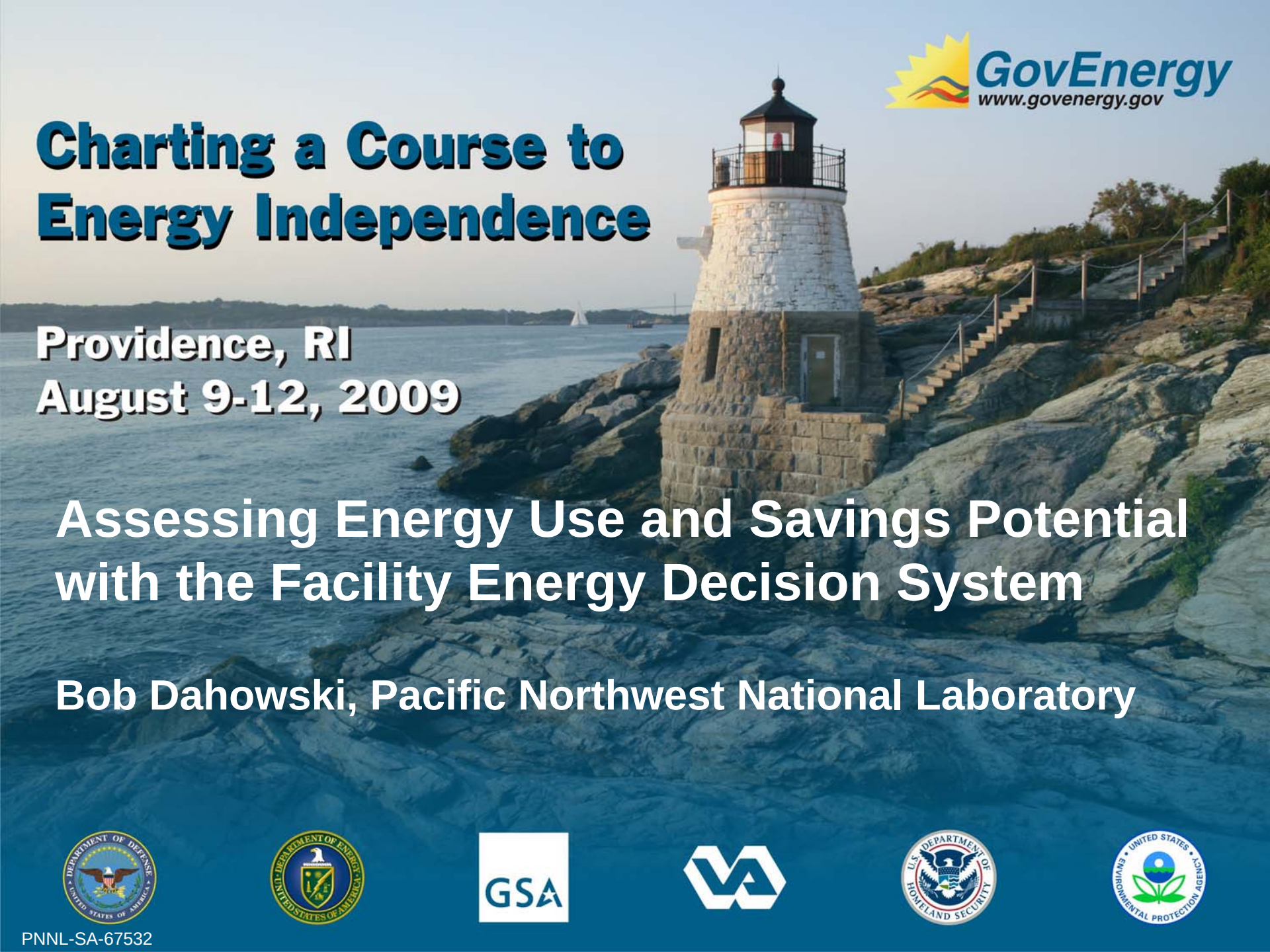
GovEnergy
www.govenergy.gov
Charting a Course to Energy Independence
Providence, RI
August 9-12, 2009
Assessing Energy Use and Savings Potential with the Facility Energy Decision System
Bob Dahowski, Pacific Northwest National Laboratory
GSA
PNNL-SA-67532

