Circular economy opportunities Vanuatu

Concise metabolic analysis

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UNDP's work on climate change spans more than 140 countries and USD $3.7 billion in investments in climate change adaptation and mitigation measures since 2008. With the goal to foster ambitious progress towards resilient, zero-carbon development, UNDP has also supported the implementation of the Paris Agreement on Climate Change by working with countries on achieving their climate commitments or Nationally Determined Contributions (NDCs).

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The NDC Support Programme provides technical support for countries to pursue a "whole-of-society", integrated approach that strengthens national systems, facilitates climate action and increases access to finance for transformative sustainable development. The programme helps countries address these financial barriers by deploying a structured approach for scaling up sectoral investments and putting in place a transparent, enabling investment environment. Beyond direct country support, UNDP facilitates exchanges and learning opportunities on NDC implementation at the global and regional level by capitalizing on our close collaboration with the UNFCCC and other strategic partners. The Programme, which works in contribution to the NDC Partnership, is generously supported by the German Federal Minister for the Environment, Nature Conservation, and Nuclear Safety (BMU), the German Federal Ministry of Economic Cooperation and Development (BMZ), the European Union and the Government of Spain.

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Summary

Economic growth is often accompanied by a gradual decrease in the quality of ecosystems and a gradual deterioration of natural assets such as soils, marine environments, fish and forests. By redefining development from a systems perspective, governments can grow their infrastructure and building stock and meet society's needs, while moving away from the linear economic model that places long-term development ambitions at risk. The systems approach outlined for Vanuatu departs from a focus on a single sector or industry. It even departs from defining the country's ability to influence emissions only within its national borders. Rather, it defines collaborative strategies to develop a circular economy along domestic and international value chains that are aligned with national objectives to safeguard natural assets, avoid waste and reduce greenhouse gas (GHG) emissions.

This way of thinking opens new avenues for Vanuatu to take action on its climate ambitions and commitments under the Paris Agreement and align these with its efforts to achieve the Sustainable Development Goals (SDGs), which relate to primary resource extraction and waste. This approach redefines development and growth, viewing them through the lens of metabolic efficiency and inspired by nature, where waste does not exist.

Identifying complementary GHG mitigation opportunities through the circular economy is part of an effort to further enhance Vanuatu's Nationally Determined Contribution (NDC) or its mitigation pledge under the Paris Agreement.

Efforts to enhance the NDC's ambition already consider a range of interventions that, together, aim to reduce national GHG emissions by 82,685 tCO_2e by 2030, when considering all sectors except livestock. The measures already considered aim to expand renewable energy capacity, vehicle efficiency and electrification, and biodiesel blending.[1]

Consumption in Vanuatu is 59 percent circular

Resource use for consumption in Vanuatu is estimated to be 59 percent circular.[2] This means that the country relies on secondary or renewable materials and energy sources for 59 percent of the materials used for domestic consumption. The remaining 41 percent of material use is not circular and can be described as following a linear 'take-make-waste' trajectory. Those materials are mostly of foreign origin and collide with the country's development ambitions because they create waste disposal problems and contribute to the deterioration of natural assets resulting from the pollution of soils, surface waters and marine environments.

However, the country can address these issues effectively because its population is directly exposed to and well-aware of the adverse impacts of pollution. The government is already prioritizing the conservation of natural assets for future generations over short-term gains. Circular economy analytics can identify the opportunities that contribute to that objective, as it aims to avoid waste and reduce the extraction of primary resources.

Vanuatu is already more circular than any other country whose circularity has been estimated. With domestic consumption estimated to be 59 percent circular, it far exceeds the global average of 8.6 percent[3], Austria's 9.7 percent and the Netherlands' 24.5 percent[4]. The country plans to make its power production fully renewable, has imposed bans on the extraction of minerals near vulnerable coastlines, and seeks international cooperation to reduce GHG emissions from livestock and more closely monitor the development of fish stocks to avoid excessive extraction. All these ambitions will make Vanuatu even more circular.

Circular economy opportunities in Vanuatu
This concise analysis aims to be solution-oriented by identifying circular economy opportunities across sectors that are aligned with the development ambitions of the Government of Vanuatu and the people who live in the country. Taken together, the circular economy opportunities proposed here can help avoid, between today and 2030, around 44 percent of solid waste, decrease primary resource extraction and reduce the trade deficit. They would also reduce domestic GHG emissions by 10 percent, or by 44 percent when taking into account only emissions from non-livestock sectors. When taking a consumption-based approach to allocating emissions, they also reduce foreign emissions in the value chains for products imported into Vanuatu by 18 percent.

The main opportunities involve:

- Converting grassland to silvopastoral livestock;
- Applying anaerobic digestion for municipal, industrial and agricultural organic waste. This will divert organic waste from landfills and produce both biogas and soil enhancers. Where volumes are too small for a biogas plant, or where the emphasis is on producing a good soil enhancer rather than producing biogas, composting can be used instead.
- Collaborating with development partners to develop circular procurement to reduce waste, resource extraction and GHG emissions associated with investments;
- Aligning Vanuatu's tax regime with its development ambitions, increasing government revenue by taxing pollution and using these revenues to support the transition to a circular economy; and,
- Collecting and sorting recyclable materials and exporting those that cannot be used or processed domestically.

Applying the circular economy concept to drive greenhouse gas mitigation

Vanuatu is on the frontlines of climate change. It is highly exposed to its impacts change, even as the country adopts policy measures that will help preserve natural assets and keep GHG emissions per capita low. With an annual per capita material footprint of 6.1 tonnes and a per capita carbon footprint of 2.1 tCO_2e, Vanuatu's population already maintains a small carbon and material footprint.[5] Furthermore, reports suggest that the country's people rank among the happiest in the world.[6]

Vanuatu's 80 islands have chosen to depart from the traditional development pathway, where the use of large amounts of carbon-intensive materials helps build infrastructure, assemble stocks of consumer goods and provide material wealth. Instead, Vanuatu prioritizes its national resources and seeks to further advance national well-being without increasing material consumption and thereby avoid associated environmental impacts.[7] The circular economy can

guide the country in reducing its material impact even further, also targeting also the remaining 41 percent of material use for consumption that is still linear and that threatens the country's natural asset base, such as its fishing stocks, forests and soils.

The circular economy is an economic concept that aims to decouple economic growth from resource use, making material use regenerative, and minimize the use of finite, non-renewable resources. It does so by optimizing the use of existing assets and materials, thus reducing the use of primary materials and lowering the output of harmful wastes. By focusing on what is already available and altering the design of new products and assets, the circular economy concept can help Vanuatu define a development pathway that diversifies its economy, avoids waste and meets the needs of its inhabitants without degrading its natural assets.

The strategy of avoiding the depletion and degradation of natural assets aligns well with the country's goal to develop as a 'blue economy.' In a blue economy, economic development and policies focus on the sustainable use of oceanic resources, based on the notion that these resources are finite and vulnerable to anthropogenic activities. This requires fisheries to be managed sustainably and fishing activities to be monitored,[8] preserving ecosystem health and avoiding pollution. The sustainable management of ocean resources also calls for an unprecedented level of collaboration across nation-states and between the public and private sectors,[9] as pollution travels great distances in a marine environment. Collaboration, sustainable extraction levels and avoiding pollution are also the fundamentals of a circular economy.

This analysis of circular economy opportunities for Vanuatu seeks to help reduce the waste flow of imported materials, while also examining how to improve the resource efficiency of all material use, including domestically-sourced materials. The analysis focuses on materials with a relatively large carbon footprint. Where they include imported goods and materials, their reduction will also help to decrease emissions in other countries.

Understanding the flow of materials and identifying where materials and products can be reduced, re-used and recycled reveals the most promising circular economy opportunities. Like a living organism, a country's population needs clean air to breathe, healthy food and clean water to live, energy for thermal comfort, and mobility and materials to deliver houses, vehicles and other consumer goods. Mapping a country's 'metabolic system' helps us understand how it uses material resources to deliver valuable services – such as nutrition, shelter and mobility – to its residents and identify opportunities for improvement.

Finally, the circular economy can help Vanuatu communicate how it has consistently chosen an alternative to the linear development pathway and takes responsibility for future and past generations, as well as for the lives of those on distant shores.

Figure 1 provides an overview of all circular economy opportunities and their ability to reduce greenhouse gas emissions and avoid solid waste. The main opportunities involve:

- Converting grassland to silvopastoral livestock;
- Applying anaerobic digestion for municipal, industrial and agricultural organic waste. This will divert organic waste from landfills and produce both biogas and soil enhancers. Where volumes are too small for a biogas plant, or where the emphasis is on producing a good soil enhancer rather than producing biogas, composting can be used instead.
- Collaborating with development partners to develop circular procurement to reduce waste, resource extraction and GHG emissions associated with investments;
- Aligning Vanuatu's tax regime with its development ambitions, increasing government revenue by taxing pollution and using these revenues to support the transition to a circular economy; and,
- Collecting and sorting recyclable materials and exporting those that cannot be used or processed domestically.

Table 1 on page 4

The circular economy opportunities identified and prioritised by stakeholders in Vanuatu, along with their ability to reduce greenhouse gas emissions and reduce solid waste (n/a refers to data not available).

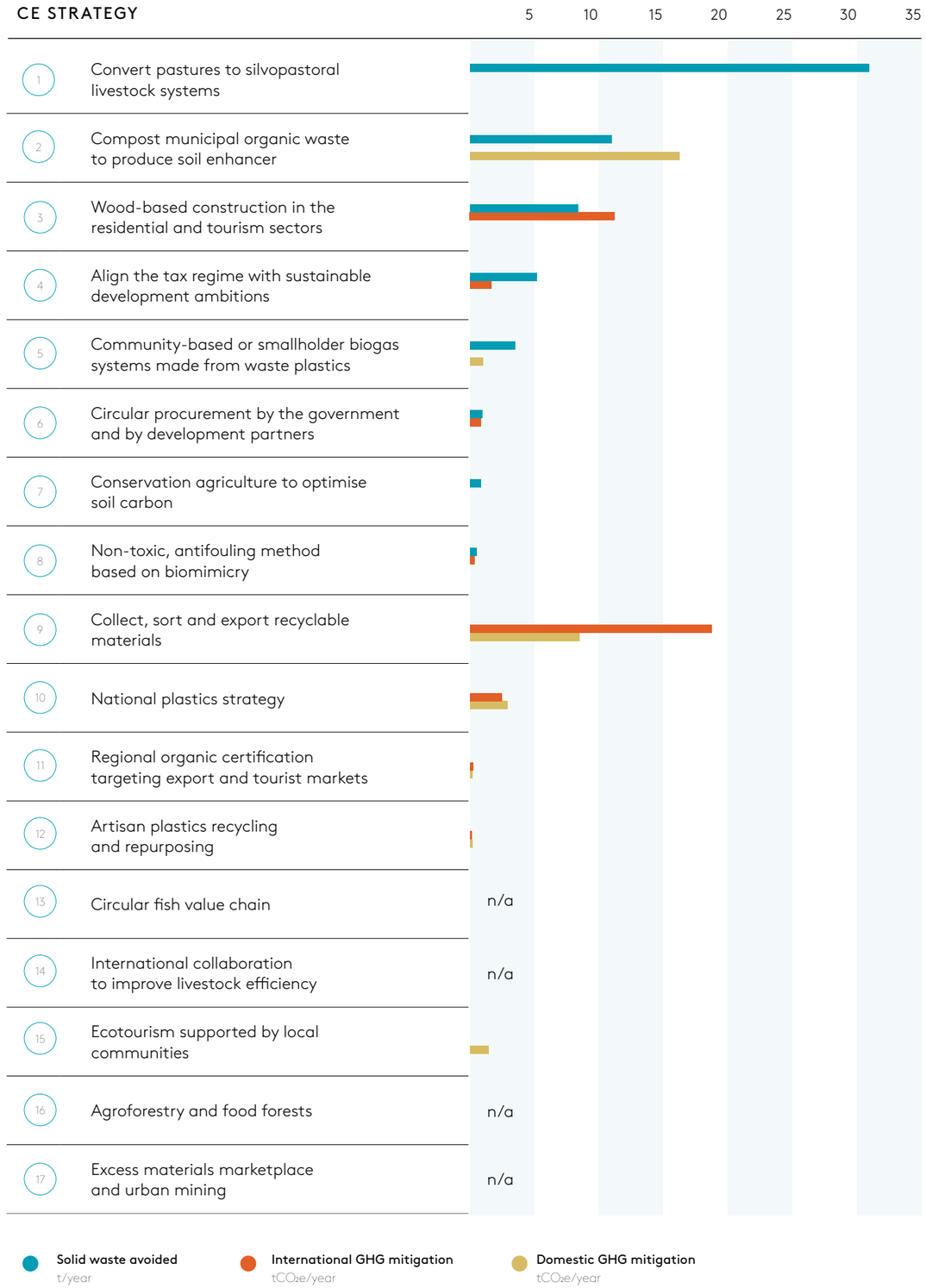


FIGURE 1

42%

wages and salaries make up 42 percent of household income

25%

25 percent of the population lives in cities

65%

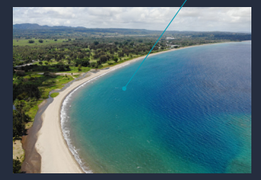
65 percent of the workforce works in the primary sector, such as agriculture, forestry and fishing

Waterfalls, North Vanuatu

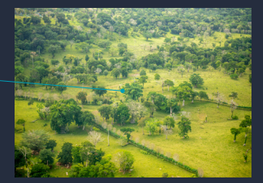
Wooden houses, Pentecost island

Livestock in the shade of trees

Port Vila harbour



Coast line Pacific Ocean, Port Vila



Vanuatu's green landscape

1 Current situation, trends and ambitions

1.1 Reader's guide

This report describes current trends and Vanuatu's development ambitions and relates them to circular economy solutions. The most promising recommendations were selected at a national workshop and are based on an analysis of resource use, asset use and waste disposal in the country. The report's structure and the analytical approach follows that of an earlier Shifting Paradigms project for the city of Almaty, Kazakhstan.[10] The report is structured as follows:

Part 1: Current situation, developments and ambitions: This part describes the current situation in Vanuatu and important trends going forward. It also highlights which of Vanuatu's policies and development ambitions align well with a transition to a more circular and low-carbon future.

Part 2: Thinking in flows and stocks: Part 2 maps out the material resources used in Vanuatu, distinguishing domestic products from imports. Data visualization helps explain how the use of products, materials and half-fabricates relate to GHG emissions in Vanuatu and emissions associated with the production of imported goods and services.

No country starts from scratch when making the transition to a circular economy. Therefore, Part 2 also describes existing circular economy initiatives. They provide the basis from which to expand or develop new initiatives that rely on similar principles and enabling conditions.

Part 3: Circular economy strategies: Stakeholders and experts from Vanuatu identified and selected the most promising circular opportunities, which are described in Part 3. The strategies were selected based on their material potential and their ability to reduce GHG emissions by 2030, and to contribute to the development ambitions described in Part 1.

Part 1 introduces the political, socio-economic and environmental situation in Vanuatu. It sets priorities for the analysis in Part 2 and the recommendations in Part 3. The description of the environmental situation points out where material value is lost in the form of emissions into the air, water and soil. The socio-economic situation describes which sectors or economic activities are most important to Vanuatu in terms of added value and jobs. This first part also provides an overview of relevant trends and developments in infrastructure, imports and exports, demographics, and land use.

1.2 Infrastructure and trade relations

Vanuatu's population totals 293,000[15] and grew by 2.5 percent in 2018. It has a relatively low urbanization rate, with 25 percent of the population living in cities.[16] The country consists of a string of islands in the Melanesia region of the Pacific Ocean, located 1,750 km east of Northern Australia. Vanuatu shares maritime borders with New Caledonia, the Solomon Islands and Fiji.

The country has over 80 islands, most of which are inhabited, with total land area of 12,190 km² and a combined coastline of 2,530 km[17]. Vanuatu's exclusive economic zone covers over 600,000 km²[18]. The largest cities are the capital, Port Vila, on the island of Efate, and Luganville, on Espiritu Santo, the archipelago's largest island.[19]

The country's main export destinations are Japan, China and Australia. Fifty-five percent of the export value of Vanuatu's products are based on fish products, approximately 60 percent of which are exported to Japan. The country's second export product is scrap vessels, which go to Turkey, while coca beans head for Malaysia and an estimated annual 2,500 tonnes of wood is transported to China and Japan.[20]

Vanuatu has a negative trade balance, with 2018 exports totalling US$167 million and imports, $268 million.[21] Twenty-four percent of its import value comes from China and 19 percent from Australia. Chinese imports include products such as liquid fuels, machinery, clothing and tires. Singapore supplies liquid fuels and Australia provides medical equipment, meat, asphalt, tobacco and liquor. Most food products, such as baked goods, pasta, wheat and flour, come from Fiji, while New Zealand supplies primarily meat and iron for the construction sector.

Vanuatu's economy is too small to allow for investment in industrial recycling facilities for metals, glass and paper. However, because the country has ample capacity for reverse logistics – imported products are returned to their manufacturer or to a recycling facility when they reach the end of their lifetime – it may not need such facilities. Some 10,800 20-foot equivalent container units dock at the ports of Santo and Port Vila every year; 8,700 of them return empty.[22] While in the past, some of this capacity was used to return recyclable materials to foreign industries, the recent decline in the value of secondary materials, perhaps in response to Chinese import bans,[23] has ended most of these exports.

The most carbon-intensive products that Vanuatu imports are food products, mineral products, construction materials and vehicles. Most are taxed at the border. Vanuatu levies import duties of 15 percent to 30 percent on most food products; carbon-intensive products, such as meat, are subject to duties close to 30 percent. Mineral fuels and chemical products are in the 0 percent to 5 percent range, while most plastic products are charged 15 percent and most mineral and metal construction materials are subject to 10 percent duty. The highest rate – 55 percent – is applied to tobacco products only.[24]

Vanuatu relies primarily on domestic production of food products and firewood, making the country relatively independent from imports. The subsistence nature of its economy means that the gross domestic product (GDP) does not reflect all production and consumption. This is also true for household income. According to the latest household income survey, wages and salaries make up 42 percent of household income, compared to own production (33 percent) and household enterprises (28 percent). Most expenditures involve food (56 percent) and housing (7 percent). Transport accounts for 5 percent.[25] Ninety-one percent of households use fuelwood or coconut shells as their primary source of cooking fuel.[26]

1.3 Social, economic and environmental data by sector

Vanuatu's formal economy was estimated to total $830 million in 2017. According to national statistics, the four main components of its GDP are agriculture, retail and wholesale trade, government, and commercial and financial services.[28] However, GDP does not capture all economic activity (particularly agriculture and fisheries) since part of production meets subsistence needs directly.

The employment statistics suggest different priority sectors, as agriculture, fisheries and animal husbandry support the majority of the population, followed by tourism. An estimated 80 percent of the population relies on subsistence agriculture and an estimated 50 percent of households is involved in fishing.[29] When farmers and fisherfolk produce for subsistence needs, their production is not reflected in GDP.[30]

Vanuatu's youth unemployment rate is approximately 10 percent[31] and the government seeks to create attractive career opportunities for youth.[32] Foreign direct investment in Vanuatu is important, as an estimated 40 percent of the country's salaried workforce is employed by foreign investors.[33] The second-leading segment, an estimated 2,500 to 7,000 indigenous Ni-Vanuatu workers, are employed as seasonal workers in Australia and

BOX 1

Key definitions

Socioeconomic metabolism
"The set of all anthropogenic flows, stocks, and transformations of physical resources and their respective dynamics assembled in a systems context."[11] In the context of this analysis, Vanuatu's metabolism refers to the flows and stocks of material resources, energy and waste.

Circular Economy
"Looking beyond the current 'take, make and dispose' extractive industrial model, the circular economy is restorative and regenerative by design. Relying on system-wide innovation, it aims to redefine products and services to design waste out, while minimizing negative impacts. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural and social capital."[12]

Systems approach
"A focus on the development of an integrated perspective that includes all levels, rather than on the isolated search for ready-made solutions to sub-problems."[13]

Metabolic analysis
In this report, an analysis that examines both material flows and stock dynamics. The latter considers both the development of the stock produced, such as building stock, vehicle fleet, transport and communications infrastructure, and the impact of economic activities, notably material extraction and disposal, on depletive mineral reserves and regenerative natural assets, such as maritime and terrestrial ecosystems.

Secondary resources
Once "waste" has been collected and prepared for recycling, it becomes a new resource. It is a secondary resource, which differs from a primary resource that originates from extractive industries, such as mining.

Nationally Determined Contribution
Countries' submissions to the United National Framework Convention on Climate Change (UNFCCC) of their mitigation commitments for 2030, or beyond, under the Paris Agreement.[14]

New Zealand.[34] Priority should be given to circular economy opportunities that can create new jobs in services, recycling, repair and remanufacturing and help reduce the unemployment rate further.[35]

Annual GHG emissions from Vanuatu totalled 610,204 tCO_2e in 2015 (excluding net sinks from land use change and emissions from international shipping and aviation). Livestock emissions, related to enteric fermentation and manure management, total 77 percent of the country's GHG emissions.[36]

The agricultural sector in Vanuatu uses the most resources, partly because it supports a significant export volume, followed by construction. Like agriculture, construction also relies primarily on locally available construction materials with a low carbon and environmental footprint.[37]

The resource use, added value, employment and GHG emissions of Vanuatu's industrial/manufacturing sector is low. Most manufactured or industrial products are imported, while national industries are involved primarily in food and wood processing.

Financial and commercial services generate valuable revenues, while their contribution to resource use and GHG emissions is negligible. Vanuatu has a favourable tax regime that is attractive to business like international shipping companies, which try to minimize their taxes. Vanuatu also provides asylum services.[38]

1.4 National trends and developments

Several trends are placing pressure on the government's development ambitions. Vanuatu's urban centres are growing rapidly[39] and tourism and urban communities are gradually consuming increasing amounts of imported goods. This increases solid and liquid waste volumes, posing a risk to the environment and human health.[40] [41]

The government is concerned about vested private sector interests and how they may affect the country's ability to achieve its GHG mitigation targets.[42] Tourism is one of the sectors in which the private sector plays a large role. The high level of foreign ownership in this sector means that foreign companies earn a relatively large share of those revenues.[43]

Vanuatu ranks first among countries most exposed to the risk of extreme natural events.[44] The country was struck by two Category 5 cyclones in recent years (Pam in 2015[45] and Harold in 2020[46]). The frequency and intensity of these cyclones may increase as a result of climate change[47] and their impacts are already significant. It has been estimated that Cyclone Pam caused economic damage equivalent to 64 percent of the country's GDP[48]. Some islands also experience volcanic eruptions. In 2018, the government evacuated the islands of Ambae, Ambrym, and Tanna when Manaro Voui erupted.[49]

Vanuatu ranks 4th on the Happy Planet Index. The New Economic Foundation attributes this high ranking to immaterial aspects such as cultural diversity, a sustained peaceful and democratic tradition, and tight-knit communities that meet regularly to resolve conflicts.[50] [51] Other elements that may contribute to national well-being are a high level of land ownership among residents, which allows them to support themselves. According to other sources, the involvement of many Ni-Vanuatu people in food production and sharing of knowledge on the planting cycle and the importance of flora and fauna also contribute to well-being.[52] The right to own land is protected by a regulatory ban on the sale of land to foreigners, but long-term leases are permitted. This allows foreigners to own holiday homes and foreign project developers to use agricultural land.[53]

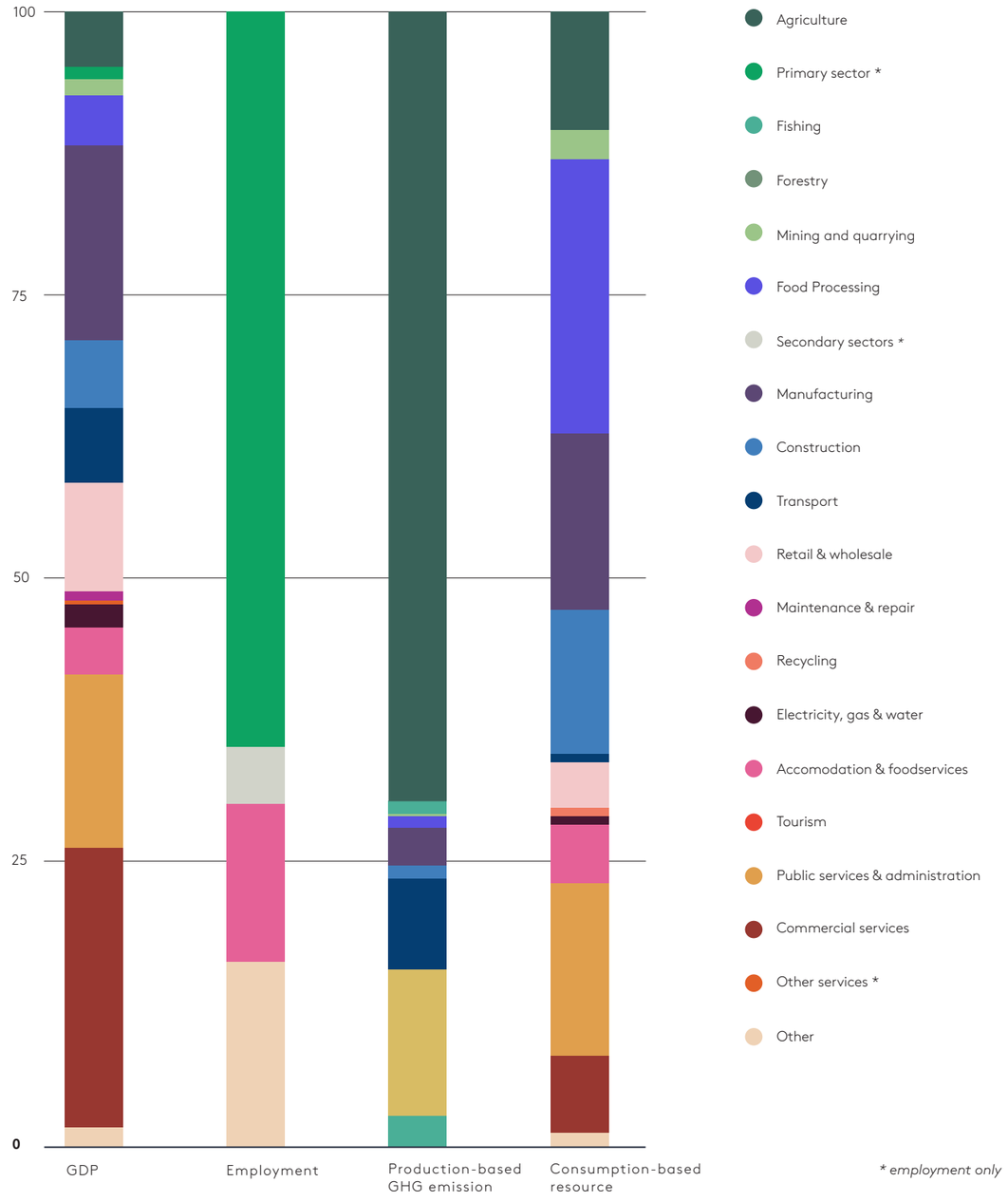
Where rural society is rooted in subsistence agriculture, economic and political inequalities remain muted. However, the differences between rural residents and the educated and employed population, most of whom live in urban areas, is increasing. To date, these differences are less of a concern as urban residents maintain strong ties with their home villages.[54]

Urbanization also offers an opportunity to install centralized waste treatment collection systems in cities like Port Vila. Port Vila is an exception in the Pacific – similar, perhaps, to Suva, Fiji – as the city collects individual property taxes and waste collection fees. The waste collection and management system that these fees fund could be improved and should prepare for further urbanization and tourism growth.[53]

FIGURE 2

Breakdown of gross domestic product, employment, GHG emissions and resource use per sector[27]

$ktCO_2e/year$



Vanuatu's most recent GHG inventory was conducted in 2015. The country's GHG emissions show a gradual increase between 2007 and 2015, with most of the growth occurring in the transport sector. Emissions from other sectors have been relatively stable.[56] The residential sector uses the most fuel when energy consumption is expressed in tonnes of oil equivalent. Most involves burning firewood and agricultural residues. Fuel consumption in the transport sector is second, followed by fuel consumption for power generation.[57]

1.5 Political and public agenda

'Vanuatu 2030' is the country's mid-term development road map. It states that 'For Vanuatu, development is much more than just acquiring material wealth.' The road map describes the key national values in this way:

> 'Our people and place are at the very heart of our development aspirations. Together we strive for a nation that is stable, sustainable and prosperous, so that all people have a just and equal opportunity to be well-educated, healthy and wealthy. Just as we strive to progress in a way that protects and preserves our natural resources for our children, and theirs…It requires safeguarding the remarkable natural assets we have been blessed to inherit, and which serve as the bedrock of our identity.'[58]

During public consultations held during the development of Vanuatu's Vision 2030, participants called for improved quality and distribution of healthcare facilities, education and transport infrastructure and better access to essential services and utilities, such as modern energy sources, safe drinking water and sanitation, while minimizing disturbances to the natural land and marine environment.[59] These calls reflect the fact that although Vanuatu has experienced economic growth, it has made little progress on the Human Development Index. This index includes per capita income, as well as indicators related to health, life expectancy, education and inequality.[60]

These aspirations require investments in material assets like schools, hospitals and transport infrastructure. Apart from such investments, the country also seeks to improve storage capacity to enhance food storage and to stock sufficient food supplies to prepare for the aftermath of natural disasters. This requires investing in physical infrastructure and will increase short-term demands for resources. In seeking international collaboration on infrastructure development, Vanuatu's Vision 2030 aims to strengthen partnerships to enhance the effective use of resources and ensure sustainable asset management and maintenance.

