Energy Conservation Measure Development – Identify, Screen, and Analyze

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Agenda

- Definition of Energy Conservation Measure(ECM)
- Anatomy of an ECM
- Identify ECM
- ECM Development
  - Data Analysis
  - Site Investigation
- Screening
- Final Analysis

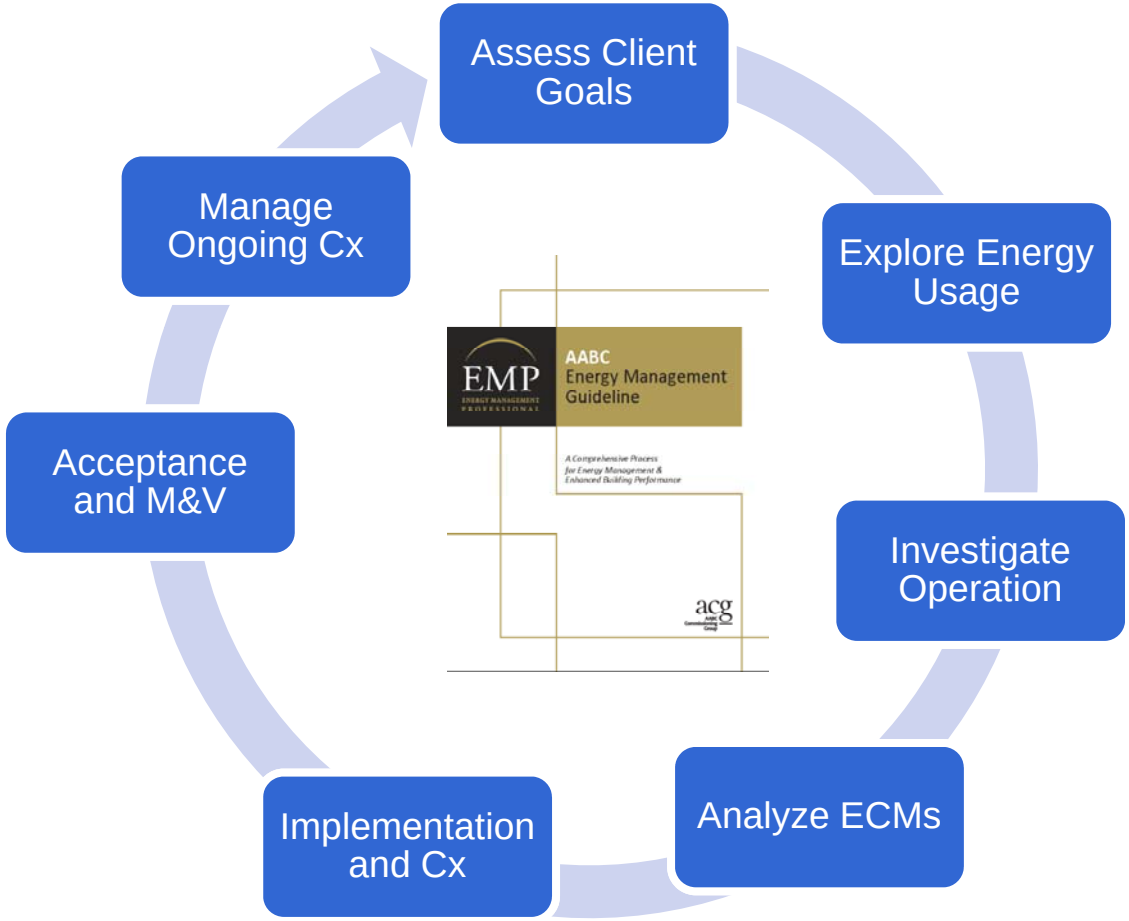
Eliminate unnecessary energy use
Improve the efficiency of needed energy use

Energy – Commercial Buildings

- ANSI/ASHRAE/IESNA Standard 90.1 Building energy code
- Federal Mandates (EPAct, EISA, EO 13423, EO 13514, other)
- Certification (LEED, Energy Star and other)
- Energy Management Guideline (AABC & Other)
- More
  - International Energy Conservation Code(IECC)
  - ASHRAE-USGBC-IESNA Standard 189.1
  - AEDG Advanced Energy Design Guide Series
  - International Green Construction Code (IGCC)
  - Other Standards and guidelines etc.

