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ISSUES PAPER

IN SUPPORT OF THE DEVELOPMENT OF A BIOMASS FUEL SUPPLY CONCEPT IN NAMIBIA

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ABBREVIATIONS

| | |
|-----------------|--|
| BSG | biomass suppliers group |
| ECB | Electricity Control Board |
| FSA | fuel supply agreement |
| GIZ | Deutsche Gesellschaft für Internationale Zusammenarbeit |
| GRN | Government of Namibia |
| km | kilometre, i.e. one thousand metres |
| kt | kilotons, i.e. one thousand metric tons |
| kt/a | kilotons per annum |
| kWh | kilo Watt hour, unit of energy |
| MAWF | Ministry of Agriculture, Water and Forestry |
| MET | Ministry of Environment and Tourism |
| MLR | Ministry of Lands and Resettlement |
| MME | Ministry of Mines and Energy |
| MoL | Ministry of Labour |
| MTI | Ministry of Trade and Industry |
| Mt | megatons, i.e. one million metric tons |
| Mt/a | megatons per annum |
| MW | Megawatt, unit of electrical generation capacity of a power plant |
| N\$ | Namibian dollars |
| NamPower | Namibia Power Corporation (Pty) Ltd |
| NPC | National Planning Commission |
| NQA | National Qualifications Authority |
| Project | GIZ/MAWF De-bushing in Namibia Project |
| SADC | Southern African Development Community |
| SEA | Strategic Environmental Assessment |
| SWOT | strengths, weaknesses, opportunities and threats |
| t/ha | metric tons per hectare |
| ToR | Terms of Reference |
| TWh | tera Watt hour, i.e. one billion kWh, unit of energy |
| VTC | Vocational Training Centre |

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1. Introduction

In mid-August 2014, the MAWF/GIZ Support to De-bushing Project commissioned VO Consulting to compile an Issues Paper focusing on the main issues and aspects likely to play a role in the establishment of sustainable biomass fuel supplies from invader bush for one or several large-scale users in Namibia.

2. Purpose

This Issues Paper provides a brief overview of the main issues and aspects of importance in the establishment of sustainable biomass fuel arrangements from local invader bush that can supply large-scale users such as a biomass-fuelled power plant and/or similar industrial-scale off-takers, and presents recommendations on the way forward.

3. Structure of this paper

The remainder of this Issues Paper consists of the following parts:

- Section 4 summarises the approach used in the compilation of the issues;
- Section 5 describes the high-level supply and demand side issues and aspects under which a biomass fuel supply concept is to be established;
- Section 6 discusses the likely barriers and challenges in the way of establishing large-scale biomass supply activities in the country;
- Section 7 identifies the critical stakeholders who are likely to be impacted and/or affected by the establishment of biomass supply chains in Namibia;
- Section 8 focuses on the strategic and main operational issues of an industrial-scale biomass fuel supply in the country;
- Section 9 reflects on the elements that are necessary to create a national biomass fuel supply concept; and
- Section 10 presents a SWOT and risks summary, the main conclusions of this Paper, and a set of recommendations to describe the way forward.

4. Approach

The author has identified and described the main issues likely to be of importance in the establishment of sustainable biomass fuel supply arrangements from local invader bush following a review of some of the literature on the topic and interactions with persons currently or intending to be active in the biomass sector, including a dedicated brainstorming session. The incorporation of such input has been at the discretion of the author.

5. Demand and supply of woody biomass in Namibia

This section provides a high-level description of **the main supply and demand side issues and aspects** under which a Namibian biomass fuel supply concept is to be established.

In the context of this paper, a “**biomass supply concept**” is understood to include *the legal, institutional, organisational, financial and related aspects that have to support the emergence and systematic development of value chains that involve and benefit from Namibia’s considerable invader bush resource.*

Presently, more than 26 million hectares of Namibian rangelands are infested with invader bush in Namibia. Assuming a conservative average yield of 7.5 t/ha therefore results in a **total bush resource of some 200 Mt**. Evidence suggests that invader bush regenerates itself within 5 to 15 years if no post-harvesting measures were taken, which is indicative of re-growth rates of between 5 to 20% per year. Re-growth depends on the amount and timing of rainfall, bush species, degree of soil disturbance, bush use and aftercare measures applied, and others. While such re-growth rates cannot be applied across the entire bush-infested area, mainly because of the significant difference between bush species, rainfall patterns, soil and usage characteristics over a given number of year, they still provide a first-order estimate of **annual re-growth, which amount to an estimated 10 Mt/a**.

The **total annual consumption of Namibian wood and wood products** is estimated to amount to some **800 kt/a**. This includes an estimated 440 kt/a of wood and woody biomass (not all from bush-infested areas) used for domestic and farming purposes, harvesting operations for charcoal (using about 200 kt/a), wood chips for the cement industry (about 80 kt/a), torrefied wood pellets and several wood briquette manufacturers (about 40 kt/a), and wood harvesting for recreational, high-end domestic use as well as for export (some 40 kt/a). Most of these figures are estimates, as reliable wood collection and harvesting figures – particularly those used by domestic end users – are unavailable. Also, the amount of woody **biomass lost as a result of intentional and accidental veld fires is not included** in the above. Noting that some of the woody biomass use identified above is from non-invader bush, the **estimated annual harvest and use amounts to some 0.4%** of the total invader bush resource, or some **8% of the average annual re-growth**. Although these numbers are far from certain or accurate they illustrate that the amount of woody biomass in bush-infested areas is significant, and that current woody biomass use is significantly less than the annual increase of the resource.

As illustrated above, the local demand for woody biomass and products from invasive bush species can be considered underdeveloped. However, numerous new and/or additional uses of this resource can in principle be developed and could – in time – **contribute to the country’s economic development**: markets that could utilise local woody biomass include those that are already established and operational, including for domestic wood use, for charcoal and wood briquettes, and a variety of enterprises that include the provision of biomass fuel to one or several power stations, wood chips for furniture and as a supplement in livestock fodder, white and green pellets, biofuels and as a source of natural fibre.

This paper focuses mostly on the requirements for the establishment of a biomass fuel supply concept providing one or several large off-takers with woody biomass products from invader bush. One such potential group of end users includes those who seek to utilise such **biomass for its energy content**. The calorific value of Namibian woody biomass from invader bush ranges between 4 and more than 6 kWh per kilogram. This implies that the **total calorific potential of bush-infested areas in Namibia amounts to more than 1 000 TWh**, while the annual **re-growth has a calorific value of some 50 TWh**. Even with conversion losses of 90%, the annual re-growth alone would more than adequately cover Namibia's total current electrical energy needs, amounting to some 4 TWh in 2014. However, it would be premature to suggest that Namibia could rely on biomass fuel from its vast invader bush resource base to generate its electricity needs. Indeed, it is most undesirable to have an energy mix that only relies on one or two energy carriers. In this spirit therefore it **is considered both feasible and desirable for Namibia to increasingly utilise its local biomass fuel resource to contribute to the country's overall electrical energy mix**, and this becomes more likely and viable if the multiple challenges identified in this Issues Paper can be overcome.

Namibia's woody biomass resource locked in bush-infested areas far exceeds what the market demands, even if considerable additional de-bushing activities and end uses were to be established. In other words, Namibia's **invader biomass resource** is abundant, and at least in principle, **a most useful local renewable resource**. Invader bush has well-documented negative repercussions on the country's agricultural sector, mainly as a result of the loss of productive capacity of rangelands, the decline of groundwater recharges from rainwater as a result of evapo-transpiration from bush, and the loss of biodiversity. Given these negative impacts of bush infestation, one wonders why the bush resource has and is not being used more deliberately. One of the main reasons is the notable **absence of well-established value chains that use or benefit from the use of biomass from invader bush**. Another reason is the **lack of one or several formal markets for biomass from bush**. Also, the **absence of a bush use policy** is evident: it would necessitate an intra-ministerial collaboration between the Ministry of Agriculture, Water and Forestry (MAWF) on the one hand, and the Ministry of Lands and Resettlement (MLR) and the Ministry of Trade and Industry (MTI) on the other. Despite numerous pronouncements, including by high-ranking officials from the above entities, these institutions have as yet **not offered any compelling or realistic vision of how the national bush challenge could be turned into economic growth opportunities**. The national demand for biomass from invader bush could likely be invigorated by **creating a clear and conducive legal and regulatory framework** in which large-scale bush utilisation is to happen in future.

