Energy production and climate change mitigation in Vietnam

CIRED international seminar , 24/10/2011

Minh Ha-Duong

Nguyen Thanh Nhan

Economic potential of Renewable energy in Vietnam's power sector

Nguyen Thanh Nhan and Minh Ha-Duong

Centre International de Recherche sur l'Environment et le Development
CIRED/CNRS-FRANCE

18th-20th June, 2008

31th IAEE Conference, Istanbul

1. Outline

1. Vietnam power sector grows fast up to 2030
2. Integrated resource planning (IRP) model
3. Results with and without renewable energy

1. Outline

1. **Vietnam power sector growth up to 2030**
2. **Integrated resource planning (IRP) model**
3. **Results with and without renewable energy**

- **Fossil fuels expected to be dominant**
- **Renewables can avoid installing 1GW coal**
- **and bring co-benefits**

7.4%yr^{-1} GDP Growth, 2000-2005

Sector	2000	2001	2002	2003	2004	2005
Agriculture, Forest & Fishing	4.6	3.0	4.1	3.2	3.4	3.8
Industry & Construction	10.1	10.4	9.4	10.3	10.3	11
Service	5.3	6.1	6.5	6.6	7.5	8.2
Total	6.8	6.9	7.04	7.24	7.7	8.5

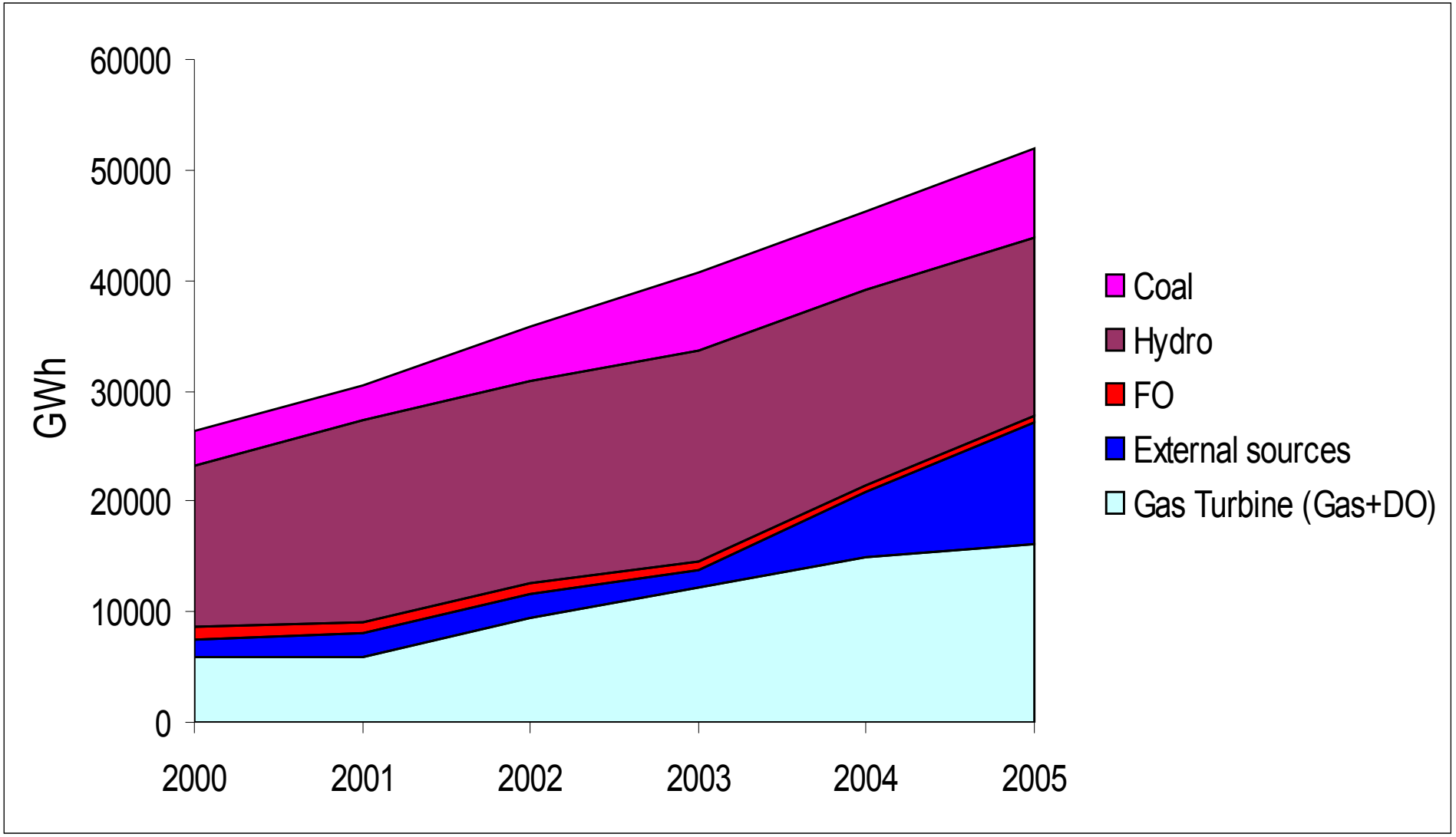
Source: General Statistics Department of Vietnam, 2005

Power generation grows faster

Installed capacity in 2005	**Generation** in 2005	Average annual growth rate	
		Total electricity generation (2000-2005)	Thermal electricity generation (2000-2005)
11.340 MW	52.050 GWh	15.18%	22.40%

