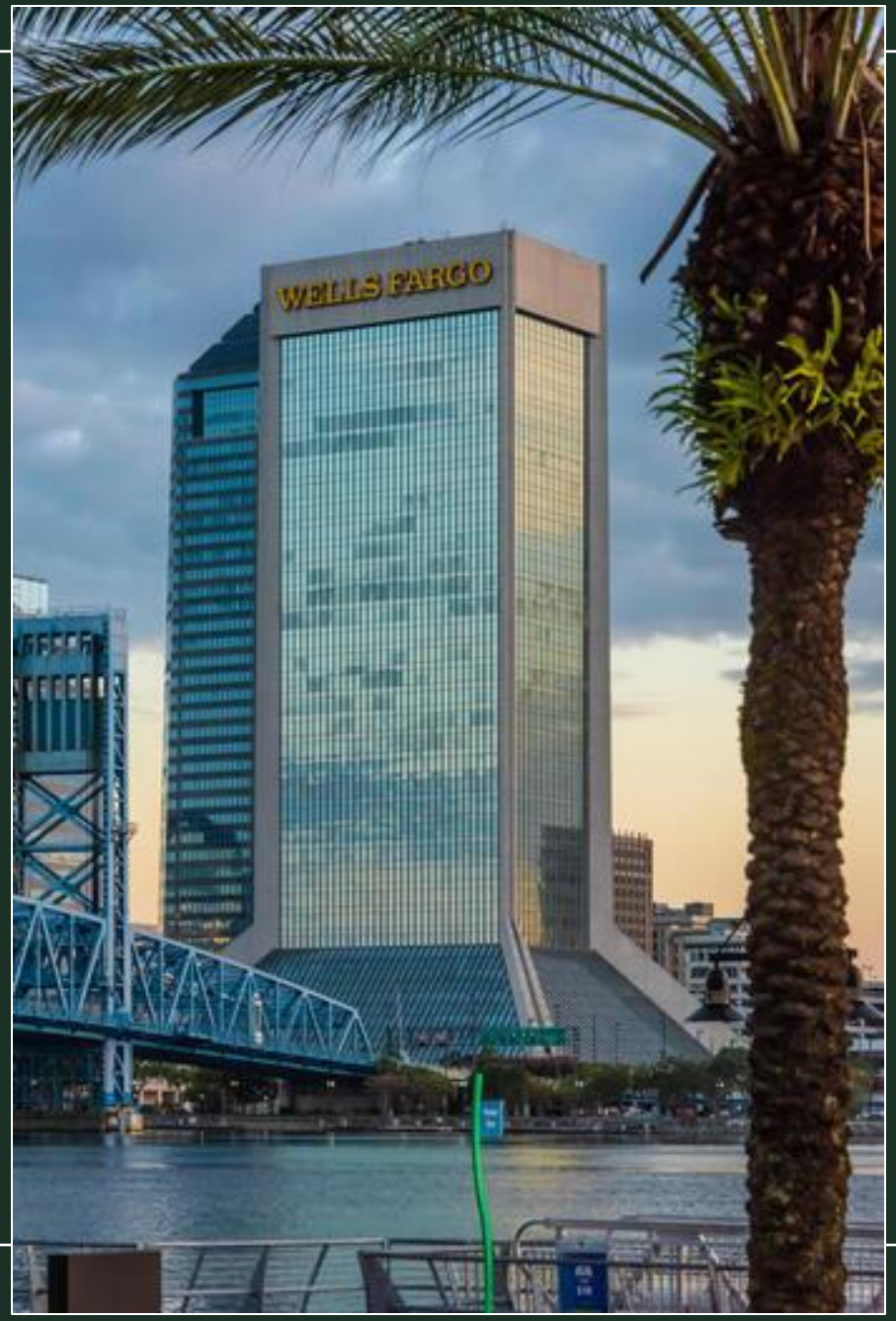


JACKSONVILLE REIMAGINED

Tackling Grand Challenge Four:

Create Efficient, Healthy, Resilient Cities

GRAND CHALLENGE FOUR:

Create efficient, healthy, resilient cities

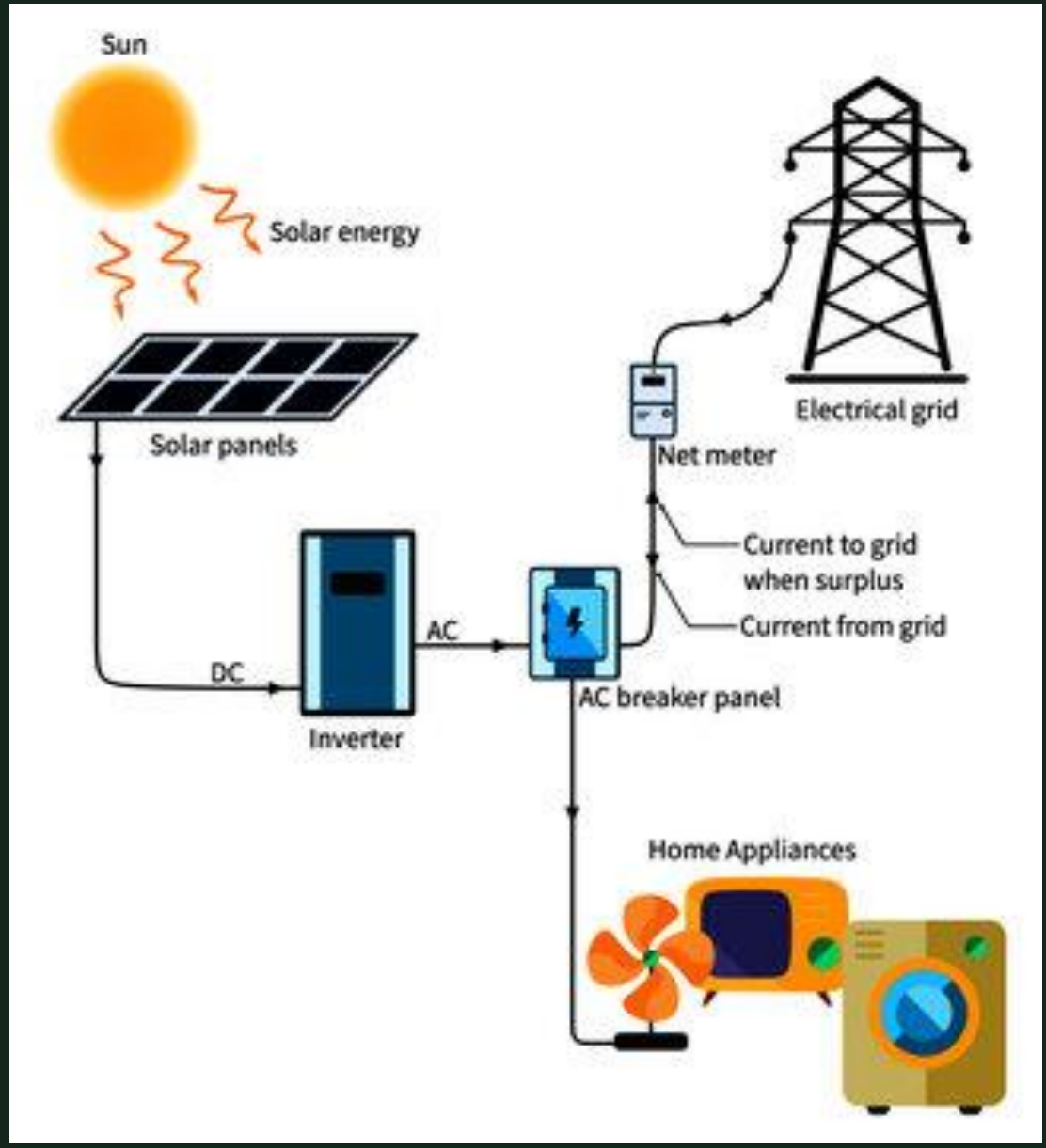
- Cities tend to face problems with pollution, housing, energy distribution, and waste management.
- As urbanization and the effects of climate change increase, it's vital that cities adapt to changes with sustainability as a priority
- The American Council for Energy-Efficient Economy(ACEEE) ranked Jacksonville as one of the lowest scoring cities in the country, implicating that Jacksonville needs to adapt in terms of energy efficiency

OBJECTIVE

- Due to the frequent warm and sunny weather in Jacksonville, it is clear that solar energy is the best renewable energy source for the city
- This presentation will focus on the addition of solar panels to Wells Fargo Tower in downtown Jacksonville, to improve its energy efficiency and promote sustainability throughout the rest of the city.

TECHNOLOGY: SOLAR PANELS

- Sunlight strikes the solar cells exciting the electrons within the cells.
- Increases the energy levels causing the electrons to break free and flow as electrical current.
- An internal electrical field within the solar cell guides the electrons, creating a direct current (DC) of electricity.
- Then an inverter is used to convert the DC electricity into alternating current (AC) commonly used in homes and businesses



TECHNOLOGY: SOLAR PANELS

Pros

- Both a renewable and inexhaustible energy source
- Reliable source of energy since there is minimal maintenance required
- There is a focus in research into solar panels that opens the door for improvements in efficiency
- In the long run the investment into solar panels will save money
- A clean energy source that benefits the environment and has a sustainable impact

Cons

- Solar panels are only 46% efficient because not all the light that hits the panels can be turned into energy
- The amount of energy created is dependent on the sun visibility per day, days with poor weather will lead to less energy conversion
- There is a high cost for solar panels with an average of $2.63 per watt
- Takes on average 10.33 years to recover from investing in solar panels

