IAEA 60 Years
Atoms for Peace and Development

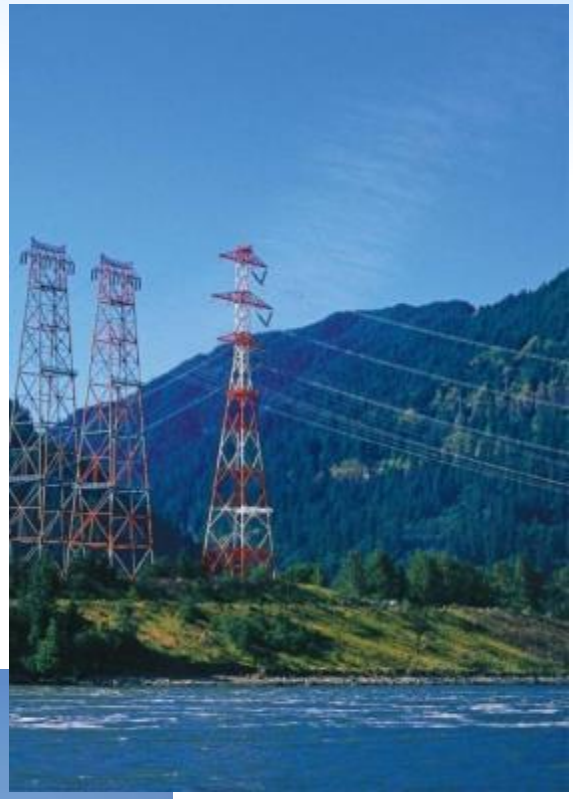
# IAEA and ADS

*Stefano Monti* – Section Head
Nuclear Power Technology Development
Department of Nuclear Energy
International Atomic Energy Agency

EuCARD$^2$ – Status of Accelerator Driven Systems
Research and Technology Development
7-9 February 2017

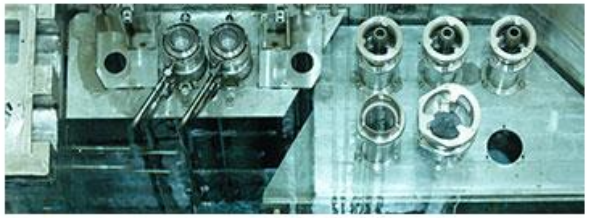
# IAEA Statute

"…accelerate & enlarge contribution of atomic energy to peace, health and prosperity…"



