National Biomass Strategy

Bioeconomy and Malaysia’s Palm Oil Industry
THE DISTANCE (CONNECTION)

18,284km
26 hours
THE OIL PALM INDUSTRY IN A GLANCE

CURRENT CHALLENGES

- Fluctuating palm oil prices
- Competitions especially from soybean
- Possible large surpluses of vegetable oil in 2020 (there were stockpiles in 2014-2016 due to excess)
- Phasing out of 1G biodiesel market in Europe and US (Renewable Diesel)
- Many plantations are old and in need of replanting, and little opportunity for new planting (capped at 6 million hectares)
- Shortage of labour on plantations – 77% are foreigners (from Indonesia)
- Association with environmental issues – struggling with certification (RSPO)
The Malaysian Opportunity

- Attractive market for high-value oleo-chemical and 2G products (products) – food derivatives, pharmaceutical and etc.
- Potential bio-based substitutes for fossil-based materials
- Limited local oil reserves for long-term – need to develop alternatives
- Creating local demand for biodiesel – blending mandates
- Well-developed infrastructure that could be shared across various bio-based downstream industries
- Availability of (highly) skilled local young workforce
- Can potentially contribute to environment if managed properly
THE THOUGHTS ON FUTURE

- 75% of chemistry and advanced materials strategy officers agree that by 2025 the primary feedstock for chemical production will shift from oil & gas to bio based and recycled materials

1. ABOUT AIM

- Governance Structure
- Innovation Ecosystem
- Transforming Strategic Sectors
Agensi Inovasi Malaysia (AIM), Malaysia’s National Innovation Agency is a statutory body, under the Prime Minister’s Department created to jump start wealth creation through knowledge, technology and innovation to stimulate and develop the innovation eco-system in Malaysia. We lay down the foundation of innovation that inspire and produce a new generation of innovative entrepreneurs.

VISION:
- Wealth creation through knowledge, technology and innovation.

MISSION:
- To stimulate and develop the innovation eco-system in Malaysia towards achieving Vision 2020.

OBJECTIVES:
- Generate additional revenue and contribute to Malaysia’s GDP.
- Provide additional jobs for the Malaysian workforce.
- Inspire and produce a new generation of innovative entrepreneurs.
- Facilitate the evolution of Malaysian companies into major global players.
AIM’S INNOVATION ECOSYSTEM

Equipping Malaysia’s next generation with ability to think critically and creatively

Making selective investments to catalyse new ventures and startups (future leaders in innovation)

Catalysing the social sector eco-system to enable strategic public-private collaboration & citizen empowerment

Providing support to mid-size and large organisations on innovation

Catalysing greater collaboration activities between industry and academia to generate commercial-ready IP

Defining national strategies to transform identified strategic sectors of the future
TRANFORMING STRATEGIC SECTORS

Initiatives that have a direct impact on the economy, job creation, and industry formation

Increase in GNI, Revenue and Create Regional and Global Companies

Increase in High Value Jobs
2. BIOECONOMY

- Definition
- Implementation Pathways
- Malaysia’s Bioeconomy
Bioeconomy can be understood as a world in which biotechnology contributes to a considerable extent to the economic output - OECD

The bioeconomy comprises those parts of the economy that use renewable biological resources from land and sea – such as crops, forests, fish, animals and micro-organisms – to produce food, materials and energy (Europe’s Bioeconomy Strategy, European Commission, 2012).
<table>
<thead>
<tr>
<th>Elements</th>
<th>Technology-Based Approach</th>
<th>Socio-Ecological Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding of sustainability</td>
<td>Sustainability as an implicit result of the bioeconomy</td>
<td>Bioeconomy will contribute to sustainability if certain preconditions are met</td>
</tr>
<tr>
<td>Biomass production</td>
<td>Increased production within the framework of conventional intensive agriculture; In the long run, detachment of agricultural production from land and increased biomass production in the laboratory</td>
<td>Transition to a multifunctional, decentralized, agro-ecological agriculture</td>
</tr>
<tr>
<td>Perspectives on nature</td>
<td>Adaptation of nature to industrial processes and cycles</td>
<td>Adaptation of industrial material flows to natural cycles</td>
</tr>
<tr>
<td>Resource utilization</td>
<td>Increased resource efficiency due to new conversion technologies (lower raw material input per unit of product)</td>
<td>Reduction of resource demand by implementation of a circular economy</td>
</tr>
<tr>
<td>Consumer behavior</td>
<td>Technology will bridge resource gaps, persistence of today’s consumption patterns</td>
<td>Sufficiency approaches and sustainable consumption</td>
</tr>
<tr>
<td>Innovation</td>
<td>Technology leadership, intellectual property (e.g., patents) and multinational companies</td>
<td>Promoting social innovations, use of the local experience of different stakeholders and tacit knowledge of farmers</td>
</tr>
<tr>
<td>Spatial level</td>
<td>Promoting international cooperation and establishment of global value-chains, strengthening the international competitiveness through export of innovations</td>
<td>Strengthening of rural areas, creation of regional value chains, autarchy in supply of food and energy, linking local stakeholders</td>
</tr>
<tr>
<td>Scale of technology solutions</td>
<td>Promotion of central large-scale solutions to benefit from economies of scale</td>
<td>Promotion of small-scale solutions tailored to the region-specific biomass supply</td>
</tr>
<tr>
<td>Participation</td>
<td>Strong partnerships between policy, science, and industry</td>
<td>Participation of civil society in shaping and advancing a bioeconomy</td>
</tr>
<tr>
<td>Research funding</td>
<td>Increased support in the field of life sciences as key enabling technologies for the bioeconomy</td>
<td>Wide range of research, concerning both the natural and the social sciences, inter- and transdisciplinary approaches</td>
</tr>
</tbody>
</table>
In 2005, Malaysia among the first few countries in the world to look at Bioeconomy

- As of 2015, BIOECONOMY as a whole is estimated at 11.3 % of the total Malaysian GDP, a contribution equivalent to RM131 billion (USD 30 billion). This value encompasses economic impact from all sectors of economy that could possibly benefit from application of bio-based technology, like agriculture, chemical production, as well as oil and fat processing.

