Better Buildings®
U.S. DEPARTMENT OF ENERGY

Ramping up Technology to Mitigate Climate Change: Innovations in Project Design and Program Development

Better Buildings Summit 2015
Washington, DC
Wednesday, May 29, 2015

U.S. DEPARTMENT OF ENERGY

Session Description

- The development and deployment of renewable energy technologies are an important part of our "all of the above" strategy to mitigate climate change.
- In this session, hear from a state government, local government, and K-12 school district that have developed innovative programs or approaches to clean energy project design including microgrids, renewable energy technologies, and energy master planning.

Moderator: Heidi Burkart
Camas School District (WA)

U.S. DEPARTMENT OF ENERGY

Creating an Energy Master Plan

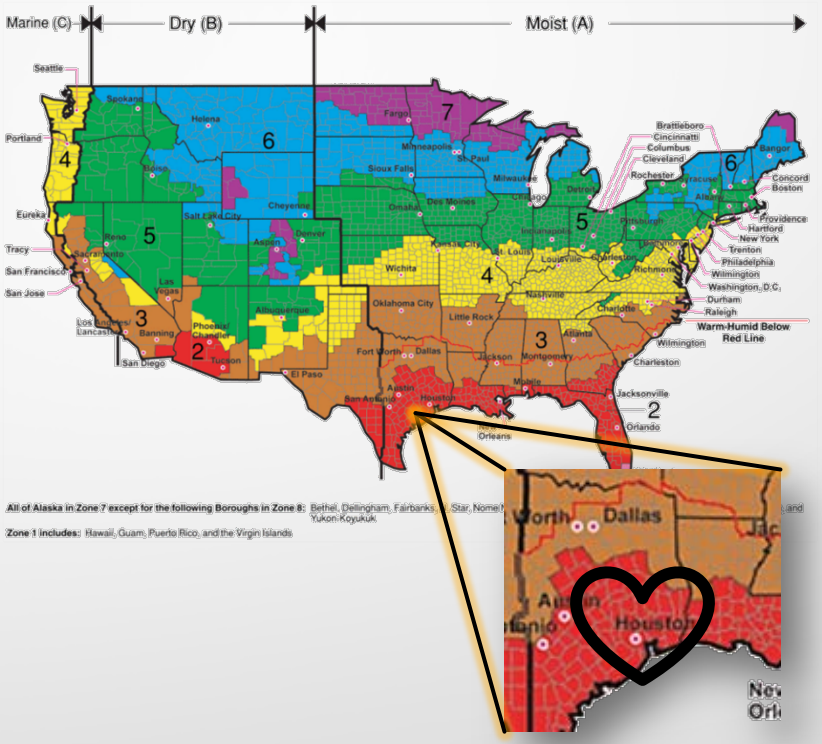
Kellie Williams, C.E.M.

Houston Independent School District

kwilli53@houstonisd.org

Snapshot: Houston ISD

- 300+ Buildings
- 30 M Square Feet
- 245,000 occupants
- $40+ M in annual energy expenses
- BBC Partner since 2011



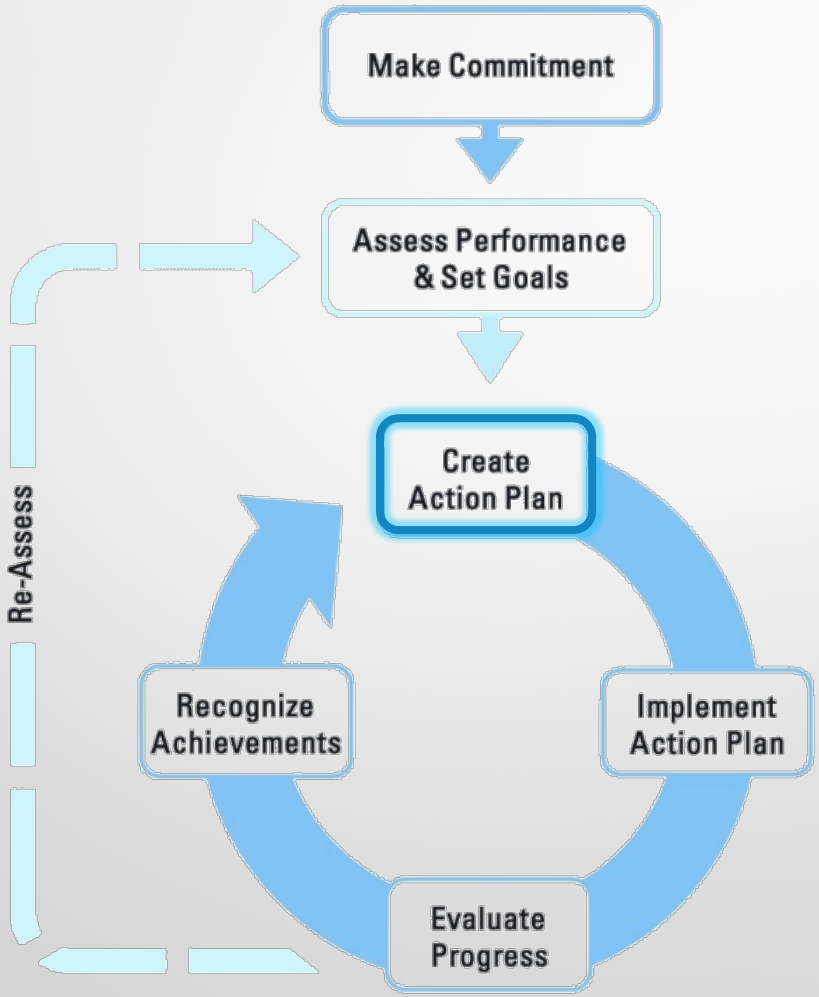
Survey

How many of you work in Facilities Management?

GOAL

NAILED IT!!!

Continuous Improvement Cycle



Planning Prep

1. Define your committee
2. Set clear goals and deliverables
3. Determine meeting frequency

Policy Development

POLICY BOARD OF EDUCATION OF MONTGOMERY COUNTY

Related Entries: ECM, ECM-RA
Responsible Office: Supportive Services

Energy Conservation

A. PURPOSE

To ensure that Montgomery County Public Schools pursues energy conservation efforts and practices that continue to preserve our natural resources while providing a safe and comfortable learning environment for all staff and students

B. ISSUE

The nation is experiencing a depletion of its natural resources which include crude oil, natural gas, and other energy sources. The Montgomery County Public Schools is committed to reducing its consumption of natural resources and still improving the quality of its educational programs. The Montgomery County Board of Education desires to work with other agencies of government and plan school system activities so that the learning environment of essential education programs are not curtailed or compromised.

C. POSITION

1. The superintendent of schools shall continue to establish procedures to ensure the conservation of natural resources by personnel at all levels of the school system, which shall include the following practices:

   a) Generation of a systemwide annual resource conservation plan that outlines goals and objectives

   b) Development of acceptable energy conservation guidelines as outlined in the resource conservation plan

   c) Continued development and implementation of conservation programs

   d) Performance of energy studies on all new MCPS construction

   e) Monitoring the general operation and maintenance of all heating, ventilation, and air conditioning equipment

   f) Procurement and consumption management of fossil fuels and electricity

   g) Continuing reminders to staff and students of the need for conservation of all natural resources

2. MCPS will participate in a coordinated effort by government authorities to establish appropriate resource conservation plans and utility price monitoring systems to ensure that public schools have adequate supplies of essential fuels and can obtain these at the best possible prices.

D. DESIRED OUTCOME

Create a healthy and comfortable learning environment while controlling energy consumption more efficiently and diverting the otherwise rising utility costs towards educational programs. Continue development of energy conservation efforts that proportionally reduces energy consumption in new and existing facilities.

E. IMPLEMENTATION STRATEGIES

1. Should natural resources be insufficient to meet normal operating needs, the superintendent will develop further plans for the consideration of the Board of Education to conserve energy.

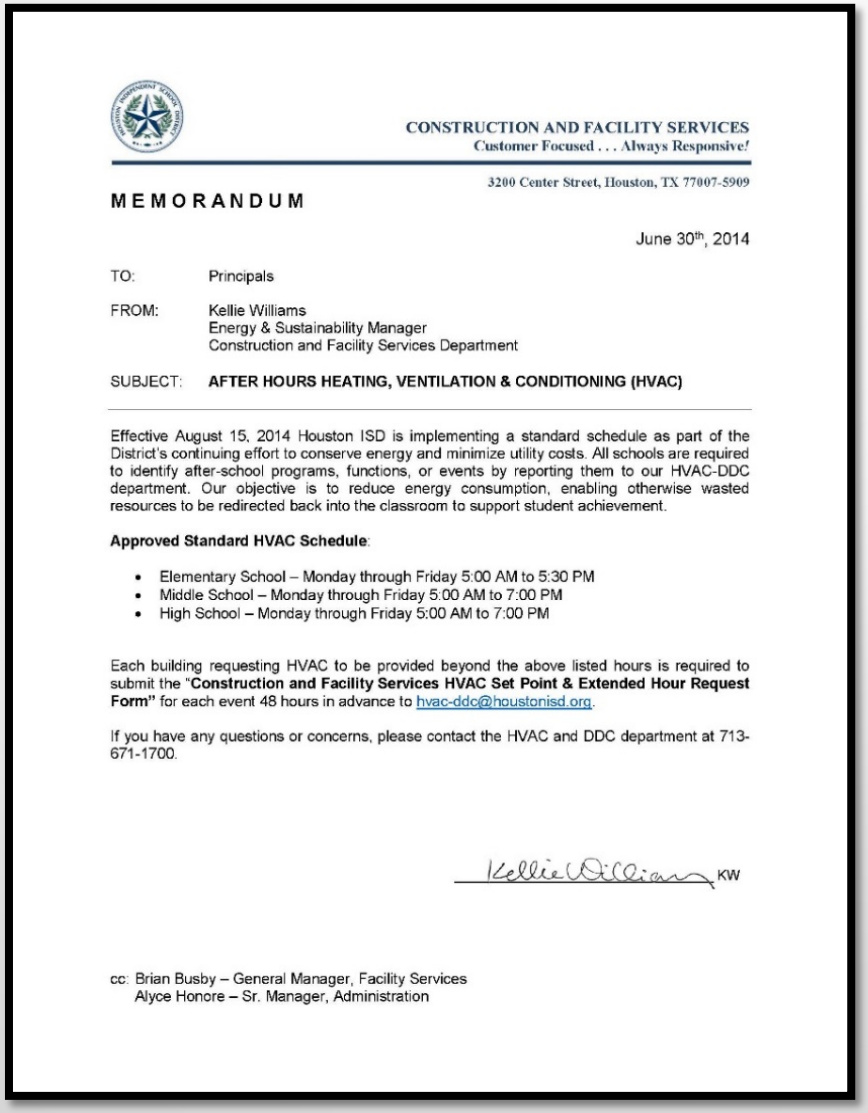
2. Copies of this policy and the annual resource conservation plan will be sent to appropriate school system and county government officials.

F. REVIEW AND REPORTING

This policy will be reviewed on an on-going basis in accordance with the Board of Education's policy review process.

Policy History: Adopted by Resolution No. 654-73, November 13, 1973; amended by Resolution No. 285-97, May 13, 1997; reviewed April 19, 2002.

