

Efforts to Minimize the Environmental Load at LNG Receiving Terminal

June 2006

Tokyo Gas Co.,Ltd.

Ohgishima LNG Terminal

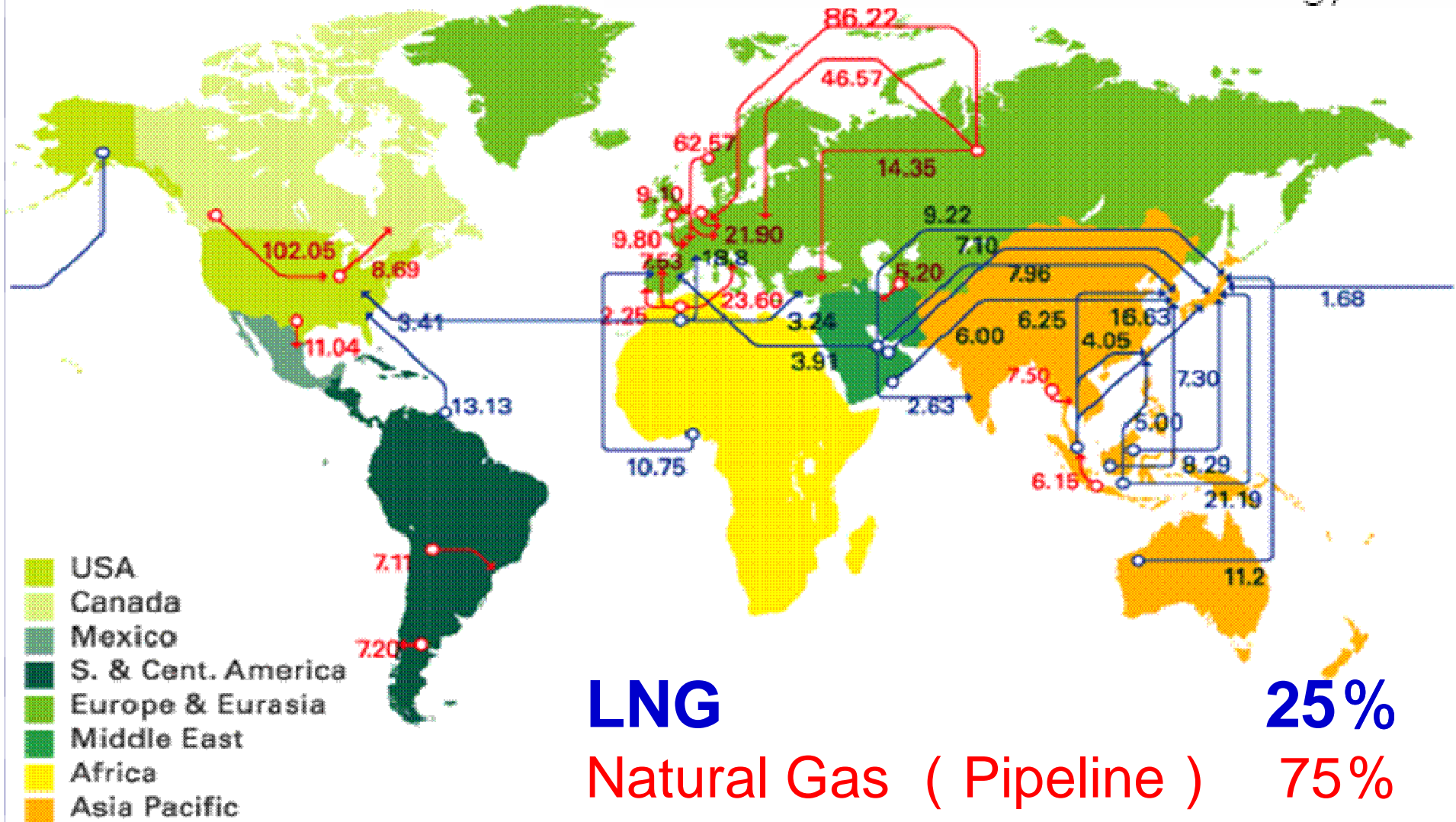
Mitsutaka Kajitani

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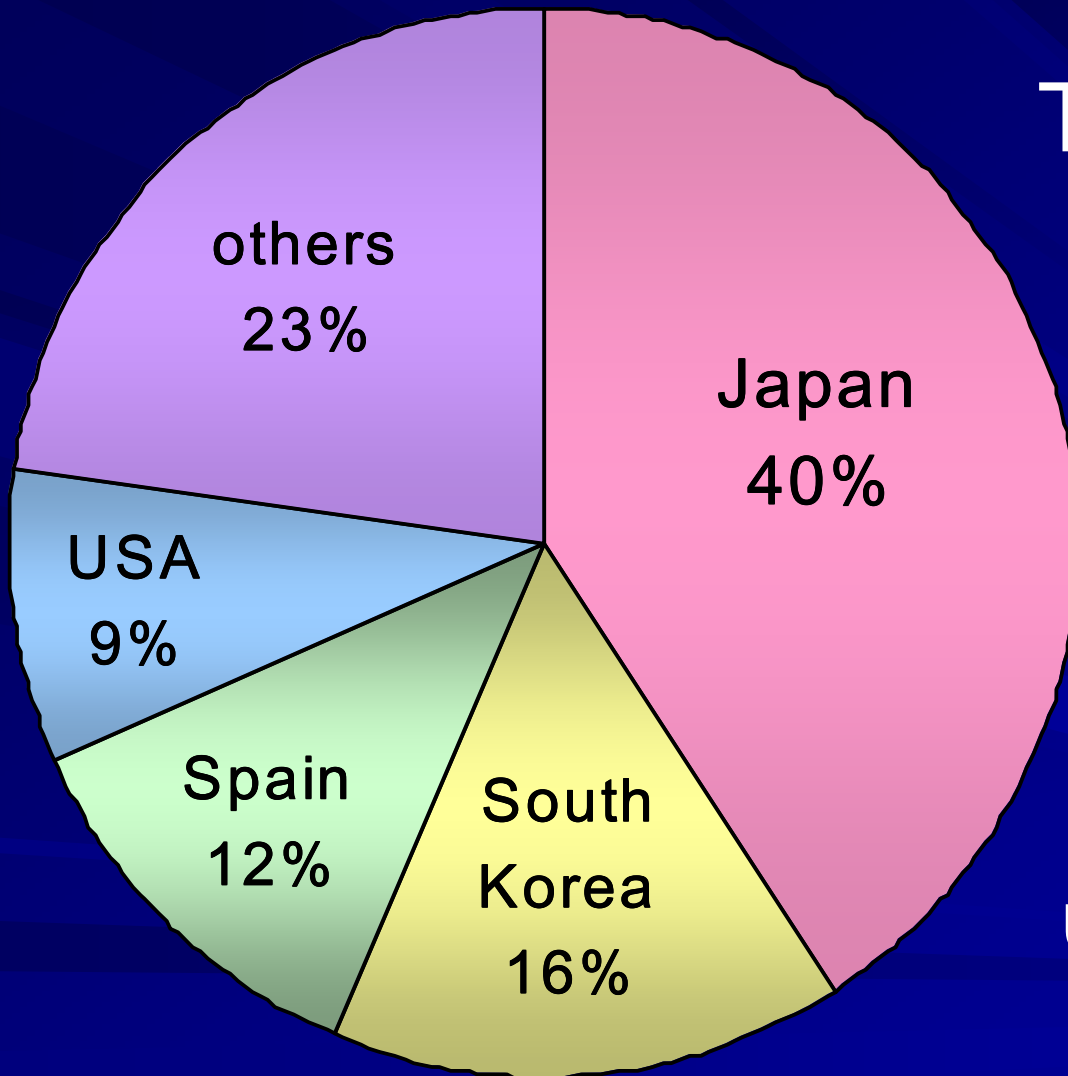
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Trade Flows of Natural gas & LNG

BP Statistical Review of World Energy 2005



World LNG Imports (2005)