# IAEA: Main work areas

Nuclear Technology & Applications



Nuclear Safety & Security

Safeguards & Verification

**Nuclear Energy**

**Nuclear Safety & Security**

**Safeguards**

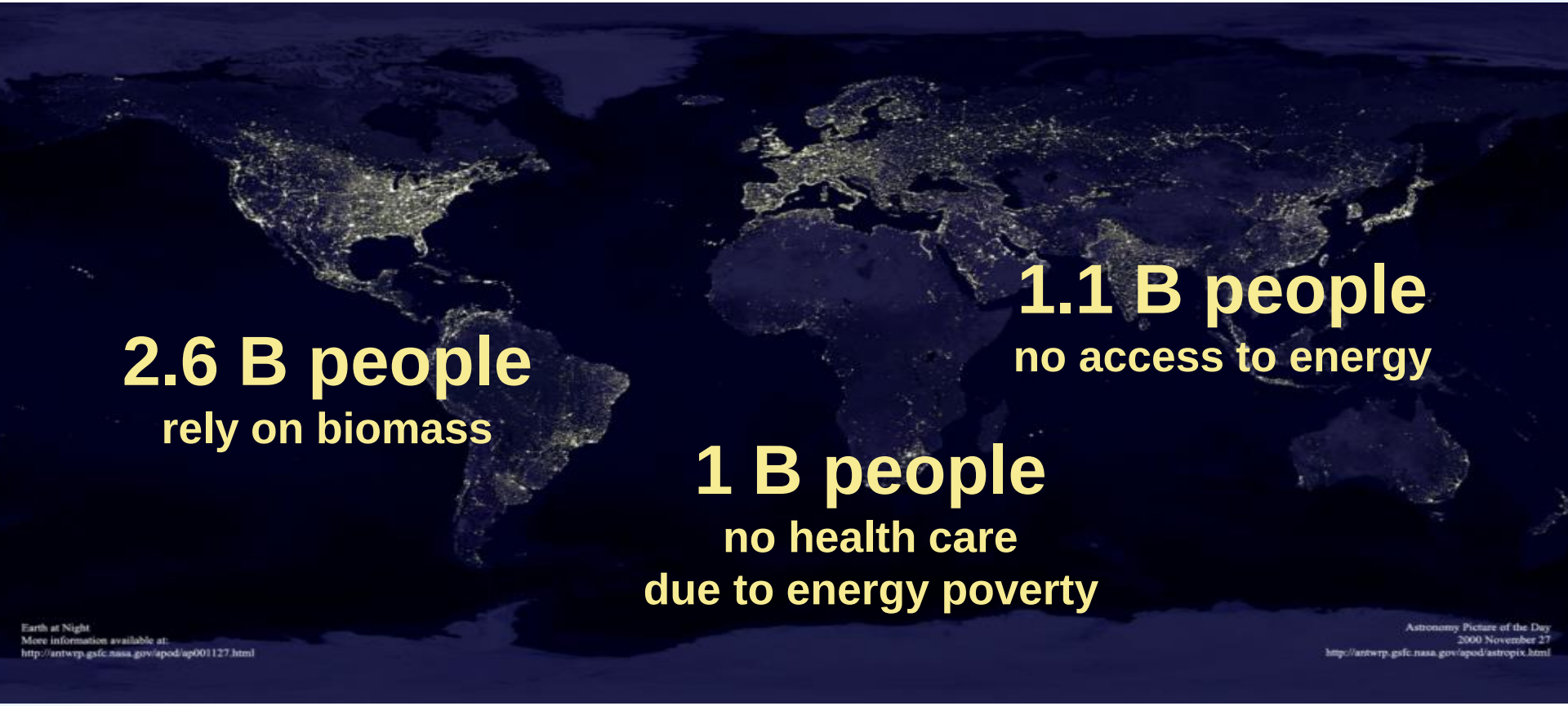
**Nuclear Sciences & Applications**

**Technical Cooperation**

# IAEA & SDGs

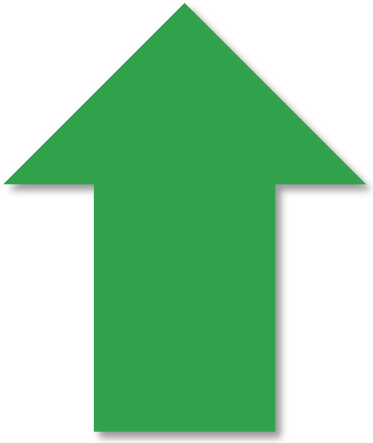

1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

# Energy 2016


2.6 B people
rely on biomass
1.1 B people
no access to energy
1 B people
no health care
due to energy poverty
Earth at Night
More information available at:
http://antwrp.gsfc.nasa.gov/apod/ap001127.html
Astronomy Picture of the Day
2000 November 27
http://antwrp.gsfc.nasa.gov/apod/astropix.html

