

Dalberg

Ethanol Cooking Fuel Master Plan

WORKING GROUP MEETING
10TH SEPTEMBER 2019

Supported by:



Federal Ministry
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and Nuclear Safety

based on a decision of the German Bundestag



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1. Context & Objectives

2. Demand for Ethanol cooking fuel
3. CAPEX required to establish local industry
4. Employment, earnings, health, & environmental impact

Households in Kenya still primarily use dirty fuels; Ethanol cooking fuel could present a viable alternative

- **The current Kenyan cooking fuel market is dominated by charcoal (14.6%), firewood (54.6%), LPG (13.4%) and kerosene (14%) as primary fuels**
 - The use of multiple fuels and stoves in a household, known as stacking, is a common phenomenon in Kenya making charcoal and kerosene even more widespread. Nairobi is unique, with far higher share of households using LPG (44%) and kerosene (47%) as primary cooking fuels (2017).
- **The continued dependence on dirty fuels poses serious health, environmental, and socio-economic costs for Kenya**
 - 8-10% of early deaths are attributable to indoor air pollution from charcoal and wood cooking in Kenya; this excludes the unquantified but likely substantial negative effects of kerosene cooking on lung function, infectious illness and cancer risks, as well as burns and poisonings. In addition, significant amounts of deforestation are attributable to firewood and charcoal use.
- **Clean cooking fuels are available in Kenya, and new suppliers are working with the government to overcome awareness, affordability, and accessibility barriers**
 - LPG is well understood and increasingly common in urban Kenya, but despite continued investments in capacity it is unlikely to become the primary fuel for the majority of urban populations due to high costs and limited availability outside of Nairobi.
- **Ethanol cooking fuel (ECF) is a viable alternative as a clean and affordable cooking fuel**
 - While still nascent, there has been significant investment in increasing access with investments from KOKO networks and Vivo Energy on the distribution section of the value chain

The Kenyan Ethanol Cooking Fuel (ECF) masterplan is being developed to support the establishment of an ECF industry

CONTEXT

The Ethanol cooking fuel (ECF) masterplan was commissioned to support the establishment of an ECF industry in Kenya, with the objective of providing potential investors, policymakers, and researchers with an evidence base to guide the development of ECF infrastructure and distribution systems in Kenya. It also provides policy recommendations on how the Government of Kenya can support the industry.

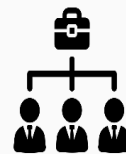
DALBERG STUDIED:



Demand
for
Ethanol
cooking
fuel



CAPEX
required
to set up
a local
industry



Impact
on employment,
earnings, health
& the
environment

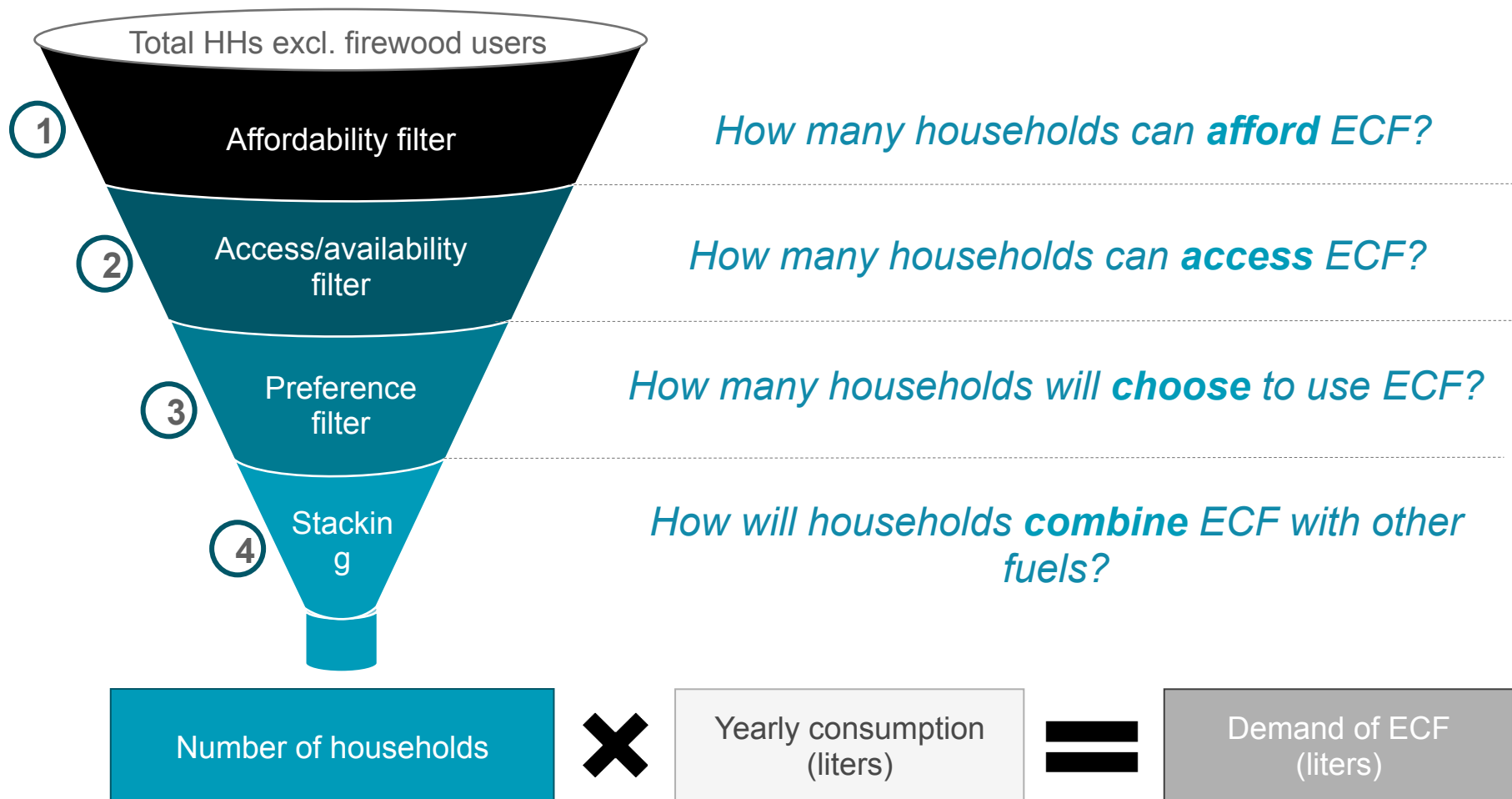


Policy
recommendations
to support the
industry



1. Context & Objectives
- 2. Demand for Ethanol cooking fuel**
3. CAPEX required to establish local industry
4. Employment, earnings, health, & environmental impact

Methodology: Demand for ethanol cooking fuel (ECF) was calculated by identifying & assessing the drivers of demand

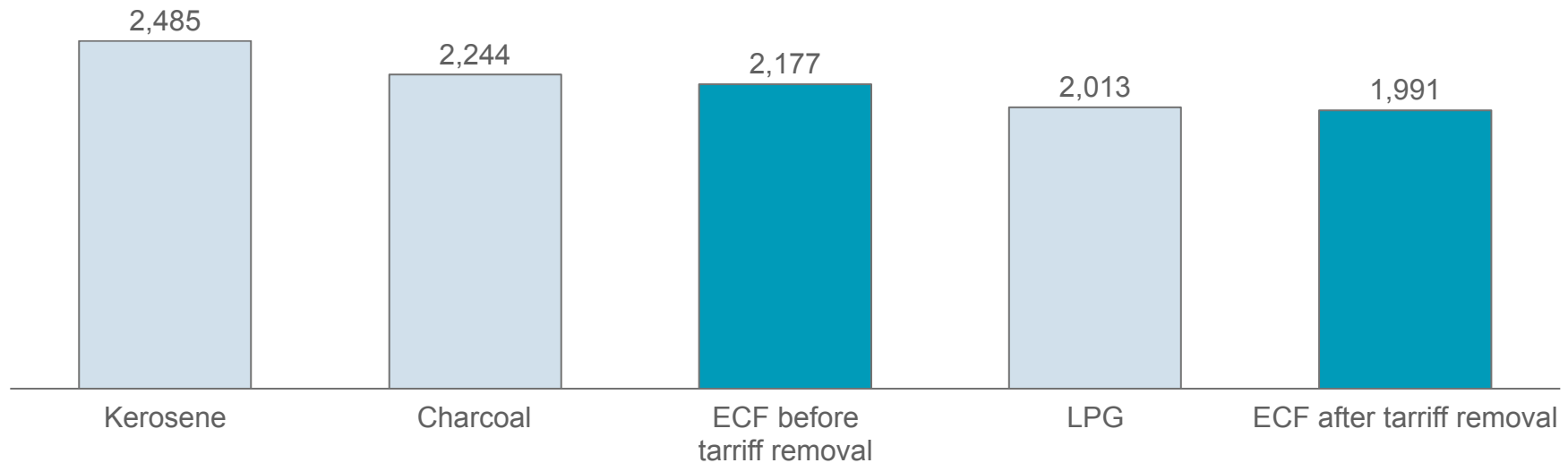


Note: ECF stands for Ethanol cooking fuel

Affordability: ECF is more cost efficient than kerosene or charcoal; a tariff removal could make it the cheapest option

