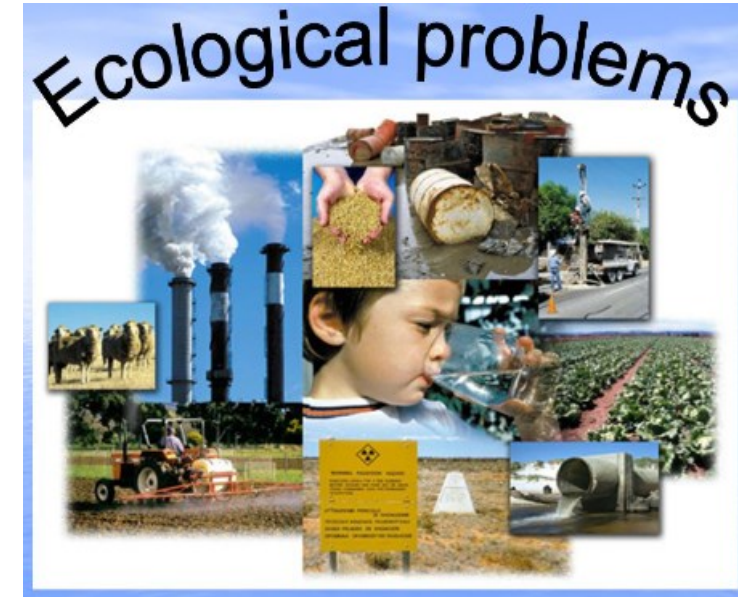


# Introduction to ZECURA Project

**Dr. Seydou Sinde**

**Lead Researcher and the Country Coordinator of ZECURA**

# Contributions of ZECURA



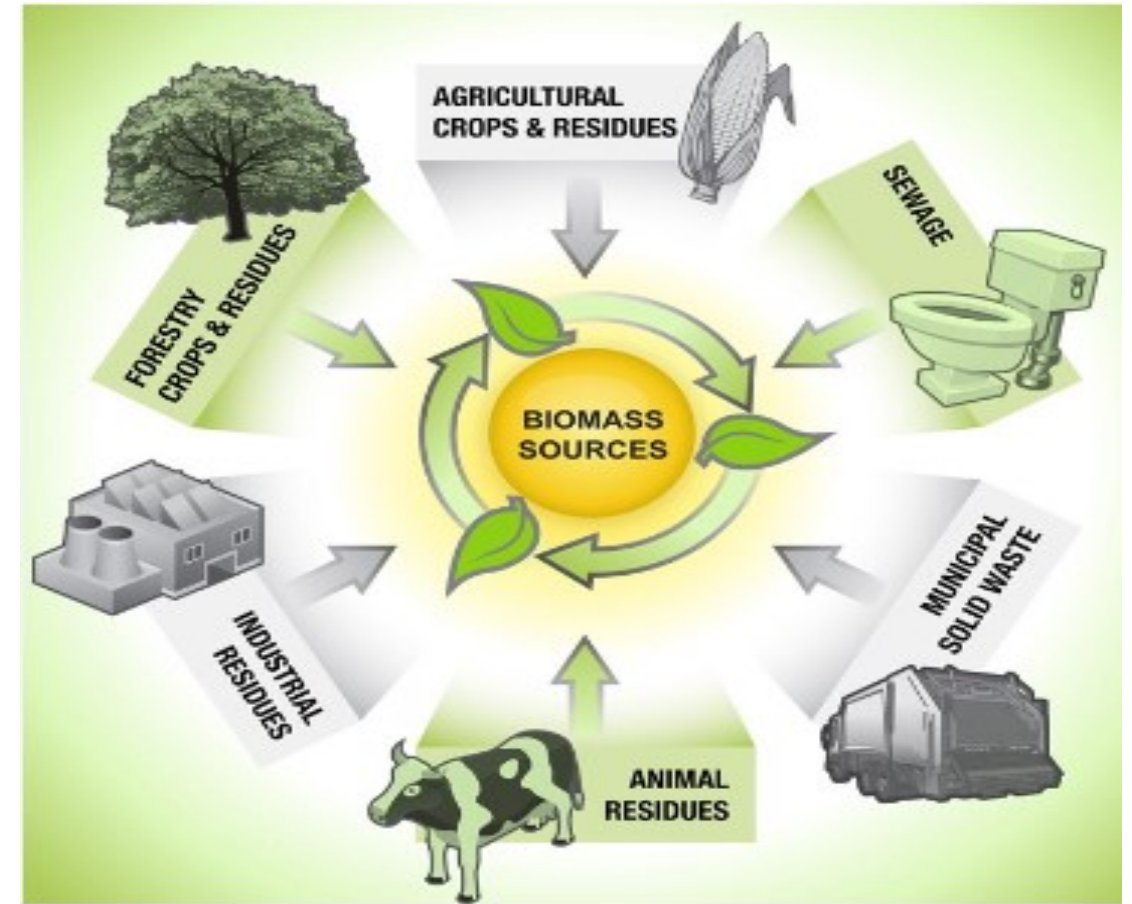
SOURCE: <https://images.google.com/>

# Circular Economy Approach





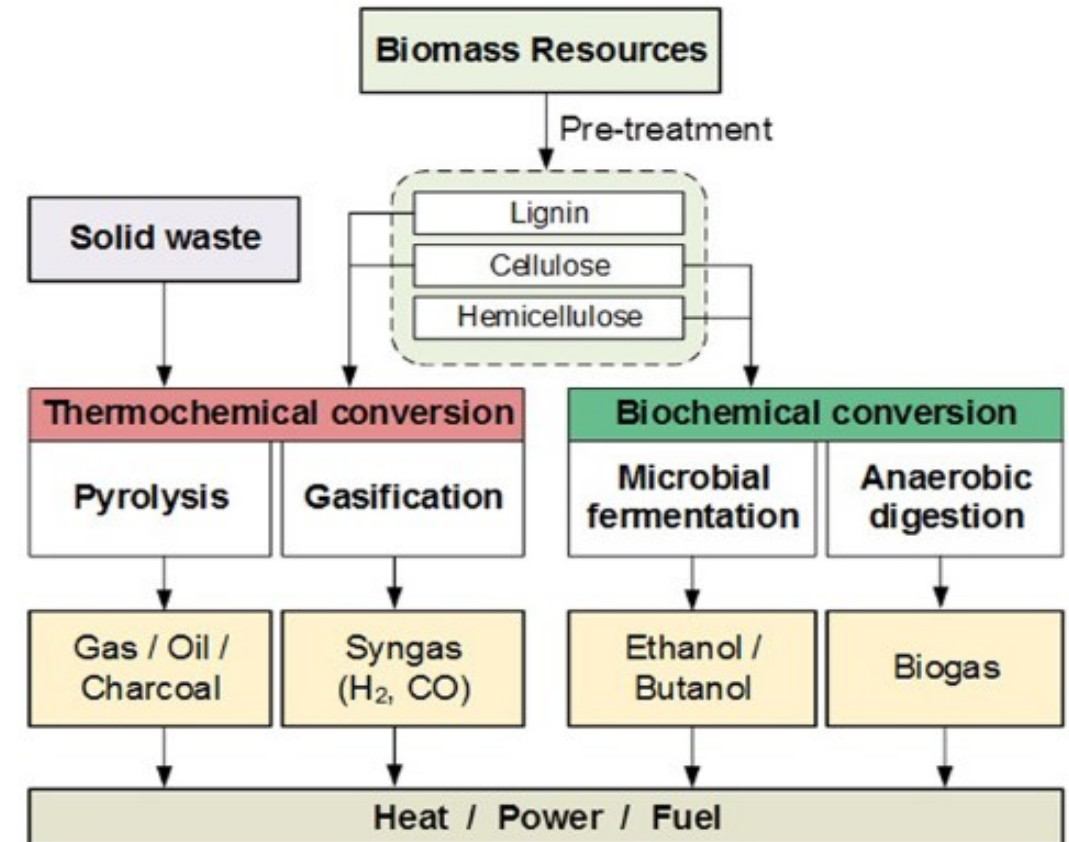
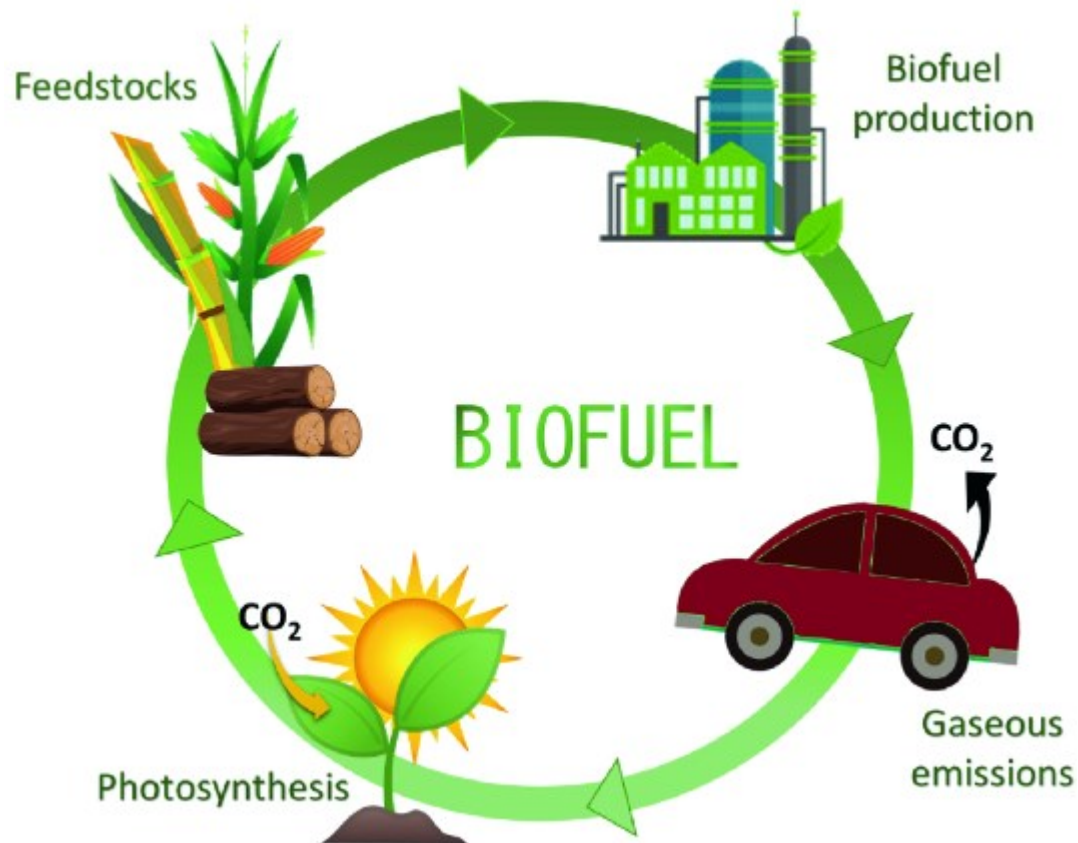
# Optimization of the Exploitable Resources







# Optimization of the Exploitable Resources



# Optimization of the Exploitable Resources

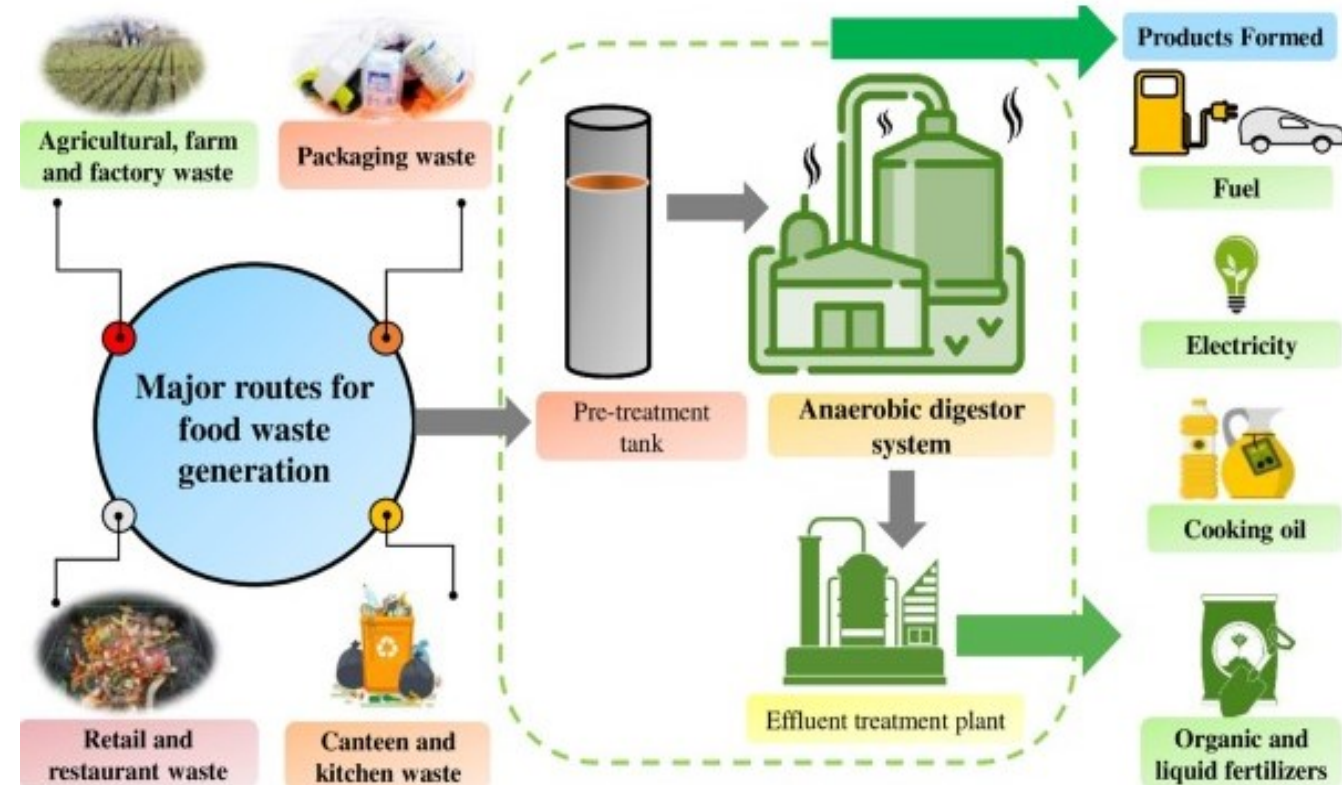
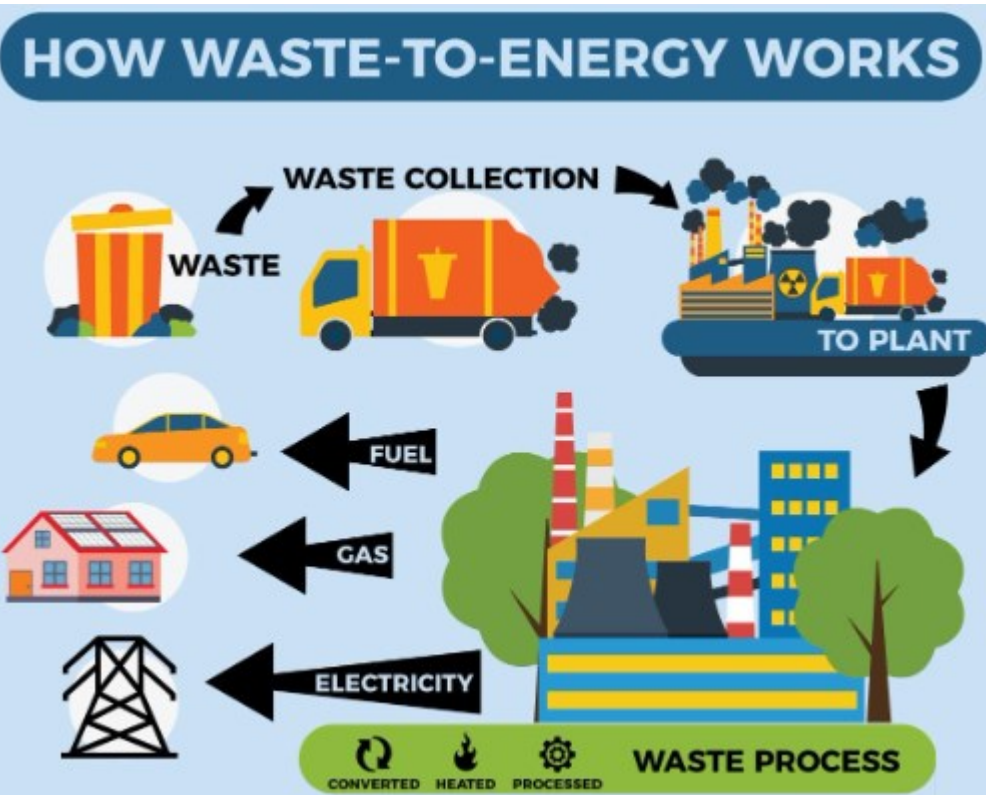


## SOLID WASTE MANAGEMENT





# Optimization of the Exploitable Resources







# Optimization of the Exploitable Resources





# Optimization of the Exploitable Resources

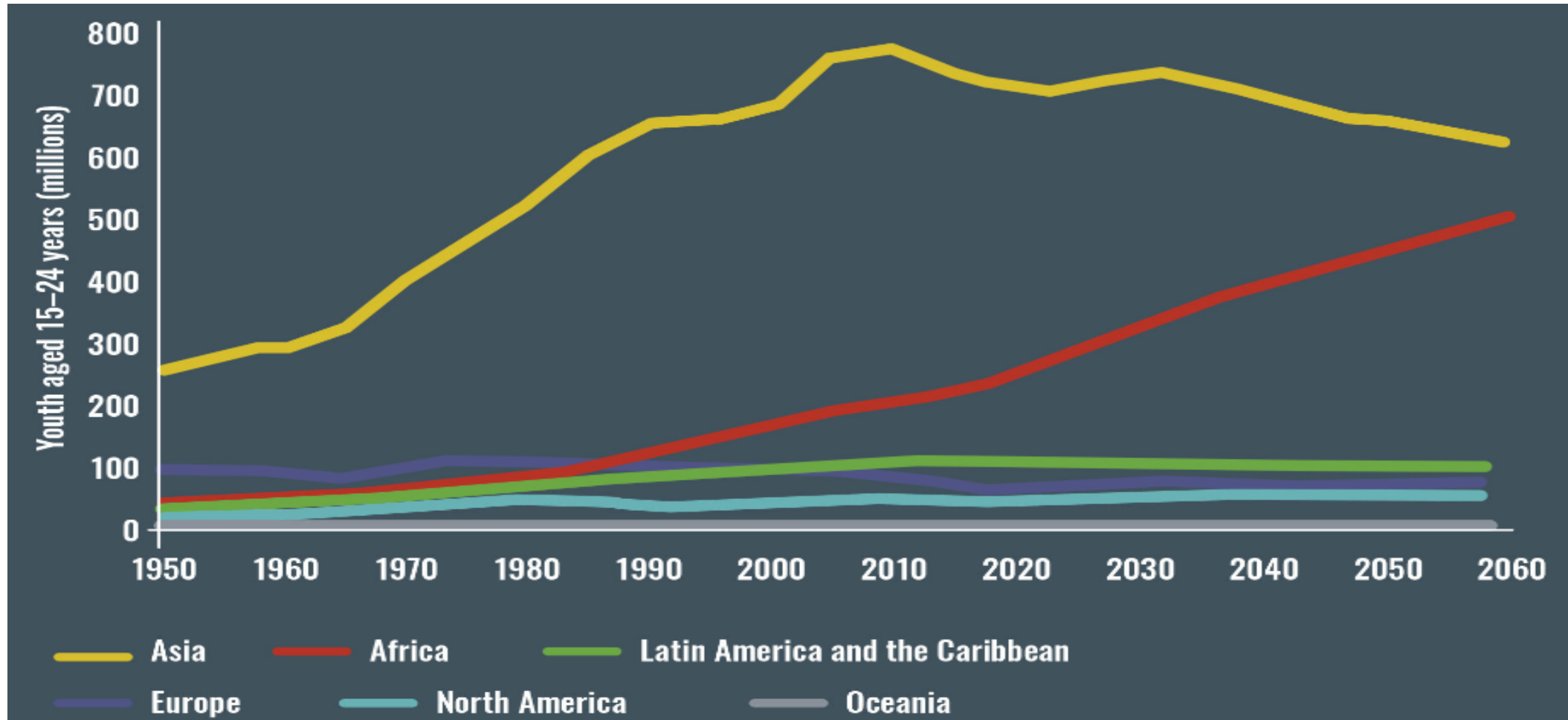


# Partners of ZECURA





# Solutions for the Fast Population Growth



SOURCE: <https://www.weforum.org/agenda/2020/01/the-children-s-continent/>

# Objectives and Goals of ZECURA

- TRIER University in Germany leads ZECURA project
- The main ZECURA objective is the development of strategies:
  - Innovative
  - Practical
  - Resilient
  - Zero emission concept



