



Approach for the Improvement of Energy performance of a stock of buildings

Hossein Vaezi-Nejad & Jérôme Bouillon

Luc Crozier & Gérard Guyot

vaezi@cstb.fr

Objective of the project



- **The Ministry of equipment promotes a policy of improving:**
 - The management of its property holding
 - The energy performance its buildings
 - 7 millions square meters (75 millions ft², 10 000 buildings)
 - Wide range of different buildings of different sizes and uses
 - The objective of the action for state buildings:
 - Drive the other administrators of state buildings on the improvement of their buildings performance
 - Decrease the greenhouse gas emission
 - Save money

Four major Phases for the project



Phase 1

- Analysis of existing tools for energy performance evaluation

Phase 2

- Identification of the end-users of the tools and definition of a building typology

Phase 3

- Development of tools adapted to the end-users

Phase 4

- Validation and improvement of the tools

■ Ministry action to modernize the management of its stock of buildings

- 1998 : Development of a tool for collecting information about their buildings
- 2000 : Centralization of the information about buildings energy and water consumptions
- 2002 : Beginning of the collaboration with CSTB and ADEME



GPI



GPBât



GDBât

1st Phase: Analysis of existing tools for energy performance evaluation

- Definition with the end-users of a list of indicators with statistical reference values established for a family of buildings

Filter for selecting a family of building

Selection of a family

Indicators and reference values



Tool to analyze the performance of buildings

Indicateurs énergétiques

	Euros/m ³ (total)	Euros/effectif	m ³ /effectif	Euros/m ² (fossile)	Euros/m ² (elec)	Euros/effectif (eau)
Médiane	10	265	28	5	5	25
1er quartile	6	197	21	3	3	14
3ème quartile	16	477	44	7	9	42

Graphe

	kWh/m ² (fossile)	Euros/kWh (fossile)	kWh/m ² (elec)	Euros/kWh (elec)	m ³ /effectif	Euros/m ³
Médiane	38,9	0,13	35,1	0,13	10	2,40
1er quartile	140,0	0,08	23,9	0,11	7	1,99
3ème quartile	1.206,3	0,04	61,2	0,16	19	2,91

Graphe

Autres indicateurs

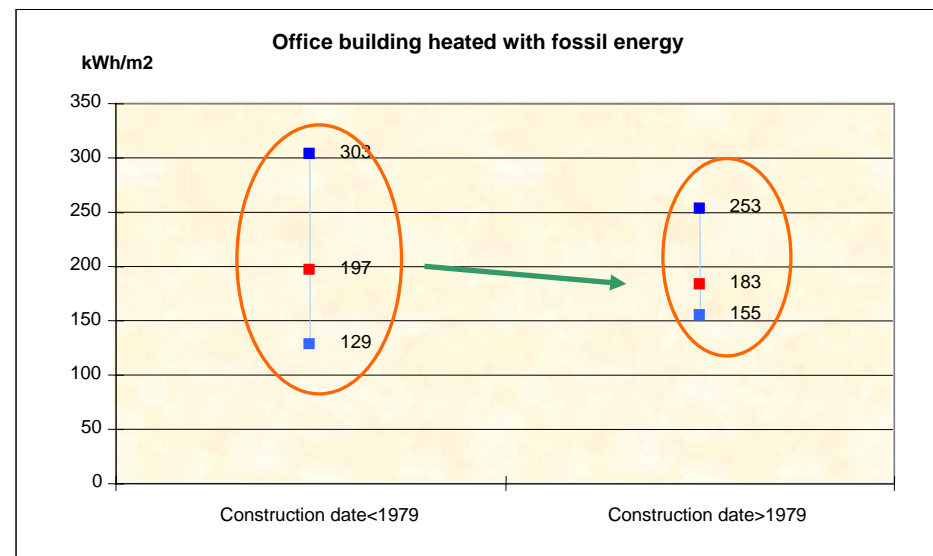
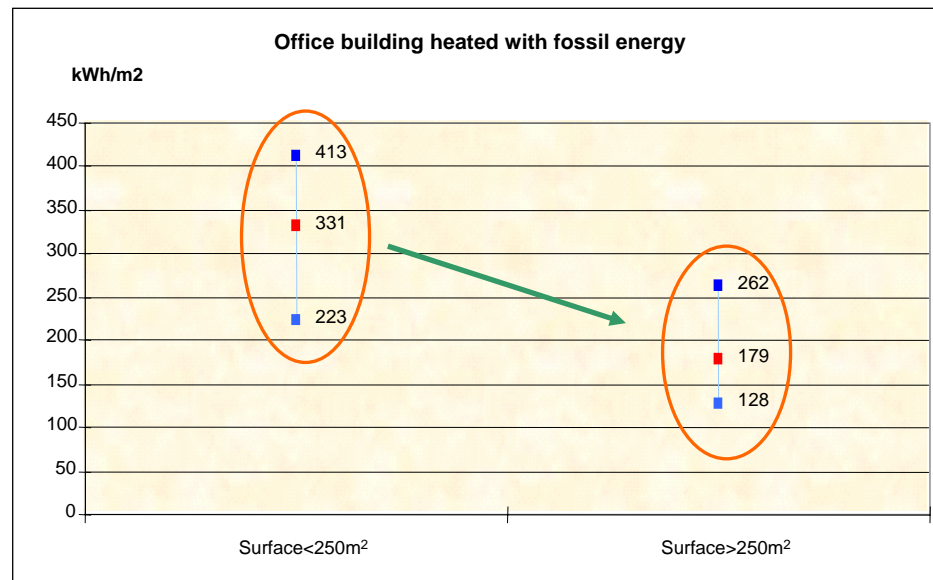
Estimate indicators of performance with the reference values

