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CO_2 emissions mitigation potential in Vietnam's power sector

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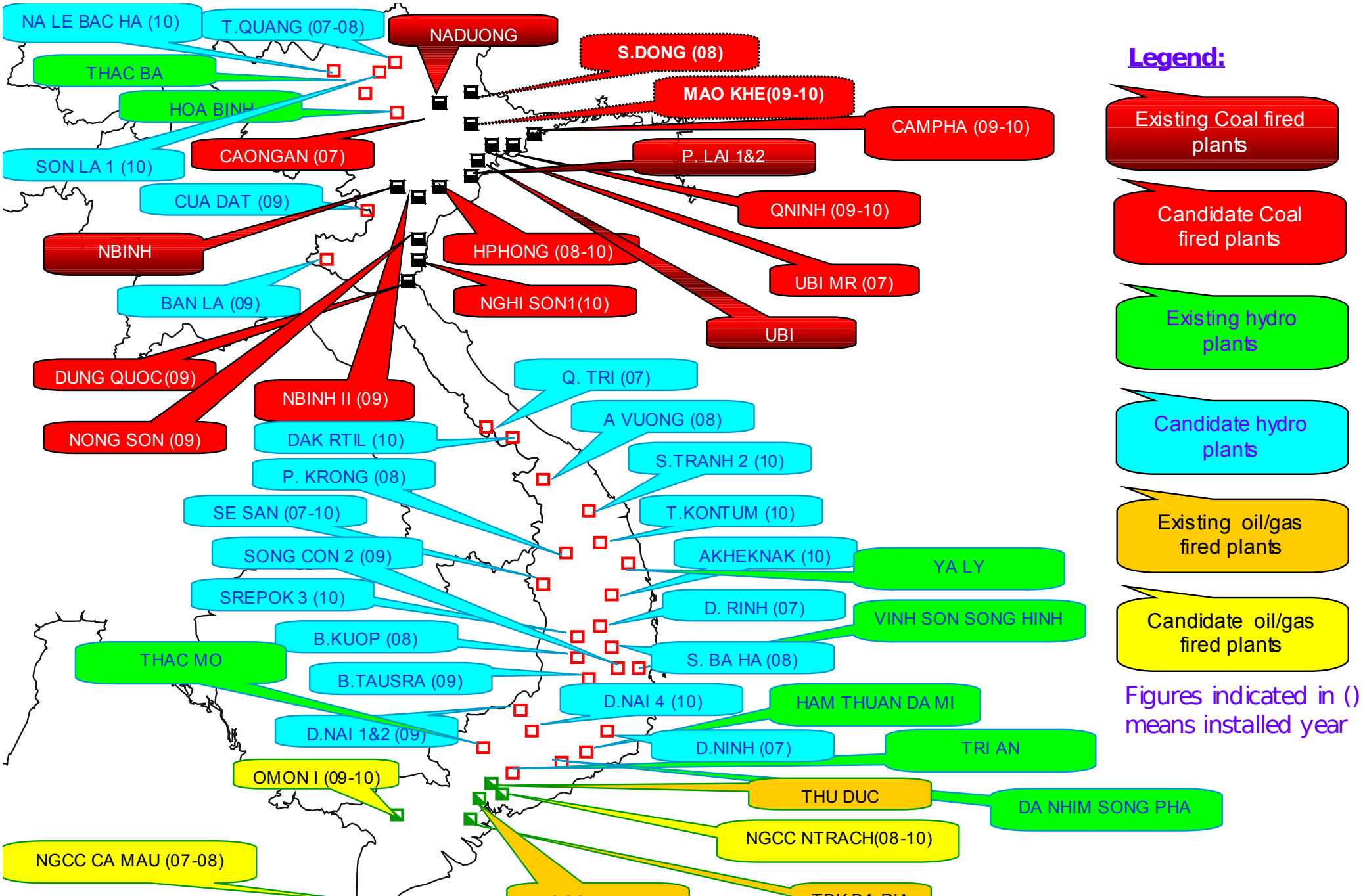
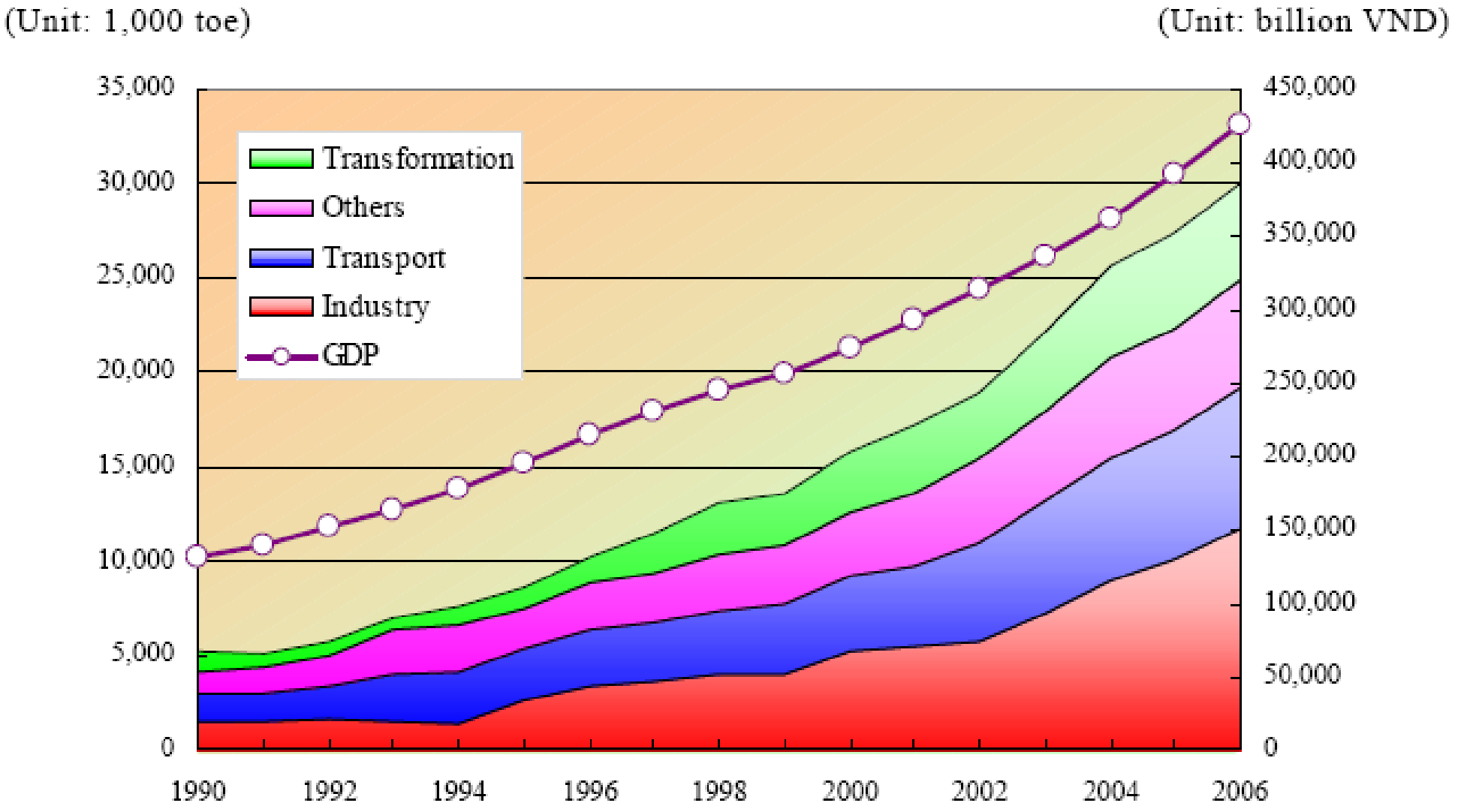
Outline

