



• August 15-18, 2010 • Dallas, Texas •
• Dallas Convention Center •



Pentagon Energy Projects

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History of the Pentagon

The Pentagon Reservation – “An Installation Under One Roof”



Ground Breaking Ceremony for the Pentagon was September 11, 1941. The building was dedicated on January 15, 1943 nearly 16 months for completion at a cost of \$83 million dollars.

The First major renovation was undertaken in 1991

Currently the Pentagon is undergoing renovation and modernization..

Pentagon Land Purchase “Hell’s Bottom”



Potts and Callahan - Headquarters, Old Washington Airport

Size of the Pentagon

The Pentagon Reservation – “An Installation Under One Roof”



- **Equivalent to 3 Empire State Buildings**
- **34 Acres Size of the Pentagon Foot Print**
- **6.636,363 Million Building Square Feet**
- **95,000 Kilovolts of Electrical Power**
- **583 Acres Total Land Area**
- **\$5.2B Dollars of Plant Replacement Value**
- **17.5 Miles of Corridors**
- **200 Acres of Landscaping**
- **16 Parking lots 8,770 Parking Spaces**
- **130,000 S/F Physical Fitness Center**
- **More than 120 single roofs on the Pentagon**

Complexity

- 24/7 Operations
- Always under threat , Military Command Centers in War Events
- Security and screening at all entrances
- 23,000 Military 3,000 Civilians 3,500 Visitor a day