Internal Policy



CONSTRUCTION AND FACILITY SERVICES
Customer Focused . . . Always Responsive!

3200 Center Street, Houston, TX 77007-5909

MEMORANDUM

June 30th, 2014

TO: Principals

FROM: Kellie Williams
Energy & Sustainability Manager
Construction and Facility Services Department

SUBJECT: **AFTER HOURS HEATING, VENTILATION & CONDITIONING (HVAC)**

Effective August 15, 2014 Houston ISD is implementing a standard schedule as part of the District's continuing effort to conserve energy and minimize utility costs. All schools are required to identify after-school programs, functions, or events by reporting them to our HVAC-DDC department. Our objective is to reduce energy consumption, enabling otherwise wasted resources to be redirected back into the classroom to support student achievement.

Approved Standard HVAC Schedule:

- Elementary School – Monday through Friday 5:00 AM to 5:30 PM
- Middle School – Monday through Friday 5:00 AM to 7:00 PM
- High School – Monday through Friday 5:00 AM to 7:00 PM

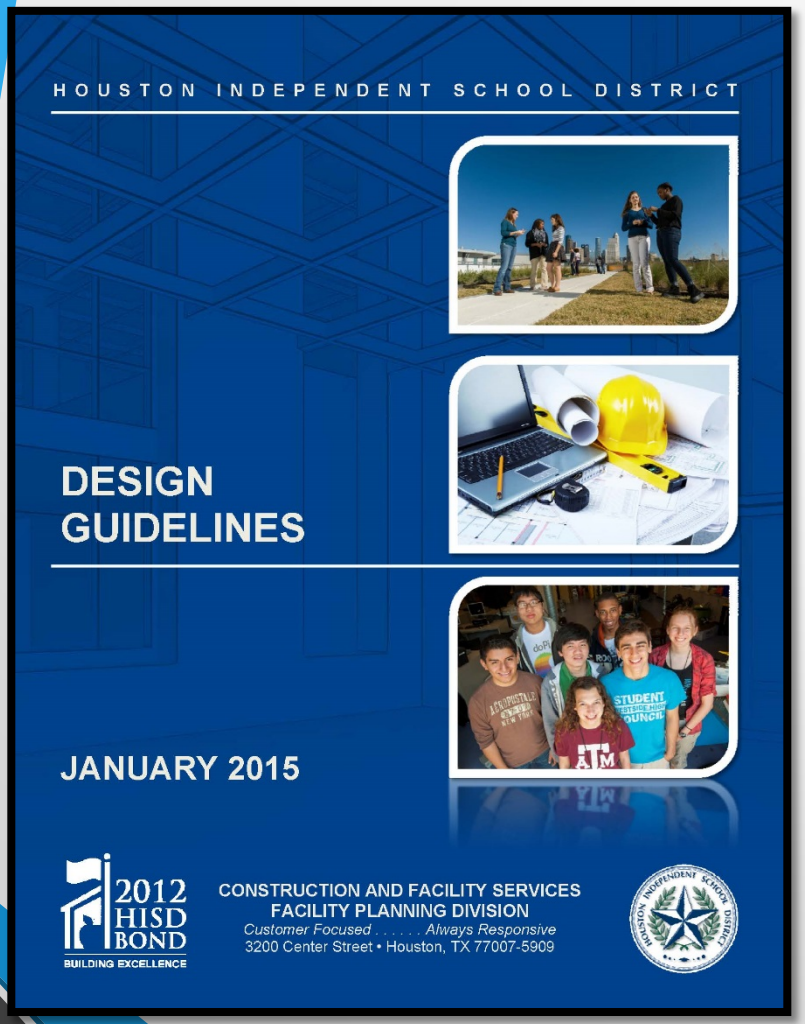
Each building requesting HVAC to be provided beyond the above listed hours is required to submit the "**Construction and Facility Services HVAC Set Point & Extended Hour Request Form"** for each event 48 hours in advance to hvac-ddc@houstonisd.org.

If you have any questions or concerns, please contact the HVAC and DDC department at 713-671-1700.

Kellie Williams KW

cc: Brian Busby – General Manager, Facility Services
Alyce Honore – Sr. Manager, Administration

Design Guidelines

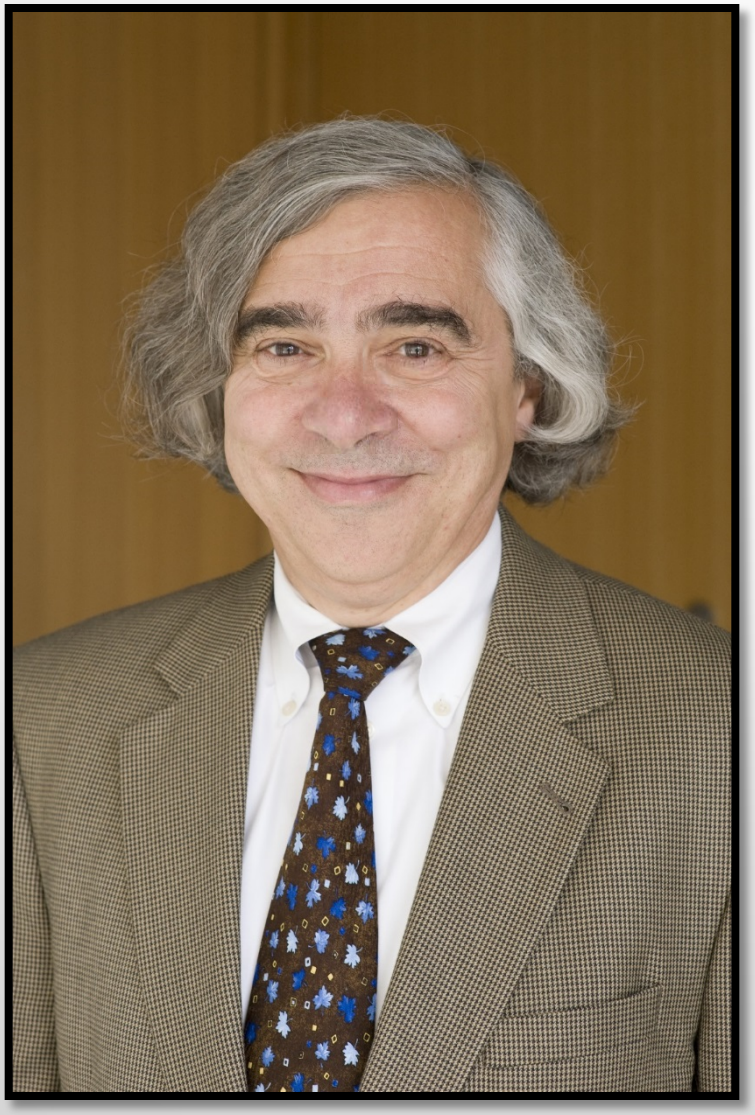


- New construction
- Standardize equipment
- Committee reviewed
- Bi-weekly meetings
- Quarterly revisions

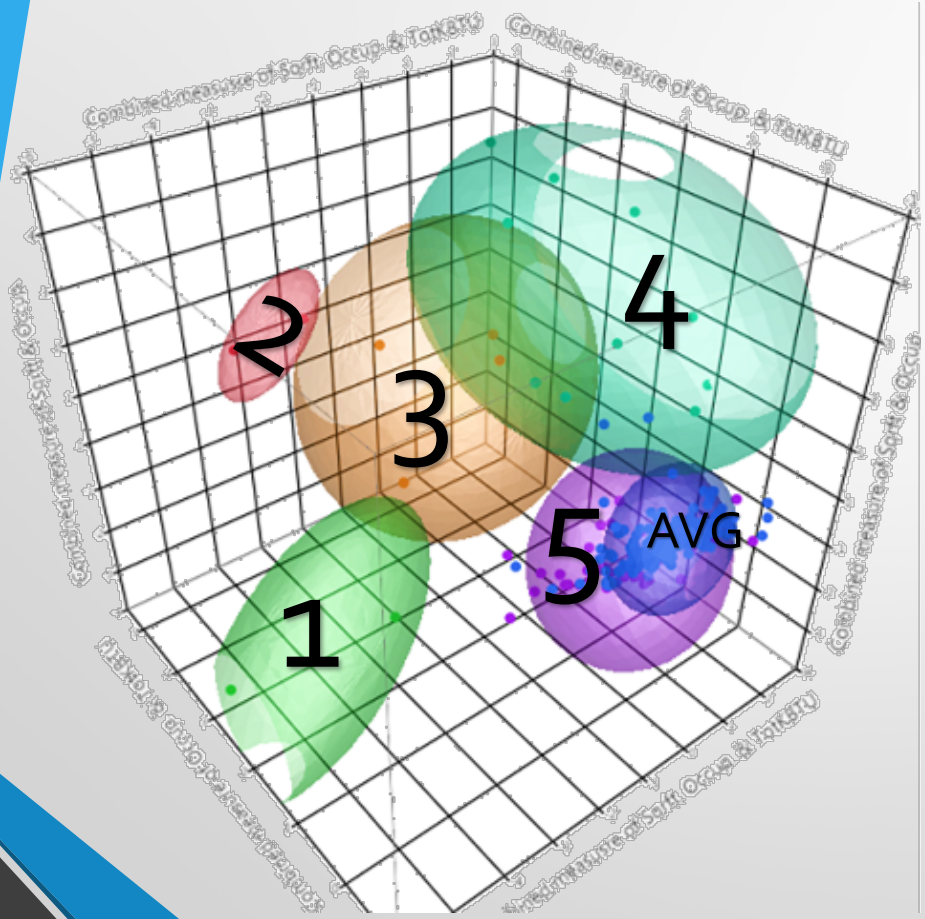
Benchmarking & Data Analysis

- Data collection
- Data quality
- Data analysis

Principal Component Analysis



Principal Component Analysis



- Analyze relationships between variables
  - Total occupancy
  - Building SF
  - Total energy consumed
- Identify targets

Energy Audits

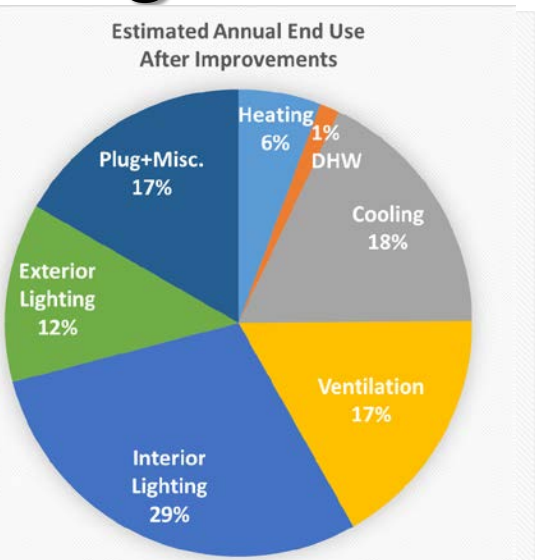
- Professional Engineer
- ASHRAE Level 2 Audit
- Calculations vs. actual usage
- ECM recommendations
- Best practices

