National Research Nuclear University "MEPhI"

International Centers for
Nuclear Education and Nuclear Knowledge
Management:

International Conference on Human Resource Development for Introducing and Expanding Nuclear Power Programmes:

"The Role of IAEA in Knowledge Transfer."

(Panel Discussion)

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Countries are going to use nuclear energy during 2015-2030 and taking some initial actions for that.

- Latin America: 3 + 2 expected new (Chile, Peru)
- Western Europe: 9 + 3 expected new (Italy, Portugal, Turkey)
- Eastern Europe: 10 + 3 expected new (Belarus, Kazakhstan, Poland)
- Africa: 1 + 5 expected new (Algeria, Egypt, Libya, Morocco, Tunis)
- Middle East&South Asia: 3 + 1 expected new (Bangladesh)
- South East Asia&the Pacific: 0 + 4 expected new (Australia, Indonesia, Malaysia, Thailand)
- Far East: 3 + 3 expected new (North Korea, Philippines, Vietnam)
- In total about 21 new countries are considering to start using nuclear energy during 2015-2030

Nuclear power in weapons and non-weapons states (recent situation)

Parameter	In 5+2 nuclear weapons states	In 24 non-nuclear weapons states	
Number of nuclear power units: in operation under construction	 243 11	 200 18	Japan 56, S. Korea 20 Canada 18, Germany 17 Ukraine 15, Sweden 10 Spain 9, Belgium 7
Total installed GW(e) in operation under construction	 216.3 10.6	 153.3 11.2	

Few companies (Rosatom (Russia), URENCO, USEC (USA), EURODIF (France), CNNC (China) and JNFL (Japan) can enrich uranium on industrial scale.

Few countries (France, UK, Russia, Japan, India and China) have nuclear fuel reprocessing capacities.

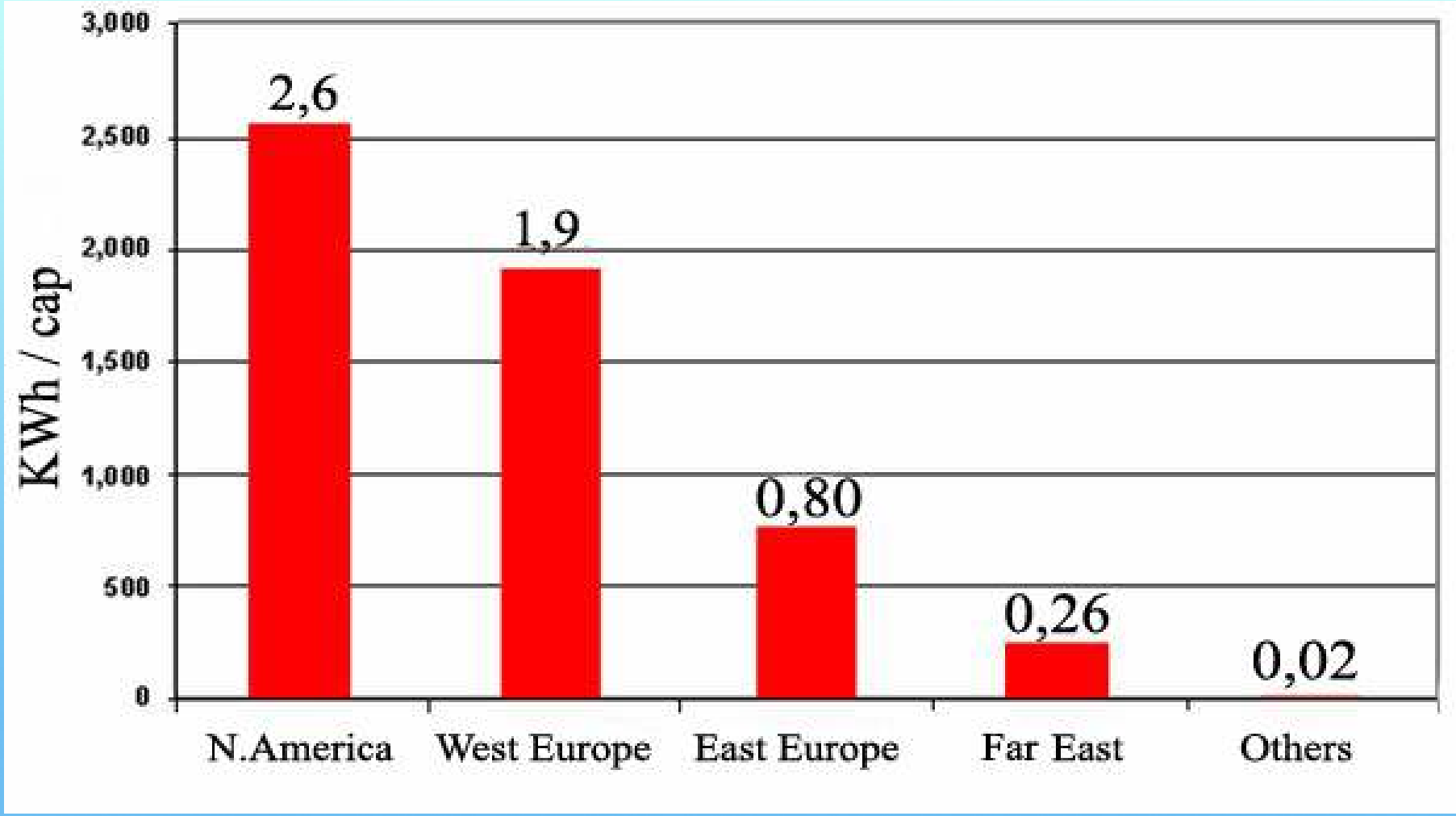
Few countries have advanced fast reactor developments (Russia, France, Japan, India, China)

