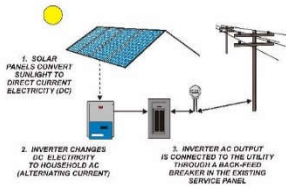


What's a PV System?

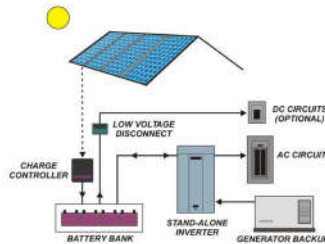
A renewable power source that you can own that generates electricity for you everyday. Installed on your roof, in the ground in your backyard, on your awnings, or on your carport, it consists of solar panels (photovoltaics – PV) and balance of system equipment such as racking, wire harnesses, inverters, charge controllers, and possible batteries for storage. In standard grid-tie, an inverter connects the DC into grid AC and feeds it via the breaker panel to the utility's meter onto the grid. For off-grid and grid-tie with battery backup, battery storage and a MPPT charge controller are required as illustrated above. Financial incentives (including utility incentives) for solar and energy efficiency which include a 30% federal tax credit for PV for-profit business and individuals are outlined at <http://www.dsireusa.org>

Grid-Interactive



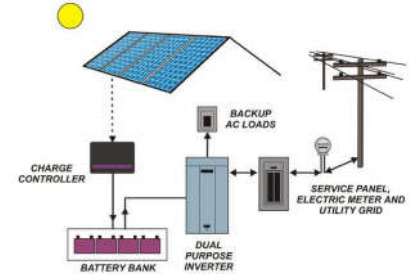
<http://www.aladdinsolar.com/pvsystems.html>

Standalone – Off-grid



<http://www.aladdinsolar.com/pvsystems.html>

Grid-tie with Battery Backup



<http://www.aladdinsolar.com/pvsystems.html>

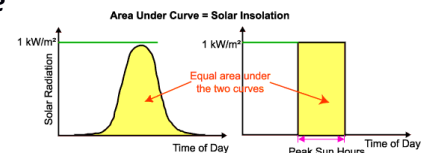
Estimating your PV system size

In Atlanta average of 5 peak sun hours (psh) per day
 (~3.5 psh in winter; ~6 psh in summer)

$1000 \text{ W/m}^2 \times 5 \text{ psh} \times 80\%$ (approx. derate) =

4000 Wh of energy per day for every 1 kW of PV you install

So if you install a 4 kW PV system, expect around 16 kWh of energy per day on average in Atlanta



Steps to a PV System

- Review your bills
- Make the appropriate behavioral changes/conserve
- Do an energy audit
- Tighten up your thermal envelope and reduce loads
- Understand your needs and an appreciation of the technology
- Type of system based on needs
- Estimate your PV system size, your budget, and your financial incentives
- Survey your land/roof
- Talk with an installer/designer

- **What's your goal?**
- -> **Type of System (grid-tie to microgrid)**

- **Where can you install?**
- -> **Mounting and Shading analysis**

- **How much do you want to offset?**
- -> **PV system size analysis**

- **How much can you afford?**
- -> **Cost Analysis**

- **Off-grid system or with batteries?**
- -> **Load Analysis**

Parts of PV System

Panels (typically monocrystalline or multicrystalline) as measured in DC Watts under Standard Test Conditions (STC). Typical Wattage is between 250 W to 310 W depending on size of panels.

Inverters: convert DC from Panels to AC to feed into the grid. If using DC loads directly such as LED lighting then inverters are not required for those loads

Racking, wire harnesses, safety disconnects, combiner boxes.

What are my financial incentives?

