Eco-charcoal from Water Hyacinth for Rural Energy Application: A Social Enterprise

Adlansyah Abd Rahman
6th September 2018
Presentation Outline

• Water Hyacinth
• Rural Fuel
• Social Enterprise
• Solutions?
• Minimum Viable Product (MVP)
• Smokeless eco-charcoal
• Impacts
• In the media
• Funding & Exposure
• Market growth potential
Water Hyacinth, *Eichhornia crassipes*

- Floating aquatic plant
- Fast growing – approximately double spatially every fortnight
- Block waterways entrance and exit – cause of local flooding
- No commercial value – removal incur cost
Rural fuel

• Firewood and charcoal in many regions
• Mainly for cooking and heating
• Source of domestic indoor air pollution → respiratory diseases
• Firewood derived from young trees propagate local deforestation
Social Enterprise

• Social Entrepreneurship - *The use of start-up companies and other entrepreneurs to develop, fund and implement solutions to social, cultural, or environmental issues*

• HiGi Energy Pte Ltd was set up to supply affordable cooking fuel while alleviating water hyacinth flooding and providing local community employment

• Not a charity to ensure longevity

• Not a ‘grantpreneur’ to ensure independent decision making

• The team:

  Jackie Yap (CEO)  
  Leon Kee (CTO)  
  Hazel Pajotagana (CFO)
Advisory Board and support

• Engineering & Business Development

Dash Dhakshinamoorthy
Pre-seed investor & he has 10 years experience in startups, exited several companies

Katka Letzing
More than 10 years experience in business & entrepreneurship

Adlansyah Abd Rahman
More than 12 years experience in biomass research & community engagement projects

Jorden Woods
Exited 3 startups & based in Silicon Valley, USA

Kres Jacobsen
Director at Northwind Power Corp, owned wind (60MW) & solar farms (2.5MW) in Philippines, familiar with solar power market

Rahul Mirchandani
CEO at Aries Agro Limited, listed on India Stock Exchange
Solutions?

- Non-energy
- Community biogas
- Gasification stoves
- Fuel replacement

![Diagram showing energy sources and conversion efficiencies, with labels like High income, Low income, Very low income, and Conversion efficiency %]

*Energy content MJ kg⁻¹, Conversion efficiency %*

- 38 MJ m⁻³, 60%
- 45.5 MJ m⁻³, 60%
- 22 MJ m⁻³, 60%

*Kurmi et al, Eur Resp J, 2012*
Minimum viable product (MVP)

- Crushed water hyacinth briquette
- Approx. 1” x 2” x 6”
- Direct replacement of firewood
Testing and Analysis of MVP

**Energy density**

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Gross Calorific Value (MJ/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water hyacinth briquette</td>
<td>18.71</td>
</tr>
<tr>
<td>Rubberwood</td>
<td>18.41</td>
</tr>
<tr>
<td>Sentang firewood</td>
<td>16.84</td>
</tr>
<tr>
<td>Sesendok firewood</td>
<td>16.95</td>
</tr>
</tbody>
</table>

**Proximate analysis**

- **Sesendok firewood**
- **Sentang firewood**
- **Rubberwood**
- **Water hyacinth briquette**

**Burning test:**

- Smoke released improved than traditional firewood
Smokeless eco-charcoal

• MVP failed to gain market traction
• Little competitive advantage at minimum selling price
• Low income market wants a smokeless fuel → charcoal
  ✓ Allow more competitive pricing
• Charcoal has larger market
  ✓ Domestic low & medium income (cooking & heating)
  ✓ Street food vendors
  ✓ Domestic high income (leisure)
  ✓ Niche restauranteurs
  ✓ Export
• Must employ clean production
Lili Process (patent pending)
Harvesting

- HiGi is contracted, responsible for water hyacinth removal (exclusive access in Taytay, Rizal, Philippines)
- Employ local residents, beneficiaries, to harvest and dry
- HiGi buys at PHP 1 per kg
Clean carbonisation

- Batched loading; sealed drum
- Three drums in tandem for semi-continuous operation
- Recirculation of volatile gases to support heating
Testing and Analysis of Lili

• Energy density of 20* MJ/kg

![Calorific Value MJ/kg graph](chart1.png)

* to be repeated

• Burning test:
  • visibly smokeless
  • can sustain for 45 mins per piece

![Proximate analysis graph](chart2.png)
Testing and Analysis of Lili

- Thermogravimetric

![Graph showing Thermogravimetric Analysis]

- Moisture: 6.65%
- Volatile: 24.21%
- Fixed carbon: 35.14%
- Ash: 14%
- Total weight loss: 86%
Impacts: direct

**Environment**
850 m³ of water hyacinth regulated daily

**Social - Blue economy**
35 beneficiaries could be lifted out of poverty earning US$ 3 / day

**Affordable and Clean Energy**
28,500 MJ of energy renewed from pest plants to serve 25 restaurants

@ 5 x more efficient energy than competitors
Impacts: indirect

Rural families of domestic application

Education and awareness

Social health and disaster

Source: SUSTAINABLE ENERGY FOR ALL GLOBAL TRACKING FRAMEWORK
In the media

Making cleaner energy from peat
Rappler - 26 Jan 2018
In 2015, they co-founded HIGi Energy. Their solution is to convert water hyac

These Are 2 Crazy Innovative Cle
Forbes - 14 Mar 2017
So he launched a startup, HIGi Energy, which markets the briquettes to wealthier con

Watch This Space: 5 Promising G
http://www.impact4all.org/press-release
HIGi Energy focuses on producing biofuel that is used to power small-scale power sta

8 promising green energy startups
Rappler - 13 Aug 2016
HIGi Energy: They convert water hyacinth to briquettes. They have also started working o

4 Renewable Energy Startups to T
Tech Co. - 1 May 2017
HIGi Energy is a Philippines-based startup that produces briquettes from water hyacinth a

www.facebook.com/higi-energy  www.higi.biz/
Funding & exposure

• Seed funder + founders

• Startup Competitions
  → Startup Malaysia
  → GIST Network Tech-I, Silicon Valley
  → ImpactHub, Philippines
  → TAYO 14, Philippines

• Angel investment
  → 1st Round: Dec 2017 (US$100k)
  → 2nd Round: Dec 2018 (US$??)

• R&D Grant
  → AAIBE Chair of Renewable Energy
  → UNITEN
Market growth potential

- Water hyacinth infestation

- Solid fuel for domestic cooking and heating

Kurmi et al
Thank You

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