■ Statistical tests help to define family of buildings and parameters that have important influence on energy consumption

- Usage
 - Offices or Technical Premises
- Heating Energy
 - Fossil or Electricity
- Surface
 - Offices : greater or less than 250m²
 - Technical Premises: greater or less than 400m²
- Construction date
 - Before and after 1979

- The surface of the office building heated with fossil energy has great influence on the indicator kWh/m²

- The construction date of the office building heated with fossil energy has low influence on the indicator kWh/m²

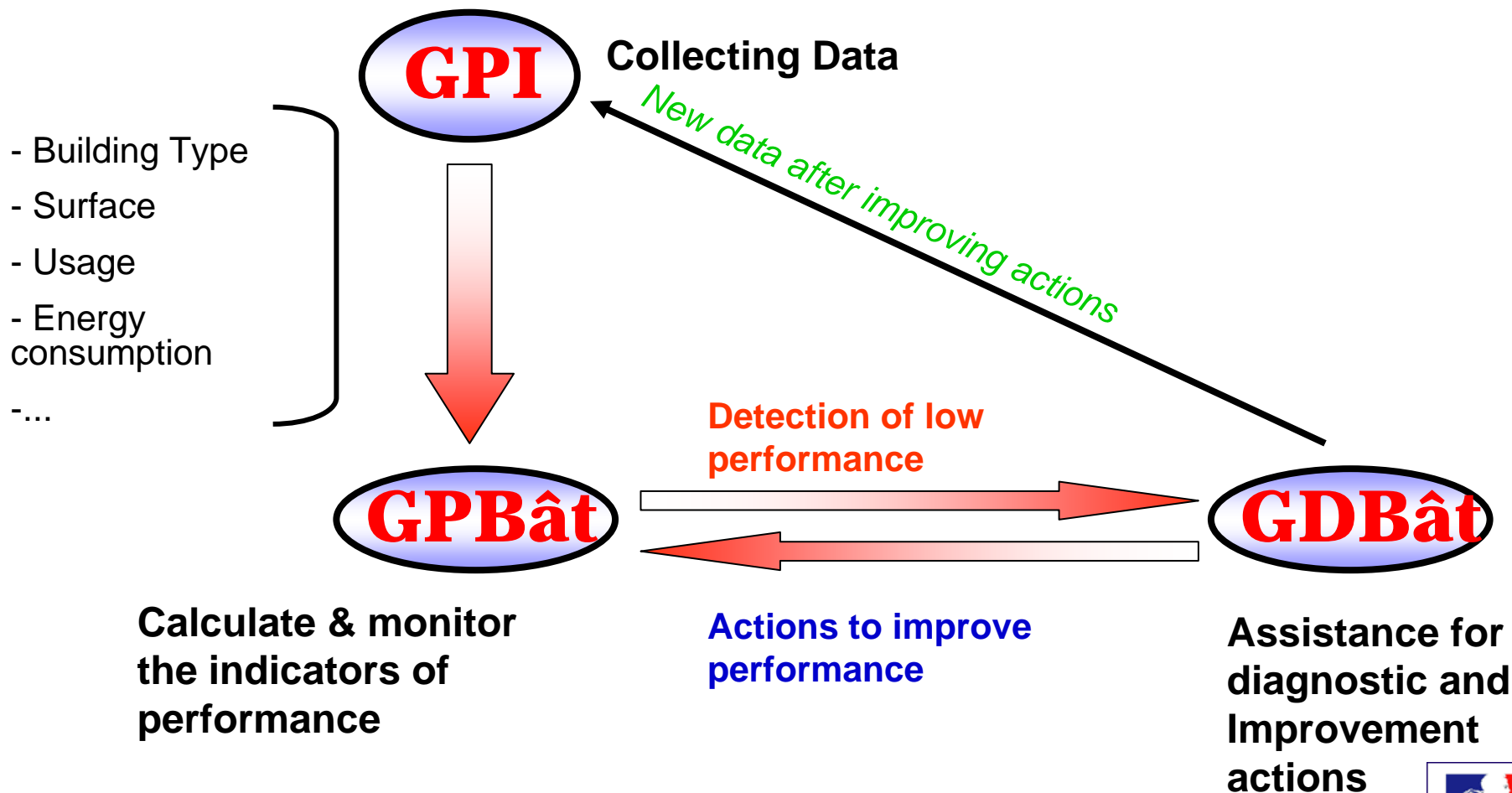


3rd Phase: Development of tools adapted to the end-users



