



Towards a circular economy in Thua Thien-Hue province

A metabolic analysis to assess the socio-economic
and environmental impacts

Colophon

Concept development, lead author and analysis

Jelmer Hoogzaad (Shifting Paradigms)

Contributing authors

Cung Trong Cuong, Cao Quoc Hai, Nguyen Thi Hong Hanh, Ho Nguyen Thanh Huy (HueIDS)

Nguyen Hoang Nam (Expert)

Morgane Rivoal, Hoang Thanh Vinh, Nguyen Thi Thu Thuy.

Hoang Thi Dieu Linh (UNDP)

Organisations represented in consultation and strategy meetings

Office of the Provincial People's Committee of Thua Thien-Hue, Department of Natural Resources and Environment of Thua Thien-Hue, Department of Industry and Trade of Thua Thien-Hue, Department of Transport of Thua Thien-Hue, Department of Tourism of Thua Thien-Hue, Department of Agriculture and Rural Development of Thua Thien-Hue, Department of Labour, Invalids and Social Affairs of Thua Thien-Hue, Department of Construction of Thua Thien-Hue, Department of Planning and Investment of Thua Thien-Hue, Thua Thien-Hue Statistical Office, Customs Department of Thua Thien-Hue, Thua Thien-Hue Water Supply Joint Stock Company (HueWACO), Hue Urban Environment and Public Works Joint Stock Company (HEPCO), Management Board of Thua Thien-Hue Economic and Industrial Zones, Hue Innovation Hub

Editor

Merran Eby (UNDP)

Design and layout

Johanna Bayerlein (Heads up Hands on)

Produced by

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Foreword

In the words of H.E. Mr. Pham Minh Chinh, Prime Minister of the Socialist Republic of Viet Nam, **"We need to develop and transition to a green, circular, digital, sharing, smart economy, and promote innovations and start-ups"**. He made the remarks at the 78th Session of the General Assembly of the United Nations in New York in September 2023.

The Government of Viet Nam has set forth a clear path to advance the transition towards a circular economy. The circular economy is featured prominently in the revised Law on Environmental Protection 2020 and in the five-year Socio-Economic Development Plan for 2021-2025. Moreover, the landmark National Action Plan on Circular Economy has established priority sectors and a monitoring and evaluation framework, with clear ministerial responsibilities.

Inspired by this national vision, the Provincial People's Committee of Thua Thien-Hue adopted the Resolution of the 16th Provincial Party Congress which has set the ambitious goal of **"becoming a municipality that preserves and promotes the values of the ancient capital's heritage and Hue's cultural identity, with the characteristics of culture, heritage, ecology, environmentally-friendly, and smart urban landscape."**

In this context, we are honoured to introduce, together with our partners from the Hue Institute of Development Studies, the first metabolic analysis conducted in Viet Nam. This innovative and pioneering report provides a clear pathway for evidence-based policy making. By relying primarily on the dataset provided by the Government, it enables policymakers, development partners and private stakeholders alike to efficiently grasp the economic, social and environmental opportunities availed by the implementation of fourteen priority circular interventions.

In this connection, the research strongly benefited from the invaluable support of, and close cooperation with, the Provincial People's Committee, as well as the departments and district authorities, of Thua Thien-Hue province.

Following a detailed mapping of material flows, two stakeholder consultations and a collection of existing initiatives, fourteen circular economy opportunities were identified. Combined and compared to the business-as-usual scenario, these fourteen interventions have the potential to circumvent 16 percent of greenhouse gas (GHG) emissions, reduce 89 percent of waste, and conserve 14 percent of water, by 2030. The gross regional domestic product could also grow by 4.5 percent on top of existing growth forecasts and increase jobs by an additional 2 percent.

Not only would these interventions lead to the aforementioned development benefits in the province, but they would also complement the commitments of the Government of Viet Nam in the country's revised Nationally Determined Contribution from 2022. The positive results further signal that circular development trajectories will yield GDP growth while generating several co-benefits in terms of reducing GHG emissions, minimising waste, conserving water, and creating jobs.

This report provides concrete and actionable circular interventions for the provincial government of Thua Thien-Hue province. The consultations have also helped to ascertain that the transition towards a circular economy is inclusive and enables the people of the province to reap the benefits. The circular interventions will help to ensure that no one is left behind, resonating with the province's longstanding tradition of **"Solidarity - Democracy – Creativity,"** and placing these values at the core of its development.

We hope this publication will support a long-term strategy towards realising **Thua Thien-Hue's ambition to sustain economic development, preserve and create jobs, achieve carbon neutrality by 2050, and reduce environmental impacts.** With this metabolic research, Thua Thien-Hue demonstrates its leadership and vision in adopting, translating, and implementing national policies on circular economy in the province.

Lastly, we call on all development partners, investors, non-governmental organizations and the private sector at large to pick up some of the identified interventions and join hands with the United Nations Development Programme (UNDP) to continue supporting the transition to a circular economy within Thua Thien-Hue province.



Ramla Khalidi
Resident Representative
of UNDP in Viet Nam

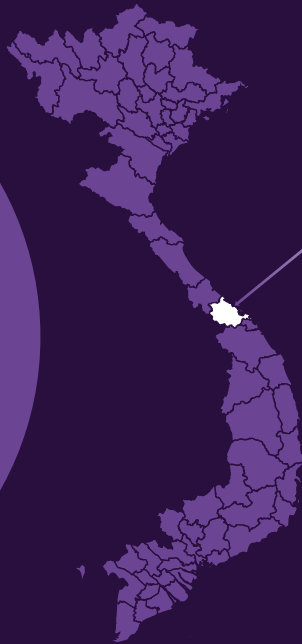


Cung Trong Cuong
Director
of Thua Thien-Hue Institute for Development
Studies

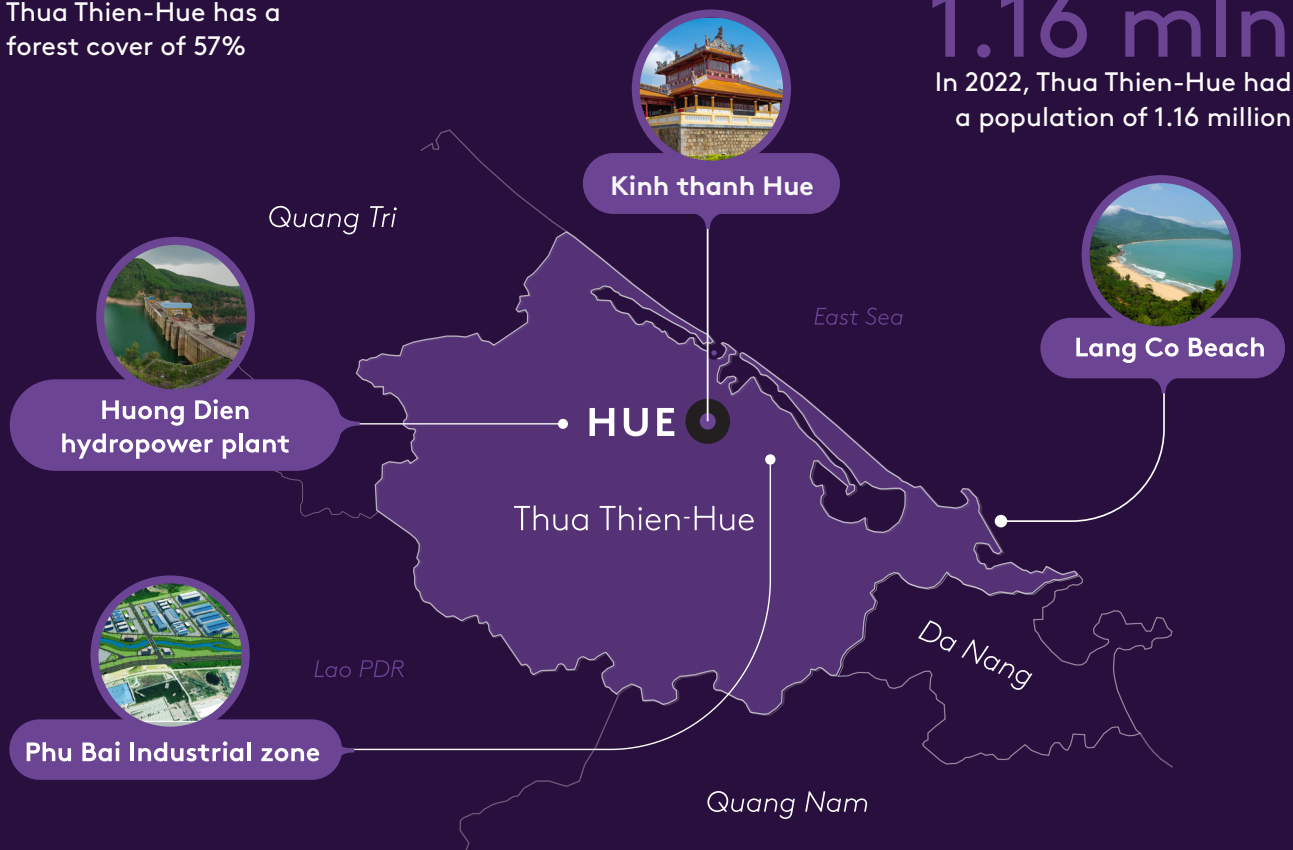
VIET NAM



57%
Thua Thien-Hue has a forest cover of 57%



1.16 mln
In 2022, Thua Thien-Hue had a population of 1.16 million



Thua Thien-Hue is a province in central Viet Nam. It is situated between Lao PDR on the west and the open sea on the east. It connects north and south Viet Nam and borders Quang Tri province to the north and Da Nang and Quang Nam to the south.

Executive summary

This report proposes 14 circular economy interventions for Thua Thien-Hue to improve its resource efficiency, reduce waste and reduce water consumption while maintaining jobs and stimulating economic development. The interventions can accelerate the transition to a circular economy, contribute to provincial development ambitions and address environmental as well as socio-economic challenges. The recommendations are based on an analysis of resource use, the utility rate of assets and waste disposal in the province.

Sustaining economic growth while reducing environmental impacts

The provincial government of Thua Thien-Hue aims to sustain economic growth and jobs while reducing GHG emissions, reducing poverty and increasing forest cover. To reach that ambition, it will have to decouple the material and greenhouse gas (GHG) emissions from economic growth, preferably in a way which also frees up land to expand forest cover.

To realise that ambition, the focus should be on six sectors, each for a different reason. The first three are 1) agriculture, forestry and fishing, 2) construction, and 3) industry and manufacturing. These have been selected because of their resource use and GHG footprint. Because of their socio-economic relevance, 4) garments and 5) tourism have been selected as well. Finally, 6) transport is important because of its GHG emissions and the magnitude of planned investments in infrastructure.

The most substantial material flows are construction materials and food

A few material flows in Thua Thien-Hue stand out because of their size in tonnes, GHG footprint, water footprint and monetary value. Figure 1 (page 6) gives an overview based on categorising 174

material flows into eleven categories.

It shows that construction materials make up 77% of all material flows when expressed in tonnes. Most of these materials are being used to develop new infrastructure. Other large flows are animal products and associated flows like manure and emissions from livestock, vegetable products, fossil fuels, chemicals, textiles, wood products and vehicles. These seven product categories together make up more than 97% of the total mass, embodied carbon, water footprint and value in provincial materials flows.

14 circular economy opportunities have been identified based on a detailed metabolic analysis, two stakeholder consultations, existing initiatives within Thua Thien-Hue and best practices from other regions. Table 1 shows how these interventions support the development ambitions of the province. These impacts would both support and complement the commitments of the Government of Viet Nam as formulated in its NDC from 2022.¹

The list of circular economy interventions distinguishes between interventions in

**Viet Nam wants
to decouple
development
from a decrease
in the quality of
ecosystems and
the deterioration of
natural resources**

construction, food and agriculture, transport, waste management, garments and tourism. The last four interventions are enablers, i.e., their impact overlaps with the impacts estimated for the other interventions.

Compared to the business-as-usual scenario, by 2030, the interventions have the potential to avoid 16% of GHG emissions and 89% of waste and save 14% of water. The gross regional domestic product could grow by an additional 4.5% on top of existing growth forecasts and increase jobs by an additional 2%. By 2050 the GHG sequestration potential will increase to 41%, mainly due to the increased potential of interventions in the long term.

A metabolic analysis to quantify the impact of changing material flows

Viet Nam wants to decouple development from a decrease in the quality of ecosystems and the deterioration of natural resources such as soils, marine environments, fish stocks and forest standing stocks. The identification of circular economy opportunities for Thua Thien-Hue Province combines an analysis of material use and flows with an analysis of trends in natural assets and produced stock or manufactured capital.

The analysis of stocks sheds light on whether the extraction and disposal of materials have a positive or negative effect on the ability of the country's natural assets to regenerate and serve future generations. This report refers to that combined review of both flows and stocks as a metabolic analysis. In this report, such an analysis has been completed for 2021, distinguishing 174 flows.

The material flows have been analysed both in material tonnes and in their embodied GHG footprint, water footprint and monetary value, as depicted in Table 1. The circular economy interventions proposed will alter materials flows in Thua Thien-Hue in the future, which will also change the material, water and GHG footprint of the province. Since the material flows include imports and exports, the impact of the interventions on cross-border flows and upstream or downstream impacts could also be estimated. Changes in the value of the flows were used to estimate the impact on the gross regional product (GRP) and the number of jobs which the provincial economy can support. Qualitative impacts have been defined along the 169 targets under the Sustainable Development Goals.

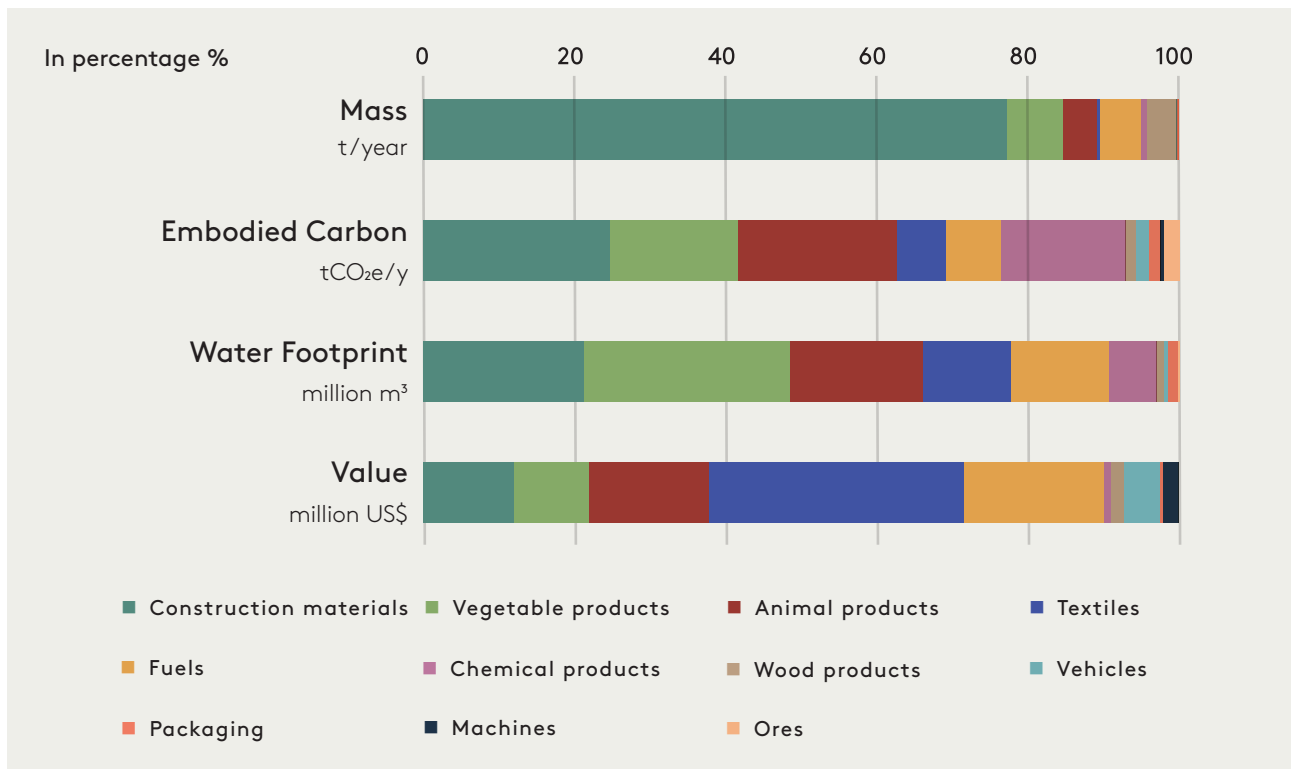


Figure 1: Material flows in Thua Thien-Hue and their environmental and economic impacts

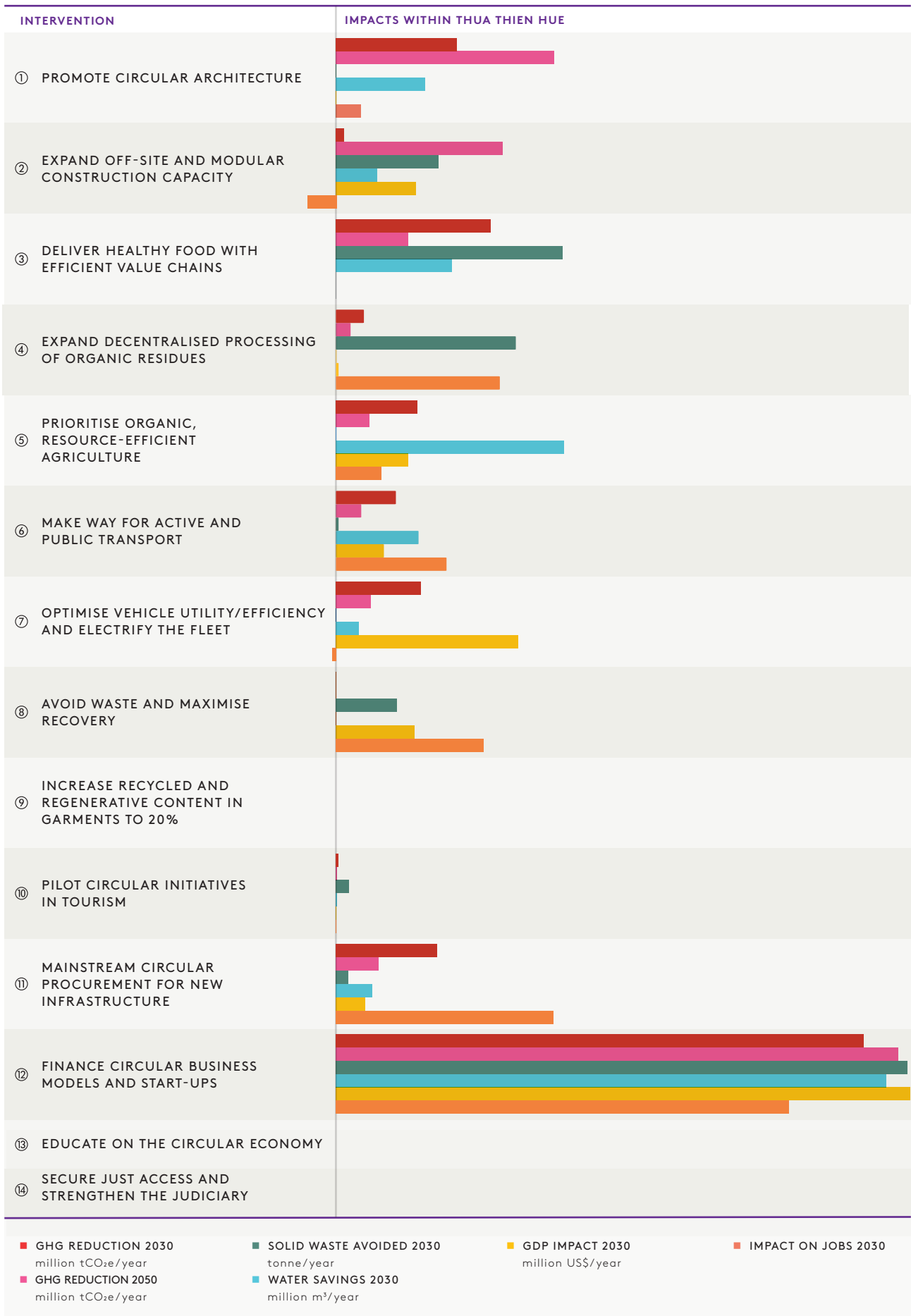



Table 1: 14 circular economy opportunities and their environmental and socio-economic impacts within Thua Thien-Hue



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Viet Nam's successful
export-led development
model was built
chiefly on the low value
added manufacturing sector

—

1 Current situation, trends and aspirations

This part describes the current situation in Thua Thien-Hue, its development ambitions and important trends into the future. It provides an overview of planned investments in infrastructure, import and export, demographics and land use in Thua Thien-Hue and describes where its policies and development ambitions align well with a transition to a more circular and low-carbon future.

The socio-economic situation describes which sectors or economic activities are most important to Thua Thien-Hue Province in terms

of added value and jobs. The description of the environmental situation points out where material value is lost in the form of emissions and pollution into the air, water and soil.

1.1 Sectors and their impacts

Figure 2 shows that industry and manufacturing; agriculture, forestry and fishing; and retail, wholesale and motor vehicle repair services² contribute most to Thua Thien-Hue's gross regional product and provide the most employment. The sectors of industry and

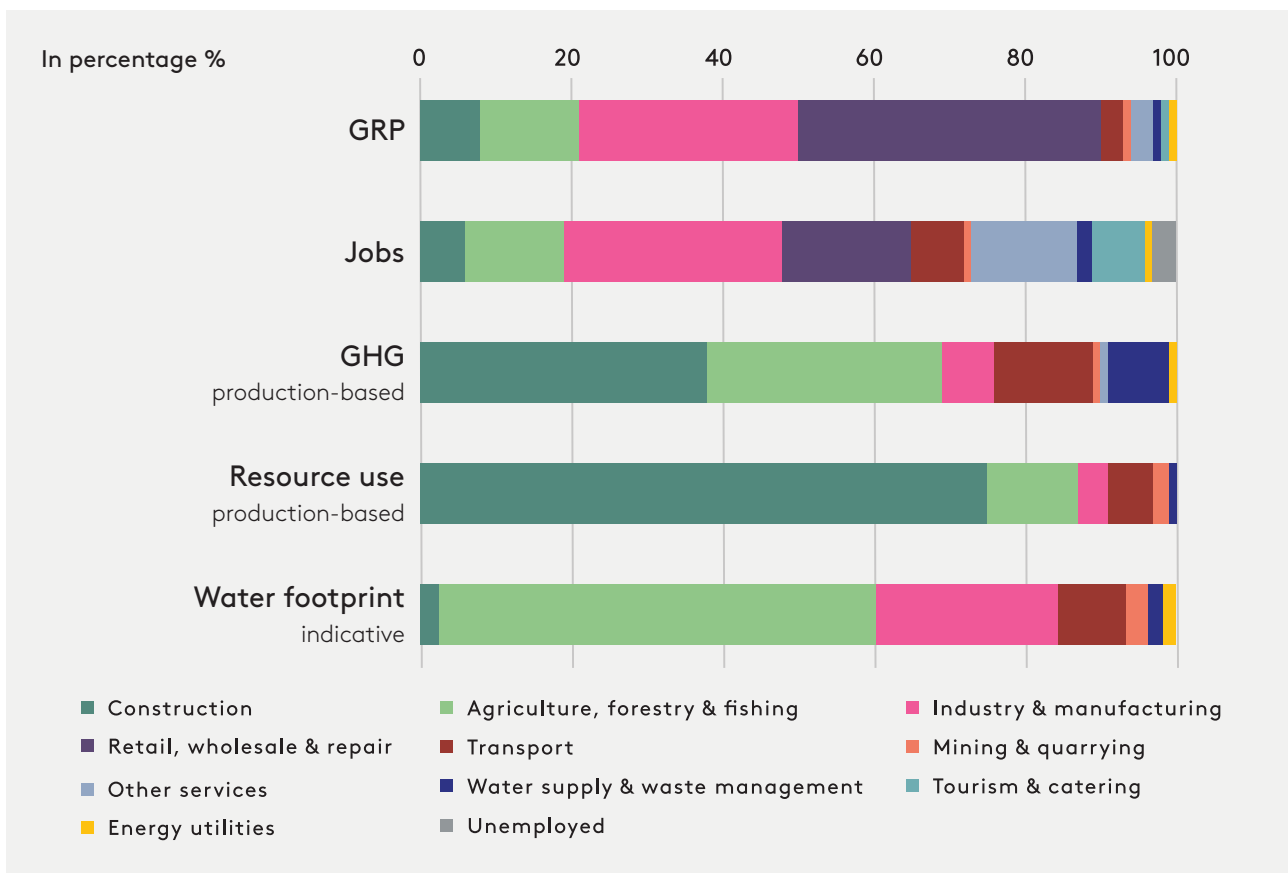


Figure 2: Breakdown of gross regional product, employment, production-based GHG emissions, resource use and water footprint by sector.⁴

manufacturing and retail, wholesale and motor vehicle repair services both have a high throughput of materials and add value, but make only a modest contribution to a product's material and carbon footprint.

Most production-based GHG emissions and resource use are in construction, followed by agriculture, forestry and fishing. The construction sector has a major material footprint, adsorbing a substantial tonnage of materials from mining and quarrying. Agriculture, forestry and fishing have the largest GHG footprint, followed by transport, water supply and waste management. The largest water footprint is also in agriculture, forestry and fishing, with industry and manufacturing ranking second. The water footprints are indicative only, due to challenges in translating water footprints per product to water footprints per sector.³

1.2 New infrastructure development and buildings

The government of Thua Thien-Hue province considers infrastructure development an

important condition to attract investors.

Investments in infrastructure have a large impact on material use. It is about channelling large volumes of construction materials into the built environment and storing them there for decades and centuries.⁵

In 2021, a number of large projects entered into operation, including the Song Bo and Thuong Nhat hydropower projects, the Phong Dien II solar power project, the second phase of the Billion Max Viet Nam manufacturing plant and the Lux Quartz artificial quartz slab plant.⁶

For the period of 2022 to 2025, Thua Thien-Hue is expecting 25,000 billion VND or an estimated annual US\$334 million in private and public sector investments in transport and water purification infrastructure, residential buildings, resorts, shopping centres, industrial parks and Forest Stewardship Council (FSC)-certified forestry plantations.⁷ These investments require materials. Combined, they are expected to have a GHG footprint of 275,000 tCO_{2e} during

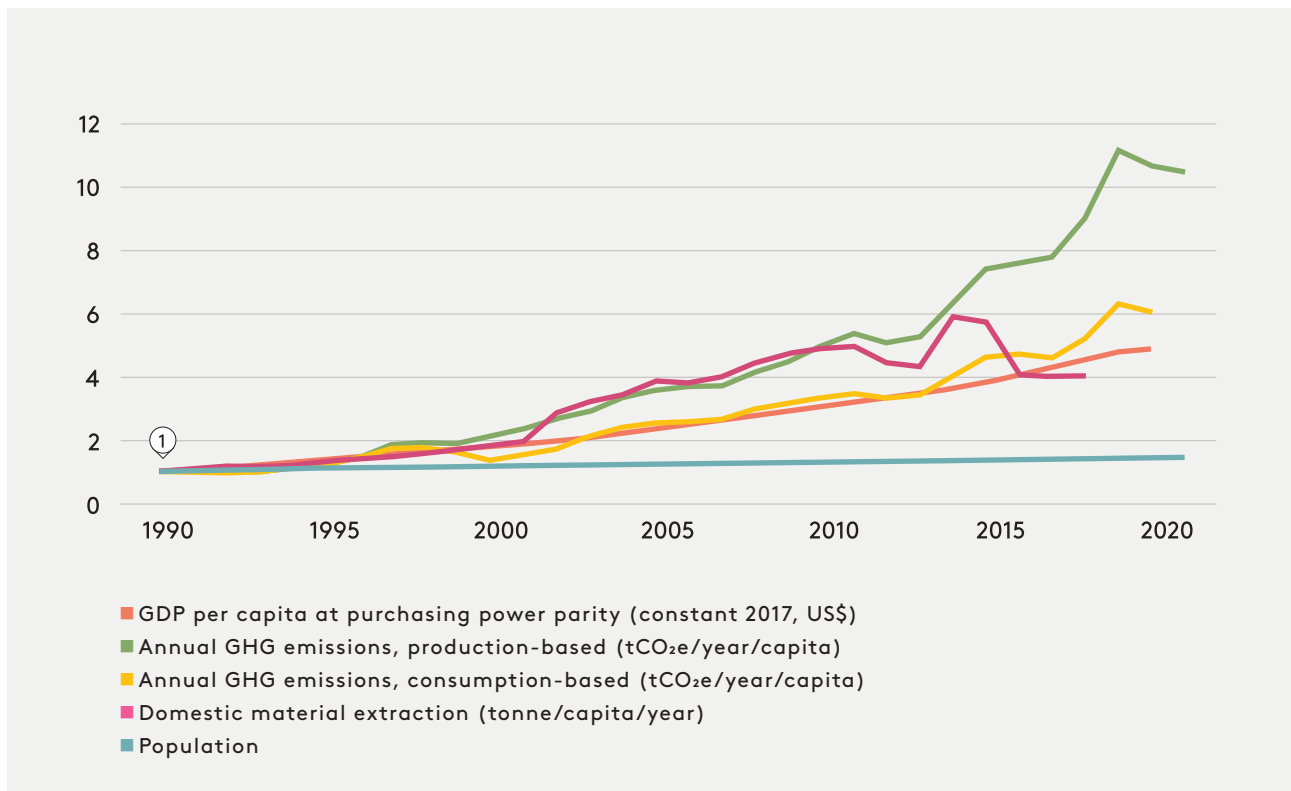


Figure 3: Trends in per-capita domestic material extraction, consumption and production-based GHG emissions in Viet Nam compared to trends in GDP and population with 1990 as base year (index=1).⁹

the construction phase.