Topics

- Federal Energy Efficiency Goals
- FEDS Capabilities
- FEDS Applications
- What's new in FEDS 6.0
- How to get FEDS

Facility Energy Decision System

www.pnl.gov/FEDS

Decision-Making Software for Building Energy Efficiency

A Key Tool for our National Energy Priorities

- The Nation is embarking on a new era of energy awareness and action
- **Existing** buildings represent a significant target for energy savings
- FEDS can be used by government or private sector facility energy managers to:
  - Quickly and easily identify energy savings opportunities, $ savings, emissions reductions
  - Identify options for meeting federal energy efficiency goals
- FEDS combines a unique set of features to provide valuable energy efficiency screening plus more detailed analyses to support project development

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Energy Savings Goals, Requirements, & Opportunities

- Energy Policy Act of 2005
- Executive Order 13423
- Energy Independence and Security Act of 2007
- Other federal and agency level targets and guidance
- The American Recovery and Reinvestment Act of 2009

Selected Requirements from the Energy Independence and Security Act of 2007

- **Section 431 – Energy Reduction Goals for Federal Buildings**
  Increasing energy reduction goals towards a 30% reduction target by 2015, from a 2003 baseline.
- **Section 432 – Management of Energy and Water Efficiency in Federal Buildings**
  - Annual comprehensive evaluation for 25% of covered facilities at each agency.
  - Implementation of energy and water efficiency measures within 2 years after completion of each evaluation, that are life cycle cost effective
- **Section 435 – Leased Facilities**
  - 3 years after enactment of the legislation no agency may enter a lease for a building that has not earned an Energy Star label in the most recent year
  - Buildings already occupied by an Agency must be renovated with cost effective energy efficient measures within a year.

Overview of the FEDS Software

Decision-Making Software for Building Energy Efficiency

- Estimates energy consumption for all energy systems and fuels types
- Determines the minimum life-cycle-cost retrofits to systems within a single facility and for an entire installation or campus, considering interactive effects

Does this quickly and easily, requiring minimal modeling experience

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Development History

- Originated to meet energy analysis needs found in no other software, to quickly analyze large multi-building complexes with single meter
  - Determine where energy was going and what savings opportunities existed
- Enhancements and features added over time to increase functionality and flexibility, and update technology performance and cost data

Building Systems Evaluated by FEDS

- Building Shell
- Advanced HVAC Options
  - Heat pumps (incl. ground-coupled & dual-fuel)
  - Gas engine, absorption chillers
  - Radiant / infrared heating
- Lighting
- Motors
- Refrigeration Equipment
- Plug Loads
- Central Energy Plants and Thermal Loops

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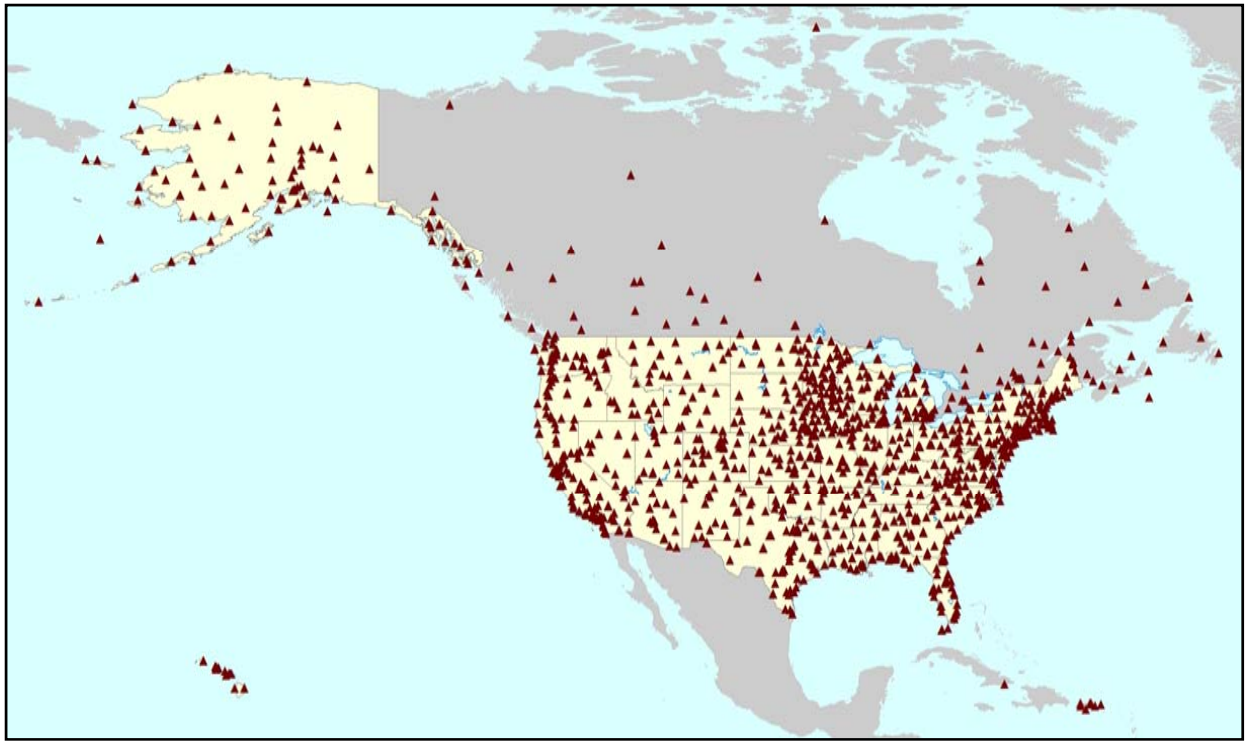
Weather Data

