U.S. Department of Energy
Energy Efficiency and Renewable Energy

federal energy management program

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DOE/FEMP

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# Section 1 Introduction

- The Energy Policy Act of 2005 (EPAct 2005), Sec.103,(a)
  - requires installation of meters and advanced electric meters on all federal buildings by the year 2012,
  - according to guidelines set forth by the Department of Energy (DOE) in consultation with other federal agencies and stakeholder groups.

# Stakeholders

- The Alliance to Save Energy
- The Demand Response and Metering (DRAM) coalition
- Texas A&M Engineering Experiment Station
- Edison Electric Institute
- Lawrence Berkeley National Laboratory
- Pacific Northwest National Laboratory
- Oak Ridge National Laboratory
- National Renewable Energy Laboratory
- Association of Energy Engineers
- Defense Departments of the Navy, Army, Air Force and Marines
- US Department of the Interior
- National Institute of Health
- General Services Administration
- Department of Energy
- National Aeronautics and Space Administration
- Federal Utility Partnership Working Group

# Underlying Assumptions

- Section 103 pertains to ELECTRIC metering only.
- Section 103 applies to ALL electric metering, standard and advanced, at all federal buildings and subsystems, based on cost-effectiveness and practicability.
- The definition of "buildings," for the purposes of Section 103, should be considered the same as for annual energy reporting, and will also include industrial or process applications.
- "Maximum extent practicable" includes:
  - installation of metering and advanced metering wherever feasible;
  - the capability of providing useful data and information that leads to improved energy management practices or operations and maintenance improvements resulting in energy and/or energy-related cost savings;
  - the sensible application of metering technology; and
- cost-effectiveness is based on a 10_year simple payback, assuming annual savings of at least 2%, or higher depending on the use of the metered data to implement energy savings and other cost savings measures.

# Requirements for Federal Agencies:

- Agencies must submit their implementation plan by August 4, 2006.
- Agencies are required to install standard or advanced meters at all federal buildings to the maximum extent practicable, by October 1, 2012.

# Section 2 Definitions

- **Advanced meters**.
  - have the capability to measure and record interval data (at least hourly for electricity),
  - communicate the data to a remote location in a format that can be easily integrated into an advanced metering system.
    - EPAct Section 103 requires at least daily data collection capability.

# Definitions

- **Advanced metering systems**.
  - collects time-differentiated energy usage data from advanced meters via a network system on either an on-request or defined schedule basis.
  - capable of providing usage information on at least a daily basis
  - supports desired features and functionality related to energy use management, procurement, and operations.

# Definitions

- **Standard meters**.
  - Electromechanical or solid state meters that cumulatively measure, record and store aggregated kWh data that is periodically retrieved for use in customer billing or energy management.
    - Meters that are not advanced meters are standard meters.

# Section 3 Uses of Metered Data

- **Revenue Billing**
  - utility companies install meters to charge customers for the amount of electricity they use.
  - not very detailed,
    - monthly totals of energy usage/peak demand.
- **Time-of-Use Metering**
  - Many utilities and regulators are moving toward time-of-use rates, which charge more for the energy use contributing to the system peak demands, and also providing an incentive for utility customers to shift demand to off peak periods.
  - Time-of-use rates require special meters to provide this information for billing purposes.
    - EPAct Section 1252 addresses utility requirements for time-of_use metering (see following text box).

# Uses of Metered Data

- **Real-Time Pricing**
  - similar to time-of-use metering in data requirements,
  - for customers who receive power under a real-time pricing (RTP) contract
  - energy prices change dramatically from season to season, and even hourly during periods of high system demand
- **Load Aggregation**
  - to combine facilities that are geographically separate from each other for purposes of acquiring and billing utility services.

# Uses of Metered Data

- **Submetering**
  - Provides information about the loads at individual building/subsystems
  - Can be a strong incentive for building occupants to conserve utility resources.
- **Energy Use Diagnostics**
  - Helps identify changes in operation that reduce energy consumption.
  - Provides comparisons of energy use indices (EUI) such as the amount of kilowatt-hours used per square foot (kWh/SF).
  - Makes predictive maintenance possible.

# Uses of Metered Data

- **Power Quality**
  - Advanced meters can capture electrical anomalies such as
    - transients,
    - voltage disturbances,
    - power factors, and
    - harmonics in order to troubleshoot power quality problems.
  - Using advanced meters allows detection and documentation of power quality problems so solutions to those problems may be developed and implemented.

