



INPRO Dialogue Forum

“Drivers and Impediments Regional Cooperation on the Way to Sustainable Nuclear Energy Systems”

CROATIA

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Republic of Croatia - Key Facts



Zagreb

25 June 1991 (from Yugoslavia)

South- Eastern Europe

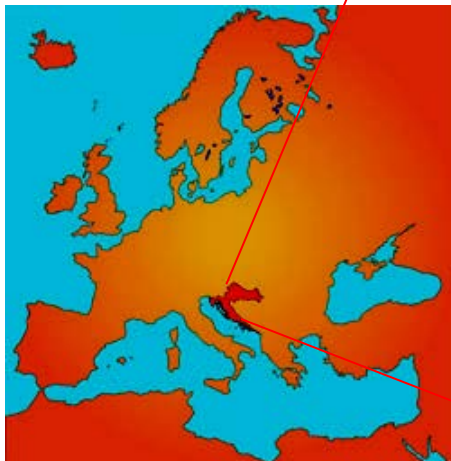
4.32 million

56 600 km²

31 000 km²

1185 Islands

- **Capital:**
- **Date of independence:**
- **Position:**
- **Population:**
- **Area:**
- **Sea surface**
- **Adriatic coast with**
- **Part of Pannonian Plain in North**
- **Strong maritime, agricultural and tourist potential**



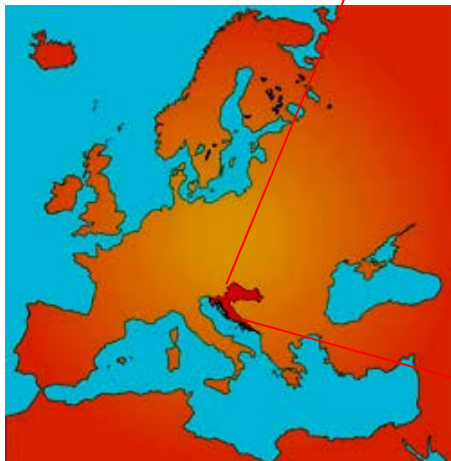


Republic of Croatia - Key Facts



• Croatia's Economic Indicators for 2010

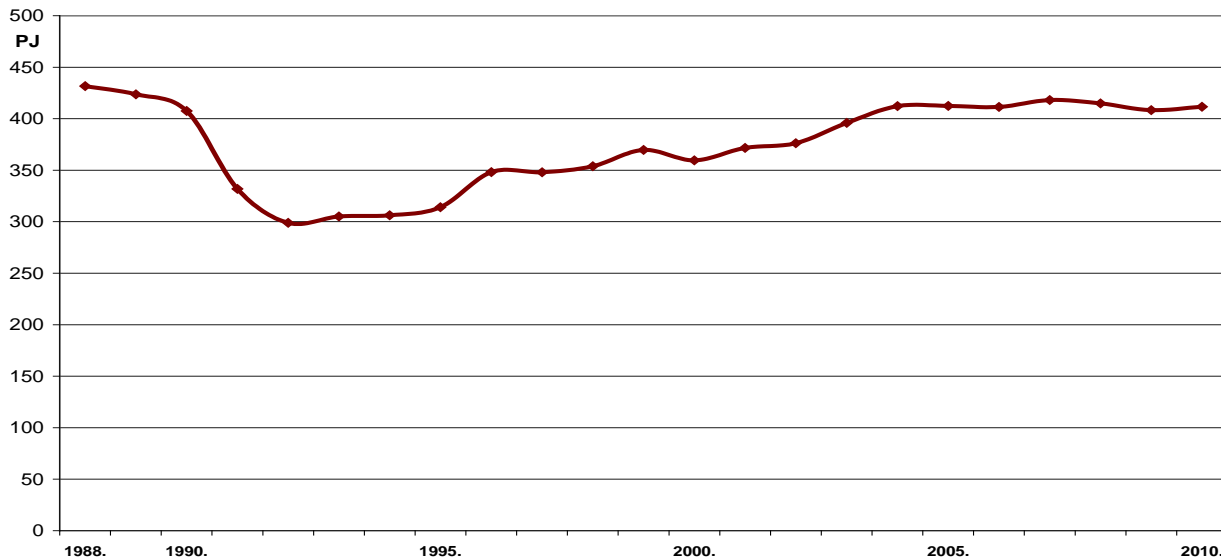
– GDP, bn EUR	45.9
– GDP per capita, EUR	10,380
– GDP per capita; PPP (US dollar)	19,516.06
– Industrial output (%)	-1.4
– Inflation rate (%)	1.1
– Unemployment rate (%)	11.8
– Exports, m EUR	8,902.4
– Imports, m EUR	15,127.2
– Balance of payments - current account, (% of GDP)	-1.4
– General government deficit (% of GDP)	-5.2
– Average monthly gross salary, EUR	1,054
– Average no. of employed persons	1,418,779