Low Energy Building: A building that reduces energy use at least 50% below the energy use of the average building of its given type, in its given climate zone

Energy Management

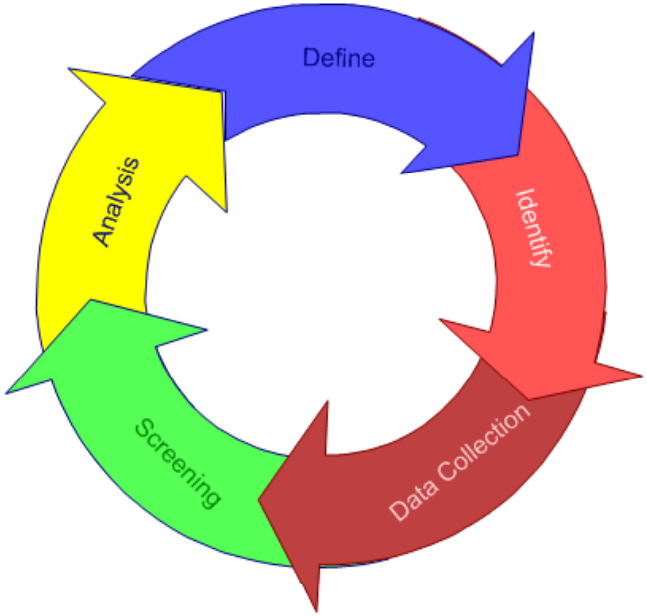


Comprehensive process for energy management and enhanced building performance

Energy Conservation Measure

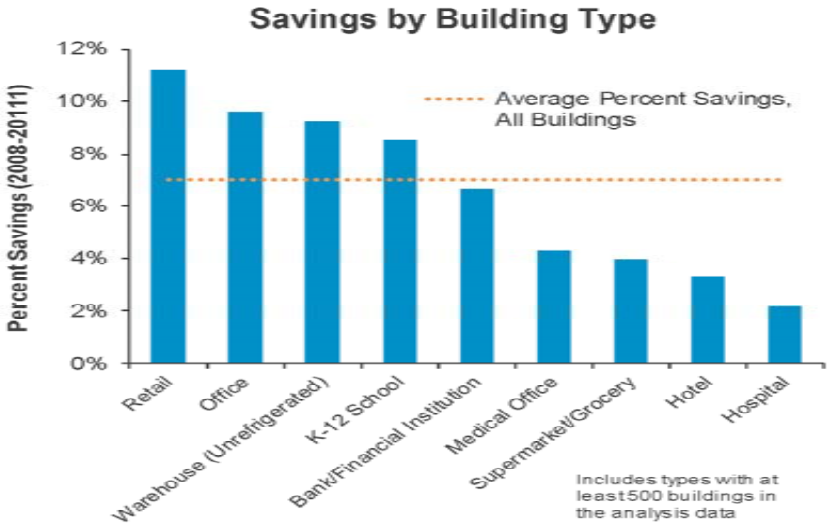
Energy Conservation Measure

"Building operational improvements, equipment installations, or other upgrades that provide energy payback, regardless of initial cost. Reduced energy consumption leads to savings on monthly bills."



