



Feasibility and sustainability of co-firing biomass in coal power plants in Vietnam

A.H. Truong, M. Ha-Duong, H.A Nguyen-Trinh

truonganha87@gmail.com; minh.haduong@gmail.com ; hoanganhelec@gmail.com

Centre International de Recherche sur l'Environnement et le Développement (CIRED), France

Clean Energy and Sustainable Development Laboratory (CleanED), Vietnam

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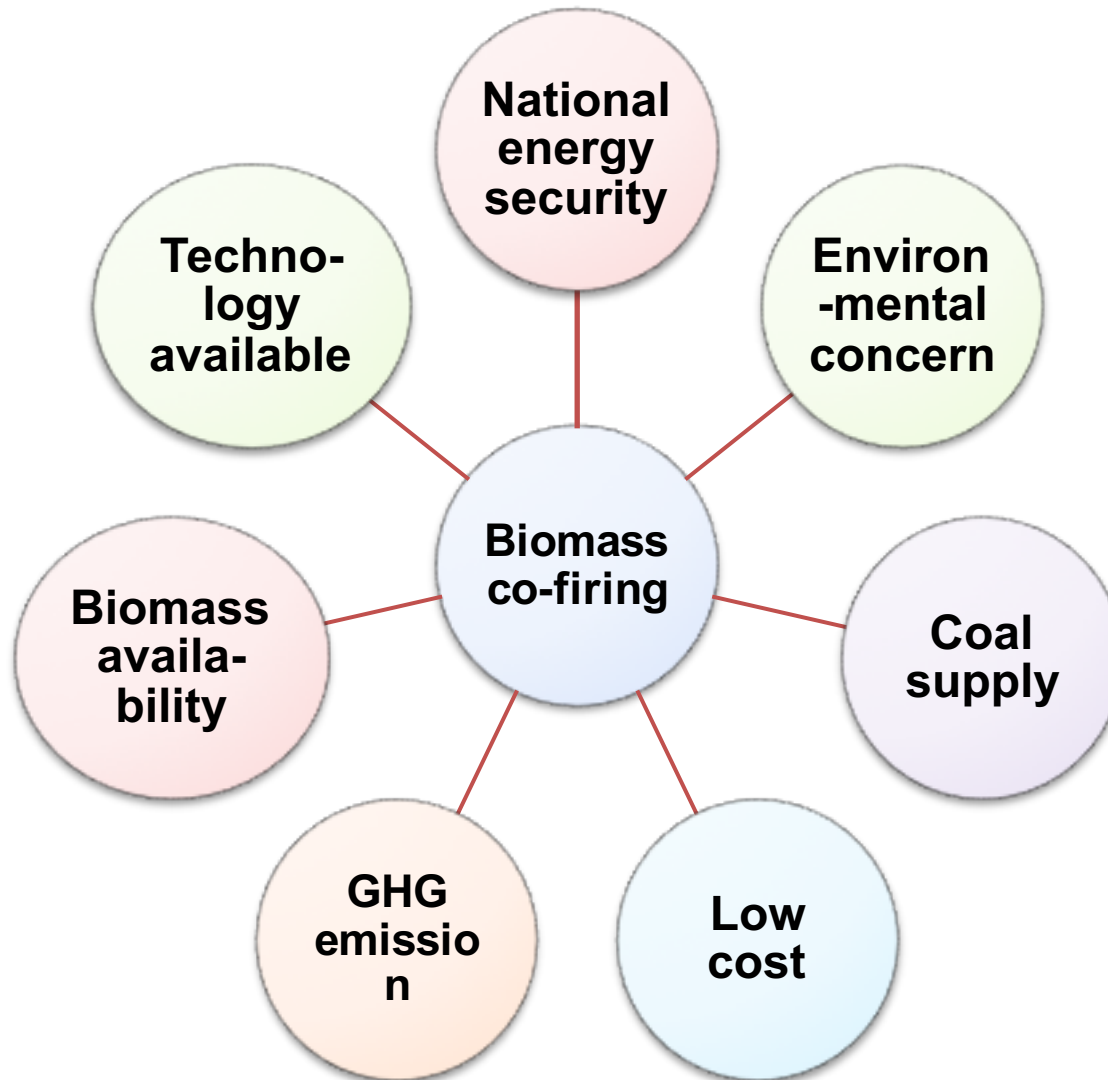
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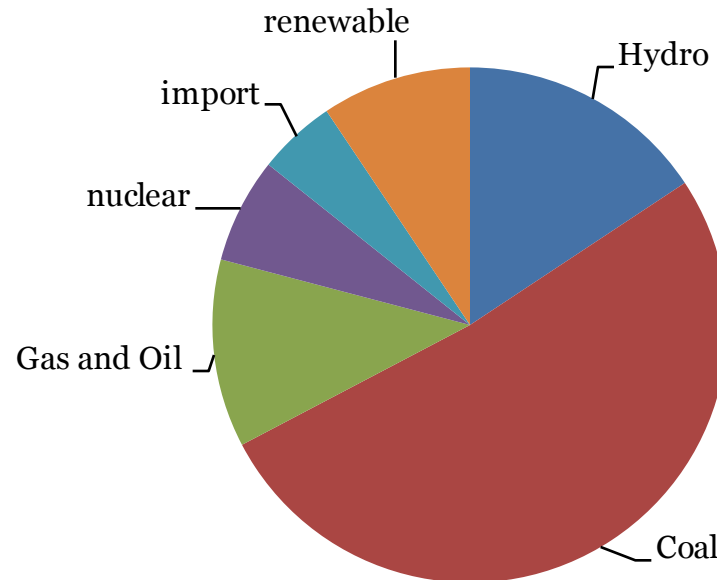
Introduction

