

# Reducing buildings energy consumption in Accra

## Benefits Assessment - Preliminary results

May 2024 - Reading time: 12 min

Facing a rising electricity demand from population growth, and the use of polluting generators as a power back-up, Accra is looking at reducing building energy consumption through energy retrofits and investments in renewable energy.

The city has investigated the energy use of 13 public buildings, including schools, hospitals, markets, and offices. The energy audit has also identified energy saving strategies, like transitioning lighting to LEDs, smart controls, more efficient cooling, and the potential of installing rooftop solar panels.

**This report shows the preliminary impacts the pilots could have, based on data collected in March 2024 from detailed energy audits.**

# Reducing operational costs while reducing emissions

Accra, the capital city of Ghana, serves as the economic, cultural, and administrative centre. With a population just over 2 million residents, Accra combines a diverse mix of high-rise buildings, colonial-era architecture, and vibrant markets. The rapid growth is placing additional pressure on the city's infrastructure and resources.<sup>1</sup>



**over 2 million**  
residents



**32%**  
of the city GHG  
emissions come from  
buildings & energy

Ghana's energy sector is dominated by fossil fuel (Gas and Oil, 65%), followed by hydroelectric power (34%), with marginal contributions from other renewables.<sup>2</sup> However, gas is subject to market fluctuations and availability, and the hydroelectric power is influenced by changes in rainfall and water levels. Commercial and industrial facilities also rely on backup diesel generators. Those generators and cooking fuels emit harmful pollutants which contribute to the city's air pollution. **In total, the buildings & energy sector is responsible for a third of the city greenhouse gas (GHG) emissions, followed by transport and waste.**<sup>3</sup>

The Accra Metropolitan Assembly (AMA) holds the responsibility for governing the Accra Metropolis, its urban planning, infrastructure development, environmental protection, public health services, and revenue generation. While the city of Accra does not

have direct control over electricity generation, the city can promote efficiency improvements, starting with its own buildings, as well as the installation of distributed solar energy on rooftops.

Efforts to promote energy efficiency (EE) and conservation in Ghana have a history dating back to the mid-1980s as a response to the energy crisis. Ghana's energy efficiency policies have placed a significant focus on the residential sector, aiming to phase out inefficient household appliances and lighting systems. This includes the distribution of 6 million energy-efficient lamps, driving a 124 MW reduction in peak load.<sup>4</sup> In contrast, the industrial sector's energy efficiency efforts are in the developmental stages, partly due to the absence of baseline data.

**Accra Metropolitan Assembly wants to lead the way by retrofitting municipal buildings and bridge the gap of data availability. This report summarizes the findings from 13 public buildings energy audits and their recommended efficiency measures.** It is estimated that implementing energy retrofits and installing solar energy on those 13 buildings could:

**Reduce  
electricity use by 65%**



Energy efficiency measures could save 445 MWh of electricity each year. The solar PV could also produce 422 MWh of affordable and reliable energy. **This represents a drop of 65% (867 MWh) of the energy demand across all 13 buildings.**

**Be paid back in just  
under 3.5 years**



If all renewable energy and energy efficiency measures are implemented, this could cost 4.9 million GHS (392,200 USD). **This could save 1.5 million GHS (117,000 USD) each year, with current energy costs. This means that the investment could be paid back in less than 3 and a half years.**

**Save 3,470 t of CO<sub>2</sub>  
emissions over 10 years**

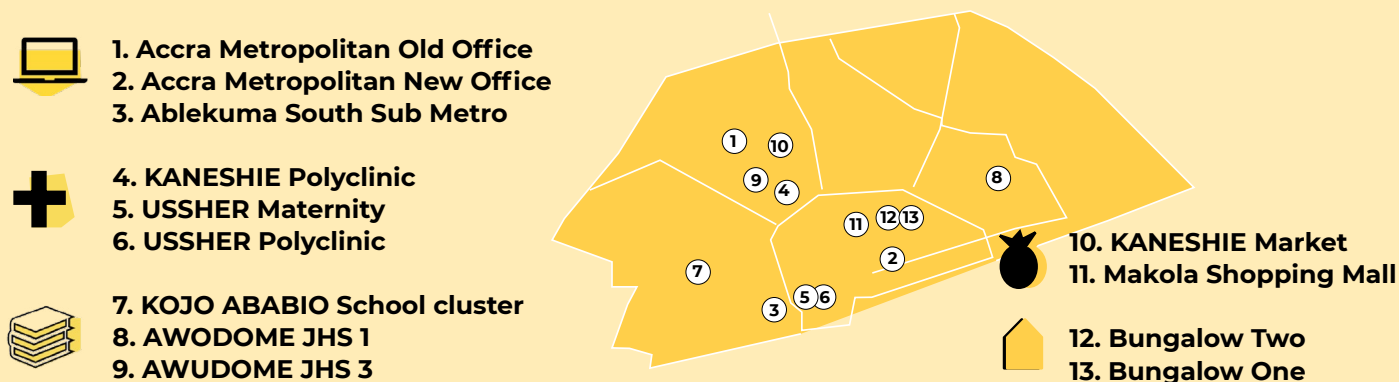


The reduction in energy use would reduce the demand to the grid. This would reduce the emissions of greenhouse gas (GHG) by 3,470 tonnes of CO<sub>2</sub> over 10 years for all buildings, equivalent to 27 tonnes per building per year on average.



# Piloting renewable energy and public building retrofits

The city has investigated the energy use of 13 public buildings across different typologies, including schools, hospitals, markets, and offices. The audit looked at the energy use by type of lighting, appliances and medical technology, cooking and water heating. Overall, the major energy consumption appliance is the AC, which can harness the biggest energy savings, followed by lighting, and then office and other equipment (computers, microwaves, kettles, etc.).



