

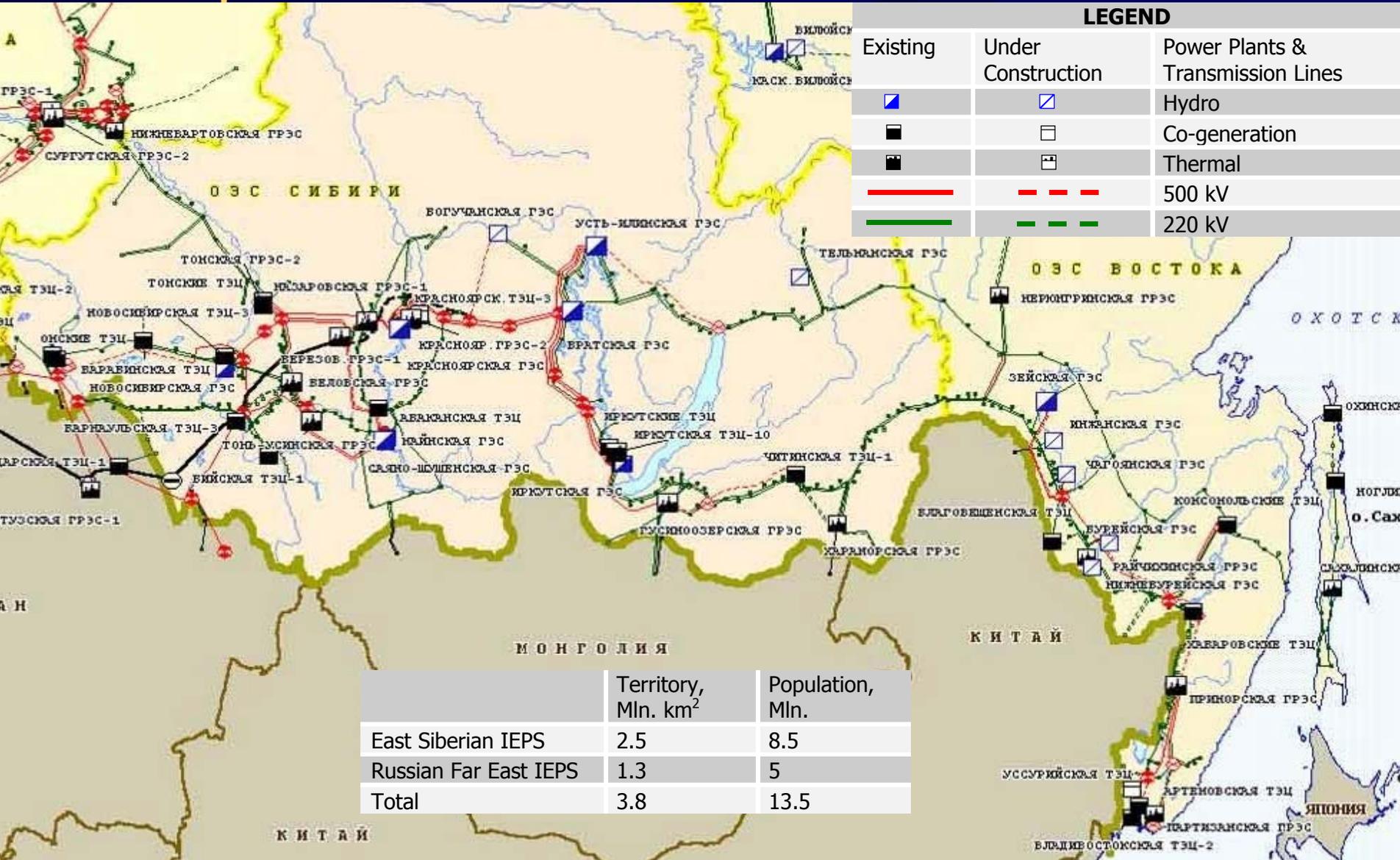
POWER GRID INTERCONNECTION IN NORTHEAST ASIA: VIEW FROM EAST RUSSIA

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- Current State and Perspectives of East Russian Electric Power Industry
- Potential Effects of Power Systems Interconnections in Northeast Asia
- Electric Ties of Russia with Northeast Asian Countries
- Methodology for Study of Interstate Electric Ties in the Region
- Formation of Power Grid Interconnection in the Region

