Implementation of Waste to Energy Technologies in Pacific Island Communities – Considerations of Technical, Environmental and Social Impact

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EXTENDED ABSTRACT

This paper is focused on providing an insight into the emerging translation of green and woody waste products into biomass feedstocks for energy conversion technologies within the Pacific island community. In particular, the availability of waste streams, locations and volume are discussed and matched to current and prospective energy conversion sources. These technologies are rated according to the current level of maturity, i.e. Small scale research, pilot scale, pioneer scale, full scale. In the context of scale and technology, the pacific island community and consideration of these aspects will be discussed in conjunction with social and institutional aspects.

1. Green waste availability in the Pacific

The availability of green waste throughout Pacific islands spans geographical regions from large volcanic islands like Fiji to small coral atolls like Tuvalu. This variation accompanies population sizes of 900,000 (Fiji) to 11,000 (Tuvalu). In addition, waste streams will vary in locale from municipal green waste, dispersed invasive flora and by-products from industry (e.g. sawmill waste, coconut husks). The availability of these waste streams are time dependant and can classified into continuous (e.g. green market waste), seasonal (e.g. sugar cane bagasse) and spatial and temporal (invasive flora harvesting and disaster waste). This paper will aim to identify potential waste streams for three island nations, namely Fiji, Samoa and Tuvalu. A summary of some of the green waste streams are detailed below:

Fiji: Invasive vines, sugarcane bagasse (see Figure 1), municipal market waste, sawmill waste (see Figure 1).

Samoa: Coconut husks, invasive trees, senescent coconut trees)

Tuvalu: Mixed green waste (breadfruit, pandanus, palm frond, coconut)

Figure 1. Fiji sugarcane bagasse stockpiles (left), drying older bagasse for processing (centre) and sawmill waste (right)

In addition, waste from disasters such as tropical cyclones, storms and tsunami's form part of the waste to energy feedstock equation. The paper will expand on these waste streams in terms of location, quantity and availability and describe their use in relation to future biomass energy plans.

2. Green waste to energy conversion technologies

The section of the paper will investigate the current and potential utilisation of technologies in the pacific island energy market. These technologies include:

- Current Waste to Energy systems:
  - Sugarcane bagasse – Sugar refinery cogeneration, Fiji
  - Nabou green energy biomass energy plant - Fiji
- Other potential utilised technologies
  - Gasification – Anaerobic digesters
  - Pyrolysis systems
  - Ligno-cellulosic ethanol production

To assess feasibility of the conversion technology, definition of the minimum biomass feedstock requirements, energy yield, materials handling and process cost and by-product utilisation (e.g. ash or other solids) will be made. Subsequently, the carbon balance and emission concepts will be presented, from which a green life cycle can be assessed. A concept of a green life cycle for a combustion type biomass plant is shown below:

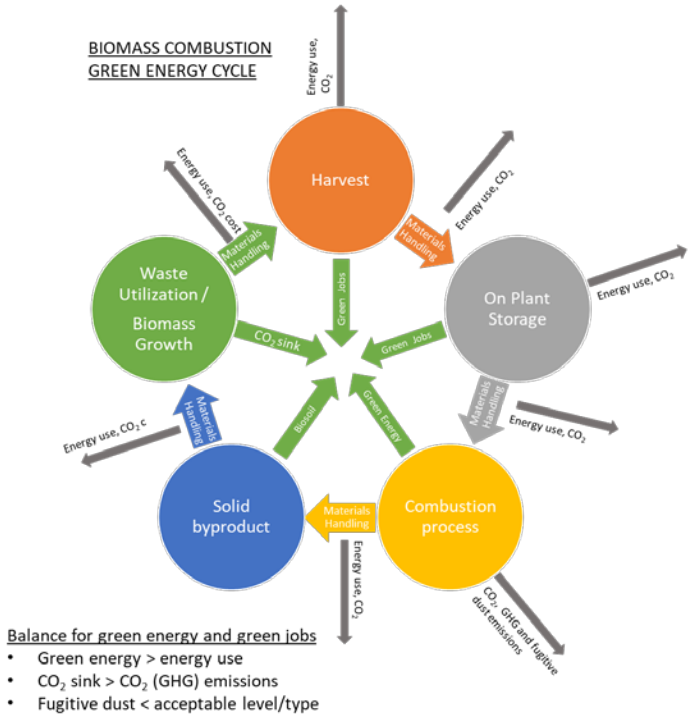

Figure 2. Green cycle for a biomass combustion energy plant

3. Scale and technology challenges and economic viability

In terms of waste volume and availability and location, there are two important aspects to consider:

- Scale of Conversion technology – output power, usability and storage capacity immediate and future requirements
- Local technical capability – Current capability within the island or location and capacity building to service the new technology.

In both cases, a co-ordinated approach is essential to ensure that the technology is fit for scale and that can be sustained throughout its service life. This paper will expand on these aspects with particular reference to the following documents:

- A Cleaner Pacific 2025 – Pacific Regional Waste and Pollution Management Strategy 2016-2025
- Tuvalu Infrastructure Strategy and Investment plan 2017.
- Samoa Energy Sector Plan 2017 – 2022
- Development of Fiji's NDC Energy Sector Implementation Roadmap 2017

4. Social aspects

Whilst the technical and economic aspects of bioenergy are fundamental to industry development across South Pacific Island countries, the social and institutional dynamics of the emergent bioenergy sector will ultimately underpin industry outcomes across diverse regions. Understanding the relationship between bioenergy systems, policy, social groups, setting, acceptance and participation is a key task for policy makers and industry proponents; a task made challenging by the volatility of social factors to context, approach, temporal factors and lived experience. In their report on new energy deployment and societal acceptance in Europe, Heiskanen et al. (2008: 8) note that 'our understanding

of the non-technical forces shaping the application of new energy technologies, particularly at the local and regional level, is still underdeveloped', thus highlighting the importance of social research to the development of bioenergy capabilities across the Pacific.

This section of the paper explores the social and institutional dynamics that will shape the development of an integrated bioenergy system across Pacific Island countries, with a particular focus on societal acceptance and procedural fairness in the evolution of the industry. The section begins with an overview of potential social benefits—including employment, supply chain integration, rural development and social enterprise opportunities—and social costs—including crop substitution, water impacts, and amenity issues (e.g. noise, traffic, visual)—before addressing the role of proximity, knowledge and engagement in facilitating integration of energy systems in diverse communities. The section also explores the critical role of distributive and procedural fairness (perceived and actual) in shaping the future success of bioenergy system development in the Pacific.

5. Case Study

To assimilate the previous concepts, a feasibility study will be presented based on waste product availability and cellulosic ethanol production. Outcomes of the study will also include threshold waste volumes required for economic viability in conjunction with technical support requirements, social consideration and governance aspects.

6. Summary

There is clear potential for green waste to form part of the biomass feedstock for new types of energy conversion systems within pacific island nations. Implementation of these technologies must be tempered with rational qualification of the ability of the region to support the new technology or provide a capacity building program, to effectively assess the environmental and social impact and the carbon footprint. These elements must overlayed with sound local, regional, national and pacific community governance. This paper will aim to identify some of the intrinsic pacific island challenges in terms of these feasibility assessment and discuss challenges of population and island size, waste volumes, engineering and technical capacity and identify appropriate waste to energy technologies. In summary, life cycle assessment of waste to energy technologies will require a unique examination when applied to pacific island communities.

References

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