The **non-familiarity of many potential project developers and funding institutions** in regard to the requirements to unlock Namibia's bush resource also constrains local market development. Most local funding entities are hesitant to provide finance for biomass production processes. Current bush use activities, such as by the charcoal industry, are dominated by **business models that often do not require access to formal loan funding**. Small-scale harvesters active in this industry use tools and equipment which are readily funded by the owner(s) of the biomass

resource. On the other hand, larger entities that produce tens or even hundreds of thousands of tons of harvested biomass per year require capital investments of the order of tens of millions of Namibian dollars (N\$), and incur operational costs exceeding several millions of N\$. Such investments require **bankable off-take agreements as securities, and convincing business models**. Presently, both such off-take agreements and realistic business models seem in short supply.

In addition, it is speculated that the **mind-set of bush resource owners** often stands in the way of becoming suppliers of biomass. Commercial agriculture, such as cattle breeding or game farming, are exposed to a **variety of external challenges and uncontrollable factors**, including the weather, product price development and impact of possible policy changes. Therefore, venturing into new and uncertain business fields that necessitate **investments that takes an unknown number of years to achieve payback** may not be palatable to many, although exceptions exist. This constrains the national supply, including in activities that have already created some value chains. The **absence of established market structures** that incentivise resource owners to participate in or individually embark on systematic bush harvesting is evident. Interestingly therefore, the abundance of the resource base says little about the ability and/or willingness to venture into becoming a supplier of woody biomass, especially because the **longer-term local demand for such products is unknown** or does not formally present itself.

The **local market for woody biomass products**, and especially those originating from invader bush, is **small by international standards** and has traditionally been slow to respond to create or respond to opportunities. **Few innovations**, as may likely be required to ramp up production, are evident, even though a number of small-scale entrepreneurs have developed new approaches. One reason for the **sluggish market dynamics is likely the limited size of the local market**, which offers few immediate opportunities for suppliers of woody biomass.

Another impediment to increasing the supply from bush harvesting operations, as is for example witnessed in the charcoal industry, is the **limited availability of a suitable labour force**. Reliance on a limited labour force usually incentivises greater mechanisation, and it remains unclear why this is not happening in Namibia.

In regard to the **commercial availability of woody biomass** in the country, for example for the manufacturing, construction and farming sectors, Namibia continues to **rely on standardised product imports from (mainly) South Africa**. In addition, the use of fossil fuels for industrial heating and electricity generation purposes, have not offered sufficient incentives to cause off-takers to switch fuel sources. In addition, and in the **absence of a degree of standardisation**, the reliability and pricing of substitute fuels from woody biomass continue to be obstacles. This is one of several factors indicative of a **catch 22 situation** in which the local bush utilisation industry finds itself: **the market does not offer products that have a limited local demand, and off-takers are weary to enter into supply agreements that have no or little track record in offering long-term security of supplies**. And therefore, the immature market neither offers sufficient investment opportunities nor the required investment certainty, the latter increasing the risk of investments and thus dis-incentivising would-be investors.

A characteristic of the **Namibian woody biomass market is its limited size and scale, and the presence of informal or immature value chain elements.** To illustrate, the charcoal industry relies on numerous informal contractors, for example to undertake bush harvesting. Such harvesters often merely sell their physical ability, which implies that the harvesting value chain elements remain both rudimentary as individual entrepreneurs prefer ad hoc arrangements to longer-term commitments as would be required to up-scale and formalise such activities. Such a short-term focus also reflects the entrepreneurial uncertainty about the future of the biomass supply industry and its longer-term potential. Notable exceptions are two companies not active in the charcoal industry who have business models that are underwritten by an industrial-scale off-taker on the one hand, and a private investor respectively.

A pathway towards strengthening both the supply and demand of biomass fuels in Namibia necessitates the active development of local off-take opportunities while deliberately strengthening the industry's value chain elements. A signal that could change the market would have to emphasise the **considerable local employment potential locked in the country's biomass sector, and the numerous local benefits arising from the increased use of Namibia's indigenous biomass resource.** However, most traditional finance and engineering considerations do not recognise the **wider economic value addition that occurs when local fuels displace imported ones,** and current policy does not actively pronounce itself on how such local industry development is to be invigorated.

6. Barriers and challenges of large-scale biomass fuel supply

This section describes the likely **barriers and challenges expected in the run-up and during the establishment of value chains** that provide feedstock to one or several large-scale biomass off-takers from invader bush in Namibia.

By way of illustration, a **5 MW thermal power plant** relying exclusively on woody biomass requires some **40 kt/a or 1 Mt over 25 years** when operating at a capacity factor of 80%, i.e. operating as a base load plant. At an assumed harvesting yield of 10 t/ha, the fuel required for the entire operating period **could be supplied from some 100 000 ha**, i.e. an area covered by a circle of almost 18 km radius when the area is harvested once only. If the average harvesting rate per hectare is halved, for example if the terrain is not suitable or if there are to remain “no-harvesting islands” within the total harvesting location, the area required for harvesting doubles and the radius (of a hypothetical circular area in which harvesting is to be done) increases to some 25 km.

When contrasted with the annual consumption of woody biomass in Namibia, an additional off-taker requiring **40 kt/a would represent an increase of some 5% of current use**, or one-fifth of the annual requirement of the charcoal fraternity, or one-half of the reported harvesting volume of EFF. Therefore, the **addition of one or several new off-takers each requiring several tens of kt/a can most likely be met quite easily by the market, and is unlikely to be a barrier.**

However, as argued in the previous section, **a market or market mechanism that would be able to almost instantaneously supply a power plant or similar industrial-scale off-taker does not exist in Namibia.** For entrepreneurs wishing to become suppliers, this is good news, and may seem attractive. However, the absence of more formal market and supply mechanisms also implies that **no market conditions have been established** as would likely have to be in place to reliably provide industrial biomass volumes over two or more decades. **Market development is therefore considered to be a significant challenge.** As argued before, the Namibian bush resource base is vast and will not limit the activities of one or several large-scale harvesters establishing themselves to supply one/several new off-takers. This can lead to dramatic increases in the growth of the local market, and impact on established market niches, as exist in form of charcoal producers and others.

As new windows of opportunity open for biomass fuel producers, **potential competitors are likely to enter the local market.** In principle, such competition is highly desirable and may infuse new technological know-how and skills. However, if such **producers focus on a single off-taker it is likely to entrench the off-taker’s bargaining position in the market**, and only create one or a small number of new supply entities as the monopoly off-taker wishes to minimise the transactional cost associated with having to deal with multiple supply entities. This **monopolises the market and skews the value chain to serve the needs of a single off-taker**, which is likely to limit the establishment of other supply entities in a given area of supply.

On the other hand, the creation and operationalization of **several competing off-takers** would likely contribute to the development of a more robust and diversified supply chain. Unless off-takers operate in the same geographic area, which is possible but not a necessity, the **bargaining power of individual off-takers is likely to be limited to their supply area**, without significantly affecting the developments in other supply areas. To illustrate, a power plant in the greater Otjiwarongo area is unlikely to be affected by the harvesting arrangements made by Ohorongo or those in the greater Tsumeb area, as the cost and feasibility of logistics are expected to limit the potential off-take areas to specific geographic areas.

When **two or more potential off-takers operate in the same geographic supply area**, critical service elements such as the speed at which harvesting can be undertaken, the harvesting method and the risks associated with harvesting will become inter-related, and **have an effect on the price at which the product can be offered**. To illustrate: a single harvester may be able to charge a land owner for debushing their land. However, if a market is created and offers either several large-scale harvesters or a price per harvested product, feedstock owners are likely to wish to benefit from more than merely having their land cleared. This implies that, if two or more potential off-takers offer harvesting services in the same area, a competition for price and/or other services is likely to ensue, which is expected to see erstwhile **price takers become price makers**. Whether the principle of cost neutrality can be established and/or maintained under such conditions is considered unlikely as each resource owner is expected to want to maximise the non-monetary plus monetary value accruing from harvesting activities.

Part of any **biomass harvesting arrangement is legal compliance**. To this end, harvesting permits are a local requirement. However, the enforcement of such regulations, including the capacity required to systematically and regularly undertake inspections of harvesting activities is considered a **major bottleneck, and likely to require significant development** so as to limit the risk of supply interruptions.

The demographics of commercial land owners are tilted towards those in the latter part of their life. It is noted that elderly land owners are often more **risk averse** than their younger peers. While elderly land owners will have witnessed the encroachment of invader bush on their land, and may no longer have immediate financial needs, younger owners will more likely be willing to clear their land so as to have access to more productive pastures. The demographic distribution of commercial land owners also implies that **long-term harvesting arrangements are considered unlikely, and a potential systemic challenge of most supply agreements**.

