



Vehicle to Microgrid:
DC Charging
March 10, 2011

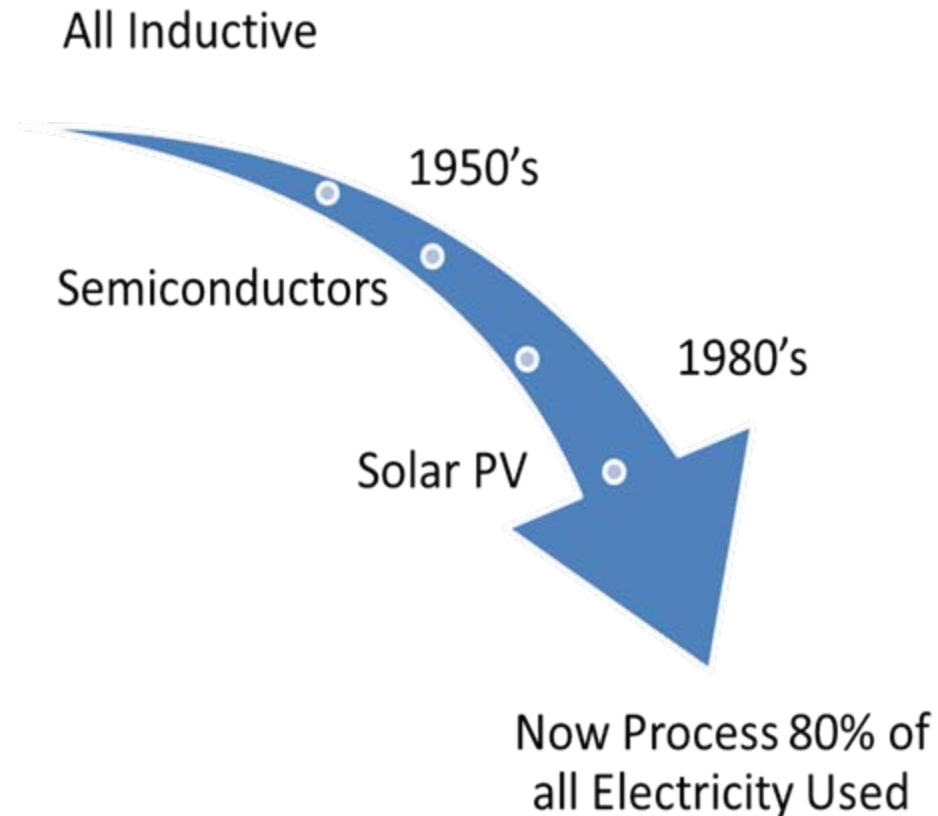


Solving the Power Problem in A New Way



What About the Loads?

Shift to Semi-conductors



The Power Equation in the Buildings



Source: **EPRI** | ELECTRIC POWER RESEARCH INSTITUTE

More DC
Generation



More DC
Consumption

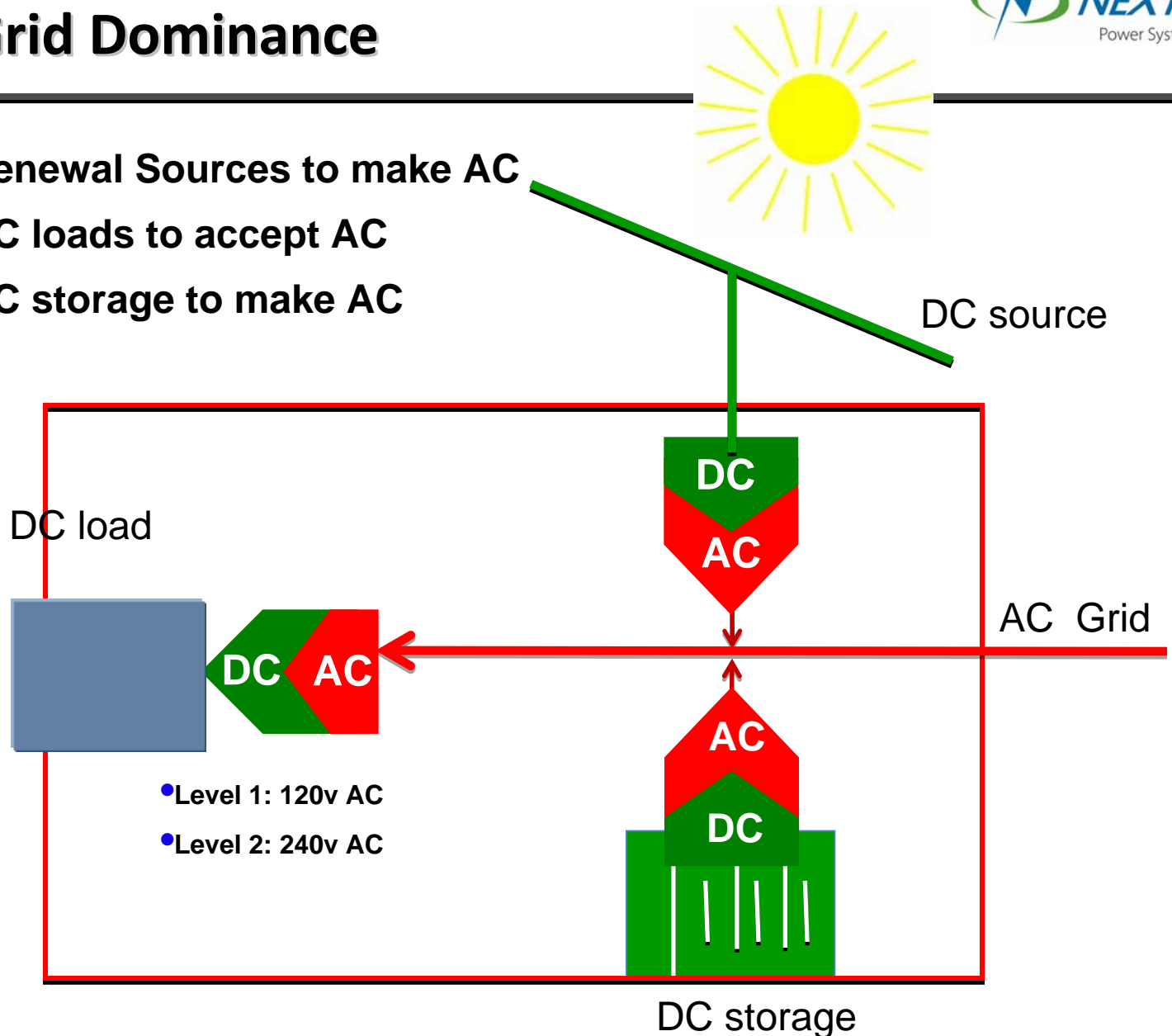
Most alternative energy are native DC power generators