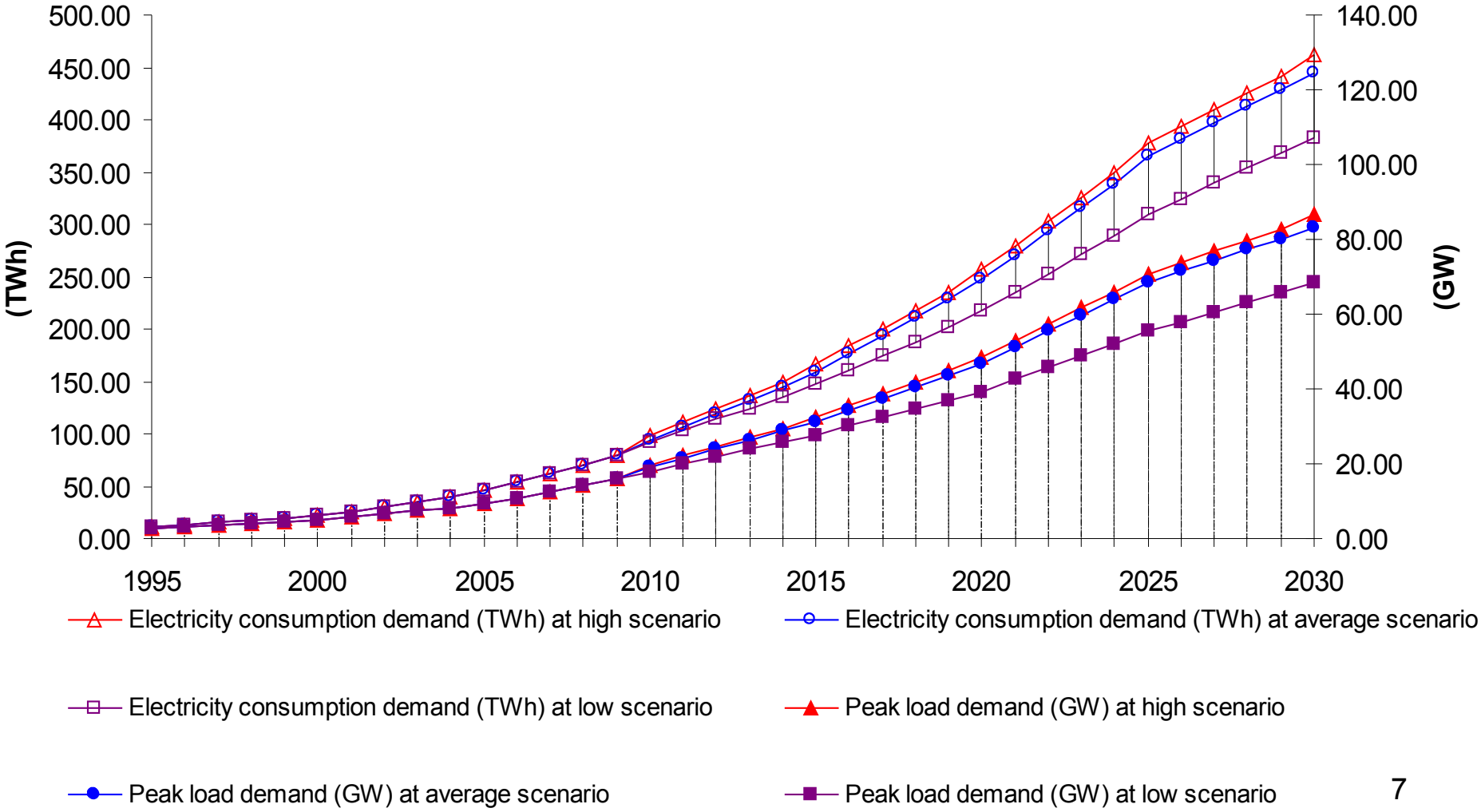
Source: Institute of Energy of Vietnam, 2005 and EVN 2005

Primary sources, 2000-2005



Source: Institute of Energy of Vietnam, 2005

Electricity demand forecasts to 2030



Source: Institute of Energy of Vietnam, 2006

Policy options

- Improve end use energy efficiency
- Develop nuclear power

} Not discussed here

- Import electricity (Laos, Cambodia, China)
- Import coal (Australia, Indonesia)
- Import natural gas (via ASEAN pipeline)
- Develop renewable energy sources

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

Accounting for:

Future generation technologies & fuels mix

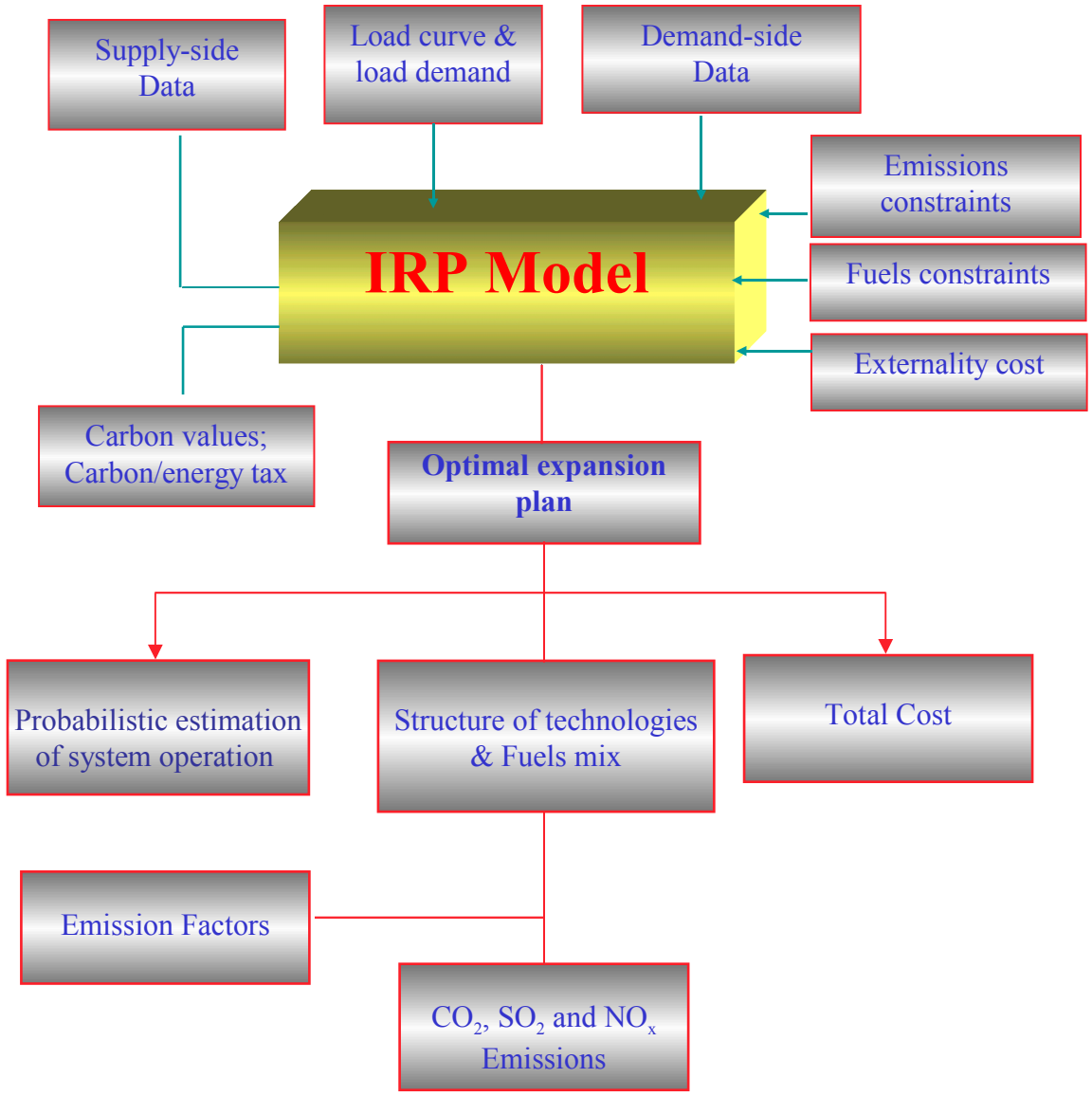
Reliability, probabilistic estimation of system operation

