ENERTER: A Tool to Simulate Housing Energy Consumption

Energies Demain - Johan Schram

Context

- Old housing stock with poor thermal performance
  - Large stock of housing constructed before 1900
  - Construction boom in the 60's (no thermal rules)
- Increasing energy pressure
- Ambitious goals of energy and emission reduction

Questions to answer :

- **How, where, by whom is energy consumed in the residential sector?**
  - Need of knowledge about the existing housing stock
- **How is consumption likely to evolve in the future?**
  - Natural trend scenarios
- **What can be done?**
  - Renovation scenarios : cost, impact

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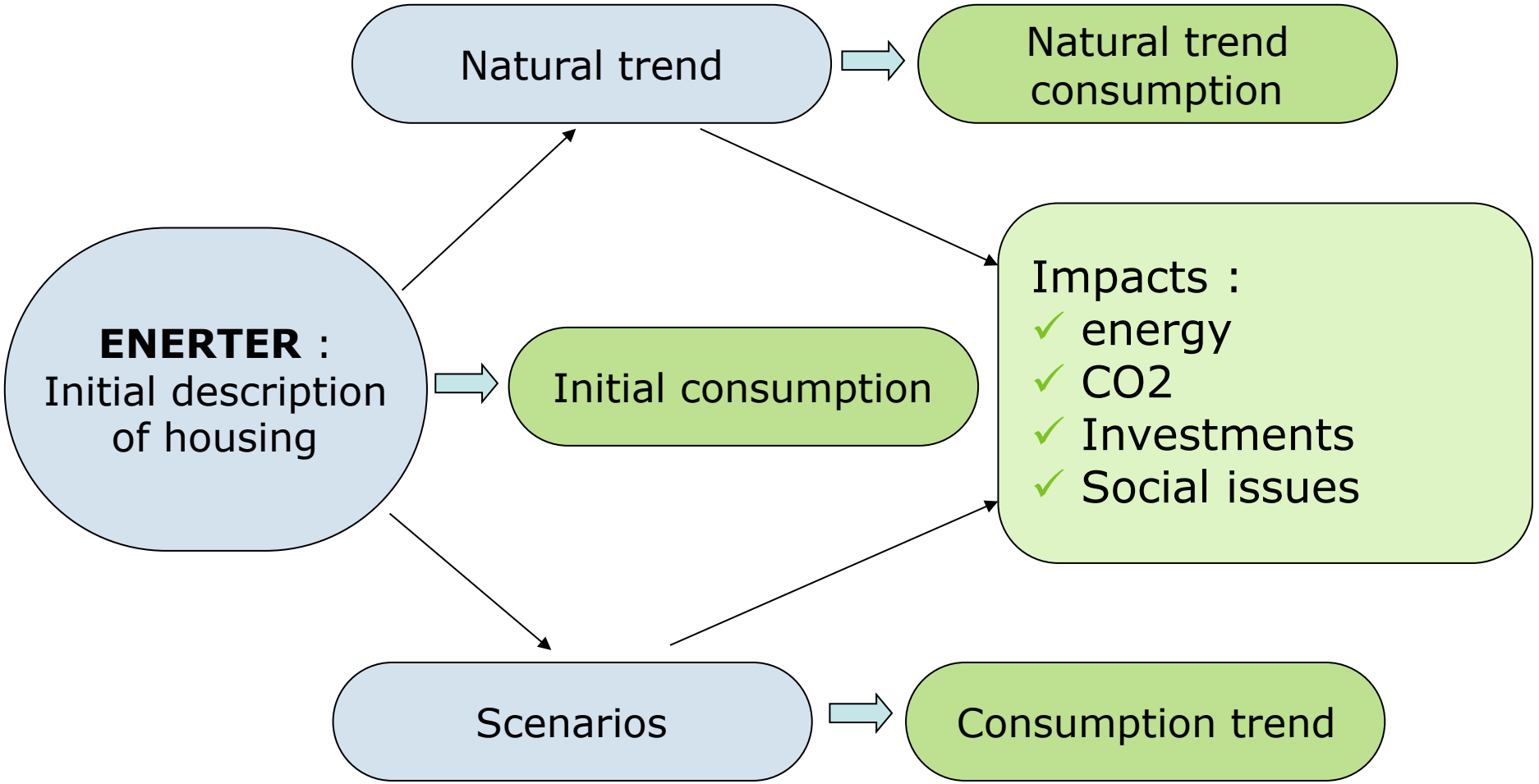
ENERTER purpose