Access to the bush resource implies that the biomass harvesting entity/ies will have to have **credible access agreements to bush-infested land**, spanning over a considerable period into the future. Whether sufficient land owners will be interested to sign access and supply agreements with harvesters, when the **timing of the harvest is only in the distant future, is considered unlikely**. Here, off-take arrangements that include both a short-term (e.g. harvesting 500 ha of each

participating resource owner each year) and longer-term off-take agreement may hold more upsides and ensure better access and longer-term price stability.

The reaction of land owners, when approached to sign a fuel supply agreement is likely to be **driven by the short-term benefits and incentives**. It is considered unlikely that land owners would wish to sign up to have their land cleared many years in future when they could possibly benefit from clearings more immediately. This implies that **fuel supply agreements that are to be entered into with land owners are considered unlikely if the benefits of such agreements are not to be had within a few years following their conclusion**. However, for most industrial-scale biomass users, long-term supply contracts are essential, and may be a pre-requisite to making an investment decision.

It is difficult to quantify whether or not new or more financially rewarding uses for invader bush will be identified in future. However, it is considered likely that most **biomass owners would likely wish to have exit clauses included in longer-term supply agreements**, also with a view to broaden their options when alternative or more lucrative opportunities arise.

Namibia's commercial land reform initiative has **effectively removed land as a readily tradable commodity from the market**, and reduced the farm land that is available for acquisition. This implies that those wishing to enhance their productivity are often seeking to lease land and/or improve the productivity per hectare on their own land rather than by way of purchasing additional land. A further **scarcity of farm land**, be it created by legal reform or natural events including droughts are likely to increase the pressure on land owners to enhance the value of their own properties and consider fuel supply agreements, even if these imply that they have to **forego an income from biomass products**.

Providing access to freehold land and the biomass resources on the land is the prerogative of the land owner. Longer-term biomass access and supply agreements will have to specifically address how such arrangements will be affected when there is a **change of land ownership**, for example when the land lord passes away, when legal changes occur, or the land is acquired and/or nationalised by government. While the current system of land tenure in Namibia appears reliable, few would venture to make pronouncements about its development in the coming decades which may **profoundly change current land ownership patterns, as well as introduce changes to land use rights in communal areas**. Such changes are likely to affect how and with whom biomass supply agreements can realistically be entered into, especially if they only take effect in a decade or two.

Lastly, it is important to briefly reflect on the **role of water** for any enterprise involving biomass fuel. This Issues Paper focuses predominantly on the supply of biomass fuel, and less so on any specific end use. While water is an essential pre-requisite on the supply side, **upstream water requirements are likely to be far less than the downstream requirements**, for example those of a power plant or similar large-scale biomass end-user. Under Namibia's environmental laws, both the Environmental Impact Assessment (EIA) and Management Plan deal with water, as well as other essential inputs and impacts, and the **EIA has to give evidence that sufficient quantities of water are available throughout the life of each project**.

7. Biomass fuel supply stakeholders

This section provides a summary of the **main stakeholders likely to contribute to, be affected by, oppose, make use of or will be otherwise impacted upon** by the implementation of a large-scale Namibian biomass fuel supply undertakings.

Before contemplating who will likely be impacted upon or affected by large-scale biomass fuel supply activities one has to have a working definition of what an **industrial-scale supply undertaking** likely entails. For the purposes of this section therefore it is assumed that a dedicated amount of **100 kt will have to be supplied per year, for a period of 25 years**. Such an amount would be required by a single 12.5 MW power station, or a briquetting/pelletising plant producing for export. To illustrate, a harvesting volume of 100 kt/a necessitates capital investments of between N\$ 70 million and N\$ 90 million.

The industrial-scale provision of woody biomass from invader bush will include a wide spectrum of stakeholders. Broadly, these will include the **owners of the bush resource, one or several project owners and developers, harvesters and biomass preparation crews, transport and logistics entities, equipment, spare parts and maintenance providers as well as the wider support industry, and general labour**. In addition, **legal and regulatory bodies** including government entities as discussed below have responsibilities vis-à-vis large-scale harvesting and use of invader bush. **Certification bodies** may become relevant, especially for products that are to be exported, as are one or several **monitoring and verification entities** if the operations are to benefit from revenues from carbon credits, off-set arrangements or similar additional revenue mechanisms.

Entities that have **legal and/or regulatory roles and responsibilities** under the above supply scenario include the **Ministry of Environment and Tourism (MET)**, who have responsibilities under the Environmental Management Act (7 of 2007) and Nature Conservation Ordinance (4 of 1975) and associated regulations, in particular the assessment and approval of environmental impact assessments and the application of environmental management plans for the various value chain elements of the total operation(s) under consideration. In addition, the **Ministry of Agriculture, Water and Forestry**, who is the custodian of Namibia's forested lands, has permitting responsibilities under the Forestry Act (12 of 2001) and Soil Conservation Act (76 of 1969) and its amendments, and the Water Act (54 of 1956). **Permits are granted by the Directorate of Forestry, including for harvesting and transport, and if applicable, for the export of wood and/or products from processed wood**. Certain bush species are protected under the Act and therefore necessitate particular attention when embarking on a large-scale biomass supply agreement. The **Ministry of Labour (MoL)**, under the Labour Act (11 of 2007) has responsibilities, including those pertaining to ensuring that labour conditions and occupational health and safety provisions are adhered to. Also, if the biomass fuel is to be used for a power station, **the Ministry of Mines and Energy**, as custodian of the country's energy sector, has licensing responsibilities, which are handled through the **Electricity Control Board (ECB)** under the Electricity Act (4 of 2007).

Bush encroachment is a phenomenon occurring in both communal and freehold areas in Namibia. Individuals residing on **communal land often have usage rights to the land**, both for livestock and limited cereal production, and may use fire wood for own consumption. Large-scale harvesting on communal land however necessitates **intra-ministerial collaboration and agreement**, including from the MLR, MET and MAWF, and has as yet presented itself a challenge. Unless those living on communal lands are endowed with bush harvesting rights, and such individual rights can be sensibly agglomerated, commercial bush harvesting is likely to continue to be **focused on commercial freehold land** where owners are also the legal proprietors of the bush resource on their land. These **legal foundations limit industrial-scale biomass harvesting to some 60% of the total bush-infested area** in Namibia, and exclude the remainder from the benefits of systematic land clearing and value creation from large-scale de-bushing activities.

Project owners and project developers are likely to play a significant role in advancing large-scale de-bushing activities in Namibia. While potential owners and/or operators of power plant could be Independent Power Producers, other entities such as producers of briquettes and pellets, wood chip producers and related large-scale off-takers are considered likely to enter the market too. In addition, project owners could include those that are active in one part of the value chain only, for example in harvesting and processing. Such entities would likely infuse entrepreneurial passion, know-how and funding into Namibia's fledgling biomass supply industry.

Harvesters and in-field handling and processing crews are the key to cost-effective industrial-scale biomass fuel supply. It is considered unlikely that large-scale harvesting operations can be viable when relaying mainly on manual harvesting, as even the charcoal industry today seems constrained by the availability of suitable manual labour. Therefore, the mechanisation of harvesting and in-field biomass processing is critical, and creates additional biomass supply stakeholders, namely the providers of machinery and related operating and maintenance services.

Skills requirements for staff operating mechanised harvesting machinery are very different than those required by manual harvesters. In most instances, rural Namibia has not benefitted from the scale and scope that well-trained teams of harvesting contractors and fuel processors could introduce. Such approach would necessitate a departure of the mind-set of many contemporary resource owners, whereby access to land is limited to individuals who are personally known. The Namibian mining industry has demonstrated for years how contractor teams cost-effectively undertake well-defined and time-limited activities while de-risking the negative repercussions of having to deal with 'outsiders'.

Once the biomass fuel has undergone some preliminary in-field processing, for example drying and chipping, it needs to be conveyed. **Transport and logistics of wood chips is a critical part of the bush use value chain, and demands a high-level of planning and organisation.** In many of the bush-infested parts of Namibia, access to the railway is unavailable. Transport will therefore mostly have to be undertaken by truck, even if only to the nearest railway loading point. However, the flexibility and competitiveness of road transport is likely to limit the conveyance

of bush fuel by rail, but exceptions to well-connected end-use localities may exist under select circumstances. In most instances however, both existing and new commercial logistics operators will be available to provide such services, and are a critical ingredient to the overall cost-effectiveness of biomass fuel delivered to the end user(s).

