[2] Master Plan on Optimization for Peaking Power Supply

Japan International Cooperation Agency (JICA)

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- Part1: Outline of Study
- Part2: Scenarios
- Part3: Results of Simulations
- Part4: Optimal Power Development Plan

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Part1 : Outline of Study

- Study Flow
- Methodology
  - System Reliability Analysis
  - Quantification of Annual Costs

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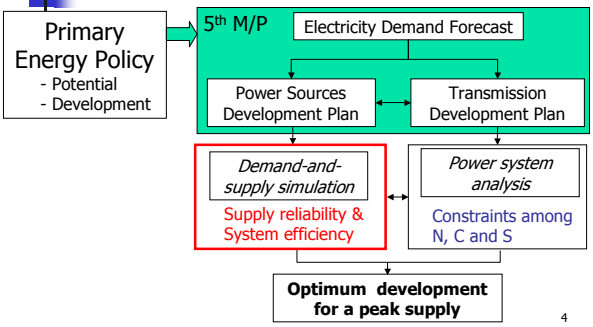
Study Flow



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Power system analysis

To identify

- Constraints among North, Center and South through 500 kV T/L

  Due to :
  - Spec. of Transmission systems
  - Stability
  - Power supply reliability

Reflecting to Supply-and-Demand Simulation

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Methodology

(Simulation Tools)

- System Reliability — RETICS
- Annual Costs — PDPAT II
- Balance between Demand and Supply — PDPAT II

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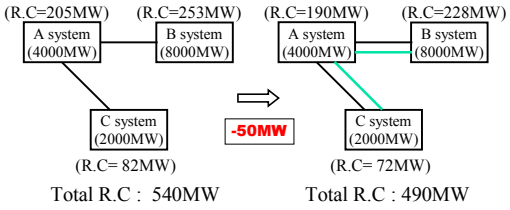
System Reliability Analysis by RETICS

- To simulate how Reserve Capacity Required changes along with Interconnection Capacity on the Same Reliability



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Simulation of Supply & Demand Balance by PDPAT II (1)

- Computation of Annual Cost
  - Fixed Cost
    - Depreciation, Interest
    - O&M
  - Energy Cost
    - Fuel
    - Power Exchange

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Simulation of Supply & Demand Balance by PDPAT II (2)

- Computation of Balance between Demand and Supply (Economic Dispatch)
  - Most Economical Energy Balance (Fuel Balance)
  - Optimal Power Balance
  - Reserve Margin
  - Fuel Consumption
- Computation of Power Exchange
  - Quantity & Frequency of Exchange
  - Economical Power Exchange

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Part2 : Establishment of Scenarios

- Situations & Conditions
  - Load Curve, Limitation of Interconnection
- Screening Analysis
  - Selection of Economical Peak Suppliers
- System reliability analysis
  - Necessary Reserve margin

To establish Scenarios for Quantification of annual costs by PDPAT II Simulation for divided systems

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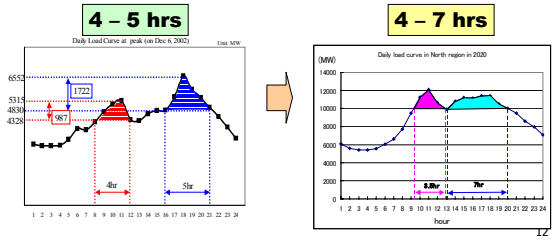
Load Curve Forecast

- Peak shift affects the duration of peak demand



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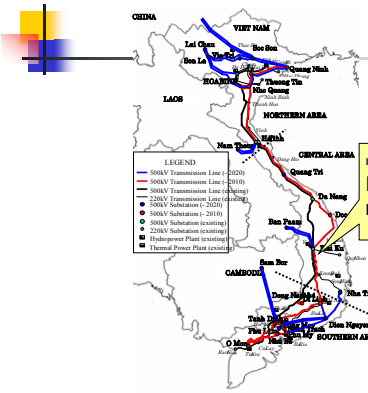
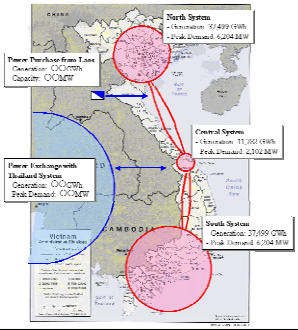
Limitation of Interconnection



- The Limitation of Interconnection still remains in 2020

PDPAT Ⅱ Input; Multi-system Model



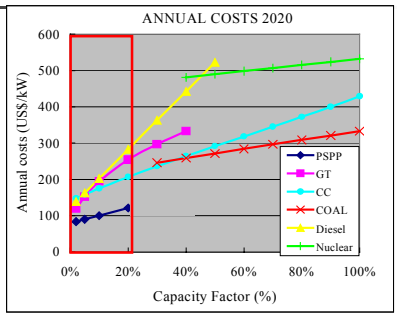
Screening analysis

- Which peaking power supply should be selected from economic aspect?