Total Amount **143**

The Import Volumes
for Major Countries

JAPAN 58.1

South Korea 22.5

Spain 17.0

Unit: Million Metric Tons

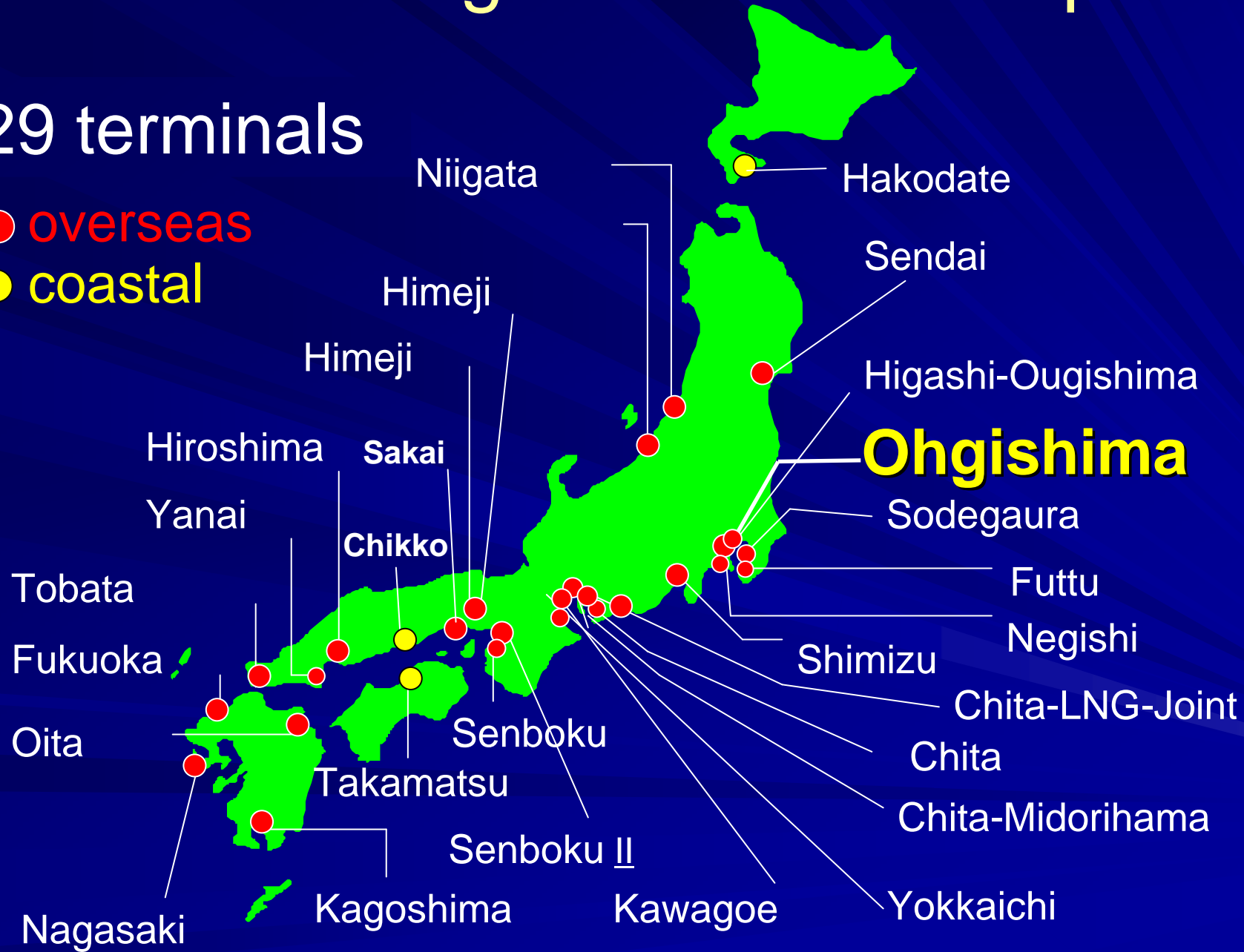
Diamond Gas Report (May24,2006)

LNG Receiving Terminals in Japan

29 terminals

● overseas

● coastal



Tokyo Gas LNG Receiving Terminals

Ohgishima 1998~



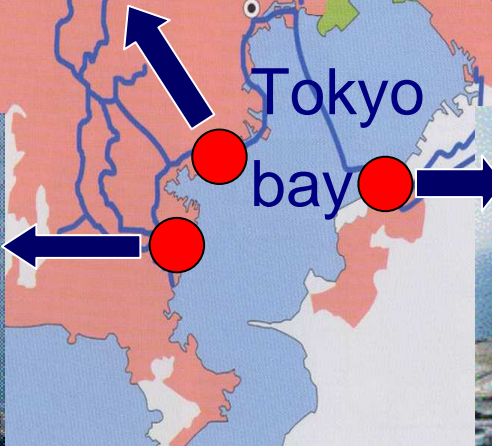
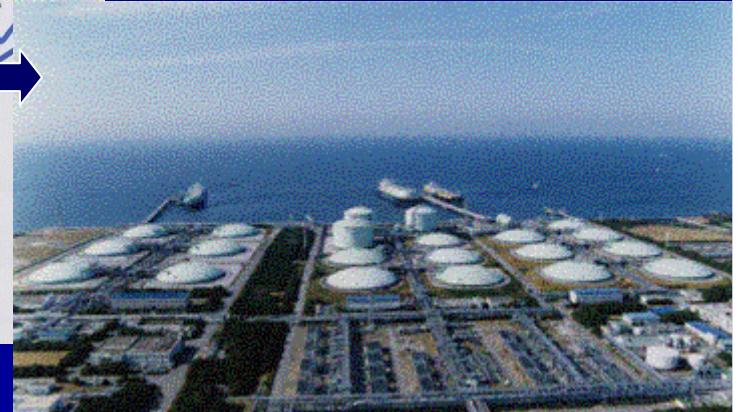
Import Volume (2005)
15.4 Million Metric Tons
(10.7% of World Imports)



Negishi 1969~



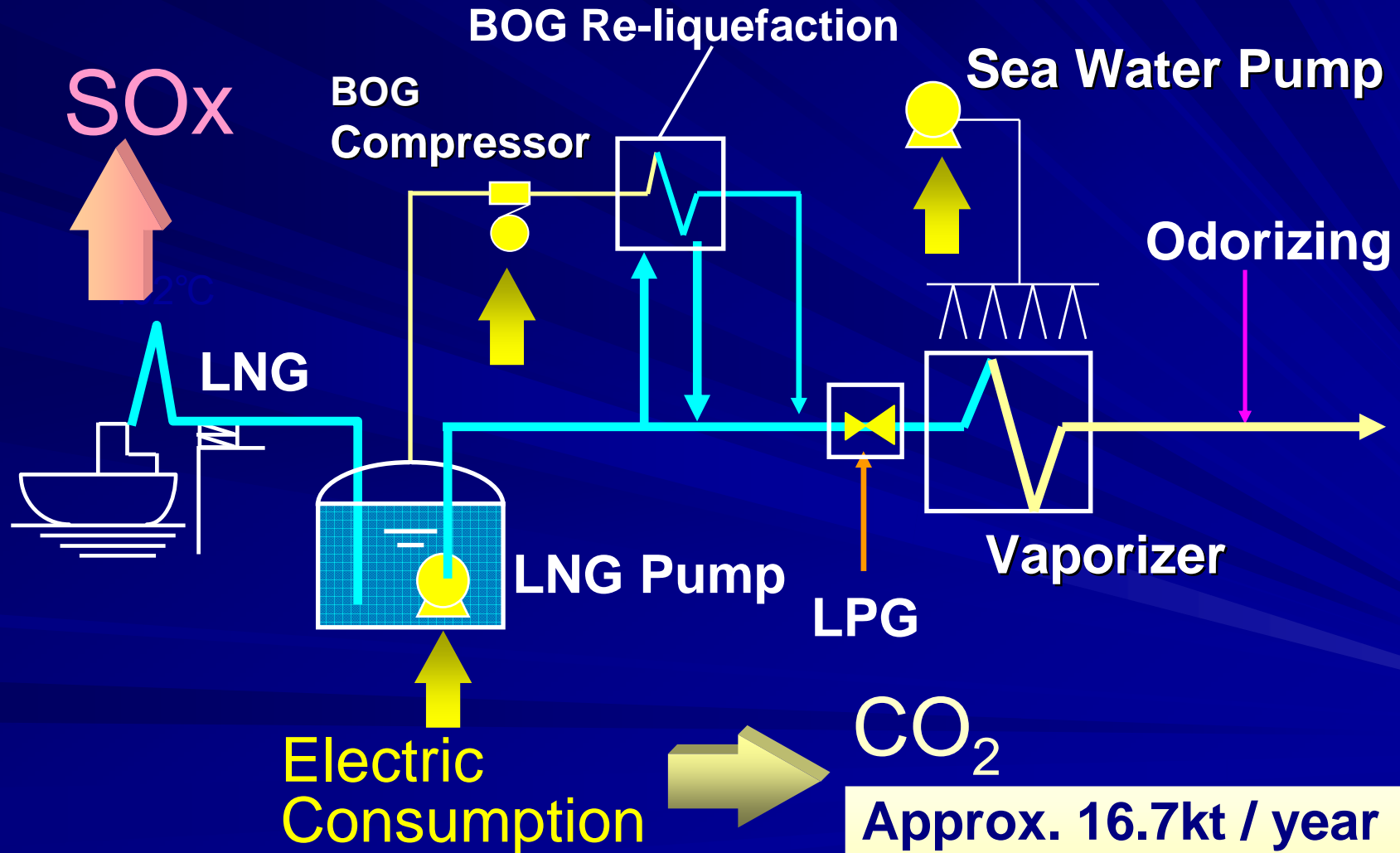
Sodegaura 1973~



Environmental Load at Ohgishima Terminal

(2005)