- At a stimulated 15% annual growth, the size of the Malaysian BIOECONOMY sector is projected to grow to RM149.1 billion in 2020 and RM181.2 billion in 2030 respectively.
3. NATIONAL BIOMASS STRATEGY

• Malaysia’s National Biomass Strategy
• The Impact and Pathways (Understanding Local Dynamics)
• National Biomass Strategy Delivery Unit
OBJECTIVE OF THE NBS2020

- high-value downstream activities (e.g., bioenergy, biofuel, biochemical)

Primary objective: maximize sustainable GNI impact from biomass in the 2020 time frame

Other considerations
- Downstream
- High value job creation
- “Indigenous technology” creation within Malaysia (direct and indirect value creation)
- Sustainability impact and emissions impact
- Using Biomass as leverage to form smart partnerships with downstream companies

Strategy Design principles
- Private Sector Led
- Portfolio Approach for Downstream Activities and Objective industry facilitation
- No Specific Technology Recommendations

Malaysia’s Opportunity to Capture

RM30 billion additional GNI impact

~66,000 new jobs

RM25 billion investment opportunities

~12% CO₂e abatement
>50% of total planted area in Sabah and Sarawak
2.8 million hectares combined

Total Planted Area in Malaysia: 5.39 million hectares

Planted palm oil area as of Dec 2014
Million hectares

- Sabah: 1.51
- Sarawak: 1.26
- Johor: 0.73
- Pahang: 0.71
- Perak: 0.39
- Negeri Sembilan: 0.17
- Terengganu: 0.17
- Kelantan: 0.14
- Selangor: 0.14
- Kedah: 0.08
- Malacca: 0.05
- Penang: 0.01
- Perlis: 0.0

SOURCE: As of end December 2014; MPOB; Poyry
**Solid (dry weight)**

<table>
<thead>
<tr>
<th>Description</th>
<th>Site of production</th>
<th>Annual Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaves of oil palm tree</td>
<td>Plantation</td>
<td>9.6 51.7</td>
</tr>
<tr>
<td>Tree trunk available at end of plantation lifecycle</td>
<td>Plantation</td>
<td>3.0 16.2</td>
</tr>
<tr>
<td>Remains after removal of palm fruits</td>
<td>Mill</td>
<td>1.4 7.5</td>
</tr>
<tr>
<td>Remains after palm kernel oil extraction</td>
<td>Mill</td>
<td>0.8 4.3</td>
</tr>
<tr>
<td>Remains after oil extraction from mesocarp</td>
<td>Mill</td>
<td>1.4 7.5</td>
</tr>
</tbody>
</table>

**Liquid (wet weight)**

<table>
<thead>
<tr>
<th>Description</th>
<th>Site of production</th>
<th>Annual Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid by-product from sterilization and milling process of FFB</td>
<td>Mill</td>
<td>12.2 65.7</td>
</tr>
</tbody>
</table>

---

1 Based on end 2014 records, 5.39m ha total planted areas in Malaysia, 4% replanted area per year and company specific information

**SOURCE:** MPOB; Interviews
A detailed costing methodology has been developed to illustrate how biomass can be mobilized in a Sustainable Way.

<table>
<thead>
<tr>
<th>Biomass types (USD per tonne dry weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fronds</td>
</tr>
<tr>
<td>Trunks</td>
</tr>
<tr>
<td>EFB</td>
</tr>
<tr>
<td>PKS</td>
</tr>
<tr>
<td>Fiber</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage</th>
<th>Fronds</th>
<th>Trunks</th>
<th>EFB</th>
<th>PKS</th>
<th>Fiber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation</td>
<td>9 - 80</td>
<td>8 - 81</td>
<td>0 - 113</td>
<td>0 - 40</td>
<td>0 - 97</td>
</tr>
<tr>
<td>Pre-processing</td>
<td>19 (chipping)</td>
<td>26 (chipping)</td>
<td>31 (shredding + compacting)</td>
<td>0</td>
<td>5 (compacting)</td>
</tr>
<tr>
<td>Harvesting &amp; collection</td>
<td>5 - 21</td>
<td>15</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Substitution</td>
<td>11 + 5 (fertilizer) (application)</td>
<td>24 + 3 (fertilizer) (application)</td>
<td>29 (fertilizer), no application exist (2010 price)</td>
<td>41 (2010 price)</td>
<td>13 (2010 price)</td>
</tr>
</tbody>
</table>

SOURCE: M. Islam et al.; K. Haron et al.; H. Kalid et al.; Lazaro A. et al.; ICIS; MARDI; MPOB; Field visit; Interviews
Inclusive stakeholder efforts on the development of National Biomass Strategy 2020: 300+ interactions (development work in 2010 and launched in 2011)

**INDUSTRY – GOVT – ACADEMIA COLLABORATION**

**Stakeholder involvement**
- Advisory panel
- Stakeholder labs
- Survey with ~200 plantations and ~200 mills
Additional 20% biomass shift towards portfolio of Higher Value Uses by 2020 (inclusiveness)

<table>
<thead>
<tr>
<th>Use of biomass by type of end-product</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Biomass used</strong></td>
</tr>
<tr>
<td>Million tonnes, dry weight</td>
</tr>
<tr>
<td><strong>Pellets</strong></td>
</tr>
<tr>
<td>Pellets enable <strong>profitable mobilization today</strong>, and act as <strong>flexible buffer</strong> once biobased chemicals become commercially available</td>
</tr>
</tbody>
</table>

**Biomass to wealth**

<table>
<thead>
<tr>
<th>Biomass to wealth</th>
<th>GNI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biobased chemicals</td>
<td>~14 bln</td>
</tr>
<tr>
<td>Fuels</td>
<td>~8 bln</td>
</tr>
<tr>
<td>Pellets</td>
<td>~8 bln</td>
</tr>
</tbody>
</table>

