


National Biomass Strategy 2020: New wealth creation for Malaysia's biomass industry

Version 2.0, 2013




Contents

Preface and acknowledgements

Agensi Inovasi Malaysia (AIM) was set up in 2010 through an act of Parliament mandated by the Prime Minister as the nation's Innovation Agency. It was tasked in its role to assess Malaysia's combined strengths and resources as a nation and create new industries and high-value jobs for Malaysians by introducing innovative approaches and strategies to capitalize on these existing strengths.

Agensi Inovasi Malaysia's role is to create wealth through innovation and to enable the innovation eco-system of the country in areas such as Industry, Government and Education. The Strategic Innovation unit within the agency develops strategies for creating additional wealth based on the country's inherent strengths such as specific industries, resources, geographic advantages and all other differentiating factors that will strengthen Malaysia's position and the Southeast Asian region at large.

The first edition of the National Biomass Strategy (NBS) 2020 was published in November 2011 after extensive collaboration between the Malaysian Government and private sector companies as well as domestic and international research institutes and academia. Its aim was to assess how Malaysia can develop new industries and high-value opportunities by utilising agricultural biomass for high value products, starting with oil palm biomass. An explicit goal of the study was to determine how Malaysia can develop new biomass sectors with the aim of creating higher value-added economic activities that contribute towards Malaysia's gross national income (GNI) and creating high value jobs for the benefit of Malaysians.

We would like to acknowledge and thank the contributions and support of all collaborating government agencies, academic and research institutions and private sector partners that helped to make the National Biomass Strategy 2020 a reality.

Mark Rozario
Chief Executive Officer
Agensi Inovasi Malaysia (AIM)

Foreword

The biomass sector in both Malaysia and internationally has seen significant progress over the last few years. Some of the indicators include the commercialization of second generation ethanol, suggesting that the technology will be mature by 2015. There has also been an increase in activities and investments into bio-based chemicals, increasing confidence in the viability of the industry and maturity by 2020.

Since the publication of the last report, we have worked with over 100 Malaysian mill and plantation owners to create awareness about downstream opportunities. The NBS strategy has also been presented to industry players and government partners in Asia, EU and USA both during international road shows and at speaker invitations in international conferences.

Malaysia's reputation as a country ripe for investments in the biomass space has also grown. Increased awareness has resulted in numerous technical/strategic-level visits by international investors and technology partners to Malaysia for the exploration of investment into bio-pellets, 2nd generation bioethanol, and other activities. These visits have resulted in workshops, direct negotiations and meetings between investors and biomass industry suppliers, facilitated by the government.

Recognizing higher value uses of their biomass, biomass owners, such as mills, have been working to develop partnerships to consolidate their biomass within 'joint venture clusters'. New incentives, such as the Pemandu Biomass Pelletisation business opportunity, have been well received and have seen multiple applications. In addition, incentives within EPP6 have been extended to the production of bio-based chemicals derived from oil palm biomass. Such progress has received extensive coverage in national publications such as the *New Strait Times*, *The Star*, *The Edge* and *Green Prospects Asia*.

Due to the positive momentum and increasing interest by industry in the biomass sector, we have explored the opportunity for Malaysia to capitalise on other types of biomass, such as forestry residues and the potential to produce 2nd generation bio-butadiene for synthetic rubber. The production of 2nd generation bio-based chemicals provides additional opportunity to capture more value-add within Malaysia. In conclusion, we would just like to add that the outlook for the industry continues to look positive.

Bas Melssen
National Biomass Strategy Team Leader
Executive Vice President - Strategic Innovation
Agensi Inovasi Malaysia (AIM)

Executive summary

Malaysia currently generates about 12 percent of GNI from the agriculture sector. In the process of creating this value, a significant amount of biomass is generated every year across a variety of crops, including but not limited to palm oil, rubber and rice. Within agriculture, by far the largest contributor to GNI is the palm oil sector, contributing about 8 percent or over RM 80 billion. The palm oil sector correspondingly generates the largest amount of biomass, estimated at 83 million dry tonnes in 2012. This is expected to increase to about 100 million dry tonnes by 2020, primarily driven by increases in yield. This is why the National Biomass Strategy 2020 had thus far focused on oil palm biomass. We are currently in the process of also extending the scope to include all types of biomass from sources such as rubber, wood and rice husk.

The vast majority of the oil palm biomass being generated today is returned to the field to release its nutrients and replenish the soil. The biomass returned to the field as organic fertiliser plays an important role to ensure the sustainability of fresh fruit bunch (FFB) yields. However, there is also the potential to utilise this biomass for a variety of additional high value end-uses, including but not limited to the production of wood products, pellets, bioenergy, bioethanol and biobased chemicals. Due care and caution must be taken to balance the amount of biomass that is left in the field for its nutrient value versus that utilised for higher value-added uses.

The different uses have very different risk-return profiles, given different technological maturities, global demand potential and competitive dynamics. Not surprisingly, the highest-value opportunities – bioethanol and biobased chemicals – also carry the highest technological uncertainties and competitive risks. A portfolio approach is therefore critical for the nation to ensure there is a combination of short to medium-term investments into immediate opportunities and longer-term investment in higher value-added opportunities.

A scenario where an additional 20 million tonnes of oil palm biomass is utilised by 2020 for higher-value uses could have the potential to contribute significantly to the nation's economy. In addition to a significant incremental contribution to GNI of RM 30 billion by 2020, this National Biomass Strategy 2020 offers Malaysia a way to meet its renewable energy target, reduce emissions and create about 66,000 incremental jobs. This strategy also offers an opportunity for Malaysia to build several biofuels (pellets and ethanol) and biobased chemical downstream clusters to ensure the nation benefits from the downstream value creation potential.

From a supply-side perspective, by 2020, Malaysia's palm oil industry is expected to generate about 100 million dry tonnes of solid biomass. This includes not only the empty fruit bunches (EFB), mesocarp fibres (MF) and palm kernel shells (PKS), but also the oil palm fronds and trunks. Excluded from this figure is oil palm mill effluent (POME). On current course, most of this solid biomass will remain in the plantations as fertiliser, with a small but increasing amount being utilised for bioenergy given the introduction of a renewable energy feed-in-tariff system.

Biomass should not be removed from the field without consideration of its nutrient value and protection to the top soil. However, there is the potential to retain in the field the portion of the biomass that has the highest nutrient value but the lowest downstream value, as represented by its carbohydrate content, and replace the balance with inorganic substitutes. Moreover, converting the mostly unused POME into biogas for either powering the mills or selling power into the national grid would contribute towards the renewable energy target of Malaysia – 410 MW of installed biogas capacity by 2030. This initiative alone would reduce the nation's carbon dioxide (CO^2) emissions by 12 percent and free up significant biomass for higher value-added uses. Taken in combination, this has the potential to free up 20–30 percent of the available solid biomass for higher value-added uses without affecting oil palm yields. This of course is a decision each biomass owner will have to make based on its long-term commercial and sustainability merits.

Assessing the various costs of mobilising oil palm biomass today – harvesting, collection, pre-processing, substitution and transportation to a downstream hub – in the order of 25 million tonnes of biomass can be mobilised at globally competitive costs, i.e., at a cost of between USD20 - USD 80 per dry-weight tonne.

On current course (i.e., business as usual), approximately 12 million tonnes of solid biomass will likely be utilised for non-fertiliser uses by 2020, primarily for wood products and bioenergy. An additional 20 million tonnes could be mobilised for additional uses such as pellets, bioethanol and biobased chemical industries. In total, this is approximately 30 percent of the solid biomass the palm oil industry is expected to generate annually by 2020.

Pellets is a natural entry point, as the technology is reasonably mature, the cost of developing infrastructure relatively low (i.e., RM 30–40 million per plant with a capacity of 100,000 tonnes per annum) and the payback of 5-7 years relatively quick. Hence, while pellets enable profitable mobilisation today, they also act as a buffer. Should higher value biobased chemicals materialise earlier or should Malaysia capture a bigger share of the global biobased chemicals market, biomass can be diverted from pellets to capture these higher value opportunities. These business-as-usual uses of wood products, bioenergy and pellets provide an opportunity to generate value from biomass today, with the potential to generate revenue of RM 200–1,000 per dry tonne of solid biomass input. In parallel, resources should be expended to invest in longer-term projects around bioethanol and biobased chemicals. While these have only recently started to reach commercial scale, they also have the potential for significantly higher value creation – in the order of RM 1,000–3,000 of revenue per dry tonne of solid biomass input. The biggest long-term opportunity for Malaysia is in biobased chemicals, with a forecasted global market size of RM 110–175 billion by 2020.

A critical success factor will be the mobilisation of biomass, both with regard to logistics – how to move it efficiently from plantations to centres of production – and to cost – to ensure globally competitive costs. It will also be critical to create best-practice joint structures to enable smaller mills and small holders to participate.