Thanks to its geography, the Vanuatuan economy faces – naturally – the pricing incentives often recommended to help countries reduce their material and carbon footprint. Given long shipping distances between islands and the small cargo volumes transported to individual islands, the price of fossil fuels is around 40 percent higher than in Australia.[61] The added costs of domestic transport between islands further encourages community independence in which local products prevail, naturally, over imports. On the other hand, the low quality of domestic infrastructure also constitutes a barrier to sustainable development where, for example, it hampers access to markets willing to pay a premium for sustainably produced products from Vanuatu, such as certified organic food products. The energy infrastructure will tap into renewable energy resources. In 2015, in its first mitigation pledge to the UNFCCCC, the government committed to achieving close to 100 percent renewable power generation by 2030, conditional upon receiving financial and technical support from international climate funds. Decarbonizing power generation creates opportunities for the sustainable operation of circular economy initiatives that require electricity, while the reduced fossil fuel imports will make Vanuatu's economy more circular.[62]

Meat production is a mainstay of Vanuatu's economy. The country produces around 1,670 tonnes of beef per year and consumes 2,966 tonnes domestically; 380 tonnes are consumed in the tourism sector.[63] The islands' herds total around 200,000 head[64], with a national target of 500,000 by 2025.[65]

Livestock is an important source of income from dairy and meat for smallholder farmers, while also providing manure to fertilize the land and draught or even transport power. Thus, the Government of Vanuatu has prioritized beef production intended for export and the tourism sector. Livestock also plays an important role in a circular food system; for example, by converting residual flows or crops unsuitable for human consumption into protein, consuming grass and herbs from pastures in areas unsuitable for growing food, and providing manure to enhance soil quality. According to the World Bank, livestock supports the livelihoods and food and nutrition security of almost 1.3 billion people globally, while contributing to the preservation of biodiversity and to carbon sequestration in soils.[66]

On the other hand, beef is the most resource-intense of all protein sources [67] and has a relatively high GHG footprint, due to its methane emissions. In Vanuatu, livestock is the source of 73 percent of national GHG emissions.[68] An estimated 81 percent of that 73 percent can be attributed to beef production and the rest to dairy, chicken, goats and pigs.

The circular mitigation options analysis aims to identify opportunities that do not compromise the growth ambitions of the livestock sector. The analysis also focuses on opportunities that can complement the interventions that are already included in the NDC enhancement. They are to:

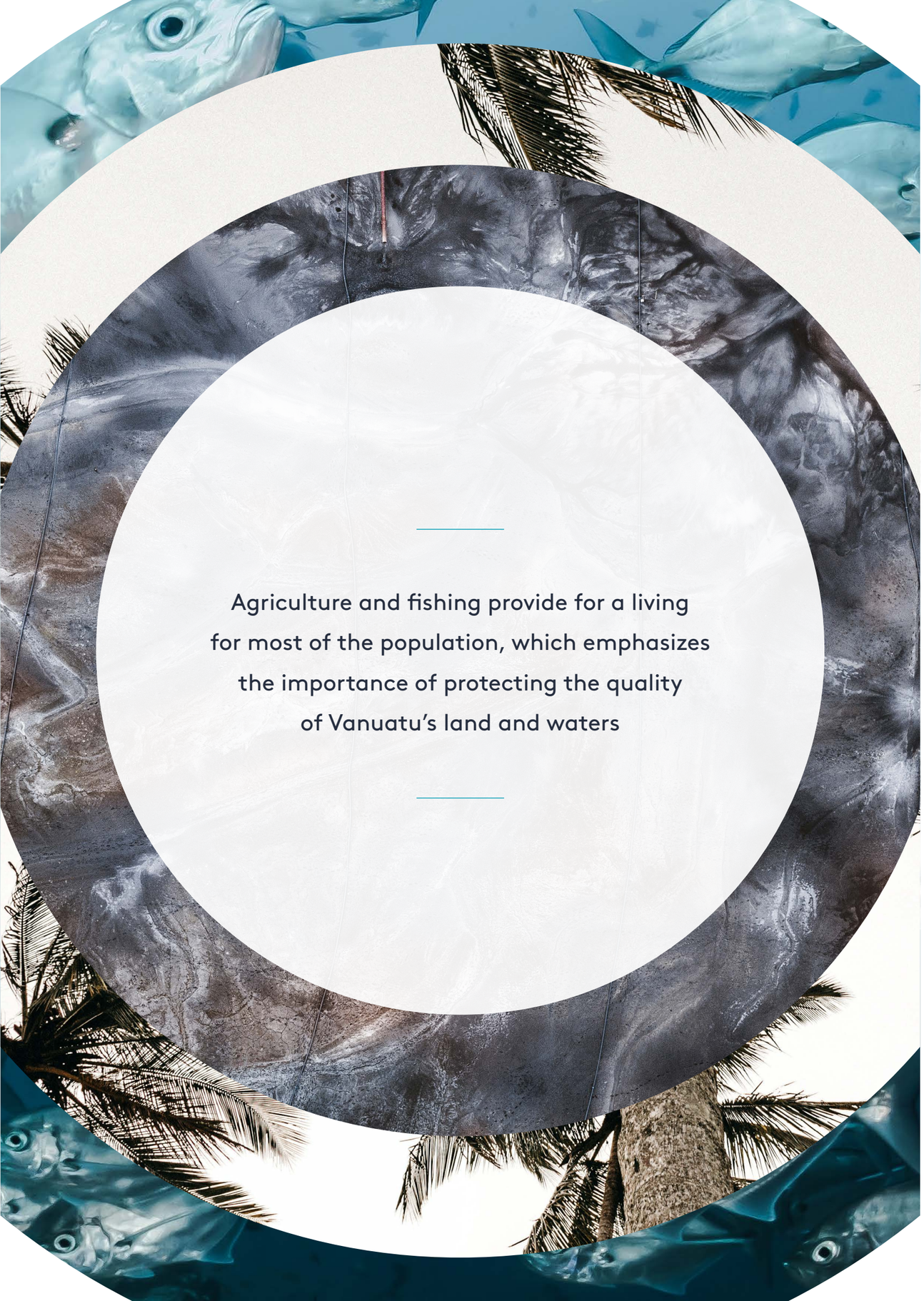
- expand renewable energy capacity (53,930 tCO_2e by 2030);
- improve transport energy efficiency and introduce electric vehicles (10,265 tCO_2e); and,
- blend 22 percent biodiesel in diesel (18,500 tCO_2e)[69]

GHG mitigation and climate change resilience are integrated into Vanuatu's sectoral policies.[70] The government seeks to strengthen its institutional capacity to manage climate adaptation initiatives and attract more international funding for this purpose. Adaptation priorities are as follows:

- Agriculture and food security
- Sustainable tourism development
- Community-based marine resource management
- Sustainable forest management
- Integrated water resource management.[71]

The government also often places the quality of natural assets first in the context of climate change adaptation. It prioritizes 'soft' ecosystem-based climate change adaptation measures over 'hard' engineered infrastructure to secure ecosystem functioning. For example, it favours coastal revegetation over sea walls.[72] For Vanuatu, protecting natural assets such as vulnerable forests, watersheds and catchment areas is important, as they are known to provide valuable services, including community freshwater sources. In addition, biodiversity and ecosystems play a major role in Vanuatu's culture and community rituals.[73]

Finally, while Vanuatu is working to foster international cooperation, it is also regulating international trade to prevent harmful substances from entering the country's environment or having an adverse impact on national health. This requires an effective customs system. In line with this objective, the government introduced a ban on single-use plastics[74] and launched an import tax on products that contain excessive amounts of sugar.[75] The government is often equally strict with regard to domestic activities that put ecosystems at risk, as illustrated by its recent ban on sand extraction.[76]



Agriculture and fishing provide for a living for most of the population, which emphasizes the importance of protecting the quality of Vanuatu's land and waters

2 Thinking in flows and stocks

2.1 Reader's guide

Part 1 showed that food value chains, construction and trade are the economic activities with the highest material throughput. Agriculture and fishing provide for a living for most of the population, which emphasizes the importance of protecting the quality of Vanuatu's land and waters.

Part 2 examines material flows and their impact on the quality of natural resources and the accumulation of material stocks in national vehicle fleets, transport infrastructure and buildings.

Shifting from sectoral silos to flows and stocks, this part portrays Vanuatu's economic system through a metabolic analysis, which combines a material flow analysis and a stock dynamics analysis. The latter examines both the development of build stock, as well as the impact of economic activities on natural assets such as maritime and terrestrial resources. In addition, because no country starts from scratch in the transition to a circular economy, Part 2 also describes existing circular economy initiatives, based on the key enablers and strategies listed in Box 2. These initiatives provide a basis for further progress.

2.2 Metabolic analysis to understand a circular future

The resource and energy efficiency of an economy is more than the sum of the efficiencies of all its components. Decoupling economic growth from resource and energy use requires understanding how individual components operate. However, above all, it involves providing an overview of how individual elements interact and work together to deliver a diverse set of services to society.[77]

Mapping the flows and stocks of a supranational entity, country or government subdivision shifts the focus from environmental issues and short-term priorities to the performance of the overall system and 'the development of an integrated development perspective that includes all levels and sectors.'[78] This requires large quantities of data on resource use and assets to observe how flows of minerals, biomass, metals, fuels, water and assets such as buildings, vehicles and means of production work together to respond to individuals' needs. Data visualization helps stakeholders develop a consensus on the current situation and, based on that consensus, explore the most promising circular economy opportunities.[79]

2.3 Resource use and climate change

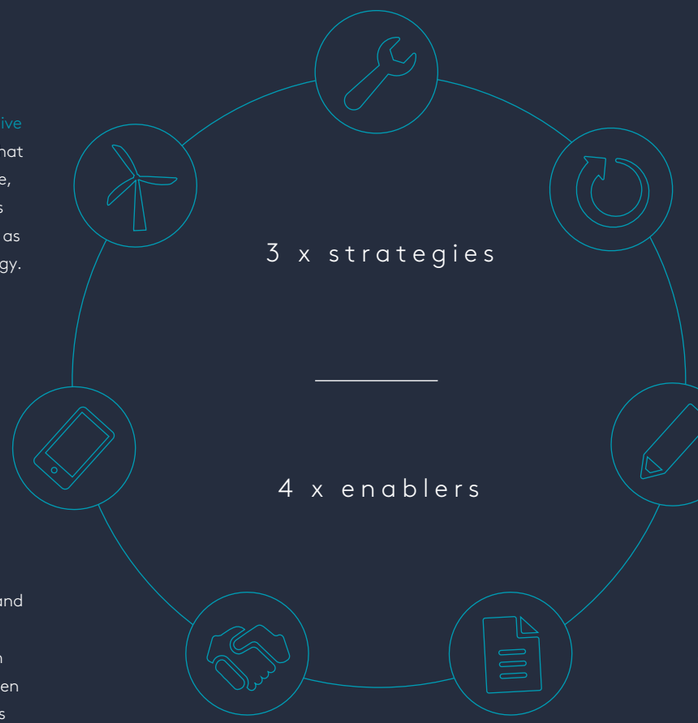
When envisioning a long-term development perspective for Vanuatu, resource efficiency and GHG mitigation should be addressed in tandem. A major share of the resources extracted are the fossil fuels that contribute to climate change. In practice, most of these fuels are used to extract, transport and process materials and products. An

BOX 2

To define a common language for the circular economy, the NGO, Circle Economy, inventoried the terms and definitions used by over 20 organisations, from NGOs to government agencies, academia and consultancies.

Three strategies and four enablers emerge

Sustain and preserve what's already there: Maintain, repair and upgrade resources in use to maximize their lifetime and give them a second life through take-back strategies, where applicable.



Prioritize regenerative resources: Ensure that renewable, reusable, non-toxic resources are used efficiently as materials and energy.

Use waste as a resource: Utilize waste streams as a source of secondary resources and recover waste for reuse and recycling.

Incorporate digital technology: Track and optimize resource use and strengthen connections between supply-chain actors through digital, online platforms and technologies.

Design for the future: Adopt a systemic perspective during the design process to employ the right materials for appropriate lifetime and extended future use.

Team up to create joint value: Work together throughout the supply chain, internally within organizations and with the public sector to increase transparency and create shared value.[84]

Rethink the business model: Consider opportunities to create greater value and align incentives by reconsidering business models; for example, by replacing a sales model with one based on providing a service or sharing assets.

estimated 67 percent of global GHG emissions are related to material management.[80] As a result, only the mutually reinforcing combination of low-carbon development and resource efficiency can put the world on a 2^0C or, even, a 1.5^0C pathway.[81]

The circular economy also makes economic sense. For some sectors, decoupling resource use from economic growth will bring GHG emissions in line with the ambition to keep global warming at 2^0C.[82] This opens up a development perspective in which reduced dependency on material resources and fossil fuels can create the financial savings that accelerate economic development. The public debate on the immediate costs of climate change mitigation often overlooks the fact that the economic benefits of resource efficiency and low-carbon development exceed the near-term costs of shifting to a 2^0C emissions pathway.[83]

2.4 Mapping resource flows, stocks and embedded emissions

Material flows distinguish among biomass, minerals, metals, fossil fuels, GHG emissions and water. The flows have been quantified using statistical data from the national statistics bureau. They cover extraction, import, processing and production, consumption, construction, waste management, and export.

Data gaps were addressed by drawing on other statistical sources and academic and grey literature. By connecting the flows at product level and breaking them down into different resource types, they can be traced from origin to final destination. Since the aggregated mass of all materials should be maintained during the conversions, comparing the flow totals in each part of the value chain allowed for cross-checking.

Material flows

BIOMASS flows include food products of vegetable and animal origin and the wood, rubber and paper used to make products such as furniture, construction materials and packaging.

MINERALS are mostly mineral construction materials, such as cement, tiles and bricks. They also include oil-based products, such as chemicals, fertilizers and the bitumen used in road construction.
METALS include raw and processed metals and their products, ranging from iron plates to copper wiring, vehicles, machinery and metal building structures.

WATER flows include the rivers and rainwater that flow from the islands into the ocean, part of which is cleaned and used as drinking or irrigation water and discharged.

FOSSIL FUELS are gas, liquid and solid fuels (primarily diesel in Vanuatu). Fossil fuels are used primarily in the transport sector and to generate heat and electricity.

EMISSIONS are GHG emissions, most of which are carbon dioxide or CO_2 following by methane or CH_4.

Three sources of materials are distinguished.

IMPORTED refer to materials and products imported into Vanuatu. These originate from wells, quarries, mines or fields located outside the country.

DEPLETIVE EXTRACTION refers to materials and products produced or extracted in national mines, wells, quarries, forests, agriculture and fishing. Where materials are extracted from depletive sources – for example, sand extraction or wood harvests that lead to a decline in forest stock – they are referred to as depletive.

SECONDARY AND REGENERATIVE refers to secondary and regenerative resources used in Vanuatu, which often involves the use of organic residues as soil enhancers and also includes the recovery of recyclable materials from national waste streams. Agricultural, forest and fish products are regenerative when forest stock, fish stock and soil quality are stable or show improvement over time.

In addition to mapping the materials used, the analysis also shows what happens to waste or products after they are used.

SOLID WASTE refers to secondary resources or wastes that are dumped or partially burned and then dumped in a dumpsite, garden or the sea. Due to the mixing of resources and their degradation over time, considerable value is lost. In addition, organic material that is dumped decays under anaerobic conditions, which creates methane emissions. Methane is a potent GHG.

LONG TERM USE (LTU), also referred to as stock addition, refers to the use of materials over a long

period, as in a new building, vehicle, or transport and communications infrastructure. Materials in such produced stock can be extracted at the end of the asset's lifetime.

EXPORTED refers to products and materials that are exported to other countries.

DISCHARGED refers to the discharge of treated or untreated wastewater into surface water.

NUTRITION refers to that part of organic material or food that organisms use as a source of water, energy, protein or minerals. These materials are partly discharged through the sewage system, but some cannot be traced back in measurable flows.

SOIL ENHANCERS refers to materials that are applied on land to retain soil fertility and/or enhance soil organic carbon.

RECYCLED refers to waste that is first recovered for processing and then reused. Throughout the recycling process, value that was embedded in the original product is lost, which means that recycling is a suboptimal waste treatment method, although it is better than landfill burial. In Vanuatu, some metals and plastics are recycled for domestic use or export, while large volumes of organic waste are used as soil enhancers and kept in circulation.

Finally, four types of GHG emissions are identified and quantified.

TERRITORIAL EMISSIONS are those produced in Vanuatu. They are created by the combustion of fossil fuels or the anaerobic digestion of organic materials.

EMBEDDED EMISSIONS are those produced outside the country during the production of goods and materials that are then imported into Vanuatu.[85]

EXPORTED EMISSIONS are those associated with goods and materials that are exported.

UPSTREAM EMISSIONS refer to those associated with imported goods and materials that are consumed in Vanuatu and attributed to the country's consumption-based emissions.

Stocks and national assets

Just as a company's health cannot be assessed by looking only at its cash flow, a country's metabolic situation cannot be assessed by looking only at its material flows. A country may invest in or safeguard its natural assets, which would make them more attractive and productive in the future. It may also draw on those assets, which would prevent it from sustaining current production levels in the future. In keeping with the business analogy, the latter can be considered a form of 'asset stripping.' Likewise, understanding the impact of economic activity on a country's national assets, including biodiversity, pollination services, water quality and soil fertility, requires understanding trends in the quality of natural assets.[86]

2.5 Historic trends in material use and emissions

The Sustainable Consumption and Production Hotspot Analysis Tool, a joint initiative of the Life Cycle Initiative, the One-Planet Network and the International Resource Panel, provides an overview of trends in material and land use. As shown in figure 2, Vanuatu's per-capita material footprint is relatively stable, while per-capita land use has even declined. With relatively stable material, carbon and land footprints, the country has been able to sustain a slow but gradual increase in its Human Development Index score and in its population and GDP.

Historic trends in material, land and GHG footprint, species loss, population and GDP growth.[87]
(See figures 4-7, page 26-27)

However, the SCP-HAT tool shows that biodiversity in Vanuatu is in decline, with the number of species lost gradually increasing. This trend is not unique to Vanuatu, with nature and its vital contributions to people deteriorating worldwide. The main causes of global biodiversity loss are land-use change, climate change, pollution and population growth, coupled with economic incentives that favour a continuous expansion of economic activity over conservation and restoration.[88]

The SCP-HAT data runs till 2015. The data points for 2018 are from the metabolic analysis.

FIGURE 3

Flows & stocks

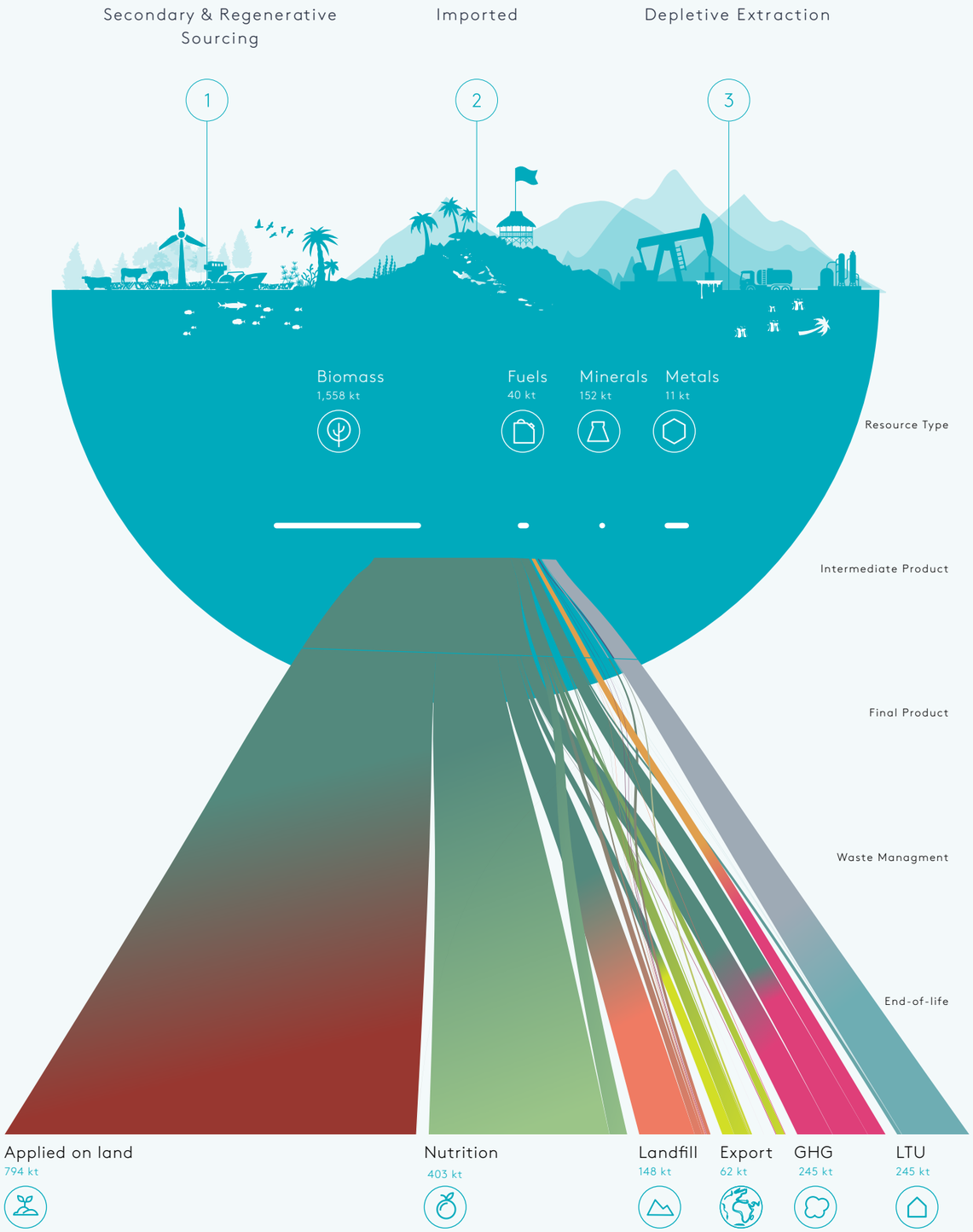


FIGURE 4

Historic trends in material, land and GHG footprint per capita

Vanuatu 1990 — 2018

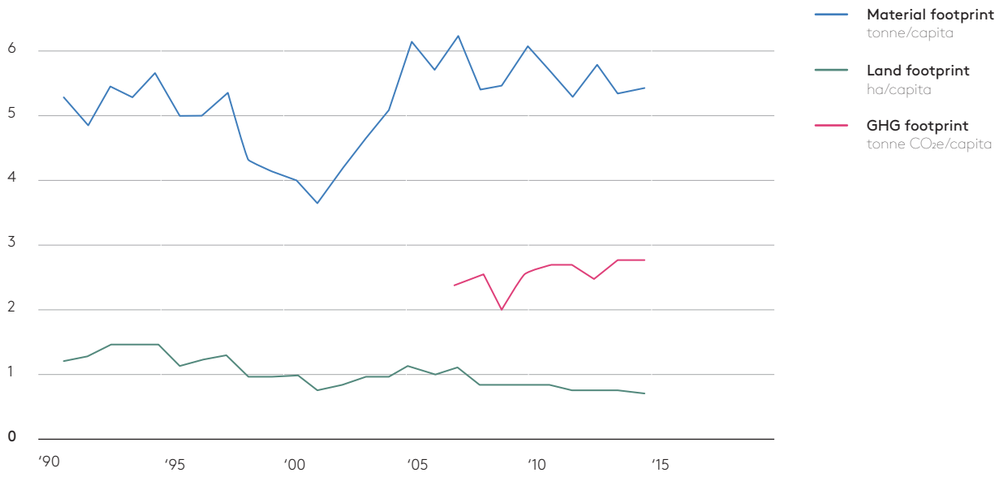


FIGURE 5

Historic trends in material footprint and extraction, GHG emissions, GHG emissions, species loss

