

**Fourth GMSARN International Conference 2009 on  
“Energy Security and Climate Change: Problems & Issues in GMS”  
Ha Long City, Vietnam, 25-27 November, 2009**

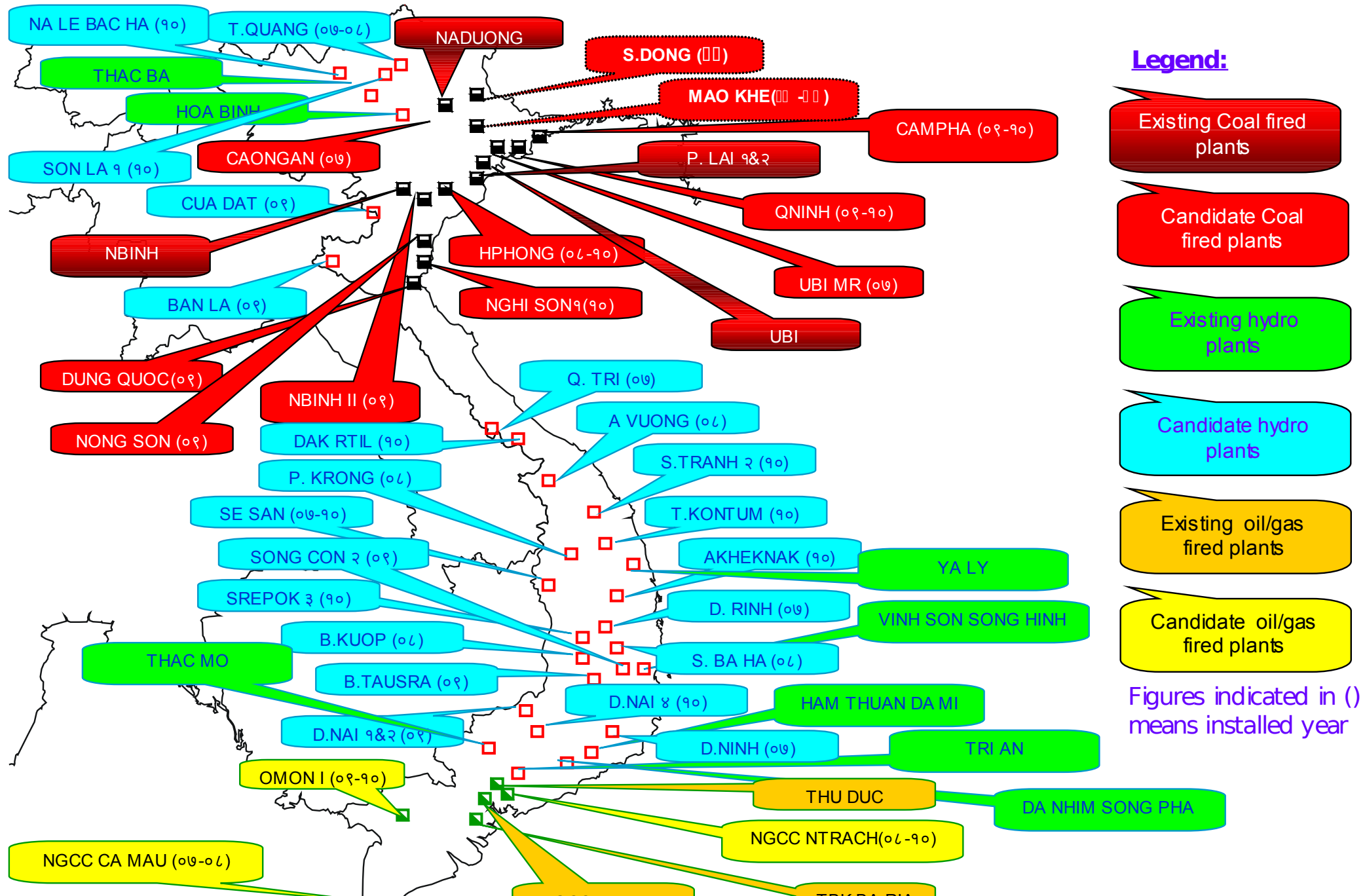
# **CO<sub>2</sub> emissions mitigation potential in Vietnam's power sector**