Based on the municipal buildings audits, it is estimated that energy efficient measures and transitioning to renewable energy could:

		Cost of retrofits (GHS, USD)	Reduce energy use (kWh/year, %)	Lower energy bills (GHS/year, USD)	Avoid CO2 emissions (t/year)
<b>Offices</b>					
	1.	220,070 GHS (17,540 USD)	22,920 kWh (57%)	35,960 GHS (2,870 USD)	9.2 t/year
	2.	1,313,630 GHS (104,670 USD)	232,970 kWh (64%)	472,940 GHS (37,680 USD)	93.2 t/year
	3.	97,890 GHS (7,800 USD)	15,290 kWh (49%)	23,990 GHS (1,910 USD)	6.1 t/year
<b>Healthcare</b>					
	4.	740,410 GHS (59,000 USD)	146,400 kWh (62%)	229,850 GHS (18,320 USD)	58.6 t/year
	5.	281,480 GHS (22,430 USD)	42,180 kWh (76%)	66,170 GHS (5,270 USD)	16.9 t/year
	6.	615,910 GHS (49,080 USD)	102,480 kWh (41%)	160,780 GHS (12,810 USD)	41.0 t/year
<b>Markets</b>					
	7.	574,390 GHS (45,770 USD)	100,910 kWh (92%)	158,330 GHS (12,620 USD)	40.4 t/year
	8.	914,140 GHS (72,840 USD)	177,800 kWh (87%)	277,370 GHS (22,100 USD)	71.1 t/year
<b>Schools</b>					
	9.	35,250 GHS (2,810 USD)	5,230 kWh (78%)	8,160 GHS (650 USD)	2.1 t/year
	10.	32,930 GHS (2,620 USD)	4,310 kWh (48%)	7,390 GHS (590 USD)	1.7 t/year
	11.	44,210 GHS (3,520 USD)	6,830 kWh (67%)	10,720 GHS (850 USD)	2.7 t/year
<b>Residential</b>					
	12.	26,410 GHS (2,100 USD)	5,390 kWh (50%)	9,590 GHS (760 USD)	2.2 t/year
	13.	25,670 GHS (2,050 USD)	3,980 kWh (36%)	7,080 GHS (560 USD)	1.6 t/year
<b>Median</b>					
Total		220,073 GHS (17,536 USD)	22,920 kWh (62%)	35,960 GHS (2,870 USD)	9.2 t/year
Total		4,922,394 GHS (392,223 USD)	866,390 kWh (65%)	1,468,330 GHS (117,000 USD)	347 t/year



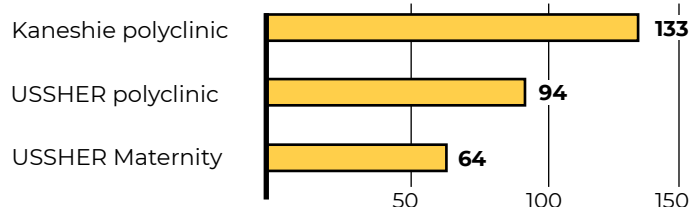
## Zooming in on: Enhancing healthcare capacity systems

Energy efficiency in hospitals is critical in ensuring the seamless delivery of quality healthcare while minimising operational costs and environmental impacts. Adopting energy-efficient technologies and practices can help healthcare centers allocate more resources towards patient care and medical advancements.

Moreover, efficient energy management enhances the resilience of healthcare facilities, ensuring uninterrupted power supply during power outages. It also contributes to a healthier environment by reducing air pollution associated with the use of generators.

The pilot audited 3 facilities: Kaneshie, Ussher Maternity and its polyclinic; all operating 24/7. Cooling and lighting energy consumption are a high source of energy use for these buildings.

**Energy intensity Use** Unit: kWh/m<sup>2</sup>/year



### KANESHIE Polyclinic



**368,800 GHS spent on power every year (28,230 USD)**



**1,763 m<sup>2</sup>**

**Typical energy profile:**



**133 kWh/m<sup>2</sup>**



**24/7 Operations**

**13% Office equip.**

**21% Lights**

**45% AC and fans**

**10% Refrigerators**

**10% Other**

**Different measures can be considered to reduce the energy use of the polyclinic:**

**Energy savings  
(kWh/year, and %)**

**Cost of installation  
(GHS, and USD)**

**CO2 emissions  
avoided (t/year)**

1. Timed plugs for office equipments	1.6 MWh (1%)	2,280 GHS (180 USD)	0.6 t CO2/year
2. Switching light bulbs to LED	3.7 MWh (2%)	3,750 GHS (300 USD)	1.5 t CO2/year
4. Installing smart lighting controls	5.0 MWh (2%)	17,500 GHS (1,400 USD)	2.0 t CO2/year
5. Regular servicing of ACs	5.6 MWh (2%)	4,100 GHS (330 USD)	2.2 t CO2/year
7. More efficient fans	6.2 MWh (3%)	14,600 GHS (1,160 USD)	2.5 t CO2/year
6. Smart Meters & Raising Awareness	13.3 MWh (6%)	49,200 GHS (3,920 USD)	5.3 t CO2/year
3. Smart thermostatic controls	18.8 MWh (8%)	10,000 GHS (800 USD)	7.5 t CO2/year
8. Replacing the AC Inverter	34.6 MWh (15%)	125,980 GHS (10,040 USD)	13.8 t CO2/year
9. Installation of rooftop solar PV	57.6 MWh (25%)	513,000 GHS (40,880 USD)	23 t CO2/year
<b>Total without solar PV</b>	<b>88.8 MWh (38%)</b>	<b>227,410 GHS (18,120 USD)</b>	<b>35.5 t CO2/year</b>
<b>Total with the solar PV</b>	<b>146.4 MWh (62%)</b>	<b>740,410 GHS (59,000 USD)</b>	<b>58.6 t CO2/year</b>

If all retrofits were implemented in the polyclinic, this could:



**Reduce  
electricity use by 62%**

Energy efficiency measures could save 88.8 MWh of electricity each year on average. The solar PV could also produce 58 MWh of affordable and reliable energy. **This represents a drop of 62% (146 MWh) of the energy demand.**



