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Energy planning at the regional level – the Baltic experience.

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Lithuanian Energy Institute

Plan of presentation

Current situation and objective of the study,

Study organisation,

Methodology,

Assumptions,

Scenarios,

Results,

Conclusions.

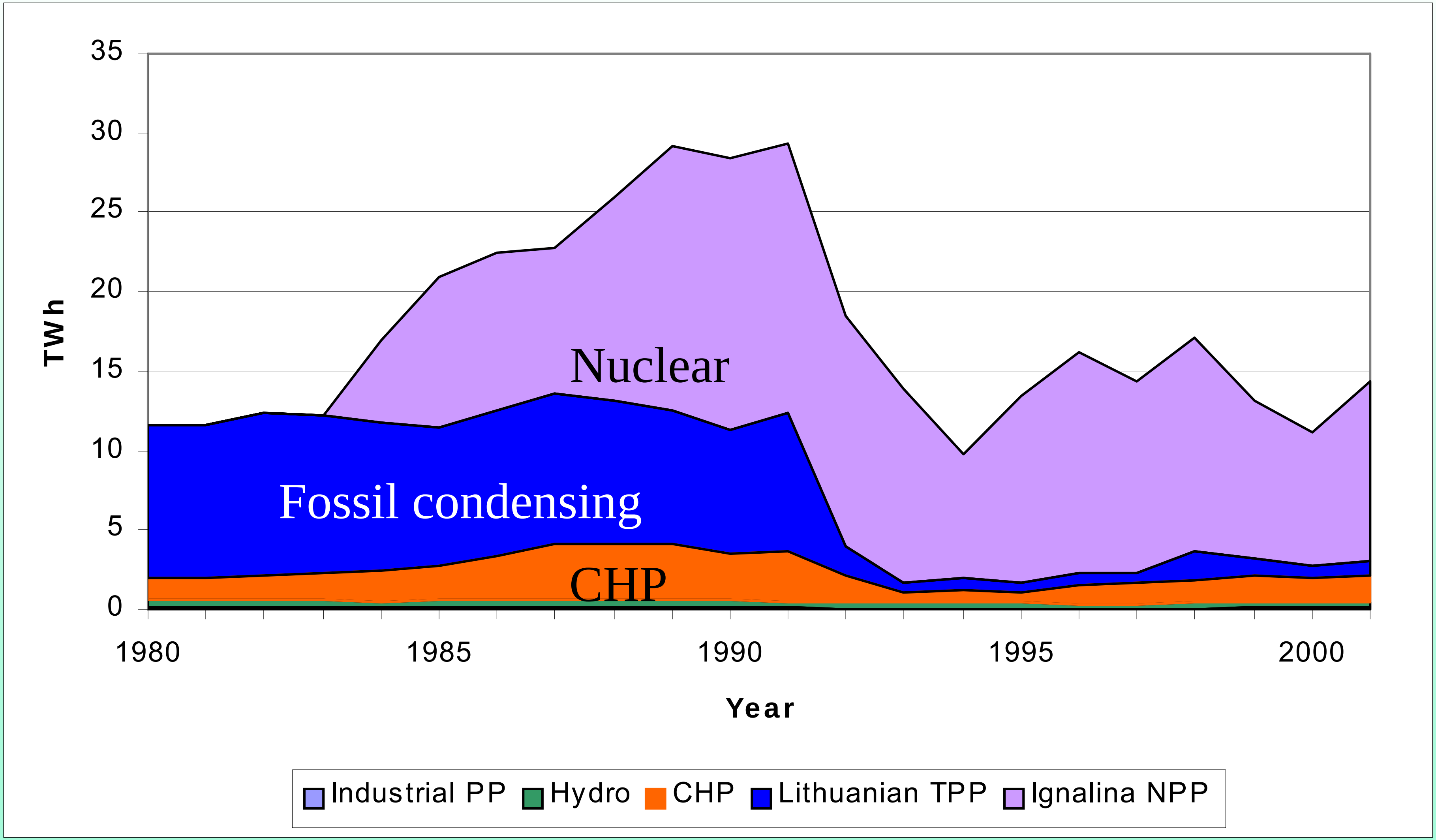
Current situation and objective of the study

Objective of the study

Development and comprehensive assessment of various future energy system development scenarios until 2025 ensuring rational utilization of existing and future energy supply infrastructures in order to minimize cost of energy supply in the region, keeping emissions below environmental limits and taking into account energy supply supply security issues.

The main attention, however, was paid to the analysis of power system development taking into consideration earlier closure of the Ignalina NPP (Lithuania) and investigation of effectiveness of construction of new nuclear power plant in the region in order to cover future electricity demand and increase security of energy supply.

Gross electricity production in Lithuania

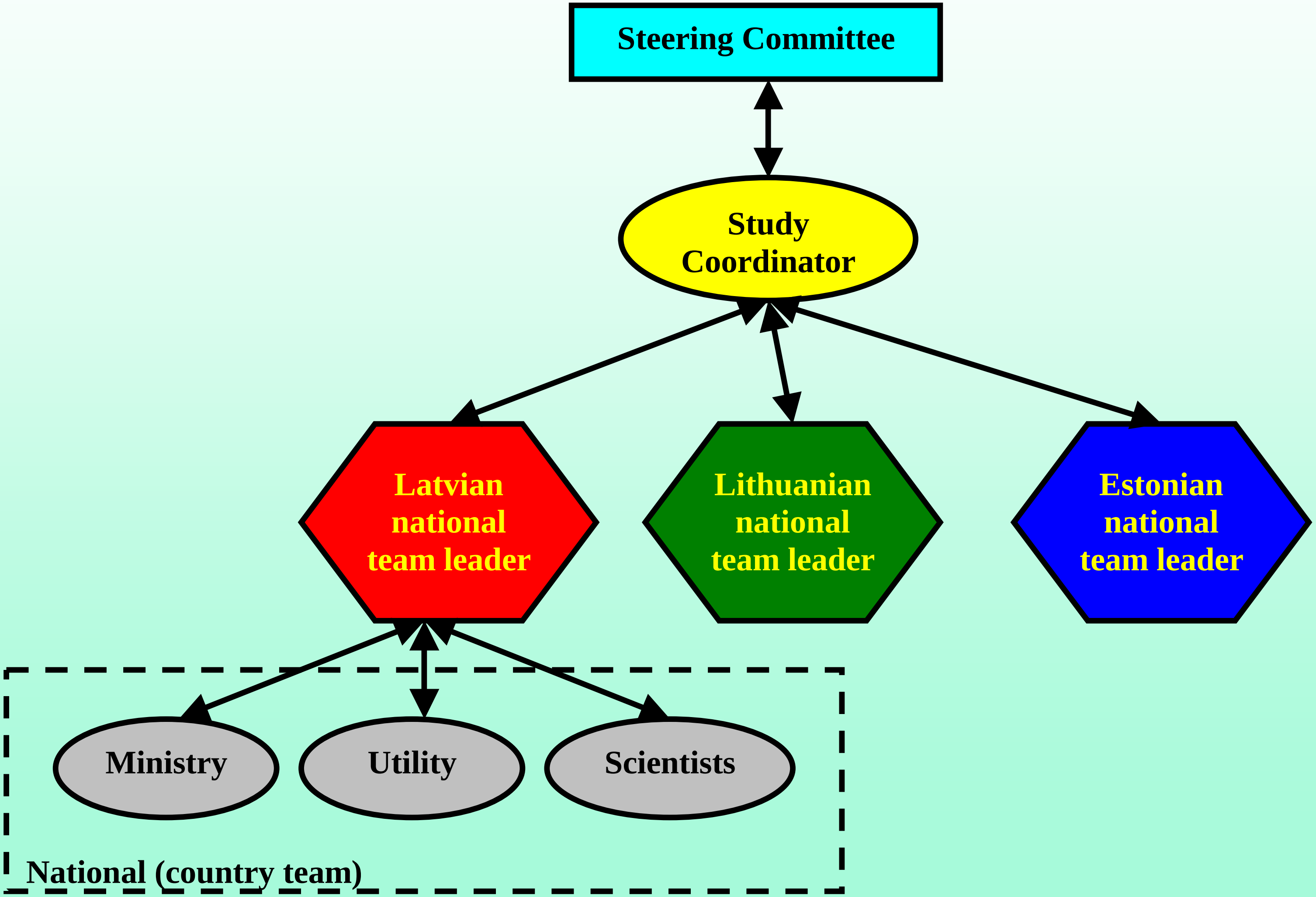


Network of electricity supply

Network of gas supply

Study organisation

Organization of the study



Parties involved in the study

Ministries:

- ✓ Providing information on legislation, policies and international obligations.
- ✓ Assistance in data acquisition by signing letters to relevant organizations.
- ✓ Review of results & recommendations.
- ✓ Contacts with policy makers.
- ✓ Organization of work groups from representatives of other organizations

Utilities:

- ✓ Financing (sponsorship) of study work.
- ✓ Steering Committee meeting organization.
- ✓ Assisting experts in data collection, model calibration & calculations.

Parties involved in the study

Research Institutes:

- ✓ Data collection.
- ✓ Calibration.
- ✓ Calculation.
- ✓ Analysis.

IAEA:

- ✓ Support of the study coordinator.
- ✓ Advice, consultancy.
- ✓ Methodology (models), training in methodology.
- ✓ Link to NATO and EU institutions.

