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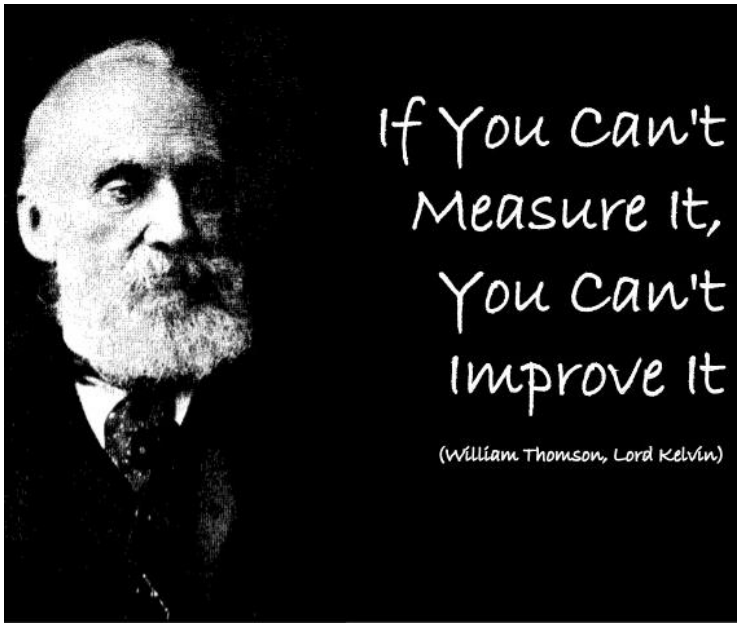
Energy performance guarantee Innovative in situ measurement methods

Hervé Charrue, Director of Research and Development

Why measuring energy performance of buidlings?

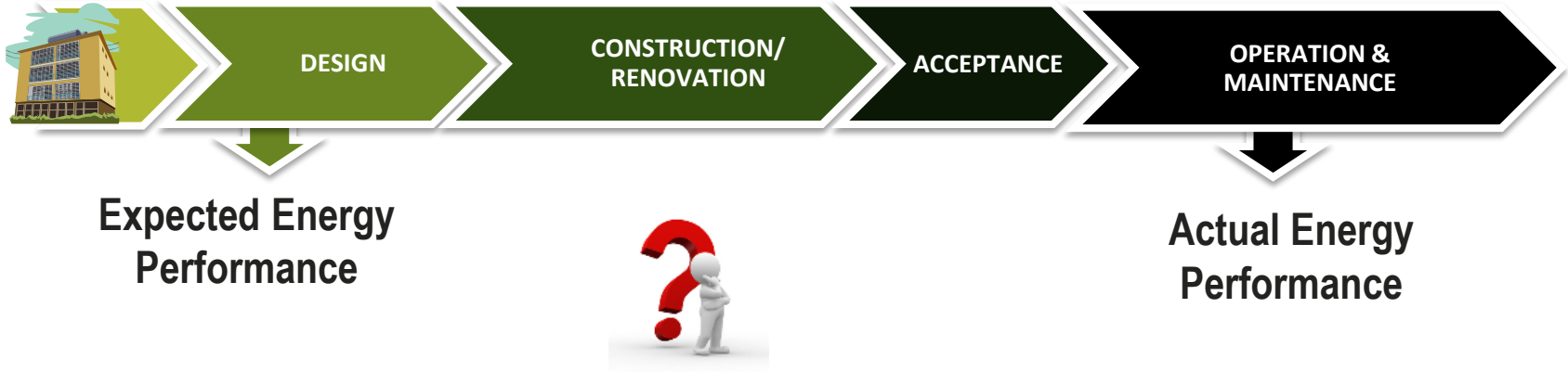


> **Give credibility to national policies of sustainable development and energy transition,**

> **Provide right market signal for building renovation investments,**

> **Promote skills and know how of the professional building stakeholders**

Why measuring energy performance of buidlings?



Is there a gap between expected and actual energy perfromance?

How to reduce this gap?

Why measuring energy performance of buidlings?

