

RICE RESIDUES BURNING IN VIETNAM AND POSSIBLE TECHNOLOGICAL SOLUTIONS

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Haze and biomass burning in Asia - a systems perspective to reveal opportunities with benefits for long-term transformations

Bandung, 04-05 October, 2018

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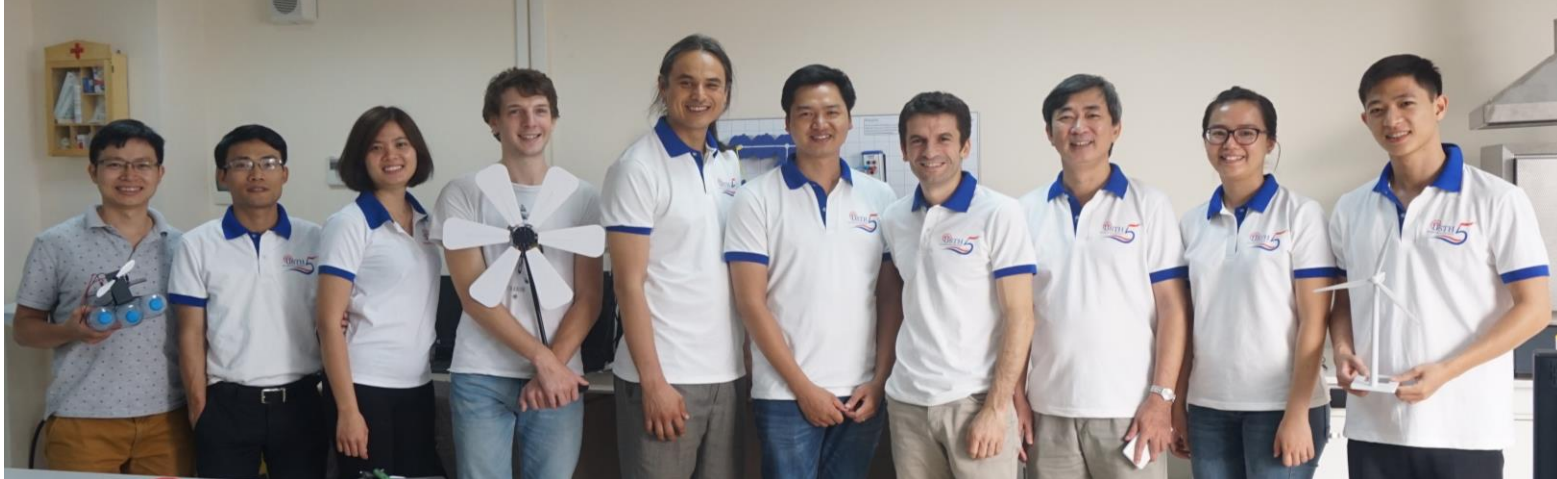
Rice residues burning in Vietnam

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Possible technological solutions

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Conclusions and perspectives



CleanED LABORATORY

Research

1. Energy economics and policy
2. Biomass & waste to energy
3. Smart grid optimization
4. Materials for energy

Collaboration



Core members:
WWF, GreenID, CleanED,
CEWAREC, Live & Learn



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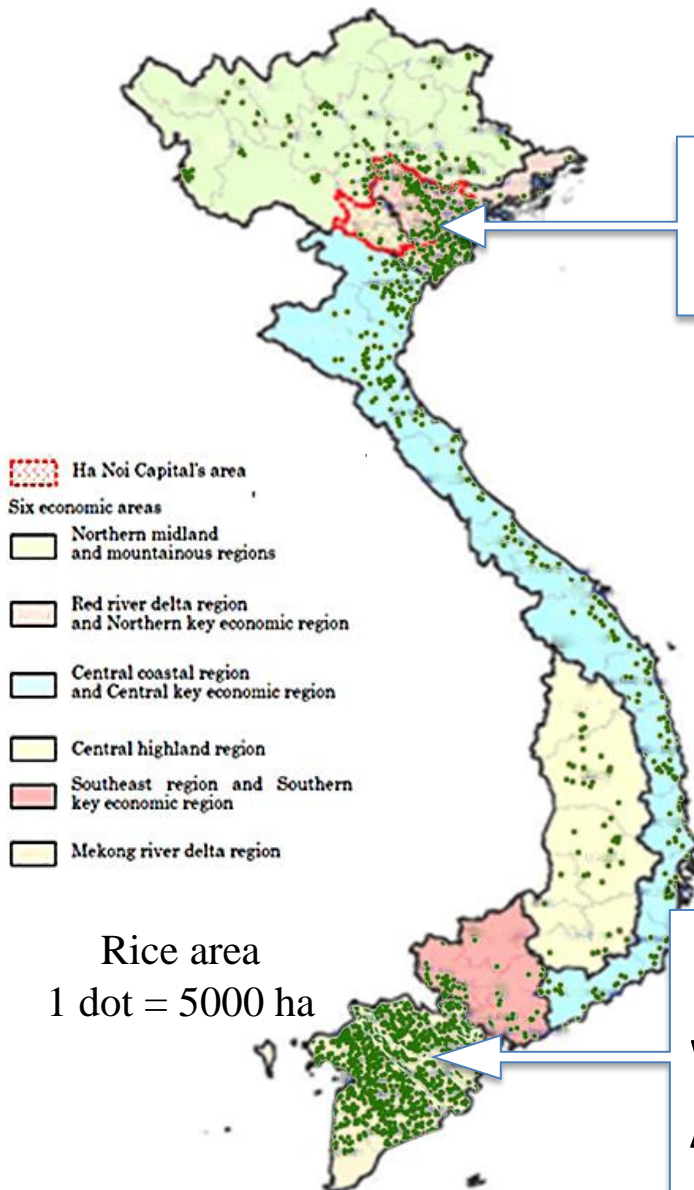
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Rice production of Vietnam