As the world's second largest producer and largest exporter of palm oil, this is a natural opportunity for Malaysia to capture, with a significant prize. However achieving full potential will require significant coordination and cooperation among multiple stakeholders. The development of partnerships is critical for mobilising the biomass, and the government has already put in place certain incentives and strategies to encourage development as a result of this National Biomass Strategy.

Introduction

The National Biomass Strategy 2020 lays the foundations for Malaysia to capitalise on its biomass by channelling it into higher value downstream uses. While the strategy initially focused on the palm oil industry since it was the largest producer of biomass in Malaysia, we are currently in the process of extending the scope to include all types of biomass from sources such as rubber, wood and rice husk. Take woody biomass for instance: As much as 2.7 million tonnes of woody biomass is available in Sarawak alone, predominantly from existing plantations.

Thus far, palm oil has been the most important agricultural crop of Malaysia. Overall, the palm oil industry is the fourth largest contributor to the country's GNI, accounting for about 8 percent or over RM 80 billion of GNI. Globally, Malaysia is the second largest producer and the largest exporter of crude palm oil. To date, government support for downstream activities has been targeted at palm oil based products such as oleochemicals and, more recently, at strengthening the role of the private sector in this industry as part of the Palm Oil National Key Economic Area (NKEA). The palm oil industry also generates significant amounts of biomass every year (see *What is oil palm biomass?*), which is mostly used as fertiliser in plantations.

But the National Biomass Strategy is not restricted to recommending biomass utilisation for higher value purposes. It goes on to identify opportunities by which Malaysia can achieve significant additional contribution to GNI, and increased wealth and job creation from its biomass. It provides a 2020 biomass-to-wealth scenario, which will drive the development of national clusters in the pellets, bioethanol and biobased chemicals industries as well as fulfil the national renewable energy target for converting biomass to energy while ensuring sufficient nutrients are left for soil replenishment. Further, the report emphasises the most immediate priorities that Malaysia can consider as it embarks on the journey towards implementation. The successful realisation of the vision outlined by the National Biomass Strategy 2020 will rely upon strong collaboration among many government agencies as well as among many biomass owners. In addition, it will require the support of the private sector and academic and research institutions.

What is oil biomass?

Six types of oil palm biomass are produced as by-products of the palm oil industry: oil palm fronds (OPF), oil palm trunks (OPT), empty fruit bunches (EFB), palm kernel shells (PKS), mesocarp fibre (MF) and oil palm mill effluent.

In the plantations, OPFs are available throughout the year as they are regularly cut during the harvesting of fresh fruit bunches (FFBs) and pruning of palm trees. Additional fronds as well as OPTs become available in the plantations during the replanting of oil palm trees every 25 to 30 years.

In the mills, EFBs remain after the removal of the palm fruits from the fruit bunches. MF and PKS are recovered during the extraction of crude palm oil (CPO) and palm kernel oil (PKO), respectively. In addition, palm oil mill effluent (POME) accumulates as a liquid biomass at the mills.

Six different types of oil palm biomass exist in plantations and mills

Biomass type	Description	Site of production
Fronds	Leaves of oil palm tree	Plantation
Trunks	Tree trunks available at end of plantation lifecycle	Plantation
EFB	Remains after removal of palm fruits	Mill
Shells (PKS)	Remains after palm kernel oil extraction	Mill
Fiber (MF)	Remains after CPO extraction from fruit bunches	Mill
POME	Liquid by-product from sterilisation and milling process of FFB	Mill

Costing the mobilisation of biomass to create more value from oil palm biomass

Malaysia's oil palm plantations are spread out across both Peninsular and East Malaysia, with the states of Sabah and Sarawak containing the largest proportion of planted area. The total acreage under cultivation grew from 3.38 million hectares in 2000 to 4.85 million hectares in 2010.

Potential upstream volume by 2020

In 2012, Malaysia's palm oil industry produced over 83 million dry tonnes of solid biomass p.a. This volume is projected to increase to 85–110 million dry tonnes by 2020. Similarly, POME volumes are expected to increase from 60 million tonnes today to 70–110 million tonnes by 2020.

Historically, an increase in planted area for oil palm was the main driver of biomass volume growth. Going forward, the forecasted growth will be influenced by a combination of plantation expansion and FFB yield improvement. Improvements in the yield of FFB for palm oil production are possible with continuous improvements in plantation management, crop material and replanting of mature plantations.

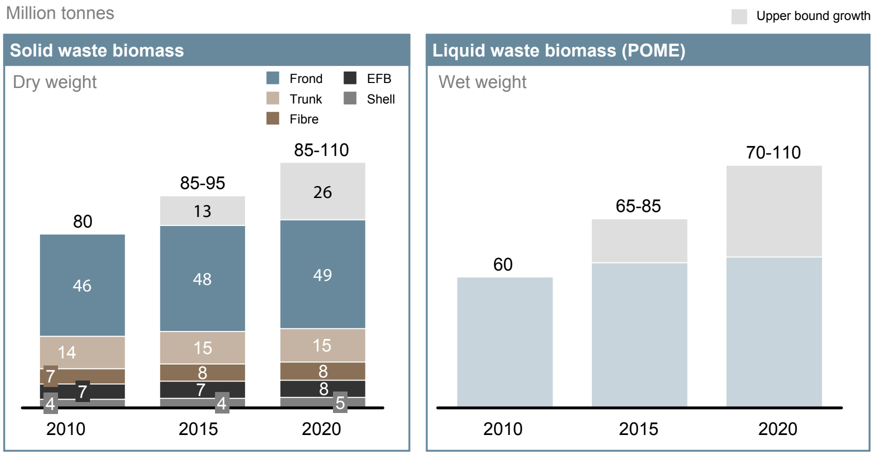
Most of the solid biomass is found in the plantations, as fronds and trunks account for about 75 percent of the solid biomass volume as illustrated in Exhibit 1. The remaining 25 percent is generated in the mills during the extraction of oil palm.

Cost of mobilising upstream volume

For Malaysia to fully capture the downstream potential of oil palm biomass, it is necessary to free up part of the biomass from its current uses and establish a collection system for fronds and trunks, which presently remain in the plantations. It is critical that the oil palm biomass be mobilised at a cost that is competitive with global substitutes and other agricultural residues such as sugar cane leaves, corn stover and wheat straw. The cost of these residues typically ranges between RM 130 to RM 180 per dry tonne at mill gate. Therefore, it is important to understand the volume of oil palm biomass that can be mobilised at an average cost of less than RM 150 per tonne at mill gate. For the purpose of assessing the economic feasibility of mobilisation, four kinds of cost were considered for making biomass available for downstream uses: substitution cost, harvesting and collection cost, pre-processing cost and transportation cost.

EXHIBIT 1
By 2020, solid waste biomass will increase to 85-110 million tonnes, POME to 70-110 million tonnes

Million tonnes



Forecast assumptions:
Yield growth: lower bound: historical growth rate of CAGR of 0.1%; upper bound: ETP projections of 26 tonne FFB/ha in 2020
Increase in planted area: lower bound: MPOB - increase of 1.1 million ha over 2005 figures; upper bound: ETP upper limit of 28% area increase over 2010. Figure excludes seasonality

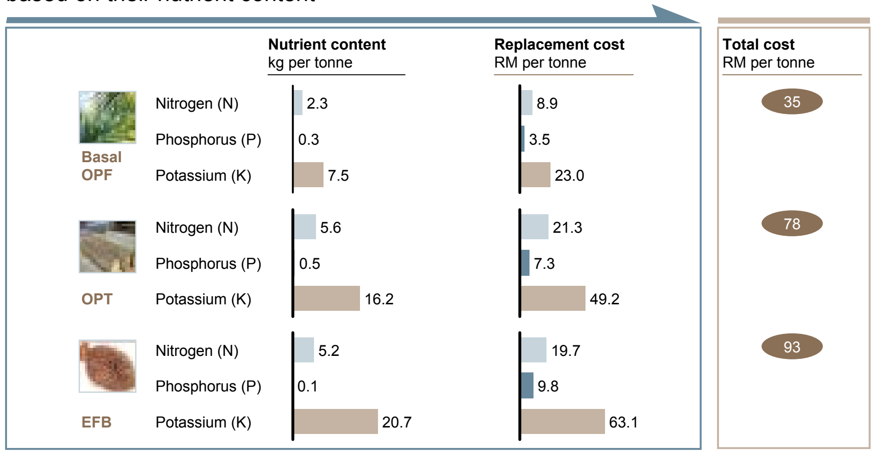
SOURCE: ETP; MPOB; "Exploring land use changes and the role of palm oil production in Indonesia and Malaysia" 2010. B. Wicket

Substitution cost
Today, an estimated three quarters of solid biomass is used for nutrient replacement and mulching purposes in plantations. To this end, fronds and trunks are retained in the plantations, and a large share of the EFBs is returned from the mills to the plantations. In the mills, mesocarp fibre, palm kernel shells and some EFBs are utilised for steam and power generation. In addition, some of the biomass is used for niche downstream applications, such as in the wood industry and as animal feed.

