Two scenarios for carbon capture and storage in Vietnam

Minh Ha-Duong
CIRED/CNRS

Hoang Anh Trinh Nguyen
CleanED/USTH

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Clean Energy and Sustainable Development Lab

Founded in 2014, building a world-class interdisciplinary research team with the mission to contribute to the green growth of the energy sector in Vietnam and other South East Asian countries.

http://cleaned-usth.com

The University of Science and Technology of Hanoi

USTH created in 2010 with France

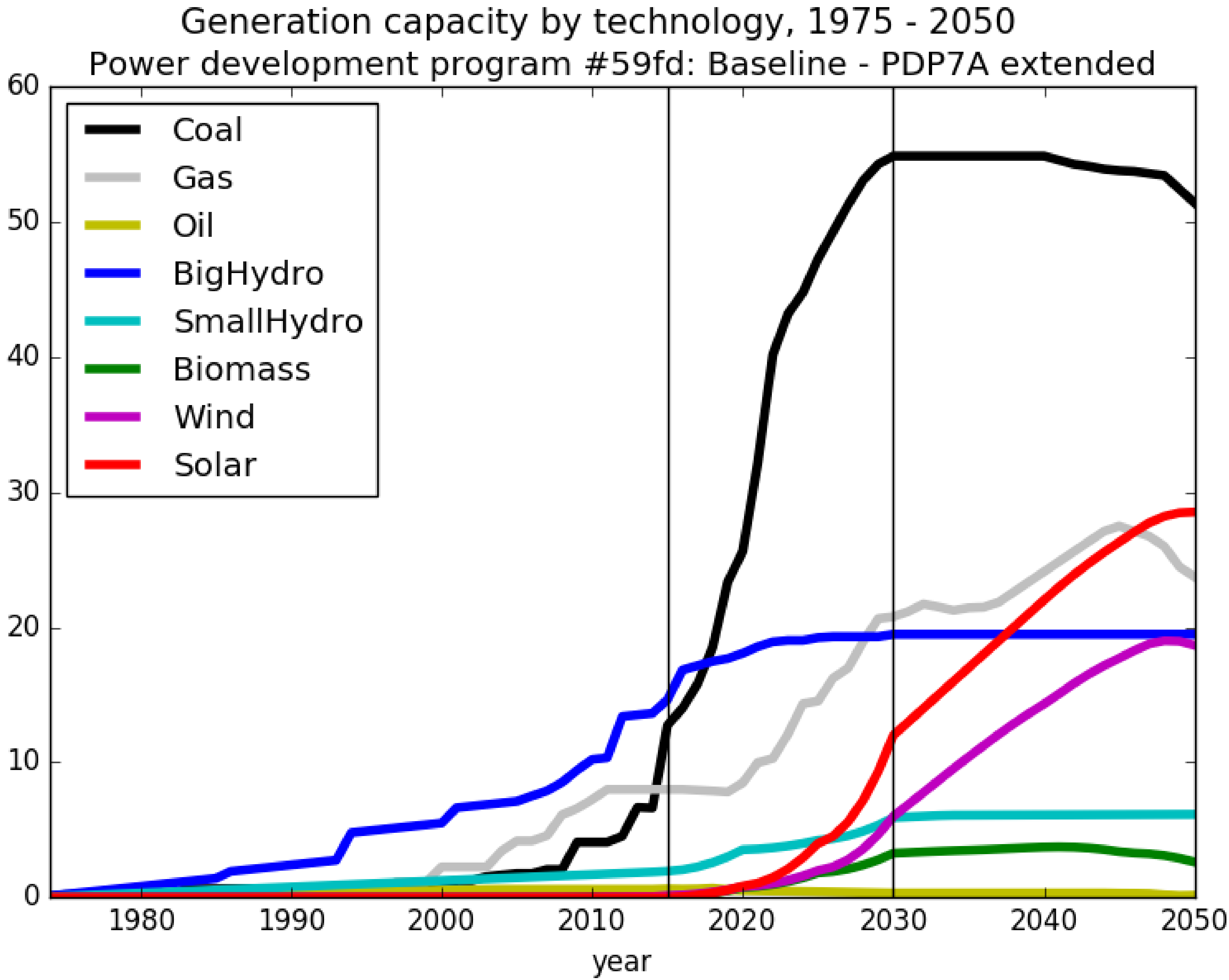
Vietnamese public New Model University

603/608/610 USTH building, VAST campus
18 Hoang Quoc Viet, Cau Giay, Ha Noi, Viet Nam