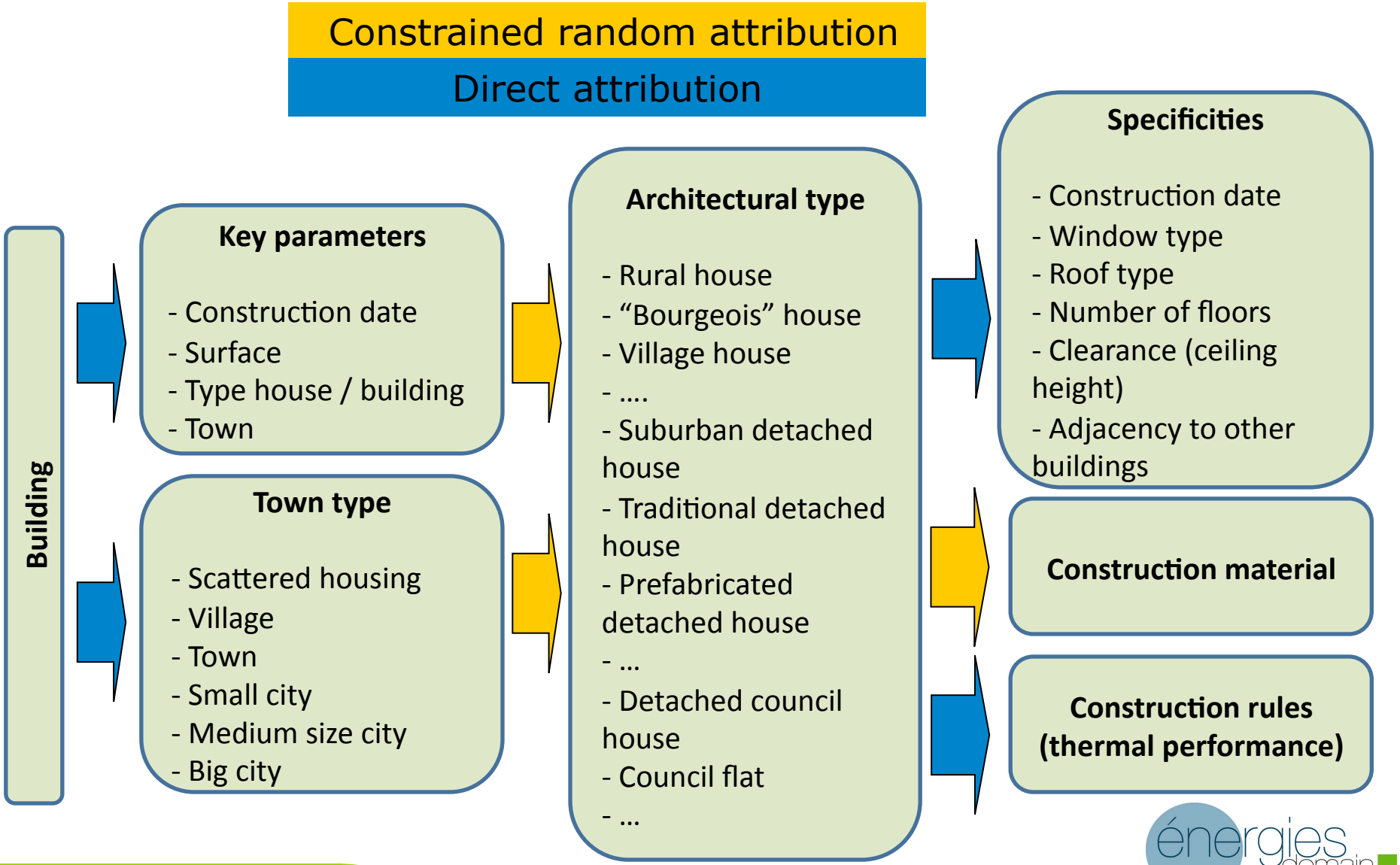
ENERTER principles

- Discrete database
  - Each house is described (30 million records)
  - Probabilistic approach

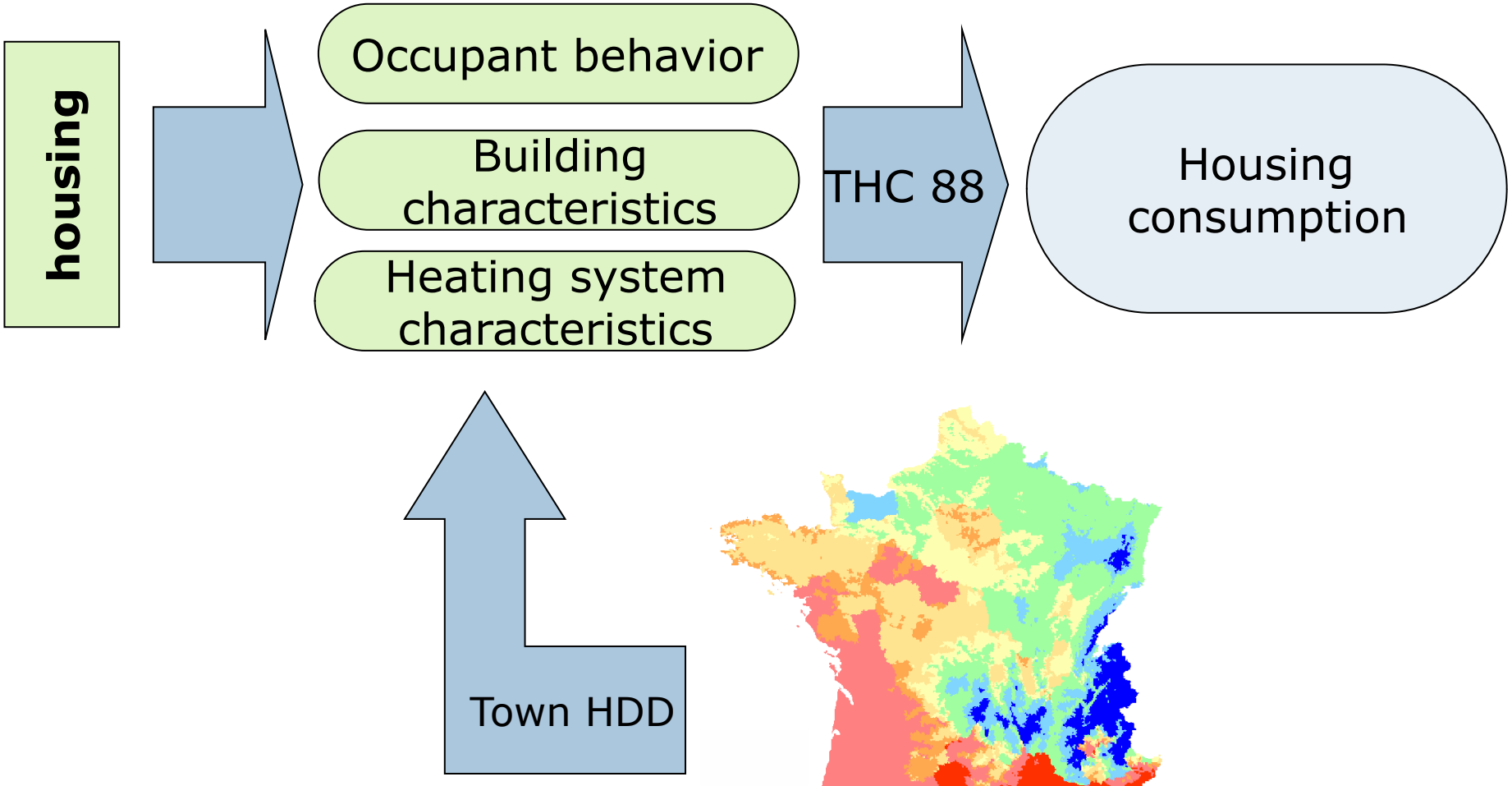
- Description of :
  - Architectural type
    - Construction type
    - Number of floors
    - Construction material
    - Wall, roof, floor, windows thickness/insulation
  - Location
    - Climate harshness
    - Adjacency to other building(s)
  - Heating system
    - Type
    - Energy carrier
    - Performance
  - Housing occupants
    - Behavior
    - Occupancy (owner, renter, main residence, second home)
  - System
    - Ventilation

