Future of the nuclear power generation in Hungary

Dr. Tamás János KATONA
Scientific Advisor
Paks Nuclear Power Plant
Hungary

International Conference on Opportunities and Challenges for Water Cooled Reactors in the 21st
Vienna, 27-30 October 2009

Content

- The Hungarian energy issue
  - Vulnerability of the Hungarian economy
  - Strengths and weaknesses of the power generation industry
  - Role of the Paks NPP
- Development options for the power industry
- Strategy for development of the nuclear power generation:
  - (Operation of existing plant: power up-rate, extension of operational lifetime)

Preparation of the political decision on the new nuclear and preparation of the NEW NUCLEAR PROJECT

The Hungarian case

Vulnerability of the Hungarian economy

- Export dependent economy
- Energy- import dependent country (>70% recently, ~90% in 2015)
- Extraordinary high gas-import dependence
- Regular disturbances due to Russian-Ukrainian relations
- Diversification of gas-pipelines (time and money!)

Strengths and weaknesses of the power generation industry

- Diverse and well balanced considering the sources and technologies (gas, nuclear, coal)
- Growing share of renewable sources, but limited possibilities
- Gas- import dependent
- Needs further development
  - Replacement of obsolete capacities
  - Covering the growing needs

Value of the Paks NPP

four WWER-440/213 units

~2 000MWe, ~20% of domestic generating capacities

~ 37.2% of domestic production (14 818 GWh) in 2008

Value of the Paks NPP

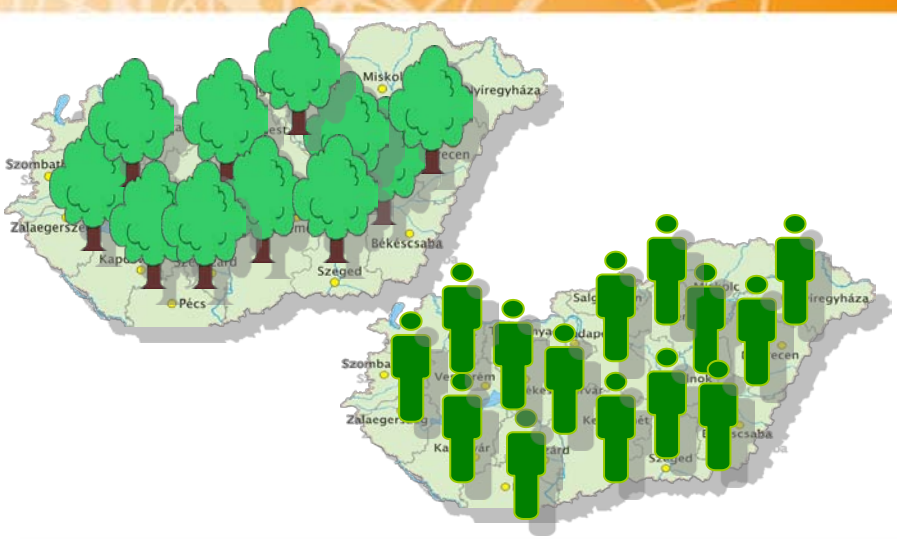
cheapest and largest producer; production cost-index was during the whole history of plant lower than the average price index

no environmental impact (27 years of operation); it saves 5.6 million tons/ a of CO2; external costs internalized

safety level as in case of other PWRs of same vintage; high reliability/availability (86%)

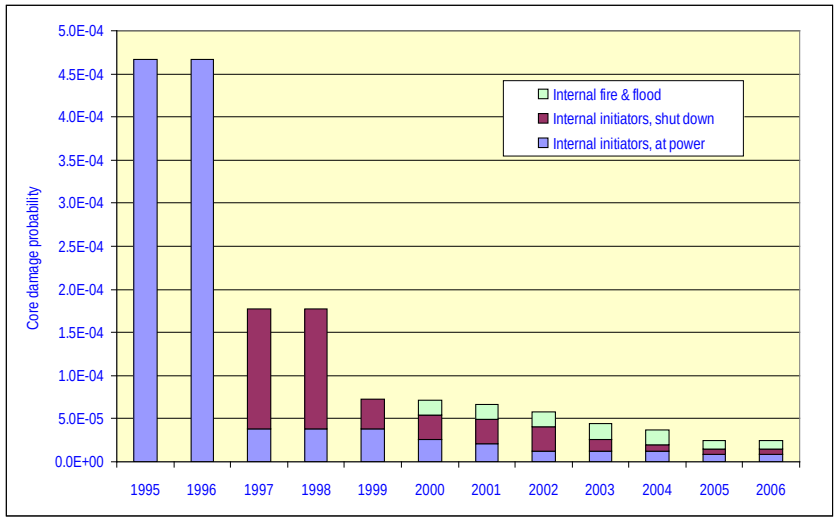
Large human capital, high-tech jobs; largest regional employer

