Deep Energy Retrofit Case Studies

• Wayne Aspinall Federal Building
• GSA National Deep Energy Retrofit Program (NDER)
  • New Carrollton Federal Building
  • Almeric Christian Federal Building
Wayne Aspinall Federal Building History

Designed by Office of Supervising Architect - James A. Wetmore in 1915

Third floor addition in 1916

Original construction completed in 1918 @ $250K

1938 Expansion @ $216K

Named after Congressman Wayne N. Aspinall in 1972

Listed on the National Register of Historic Places in 1980
Recovery Act Case Study

- Net-zero energy target
- Platinum LEED rating goal
- Historic Building
- 123 kW PV array to produce 170,000 kWh a year (greater than 50% of the building’s historical annual electricity use)
- Ground source heat pumps
- ECMs: lighting control and monitoring, demand controlled ventilation, plug load management measures, thermally improved building envelope.
- Building physics analysis used
Wayne Aspinall Federal Building Renovation

- Variable refrigerant flow heating and cooling (air-cooled)
- Demand controlled ventilation using multi-parameter system
- 0.6 W/sf avg. lighting power density
- Interior storm window with solar film
- Dedicated outdoor air system with heat recovery & indirect evaporative cooling
- Daylighting / occupancy controls
- Wireless sensors
- Energy sub-metering
- Integrated building automation system
- R-30 cool roof
- Solar thermal service hot water

Beck/Westlake Reed Leskosky
Utilizing Historic Resources
Interior Preservation

Source: WRL Design
Project History

• Original Scope
  • $12-15 M project cost, 42,000 gsf
  • HVAC Life-Cycle Cost Analysis
    • 4-pipe FCU
    • WSHP
    • Air-source VRF
  • LEED Silver, 30% below
  ASHRAE 90.1-2007
National Deep Energy Retrofit NDER

- 23 facilities
- 10 Task orders awarded in 2014
- 14.7 million square feet
- 38% average energy reduction
- $172 million implementation cost
- $10.6 million annual savings
- 365 billion Btus annual energy
- Goals:
  - Retrofit plans that move a building towards net zero energy consumption
  - Use of innovative technologies
  - Use of renewable energy technologies
  - Unstated objective: achieve deep(er) energy savings than in past projects
NDER Round 1 Results

- Energy Savings
- NDER Project % Energy Reduction
- NDER Program Average
- Other Federal ESPC Project Average

Chart showing energy savings for different regions.
The NDER Keys to Success

- **Aggressive Goals:** Emphasis on deep retrofits in the notice of opportunity

- **Clean Sheet and Integrative Design:** Design charrettes studied integrative design theory and reinforced the need for ESCOs to dig deeper (and propose ECMs with longer simple paybacks) than past projects

- **Support System:** Program Management Office provided central source of information for GSA regional managers
The keys to successful deep ESPC projects are **well-understood** and **achievable** strategies.

- **Communication**, deliberate **goal setting**, and **holistic design** are key to deep ESPCs.

- Deep ESPCs are a **responsible investment** of taxpayer money.

- Investing in efficiency today prepares our buildings to become **resilient grid assets** and supports goals like **net-zero energy**.
New Carrollton Federal Building

• 1.1M SF
• Completed in 1994, consists of three nine-story office towers connected by “public level” on the ground floor
• Occupancy is approximately 5,000
• All electric heating & cooling
• Initial EUI of 115

$44 M ESPC - Ameresco
60% reduction of total energy
54% water reduction
$2,839,770 annual energy savings
Over 20,000 tons of annual GHG emissions reduction
**Project Highlights**

**Integrated ECMs**
- Lighting & Advanced Controls - 15% energy reduction
- Chiller System Optimization - 7% reduction
- Building Controls - 30% reduction
- Other improvement measures - 9% reduction
- Infrastructure measures - 1% reduction

**Renewable Energy**
- Solar Thermal & PV System
- Geothermal Field

**Economics**
- $45 M Project Implementation Costs
- 22-Year Performance Period
- $4 M Rebates

- 11,000 LED lighting fixtures
- new control systems
- geothermal well field
- two new high efficiency chillers and one new chiller-heater
- 808kW solar canopy
- 67kW carport structure
- solar thermal heating
- new rain gardens
Almeric Christian Federal Building
First Net Zero ESPC

• GSA Region 2

• Schneider Electric selected in 2012, through NDER, to implement ESPC

• TO awarded September, 2013

• Construction completed September, 2014

• Project parameters
  • $6.4 million investment
  • $0.5 million/year guaranteed savings
  • 19 year finance term
Key Facts

Building Characteristics:
- **Location:** St. Croix, Virgin Islands
- **Floor Area:** 57,872 ft²
- **Original Construction:** 1989
- **Tenant:** Federal Courts
- **Baseline EUI:** 57 kBtu/ft²
- **Local Utility Rate:** $0.52/kWh

Project Details:
- **Project Duration:** Approx. 24 months, 12 each for development & construction
- **Investment Value:** $6.4 million
- **Projected Energy Reduction:** 100%
- **Projected Savings:** $500,000/year
- **Contract Term:** 19 years
Technical Specifications

- **Key ECMs**
  - Building Automation System
  - Lighting upgrades
  - Chiller and AHU upgrades

- **Renewables**
  - 462 kW ground-mounted solar

- **M&V**
  - Option B: PV system
  - Option C: all other ECMs

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**Investment Value, by Detailed ECM Category**

- **Ground Mounted Solar**, $3,322,147
- **Chiller Improvements**, $675,877
- **BAS Improvements**, $502,902
- **HVAC - replace AHUs 2, 4 & 6**, $517,771
- **Interior Lighting Improvements**, $802,949
- **Window Film Installation**, $39,635
- **VFDs - Variable volume CHW Distribution**, $81,885
- **Retro Commissioning**, $18,621
- **Building Transformer Replacement**, $291,464

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• 670kW PV system
• New Chillers
• New substation
• New air handling units
• New building automation system (BAS)
• Lighting upgrade
• Window film
Benefits of the ESPC

- 100% reduction in grid supplied electricity
- Stable utility rates
- Improved lighting and comfort conditions for the tenants
- New equipment reduces O&M expense
- Risk of substation failure is eliminated
Keys to Success

- Well-structured communication plan
- Building tenant buy-in
  - Proactively addressed tenant concerns
- Consideration of unique project characteristics
  - Utility rates
  - Security requirements
- Information collection and dissemination processes could be improved
  - More existing asset data needed
  - Standardized central location for all project information
Resources

GSA Office of Federal High Performance Green Buildings
www.gsa.gov/hpgb
ESPC Charrette Reports and Case Studies
www.rmi.org/gsaretrofits
ORNL report Energy Savings from GSA’s National Deep Energy Retrofit Program
http://www.gsa.gov/portal/mediaId/198447/fileName/NDEREnergySavingsReport5.action
Wayne Aspinall FB
http://www.gsa.gov/portal/content/121123