Emissions and fuel usage constraints

Carbon/energy tax, and carbon values

Externalities and pollution costs

The IRP model



Minimize: Total System Costs =

{Capital + O&M +Fuels + DSM + Imported electricity}

Subject to:

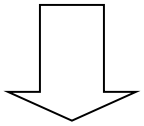
- Peak demand constraints
- Annual energy constraints
- Hydro-energy constraints
- Reliability constraints
- Generating unit availability constraints
- Fuels or resources availability constraints
- Imports availability constraints
- Emission constraints

Model parameters

- Plant types: 5 conventional, 9 renewables
- 11 fuel prices, growing 1-2% per year
- Assumed economic potentials:
  - Small hydro 2 - 4 GW
  - Geothermal 1.4 GW
  - Wind 15 GW
  - Nuclear and DSM left out of these runs

Model use scenarios

Compare a model run without renewables against a model run with renewables



- Quantify the benefits of a **more diverse supply** for the electric power generation plan.
- How much could renewables help to save domestic energy ressources and alleviate the burden of imports?
- How much could renewables lessen health and environmental impacts?
- When are renewables cost-competitive?

3. Results: Fossil fuels dominate

	Renewables sources			Fossil fuels						
	RET	Large Hydro	Pump Storage	Domestic Coal	Import Coal	Domestic Gas	Imported Gas	Oil	Electricity imported	Total
Generation capacity share (%)										
Without RETs	0.0	14.1	10.2	35.5	12.0	13.2	7.5	0.6	6.8	99833 (MW)
With RETs	4.4	14.1	10.2	31.2	12.0	13.2	7.5	0.6	6.8	100065 (MW)
Electricity generation share (%)										
Without RETs	0.0	16.1	2.3	30.3	13.4	25.5	6.9	0.3	5.2	7389.6 (TWh)
With RETs	5.0	16.1	2.3	25.8	13.1	25.4	6.6	0.3	5.1	7370.1 (TWh)

RET: cost-effective yet, 4.4 GW includes small hydro (2 GW), geothermal (1.4 GW), biomass residues (1 GW).

Technical effects of renewables

HDM to NTN: Reorder this carefully so that it flows with the explanation

New capacity installed: reduced by 1 GW

Total generation: reduced by 19.5 TWh over 20XX - 20XX

Domestic coal & natural gas: use reduced by 14.6% and 0.52%

Average thermal efficiency: improved, 46.7 → 47.2%

Reliability: much improved, 0.05% → 0.01% (??? LOLP ???).

Benefits to economy & environment

HDM to NTN: The economic numbers seem contradictory.

Price of electricity (AIC): reduced by 0.03 $cent/kWh.

Savings : 131.4 M US$ capital costs + 585 M US$ fuel costs.

Financial drain: avoids 1.34 billion US$ for imports

CO2 emission: reduced by 8.2% (over 3.8 Gt).

SO2, and NOx emissions: reduced by 3.1% and 4.1%.

Renewables cost- effective now

Economic potential over 2010-2030
(this IRP simulation result)

Small hydro	146 TWh
Geothermal	124 TWh
Biomass residues	99 TWh
Total	**370 TWh**

Conditions for other renewables

Wind	enters if price ≤ 900 US$/kW + fuel prices high
Wood	enters if price ≤ 1 500US$/kW + fuel prices high
Mini hydro	limited supply, up to 4.7 GWh if high fuel prices
Solar	assumed not cost-effective in the IRP

Conclusions

Vietnam's power sector mainly relies upon fossil fuels after 2015

Cost-competitive now: Small hydro, geothermal, biomass residues.

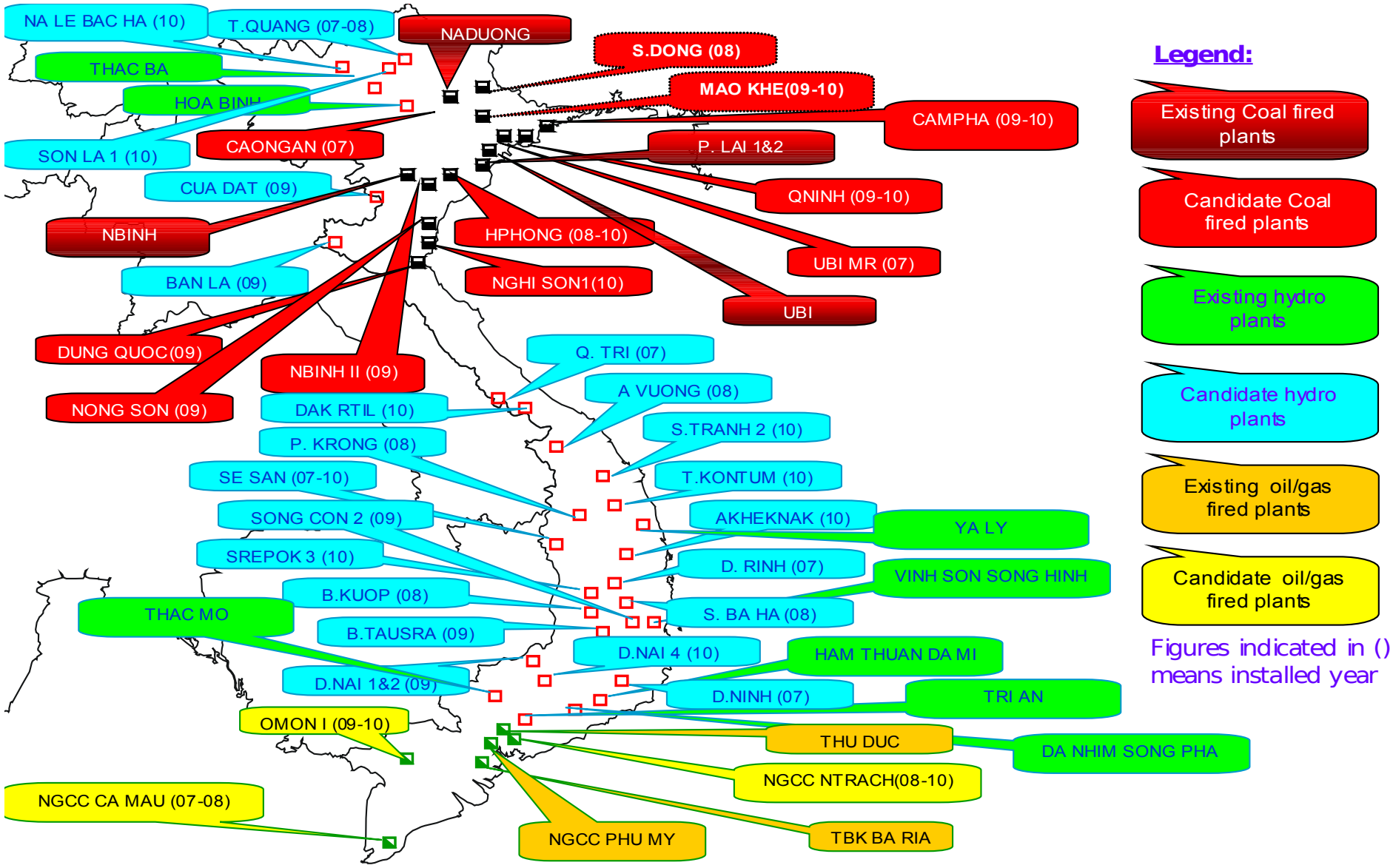
Developing renewables over 2010-2030 could:

- improve quality of electricity supply
- reduce the share of coal generation by 5% (saves installing 1GW)
- decrease CO_2 emissions 8% , SO_2 3% and NO_X 4% ,
- help conserve domestic natural and financial resources

Large potential: wind power, unused land for plantation.

THANK YOU!

Power generating plants to 2010



Source: Institute of Energy of Vietnam, 2005

Characteristics of technologies

Candidate plants	Capital cost ($/kW)	Efficiency (%)	Fixed O&M cost ($/kW·month)	Variable O&M cost ($/MWh)	Emission factor (kg CO_2/MWh)
Conventional coal	1100	40	2.8	0.15	880
Supercritical coal	1200	43	2.8	0.15	800
IGCC coal	1300	45	3.55	0.15	704
NGCC	700	54.63	1.98	0.99	370
Steam Oil	900	43.57	1.63	1.48	730
Solar grid connected	5500	100	2.5	0	0
Wind turbine	1000-1300	100	1.35	0	0
Geothermal	1700-2000	100	2.38	0	0
Very large hydro	1120	100	0.54	0	0
Medium and large hydro	1100 - 1500	100	0.76	0	0
Small and mini hydro	1200 - 1600	100	1.5	0	0
Bagasse direct combustion	850	23	3.58	5	71.64
Biomass IGCC	1600	38.30	3.75	2.9	71.64
Wood IGCC	1600	38.30	3.75	2.9	71.64

Fuel prices assumptions

Fuel type	Scenario analysis		Sensitivity analysis	
	Fuel prices ($/Gcal)	Escalation rate (%)	Fuel prices ($/ Gcal)	Escalation rate (%)
Domestic coal	5	1.5	7.142	1.5
Imported coal	6.15	1	9.23	1
Imported FO	28.37	2	50.66	2
Imported DO	30.79	2	56.7	2
Domestic gas	15.87	2	17.46	2
Imported natural gas	18.25	1.5	23.8	1.5
Imported LNG	22.62	1.5	27.78	1.5
Bagasse	0.781	1	0.781	1
Rice husk	0.71	1	0.71	1
Paddy Straw	0.625	1	0.625	1
Wood residue	4.4	1	4.4	1

Renewable energy potential

Energy sources	**Economical potential**	**Current development in (2005)**	**Remarks**
Hydro	83,5 TWh (*)		
Large & medium hydro (>30 MW)	18-20 GW	About 4.2 GW equivalent to 18 TWh exploited from hydro energy sources at year 2006.	
Small hydro (<30 MW)	2-4 GW[1]		
Mini hydro (<1 MW)	100 MW		
Hydro pump storage	10.2 GW	No	
Geothermal	1.4 GW[2]	No	
Wind turbines	20 GW[3]	No	
Solar grid integrated	1 GW[4]	No	
Rice husk	440 MW[5]	No	
Paddy straw	600 MW[6]	No	
Bagasse	300 MW[7]	few	
Wood residue	100 MW	No	

([1]) Only 2.4 GW is assumed for the paper
([2]) This economical potential is assumed to be used for electricity generation only, not for direct use purposes.
([3]) This economical potential is estimated with feed-in tariffs varying from 5-7 US cent/kWh)
([4]) This economical potential is assumed for input of IRP model
([5]) Only 250 MW is assumed for the paper
([6]) Only 550 MW is assumed for the paper
([7]) Only 200 MW is assumed for the paper

« GMSARN International Conference 2009 »
Ha Long Bay, Vietnam, 25-27 November 2009

The Clean Development Mechanism in Vietnam: potential and limitations

Nhan T. Nguyen[a], Minh Ha-Duong[a], Sandra Greiner[c]

[a]Centre International de Recherche sur l'Environnement et le Développement, CIRED-CNRS. Campus du Jardin Tropical, 45bis ave. de la Belle Gabrielle, 94736 Nogent-sur-Marne, France. Tel: +33 01 43 94 73 65 Fax: +33 1 43 94 73 70. Corresponding author: nhan@centre-cired.fr.
[b]Climate Focus. Minervahuis III, Rodezand 34, 3011 AN Rotterdam, Netherland.

Introduction

The CDM experienced a spectacular rise of activity since mid-2005 and the opportunity window for CDM implementation has almost closed.

But, the CDM in Vietnam is used as a way below its full potential.

Even 2008 and 2009 have shown increased activity & many projects are underway, Vietnam still lags behind neighboring countries in term of submitted & registered projects.

Outline

1. **Overview: the CDM**
2. **Study approach and data**
3. **Vietnam & the CDM: a late starter on the global rise.**
4. **Barriers analysis: why Vietnam has not been more successful? ⇒ strategic recommendation.**
5. **Vietnam's positioning in a post-2012 environment.**
6. **Conclusions.**

1. CDM: current status & prospects

The CDM is defined in Article 12, the Kyoto Protocol :

+ developed countries: benefit from projects implemented in developing countries to offset their mandatory emissions reduction commitments.

+ developing countries: benefit from the funding through CDM projects that could assist them to reach sustainable development.

As of 6 May 2009, there are 285.5 million emissions credits issued by CDM-EB over 292 million CERs requested by host parties (UNFCCC, 2009).

current status & prospects (cont'd)

The CDM's effectiveness argued: expensive and lengthy project approval process, methodologies for calculating whether the project actually reduces GHGs,… etc?

The first commitment of the Kyoto terminates at end of 2012 & the world has been negotiating for replacement agreement.

The opportunity window for CDM implementation currently has almost closed. ***Anyone who is starting a project now will be too late for the deadline 2012.***

2. Study approach & data

Approach: the study is based on a review of major documents as well as interviews carried out with a number of stakeholders inside and outside Vietnam.