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# Outline

- 1. Vietnam power sector grows fast up to 2030**
- 2. Integrated resource planning (IRP) model**
- 3. Abatement potentials**

# 1. Vietnam power generation

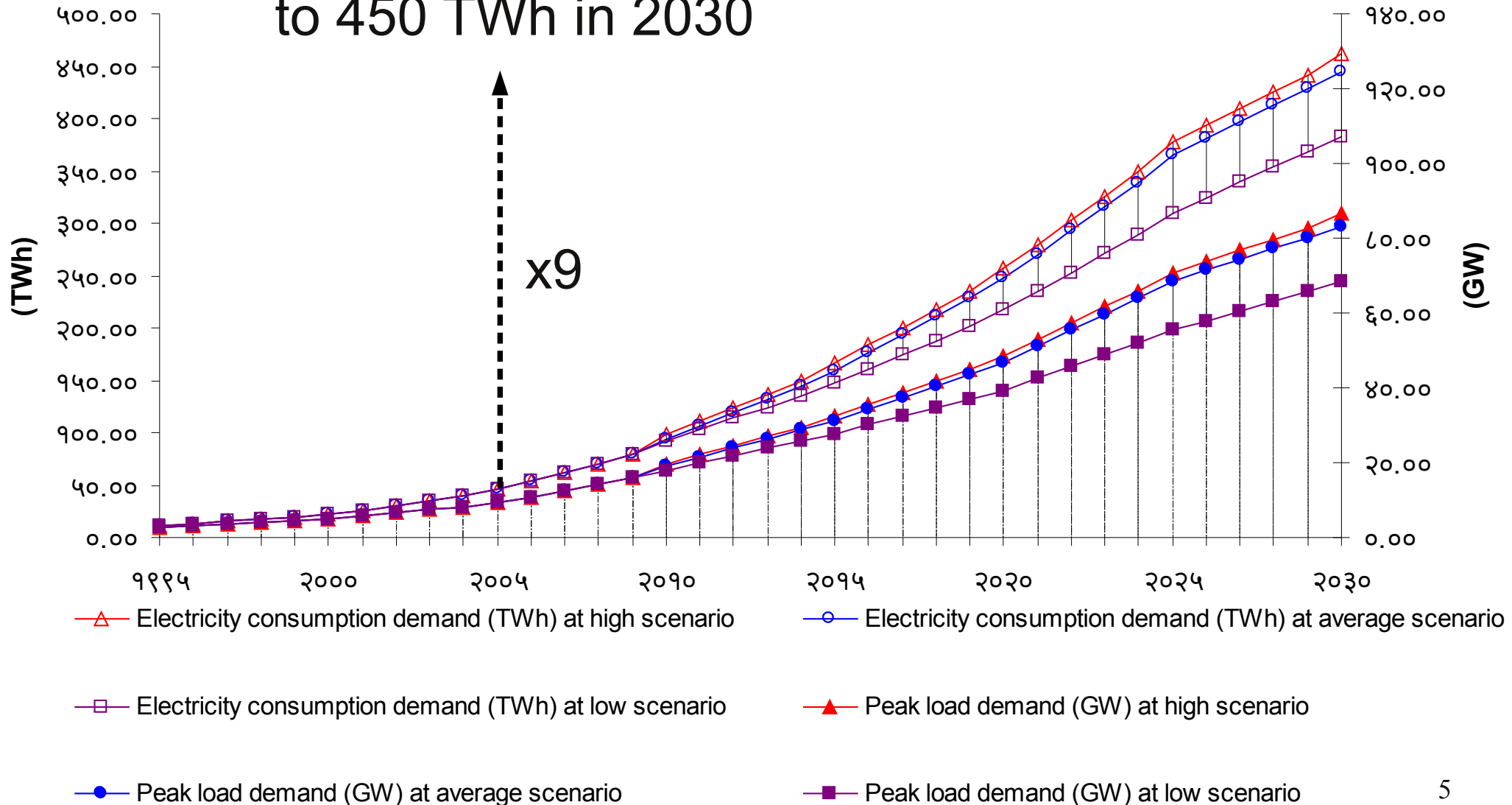


# High growth, led by coal

Installed capacity in 2007	Generation in 2007	Growth rate (2000-2007)	
		Total generation	Thermal generation
13.5 GW	69 TWh	19 % yr <sup>-1</sup>	23 % yr <sup>-1</sup>

# Electricity demand forecasts to 2030

From 52 TWh in 2005  
