SMART HVAC SYSTEM

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Digital Skills For
Sustainable Societal
Transitions

PROBLEM

Introduction and context survey

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PROBLEM ANALYSIS

Some specific analysis

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Our main idea and specific plan

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MARKET ANALYSIS

Analysis in different aspect.

01

PROBLEM

Introduction:

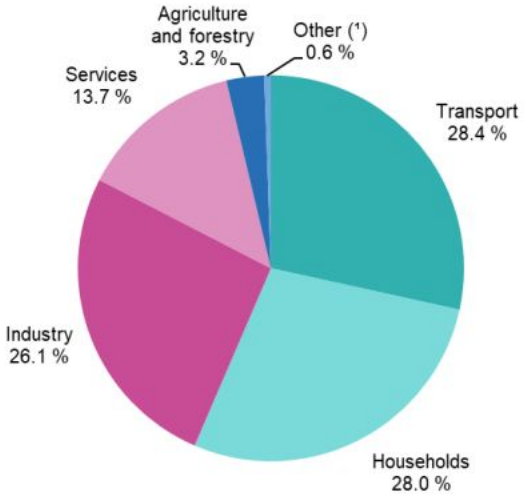
We spend most of our time in buildings.

- Residential and commercial buildings consume **almost half a country's total energy**.
- This percentage is also affected by the level of **electrification, urbanization, number of buildings per capita, and prevailing climate**.
- Most countries consume **more energy from buildings than from transportation and industry**.
- The International Energy Agency (IEA) estimates that the **building sector** consumes **42 percent more electricity** than any other industry worldwide.

EU Energy consumption

- buildings account for 30% of the EU's energy consumption,
- **building energy efficiency** has been one of the most **significant research** topics so far.
- **Currently**, some commercial **Energy Management Systems** (BEMS) take care of controlling, monitoring, and optimizing energy usage in buildings.
- Energy use **data is collected by these systems** using non-intrusive meters installed at electric circuits (Jia. m. et al, 2019).

Final energy consumption by sector, EU, 2020
(% of total, based on terajoules)



(*) International aviation and maritime bunkers are excluded from category Transport.

Source: Eurostat (online data code: nrg_bal_s)

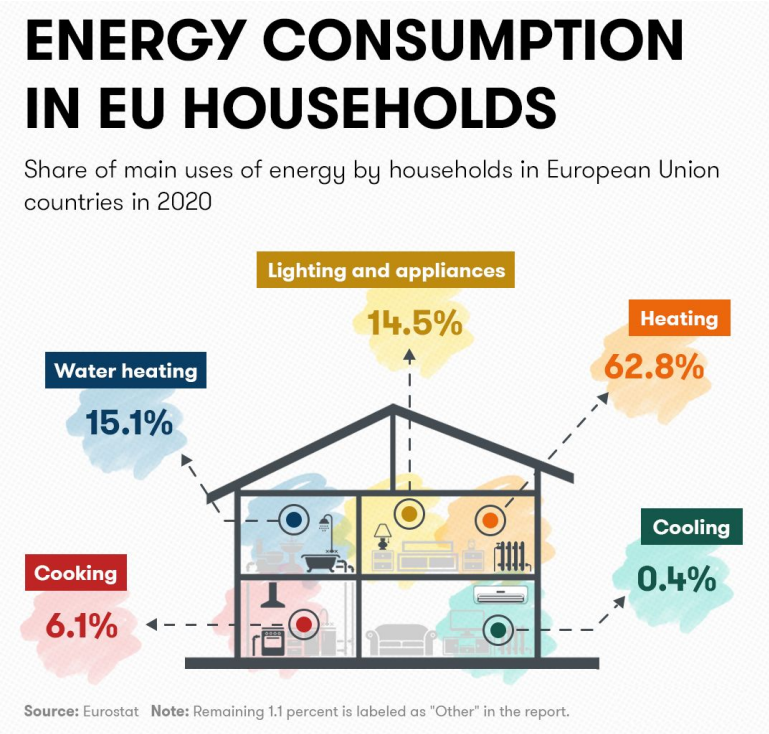
eurostat

Household Energy consumption:

A variety of **end-use activities** are undertaken in the building sector, each resulting in a **different energy consumption level**.