- Co-firing is new concept in Vietnam
- Aims of the study
 - Reviewing biomass potential in Vietnam for co-firing
 - Building a set of indicators
 - Applying indicators in two real cases
 - Mong Duong CPP: new plant, modern technology
 - Ninh Binh CPP: old plant, old technology
- Key results:
 - Not yet economical feasible
 - Offer environmental and social benefits

Why considering biomass co-firing in Vietnam?



Co-firing help cut dependency on coal for energy

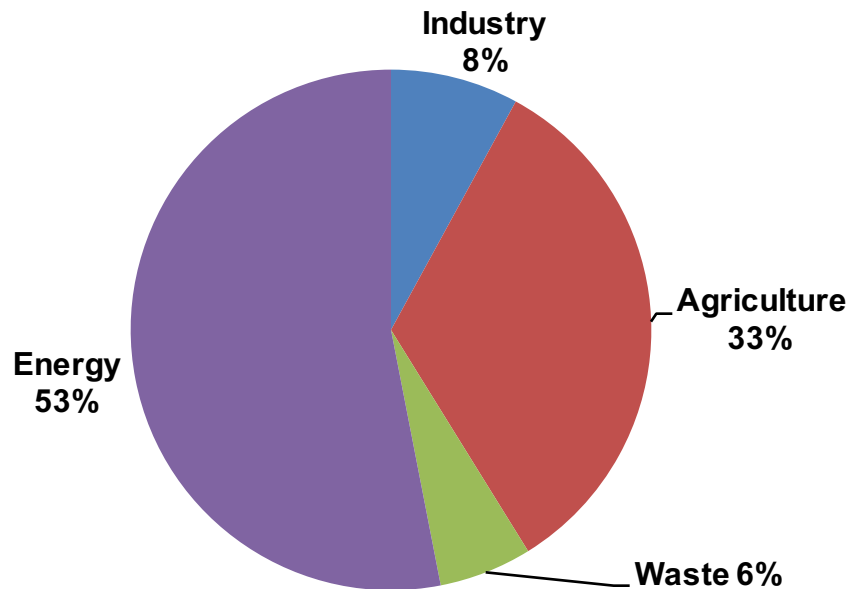


Electricity supply by sources by 2030

- Vietnam will depend more on coal for electricity
- By 2030: **80 Mton** coal imported per year