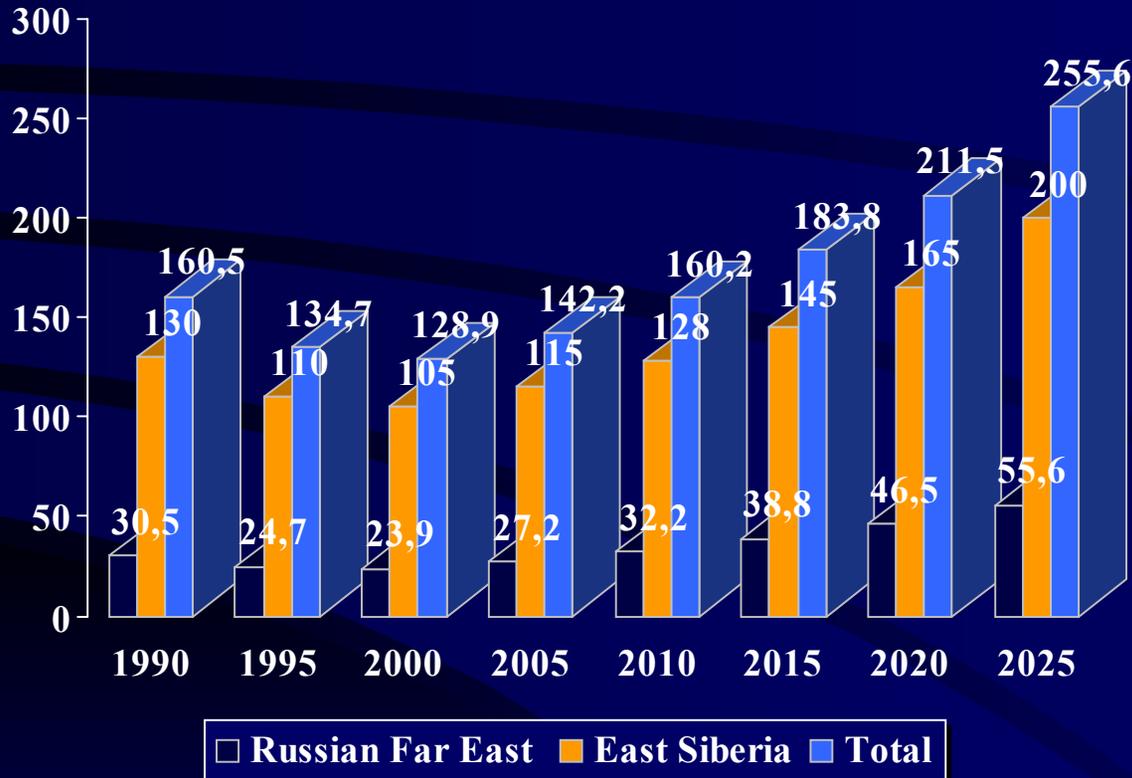
Map of East Russian Interconnected EPSs



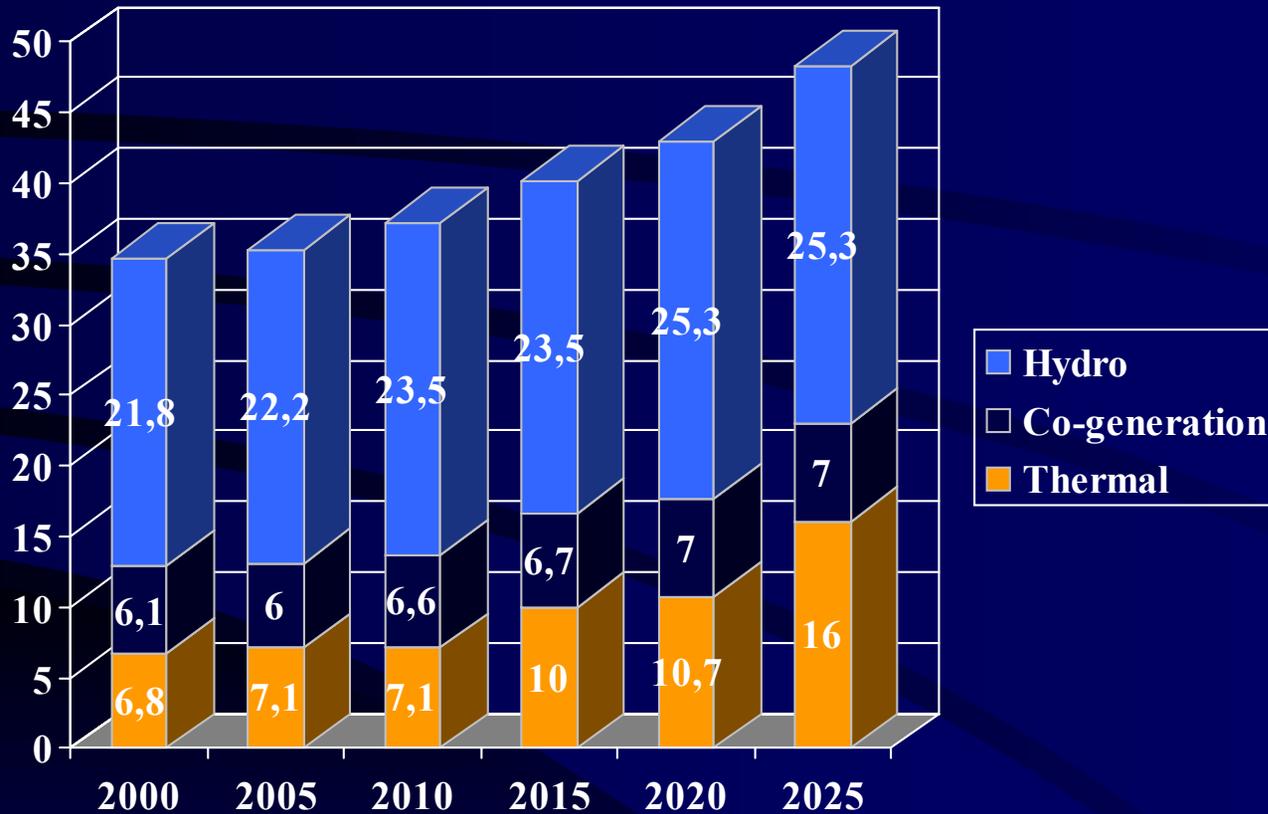
	Territory, Mln. km ²	Population, Mln.
East Siberian IEPS	2.5	8.5
Russian Far East IEPS	1.3	5
Total	3.8	13.5

Workshop on Power Grid
Interconnection in Northeast Asia,
Beijing, China, May 14-16, 2001