Data sources: key documents and specific country reports, most updating online-published CDM databases (UNFCCC, UNEP Risø, IGES, CD4CDM, OECD,, Point Carbon, IDEAcarbon, Germany Trade & Invest, … etc).

❑ **This was implemented in France: three oversea study voyages were carried out during 2007-2009.**

3. A late start on the global rise

We can observe this late by looking at:

3.1 The country's significant potential?

3.2 Opportunities exploited so far?

3.3 How is the country lagging behind others?

4  barrier analysis ⇒ why Vietnam not been more successful

By looking at: international practice, lessons learnt, current status as well as interviews stakeholders in field.

Regulatory barriers

+ The institutional structure and regulatory framework: cumbersome and inefficient.

+ Delays in approval process: difficult & so long.

+ Document submission system: inadequate and very underdeveloped.

+ Lack of approval criteria: evaluation & approval system has lack of clear criteria per se.

+ Provincial approvals: a mass of difficulties to obtain the endorsement letters.

4  barrier analysis (cont'd)

Barriers due to business climate

+ Corruption and bureaucracy: Vietnamese CDM investment climate is ranked as "average climate".

+ Tariff uncertainty: no government-incentives for pricing reflective of clean energy's extra.

Access to information: **data not widely public, hardly accessible, often obtained through personal contacts & relationships but lacking official feature.**

Local capacity: **definitely constrained creating frustration to project development.**

* experience lacking with CDM instruments at all levels
* difficulty in communication: foreign language barrier
* insufficient knowledge among local CDM participants
* poor quality PDDs establishing.

⇒ Strategic suggestions

+ approval system to be strongly changed & streamlined to ensure righteous application process for approval letters.

+ clearer set of criteria & guidelines to be built up for evaluating projects in a common manner.

+ to cut down cumbersome capacity within the DNA by reducing the required number of participations to 50%.

+ learnt lessons from neighbors (China, India, Indonesia) in providing favorable conditions for involved parties.

+ business standards (postal-mail, electronic-email) should be legally obligated for the submission of PDDs.

+ to intensify partnerships with foreign counterparts to disseminate deep knowledge on CDM, foreign language.

5. Vietnam's positioning in a post-2012 environment

the future prospects of CDM projects for Vietnam are not clear <= unclear whether & how the CDM (or a CDM-like mechanism) will be included into a post-2012 and, if such mechanism included, how much demand & supply of carbon credits will exist in any future agreement.

5.1 Can the big players come on board if CCS is endorsed?

+ given the possibility: large-scale agreements on clean energy would be set as a priority, i.e. the inclusion of large-scale CCS technology would exist in future CDM-like mechanism.

+ Central coal (70 GW) for electricity generation by 2030. Currently, the White Tiger Field project is proposed for CDM implementation in Vietnam (IEA, 2008). This is likely to become the 1st commercial CCS project in Asia. Thus, the adoption of CCS technology would be not an implausible possibility.

⇒ *the only question arisen is can the big players like EVN come on board if CCS is endorsed?*

5.2 if a wider set of climate policies included towards climate goals

Vietnam (large CDM potential) would gain greater opportunities ⇒ *Vietnam should do streamlining of CDM procedure focusing on plentiful endowed resources of renewables, especially small hydropower.*

This fast-track procedure should be as standardized as possible, especially standardized emission reduction baselines, in order to facilitate and speed-up the assessment of small-scale projects.

6. Conclusion

+ We have shown that Vietnam is a *late-starter on the global rise of CDM even having very big potential*.

+ The barrier analysis outlined the ways facilitating the CDM but it is not methodically efficient enough to complete successful projects in Vietnam.

+ *Climate mitigation is not yet considered a strategic priority in the long-term economic development plan*. If nothing is changed, it is unlikely that a success of expanded CDM or other CDM-like mechanism occurs.

+ Policy measures available for a stronger strategy, consistent with general goal of improving the country's investment climate by *reducing red tape (bureaucracy, cumbersome regulation),& fighting corruption.*

Key message

"turning the climate challenges into sustainable development opportunities for Vietnam"

the end!

3.1 Country has a significant potentia

Large potential for implementation of CDM projects

+ Due to growing energy needs, highly inefficient energy usage, an ample potential for renewables ⇒ enormous opportunities for developing CDM projects.

+ Most potential sectors: renewables (dominated by hydropower, wind energy), waste, waste water treatment, fossil fuel switching, energy efficiency, etc.

How big potential? ⇒ for further ref: ***Nguyen and Minh Ha-Duong, 2009 "Economic potential of renewables" Energy Policy; Nguyen and Minh Ha-Duong, 2009 "Potential for CO2 mitigation in Vietnam" (IAEE Conference, other international Conferences in France, Germany & the 5th International Academy, to be published through Lexxion Verlag, Berlin).***

significant potential (cont'd)

The country has no shortage of CDM buyers

+ Most buyers are from foreigners. Japanese companies are first buyers & most dominant group.

+ Project entities dealing with European compliance buyers. The country cooperated with JBIC, Austrian Ministry of Agriculture, Forestry, Environment.

Available supports from CDM partnership agreements

+ Many partners from Austria, Japan, Germany, Denmark…, etc on climate change issues.

+ Supports from international organizations: the UNEP, AIT, GTZ, etc for local capacity building.

3.2 How opportunities exploited

+ Growth of projects (at validation) in Asia & Pacific:

2004	2005	2006	2007	2008	1st quarter of 2009
13	265	449	994	1198	709

+ The first commitment expires end of 2012 ⇒ the opportunity window for CDM projects closes very soon.

+ *121 hydro run-of-river projects* around the world registered as of 6/2008, expected to generate about 10 Mt CO_2 reduction annually over 2008-2012.

⇒ Given the situation: until 6/5/2009 *only 4 projects registered*: large-scale Rang Dong gas flaring reduction, *only one small-scale* 2 MW hydropower, Landfill gas, Binh Thuan wind farm.

