Production of Refuse-Derived Fuel (RDF) as Alternative Fuel in Cement Kiln

2nd ANSWER 2019, 13-14 November 2019, Yogyakarta
In January 2019, Semen Indonesia Group represented by its subsidiary; PT Semen Indonesia Industri Bangunan (SIIB), acquired majority shares of PT Holcim Indonesia Tbk. The company then changed its name consequently to PT Solusi Bangun Indonesia Tbk on 11 February 2019.

- **53** Million tons of cement per annum
- **55%** Innovative portfolio
- **55%** Market share in Indonesia
- **37.2** Trillion of revenue
- **> 8,000** Employees
OUR VISION

To be the Biggest Building Materials and Solutions Provider in The Region

MISSION

• Customer Satisfaction oriented in every business initiatives
  • Implement best standards to secure best quality
• Focus to create environment preservation and sustainable social responsibility
  • Provide best added-values for all stakeholders
• Focus on human resources as the center of company development
Sustainability as our competitive advantages

VISION:
To be the Biggest Building Materials and Solutions Provider in the Region

PROFIT
Providing solutions (innovative products & services) to address urban problems (waste, floods, poor air quality, climate).

Generating revenue from sustainable solutions

PLANET
Demonstrating leadership in environmental stewardship and being a responsible role model for future generations.

1. CO₂ reduction
2. Utilization of renewable resources
3. Biodiversity initiative
4. Water management

PEOPLE
Creating shared value to community.

1. Keeping people safe
2. Community empowerment through partnership
3. Social license acceptance

CIRCULAR ECONOMY

SUSTAINABLE SOLUTION

CLIMATE, WATER & NATURE

CREATIVE ECONOMY
Why we need SD?

1. Address Risk: Companies may not be able to continue to create capital over the long term if natural, social, financial and manufactured capital is being eroded elsewhere.

2. Attract capital: Investors are increasingly paying attention to environmental, social and governance (ESG) risks when making investment decisions.

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” (Bruntland report, UN 1987)
Over the time, energy resources becoming more expensive and scarce. An alternative energy is a solution to maintain competitiveness and avoiding land degradation.
Sustainability and AFR

How AFR answers Sustainable Development demand

ECONOMICAL BENEFITS
Through AFR we are able to improve our industrial competitiveness by reduction of the overall manufacturing costs through two main factors:

1. Substitution of traditional fossil fuels and/or traditional raw materials
2. Additional revenues from offering waste management solutions

ENVIRONMENTAL BENEFITS
Preservation of natural resources and reduction of the global and local environmental impacts:

1. Reduction of the overall emissions as the emissions of our kilns are not affected by the AFR, but other waste management solutions have additional emissions too.
2. Reduction of the greenhouse effect as no "fresh" fossil fuel is used.
3. Reduction of the natural resources extraction in our quarries.
4. Safe and optimal waste treatment as the clinker manufacturing process ensures the right conditions for safe waste treatment.

SOCIAL BENEFITS
The social benefits as follows:

1. Effective contribution to waste management at local and regional levels.
2. Regional job creation in waste collection and pre-treatment facilities.
3. Especially in developing countries, saving of public funds otherwise needed to build additional incinerators as the infrastructure (cement kilns) is already in place or build up by private businesses.

4. Substitution of traditional fossil fuels and/or traditional raw materials
5. Additional revenues from offering waste management solutions
<table>
<thead>
<tr>
<th>Pillar</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solusi Solutions</td>
<td>3.9% atau Rp 371 Milyar pendapatan dari Solusi Berkelanjutan 3.9% atau Rp 371 Billion of revenue from Sustainable Solutions</td>
<td>9.8% atau Rp 930 Milyar pendapatan dari Solusi Berkelanjutan 9.8% atau Rp 930 Billion of revenue from Sustainable Solutions</td>
<td>8.95% atau Rp 928 Milyar pendapatan dari Solusi Berkelanjutan 8.95% atau Rp 928 Billion of revenue from Sustainable Solutions</td>
</tr>
<tr>
<td>Iklim Climate</td>
<td>655kg CO₂ per ton cemmat atau 21.2% lebih rendah dibandingkan tahun 1990 655kg CO₂ per ton cemmat or 21.2% reduction compared to 1990</td>
<td>651kg CO₂ per ton cemmat atau 21.6% lebih rendah dibandingkan tahun 1990 651kg CO₂ per ton cemmat or 21.6% reduction compared to 1990</td>
<td>630kg CO₂ per ton cemmat atau 24.2% lebih rendah dibandingkan tahun 1990 630kg CO₂ per ton cemmat or 24.2% reduction compared to 1990</td>
</tr>
<tr>
<td>SDG #9, #11, #13</td>
<td>8.1% Subtitusi Energi Panas (Thermal Substitution Rate/TSR) dari Bahan Bakar Alternatif 8.1% Thermal Substitution Rate (TSR) from Alternative Fuel</td>
<td>8.32% Subtitusi Energi Panas (Thermal Substitution Rate/TSR) dari Bahan Bakar Alternatif 8.32% Thermal Substitution Rate (TSR) from Alternative Fuel</td>
<td>8.16% Subtitusi Energi Panas (Thermal Substitution Rate/TSR) dari Bahan Bakar Alternatif 8.16% Thermal Substitution Rate (TSR) from Alternative Fuel</td>
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</table>
CO2 Emission Reduction 2016-2018