Co-firing can fit international/national policies on GHG emission reduction

GHG emission by sector

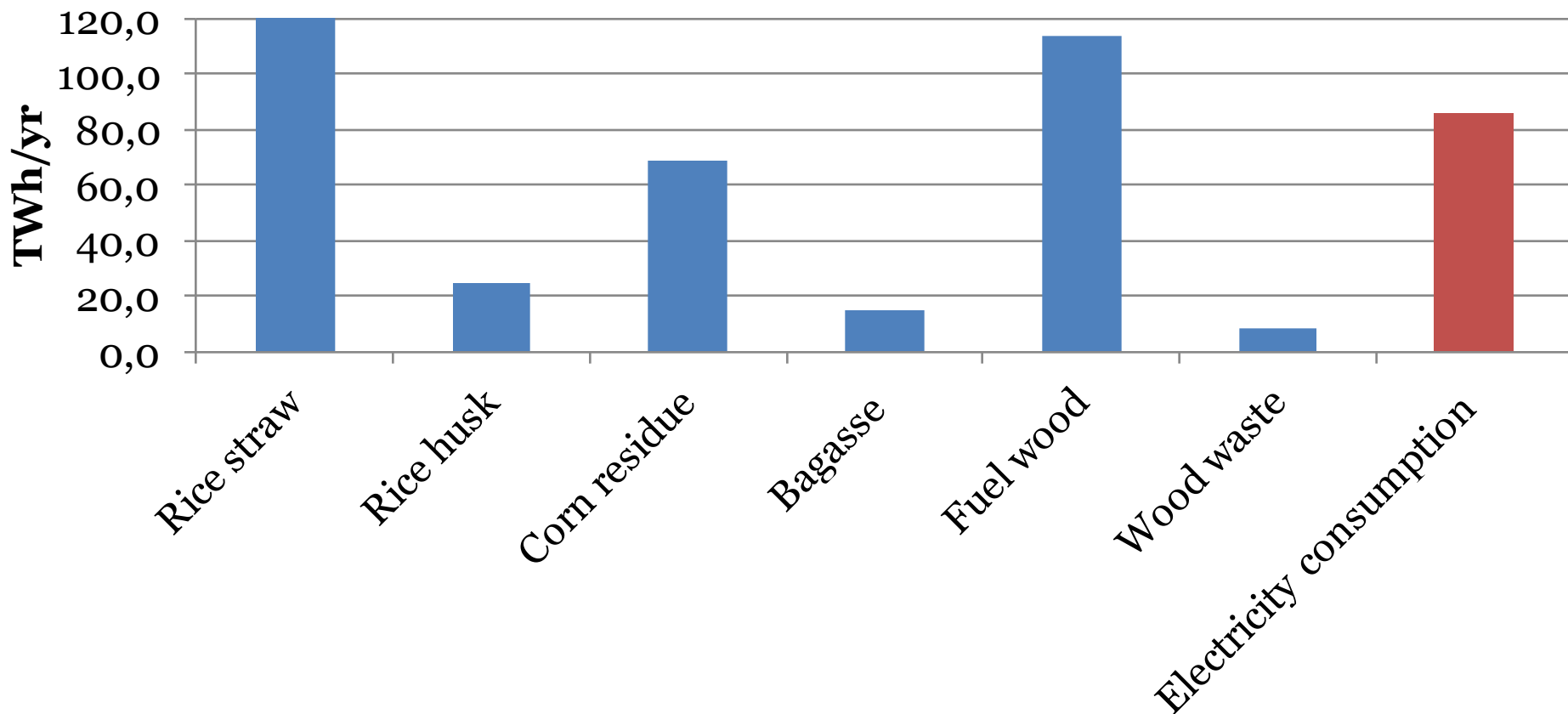


266 Mton CO₂e

- National target: reduce 20-30% GHG emission by 2030
- Clean Development Mechanism
- Joint Crediting Mechanism

Co-firing can utilize biomass potential in Vietnam

Biomass potential in 2010

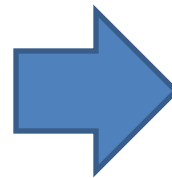


Co-firing might help overcome barriers of bioenergy development

- Electricity generated from biomass is much lower than its potential
 - CHP system in sugar mills: 150MW installed capacity
 - No biomass power plant in operation