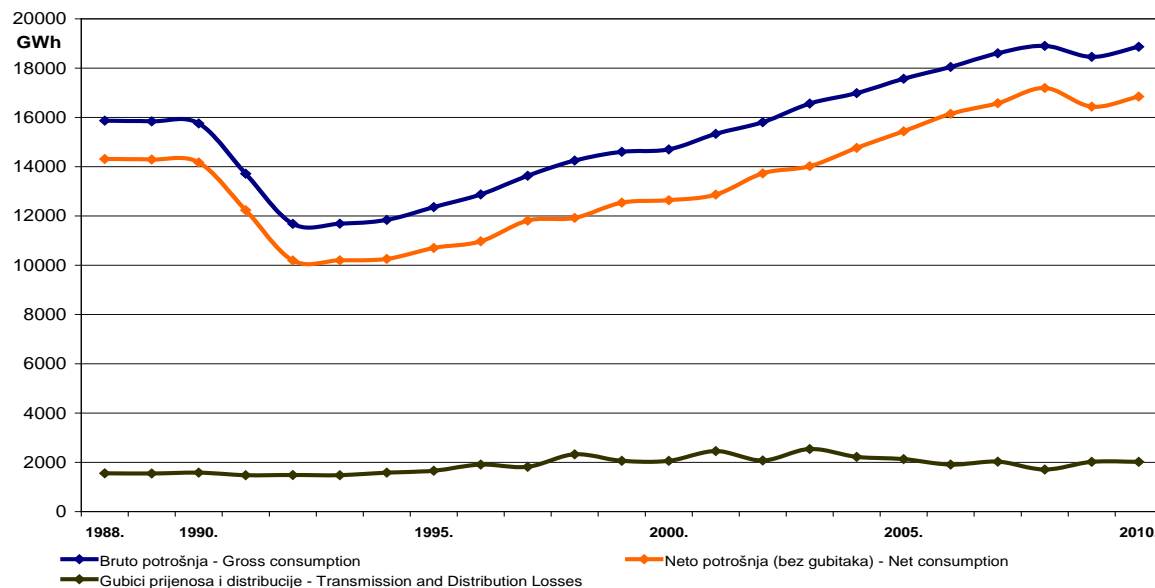
ENERGY AND ELECTRICITY IN CROATIA





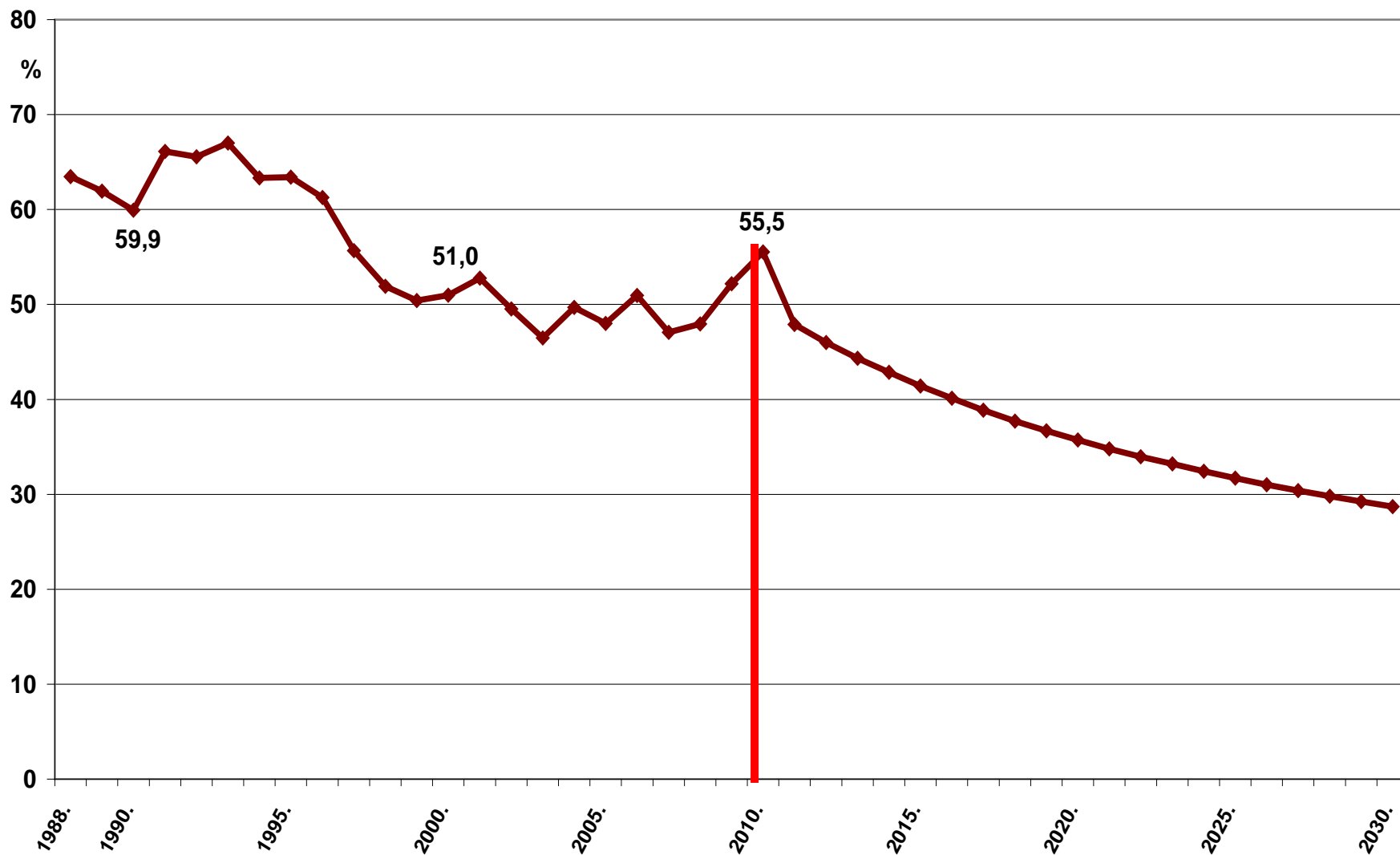
Total primary energy supply

Electricity consumption



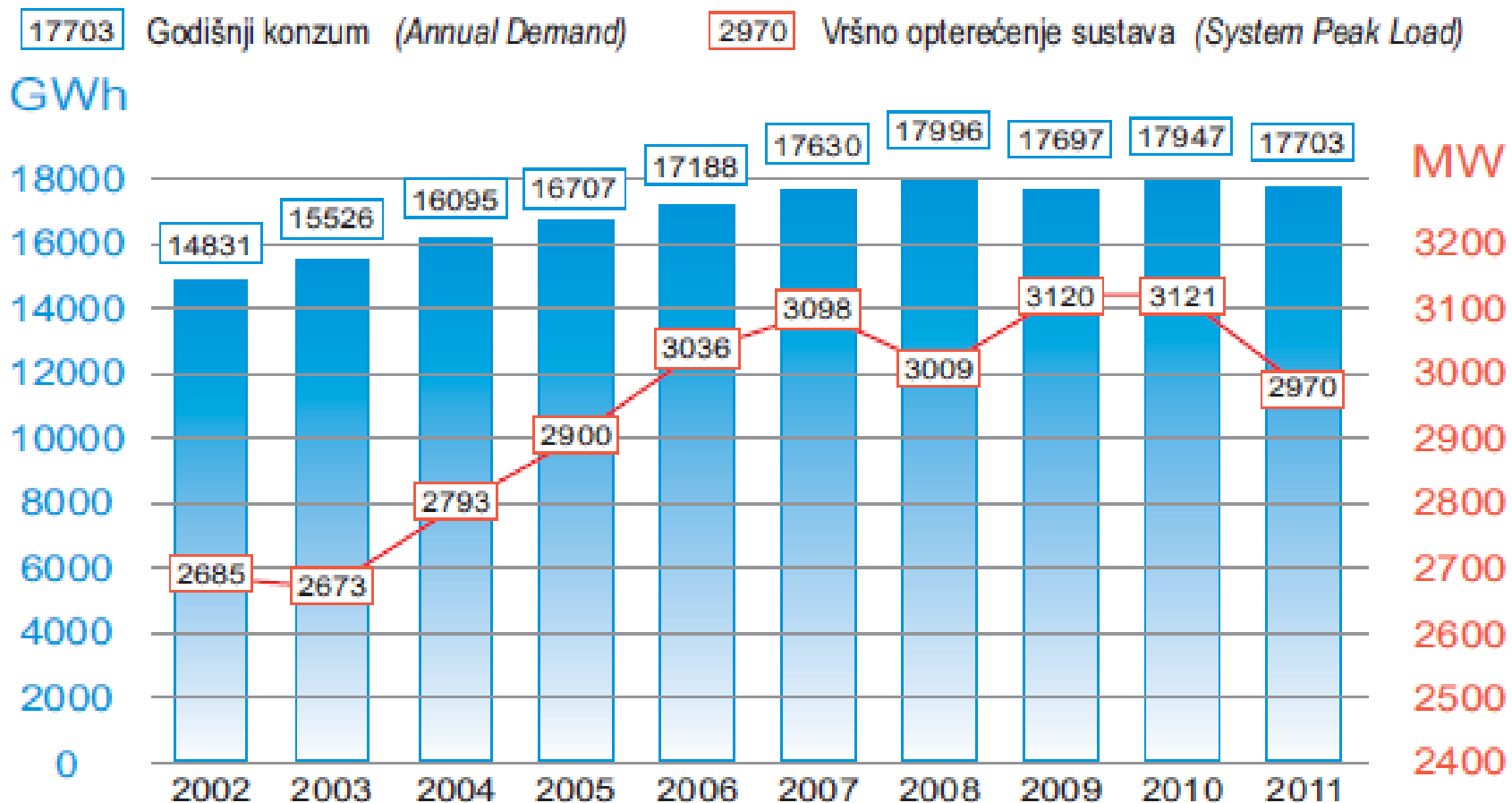


Primary energy self-supply in Croatia



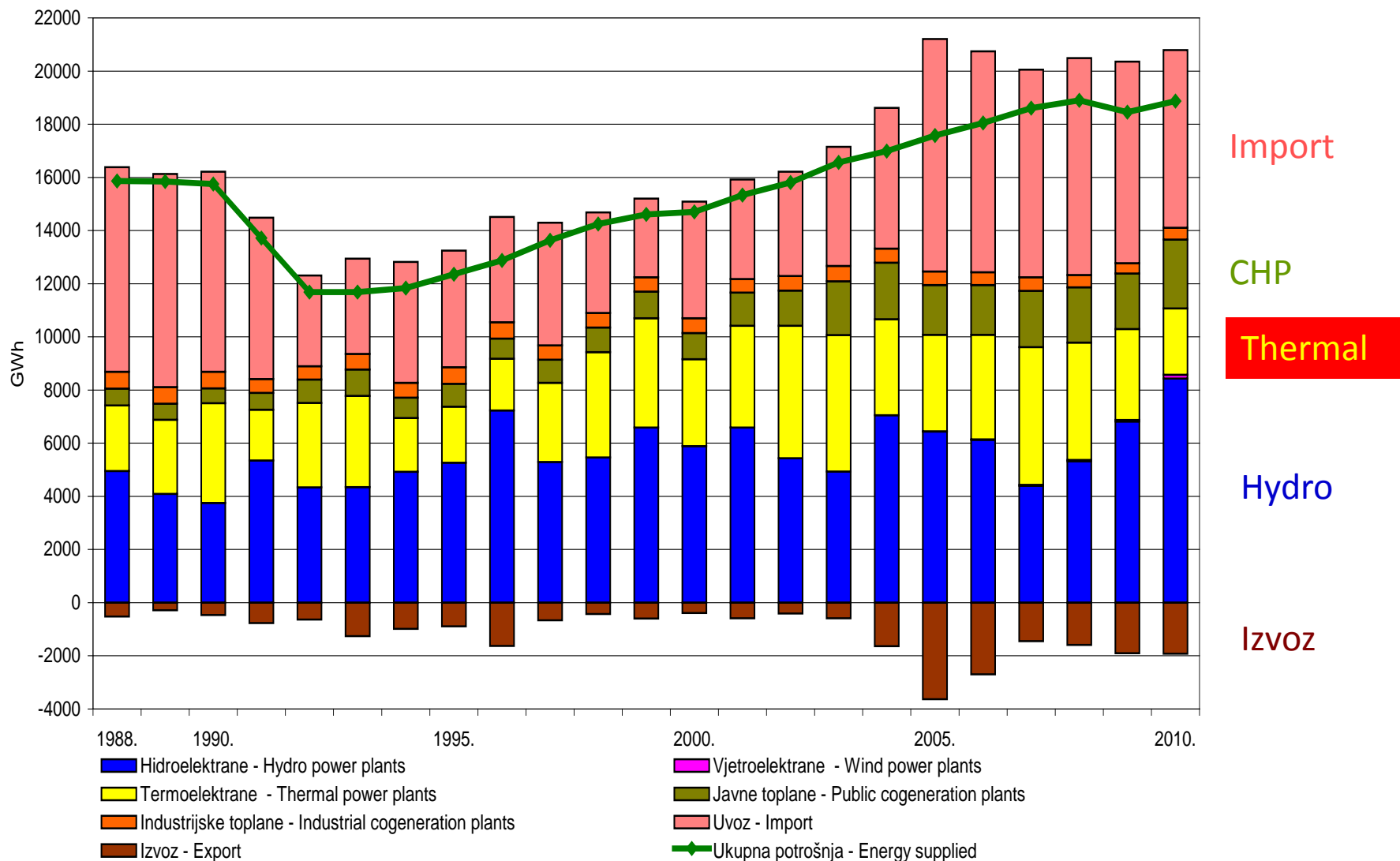


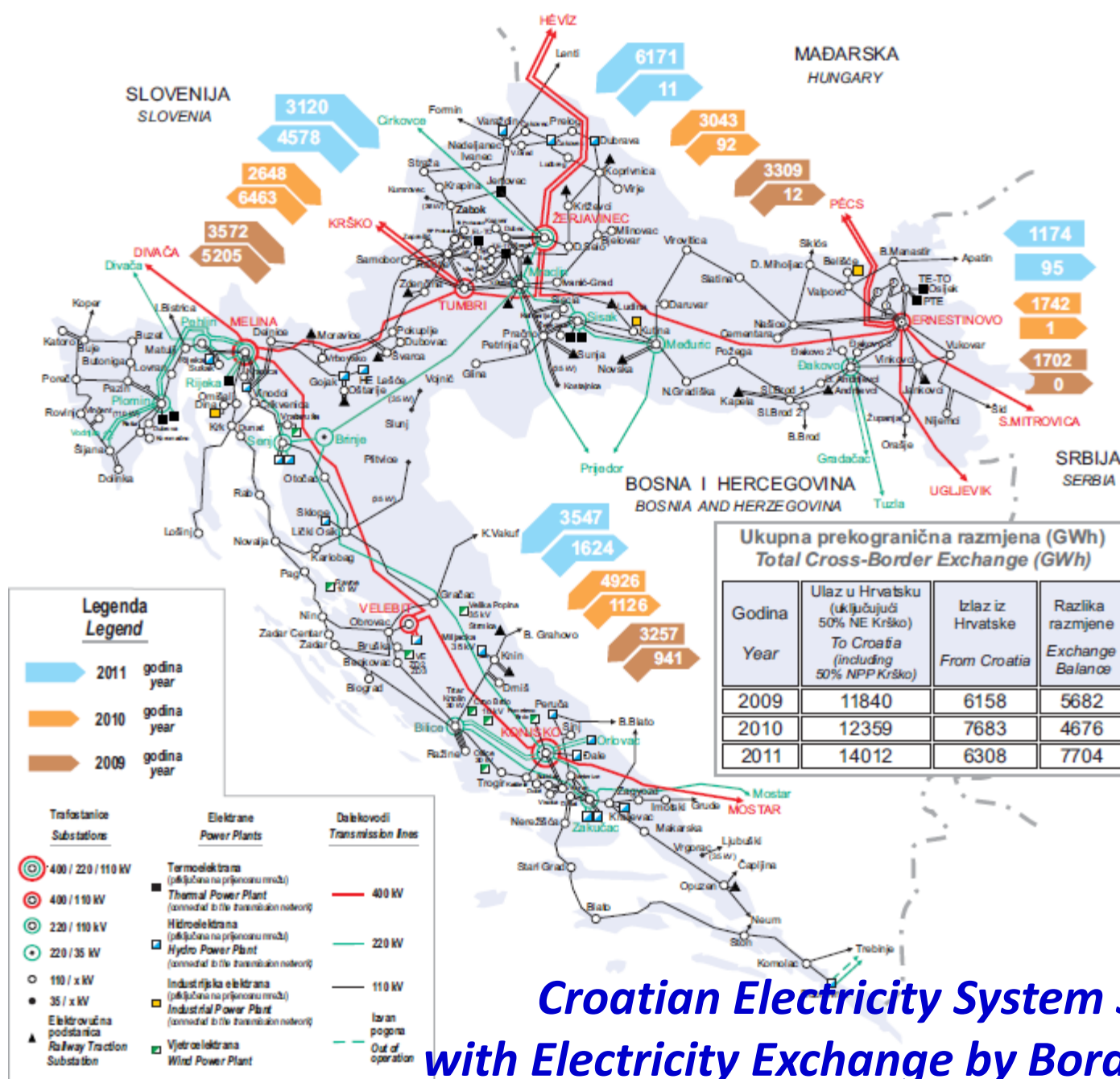