Examples

- Air-Side Economizers
- Demand Control
- Energy Monitoring
- Lighting
- Lockouts
- Resets
- Scheduling
- Ventilation Control



Define ECM

- ECM Description
- Systems Impacted
- ECM Narrative
- Scope of work
- Material Resources and Cost
- Savings Calculations

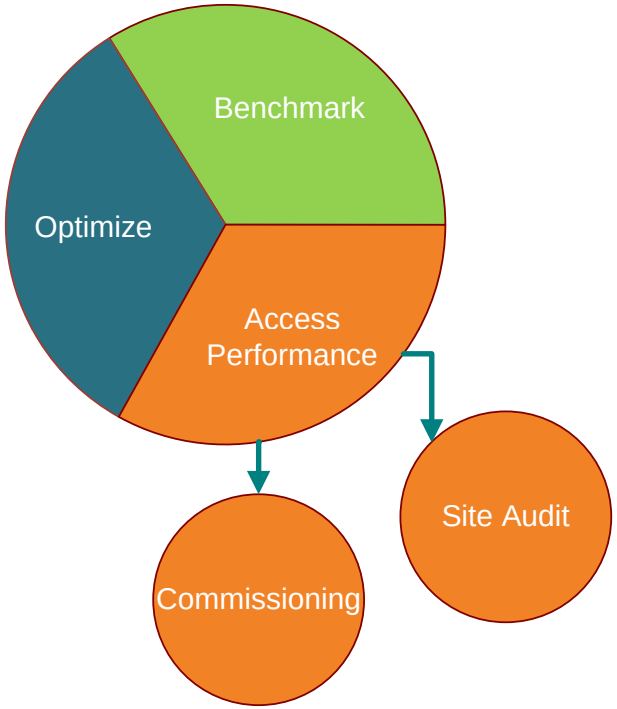
ECM Projects

- Program Elements
  - Energy Reduction
  - Cost Savings
  - Cash flow and Payback
  - CO_2 Emissions Reduction
  - Other incentives
- Project
  - Assessment, Data Collection
  - Implementation (replace, upgrade, retrofit etc.)
  - Retro-commissioning, auditing and measurement & verification

ECM Projects

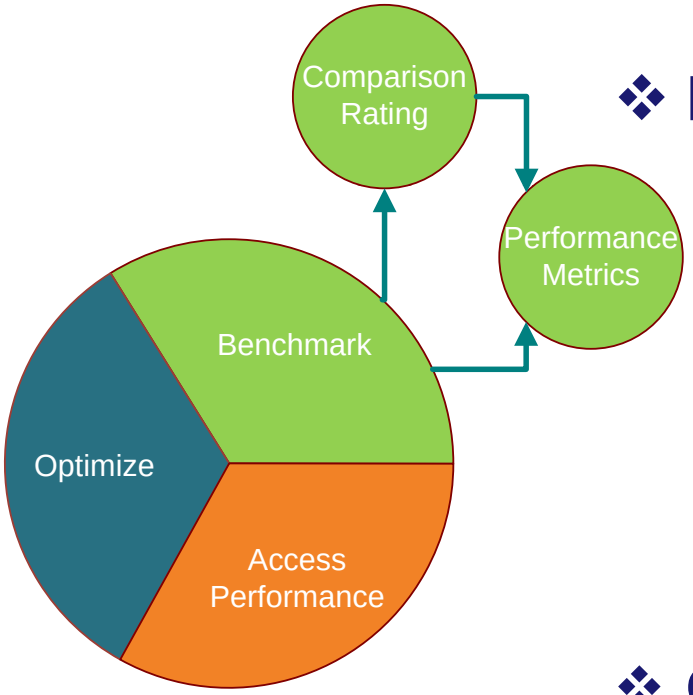
- Project Team
- ECM Cost Effectiveness
  - Energy Savings
    - Analysis
    - Simulation
  - Cost Considerations
    - Construction Cost
    - Assumptions
- Recommendations
- Business Case
- Client Approval

Assessment



- Site Audit
  - Review of available building documentation Facility Characteristics
  - Identify Low/No Cost Improvements
  - Identify Potential Capital Improvements
- Commissioning
  - O&M Problems
  - Systems Conditions
- Data
  - Develop monitoring and data collection plan and level of analysis
  - Implementation monitoring plan, collect data
- Other
  - Identify Customer Goals, team members
  - Discover whether the building may qualify for any incentives or recognition