ECF could be the cheapest cooking fuel in the market

Average monthly cost of cooking* (KSH)



Insights

- Given the recent increases in the prices of kerosene and charcoal, **the monthly cost of using ECF is ~2177KSH lower than the dirty fuels**
- **Price per liter of ECF could reduce from ~95KSH/l to ~85KSH/l with the removal of import tariffs.** reducing the monthly cost of using ECF to ~1990KSH

Note: Average monthly cost of cooking is calculated by multiplying HH fuel consumption by unit price. Fuel consumption obtained from Dalberg 2018 report – Scaling up clean cooking in urban Kenya with LPG and Ethanol. Prices obtained from KOKO Network surveys
Source: KOKO Networks, Dalberg analysis

Availability: Access to ECF is on the rise, with rapid expansion of wholesale & last-mile distribution networks

Distribution networks are being created across the country

Storage



Vivo energy is repurposing storage space from dirtier fuels to ethanol

Last-mile distribution



Vivo energy is investing in tankers and fuel station dispensers

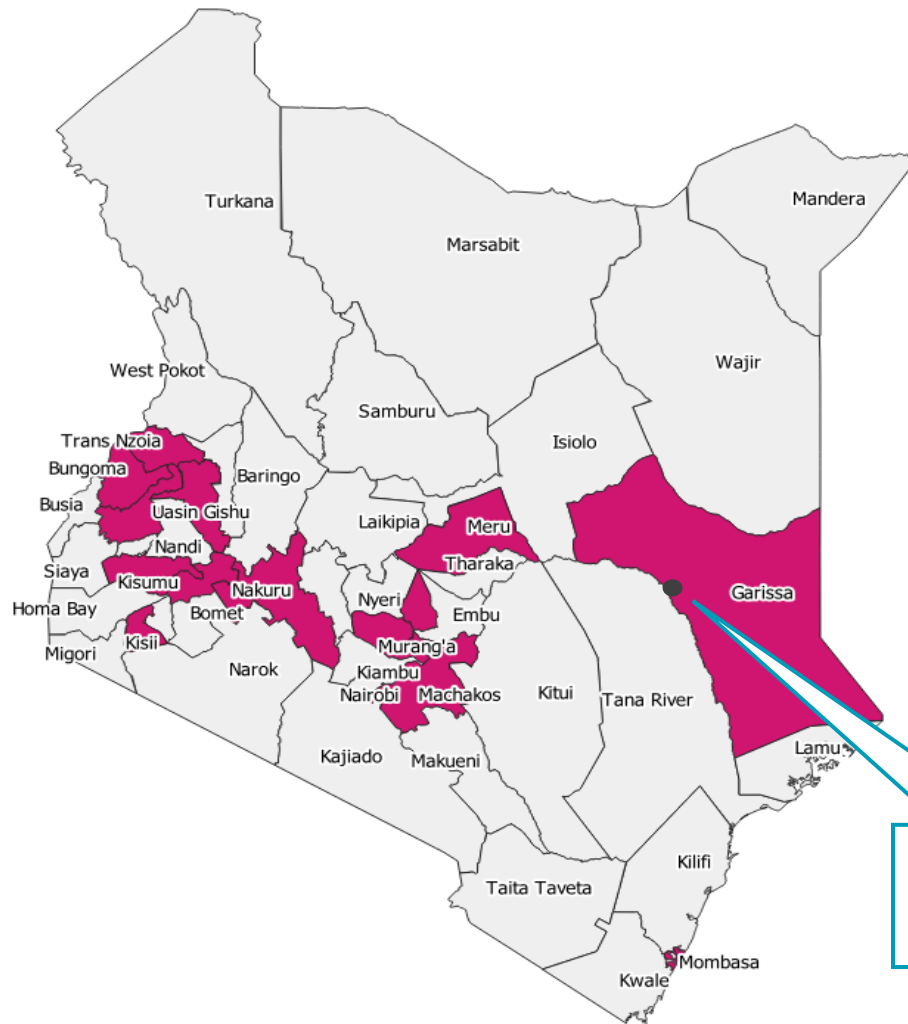
Retail



KOKO Networks has developed a cost efficient tech-enabled retail system



Availability: ECF is currently available in Nairobi; there is a planned expansion in 14 counties

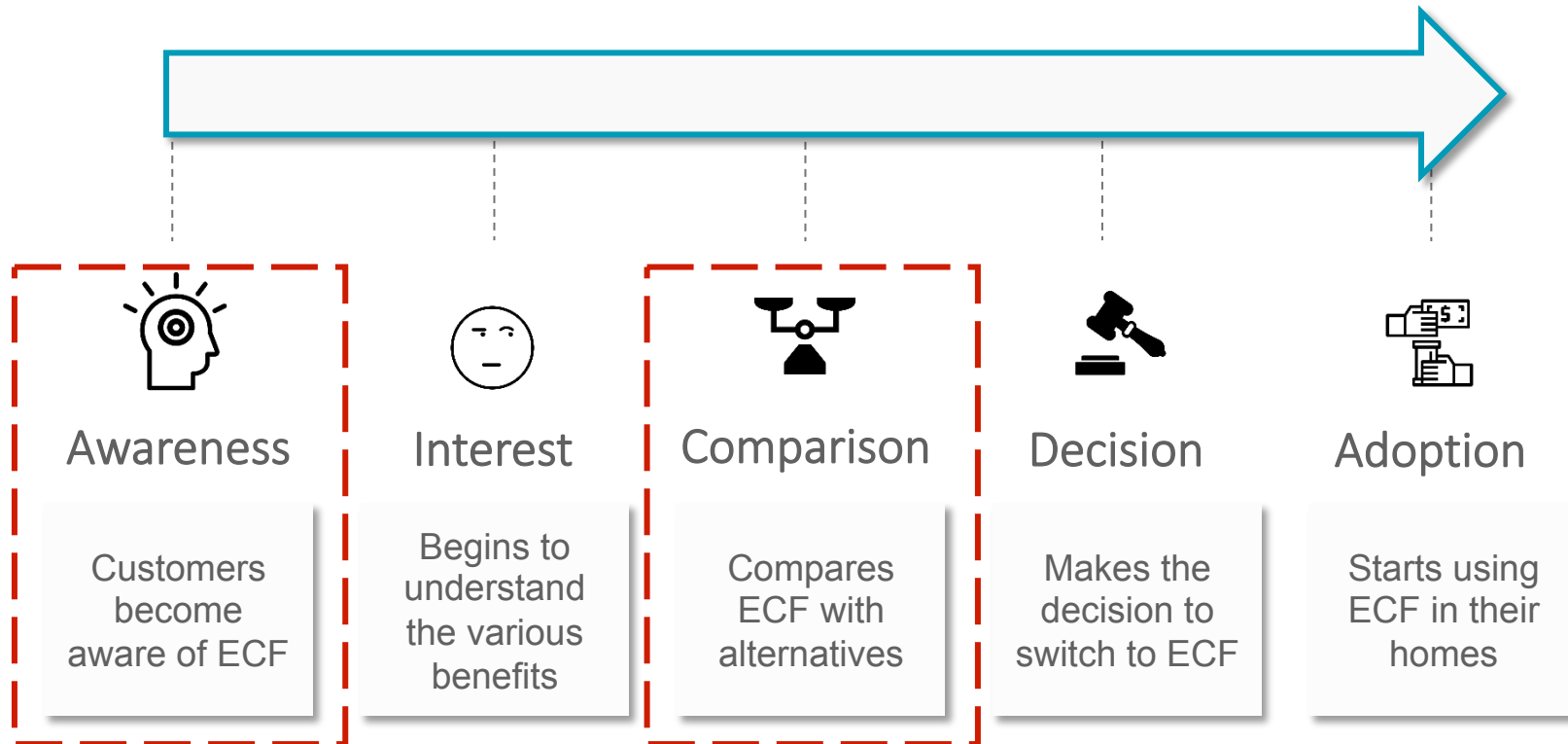


KOKO and Vivo's expansion to begin with 14 urban areas (highlighted). Rural expansion to be initially limited due to infrastructural challenges

Expansion in Garissa to be initially limited to Garissa city, capital of Garissa county

Preference: To spur on adoption, it is critical to raise awareness & demonstrate benefits for customer comparison with other fuels