Pentagon Landscaping 1943



Concrete Road Work

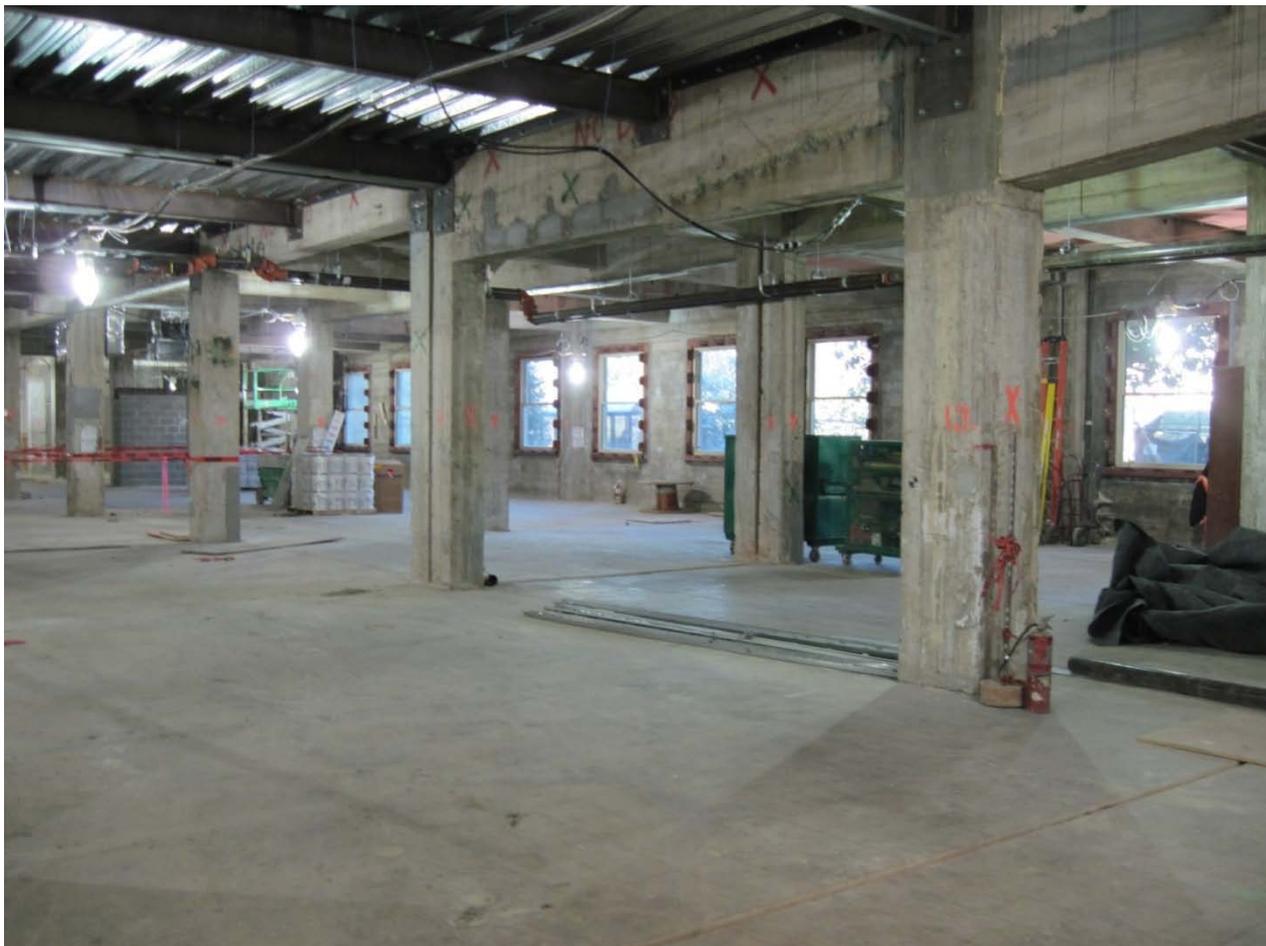
Pentagon Construction 1942



Second Floor Construction

Original Construction Techniques

Construction Site on E Ring 5th Floor



Energy Project Windows

Pentagon Windows and Doors

There are 7,754 new windows and 60 outer doors installed by the Pentagon Renovation Program.

A 17% energy savings is anticipated as a result of the new windows, doors and insulation in walls and roof renovation.

Annual Cost Savings 17%. \$ 3,084,995

MBTUs Saved 223,065



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BLAST RESISTANCE WINDOWS

Designed floor-ceiling connection scheme, these plates are welded and bolted to their counterpart on floors above and Below



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Fork Lift Truck with special suction cups mount in place the window for alignment for bolting and welding



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Tragedy Strikes:
Stabilize, Demolish, Rebuild Structure



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Interior

**Windows and insulation around all walls
Size of windows 5' x7' Permanently Closed**



Pentagon Energy Project HVAC

New HVAC Systems and Building Controls

The Building Operations Command Center (BOCC) was commissioned in June 2001 and provides an Energy Management Control System (EMCS) that controls mechanism for thousands of Johnson Controls sensors and actuators in the HVAC, lighting and safety systems for the Pentagon Complex.

.The (EMCS) and the PHRP is projected to reduce energy by contributing to reductions of the Pentagon centric environmental foot print by 8 Percent.