most important capacity concerning security of supply

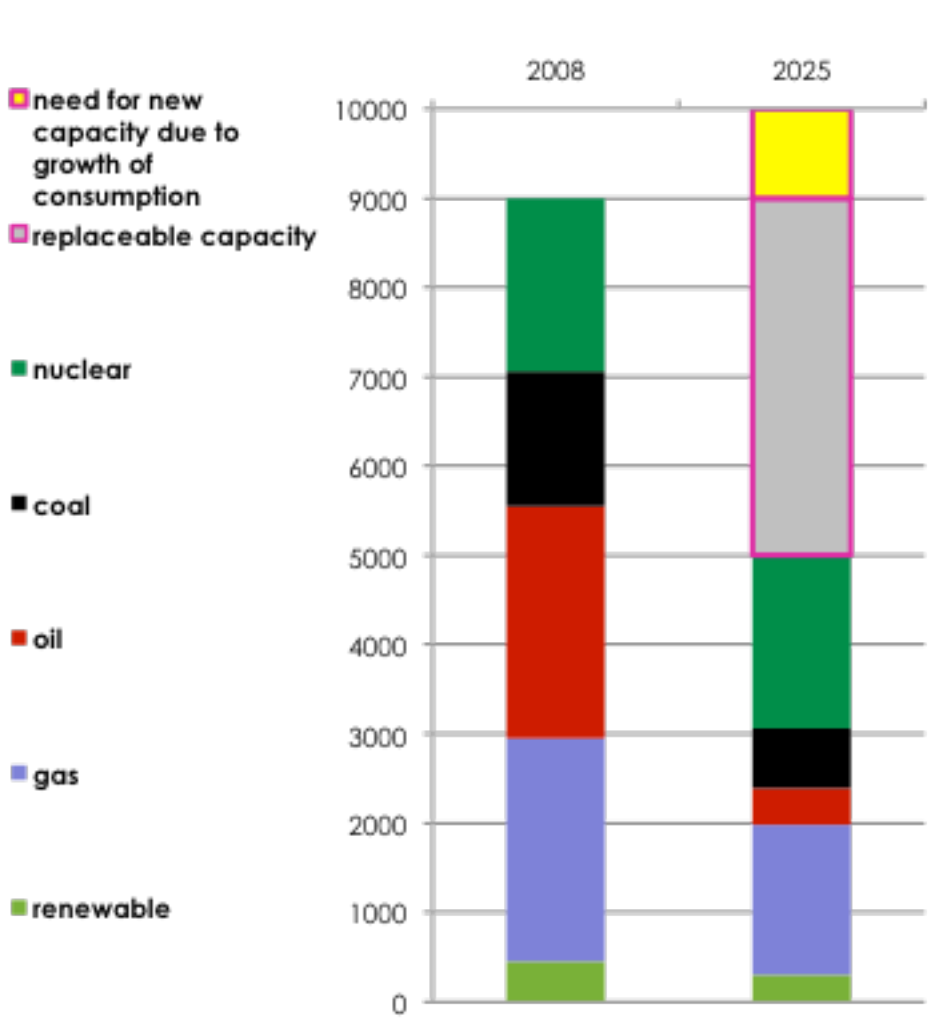


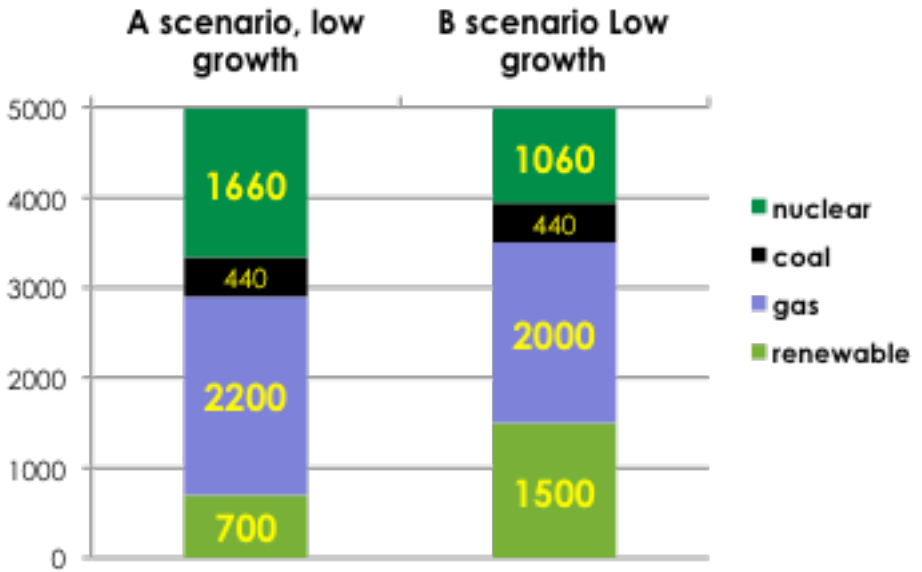
Strategy of Paks NPP

- Safety - paramount
- Competitiveness
  - Power up-rate:+8% reactor thermal power
  - Operate as long as reasonable (20 years extension of operational life-time)
- Acceptance



Development options





Low growth – 0.5%/a
High growth – 1.5%/a

New nuclear is a viable option

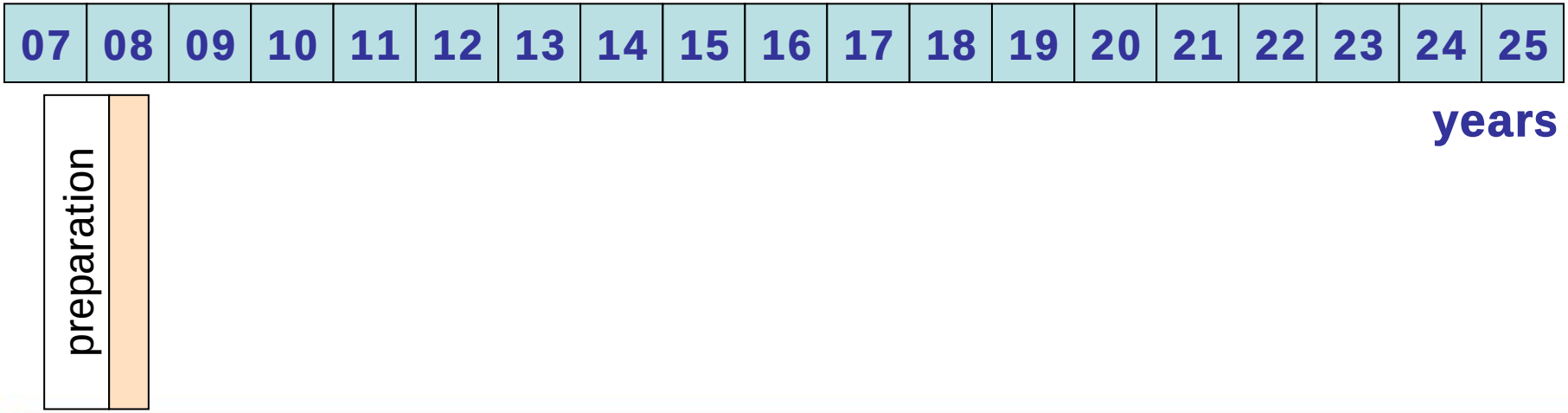
Development options

- EU obligations:
  - 3 times 20%
- National interests:
  - Security of supply (diversity of sources/markets)
  - Cheap and reliable energy production
  - Progress towards sustainability
- Trends in the industry:
  - Low risk investments in preparation – mainly gas, completely neglecting the adverse effects (only one project for domestic coal/lignite)
  - Use of state subsidies (the real motivation for the utilisation of the renewable sources)

Preconditions, time scale

17th of April 2008: Parliament approved the Energy Policy: preparation of the political decision on new nuclear project has to be done

7. § (2) For the start of preparation of new nuclear unit, radwaste storage facility or extension of the existing NPPs by new unit is necessary to obtain the prior principal agreement of the Parliament.



