Hungarian-Vietnamese Nuclear Energy Train the Trainers Course

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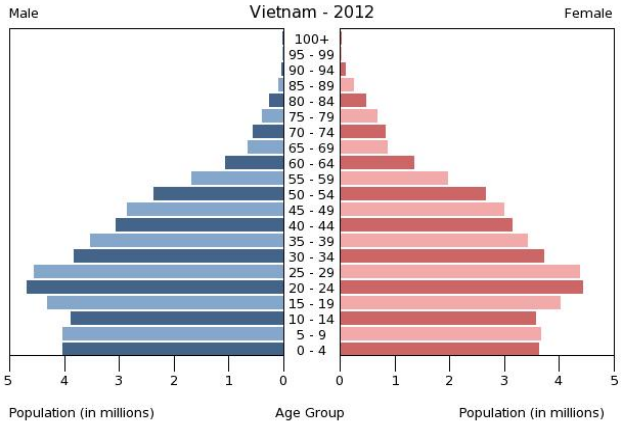
Vietnam

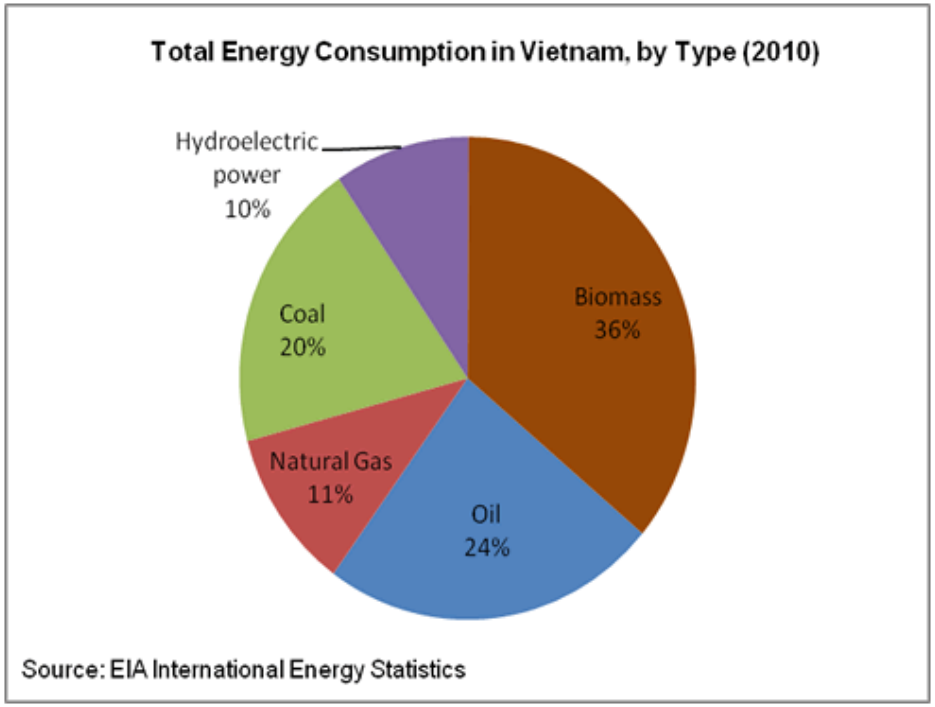
- Socialist Republic of Vietnam
- Area: 331 689 km^2
- Population: 92 million (annual growth rate: 1,03%)
- Capital: Hanoi
  - Largest cities: Ho Si Minh City (6 million), Hanoi (2,7 million), Haiphong (2 millió), Da Nang (0,8 millió)
- GDP per capita: 3 600 USD (World ranking: 170)
- Education expenditures: 6% of GDP
- Annual growth of GDP ~5%