- MBTUs Saved 104,972
- Annual Cost Savings 8% \$1,451,763



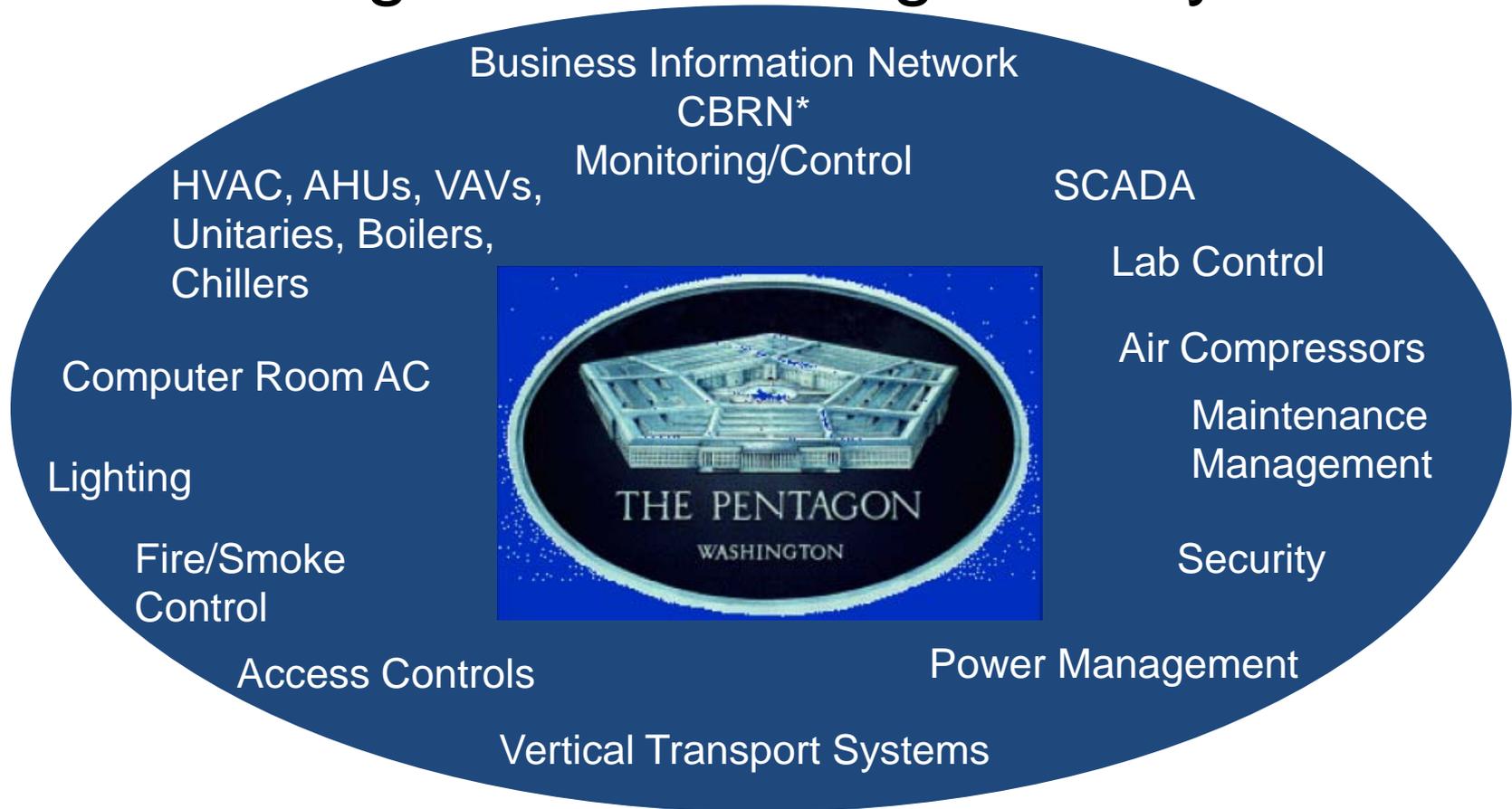
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**Building Operation Command Center (BOCC)
Tenants call all complaints into BOCC 2,400 S/F
Interior Design /Build**



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Pentagon BOCC Integrated Systems



**CBRN – Chemical, Biological, Radiological, Nuclear*

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Install Satellite Boilers at FOB 2

The installation of a two satellite boiler eliminated over 5000 feet of buried high –pressure steam lines leaks. The energy radiation loss from the steam and condensate piping system from the Pentagon to the Navy Annex and Henderson Hall, cost more than \$100,000 per year.

MMBTU's Saved 46,862

Annual Cost Savings \$648,101

2 each 300 HP

1 each 151 HP



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ESPC Water Side Economizer Renewable Energy Project

A plate and frame heat exchanger was installed in the Pentagon Heating and Refrigeration Plant to generate 4,250 tons of cooling using Potomac River water. The water at a temperature below 40 degrees provides 75% of the hours for free cooling from December through March.