NATO:

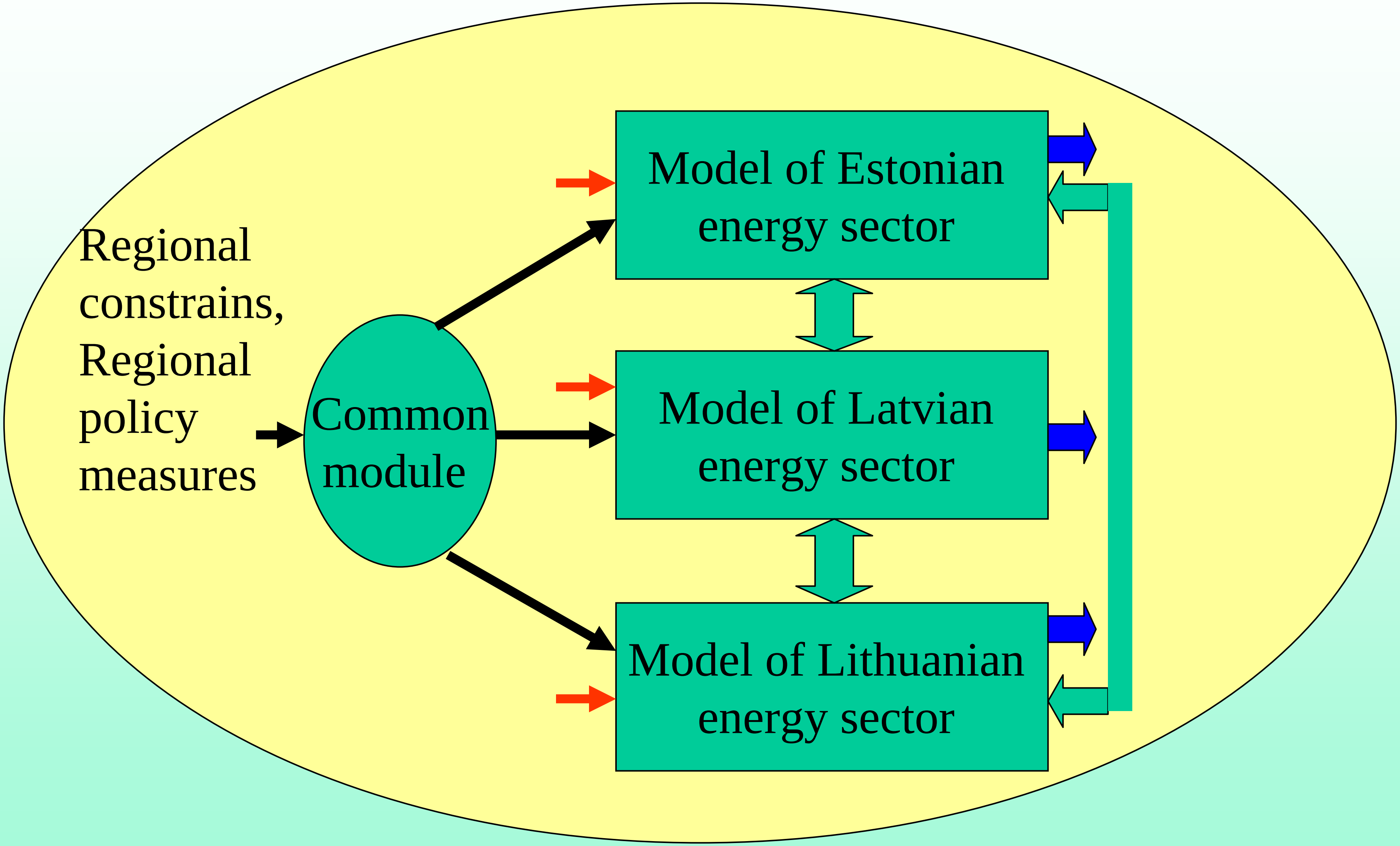
- ✓ Security analysis (assessment of energy supply security of Baltic States).

Financial responsibilities

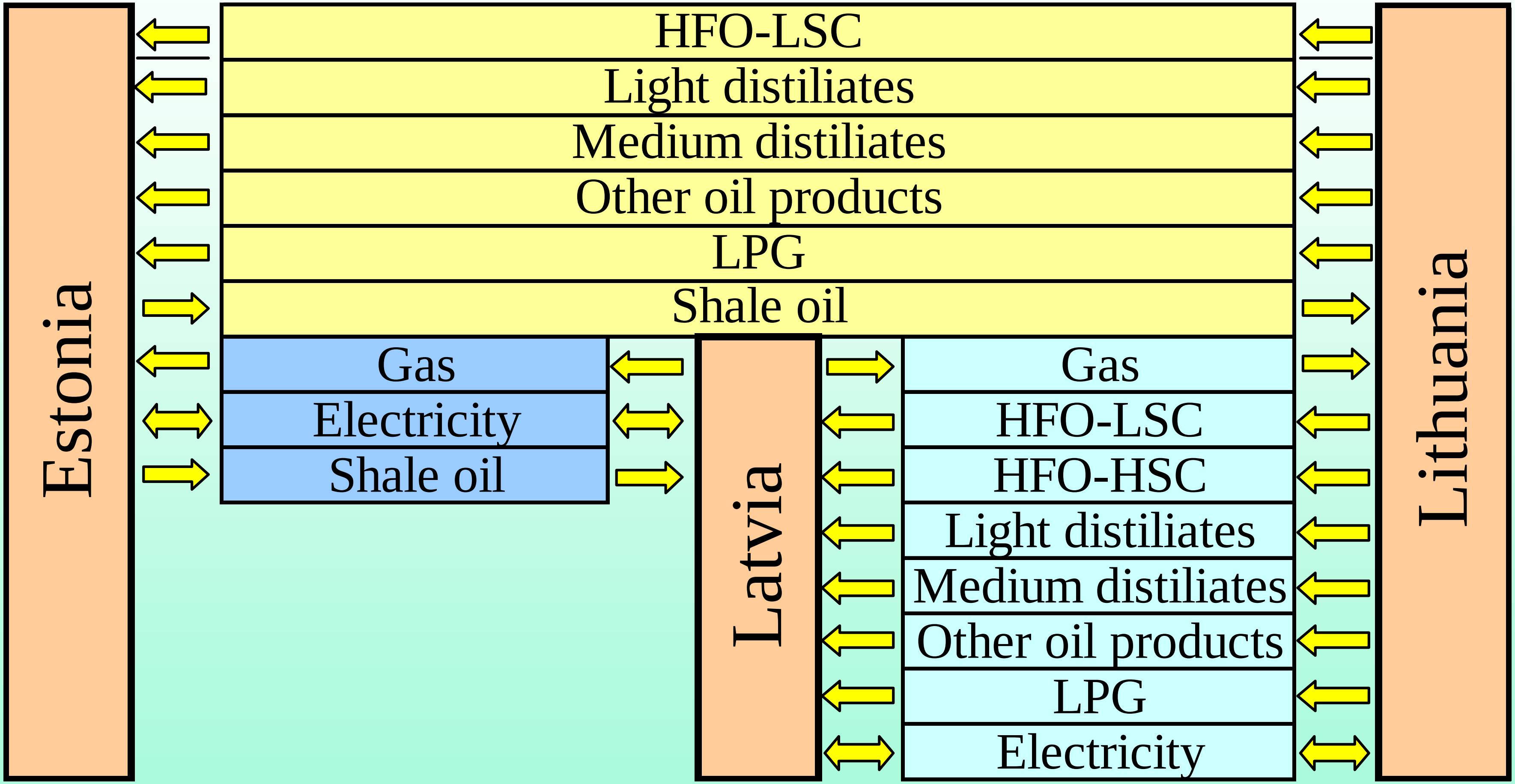
Expenditures	Responsible party
Costs of Study Coordinator, IAEA expert and consultants	IAEA
Expenditures for IAEA staff travel	IAEA
Training in MESSAGE model and Steering Committee meetings in Vienna	IAEA
MESSAGE model	IAEA (model is provided free-of-charge for all participating parties).
Local costs including local experts	Participating countries
Data collection	Participating countries
Hardware	Participating countries
Traveling expenses for country teams	From participating countries, each party for its own costs
Steering Committee meetings & workshop organization in Baltic states	Utilities
NATO experts	NATO

