

Current Status and Trend of BioCNG Technology in Thailand: Opportunities for Thai-Danish Collaboration within the Waste-to-Energy Sector

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Biogas business landscape in Thailand



Thailand has made significant advancements in “the low hanging” waste feedstocks such as agricultural residues rice husk and bagasse, and organic wastewater from cassava and palm industries. The country has a large fleet of 1st and 2nd generation bioenergy plants totaling over 2,000MW including 1,700 biogas plants.

The majority of biogas plants are small scale. **Many plants waste biogas by flaring the excess without any benefit. It is estimated that up to 20% gas is flared on average, representing around 100 MW.** The total potential for retrofits and upgrade of the large-size biogas segment is about 30-40 projects with the possible upgrade/retrofit investment potential up to USD100mn.

The ongoing *Energy for All* scheme is changing the market landscape. The first round of bidding included 75MW of new grid-connected biogas capacity, i.e., 25 projects with over USD200mn investments.

In the municipal solid waste to energy (MSW2E) segment, an estimated 10 MSWRDF plants operate without an anaerobic digestion (AD) component, still sending the organic fractions back to open dumps. The biogas retrofit opportunity is over USD100mn in MSW2E segment.

Four biogas segments in different maturity investment cycles

The private sector is driving four biogas market segments i] **Energy for All greenfields**, ii] **MSWRDF AD retrofits**, iii] **BioCNG retrofits** and iv] **other bioproducts from biogas**. The Investment barriers, impact, capacity and opportunities differs between these segments

Alternative Energy Development Plan (AEDP2015)

Thailand has considered bio-compressed natural gas (BioCNG), as one option for alternative transport fuel in AEDP 2015 and has set a production target of 4 800 tons per day by 2036. However, only 5 BioCNG pilot project has been constructed and biogas developers are not advancing new investments.

ITMOs and Green Gas Certification

Thailand’s biogas projects are currently not generating carbon credits,. Another market-making instrument to be considered is Green Gas Certificates.

Biogas offers positive impacts to Thailand’s NDCs and relevant SDGs

Reduced CO2 emission and air pollution

Sustainable waste management and greener production

Public finance leveraged and private sector capital unlocked

Advanced green jobs created, and rural value chains valorized

PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

Intended Nationally Determined Contributions

7 AFFORDABLE AND CLEAN ENERGY

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

11 SUSTAINABLE CITIES AND COMMUNITIES

13 CLIMATE ACTION

Thailand BioCNG Program

The BioCNG program is supported by the government of Denmark towards addressing the clean energy transition, and to integrate concerns for innovation, gender, livelihoods and jobs. The funding is supporting GGGI’s mission and strategic objectives of transformation of countries to low-carbon and resilient economic models.

The Danish industry is highly specialized in BioCNG production and is continuing to improve its performance playing a significant role in Denmark’s future energy system. Danish industries will also have an opportunity to collaborate with target country’s industry counterparts for the purpose of exchange of information and technology transfer through this program.

Financial feasibility in key business cases



MSW2E



Energy For All
(Bioenergy)



BioCNG



**Other
bioproducts**

bankable sub-sectors

with enabling policy environment and strong bankability (IRR of over 10%)

non-bankable sub-sectors

Further analysis required and possible policy support assessments to strengthen its bankability

MSW2E and Bioenergy under Energy for All are proven waste-to-energy business cases, with mature of technologies and enabling policy environments..

The immediate biogas investment pipeline is about 35 large size grid-connected projects, totaling about USD300-400mn.

GGGI analyzed on the currently flared excess biogas for BioCNG retrofit (financially most optimal case).

BioCNG and other bioproducts business cases are generally non-bankable either because of low financial feasibility, high technology risk or unsure offtake arrangements.

BioCNG upstream/downstream tech solutions



Sub-segment	MSWTE	Energy-for-All (bioenergy)	BioCNG	Bioproducts
Tech solutions	Dry anaerobic digestion	Dry and semi-dry anaerobic digestion	Membrane for typical retrofit size.	No official pilots on biomethanol or hydrogen

Feedstocks

Wastewater cassava factory

Wastewater from palm factory

Bagasse

Rice straw

MSW

Napier

Biogas Reactors – energy generation

Many types of biogas system including in-ground “covered lagoon” and “tank based” systems. Generally, the market coverages of best international quality biogas solutions in relatively high.

❖ **Wet AD covered lagoon systems** are generally the best technical and **most proven economic solution in Thailand.**

❖ Currently, **no dry AD solution is clearly proven in Thailand.** The 1st round auction of Energy-for-All program will award 25 new large-scale plant that are expected to be dry AD or semi-dry AD reactors.

BioCNG

The common water wash/scrubbing, amine, PSA, membrane and cryogenic solution have been assessed by several project developers and think tanks.

