



REPUBLIC OF KENYA

KENYA INDUSTRIAL BIOMASS TRANSITION WHITE PAPER

Accelerating Industrial
Decarbonisation, Energy
Security and Green
Manufacturing



**Building a resilient, competitive
and sustainable industrial future
powered by Kenya's resources.**

An Independent Policy White Paper

May 2025



ENERGY
SECURITY



CLIMATE
ACTION



RURAL
DEVELOPMENT



INDUSTRIAL
COMPETITIVENESS

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Kenya Industrial Biomass Transition White Paper

Accelerating Industrial Decarbonisation, Energy Security and Green Manufacturing

A Policy White Paper for Kenya

Core National Message

Kenya has an opportunity to reduce dependence on imported Heavy Fuel Oil, strengthen industrial competitiveness, save foreign exchange, create rural employment, and accelerate industrial decarbonisation through the adoption of sustainable biomass.

Headline Figures

300 Million Litres

Approximate annual Heavy Fuel Oil imported into Kenya

20+ Million Tonnes

Estimated annual sustainable biomass resource potential

~1 Million Tonnes

Approximate biomass required annually to replace Kenya's imported HFO energy demand

~5%

Share of Kenya's estimated biomass resource needed to replace current HFO imports

Prepared For

Ministry of Energy & Petroleum
National Treasury
Energy & Petroleum Regulatory Authority
Kenya Association of Manufacturers
Council of Governors
Development Partners

Purpose of the White Paper

This white paper proposes a practical pathway for Kenya to accelerate industrial fuel switching from imported Heavy Fuel Oil to locally available sustainable biomass, with the aim of strengthening energy security, reducing greenhouse gas emissions, supporting rural economic development, and improving the competitiveness of Kenyan manufacturing.

2. Executive Summary

A Strategic Opportunity for Kenya

Kenya stands at a pivotal moment in its industrial and energy transition. As the country pursues the objectives of **Vision 2030**, the **Bottom-Up Economic Transformation Agenda (BETA)**, and its **Nationally Determined Contributions (NDCs)** under the Paris Agreement, there is a significant opportunity to accelerate industrial decarbonisation while strengthening national energy security and economic resilience.

Today, Kenya imports approximately **300 million litres of Heavy Fuel Oil (HFO) annually**, accounting for approximately **4–6% of the country's total petroleum imports**. Approximately **30–35%** of this fuel is used for electricity generation, while the remaining **65–70%** is consumed by Kenya's manufacturing sector for steam generation, process heating and other industrial thermal applications.

This dependence on imported fossil fuels exposes Kenyan industries to volatile international oil prices, foreign exchange fluctuations and supply chain disruptions, while increasing greenhouse gas emissions and reducing manufacturing competitiveness.

At the same time, Kenya possesses one of Africa's most significant renewable energy resources—**sustainable biomass**.

Current estimates indicate that Kenya produces **more than 20 million tonnes of sustainable biomass annually**, including agricultural residues, forestry residues, agro-processing by-products and sustainably managed wood resources. These indigenous resources represent an untapped strategic asset capable of supporting industrial growth while reducing dependence on imported fossil fuels.

Analysis presented in this White Paper indicates that replacing the energy currently supplied by imported HFO would require approximately **0.9–1.0 million tonnes of sustainable biomass annually**. This represents only **around 5% of Kenya's estimated annual sustainable biomass resource base**, demonstrating that biomass availability is not a limiting factor for industrial fuel switching.

The transition from HFO to biomass presents a unique opportunity to deliver multiple national objectives simultaneously:

- **Strengthen national energy security** through greater utilisation of indigenous energy resources.
- **Reduce foreign exchange expenditure** by decreasing imports of Heavy Fuel Oil.
- **Improve industrial competitiveness** through more stable and locally sourced fuel supplies.
- **Create rural employment and stimulate agricultural value chains** by expanding markets for agricultural and forestry residues.
- **Reduce greenhouse gas emissions** and improve local air quality.

- **Support Kenya's transition towards a green manufacturing economy.**

To unlock this opportunity, this White Paper proposes a strategic policy intervention centred on the **gradual introduction of an environmental levy on industrial Heavy Fuel Oil**, with revenues ring-fenced into a dedicated **Green Industrial Transition Fund**. The Fund would support biomass infrastructure, industrial fuel-switching projects, green financing mechanisms and the development of sustainable biomass supply chains.

The proposed approach is designed to be **gradual, predictable and market-oriented**, enabling industries to transition over time while maintaining competitiveness and attracting private-sector investment.

Ultimately, this White Paper argues that industrial biomass should be recognised not merely as an alternative fuel, but as a **strategic national resource** capable of enhancing Kenya's energy security, strengthening manufacturing, promoting rural economic development and advancing the country's long-term climate and economic objectives.

Key Messages

Indicator	Value
Annual Heavy Fuel Oil imports	~300 million litres
Share of petroleum imports	4–6%
HFO used for power generation	30–35%
HFO used by industry	65–70%
Estimated sustainable biomass availability	20+ million tons/year
Biomass required to replace imported HFO	0.9–1.0 million tons/yr
Share of biomass resource required	~5%

Kenya possesses sufficient sustainable biomass resources to substantially reduce dependence on imported Heavy Fuel Oil while strengthening energy security, supporting rural livelihoods, improving industrial competitiveness and accelerating the transition to a low-carbon manufacturing economy.