3.3 How the country is lagging?

⇒ at *lower end of countries in region*, just > other low-income countries: Cambodia, Lao PDR, Mongolia, in *submitted & registered projects.* *(as per 6/5/2009)*

Country	submitted to UNFCCC	Registered to CDM EB		Under validation	Others*	Rejected
		Total projects	Expected average annual reductions (tCO_2eq)			
Cambodia	9	4	124,356	5	0	0
China	2,666	537	173,090,792	1,993	119	17
India	1,982	422	34,662,458	1,491	32	37
Indonesia	155	24	3,337,551	128	2	1
Lao PD.	2	1	3,338	1	0	0
Malaysia	237	45	3,096,701	183	5	4
Mongolia	7	3	71,904	4	0	0
Philippines	124	27	1,367,251	95	1	1
Rep of Korea	112	26	14,737,147	81	3	2
Singapore	9	1	15,205	8	0	0
Sri Lanka	35	5	152,884	27	0	3
Thailand	151	16	1,189,114	132	2	1
Vietnam	89	4	886,912	79	5	1

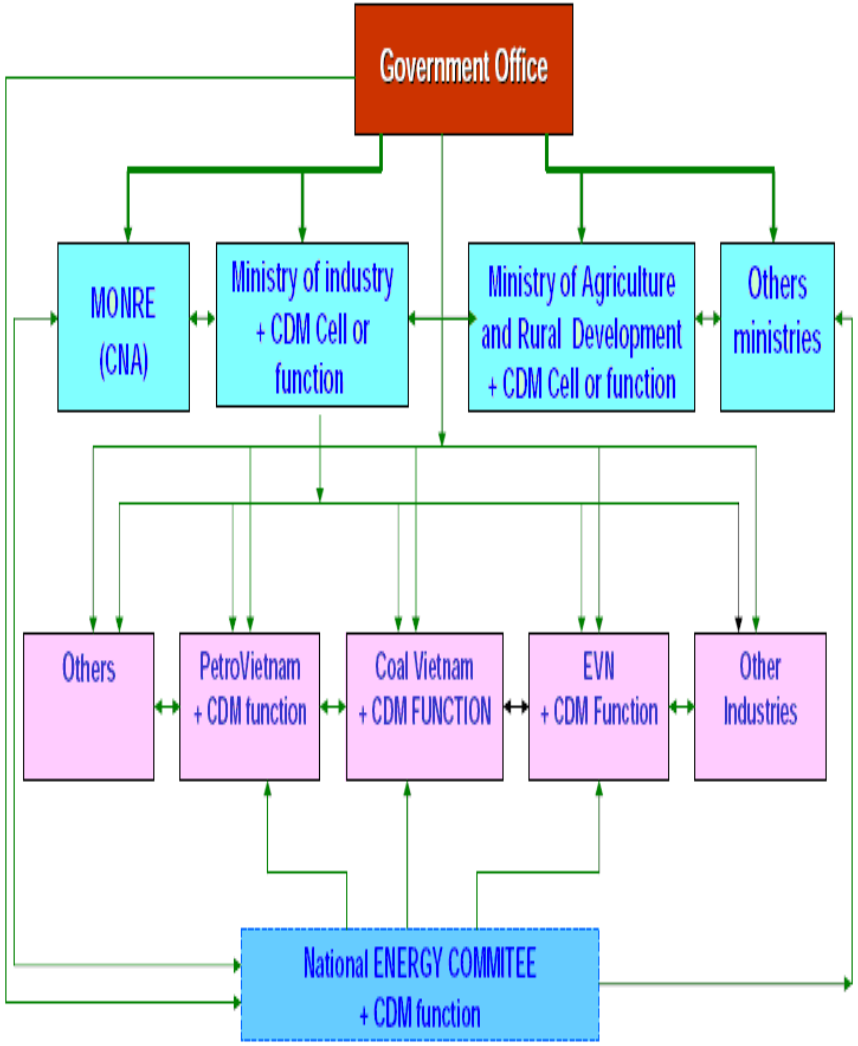
* Total projects are requesting registration, review requested, under or following review, micro corrections or corrections following request for review

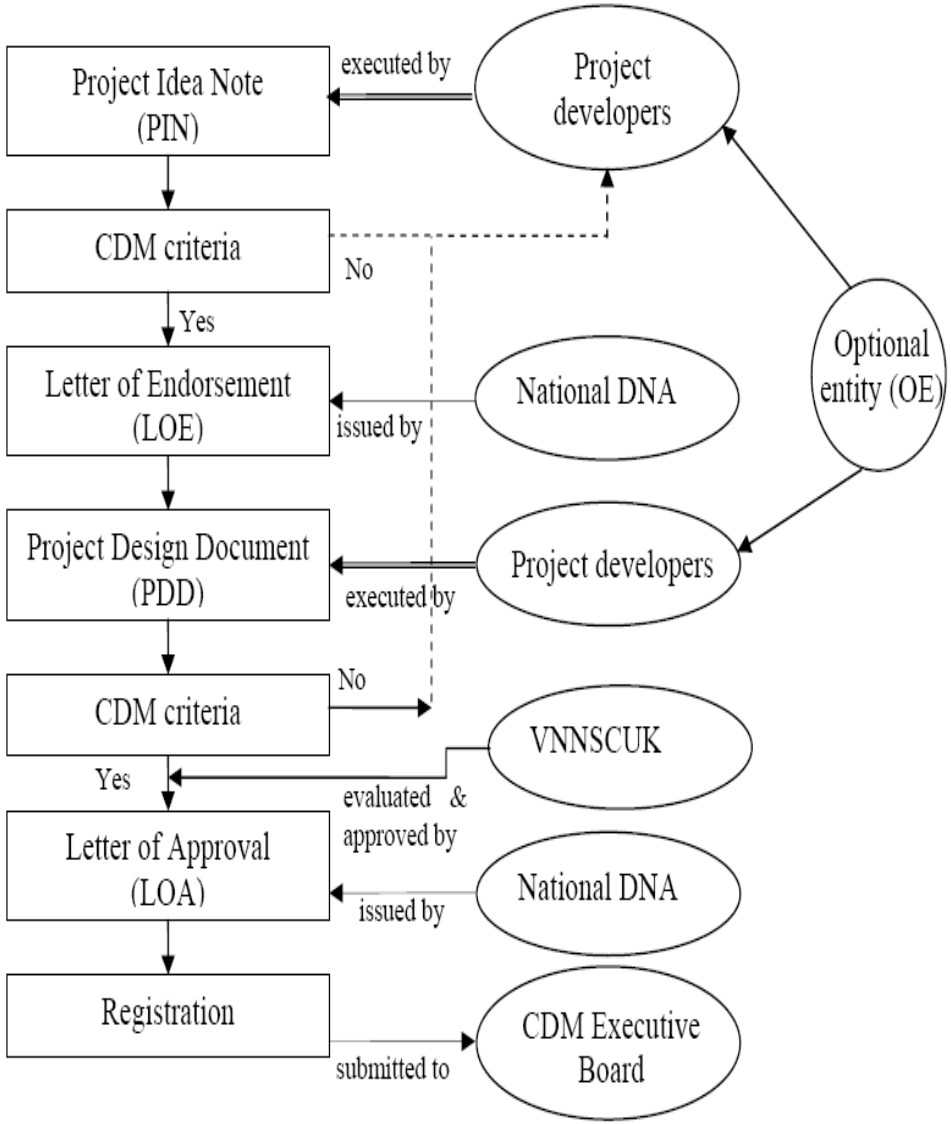
CDM investment climate index in Asian region by April 2009

Rank	Country	CDM ICI (max 100 points)	Regional classification
1	Malaysia	91.7	Very good climate
2	Korea (Rep)	90.2	Very good climate
3	Thailand	83.7	Good climate
4	China	83.3	Good climate
5	India	80.7	Good climate
6	Indonesia	80.1	Good climate
7	Philippines	79.5	Good climate
…	…	…	…
25	Vietnam	54.4	Average climate
…	...	...	