Entities supplying equipment, spare parts and maintenance are essential as soon as harvesting is undertaken with any degree of mechanisation. Current agricultural experience would indicate that services from such providers can be readily up-scaled to provide new or extended services, provided that machinery has an established regional support network. Here, specialty harvesters or related machinery may be less likely to benefit from prompt service, which necessitates that owners/operators of such machinery investigate the local support capacity and ability to provide responsive services.

Large-scale biomass end-users could be processors, for example briquette, pellet and/or furniture manufactures, and/or one or several power plants. Each of these operations would have their own set of operational and staffing requirements, which would have to be procured. The skills deficiencies, especially in vocational and technical fields in rural Namibia, are a critically important factor which necessitates timely recruitment as well as on-the-job up-skilling.

The creation of new or substantially enhanced de-bushing and/or bush utilisation endeavours will have wide-ranging **repercussions on existing communities and available infrastructure and services**. For example, a harvesting, processing and logistics operation producing **100 kt/a would likely create 400 or more new full-time positions, with some 150 to 200 unskilled and semi-skilled staff on the up-stream harvesting side, and the remainder in logistics and down-stream end-use activities**. In rural Namibia, a single new upstart (as witnessed in the case of B2Gold's Otjikoto Mine) creates a considerable influx of persons, who in turn place new demands on housing, medical services, schooling and other services provided at or close to their place of work. While the demand for new services is less likely to cause supply bottlenecks in central or western Namibia, **most rural towns would be challenged to provide such services**. New projects also exercise a considerable attraction on unemployed persons, who move to where opportunities may arise, thus creating additional pressure on basic services.

Entities and individuals who may oppose large-scale de-bushing, or may otherwise be impacted upon, may include those who are affected by such operations without having benefits from it. Namibia's civil society voices are usually quiet, and there is little evidence that these would arise when industrial-scale de-bushing commences. Freehold land owners are often sceptical about initiatives that cause an inflow of a substantial number of would-be labourers close to or into their areas. Also, those who are dependent on and make use of existing infrastructure such as roads, schools and hospitals may feel the impact of such initiatives. However, in most cases, large de-bushing initiatives also **imply the creation of new job opportunities, which remain most limited in rural Namibia**. While there will be social and economic changes as a result of the commencement of new initiatives,

the short-term benefits mostly outweigh the impacts on individuals or communities.

Lastly, it is considered likely that the creation of **new value chain elements**, for example the local processing of biomass chips, will **bring about additional uses and create a demand for the product**. For example, **wood shavings** that are traditionally imported from South Africa could likely be sourced from a local wood processing facility, and the **process heat and/or waste water** arising at a power station would conceivably attract those who would otherwise have to create it for their **processing and/or manufacturing endeavours**.

8. Strategic and operational issues of a biomass fuel supply concept

This section focuses on the **strategic and main operational issues** of an industrial-scale biomass fuel supply in the country.

The **reliability of supply** of biomass fuel is a key consideration to all end users. It is determined by the specific harvesting arrangements, storage, stockpiling and transport provisions, weather, the reliability of staff and harvesting/logistics machinery, operational effectiveness and many other factors. Any industrial-scale end user will seek to **maximise the reliability of biomass fuel supplies across the value chain**, i.e. harvesting, processing and all pre-end use fuel preparation. Because the harvesting, preparation and transport of biomass incurs both capital and operational expenses, **an unreliable fuel supply is a key strategic and operational risk**.

A critical aspect of using biomass fuel relates to the **absence of suitable replacements or substitute products**. To illustrate, a power station built to fire wood chips, or a pellet plant cannot simply switch fuel or operate with biomass substitutes. Plant with an economic life of 20 or more years require a constant supply of biomass that is sustainably sourced, and continues to fulfil the physical requirements and characteristics required. Replacement or substitute products, if available, seldom fulfil the **original fuel characteristics**, such as ash content, moisture content and elemental composition, which implies that the fuel supply characteristics must be assured and remain within specified tolerances for a considerable period of the operating life of the plant.

The degree of **sophistication of the market** for biomass fuel will determine how successful an off-taker will be in sourcing and securing long-term supply agreements that meet the given supply requirements. In 2014, the **local market for biomass fuel from invader bush is considered both immature and unreliable**. Although a few operators exist and have the capacity to supply a few tens of thousands of tons of biomass per annum, **there is as yet no evidence that either one or even a group of suppliers would be able to offer a supply contract spanning a decade or more**. For a utility or industrial-scale off-taker requiring constant supplies over decades, this is considered a **significant strategic risk that necessitates the establishment of one or several credible biomass supply entities**.

While less than a handful of current operators have industrial-scale harvesting and biomass supply experience, few if any indications exist that allow any conclusions in regard to whether such operators could effectively and reliably operate their businesses when faced with **external changes to the operating environment**, such as across several years of drought or extreme rainy seasons, or when faced with substantial changes in fuel and/or spare part cost increases, or increased competition from other biomass users, or a change in the legal environment in which harvesting and operations are to take place. Again, for any industrial-scale off-taker, the **ability of any supplier to deliver despite changes in the operating environment is a significant strategic risk** in an industry that offers few actual lessons on how such change factors could individually and jointly be mitigated.

Despite NamPower's wish to enter a multi-decade supply agreement with as few as possible supply partners, there is **no legal or other guarantee that the utility's own operating environment will remain as is**. In fact, it would seem most likely that the utility will not be able to perpetuate its single buyer status across the coming decade, and may likely face competition from both Independent Power Producers and distribution and supply entities in regard to the generation of electricity. The **end-user's inability to guarantee off-take** across a decade or more is therefore a strategic risk that a fledgling biomass fuel industry will have to learn to cope with.

In the face of an **insecure supply and demand environment** in which both the procurement and/or the delivery of biomass fuel is likely to undergo considerable changes in time, a dynamic fuel supply and demand market structure is likely to offer the best guarantees. On the supply side, the **market can be strengthened if there are several commercially independent supply entities serving the market**. Likewise, diversification on the demand side, whereby several independent medium-scale off-takers constitute the downstream market seems one way to ensure that both supply and demand can exist in the longer term. In this sense, the stringent fuel supply conditions recently put forward by NamPower are therefore more likely the result of a **lack of imagination how a dynamic future supply situation can best be created and managed, and are certainly not a reflection of what can reasonably be expected from the Namibian biomass fuel supply and demand situation in the years until the market reaches some maturity**.

A **definite risk** to an unfolding Namibian biomass fuel supply sector is if the **industry's development was singularly driven by the unique requirements of one large off-taker**. As yet, most potential suppliers of biomass are unfamiliar with the requirements of a local bioenergy industry. This implies that one first mover may readily monopolise the market and shape it to fit its requirements at the detriment of the development of the industry as a whole. As witnessed in other countries, in conditions where a monopoly off-taker locks in one or a small group of supply entities, there are likely to be attempts to focus on the low-hanging fruit the market offers. Market dominance often results in the lock-in of the most lucrative potential biomass fuel supplies for their project(s), and guards against other market entrants and/or market developments that could challenge their position. The fledgling Namibian biomass fuel industry would be well-advised to put in place mechanisms that **prevent the monopolisation of the market** and the use of **high-yield island harvesting** approaches by suppliers, as both such endeavours will undermine the industry's ability to establish sustainable structures and processes necessary for long-term development and value addition. However, it is considered possible and desirable that **foreign interest will create additional off-take avenues** once the industry has established first structures and overcome initial teething problems.

In regard to actual and potential market players the current market offers few tangible pointers as to how **the price development for biomass fuel and the maintenance of acceptable technical standardisation of the product(s)** may develop. In fact, most of the current supply arrangements are **not sufficiently transparent** to allow an assessment of whether they could or would be sustainable

over the longer term, or which conditions may have to be created to reduce the risk of an **unsustainable biomass fuel value chain**.

The **absence of a regulatory framework for sustainable biomass development and use** is another key concern. Similar to what is happening in the solar photovoltaic sector in Namibia, where substantial private investments are made without any legal basis or backing, the **industrial-scale supply of biomass to several large-scale off-takers will experience legal and statutory challenges**. While the absence of a regulatory framework has not, and is unlikely to constrain the small-scale supply of biomass, it is **unlikely that significant investments** as are necessary to establish the supply and value chain for industrial-scale off-takers **are to be made**.