The cost of replacing some of the biomass with synthetic fertiliser is calculated by combining the price of synthetic fertiliser with equivalent nutrient content with the cost of applying that synthetic fertiliser in the plantation. Exhibit 2 outlines the differences in nutrient content between OPFs, OPTs and EFBs, and the respective fertiliser replacement costs. Of note is the fact that only the frond's basal portion is collected for downstream uses in bioethanol and biobased chemicals, while the frond's leaflets which contain most of the nutrients are left in the mill (see *The nutrient content of fronds*). Across all biomass types, 80 percent of nutrients remain in the plantations in the 2020 biomass to wealth scenario. Further long-term research studies are still needed to assess any potential impact on CPO yield and soil health.

Besides being used for steam and power generation at the mills, mesocarp fibre and palm kernel shells are also being sold today, e.g., for non-mill power generation or to the cement industry. In 2010, the market price for mesocarp fibre was RM 40 per tonne and the price for palm kernel shells was RM 130. We used these figures as the cost of substitution, however recent increases in demand have been seen prices of palm kernel shell rise to over RM 200 per tonne.

EXHIBIT 2
Fertiliser replacement costs were estimated for OPF, OPT and EFB based on their nutrient content



SOURCE: Quantification of oil palm biomass and nutrient value in a mature plantation. Khalid et al.

Harvesting and collection cost
Today FFBs are harvested and collected in the plantations and subsequently transported to the mills for production of crude palm oil (CPO). As a result, EFBs, palm kernel shells and mesocarp fibre are already available at the mills and can thus readily be transported to aggregation hubs or downstream processing facilities. For fronds and trunks, on the other hand, a new harvesting and collection system will need to be established.

Oil palm fronds can be obtained during plantation replanting, pruning of the oil palm tree and harvesting of FFBs, with the latter accounting for the greatest share of volume and 'fresher' fronds as they are cut for the purpose of harvesting, whereas pruning is typically to cut off the dead leaves. Today, the cut fronds are left as top soil replacement and natural fertiliser. Different collection methods could be adopted to collect the fronds ranging from simple manual collection with a wheelbarrow, to collection with a buffalo cart or motorised cart, to advanced mechanisation. The choice of collection method for a specific plantation depends on the terrain (e.g., elevation, spacing of trees), labour constraints and economies of scale. Depending on the collection method, cost estimates range from RM 16–67 per dry tonne.

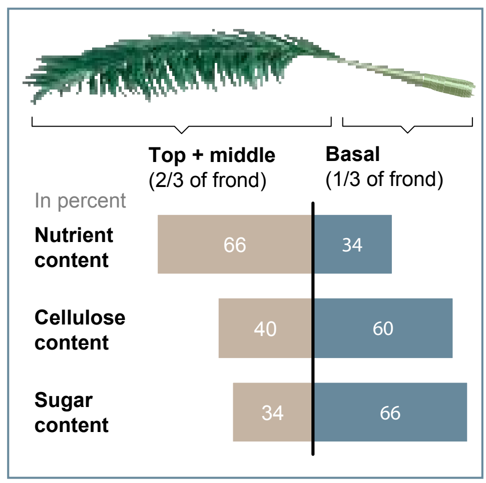
Oil palm trunks become available at the end of a plantation's life cycle every 25–30 years. Today, most of the trunks remain in the plantation as fertiliser. Trunks are either felled or chipped to allow for quicker return of nutrients to the soil, or are killed with poison and left standing to decompose naturally in the field. A small percentage of trunks are currently used for niche uses in the wood industry, for example flooring, plywood, fibre board and furniture.

Over the next 10 years, approximately 240 million tonnes of trunks will become available during replanting. However, this supply will be unevenly distributed across Malaysia's states as well as over time due to different maturities of the plantations. These geographic and timing constraints pose severe challenges on the collection

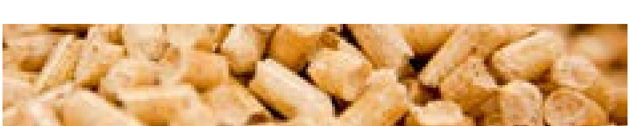
The nutrient content of fronds

The oil palm frond is approximately 2–3 metres long and weighs about 10 kg (wet weight). It consists of the petiole (the stem) and many long leaflets on either side of the stem. The top two-thirds of the frond contain most of the nutrients, while the basal (lower) third is rich in cellulosic materials and sugars, which are needed in the production of biofuels and bio-based chemicals.

The collection of only the basal portion of the fronds for downstream uses has two key advantages: two-thirds of the desirable content for production of biofuels and biobased chemicals (contained in the basal portion of the frond) would be made available for downstream applications; at the same time two-thirds of the nutrients (contained in the remaining two-thirds of the frond) would remain in the plantations as fertiliser.



SOURCE: MPOB; M. Islam et al.; K. Haron et al.; H. Kalid et al.; Interviews



model as well as on potential uses, since many of the downstream industries are dependent on a consistent and regular supply of biomass over time. Based on today's fees paid to contractors to remove trunks from plantations, the cost of harvesting and collection is estimated at RM 47 per dry tonne.

Pre-processing cost

Different biomass types can undergo different forms of pre-processing in order to reduce the moisture content, reduce the weight or volume to be transported and/or in preparation for a specific end use. For instance, trunks and fronds can be chipped, dried and/or pelletised, while EFBs and mesocarp fibre can be shredded, dried and/or compacted. Palm kernel shells already have very low moisture content and thus can be used or transported without further pre-processing. Depending on the type of biomass and the extent of pre-processing required, cost estimates range from RM 17–550 per tonne for mesocarp fibres, fronds, trunks and EFBs. With drying accounting for a large proportion of pre-processing cost, it is likely that both plantations and downstream industries will explore scenarios that do not require biomass to be dried.

Transportation cost

Most of the crude palm oil (CPO) is currently transported from the mills to port-based bulking and refinery installations, where it is either further refined or exported internationally by ship. A similar structure is envisaged for the biomass supply chain in order to aggregate sufficiently large biomass volumes in hubs where further processing can take place.

EFBs, palm kernel shells and mesocarp fibre accumulate at the mills and can be transported directly from the mills to these hubs. Fronds and trunks on the other hand first need to be collected in the plantations. They could either be transported first from the plantation to the mill and subsequently to a hub or directly from the plantation to a hub. The exact mode of transport would depend on the transport distance, the possible savings in transport cost from pre-processing and the final end use.

Current cost estimates, based on the density of the product and the distance transported, range from about RM 0.2 to 10.0 per kilometre per tonne. However, these estimates are based on road transport by truck, and the actual transport cost could be lower in regions where transport by train and/or barge is feasible, and where costs can be shared with return cargo.

Summary of costs

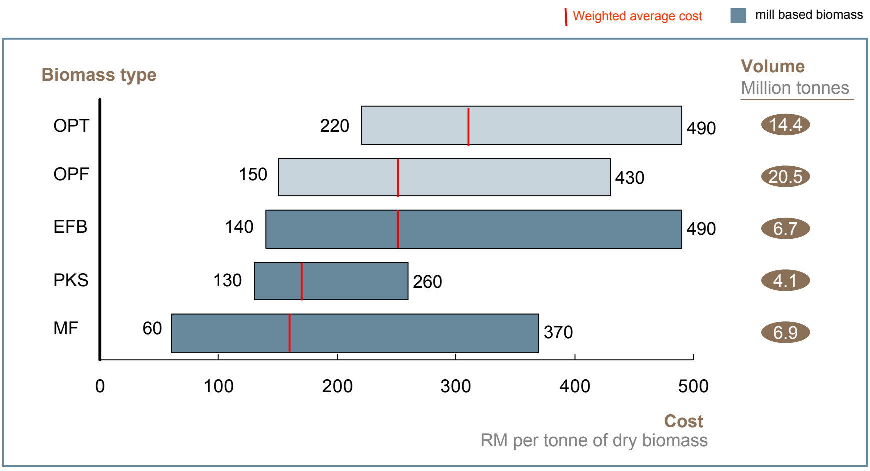
Mill-based biomass, i.e., mesocarp fibre, palm kernel shells and EFBs, accounts for most of the biomass that can be sourced at the lowest cost (Exhibit 3).

