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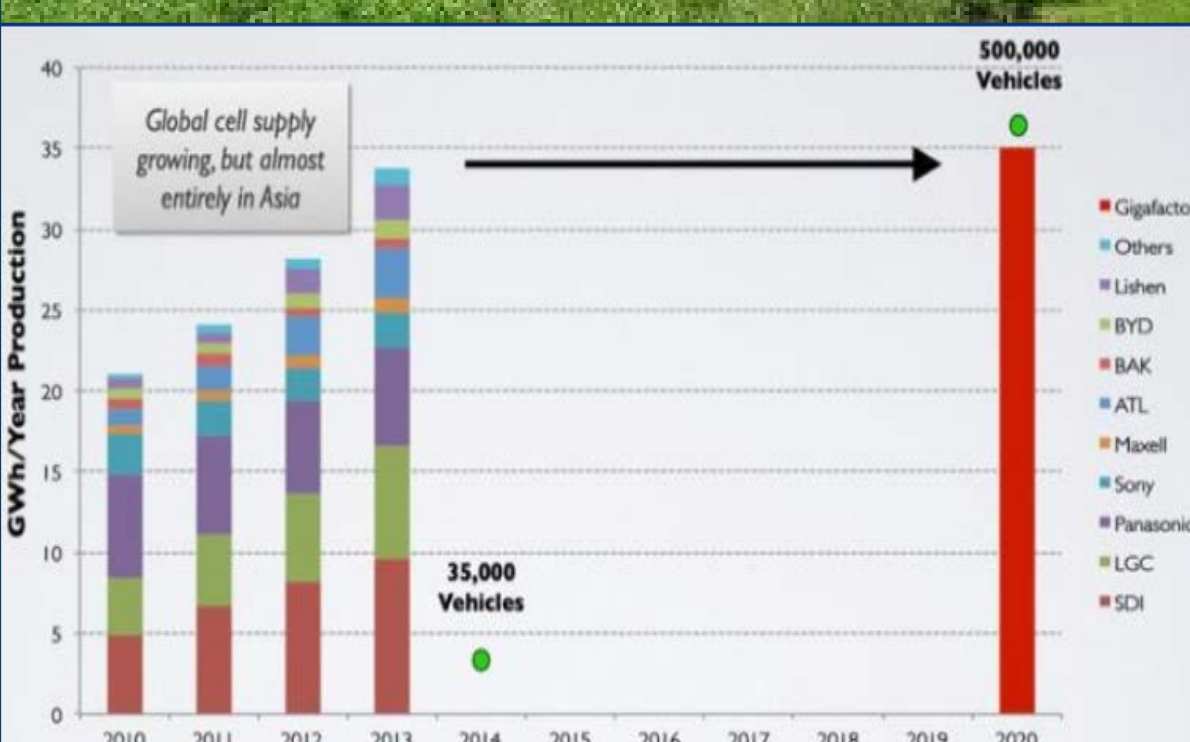
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Local DC Electricity Generated by Photovoltaics (PV): Transforming the Electricity Infrastructure of the 21st Century

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What's the Point?



- The United States' aging electricity infrastructure is **dominated by alternating current (AC)**.
- Most of the loads in the world today are direct current (DC) load**, with commercial buildings having more than **80 % DC loads** so **great losses are incurred from converting AC to DC**.
- Nowadays DC infrastructure can be implemented with all the advantages of saving energy and improved reliability of the grid.
- The installed **PV system cost is as low as \$1.50 per peak watt**.
- Due to growth of electric vehicles and grid storage, **battery cost is also reducing every day**.
- Combination of PV and battery storage is going to transform the electricity infrastructure of the 21st century.**