Vanuatu 1990 — 2018

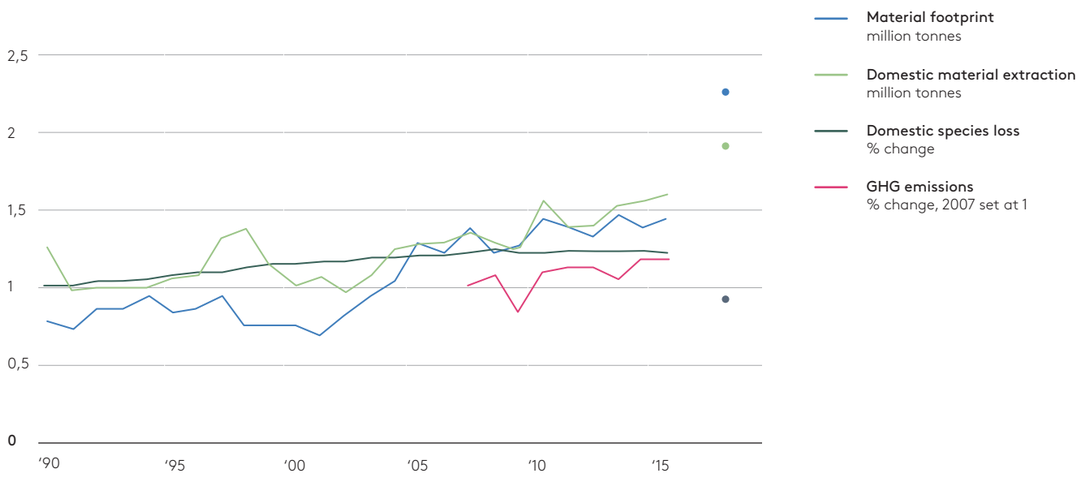


FIGURE 6

Historic trends in population and GDP growth

Vanuatu 1990 — 2018

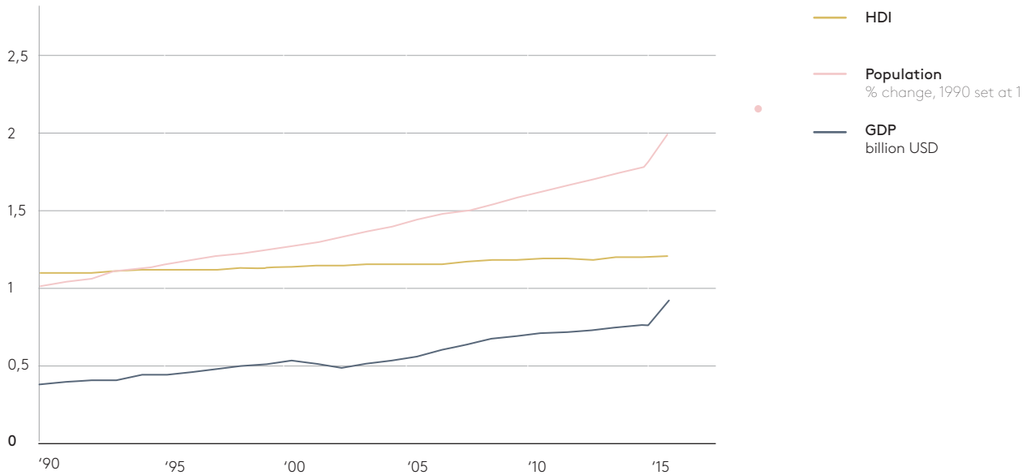
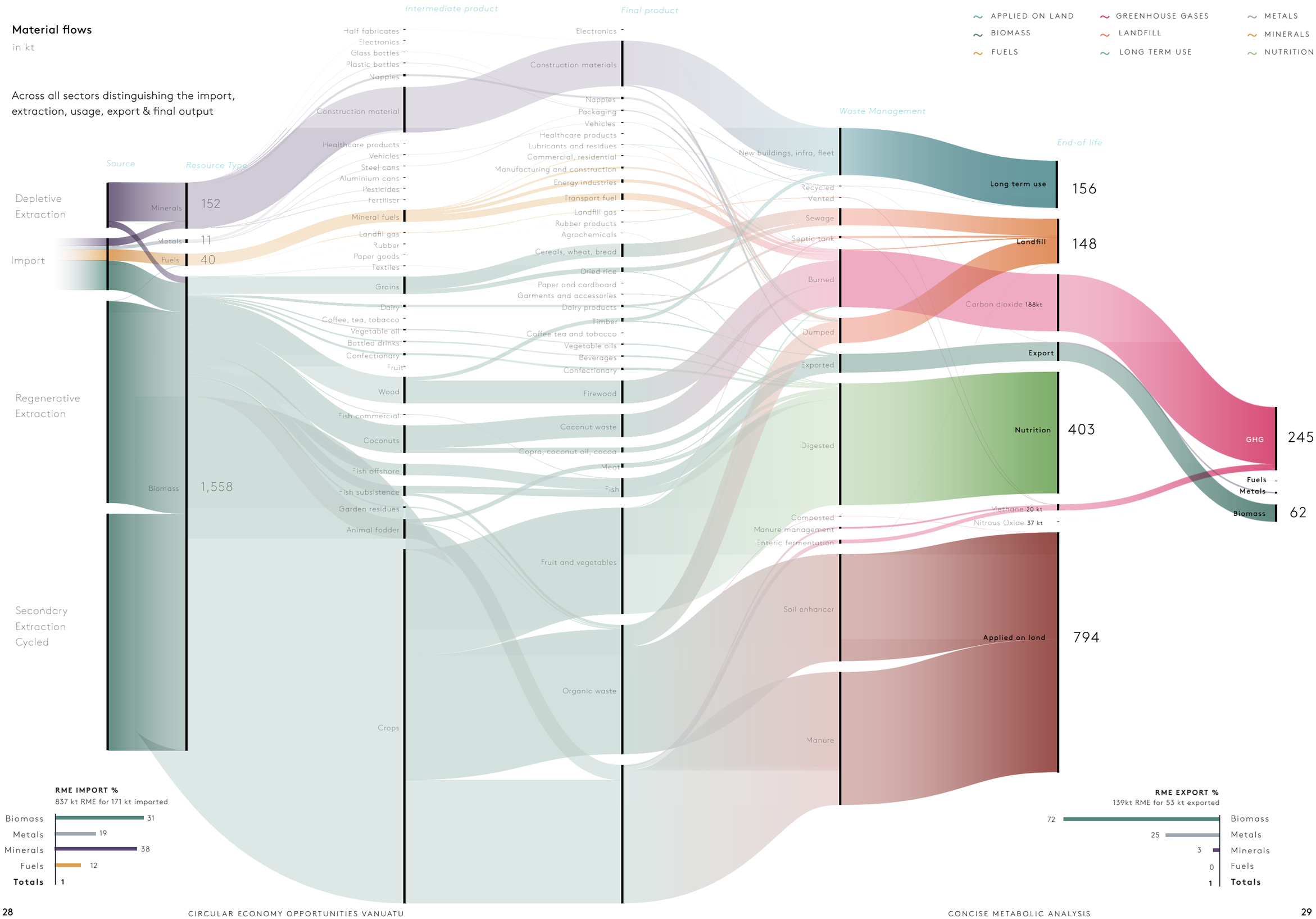


FIGURE 7

Material flows

in kt

Across all sectors distinguishing the import, extraction, usage, export & final output



RME IMPORT %

837 kt RME for 171 kt imported

Biomass	31
Metals	19
Minerals	38
Fuels	12
Totals	1

RME EXPORT %

139kt RME for 53 kt exported

72	Biomass
25	Metals
3	Minerals
0	Fuels
1	**Totals**

2.6 National material flows

This complete overview of material use in Vanuatu's economy shows all materials used annually in metric tonnes, except for water and air. The width of each flow represents the tonnes of materials involved. When read from left to right, starting at the top left, the 'Source' column shows that most materials used are cycled and extracted. Vanuatu relies on domestic resources, mostly food, timber, firewood and minerals, for 90 percent of its material needs. The 10 percent of materials that do not originate from Vanuatu are imported. They are the less circular materials and more often are based on materials from depletive resources, such as metals. Given a waste management system that is not designed to process the metals and minerals in imported goods and materials, they are an immediate threat to Vanuatu's environment and subsistence tradition. Most of these materials end up in the ecosystems on which many people rely.

The 'Resource type' column shows that most materials used in Vanuatu are biomass, composed of agricultural products and wood. Most are extracted in Vanuatu. Imports are mostly fuels, metals and minerals. The middle section – 'Final product' – provides the most detail, indicating the steps by which the intermediate product is converted to the final product. For example, coconuts are used to produce copra and coconut oil.

On the right, the 'Waste management' and 'End-of-life' columns show that most organic residues are applied on land as a soil enhancer, while a significant share of biomass weight is consumed. Most imported materials end up as solid waste, while imported fossil fuels contribute to territorial GHG emissions when they are combusted. Territorial GHG emissions total 610,154 tCO_2e/year. In this graph, GHG emissions are depicted as too low as they equal the weight of the actual fuel or GHG in tonnes and do not consider the global warming potential of the gasses emitted. Section 2.8 shows actual and embedded GHG emissions in tonnes of CO_2 equivalents and considers the Global Warming Potential of the gasses emitted.

Figure 3: Material flows in tonnes across all sectors distinguishing the import, extraction, usage, export and final output.[89] **(See p.28-29)**

2.7 Vanuatu is 59 percent circular

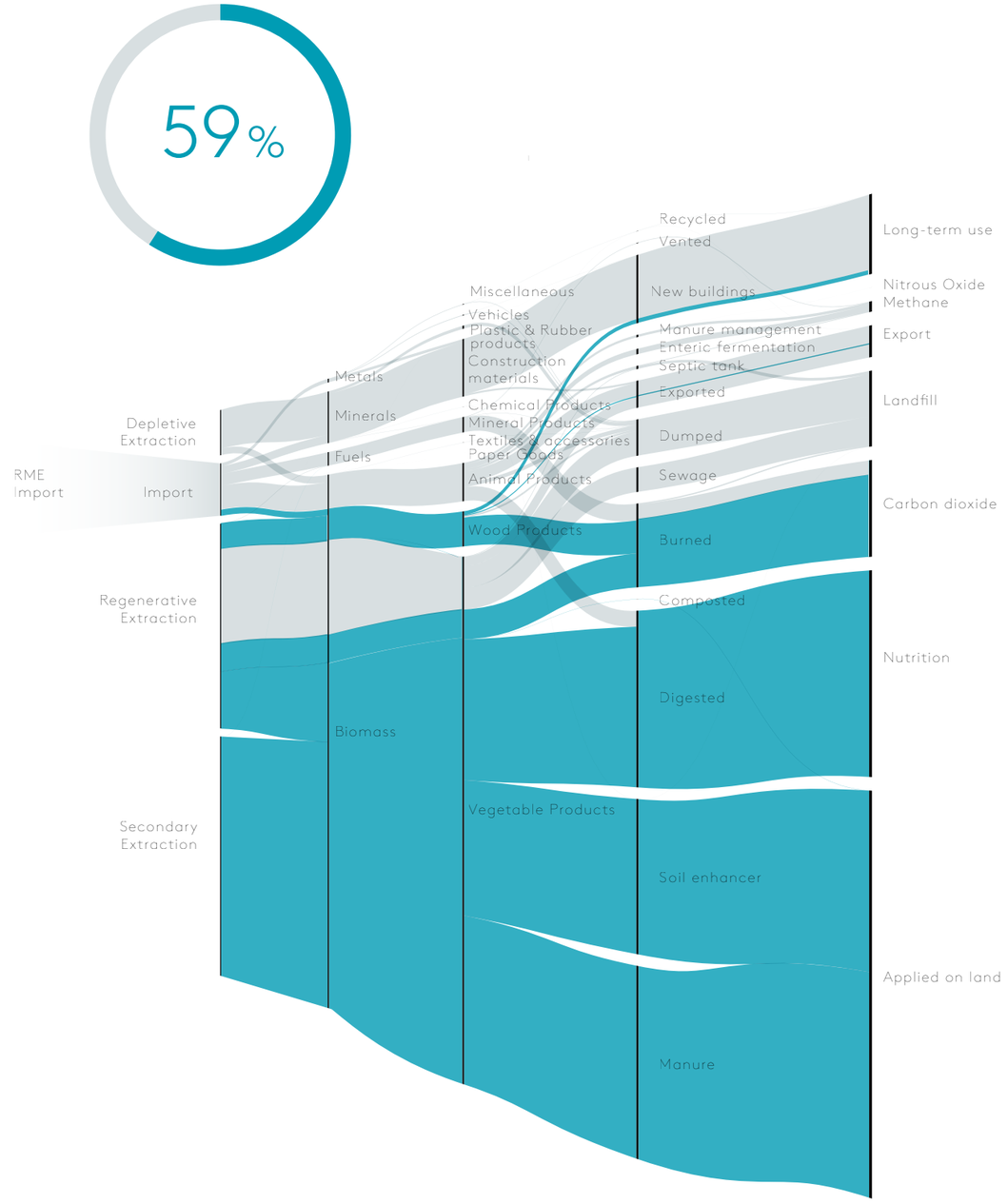
Vanuatu's circularity gap of Vanuatu can be calculated using the data underlying the visual of material flows. To determine these material flows, data from a large number of different sources has been combined, with priority given to Vanuatu data sources, primarily from the Government of Vanuatu or the partner organization within the country that supported data collection. Giving priority to national statistics and information ensures that the results are based on the data that the Government of Vanuatu and other stakeholders in the country use to make their decisions. Most sources rely on 2018 data, but older data had to be used in some cases.

The approach to calculating the circularity gap follows the rationale developed for the Global Circularity Gap Reports[90], which builds on earlier work by Haas et al.[91], Krausmann[92], Wiedman[93] and the International Resource Panel[94]. To incorporate international trade flows, the approach taken in Norway's circularity gap report was adopted.[95] It defines circularity as 'measuring the share of cycled materials as part of the total material inputs into a national economy every year.' For Vanuatu, some regenerative resources are also considered as circular, at least where fish stocks, forest resources and soil quality are stable.

The consumption-based circularity gap for Vanuatu specifies which share of domestic consumption is from renewable or secondary resources. Vanuatu's material footprint Vanuatu totals 1,761 ktonnes, which is the total amount of materials used in the country annually, regardless of its origin or destination (excluding water and air). Domestic extraction of materials, which refers to the extraction of minerals, fish, forestry products and agricultural products and the total volume that is recycled, totals 1,559 ktonnes.

When seeking to determine the raw material footprint of what is being consumed in Vanuatu, the raw material footprint of imports should be added and that of exports should be deducted. An annual amount of 172 ktonnes is imported. However, to be able to deliver this amount of products in Vanuatu, far more materials have been extracted and used for their production. Therefore, the imported amount needs to be adjusted for its raw material equivalent, which is 837 ktonnes. Likewise, the raw material equivalent of the 62 ktonnes exported from Vanuatu should be deducted from the total material use in Vanuatu. The raw material footprint of exports is 138 ktonnes.

FIGURE 8



The raw material footprint of exports and imports is calculated by relating close to 100 different commodity types to their specific raw material equivalent. As a result, the average raw material equivalent of exports differs from that of imports. Indeed, the average raw material equivalent of imports is significantly higher than that of exports. This is because the range of products exported are mostly agricultural commodities with a relatively small material footprint, while imports are mostly processed food products, machines, construction materials and fossil fuels with a higher average raw material footprint.

Once corrected, the raw material footprint of consumption in Vanuatu is 2,349 ktonnes. This raises the question of what share of this value is circular and stems from secondary or regenerative resources. Of the raw material footprint of imports, 8.6 percent is estimated to be circular. This is a global average, as the 2020 Global Circularity Gap report concluded that the world is 8.6 percent circular. In addition, the sourcing of material from within Vanuatu has been corrected for the domestic extraction of minerals, which is a depletive resource. Finally, wood extraction has been corrected for deforestation. The UNFCCC indicates that 15 percent of forestry extraction in Vanuatu is non-renewable.

These multiple calculations confirm that 59 percent of materials consumption in Vanuatu is circular. This high value is mainly attributable to a largely sustainable and, even, partly organic, agricultural and forestry sector, a very high share of biomass used, including renewable firewood, and relatively low amounts of materials landfilled or burned. The 41 percent of the consumption-based raw material footprint that is not renewable primarily reflects imports, deforestation and domestic mineral extraction.

2.8 Greenhouse gas emissions in Vanuatu and embedded in product imports & exports

Territorial GHG emissions totalled just above 610 ktonnes CO_2e in 2015, while emissions generated during the production of imported goods and services amounted to 202 ktonnes CO_2e in 2018 (figure 10). The average carbon footprint of imported goods and materials, in tonne CO_2e/tonne of imported product, is significantly higher than that of domestic production. Most upstream emissions are related to the import of fuels, construction materials and food. Vanuatu's territorial carbon footprint is broken down into 73 percent from livestock, 21 percent from the combustion of imported fossil fuels and the remaining 6 percent from waste management. Vanuatu's upstream GHG emissions, related to the production of imported products consumed in Vanuatu, total 202 ktonnes CO_2e.

Approximately 248 ktonnes CO_2e of national emissions are related to the production of goods and materials that are exported for consumption elsewhere. When assessing consumption-based emissions, emissions generated in Vanuatu while producing products that benefit consumers abroad may be deducted from Vanuatu's consumption-based emissions. Still, efforts to reduce territorial emissions may also reduce the carbon footprint of exported products, allowing foreign consumers to consume products with an even lower footprint. This may resonate well with the ambitions of foreign governments, such as Denmark, to reduce their own consumption-based footprint.[101]

Vanuatu aims to transition to a power sector fuelled entirely by renewable energy sources by 2030.[102] If successful, the country will reduce national GHG emissions by 32 ktonnes CO_2e[103] by that year. This ambition is challenging as demands for power will increase as the share of the population with access to electricity increases.[104]

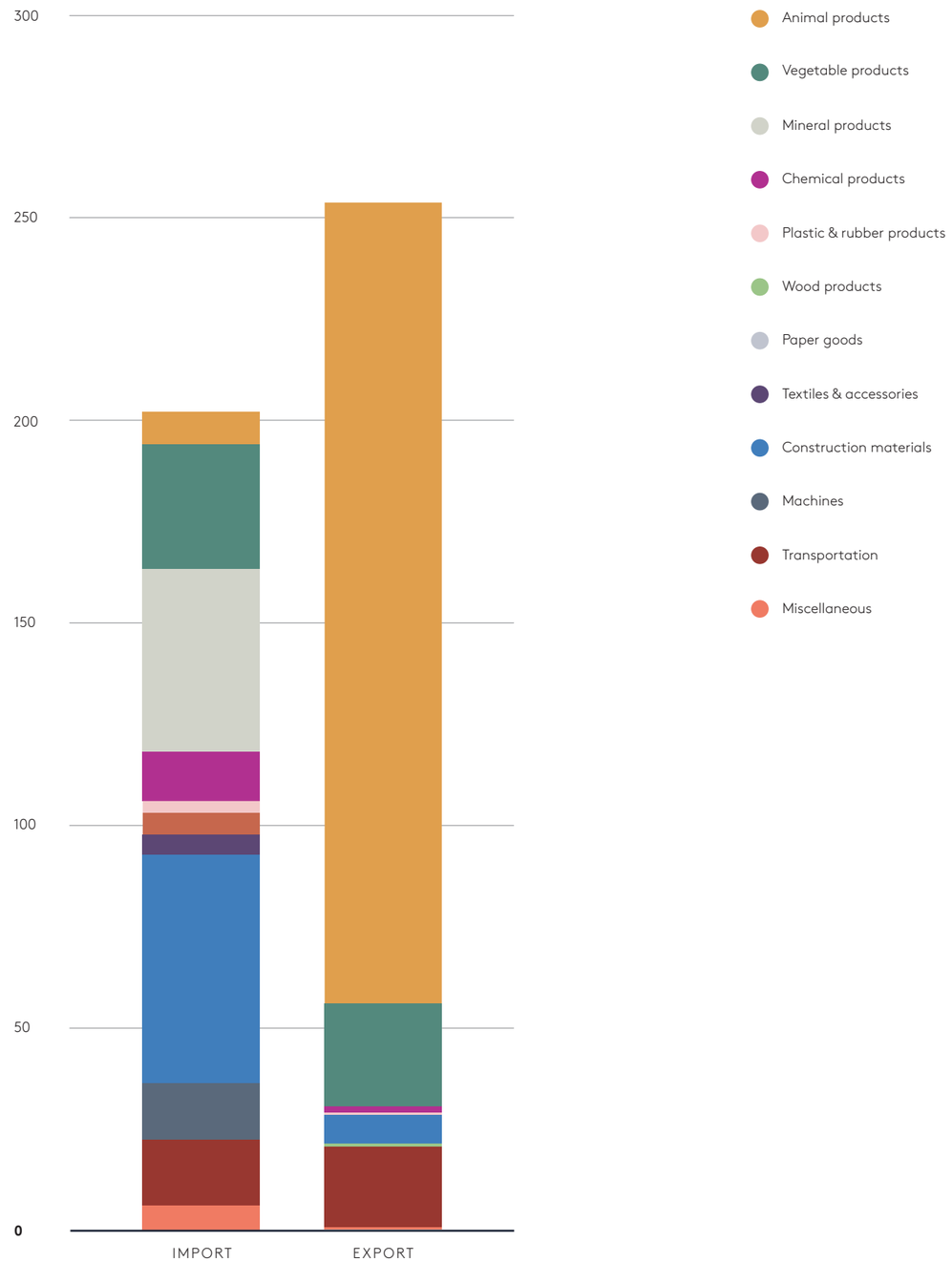
Coconut oil exports represent approximately $1.4 million of Vanuatu's total export value of $167 million.[105] The country has been using coconut oil to generate power. Coconut oil could help increase the share of renewables in future power generation[106] or reduce reliance on imported fossil fuels in the transport sector.[107]

Fossil fuels are the largest category of imported products, totalling $39 million. Expanding Vanuatu's renewable energy capacity is a national target. It was included in the first energy sector roadmap (2013-2020[108]) and the Vanuatu National Energy Policy Framework and was one of the main targets in the country's first Nationally Determined Contribution, or Paris pledge to the United Nations Framework Convention on Climate Change. The role of renewables in Vanuatu's power generation fuel mix expanded gradually from 2012 to 2017[109] and the government has developed a detailed road map for the phase-out.

FIGURE 9

Embedded GHG emissions in imports and exports

$ktCO_2e$/year



BOX 3

The Circularity of National Consumption

This Vanuatu report introduces a new metric to benchmark the country's circularity. This allows Vanuatu to set a benchmark from which to track progress in the transition to a circular economy.

This metric differs from earlier circularity metrics because it also tries to capture the fact that photosynthesis allows for the growth of forest, marine and agricultural resources. Agricultural, forest and fish products are regenerative when forest stock, fish stock and soil quality are stable or show improvement over time. This metric thus combines an analysis of natural stocks, to determine whether they are degrading, with an analysis of flows and whether they are cycled.

As a result, the 59 percent circularity of domestic consumption is the share of all material used, including the raw material equivalents of imports, which:
are a combination of:

1 being of regenerative origin,
2 while organic material and nutrients are brought back to the ecosystem to retain or improve soil organic content and soil life.

- The regenerative origin refers to domestic products from agriculture, forestry or fisheries that do not contribute to natural resource depletion or degradation. They can be described as circular when they become agricultural residues or food waste that is applied on land, composted or undergoes anaerobic digestion. They can also be described as circular when, after consumption by humans or animals, their excretion or manure is applied on land or otherwise stays in the ecosystem;
- are construction materials from sustainable forestry which are applied in the built environment;
- is firewood from sustainable origin; Or,
- consists of minerals, metals or fuels that are recovered and recycled after use, regardless of whether they are exported from Vanuatu and recycled abroad. This applies primarily to plastics, scrap metal, glass and mineral oil residues.

Excluded flows are those that originate from overfishing, deforestation or agricultural practices that lead to soil degradation, and when, after consumption, the nutrients and organic material is lost to surface waters or the sea or become greenhouse gases, such as methane or nitrous oxide. For the raw material equivalents of imports, 8.6 percent circularity has been assumed, equal to the global average.[96]

In Vanuatu's case, agricultural production is considered circular since yields are stable with very low use of synthetic fertilizer and pesticides. Forest products are considered to be 74 percent renewable. This is based on an average deforestation rate of 1,195 ha/year[97] and an average yield of 17.5 tonne/ha[98]. Of all fish extracted, only the bigeye tuna shows signs of overfishing.[99] Apart from an estimated 9,000 tonnes of bigeye tuna, fishing is circular.[100]

This metric is new and being applied for the first time in Vanuatu.

Please share any suggestions for improvement or refinement

with Shifting Paradigms

2.9 The development and quality of natural assets and stocks

All flows have an origin and a destination. Some contribute to the quality of the place from which they originate or their destination, while others do not. Flora and fauna can recover from extraction, such as fishing, forestry and agriculture, unless the ecosystem's regenerative capacity is exceeded. Other natural stocks, such as mineral deposits, are finite and cannot be replenished. Extracting mineral deposits, such as fuels, ores and sand, is depletive, creating revenue only in the short run and during the economic lifetime of the product in which the resource is used.

At the end of a flow, organic residues can be used to enrich soils. This can also cause eutrophication or methane emissions when organic material decomposes in landfills. This section reviews trends in natural asset quality, providing insight into the ability of these assets to support life in Vanuatu today and in the future. With an estimated 50 percent of households practicing fishing,[110] a large share of the population benefits from the wealth of coastal ecosystems. Where this common interest is compromised, people call on the government to take action. For example, concerns have been expressed recently over re-opening the sea cucumber harvest. This lucrative maritime export product is also a species that is nearly extinguished.[111]

Vanuatu is listed in the World Bank's analysis of the share of a country's GDP provided by resource rents. Resource rents are generated by exploiting depletive reserves such as fossil fuels, mineral deposits and forestry resources. These rents account for 0.9 percent of Vanuatu's GDP, primarily from forestry. According to the World Bank, the use of all other resources is sustainable.[112]

Most natural assets in Vanuatu do seem relatively stable in quality and quantity. Some are protected by the country's geography. Forest cover totals approximately 36 percent of total land area, but only 20 percent of these resources are accessible for harvesting.[113] Some sources state that forest stock is relatively stable,[114] while others conclude that it is degrading.[115] According to the UNFCCC, 85 percent of fuelwood use in Vanuatu is considered non-renewable.[116] In any case, cyclones and volcanic damage put the country's forest stock at risk.

36%

An estimated 36 percent of Vanuatu's land area is covered with forest

50%

With an estimated 50 percent of households practicing fishing, a large share of the population benefits from the wealth of coastal ecosystems

Soil quality seems stable, as crops yields are stable or show a small increase at constant levels of mineral input. The country has adopted an ambitious fisheries development policy to secure sustainable extraction levels[117] and has well-documented fish resources and fisheries. This information is crucial to build sustainable fisheries at village scale and across all Pacific Island countries and territories. Offshore fishing relies on some species with stable stocks, such as skipjack, yellowfin tuna and, probably, South Pacific albacore. The situation for bigeye tuna is different; analysis indicates that this species is being overfished.[118]

2.10 The primary sectors: agriculture, fishing and forestry

The extraction of biobased or regenerative products like food and timber falls into the primary sector. This involves extracting depletive materials (minerals and metals) through mining and fossil fuel extraction. Vanuatu relies primarily on imports for technical materials. The country relies heavily on its own natural assets for biobased products, while trying not to exceed their carrying capacity.

Agriculture

According to the Vanuatu Economic Outlook, agricultural sector production is stable. Investments in farming skills, soil fertility and the adoption of more climate-resilient crop species can help strengthen agricultural production further.[119] FAO statistics confirm stable yields and other sources indicate that agricultural practices are sustainable in general, with a few exceptional examples of soil erosion due to monocultures and deforestation due to land clearing for cropping. However, population growth and growth of large commercial plantations and farms could change this in the future.[120]

The National Livestock Policy [121] outlines how commercial farms can support smallholder farmers; organic farming is mentioned as a way to increase the sector's added value. Adaptation priorities in agriculture include crop diversification and new varieties, agroforestry and farmer field schools.[121] Agroforestry can also contribute to mitigation if agricultural practices are combined with an increase in forest carbon stock, aiming for higher quality and higher value-added market segments overall.[122]

68%

68 percent of the greenhouse gas emissions embedded in exports are food products

200,000

The islands' herds total around 200,000 head

Forestry

An estimated 36 percent of Vanuatu's land area is covered with forest. These forests protect critical watersheds, regulate the local climate, reduce soil erosion and water runoff, and provide agricultural products and medicines. The main drivers of deforestation in Vanuatu are the expansion of agriculture for beef and copra production, cyclones, invasive species and unregulated extraction of firewood.[124]

The government does not issue forestry concessions and timber harvesting is small scale, with mobile sawmills. With standing stock of 13 million m3 of commercially-viable forest species, the estimated annual sustainable yield totals 68,000 m3 from accessible commercial forests.[125] The actual harvest remains around 10,000 m3, or well below 68,000 m3, allowing the country to preserve its standing stock. To preserve forest resources, the government 'prohibits the commercial conversion of natural forest to forest plantations, including for forest carbon schemes.' [126]

Forests provide timber and firewood. An estimated 37 ktonnes of oil equivalent of fuel wood is burned each year in Vanuatu for cooking and crop drying. IRENA reports that there is no evidence that firewood extraction is detrimental to Vanuatu's forests. Rather, deforestation appears to be driven by logging and agricultural and urban expansion.[127]

Vanuatu has the potential to produce more wood[128] while preserving forest stock levels and the government is promoting the establishment of forestry plantations. Specifically, whitewood production on the island Santo has generated attractive yields in the past.[129]

Fishing

Vanuatu receives around $1 million a year from licensing offshore tuna fishing. The country is re-establishing its fish processing industries with support from foreign investors[130] and the government is promoting fish farming.[131]

2.11 Current circular economy initiatives in the primary sectors

Existing circular economy initiatives in Vanuatu focus on the use of organic residues and the promotion of organic agricultural production.
(See table p. 38)

37%

Forests provide timber and firewood. An estimated 37 ktonnes of oil equivalent of fuel wood is burned each year in Vanuatu for cooking and crop drying.