The customer preference journey will consist of 5 stages

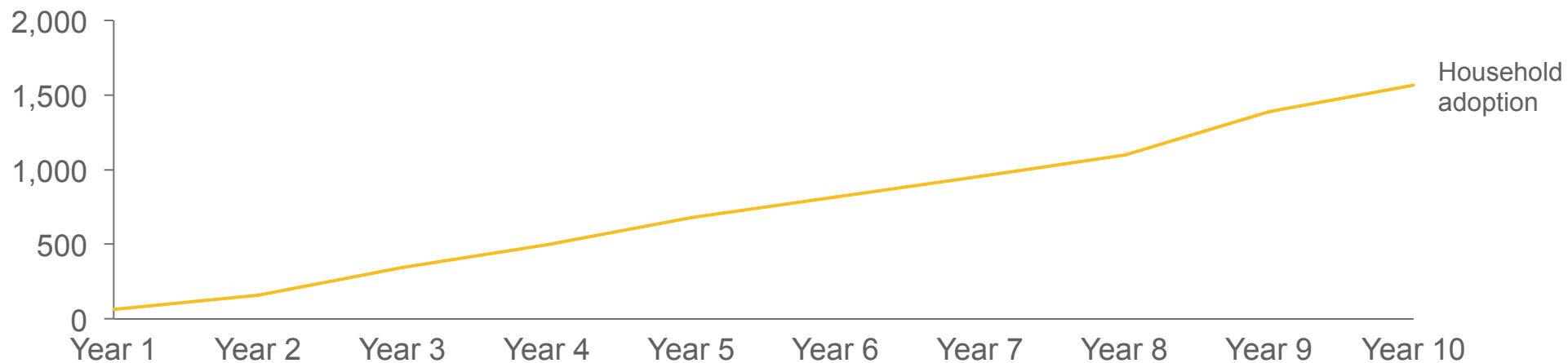


Awareness and comparison are critical points in the process

Demand: Household use of ethanol cooking fuel (ECF) is projected to rise rapidly over the next 10 years

Households adopting ECF to rise from ~58k in Yr. 1 to ~697k in Yr. 10

Total no of HHS adopting ECF ('000)

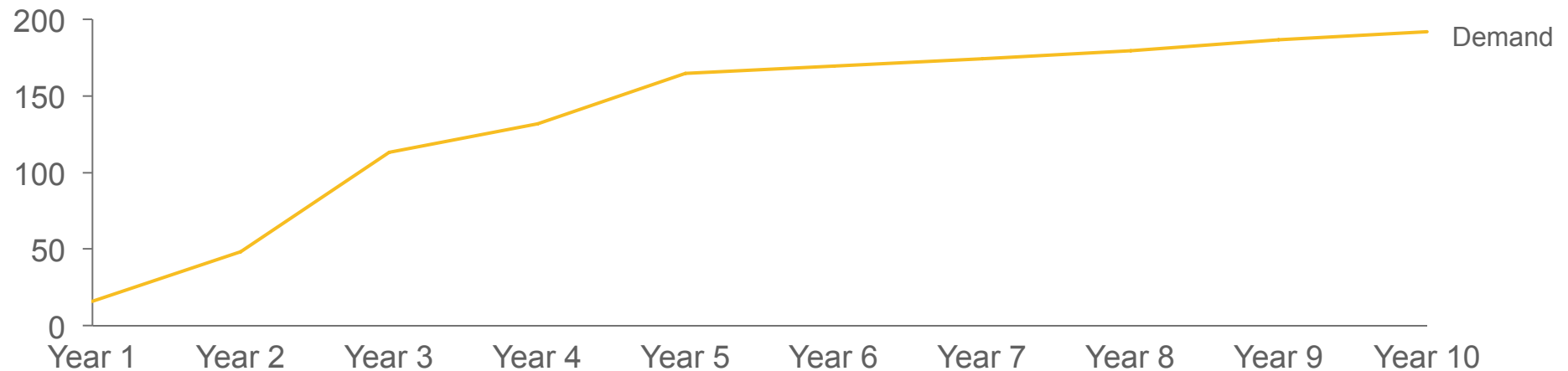


Each HH to consume ~275litres per year

Demand: In terms of liters consumed, total demand for ECF is expected to rise to 192M in 10 years

Total demand to increase rapidly to ~192M liters

Total demand (millions of liters)



Policy recommendations: Increasing the demand for ethanol cooking fuel (1/2)

FOR DISCUSSION

1. REMOVE THE 25% IMPORT DUTY FOR ETHANOL AS A COOKING FUEL FOR A LIMITED PERIOD OF TIME

- **Impact:** Removing the 25% import duty on ethanol will drive the price down for consumers and encourage the uptake of ethanol as a clean cooking fuel
- **Rationale:** Affordability has been identified as one of the main drivers of the demand of ethanol cooking fuel and therefore is a key lever in driving consumers' switch. Additionally, imports are necessary to support the market while domestic production is established. The removal of the import duty must be reviewed within an appropriate period to ensure the development of a domestic ethanol industry

2. EXPAND EXISTING REGULATIONS ON KEROSENE AND CHARCOAL TO OTHER COUNTIES WITH THE GROWTH OF THE ECF MARKET

- **Impact:** Introducing and enforcing regulations on traditional fuels will decrease the number of households consuming charcoal and kerosene. This recommendation should be implemented once viable alternatives are in place
- **Rationale:** Trade bans are currently in place in some counties. For effective uptake of ECF this can be expanded to other counties across the nation

Policy recommendations: Increasing the demand for ethanol cooking fuel (2/2)

FOR DISCUSSION

3. WORK WITH THE PRIVATE SECTOR TO DESIGN STOVE FINANCING OPTIONS

- **Impact:** Private sector consumer schemes will allow more households to access ethanol as a cooking fuel in the next few years
- **Rationale:** Such models have been deployed in other countries to support the uptake of certain products. E.g. IDCOL – a specialized Infrastructure Development Company owned by the Bangladesh Ministry of Finance – donated credit to support households in purchasing clean cookstoves

4. CONTINUE TO EXPAND ON CURRENT AWARENESS AND COMMUNICATION CAMPAIGNS TO PROMOTE ECF AND HIGHLIGHT THE RISK OF TRADITIONAL COOKING FUELS

- **Impact:** Awareness and communication campaigns will help informing the consumers about the dangers of traditional fuel sources, while supporting uptake
- **Rationale:** There is still a lack of awareness of the dangers of traditional fuels on consumer's health, and campaigns have been a critical part of ensuring uptake in other countries