Creative Inquiry Aim

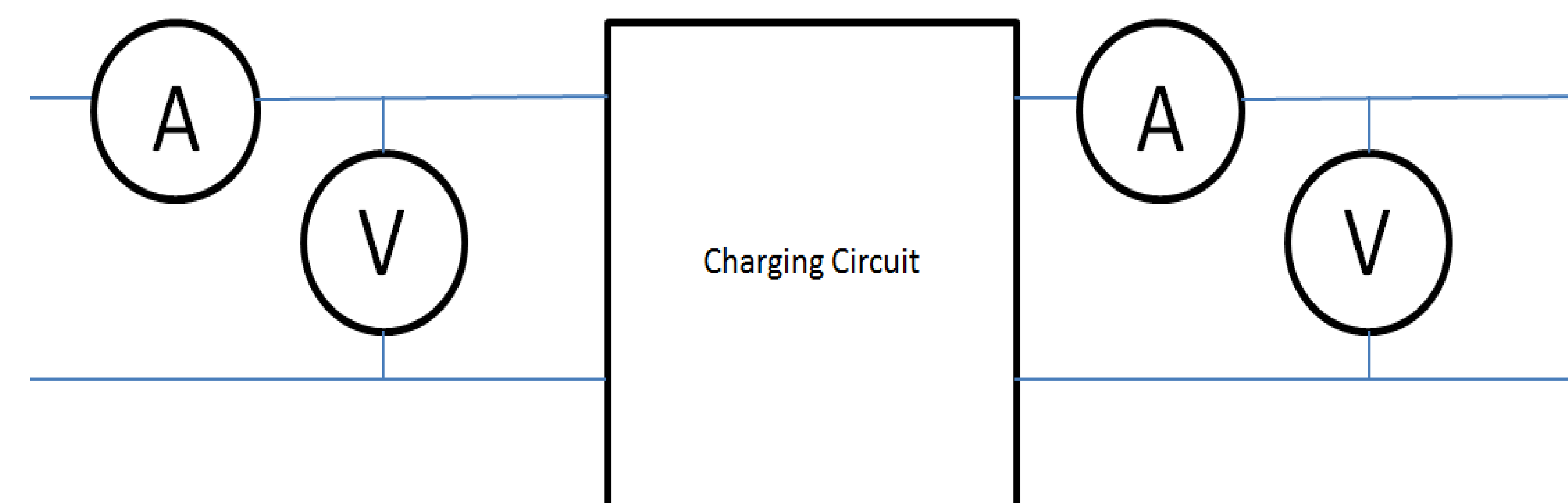
This creative inquiry shall show the losses that are incurred in the conversion from AC Power to DC Power by measuring the efficiency of traditional cellphone chargers, where the conversion takes place. These losses would be eliminated by charging using purely DC. Showing these advantages on a small scale opens the door for this to work on larger and more complex appliances.

Objectives

- Test various mobile phones and compare the efficiencies of DC charging over AC charging
- Research different batteries and their capacities
- Show the advantages of DC power over AC power
- Study the rewards of point-of-load distribution

Experimental Process

To analyze the conversion losses between the AC input power and the DC output power, of the charging circuit inside the charging unit that connects to the wall outlet, the input and output voltages and currents had to be measured.



The voltages and currents could then be used to calculate the input and output Power by the fundamental relationship:

$$P = I_{rms} \times V_{rms}$$

The losses and the efficiency could then be calculated using these results:

$$P_{losses} = P_{AC} - P_{DC}$$

$$efficiency = \frac{P_{DC}}{P_{AC}} \times 100\%$$

Results

Phone Type	P _{AC} (W)	P _{DC} (W)	P _{losses} (W)	Efficiency (%)
Samsung- Smart	5.2849	2.408	2.8773	45.55577385
Samsung- Flip	4.6176	1.945	2.6728	42.12879143
LG Windows	6.1592	2.262	3.89678	36.73288172