1.3 Trends in resource use and greenhouse gas emissions

When envisioning a long-term development perspective for Thua Thien-Hue, resource efficiency, waste avoidance and GHG mitigation should be addressed together.⁸ In Thua Thien-Hue, fossil fuels make up less than 2% of the resources used, but are responsible for 28% of GHG emissions. In the province, an estimated 87% of these fossil fuels are used to extract, transport and process materials and products. The remainder is used for personal thermal comfort and passenger transport.

Only a few countries have managed to decouple their economies from production and consumption-based GHG emissions,¹⁰ although other sources argue that decoupling is more widespread.¹¹ The production- and consumption-based carbon footprint of Viet Nam has increased more than its GDP (Figure 3), indicating that the country saw GHG emissions increase per unit of GDP which its economy produced, both in terms of GHG emissions related to domestic production and exports and domestic consumption and imports. Under the new strategy for 2021 to 2030, this will have to change. Since production-based GHG emissions have increased more than consumption-based emissions, this should include reducing the GHG intensity of production.

Until recently, the growth in domestic extraction of materials has outpaced economic growth. Although this data is only available up to 2018, the latest trend seems to indicate that the material footprint of the economy on a per-capita basis is decreasing or stabilising.

1.4 Socio-economic development priorities

The selection of circular economy opportunities for Thua Thien-Hue should be aligned with provincial and national environmental and socio-economic development priorities. This includes the ambition to reduce GHG emissions and enhance sinks to reach net zero emissions by 2050. In its updated NDC from November 2022, Viet Nam aims to reduce GHG emissions to 16% below 2014 levels by 2030. With international support, that figure could reach 44%.¹²

For the period of 2022 to 2025, Thua Thien-Hue is expecting 25,000 billion VND or an estimated annual US\$334 million in private and public sector investments

Next to supporting national ambitions, Thua Thien-Hue aims to improve economic integration with nearby regions such as Da Nang and Quang Tri, increase forest cover, reduce poverty,¹³ keep the unemployment rate low and avoid the outflow of talent.¹⁴

Sustaining high levels of economic growth and attracting industries is another important ambition for Thua Thien-Hue. To drive economic growth, it is attracting investors with special economic zones and tax incentives.¹⁵ Between 2010 and 2020, the province saw the share of industry and construction in its gross regional product increase from 42% to 47%.¹⁶

In 2021, Thua Thien-Hue saw its economy recover from the COVID pandemic. In that year, beer production increased by 6.5%, yarns by 14.6%, underwear by 24.2% and cement by 2.8% compared to their 2020 levels. The larger industries in Thua Thien-Hue are food, beverages, construction materials, seafood processing and garments. Thua Thien-Hue is positioned on several transport arteries, connecting Myanmar, Thailand, and Laos with the East Sea through the Chan May deep seaport and connecting the northern and southern parts of Viet Nam.

Next to industry, mining and services are important. Thua Thien Thua contains around 120 mines and quarries, most of which supply construction materials to the provincial market.¹⁷ Peat from peat mines located in Phong Dien district¹⁸ is mainly exported as fertiliser. Finally, services are an important economic pillar for Thua Thien-Hue, and the province marked tourism as a spearhead economic sector.¹⁹

At the national level, the World Bank has observed that “Viet Nam’s successful export-led development model was built chiefly on the low-value-added manufacturing sector.” The growth of the manufacturing industries was fuelled by a population dividend and Viet Nam’s integration into the global economy, but that growth model is losing momentum. For 2021-2030, the national government plans to drive continued growth with productivity gains, digitisation, more efficient and greener technology, and investing in human resources.²⁰ With its educational institutes, Thua Thien-Hue can play an important role in that ambition, while circular economy principles can guide the transition from low value-added manufacturing to increased resource efficiency and the application of green technologies.

1.5 Conclusions – Part 1

The development priorities of Thua Thien-Hue are to sustain economic growth and jobs while reducing GHG emissions, reducing poverty and increasing forest cover. These provincial ambitions have been formulated in a national context where the growth in domestic extraction of materials from Viet Nam has outpaced its economic growth. The transition to a circular economy in Thua Thien-Hue should support a national decoupling of both material footprints and resource use from economic growth in a way which also frees up land to expand forest cover.

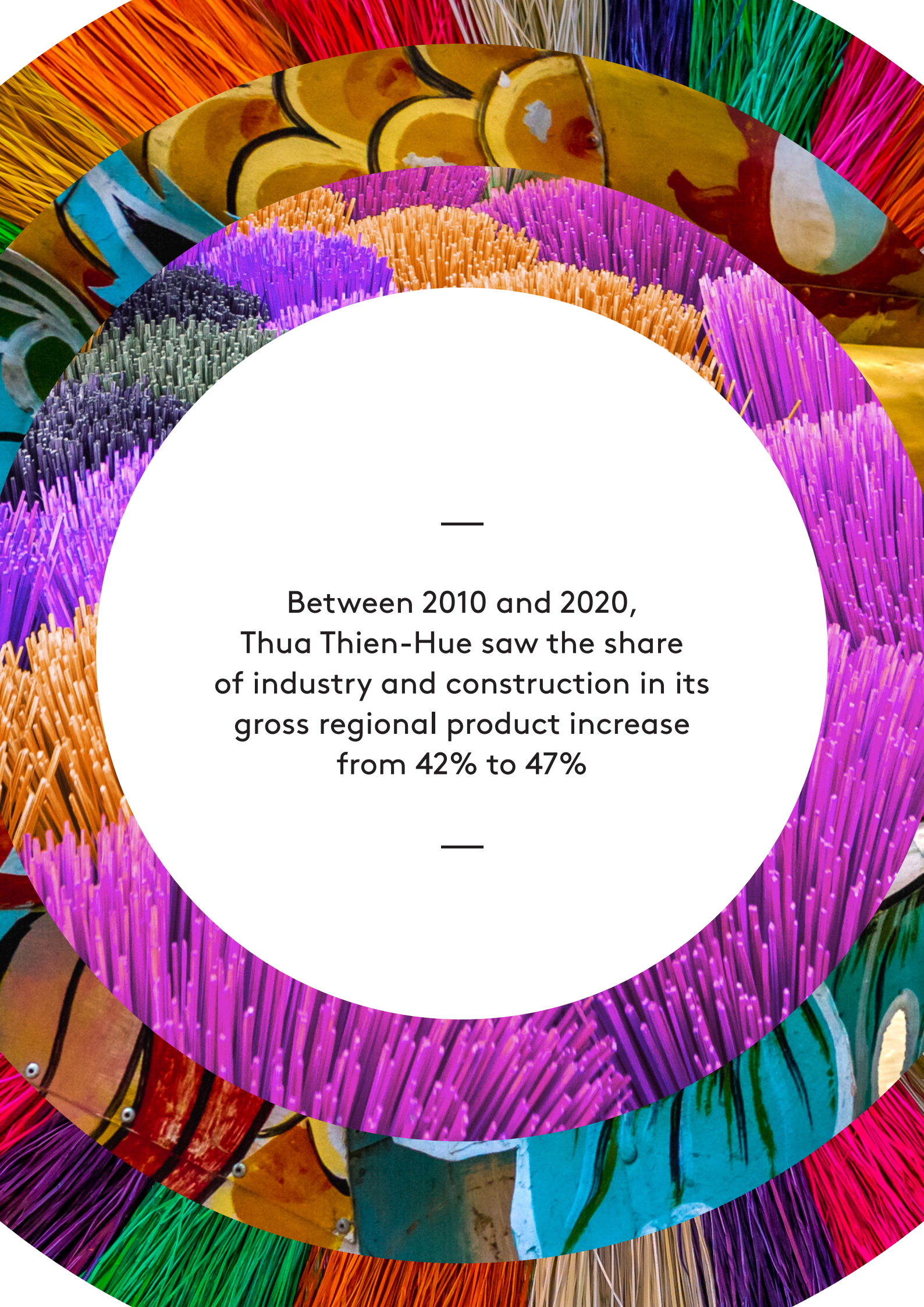
Considering the development ambitions, sectoral resources, GHG emissions and water footprints, circular economy interventions should focus on six sectors. These are 1) food value chains together with forestry, 2) the construction sector and 3) industry and manufacturing (with a focus on garments), 4) retail, wholesale and vehicle repair services, 5) transport and 6) tourism.

The sectors of industry and manufacturing and retail, wholesale and motor vehicle repair services account for the lion’s share of the gross regional product and employment in Thua Thien-Hue province. However, these are not the sectors with the largest environmental impact. The construction sector has by far the largest material footprint, absorbing a substantial tonnage of materials extracted from mines and quarries. Construction and agriculture, forestry and fishing have the largest GHG footprint, while the latter also dominates the water footprint.

Stakeholder consultations pointed at a preference to focus on the garments industry as a subsection of industry and manufacturing. Next to this, 78% of construction materials go into the development of new infrastructure, mostly serving the ambitions of Thua Thien-Hue to improve its economic integration with nearby regions such as neighbouring. That makes also transport an important sector to consider.

Retail, wholesale and vehicle repair services are an important part of the economy, but have a small environmental footprint. Still, they have been included among the interventions as part of an effort to reduce packaging waste, which stakeholders also pointed out as being a concern.

Finally, the tourism sector is important. It makes up a small part of the economy and has a modest environmental impact, but it is a political priority for the province²¹ and therefore deserves attention in the transition to a circular economy.



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Between 2010 and 2020,
Thua Thien-Hue saw the share
of industry and construction in its
gross regional product increase
from 42% to 47%

—

2 Material flows and their impacts

Part 2 depicts the material resources used in Thua Thien-Hue. It distinguishes provincial products from imported products and provincial consumption from exported products. Data visualizations help to explain how the use of products, materials and semi-fabricated products relates to resource use, GHG emissions, value creation and water use in Thua Thien-Hue and the value chains of imported goods.

2.1 Material flows

Material flows distinguish between biomass, minerals, metals and fossil fuels. They flow from the start on the left, with finite extraction, secondary sources, certified sources, production of biomass and import, to various end-of-life stages on the right. The product types include food products which provide nutrition, short-lived consumables like packaging, fuels and textiles, and long-lived products that contribute to stocks, such as expanding and maintaining the building stock and adding to the provincial vehicle fleet.

On the left of Figure 4, five origins are presented. In addition to imported materials: finite extraction refers to materials extracted from mines, wells, quarries, forests, agriculture and fishing in a way which depletes natural assets. Secondary sourcing refers to those value chains where resources are recovered and re-used, often through recycling or land-application of organic residues. Production of biomass refers to forestry, agriculture and fishing operations. It is unclear whether these

are regenerative or sustainable in the sense that they do not deplete forest stock, fish stock or soils. Certified sources are certified by a verification body which verifies whether natural assets like forest stock, fish stock or soils are preserved or even regenerated. In Thua Thien-Hue, around 1,000 hectares of agricultural land are certified as Vietnamese Good Agricultural Practices (VietGAP), 15,000 hectares of timber plantations are certified by the Forest Stewardship Council (FSC) and around 10% of livestock farms are organic. These value chains are labelled regenerative, but this approach likely underestimates the size of regenerative value chains. For example, smallholders may use regenerative practices, but data is lacking to verify this assumption and quantify the contribution of these smallholders.

2.2 The dominance of construction materials

Material flows in Thua Thien-Hue are dominated by construction materials, which make up 77% of all materials used. In the second column of Figure 4, the construction materials are 'half-fabricates' like clay, gravel, sand, limestone and some of the metals.

78% of construction materials go into new infrastructure, such as roads and hydropower stations. A further estimated 14% goes into new buildings. The rest goes to maintenance of both infrastructure and buildings. At 98%, most construction materials are minerals like gravel,

sand and limestone. These are largely sourced within the province itself and applied in Thua Thien-Hue's construction sector. The metals used in construction are imported.

The long-term stock also includes materials used to expand and maintain the vehicle fleet and install capital equipment like trucks, machines in factories, turbines in hydropower stations and power distribution cables. Vehicles and technical means of production tend to last more than a year. As such, they can be counted towards Thua Thien-Hue's long-term produced stock, serving current and future generations alike.

The Government of Thua Thien-Hue is investing, or attracting investments, in rails, roads, hydropower generation and transmission infrastructure, housing, shopping centres, resorts and industrial estates. This is part of an effort to expand transport infrastructure and hydropower, industrial and retail capacity. These investments will continue to demand large volumes of construction materials in the years to come.

These materials are not lost, but remain stored for decades in buildings and infrastructure. The absolute carbon footprint of these materials is significant due to their large volume, but on a per-tonne basis it is relatively low. While construction materials represent 72% of the materials used in Thua Thien-Hue in tonnes, they have a GHG footprint of 25% (Figure 5). The GHG emissions mainly stem from the cement and steel used in construction, or rather the blast furnaces and cement kilns where these materials are produced.

Globally, about half of the materials extracted are used to build up or maintain stocks.²⁴ For Thua Thien-Hue, this value is also around 50%. Due to the materials and carbon intensity of stock build-up, regulating ongoing stock expansion is an important lever for sustainable resource use.²⁵ In studies of the metabolism of nations, the monetary productivity of stocks was relatively stable between 1990 and 2010. The growth of stock levels may slow down as GDP growth rates decline.²⁶ When that will happen also depends on the policy context. ASEAN strategies like 'getting more out of existing assets' including demand management and 'strategies... to better utilise infrastructure without the burden on excessively huge capital spend' can play an important role,²⁷ with the circular economy as a guiding principle.

In Thua Thien-Hue, fossil fuels make up less than 2% of the resources used, but they are responsible for 28% of GHG emissions. In the province, an estimated 87% of these fossil fuels are used to extract, transport and process materials and products

Other sizeable material flows are related to food production and consumption. Thua Thien-Hue produces around 580,000 tonnes of agricultural commodities per year. The main product is rice, at 340,000 tonnes per year, followed by cassava (100,000) and maize (58,000).

When ranking material flows expressed in tonnes, the construction materials are the largest, followed by vegetable products, fossil fuels, animal products and wood products. In Figure 4, the larger food products in the column with 'half-fabricates' are rice, grazed biomass and fodder crops, vegetables, animal feed and cassava. Other flows are related to food production, such as manure, emissions from livestock, synthetic fertilisers and pesticides. Food value chains in Thua Thien-Hue use 14% of material mass.²² Fossil fuels are mostly used in transport and the cement industry.

The residual categories are fossil fuels and consumables. In the second column from the left in Figure 4, these are the fossil fuels used by households, services, transport, packaging, garments, imported consumer goods and wood products used for consumer goods like furniture.

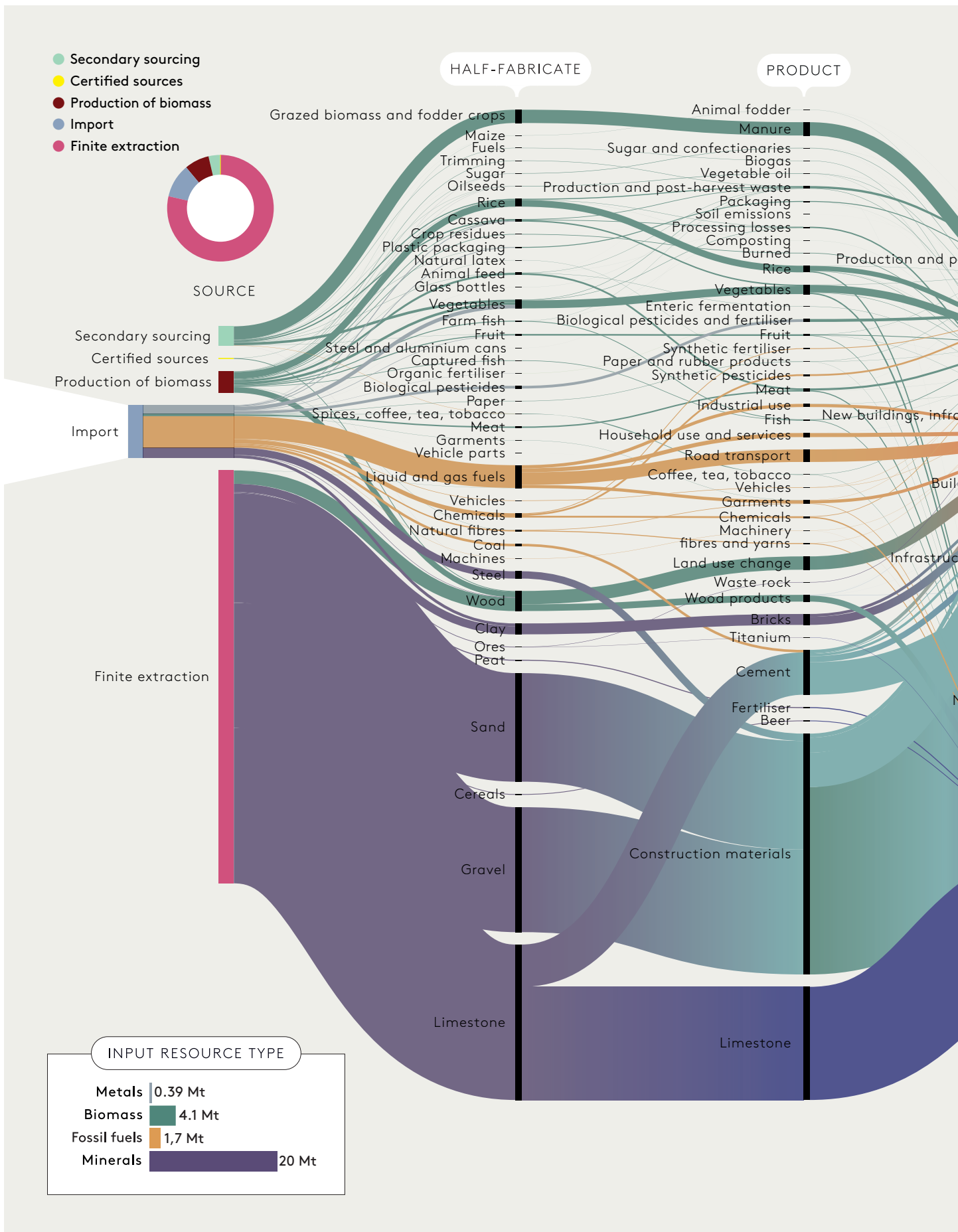
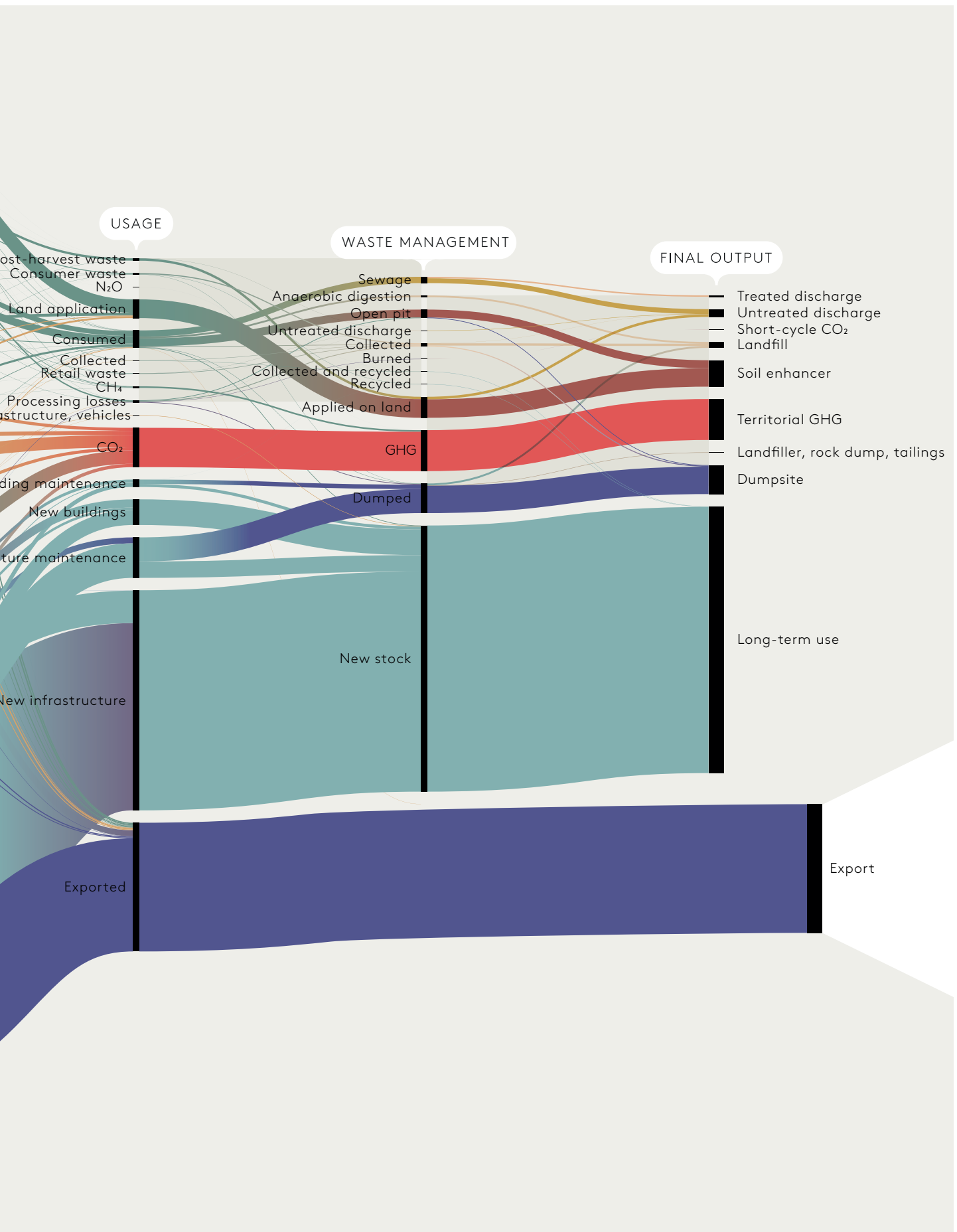


Figure 4: Material flows in Thua Thien-Hue²²



2.3 The embodied carbon in imports is larger than in exports

The GHG footprint of imported products is larger than the footprint of all exported products (Figure 5). Much of the added embodied carbon in Thua Thien-Hue relates to the production and processing of materials originating in the province. The added embodied carbon from the processing of imported materials is relatively small, since most imported products are final products. Many imports are final products. One clear exception is textiles, where yarns and fibres are imported and consequently exported as garments. However, the added embodied carbon in that process is modest.

The larger GHG footprints are from construction materials, animal products, vegetable products, chemicals (mainly fertilisers and pesticides), fuels and textiles. Since a fair share of the GHG footprint of these products also occurs upstream in imported products, interventions in Thua Thien-Hue will likely also affect GHG emissions outside of the province.

Meat accounts for 31,000 tonnes of agricultural production. Meat production comes from 14,000 buffaloes, 28,000 cattle, 104,000 pigs and over 4 million heads of poultry. Manure production is estimated at 640,000 tonnes per year. Next to this, Thua Thien-Hue produces 68,000 tonnes of fish per year, of which about two thirds come from capture fishing and the remainder from aquaculture.

Thua Thien-Hue reported that the agricultural sector emitted around 800,000 tCO₂e in 2021, of which 270,000 tCO₂e came from livestock. The metabolic analysis shows that meat is produced with a GHG footprint between 9-18 tCO₂e/tonne, compared to vegetables at 0.5-1.0 tCO₂e/tonne.

Some material flows rely largely on imported products, such as fossil fuels, or on imported half-fabricates like fibres and yarns, chemicals and packaging products. Substituting these materials with secondary or regenerative materials sourced in Thua Thien-Hue can help reduce upstream environmental impacts.

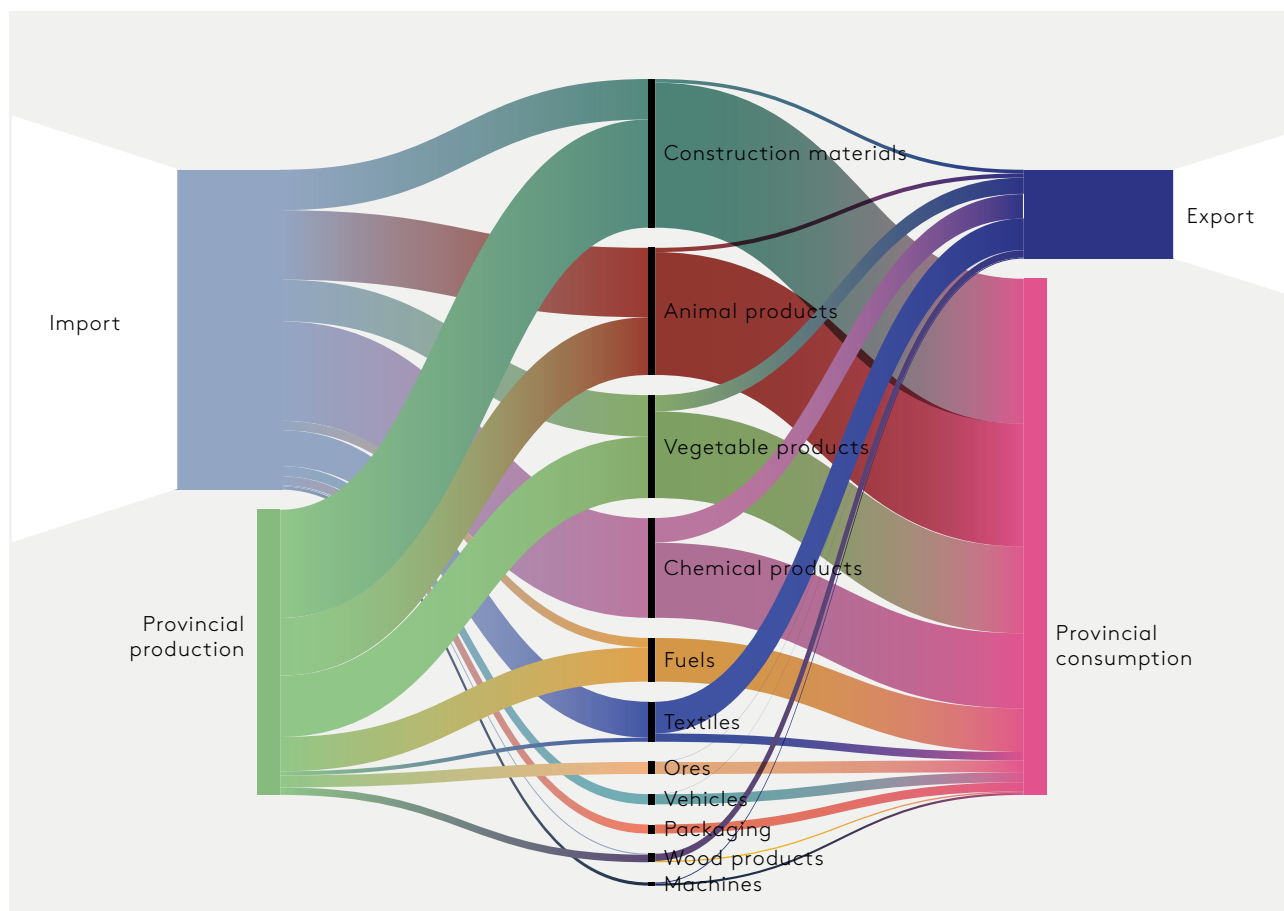


Figure 5: GHG emissions embodied in products and materials from Thua Thien-Hue and in its imports and exports ^{22, 28}

2.4 The larger water footprints are with food and construction materials

Policymakers in Thua Thien-Hue wanted to see the impact of interventions on water footprints reflected in the metabolic analysis. The availability of clean water is a concern, and draughts have recently affected agricultural production in the province.²⁹ Projected temperature increases in Viet Nam are between 1.0°C and 3.4°C by 2080–2099.³⁰ Risks to agricultural yields could be three times higher at 3°C compared to 2°C, due to the combined effects of water and temperature changes.³¹ The majority of Viet Nam's water reserves are polluted to levels that cannot even be used for industrial production. Water pollution from the violation of environmental laws by industries, poor sanitation and waste management has been identified as a major cause of illnesses.³² Mr. Vo Tuan Nhan, Deputy Minister of Natural Resources and Environment of Viet Nam, stated that 'Ensuring water security in the context of climate change, population growth, urbanisation and industrialisation is challenging'.³³

The water footprint is relatively equally divided over the different product categories (Figure 6), but the focus is on vegetable products, construction materials, animal products, fuels, textiles and chemical products. The water footprint of the province's imports is larger than its exports.