JUSTIFICATION: *WHY SOLAR ENERGY IS A GOOD FIT FOR JACKSONVILLE*

- Solar power is most beneficial where sunlight is prevalent, making it the perfect energy source for Jacksonville– a city where 60.5% of the year is sunny (221 days out of the year).
- The Wells Fargo Tower stands taller than most of the surrounding structures, meaning it will receive sunlight across all sides of the tower as the day goes on.
- This staple of Jacksonville's skyline does not already have solar panels, and the addition of solar panels will improve the building's efficiency by relying on a completely renewable energy source

$$\%\ of\ sunny\ days = \frac{221\ \text{days / year}}{365\ \text{days / year}} * 100$$

$$= 60.5\ \%\ \text{of the year is sunny on average.}$$

JUSTIFICATION: *CALCULATIONS*

- The addition of solar panels to the Wells Fargo Tower is further justified by the following facts and calculations:

- Square footage of building: 648,300 ft^2.

- Average energy consumption per square foot: 22.5 kWh/year.

- Average electrical energy generated from solar panels in Jacksonville per year: 180.06 kWh/ft^2/year.

- Average area of solar panel: 17.5 ft^2.

1

$$Total\ energy\ consumed = \frac{22.5\ kWh/year}{1\ ft\text{^}2} * 648{,}300\ \text{ft^2}$$

=14,586,750 kWh/year

2

$$Total\ square\ footage\ of\ solar\ paneling\ needed = \frac{14{,}586{,}750\ kWh/year}{180.06 \frac{kWh}{year}/ft\text{^}2}$$

=81,010.4965 ft^2 of solar paneling

3

$$Number\ of\ solar\ panels\ needed = \frac{81{,}010\ ft^2}{17.5 \frac{ft^2}{solar\ panel}}$$

=4,629 solar panels would be needed to power the building

ASSUMPTIONS

Examining a similar-sized building that went solar is useful to make assumptions

CIS Tower Manchester, England

- Retrofitted in 2006
- 5,000 functional 80 W voltaic cells on side of building
- 390 KW / year = 10% of building's energy needs
- $8.04 million cost
- Energy provided will likely never offset cost of installation
- Saves 100 tons of CO2 emissions annually

ASSUMPTIONS

- Since 2010:
  - Cost of solar panel installation has dropped 80%
  - Cost per watt of solar power has dropped from $5.79 to $1.25

- Jacksonville = 2,885 hrs sun/year
- Manchester = 1,415 hrs sun/year
  - Fewer solar panels needed
  - MORE energy efficient

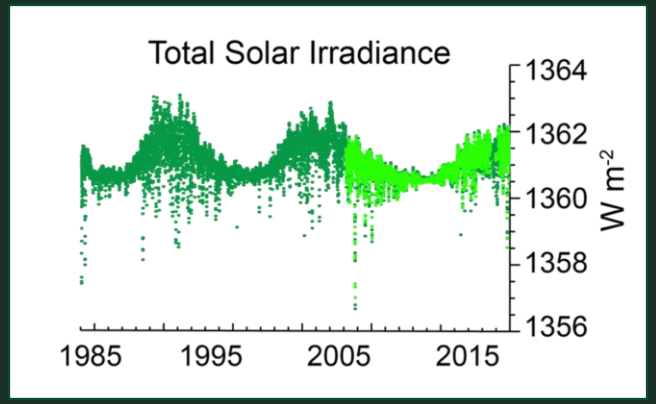
- Structurally sound to support weight of panels

KNOWLEDGE GAINED

- Local government policies apply to solar energy landscape
- Jacksonville has specific policies and incentives relating to:
  - Solar panel instillation
- Federal incentives are also significant
  - Investment Tax Credit
  - Solar Investment Tax Credit
- Solar industry reports and publications
- Academic journals on peer reviewed research

KNOWLEDGE GAINED

- Local solar energy associations and organizations such as the Northeast Florida Solar Energy Society provide information for Jacksonville
- On a broader scale, Florida Solar Energy Industries Association offers information for Florida
- Solar panel companies offer valuable information
  - Market trends, pricing, and technical intricacies tailored to Jacksonville
- The National Renewable Energy Laboratory or local weather stations allow solar irradiance to be accessed
- Historical energy production provides data on installed systems over time



CONCLUSION

- There are political and social factors outside the scope of this presentation that would need to be considered to adapt this technology in the real world
- However, our technology is still a viable solution as it would reduce carbon emissions and energy usage, while promoting sustainability in an area lacking efficient infrastructure
- Although Jacksonville lacks motivation to reduce its energy usage, starting to implement solar energy systems could lead to a great increase in the energy efficiency of Jacksonville.
- Grand Challenge Four requires a reduction of using finite resource, and solar energy for one of the largest buildings in Jacksonville would be a good starting place to reduce nonrenewable energy sources.
- Overall, a start of using solar energy will lead to a more efficient, healthier, and resilient version of Jacksonville.

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