Studies for decision-making

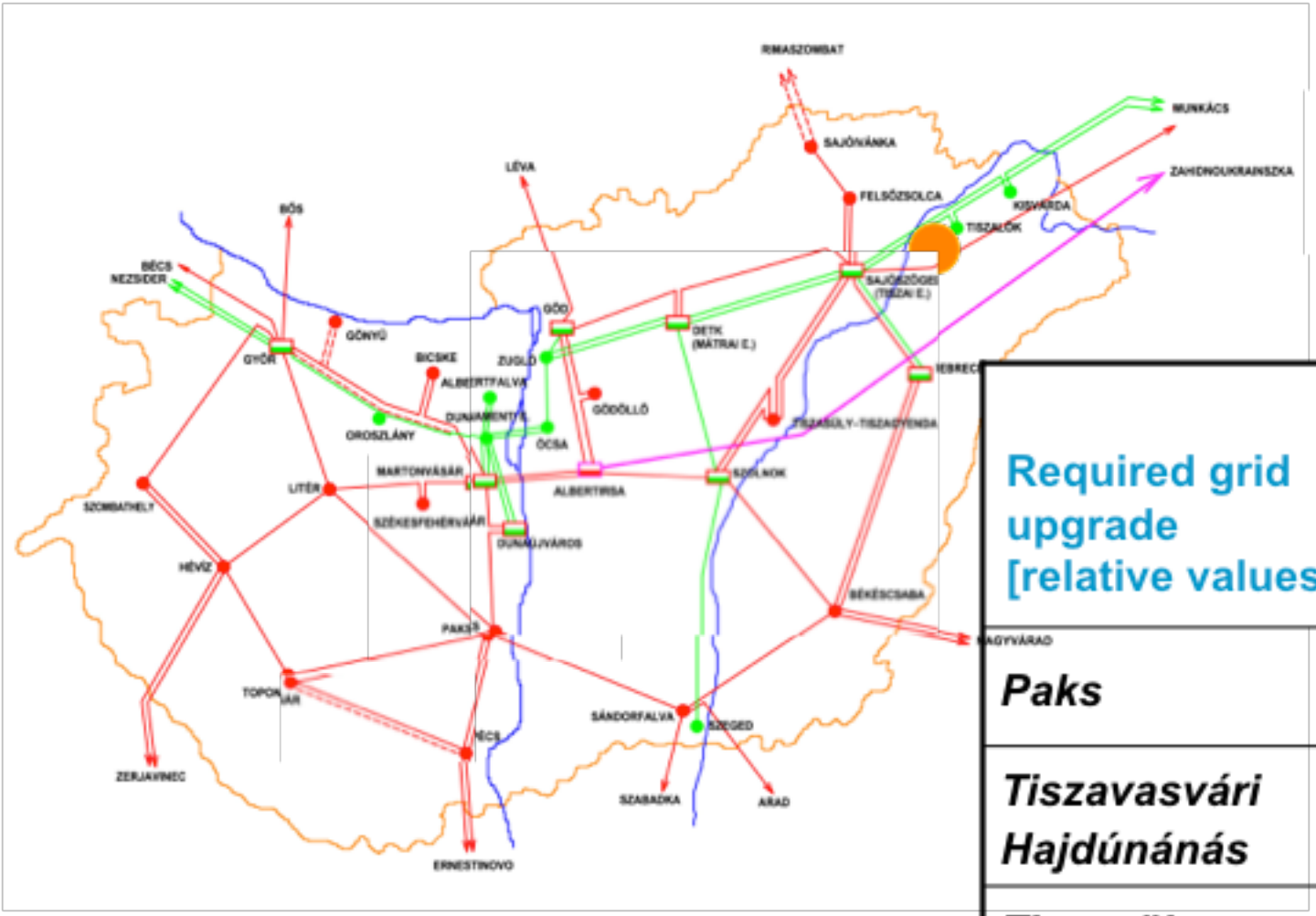
Topics studied (6 workgroups, 300 engineer-years)

1. Production, grid analysis
2. Energy policy, strategy
3. Economy, trade
4. Public acceptance, communication
5. Nuclear issues, environment
6. Law and licensing

Sources:

- Earlier MVM Tender (90s')
- EUR for LWR Nuclear Power Plants
- IAEA Sources
- IEA, DoE EIA, NEA outlooks
- Different studies by research institutions, universities, consultants, banks, law firms, traders, etc.