**Business as usual**

<table>
<thead>
<tr>
<th>Business as usual</th>
<th>GNI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood products</td>
<td>~3 bln</td>
</tr>
<tr>
<td>Energy</td>
<td>~2 bln</td>
</tr>
</tbody>
</table>

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The National Biomass Strategy looked into 4 Key Aspects of Malaysia’s Potential to Develop a Sustainable Biomass Industry

1. Availability, Cost, Location of Biomass in Malaysia
2. Technology Available to Process Biomass (Maturity)
3. Portfolio of Uses for Biomass
4. Malaysia’s Biomass Opportunities

2011: Oil Palm Biomass

2013: Expanded Scope to Cover Forestry and Dedicated Crops As Source of Biomass
25 m tonnes of biomass could be mobilised across Malaysia
Biobased Chemicals should offer highest value-add in the future

Revenue generated per tonne of lignocellulosic biomass input (dry weight)

<table>
<thead>
<tr>
<th>Product</th>
<th>Existing revenue per tonne today</th>
<th>Upper range</th>
<th>Lower range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fertilizer</td>
<td>24-78</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bioenergy</td>
<td>215-390</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wood industry / Pellets</td>
<td>430-1,100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biofuels</td>
<td>380-1,250</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biobased-chemicals</td>
<td>1,100-3,515</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Changing Prices of Downstream Products:
USD90-96 cfr in the latest tender by EWP for 30,000t wood pellet for March, delivery May 2016. (Source: Argus)

Changing Prices of Downstream Products:
USD110-120 FOB Vietnam to Japan with FM Certification (Source: Argus)

*Based on figures 2010-2011
Wide range of downstream uses for ligno-cellulosic biomass: 2G BioFuels have reached commercial scale, 2G Biochemical between 2016-2020

October 2013
- Beta Renewables’ cellulosic ethanol facility in Crescentino, Italy is the first plant in the world to produce commercial quantities of advanced biofuels.
- 40-60K/annum capacity (fermentation based)

Sept 2014
- Poet-DSM became the World’s 2nd Cellulosic Ethanol Plant using straws as feedstock located in the US
- 70K/annum capacity (fermentation based)

In 2013, Lignocellulosic biofuels already being commercialized (accelerated pace)

VALUE CHAIN IN MALAYSIA

RM25b
Investment Opportunities to Participate in the Biomass Value Chain in Malaysia

AGRICULTURAL INPUTS AND SUPPLIES
- Seeds
- Crop Protection
- Biofertilisers

BIOMASS PRODUCTION
- Bioenergy Crops
- Short Rotation Crops
- Short Rotation Woods

BIOMASS MOBILISATION
- Agricultural Waste Aggregation (Oil Palm, Forest, Plantation, etc.)
- Municipal Solid Waste
- Logistics
- Compacting
- Technologies
- Biomass Trading
- Biomass Supply
- Partnerships & Innovation Models

BIOREFINING INPUTS
- Enzymes
- Organism Pretreatment Chemicals

BIOREFINING CHEMICALS
- Bulk Chemicals Production
- Specialty Chemicals Production

DOWNSTREAM CHEMISTRY
- Biochemicals
- Monomers
- Lactic Acid
- Synthetic Rubber

END PRODUCTS
- Biofuels
- Bioplastics
- Manufacture
- Synthetic Rubber
- Gloves Manufacture
- Others

BIOREFINING BIOFUELS
- 2nd Gen Advanced Biofuels Production (Bioethanol, Biofuels, etc)

BIOFUELS DISTRIBUTION
- Biofuels Trading & Distribution
- Biofuels Retailing

BIOMASS POWER & STEAM PRODUCTION
- Co-Firing
- Dedicated CHP
- Steam Production

POWER & STEAM SUPPLY AND DISTRIBUTION
- Feed-in-Tariff
- Industry Power Supply
- Industrial Steam Supply

BIOMASS PELLET MANUFACTURE
- Pellet/Biocoal Production (Power & Heat)
- Pellet Production (Animal Feed)

DISTRIBUTION & SUPPLY OF PELLETS AND SOLUTIONS
- Pellet/Biocoal Trading
- Industrial Solutions
- Fuels-Boiler, Steam, Heat & Power

OTHER FIBRE PRODUCTS
- EFB fibres
- OFT Fibres
- Wood Fibres
- Others

DISTRIBUTION & SUPPLY OF PRODUCTS
- Biomass Fibres Trading

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Portfolio approach to downstream allows integration building a sustainable business model
2020 SCENARIO

BIOMASS FLOW ACROSS SECTORS (ESTIMATED)

31M b.d.t
Biomass/Mobilised

IMPACT (GNI)

<table>
<thead>
<tr>
<th>Value</th>
<th>Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>RM3b</td>
<td>WOOD PRODUCTS</td>
</tr>
<tr>
<td>RM2b</td>
<td>BIOENERGY</td>
</tr>
<tr>
<td>RM8b</td>
<td>PELLETS</td>
</tr>
<tr>
<td>RM9b</td>
<td>ADVANCED BIOFUELS</td>
</tr>
<tr>
<td>RM14b</td>
<td>BIOCHEMICAL</td>
</tr>
</tbody>
</table>

Bioenergy (29%)  Biochemicals (19%)  Biofuels (13%)
Pellets (29%)    Wood Products (10%)

NBS TO STRENGTHEN MALAYSIA AS A BIOECONOMY HUB BY 2020
THE BIOMASS CENTRAL FACILITATION UNIT

ONE GOVERNMENT AGENCY FOR EVERYTHING BIOMASS IN MALAYSIA

**The Launch of 1MBAS March 2012**

"A Priority Area for 1MBAS will be to encourage Malaysian companies to invest in Biomass and to attract foreign companies to invest in Malaysia and partner with our Malaysian companies."

