UMassAmherst
The Commonwealth's Flagship Campus

LEARN LIVE LEAD Sustainable UMASS

Solar Carports: Turning University Parking Facilities into Renewable Electricity Plants

September 26, 2017

www.umass.edu/sustainability

Timeline – &

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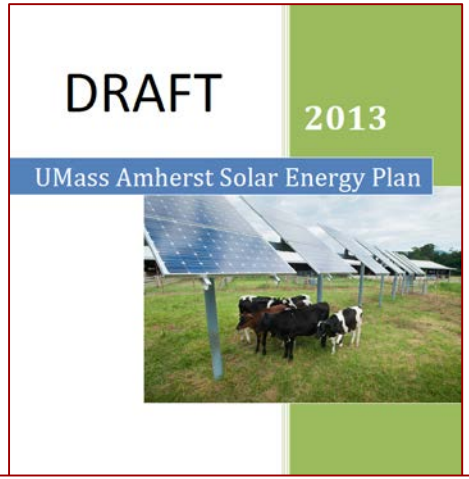
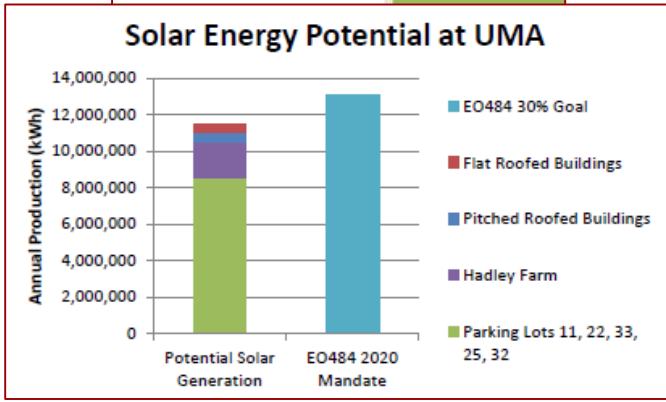
State Regulatory Framework

Campus Response

- 2007: EO484 – 15% RE by 2012; 30% by 2020
- 2008: Green Communities Act and SRECI/Solar Carve-Out
- 2012: State RE goals - 250 MW by 2012; 1600 by 2020
- 2012: Campus Master Plan Completed
- 2013: Solar Energy Plan Drafted
- 2014: External Review of sustainability across campus
  - Key Finding: “Significant gaps in present operational practices: Renewable energy”
- 2014: VC A&F Authorizes $1.7M APS revenue to revolve into on-site solar projects
- 2015-2016: Robsham Canopy Project
- 2016-2017: Campus Wide PPA Solar Project





Phase I – Robsham Visitor Center

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- Public bid opened December 17, 2014
- Completed February 19, 2016
- **Designer/Architect:** Fuss & O'Neil, W.Springfield, MA
- **Contractor:** RAC Builders, Agawam, MA
- **Electrical:** M.L. Schmidt, Springfield, MA
- **Canopy Manufacturer:** Solaire/SunPower, Boston, MA

Phase I – Robsham Visitor Center

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- **Owned and Operated** by UMass Amherst
- **UMA Design & Install Cost**: $2,000,000
- **DOER Clean Energy Grant**: $146,000
- **20 Year Expected Emissions Avoided**: 2,000 MT (to the regional grid, not UMA)
- **15 yr SREC II Potential Revenue**: $500,000-$800,000 estimated
- **20 yr Forecasted Avoided Electricity Costs**: $898,000
- **Simple Payback**: 14 years

Phase I – Robsham Visitor Center

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- **Size:** 336kW DC, 192 kW AC
- **Est Annual Production:** 330,639 kWh
- **Year 1 Actual:** 295,302 kWh
- **PV Modules**: 1,008 UpSolar UP-M300P (300W)
- **Inverters**: 12 Advanced Energy (AE) 3TL 600 Series String Inverters (out of production)
- **EV Charging**: Fast Charger and 2 Duel Level II Chargers (CT4000 Level 2 Commercial Charging Stations)