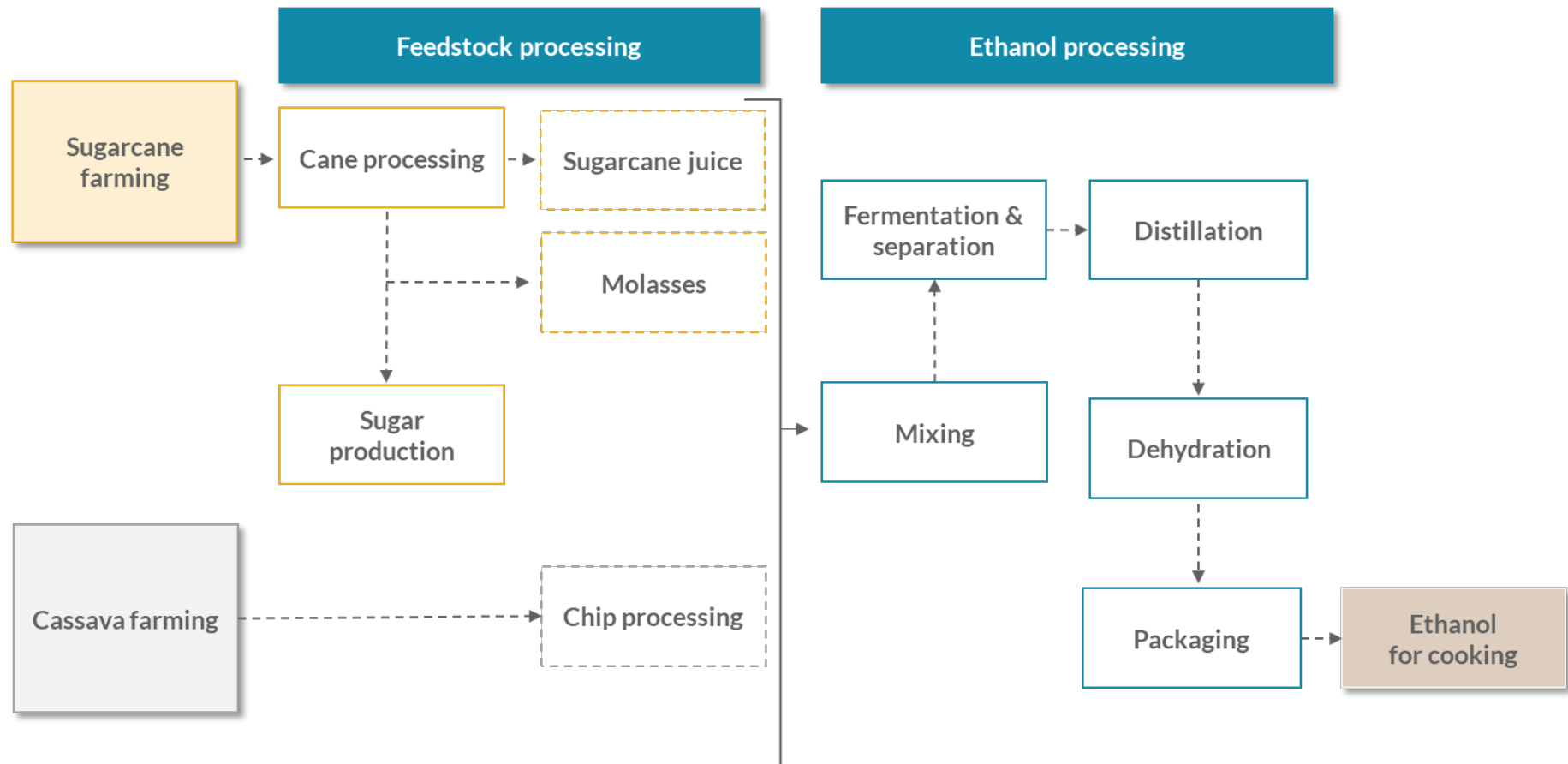
Question

- Which policy recommendations could incentivize the manufacturing of domestic cookstoves in Kenya?



1. Context & Objectives
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3. **CAPEX required to establish local industry**
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Methodology: We chose to examine 3 types of feedstock: molasses, sugarcane juice, and cassava



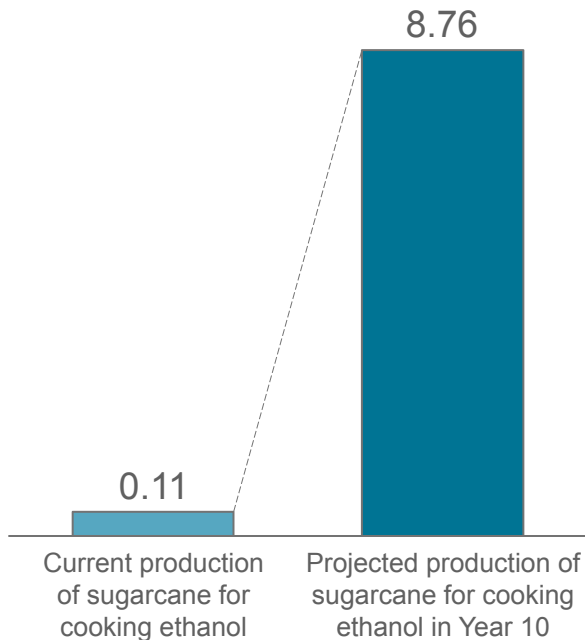
Methodology: 3 sections of the value chain were examined to calculate the CAPEX required to establish a bio-ethanol industry

	1 Feedstock production	2 Ethanol Processing	3 Ethanol distribution
Description	- Assesses the feedstock production both local and imported necessary to meet projected ethanol demand - Calculates CAPEX needed to mechanize large scale farms as well as number of hectares required to meet sugarcane or cassava production	- Estimates the quantity of ethanol production, local and imported necessary to meet the projected demand - Calculates CAPEX needed to set up ethanol plants across the three feedstocks as well as sugar plants to provide molasses	- Estimates the number of trucks, smart depots and dispensing devices required to meet demand - Projects the CAPEX required yearly for each step of the value chain (i.e. distribution to fuel stations, within the fuel stations, to retail stores, and to the final consumers)
Current players (not exhaustive)			

1.1 Molasses pathway: Given the feedstock gap, an increase of production is needed to meet the projected demand of ethanol

Projected sugarcane gap

Millions of tons per year



Assumptions:

- (1) 100% of the ethanol is sourced from molasses over 10 years
- (2) 50% of domestic ethanol production
- (3) Base case demand
- (4) The current yield of sugarcane is 60T/Ha while the projected yield is 80T/Ha due to improved quality of crops and mechanization

Challenges of feedstock production

- Low yield of sugarcane due to the use of poor quality crops and seeds not being planted in the most conducive regions
- Deficit of investments in sugarcane production with a limited number of large-scale mechanized sugarcane farms

How to achieve success



108,153 new hectares will need to be allocated for sugarcane production

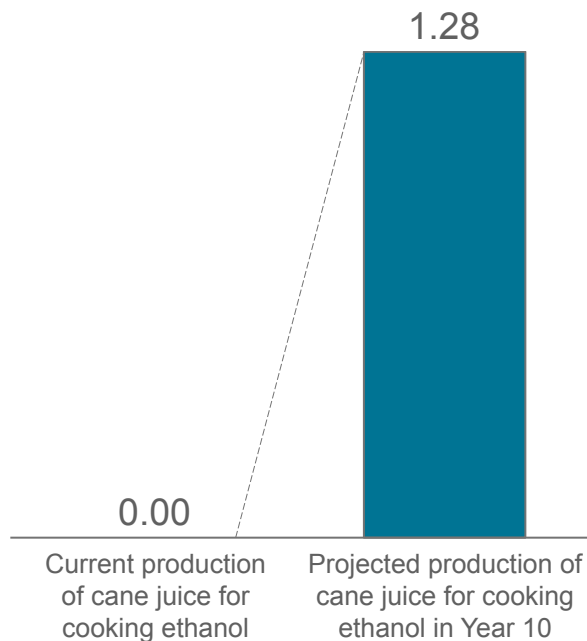


4 large-scale mechanized sugar farms will need to be set up to produce the required sugarcane

1.2 Cane-juice pathway: Given the feedstock gap, an increase of production is needed to meet the projected demand of ethanol

Projected cane-juice gap

Millions of tons per year



Assumptions:

- (1) 100% of the ethanol is sourced from cane-juice over 10 years
- (2) 50% of domestic ethanol production
- (3) Base case demand
- (4) The current yield of sugarcane is 60T/Ha while the projected yield is 80T/Ha due to improved quality of crops and mechanization

Challenges of feedstock production

- Productivity of sugarcane is currently low in Kenya with poor quality crops
- Sugarcane juice's shelf is only 24-48 hours which could result in losses
- Will be direct competition with the sugar industry as both would be using sugarcane directly as raw materials

How to achieve success



15,973 new hectares will need to be allocated for cane-juice production

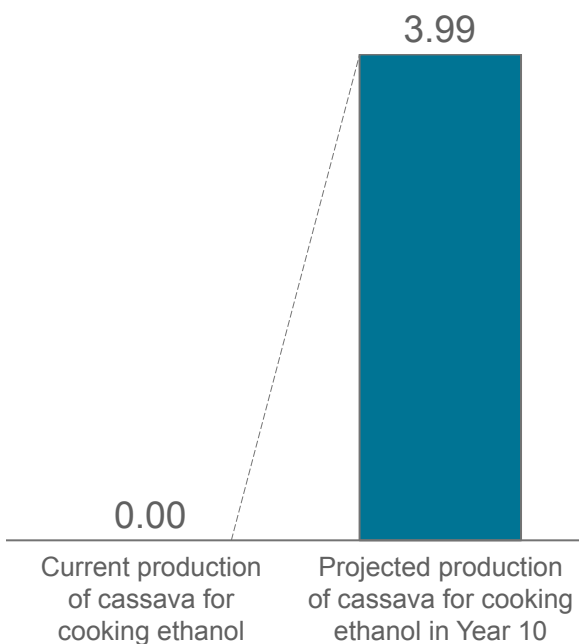


1 large-scale mechanized farm will need to be set up to produce the required sugarcane

1.3 Cassava pathway: Given the feedstock gap, an increase of production is needed to meet the projected demand of ethanol

Projected cassava gap

Millions of tons per year



Assumptions:

- (1) 100% of the ethanol is sourced from cassava over 10 years
- (2) 50% of domestic ethanol production
- (3) Base case demand
- (4) The current yield of cassava is 12T/Ha while the projected yield is 20T/Ha due to mechanized farm

Challenges of feedstock production

- Kenya's cassava value chain is currently underdeveloped leading to low yields
- Cassava roots rot quite quickly (24-48 hours)
- The bulkiness of cassava roots could result in additional transport costs
- Cassava can be damaged by several diseases including the brown streak virus