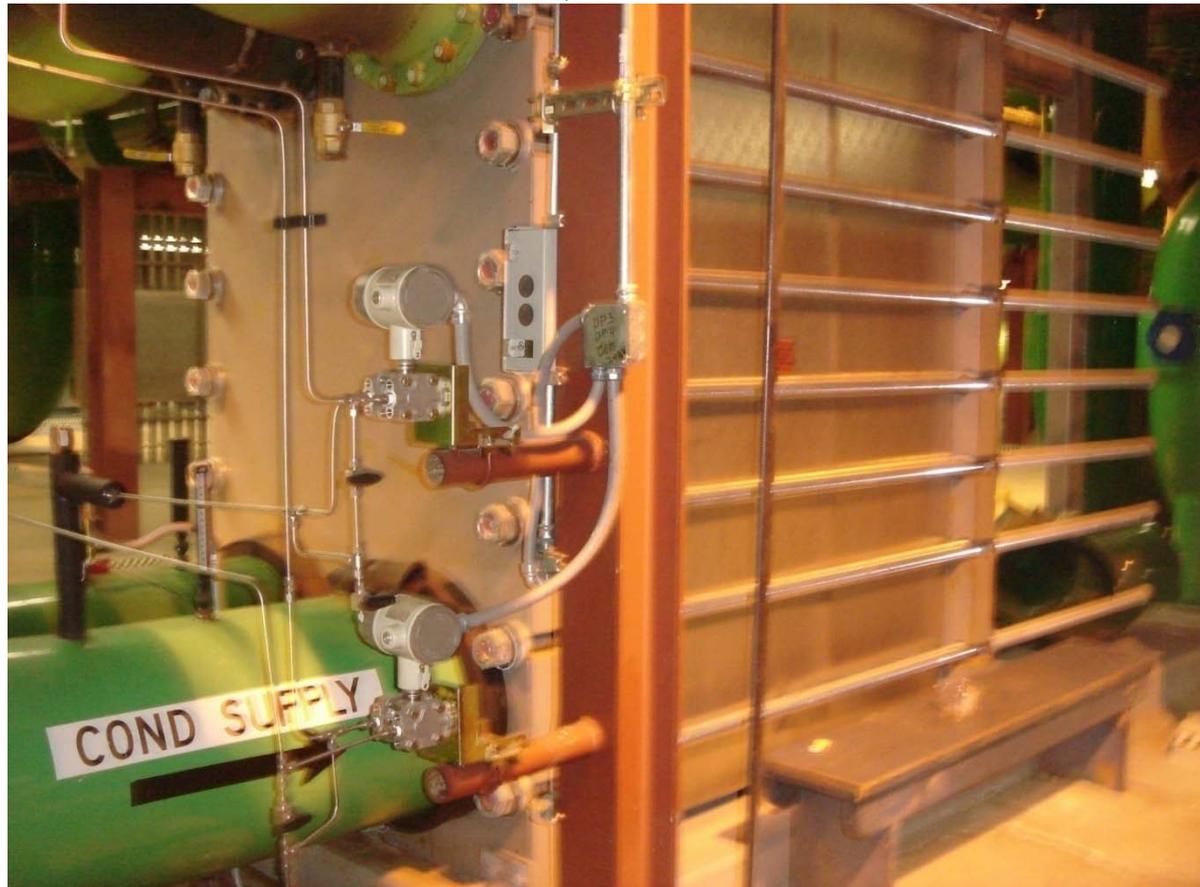
- **MBTUs Saved 26,087**
- **Annual Cost Savings \$360,000**



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ON LINE IN WINTER

**Plate and Flame Heat Exchanger no moving parts
saved 26,087 MBTUs**



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OFF LINE

3,750 Tons Chiller Savings \$360,000



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Boilers



Pentagon Energy Projects

Ongoing Energy Projects (2009 cost avoidance)