3. Kenya's Industrial Energy Landscape

Powering Kenya's Manufacturing Sector

Manufacturing is a cornerstone of Kenya's economy, contributing approximately **7–8% of Gross Domestic Product (GDP)** and supporting hundreds of thousands of direct and indirect jobs. The Government of Kenya has identified manufacturing as a priority sector under **Vision 2030** and the **Bottom-Up Economic Transformation Agenda (BETA)**, with the objective of increasing industrial output, creating employment and enhancing export competitiveness.

Industrial growth, however, depends on access to **reliable, affordable and secure thermal energy**.

While Kenya has made remarkable progress in renewable electricity generation through geothermal, hydro, wind and solar resources, **industrial process heat remains heavily dependent on imported fossil fuels**, particularly Heavy Fuel Oil (HFO), diesel and Liquefied Petroleum Gas (LPG).

Unlike electricity, many industrial processes require continuous high-temperature thermal energy for:

- Steam generation
- Drying
- Sterilisation
- Pasteurisation
- Chemical processing
- Textile production
- Food manufacturing
- Paper production
- Glass manufacturing
- Cement production

These thermal energy requirements account for a significant proportion of industrial operating costs and represent one of the largest remaining opportunities for decarbonisation.

Heavy Fuel Oil: A Strategic Vulnerability

Heavy Fuel Oil remains one of Kenya's principal industrial fuels because of its relatively low historical cost and suitability for high-capacity steam boilers.

However, reliance on imported HFO creates several strategic challenges:

Energy Security

Industrial production becomes dependent on international fuel markets and imported petroleum supply chains.

Foreign Exchange Exposure

Every litre of imported HFO increases Kenya's demand for foreign currency, placing additional pressure on the country's balance of payments.

Price Volatility

Manufacturers remain exposed to unpredictable fluctuations in global oil prices, increasing production costs and reducing competitiveness.

Carbon Emissions

HFO combustion contributes significantly to industrial greenhouse gas emissions, making industrial heat one of Kenya's largest opportunities for emissions reduction.

Kenya's Industrial Heat Opportunity

Industrial heat represents the next frontier of Kenya's energy transition.

Whereas substantial investments have already been made in renewable electricity generation, comparatively little attention has been given to replacing fossil fuels used for industrial steam and process heating.

The transition to sustainable biomass presents a unique opportunity to:

- Reduce dependence on imported fossil fuels.
 - Improve national energy security.
 - Lower industrial operating costs over the long term.
 - Increase resilience against international fuel price shocks.
 - Support domestic agriculture and forestry value chains.
 - Create employment throughout biomass production, processing and transport.
 - Accelerate industrial decarbonisation without compromising production reliability.
-

A National Opportunity

Kenya has already demonstrated global leadership in renewable electricity, with geothermal energy supplying a significant proportion of the national grid.

The next stage of the country's clean energy transition is to extend this leadership into **industrial thermal energy**.

By replacing imported Heavy Fuel Oil with locally sourced sustainable biomass, Kenya can build a manufacturing sector that is:

- **More competitive**
- **More resilient**
- **Lower carbon**
- **Less dependent on imported fuels**
- **Better positioned to compete in global markets increasingly influenced by carbon regulations and sustainable supply chains**

This transition represents not only an environmental imperative but also a strategic economic opportunity capable of strengthening Kenya's industrial base while supporting inclusive rural development.

Industries with the Greatest Transition Potential

The sectors with the highest remaining potential for biomass fuel switching are those that continue to rely heavily on Heavy Fuel Oil for process steam and thermal energy.

Industrial Sector	Typical Thermal Energy Requirement	Biomass Transition Potential
Food & Beverage	Steam generation, pasteurization, cooking	High
Dairy Processing	Steam and hot water	Very High
Chemicals & Pharmaceuticals	Process steam	Very High
Hotels & Hospitals	Boiler steam and hot water	Very High
Glass Manufacturing	Process heat and waste heat recovery	High

Industrial Sector	Typical Thermal Energy Requirement	Biomass Transition Potential
Edible Oils & Fats	Process heating and steam	Low (<i>Most factories have already transitioned to biomass, primarily wood fuel and agricultural residues.</i>)
Plastics & Packaging	Process heating	Medium
Tea & Coffee Processing	Drying, roasting and steam	Low (<i>Most factories have already transitioned to biomass, primarily wood fuel and agricultural residues.</i>)
Textile Manufacturing	Steam, dyeing and drying	Low (<i>Many textile manufacturers have already adopted biomass boilers for thermal energy.</i>)
Paper & Packaging	Steam and drying	Low (<i>A significant proportion of the sector already utilises biomass, particularly wood residues and other biomass fuels.</i>)

The greatest opportunity for industrial decarbonisation therefore lies in sectors that continue to depend on imported Heavy Fuel Oil despite the commercial availability of sustainable biomass technologies. Accelerating fuel switching within these industries would deliver the largest reductions in fossil fuel imports, greenhouse gas emissions and foreign exchange expenditure while supporting the development of domestic biomass supply chains.