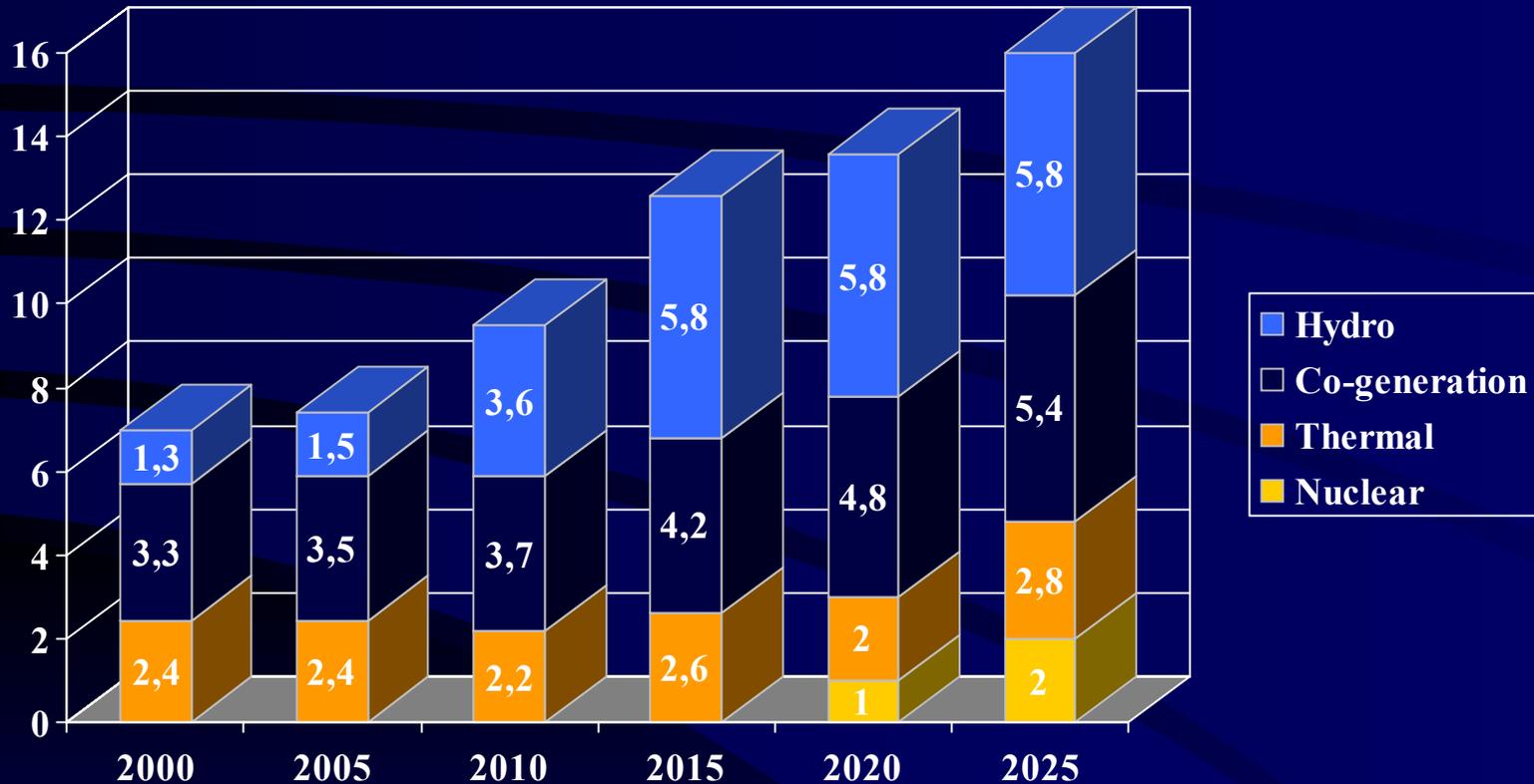
Electricity Consumption of East Russia, Bln.kWh/year