Annual Demand (GWh) and System Peak Load (MW)





Energy Balance of Electricity





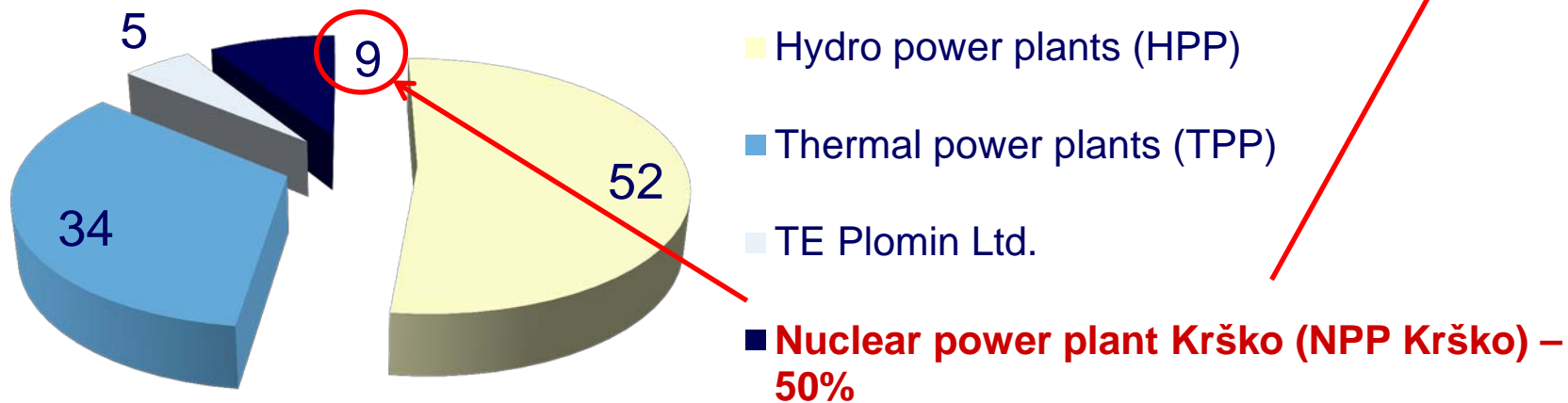
Croatian Electricity System Scheme with Electricity Exchange by Borders (GWh) in 2011



Available electricity generation capacity for Croatia – Generation Mix in 2010



Electricity generation capacity	Available power [MW]	Share [%]	Electricity produced in 2010 [GWh]	Share [%]
Hydro power plants (HPP)	2 134,56	51	8 308	53
Thermal power plants (TPP)	1 489	36	3 276	21
TE Plomin Ltd.	192	4,6	1 510	10
Total in the Republic of Croatia	3 815,56	91,6	13 094	83
Nuclear power plant Krško – 50%	348	9	2 690	17
Total (HEP Group)	4 163,56	100	15 789	100





Electricity Net Import (GWh)