Barriers :

- Fossil fuel subsidized
- Low electricity tariff
- High investment cost
- Continuous biomass supply required



Opportunities for co-firing:

- Lower investment cost
- No need continuous biomass supply

Co-firing could improve local air quality



- 60-90% rice straw is burned in-field
- Emission: 1.2 – 3 mil. Ton/year (Nguyen 2012)
- Co-firing
 - → less in-field burning
 - → pollutant emission more concentrated but filtered

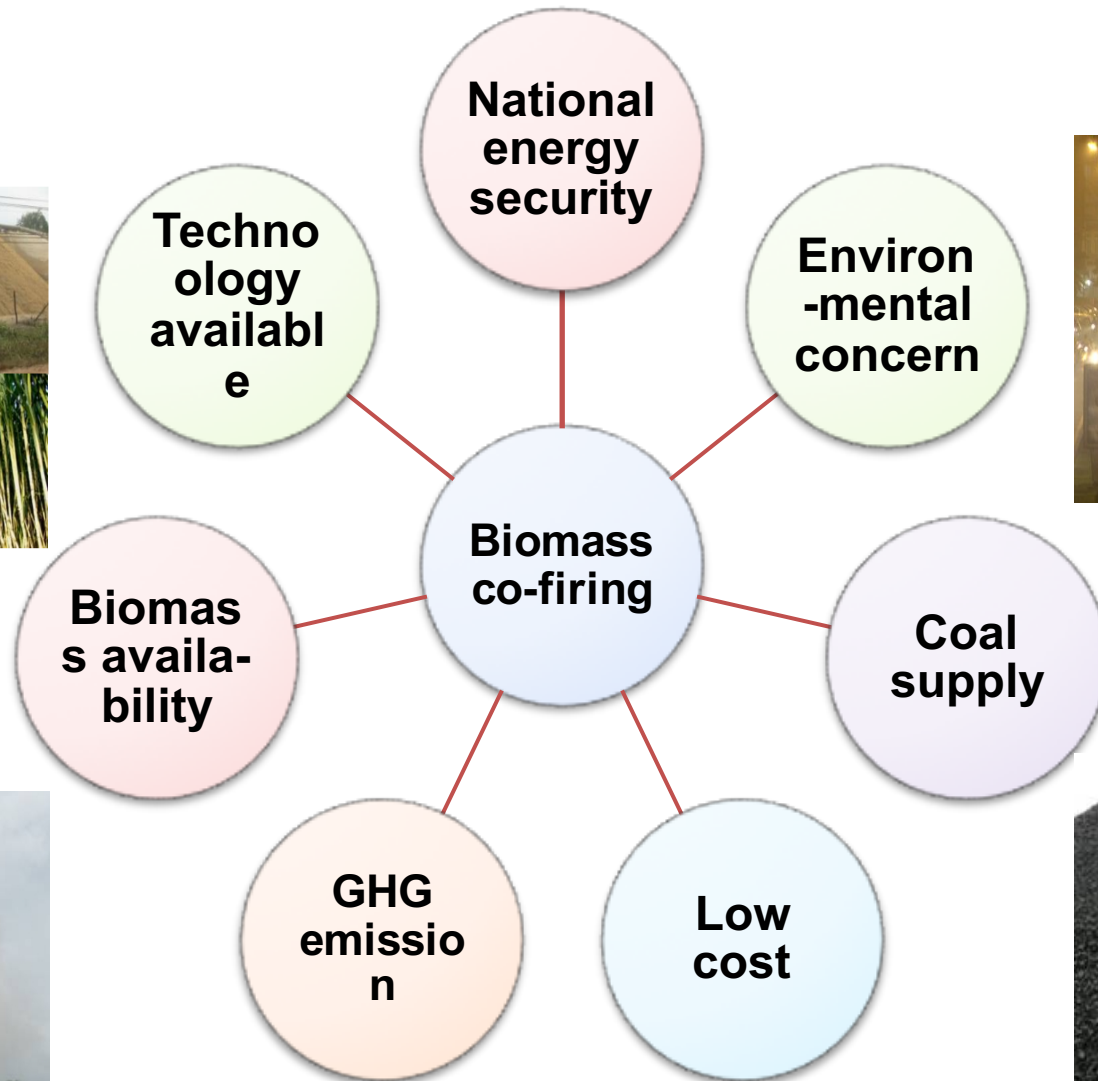
Experiences on co-firing exist worldwide