- Over 1730 weather station data files
- Derived from Typical Meteorological Year (TMY, TMY2, TMY3), Weather Year for Energy Calculations (WYEC, WYEC2), Test Reference Year (TRY) 8760 hourly data.
- U.S.
- Caribbean
- Pacific Islands
- Canada
- Other Int'l

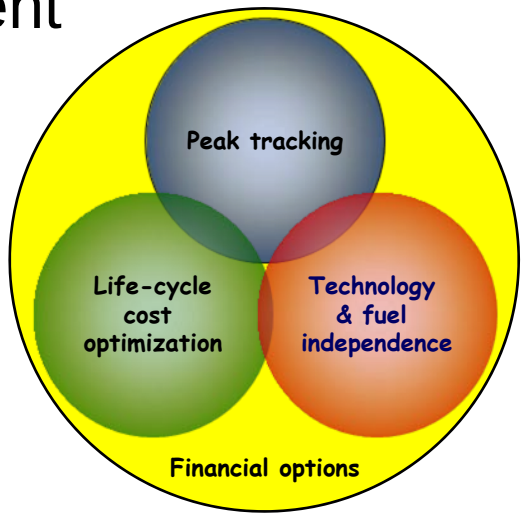


Energy Analysis: There are no All-Purpose Tools

- Limitations:
  - FEDS is NOT a design tool
  - Does not model every available advanced technology
  - Currently considers only limited renewable energy technologies
  - Does not currently assess water efficiency
- Strengths:
  - Easy to use
  - Multi-building analyses & screening assessments
  - Estimating current energy consumption and costs, and identifying and evaluating economics of savings opportunities
  - Life-cycle costing
  - Considers interactive effects, both intra-and inter-facility
  - Integrated central energy plant analysis with building evaluations