2.5 Most value added is from garments, food and construction products

The visual for the value of imported, produced, consumed and exported products is indicative (Figure 7). The value of an imported half-fabricate changes when it leaves the province or is consumed as a final product. That increase has been estimated and added to the visual as 'provincial production', but the accuracy of such estimates is limited. In an assembly process, or labour-intensive processes like the production of garments from imported fibres and yarns, very little material mass is added to the product. As a result, this visual depicts flows which do not

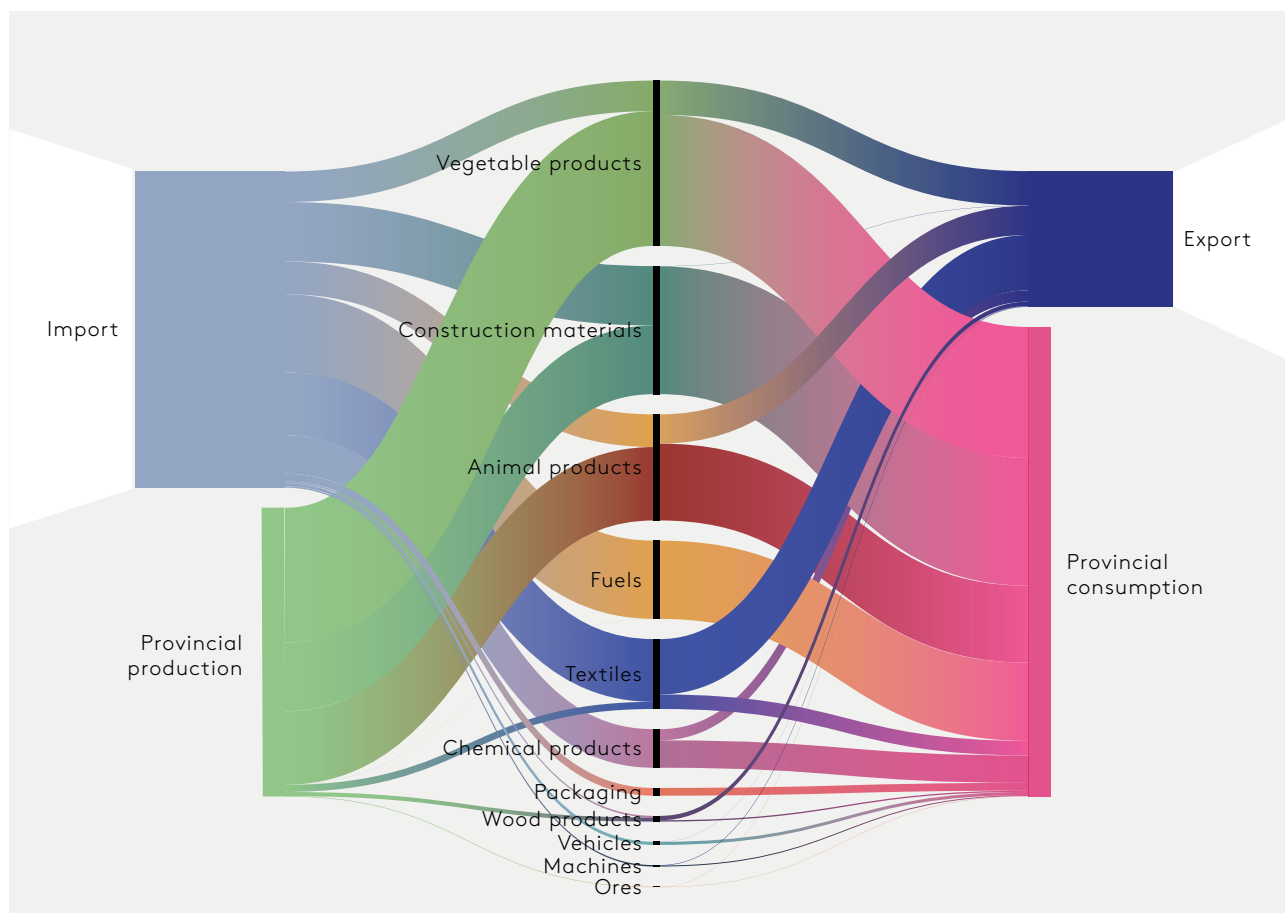


Figure 6: Water footprints of production and consumption in Thua Thien-Hue and those of imported and exported goods and materials^{22,34}

appear in the charts on mass.

Significant value is represented in products which are imported and exported with little or no change in their mass or value, as with fuels and vehicles. Textiles is a sector with a high added value. Value is also created with the production of food products, construction materials, and wood products. This overlaps with the focus product types from the previous graphs on water, embodied carbon and mass.

2.6 Conclusions – Part 2

When looking at the mass, GHG, water and value footprints of material flows in Thua Thien-Hue, a few flows stand out. The larger flows by mass are the construction materials, and most of them are applied in the development of new infrastructure. Other large flows are fossil fuels and food-related flows such as vegetables, meat, manure and emissions from livestock. When looking at the

GHG footprint of material flows in Thua Thien-Hue, the same flows stand out (construction materials, animal products and vegetable products), but chemicals (including fertilisers and pesticides) and textiles also appear. In the water footprints, the same categories dominate, but in value, textiles and vehicles appear as a new flow of interest.

To conclude, the material flows and products which should be targeted with circular economy interventions in Part 3 are:

1. Construction materials
2. Animal products
3. Vegetables
4. Fossil fuels
5. Chemicals (notably pesticides and fertilisers)
6. Textiles
7. Vehicles

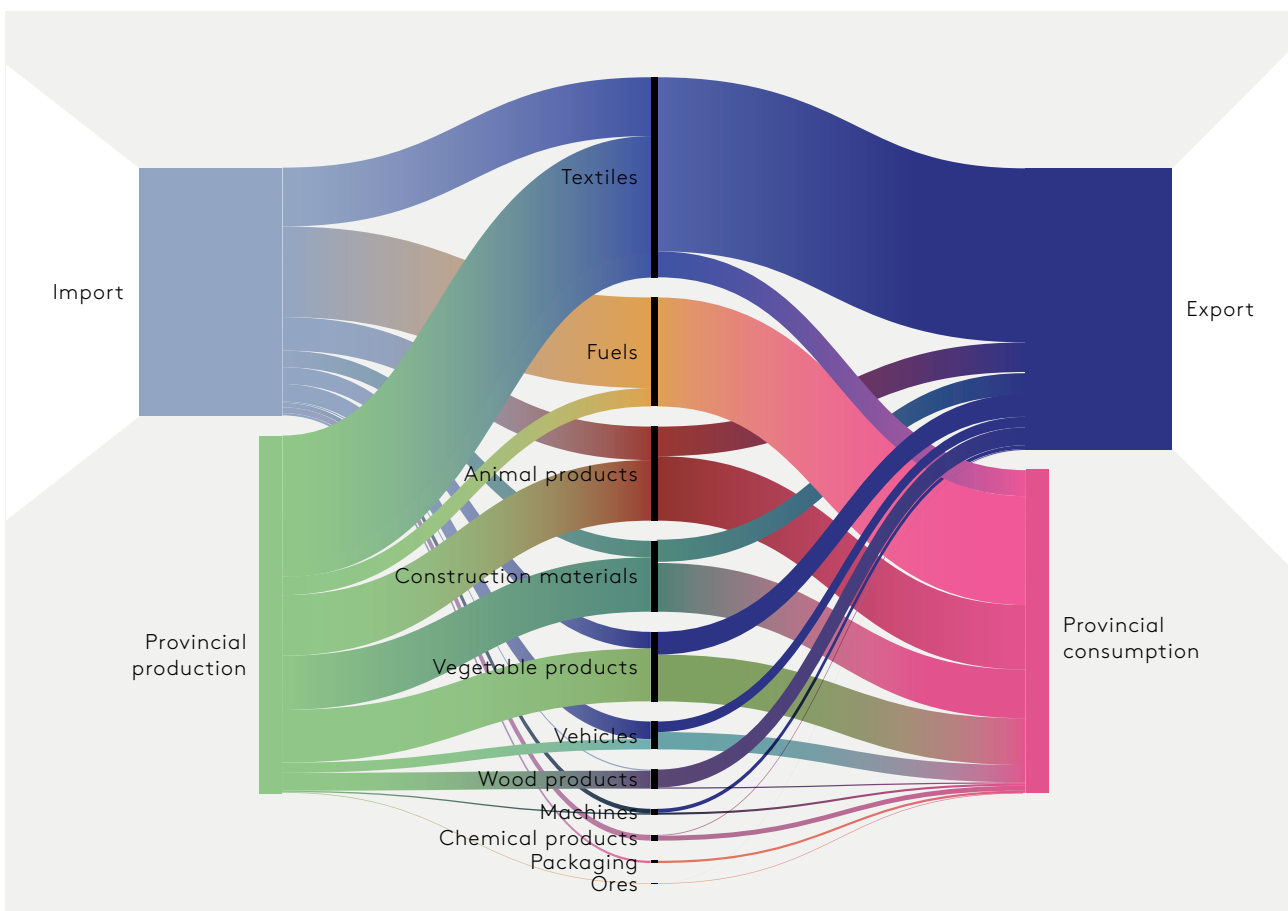
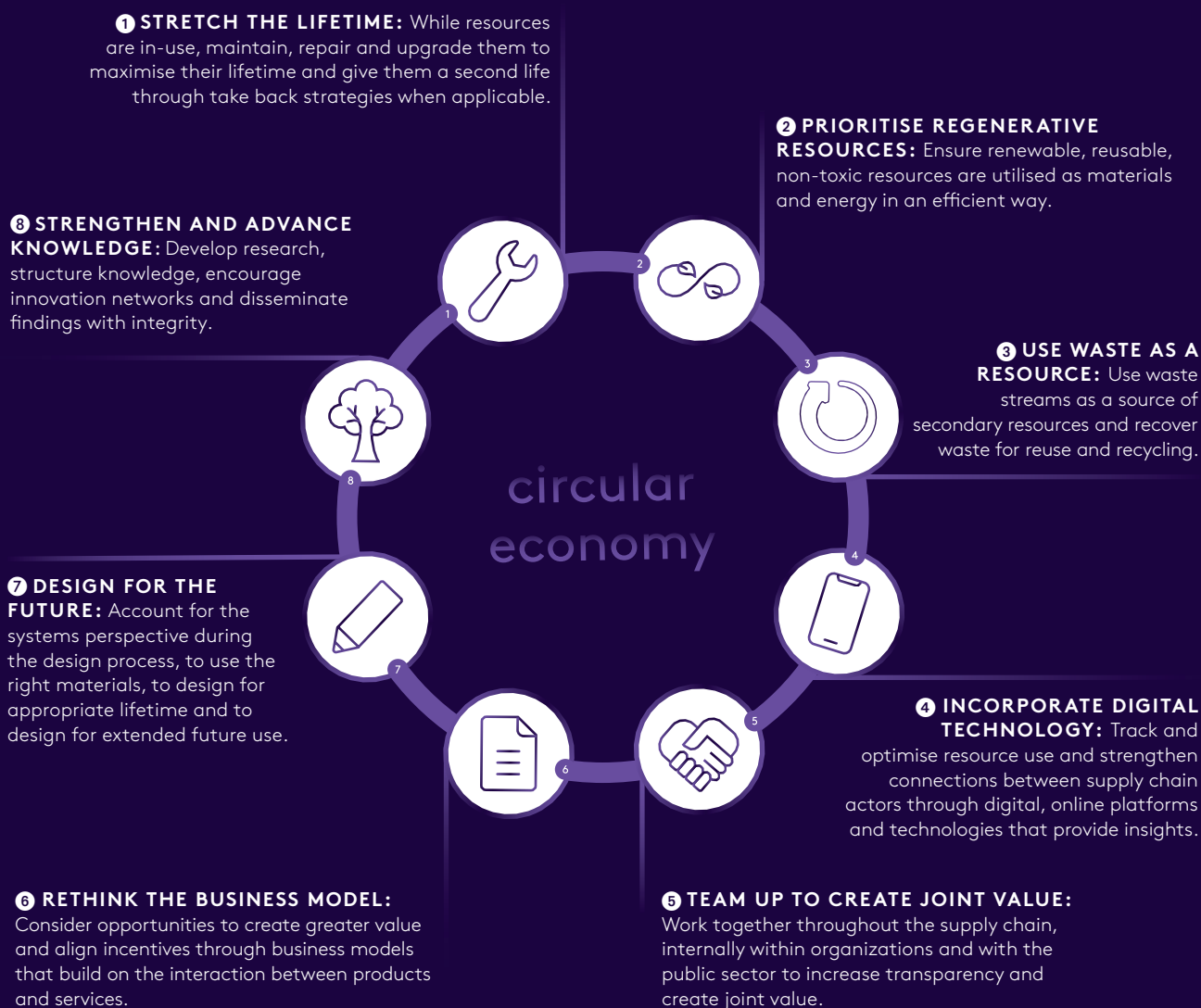


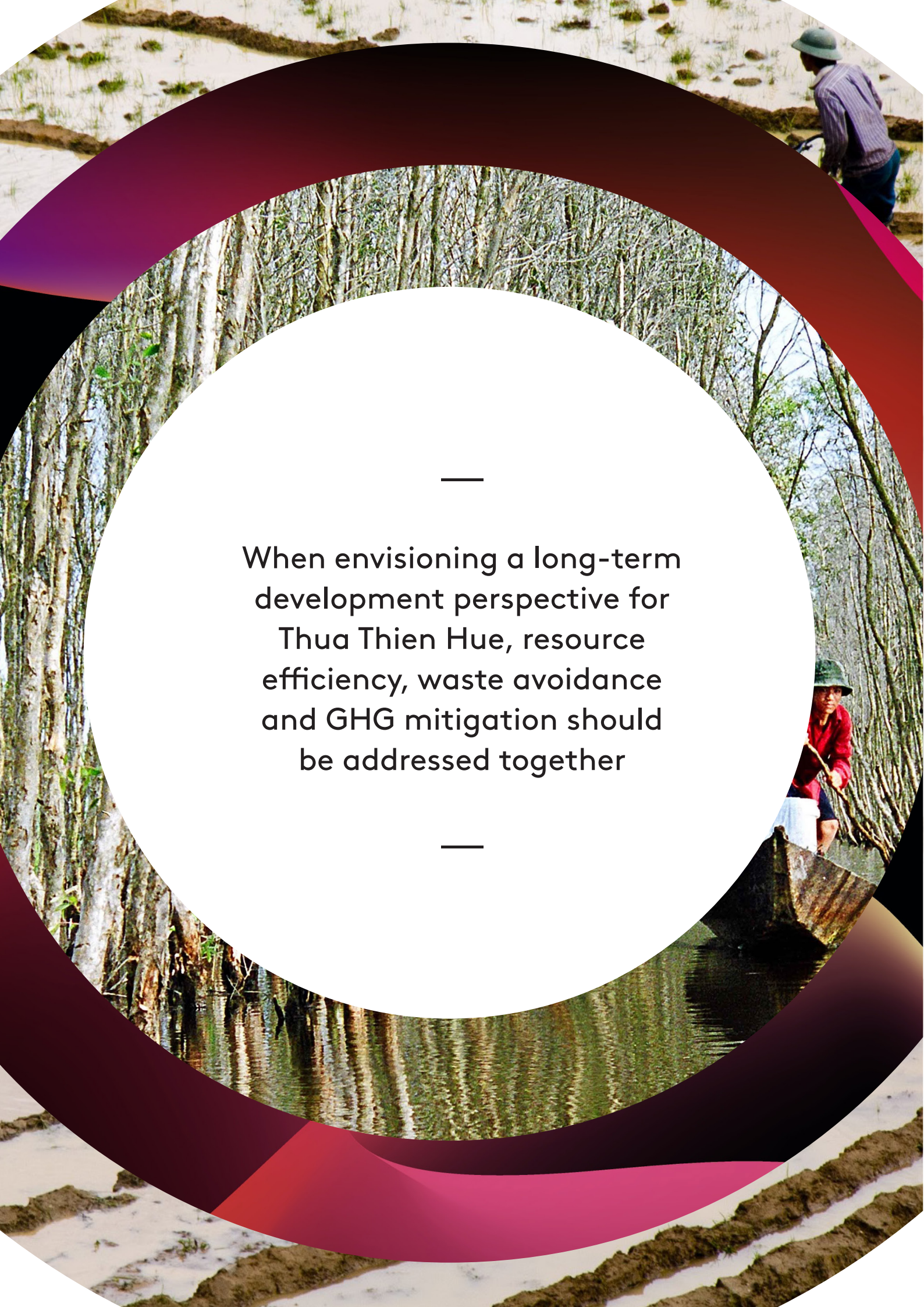
Figure 7: Value of production and consumption in Thua Thien-Hue and the value of imported and exported goods and materials ^{22,35}

Circular economy enablers and principles

To define a common language for the circular economy, the non-governmental organization (NGO) Circle Economy has mapped out the terms and definitions used by over 20 organizations, ranging from NGOs to government agencies, academia and consultancies. Three strategies and five enablers have emerged from these terms and definitions³⁶:



The Vietnamese government adopted a definition of the circular economy in the Law on Environmental Protection which focuses on the elements of design, service models, lifetime extension and waste reduction where recycling can play a role. This definition is: 'an economic model which encompasses the design, production, consumption and services activities aimed at reducing raw materials, extending product life, reducing waste generation and minimizing adverse impacts on the environment'.³⁷



—

When envisioning a long-term development perspective for Thua Thien Hue, resource efficiency, waste avoidance and GHG mitigation should be addressed together

—

3 Circular economy interventions

Part 3 looks at specific material flows in more detail and proposes 14 circular economy interventions. These interventions are based on an analysis of specific material flows and a round of consultations with 30 representatives from different government departments and interest groups in the province. Nine of these interventions occur along the value chains of construction materials, food product and consumer goods. The other four interventions relate to services such as governance, finance, education and legal services. These help to create an enabling context and aim to accelerate a cross-sectoral transition to a circular economy.

No country starts from scratch in the transition to a circular economy. Therefore, Part 3 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.

3.0 The environmental and socio-economic impact of all interventions

The impact of the 14 interventions has been quantified on six dimensions: four environmental, one economic and one social. The results are listed in Table 2. The environmental impacts distinguish between impacts which take place within Thua Thien-Hue and those outside of Thua Thien-Hue. The latter relates to reducing the demand for imported goods and materials.

The interventions start with construction, food value chains, transport, industry and manufacturing and enablers. Within each category, the interventions are sorted in a logic which helps avoid double counting of impacts. For example, when electrifying the transport vehicle fleet, it makes sense to first determine how large that fleet becomes when the utility rate of individual

vehicles is optimised and non-motorised transport is deployed to its full potential (Table 2).

The GHG mitigation potential is estimated for 2030 and 2050. For the two interventions in construction, the mitigation potential in 2050 is significantly larger than in 2030, which is due to the increased GHG mitigation potential of circular design and architecture in the long term. Next to this, the mitigation potential of off-site and modular construction methods increases due to the assumption that the use of wood-based construction materials will increase after 2030. As a result, at 41%, the 2050 provincial GHG reduction potential of the 14 interventions is much higher compared to the estimated total baseline emissions than the 16% in 2030.

Solid waste avoidance is substantial at 89%. This is due to waste reductions from off-site construction and reduced food waste and losses, combined with waste avoidance and waste recovery. Water savings from these interventions are mainly in agriculture, where 49% of water is used. Looking at the socio-economic indicators, fuel savings and improvements to the utility rates of assets can create value in transport, while the recovery of recyclable materials can support value creation in industry and waste management. Job creation is mainly in agriculture, transport and waste management.

The impact of the enablers has also been quantified, but overlaps with the interventions in value chains. For example, circular procurement can accelerate the adoption of circular economy principles in construction, but the impact of that intervention is also quantified under the two interventions in that specific sector. To avoid overlap, potential when removing sectoral overlap has been listed at the bottom of the table.

INTERVENTION PER SECTOR	ENVIRONMENTAL IMPACT					
					Thua Thien-Hue	
	GHG REDUCTION BY 2030 million tCO ₂ e/year		GHG REDUCTION BY 2050 million tCO ₂ e/year		WASTE AVOIDED BY 2030 tonne/year	
	⊙	●	⊙	●	⊙	●
→ CONSTRUCTION						
① PROMOTE CIRCULAR ARCHITECTURE	300,000	120,000	2,100,000	820,000	0	0
② EXPAND OFFSITE AND MODULAR CONSTRUCTION CAPACITY	19,000	7,000	1,600,000	45,000	78,000	0
→ FOOD AND AGRICULTURE						
③ DELIVER HEALTHY FOOD WITH EFFICIENT VALUE CHAINS	38,000	160,000	700,000	330,000	170,000	0
④ EXPAND DECENTRALISED PROCESSING OF ORGANIC RESIDUES	69,000	0	137,000	0	135,000	0
⑤ PRIORITISE ORGANIC, RESOURCE-EFFICIENT AGRICULTURE	200,000	82,000	320,000	130,000	0	0
→ TRANSPORT						
⑥ MAKE WAY FOR ACTIVE AND PUBLIC TRANSPORT	150,000	38,000	240,000	61,000	2,900	0
⑦ OPTIMISE VEHICLE UTILITY/EFFICIENCY AND ELECTRIFY THE FLEET	210,000	28,000	330,000	45,000	0	0
→ WASTE						
⑧ AVOID WASTE AND MAXIMISE RECOVERY	0	140,000	0	300,000	46,000	0
→ GARMENTS						
⑨ INCREASE RECYCLED AND REGENERATIVE CONTENT IN GARMENTS TO 20%	0	68,000	0	110,000	0	11,000
→ TOURISM						
⑩ PILOT CIRCULAR INITIATIVES IN TOURISM	5,900	6,100	9,700	10,000	9,200	3,400
→ GOVERNMENT						
⑪ MAINSTREAM CIRCULAR PROCUREMENT FOR NEW INFRASTRUCTURE	250,000	83,000	410,000	130,000	9,900	220
→ FINANCE						
⑫ FINANCE CIRCULAR BUSINESS MODELS AND START-UPS	1,300,000	640,000	5,400,000	410	430,000	11,000
→ EDUCATION						
⑬ EDUCATE ON THE CIRCULAR ECONOMY	n/a	n/a	n/a	n/a	n/a	n/a
→ JUDICIARY						
⑭ SECURE JUST ACCESS AND STRENGTHEN THE JUDICIARY	n/a	n/a	n/a	n/a	n/a	n/a
TOTAL	2,900,000	1,400,000	11,000,000	2,000,000	880,000	26,000
☆ POTENTIAL *	1,300,000	640,000	5,400,000	1,800,000	430,000	11,000
↓↑ REDUCTION/INCREASE **	-16%	-7%	-41%	-12%	-89%	n/a

Table 2: The environmental, economic and social impacts of the 14 circular economy interventions.

INTERVENTION PER SECTOR	WATER SAVINGS million m ³ /year		ECONOMIC IMPACT GDP IMPACT BY 2030 million US\$/year	SOCIAL IMPACT IMPACT ON JOBS BY 2030
	⊕	⊖	Net result	Net result
→ CONSTRUCTION				
① PROMOTE CIRCULAR ARCHITECTURE	130	52	8.2	0
② EXPAND OFFSITE AND MODULAR CONSTRUCTION CAPACITY	60	30	25	-700
→ FOOD AND AGRICULTURE				
③ DELIVER HEALTHY FOOD WITH EFFICIENT VALUE CHAINS	170	80	0	0
④ EXPAND DECENTRALISED PROCESSING OF ORGANIC RESIDUES	0	9	0.8	4,000
⑤ PRIORITISE ORGANIC, RESOURCE EFFICIENT AGRICULTURE	330	22	23	1,100
→ TRANSPORT				
⑥ MAKE WAY FOR ACTIVE AND PUBLIC TRANSPORT	120	5.3	15	2,700
⑦ OPTIMISE VEHICLE UTILITY/EFFICIENCY AND ELECTRIFY THE FLEET	34	110	57	-100
→ WASTE				
⑧ AVOID WASTE AND MAXIMISE RECOVERY	0	70	25	3,600
→ GARMENTS				
⑨ INCREASE RECYCLED AND REGENERATIVE CONTENT IN GARMENTS TO 20%	3,2	28	24	n/a
→ TOURISM				
⑩ PILOT CIRCULAR INITIATIVES IN TOURISM	1.8	1.8	n/a	n/a
→ GOVERNMENT				
⑪ MAINSTREAM CIRCULAR PROCUREMENT FOR NEW INFRASTRUCTURE	53	56	9.1	5,300
→ FINANCE				
⑫ FINANCE CIRCULAR BUSINESS MODELS AND START-UPS	800	410	180	11,000
→ EDUCATION				
⑬ EDUCATE ON THE CIRCULAR ECONOMY	n/a	n/a	n/a	n/a
→ JUDICIARY				
⑭ SECURE JUST ACCESS AND STRENGTHEN THE JUDICIARY	n/a	n/a	n/a	n/a
TOTAL	1,700	900	370	27,000
☆ POTENTIAL *	800	410	180	11,000
↑↓ REDUCTION/INCREASE **	-14%	-10%	4,5%	2,0%

* when removing sectoral overlap ** as share of total emissions, waste volume, water usage, GRP, jobs



INTERVENTION TARGET SECTORS

→ Construction



24%

The construction sector in Thua Thien-Hue is responsible for 77% of material use and 24% of GHG emissions. The sector contributes 7% of GDP and provides 11% of jobs.

3.1 Intervention 1: Promote circular architecture

Strategy

This intervention aims to optimise the design of buildings and infrastructure to minimise resource use. When making environmental considerations a design criterion, the most effective combination of circular economy interventions can be applied. These include applying secondary and regenerative low-carbon construction materials, reusing, prioritising low-carbon construction materials, designing for disassembly and avoiding overspecification that leads to designing structures for higher loads than necessary.