to 450 TWh in 2030



# Rising environmental impacts

Concerns about air pollution from coal

Typhoon, floods, droughts intense and frequent

Sea level to rise 30cm – 1m by 2100:

- 12% territory loss
- 23% population
- Increased salinity

## 2. The IRP model

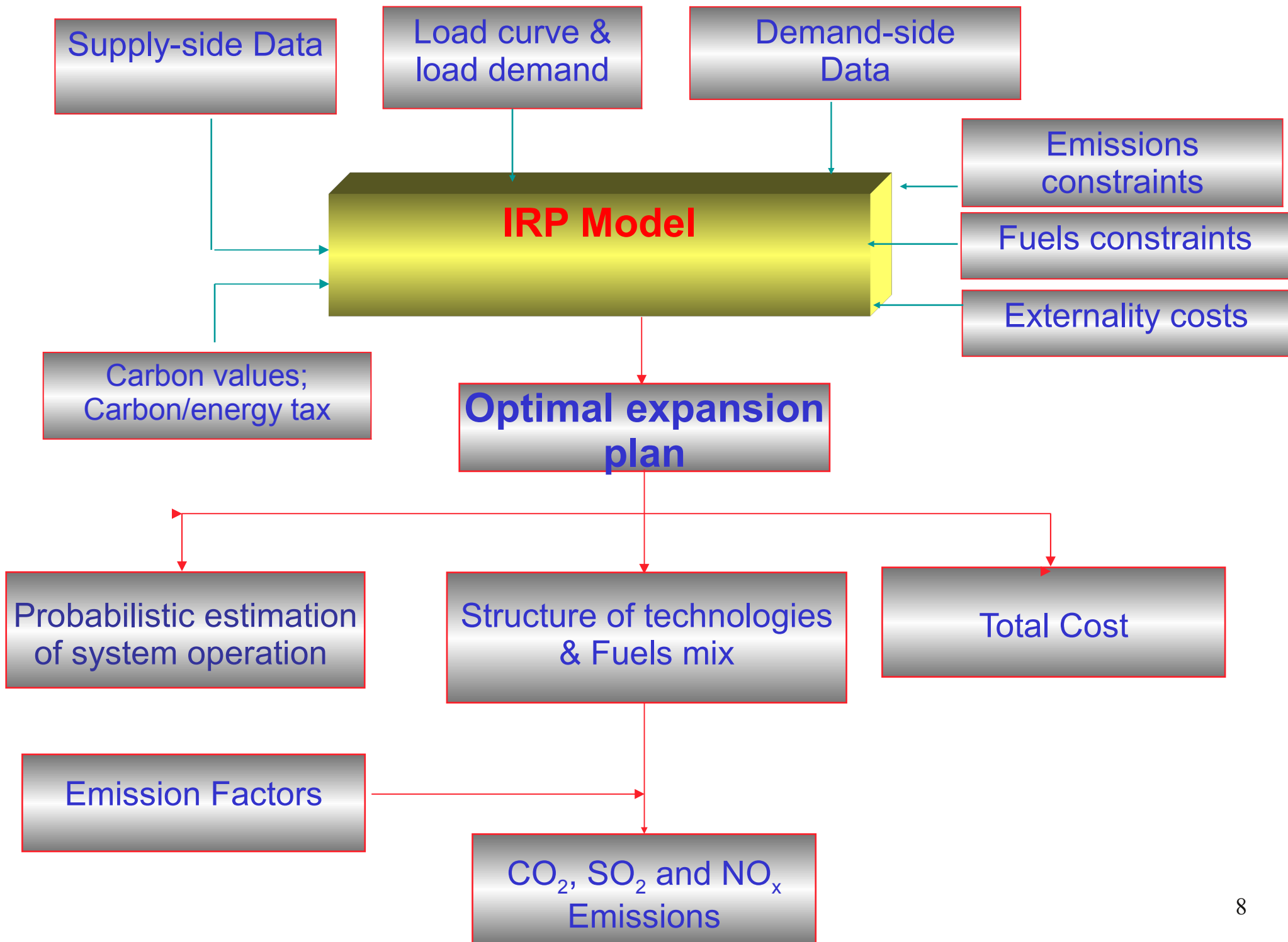
- Name:** Integrated Resource Planning
- Kind:** Bottom-up, MILP solved by CPLEX
- Author:** Energy Program, Asian Institute of Technology, Thailand
- Result:** Optimal plan to expand generation capacity to 2030