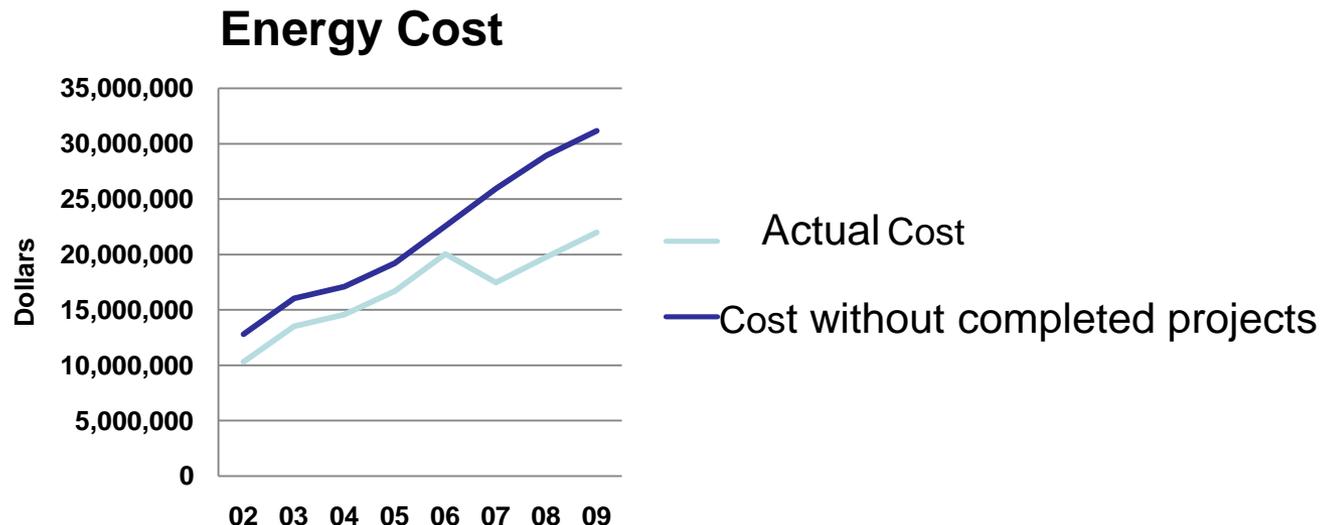
Projects	\$ Utility Cost Avoided	MMBTU's Avoided
• 003% Boilers at FOB 2 (2008)	\$ 648,101	46,862
• 017 Windows (2007)	\$ 3,084,995	223,065
• 018 Water Side Economizer (2007)	\$ 360,000	26,087
• .08 HVAC Controls Modifications (2007)	\$ 1,451,763	04,972
• .012% State of the Art Heating & Refrigeration Plant (1990)	\$ 2,514,630	469,496
• <u>.05% Lighting and Controls (2007)</u>	\$ 1,100,261	<u>79,556</u>
30.12% Total Savings	\$ 9,159,750	950,038

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Energy Cost Savings Thru FY09:

Pentagon utility bill would have been \$31,164,968 today if Energy Project would have not been implemented compared to FY-09 \$22,005,218

Cost avoidance of \$9,159,750 and the reduction of 174,092 metric tonnes of CO₂e Carbon Dioxide emissions into the upper atmosphere through this energy conservation program.



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Current Energy Program Initiatives Section 2

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- Renewable Energy Study
- **Purpose – Performed a renewable energy feasibility study to determine what, if any, renewable energy projects would be good for the Pentagon reservation.**
- **Study Requirements:**
 - **Concentrate on the following renewable:**
 - **Solar for 30% of hot water**
 - **Solar Photovoltaic panels for parking lots and other areas**
 - **Fuel Cells**
 - **Ice Storage at Pentagon Heating and Refrigeration Plant**
 - **Wind Turbine on the lagoon for bar rake water intake of condensers**
 - **Micro Hydro Turbine**

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- Demonstration Technologies that are not cost effective
- Not cost effective over a 25 year life cycle, but may be implemented to showcase renewable technologies or unfeasible due to lack of resource or site constraints.
 - PHOTOVOLTAIC: Parking lot canopies, 97 year payback (No)
 - WIND POWER: Demonstration project for a three residential scale wind turbines
 - (4-4kW each) near the Pentagon lagoon. (Yes)
 - BIOMASS GASIFICATION: Security concerns. (No)
 - FUEL CELLS: A feasibility study is recommended. (Yes)
 - GEOTHERMAL HEAT PUMPS: A feasibility study is recommended. (Yes)
 - MICRO HYDROELECTRIC POWER: Potomac River in-stream current insufficient. (No)

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Energy Dashboard

Purpose

- **Portal allows managers access to real-time information about building operations**
- **Communication over the Intranet by modem.**
- **Makes it possible for information to be shared between many different systems.**
- **Values may include temperature, pressure, flows, power usage, etc.**
- **Values are processed to obtain key performance parameters for the equipment , utility usage/cost, service calls, repairs, local weather, and M&V of HVAC systems.**

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- Energy Dashboard
- Develop workflows and methods for gathering/manipulating energy data to:
 - Provide real time monitoring of energy use, peaks, troughs, trending, and forecasting
 - Provide energy reports to identify high energy users and inefficient operations
 - Monitor /read all utility meters read by the utility companies to verify usage/cost on utility bills
 - Perform analysis of energy consumption and patterns that may indicate maintenance issue w/failure notification
 - View/store total building energy consumption with the ability to drill down into electric, water, gas, etc. in real time, hourly, daily, monthly, yearly with the ability to compare to previous years
 - Measure energy usage against reduction targets w/analysis on areas of possible reduction measures