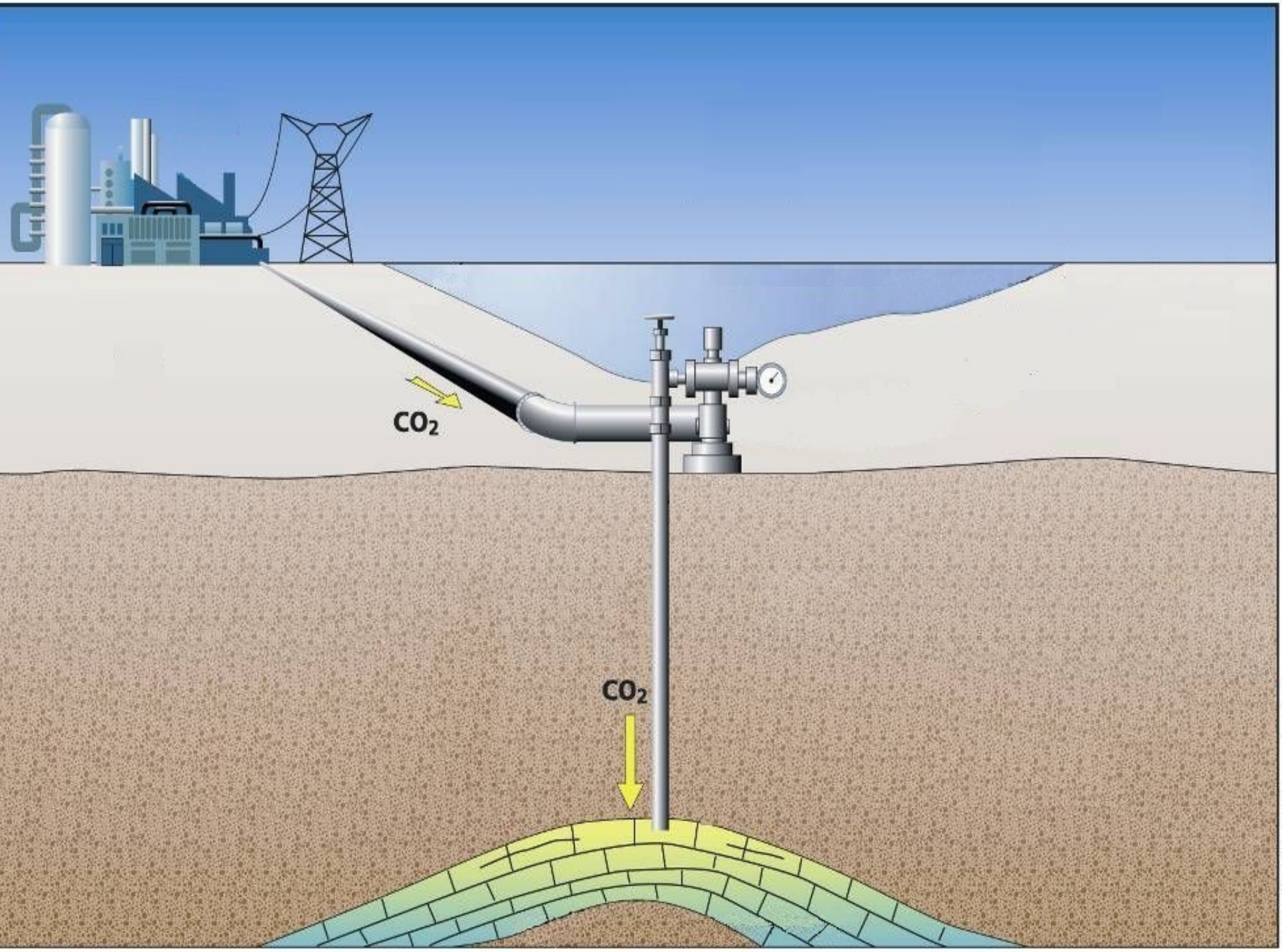
Source: DEG- Deutsche Investtions and Entwicklungsgesellschaft mbH cited by Germany Trade & Invest.

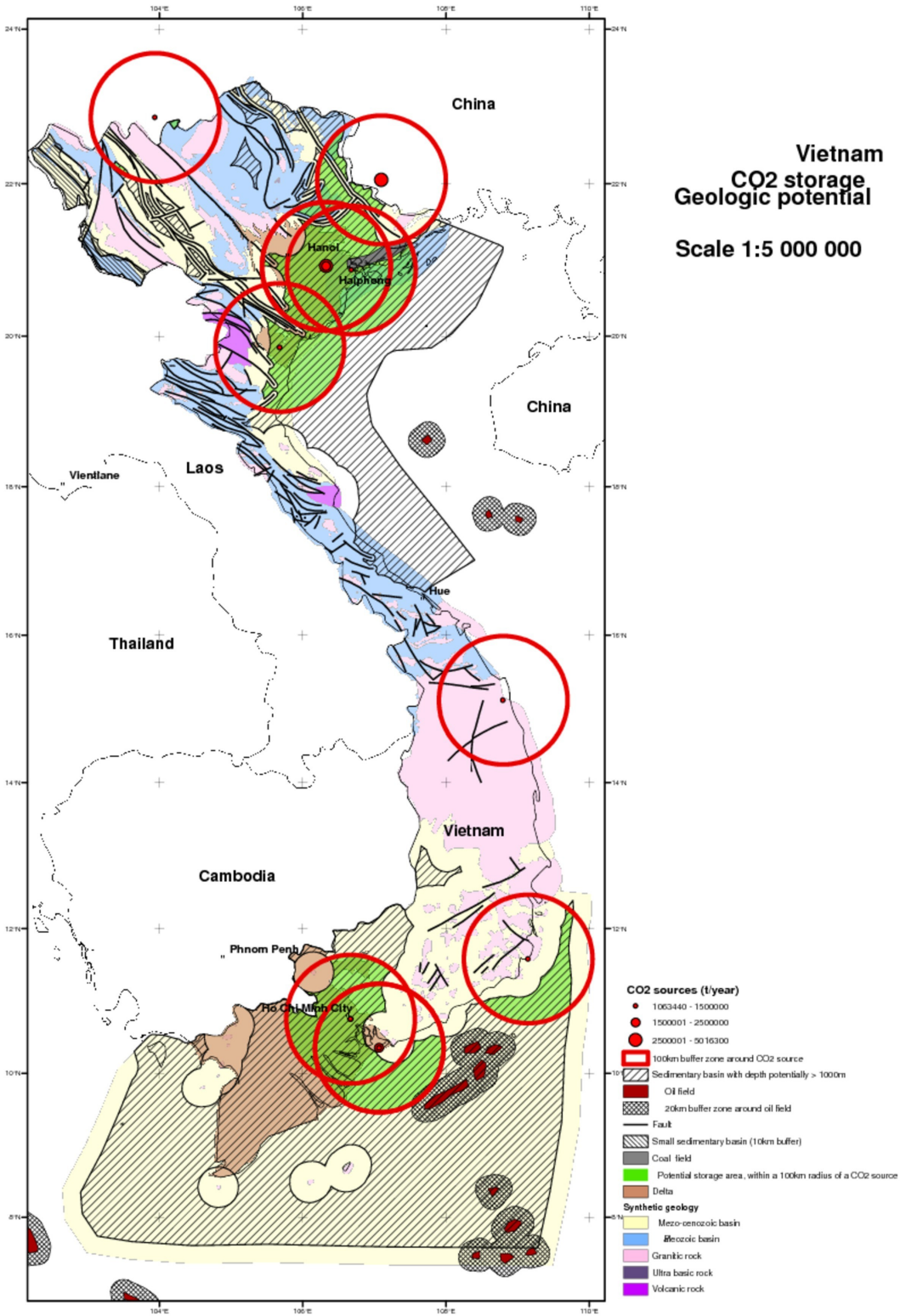
CDM institutional structure and host country approval procedures