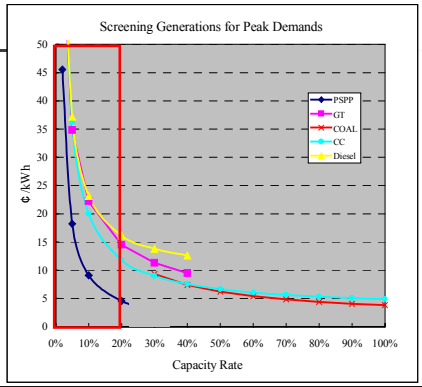
Screening Analysis (conditions)

	Construction Cost	Life time	Annual O&M Cost Rate	Fuel Cost in 2020	
PSPP	650 US$/kW	40	1.0%	Hydro 0 ¢ /kWh	Coal 2.4 ¢ /kWh
GT	400 US$/kW	20	5.0%	3.9 ¢ /kWh	
CC	600 US$/kW	25	4.5%	2.4 ¢ /kWh	
Coal	938 US$/kW	30	3.5%	1.5 ¢ /kWh	
Diesel	800 US$/kW	15	3.0%	9.0 ¢ /kWh	

Screening Analysis (1)

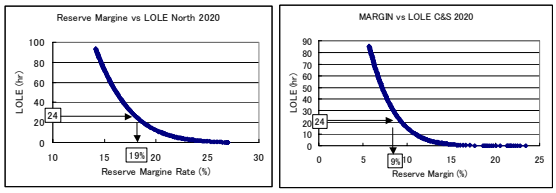


Screening Analysis (2)



Reliability analysis by RETICS (1)

- Divided systems



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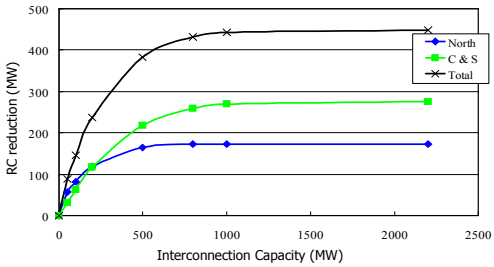
Reliability analysis by RETICS (2)

- Reduction of Reserve Capacity



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Reserve Margin of Revised 5th M/P

	Installed capacity (MW)	Reserve margin	LOLE	Annual costs mil,.US$/yr
Whole system	42,162	19.3%	0.08	9,515
North	16,290	10.9%	86.46	2,925
C&S	25,872	20.2%	0.03	6,699
Total	42,162			9,624

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Required Reserve Margin (MP load profile)

	Installed capacity (MW)	Reserve margin	LOLE (hrs)	Annual costs (mil.US$/yr)
①Whole system	39,793 -2,369	9.7%	24.6	9,400 -115
②Divided system				
(North)	16,225 -65	14.2%	23.4	3,083 +158
(C&S)	24,538 -1,334	7.9%	23.3	6,555 -144
Total	40,763 -1,399			9,638 +14

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Establishment of scenarios

	PSPP	GT
Target years	2015, 2020	2015, 2020
Power system	Whole, North, C&S	Whole, South
Installed capacity	0 - 10%	0 - 10%
Capacity of interconnection	800, 1300, 2200MW	800, 1300, 2200MW
Son La construction	2,400 or 0	2,400 or 0
Demand forecast	MP load curve, Peak Shift	MP load curve, Peak Shift
Power Purchase from Neighbor Countries	Laos, None, All	Laos, None, All
Soaring fuel prices	Base×2	Base×2

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Part3 : Simulation of Supply & Demand Balance by PDPAT II

- Results in 2015 for optimal peak supply
  - Effects of Son La
- Results in 2020 for optimal peak supply
  - Effects of peak shift
  - Effects of interconnection
  - Effects of system limitations
- Optimal composition
  - Effects of limitations of fuel consumption
- Optimal operating hours for PSPP