Per-capita electricity consumption and projected nuclear power growth in selected countries and in Africa

IAEA

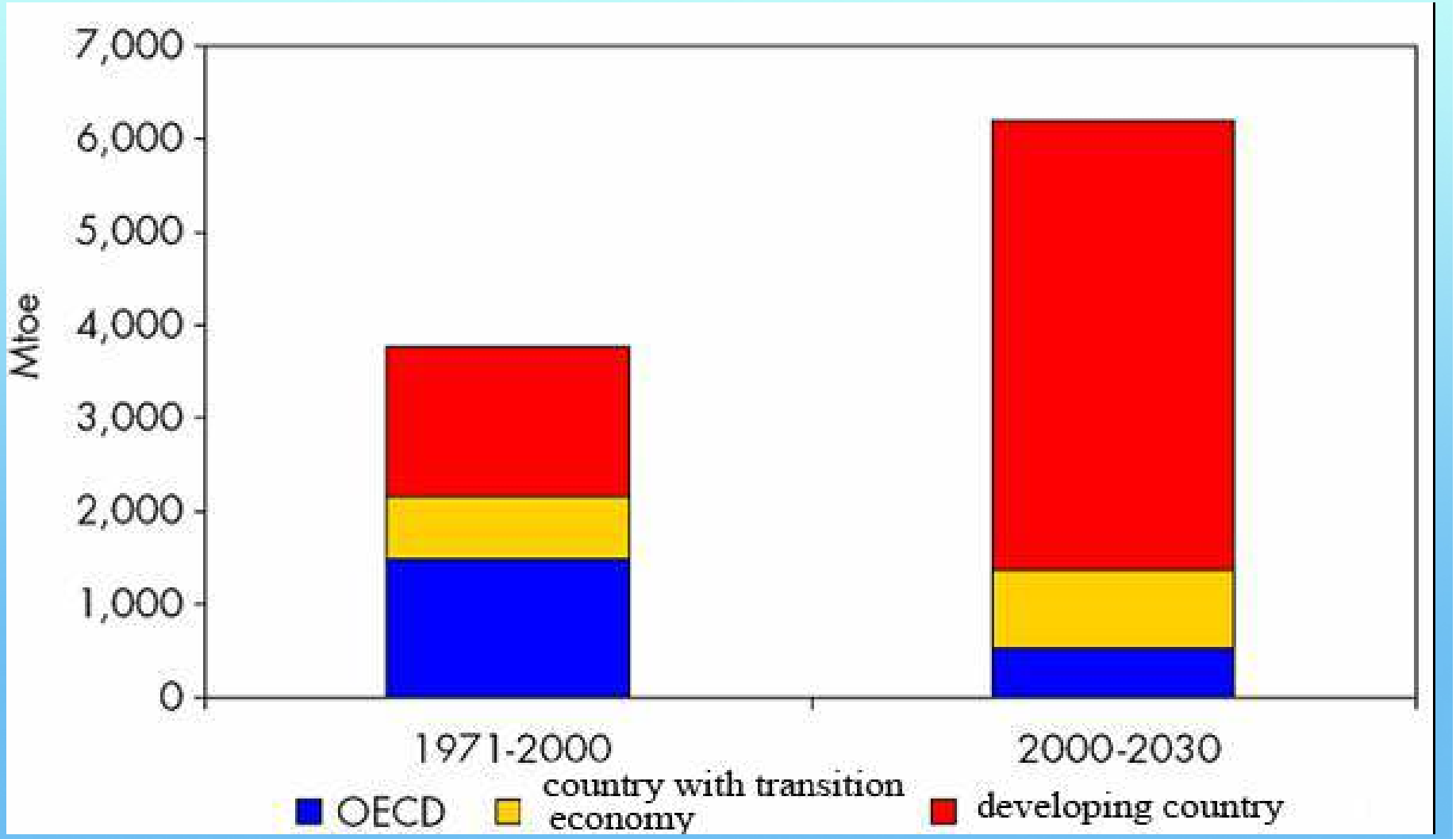
Country	Years	Annual electricity consumption, kWh/capita	Installed or projected nuclear power capacity, GW(e)	Projected growth in nuclear power capacity
China	2002	1208	5.3	6-7 times
	2020		32-40	
India	2002	421	2.6	11 times
	2022		29	
Pakistan	2002	384	0.42	10 times
	2030		4.2	
Russia	2002	5320	21	2 times (100%)
	2020		40--45	
ROK	2005		16.8	57%
	2015		26.4	
USA	2002	13228	99	11%
	2020		~110	
Africa	2002	514	1.8	0-128%
	2020		1.8-4.1	

Nuclear energy KWh/cap in the different region (2008)