Main causes of energy performance gap

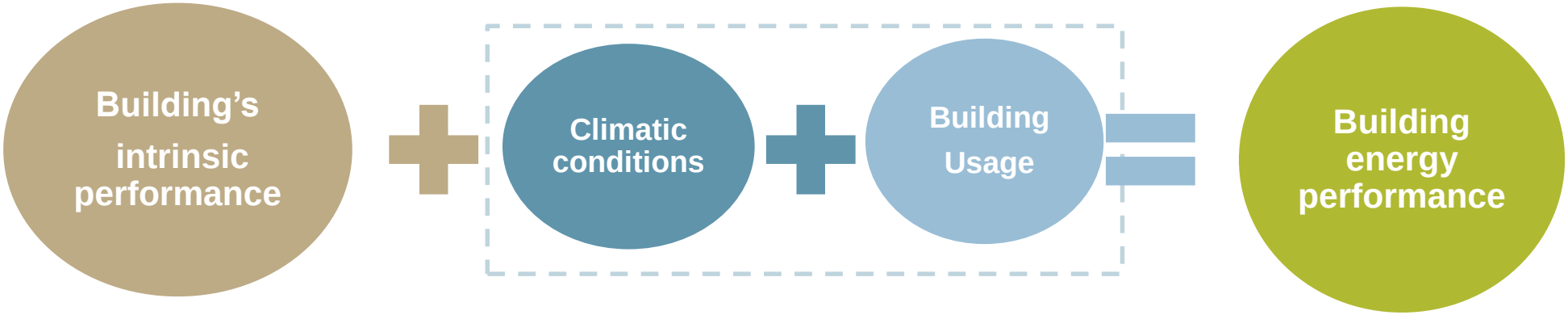
- unreliable predictions at design phase

- Non compliance of materials
- Damage to material performance during shipping and storage
- Workmanship quality

- Climatic conditions
- Evolution or change in building usage
- Human behaviour and Occupant preferences
- Quality and maintenance of the HVAC systems

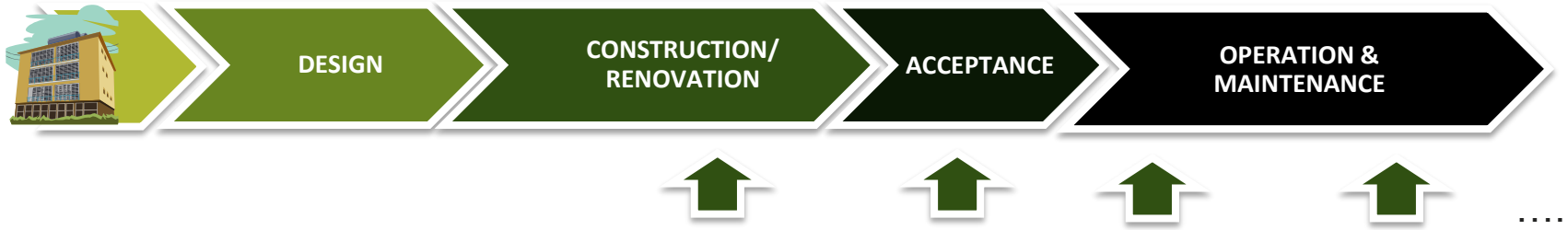
=> Difficult to identify root causes and responsibilities of stakeholders

Energy performance of buildings



Envelope
+
HVAC Systems

When measuring?



