Sweetening the Deal for Biomass Energy in Viet Nam’s Sugar Industry

Insight Brief 01/Viet Nam/November 2018
The GGGI writing team included Adam Ward, Hanh Le, Thinh Tran, and Nguyet Pham. The team would like to recognize the valuable comments and inputs from Ingmar Stelter (GIZ), Vu Quang Dang (GIZ), Do Duc Tuong (USAID), and Tero Raassina (GGGI). Hang Nguyen (GGGI) has contributed to the design of this report.

This insight brief builds on the results of the pre-feasibility studies (pre-FS) conducted in 2017 by GGGI and GIZ for five sugar mills. GGGI, GIZ, and the project team would like to express their gratitude to the Viet Nam Sugar and Sugarcane Association (VSSA) for their assistance and collaboration in gathering the required data, JSC Power Engineering Consulting 4 (PECC4), Energy Conservation Research and Development Centre (ENERTEAM), and Institute of Energy Science (IES) for having successfully completed the five pre-FS.
# Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEDP</td>
<td>Alternative Energy Development Plan</td>
</tr>
<tr>
<td>CHP</td>
<td>Combined Heat and Power</td>
</tr>
<tr>
<td>DPPA</td>
<td>Direct Power Purchase Agreement</td>
</tr>
<tr>
<td>FIT</td>
<td>Feed in Tariff</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GGGI</td>
<td>Global Green Growth Institute</td>
</tr>
<tr>
<td>GHG</td>
<td>Greenhouse Gas</td>
</tr>
<tr>
<td>GIZ</td>
<td>Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH</td>
</tr>
<tr>
<td>GoV</td>
<td>Government of Viet Nam</td>
</tr>
<tr>
<td>GW</td>
<td>Gigawatt</td>
</tr>
<tr>
<td>IRENA</td>
<td>International Renewable Energy Agency</td>
</tr>
<tr>
<td>LDC</td>
<td>Least developed country</td>
</tr>
<tr>
<td>MOIT</td>
<td>Ministry of Industry and Trade</td>
</tr>
<tr>
<td>MW</td>
<td>Megawatt</td>
</tr>
<tr>
<td>MWh</td>
<td>Megawatt hours</td>
</tr>
<tr>
<td>NDC</td>
<td>Nationally Determined Contribution</td>
</tr>
<tr>
<td>NPV</td>
<td>Net Present Value</td>
</tr>
<tr>
<td>PDP7</td>
<td>Revised Power Development Plan VII</td>
</tr>
<tr>
<td>PPA</td>
<td>Power Purchase Agreement</td>
</tr>
<tr>
<td>Pre-FS</td>
<td>Pre-feasibility studies</td>
</tr>
<tr>
<td>RE</td>
<td>Renewable Energy</td>
</tr>
<tr>
<td>SGDs</td>
<td>Sustainable Development Goals</td>
</tr>
<tr>
<td>SPV</td>
<td>Special Purpose Vehicle</td>
</tr>
<tr>
<td>VSSA</td>
<td>Viet Nam Sugar and Sugarcane Association</td>
</tr>
</tbody>
</table>
SWEETENING THE DEAL FOR BIOMASS ENERGY IN VIET NAM’S SUGAR INDUSTRY

OVERVIEW OF VIET NAM’S SUGAR INDUSTRY

- US$ 1.08 billion
- 41 Sugar Mills
- 0.53% GDP

KEY CHALLENGES FOR BIOMASS ENERGY

- Low FIT (U.S 5.8 cents)
- Unbankable PPA
- Lack of finance

Potential Capacity: 737 MW

Current Capacity: 352 MW

RECOMMENDATIONS TO REACH POTENTIAL

1. Increase FIT
2. Revise PPA
3. Multi-fuel Solutions
4. SPV Financing

- Dispute resolution
- Extension Rights
- Grid connections
- Termination rights

BENEFITS OF INCREASED BIOMASS ENERGY

- 2.7 MtCO₂
- 2,180 Green Jobs
- 4,300 GWh

CO₂ Emissions Reduction pa

Equiv. to consumption of 630,000 households pa

Published by Global Green Growth Institute and GIZ
I. Introduction

Viet Nam's impressive economic transformation over the past two decades has gone hand in hand with a rapid increase in demand for energy. The strategies of the Government of Viet Nam (GoV) are to ensure that future economic growth is more sustainable. As such, whilst modest, the Revised Power Development Plan 7 (PDP7) has set targets for renewable energy development including solar, wind and biomass energy. Biomass energy is set to take up 2.1% of total electricity production by 2030.