# Uses of Metered Data

- **Measurement and Verification of ESPC Savings**
  - Goes beyond modeling and stipulation to capture actual performance.
- **Emergency Response**
  - to make decisions regarding physical plant closure or interruption of non-critical loads.
- **Planning and Reporting**
  - collect, reduce, and present information that would describe agency energy use and progress toward goals set by legislation and Executive Order, or other goals set by agencies.

# Metering

helps us understand what's going on.

22. The inventor will no longer understand his own machine. 1941

# Metering Approaches and Technologies

- **Generic Approaches**
  - One-time/spot measurements (system/sub-system)
  - Run-time measurements (system/sub-system)
  - Short-term monitoring (system/sub-system/whole building)
  - Long-term monitoring (system/whole building)

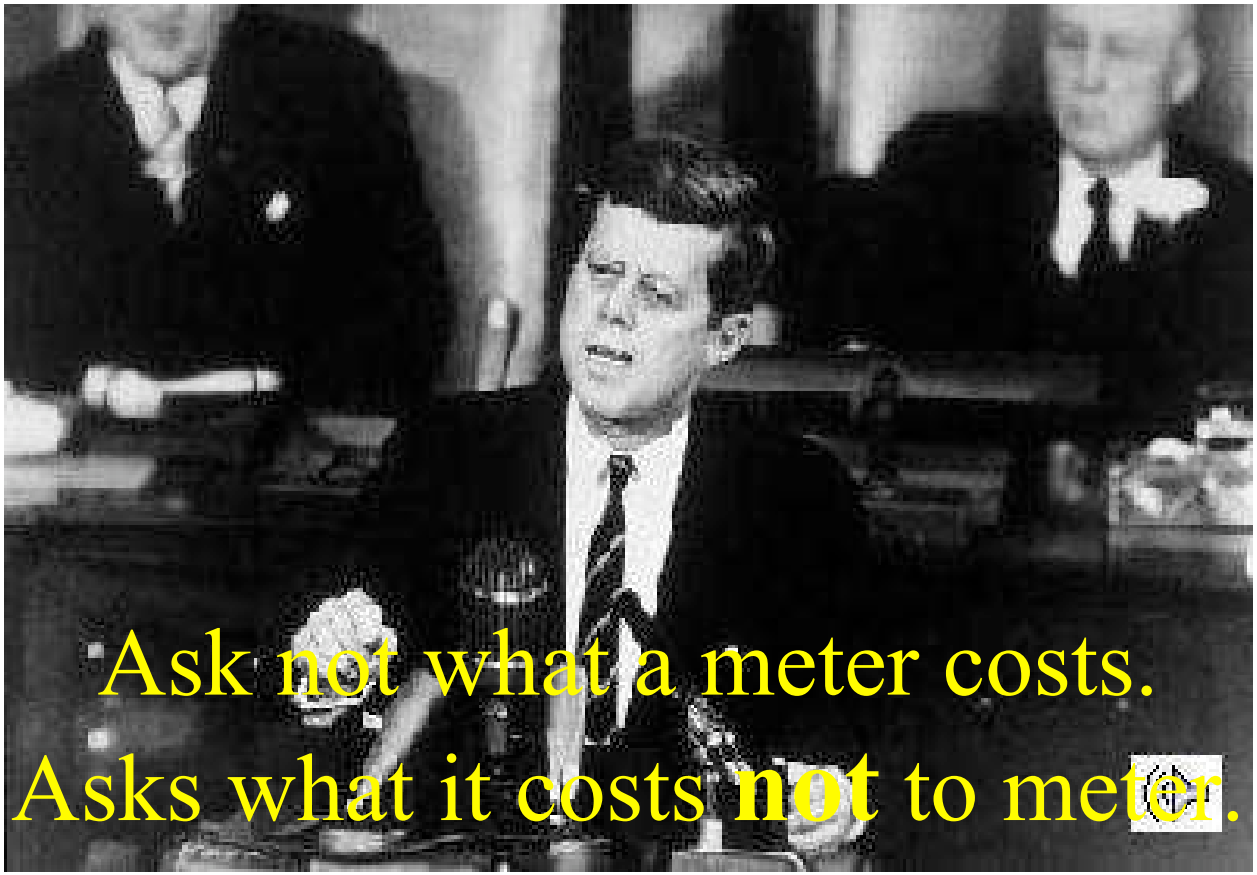
# Metering Approaches and Technologies

- **Metering System Components**
  - Meters
  - Data Collection
    - *Phone modem*
    - *Local area network*
    - *Building automation system (BAS)*
    - *Radio frequency (wireless)*
    - *Power-line carrier*
  - Data Storage

# Section 5 Metering Cost-Effectiveness

- "Maximum Extent Practicable"
- To determine cost-effectiveness we need to estimate
  - the cost to design, purchase, install, maintain, store data, and operate the meter/metering system, and analyze the data output, and
  - the resulting energy cost savings.