→ **Energy consumption**

Attribution of housing Characteristics



Consumption calculation



ENERTER applications

- Town to national scale
  - Possibility of isolating specific housing types (blocks of council flats, etc.)

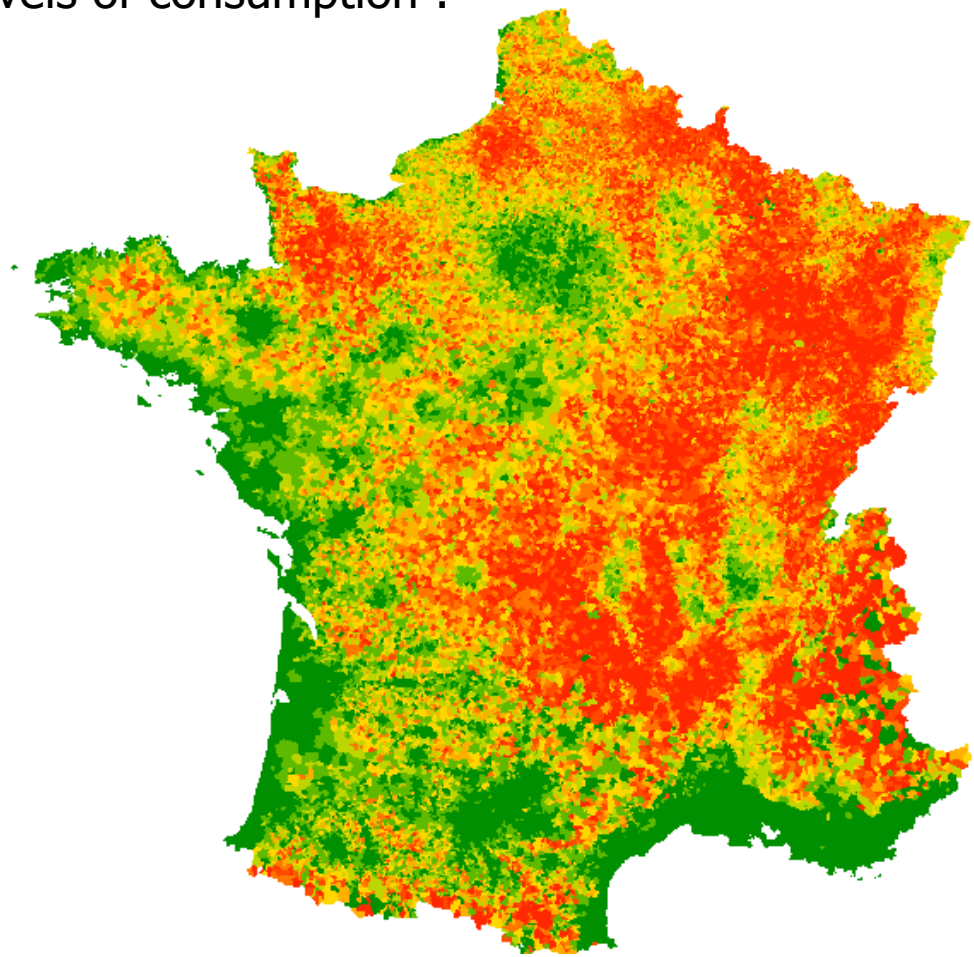
- Housing consumption analysis
  - Understand WHERE, HOW, by WHOM is energy consumed
  - Consumption per construction date, building architectural type, building category (council house, regular house), heating system / energy carrier, location, occupancy (owner, renter, etc.)

- Housing consumption scenario
  - Natural trend (housing needs, heating system characteristics, etc.)
  - Action scenarios:
    - Definition of scenarios based on goals (such as – 75 % of GHG emissions for 2050)
    - Impact (consumption / emission) of scenarios