The risks associated with one or several **changes in the broader policy environment** of relevance to the biomass fuel industry are considerable. One example of how change can affect long-term supply agreements is when carbon emissions are penalised: while it is premature to speculate how this would affect carbon emissions from bush-infested areas it must be noted that vast tracts of Namibian rangeland are presently reducing the country's net carbon emissions. In the face of industry-scale systematic harvesting, **bio-capture and binding of carbon is reduced and soil emissions are likely to increase**, all of which may eventually affect the price of the biomass fuel feedstock. Other policy changes, as may directly affect the supply of biomass fuels (e.g. **land reform**), or those that affect the longer-term demand for biomass fuel (e.g. **local content rules and regulations in regard to fuel**) are likely and part of the industry's risk portfolio.

Internationally, biomass already meets approximately 10% of the world's energy demand. In Namibia, the contribution of biomass to the total energy balance exceeds 15% of all energy used, and is of a similar order of magnitude than the country's electricity sector. The international focus to meet greenhouse gas reduction targets has meant an increase in the search for and harvest of biomass. While Namibia cannot be compared with biomass exporters such as Canada, it would not be entirely unexpected if the increased regional focus on biomass co-firing of power stations (e.g. in form of pellets) will also be felt in Namibia. This implies that the **local market development initiatives may well be overtaken and ultimately driven by external demands for fuels**, as has been witnessed in other sectors of the Namibian economy (c.f. the uranium mining industry).

While a market entry of large international players would **introduce much-needed competition and know-how** in the Namibian biomass fuel industry, such additional market forces are expected to **reduce the chances that long-term biomass fuel supply contracts can be concluded with individual suppliers**. To illustrate, a land owner who is offered a harvesting agreement that is to take place in 10 or more years' time is unlikely to sign if offered similar services at an earlier time and/or on more favourable terms. This re-emphasises the importance of offering harvesting terms including both short- and long-term benefits. **Competition for the biomass fuel resource will likely lead to protracted bargaining and negotiations** between those who offer the resource and those who need it, while the dynamic character of the market is likely to increase biomass fuel prices as well as more favourable conditions (for the owner of the resource) at which these resources can be secured.

Another aspect of relevance to the strategic and operational environment in which the Namibian biomass fuel supply industry is likely to be exposed to is the **emergence of new and innovative biomass/bioenergy technologies**, especially in the area of large-scale harvesting, pre-processing and conditioning of biomass fuel feedstock. Here, the process of torrefication holds many advantages, especially when considering biomass-based fuels for export. **Other technological changes**, such as the enhancement of energy conversion efficiencies of traditional biomass boilers, co-firing applications of traditional coal-fired power plant with biomass fuel, and the establishment of bio-refineries for woody biomass all have a potential impact on the longer-term strategic playing field in which the fledgling Namibian biomass fuel industry will develop.

The **country's policy environment does not as yet adequately recognise the potential role and contribution that the sustainable use of invader bush could make**. The absence of incentives for restoring natural rangelands and the lack of focus on how this national resource can be used to infuse revenue into rural Namibia are evident. Yet, **policy can change**, and can then create opportunities or place restrictions and/or regulate activities and thus increase the cost of business.

A champion who recognises that Namibia's biomass fuel resource is more than a nuisance would pro-actively support and create the required policy and enabling framework conditions that incentivise investments in bush harvesting and local use of local biomass products. Such a champion would likely be a well-connected individual, who has the clout and ability to influence and expedite both political and private sector decisions in regard to the way that Namibia's significant biomass stock is viewed and used. In this way, such a champion would first and foremost change the prevailing mind-set while driving the change process needed to turn the opportunities locked in the country's biomass fuels into tangible economic realities.

Namibia's energy supply industry is remarkably wedded to the idea of centralised power generation. While these concepts have their validity, particularly in densely populated countries, the industrialisation of Namibia is unlikely to be driven by centralised power generation. The realisation that **locally grown feedstock for decentralised power generation can provide much-needed base load power and create permanent local jobs** predominately in rural Namibia is only slowly dawning on some decision-makers, but could dramatically alter the way that the nuisance called invader bush is viewed and utilised in the country.

Lastly, although **environmental considerations** such as atmospheric emissions from power plant do not yet constitute a significant risk for power station owners in Namibia, such issues are of increasing international importance. While local biomass fuel-powered electricity generation is likely to be more carbon friendly than traditional coal-fired power plant in the SADC region, it will remain important to ensure that the biomass fuel supply chain in its entirety does not cause unmanageable impacts on the environment. Here, additional research is necessary, to **ensure that Namibia's bush resource becomes and remains productive while limiting the impact that large-scale harvesting and bush utilisation will have, especially in regard to the land's nutrient and water balances, and the large-scale increase of greenhouse gas emissions from de-bushed soils**.

9. Elements of a Namibian biomass fuel supply concept

This section presents a **high-level overview of the main features of a national biomass fuel supply concept**. It departs with a reflection on the main issues that underpin the future industrial-scale demand and supply scenario of biomass fuels. In regard to the **ongoing availability of the biomass fuel resource, it is assumed that it will remain abundant in the decades to come**. However, as noted above, the supply of the resource to where it may be needed in future is not yet organised in a way that **creates any degree of longer-term supply certainty**. This is therefore a key aspect of a future large-scale biomass fuel supply concept in the country.

Because future biomass fuel supplies will have to **aggregate supplies from various individual harvesting sites**, each of which is likely to be owned by a separate resource owner, a **fuel supply agreement (FSA) may have to be entered into with each individual potential feedstock supplier, unless such aggregation is managed by, for example, a biomass suppliers group**. FSAs typically need to specify the modalities and methods that are to be used for harvesting and on-site processing, as well as the conditions (s.a. size of harvesting team), rules and procedures that are to be used by harvesters when accessing and working on a certain farm, the roles and responsibilities in regard to the permits required for industrial-scale harvesting, rules for the labour force including their on-site accommodation, access to water and supplies as well as access of third party providers, the quantification of harvests, monitoring and oversight of harvesting and other activities taking place on site and the responsibilities of these activities, the timing of intended harvesting operations, procedures in case of emergencies and/or incidents, exit clauses of both parties, notification requirements, and the cost or price per hectare or per ton harvested. Contentious aspects are likely to include site access and labour rules, the timing of harvesting operations, cost or price of the feedstock, and exit clauses.

While most of the above aspects can be part of a standard FSA that can be developed under the de-bushing project, **it remains unknown whether resource owners are likely to be interested in signing a FSA if the timing of the intended harvesting activities is too far in the future**, and/or in case cost or price expectations cannot be addressed satisfactorily. In the present context, a cost implies that the resource owner pays the harvesting entity to clear bush from a given land area, while a price is what a resource owner may expect to receive for making available bush-infested land for the harvesting of biomass fuel. It is to be noted that the **commencement of one or several large-scale harvesting operations may change the perception of the value of bush-infested land, and trigger expectations that the bush resource could contribute to create additional on-farm revenues**. Once biomass owners understand the long-term demand that industrial-scale operators will have, they may demand a price for the resource. In this way, the erstwhile **invader bush nuisance will suddenly acquire a monetary value**, which in turn impacts how resource owners will negotiate the terms of future FSAs.

As part of the creation and strengthening of value chain elements related to industrial-scale bush harvesting and use in Namibia, it will be important to create (for example by way of incentives) **additional local off-take opportunities**. While

individual industrial-scale off-takers are likely to focus predominantly on meeting their own requirements, many other up- and down-stream value chain actors are likely to prefer to have several potential supply opportunities available to minimise their own operational risk. In this regard, an important **policy instrument** could be the **creation of an infant industry protection mechanism**, including access to project establishment and development support, **access to credit to establish particular biomass fuel supply chain elements**, and support in the establishment and operationalization of small and medium enterprise businesses. As discussed above, without a **compendium of support measures directed at strengthening the various supply chain elements necessary to establish local biomass fuel supplies, it is considered likely that the upstream supply chain in particular is rapidly monopolised by one or a few large operators only**, which in turn may create other undesirable monopoly-/oligopoly-like entities similar to those that already exist in several other sectors in Namibia.

A further initiative in the establishment of a biomass fuel supply concept has to focus on **streamlining the licensing, permitting and inspection regime undertaken by various government entities**. Most investors would not accept the risk of not having a harvesting, transport or similar license renewed once an industrial-scale processing or off-take facility is established. Currently, **the restrictive and inefficient inspection and licensing regime governing biomass fuel suppliers is a significant bottleneck** that can delay or even prevent the entry of large-scale operators into the sector. Here, additional training and the streamlining and upskilling of licensing and inspection procedures and persons is an essential prerequisite to invigorate activities that are and will likely remain under immediate government control in future.