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

1. Vietnam power generation

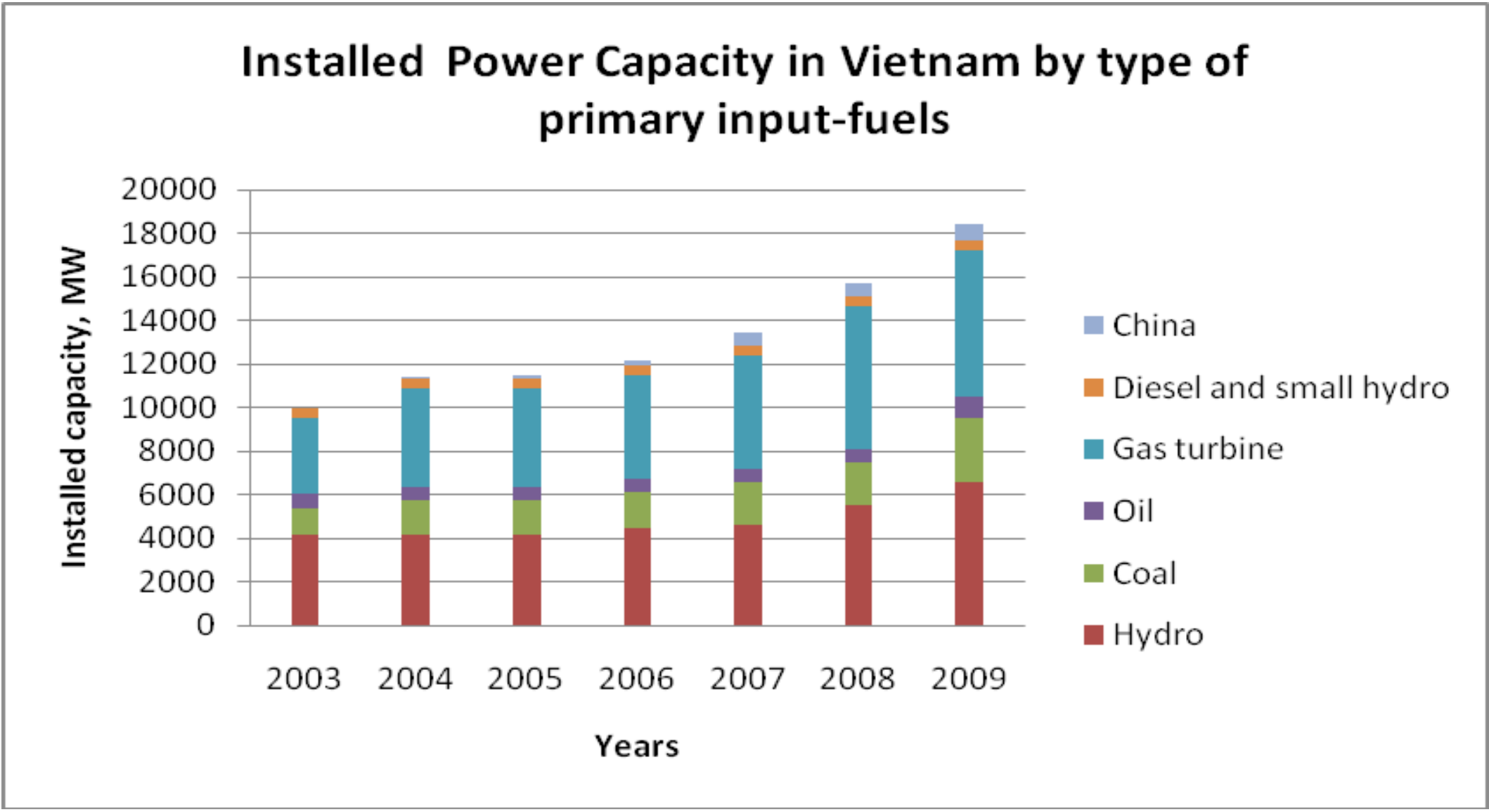


Energy demand grows faster than GDP