Most digital devices in use today and use DC power natively

Still AC Grid Dominance

- Forcing Renewal Sources to make AC
- Forcing DC loads to accept AC
- Forcing DC storage to make AC



Yale Case Study

“The total amount of energy flowing into external power supplies in the U.S. today is about 100 TWh/year. DC power is also used in electronic products with internal power supplies. These collectively consume in excess of 250 TWh/year. Taking the Energy Star Tier 1 levels as the average for the near-future stock, the average efficiency of this conversion is about 68%...”*



Sector	Potential MWh Saved	Potential Efficiency Gain in Sector(s)	Potential Reduction in National Load
Residential	185,264,820	25.32%	2.98%
Commercial	123,290,000	19.03%	3.03%
Manufacturing	77,128,960	20%	1.90%
Data Centers	9,657,827	18%	0.24%
Total	396,341,607	21.15%	8.15%

***Low-voltage DC: Prospects and Opportunities for Energy Efficiency** Bruce Nordman, Rich Brown, Chris Marnay Lawrence Berkeley National Laboratory, November 16, 2007

Environmental Impact

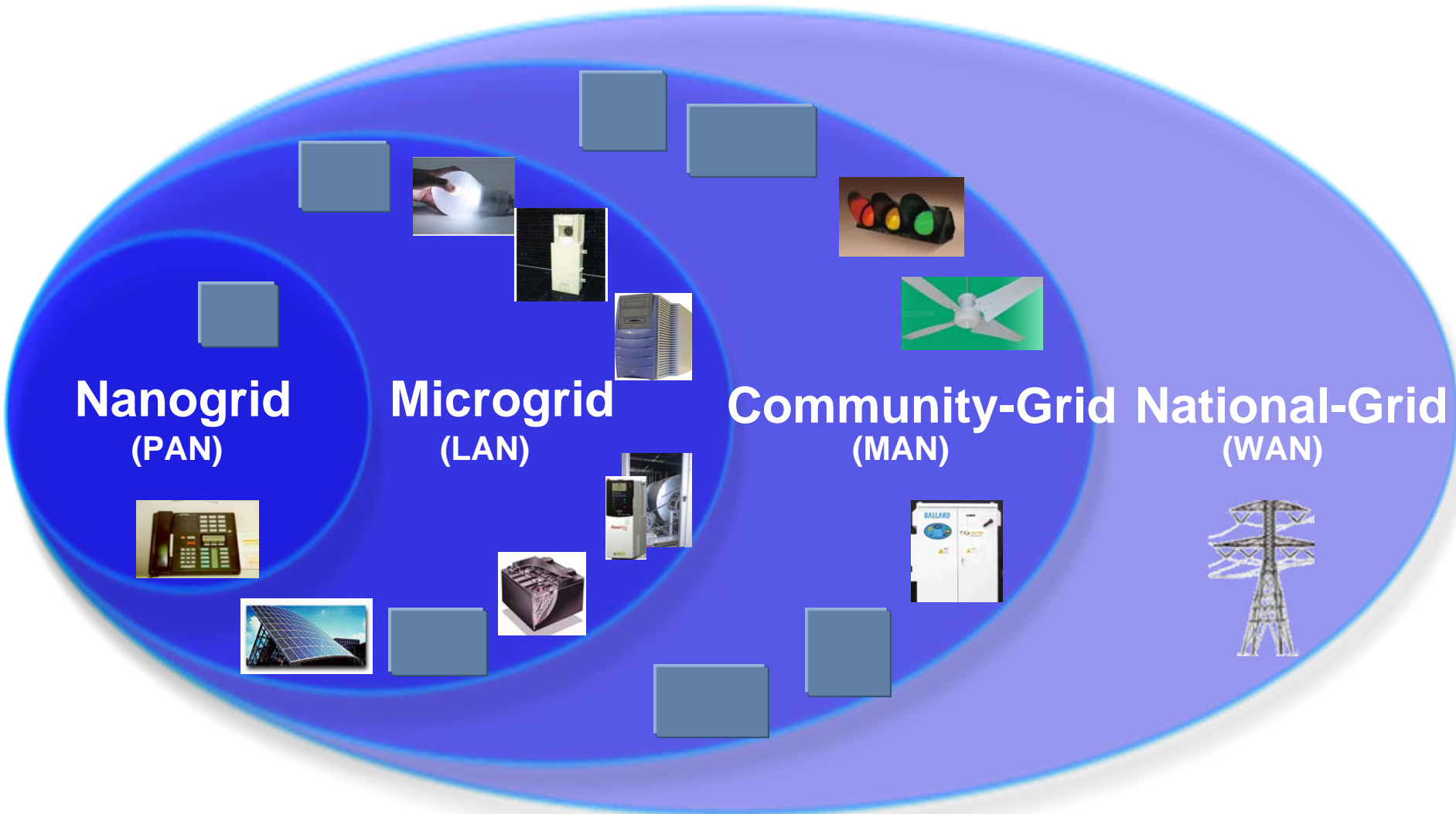
According to research on power supply efficiency sponsored by the U.S. Environmental Protection Agency and the California Energy Commission, as of 2004, there were nearly 2.5 billion electrical products containing power supplies in use in the U.S., with about 400 to 500 million new power supplies sold each year. Greenplug estimates 528 million external power supplies were shipped to U.S. in 2009, 340 million were retired in the U.S. and only 12.6% of them were recycled, resulting in 279 million going into U.S. landfill's.⁽¹⁰⁾

Think of the “brick”
charging your laptop
or cell phone

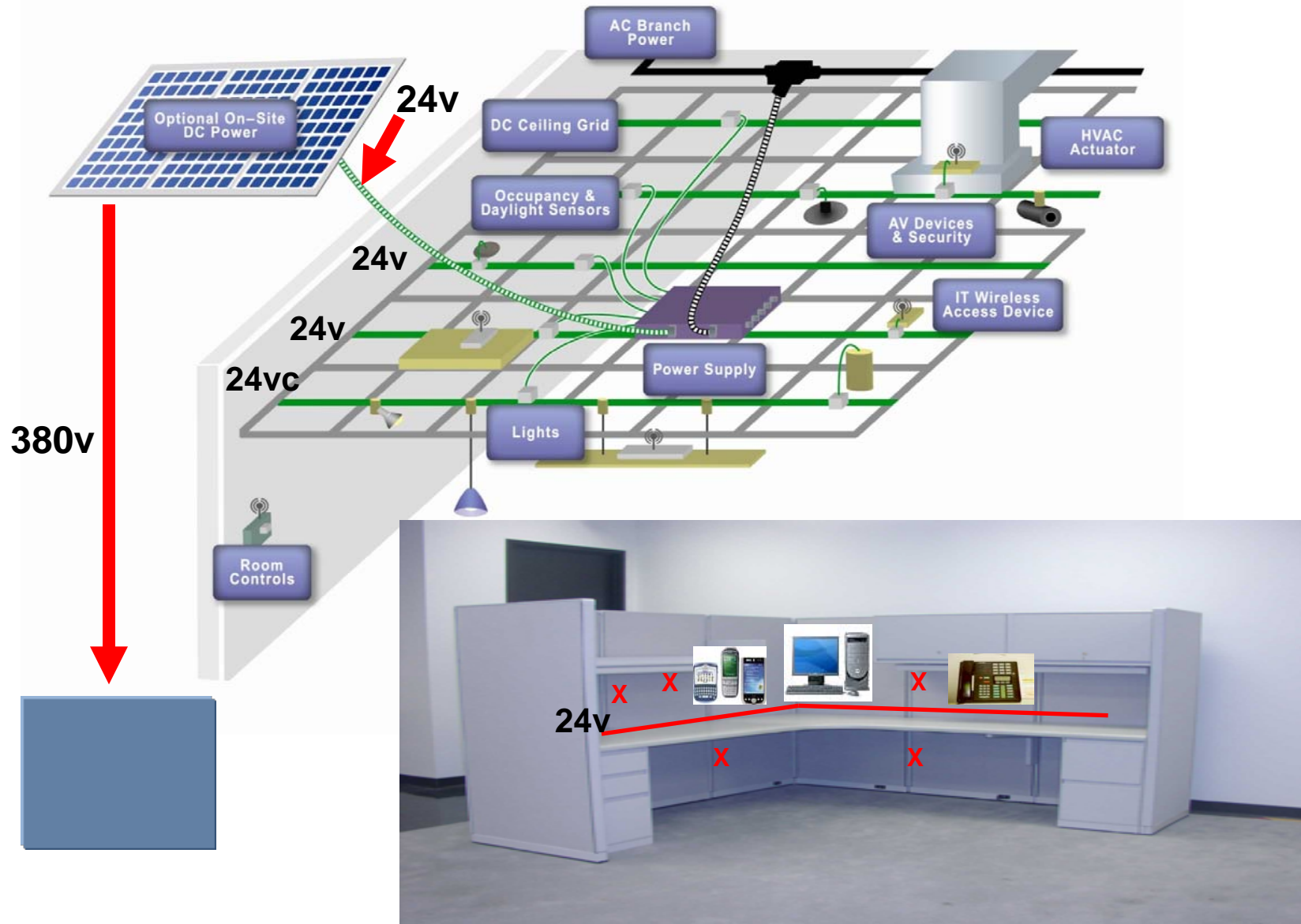
Digital = “DC”