Penurunan Emisi CO2 SBI
SBI CO2 Emission Reduction

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SBI Sustainable Solution Initiatives

Nathabumi – Business Unit Providing Waste Management services using Co-processing Technology at Cement Kiln
Nathabumi – Professional Waste Management Services

- **Since 2007 as Business unit at PT SBI Tbk** – We do Waste Management for Industrial Waste and Municipalities for Hazardous and Non-Hazardous waste material

- We are processing and managing waste from Industrial and municipalities activities to be eliminate through our co-processing method in Cement Kiln as Alternative Fuel and Raw material

- The business unit has managed to provide waste management solution to more than 400 clients such as Chevron, Pertamina, Unilever and Nike.

**Our Services:**
- Hazardous Waste Management Services
- Non-Hazardous Waste Services
- Field Services
- Tailor Made Services
- Consulting Services
- Secured Destruction Services
- ODS Destruction Services
- Document Destruction Services
A Wide Range of Waste We Can Handle

Solid
- Plastics and used or contaminated packaging materials
- Oil and solvent contaminated rags
- Consumer products (Off Spec or expired)
- Rubber waste or manufacturing off cuts
- Rejected packaging materials
- Textile or garment waste
- Bottom ash and other process residues
- Waste Water Treatment Sludge or filter cake
- Foundry Sand
- Contaminated Soil

Liquid
- Solvents
- Spents oils
- Contaminated liquids

Sludge
- Oil sludge
- Paint sludge
- Petrochemical sludge

Gas
- Phased out or contaminated refrigerant gases
# Regulatory Compliance

<table>
<thead>
<tr>
<th>Entity</th>
<th>Unit/Plant</th>
<th>Scope</th>
<th>Permit</th>
<th>Deskripsi</th>
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</thead>
<tbody>
<tr>
<td>PT Solusi Bangun Indonesia Tbk</td>
<td>Narogong Plant</td>
<td>AF, AR</td>
<td>Kep Men LH Nomor 478 Tahun 2015</td>
<td>Permit to manage &amp; utilized hazardous waste materials (B3)</td>
</tr>
<tr>
<td>PT Solusi Bangun Indonesia Tbk</td>
<td>Gilacap Plant</td>
<td>AF, AR</td>
<td>Kep Men LH Nomor 896 Tahun 2016</td>
<td>Permit to manage &amp; utilized hazardous waste materials (B3)</td>
</tr>
<tr>
<td>PT Solusi Bangun Indonesia Tbk</td>
<td>Tuban Plant</td>
<td>AR</td>
<td>SK No 392/Menlhk/Setjen/PLB.3/8/2017</td>
<td>Permit to manage &amp; utilized hazardous waste materials (B3)</td>
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</table>

<table>
<thead>
<tr>
<th>Entity</th>
<th>Unit/Plant</th>
<th>Cakupan</th>
<th>Permit</th>
<th>Deskripsi</th>
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<tbody>
<tr>
<td>PT Solusi Bangun Andalas Tbk</td>
<td>Lhoknga Plant</td>
<td>AR (Flyash Bottom Ash)</td>
<td>SK No 620/Menlhk/Setjen/PLB.3/8/2016</td>
<td>Permit to manage &amp; utilized hazardous waste materials (B3)</td>
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</table>
Co-processing, The Safer & Environmentally Friendly Solution

SBI through Nathabumi, Specialized in a secure form of waste management known as Co-processing.

**Co-processing** - means the substitution of fossil fuel and primary raw material by waste derived materials in industrial processes.
Q: What happens to the waste?
A: It is subjected to ultra high temperature over long residence time, completely destroys all organic materials.

Q: What about gas emissions?
A: Chlorine and sulphur from organic material produce acid gases (HCL & SO$_2$) which are absorbed and neutralised by limestone and other alkaline materials.