How to achieve success



55,576 new hectares will need to be allocated for cassava production

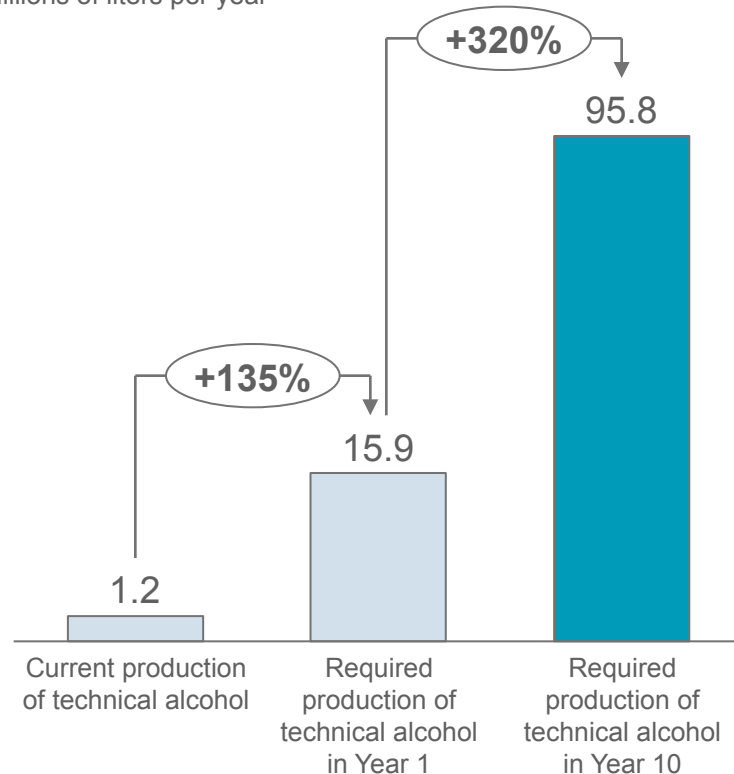


1 large-scale mechanized farm will need to be set up to produce the required cassava

2. Ethanol processing: An increase of ethanol processing will also be required to meet the projected ethanol demand

Projected ethanol gap

Millions of liters per year



Assumptions:

- (1) 100% of the ethanol is sourced from molasses, cane juice or cassava
- (2) 50% of domestic ethanol production
- (3) Base case demand

Current challenges of ethanol processing

- High prices of locally sourced molasses resulting from a shortage of feedstock
- Inadequate investment in the sector – only 2 ethanol plants are currently functional

How to achieve success



4 joint ethanol plants will need to be set up

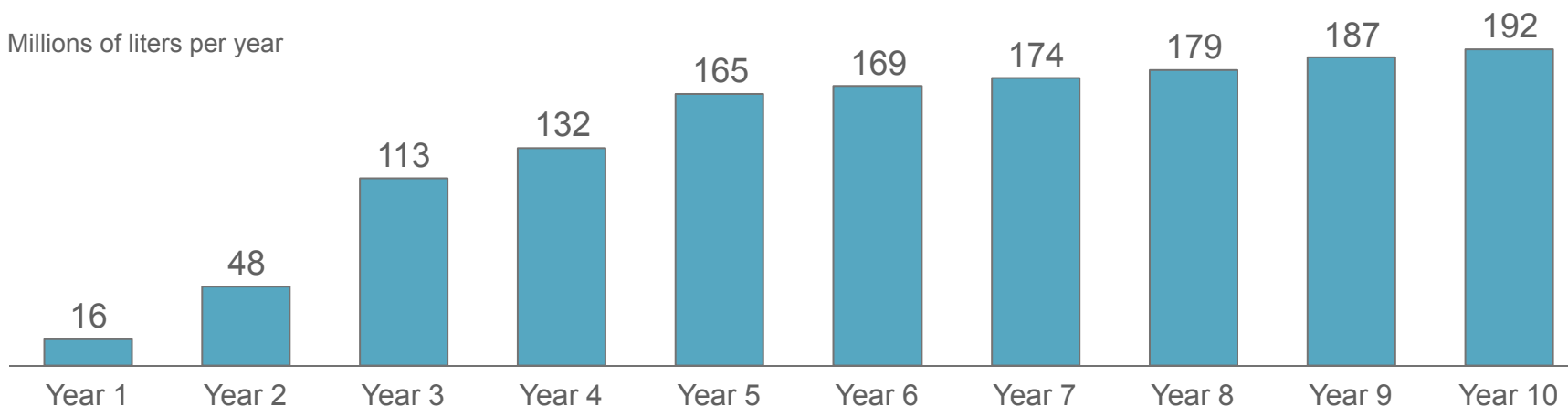


6 standalone sugar plants will need to be set up to supply molasses if that pathway is chosen

3. Ethanol distribution: The ethanol distribution network needs to meet the projected ethanol demand over 10 years

Projected volumes distributed in Kenya

Millions of liters per year



Current challenges of ethanol

distribution

- Current distribution system only designed for urban and peri-urban areas due to the use of high-level of technology
- Difficulty to expand in rural area due to limited infrastructures

How to achieve success



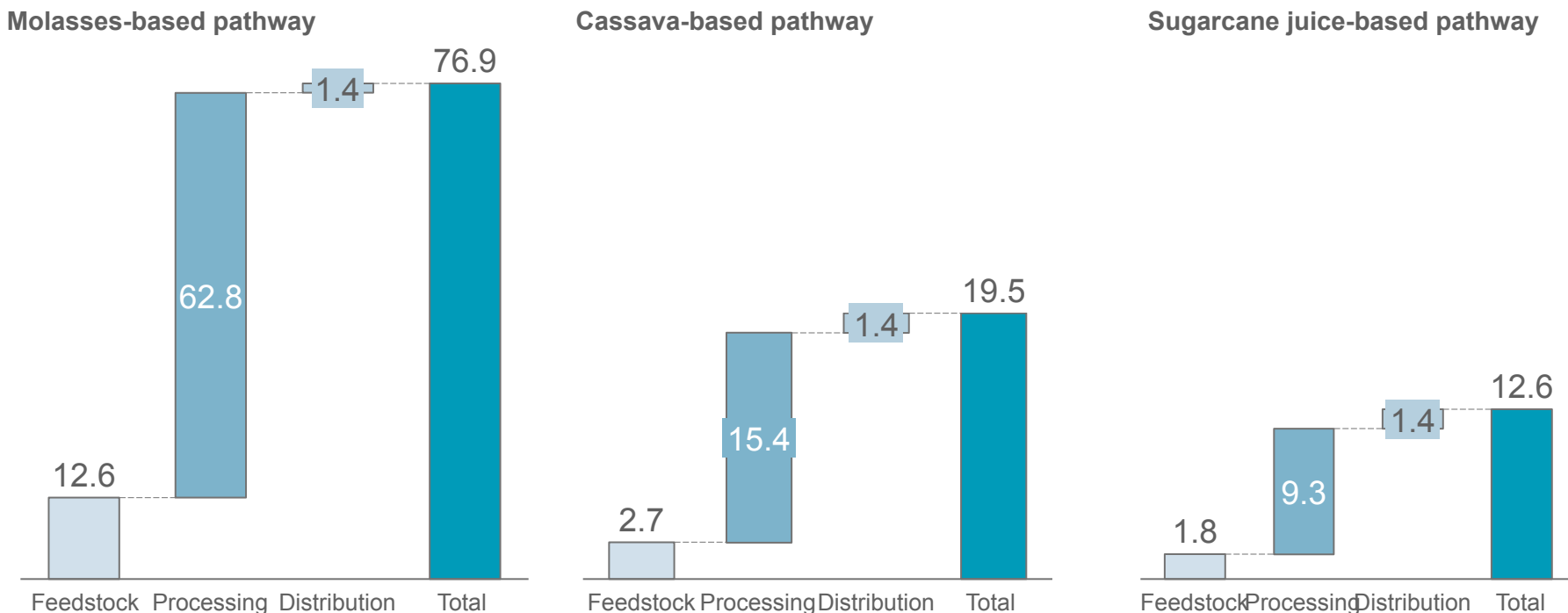
26 new tankers
146 additional trucks
68 smart depots
3,199 dispensers

Assumptions:

(1) Base case demand

4. Total CAPEX: Given the supply gap, CAPEX will be required for each stage of the value chain across the 3 feedstocks

Projected CAPEX (KES in billion)



- Ethanol processing makes up the majority of CAPEX required to expand the local ECF industry in Kenya (on average **78%**), followed by feedstock production (on average **15%**) and ethanol distribution (on average **7%**)

Assumptions:

- (1) 50% of domestic ethanol production
- (2) Base case demand

Policy recommendations: Supporting inclusive local production of ECF (1/3)

FOR DISCUSSION

5. PROVIDE TAX REBATES TO ETHANOL PRODUCERS THAT SOURCE DIRECTLY FROM KENYAN FARMERS

- **Impact:** Tax rebates are a strong incentive to partner between local farmers and producers – facilitating transactions along the value chain
- **Rationale:** EAML – the malting division of East African Brewery Limited (EABL) – has benefited from government tax rebates through its aggregation system with Kenyan farmers. This model could be replicated for ethanol producers that source directly from Kenyan farmers to help build a new value chain