This insight brief analyses the potential contribution of biomass energy to the development of the power sector in Viet Nam, with a focus on the sugar industry. The electricity generation in this industry requires either single fuel (bagasse only) or multi-fuel (bagasse and other types of biomass such as wood chips and rice husks, among others). The brief examines the challenges and opportunities in scaling up the development of bagasse energy projects in Viet Nam through the pre-feasibility studies (pre-FS) that GGGI and GIZ have jointly developed together with five sugar mills in Viet Nam. Based on this analysis, the brief presents key considerations in enhancing the bankability of biomass energy projects.

As the core analysis of this brief is conducted based on these five pre-FS together with data collected from the Viet Nam Sugar and Sugarcane Association and the Business Directory of Sugar Industry in Viet Nam, the findings are limited to the assumptions of the pre-FS which are detailed in the Annex and rely heavily on the accuracy of the available data.

This brief is intended for policy-makers, sugar mills, project developers, financial institutions, relevant associations (sugar, clean energy etc.), national and international organizations which are interested in the development of Viet Nam's renewable energy sector and the public at large.

This brief as well as the five pre-FS which the analysis is based on are jointly prepared and funded by GGGI and GIZ. This cooperation falls under the framework of a Memorandum of Understanding signed in 2011 in which GIZ and GGGI committed to establish an active cooperation in combating global climate change and promoting green growth and sustainable development in developing countries. In Viet Nam, the collaboration between the two institutions kicked off in 2016 aiming to assist the GoV to reach its biomass energy targets by accelerating the development of provincial biomass energy planning and enhancing bankability of biomass energy projects, with a focus on the sugar industry.

---

1. Decision 428/QD-TTg dated 18 March 2016
II. Viet Nam’s Rising Demand for Energy

1. FAST ECONOMIC GROWTH COUPLED WITH INCREASED ENERGY DEMAND

Viet Nam’s economic growth and development has been remarkable since the Doi Moi economic reforms in 1986, transforming Viet Nam from a low-income country (LIC) to the current lower-middle income status. Over the last two decades, GDP per capita has increased seven-fold with sustained GDP annual growth rates\(^2\) of between 5-7%. Coupled with this impressive economic growth is a rapidly increasing demand for energy (Figure 1). For electricity demand, the PDP7 projects installed capacity of electricity generation will need to triple in 2030 compared to 2015, which will require significant investments and diversification of power sources.

Figure 1: Vietnam’s rapid growth rate and rising energy demand

\(^2\) World Bank, World Development Indicators, Vietnam

(\(^*:\) projected) (GIZ – Highlights of PDP7 Revised and World Bank Open Data)
2. THE ROLE OF RENEWABLE ENERGY

To meet this rising energy demand, as shown in Figure 2: Viet Nam's electricity production is increasingly dependent on coal which is projected to contribute more than half of total electricity production in 2030. This heavy dependence on coal presents new challenges for Viet Nam, including threats to energy security for becoming a net importer of coal for power generation, increasing GHG emissions and deteriorating air quality.

Recognizing these challenges as well as the abundance of renewable energy sources such as solar, wind and biomass, the GoV has set targets for renewable energy to be integrated into the power mix. According to the PDP7, the installed capacity of renewable energy is planned to reach 12GW by 2025 and increase to 27GW by 2030, representing 21% of total planned installed capacity. At this targeted installed capacity, renewable energy is planned to reach 11% of total electricity production by 2030 including relatively equal contributions by biomass and wind at 2.1% each and solar at 3.3%.