It is **not just** the **efficiency of temperature control and lighting systems** that determines how much energy buildings use, but also the **efficiency of the buildings** in which they operate, which account for a majority of building energy use in industrialized countries.

A select set of end uses is affected by **building designs** and materials. Building design, **however, does not affect** the energy consumption associated with **cooking or appliances**, *even though these end uses are attributed to the building industry*.



The Biggest Energy Wasting Habits At Home

Leaving the Lights On,

Leaving Electronics Plugged In,

Running the Dishwasher Half-Full,

Browsing Your Refrigerator,

Using Incandescent Bulbs,

Powering an Empty Chest Freezer,

Washing Clothes in Hot Water,

Forgetting to Change Air Filters

Not Programming Your Thermostat, Setting the water heater Thermostat Too High,

Why energy efficiency is needed

Approximately **75% of buildings** built date back to a time when there were **neither energy-related building codes nor minimal regulations**.

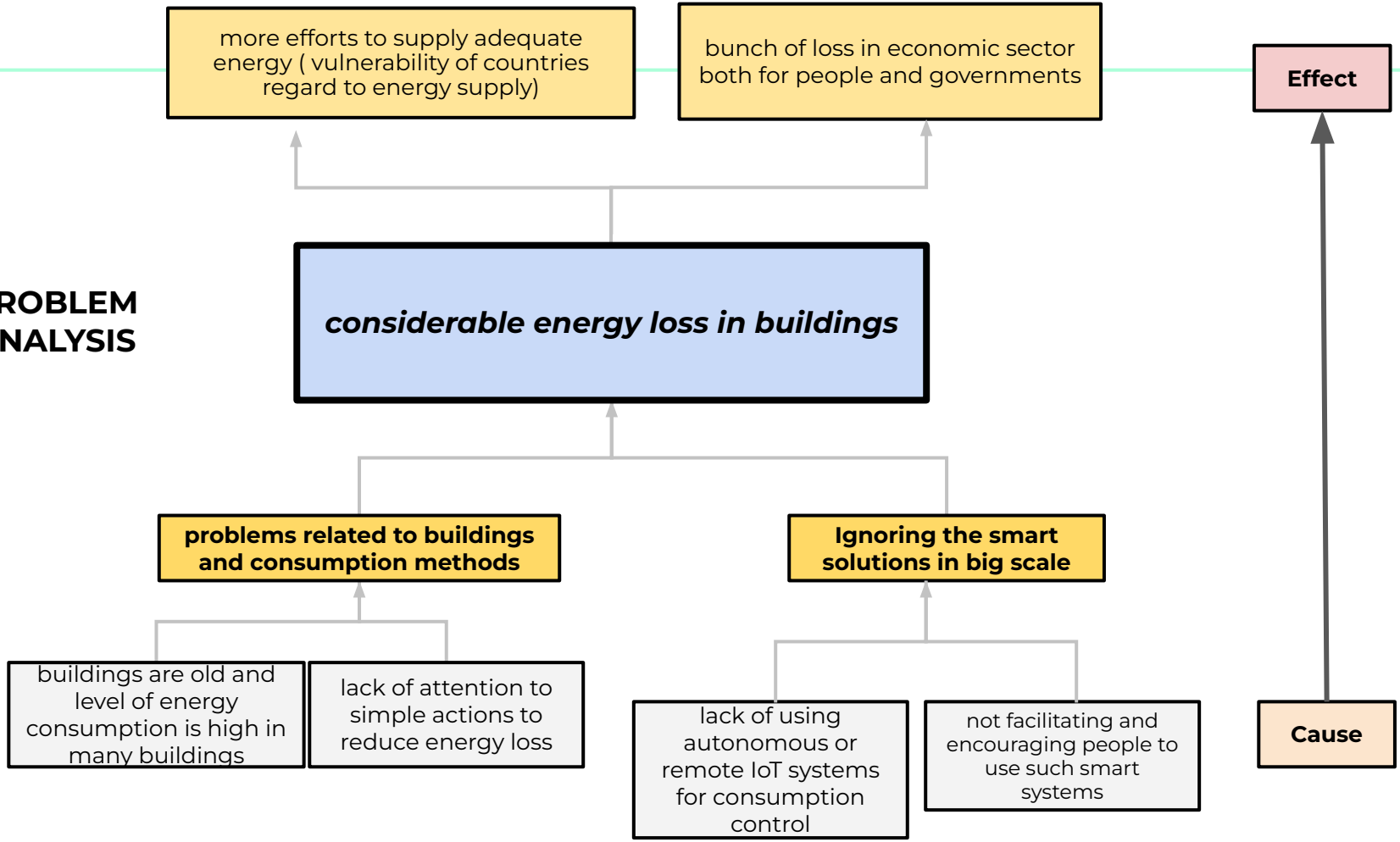
Until 2050, 90% of these buildings will still be in use (Eurostat, 2018).