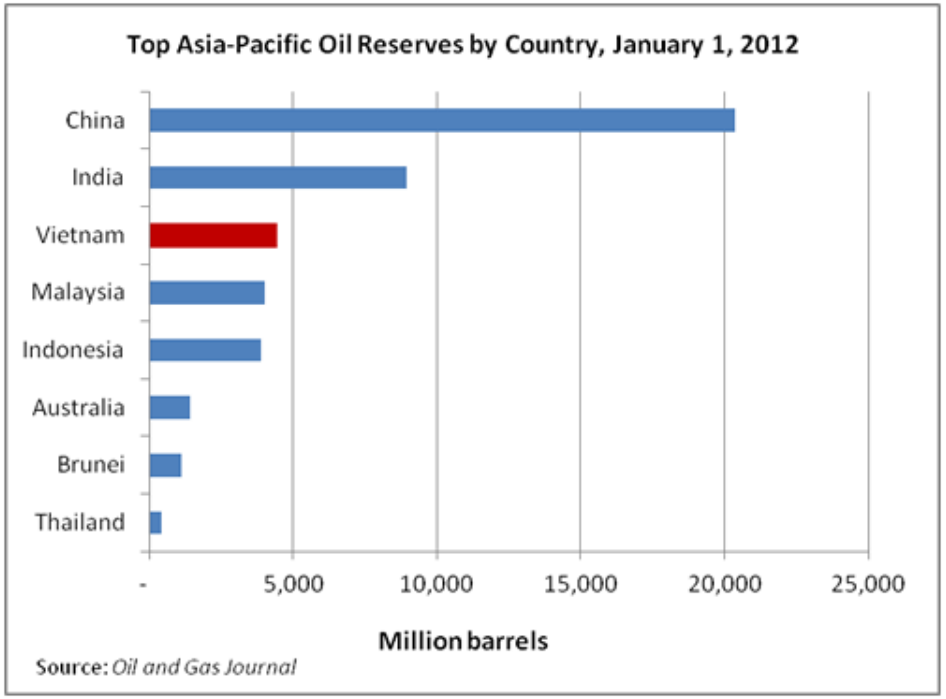


Source: CIA Factbook, NatGeo

Energy industry in Vietnam

- Annual electricity production: 117 TWh
- Installed capacity: 26 GW (64% fossil, 36% hydro)
- Annual growth of electricity consumption: ~11%
- Rapid growth of electricity consumption is assumed for the next two decade (3-5-fold until 2025)

