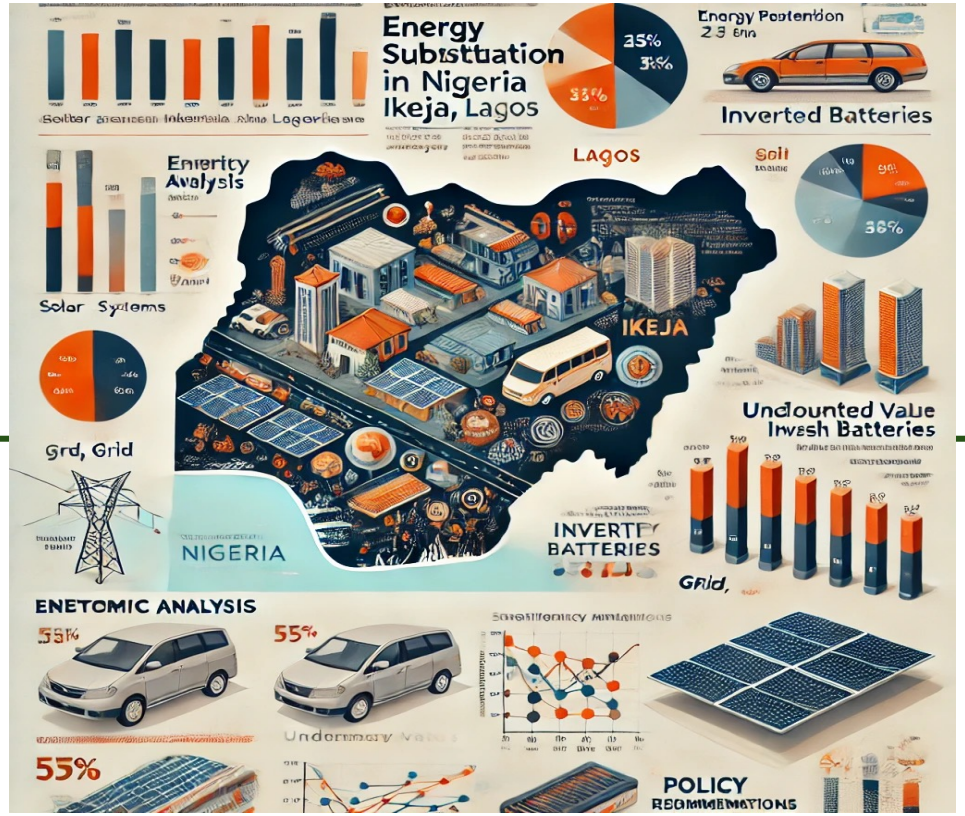
# Feasibility of Energy Substitution in Nigeria: Solar Panels and Inverter Batteries

