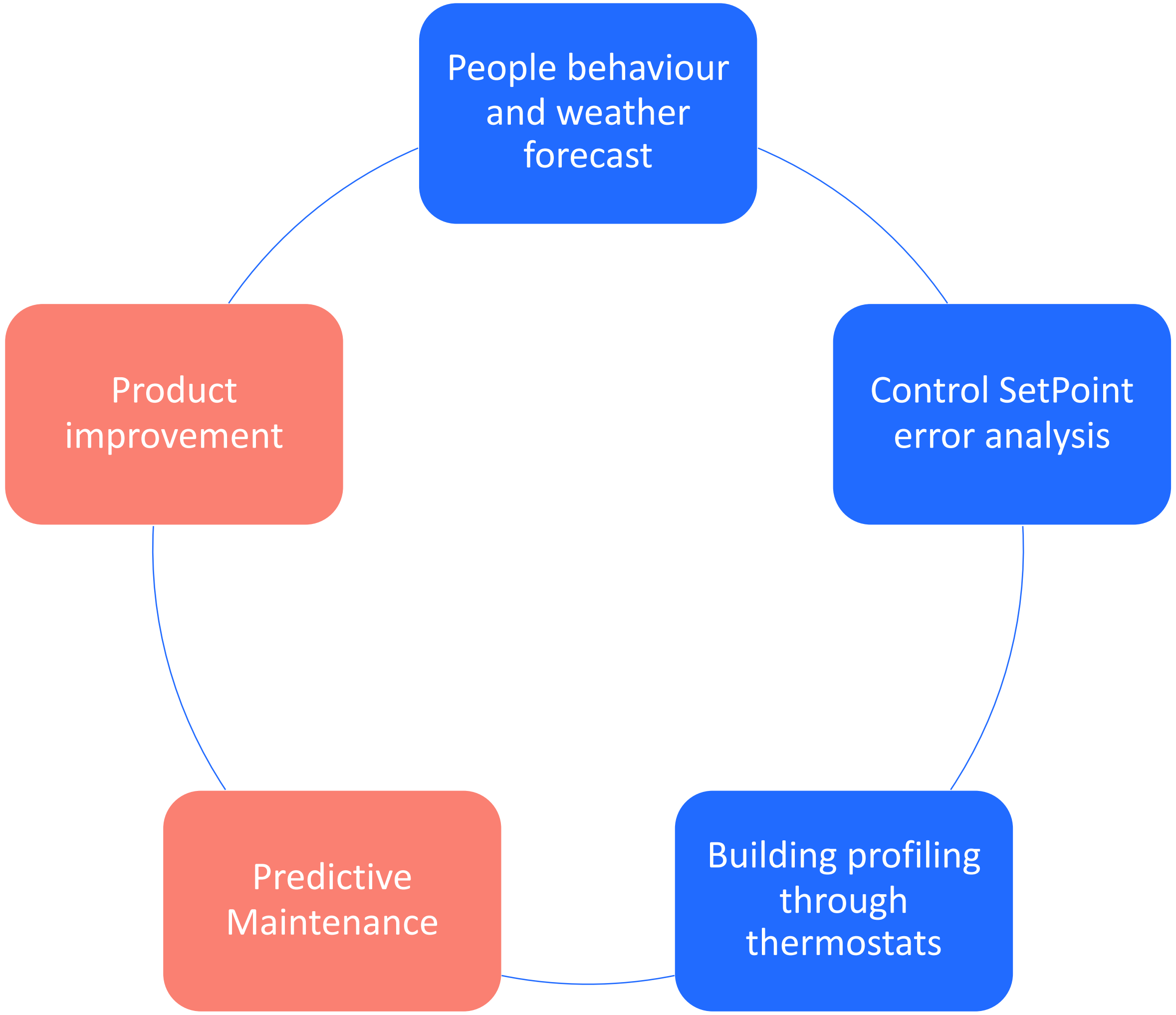
Concluding

The impact of thermostats on energy consumption is fundamental, but we are used to their presence to the point of considering them trivial.

The same is for generators. Many times we don’t even know where they are physically installed. Until they stop working, creating severe discomfort that can last for days.

Nowdays we have new instruments and new data that can boost HVAC devices, saving energy and improving the life of many people.

We hope that the five open issues seen today will inspire you in the future.



Grazie per l'attenzione

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