Conclusions

The phone charger's efficiency was compared using the three phones which provided an average **efficiency of 41.47%**. Although cell phones are typically low-power devices the **potential energy saved by utilizing a DC Micro-Grid could be enormous** considering **Samsung alone sold over 117 MILLION Cell phones** in the third fiscal quarter of 2013. **The next step for this research will look into losses incurred by more power hungry electronic devices such as laptops.**

Big Picture



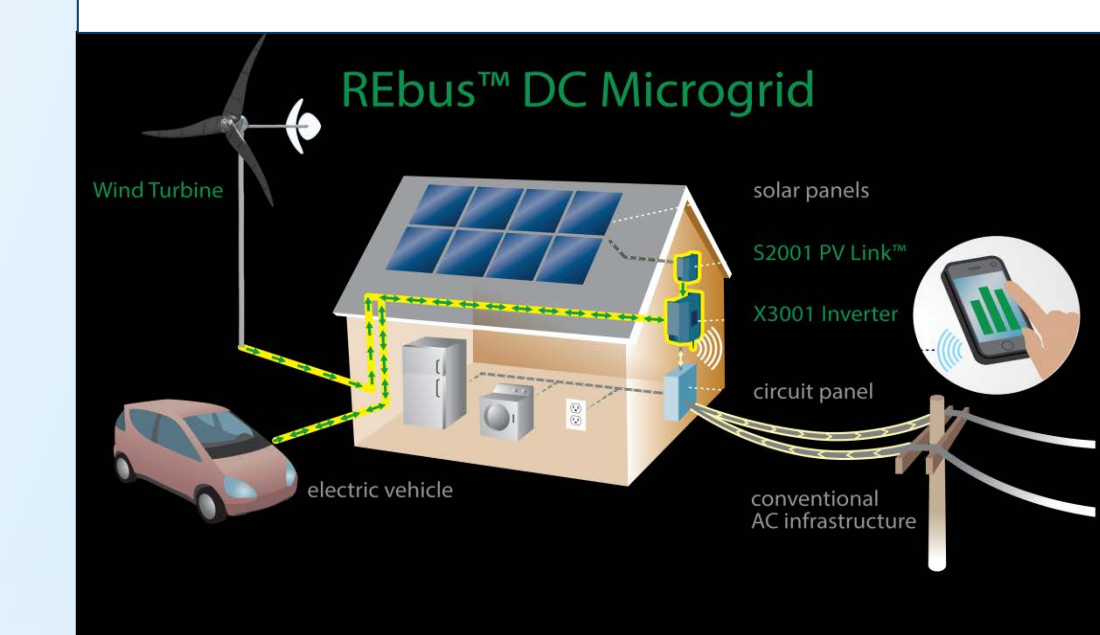
Centralized Power

- 500 BILLION Dollars** per year wasted
- Accounts for ¼ of total carbon dioxide emissions[4]

