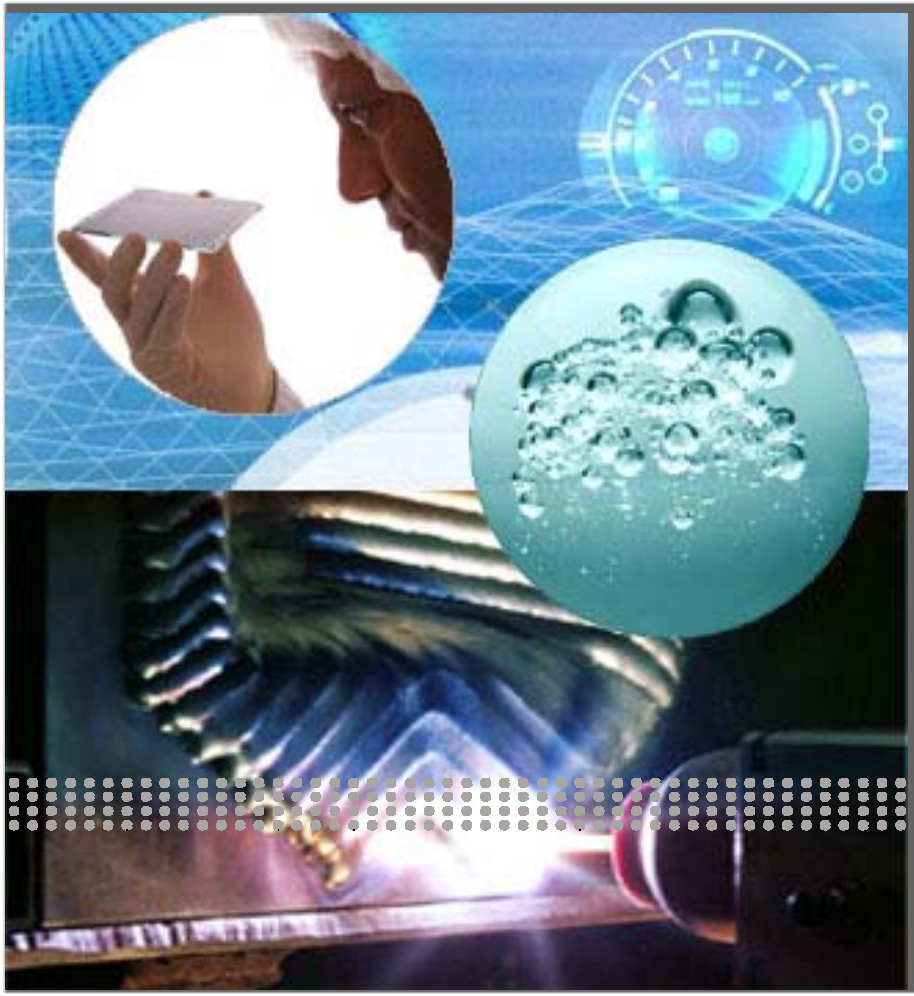

Buildings without any fossil energy in France in 2050 ?

(in Futuribles, July 2008)