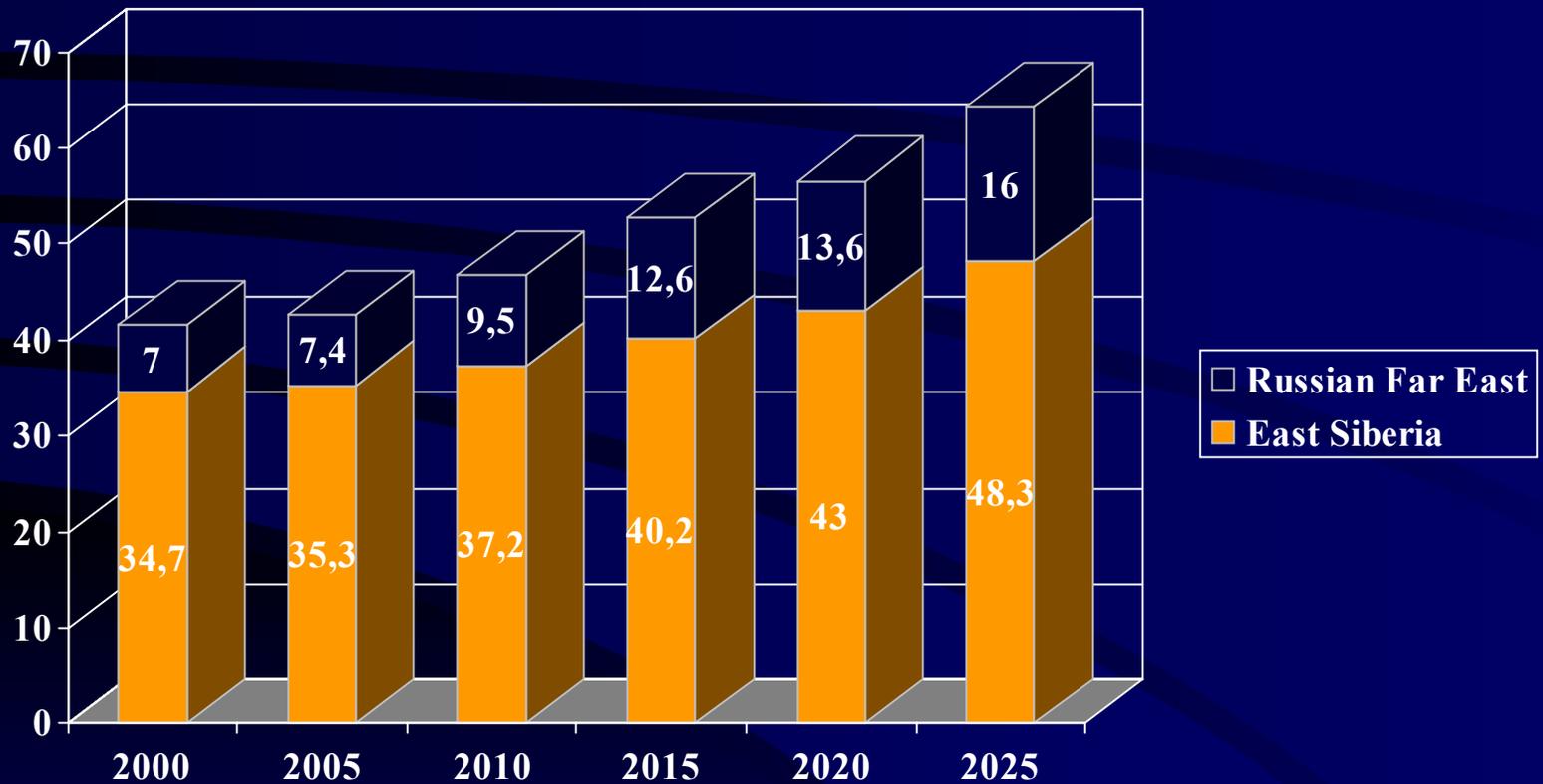
Capacity Mix of East Siberia, GW



Capacity Mix of Russian Far East, GW



Capacity of East Russia, GW



Large Power Plants of East Russia

Power Plants			Installed Capacity, GW
Hydro	East Siberia	Sayano-Shushensk	6.4
		Krasnoyarsk	6
		Bratsk	4.5
		Ust-Ilimsk	3.8
	Far East	Zeya	1.3
	Subtotal		22
Thermal	East Siberia	Irkutsk	1.1
		Berezovsk	1.6
		Nazarovsk	1.3
		Krasnoyarsk	1.25
		Gusinoozyorsk	1.25
	Far East	Primorye	1.5
Subtotal		8	
TOTAL		30	

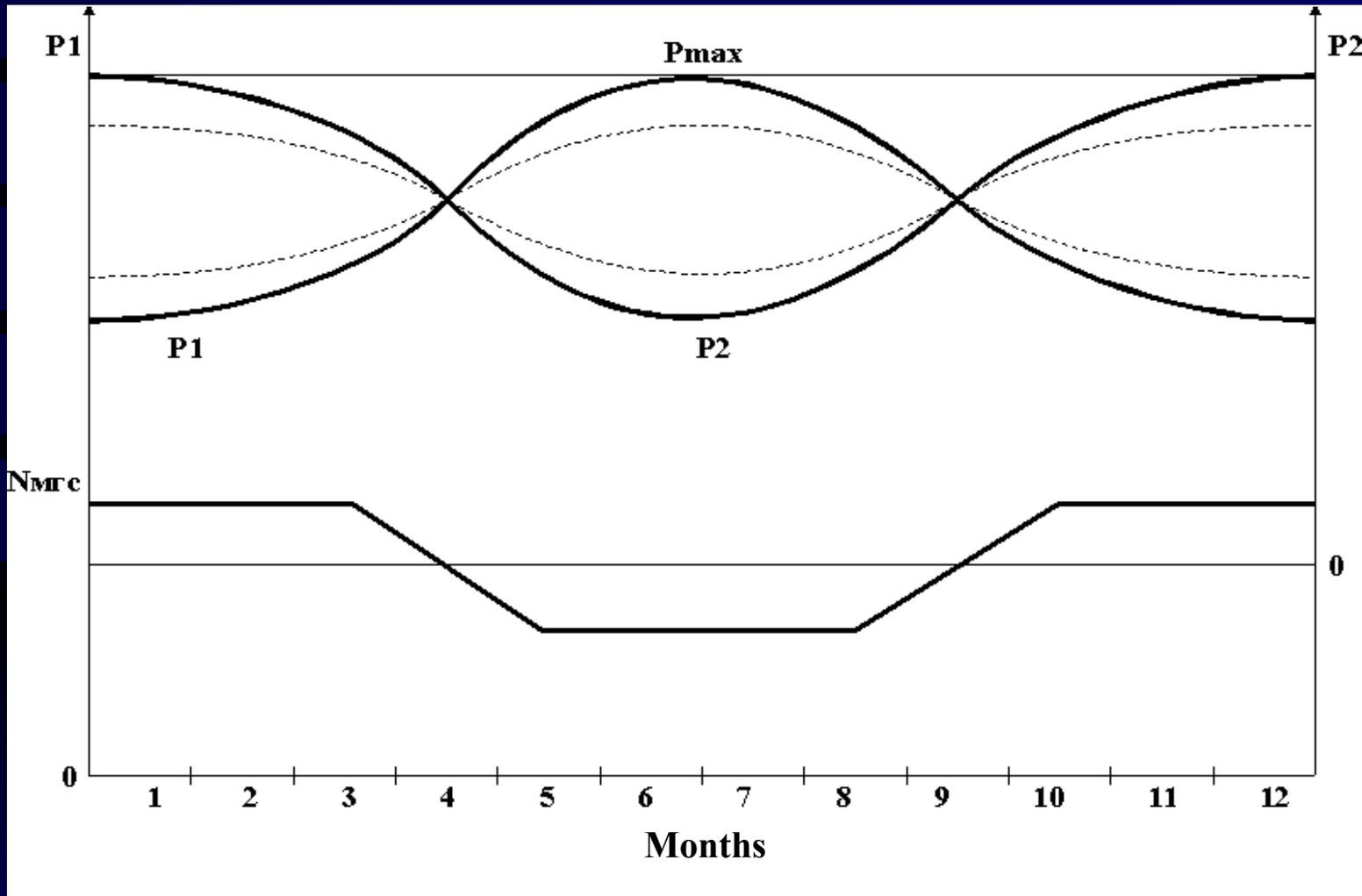
Prospective Large Power Projects

Region	Project	Capacity, GW	Yearly Output, TWh
East Siberia	Boguchunsk Hydro (under construction)	3	17.6
	Moksk Hydro	1.3	5.3
	Beresovsk Thermal (under construction)	6.4	40
	Subtotal	10.7	62.9
Russian Far East	Bureysk Hydro (under construction)	2.4	8.8
	Uchursk Hydro	3.7	17.2
	Urgal Thermal	1.2	7.5
	Primorye Nuclear	2	15
	Tugursk Tidal	6.8	16
	Subtotal	16.1	64.5
TOTAL		26.8	127.4

