

1 PhotoVoltaics

2 Objectives

- Energy Requirements vs Energy Available
- How sunlight is converted to electricity
- Costs and Benefits of Solar PV
- Basic Equipment Overview

3 POWER (kW)

- ENERGY (kWh)

4 Energy

- 1 Gallon of Gasoline = 34kWh
- Average home consumes ~1500kWh/mo (\$150 @ \$0.10/kWh)
- A 8kW PV system will produce ~1500kWh/mo
- 8kW system occupies ~500 square feet

5 Power

- HVAC ~4kW
- Dryer ~3kW
- Microwave ~1.2kW
- 46" Television 200W
- Output of 12k BTU heater ~3.5kW

6 Solar Resources

- Andrews County is 1500 sq miles
- 1 sq Mile receives ~2.5GW of solar power
- Andrews County receives ~3.7TW of solar power
- Annually Andrews County receives 8000 TWh
- US annual electric consumption: 4000TWh

7 PV = Simplicity

8 Maximum Power Point

9 'Christmas Light Effect'

10 

11  **Durability and Long Life**

12  **\$\$\$\$\$\$\$\$\$\$\$\$\$\$\$\$**

- Assume \$4/w cost; \$0.10/kWh savings
- Example 8kW system
- Upfront Cost: \$32,000 minus 30% ITC = \$22,400
- Expected annual production: 17MWh
- Expected Lifetime Production (25 years): >400MWh
- Value of Lifetime Production = >\$40,000

13  **Basic Equipment overview**

14  **Types of PV systems**

- Grid-Tie
- Hybrid
- Off-Grid

15  **Grid-Tie**

- Very Efficient (>95%)
- Will not function during grid failure (anti-islanding)*
- ~40% less expensive than a hybrid system

16  **Types of Grid-Tie**

17  **Hybrid & Off-Grid Systems**

- Capable of Operating during a grid failure
- Typically ~40% more expensive than Grid-Tie
- Requires Batteries
- Requires Charge Controller or Grid-Tie Inverter
- <90% efficient

18  **Production / Exports / Imports**

19 **Storage and Back-up with Grid-Tie Systems**

- AC Coupled
- DC Coupled
- Opportunity Power

20 **AC Coupled**

- Requires AC-Couple inverter 50% larger than grid-tie*
- Possible Resonance issues
- Automatic Backup*
- Payback with Arbitrage*

21 **DC Coupled**

- New Tech
- High Efficiency
- No additional inverter required
- Limited Compatibility

22 **Opportunity Power**

- Only Available from SMA
- Limited Power <2kW
- No Batteries
- Least Expensive Option
- Only Available during Day
- Manual