

Alternative Energy at the Intersection

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Why Alternative Power

- Dark intersections are dangerous
- Bring safety of signalized intersections
- Environmentally friendly
- Touch safety
- Options with power

Options for Alternative Power

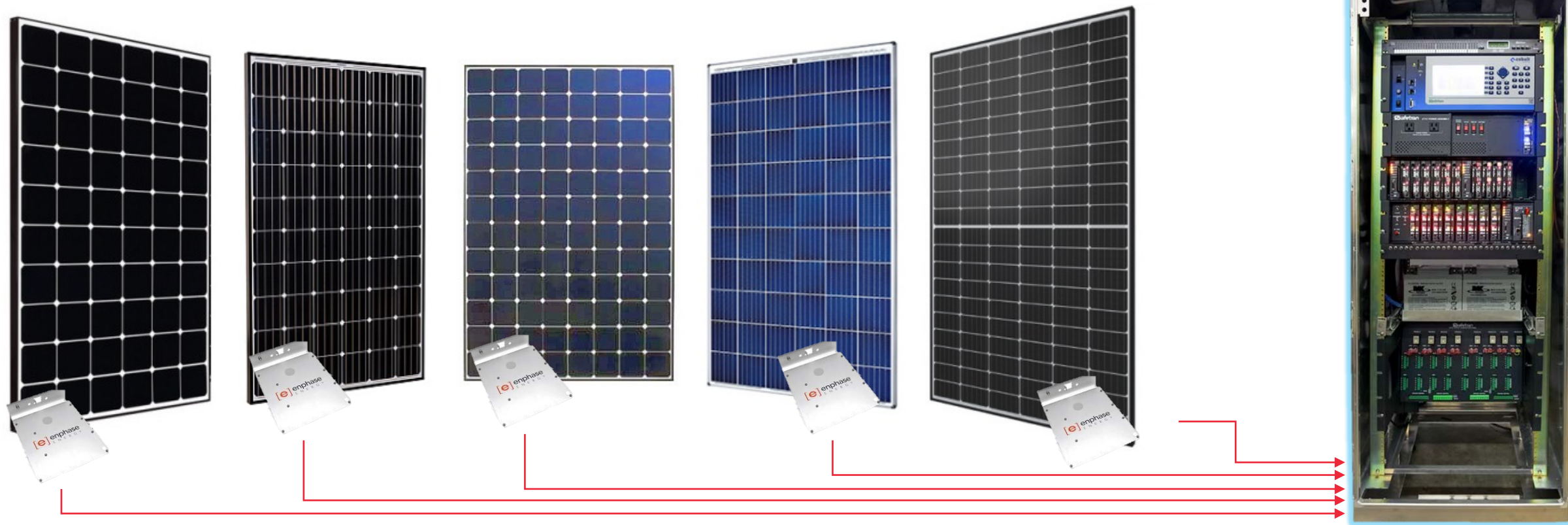
- Solar Power
 - AC, DC & Hybrid
 - Battery Types
- Fuel Cells
- Generators
 - Natural Gas / Propane
 - Gasoline
- Wind Power
- Battery Backup

Solar Power

- Intersection Power draw will change # of panels required
- Disconnected from Grid
 - Cannot back feed into grid
- Will require batteries
- ~8 DC panels, ~30x60" each – 600 watts (charge batteries & run intersection)
- Industrial inverter / battery charger (not NEMA temperature rate – expect 0-60°C)
- Hurricane rated panels and mounting fixtures
- Update PDA on existing cabinets to auto-transfer power from Utility to Solar



