Outline

- What we are trying to achieve in fusion research
- Objectives, activities and funding in FP7
- Organisation of the European fusion programme
- ITER and Broader Approach Activities
- Contact information
Fusion as a potential energy source

- **Fuels**
  - abundant and distributed world-wide

- **Safety, waste, the environment**
  - no transport of radioactive fuel for normal operation, no meltdown accidents
  - waste not a burden for future generations (less than 100 years radiotoxicity)
  - no CO₂ emissions

- **Scale**
  - potential for the production of baseload electricity (and hydrogen)

- **Economics and social acceptability**
  - difficult to make long term predictions, but studies show promising results
The European Fusion Programme

- The programme has a well defined long term objective: the joint realisation of prototype fusion power plants
- This orientation is an essential motivation for supporting a programme of this size
- Programme is fully integrated at the European Level, with a strong international dimension
  - overall co-ordination
  - extensive collaborations
  - large joint projects

→ Fusion has a unique character in all the research supported by the EU Framework Programmes
The objectives of fusion research in FP7

- Building on the achievements of previous FPs, and maintaining the same overall direction:

“Developing the knowledge base for, and realising ITER as the major step towards, the creation of prototype reactors for power stations which are safe, sustainable, environmentally responsible, and economically viable”

(Council Decision on Euratom-FP7)
Areas of activity in FP7

- The realisation of ITER
- R&D in preparation of ITER operation
- Technology activities in preparation of a demonstration fusion reactor (DEMO)
- R&D activities for the longer term
- Human resources, education and training
- Support actions
Funding for fusion in FP7

- The Euratom Framework Programme is limited by the Euratom Treaty to a duration of 5 years.
- Euratom FP7 runs from 2007 to 2011, with an extension foreseen for the period 2012-2013.
- The fusion budget for 2007-2011 is €1,947 million.
  - of which at least €900 million will be reserved to activities other than the construction of ITER.
The Fusion Associations

- The Framework Programme supports fusion R&D in the Member States and Switzerland through bilateral Contracts of Association between Euratom and research organisations

- The Associates:
  - carry out a focused physics and technology programme for consolidation of ITER project choices and in preparation for a rapid start-up of ITER operation
  - carry out longer term fusion R&D, developing competences and enlarging the knowledge base in strategically relevant fields
  - participate in procurements for ITER under contracts from the Joint Undertaking
JET and the Fusion Associations

Countries participating in the European Fusion Programme

- Euratom - CEA (1958) France
- Euratom – ENEA (1960) Italy (incl. Malta)
- Euratom - IPP (1961) Germany
- Euratom - FOM (1962) The Netherlands
- Euratom - FZJ (1962) Germany
- Euratom - Belgian State (1969) Belgium
- Euratom - RISØ (1973) Denmark
- Euratom – UKAEA (1973) United Kingdom
- Euratom - VR (1976) Sweden
- Euratom - Conf. Suisse (1979) Switzerland
- Euratom - FZK (1982) Germany
- Euratom – CIEMAT (1986) Spain
- Euratom – IST (1990) Portugal
- Euratom - DCU (1996) Ireland
- Euratom - ÖAW (1996) Austria
- Euratom – MEdC (1999) Romania
- Euratom - IPPLM (2005) Poland
- Euratom - MHEST (2005) Slovenia
- Euratom – CU (2007) Slovakia
- Euratom – LEI (2007) Lithuania
EFDA is a multi-lateral agreement between Euratom and all the fusion Associates

Its tasks are:

- coordination of the collective scientific exploitation of JET by the Associations
- co-ordination of activities of the Associations for research, and for the development and exploitation of common tools or facilities/devices
- training of researchers, promoting links to universities and carrying out support actions for the benefit of the fusion programme
- A framework for coordinating European contributions to international collaborations other than ITER
Other areas of activity

- **The Fusion Mobility Agreement**
  - Supports mobility of researchers to enhance collaboration and integration, and to foster international co-operation

- **Fellowships and Training**
  - High-level training at post-graduate and post-doctoral level of engineers and researchers, supported through call(s) for proposals or included in the EFDA activities.