4. Heavy Fuel Oil in Kenya: Trends, Consumption and Strategic Implications

Heavy Fuel Oil Remains Critical to Kenya's Industrial Economy

Although Kenya has significantly diversified its electricity generation mix through geothermal, hydro, wind and solar energy, Heavy Fuel Oil (HFO) continues to play a critical role in supplying industrial thermal energy.

Approximately **300 million litres of HFO are imported into Kenya each year**, representing an estimated **4–6% of the country's total petroleum imports**. While this represents a relatively small share of total petroleum volumes, HFO remains strategically important because it supports industries that contribute significantly to Kenya's GDP, exports and employment.

Current estimates indicate that:

- **30–35%** of imported HFO is consumed by thermal power generation facilities.
- **65–70%** is utilised by industries requiring high-temperature process heat and steam.

This continued dependence on imported HFO exposes Kenya's economy to external market risks and constrains progress towards industrial decarbonisation.

Historical Trends in HFO Consumption

Over the past three decades, Kenya's petroleum imports have increased alongside economic growth, industrialisation and rising energy demand.

Although the share of HFO used for electricity generation has gradually declined due to the expansion of geothermal and other renewable power sources, industrial demand has remained relatively stable. Manufacturing sectors continue to depend on HFO because of its:

- High energy density
- Reliable combustion characteristics
- Established boiler infrastructure
- Continuous availability

As Kenya continues to industrialise, the challenge is no longer simply ensuring fuel availability, but ensuring that industrial growth is supported by **cleaner, more secure and locally available energy sources**.

Economic Implications of HFO Dependence

Reliance on imported HFO has consequences that extend beyond energy costs.

Foreign Exchange Outflows

Every litre of imported HFO requires foreign currency, increasing pressure on Kenya's balance of payments and exposing industries to exchange-rate volatility.

Industrial Competitiveness

Global fuel price fluctuations directly affect production costs, reducing the competitiveness of Kenyan manufacturers in domestic and export markets.

Energy Security

Dependence on imported fuels leaves industries vulnerable to international supply disruptions, shipping constraints and geopolitical events.

Climate Commitments

Industrial combustion of HFO contributes significantly to greenhouse gas emissions. As global markets increasingly favour low-carbon supply chains, reducing reliance on HFO will become an important factor in maintaining export competitiveness.

The Case for Transition

Kenya has already demonstrated that long-term investments in indigenous renewable energy can improve energy security and reduce dependence on imported fuels.

A similar transition is now possible for **industrial thermal energy**.

Replacing imported HFO with sustainably sourced biomass offers an opportunity to:

- Improve industrial resilience.
- Reduce foreign exchange expenditure.
- Support domestic agriculture and forestry.
- Create rural employment.
- Reduce greenhouse gas emissions.
- Enhance Kenya's position as a regional leader in green manufacturing.

The following chapter examines whether Kenya possesses sufficient sustainable biomass resources to support this transition and assesses the geographic distribution of these resources across the country.

5. Kenya's Biomass Resource Assessment

Kenya Possesses More Than Sufficient Biomass Resources

One of the most common concerns regarding industrial fuel switching is whether Kenya has sufficient sustainable biomass resources to replace imported Heavy Fuel Oil (HFO).

Current evidence indicates that the answer is **yes**.

Kenya is an agricultural economy with abundant renewable biomass resources generated through forestry, agriculture and agro-processing activities. These resources are widely distributed across the country and are already utilised to varying degrees for domestic energy, industrial heat and electricity generation.

The Ministry of Energy's National Bioenergy Strategy, FAOSTAT and published scientific studies estimate that Kenya generates **more than 20 million tonnes of sustainable biomass annually**, making biomass the country's largest indigenous renewable energy resource.

Major Biomass Resources

Resource	Estimated Annual Availability	Major Producing Counties
Wood Fuel & Forestry Residues	≈11.8 million tonnes	Nakuru, Kericho, Nyeri, Meru, Elgeyo Marakwet, Trans Nzoia, Uasin Gishu
Maize Residues	3–5 million tonnes	Trans Nzoia, Uasin Gishu, Bungoma, Narok, Nakuru
Sugarcane Bagasse	1–2 million tonnes	Kakamega, Bungoma, Busia, Kisumu, Migori
Coffee Husks	≈100,000 tonnes	Kiambu, Nyeri, Kirinyaga, Murang'a, Embu
Rice Husks	≈150,000 tonnes	Kirinyaga, Kisumu, Busia
Macadamia Shells	≈80,000 tonnes	Murang'a, Embu, Kirinyaga, Meru
Coconut Residues	≈150,000 tonnes	Kilifi, Mombasa, Kwale, Lamu
Municipal Organic Waste	Significant untapped resource	Nairobi, Mombasa, Kisumu, Nakuru, Eldoret

Figures are indicative estimates compiled from FAOSTAT, the Kenya National Bioenergy Strategy and published biomass resource assessments. Actual recoverable quantities depend on sustainability criteria, competing uses and collection efficiencies.