Red River Delta: 18%, 2 seasons:
Winter-Spring and Autumn-Winter

5th biggest rice exporter in the world

Annual paddy production
over the last 5 years: ~ 41 Mt

Mekong River Delta: 52%, 3 seasons:
Winter-Spring, Summer-Autumn and
Autumn-Winter

Rice residues production in Vietnam

Region	Rice straw (Mt)			Rice husk (Mt)		
	Winter-Spring	Summer-Autumn	Autumn-Winter	Winter-Spring	Summer-Autumn	Autumn-Winter
Red River Delta	3.58	-	3.00	0.72	-	0.60
Northern Midlands and Mountains	1.45	-	1.94	0.29	-	0.39
North Central and Central Coast	3.53	1.86	1.49	0.71	0.37	0.30
Mekong River Delta	9.99	12.68	1.55	2.00	2.54	0.31
Sub-total	18.55	14.54	7.98	3.72	2.91	1.60
Total	41.07			8.23		

Rice residues potential

41 Mt/year
~ 15 MJ/kg*



+

8 Mt/year
~ 13 MJ/kg*



=

~ 28 Mt of coal
~ 26 MJ/kg*



=

200 TWh
(~1.6 times electricity
consumption in 2016)



* Our own measurements in the laboratory

Rice straw usage



**Non-energy
use (~5%)**

Mushroom cultivation

Cattle feeding

Incorporation to soil etc.

**Energy use
(~15%)**

Direct burning in traditional
cookstoves

**Open field
burning
(~80%)**

For disposal

Rice husk usage

Non-energy use (~15%)

Soil amendment

Livestock

Sorbent & building material, etc.

Energy use (~20%)

Direct burning in traditional cookstoves, brick/ceramic kilns

Open field burning (~35%)

For disposal

Another disposal ways (35%)

(left on the field, dump into the canals (35%))

Burning of rice residues in Vietnam



<http://phapluatdansinh.phapluatxahoi.vn/>



<http://tinmoitruong.vn/>



<http://hoabinhxeanh.vn/>



<http://Samtrix.vn/>

Quantity of rice residues burned

Region	Rice straw (Mt)	Rice husk (Mt)
Red River Delta	5.92	0.99
Northern Midlands and Mountains	3.14	0.48
North Central and Central Coast	5.50	0.62
Mekong River Delta	21.80	2.42
Total	36.36*	4.51*

*Including open field burning for disposal and direct burning in traditional cookstoves, brick/creamic kilns

The quantity burned varies depending on the location: rural areas – suburban areas, and the season: winter-spring -- autumn-winter are not considered