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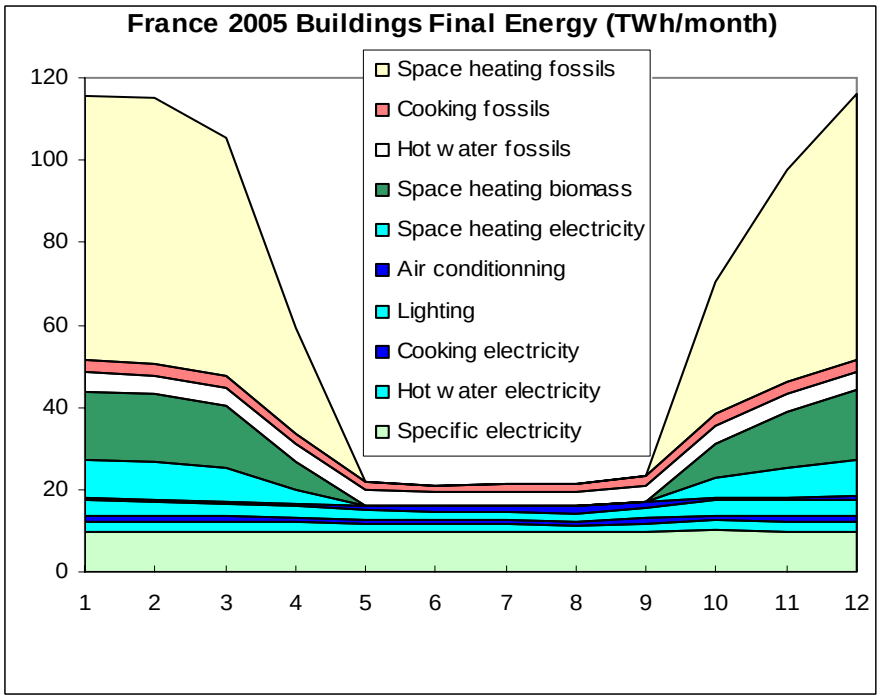
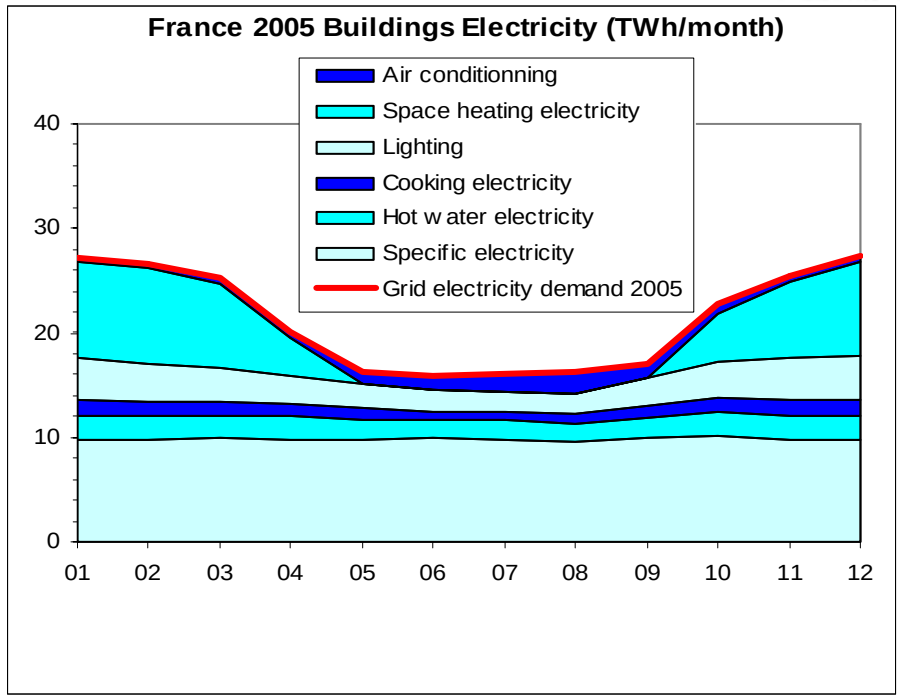
Today's buildings energy use in France is mainly for space heating, and is based on fossil energy