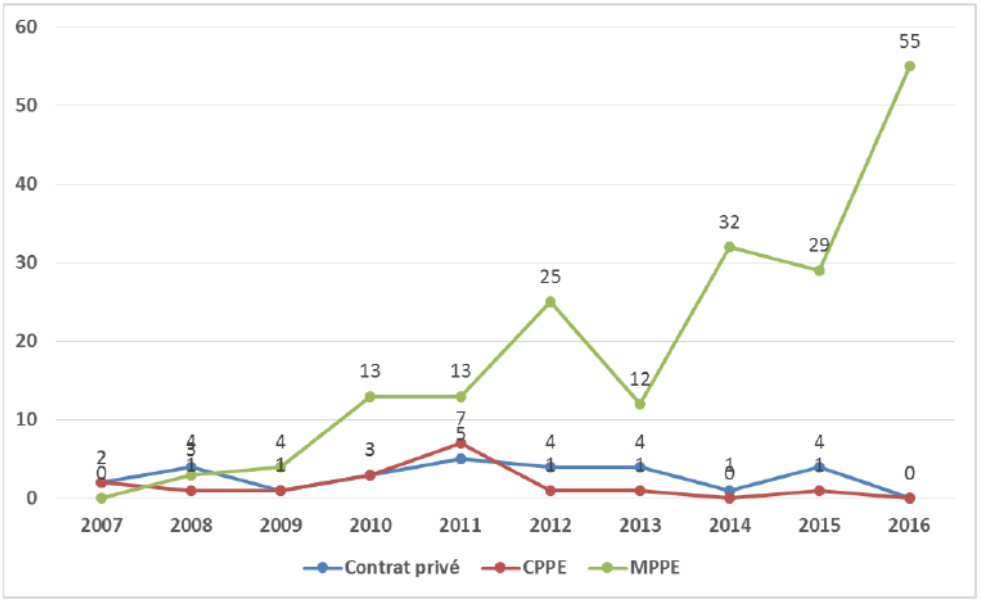
Energy performance guarantee practices

French Situation

ENERGY PERFORMANCE CONTRACTS

> Slight increase of the number of EPC since 2012

EPCs - France
source : les premiers résultats de l'OCPE – nov 2017



IN SITU ENERGY PERFORMANCE MEASUREMENT

> Air permeability test, part of intrinsic energy perfromance of the building
> Mandatory for new houses

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Innovative in situ measurement methods

ISABELE & REPERE

Two complementary innovative methods to in situ measure energy performance

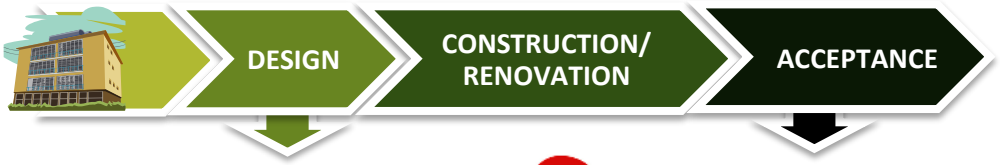
DESIGN → CONSTRUCTION/ RENOVATION → ACCEPTANCE → OPERATION & MAINTENANCE

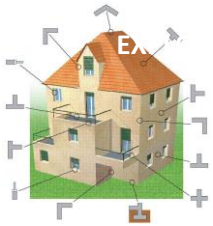
	ISABELE	REPERE
In situ measurement of energy performance	Performance of the building enveloppe	Actual energy performance of the building

ISABELE

IN SITU ASSESSMENT OF THE BUILDING ENVELOPE PERFORMANCE

> Innovative process developed by CSTB to in situ measure the global level of insulation,
> **Measurement of the heat loss coefficient by transmission H_{tr} (NF EN ISO 13790:2013) and H_{tr} uncertainty**



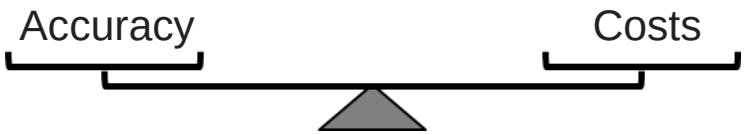


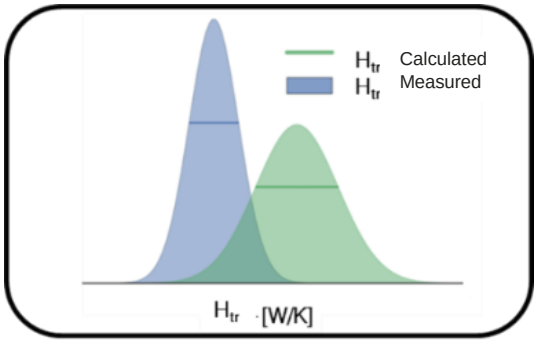
PRINCIPLE

> Direct measurement is not possible. Heating power is injected, controlled and measured. Measurement of internal and external resulting temperatures during the test. Htr is identified using suitable thermal modelling.