# Energy challenge





**Population**

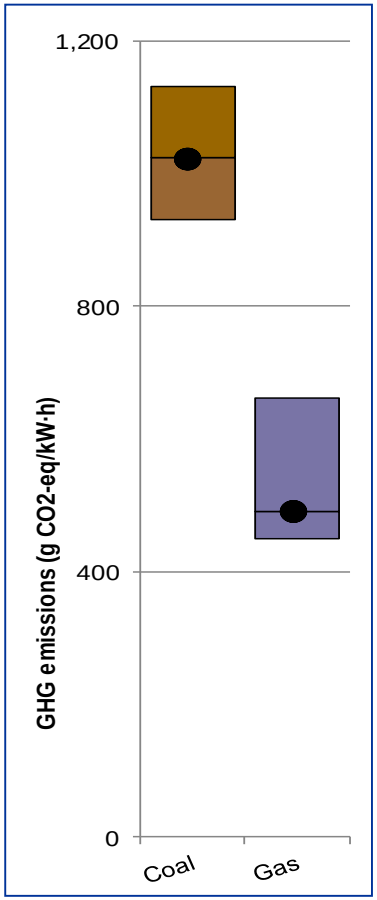
**Energy demand**

**Energy security**

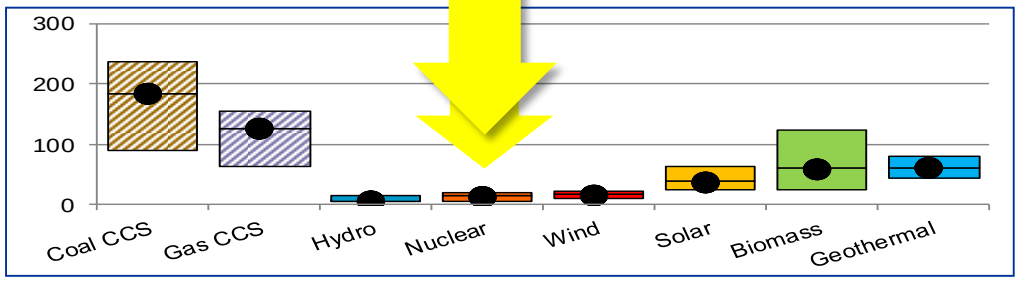
**Environment**

**Climate change**

# Nuclear power is a low-carbon energy source




## Life cycle GHG emissions from electricity generation




● Median value ▯ Interquartile range

# NP Reactors

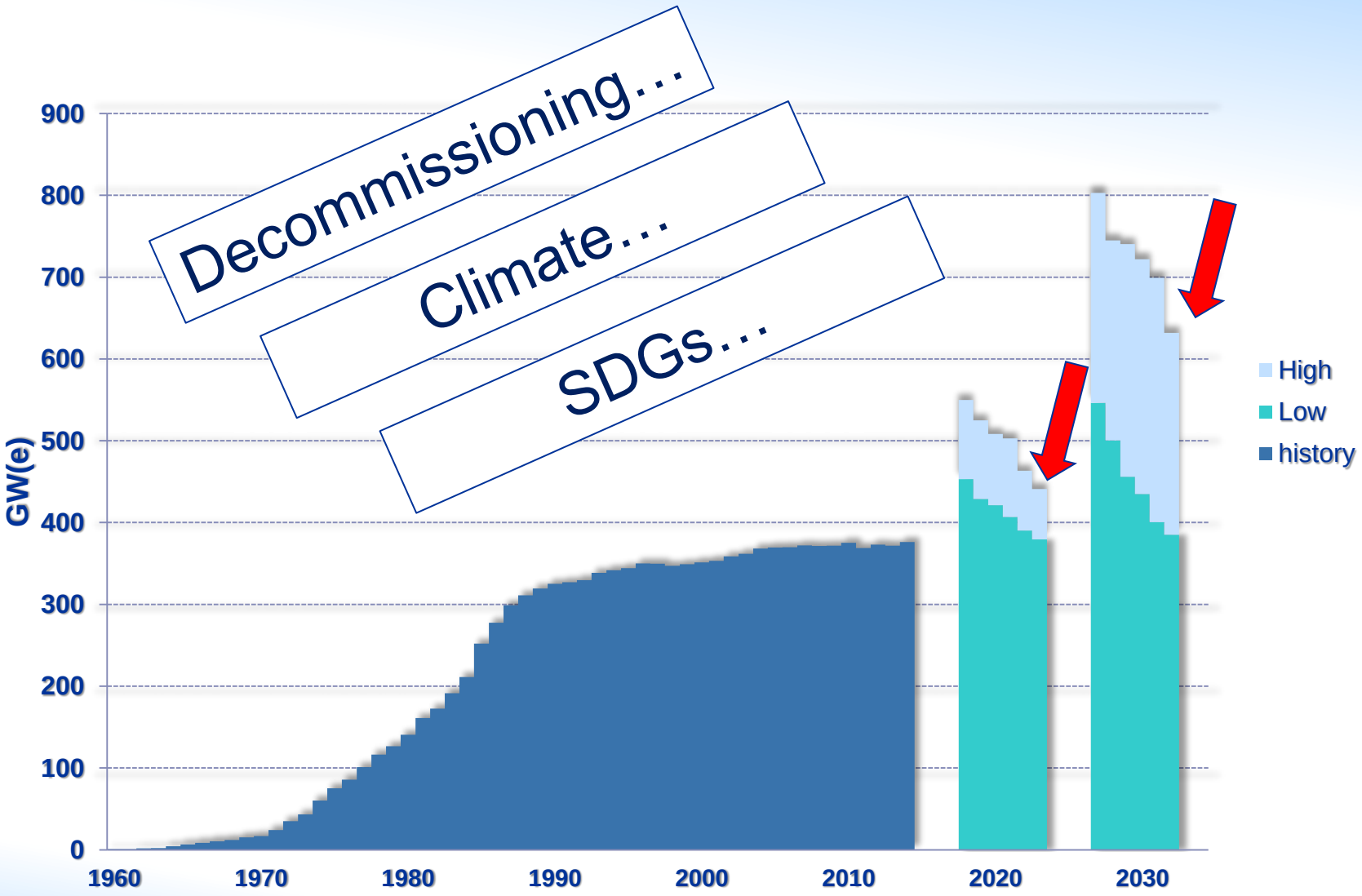