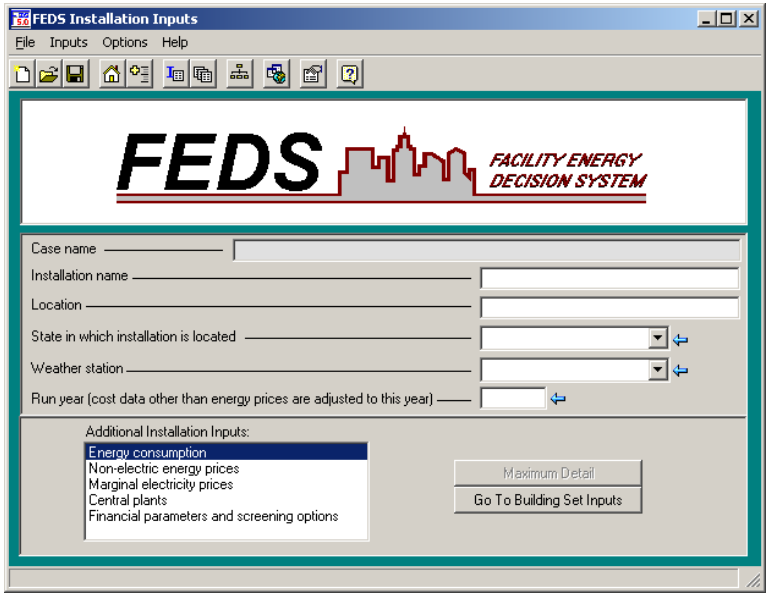
Key Characteristics that Set FEDS Apart

- **Flexible & easy to use:** Accepts generic or very detailed inputs and provides intelligent inferences for missing data – excellent screening tool
- Examines single buildings to **large multi-building complexes**
- **Powerful:** Evaluates the cost and performance of thousands of building energy retrofit technologies, estimating energy consumption, electric demand, and savings potential based on minimum LCC



Key Characteristics that Set FEDS Apart (cont.)

- Provides **detailed** efficiency recommendations, including technology selection and associated economic parameters
- Determine the optimal set of retrofits to the current system - considering **interactive effects**
- **Flexible** occupancy scheduling
- Tracks **emissions** impacts
- Conducts **alternative financing** analyses
- Replace on failure economics



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FEDS Requires only Limited Data Input

- Installation and Financial
  - Location
  - Energy Price Data and Analysis Year
  - Cost of Money (if not DOE/EIA)
- Buildings
  - Type, Vintage, Square Footage, Quantity
  - Operating Hours
  - Equipment (Lights, Heat, Cool, Hot Water)
- Central Plants
  - Fuel produced
  - Fuels used
  - Equipment type
  - Buildings served

FEDS Inferences: Automatically fill in the remaining detailed parameters based on the input data set

Retrofit Modeling

- Types of retrofits evaluated include:
  - complete replacement with similar, but more efficient equipment
  - changes to different types of equipment which provide equivalent service more efficiently
  - changes to more efficient equipment using a different fuel (fuel-switching)
  - central plant decentralization options
- Project capital costs include installation (materials + labor), taxes, profit, and are adjusted for regional differences in materials and labor costs (along with O&M costs)

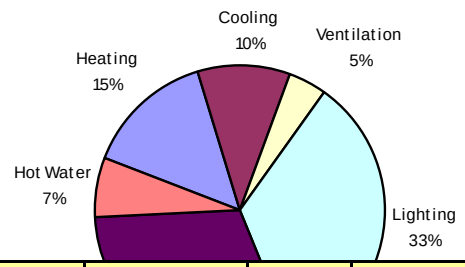
FEDS Output

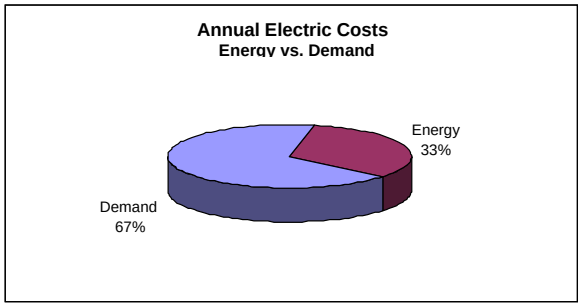
- **Summary Report:**
  - Energy, demand, dollar, and emissions impacts for the overall installation, plus central plants, and buildings
  - Energy use and intensities by building, fuel type, and end use
  - Peak demand: total and coincident value and time, for installation and by building set
  - Estimated total investment and life-cycle cost savings
- **Detailed Retrofit Reports:**
  - Project by project information on each identified measure
  - Technology description and performance characteristics (base and retrofit)
  - Energy, demand, dollar, and emissions impacts
  - Economic parameters: installed cost, O&M costs, NPV, SIR, Payback
- **Energy Conservation Investment Program (ECIP) Report**