National Distribution of Biomass Resources

Kenya's biomass resources are geographically diversified, providing opportunities to establish regional biomass supply hubs close to major industrial centres.

Western Kenya

- Sugarcane bagasse
- Maize residues
- Forestry residues

Central Kenya

- Coffee husks
- Macadamia shells
- Forestry biomass

Rift Valley

- Maize residues

- Wheat straw
- Forestry resources

Coastal Region

- Coconut biomass
- Cashew residues
- Forestry resources

Eastern Kenya

- Maize residues
- Cotton stalks
- Forestry biomass

This geographic diversity reduces supply risks and enables the development of local biomass value chains tailored to regional agricultural production.

Can Biomass Replace Heavy Fuel Oil?

Kenya currently imports approximately **300 million litres of Heavy Fuel Oil annually**.

Assuming:

- Heavy Fuel Oil calorific value: **10,500 kcal/kg**
- Sustainable biomass calorific value: **3,500 kcal/kg**

Replacing the energy currently supplied by imported HFO would require approximately:

900,000–1,000,000 tonnes of sustainable biomass annually

Compared to:

More than 20 million tonnes of biomass available annually

This means that replacing Kenya's entire imported HFO requirement would utilise **only around 5% of the country's estimated annual sustainable biomass resource base.**

Key Finding

The analysis demonstrates that **biomass availability is not the primary constraint to industrial fuel switching in Kenya.**

The greater challenge lies in strengthening biomass aggregation, processing, logistics, fuel quality standards and long-term supply chain investment.

With appropriate policy support and private-sector investment, Kenya possesses sufficient indigenous biomass resources to become a regional leader in low-carbon industrial heat.

Kenya's Biomass Resource Assessment

Kenya Possesses More Than Sufficient Biomass Resources

Kenya is an agricultural economy with abundant renewable biomass resources generated through forestry, agriculture and agro-processing activities. These resources are widely distributed across the country and are already utilised to varying degrees for domestic energy, industrial heat and electricity generation.



More than 20 million tonnes of sustainable biomass are available annually – Kenya's largest indigenous renewable energy resource.

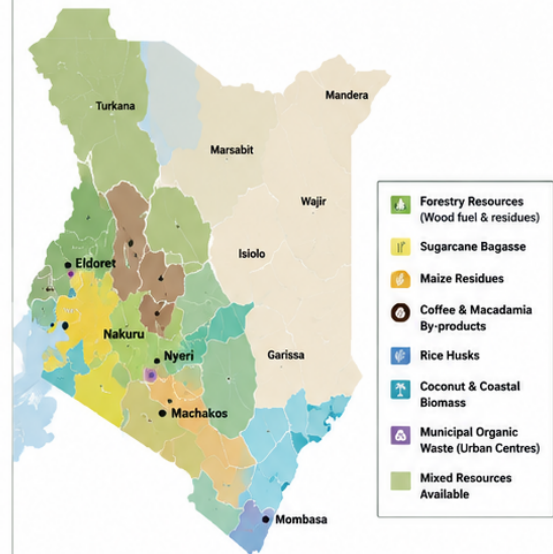
5.1 MAJOR BIOMASS RESOURCES IN KENYA

Biomass Resource	Estimated Annual Availability	Major Producing Counties
Wood Fuel & Forestry Residues	≈ 11.8 million tonnes	Nakuru, Kericho, Nyeri, Meru, Elgeyo Marakwet, Trans Nzoia, Uasin Gishu
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5.2 GEOGRAPHIC DISTRIBUTION OF BIOMASS RESOURCES

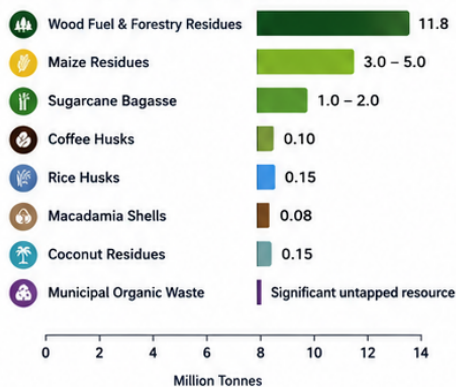
Dominant biomass resource by county/region



Kenya's biomass resources are geographically diversified, enabling development of regional biomass supply hubs close to major industrial centres and reducing supply risk.

5.3 ANNUAL BIOMASS AVAILABILITY BY RESOURCE TYPE

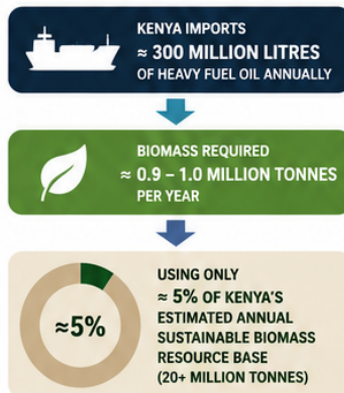
(Estimated million tonnes per year)



Source: FAOSTAT (2023), Kenya National Bioenergy Strategy (2020–2030), KFS Forest Statistics (2023), KALRO, Various Studies.