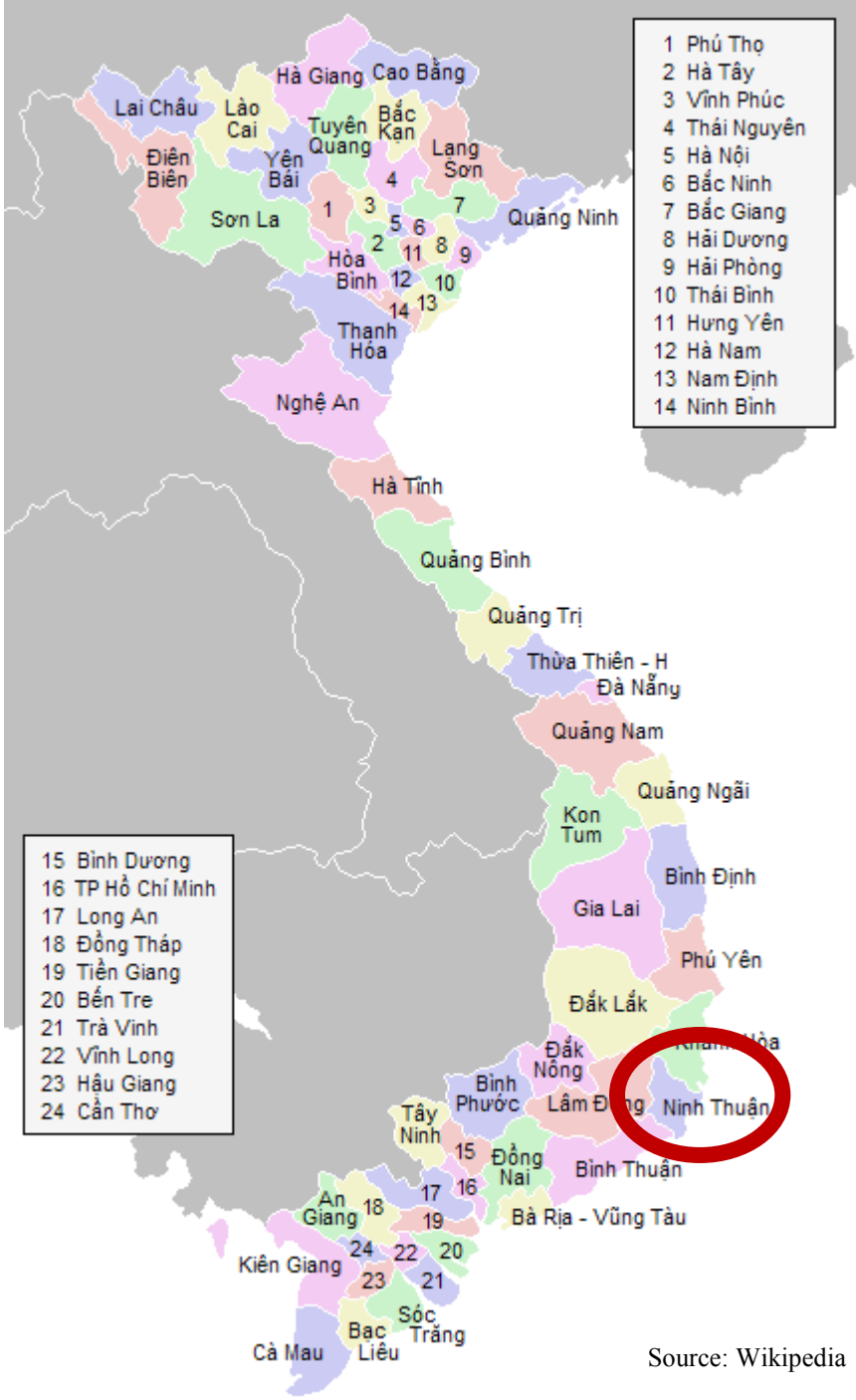




Source: IEA

Nuclear energy in Vietnam

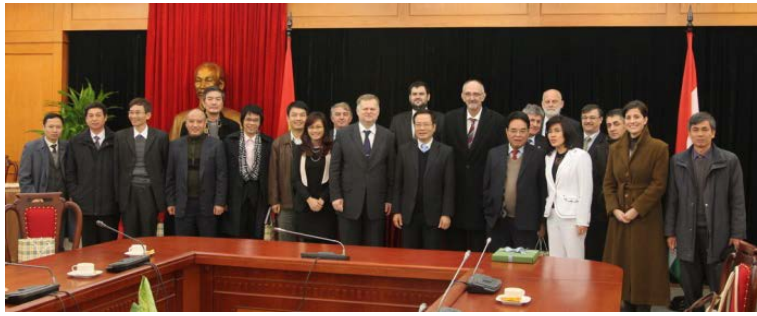
- Installation of 2000 MWe nuclear capacity announced in 2007 until 2020
- Further plans for additional 6 reactors, total 8000 MW nuclear capacity by 2025
- First selected nuclear site:
  Phuoc Dinh in Ninh Thuan province, where 2+2 reactors could be commissioned in 2020s
- October 2010: intergovernmental agreement with Russia for the construction of two VVER-1000 reactors (AES-91, like in Tianwan, China)
  - Assumed construction start: 2014 (2016)
  - Financed by Russian state credit.
- Further negotiations with Japan about possible construction of two Generation 3 reactors



Source: Wikipedia

HUVINETT 2012-2013: Hungarian-Vietnamese Nuclear Energy „Train the Trainers” Course

- Preparation
  - Coordinated at the highest diplomatic levels since 2009
  - In consonance and harmony with IAEA-frameworks
  - Several exchanges of delegations to construe a powerful training content
  - Preliminary agreements for many years in different fields
- The product
  - **HUVINETT** - Hungarian-Vietnamese Nuclear Energy „Train the Trainers” Course
  - Six-week course
    - comprehensive overview of the technical-scientific background for the construction-operation of an NPP,
    - theoretical background,
    - human resource needs and associated training programs
  - 3 weeks at BME NTI + 3 weeks in Paks NPP



Institute of Nuclear Techniques, BME, Hungary
Training reactor

- Location: Campus of the Budapest University of Technology and Economics (BME)
- Reactor type: pool-type reactor (Hungarian design)
- First criticality: 1971.
- Nominal Power: 100 kW
- Moderator and coolant: light water
- Horizontal and vertical irradiation channels
- Pneumatic dispatch system for the transfer of the samples into the core

Education at Training Reactor, Hungary

- Levels of courses:
  - BSc, MSc, PhD
  - Post-graduate courses
- Specialties:
  - Physics BSc and MSc with nuclear specialization
  - Energy Engineering (power engineering BSc and MSc with nuclear specialization)
  - Very active PhD school
- Measurement exercises for other universities and faculties of BME
- Different international short courses

Photo: Fehér S.