# IfaS

---

Institute for Applied Material  
Flow Management

Identifying Potentials – Optimizing Processes – Creating Value



[stoffstrom.org](http://stoffstrom.org)



# Green Universities

## Contributions to Circular Economy and Sustainable Development

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Marco Angilella  
Grand-Bassam, 18.09.2023

Global carbon-dioxide emissions, gigatons (GtCO<sub>2</sub>) per year

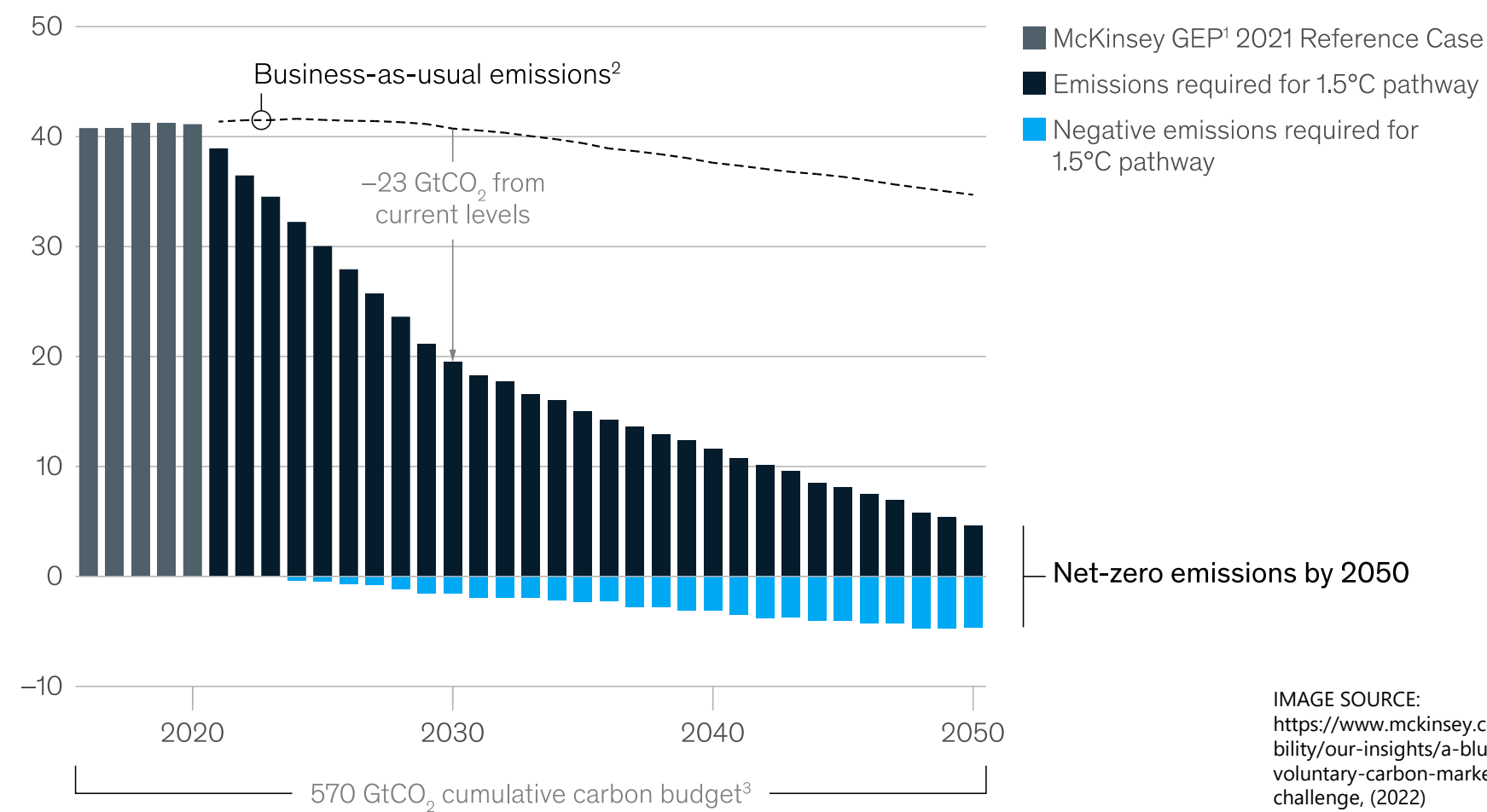
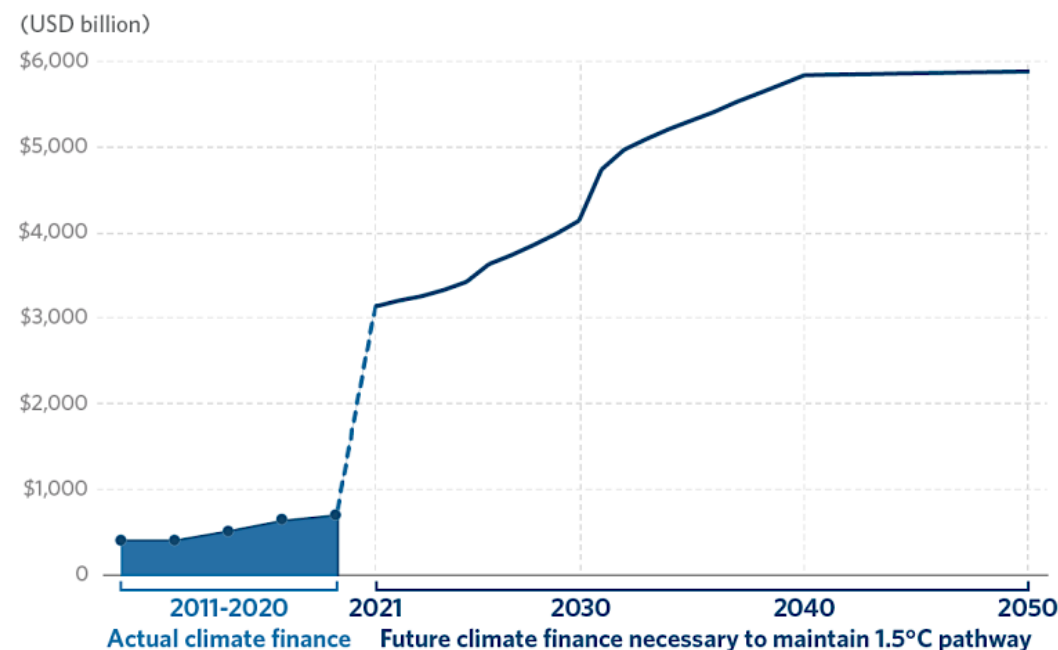


IMAGE SOURCE:  
<https://www.mckinsey.com/capabilities/sustainability/our-insights/a-blueprint-for-scaling-voluntary-carbon-markets-to-meet-the-climate-challenge>, (2022)

- In Scenario 1.5°C strict emission reductions and carbon removals are required!
  - Need for 100% renewable (electricity, heat, mobility)
  - Massive investments in RE and Circular Economy and new business concepts necessary
  - Africa is a prime spot to leapfrog green development
- 
- Current investment levels are nowhere enough to limit global warming to 1.5 °C
  - By 2030, finance must increase by **550%**



SOURCE: Climate Policy Initiative: Landscape of Climate Finance 2019-2020





**Water management**  
Water security  
Wastewater management

**Energy management**  
Energy efficiency and renewable energy

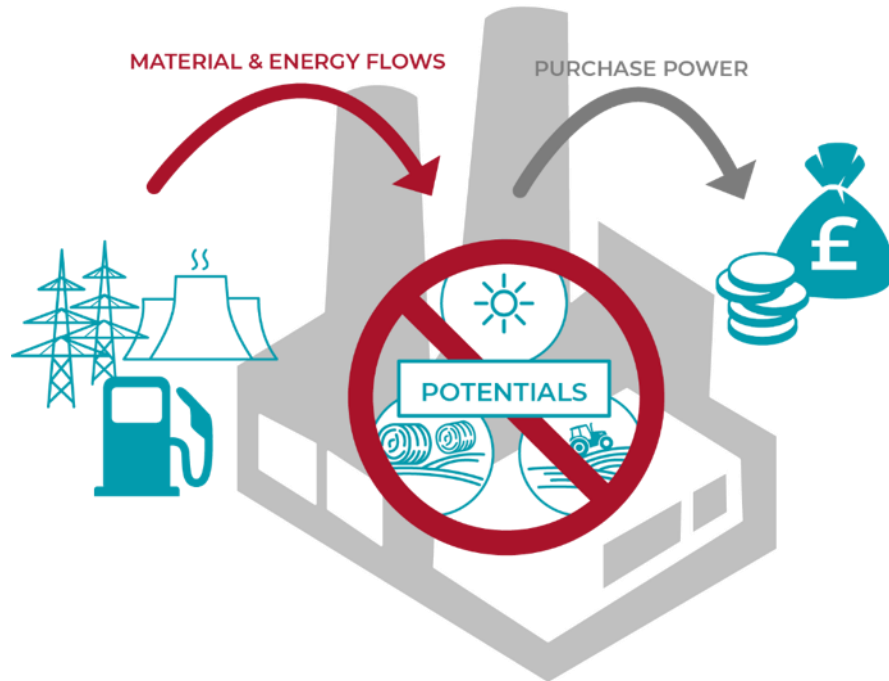
**Municipal solid waste management**  
Collection and Valorization  
Avoiding, Recycling & Upcycling

**Land use management**

**Sustainable tourism**

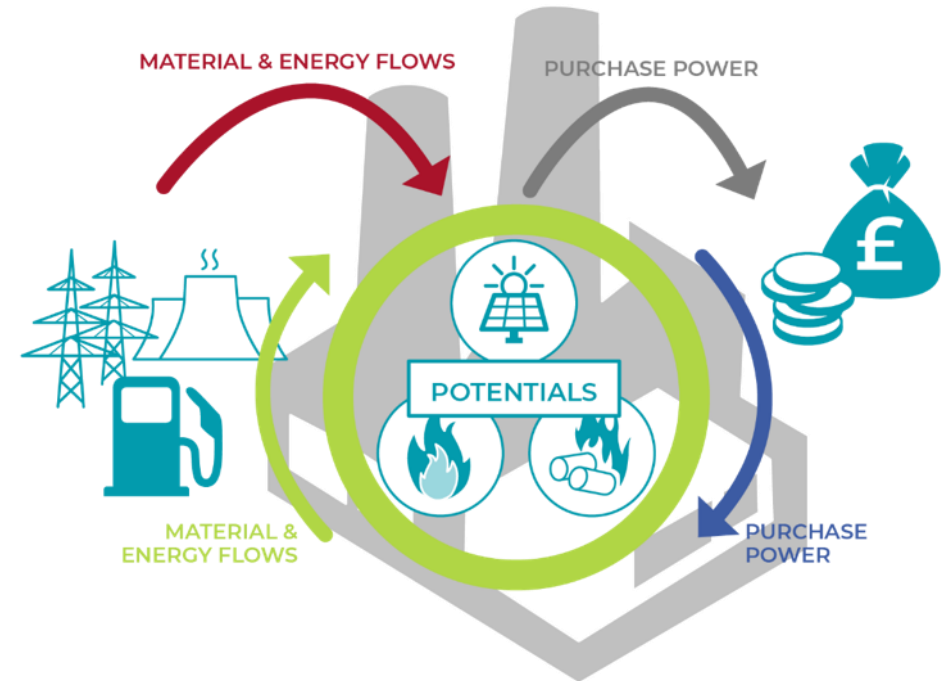
**Capacity building and research**

## Nowadays “throughput society”



- Low CAPEX – High OPEX
- Negative Environmental impact

## Vision and Goal – Zero Emission!



- High CAPEX but improved Project-IRR
- Environmental Protection and Regional Added Value



# #1 Greenest University Campus

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# A unique story for CE



Up to 1994:  
US Military Hospital



1996: Inception of the  
endeavour



Germany's Greenest  
University Campus



# 100%

- Renewable heat supply based on
  - waste wood
  - biogas (co-generation)
  - solar thermal





# 100%

- Renewable electricity supply based on
  - Photovoltaic
  - Biogas from org. Waste





# 100%

- Renewable cooling system based on
  - Geothermal
  - Biomass
  - Solar adsorption chilling
  - Rainwater





# 100%

- Rainwater retention and collection
  - Natural water ponds
  - biotope system for ground water recharge
  - valorization as service water





## EE/RE

- State-of-the art energy and resource efficiency technologies and strategies in place

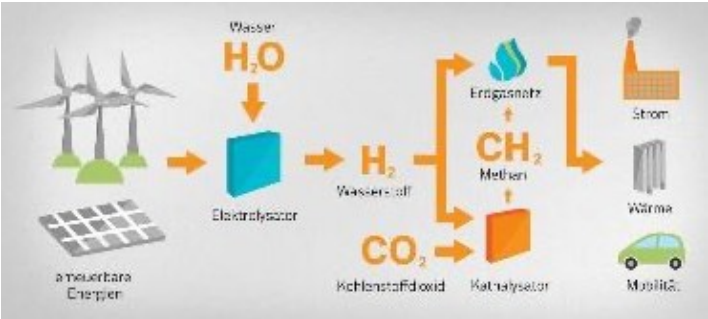
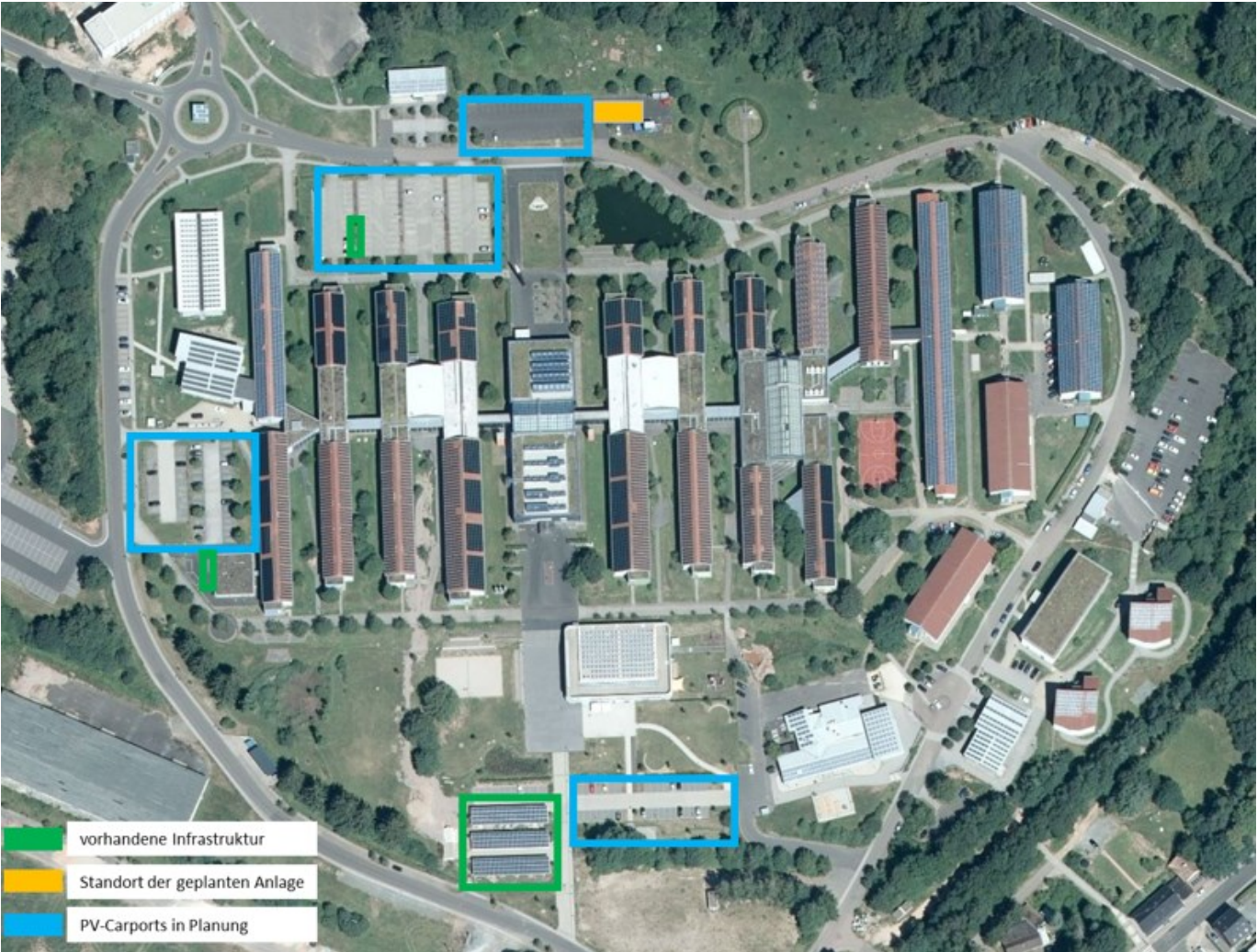
















- Separate collection and use of wastewater and biomass potentials (household biowaste).
- Integration of a New Sanitation Concept (NASS) into an existing student dorm on the ECB:
  - Vacuum drainage system and sanitary system
  - Transportation of biowaste together with blackwater



<https://en.run-projekt.de/>



Joint education, research &  
technology transfer for **Circular Economy**



**9<sup>th</sup> - 13<sup>th</sup> October 2023**  
**11<sup>th</sup> October: Conference**

**More than 100  
international participants**

- Provide an understanding on the **challenges, strategies, technologies** and **opportunities** offered by Circular Economy, Zero Emission and Material Flow Management
- Provide an understanding on the IfaS' regional Material Flow Management and Circular Economy approach methods
- Provide an overview on innovative CE & ZE technology and services offered by German SME's
- Encourage you to establish new international networks with companies, public sector participations from Germany and other delegations