# Metering Cost-Effectiveness



# Metering Cost-Effectiveness

- **Developing a Metering Cost Estimate**
  - Hardware
    - Meter purchase cost
    - Ancillary devices.
      - current transformers (CTs)
      - safety switches.
  - Communications module
    - Handheld reader communicator
    - telephone modem,
    - radio transceiver,
    - power line carrier modem,
    - Ethernet modem, and
    - SCADA interface RS232-RS485.
  - Miscellaneous supplies.
    - wire, conduit, and junction boxes
  - Labor
  - Recurring costs.

# Metering Cost-Effectiveness

- New York State Energy Research and Development Authority Residential Electrical Submetering Manual (October 1997, revised October 2001)
  - "the change from master-metering to submetering typically reduces the consumption of electricity in apartments by 10-26 percent."
- U.S. Environmental Protection Agency, in a 2002 paper "Submetering Energy Use in Colleges and Universities: Incentives and Challenges,"
  - reduce electric demand by 10 percent through demand aggregation.
  - 10 percent reduction in electricity use was realized

# Metering Cost-Effectiveness

| **Action** | **Observed Savings** |
|---|---|
| Installation of meters | 0-2% (the "Hawthorne Effect") |
| Bill allocation only | 2 _ to 5% (improved awareness) |
| Building tune-up | 5 to 15% (improved awareness, and identification of simple O&M improvement) |
| Continuous Commissioning | 15 to 45% (improved awareness, ID simple O&M improvements, project accomplishment, and continuing mgmt. attention) |

# Metering Cost-Effectiveness

If Charlie could talk, he'd say:

Metering makes good sense- you can't manage what you can't measure. Without a comprehensive and common sense approach, energy and cost saving opportunities will surely be missed, particularly with respect to O&M.

# Metering Cost-Effectiveness

$$\frac{\left[\left(\frac{\text{Installed Cost}}{\text{Desired Simple Payback}}\right) + \text{Annual Cost}\right]}{\text{\% Annual Savings}} = \text{Minimum Annual Electric Bill}$$

# Metering Cost-Effectiveness

| | Case 1 | Case 2 | Case 3 | Case 4 |
|---|---|---|---|---|
| Installed cost | $5000 | $3000 | $2000 | $2000 |
| Desired simple payback | 10yrs | 10yrs | 10yrs | 10yrs |
| Annual Costs | $300 | $300 | $300 | $600 |
| % Annual Savings | 2% | 4% | 10% | 2% |
| Minimum Annual Electric Bill | $40000 | $12000 | $5000 | $40000 |

# Section 6 Methods of Prioritizing Buildings

- Prime considerations
  - The amount of electricity
  - The cost of electricity
  - The expected/estimated benefits from the metering program
- Potential exclusions
  - Low energy intensity buildings
  - Small buildings
  - Leased buildings
- Periodically Revisit Your Building Priority Lists
  - Technology changes
  - Economics change

# Section 7 Methods of Financing

- Appropriations
- Retained energy savings
- Energy Savings Performance Contracts (ESPCs)
- Utility Energy Services Contracts (UESCs)
- Utility company financing
- Bonneville Power Administration (BPA)
- Public benefits programs and utility demand response programs
- Require as part of new building and major renovations projects
- Mandatory tenant submetering fees
- O&M Performance Incentives
- Lease metering equipment