Example of applications national scale

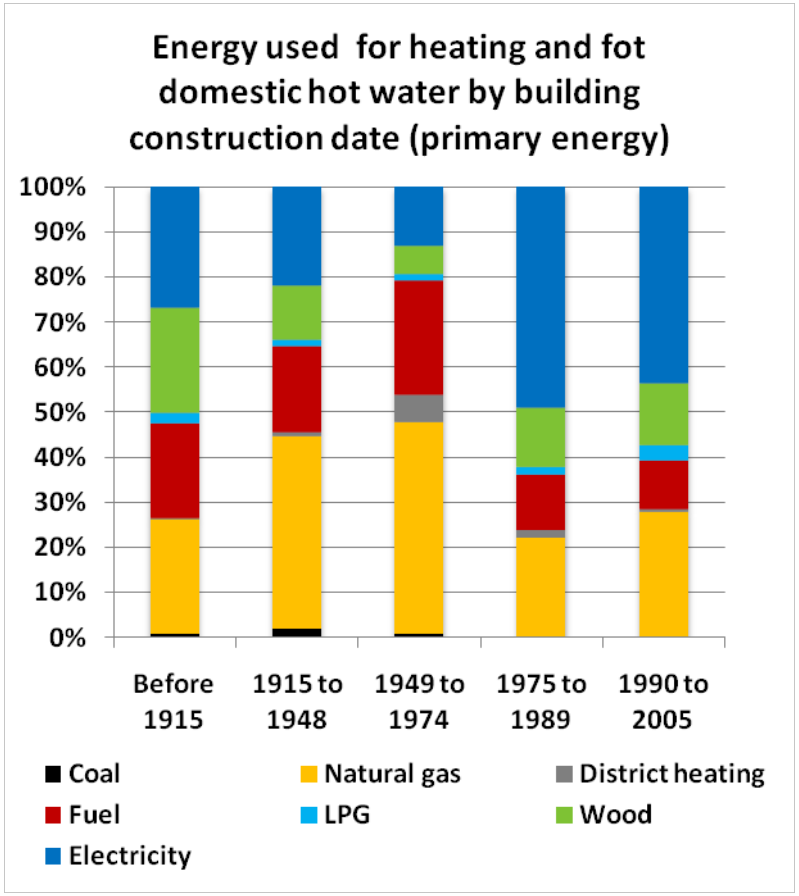
Housing consumption analysis

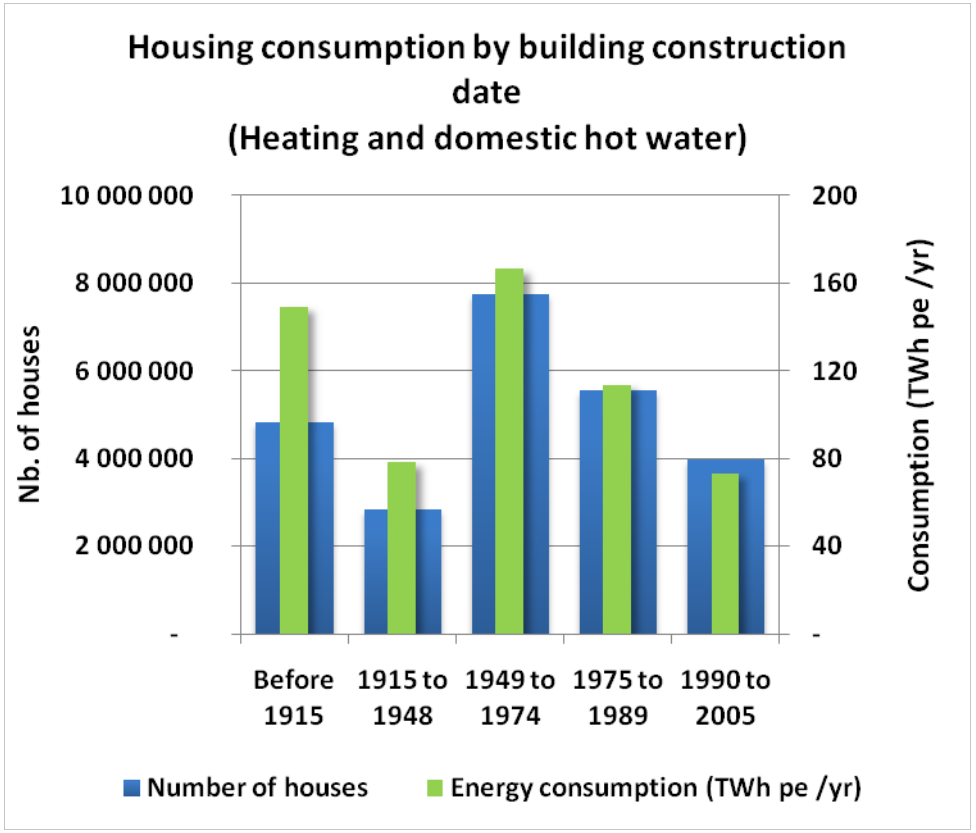
- Various levels of consumption :



Example of applications national scale

Housing consumption analysis





Example of applications
Regional scale : Brittany

Potential energy savings per architectural type

- Definition of 2 scenarios
  - Cautious renovation scenario
  - Aggressive renovation scenario (best technology available)
- Definition of renovation scenarios for each architectural type
  - Roof, wall, floor insulation
  - Heating system improvement
  - Changing windows
  - Cost

- Results :

Aggressive scenario

- 80 % of energy savings
- 0.09 €/ kWh ep saved, i.e 30 billion € (± 15%)