1. Context highlights

- CCS is relevant for Vietnam: power capacity from coal and gas is expanding faster than +1GW per year
- Lack of policy interest and the CCS costs are the biggest barriers for CCS development in Vietnam
- Capture readiness would lower the costs of using CCS in Vietnam, but is not mandatory today

Power capacity from coal and gas planned expansion in Vietnam

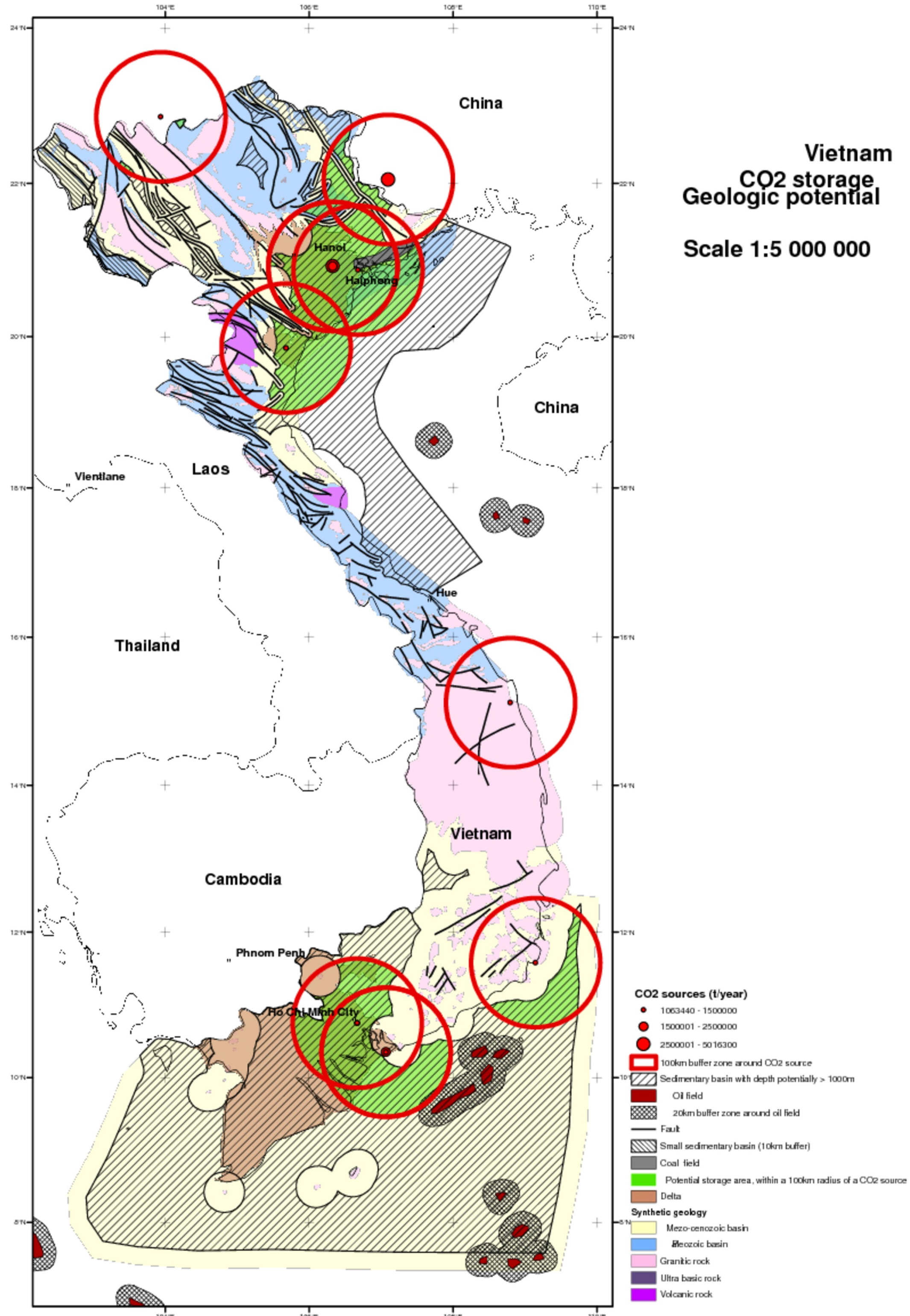


Generation capacity by technology, 1975 - 2050
Power development program #59fd: Baseline - PDP7A extended
Coal
Gas
Oil
BigHydro
SmallHydro
Biomass
Wind
Solar
0
10
20
30
40
50
60
1980
1990
2000
2010
2020
2030
2040
2050
year

Near-shore CO_2 storage possible

Vietnam
CO2 storage
Geologic potential

Scale 1:5 000 000



Lack of policy interest

The players

	Low stakeholder interest	High stakeholder interest
High stakeholder influence	Policy makers Local community/government Electricité du Vietnam VinaCoMin Local and international media Investors	CCS industry and researchers International carbon finance Fossil-fuel power industries PetroVina
Low stakeholder influence	Renewable energy industries Domestic environmental NGOs Education and training institutes	

Could Government of Vietnam do a pro-CCS policy ?