Figure 2: Power Mix and RE Integration 2030 (Revised PDP7)

3. TAPPING VIET NAM'S BIOMASS ENERGY POTENTIAL

Given the strong presence of the agriculture sector in Viet Nam, biomass energy can come from multiple sources of feedstock, ranging from sugar bagasse, wood chip to rice husks and stalks. Utilisation of Viet Nam's huge biomass energy potential will help not only reduce the dependency of Viet Nam on conventional energy sources, reduce carbon emissions and environmental pollution but also bring economic benefits to farmers who participate in the bioenergy value chain. Meeting the national target of biomass energy will also contribute to the achievement of Viet Nam's Nationally Determined Contribution (NDC) which prioritises mitigation actions in the energy sector that represent more than half of the nation's annual GHG emissions.3 The development of biomass energy projects will also create green jobs and increase industrial efficiency, especially in the sugar industry which currently suffers from obsolete inefficient technologies and, as a result, is increasingly uncompetitive in the region. Further, given that biomass energy is not a fluctuating renewable energy source like solar and wind energy, it can contribute positively to the supply of stable baseload energy.

III. Policy Framework for Developing Viet Nam’s Biomass Energy

The GoV recognizes the role of renewable energy in the power sector in many of its policies, reflected in the various legal and policy documents, from laws to master plans and policy decisions. Below is a summary of government policies that show support for renewable energy and, specifically, biomass energy.

Table 1: Summary of Viet Nam’s key policies supporting RE and Biomass Energy

<table>
<thead>
<tr>
<th>Policy</th>
<th>Issue No/Date</th>
<th>Relevant Content for RE and Biomass Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity Law</td>
<td>In effect from 2005 with amendments in 2012 (24/2012/QH13)</td>
<td>Article 4. - To step up the development and use of new and renewable energy sources for electricity generation. Article 13. - Investments in new and renewable energy sources are entitled to investment preferences, electricity and tax rates. Article 60. - Encouraging organizations and individuals to invest in the construction of electricity grids or power-generating stations using local energy, new energy and renewable energy to supply electricity to rural, mountainous and island areas.</td>
</tr>
<tr>
<td>Strategy on Development of Viet Nam Electricity Industry 2004-2010, With Orientations Towards 2020</td>
<td>Prime Minister’s Decision (176/2004/QD-TTg)</td>
<td>Development of new and renewable energy plants. To make use of new on-spot energy sources to generate electricity for areas where the national grid cannot supply or supply inefficiently, especially to offshore islands.</td>
</tr>
<tr>
<td>Viet Nam’s INDC</td>
<td>2016</td>
<td>Section 2.5.4 Promote effective exploitation and increase the proportion of new and renewable energy sources in energy production and consumption</td>
</tr>
<tr>
<td>Revised Power Development Plan 7</td>
<td>Decision 428/QĐ-TTg dated 18/3/2016</td>
<td>Renewable energy targets by 2030: - Installed capacity: 27,000 MW - Biomass energy: 2.1% of electricity production</td>
</tr>
<tr>
<td>National Strategy for Renewable Energy Development in Viet Nam until 2030 with a vision to 2050</td>
<td>Decision 2068/QD-TTg dated 25/11/2015</td>
<td>Setting ambitious targets of biomass energy production at 6.3% in 2030 and 8.10% in 2050 - Outlines measures for implementation such as conducting renewable energy planning at the national and provincial level, strengthening the role of the government in regulating RE, and conducting research on RE.</td>
</tr>
<tr>
<td>Regulation - supporting the development of biomass energy</td>
<td>Prime Minister’s Decision (24/2014/QD-TTg)</td>
<td>Setting prices for biomass energy: - FIT for electricity produced using Combined Heat Power (CHP) technology at 5.8 (U.S. cents)/kWh - Avoided cost tariff (based on imported coal prices) for other biomass energy technologies (other than CHP). The current avoided cost tariffs are set in Decision 942 by MOIT (2016) at: o US 7.5c/kWh in the northern region o US 7.3c/kWh in the central region o US 7.4c/kWh in the southern region</td>
</tr>
<tr>
<td>Regulation – PPA template for biomass energy projects</td>
<td>Decision 44/2015/TT-BCT dated 09/12/2015</td>
<td>Decision on a template for a Standard Power Purchase Agreement (PPA) for biomass energy projects</td>
</tr>
</tbody>
</table>