**(as of 30 January 2017)**

## 449 in operation

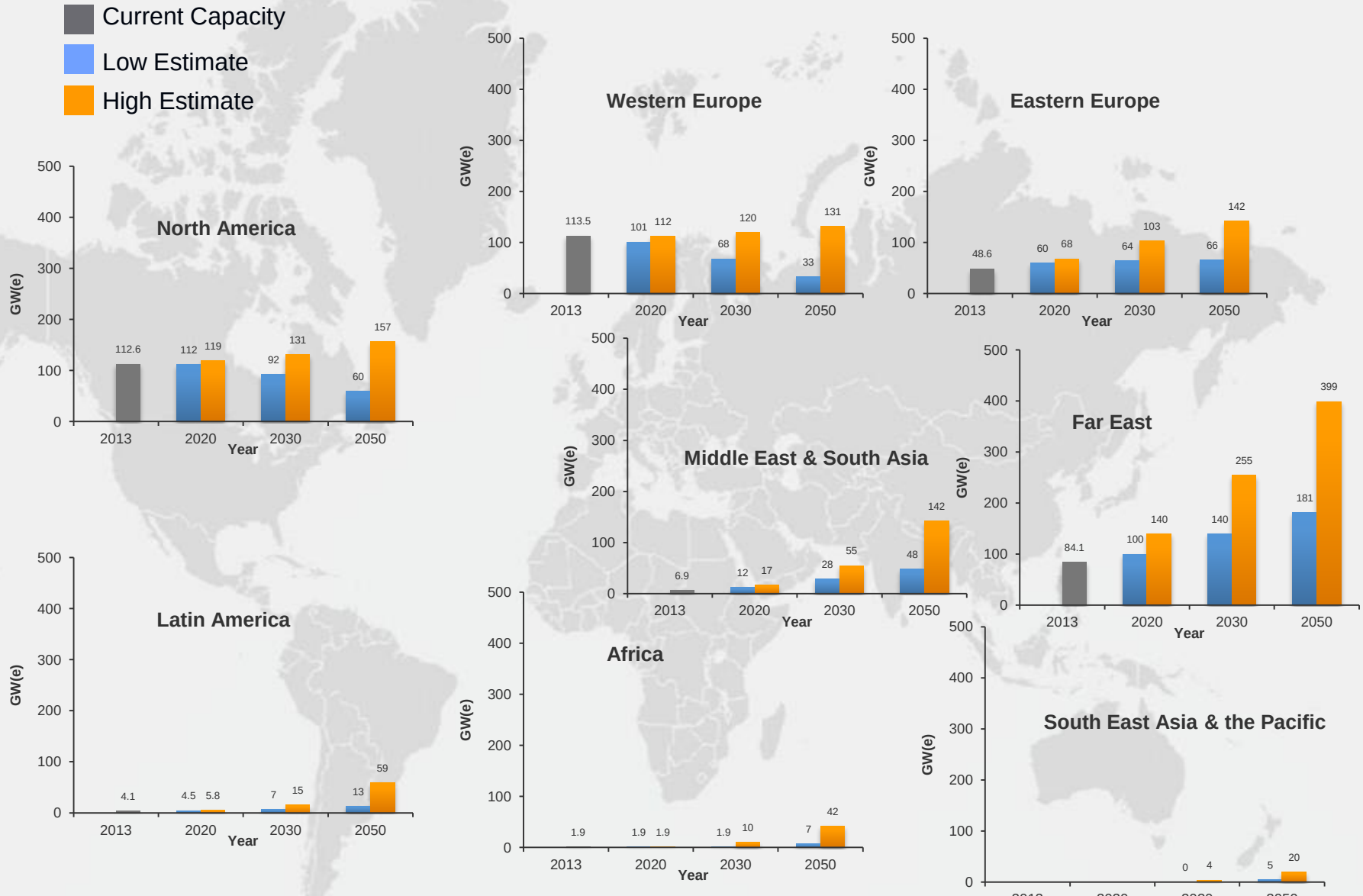
## 392 GW(e) Capacity

## 60 under construction (2/3 in Asia)

# 2030 Projections

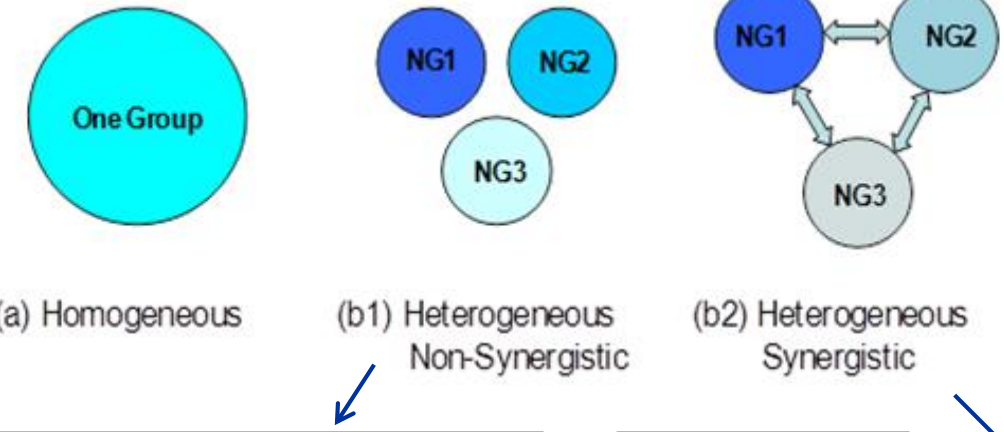


# NP Development in Different Regions



# International Project on Innovative Nuclear Reactors and Fuel Cycles "*Global Scenarios*": Heterogeneous world model introduced in GAINS