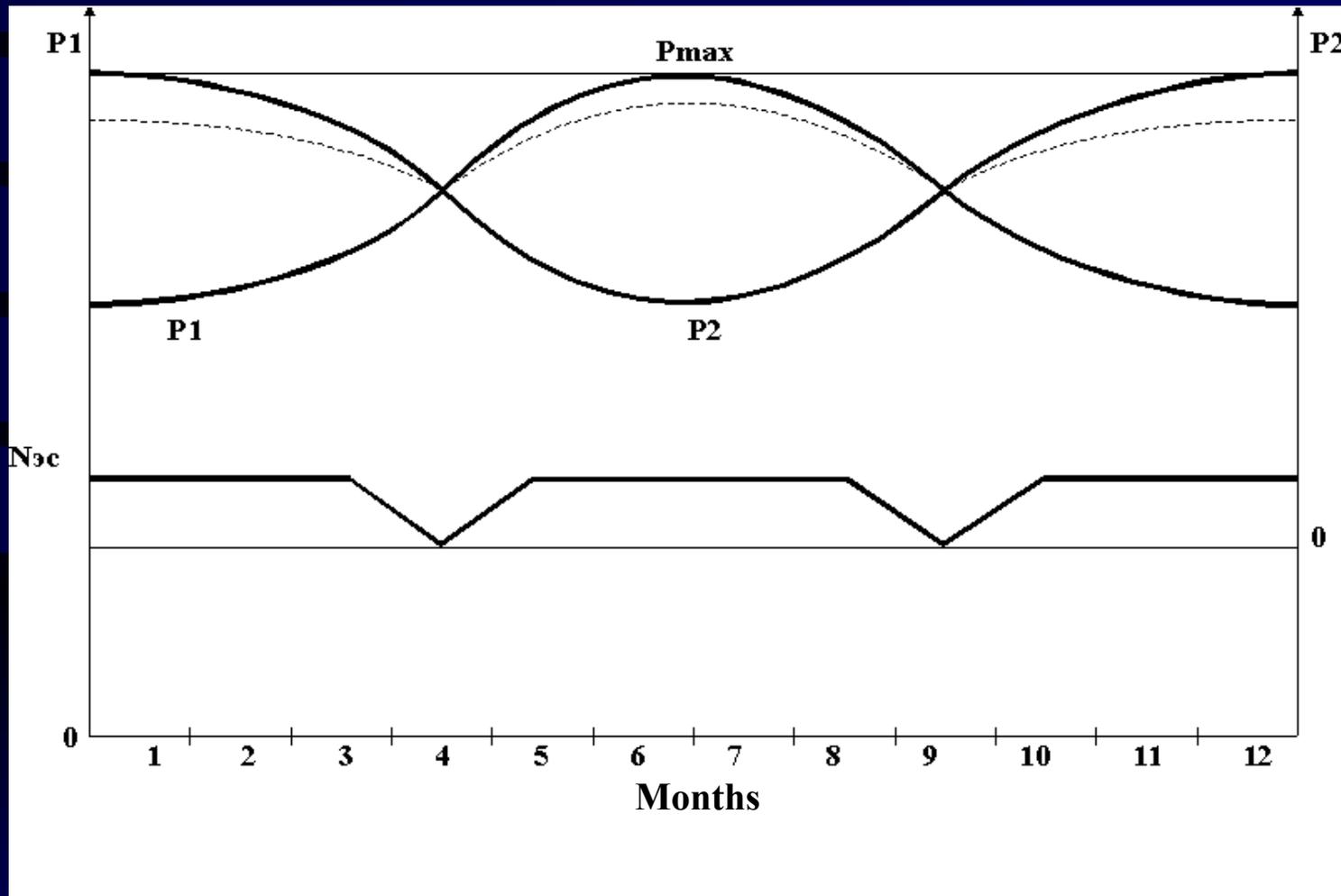
Effects of Power Systems Interconnection in Northeast Asia

- Decrease of Required Installed Capacity of Power Plants
- Decrease of Fuel Cost
- Improvement of Interconnected Power Systems Reliability
- Environmental Burden Relieve