**Be paid back in  
less than 4 years**

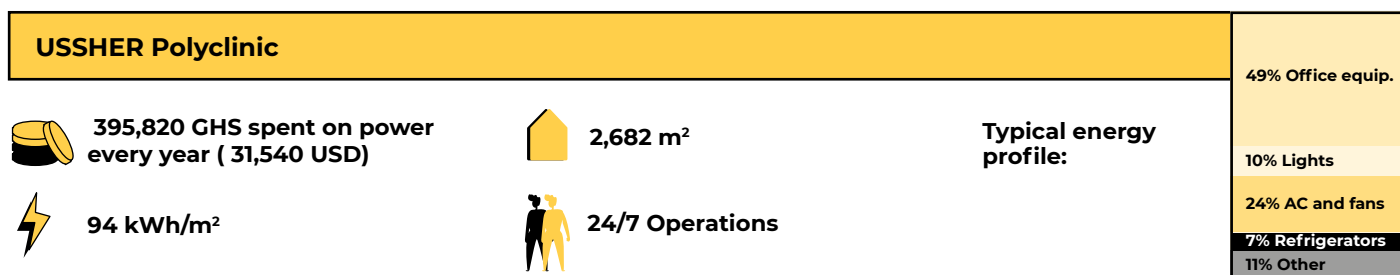
Although the measures could cost 740,410 GHS (59,000 USD), this could save 229,850 GHS (20,162 USD, 62%) each year with current energy costs. **This means that the investment could be paid back in less than 4 years.**



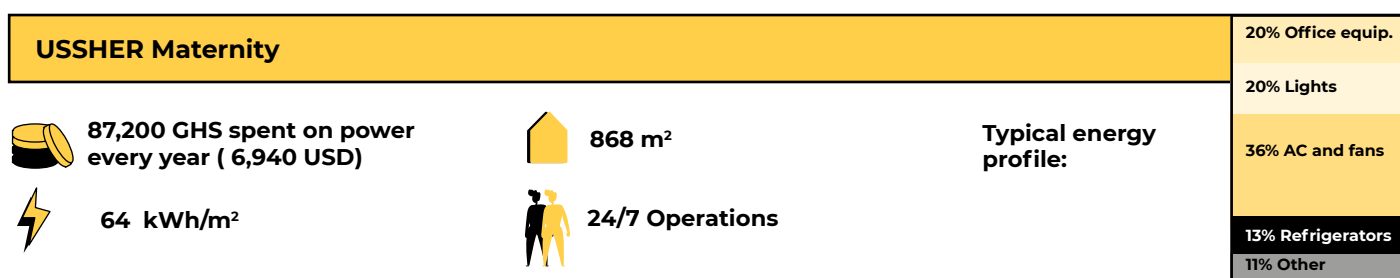
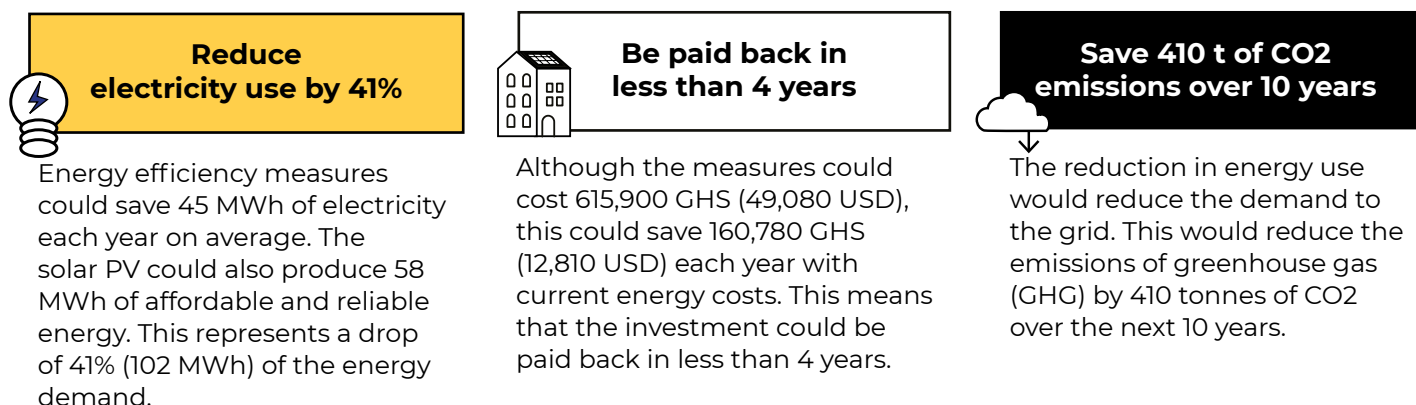
**Save 586 t of CO2  
emissions over 10 years**

The reduction in energy use would reduce the demand to the grid. **This would reduce the emissions of greenhouse gas (GHG) by 586 tonnes of CO2 over the next 10 years.**

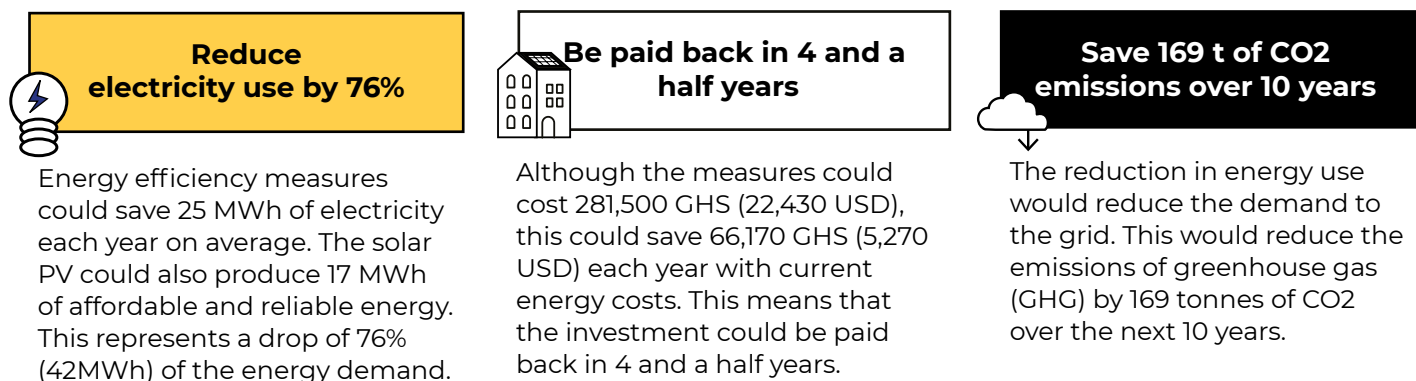
Similar measures could be implemented for USSHER polyclinic and maternity, including improving lighting and air conditioning efficiency, installation of smart meters and fitting of solar panels on the roof.



