IEA Bioenergy
Technology Collaboration Programme

Bioenergy in remote Indigenous communities

Utilising woody waste from mine clearing in northern Australia

IEA Bioenergy: Task 43

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Dr Sam Van Holsbeeck

Edited by Kelly Murphy

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Summary

Remote Indigenous communities around the world are socioeconomically disadvantaged and highly reliant on fossil fuels for their energy needs. Indigenous community-owned forests are often cleared and burnt ahead of mining developments. The potential for forest biomass salvaged from mine-clearing to support the energy needs of the remote Indigenous community of Aurukun and two nearby potential bioenergy hubs in the western Cape York Peninsula in northern Australia is evaluated. Results show at least 88,100 dry tonnes of forest biomass per year are available in the first thirteen years (from 2021) and 99,300 dry tonnes/year between years 14-40. Modelled energy yields from gasification show promising results, providing over 60% of the energy demand in two of the three bio-hubs in the next 13 years. Pyrolysis energy yields are low, however, additional biochar yields can be used for local mine rehabilitation and could provide new local Indigenous employment and business opportunities. The findings can inform the mining sector in making more informed land use and energy decisions, and bioenergy industry policymakers and investors wanting to support remote Indigenous community development in places where extractive industry developments are clearing large areas of forest.

1. Introduction

Around the world, there is a growing awareness and adoption of woody biomass energy [1,2]. In Australia, wood-based bioenergy is still largely the ‘forgotten renewable’ [3] as there remains an underdeveloped opportunity that links sustainably derived forest biomass with energy generation and climate change mitigation goals [3]. In some places of Australia, extensive forest resources are impacted by mining developments that clear large areas of forests [4,5]. The clearing and burning of waste from the often Indigenous-owned forests have typically preceded mining in northern Australia. However, the opportunity to integrate forestry operations involving the pre-mining salvage harvesting and local processing of high-value solid wood products alongside chipping of lower grade logs and other woody residues for local bioenergy feedstock has never been explored [22]. Thus, a better understanding of woody biomass supply chains and conversion technologies that are compatible with local energy needs, land use, and integration with sustainable forestry practices, is needed [6].

Indigenous communities in northern Australia, own, manage, or have special rights over extensive forest resources and are highly impacted by mining development [21]. Quite often the communities face low energy security and are disconnected from the power grid and reliant on diesel for their energy needs [7,8]. Limited access and unreliable energy supply have negative impacts on community wellbeing, education, health, and sustainable community development [9]. The development of small-scale community-based bioenergy industries could provide a solution to support sustainable economic development in this region. Implemented to meet the community demand, these systems could provide commercial partnerships and reinvestment into the community, alongside local employment, reduced-cost electricity, and energy security.

Small-scale community-based renewable energy systems have been successfully implemented around the world [10–12]. Bioenergy systems based on waste woody biomass are one such option and conversion technologies such as combustion are adaptable to community needs, are readily available and can deliver heat, cooling, and power [2,13]. Small-scale gasification and pyrolysis systems can also produce carbonaceous biochar [14] that can be used for soil improvement [15]. Such energy projects can reduce environmental impacts compared to fossil energy systems, and have the potential to be integrated with waste and biomass supply streams of local industries (e.g. forestry, mining) [16]. In decentralized locations such as remote parts of northern Australia, biomass conversion systems are best applied on a small scale using locally available waste feedstocks, for example, those derived from bauxite mine clearing, to avoid complex and costly supply chain and operational logistics [17–19] while diversifying the supply of energy [1,20].

This report explores the potential for waste woody biomass sourced through integrated forestry operations before bauxite mine clearing in the Weipa-Aurukun region of western Cape York Peninsula to support the energy needs of the region’s remote Indigenous communities. The case study assesses the forest biomass resources potentially available for the generation of bioenergy and biochar at a regional level; the spatial and temporal distribution of forest biomass availability for three potential community-based bioenergy hubs in the region; and the suitability of different wood-fired energy conversion systems that could be installed at the proposed hubs. The findings provide strategic guidance for decision-making by the mining sector and bioenergy industry policymakers and investors wanting to reduce environmental impacts and support remote Indigenous community development.

2. Study area

The study focuses on the Amrun area of the Rio Tinto Mining Lease 7024 (i.e. the AML) which covers 103,000 ha between Weipa (south of the Embley River) and Aurukun in the western Cape York Peninsula (Figure 1). Aurukun is a town of around 1200 mostly local Indigenous Wik and Wik-Waya people. It is one of the larger communities in the western Cape York Peninsula and one of the most disadvantaged communities in Australia [21]. The Accessibility/Remoteness Index of Australia (ARIA) rates Aurukun as ‘very remote’ with limited availability of goods, services, and opportunities for employment [21]. The Aurukun Shire is reliant on cooperative arrangements with the government, outside organisations, and businesses to grow commercial activities and local employment. Through pre-mining integrated forestry operations, currently wasted forest products from nearby mining developments could be diverted to commercial solid wood products and energy markets to reduce the environmental impacts of mining and support much-needed community development in the Weipa-Aurukun region.