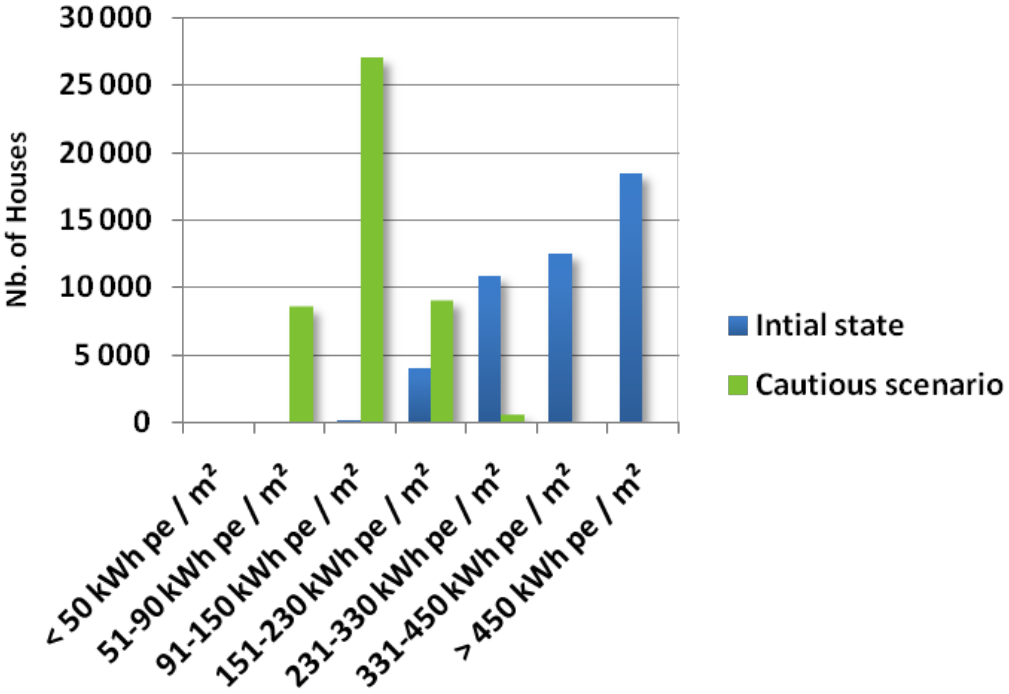
Cautious scenario

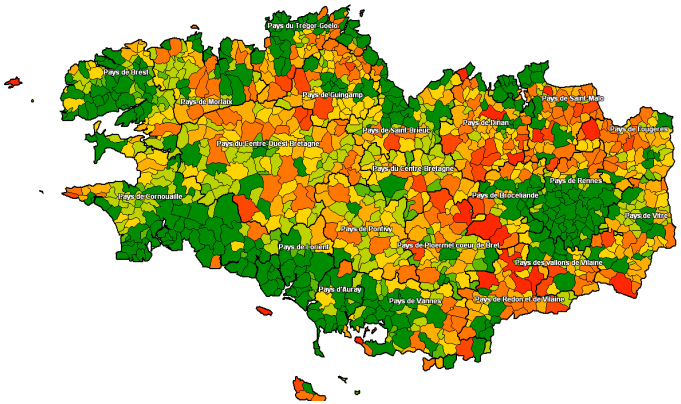
- 54 % of energy savings
- 0.07 €/ kWh ep saved, i.e 15 billion € (± 15%)

Example of applications
Regional scale : Brittany

Cautious scenario : example based on architectural type :

"rural house bf. 1915"





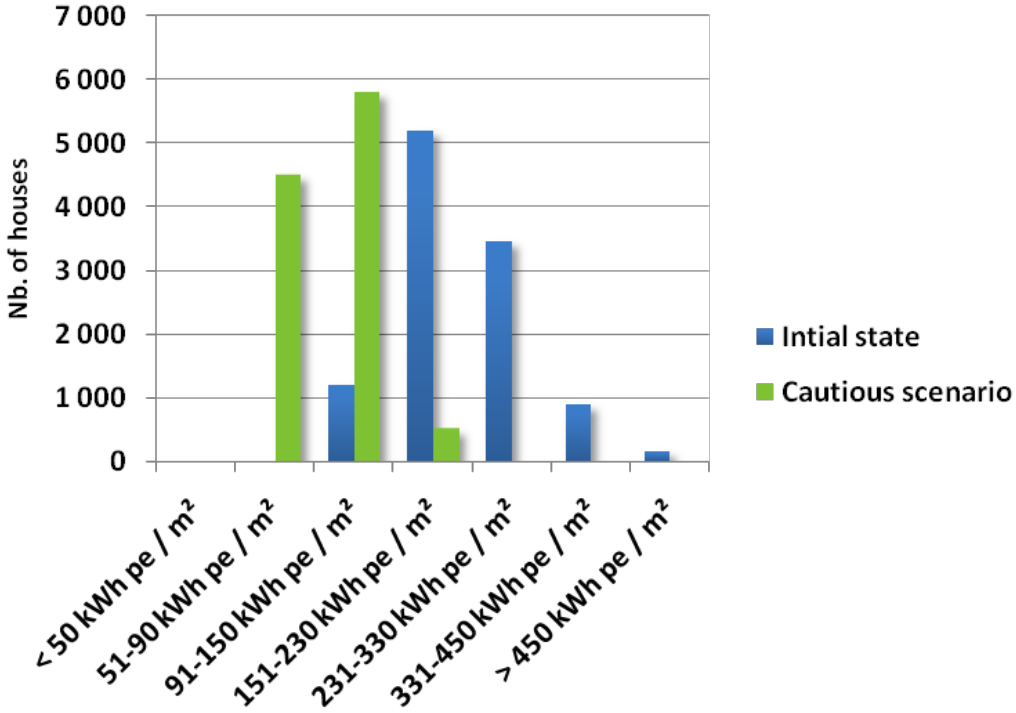
House location in Brittany

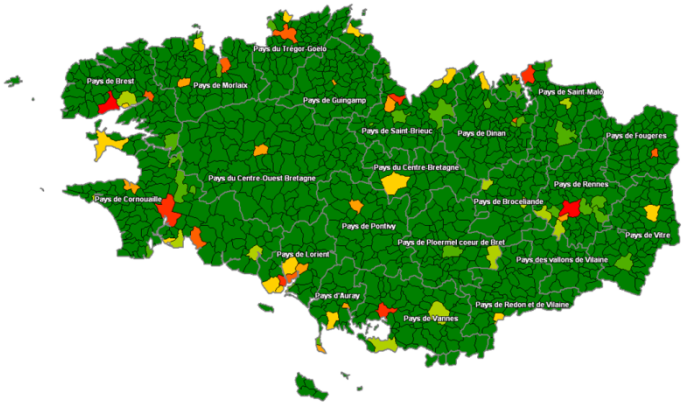
- 0.03 €/ KWh ep saved
- 17 000 € / house (± 20%)
- 27 000 kWh ep saved / yr . House