6. BUILD INTERNATIONAL PARTNERSHIPS TO CREATE OPPORTUNITIES FOR TECHNOLOGY/ KNOWLEDGE TRANSFERS

- **Impact:** Will encourage technology/knowledge transfers along the value chain, which will in turn increase the feedstock production required to meet the demand of ethanol
- **Rationale:** Current yields for both sugarcane and cassava in Kenya are low due to poor quality crops and seeds not being planted in the most conducive areas in the country. Technology/Knowledge transfers would be key in improving farming techniques

Policy recommendations: Supporting inclusive local production of ECF (2/3)

FOR DISCUSSION

7. ALLOCATE MORE LAND IN HIGH YIELD AREAS TO CANE AND CASSAVA (E.G. BY THE COAST, POTENTIALLY LINKED TO NEW SUSTAINABLE SPECIAL ECONOMIC ZONES)

- **Impact:** Ensures that investors are able to access land to produce feedstock
- **Rationale:** Increasing the number of hectares allocated for feedstock production will be required to meet the potential demand for ethanol

8. SECURE FUNDING FROM MULTI-LATERAL ORGANIZATIONS TO CONDUCT FEASIBILITY STUDIES ON SETTING UP ETHANOL PLANTS

- **Impact:** Multi-lateral organizations can play an important part in de-risking investment by funding feasibility studies and encouraging financing into Ethanol manufacturing
- **Rationale:** To increase the production of ethanol locally, additional ethanol plants will need to be set up. Sourcing funding for feasibility studies is a key step to ease the process

Policy recommendations: Supporting inclusive local production of ECF (2/3)

FOR DISCUSSION

9. REMOVE IMPORT DUTIES ON MACHINERY FOR ETHANOL PROCESSING AND SPECIALIZED SUPPLY CHAIN EQUIPMENT

- **Impact:** Removing the import duty of machinery for ethanol processing will help increase the domestic production of ethanol
- **Rationale:** The major supplier of ethanol plant in Kenya is located in India (ie. Praj industries). Removing import duty for ethanol machinery will help lower the cost of ethanol plants

10. CREATE A ONE STOP SHOP FOR LICENSING, CERTIFICATION, AND AUTHORIZATION FOR ACTORS ALONG THE ECF VALUE CHAIN

- **Impact:** Will support local production, as a one-stop-shop will allow interested investors to quickly set up and begin production
- **Rationale:** Easing the regulatory framework is a key step in attracting foreign investments to set up new ethanol plants

Question

- Which regulations should be adapted to incentivize the production of ethanol from other sources ie. sugarcane juice and cassava?

Policy recommendations: Attracting more investment to the ethanol ecosystem

FOR DISCUSSION

11. STIMULATE THE MARKET WITH LOW INTEREST LOANS FOR LOCAL ETHANOL PRODUCERS

- **Impact:** Low interest rate loans will support local production by encouraging more processors to enter the industry
- **Rationale:** Other countries have used low interest loans to develop the ethanol industry. The Brazilian Development Bank (BNDES) plays a central role in financing the ethanol ecosystem locally by ensuring low interest rates and extending lending facilities. This could be replicated in Kenya

12. DEPLOY RESULT-BASED FINANCING THAT CAN ENHANCE ETHANOL ENTERPRISE ECONOMICS

- **Impact:** Result-based financing can play a significant role in attracting investments in the first years to expand the ethanol upstream part of the value chain
- **Rationale:** Donors are increasingly using results-based financing programs to enhance returns and channel capital in the market. For instance, SNV stove auctions in Cambodia, or the Nordic Environment Finance Corporation (NEFCO) to help develop ethanol production in Uganda

13. UNLOCK CLIMATE FINANCING (BY DEMONSTRATING THE KEY BENEFITS OF ECF) TO DEVELOP THE ECF ECOSYSTEM AT DIFFERENT STAGES OF THE VALUE CHAIN

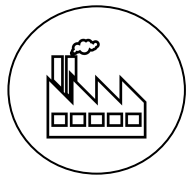
- **Impact:** Unlocking climate finance can help the ethanol industry's growth. Several large players could contribute such as Green Climate Fund, Global Environment Facility, and Climate Investments Funds up to USD300M
- **Rationale:** Given the many environmental benefits of switching to ECF, climate financing would be a reasonable source of funds to develop the local industry



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Boosting the bio-ethanol industry aligns with Kenya's Vision 2030 and Big Four Agenda

How does the masterplan contribute to Vision 2030 and the Big 4 agenda?



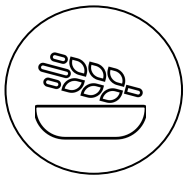
Big Four Agenda: Boost the manufacturing industry

- One of the goals of the Big 4 Agenda is to increase the manufacturing sector's share of GDP from about 9% in 2017 to 15% in 2022, through interventions that support value addition
- This will be supported by ethanol processing as well as cookstove manufacturing



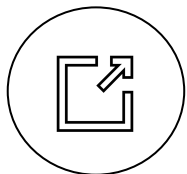
Big Four Agenda: Create jobs for young people within manufacturing

- The Jubilee government plans to create 1.3 million manufacturing jobs by 2022
- The ECF plan will create new jobs and opportunities for SHFs across the supply chain



Big Four Agenda/ Vision 2030: Food security

- A key tenet of the Big 4 Agenda is to achieve 100% food security; to reach 1 million farmers and unlock 150,000 acres of uncultivated land
- Investments into feedstock (through high quality inputs and improved productivity) is anticipated to boost yields, which combined with an eat first strategy, will contribute significantly to food security



Vision 2030: promote export driven manufacturing

- Investments in local ethanol production aligns with Vision 2030's goal to:
 1. Boost the capacity and local content of domestically manufactured goods
 2. Develop niche products for existing and new markets

The potential impact of HHs switching to ECF is measured along jobs, income, health and environmental dimensions

1 Jobs and Income



1. **Jobs/Opportunity:** New opportunities for Small Holder Farmers (SHFS) in the sugarcane and cassava value chains. As well as new jobs in ethanol processing, storage & distribution and sales
2. **New income generated:** New income generated for SHFS and total new income generated at different points of the supply chain

2 Health



The averted negative health impacts due decreased exposure to household air pollution from dirty fuels:

1. **Deaths averted:** Total deaths caused by lung cancer, stroke, ischemic heart disease and chronic obstructive pulmonary disease and lower respiratory disease
2. **DALYs averted:** “DALY” refers to a **Disability Adjusted Life Year**, a measure of overall disease burden, expressed as the number of years lost due to ill-health, disability or early death

3 Environment

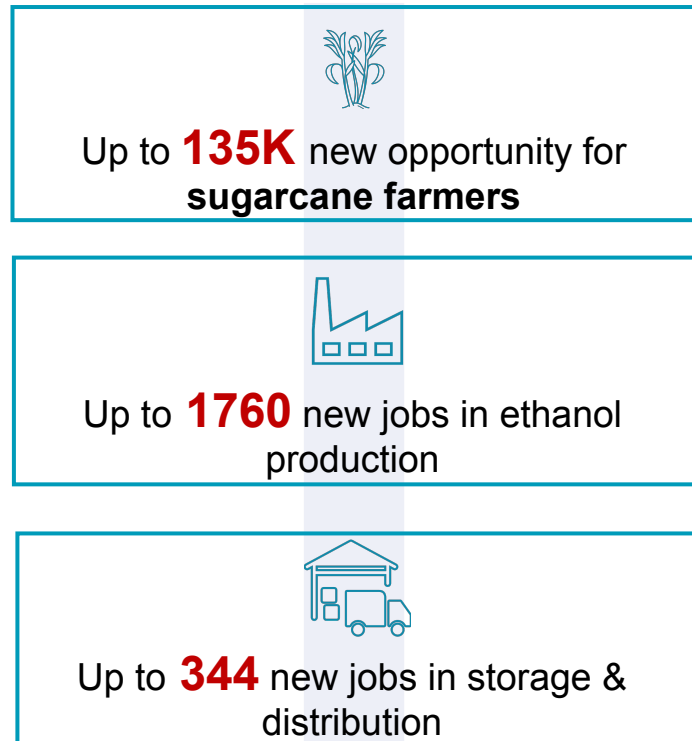


The effect of switching to ethanol has an impact on the environment and shall be measured through:

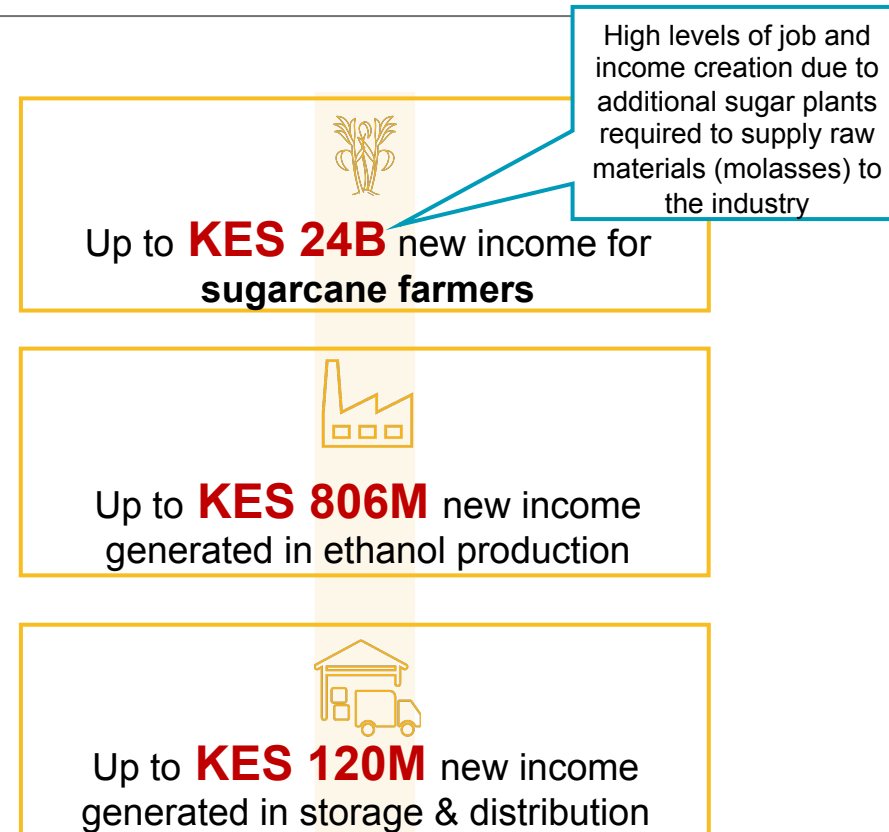
1. **Deforestation averted:** The aggregate number of trees saved by switching from charcoal to ethanol
2. **Greenhouse Gas emissions:** A measure of the total CO₂eq emissions saved by switching from each fuel type to ethanol

Molasses - Investments into the ethanol industry will create new opportunities across the supply chain

Jobs – Number of new jobs/opportunity created



Income – Amount of yearly new income generated

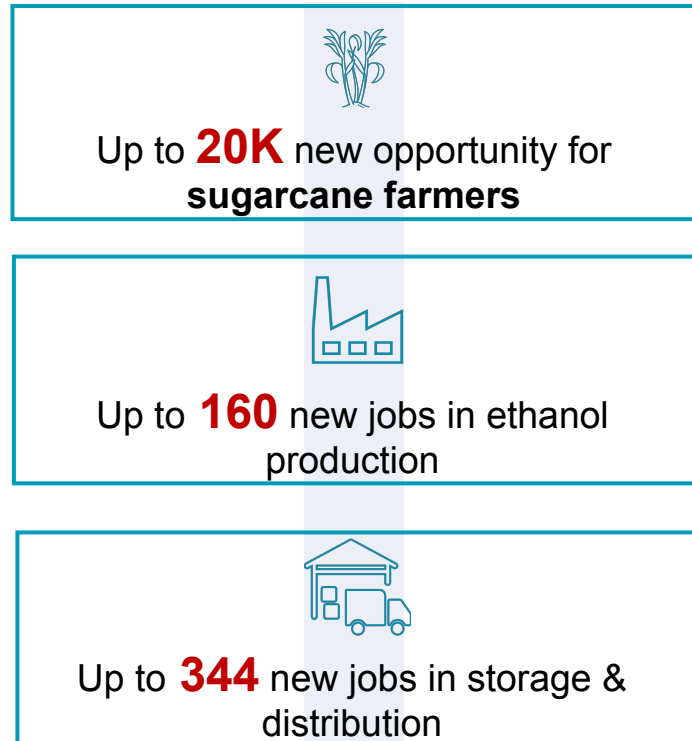


Assumptions:

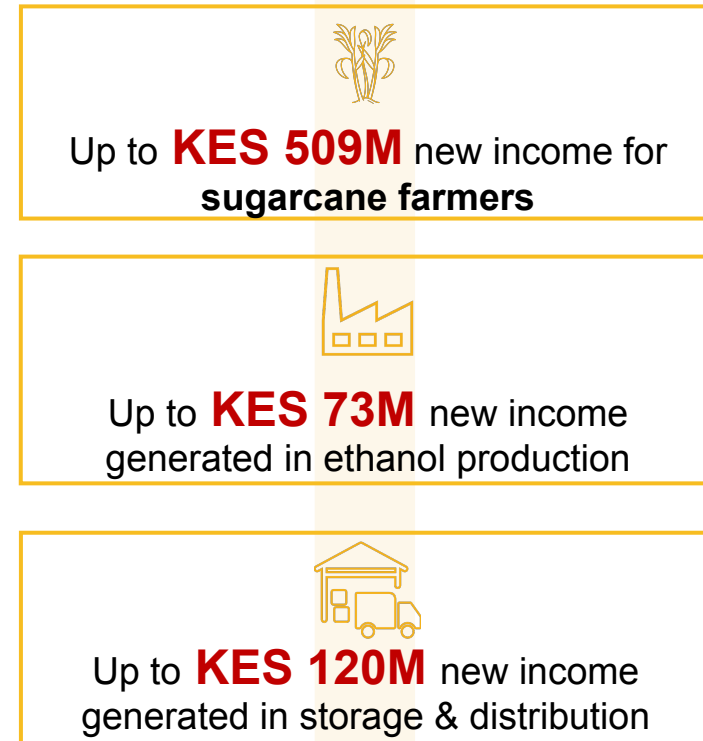
- (1) 50% of domestic ethanol production
- (2) Base case demand

Sugarcane juice - Investments into the ethanol industry will create opportunities across the supply chain

Jobs – Number of new jobs/opportunity created



Income – Amount of yearly new income generated

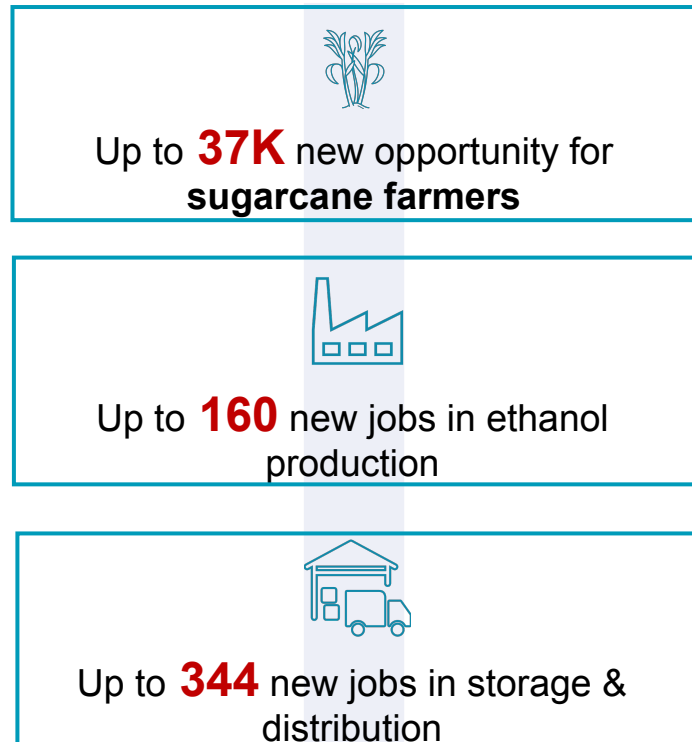


Assumptions:

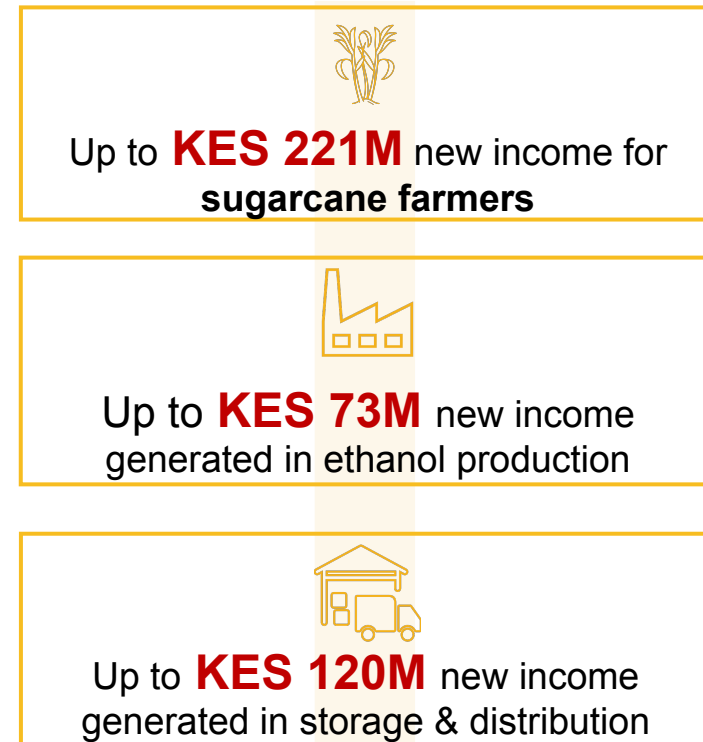
- (1) 50% of domestic ethanol production
- (2) Base case demand