Phase I – Robsham Visitor Center

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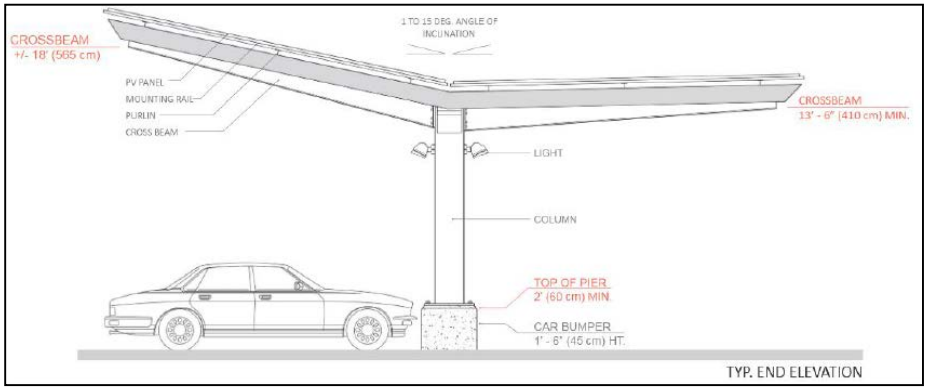
Solaire by Sun Power Premium Specs:

- Duel incline steel structures that feature an integrated decking and gutter system designed to manage rain and snow and full rain water collection
- 180 x 39 ft., 13’ 6” clearance (plowing, truck deliveries)
- 1 and 15 degree inclination on crossbeams
- Pier foundations precast reinforced concrete



Phase I – Robsham Visitor Center

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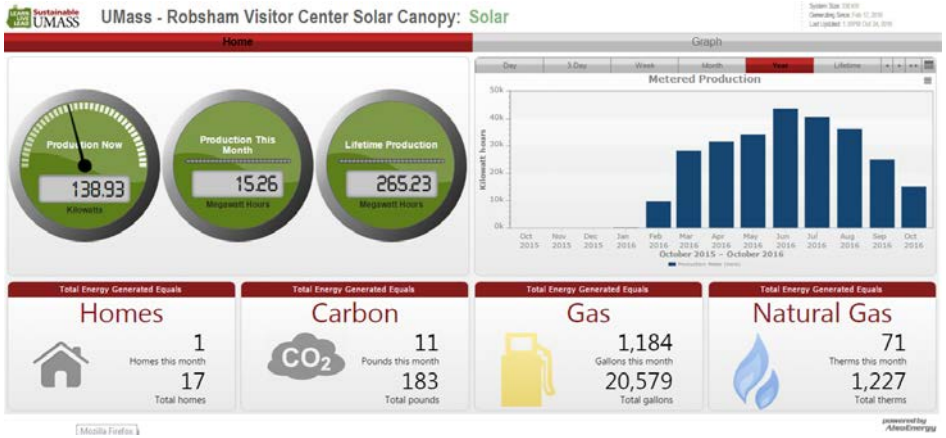
Metering:

- AlsoEnergy
- Veris E51C2 Production Meter
- 5 year meter subscription and software service
- 5 year inverter monitoring, data storage and maintenance
- Cellular Modem
- Weather Station



Dashboard:

- AlsoEnergy
- Customizable, data download
- Displayed on touch screen in building and online

Phase I – Robsham Visitor Center

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Robsham Lessons Learned:

- Major construction
- Site Issues and Campus Trees
- MA plumbing code variance
- Metering and campus SCADA security
- Own and operate issues: Equipment failure (inverters)
- SREC Factor incorrectly filed in SQA with DOER (rooftop not canopy)

Phase II – Campus Wide PPA

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- Public bid opened December April 20, 2015. Completed January, 2017
- **Consultant:** CES, Portland, ME
- **Developer:** Brightergy, Saint Louis, MO; formerly Charlestown, MA
- **Canopy Manufacturer:** Solaire/SunPower, Boston, MA
- **Project Financer**: Sol Systems, Washington, DC
- **Project Owner**: ConEdison Solutions, New York, NY

Phase II – Campus Wide PPA

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- Bid/Planning Committee consisted of faculty, staff and students.
- Award criteria:
  - Qualifications (GC and Subs)
  - Cost effectiveness
  - Campus, canopy, roof and storage experience
  - Interview and References
  - Financial stability
  - Project Plan showing min. interference with campus activities/operations
  - Completeness of submission
  - Experiential learning opportunities