Prime Minister of Malaysia Dato’ Sri Mohd Najib Razak

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1. **Execute**
   - Delivery of National Biomass Strategy 2020 (NBS2020)

2. **Coordinate**
   - All Government-side of things for Biomass Utilization across sectors for industry

3. **Promote**
   - Biomass Utilization across balanced portfolio downstream opportunities

4. **Communicate**
   - Monitor and Report All Activities relating to Biomass across all sectors

5. **Create**
   - End Market Development, New Business Models and Innovative Partnerships

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Palm Industry Alone
85-110 million dry tonnes.
Solid Biomass Potential

By 2020
4. DEFINING STATE LEVEL STRATEGIES

- Internalisation of National Strategy at a State Level
- Capabilities and potential differs between locations
- Local Governments championing imperative to continuity and long-term success
NBS 2020 Succession Plan: State Level Champions To Drive NBS (Internalisation)
SABAH & SARAWAK: "LAUNCHPAD FOR MALAYSIA AS THE PREMIER BIOMASS PROCESSING HUB IN SOUTH EAST ASIA"

- Close collaboration between Federal and State Governments
- Both states account for more than 50% of the biomass generated in the country
- Potential for
  - RM 8.0 billion in GNI
  - > 55,000 jobs
  - > RM 31.5 billion in investment in East Malaysia

Officially launched by YAB Dato’ Sri Mohd Najib Bin Tun Haji Abdul Razak
On the 25th February 2016
A BIO-HUB CONCEPT
Portfolio approach and integration allows a sustainable and more resilient business model.
Bioeconomy: More than Circular Economy

Bioeconomy
- Renewability
- Saving fossil resources
- Climate Neutrality
- Improve productivity and sustainability

Sun

Agriculture & Forestry

Biomass

Processing

Food & Feed

Bioinnovation
Agriculture & Forestry Smart Farming
- precision agriculture
- Internet of Farm Things
- robotics and automation
- artificial intelligence
- soil nutrient supply
- soil sensors, plant sensors, animal sensors
- low cost gene editing, gene editing
- next generation breeding
- interdisciplinary in crops and environment
- higher conversion efficiency, increase output while reducing impact on the environment
- sustainable intensification

Bioinnovation
Chemicals
- innovation molecules
- new chemicals and materials
- new functionalites & properties
- more nature compatible
- less toxic
- green and sustainable chemistry

Bioinnovation
Products
- new functionalities & properties
- more nature compatible
- biodegradable or compostable
- new applications
- less toxicity

Bioenergy & Biofuels

Bio-based products
- sustainable, biodegradable, renewable
- reduces emissions

Bioinnovation
Smart Processing
- new efficient, short pathways
- new energy
- lower toxicics
- dilution of harsh chemicals
- lower temperature
- lower pressure
- from oxidation to reduction
- high efficiency
- synthetic biology

Cascading Biostructures
Recycling

Organic recycling

Chemicals & Materials

share, maintain, reuse, redistribute

Graphic available at
bio-based.eu/graphics
Community-based Dedicated Crop Contracting and Farming provides involvement of rural population with sustainable source of income

Comprehensive Dedicated Plantation Package for Sustainable Growth

**Contract Farming**
Involve any individual that has land and planting cost. Project Developer guarantee buy-back.

**JV in Dedicated Crop Farming**
Farmers provide land and labour while project developers provide seedlings/plantlets and technology.

**Growers Scheme**
Similar to existing palm oil and rubber growers schemes, whereby the growers have shares in downstream value.

**Investors Scheme in Dedicated Plantation**
Structure to be proposed and relevant to local policies and regulations but would ensure international participation.

Source: Team analysis, NBS2020, POYRY analysis
Sarawak could become an example for sustainability and green industries - creating a positive image amongst stakeholders globally

<table>
<thead>
<tr>
<th>WWF key criteria for sustainability</th>
<th>Greenpeace champions ‘environmentally responsible’ and ‘socially just’ solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Cleaner Energy</td>
<td>• Growing Carbon negative crops on marginal land not suitable for agriculture (part of reforestation efforts)</td>
</tr>
<tr>
<td>• Less Waste</td>
<td>• Replacing fossil fuels based resources</td>
</tr>
<tr>
<td></td>
<td>• Re-using biomass waste</td>
</tr>
<tr>
<td></td>
<td>• Improving quality of life for rural communities</td>
</tr>
</tbody>
</table>

Source: Team analysis.
THE LAUNCH OF SABAH AND SARAWAK BIOMASS DEVELOPMENT PLAN AS PART OF SOUTH EAST ASIA’S PREMIER BIOMASS PROCESSING HUB

SABAH AND SARAWAK Launchpad for Malaysia as the Premier Biomass Processing Hub in South East Asia. (From left) Permanent Secretary of Ministry of Industrial Development Sabah Datuk Hashim Paijan, Agensi Inovasi Malaysia CEO Mark Rozario, Minister of International Trade and Industry Dato’ Sri Mustapa Mohamed, Sabah Deputy Chief Minister Datuk Raymond Tan Shu Kiah, Minister in the Prime Minister’s Department Dato’ Mah Siew Keong, Prime Minister of Malaysia Dato’ Sri Najib Tun Razak, Sarawak Assistant Chief Minister Datu Haji Len Talif Salleh, Director of Sarawak State Planning Unit Datu Haji Ismawi, Minister of Science, Technology and Innovation Datuk Seri Panglima Madius Tangau, Minister in the Prime Minister’s Department Dato’ Sri Abdul Wahid, Deputy Finance Minister Datuk Johari at Prime Minister’s Office, Putrajaya
The Sabah Biomass Industry Development Plan can strengthen Malaysia’s proposition as the Premier Biomass Processing Hub.