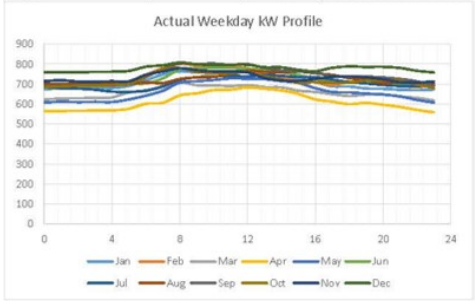
Pershing MS

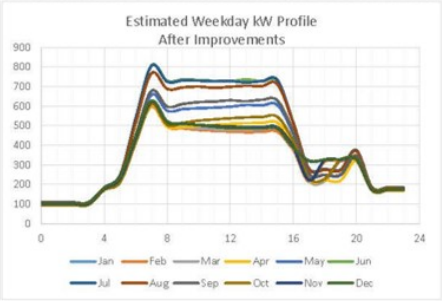
Metrics	Actual	
Square Feet	230,899	SF
Enrollment	1,653	Students
Annual Electricity	6,063,820	kWh
Sum of Peak kW	10,958	kW
Annual Nat. Gas	3,852	CCF
EUI	91.3	kBtu/SF
kWh Cost @ $/kWh	$ 308,023	$ 0.05
kW Cost | $/kW	$ 117,513	$ 10.72
NG Cost | $/CCF	$ 3,015	$ 0.78

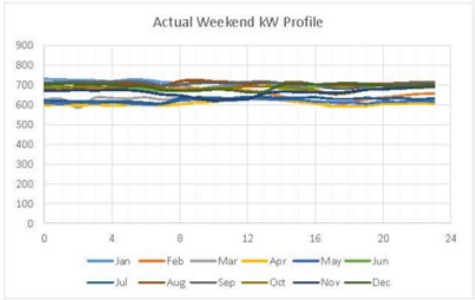
Savings	After Improvements	
54%	2,812,520	kWh
13%	7,984	kW
9%	3,502	CCF
53%	43.1	kBtu/SF
kWh Savings	3,267,785	$ 165,993
GHG Emissions Saved	1,936	Tons CO2
kW Savings	2,974	$ 31,892
CCF Savings	350	$ 274
Potential $ Savings	$	198,159

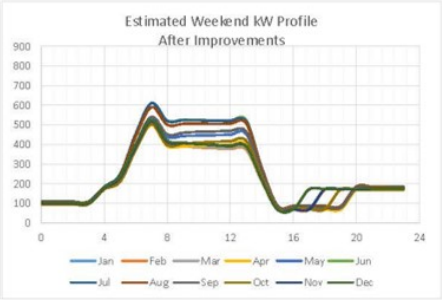
Energy End Use	kBtu/SF	%
Heating	2.5	6%
DHW	0.6	1%
Cooling	7.7	18%
Ventilation	7.4	17%
Interior Lighting	12.7	29%
Exterior Lighting	5.4	13%
Plug+	7.3	17%











Energy Conservation Measures

Table 1. Energy Conservation Measure Summary Table

[1]ECM #	ECM Type	ECM Description	Peak Demand Savings (kW)	Annual Energy Savings (kWh/yr)	% Annual Energy Savings	Annual Energy Cost Savings ($/yr)	[2]Estimated Cost ($)	Simple Payback (yrs)
ECM-1	Reduce Facility Electricity Base Load	(i) Ensure all HVAC and domestic water equipment are turned off based on the HVAC operation schedule (ii) Turn off non-emergency interior lighting and turn off/activate energy saver mode for plug loads during nights/weekends (HVAC schedule)	--	991,278	12.8%	$69,389	$0	0.0
ECM-2	Optimize HVAC Operation Schedule	Shutdown the HVAC system at 5:00 PM during the summer months (June – August) and at 7:00 PM during the rest of the year	132.2	334,606	4.3%	$23,422	$0	0.0
ECM-3	Optimize Chiller Plant Operation	(i) Return all chiller controls from manual to automatic (ii) Optimize chiller sequencing by running the most efficient chillers at their most efficient loading (iii) Reset chiller leaving water temperature (LWT) based on outside air temperature (iv) Turn off primary pumps when the associated chillers are not in operation (v) Reset secondary chilled water pump speed based on cooling demand and optimize sequencing of pumps	49.3	390,830	5.0%	$27,358	$0	0.0
ECM-4	Repair VFD for AHU-1E-2	The supply fan for AHU-1E-2 serving the office space runs at a constant 100% as the VFD is not working and needs to be repaired	0.6	10,107	0.1%	$708	$0	0.0
ECM-5	Optimize VAV AHU Discharge Air Temperature Reset	(i) Raise the minimum and maximum discharge air temperature setpoints (ii) Increase VAV box minimum airflow to reduce simultaneous heating and cooling	0.7	29,639	0.4%	$2,075	$0	0.0
ECM-6	Reset VAV AHU Discharge Air Static Pressure	(i) Reset the discharge air static pressure setpoint of VAV AHUs based on terminal box damper positions	0.0	14,260	0.2%	$998	$0	0.0
ECM-7	Optimize Hot Water System Operation	Minimize simultaneous heating and cooling (refer to ECM-5 & ECM-6), and lock out boiler to only operate at lower outside air temperatures	19.9	63,446	0.8%	$4,441	$0	0.0
		*Electricity rate ($/kWh) = $ 0.07						
		**Baseline Annual Energy Consumption (kWh/yr) = 7,743,367						
		Total (All ECMs)	**202.6**	**1,834,167**	**23.7%**	**$128,392**	**$0**	

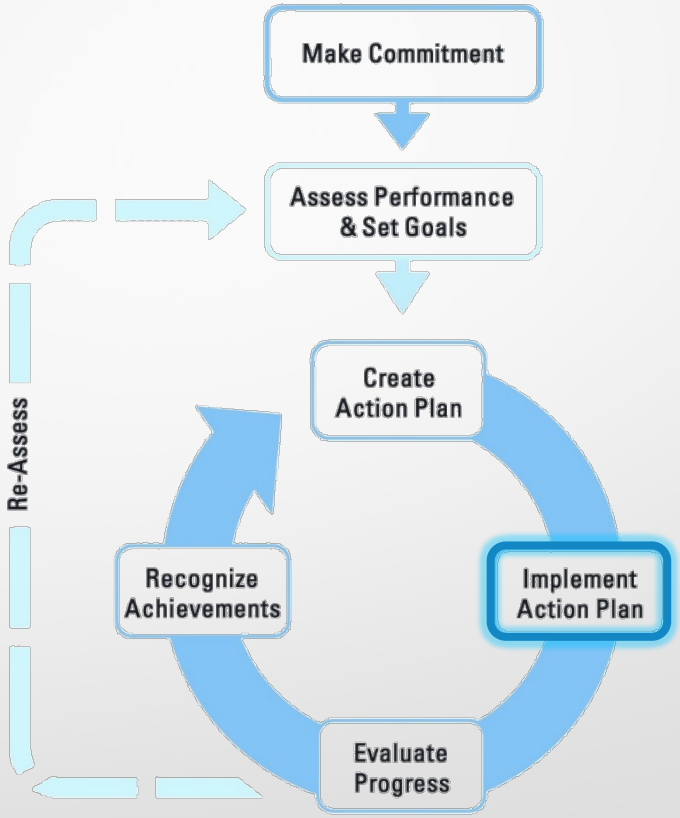
[1] Peak demand reduction and annual energy savings are estimates only, derived from engineering calculations based on facility information and utility data; actual results may vary.

[2] BAS work is assumed to be performed in-house, and hence implementation cost is $0.

Act: Utilize Partnerships

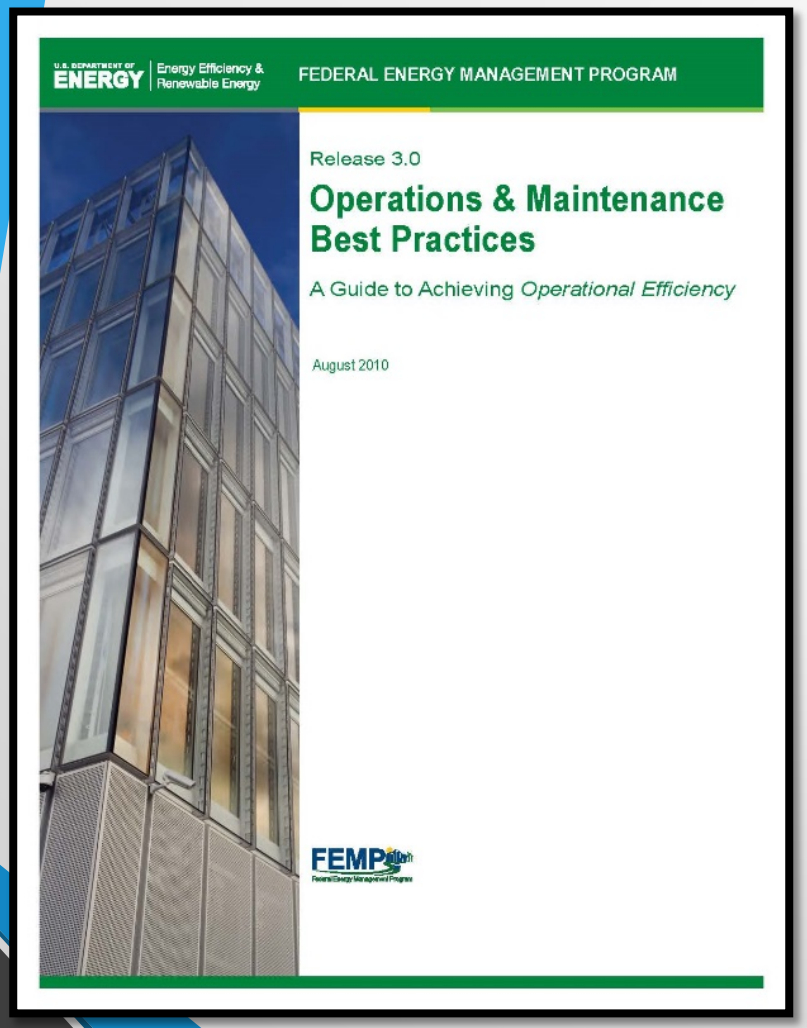
TDSP Programs

- SCORE
- Retro-Commissioning
- Load Shedding



CenterPoint® Energy

Best Practices



- **Generator** – Where the dilute solution flows over the generator tubes and is heated by the steam or hot water.
- **Condenser** – Where the refrigerant vapor from the generator releases its heat of vaporization to the cooling water as it condenses over the condenser water tube bundle.

9.4.4 Safety Issues (TARAP 2001)

Large chillers are most commonly located in mechanical equipment rooms within the building they are air conditioning. If a hazardous refrigerant is used (e.g., ammonia), the equipment room must meet additional requirements typically including minimum ventilation airflows and vapor concentration monitoring.

In many urban code jurisdictions, the use of ammonia as a refrigerant is prohibited outright. For large chillers, the refrigerant charge is too large to allow hydrocarbon refrigerants in chillers located in a mechanical equipment room.

9.4.5 Cost and Energy Efficiency (Dyer and Maples 1995)

The following steps describe ways to improve chiller performance, therefore, reducing its operating costs:

- **Raise chilled water temperature** – The energy input required for any liquid chiller (mechanical compression or absorption) increases as the temperature lift between the evaporator and the condenser increases. Raising the chilled water temperature will cause a corresponding increase in the evaporator temperature and thus, decrease the required temperature lift.

  On a centrifugal chiller, if the chilled water temperature is raised by 2˚F to 3˚F, the system efficiency can increase by as much as 3% to 5%.