Strengths -The ability to issue policies regarding CCS industry	**Weaknesses** -Lack of technical knowledge -Lobbied by other industries
Opportunities -Giving subsidies, framework for co-operations -Lobbied by CCS industry	**Threats** -Do not pay attention to CCS deployment

2. Two scenarios

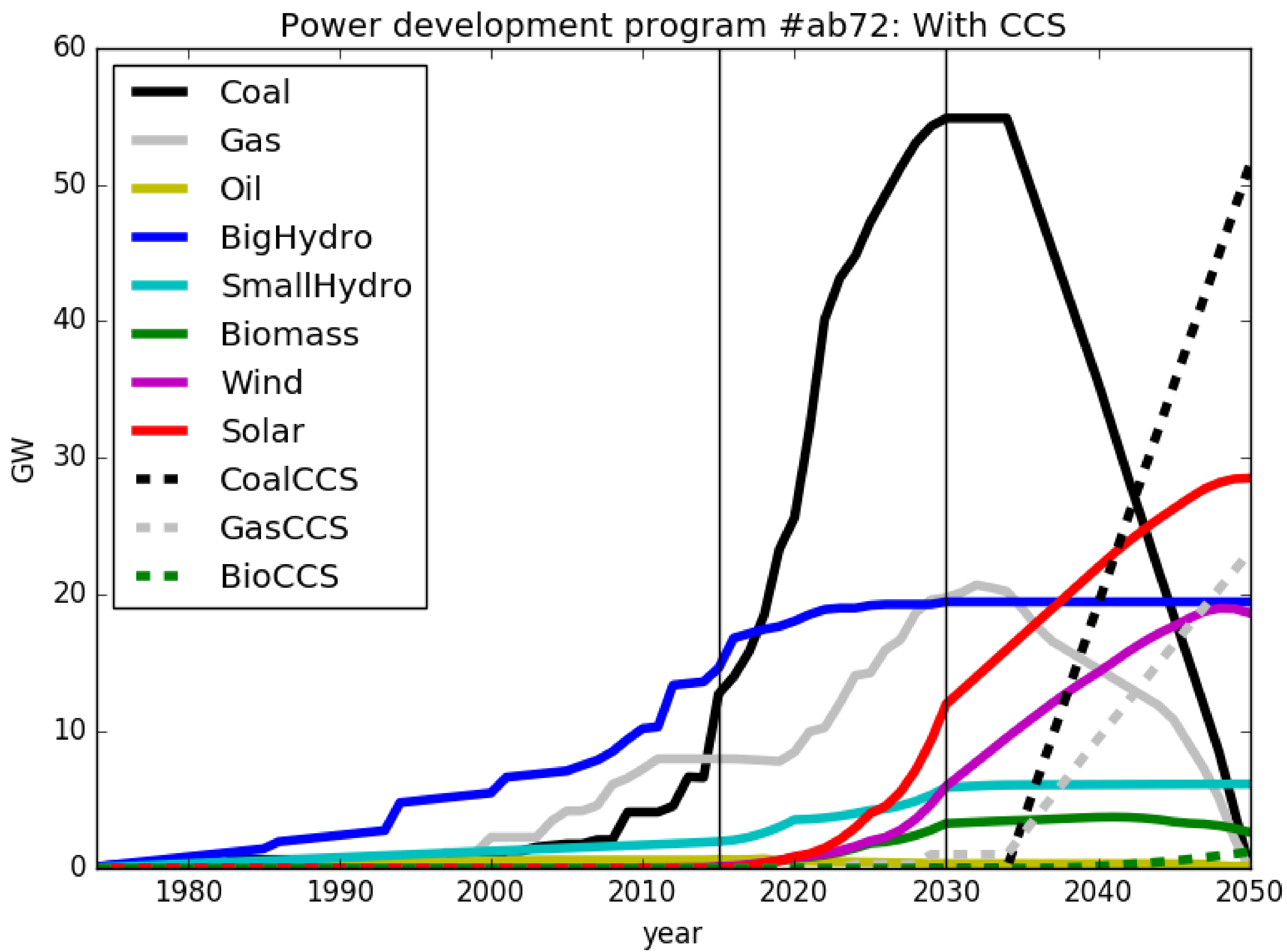
A) 1GW pilots in 2030, gas-fired CCS, supported by EOR and carbon finance, then stop.