Over-dimensioning to ensure building durability and safety can cause construction companies to use between 30-50% more cement and steel than would be necessary if value chains were optimised. This strategy also aims to reduce overspecification, high-strength steel and techniques such as post-tensioning.³⁸

The focus of this intervention is on embodied carbon, which refers to the GHG emissions associated with a building's construction materials

and its full life cycle (excluding operational emissions from its use phase). However, design can also reduce the operational emissions, for example, by optimising a building's context and positioning, making use of aspects like trees, shading,³⁹ green roofs,⁴⁰ wind and passive design principles. These help to reduce or avoid both the operational and embodied carbon impact of technical solutions such as air conditioning.⁴¹

Policy framework

Viet Nam promotes the use of non-fired construction materials, such as, for example, pressed bricks. The government has adopted legislation to increase the use of non-fired construction materials, and in 2022 this legislation was translated into provincial targets. Between 2022 and 2025, all construction should use 80% non-fired construction materials. For public and foreign investments, 100% is required. Construction projects which cannot comply will require prior approval by the competent state bodies.⁴²

This requirement has the potential to alter the design of buildings and shift priorities to low-carbon construction materials. Industry

associations point out that there are issues with the production of sufficient materials like non-fired bricks.⁴³ The next interventions looks at sustainably produced wood-based construction materials, which could provide a lightweight alternative to mineral construction materials. Circular economy principles for the construction sector can help architects and construction companies to comply with provincial regulations while assembling buildings such that they can become a source of valuable secondary construction materials at the end of their lifetime.

Existing initiatives within Thua Thien-Hue

The Nest⁴⁴ is a flexible and modular housing concept in Viet Nam designed by ROOM+ Design & Build that responds to decreasing household sizes with designs that can accommodate up to two people, instead of three generations like in the past. Over time, a household of one or two persons might expand to three or four. A designer from The Nest explained that 'We believe that good housing is not primarily a question of size, but a broadly effective layout that suits many uses'.⁴⁵ Apart from flexibility, The Nest also applies passive design strategies which consider the building orientation and façade design to maximise natural ventilation and lighting. They also use vegetation on the terraces and make sure the design can accommodate gardens, vegetable farms and roof parks.

Between 2014 and 2019, UNDP implemented the project 'Promotion of Non-Fired Brick (NFB) Production and Utilization in Viet Nam', funded by the Global Environment Facility. The project supported the displacement of fired clay brick kilns and aimed to reduce GHG emission reductions. It also supported policy development and deemed that a programme to promote the use of non-fired bricks would be realistic and bring socio-economic and environmental benefits.⁴⁶

Inspiring circular economy examples

Rijkswaterstaat, the executive agency of the Dutch Ministry of Infrastructure and Water Management, made circular economy criteria part of the procurement of a viaduct. The result was a viaduct which has been successfully assembled and disassembled for a second life at a different location. This is an example of design for disassembly in civil works. By sharing knowledge and experience, Rijkswaterstaat aims to make circular procurement a common practice in the Netherlands.⁴⁷

The SmartCrusher is a container-sized technology that can crush concrete from demolition sites, allowing for recovery of the heterogeneous composite elements of concrete, including unhydrated and hydrated cement, gravel and sand. These materials can be used immediately with limited processing as a resource for new concrete onsite. Recycled cement is sold in the Netherlands as Freement. According to a Dutch consultancy, this technology can reduce the embodied carbon in concrete by 68%, while reducing concrete costs by 56%.⁴⁸

Next steps

With its regulations to encourage the use of non-fired bricks in construction, the provincial government of Thua Thien-Hue is already making efforts to reduce the embodied carbon of new construction. Further steps could include:

1. Train architects and construction and demolition companies on circular economy concepts like design-for-disassembly, urban mining, circular design, pay-per-use models in building installations like air conditioning and elevators, concrete recycling and the use of wood-based construction materials which sequester, rather than emit, GHGs.
2. Promote circular procurement by government and private sector stakeholders and make environmental considerations, notably the estimated embodied carbon, part of investment decisions.

**Over-dimensioning
can cause construction
companies to use
between 30% and 50%
more cement and steel
than necessary**

3. Provide financial incentives which improve savings related to circular economy interventions and the competitive position of low-carbon construction materials. Examples include increasing taxes or levies on carbon-intensive materials like Portland cement and steel with a low recycled content. Revenues from such tax reforms could be invested into designs with reduced embodied carbon through circular procurement (intervention 11) or subsidies for low-carbon construction materials. Such tax reforms can help avoid rebounds whereby cost reductions due to efficiency improvements are invested in larger buildings with a larger environmental footprint.⁴⁹

4. Consider resource recovery when procuring demolition services. By stipulating the share of materials and construction elements which should be reused, governments can incentivise the harvesting of secondary construction materials. When also granting demolition companies sufficient time to find a buyer for these materials and components, they can gradually move from demolition to disassembly. Building partnerships with recycling facilities and developing a local market for secondary construction materials should be encouraged.

Potential impact

Research on case studies globally indicated that considering circular economy principles in the design phase of new construction can reduce

embodied carbon by 41% for buildings and 56% for infrastructure. These figures are assumed to be realistic for the long term (Table 3), while estimating the short-term potential at 15% embodied carbon reduction for buildings and 12% for infrastructure. This is conservative, since studies on the EU construction sector indicate that reducing embodied carbon emissions in the construction sector to 1% by 2050 is possible. The GRP impact is related to reinvesting a 2% savings on investment costs of new construction. The impact on jobs is negligible, since research indicates that reducing embodied carbon only requires slightly more design effort.⁵⁰ The GHG impact outside of Thua Thien-Hue mainly relates to savings on imported steel.

Qualitative impacts can likely be seen across the following SDG targets. Throughout the report, the SDG targets have been reformulated to be more concise:

- SDG 9.1. Develop reliable, sustainable and resilient infrastructure, with affordable and equitable access for all
- SDG 9.4. Upgrade infrastructure and retrofit industries to make them sustainable, and improve resource efficiency
- SDG 11.1. Ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums
- SDG 13.2. Integrate climate change measures into national policies, strategies and planning

① PROMOTE CIRCULAR ARCHITECTURE

→ Construction

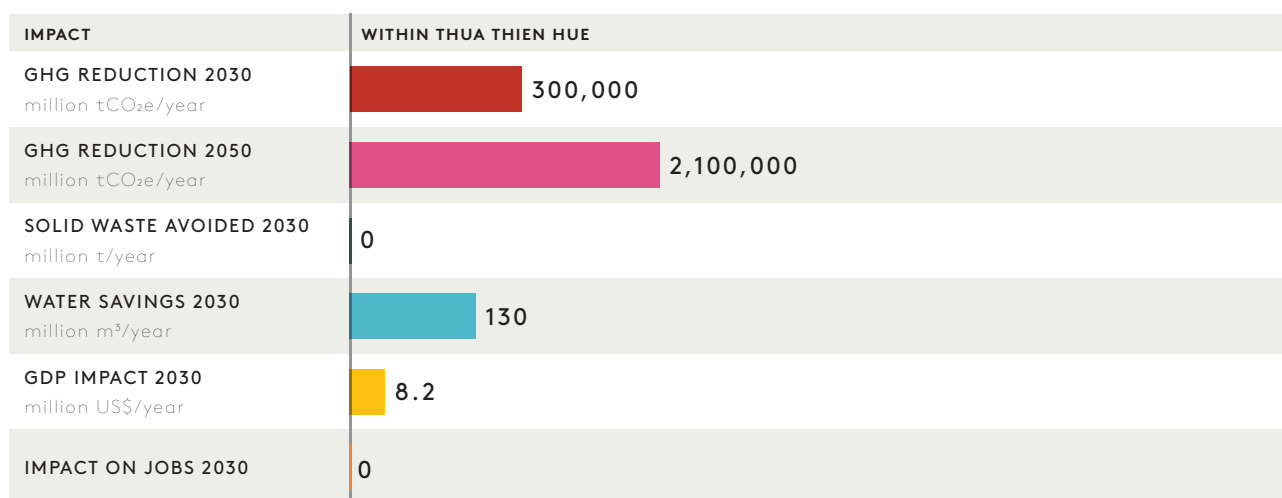


Table 3: Overview of impacts from promoting circular architecture (bar size has been scaled as in table 1)^{22,51}



INTERVENTION TARGET SECTORS

→ Construction

70%

Wood based and off-site construction can reduce embodied carbon by 80% and waste by 70%



3.2 Intervention 2: Expand offsite and modular construction capacity

Strategy

This intervention focuses on improving the construction process by adopting off-site and modular construction methods. These involve completing part of the construction in a factory setting and assembling the finished modules on site. This strategy abates GHG by reducing both material waste and transport movements.

Off-site construction can reduce emissions from new construction by 25% on average.⁵² Prefabrication can also help reduce both embodied carbon and the cost of renovation and retrofitting by an estimated 15%.⁵³ Off-site construction also offers workforce benefits, including 'greater productivity, higher learning rate, better working conditions, enhanced worker quality, and improved safety and health'.⁵⁴

This intervention can be combined with a gradual transition to wood-based construction. Prioritizing bio-based materials can also reduce embodied carbon and may even sequester carbon. Choosing materials with low embodied

carbon is often cost-effective. Industry players report that, together, wood-based and off-site construction can reduce embodied carbon by 80% and waste by 70%.⁵⁵

Policy framework

Thua Thien-Hue has regulations to encourage the use of non-fired bricks with a reduced carbon footprint. There are no other regulations to improve resource efficiency or reduce embodied GHG emissions from construction.

Existing initiatives within Thua Thien-Hue

There are several initiatives in Thua Thien-Hue which apply modular housing designs. Some of them also prioritise sustainably produced wood-based construction materials.

1. The O2 Café in Hue City was inspired by the 17th century ruong house, a house with a wooden frame that could be easily disassembled. The O2 Café can also be easily disassembled and its elements reused.⁵⁶ The café appeared in ArchDaily.⁵⁷
2. The Nest is a flexible and modular housing concept in Viet Nam which has already been presented in Intervention 1. A design which

allows households to adjust their apartments over time, it is a good example of how modular construction methods can increase flexibility.⁵⁸

3. The Timber House factory located in Binh Duong designs and manufactures prefabricated wooden houses. They use laminated timber products to provide structural rigidity. Amongst their clients are eco-resorts.⁵⁹

4. Another company offering prefabricated modular housing solutions is Hoang Sa Viet. They supply prefabricated steel frame houses and can deliver multi-storey buildings.⁶⁰

Inspiring circular economy examples

International examples and case studies related to modular and offsite construction include:

1. The Dutch construction company Ursem Modulair Bouwen has adopted modular and off-site construction techniques. The company reports that this approach enables it to reduce construction time by 50% and waste production to less than 1% of total materials used. This is in comparison to traditional construction methods, where waste volumes can reach 10% to 15% of total material use.⁶¹

2. Case studies from Scotland find that timber use can reduce a building's embodied carbon by up to 48% compared to the baseline case of reinforced concrete and 58% compared to steel.⁶²

3. A Canadian study that compared a cast-in-place concrete building and a mass timber structure found that the latter reduced embodied carbon by 24%.⁶³

Next steps

The next steps are a combination of policy incentives and facilitating collaboration along construction value chains.

1. Regulate embodied carbon emissions in the construction sector, following draft regulations in the European Union as described by Ramboll.⁶⁴

2. Adopt policies which incentivise improvements in construction efficiency and flexibility in the purpose and layout of a building, and which aim to increase the end-of-life value of buildings.

Modular and off-site design practices can support such objectives. Other incentives could relate to encouraging modular construction with circular procurement and providing credit support to modular structures.

3. Where needed, adjust the building code to facilitate the adoption of modular design, design for disassembly and the application of secondary building materials.

4. Facilitate the coordination of supply and

Off-site construction can reduce emissions from new construction by 25% on average

demand for secondary construction material and elements. Such coordination between construction and demolition activities can be facilitated with online marketplaces like the German Restado⁶⁵ and it can be a physical warehouse for secondary construction materials like Jan van IJken in the Netherlands.⁶⁶

5. Subsidise wood-based construction, perhaps with revenues from emission allowance schemes, following the example of Bavaria where the Bavarian Timber Construction Promotion Programme pays a 500 EUR grant per tonne of CO₂ stored.⁶⁷

Potential impact

Of the greenhouse gas emissions remaining after implementing Intervention 1, modular construction can reduce GHG emissions by another 10% to 39% in new buildings and 15% in building renovations.⁶⁸ The 10% reduction potential has been applied to the 2030 estimate, and the 39% to the 2050 estimate, while the metabolic analysis indicates that 14% of construction materials go to new buildings and 2% to renovations. The mitigation potential has been applied only to the GHG emissions related to these two activities. Off-site construction can drastically reduce waste production.

Although savings in construction materials can be reinvested, allowing GRP to increase, jobs may go down slightly, since off-site construction may require 3% less labour. However, what has not been modelled is the extent to which the production of construction modules which are faster to assemble with fewer safety risks and less nuisance on-site might become an interesting export product. In that case, jobs might increase. In addition, the use of wood-based construction materials can support countries with their GHG mitigation and removal ambitions.

For the 2050 estimate of the GHG mitigation potential, wood-based construction is also considered. If Thua Thien Hue succeeds in diverting an amount equal to 80% of the 2021 wood production into construction materials by 2050, the province would be able to sequester carbon into its built environment while avoiding GHG emissions from industries which produce mineral and metal construction materials. In that case, 91% of the GHG mitigation potential in 2050 would stem from wood-based construction. A conservative estimate suggests that the province would be able to sequester 0.36 tCO₂e/tonne of wood in new buildings.⁶⁹ It would also avoid emissions from

the production of mineral construction materials. The sequestration potential of the forest is not estimated, since the wood is assumed to come from existing plantations. In 2050, 92% of the GHG mitigation potential comes from wood-based construction.

This intervention can contribute to several SDG targets.

- SDG 9.1. Develop reliable, sustainable and resilient infrastructure, with affordable and equitable access for all
- SDG 9.4. Upgrade infrastructure and retrofit industries to make them sustainable, and improve resource efficiency
- SDG 11.1. Ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums
- SDG 13.2. Integrate climate change measures into national policies, strategies and planning

② EXPAND OFF-SITE AND MODULAR CONSTRUCTION CAPACITY

→ Construction

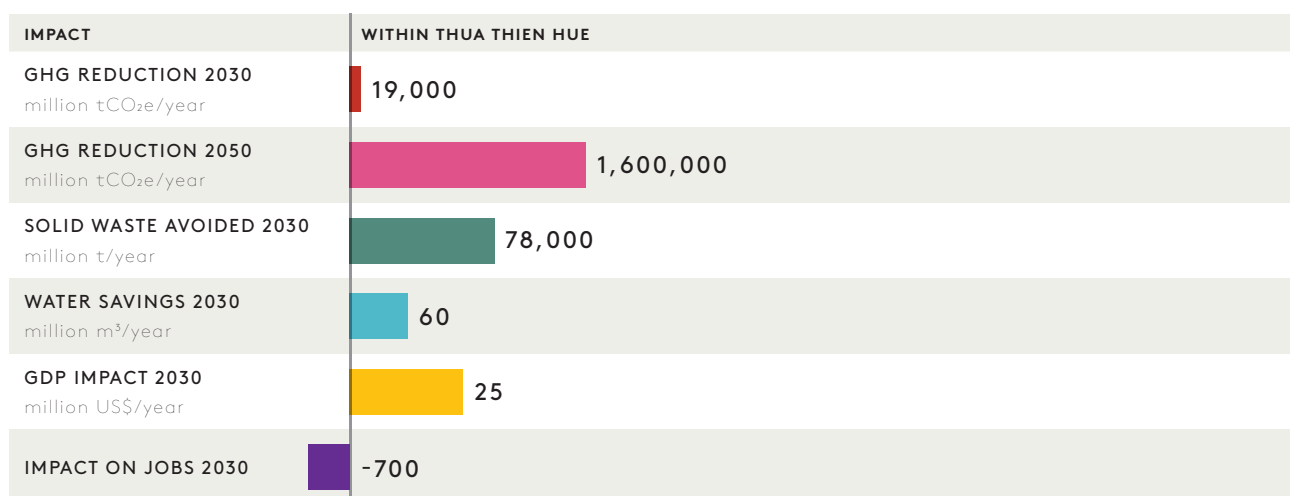


Table 4: Overview of impacts from expanding off-site and modular construction capacity^{22,70}



INTERVENTION TARGET SECTORS

→ Agriculture, industry and manufacturing, retail and wholesale trade, transport



8.5→19%

childhood overweight and obesity rates increased from 8.5% to 19% between 2010 and 2020

3.3 Intervention 3: Deliver healthy food with efficient value chains

Healthy food can cushion the impact of a pandemic. According to the World Health Organisation (WHO), unhealthy diets accounted for 86% of COVID-related deaths in parts of Europe.⁷¹ Although the prevalence of undernourishment has shown a steep decline in Viet Nam (from 20% in 2000 to 6% in 2020),⁷² the occurrence of obesity is increasing, with childhood overweight and obesity rates increasing from 8.5% to 19% between 2010 and 2020.⁷³ This is part of a trend of rising nutrition-related chronic diseases and connected with dietary changes, i.e., fewer fresh vegetables and more meat, dairy, sweets and sweetened beverages.⁷⁴ Since diets are shifting towards more carbon-intensive products like meat, dairy and processed food, preserving and promoting healthy diets can also help reduce the environmental impact of food value chains.⁷⁵ According to the WHO, 'a healthy diet is a sustainable diet'.⁷⁶

Excessive meat consumption is related to chronic diseases⁷⁷ and global environmental issues. The livestock sector is globally the largest

user of land, using 70% of agricultural land. It contributes to climate change, deforestation, land degradation, and the eutrophication of water bodies, and threatens biodiversity.⁷⁸ This is causing environmental issues in areas with a lot of intensive animal breeding like the Netherlands⁷⁹ and increasing opposition to intensive farming systems,⁸⁰ also in Viet Nam.⁸¹ The metabolic analysis shows that meat is produced with a GHG footprint of between 9-18 tCO₂e/tonne, compared to vegetables at 0.5-1.0 tCO₂e/tonne.

Another issue is food waste and losses. The material flows in Figure 4 also show that part of the food produced is lost during harvest, transport and storage, processing, retail and consumption. Food losses in Viet Nam are relatively high and estimated at more than half of what is produced. A quarter is lost before the food reaches processing plants or distribution centres. Fruit and vegetables face the highest losses and waste.⁸² The metabolic analysis shows that for Thua Thien-Hue, food losses and waste are estimated at 340,000 tonnes/year at an economic value of around US\$260 million/year. This is around 9% of the value of food products produced and consumed in Thua Thien-Hue.

Most of the losses occur in the early stages of the food value chain at production, post-harvest, processing and distribution, and they exceed averages across Southeast Asia.⁸⁴ Food losses and waste increase food prices and reduce food security worldwide, and uneaten food has a substantial environmental impact, contributing to 8% of GHG emissions globally.⁸⁵ Project Drawdown, a non-profit which aims to advance effective, science-based climate solutions and strategies to help stop climate change, has listed reducing food waste and losses first in its ranking of the most effective mitigation measures.⁸⁶ It can also be financially attractive: research indicates that investing US\$1 in reducing food losses and waste can save up to US\$14.⁸⁷

Strategy

This intervention seeks to adjust food value chains such that they deliver what is needed for a healthy diet with the least amount of food losses and waste. This intervention is directed at:

1. reducing food losses and waste⁸⁸, and
2. aiming for an intake of proteins at a level recommended by Wageningen University.⁸⁹

The World Health Organisation refers to a maximum animal protein intake of 71 grams a day⁹⁰, but does not specify what a healthy intake would be. Wageningen University refers to a recommended 56 grams per day of protein which can be both from animal and plant-based sources. Fish consumption levels in Thua Thien-Hue already provide 63 grams of protein per person per day. The remainder can come from plant-based sources. With such an approach, meat production could be reduced to levels needed to sustain a healthy agricultural system,⁹¹ avoiding the accelerated adoption of intense animal breeding systems⁹² and freeing up valuable land for other purposes.

Policy framework

The Government of Viet Nam has adopted policies to improve post-harvest food handling, cold chains and processing industries⁹³, such as reducing land use taxes to free up means to invest in cold storage and promoting public-private investments in post-harvest processing. The agricultural extension network has been mobilised to train farmers in post-harvest techniques and cooperative business models aimed to link value chain partners.⁹⁴

Next to this, Vietnamese health policy acknowledges that dietary changes cause obesity

issues. It aims to make nutrient-rich foods more accessible and nutrient-poor or ultra-processed foods less accessible and desirable.⁹⁵

Existing initiatives within Thua Thien-Hue

The Thua Thien-Hue Agricultural Materials Joint Stock Company produces and trades bio-organic fertilizers and rice and runs eco-tourism facilities. In 2021, the company commissioned a rice drying and milling facility fuelled with rice husks. The rice bran is fed to livestock.

Another example is the Que Lam Organic Agriculture Products One Member Co., Ltd., which produces 'Que Lam Organic Rice'. The company appoints technical staff to supervise and guide farmers in cultivating organic rice. At the end of the season, the company buys all the organic rice from the farmers at a pre-agreed price which is 30% above market levels.⁹⁶

Inspiring circular economy examples

Roti Bank is a non-governmental organization in Mumbai which works with caterers, wedding planners and other food services to rescue surplus food and serve the hungry. Roti Bank checks food quality and hygiene levels before redistributing the food. The redistribution takes three to four

Meat is produced with a GHG footprint of between 9 and 18 tCO₂e/tonne, compared to vegetables at 0.5 to 1.0 tCO₂e/tonne

hours. In June 2020, Roti Bank distributed around 37,000 meals a day and expanded operations to Nagpur, Coimbatore and Hyderabad.⁹⁷ Another initiative which reduces food waste is Tekeya, an application developed in Egypt, which makes unserved or unsold food available at a reduced price or available for donation to those in need.⁹⁸

The value chains for cassava, which accounts for 19% of crop production in Thua Thien-Hue⁹⁹, tend to incur relatively high transport losses, and the crop can perish within 48 hours of harvesting.¹⁰⁰ Research on cassava value chains in Guyana indicates that investments that reduce losses and waste throughout the value chains offer attractive returns, in particular because the investments required, including hand tools for harvesting and crates for transport, are available at low costs.¹⁰¹

In 2016, the Chinese government issued guidelines to reduce domestic meat consumption from 75 to 40 grams per day per person, a reduction of around 50%.¹⁰² Information campaigns and awareness-raising around healthy levels of animal protein consumption can help to reduce meat consumption. Of 2,000 Chinese people surveyed in 2018, 70% of respondents indicated that meat reduction campaigns have made them more aware of the benefits of eating less meat.¹⁰³ 14% reported eating less pork and 6.4% reported eating less poultry.¹⁰⁴

The Chilean government adopted advertising restrictions on unhealthy foods, introduced front-of-package warning labels and banned junk food in schools. The impact analysis showed that 18 months following the adoption of these regulations, consumption of sugar-sweetened drinks dropped by nearly 25%, while the sale of bottled water and drinks without added sugar increased.¹⁰⁵

Next steps

Four activities can reduce food loss and waste:

1. Set up a small grants fund for small farmers to invest in food loss reduction, similar to the IFAD fund on food loss reduction.¹⁰⁶ Sometimes small investments, like in crates to harvest and transport food, can deliver substantial food loss reductions.¹⁰⁷ Larger investments can be directed towards mobile food processing systems, improved packaging, relaxing regulations and standards on aesthetic requirements for fruit and vegetables and strengthening infrastructure and logistics,

including sustainable cold chains and cooling technologies.¹⁰⁸

2. Provide training, technology and innovation, including for small-scale producers to reduce food losses and waste and promote behaviours that value and make the most of food at home.¹⁰⁹

3. Shorten value chains by facilitating farmers' direct access to consumers with farmers' markets, cooperatives, types of consumer participation in farm operations, or funding, and thereby strengthen rural-urban linkages and improve the predictability of demand.¹¹⁰

4. Encourage and motivate stores and supermarkets to monitor and reduce food waste and support initiatives where safe surplus food is collected and redistributed,¹¹¹ following international examples like Roti Bank and Tekeya App.

Next steps to aid in the preservation and adoption of healthy and sustainable diets can include the following:

1. Increase the demand for commodities which can address nutrition gaps by improving consumer awareness on healthy food and nutrition and make healthy food more visible and available.¹¹²

This includes educating students and informing people of the adverse impacts of excessive meat consumption on human health, animal wellbeing and the environment¹¹³, such as through the use of labels which reflect the health and environmental impacts of food products.¹¹⁴ In campaigns, target specific demographic groups with a suite of dedicated policies¹¹⁵ and make sure that protein consumption is equally distributed. Suggestions from stakeholders were to include the promotion of macrobiotic culture through programmes and festivals.

2. Adopt a nutrition-sensitive value chain approach whereby understanding the nutrition problem of consumption patterns and dietary quality allows governments to set priorities. Based on specific diet gaps and nutritional issues, specific food commodities can be identified and prioritised. The approach should be such that all parts of society benefit from and gain access to these commodities.¹¹⁶

3. Ensure that the negative externalities of unhealthy food consumption and marketing are accounted for. 'Malnutrition and non-communicable diseases generate costly externalities of the agrifood system that are not reflected in food prices.'¹¹⁷ Installing a true pricing mechanism whereby these externalities are factored into commodity prices might seem

challenging, but the government can take measures such as:

- a. restricting advertisements which promote the consumption of unhealthy food products and
- b. banning junk food in and near schools (in line with intervention 13).¹¹⁸

4. Facilitate initiatives that connect producers and consumers for access to healthier and more sustainable food, since these tend to include fairer incomes for farmers and have very low food losses in comparison to conventional food retail.¹¹⁹ This could include the direct sale of local products like the mushroom production in Le Xa Dong village (intervention 5), lotus products and medicinal products.

Potential impact

The impact of this intervention has been quantified by reducing food waste and losses by 50% in line with the 2030 target specified by the Sustainable Development Goals.¹²⁰ When determining what the reduced food loss and waste will bring, Thua Thien-Hue will have to choose between reaping the environmental or economic benefits.¹²¹ Here, the improved value chain efficiency is used to reduce the amount of agricultural land in use while keeping the volume of food consumed stable. For the impact analysis, the land which then becomes available is assumed to become a natural forest. GHG emissions will be reduced from agricultural production and the disposal of organic waste, and the forest offers additional sequestration potential.

Preserving and promoting healthy diets would allow meat production to be reduced by 50% by 2030, and 80% by 2050. In the long run, this requires policies which aid a fair distribution of valuable proteins amongst the population of Thua Thien-Hue. The figure of 80% acknowledges that small-scale and decentralised animal husbandry also has a place in a circular food system.¹²² Considering that meat requires between 5-100 times more land per tonne of product,¹²³ this will free up a large amount of land to produce other agricultural commodities. It would reduce the environmental impact of meat production, and on a per-hectare basis it would allow farmers to slightly increase their revenues and create new jobs.

Contributions to the Sustainable Development Goals are mainly related to hunger and food security.

- SDG 2.1. End hunger and ensure access by all people to safe, nutritious and sufficient food all year round
- SDG 12.3. Halve per capita global food waste at the retail and consumer levels and reduce food losses
- SDG 15.2. Promote the sustainable management of forests and increase afforestation and reforestation

③ DELIVER HEALTHY FOOD WITH EFFICIENT VALUE CHAINS

→ Food and agriculture

IMPACT	WITHIN THUA THIEN HUE
GHG REDUCTION 2030 million tCO ₂ e/year	380,000
GHG REDUCTION 2050 million tCO ₂ e/year	700,000
SOLID WASTE AVOIDED 2030 million t/year	170,000
WATER SAVINGS 2030 million m ³ /year	170
GDP IMPACT 2030 million US\$/year	0
IMPACT ON JOBS 2030	0

Table 5: Overview of impacts from delivering adequate nutrition with efficient food value chains^{22, 124}



INTERVENTION TARGET SECTORS

→ Waste management, agriculture



1.4 Mt/yr

The province produces an estimated 1.4 million tonnes of organic waste per year

3.4 Intervention 4: Implement decentralised processing of organic residues

Methane emissions from organic waste and manure management are the source of 480,000 tCO_{2e} in methane emissions from Thua Thien-Hue, or around 12% of provincial GHG emissions. The province produces an estimate 1.4 million tonnes of organic waste per year, of which an estimated 150,000 is collected as municipal solid waste. The remainder is applied on land, dumped in unregulated dumpsites or discharged through waterways.