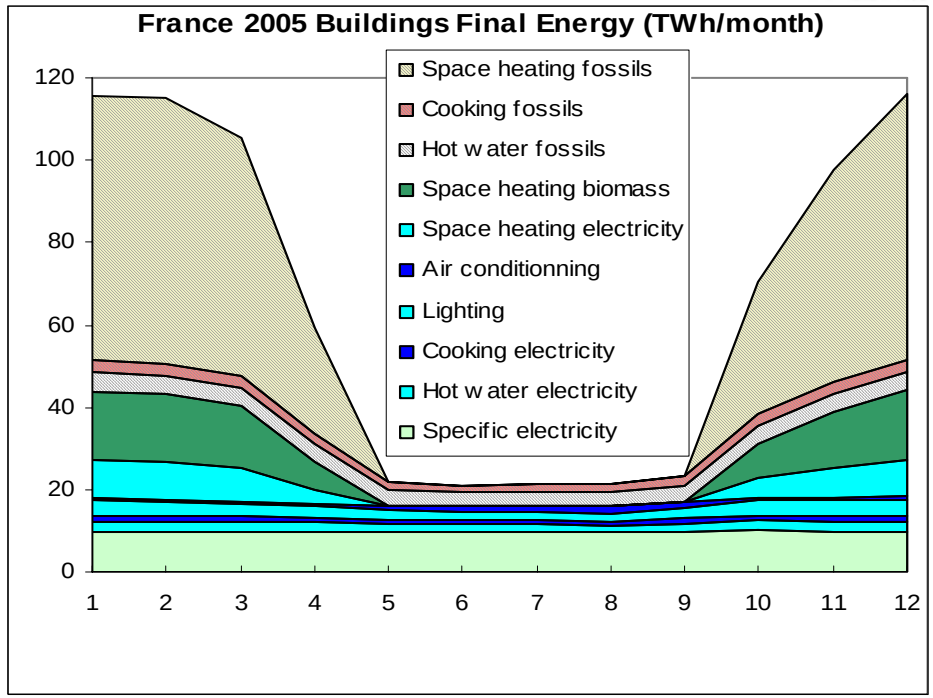




- In January, buildings energy use peaks to 117 TWh/month, mainly for space heating (91 TWh/month : 65 from fossils, 17 biomass and 9 electricity).
- During summer, energy demand falls to 21 TWh/month, mainly electricity (16 TWh).
- Today, 2/3 of the space heating electricity is carbon free, mainly because the nuclear plants scheduled maintenance stops are concentrated in summer.

Is it possible to avoid all buildings fossil energy use…
… in a realistic way ?

- Today's buildings fossil energy use is the shaded area opposite (55% of annual energy demand, 70% of autumn+winter energy demand)



- Avoid fossils may be feasible, but it has also to be as realistic as possible to make sense
- In our study, this means :

1. **Only available technologies are used**
2. **No major behavior changes are expected**
3. **No unrealistic estimate of the biomass availability for space heating**
4. **No massive transfer to electricity from space heating energy demand**

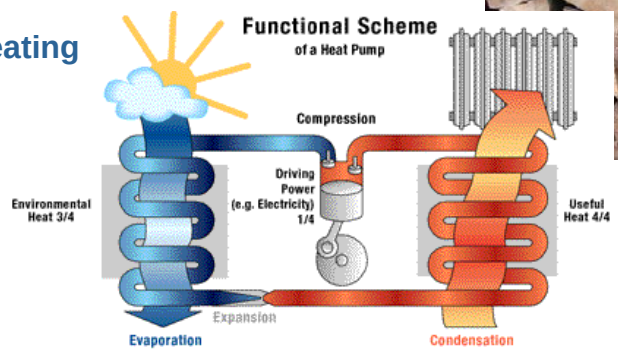
Our scenario relies on available technologies : Thermal insulation, Heat pumps, Biomass, and Solar .

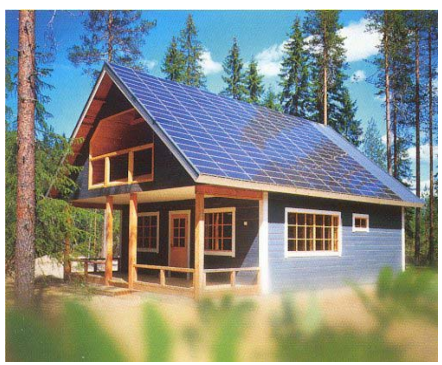
1 / Lower space heating needs through thermal insulation of existing buildings, and new construction standards.

- Space heating needs in 2050 for ante 2005 buildings :
  - **Residential retrofitting : minus 45% vs. 2005 (rebound effect included)**
  - **Services buildings retrofitting : minus 20% vs. 2005**
- Buildings construction energy standards from 2005 to 2050 :
  - **Residential : BBC (Low Energy Building), minus 30% vs. current standard**
  - **Services buildings : minus 15% vs. current standard**

2 / Use efficient space heating and hot water production systems, mainly heat pumps and biomass.

- Market shares for buildings space heating in 2050 :
  - **75% electricity, of which 90% are Heat Pumps**
  - **25% biomass, of which 60% are CHP district heating**
- Market shares for buildings hot water production in 2050 :
  - **80% electricity, of which 70% are Heat Pumps**
  - **20% biomass**





3 / Use solar energy as widely as realistic.