- **Reduce condenser water temperature** – The effect of reducing condenser water temperature is very similar to that of raising the chilled water temperature, namely reducing the temperature lift that must be supplied by the chiller.

  On a centrifugal chiller, if the condenser water temperature is decreased by 2˚F to 3˚F, the system efficiency can increase by as much as 2% to 3%.

- **Reducing scale or fouling** – The heat transfer surfaces in chillers tends to collect various mineral and sludge deposits from the water that is circulated through them. Any buildup insulates the tubes in the heat exchanger causing a decrease in heat exchanger efficiency and thus, requiring a large temperature difference between the water and the refrigerant.
- **Purge air from condenser** – Air trapped in the condenser causes an increased pressure at the compressor discharge. This results in increased compressor horsepower. The result has the same effect as scale buildup in the condenser.
- **Maintain adequate condenser water flow** – Most chillers include a filter in the condenser water line to remove material picked up in the cooling tower. Blockage in this filter at higher loads will cause an increase in condenser refrigerant temperature due to poor heat transfer.
- **Reducing auxiliary power requirements** – The total energy cost of producing chilled water is not limited to the cost of operating the chiller itself. Cooling tower fans, condenser water circulating pumps, and chilled water circulating pumps must also be included. Reduce these requirements as much as possible.

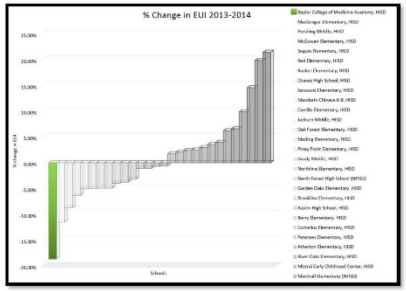
Behavioral Programs

- CenterPoint's *Sustainable Schools*
- National Wildlife Federation's *Eco Schools Challenge*
- Houston ISD's *Green Schools Challenge*

Green School Report Cards

HOUSTON ISD
GREEN SCHOOLS CHALLENGE

BAYLOR COLLEGE OF MEDICINE ACADEMY
2014-2015 REPORT CARD



Congratulations! Your school ranked **First** in energy reductions per square foot. As a result, you **saved $19,677** and enough energy to power 16 homes for 1 year.

Your Energy Star score is a **31** out of 100, so there's room to improve. The good news is you're already moving in the right direction.

Thank you for your continued efforts and keep up the good work!

Score
31

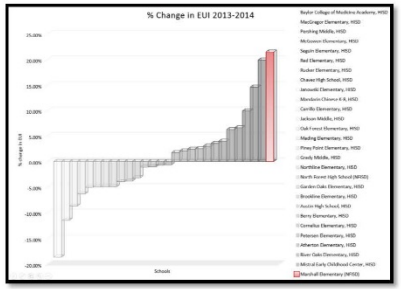
Saved
$19,677

Powered
16

Winners will receive a paint or landscape project. CFS will contact the winning schools with details.

HOUSTON ISD
GREEN SCHOOLS CHALLENGE

MARSHALL ELEMENTARY SCHOOL
2014-2015 REPORT CARD



Uh-oh! Your energy usage per square foot increased enough to power 91 homes for 1 year and your energy expenses increased by $35,788.

Your Energy Star score is a **1** out of 100, so there's room to improve.

Thank you for your participation and please continue your energy saving efforts!

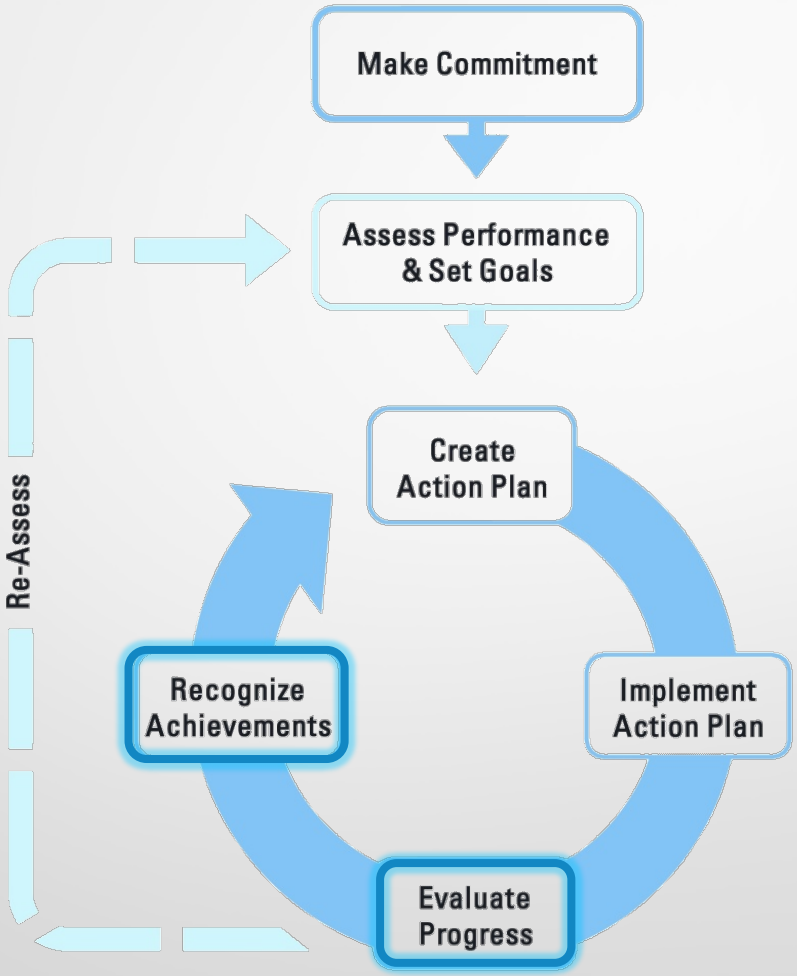
Score
1

Spent
$35,788

Usage
91

Winners will receive a paint or landscape project. CFS will contact the winning schools with details.

Continuous Improvement Cycle



Questions to Ask Your Committee

What went well?

What didn't go well?

What could we do differently?

Questions to Ask Yourself

What did I learn?

Better Occupants **LEAD** to Better Buildings

Resources

- DOE Federal Energy Management Program O&M Best Practices

  http://www1.eere.energy.gov/femp/pdfs/omguide_complete.pdf

- ENERGY STAR Guidelines for Energy Management

  http://www.energystar.gov/sites/default/files/buildings/tools/Guidelines%20for%20Energy%20Management%206_2013.pdf

- Consortium for Energy Efficiency Program Resource

  http://www.cee1.org/content/cee-program-resources

- Collins, James C. *Good to Great: Why Some Companies Make the Leap- and Others Don't*. New York, NY: HarperBusiness, 2001.

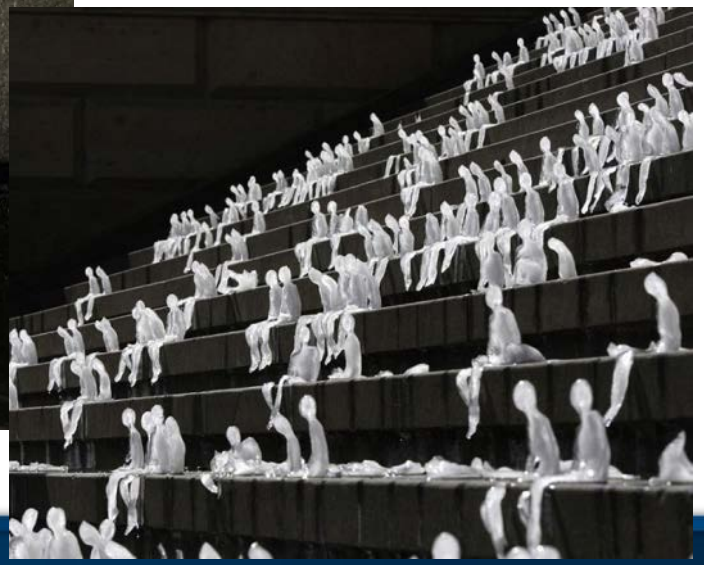
The Hybrid DC Microgrid Building: Leading the Way to a New Paradigm

John Phelan, PE

Energy Services Manager, Fort Collins Utilities

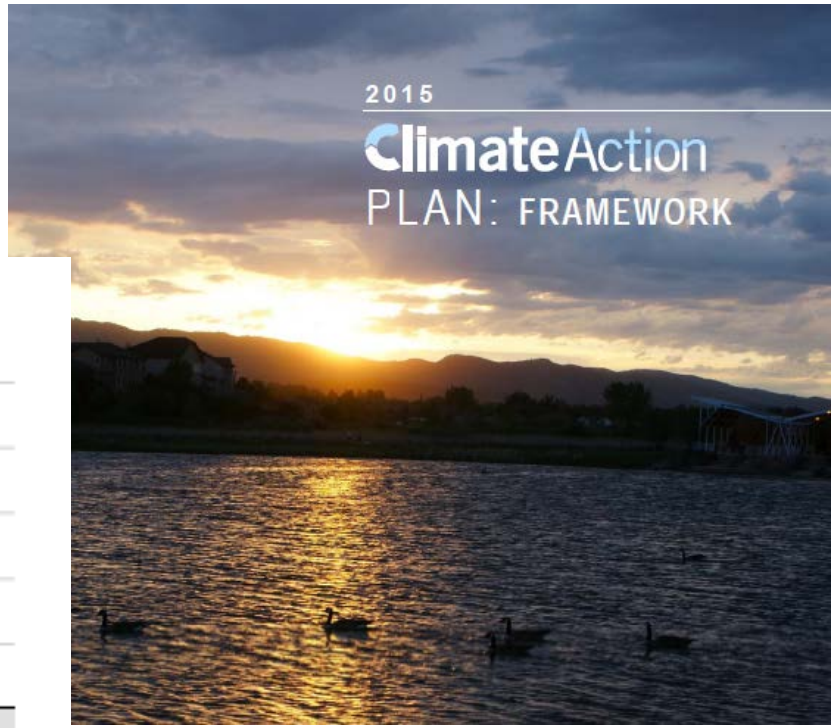
5-27-15

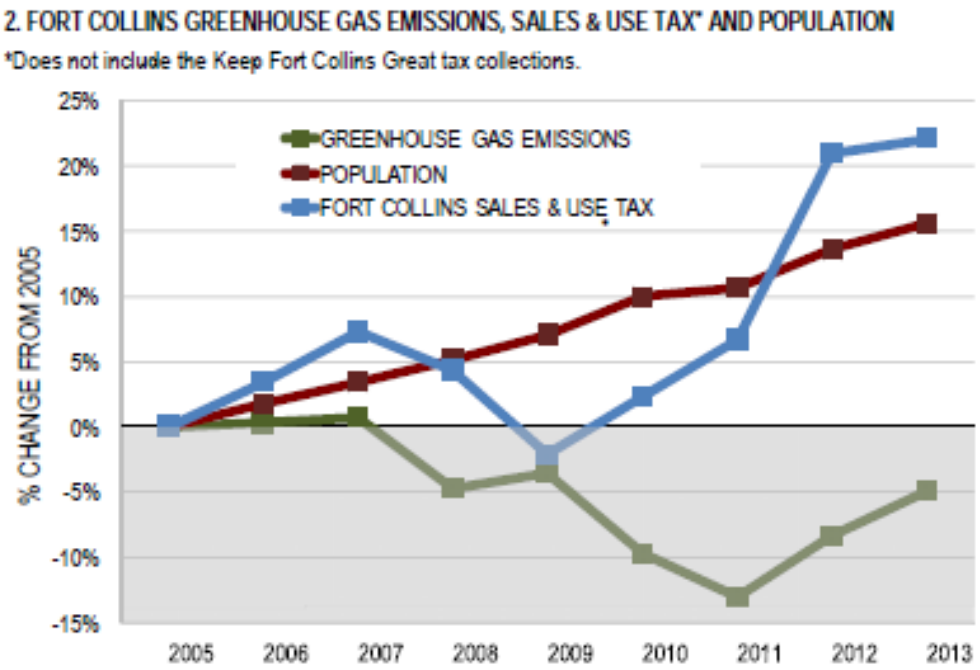
Climate Imperative



Local Action

- Fort Collins Goals are to reduce CO2
  - 20% by 2020
  - 80% by 2030
  - Carbon neutral by 2050





Let’s go on a journey

Fort Collins Utilities

Why Fort Collins?