Example of applications
Regional scale : Brittany

Cautious scenario : example based on architectural type :

"Intermediate Collective building 1968 - 1975"





House location in Brittany

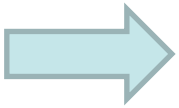
- 0.52 €/ KWh ep saved
- 15 000 € / flat (± 20%)
- 820 kWh ep saved / yr . flat

Example of applications local scale : OPAH

Definition of an Operation of housing Improvement (OPAH)

- Town community of 21 rural villages : 10 000 houses
- Program targeting households with small incomes
- Financial/technical help to
  - Improve housing comfort
  - Improve housing energy efficiency
- Encourage building rehabilitations instead of only systems (heating systems , windows, etc.) rehabilitations

- ENERTER :
  - Evaluation of housing consumption -> heating cost
  - Evaluation of the rehabilitation potential and its cost
  - Simulation of rehabilitation scenarios to estimate their rate of return for households



Definition of the OPAH objectives (nb. of houses to rehabilitate)
Optimization of the subsidies

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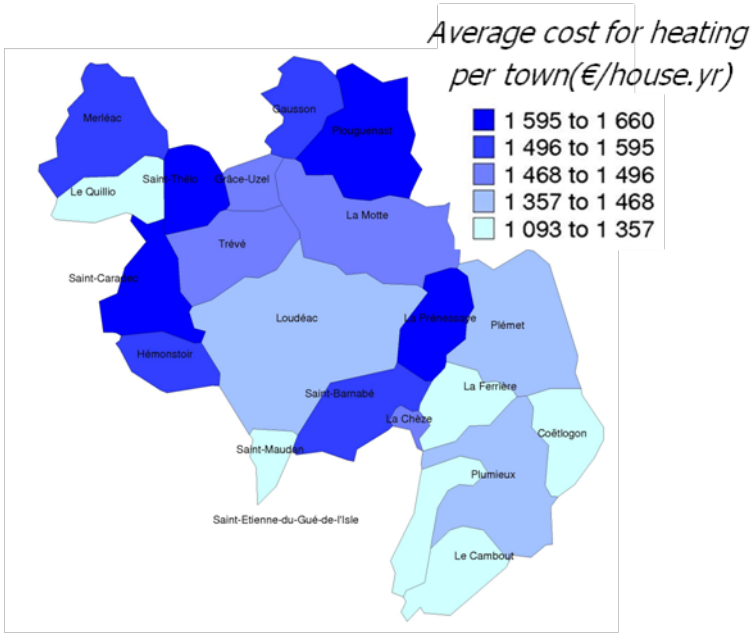
Example of applications local scale : OPAH

- Rehabilitation cost simulation (average)

Energy savings	Réhabilitati on cos simulati on	Global cost (rehabilitati o + energy bill (10 yrs))
<20%	9 000 €	29 000 €
20%	11 500 €	26 900 €
40%	14 000 €	25 000 €
60%	18 500 €	28 500 €