MAIN DIFFICULTY

> **Quantifie Htr uncertainty**
> **Optimize cost/accuracy balance**





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ISABELE
In Situ Assessment of the Building EnveLopE performance

ISABELE – Measurement Device

INDOOR UNITS

- Electric convector heaters + fan
- Energy consumption metering
- Indoor air temperature sensors

One per room (~20m²sensors)

Data concentrator

One per building

OUTDOOR UNITS

- Equivalent outdoor temperature sensors

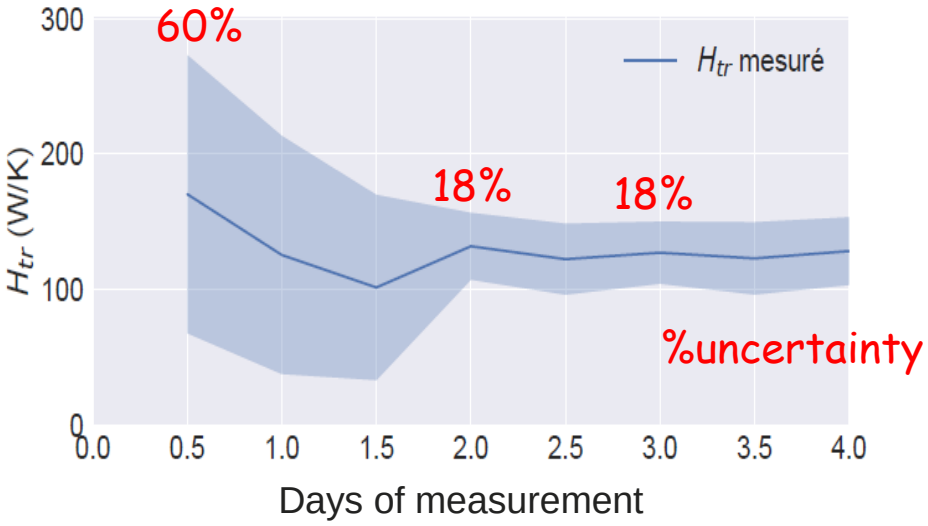
One per building face

- Air Temperature sensor

ISABELE – Results – first example

1 Measured level of insulation

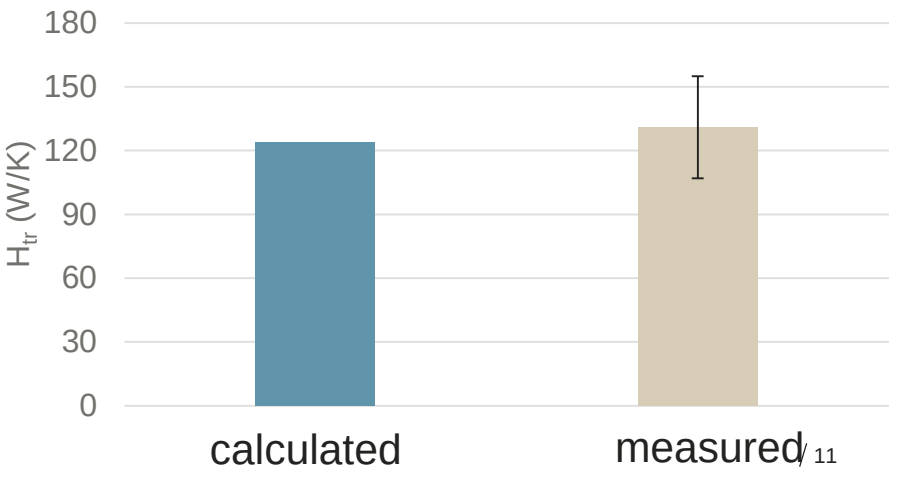
Htr * measured = 131 ± 24 W/K



** H_{tr} coefficient d'isolation globale défini par la norme NF EN ISO 13790:2013)*

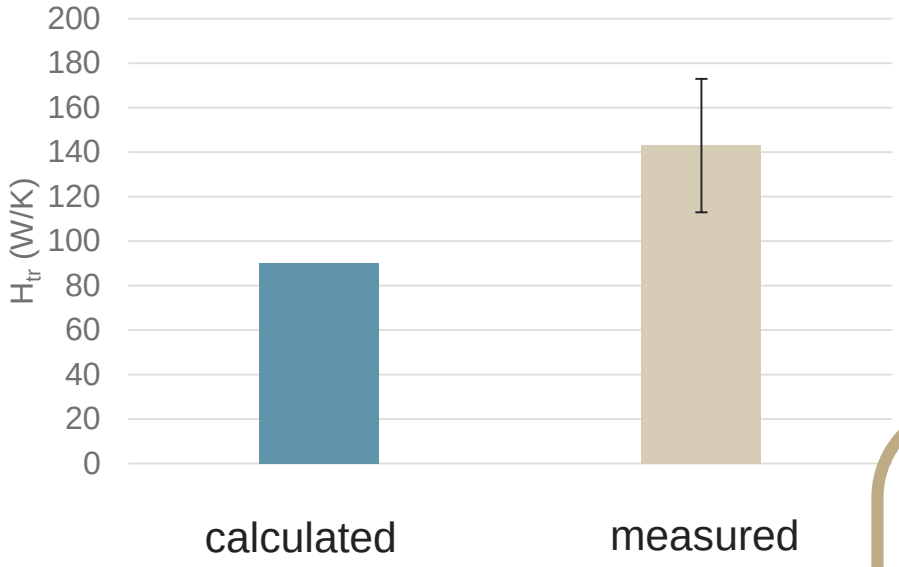