## Technical visits

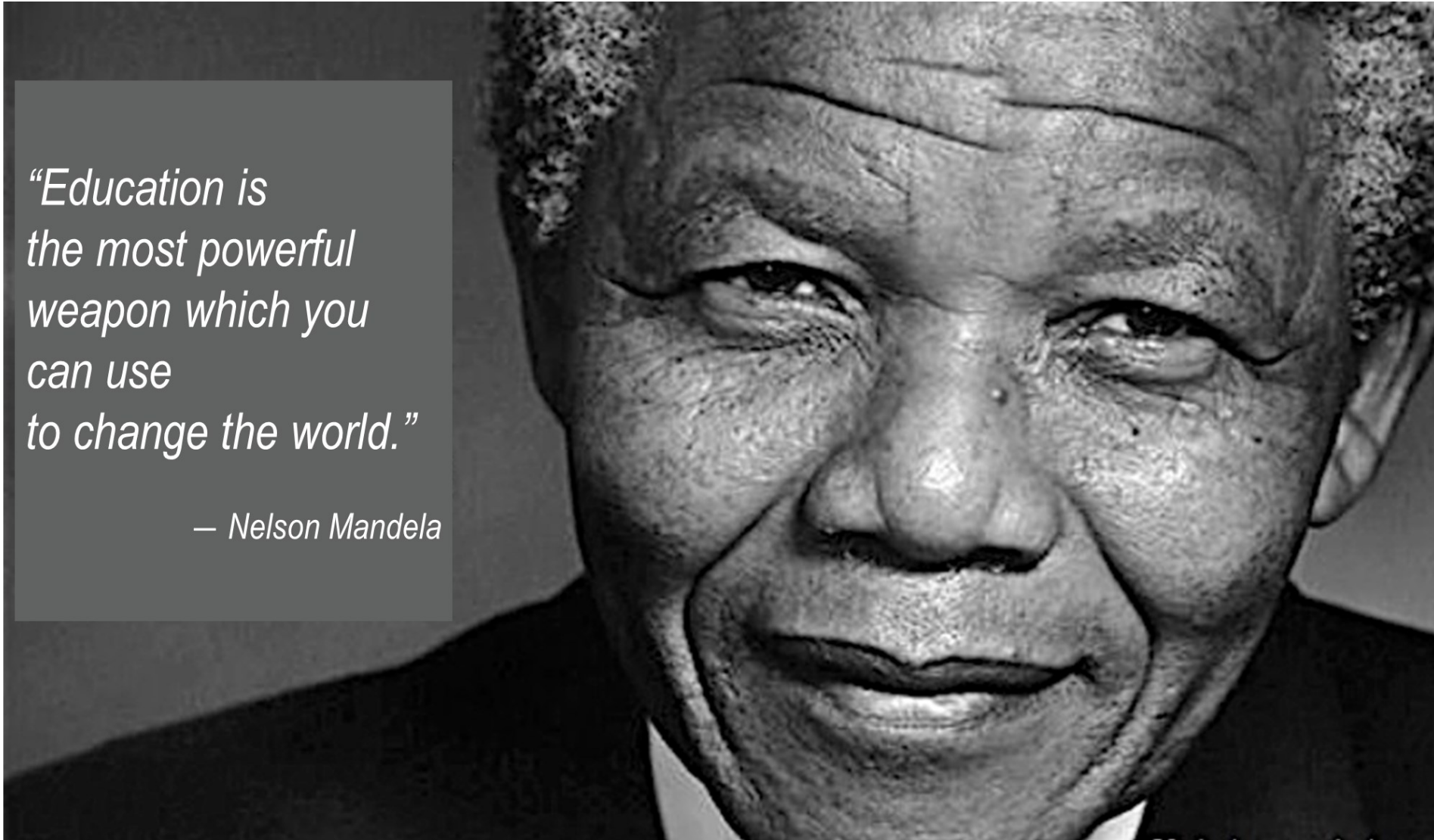
- Energy efficiency
- Renewable Energy
- Waste treatment systems (energetically and material utilization)
- Wastewater treatment systems





*“Education is  
the most powerful  
weapon which you  
can use  
to change the world.”*

*— Nelson Mandela*





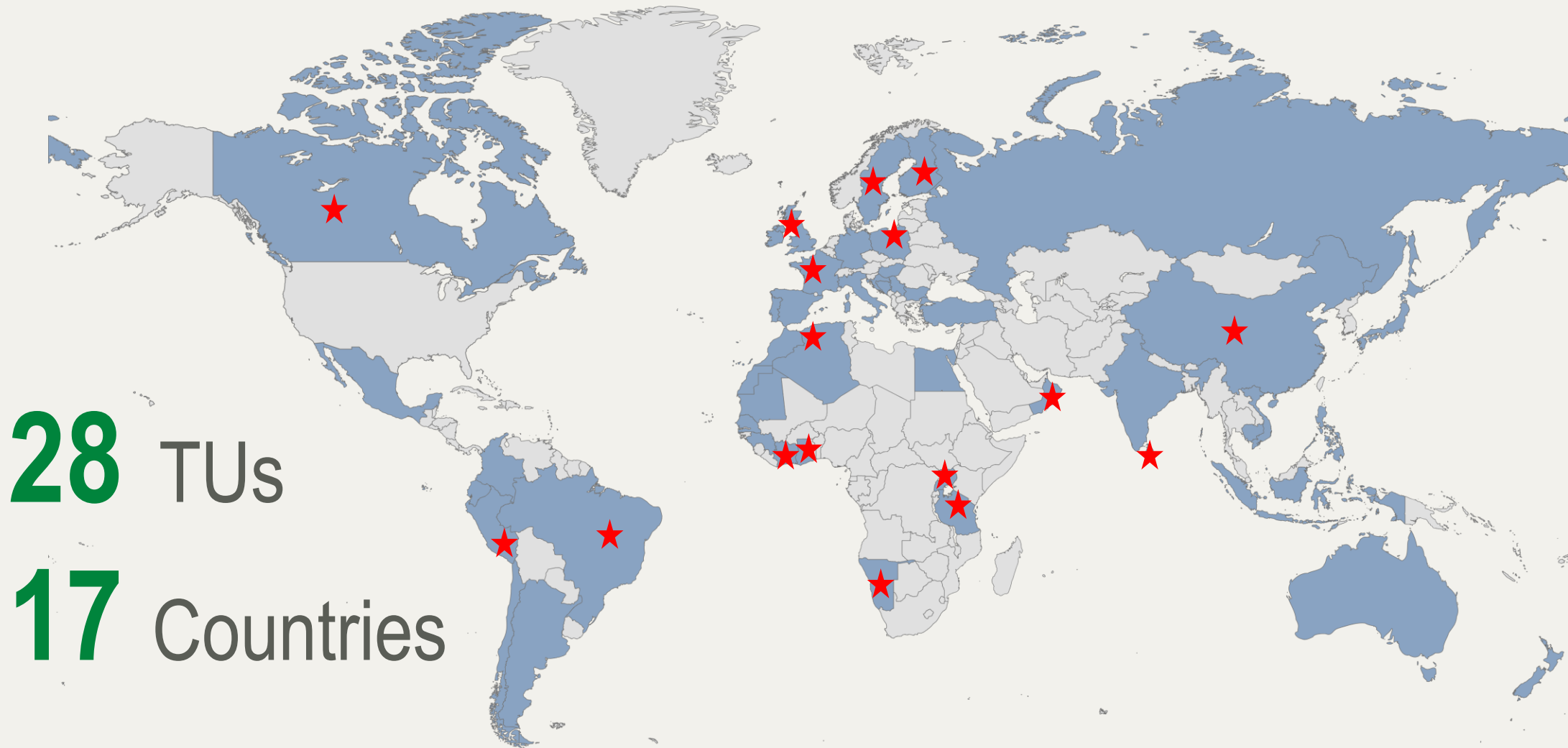
ZECURA

Zero-Emission Concepts for Urban  
Resilience in selected African cities

# Grand Finale

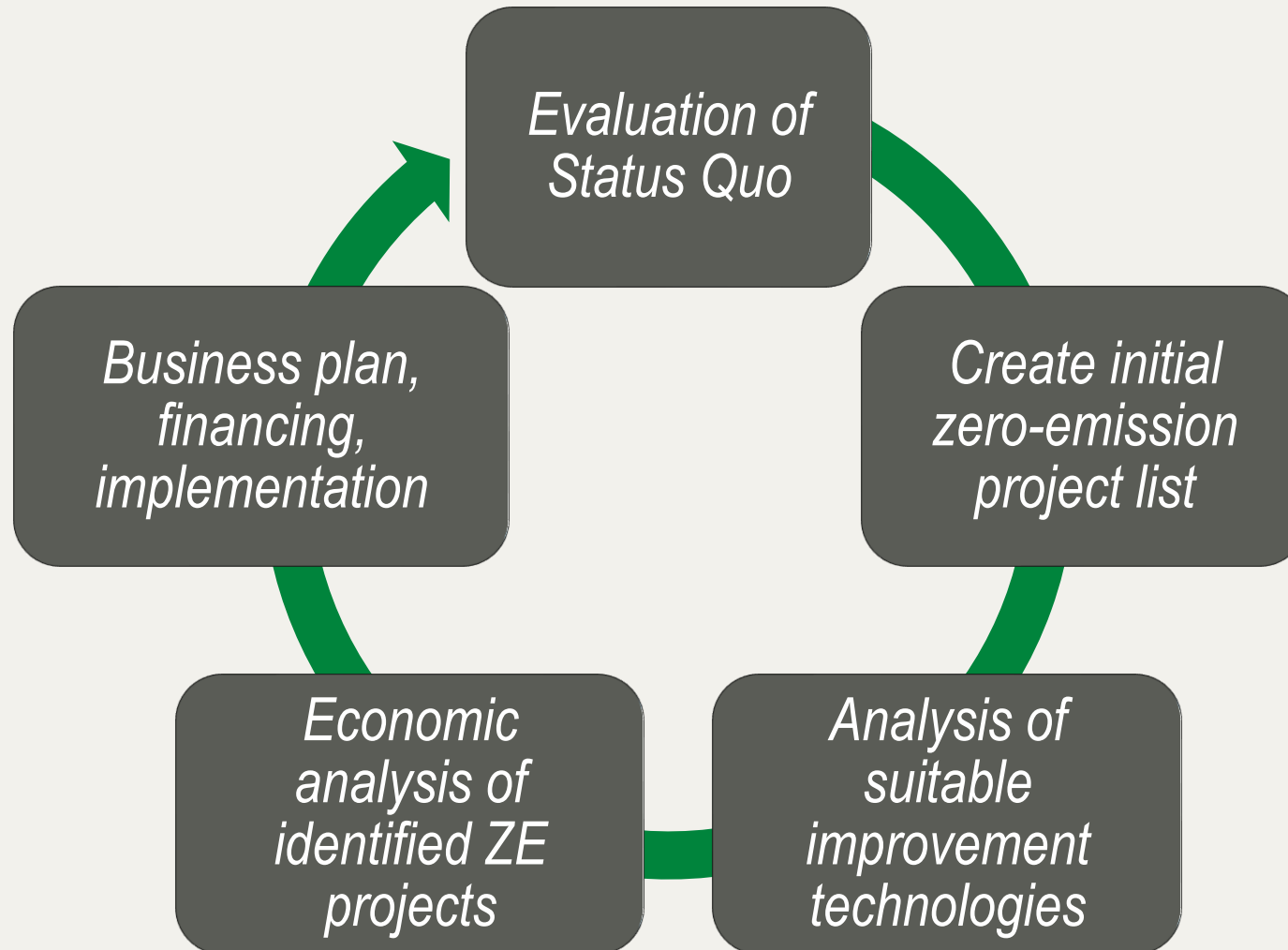
## Diagnostic Summary: Zero-Emission Campus Master Plan

# Travelling University: geography





# Travelling University: MFM methodology



— Vision —

---

*“Our vision is to create innovative resilience strategies for fast growing cities to successfully overcome current and future sustainability challenges”.*

---

— Mission —

---

*“Our mission is to make Grand Bassam a resilient city; a city that withstands socio-political and environmental stressors and demographic change whilst accelerating its economic growth.*

*IUGB will be the sustainability, technology and transport hub of Côte d’Ivoire through a secure, independent and sustainable economy, whilst sharing its knowledge with surrounding communities”.*

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# Research team

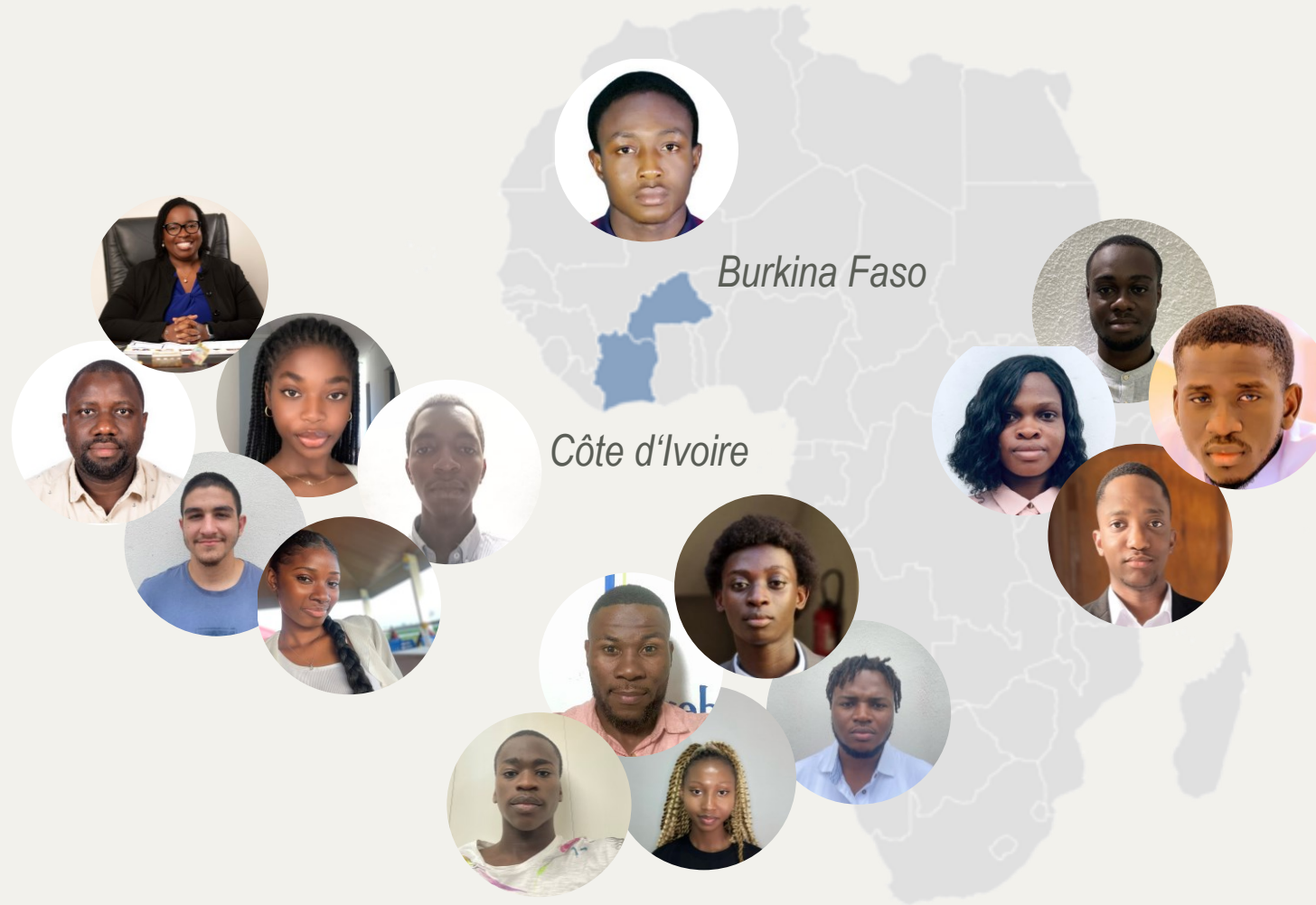
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# Visiting team





# Host team



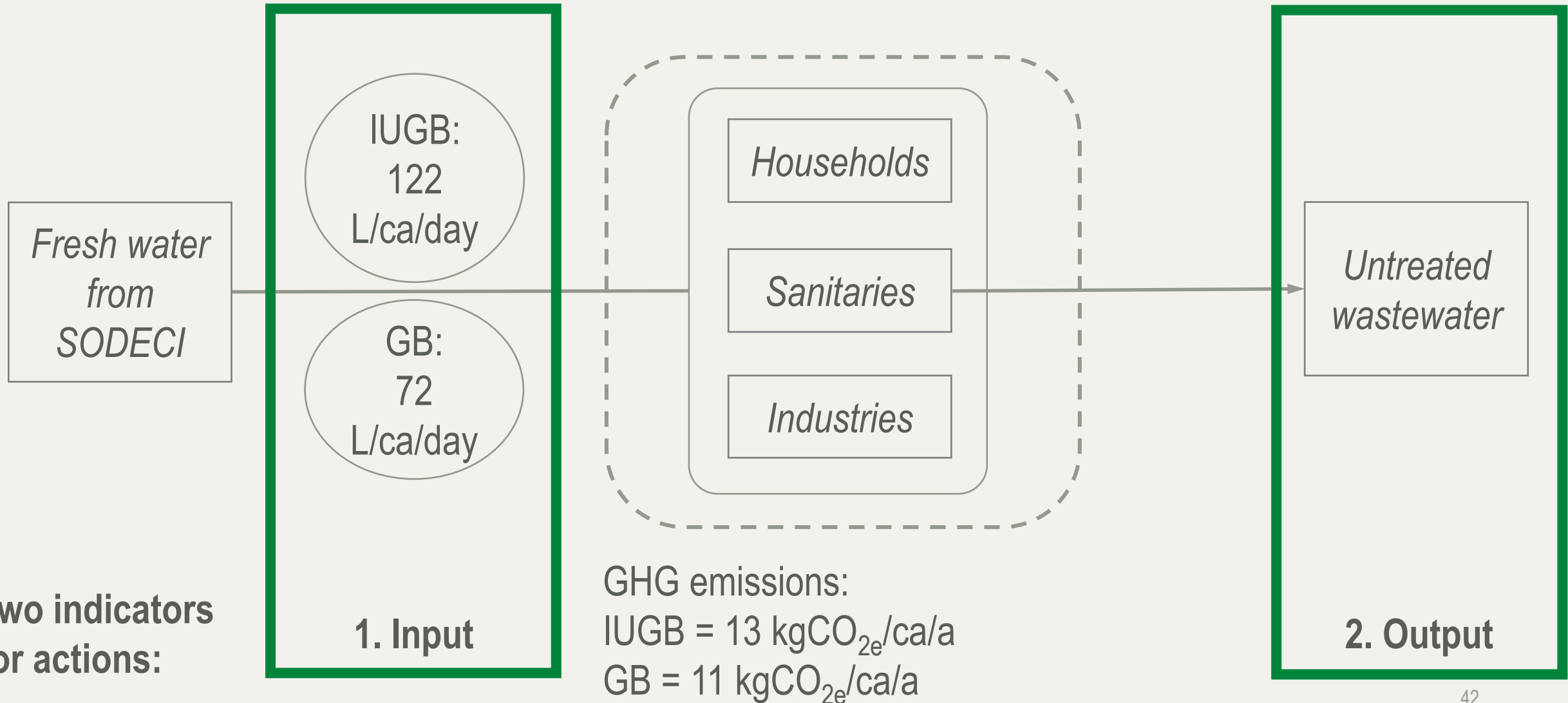
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# Freshwater & wastewater

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# Status quo

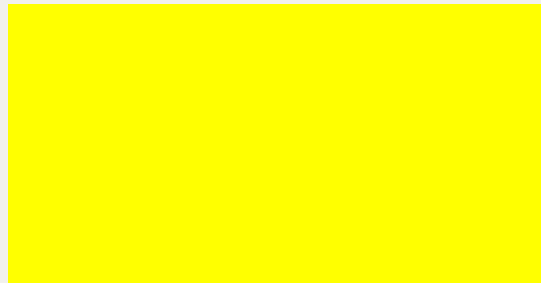


# Types of wastewater



**Greywater**

Water from households  
(*e.g. washing hands,  
showering, laundry*)