- **Building managers' motivation is an important factor to improve the energy performance of the buildings**
 - The information that the building managers have to provide must be reliable, clearly defined and as simple as possible
 - The building managers will be more motivated to improve the energy performance of their buildings if they can also improve their comfort level
 - The building managers need some simple and flexible tools with different levels of details in order to let them assess their buildings performance from a top-down approach
 - The tools must be accessible via the Intranet of the ministry in order to be easily and widely accessible.

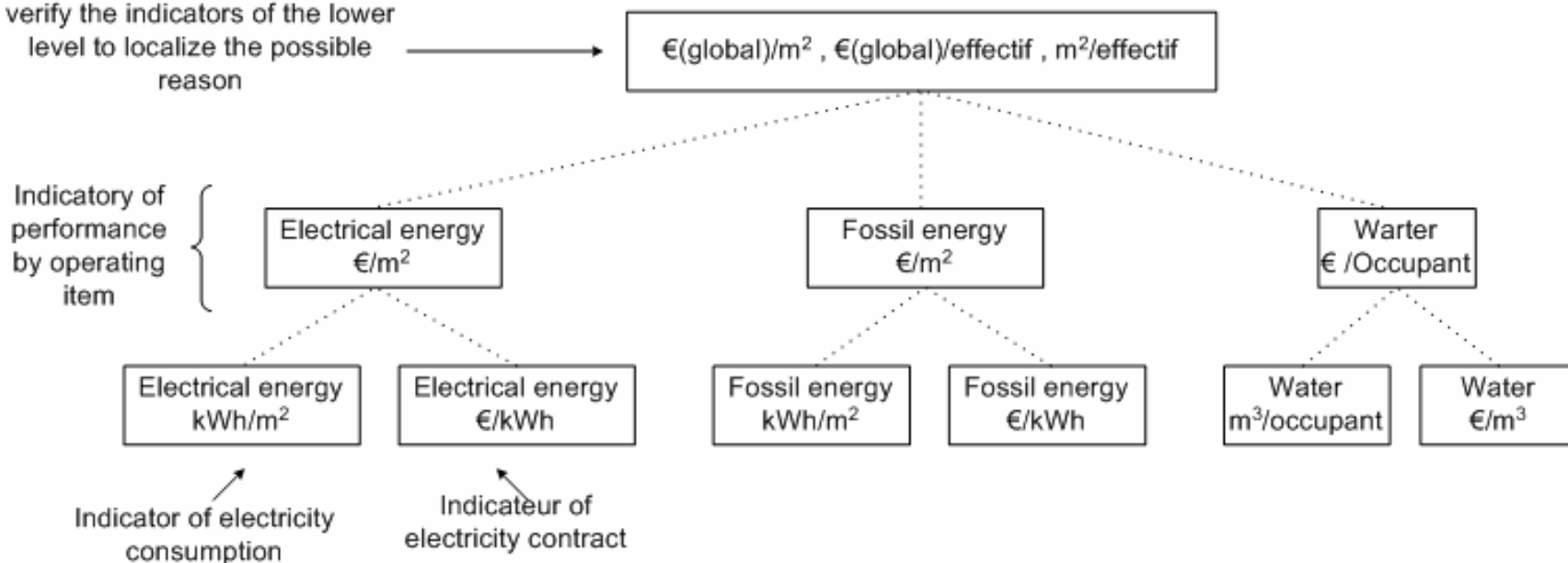
■ Development of tools adapted to end-user