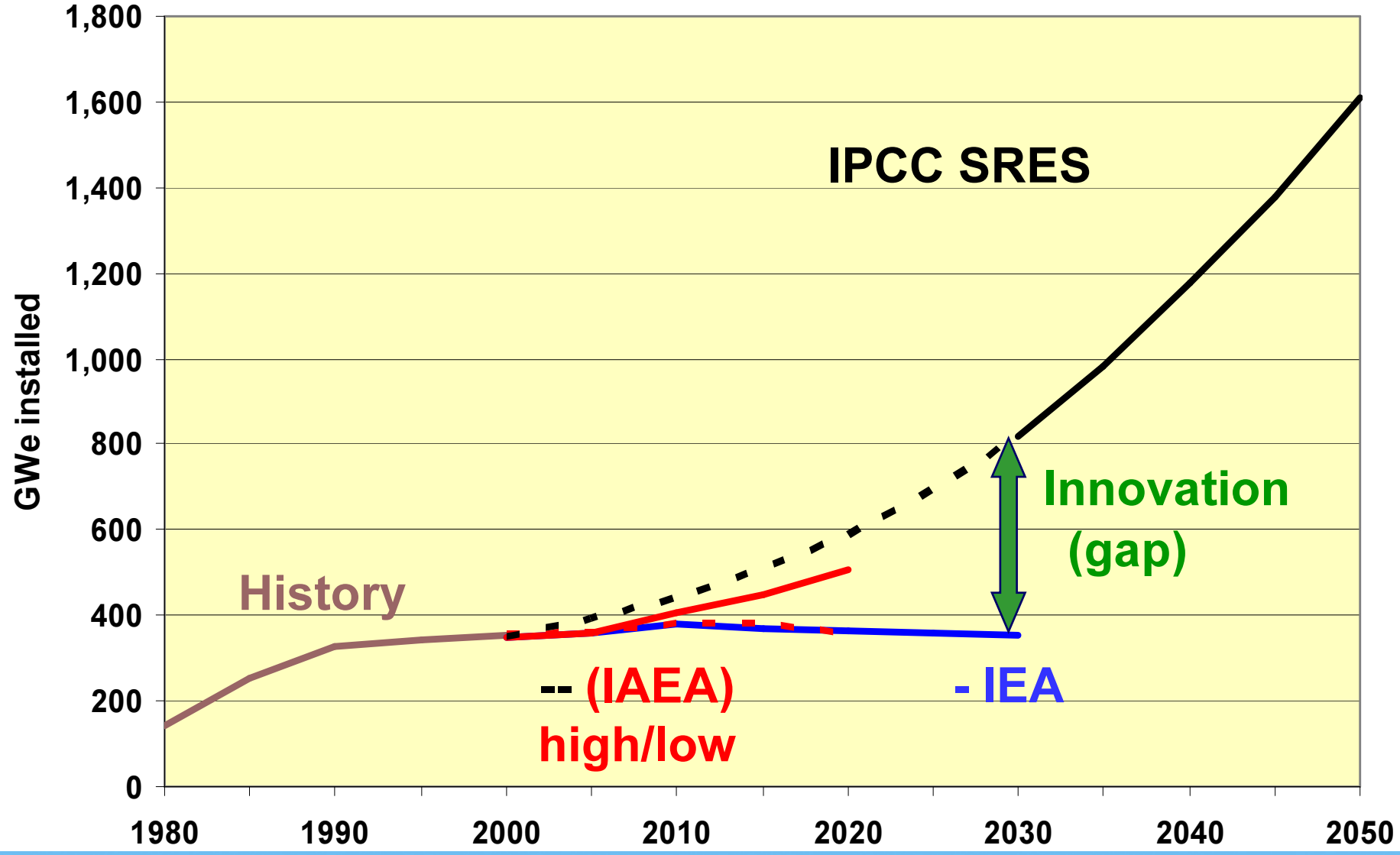
IAEA

Consumption energy in the world