**Yellowwater**

Urine



**Brownwater**

Feces



# Water demand decrease

## Potentials:

Saves resources

Saves money

Reduces GHG emissions

## How to achieve:

Awareness

Efficiency

Substitution

# Awareness

Acknowledge water as a  
valuable resource

Educate people how to  
save water

Otherwise, efficient  
technologies will not work  
out

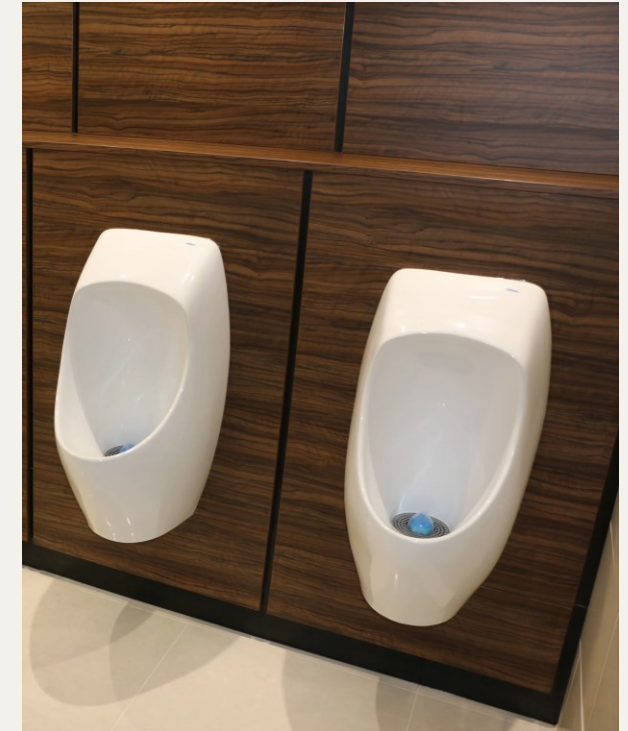


# Waterless urinals

Parameter	Unit	Conventional	Waterless
Water output	L/flush	2	0
Units	x	100	100
Total usage per day	times	5,000	5,000

2 L/ca/day saved water  
→ 100 %

Payback period: 4 years



# Separation toilets

Parameter	Unit	Conventional	Separation
Water output	L/flush	6	3
Units	x	1,650	1,650
Total usage per day	times	22,000	22,000

13 L/ca/day saved water  
→ 50 %

Payback period: 14 years



SOURCE:

[https://www.de.laufen.com/LaufenResourceServlet/resources/getTransformation?idObject=a7abecabf1cb312956c3683e24a8905f&trName=TF\\_Mob\\_solu\\_xxl\\_v2](https://www.de.laufen.com/LaufenResourceServlet/resources/getTransformation?idObject=a7abecabf1cb312956c3683e24a8905f&trName=TF_Mob_solu_xxl_v2)

# Water-efficient faucets

Parameter	Unit	Conventional	Efficient faucets
Water output	L/min	6	1.9
Units	x	1,675	1,675
Usage per day	min	10	8



15 L/ca/day saved water  
→ 68 %

Payback period: 12 years



# Water-saving showerheads

Parameter	Unit	Conventional	Water-saving heads
Water output	L/min	12	5
Units	x	1,595	1,595
Usage per day	min	8	8

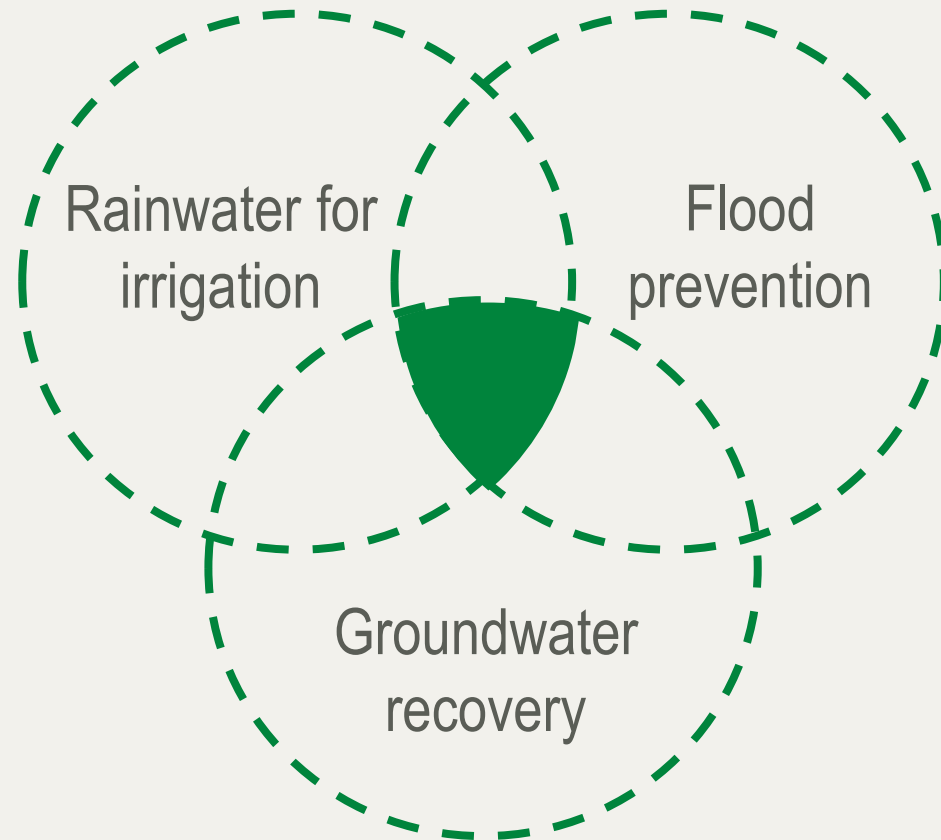
18 L/ca/day saved water  
→ 58 %

Payback period: 5 years

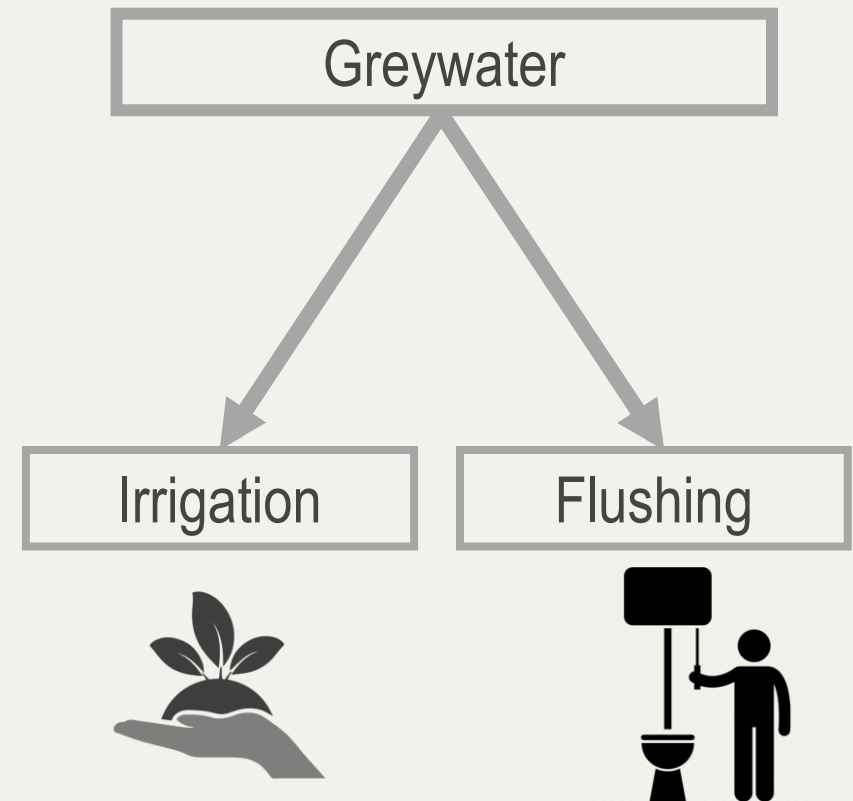


# Substitution

## Rainwater harvesting:



## Treated greywater:



# Projected water consumption

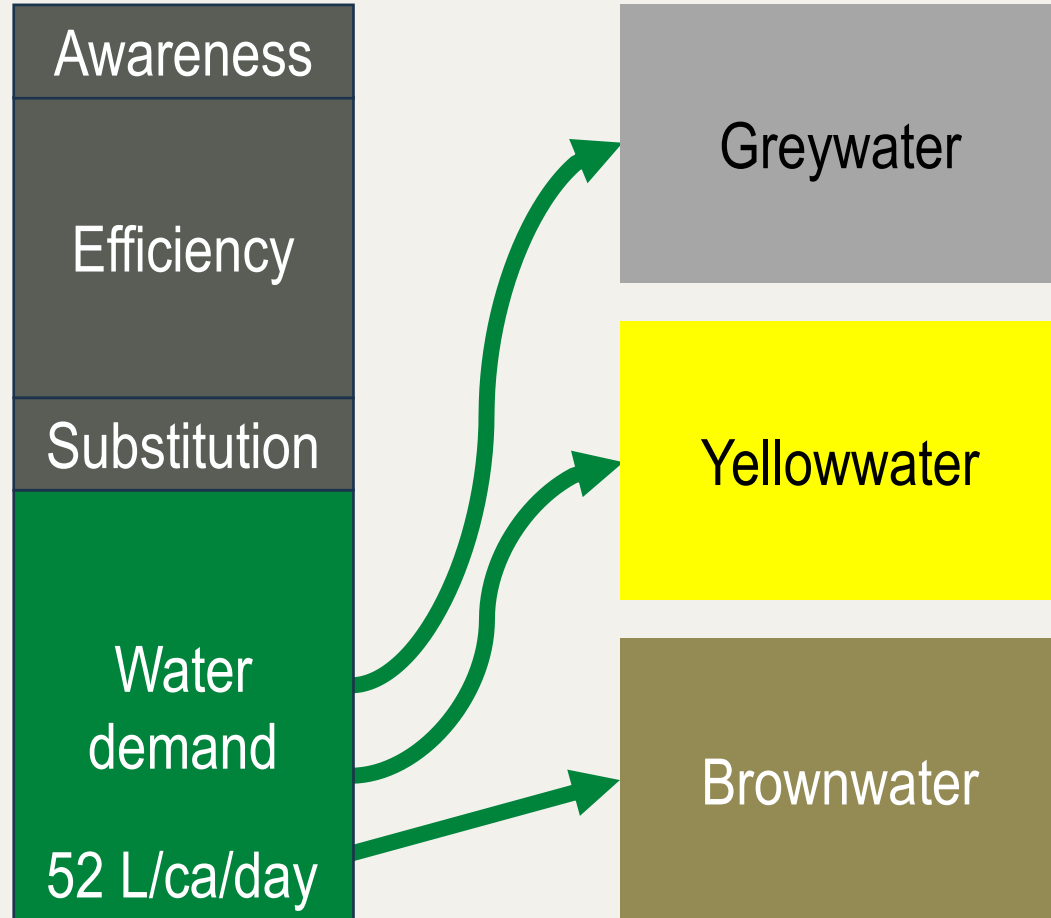


## Total savings:

- 70 L/ca/day
- 58,000,000 FCFA/a
- → 57 %

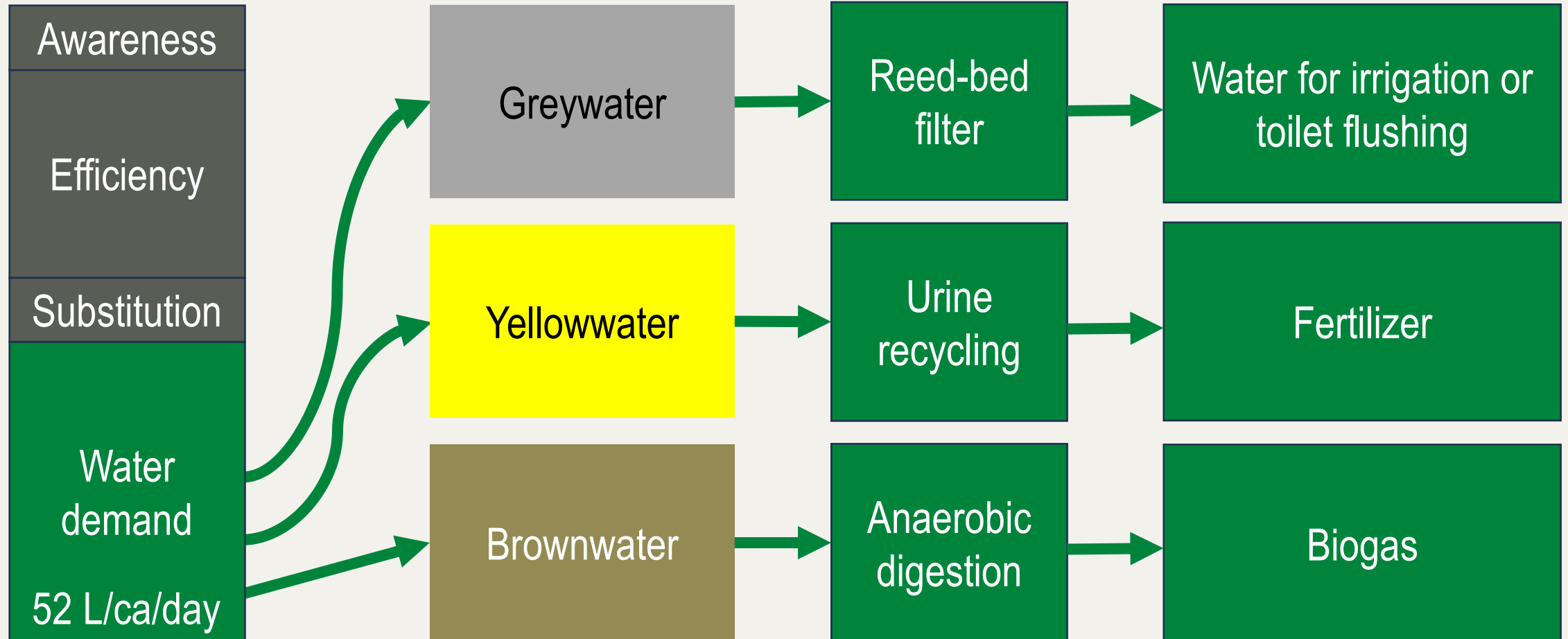


# Wastewater



- Water shortage issue
- Protection of the environment
- Protect the ecosystem
- Reduce pollution
- Cost saving
- Public health

# Wastewater treatment



# Reed-bed filter



Parameter	Unit	Amount
Greywater treated	m <sup>3</sup> /a	78,475
Wetland area	m <sup>2</sup>	2,688
CAPEX	FCFA	344,400,000
Levelized costs	FCFA/m <sup>3</sup>	498
Water purchase price	FCFA/m <sup>3</sup>	665

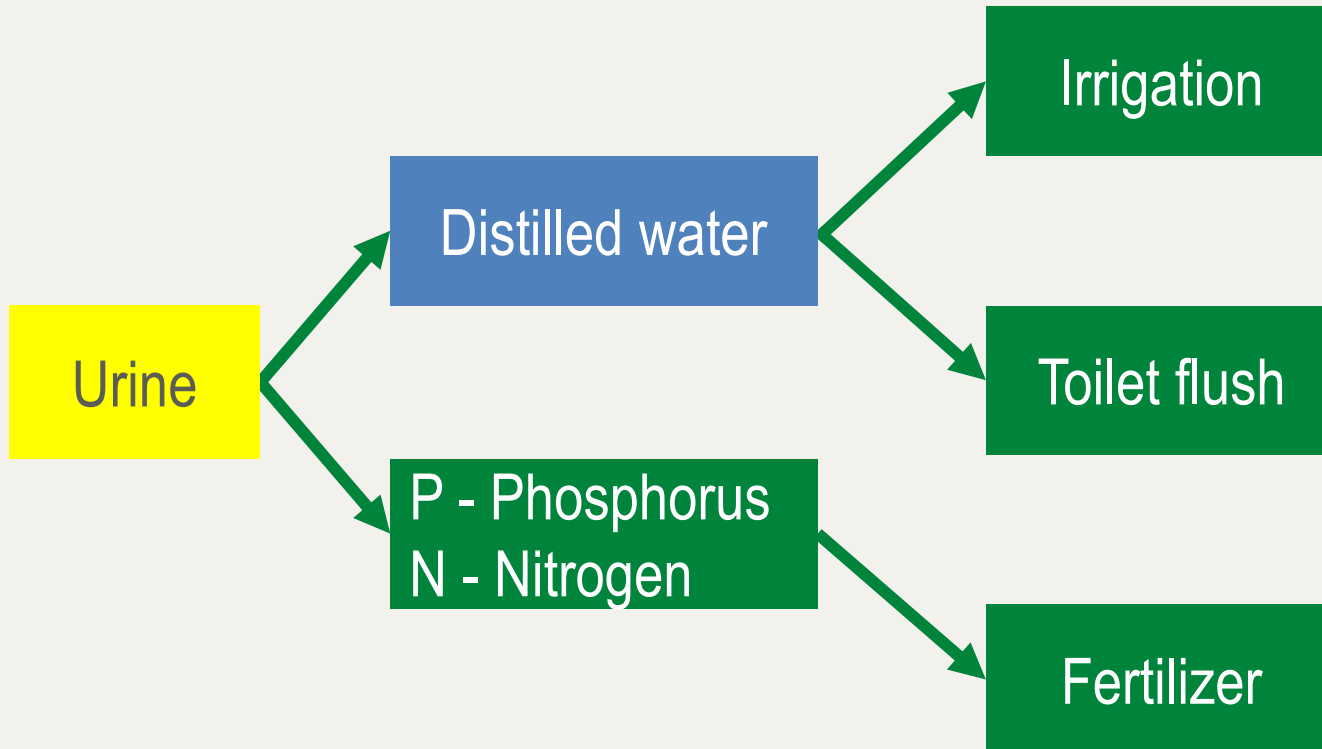
Levelized costs of  
treated greywater



Water purchase  
price



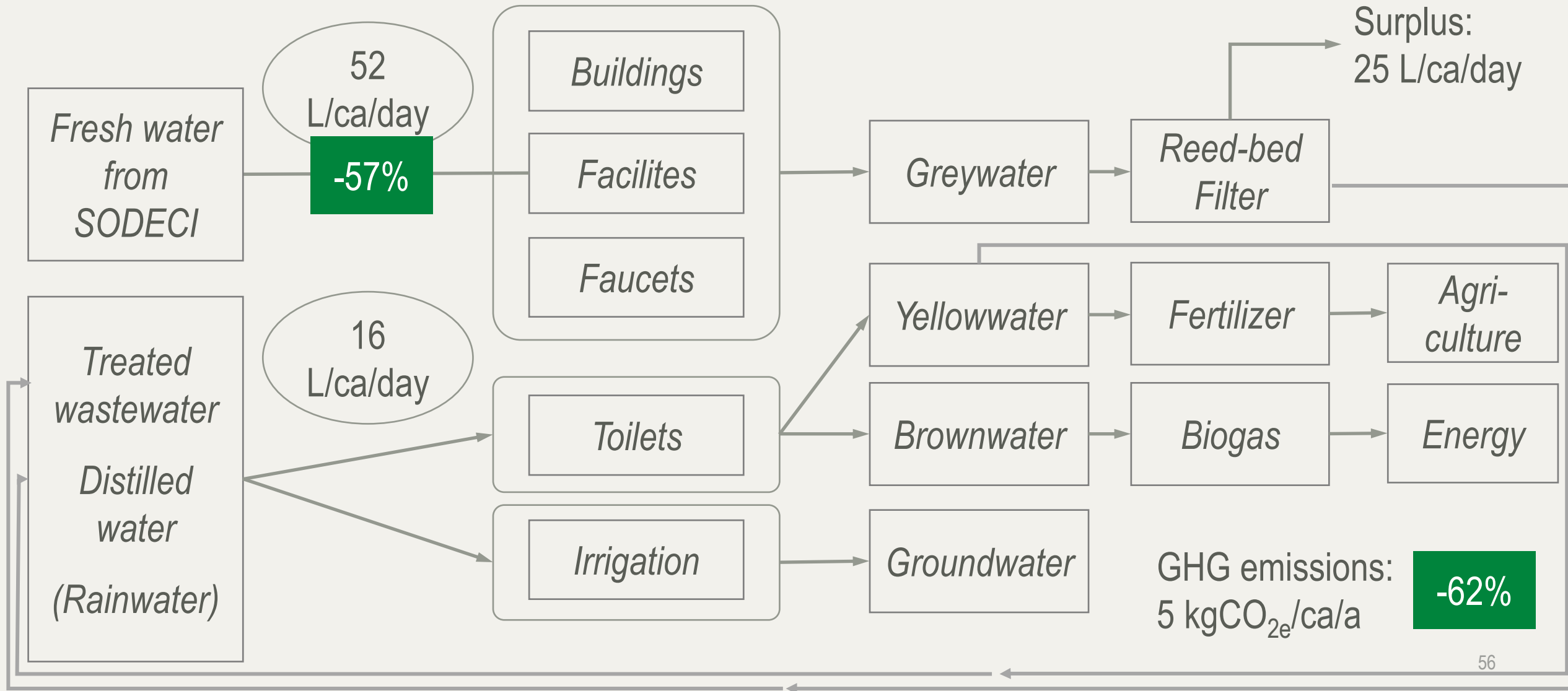
# Urine recycling



Parameter	Unit	Amount
Fertilizer	m <sup>3</sup> /a	96
Distilled water	m <sup>3</sup> /a	1,279
Levelized costs	FCFA/m <sup>3</sup>	593,000
Fertilizer price	FCFA/m <sup>3</sup>	600,000