- About 230 plants
- Mostly in Europe (11 countries) and the US



Drax Coal Power Plant, UK (*Source: Alstom*)

Reasons for considering co-firing in Vietnam



Research steps

Literature review

- Research question: feasibility and sustainability of co-firing in VN

Interview and field trip

- Collect data
 - Through interviewing experts
 - Field trip to Ninh Binh coal power plants

Indicators identification

- Building a set of indicators

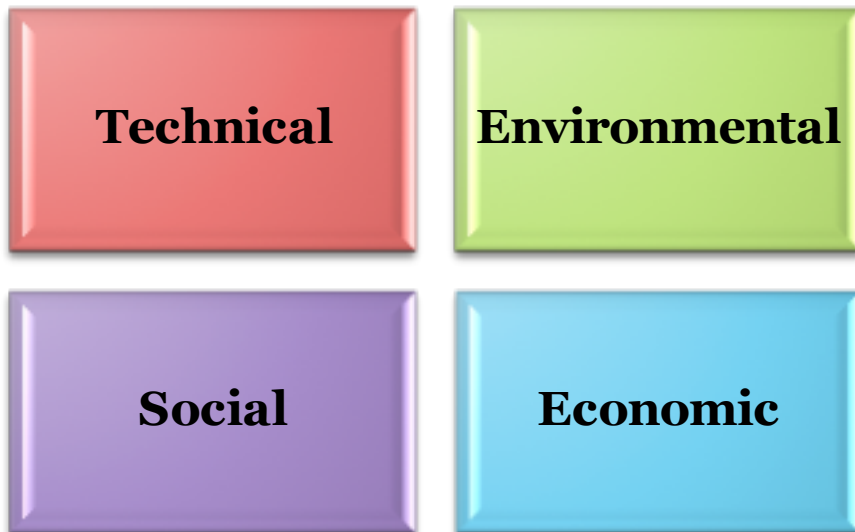
Case study

- Apply indicators for 2 cases

Conclusion

- Conclude about the feasibility and sustainability of biomass co-firing

Indicators for feasibility and sustainability assessment



- **Criteria**
 - **Relevance**
 - **Practical**
 - **Scientific based**
 - **Covers 4 aspects**
 - **Serve various users**

Selected indicators

	Indicator	Unit
Technical aspect	Biomass needed	ton/year
	Biomass available density	ton/km ² ·yr
	Collection radius	km
Economical aspect	Biomass unit cost	USD/ton
	Biomass cost per GJ	USD/GJ
	Effect to national trade balance (Extra revenue for coal export)	USD/year
	Levelized cost of electricity	USD/kWh
	Net Present Value	USD
	Fuel cost saved	USD/year
Environmental aspect	GHG emission reduction	ton CO ₂ e/yr
	Local air quality (NO _x , SO ₂ , PM _{2.5} , PM ₁₀)	mg/MJ
	Resource conservation	ton of coal/year
Social aspect	Extra income for farmer	USD/ha
	Number of jobs created per year	FTE jobs/ year

Case study: new FB plant and old PC plant

Mong Duong 1 Coal Power Plant

- 1080 MW
- 6.5 TWh/year
- Fluidized Bed
- Located next to coal mine



(Source: lisemco2.com)