- **30% of buildings with half of hot water from solar**
- **25% of single family houses with 2 kWp PV**
- **75% of roofs of services buildings PV equipped**

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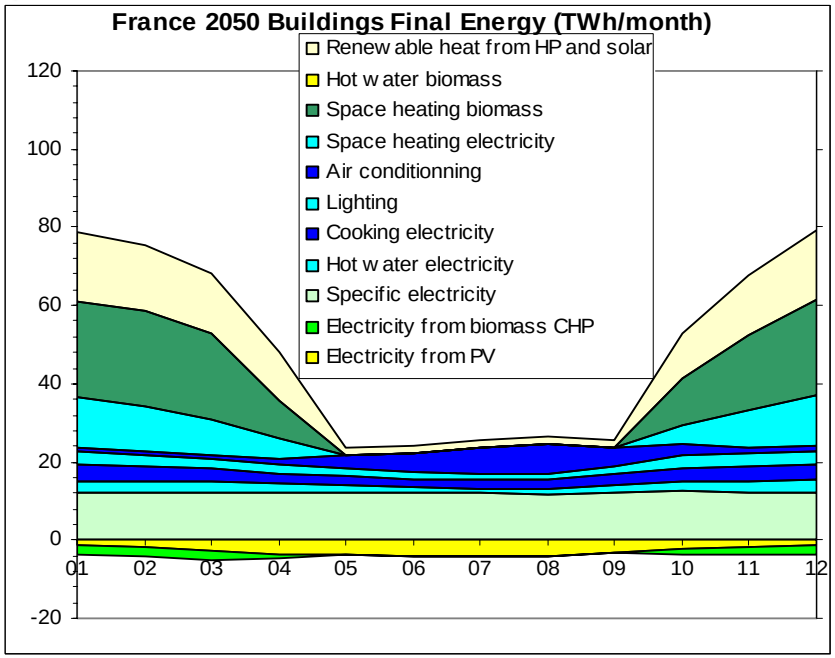
Energy efficient technologies dissemination allows fossil shift out with moderate growth of biomass and electricity