# Section 8 Template for an Agency Metering Plan

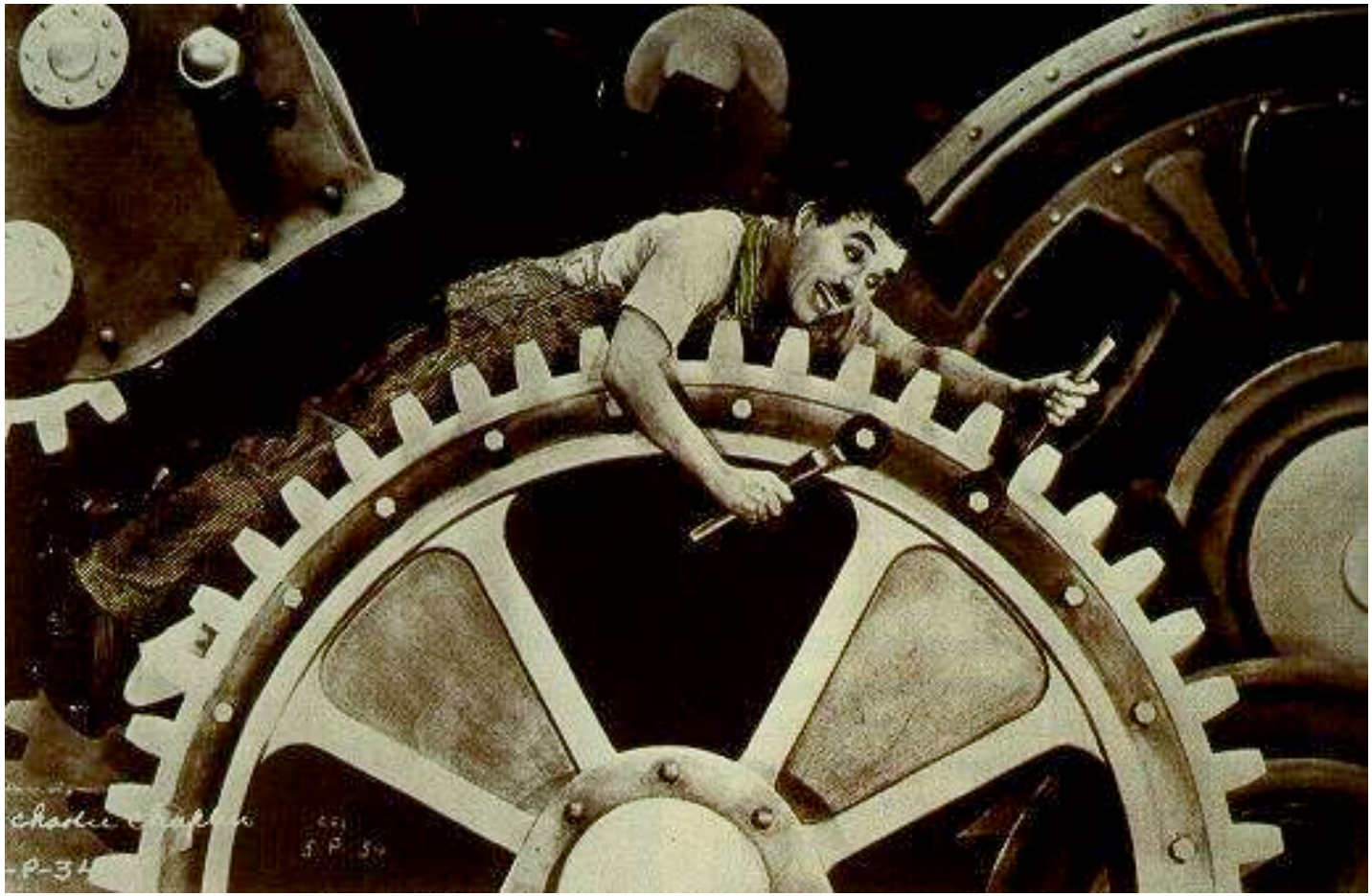
- Set Goals
  - Identify, confirm & prioritize
  - Formalize the outcomes
- Metering program structure
  - Data needs
  - Analysis methodologies
  - Equipment needs
  - Existing infrastructure
  - Staffing requirements
- Set cost/benefit criteria
- Prioritize Opportunities
- Develop Performance measures

# Section 9 Performance Measures

| FY | Standard Meters | | Advanced Meters | |
|---|---|---|---|---|
| | Cumulative # of Buildings Metered | Cumulative % of Electric Metered | Cumulative # of Buildings Metered | Cumulative % of Electric Metered |
| 2007 | | | | |
| 2008 | | | | |
| 2009 | | | | |
| 2010 | | | | |
| 2011 | | | | |
| 2012 | | | | |

# Section 10 Special Considerations

- Leased versus owned or delegated
- O&M Contracts
- New versus existing construction
- Metering of other utilities
- Building level versus system level
- Hourly data versus more detailed
- When to retrofit existing meters
- BRAC
- Should we meter overseas facilities?



# The End

- Questions/comments?

- Thanks!

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