2 Calculated and measured values comparison

Htr* calculated = 124 W/K



ISABELE – Results – Second example

> New single house 120m²



High Gap between calculated and measured level of insulation

ROOT CAUSE OF THIS GAP :

- **Calculation errors (neglected thermal bridges)** ~33% of the gap
- **Non compliance of thermal performance of choosen materials** ~33% of the gap
- **Remain 33% of the gap, probably due to Workmanship quality**

ISABELE

In Situ Assessment of the Building EnveLopE performance

ISABELE

> **Operational method and protocol for new building**

> **On going for renovation**

Mannevilette

Brest

Saint Brieux

Clisson

Vert Saint Denis

Orléans

Grenoble

Agen

Saint Cannat

New

Rénovation

04- Innovative methods

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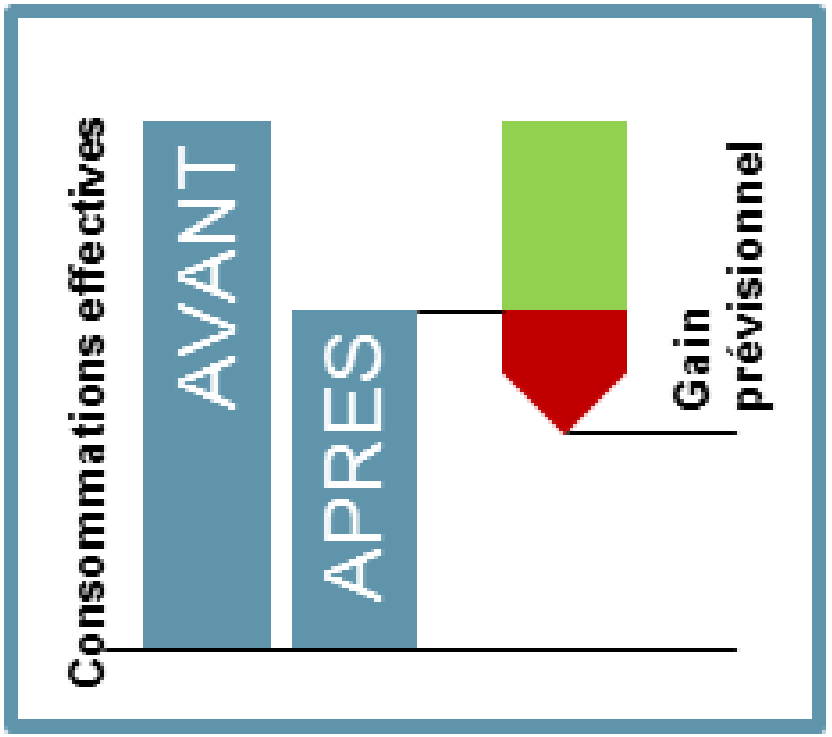
REPERE