Solar Power – Micro Inverters



Solar Power – String Inverters



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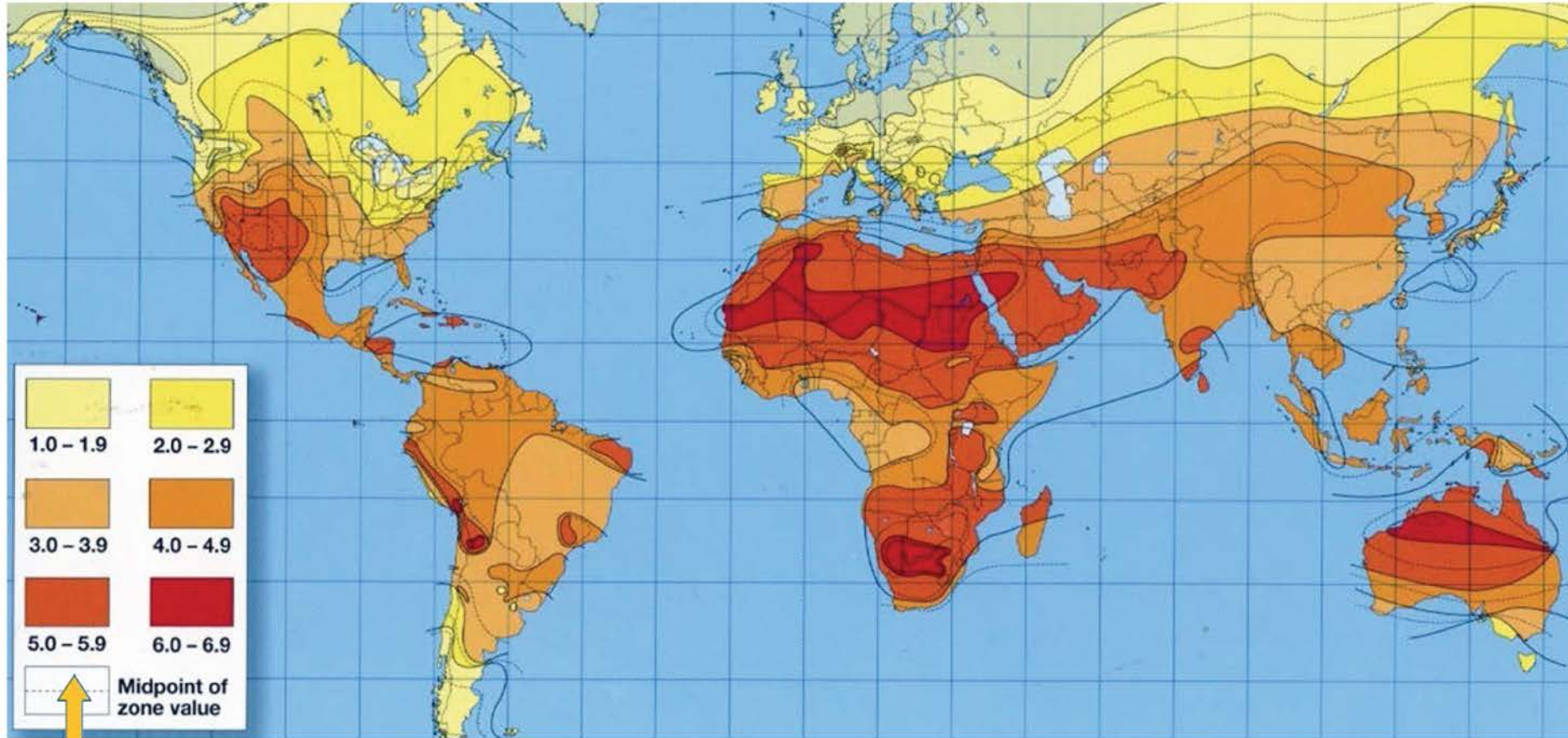
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Solar Power –Inverters

- String Solar Inverters use a string of solar panels linked together in series.
- Hybrid Inverters are a new generation all-in-one hybrid inverters combine a solar and battery inverter together in one unit.
 - AC or DC Coupled Off Grid & Hybrid Inverter
 - Hybrid System with built in battery storage
 - Combines battery, inverter / charger, solar inverter and energy management system
 - All-in-one hybrid solar Inverter
 - Combine solar inverter, charger and battery inverter
 - Battery Storage Systems
 - Lithium Ion, lead acid, AC Batteries (Tesla Powerwall 2)



Solar



Size & System calculators available at
www.sunwize.com
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Hydrogen Fuel Cell

- Additional Foundation & Cabinet
- Intersection can be run for weeks without refueling
- Quiet & Environmentally friendly
- Hurricane & NEMA temp rated
- <http://www.altergy.com/products-2/enclosures/>
- Automatic transfer switch
- Purchased product



ReliOn E-200 fuel cells at a Florida railroad crossing.