As illustrated in Exhibit 4, 25 million dry tonnes of biomass could be aggregated today at the principle port-based bulking installations for less than RM 250 per tonne. This is equivalent to a cost of approximately RM 150 per tonne at mill gate, which is required to be competitive with global substitutes. About 44 percent of this volume would be available in Peninsular Malaysia and 56 percent in East Malaysia, the bulk of which would come from Sabah.

EXHIBIT 3

Mill based biomass accounts for most of the lowest cost biomass

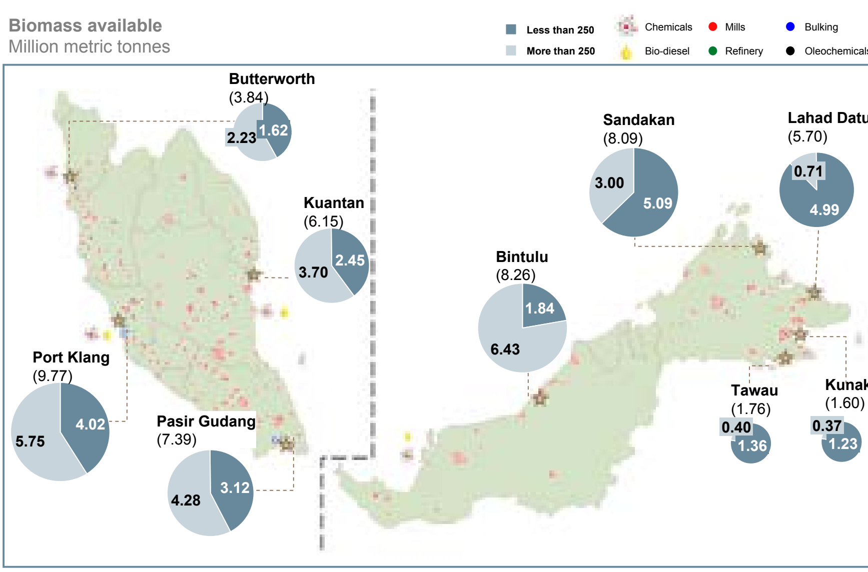
ESTIMATES



SOURCE:, M. Islam et al.; K. Haron et al.; H. Kalid et al;. Lazaro A. et al.; ICIS; MARDI; MPOB; Field visit; Interviews

EXHIBIT 4

25 m tonnes of biomass can be mobilised at competitive cost



SOURCE:, M. Islam et al.; K. Haron et al.; H. Kalid et al;. Lazaro A. et al.; ICIS; MARDI; MPOB; Field visit; Interviews

Assessing the best uses of Malaysia's oil palm biomass

Malaysia could benefit from an additional RM 30 billion contribution to GNI by utilising the biomass from the palm oil industry for a portfolio of higher value-added downstream activities. This would result in more and better jobs for Malaysians, as the country would begin producing high-value products out of a resource that is currently little used in advanced industries in Malaysia. A concerted effort by government, academia and the private sector with private investment in the order of RM 20–25 billion cumulatively over the next 5–10 years and government involvement in the form of policies and targeted incentives to reduce risk is necessary for the nation to achieve this goal by 2020.

Different uses for biomass have very different risk-return profiles, given different technological maturities, global demand potential and competitive dynamics. Malaysia already benefits from producing wood products, animal feed, energy, and using biomass directly on the field as fertilizers today. Biomass-to-energy plants are being built to take advantage of the Feed-in-Tariff. Additionally, the first pellet plants, which will allow the export of oil palm biomass, are currently being set up.

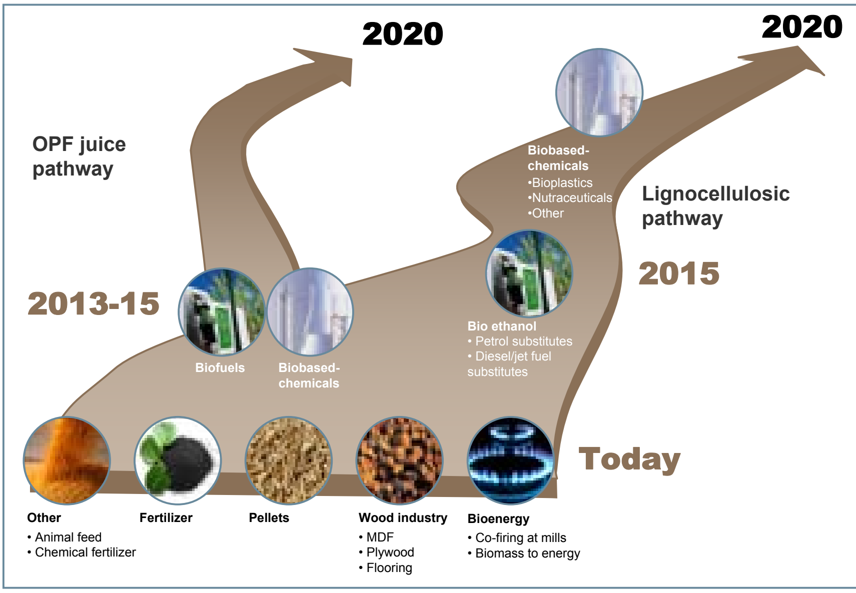
The bigger prize is in higher value and higher risk applications. Producing bioethanol and biobased chemicals from biomass will offer increased wealth as well as new and better jobs. However, the technologies to convert lignocellulosic biomass into bioethanol will only be available on a commercial scale between 2013 and 2015 as illustrated in Exhibit 5. An additional 2-3 years of optimisation of this technology platform will be required for cost-competitive production of biobased chemicals. The development of research and commercial capabilities as well as the know-how to convert lignocellulosic biomass into sugars will allow Malaysia to tap into the high-value opportunities in biobased chemicals.

Downstream technologies of today

The downstream technologies to produce wood products, bioenergy and pellets are already well known and available on a large commercial scale across the world and the first installations are on the ground in Malaysia.

Today, oil palm biomass is already used as input in the wood industry to produce products such as plywood and medium-density fibre boards (MDF). Large scale pellet plants with more than 750,000 tonnes annual capacity already exist in countries such as Brazil and Sweden, and that technology can be applied in Malaysia.

EXHIBIT 5
Timeline of technological availability



The transformation of biomass to energy already takes place in Malaysia, but on a smaller scale than that practiced in Europe. With the new renewable energy feed-in tariff system, biomass-to-energy plants of a similar scale to Europe will have to be constructed in Malaysia (see *Malaysia's renewable energy target*).

Downstream technologies of tomorrow

1st generation bioethanol and biobased chemicals – using food crops such as sugarcane, cassava or corn as feedstock – are already produced at commercial scale today, at plants such as the 400,000-tonne ethanol plant and 100,000-tonne lactic acid plant in Thailand based on cassava and sugarcane feedstock, or similar ethanol plants in Brazil based on sugarcane feedstock. In contrast to these existing technologies that use food biomass as inputs, emerging 2nd generation technologies are exploring the use of non-food, lignocellulosic biomass (e.g., forest and agricultural residues). The term lignocellulosic biomass refers to the main building blocks of plant matter: lignin, cellulose and hemicellulose.

There is strong evidence that 2nd generation technologies to convert lignocellulosic biomass to bioethanol while still in the development stages will likely mature by 2015. Commercial plants have already been established (e.g., Beta Renewables in Crescentino in northwestern Italy, Shengquan Group in Shandong Province in China) and an estimated 700 million liters of 2nd generation bioethanol is projected to be commercially produced by 2015 globally. However, technological uncertainty does still remain around the step of breaking down the biomass into individual sugars that can subsequently be fermented into biobased chemicals in a manner similar to existing 1st generation approaches.

As a steep learning curve is expected in the first years of commercialisation, 2nd generation ethanol may initially not be cost-competitive with 1st generation ethanol from sugar cane. There are strong indications, however, that 2nd generation bioethanol is likely to be better accepted in the US and EU than 1st generation bioethanol, with specific targets already being set for the consumption of "advanced" bioethanol in the US. Local support tools such as a blending mandate, guaranteed offtake, and minimum price support could act as a buffer against volatility and uncertainty of international demand.

Moreover, this drive for the 2nd generation biofuels could also expedite the development of a biobased fuel/ethanol intermediary which would, in turn, move Malaysia further forward in its development towards biobased chemicals that will ultimately be of such great value to the country.

What must be kept in mind, however, is that the production of biobased chemicals from lignocellulosic biomass faces additional hurdles. Biobased chemicals derived from sugars can be produced on a commercial scale once the process of converting lignocellulosic biomass to sugars has been optimised at scale and the exact composition of the input is known. Although the production of other (non-ethanol) biobased chemicals from lignocellulosic biomass is slightly more difficult, small scale pilots are being built today, for example, a 1,000-tonne succinic acid plant in China's Jiangsu Province. Production is expected to reach commercial scale between 2015 and 2020.