Example Analysis & Results

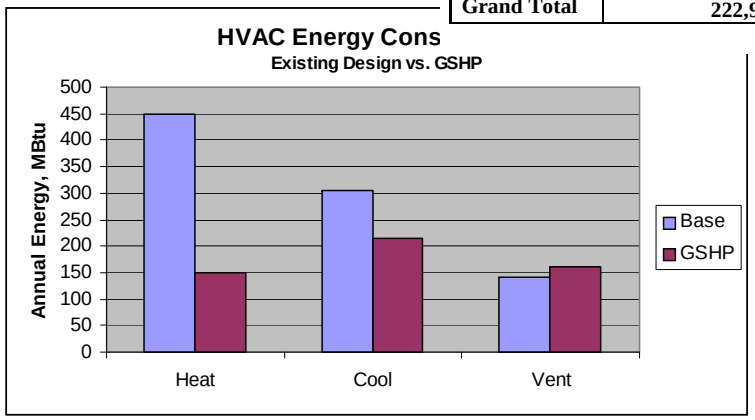
Estimated Annual Energy Use and Costs

Fuel Type	Annual Consumption	Annual Cost ($)
Electricity	748,352 kWh	37,429
Natural Gas	4,490 therms	3,813
Total Combined	3.003 MBtu	41,242





Retrofit Type	Energy Savings (Million Btu/yr)	Annual Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR	Simple Payback (yr)
Envelope	102,110	$1,325,115	$6,211,053	$12,545,974	3.11	4.7
Cooling	541	$13,126	$150,071	$12,063	1.13	11.4
Heating	50,465	$672,784	$1,927,103	$4,398,671	5.26	2.9
Heat Pumps	4,921	$102,581	$900,275	$134,546	1.23	8.8
Hot Water	9,704	$219,934	$245,653	$2,148,905	15.12	1.1
Lighting	55,223	$1,882,259	$7,076,071	$23,240,358	4.25	3.8
Grand Total	**222,964**	**$4,215,799**	**$16,510,226**	**$42,480,517**	**3.84**	**3.9**



Pollutant	Annual Emissions
Sulfur Dioxide (SO_2), lb	5,016
Nitrogen Oxides (NO_x), lb	5,525
Carbon Monoxide (CO), lb	251
Carbon Dioxide (CO_2), tons	807
Particulate Matter, lb	779
Hydrocarbons, lb	47

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Analyses Beyond Project Identification

FEDS Provides a Great Platform to Quickly:

- Asses impacts of change:
  - Mission changes
  - New/expanded/retired/demolished facilities
  - Operating schedules and occupancy levels
  - Increasing energy rates or alternate tariff
  - New technologies
- Value “deals” including fuel switch opportunities
- Evaluate building designs, alternative technology applications
- Apportion costs to reimbursable customers
- Document energy efficiency

FEDS Use for the Army at PNNL

- Energy Engineering Analysis Program (EEAP)
  - Partnership with Army Corps of Engineers Huntsville Engineering and Support Center, the Construction Engineering Research Laboratory, and private contractors
  - Multi-year program performing 5 to 8 FEDS assessments at Army installations each year.
- IMCOM-Southeast ECIP project support
  - Utilize existing FEDS model to analyze performance of proposed projects (e.g., solar, controls, water, etc.)
- Ground-source heat pump evaluations
  - Installations with existing models can use FEDS for initial screening for ground-source heat pumps
- Central plant assessments

