Energy. The Past.
Key
Red: generation
Blue: transmission
Green: distribution
Black: customers

transmission lines
765, 500, 345, 230 and 138 kV

subtransmission customer
26 kV and 69 kV
primary customer
13 kV and 4 kV
secondary customer
120 V and 240 V

Source: Adapted from North American Electric Reliability Corporation
SMART GRID
A vision for the future — a network of integrated microgrids that can monitor and heal itself.

Smart appliances
- Can shut off in response to frequency fluctuations.

Demand management
- Use can be shifted to off-peak times to save money.

Solar panels
- Houses

Processors
- Execute special protection schemes in microseconds.

Disturbance in the grid

Storage
- Energy generated at off-peak times could be stored in batteries for later use.

Sensors
- Detect fluctuations and disturbances, and can signal for areas to be isolated.

Isolated microgrid

Wind farm

Generators
- Energy from small generators and solar panels can reduce overall demand on the grid.

Central power plant

Industrial plant
Fun Fact

Power outages caused by weather cost the US economy:

A. $500 - $900 million per year
B. $1 - $5 billion per year
C. $5 - $10 billion per year
D. $20 - 40 billion per year
A microgrid is a local energy grid with control capability, which means it can disconnect from the traditional grid and operate autonomously.

On the Island

Independent generation
The microgrid system can generate electricity from a single solar or wind installation, or a combination of traditional and alternative power generation methods.

Critical services
A microgrid is usually built to power critical community resources like hospitals, police and fire departments, and schools so they can continue to function in emergency situations.

Storms
Storms and other disasters can cause large-scale outages on the main grid. Microgrids are being built today to increase resilience and keep the power on during emergencies.

On the Mainland

Main power generator
Power for most homes and businesses is generated at a base-load plant. In non-emergency situations, microgrids can help reduce peak demand at the base-load plants.

Substation
A substation is the intermediary between the power plant and the customer. If the substation fails or has problems, customers lose power or experience brownouts.

Main coupling switch
The microgrid and main grid connect. The coupling switch functions as the main switch in case of grid outage. On an average day, the coupling switch ensures that voltage levels remain equal between the regular grid and the microgrid.

Homes
Individual homes are usually low on the microgrid priority list, but can be linked to the microgrid if they have power generating capabilities, like rooftop solar panels.

Businesses
A key commercial property may sometimes be included in the microgrid, depending on its generating power and the needs of the community.
The 3 Trends
Decentralization
Decentralization
Decentralization
The March To...
Moore’s Law
Metcalf’s Law

Think of this as a Rolodex

Think of this as your first Palm Pilot or PDA.

Think of this as all of your social media connections, your LinkedIn network, your business contacts, & their interconnectedness to CRM systems & other platforms & tools.
Sach’s Law

Cumulative production GigaWp

- 1978
  - Single crystal, evaporated contacts
  - Screen printed metal
  - Wire saws
  - Textured mono
  - Aluminum BSF
  - Cast multi
  - Point contact mono
  - Passivating SN
  - Iso-texture multi

Retail Natural Gas Electricity - Grid Parity - Wholesale Coal Electricity

Today - 2015 - 2020

7% Global Generation from PV

Source: Professor Emanuel Sachs, Massachusetts Institute of Technology

*Assumes annual production growth of 35% and an 18% learning curve; PV costs based on 18% capacity factor and 7% discount rate.
What happens when all 3 merge?
Automation?
The Economic Opportunity.
61%
38%
$1,000,000,000,000
77%
Irony
$2.0 \text{ Trillion} = \$3.8 \text{ Trillion}
$0.5\text{ Trillion} = \$1.9\text{ Trillion}
U.S. Direct & Secondary Energy Jobs

- Solar (2015)
- Nuclear (2015)
- Coal (2012)
- Natural Gas (2015)

- Direct Jobs
- Total w/ All Secondary Jobs

Jobs

- 1,600,000
- 1,400,000
- 1,200,000
- 1,000,000
- 800,000
- 600,000
- 400,000
- 200,000
Solar Pricing History in Alabama

2007
• Residential system ~ $8/W
• Small commercial system ~ $7.50/W

2012
• Residential system ~ $5/W
• Small commercial system ~ $4.50/W

2015
• Residential system ~ $3/W
• Small commercial system ~ $2.75/W

2017
• Residential system ~ $2/W
• Small commercial system ~ $1.75/W
Avion Solutions Inc.