$ 1,000,000

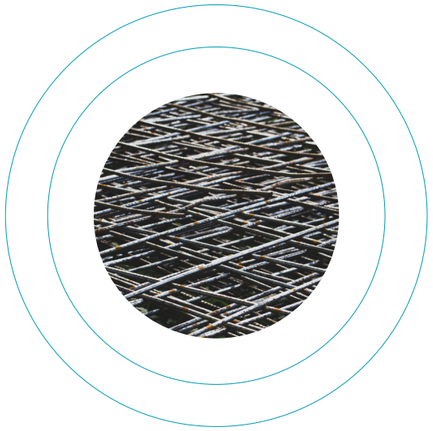
Vanuatu receives around $1 million a year from licensing offshore tuna fishing

Table 2 Current circular economy initiatives in the primary sectors

Emae Island		**Local bans on the use of agri-chemicals** On 4 July 2016 Emae islanders took an oath to use only organic farming methods to protect soil health. Their commitment to organic production has been certified under the Pacific Organic and Ethical Trade Community.[132] Emae Island followed in the footsteps of Cicia Island in Fiji, which was certified in 2013.[133]
Nakau Programme		**Agroforestry in the Loru tropical rainforest** On the island of Espiritu Santo, 293 ha of tropical rainforest are protected. The community that owns the forest relinquished the right to clear the forest for coconut plantations in exchange for carbon revenues.[134] Fiji's Sovi Basin Trust Fund uses a similar approach, by which landowners are compensated if they forego timber royalties.[135]
Val Pacific		**Natural grass-fed, antibiotic and hormone free beef** Val Pacific is a public company owned by the Government of Vanuatu and private investors. It processes only certified organic beef from freeroaming cattle that are grass-fed and free from antibiotics and hormones.[136]
Venui Vanilla		**Organic spices** Venui Vanilla produces organic vanilla, peppercorn, ginger, turmeric, coconut oil and chilli, while providing advisory services to others seeking to transition to organic food production.[137]
Onesua		**Household and farm-level biogas systems** Community-level anaerobic digesters can provide biogas for cooking and organic fertiliser. Onesua Presbyterian College was the first entity to install a biogas system.[138]
GiZ		**Composting toilets** Pele Island experiences water shortages due to deforestation. GiZ introduced composting toilets on the island to use human waste to produce 40kg of fertilizer/year and avoid surface water contamination.[139]
Barrel One Coffee Organic coffee		**Organic coffee from Tanna island in Australia** Barrel One Coffee sources coffee directly from organic cooperatives on Tanna Island and sells it throughout Australia.[140]
Pacific Organic and Ethical TradeCommunity (POETCom)		**Organic farming and organic menus** POETCom launched an initiative to engage young farmers in organic farming, while supporting the ministries of agriculture in Fiji and Vanuatu to implement relevant measures.[141] Organic Paradise supports organic farmers with a retail outlet.[142]
Various cookstove manufacturer		**Promoting efficient use of firewood** On International Forest Day, improved cookstove manufacturers demonstrated their efficient and smokeless wood stoves, which are produced and sold locally.[143]

50%

approximately 50 percent of buildings use traditional building materials, such as wood and thatch, for walls and roofs



28%

28 percent of the greenhouse gas emissions embedded in imports are construction materials

2.12 Construction

In recent years, Vanuatu has been able to decouple GHG emissions from economic growth,[144] but resource extraction has kept pace with national GDP growth. The extraction of mineral resources for the construction sector is often associated with the construction of important infrastructure for transport, renewable energy production capacity, power distribution, healthcare, schools and waste treatment. In Vanuatu, most depletive extraction involves sand extracted from shorelines to be used in the construction sector. This contributes to shoreline retreat, which threatens coastal communities and infrastructure and causes land degradation.[145]

Vanuatu's national transport and communication infrastructure and buildings must be able to withstand cyclones.[146] Traditional architecture uses light materials, with roofs reaching to the ground. Such buildings can resist cyclones. Floors are made primarily of concrete, but approximately 50 percent of buildings use traditional building materials, such as wood and thatch, for walls and roofs.[147] The light weight of these materials protects people inside from falling construction elements and the porous structures reduce the pressure difference between the building's exterior and interior during cyclones[148] . Unfortunately, cyclones reduce the availability of these materials, when the need to make repairs increases the demand for them.[149]

These buildings have low energy efficiency. The United Nations' Economic and Social Commission for Asia and the Pacific (UNESCAP) notes that 'there is a great potential to improve the status quo through eco-efficient design, construction and operation of buildings which could improve the quality of infrastructure services and reduce utility costs.'[150]

2.13 Current circular economy initiatives in construction

The construction sector supports several inspiring initiatives that support sustainable construction, relying primarily on traditional knowledge of building design and tapping into locally available materials. **(See list p. 41)**

Table 3 Circular economy initiatives in construction

Vanuatu Homes	**Wood-based construction** Vanuatu Homes is an architecture firm and construction company based in Port Vila that offers wood-based construction, including floors. It uses termite-resistant timber or triboard from New Zealand, which can withstand tropical heat, moisture, extreme weather and seismic events.[151]
Crosslam Australia	**Cross-laminated timber for construction** Australia is the country closest to Vanuatu that produces cross-laminated timber, which can be used to replace reinforced concrete in building construction.[152] PlanetArk in Australia has done research on the potential of using wood in the construction sector.[153]
Sustainable Islands Tourism Conference	**A traditional nakamal for international conferences** Vanuatu built a nakamal (traditional meeting place) for the 2019 Sustainable Islands Tourism Conference using only local building materials.[154]
Australian Centre for International Agricultural Research (ACIAR)	**Timber industries to encourage whitewood thinning** Producing high-quality whitewood requires thinning. Developing processing industries for small-diameter trees encourages entrepreneurs to carry out that thinning. The small trees are used to produce construction poles or fence poles to support rotational grazing under improved pasture management. ACIAR is also supporting agroforestry systems with a mix of species in smallholder gardens.[155]

2.14 Industry

Vanuatu's industrial sector is small and most manufactured products are imported. In the past, manganese was mined in Vanuatu. Current industrial activity focuses on abattoirs,[156] sawmills and other food processing, such as a brewery and water bottling factory. Industrial expansion is planned in fish processing.[157] Despite the industrial sector's small size, it is expected to see most of the growth in 2020.[158]

Most industrial products are imported and are accumulating in Vanuatu's dumpsites or in the sea. In response, Vanuatu banned single-use plastics in 2018, ahead of a similar initiative by the European Union.[159] At the end of 2019, the ban was extended and currently covers plastic items such as bags, flowers, cutlery and plates and all polystyrene containers. It also covers biodegradable and compostable plastics and spurred innovation to revive traditional packaging, which relied on available organic materials.[160]

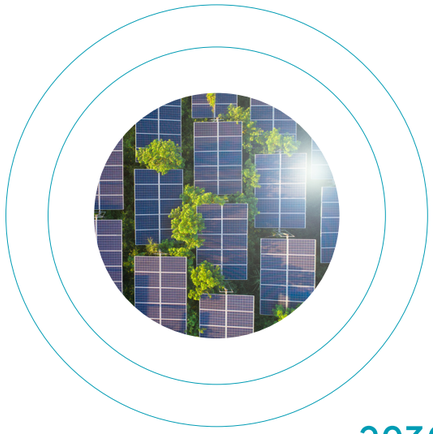
Vanuatu submitted its greenhouse mitigation plans for the period 2020-2030 to the UNFCCC in the country's Intended Nationally Determined Contribution (INDC). In this document, the country targets energy industries and the energy demand side, with the intention to transition to 100 percent renewable energy in the power sector by 2030 [161] and reduce all energy-related emissions by 30 percent by 2030.[162]

2.15 Current circular economy initiatives in industry

Circular economy initiatives in the industrial sector focus on collecting and recycling metals and minerals, composting organic waste and producing renewable energy — biodiesel — from coconut oil. **(See table p. 43)**

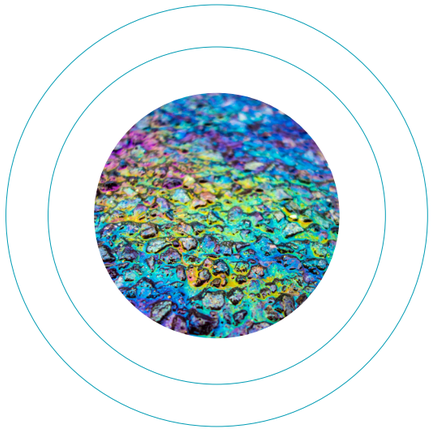
2.16 Public, commercial and financiaservices: current initiatives

Circular initiatives are not limited to the food value chains, industry and construction, but are also underway in public, commercial and financial services to accelerate the transition to a circular economy. **(See table pp. 44-45)**



2030

Vanuatu aims to transition to a 100% renewable energy in the power sector by 2030



22%

22 percent of the greenhouse gas emissions embedded in imports are fossil fuels

Table 4 circular economy initiatives in industry

UNELCO	**Energy from coconut oil** Filtered and cleaned coconut oil can substitute for diesel in vehicles or diesel generators.[163] Several successful trial projects have been implemented across the Pacific. In Vanuatu, coconut oil has generated 28 GWh in 10 years, making it one the larger renewable energy sources in the country.
Activ Association	**Bringing local products to international markets** Activ Association supports entrepreneurs by diversifying local food production and connecting products with international markets.[165]
RecycleCorp Vanuatu	**Scrap metal collection and export** RecycleCorp Vanuatu collects, processes and exports scrap steel copper, aluminium, brass, e-waste and batteries.[166]
PacWaste Plus	**Improving waste management in the Pacific** PacWaste Plus is an EU-funded programmed for the Pacific. The first project (2014-17) targeted healthcare waste, batteries, asbestos and e-waste and the new programme targets large bulk flows, including recyclable solid waste, organic waste, disaster waste, and wastewater effluent.[167]
Wan Smol Bag Theatre	**Cash for aluminium cans** Wan Smol Bag Theatre is a non-government organisation in Port Vila that teamed up with RecycleCorp, JICA and the municipality to introduce a collection and payment scheme for aluminium cans.[168] Wan Smol Bag also offers sewing classes on making purses from waste.[169]
Vanuatu Brewing and Vanuatu Beverage Ltd.	**Deposit schemes for glass bottles** Both companies run a deposit scheme for glass bottles at the point of sale. The deposit is refunded when the bottle is returned.[170]
Azure Pure Water	**Deposit scheme for plastic bottles** Azure Pure Water is a water production company and major exporter that sought to introduce a rebate on plastic bottles for collection and export of plastic bales for recycling.[171] Unfortunately, the company shut down in 2019.[172]
Port Vila Municipality and Luganville Municipality	**Pre-paid waste bag system** Waste collection is regulated with a pre-paid waste bag scheme. Both municipalities also have initiatives for composting market and other organic wastes, as well as separate collection of aluminium cans, tin cans, cardboard and toner cartridges.[173]

Table 5 circular economy initiatives in the service sector

Public services: healthcare, education, public

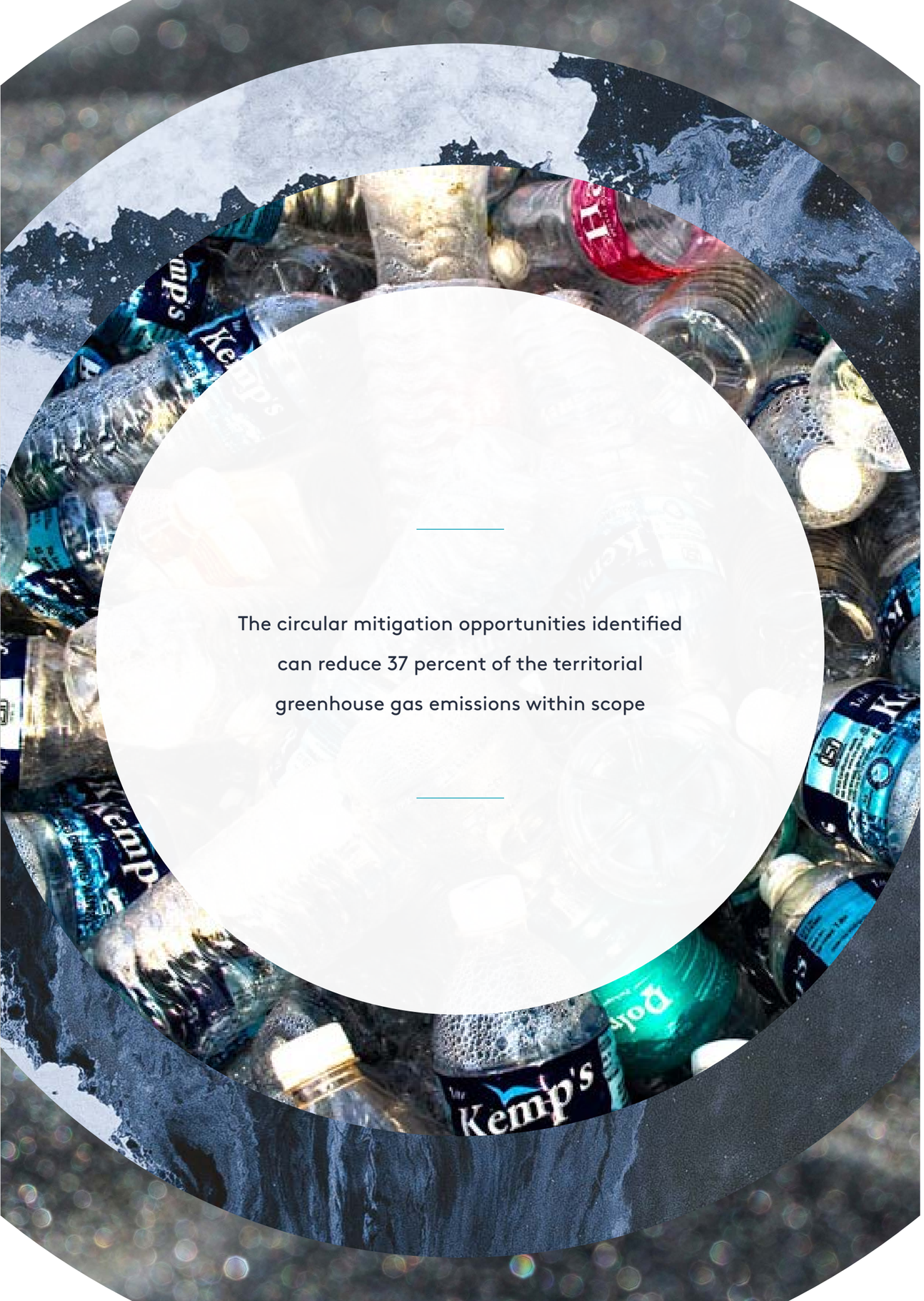
Vanuatu Environmental Science Society	**Conservation and protection** The Vanuatu Environmental Science Society was one of the driving forces behind the single-use plastic ban in Vanuatu, laying the groundwork by organizing a "No Plastic Challenge Day" and coastal clean-up initiatives. The Society is also involved in the conservation of flora and fauna with support from the Global Environment Facility.[174]
Critical Ecosystem Partnership Fund (CEPF)	**Education to empower biodiversity conservation** The CEPF supports projects that strengthen educational, administrative, legal, financial and civil society capacity to support biodiversity awareness and conservation in Vanuatu.[175]
Port Vila Municipality and Luganville Municipality	**Pre-paid waste bag system** Waste collection is regulated with a pre-paid waste bag scheme. Both municipalities also have initiatives for composting market and other organic waste, as well as separate collection of aluminium cans, tin cans, cardboard and toner cartridges.[176]
Vanuatu Recycling and Waste Management Association	**Banning single-use plastics** The Association brings stakeholders together to support and advance the implementation of bans on single-use plastics, deposit schemes for beverage containers and other measures to avoid waste.[177]
Wan Smol Bag, Vanua-Tai and Live and Learn	**Education, art and environmental awareness** Wan Smol Bag is a non-governmental organisation that has produced plays on turtle sanctuaries, aiming to promote the importance of the marine environment. Other organisations operating in this area include Vanua-Tai, which monitors fishing communities; Live and Learn, which teaches students about environmental and ocean issues; and Reef Check Vanuatu, which monitors fish stocks. Together, these activities contribute to creating public support for investments in natural assets.[178]
Kamewa School	**Composting at a Port Vila school in Port Vila** Another example with an educational angle is composting and a nursery at Kamewa School in Port Vila.[179]

Commercial services: transport and storage, wholesale, retail trade and vehicle repair

Vanuatu Mobile and Laptop Repairs Ltd.	**Repair services** Repair extends products' lifetime and avoids the use of primary resources required to replace broken products. Vanuatu Mobile and Laptop Repairs Ltd. offers repair services for consumer electronics.[180]

Financial services: finance, insurance and real estate

Various organisations	**Renewable energy and rural electrification** Renewable energy taps into regenerative resources for energy production and allows Vanuatu to reduce imports of fossil fuels. Various organizations support the country's transition to renewable energy, including GiZ, which supports solar systems for tourist resorts[181] and the Institute for Environmental Analytics, which provides satellite data to determine the optimum renewable energy mix.[182] **The World Bank, Government of New Zealand** and others support the Vanuatu Rural Electrification Program. The first phased aimed to connect 17,500 rural households to solar mini-grids.[183] The second phase targets another 9,000 households or 15 percent of the population.[184] **The Asian Development Bank** supports investments to increase access to electricity on Malekula and Espiritu Santo islands and to replace diesel power with hydropower.[185]



The circular mitigation opportunities identified can reduce 37 percent of the territorial greenhouse gas emissions within scope

3 Circular economy strategies and next steps

3.1 Introduction

Part 1 described the ambitions, trends and developments that will have a material impact on resource use in Vanuatu. Part 2 showed the outcome of an analysis of resource use, waste production and the quality of natural assets.

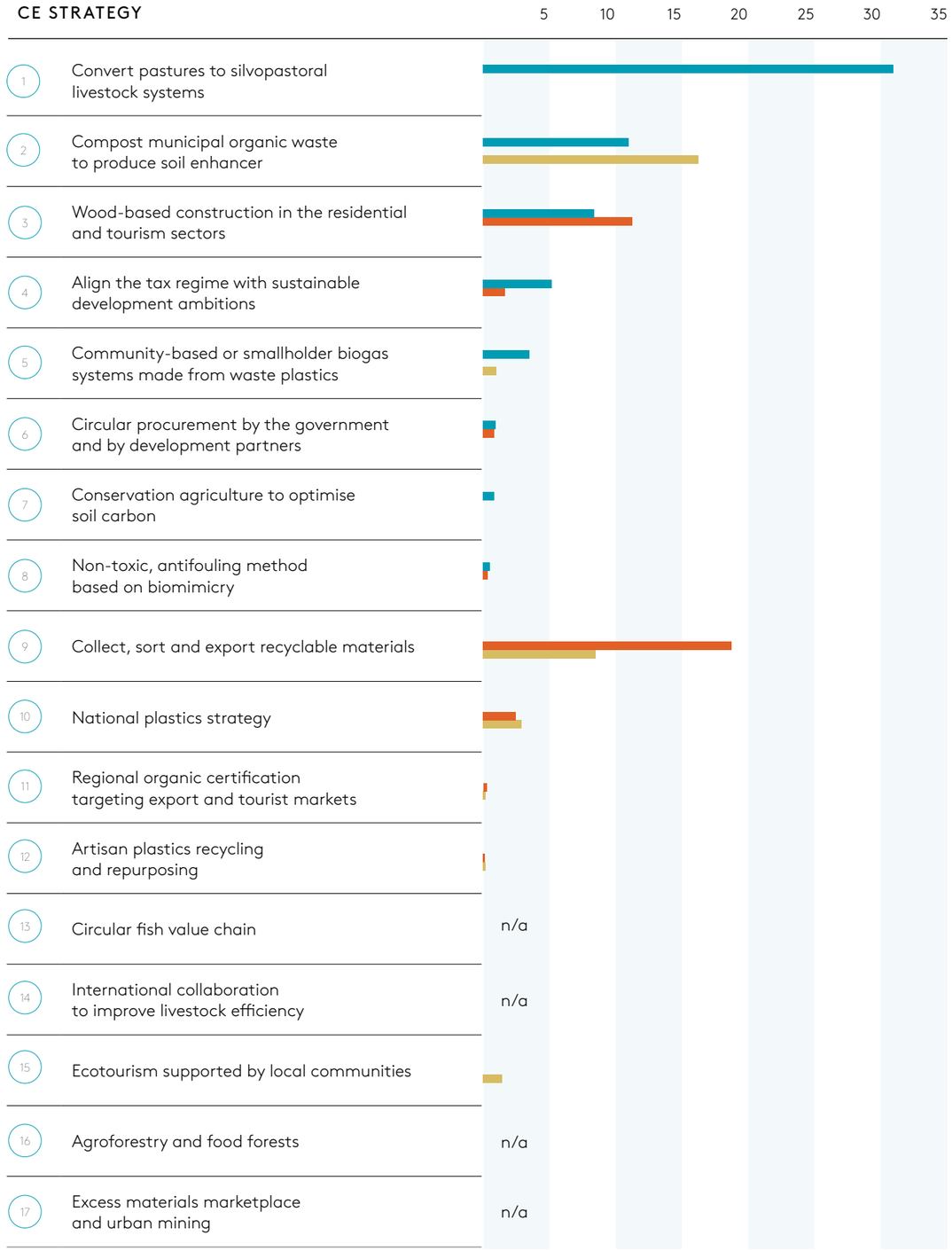
Part 3 combines the results of the data analysis in the previous sections and suggestions from experts and stakeholders consulted in interviews and workshops to draft a series of recommendations on circular economy strategies. The strategies tap into the larger flows of secondary resources and existing underused assets. Other strategies aim to replace the use of primary resources where their production, use or disposal is particularly harmful to human health or the environment.

3.2 Circular mitigation strategies

The road to a circular, low-carbon Vanuatu involves ambitious, sectoral government programmes, policy amendments and community initiatives. The recommendations are ranked by their GHG mitigation potential both within Vanuatu and international value chains, while including an estimate of their potential impact on primary resource extraction and waste disposal. In addition, opportunities that have only a marginal impact on GHG emissions but that do contribute to reduced use of primary resources or waste accumulation are also listed. Some opportunities have impacts that are more difficult to quantify; for example, where they create public awareness or behavioural change.

Taken together, the options listed target 37 percent of national GHG emissions in sectors other than livestock. They also aim to reduce upstream emissions embedded in imported products with over 35,000 tCO_2e and target avoiding over 28,000 tonnes of solid waste per year, or 44 percent of the total.

See table, page 49: Circular mitigation options and their estimated GHG mitigation potential.



CE STRATEGY		Domestic GHG mitigation tCO₂e/year	International GHG mitigation tCO₂e/year	Costs	Solid waste tCO2e/year
1	Convert pastures to silvopastoral livestock systems	30,977	0	Low	n/a
2	Compost municipal organic waste to produce soil enhancer	10,943	0	Medium	16,176
3	Wood-based construction in the residential and tourism sectors	8,366	11,272	Medium	0
4	Align the tax regime with sustainable development ambitions	5,180	1,693	Low	0
5	Community-based or smallholder biogas systems made from waste plastics	3,500	n/a	Medium	962
6	Circular procurement by the government and by development partners	910	910	Medium	0
7	Conservation agriculture to optimise soil carbon	827	0	Low	n/a
8	Non-toxic, antifouling method based on biomimicry	577	374	High	0
9	Collect, sort and export recyclable materials	0	18,717	High	8,520
10	National plastics strategy	0	2,479	High	2850
11	Regional organic certification targeting export and tourist markets	0	213	Medium	52.1
12	Artisan plastics recycling and repurposing	0	26	Low	12
13	Circular fish value chain	n/a	n/a	High	n/a
14	International collaboration to improve livestock efficiency	n/a	n/a	High	n/a
15	Ecotourism supported by local communities	n/a	n/a	Low	n/a
16	Agroforestry and food forests	n/a	n/a	Medium	n/a
17	Excess materials marketplace and urban mining	n/a	n/a	Low	n/a
	Total	**61,281**	**35,684**		**28,572**
	Share of national total	37% of GHG emissions within scope	18%		44%

2.7 tCO_2e/ha

Converting grasslands to silvopastural systems can sequester 2.7 tonnes of CO2e per hectare per year

3.3 Convert pastures to silvopastoral livestock production systems

Strategy description

Silvopastoral livestock systems combine forestry activities with livestock grazing. This intervention proposes to increase forest carbon by planting trees on grassland. This can increase livestock productivity, while the dual use of land increases overall revenue per hectare. When converting grassland to silvopastoral livestock systems, additional carbon is sequestered in the trees.

International examples

With funding from the Global Environment Facility, Colombia converted 32,000 hectares to silvopastoral systems with higher production levels and revenues.[186] In addition to strengthening institutional capacity, the project has two main elements:

1. Introduce silvopastoral production systems for cattle ranching. This expands the range of environmental services offered by farmers related to biodiversity, land, carbon, and water.
2. Reduce land degradation in participating farms through differentiated payments for environmental services. This includes introducing riparian and terrestrial corridors to improve connectivity between natural ecosystems and cattle farms.

Next steps

Financial incentives could be introduced to convert grasslands to silvopastoral systems. This could include payment of environmental services financed through the dual use of land and increased productivity of livestock farming.

Where pastures are maintained, the restoration of degraded grasslands can help increase soil organic carbon.[187]

Impact

Vanuatu has an estimated 11,473 hectares of grasslands.[188] Converting them to silvopastoral systems, following Colombia's example,[189] can sequester 2.7 tonnes of CO_2e per hectare[190] per year.

Investment costs	Low	
IPCC sectors targeted	Land use change	
	Domestic	**International**
GHG mitigation potential tCO_2e/year	31,000	0
Waste avoidance t/year	0	0
Primary resource extraction reduction t/year	n/a	0

27,000 t/year

Households in Vanuatu produce an estimated 27,000 tonnes of organic waste per year

3.4 Composting municipal organic waste to produce soil enhancer

Strategy description

Households in Vanuatu produce an estimated 27,000 tonnes of organic waste.[191] In some cities, that represents close to 80 percent of waste volumes.[192] The government has set a target to compost 60 percent of organic waste,[193] which would reduce methane emissions from landfills. Where demand exists for biogas, perhaps as a cooking fuel, anaerobic digestion of the organic waste and, perhaps, human extraction can be prioritized. This option is discussed further as Circular Economy strategy 3.3.

Small-scale composters can be installed to produce compost at household or community level[194] and used directly in gardens or parks. Alternatively, separate collection of organic fractions can allow for more centralized treatment and compost production. Waste from larger sources, such as industrial facilities, could be treated using anaerobic digestion with sludge composting.