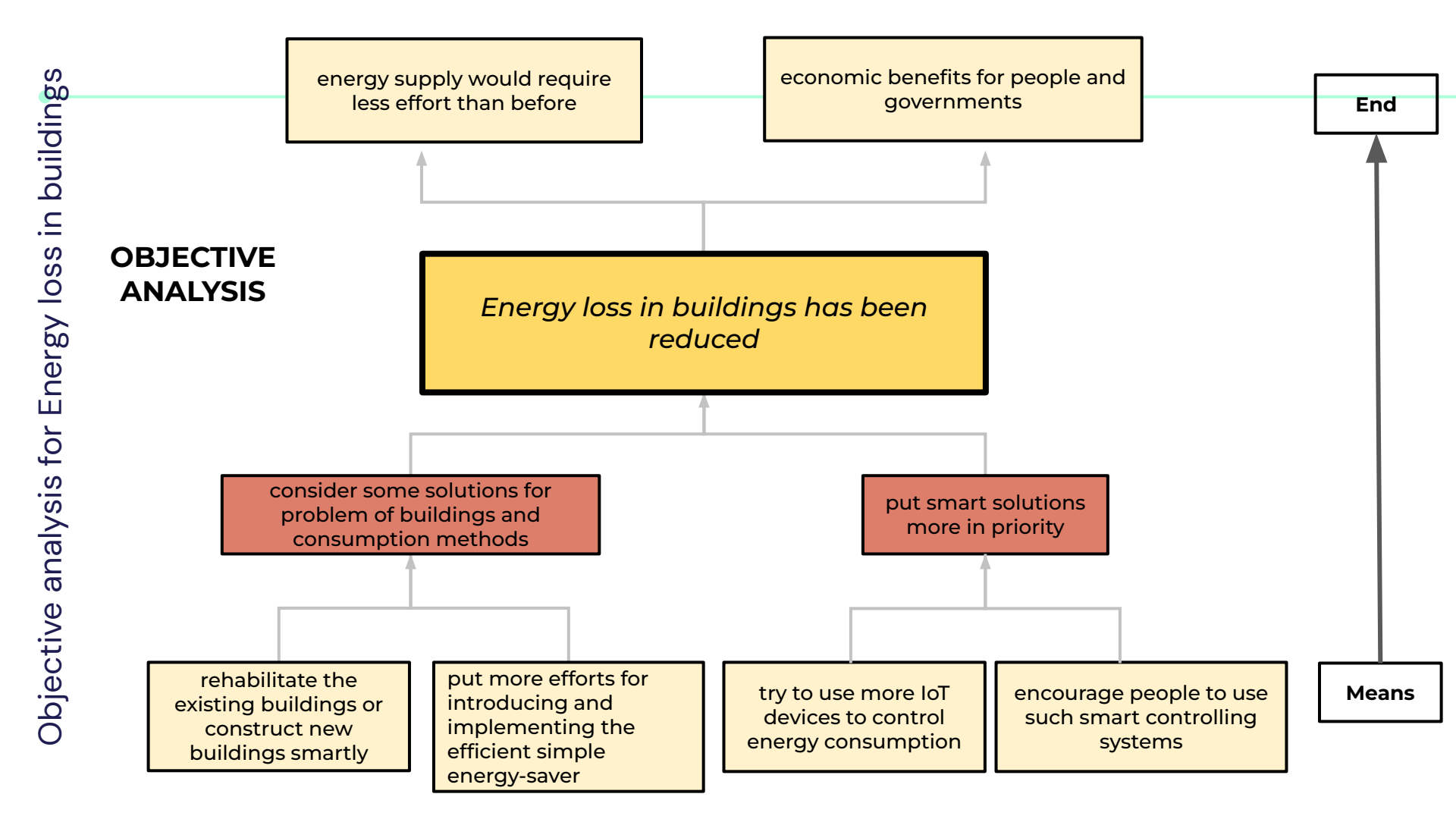
There is a clear need for energy efficiency measures to focus on the energy efficiency of the existing buildings (Haines V., Mitchell V.).