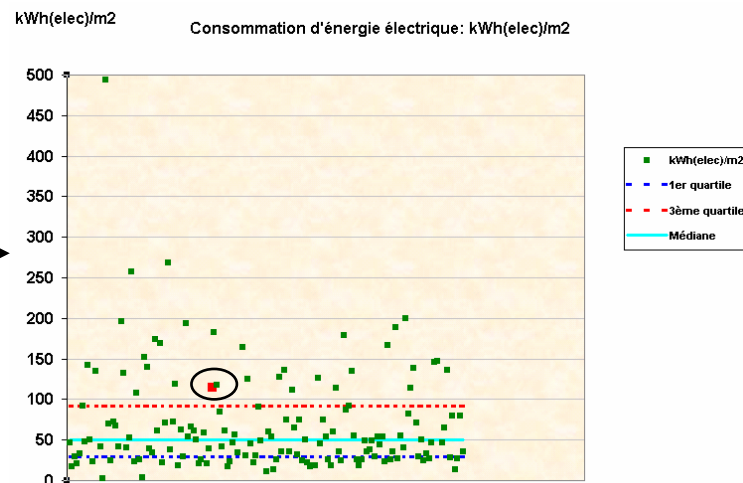
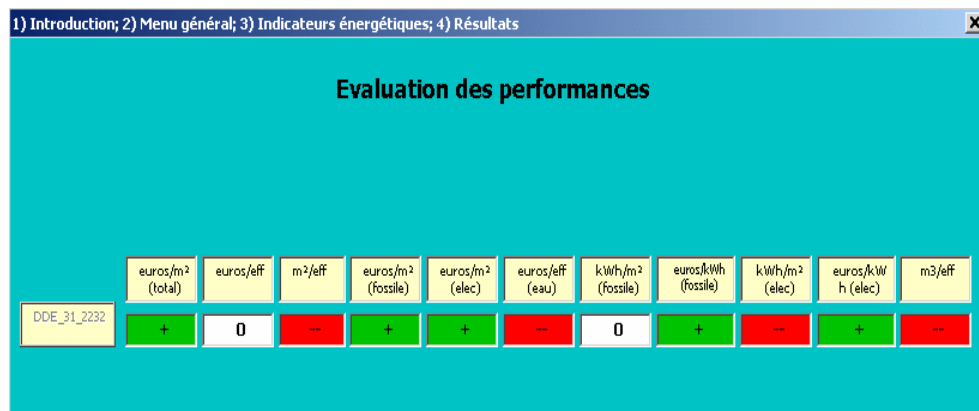
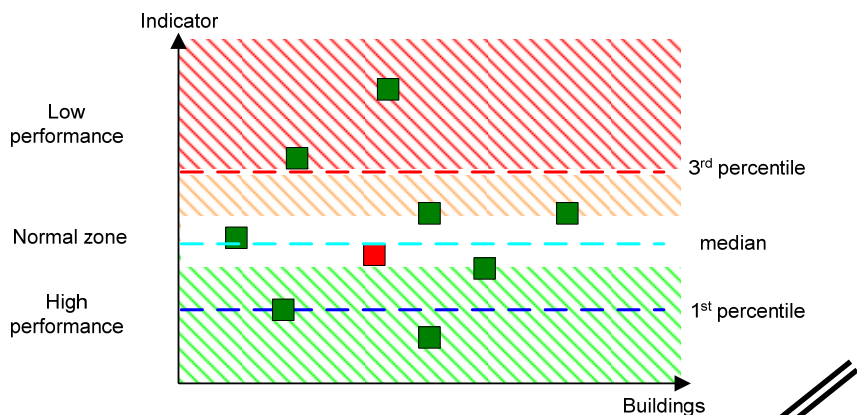
■ GPBat: a tool to analyze the energy performance and water consumption