Effect of Interconnecting Power Systems with Different Seasons of Load Maxima



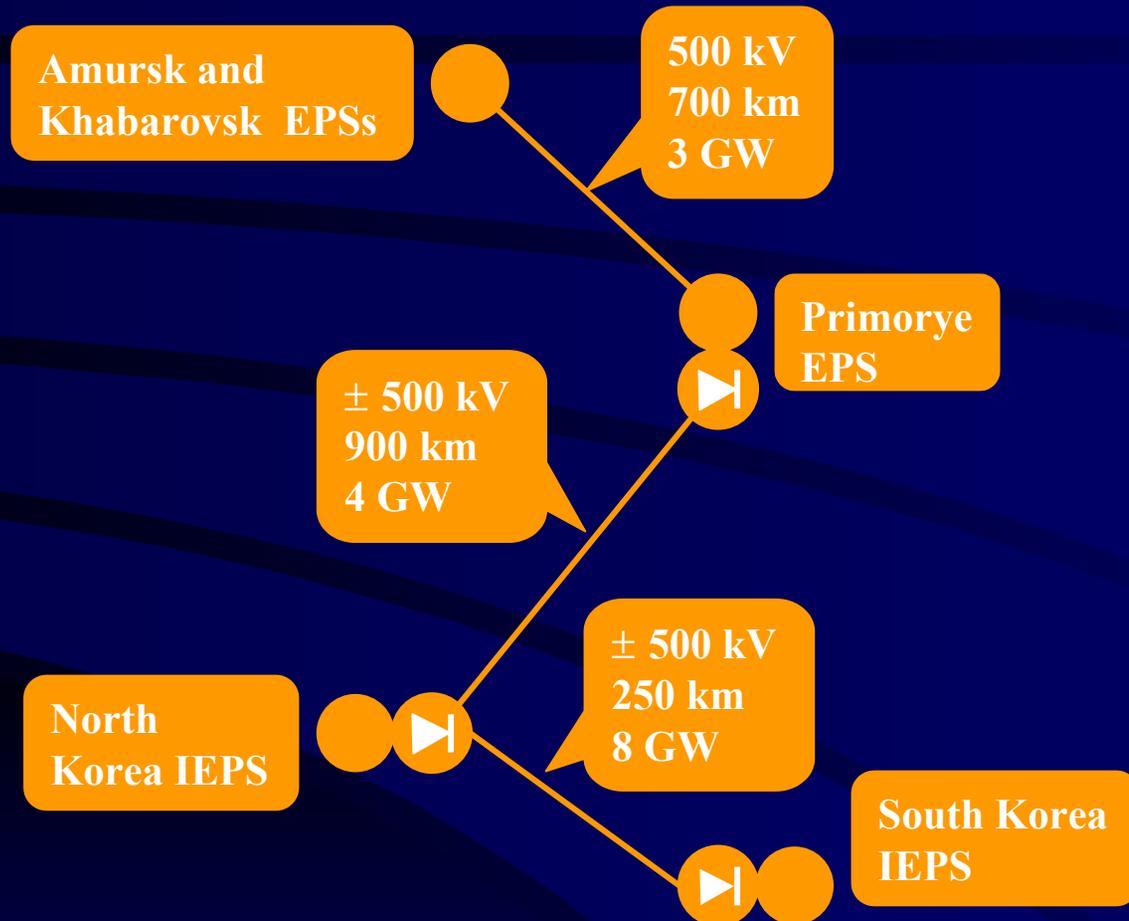
Utilization of Power Plants Capacity in Interconnected Power Systems with Different Seasons of Load Maxima



Prospective Electric Ties of East Russia with Northeast Asian Countries

ISET	Length, km	Voltage, kV	Transfer Capability, GW	Transmit. Electricity, TWh/year	Cost for ISET, \$ Bln.	Cost for Power Plants, \$ Bln.	Total Cost, \$ Bln.
Phase I (up to 2015)							
Bratsk-Beijing	2600	± 600	3	18	1.5	2.7 (Boguchansk Hydro)	4.2
Bureya Hydro – Kharbin	700	± 400	1	3	0.3	1.8 (Bureya Hydro)	2.1
Phase II (2015 – 2025)							
RFE – KPDR – Republic of Korea	1100/ 700	± 500	4/8	8.5	2	2.8 (Primirye Nuclear)	4.8
Sakhalin – Japan	470	± 500	4	23	2.6	4.1 (Sakhalin Gas)	6.7
Phase III (beyond 2025)							
Far East Nuclear – China – Republic of Korea	2300	± 500	2.5	18	3	4 (Far East Nuclear)	7
Uchursk Hydro – China – Republic of Korea	3500	± 500	3.5	17	4.5	6 (Uchursk Hydro)	10.5

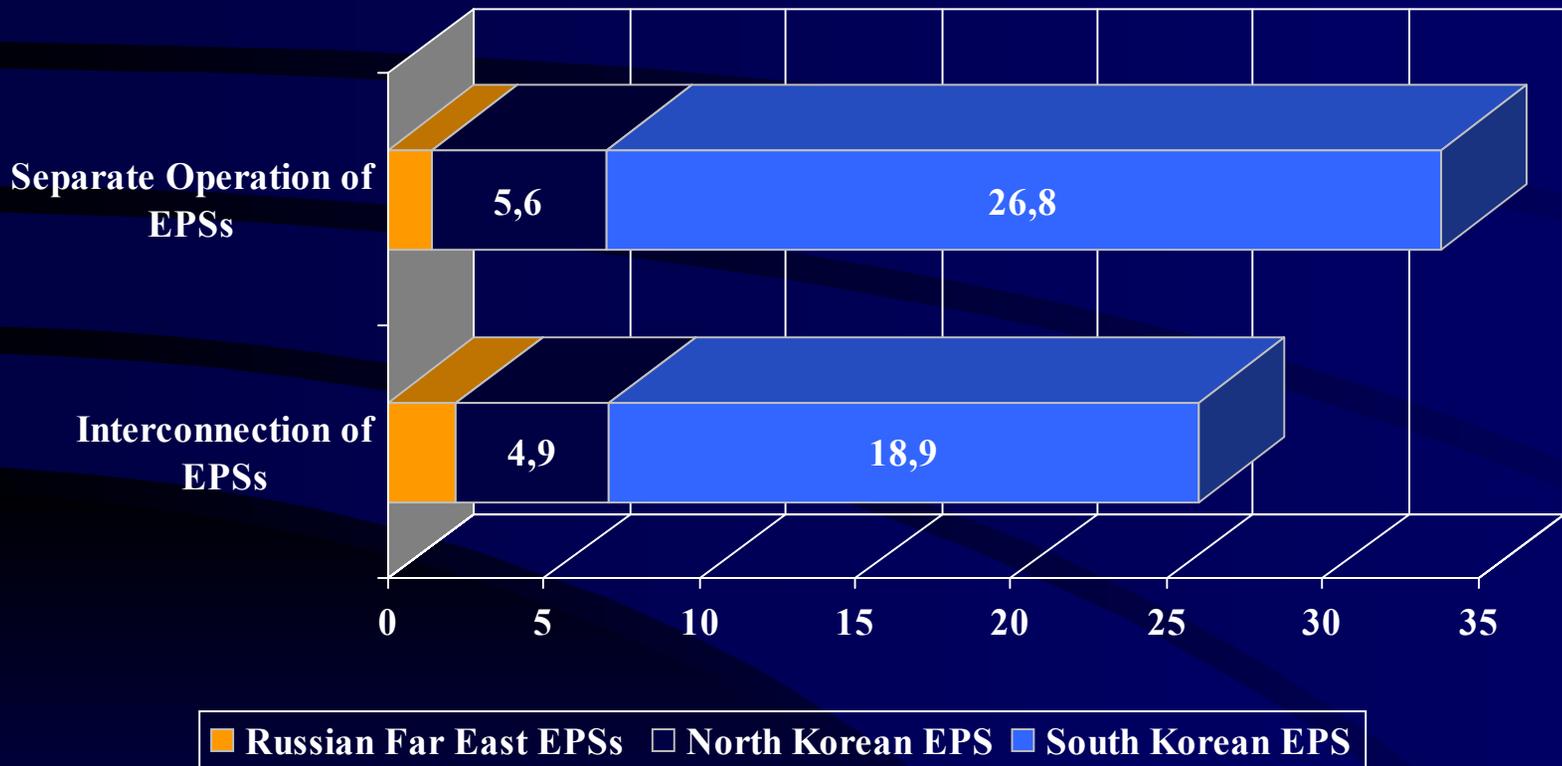
Scheme of Electric Tie «Russian Far East - North Korea - South Korea»