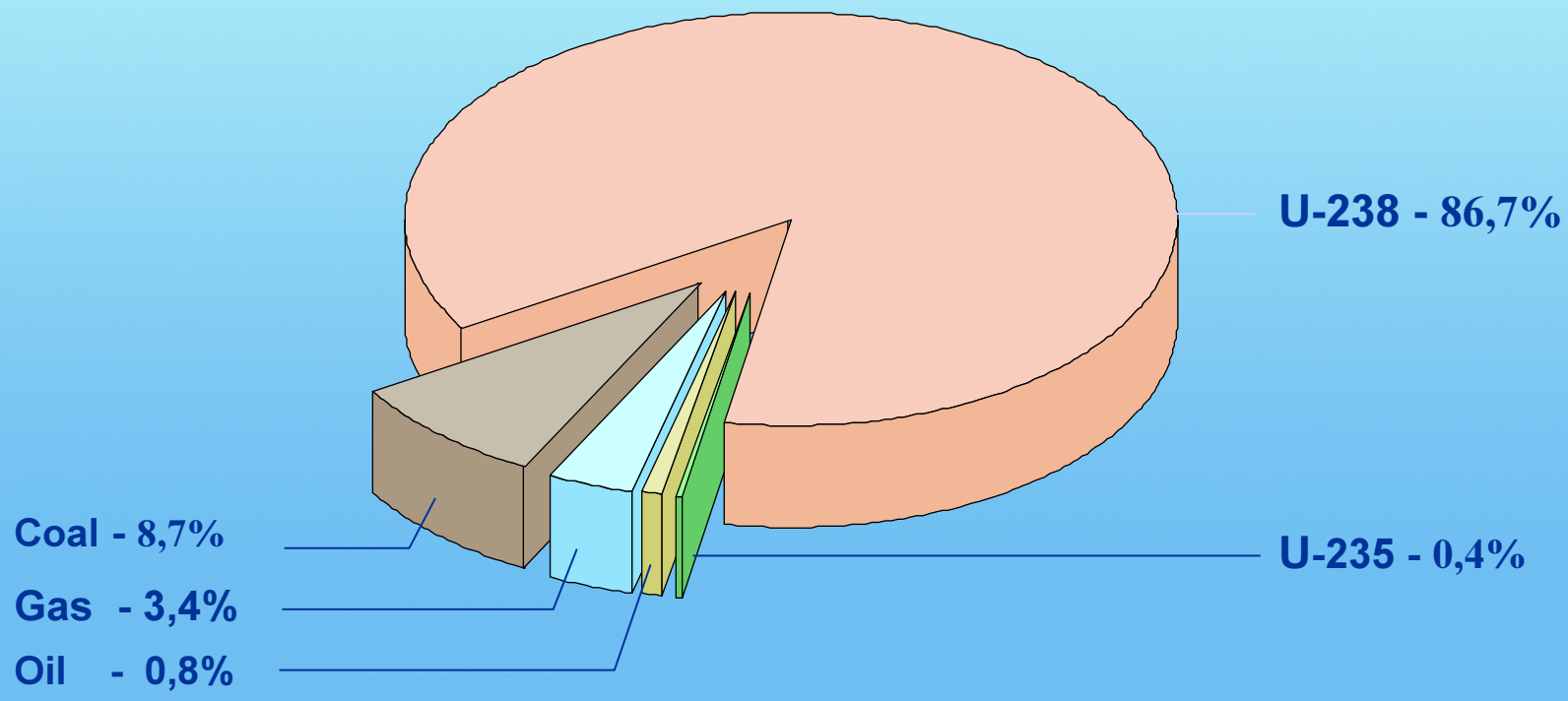
Reference: IEA

Development NP – the