**The Sabah Biomass Opportunity …**

- Could help Sabah capture:
  - ~RM3.2 billion* additional revenue per year
  - ~25,000+ new Green jobs
  - ~RM13.5 billion in investments

Note: The forecast is based on dedicated feedstock supply and not taking into consideration feedstock sharing/optimisation.
Sandakan, Lahad Datu, and Tawau can mobilise 4.8 million dry tonnes of biomass with future potential in Labuk Sugut.
Renewable energy policy in Sabah has lead to significant investment in biomass-based power generation.
And there are now 9 power plants consuming over 1 million tonnes of biomass

<table>
<thead>
<tr>
<th>Rank</th>
<th>Company</th>
<th>Location</th>
<th>Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IOI Sandakan</td>
<td>Sandakan</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>Cash Horse</td>
<td>Sandakan</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>Kina Biopower</td>
<td>Sandakan</td>
<td>11.5</td>
</tr>
<tr>
<td>4</td>
<td>Seguntor Bioenergy</td>
<td>Sandakan</td>
<td>11.5</td>
</tr>
<tr>
<td>5</td>
<td>Bell (planned)</td>
<td>Lahad Datu</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>Kwantas (SD Resources)</td>
<td>Lahad Datu</td>
<td>15</td>
</tr>
<tr>
<td>7</td>
<td>TSH Bioenergy</td>
<td>Tawau</td>
<td>14</td>
</tr>
<tr>
<td>8</td>
<td>FELDA (Sahabat)</td>
<td>Tawau</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>Teck Guan (Evergreen)</td>
<td>Lahad Datu</td>
<td>6</td>
</tr>
</tbody>
</table>

Total biomass consumption: 1.16 million tonnes

~97.8 MW

Not all plants in operation yet.
5 investments were identified as opportunities for Sabah within 10 years

1. Commercial-scale Teck Guan plant using EFB and fronds as feedstock
2. N-butanol plant in Tawau with remaining EFB and woody biomass as feedstock
3. Improvement of current pellet plants in Lahad Datu and Tawau to reach profitable commercial-scale industry
4. Integrated xylitol and ethanol plant in Lahad Datu using fronds as feedstock
5a. Integrated MEG and ethanol plant in Labuk Sugut with significant investment on infrastructure (jetty, roads, utilities)
5b. Bio-energy in Labuk Sugut with minimum infrastructure investment
The Sabah biomass industry offers several development opportunities over time

**Phase I (2016)**
- Bioenergy, pellet plants improvement
- Due diligence for first chemical plants
- Investments:
  - 10 MW biomass power plant/few small plants
  - 3 pellet plants, 383k tons/yr (capture current capacity)
- Biomass mobilised: 2.1 mn dry tons (~200 mn MYR)
- Jobs created: 758

**Phase II (2017-2022)**
- 1st wave of bio-based chemical plants
- OPF mobilisation
- Investments:
  - 2 integrated MEG/ethanol plants
  - 1 integrated Xylitol/ethanol plant
- Biomass mobilised: 3.6 mn dry tons (5.4 bn MYR)
- Annual revenue generated: 182 mn MYR
- Jobs created: 8,586

**Phase III (2022-2027)**
- 2nd wave of bio-based chemical plants
- Large scale OPF mobilisation
- Investments:
  - Next integrated MEG/ethanol plant
  - First integrated n-Butanol plant
- Biomass mobilised: 4.5 mn dry tons (8.5 bn MYR)
- Annual revenue generated: 1.4 bn MYR
- Jobs created: 14,124

**Phase IV (2027-2032)**
- 3rd wave of bio-based chemical plants
- FIT expires
- Additional plants:
  - Integrated MEG plant
  - Integrated Xylitol plant
  - Integrated n-Butanol plant
- Biomass mobilised: 4.8 mn dry tons (13.5 bn MYR)
- Annual revenue generated: 2.1 bn MYR
- Jobs created: 3.2 bn MYR
- Jobs created: 25,384
Sarawak has the opportunity to become a leader in high-value biomass industries, and Asia’s First Integrated Biomass Hub

The Sarawak cluster could become Asia’s …

1st Commercial-scale biomass plantation
1st Multi-feedstock Biomass Hub
1st Bio-port
1st 2G Ethanol plant
1st 2G Bio chemicals plant

And could help Sarawak capture:

~RM4.8 billion* additional revenue per year
~35,000+ new Green jobs
~RM18 billion in investments

Note: The forecast is based on dedicated feedstock supply and not taking into consideration feedstock sharing/optimisation.
Sarawak can mobilise 6 million dry tonnes of biomass in 4 main clusters, Bintulu & Miri highest potential.
Miri, Bintulu and Samalaju Ports have competitive delivered biomass costs with short distances of supply sources

<table>
<thead>
<tr>
<th>Biomass cluster</th>
<th>Delivered Biomass cost¹</th>
<th>EFB and OPF Supply sources</th>
<th>Potential biomass uses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MYR/dry tonne</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Miri</td>
<td>71</td>
<td>120-150km road distance from Miri Port</td>
<td>No existing consumers of biomass</td>
</tr>
<tr>
<td></td>
<td>97</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bintulu</td>
<td>63</td>
<td>90-130km km road distance from Bintulu Port</td>
<td>Planned: 1 pellet plant, 1 bioethanol plant, 1 power plant, Existing: 2 refineries</td>
</tr>
<tr>
<td></td>
<td>92</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Samalaju</td>
<td>56</td>
<td>80-100km km road distance from Samalaju Port</td>
<td>No existing consumers of biomass</td>
</tr>
<tr>
<td></td>
<td>86</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tanjung Manis</td>
<td>89</td>
<td>230-310km km driving distance + barging from Tanjung Manis Port</td>
<td>2 wood pellet plants</td>
</tr>
<tr>
<td></td>
<td>114</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>124</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kuching</td>
<td>87</td>
<td>400-500km km driving distance + barging from Kuching Port</td>
<td>1 wood pellet plant</td>
</tr>
<tr>
<td></td>
<td>126</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>127</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹ Weighted average cost based on 500 kt of supply

Source: State Government, AIM, Poyry Analysis, 2015
Within the next 6 years, 3 to 5 bio-based chemical plants could be established in the relevant clusters.