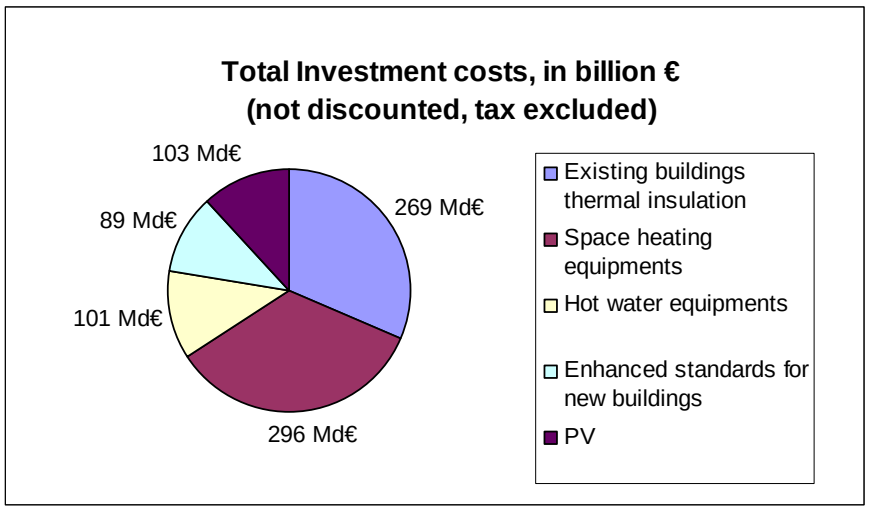


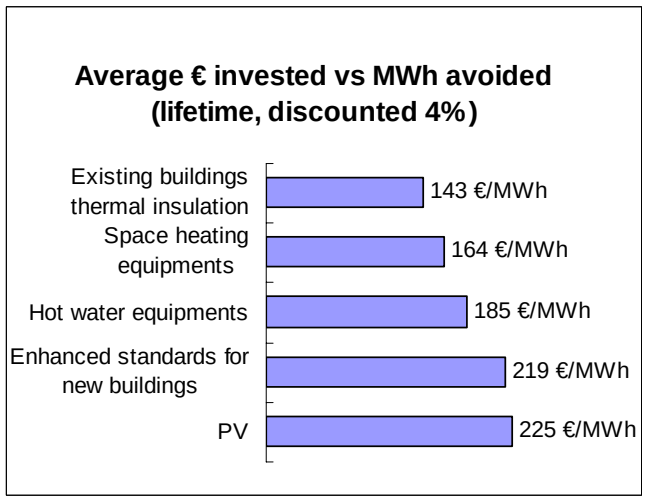
BUILDINGS (TWh final energy)	2005	cold seasons specific	2050	cold seasons specific
Space heating electricity	51	51	66	66
Renewable heat from heat pumps	5	5	92	92
Space heating biomass	94	94	136	136
Space heating fossils	360	360	0	0
Hot water electricity	25	4	28	13
Renewable hot water from heat pumps	0	0	17	8
Hot water biomass			11	3
Hot water solar	0		8	
Hot water fossils	49	8	0	0
Cooking electricity	15	4	36	11
Cooking fossils	29	9	0	0
Specific electricity	118		145	
Lighting	36	13	30	11
Air conditionning	12		37	
Total energy demand	**794**	**541**	**606**	**314**
Renewable heat vs demand	**13%**		**43%**	
Electricity from PV			33	
Electricity from biomass CHP			15	
Grid electricity demand	**256**	**65**	**294**	**82**

- Globally, in 2050 :
  - **Biomass use increases : + 45 TWh vs. 2005 (coherent with lowest availability estimates)**
  - **Grid electricity building demand increases : + 40 TWh vs. 2005, representing :**
    less than 15% growth vs. 2005,
    0,3% average annual growth rate from 2005 to 2050.
  - **Renewable energy is 43% of buildings final demand.**
  - **The “free of charge” renewable heat provided by heat pumps is around 100 TWh.**
  - **No more direct CO_2 emissions from the building sector (92 Mt in 2005 and 83 in 1990)**

End user's investment may probably be profitable… …but is far beyond his current effort on energy efficiency.

- Investment costs at current prices : **1 150 billion €$_{2005}$** coherent with other evaluations (ADEME, FFB).
- With conservative "learning curve" cost reductions, investment is lowered to : **860 billion €$_{2005}$**





- €/MWh above ratios try to take into account real performance (thermal bridges…) and rebound effects. Ratios on thermal insulation are based on heat losses reduction, and not final (metered) energy reduction.
- Profitability : if oil price is high and steady around **150 $$_{2005}$/bl**, otherwise subsidies will be needed.
- For the residential sector, the needed investment is 3 times the current (2002…) investment dedicated to energy efficiency in houses : **financial incentives will be required**.
- Current global activity of the buildings construction and maintenance sector is adequate. Structure of this activity has to change : less windows and boilers, more thermal insulation, heat pumps and solar systems.

Some remaining questions… and a conclusion : Heat pumps may play a key role in 2050 French buildings

- At least two remaining technical open questions :
  - **How will the electricity generating system feed this demand ?**
    - The 2050's load curve is close than today's… looking at monthly averages.
    - But Hazards will be different :
      - ✓ 33 TWh of decentralized PV weather dependant add uncertainties on demand
      - ✓ Heat pumps performance decreases on very cold external temperatures, so weather hazards may have a different impact on electricity demand than resistance heating – is it significant ?
      - ✓ On the supply side, 30 to 50 TWh from windmills will also add hazards
    - Demand response and energy storage will probably play a growing role
  - **How climate change may modify demand and hazards ?**

- Buildings without any fossil energy in France in 2050 ?
  - **In a mild climate country like France, with some biomass availability, a realistic dissemination of existing thermal insulation, heat pumps, biomass and solar technologies, allow to shift out direct fossil energy use in buildings.**
  - **Investment costs, as roughly evaluated, are high, so profitability cannot be guaranteed in any case for the end user. However, a focus of the retrofitting actions on the oldest buildings, and R&D on equipments, may improve significantly the global profitability and affordability of the investments.**
  - **The "burden transfer" to the electric supply system seems manageable. Investigations are needed to evaluate extra costs.**

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