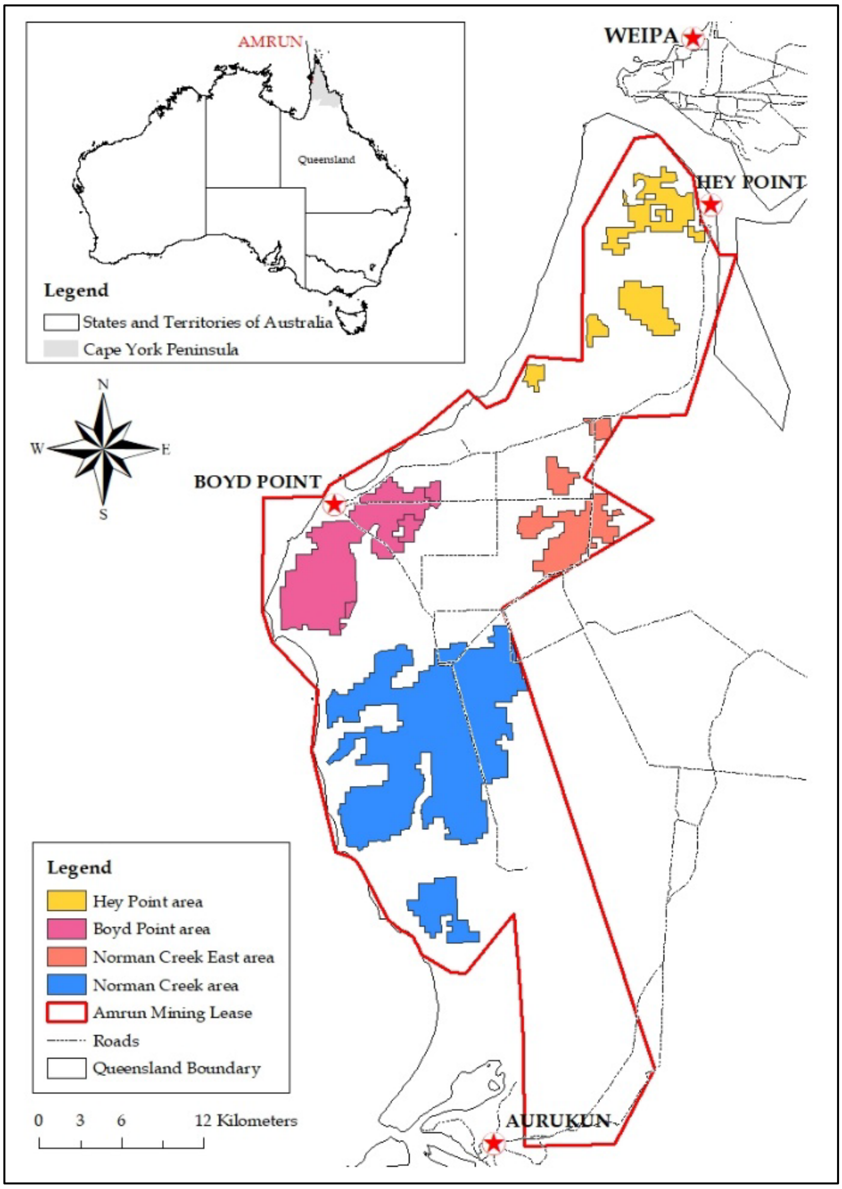

Figure 1. The Amrun Mining Lease (AML) and its distinct mining areas (covering 103,000 ha) in the western Cape York Peninsula.

The AML is mostly covered by savanna woodlands to open-forest with dominant canopy species *Eucalyptus tetrodonta* (Darwin stringybark), *Corymbia nesophila* (Melville Island bloodwood), and *Erythrophleum chlorostachys* (Ironwood). The savanna woodlands with interest for forest resources cover vast areas of Cape York Peninsula, estimated at nearly 2 million ha [22], with historically very little disturbance other than sustaining the livelihoods of local Indigenous communities for many thousands of years. The AML has four distinct mining areas – Hey Point, Boyd Point, Norman Creek East, and Norman Creek (Figure 1). The AML has an expected mine life of 40-years (operations commenced in 2018).

3. Methodology

The case study used the following approach:

- Determine the woody biomass availability from pre-mining salvage harvests (i.e. thinning and final clearfall harvests) based on the forest inventory data and mining footprint mapping.
- Evaluate the locations and energy capacities of three potential wood-fired bioenergy hubs based on the estimated biomass supply to the facilities, the energy demand of nearby Indigenous communities, and different biomass transport scenarios.
- Compare the potential bioenergy and biochar yields at the three hubs according to two conversion technologies - gasification and pyrolysis.