Awareness of the costs and benefits of establishing new biomass fuel-use ventures is considered to be poor or even non-existent amongst policy makers in Namibia. This is an area that will definitely require support in the establishment of a biomass fuel supply concept in the country.

Some industrial-scale biomass fuel utilisation endeavours are likely to require some **initial seed funding**, for example to reduce capital cost, for training, licensing, certification and others. Such upfront costs are likely to be small in comparison with the long-term income earned from taxes and royalties earned once a sustainable market with long-term off-take contracts has been established, and should therefore be **made available from government, possibly as part of an infant industry establishment program**.

Development funding often considers **metrics other than the immediate cost efficiency of activities. This is of critical importance when new value chains are to be deliberately created by government intervention.** While such a focus seems self-evident, taking the wider socio-economic costs and benefits into account when establishing new industries appears a non-existent consideration in the run-of-the-mill finance and engineering fraternities that dominate commercial undertakings in Namibia. For entities such as the National Planning Commission (NPC), the Ministry of Trade and Industry (MTI) and other government organs who are likely to be involved in the establishment of large-scale biomass fuel supply arrangements, the

economic value addition of the entire undertaking must be recognised and quantified to ensure that **public expenditure occurs where it has the greatest impact. In the absence of a vision and a policy framework that incentivises the use of local fuels the above considerations are likely to remain a talking point and not result in tangible action.**

It has been suggested that the **formation of a biomass suppliers group (BSG)** may well be able to effectively address the organisational requirements necessary for an industrial-scale biomass fuel supply to one or several large-scale off-takers. A BSG could be formed by several larger-scale biomass supply entities, and could serve as a central entity that negotiates and enters into fuel supply agreements with future large-scale off-takers. Bundling of individual capacities of existing biomass suppliers increases the capacity of a BSG and allows it to more reliably fulfil industrial-scale off-take agreements. It would also likely **reduce the risk of supply that large-scale off-takers will be faced with, as the aggregated capacity of the group as a whole is likely to withstand at least some of the supply constraints faced by its members.**

Despite the advantages of a BSG, it will be important that **collusive practices between group members** are minimised, and that **it remains open to new entrants.** While a BSG is likely to be better constituted to enter into longer-term supply agreements than individual biomass fuel suppliers are, the temptation of such a group **attempting to monopolise the supply** to large-scale off-takers and exercising pressure (e.g. on price) on signed-up resource owners is likely to be considerable. The **economies of scale** of a BSG would probably allow them to offer more competitive longer-term harvesting conditions to resource owners. Also, a BSG is likely to face **continued scrutiny** by those potential suppliers who are – for whatever reason – not part of the group. This will make it even more important that any supply arrangements are offered without there being issues in regard to **the transparency and/or conflict of interest** that frequently arise in circumstances where entire market niches are captured. Therefore, while the concept of a BSG includes promising features, numerous unresolved issues remain, and warrant a more in-depth assessment of the **modalities that would underpin such an entity.**

A national biomass fuel supply concept will need a champion and driver. As yet it remains unclear whether an entity or group of entities exists that will initiate the multitude of steps to place a Namibian biomass fuel supply on a firm footing. While government, and in particular the **MAWF**, would seem the natural home for initiatives promoting national biomass developments, entities such as the **MTI may be better positioned to incentivise the establishment of new industries.** Also, the **Project** is to foster greater collaboration between key stakeholders, and in this way facilitate the purposeful creation of a biomass fuel supply concept in Namibia.

Whichever way progress is made, invader bush has been considered a nuisance for a long time. While there have been many statements about how de-bushing is best to be achieved, few tangible activities have taken place that indicate that key role-players have been serious about converting this plentiful resource into a commodity that contributes to Namibia's economy. It is hoped that this Paper provides some momentum in addressing this important national issue.

10. Conclusions and Way Forward

This Issues Paper **identifies and discusses a variety of issues and aspects** that are of importance in the run-up and during the establishment of an industrial-scale biomass fuel supply concept in Namibia.

This section presents the conclusions and way forward towards the establishment of an industrial-scale biomass supply industry in Namibia. Three sub-sections are included and provide

- a summary of the **key strengths, weaknesses, opportunities and threats (SWOT) and ranked list of key risks** characterising the current biomass supply sector;
- **conclusions** that capture the main considerations in regard to the establishment and operationalization of an industrial-scale biomass fuel supply industry in Namibia; and
- **the way forward expressed in form of recommendations** that bundle urgent and/or important activities into actionable work packages that are designed to create a consistent set of first steps towards the establishment of a sustainable Namibian biomass industry.

10.1 SWOT and risk identification of the current biomass supply sector

This section presents a summary of the **key strengths, weaknesses, opportunities and threats (SWOT)** and a **ranked list of key risks** characterising Namibia's current biomass supply sector.

Strengths

- The Namibian biomass resource base in form of invader bush is estimated to consist of some 200 Mt of standing biomass in bush-encroached areas across the country. This resource base is substantial and can support multiple long-term industrial-scale harvesting and bush-use operations, and is considered a key strength.
- The annual re-growth of biomass in form of invader bush (approx. 10 Mt/a) is estimated to exceed the current annual off-take requirements by more than a factor of 10.
- Provided the resource is properly managed and the emerging industry benefits from some regulation, biomass fuel from invader bush can be a sustainable renewable product that can contribute to Namibia's development endeavours.
- Bush clearing or bush thinning creates multiple benefits, including the creation of long-term jobs in rural Namibia, the enhancement of water penetration into the soil, the restoration of productive rangelands for agricultural purposes, and others.
- There are few credible and affordable substitute products that can be used by industrial-scale biomass users. This feature is likely to create long-term supply relationships for biomass supply entities and should strengthen their ability to raise capital and operate a viable business.

Weaknesses

- Most biomass fuel value chain elements are currently immature.
- A bush use policy does not exist.
- Namibia's policy environment lacks incentives to promote investments in bush harvesting and bush use.
- The local market for biomass is small when compared to the size of the resource base, and is under-developed.
- There is no standardisation of local biomass fuel products.
- Industrial-scale off-takers require long-term supply agreements which the market cannot as yet offer.
- The short-term objectives of resource owners (e.g. profit maximisation) may significantly influence the conditions on which biomass supply agreements may have to be negotiated in future.
- Most industrial-scale off-takers will incur high capital investment costs which necessitate long-term secure biomass supply agreements which the current market is unable to provide.
- The long-term demand for biomass fuel is unknown and limits investments in large-scale harvesting and supply machinery and equipment.
- The current permitting, licensing, monitoring and verification regime is weak and unsuitable for the industrial-scale harvesting and use of biomass from invader bush.
- There is little specificity in terms of when and by how much the demand for biomass fuel will change, which limits investments in the sector.
- The available technical skills base is poorly developed in rural Namibia.

Opportunities

- Biomass resource owners are keen to urgently have invader bush thinned or even cleared from bush encroached areas under their control, and actively support emerging biomass fuel harvesting and end-use activities.
- The establishment of industrial-scale biomass fuel supplies stimulates the creation of new value chains and value adding activities, and thereby creates the demand for other biomass products that are currently imported to Namibia.
- The demand for Namibian biomass fuel from invader bush increases – driven by international interest – once the first steps to-wards the establishment of credible industrial-scale biomass fuel supplies have been taken.
- A local industrial-scale biomass industry makes sizable national development contributions once it is established and operational.

Threats

- Policy fails to recognise that the national biomass resource is significant and can contribute to Namibia’s economic development.
- Policy fails to establish the necessary legal and statutory provisions to create conducive framework conditions for the emergence of a local biomass industry.
- Potential industrial-scale off-takers delay investment decisions, which in turn retard the development of a local biomass fuel supply industry.
- Biomass owners do not agree to long-term harvesting contracts based on cost neutrality, which in turn drives the unit cost of biomass fuel and undermines the prospects of achieving long-term price stability.
- Biomass fuel owners may become price makers, which weakens or threatens the long-term security of supply of industrial off-takers and their viability.

Ranked List of Key Risks

1. Lack of vision about the role and contributions that Namibia’s biomass resources can play in the country’s future economic development, incl. the power sector.
2. Biomass fuel supply provisions do not meet the requirements set by financiers.
3. Lack of policy support for the deliberate strengthening of biomass value chains.
4. Access to the resource remains dependant on individual agreements with owners.
5. The balance between the cost and price of biomass fuel remains volatile.
6. Lack of investment incentives to kick-start the infant biomass fuel industry.
7. Long-term access to and security of supply of biomass fuel cannot be assured.
8. Some value chain elements remain marginally profitable and therefore unreliable.
9. Policy, legal and regulatory requirements remain an impediment to the industry.
10. Up- and downstream monopolisation of the industry, particularly in early stages.