Phase II – Campus Wide PPA

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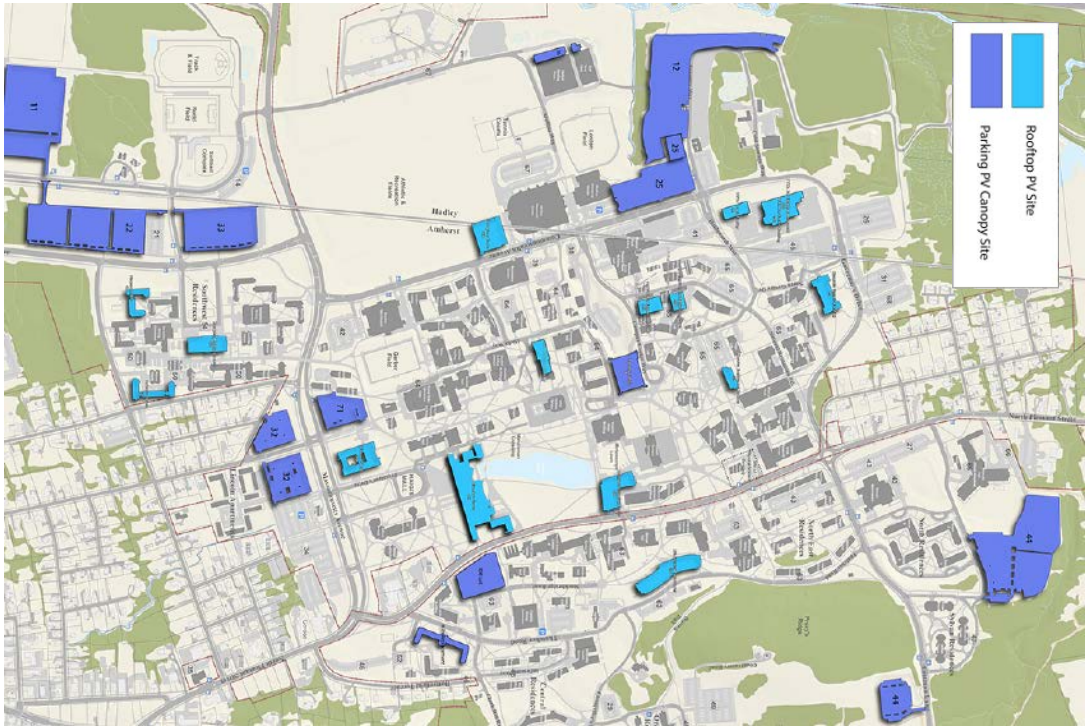
- Project started with 22 buildings and 12 parking lots, then to 5 and 2…



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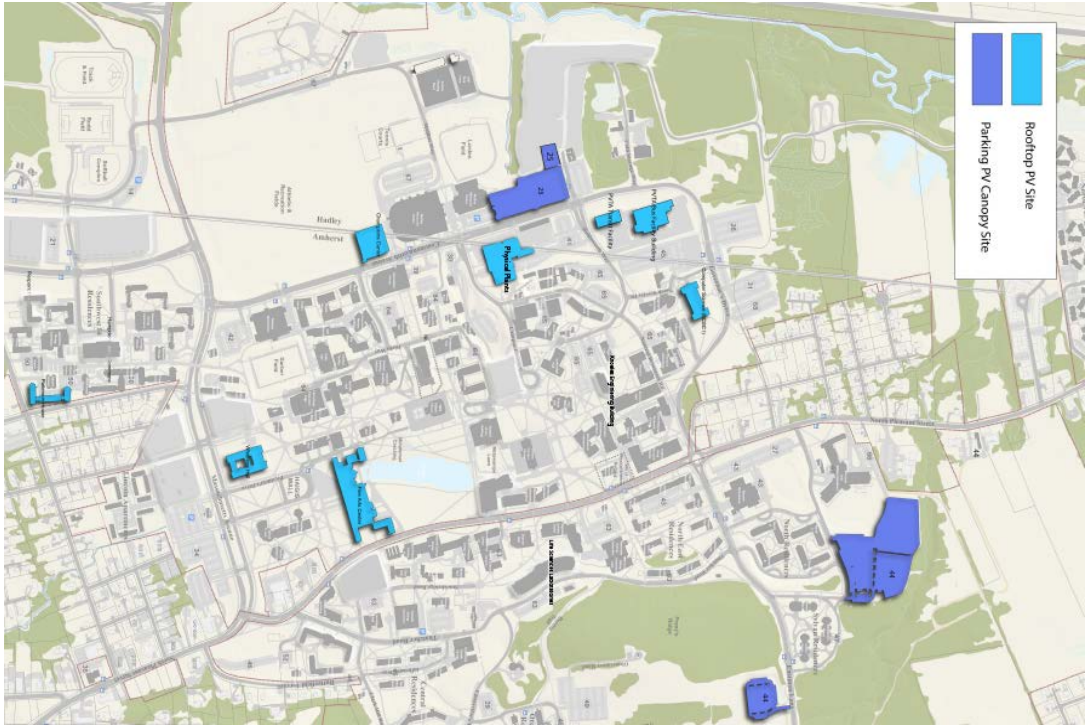