Practices that demonstrate the value of compost and its ability to produce fresh food can be implemented in schools to create awareness. Coffee grounds can be used to produce champignons or more exclusive types of mushrooms[195] or other food products that are currently imported. For example, Vanuatu imports, produces, consumes and exports coffee. Demonstrating the value of coffee waste or coffee grounds could be an appealing showcase project for international business partners that purchase organic coffee from Vanuatu. In some cases, products can be produced for the international market using organic residues, such as green banana paper from Kosrea, Micronesia.[196]

Vanuatu's waste management sector is the largest source of unintentional persistent organic pollutants, which are produced primarily through waste burning. Increased composting can help reduce the amount of waste that is burned.[197]

International examples

Amsterdam's worm hotels bring communities together around small-scale composting facilities.[198] Portugal's Terra à Terra promotes home composting at collective buildings, houses and in public or private institutions in eight municipalities served by Greater Porto's waste management agency. Local treatment[199] of organic waste reduces the logistics of collection and centralized treatment, which is also the rationale behind a similar project in Sofia, Bulgaria.[200]

Next steps

The Government of Vanuatu could support the adoption of small-scale composting facilities by making equipment available. If government policies up to 2030 allow for a residual fraction of plastic waste to remain, it could be collected and used to produce products from secondary plastics. An example could be household, farm or community-level composting facilities [201] or street furniture [202] from recycled plastics. Since such a scheme would probably not be economically viable immediately, international funding based on GHG emissions avoided could contribute to the financing needed.

Impact

Approximately two-thirds of municipal solid waste is organic. Thus, diverting 100 tonnes of waste from dumping would reduce GHG emissions by 64 tCO_2e the following year. The estimates below assume that organic materials equal to 60 percent of the organic waste is diverted from landfills, which would align with the national target to compost 60 percent of organic waste.

Investment costs	Medium	
IPCC sectors targeted	Solid waste disposal	
	domestic	**international**
GHG mitigation potential tCO_2e/year	11,000	0
Waste avoidance t/year	16,000	0
Primary resource extraction reduction t/year	n/a	0

3.5 Wood-based construction in the residential and tourism sectors

Strategy description

Around 28 percent of Vanuatu's embedded emissions are in imported construction materials used for new construction. Technical limitations severely restrict the extent to which energy efficiency and industrial symbiosis can lower the carbon footprint of concrete and steel faces.[203]

Regenerative construction materials provide a low-carbon alternative. Vanuatu's rich forest resources and available sawmilling capacity already provide wood for the construction sector. Where materials must meet stricter technical requirements, for example in buildings with several storeys, Vanuatu could use industrial construction materials, like cross-laminated timber imported from New Zealand.[204] Rather than emitting CO_2 to produce cement and steel, wood stores carbon for the lifetime of the building.[205]

Wood-based construction is already common practice in Vanuatu, but only for smaller buildings up to two storeys.[206] Building codes might need to be revised if wood is to be used in larger structures. Such revisions can be combined with the integration of passive design principles to help minimize or, even, avoid emissions in the building's use phase.

International examples

China is already investing in renewable construction materials.[207] It is also exploring the use of wood and bamboo composites.[208] Construction material and design companies, including Stora Enso (Finland)[209], Sumitomo Forestry (Japan)[210] and Ramboll (UK)[211] are using wood as a renewable resource for contemporary architecture.[212]

Next steps

In the short term, Vanuatu could develop a showcase project that demonstrates how the use of wood-based construction materials can help lower the carbon footprint of construction, while providing safe and comfortable buildings.

A circular showcase building or structure can demonstrate the versatility of wood-based structures. International examples are the Metropol Parasolin[213] Seville, Spain and Circl[214] in Amsterdam.

In the long run, the environmental benefits of low-carbon construction materials must translate into a competitive advantage over concrete and steel. Stable and well-enforced national policies, like a carbon tax, can help tip the balance in favour of low-carbon construction materials. Import levies can help reach that tipping point.

Impact

The impact estimates are based on substituting 20 percent of imported mineral and steel construction materials with wood-based alternatives. This is merely an indicative figure. Understanding the mitigation potential in detail requires further research on the current use of imported construction materials and their substitution potential.

Investment costs	Medium	
IPCC sectors targeted	Harvested wood products	
	domestic	**international**
GHG mitigation potential tCO2e/year	8,000	11,000
Waste avoidance t/year	0	0
Primary resource extraction reduction t/year	n/a	67,000

28%

Around 28 percent of Vanuatu's embedded emissions are in imported construction materials used for new construction

$30/tCO2e

A carbon tax of $30/t Co2e would generate enough revenue to double the current levels of social assistance in 60 countries

Investment costs	Low	
IPCC sectors targeted	Fuel combustion activities	
	domestic	**international**
GHG mitigation potential tCO2e/year	5,000	0
Waste avoidance t/year	0	0
Primary resource extraction reduction t/year	1,532	0

3.6 Aligning the tax regime with sustainable development ambitions

Strategy description

Vanuatu's government expenditure is 17 percent of GDP, which is below that of New Zealand and Australia.[215] The country is considering adopting an income tax.[216] A recent study in Bangladesh shows that prioritizing environmental levies, rather than income tax, as a source of government revenue can help keep countries on track to achieve the Sustainable Development Goals.[217]

In a country with an unemployment rate of 4 percent and with concerns over youth unemployment, increasing the tax burden on labour may not help reduce unemployment rates. UN Secretary-General António Guterres advocates taxing pollution. A carbon tax is a the most promising option. A World Bank study indicated that a carbon tax of $30/t tCO2e would generate enough revenue to double the current levels of social assistance in 60 countries.[218]

The national government must provide the correct tax incentives. A government needs revenues to operate, but should collect them from the activities it seeks to discourage. This could include taxing carbon-intensive products, including cement, steel, synthetic fertilizers and plastics. Since Vanuatu imports most of these materials, import levies would have to be adjusted. However, import restrictions are controversial as they disrupt the free flow of goods and competition. On the other hand, Vanuatu has been a member of the WTO since 2012[219] and WTO rules allow countries to take measures to pursue environmental policy goals.[220]

Revenues collected from carbon taxes or import levies on carbon-intensive products can be used to encourage sustainable and renewable means of production; for example, by lowering taxes on labour and repair activities[221] and supporting the use of renewable resources.

This approach would stimulate the development of fuel from coconut oil and improve the trade balance, while providing funding that could forestall the introduction of an income tax.

International examples

Ex'tax is a Dutch foundation that promotes tax reform. It estimated that in the case of Bangladesh, a tax reform involving a carbon tax of $30/tonne, with revenues invested in infrastructure or social spending, would reduce GHG emissions by about 4 percent. Ex'tax launched similar studies for the EU, Finland and the Netherlands.[222] Several countries have adopted environmental tax reforms, including Sweden, which reduced the VAT on repair services.[223]

The World Bank has explored the introduction of carbon pricing in Ethiopia. A substantial share of its GHG emissions, like Vanuatu's, originate from livestock. The Bank found that a carbon tax on fuels, which would rise gradually to $30/tonne by 2030, would reduce most GHG emissions if the revenue were used to reduce the personal income tax.[224]

Next steps

As a first step, the Government of Vanuatu could commission an economy-wide study to understand which tax reforms are most effective in allowing for economic development while safeguarding natural assets. This study should also help identify how the more vulnerable segments of the population, which often lack the means to adapt to changing economic incentives, can be supported. Next, tax reforms could be introduced gradually to allow the private sector and the population to adapt. Communication around this change in the tax regime should focus on the fact that, rather than simply raising more tax revenue, it can ensure sustainable development that is also budget neutral, or perhaps even positive, for people in Vanuatu's lower income brackets, particularly if their fossil fuel consumption is low. This can be achieved, for example, by balancing an income tax reduction for those in the lower income brackets while leveraging a carbon tax.

Impacts

Reducing Vanuatu's GHG emissions by 4 percent would translate to approximately 5,180 tCO2e/year. This refers only to fuel-related emissions, although carbon taxation can also cover methane emissions. The 4 percent reduction will save a similar percentage in fuel imports.

3.7 Community or smallholder biogas systems made from waste plastics

Strategy description

Where organic materials can be collected, anaerobic digestors can be installed to produce biogas and organic fertiliser. This technology can be implemented at the smallholder, community or farm level. A 2005 study found that industrial biogas has little potential,[225] but the technology has become more mainstream since then. An advantage of anaerobic digestion over composting is that it can supply remote locations with a renewable energy source, reducing pressure on forests related to the extraction of firewood.

Although Vanuatu's goal is to divert 60 percent of organic waste from landfills by 2020, rural communities and waste management from agriculture and food processing industries are not included in the agriculture sector policy.[226] The anaerobic processing of manure can provide farms with organic fertilizer and biogas, while providing them a safe outlet for manure and human extraction. Although this assessment does not include livestock emissions, manure can be used effectively in biogas systems. Manure management is responsible for 20 percent of national GHG emissions.[227]

International examples

The international development organization, SNV, has promoted the use of biogas digesters among smallholder farms as a safe way to treat manure before it is applied as organic fertilizer and to produce biogas. SNV's support combined technical assistance and carbon finance. It supported the installation of over 700,000 digesters, most of them masonry domes.[228] In Tanzania, SimGas manufactures modular biogas domes for smallholder farms, made of plastic.[229] The next step could be to produce these systems from waste plastics.

In the Netherlands, two Microferm manure digesters on farms produce 40 m3 biogas per day, which is then cleaned and directly fed into the natural gas grid.[230]

Next steps

Vanuatu could explore anaerobic digestion as a solution to manure emissions in cattle farming.

Once specific investment opportunities have been identified, a carbon tax or levies on methane emissions could be used to raise revenues to subsidize implementation of private sector manure management solutions. This potential could be complemented by digesting waste from food processing industries and expanding on existing initiatives to introduce small-scale biodigestion in schools.

The advantage of using modular plastic domes is that they can be moved when local conditions change. To reduce the cost of transporting large biogas domes, Vanuatu could product biogas systems using waste plastics, following the SimGas example.[231]

Impact

The calculations below are based on installing 1,000 biogas systems across Vanuatu.

The long-term potential of this option could be much greater. Vanuatu seeks to more than double its herd size, which may call for more intensive farming practices. If that involves capturing manure, anaerobic digestors are an important way to keep methane emissions down, while producing both biogas and fertile sludge. With the growth of the livestock sector, Vanuatu may also be able to accelerate its transition to renewable energy in remote areas.

Investment costs	High
IPCC sectors targeted	Manure management

	domestic	international
GHG mitigation potential tCO_2e/year	3,500	0
Waste avoidance t/year	1,000	0
Primary resource extraction reduction t/year	0	0

20%

Manure management is responsible for 20 percent of national GHG emissions

$ 20 million

In 2020, the government expects to invest $20 million in infrastructure

Investment costs	Medium	
IPCC sectors targeted	Fuel combustion activities	
	domestic	**international**
GHG mitigation potential tCO_2e/year	910	910
Waste avoidance t/year	n/a	n/a
Primary resource extraction reduction t/year	6,800	6,800

3.8 Circular procurement by the government and development partners

Strategy description

Vanuatu's national budget is approximately $244 million. In 2020, the government expects to invest $20 million in infrastructure.[232] If the government links circular requirements to the issuance of licences, investments in infrastructure and issuance of land titles[233] and concessions, government expenditure can drive circular design, investments and innovation. In addition, in partnership with development institutions, the Government of Vanuatu could emphasize the importance of circular investments.

This applies to all infrastructure, as well as Vanuatu's renewable energy goals, which will require significant volumes of materials in the coming years. In its effort to generate power only from renewables by 2030, the country will install many hydropower stations, wind mills and solar panels.

When building the energy infrastructure that will help Vanuatu become less dependent on imported fuels to generate power, the government could select the most suitable technology based on the carbon footprint of renewable energy technologies throughout their lifetime. Renewable energy infrastructure undoubtedly has a lower carbon footprint than fossil fuel-based energy technologies.[234] By considering only the GHG abatement potential during a technology's use phase, Vanuatu could reduce domestic emissions, but increase emissions in the production and installation of these technologies or in their end-of-life phase.

International examples

A national institute supports circular procurement in the Netherlands by providing training and by collecting and sharing experiences with circular procurement.[235] Through circular procurement, the Dutch committed to taking the lead in the transition to a circular economy simply by creating demand for circular products and services.[236] Through a green deal, several banks and large companies signed on to a joint commitment to circular procurement.[237] As early as 2015, UNEP identified the potential of product-service systems to reduce the environmental impact of public procurement.[238]

Next steps

Vanuatu could launch a pilot project to gain experience with circular procurement. It could focus on circular demolition, perhaps combined with circular construction. In the procurement process, applicants could be asked to adapt the new building's design by incorporating as many materials as possible from the old building or from other secondary sources. Where re-use on-site is not possible, the applicant could seek alternative applications in Vanuatu. This way, landfilling becomes the last resort, rather than the default option.

Circular procurement can also be used to seek private sector solutions for pressing environmental problems. For example, 6,730 tonnes of diapers are disposed of in Vanuatu every year.[239] This constitutes the largest single-use plastic waste volume in the country. Current disposal methods in rural areas create serious soil and lagoon pollution. Circular procurement, with well-defined terms and conditions, can invite private entities to propose a suitable solution.[240] When a company's proposal leads to a contract, it also obtains valuable marketing exposure that could bring the idea to a larger market and, perhaps, convince its competitors to do the same.

Impact

The estimates below are based on the $20 million investment in infrastructure for 2020. This level of investment typically generates an estimated 9,000 tonnes of GHG emissions. Estimating the potential of circular procurement requires making a detailed analysis of the kind of investments planned. As an indication, circular procurement could target a 20 percent reduction in emissions related to government and donor expenditures, half import-related and half domestic-related. These estimates do not yet include infrastructure developed by development partners.

3.9 Conservation agriculture to optimize soil carbon

Strategy description

Conservation agriculture proposes a combination of measures that reduce GHG emissions, while increasing productivity and strengthening the resilience of agricultural production to climate change impacts by improving soil retention and fertility. It aims to optimize the carbon content of soil,[241] turning agricultural systems into the next carbon sink.[242]

In Vanuatu, regenerative agriculture can be applied to the production of groundnuts, maize, roots and tubers, and vegetables. Organic residues can be composted or used in anaerobic digestion plants to produce compost or sludge, which is then applied to the land[243]. A balanced mix of organic residues[244] can create compost that is tailored to the needs of the soils in different parts of the country and help optimize soil organic content. The mix of input materials could include manure, food and vegetables from households, smallholder and livestock farms and, perhaps, even food processing industries.

Investing in soil quality can help reduce mineral inputs and the cost, to farmers, of products that provide the services that the soil provided, at least in part, for free.[245] Increasing soil organic content reduces irrigation needs and restores soil organic carbon.

International examples

Honduras has adopted regenerative agricultural practices, minimizing soil tillage and applying organic matter to the soil rather than burning it. Soil organic content increased from 2 percent to 3.3 percent in 20 years, or by 10 tonnes of carbon in the topsoil layer.[246]

Next steps

The measures proposed should be part of a strategy that improves climate resilience and reduces GHG emissions. The proposed measures include:

1. Conservation agriculture with adequate crop rotation, minimized tillage and the use of cover crops for cereal production and composting, which would affect 8,600 hectares in Vanuatu.

2. Integrated pest management and intercropping for groundnuts,[247] which would affect 2,300 hectares in Vanuatu.[248]

Impact

Implementing conservation agriculture in the production of groundnuts, maize, roots and tubers and vegetables in Vanuatu could result in soil carbon sequestration of 8,268 tCO_2e average per year over a period of 10 years.

This estimate of soil organic carbon sequestration across Vanuatu is conservative and based on the estimated sequestration impact of reduced tillage practices only.[249] This value has been applied to the latest data on areas planted with groundnuts, maize, roots and tubers, and vegetables.

Investment costs	Medium
IPCC sectors targeted	Land

	domestic	international
GHG mitigation potential tCO_2e/year	827	0
Waste avoidance t/year	n/a	0
Primary resource extraction reduction t/year	n/a	0

8,268 tCO_2e

Implementing conservation agriculture in Vanuatucould result in soil carbonsequestration of 8,268 tCO2e average per year over a period of 10 years

16-86%

Fouling on a ship's hull can decrease power efficiency by 16 percent to 86 percent

3.10 Non-toxic, antifouling method based on biomimicry

Strategy description

When marine species such as algae and barnacles attach to the hull of ships, this slows their speed, increases fuel consumption and reduces their lifetime. Fouling on a ship's hull can decrease power efficiency by 16 percent to 86 percent. The conventional solution is to mix organotins, chemicals that kill the organisms that try to attach to the hull, into ship paints. These chemicals are persistent and bio-accumulative. They harm marine environments as they leach from the paint[250] and many have hormone-disrupting properties.

The solution is a non-toxic antifouling that mimics the skin of sharks. Microscopic topography reduces fouling and allows ships to sail longer before they need treatment.

International examples

Finsulate developed a natural antifouling paint without biocides that relies on the paint's physical properties. It has been applied successfully to a 26 ft. trawler in San Diego.[251] Other examples are the use of adhesive foil, Sharklet AF, Shell's microtopographic surfaces [252] and A-LF-Sea coatings.[253]

Impact

In the estimate below, the biological antifouling is assumed to reduce fuel use by 10 percent.[254] If this technology is applied to all vessels under the Vanuatu flag, the mitigation potential could be even higher. The mitigation potential applies to the emissions from international fishing and domestic shipping.

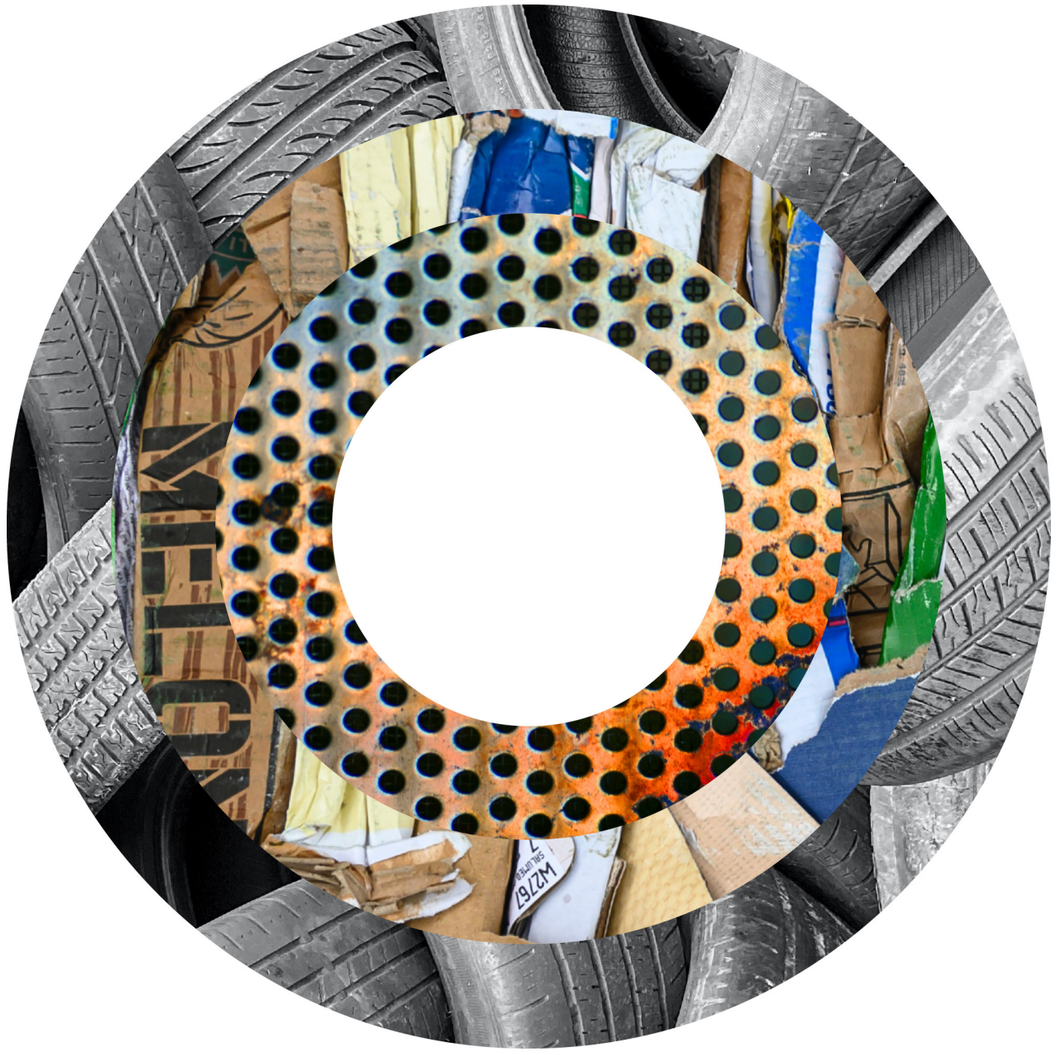
Investment costs	High
IPCC sectors targeted	water-borne navigation - Domestic - International

	domestic	international
GHG mitigation potential tCO_2e/year	577	373
Waste avoidance t/year	0	0
Primary resource extraction reduction t/year	170	110

international bunkers*

8,520 t/year

Asia Pacific Waste Consultants has estimated that around 8,520 tonnes/year of inorganic waste materials can be recycled from waste streams in Vanuatu, excluding plastics.



3.11 Collecting, sorting and exporting recyclable materials

Strategy description

Vanuatu has one recycling company that collects metals and used oils. There are only small volumes of other materials, such as paper, to be collected and recycled.[255] Because many food products are imported to the islands, the country relies on international suppliers to reduce packaging waste. Once the volume of packaging materials is minimized, the collection of materials for recycling can provide jobs, while tapping into resources that would otherwise be sent to landfills. To demonstrate the value of recycling, the secondary origin of materials can be made more visible and explicit. One option would be to locate the small-scale recycling and artisan repurposing of materials within tourist centres to give these processes, and the issue, more visibility.

The low price for recyclables on international markets for secondary materials have reduced the volumes of exported secondary materials. To help finance the revival and scaling up of collection, export and recycling of packaging materials and packaged products, import levies could be imposed on packaging materials and packaged products, perhaps coupled with a carbon price on avoided GHG emissions when recycling materials.

Between 20 and 100 individuals collect recyclable waste at Vanuatu's largest landfill, Bouffa on any given day. To improve the collection of recyclable materials, Vanuatu could consider developing a digital tool that connects these waste sorters with supply.

International examples

In Brazil, a mobile phone application supports the separate collection of recyclable materials by informal waste collectors. These waste collectors can create a profile allowing residents to contact them directly to collect waste at homes or businesses. In addition to improving logistics and facilitate sorting, the application elevated the status of the waste collectors.[256] This project won the UNESCO digital innovation award in 2018.[257]

A decentralized alternative would involve establishing a facility near the landfill to simplify the sorting and separation of recyclable materials. Around 25 percent of materials in Nairobi are separated and recycled, creating 1,600 jobs and reducing GHG emissions by diverting waste from landfills. [258]

Impact

Asia Pacific Waste Consultants has estimated that around 8,520 tonnes/year of inorganic waste materials can be recycled from waste streams in Vanuatu, excluding plastics. That value assumes a certain recovery rate per item. The largest fractions that can be recycled are scrapped cars, paper and cardboard, scrap metals, and used motor oil. Secondary, or recycled, materials have a lower carbon footprint than materials that are extracted and processed as primary materials.[259] [260]

Vanuatu lacks the facilities to recycle paper, metals and glass, which must be exported to be recycled. When sending them to recycling facilities abroad, Vanuatu could reduce GHG emissions in the country of destination by approximately 18,000 tCO_2e per year.

Investment costs	High	
IPCC sectors targeted	International	
	domestic	**international**
GHG mitigation potential tCO_2e/year	0	18,000
Waste avoidance t/year	9,000	0
Primary resource extraction reduction t/year	0	15,000

3.12 National plastics strategy

Strategy description

Vanuatu's goal is to reduce plastics imports by 50 percent by 2030.[261] Import restrictions and duties can be instrumental in achieving that goal.

Vanuatu has already banned the import of a range of single-use plastics.[262] This, it has begun to restrict the import of products and materials that the country's current waste management system cannot process adequately. This has encouraged the use of locally available and regenerative alternatives.[263] In addition, the country has imposed import duties on some, but not all, carbon-intensive materials.

Vanuatu could extend these restrictions and discourage the import of products that create serious waste problems in the country by, for example, imposing excise duties (see strategy 3.5).[264] Revenues from these duties could be invested in supporting the development of sustainable local alternatives and strengthening waste collection and processing. The latter would constitute an extended producer responsibility scheme, which could allow the country to lift restrictions in the future. The duties would also compensate for the low price for recyclable material on international markets and cover the costs of reverse logistics and adequate processing in Vanuatu or abroad.

Plastic waste can be reduced further through improved management of plastic products on the islands. Vanuatu has already launched initiatives to price recyclable materials and introduced deposit schemes for plastic packaging.[265] Improved logistics as part of the Interisland Shipping Support Project to improve domestic shipping can provide new opportunities to recover recyclable materials from the outer islands and allow all communities to participate in container deposit and extended producer responsibility schemes.[266]

Regional collaboration among Pacific islands can help negotiate extended producer responsibility schemes[267] that support waste collection and recycling and, more importantly, accelerate product or value chain design improvements to avoid plastic waste altogether.

International examples

Without proper waste management systems in place, reducing plastic pollution requires reducing its production and use, which requires product or system innovation. In England, the introduction of a charge on plastic bags led to a 59 percent reduction in their use.[268] Loop offers another example. This company developed a closed loop for packaging, supported with reverse logistics, to bring empty packaging back to the producer or packaging company for re-use and also developed a range of compostable or plastic-free packaging solutions.[269]

Impact

Vanuatu produces an estimated 5,700 tonnes of plastic waste, Reducing imports by 50 percent could thus reduce upstream emissions from the production of plastic products by approximately 1,700 tCO_2e.

50%

Vanuatu's goal is to reduce plastics imports by 50 percent by 2030

Investment costs	High
IPCC sectors targeted	International

	domestic	international
GHG mitigation potential tCO_2e/year	0	2,500
Waste avoidance t/year	2,800	0
Primary resource extraction reduction t/year	0	5,000

3.13 Regional organic certification targeting export and tourist markets

Strategy description

Depending on the province, between 1 percent and 49 percent of smallholder farms apply fertilizers and between 0.4 percent and 47 percent apply pesticides.[270] This circular economy strategy aims to expand the share of Vanuatu's agricultural export commodities such as beef, copra, cocoa and coconut oil, which are produced under certified organic conditions. In time, regional certifications can replace the certification of individual farms and value chains.

Vanuatu has a key comparative advantage in high-value agricultural products. Increasing the export value of agricultural commodities, combined with renewable energy ambitions that would reduce the need to import fuels, could help reduce the trade deficit. Integrating ecotourism ambitions with organic food production could further reduce the need to import food products for the country's temporary residents.[271]

International examples

Uganda was an early adopter of certification schemes and labels for organic production systems. As a result, its revenues from certified organic exports increased from $3.7 million in 2003/4 to $22.8 million in 2007/8. The scheme also reduced GHG emissions and chemical runoff into surface water.[272] [273]

Impact

In 2018, Vanuatu imported around $36,500 of nitrogen fertilisers and $287,000 of pesticides.[274] Avoiding the use of these estimated 70 tonnes of nitrogen fertilizers would avoid around 210 tCO_2e/year of GHG emissions abroad. Further emissions can be avoided when organic production practices help avoid domestic emissions from organic waste disposal.

70t

Avoiding the use of 70 tonnes of nitrogen fertilizers would avoid around 210 tCO2e/year of GHG

Investment costs	Medium
IPCC sectors targeted	International

	domestic	international
GHG mitigation potential tCO_2e/year	n/a	210
Waste avoidance t/year	n/a	0
Primary resource extraction reduction t/year	0	54

3.14 Artisan plastics recycling and repurposing

Strategy description

Vanuatu has taken measures to clear its coastlines of plastics by organizing coastal clean-ups and special days on which Vanuatuans are challenged not to use any plastics for a day. These campaigns help create awareness. The effort to collect secondary plastics could be made permanent by developing artisan plastics recycling workshops, perhaps even targeting the tourism industry with creative souvenirs, or taking advantage of plastics' qualities for small-scale applications in the construction sector. By giving plastic recycling a visible and permanent place, Vanuatu can send a clear message to the country's visitors and reduce plastic waste and pollution.