1. 1 integrated commercial scale chemical plant in Miri using EFB as main feedstock.
2. 1 integrated commercial scale chemical plant in Samalaju using EFB as feedstock.
3. Brooke Renewables ethanol plant in Bintulu using dedicated short rotation crops as feedstock.
4. For Kuching and Tanjung Manis each:
   a. A demonstration plant using EFB only, or
   b. A full-scale MEG or xylitol plant using EFB as feedstock, or
   c. A pellet plant using only EFB as feedstock.
The available biomass at a competitive cost can support new investments in four phases over time.

**Investment**

- **Bioenergy, pellet plant**
- Due diligence for first chemical plants
  - SRC cultivation for Brooke
  - Olive Energy (planned)
  - Wood residues pellet plant in Bintulu (planned)

- **Biomass mobilized cumulative**
  - 0.35 mn dry tons
  - 2.1 mn dry tons
  - 4.0 mn dry tons
  - 6.0 mn dry tons

**Sarawak biomass industry development plant**

- **Focus of evaluation**

**Phase I (2016)**
- A new EFB pellet plant in Kuching

**Phase II (2017-2022)**
- 1st wave of bio-based chemical plants
  - EFB mobilisation, SRC plantations
  - Brooke Renewables ethanol plant in Bintulu using SRC
  - 2 commercial scale biochemical plants in Miri
  - Bintulu using EFB
- 1 demo scale biochemical plant in Tanjung Manis using EFB

**Phase III (2023-2027)**
- 2nd wave of bio-based chemical plants
- OPF mobilisation
- Full-scale biochemical plant in Tanjung Manis using EFB and OPF
- ~3 additional biochemical plants in selected locations using EFB/OPF (Miri, Bintulu, Samalaju)

**Phase IV (After 2027)**
- 3rd wave of bio-based chemical plants
- New plantations generate additional EFB and OPF supply
- ~4 additional biochemical plants in selected locations using EFB and OPF
- Exact location depends on new plantation area but ideally close to processing hubs.

Note: The forecast is based on dedicated feedstock supply and not taking consideration of feedstock sharing/optimisation.
WHICH CHEMICALS DO WE CHOOSE? WE FOLLOW A 2-STEP APPROACH TO SELECT POTENTIAL CHEMICALS

1. Technical feasibility of 2G technology in 3-5 years
2. Market opportunity and cost competitiveness compared to conventional or 1G chemicals

40-50 chemical building blocks derived from biomass

7 chemicals

3 chemicals
### SEVEN CHEMICALS PASSED THE FIRST SCREENING STEP

40-50 chemical building blocks derived from biomass

<table>
<thead>
<tr>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
<th>Cn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methanol</td>
<td>Ethylene</td>
<td>1,3-Propadienol</td>
<td>n-Butanol</td>
<td>Furfural</td>
<td>Sorbitol</td>
<td>PHA</td>
</tr>
<tr>
<td>Formic acid</td>
<td>Ethylene oxide</td>
<td>Ethyl lactate</td>
<td>1,4-Butadienol</td>
<td>Adipic acid</td>
<td>Ethylene oxide</td>
<td>Ethylene glycol</td>
</tr>
<tr>
<td>Methane</td>
<td>Ethyl acetate</td>
<td>Isopropanol</td>
<td>Iso-butanol</td>
<td>Lysine</td>
<td>Ethylene oxide</td>
<td>Furfural</td>
</tr>
<tr>
<td>Syngas</td>
<td>Ethanol</td>
<td>n-Propanol</td>
<td>Iso-butene</td>
<td>FDCA</td>
<td>Isoosorbide</td>
<td>Ethylene glycol</td>
</tr>
<tr>
<td></td>
<td>Glycolic acid</td>
<td>Propylene glycol</td>
<td>Methyl methacrylate</td>
<td>Glucaric acid</td>
<td>Glucaric acid</td>
<td>Propylene glycol</td>
</tr>
<tr>
<td></td>
<td>Ethylene glycol</td>
<td>Acetic acid</td>
<td>Succinic acid</td>
<td>Citric acid</td>
<td>Citric acid</td>
<td>Propylene glycol</td>
</tr>
<tr>
<td></td>
<td>Acetic acid</td>
<td></td>
<td></td>
<td>Caprolactam</td>
<td>Caprolactam</td>
<td>Propylene glycol</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>N-butanol</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Xylitol</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Many of the high growth chemicals such as lactic acid and succinic acid were screened out because of the early stage of 2G technology.


Sarawak Biomass Industry Development Plan 2015
## Market opportunities and cost competitiveness

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethylene</td>
<td>Strong demand for bio-alternative from brand-owners but there is a major cost disadvantage compared to shale-gas based ethylene. The competitiveness of 2G to 1G ethanol as feedstock defines the cost position of ethylene from 2G sugars to sugarcane-based ethylene.</td>
</tr>
<tr>
<td>Ethylene oxide</td>
<td>Ethanol derivative, see above</td>
</tr>
<tr>
<td>Furfural</td>
<td>Current production consists of a large amount of small capacity plants concentrated in China. There are limited new projects and a fear of overcapacity. Pulp mills could produce furfural as a side product but there is not enough demand for such new volumes.</td>
</tr>
<tr>
<td>Ethylene glycol</td>
<td>One of the fastest growing sugar-based chemicals. Strong demand from consumer brands, particularly for 2G feedstocks. Direct conversion of 2G sugars is a much shorter production route than the commercial sugarcane ethanol or fossil ethylene based technologies.</td>
</tr>
<tr>
<td>Propylene glycol</td>
<td>Same technology with ethylene glycol but lacking as strong demand from consumer brands. Bio-based market is still limited in size with only few commercial producers.</td>
</tr>
<tr>
<td>N-butanol</td>
<td>Bio-based production route shorter than conventional fossil based process, and may benefit from the recent shale-gas boom. N-butanol is a commodity chemical but also potential biofuel component. Market opportunities in chemical applications will be determined by the competitiveness with fossil-based n-butanol.</td>
</tr>
<tr>
<td>Xylitol</td>
<td>Growing market as a sweetener and interesting potential as a chemical building block. Xylitol is a natural sweetener with less side-effects as artificial sweeteners, benefits for dental health, and lower calorific value than regular sugar.</td>
</tr>
</tbody>
</table>
### 2G Production Routes are Much Shorter Compared to 1G Production Routes for the Selected Chemicals