B) Do pilots, then each year from 2035 until 2050:

- retrofit 3.2 GW coal CCS
- install 1.2 GW gas with CCS

Scenario driving forces

	Low scenario: CCS only EOR	**High scenario: CCS in power**
Government stance on CCS	Laisser-faire. Climate policy instruments are generic	Intervention to promote it with specific incentives.
Economic growth until 2050	Trapped at middle-income level	Catches up with South Corea and Japan
CCS technology costs	A global ban on coal hurts CCS scale up.	General adoption of CCS in China and elsewhere push costs down
Carbon price trajectory	Implicitly weak, below 30USD/tCO_2 in 2050	Most nations adopt a notional price of carbon reaching 50 USD/tCO_2 in 2050
Social acceptance	No, an international convention against onshore CCS is discussed.	Yes, most storage in Vietnam is offshore
Alternative technologies	Solar and wind win the cost race	Coal with CCS remains more expensive for new capacities, but capture-ready plants are retrofit rather than closed.


Power development program #ab72: With CCS
Coal
Gas
Oil
BigHydro
SmallHydro
Biomass
Wind
Solar
CoalCCS
GasCCS
BioCCS
GW
year
0
10
20
30
40
50
60
1980
1990
2000
2010
2020
2030
2040
2050

National energy mix simulation model

- Computes the system Levelized Cost of Electricity Generation (LCOE) and greenhouse gases emissions.
- Standard bottom-up, no optimization, storage or within-year time slices
- Technologies: coal, gas, oil, big hydro, solar, wind, small hydro, biomass, coal CCS, gas CCS, bio CCS, and imports.

- Subset of Howells et al. (2011) OseMOSYS limited to the equations blocks about Objective, Total Discounted Cost, Operating Cost, Capital Costs, Salvage Value, Emissions
- Python 3.5. For more details, code and data are available under the Creative Commons Attribution Sharealike International license at : https://github.com/MinhHaDuong/VN-CSS-Scenario.

Parameters

- Today's installed capacities: EVN (2016) inventory.
- Future capacity addition up to 2030: Power Development Plan 7 revised in 2016
- Median value of studies reported in:
  - Technical and economic parameters: OpenEI Transparent Cost Database (2017)
  - Technology emission factors: IPCC SRREN (Moomaw et al. 2011, Table A.II.4 page 982).
- LCOE : 6% discount rate, no external costs.

Simulation results

	Baseline	High CCS	difference	Units
Power produced	6385	6385	0	Twh
System LCOE	60.5	69.9	**+9.4**	USD/MWh
Total cost	386	446	**+60**	bn USD
CO2 emissions	11.1	8.9	**-2.2**	GtCO2eq
CO2 capture	0	2.7	**2.7**	GtCO2

3. Discussion

CCS scenario fails cost-benefit analysis under these cost of carbon assumptions :

- Zero until 2020
- 50 USD/tCO2eq in 2030
- 100 USD/tCO2eq in 2050

	Baseline	High CCS	difference	Units
Total cost	386	446	+60	bn USD
CO2 cost	173	139	-34	bn USD
Cost with CO2	559	585	**+26**	bn USD

Challenges

- Financial : international mechanisms only plausible option
- Legal : government could align incentives with other low carbon technologies
- Energy security : CCS increases imports

Vietnam energy policymakers should not defer thinking hard about CCS

- Decisions on CCS will have to be made before 2030, conditional on the today's choices about capture ready.
- The White Tiger project shows there are options to explore for EOR by CO2 injection in Vietnamese oil fields.
- Vietnam might benefit from future international or bilateral agreements to finance CCS projects in developing countries. Networking and capacity building, such as joining global CCS institutes & research forums, would help to prepare.

Conclusions

- Technical potential : Promising geological formations for CO2 storage less than 100km away from present and future fossil-fuel power plants.
- No commitment to the technology in Vietnam, not even much interests in CCS research and development.
- A scenario in which CCS is used in fossil-fuel power plants in Vietnam cannot be excluded. There is a real option value to building capture-ready power plants today.