VS

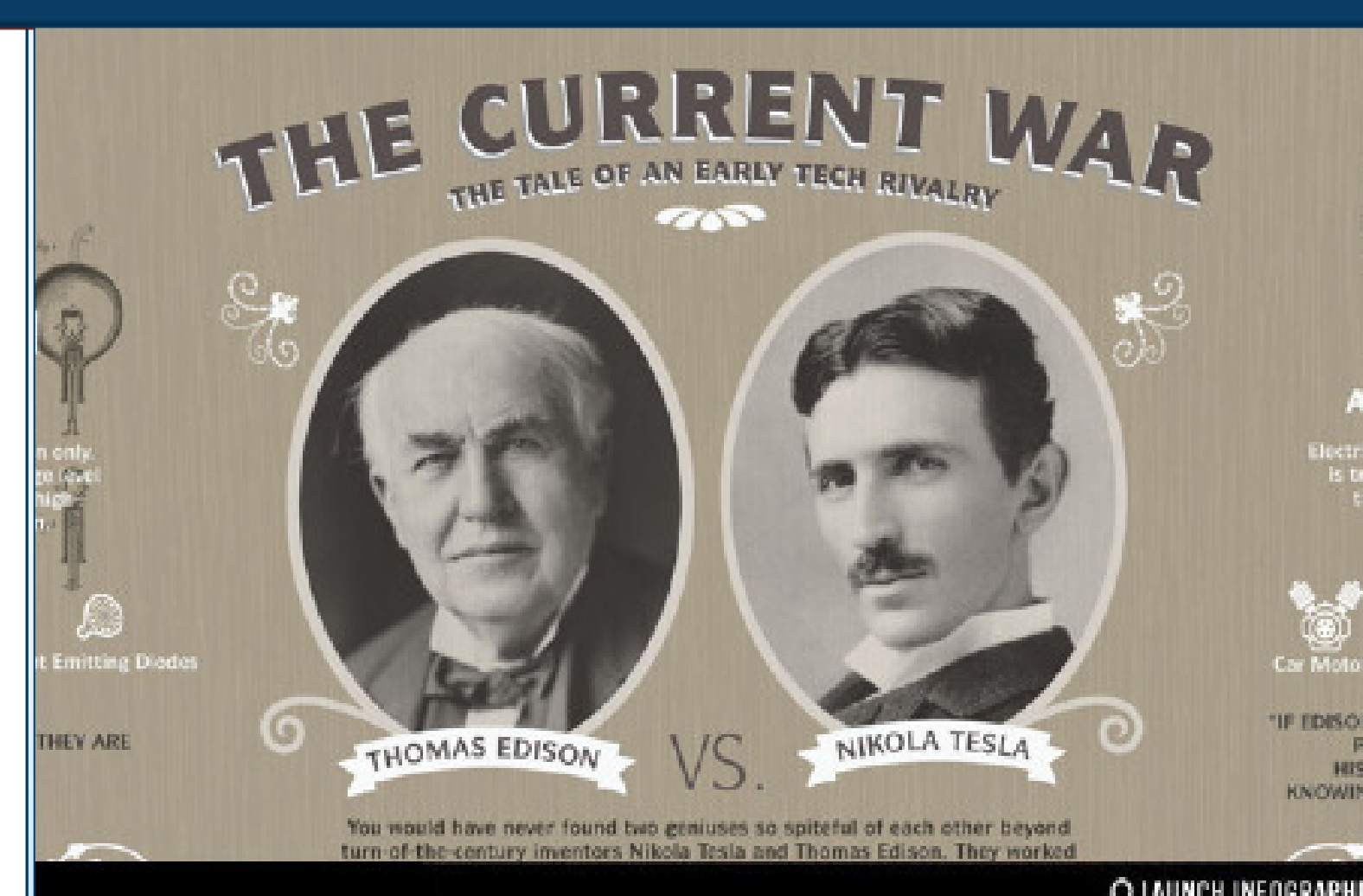
Distributed Power

- Clean & Renewable