City of Fort Collins

2014 ENERGY POLICY UPDATE

City of Fort Collins Utilities

Our Goals

This report provides an update of 2014 activities and results related to the City of Fort Collins Energy Policy, adopted in 2009.

The primary goals of the Energy Policy are to sustain high-system reliability and to contribute to the community's climate protection goals and economic health. The Energy Policy 2050 vision is to ensure highly reliable, competitive, carbon neutral electricity supplies, managed in a sustainable, innovative, responsible and efficient manner for the Fort Collins community.

The Energy Policy Annual Update reviews progress made to date in the primary goal areas of the policy: reliability, climate protection, economic health and the City's collaboration with Platte River Power Authority. The Energy Policy and most recent annual update are available at *fcgov.com/utilities/what-we-do*.

Did you know?

The Energy Policy will be revised in 2015 to reflect all primary energy use within the community and the new Climate Action Plan Framework.

Annual Results

We can lead in **ENERGY EFFICIENCY** and have **LOW RATES** and **HIGH RELIABILITY.**

Customers continued to receive **HIGHLY RELIABLE ELECTRIC SERVICE,** as measured by an average system availability index of

99.9951%

The Point?

We have very reliable electric service, on average, customers had 0.4 outages (e.g. most customers zero, some customers one) for a total duration of 68 minutes.

Customer electricity **savings from efficiency programs** totaled

OVER 32,600 MEGAWATT-HOURS (MWh)

or 2.2% of the community's annual usage. **This is equivalent to the annual electric use of over 3,600 typical Fort Collins homes.**

x100

What Does This Mean?

Customers are taking advantage of efficiency programs at a record pace.

Efficiency programs saved electricity with a lifecycle cost-of-conserved energy of 2.2 cents per kilowatt-hour (kWh), compared to an average wholesale electricity cost of 5.4 cents per kWh.

IT'S CHEAPER TO SAVE ELECTRICITY WITH EFFICIENCY than it is to buy it **WHOLESALE.** $$

PV

Photovoltaic (PV) capacity additions totaled 958 kW (620 kW residential and 338 kW commercial).

300% more PV installed in 2014 than 2013!

Fort Collins Solar Power Purchase Program will add nearly **4 megawatts** of locally installed solar by December 2015. The Riverside Community Solar project started in late 2014 and will add over **600 kilowatts** and a gateway feature to the City.

So What You're Saying Is?

Solar is growing rapidly and in new ways!

RENEWABLE ENERGY

comprised 6.2% of total electricity in 2014.

And is growing with more solar and wind energy

EFFICIENCY PROGRAMS GENERATED OVER $27 MILLION

in local economic benefits through reduced utility bills, direct rebates and leveraged investment.

Reducing energy bills is a WIN WIN

Utilities started the Peak Partners demand response program with **WEB ENABLED WI-FI THERMOSTATS**

CO_2

245k METRIC TONS

Avoided annual carbon emissions of over 245,000 metric tons from Energy Policy related programs.

That's a lot of carbon. See pie chart on back.

LOW RATES

As of July 2014, Fort Collins typical residential customer bills were in the lowest 16% of 55 Colorado utilities reporting to the Colorado Association of Municipal Utilities (CAMU).

Platte River added 60 megawatts of wind energy during 2014 and plans to add up to 30 megawatts of solar in 2015.

60 MEGAWATTS

TRACKING PROGRESS

CUSTOMER ANNUAL EFFICIENCY SAVINGS

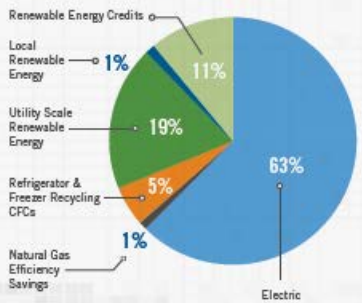
(% of community electricity use)

PER CAPITA ELECTRICTY USE

(% reduction from 2005)

GHG EMISSIONS REDUCTIONS

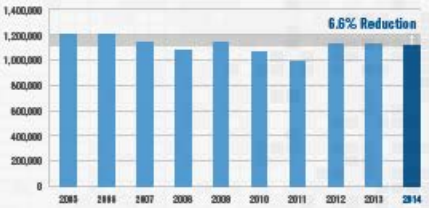
(Metric Tons)



Total = 244,216

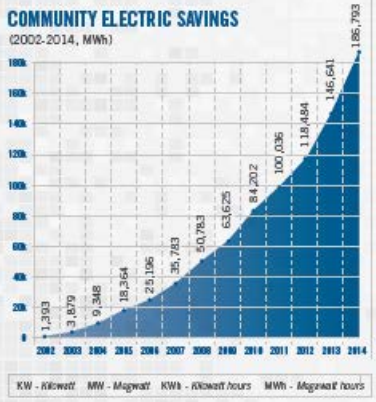
ELECTRICITY CARBON EMISSIONS INVENTORY

(2005 - 2013)

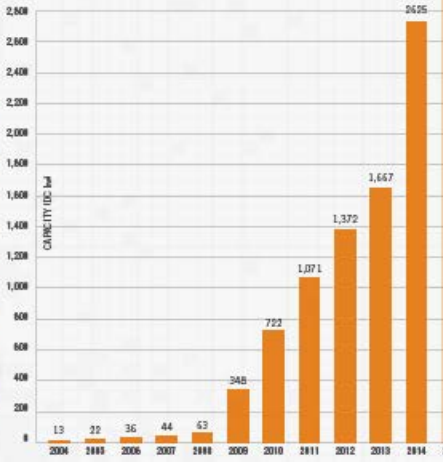


COMMUNITY ELECTRIC SAVINGS

(2002-2014, MWh)