Year	Import - Total	NEK - CRO	Import without NEK	Total consumption	Import share % (without NEK)	Import share % (including NEK)
2009	5682	2730	2952	17697	17%	32%
2010	4676	2690	1986	17947	11%	26%
2011	7704	2950	4754	17703	27%	44%



CROATIAN ENERGY STRATEGY

Adopted in October 2009



BASIC CROATIAN ENERGY STRATEGY OBJECTIVES

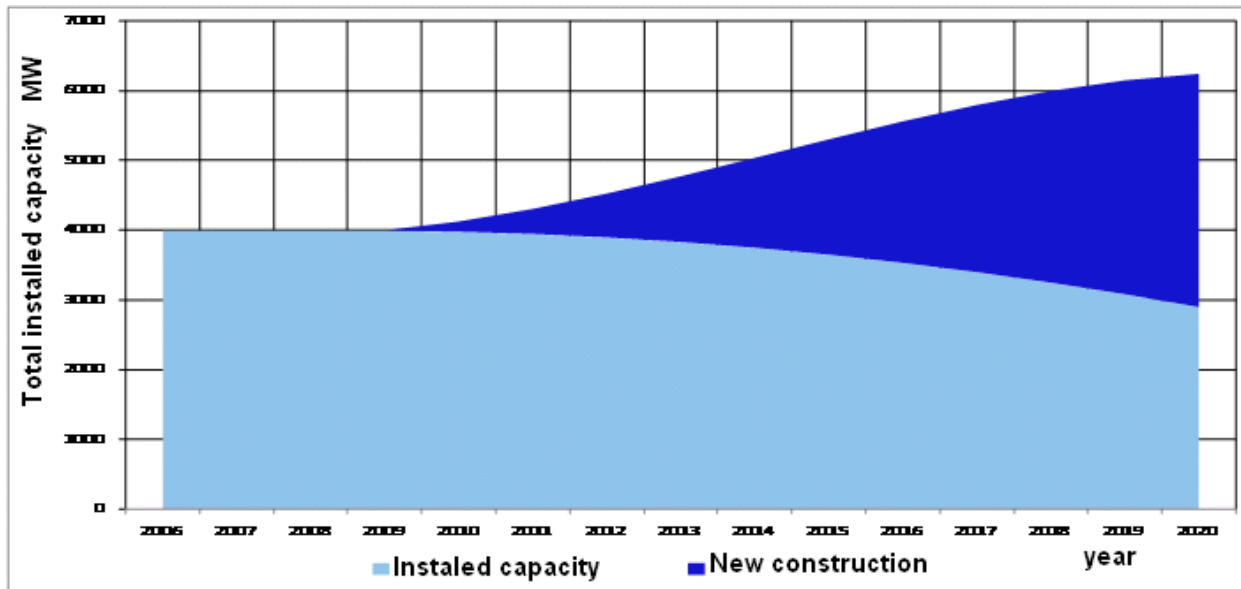
- **National Energy Strategy** is adopted by the Croatian Parliament on October, 16th 2009.
- The Croatian Energy Strategy has three basic energy objectives:
 - **Security of energy supply;**
 - **Competitiveness of energy sector;**
 - **Sustainable development.**
- Mainly until 2020 – look on 2030



ELECTRICITY until 2020

Final electricity consumption and total electricity consumption in sustainable scenario

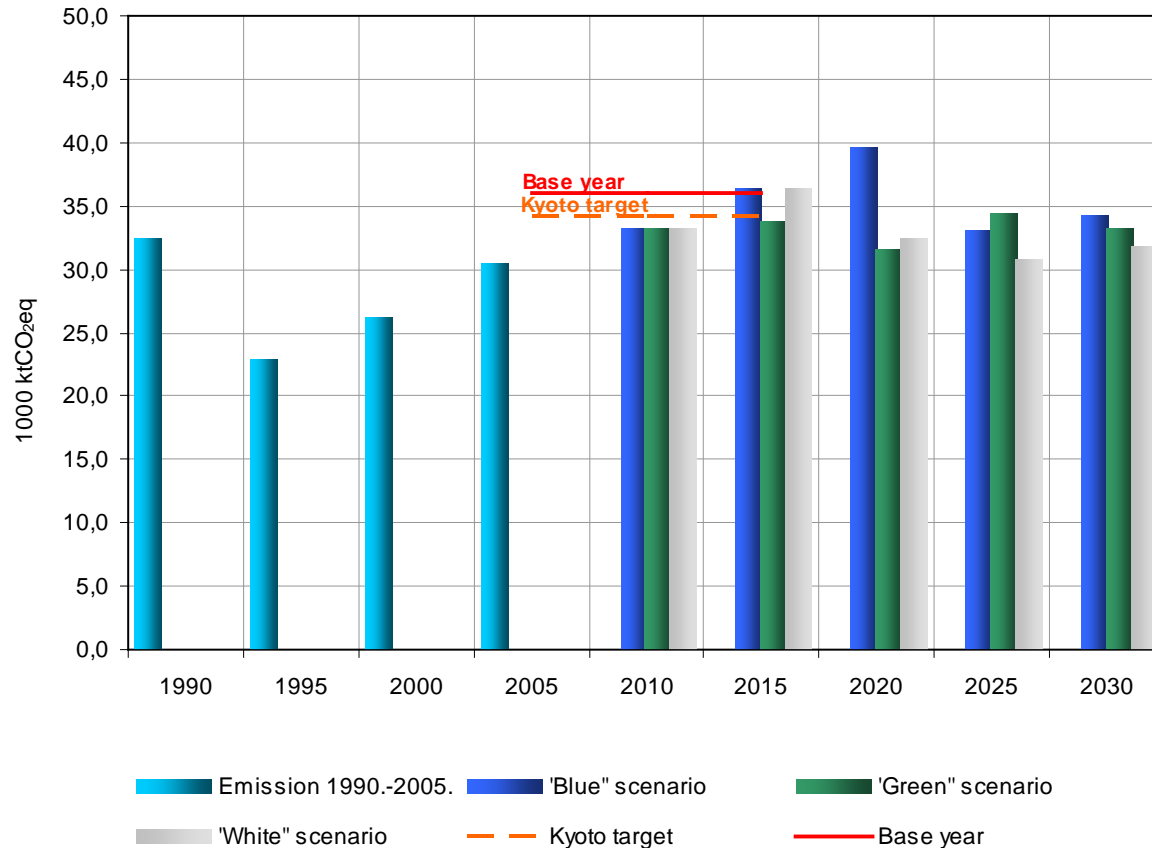
Year	2006.	2010.	2020.	Growth rate of consumption 2006. - 2020. (%)	2030.
Immediate consumption according to the basis projection (TWh)	15,0	18,0	27,0	4,3	36,9
Final consumption towards a sustainable scenario (TWh)	15,0	17,0	25,0	3,7	33
Total electricity consumption for sustainable scenario (TWh)	17,3	20,0	28,0	3,5	36,8