Overall, these policies are important initial efforts by the government to unlock the potential of renewable energy, including biomass. However, the development and implementation of biomass energy projects has been slow and limited. The technologies currently deployed in the sugar industry are mostly inefficient, presenting low-hanging fruit opportunities to capture the potential of biomass energy production should the policy incentives be set correctly.
IV. Capturing Viet Nam’s biomass energy potential in the sugar industry

Currently, there are 38 sugar mills in Viet Nam that are using biomass for electricity and heat production with a total capacity of around 352 MW\(^4\). Among them, only eight plants are grid-connected with a total capacity of 82.51 MW (22.4\%)\(^5\), selling 15\% of electricity produced from biomass to the grid at US 5.8 cents/kWh.

1. UPSCALING BIOMASS ENERGY PRODUCTION IN THE SUGAR INDUSTRY

As part of the cooperation framework on biomass energy, in 2017, GGGI and GIZ jointly conducted pre-feasibility studies (pre-FS) of biomass energy projects with local sugar mills with the aim to support the acceleration of investments in biomass energy in Viet Nam. Working together with the Viet Nam Sugar and Sugarcane Association (VSSA), GGGI and GIZ received interest from domestic sugar mills and selected five for pre-FS development, reflecting a variety of sizes and locations of the mills to provide results that can be representative (to the extent possible) for other mills in the sector (see Figure 3).

Figure 3: Locations of five selected sugar mills for biomass energy pre-FS

- Lam Son Sugar Mill
  Located in Thanh Hoa province
  Crushing capacity: 7,000 TCD/day

- Nghe An Sugar Mill
  Located in Nghe An province
  Crushing capacity: 8,500 TCD/day

- DakLak Sugar Mill
  Located in Daknong province
  Crushing capacity: 2,500 TCD/day

- Phung Hiep Sugar Mill
  Located in Hau Giang province
  Crushing capacity: 3,000 TCD/day

- Vi Thanh Sugar Mill
  Located in Hau Giang province
  Crushing capacity: 3,500 TCD/day

4. Viet Nam Sugarcane and Sugar Association statistics
The economic analyses from these five pre-FS examine the required feed in tariff (FiT) levels that would turn the projects economically viable under two scenarios namely i) single fuel (bagasse) and ii) multifuel (bagasse and other available feedstocks). The preliminary financial analyses were then conducted to the remaining 33 sugar mills to assess the potential of biomass energy in the sugar industry at varying FiT levels. The financial analyses are based on the methodology established and applied in the pre-FS (please see the Annex for more information regarding the extrapolation method).

Based on this analysis, the sugar industry can potentially capture nearly 737 MW of biomass energy capacity under the multi-fuel scenario (Figure 4) and produce almost 4,300 GWh annually, which amounts to almost 2.7 MtCO2e in emissions reduction. This potential capacity would nearly double the current installed capacity in the sector. Under the single fuel scenario, the industry potential can reach as high as 564 MW and produce up to 1,600 GWh per annum, equivalent to 1 MtCO2 in emissions reduction.

Figure 4: Potential Biomass Energy of Vietnam's Sugar Industry

2. RAISING FIT TO US 9.35 CENTS/KWH

As evident from Figure 4, the current FiT at US 5.8 cents/kWh is insufficient to capture the potential 737 MW biomass energy capacity in the sugar mill industry. At this rate, no further capacity is estimated to be economically viable to be added to the existing 352 MW of installed capacity, under both scenarios of single and multi-fuel. At US 7.4 cents/kWh which is currently regulated for non-CHP biomass technologies, our analysis shows an increase of capacity to 512 MW under the multi-fuel scenario whilst Net Present Values (NPVs) are still negative under the single-fuel scenario. To capture the potential fully at 737 MW, the FiT is recommended to be at US 9.35 cents/kWh and using multi-fuel instead of single fuel.