Impacts of rice residues burning

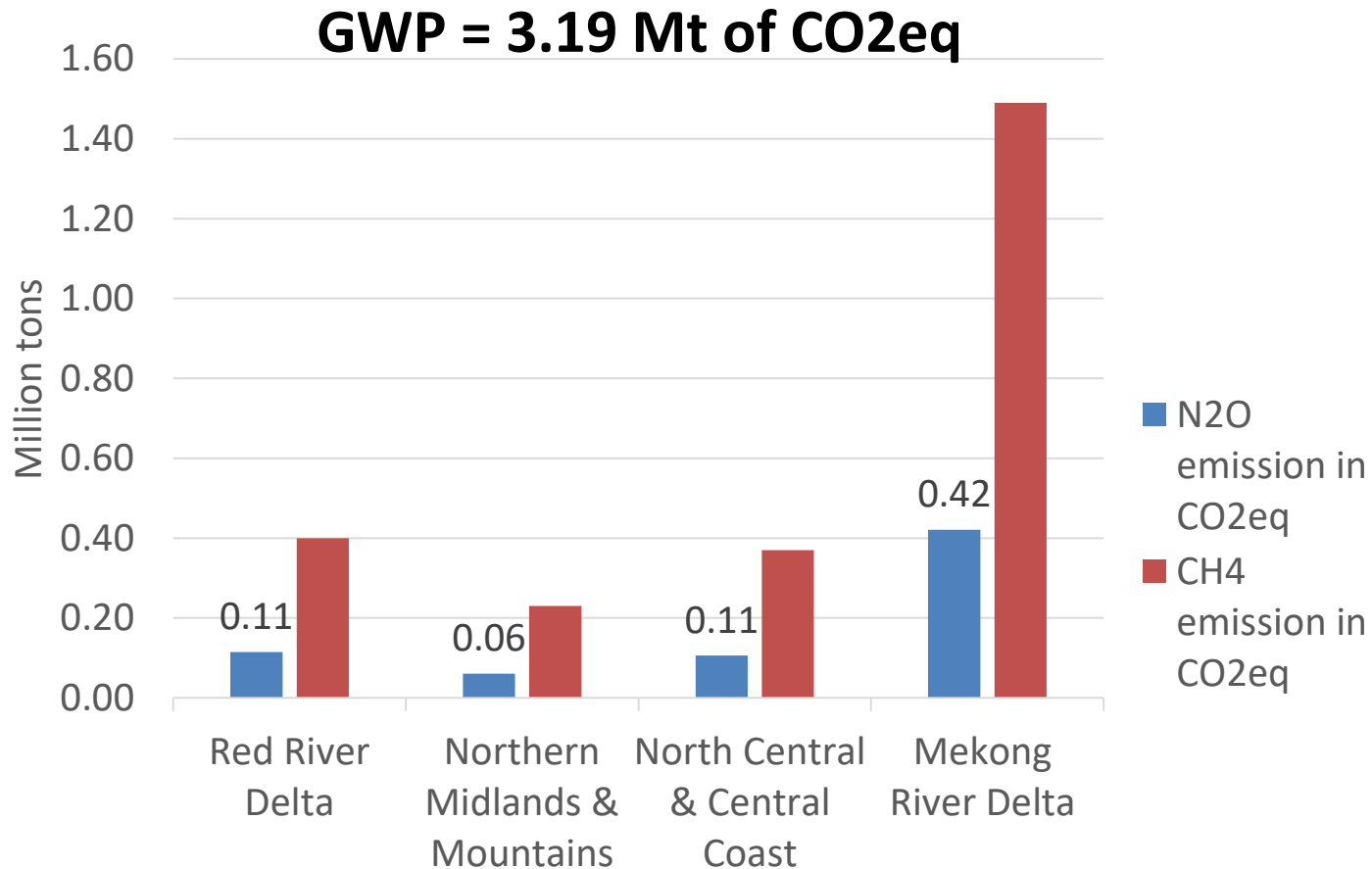


GHG emission

Soil quality & local environment

People's health

Emission from rice residues burning

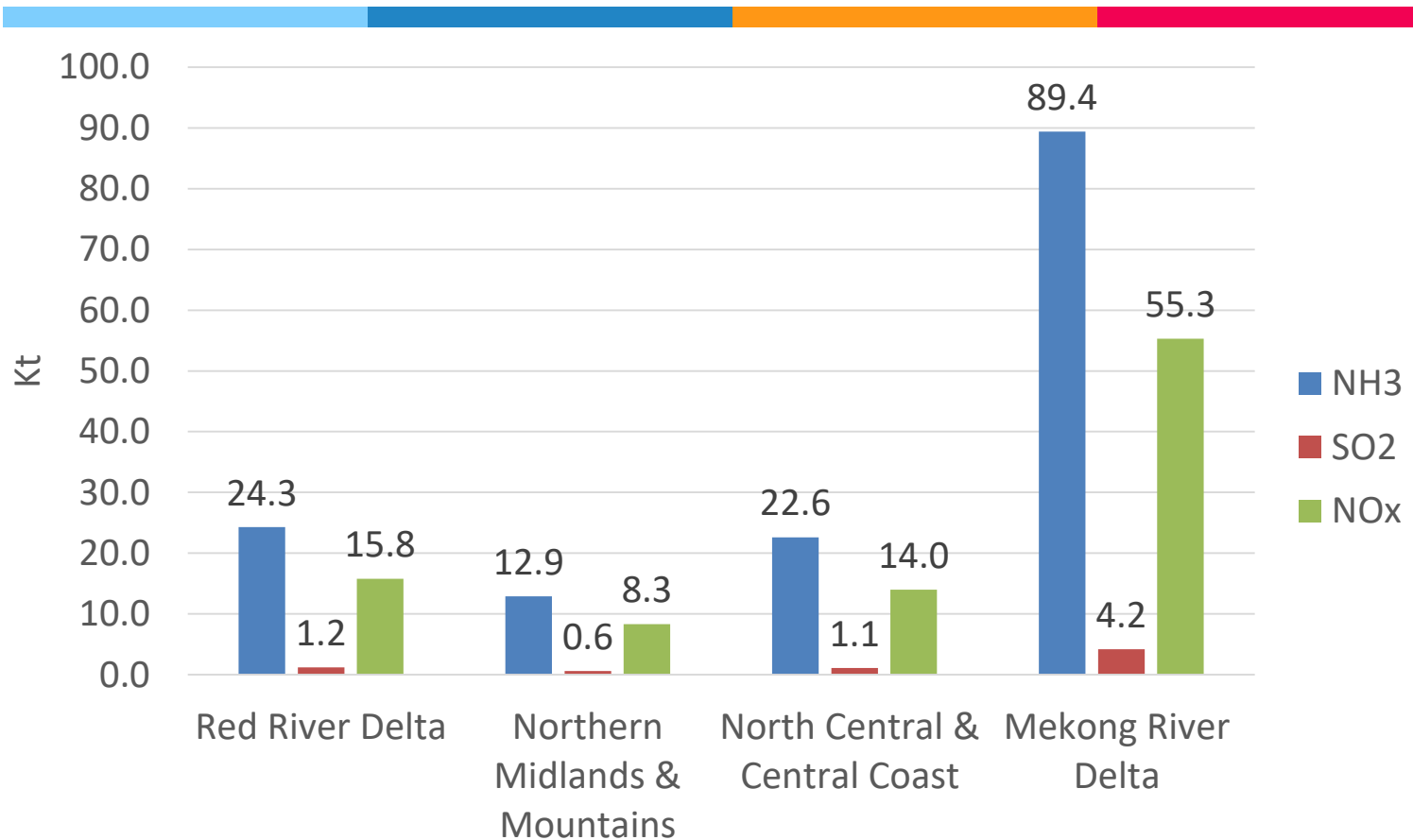


Open field burning of rice straw

(M. D. Nguyen 2012; Arai et al. 2015; Cuong, Le, and Hoang 2016; Le, Nguyen, and Le, n.d.; H. V. Nguyen et al. 2016; Yu, Lin, and Chang 2012)

Burning of rice husk in brick/ceramic kilns/traditional cookstoves (Ahiduzzaman 2007; Irfan et al. 2014; Ichikawa and Naito 2017; Wang et al. 2012)