Energy Sources
- Reduce cost** of energy to \$0.02 per kWh



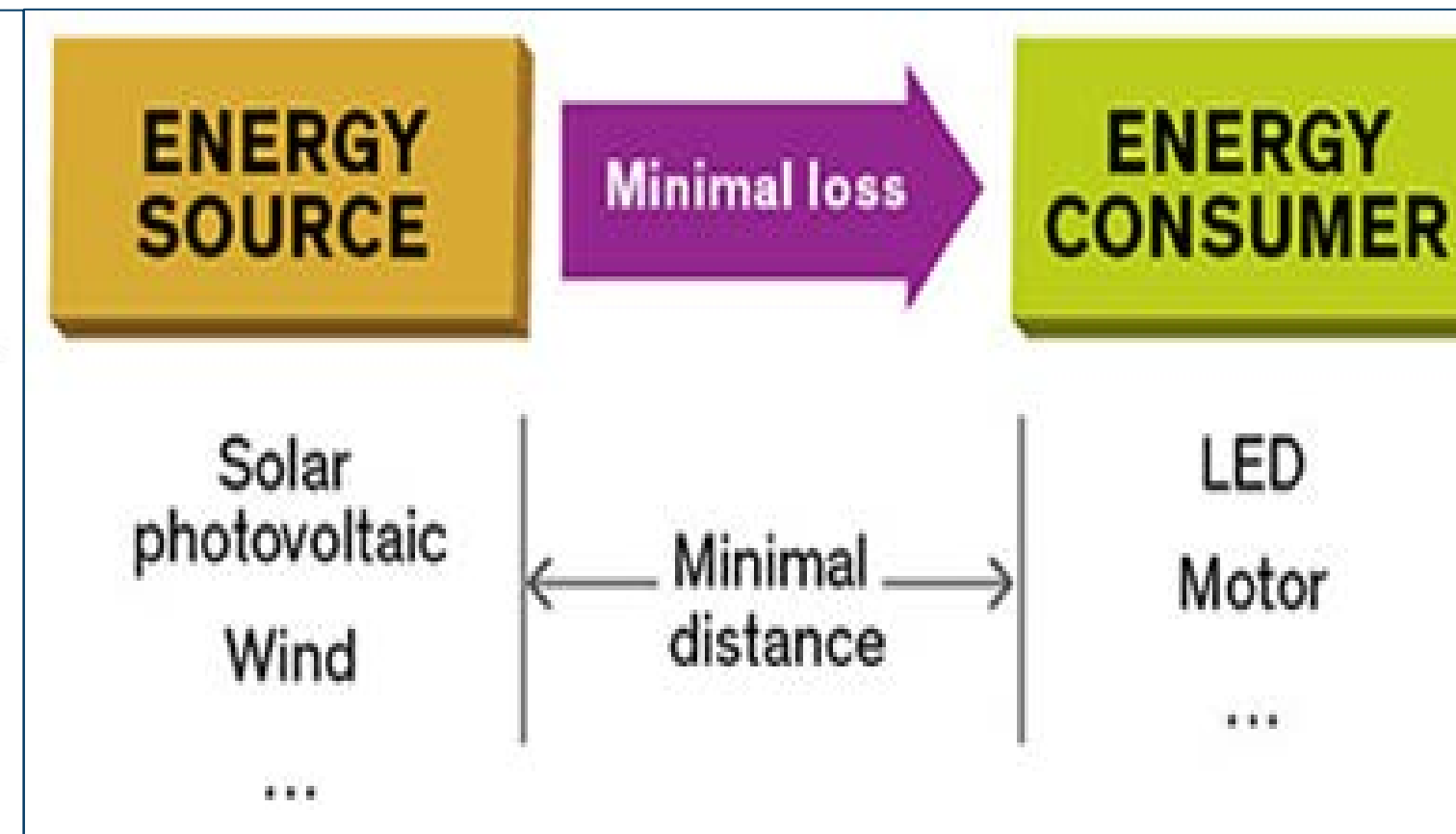
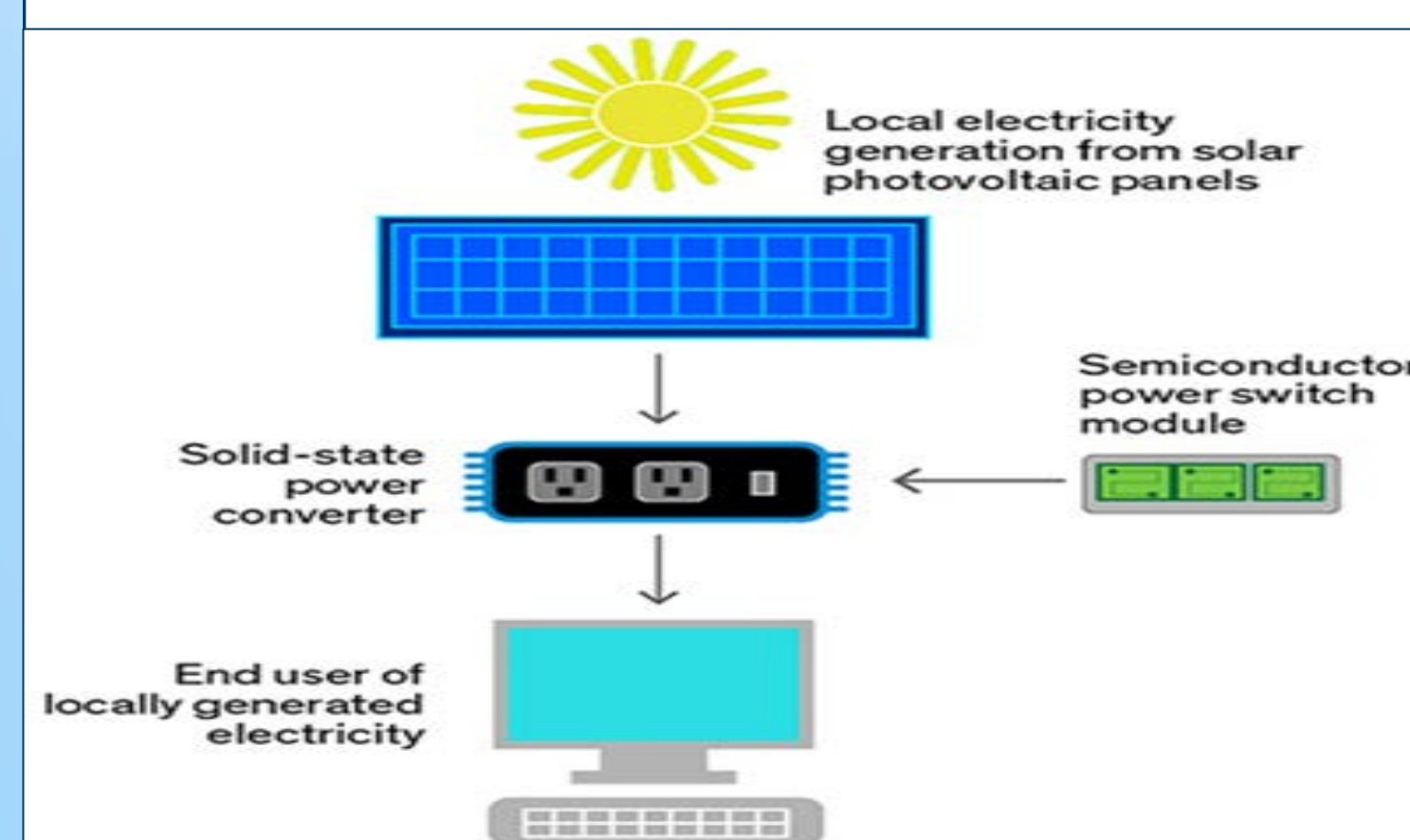
What is DC Power?