An alternative route to derive bioethanol and biobased chemicals from oil palm biomass is to squeeze sugar juice from the basal part of the oil palm frond. Similar to sugar cane, the juice can then serve as feedstock for production of 1st generation bioethanol and biobased chemicals, and thus many of those products could be produced today. However, the juice of the oil palm frond contains less than 10 percent of the carbohydrates present. The remaining sugars are the building blocks of the insoluble, cellulosic material of the frond. Hence, from 1 tonne of wet weight oil palm fronds, 400 kg of sugars can be recovered by breaking down the cellulosic components, compared to only 40 kg of sugars from just the oil palm frond juice. While the use of sugar juice is unlikely to be the most economically viable in the long term, it could be used for the industry until the lignocellulosic route becomes fully matured.

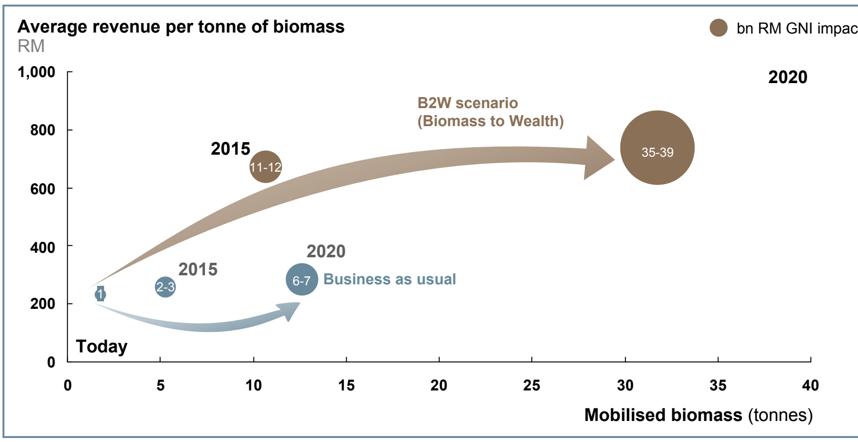
Business as usual

Today, a majority of oil palm biomass is left in the field while the rest is mulched and returned to the field as fertilizer. In addition, in a business as usual scenario, by 2020, Malaysia's palm oil industry will utilise 12 million tonnes of biomass p.a. for use in wood products and bioenergy.

Currently, oil palm biomass makes up a small percentage of the input to the wood industry. This is expected to grow steadily to about 1 million tonnes p.a. by 2015. With industry growth and a higher share of oil palm biomass as input instead of rubber wood, the volume is expected to reach almost 3 million tonnes of biomass p.a. by 2020.

In 2015, more than 3.5 million tonnes of biomass and, in 2020, close to 9 million tonnes of biomass will be used to produce energy so that the country can meet its renewable energy target (see *Malaysia's renewable energy target*).

EXHIBIT 6
National Biomass Strategy 2020 would deliver incremental GNI of approximately RM 30 bn



In all, the use of oil palm biomass in the wood and bioenergy industries could, by 2020, contribute RM 2.8 billion and RM 2.4 billion to GNI, respectively (Exhibit 6). The growth of bioenergy alone will create about 1,400 direct and 3,900 indirect jobs and require an additional private investment of RM 8–10 billion.

Additional value creation: Biomass to wealth

To fully capitalise on the biomass opportunity, an additional 20 million tonnes of biomass compared to a business as usual scenario could be deployed towards higher-value downstream activities such as pellets, bioethanol and biobased chemicals.

Pellets

Pellets is a natural entry point for capturing this opportunity since the technology is reasonably mature, the cost of developing infrastructure relatively low (i.e., RM 30–40 million per plant with a capacity of 100,000 tonnes) and the payback of 5-7 years relatively quick. Converting biomass to pellets will allow biomass owners in Malaysia to immediately capitalise on available biomass. Pellets produced in Malaysia can be shipped to other Asian countries such as Japan and Korea where there is already an existing market demand for biomass.

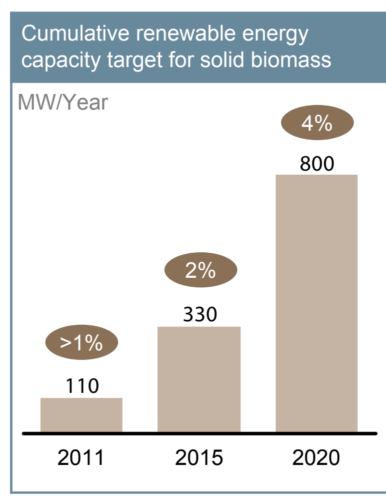
Globally, the demand for biomass pellets is forecasted to reach ~20 million tonnes by 2020. Korean and Japanese policies have already created an increased demand for bio-based pellets in the region. In Korea, the first dedicated biomass power plant is scheduled to go online in 2013 in Dong Hae. By 2020, Korean demand for wood and biomass pellets is forecasted to reach 5 million tonnes.

Meanwhile competition continues to increase. Malaysia, therefore, needs to accelerate speed to market, possibly also creating local demand to expedite the development of the industry. While Malaysia does have a distinct advantage in terms of proximity to the markets in Asia, to capitalise on the advantage, it must deliver in an efficient, proactive and timely manner.

Malaysia's renewable energy target

The Renewable Energy Policy and Action Plan sets a target of 4,000 megawatts of installed renewable energy capacity for 2030, raising the total installed capacity to 17 percent from less than 1 percent today. This target covers five individual types of renewable energy: biogas, biomass, solid waste, small hydro and solar photovoltaic (PV).

The target for biogas alone is 410 MW installed capacity by 2030, which can only be achieved by the conversion of almost all mills to use biogas, already mandated through EPP 5 of the Economic Transformation Programme with a deadline of 2020. This can be achieved by capturing the biogas produced by the POME at the palm oil mills. To generate energy, a facility to capture the biogas must be constructed at a cost of RM 4–5 million and the existing boilers in the mills converted to use biogas as input at a cost of about RM 0.5 million. Importantly, this will supply the mills with sufficient power and steam to run their processing facilities, and allow those mills connected to the power grid to supply some power to the grid.



The target for biomass to energy is to reach 1,340 MW by 2030.[1] This can be achieved by a combination of installing small power plants in the vicinity of grid connected mills, or larger, more efficient power plants closer to industrial clusters. The interim target of 800 MW in 2020 will require 6–9 million tonnes of biomass for this purpose, depending on the efficiency of the plants constructed.

1 National Renewable Energy Policy & Action Plan. KeTTHA. 2009

A series of incentives has already been put in place to catalyse the industry (e.g., tax breaks, business opportunity under the oil palm NKEA that will provide 10-15 percent of capex for the first five new pellet plant applications). Mobilising 10 million tonnes of biomass for pellets by 2020 could create about RM 9–10 billion in GNI and about 5,500 and 6,800 direct and indirect jobs, respectively.

In addition to the contribution to GNI and the creation of new jobs, pelletisation allows industry to mobilise its biomass and, in so doing, the logistics and infrastructure associated with mobilising the biomass can be established. This will be relevant for the development of the bioethanol and biobased chemicals industry.

Bioethanol

There is increasing evidence that the 2nd generation bioethanol market will be mature by 2015. Commercial plants (e.g., Beta Renewables in Crescentino in northwestern Italy and Shengquan Group in Shandong province in China) have already been established and over 700 million litres of 2nd generation bioethanol is likely to be commercially produced by 2015.

The US has separate targets for 2nd generation bioethanol, and there is a possibility that the EU could establish a similar policy. However, demand coming from these markets is highly dependent on regulation.

Incentives for the production of bioethanol, such as the expansion of EPP6 to include biobased chemicals to provide capex incentives of up to 40 percent and tax breaks have been put in place to catalyse the development of the industry.

Biobased chemicals

Biobased chemicals represent the largest potential for Malaysia. Currently, the global market for all chemicals amounts to more than RM 7 trillion. Of this, lignocellulosic biomass can supply about 0.6 percent, equivalent to a global market size of RM 48 billion, which is expected to grow to as much as RM 110–175 billion by 2020.

By taking a diverse portfolio approach, Malaysia can produce as much as 1.6 million tonnes of biobased chemicals, with a market value of RM 7–9 billion. This would cover a broad range of chemicals from ethanol based chemistry like polyethylene and ethylene oxide, to amino acids like glutamic acid and serine, to other chemicals like polylactic acid and acetone. What will become the most attractive chemical to focus on is difficult to judge at this time, as is the most attractive way of deriving it (see *The brave unknown*).

Producing 1.6 million tonnes of biobased chemicals would require 10–20 biobased chemical plants and a total investment of RM 10–15 billion by the private sector as well as the mobilisation of about 5.5 million tonnes of biomass. Seizing the biobased chemicals opportunity could lead to an increase in GNI of RM 14–15 billion and the creation of 2,500 and 13,400 direct and indirect jobs, respectively.