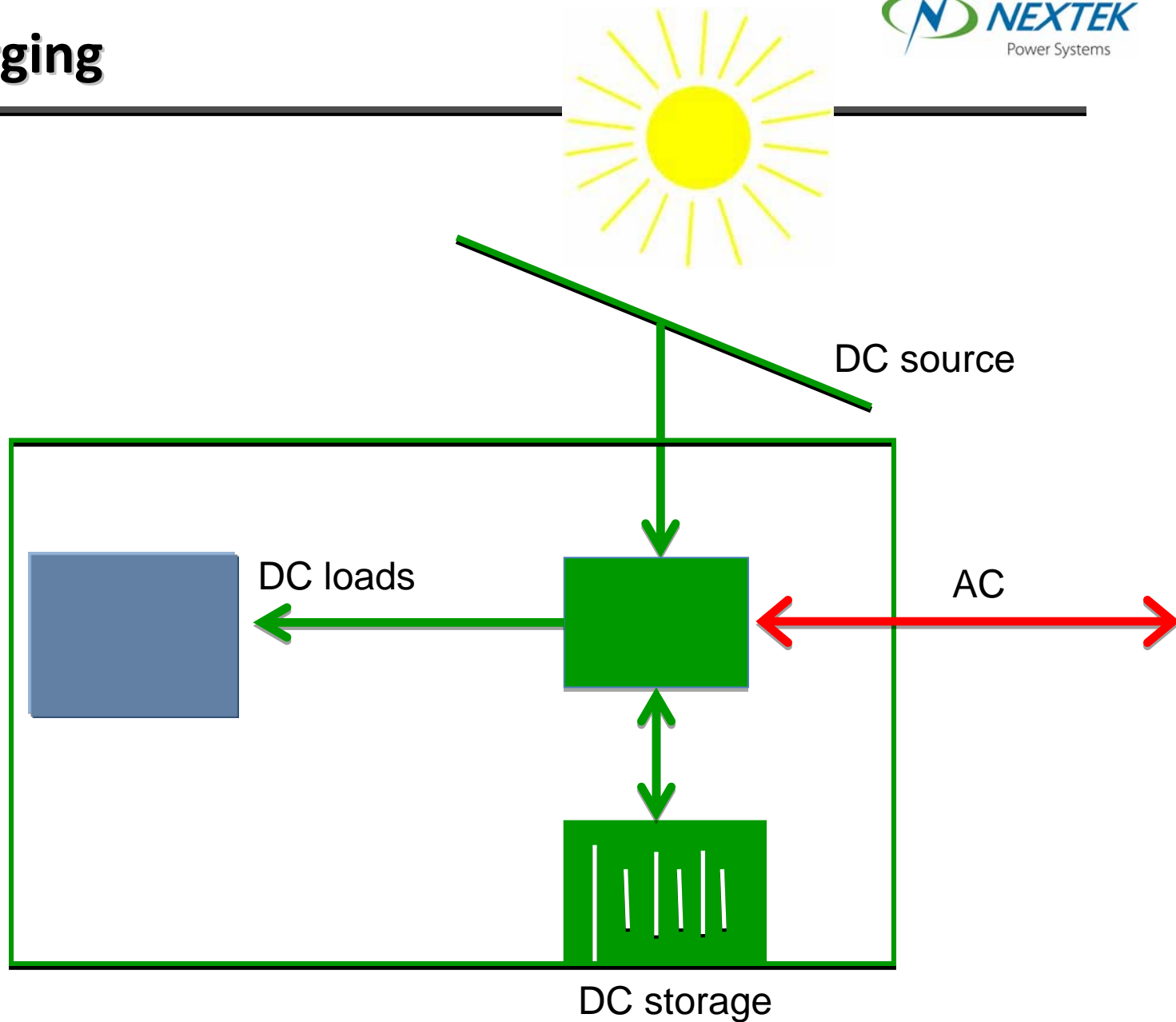
Use Power How and Where It Is Generated



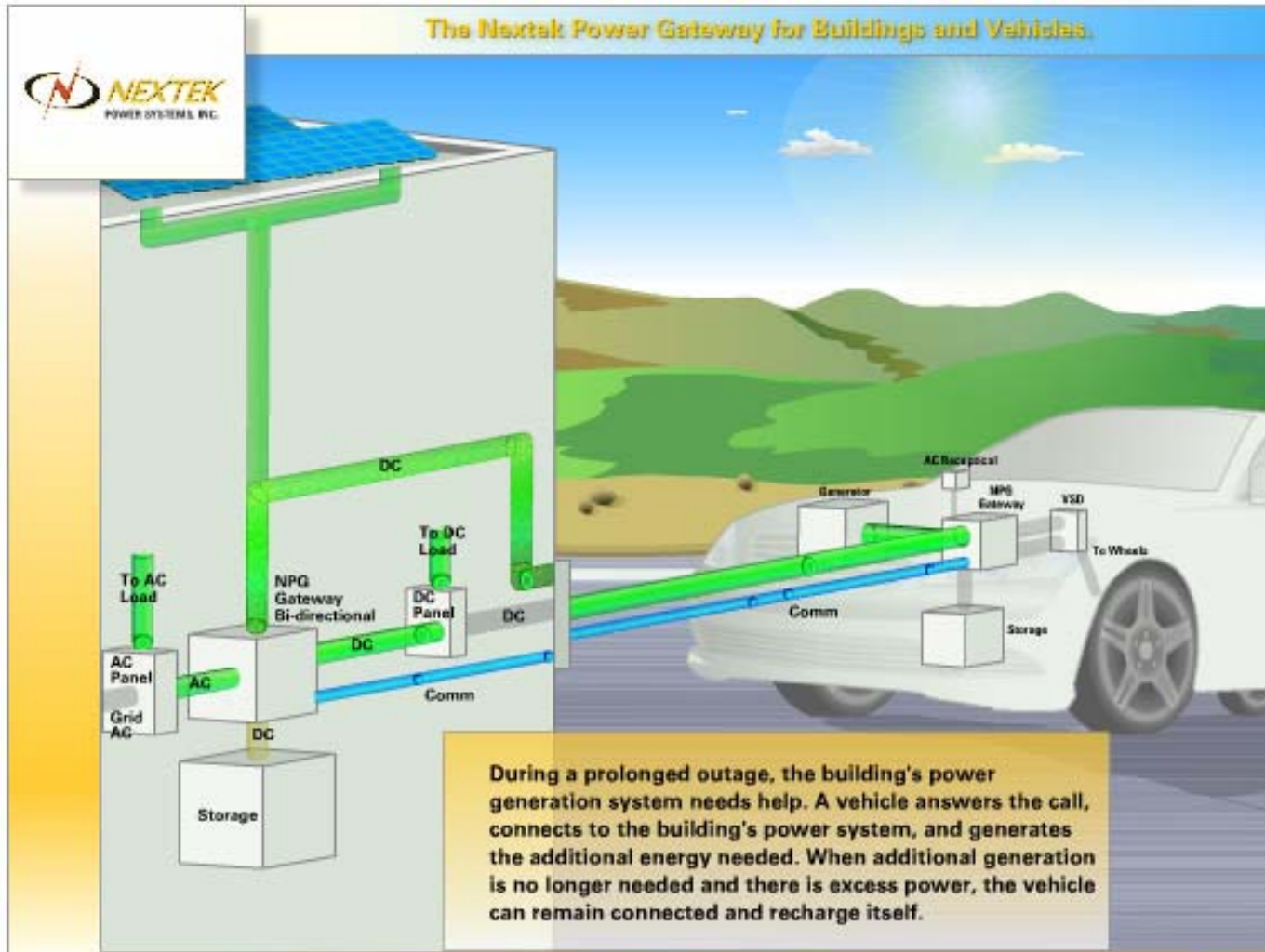
EMerge System: Ceiling Grid as a DC “Power Highway”