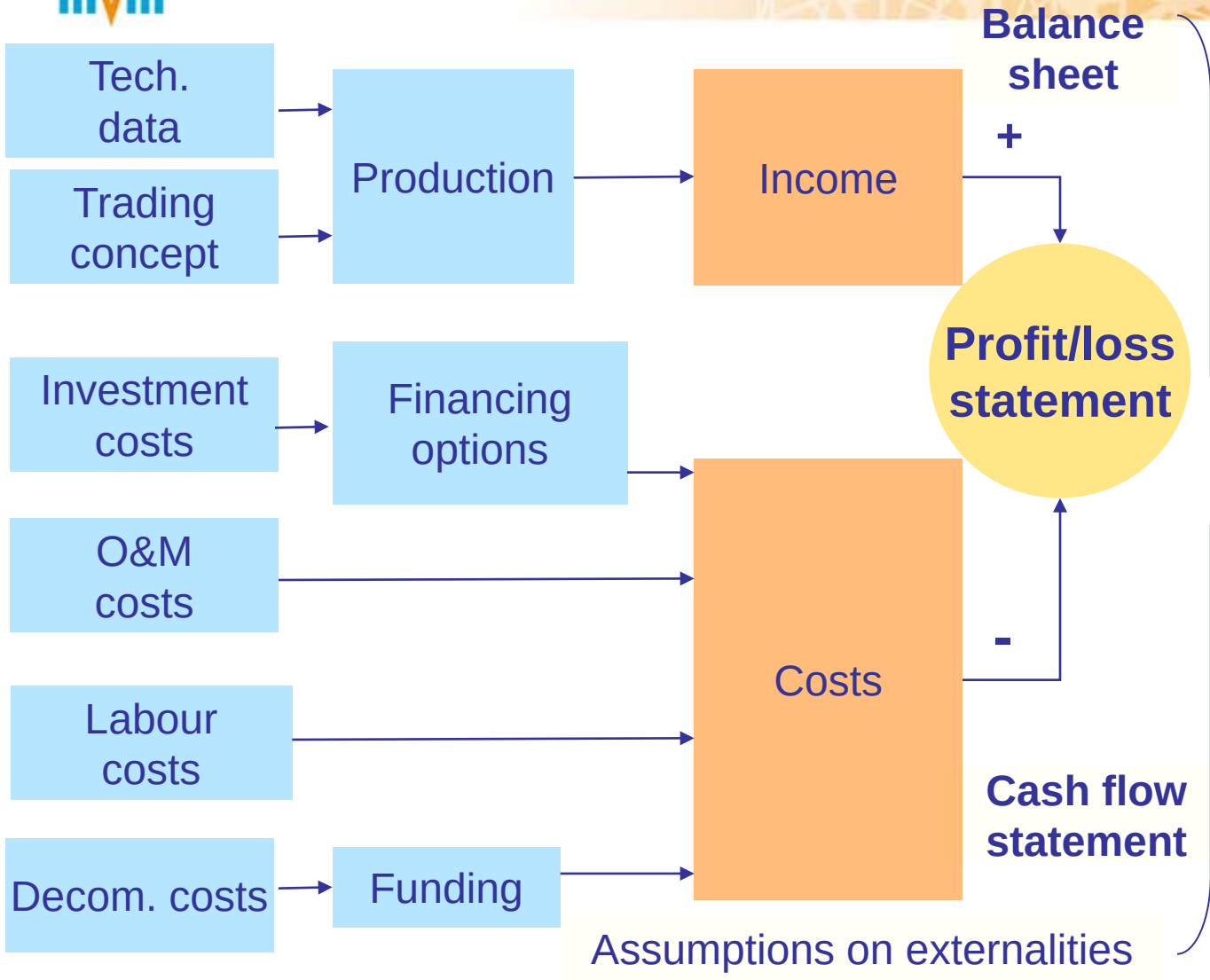
Analysis of the grid



750 kV
400 kV
220 kV
220 (400) kV

Required grid upgrade [relative values] [MW]	2 x 1000	2 x 1600
Paks	100	153
Tiszavasvári Hajdúnánás	232	289
Tiszasüly Tiszagyenda	268	310