- **1,1 GW power plants will be shut down.**
- **2,4 GW thermal power plants should be built to cover consumption and support generation from RES.**

Installed capacity and starting up new plants

Green book: 3 POSSIBLE SCENARIOS AND CO₂ EMISSIONS



- ◆ **Blue** scenario without **NPP** (gas, coal, RES);
- ◆ **NPP** after 2020 in **Green** (gas, **NPP**, RES) and **White** scenario (gas, coal, **NPP**, RES);
- ◆ After 2020 CCS technology included.
- ◆ **NPP after 2020**

- ◆ Even with nuclear option Croatia will **have difficulties** in meeting internationally **binding targets**, CO₂ reduction until 2020 in comparison to 1990 while **maintaining security of supply** and competitiveness.

STATUS AND PROSPECTS OF A NUCLEAR POWER PROGRAMME



NUCLEAR - PRESENT NATIONAL POSITION

- **National Energy Strategy** approved by the Croatian Parliament on 16 October 2009 decided in favor of **launching the Croatian Nuclear Energy Program (CRONEP)**, consistent with the **IAEA methodology**
 - Croatia has been **entering into PHASE 1** – considerations to launch a nuclear power program prior to decision making
 - It was primarily planned **decision-making on building the nuclear power plant by 2012**, **nowdays is not realistic** but launching nuclear program is necessary and is in the process.
- **Final decision about NPP** will be taken by the Croatian Parliament



NUCLEAR - PRESENT NATIONAL POSITION (2)



- The Program of Preliminary Activities on CRONEP will be detailed in the **Strategy Implementation Programme for the period 2010-2014** (contains also a list of preparatory activities of the Phase 1) – still in preparation



NUCLEAR - PRESENT NATIONAL POSITION - ROLE OF CRONEP

- ◆ The **launching** of the Croatian Nuclear Energy Programme comprises two basic goals:
 - **providing for existence** (co-existence) in immediate vicinity of two nuclear power plants and five nuclear reactors in NPP Krško and NPP Paks
 - **providing for preconditions required for decision making and realization of nuclear power plant construction.**
- ◆ **Nuclear safety and public awareness** will be in the focus of the CRONEP.

Drivers (motivations) for considering nuclear power programme

THE DRIVING FORCES FOR CONSIDERING A NUCLEAR POWER PROGRAMME



Why nuclear?

EXPERIENCE IN NUCLEAR

- The Republic of Croatia **has previous nuclear experience** and belongs to a group of **countries that use nuclear power for energy purposes.**
- Croatian nuclear experience arises from:
 - more than 10 years of preparations and construction of NPP Krško;
 - 29 years of successful operation of NPP Krško;
 - **preparation for construction of the first NPP in Croatia carried out until 1987 (NPP Prevlaka).**
- **Positive influence of NPP Krško construction and operation is still present in the Croatian industry.**



Country's energy policy: Why nuclear?

- **NP is already a part of energy supply** -Hrvatska Elektroprivreda (Croatian Power Utility) is co-owner of **696 MWe NPP Krško** in Slovenia
 - Share in installed capacity of Croatia 9%
 - NEK share in Electricity produced in 2008 15%
 - NEK share in Electricity produced in 2011 16.7%
- Preparation for construction of **the first NPP in Croatia carried out until 1987** (NPP Prevlaka)
- In 1987 NPP Prevlaka project was terminated after Chernobyl accident.



Country's energy policy: Why nuclear?

- Reports from the **Energy Strategy Green Book** (2009) notify that the **Government** cannot take over the responsibility for **excluding** the nuclear option from the future energy structure, as well as the responsibility for **delaying the preparation** activities necessary to make decision on building the nuclear power plant.
- **Lost time could not be possible to compensate**, and the right strategy does not limit the future development possibilities.



Country's energy policy: Why nuclear?

- The Energy Strategy Green Book indicates that energy system **development scenarios with nuclear power plants and coal-fired power plants** provide:
 - the **regional competitiveness** in electricity generation,
 - contribute to the **security of energy supply**, and
 - that the nuclear power is the only one, along with the renewable energy sources, which **contributes to reducing the CO₂ emissions** in the atmosphere.

Possible **impediments** (difficulties, “showstoppers”) for considering nuclear power programme

IMPEDIMENTS FOR CONSIDERING A NUCLEAR POWER PROGRAMME



Possible **impediments** (difficulties) for considering nuclear power programme

- **Public** - the construction of a NPP is a project of large public interest and also **opposition**
- **Long time and high costs for preparation**
- **Financing – large investment cost in small economy**
- Human Resources



Key Communication Challenges regarding Nuclear Power

► Public communication

- **A limited range of public surveys were conducted** in the past 3-4 years, mostly among **student population**
- **NEMIS - internet portal** (www.nemis.zpf.fer.hr) containing objective information on nuclear issues was **set up in 2009**
- During the process of **preparation the National Energy Strategy**, **positive aspects of nuclear energy were recognized among participating parties**
- **Engagement of a professional communication agency is inevitable in the near future**



Financing

▶ Financing

- ▶ Absence of overall financing scheme for the launching national nuclear project
- ▶ **Financing scheme for construction of NPP?**



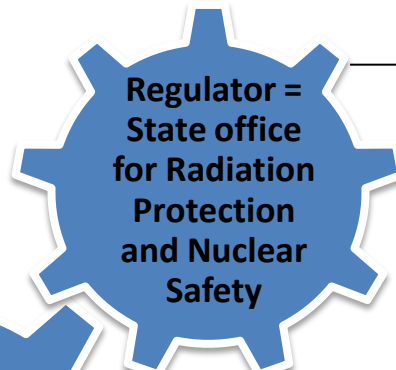
Overview of Current **Human Resources** in Croatia to Support Nuclear Power