Ninh Binh Coal Power Plant

- 100 MW
- 0.75 TWh/year
- Pulverized Coal
- Located 200 km from coal mines



Case study: biomass option selected for the cases

Technology

- Direct co-firing
- Blending coal with biomass

Co-firing rate

- 5%

Biomass feedstock

- Rice straw

Results: Local rice straw supply is adequate for biomass co-firing

Indicator	Value		Unit
	Mong Duong 1 CPP	Ninh Binh CPP	
Biomass needed	259	53	Thousand ton/year
Biomass available density	53	69	ton/km ² ·year
Collection radius	71	16	km

Results: co-firing is not economically feasible

Indicator	Value		Unit
	Mong Duong 1 CPP	Ninh Binh CPP	
Biomass unit cost	41.31	38.15	USD/ton
Levelized cost of electricity	4.5	6.6	UScent
Net Present Value	17.6	- 3.7	Million USD
Fuel cost saved	-2,485	32	Thousand USD/year
Extra revenue for coal export	1.4	0.35	Million USD/year

Coal price:
Case 1: 53 USD/ton
Case 2: 84 USD/ton

Electricity selling tariff:
5.4 UScent/kWh

Case 1: Low coal price → negative fuel cost saving

Coal is subsidized → low price

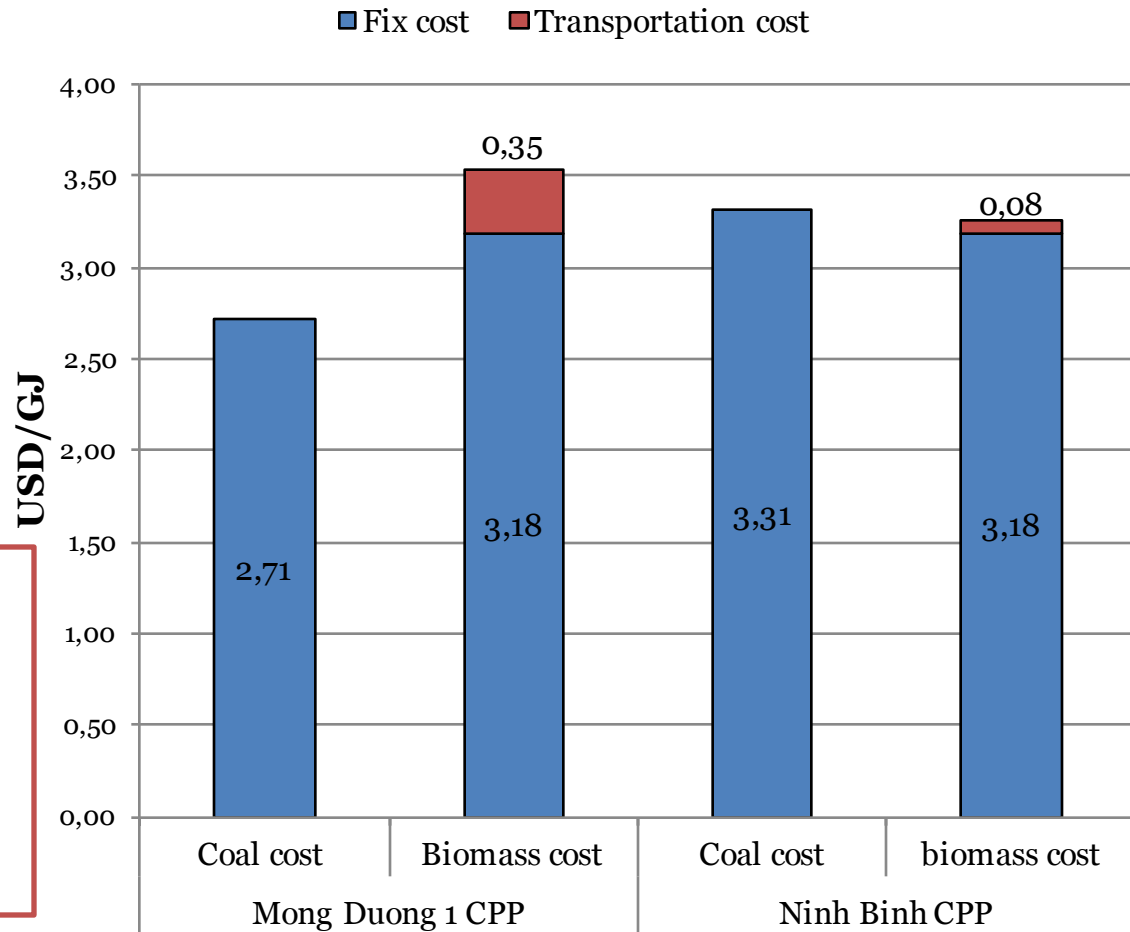
Cost per GJ of biomass is higher than coal