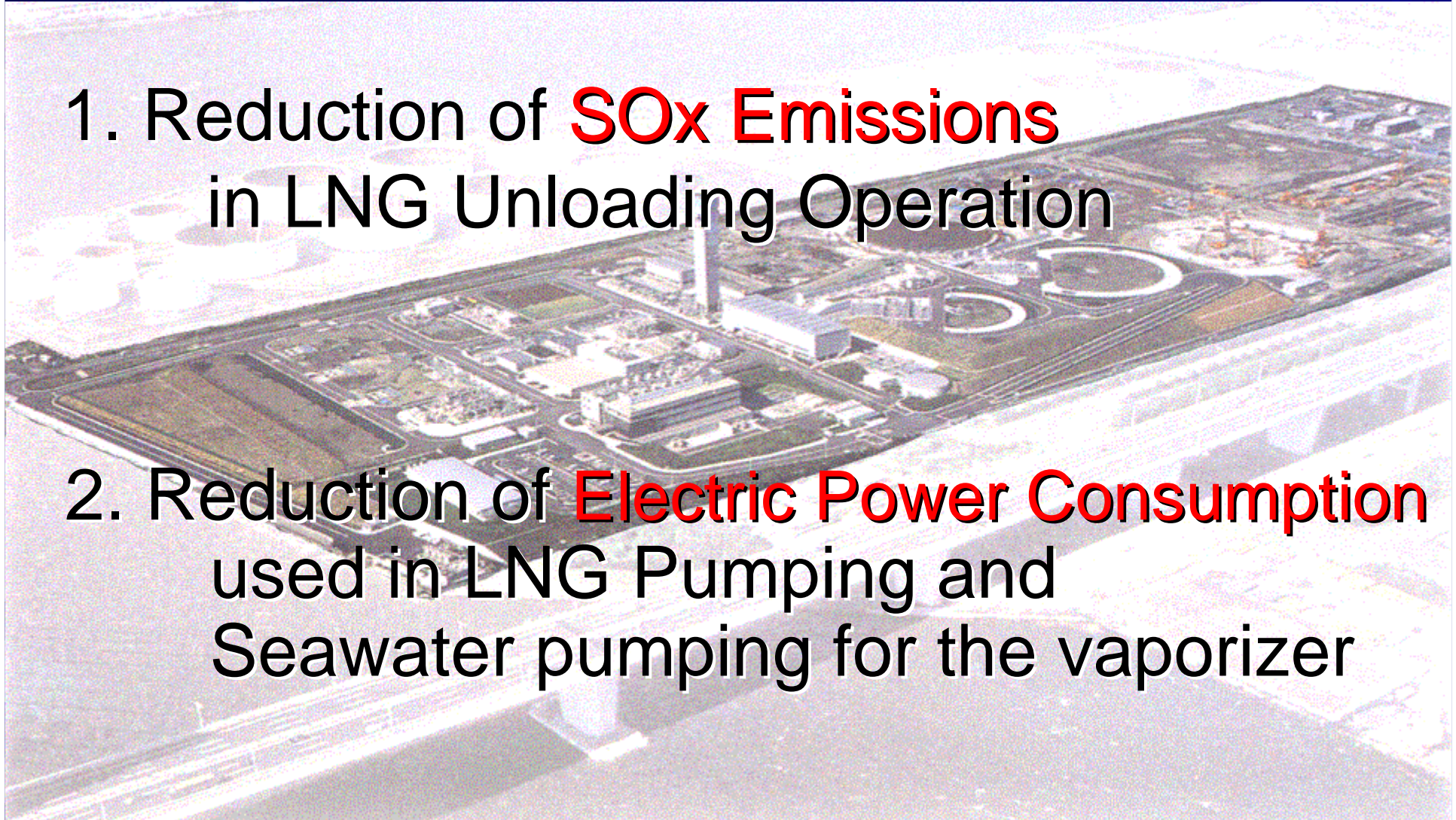
Approx. 1.7 t / cargo



Examples for Minimizing the Environmental Load at Terminal

1. Reduction of **SOx Emissions** in LNG Unloading Operation

2. Reduction of **Electric Power Consumption** used in LNG Pumping and Seawater pumping for the vaporizer



Reduction of SOx Emissions in LNG Unloading Operation

Cargo pumps consume much electricity



Fuel for generators
bunker oil (High sulfur)



SOx Emissions
: 1.7 t / cargo
(Tokyo Gas ship)

How to Reduce SOx

Change fuels

Single burning
bunker oil

Dual burning

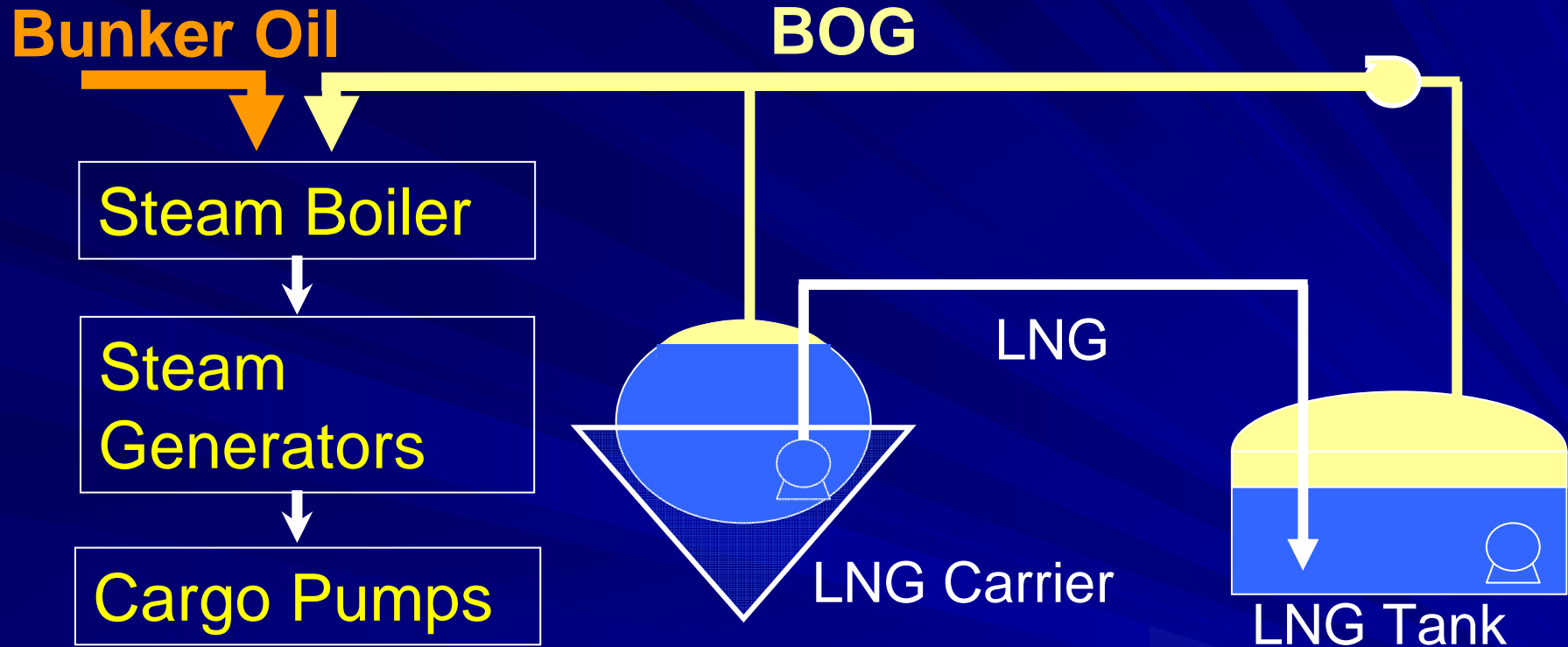
Bunker oil + BOG (sulfur free)