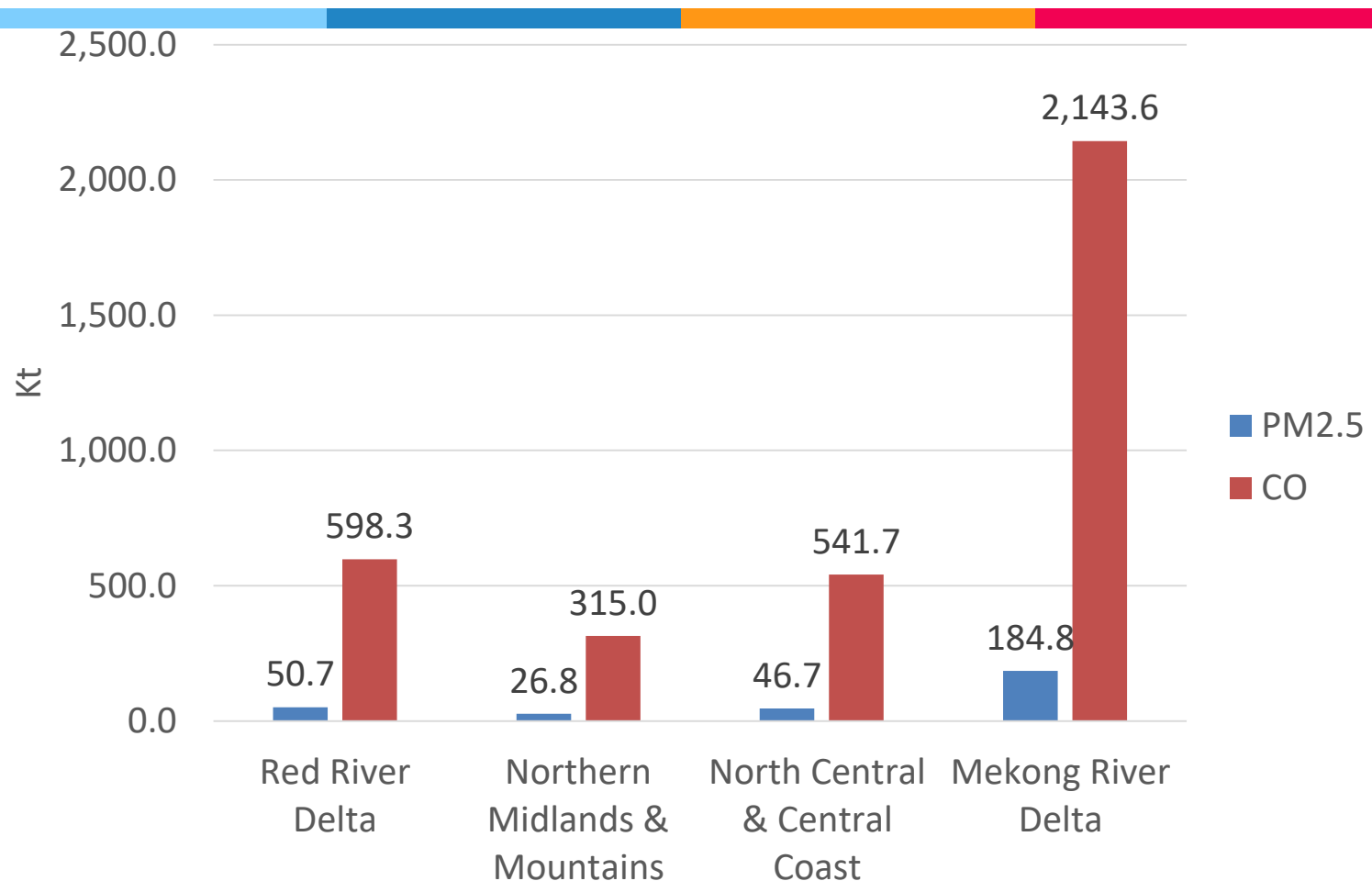
Emission from rice residues burning



Increase of soil temperature, decrease of microorganisms (Son Tung, Xuan Cu, and Xuan Hai 2014)

Deprivation of organic matters, increase of pH in the soil (Mandal et al. 2004)

Emission from rice residues burning



Aggravation of respiratory, eye and skin diseases (Kumar, Kumar, and Joshi 2015, Hong Nam Nguyen et al. 2016)

Vascular diseases (Torigoe et al. 2000; Gadde et al. 2009, Co et al. 2014)

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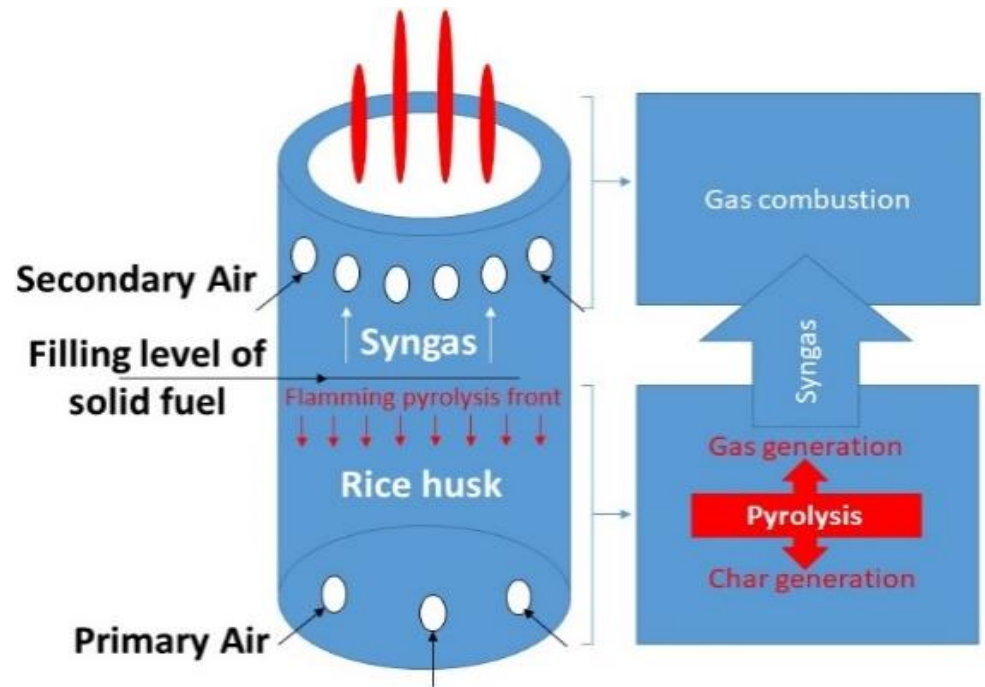
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Clean cook stoves in Vietnam



