Power Rangers

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Introduction

Challenge: Project involving power that is cheap, safe, and involves a microcontroller

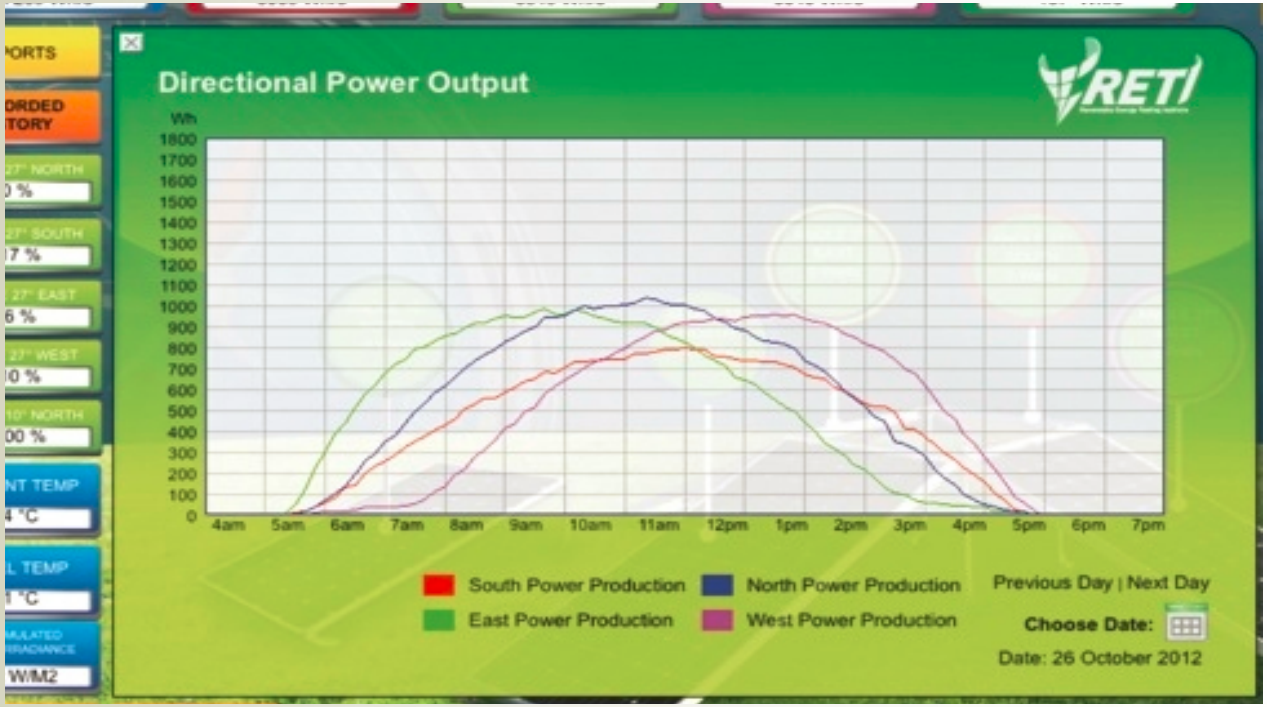
Met with Dr. Lemmon and came up with a project involving a solar cell array he has