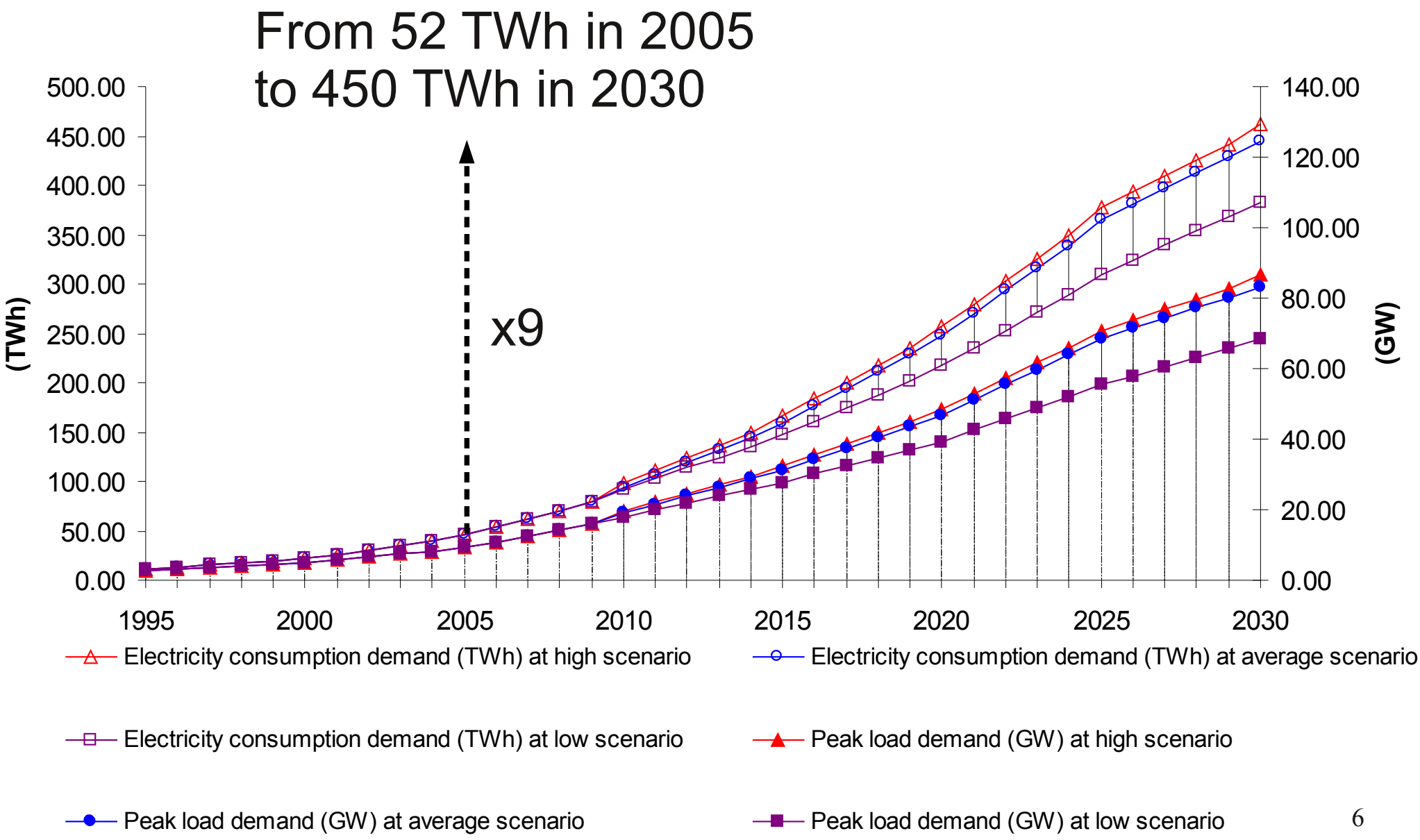
Energy demand over 1990-2006. Sources: Shinji Omoteyama, IEEJ 2009

Power generation towards fossil fuels (coal)