Strategy

Thua Thien-Hue has an advanced value chain for organic fertilisers¹²⁵ and experience with biogas systems. Building on this experience, the environmental impact of organic waste can be reduced further by:

1. improving source separation and introducing composting yards which supply to urban farming initiatives,
2. installing bio-energy systems at industrial facilities and

3. supporting methane recovery from landfills, wastewater treatment and manure management systems.

Policy framework

National and provincial-level strategies, policies and programmes already target organic waste management. The national Law on Environment Protection from 2020 specifies that by the end of 2024 municipal solid waste generated by households and individuals will be sorted.¹²⁶ This law was translated into provincial law in 2023, strengthening environmental protection, food safety and rural clean water supply in new rural construction in the 2021-2025 period in Thua Thien-Hue province.¹²⁷

This provincial law regulates the processing of domestic waste and wastewater and foresees the separation¹²⁸ and treatment of organic waste on-site to produce compost, fertilisers or biogas in line with the national law. It also supports the formation of a network for solid waste collection, establishment of collection points and centralized treatment and circular economy initiatives in the treatment of waste and agricultural by-products.¹²⁹

Existing initiatives within Thua Thien-Hue

Several initiatives stand out in Thua Thien-Hue in their efforts to improve organic waste management:

1. Hue City administration and WWF launched a programme for waste segregation at the source in 2022. As part of the programme, they launched awareness campaigns and installed containers for segregated waste collection at government agencies and schools.¹⁵⁰
2. Viet Nam has participated in biogas initiatives in the animal husbandry sector. Since its inception in 2003, nearly 250,000 digesters have been installed under a programme by the Dutch non-profit organisation SNV and its spin-offs. The digesters use manure and organic waste to produce biogas for cooking and organic fertiliser for land application.¹⁵¹ In Thua Thien-Hue there are various initiatives to support their deployment, as well as for the treatment of manure.¹⁵²
3. In 2022, the province had 303 participants in an indigenous microorganism programme who were educated on composting methods. They produced 2,417 litres of fertilizer and enzyme products, some of which could be used as cleaning agents.¹⁵³

Inspiring circular economy examples

São Paulo, Brazil, has 883 street markets which generate 34,000 tonnes of organic waste per year. The municipality generates an additional 39,000 tonnes of organic material from tree and plant pruning. A system of decentralised composting locations allows São Paulo to divert organic waste from landfills and produce compost. The composting facilities, or 'yards', handle up to 50 tonnes of waste a day and, in 2018, were estimated to prevent about 1,920 tonnes of CO₂e emissions annually.¹⁵⁴ Although the initiative does not process very large volumes, community engagement can play a significant role in improving awareness and willingness by household members to engage in source separation.

A similar initiative in Singapore, called Edible Garden City, invests specifically in awareness and education. It provides urban garden consultancy, trainings, workshops for property developers and restaurants, schools, malls, offices, homeowners and schools.¹⁵⁵

Next steps

Next steps could include the following:

1. Set up a dedicated Community of Practice¹⁵⁶ under the Hue IDS for organic waste flows

from industries, like the brewery, cassava starch processing and seafood processing in Phu An, also involving the farmers who seek to procure organic soil enhancers.¹⁵⁷ Such a Community of Practice would allow these industries to learn from each other and connect with experts, financing, technology providers and potential customers for processed organic residues and bio-energy.

2. Support initiatives which reduce biogas emissions from wastewater treatment systems and existing landfills. Enrol in programmes which aim to improve access to bioenergy to substitute fossil fuels, like the Sustainable Bioenergy Markets programme.¹⁵⁸

3. Support the establishment of composting facilities near food markets and community areas and make household organic waste bins available which could supply these composting facilities. Organise community initiatives to develop urban farms based on the compost from markets and households and combine these with awareness raising and educational initiatives to improve the willingness to undertake source separation.

4. Provide enterprises which produce compost preference and encouragement in producing compost, for example by improving their competitive position compared to suppliers of synthetic fertilisers, and support them to improve

The national Law on Environment Protection from 2020 specifies that by the end of 2024 municipal solid waste generated by households and individuals will be sorted

the quality of their compost with scientific research and technology development.¹³⁹

5. Mobilize human and financial resources to implement waste segregation at the source. This can improve both the quality of organic residues for composting and the quality of the compost itself, and might involve a comprehensive solid waste segregation plan in combination with the delivery of segregation containers, establishment of collection infrastructure, capacity building and training and establishment of partnerships to exchange organic waste between enterprises.

Potential impact

To avoid double-counting of emissions in the calculation of the impact, one assumption is that intervention 1 is fully implemented. Of the organic waste remaining, including garden waste, food waste and sludge, 50% will be subject to source separation by 2030 and used to produce compost. In 2050, this figure is 95%, accepting that some biomass may always slip through. The socio-economic impact is estimated based on the land area and agricultural production which this compost volume can support and the labour which is required to collect and process the organic residues into a soil enhancer. With that, this intervention in product value chains has the highest job potential. The compost is expected to replace imported synthetic fertiliser and increase yield by 10% when applied at a rate of 16 tonnes per hectare.¹⁴⁰

This intervention can contribute to several SDG targets.

- SDG 2.1. End hunger and ensure access by all people to safe, nutritious and sufficient food all year round
- SDG 4.7. Ensure that all learners acquire the knowledge and skills needed to promote sustainable development
- SDG 11.6. Reduce the adverse per capita environmental impact of cities
- SDG 11.7. Provide universal access to safe, inclusive and accessible, green and public spaces
- SDG 11.a. Support positive economic, social and environmental links between urban, peri-urban and rural areas
- SDG 12.8. Ensure that people have the information and awareness for sustainable lifestyles

④ EXPAND DECENTRALISED PROCESSING OF ORGANIC RESIDUES

→ Food and agriculture

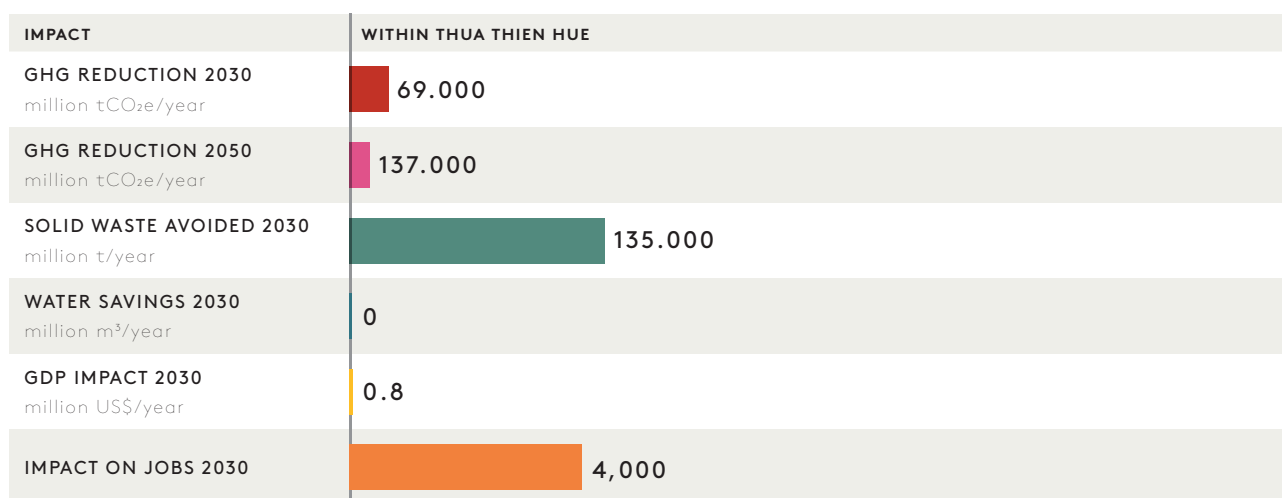


Table 6: Overview of impacts from implementing decentralised processing of organic residues^{22, 141}

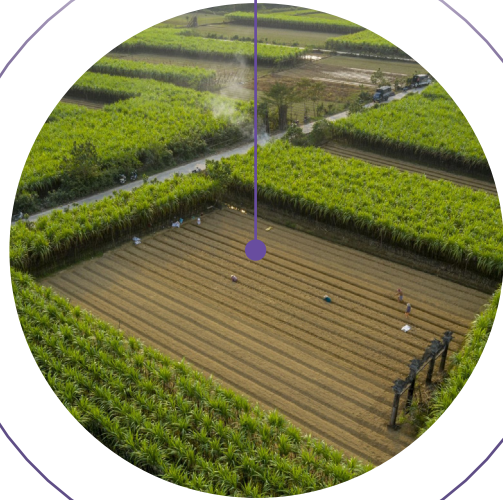


INTERVENTION TARGET SECTORS

→ Agriculture

42%

42% of GHG emissions from agriculture in Thua Thien-Hue stem from rice cultivation



3.5. Intervention 5: Prioritise organic, resource efficient agriculture

Pesticide use in Viet Nam is linked to an increase in non-communicable diseases.¹⁴² Research indicates the use of synthetic agro-inputs reduces soil fertility. On the other hand, the presence of soil organic matter and soil microbial populations are primarily useful indicators of soil health and productivity of both crops and livestock.¹⁴³ The use of pesticides could be connected to a range of health effects like neurotoxicity, cancer, reproductive effects and birth defects.¹⁴⁴ Concerns mainly relate to the testing and approval of single pesticides, while in reality often cocktails are applied.¹⁴⁵

Rice is an important export commodity for Viet Nam, but currently around two thirds of fertilisers sold in Viet Nam are used in rice production.¹⁴⁶

In 2019, the country imposed a ban on the use of glyphosate, a herbicide linked to cancer and a key ingredient of Roundup.¹⁴⁷ Applying synthetic pesticides and herbicides in agricultural production pollutes surface waters while these materials also have a substantial carbon footprint.

Organic certification of agricultural commodities can help to sustain the health of soils, ecosystems and people¹⁴⁸ while adding value.

Viet Nam already has a position in this global market. Its export value of organic commodities is US\$335 million.¹⁴⁹ The value of the organic food trade in 2026 is expected to reach US\$437 billion globally with a compounded annual growth rate of 14%.¹⁵⁰ The trade agreement between the European Union and Viet Nam¹⁵¹ may help to increase demand for organic food products from Viet Nam.

Viet Nam has developed an advanced value chain for biofertilizers, which aim to restore soil life and reduce the need for chemical inputs.¹⁵² ACIAR has estimated the country's biofertilizer production at 400,000 tonnes per year, involving over 500 strains of micro-organisms. Despite these efforts, the use of chemicals remains substantial. In a 2016 comparison with other countries in the region, the use of mineral fertiliser per hectare in Viet Nam (430 kg/ha/year) was second only to China (503 kg/ha/year) and far above other countries in the Greater Mekong Region (17 kg/ha/year in Cambodia and 162 kg/ha/year in Thailand). This contributes to health issues and soil degradation

and makes agricultural production dependent on imported products.¹⁵³ In Thua Thien-Hue, an estimated 1.5% of the agricultural area produces commodities which are certified under an organic agriculture label.¹⁵⁴

42% of GHG emissions from agriculture in Thua Thien-Hue stem from rice cultivation. These emissions occur from decaying organic material in flooded rice fields and emissions from burning leftover rice straw. Nitrous oxide emissions from overuse of fertilisers add to the crop's GHG footprint.¹⁵⁵

Strategy

This intervention involves a mix of interventions aimed to support organic farming practices:

1. GHG emissions from rice production can be further reduced by expanding programmes which aim to reduce methane and nitrous oxide emissions from rice production in the Mekong Delta¹⁵⁶ to Thua Thien-Hue.
2. Reduce the combustion of rice straw and husks by using it in anaerobic digesters for biogas and organic fertiliser production under intervention 4, or by using it as a substrate for mushroom production after mixing it with chicken manure.¹⁵⁷ The high protein content of the mushrooms¹⁵⁸ make it an interesting substitute for animal protein under intervention 3.
3. Direct sales of food products between farmers and consumers can reduce food waste, reduce packaging and support organic farming practices.¹⁵⁹ Surveys on direct sales of food products indicate that consumers value product freshness and information on product origin and safety. Farmers on the other hand, 'value direct retail sales because it enables quick cash delivery and a higher share of the final price'.¹⁶⁰
4. Finally, this intervention aims to improve the resource efficiency of aquaculture and fish processing industries. Examples are rice-shrimp or rice-fish diversified systems.¹⁶¹

Policy framework

The government of Viet Nam is promoting the production of certified organic food commodities and the adoption of cooperatives with closer ties between producers and consumers. When providing support, the government prioritises agricultural entities which are organised as cooperatives or associations involving both producers and consumers, which produce certified organic products, or which produce certified products under the Viet Nam Good Agricultural

Organic certification of agricultural commodities can help to sustain the health of soils, ecosystems and people while adding value

Practice (VietGap) label¹⁶² or its global equivalent, Global GAP.¹⁶³

Existing initiatives within Thua Thien-Hue

Several companies in Thua Thien-Hue have adopted resource-efficient food production methods or are pioneering the production of new food commodities from organic residues. Examples are:

1. Huy Phuoc Group has created a 1-2 square metre hydroponic system to grow vegetables without soil. It can be installed in small gardens or balconies and is designed to require little maintenance and cater to people with busy lives.
2. Kim Long Community Garden (Kim Long ward, Hue City) has become a gathering place for farmers who practice organic farming. At this site, they teach each other how to grow organic vegetables which are directly sold to visitors, providing a stable income for the farmers.¹⁶⁴
3. M.A.I Organics has developed a value chain for sustainable and healthy organic food with traceable origins. The company has a farm that does not use harmful chemicals.¹⁶⁵
4. Le Xa Dong village hosts a concentration of mushroom farms producing straw, oyster and lingzhi mushrooms. More than half of the

households in the village use straw residues to produce mushrooms, earning around US\$850-1,200 a year.¹⁶⁶

5. Rice intensification programmes and climate-smart agriculture practices aimed to improve the efficiency of rice production. Unlike the 1M-5R (One Must Do, Five Reductions) programme from the Mekong Delta¹⁶⁷, Thua Thien-Hue did a pilot with the 3R-3I (Three Reductions, Three Increases) approach covering 106 hectares. Reducing fertilisers, pesticides and rice varieties allowed for stable yields or small increases.¹⁶⁸

At a national level, the Food and Agriculture Organisation (FAO) has developed initiatives ranging from media engagement promoting healthy diets to developing sustainable wetland agriculture and a national soil health action plan.¹⁶⁹

Inspiring circular economy examples

Several examples from outside Thua Thien-Hue support findings from Viet Nam on the value of organic production methods:

1. Long Sinh company in Nha Trang, Viet Nam, produces a bio-fertiliser from seafood waste.¹⁷⁰
2. The application of organic fertiliser in Bogor, Indonesia, demonstrated that the use of organic fertilisers from market waste can support a rice

intensification programme and deliver higher yields than conventional rice cultivation.¹⁷¹

3. The use of rice husks and straw to grow mushrooms in the Philippines and Cambodia.¹⁷²

4. The Community Supported Agriculture network involve consumers in the production of food commodities and communicates on sustainable farming interests.¹⁷³ Examples are 'De Nieuwe Ronde' near Wageningen in the Netherlands¹⁷⁴ and 'Kattendorfer Hof' near Hamburg in Germany.¹⁷⁵ Bypassing traders can make healthy and sustainably produced food available at prices below that in grocery stores.¹⁷⁶ This concept helps increase consumer confidence in food quality and safety, and surveys indicate that this is a key concern for Vietnamese consumers.¹⁷⁷

Next steps

This intervention includes seven activities:

1. Explore options to strengthen the link between producers and consumers with the objective of expanding the area under organic farming, reducing food losses and waste and reducing packaging. Direct farmer-consumer relationships can be supported by making low-cost shops or market stalls available to certified farmers and by allocating public resources to the development

⑤ PRIORITISE ORGANIC, RESOURCE-EFFICIENT AGRICULTURE

→ Food and agriculture

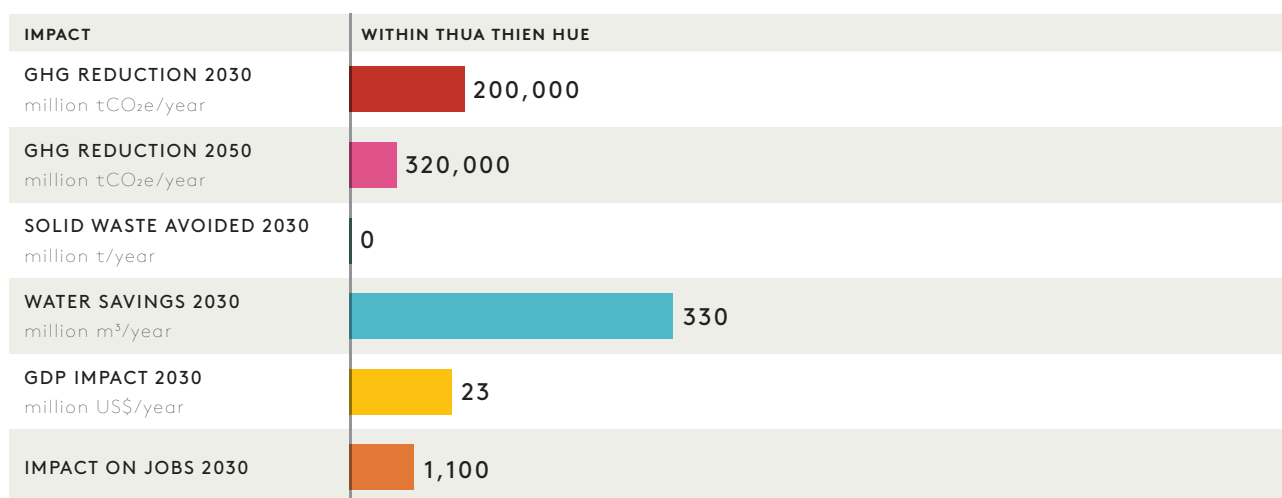


Table 7: Overview of impacts from prioritising organic, resource-efficient agriculture^{22,190}

of farmers' markets and quality certification. The focus can initially be on peri-urban areas.¹⁷⁸

2. Develop policies to promote the organic production of specific crops like rice and specialty crops.
3. Perform a critical assessment of organic and sustainable farming standards to ensure that the standards selected properly address environmental, climate and perhaps social issues, perhaps inspired by the example from the European Parliament.¹⁷⁹ Launch awareness campaigns on organic and sustainable farming to improve awareness.
4. Conduct further research on sustainable smallholder farming with organic fertilisers.¹⁸⁰
5. Replicate the 3R-3I or the 1M-5R program within Thua Thien-Hue to reduce GHG emissions from rice production.¹⁸¹
6. Provide extension services to rice farmers and communities to address the knowledge gap related to using rice husks and straw as a substrate for mushroom production.¹⁸²
7. Explore opportunities for closed loop aquaculture, like adopting Best Aquaculture Practices certification,¹⁸³ improving the circularity of fish feed production and valorising by-products from seafood production and processing.¹⁸⁴ Draw from lessons learned in the region, including other provinces in Viet Nam.¹⁸⁶

Potential impact

The impact of this intervention focuses on rice and maize cultivation, since these two crops occupy around 82% of the agricultural area in Thua Thien-Hue. The 3R-3I programme can reduce chemical use by 9%¹⁸⁷ and alternate wetting and drying¹⁸⁸ can reduce emissions from rice production by 48%.¹⁸⁹ These values have been used as a proxy of what organic, resource-efficient farming can deliver to consumers, the environment and the economy of Thua Thien-Hue.

Contributions to the SDGs are mainly related to hunger, food security and health, including savings on health expenses.¹⁹⁰

- SDG 2.1. End hunger and ensure access by all people to safe, nutritious and sufficient food all year round
- SDG 2.4. Ensure sustainable food production systems and implement resilient agricultural practices
- SDG 2.5. Double the agricultural productivity and incomes of small-scale food producers
- SDG 3.9. Reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil contamination
- SDG 6.3. Improve water quality by reducing pollution
- SDG 6.4 Substantially increase water-use efficiency across all sectors



INTERVENTION TARGET SECTORS

→ Transport



19%

Transport contributes to 19% of GHG emissions from Thua Thien-Hue

3.6 Intervention 6: Make way for active and public transport

Transport contributes to 19% of GHG emissions from Thua Thien-Hue and road transport plays a dominant role.¹⁹² With major infrastructural investments planned and a vehicle fleet growing at an annual rate of 9.5%, this share is likely to increase further. This is in line with global trends, where the steady growth of transport emissions resumed after a brief decline in 2020 due to COVID.¹⁹³

The rapid growth of private car ownership in Thua Thien-Hue comes at a price. Car drivers and motorcyclists enjoy flexibility and comfort, but these modes of transport have the highest spatial footprint per user, create the most congestion, pollution, injuries¹⁹⁴ and noise¹⁹⁵, and do not offer benefits such as improved health and urban liveability.¹⁹⁶

In the long run, building more roads like in Hanoi¹⁹⁷ will not resolve traffic congestion. New roads attract more traffic in a process called ‘induced demand’.¹⁹⁸ The former mayor of Bogotá, Enrique Peñalosa, has commented that ‘trying to solve traffic problems by building more roads is like putting out a fire with gasoline.’¹⁹⁹

Strategy

The only way out of the induced demand issue is to expand modes of transport with a smaller land and environment footprint and a positive effect on health and living conditions. According to the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), the future of Asia’s transport sector lies with public and active transport.

A focus on active and public transport helps keep mobility accessible to all parts of society. Transport systems which benefit mainly higher-income groups aggravate inequality. Next to this, lower-income groups are often disproportionately affected by the negative impacts of transport systems, like noise pollution and even injuries.²⁰⁰ UNESCAP recommends municipalities to shift away from building infrastructure that focuses on private transport, which benefits only a few. Instead, the focus should be on public transport and active mobility and on promoting a compact urban development pattern with mixed functions.²⁰¹

Since mobility relies on infrastructure, it is important that investments in infrastructure will support an ambition for a sustainable

and inclusive mobility system whereby sunk investments are avoided. A sunk investment does not contribute to the stated policy objectives. An example is when investments in more roads to ease congestion attract more transport movements, which pushes congestion back to its pre-investment level. UNESCAP underscores the need for rapidly developing cities to slow the pace of motorization, especially during periods of rapid economic growth and urbanization. The dense cities throughout Asia are particularly vulnerable to the negative impacts of traffic.²⁰² When investing in public and active transport, Hue City is aligning itself with a global trend.²⁰³

Policy framework

Thua Thien-Hue is investing in its public transport network. In 2023, it stipulated the following policy objectives:

1. Develop programmes and policies for the transition to vehicles running on electricity and green energy.
2. Develop green transport infrastructures.
3. Improve energy efficiency and GHG emissions reduction.
4. Strengthen international cooperation, science and technology and develop human resources and communication.²⁰⁴

Plans to develop a public passenger transport network in Thua Thien-Hue province up until 2030 prioritise buses in Hue City, stating that 'developing public transport by bus is an important and strategic task... in order to build a civilized, modern, and worthy Hue City'.²⁰⁵

Existing initiatives within Thua Thien-Hue

In 2022, Hue City launched a bike-sharing programme. The initial seven stations with 10-20 bicycles each will be expanded to 20 stations by the end of 2023. The system is expected to serve both tourists and residents of Hue City, and is an initiative by the People's Committee of Hue City, the German Development Cooperation Agency (GIZ), and the Vietsoftpro Joint Stock Company.²⁰⁶

From April 2023, the Phuong Trang Bus Joint Stock Company started operating ten new bus routes in the province with new and modern buses. With the new bus lines, the company aims to encourage people to use public transport, limit the use of personal vehicles and reduce traffic congestion and environmental pollution while 'bringing a new and civilized appearance to urban traffic'.²⁰⁷

The only way out of the induced demand issue is to expand modes of transport with a smaller land and environment footprint and a positive effect on health and living conditions

The government of Thua Thien-Hue and Da Nang support intercity bus routes between Hue and Da Nang. The line previously used old cars and faced issues with the quality of its services, traffic safety and emissions. The deployment of new cars and increasing frequency is making the bus a more attractive option. The Hanoi Tourism Joint Stock Company has launched a pilot service for transporting tourists by open-roofed double-decker bus in Thua Thien-Hue province, with three vehicles allowed to operate regularly.²⁰⁹

Finally, urbanist firm AREP developed a concept proposal for a 'Tram-Train' to use the existing railroad as a light rail or tramline optimising the utility of existing infrastructure. It would be around 60km long and connect Hue City with the airport and places along the railway further north and south.²¹⁰

Inspiring circular economy examples

Other cities are also following a development model which prioritises active and public transport. Ho Chi Minh City, for example, has six million motorbikes which clog walkways when parked. To respond to this issue, the city

is investing in bus rapid transit and in active and shared mobility, aiming to bypass the car-dependent development stage. Public and active transport should also provide a solution to the large number of motorbikes in the city. Nevertheless, in 2016 motorbike accidents in Viet Nam were called the ‘hidden epidemic’.²¹¹

Taipei has invested in a public bike-share scheme to double the modal share of cycling and reduce motorbike use. It is implementing 500km of bike lanes, with YouBike stations always within 10 minutes’ walking distance of each other.²¹²

Car-free zones are sometimes opposed by local businesses fearing that their turnover might suffer, but a case study from Seoul on establishing car-free zones showed that this did not negatively affect businesses. The mayor described this car-free policy as launching the transition to a human-centred city.²¹³ Along the same lines, Wired magazine referred to public responses to car-free city initiatives as ‘people hate the idea of car-free cities—until they live in one’.²¹⁴

Next steps

The following interventions aim at further expanding the modal share of public and non-

motorised transport:

1. Prioritise public and active or non-motorized transport investments over private transport-oriented investments and invest in public transport infrastructure, safe bike lanes and pedestrian lanes.²¹⁵
2. Develop peripheral parking facilities.²¹⁶ Slow car traffic to make active transport safer and increase the cost of parking to reflect the true cost of car use in urban centres.²¹⁷ Following the example of Seoul, consider pilot projects with car-free streets and districts in Hue City.
3. Urban planning should be based on a clearly articulated roadmap for sustainable, safe and healthy urban mobility. City planning should aim to reduce transport demand and establish the prerequisite for efficient and equitable mobility systems.²¹⁸ Urban planning decisions can be based on data provided by the Asian Development Bank under the Asian Transport Outlook project.²¹⁹
4. Consider joining the ICLEI EcoMobility Alliance to learn from peers.²²⁰
5. As part of interventions 13 and 14, communicate with the public on the benefits of a circular, sustainable transport system. People with access to such a system:
 - a. enjoy a greater proximity between where they live, work, and play;

⑥ MAKE WAY FOR ACTIVE AND PUBLIC TRANSPORT

→ Transport

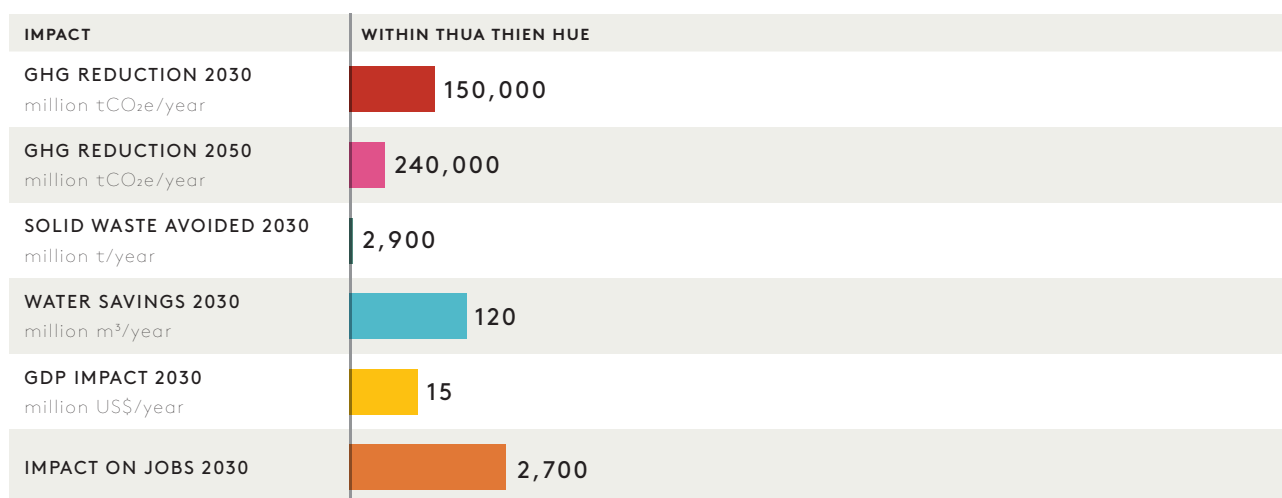


Table 8: Overview of impacts from making way for active and public transport^{22,230}

- b. have cleaner air as vehicles switch to zero-emission engines and congestion is reduced as shared transit increases;
- c. can improve their health and interactions with local businesses and communities as more people walk and cycle to work; and,
- d. free up valuable land previously dedicated to roads and car parks for green spaces, commerce, offices, houses and recreation.²²¹

Potential impact

Passenger transport makes up around 61% of all transport.²²² The interventions proposed are assumed to benefit mainly the 53% urban population in Thua Thien-Hue. The GHG emission reduction potential is estimated at 12% from optimised bus rapid transit and rail,²²³ 21% from avoid-and-reduce options²²⁴ and 15% from lowering the maximum speed.²²⁵

Prioritising public and active transit supports individuals with access to existing jobs. Investing in public transportation itself is also proven to create jobs.^{226 227} Per dollar invested, public transit produces roughly 20% more jobs than investing in roads.²²⁸ According to the World Bank, such investments create 'broader ripple effects in the economy like greater bargaining power for workers and shifts in the labour force from informal- to formal-sector jobs'.²²⁹ The expected contributions to SDG targets are in line with these findings.