Compared with the neighboring countries in the region, the FiT levels for biomass energy in Viet Nam are considerably lower, less than half of Thailand (US 13 cents) and the Philippines (US 12.4 cents) (Figure 5).
As such, compared to other countries in Southeast Asia, Viet Nam’s current installed capacity for biomass energy is very low at only 352 MW, with Thailand at 3.3 GW and Indonesia at 1.7 GW. Thailand has been leading Southeast Asia in biomass energy due to its abundant resources, available grid connection and favorable policies. In 2014, biomass and biogas contributed 58% of renewable energy generation in Thailand and this is predicted to increase to 62.5% in 2025. The Thai Alternative Energy Development Plan (AEDP) in 2015 identified solar and biomass power as the largest renewable energy source for electricity and heat generation. To encourage investment, Thailand has set the FiT for biomass energy as high as US 13 cents, driving private investments into the sector.

6. IRENA data – http://www.irena.org/bioenergy
8. Ibid
Compared with the FiT of other renewable energy generation in Viet Nam, the difference is equally striking. As seen in Figure 6, the FiT set for solar energy is currently at US 9.35 cents\(^9\), FiT for wind energy has been increased to US 8.5 cents for on-shore and US 9.5 cents for off-shore\(^10\), and FiT for waste to energy is US 10.5 cents\(^11\). This shows an unfair treatment between different types of renewable energy, resulting in unequal opportunities for independent developers as well as investors in biomass energy. Moreover, as with other types of renewable energy, biomass energy brings in not only economic but also social benefits especially in the agriculture sector. Thus, addressing this current disparity in the FiT will bring more private investments into biomass energy and scale up the sector.

3. REVISING PPA TO INCREASE BANKABILITY

As is the case with other renewable energy projects in Viet Nam, the current PPA for biomass energy is considered by many investors, banks and developers as non-bankable. Several key issues related to the PPA include\(^12\):

- Sole off-taker: EVN is the only buyer of electricity which would impact the PPA bankability given EVN’s low creditworthiness. EVN’s creditworthiness is a key issue for many international financiers because of the associated risks. Though domestic financiers have a higher risk tolerance for EVN’s rating, it still results in higher financing cost.
- Dispute resolution: lack of provision for international arbitration on a neutral forum
- Term: 20 years without extension rights
- Grid connection: electricity sellers to bear the risks and costs of connecting the power plants to the grid.
- Termination rights: lacks details and specific terms on termination rights

---

\(^9\) Decision 11/2017/ QD-TTG dated 11 April 2017 issued by the Prime Minister on Supporting Mechanism for Developing Solar Power Project

\(^10\) Decision 39/2018/QĐ-TTg dated 10 September 2018 by the Prime Minister on Provision of Assistance in Development of Wind Power Projects in Vietnam

\(^11\) Decision 31/2014/QĐ-TTg dated 5 May 2014 issued by the Prime Minister on Supporting Mechanism for Development Of Power Generation Projects Using Solid Waste In Vietnam

\(^12\) Decision 44/2015/TT-BCT issued by Ministry of Industry and Trade on 9 December 2015
4. USING MULTI-FUEL SOLUTIONS TO INCREASE FINANCIAL VIABILITY.

The success of a biomass energy project is highly dependent on the availability of biomass supply and location of the plants. Most sugar mills use bagasse as their primary input for electricity production. However, bagasse supply is subject to seasonal variations which would result in a lack of feedstock supply during the non-crushing season. The pre-FS analyses show that the financial viability of the project would improve should there be other sources of feedstock to complement the bagasse during low season. To do so, it will be important for strengthened cooperation between VSSA and other associations such as Viet Nam Timber and Forest Product Association to enhance the use of multi-feedstocks.

Another important factor is the distance between the source of the biomass feedstocks and the plant site which determines the transport cost and the risk of delay or loss of feedstocks. This factor has proven to have an impact on the cost benefit ratio of the project. Whilst storage facilities can be used to address part of this risk, it creates an additional cost to the project's finance. On the other hand, the distance from the plant site to the grid connection point is another important factor, especially if the plant is to sell excess electricity back to the grid.