- «Top-lit updraft» principle
- Better performance than traditional stoves theoretically
- Product quality and efficiency vary greatly by design



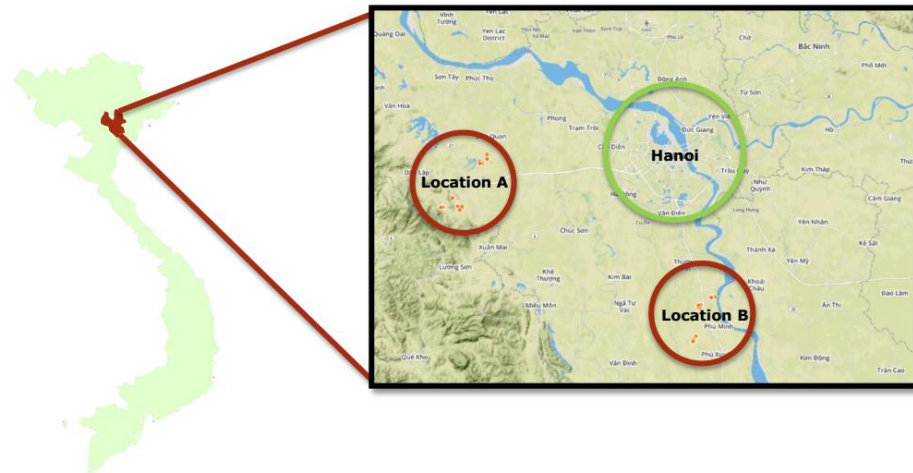
Clean cook stoves in Vietnam: End-user adoption study

- Evaluation of existing designs in Vietnam
- Disseminate appropriate designs



Clean cook stoves in Vietnam

- Performance test of 09 existing stove designs (Global alliance of Clean cookstove protocol)
- Introduction of 2 stoves in 60 households in 7 villages