Coal price vs fuel cost saving:

53 USD/ton → -2.5 mil.USD

69 USD/ton → zero USD

Coal import price: 73 USD/ton



Fuel cost (per GJ) breakdown for two cases

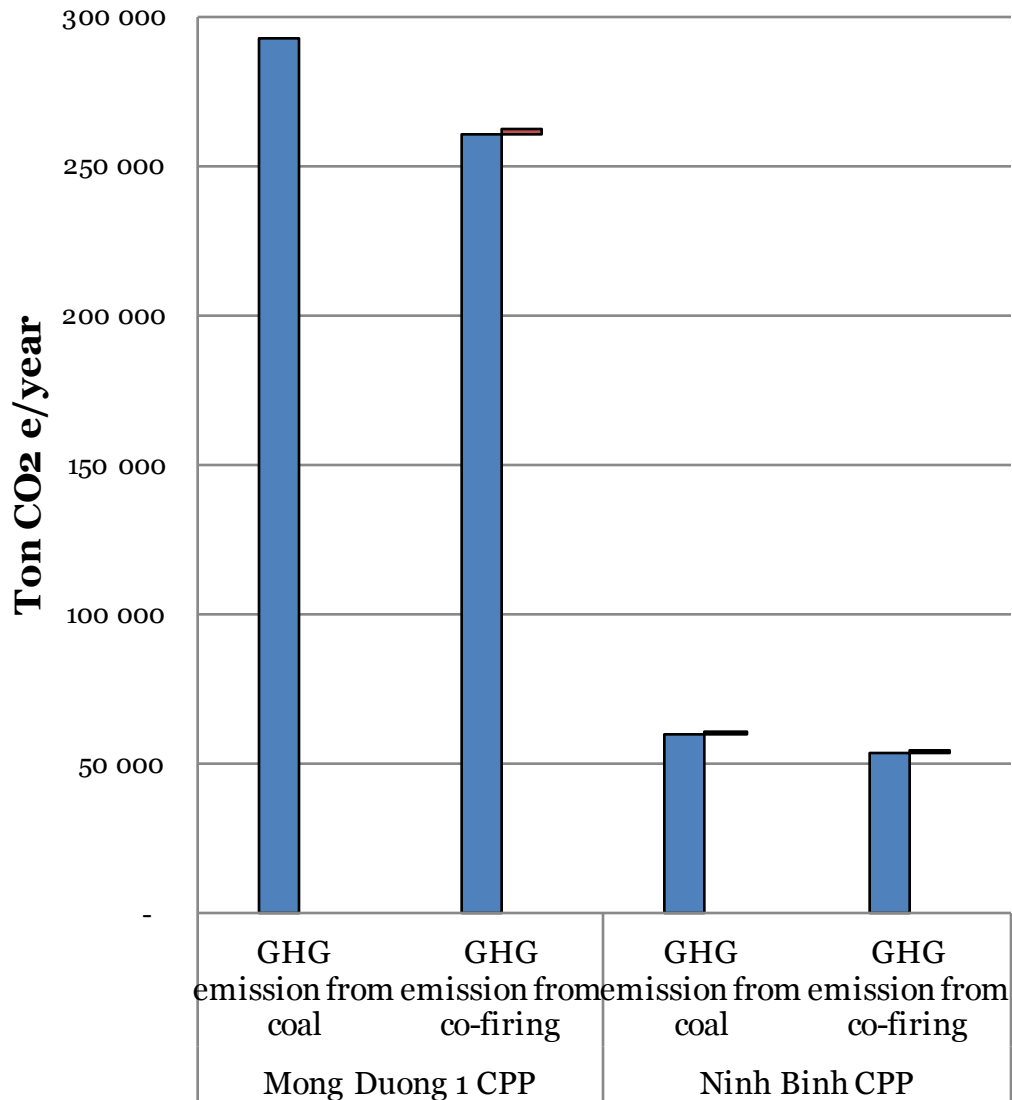
Case 2: High LCOE → negative NPV

- LCOE = 6.6 Uscent/kWh > tariff = 5.4 Uscent/kWh
- Co-firing is not yet subjected to supporting mechanisms
- Higher electricity tariff/FIT could make NPV positive

Results: Co-firing offers environmental & social benefits

Indicator	Value		Unit
	Mong Duong 1 CPP	Ninh Binh CPP	
GHG emission reduction	30,460	6,945	ton CO ₂ e/year
% emission reduced	10.4	11.5	%
Resource conservation	156	25	Thousand ton of coal/year
Extra income for farmer	143 - 194	172	USD/ha
Number of direct job created per year	253	46	FTE jobs/ year

GHG emission reduction from co-firing in two cases