5.4 CAN BIOMASS REPLACE HEAVY FUEL OIL?

Replacing the energy currently supplied by imported HFO would require:



5.5 KEY FINDING



The analysis demonstrates that biomass availability is NOT the primary constraint to industrial fuel switching in Kenya.

The greater challenge lies in strengthening biomass aggregation, processing, logistics, fuel quality standards and long-term supply chain investment.



Kenya has more than enough sustainable biomass to replace its entire Heavy Fuel Oil requirement for industry – unlocking energy security, economic resilience and a low-carbon industrial future.

6. Biomass Supply Chain: Unlocking a Multi-Billion Shilling Rural Economy

Biomass is More Than an Energy Source—It is an Economic Opportunity

Unlike imported fossil fuels, every shilling spent on sustainably produced biomass remains within the Kenyan economy.

The transition from imported Heavy Fuel Oil (HFO) to locally sourced biomass has the potential to stimulate investment across agriculture, forestry, transport, manufacturing and rural enterprise development.

Developing a modern biomass industry would not only strengthen Kenya's industrial energy security but also create thousands of jobs, improve farmer incomes and establish entirely new value chains centred on renewable energy.

The Biomass Value Chain

The industrial biomass supply chain spans multiple sectors of the economy, creating value at every stage.

1. Biomass Production

Feedstocks originate from:

- Sustainable forestry
- Commercial tree plantations
- Agricultural residues
- Agro-processing industries
- Municipal organic waste
- Energy crops (where appropriate)

Primary participants:

- Farmers
- Forest owners
- County governments
- Agro-processors

2. Collection & Aggregation

Biomass is collected, sorted and transported to regional aggregation centres.

Activities include:

- Baling
- Chipping
- Drying
- Storage
- Quality control

3. Processing

Raw biomass is converted into industrial fuels through:

- Chipping
- Crushing
- Screening
- Briquetting
- Pelletising

4. Transport & Logistics

Processed fuel is transported to industrial users using regional logistics networks.

5. Industrial Energy Generation

Biomass fuels are utilised in:

- Steam boilers
- Thermic fluid heaters
- Combined Heat & Power (CHP)
- Industrial process heating

6. Manufacturing

Industries benefit from:

- Lower operating costs
 - Stable energy prices
 - Reduced carbon emissions
 - Improved energy security
-

Economic Benefits Across the Supply Chain

Stakeholder	Economic Benefit
Farmers	Additional income from agricultural residues that would otherwise be underutilised.
Biomass Aggregators	Creation of regional fuel collection and trading businesses.
Transporters	Increased demand for rural logistics and haulage services.
Fuel Processors	Investment in briquetting, chipping and pelletising facilities.
Equipment Manufacturers	Growth in local fabrication and engineering services.
Industries	Lower exposure to international fuel price volatility and improved long-term competitiveness.
Government	Reduced foreign exchange expenditure, increased rural economic activity and enhanced energy security.

Strengthening Rural Economies

Unlike imported petroleum fuels, biomass creates economic activity throughout the country.

Every tonne of sustainably sourced biomass generates value through:

- Farm income
- Transport services
- Fuel processing
- Equipment maintenance
- Engineering services
- Local manufacturing
- Employment in rural communities

This enables industrial energy expenditure to circulate within Kenya rather than leaving the country through fuel imports.

Towards a Circular Green Economy

Industrial biomass also supports Kenya's transition towards a circular economy by converting agricultural and forestry residues into valuable industrial fuel.

Rather than being burned in open fields or disposed of as waste, biomass residues can become a productive energy resource that:

- Reduces waste.
 - Generates additional income.
 - Improves resource efficiency.
 - Lowers greenhouse gas emissions.
 - Supports sustainable land management.
-

Key Finding

The transition to industrial biomass is not simply an energy project—it is a national economic development strategy.

A modern biomass supply chain has the potential to connect Kenya's farmers, transporters, processors, manufacturers and investors into a resilient green industrial ecosystem that delivers long-term economic, environmental and social benefits.

6 Biomass Supply Chain: Unlocking a Multi-Billion Shilling Rural Economy

Unlike imported fossil fuels, every shilling spent on sustainably produced biomass remains within the Kenyan economy.