## CP on SYNERGIES and ROADMAPS

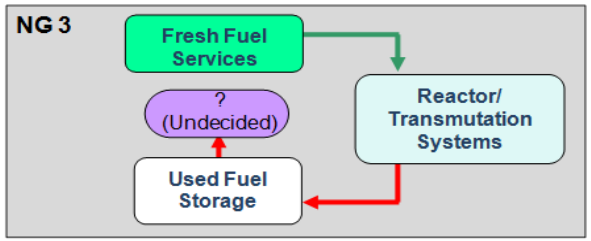


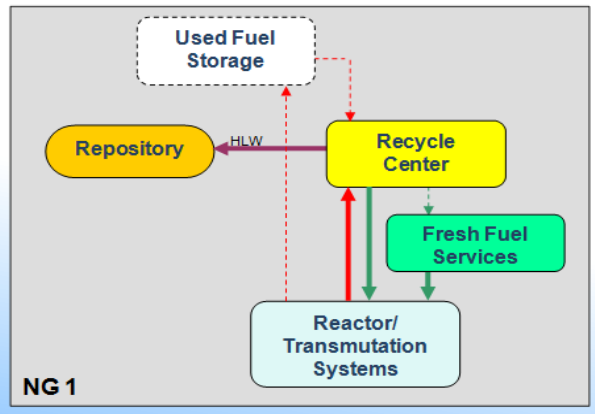

Non-personified, non-geographical groups of countries with different policies regarding the fuel cycle back end:

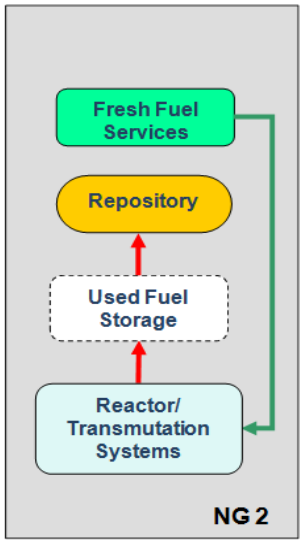
**NG1**-recycling strategy;

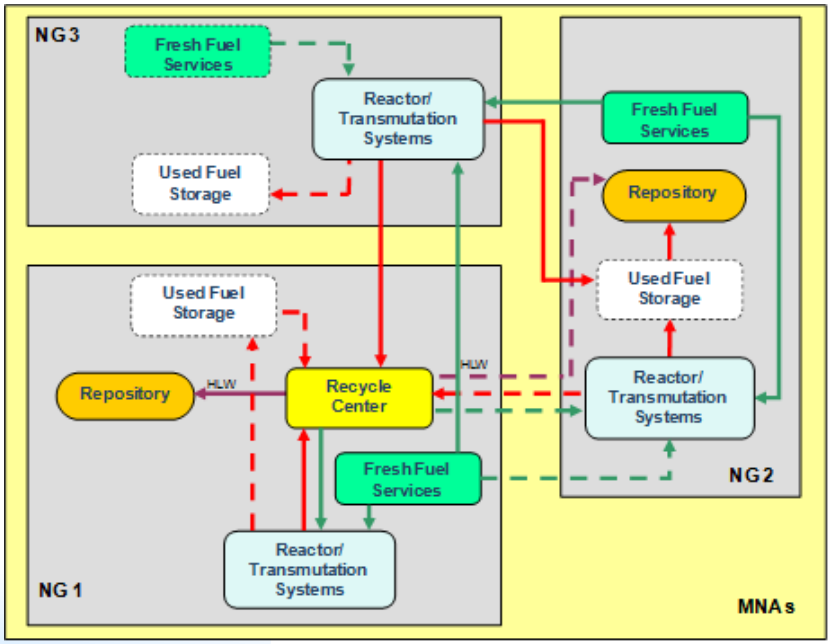
**NG2-**direct disposal/reprocessing abroad strategy

**NG3**- looking for minimal NFC infrastructure: disposal or reprocessing abroad



# Advanced Technologies

- ARIS Database
- Reactor Technology Assessment Methodology
- Non-electric applications


# Technical Working Groups related to P&T and FNS:

Group of experts from MSs that advises the IAEA on the definition and implementation of programmatic activities

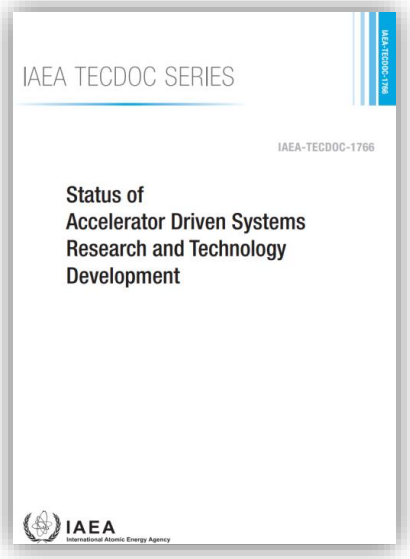
- **TWG-NFCO:** focuses on nuclear fuel cycle options: innovative fuel cycles and nuclear materials management
- **TWG-FR:** fast spectrum systems, both critical and subcritical, for energy production and transmutation of long-lived radionuclides