3.1. WOODY BIOMASS ASSESSMENT

The woody biomass potentially available for bioenergy consists of chip logs, sawmill residues, and parts of trees unsuitable for timber such as tops, bark, branches, and stumps (i.e. harvest residues). No woody biomass is required to remain on-site for sustainability purposes. Depending on the location within the AML, a final pre-mining integrated salvage harvest will not occur in many areas for up to 40 years from January 2021, which enables an intermediate silvicultural treatment harvest (i.e. thinning) in some areas. This silvicultural treatment is anticipated to stimulate growth in the retained trees in response to reduced competition, and it is thereby assumed that before their final clearing, the thinned forests will reach a state equal to that measured in the forest inventory. All woody biomass is converted to a unit of air-dry metric tonnes (DMT) with a moisture content of 12%. A lower heating value of 16.83 (MJ kg^{-1}) [23,24] was used for the conversion of DMT of forest biomass to energy (PJ).

The average chip log volumes (m^3 ha^{-1}) in the AML available at a final integrated salvage harvest were directly derived from the product breakdown in the forest inventory (Table 1). During silvicultural treatment harvests, a volume of 21.84 m^3 ha^{-1} of chip logs (30% moisture content) can be retrieved based on an average silvicultural treatment rate of 25 green metric tonnes (GMT) ha^{-1} in native forests [25].

Table 1. Summary of the forest inventory data for trees ≥10 cm DBH (average per ha values).

Stems /ha	Basal Area (m^2/ha)	Saw Vol.* (m^3/ha)	Veneer Vol.* (m^3/ha)	Chip Vol.* (m^3/ha)	1 m Stump Vol.* (m^3/ha)	AGB** (ODMT /ha)	Non-stem residue *** (ODMT/ha)
217.4 ± 13.5	12.9 ± 0.9	14.63 ± 2.2	2.79 ± 0.3	51.95 ± 4.5	9.44 ± 0.7	123.99 ± 9.8	54.72 ± 3.7

*Vol. – Timber volume under bark (first meter of stem not included). ± values are standard errors.
**AGB values are based on basic density and include the first meter of the stem. ± values are standard errors.
***Non-stem residue value includes tops, branches and leaves.

The amount of harvest residues was only calculated for the final integrated salvage harvests. The harvest residues include a 1 m stump, treetops, branches, and bark. Leaves constitute 5% of the AGB [26] and are not included in the harvest residue calculation. Thus, the proportion of harvest residues is calculated by subtracting the volume of veneer, saw, and chip logs from the AGB together with the leaf fraction, as outlined below.

$$V_{harvest\ residue} = \theta AGB_{est} - V_{veneer\ log} - V_{saw\ log} - V_{Chip\ log} - 0.05 * \theta AGB_{est}$$

Where: $V_{harvest\ residue}$ is the green volume of harvest residues (m^3);

θ is a species-specific conversion factor (m^3 kg^{-1}) to convert oven-dry AGB_{est} into green volume (V);

AGB_{est} is the aboveground tree biomass (kg of oven-dry matter);

$V_{veneer\ log}$ is the green volume of veneer logs (m^3);

$V_{saw\ log}$ is the green volume of saw logs (m^3);

$V_{chip\ log}$ is the green volume of chip logs (m^3); and

0.05 compensated the percentage of leaves from the AGB_{est}.

In addition to the chip log and harvest residues, a community sawmill at Hey Point will process on average 30,000 GMT of logs per year with a sawn product recovery rate of 30% [27]. This corresponds to 18,347.13 m^3 yr^{-1} or 19,421.50 DMT yr^{-1} of sawmill residues.

The different wood density (ρ) values of the dominant tree species used for the conversion of the tree volume (m^3) to mass (kg) at various moisture contents are presented in Table 2. The distribution of tree species according to the inventory is also presented in Table 2.

Table 2. Distribution and density (ρ) values* of the dominant tree species of the AML.

Species	Green density (kg/m^3)	Air-dry density (kg/m^3)	Oven-dry density (kg/m^3)	Reference	Share of Species in AGB** [%]
Eucalyptus tetrodonta	1163.5	1092.0	895.0	[28]	70.9 ± 4.0
Corymbia nesophila	1107.6	993.0	852.0	[28]	12.7 ± 2.8
Erythrophleum chlorostachys	1345.8	1220.9	1035.2	[28]	6.6 ± 2.3
Miscellaneous***	920.3	792.8	707.9	[29]	9.8 ± 2.2
Moisture Content	30%	12%	0%		

* Where unavailable, specific wood densities were estimated from available wood densities [28,29].

** Inventory results. AGB calculated based on basic density for trees ≥10 cm DBH; ± values are standard errors.

*** The Miscellaneous class included *Corymbia stockeri* as an occasional canopy species, and *Grevillea glauca*, *Planchonia careya*, *Acacia rothii*, and *Xylomelum scottianum* as the dominant mid-strata species.

3.2. SPATIAL AND TEMPORAL DISTRIBUTION OF WOODY BIOMASS AVAILABILITY

The spatial assessment of forest biomass availability was mapped, using a geographic information system (GIS), according to the four mining areas shown in Figure 1. The biomass quantities were associated with the mining areas corresponding to the size of the area and the projected final harvest year. The forest type and therefore the distribution of species and tree volumes is generally uniform throughout the four mining areas. However, the years in which an area will be cleared varies (Figure 2). Areas to be cleared for mining in the next 13 years (from January 2021) will thereby not be suitable for an intermediate silvicultural treatment harvest. Areas to be cleared for mining between years 14-40 will undergo at least one silvicultural treatment harvest.