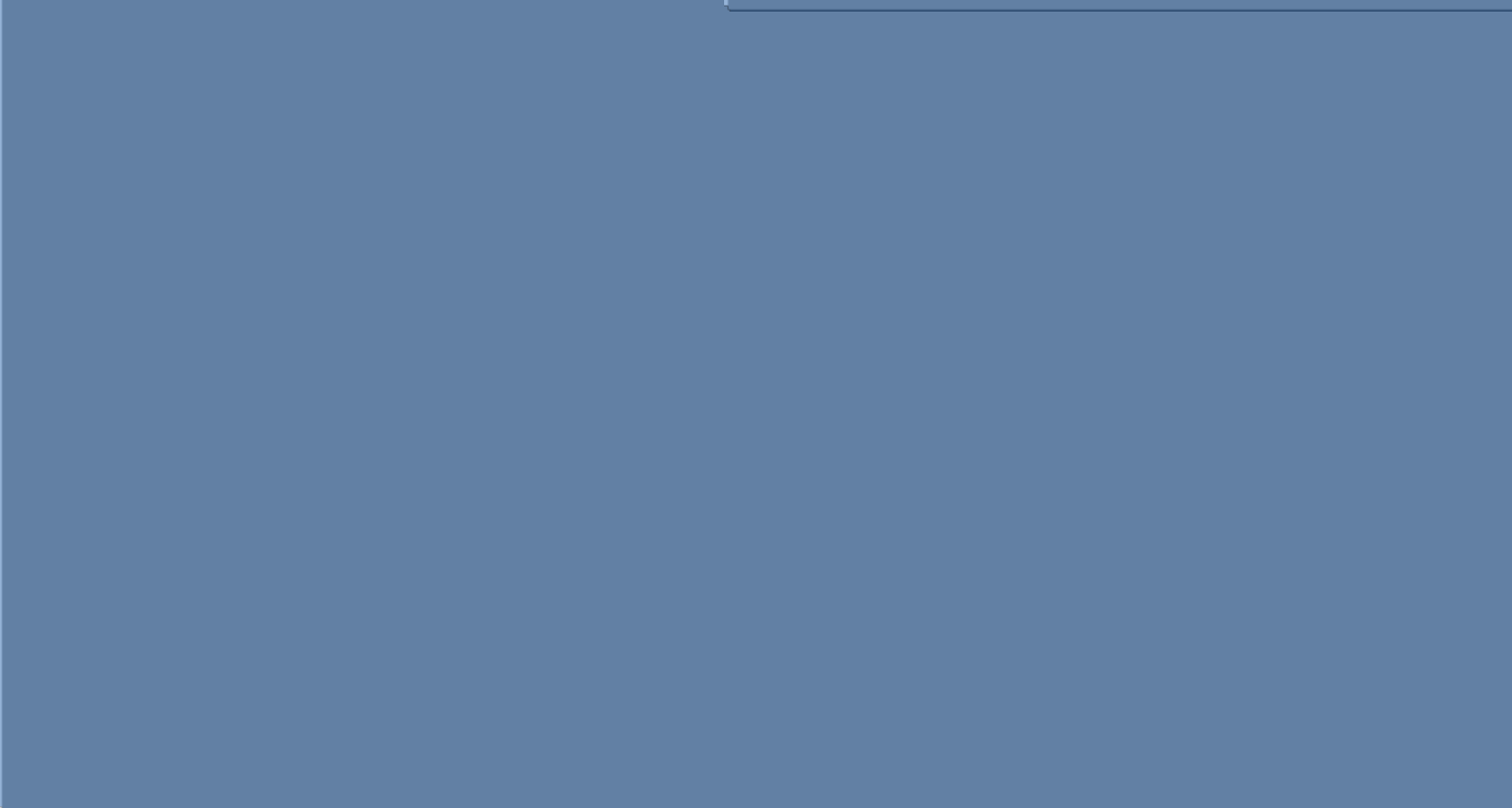
Green Charging



How does it work?