- **Coordination and Support Actions**
  - **Fusion education**: supporting cooperation between research and higher education institutions in fusion physics and engineering, aimed at enhanced qualifications
  - **Materials research**: bringing together a range of organisations for cross-field materials activities
  - **Atomic data & modelling in support of fusion plasma modelling and diagnostics**
ITER - Overview

- ITER is the essential next step to demonstrate the scientific and technical feasibility of fusion power.
- A joint international project with 7 partners hosted by Europe (in Cadarache, F): China, EU, India, Japan, South Korea, Russia, USA.
- The International Agreement has been signed on 21 November 2006:
  - An international organisation is being established.
  - Procurement of components will begin this year.
- The EU has a special responsibility as the ITER host, and a leading role.
The aims of ITER

- Produce and study burning plasmas at energy multiplication factor of 10 for about 400 sec
- Aim at producing steady-state burning plasma
- Demonstrate the availability and integration of essential fusion reactor technologies
- Test components for a future reactor including tritium breeding module concepts
The project will be jointly implemented through an International Organisation established by the 7 Parties, based on an International Agreement.

The ITER Organisation will have legal personality and be governed by international law.

The ITER Organisation will have its own procurement rules, financial rules, etc.

The project duration is 35 years, with the possibility of an extension for up to 10 years.
ITER Organisation (II)

- Provisional application of Agreement as of its signature on 21 November 2006.
- The cost is about € 5 billion for construction (over 10 years) and € 5 billion for operation and decommissioning (over 25 years)
- The EU share is about 45% of construction costs and 34% of operation costs
- Contributions by the Partners will be mostly in-kind (90%) through their Domestic Agencies
ITER components to be provided by Europe

- Toroidal Field Coil
  Nb₃Sn, 18 coils
- Vacuum Vessel
  9 sectors
- Central Solenoid
  Nb₃Sn, 6 modules
- Blanket Module
  421 modules
- Additional Heating
  IC, EC, NBI
- Inner Divertor
  54 cassettes
- Diagnostics +
- Remote Handling
- Tritium Plant
- Pumping/Fuelling
- Power Supplies…
The European Joint Undertaking for ITER and the Development of Fusion Energy (I)

- **The European Domestic Agency for ITER, located in Barcelona (Spain)**
  - established as a Joint Undertaking under the Euratom Treaty, largely financed through the Framework Programme

- **It will provide the contribution of EURATOM to the ITER Organisation**
  - In-kind contribution: it will be responsible for the placement and execution of contracts for the components to be delivered to ITER
  - Personnel: it will be responsible for providing personnel to the ITER Organisation
The European Joint Undertaking for ITER and the Development of Fusion Energy (II)

- *It is a legal entity with its own legal personality, financial regulations and procurement system, which can operate flexibly and respond rapidly*

- It will also provide the contribution of EURATOM to Broader Approach Activities with Japan

- It will implement a programme of long term R&D activities in preparation for a future demonstration fusion reactor (DEMO)
Broader Approach Activities

- European contributions to “Broader Approach” projects with Japan:
  - design of a materials test facility (IFMIF)
  - superconducting upgrade of the JT-60U tokamak
  - International Fusion Energy Research Centre

- These projects complement the construction of ITER, following a “fast track” approach to commercial fusion energy

- These projects are financed with voluntary contributions from some Member States and Switzerland, as for ITER, mostly in kind
R&D in support of ITER and the longer term aims

- **R&D in preparation of ITER operation**
  A focussed physics and technology programme: assess key ITER technologies, consolidate ITER project choices, prepare for ITER operation, ...

- **Technology activities in preparation of DEMO**
  Fusion materials and key technologies, preparation for IFMIF, irradiation testing, studies of DEMO concept, design, safety, ...

- **R&D activities for the longer term**
  Further developments of improved concepts, theory, modeling

- **Human resources, education and training**
  Ensuring that adequate human resources will be available
Contacts for more information

Fusion Associations
- For a complete list, with links to web sites, see the links page in the fusion section of:
  http://ec.europa.eu/research/energy/index_en.htm

EFDA
- The EFDA Leader, Dr Jerôme Pamela, efda-leader@efda.org,
  The EFDA web site: www.efda.org

The Joint Undertaking
  or email to the head of Unit J6 in DG RTD, Mr Stavros Chatzipanagiotou
  Stavros.Chatzipanagiotou@ec.europa.eu

ITER
- www.iter.org
Conclusion

Fusion has the potential to make a major contribution to the realisation of a sustainable and secure energy supply in a few decades from now, thus helping address the key challenges facing the EU economy as a whole.