- Check <http://www.dsireusa.org> for the **30% federal tax credit** and utility rebates
- Check your utility for its incentives
- Consider your electric tariff/schedule



Georgia Power:

<http://www.georgiapower.com/earthcents/green/solar-buyback.cshtml>

Jackson EMC

<http://www.jacksonemc.com/sunpower>

Cobb EMC

<http://www.cobbemc.com/solarpanel>

Marietta Power

Walton

Suwanee

Greystone Power

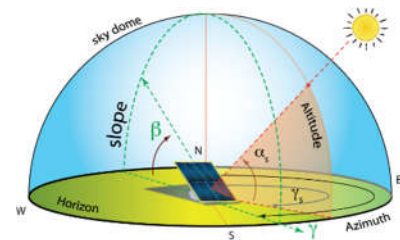


How does tilt and orientation affect me? (I might have shading issues)

In general you want to avoid partially or fully shading panels during peak sun hours (such as solar noon). Best tilt angle is around 30 degrees from the horizontal for the Atlanta area facing due South. However don't sweat the small stuff. The chart below shows how much you lose from installing away from 30 degrees tilt and facing due south. Also keep in mind that solar south (or north) is different than magnetic south (or north) – this can be determined by magnetic declination (or variation) charts.

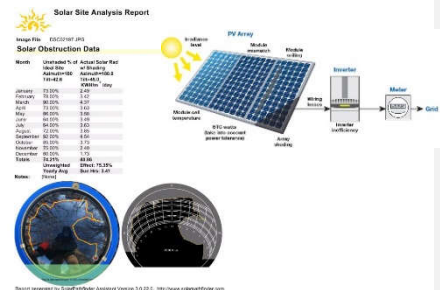
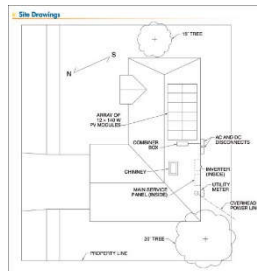
Orientation - Compass bearing

	West		SW			South			SE			East	
	270°	255°	240°	225°	210°	195°	180°	165°	150°	135°	120°	105°	90°
Vertical	90°	56	60	64	67	69	71	71	71	69	65	62	50
	80°	63	68	72	75	77	79	80	80	79	77	74	65
	70°	69	74	78	82	85	86	87	87	86	84	80	76
Roof Pitch (Degrees)	60°	74	79	84	87	90	91	93	93	92	89	86	81
	50°	78	84	88	92	95	96	97	97	96	93	89	85
	40°	82	86	90	95	97	99	100	99	98	96	92	88
	30°	86	89	93	96	98	99	100	100	98	96	94	90
	20°	87	90	93	96	97	98	98	98	97	96	94	91
	10°	89	91	92	94	95	95	96	95	95	94	93	91
Horiz.	0°	90	90	90	90	90	90	90	90	90	90	90	90



What can I expect from my installer?

- Shading analysis, site plan analysis
- Energy yield estimate/simulations
- Mechanical drawings
- Electrical drawings
- Safety / NEC Compliance sheet
- Cost breakdown



How much will this cost (standard grid-tie model without including incentives)?

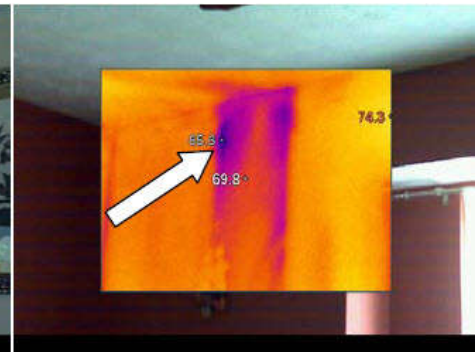
- 2 kW** system: 8 kWh energy/day (244 KWH/month)
 - Cost: ~\$7K (not accounting for any tax credits)
- 5 kW** system: 20 kWh energy/day (610 KWH/month)
 - Cost: ~\$17K (not accounting for any tax credits)
- 8 kW** system: 32 kWh energy/day (976 KWH/month)
 - Cost: ~\$27K (not accounting for any tax credits)

House Summary



- An Atlanta-based standard 2000 square foot house feature solar PV, battery-storage, solar thermal, a DC microgrid, induction cooking, full LED lighting, super insulation, and a 20+ SEER heatpump system for heating and cooling.
- Work and research on the house was done in conjunction with Oakridge National Labs, Southface Energy Institute, and the Southern Company.
- Net-50 going to Net-Zero with expansion in solar PV and battery storage.
- Various microgrids allow the house to operate independently of the main utility grid as well as in conjunction it.