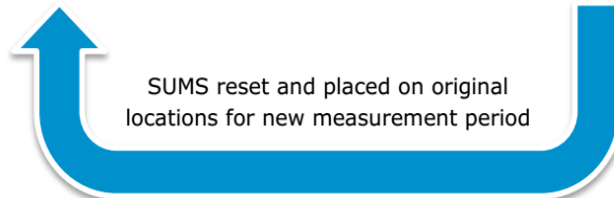
- Data collection in 3 months



Temperature Data
Compilation



Data Analysis and Processing
of Cooking Events



SUMS reset and placed on original
locations for new measurement period

+ Survey on people
health and environmental
concerns

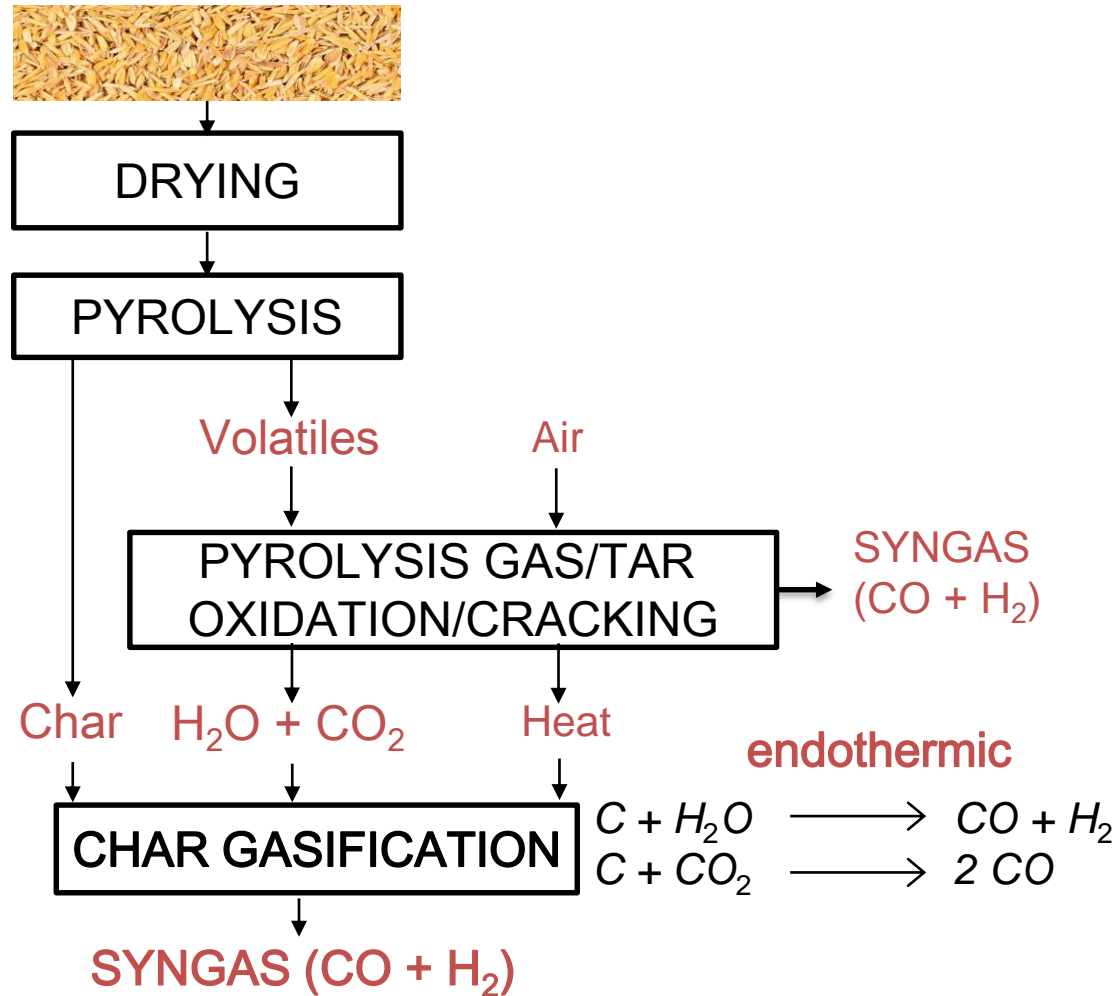
Clean cook stoves in Vietnam

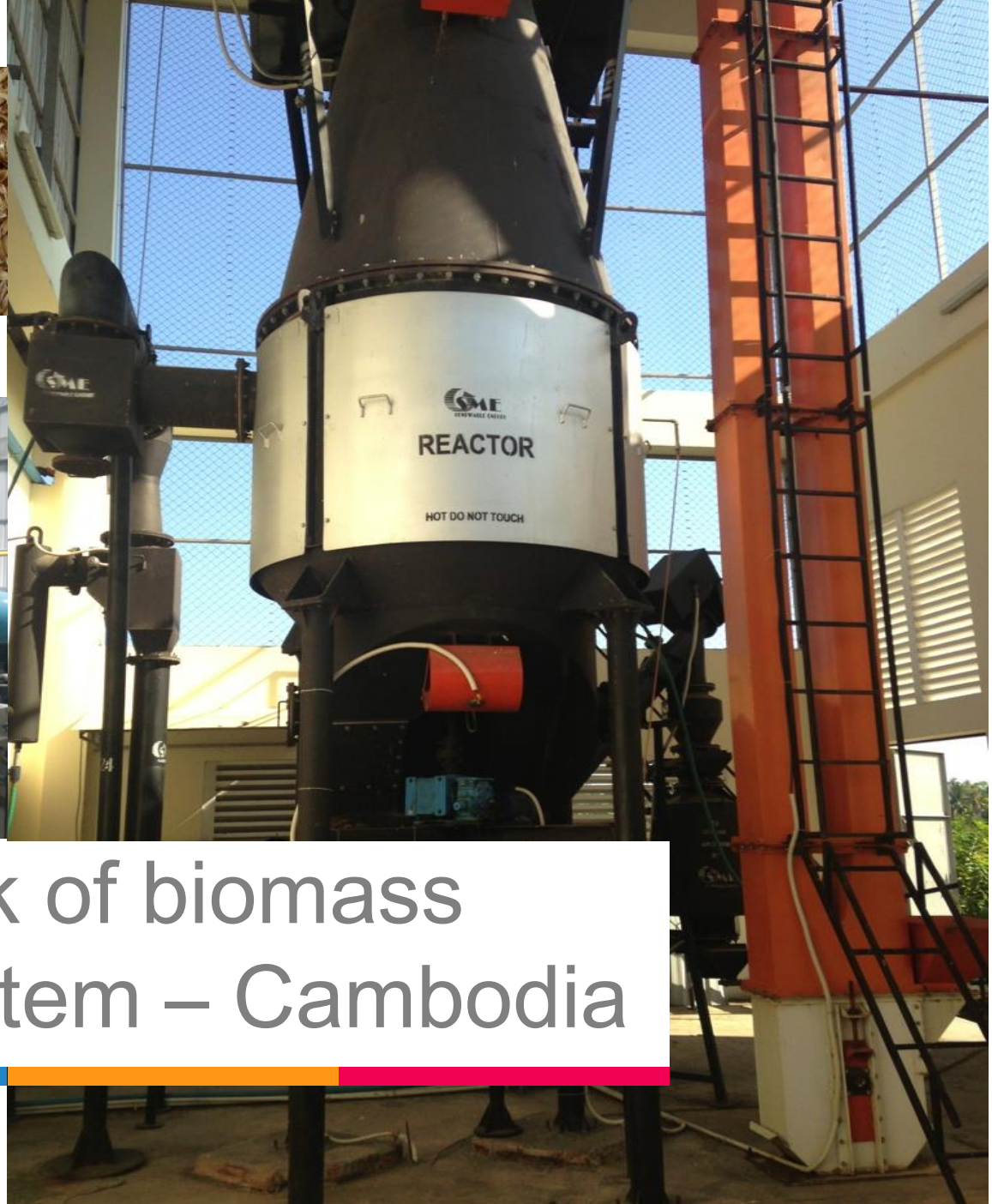


- Critical review of available cookstove technologies in Vietnam
- Adoption of new technology occurred (0.7 – 1 time/day for new device)

Nguyen Hong Nam & SNV Netherlands, Market Acceleration of Advanced Clean Cook Stoves in the Greater Mekong Sub-Region, End User Adoption Study, Project report 2016.