MVM Paks NPP

- 4 VVER-440 type units in operation since 1982 - 1987
- 46 % share in the domestic electric energy production (37% in consumption)
- Continuous upgrading of safety and production performance through innovative development
- Excellent availability and safety indicators
- Extended service time (30 ➔ 50 years)
- Very strong scientific-educational system and associated infrastructure
- Extensive knowledge and experiences accumulated from more than 100 reactor years operation

Photo: Paks NPP

HUVINETT 2012-2013: Hungarian-Vietnamese Nuclear Energy „Train the Trainers" Course

HUVINETT Courses at BME NTI

- 80 hours lectures

- Key topics of lectures:
  - Nuclear Fundamentals
  - Reactor physics
  - Thermal hydraulics
  - Nuclear Fuel cycle
  - Nuclear power plants
  - Nuclear Safety
  - Operation of nuclear power plants
  - Nuclear measuring method
  - Radiochemistry
  - Radiation and environmental protection

Photo: Aszódi A.

HUVINETT 2012-2013: Hungarian-Vietnamese Nuclear Energy „Train the Trainers" Course

HUVINETT Courses at BME NTI

- 36 hours laboratory demonstrations

- Selected laboratory exercises:
  - Introduction to laboratory exercise, radiation protection and safety training
  - Measurement of scintillation and semiconductor detectors
  - Measurement of gas filled and neutron detectors
  - Reactor operation exercise
  - Determination of spatial distribution of thermal neutron flux in the core of the training reactor

Photo: Aszódi A.

HUVINETT 2012-2013: Hungarian-Vietnamese Nuclear Energy „Train the Trainers" Course

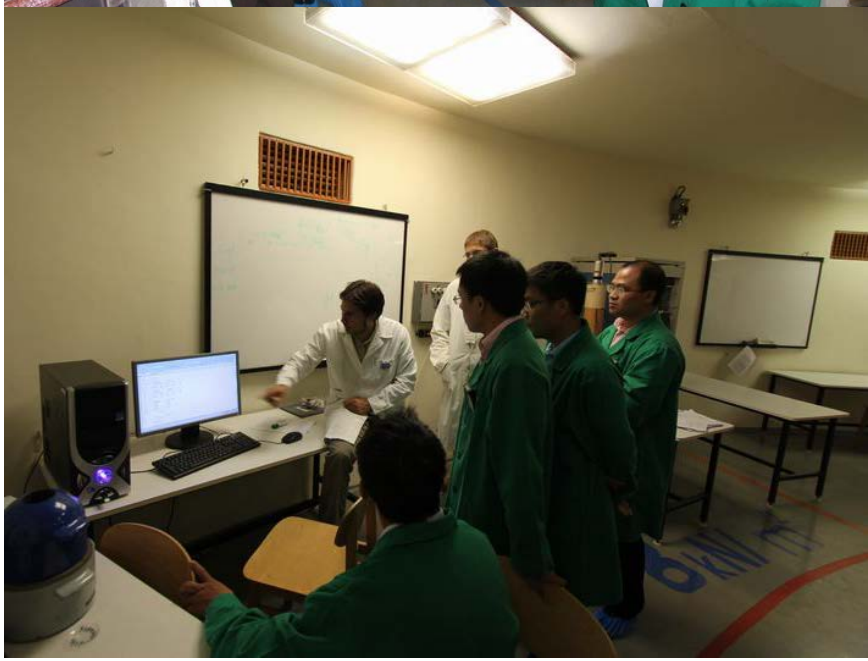
HUVINETT Courses at BME NTI

- 36 hours laboratory demonstrations

- Selected laboratory exercises:
  - Experimental demonstration of Thermal-hydraulics of PWRs during Loss-of Coolant Accidents on TRATEL Plexiglas mock-up
  - Radiation protection in practice
  - Demonstration of PWR primary circuit behavior on simulator
  - VVER-1000 simulator exercise

Photo: Aszódi A.