Methodology

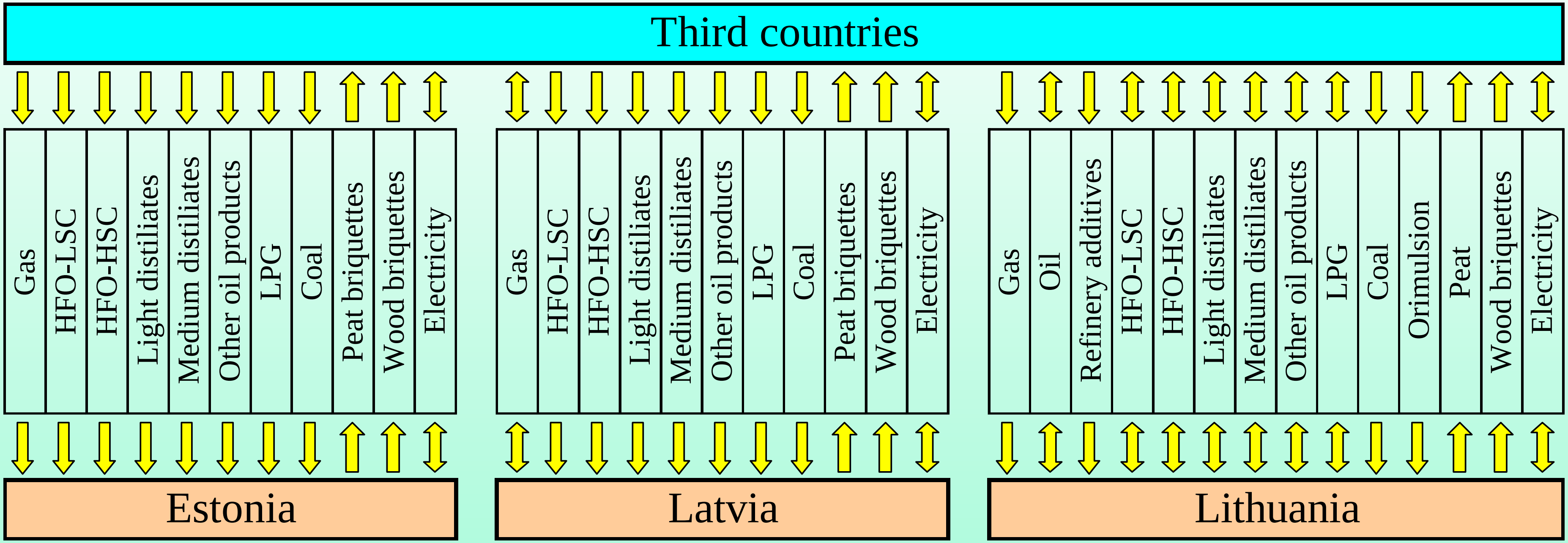
Structure of the multi-regional model



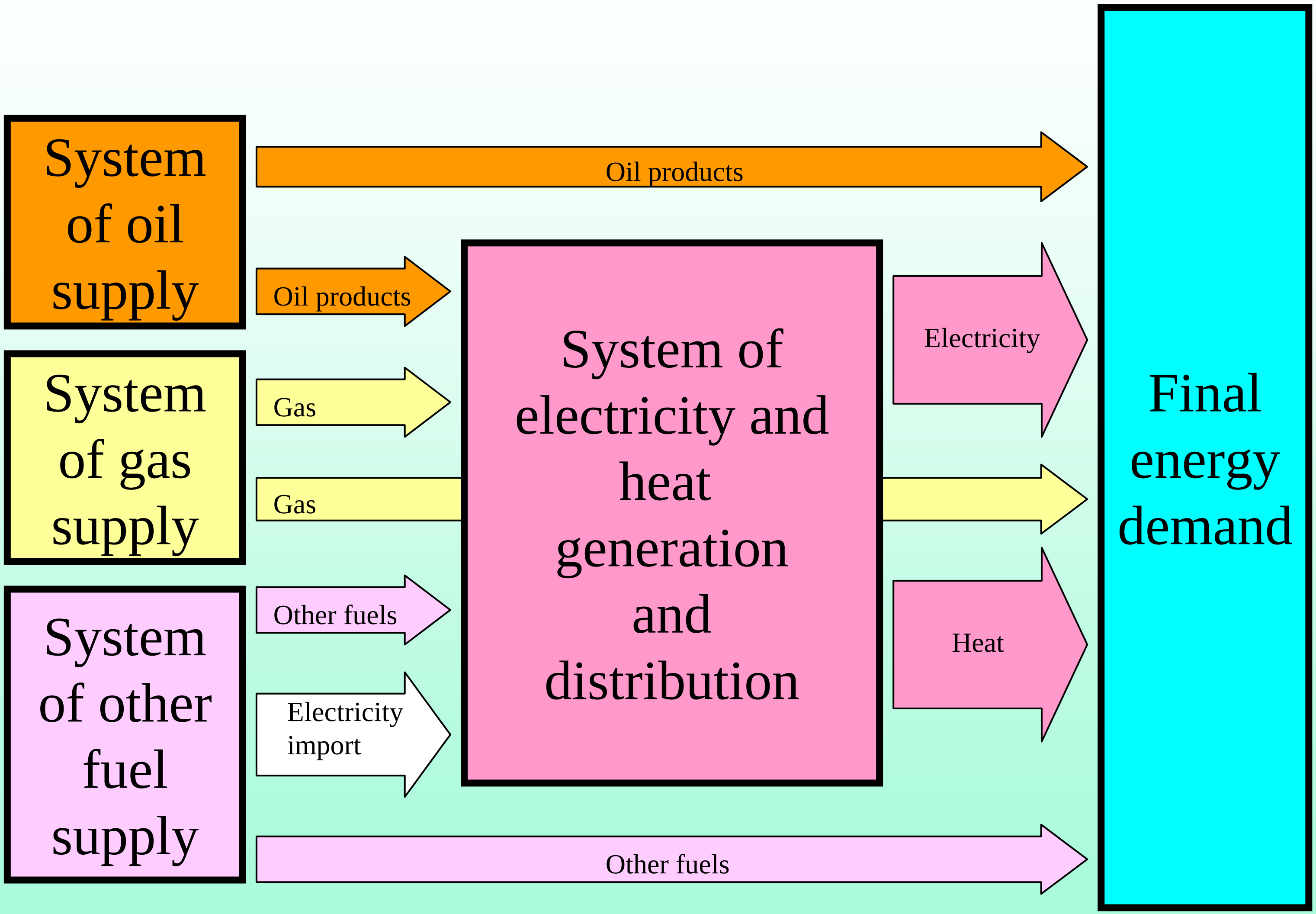
Energy exchange between Baltic countries



Energy exchange between Baltic countries and third countries



Structure of the country energy sector model



The most important components of energy systems

Estonia: Mining of oil shale; Production of shale oil; Two power plants on oil shale;

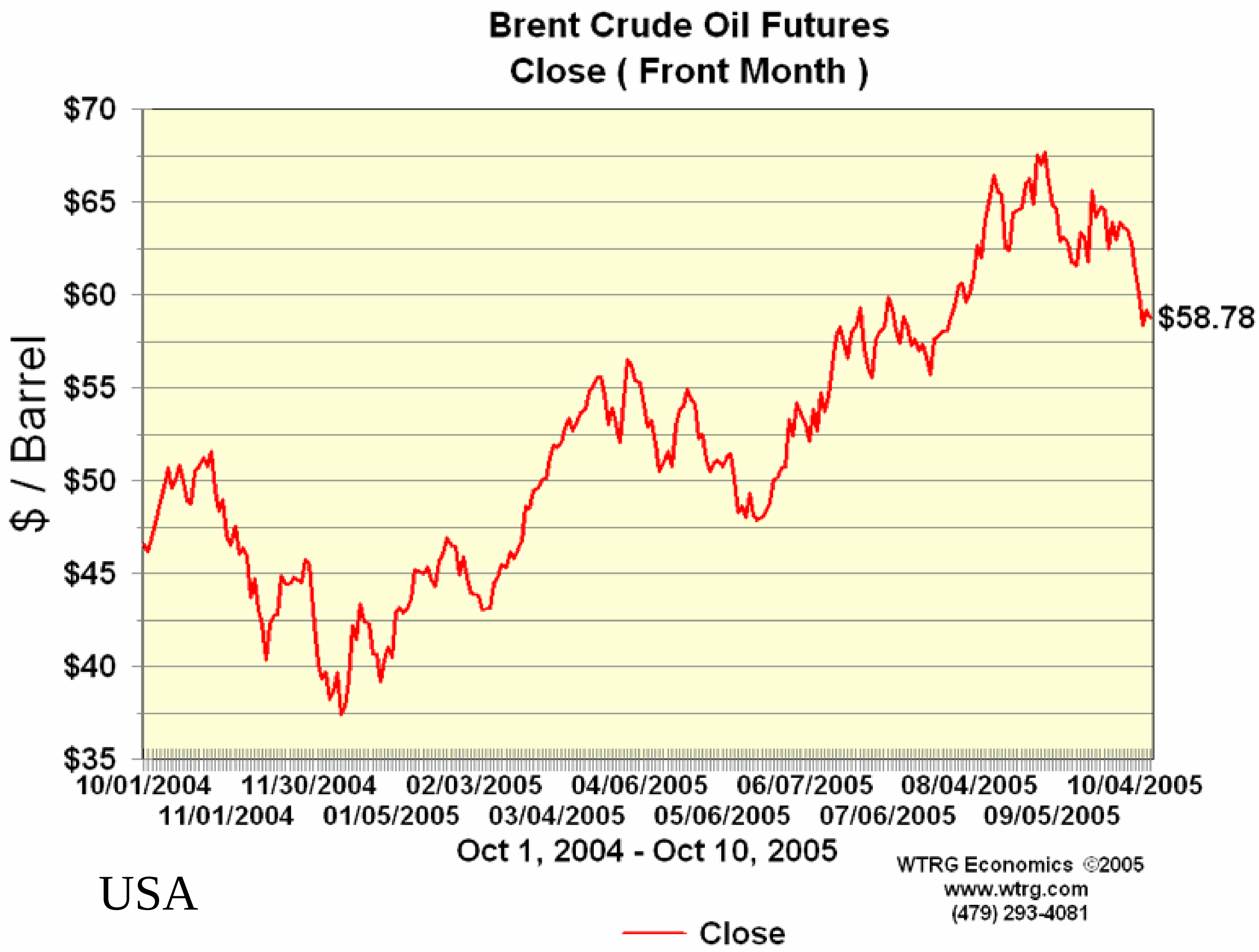
Latvia: Cascade of hydro power plants; Underground gas storage; Big terminal for oil products;

Lithuania: Two big terminals for crude oil and oil products; Refinery; Thermal power plant on HFO, gas and orimulsion with possibility to install FGD; Nuclear power plant; Hydro pumped storage power plant;

Assumptions

Technology options

Estonia	Latvia	Lithuania
Refurbishment of oil shale power plants	Replace existing CHP	Modernization of Lithuania TPP
Conversion/replacement of DH boilers to/with CHP	CHP biomass & pulp	Modernization of existing CHPs and new CHP
CFBC (oil shale)	CHP (natural gas)	Conversion/replacement of DH boilers to/with CHP
CHP (imported coal)	CHP (imported coal)	Small scale CHPs (gas & biomass)
CHP biomass / peat	Coal power plant	nuclear power plant
CCGT	CCGT	CCGT
Gas turbines	Wind	Wind
Wind	Hydro	Small hydro
Mini & micro hydro	Additional gas storage	Lithuania TTP (orimulsion)
Full implementation of strategic oil/oil product reserves		
Electricity links to Finland, Sweden Poland,		