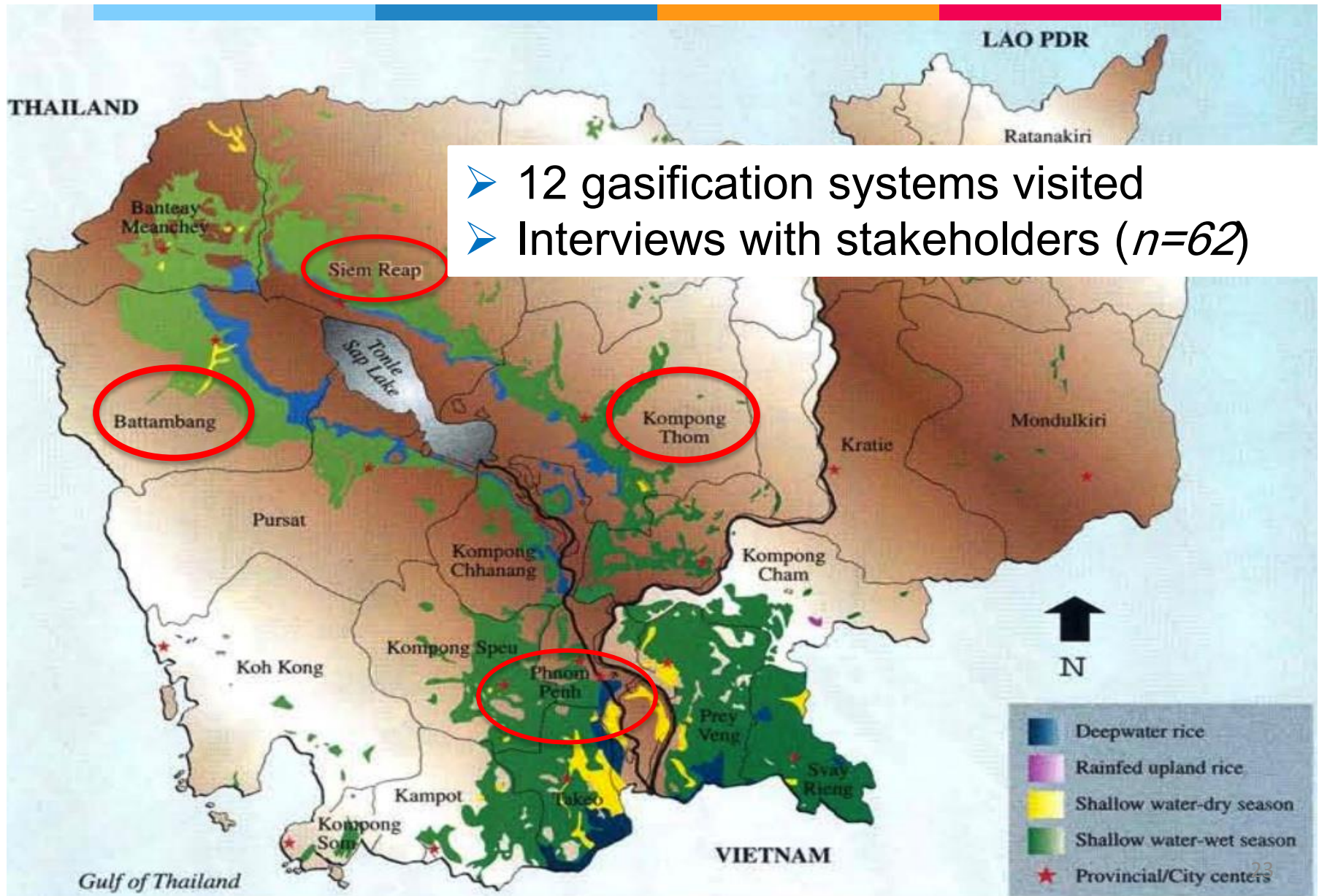
Biomass gasification systems





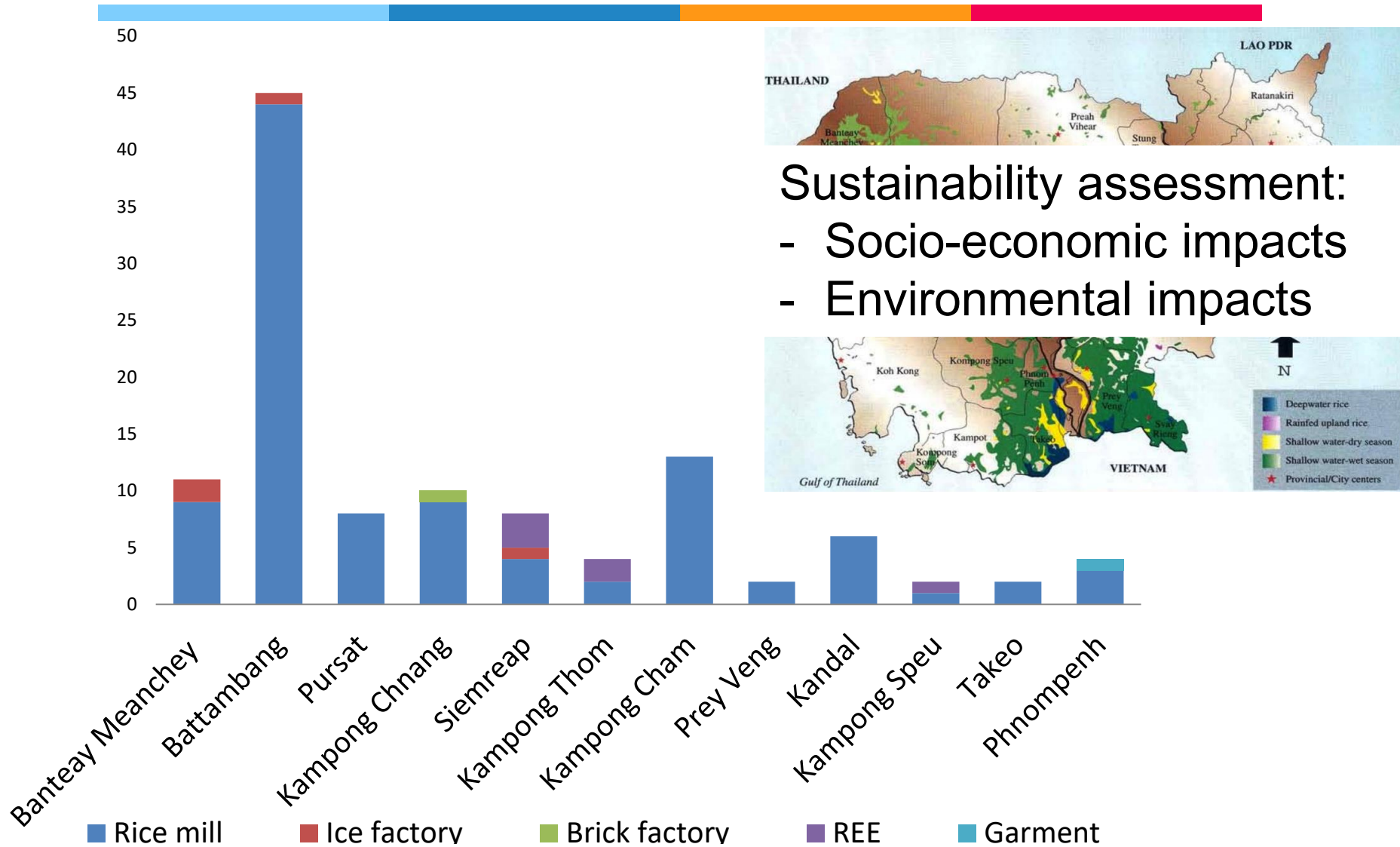
Critical look of biomass gasification system – Cambodia

Biomass gasification in Cambodia



- 12 gasification systems visited
- Interviews with stakeholders ($n=62$)

Biomass gasification in Cambodia



Number of power gasification systems by province in 2014

Socio-economic impacts

- Job creation:

2 full-time jobs for a 150kW_e system

- Diesel substitution:



Dual engine
60-80%



Gas engine
100%

- Technology transfers:



Imported products
(Ankur manufacturer)
Workshops, trainings
provided by SME
company



Local products
No workshops,
no trainings

- New rice husk market creation:

Rice husk: (>50% sold out)

Environmental impacts

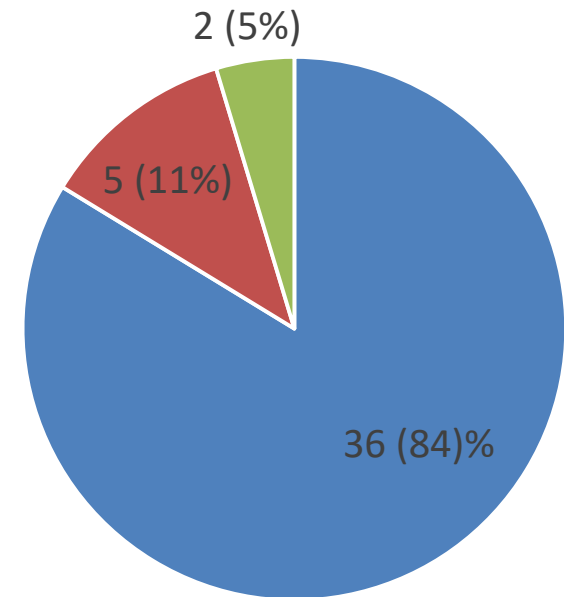


Yam Chan rice mill Deum Pou village



Deum Pou village

Number of gasifiers stopped until 2014



- Management of waste issues
- No milling
- Upgrade system

Gasification system in Cambodia



- Current technology works, but **not sustainable**
- Technological improvement needed

Biomass gasification research



- Fundamental research to study the behaviours of rice residues during gasification, gasification of rice husk and rice straw pellets, etc.

¹ Hong Nam Nguyen, Minh Ha Duong, Laurent Van de Steene, “A critical look at rice husk gasification in Cambodia: Technology and Sustainability”, *Journal of Science and Technology* 53 (3A), 2015

² Hong Nam Nguyen, Laurent Van de Steene, Minh Ha Duong, “Rice husk gasification technology: From industry to laboratory”, *IOP Conf. Series: Earth and Environmental Science* 159 (2018) 012033, DOI:10.1088/1755-1315/159/1/012033,

³ Hong Nam Nguyen, Laurent Van de Steene, “Kinetics of rice husk char gasification in an H₂O or a CO₂ atmosphere”, *Energy Sources, Part A: Recovery, Utilization, and Environmental Effects*, DOI:10.1080/15567036.2018.1486900

Biomass gasification research

- Applied research: setup a pilot system of pelletizer + gasifier for electricity production



Conclusion and perspective



- Rice residues in Vietnam: great potential, but being wasted by burning
- Possible technological solutions: clean cook stoves, biomass gasification systems
- Possible research collaborations:
 - Clean cook stoves
 - Gasification technologies
 - Assessment of clean >< traditional technologies (sustainability, pollutant emissions, people's health, etc.)



Thank you for your attention!