**Minimize** Total Cost =

Capital + O&M + Fuels + DSM + Imported electricity + **CO2 value**

**Subject to constraints on**

- Peak demand
- Hydro-energy
- Generating unit availability
- Imports availability
- Annual energy
- Reliability
- Fuels or resources availability



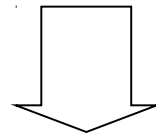


# Model parameters

- Plant types: 8 conventional, 6 renewables
- 14 fuel prices, growing 1-4% per year
- Assumed economic potentials:
  - Small hydro 4 GW
  - Biomass 1.5 GW
  - Geothermal 0.4 GW
  - Wind 22 GW
  - Solar 1 GW

# Model use scenarios

Compare model runs for **CO2 value up to 20\$/tCO2**,  
exploring different policy assumptions for  
**Demand Side Management (DSM), renewables, nuclear.**



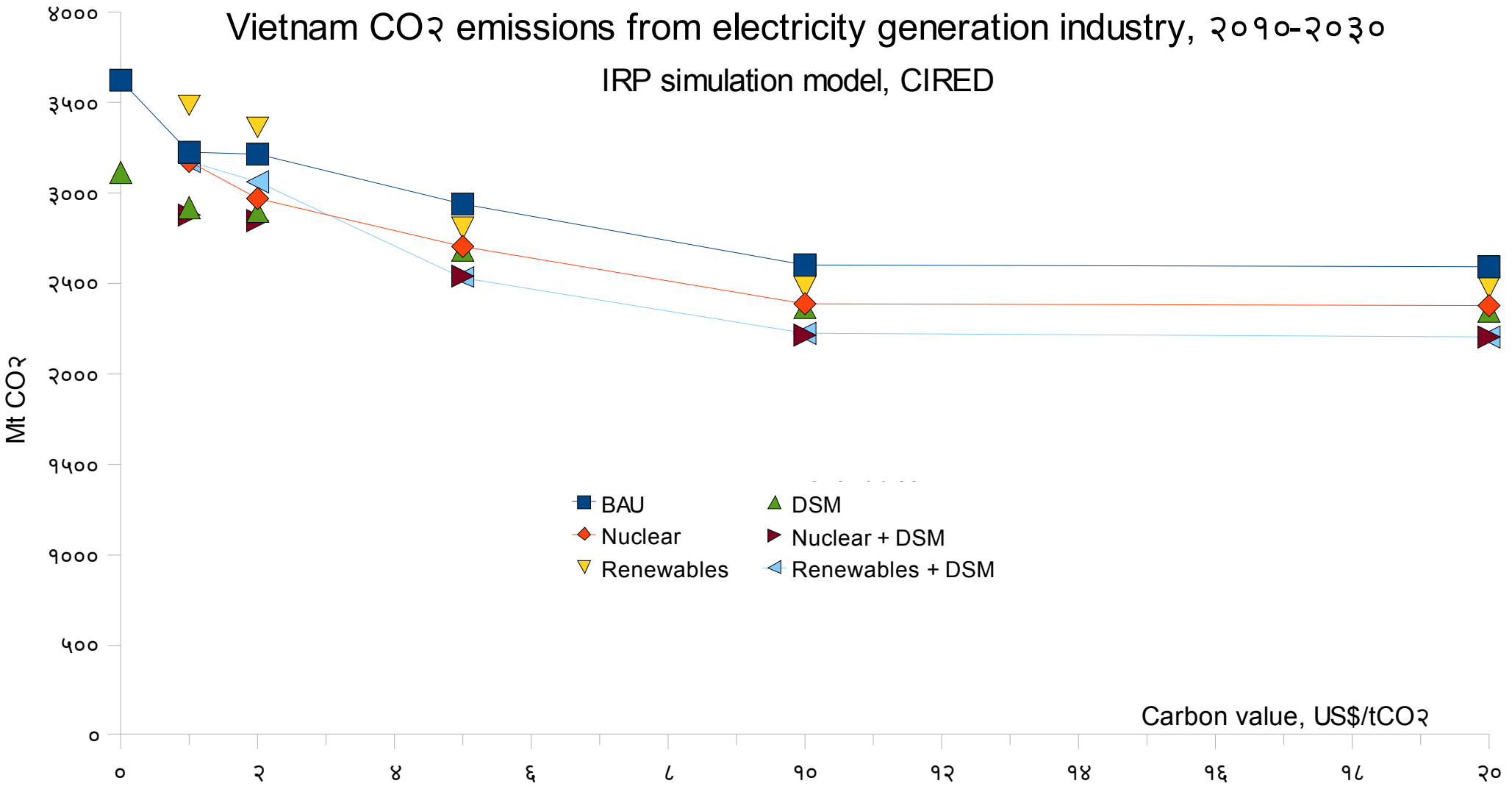
- What are the mitigation costs and potentials in the Vietnam power sector ?
- What is the order of merit of different technologies ?

# 3. Results: base case

## Without DSM, renewables, or nuclear policies

- Fossil fuels up to 74% of the mix in 2030  
(to 108GW total capacity, need 73 B\$ over the period)
- Imports coal & natural gas  
(40% & 14% of 2010-2030 consumption)
- CO<sub>2</sub> emissions x 10  
(to 357 Mt/yr in 2030, from 36 Mt in 2006)