The CHAdeMO Standard – March 2010



The CHAdeMO Specifications

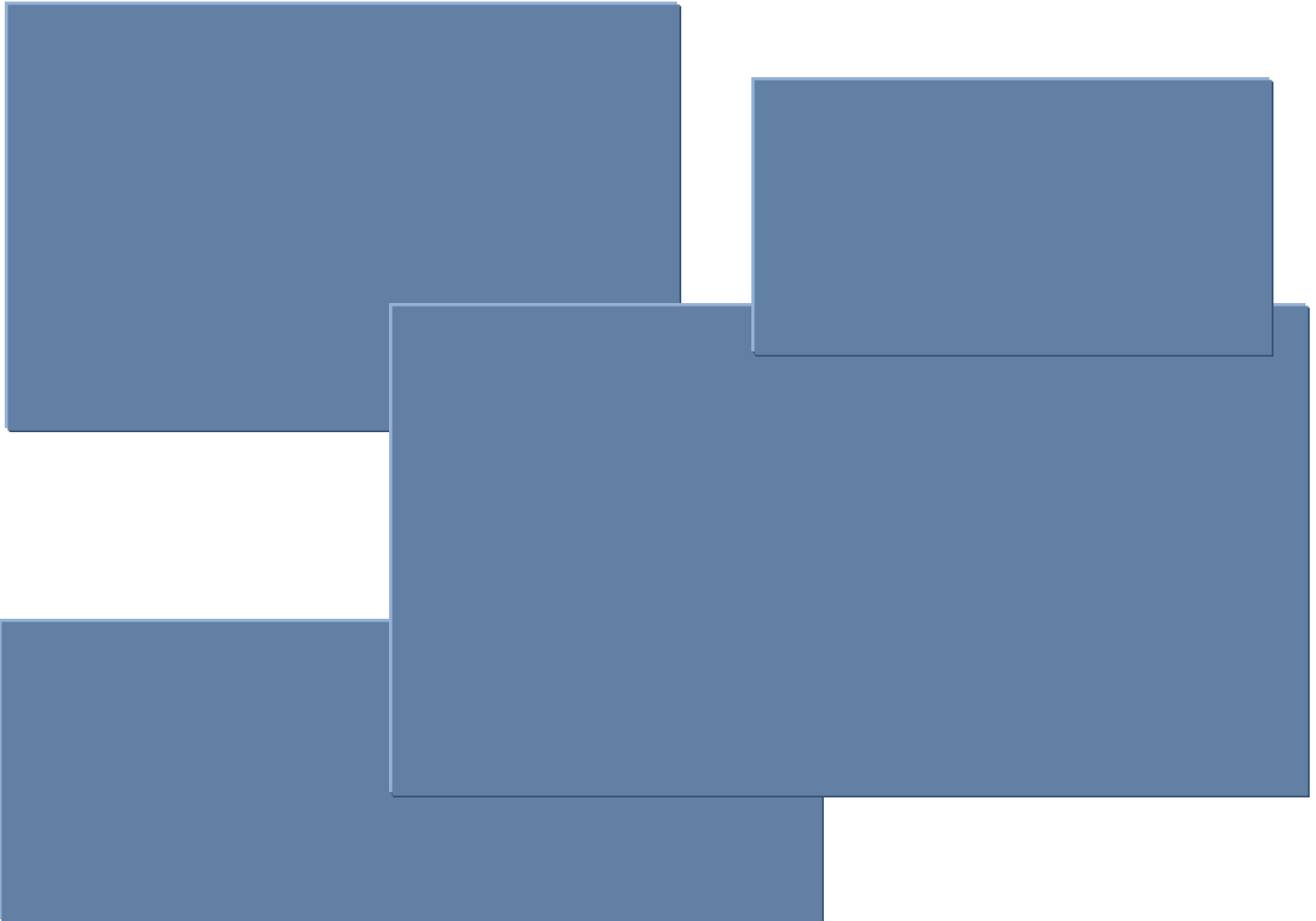
- Input: 3-phase 200vAC
- Output: 50kw Max. 200-500vDC, 125Amp Max
- 5min charge/25mile drive range, 10min charge/37 mile range
- CAN for communication and control



The Savings Beyond Efficiency

- **11 pounds saved per vehicle – copper, aluminum**
 - A 3.3kw vehicle charger with a 5kg weight target
- **143 million pounds saved in USA**
 - 13 million vehicles on the road 2011
 - Fuses, transistors, transformers, diodes and resisters
- **715 million pounds saved globally**
 - 65 million vehicles world wide

EPRI Report – Beyond Sun Power – Aug. 2010



Solar DC Air Handling – Town of Hempstead

The Town of Hempstead Challenge