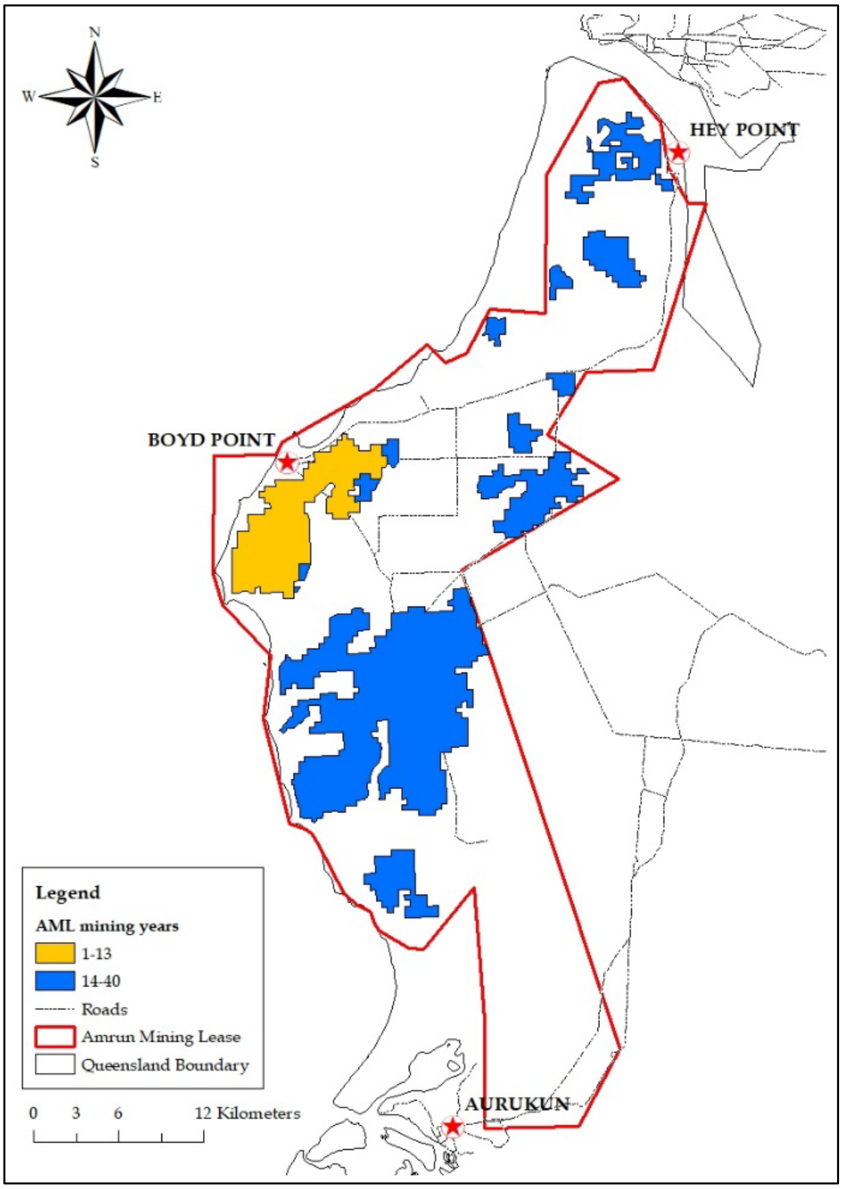

Figure 2. The temporal mining periods of the mining areas within the AML. The colour-coded time periods define the years of the final harvest.

Three locations (i.e. bioenergy hubs) where potential energy conversion could occur were identified: the town of Aurukun, with an estimated annual energy demand of 0.36 PJ and a population of 1200; the community sawmill at Hey Point with an estimated energy demand of 0.15 PJ which is equivalent to a population of 500; and the Boyd Point mining camp with an energy demand of 0.30 PJ and population of 1000, according to the average energy consumption of 300 GJ per person per year [30].

There is uncertainty around the longevity of the Boyd Point mining camp as a potential bioenergy hub; hence two scenarios were established (Figure 3). In scenario A, Boyd Point is considered a temporary location that will be closed when mining of the area is completed. Preference was therefore given to the town of Aurukun and the proposed Hey Point community sawmill in the mining area allocation. In this scenario, the areas of Hey Point and Norman Creek East will be allocated to the proposed Hey Point hub, the Norman Creek area will be allocated to the town of Aurukun, and the remaining Boyd Point area, largely cleared for mining within the next 13 years, will be allocated to the proposed Boyd Point hub. Scenario B explores the option of considering Boyd Point a permanent location and therefore allocated the Norman Creek East area to Boyd Point instead of Hey Point. Since Hey Point will likely receive a surplus of forest biomass as sawmill residues, there will be a significant amount of biomass available for the Hey Point hub and the associated demand for energy is relatively low compared to Boyd Point and Aurukun. The other configurations between the mining area and the proposed hubs remain unchanged (Figure 3).