~~Single burning
BOG~~

Regulatory issues

Not permitted because
of safety requirements
for emergencies

Fuel Flow for Generators

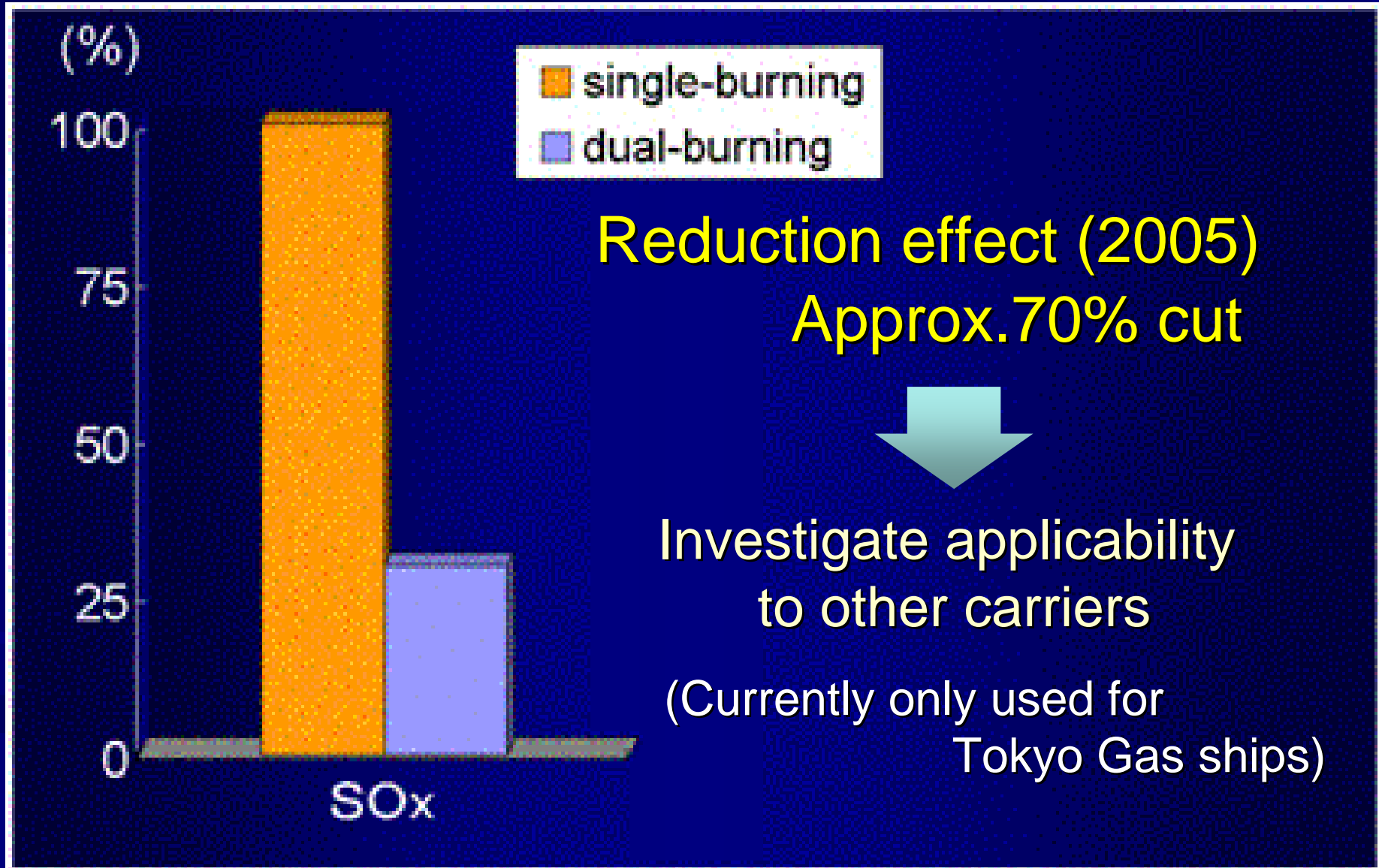


$$\text{LNGBOG} = \text{Boiler Demand} - \text{Bunker Oil}$$

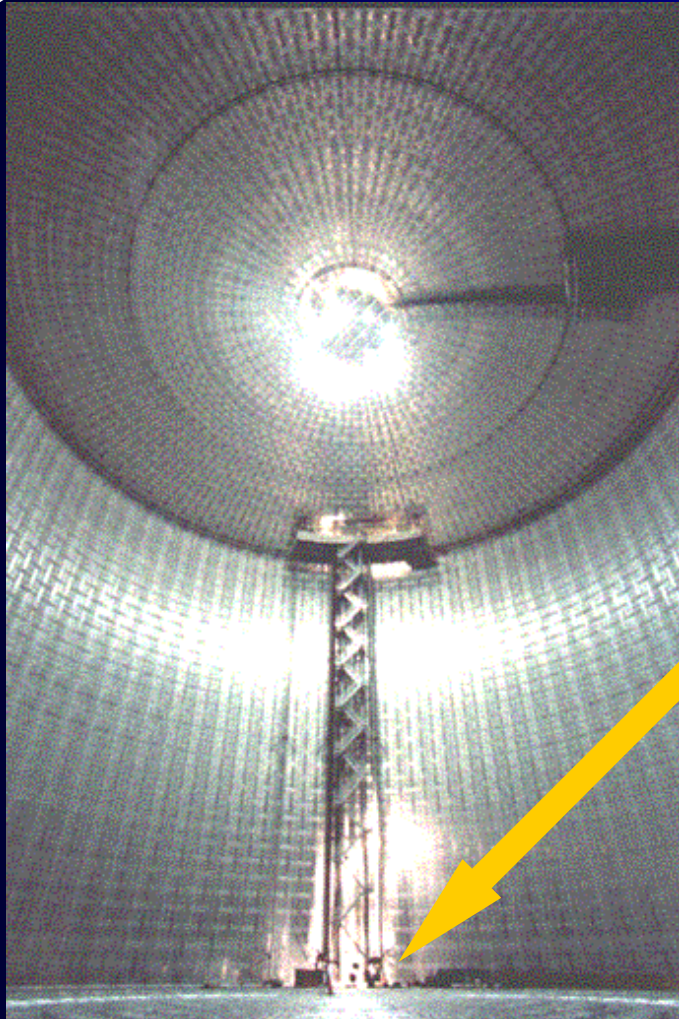
※ LNG BOG : Average 1.2t/h

※ Bunker Oil : Minimum Approx. 0.6t/h

SOx Reduction



Reduction of Electric Power Consumption Used in LNG Pumping



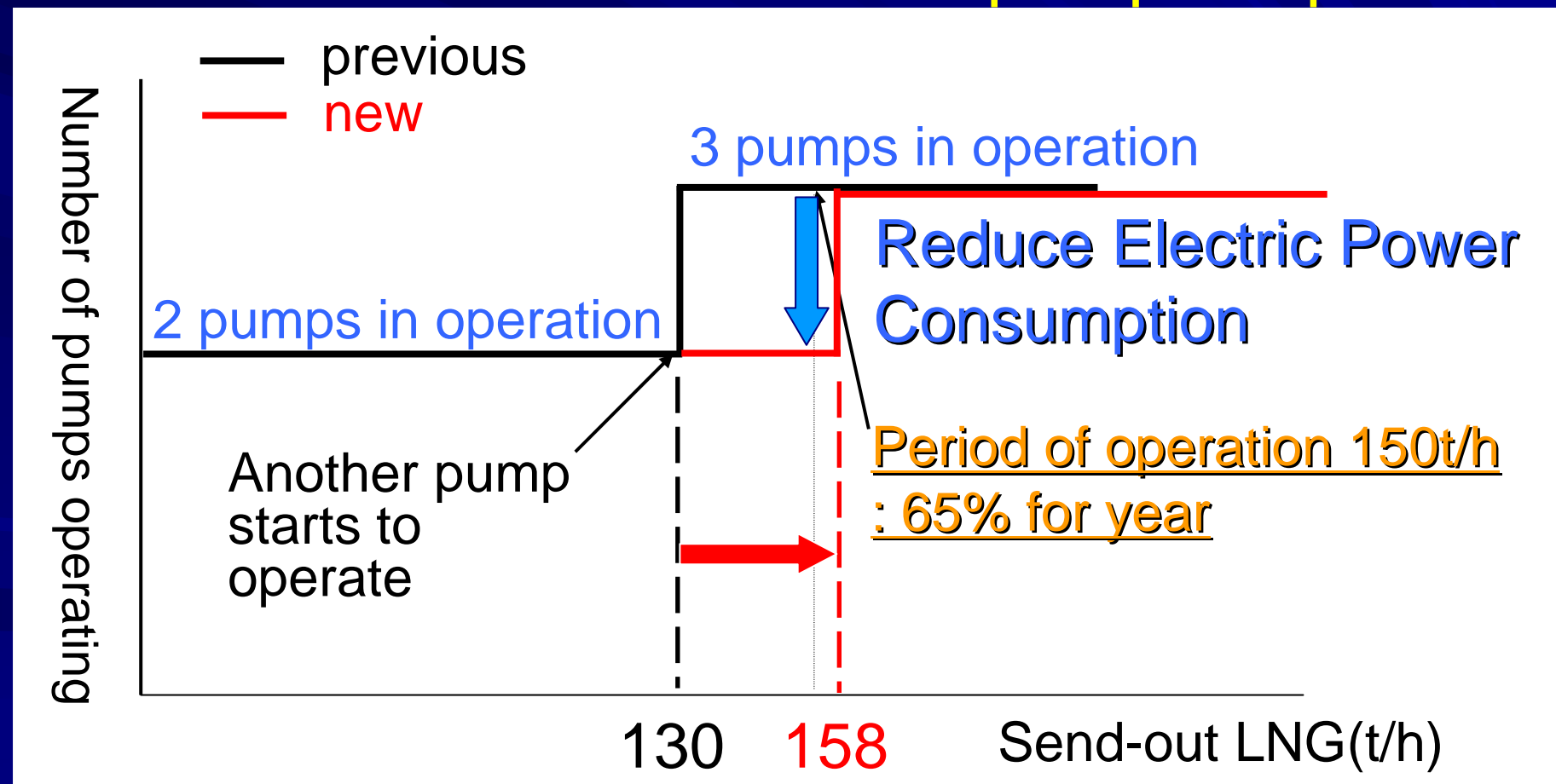
LNG Pump

The number of pump is automatically controlled

More than the minimum required number of pumps is operated concerning to the risk of a pump failing.

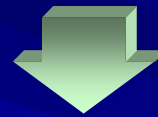
How to Reduce the Number of Operating LNG Pumps

Increase send-out LNG of each pump in operation



Influence at LNG Pump's Failure when the number of operating pump is reduced

LNG pump trips  Send-out gas pressure
decreases more than previous
(Reserve pump starts automatically)