As the advancement of biobased chemicals continues, several promising biobased chemicals are starting to emerge. The most successful ones combine competitiveness (time to market; technical feasibility; relative cost position to fossil-based products) with demand. Ethylene Glycol and Succinic acid belong to the group of chemicals that appear to be the most promising.

In its effort to strive towards complete success, Malaysia is working to ensure that further downstream processing and manufacturing of chemicals is captured within the country by encouraging the building of plants within chemical clusters.

Summary
In total, the additional value creation from pellets, bioethanol and biobased chemicals represents a possible GNI increase of RM 30–34 billion by 2020 and the creation of 66,000 jobs, respectively compared to business as usual (Exhibit 6). For this opportunity to be realised, an additional 20 million tonnes of biomass must be mobilised beyond those required in a business as usual scenario, which includes the wood industry and bioenergy. The realisation of this opportunity for Malaysia will also require active private sector participation and investments amounting to RM 20–26 billion.

Initiatives until 2020

Many initiatives will have to be launched before future technologies can become commercially attractive. Mills will have to switch from burning biomass to using biogas and begin mobilising biomass for pellet plants and other end uses. Different conversion technologies will need to be tested, starting with demo plants and leading up to commercial scale plants and, before 2015, an industry around 2nd generation bioethanol will have to be developed.

Given the higher risk and return of future technologies, private sector participants might choose to jointly develop and scale up future downstream end uses. However, it is important to Malaysia's success in developing new higher value industries that these building blocks for future scenarios are laid today.

The Brave Unknown

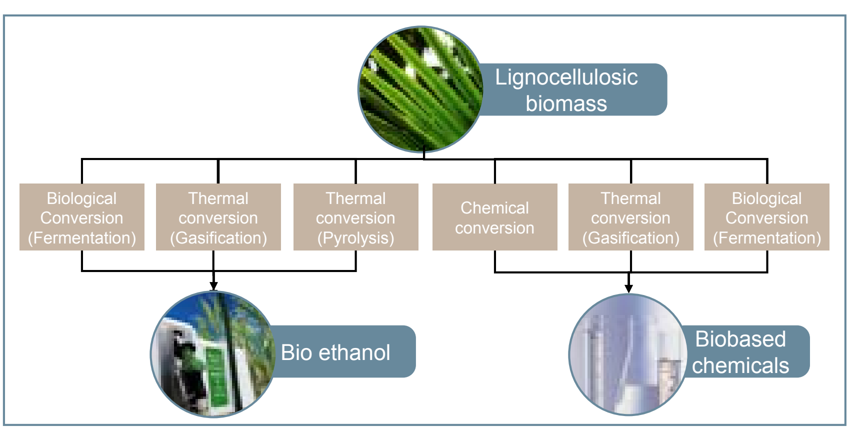
Three main biomass conversion technology platforms are being explored today: thermal, biological and chemical.

Thermal conversion: Biomass is first broken down into syngas using heat and low oxygen concentrations. Subsequently, a range of thermo-chemical processes can be applied to generate fuels or chemicals.

Biological conversion: Biomass is treated by chemicals and/or enzymes to produce sugars, which are then fermented into the desired fuels or chemicals.

Chemical conversion: Biomass and sugars are treated using chemicals only in a variety of methods to produce fuels or chemicals.

Pilot scale plants employing each of these technologies have been completed for both biofuels and biobased chemicals. At this stage of development it is impossible to predict a winning technology platform and it is likely that several technologies will emerge depending on what specific end products are desired. Thus no specific technology is expected to become vastly dominant across the biobased chemical industry.



SOURCE: WEF The Future of Biorefineries, 2010; Cellulosic Ethanol: Feedstocks, Conversion Technologies, Economics, and Policy Options, Randy Schnepf, Congressional Research Service, 2010

Capturing the RM 30 billion opportunity

To realise this opportunity, Malaysia must move decisively and ensure that the right structures, regulatory framework and incentive packages are put in place. This chapter delineates some of the incentives and strategies that have been put in place to encourage this development:

- **Joint Venture (JV) clusters to help aggregation of biomass** –The creation of JV clusters will help alleviate the risk of vertical market failure between the owners of biomass and downstream users, such as biobased chemical refineries and pellet plants. Downstream opportunities require the mobilisation of a large amount of biomass in a single location. No single owner has sufficient scale to mobilise a sufficient amount of biomass, hence the need for JV clusters. JV clusters would normally consist of a number of mill owners co-located in the same area. On a mill by mill basis, the scale of individual mills is too small to mobilise sufficient biomass for higher value downstream uses. This is why the scale provided by the structure of a JV cluster would reduce the risk that would need to be taken by individual mill owners. Ideally, JV clusters would take ownership stakes in downstream industries, thereby giving the owners of biomass a share in the additional value creation. JV clusters can and should have different investment strategies, e.g., one might be regionally focused on producing very cost-competitive pellets, while another might take a complete portfolio perspective by supplying to all possible end users. It is imperative that such partnerships are biomass owner owned and controlled so that the owners are able to choose between different portfolios depending on their investment preference without interference. The government, however, can facilitate the establishment of such partnerships and provide capabilities, expertise and advice where required by the biomass owners.

- **Transparency of potential opportunities and adopting a portfolio approach** – The Government will play a role to ensure transparency of potential downstream uses, starting with the National Biomass Strategy 2020. There will be a natural tendency for companies to focus on lower-risk opportunities. It will, however, be critical that biomass owners adopt a longer-term view to extracting higher value from the biomass from opportunities in bioethanol and/or biobased chemicals.

- **Oil Palm Biomass Centre (OPBC)** – The creation of a consortium of upstream and downstream companies to accelerate the development of lignocellulosic conversion technologies benefits all companies in the industry. The ultimate objective of the OPBC, therefore, is to accelerate time-to-commercialisation of the biobased chemicals opportunity. The OPBC focuses on developing technology, accelerating implementation and producing intellectual property for further commercialisation of technologies to convert lignocellulosic biomass into higher value-added uses such as bioethanol and biobased chemicals.

Incentives to support the development of a pellet industry, bioethanol, biobased chemicals and/or intermediate products have also been established. These include:

- **Pelletisation Capacity Incentive** – The production and export of biomass pellets to markets with steeply growing demand can generate RM 9–10 billion GNI in impact and provide about 12,000 new jobs in Malaysia. The pelletisation capacity incentive (the Pellet Business Opportunity incentive under the palm oil NKEA) has already been put in place and provides 10-15 percent in capex incentives to the first 5 successful applicants for new pellet plants in Malaysia.

  Pelletisation technology is already economically viable, allowing mill owners to generate immediate value from their biomass and encouraging, in turn, the immediate mobilisation of biomass. To illustrate, a medium sized pellet plant of 100,000 tonnes capacity p.a. requires an investment of RM 30–40 million and has a payback period of 5-7 years.

- **EPP 6 Developing Oleo Derivatives** – The scope of EPP 6 has been expanded to include biobased chemicals derived from lignocellulosic biomass. This expansion in scope has helped reduce the risk for private sector investment in this area and provided support for the set-up of commercial scale plants. EPP 6 provides capex incentives of up to 40 percent to local investors for the establishment of a biobased chemical facility.

- **Tax incentives** – The Government has established a series of tax incentives to cultivate the establishment of downstream industries. These incentives can be applied in addition to the previously mentioned EPPs and capex incentives but are mutually exclusive to one another.

  — BioNexus Status: The BioNexus Status is awarded through the BiotechCorp to companies that participate in “value-added biotechnology and/ or life science activities”. These companies, on achieving this status, receive tax breaks and can apply for funding. It is usually awarded to companies seen as complying with the criteria of “bringing benefits to the overall biotechnology and life sciences industry in Malaysia”. Going forward, still greater funding is expected to be granted to higher value-added production.

  — Pioneer Status: This is an incentive that is awarded by MIDA to manufacturing businesses. Such companies receive 30 percent exemption from taxable statutory income for five years and 100 percent exemption if investments are made in promoted areas, i.e., the States of Sabah, Sarawak, Perlis and the designated “Eastern Corridor” of Peninsular Malaysia. In the near future, 100 percent exemption will also start being provided to “high value added” production in non-promoted areas.

— Investment Tax Allowance: This is awarded by MIDA to companies with high capex and R&D investments. Under this, companies are allowed to offset 60 percent of the qualifying capital expenditure they incur within five years against 70 percent of their statutory income. The allowance increases to 100 percent if the investment is made in a promoted area. Going forward, 100 percent exemption will also be provided to "high value added" production in non-promoted areas.[1]

1 For more information on MIDA incentives, visit http://www.mida.gov.my/env3/index.php?page=manufacturing-related-services

2 For more information on BioNexus status, visit http://www.biotechcorp.com.my

Forestry based biomass

The National Biomass Strategy 2020 was always intended to cover a wider range of biomass opportunities for the Nation, from various sources. After Oil Palm Biomass, Forestry related biomass is the next sizable opportunity for the country.