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- Emergency Demand Load Response Program
- **Program Purpose – A demand response program designed to help balance electrical supply and demand requirements and prevent brownouts in the Pennsylvania-Jersey-Maryland (PJM) electrical grid.**
- **Benefits:**
 - **Energy Conservation savings through load reduction rebated to utility bills**
 - **Receive free advanced metering and combine efforts with sub-metering projects with current energy conservation initiatives**
 - **Meets Federal mandates requiring demand response participation**
 - **Reduces greenhouse gases**

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- Emergency Demand Load Response Program
- Pentagon participated in the PJM Performance Audit 12:15 – 2:00 PM on 5 August 2009.
 - Generators provided power during this time period
 - Performance resulted in a savings of 9,179kw of power from Dominion Virginia Power against a nomination of 9,000kw
 - Pentagon performance was 102% of that expected.
 - This savings resulted in a credit of \$447,319.



GovEnergy 2010

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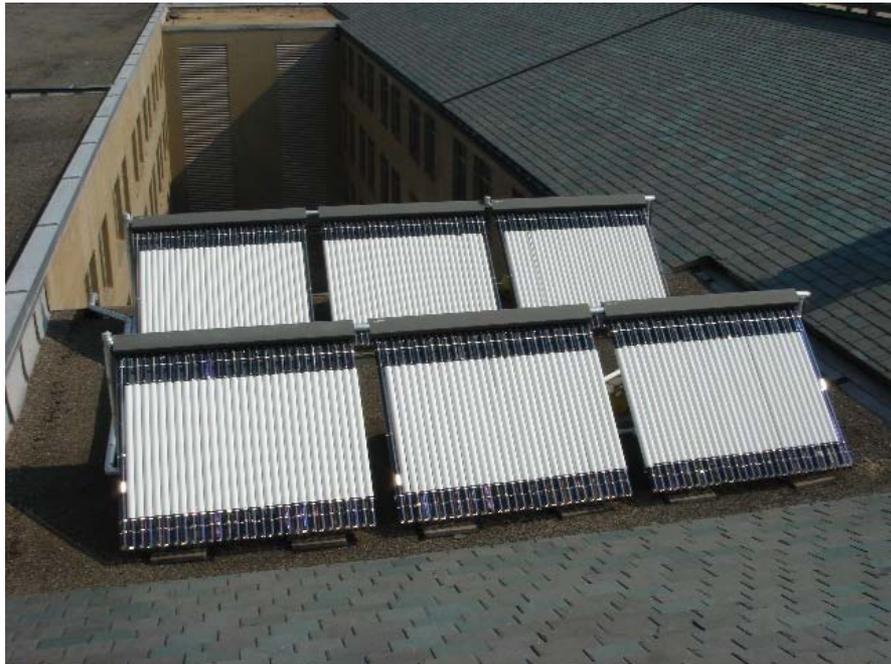
Additional Projects

- Parking Lot Lighting
 - Parking lot lighting controls and new lighting bulbs
 - Maintenance Solar contract for parking lighting systems SOW and Estimate



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- Additional Projects
- Solar Hot Water
 - Retrofit solar system in wedge 1
 - Solar Hot Water on the roof between 9 & 10 (Renewable Study)



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- Additional Projects
- Vending Machine Energy Misers
 - Energy Saving Devices on vending machines – Partnering w/Navy Welfare
 - Monitor the use of machines and power down when not in use



Pentagon Energy Projects

- Additional Projects
 - **Wedge 1 and 2 De-lamping lighting system**
 - These wedges are over-lit with light levels over 75 foot-candles
 - Propose to reduce the number of lamps to 2 and add a reflector
 - **Install Lighting Controls**
 - Current lighting controls through the BOCC are for large quantities of fixtures controlled together
 - Install lighting controls that would allow for tighter control w/possible use of intelligent lighting systems or refined occupancy sensors