- **Conventional chemicals** are produced from fossil fuels (crude oil, natural gas, shale gas)
- **First-generation (1G)** chemicals are produced from sugars and starch (corn, sugarcane, wheat)
- **Second-generation (2G)** chemicals are produced from cellulosic biomass (corn stover, rice husk, other agriculture waste)

#### Biomass Product Options

<table>
<thead>
<tr>
<th>Conventional (fossil)</th>
<th>Crude oil</th>
<th>Naphtha</th>
<th>Ethane</th>
<th>Ethylene</th>
<th>Ethylene oxide</th>
<th>MEG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethylene glycol</td>
<td>Sugar</td>
<td>Ethanol</td>
<td>Ethylene</td>
<td>Ethylene oxide</td>
<td>MEG</td>
<td></td>
</tr>
<tr>
<td>1G sugar</td>
<td>Sugar</td>
<td>Ethanol</td>
<td>Ethylene</td>
<td>Ethylene oxide</td>
<td>MEG</td>
<td></td>
</tr>
<tr>
<td>2G biomass</td>
<td>Biomass</td>
<td>Ethanol</td>
<td>MEG</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conventional (fossil)</th>
<th>Crude oil</th>
<th>Naphtha</th>
<th>Propylene</th>
<th>Butyraldehyde</th>
<th>n-Butanol</th>
</tr>
</thead>
<tbody>
<tr>
<td>n-Butanol</td>
<td>Sugar/biomass</td>
<td>n-Butanol</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>n-Butanol</th>
<th>Sugar/biomass</th>
<th>n-Butanol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xylitol</td>
<td>Xylose</td>
<td>Xylitol</td>
</tr>
<tr>
<td>2G biomass</td>
<td>Biomass</td>
<td>Ethanol</td>
</tr>
</tbody>
</table>

1 Pulp mill side-streams
A COMMERCIAL SCALE MEG PLANT REQUIRES 400-500KT OF BIOMASS AND CAN BE INTEGRATED TO ETHANOL PRODUCTION

Biomass input

Chemical products

End-use applications

**Biomass input**

400-500k dry tonnes

EFB

**Monoethylene glycol (MEG)**

30 kt

3.6 bn PET bottles

**Monopropylene glycol (MPG)**

30 kt

**Bio-ethanol**

75 kt

**Lignin**

Plant’s energy consumption/ sale as pellets

**Chemical products**

PET bottles

Polyester fibers

De-icing fluids

**End-use applications**

PET bottles

Electronic cigarettes

Pharmaceuticals

Tobacco products

Automotive fuel

Hand sanitizer

De-icing fluids

Electronic cigarettes

Pharmaceuticals

Tobacco products

Automotive fuel

Hand sanitizer
XYLITOL IS USED AS A SWEETENER AND IS TYPICALLY INTEGRATED TO ETHANOL PRODUCTION

<table>
<thead>
<tr>
<th>Biomass input</th>
<th>Chemical products</th>
<th>End-use applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bio-ethanol</td>
<td>115 kt</td>
<td>Mint and chewing gum</td>
</tr>
<tr>
<td>Lignin</td>
<td></td>
<td>Plant’s energy consumption</td>
</tr>
<tr>
<td>Xylitol</td>
<td>15 kt</td>
<td>Mint and chewing gum</td>
</tr>
<tr>
<td></td>
<td>1.7 billion bottles of chewing gum</td>
<td>Mint and chewing gum</td>
</tr>
</tbody>
</table>

Biomass input: 400-500k dry tons fronds
**Sarawak Biomass Industry Development Plan 2015**

**Biomass Product Options**

**N-BUTANOL HAS VARIOUS APPLICATIONS IN FUELS/ CHEMICALS AND REQUIRES SIMILAR BIOMASS INTAKE FOR COMMERCIAL SCALE PLANTS**

<table>
<thead>
<tr>
<th>Biomass input</th>
<th>Chemical products</th>
<th>End-use applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>400-500kt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EFB and woody biomass</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**n-Butanol**
- 95 kt
- ~1000 car/year at 15% blending

**Acetone**
- 15 kt

**Lignin**
- Plant’s energy consumption

**End-use applications**
- Main product
  - Automotive fuel
  - Intermediate of other chemical products
  - Textile
  - Brake fluid for automotive
  - Perfumes
  - Nail polish remover
  - Paints and varnishes
  - Pharmaceuticals

**End-use applications**
- Intermediate of other chemical products
  - Pharmaceuticals
  - Textile
  - Paints and varnishes
  - Perfumes
  - Automotive fuel
  - Brake fluid for automotive
  - Nail polish remover
KEY CONSIDERATIONS FOR BUILDING COMPONENTS TO ENABLE SARAWAK TO MAXIMISE ITS POTENTIAL

• Cost Competitiveness of Production in Sarawak based on Market Pricing compared to Petrochemical Means of Production

• Inclusiveness of the entire value chain and participation opportunities for local companies of all sizes

• Products that have regional demand and mass market appeal
CATALYST PROJECTS
New developments on end markets and value chain

- Palm Kernel Cake Bio Refinery Project
  - 1st Plant Construction
  - Commissioning and Operations

- MSW to biogas
  - Formalise the business cases
  - 1st Plant Construction
  - Commissioning and Operations

- 2G Bioethanol
  - Formalise the business cases
  - 1st Plant Construction
  - Commissioning and Operations

- 2G Sugars Refinery
  - Technical & Commercial Viability Assessment + Formalise the business cases
  - 1st Plant Construction

- 2G Biobutanol Plant
  - Feasibility Study
  - Site Decision
  - Formalise business cases + Detailed Technical & Commercial Study
  - 1st Plant Construction

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PKC BIO REFINERY PROJECT

Background:
- AIM together with KNM Group (the Local EPCC player in plant manufacturing) and Novozymes (the global leader in industrial enzymes) will be establishing a first-of-its-kind PKC Bio-Refinery that produces 2nd Generation Bio-Chemicals (ethanol) and high value poultry feed for local consumption and export.