*An Analysis of Economic Viability Under New Electricity Tariffs*

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*July 2024*

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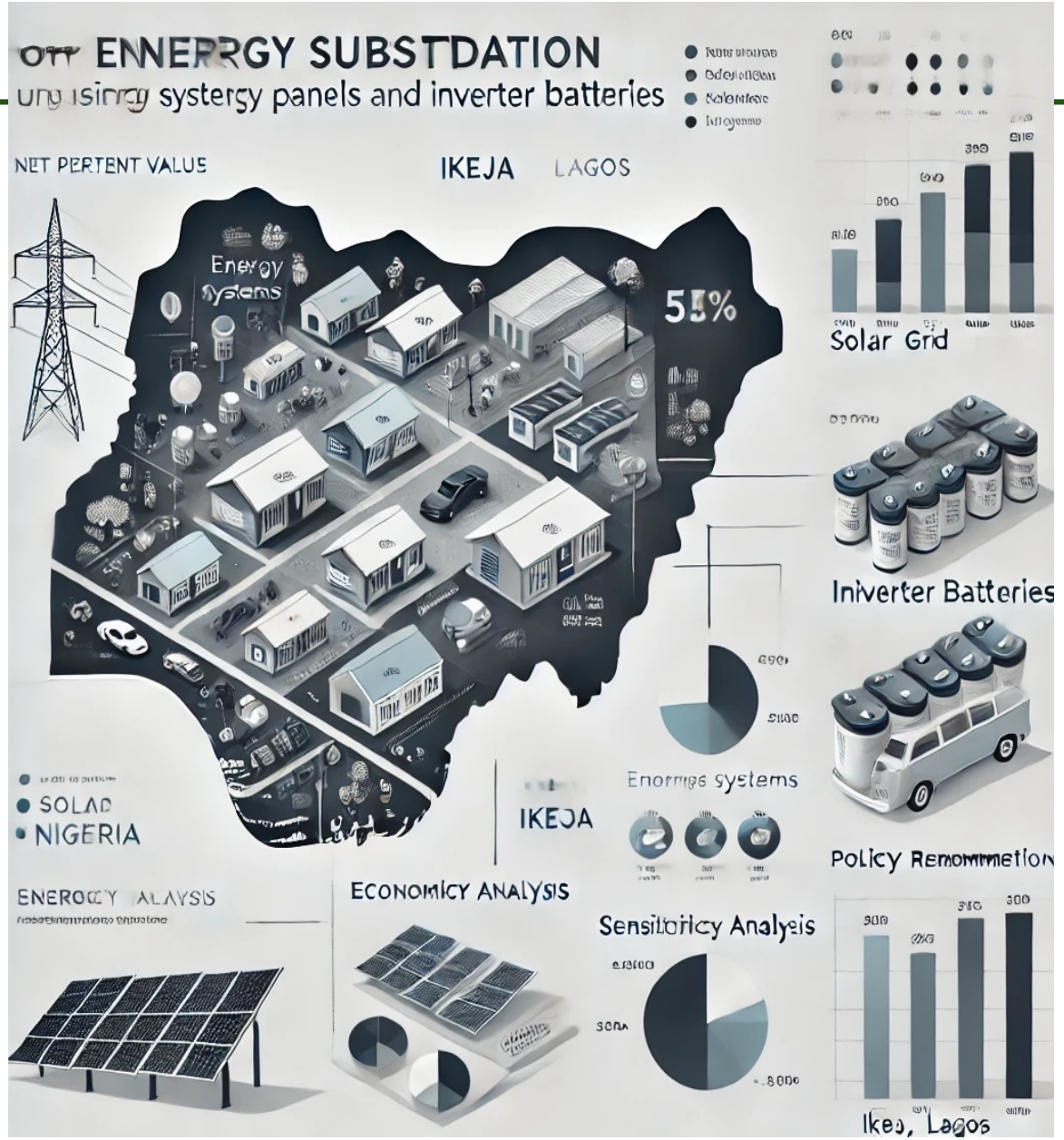


# Introduction

- **Aim of the Study**: To analyse the economic feasibility of adopting different energy systems in Nigeria, focusing on solar panels and inverter batteries, given the new electricity tariff reforms.
- **Overview of Electricity Tariffs in Nigeria**: As of the latest updates, the electricity tariff in Nigeria has seen an adjustment to reflect the actual cost of producing electricity. This adjustment aims to encourage energy efficiency and the adoption of alternative energy sources. This study uses the new electricity tariffs as announced earlier in 2024 for the Ikeja, Lagos environs, which was set at 225 Naira per kilowatt-hour (kWh). Using sensitivity analysis, the effect of other regional pricing can be inferred. https://nerc.gov.ng/
- **Importance of Energy Substitution in Nigeria**: Given Nigeria's energy supply challenges, and the need for reliable, environmentally friendly and sustainable energy, solar systems are being deployed to provide a stable and sustainable alternative.

# Overview of Inputs

- **Energy Sources**: In this analysis, two independent - Solar only, Grid only, and one hybrid energy system- solar plus grid is being evaluated solely on an economic basis (other factors like reliability and environmental impact are not discussed).
- The power demand used was generated for a medium sized home (3 bed-room apartment).

| | | Power Demand | | | | |
|---|---|---|---|---|---|---|
| S/N | Load | Quantity | Wattage | Total Power (W) | Hours Used Daily (Hr/Day) | Watt Hour (Whr/day) |
| 1 | Lights | 15 | 10 | 150 | 14 | 2100 |
| 2 | Ceiling Fan | 2 | 75 | 150 | 6 | 900 |
| 3 | TV | 1 | 95 | 95 | 8 | 760 |
| 4 | Laptop + Charging Points | 4 | 75 | 300 | 12 | 3600 |
| 5 | Rechargeable Fan | 4 | 30 | 120 | 20 | 2400 |
| 6 | Freezer | 1 | 250 | 250 | 12 | 3000 |
| 7 | Fridge Freezer | 1 | 200 | 200 | 12 | 2400 |
| 8 | AC 2kvA | 1 | 1800 | 1800 | 3 | 5400 |
| 9 | AC 1.5kvA | 2 | 1350 | 2700 | 3 | 8100 |
| 10 | Water Pump | 1 | 350 | 350 | 2 | 700 |
| | **Total** | | | 6,115 | | 29,360 |