Sources: combined by authors

Electricity demand forecasts to 2030



Source: Institute of Energy of Vietnam, 2006

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

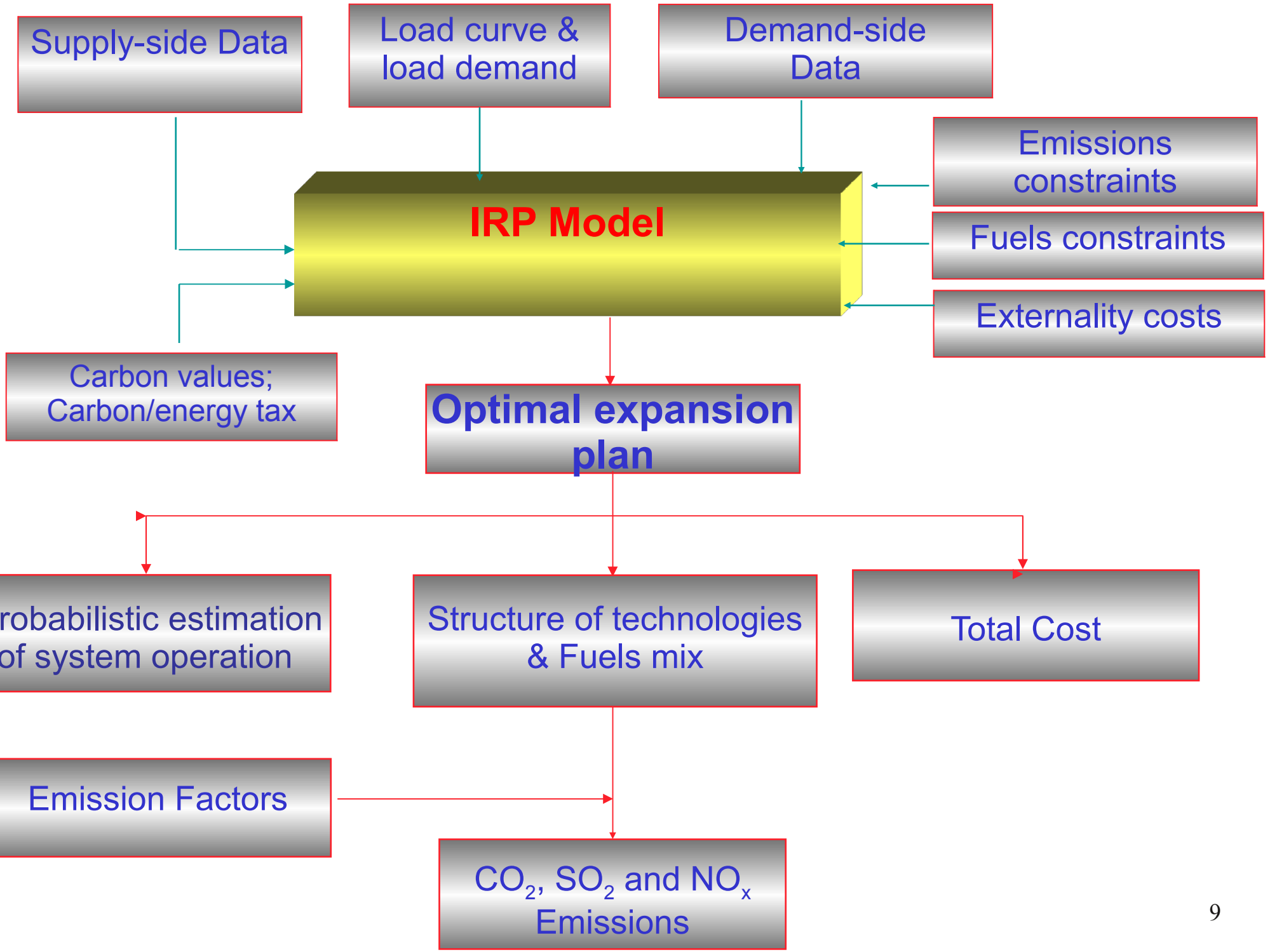
Result: Optimal plan to expand generation capacity to 2030

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

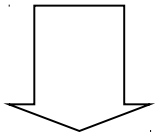

Supply-side Data
Load curve & load demand
Demand-side Data
Emissions constraints
IRP Model
Fuels constraints
Externality costs
Carbon values; Carbon/energy tax
Optimal expansion plan
Probabilistic estimation of system operation
Structure of technologies & Fuels mix
Total Cost
Emission Factors
CO_2, SO_2 and NO_x Emissions