While there are forestry activities across the Nation in the Peninsular as well as in Sabah and Sarawak, the only large-scale opportunity for a fully integrated biomass hub is the state of Sarawak. This is mainly a function of existing forestry activities, proximity, land availability and infrastructure.

Sarawak is a natural hub for forestry activities and holds most of the Nation's forestry resources. A high- level assessment was conducted to size the opportunity of using biomass materials from forest plantations, residues from sawmills and veneer mills in Sarawak. This chapter reviews the potentially available quantities and cost of forest-derived and dedicated biomass feedstock, possible end-uses, as well as economics and benefits until 2020. We will also present a view on how this opportunity compares to and can link to other downstream activities in the State.

The National Biomass Strategy 2020 seeks to establish possible portfolio scenarios to create new industries such as solid bio-fuels (pellets), liquid biofuels (bio-ethanol) and bio-based chemicals, integrated with existing activities such as pulp and paper, engineered wood and other products. A combination of these activities would optimize the potential impact on incremental GNI and high-value jobs creation for the State.

In analysing the feedstock availability, fibre source and cost of mobilisation, we took into consideration the following sources:

- Sawmill and veneer mill residues and woodchip.
- Wood from existing plantations established for proposed pulpmills, and chiplogs from plantations established for veneer and sawlogs.
- Harvest residues produced as a by-product of log production from existing plantations.
- New plantations on pulpwood regimes established primarily for producing biomass.
- New woody and non-woody short rotation plantations such as grasses, canes and bamboo.

Another consideration is the different paying capabilities for various downstream uses such as engineered wood, pulp and paper, furniture, pelleting, biofuels, energy, and bio-based chemicals for these fibres. The respective wood-paying capabilities (WPC) depicted are calculated based on the price difference end-users can afford to pay for the fibre with break-even as the threshold.

Resources and mobilisation

Sarawak has sources of fibre from log-processing residues, existing plantations and potentially new plantations. We examined the suitability of each resource as potential feedstock for pellets, biofuels and bio-based chemicals, and made the following findings:

- Residues from sawmills and veneer mills are available in large volumes but the WPC of the existing users (for particleboard, MDF and export woodchip) is greater than that of pellets and bio-based chemicals, thus cost of feedstock could be prohibitive to certain industries.

- Transportation costs have to be minimised in order for biomass pellets, biofuel and biochemical processing to be economically viable. This could be possible if these downstream manufacturing facilities are close to the biomass or plantations rather than in central locations in the State.

- Bintulu seems a logical site for biomass processing. There is potentially 1 million BDMt/annum available, at an average cost of USD103/BDMt. (from existing planted Acacia Mangium plantations)

- Other areas may seem logical collection points for plantation biomass, but typically would require the establishment of new plantations. The WPC of pellets, biofuels and bio-based chemicals is too low to attract investment in new plantations.

- Harvest residues from plantation forests are an affordable feedstock for manufacturing pellets, but are unsuitable as feedstock for biofuels and bio-based chemicals that require wood without bark. Potentially, about 520,000 BDMt/annum of harvest residues could be mobilised around Bintulu area.

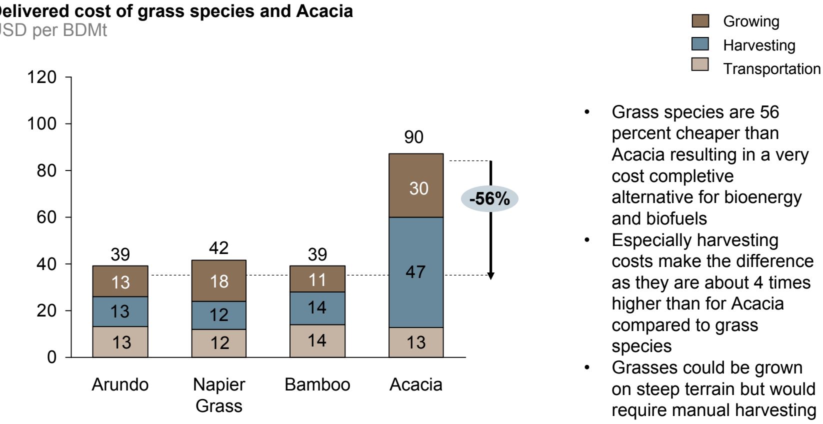
- Bamboo and perennial grasses can grow on flat land to produce fibre with a delivered cost below the WPC of a pellet plant (Table-1), assuming minimal land-holding costs. However, it would be unlikely that it would produce sufficient returns for it to compete for land with high value crops such as oil palm.

The feedstock volumes potentially available are shown in Exhibit 8. The most promising feedstock is forest residues and dedicated short-rotation crops.

EXHIBIT 7

Delivered costs of all considered grass species is significantly below timber

Delivered cost of grass species and Acacia
USD per BDMt



Assumes minimal land costs

- Grass species are 56 percent cheaper than Acacia resulting in a very cost completive alternative for bioenergy and biofuels
- Especially harvesting costs make the difference as they are about 4 times higher than for Acacia compared to grass species
- Grasses could be grown on steep terrain but would require manual harvesting and have a cost of about USD53/BDMt

SOURCE: Poyry Analysis

EXHIBIT 8

Only harvest residues and grasses are viable for pellets (at USD180/T CIF)

Item	Maximum Potential Volume (BDMt/a)	Average cost for a supply volume and WPC		
		Supply Volume (BDMt/a)	Average Delivered Cost (USD/DMt) for	Pellet WPC (USD/BDMt)
Mill residues	300 000	300 000	143	72
Export Woodchips	200 000	200 000	70	64
Existing plantations – no pulpmill	1 700 000	1 000 000	103	64
Existing plantations – pulp mill proceeds	670 000	670 000	114	64-72
New plantations	9 100 000	450 000	122	64
Harvest residues	520 000	400 000	54	64
Arundo donax – 16 700 gross ha	-	400 000	39	55
Bamboo – 17 000 gross ha area	-	200 000	43	50

SOURCE: Poyry Analysis

Downstream uses

The National Biomass Strategy 2020 reviews and provides information about biomass utilisation options that are commercial-scale ready or likely to reach commercial-scale over the next 5 years. In general, all reviewed end-uses i.e. pellets, biofuels and biochemical products, may have a low WPC relative to existing industries in Sarawak like wood panel, pulp and paper, logs and sawn timber. However, the biomass options have greater long-term sustainable economic and social benefits for the State as well as the opportunity to leverage these resources to get ownership stakes in downstream value activities.

- Pellet manufacturing has proven technology and while the market for pellets in Asia is currently small, it is expected to grow due to various Feed in Tariffs (FiTs) and renewable energy certificates (RECs) driven mainly by South Korea and Japan. Pellets currently have a lower CIF price than woodchip. Therefore, in order to cover the pelletizing costs, the cost for feedstock needs to be less than for woodchips.

- Cellulosic ethanol can be produced from agricultural residues, other lignocellulosic raw materials e.g. woodchip or purpose-grown grasses. The cellulosic ethanol is chemically identical to first-generation bioethanol. It is a substitute for petrol, and can be a platform to eventual production of high value bio-based chemicals. The high capital investment cost is the main barrier to the economic viability of cellulosic ethanol. As ethanol is a substitute for petrol, a large increase to petroleum prices and/or incentives favouring ethanol will be required for cellulosic ethanol to have a WPC sufficient to cover the cost of wood in Sarawak. A pulpmill that has integration with a bio-ethanol plant could improve the profitability of both due to shared infrastructure costs.

- In general, any process producing chemicals from woody biomass needs to be integrated to other wood processing, e.g. pulp, paper or sawmills. Recoverable chemicals represent a small portion of the woody biomass. The revenues from the chemicals cannot support the logistics, handling and processing of the entire wood flow. Although a dedicated chemicals production facility would not justify the large investments it requires, it can be a good and more stable source of additional income to supplement other existing downstream operations in the State that may have surplus wood fibre.

Scenarios and macro economic impact

The effect of wood processing on gross national income (GNI) and the creation of jobs under four scenarios for Sarawak could be high, depending on the scenario ultimately adopted by industry. These scenarios are being evaluated based on the assumption that the processing is economically viable.

- **Scenario 1:** Business as usual assumes only production from plantations for export of woodchip and logs.

- **Scenario 2:** Pulpmill will proceed but no pellets, biofuels or biochemical industries.

- **Scenario 3:** Pulpmill integrated with pellet, biofuel and biochemical manufacture. Assumes the planned pulpmill goes ahead with a pellet plant, ethanol plant and N-butanol production. In addition, a pellet plant is built based on dedicated biomass.