**Vienna, April 2016**

**Buenos Aires, May 2016**

# TECDOC: Status of the Accelerator Driven Systems Research and Technology Development

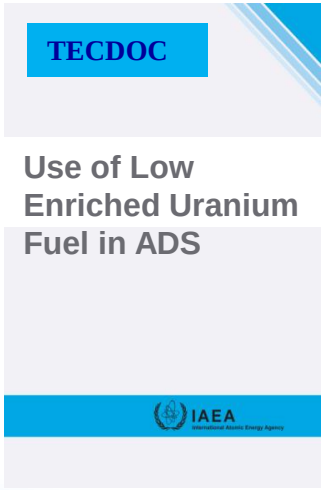
- Update of the IAEA-TECDOC-985 published in 1998
- Content of the document:
  - Description of the different ADS concepts under development
  - State of the art of research and technological development
  - National and international programmes and projects
- 350 pages document, with 100 contributors.
- Published in 2015 and available online

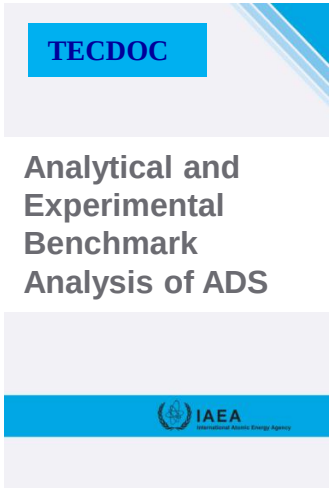



http://www-pub.iaea.org/books/iaeabooks/10870/Status-of-Accelerator-Driven-Systems-Research-and-Technology-Development

# CRP on Analytical and Experimental Benchmark Analysis of Accelerator Driven Systems
# &
# Use of LEU in Accelerator Driven Subcritical Systems
## *both carried out from 2005 to 2010*

- Knowledge and understanding about existing or proposed ADS facilities
- 8 benchmark analytical and experimental exercises on ADS
- Perform additional studies on physics and operational characteristics of ADS facilities
- Investigate options for carrying out ADS research using low enriched uranium (LEU) fuel




- Expected to be published in July 2017

# CRP on "Accelerator Driven Sub-critical Systems (ADS) and Use of Low Enriched Uranium (LEU) in ADS"

## Main Objectives

- Focus on Developing LEU ADS Systems
- Continue Development of Analytical Techniques
  - Experimentation in facilities
  - Benchmarks against analytical results
  - Development of new measurement techniques
  - Sensitivity studies between various cross section libraries
- Application Development and Demonstration
  - **Spent fuel transmutation**
  - Radioisotope production
  - Material irradiation
  - Thorium fuel cycle development

CRP started in December 2015 with 24 participants from 14 MSs

IAEA.org
International Atomic Energy Agency


› Nuclear Data

IAEA Nuclear Data Services Home Page

› ADS Library



HOME

ADS-ENDF (ENDF format)

ADS-ACE (ACE format)

ADS-MATXS (MATXS format)

ADS-GENDF (GENDF format)

NJOY INPUTS (by material)

› Downloads

NJOY UPDATES

NJOY INPUTS (all)


# ADS Nuclear Data Library v2.0

## ACE formatted Library for Accelerator Driven Systems

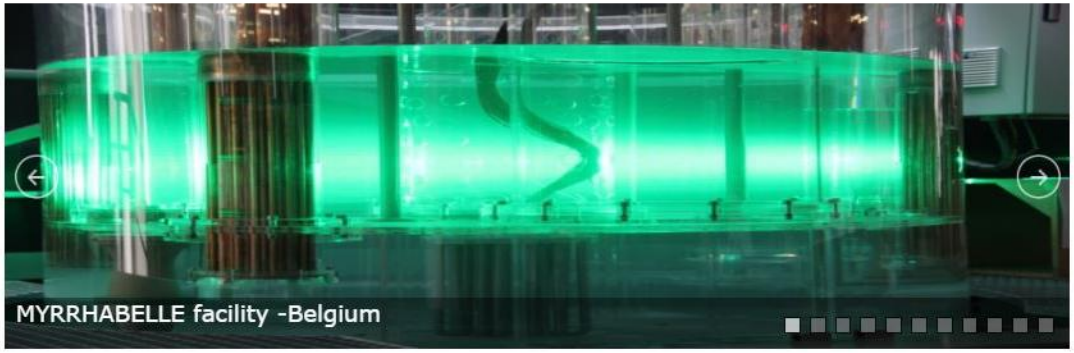
**(Energy continuous data for Monte Carlo Calculations)**

---

ADS-ACE: Contains pointwise continuous-energy cross-section data in ACE format for MCNP calculations at different temperatures; also includes probability tables (PT) in the unresolved resonance range, if applicable.