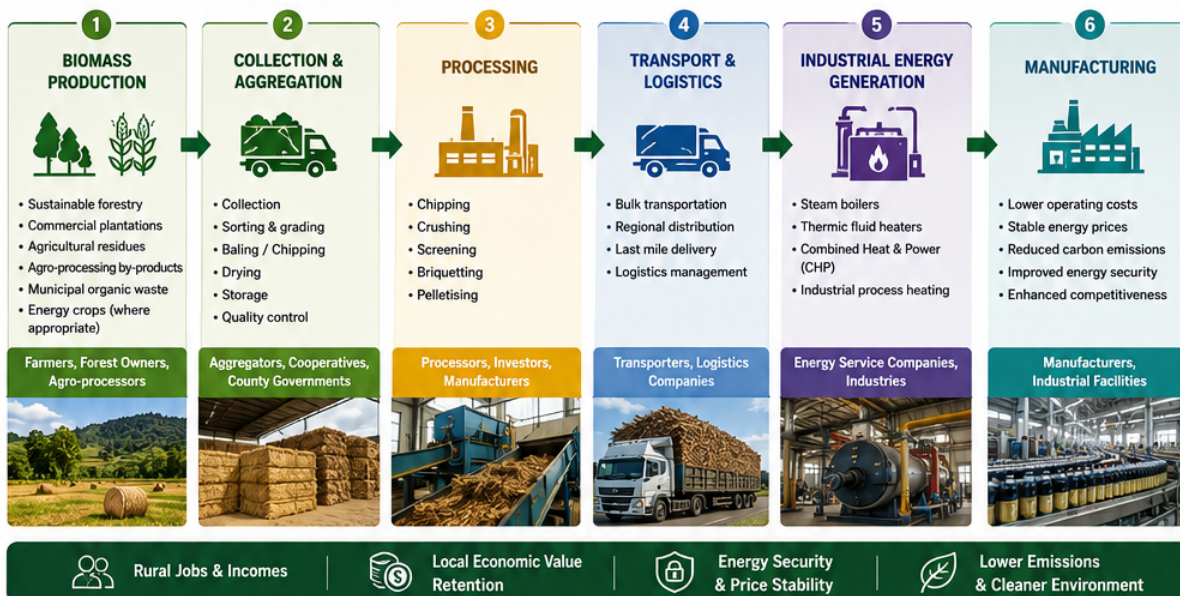
The transition from imported Heavy Fuel Oil (HFO) to locally sourced biomass has the potential to stimulate investment across agriculture, forestry, transport, manufacturing and rural enterprise development.



A National Opportunity

Every 1 million tonnes of biomass utilised for industry can unlock multi-billion shilling economic value and support thousands of jobs across Kenya.

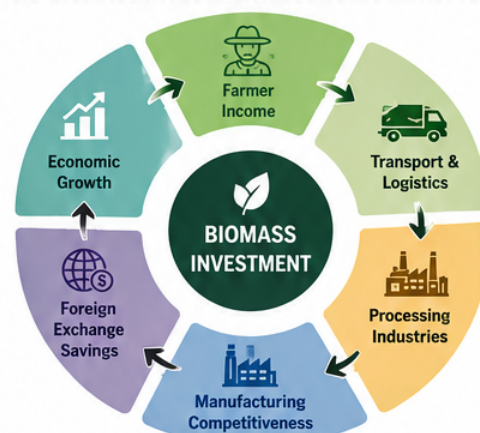
6.1 KENYA INDUSTRIAL BIOMASS VALUE CHAIN



6.2 ECONOMIC BENEFITS ACROSS THE SUPPLY CHAIN

Stakeholder	Economic Benefit
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Industries	Lower exposure to international fuel price volatility and improved long-term competitiveness.
Government	Reduced foreign exchange expenditure, increased rural economic activity and enhanced energy security.

6.3 BIOMASS INVESTMENT: ECONOMIC IMPACT FLOW



6.4 STRENGTHENING RURAL ECONOMIES

Every tonne of sustainably sourced biomass creates value and jobs:



Industrial energy expenditure circulates within Kenya, strengthening rural economies and reducing poverty.

6.5 TOWARDS A CIRCULAR GREEN ECONOMY

Biomass utilises agricultural and forestry residues productively, reducing waste and supporting sustainability.



Waste today, value tomorrow – powering industry sustainably while protecting our environment.



The transition to industrial biomass is a national economic development strategy – creating jobs, retaining value in Kenya and building a resilient, green industrial future.

7. Economic Impact Assessment: Foreign Exchange, Employment and National Growth

Industrial Biomass is an Investment in Kenya's Economy

Unlike imported fossil fuels, investment in sustainable biomass circulates within the domestic economy. Every tonne of biomass produced, processed and consumed supports Kenyan farmers, transporters, manufacturers and rural enterprises while reducing dependence on imported petroleum products.

Transitioning industrial energy from imported Heavy Fuel Oil (HFO) to sustainable biomass represents an opportunity to strengthen Kenya's balance of payments, stimulate private investment and accelerate inclusive economic growth.

Reducing Foreign Exchange Outflows

Kenya currently imports approximately **300 million litres of Heavy Fuel Oil annually**, requiring substantial foreign currency expenditure.

Replacing imported HFO with locally produced biomass would:

- Reduce annual petroleum imports.
- Improve Kenya's balance of payments.
- Lower exposure to international oil price volatility.
- Reduce pressure on foreign exchange reserves.
- Improve long-term industrial energy security.

Instead of exporting capital through fuel imports, expenditure on industrial energy would increasingly support domestic production and employment.

Employment Creation

The biomass economy is considerably more labour-intensive than imported fossil fuels.

Developing sustainable biomass supply chains creates employment throughout the value chain, including:

- Sustainable forestry
- Agricultural residue collection
- Biomass aggregation
- Fuel processing
- Transport and logistics
- Equipment manufacturing
- Boiler installation
- Operations and maintenance
- Engineering services
- Environmental monitoring

Unlike petroleum imports, these activities generate employment within Kenya and contribute to rural economic development.

Strengthening Agricultural Value Chains

Many agricultural residues currently have limited commercial value despite their energy potential.