PV-COMMUNITY CAPACITY

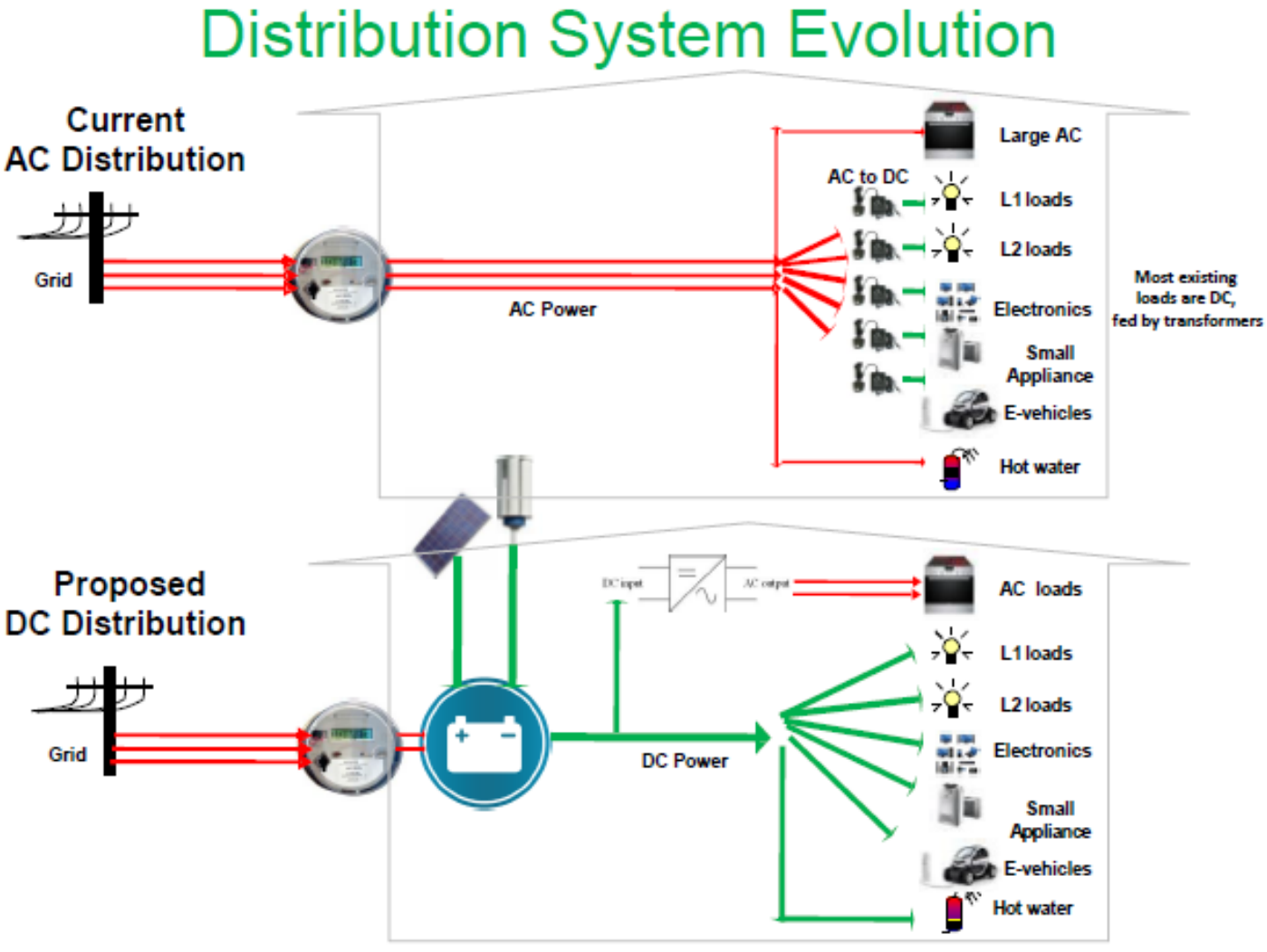


Utility Admin Building

Imagine a building that

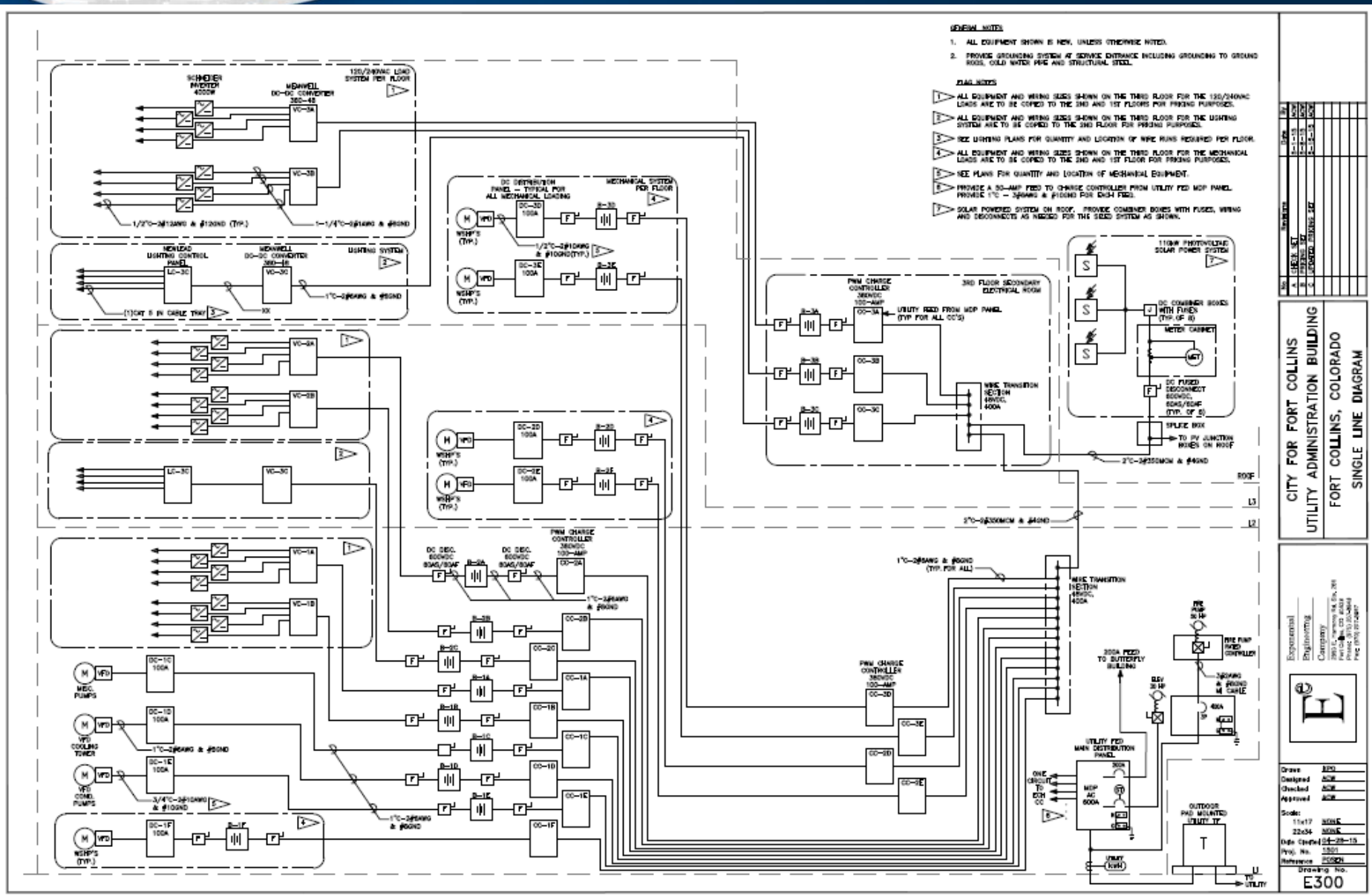
- Uses 25-50% less energy
- Gets 15% more PV output
- Has built in resiliency and backup power
- Whose load shape is independent of the grid
- Costs the same or less
- Provides a productive, healthy, safe and comfortable environment for humans

Hybrid DC Microgrid Building

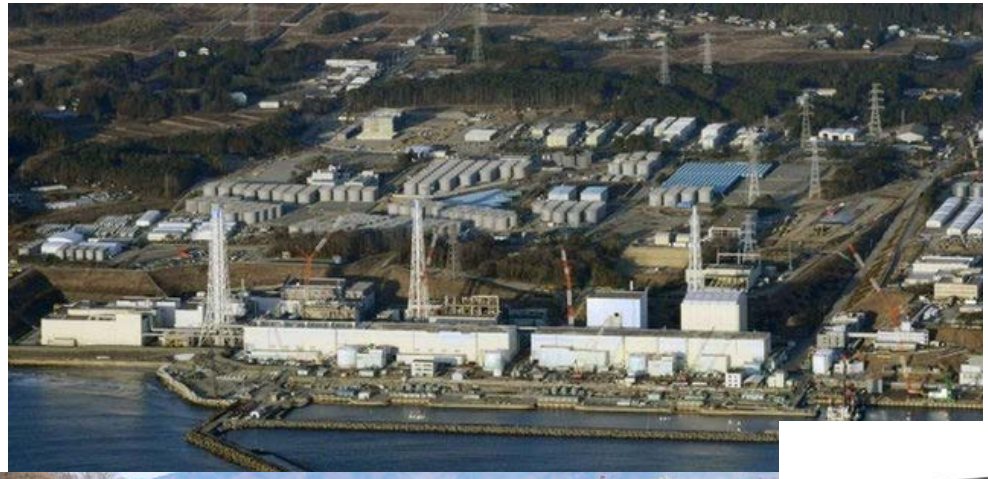


Everyday DC

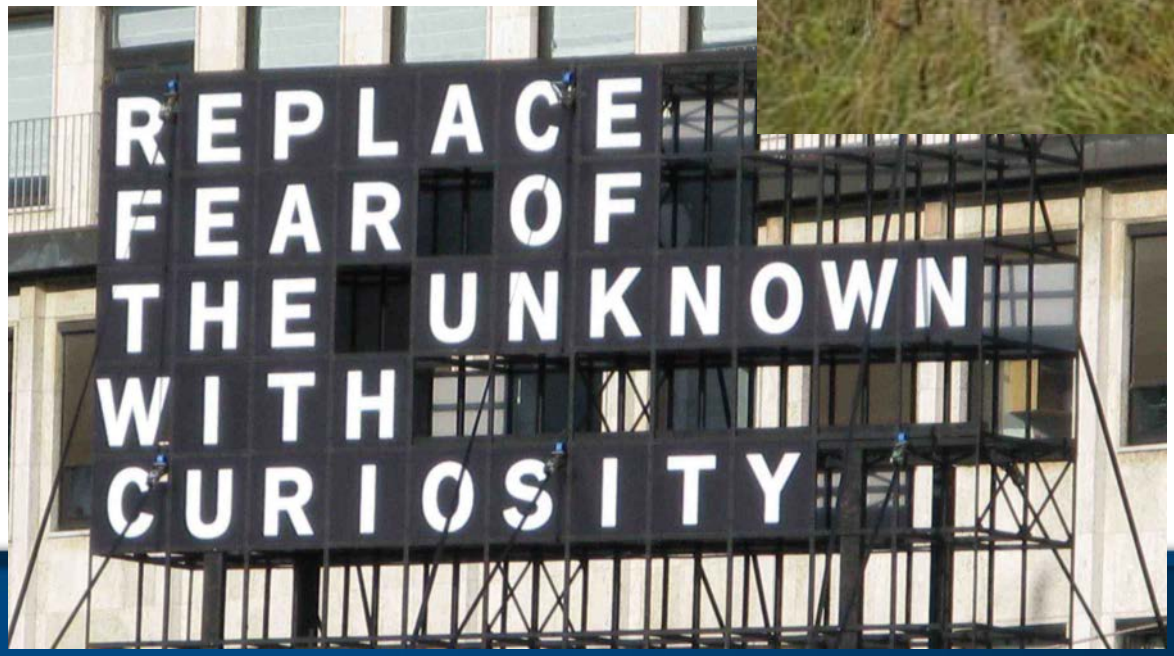
Modular Hybrid DC System



Link to Fukushima



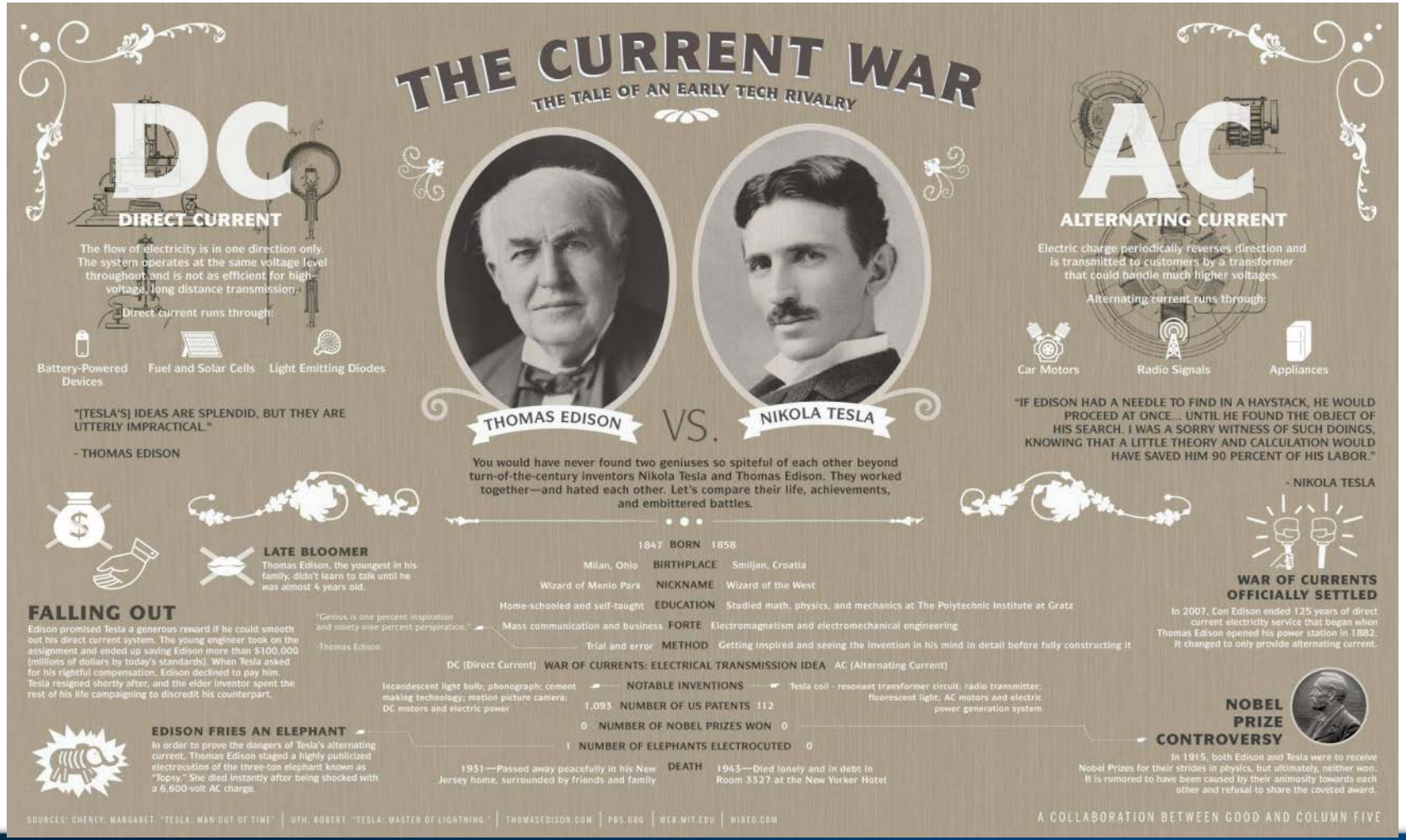
Obstacles and possibilities



DC Buildings

Hybrid DC Microgrid

Peace at Last



Thank you!