If all retrofits were implemented in the polyclinic, this could:



If all retrofits were implemented in the maternity, this could:





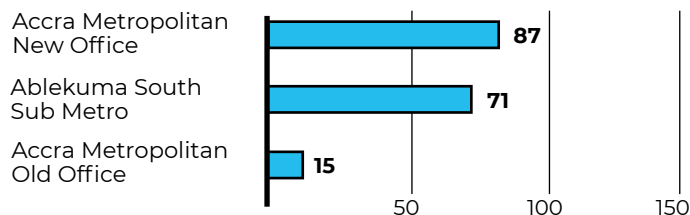
## Zooming in on: Improving administration buildings

Energy efficiency in administration offices saves government funds, allowing resources to be used elsewhere. It also shows a commitment to the environment by leading the energy transition in the energy sector. Improving the indoor environmental quality of offices can also improve health, well-being and workers' performance: well-cooled, ventilated offices and adequate lighting can reduce drowsiness and help people stay focused.

The buildings are mainly used during the office

hours, so lighting and computers represent the majority of the energy use of the buildings.

**Energy intensity use** Unit: kWh/m<sup>2</sup>/year



### Accra Metropolitan New Office



**568,560 GHS spent on power every year (41,480 USD)**



**87 kWh/m<sup>2</sup>**

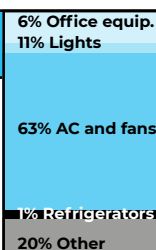


**4,150 m<sup>2</sup>**



**8h day, weekdays**

**Typical energy profile:**



**Different measures can be considered to reduce the energy use of the office:**

**Energy savings (kWh/year, and %)**

**Cost of installation (GHS, and USD)**

**CO2 emissions avoided (t/year)**

1. Switching light bulbs to LED	1.2 MWh (0.3%)	2,250 GHS (180 USD)	0.5 t CO2/year
2. Timed plugs for office equipments	1.1 MWh (0.3%)	4,560 GHS (360 USD)	0.5 t CO2/year
3. Installing smart lighting controls	3.9 MWh (1%)	14,000 GHS (1,120 USD)	1.6 t CO2/year
4. Optimise printers distribution	6 MWh (2%)	54,000 GHS (4,300 USD)	2.4 t CO2/year
5. Regular servicing of ACs	23 MWh (6%)	12,800 GHS (1,020 USD)	9.1 t CO2/year
6. Smart Meters & Raising Awareness	29 MWh (8%)	10,000 GHS (800 USD)	11.6 t CO2/year
7. Smart thermostatic controls	34 MWh (9%)	15,600 GHS (1,240 USD)	13.6 t CO2/year
8. Installation of rooftop solar PV	135 MWh (37%)	1,200,420 GHS (95,650 USD)	54 t CO2/year
<b>Total without solar PV</b>	<b>98 MWh (27%)</b>	<b>113,210 GHS (9,020 USD)</b>	<b>39.2 t CO2/year</b>
<b>Total with the solar PV</b>	<b>233 MWh (64%)</b>	<b>1,313,630 GHS (104,670 USD)</b>	<b>93.2 t CO2/year</b>

If all retrofits were implemented in the office, this could:



**Reduce electricity use by 64%**

Energy efficiency measures could save 98 MWh of electricity each year on average. The solar PV could also produce 135 MWh of affordable and reliable energy. **This represents a drop of 64% (233 MWh) of the energy demand.**



**Be paid back in less than 3 years**

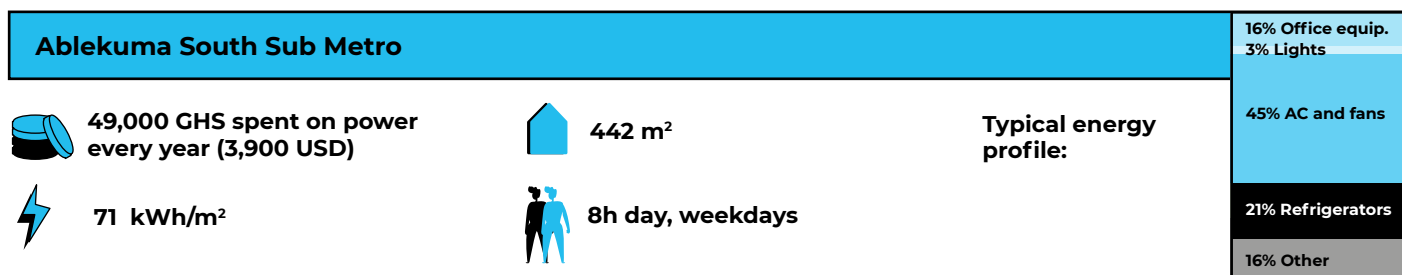
Although the measures could cost 1.3 million GHS (104,670 USD), **this could save 472,940 GHS (37,680 USD) each year. This means that the investment could be paid back in just under 3 years.**



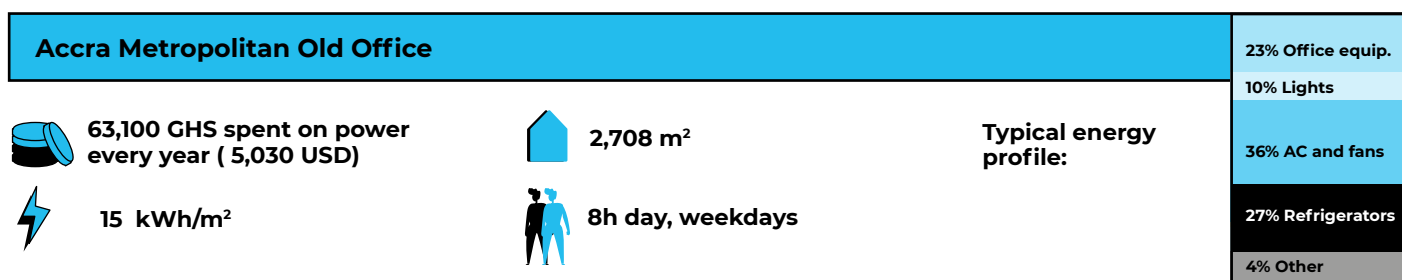
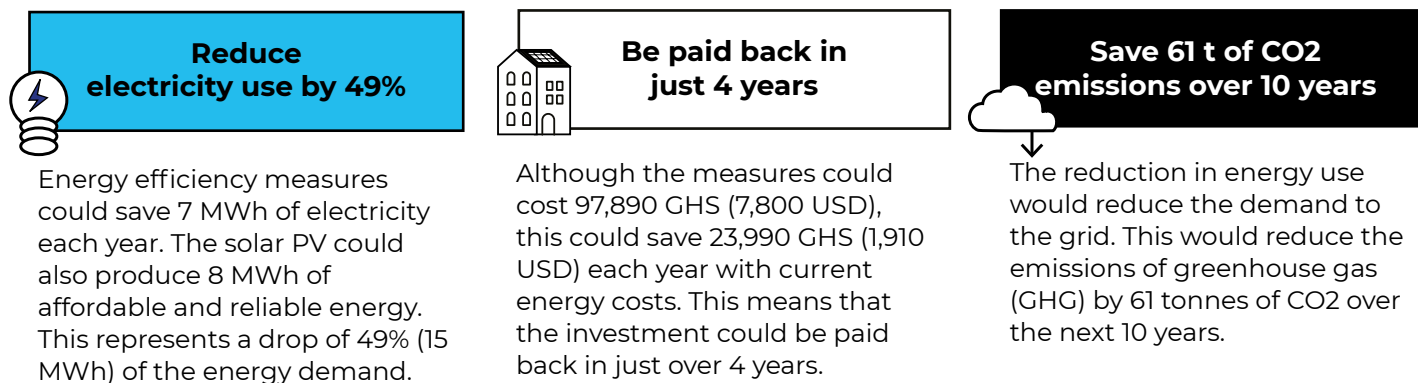
**Save 932 t of CO2 emissions over 10 years**