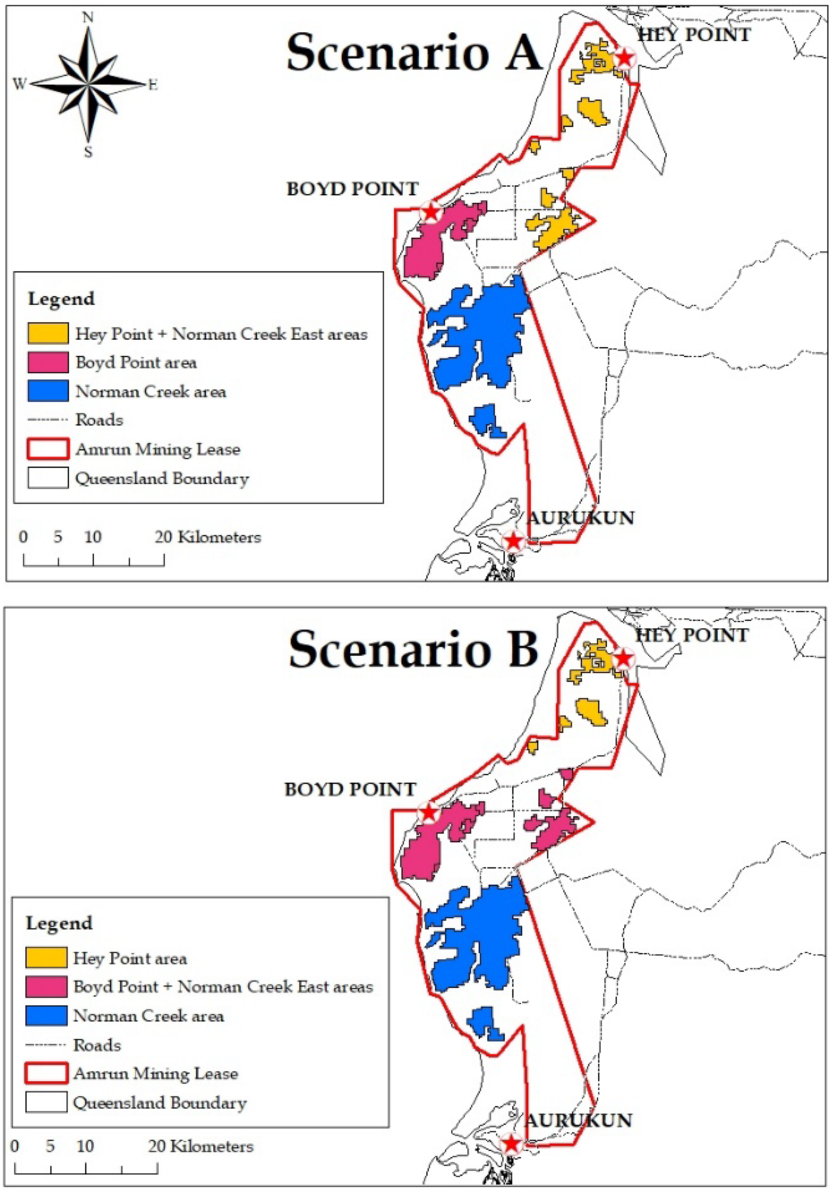

Figure 3. Spatial visualization of mining area allocation in scenarios A and B where the Norman Creek East area is allocated to Hey Point and Boyd Point, respectively.

3.3. BIOENERGY AND BIOCHAR PRODUCTION

To maximize the potential of the available forest biomass for bioenergy and biochar production according to the energy demand and geographic location, the following two conversion scenarios were compared: gasification, and combined energy and biochar through pyrolysis. For the gasification scenario, we assumed a process with 20% energy efficiency. For the pyrolysis scenario, we assumed a slow process with an energy efficiency of 10% and a 35% char yield. The potential woody biomass availability that underpins both scenarios is a theoretical potential [31], but also a realistic estimate given the forests are located on Mining Lease tenure, meaning all biomass can be removed (i.e. no biomass is required to be retained on-site for sustainability purposes).

Given the low energy demand in the remote locations of western Cape York Peninsula and the relatively low supply chain cost (mostly transport) of bulk forest biomass quantities from salvage harvest, the service area of a bioenergy hub can be minimised. This increases the overall efficiency of the potential hubs. In Australia, a 90 km return trip for chip transport is considered an allowable distance to maintain a profitable supply of a facility with an installed capacity of 6 MW [17,32]. In this study, a service area with a radius of 40 km was used. However, since the harvest areas within the AML are clearly defined, the biomass harvest areas could be visually designated to the potential hubs. Regardless of the scenario, there will be no competition between hubs for forest biomass.

4. Results

4.1. WOODY BIOMASS ASSESSMENT

Table 3 presents the total woody biomass and energy potential from the AML over 40 years from 2021. The total energy in petajoules (PJ) is the theoretical energy potential in the forest before harvest, transport, storage, and conversion.

Table 3. Total woody biomass and energy potential of the AML over 40 years (from 2021).