# New IUGB outlook



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# Solid waste

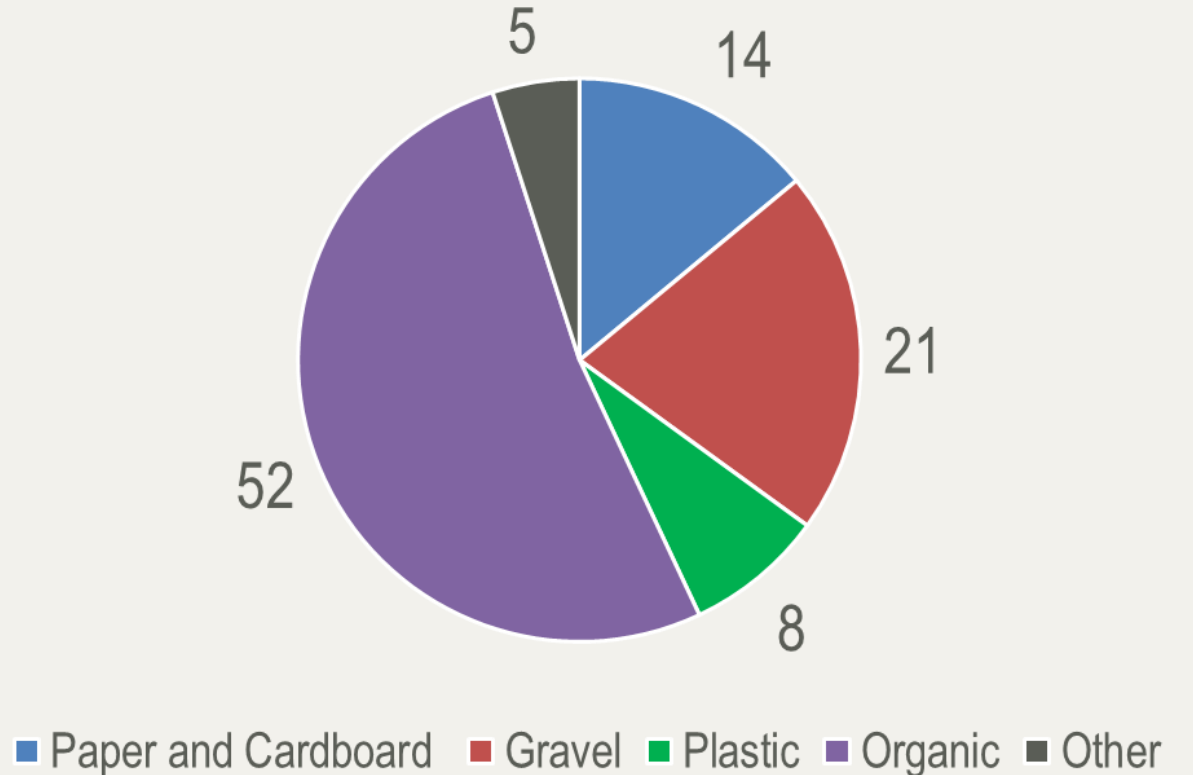
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# Status quo: Grand-Bassam

Parameter	Unit	Amount
Population	x	267,103
Solid waste	kg/day/ca	<b>0.82</b>
	kg/a/ca	299
<b>Total amount generated</b>	t/a	<b>80,000</b>

Waste composition Grand-Bassam [in %]





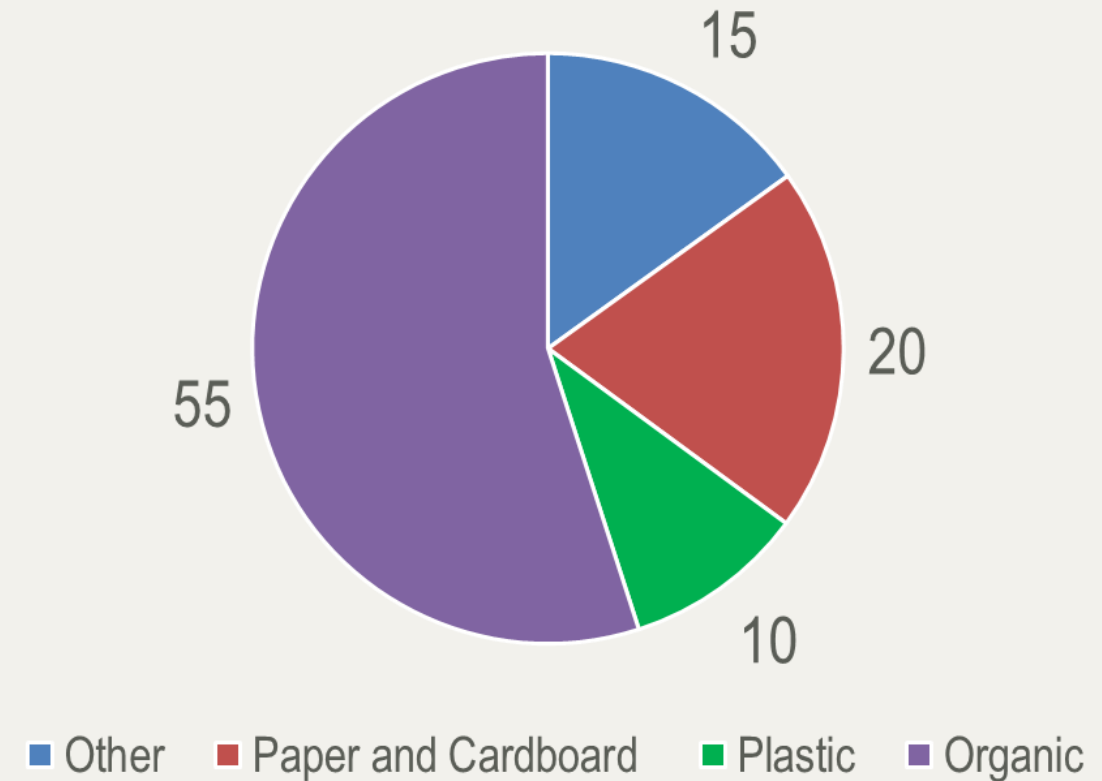




# Status quo: IUGB

Parameter	Unit	Amount
People IUGB (student & staff)	x	950
Occupancy IUGB Campus	day	245
Solid waste	kg/day/ca	<b>0.8</b>
	kg/a/ca	196
<b>Total</b> amount generated	t/a	<b>186</b>

Estimation waste composition IUGB [in %]





# Waste collection - Let's talk about our waste



Where  
we are

4 hours



SOURCE: Pictures taken by the team.



# Waste composition (open and spread)





# Waste composition (reorganized, repackaged by waste type)

## Green Business Models

- A** Paper, cardboard, plastic bags, wrappers, tetrapack, pens, diverse of plastics, hygienic products, ...
- B** Organic waste (~ 4kg)
- C** Plastic bottles, diverse other plastics (14 PET bottles)
- D** Styrofoam, single use dishes, single use cutlery (27 units styrofoam)



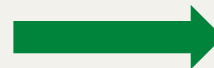


# Waste valorization: plastic

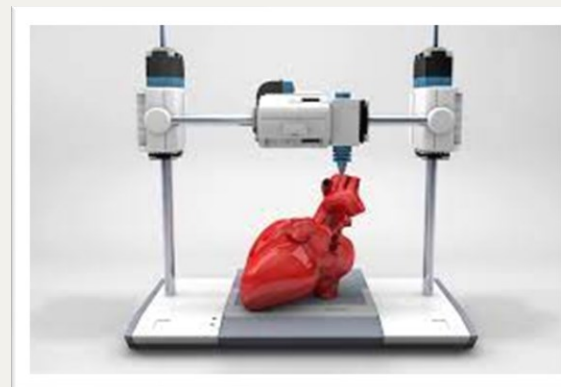


**4 = 50 FCFA**

**1 = 25 FCFA**



# Waste valorization: plastic



Parameter	Unit	Amount
Price of shredded PET	FCFA/t	807,151
CAPEX	FCFA	2,850.000
Shredding capacity	kg/h	50
Plastic waste IUGB	t/a	97
PET	kg/d	40.55
Shredded PET	FCFA/a	<b>7,600,000</b>


# Waste valorization: paper and cardboard



Parameter	Unit	Amount
Paper price	FCFA/t	45,810
Cardboard price	FCFA/t	55,278
Paper and cardboard waste	t/a	196
Estimated revenue	FCFA/a	1,850,000



# New university's green area exploitation



Eco-Innovation Park

Main Campus



# Benefits



Cocoa/coffee



*Promoting  
sustainable  
agriculture*

*Develop innovative  
technics for  
agriculture*

*Produce energy  
and fertilizer*

*Income source*



Cassava/Plantain



*Produce biofuel  
and fertilizer*

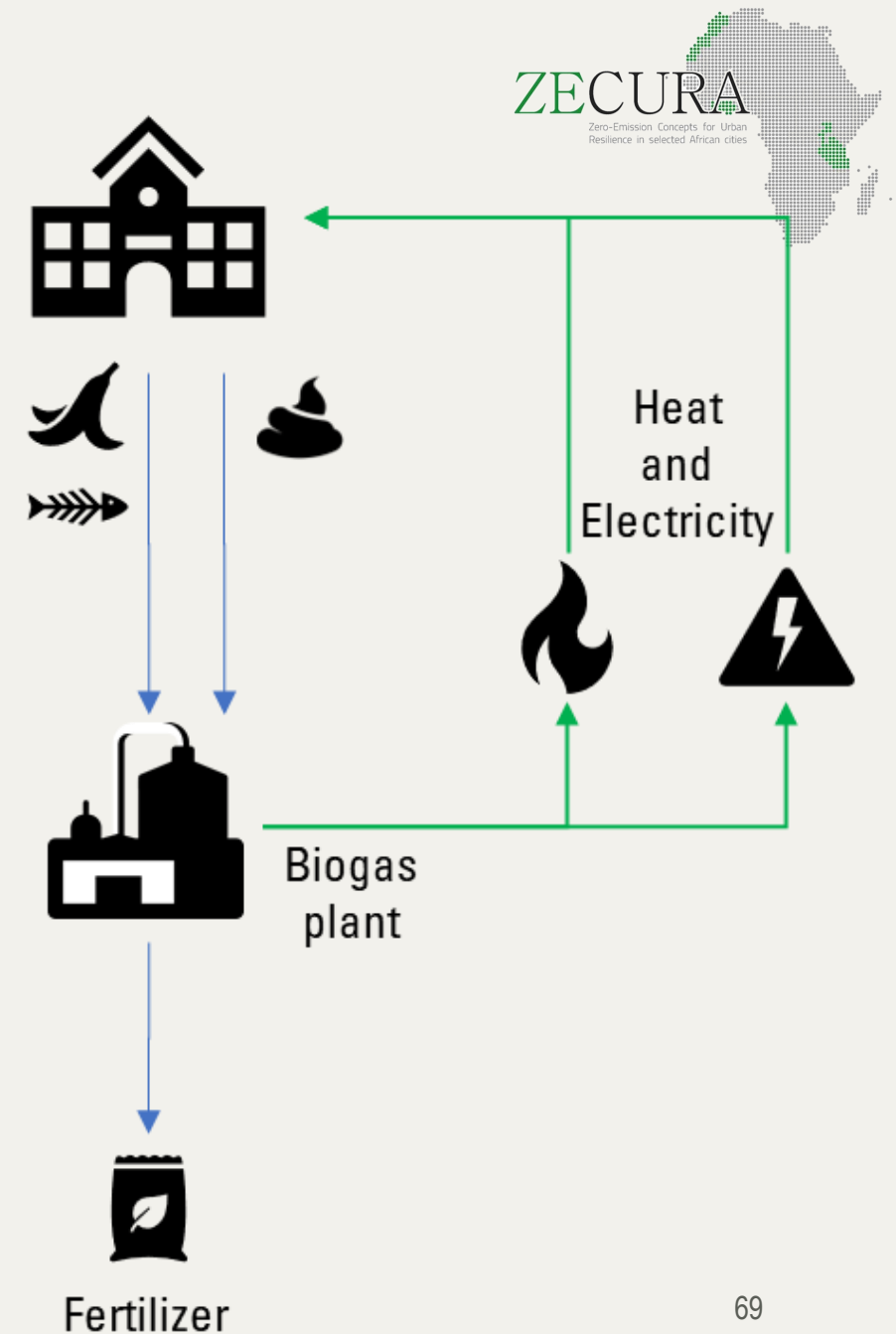
*Respond to  
local market  
demand*

*Bio-based product*

*Income source*

# Waste valorization: Biogas production

Parameter	Unit	Amount
Total organic waste IUGB	t/a	538
Brownwater	m <sup>3</sup> /a	16,000
Methane	m <sup>3</sup> /a	32,000
Electricity production	kWh/a	<b>107,000</b>
Coverage IUGB demand	%	<b>4</b>





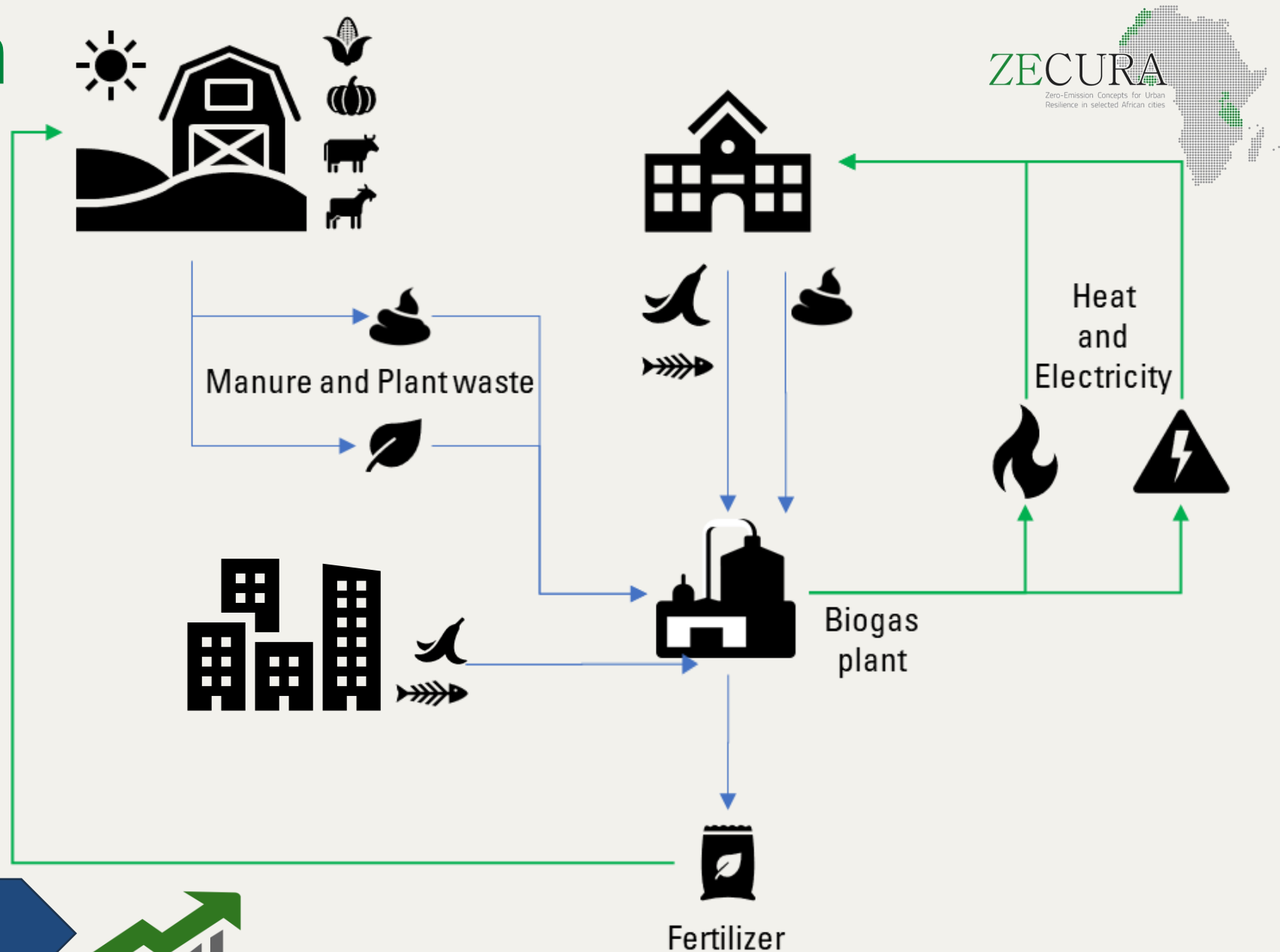
# Biogas production

Connecting food,  
waste and  
energy production  
at IUGB with Grand-  
Bassam

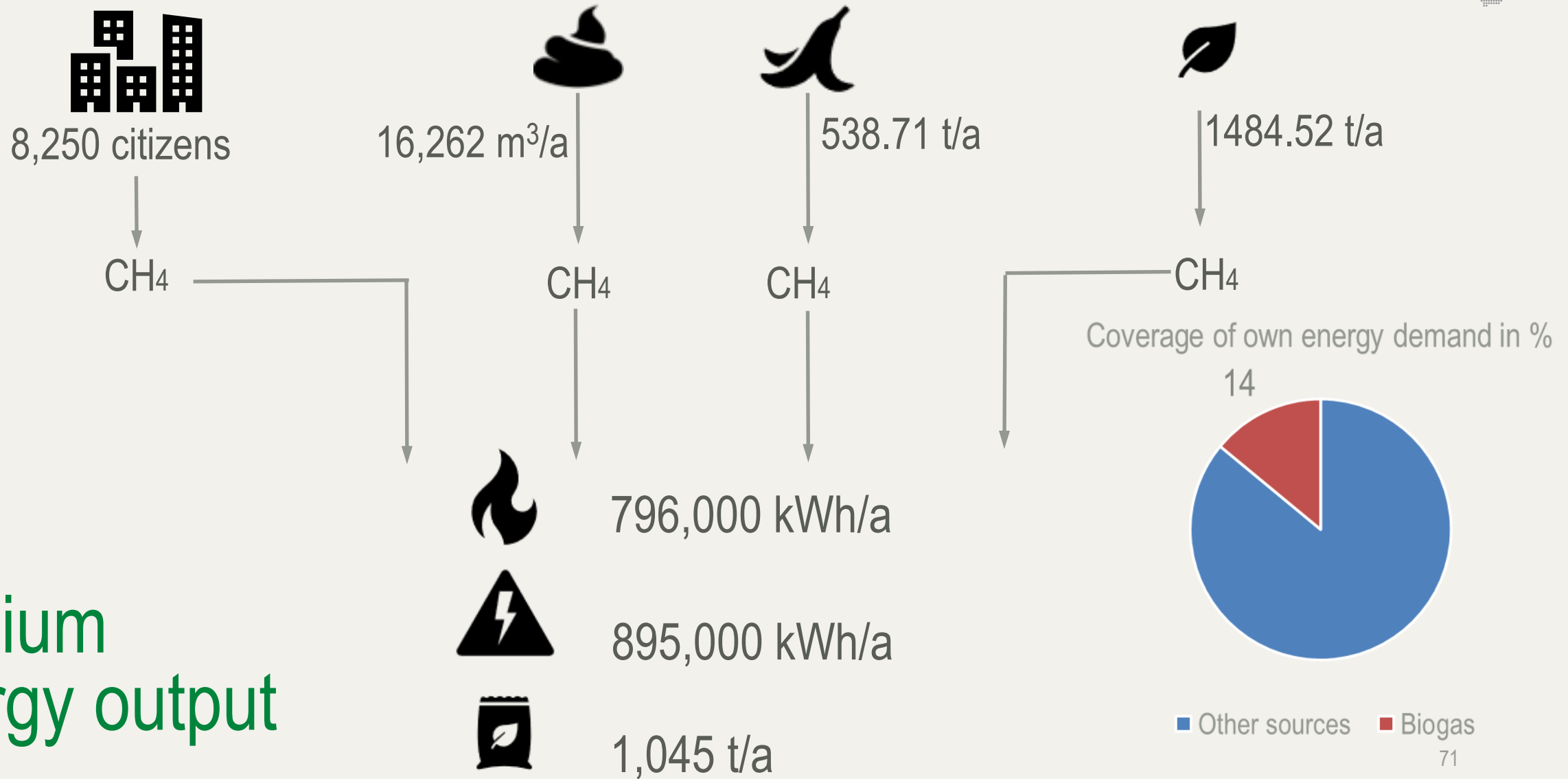
Savings and  
sustainable  
investments



REGIONAL ADDED VALUE



# Biogas production – medium energy output



Medium  
energy output

# Financial assessment – medium energy output

Parameter	Unit	Amount
Estimated investment	FCFA	1,130,000,000
Total cost saving potential	FCFA/a	36,500,000
Maintenance (4%)	FCFA/a	45,000,000
Levelized cost of organic waste treatment	FCFA/t	<b>67,000</b>
Treatment cost of organic waste	FCFA/d/ca	<b>18,700</b>