Brent Crude Oil Futures
Close (Front Month)
$ / Barrel
$70
$65
$60
$55
$50
$45
$40
$35
$58.78
10/01/2004
11/30/2004
02/03/2005
04/06/2005
06/07/2005
08/04/2005
10/04/2005
11/01/2004
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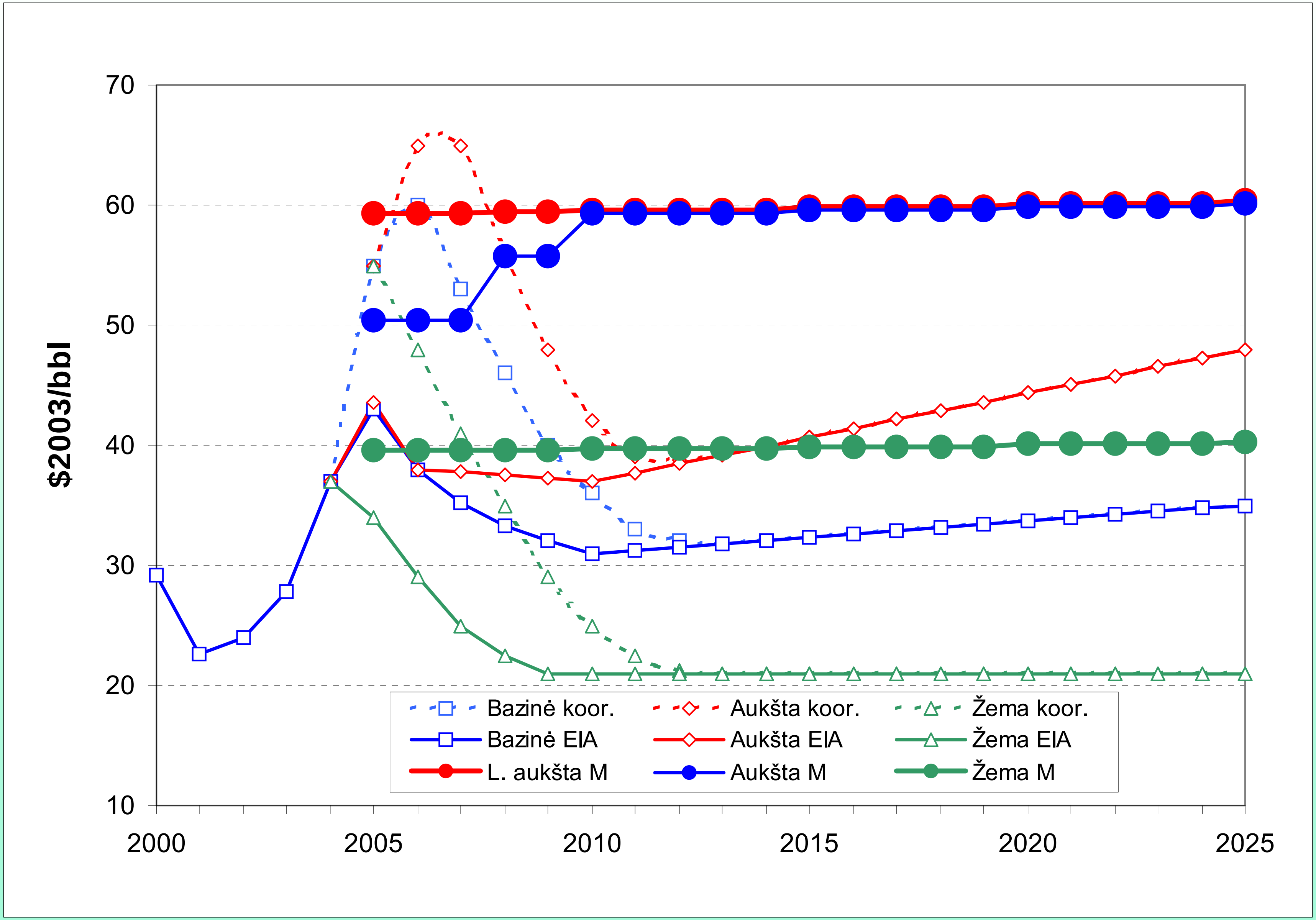
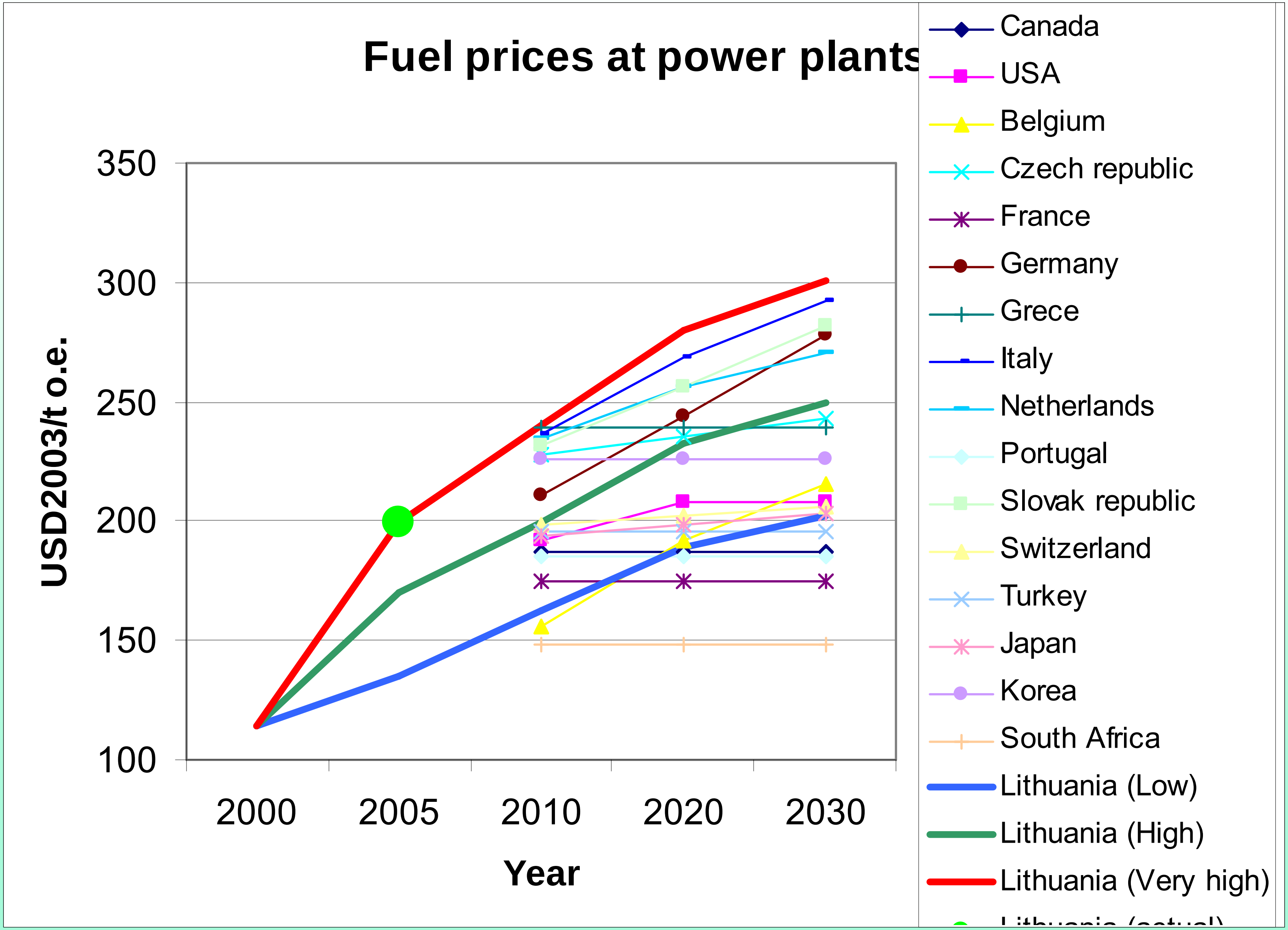
Oil price forecast



Gas price forecast



Scenarios

Definition of scenarios

<u>National supply scenario:</u>

Scenario 1N: National Self-sufficiency Scenario (to be carried out for each country)

This scenario incorporates:

a) All relevant existing requirements of laws and obligations are incorporated in the national models as constraints;

b) Shut-down of the Ignalina NPP in accordance with the agreement with EU;

c) The most probable modernization of Estonian oil shale, Riga CHPs and Lithuanian Thermal power plant (Lithuanian TPP);

d) National electricity demand 100% supplied by national power plants for all countries starting from 2010;

e) When electricity import/export is allowed it is in a base regime;

f) Storage requirement for oil products of 90 days (after optimization).

Definition of scenarios

Scenario 1N: National Self-sufficiency Scenario,

Scenario 1R: Regional Self-sufficiency Scenario – BASECASE,

Scenario 2R: Regional Scenario with Cross-Boarder Power Exchanges – INTERLINKS,

Scenario 3R: Regional Scenario with Enhanced Security of Gas Supply – GAS STORAGE,

Scenario 4R: Regional Scenario with Gas Supply Limitation
25% (**4R**), 30% (**4Rc**), 20% (**4Ra**),

Scenario 5R: Regional Scenario with Prolonged Operation of IGNALINA NPP Unit II

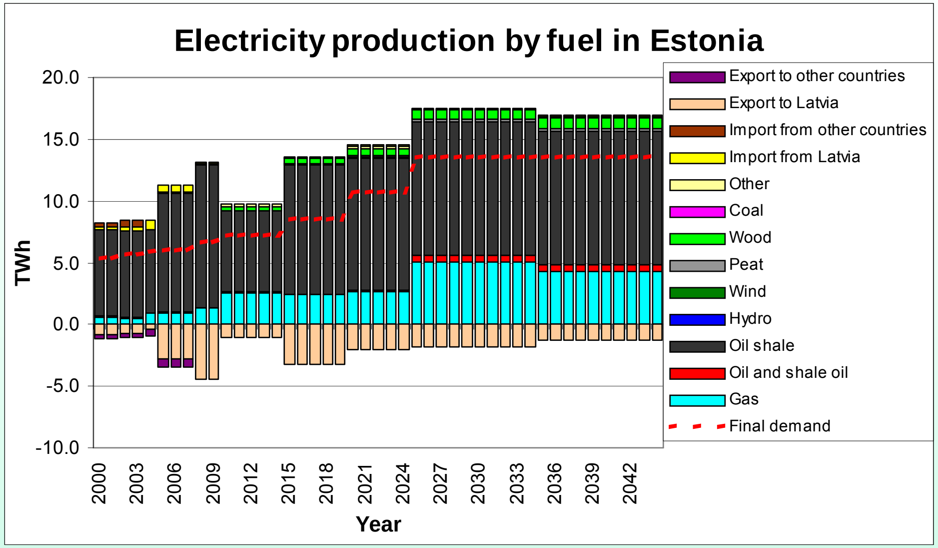
Scenario 6R: Regional Scenario with FUEL DIVERSIFICATION
Ignalina NPP (**6Ra**) after 2010, Coal-fired plant in Latvia (**6Rb**) after 2010, Ignalina NPP and coal-fired plant in Latvia after 2010 (**6R**),

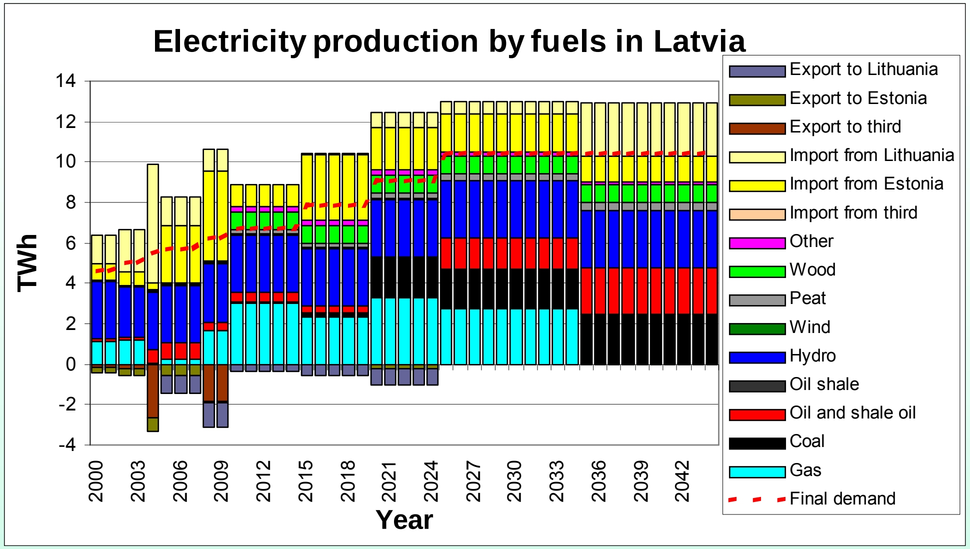
Scenario 7R: Regional Scenario with different ENVIRONMENTAL TAXES
(5 EUR/t (**7Ra**), 10 EUR/t (**7Rb**), 20 EUR/t (**7R**) from 2008).