5. EXPLORING INNOVATIVE FINANCING STRUCTURES SUCH AS SPECIAL-PURPOSE VEHICLE (SPV)

As is the case with other renewable energy projects, long term investment and payback periods are among the biggest barriers to financing biomass energy projects. Project’s lifetime of around 20 years and average payback period of 10 years often increase risk perception and cost of financing. SPV can be an effective financing model to address this problem. A SPV is a legal entity that is independent of the parent company or project owner (e.g. the sugar mill), often created to fulfill specific or short-term objectives and used in infrastructure financing.

In Viet Nam, SPVs are used in infrastructure projects such as roads, hospitals, and power plants by independent power producers. However, guarantees from the government and/or project sponsor are often required even if there are off-take or minimum traffic agreements.

The pre-FS analyses suggest that SPV might be a suitable model for some biomass energy projects because:

- It is potentially easier to raise capital, especially from investors that are interested primarily in power not sugar production
- SPV structure would increase the transparency of the power project
- If the business is interested in exploring other power development opportunities

On the other hand, local financial institutions are reluctant to invest in biomass energy projects due to their lack of experience and the lack of success stories in Viet Nam. Many commercial banks in Viet Nam are new to renewable energy financing, especially with the SPV model vis a vis the conventional balance sheet financing, and they often have limited experience in appraising biomass energy projects.

In 2017, GGGI and GIZ conducted training on appraising biomass energy project feasibility and technologies to eight local banks where the SPV model was also introduced for these types of projects. The training received positive feedback from the banks. To increase financing of biomass energy and renewable energy projects in general, it is important to continue enhancing capacity for local commercial banks on project financing and biomass energy and other renewable energy technologies.
V. Benefits of scaling up biomass energy in the sugar industry

Biomass energy contributes to GHG emission reduction, creates green jobs and increases access to sustainable energy. Through investments in more efficient technologies, it also contributes to the long-term competitiveness of agricultural sector, such as the sugar industry.

1. GHG EMISSIONS REDUCTION

Figure 7: Potential CO$_2$e Emissions Reduction per annum

Increasing the FiTs and moving from sing-fuel model to multi-fuel solutions would result in higher GHG emissions reduction potential. Specifically, GHG emissions reduction of the multi-fuel scenario is estimated to double that of single fuel, from 1MtCO$_2$e to 2.7 MtCO$_2$e at the FiT of US 9.35 cents/kWh. This equals to almost 7% of GHG emissions of HCM City$^{13}$ (in 2013) and represents approximately 1.8% of emissions from the energy sector$^{14}$ (in 2013). These figures represent a significant opportunity to contribute to Viet Nam’s NDC targets.

---

13. GHG Inventory of Ho Chi Minh City, Project to Support the Planning and Implementation of NAMAs in a MRV Manner, JICA
2. GREEN JOB CREATION

Figure 8: Potential Green Job Creation

Increasing biomass energy potential in the sugar industry would create more green jobs. As seen in Figure 8, it is evident that the higher FiT levels, the more green jobs would be created. At US 9.35 cents/kWh, the number of green jobs created is estimated to more than double that of the current FiT (US 5.8 cents). Further, the multi-fuel scenario would create more green jobs than the single-fuel scenario. This is due to the increase in bankable and larger projects at the higher FiT levels and using multi-fuel solutions.

3. IMPROVING THE SECURITY AND QUALITY OF ELECTRICITY SUPPLY

Figure 9: Electricity output per annum under the Multi-fuel scenario at US 9.35/kWh

Increasing biomass energy potential in the sugar industry would create more green jobs. As seen in Figure 8, it is evident that the higher FiT levels, the more green jobs would be created. At US 9.35 cents/kWh, the number of green jobs created is estimated to more than double that of the current FiT (US 5.8 cents). Further, the multi-fuel scenario would create more green jobs than the single-fuel scenario. This is due to the increase in bankable and larger projects at the higher FiT levels and using multi-fuel solutions.
Electricity production from biomass energy strengthens energy security and quality of energy supply. As shown in Figure 9, at US 9.35 cents/kWh, the electricity production from biomass is estimated to meet the average demand of nearly 630,000 households, an almost two-fold increase compared to the current FiT at US 5.8 cents/kWh (equivalent to around 345,000 households). Across these 3 FiT levels in our analysis, the potential electricity production is more than doubled in the multi-fuel scenario compared to the single fuel scenario. By adding electricity to the grid, biomass energy can enhance access to electricity during peak hours and contribute to the quality and stability of the electricity supply. It is therefore recommended to both increase the FiT and use multi-fuel technical solutions instead of single fuel to maximize the supply of clean and green electricity.