Feedback on effective performance of energy renovations

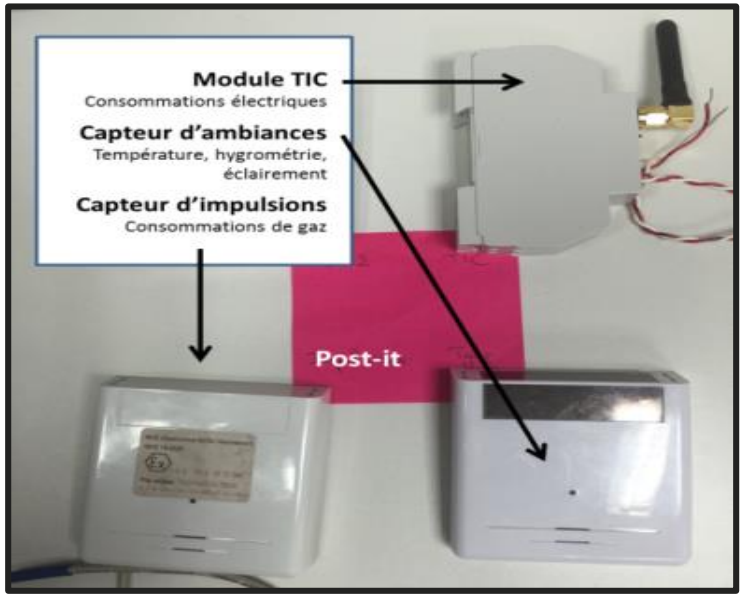
Objective :

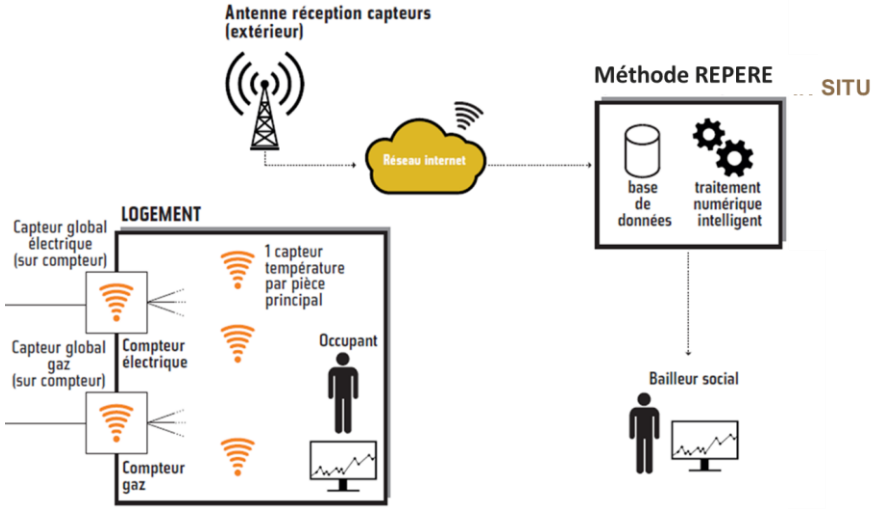
> Measuring the real performance gain obtained after renovation
> Comparing to estimates

Feedback on effective performance of energy renovations

> **Acquisition of measurement data**

Dwellings equiped with low-cost technologies based on the internet of things, bringing new possibilities of measurement