Cases analyzed

Scenario	Conditions									
	Unconstrained gas supply					Gas supply is constant during year				
	Low fuel prices	Gas and orimulsion in 4R, 4Ra, 4Rc. Low fuel prices	Low fuel prices. Forced construction of gas storage	High fuel prices	Low fuel prices. 3% growth of electricity from RES since 2010	Low fuel prices	Gas and orimulsion in 4R, 4Ra, 4Rc. Low fuel prices	High fuel prices	Low fuel prices. No orimulsion. Modernization of LTPP is not obligatory.	Low fuel prices. Limited capacity of modernized oil shale power plants.
	Aa	Aaa	Aab	Ab	Ea	Ba	Baa	Bb	Ca	Da
1N	+									
1R	+			+	+	+		+	+	+
2R	+			+	+	+		+	+	+
3R	+		+	+	+					+
4R	+	+		+	+	+	+	+	+	+
4Ra	+	+		+		+	+	+		
4Rc	+	+		+		+	+	+		
5R	+			+	+	+		+	+	+
6R	+			+	+	+		+	+	+
6Ra	+			+		+		+		
6Rb	+			+		+		+		
7Ra	+			+		+		+		
7Rb	+			+		+		+		
7Rc	+			+	+	+		+	+	+

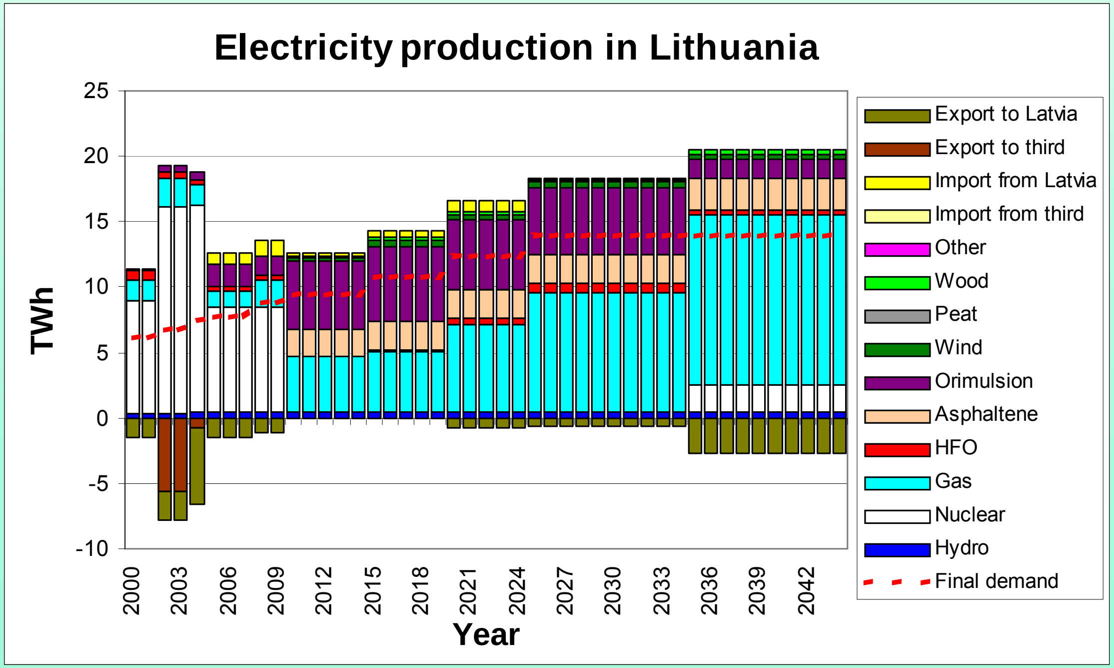
Results

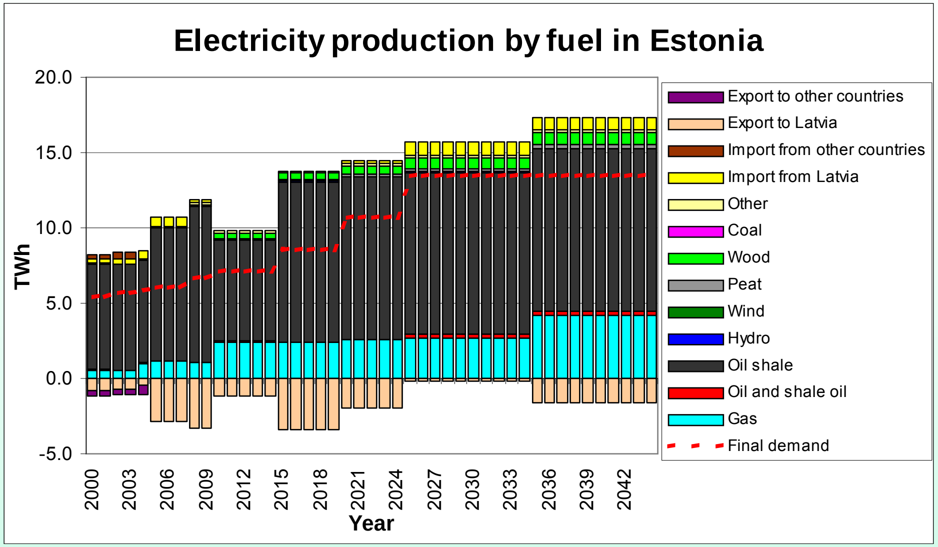


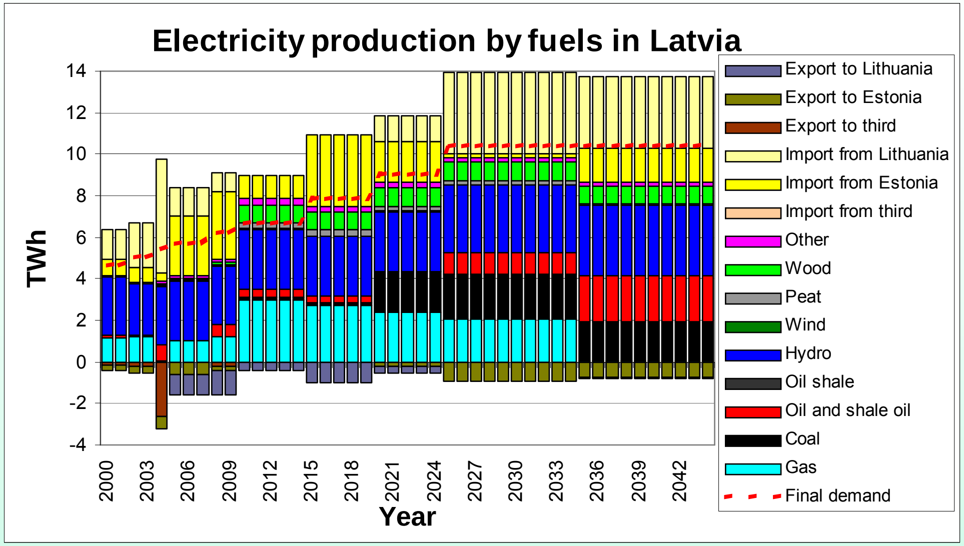


Base case (1R(Aa)) scenario

By fuel type

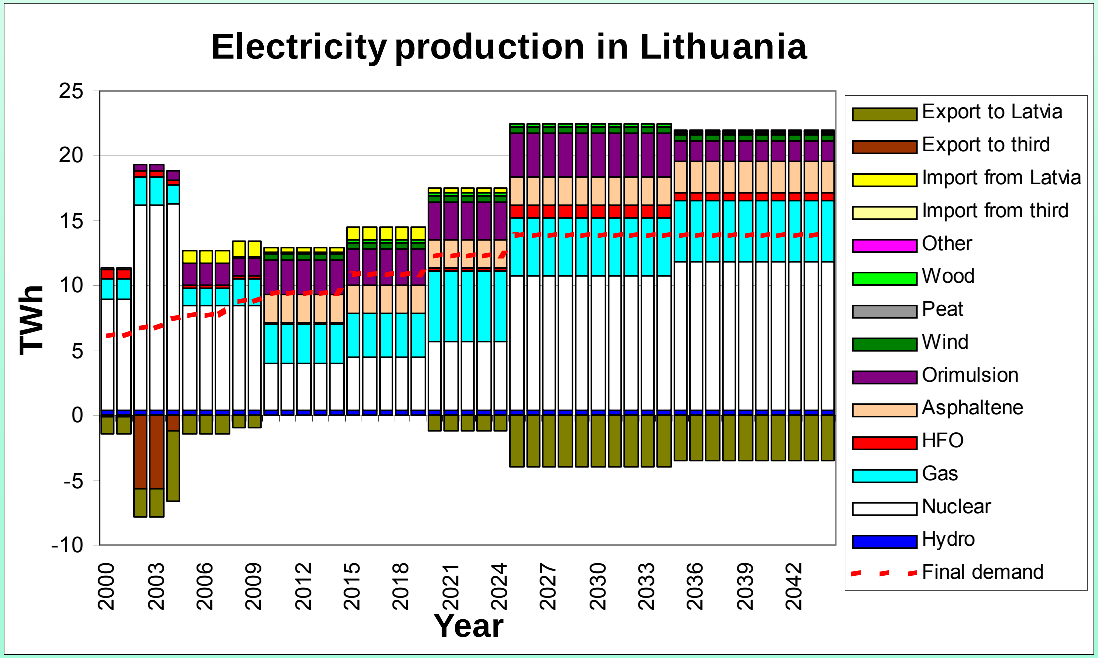


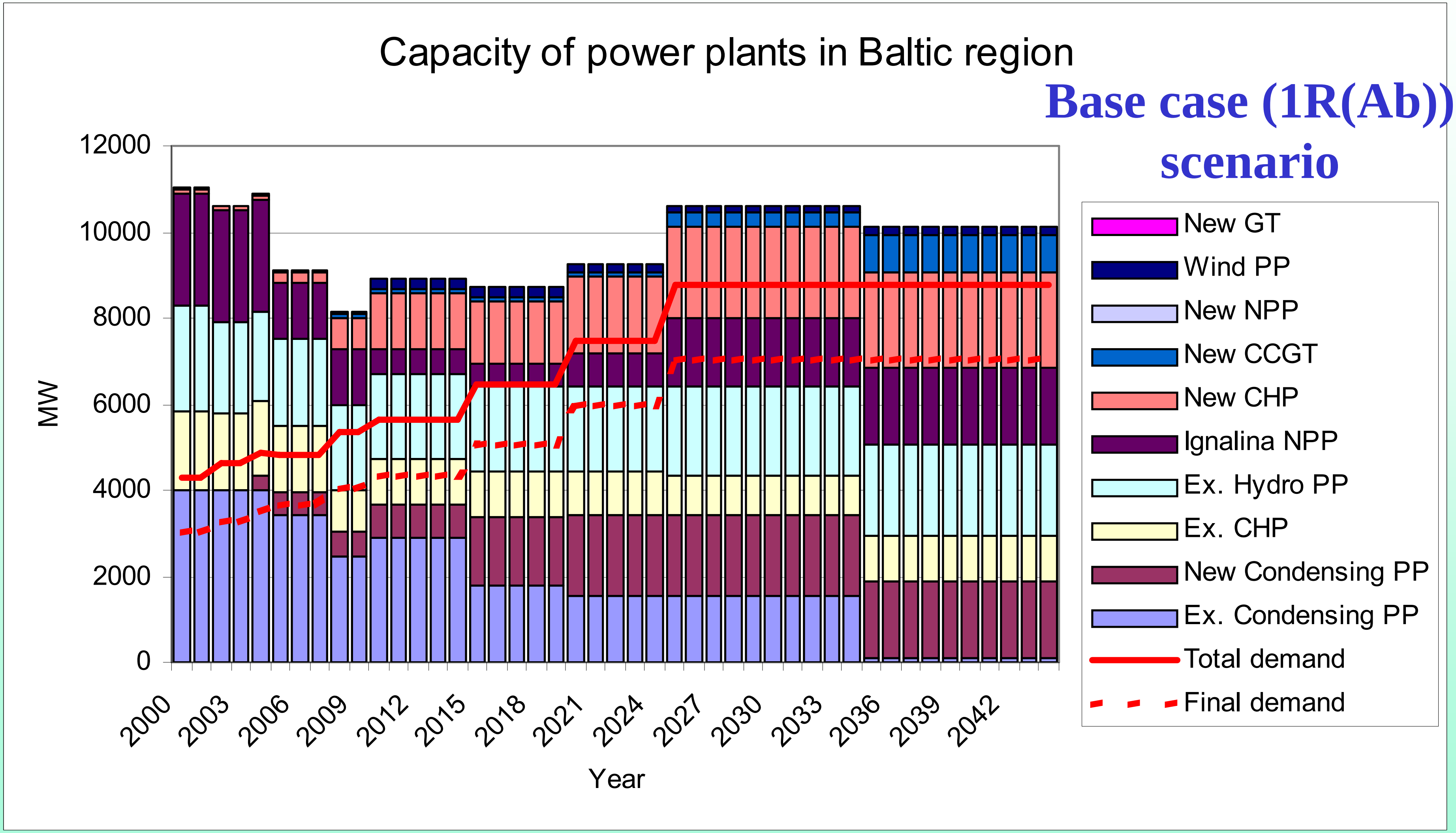




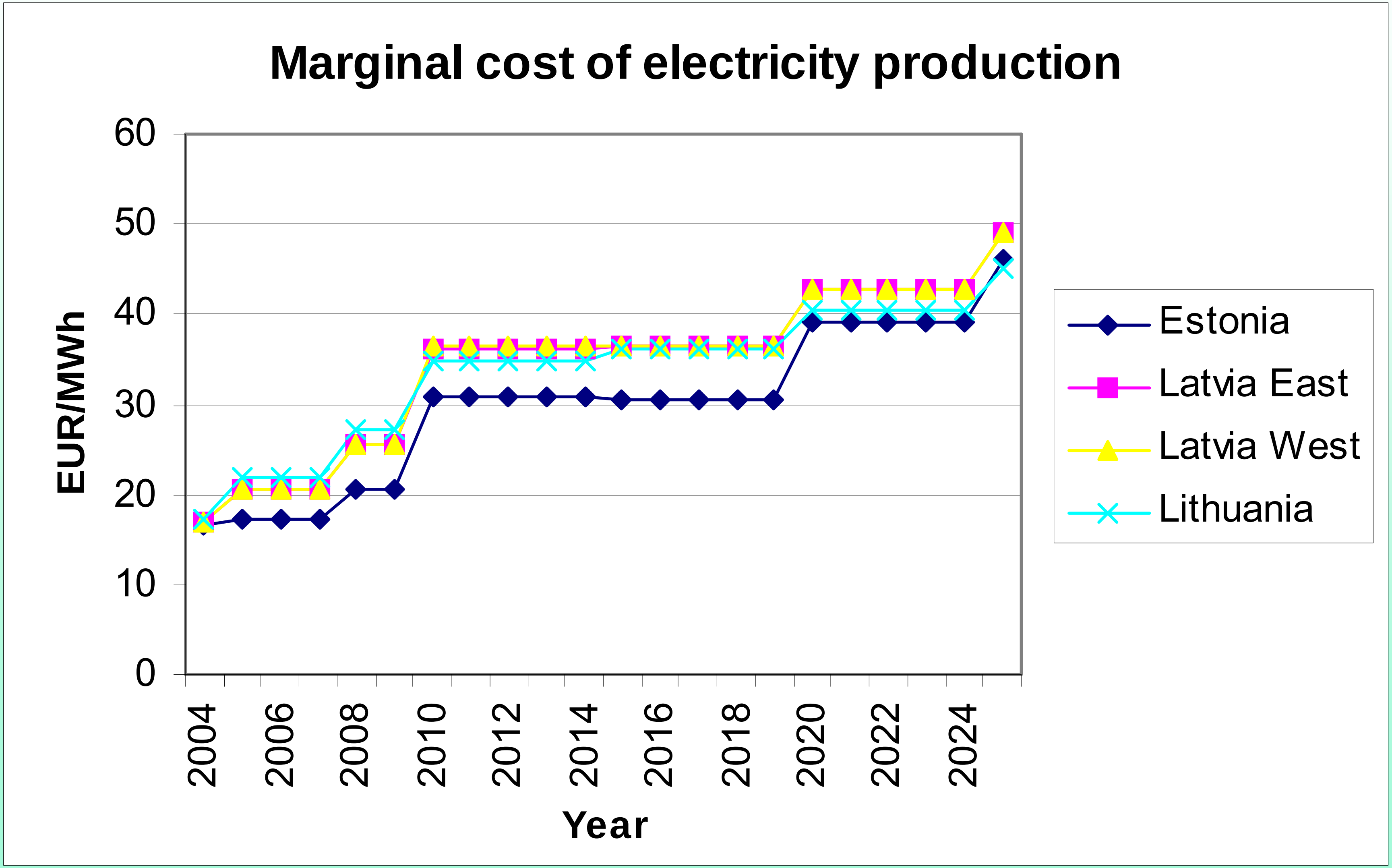
Very high fuel price (1R(Ab)) scenario

By fuel type

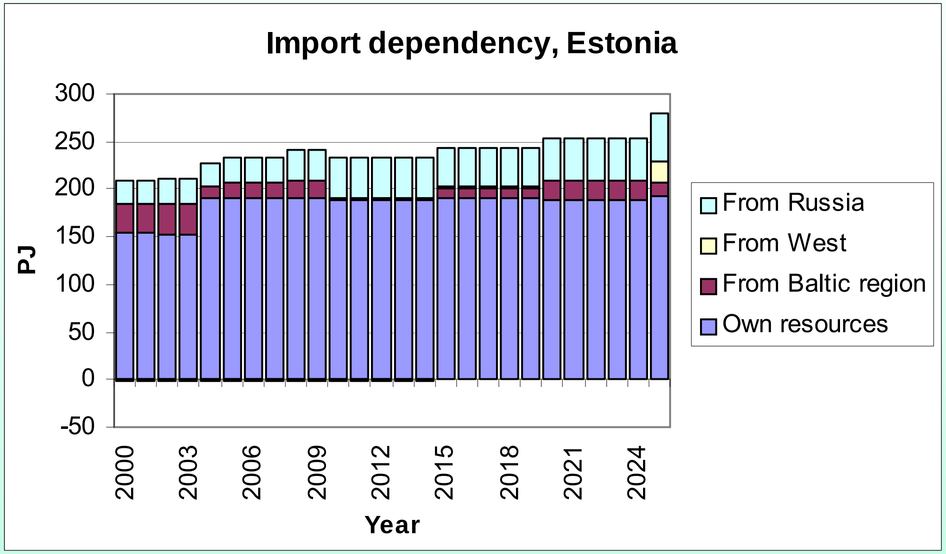


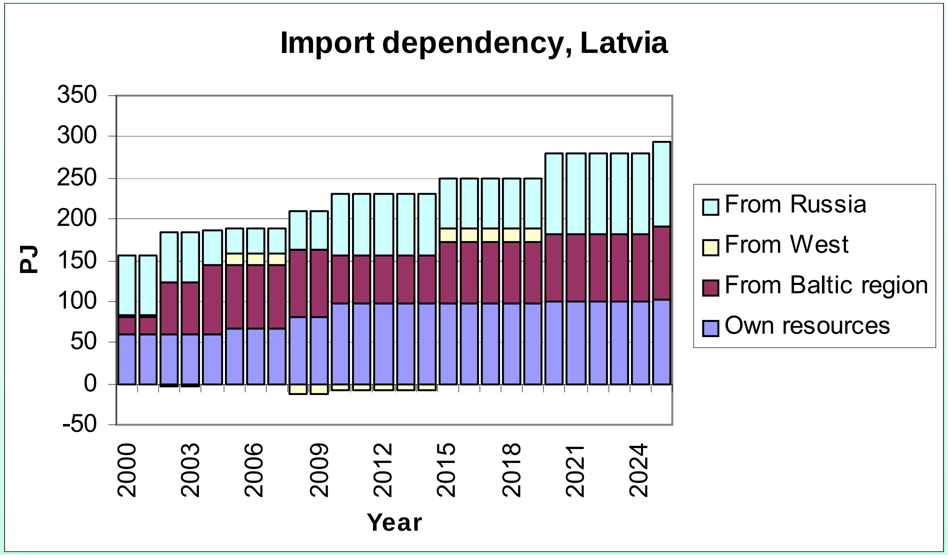

Capacity of power plants in Baltic region
Base case (1R(Ab)) scenario
MW
12000
10000
8000
6000
4000
2000
0
2000
2003
2006
2009
2012
2015
2018
2021
2024
2027
2030
2033
2036
2039
2042
Year
New GT
Wind PP
New NPP
New CCGT
New CHP
Ignalina NPP
Ex. Hydro PP
Ex. CHP
New Condensing PP
Ex. Condensing PP
Total demand
Final demand