- Under a law settlement, Virginia Electric Power Company was required to pay \$2.1 million for air pollution mitigation projects in New York State. The \$2.1 million is being administered by the New York State Energy Research and Development Authority to install solar energy equipment on government-owned buildings in the state.

Nextek Solution

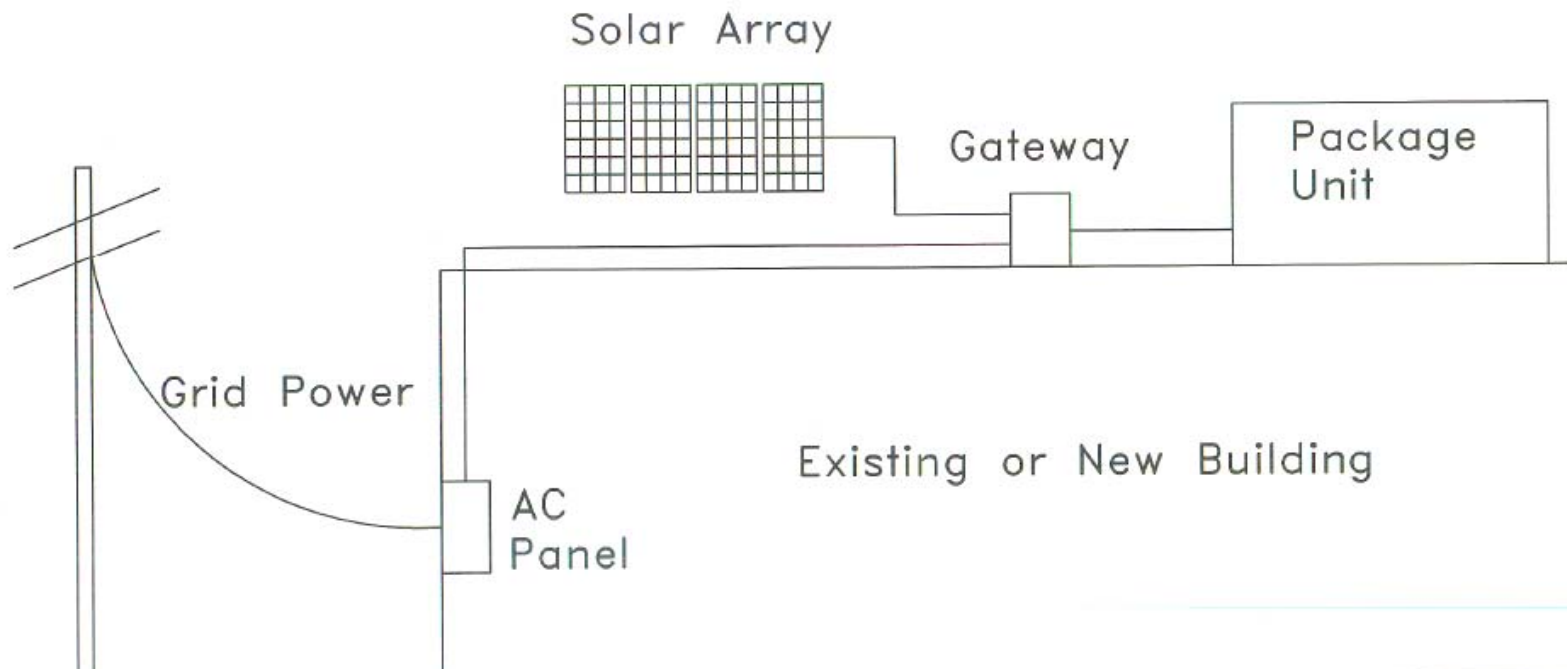
- Nextek's NPS1000 brings solar electricity to Allen-Bradley PowerFlex 700 series motor drives, integrated in the Town Hall's HVAC system
- 256-panel/40-kilowatt solar energy supporting the motor drives without any hardware modification. The solar PV carries 2 motors (a 40hp and a 25hp) during the peak of the day, seamlessly changing the power source to grid-supplied AC as the sun goes down, watt for watt.