- SDG 3.6. Halve the number of global deaths and injuries from road traffic accidents
- SDG 9.1. Develop reliable, sustainable and resilient infrastructure, with affordable and equitable access for all
- SDG 9.a. Facilitate sustainable and resilient infrastructure development in developing countries
- SDG 11.2. Provide access to safe, affordable, accessible and sustainable transport systems for all
- SDG 11.6. Reduce the adverse environmental impact of cities, including by paying special attention to air quality
- SDG 11.a. Support positive economic, social and environmental links between urban, peri-urban and rural areas



INTERVENTION TARGET SECTORS

→ Transport

9%

In Thua Thien-Hue, the private vehicle fleet is growing at a rate of 9% per year



3.7 Intervention 7: Optimise vehicle utility/efficiency and electrify the fleet

Southeast Asian cities suffer from congestion and traffic-related pollution and are experiencing growth in private car ownership rates. Cities lack the space to support widespread private car ownership. In Thua Thien-Hue, the private vehicle fleet is growing at a rate of 9% per year. At this pace, the fleet size will double every eight years. That growth will continue to run into the limits of what infrastructure can support.

Electrification is an important part of making transport more sustainable. The scarcity of key minerals for electric vehicles, however – namely lithium, magnesium, neodymium, praseodymium and dysprosium^{231 232}, – limits the extent to which electrification can reduce transport emissions when mobility relies on structurally underused private vehicles (research from the United Kingdom found that a car is only used for 4% of its lifetime).²³³ Resource scarcity will persist even when recycling rates increase, since there is competition between sectors. Electric vehicles require some of the same key minerals as solar and wind power assets.²³⁴

Electrifying transport is only possible when addressing the exceptionally low use rate of privately-owned vehicles. In addition to the options listed in intervention 6, this can be done with new business models based on mobility-as-a-service, vehicle sharing and shifting to lighter electric vehicles.²³⁵

Strategy

Replacing internal combustion engine vehicles with electric vehicles requires improvement in the utility rate of vehicles. With mobility-as-a-service ride-hailing and car-sharing, consumers shift from ownership towards access to mobility.²³⁶ These models require smaller vehicle fleets that deliver similar service levels at higher vehicle utility rates. The higher use intensity of the vehicles accelerates the replacement rate of the smaller fleet. This will pave the way for accelerated electrification and require less of the scarce minerals which are required for electric vehicles.

Secondly, when electrifying a car fleet, it is important to regulate its energy efficiency to avoid excessive power use. The weight and aerodynamics of an electric car are the two determining factors for its energy use.²³⁷ The EU has adopted legislation

to regulate the GHG emissions of vehicles with combustion engines.²³⁸ Since the energy efficiency of electric vehicles is not yet regulated, the electrification of cars risks reversing a trend towards more efficient vehicles by increasing electric vehicle size, weight and power. Such trends will ramp up demand for electricity from preferably renewable sources. In an electric vehicle market where vehicle efficiency is not regulated, or is made subject to vehicle size or weight like in the EU, it is unrealistic to assume that electrification will yield environmental benefits.

According to the International Energy Agency, the sale of heavier passenger cars in recent years erased all environmental gains from improved vehicle efficiency over recent decades.²³⁹ A higher-than-expected adoption of large passenger vehicles in the US made transport exceed all emission targets set by the Obama administration.²⁴⁰ Viet Nam can avoid such mistakes by regulating vehicle efficiency regardless of size and weight.

Another argument to regulate vehicle size and efficiency is that larger and heavier passenger cars are more dangerous to cyclists and pedestrians. This relates to their increased engine capacity and high front-end design.²⁴¹ The increasing popularity of such vehicles can frustrate ambitions to promote active transport and keep roads safe for all users, including children.

Policy framework

Decision No. 876/QĐ-TTg from 2022 targets emissions from transport. It has the following policy objectives:

1. Develop programs and policies for the transition to vehicles running on electricity and green energy;
2. Develop green transport infrastructures;
3. Improve the energy efficiency and GHG emissions reduction;
4. Strengthen international cooperation, science and technology, develop human resources and communication.²⁴²

In 2018 Viet Nam reduced the Special Consumption Tax (SCT) for cars with an engine size below 2.0 litres. With that policy, the government already makes a distinction related to characteristics like car size or weight, engine size and emissions.²⁴³

Existing initiatives within Thua Thien-Hue

In May 2023, the Green and Smart Mobility Joint Stock Company (GSM) put more than 200

electric taxis into operation in Thua Thien-Hue. In addition, UNDP is piloting the use of electric bikes under its green e-transportation initiative. This includes a pilot e-bike sharing scheme with 500 e-bikes at 50 stations.²⁴⁴ UNDP is also supporting the adoption of electric waste trucks²⁴⁵ and electric delivery motorbikes.²⁴⁶

Ride-sharing is a very familiar concept in Viet Nam, but vehicle-sharing is less common. The MIOTO vehicle-sharing platform connects drivers and passengers to increase the utility rate of vehicles.²⁴⁷ Other ride-sharing applications include Be, Gojek and Grab.²⁴⁸

Inspiring circular economy examples

GetGo from Singapore recognises that electrifying car fleets should be combined with improving utility rates.²⁴⁹ The company deploys electric vehicles as part of a mobility service scheme.²⁵⁰

The city of Boston has developed Good2Go, an electric car-sharing system which makes cars available at rates below the costs of ownership. The programme offers a discount to low-income users²⁵¹ and aims to help people to be less dependent on cars, reduce residents' carbon footprint and reduce gasoline-related pollution.²⁵²

The Dutch government has conducted a car-sharing pilot in the town of Wageningen. The pilot demonstrated that car-sharing results in a reduction in demand for parking because (second) car ownership decreases. The number of kilometres driven by a car decreased because people became more critical about their use of cars.²⁵³

Next steps

The accelerated adoption of circular business models in transport could involve the following steps:

1. Provide seed funding to car-sharing initiatives, reduce parking fees for shared vehicles and provide priority parking space for shared vehicles. The government could also consider providing exclusivity to electric and non-motorised vehicles when providing access to specific historic, monumental and religious sites and natural parks.
2. Explore the aspects of car culture and adopt policies which aim to avoid the cultural institutions that have coalesced around the private car and continue to exert a profound influence on people's choices and behaviours. According to researchers from Dortmund

University, these institutions encourage people to travel by car even if there are other options available which are superior in terms of price, convenience, and societal and environmental impact.²⁵⁴ Such interventions could also be part of a communication package under intervention 13.

3. The government could consider establishing a fund to invest in infrastructure which supports the electrification of the transport sector. This could include investing in charging stations and continuing efforts to electrify buses and motorcycles.²⁵⁵

4. Strong policies, such as a tax or even a restriction or future ban on the ownership or use of internal combustion engines in passenger vehicles, are needed to accelerate the electrification of the transport sector.²⁵⁶ As similar efforts are made globally, demand for transport fuels may decrease, which could improve their availability.²⁵⁷ Policies will have to anticipate the rebound effect of lower fuel prices or improved availability, while on the other hand protecting those sections of the population that are vulnerable to changes in transport costs and lack the means to adapt. Incentives for the electrification of vehicles should not encourage private car ownership.

5. Regulating vehicle efficiency is in line with Decision No. 876/QĐ-TTg of the national government of Viet Nam, which aims to improve the energy efficiency of vehicles. It would also help ensure that scarce resources for electric vehicles remain accessible to a larger part of the population.

Potential impact

Mobility as a service is estimated to be able to reduce GHG emissions by 49% in an optimistic scenario. For this impact analysis, the more conservative 17% has been applied²⁵⁸ to the passenger transport-related emissions remaining when implementing intervention 6 completely. A full ban on combustion engines is expected to reduce GHG emissions by another 15%.²⁵⁹ Jobs may decrease slightly when implementing these interventions, but combined with intervention 6, overall employment in transport would still increase.

The intervention contributes to five SDG targets in particular:

- SDG 9.a. Facilitate sustainable and resilient infrastructure development in developing countries
- SDG 11.2. Provide access to safe, affordable, accessible and sustainable transport systems for all
- SDG 11.4. Strengthen efforts to protect and safeguard the world's cultural and natural heritage
- SDG 11.6. Reduce the adverse environmental impact of cities, including by paying special attention to air quality
- SDG 11.a. Support positive economic, social and environmental links between urban, peri-urban and rural areas

⑦ OPTIMISE VEHICLE UTILITY/EFFICIENCY AND ELECTRIFY THE FLEET

→ Transport

IMPACT	WITHIN THUA THIEN HUE
GHG REDUCTION 2030 million tCO ₂ e/year	210,000
GHG REDUCTION 2050 million tCO ₂ e/year	330,000
SOLID WASTE AVOIDED 2030 million t/year	0
WATER SAVINGS 2030 million m ³ /year	34
GDP IMPACT 2030 million US\$/year	57
IMPACT ON JOBS 2030	-100

Table 9: Overview of impacts from optimizing vehicle utility and electrifying the fleet^{22, 260}



INTERVENTION TARGET SECTORS

→ Waste management, packaging industries, wholesale and retail

33%

The recycling rate of recyclable materials in Thua Thien-Hue Province is below 33% for plastics, 80% for steel packaging and 15% for glass bottles

3.8 Intervention 8: Avoid waste and maximise recovery

Hue City is regarded as a national leader in solid waste management. About 95% of the waste generated is presently being collected and transported.²⁶¹ The figures for the wider province are likely different, since waste collection in less densely populated areas is often less developed.²⁶²

Part of the collected waste are materials which can be recycled. The main recyclable fractions in solid waste are paper, glass, metals and plastics. The recycling rate of recyclable materials in Thua Thien-Hue Province is below 33% for plastics,²⁶³ 80% for steel packaging and 15% for glass bottles.²⁶⁴ A large fraction of the waste volume is organic waste. That waste flow is addressed in intervention 4, while this one focuses on the recyclable materials.

Waste statistics in Thua Thien-Hue are uncertain. A recent report on nearby Da Nang city indicated that littering is a major source of plastic pollution, along with illegal dumping.²⁶⁵ Such practices make it harder to quantify waste volumes while

exacerbating the environmental impacts of waste disposal. These practices may also occur within Thua Thien-Hue province, complicating efforts to collect accurate and reliable waste statistics.

Strategy

This intervention aims to reduce waste volumes by avoiding waste and further improving the recovery, sorting and recycling of recyclable materials that are currently sent to landfills or incinerated. The climate impact of this intervention results from the increased use of secondary materials, which have a lower carbon footprint than materials of primary origin.

Policy framework

In its National Action Plan for the Management of Marine Plastic Litter, the government of Viet Nam committed to cutting marine plastic litter by 50% by 2025 and by 75% by 2030. Part of the plan is to ban single-use plastics from coastal tourism destinations and protected marine areas from 2025 onwards, and to collect and remove 100% of discarded fishing gear.²⁶⁶ Additionally, the government will ban the production and import of non-biodegradable plastic bags for domestic consumption starting in 2026. From 2031 onwards, all single-use plastics will be banned.²⁶⁷

In support of these waste reduction ambitions, a more recent decision requires the segregation of waste along four groups: recyclables (plastics, metals, paper and glass), food waste, hazardous waste (e.g., fluorescent bulbs and broken electronic devices) and a residual category.²⁶⁸ Finally, the Government of Thua Thien-Hue province has requested government bodies not to use single-use bottled drinking water in offices as well as meetings and conferences.

Existing initiatives within Thua Thien-Hue Hue City, and Thua Thien-Hue Province more broadly, have hosted several initiatives to reduce waste pollution. In Hue City, source separation and the submission of sorted waste is encouraged with gifts in a US\$2.7 million programme supported by the World Wildlife Fund, the Viet Nam Packaging Recycling Alliance and the Viet Nam Industrial Park and Urban Environment Association (VUREIA). The objective is to avoid plastic waste altogether by 2030 while achieving a 70% reduction by 2024.²⁶⁹

UNDP's Ending Plastic Pollution Innovation Challenge (EPPIC) targets plastic pollution across six countries in Southeast Asia with a combination of direct interventions to reduce plastic pollution, capacity building, improving the legal context and supporting innovation.²⁷⁰ Innovations supported range from biodegradable packaging and straws to refill solutions.²⁷¹ The initiative includes Viet Nam and Thua Thien-Hue Province. Hue City itself has also launched several initiatives to stimulate the adoption of new solutions for plastic pollution and to explore options for packaging waste reduction at shops.²⁷²

The town of Huong Thuy just south of Hue City is investing US\$72 billion in a waste incineration facility which can combust 600 tonnes/day. The plant aims to reduce the volume of waste sent to landfills, solving the issue of landfills in the region having come close to reaching their full capacity.²⁷³ Although the plant will operate with energy recovery, waste incineration is a last-resort option in the hierarchy of waste management. According to some organisations, it is prone to creating a lock-in effects²⁷⁴ which stand in the way of a transition to zero-waste.²⁷⁵ Waste incineration can also aggravate air pollution.²⁷⁶ With waste issues and marine plastics getting out of hand, and the impact of national waste reduction programmes still to mature, for communities like Huong Thuy it is like choosing between a rock and a hard place.

The Women's Union has pioneered a waste segregation-at-source and composting model in Quang Dien district in Hue City. Part of the model is treating organic waste at home, along with separating and delivering recyclable waste.²⁷⁷

Inspiring circular economy examples

A community initiative to set up a grocery store in the Dutch city of Amersfoort which relies solely on products from the region has culminated in a shop which is also largely packaging-free. The shop provides bulk food like rice, pasta and lentils in refill containers and offer re-useable packaging solutions for most of the products it sells.²⁷⁸ Similar examples have emerged in Kadikoy Municipality in Greece, which now has a community-based zero-waste shop,²⁷⁹ shop owners in Ho Chi Minh City who encourage their customers to bring their own packaging containers²⁸⁰ and various packaging-free shops in Viet Nam.²⁸¹

Since July 2023, food and beverage take-away services in the Netherlands are no longer allowed to use disposable single-use cups, packaging and containers. They need to offer reusable alternatives and encourage customers to bring their own cups and containers.²⁸²

Within the project 'Reducing plastic waste in agricultural production and business activities in Hue City' funded by the World Wildlife Fund, the Hue City Farmers' Union cooperated with the Farmer's Store and the Green Alliance Store to build the first refill station in Hue City. The objective is to reduce plastic waste through new sales methods.

Next steps

By imposing bans on certain wasteful products, the government of Viet Nam is not placing the burden of waste management onto communities, but rather forcing packaging producers and distributors of single-use plastics to avoid disseminating products which end up as waste. In this way, it adopts a precautionary principle: taking measures to prevent waste without waiting for scientific evidence²⁸³ tying the production of certain products to the harm done to the environment. Tight regulations on the sources of the pollutants promise to be more effective than merely trying to manage the waste itself.

It is also important not to place the burden of cleaning up waste on the national budget.

Extended Producer Responsibility (EPR) could help retrieve the costs from the producers. Viet Nam has set a timeline for implementing EPR for packaging starting from 1 January 2024, as per Decree 08/2022.

Activities which can support the Government of Viet Nam with targeting the sources of plastic pollution are:

1. Support shops which use refill stations and encourage customers to bring their own packaging to minimise waste. This can be an intermediate step towards a phase-out and eventual ban on single-use plastics and packaging in retail. The development of zero-waste shops is considered and could perhaps be supported under the EPPIC programme.
2. Develop a national or provincial 'zero waste action plan' building on the soon-to-be developed Sustainable Solid Waste Management Strategy, as well as regional examples from Thailand, Singapore and Malaysia.
3. Gradually implement a 'polluter pays' principle by which producers, distributors and perhaps consumers in the province are held responsible for the illegal disposal of waste, or the mere presence of waste which holds their logos at unregulated disposal sites or in marine environments.
4. Thua Thien-Hue is investing in centralised trade centres and supermarkets.²⁸⁴ This development could be regulated with ambitious requirements on food loss and waste reduction and to minimise the use of packaging by

requiring refill stations for all commodities where technically possible.

5. Since Thua Thien-Hue will invest in improving separation at the source, the accessibility of recyclable materials will improve. The province can invest in a collection and recycling centre to create value out of segregated waste flows and create jobs.

Other possibilities which target the waste issue itself can mitigate the damage done by historic pollution. These include efforts to increase the recovery rate with initiatives like Fishing for Litter.²⁸⁵ Other options would be to support communities to increase their waste collection rate, sorting efficiency and recycling of post-consumer recyclables. This could take a decentralized approach following the guidelines from WasteAid, a British charity created to share low-cost waste management know-how with communities in low-income countries.

Potential impact

The impact of current government measures and the implementation of recent regulations from the national government in Thua Thien-Hue province have been estimated by assuming that by 2030 plastic waste production is reduced by 50% while 50% of all remaining recyclables are recovered and recycled. From 2035 onwards, this percentage increases to 100%. This is a consequence of applying a precautionary principle with bans on single-use packaging and products which are

⑧ AVOID WASTE AND MAXIMISE RECOVERY

→ Waste

IMPACT	WITHIN THUA THIEN HUE
GHG REDUCTION 2030 million tCO ₂ e/year	0
GHG REDUCTION 2050 million tCO ₂ e/year	0
SOLID WASTE AVOIDED 2030 million t/year	46,000
WATER SAVINGS 2030 million m ³ /year	0
GDP IMPACT 2030 million US\$/year	25
IMPACT ON JOBS 2030	3,600

Table 10: Overview of impacts from avoiding waste and maximising recycling^{22, 286}

harmful to the environment and by enforcing a liability to clean up pollution by the producers from which pollutive products and packaging originate.

Most packaging products are produced outside of Thua Thien-Hue. In result, the emission reductions and water savings from waste avoidance mature largely outside of the province. Waste reduction does benefit the province while cost savings and value recovery from recycling support new economic activities and jobs. What is not accounted for is the extent to which avoiding pollution sustains jobs which rely on undisturbed productive ecosystems like fishing grounds, soils, groundwater, etc. These jobs could be in fishing and agriculture but also in tourism.

Six SDG targets may benefit from this intervention.

- SDG 3.9. Reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil contamination
- SDG 6.3. Improve water quality by reducing pollution
- SDG 11.6. Reduce the adverse per capita environmental impact of cities
- SDG 12.5. Substantially reduce waste generation through prevention, reduction, recycling and reuse
- SDG 14.1. Prevent and significantly reduce marine pollution of all kinds,
- SDG 14.2. Sustainably manage and protect marine and coastal ecosystems



INTERVENTION TARGET SECTORS

→ Textiles, waste management

792 mln m³

The water footprint of the textiles industry in Thua Thien-Hue is estimated at 792 million m³



3.9 Intervention 9: Increase recycled and regenerative content in garments

The textiles industry and its products are a major global polluter. Around 20% of global industrial wastewater pollution comes from textile dyeing and finishing, and 35% of microplastics come from washing synthetic clothes.²⁸⁷ Viet Nam is the second-largest exporter of textiles and garments after China.²⁸⁸

Thua Thien-Hue produces an estimated 55,000 tonnes of textiles, most of which is destined for export.²⁸⁹ The sector contributes 3% to provincial GHG emissions. The water footprint of the textiles industry in Thua Thien-Hue is estimated at 792 million m³, making it one of the most water-intensive industries per tonne of product.²⁹⁰

The environmental impact of the textiles industry is increasingly raising public opposition. Local stakeholders increasingly oppose textile industries out of fear of pollution,²⁹¹ in particular related to the use of chemicals in the dyeing process and water pollution.²⁹² Such concerns are also prevalent in Thua Thien-Hue province. Other sources of pollution include the solid waste from the

production process. Cutting losses tends to make up 10-30%.²⁹⁴ Sometimes production contracts in the textiles industry require the destruction of excess raw materials.

Strategy

The Vietnamese garments industry relies predominantly on imported materials. Recycling materials and reducing losses will make the sector less dependent on foreign suppliers. Other strategies to reduce the environmental impact of this industry are related to reducing water pollution by using modern technologies in the dyeing process.

There is also an issue on the side of retail, marketing and the consumer behaviour which they stimulate. The concept of fast fashion, or the mere notion that what is fashionable changes over time, is designed to shorten the lifetime of a product and aims to increase the volume of textiles consumed by customers, a concept that goes against the circular economy principle to make the lifetime of a product as long as possible. Initiatives which challenge that concept, like eco-friendly²⁹⁵ and durable textiles which are less sensitive to trends in fashion, should be supported.

Policy framework

The textiles industry in Viet Nam aims to reduce its environmental impact on a voluntary basis. This initiative is led by the Viet Nam Textile and Apparel Association (VITAS). By 2030, it aims to reduce energy consumption by 15% and water consumption by 20%.²⁹⁶ Viet Nam does not have specific legislation regarding textile waste.²⁹⁷

Existing initiatives within Thua Thien-Hue

Four initiatives support greening the textiles industry in Thua Thien-Hue:

1. Piktina is a marketplace in Viet Nam for second-hand clothing.²⁹⁸
2. Sustainable fashion brands across Viet Nam have adopted 'slow fashion', zero-waste production and preserving traditional values by relying on craft villages. Examples from Hue City are dragon shoes²⁹⁹ and Fashion4Freedom.³⁰⁰
3. Traditional repair industries support the lifetime extension of clothes.³⁰¹
4. Popular second-hand clothing markets in Hue include Xep Thuan Loc Market, Tay Loc Market, Ben Ngu Market, Dong Ba Market and Den Market.

Inspiring circular economy examples

Across Viet Nam and beyond, many more initiatives aim to reduce the environmental impact of the textiles industry.

1. Musa Pacta produces fashion accessories from banana fibre³⁰² and Bananatex is a waterproof fabric made from sustainably grown banana plant fibres³⁰³.
2. Well Fabric is a company producing and supplying a range of sustainable yarns and fibres using raw materials like bamboo, cotton and fibres from recycled textiles.³⁰⁴ In Viet Nam, Good Earth Cotton and Fibretrace use traceable and carbon-positive fibres.³⁰⁵
3. Free e-learning courses from GIZ FABRIC include 'Climate Action Training' and 'Chemical Management Training'.³⁰⁶
4. The EU Strategy for Sustainable and Circular Textiles contains requirements on eco-design which aim to reduce waste production in the textiles industry. It requires a certain recycled content, making garments easier to repair, as well as the use of digital product passports.³⁰⁷
5. RMIT University, which has locations in Hanoi and Ho Chi Minh City, is exploring new materials in its courses on sustainable fashion, such as textiles made from kombucha as a form of bacterial cellulose.³⁰⁸
6. Saitex is a clothes manufacturing company in Dong Nai that strives to run a textiles value chain

Sustainable fashion brands across Viet Nam have adopted preserving 'slow fashion', zero-waste production and preserve traditional values by relying on craft villages

with the lowest environmental impact. It runs a closed water system and sources primarily organic and recycled raw materials.³⁰⁹

Next steps

Viet Nam could start by defining what a slow, circular and sustainable fashion industry entails, and then work towards positioning itself with a realistic sustainable fashion profile on the international market. Triodos, a Dutch sustainable bank, defines sustainable fashion as a 'business model... build on the provision of valuable and durable products as sources of revenue. Corporate initiatives to increase the circularity and longevity of clothes include take-back programs, recycling and designs which incorporate re-use. Instead of chasing the lowest price and inciting mass consumption, fashion companies should create fashion awareness and appreciation.'³¹⁰

Concepts which could support the transition to such a textiles industry are a combination of:

1. Planning: developing a roadmap for selected products and commodities to increase recycled contents, together with cost-benefit analyses to promote the market of recycled products.
2. Technology: develop a database of Best

Available Technologies,³¹¹ implement fabric waste sorting and segregation at the factory level³¹², introduce water-saving and efficient methods to industrial parks, CO₂ dyeing³¹³ and reserve logistics for textiles.³¹⁴

3. Knowledge and cooperation: promote training from sources like GiZ,³¹⁵ establish a multi-sector Lancang-Mekong River Stewardship Collective on river-related risks and opportunities, establish a textile sector water partnership.³¹⁶

4. Sustainable sourcing: focus on increasing the availability of recycled textiles, increasing recycled content and production plant-based fibres like cotton, linen, sisal, hemp and Vietnamese banana fibre.

5. International cooperation: learn from initiatives nearby, like the textiles recycling centre in Singapore³¹⁷ or Switch Asia initiatives in textiles.³¹⁸

Potential impact

The impact has been defined as increasing the recycled content of garments by 20%, which is a target set by the WWF.³¹⁹ Increasing the share of plant-based fibres as well, notably those produced in Viet Nam, could yield even more emission reductions. Due to uncertainties on the availability, this option has not been included in the impact analysis.

Since most fibres and raw materials for the textiles industry are imported, the impact of the proposed interventions will largely reduce GHG emissions elsewhere. When prioritising local plant-based and recycled fibres, these products will substitute imports and reduce foreign emissions. The GHG emissions within Thua Thien-Hue could even increase, while emissions from primary production in other regions decrease. Thua Thien-Hue would reap the benefits in terms of water savings, value retention and perhaps jobs, although data is lacking to quantify the latter.

The intervention can contribute to five SDG targets.