- ▶ **20-30 years ago Croatia had experienced** nuclear staff
- ▶ Knowledge achieved during two nuclear projects:
 - ▶ **Construction and operation of NPP Krško – jointly built with Slovenian partners**
 - ▶ **Construction of NPP Prevlaka – project ceased in 1987, after Chernobyl accident**
- ▶ The biggest number of nuclear experts (nuclear power engineers) **already retired**
- ▶ Lack of new nuclear projects in the last 20 years resulted in
 - ▶ **Multy skilled workforce – a number of ex-nuclear staff has been involved in different areas of business today**
 - ▶ **Drop of interest of local industry for participation in relatively narrow range of jobs and services related to NPP Krško**
 - ▶ **Drop of interest of students for nuclear power courses**



Overview of Current Human Resources in Croatia to Support Nuclear Power

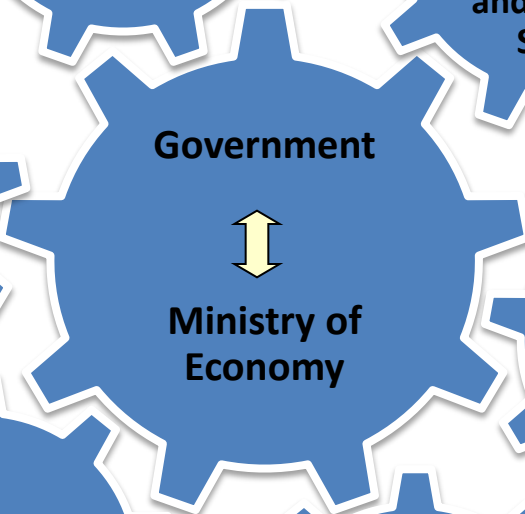
4 nuclear engineers + variety of workforce in fields needed to start with PHASE 1



Currently 12 +14 employees



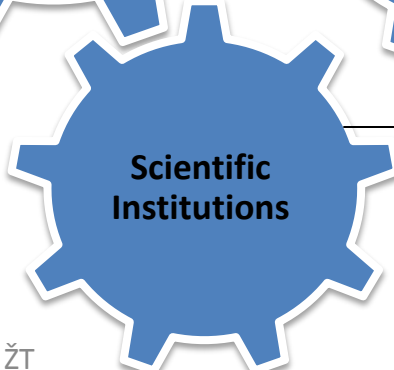
Faculty of Electrical Engineering and Computing Zagreb



10-20 companies with working experience on NPP Krško



Domestic + foreign + Croatian workforce from NPP Krško (80 workers)



Institute Ruđer Bošković, ...

HOW THE NUCLEAR ENERGY SYSTEM MAY LOOK LIKE IN 2030 AND IN 2050



How the nuclear energy system may look like in 2030 and in 2050

- The **Energy Strategy of the Republic of Croatia** is focused on the **period until 2020** that corresponds with the period covered by all adopted EU energy strategies.
- Due to long-term preparation, construction and exploitation of power generation facilities, decisions made based on the Strategy will influence on the period after 2020 as well.
- Therefore, the Strategy offers a “**glimpse** into future” until 2030.
- **There is no long-term energy strategy**
- **No official criteria for selecting nuclear technologies**

DOMESTIC INDUSTRY IN DEPLOYMENT OF NUCLEAR POWER PLANTS



Which role may play domestic industry in deployment of nuclear power plants by foreign suppliers

▶ **Inclusion of domestic industry**

- Positive influence of participation of Croatian industry **in construction and operation of NPP Krško**
- However, very small number of Croatian companies have had success in creation strong international position (INETEC)
- **Still great potential for domestic industry**

▶ **Policy regarding the procurement of equipment and services**

- Dependence on the solutions for contracting

**VISION OF *BACK-END FUEL CYCLE*
SERVICES FOR NATIONAL NUCLEAR
POWER PROGRAMME**



Vision of *back-end fuel cycle services* for national nuclear power programme

► Nuclear fuel cycle

- **Croatia doesn't have tendency** toward national participation in manufacturing of any segment of nuclear fuel
- Existing option for “**Back end fuel Cycle** “ – National Strategy for Management of radioactive waste and spent nuclear fuel (July 2009)
- **Croatia has obligation to find solution for half of the waste from NPP Krško**



Radioactive waste

- **National Strategy for Management of radioactive waste and spent nuclear fuel** (July 2009) – **3 options**

Joint CRO-SLO repositories

Export in 3rd country

Repository in Croatia

- **Site for LILW** is included in the National Spatial Plan (1999)
- **Fund for financing decommissioning of NPP Krško and disposal of NPP Krško radioactive waste and spent nuclear fuel established in 2007.**
- **Under review common „Program for decommissioning NPP Krsko” – lot of disputes (type, costs etc.)**

SUSTAINABLE NUCLEAR ENERGY SYSTEM



How you understand the concept of a sustainable nuclear energy system

The barriers, which must be overcome for nuclear power to be included in sustainable energy sources:

- **The nuclear energy life cycle**
 - eliminate all radioactive waste at the end of life and minimize the environmental impact during mining and operations;
- **Security of supply**
 - Even with a significant deployment of fast reactors, the **uranium resources can remain a crucial issue,**
- **Public acceptance**
 - nuclear installation safety, protection of workers and populations against radiation, management of all types of waste
- **Nuclear safety**
 - continuous improvement of safety levels
 - continuous improvement of resistance to proliferation.



How you understand the concept of a sustainable nuclear energy system

The barriers, which must be overcome for nuclear power to be included in sustainable energy sources:

- **Competitiveness**
 - Eliminate nuclear insecurity to reduce the risks associated with nuclear power so that the free market can insure the nuclear industry without large public nuclear energy insurance subsidies;
- **Spent-fuel and waste management,**
 - Solution for spent-fuel & HLRW
 - waste minimization issue
- **Economic sustainability**
 - The nuclear industry must also address difficult issues of equity both in the present and for future generations
 - Need a significant progress in economic performance
- **The nuclear industry must gain public trust**
 - innovative technical solutions need to be discovered for the fundamental inherent environmental handicaps of nuclear energy technology

ENERGY INDEPENDENCE AND SECURITY OF SUPPLY



Elaborate on your vision of *Energy independence and Security of supply*

SECURITY OF ENERGY SUPPLY

- Security of energy supply is defined as a long-term availability of energy sources and ability for proper market functioning, i.e. a desired level of competitiveness on the energy markets.
- **Market mechanisms create the security of supply.**
- However, the **Government is responsible for the security of supply.**
- The **Government shall take care of the supply security** by **planning, timely observing the possible endangerment of the security of energy supply and timely encouraging the investor's interest for building the necessary infrastructure.**
- Croatia recognizes its role in regional planning of the security of energy supply