Benchmark

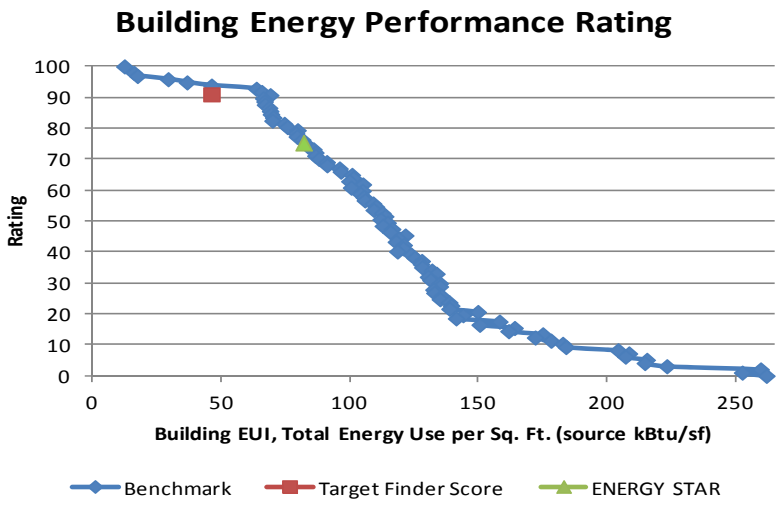


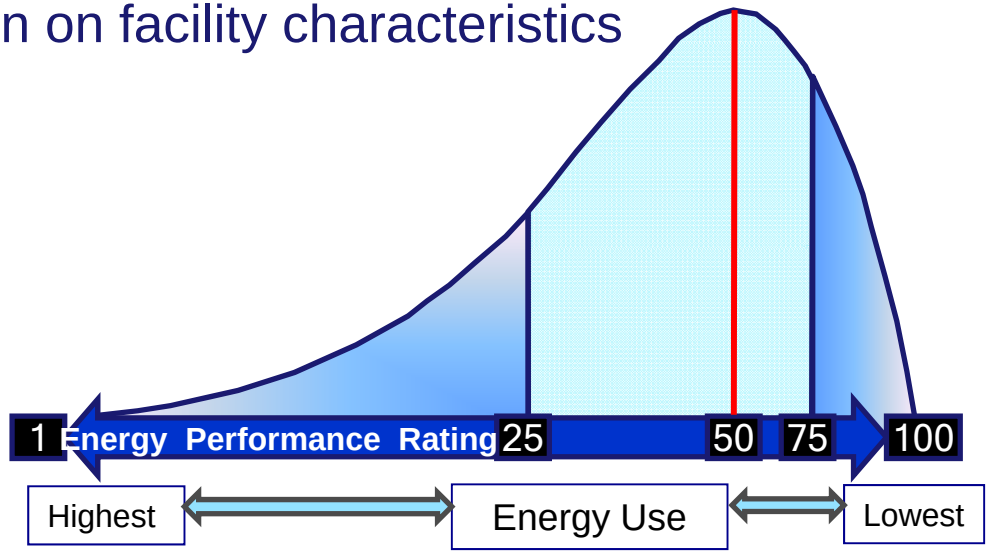
- What's needed?
  - Facility & Usage Data
  - 1 year utility bill data
- Benchmarking (similar building)
  - EPA Energy Star Portfolio Manager
    - https://www.energystar.gov/istar/pmpam/
    - www.energystar.gov/targetfinder
  - Commercial Building Energy Consumption Survey (CBECS)
    - http://www.eia.gov/consumption/commercial
  - Other web based benchmarking
- Comparison
  - Compare to building history
  - Energy Modeling