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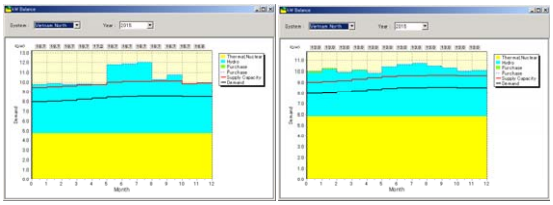
Effects of Son La

- Effects peak supply installation



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Results in 2020

- PSPP in N system shows benefits

Scenario		PSPP in N		PSPP in S		GT in S	
Demand	Interconnection	%	US$ mil/Yr	%	US$ mil/Yr	%	US$ mil/Yr
Peak shift	Whole system	0	9,621	0	9,621	0	9,621
	0MW	3.5	9,875	0	9,956	0	9,973
	800MW	3.5	9,650	0	9,727	0	9,729
	1,300MW	3.5	9,618	0.6	9,663	0	9,667
	2,200MW	2.4	9,598	1.8	9,588	0	9,622
IE	Whole system	0	9,400	0	9,400	1.2	9,397
	0MW	1.2	9,546	0	9,592	0	9,592
	800MW	1.2	9,307	0	9,341	0	9,341
	1,300MW	1.2	9,260	0	9,276	0	9,276
	2,200MW	0	9,233	0	9,233	0	9,233

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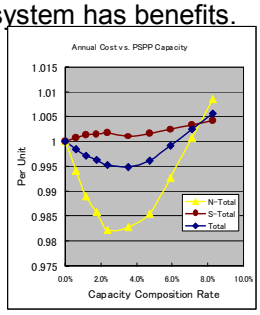
PSPP in N system PS demand (1)

- N system has benefits.



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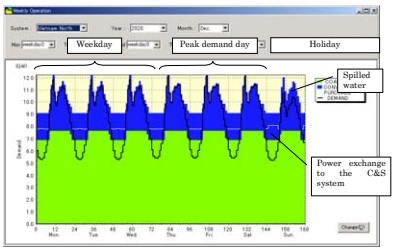
Simulation results (1)

- Before PSPP installation, N system



Dec. 2020 N system

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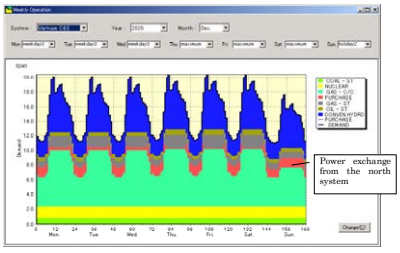
Simulation results (2)

- Before PSPP installation, C&S system



Dec. 2020 C&S system

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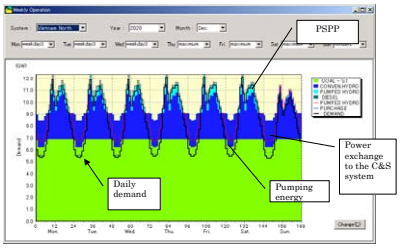
Simulation results (3)

- After PSPP installation, N system



Dec. 2020 N system PSPP 1500MW in N

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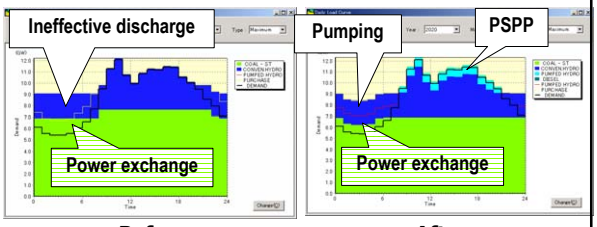
Effects of PSPP in 2020

- Utilization of off-peak surplus supply



Before **After**

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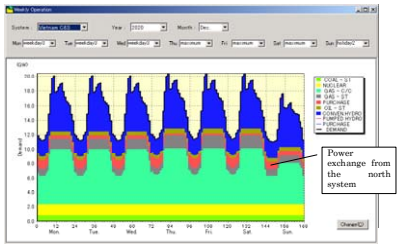
Simulation results (4)

- After PSPP installation, C&S system



Dec. 2020 C&S system PSPP 1500MW in N

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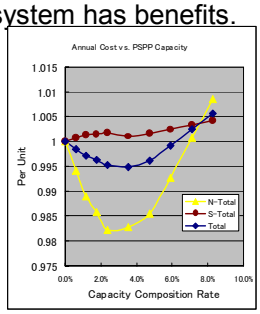
PSPP in N system PS demand (1)

- N system has benefits.