*It is needed to point out that this estimations are affected by external factors of the system to be considered towards more efficiency.*

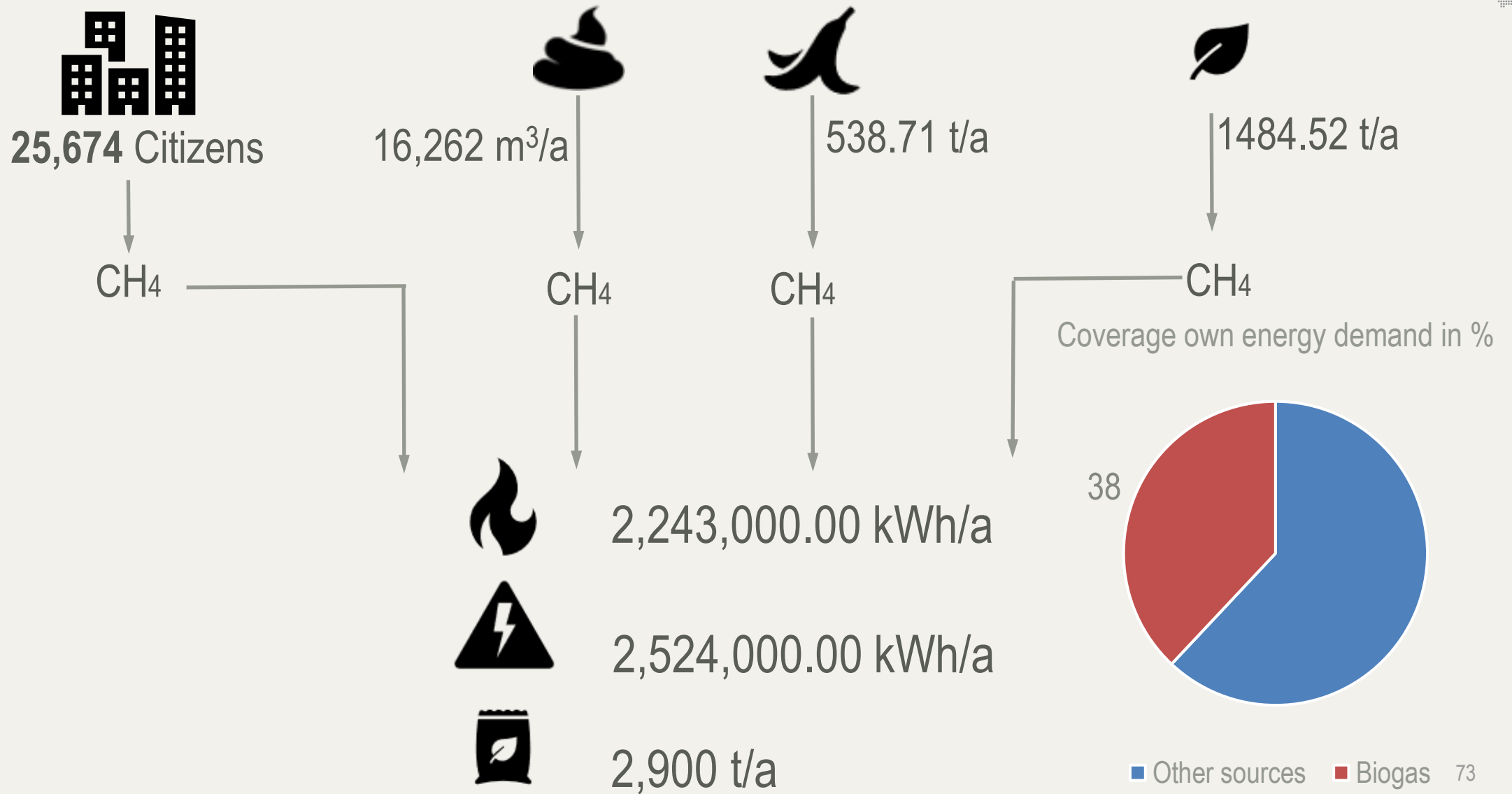
*Several elements which costs are not consider because the lack of register information*



SOURCE: [www.rh-entsorgung.de](http://www.rh-entsorgung.de)



# Biogas production – high energy output



# Financial assessment: high energy output

Parameter	Unit	Amount
Estimated investment	FCFA	1,600,000,000
Total cost saving potential	FCFA/a	90,000,000
Maintenance (4%)	FCFA/a	64,000,000
Levelized cost of organic waste treatment	FCFA/t	<b>30,000</b>
Treatment cost of organic waste	FCFA/d/ca	<b>8,300</b>

*It is needed to point out that this estimations are affected by external factors of the system to be considered towards more efficiency.*

*Several elements which costs are not consider because the lack of register information*



# CE Initiatives: Integrate IUGB community perception

*"It is only a development, if we don't leave anyone behind."*



## IUGB- Économie circulaire. Idées

Outil de diagnostic

alberto.ninho.glz@gmail.com [Switch account](#)

Not shared

\* Indicates required question

1) Quel type d'élément est abondant en termes de déchets à Grand Bassam? // Which kind of element is abundant in terms of waste at Grand Bassam? \*

Your answer

2) Quel type d'élément est abondant en termes de ressources naturelles (environnementales) à Grand Bassam ?// Which kind of element is abundant in terms of natural resources (environmental) the Grand Bassam? \*

Your answer

Source: Made by the team for the project research in Google Survey Forms

**Response:** 18

**Diagnostic tool:** sense the perception of topics



# Let`s talk about our resources

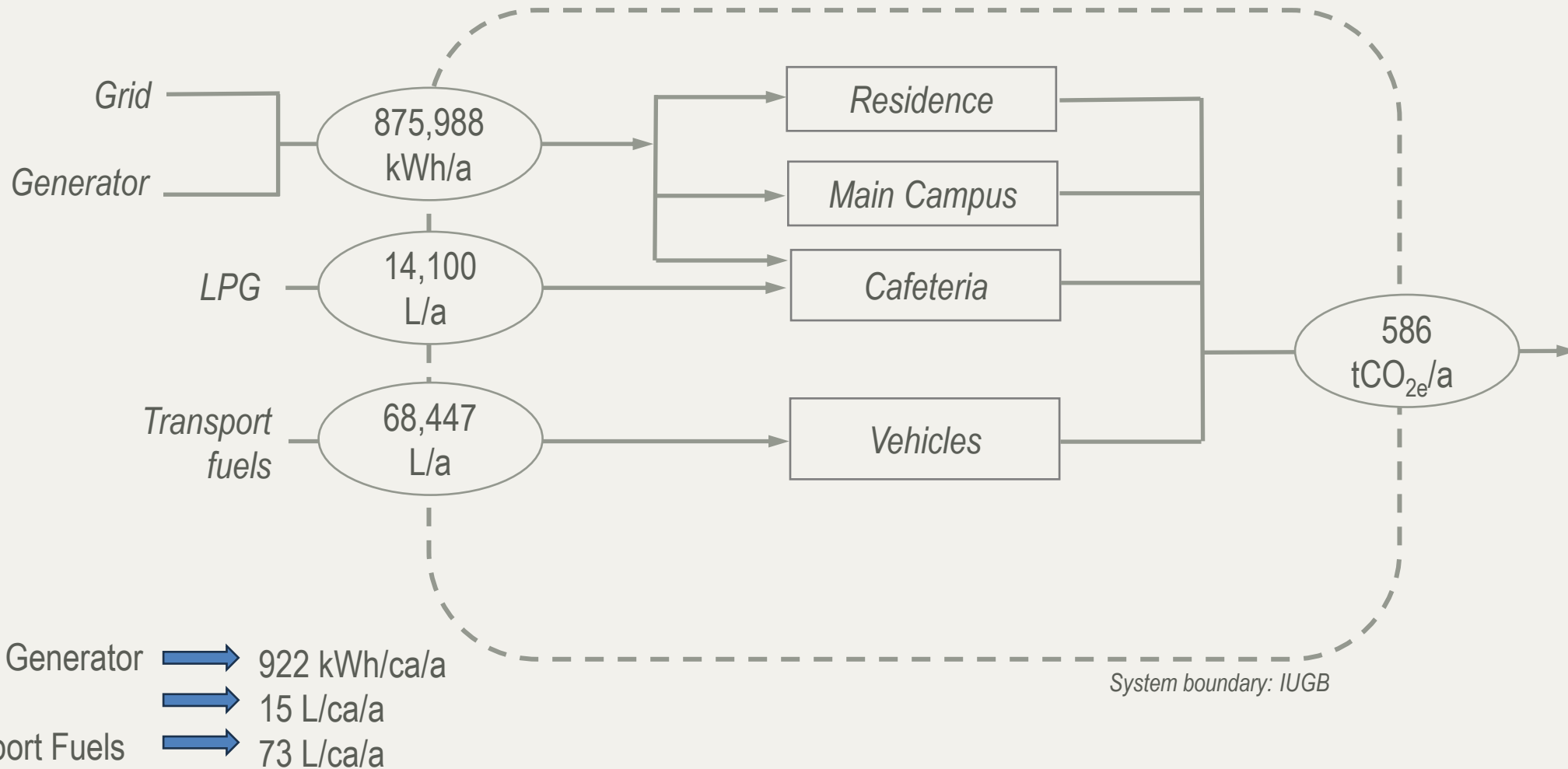


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# Energy efficiency

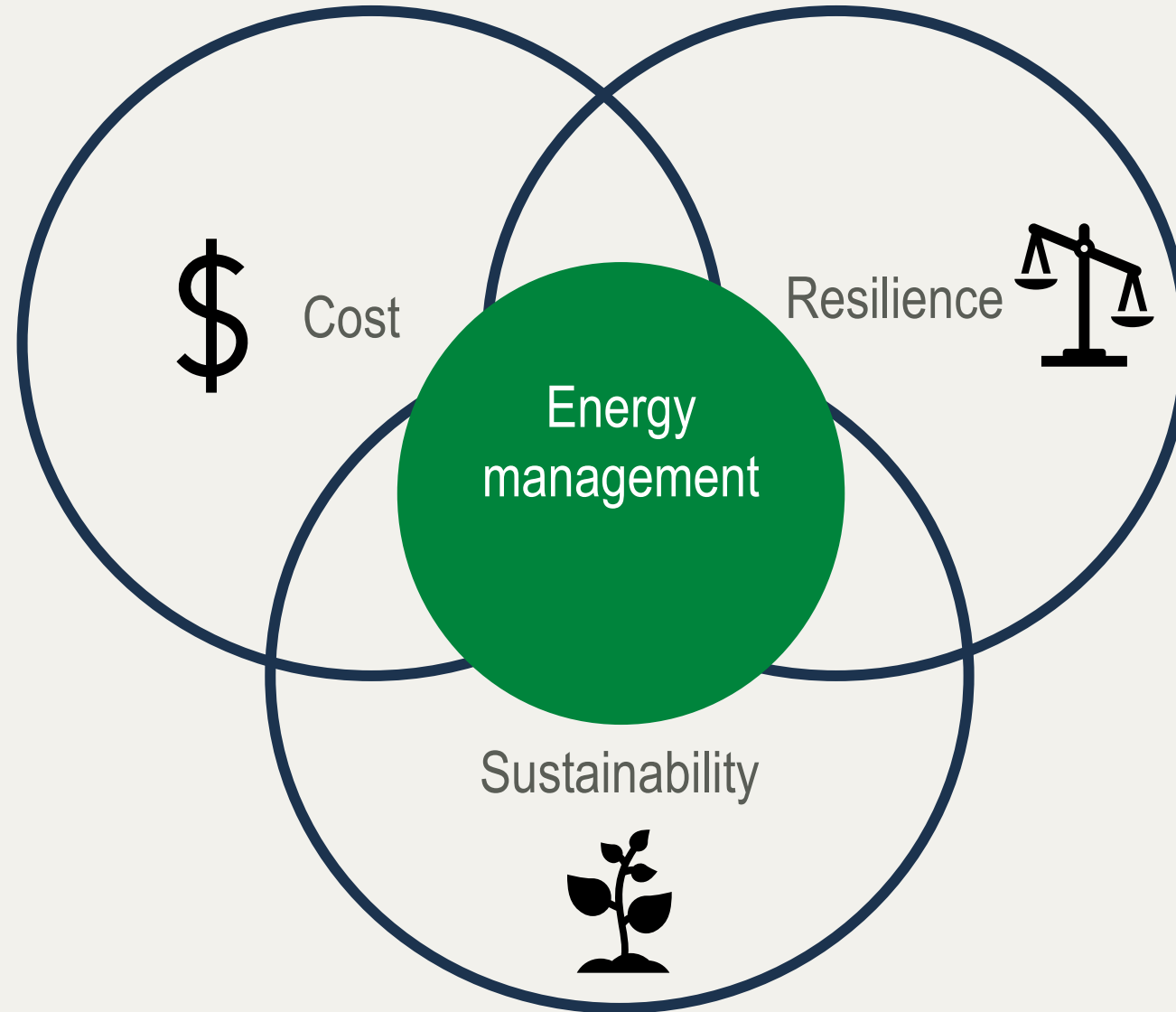
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# Status quo: energy total

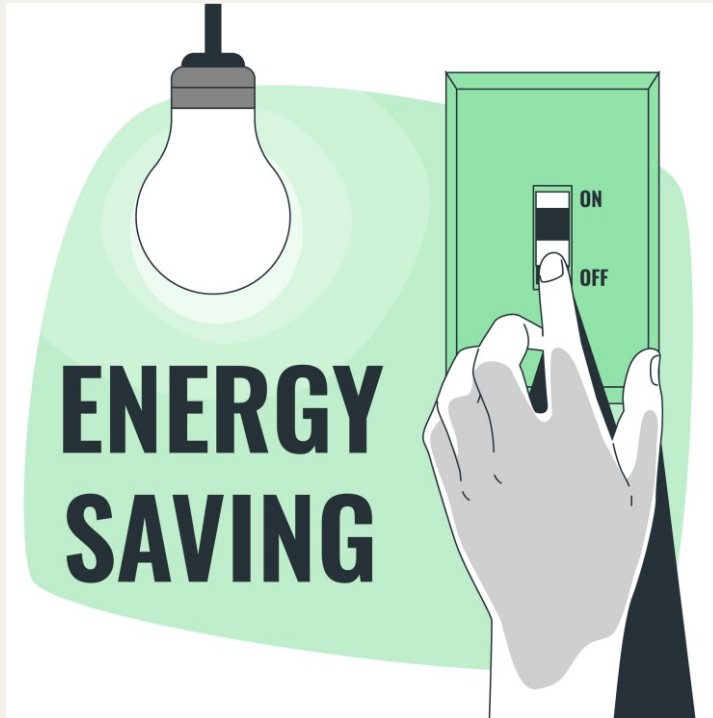




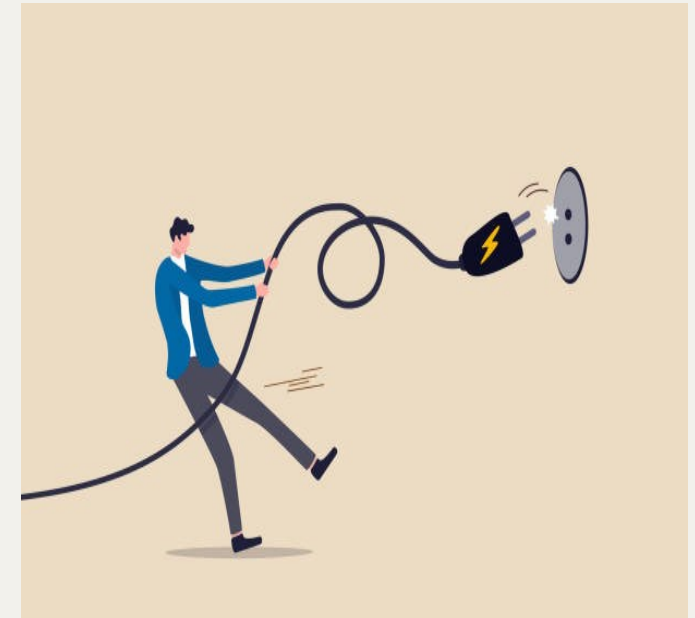
# Ideas & strategies: efficiency & renewable



# Saving energy through awareness



Increasing awareness can lead to a **reduction** of energy consumption by up to **10%**.



Save electricity: save **one unit** a day – keep power cuts **away**.

# Energy-efficient illumination

Parameter	Unit	Fluorescent light	LED low-tech	LED high-tech
Approximate cost per tube	FCFA	1,000	791	8,000
Average lifespan	h	13,000	12,000	75,000
No. of tubes needed for 75k hours of use	x	6	6	1
Total purchase price of tubes over 75k hours <sup>1</sup>	FCFA	5,769	4,944	8,000
Total cost of electricity used (75k hours a FCFA/kWh) <sup>1</sup>	FCFA	221,184	110,592	86,016
Total cost over 75k hours <sup>1</sup>	FCFA	226,953	115,536	94,016
GHG emissions	tCO <sub>2e</sub> /a	1.26	0.63	0.49
Cost per operational year <sup>1</sup>	FCFA/a	10,894	5,546	4,531



<sup>1</sup>Assuming **3,600** operating hours per year.