Identify areas of potential improvement and operating savings

Benchmark Facility

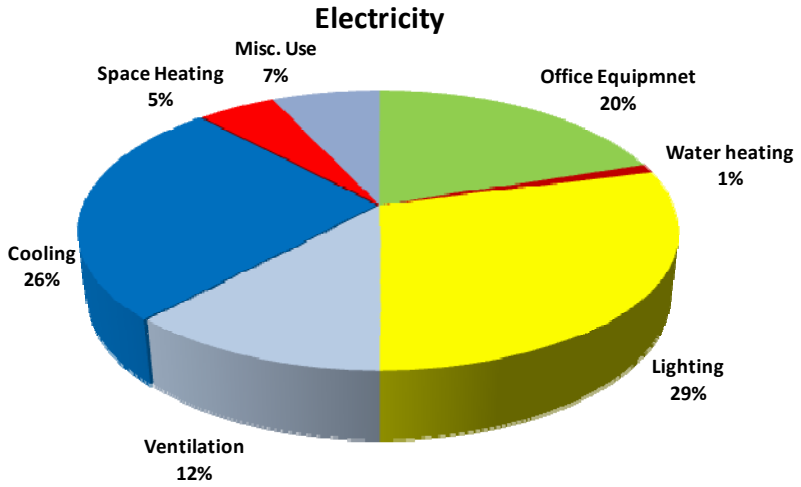
- ECM Site Investigation
  - Identify flows & boundaries of energy using systems
  - Identify target performance metrics
    - Consumption (all sources)
    - Energy Star Rating (1 – 100)
    - Energy Use Intensity (kBtu/sf /yr)
    - Building CO_2e
  - Obtain information on facility characteristics



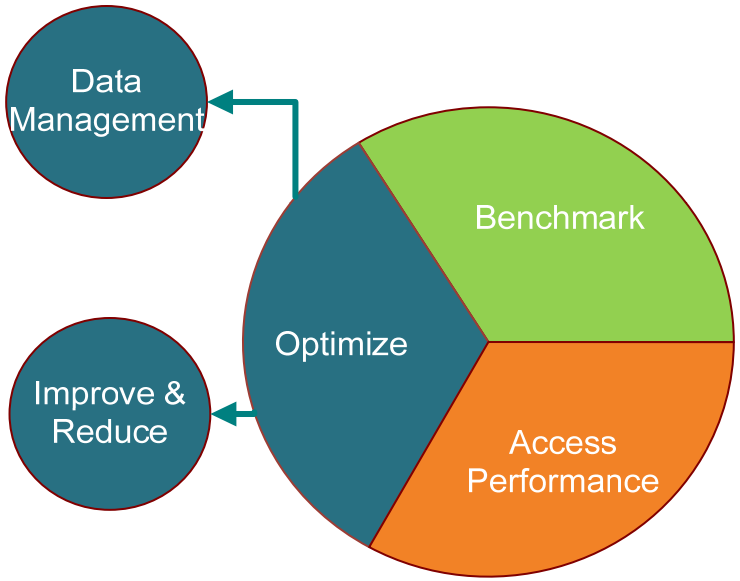


Facility Characteristics

- Building
  - Floor Area, Occupancy, Usage Schedule
- Flows and boundaries of major energy-using systems
  - Identify thermal energy flows (cooling, space heating, domestic hot water, steam)
  - Review electrical system organization and special features
  - Consider temporal and seasonal variance of energy-using systems



Optimize



- Data Management
  - Metering
  - Energy Use by Sub-System
  - Building Automation System
- Analysis
  - Energy analysis / energy modeling
  - Historical Energy Use Analysis
  - Utility Rate Analysis
  - Analysis using custom /online tools
  - Incentive/tax analysis
- Improve & reduce
  - Facility & System improvements
  - Preventive Maintenance
  - ReCx, On-going Cx

Identify, quantify, prioritize and implement savings opportunities

Data Analysis

- Data Collection
  - Develop monitoring and data collection plan
  - Implementation monitoring plan, collect data
  - Trending
  - Install Sensors (permanent / temporary) and calibrate sensors
  - One-time measurements (e.g. fixed-speed pump or fan power)