role of Innovation

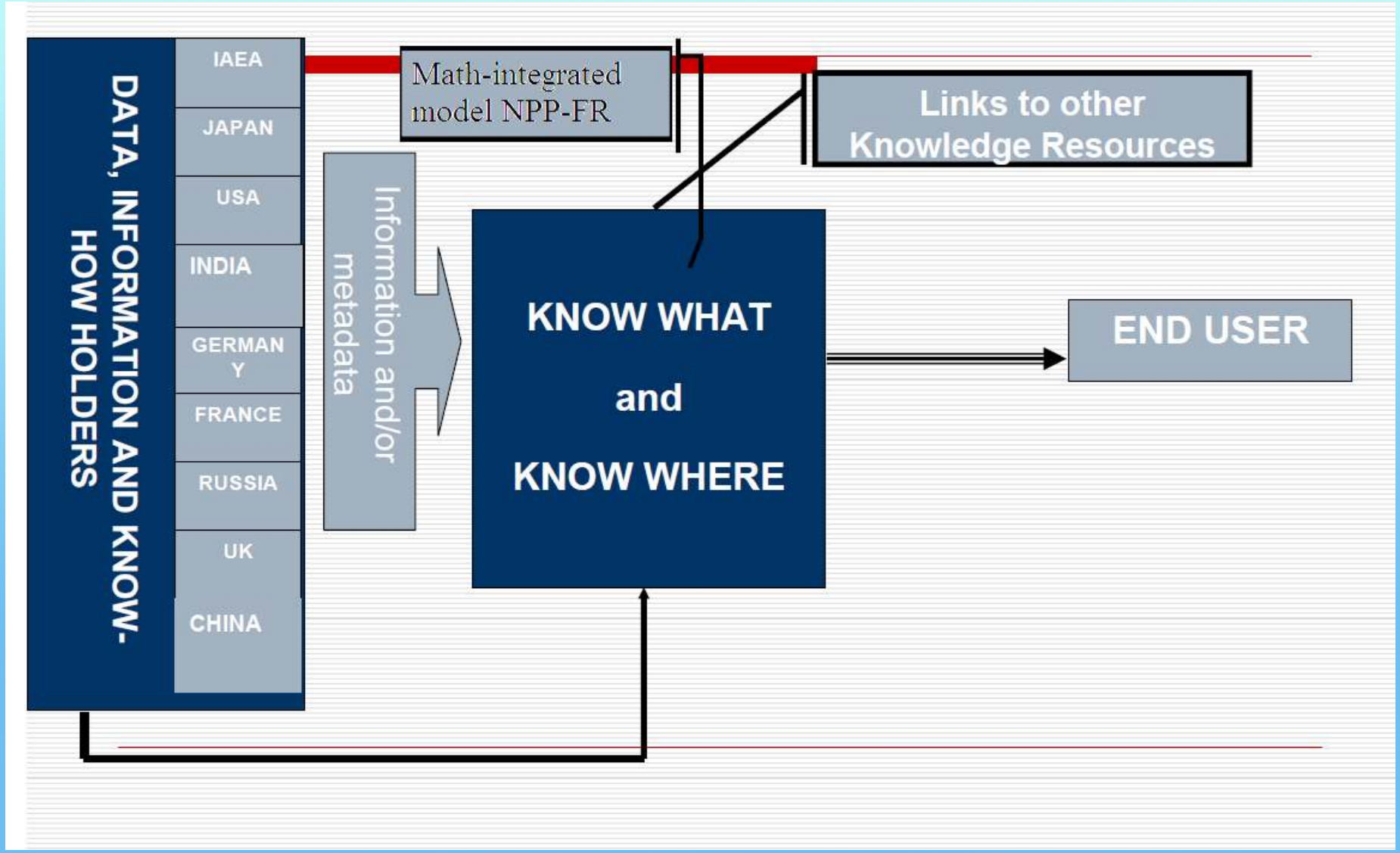


IAEA