| Element | Isotopes | | | | |
|---|---|---|---|---|---|
| H | H-1 | H-2 | Thermal scattering law | HINH2O | DIND2O |
| He | He-3 | He-4 | | | |
| Li | Li-6 | Li-7 | | | |
| Be | Be-9 | | | | |
| B | B-10 | B-11 | | | |
| C | C-nat | | Thermal scattering law | GRAPHITE | |
| N | N-14 | N-15 | | | |
| O | O-16 | | | | |
| F | F-19 | | | | |

# Catalogue of Facilities in Support of Liquid Metal-cooled Fast Neutron Systems (LMFNS Catalogue)




This LMFNS catalogue is a living database, which is, in its current form, presents an electronic version of section 4 of the IAEA Nuclear Energy Series publication *(in progress)* "Experimental Facilities in Support of Liquid Metal Cooled Fast Neutron Systems. A Compendium".

**LMFNS Compendium. Summary of the IAEA publication**

To overview the potential capabilities of 150 experimental facilities in 14 IAEA Member States to support the development and deployment of the innovative Liquid Metal cooled Fast Neutron Systems (LMFNS) and navigate yourself through the LMFNS Facilities Database" click on the below buttons:

**Overview of SFR** **Overview of LFR**

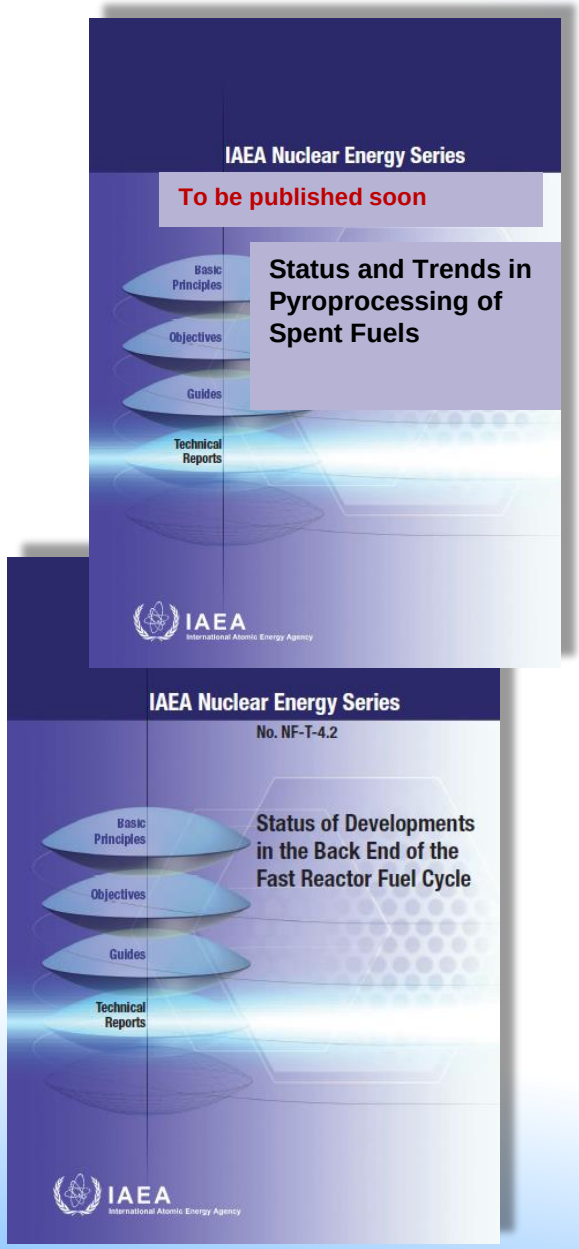
For detailed information on these facilities 1) click on the below button "LMFNS Facilities Database" (also on top of this page), 2) select the Coolant technology - SFR, LFR or both in the search box, 3) use other search and filtering tools as appropriate, 4) click on the Facility Profile you are interested in.

**LMFNS Facilities Database**

Announcements:

15-19 May 2017 50th Meeting of the Technical Working Group on Fast Reactors, VIC, Austria

# Innovative Fuel Cycles




- **TM on "Challenges in Reprocessing Used Fast Reactor Fuels" , Vienna, June 2015**
- **TM on "Advanced Fuel Cycles for Waste Burden Minimisation", Vienna July 2016**

*France, China, Hungary, India, Japan, Republic of Korea, Russia Federation and USA*

## ACTIVITY RECENTLY LAUCHED

Technical document on different strategies and advanced technologies for waste burden minimisation in order to enhance nuclear power sustainability

Technical Meeting on "Advanced Fuel Cycles to Improve the Sustainability of Nuclear Power through the Minimization of High Level Waste",
**17-19 October 2017, IAEA, Vienna**

# Integrated Nuclear Fuel Cycle Information System

IAEA 60 Years
Atoms for Peace and Development

http://infcis.iaea.org

IAEA | INFCIS

## Nuclear Fuel Cycle Information System (NFCIS)

NFCIS covers civilian nuclear fuel cycle facilities around the world. It contains information on operational and non-operational, planned, and cancelled facilities. All stages of nuclear fuel cycle activities are covered, starting from uranium ore production to spent fuel storage facilities.