4. INCREASE THE COMPETITIVENESS OF THE SECTOR

Generating biomass power enhances the competitiveness of the sugar industry by providing additional revenue for sugar companies, increases efficiency, and reduces waste. Moreover, it provides an additional income to farmers and tax for local authorities, thus increasing the value of biomass and contributing to the development of the agriculture sector and Viet Nam's economy.
VI. Conclusion

If Viet Nam is to meet its NDC, Viet Nam’s Green Growth Strategy, and Sustainable Development Goals (SDGs), it will need to increase the share of renewable energy in the power mix. Renewable energy will also help to meet Viet Nam’s increasing energy demand as its economy continues to grow. To achieve this goal, biomass energy plays an important role, and by realizing its full potential, will create thousands of jobs, reduce emissions, increase competitiveness of the industry and result in higher energy security and quality of electricity supply. However, to capture these benefits, the key issues analyzed above need to be addressed.

Going forward, the government, the sugar industry and the financial sector are recommended to work together to enhance the bankability of biomass energy projects:

- The FiT needs to be raised to US 9.35 cents/kWh for all biomass energy technologies for the industry to reach 737MW in potential capacity.
- Improvements to the PPA to increase bankability.
- Consideration of multi-fuel options would help address the seasonal issue of using bagasse only, provided that the transportation costs do not outweigh the benefit.
- Developers are encouraged to consider new financing models such as SPV to attract more investments. Local banks need to enhance their capacity in handling RE projects and SPV financing.
ANNEX – Methodology to Assess Biomass Energy Potential for the Sugar Industry

SELECTION OF DATA INPUT

a) Pre-FS results

- In 2017, GGGI and GIZ jointly conducted five Pre-Feasibility studies for five sugar mills, out of 38 sugar mills in Viet Nam that use bagasse for heat and electricity production.
- The industry analysis in this report is conducted based on the Pre-FS results of these five biomass projects.

b) List of 38 sugar mills and VSSA’s update on sugarcane volume:

- The list of 38 sugar mills and their features are collected from Business Directory of Sugar Industry in Viet Nam, published by GGGI/GIZ in 2017.
- The available sugarcane volume is based on data provided by VSSA for the crushing season 2017/2018, with revisions based on further desk research.

MODELING METHODOLOGY:

- The methodology used in the financial analyses of these five pre-FS are applied to the financial analyses for the remaining sugar mills in the industry.
- In particular, the financial analyses were performed for 38 sugar mills based on the FITs (i.e. US$5.8 cents/kWh, US$ 7.4 cents/kWh and 9.35 cents/kWh) and under two scenarios: i) single-fuel and ii) multi-fuel. US$ 5.8 cents is the current avoided cost tariff for biomass electricity produced using CHP technology, which is the case for most sugar mill companies. When considering SPV models, it is assumed that FIT would equal to US$ 7.4 cents/kWh since this is the avoided cost tariff for biomass electricity produced using technologies other than CHP. The financial analysis also considers US$ 9.35 cents/Kwh which is the current FiT for solar energy. This is to show the potential of the industry when FiT for biomass energy is raised to the same level with FiT for other types of energy, such as solar.
- The total industry figures are based on the results of these financial analyses.

ASSUMPTIONS AND CAVEATS

- Most assumptions from the pre-FS studies are applied in performing the financial analyses for the remaining sugar mills in the industry.
- In particular, the key assumptions for the analyses include:
  - Technology options based on EPC proposals
  - Electricity output/ Designed power capacity
  - Available bagasse and total sugarcane volume
  - Number of operation days
  - Additional feedstock availability and costs depending on the sugar-mill locations (North, Central, or South regions)
  - Capex/opex