- Hierarchical approach for analyzing indicators

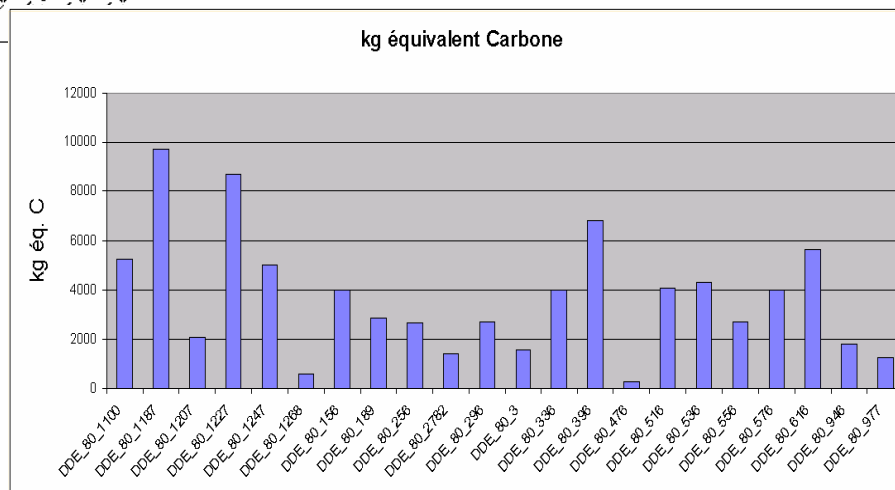
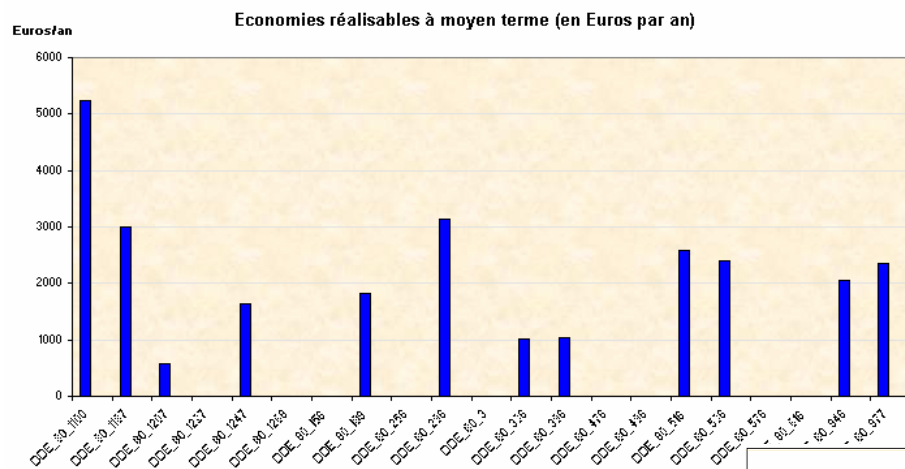
If a problem is detected then verify the indicators of the lower level to localize the possible reason