High-level economic model



Evaluation criteria

- dividend
- IRR
- unit cost
- payback period

Sensibility analyses

- electricity price
- investment costs
- fuel price
- interest rate
- wages

The project seems to be profitable and financially feasible

Findings and conclusions for the decision

- Power rate: grid and economy calculations: 1000-1600 MW
- Selection of the Paks site for new plant is reasonable (cost, infrastructure, experience, synergy, acceptance, well studied site)
- 60 years lifetime
- Pressurized light water reactor (PWR) – utilisation of experience
- Load following capacity (50-100%) – small capacity system
- Not first of a kind

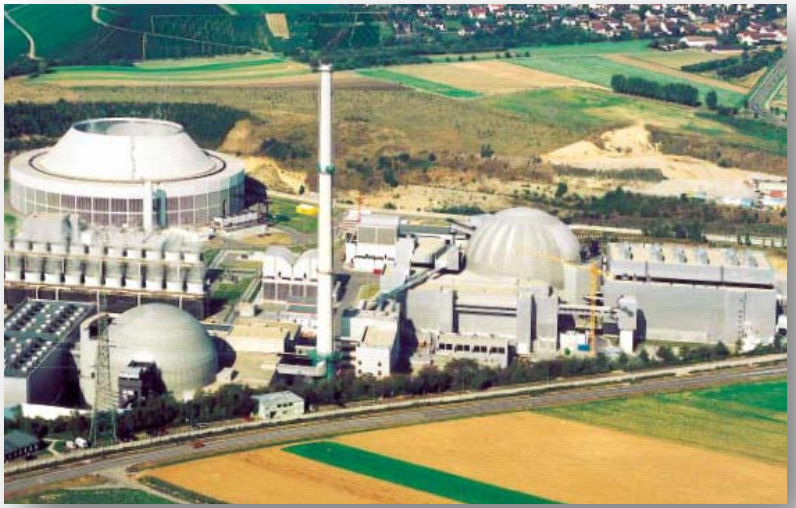
EPR AREVA

AES-92 Atomstrojexport

AP1000 Westinghouse

Findings and conclusions for the decision

- Generic Environmental Study (developed for the bounding for envelop plant parameters)
- Not a green-field project, 27 years of operation, well developed environmental monitoring programme in place (for Licence Renewal purposes)
- Specific finding, based on the experience:
- Cooling towers are needed instead of fresh-water cooling



Documents prepared for the decision-making

- Feasibility study
- Preliminary environmental impact assessment
- Analysis of the storage of spent fuel and radioactive waste from the new units

Decision for about 100 years (difficult scientific, t… …al and economic q…

Inform and convince the public – booklet for 60 thousend housholdes

The political decision

30th of March 2009 political decision of the Parliament; 95.4% pro for new plant at Paks

Paks-5 start-up?

Paks-6 start-up?

07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

years

preparation

licensing

bid

design

construction

commissioning

Preparation of the new project

Project is launched with following main tasks:

1. Development of economic implementation concept (the way of financing), founding of the project company
2. Preparation of the suppliers' tender (bid invitation specification, bid evaluation).
3. In-depth economic & technical studies (energy/electricity demand, adjacent markets, transmission capacities, system regulation, reserve/network development, cooling towers)
4. Early licensing (environmental and site license...)
5. Dealing with legal issues
6. Public acceptance, communication
7. Social and economic relations (local & nation wide), nuclear cluster

Working with potetial vendors and investors

Preparation of the new project

Most important questions

- Ownership and finacing structure which provides the adequate financial resources for the project
- Analyses of potential investors
  - Motivation factors of participation
  - Willingness to take risk, risk sensitivity
  - Preferences on share (majority/ minority)
  - Preferences regarding type of units, vendor, capacity, etc.
- In-depth market analysis
- Vendors' market analysis (2010-2025)
- Identification of possible bottlenecks at suppliers' market
- Investment and procurement
- Identification and mitigation of the financing-relevant risks

Licensing procedures

Parallel as much as possible, the longest takes about 5 years

Law on Protection of Environment	Law on Nuclear Energy	Law Electric Energy	Building Code	Law on Use of Water Resources
Consulting on the EIS	Site license			Principal license
Final EIA licensing	Construction Licenses,	Construction license	Construction licenses	Construction License
Public hearing (national + international involvement) possible appeals)	Systems/component level approvals			
	Start-up and operation licenses	Production/ operation license	Utilization licenses	Operation license

Thank you for attention!