Expanding industrial biomass utilisation creates additional revenue streams for:

- Maize farmers
- Sugar mills
- Coffee cooperatives
- Rice producers
- Coconut processors
- Macadamia growers
- Commercial forestry operators

This improves agricultural profitability while reducing waste and supporting a circular economy.

Improving Industrial Competitiveness

A reliable domestic biomass market can help industries:

- Reduce exposure to volatile international fuel prices.
- Improve long-term energy cost predictability.
- Enhance resilience against global supply chain disruptions.
- Meet increasingly stringent sustainability requirements from export markets.
- Reduce operational carbon footprints.

As international markets increasingly introduce carbon-related trade measures, low-carbon manufacturing will become an important source of competitive advantage.

Estimated National Economic Benefits

Area	Expected National Benefit
Foreign Exchange	Reduced expenditure on imported Heavy Fuel Oil
Employment	Thousands of jobs across rural and industrial value chains
Agriculture	Additional income from agricultural and forestry residues
Manufacturing	Improved long-term competitiveness through stable energy costs
Investment	Growth in biomass processing, logistics and engineering industries
Environment	Lower greenhouse gas emissions and improved air quality

A Multiplier Effect Across the Economy

The economic impact of biomass extends well beyond the energy sector.

Investment in industrial biomass stimulates demand across multiple industries simultaneously, creating a positive multiplier effect:

- Agriculture**
- **Transport**
- **Fuel Processing**
- **Engineering**
- **Manufacturing**
- **Exports**
- **Economic Growth**

Unlike imported fossil fuels, biomass expenditure remains largely within the domestic economy, supporting businesses and communities throughout Kenya.

Key Finding

Industrial biomass should not be viewed solely as an alternative fuel.

It represents a strategic economic development opportunity capable of strengthening Kenya's manufacturing sector, improving rural livelihoods, retaining foreign exchange within the country and supporting long-term sustainable economic growth.

"Every shilling spent on imported Heavy Fuel Oil leaves the Kenyan economy. Every shilling spent on sustainably produced biomass supports Kenyan farmers, businesses, workers and communities."

8. International Experience: Lessons from Global Leaders in Industrial Biomass

Industrial Biomass is a Proven Solution

Around the world, countries seeking to strengthen energy security, reduce greenhouse gas emissions and improve industrial competitiveness have successfully integrated sustainable biomass into their industrial energy systems.

These experiences demonstrate that biomass is not an experimental technology—it is a mature, commercially proven solution capable of supporting large-scale industrial heat and power generation.

Kenya is well positioned to build upon these international experiences while leveraging its own abundant agricultural and forestry resources.

Sweden

World Leader in Industrial Bioenergy

Sweden has spent several decades replacing fossil fuels with biomass across district heating systems and industrial applications.

Today, biomass plays a central role in supplying heat to:

- Food industries
- Timber processing
- Paper and pulp manufacturing
- District heating networks

Key policy measures included:

- Carbon taxation on fossil fuels
- Long-term investment certainty
- Sustainable forestry management
- Strong private-sector participation

Key Lesson for Kenya

Long-term policy certainty encourages sustained private investment in renewable industrial energy.

Denmark

Combining Biomass with Industrial Competitiveness

Denmark successfully transitioned many industrial and district heating systems from coal and oil to sustainably sourced biomass.

The transition was supported through:

- Stable energy policies
- Biomass sustainability standards
- Public-private partnerships
- Investment in efficient heating infrastructure

Key Lesson for Kenya

Clear sustainability standards and predictable policies accelerate industry adoption.

Finland

Maximising Forestry Resources

Finland has developed one of the world's most advanced forest-based bioeconomies.

Industrial biomass fuels are produced from:

- Forest residues
- Wood processing by-products
- Sawdust
- Bark
- Black liquor from pulp production

The forestry sector now supplies both industrial energy and significant export revenue.

Key Lesson for Kenya

Natural resource industries can become major suppliers of renewable industrial fuels while creating additional economic value.

Brazil

Turning Agricultural Residues into Industrial Energy

Brazil has become a global leader in utilising sugarcane bagasse for industrial heat and electricity generation.

Most sugar mills now generate their own steam and power using biomass, with many exporting surplus electricity to the national grid.

This has:

- Reduced fossil fuel dependence.
- Increased energy security.
- Improved competitiveness of the sugar industry.

Key Lesson for Kenya

Agricultural residues can become valuable industrial energy resources rather than waste products.

India

Scaling Industrial Biomass Across Manufacturing

India has promoted biomass utilisation across thousands of industrial facilities through:

- Biomass briquettes
- Agricultural residue markets
- Biomass pellet programmes
- Financial incentives for industrial fuel switching

This has stimulated rural employment while reducing open burning of agricultural residues.

Key Lesson for Kenya

Strong biomass supply chains can simultaneously improve rural livelihoods, reduce pollution and support industrial growth.

What Kenya Can Learn

Although each country has followed a different pathway, several common success factors emerge.

Successful industrial biomass transitions require:

- Long-term policy certainty.
- Sustainable biomass resource management.
- Reliable fuel quality standards.
- Private-sector investment.
- Efficient supply chains.
- Stable financing mechanisms.
- Collaboration between government and industry.