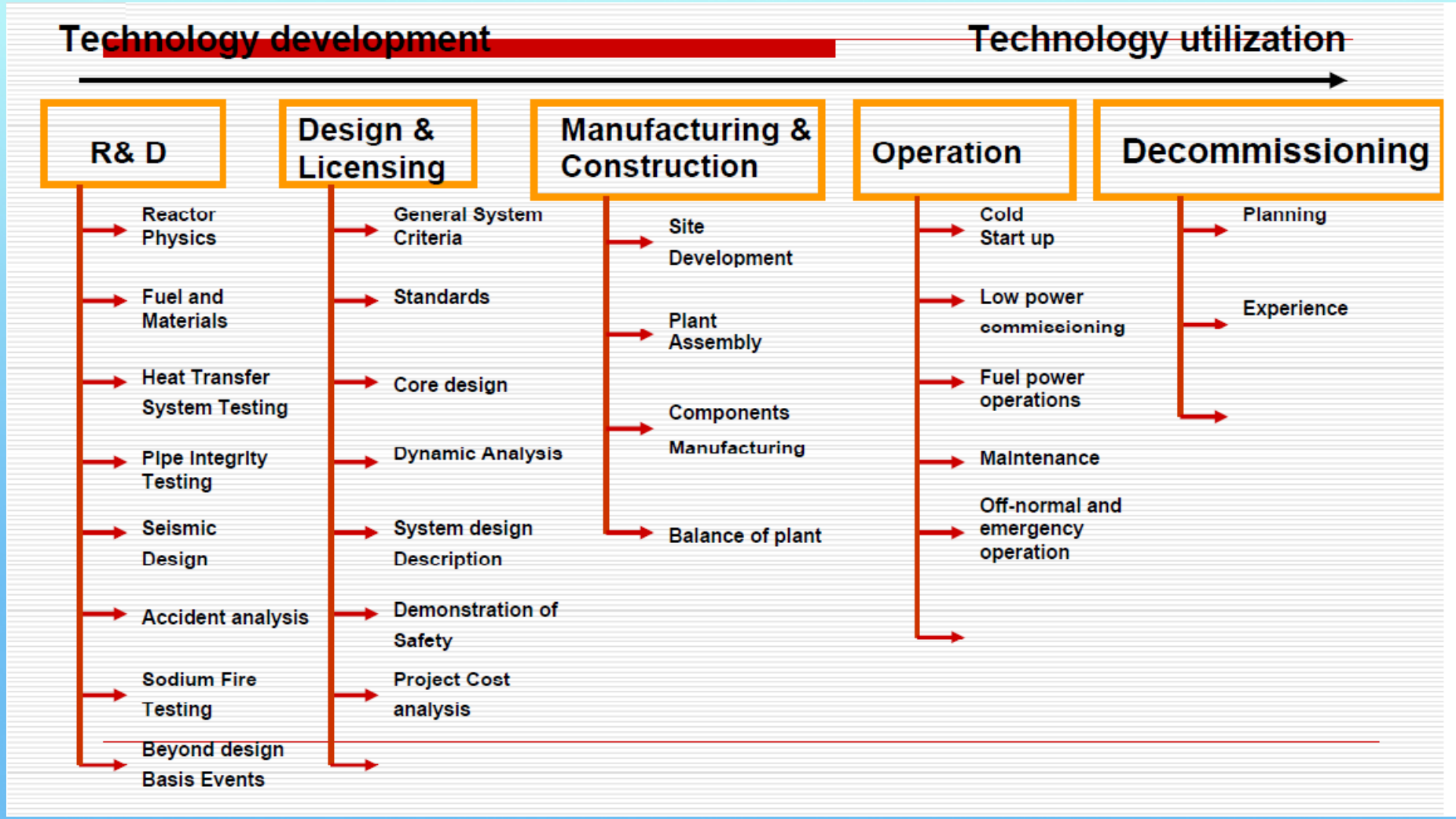
Relative energy content of natural fuel resources