The Hybrid DC Microgrid Building: Leading the Way to a New Paradigm

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Marta Tomic

Solar Energy Program Manager

Maryland Energy Administration

Powering Maryland's Future

May 27, 2015

AGENDA

1. MARYLAND'S SOLAR PROGRESS
2. SOLAR POLICY
3. MEA PROGRAMS
4. LESSONS LEARNED

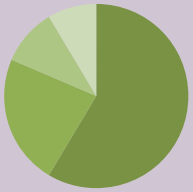



Maryland Energy Administration

Renewable Energy
MEA provides grants for innovative clean energy systems and supports the development of offshore wind.

Smart Investments

Energy Efficiency
MEA provides grants for money saving energy efficiency measures in the commercial and industrial sector and for low-to-moderate income Marylanders.

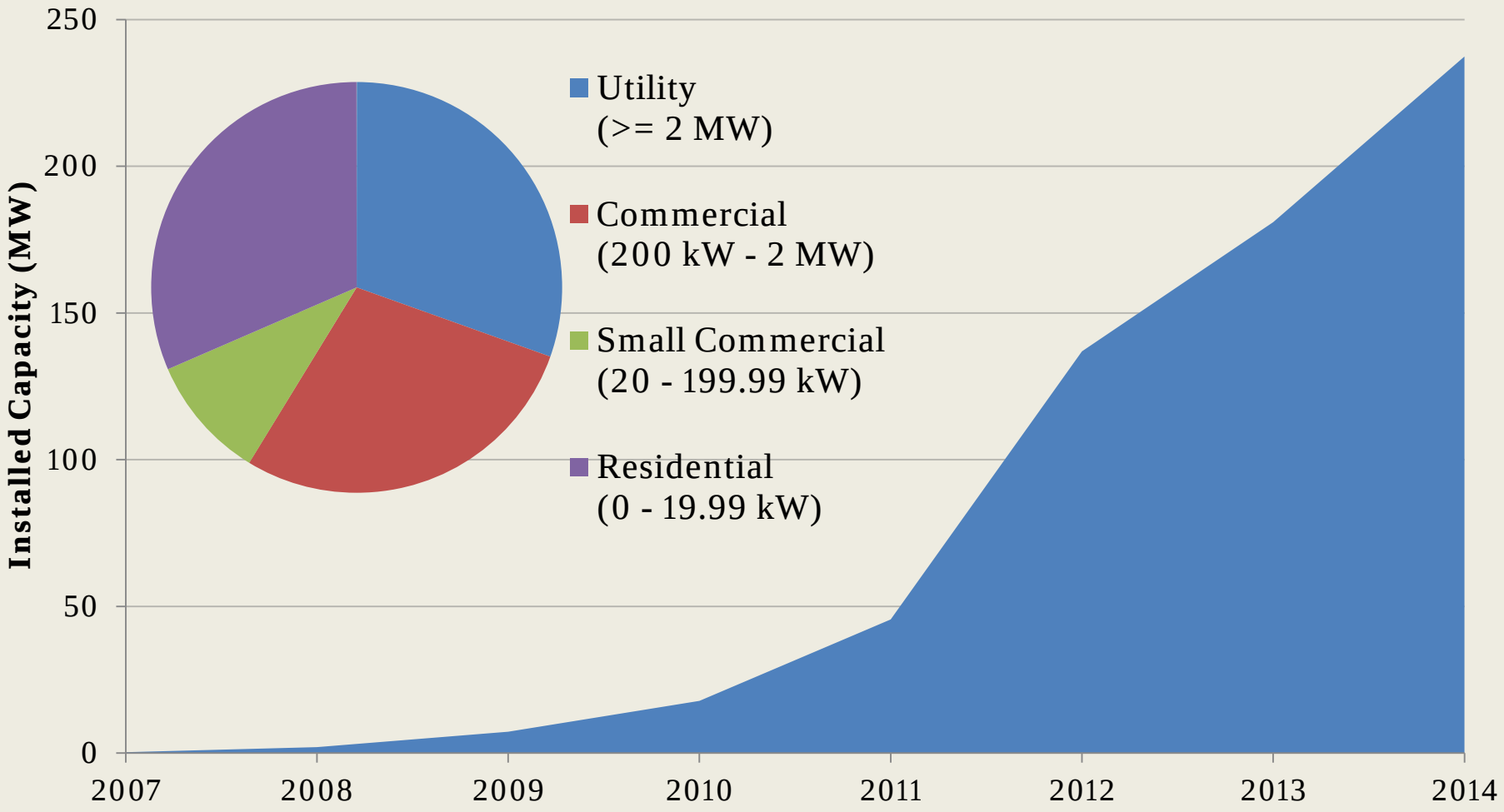


Policy, Planning & Analysis
MEA provides expert support on key energy policy issues facing Maryland, from efficiency to resiliency.

Real Results

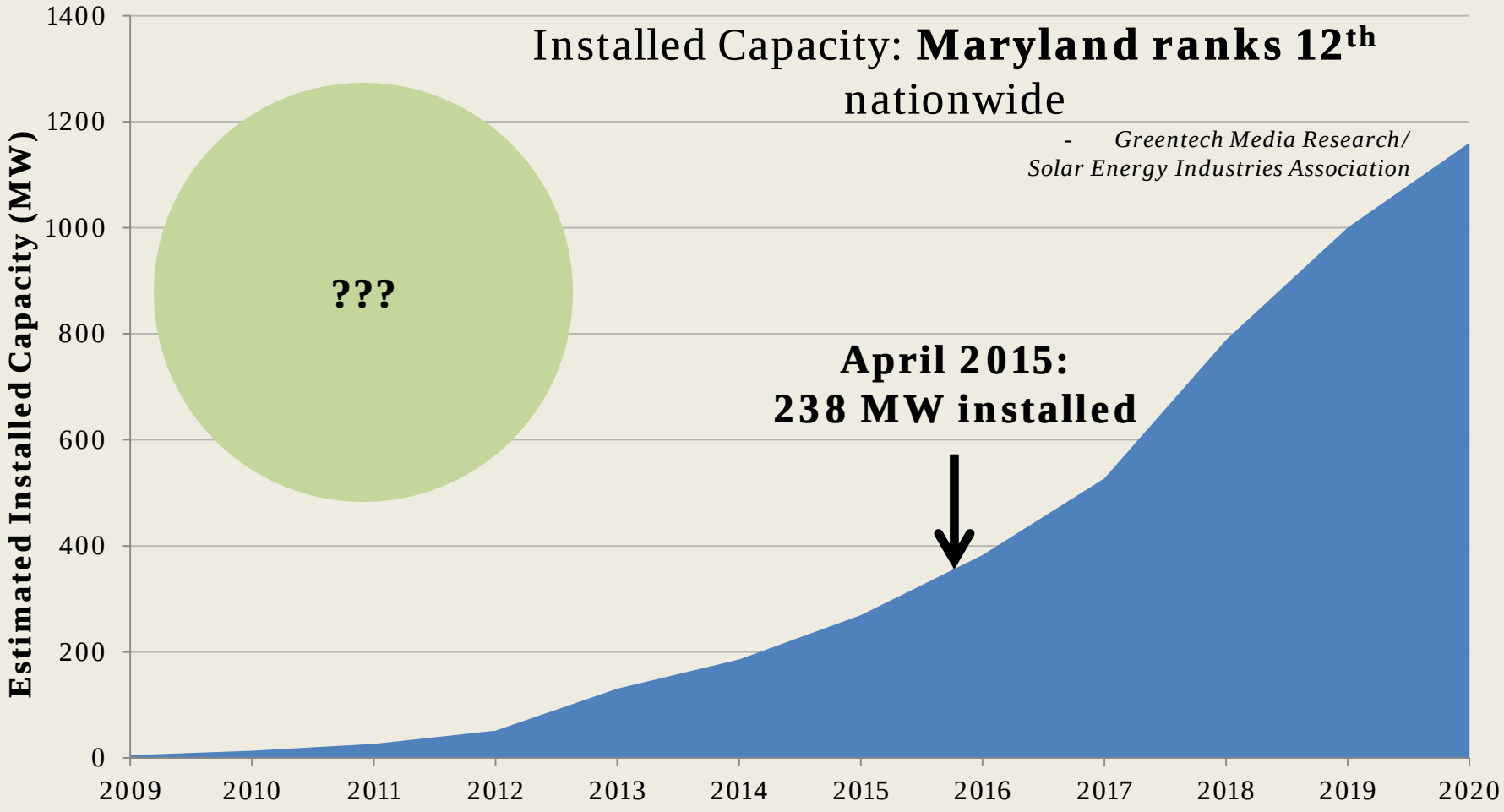
Maryland Energy ADMINISTRATION
Powering Maryland's Future

RPS: 20% by 2022, 2% in-state solar



Source: PJM GATS

RPS: 20% by 2022, 2% in-state solar

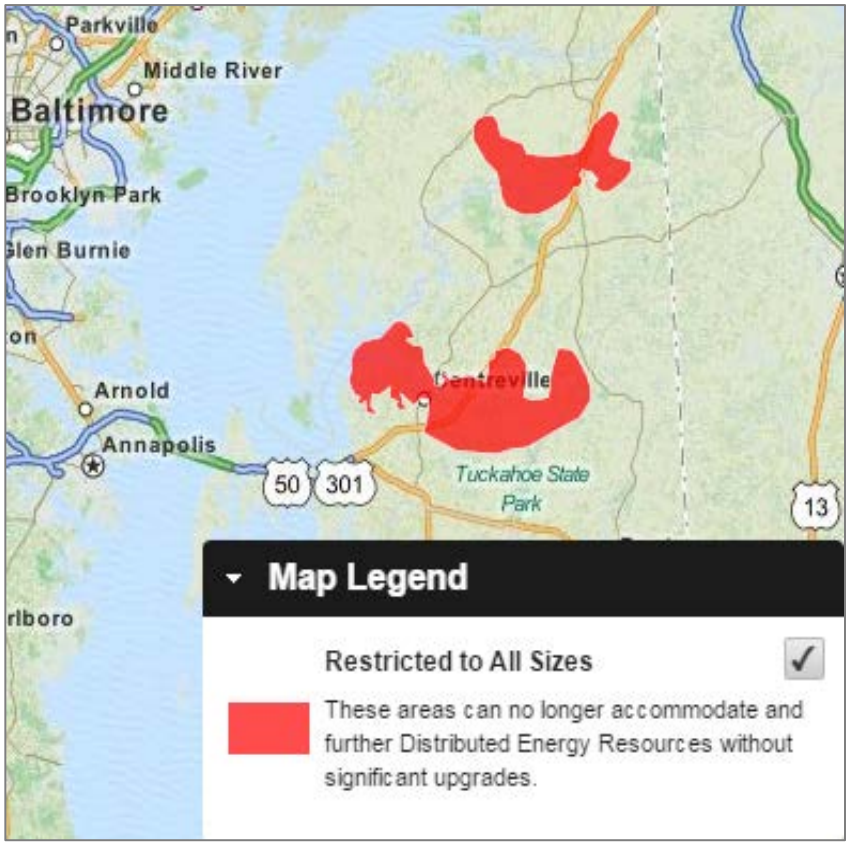


Source: PJM GATS

MD Policy

- Net Metering
- Aggregate Net Energy Metering
- Community Solar Pilot (2015)
- Interconnection (2015)