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 cases

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

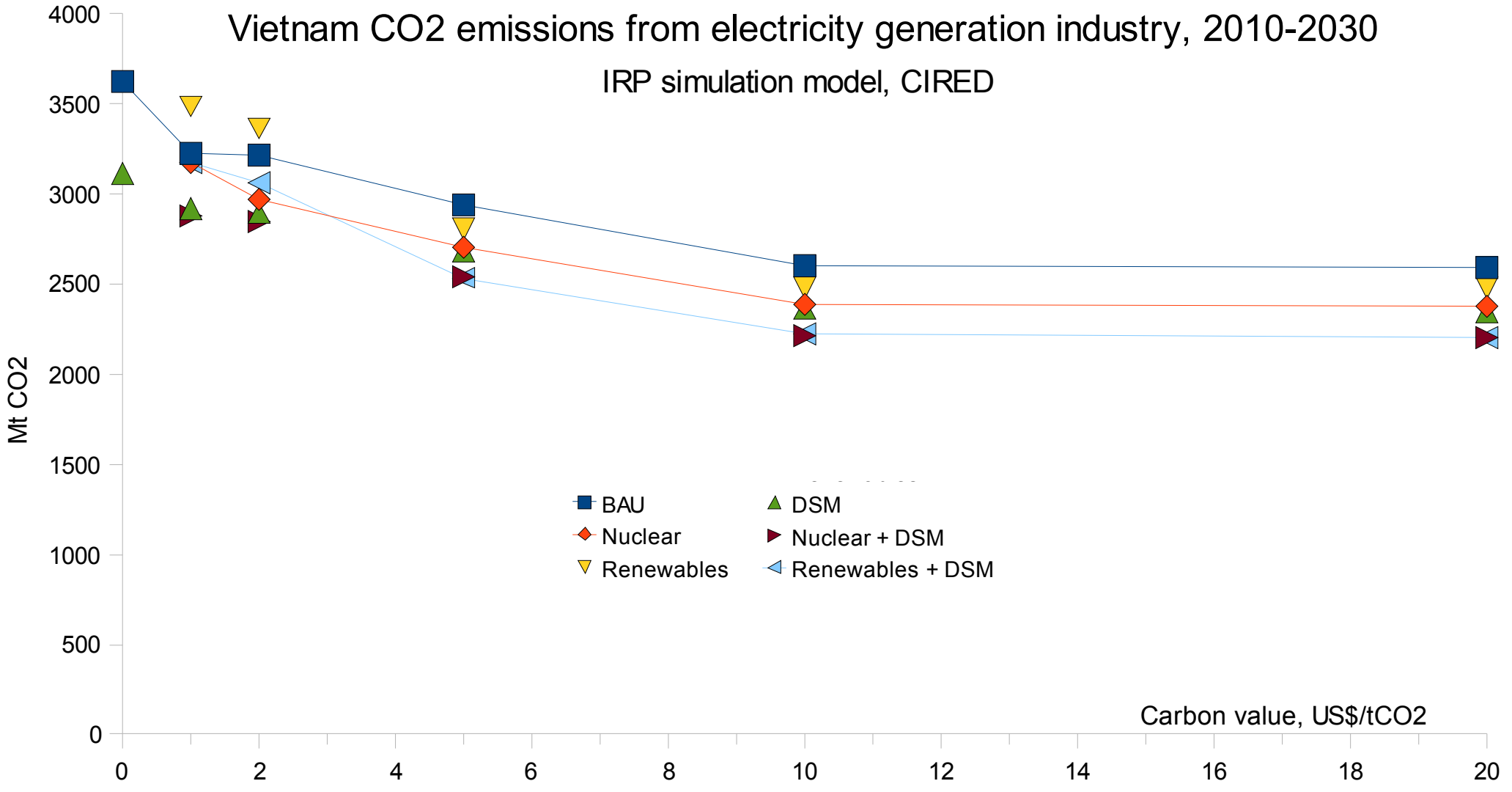


- What are the mitigation costs and potentials in the Vietnam power sector ?
- What is the order of merit of different technologies ?

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_2 emissions x 10
  (to 357 Mt/yr in 2030, from 36 Mt in 2006)

CO_2 abatement potential for various policies



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 $/tCO2)

4. Wind
(enters at 3 $/tCO2, big resource)

10GW nuclear by 2030 ?

Political will, uncertain reality

Significant emissions reductions

- 12% even at no CO_2 value
- 34% at 20 $/t CO_2 value

Only part of the solution at best

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

Conclusions

- Climate change a vital issue for Vietnam,
  vs. baseline x10 CO_2 emissions by 2030 ??

- Demand side management first, then
  Much happens at 5 $/t CO_2

- Coal is central → Carbon Capture and Storage