50kW solar covered parking

- ~$6,300 annual energy revenue
- 8.2 years payback
- 9% IRR
MediaFusion, Inc.

Size: 50 kW

Production: 69,425 kWh

Pre-incentive cost: $96,500 ($1.93/watt)

Post-incentive cost: $38,841
MediaFusion, Inc.

With incentives payback = ?
  5.8 years
Without incentives payback = ?
  12.5 years
## 2 Project Summary

<table>
<thead>
<tr>
<th>Payment Options</th>
<th>Cash Purchase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Project Costs</td>
<td>$97,500</td>
</tr>
<tr>
<td>Upfront Investment Payment</td>
<td>$97,500</td>
</tr>
<tr>
<td>30-Year Electric Bill Savings</td>
<td>$323,311</td>
</tr>
<tr>
<td>Electric Bill Savings Year 1</td>
<td>$6,313</td>
</tr>
<tr>
<td>30-Year IRR</td>
<td>14.85%</td>
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<tr>
<td>30-Year LCOE Utility</td>
<td>$0.178</td>
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<tr>
<td>30-Year LCOE PV</td>
<td>$0.021</td>
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<tr>
<td>Payback Period</td>
<td>5.9 Years</td>
</tr>
<tr>
<td>Blended Savings Per kWh PV</td>
<td>$0.093</td>
</tr>
<tr>
<td>Electricity Escalation Rate</td>
<td>4.00%</td>
</tr>
</tbody>
</table>

Combined Solar PV Rating
Power Rating: 50,000 W-DC
Power Rating: 44,669 W-AC-CEC
3.1.1 PV System Details

**General Information**
Facility: MediaFusion  
Address: 4951 Century Street Northwest Huntsville AL 35816

**Solar PV Equipment Description**
Solar Panels: 50.0kW-DC Premium Modules  
Inverters: Standard Inverter

**Solar PV Equipment Typical Lifespan**
Solar Panels: Greater than 30 Years  
Inverters: 15 Years

**Solar PV System Cost And Incentives**
Solar PV System Cost: $97,500  
Federal Tax Credit: -$29,250  
Federal - MACRS Bonus Depreciation: -$29,006  
Net Solar PV System Cost: $39,244

**Solar PV System Rating**
Power Rating: 50,000 W-DC  
Power Rating: 44,669 W-AC-CEC

**Energy Consumption Mix**
Annual Energy Use: 84,400 kWh

- **Utility**: 16,824 kWh (19.93%)  
- **Solar PV**: 67,576 kWh (80.07%)
Policy
3rd Party Solar PV Power Purchase Agreement (PPA)

www.dsireusa.org / July 2016

At Least 26 States + Washington DC and Puerto Rico Authorize or Allow 3rd Party Power Purchase Agreements for Solar PV
RISE OF 3RD PARTY OWNERSHIP

CALIFORNIA RESIDENTIAL SOLAR INSTALLS

Percent 3rd party owned

2007: 12%
2008: 7%
2009: 12%
2010: 23%
2011: 46%
2012: 71%
2013: 71%
2014: 66%


INSTITUTE FOR LOCAL SELF-RELIANCE
Better Local Permitting Means Big Solar Savings

As the cost of solar falls...

...the savings from streamlined permitting rise

Approx. year for residential installation*

<table>
<thead>
<tr>
<th>Year</th>
<th>2013</th>
<th>2017</th>
<th>2023</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>$6.00</td>
<td>$5.00</td>
<td>$4.00</td>
</tr>
<tr>
<td></td>
<td>$3.00</td>
<td>$2.00</td>
<td></td>
</tr>
</tbody>
</table>

Installed Cost per Watt

*From ILSR’s Rooftop Revolution reports: http://www.ilsr.org/rooftop-revolution/

Data from: The Impact of City-level Permitting Processes on Residential Photovoltaic Installation Prices and Development Times (LBNL, 2013)
Community Solar
The Power is in Your Hands

Your Panels

Your Neighbors’ Panels

powered by Clean Energy Collective
The Alabama Ethics Commission today deadlocked on whether a member of the Public Service Commission could lease land to a solar energy company that plans to sell electricity to Alabama Power Company.