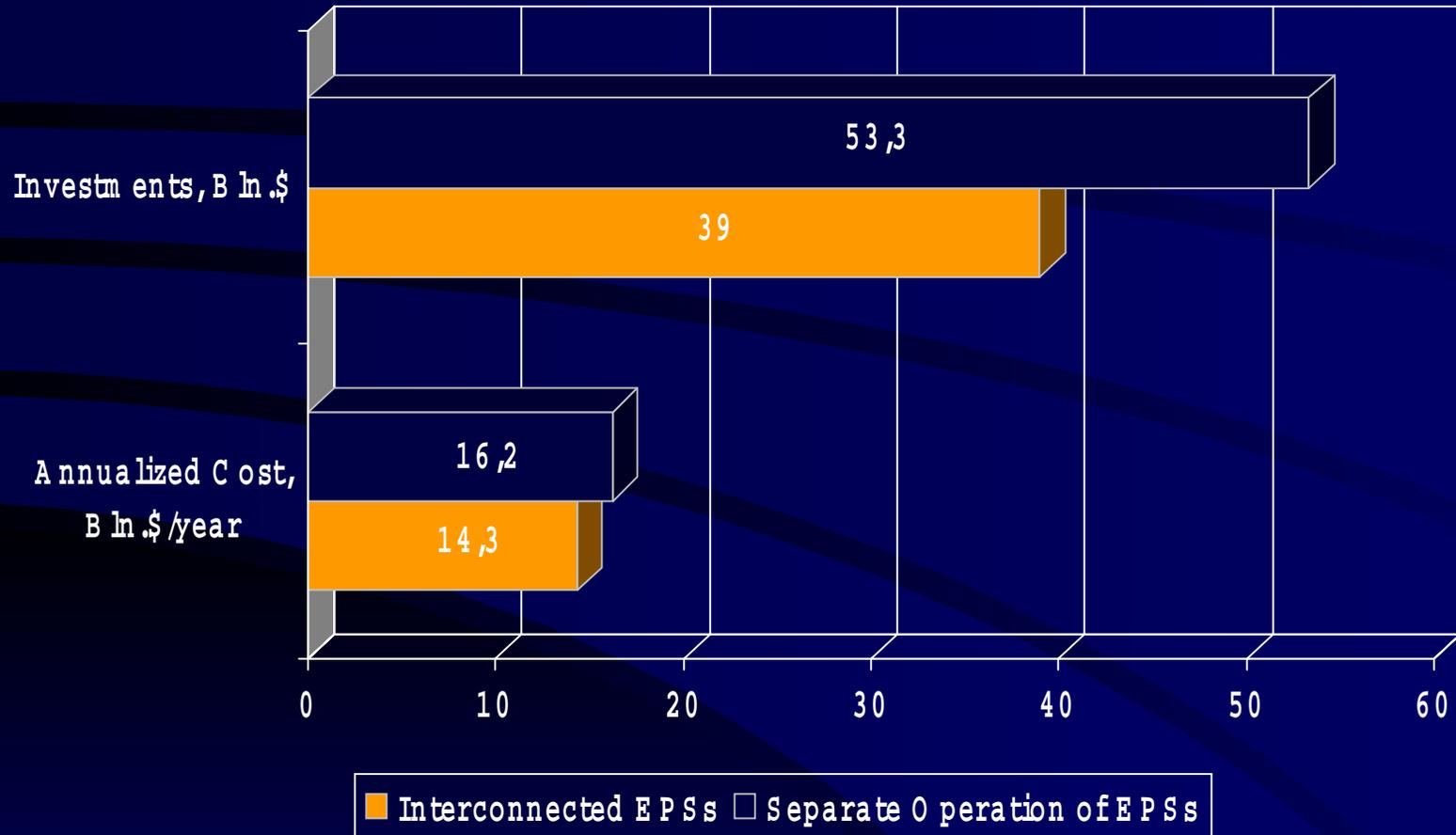
Electricity Exchange via Electric Tie «Russian Far East - North Korea - South Korea», Bln.kWh/year



Commissioning New Capacities, GW



Costs for New Capacities



Interconnection Effects for Russia

Effects	Estimates
Benefit from export amounts to	\$ 420-585 Mln./year
Increasing capacity factor results in	reduction of fixed costs by 15 %
Commissioning large power units of 1000 MW instead of 640 MW on Primorye Nuclear brings about	investment decrease by more than 25 %
Receiving electricity from abroad in peak hours is	0.4 Bln.kWh/year
Decreasing power under-supply by	235 MWh/year
Fossil fuel saving is about	2.5 Mln.tce/year
Carbon oxide emission reduction is nearly	6 Mln.t/year

Methodology for Study of Interstate Electric Ties in Northeast Asia: Tasks have to be Solved. I