Q: And everything else?
A: Inorganic constituents become part of the clinker.

Q: Can waste affect cement quality?
A: All waste inputs are carefully assessed to guarantee the compatibility of the materials with the cement process and the quality of cement.
Waste Utilization Background

Utilization of Waste Contributes to Reducing Global Warming
Minimizing Risk by Maximizing Work Safety

- Internal & External routine audits
- OHS Training for transporters and contractors
- Customer Manifest Training
- We held certification in ISO 90001, ISO 14000 and OHSAS 18001 Quality Management System.
- We identify changes to laws and regulations and periodically analyze the effectiveness of implementation.
- We ensure implementation of the AFR Directive & Policy as part of our commitment to compliance.
- We maintain good relationships with our stakeholders (the surrounding community, government, employees and contractors).
Waste Pre-treatment Facility in Narogong Plant
Waste Laboratory

- ISO 17025 accredited laboratory
- Skilled technicians specialise in waste analysis, ensuring the safe & effective management of waste streams.
Diverse Client Base and Extensive Reach

Hazardous Waste Management

On-Site Waste Management

Waste Analysis Laboratory

Secured Destruction

Waste Transportation Services

Waste Consultation Service

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Waste Co-processing Volume

<table>
<thead>
<tr>
<th>Year</th>
<th>AF</th>
<th>AR</th>
<th>Biomass</th>
<th>TOTAL</th>
</tr>
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<tbody>
<tr>
<td>2010</td>
<td>35,601</td>
<td>68,252</td>
<td>152,468</td>
<td>256,321</td>
</tr>
<tr>
<td>2011</td>
<td>41,602</td>
<td>90,752</td>
<td>77,863</td>
<td>210,217</td>
</tr>
<tr>
<td>2012</td>
<td>52,041</td>
<td>94,228</td>
<td>133,663</td>
<td>279,932</td>
</tr>
<tr>
<td>2013</td>
<td>48,771</td>
<td>64,348</td>
<td>117,102</td>
<td>230,221</td>
</tr>
<tr>
<td>2014</td>
<td>48,325</td>
<td>112,116</td>
<td>88,186</td>
<td>248,627</td>
</tr>
<tr>
<td>2015</td>
<td>65,890</td>
<td>152,149</td>
<td>66,865</td>
<td>284,904</td>
</tr>
<tr>
<td>2016</td>
<td>71,793</td>
<td>223,331</td>
<td>62,282</td>
<td>357,406</td>
</tr>
<tr>
<td>2017</td>
<td>75,387</td>
<td>284,269</td>
<td>94,498</td>
<td>454,154</td>
</tr>
<tr>
<td>2018</td>
<td>84,463</td>
<td>374,403</td>
<td>75,562</td>
<td>534,428</td>
</tr>
</tbody>
</table>
MSW to RDF Development Project
Map of potential future development of MSW business in Semen Indonesia Group

Ongoing development project:
1. Cilacap: SBI RDF Pilot Project
2. DKI Jakarta: SBI - Landfill Mining study
Technology of processing MSW into fuel
Basic principle of MSW utilization as alternative fuel

RDF or Refused Derived Fuel
Is renewable energy produced from municipal solid waste with pre-treatment process
Technology of processing MSW into fuel
Waste type that required specific treatment

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>INDONESIA (JAKARTA) (%)</th>
<th>TYPICAL EUROPE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food and Yard Waste</td>
<td>67</td>
<td>20</td>
</tr>
<tr>
<td>Paper (high CV)</td>
<td>6</td>
<td>40</td>
</tr>
<tr>
<td>Plastic (high CV)</td>
<td>17</td>
<td>6</td>
</tr>
<tr>
<td>Metal</td>
<td>0.5</td>
<td>8</td>
</tr>
<tr>
<td>Glass</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Other (textiles, stone, sand, etc.)</td>
<td>8.5</td>
<td>18</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Moisture content %

- 55-60
- 20-25

To sort high CV waste in Indonesia is not economic viable
- In each ton there is lesser high CV material in Indonesia waste type
- Government required full solution

Food waste / organic waste are the biggest composition in Indonesia
- Contribute to high moisture level content in the waste
- There is a unique condition that can be benefit in a waste management processing

Source: Clinton Foundation’s study in Jakarta

Because of the average of Indonesia waste are having high moisture content, therefore to turn it into alternative fuel required a drying process technology.
Technology of processing MSW into fuel
Bio Drying Membrane

- Biological drying using Bacteria from organic waste
- Special membrane that can evaporate water but will not penetrate water from outside
- Air flow and turning process to help bacteria stay alive during the drying process
- It takes 21 days of the drying process to produce RDF with the specifications required by the Cement plant
Technology of processing MSW into fuel
RDF specifications that can be used in the cement industry