Large scale retrofit segment majority of project fit to **membrane solution.** The larger projects (from 36,000m3) would be most economically suitable according to leading Thai research institute. And three demonstrations plants have been operational soon 24 months and run smoothly.

Other Bioproducts

Downstream solutions to convert biogas to biomethanol or biohydrogen have not yet been demonstrated in Thailand.

“proven”

Thailand BioCNG tech solutions

Feedstocks:	organic wastewater from cassava factory
Biogas Reactor	Wet AD covered lagoon systems
BioCNG Retrofit technology	Membrane

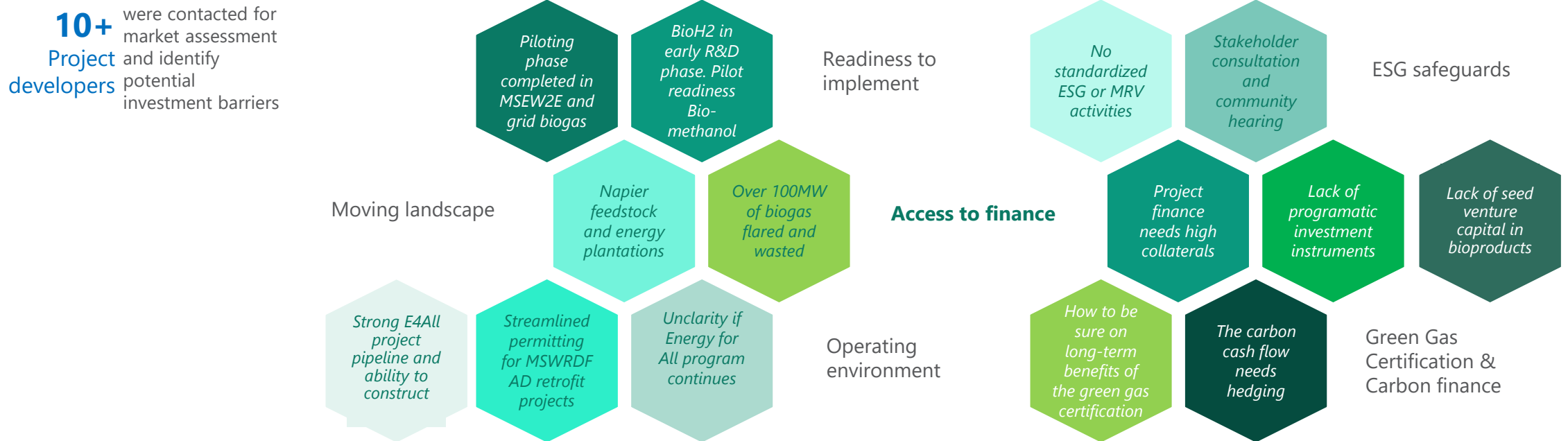


Vertical diagnostics in biogas technologies in Thailand in 2021

Messages from Thai biogas project developers



In Q1/2021, GGGI conducted teleconference consultation with the management team of three largest Thailand based biogas EPCs and project developers, leading bioeconomy research institution, Thailand Biogas association and several bioeconomy project developers that participated the first Energy For All auction in biogas segment. The following diagram illustrates the key messages:



Key notes

In 2021-2, the key investment area is in Energy for All. MSW2E needs catalytic first-in-line project. The immediate investment interest in BioCNG is limited given the lack of bankable offtake.



GGGI recommends analysis in AD retrofitting of the existing MSWRDF plants. The environmental impact is large and scaling-up opportunity is attractive. Thailand has over 10 MSWRDF plants without AD component in the organic material treatment.

Denmark-Thailand co-operation opportunities



Potential areas for Thai-Danish collaboration

G2G

- ❖ Collaborate under a specific **advanced bioeconomy sandbox** (ERC framework)
- ❖ **ITMO partnership** to support scaling up biogas in MSW2E and Energy for All sub-sectors.
- ❖ Tech transfer/incubation tech transfer and **piloting focused equity strategy**
- ❖ **Green Gas Certification** development partnership

Private Sector

- ❖ Tech partner in **Energy for All biogas component in dry AD**
- ❖ Technology partner and investor in **bioCNG, biomethanol or biohydrogen retrofit opportunities** in the existing biogas plants
- ❖ Co-investor/tech partnership in **first MSWRDF AD retrofit project**
- ❖ **Biomethanol offtake partnership** in shipping industry (Maersk)

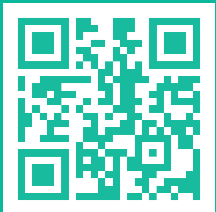
R&D

- ❖ **Sandbox R&D partnership** in advanced bioproducts
- ❖ **Protein extraction from Napier grass** tech transfer
- ❖ **Compost/fertilizer products** from Napier solutions
- ❖ **Rice straw to bioproducts value chain valorization**

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