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 0-60ºC)
- 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
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 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
Hydrogen Fuel Cell

• Additional Foundation & Cabinet
• Intersection can be run for weeks without refueling
• Quiet & Environmentally friendly
• Hurricane & NEMA temp rated
• Automatic transfer switch
• Purchased product
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
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

<table>
<thead>
<tr>
<th>Solution – Technology</th>
<th>Run Time</th>
<th>Portability</th>
<th>Sustainability &amp; Environment</th>
<th>Equipment Cost</th>
<th>Installation Cost</th>
<th>Maintenance Overhead</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead Acid Battery Backup System (batteries only)</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>$$</td>
<td>$$</td>
<td>$$</td>
<td>BBS-only solution run-times determined by load and installed battery capacity.</td>
</tr>
<tr>
<td>Nickel Zinc Battery Backup System (batteries only)</td>
<td>⬤</td>
<td>⬤ ⬤ ⬤ ⬤</td>
<td>⬤ ⬤</td>
<td>$$$</td>
<td>$</td>
<td>$$</td>
<td>BBS-only solution run-times determined by load and battery capacity.</td>
</tr>
<tr>
<td>Portable gasoline generator</td>
<td>⬤ ⬤ ⬤</td>
<td>⬤ ⬤</td>
<td>⬤</td>
<td>$</td>
<td>$</td>
<td>$$$ (refueling)</td>
<td>Requires regular fill-up, depending on run-time durations. Portable, but not permanent. Subject to theft.</td>
</tr>
<tr>
<td>Gas (NG/LP) powered generator</td>
<td>⬤ ⬤ ⬤ ⬤</td>
<td>⬤ ⬤ ⬤</td>
<td>⬤ ⬤</td>
<td>$$$</td>
<td>$$$</td>
<td>$$</td>
<td>Needs NG/LP fuel source. Permanent. Installation can be complex.</td>
</tr>
<tr>
<td>Solar Panels, coupled with battery backup (Varies according to sunlight)</td>
<td>⬤ ⬤ ⬤ ⬤ ⬤</td>
<td>⬤ ⬤</td>
<td>⬤ ⬤ ⬤</td>
<td>$$$$$$</td>
<td>$$$$$$$</td>
<td>$$$</td>
<td>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</td>
</tr>
<tr>
<td>Hydrogen Fuel Cell</td>
<td>⬤ ⬤ ⬤ ⬤ ⬤</td>
<td>⬤ ⬤</td>
<td>⬤ ⬤ ⬤</td>
<td>$$$$$$</td>
<td>$$$$$$$</td>
<td>$$$</td>
<td>High reliability with zero carbon footprint. Expensive to install, requires replacing H₂ bottles when depleted. Can last for weeks.</td>
</tr>
</tbody>
</table>