Towards energy independence & low CO_2

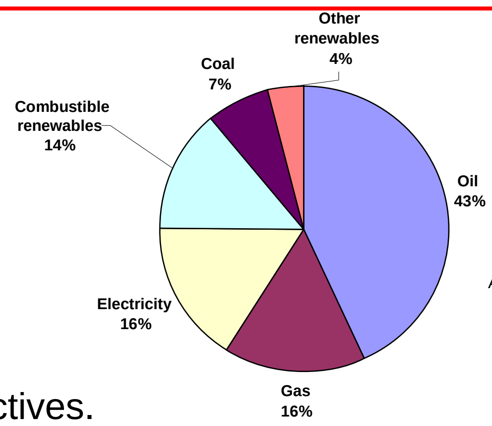
HTR for industrial process heat, synthetic fuels & hydrogen

Beyond the grid

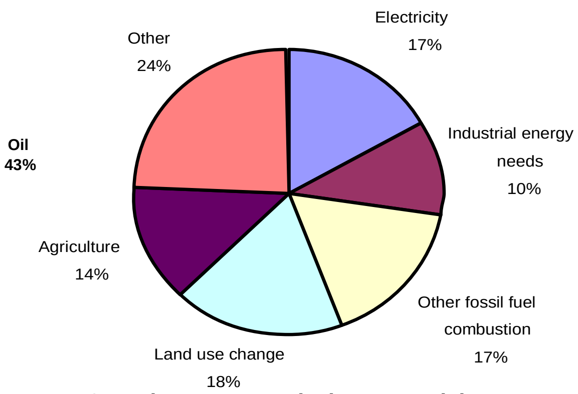
- Most of the final energy consumption in the world is not electricity consumption, but direct use of the energy produced by fossil fuel combustion.

⇒Electricity is also only responsible for a small part of the greenhouse gas emissions.

⇒Increasing the nuclear share in the electricity market will only contribute in a limited way to SET Plan objectives.



Final energy consumption, worldwide (AIE, 2006)



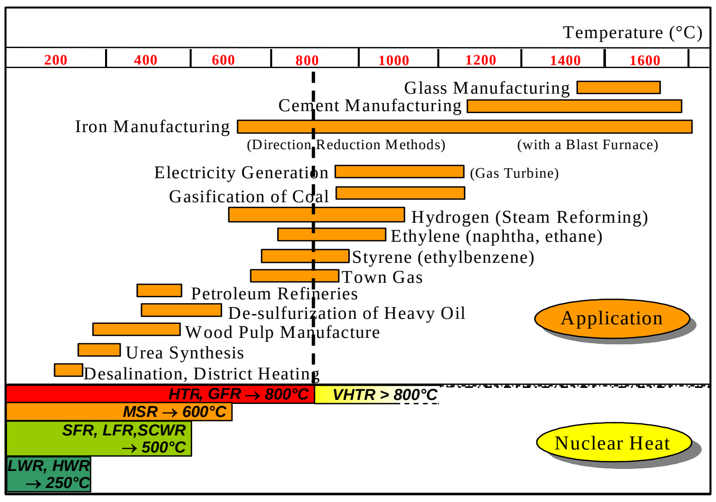
Greenhouse gas emission per activity sector (World Resources Institute 2005)

⇒To contribute significantly to SET Plan objectives, nuclear should also address the huge non-electricity energy market

- Nuclear energy can substitute for fossil fuel only for heat intensive uses: **industrial process heat applications**
- In particular nuclear systems can provide heat for CO_2 lean production of **synthetic fuels** and **hydrogen**

HTR, relevant to address industrial process heat needs

- **High operating temperature**: with flexible **cogeneration** plants, HTR can supply electricity and heat (up to 800°C with present materials and fuel technologies) to a wide range of industrial applications.



- **Modularity**: the small size of modular HTR (a few hundred MW) allows **flexibility** for very versatile industrial needs with high availability and reliability
- **Short term deployment is needed**: **SET-Plan requires curbing CO_2 emissions as soon as possible**. Due to its industrial maturity, HTR can bring an <u>industrial</u> contribution within less than 2 decades.

A fast track for industrial deployment

- Operating a nuclear reactor as an industrial heat source is the first challenge to face. Very high temperature might follow only in the longer term.
- **Large scale demonstration of HTR coupling** with process heat applications needed for market breakthrough. Based on past experience and present developments, the demonstrator could start by ~ 2020.
- The first commercial plant can follow within a few years, as no up-scaling is required for modular design.
- HTR-TN proposes to launch a first step of this demonstration in FP7:
  - → Initiating **partnership with non-nuclear industries** in the EUROPAIRS project, proposed with partners from steel industry (ARCELORMITTAL), oil engineering (SAIPEM, PROCHEM, TECHNIP KTI) and chemical industry (DSM).
  - → Developing jointly with end-users the pre-conceptual design of a HTR coupled with industrial processes.
  - → Performing required technology developments
    - ❑ Continuation of HTR R&D
    - ❑ Adaptation of application processes and development of coupling technologies.
  - → Developing a frame for a future demonstrator (funding, partnership, international cooperation…)

HTR, part of the sustainable low carbon future

HTR can contribute to a better management of fissile resources and of nuclear wastes

- Cogeneration allows multiplying by a factor of nearly 3 the useful energy extracted from the same fissile content
- HTR fuel can be reprocessed and is therefore compatible with closed fuel cycle: a specific head-end based on technologies used for recycling scraps of fuel fabrication is needed, followed by standard PUREX process.

⇒ Operated in symbiosis with FBRs, HTRs can be included as well as LWRs in a sustainable U-Pu fuel cycle.

- With HTR, thermal breeding is possible with Th. Th-^{233}U cycle produces 7 times less actinides than U-Pu cycle.
- The management of irradiated graphite (including recycling) is addressed in the CARBOWASTE project (FP7).