Breakdown	m3	m3/ha	DMT	PJ
Chip log silvicultural treatment	477,779.29		505,757.14	8.51
Chip log final harvest	1,407,551.83	51.95 ± 4.5	1,478,807.32	28.54
Harvest residue final harvest	1,764,089.71	65.11 ± 4.4	1,843,653.07	31.04
Sawmill residue	733,885.11		776,860.04	13.08
Total	**4,383,305.95**		**4,605,077.56**	**81.17**

4.2. SPATIAL AND TEMPORAL DISTRIBUTION OF WOODY BIOMASS

Table 4 presents a breakdown of the potentially available woody biomass by harvest type and mining zone across the AML. In scenario A, a total of approximately 10,800 DMT yr^{-1} in years 1-13 and approximately 27,500 DMT yr^{-1} in years 14-40 can be transported to the Hey Point hub. The remaining biomass in the Boyd Point mining area totals approximately 50,100 DMT yr^{-1} in years 1-13 and approximately 2,200 DMT yr^{-1} in years 14-40 and is allocated to the Boyd Point hub.

In scenario B, a total of approximately 55,100 DMT yr^{-1} in years 1-13 and approximately 14,900 DMT yr^{-1} in years 14-40 will be moved to the Boyd Point hub. In this scenario, the Hey Point hub will receive approximately 5,800 DMT yr^{-1} from the Hey Point mining area in years 1-13 and approximately 14,800 DMT yr^{-1} in years 14-40, with approximately 19,400 DMT yr^{-1} in additional woody biomass from the community sawmill in years 1-40.

Table 4. The woody biomass potential in dry metric tonnes (DMT) from silvicultural treatment and final harvest across the AML.

Year (from January 2021)	Mining zone	Area (ha)	Chip log silvicultural treatment (DMT)	Chip log final harvest (DMT)	Harvest residues final harvest (DMT)	Total* (DMT)	Annual total (DMT yr-1)	Average total (DMT ha-1)
1-13	Hey Point	3,254.80	75,253.67	-	-	75,253.67	5,788.74	23.12
1-13	Norman Creek East	2,807.11	64,902.82	-	-	64,902.82	4,992.52	23.12
1-13	Boyd Point	5,700.52**	11,098.69	284,927.14	355,223.29	651,249.12	50,096.09	114.24
1-13	Norman Creek	15,332.58	354,501.96	-	-	354,501.96	27,269.38	23.12
1-13	AML	27,095.01	505,757.14	284,927.14	355,223.29	1,145,907.57	88,146.74	
14-40	Hey Point	3,254.80	-	177,642.31	221,469.56	399,111.87	14,781.92	122.62
14-40	Norman Creek East	2,807.11	-	153,208.30	191,007.27	344,215.57	12,748.72	122.62
14-40	Boyd Point	480.03	-	26,199.34	32,663.14	58,862.48	2,180.09	122.62
14-40	Norman Creek	15,332.58	-	836,830.22	1,043,289.82	1,880,120.04	69,634.08	122.62
14-40	AML	21,874.52	-	1,193,880.17	1,488,429.78	2,682,309.96	99,344.81	
1-40	**AML**	**48,969.53**	**505,757.14**	**1,478,807.32**	**1,843,653.07**	**3,828,217.53**	**-**	**-**

*Does not include 19,421.50 DMT yr-1 sawmill residue generated by the community sawmill at Hey Point.

**Includes 5220.49 ha under final harvest by year 13 and 480.03 ha under silvicultural treatment by year 13 (for final harvest by year 40).

4.3. BIOENERGY AND BIOCHAR PRODUCTION

Based on the theoretical biomass availability of the AML, there is potential to supply up to 81.17 PJ of energy over 40 years (Table 3). Utilising chip logs and other harvest residues from the areas cleared for mining can produce up to 0.71 PJ and 0.78 PJ of energy per year, respectively. Residues from local processing of the sawlog component could add 0.33 PJ to the annual energy potential. Silvicultural treatments in some areas of the AML could generate an additional 0.21 PJ of energy per year derived from chip logs.

Bioenergy from chip logs and harvest residues is evenly distributed across the AML. In the four temporal and spatial scenarios, energy efficiency varied between the two technologies that were compared (Figure 4). Gasification had the highest energy efficiency, which can satisfy the energy demand at the Hey Point hub (0.15 PJ) in years 14-40. In years 1-13, the energy supply can meet 68%, 60%, and 26% of the energy demand at the Hey Point, Boyd Point, and Aurukun hubs, respectively. Pyrolysis facilities have low electric efficiency and cannot satisfy the energy demand of any of the three hubs. Only at the Hey Point hub, where sawmill residues are added to the feedstock, can up to 55% or 39% of the energy demand be provided through pyrolysis in scenarios A and B, respectively.