The reduction in energy use would reduce the demand to the grid. **This would reduce the emissions of greenhouse gas (GHG) by 932 tonnes of CO2 over the next 10 years.**

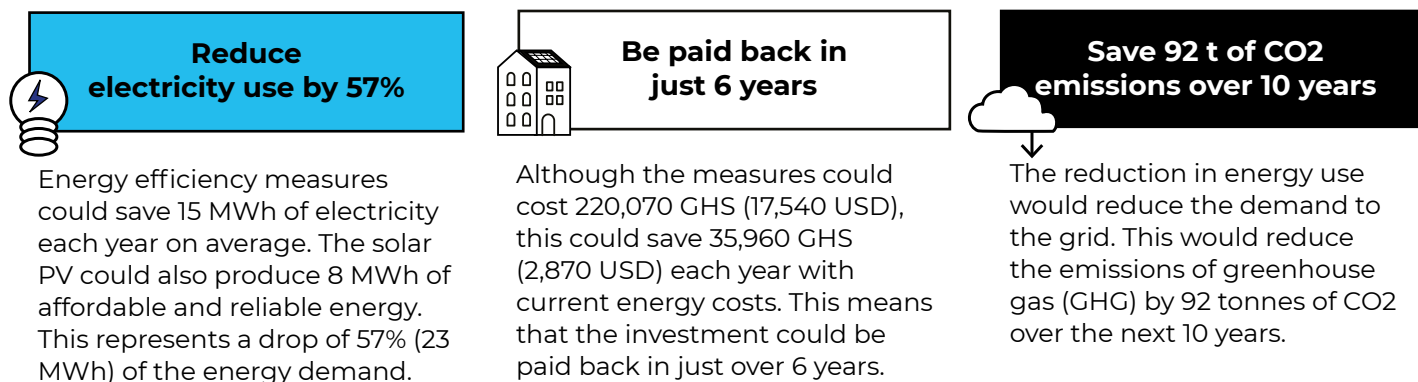
Similar measures could be implemented for Ablekuma South Sub Metro and the old AMA office, including improving lighting and office equipments efficiency, installation of smart meters and fitting of solar panels.



If all retrofits were implemented in the office, this could:



If all retrofits were implemented in the office, this could:







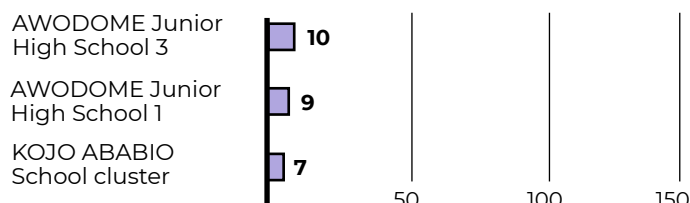
## Zooming in on: Improving school environments

Installing solar panels and investing in efficient lighting on schools can lower their energy costs, freeing up budget resources for educational programs and improvements. The initiative can also serve as an educational tool, raising awareness among students and the community about the importance of clean energy and environmental responsibility.

Better school buildings can also improve student performance: thermal comfort improves attention, decreasing air pollution increases cognitive performance, reduced noise supports focus and memory; and good lighting boosts alertness and motivation.

**The audit focused on 3 schools: Awodome Junior High Schools 1 and 3, and Kojo Ababio school cluster. Schools have a much lower energy intensity than previous buildings, mostly because they do not use AC, but more office equipment.**

**Energy intensity use** Unit: kWh/m<sup>2</sup>/year



### AWODOME Junior High School 3



**16,090 GHS spent on power every year (1,280 USD)**



**10 kWh/m<sup>2</sup>**



**978 m<sup>2</sup>**



**6h day, weekdays**

**Typical energy profile:**

**22% Office equip.**

**37% Lights**

**32% Fans**

**9% Other**

**Different measures can be considered to reduce the energy use of the school:**

**Energy savings (kWh/year, and %)**

**Cost of installation (GHS, and USD)**

**CO<sub>2</sub> emissions avoided (t/year)**

1. Timed plugs for office equipments	0.03 MWh (0.3%)	342 GHS (30 USD)	0.01 t CO <sub>2</sub> /year
2. Regular servicing of ACs	0.2 MWh (2%)	100 GHS (9 USD)	0.1 t CO <sub>2</sub> /year
3. Smart thermostatic controls	0.3 MWh (2%)	1,200 GHS (100 USD)	0.1 t CO <sub>2</sub> /year
4. Installing smart lighting controls	0.4 MWh (4%)	2,450 GHS (200 USD)	0.2 t CO <sub>2</sub> /year
5. Smart Meters & Raising Awareness	1.5 MWh (15%)	10,000 GHS (800 USD)	0.6 t CO <sub>2</sub> /year
6. More efficient fans	2.2 MWh (21%)	9,600 GHS (770 USD)	0.9 t CO <sub>2</sub> /year
7. Installation of rooftop solar PV	2.3 MWh (22%)	20,520 GHS (1,640 USD)	0.9 t CO <sub>2</sub> /year
<b>Total without solar PV</b>	<b>4.5 MWh (44%)</b>	<b>23,692 GHS (1,890 USD)</b>	<b>1.8 t CO<sub>2</sub>/year</b>
<b>Total with the solar PV</b>	<b>6.8 MWh (67%)</b>	<b>44,212 GHS (3,520 USD)</b>	<b>2.7 t CO<sub>2</sub>/year</b>