Hydrogen Safety

- Hydrogen is no more dangerous than gas or any other fuel
- Lighter than air – will dissipate
- <http://www.hydrogenandfuelcellsafety.info/>



Gasoline Generator - Portable

- Easy to deploy
- Inexpensive and portable
- Used as needed
- *Should* require bypass switch
- Limited security
- Limited run time
- Tips
 - Use generator locking door
 - Chain generator to foundation or pole
 - Use bypass switch or relay



Propane Generator - Portable

- Tamper Proof Enclosure
- The Continuous Monitoring and Reporting System
- Asset location via GPS
- 4 – 20lb cylinders and gas regulator inlet
- Continuous service at the load specified 50 amps
- Engine size is 570cc
- Includes a 12 volt 2 amp SCR voltage regulated current limited Battery Float Charger to maintain fully charged cranking batteries.
- Diagnostic Control Center Alerts



Natural Gas Generator - Stationary

- Requires NG piped within 25' of intersection
- Needs oil filter changed regularly
- Readily available in 8kw, 10kw and 12kw solutions – “off-the-shelf”
- Does not require refilling of H2 bottles
- Hurricane and NEMA rated
- Solid enclosure mounted on a foundation
- Portable options also available
- <http://www.poweruppowersystems.com/products/traffic-systems/#!>



Battery Backup Systems

- Low cost
- Easy to deploy
- Automatically turn on and charge batteries from utility power when available
- Limited run time
- Line Interactive & Dual Conversion
 - Used with lead acid or Li Ion batteries
- Intelligent Conversion
 - Nickel Zinc
- Conditions power from utility
- Requires ongoing battery maintenance



Battery Backup Systems

- Dual Conversion vs Line Interactive
 - Dual Conversion is always on, cleans power, reduces efficiency
 - Line Interactive, monitors power to see when buck or boost is required, no reduction on efficiency
- Tips:
 - Multiple parallel strings
 - Separate built in compartments
 - Load Shedding
 - Fixed time
 - Other tips?



Battery Backup – Nickel Zinc

- Easy installation
 - No External Cabinet required
 - Charge batteries directly from 120 VAC – has built in charger
 - Charges in 4 hours
 - Limited run time
 - Hot Swappable / Replace batteries without going dark
 - Conditions power from utility
 - Automatic battery maintenance
 - Generator Mode
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Wind Turbine Power

- Predictable wind?
- Large battery bank
- Not yet practical for applications
- Alternative energy solution yet to be proven



Low Voltage Cabinets

- 48 VDC power source and signals
- Lowest current consumption
- Longer run times on batteries
- Directly charge batteries from alternative power options
- Exposed wires from hurricane damage are touch safe



Tips

- Plan ahead
- Hybrid approach for alternative energy
 - Permanent installations for critical routes
 - Portable / backup solutions
- Design for low power
 - Low voltage cabinets
 - Load shedding
- Communications
 - Is intersection really running?
 - Ethernet controlled power



Comparing Technology

Solution – Technology	Run Time	Portability	Sustainability & Environment	Equipment Cost	Installation Cost	Maintenance Overhead	Comments
Lead Acid Battery Backup System (batteries only)	●	●●	●	\$\$	\$\$	\$\$	BBS-only solution run-times determined by load and installed battery capacity.
Nickel Zinc Battery Backup System (batteries only)	●	●●●●	●●●	\$\$\$	\$	\$\$	BBS-only solution run-times determined by load and battery capacity.
Portable gasoline generator	●●●	●●●	●	\$	\$	\$\$\$ (refueling)	Requires regular fill-up, depending on run-time durations. Portable, but not permanent. Subject to theft.
Gas (NG/LP) powered generator	●●●●	●●	●●	\$\$\$\$	\$\$\$\$	\$\$	Needs NG/LP fuel source. Permanent. Installation can be complex.
Solar Panels, coupled with battery backup	●●●●●●● (Varies according to sunlight)	●	●●●●●	\$\$\$\$\$\$\$	\$\$\$\$\$\$\$	\$\$\$\$	Environmentally friendly. Abundant sunshine=abundant energy. Lots of photovoltaic area needed to power. Lower voltage options available for intersection equipment, but swap out would be costly. Mounting concerns
Hydrogen Fuel Cell	●●●●●	●●	●●●●●	\$\$\$\$\$\$\$	\$\$\$\$\$\$\$	\$\$\$	High reliability with zero carbon footprint. Expensive to install, requires replacing H ₂ bottles when depleted. Can last for weeks.