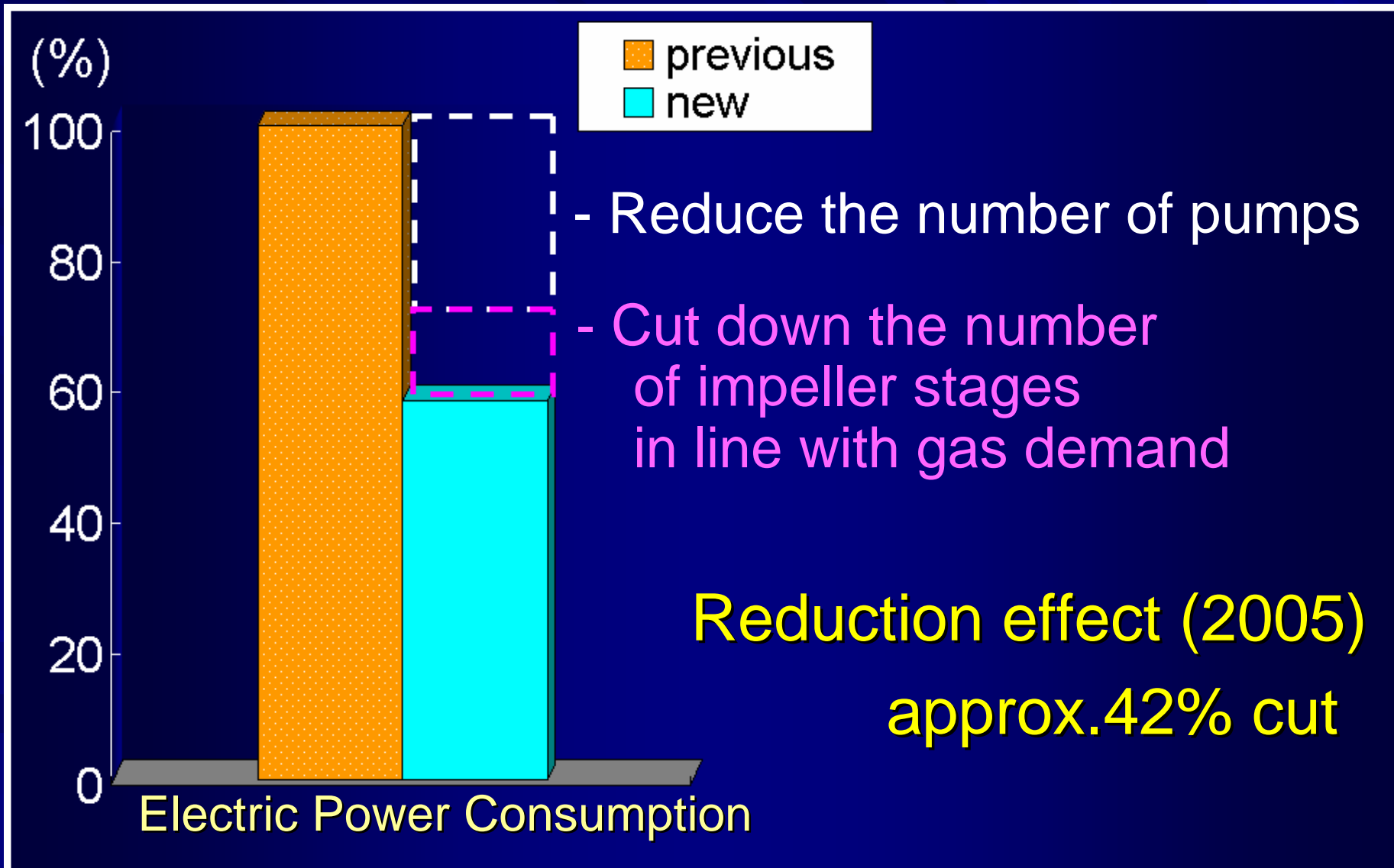


Possibility to stop sending out gas from the terminal

Precautions

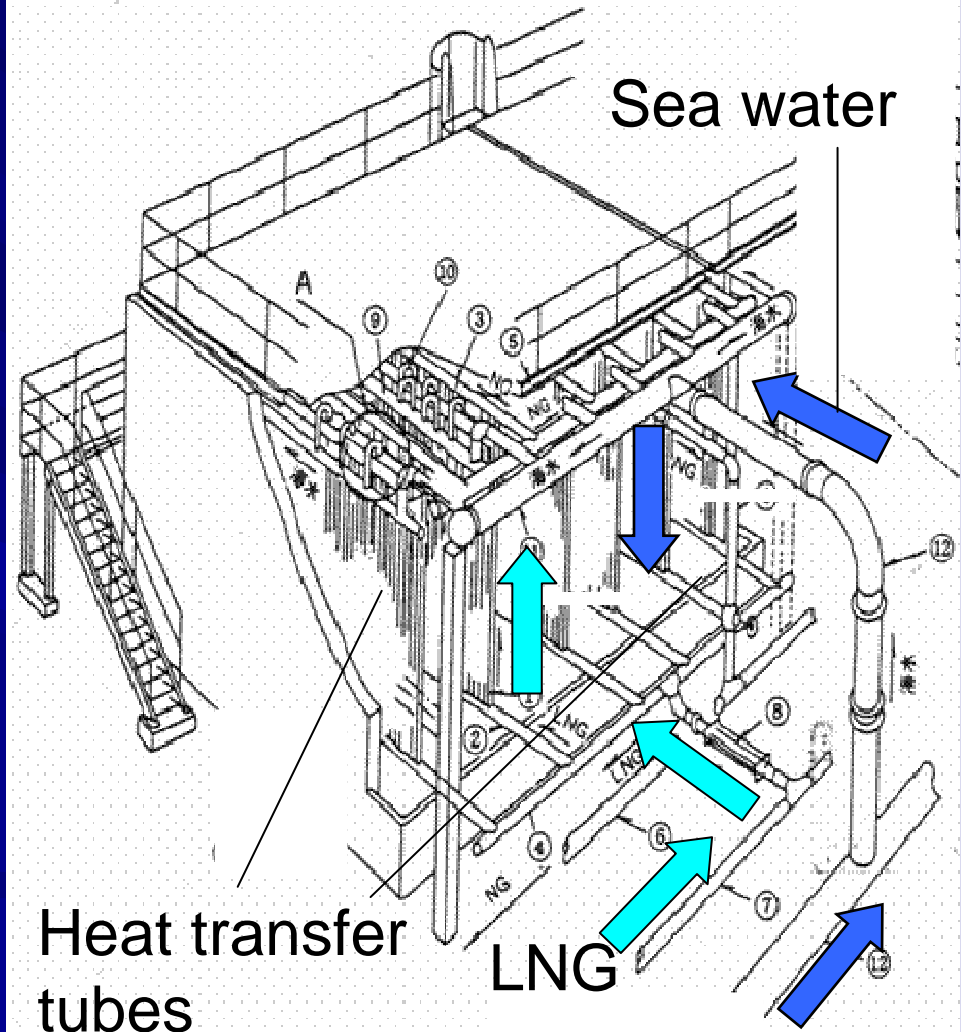
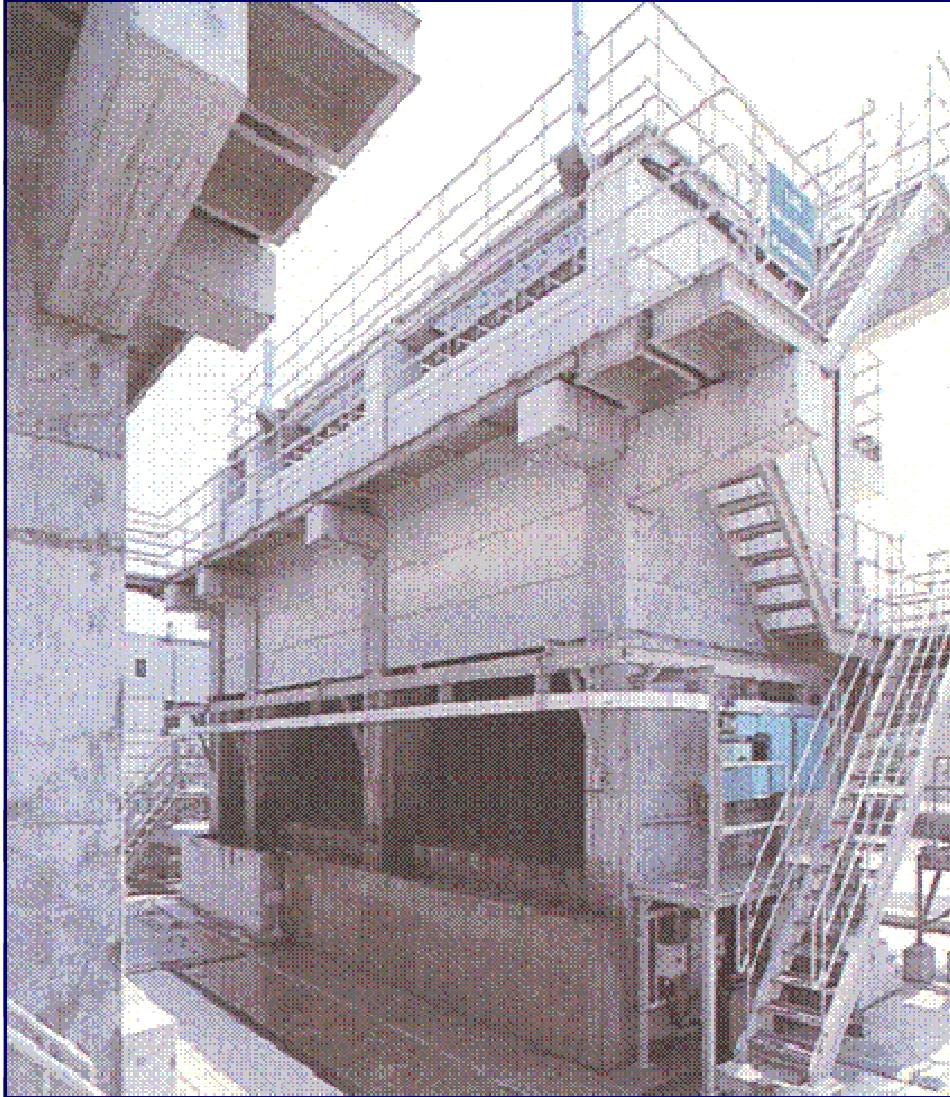
- Check the influence on operation by simulation
- Test of making LNG pump trips under the severe conditions