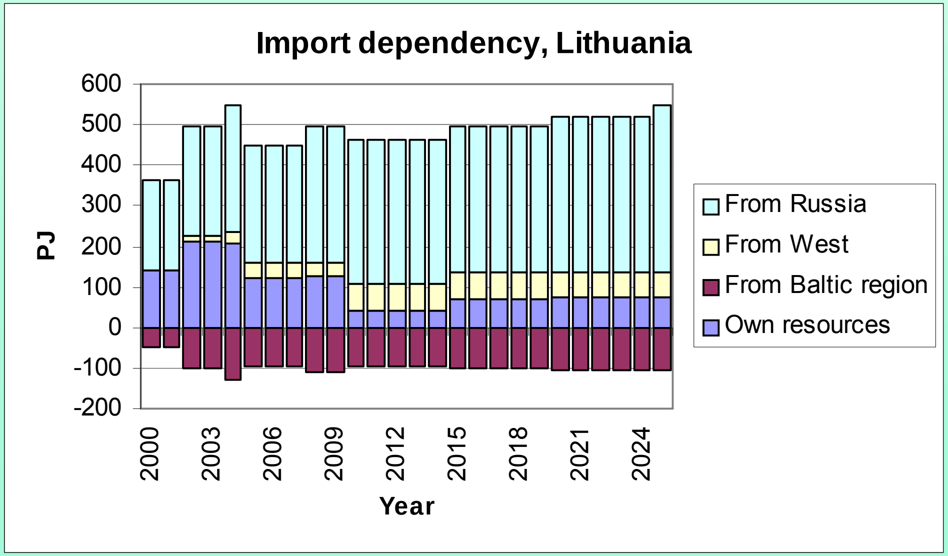
Base case (1R(Aa)) scenario

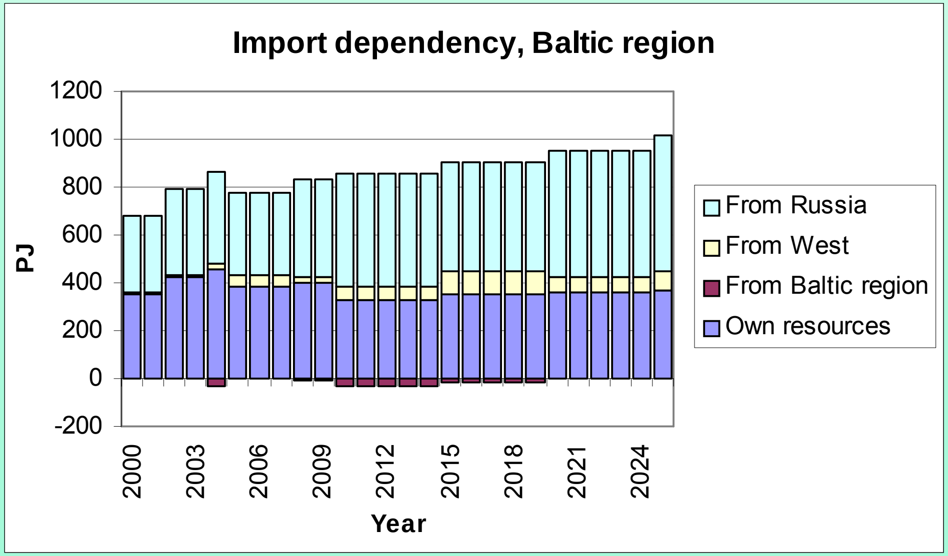


Import dependency. Base case (1R(Aa)) scenario

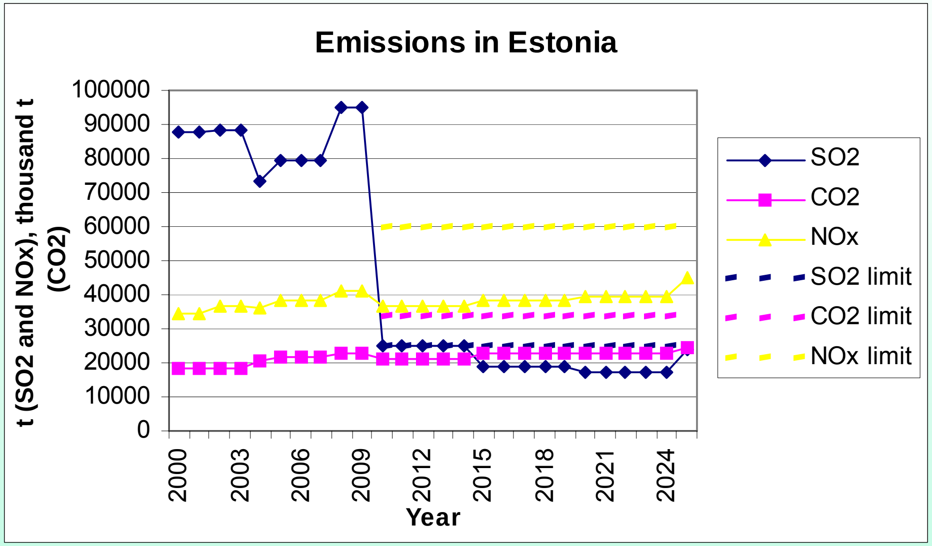


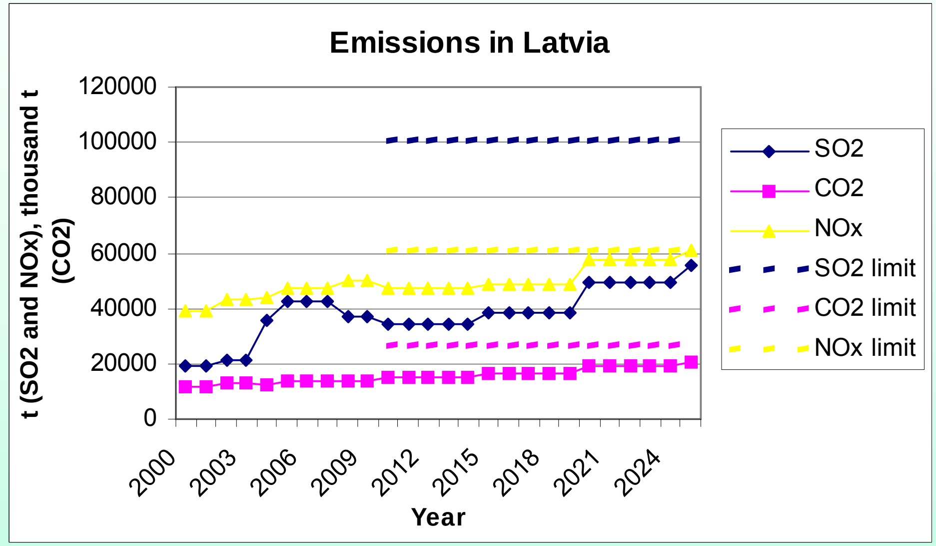


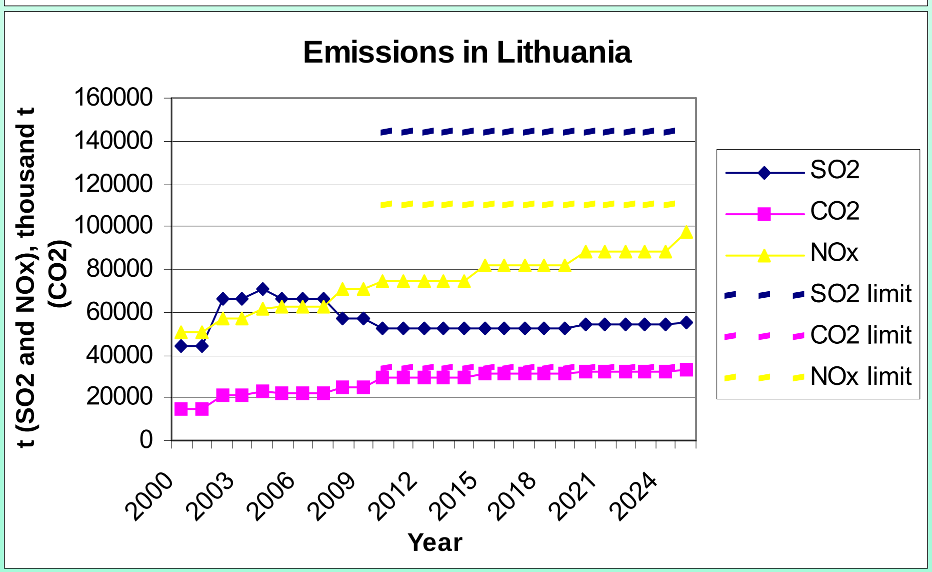


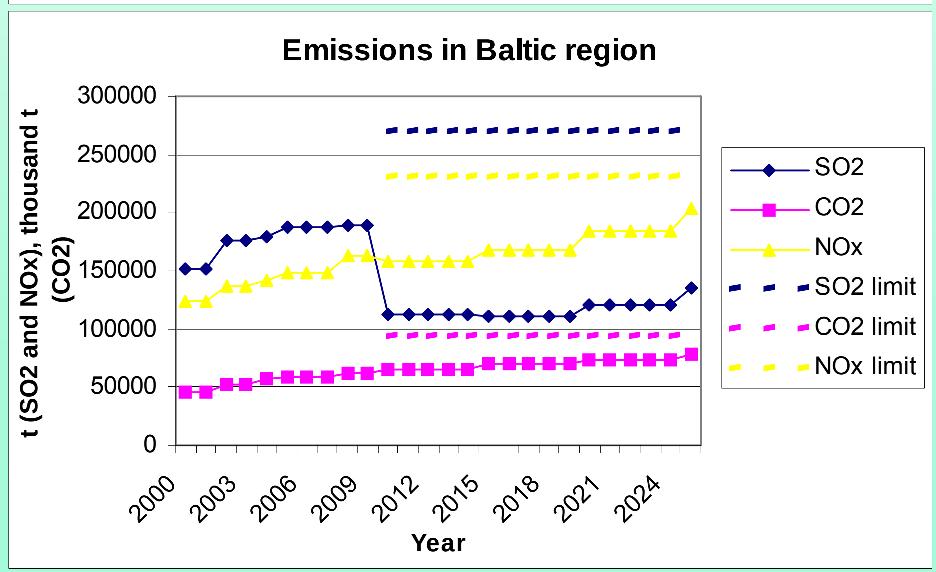


Emissions into atmosphere. Base case (1R(Aa)) scenario

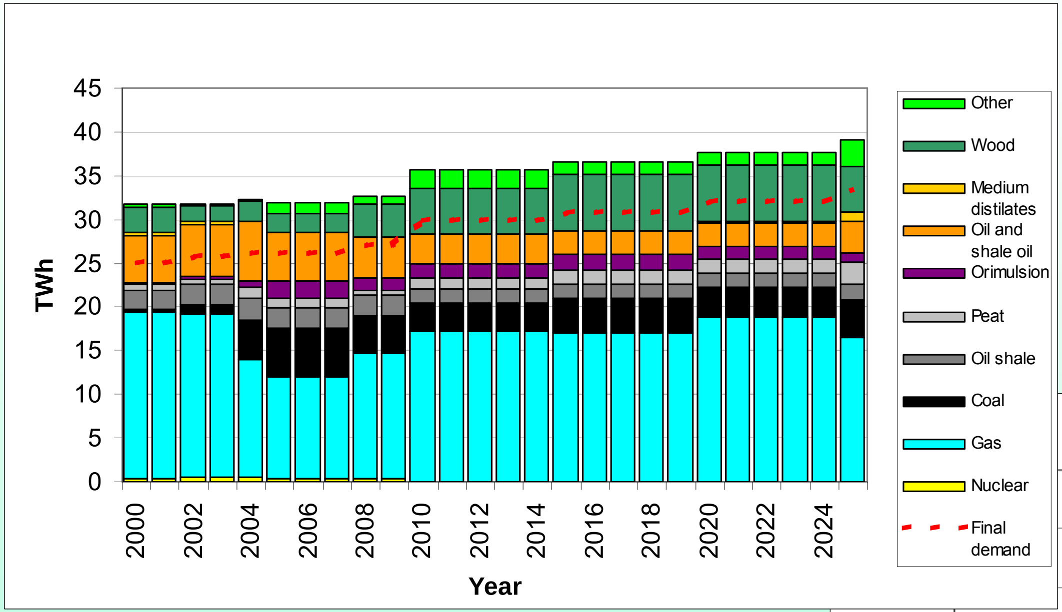






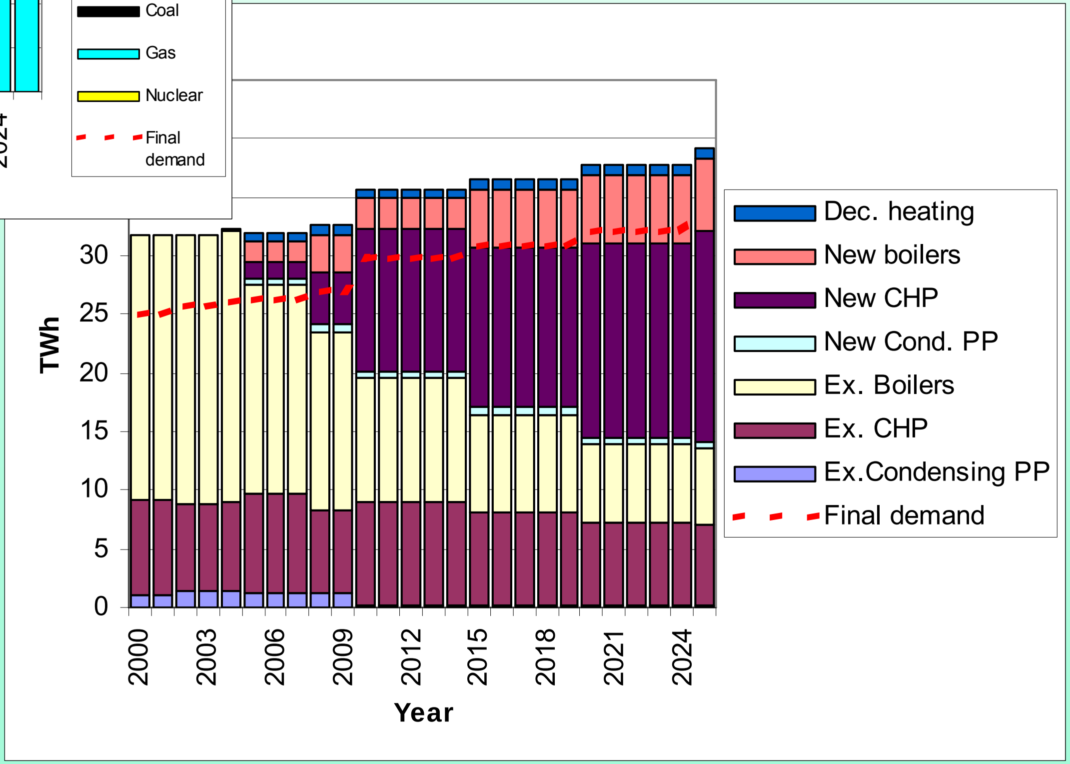


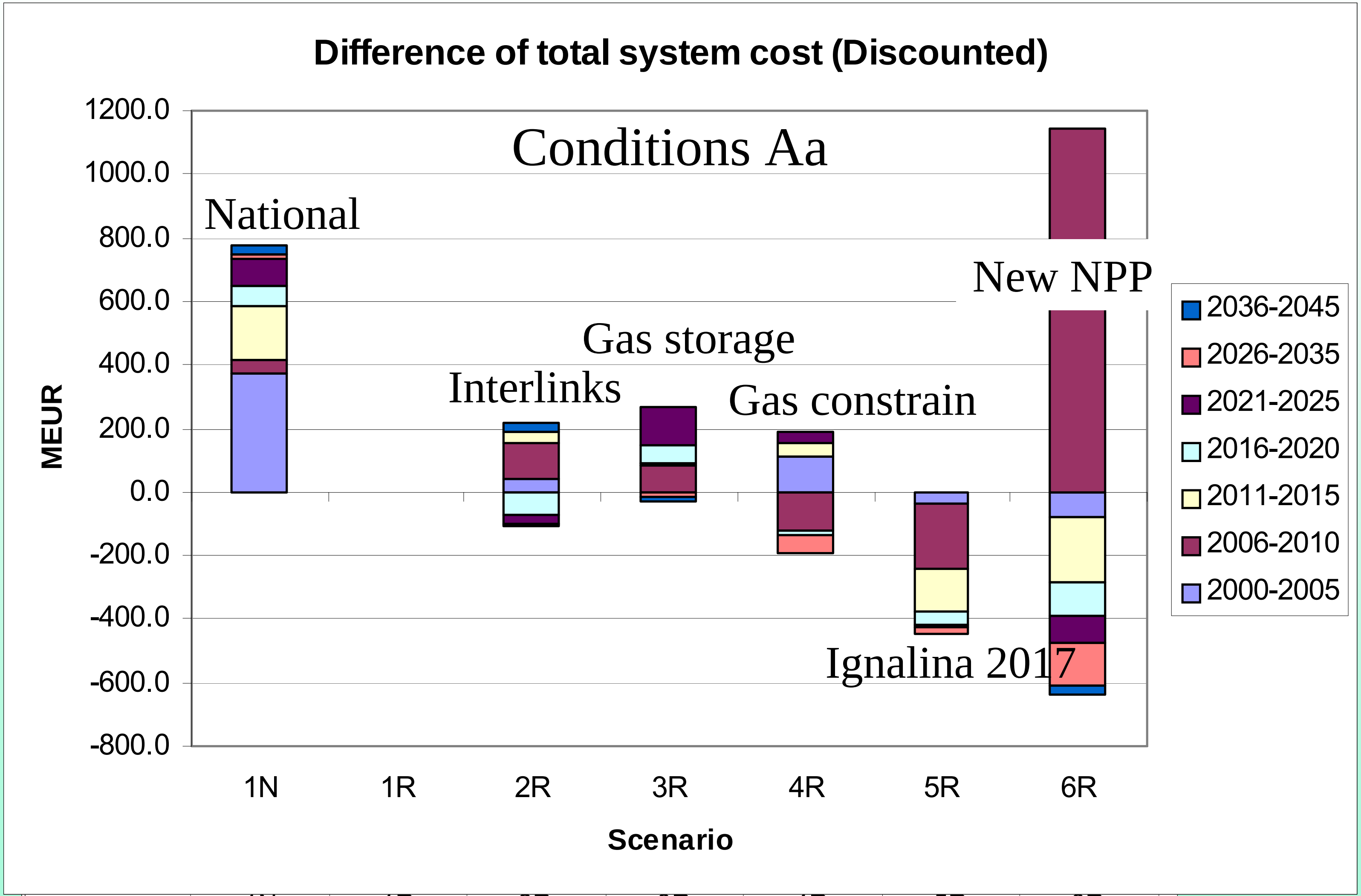
Heat production in Baltic region (1R(Aa) scenario)



By fuels

By technologies





	1N	1R	2R	3R	4R	5R	6R
Series1	761.1	0.0	115.6	229.7	19.1	-439.7	520.1

Scenario

Conclusions

Solutions approached from a regional perspective are more effective than the same solutions pursued independently by each of the three countries. There are immediate economic benefits - but not necessarily improved energy supply security.

The main difference in the regional energy supply mix is a larger share of natural gas imported from Russia and an additional crude import and higher refined product exports abroad.

The net result is a four percent increase in the net energy import dependence after 2010 (essentially all from Russia) increasing to seven percent by 2025.

Looking purely from an economic point of view, the most rational option for Lithuanian and the whole Baltic energy system would be continued operation of the 2^{nd} unit of Ignalina NPP until the end of its technical lifetime with existing fuel cannels and, if necessary, with their subsequent replacement. Extension of life time of the second unit of the Ignalina NPP until 2017 for the Baltic energy system may give benefit of **440 million Euro**. At the same time it increases security of energy supply.

New NPP increases security of energy supply in the region but its economic justification depends on fuel prices and other factors

In the case of ***low fuel prices*** and without limitations on gas and orimulsion supply commissioning of new NPP in Lithuania is economically **not justified before 2025**;

However, strong constrain (25% or less) on *common share of **natural gas and orimulsion*** in total fuel consumption for electricity and heat production **shifts commissioning date of new NPP to 2015 – 2020**.

Constrains on share of gas only has practically no impact on commissioning date of new NPP because orimulsion can substitute gas for electricity generation;

In the case of ***high fuel prices*** *and without available cheaper electricity import* from Russia and other countries

or

in the case of ***extra high fuel prices*** *but with gas supply in the base-load regime* commissioning of new NPP in Lithuania is economically justified **in about 2020**.

Available cheaper electricity import will postpone commissioning date of new NPP **for about 5 years** in the case *high fuel prices* and for **more than 10 years** in the case of *low fuel prices*

Commissioning of new NPP ***as soon as possible*** after closure of the second unit of the Ignalina NPP can be economically justified

in the case of ***high*** *(20EUR/t or more)* ***taxes on*** CO_2 emissions

and

in the case of ***extra high fuel prices without limitations on gas supply regime*** *and* ***without*** *available cheep electricity* ***import****;*