■ GPBat, hierarchical approach for presenting the results

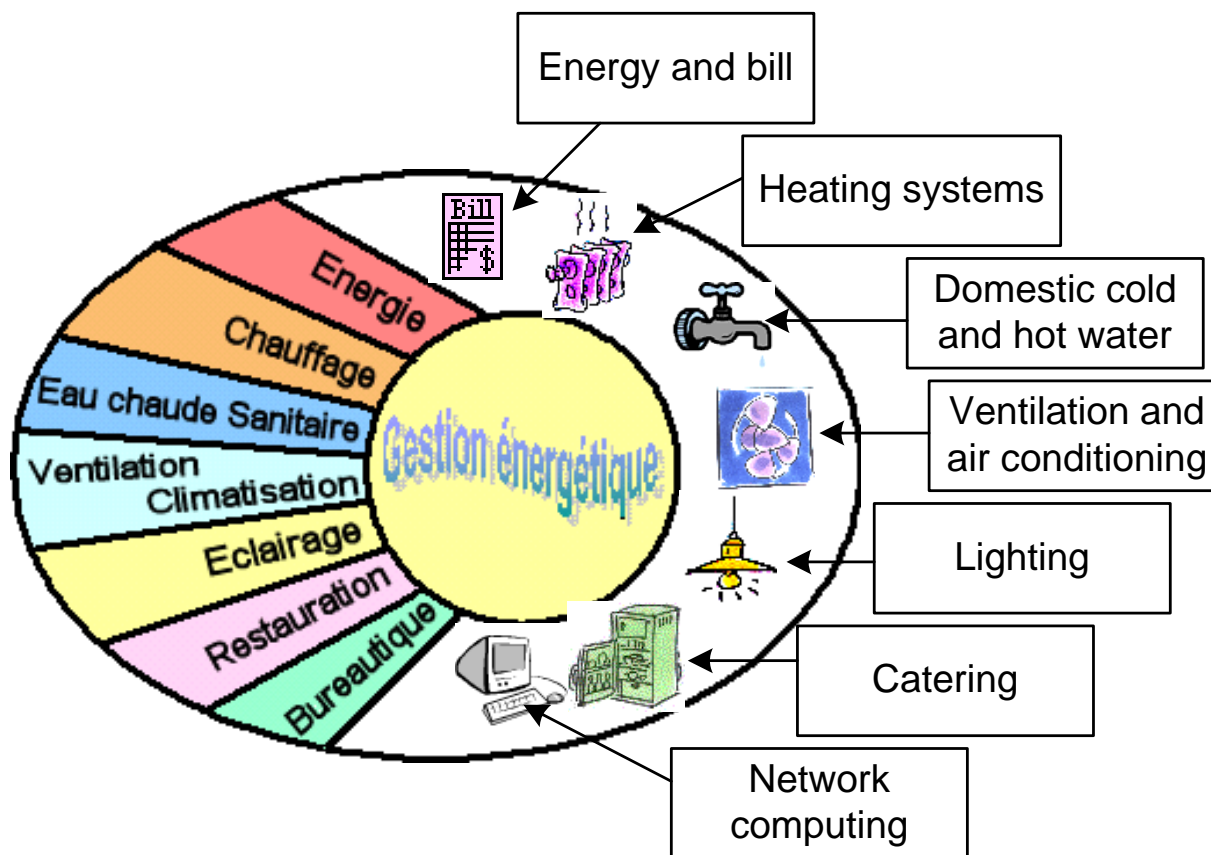


■ GPBât CO2 emission and Gain estimation



3rd Phase: Development of tools adapted to the end-users


- **GDBat: a tool to help for diagnosis and to develop improvement actions**



■ GDBat: each Item has globally the same structure


« Return » and
Item symbol space


« Title » space




Le chauffage
Améliorer le confort, le bâti, l'installation de chauffage, réduire les coûts

Introduction

Confort 
• Les usagers sont-ils satisfaits ?

Installation 
• L'installation de chauffage peut-elle être améliorée ?

Dépenses 
• les coûts peuvent-ils être réduits ?

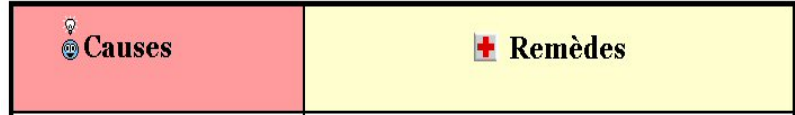
Menu Installation

- ☺ Quelles anomalies constatez-vous ?
 - ◆ Fréquentes pannes
 - ◆ Démarrage et arrêts fréquents de la chaudière
 - ◆ Programmation trop lourde à gérer
- ☺ Ce qu'il est possible d'améliorer :
 - ◆ Le rendement de la chaudière
 - ◆ La régulation de la chaudière
 - ◆ Le eau

General Items

- Comfort
- Installation
- Operating expense

Selection to access to the
“Causes” and
“Solutions”





Technique - Economies


1°- Notes

- Les tarifs électriques
- La ventilation naturelle
- L'isolation thermique
- Les onduleurs ...



3°- Questionnaire Occupants comfort

- Éclairage
- Chauffage
- Eau chaude sanitaire
- Ventilation
- Climatisation



Questionnaire :
confort des occupants



2°- Technical maintenance cards

- Chaudière centralisée au fioul
- Ballon d'eau chaude sanitaire
- Ventilateur VMC ou axial
- Centrale de traitement d'air ...