- SDG 3.9. Reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil contamination
- SDG 6.3. Improve water quality by reducing pollution
- SDG 8.2. Achieve higher levels of economic productivity through technological upgrading and innovation
- SDG 8.4. Improve global resource efficiency and decouple economic growth from environmental degradation
- SDG 12.5. Substantially reduce waste generation through prevention, reduction, recycling and reuse

⑨ INCREASE RECYCLED AND REGENERATIVE CONTENT IN GARMENTS TO 20%

→ Garments

IMPACT	WITHIN THUA THIEN HUE
GHG REDUCTION 2030 million tCO ₂ e/year	0
GHG REDUCTION 2050 million tCO ₂ e/year	0
SOLID WASTE AVOIDED 2030 million t/year	0
WATER SAVINGS 2030 million m ³ /year	3.2
GDP IMPACT 2030 million US\$/year	24
IMPACT ON JOBS 2030	n/a

Table 11: Overview of impacts from increasing recycled and regenerative content in garments^{22,320}



INTERVENTION TARGET SECTORS

→ Tourism



8%

Tourism accounts for about 8 percent of global GHG emissions

3.10 Intervention 10: Pilot circular initiatives in tourism

The tourism sector is a major contributor to global GHG emissions. According to the journal *Nature Climate Change*, tourism accounts for about 8% of global GHG emissions, mostly from travel, shopping and food consumption. With an annual growth rate of 4%, it is outpacing the decarbonization potential of technological progress in the sector.³²¹

The environmental impact of tourism is a concern in Viet Nam, where tourists are attracted to the country's natural beauty. The tourism sector should be used as a lever to preserve the country's natural assets,³²² instead of a force which contributes to their rapid degradation. The number of tourist arrivals to Viet Nam is increasing rapidly, although it is still below levels from before the COVID-19 pandemic.³²³

Strategy

Ecotourism can help reduce tourism's environmental footprint. The tourism sector can also be a pilot sector to develop new initiatives on active transport,³²⁴ sustainable infrastructure like

cycling tracks,³²⁵ zero-waste initiatives, eco-design and sustainable architecture.³²⁶

Policy framework

A joint project by the Government of Viet Nam and the European Union has led to the formulation of policy guidelines for responsible tourism in Viet Nam. One recommendation is that the existing Tourism Law should be revised to make the sector more sustainable.³²⁷

Existing initiatives within Thua Thien-Hue

Thua Thien-Hue hosts several sustainable tourism initiatives:

1. Hue Eco Homestay aims to distribute sustainable accommodation more equally across Thua Thien-Hue. By raising environmental awareness, Hue Eco Homestay hopes to reduce the negative impact of tourism on the environment.³²⁸
2. Tourist can access a broad range of sustainable transport solutions, including bicycles, electric buses, trams and cyclos or rickshaws. These means of transport also provide convenient access to the region's natural and cultural heritage sites.³²⁹
3. 'Free Sanitation Points' for tourists on the central routes of Hue City make existing toilets at state agencies and homes available to tourists. In March 2023, 138 such points were opened.³³⁰

4. Two support programmes are the circular tourism initiative by the Department of Tourism in Thua Thien-Hue,³³¹ and the use of Village Development Funds to invest tourism revenues into community development.³³²

Inspiring circular economy examples

Several countries are already marketing themselves as high-end ecotourism destinations, trying to attract tourists who will have a smaller ecological footprint during their stay while perhaps even increasing revenues per visitor. Costa Rica offers ecolodges and eco-adventure holidays backed by a voluntary certification programme. The Dominican Republic prioritises the engagement of local communities by focusing on community-backed tourism development³³³, while Bali's initiatives involve efforts to reduce tourism-generated plastic waste.³³⁴

Closer to Thua Thien-Hue, the Hoi An Eco Hub is an information and education hub for environmental sustainability in Hoi An. The south of Thua Thien-Hue, Hoi An Kayak tourism company organises kayak tours combined with waste collection activities in Hoai River, and there has a restaurant called Sapu Hoi An which has converted 300 litres of waste oil into soap to date, and discourages tourists from bringing single-use plastics when travelling.³³⁵

Ecotourism itself can also be aimed at educating tourists on ecosystems and biodiversity, and ensuring that tourism contributes to environmental protection and the expansion of protected natural reserves

Next steps

Thua Thien-Hue could position itself as a prime ecotourism destination, focussing on attracting tourism operators and service providers which commit to a clear set of sustainable tourism criteria. This could involve incentivising existing tourism companies to comply with the same set of criteria within a few years, and perhaps considering certifying ecotourism initiatives.

Hue City has many educational institutes and can provide vocational training in ecotourism and hospitality, including training for local guides and accommodation providers. On the other hand, ecotourism itself can also be aimed at educating tourists on ecosystems and biodiversity and ensuring that tourism contributes to environmental protection and the expansion of protected natural reserves.³³⁶ Along those lines, the government can develop master plans for tourism in national protected areas, including solutions for managing waste from tourism activities and last-mile infrastructure and banning certain products from vulnerable areas which lack the waste processing capacity to manage non-native waste materials. The latter would be in line with the ban on single-use plastics in certain areas.

Finally, since tourism infrastructure and accommodation are typically located in vulnerable areas, the government could support modal shifts to active transport, electric transport and the use of locally-sourced, regenerative construction materials to help preserve the appeal of urban centres and sites with vulnerable nature for Vietnamese and foreign visitors.

Potential impact

The impact of circular economy interventions in tourism cuts across other sectors and industries like packaging, food processing, construction and transport. The impact is modest, considering that tourism contributes 2.2% to the Vietnamese GDP.³³⁷ The impact has been estimated by considering a breakdown of the GHG emissions from tourism into different elements like travel, accommodation and food.³³⁸ For each of these items, the mitigation potential has been obtained from earlier interventions or from literature.³³⁹ The impact is not unique, however, and overlaps with impact estimates in other interventions.

Qualitative impacts can likely be seen across the following SDG targets.

- SDG 4.7. Ensure that all learners acquire the knowledge and skills needed to promote sustainable development
- SDG 6.4. Substantially increase water-use efficiency across all sectors
- SDG 6.3. Improve water quality by reducing pollution
- SDG 8.9. Devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products

⑩ PILOT CIRCULAR INITIATIVES IN TOURISM

→ Tourism

IMPACT	WITHIN THUA THIEN HUE
GHG REDUCTION 2030 million tCO ₂ e/year	5,900
GHG REDUCTION 2050 million tCO ₂ e/year	9,700
SOLID WASTE AVOIDED 2030 million t/year	9,200
WATER SAVINGS 2030 million m ³ /year	1.8
GDP IMPACT 2030 million US\$/year	n/a
IMPACT ON JOBS 2030	n/a

Table 12: Overview of impacts from piloting circular initiatives in tourism^{22, 340}



INTERVENTION TARGET SECTORS

→ Government

US\$ 300 mln

Government and private sector invest an estimated 300 million US\$ per year into Thua Thien-Hue province



3.11 Intervention 11: Mainstream circular procurement

The government and private sector invest an estimated US\$300 million per year into Thua Thien-Hue province. The carbon footprint of these investments in new roads, bridges, residential areas, port and industrial facilities, trade centres and tourist accommodations is estimated at around 275,000 tCO₂e/year.²²

Strategy

As a major investor, the government has an opportunity to accelerate the adoption of circular construction methods. Promoting circular procurement, such as by incorporating criteria to reduce the carbon footprint of capital investments, can reduce this impact. The government can further promote the adoption of circular economy criteria by making them part of its issuance of licences and permits.

Circular procurement involves integrating circular economy requirements into the procurement of goods and services. It aims to offer a competitive advantage to more sustainable products and service providers in procurement processes.³⁴¹

Examples of such requirements include minimizing GHG emissions throughout the whole lifecycle of the investment. This includes reductions in embodied and operational GHG emissions.³⁴² Beyond the built environment, government can demand a certain amount of recycled or regenerative content in products, requiring that packaging is compostable, or requiring a take-back scheme for the end of a product's lifetime. As such, governments can drive change alongside many of the interventions listed above.

Policy framework

Existing policies on public procurement in Thua Thien-Hue focus on procurement efficiency and avoiding financial losses.³⁴³ Recently, the Government of Thua Thien-Hue has started integrating sustainability into the procurement modalities of the province. Two examples are:

- To reduce GHG emissions related to new construction, all provincial departments, boards and agencies, district-level People's Committees, towns and cities in Hue are required to increase the use of non-fired construction materials.³⁴⁴
- The authorities and public offices in the province are required to refrain from using

single-use bottled drinking water (with a capacity of 330-500 ml) in the workplace and during meetings, conferences, and seminars. Instead, they are expected to use large water containers with a capacity of over 20 litres. The province also prohibits the use of plastic bags and disposable wipes in all public institutions' activities.

The national government is aware of the role which government expenditures and investments can play in creating demand for circular products and infrastructure. To date, the focus is on minimising the environmental impact of projects, but environmental criteria could have a more decisive role, for example by making the environmental aspects an important selection criterion.³⁴⁵

Existing initiatives within Thua Thien-Hue
Existing government initiatives to support circular procurement are listed in the policy framework section above.

Inspiring circular economy examples

The government of Thailand adopted a Green Public Procurement Promotion Plan. This plan includes

1. specific targets for green procurement;
2. rewards for offices with good green public procurement performance;
3. rewards for manufacturers or service providers that consistently deliver green products or services;

4. comprehensive targets and metrics related to the performance of the Green Public Procurement Promotion Plan, including measuring national expenditures on green products and estimating the GHG emissions saved by green procurement;
5. an electronic platform for managing green public procurement information;
6. a database of green products and services;³⁴⁶ and,
7. training workshops

Next steps

National and sub-national government bodies in Viet Nam could use their role as investors and major buyers of goods and services to accelerate the transition to a circular economy with three measures:

1. Integrate circular principles, such as resource efficiency, low-carbon design³⁴⁷ and passive design into the procurement of architecture and construction services, which is where most of the potential lies. Try to expand circular procurement to circular products when it comes to gifts, equipment, etc.
2. Integrate green procurement requirements into existing public procurement policies based on regional examples such as the Thai Green Public Procurement Promotion Plan or Malaysia's Green Government Procurement Guidelines. Develop clear product criteria and ecolabelling schemes that simplify the green public procurement process.
3. Train government procurement officials

⑪ MAINSTREAM CIRCULAR PROCUREMENT FOR NEW INFRASTRUCTURE

→ Government

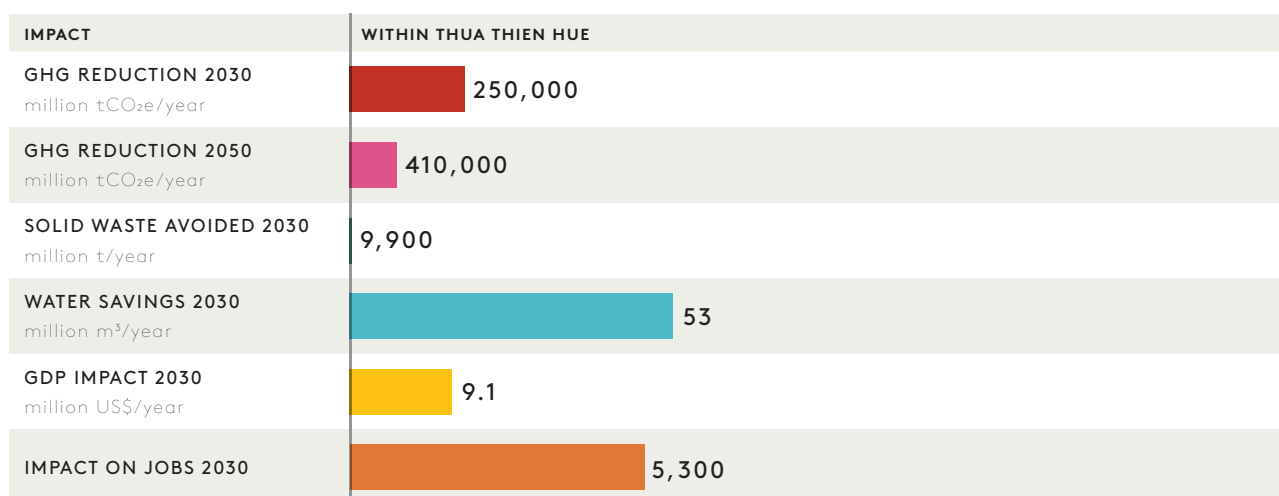


Table 13: Overview of impacts from mainstreaming circular procurement²²

on circular procurement, support peer-to-peer learning, develop pilots, set targets and measure the impact.³⁴⁸ Consider joining international fora for green procurement and consider further sharing of experience with green procurement³⁴⁹ within ASEAN.

Potential impact

The potential impact of circular procurement lies mainly in the construction sector. In this intervention, the potential has been estimated for new infrastructure, where a 12% reduction in embodied carbon is realistic, combined with a 2% reduction of costs.³⁵⁰ The cost savings would support additional jobs in other sectors.

Qualitative impacts can likely be seen across four SDG targets.

- SDG 4.7. Ensure that all learners acquire the knowledge and skills needed to promote sustainable development
- SDG 8.4. Improve global resource efficiency and decouple economic growth from environmental degradation
- SDG 11.1. Ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums
- SDG 13.2. Integrate climate change measures into national policies, strategies and planning



INTERVENTION TARGET SECTORS

→ Financial, banking and insurance



4.5 %

the circular economy offers a US\$ 180 million opportunity, supporting 4.5% additional GRP growth

3.12 Intervention 12: Finance circular business models and start-ups

Circular economy opportunities can have an attractive business case, but financing is a major obstacle to their realisation.

Strategy

The gross regional product potential of all circular economy interventions shows that the circular economy offers a US\$180 million opportunity, supporting 4.5% additional growth. This figure does not yet account for the growth opportunities which could come with improved resource efficiency and tapping into new markets for green or circular products and services.

Developing this potential will require a substantial investment. Therefore, Viet Nam should establish a comprehensive green finance strategy aimed at attracting green investment, both foreign and domestic, and improving access to finance for circular businesses. Circular business or revenue models are different from conventional or linear business models in that a circular business that supplies products assumes responsibility for the

product throughout its entire lifecycle.³⁵¹ That approach merits the use of concepts like product-as-a-service, take-back schemes and design for disassembly. Designing products such that they have a higher end-of-life value can require a higher upfront investment. Priority could be given to manufacturing, textiles³⁵² and construction. Producers retaining product ownership in service models, take-back schemes and modular buildings with a high end-of-life value are examples with implications for financing and accounting.³⁵³ Financial institutions need to build up the capacity and confidence to handle this.

The interventions listed in this report can reduce GHG emissions by 5 million tCO_{2e} per year by 2050. When valuing the avoided GHG emissions to the average 2022 price in the China GHG Voluntary Emission Reduction Programme,³⁵⁴ they would be worth US\$41 million per year. When using the EU Emission Trading Scheme (ETS) as a benchmark with 86 EUR/tCO_{2e} in May 2023,³⁵⁵ the GHG mitigation potential would be worth US\$424 million per year.

Other benefits also have economic benefits. Tap water, for example, is sold at prices around 8,000

VND/m³.³⁵⁶ Valued at this price, the water savings across all interventions would be worth US\$61 million per year. Other benefits are harder to quantify, but no less relevant, such as savings in medical expenses from reduced exposure to pollutants, healthier food and more active lifestyles, preserved tourism potential by cleaning and protecting natural areas, reduced soil erosion and runoff due to expanding forest cover, etc.

These benefits all have both a societal and a monetary value. The challenge to financial institutions is to use that value to, for example, reduce the cost of financing. An argument could be that investments along the interventions listed above face lower risks since they improve the resilience of the population of Thua Thien-Hue and its natural resources.

Policy framework

Promotion of circular business models has been stipulated in the Master Plan on Circular Economy Development³⁵⁷ and the National Action Programme for Sustainable Production and Consumption for 2021-2030³⁵⁸.

Viet Nam should establish a comprehensive green finance strategy aimed at attracting green investment, both foreign and domestic, and improving access to finance for circular businesses

Putting a price on GHG emissions is a way to improve the competitive position of investments which mitigate GHG emissions. A decree from 2020 under the Law on Environmental Protection defines a roadmap for the implementation of an ETS. Viet Nam anticipates launching a pilot ETS in 2026, before launching a full ETS in 2028.

Existing initiatives within Thua Thien-Hue

In April 2022, Hue Innovation Hub launched the Hue Circular Economy Hub with technical support from UNDP. This network's main functions are related to improving the capacity of connecting technology, finance, and knowledge for businesses and the community. At the same time, partnerships with the Viet Nam Circular Economy Hub at the national level create synergies to accelerate the transition at the local level, while practical research will inform specific policies and advice for governments and businesses.

Inspiring circular economy examples

Thailand's Sustainable Financing Framework³⁶⁰ establishes how the country will issue green, social and sustainability bonds and loans. Proceeds will be used to finance and refinance government loans or expenditures. A second-party opinion has confirmed that the framework meets international green bond standards.³⁶¹ For Viet Nam, the European Climate Foundation has already commissioned a report on green investment opportunities.³⁶²

Circle Economy from the Netherlands has established the International Financial Institutions Circularity Exchange Network (IFI CEN). The group meets regularly to 'discuss the opportunities, bottlenecks and best practices in financing circular projects— and the key actions required to address them'.³⁶³

Next steps

Several activities can support the acceleration of circular finance in Thua Thien-Hue:

1. The Government of Thua Thien-Hue could commission a study to understand what the existing barriers to circular finance are in Thua Thien-Hue and how to overcome them. The study should address mismatches in the allocation of finance and the needs. For example, 'less than 5% of global commercial finance goes to sustainable land use, despite the fact that agriculture, forestry and other land use contribute up to 40% of GHG emissions in Southeast Asia.'³⁶⁴
2. The Government of Thua Thien-Hue could

promote and support initiatives, start-ups and businesses applying circular economy principles. Examples are access to credit, investment support, trainings and tax cuts.

3. Improve access to alternative financing mechanisms like carbon and climate funds. Consider allocating public funding to create effective finance mechanisms for circular projects, perhaps as part of a green financing framework based on the regional examples implemented by ASEAN partner states.

4. Develop a circular economy taxonomy³⁶⁵ aligned with international guidance, such as the EU Categorisation System for the Circular Economy or World Bank guidance.

5. Encourage the national government to implement fiscal policy reform which discourages CO₂-intensive sectors and favours investments in renewable energy and circular economy.³⁶⁶ Experience with such fiscal reforms in other countries shows that when increasing costs for consumers, it is important that the revenues flow back to these consumers, for example in the form of a reduction in income tax.³⁶⁷ An even more ambitious approach would be to encourage the national government to align the Vietnamese tax system with the country's Sustainable Development Goals. Ex'tax is a Dutch foundation which supports countries with such tax reforms. It has launched impact studies for the EU, Finland, the Netherlands and Bangladesh.³⁶⁸ Tax reform is an important part of avoiding rebounds³⁶⁹ whereby savings from efficiency improvements are invested in additional consumption, preventing environmental benefits from maturing.

Potential impact

Most circular economy opportunities require financing, making circular finance an important prerequisite for their adoption. The impact is defined as the joint impact of all previous interventions, making the impact of this intervention relatively high. To avoid double-counting, this intervention has not been added to the total potential impact of all interventions listed in this report.

The intervention can also contribute to the following SDG targets.

- SDG 8.10. Strengthen the capacity of domestic financial institutions to encourage and expand access to banking, insurance and financial services for all
- SDG 9.3. Increase the access of small-scale industrial and other enterprises to financial service
- SDG 10.4. Adopt policies, especially fiscal, wage and social protection policies, and progressively achieve greater equality

12 FINANCE CIRCULAR BUSINESS MODELS AND START-UPS

→ Finance

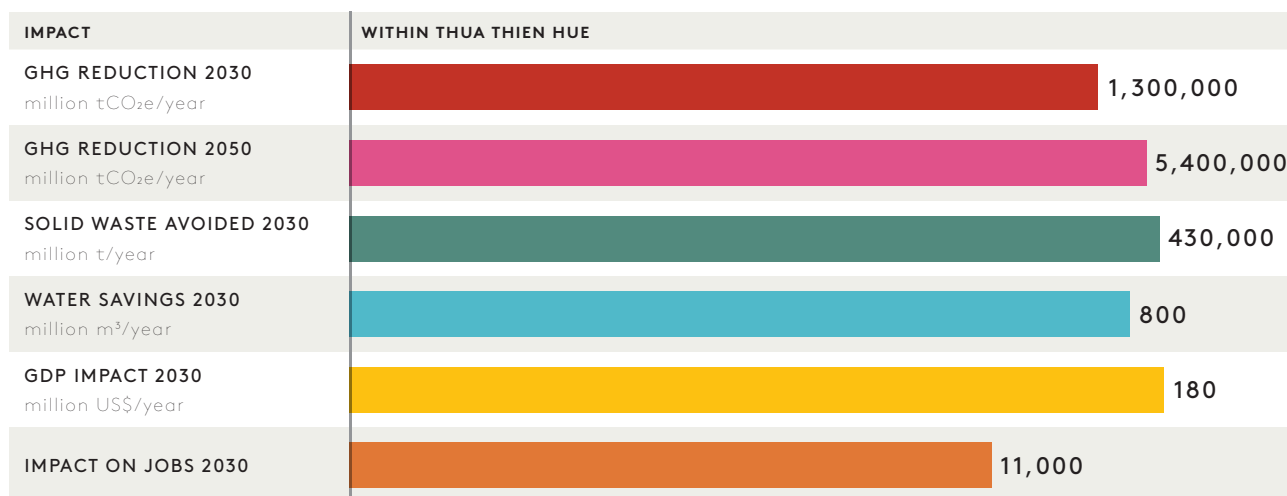


Table 14: Overview of impacts from financing circular business models and start-ups²²



INTERVENTION TARGET SECTORS

→ Education

41,617

Thua Thien-Hue hosts ten university locations which accommodate 41,617 students



3.13 Intervention 13: Educate on the circular economy

Hue City, the former royal capital of Viet Nam, has several institutions for higher education. Thua Thien-Hue hosts ten university locations which accommodate 41,617 students. The region also has 193 primary schools, 148 secondary schools and eight colleges, which educate 220,000 students.³⁷⁰

Strategy

The circular economy can be both taught and practised in educational institutions. Thua Thien-Hue has a strong education sector. This can equip the future workforce with the qualifications required in a circular future, and can support just transitions whereby the change is fair and inclusive. This requires ‘minimizing and carefully managing any challenges – including through effective social dialogue among all groups impacted, and respect for fundamental labour principles and rights.’³⁷¹

In the transition to a circular economy, new circular jobs will be created and linear jobs might be lost. Postgraduate courses can reskill the workforce from the linear economy to become the

skilled workers of the circular economy. Primary and secondary education can train schoolchildren to become conscious consumers. Although overconsumption is primarily an issue in high-income countries,³⁷² Viet Nam itself also has a growing high-income group.³⁷³ Education can help future consumers make conscious purchasing decisions geared towards products with a lower environmental footprint.

Policy framework

The Vietnamese Ministry of Education and Training is aligning the educational sector with the government’s 2030 Agenda for Sustainable Development. In 2022, it announced that educational reform will follow three pillars: 1) the governance system, 2) environmental transformation and 3) digital technology.³⁷⁴ The reform is in response to disruptions in learning programmes due to the COVID-19 pandemic, and it responds to the trends in Viet Nam related to ‘issues such as inequity in access, learning loss, digital divide, gender gaps, education financing gaps.’³⁷⁵

Existing initiatives within Thua Thien-Hue
A municipal waste recycling programme in Hue

City aimed to reduce waste volumes and improve recycling rates at schools. Throughout the project, a total of 2.5 tonnes of waste was collected, worth US\$270. These are modest volumes, but the main gains of the project were in education and awareness. Another initiative aimed at capacity building and education is the Circular Economy Capacity Building Programme for 105 businesses in Ha Noi, Thua Thien-Hue and Ho Chi Minh City implemented by UNDP Viet Nam with support from the Netherlands Embassy. Beside three-day trainings in each city, enterprises have opportunities to join field trips to see circular economy models operate in practice and receive post-training support and advisory service.³⁷⁶

Other educational activities are:

1. Developed by UNDP and ISPONRE, the Viet Nam Circular Economy Hub provides an open-knowledge hub offering readers access to the latest policies and resources on the circular economy in Vietnamese. The Hub aims to enhance dialogue, generate know-how and mobilise collective action towards the transition to circular economy in Viet Nam. The Hub has also developed an open-knowledge platform³⁷⁷ and curriculum on the circular economy in collaboration with Vietnamese universities.³⁷⁸
2. The Youth4Climate Initiative³⁷⁹ developed by UNDP includes a Climate Learning Hub,³⁸⁰ a bilingual platform entirely designed by youth for youth. It showcases reliable and accessible knowledge about climate change.
3. Summer camps organised by the Thua Thien-Hue Province Children's Activity Centre to raise awareness about the importance of abolishing single-use plastic products and disseminate this message to the community and society.³⁸¹
4. In 2019, many programmes and campaigns from the 'Green Sunday'³⁸² movement were launched across Thua Thien-Hue. Most of the initiatives aimed at reducing litter and carried names like 'no-trash neighbourhood', 'zero-waste village', 'build a green-clean-beautiful road', 'a route without plastic bags, without waste', 'civilized and clean offices' and 'let's clean the sea'.

Inspiring circular economy examples

There are several public courses and open-source educational materials on the circular economy in addition to the Viet Nam Circular Economy Hub. Examples of open-source materials on the circular economy are primary school materials and games³⁸³ and guidance to make the circular economy part of the national education system,

both collected by the Finnish Innovation Fund (SITRA)³⁸⁴, along with a series of examples of educational programmes from The Circular Collective³⁸⁵ and courses from FAO on topics like sustainable food value chains for nutrition.³⁸⁶ Several Massive Open Online Courses from universities can be accessed through the Holland Circular Hotspot,³⁸⁷ and further courses can be found from the UK-based Ellen MacArthur Foundation³⁸⁸ and the Massachusetts Institute of Technology.³⁸⁹

Next steps

To further disseminate learnings on the circular economy into school curricula, Thua Thien-Hue could use the materials from the Viet Nam Circular Economy Hub. These materials can be further developed based on the course materials which are publicly available from SITRA³⁹⁰ and the Ellen MacArthur Foundation.³⁹¹ For more practical lessons, educational institutions could integrate Do-It-Yourself technologies into school programmes. Examples are the production and use of machines with open-sources manuals from Precious Plastics³⁹² and school-level composting or anaerobic digestion solutions, potentially combined with urban farming initiatives. Further

Thua Thien-Hue has a strong education sector. This can equip the future workforce with the qualifications required in a circular future, and can support just transitions whereby the change is fair and inclusive.

research can specifically support the development of more extra-curricular materials on the circular economy for schools.

International organisations can support the establishment of a training centre for small and medium-sized enterprises (SMEs), who play a pivotal role in the ecological transition from a linear to a circular economy.³⁹³ Thua Thien-Hue should specifically target SMEs with a programme to jointly search for promising circular economy opportunities. This can be organised via a Community of Practice³⁹⁴ whereby companies along a specific value chain work together. The focus should be on the design of products, rather than the recovery of materials, since this has proven to have the most environmental benefits and the highest contribution to the SDGs.³⁹⁵ The programme can build upon the approach adopted by initiatives like SwitchMed³⁹⁶ or SwitchAsia³⁹⁷.

Higher education, on the other hand, can integrate tailored circular economy courses into its programmes, thereby making its graduates ready for the transition and better positioning educational institutions in Thua Thien-Hue. This should also target post-graduates and be part of the promotion of lifelong learning opportunities for all by the national government.³⁹⁸

The circular economy is relevant to nearly all courses provided, whether it is on tourism, business administration,³⁹⁹ accounting,⁴⁰⁰ policy making,⁴⁰¹ marketing, waste management⁴⁰²

or technical education⁴⁰³. Where knowledge is lacking, educational institutions can forge new collaborations with foreign universities, like the one between Hanoi University of Natural Resources & Environment (HUNRE) and the Dutch Technical University in Delft.⁴⁰⁴

Potential impact

The impact of this intervention is hard to quantify. Qualitative impacts on the Sustainable Development Goals can be expected in the following three targets.

- SDG 4.4. Increase the number of learners who have relevant skills for employment, decent jobs and entrepreneurship
- SDG 4.7. Ensure that all learners acquire the knowledge and skills needed to promote sustainable development
- SDG 12.8. Ensure that people have the information and awareness for sustainable lifestyles

13 EDUCATE ON THE CIRCULAR ECONOMY

→ Education

IMPACT	WITHIN THUA THIEN HUE
GHG REDUCTION 2030 million tCO ₂ e/year	n/a
GHG REDUCTION 2050 million tCO ₂ e/year	n/a
SOLID WASTE AVOIDED 2030 million t/year	n/a
WATER SAVINGS 2030 million m ³ /year	n/a
GDP IMPACT 2030 million US\$/year	n/a
IMPACT ON JOBS 2030	n/a

Table 15: Overview of impacts from educating on the circular economy



INTERVENTION TARGET SECTORS

→ Judiciary



Increasing environmental footprints have been paralleled by increasing inequality

3.14 Intervention 14: Secure just access and strengthen the judiciary

To effectively reduce the environmental footprint of economic activities in Thua Thien-Hue, all levers which exacerbate these impacts should be addressed. Research published in *Nature Sustainability* indicates that increasing environmental footprints have been paralleled by increasing inequality. Achieving the SDGs which relate to the planetary boundaries does not only require technology and behavioural change; it also requires a radical redistribution of resources.⁴⁰⁵

The SDGs define poverty as an income threshold of US\$1.90 per day. In practice, this is often insufficient to achieve 'levels of access to food, energy, water and infrastructure [which] are needed for people to live with dignity and escape from poverty.... Accessing these goods and services outside the market is also problematic in a world where the capacity and willingness of states to provide public/merit goods (such as free water or food subsidies) and the ability of ecosystems to provide free services are shrinking.'⁴⁰⁶ With that in mind, it is important that economic growth in Viet Nam does not degrade ecosystems and that 'just

access' is maintained. The legal system can play an important role in keeping economic growth within the carrying capacity of Vietnamese ecosystems.⁴⁰⁷

The linear economy developed in an era with a smaller population and seemingly abundant resources and energy. It left a legacy of valuable infrastructure, building stock and vehicle fleets, but also environmental degradation and climate change. Vested interests from the linear economy are continuing to promote consumption patterns based on maximising material throughput. They resist change and thereby exacerbate the adverse environmental impacts of an economic system which is no longer appropriate.