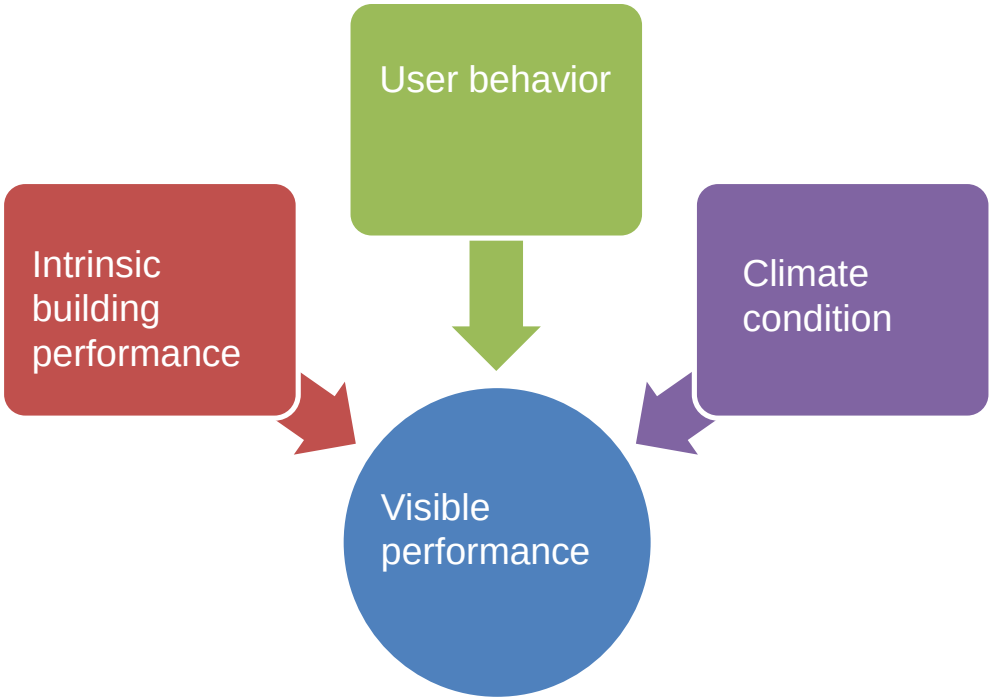




Feedback on effective performance of energy renovations

Expert numerical treatment of measured data

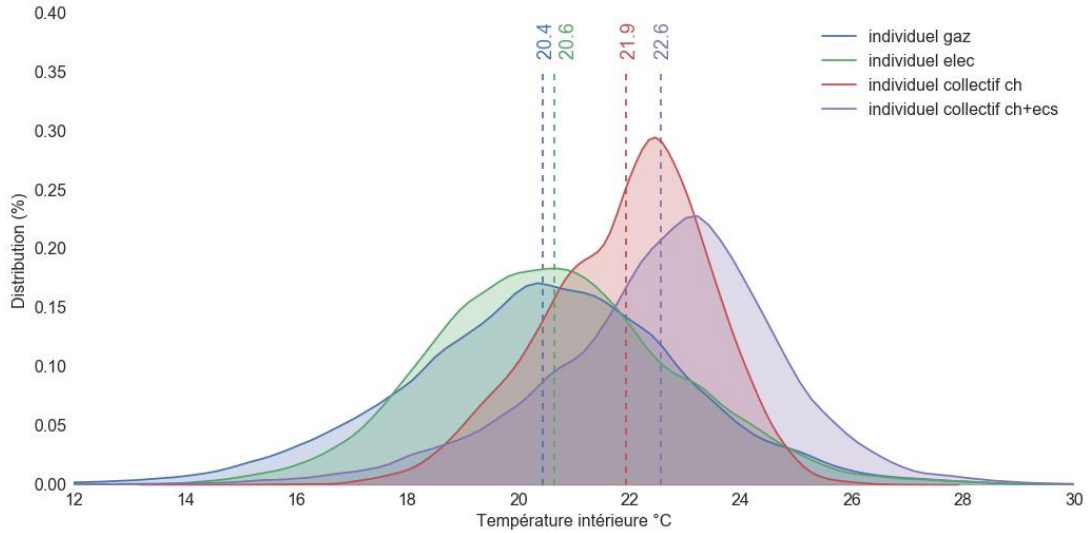
> Assessment of the energy performance gain, independently from the climate and use conditions



Feedback on effective performance of energy renovations

Expert numerical treatment of measured data

> Analysing the gaps compared to estimates (e.g. indoor temperature)



References

EVALUATION OF A RENOVATION PROGRAMME FOR 1300 DWELLINGS (2012-2014)

EVALUATION OF A RENOVATION PROGRAMME FOR 1000 DWELLINGS (2017)

And now?

> **Measuring performance, a key tool to generalise renovation!**

> **On the energy aspect:**
  - **An important research activity for the last years: innovative methods are now mature!**
  - **The professionals need to test and use these new tools thinking about technical aspects, responsibility, costs, etc.**

> **Challenges tomorrow:**
  - **Include other topics in the approach: indoor air quality, acoustics, etc.**
  - **Think about performance linked with a period of time.**

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