# Overview of Inputs cont'd

- **System Specifications**

Battery lifespan – 4 years (12V, 220Ah Tubular batteries), Solar Panels lifespan – 20 years (550Wp)

Electricity tariff at 225 Naira per kilowatt-hour.

| | Upfront Costs - **Hybrid** | Naira |
|---|---|---|
| 1 | Breakers, surge arresters, cables etc | 430,000.00 |
| 2 | Installation and logistics | 170,000.00 |
| 3 | Solar Mounting Rails | 107,500.00 |
| 4 | Battery Rack | 48,375.00 |
| | Total | 755,875.00 |
| | Amortised Costs | |
| 1 | Batteries - 4 units (Change every 4 years) | 1,592,290.00 |
| 2 | Solar Panels - 6 units (20 years Lifespan) | 1,186,800.00 |
| 3 | Inverter System | 435,000.00 |

| | Upfront Costs - **Solar Only (off-grid)** | Naira |
|---|---|---|
| 1 | Breakers, surge arresters, cables etc | 430,000.00 |
| 2 | Installation and logistics | 340,000.00 |
| 3 | Solar Mounting Rails | 537,500.00 |
| 4 | Battery Rack | 241,875.00 |
| | Total | 1,549,375.00 |
| | Amortised Costs | |
| 1 | Batteries - 20 units (Change every 4 years) | 7,961,450.00 |
| 2 | Solar Panels - 30 units (20 years Lifespan) | 5,934,000.00 |
| 3 | Inverter | 2,175,000.00 |

NB: Prices determined by averages of May 2024 market survey.

# Mode of Analysis

- **Methodology**: Net Present Value (NPV) was used to evaluate the long-term cost-effectiveness of each energy system over 20 years, using a 10% discount rate. The total undiscounted cash expenditures are also presented.

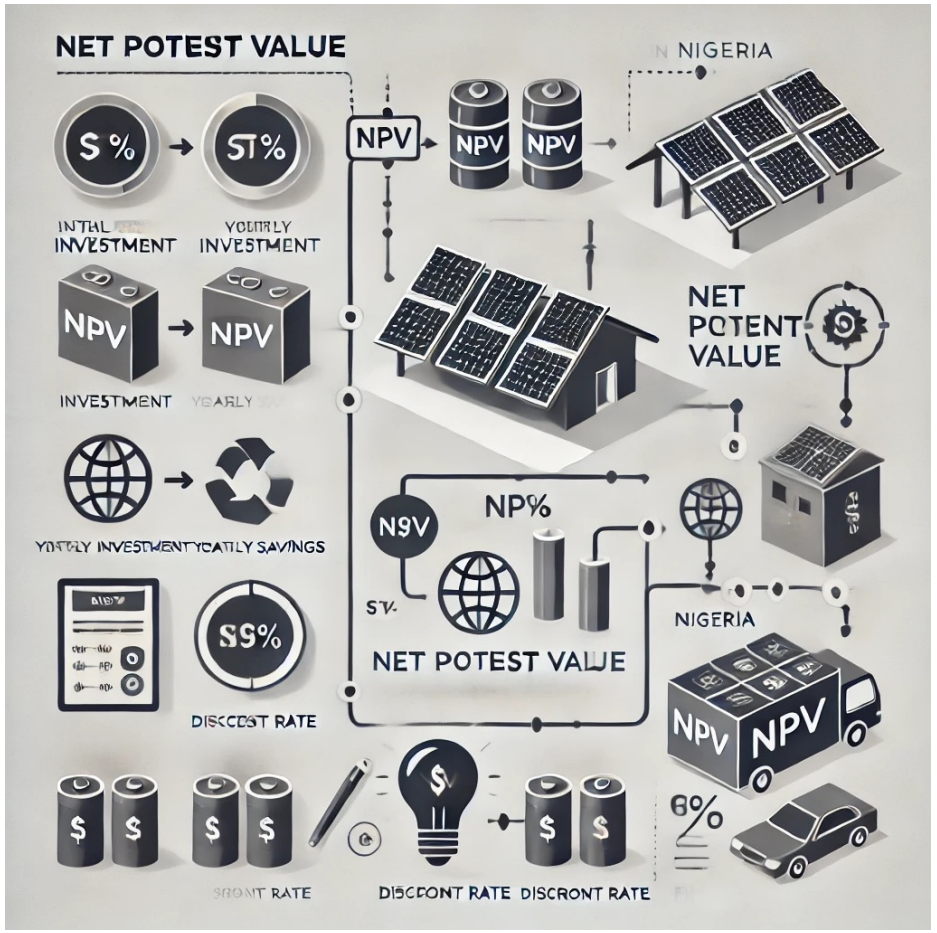
- **Assumptions**:

✓ Discount rates: 10%

✓ Expected increase in electricity rates: 3% pa.