- Subsidies optimization

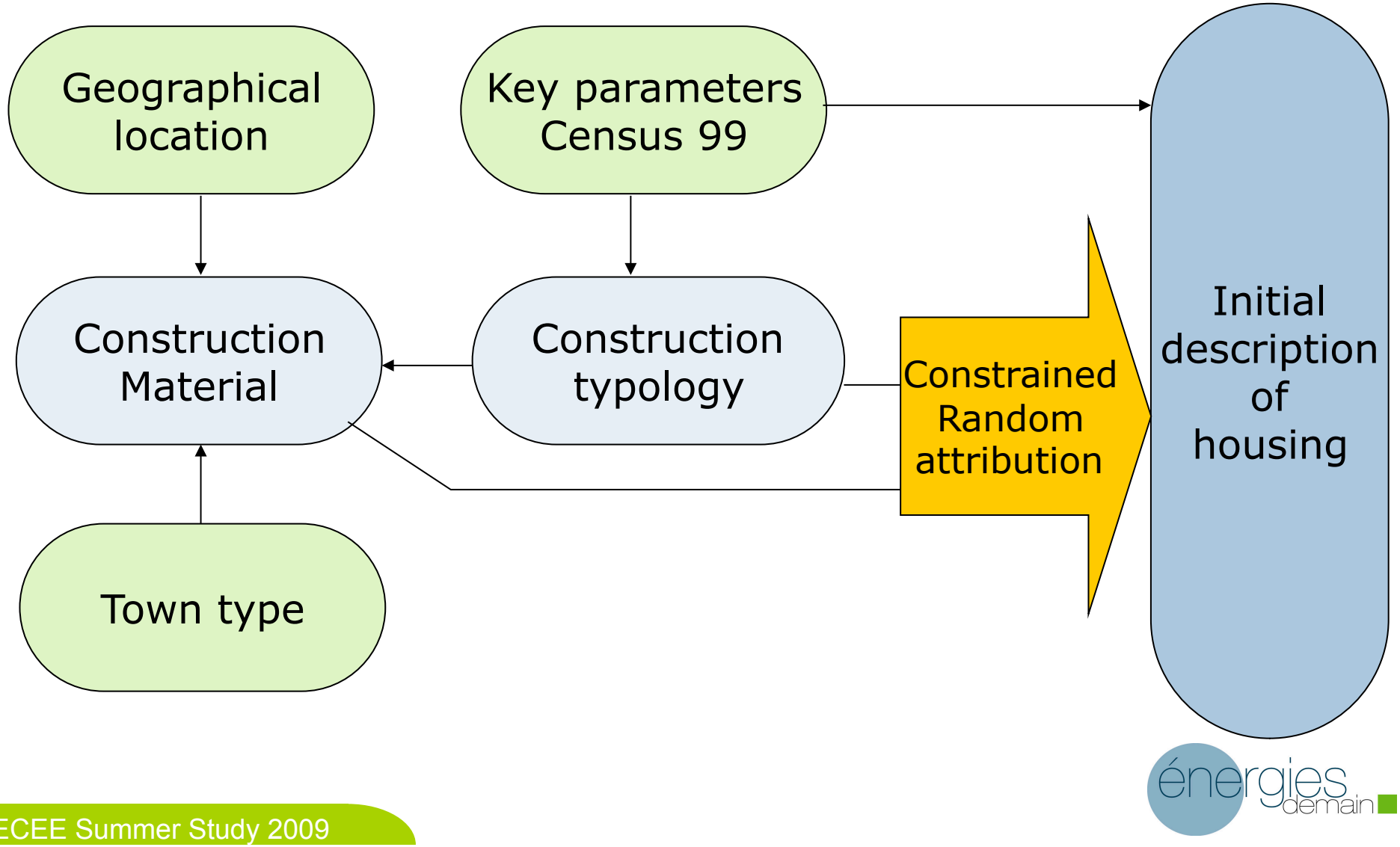
Energy savings	Regular rehabilitati on subsidy rate	Rehabilitati on cost for the housing occupant (regular subsidies allocati on)	Return on invest (yrs)	Opti mized rehabilitati on subsidy rate	Rehabilitati on cost for the housing occupant (opti mized subsidies allocati on)	Return on invest (yrs)	Goal (Nb. of houses)
<20%	42%	5 217 €	26	32%	6 117 €	31	15
20%	52%	5 470 €	8	52%	5 470 €	8	60
40%	57%	6 061 €	6	61%	5 411 €	5	32
60%	52%	8 808 €	7	59%	7 508 €	6	8

Conclusion

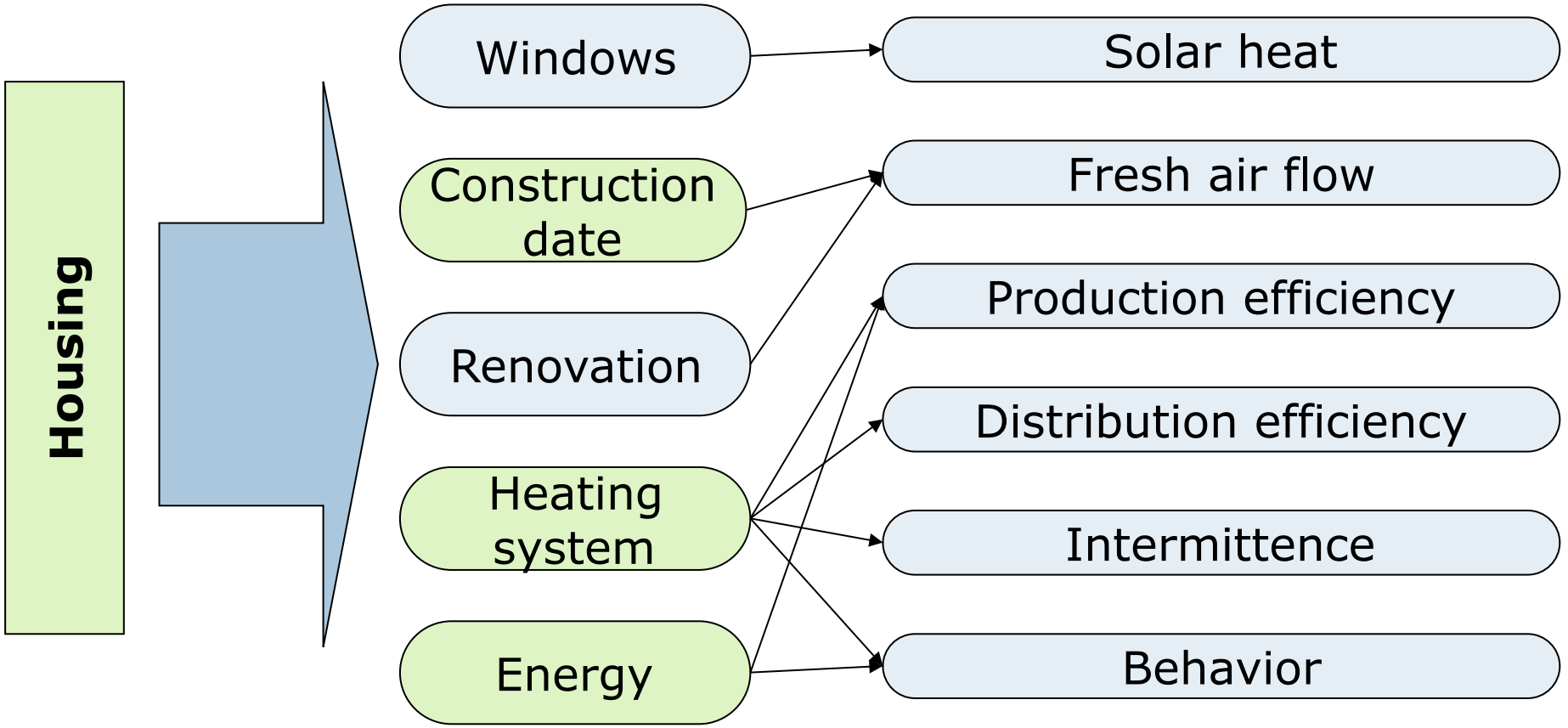
Propose a way to reach energy and GHG emissions goals from local to national scale…