- Optimization of Capacity Mix of Interconnected Power Systems
- Determination of Power Systems Reliability Indices
- Optimization of Operating Conditions of Interconnected Power Systems and Interstate Electric Ties
- Determination of Export-Import Tariffs

Methodology for Study of Interstate Electric Ties in Northeast Asia: Tasks have to be Solved. II

- Assessment of Energy, Economic, Financial and Environmental Effects of Interstate Electric Ties in Total and for Each Country-Participant
- Splitting up Costs of Interstate Electric Ties among Countries-Participants
- Ensuring Energy Security for Countries-Participants

Potential Barriers to Power Systems Interconnection in Northeast Asia. I

- Dependence of Countries-Participants on External Electricity Supply
- Different Technical Standards in Power Industry in Various Countries of the Region
- Different Energy Legislation in Countries of the Region
- Long Distances, Difficult Routes and High Cost for Interstate Electric Ties

Potential Barriers to Power Systems Interconnection in Northeast Asia. II

- Financing
- Necessity to Open up Internal Information for Other Countries
- Necessity to Accord National Energy and Power Strategies and Plans with other Countries of the Region
- Political Tension Between Some Countries

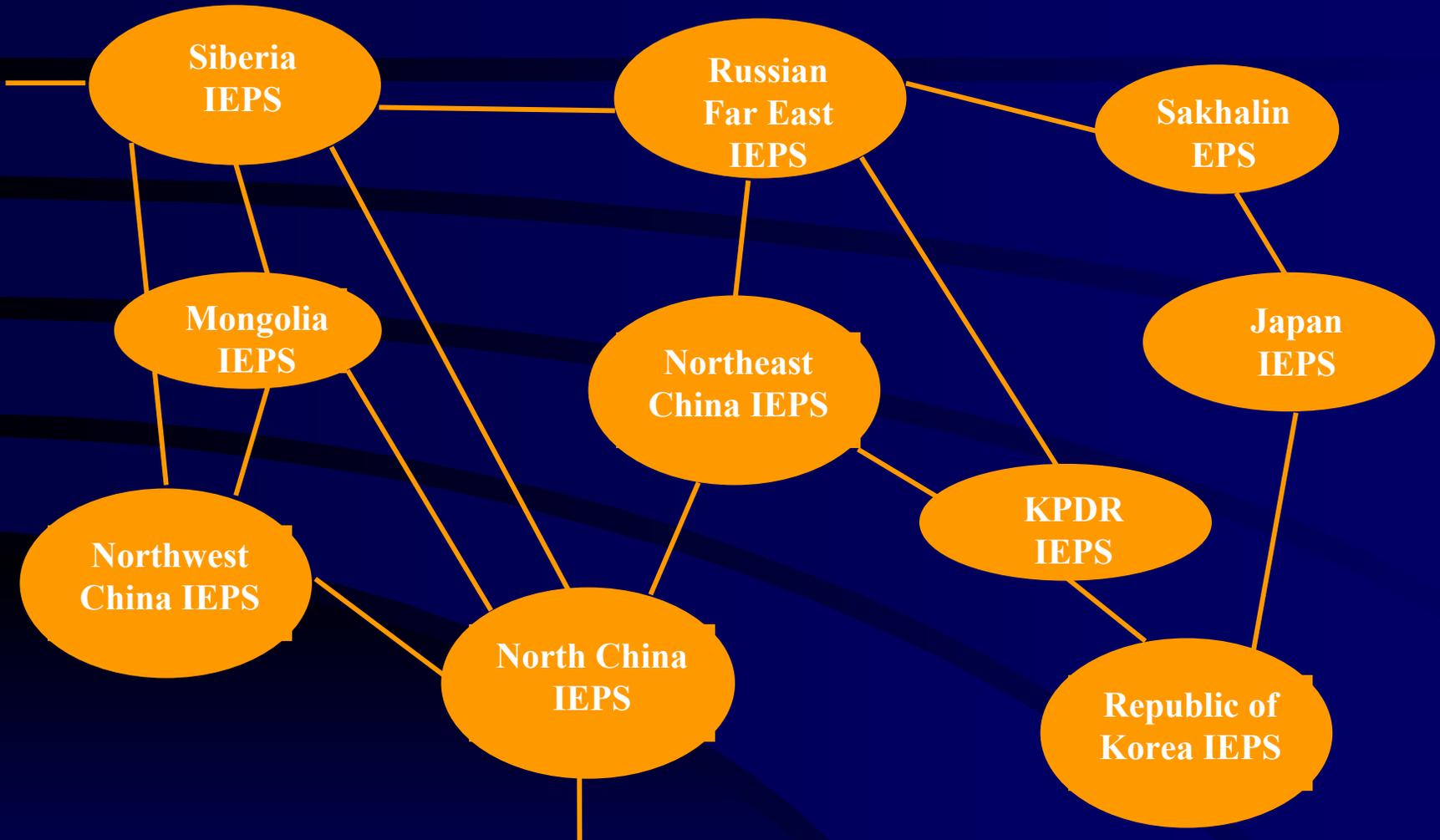
Development of Northeast Asian Power Grid Interconnection Project



Stages of Power Grid Formation

- 1 Reinforcement of Domestic Transmission Lines and Construction of the First Interstate Electric Ties with Concluding Bilateral Agreements
- 2 Reinforcement of Constructed Interstate Electric Ties and Constructing New Ones with Coordination of their Commissioning and Concluding Multilateral Agreements

Power Grid Interconnection in Northeast Asia



Inferences

- Power Integration of the Northeast Asian Countries with Formation of Interstate Electric Ties and Power Grid Interconnection will Bring about Substantial Effects to the Countries-Participants
- There are Barriers to Power Systems Interconnections in the Region but they can be Overcome
- Development of Methodology, Mathematical Models and Collecting Information on Power Industries of Northeast Asia Countries for Studies of Power Grid Interconnection Project are Required
- Cooperation of all Concerned Organizations of Various Countries is Needed to Develop Northeast Asia Power Grid Interconnection Project