If all retrofits were implemented in the school, this could:



**Reduce electricity use by 67%**

Energy efficiency measures could save 4.5 MWh of electricity each year on average. The solar PV could also produce 2.3 MWh of affordable and reliable energy. **This represents a drop of 67% (6.8 MWh) of the energy demand.**



**Be paid back in 4 years**

Although the measures could cost 44,212 GHS (3,520 USD), this could **save 10,720 GHS (850 USD) each year with current energy costs. This means that the investment could be paid back in just over 4 years.**



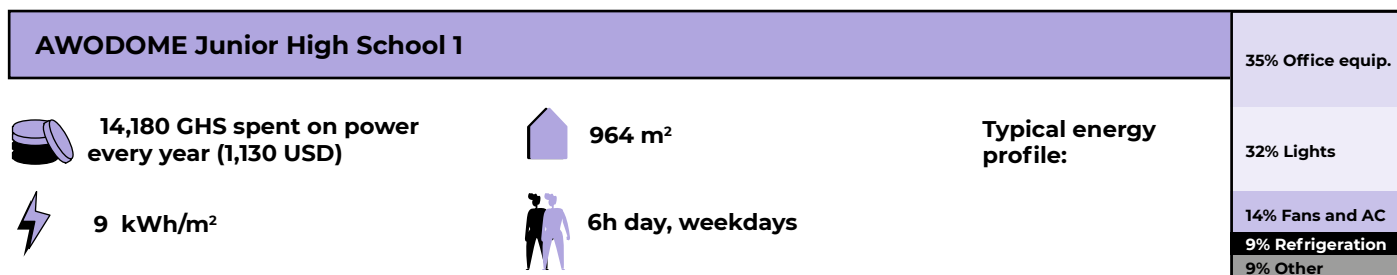
**Save 27 t of CO<sub>2</sub> emissions over 10 years**

The reduction in energy use would reduce the demand to the grid. **This would reduce the emissions of greenhouse gas (GHG) by 27 tonnes of CO<sub>2</sub> over the next 10 years.**

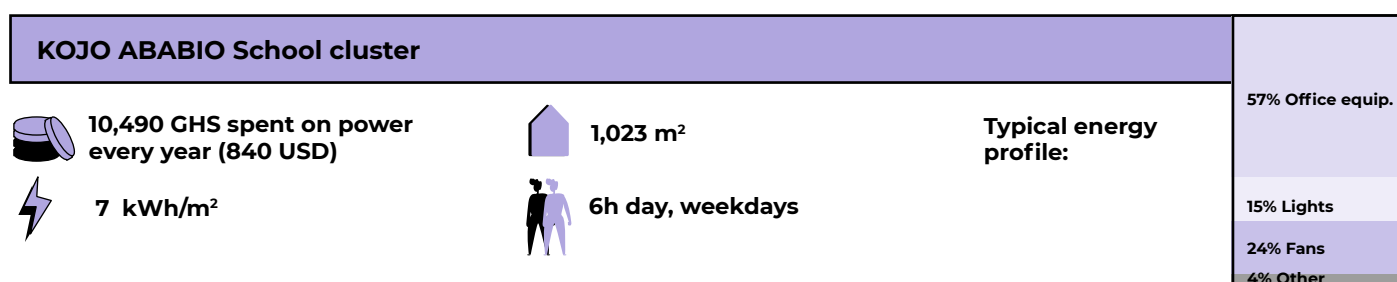
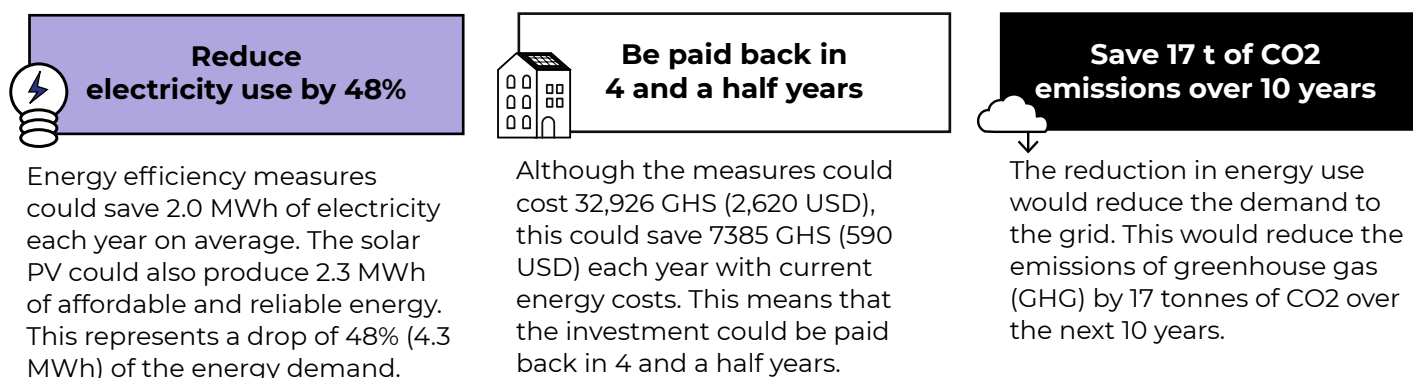