02
PROBLEM ANALYSIS

problem analysis for energy loss in buildings

PROBLEM ANALYSIS

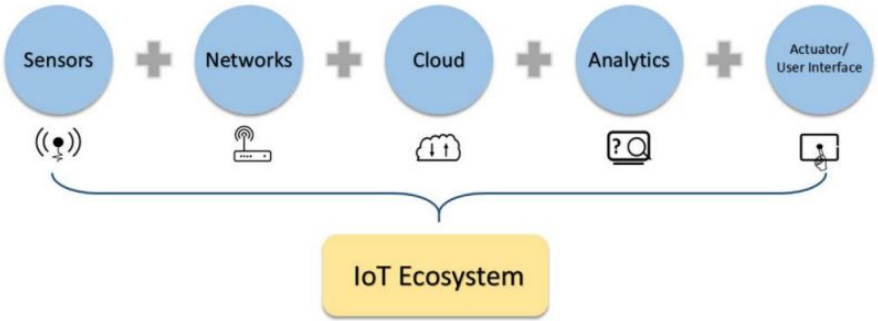


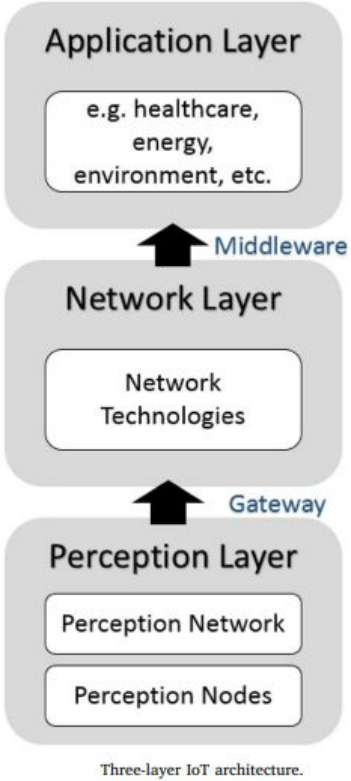

Objective analysis for Energy loss in buildings
energy supply would require less effort than before
economic benefits for people and governments
End
OBJECTIVE ANALYSIS
Energy loss in buildings has been reduced
consider some solutions for problem of buildings and consumption methods
put smart solutions more in priority
rehabilitate the existing buildings or construct new buildings smartly
put more efforts for introducing and implementing the efficient simple energy-saver
try to use more IoT devices to control energy consumption
encourage people to use such smart controlling systems
Means

The role of the IoT in smart buildings

- **Science** and **technology** have been integrated to create smart buildings.
- There is **no limit to how far smart buildings can be developed**, even though they have been proposed for years.
- **IoT will remain the primary technology for smart buildings in the present and in the near future**(Jia. m. et al, 2019).