Fast reactors knowledge preservation



Taxonomy of fast reactors knowledge



Nuclear Knowledge have to be managed and preserved

- **Nuclear Knowledge has been developed mostly during last 60 years with a significant governmental support;**
- **Amount of nuclear knowledge is more then needed for current commercial needs;**
- **There is a risk to loose some nuclear knowledge forever;**
- **Some knowledge is free for a dissemination, some knowledge is limited for a distribution, some is closed and prohibited for a distribution (non-proliferation of sensitive nuclear technologies);**
- **Today a status of nuclear knowledge and its management are unsatisfied.**

- **Role of the international programs (IAEA, WNU, EC, ANENT, ENEN) on knowledge management:**
- **knowledge management in industry and scientific centers;**
- **knowledge management and development for innovation fields not claimed today but important for future development: fasts reactors, closed NFC, HTGR, hydrogen production, small NPP, Th – U233 cycle;**

Large scale design and construction of new NPPs are dangerous without careful analyzing:

- **resources including nuclear knowledge;**
- **needs in human recourses;**
- **strategy for knowledge management;**
- **methods and tools for knowledge management;**
- **risks of knowledge and competency loss.**

"Nuclear Knowledge" is defined to include everything from technical information (documented on paper or on electronic media) to insights, capabilities, and skills embodied in people.

In the beginning of the 21st century the development of nuclear science, technology and industry is under risks of:

- ageing of workforce, retirement and as a result – a loose of nuclear knowledge;
- degradation of technological skills and a loose of «know-how»;
- degradation of safety and decreasing (disappearance) innovative capabilities.

Nonproliferation problems – necessity of strict control and management of nuclear knowledge.

- **The free exchange and non-controlled usage of nuclear knowledge are strictly regulated because of importance of nuclear security and nonproliferation.**
- **Nuclear safety requests the free exchange of information and experience in order to prevent the repetition of events leaded to accidents.**
- **In nuclear knowledge management the proper balance between the nuclear safety and non-proliferation requirements is to be established.**

Development of innovation technology is the difficult and expensive task.

It can not be done by only one country. There is the international cooperation for innovation nuclear technology development both on intergovernmental and industry levels.

One of such strategic directions – a creation of international networks, such as ENEN, ANENT and centers for nuclear knowledge preservation - Centers of Excellency IAEA .