The export of recyclable materials has stalled due to the decline in prices for secondary materials.[275] Using the materials in Vanuatu avoids shipping costs.

International examples

Dutch industrial designer Dave Hakkens promotes open-source do-it-yourself initiatives to recycle plastics and make consumer products or artwork out of secondary plastics. Instructions for a mobile plastics recycling facility are available online. It uses a shredder, extruder, injector and press that cost less than 3,000 EUR, while the community has developed many more machines that people can build themselves. [276] Using such a facility can be combined with crowdsourcing waste to produce valuable products for the community. The city of Eindhoven used crowdsourced plastics waste for the façade of a new building, mobilizing the community to collect and sort the plastics by colour.[277]

Plastic Whale[278] is a social enterprise that develops high-end products, such as furniture and boats from plastics recovered from marine environments.[279]

Inspiring examples do not come only from abroad. Vanuatu's Azure Pure Water has tested a concept that uses a mobile shredder and extruder that could travel from community to community and process one tonne of plastics/month.[280] [281] Wan Smol Bag from Port Vila, which trained students to make purses from plastic waste, is another example of an artisan plastics recycling initiative. [282]

Impact

The estimate below is based on one installation capable of processing one tonne of plastics/month.

1t/month

Vanuatu's Azure Pure Water has tested a concept that uses a mobile shredder and extruder that could travel from community to community and process one tonne of plastics per month

Investment costs	Low
IPCC sectors targeted	International

	domestic	international
GHG mitigation potential tCO_2e/year	0	26
Waste avoidance t/year	12	0
Primary resource extraction reduction t/year	0	21

3.15 Circular fish value chain

Strategy description

Vanuatu has valuable fish stocks that it seeks to preserve. Working with fishing companies can help identify ways to do that and minimize bycatch. In addition, a balance should exist between land-based nutrients that reach the seas though river flows and nutrients brought ashore as fish, crustaceans and seaweed. This could also involve selecting the most valuable fish with the least negative impact on the marine ecosystem.[283]

Finally, once fish have been brought ashore, food losses should be minimized.[284] This involves minimizing waste from fish processing or using fish waste to produce new products.

International examples

The World Wildlife Fund works with Solander (Pacific) Ltd., a New Zealand-based longline tuna fishing company that operates from Fiji. The two are collaborating to limit bycatch and allow the company to obtain Marine Stewardship Council (MSC) certification.[285]

Vanuatu will soon commission a fish processing plant. Fish waste can be used to produce nitrogen fertilizer[286] and fish skins can be upcycled into fashion accessories.[287]

The fish industry can also become more resource efficient by repairing plastic crates used for fish auctions and introducing a recycling scheme for fishing nets, like Odyssey Innovation's, which offers drop-off points at fishing ports in the United Kingdom.[288]

Next steps

Fish processing industries could be required to adopt circular economy fishing to obtain licences and permits. In addition, collaboration throughout the value chain can further reduce waste volumes.

Impact

Estimating the impact of circular economy strategies in the fish value chains requires more information on the volumes of bycatch and waste produced in future fish processing facilities.

Investment costs	High
IPCC sectors targeted	n/a

3.16 International collaboration to improve livestock efficiency

Strategy description

Even as Vanuatu's livestock sector pursues its growth goals, a low-carbon growth perspective must be maintained. Because it is difficult to reduce GHG emissions from livestock, international cooperation may help to identify viable options for Vanuatu.

Many climate mitigation investments target manure management by introducing biodigesters. This requires collecting manure. This is not practiced in Vanuatu, as most livestock is free range. Another option is to combine forestry or plantation with cattle grazing. This is already practiced in Vanuatu, where cattle roam freely in coconut plantations and where coconut meal, a waste product, is used as a source of protein for the cattle.

Still, given that beef and dairy production produce up to 60 percent of national GHG emissions, even a small reduction would cut those emissions significantly. The World Bank[289] and FAO[290] have identified measures that could be relevant in the Vanuatuan context.

International examples

The World Bank supported the adoption, by family farmers in Uruguay, of climate-smart livestock practices, which helped improve grazing areas, animal waste management in watersheds and carbon sequestration in grasslands.[291] Similar programmes in Vietnam targeted over 23,000 household-based livestock farmers and helped them reduce their environmental impact through livestock waste management, disease control and the provision of veterinary services.[292]

Costa Rica is analysing and developing the business case for low-carbon livestock, targeting the widespread adoption of climate-smart practices and technologies in the agriculture and livestock sectors.[293] The FAO provides an overview of policy measures that can help expedite the transition to a low-carbon livestock sector. Their recommendations range from pricing externalities with a carbon tax (see intervention 3.5) to producer support programmes,[294] such as the World Bank programmesmentioned above.

Next steps

Steps towards a more circular meat value chains could include:

1 Training smallholder farmers to support productivity increases;[295] for example, by enhanced feeding,[296] improving animal health and welfare through disease prevention and veterinary services,[297] improved pasture management and rotational grazing, perhaps supported with fencing from whitewood thinning.[298]

2 Replacing mineral fertilizers with processed organic residues.[287] Vanuatu imports around 70 tonnes of nitrogen fertilizer annually.[300]

The Government of Vanuatu seeks to cooperate with New Zealand and other interested countries to find and develop ways to mitigate emissions through ruminant and pasture management.[301]

Impact

Data is lacking to quantify the potential and related impact of increased livestock productivity on GHG emissions.

Investment costs	Low
IPCC sectors targeted	Enteric fermentation; manure management

3.17 Ecotourism supported by local communities

Strategy description

Vanuatu has adopted a Sustainable Tourism Policy[302] that aims to minimize waste and GHG emissions from tourism and target responsible and high-value tourists, which can enhance and conserve the country's environmental and cultural resources.

Vanuatu has important and valuable experiences to share with visitors, including adopting a low-carbon lifestyle and the value of protecting natural resources, which are the fundamentals of tourism in the country. Through ecotourism, Vanuatu might inspire visitors to bring home inspiring lessons on lifestyle change.

Other targets that could support ecotourism might focus on sourcing locally-produced food. An estimated 27 percent of tourism revenues are used to procure goods and services from abroad.[303] Given the long transport distances to Vanuatu, local production tends to have a lower carbon footprint, use less packaging and support local communities.[304]

Emphasizing ecotourism means targeting tourists who appreciate Vanuatu for its natural beauty, the way of life that some islanders practice (emphasizing immaterial, rather than material, values), and its efforts to preserve natural assets for future generations. By positioning Vanuatu as a country that has made fundamentally different development choices, rather than one that has failed to make progress on a conventional development pathway, the country can stand out, with dignity, as a destination.

International examples

Costa Rica distinguishes itself as an ecotourism destination, offering ecolodges and eco-adventure holidays, backed by a voluntary certification programme. In the Dominican Republic, community-supported tourism development helps engage local companies.[305]

Next steps

The following options could encourage ecotourism:

1 Establish collaboration between farms and the tourism sector to increase the use of food products from Vanuatu;

2 Adopt minimum standards for tourism operations, perhaps following guidance from the Sustainable Tourism Stewardship Council. These standards could be included in the process for obtaining a licence for tourist operations or an ecotourism certificate;

3 Implement a green tax on tourism, which would collect revenue from tour operators to pay for the ecosystem services that attract tourists. This tax could be levied on hotel rooms;[306]

4 Encourage tourism companies to adopt green building standards that rely on domestic construction materials and construction traditions. This could also be part of obtaining an ecotourism certificate; and,

5 Prioritize local products to reduce plastic waste from tourism. Those wastes have an impact on natural assets and marine litter reduces the country's tourist appeal.

Impact

Estimating the impact of prioritizing local products in the tourism sectors requires more information on the volume and type of imported products for which local products can be substituted and on the impact of enforcing green building standards for hotels and resorts.

Investment costs	Low
IPCC sectors targeted	International

3.18 Agroforestry and food forests

Strategy description

Commercial forestry activities are threatening the country's native forests. Agroforestry systems have been part of the country's tradition and many smallholders graze their herds under coconut trees.[307] Combining useful trees with crops also helps protect soil nutrients, soil moisture and avoid erosion while storing more carbon than in a monoculture cropping system.[308]

Recommendation 3.3 on silvopastures refers to combining livestock with forestry, while agroforestry refers to combinations of crops and forestry. Agroforestry systems can be combined with carbon incentives like REDD+, seeking to diversify land use systems where appropriate. The productivity of some old coconut plantations can be increased by replanting and mixing with other useful local species or cattle ranging. This approach can also be used to rehabilitate degraded land, where cattle are used to clear areas infested with invasive species like meremmia vine.[309]

Next steps

To encourage the use of agroforestry, carbon incentives can support farmers or communities that would like to maintain a certain carbon stock on their land, such as in the Loru tropical rainforest on the island of Espiritu Santo[310] or Fiji's Sovi Basin Trust Fund.[311] Among smallholder farms, the concept of food forests can help optimize and diversify food production on small plots of land.[312]

Impact

As a next step, the Government of Vanuatu could explore the potential and impact of agroforestry and the introduction of food forests. However, data is lacking to assess the potential across Vanuatu.

27%

An estimated 27 percent of tourism revenues are used to procure goods and services from abroad

Investment costs	Medium
IPCC sectors targeted	— Forest land — Aggregate Sources & Non-CO_2 Emissions Sources on Land

3.19 Excess materials marketplace and urban mining

Strategy description

Vanuatu uses an estimated 160,000 tonnes of construction materials per year, of which 17 percent is imported. Some demolition is carried out,[313] especially in the wake of cyclones. Demolition sites could provide construction materials for other buildings if the building is disassembled, rather than demolished. Construction sites also often are a source of excess construction materials. Given that the country extends over 80 islands, matching supply and demand for excess materials and products is challenging.

One solution would be to introduce an online exchange, which can be made accessible through the large numbers of mobile phones in Vanuatu. The exchange should provide for intuitive product categorization, allowing people with surplus materials or products to place them for sale and connect with buyers.

A second solution would be to integrate circular economy principles in the procurement of demolition services. If demolition companies are given more time, they can often find a new use for materials and construction elements that can be salvaged during demolition and can disassemble parts when possible.

International examples

The Excess Materials Exchange is an example of an online marketplace for residual materials.[314] Another company, New Horizon, specializes in materials recovery during demolition.[313] Last, the SmartCrusher technology can recycle concrete into hydrated and unhydrated cement, gravel and sand.[316] These could be interesting solutions for processing of post-hazard debris into new construction materials.

Next steps

The Government of Vanuatu could approach the Government of Australia to explore whether synergies might exist between the goals of the Australian Circular Economy Hub[317] and Vanuatu's circular economy ambitions. The Australian circular economy programme includes developing a marketplace for excess materials and products. Vanuatu could also launch circular procurement of products and services, including construction and demolition services. This is developed further in strategy 3.7

Further research is needed to estimate the potential and impact of connecting with an Australian Excess Materials Exchange.

17%

Vanuatu uses an estimated 160,000 tonnes of construction materials per year, of which 17 percent is imported

Investment costs	Low
IPCC sectors targeted	International

Literature references

1 Republic of Vanuatu, Intended Nationally Determined Contribution (INDC), available from: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Vanuatu%20First/VANUATU%20%20INDC%20UNFCCC%20Submission.pdf

2 This value has been calculated based on the metrics proposed by Circle Economy in its National Circularity Gap analysis for Austria, The Netherlands and Norway.

3 Circle Economy and Shifting Paradigms (2019), 3rd Global Circularity Gap report: When circularity goes from bad to worse: The power of countries to change the game, available at: https://pacecircular.org/sites/default/files/2020-01/Circularity%20Gap%20Report%202020.pdf

4 Circle Economy (2020), The Circularity Gap Reporting Initiative: a global score for circularity, available at: https://www.circularity-gap.world/

5 UNEP (2020), Sustainable Consumption and Production Hotspot Analysis Tool (SCP-HAT), available at: http://scp-hat.lifecycleinitiative.org

6 New Economic Foundation (2016), Happy Planet Index Vanuatu, available at: http://happyplanetindex.org/countries/vanuatu. The Happy Planet Index considers life expectancy, well-being, ecological footprint and inequality.

7 Department of Strategic Policy, Planning and Aid Coordination Republic of Vanuatu (2016), Vanuatu 2030 – The People's Plan - National Sustainable Development Plan 2016 to 2030, available at: https://www.gov.vu/images/publications/Vanuatu2030-EN-FINAL-sf.pdf

8 Global Fishing Watch, Vanuatu monitors fishing activities with Global Fishing Watch, available at: https://globalfishingwatch.org/map/

9 UN and World Bank Group (2017), The Potential of The Blue Economy - Increasing Long-term Benefits of the Sustainable Use of Marine Resources for Small Island Developing States and Coastal Least Developed Countries, available at: https://sustainabledevelopment.un.org/index.php?page=view&type=400&nr=2446&menu=1515

10 Shifting Paradigms (2019), Circular Economy opportunities in Almaty – A metabolic approach to define resource efficient and low-carbon future for thecity, available from: https://www.shiftingparadigms.nl/projects/almaty/

11 Paulik, S., Muller, D.B, (2014), The role of in-use stock in the social metabolism and in climate change mitigation, Global Environmental Change, Vol. 24, available from: http://www.industrialecology.uni-freiburg.de/research/Documents/GEC-D-13-00391_Self_Archive.pdf

12 Ellen MacArthur Foundation (2015), "What is a circular economy?", available at: https://www.ellenmacarthurfoundation.org/circular-economy/concept.

13 Brugmans, G. (2015). The Metabolism of Albania: Activating the Potential of the Albanian Territory (Rotterdam, iabr/UP, 2015), available from: http://iabr.nl/nl/publicatie/albania_book

14 UNFCCC, Nationally Determined Contributions, available at: https://unfccc.int/nationally-determined-contributions-ndcs.

15 World Bank (2018), Vanuatu, available at: https://data.worldbank.org/country/vanuatu.

16 World Bank (2018), Vanuatu Country Profile, available at: https://databank.worldbank.org/views/reports/reportwidget.aspx?Report_Name=CountryProfile&Id=b450fd57&tbar=y&dd=y&inf=n&zm=n&country=VUT.

17 World Bank (2020), land area (sq km), available at: https://data.worldbank.org/indicator/AG.LND.TOTL.K2?locations=VU.

18 FAO (2002), FAO Fishery Country Profile – Vanuatu, available at: http://www.fao.org/fi/oldsite/FCP/en/VUT/profile.htm

19 Pacific Region Infrastructure Facility (2018), Vanuatu profile in the solid waste and recycling sector, available at: https://www.theprif.org/documents/vanuatu/waste-management/vanuatu-profile-solid-waste-and-recycling-sector.

20 BACI (2020), International Trade Database at the Product-Level - HS6 REV. 1992 (1995 - 2018), available at: http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=37.

21 BACI (2020), International Trade Database at the Product-Level - HS6 REV. 1992 (1995 - 2018), available at: http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=37

22 Pacific Region Infrastructure Facility (2018), Vanuatu profile in the solid waste and recycling sector.

23 Shifting Paradigms (2019), Chinese waste ban forcing a breakthrough in circular economy ambitions in Australia, available at: https://www.shiftingparadigms.nl/projects/chinese-waste-ban-forcing-a-breakthrough-in-circular-economy-ambitions-in-australia/

24 Vanuatu Customs (2017), Harmonized Coding System, available at: https://customsinlandrevenue.gov.vu/images/Customs_Tariff/Final_HS2017_English.pdf.

25 Vanuatu National Statistics Office (2010), Vanuatu Household Income and Expenditure Survey 2010, available at:https://mjcs.gov.vu/images/research_database/2010_HIES_REPORT.pdf

26 Vanuatu National Statistics Office (2016), Post Pam Mini Census Report, Vol 1, available from: https://vnso.gov.vu/images/Public_Documents/Census_Surveys/Census/2016/2016_Mini_Census_Main_Report_Vol_1.pdf., Government of Vanuatu (2018), Vanuatu National Action Plan to reduce releases of Unintentional Persistent Organic Pollutants 2018-2022, available at: https://www.sprep.org/attachments/Publications/WMPC/upops-action-plan-vanuatu.pdf

27 Primary resource: UNEP (2020), Sustainable Consumption and Production Hotspot Analysis Tool (SCP-HAT), available from: http://scphat. lifecycleinitiative.orgComplemented with data from: Vanuatu National Statistics Office (2020), Gross Domestic Product, https://vnso.gov.vu/index.php/new-releases/annual-news/gross-domestic-product Vanuatu National Statistics Office (2016), Post Pam Mini Census Report, Vol 1, available from:https://vnso.gov.vu/images/Public_Documents/Census_Surveys/Census/2016/2016_Mini_Census_Main_Report_Vol_1.pdf

28 Vanuatu National Statistics Office (2020): Statistics Release: Gross Domestic Product 2017, available from: https://vnso.gov.vu

29 Vanuatu National Statistics Office (2016), Post Pam Mini Census Report, Vol 1, available from: https://vnso.gov.vu

30 Government of Vanuatu (2015), Vanuatu Agriculture Sector Policy 2015-2030, available from: https://www.nab.vu/document/vanuatu-agriculture-sectorpolicy-2015-2030

31 ILO (2017), Improving labour market outcomes in the Pacific - Policy Challenges and Priorities, available from: https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/---ilo-suva/documents/publication/wcms_559066.pdf

32 GGGi (2018), Guide to Green Entrepreneurship in Vanuatu, available from: https://gggi.org/site/assets/uploads/2019/04/GGGI-Guide-to-Green-Entrepreneurship-in-Vanuatu.pdf

33 IFC, Streamlining Foreign Investment Processes in Vanuatu.World Bank (2019), Success Stories: Foreign Investment Processes Streamlined in Vanuatu.

34 Data and information provided through interviews and report review rounds.

35 Circle Economy (2017), Circular Jobs: The Circular Economy and Opportunities for Employment in the Netherlands

36 Government of Vanuatu (2019), Vanuatu's Third National Communication – National GHG Inventory – Draft.

37 Vanuatu National Statistics Office (2009), National Population and Housing Census - Analytical Report Volume 2.

38 Government of Vanuatu (2020), Government of the Republic of Vanuatu Budget 2020 - Volume 1Fiscal Strategy Report Incorporating the Economic And Fiscal Update and the Budget Policy Statement, available from: https://doft.gov.vu/index.php/widgetkit/budget-appropriation

39 Department of Strategic Policy, Planning and Aid Coordination Republic of Vanuatu (2016), Vanuatu 2030 – The People's plan - National Sustainable Development Plan 2016 to 2030.

40 Pacific Region Infrastructure Facility (2018), Vanuatu profile in the solid waste and recycling sector, available from: https://www.theprif.org/documents/vanuatu/waste-management/vanuatu-profile-solid-waste-and-recycling-sector

41 Future Directions (2019), Food and Water Security in Vanuatu, available from: http://www.futuredirections.org.au/publication/food-and-water-security-invanuatu/

42 The GEF (2019), DRAFT Mitigation Assessment Report - Vanuatu's Third National Communication (TNC) to the United Nations Framework Convention on Climate Change (UNFCCC).

43 Massey University (2013), Sharing the Riches of Tourism in Vanuatu, available from: https://tourism.gov.vu/assets/docs/reports/SharingTheRichesOfTourismInVanuatuFinalReport2013.pdf

44 Bündnis Entwicklung Hilft (2019), WorldRiskReport 2019, available from: https://reliefweb.int/sites/reliefweb.int/files/resources/WorldRiskReport-2019_Online_english.pd

45 BBC (2015), In pictures: Cyclone Pam hits Vanuatu, available from: https://www.bbc.com/news/world-asia-31901998 Daily Post Vanuatu (2016), The devastation of Tropical Cyclone Pam available from: https://dailypost.vu/news/the-devastation-of-tropical-cyclone-pam/article_e7ea51f0-3e4f-5b74-b72f-7d8e7c3dece0.html

46 The Guardian (2020), Communications down after category 5 Cyclone Harold hits Vanuatu, available from: https://www.theguardian.com/world/2020/apr/06/communications-down-after-category-5-cyclone-harold-hits-vanuatu

47 National Oceanic and Atmospheric Administration (2020), Study: Climate change has been influencing where tropical cyclones rage, available from: https://www.noaa.gov/news/study-climate-change-has-been-influencing-where-tropical-cyclones-rage

48 World Bank (2018), Project Information Document/Integrated Safeguards Data Sheet (PID/ISDS) Vanuatu Climate Resilient Transport Project (P167382), available from: http://documents.worldbank.org/curated/en/402161542854905069/pdf/Concept-Project-Information-Document-Integrated-Safeguards-Data-Sheet-Vanuatu-Climate-Resilient-Transport-Project-P167382.pdf

49 BBC (2018), Vanuatu: Ambae island evacuated again over volcano eruption, available from: https://www.bbc.com/news/world-asia-44978132

50 New Economic Foundation (2016), Happy Planet Index Vanuatu, available from: http://happyplanetindex.org/countries/vanuatu. The Happy Planet Index considers life expectancy, well-being, ecological footprint and inequality.

51 Vanuatu was not included in the 2019 World Happiness Report. The 2020 World Happiness Report looked at cities.

52 BBC (2020), What makes Vanuatu one of the happiest places in the world?

53 Data and information provided through interviews and report review rounds.

54 EveryCulture (2006), Vanuatu, available from: https://www.everyculture.com/To-Z/Vanuatu.html#ixzz6Om5bRzVt

55 ADB, (2014) Solid Waste Management in the Pacific Vanuatu Country Snapshot, available from: https://www.adb.org/sites/default/files/publication/42658/solid-waste-management-vanuatu.pdf

56 Government of Vanuatu (2019), Vanuatu's Third National Communication – National GHG Inventory – Draft

57 IRENA (2015), Renewables Readiness Assessment, available from: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2015/IRENA_RRA_Vanuatu_2015.pdf

58 Department of Strategic Policy, Planning and Aid Coordination Republic of Vanuatu (2016), Vanuatu 2030 – The People's plan - National Sustainable Development Plan 2016 to 2030.

59 Department of Strategic Policy, Planning and Aid Coordination Republic of Vanuatu (2016), Vanuatu 2030 – The People's plan - National Sustainable Development Plan 2016 to 2030.

60 UNDP (2020), Human development Index, Vanuatu.

61 Pacific Fuel Price Monitor (2020), Covering 1stQuarter 2019 (January -March), available from: http://prdrse4all.spc.int/sites/default/files/pacific_fuel_price_monitor_q12019_final.pdf UNDP (2007), Land Transport Sector - An Assessment of Priority Issues & Options for the Land Transport Sector in Vanuatu.

62 Government of the Republic of Vanuatu (2015), Vanuatu Climate Change and Disaster Risk Reduction Policy 2016-2030.

63 The Vanuatu Beef Industry (2019) Country report for ACIAR Project LS/2018/102Research opportunities for smallholder beef cattle systems in Pacific island countries.

64 Daily Post Vanuatu (2015), Vanuatu beef value chain at a glance, available from: https://dailypost.vu/news/vanuatu-beef-value-chain-at-aglance/article_16c-12fa0-2c52-5ea9-b968-6616f23c6b2a.html

65 Daily Post Vanuatu (2017), Livestock confident to reach 500,000 mark, available from: https://dailypost.vu/news/livstock-confident-to-reach-500-000-mark/article_6e5a011e-5a90-5265-b566-0479cd14c601.html

66 World Bank (2019), Moving towards sustainability: The Livestock Sector and the World Bank, available from: https://www.worldbank.org/en/topic/agriculture/brief/moving-towards-sustainability-the-livestock-sector-and-the-world-bank

67 Climate Focus (2017), Taking a Bite out of Climate Change: Why we should stop eating too much beef, available from: https://www.climatefocus.com/news/new-report-taking-bite-out-climate-change-why-we-should-stop-eating-too-much-beef

68 Draft-Vanuatu's National GHG Inventory-V2- Report, page 92

69 UNDP (2020), DRAFT Vanuatu's Enhanced Nationally Determined Contributions (NDC) 2020-2030, Technical Assistance Consultancy - Enhancing and Fast-tracking Implementation of Vanuatu's Nationally Determined Contribution (NDC) – Review and Updating Vanuatu's NDC (RFP MOCC/002/2020).

70 Government of the Republic of Vanuatu (2015), Vanuatu Climate Change and Disaster Risk Reduction Policy 2016-2030.

71 Republic of Vanuatu, Intended Nationally Determined Contribution (INDC), available from: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Vanuatu%20First/VANUATU%20%20INDC%20UNFCCC%20Submission.pdf

72 Government of the Republic of Vanuatu (2015), Vanuatu Climate Change and Disaster Risk Reduction Policy 2016-2030.

73 Department of Strategic Policy, Planning and Aid Coordination Republic of Vanuatu (2016), Vanuatu 2030 – The People's plan - National Sustainable Development Plan 2016 to 2030.

74 Republic of Vanuatu (2019), Waste Management Act No.24 of 2014, amendment order no. 128 of 2019, available from: https://www.vanuatuconservation.org/wp-content/uploads/2019/11/Waste-management-regs-2019.pdf

75 Daily Post Vanuatu (2010), Ministry to Impose Taxes on Imported Products, available from: https://dailypost.vu/news/ministry-to-impose-taxes-onimported-products/article_bf4ad818-6185-11ea-8c58-b3c3e1d82745.html

76 Daily Post Vanuatu (2018), Ban on commercial coastal sand mining along Teouma Bay and Mele Bay, available from: https://dailypost.vu/news/ban-oncommercial-coastal-sand-mining-along-teouma-bay-and-mele-bay/article_3ad26b91-dc91-5950-b222-5976dbd6d973.html

77 Circle Economy and Shifting Paradigms (2019), 2nd Global Circularity Gap report: Circular economy strategies would tip balance in battle againstdangerous climate change, available from: https://www.shiftingparadigms.nl/projects/circular-economy-strategies-would-tip-balance-in-battle-againstdangerous-climate-change/

78 Brugmans, G. (2015), The Metabolism of Albania: Activating the Potential of the Albanian Territory, available from: https://iabr.nl/nl/publicatie/albania_book

79 UNDP (2017), Circular economy strategies for Lao PDR – A metabolic approach to redefine resource efficient and low-carbon development, available from: https://www.undp.org/content/undp/en/home/librarypage/climate-and-disaster-resilience-/circular-economy-strategies-for-lao-pdr.html

80 Own analysis of the underlying data of Figure 2 from: B. Bajželj, J.M. Allwood and J.M. Cullen (2013), "Designing Climate Change Mitigation Plans That Add Up", Environmental Science & Technology, 47 (14): 8062–8069, July 2013, available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3797518/

81 Circle Economy and Shifting Paradigms (2019), 2nd Circularity gap report: Circular economy strategies would tip balance in battle against dangerous climate change, available from: https://www.shifting-paradigms.nl/projects/circular-economy-strategies-would-tip-balance-in-battle-against-dangerousclimate-change/

82 Paulik S., Müller D. B. (2014), "The role of in-use stocks in the social metabolism and in climatechange mitigation", Global Environmental Change, Vol.24, available from: http://dx.doi.org/10.1016/j.gloenvcha.2013.11.006

83 Hatfield-Dodds, S. (2017), "Assessing global resource use and greenhouse emissions to 2050, with ambitious resource efficiency and climate mitigation policies", Journal of Cleaner Production, Vol.144, available from: http://dx.doi.org/10.1016/j.jclepro.2016.12.170

84 Circle Economy (2019), Making Sense of the Circular Economy The 7 Key Elements, available from: https://www.circle-economy.com/circulareconomy/7-key-elements.