## Post Irradiation Examination Facilities Database (PIE)


PIE is derived from a catalogue of such facilities worldwide that the IAEA issued in the 1990s. It includes a complete survey of the main characteristics of hot cells and their PIE capabilities.

## Minor Actinide Property Database (MADB)


MADB is a bibliographic database on physico-chemical properties of selected Minor Actinide compounds and alloys. The materials and properties are selected based on their importance in the advanced nuclear fuel cycle options.

# Forthcoming IAEA Emerging Technologies Workshops: Trends and Implications for Safeguards Vienna, 13-16 February 2017

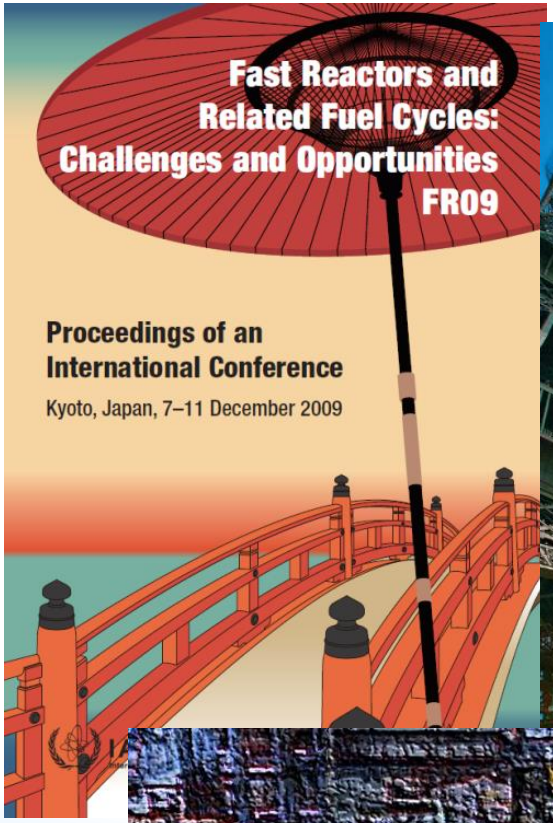
- **Objectives:** increase the Safeguard Department's awareness and preparedness for addressing emerging technologies (nuclear and non-nuclear) that are expected to impact IAEA safeguards implementation work in the coming years.

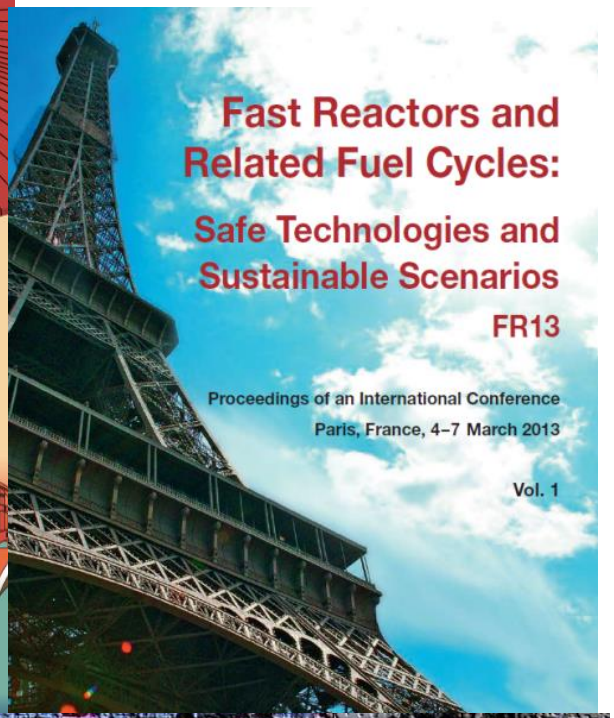
- **Priority themes**: transportable reactors, Generation IV reactors, transmutation systems, laser technologies, additive manufacturing, etc.

- **Example → ADS Facilities**
  - ✓ No critical mass → no criticality test
  - ✓ Challenges:
    - *Estimation of the quantity of fissile material in the core;*
    - *Identification of misused targets in the core/blanket (if present);*
    - *Power depends from the neutron source and not only from the quantity of fissile material in the core*
  - ✓ <u>New SG approaches/methods may be needed to verify ADS</u>

# 3rd International Conference on Fast Reactors and Related Fuel Cycles (FR17)

## Yekaterinburg, RF, 26-29 June 2017





IAEA 60 Years
Atoms for Peace and Development

# Thank you!



**@IAEANE**

**s.monti@iaea.org**