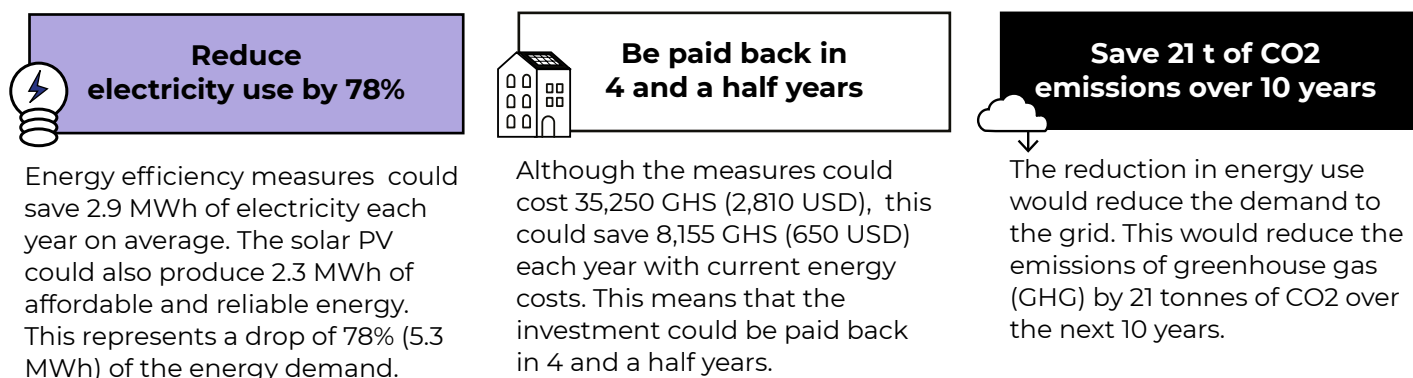
Similar measures could be implemented for the other schools, including smart lighting and office equipments efficiency, installation of smart controls and fitting of solar panels. Some schools already use LEDs.



If all retrofits were implemented in the school, this could:



If all retrofits were implemented in the school, this could:





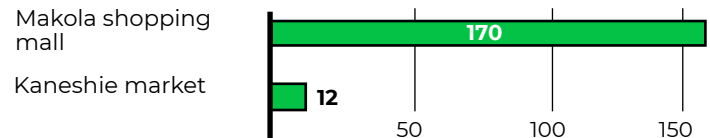
## Zooming in on: reducing market costs

Market traders, building managers as well as visitors all benefit from markets improvement. Upgraded lighting improves comfort and working conditions for traders, while providing them a more attractive workspace and visibility for customers.

Replacing generators by clean electricity reduces air and noise pollution. Solar panels can also reduce the market's operating costs on the long run.

The audit looked at both a market and a mall, in Kaneshie and Makola. Light and office equipment are the leading sources of energy consumption for those buildings.

**Energy intensity use** Unit: kWh/m<sup>2</sup>/year



### Makola shopping mall



**320,270 GHS spent on power every year (25,520 USD)**



**171 kWh/m<sup>2</sup>**

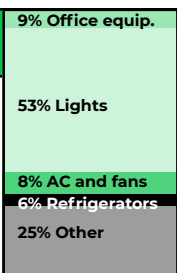


**1,199 m<sup>2</sup>**



**15h day**

**Typical energy profile:**



**Different measures can be considered to reduce the energy use of the office:**

**Energy savings (kWh/year, and %)**

**Cost of installation (GHS, and USD)**

**CO<sub>2</sub> emissions avoided (t/year)**

1. Timed plugs for office equipments	0.9 MWh (0%)	4,560 GHS (360 USD)	0.4 t CO <sub>2</sub> /year
2. Regular servicing of ACs	1.5 MWh (1%)	4,500 GHS (360 USD)	0.6 t CO <sub>2</sub> /year
3. Smart thermostatic controls	2.3 MWh (1%)	44,400 GHS (3,540 USD)	0.9 t CO <sub>2</sub> /year
Installing smart lighting controls	3.3 MWh (2%)	5,400 GHS (430 USD)	1.3 t CO <sub>2</sub> /year
4. More efficient refrigeration	5.7 MWh (3%)	89,985 GHS (7,170 USD)	2.3 t CO <sub>2</sub> /year
5. Replacing the AC Inverter	10.9 MWh (5%)	10,500 GHS (840 USD)	4.3 t CO <sub>2</sub> /year
6. Smart Meters & Raising Awareness	16 MWh (8%)	20,000 GHS (1,600 USD)	6.6 t CO <sub>2</sub> /year
7. Switching light bulbs to LED	68 MWh (33%)	119,200 GHS (9,500 USD)	27.1 t CO <sub>2</sub> /year
8. Installation of rooftop solar PV	69 MWh (34%)	615,600 GHS (49,050 USD)	27.6 t CO <sub>2</sub> /year
<b>Total without solar PV</b>	<b>108 MWh (53%)</b>	<b>298,540 GHS (23,790 USD)</b>	<b>43.6 t CO<sub>2</sub>/year</b>
<b>Total with the solar PV</b>	<b>178 MWh (87%)</b>	<b>914,140 GHS (72,840 USD)</b>	<b>71.2 t CO<sub>2</sub>/year</b>

If all retrofits were implemented in the office, this could:



**Reduce electricity use by 87%**

Energy efficiency measures could save 108 MWh of electricity each year on average. The solar PV could also produce 69 MWh of affordable and reliable energy. **This represents a drop of 87% (178 MWh) of the energy demand.**



**Be paid back in 3 and a half years**

Although the measures could cost 0.9 million GHS (72,840 USD), **this could save 277,370 GHS (22,100 USD) each year. This means that the investment could be paid back in 3 and a half years.**