Benefits

- Nextek's system improves the solar utilization by ~10% when compared to conventional systems
- The reduced up-front capital expenditure, avoided grid power purchases, lower demand charges and other control benefits improve the Town's ROI by ~40%
- Daytime Solar Contribution and Nighttime Speed Reduction Reduce Utility Load By 75%



Solar DC Air-conditioning



- Reducing Fan Speed at Night Reduces Power Requirement Disproportionately
- Daytime Solar Contribution and Nighttime Speed Reduction Reduce Utility Load By 75%
- Additional Loads: Fan coil unit, Centrifugal chillers, Air handler, Pumps, Cooling towers

Solar DC Air-conditioning

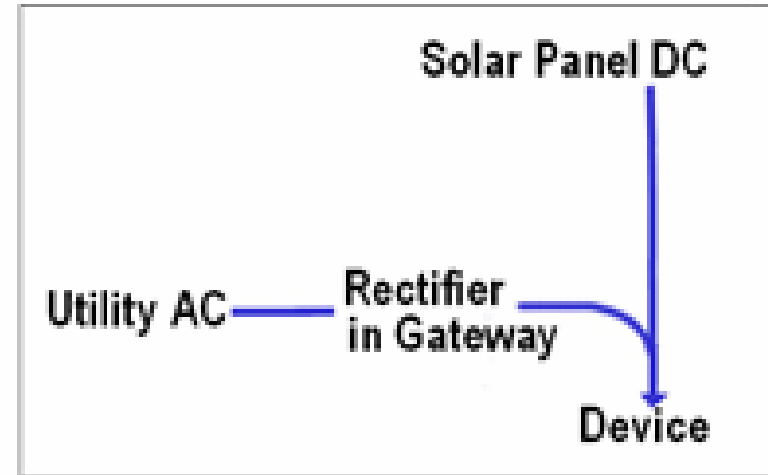
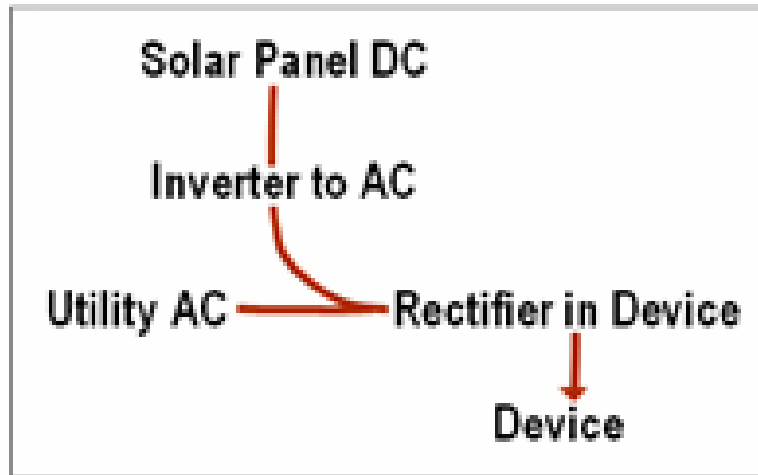




Michigan Assembly Plant



Conclusion



- **Increases the Efficiency of PV by 10% Minimum, and Up to 45%**
- **Eliminates Disconnection of PV Systems Under IEEE 1547**
- **Facilitate Easy Interconnection of Battery Storage**
- **Enables Triple Redundancy for Higher Reliability**

Who Are the Innovators?



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