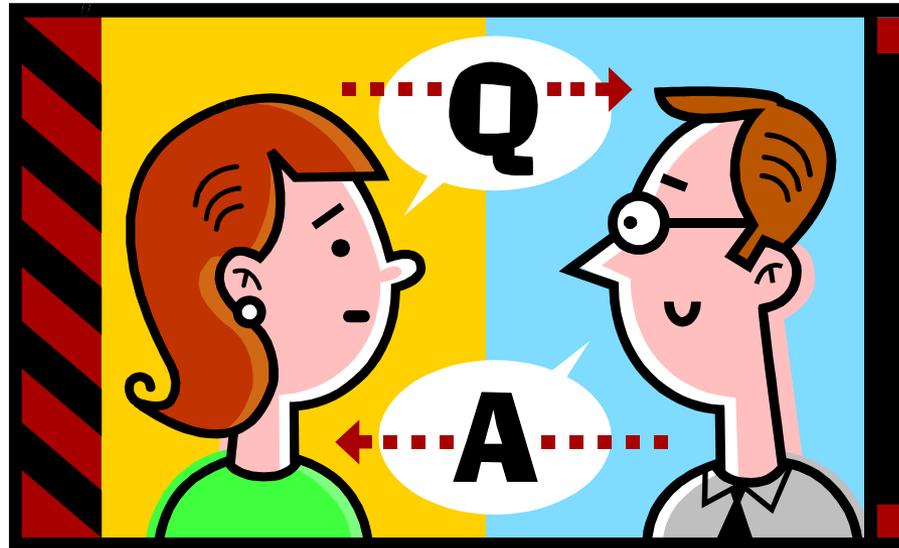
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- Summary
- **The Pentagon has and is implementing cost saving and energy reducing measures to meet Federal mandates, but further research and funding is needed to meet the requirements established**
- **The Energy Dashboard will allow for real time monitoring of energy use, peaks, troughs, trending, and forecasting which will provide energy reports to identify high energy users and inefficient operations**
- **The Pentagon will participate in an emergency demand load response program at no expense to the Pentagon that will fulfill a Federally mandated requirement along with providing monetary credits to our utility bill**

Pentagon Energy Projects

Discussions...

Questions?



Pentagon Sustainability Program

- ❖ Washington Headquarters Services (WHS) uses the US Green Building Council, Leadership in Energy and Environmental Design (LEED) to benchmark 'green' design, construction and operations

- ❖ LEED certifications
 - ✓ Metro Entrance Facility (MEF) – received “Certified” LEED rating, 2003
 - ✓ Pentagon Athletic Center (PAC) – received “Certified” LEED rating, 2004
 - ✓ Remote Deliver Facility (RDF) – received “Certified” LEED rating, 2005
 - ✓ Pentagon Library Conference Center (PLC2) – received “Silver” LEED rating, 2008
 - ✓ Wedge 2 – received “Certified” LEED rating, 2007
 - ✓ Wedge 3 – received “Certified” LEED rating, 2008
 - ✓ Wedge 4 – received “Silver” LEED rating, 2010
 - ✓ Wedge 5 – anticipate “Silver” LEED rating, 2011
 - ✓ BRAC 133 – anticipated “Gold” LEED rating, 2011



Sustainable Design, Construction, O&M at the Pentagon

Using LEED...Continuous Improvement

- Support and official announcement of mission/goals for Sustainable/LEED program
- Developing program and tracking mechanisms to record progress in meeting EO 13514
 - ✓ Participation in DoD/OSD EO/Sustainable Working Group
 - ✓ Reporting to OSD of progress in EO scorecard
- Using LEED as benchmarking tool to meet Federal Mandates

Sustainable Design, Construction, O&M at the Pentagon

In Conclusion...

- **Currently setting goals for greening our facility**
 - ✓ Energy efficiency is top priority
 - ✓ Benchmarking
 - ✓ Baseline metering/sub metering
 - ✓ Development of smart tools (i.e., energy dashboard)
- **Team established to monitor and document credits and status**
- **Continual Improvement...**
 - ✓ Identify what your next level to achieve
 - ✓ Establish goals to move to the next level
 - ✓ Identify lessons learned
 - ✓ Implement best practices