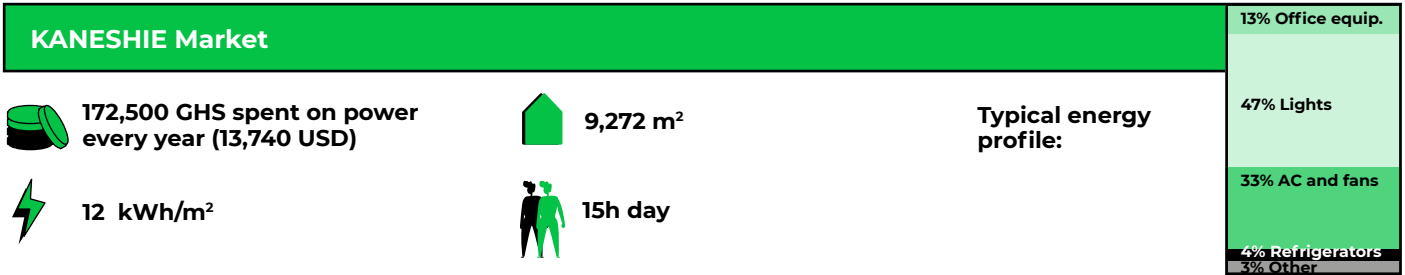


**Save 712 t of CO<sub>2</sub> emissions over 10 years**

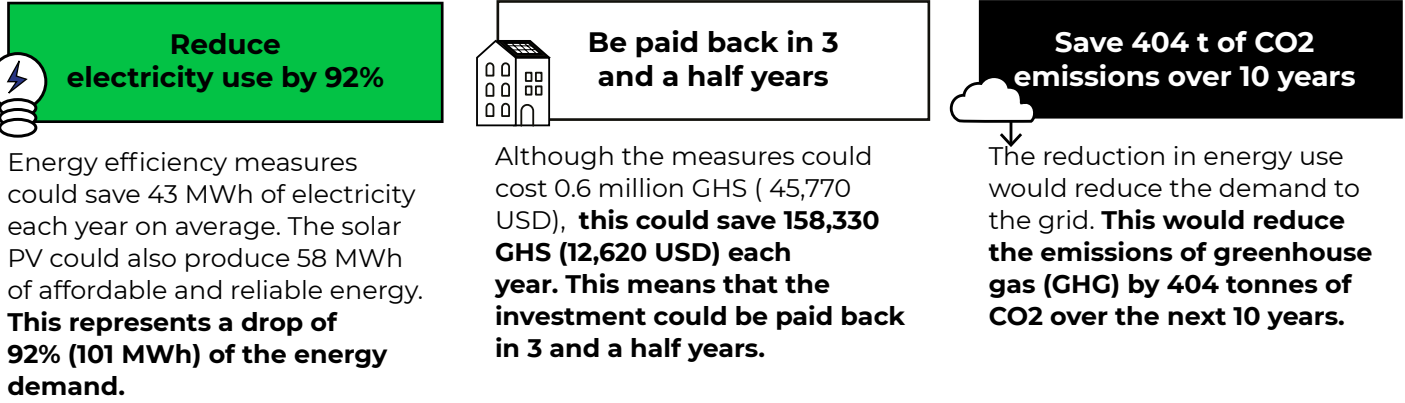
The reduction in energy use would reduce the demand to the grid. **This would reduce the emissions of greenhouse gas (GHG) by 712 tonnes of CO<sub>2</sub> over the next 10 years.**



Photo by Abdullah Assad on Pexels



Similar measures could be implemented for the other markets and malls. Kaneshie market measures target in priority the solar panels installation with would cover 52% of reduction of energy use, followed by light switch to LEDs which reduce energy use by 18%. If all retrofits were implemented in the office, this could:





# References & Methodology

**This report shows the preliminary impacts, based on energy audits finalised in March 2024.**

## References:

<sup>1,2</sup> Ministry of Energy (2022). Ghana National Energy Transition Framework. Available at: [https://energymin.gov.gh/sites/default/files/2023-09/FINAL%20GHANA%27S%20NATIONAL%20ENERGY%20TRANSITION%20FRAMEWORK\\_2023\\_compressed%20%281%29\\_compressed%20%282%29.pdf](https://energymin.gov.gh/sites/default/files/2023-09/FINAL%20GHANA%27S%20NATIONAL%20ENERGY%20TRANSITION%20FRAMEWORK_2023_compressed%20%281%29_compressed%20%282%29.pdf)

<sup>3</sup> C40 Cities (2018). Accra GHG emissions in 2021. Accessible at: [https://www.c40knowledgehub.org/s/article/C40-cities-greenhouse-gas-emissions-interactive-dashboard?language=en\\_US](https://www.c40knowledgehub.org/s/article/C40-cities-greenhouse-gas-emissions-interactive-dashboard?language=en_US)

<sup>4</sup> ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE) (2015). National Energy Efficiency Action Plan (NEEAP) of Ghana. Available at: [https://www.se4all-africa.org/fileadmin/uploads/se4all/Documents/Country\\_PANEE/Ghana\\_National\\_Energy\\_Efficiency\\_Action\\_Plan.pdf](https://www.se4all-africa.org/fileadmin/uploads/se4all/Documents/Country_PANEE/Ghana_National_Energy_Efficiency_Action_Plan.pdf)

## Methodology:

### Current energy use

The primary sample survey for the energy audits were conducted at ASHRAE Level 1 and Level 2 Energy Audit where energy supply & demand data from the selected buildings was collected through taking an inventory of electrical and other appliances in the buildings, building physical characteristics (layout and materials), building occupancy and operating hours, daily peak electricity measurements, energy expenditure, power interruption frequency and duration etc...

Data collected from the sample surveys was used to estimate hourly, daily and monthly electricity consumption for the buildings for typical working days. The demand analysis also included other energy types used in the buildings (including diesel fuel consumption for backup generators, petroleum and biomass fuels used for heating and cooking).

The electricity consumption was crossed with Historical data on electricity bills when available, from the Electricity Company of Ghana (ECG).

The grid emission factor considered was 0.4 t CO<sub>2</sub>/MWh from the National Energy Statistics 2022, accessible at: <https://energycom.gov.gh/files/2022%20Energy%20Statistics.pdf>.

Electricity costs were estimated at 1.569 GHS/kWh across the array of buildings, based on the audit results.

Exchange rate from USD to GHS is 12.55, as an average for 2023, according to [Forbes](#).

### Energy scenarios

The survey indicated potential opportunities for energy efficiency (EE) and renewable energy (RE) measures for the buildings.

All options for the energy retrofits have been detailed and prioritised in the full report: [Energy Audit Report: Gaps and needs assessment for the CAI energy project in Accra](#), March 2024, ordered by C40 and submitted by DTT Energy Limited.

All materials, case studies, presentations, data, images and documentation provided in this report are for informational and educational purposes only and do not constitute investment advice. C40 makes no representation or recommendation regarding the advisability of investing in any particular project, structure, company, investment fund or other mentioned in this publication. C40 is not, and does not provide services as, an investment advisor, financial advisor, investment analyst, broker, broker-dealer, market-maker, investment bank or underwriter. The intention is for these ideas to be a starting point for other stakeholders to consider their own approaches within their own contexts.



**Climate Action  
Implementation**



**UK International  
Development**

Partnership | Progress | Prosperity