

---

# How Realistic Are the 4th Generation NPPs and Fusion as Electricity Producers Before 2050

Harri Tuomisto  
Fortum, Finland

SAFIR2014 Interim Seminar, 21-22 March 2013, Hanasaari

## **Fission Reactors Beyond the Current Mainstream of Gen II/Gen III/Gen III+ Light Water Reactors**

- Six Gen IV reactor concepts defined in GIF (Generation-4 International Forum)
  - Pay attention to those concepts that are currently being pursued in European projects: sodium cooled, lead cooled and gas cooled fast systems
  - Molten salt reactors present an interesting approach to make a nuclear reactor in the similar way as chemical reactors are normally done
- Small Modular Reactors (SMR)
  - Increasing interest as a consequence of the financial crisis
  - Various technologies proposed; in USA, DOE funding available (based in LWR)
- HTR (High-Temperature Gas Cooled Reactors)
  - currently under construction e.g. in China
  - Interesting prospects for non-electricity nuclear energy: process heat, hydrogen

# Fusion Reactors for Power Production

---

- Mainstream: technology development for magnetic confinement DT fusion
  - Slow progress with the main focus in large Tokamaks
  - ITER (experimental reactor) to operate with DT plasma: late 2020's
  - DEMO: design to be completed in 2030's, DT operation in 2040's
- Inertial Confinement Fusion
  - pulsed implosion operation, DT
  - technology to simulate thermonuclear explosions, hardly for power production
- Examples of other technologies (searching shortcut to energy production)
  - magnetized target fusion: combining magnetic and inertial confinement
  - Tri Alpha: combining magnetic confinement and collisions ( $B^{11} + H^1$ ); aneutronic
  - private investors have found these attractive for funding

# Realistic before 2050

---

Gen III+ / ++ will be built still beyond 2050's

Realistic fission sources beyond the current mainstream:

- Sodium cooled fast breeders will be built
- SMR will be built (economy means: in large numbers)
- HTRs will be built for electricity, hydrogen and process heat production
- Lead cooled systems might be there: ADS and/or fast systems
- Thorium fuel cycles developed and implemented

Fusion reactors

- Magnetic confinement fusion technology development will be completed for power production
- Meaningful power production will start beyond 2050's