10.2 Conclusions

The main considerations in regard to the establishment and operationalization of an industrial-scale biomass fuel supply in Namibia include the following:

1. Namibia's biomass resources in bush-infested areas are significant, and **constitute an under-utilised national asset that holds largely untapped industrial-style development potentials.**
2. Provided that the invader bush's **renewable riches are explicitly recognised and tangibly promoted by policy, they can more meaningfully contribute to the country's economy and economic development, and infuse much-needed jobs, capital, skills and growth initiatives into rural Namibia.**
3. The **creation of new industries rarely happens on its own, and usually necessitates both government and private sector engagement.** In this regard, the **creation of a small number of industrial-scale biomass fuel utilisation efforts,** such as the supply of small- to medium-sized biomass-fuelled power stations (e.g. in the range of between 5 and 20 MW each) and the **deliberate strengthening of critical supply chain activities** (e.g. by way of project support, training and/or tax breaks) will **incentivise the creation of the required market structures that are as yet largely under-developed or even non-existent.**
4. **Economies of scale are critical** in the establishment of industrial-scale biomass fuel supplies in Namibia. This implies that harvesting, pre-processing and logistics efforts are best scaled to achieve critical long-term volumes of supply, i.e. **of the order of 40 kt/a over 25 years per main harvesting area.** To achieve such production, a few **non-overlapping biomass fuel production areas** should be identified, each having the **potential to be scaled up to reach suitable economies of production scale.**
5. Despite the abundance of the resource, **securing long-term supplies is by no means assured,** and necessitates specific attention to ensure that **biomass fuel can be produced over a period of decades, and that the associated cost of production remains capped.** A dynamic market development in which resource owners who are currently price takers become future price makers is considered likely, and will have a significant impact on the ability to cap long-term production costs.
6. Biomass fuel occurs in harvestable quantities on both communal and freehold areas in Namibia. While harvesting arrangements on freehold areas are covered under Namibia's existing legal provisions, additional legislative work is necessary if industrial-scale biomass harvesting is to benefit communal areas too.

7. **Biomass from invader bush cannot readily be produced continuously**, mainly due to intermittent weather and related factors. In addition, both the quality and harvestable quantity of harvestable biomass varies significantly per area, as do the dominant bush species that can be harvested, and the timing of harvesting activities in relation to any prior bush thinning or bush eradication efforts. **Biomass from Namibian invader bush is not an industrial product, and therefore necessitates that industrial-scale off-takers must pay particular attention to manage the considerable inherent variations in product quality and quantity.**
8. An industrial-scale biomass fuel supply **necessitates a labour force that has considerably different skills sets than those required for manual harvesting of invader bush.** The development of a suitable skills base cannot realistically be left to entrepreneurs alone, and necessitates government action.
9. Current **regulatory provisions relating to the harvesting of biomass fuel are unlikely to be able to cope or be adequate once the development of an industrial-scale biomass fuel supply commences, and will therefore necessitate deliberate streamlining and efficiency improvements.** In this regard it would be considered most beneficial if a national biomass fuel champion could be identified who could rally the various stakeholders to finally take action on a national challenge that offers the opportunity to contribute significantly to the country's economy.
10. While the industrial-scale production of biomass fuel from invader bush is likely to be initiated by a few actors only, **an industry that remains focused on the needs of only one or a few off-takers is likely to establish and/or perpetuate an undesirable concentration of dominance in the industry,** and the neglect of peripheral supply chains that do not directly serve the interest of these main actors. This **necessitates government's continued oversight, to ensure that a diversified market develops and remains accommodative of new entrants.**

10.3 Way Forward

The GIZ/MAWF Project hosted a brainstorming meeting with key stakeholders on 26 September 2014, which led to the identification of some work packages and the way forward. Below, **Recommendations 1 to 7 are presented in order of descending priority**, while **Recommendation 8 addresses communication** as an overarching activity which is to strengthen and support all Project activities.

The recommendations presented below **bundle related activities into actionable work packages**, which are individually and jointly aimed to create a systematic pathway towards the establishment of a sustainable Namibian biomass industry.

Recommendation 1: **quantify the actual biomass resource yield in select areas, and formulate a best practice guide for future biomass resource estimation**

Rationale: A statistically significant quantification of the biomass resource yield in areas where future large-scale biomass use is likely to take place is a pre-requisite to satisfy the requirements of both regional and international financiers, and therefore of actual and potential project developers.

Approach: **A study** is to be undertaken, which is to be informed by the requirements of development financiers, to quantify the actual biomass resource yield in select areas where large-scale future biomass use is considered likely. The study is to include the determination of actual resource yields in a number of predetermined areas as well as the verification and ground-truthing of satellite-borne biomass resource data for such locations. Localities to be assessed include, amongst others, those identified as priority sites by NamPower. The study is to take previous biomass quantification outcomes into account, and is to establish a best practice guide to reliably and cost-effectively quantify future biomass resource yields in other locations in future.

Action: Under the Project, Terms of Reference are to be developed, which are to guide the above study, focusing on locations where the establishment of one or several large-scale users (e.g. biomass power stations in locations as per NamPower's transmission infrastructure plan, and others) is considered likely. The study is to be undertaken by independent consulting firms and private-sector biomass harvesting companies, under the auspices of a Study Committee under the Project. If available, the Study Committee will draw on the expertise of survey teams in the MAWF's Department of Forestry, and/or staff of the Polytechnic of Namibia.

Priority: **Very high**, as the development of a biomass industry hinges on the reliable quantification of the resource base.

Recommendation 2: clarify the legal, statutory and regulatory requirements that are to underpin an industrial-scale biomass industry

Rationale: The development of an industrial-scale biomass industry hinges on an unambiguous interpretation of all relevant legal, statutory and regulatory pre- and co-requisites and associated requirements under Namibian and relevant international laws.

Approach: A study is to identify the relevant legal, statutory and regulatory pre- and co-requisites, as well as requirements to be met when developing an industrial-scale biomass industry in Namibia. Relevant requirements are to include the current stipulations under Namibia's legal, statutory and regulatory provisions, as well as the requirements by regional and international development funding institutions and potential international certification authorities. In addition, the study is to address, discuss and put forward proposals on how the various legal arrangements and requirements can best be met to secure the long-term access to the biomass resource base in both commercial farming and communal areas in Namibia, for example by way of access and fuel supply agreements, and other legal instruments if considered suitable. The study is to result in an actionable list of all relevant requirements that have to be fulfilled by project developers wishing to establish themselves in the emergent biomass industry in Namibia, including template resource access and fuel supply agreements.

Action: Under the Project, Terms of Reference are to be developed, which are to guide an in-depth identification and assessment of the legal, statutory and regulatory pre- and co-requisites and associated requirements that have to be satisfied when embarking on the establishment of an industrial-scale biomass industry in Namibia, including resource access and fuel supply agreements. It is to be undertaken by independent legal and technical experts under the auspices of a Project Study Committee.

Priority: **Very high**, as the development of an industrial-scale biomass industry hinges on the unambiguous interpretation of all relevant legal, statutory and regulatory pre- and co-requisites and requirements that have to be met by potential biomass industry actors and participants, including access and fuel supply agreements.

Recommendation 3: identify the legal, structural, organisational and operational requirements to establish and operate a biomass suppliers group, including the development of suitable business models for such a group

Rationale: A biomass suppliers group is one of the potential organisational arrangements that could supply biomass on an industrial-scale to off-takers in Namibia and beyond.

Approach: A **Concept Paper** is to address how a biomass suppliers group is to be established and operated in order to supply biomass on an industrial-scale to potential off-takers. It is to include a detailed description of suitable organisational requirements (for example an Association, or a company), contractual provisions with its members and external biomass owners, the requirements to ensure the long-term redundancy of potential suppliers within a given harvesting area, possible shareholding of resource owners in the group, as well as relevant legal and practical constructs to ascertain that the group can fulfil the requirements of future biomass off-takers and their financiers. The development of suitable business models for the group is to be another output of the Paper. In addition, the Concept Paper is to identify, assess, describe and cost mechanisms that will ensure the long-term price stability of biomass fuel, as this is the commodity that is traded by the group. This includes mechanisms to ensure the price neutrality of supplies (if this can be achieved), price capping and other mechanisms. Also, the Concept Paper is to describe sustainable harvesting methods and concepts, including mechanised and labour-based harvesting, as well as transport and logistics requirements and approaches. The Concept Paper is to take opinions of farmers' representatives and current biomass fuel suppliers into account, and incorporate the requirements of development funding agencies where applicable.