- Similarly to a human's eyes, ears, nose, and brain, **IoT collect and analyzes important information in buildings.**
- This indicates that the **Internet of Things is the most crucial component for smart building** development going forward.
- In an IoT architecture, **the application layer has the greatest potential for improvement,** and domain-specific data analytic techniques will be crucial moving forward.
- A system of algorithms will enable the Internet of Things to deliver information to humans by using the fundamentals of physics, chemistry, and biology (Jia. m. et al, 2019).

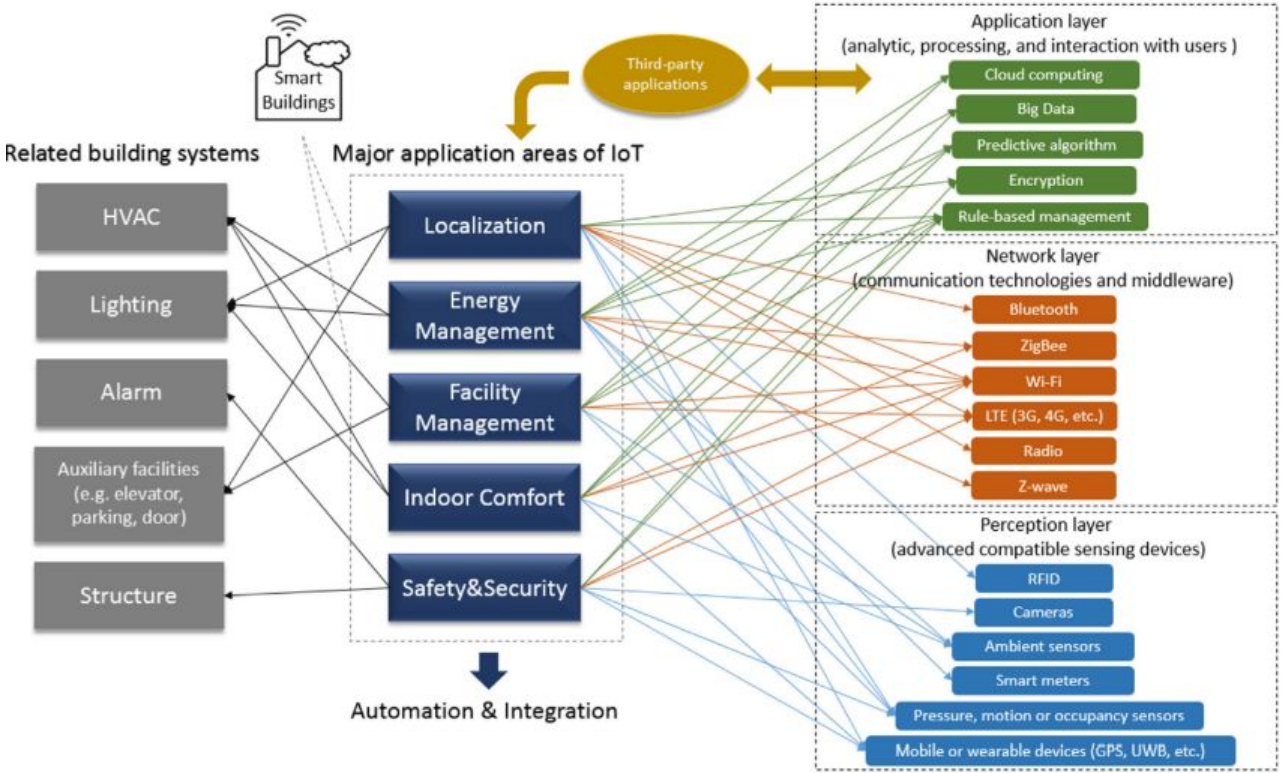




Three-layer IoT architecture.