Commissioner Chip Beeker sought the advisory opinion on whether he could lease 451 acres he owns in Greene County to a company called Coronal Development Group.

The lease would pay $500 per acre, per year over 25 years, which would total $225,500 a year and $5.6 million over 25 years.
Section 2. Amend ARTICLE 73 - SUPPLEMENTARY REGULATIONS, Section 73.1.1 - Accessory Uses to add the Following:

(5) Photovoltaic Solar Energy System, On-Site

A photovoltaic solar energy system ("solar energy system") is permitted in all zoning districts as an accessory use to a principal use except in the case of a non-residential use in a residential zoning district. A solar energy system as an accessory use to a non-residential use in a residential zoning district requires a Special Exception. A solar energy system is considered an accessory use when the power generated from the solar energy system is equal to or less than the expected power usage of the principal use and any other accessory use on the property based on Huntsville Utilities Electric Department estimates. The installation and construction of a solar energy system shall be subject to the following development and design standards:

(a) A solar energy system shall provide power for the principal use and/or accessory use of the lot on which the solar energy system is located and shall not be used for the generation of power for the sale of energy to other users.

(b) The owner of a solar energy system connected to the utility grid shall provide written authorization from the local utility company acknowledging and approving such connection.

(c) A solar energy system may be roof mounted, pole mounted or ground mounted.

(d) A roof mounted system may be mounted on a principal...
Alabama 2016 Solar Report Card

Overall Grade: F

Policy:
- RPS Law: F
- Solar Carve-Out: F
- Electricity Cost: C
- Net Metering: F
- Interconnection: F

Incentives:
- Tax Credits: F
- Rebates: C
- Performance Payments: D
- Property Tax Exemption: F
- Sales Tax Exemption: F

5-kW Solar Payback Time: 15 Years
Investment Return (IRR): 6.2%
The Wildcard.
Battery costs have decreased significantly from 2007 to 2017:

- **2007**
  - Residential system: $8/W
  - Small commercial system: $7.50/W

- **2012**
  - Residential system: $5/W
  - Small commercial system: $4.50/W

- **2015**
  - Residential system: $3/W
  - Small commercial system: $2.75/W

- **2017**
  - Residential system: $2/W
  - Small commercial system: $1.75/W

---

**LITHIUM-ION EV BATTERY EXPERIENCE CURVE COMPARED WITH SOLAR PV EXPERIENCE CURVE**

- Crystalline Si PV module
- Li-ion EV battery pack

**Historical Price (USD/W, USD/Wh)**

**Cumulative Production (MW, MWh)**

- **1976**
- **1988**
- **1998**
- **2004**
- **2008**
- **2010**
- **H1 2014**
- **2014**

**Note:** Prices are in real (2014) USD.

**Source:** Bloomberg New Energy Finance, Maycock, Battery University, MIT

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**m = 24.3%**

**m = 21.6%**
Battery 2007
• Residential system ~ $8/W
• Small commercial system ~ $7.50/W

2012
• Residential system ~ $5/W
• Small commercial system ~ $4.50/W

2015
• Residential system ~ $3/W
• Small commercial system ~ $2.75/W

2017
• Residential system ~ $2/W
• Small commercial system ~ $1.75/W

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Notes: USD/kWh = United States dollars per kilowatt-hour; Wh/L = watt-hours per litre. PHEV battery cost and energy density data shown here are based on an observed industry-wide trend, include useful energy only, refer to battery packs and suppose an annual battery production of 100,000 units for each manufacturer.

Sources: US DOE (2015 and 2016) for PHEV battery cost and energy density estimates; EV Obsession (2015); and HybridCARS (2015).
100% ISN’T JUST POSSIBLE. IT’S IMPERATIVE.
JOIN! | BE A MEMBER

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• Heads up on events & parties
• Latest local clean energy updates
• Support better policy

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