Restricted Circuit Map:
Delmarva & Pepco



Source: Delmarva Green Power Connection

Grant Programs

- Clean Energy Grant Program
- Solar PV/EV Canopy Grant Program
- Smart Energy Communities
- Demand Response & Building Automation
- Mathias Agriculture Program (EE + RE)

Building Energy Management System (BEMS)

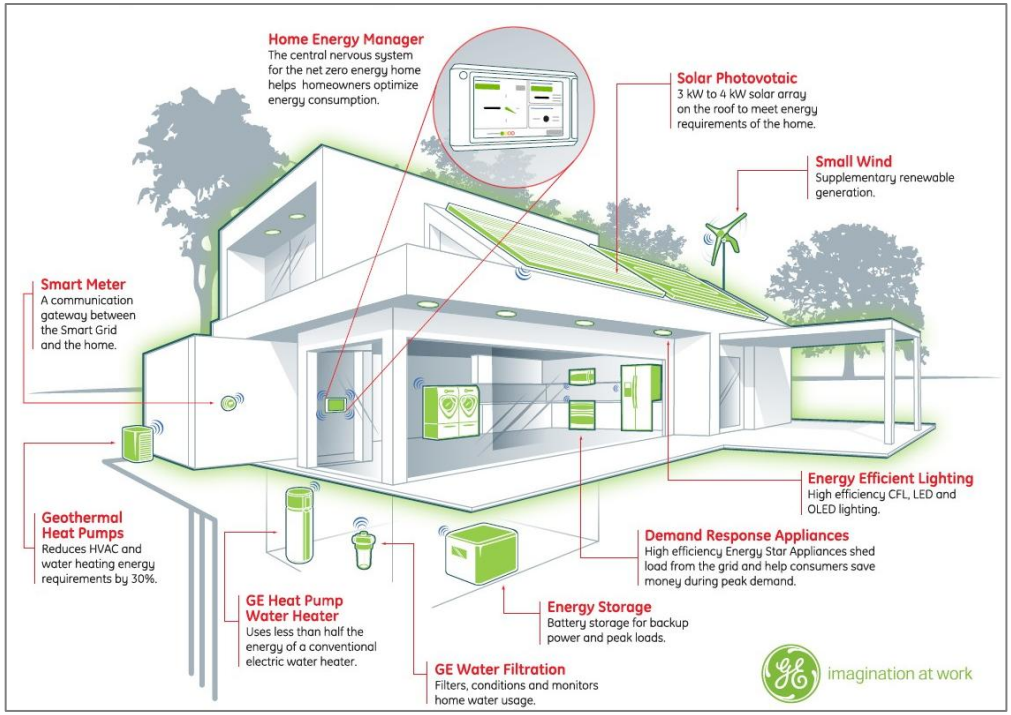
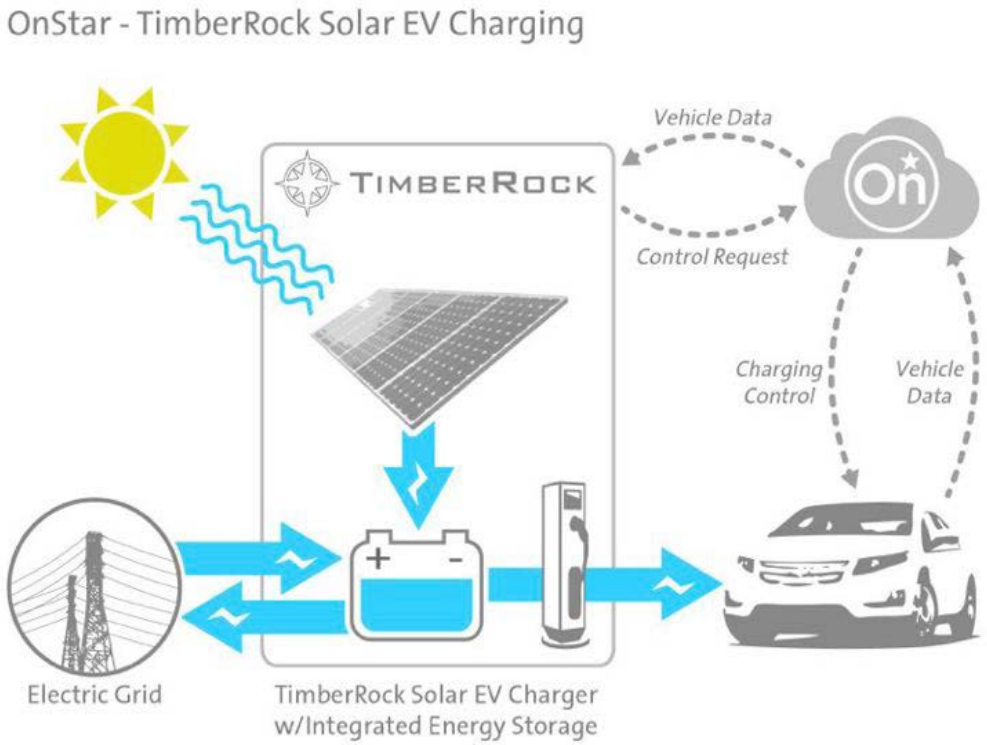


Image Source: http://www.climatetechwiki.org/technology/jiqweb-bems

Game Changers

- Maryland's first microgrids
- Aggregated residential storage
- Plug & play solar
- Public-private partnerships



Source: Timber Rock Energy Solutions, MEA Game Changer Awardee

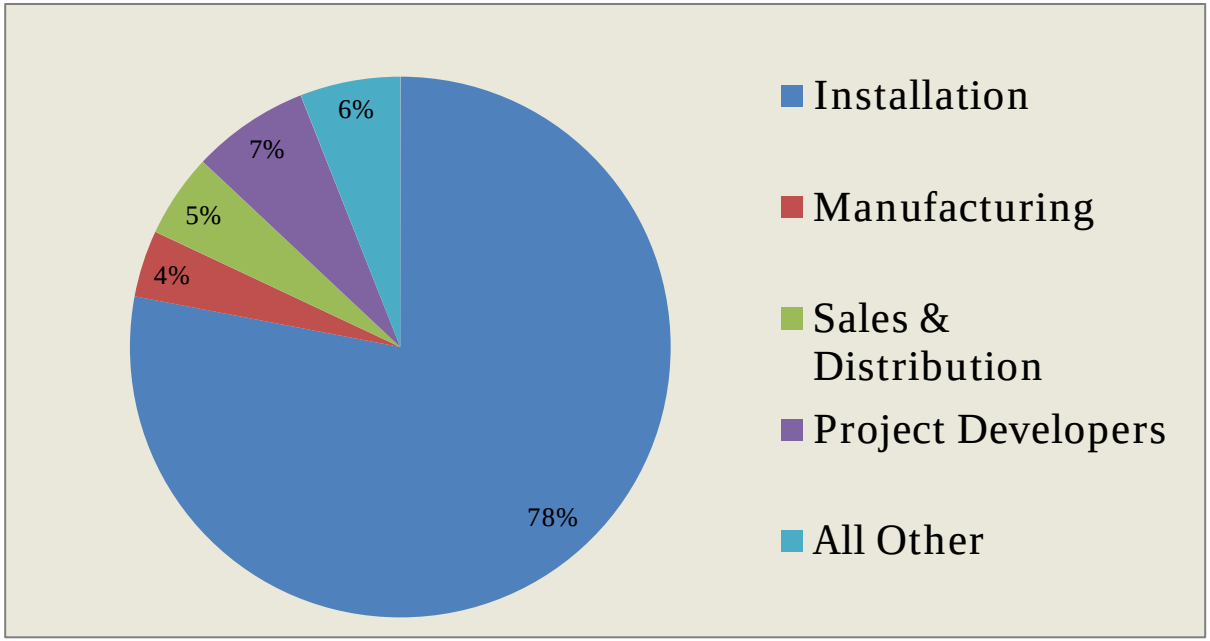
Targeted Initiatives

- Guidebook on Net Metering in Maryland
- Solar thermal on correctional facilitates
- Solar PV on K-12 schools
- Comprehensive Online Application Portal
- Underserved populations in Maryland's solar industry

Maryland's Solar Industry

Maryland **Solar Industry Jobs Grow 29%**: Now Ranks 13th Nationally

- The Solar Foundation



Source: The Solar Foundation, MD Solar Jobs Census

Lessons Learned / Replicable Steps

- Grant program transparency
- Education and awareness
- Collaboration with stakeholders
- Industry communication
- Technical assistance
- Policy team support

- Identify opportunities & initiatives to advance industry

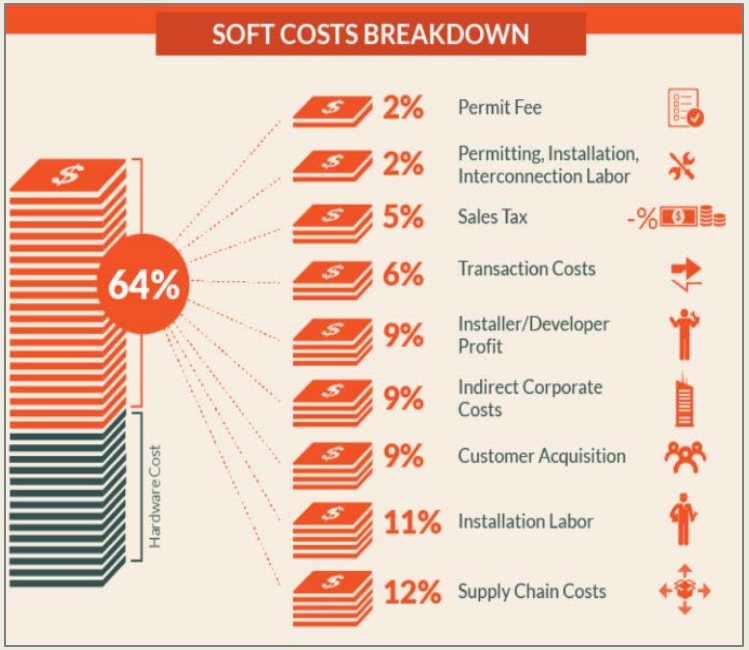


Image Source: CleanTechnica

Resources

- PJM GATS, http://www.pjm-eis.com/reports-and-news/public-reports.aspx
- SREC Trade Maryland, https://www.srectrade.com/srec_markets/maryland
- Delmarva Green Power Connection, http://mangomap.com/maps/34055?preview=true#
- TimberRock Energy Solutions, http://timberrockes.com/company.html#collaborations
- MEA Microgrid Report, http://energy.maryland.gov/documents/MarylandResiliencyThroughMicrogridsTaskForceReport_000.pdf
- 2014 Maryland Solar Jobs Census, http://www.thesolarfoundation.org/wp-content/uploads/2015/02/Maryland-Solar-Jobs-Census-2014.pdf
- Solar Market Insight Report 2014 Q4, http://www.seia.org/research-resources/solar-market-insight-report-2014-q4
- Rocky Mountain Institute, http://www.rmi.org/simple
- Berkley Labs, http://emp.lbl.gov/reports/re

Thank you!

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