✓ Inflation rate: 3% pa.

✓ maintenance costs: Battery replacement costs only



# Results

- **Economic Outcomes**: The hybrid system provides the most cost-effective solution under new tariffs, while the grid is less costly than solar alone on an NPV basis.

- **Undiscounted Basis**: Without discounting future cash flows, solar costs eventually fall below grid power, demonstrating its potential for long-term savings.

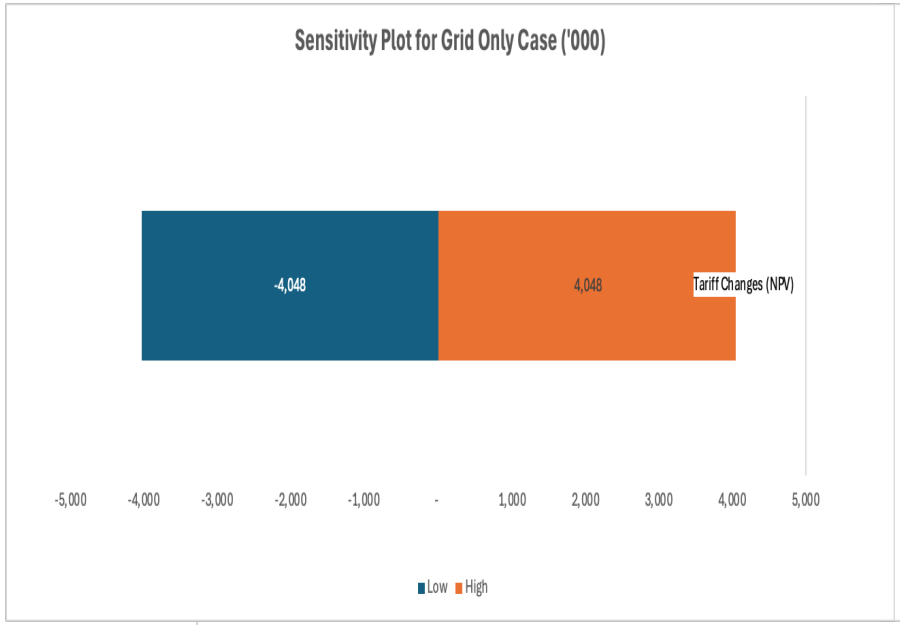
| Economic Metric | Hybrid (#'000) | Grid Only (#'000) | Solar Only (#'000) |
|---|---|---|---|
| NPV (10% DF) | 21,446 | 26,989 | 33,323 |
| Sum of Cash Exp. | 44,687 | 61,968 | 56,631 |