Action: Under the Project, a Concept Paper is to be commissioned, based on Terms of Reference that are to be developed by GIZ/MAWF. The Paper is to identify, describe and compare the options and modalities to establish and operate a biomass suppliers group, including a description of suitable business models that can underpin the group's operations.

Priority: **High**, as a biomass suppliers group is a potential organisational form that may be called upon to supply biomass on an industrial-scale to off-takers.

Recommendation 4: explore the requirements to create an enabling environment in which a biomass industry can best be established in Namibia

Rationale: Public and private actors and role players have to collaborate to create the framework conditions necessary for the establishment of a biomass industry in Namibia.

Approach: A series of facilitated discussion meetings, organised and called under the Project, with public and private stakeholders is to clarify the requirements that are to characterise an enabling environment in which a biomass industry can be established. In particular, it will be important that actual and potential roles and responsibilities of key stakeholders responsible for an enabling environment are clarified and agreed upon. Stakeholders to participate in discussions include the

- **MTI**, in regard to the promotion of agro-processing industries in Namibia, and the granting of infant industry protection to an emerging biomass industry, and related support activities;
- **MET**, in regard to the conditions for Environmental Impact Assessments and Environmental Management Plans as are relevant for large-scale bush harvesting operations;
- **MAWF**, in regard to streamlining the requirements, inspection regime, conditions and the timely issuing of biomass harvesting permits in Namibia;
- **ECB**, in regard to the granting of generation licenses for biomass-fuelled power stations, and incentivising renewable energy feed-in tariffs;
- **MME**, in regard to provisions in the forthcoming Energy Act and Renewable Energy Law; and
- **biomass owners, farmers' associations from commercial and communal areas, and other supply chain actors**, to address the expectations and requirements of an enabling environment under which a biomass industry can be established.

Action: Under the Project, conduct a series of facilitated discussion meetings with the various institutional actors and private role players identified above.

Priority: **High**, as the process to establish an enabling environment in which both public and private actors have important roles and responsibilities is expected to take time.

Recommendation 5: assess the macro-economic impacts/repercussions of establishing an industrial-scale biomass industry

Rationale: Public expenditure, as may be required to create and/or support the establishment of new industries in Namibia, is best underpinned by facts. At present however, potential macro-economic impacts of a to-be-developed industrial-scale biomass industry are not readily understood.

Approach: A study is to quantify the impacts and repercussions of establishing an industrial-scale biomass industry in Namibia, and compare these with the costs and benefits as a result of present day bush encroachment. The study's outcomes are to inform the discussions with public and private actors and entities, specifically aiming to identify and quantify the positive and negative impacts brought about by an emerging biomass industry in Namibia. The study is to identify the individual and cumulative impacts expected in areas where large-scale biomass harvesting is likely to be undertaken, and relate these to relevant macro-economic indicators. Also, the study is to develop several future scenarios (base case with bush encroachment, and scenarios with small, medium and large biomass use) to quantify the social, environmental, technical and financial impacts resulting from the systematic establishment of industrial-scale biomass fuel harvesting on communities, infrastructure as well as the local economic and the country's macro-economic environment, and contrast these with the costs/benefits arising from ongoing bush encroachment. The study is to quantify measures to foster the emergence of a biomass industry, and describe how positive impacts are to be strengthened and negative impacts are to be mitigated.

Action: Terms of Reference are to be developed under the Project, to guide the study on the macro-economic impacts of establishing an industrial-scale biomass industry in Namibia. The study is to be undertaken by independent specialists, under the auspices of a Study Committee under the Project. In order to minimise the duplication of efforts, and prior to the development of the ToR for the study, the Project is to convene a meeting with the authors of a previous Strategic Environmental Assessment (SEA) on the large-scale roll-out of bush-to-electricity power plants in Namibia, to explore how the results of the SEA can best inform the envisaged macro-economic impacts study.

Priority: High, as the macro-economic impacts of an industrial-scale biomass industry are not sufficiently known to date, and may be required by project financiers in future.

Recommendation 6: develop a roadmap for the industrial-scale supply and use of biomass fuel in Namibia

Rationale: The roadmap is to be a guidance document for key decision-makers and industry stakeholders, and is to establish a common vision and storyline of how the ramp-up of an industrial-scale supply and use of biomass is to be achieved in Namibia, including a discussion of the critical steps required and description of the potential projects relying on the use of biomass fuel from invader bush that are likely or may be initiated in Namibia in future.

Approach: A **roadmap** is to describe the steps required to ramp-up Namibia's biomass supply industry, using a set of likely future biomass industry development and establishment scenarios. One such scenario is to describe the role of a small- to medium-sized pioneering project, such as a biomass-fuelled power station, that is to be used to prepare the way towards the establishment of the necessary provisions to ensure the long-term use of biomass for Namibia's development. In addition, descriptions of other future large-scale users of biomass fuel, such as co-firing of an existing power station, the co-firing of a to-be-established concentrated solar power plant, one or several large-scale briquette and/or pellet plants and similar initiatives are to be included as part of the scenarios elaborated in the roadmap.

Action: Under the Project, Terms of Reference are to be developed, to guide the compilation of a roadmap for the establishment of an industrial-scale use of biomass in Namibia. The roadmap study is to be undertaken by independent specialists, under the auspices of a Study Committee under the Project.

Priority: **Medium to high**, as the roadmap is likely to be an important vision document that inspires, guides and informs key decision makers about the integrated long-term development of an industrial-scale biomass industry in Namibia.

Recommendation 7: assess the current Namibian skills base and its development requirements to best support an emerging industrial-scale biomass industry in Namibia

Rationale: Industrial development hinges on having available a sufficient number of suitably skilled persons to draw from.

Approach: A series of facilitated discussion meetings are to be convened with key stakeholders drawn from the Namibian tertiary training fraternity, including but not limited to the National Qualifications Authority (NQA), Vocational Training Centres (VTC) and other providers of tertiary vocational skills development. Such information-sharing meetings are to be facilitated, and aimed to elaborate how best to gauge the skills sets offered by current VTC graduates. In addition, the skills required to meaningfully contribute to the various value chain elements as will be characterising a Namibian industrial-scale biomass industry are to be elaborated, and are to result in a summary of current skills, the likely skills requirements of a future biomass industry, and how any skills gaps can best be addressed by training providers. Special cognisance is to be given to how the Namibia Training Authority's vocational education and training levy can be used to upskill persons seeking employment in the value chain elements created once a biomass industry is established.

Action: Under the Project, a series of facilitated discussion meetings is to be initiated with the key role players in the Namibian vocational training and related sectors.

Priority: **Medium to high**, as training measures to upskill persons to optimally support an emerging industrial-scale biomass industry will take time to develop, implement and yield suitably skilled graduates.

Overarching activity to strengthen and support all other Project activities:

Recommendation 8: develop a communication strategy and action plan to ensure that actual and potential Project stakeholders are and remain informed about the developments towards a Namibian biomass industry

Rationale: Effective communication between and amongst actual and potential biomass industry stakeholders is a pre-requisite for establishing common ground and initiating and implementing mutually beneficial activities.

Approach: A stakeholder communication strategy is to elaborate the purpose, objective, goals and a consistent and transparent approach which is to guide all interactions with actual and potential stakeholders in the to-be-established biomass industry in Namibia. Both electronic and printed media are to be used to ensure that relevant stakeholders are kept in the loop on developments towards the establishment of a Namibian biomass industry. An action plan is to include a schedule of activities that is to be based on the individual informational and engagement requirements that the different biomass industry stakeholder groups have. Of particular importance in the formulation and implementation of a communication action plan is that stakeholder expectations are known and can be pro-actively managed, while also maintaining interest and ongoing momentum in establishment of a local biomass industry.

Action: Under the Project, a communication strategy and action plan is to be developed, which is to ensure that both key and peripheral stakeholders are identified, and that mutually reinforcing communication approaches are elaborated and implemented. An action plan is to ensure that stakeholders become and remain aware of, and actively participate in all relevant developments towards the establishment of a Namibian biomass industry.

Priority: Consistent, timely and effective communication is the single most important overarching activity exerting an influence on all other activities undertaken as part of the Project. It is the key to meaningfully initiate and sustain the collaboration with a wide range of actual and potential stakeholders who will or may contribute to the establishment of a biomass industry in Namibia.

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