Strategy

The policy framework, including the tax system, building codes, accounting rules and education are often still based on linear principles. Examples are fossil fuel subsidies, free parking spaces provided to cars and building codes which do not regulate or allow for the use of clinker substitutes, prefab or wood-based construction. Another example is waste incineration in Denmark, which became an important part of the country's energy system. With waste reduction measuring gaining traction,

the country is currently importing waste to keep the incinerators running.⁴⁰⁹ The policy decisions of today will affect materials flows for years to come.

Another aspect that should be targeted is marketing. Advertisements can aim to keep consumers locked into a material-intensive lifestyle. Purpose Disruptors, a coalition of climate-concerned industry insiders, states that advertisements inflate the GHG emissions from consumption in the UK by over 186 million tons of CO₂, or 28% of the nation's annual carbon footprint. Regulating advertising to make people less receptive to unsustainable business models can help position circular alternatives. It may even be a prerequisite to avoid linear growth continuing to outpace the growth of the circular economy.

Companies from the linear economy have a lot of lobbying power⁴¹⁰, which makes it difficult to create a policy framework which is neutral or perhaps favours circular business models. It is possible, however, to create a new political reality in which circular businesses can thrive and resources are distributed more equally across the population of Thua Thien-Hue.

The government should consider regulating marketing expressions to ensure they do not overrepresent the green credentials of companies or promote lifestyles which would compromise government efforts to achieve its commitments under the Sustainable Development Goals. For some, regulating marketing seems a step too far, or perhaps subject to legal constraints, but it is common practice to restrict the marketing of harmful products. For example, one of the SDG targets already calls explicitly for such regulations in the context of tobacco.⁴¹¹

Policy framework

The Revised Law on Environmental Protection which entered into effect in 2022 requires factory owners to use the best available technology to control pollution and limit environmental impacts. However, approximately three-quarters of industrial wastewater is still discharged without proper treatment. Although these laws are ambitious, their enforcement is important to bring actual pollution levels down.⁴¹²

Since 2013, the Vietnamese government is regulating the marketing of products with adverse side effects. Examples are the Law on Tobacco Control and the Law on Advertisement, which

prohibit the advertising of any tobacco products in Viet Nam.⁴¹³ Further enforcement could make the law more effective, since some sources indicate that the tobacco industry is incentivising retailers to market their products at the point of sale.⁴¹⁴

Existing initiatives within Thua Thien-Hue Viet Nam has included ecocide in its penal code (article 278) since 1990, defining it as 'destroying the natural environment', whether committed in time of peace or war, and constituting a crime against humanity.⁴¹⁵

In 2021, the 'Stop Ecocide Foundation' proposed to add ecocide as a new crime to the International Criminal Court (ICC) Rome Statute (RS). It recommended amendments regarding substantive law and the structure of the crime of ecocide. The discussion on the topic started as scientific and biological debate during the Viet Nam War, when ecocide arguments became foremost political and then juridical.⁴¹⁶

The investment policy of Thua Thien-Hue requires economic and industrial zones to complete a general assessment of environmental impacts and solutions to environmental protection.

Another aspect is which should be targeted is marketing. Advertisements can aim to keep consumers locked into a material-intensive lifestyle.

Inspiring circular economy examples

The number of cases in which stakeholders and non-governmental organisations use litigation to hold companies accountable for their environmental impact is increasing. Examples of countries where the climate crisis is recognised as a human rights violation have emerged from the Netherlands, Australia, South Africa, the United States, the European Union, New Zealand, Switzerland and Mexico. This has opened the door for courts to rule against coal-fired power plants which would endanger the Great Barrier Reef, handle cases against an oil pipeline in Africa and examine various fuel extraction projects. It has also prompted children to go to trial against their governments for failing to protect their constitutional rights through continuous financial support for an energy system driven by fossil fuels.⁴¹⁷ A Dutch court ordered Shell to reduce its CO₂ emissions after proceedings initiated by seven foundations and associations and over 17,000 individual claimants.⁴¹⁸

Not only national cases are initiated. In 2007, the Environmental Liability Directive (ELD) established an EU-wide polluter-pays principle which includes making those which caused environmental damage liable for remediation.⁴¹⁹ The concept of 'parental liability' makes it possible to hold European companies liable for damage caused by their subsidiaries in other countries or for environmental damage which they caused.⁴²⁰ In the Netherlands, a court ruled that Shell was liable for pollution in Nigeria and had a duty of care for those affected. Other companies facing environmental charges include Norsk Hydro, BHP, TotalEnergies and Vendanta Resources.

Law firms like Pogust Goodhead specialise in cases of individuals and groups against large companies.⁴²¹ The liability may also cover climate change. A Peruvian farmer filed a case against the German energy company RWE for its contribution to the climate crisis.⁴²²

Governments and government bodies which regulate marketing expressions started opposing campaigns which compromise SDG objectives. Examples include the following:

1. France has forbidden the advertising of fossil fuels like gasoline and diesel since 2022. The law falls short of the original proposal by a citizen's assembly to ban advertising for fossil-fuelled cars, air travel and the fossil fuel industry altogether.⁴²³
2. The Advertising Standards Authority (ASA) in

the United Kingdom banned a campaign by Shell, arguing that the advertisements are 'likely to mislead consumers if they [have] misrepresented the contribution that lower-carbon initiatives played, or would play in the near future, as part of the overall balance of a company's activities'.⁴²⁴ The ASA earlier banned 'green' advertisements in the United Kingdom by Spanish oil company Repsol, Malaysia's Petronas and the airlines Etihad Airways and Lufthansa for not providing full information on their activities or using misleading words like 'sustainable aviation'.⁴²⁵ Shell previously lost a similar lawsuit in the Netherlands for misleading claims on the environmental benefits of their carbon offset products.⁴²⁶

3. Ban Fossil Fuel Ads is an EU civil initiative to regulate advertisements by fossil fuel companies. A petition which calls for a European ban on advertisements by fossil fuel companies has been signed over 300,000 times.⁴²⁷ The Dutch branch 'Verbied Fossiel Reclame' provides a global overview of initiatives to ban fossil fuel advertisements (in English)⁴²⁸

4. Dutch cities banning certain advertisements include Amsterdam's ban on fossil fuel and aviation advertisements in its public transport system,⁴²⁹ Haarlem's ban on meat advertisements⁴³⁰ and Zwolle's ban on fossil fuel advertising.⁴³¹

Next steps

The Government of Thua Thien-Hue could strengthen environmental legislation and enforcement and make communities aware of their ability to hold local and international parent companies accountable. Doing so would increase the exposure of polluting activities, support communities to defend their interests against that of polluting companies and potentially improve the competitive position of circular companies which act in the interest of communities and future generations. The government could:

1. support legal persons with claiming compensation from offenders for damage inflicted upon them because of environmental violations, thereby preventing the state from bearing these financial consequences;
2. ensure that fine levels for environmental offences are higher than the economic benefits possibly earned by offenders;
3. apply the 'polluter pays' principle, whereby law enforcement bodies 'force legal persons to directly pay damage compensation and remedy consequences of their polluting acts'⁴³²;
4. strengthen environmental monitoring;⁴³³
5. regulate advertising for products which are

harmful to current or future generations and prevent companies from misrepresenting their contributions to a circular or low-carbon future;

6. make public space available at reduced tariffs to promote circular economy concepts like mobility as a service, public transport, local organic food products, sustainably produced wood-based construction materials, etc.;
7. increase the awareness of communities regarding their ability to file cases against the parent company of local companies which harm their interests.

Potential impact

The impact of this intervention is hard to quantify. Qualitative impacts on the Sustainable Development Goals can be expected in the following three targets.

- SDG 1.4. Ensure that everyone has equal rights to economic resources, ownership and control over land
- SDG 9.2. Promote inclusive and sustainable industrialization
- SDG 12.8. Ensure that people have the information and awareness for sustainable lifestyles

14 SECURE JUST ACCESS AND STRENGTHEN THE JUDICIARY

→ Judiciary

IMPACT	WITHIN THUA THIEN HUE
GHG REDUCTION 2030 million tCO _{2e} /year	n/a
GHG REDUCTION 2050 million tCO _{2e} /year	n/a
SOLID WASTE AVOIDED 2030 million t/year	n/a
WATER SAVINGS 2030 million m ³ /year	n/a
GDP IMPACT 2030 million US\$/year	n/a
IMPACT ON JOBS 2030	n/a

Table 16: Overview of impacts from securing just access and strengthening the judiciary

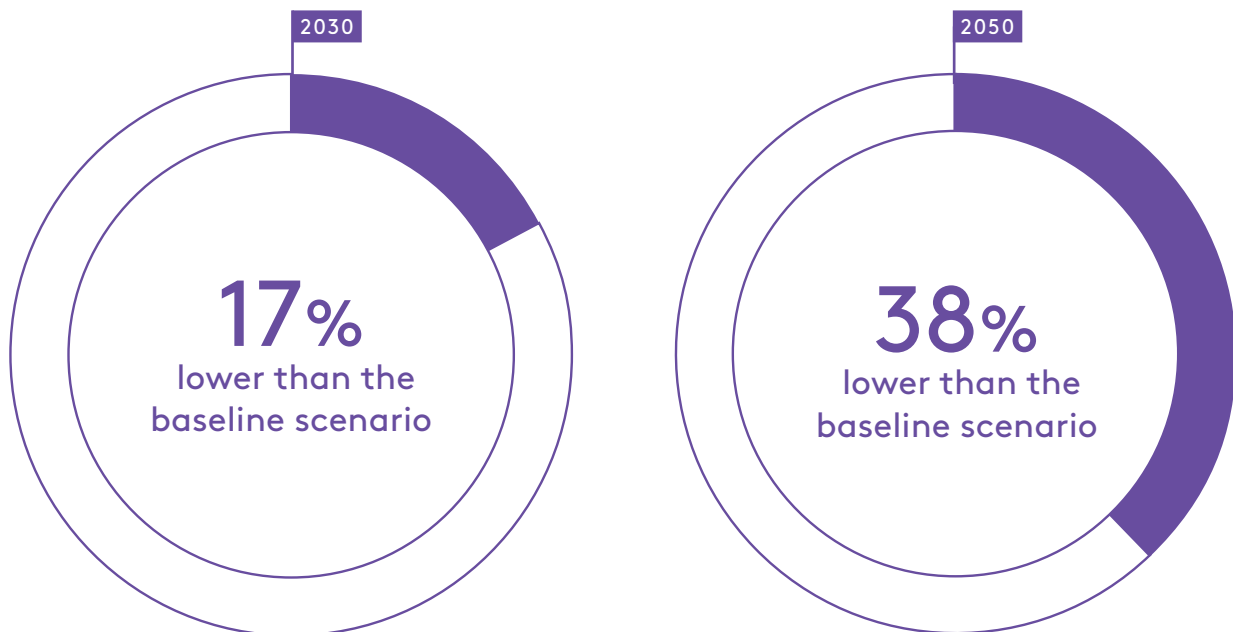
3.15 Conclusions – Part 3

The metabolic analysis has identified 14 interventions that apply circular economy principles to reduce GHG emissions and reduce waste and water footprints while supporting economic development and job creation. Altogether, these interventions can bring emissions in 2030 down by 17% from their level in the baseline scenario of 4.7 MtCO_{2e}/year, assuming that GHG emissions in Thua Thien-Hue follow the same growth scenario as national emissions.⁴³⁴ The GHG abatement potential increases to 38% by 2050. This potential shows some overlap with the measures proposed in the NDC but may also allow Viet Nam to reach its NDC targets with less effort or support an increase in ambition over time.

Other benefits of the circular economy interventions are a 7% reduction in the GHG footprint of imported goods and materials, reaching 12% by 2050. This emissions reduction will support other Vietnamese provinces and foreign trade partners with their climate commitments. The waste reduction potential could reach 68% by 2030, by reducing food, construction and recyclable waste. Water savings are estimated at 16% of current water usage levels in Thua Thien-Hue.

When also considering the socio-economic impact, all 14 interventions together could create 4.5% in additional growth in gross regional product by 2030 and provide green jobs to an additional 8,000 people. These estimates are an indication of the size of the circular economy. They do not consider impacts which are important but difficult to quantify, like the extent to which investments in circular education, resource efficiency or producing new circular products can open new market and growth opportunities.

The interventions with the highest impact on GHG emissions are circular, offsite and wood-based construction, reducing food losses and waste, organic agriculture and transport strategies prioritising active and public transport, along with improving the utility rate of the vehicle fleet and electrification. Other interventions which help reduce GHG emissions and waste relate to waste avoidance and secondary and regenerative sourcing for textiles. Five enablers identify the tourism sector as an important sector to pilot circular economy initiatives. They also point at the importance of mobilising the financial sector, circular procurement, education and the rule of law to mitigate the negative impact of linear activities and promote the adoption of circular economy concepts.



The 14 circular economy interventions can bring GHG emissions down by 17% by 2030 and by 38% by 2050

Methodology

4 Annex A: The metabolic analysis explained

The circular economy is a solution that advocates for a fundamental change in our current economic system and decouples development and wellbeing from the use of natural resources, creating a system where resource cycles are closed on the smallest scale possible while maintaining value for as long as possible. The benefit of this system is that it not only reduces resource consumption and waste generation, but it can also significantly contribute to a reduction in GHG emissions while at the same time providing new development perspectives and employment opportunities.

The circular economy aims to reduce resource use and waste disposal, making material use regenerative rather than depletive. It does so by proposing strategies which optimise the use of existing assets and materials, thereby reducing the use of primary materials and lowering the output of harmful waste. Resource extraction and waste disposal are the primary drivers for the degradation of natural assets like soils, forests, watersheds and fishing grounds.

By focusing on what's already available and altering the design of new products and assets, the circular economy concept can help Thua Thien-Hue to define a development pathway which diversifies the economy, reduces its reliance on imports and inspires private sector growth based on the 'mining' of secondary and regenerative materials, thereby safeguarding the ability of future generations to thrive and enjoy a certain level of material comfort.

4.1 Metabolic analysis

A metabolic analysis includes an inventory of the flows and stocks of a specific geography or jurisdiction. It aims to shift 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'.⁴³⁵ This requires data on resource use and assets to determine how they 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.⁴³⁶

The metabolic analysis for Thua Thien-Hue has been based on an extensive effort by Hue IDS and environmental experts from the province to collect data on cross-border trade, extraction, production, processing and the disposal of goods and materials. It relies on many different data sources, with some used to build the metabolic analysis and others as reference data for cross-checking and verification. The metabolic analysis is not a predefined model; the flows are identified, assembled and distinguished based on the data provided and the development priorities specified. The mass along value chains should not change, and in some cases data had to be converted from monetary units into tonnes based on the value of the product or materials. These approaches allowed us to cross-check data and fill data gaps.

With this data, insights have been generated on the lifecycle of products and materials, as well as their impact on the environment. Throughout the lifecycle of a product, the main impacts on soil, air and water occur at the point of extraction and disposal. The impact of the whole 'metabolism' of an economy on its natural assets, such as for example on the quality of its watersheds, soils, fishing grounds, forests and air, determines the impact which current economic activities have on the ability of future generations to enjoy a life with a certain level of services available to them providing access to human needs like shelter, nutrition, mobility, communication, healthcare, etc.

By prioritising data sources from Thua Thien-Hue Province over international databases, the metabolic analysis has been constructed from the bottom up, relying on the same data sources as the province's key decision-makers.

4.2 Mapping resource flows, stocks and embedded emissions

Material flows distinguish between biomass, minerals, metals, fossil fuels, GHG emissions and water. The flows have been quantified with statistical data from Thua Thien-Hue, verified and occasionally complemented with national statistics. In the visuals they flow from the start on the left, with finite extraction, secondary and regenerative sources and import, to various end-of-life stages on the right. The product types include food products (products that expire), short-lived consumables like packaging and fuels (products that flow) and long-lived products that contribute to stocks, such as vehicle fleet expansion and expanding and maintaining the building stock (products that last). Data gaps were addressed by drawing on additional statistical sources, such as the FAO, other UN bodies and academia.

By connecting the flows at the product level and breaking them down into different resource types, these flows were traced from their origin to their final destination. Since the aggregated mass of all materials must be maintained during the conversions, comparing the flow totals in each part of the value chain allowed for cross-checking.

Shifting Paradigms provided an overview of the data which is required for the metabolic analysis and the impact analysis of the prioritised interventions. This overview has been shared with the experts in Thua Thien Thua Thien-Hue Province. The data sources which were used for the analyses are listed in the literature references.

Once the materials flows are determined, they can be combined with other data based on, for example, the embodied carbon of a product or material, its water footprint, its raw material footprint, its value, the number of associated jobs, etc. For Thua Thien-Hue, that analysis was used to estimate the GHG and water footprint of both consumption and production in the province, and their relationship with value creation and jobs.

4.3 Project activities

This report, and the process that led to its

publication, provides a long-term strategy to support the ambition to sustain economic development, preserve and create jobs, achieve net carbon neutrality by 2050 and reduce environmental impacts.

This report assembles the results of the following four activities.

1 **Data collection.** The first phase focused on collecting data and onboarding Vietnamese experts. The Vietnamese experts have been trained on the circular economy and approaches to analyse resource flows in a Material Flow Analysis. A metabolic analysis in this context is referred to as an analysis of material flows and of the stocks (both produced stock and natural assets) in a specific jurisdiction. An example of a metabolic analysis is the one in Lao PDR, which focused on interventions which can reduce GHG emissions.⁴³⁷

2 **Initial analysis.** The second phase involved structuring the data and identifying the data gaps. For material flows where data is lacking at the provincial or city level, national or international data or proxies have been relied upon. In this phase, we also hosted a government workshop to identify the key development priorities and select the impact indicators against which the circular economy interventions would be assessed by the government. This phase ended with presenting preliminary results of the metabolic analysis, allowing stakeholders to select the interventions which were the most promising and appropriate. The barriers and drivers in the transition to a circular economy were also discussed.

3 **Final analysis.** For the interventions which were selected during the workshop, the socio-economic and environmental impacts were quantified along the selected impact indicators. This involved the development of a scenario to assess how forecasts on aspects like economic and population growth will affect future demand for products, and how circular economy interventions can help optimise socio-economic and environmental outcomes. Examples of such outcomes are contributions to COVID-19 recovery, job creation, reducing primary extraction, minimizing waste output, water savings, preservation of natural assets or contributions to achieving the net zero target by 2050.

4 **Design and communications.** The findings have been gathered in this report, whereby a

combination of text and visuals aims to build a compelling narrative on circular economy opportunities. The objective of the report, which is also available in Vietnamese, is to promote the circular economy ambitions of the province, both internal and external, and to provide stakeholders with sound arguments to advocate for, or perhaps against, the adoption of specific circular economy interventions.

4.4 Terms and definitions used in the material flow analysis

The following terms and definitions are used in this report.

— **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.’⁴³⁸

— **Socio-economic metabolism:** ‘The set of all anthropogenic flows, stocks, and transformations of physical resources and their respective dynamics assembled in a systems context’.⁴³⁹ In the context of this analysis, Thua Thien-Hue’s metabolism refers to the flows and stocks of material resources, energy and waste.

— **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’.⁴⁴⁰

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

— **Nationally Determined Contribution:** Countries’ submissions to the UNFCCC of their mitigation commitments for 2030 or beyond under the Paris Agreement.⁴⁴¹

— **Natural assets:** ‘Natural assets are assets of the natural environment. They consist of biological assets (produced or wild), land and water areas with their ecosystems, subsoil assets and air’.⁴⁴²

The material flow analysis distinguished six material types:

— **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 primarily mineral construction materials, such as cement, tiles and bricks.

They also include oil-based products, including 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 inland to the ocean, part of which is cleaned and used as drinking or irrigation water and discharged.

— **Fuels** are gaseous, liquid and solid fossil fuels.

— **Emissions** are GHG emissions, most of which are carbon dioxide or CO₂, followed by methane or CH₄.

Three types of products are distinguished:

— **Products that expire:** Food products with a limited lifetime that decay after a given period.

Since food products are mostly of vegetable or animal origin, their waste products are organic materials.

— **Products that flow:** Most materials entering the economy every year typically reach their end of life within a year. Examples are packaging and consumables, such as cosmetics, cleaning agents and healthcare products.⁴⁴³

— **Products that last:** The other materials become produced stock or long-term stock and are typically in use for longer than a year. Examples are capital equipment, buildings and infrastructure.⁴⁴

Five sources of materials are distinguished:

— **Imports** refer to materials and products imported into Thua Thien-Hue Province. They originate from wells, quarries, mines or fields located outside the country.

— **Finite extraction** refers to materials and products produced or extracted from national mines, wells, quarries, forests, agriculture and fishing. Where materials are extracted from sources in a way that depletes their stocks, such as sand extraction or wood harvests that lead to a decline in forest stock, they are referred to as depletive.

— **Secondary sourcing** refers to secondary resources from recycling and reused products. This often involves using organic residues as soil enhancers and recovering recyclable materials from national waste streams.

— **Regenerative sourcing** refers to biomass from forestry, agriculture and fishing operations. It is unclear whether these are sustainable, in the sense that they do not deplete forest stock, fish stock or soils.

— **Certified sources** are material sources which are certified by a verification body which verifies whether natural assets like forest stock, fish stock or soils are preserved or even regenerated. This allowed us to assume that certified sources are forest and fish products from stocks that are stable or show improvement over time and agricultural products where soil quality is also stable or improving.

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

— **Landfill** refers to secondary resources or wastes that are dumped or partially burned and then dumped in a dumpsite. As a result of the mixing of resources and their degradation over time, considerable value is lost. In addition, organic material that is dumped decays under anaerobic conditions and causes methane emissions, a potent GHG.

— **Landfill, rock dump** and **tailings** refer to the relatively large waste volumes of waste rock and tailings from the mining sector.

— **Long-term use** (LTU, or products that last) refers to the use of materials over a long period, as in new buildings, vehicles or infrastructure.

— **Exports** refer to products and materials that are exported to other countries.

— **Discharge** refers to the discharge of treated or untreated wastewater into surface water.

— **Soil enhancer** refers to materials that are applied on land to retain soil fertility and/or enhance soil organic carbon.

— **Recycled** refers to waste that is recovered for processing and then reused. Throughout the recycling process, value that was embedded in the original product is lost. Recycling is thus a suboptimal waste treatment method, although it is better than landfilling.

— **Short-cycle CO₂** involves the short-term or fast cycling of carbon through life forms on Earth or the biosphere.⁴⁴⁵ In this metabolic analysis for Thua Thien-Hue Province, it refers to CO₂ emissions from the combustion of sustainably produced firewood.

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

— **Territorial emissions** are those produced in Thua Thien-Hue Province. They are created by the combustion of fossil fuels or the anaerobic digestion of organic materials. When drawing a parallel to GHG accounting for companies, these are scope 1 and 2 emissions from activities within companies and from their use of power.

— **Embedded emissions** are those produced outside the country during the production of goods and materials that are then imported.⁴⁴⁶ For companies, these are scope 3 emissions, both upstream and downstream in the value chain of which a company is part.

— **Exported emissions** are associated with goods and materials that are exported.

— **Upstream emissions** refer to those associated with imported goods and materials that are consumed in Thua Thien-Hue Province and attributed to the country's consumption-based emissions.

4.5 Environmental and socio-economic impacts

14 interventions have been proposed that, together, help reduce GHG emissions and waste volumes while supporting economic growth and job creation. They do so by reducing reliance on carbon-intensive products and prioritising low-carbon alternatives. Furthermore, waste volumes can be reduced by tapping into secondary resources.

As part of the metabolic analysis, the material flows can be expressed in tonnes of material, GHG footprint, water footprint and value. The GRP potential of each intervention has been estimated based on expressing the changes in material flows in monetary values. For example, recycling would increase the supply of secondary materials and reduce the demand for primary materials. The GRP potential has been estimated by quantifying the change and the related difference in value between these two flows. Additional value is created when the production of regenerative materials is increased or secondary materials are recovered. That added value, corrected for the growth forecasts per sector, is used as a proxy for future growth of the circular economy's contribution to GRP.

For some interventions, like increasing the modal share of public transport, many flows are affected related to fuel use, vehicle replacement, vehicle fleet changes, repair services, bus stations, the need

for parking space, etc., which makes it difficult to estimate the economic impact based on the change in material flows. In those cases, international proxies have been relied upon to determine the impact.

Job creation is important in Thua Thien-Hue. The circular economy gives priority to human creativity and resources over the extraction and monetization of primary resources and seeks to preserve and create jobs. Jobs are preserved primarily by securing the regenerative capacity of natural assets. This is particularly important because a share of the population depends directly on the quality of the country's forests, soils and water resources. This is emphasised by the concept of fair access discussed in intervention 14.

New employment may be created in repair activities, agronomics, trading and transport of secondary resources, and the production of sustainable and possibly organic food products. In addition to agriculture and forestry, the tourism sector depends directly on healthy and attractive ecosystems, as the degradation of natural resources makes the country a less appealing tourist destination. Some of these jobs may come at the expense of employment in linear value chains within Thua Thien-Hue, Viet Nam or other countries.

The job potential of each measure has been quantified with the sectoral employment elasticity for Southeast Asia and the expected GRP growth per sector. In some cases, the intervention increases domestic production based on regenerative and secondary resources beyond volumes that the domestic market can absorb. Where increases in production volumes serve foreign markets, the additional jobs created in Thua Thien-Hue might come at the expense of employment in linear product value chains. The analysis of the job potential looks at the net result.

4.6 Modelling the long-term mitigation and sequestration potential

In its latest NDC, Viet Nam expressed the ambition to be net carbon-neutral by 2050, whereby the sequestration of GHG emissions compensates for any remaining emissions. An analysis of long-term GHG emissions requires a solid baseline scenario. For that purpose, the national GHG baseline has been translated to a provincial baseline by

applying the growth factors per sector to the relevant sectoral emissions in Thua Thien-Hue.⁴⁴⁷

In a circular economy intervention, GHG emissions are reduced by using fewer materials, avoiding waste and using fewer carbon-intensive materials. Based on the comprehensive overview of resource flows in the 2021 reference year, which was part of the metabolic analysis, and the environmental impact of these materials and products, the overall climate impact in terms of megatons of CO₂ in Thua Thien-Hue in 2021 has been calculated.

The metabolic analysis provides an overview of products used on an annual basis within Thua Thien-Hue. Calculating the mitigation potential of the interventions from the metabolic analysis involved four steps:

1. The list of products was adjusted to correct for double-counting of waste-related material flows;
2. Products were distinguished based on whether they are made or consumed within Thua Thien-Hue or abroad;
3. For each product, the GHG footprint in tCO_{2e} was obtained from an international database with environmental indicators; and
4. The result was cross-checked with data on provincial GHG emissions.

To estimate how emissions will evolve up to 2050, sector-specific growth rates obtained from the national GHG baseline were applied to each product. The result is a GHG baseline emissions scenario that begins in 2023 with territorial emissions of 4.9 MtCO_{2e} (excluding 2.7 MtCO_{2e} of sinks), reaching 8.4 MtCO_{2e} in 2030 and 13 MtCO_{2e} in 2050. The proposed interventions will reduce the emission level, complemented by the impact of measures proposed in Viet Nam's NDC.

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In this visual, the embodied carbon of the final product is reflected, which could lead to distortions where half-fabricates are imported and further processing or manufacturing in Thua Thien-Hue adds to its GHG footprint. However, since Thua Thien-Hue has heavy industries which mostly use raw materials from the province itself, like cement production and food processing, or with a modest GHG footprint, like garments, the distortion is not very large. This is also the case for the water footprint.

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