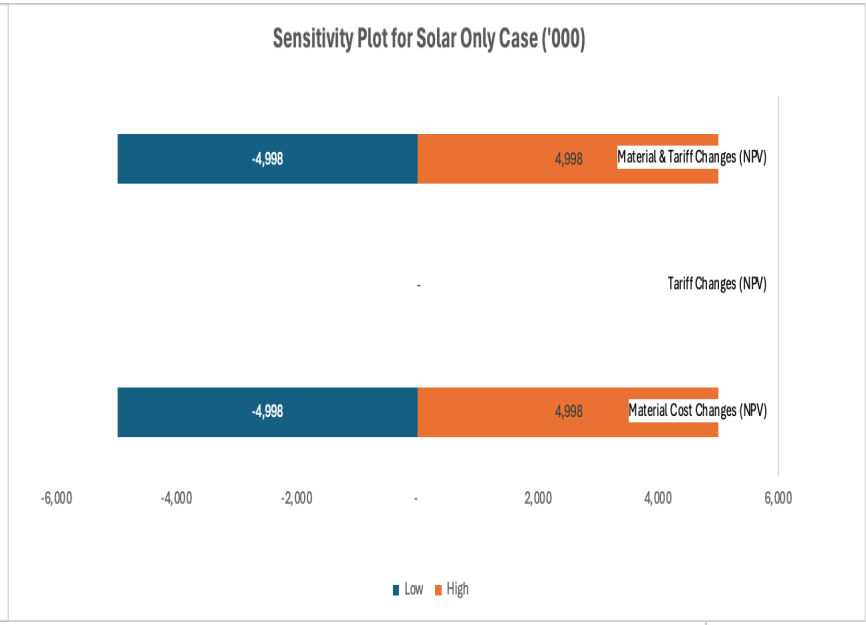
# Sensitivity Analysis

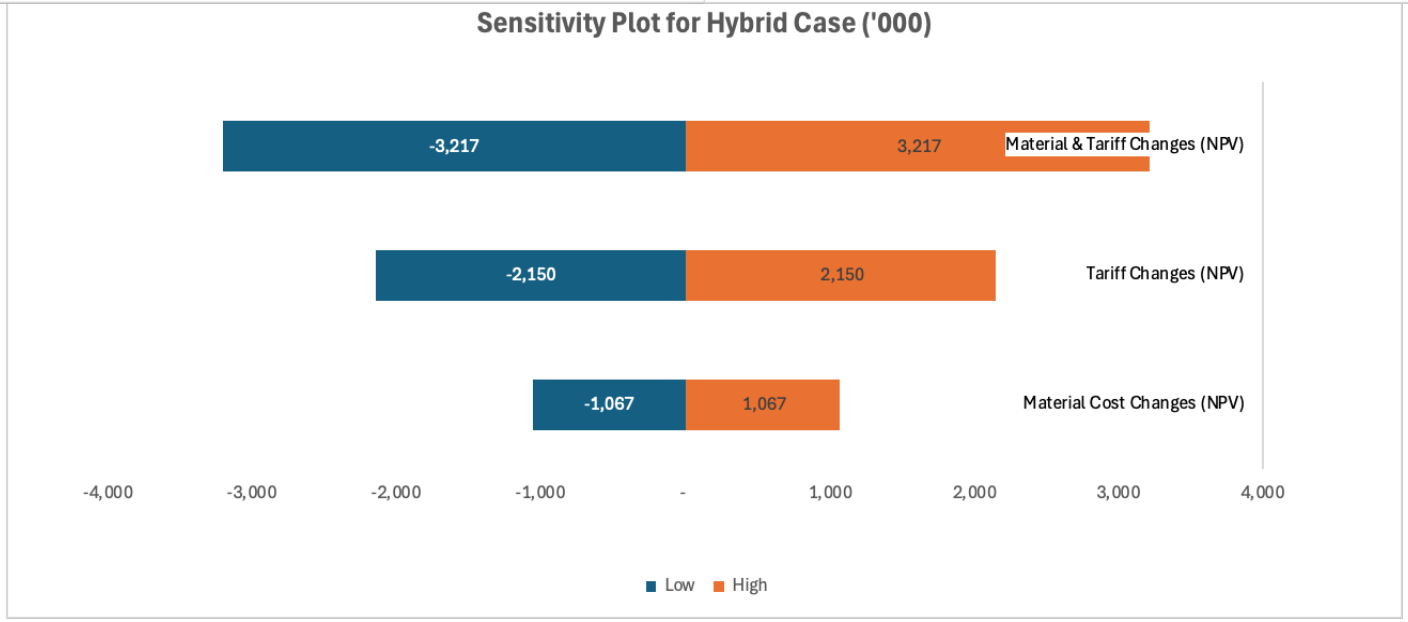
- **Summary**:

The impact of variations in inputs like tariff changes, cost of Solar panels and inverters, and variation in energy usage on the Net Present Value (NPV) can be seen in the images per case analysed.

- The sensitivity analysis presented is for a +/- 15% variation in the inputs analysed.
- Material costs have no impact on the Grid Only case, as no materials are required.
- For the Solar Only case, tariff changes have no effect as expected.
- Lastly, in the Hybrid case, Tariff changes plus material cost changes have the most impact on the NPV.



# Conclusion

- **Economic Feasibility**: While solar power alone is currently less economically viable compared to grid or hybrid systems, it has the potential to become more feasible if costs continue to decrease or if electricity tariffs increase further. This is already seen in the Sum of Undiscounted Cash Expenditures.
- **Purchase Instalments:** The possibility of having the upfront solar costs to be spread over the product's useful life at a favourable interest rate can positively impact the economics, making solar a better option than grid power. This therefore represents a business opportunity in green technology which is already available in other European Countries at the forefront of Energy Substitution.
- **Policy Recommendations**: Incentives for solar adoption should be given by the government to enhance the attractiveness of off-grid solutions.