<table>
<thead>
<tr>
<th></th>
<th>RDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCV</td>
<td>kcal/kg</td>
</tr>
<tr>
<td>H2O/moisture</td>
<td>%</td>
</tr>
<tr>
<td>Ash</td>
<td>%</td>
</tr>
<tr>
<td>Chlorine</td>
<td>%</td>
</tr>
<tr>
<td>Sulfur</td>
<td>%</td>
</tr>
</tbody>
</table>

From our commissioning at RDF Plant in Cilacap, the drying processing of fresh MSW can produced +/- 50% of RDF product that consist of:

1. Inert (0-20mm) equivalent with compost = 15%
2. RDF Product (20-50mm) = 51%
3. Reject product ( >50mm) Oversize = 34% (Re-shredded) and combined into RDF product
Case Study - Cilacap MSW to RDF Pilot Project

Cilacap

- 120 ton per day Fresh waste
- +/- 35% air will evaporate during drying process

Jeruk Legi

- 5 - 15 ton per day residu (+/- 15%)
- 40 - 60 ton per day RDF /product (+/- 50%)

Waste processing facility

- 1 - 3 ton per day Recyclable materials (>3%)

SBI Cilacap

SBI - MSW to RDF
Process Flow MSW to RDF in Jeruk Legi Cilacap

1. Weigh Bridge
2. Weighing Truk
3. Unloading
4. Sorting process
5. Sorting by waste pickers
6. Pre Treatment area
7. Shredding
8. Bay
9. Drying Process
10. AF Feeding Facility
11. Feed to Kiln
12. Kiln
13. RDF ready to be fed
14. Loading & Delivery RDF
15. Delivery RDF
16. Waste storage
17. Awaiting BAST from KLHK to Cilacap Regency

SBI - MSW to RDF
Cooperation concept between Cilacap Regency, RDF operator and SBI

Waste collection

- Govt role

- Regency government

Transporting waste to RDF plant facility

Waste processing

- RDF Operator as business unit

- Managing Risk at Kiln:
  - Emission
  - Production

- Waste processing facilities
  - Waste processing
  - Storing
  - Recyclables

- Manage Residue and Leachate Treatment

Off Taker

- Cement Plant

Transporting to cement plant

SBI - MSW to RDF
Case Study - Cooperation with DKI Jakarta for Landfill Mining

Project Background:
- DKI government are required to find solution of their volume waste that goes in Bantagebang - 7,500ton per day
- Capacity at Bantagebang are vastly reduced over many years of utilization
- The solution need to apply in the next 2-3 years

PT SBI Solution:
- **Landfill mining:** To conduct landfill mining for the old waste volume to be co-processed at cement Kiln. A study need to done to ensure waste quality that fit cement plant requirement

Project status:
- Signed 1 year MOU to conduct landfill mining study up to January 2020
- We have collected and study a sample up to 5 meter depth of the designated old waste pile
- Operational target for landfill mining Q1 2020
Development Planning with other cities

- **RDF for Lhoknga Plant:**
  - Early stage proposal development ready to be presented to Banda Aceh government

- **RDF for Tuban Plant:**
  - Conducted mapping to confirm volume data
  - Follow Up study for details follow up

- **RDF Jogjakarta:**
  - Follow up with Government for their Piyungan dump site
  - Whether or not RDF will be their preference solution

- **Development of potential RDF market:**
  - Exploring other market outside cement plant such as other thermal processing industry (Coal-Based Power Plant)
Lesson Learned and Challenges

Required extensive lead time to introduce, propose and execute project

- Mindset
- Technology selection
- Business modelling
- Tender process

Financial engineering scheme to enable all stakeholders participation and project viability (Local city government in particular):

- Tipping fee mechanism
- CAPEX and OPEX cost sharing between stakeholders
- Less aid fund available in Indonesia for waste management

Regulation support/consistency to support RDF project

- Environmental regulation discourage cement plant using AFR
- Provincial government still having issues on how to access state budget on the waste disposal fee
Three main benefits are to be expected:

**EXPECTED BUSINESS PROFIT**
- Revenue from sustainable solutions
- Reduced fuel costs
- Increased TSR
- Brand building

**EXPECTED ENVIRONMENTAL BENEFIT**
- Drastically reduce the need for landfilling
- Reduce odor & leachate
- Significant greenhouse gas reduction

**EXPECTED SOCIAL BENEFIT**
- Provision of land for active uses
- Better working environment for waste pickers
- Better living condition