Phase II – Campus Wide PPA

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- **Owned and Operated by ConEd***
- **DOER Clean Energy Grant**: $500,000
- **20 Year Expected Emissions Avoided**: 31,456 MT (to the regional grid, not UMA)
- **Forecasted Cost Savings**: $3.6M NPV (avoided e and FCM costs) over 20 yrs
- **PPA Rates**: very low locked in 20 year rate with 2% escalator
- **UMA can purchase system anytime after year 7**
- **UMA owns REC's after year 10**

* Value of project is $16M

Phase II – Campus Wide PPA

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- **2 parking canopies and 5 rooftop systems**
- **PPA Size:** 5,335.94 (5.3 MW DC)
  - Parking Lots: 4.4MW
- **Est Annual Production:** 5.9M kWh
  - Parking Lots: 4.9M kWh
- **PV Modules**: 15,000 LG NeON (300-365W)
- **Inverters**: Yaskawa-Solectria 36kW, 1000VDC Transformerless String
- **Canopies:** Solaire by Sun Power 360 D
- **EV Charging:** ChargePoint CT4000 Level 2 EV chargers will be installed at later date

Phase II – Campus Wide PPA

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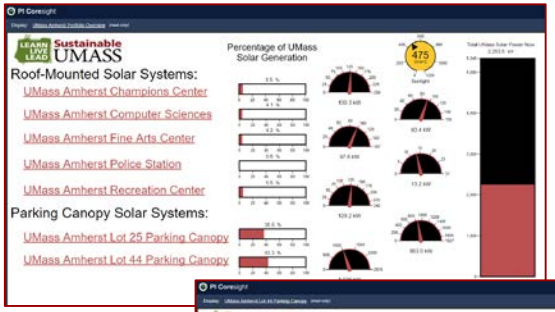
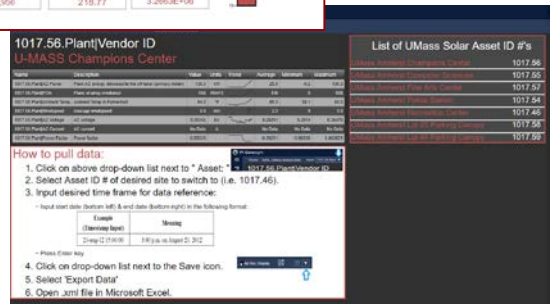
Dashboard:

- PI Coresight
- 6 dashboards across campus*
- Each site has unique URL + landing page with master campus meter + data download site
- Data site provides customizable reports for 7 values:
  - AC energy, array irradiance, windspeed, AC voltage, AC current, power factor





***Dashboard sites voted on by Sustainability Committee**

Phase II – Campus Wide PPA

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Project Benefits:

- Project helps campus both reduce peak electric demand by 2.2 MW when grid system peak occurs (10% of 22 MW peak)
- Provides year round shade to parked cars in large parking lots
- Provides UMA with $41,000 in educational opportunities through separate Educational Agreement with developer*

***This includes Tours, Internships, and Presentations, Dashboards & Charging Stations**

Phase II – Campus Wide PPA

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Lessons Learned:

- State deadlines rushed project
- Solaire 360 vs Premium
- Rooftops difficult to site
- PPA structure challenging for UMA to manage financially/logistically
- Difficult to find developer with both rooftop and canopy experience
- If developer folds, agreements void?
- Utility tied facilities difficult to include into same PPA
- Import/Export issues (generation exceeding campus load)*

*** UMA commissioned a micro-grid impact study with DOER funds – Study concluded direct trip of PV systems needed**

Next Steps

- Battery storage capability:
  - UMA partnering with Tesla to respond to the MaCEC/DOER ACES* grant program for a 1MW/4MWh Battery Energy Storage System (BESS) on campus.
  - System will capture and discharge electricity generated by both behind-the-grid solar canopies and Central Heating Plant generation.

*Advancing Commonwealth Energy Storage

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