Auditing: blower door & thermal scan



Home Energy Monitor / Audit



Comprehensive Home Energy Audit Report	
5465 Randolph Rd., Unit B, Rockville, MD 20852 Phone: 301-981-2121 www.ecobeco.com	
Customer Name: John Smith Customer Address: 1261 Wandering Lane City/State, Zip: Rockville, MD 20852 Inspection Date: 08/13/17	Estimate Photo Number: 0871-222-2222 Estimate Photo Number: 0853-333-3333 Customer Email: info@ecobeco.com Home Performance Advisor: Norman Wadler
House History: Year Built: 2004, Remodeled: 2009, Type: Colonial, Garage: 2, # of Bedrooms: 4	
Customer Concerns Airflow to outside bedrooms, Security, energy savings, electrical, water, plumbing, kitchen, laundry, clean energy bills	
Audits that comply with the Building Performance Institute (BPI) standard include blower door and combustion safety testing. The results of these tests, along with your concerns and our detailed visual inspection, determine our recommendations for you.	
Air Exchange (at 50 cubic feet per minute) Blower Door Test Results: 3.970 Your Home's Building Airflow Standard: 2.331 Your home is: 170% of standard	Recommendations Overview <input type="checkbox"/> Health & Safety Concerns <input type="checkbox"/> Air Sealing <input type="checkbox"/> Insulation Augmentation <input type="checkbox"/> HVAC Repairs <input type="checkbox"/> HVAC Repair / Tune-Up <input type="checkbox"/> Water Heater Repairs <input type="checkbox"/> Air Ductwork Repairs <input type="checkbox"/> Major Appliance Repairs <input type="checkbox"/> Add Smart Power Strips <input type="checkbox"/> Add CFLs <input type="checkbox"/> Clean Ceilings/Wall <input type="checkbox"/> Surgeprotector Solar Install
Combustion Safety Tests Results: Pass	Your Estimated Annual Utility Costs: \$3,113 Your Estimated Total Savings Are: \$844 Percentage of Savings: 27%
The pages that follow provide the prioritized list of measures broken into four areas: - Health & Safety Recommendations - These should be done first! - Energy Efficiency & Comfort Recommendations - Appliance Replacement Recommendations - These appliances should be changed now because of the age or performance of your current appliance. Keep in mind that the energy savings are not meant to pay for the appliance. Instead, the savings pays for a higher efficiency model. - Additional Opportunities - These items are either behavioral suggestions or are products that you can purchase that are not currently modeled in the energy software.	
For each recommendation, we provide a priority, an installer recommendation (where appropriate) and an implementation cost estimate. We use the EPA-approved BEAACH modeling software, which estimates the annual utility savings that you would receive from implementing these measures. Please note that the energy model provides a savings estimate based on performance of similar homes of similar configuration and when all behaviors and weather conditions are constant. ecobeco does not guarantee any specific energy savings.	

Home Energy Monitor / Audit



From ACH(50) of 14.2
to ACH(50) of 10.1

	CFM ₂₅	% Leakage to Outside
Pre-Retrofit	530	31%*
Post-Retrofit	110	6.4%**
% Reduction	79%	79%

PV Array



- Gathered data
- Tightened up the thermal envelope
- Heating and cooling system redux
- Smarter lighting
- Better appliances
- Installed a power grid (solar PV)
- Electrified transportation
- Feedback leading to behavior changes

30% reduction in whole house air leakage
80% reduction in duct work leakage
40% reduction in complete energy usage