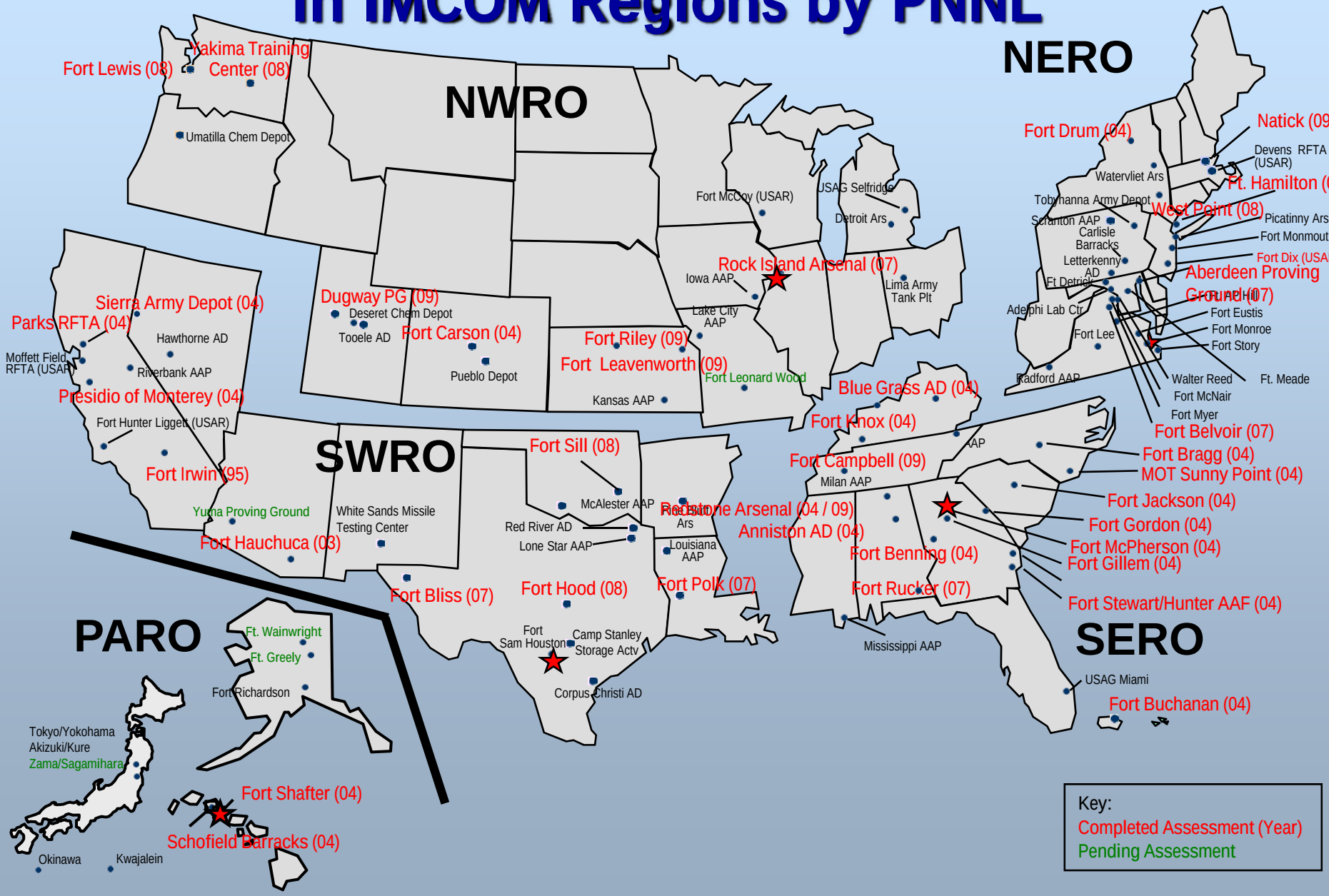
Impact of FEDS

A comprehensive energy assessment can uncover significant potential.

- During FY2008 FEDS models for the EEAP program indentified over $35M/year in energy savings in cost-effective energy projects:

	Total Investment, $M	Annual Savings, MBTU/yr	Annual Savings, $M/yr
Fort Bliss, TX	$ 23.3M	366,761	$ 5.0M
Fort Belvoir, VA	$ 24.2M	237,332	$ 6.5M
Fort Polk, LA	$ 16.6M	217,738	$ 4.1M
Fort Lewis, WA	$ 38.8M	416,376	$ 6.6M
Aberdeen PG, MD	$ 46.5M	665,009	$13.2M
TOTAL	**$149.4M**	**1,903,216**	**$35.4M**

FEDS Assessments Completed in IMCOM Regions by PNNL



FEDS 6.0 Now Available

- Key additions:
  - Central plant and thermal loop decentralization analysis
  - 1500+ additional weather locations
  - Radiant / infrared heating technologies
  - Replace on failure economics
  - Flexible scheduling / occupancy
    - 4-day workweeks; variable occupancy
  - Advanced building geometry modeling
  - User-modifiable emissions factor specification

Now more powerful & flexible than ever

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How to Obtain the Software

- Visit **www.pnl.gov/FEDS** to submit a request on-line and to view latest software news and update information

- FEDS is available free of charge to federal agencies, contractor use on federally-funded projects, and state governments on their projects
- Non-qualifying parties can purchase copies of the software
- An **update for FEDS 6.0** has just been released and can be downloaded from the website

Thank You!

Facility Energy Decision System

www.pnl.gov/FEDS

An easy to use, yet powerful & flexible tool for quickly and objectively identifying building energy savings opportunities

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