Objective:
- Establish a PKC Bio Refinery plant making 2G Bio-Chemicals (ethanol) and high value poultry feed for local consumption and export.

<table>
<thead>
<tr>
<th>Potential</th>
<th>Current Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated investment : USD 28m</td>
<td>PKC Bioethanol and Animal Feed Project in final phase of financial investment.</td>
</tr>
<tr>
<td>Estimated Impact : USD 196m</td>
<td>Proposal submitted to Sabah Development Bank in October 2016 but rejected.</td>
</tr>
</tbody>
</table>
RM25b
Investment Opportunities to Participate in the Biomass Value Chain in Malaysia
Malaysia has already implemented a wide number of incentives to facilitate further industry development

<table>
<thead>
<tr>
<th>No.</th>
<th>Incentive/Grant</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Incentive</td>
<td>Feed-In Tariff (FiT)</td>
</tr>
<tr>
<td>2</td>
<td>Grant</td>
<td>Domestic Investment Strategic Fund (DISF)</td>
</tr>
<tr>
<td>3</td>
<td>Grant</td>
<td>Green Technology Financing Scheme (GTFS)</td>
</tr>
<tr>
<td>4</td>
<td>Grant</td>
<td>Commercialisation of Research &amp; Development Fund</td>
</tr>
<tr>
<td>5</td>
<td>Grant</td>
<td>Techno Fund</td>
</tr>
<tr>
<td>6</td>
<td>Grant</td>
<td>Intellectual Property Financing Scheme (IPFS)</td>
</tr>
<tr>
<td>7</td>
<td>Incentive</td>
<td>Pioneer Status</td>
</tr>
<tr>
<td>8</td>
<td>Incentive</td>
<td>BioNexus Status</td>
</tr>
<tr>
<td>9</td>
<td>Incentive</td>
<td>Investment Tax Allowances (ITA)</td>
</tr>
<tr>
<td>10</td>
<td>Grant</td>
<td>Business Start-up Fund (MTDC)</td>
</tr>
<tr>
<td>11</td>
<td>CAPEX Incentive</td>
<td>EPP 6 Developing Oleo Derivatives</td>
</tr>
<tr>
<td>12</td>
<td>Financing Support</td>
<td>Credit Guarantee Corporation (CGC)</td>
</tr>
</tbody>
</table>
NBS2020 identifies specific opportunities and enablers to create high-value industries by mobilizing 30m tonnes biomass by 2020. AIM has facilitated NBS2020 execution through 1MBAS unit.

**Critical Factors to Achieve NBS2020, Facilitated by AIM’s 1MBAS Unit:**

- Certification of Feedstock and Sustainable Consumption (Raw Biomass does not equate Feedstock)
- Sustainable Business & Operations Model with Integration in Mind as cross-industry collaborations increases viability.
- End to end development of Biomass Industry Value Chain from upstream to end market acceptance
- Mobilization of large volumes of biomass for high-value activities (logistics & infrastructure development) - Economic efficiencies when it comes to biomass aggregation
- Industry-led approach without government interference in selecting technologies based purely on Commercial Viability
- Participation of biomass (community and smallholders) owners in downstream value creation activities will reduce income gap and create sustainable feedstock supply
- Attract downstream technology owners and off-takers to scale up of new and interesting technologies through cost efficient operating environment
- Create a Vibrant Funding Landscape for Biomass Projects – Need to rely on pool of local and international funds as Commercial Banks are still warming up to Biomass

**Biomass to Wealth**

- ~2% additional GNI impact
- >60,000 new jobs
- ~12% CO₂e abatement

**Share of total biomass available in given year**

- **Biomass used**
  - Million tonnes, dry weight

<table>
<thead>
<tr>
<th>Year</th>
<th>Total</th>
<th>2011</th>
<th>2015</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1%</td>
<td>4%</td>
<td>6%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1%</td>
<td>3%</td>
<td>9%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1%</td>
<td>9%</td>
<td>11%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Value of Biomass to Wealth**

- Biobased chemicals: ~14bn
- Fuels: ~8bn
- Pellets: ~9bn
- Wood products: ~3bn
- Energy: ~2bn

**~2% additional GNI impact**

**>60,000 new jobs**

**~12% CO₂e abatement**
5. LEARNINGS AND NEXT STEPS

• Key Learnings
• Ecosystem Development
• Next Steps
THE CONCLUSION

- Government and Industry should move parallel (Government should not just think like industry but also move like one) – no limitation on scope of involvement – cause when it comes to Industry there is none

- Clarity on Objective, Action Plan and constantly Review and Relook into progress through a proper Governance Structure

- Eco-system Approach and Sustainable (economic included) development of Green industry
  - Sustainable Feedstock supply and Mobilisation (Cost Effectiveness)
  - Technology Deployment and Adoption Roadmap (Agnostic)
  - Biomass Project Funding and Access to these Funds
  - Off-take Market Development (Policy and Recommendations, G2G and etc.)

- Drive the Bioeconomy with Passion and Urgency
Timothy Ong
Senior Vice President - Strategic Impact Projects
Head of National Biomass Strategy Delivery Unit (1MBAS)

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