# CO<sub>2</sub> abatement potential for various policy scenarios



# Technologies order of merit

1. Demand Side Management  
( $>10\%$  reduction potential free lunch)

2. Small hydro and biomass  
(some already competitive)

3. High efficiency coal  
(replaces all PC at 5  $\$/\text{tCO}_2$ )

4. Wind  
(enters at 3  $\$/\text{tCO}_2$ , big resource)

# 10GW nuclear by 2030 ?

Political will, uncertain reality

Significant emissions reductions

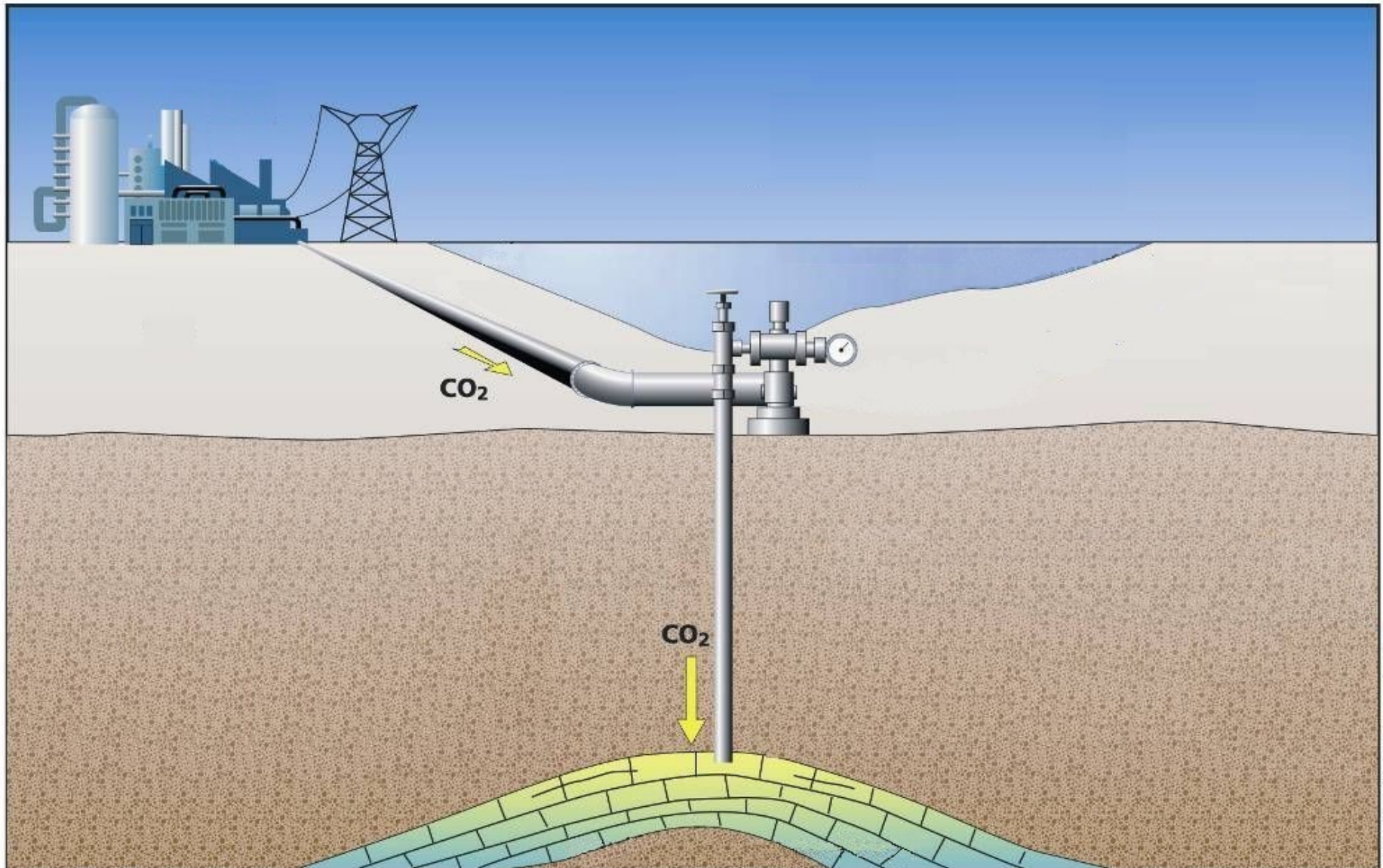
→ 12% even at no CO<sub>2</sub> value

→ 34% at 20 \$/t CO<sub>2</sub> value

Only part of the solution at best

Planning for +70GW capacity by 2030,  
there is room for DSM, renewables, CCS

# CCS is Carbon Capture and Storage



# Conclusions

- Climate change a vital issue for Vietnam, but  
Baseline x10 CO<sub>2</sub> emissions by 2030
- Demand side management first, then  
Much happens at 5 \$/t CO<sub>2</sub>
- Coal is central → Carbon Capture and Storage