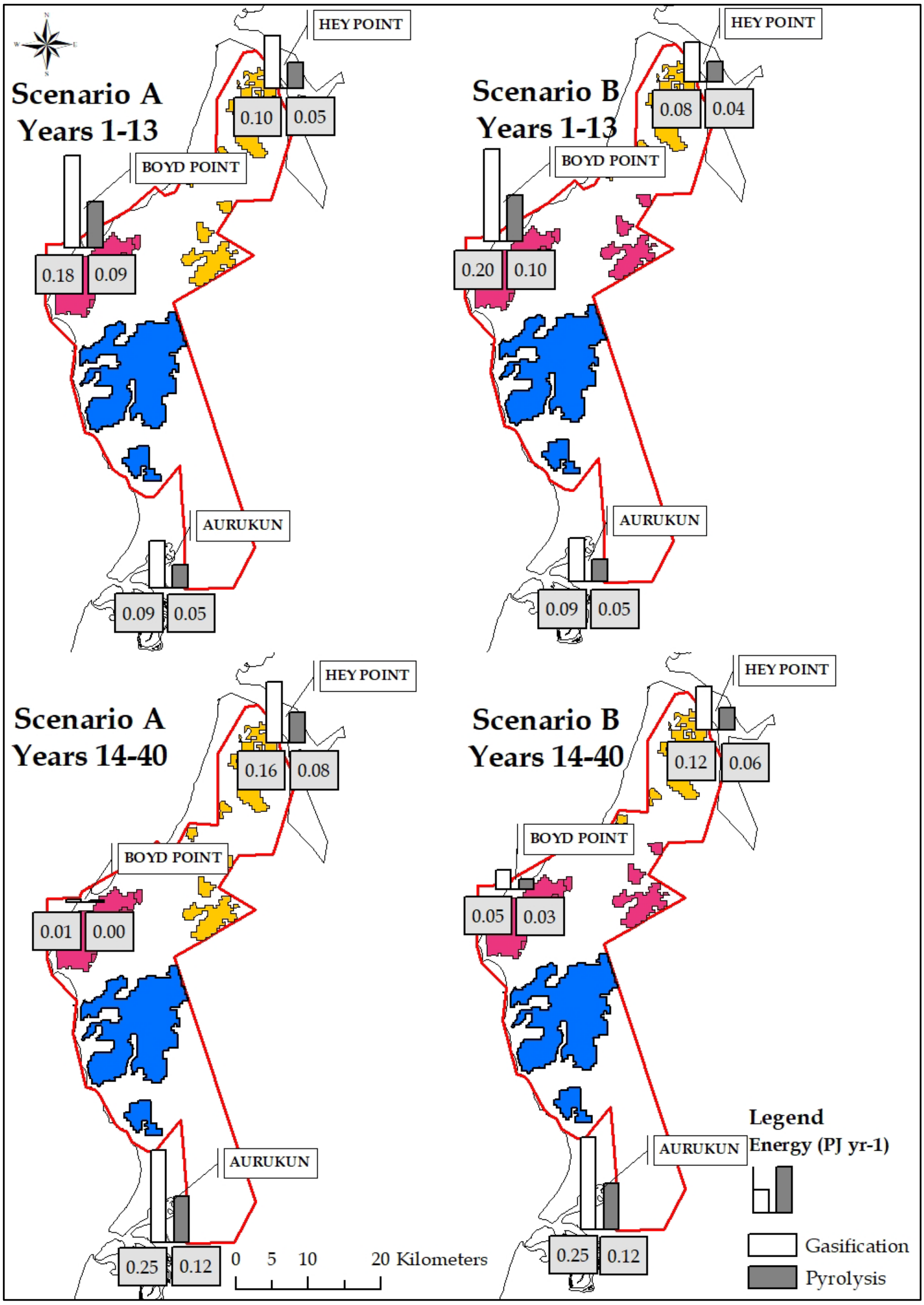

Figure 4. Potential annual biomass energy (PJ) of the gasification and pyrolysis hubs at Hey Point, Boyd Point, and Aurukun during two respective mining periods (years 1-13 and years 14-40) across the AML based on annual biomass availability. Results are presented for scenarios A and B, as described in Figure 3.

5. Discussion

The theoretically available waste woody biomass from the AML shows there is potential for this material to support the energy needs of remote Indigenous communities in the Weipa-Aurukun region of the western Cape York Peninsula. Utilising chip logs and other harvest residues from the cleared areas can produce up to 0.71 PJ and 0.78 PJ of energy per year, respectively. Residues from local sawmilling activities could add 0.33 PJ to the annual energy potential. As some areas within the AML are only planned to be cleared for mining in the next 14-40 years (after January 2021), opportunities to perform silvicultural treatment could generate an additional 0.21 PJ of energy derived from chip logs. The silvicultural treatment is anticipated to increase the growth of retained trees in response to reduced competition.

The woody biomass assessment is a measure of the theoretical potential. Often, this would be considered an upper limit of biomass availability as losses may occur during biomass supply chains [31,33]. However, in this study, the theoretical potential is a realistic estimation of the available potential (i.e. biomass available at the facility). During salvage harvesting of the AML, most of the biomass will be collectable and there is no requirement to retain a proportion for sustainability (i.e. soil or other ecological values) purposes. The current practice in the region is to rake, pile, and burn the biomass in the field. It is also important to note that the theoretical biomass potential from silvicultural treatment (i.e. intermediate harvest) in this study has only considered the harvest of chip logs. In the case harvest residues would be recovered from a silvicultural treatment, selectively harvesting chip logs at a rate of 21.84 m^3/ha [25], there is potential to generate an additional 0.19 PJ of energy per year from harvest residues after a silvicultural treatment. This would be in addition to the 0.21 PJ of energy from chip logs already indicated in this study.