Cassava - Investments into the ethanol industry will create new opportunities across the supply chain

Jobs – Number of new jobs/opportunity created



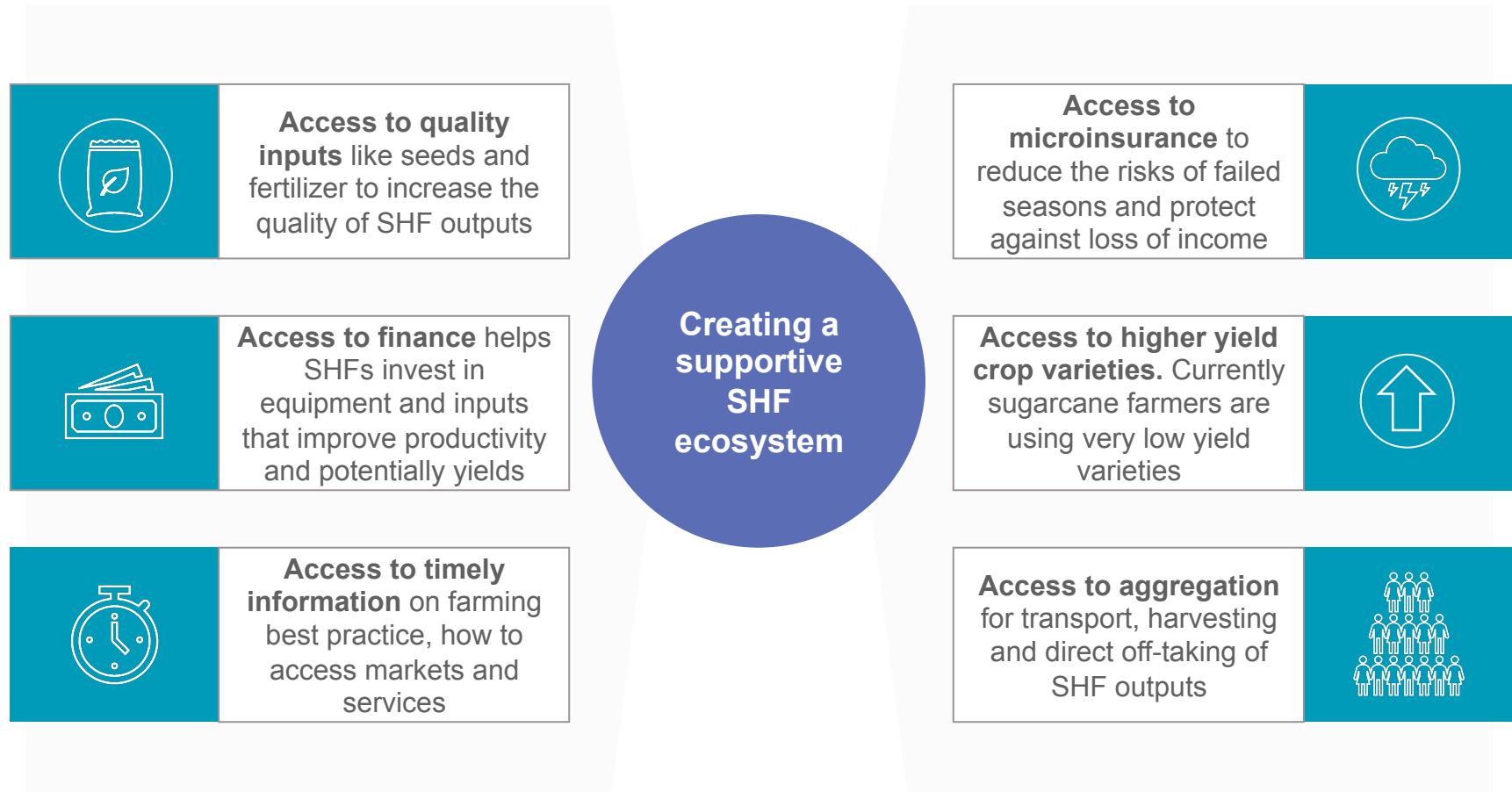
Income – Amount of yearly new income generated



Assumptions:

- (1) 50% of domestic ethanol production
- (2) Base case demand

Creating a supportive ecosystem for smallholder farmers is integral to unlocking the potential of ethanol supply chains



Creating a more supportive ecosystem for SHFs will likely increase their yields, boost productivity, increase incomes, increase integration into value chains and decrease their susceptibility to risk.

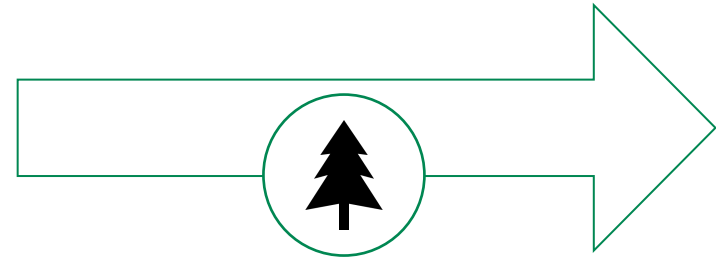
The transition of households from charcoal to ethanol has the potential to save up to 54 million trees over 10 years

Current context

- **Kenya loses 10.3 million m3 of wood from its forests every year** from unsustainable charcoal and wood fuel use, **a major contributor to the 0.3% per year deforestation rate**
- Despite national policy, **demand for energy from charcoal and wood consists of 68%** of the total country energy supply
- Both Kenya's contribution to meeting the Paris climate goal, and its National Climate Change Action Plan 2018–2022, **highlighted charcoal production as a main contributor to both deforestation and GHG emissions**

Deforestation averted by switching from charcoal to ethanol

Between Year 1 and Year 10



Up to
54,000,000
trees saved

Transitions to ECF could also significantly reduce Kenya's overall GHG emissions by up to 30%

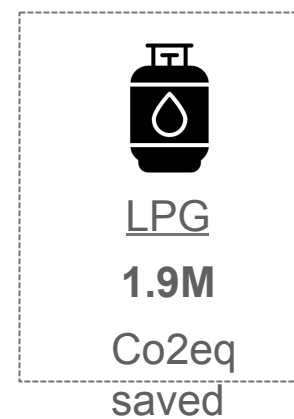
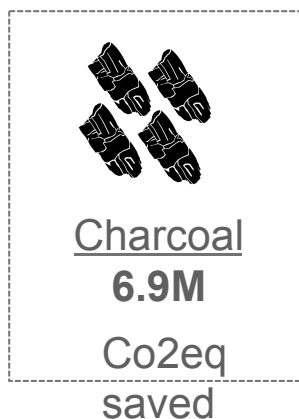
Current context

- ✗ Household fuel use in Kenya contributes 25 million tonnes of CO₂ eq each year, which is equivalent to 30-40% of total Kenya's greenhouse gas emissions
- ✗ In 2018, an estimated 105.2 million MT of CO₂eq emissions were emitted in Kenya from fuel use for cooking

How does a switch to ECF align with Kenya's broader environment strategy

- ✚ Removal of VAT on LPG and ECF
- ✚ Reduction of the import duty on efficient cookstoves from 25% to 10%, and zero-rating VAT on clean cookstoves and raw materials
- ✚ The Kenyan government is committed to reducing GHG emissions exemplified by the zero-kerosene campaign and charcoal industry regulations

Summary: Co₂eq saved (kgs) by switching to ethanol



Continued dependence on dirty fuels poses serious health risks for Kenya

Current context – health burden caused by indoor air pollution

-  **8-10% of early deaths** in Kenya are caused by indoor air pollution
-  **728k DALYs** (Disability-Adjusted Life Years) and **16.6k deaths** annually
-  Many negative cooking health effects have not yet been quantified (e.g., burns, eye diseases, physical injuries from carrying firewood, etc.)
-  **Lower respiratory tract disease is the third largest contributor of deaths** in Kenya while pneumonia is a major cause of death to children under the age of five, largely due to indoor air pollution

How does a switch to ECF align with Kenya's broader health strategy

-  **Ministry of Health's 2014-2030 policy** seeks to **contain the main risk factors to health, including indoor air pollution**
-  Ministry of Health's existing initiatives to **raise awareness around the effect of indoor air pollution**
-  WHO's new indoor air quality guidelines for household fuel combustion which gives recommendations on the best approaches to reducing household air pollution
-  The promotion of preventative health strategies is a key tenant of **Ministry of Health's 2014-2030 policy**

A transition of households from dirty fuels to ECF could result in up to 3700 deaths averted and 507K DALYs saved. DALYs and deaths count for ~KES 372B in income lost per year