(Automation in Construction 101 (2019))

How IoT works on the smart buildings



Summary of application of IoT on smart buildings (goals, technologies, and related building systems). Automation in Construction 101 (2019)

03

OUR SOLUTION

HVAC Automation

HVAC Automation defined

- A typical HVAC system consists of functionally or geographically distributed controllers that control several processes in a building or group of buildings either from a central host computer or through the Internet from a unit that connects the functions of the host computer and the webserver. HVAC equipment coming today has embedded controllers to smartly and remotely handle operations of Heating, Ventilation, and Air Conditioning of the building.
- Enabling Automation in HVAC systems is the need of today. It gives rise to the most efficient technology where building owners can adjust their cooling and heating preferences over time and adjust them automatically without wasting energy. Installation of IOT sensors in these systems gives the power to detect when occupants leave or enter the room. It prevents the unnecessary consumption of energy (air cooling or heating) in unoccupied areas. Also, these systems connect to smart devices as well such as mobile phones or laptops. The users can remotely control the temperature when needed.

What data do we need?

- Like other types of smart building technology, smart HVAC uses sensors that integrate with your building automation system. These sensors collect **data about the conditions throughout your building**. Other specialized HVAC equipment provides the ability to fine-tune temperature, humidity, and air flow in various zones (based on data from the sensors) to optimize comfort while reducing energy consumption.

What sensors do we need?

- Thermal sensors
- Occupancy sensors
- Air Quality Monitors

Thermal sensors

- Strategically-placed thermal sensors can detect the differences in conditions in each zone of your space. For example, a crowded room can get warm in a hurry, while an open office area with high ceilings can get chilly (since warm air rises and people are closer to the floor). A smart HVAC system uses that data to adjust to changing conditions throughout the day or week.

Occupancy sensors

- Occupancy sensors detect the presence of people (typically by detecting motion) currently using individual spaces within an home. That data can be used to adjust temperatures based on real-time utilization, saving you money on energy consumption.

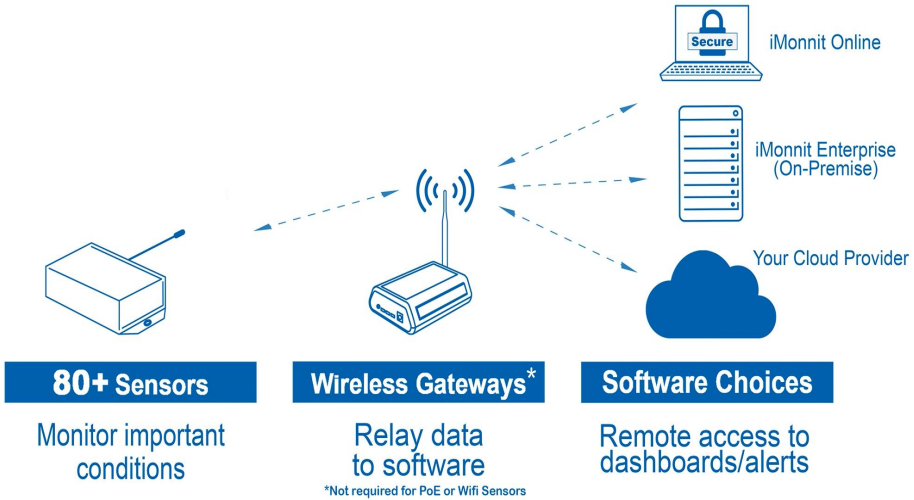
- While your HVAC system consumes anywhere from 40 to 70 percent of your building's energy usage, electricity for lighting is also a huge expense. That figure can be 25 percent or more. In addition to controlling a smart HVAC system, occupancy sensors also control lighting to further reduce lighting costs.

Air Quality Monitors

- The monitor draws air through it, and then takes measurements which you can view on the companion app. These measurements can help you make decisions on how to improve the air quality in your home

How can we used the data?