When assessing the available biomass and energy potential from the AML, attention should be given to the temporal distribution of harvesting (i.e. intermediate or final harvests). The figures presented in this study consider the fact that some areas will be salvage (final) harvested within 13 years from the start of 2021, all of which appear to be located in the Boyd Point mining area. Those regions are therefore not suitable for silvicultural treatment. Yet, other areas will only be salvage harvested within 40 years from the start of 2021 and are therefore suitable for silvicultural treatment at an intermediate time. As a result, the annual availability of biomass energy varies between years 1-13 and years 14-40. The extent of salvage harvesting is anticipated to be higher in the initial years of Mining Lease agreements which likely results in a much-increased biomass availability as harvesting commences (in years 1 and 14) and will be near zero at the end of the mining period (in years 13 and 40). This highlights the need for suitable biomass storage facilities at the proposed bioenergy hubs, or the option to convert the biomass into pellets, to facilitate a more even biomass distribution over the next 40 years.

The spatial distribution of forest biomass availability for potential bioenergy hubs in the region was investigated using two scenarios where the Norman Creek East area is either allocated to a proposed Hey Point facility (scenario A) or a proposed Boyd Point facility (scenario B). The results indicated significant losses of biomass for Boyd Point, especially in years 14-40, if the Norman Creek East area was allocated to Hey Point. In that case, temporary solutions such as mobile power facilities could be considered for Boyd Point. In both scenarios, Hey Point would also receive surplus biomass in the form of processing residues from the community sawmill which aims for a minimum throughput of 30,000 green tonnes of wood per annum [27]. The sawmill residue is considered a significant proportion of the total biomass availability at the proposed Hey Point facility and is already located at the site. Because of the large volume of sawmill residue and the low demand for energy at Hey Point, the energy demand can be easily satisfied depending on the conversion technology.

Gasification facilities with a power efficiency of 20% can generally not meet the energy demands of the proposed hubs. Only at Hey Point during years 14-40 can a gasification facility meet or exceed the demand. However, in scenario A, more than 60% of the demand can be met in Hey Point and Boyd Point in years 1-13. Applying scenario B, similar performances were estimated in Hey Point and Boyd Point, however, with slightly reduced performance (56%) in Hey Point due to the allocation of the Norman Creek East mining area to the Boyd Point hub. During years 14-40, the potential power production in Boyd Point drops significantly due to the clearing of the Boyd Point area, suggesting a very poor long-term potential for a bioenergy hub in the Boyd Point mining camp. Gasification facilities could be considered for Hey Point, although extra biomass may have to be provided from other sources to meet the energy demand.

Through pyrolysis, the power supply is low and insufficient to meet any significant energy demand at the three hubs. Compared to gasification, pyrolysis would generate biochar as a by-product which could be advantageous for improving mine rehabilitation outcomes across the AML. Producing biochar in Aurukun, the most southern part of the AML, may not be favourable as the biochar must be transported back to the mining areas, some of which are located 80 km north. There are potentially high logistical costs of redistributing biochar to the mining area, however, these could be offset by the improved soils and mine rehabilitation outcomes of distributing the char throughout rehabilitation areas. Portside locations of Boyd Point and Hey Point are more centralized for the more efficient redistribution of biochar throughout the AML or other adjacent mining areas (i.e. surrounding Weipa to the north). There may be some small high-value biochar markets that could be explored as a return on investment strategy and to support local Indigenous employment opportunities. If the focus is shifted to the local production of biochar, small-scale mobile char facilities could provide a smart solution for this purpose.

6. Conclusion

This study estimated the annually and spatially available waste woody biomass resource in Amrun Mining Lease and indicated large quantities of chip logs and forest harvest residues are readily available from mining salvage harvesting. Chip logs can be obtained from silvicultural treatment of some mining areas before a final pre-mining salvage harvest. Timber processing residues from a proposed community sawmill could also make a substantial contribution to the biomass supply. In combination, these supplies of currently wasted woody biomass could substitute a proportion of the diesel use at three potential remote Indigenous community-based bioenergy hubs located at Hey Point, Boyd Point, and the town of Aurukun.

Gasification was found to be the most efficient, however, additional biomass may need to be sourced to secure continuous power production. Conversion of biomass to pellets is an important consideration in establishing biomass to bioenergy supply chains in the western Cape York Peninsula. This will be critical to securing a consistent biomass supply and reducing energy fluxes in the region. The production of biochar is another beneficial consideration given its potential to support improved outcomes of mine rehabilitation.

The study’s findings can inform the mining sector in making more informed land use and energy decisions, and policymakers and bioenergy industry investors wanting to support remote Indigenous community development in northern Australia and elsewhere where extractive industry developments are clearing large areas of productive forests.

Acknowledgments

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