- Thomas Edison developed **Direct Current (DC)** which is **current that runs in a single direction**. For example a battery.
- Nikola Tesla developed **Alternating Current (AC)** - which is **when the current alternated direction a certain number of times per second**. [1]
- In the past AC had more positives (losses and transmission).



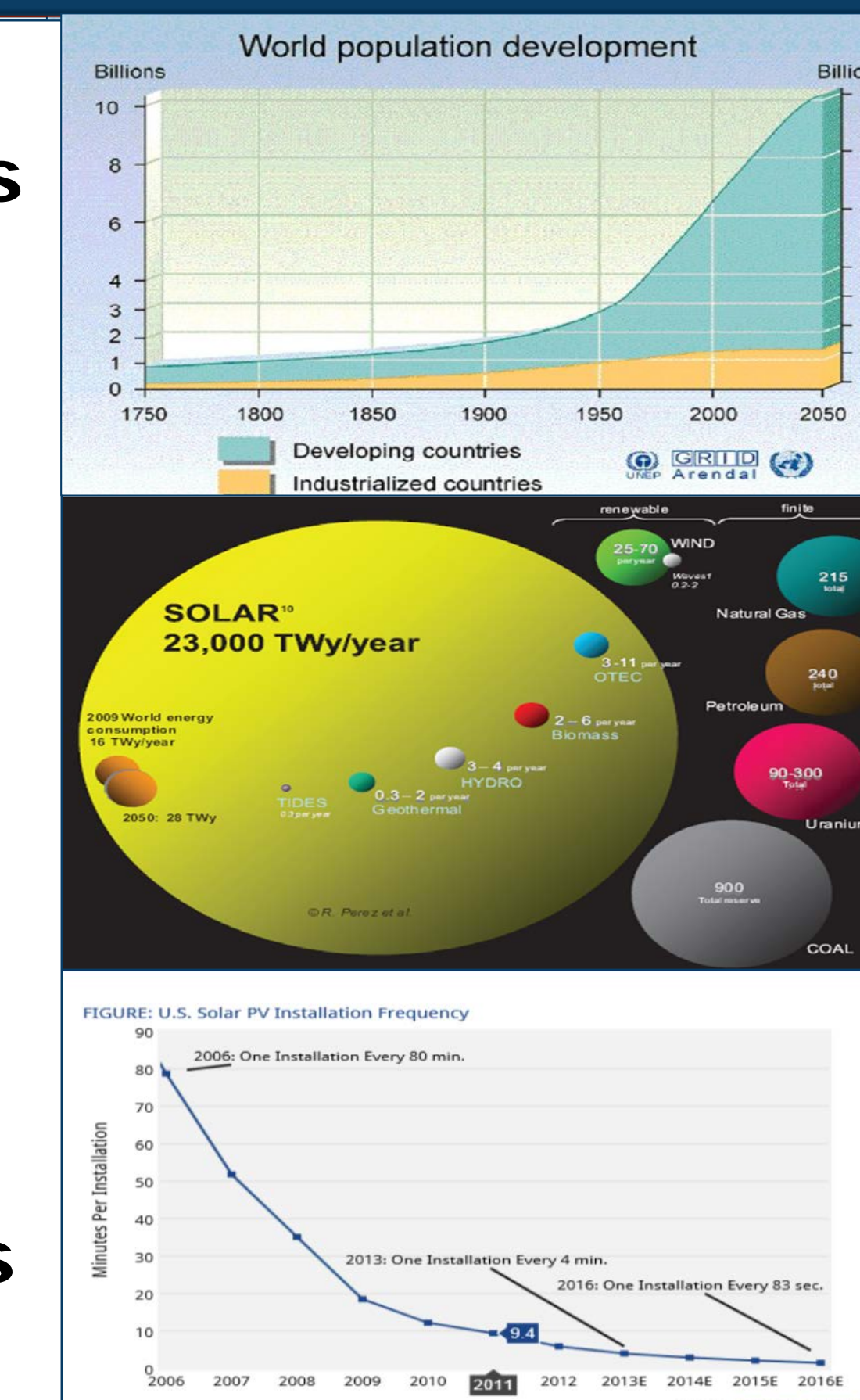
Why Make the Change?

- Solar Energy generates DC Power
- DC is becoming a more cost effective, viable option**
- Batteries, capacitors, and fuel cells store DC power. AC power increases the cost of storage device (as much as 50 % in some cases)
- In US 10 % adoption of DC electricity in 2015 will create 60,000 jobs
- DC power will reduce the cost of related power electronics (laptops, cellphones)



Moving Forward

- The need for clean renewable resources has never been greater** due to the increasing population in emerging energy markets.
- The world needs to **utilize** its greatest resource: **the sun**.
- Solar energy generation is increasing rapidly and partner perfectly with distributed energy generation so **DC Power is the future!**



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