- For a better understanding of the application of systems based on input data received from sensors and other pieces of HVAC systems, understanding the sequence of operations is necessary. They automate the functions of HVAC equipment that are taking place simultaneously. The motive should be to maintain the flexibility to control various degrees of comfort required in different applications and the least possible energy use within the same building



How can we used the data to provide value?

- Review and inspection of the design of the entire building,
- Checking the construction and installation of each heating and cooling component
- End-to-end testing to achieve fail-proof operations
- Troubleshooting each part of the HVAC system to prepare it for everyday operations

04 MARKET ANALYSIS

Persona

In addition to technical solutions that minimize energy losses and decrease demand, **people's needs and aspirations must also be met for these solutions to be successful**. Policies, designers, and suppliers face particular challenges when dealing with owner-occupiers. A property owner faces a variety of time and financial demands as the decision maker in the process. We need to learn more about these individuals' relationships with their homes and their attitudes toward making home improvements in order to persuade them to prioritize energy renovations and domestic energy products (Haines V., Mitchell V.).

buyer persona

- **Location**—EU
- **Age**—Late 30s to early 80s
- **Gender**—Predominantly male
- **Advanced degrees**—35 percent own their own business
- **Motivation**—Saving energy, and therefore money
- **Influences**—The economy and pressure to do more with less
- **Informational Needs**—Primarily nontechnical
- **Frustrations**—Information that is biased, unreliable or incomplete
- **Top Candidate for**— Energy efficiency systems in the house
- **Wants**—To save organization money.

Persona example

Jack

Age: 56
Location: Italy
Occupation: business owner
Level: small business owner

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Description

Following a successful career as a mechanical engineer for a large company, Jack founded the company 20 years ago. There are 15 full-time employees at his company, and its annual revenue is $5 million.

Personal Characteristics

- Business traveler
- self-confidence
- competitiveness
- risk taker
- humor

Hobbies and Interests

- entertaining family, friends, and business associates
- competes in a couple of triathlons each year

Family Status

Both Jack and his wife are Syracuse natives and graduates of college.

budgeting concern

Energy costs are a large part of his budget.

Challenges

- the rising cost of employee benefits
- reduce operating expenses
- not sure whom to

- the rising cost of employee benefits
- reduce operating expenses
- not sure whom to trust among energy efficiency services companies

favorite social network

Both Jack and his wife are Syracuse natives and graduates of college.

Goals

Energy costs are a large part of his budget.

favorite social network

- well-networked in the business community
- business trade journals and industry blogs
- LinkedIn

Goals

- the rising cost of employee benefits
- reduce operating expenses

Italian Smart Home market

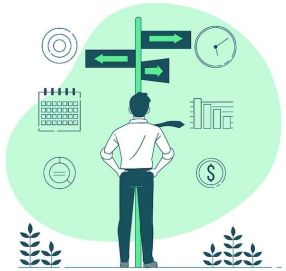
- In 2021 reached 650 million euros.
- Growth is expected for the next years.

- Still considerable gap (in terms of market value and household penetration) with other european countries.

Market characterized by:

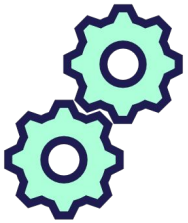
Several players

Contestable market



Big devices choice (price, characteristics…)

Privacy-security issues



Technology issues (no universal standard and multiple protocols)

Fragmentation likely to change due to:

→ Regulatory interventions (e.g. European Digital Single Market)

→ Alliances between firms

Key drivers

Political

- Fiscal incentives (e.g. Superbonus 110%)

Real estate

- Impact on property value (it depends on the type of interventions)

Key drivers

Security

- Increase hacker attacks exposition
- Integration with insurance policies

Environment

- Cut CO2 emission (up to **2.5** Mt each year) with total saving quantified between **3** and **3.5** billion euros for year.

THANKS