# Efficient illumination – project outlook

Parameter	Unit	Fluorescent light	LED high-tech
Power demand	W	36	14
Electricity demand <sup>1,2</sup>	kWh/a	609,897	237,182
Saving potential	%		61
Energy savings <sup>1,2</sup>	kWh/a		372,715
Monetary Savings <sup>1,2</sup>	FCFA/a		27,059,123
Lifespan	h	13,000	75,000
GHG abatement <sup>1,2</sup>	tCO <sub>2e</sub> /a		174
Lifespan	a	<4	21
Initial investment <sup>2</sup>	FCFA	4,706,000	37,648,000
Payback <sup>1</sup>	a		<2

<sup>1</sup>Estimated operating time 3,600 h/a

<sup>2</sup>and 4,706 units.



# Energy-efficient air-conditioning

Parameter	Unit	Westpoint WSN-1810.LE	Daikin FTXJ50AW
Nominal cool output	kW	5.2	5.5
Coefficient of performance (COP)		2.4	4.2
Power input – electrical	kW	2.2	1.3
Annual energy consumption (electrical) <sup>1</sup>	kWh/a/unit	7,700	4,550
Total energy (electricity) <sup>1,2</sup>	kWh/a	2,756,600	1,628,900
GHG savings <sup>1,2</sup>	tCO <sub>2e</sub> /a		526
Annual energy cost savings <sup>1,2</sup>	FCFA/a		92,381,184
Estimated CAPEX <sup>1,2</sup>	FCFA		436,402,000
Payback <sup>1</sup>	a		4.7

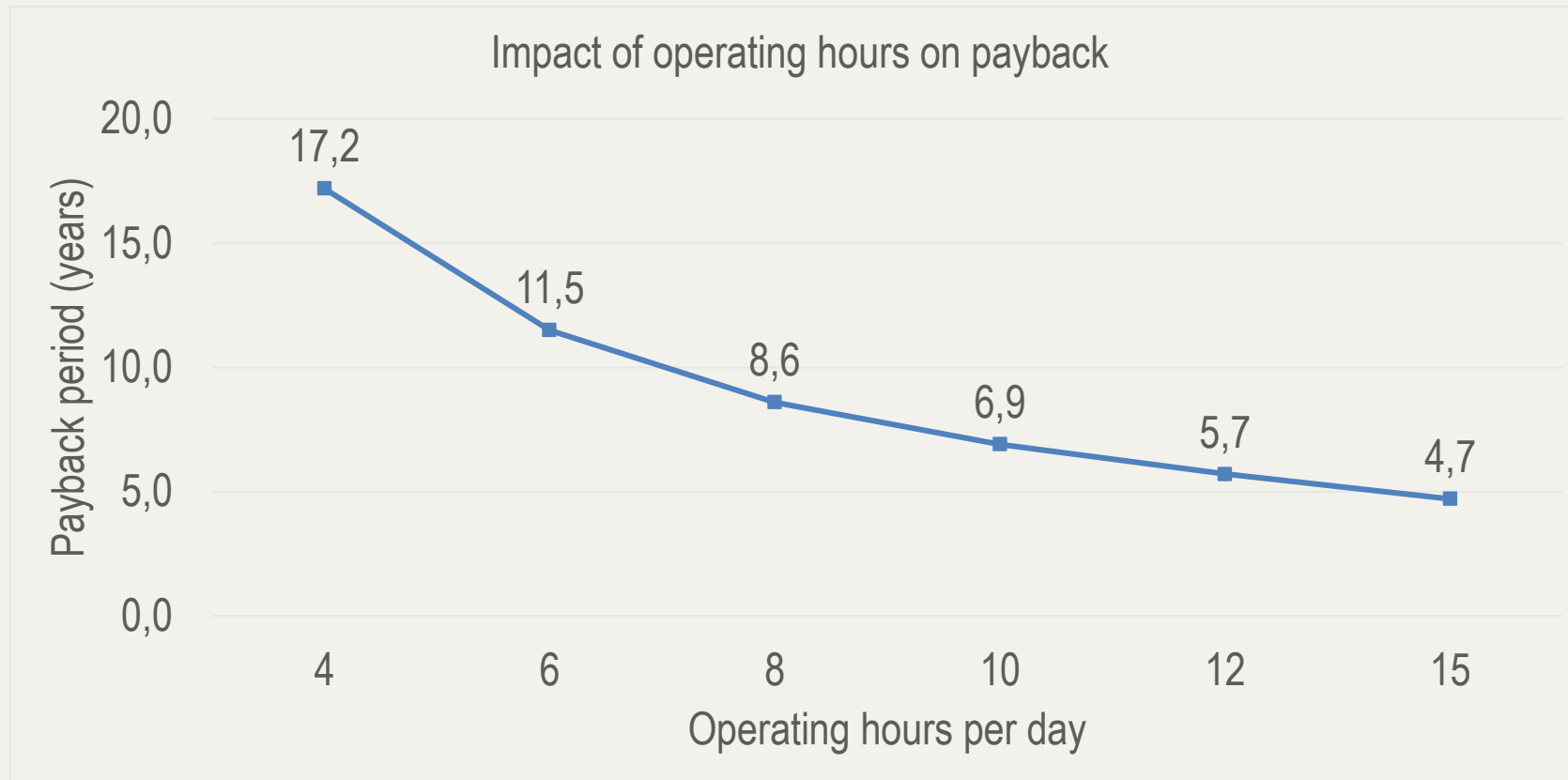


SOURCE: <https://vetall.de>

<sup>1</sup> Estimated operating time: **3,500 h/a**

<sup>2</sup> and **358** units

# Energy-efficient air-conditioning



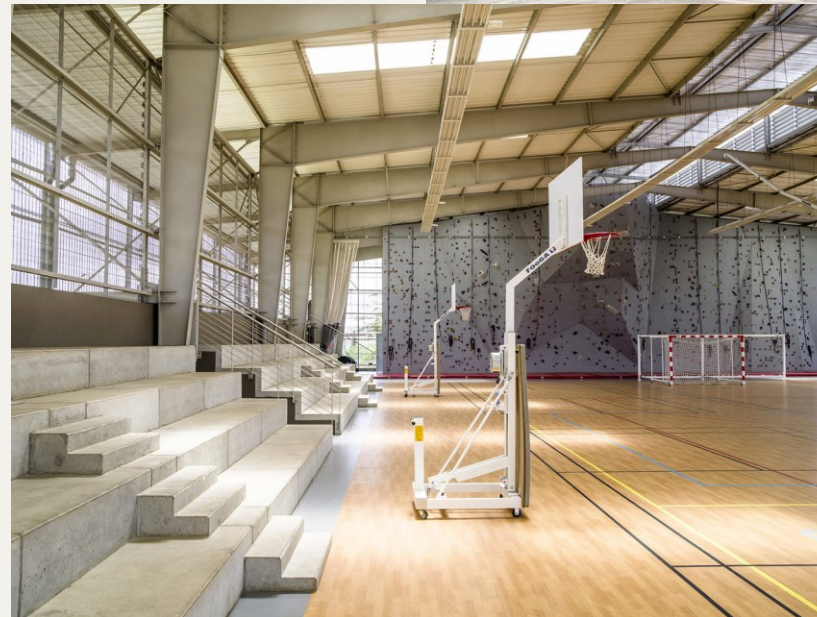
SOURCE: <https://vetall.de>



# Natural illumination and ventilation

(Gymnasium, Blaise Pascal High School, Abidjan)

Natural ventilation **reduces**  
or even **eliminates** the need  
for air conditioning systems.

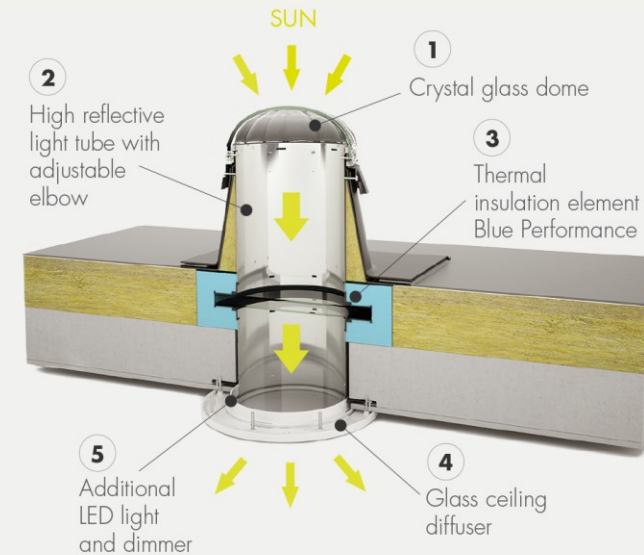


Can be tested on a  
small scale on the  
old campus.

# Natural illumination

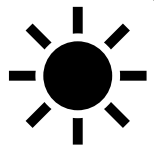


Dimming of light and air layer



Utilizing natural light

# Smart solutions



Turns light off when it is bright enough.



Controls air conditioning to reduce humidity.



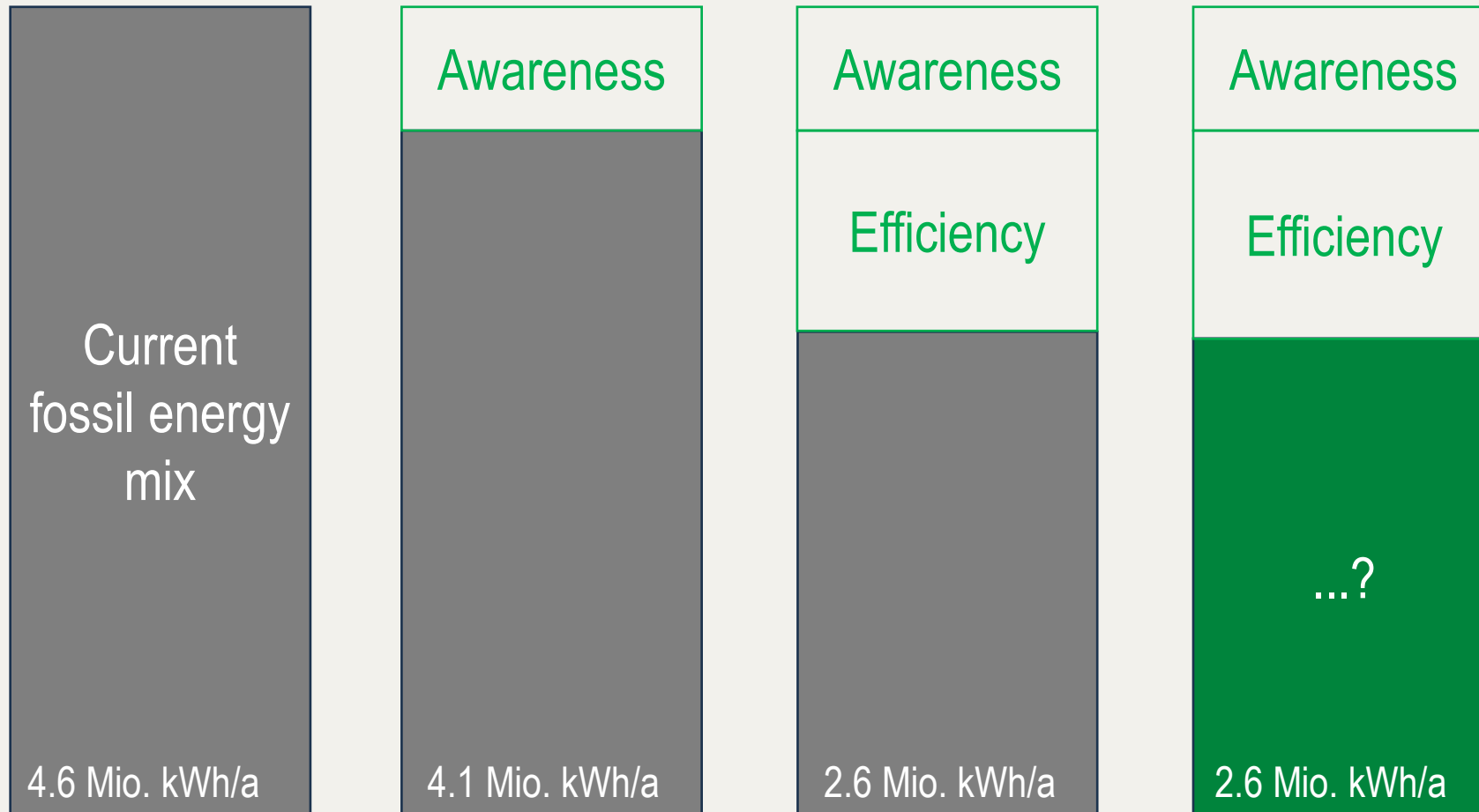
Switches light off when it is forgotten.

Light, movement and humidity sensor.





# How to achieve a zero-emission campus?



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# Renewable energy

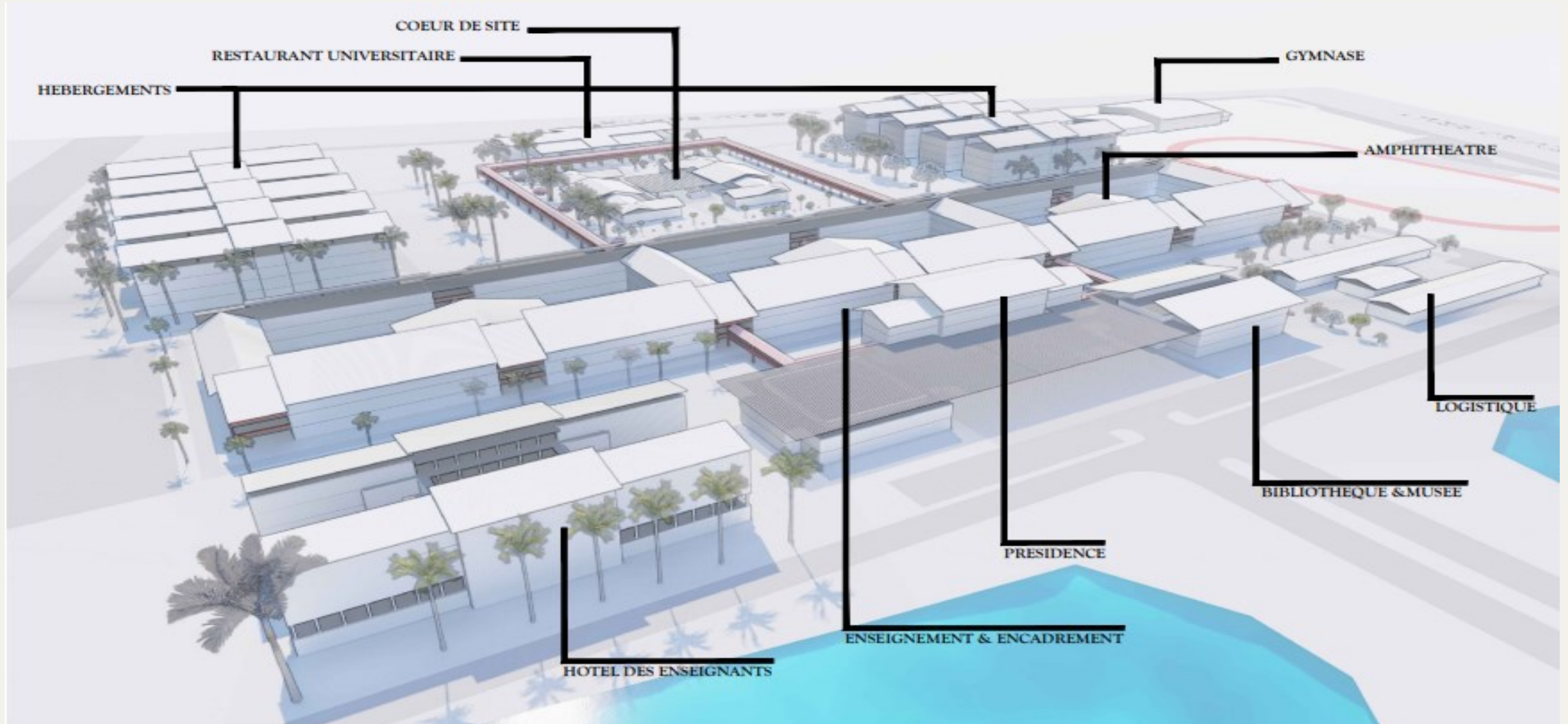
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# Existing campus