Energy options that provide flexibility are desirable. Thus, options that strengthen electricity and natural gas pipeline interlinks and also allow increased diversification of supply sources are exceptionally attractive.

High international energy market prices reduce energy import dependence. High price scenarios stimulate exploitation of previously sub-marginal domestic energy resources especially of peat, wood, biomass, wind and small hydropower, increased use of coal in rehabilitated plants as well as new capacities and a new nuclear power plant. Compared with the 2R(Aa) scenario, import dependence drops by 15 percentage points.

Additional gas storage capacity does not reduce overall energy import dependence on Russian gas but improves energy security (against interrupted delivery or price volatility) at a cost of €26 million (discounted) per year over the period 2010 and 2025. These additional costs can be interpreted as “insurance costs or premium” for higher energy security.

Fuel diversification by requiring the construction of both a new NNP and a coal-fired power plant lowers the region’s energy import dependence by **seven** percentage points at an annual cost of €62 million (discounted) per year over the period 2010 and 2025 (or €9.2 million per percentage point reduction in import dependence). These costs may be viewed as an insurance premium for enhanced supply security. In the case of high fuel prices new NPP even reduces system cost.

The effect of varying taxes on carbon dioxide (CO_2) emissions on energy security in the Baltic region is similar to higher fossil fuel prices, i.e., the higher the tax, the lower the overall energy import dependence. A €20 tax per tonne of CO_2 reduces energy import dependence by **five** percentage points (compared with 2R) at a cost of €5 million (discounted) per year. The reduction is primarily the result of the construction of new nuclear power capacities after the closure of Ignalina NPP unit 2 and an accelerated market penetration of domestic renewables.

In the case of low fuel prices it would be economically justified to replace Ignalina NPP by existing and new CHP (including small), and modernized Lithuanian TPP. In 2010 total installed capacity of CHP should reach 965 MW and grow up to 1730 MW in 2025 in the case when major part of district heat demand is covered by CHP. Significant contribution should be from existing and new 210 MW unit at Mazeikiai CHP which utilizes residue of refinery – asphaltene. Operation of new CCGT CHP unit at Kaunas CHP is justified since 2010, as well as replacement of one unit at Vilnius CHP be new CCGT CHP unit in 2020. Small part of electricity demand in some time periods will be covered by imported electricity from Estonia and Russia and in 2025 new CCGT units should come into service. High and extra high fuel prices would significantly reduce output from Lithuanian TPP, reduce installed capacity of new CHP, favor electricity import and construction of new NPP.

Smaller capacity of modernized oil shale power plants in Estonia increases utilization of Lithuanian TPP and favourable construction of new CCGT at existing sites in Lithuania (in case of low fuel prices) and new NPP (in case of high fuel prices).

THANK YOU
FOR YOUR ATTENTION!