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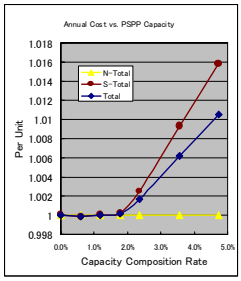
PSPP in S system PS demand (1)

- No benefit



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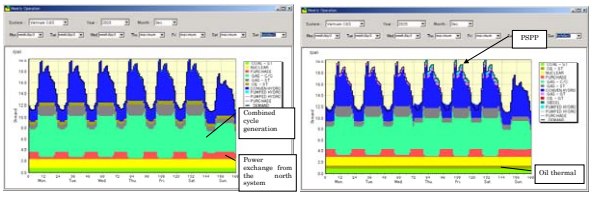
PSPP in C&S system PS demand (2)

- Increasing Oil consumption



PSPP in C&S 250MW in Dec. 2020 **PSPP in C&S 2000MW in Dec. 2020**

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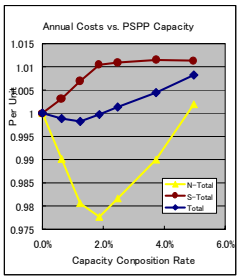
PSPP in N system, MP load profile

- Benefits from PSPP installation with IC 1300MW



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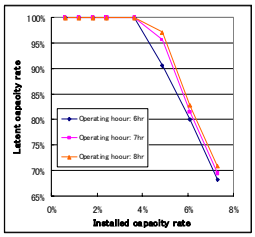
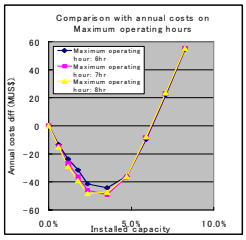
Optimal Peak Duration Time of PSPP

- 7-hour is appropriate in Vietnam system.



Latent capacity



Annual costs

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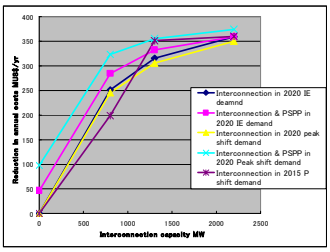
Effects of Interconnection

- Around 1300MW, benefits decelerate



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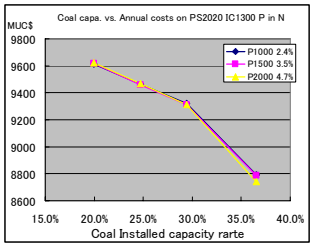
Effects of Coal TPP installation in the South

- PS demand, 2020 case



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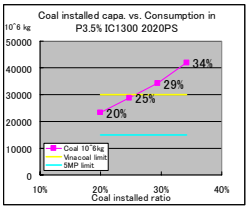
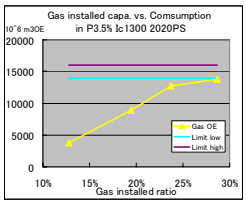
Consideration of Fuel limitation

- Coal limits at 25%, Gas not to constrain



Coal limitation



Gas limitation

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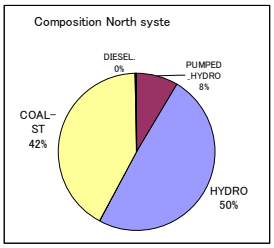
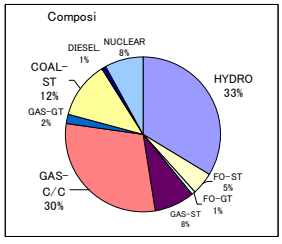
Optimal Composition

- Peak shift case, 2020 case



N system



C&S system

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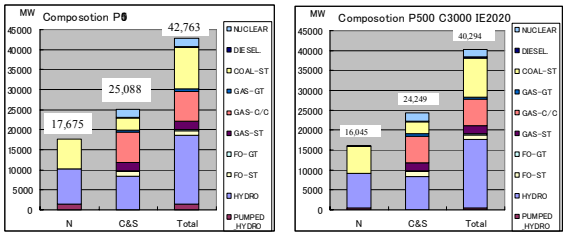
Part 4 : Optimal power development plan in 2020 (Composition)



Peak shift case **MP load profile**

Image of power development pattern from 2010 to 2020 (Peak shift case)

Thank you