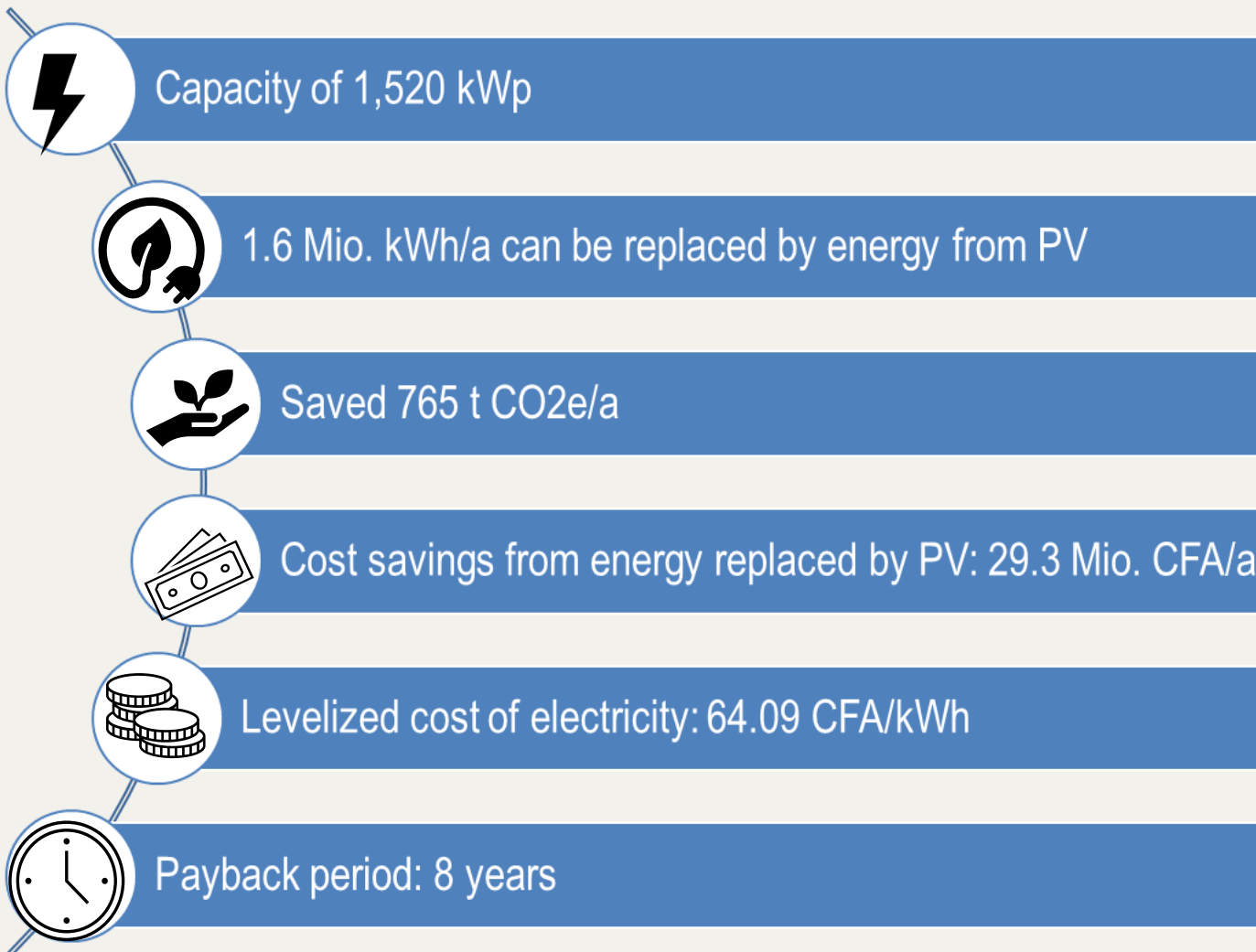


# New campus

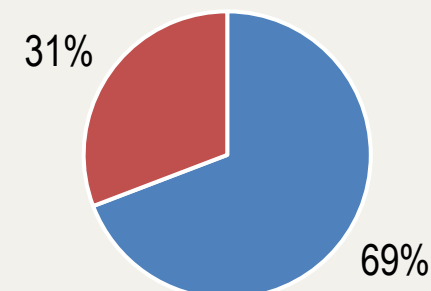


# PV on the new campus

## Scenario 1: the rooftop is 7% covered with PV

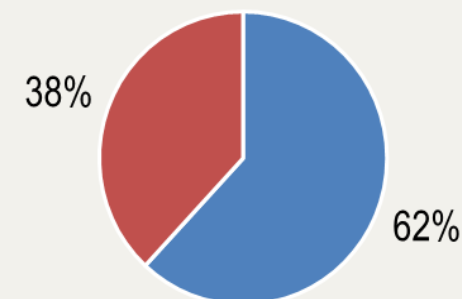


PV Generator Energy



■ own consumption ■ Surplus

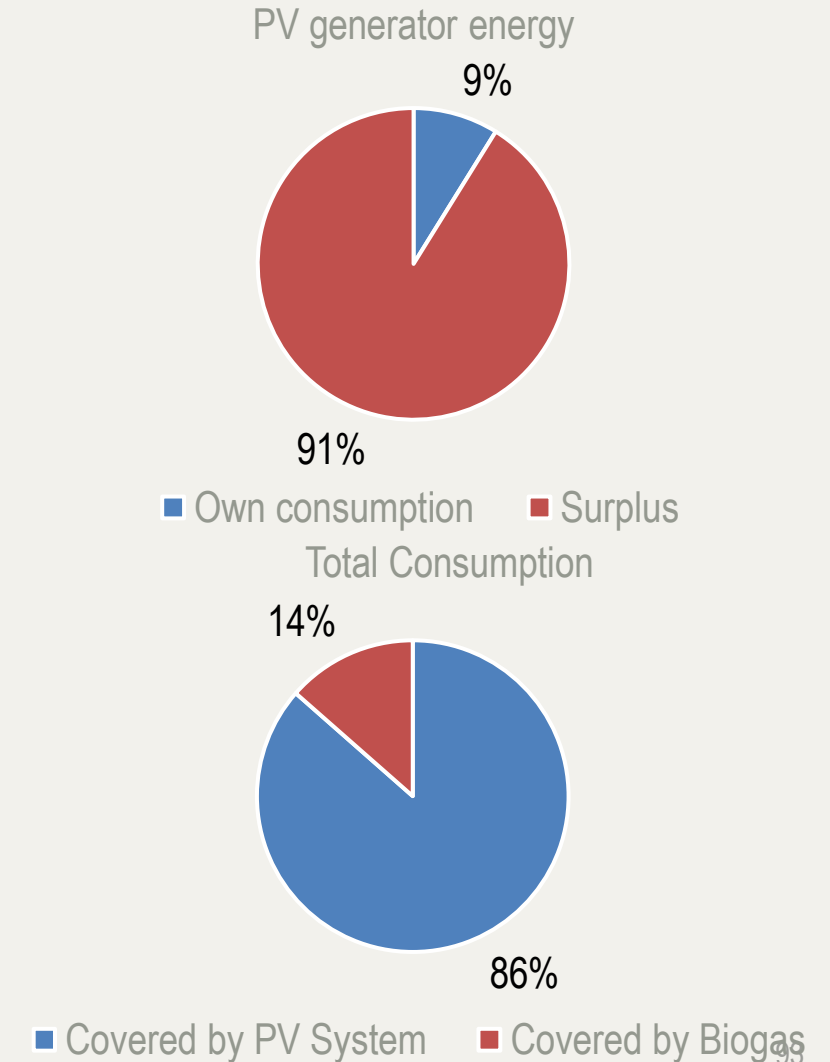
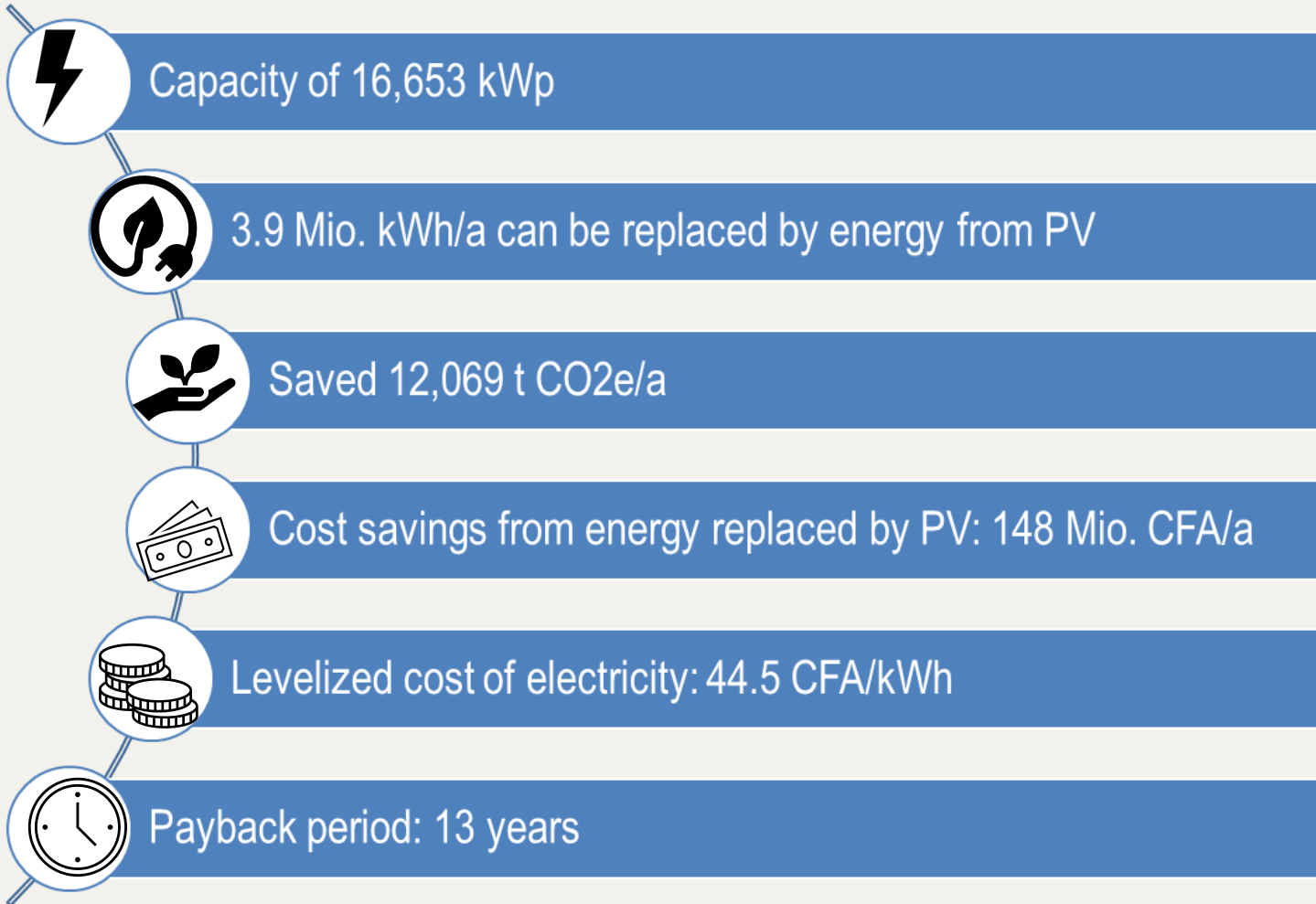
Total Consumption



■ covered by PV System  
■ covered by Biogas

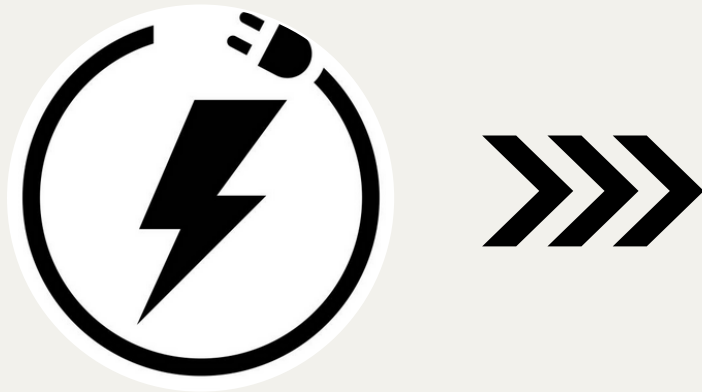
# PV on the new campus

## Scenario 2: the rooftop is 80% covered with PV





# What is e-mobility?



SOURCE: L'opinion, 2023



# E-Mobility on the new campus of IUGB

Electric bicycle



Electric Scooter



Electric car



SOURCE: U-M Campus, 2023, The Texas Tribune, 2023, <https://cnsmaryland.org>, 2023

# Status quo for transport



3

Van for students  
official travel



3

Bus for students



1

Van for  
general means

Parameter	Unit	Amount
Distance travelled	km/a	34,000
Fuel consumption	L/a	3,400
Fuel cost	FCFA/a	3,000,000
GHG emissions	tCO <sub>2e</sub> /a	8

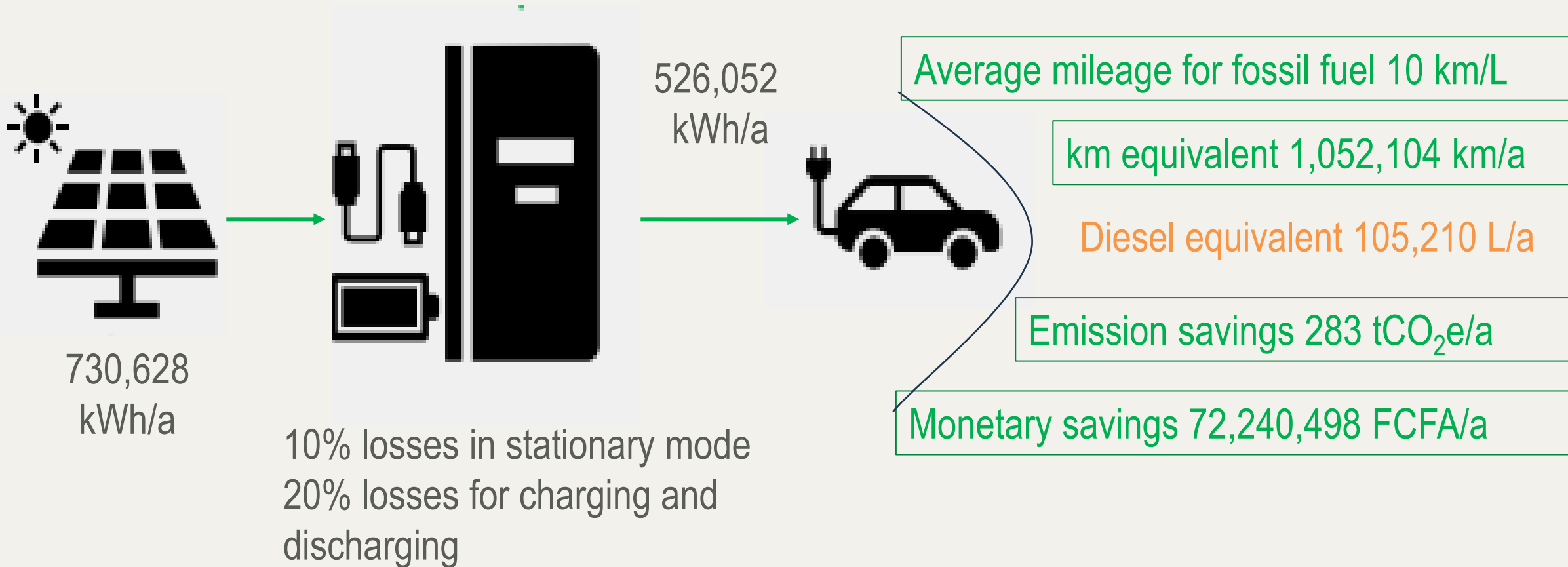


# Ford transit 2023 vs Ford e-transit 2023

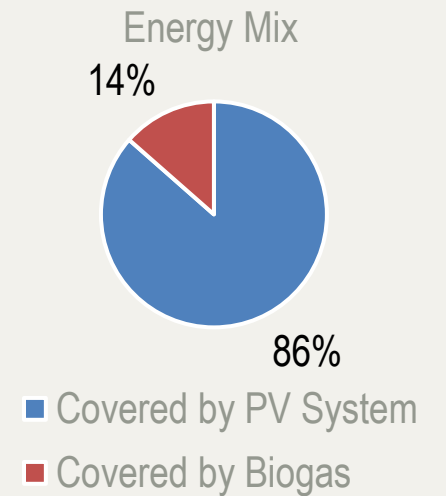
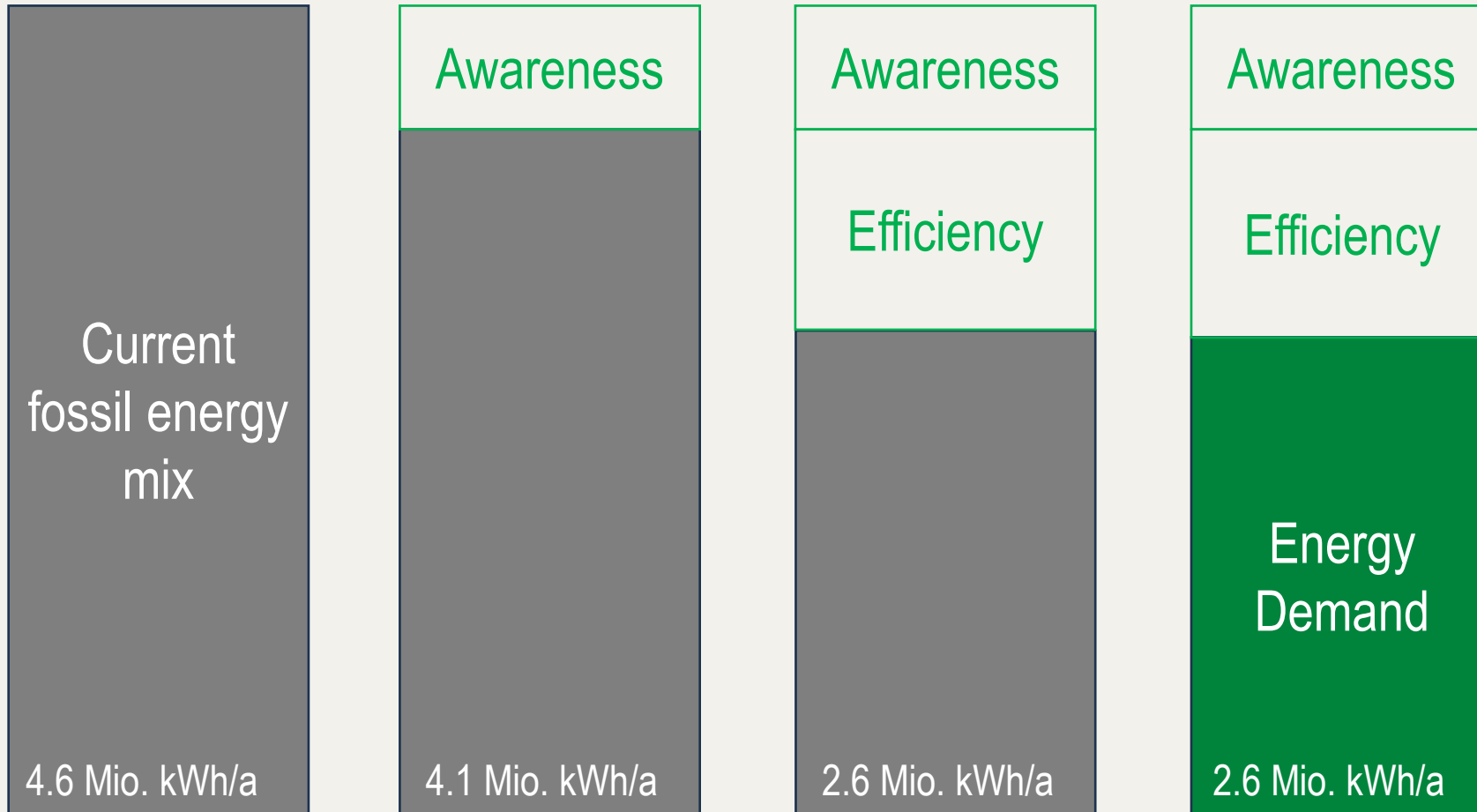
Parameter	Unit	Ford « Petrol engine »	Ford E-Transit « Electric Vehicle »
Purchase price	FCFA	31,240,430	32,774,040
Fuel consumption	l/km or kWh/km	0.2	0.2
Annual travels	km/a	5,200	5,200
Annual fuel demand	l/a or kWh/a	961	1,184
Annual consumption costs	FCFA/a	783,182	30,785
Maintenance	FCFA/a	1,562,022	937,213
GHG emissions	tCO <sub>2e</sub> /a	2	
Lifetime cost (10 years)	FCFA	54,692,469	42,454,019



# Using the solar potential



# Energy mix from the future campus





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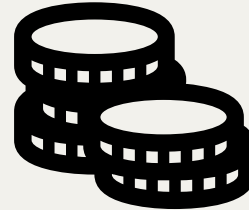
# Total benefits

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# Financial and environmental benefits

Total investment

12 Bn. FCFA



Savings/a

271 Mio. FCFA

Business as usual GHG intensity

687 kgCO<sub>2e</sub>/ca/a

Scenario 1: GHG intensity

5 kgCO<sub>2e</sub>/ca/a

National GHG intensity

426 kgCO<sub>2e</sub>/ca/a

Scenario 2: GHG intensity

-2,195 kgCO<sub>2e</sub>/ca/a

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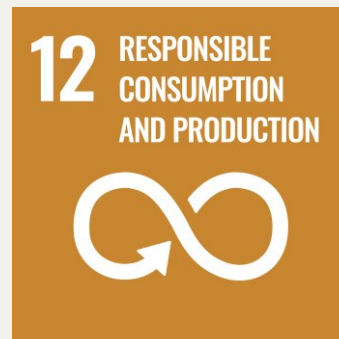
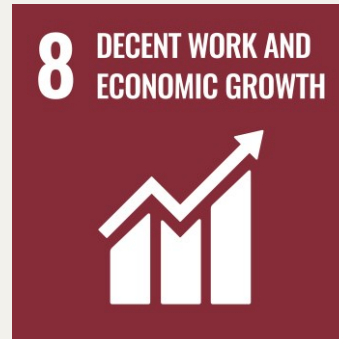
# Sustainability impacts

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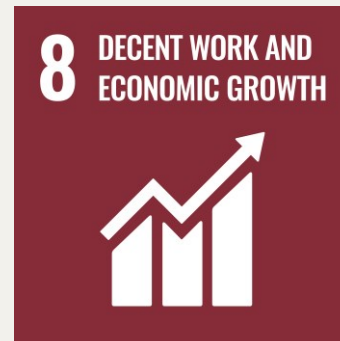
# Resource management

- Biomass exploitation
- Waste valorization
- Collection, separation and distribution
- Waste-to-energy
- Awareness and reduction



# Water management

- Greywater recycling
- Rainwater harvesting
- Low-flow fixtures
- Water-efficient landscaping
- Water plant irrigation



# Innovation and technology

- Renewable energy installation
- Energy-efficient building design
- Green mobility initiatives
- Energy education and awareness programs
- Collaboration with local utilities
- Educational initiatives