Kenya already possesses many of these fundamental advantages, including abundant biomass resources, a strong agricultural sector and a growing manufacturing base.

Kenya's Opportunity

Unlike many developed economies that invested decades in building their biomass industries, Kenya has the opportunity to accelerate this transition by leveraging existing agricultural value chains and modern biomass technologies.

By learning from international experience and adapting proven approaches to local conditions, Kenya can become a regional leader in renewable industrial heat and green manufacturing.

Key Takeaway

The experience of Sweden, Denmark, Finland, Brazil and India demonstrates that industrial biomass is not merely an environmental initiative—it is an economic development strategy that strengthens energy security, enhances industrial competitiveness and creates long-term national value.

Kenya has the natural resources, industrial demand and technical capability to join this group of leading bioenergy economies.

9. Strategic Policy Recommendation

Accelerating Industrial Fuel Switching Through a Green Industrial Transition Fund

A Strategic Opportunity for Kenya

Kenya has the opportunity to accelerate industrial decarbonisation while strengthening national energy security through the gradual introduction of an environmental levy on imported **Industrial Heavy Fuel Oil (HFO)**.

Rather than functioning as a revenue-raising measure, the proposed levy should serve as a strategic investment mechanism to accelerate Kenya's transition towards cleaner industrial energy.

All revenues generated should be **ring-fenced into a dedicated Green Industrial Transition Fund**, ensuring that proceeds are reinvested directly into projects that reduce industrial dependence on imported fossil fuels.

This approach creates a self-sustaining mechanism that simultaneously discourages fossil fuel dependence while financing the development of Kenya's domestic biomass economy.

Policy Proposal

Policy Option

Introduce a **gradual environmental levy or import duty on Industrial Heavy Fuel Oil**, implemented over a **3–5 year period**, with all revenues allocated exclusively to a **Green Industrial Transition Fund**.

The proposed approach allows industries sufficient time to adapt while providing predictable policy signals that encourage long-term investment in renewable industrial energy.

Objectives of the Policy

The proposed policy seeks to:

- Reduce Kenya's dependence on imported fossil fuels.
 - Improve national energy security.
 - Accelerate industrial decarbonisation.
 - Retain energy expenditure within the Kenyan economy.
 - Stimulate investment in sustainable biomass production.
 - Support development of modern biomass supply chains.
 - Improve the long-term competitiveness of Kenyan manufacturing.
 - Create employment opportunities throughout rural and industrial value chains.
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The Green Industrial Transition Fund

Revenues generated through the environmental levy should be transparently managed through a dedicated national fund supporting projects such as:

Industrial Fuel Switching

- Biomass boiler conversions
- Steam-as-a-Service projects
- Thermic fluid heating systems
- Waste-to-energy projects
- Waste heat recovery systems

Biomass Infrastructure

- Regional biomass aggregation centres
- Biomass processing facilities
- Briquetting and pelletising plants
- Sustainable fuel storage infrastructure

Green Finance

- Low-interest financing for industrial biomass projects
- Credit guarantees
- Blended finance mechanisms
- Public-private investment partnerships

Innovation & Skills Development

- Research and development
 - Biomass quality standards
 - Workforce training
 - Technical certification programmes
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Expected National Outcomes

Implementation of this policy would contribute to:

National Objective	Expected Outcome
Energy Security	Reduced dependence on imported Heavy Fuel Oil
Industrial Competitiveness	More stable long-term industrial energy costs
Foreign Exchange	Reduced expenditure on imported petroleum products
Manufacturing	Increased investment in low-carbon industrial technologies
Agriculture	Expanded markets for agricultural and forestry residues
Employment	New jobs across farming, transport, processing and engineering
Climate Action	Lower greenhouse gas emissions from industrial heat generation

Implementation Principles

To ensure an orderly and competitive transition, the policy should be guided by the following principles:

- **Gradual implementation** over a 3–5 year period.
 - **Transparency** through independent management and public reporting of the Green Industrial Transition Fund.
 - **Predictability** to provide investors and industries with confidence.
 - **Technology neutrality**, supporting the most effective low-carbon industrial heating solutions.
 - **Industry engagement** through continuous consultation with manufacturers and energy users.
 - **Sustainability**, ensuring that biomass resources are sourced responsibly without compromising food security or environmental conservation.
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Why This Approach Matters

Kenya has already demonstrated that long-term, consistent policy support can transform an energy sector. The country's success in geothermal development illustrates how strategic public policy, combined with private investment, can deliver lasting national benefits.

A similar approach can now be applied to industrial thermal energy.

By gradually redirecting investment from imported fossil fuels towards locally available sustainable biomass, Kenya can strengthen its manufacturing sector, stimulate rural economic development and position itself as a regional leader in green industrialisation.

Strategic Recommendation

The Government of Kenya should consider the gradual introduction of an environmental levy on imported Industrial Heavy Fuel Oil, with all revenues ring-fenced into a Green Industrial Transition Fund dedicated to accelerating industrial fuel switching, strengthening biomass supply chains and supporting the country's transition towards a competitive, low-carbon manufacturing economy.

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