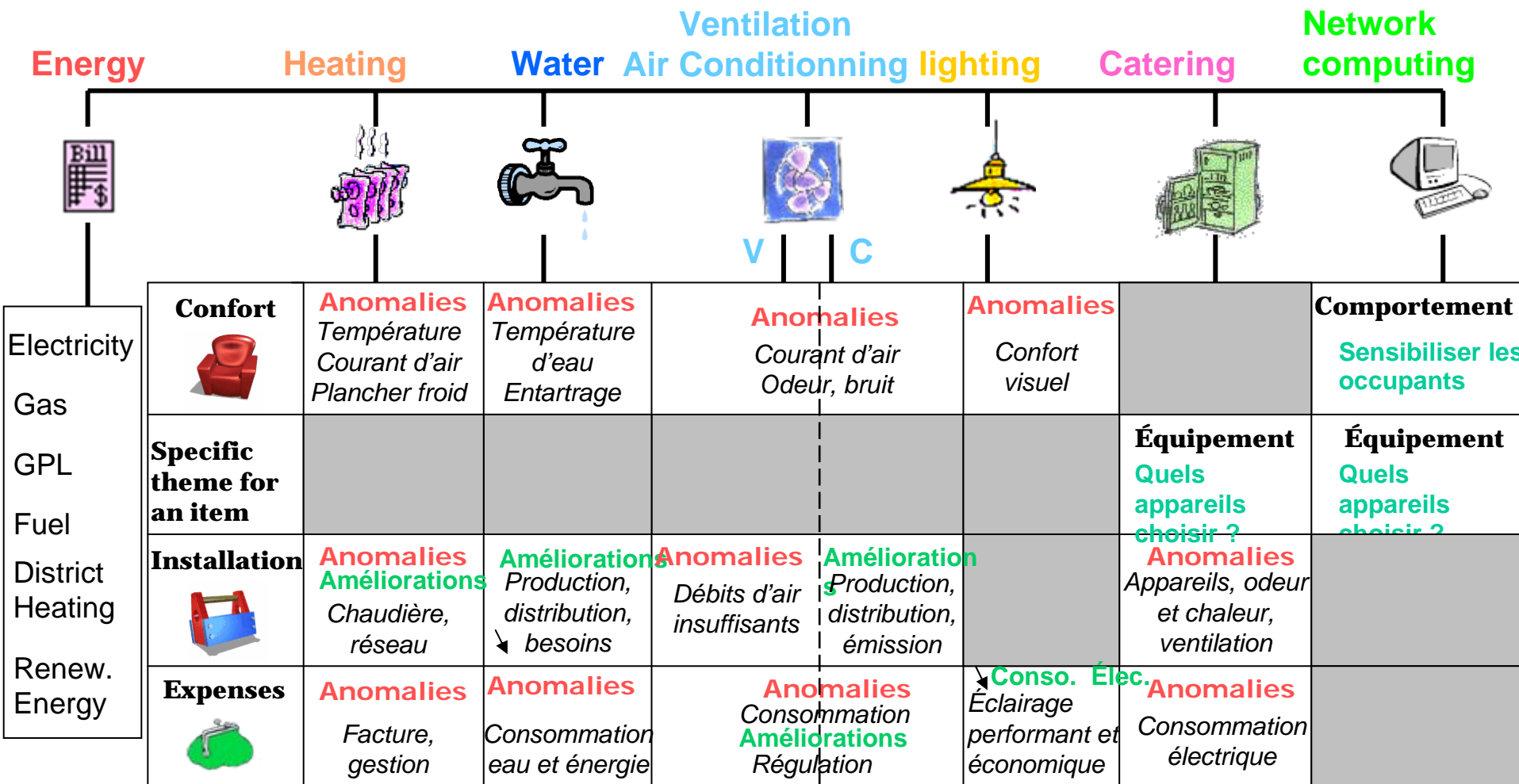
4°- Energy audit

Sur les installations et les équipements
des postes consommateurs d'énergie
et de fluide



Audit énergétique de
l'éclairage

■ GDBat structure



Conclusions



- **The last phase of validation is running now**

- **We produced an easy-to-use system with a hierarchical approach that gives the possibility to the end-user of defining the level of details he needs to access**
 - But there is a need for automation and simplification of the tools

- **For the building typological approach, we developed a typology based on the ease of identification and the usage of the sites**

- **We have tried during the development phases to find solutions that can motivate end-users and meet their needs and working constrains**
 - How to motivate managers and occupants to use the tools?
 - A specific item that can be used by the managers to exchange information about good experiences and practices would be helpful