Potential of Carbon Capture and Storage at Vietnamese power plants in 2040





Vietnam
CO2 storage
Geologic potential

Scale 1:5 000 000

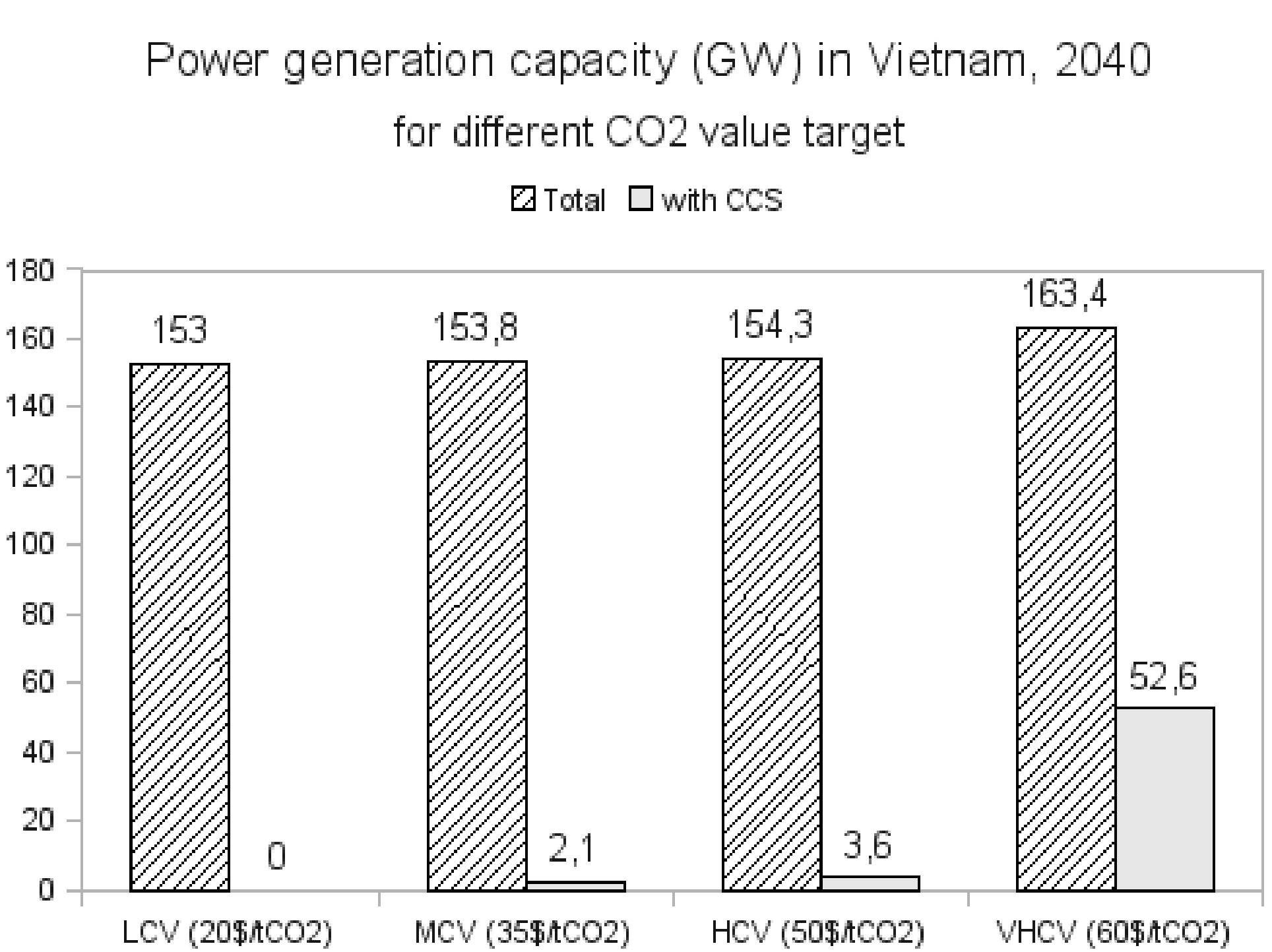
CO2 sources (t/year)

- 1063440 - 1500000
- 1500001 - 2500000
- 2500001 - 5016300
- 100km buffer zone around CO2 source
- Sedimentary basin with depth potentially > 1000m
- Oil field
- 20km buffer zone around oil field
- Fault
- Small sedimentary basin (10km buffer)
- Coal field
- Potential storage area, within a 100km radius of a CO2 source
- Delta

Synthetic geology

- Mezo-cenozoic basin
- Mezozoic basin
- Granitic rock
- Ultra basic rock
- Volcanic rock

Scenario				
CO_2 value in 2040 ($/t$CO_2$)	**$20**	**$35**	**$50**	**$60**
-critical Coal with CCS		2		
Coal with CCS			2	36
Coal with CCS				28
Gas with CCS		2	4	4
number of power plants with CCS		**4**	**6**	**68**


Power generation capacity (GW) in Vietnam, 2040
for different CO2 value target
Total
with CCS
180
160
140
120
100
80
60
40
20
0
153
0
153,8
2,1
154,3
3,6
163,4
52,6
LCV (20$/tCO2)
MCV (35$/tCO2)
HCV (50$/tCO2)
VHCV (60$/tCO2)