- **Scenario 4:** Value-adding from engineered wood production such as Laminated Veneer Lumber (LVL) production. In this scenario, plantation logs with good form and large sizes are channelled to LVL production and low-quality logs are exported as woodchip.

Exhibit 9 shows the incremental intake capacity of the processors under each scenario. All processors require wood, except for the pellet producers in scenario 3 which require 520,000 BDMt/a of harvest residues and 400,000 BDMt/a of grass.

EXHIBIT 9
Assumed incremental intake of Processors for each Scenario in 2020

	Export Woodchip	Pulp Mill	LVL	Pellets	Etahnol	Bio-chemicals
	'000 BDMt					
Scenario 1	1800					
Scenario 2		1750				
Scenario 3		1750		920	330	200
Scenario 4	170		1100			

As shown in Figure S-1 and Figure S-3, the analysis shows the large benefits to GNI and higher value jobs if more downstream facilities are setup in Sarawak compared to just exporting woodchips and other lower value add operations.

EXHIBIT 10
Significant increase in GNI when moving into a more sophisticated bio based economy

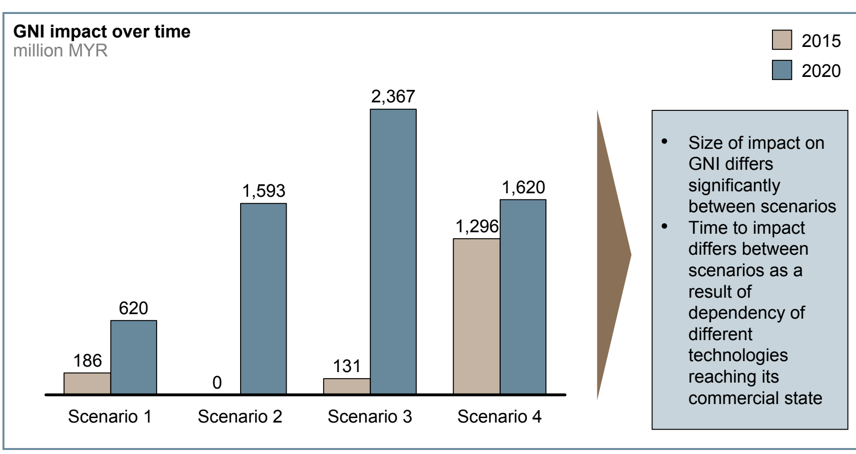


EXHIBIT 11

Job creation follows different scenarios as high level sophistication is not labor intensive

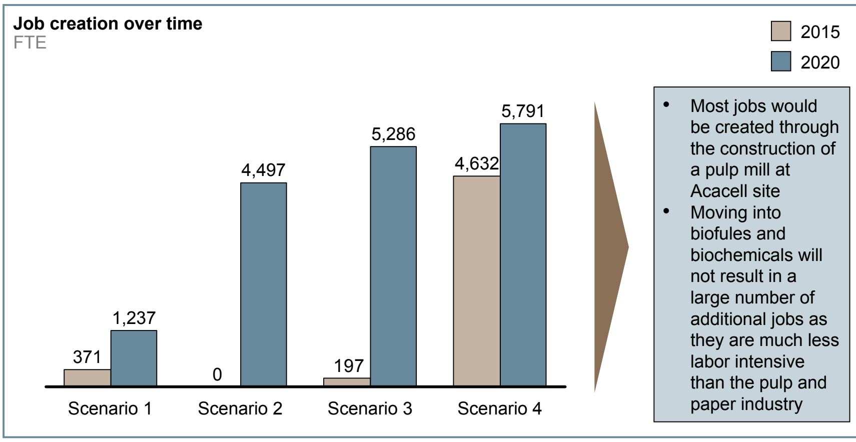
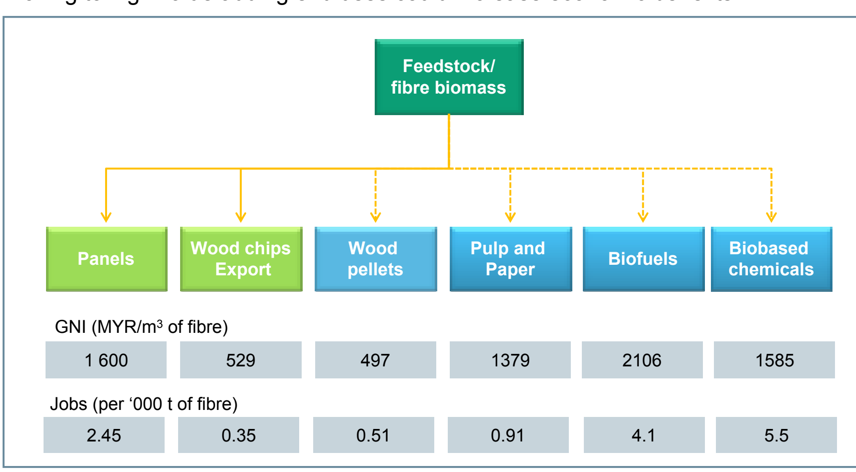


EXHIBIT 12

Moving to high value adding end uses could increase economic benefits



SOURCE: Poyry Study and Analysis

The LVL manufacturing scenario has comparable effect on GNI and jobs as a standalone pulpmill (but less high-level jobs). The pulpmill plus bioprocessing has the highest increase in GNI and jobs created, with an incremental increase in GNI of RM2.4 billion and 3,100 jobs created over the pulpmill-only scenario.

Conclusion

The National Biomass Strategy 2020 could translate into an incremental RM 30 billion in GNI and an additional 66,000 new jobs by 2020.

The outlook is positive. The NBS has looked into the availability and cost of acquiring oil palm biomass in Malaysia and found that 25 million tonnes of biomass could potentially be mobilised across Malaysia at competitive cost today. An additional 5 million tonnes could move to higher value uses by 2020. International players are both aware and interested in Malaysia. Appropriate technology to facilitate the opportunity is being developed: Biofuels from lignocellulosic biomass are expected to reach commercial scale around 2015, biobased chemicals between 2015 and 2020. Malaysian biomass owners have the opportunity to use their biomass to participate in additional downstream value creation, instead of simply supplying it to the open market.

The Government has provided a lot of incentives to make it still easier to benefit from developments. It has established a biomass Task Force (1MBAS Task Force) that will act as the single point of contact for biomass-related activities and facilitate the dissemination of information and capability building. It has also put a series of enablers in place to catalyse industry. These include: Capex support for pelletisation plants; establishment of the OPBC industry consortium; expansion of oleo-chem EPP 6 into bio-based chemicals.

Initiatives to create viability of investment in high value industries such as biomass pellet, bio-ethanol and bio-based chemical:

Perennial grasses represent one of the lowest cost and effective source of feedstock sources. However, insufficient information is available about local growth rates and yields. Thus, the establishment of growth trials for and a project to identify areas of suitable land will reduce uncertainty, due diligence costs and time for potential investors. Chemical analysis on the components of harvest residues should be carried out to determine if the resource is suitable for the manufacture of pellets.

- Given the lack of competition for the residues and the potentially low prices, Sarawak could consider making wood pellets out of Acacia Mangium harvest residues. Each component of the harvest residues, (bark, branches and leaves), should be tested for the concentration of silica, calcium oxide, phosphorus, chlorine, sodium, potassium, sulphur content as well as ash content and calorific value. The test results will indicate if the harvest residues are a suitable feedstock for pellets.

- Proponents of the pulpmills should consider designs, which would allow for low-value heat and hemicellulose to be used by adjacent facilities for the production of N-butanol and heat for the production of cellulosic ethanol, and pellets. The adjacent facilities have the potential to lower the pulpmill's infrastructure costs and provide a source of income to the pulpmill from the sale of heat, hemicellulose and harvest residues.

The onus is now on industry. Malaysia has a distinct advantage in terms of proximity to the markets in Asia. To capitalise on this advantage, however, industry must deliver in an efficient, proactive and timely manner.

The Government will continue to review the National Biomass Strategy 2020, update it and include new elements as new development occurs. It will also seek to provide further incentives for facilitation. The Government of Malaysia is fully committed to making new wealth creation from biomass a reality for the nation.

Appendix A

List of acronyms

CPO	crude palm oil
EFB	empty fruit bunch
EPP	Entry Point Project
ETP	Economic Transformation Programme
FFB	fresh fruit bunch
GNI	gross national income
MDF	medium-density fibre (for boards)
MF	mesocarp fibre
NKEA	National Key Economic Area
OPBC	Oil Palm Biomass Centre
OPT	oil palm trunk
PV	photovoltaic
PKO	palm kernel oil
PKS	palm kernel shells
POME	palm oil mill effluent