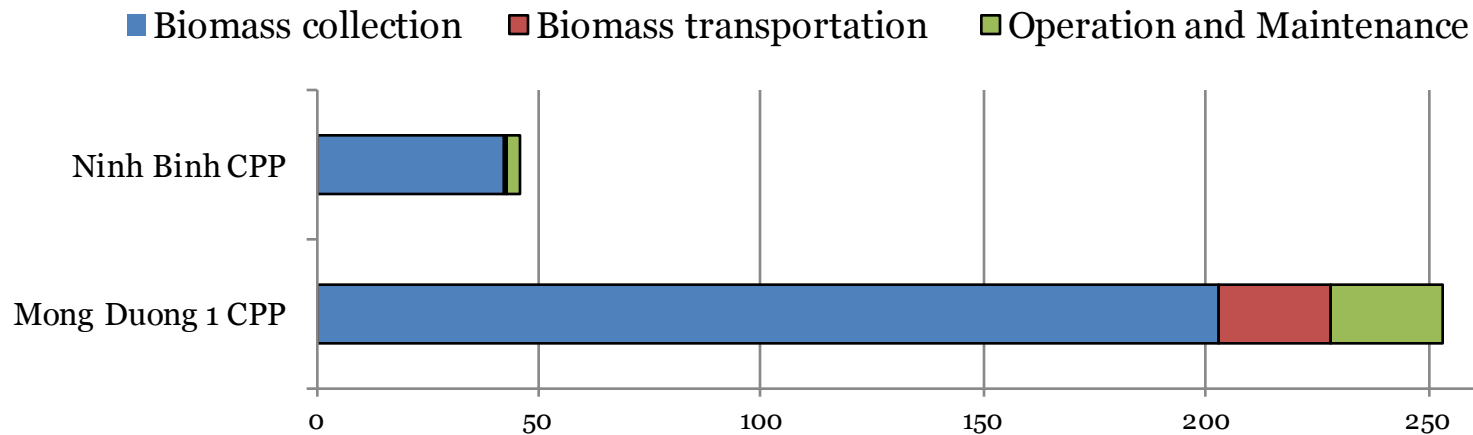


- EF of biomass < EF of coal
(~1kgCO₂e/kg) (~2.5kgCO₂e/kg)

■ Transportation
■ Combustion

Most direct jobs created from biomass collection

Direct jobs created from co-firing



Size: 50x70cm
Capacity: 400-
500 rolls/day



Conclusion

- Co-firing in Vietnam is not yet economic feasible due to
 - Coal subsidies
 - Low electricity tariff
- Co-firing in Vietnam offers various environmental and social benefits
 - GHG emission reduction
 - Local air quality improvement
 - Create market for biomass residue
 - Extra income for local farmers
 - Jobs creation
 - National trade balance
- Supporting mechanisms could be driving forces for co-firing development in Vietnam
 - Incentive taxes
 - Biomass subsidies
 - Carbon credit

Thank you for your attention!