Will involve concepts from Power Electronics and Alternative Energy Devices

Solar cell cart

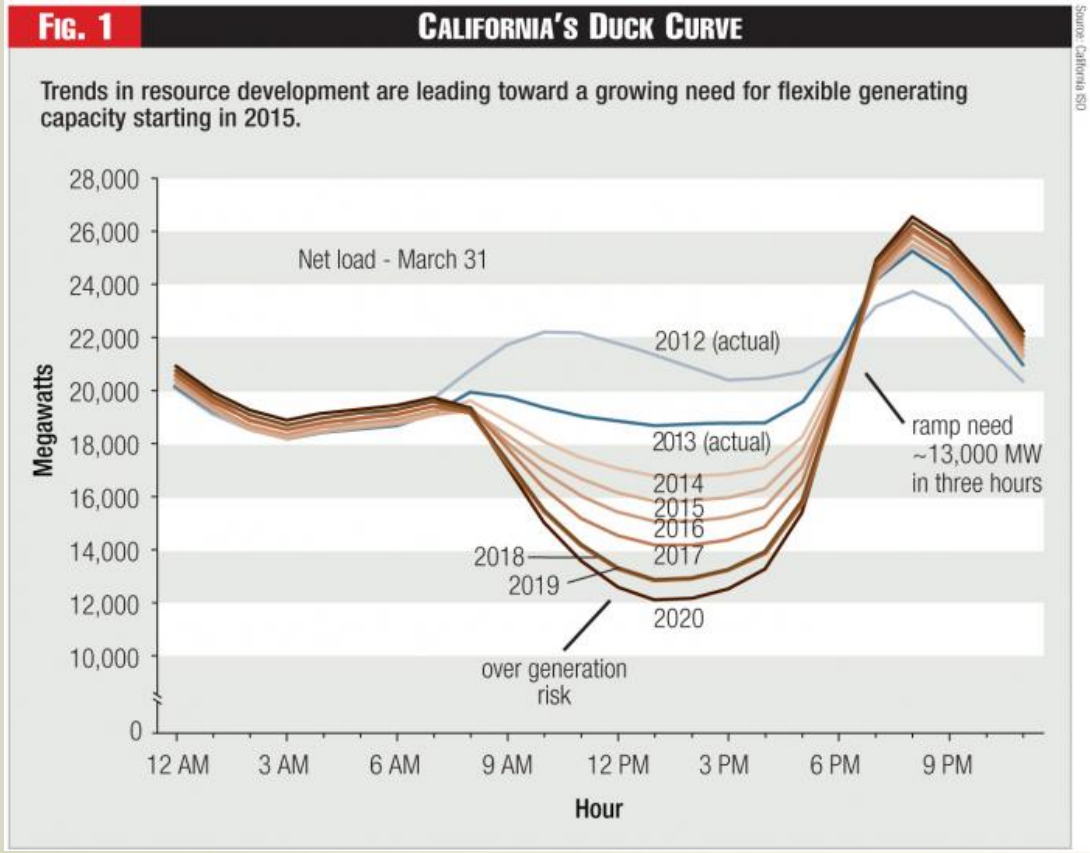
Problem – Big Picture

- Characteristic solar cell production versus time of day:



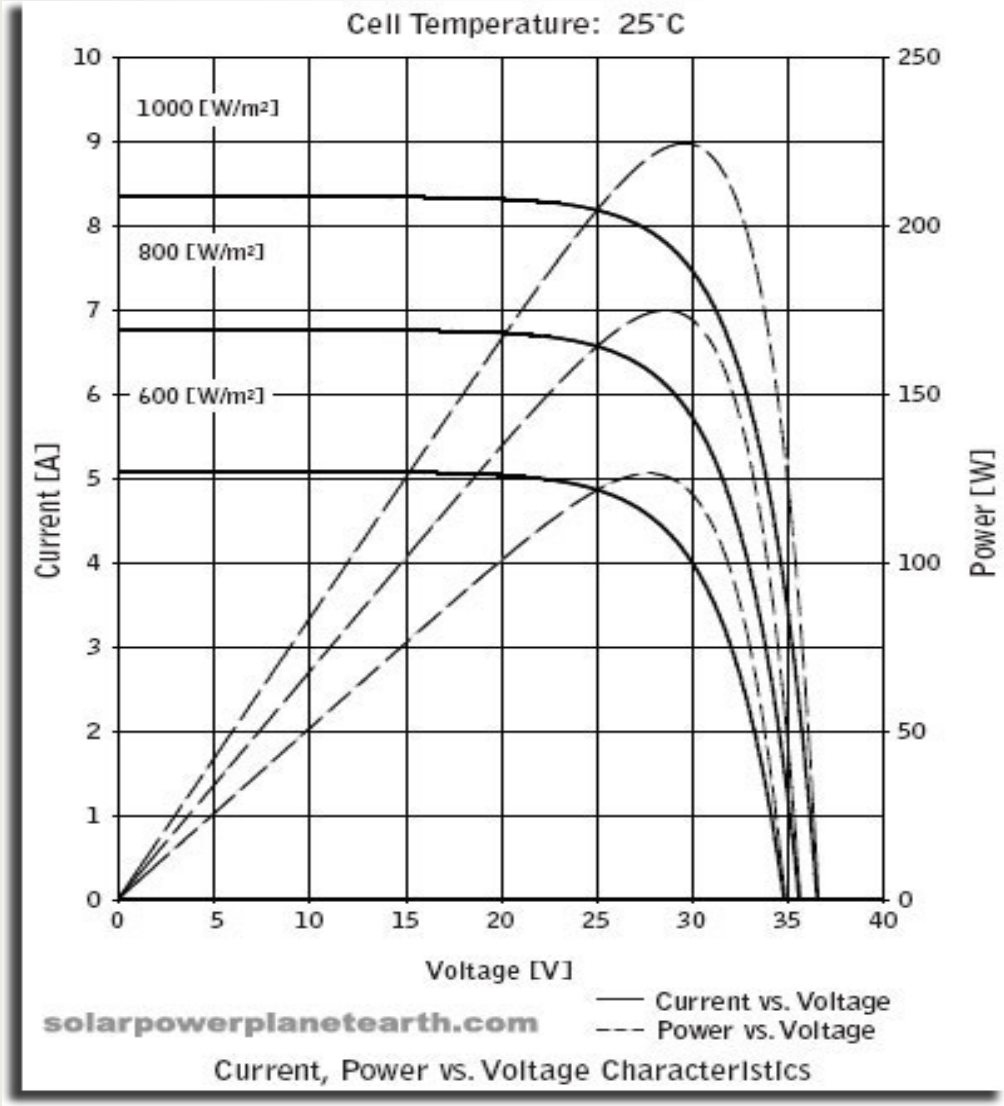
Problem – Big Picture

- Typical load of a distribution network:



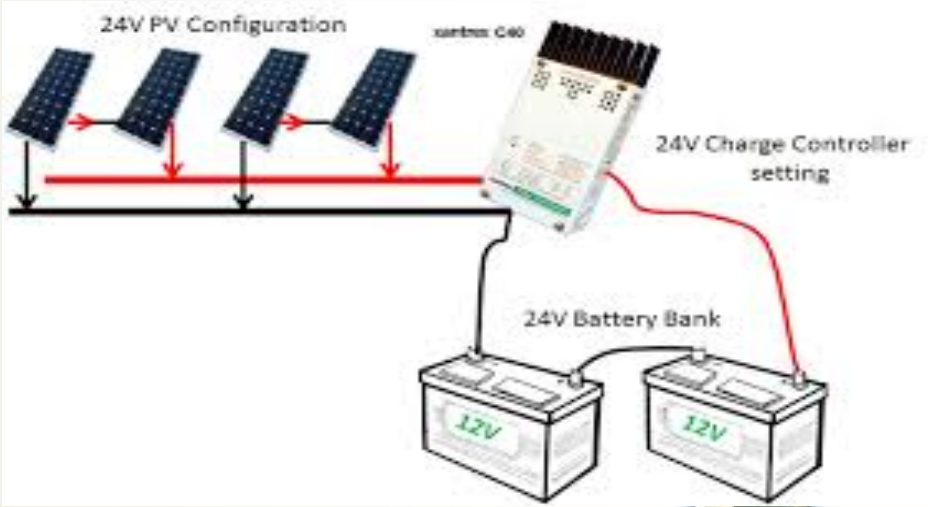
Problem

- Voltage where max power is achieved changes during the day



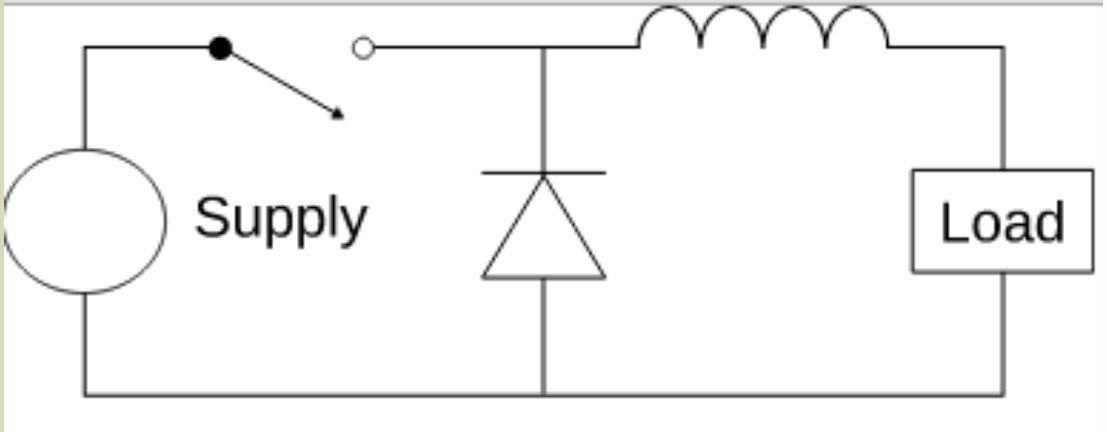
Problem

- Batteries will only charge if the potential is higher than the battery voltage
- Higher voltages equate to lower current and less efficient charging



Solution

- “Power Point” tracker so that solar array is always generating maximum power
- Variable DC-DC converter to charge at optimum voltage



Demonstration

- Data-heavy
  - Comparison of power generated with power point tracking versus without
  - Comparison of charging battery with variable converter versus without
- Demonstration of stopping the charging when full
- Videos

Available Technologies

- Solar Cells and Batteries – available
- Devices for converter circuit- FET, Diode, Inductor, Capacitors
- Microcontroller to implement power point tracking algorithm

Specs of the Solar Array

Important Specifications:

Max Power: 100W

Nominal Voltage: 12V

Maximum Voltage: 18.5V

Open Circuit Voltage: 22.7 V

Cell Efficiency: 17%

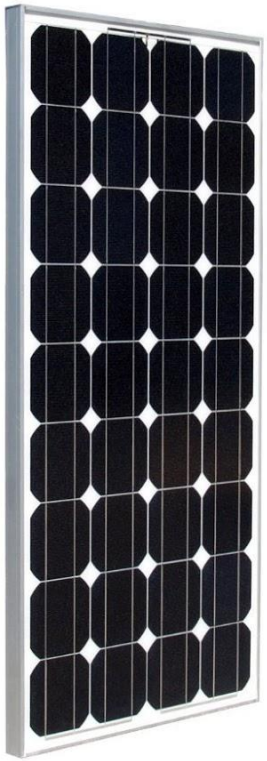
Battery Specification:

Nominal Voltage: 12V

RAMSOND®
Sensible Solutions

Alternative Energy Division
Solar Modules

100
Mono



Technical Details			
Model			SP100 125x125x36
Cell Material			Mono Crystalline
Maximum Power		Watts	100 Watts
Cell Grade		A,B,C,D	A
Nominal Voltage		Volts	12 V
Maximum Voltage (Vmp)		Volts	18.5 V
Open Circuit Voltage (Voc)		Volts	22.7 V
Maximum Current (Imp)		Amp	5.41 A
Short Circuit Current (Isc)		Amp	5.55 A
Maximum System Voltage		Volts	600 V
Cell Efficiency		%	17%
Dimensions	Length	Inch	47"
	Width	Inch	21 5/8"
	Thickness	Inch	1 9/16"
Weight		Lbs	16.5 lbs
Cell Size			125x125 mm
Cell Quantity			36
Frame Structure (Material)			Extruded Anodized Heavy Duty Aluminum
Encapsulation			EVA
Rear Side			DuPont® Tedlar™ (TPT)
Glass Thickness		Inch	1/8" 3.2mm
Max. Wind Resistance			65 m/s – 145 MPH
Max. Hail Diameter Size / Speed			1+ Inch @ 50 mph
Max. Load Capacity			200 kg / m^2

Engineering Aspects

- Building a converter that can take a given input voltage and a desired output voltage and achieve the desired ratio with good efficiency
- Implementing the algorithm for achieving the ideal power point
- Control circuitry to stop the battery from charging when full

Conclusion

- If successful, could be very important in demonstrating how to store solar energy effectively
- How we generate and distribute power is going to change drastically over our lifetime – need to be ready for changes