85 ClimateWorks Foundation (2017), Europe's Carbon Loophole, available from: https://www.climateworks.org/report/europes-carbon-loophole/

86 EU Environment, Natural Capital Accounting, available from: https://ec.europa.eu/environment/nature/capital_accounting/index_en.htm. The approachis applied to the EU, but also to Brazil, China. India, Mexico and South Africa by the System of Environmental Economic Accounting in the (2017-2020) Natural Capital Accounting and Valuation of Ecosystem Services Project, available from: https://seea.un.org/home/Natural-Capital-Accounting-Project.See also: OECD (2017), Green Growth Indicators 2017, available from: https://www.oecd-ilibrary.org/environment/green-growth-indicators-2017_9789264268586-en, which states that "Our ability to sustain economic and social progress in the long run will depend on our capacity to reduce dependence on natural capital as a source of growth".

87 UN Environment (2020), Sustainable Consumption and Production Hotspot Analysis Tool (SCP-HAT), available from: http://scphat. lifecycleinitiative.orgCombined with specific analysis of resource use, trade data and GHG emissions data from the latest inventory.

88 IPBES (2019): Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany, available from: https://www.ipbes.net/global-assessment-report-biodiversity-ecosystem-services

89 Sources used for graphs in the report:Government of Vanuatu (2019), Vanuatu's Third National Communication – National GHG Inventory –Draft.
— Vanuatu National Statistics Office (2007), Census of Agriculture 2007 Vanuatu, available from: https://www.nab.vu/document/vanuatuagriculture-census-2007
— Vanuatu National Statistics Office (2016), Post Pam Mini Census Report, Vol 1, available from: https://vnso.gov.vu/images/Public_Documents/Census_Surveys/Census/2016/2016_Mini_Census_Main_Report_Vol_1.pdf
— Vanuatu National Statistics Office (2020), Table 3 Principal Domestic Exports, in Quantity, In tonnes
— Government of Vanuatu (2018), Vanuatu National Action Plan to reduce releases of Unintentional Persistent Organic Pollutants 2018-2022,available from: https://www.sprep.org/attachments/Publications/WMPC/upops-action-plan-vanuatu.pdf
— Pacific Region Infrastructure Facility (2018), Vanuatu profile in the solid waste and recycling sector, available from: https://www.theprif.org/documents/vanuatu/waste-management/vanuatu-profile-solid-waste-and-recycling-sector
— Viranamangga, Rexon & Glencross, K. & Palmer, Graeme & Nichols, J. & Smith, Geoff. (2014). The Whitewood (Endospermum Medullosum) Value-Chain in Vanuatu and Impediments to Development
— Ministry of Agriculture, Livestock, Forestry, Fisheries, and Biosecurity (MALFFB), fisheries department, available from: https://malffb.gov.vu/index.php?id=3
— ACCOM (2017), Improving market access for Vanuatu sawn timber - A description of existing trade and priority activities, available from: http://phama.com.au/wp-content/uploads/2018/11/TR133-Improving-market-access-for-Vanuatu-sawn-timber_FINAL.pdf
— UNEP (2020), Sustainable Consumption and Production Hotspot Analysis Tool (SCP-HAT), available from: http://scphat.lifecycleinitiative.org
— IRENA (2015), Vanuatu renewables readiness assessment.
— GGGi (2016) BAU-Energy-Projection-for-Vanuatu-GGGI-2016, available from: https://gggi.org/site/assets/uploads/2018/05/Vanuatu%E2%80%99s-Vision-2030-_nergy-efficiency-policies-and-targets.pdf
— World Bank (2018), World Integrated Trade Solution, available from: https://wits.worldbank.org
— BACI (2020), International Trade Database at the Product-Level - HS6 REV. 1992 (1995 - 2018), available from: http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=37
— CEPI – Research and expertise on the World Economy, 2020 version, BACI: International Trade Database at the Product-Level. CEPII Working Paper, N°2010-23, October 2010, Guillaume Gaulier, Soledad Zignago.
— UNDP (2019), NDC Implementation Roadmap, available from: https://www.ndcs.undp.org/content/ndc-support-programme/en/home/impactand-learning/library/vanuatu-ndc-implementation-roadmap.html
— Asia Pacific Waste Consultants (2019), Vanuatu – Waste Data report - Analysis of waste generation and disposal data collected in November 2018, available from: https://apwc.com.au/case-studies/vanuatu-waste-data-2/

— Merciai, S. and J. Schmidt (2016) Physical/Hybrid Supply and Use Tables. Methodological Report. EU FP7 DESIRE Project. http://fp7desire.eu/documents/category/3-public-deliverables
— Merciai, S. and J. Schmidt (2018) Methodology for the Construction of Global Multi-Regional Hybrid Supply and Use Tables for the EXIOBASE v3 Database. Journal of Industrial Ecology, 22(3)516-531. doi:10.1111/jiec.12713
— Krausmann, F., Wiedenhofer, D., Lauk, C., Haas, W., Tanikawa, H., Fishman, T., ... & Haberl, H. (2017). Global socioeconomic material stocks rise 23-fold over the 20th century and require half of annual resource use. Proceedings of the National Academy of Sciences, 114(8), 1880-1885.
— World Bank (2018), Vanuatu, available from: https://data.worldbank.org/country/vanuatu
— Department of Strategic Policy, Planning and Aid Coordination Republic of Vanuatu (2016), Vanuatu 2030 – The People's plan - National Sustainable Development Plan 2016 to 2030.
— The GEF (2019), DRAFT Mitigation Assessment Report - Vanuatu's Third National Communication (TNC) to the United Nations Framework Convention on Climate Change (UNFCCC).
— Imperial College London (2003), SOPAC Technical Report 364 - Individual Country Biomass Resource Assessment Profiles for Fiji, Kiribati, Samoa, Tonga, Tuvalu & Vanuatu, page 66.
— FAO (2018), Fishery and Aquaculture Country Profiles - The Republic of Vanuatu, available from: http://www.fao.org/fishery/facp/VUT/en
— UNESCO (2017), Safeguarding the traditional architecture in Vanuatu.
— UNESCAP (2012), Green Economy in a Blue World Pacific Perspectives 2012, available from: https://www.unescap.org/resources/greeneconomy-blue-world-pacific-perspective-2012
— https://farmdocdaily.illinois.edu/2017/11/nitrogen-fertiliYer-prices-and-costs-lower-for-2018.html
— http://www.fao.org/faostat/en/#data/RP/visualiYe
— http://www.fao.org/fishery/facp/VUT/en
— https://www.worldometers.info/food-agriculture/vanuatu-food-agriculture/#pest
— https://malffb.gov.vu/index.php?id=3
— UNDP/UNFCCC (2014), Disseminating Efficient Cookstoves in Vanuatu.
— Nansai, et. al (2012), Estimates of Embedded Global Energy and Air-Emission Intensities of Japanese Products for Building a Japanese Input–Output Life Cycle Assessment Database with a Global System Boundary, Environmental Science and Technology, available from: https://pubs.acs.org/doi/pdf/10.1021/es2043257
— Turner, D.A. (2015), "Greenhouse Gas Emission Factors for Recycling of Source-Segregated Waste Materials," Resources, Conservation and Recycling, Vol. 105, December 1, 2015, pp. 186–97. Haas et al. (2015). How Circular is the Global Economy? An Assessment of Material Flows,Waste Production, and Recycling in the European Union and the World in 2005. Journal of Industrial Ecology Volume 19, Number 5, p.765-777.
— Wiedenhofer, D., Fishman, T., Lauk, C., Haas, W., & Krausmann, F. (2019). Integrating material stock dynamics into economy-wide material flow accounting: concepts, modelling, and global application for 1900–2050. Ecological economics, 156, 121-133.
— IRP (2017). Assessing global resource use: A systems approach to resource efficiency and pollution reduction. Report of the International Resource Panel. Nairobi, Kenya: United Nations Environment.
— IRP (2020), Global Material Flow Database, available from: https://www.resourcepanel.org/global-material-flows-database
— UNCTAD, Vanuatu, Merchandise trade matrix – product groups, exports in thousands of United States dollars, annual.
— Eurostat (2020, Handbook for estimating raw material equivalents of imports and exports and RME-based indicators on the country level –based on Eurostat's EU RME model - October 2019 RME Coefficients for Imports: Raw Material per Unit of Product 2008-2017
— ILO (2017), Improving labour market outcomes in the Pacific - Policy Challenges and Priorities, available from: https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/---ilo-suva/documents/publication/wcms_559066.pdf

90 Circle Economy and Shifting Paradigms, Global Circularity Gap Report 2020 - Circularity is in decline, but countries are stepping up to reverse the trend, available from: https://www.shiftingparadigms.nl/projects/3rd-global-circularity-gap-report/

91 Haas, W. et al, (2015) How Circular is the Global Economy?: An Assessment of Material Flows, Waste Production, and Recycling in the European Union and the World in 2005, Journal of Industrial Ecology, Volume 19, Issue 5, https://doi.org/10.1111/jiec.12244

92 Krausmann, F.,et al. (2017), Global socioeconomic material stocks rise 23-fold over the 20th century and require half of annual resource use. Proceedings of the National Academy of Sciences, 114(8), 1880-1885

93 Wiedman et al. (2015). The material footprint of nations. PNAS, 112 (20), 6271-6276, available from: https://www.pnas.org/content/112/20/6271

94 IRP (2017), Assessing global resource use: A systems approach to resource efficiency and pollution reduction. Bringezu, S., Ramaswami, A., Schandl, H., et al., Report of the International Resource Panel. United Nations Environment Programme. Nairobi, Kenya.

95 Circle Economy (2020), The Circularity Gap Norway, available from: https://www.circularity-gap.world/norway#wf-form-CGR-NOR-Report-Downloads

96 Circle Economy and Shifting Paradigms, Global Circularity Gap Report 2020 - Circularity is in decline, but countries are stepping up to reverse the trend, available from: https://www.shiftingparadigms.nl/projects/3rd-global-circularity-gap-report/

97 Global Forest Watch (2020), Vanuatu, available from: https://www.globalforestwatch.org

98 FAO (2001), Forest Plantations Thematic Papers - Mean annual volume increment of selected industrial forest plantation species, available from: http://www.fao.org/3/a-ac121e.pdf

99 FAO (2018), Fishery and Aquaculture Country Profiles - The Republic of Vanuatu, available from: http://www.fao.org/fishery/facp/VUT/en

100 Vanuatu (2015), Annual Report to The Commission, Part 1: Information on Fisheries, Research, And Statistics, Wcpfc-Sc11-Ar/Ccm-28, Rev 1 (8 August 2015)

101 BBS (2020, The law that could make climate change illegal, available from: https://www.bbc.com/future/article/20200706-the-law-that-could-make-climate-change-illegal

102 Government of Vanuatu (2019), Vanuatu National Energy Roadmap (2016-2030) – Implementation Plan.

103 NDC, Draft Vanuatu mitigation v2 report.

104 World Bank (2020), Access to electricity (% of population) - Vanuatu, available from: https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS? locations=VU World Bank (2017), Vanuatu Rural Electrification Program benefits remote communities, available from: https://www.worldbank.org/en/news/feature/2017/05/22/vanuatu-rural-electrification-program-benefits-remote-communities

105 BACI (2020), International Trade Database at the Product-Level - HS6 REV. 1992 (1995 - 2018), available from: http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=371

06 UNDP (2019), NDC Implementation Roadmap, available from: https://www.ndcs.undp.org/content/ndc-support-programme/en/home/impact-andlearning/library/vanuatu-ndc-implementation-roadmap.html

107 Coil, J. (2005), Coconut Oil as a Biofuel in Pacific Islands, available at: https://www.researchgate.net/publication/237813053

108 Government of Vanuatu (2013), Energy National Energy Road Map, available from: http://prdrse4all.spc.int/node/4/content/vanuatu-energy-road-map-2013-2020

109 Utilities Regulatory Authority (2018), Electricity Fact Sheet Vanuatu.

110 Vanuatu National Statistics Office (2016), Post Pam Mini Census Report, Vol 1, available from: https://vnso.gov.vu/images/Public_Documents/Census_Surveys/Census/2016/2016_Mini_Census_Main_Report_Vol_1.pdf

111 Vanuatu Daily Post (2018), No overexploitation of sea cucumber: Director, available from: https://dailypost.vu/news/no-overexploitation-of-seacucumber-director/article_243f7005-e40d-5392-b40f-e83a1903da17.html FAO (2018), Fishery and Aquaculture Country Profiles - The Republic of Vanuatu, available from: http://www.fao.org/fishery/facp/VUT/en

112 World Bank (2020), Total natural resources rents (% of GDP), available from: https://data.worldbank.org/indicator/NY.GDP.TOTL.RT.ZS

113 The GEF (2019), DRAFT Mitigation Assessment Report - Vanuatu's Third National Communication (TNC) to the United Nations Framework Convention on Climate Change (UNFCCC).Imperial College London (2003), SOPAC Technical Report 364 - Individual Country Biomass ResourceAssessment Profiles for Fiji, Kiribati, Samoa, Tonga, Tuvalu & Vanuatu, page 66.

114 UNESCAP (2012), Green Economy in a Blue World – Pacific Perspectives 2012.

115 World Bank (2020), Total natural resources rents (% of GDP), available from: https://data.worldbank.org/indicator/NY.GDP.TOTL.RT.ZSGGGi (2016) BAU-Energy-Projection-for-Vanuatu-GGGI-2016, available from: https://gggi.org/site/assets/uploads/2018/05/Vanuatu%E2%80%99s-Vision-2030-_nergyefficiency-policies-and-targets.pdf

116 UNFCCC, PoA 9974: Disseminating Efficient Cookstoves in Vanuatu, available from: https://cdm.unfccc.int

117 David, G. (2016), The challenge of sustainability for Pacific Island village fisheries, a historical perspective, available from: https://books.openedition.org/pacific/446?lang=en)

118 FAO (2018), Fishery and Aquaculture Country Profiles - The Republic of Vanuatu, available from: http://www.fao.org/fishery/facp/VUT/en

119 Vanuatu Ministry of Agriculture, Livestock, Forestry, Fisheries and Biosecurity (2012), Agriculture Sector Policy 2015-2030, available from: https://www.nab.vu/sites/default/files/documents/Vanuatu%20Agriculture%20Sector%20Policy%202015-2030.pdf

120 UNESCAP (2012), Green Economy in a Blue World Pacific Perspectives 2012, available from: https://www.unescap.org/resources/green-economyblue-world-pacific-perspective-2012

121 Ministry of Agriculture, Livestock, Forestry, Fisheries and Biosecurity Vanuatu (2015), Vanuatu National Livestock Policy 2015-2030.

122 The GEF (2019), DRAFT Mitigation Assessment Report - Vanuatu's Third National Communication (TNC) to the United Nations Framework Convention on Climate Change (UNFCCC).

123 Department of Agriculture and Rural Development of Vanuatu (2015), Vanuatu National Coconut Strategy 2016-2025, available from: https://pafpnet.spc.int/attachments/article/651/Vanuatu%20National%20Coconut%20Strategy%202016-2025.pdf Daily Post Vanuatu (2018), New Investor offers hope for Vanuatu Coconut farmers, available from: https://dailypost.vu/news/new-investor-offers-hope-for-vanuatu-coconut-farmers/article_d5c41ebd-1f84-5e7d-bcf1-f68a8336c71e.html

124 The GEF (2019), DRAFT Mitigation Assessment Report - Vanuatu's Third National Communication (TNC) to the United Nations Framework Convention on Climate Change (UNFCCC).Imperial College London (2003), SOPAC Technical Report 364 - Individual Country Biomass Resource Assessment Profiles for Fiji, Kiribati, Samoa, Tonga, Tuvalu & Vanuatu, page 66. Government of Vanuatu (2013), Vanuatu Forest Policy 2013-2023., available from: https://malffb.gov.vu/doc/forests/Vanuatu%20National%20Forest %20Policy.pdf Unique Forests and Lands (2017), Reducing Emissions from Deforestation and Forest Degradation (REDD+) in Vanuatu, available from: https://www.unique-landuse.de/images/publications/vereinheitlicht/2017-07-18%20Policy%20brief%20Vanuatu%201.pdf

125 The GEF (2019), DRAFT Mitigation Assessment Report - Vanuatu's Third National Communication (TNC) to the United Nations Framework Convention on Climate Change (UNFCCC).

126 Government of Vanuatu (2013), Vanuatu Forest Policy 2013-2023., available from: https://malffb.gov.vu/doc/forests/Vanuatu%20National%20Forest %20Policy.pdf

127 IRENA (2015), Vanuatu renewables readiness assessment.

128 Viranamangga, Rexon & Glencross, K. & Palmer, Graeme & Nichols, J. & Smith, Geoff. (2014). The Whitewood (Endospermum Medullosum) Value-Chain in Vanuatu and Impediments to Development of a Plantation-Based Industry. Small-scale Forestry. 14. 139-153. 10.1007/s11842-014-9278-2.Viranamangga, R., et al. "Plantation-Grown Whitewood Timber in Vanuatu: Challenges and Opportunities for Export and Domestic Use." The International Forestry Review, vol. 14, no. 4, 2012, pp. 486–491. JSTOR, www.jstor.org/stable/24310618. Accessed 26 May 2020

129 Viranamangga, Rexon & Glencross, K. & Palmer, Graeme & Nichols, J. & Smith, Geoff. (2014). The Whitewood (Endospermum Medullosum) Value-Chain in Vanuatu and Impediments to Development of a Plantation-Based Industry. Small-scale Forestry. 14. 139-153. 10.1007/s11842-014-9278-2

130 Daily Post Vanuatu (2019), Fish Processing Plant Operating in October, available from: https://dailypost.vu/news/fish-processing-plant-operating-inoctober/article_e5d8402e-06f1-5b4e-9019-c26e33afaa95.html

131 Ministry of Agriculture, Livestock, Forestry, Fisheries, and Biosecurity (MALFFB), fisheries department, available from: https://malffb.gov.vu/index.php? id=3

132 Pacific Community (2016), Emae descendants vow to protect island with organics, available from: https://www.spc.int/updates/news/2016/07/emaedescendants-vow-to-protect-island-with-organics Radio New Zealand (2016), Vanuatu Island opts for organic solution, available from: https://www.rnz.co.nz/international/programmes/datelinepacific/audio/201809741/vanuatu-island-opts-for-organic-solution Radio New Zealand (2017), Vanuatu registers 1,000 organic farmers, available from: https://www.rnz.co.nz/international/pacific-news/335681/vanuaturegisters-1-000-organic-farmers

133 Radio New Zealand (2013), Cicia, Fiji, is the Pacific's first fully-organic island, available from: https://www.rnz.co.nz/international/programmes/datelinepacific/audio/2561347/cicia,-fiji,-is-the-pacific's-first-fully-organic-island Pacific Farmer Organisation (2019), The First in the Pacific – Living the organic way, available from: https://pacificfarmers.com/the-first-in-the-pacific/

134 Nakau Programme - Protecting 293 ha of tropical, coastal rainforest on eastern Espiritu Santo, Vanuatu, combined with agroforestry, available from: http://www.nakau.org/loru---vanuatu.htmlPlan Vivo (2020), Loru Forest Project, Vanuatu – The Nakau Programme, available from: https://www.planvivo.org/project-network/loru-forest-project/

135 UNESCAP (2012), Green Economy in a

Blue World Pacific Perspectives 2012, available from: https://www.unescap.org/resources/green-economyblue-world-pacific-perspective-2012

136 Val Pacific (no date), Val Pacific export, available from: https://www.vanuatubeef.com/export.html

137 Venui Vanilla - Growing organic vanilla and spices with a focus on quality, available from: https://www.venuivanilla.com

138 Daily Post Vanuatu (2019), available from: https://dailypost.vu/news/onesua-first-to-launch-biogas-system-project/article_4367ddae-a336-57ce-8919-6c196c080c4b.html

139 Secretariat of the Pacific Community/GiZ (2015), Adaptation to climate change through composting toilets, Pele Island, Vanuatu, available from: https://www.pacificclimatechange.net/sites/default/files/documents/CCCPIR-Vanuatu_Climate%20Change%20and%20Composting%20Briefing%20Note.pdf

140 Barrel One Coffee (2020), available from: https://www.barrelonecoffee.com/

141 Hortidaily (2017), Organic farming solutions in Vanuatu and Fiji, available from: https://www.hortidaily.com/article/6038581/organic-farming-solutionsin-vanuatu-and-fiji/POETcom (no date), Crafting organic menus in Vanuatu, available from: http://www.organicpasifika.com/poetcom/news/crafting-organic-menus-in-vanuatu/

142 Organic Paradise (2020), Naturally Vanuatu, available from: https://www.organicparadisevu.com/

143 Daily Post Vanuatu (2017), International Day of Forests, available from: https://dailypost.vu/news/international-day-of-forests/article_4251dbec-da04-584a-9d8b-e338918852bc.html

144 UNEP (2020), Sustainable Consumption and Production Hotspot Analysis Tool (SCP-HAT), available from: http://scp-hat.lifecycleinitiative.org

145 Daily Post Vanuatu (2018), Ban on commercial coastal sand mining along Teouma Bay and Mele Bay, available from: https://dailypost.vu/news/ban-oncommercial-coastal-sand-mining-along-teouma-bay-and-mele-bay/article_3ad26b91-dc91-5950-b222-5976dbd6d973.html

146 Guardian (2020), 'It's all gone': Cyclone Harold cuts a deadly path through Vanuatu.

147 2009 Census Analytical Report – Volume 2

148 ABC News (2015), Tropical Cyclone Pam: Why the Vanuatu death toll was so low, available from: https://www.abc.net.au/news/2015-04-01/explainer3a-why-was-the-vanuatu-death-toll-from-cyclone-pam-so/6363970

149 UNESCO (2017), Safeguarding the traditional architecture in Vanuatu.

150 UNESCAP (2012), Green Economy in a Blue World Pacific Perspectives 2012, available from: https://www.unescap.org/resources/green-economyblue-world-pacific-perspective-2012

151 Available from: https://vanuatubuilders.vu/timber/

152 Crosslam Australia - Smart thinking and our focus on Australian needs will deliver a sustainable termite resistant panel that won't end up in landfill. Available from: http://www.crosslamaustralia.com.au/

153 PlanetArk (no date), Make It Wood, available from: https://planetark.org/campaigns/make-it-wood.cfm

154 Daily Post Vanuatu (2019), Tourism Conference to showcase Traditional and Sustainable Architecture, available from: https://dailypost.vu/news/tourism-conference-to-showcase-traditional-and-sustainable-architecture/article_e275edc4-0595-11ea-89df-cf691bc247b0.html

155 ACIAR (2017), Rebuilding Vanuatu's forestry sector: helping farmers turn trees into money, available from: http://aciarblog.blogspot.com/2017/02/rebuilding-vanuatus-forestry-sector.html

156 Tang Ying Hao (2005), A summary report of Survey on Industrial Biogas Potential in Vanuatu and Report of the Biogas Training Workshops, available from: http://prdrse4all.spc.int/system/files/industrial_biogas_potential_in_vanuatu_and_trainings.pdf

157 Daily Post Vanuatu (2019), Fish Processing Plant Operating in October, available from: https://dailypost.vu/news/fish-processing-plant-operating-inoctober/article_e5d8402e-06f1-5b4e-9019-c26e33afaa95.html

158 Government of Vanuatu (2020), Government of the Republic of Vanuatu Budget 2020 - Volume 1Fiscal Strategy Report Incorporating the Economic and Fiscal Update and the Budget Policy Statement, available from: https://doft.gov.vu/index.php/widgetkit/budget-appropriation

159 BBC (2019), What happened after this nation banned plastic?, available from: https://www.bbc.com/reel/video/p07l0ftg/what-happened-after-this-nation-banned-plastic-160 Republic of Vanuatu (2019), Waste Management Act No.24 of 2014, amendment order no. 128 of 2019, available from: https://www.vanuatuconservation.org/wp-content/uploads/2019/11/Waste-management-regs-2019.pdf

161 IRENA (2013), Pacific Lighthouses: Renewable energy opportunities and challenges in the Pacific Islands region, available from: https://www.irena.org/DocumentDownloads/Publications/Vanuatu.pdf

162 Republic of Vanuatu, Intended Nationally Determined Contribution (INDC), available from: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Vanuatu%20First/VANUATU%20%20INDC%20UNFCCC%20Submission.pdf

163 UNESCAP (2012), Green Economy in a Blue World Pacific Perspectives 2012, available from: https://www.unescap.org/resources/green-economyblue-world-pacific-perspective-2012

165 1Activ Association - We are a not-for-profit organisation, supporting local communities all over the islands of Vanuatu by facilitating fair trade of local products and helping them to generate a sustainable income, available from: http://www.activassociation.org/

166 1RecycleCorp, – committed to making Vanuatu's recycling efforts the best in the Pacific, available from: https://recyclevanuatu.com/

167 Secretariat of the Pacific Regional Environment Programme (2018), Pacific-EU Waste Management Programme (PacWaste Plus), available from: https://www.sprep.org/pacwaste-plus PacWaste (2014) Country Profile Vanuatu, available from: https://www.sprep.org/attachments/pacwaste/CP/PW-CPVanuatu.pdf

168 Pacific Region Infrastructure Facility (2018), Vanuatu profile in the solid waste and recycling sector, available from: https://www.theprif.org/documents/vanuatu/waste-management/vanuatu-profile-solid-waste-and-recycling-sectorVanuatu Ministry of Climate Change Adaptation, Meteo & Geo-Hazards, Energy, Environment and NDMO (2016), National Waste Management and Pollution Control Strategy and Implementation Plan 2016-2020, available from: https://www.nab.vu/sites/default/files/documents/soiws-2016-05-vanuatu-14-en.pdf

169 Daily Post Vanuatu (2014), Colourful purses made out of wastes, available from: https://dailypost.vu/news/colorful-purses-made-out-ofwastes/article_e1e7cf51-e32a-5fcc-b6d0-a6071c30f054.html

170 Pacific Region Infrastructure Facility (2018), Vanuatu profile in the solid waste and recycling sector, available from: https://www.theprif.org/documents/vanuatu/waste-management/vanuatu-profile-solid-waste-and-recycling-sector

171 Pacific Region Infrastructure Facility (2018), Vanuatu profile in the solid waste and recycling sector, available from: https://www.theprif.org/documents/vanuatu/waste-management/vanuatu-profile-solid-waste-and-recycling-sector

172 Daily Post Vanuatu (2019), Azure Pure water shuts down, available from: https://dailypost.vu/azure-pure-water-shuts-down/image_2a8a4692-211a-11ea-a563-9b65ca5b6f22.html

173 Vanuatu Ministry of Climate Change Adaptation, Meteo & Geo-Hazards, Energy, Environment and NDMO (2016), National Waste Management and Pollution Control Strategy and Implementation Plan 2016-2020, available from: https://www.nab.vu/sites/default/files/documents/soiws-2016-05-vanuatu-14-en.pdf

174 Vanuatu Environmental Science Society – promoting promote science in the fields of conservation, environmental protection and sustainable development within Vanuatu, available from: https://www.vanuatuconservation.org

175 Critical Ecosystem Partnership Fund's – Protecting biodiversity by empowering people, available from: https://www.cepf.net/grants/grantee-projects?f[]=field_countries:1106

176 Vanuatu Ministry of Climate Change Adaptation, Meteo & Geo-Hazards, Energy, Environment and NDMO (2016), National Waste Management and Pollution Control Strategy and Implementation Plan 2016-2020, available from: https://www.nab.vu/sites/default/files/documents/soiws-2016-05-vanuatu-14-en.pdf

177 Daily Post Vanuatu (2019), Vanuatu Recycling and Waste Management Association officially launched

178 UNESCAP (2012), Green Economy in a Blue World Pacific Perspectives 2012, available from: https://www.unescap.org/resources/green-economyblue-world-pacific-perspective-2012