Elaborate on your vision of *Energy independence and Security of supply*

- The **main principle** of the Croatian Energy Strategy is to achieve a **completely open energy market in Croatia** which is regulated as regards natural monopoly, as part of single regional and European energy market.
- There are several elementary starting points for achieving of **Security of energy supply goal**:
 - **Diversification of energy sources**
 - **Independent regulation of the Energy sector;**
 - **Government's role in securing market functioning;**
 - **Securing mandatory oil and natural gas reserves;**
 - **Using energy transit possibilities.**



Elaborate on your vision of *Energy independence and Security of supply*

- Although due to **insufficient generation capacities**, **Croatia is obliged to import the electricity**, a diversity of its energy system is satisfying:
 - **hydropower** plants contributes with 35% in satisfying the total electricity consumption,
 - while the electricity-generating structure out of **coal, natural gas and heavy fuel oil and uranium is balanced**.
 - Current significant **electricity import** in a period of poverty indicates on **reduced security of supply and a need for quick building of own sources**.
- The Government shall make assumptions to **persist on diversity of applied technologies and energy sources** for energy conversion in future development of power plants structure in the Croatian energy system.

**COOPERATION WITH OTHER
COUNTRIES IN ENERGY PROJECTS,
NUCLEAR AND NON-NUCLEAR**



The experience of cooperation with other countries in energy projects, nuclear and non-nuclear

- International cooperation in energy projects
 - **NPP Krško (Hrvatska & Slovenia)**
 - **Coal thermal power plant Plomin 2 (HEP Croatia & RWE Germany)**
 - Very successful project
 - Same principle will be used for new Coal thermal power plant Plomin 3 (500 MW)



- history

The Slovenian-Croatian Krško nuclear power plant

- The Krško Nuclear Power Plant is located in Slovenia.
- It was built as a joint venture of Slovenia and Croatia when both parts were still constituents of the Republic of Yugoslavia.
- Since their respective independence in 1991, the Krško nuclear power plant has been **a continuous source of conflicts between both countries**.
- According to Slovenians, Croatians refuse to finance a fund for the disposal of nuclear wastes and for the retirement of the plant.
- As a consequence, the **nuclear plan did not supply electricity to Croatia for five years**.
- Local population protests caused the electricity supply to begin in July 2003 instead of July 2002.
- **As a response, Croatians sued the Slovenians to receive damages in compensation of the one-year period during which Krško did not deliver the electricity.**



- history

- **1981-1992: First Decade of Commercial Operation**
 - The Krško NPP was operating without serious problems, with full respect of the provisions from the Governing Agreements
- **1993-2002: Decade of Disputes**
 - Differences in the common understanding of Governing Agreements produced numerous disputes between the Parties
 - Due to Slovenian delay in the electricity resumption, in late 2005, HEP d.d. commenced arbitration against Slovenian Government before International Centre for Settlement of Investment Disputes (ICSID) in Washington seeking compensation for the period of delay (June 30, 2002 – April 19, 2003)
- **Current time: DECADE OF GOOD OPERATION and still unsolved problems with waste**
 - Current disputes arose from the past are expected to be solved
 - The Krško NPP has been achieving excellent business results in last few years
 - The Krško NPP is in very good financial health
 - The Krško NPP is the **high profitable energy source for both co-owners today**
 - The operator can operate!
 - Both owners can enjoy benefits of low cost electricity!



Some remarks on regional NPP projects

- Decommissioning
- Decommission Funds
- Waste storage
- Price of electricity
- Employment of personnel
- Compensations to local communities
- Does improve security of supply for not-host countries?
 - Cross-border capacities – auctions
 - Long term contracts and electricity markets?



Decommissioning Funds and LILW disposal

- **Funds in each country or one fund**
 - Large amount of money for long period
 - Benefits from fund money – investment policy
- **One waste disposal**
 - Not only for specific NPP?
 - Costs?
 - Size?
 - Taxes?
 - Payment to local community?
 - VAT
- ◆ **Or in each country – more expensive!?**



Some remarks on regional NPP projects

- Need for comprehensive and detailed contracts because of **long operation time of NPP**
- Relatively well-balanced **obligations and benefits** for all sides
- Business model:
 - profit or
 - non-profit for NPP
- Needed Experts that follow operation of NPP

**VISION OF POSSIBLE DRIVERS AND
IMPEDIMENTS FOR COOPERATION
WITH OTHER COUNTRIES IN NUCLEAR
POWER PROJECTS**



Vision of possible drivers and impediments for cooperation with other countries in nuclear power projects

- **NPP Krško 2**

- There are current proposals to add a second reactor and to extend the lifetime of the existing one.
- This alternative source of energy could significantly enhance the diversification of the Croatian energy supply.
- However, the **high political tensions** existing between both countries push Slovenia to consider financing the project by itself.



Vision of possible drivers and impediments for cooperation with other countries in nuclear power projects

- “Today, a nuclear program is a possible part of the national strategy.
- In spite of that, a nuclear program would be hard to materialize since it would take more than ten years for it.
- Croatia is not rich enough to afford such kind of long-term projects - **cooperation with other countries in nuclear power projects can help**

INDICATORS TO MEASURE BENEFITS AND DISADVANTAGES OF COOPERATION WITH OTHER COUNTRIES IN NUCLEAR ENERGY PROJECTS



What could be the indicators to measure benefits and disadvantages of cooperation with other countries in nuclear energy projects

- Share of “domestic” industry in construction of NPP
- Share of “domestic” employed people
- Solution for Decommissioning
- Establishment of Decommission Funds
- Solution for Waste storage (common, separate)
- Price of electricity
- Balance of **obligations and benefits** for all sides
- Compensations to local communities (specially if close to border)



CONCLUSIONS

- Slowdown of CRONEP:
 - **Economy crisis**
 - Large cross-border capacity and no problem with import of electricity and cheap electricity from import
 - Financing of preparation activities of CRONEP
 - Wait and see „German case of RES”
- Regional cooperation
 - As host or in other country???
 - Only possible reason financing problems

Thank you for your attention !



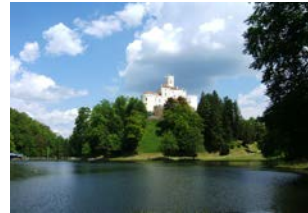
Plitvice



Krka waterfalls



Zagreb



Dubrovnik