Reduction of Electric Power Consumption

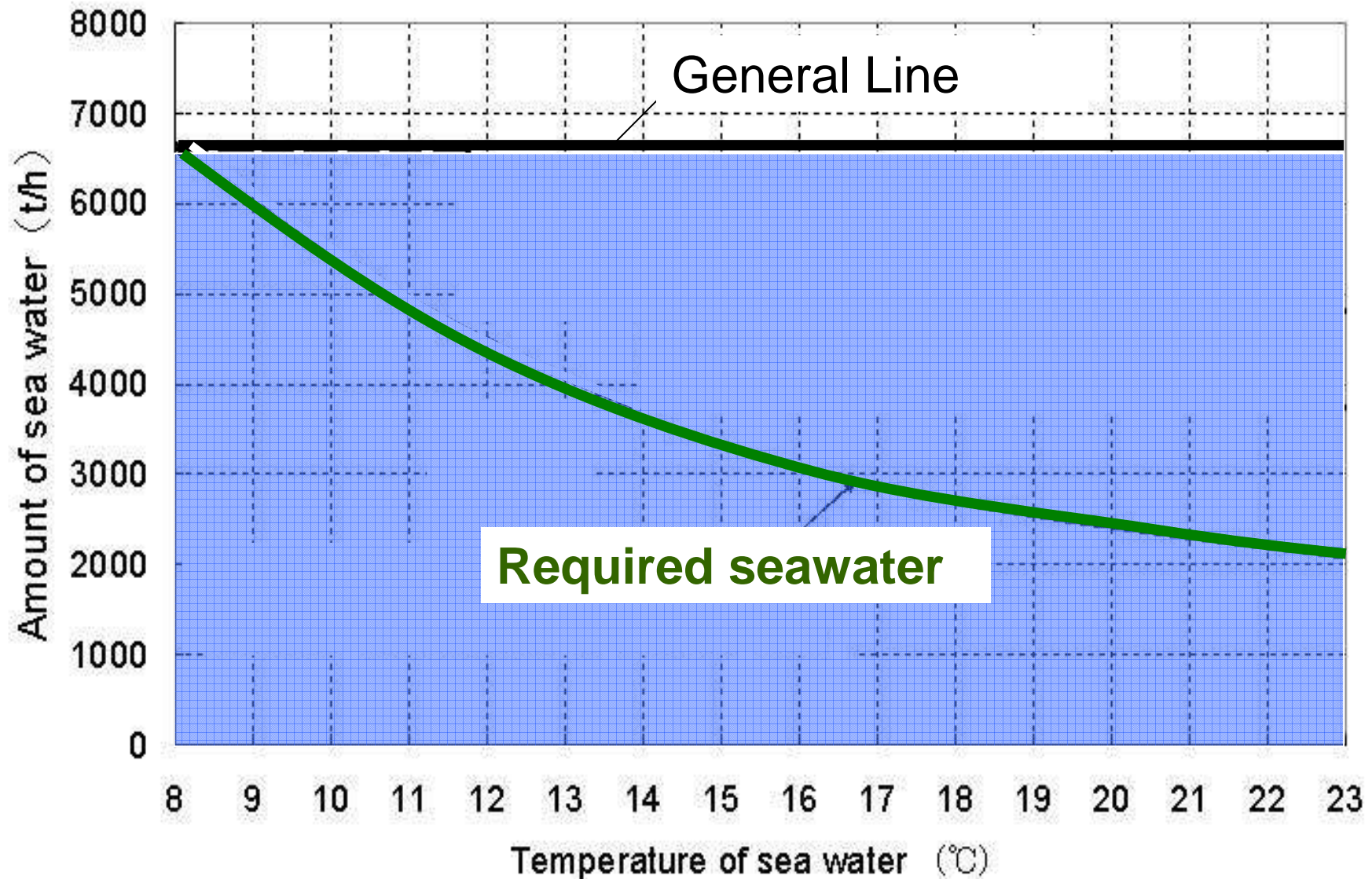


Reduction of Electric Power Consumption Used in Sea Water Pumping

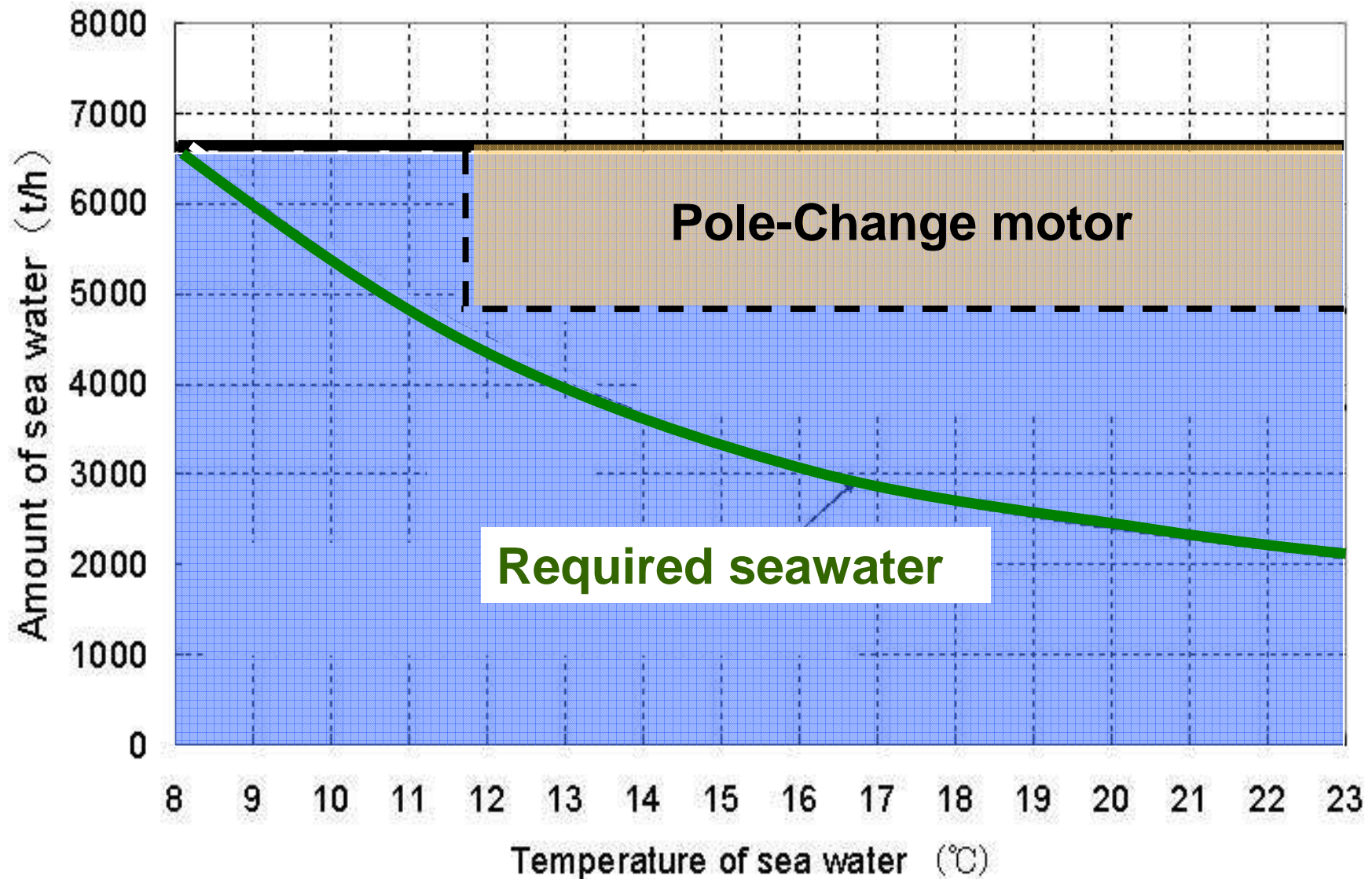
Open-rack Type Vaporizer



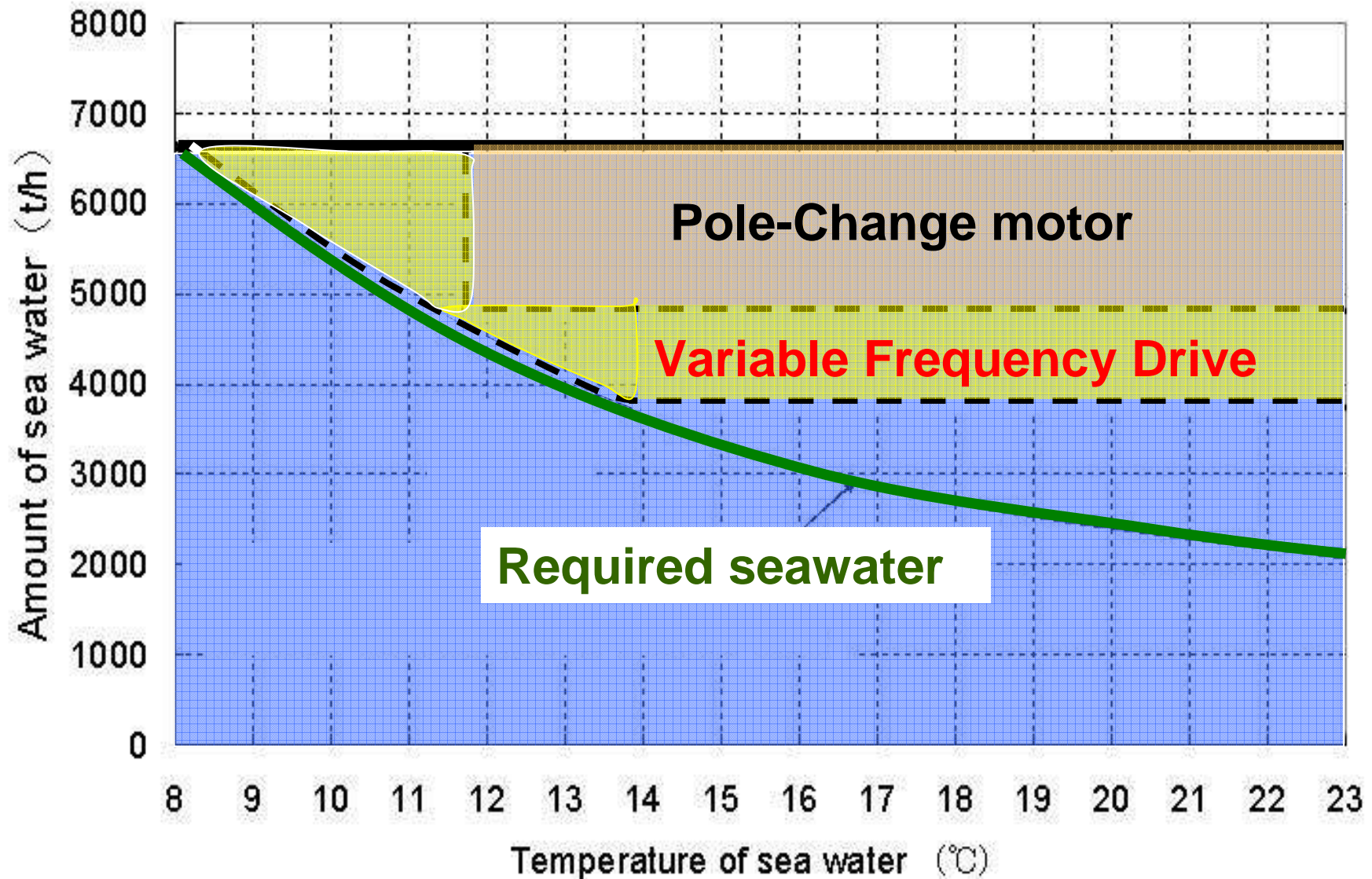
How to Reduce Amount of Sea Water



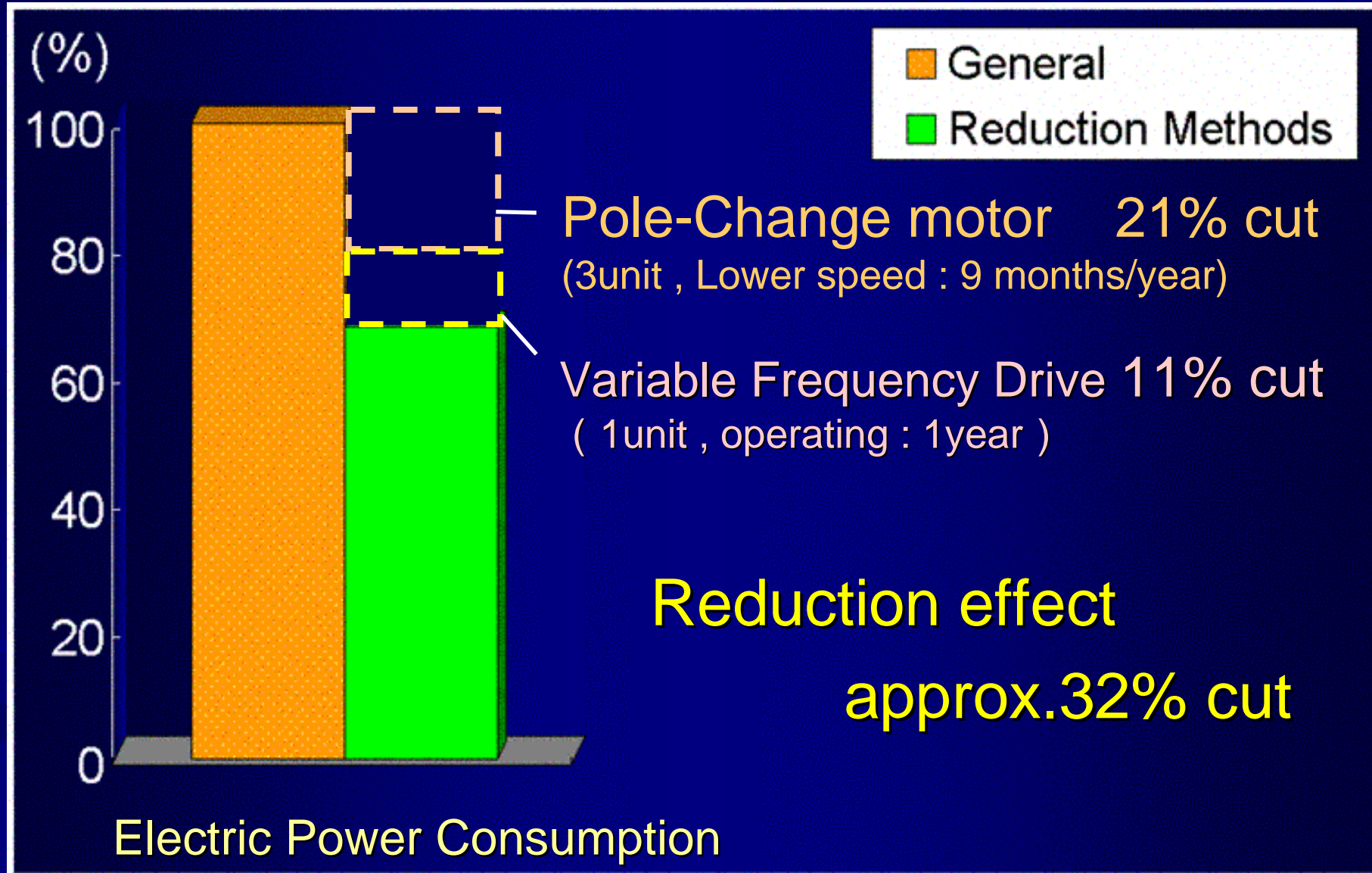
How to Reduce Amount of Sea Water



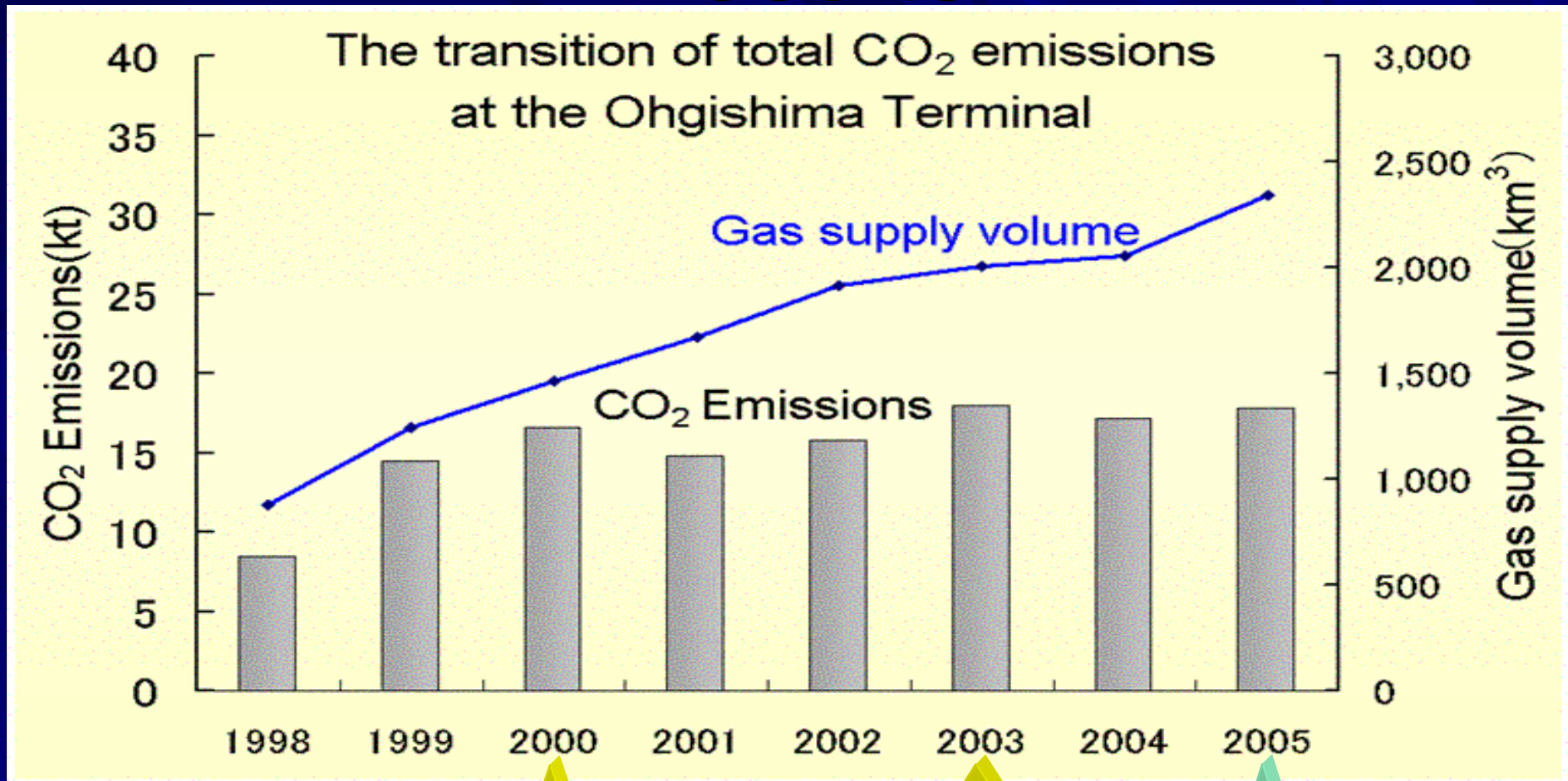
How to Reduce Amount of Sea Water



Reduction of Electric Power Consumption



Results



Reduce the number of LNG pumps operating

Cut down the impeller stages of LNG pumps

Reduce amount of seawater using variable frequency drive

The Environmental Load Reduction Effect (2005)

Emission Coefficient : 0.436tCO₂ / MWh

	Effect	Methods	
CO ₂	3,860t cut (19% cut of total)	Reduction of electric power in LNG pumping	40%
		Reduction of seawater used in LNG re-gasification	42%
		Others	18%

SO _x	approx. 70% cut	Reduction of SO _x emission in LNG unloading operation
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Conclusion

LNG import is increasing every year



Continue developing new ways to
reduce environmental load

- **Contribute to resolving environmental issues**
- **Increase competitive advantage as terminal**
 - ➔ **Continue to be the customer's choice !!**