- Target identification
- Prioritization (technical, economical, social issues)
- Program definition, taking account of the constraints
- Simulation of the program implementation
  - Cost
  - Impact (energy consumption, GHG emissions)

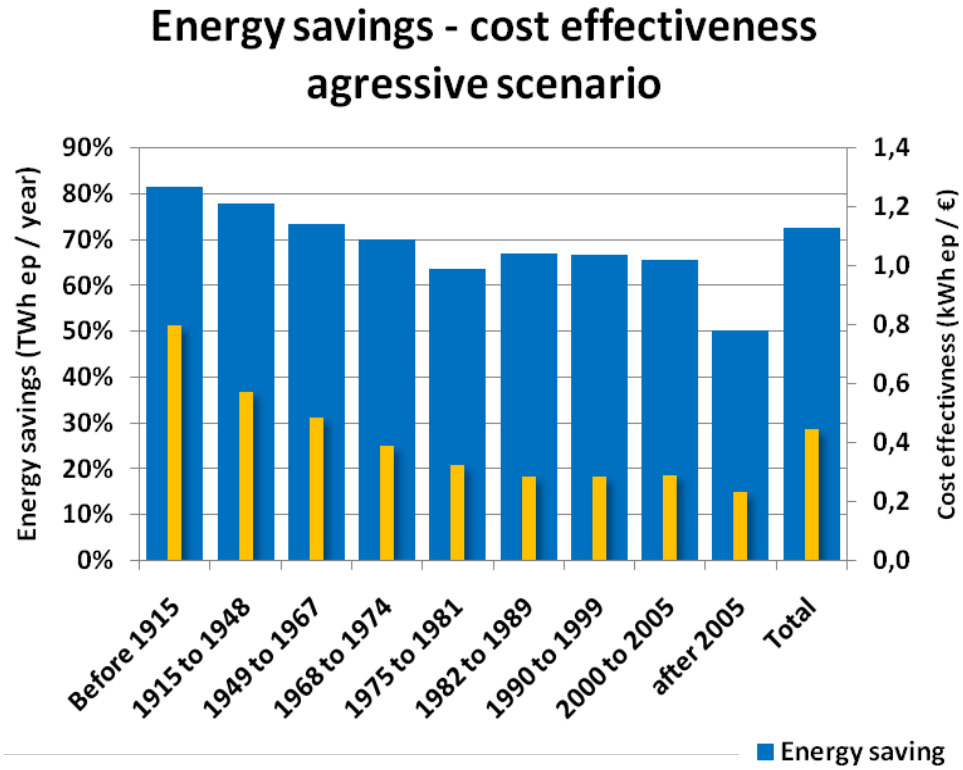
Attribution of construction material

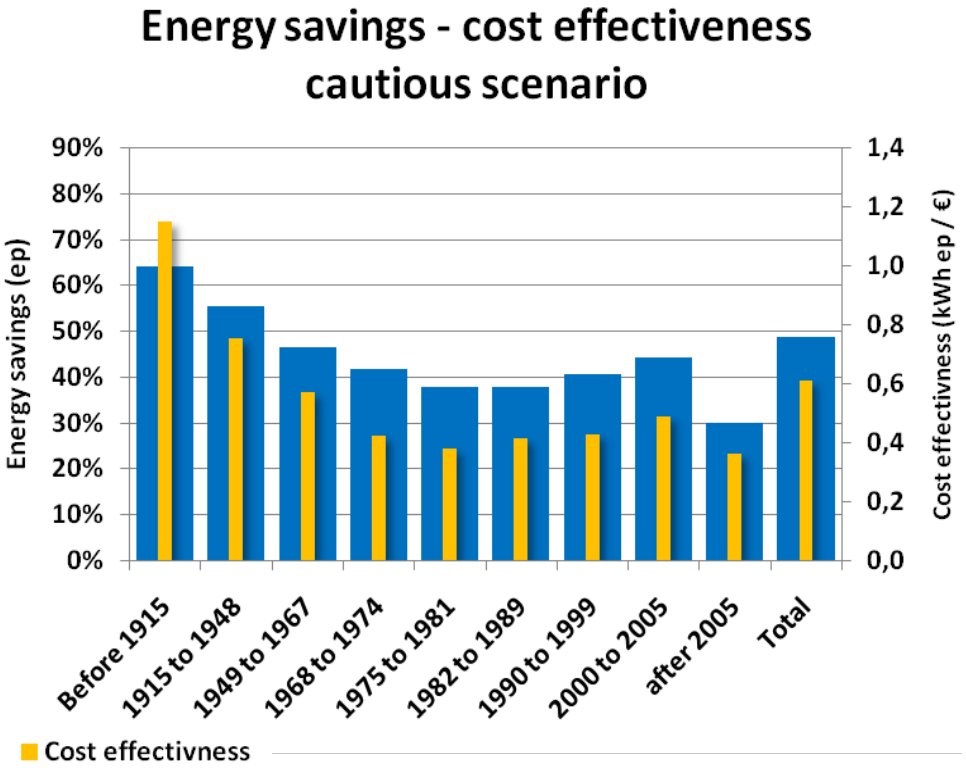


Heating system characteristics



Example of applications national scale





Aggressive scenario :

- 70 % of energy savings
- 0.45 kWh ep/€ i.e 900 billions € (± 15%)

Cautious scenario :

- 50 % of energy savings
- 0.6 kWh ep / € i.e 450 billions € (± 15%)

Example of applications national scale