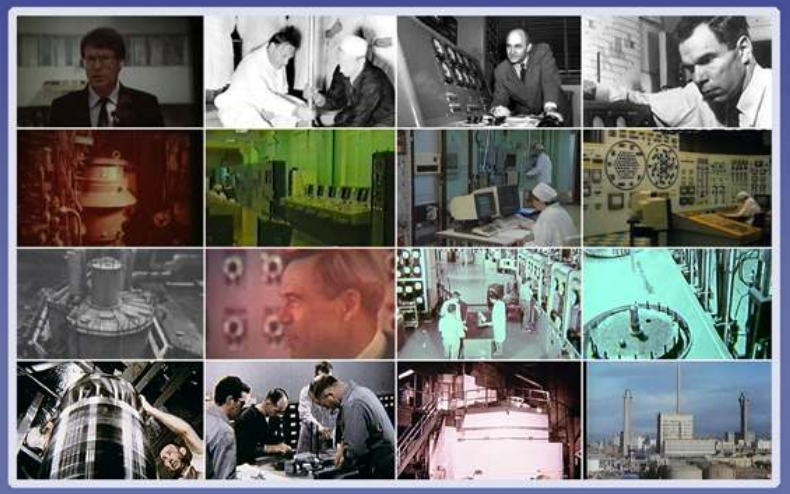
- **Participation in the international programs (IAEA, WNU, EC, ANENT, ENEN) on knowledge management:**
- **knowledge management in industry and scientific centers;**
- **knowledge management and development for innovation fields not claimed today but important for future development: fasts reactors, closed NFC, HTGR, hydrogen production, small NPP, Th – U233 cycle;**

NUCLEAR DATABASE OF UNIVERCITY
SCIENSE, EDUCATION, HISTORY

HISTORY OF NUCLEAR SCIENSE AND TECHNOLOGY DEVELOPMENT

NUCLEAR DATABASE OF UNIVERCITY
SCIENSE, EDUCATION, HISTORY

FAST BREEDER REACTORS AND NUCLEAR FUEL CYCLE



NKM in International Center NRNU

The development, maintenance and use (in educational process, R&D and for knowledge preservation) of engineering-logical models of NPP with various types of nuclear reactors (first of all, fast reactors and closed fuel cycle).

The creation of integral system:

Taxonomy FR (IAEA) + FR database (IAEA) + FR NPP model + NFC model + FR

Basic results and further goals

1.1. Based on the information collected the first reference courses of video lectures (15-30 hours) were prepared in Russian and English for students of NRNU:

- «Current problems of nuclear power»
- «The role of international scientific-technical cooperation in the field of peaceful uses of nuclear technology»
- «Innovative development of nuclear power as a basis for energy stability»
- «Non-power use of nuclear technology»

Basic results and further goals

1.2. The retrospective of video films related to the results of development and application of nuclear technology was prepared to be used in lectures for students of NRNU (more than 400 items related to 25 topics).

1.3. The textbook for the course “Current Problems of Nuclear Power” was made: Nuclear power as a basis for energy security in future: technical-economical and social-political problems of power development (Part I, Part II).

Basic results and further goals

2. Under the order of Council … EurAsEC during 2008-2009 the analysis was performed and the analytical report on the status of nuclear education in Russia and EurAsEC countries was submitted.

Based on the results of consideration of the analytical report by the Council … EurAsEC, the NRNU was entrusted with the preparation of “The Concept for development of nuclear education in EurAsEC countries” and implementation program.

Basic results and further goals

3. The proposal was made for the creation of NRNU inter-department center “The Culture of Nuclear Knowledge and Technology Non-proliferation” under the aegis of ISTC based on the international centers ICNE and IC NKM (on the analogy of “The Culture of Security”).

Basic results and further goals

4. The plans were formulated for further development of NRNU activity:

- «Vocational guidance of high school students – future students of NRNU and future nuclear specialists»
- «Consolidated educational-information space of NRNU», including the use of international system INIS
- «Training system oriented to foreign specialists from developing countries, that are about to use Russian nuclear technologies»
- «Project of the creation of inter-department center on nuclear non-proliferation»

THANK YOU FOR YOUR ATTENTION