179 Vanuatu Ministry of Climate Change Adaptation, Meteo & Geo-Hazards, Energy, Environment and NDMO (2016), National Waste Management and Pollution Control Strategy and Implementation Plan 2016-2020, available from: https://www.nab.vu/sites/default/files/documents/soiws-2016-05-vanuatu-14-en.pdf

180 Facebook (2020), Vanuatu Mobile and Laptop Repairs Ltd., available from: https://www.facebook.com/vmlr.vu/?hc_ref=ARQdBIRUPa52RALNhw8k-gAlKqT1SzmAu8b-cABF91uMKubLqwxqgA_mWaRSNt7mmkXE&fref=nf&__tn__=kC-R

181 Government of Vanuatu – National Advisory Board on Climate Change & Disaster Risk Reduction, Tourism, Renewable Energy & Climate Change Project Success in Vanuatu

182 Institute for Environmental Analytics (2019), Renewable energy space technology initiative for Vanuatu, available from: https://www.theiea.org/vanuatu/100-Percent, Vanuatu, available from: https://www.100-percent.org/vanuatu/IRENA (2015), Renewables Readiness Assessment, available from: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2015/IRENA_RRA_Vanuatu_2015.pdf

183 Government of Vanuatu – Department of Energy, Vanuatu Rural Electrification Project (VREP), available from: https://doe.gov.vu/index.php/projects-2/item/2-off-grid/7-vanuatu-rural-electrification-project-vrep

184 World Bank (2017), 45,000 People to Have Access to Renewable energy in Vanuatu under New World Bank Project, available from: https://www.worldbank.org/en/news/press-release/2017/05/31/45000-people-to-have-access-to-renewable-energy-in-vanuatu-under-new-world-bankproject Climate Investment Funds, Investing inVanuatu, available from: https://www.climateinvestmentfunds.org/country/vanuatu

185 Asian Development Bank (2017), Energy Access Project: Investment Facility Report, available from: https://www.adb.org/projects/documents/van-49450-008-rrp

186 World Bank (2020), Mainstreaming Sustainable Cattle Ranching, available from: https://projects.worldbank.org/en/projects-operations/projectdetail/P104687?lang=en

187 FAO (2014), FAO success stories on Climate Smart Agriculture – Sustainable grazing for better livelihoods in China, available from: http://www.fao.org/3/a-i3817e.pdf

188 FAOSTAT (2020), Land cover, available from: http://www.fao.org/faostat/en/#-data/LC

189 World Bank (2020), Mainstreaming Sustainable Cattle Ranching, available from: https://projects.worldbank.org/en/projects-operations/projectdetail/P104687?lang=en

190 Project Drawdown (2020), Silvopasture, available from: https://www.drawdown.org/solutions/silvopasture/technical-summary

191 Draft-Vanuatu National GHG Inventory-V2- Report and the underlying calculations for the waste sector.

192 Vanuatu Ministry of Climate Change Adaptation, Meteo & Geo-Hazards, Energy, Environment and NDMO (2016), National Waste Management and Pollution Control Strategy and Implementation Plan 2016-2020, available from: https://www.nab.vu/sites/default/files/documents/soiws-2016-05-vanuatu-14-en.pdf

193 Vanuatu Ministry of Climate Change Adaptation, Meteo & Geo-Hazards, Energy, Environment and NDMO (2016), National Waste Management and Pollution Control Strategy and Implementation Plan 2016-2020, available from: https://www.nab.vu/sites/default/files/documents/soiws-2016-05-vanuatu-14-en.pdf

194 Asia Pacific Waste Consultants (2019), Vanuatu – Waste Data report - Analysis of waste generation and disposal data collected in November 2018,available from: https://apwc.com.au/case-studies/vanuatu-waste-data-2/, page 59

195 EspressoMushrooms (2019), Kitchen gardens for mushroom production, available from: https://espressomushroom.co.uk/ www.rotterzwam.nl Starter kits for mushroom production, available from: http://www.rotterzwam.nl/196 Green Banana Paper – Natural banana fiber wallets, available from: https://greenbananapaper.com/

197 Government of Vanuatu (2018), Vanuatu National Action Plan to reduce releases of Unintentional Persistent Organic Pollutants 2018-2022, available from: https://www.sprep.org/attachments/Publications/WMPC/upops-action-plan-vanuatu.pdf

198 Worm Hotel (2020), available from: https://wormenhotel.nl/, case study identified through the Knowledge Hub from Circle Economy: https://circlelab.com/knowledge-hub

199 Urban Wins (2020), Home and Community Composting, Terra à Terra), available from: https://www.urbanwins.eu/home-and-community-composting/, case study identified through the Knowledge Hub from Circle Economy: https://circle-lab.com/knowledge-hub

200 InvestSofia, Urban Environment News, available from: http://investsofia.com/en/sofia-urban-environment-news-in-brief/, case study identified through the Knowledge Hub from Circle Economy: https://circle-lab.com/knowledge-hub

201 British Recycled Plastics, Callis Compost Bin, available from: https://britishrecycledplastic.co.uk/product/callis-compost-bin/

202 Kedel Eco Friendly Plastic Products, Street furniture, available from: https://www.kedel.co.uk/street-furniture.html

203 Hoogzaad, J.A. (2016), Technology and Policy Roadmap - For a sustainable

low-carbon future of the Kazakhstan cement industry.

204 FDM Asia (2019), Understanding Cross Laminated Timber.

205 Oliver, C.D, (2014), Carbon, Fossil Fuel, and Biodiversity Mitigation with Wood and Forests, Journal of Sustainable Forestry, 33:3, 248-275.

206 Data and information provided through interviews and report review rounds.

207 RAFT (2019), China workshop explores the potential of mass timber use in mid-to-high rise buildings as a climate change mitigation measure.

208 Li, H. (2019), Cross-laminated Timber (CLT) in China: A State-of-the-Art, Journal of Bioresources and Bioproducts, 4(1): 22–30.

209 Stora Enso, CLT, building the future.

210 Sumitomo Forestry, wood as a healthy and environmentally friendly natural resource.

211 Ramboll (2015), World's tallest CLT structure of its kind underway

212 Waugh Thistleton Architects on behalf of the Softwood Lumber Board & Forestry Innovation Investment (2018), 100 UK CLT projects, available from: https://www.thinkwood.com

213 Dezeem (2011), Metropol Parasol by J Mayer H.

214 Circl (2017), The making of Circl - The story of a 'circular' pavilion in Amsterdam's Zuidas district.

215 World Bank (2020), General government final consumption expenditure (% of GDP), available from: https://data.worldbank.org/indicator/NE.CON.GOVT.ZS

216 Australia, Pacific Islands Business Council (2017), Income Tax for Vanuatu?, available from: https://apibc.org.au/blog/income-tax-for-vanuatu/ Radio New Zealand (2017), Vanuatu govt pushing ahead with controversial tax reforms, available from: https://www.rnz.co.nz/international/programmes/datelinepacific/audio/201852040/vanuatu-govt-pushing-ahead-with-controversial-tax-reforms Daily Post Vanuatu 2018), Tax reform bill has far-reaching effects, available from: https://dailypost.vu/news/tax-reform-bill-has-far-reachingeffects/article_08cfab6a-3898-50f8-91e8-6f2e1031fac1.html

217 Ex'tax (2019), Tax as a force for good - Aligning tax systems with the SDGs and the inclusive circular economy -Case study Bangladesh, available from: https://ex-tax.com/wp-content/uploads/2019/09/Tax_as_a_Force_for_Good_Bangladesh_Report-2.pdf

218 Ex'tax (2019), Tax as a force for good - Aligning tax systems with the SDGs and the inclusive circular economy -Case study Bangladesh, available from: https://ex-tax.com/wp-content/uploads/2019/09/Tax_as_a_Force_for_Good_Bangladesh_Report-2.pdf

219 WTO, Vanuatu and the WTO, available from: https://www.wto.org/english/thewto_e/countries_e/vanuatu_e.htm

220 WTO (2020), Trade Policies For a Circular Economy: What Can We Learn From WTO Experience?, available from: https://www.wto.org/english/res_e/reser_e/ersd202010_e.pdf

221 Rreuse (2017), Reduced taxation to support re-use and repair.

222 Ex'tax (2019), Tax as a force for good - Aligning tax systems with the SDGs and the inclusive circular economy -Case study Bangladesh, available from: https://ex-tax.com/wp-content/uploads/2019/09/Tax_as_a_Force_for_Good_Bangladesh_Report-2.pdf

223 WeForum (2016), Sweden is paying people to fix their belongings instead of throwing them away, available from: https://www.weforum.org/agenda/2016/10/sweden-is-tackling-its-throwaway-culture-with-tax-breaks-on-repairs-will-it-work/

224 World Bank (2019), Exploring Carbon Pricing in Developing Countries: A Macroeconomic Analysis in Ethiopia, available from: https://openknowledge.worldbank.org/handle/10986/31717

225 Tang Ying Hao (2005), A summary report of Survey on Industrial Biogas Potential in Vanuatu and Report of the Biogas Training Workshops, available from: http://prdrse4all.spc.int/system/files/industrial_biogas_potential_in_vanuatu_and_trainings.pdf

226 Vanuatu Ministry of Agriculture, Livestock, Forestry, Fisheries and Biosecurity (2012), Agriculture Sector Policy 2015-2030, available from: https://www.nab.vu/sites/default/files/documents/Vanuatu%20Agriculture%20Sector%20Policy%202015-2030.pdf

227 Government of Vanuatu (2019), Vanuatu's Third National Communication – National GHG Inventory – Draft

228 SNV, biogas, available from: https://snv.org/sector/energy/topic/biogas

229 Simgas (2020), SimGas offers millions of households the opportunity to improve their lives and income positions, available from: https://simgas.org/

230 Nieuwe Oogst (2017), Meer groen gas in Overijssel door komst twee nieuwe installaties, example located through the Knowledge Hub from Circle Economy: https://circle-lab.com/knowledge-hub/1481/processing-cattle-waste-biogas

231 Simgas (2020), SimGas offers millions of households the opportunity to improve their lives and income positions, available from: https://simgas.org/

232 Government of Vanuatu (2020), Government of the Republic of Vanuatu Budget 2020 - Volume 1Fiscal Strategy Report Incorporating the Economic And Fiscal Update and the Budget Policy Statement, available from: https://doft.gov.vu/index.php/widgetkit/budget-appropriation

233 Government of Vanuatu (2013), Land use Planning Policy, available from: https://www.nab.vu/sites/default/files/nab/documents/04/05/2015%20-%2016%3A19/vanuatu_national_land_use_planning_policy_endorsed_2013_lores.pdf

234 IPCC (2014), 5th Assessment report, Annex 3: Technology-specific Cost and Performance Parameters, available from: https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_annex-iii.pdf

235 Piano (2020), Ditch Public Procurement Expertise Centre - Circular Procurement, available from: https://www.pianoo.nl/en/sustainable-publicprocurement/spp-themes/circular-procurementEU (2020), DG Environment – Circular Procurement, available from: https://ec.europa.eu/environment/gpp/circular_procurement_en.htm

236 Government of the Netherlands, Accelerating the transition to a circular economy, available from: https://www.government.nl/topics/circulareconomy/accelerating-the-transition-to-a-circular-economy

237 ING (2014), ING signs Green Deal to boost circular purchasing, available from: https://www.ing.com/Newsroom/News/Features/Feature/ING-signs-Green-Deal-to-boost-Circular-Purchasing.htm

238 UNEP (2015), Using product-service systems to enhance sustainable public procurement, available from: https://www.oneplanetnetwork.org/sites/default/files/using_product-service_systems_to_enhance_sustainable_public_procurement.pdf

239 Asia Pacific Waste Consultants (2019), Vanuatu – Waste Data report - Analysis of waste generation and disposal data collected in November 2018, available from: https://apwc.com.au/case-studies/vanuatu-waste-data-2/,

240 Recycle Diapers (2020), Diaper recycling: the benefits, available from: http://www.recyclediapers.com/

241 FAO, What is soil carbon sequestration? Available from: http://www.fao.org/soils-portal/soil-management/soil-carbon-sequestration/en/

242 Project Drawdown (2020), Regenerative annual cropping, available from: https://www.drawdown.org/solutions/regenerative-annual-cropping

243 FAO (2013), Climate Change and Agriculture in Vanuatu: A study of crops and farming system, available from: https://www.humanitarianresponse.info/sites/www.humanitarianresponse.info/files/documents/files/CC%20and%20Agriculture%20in%20Vanuatu.pdf

244 Tearfund (2018), Bending the curve - Best practice interventions for the circular economy in developing countries

245 Weetman, C. (2016), A circular economy handbook for business and supply chains.

246 FAO (2019), Recarbonisation of Global Soils - A tool to support the implementation of the Koronivia joint work on agriculture, available from: http://www.fao.org/3/ca6522en/CA6522EN.pdf

247 FAO (2018), Climate-Smart Agriculture in the Gambia, available from: http://www.fao.org/3/CA1673EN/ca1673en.pdf

248 FAO (2020), FAOSTAT.

249 Haddaway, N.R., Hedlund, K., Jackson, L.E. et al. How does tillage intensity affect soil organic carbon? A systematic review. Environ Evid 6, 30 (2017). https://doi.org/10.1186/s13750-017-0108-9

250 IMO (2002), Anti-fouling systems, available from: WWF, available from: http://www.imo.org/en/OurWork/Environment/AntifoulingSystems/Documents/FOULING2003.pdfWWF (no date), Toxic chemicals used to keep ship hulls free of marine organisms have contaminated the marine environment and even humans, available from: https://wwf.panda.org/our_work/oceans/problems/shipping/antifouling_paints/

251 Finsulate (2020), Antifouling for clean and healthy waterways

252 Antwerp Maritime Academy (2017), biomimicry in antifouling solutions, available from: www.vliz.be.

253 Nippon Paint Marine (2020), A-LF-Sea, available from: https://www.nippon-paint-marine.com/en/products/a_lf_sea/

254 Biomimicry, Sharklet Case Study, available from: http://toolbox.biomimicry.org/wp-content/uploads/2015/01/Sharklet-Case-Study.pdf

255 Pacific Region Infrastructure Facility (2018), Vanuatu profile in the solid waste and recycling sector, available from: https://www.theprif.org/documents/vanuatu/waste-management/vanuatu-profile-solid-waste-and-recycling-sector

256 Partin, N. (2018). Catadores: The unsung street heroes challenging Brazil's social structures through new waste app. ABC news. Retrieved from: https://www.abc.net.au/news/2018-06-30/brazil-catadores-striving-to-climb-the-social-ladder/9919082

257 Atlas of the Future (2020), Tinder for Brazil's street recyclers - Cataki, available from: https://atlasofthefuture.org/project/cataki/

258 Ministry of Environment and Natural Resources (2017), A Circular Economy Solid Waste Management Approach for Urban Areas in Kenya - Nationally Appropriate Mitigation Action.

259 Turner, D.A. (2015), "Greenhouse Gas Emission Factors for Recycling of Source-Segregated Waste Materials," Resources, Conservation and Recycling, Vol. 105, December 1, 2015, pp. 186–97.

260 Pacific Region Infrastructure Facility (2018), Vanuatu profile in the solid waste and recycling sector, available from: https://www.theprif.org/documents/vanuatu/waste-management/vanuatu-profile-solid-waste-and-recycling-sector

261 Ministry of Foreign Affairs (2020), Vanuatu National Plastics Strategy (2020-2030) - Draft For Comment (31/01/2020), available from: https://vcci.vu/wp-content/uploads/2020/02/Draft_Vanuatu_National_Plastics_Strategy_v2.pdf; page 18

262 Ministry of Foreign Affairs (2020), Vanuatu National Plastics Strategy (2020-2030) - Draft For Comment (31/01/2020), available from: https://vcci.vu/wp-content/uploads/2020/02/Draft_Vanuatu_National_Plastics_Strategy_v2.pdf; page 18

263 World Bank (2019), Meet the Innovator Battling Plastic Waste in Vanuatu: Donna Kalfatak, available from: https://www.worldbank.org/en/news/feature/2019/06/04/meet-the-innovators-battling-plastic-waste-in-vanuatu-donna-kalfatak

264 Mauritius Revenue Authority (2019), Presentation on Excise Duty on Plastic Containers,available from: https://www.mcci.org/media/189029/presentation-by-mra-plastic-containers-28-feb-2019.pdf

265 Pacific Region Infrastructure Facility (2018), Vanuatu profile in the solid waste and recycling sector, available from: https://www.theprif.org/documents/vanuatu/waste-management/vanuatu-profile-solid-waste-and-recycling-sector

266 Draft-Vanuatu's National GHG Inventory-V2- Report, page 92

267 SREP (2018), Regulating Plastics in Pacific Island Countries - A guide for Policymakers and Legislative drafters, available from: https://d3n8a8pro7vhmx.cloudfront.net/edoact/pages/211/attachments/original/1540966224/Regulating_Plastics_in_Pacific_Island_Countries_SPREP_and_EDO_oct_2018.pdf?1540966224

268 Guardian (2020), Use of plastic bags in England drops by 59% in a year, available from: https://www.theguardian.com/environment/2020/jul/30/use-ofplastic-bags-in-england-drops-by-59-in-a-yearImpaxct

269 The Grocer (2019), 10 pioneering schemes tackling plastic pollution, available from: https://www.thegrocer.co.uk/plastic/10-pioneering-schemestackling-plastic-pollution/598402.article

270 National Statistics Office, Census of Agriculture 2007, available from: https://vnso.gov.vu/index.php/document-library/category/2-agriculture

271 UNESCAP (2012), Green Economy in a Blue World Pacific Perspectives 2012, available from: https://www.unescap.org/resources/green-economyblue-world-pacific-perspective-2012

272 WRI (2011). A Compilation of Green Economy Policies, Programs, and Initiatives from Around the World. The Green Economy in Practice: Prepared for Interactive Workshop 1. Retrieved from: http://pdf.wri.org/green_economy_compilation_2011-02.pdf

273 UN (2011). Uganda Organic Agriculture Standards and Policies. SDG Partnerships Platform. Retrieved from: https://sustainabledevelopment.un.org/index.php?page=view&type=99&nr=34&menu=1449

274 BACI (2020), International Trade Database at the Product-Level - HS6 REV. 1992 (1995 - 2018), available from: http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=37

275 Asia Pacific Waste Consultants (2019), Vanuatu – Waste Data report - Analysis of waste generation and disposal data collected in November 2018, available from: https://apwc.com.au/case-studies/vanuatu-waste-data-2/

276 Dave Hakkens - Precious Plastics - Basic machines are perfect to start and get into local plastic recycling. Play around, make products, run workshops and educate people, available from: https://preciousplastic.com/solutions/machines/basic.html

277 Dezeem (2017), People's Pavilion "has

almost no ecological footprint" say designers.

278 Plastic Whale (2020), Together for plastic free waters, available from: https://plasticwhale.com/

279 Industry Leaders Magazine (2018), Dutch Firm is turning Plastic Waste into High-End Furniture, available from: https://www.industryleadersmagazine.com/dutch-firm-is-turning-plastic-waste-into-high-end-furniture/. Example located through the Knowledge Hub from Circle Economy: https://circle-lab.com/knowledge-hub

280 Daily Post Vanuatu (2018), Plastic recycling programme grows, available from: https://dailypost.vu/news/plastic-recycling-programmegrows/article_c127d6b5-5594-5f46-b949-d0ca9b33fe54.html

281 Keep Vanuatu Clean, 2019, Detailed Action plan of Priority Activities in 2019 – from the Working Group on the institutional capacity to implement the National Waste Management and pollution Control Strategy, available from: https://environment.gov.vu/index.php/environmental-protection/wastemanagement,page 8.

282 Daily Post Vanuatu (2014), Colourful purses made out of wastes, available from: https://dailypost.vu/news/colorful-purses-made-out-ofwastes/article_e1e7cf51-e32a-5fcc-b6d0-a6071c30f054.html

283 Wageningen University (2020), How does the sea fit into the circular bio-economy?, available from https://weblog.wur.eu/biobased-economy/howdoes-the-sea-fit-into-the-circular-bio-economy/?_ga=2.120822157.487592678.1591858034-90275688.1591858034

284 Wageningen University (2019), Food loss and waste management in the tuna processing industry in Thailand - A case of Sea Value Public Limited Company, available from: https://edepot.wur.nl/495753

285 UNESCAP (2012), Green Economy in a Blue World Pacific Perspectives 2012, available from: https://www.unescap.org/resources/green-economyblue-world-pacific-perspective-2012

286 The Guardian (2015), Entrepreneurs turn billion dollar seafood waste into profitable products - From wallets to antibacterial fabric, innovators are turning once discarded fish waste into money, available from: https://www.theguardian.com/sustainable-business/2015/dec/14/us-fishermen-turn-billiondollar-seafood-waste-into-profitable-products

287 The Guardian (2015), Entrepreneurs turn billion dollar seafood waste into profitable products - From wallets to antibacterial fabric, innovators are turning once discarded fish waste into money, available from: https://www.theguardian.com/sustainable-business/2015/dec/14/us-fishermen-turn-billiondollar-seafood-waste-into-profitable-products

288 Farnet (2019), Circular economy in fisheries and aquaculture areas, available from: https://webgate.ec.europa.eu/fpfis/cms/farnet2/sites/farnet/files/publication/en_farnetguide17.pdf

289 World Bank Group (2020), Sustainable Livestock Guide, available from: https://www.sustainablelivestockguide.org

290 FAO (no date), Mitigation of Greenhouse Gas Emissions in Livestock Production - A review of technical options for non-CO2 emissions, available from: http://www.fao.org/3/i3288e/i3288e.pdf

291 World Bank (2020), Sustainable Management of Natural Resources and Climate Change, available from: https://projects.worldbank.org/en/projectsoperations/project-detail/P124181?lang=en

292 World Bank (2020), Additional Financing to Livestock Competitiveness and Food Safety Project, available from: https://projects.worldbank.org/en/projects-operations/project-detail/P090723?lang=en

293 UN Environment (2020), Business case analysis of low-carbon livestock production in Costa Rica, available from: https://www.unenvironment.org/resources/case-study/business-case-analysis-low-carbon-livestock-production-costa-rica

294 FAO (2019), Five practical actions towards low-carbon livestock, Available from: http://www.fao.org/3/ca7089en/ca7089en.pdf

295 FAO (2009), The State of Food and Agriculture - Livestock, food security and poverty reduction, available from: http://www.fao.org/3/i0680e/i0680e03.pdf

296 FAO (no date), Mitigation of Greenhouse Gas Emissions In Livestock Production - A review of technical options for non-CO2 emissions, available from: http://www.fao.org/3/i3288e/i3288e.pdf

297 World Bank (2019), Moving towards sustainability: The Livestock Sector and the World Bank, available from: https://www.worldbank.org/en/topic/agriculture/brief/moving-towards-sustainability-the-livestock-sector-and-the-world-bank

298 ACIAR (2017), Rebuilding Vanuatu's forestry sector: helping farmers turn trees into money, available from: http://aciarblog.blogspot.com/2017/02/rebuilding-vanuatus-forestry-sector.html

299 Van Zanten, H.E. (2019), The role of farm animals in a circular food system, Global Food Security, Volume 21, June 2019, Pages 18-22, https://doi.org/10.1016/j.gfs.2019.06.003

300 BACI (2020), International Trade Database at the Product-Level - HS6 REV. 1992 (1995 - 2018), available from: http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=37Progressive Farmer (2019), DTN Retail Fertilizer Trends, available from: https://www.dtnpf.com/agriculture/web/ag/news/article/2019/07/24/fertilizer-prices-continue-hold

301 The GEF (2019), DRAFT Mitigation Assessment Report - Vanuatu's Third National Communication (TNC) to the United Nations Framework Convention on Climate Change (UNFCCC).

302 Government of Vanuatu (2019), Sustainable Tourism Policy, available from: https://tourism.gov.vu/policies.php

303 IUCN (2012), Fishing and Tourism in the Vanuatu Economy.

304 Massey University (2013), Sharing the riches of tourism in Vanuatu.

305 World Bank (2013), Tourism in Africa: Tourism for Growth and Improved Livelihoods, available from: http://documents1.worldbank.org/curated/en/723511468102894381/pdf/814680WP-0P13260Box0379837B00PUBLIC0.pdf Next to this, the World Tourism Organisation published a compilation of good practice examples of ecotourism in small and medium-sized enterprises: UN Digital Library (2003), Sustainable development of ecotourism : a compilation of good practices in SMEs, available from: https://digitallibrary.un.org/record/505876, with examples listed at: https://www.unwto.org/international-year-ecotourism-2002

306 UNESCAP (2012), Green Economy in a Blue World Pacific Perspectives 2012, available from: https://www.unescap.org/resources/green-economyblue-world-pacific-perspective-2012

307 University of Queensland (2019), The Vanuatu Beef Industry - Country report for ACIAR Project LS/2018/102, available from: http://www.asia-beefnetwork.com/wp-content/uploads/2019/04/190321-Vanuatu-beef-report.pdf

308 FAO (2013), Climate Change and Agriculture in Vanuatu: A study of crops and farming system, available from: https://www.humanitarianresponse.info/sites/www.humanitarianresponse.info/files/documents/files/CC%20and%20Agriculture%20in%20Vanuatu.pdf

309 Unique Forests and Lands (2017), Reducing Emissions from Deforestation and Forest Degradation (REDD+) in Vanuatu, available from: https://www.unique-landuse.de/images/publications/vereinheitlicht/2017-07-18%20Policy%20brief%20Vanuatu%201.pdf

310 Nakau Programme - Protecting 293 ha of tropical, coastal rainforest on eastern Espiritu Santo, Vanuatu, combined with agroforestry, available from: http://www.nakau.org/loru---vanuatu.htmlPlan Vivo (2020), Loru Forest Project, Vanuatu – The Nakau Programme, available from: https://www.planvivo.org/project-network/loru-forest-project/

311 UNESCAP (2012), Green Economy in a Blue World Pacific Perspectives 2012, available from: https://www.unescap.org/resources/green-economyblue-world-pacific-perspective-2012

312 The Food Forest (2020), The Food Forest is a 15-hectare property in Gawler where over 160 varieties of fruit, nuts, grains, vegetables and timber are grown, available from: https://www.foodforest.com.au/My Smart Garden (2020), Craeting a food forest, available from: https://mysmartgarden.org.au/resources/food/creating-a-food-forest/

313 Daily Post Vanuatu (2020), Demolition of Condominium building soon, available from: https://dailypost.vu/news/demolition-of-condominium-buildingsoon/article_0309bfb9-f066-563a-97da-561b4f9b34ed.html Central Tender Board (2019), Demolition Works of the Old Ex-Prison House Building, Road in Luganville, Santo, SANMA Province, available from: https://ctb.gov.vu/tenders-results/17-demolition-works-of-the-old-ex-prison-house-building-road-inluganville-santo-sanma-province
Daily Post Vanuatu (2016), Vanuatu's Malvatumauri nakamal being demolished, available from: https://www.rnz.co.nz/international/pacificnews/301161/vanuatu%27s-malvatumauri-nakamal-being-demolished

314 Excess Materials Exchange (2020). "Our digital matching platform finds new high-value reuse options for your materials or (waste) products. We give a powerful boost to your circular ambitions. And guarantee you: a smaller ecological footprint and greater financial value can simply go together," available from: https://excessmaterialsexchange.com/

315 New Horizon (2020), "Demolition with a mission," available from: https://newhorizon.nl/

316 Shifting Paradigms (2018), Urban mining of concrete, available from: www.shifting-paradigms.nl/projects/smartcrusher/

317 Australian Circular Economy Hub (2020), available from: https://circulareconomy-hub.org.au/

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