HUVINETT 2012/1, September



Final exam

Exams: detailed measurement of knowledge improvements and the end of the course

Photo: Aszódi A.

HUVINETT 2012-2013: Hungarian-Vietnamese Nuclear Energy „Train the Trainers” Course

HUVINETT Courses at Paks NPP

- 3 weeks of practice oriented training
- Practical application of nuclear theory and knowledge
- Plant technology
- Importance of nuclear safety
- Behavioral standards and required attitude in a nuclear power plant
- Practice in real working environment
  - Maintenance Performance Improvement Center
  - Simulator
  - Labs and workshops of the plant

Photo: Paks NPP

HUVINETT 2012-2013: Hungarian-Vietnamese Nuclear Energy „Train the Trainers" Course at Paks NPP

- Training program:
  - Duration: 3 weeks, 120 hours
    - Lectures, demonstrations: 64 hours
    - Plant visit, practice, exercise: 40 hours
    - Preparation, feedback, evaluation: 16 hours
- Subjects:
  - International, national requirement of NPP operation
  - Introduction of WWER-440 technology and equipment
  - Technology development/upgrade at Paks NPP
  - Safety related issues at Paks NPP
  - Nuclear fuel management and fuel handling at Paks NPP
  - Chemistry issues at Paks NPP
  - Maintenance activities at Paks NPP
  - Radiation protection at Paks NPP
  - Emergency response System at Paks NPP
  - Severe accident management
  - Technical support activities at Paks NPP
  - HR and training system at Paks NPP
  - Exercises on the simulator and on real primary circuit equipment

Photo: Paks NPP

HUVINETT 2012-2013: Hungarian-Vietnamese Nuclear Energy „Train the Trainers” Course at Paks NPP

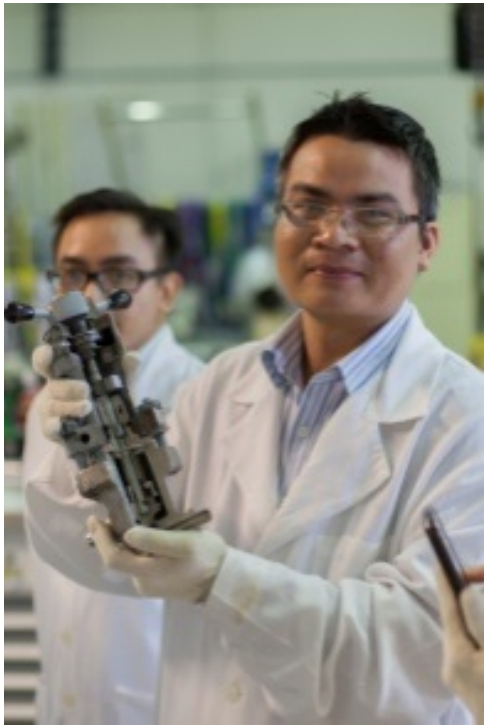


Photo: Paks NPP

HUVINETT 2012/1, September

- The first HUVINETT course
- 40 participants from Vietnam
- Successful test of the train the trainers program

Photo: Aszódi A.

HUVINETT 2012-2013: Hungarian-Vietnamese Nuclear Energy „Train the Trainers" Course

- Until now 4 HUVINETT courses with 160 participants
- HUVINETT feedback and conclusion:
  - Hungary has provided
    - unique environments for learning,
    - well prepared-organized training content,
    - experienced and knowledgeable lecturers.
- **The continuation of the HUVINETT program is considered as highly beneficial for Vietnam to better face its endeavors in nuclear education and training**
  - Next course is under preparation for September 2014
  - Other short courses are planned, too

Paks NPP, the Training Reactor of TU Budapest and the Hungarian Nuclear Education Network (HUNEN) is open for further cooperation, especially with those countries embarking upon their national nuclear program