Data Analysis

- Data processing and analysis
  - Validate data for quality assurance
  - Construct data for analysis (missing data etc.)
  - Data analysis - Calculate metrics
  - Spreadsheet Tools - Energy Charting and Metrics (ECAM), Utility Consumption Analysis, Findings Workbook
  - Custom models

Compare metrics to benchmark and assess opportunities to reduce energy consumption

Calculation Methodology

- Energy Usage / Avoidance
  - Energy Savings
  - Annual Energy and Power Cost savings
- Implementation
  - Cost Estimate
  - Schedule
- Assumptions
- Financials
  - Simple Payback
  - Cash Flow Analysis
    - Cash Flows (Revenue, Costs etc.)
    - Cost of Capital
    - Net Present Value (NPV)
    - Project Internal Rate of Return (IRR)
    - Payback in years

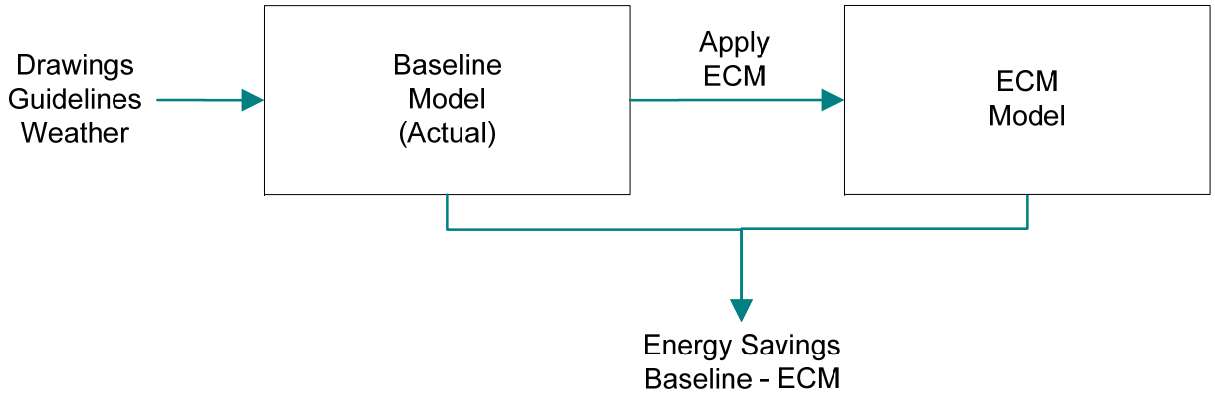
Energy Savings

- Steady state
  - Degree-day method - based on a balance temperature and the degree day
  - Bin Method
  - Assume little or no change
  - Can be performed quickly
  - Relatively simple
  - Best for rough order of magnitude

Accuracy, Complexity, Cost and Availability

Energy Savings

- Dynamic (software)
  - Whole building modeling
  - Retrofit Isolation
  - System level modeling
  - Used when internal and external factors are wide-ranging and constantly changing
  - More data required (inputs, weather)
  - Used for detailed analysis



Accuracy, Complexity, Cost and Availability

Energy Savings

- Modeling Software
- Spreadsheet Tools
  - C-BOA (Custom Building Optimization Analysis)
  - Building Optimization Analysis (BOA)
  - Systems
    - Pumping System
    - Fan System
    - Steam systems
    - Chilled water systems
    - Compressed air systems
    - Motor systems
    - Other
- Custom Spreadsheet Models

Screening ECM

- Screening Factors:
  - Potential Savings
  - Estimated Payback
  - Client Motivations
- Screening Methods:
  - Rules of Thumb
  - EUI Benchmark Savings
  - Spreadsheet Calculations
  - Simplified Energy Modeling or custom programs

Cost Effectiveness of selected ECMs

Screening ECM

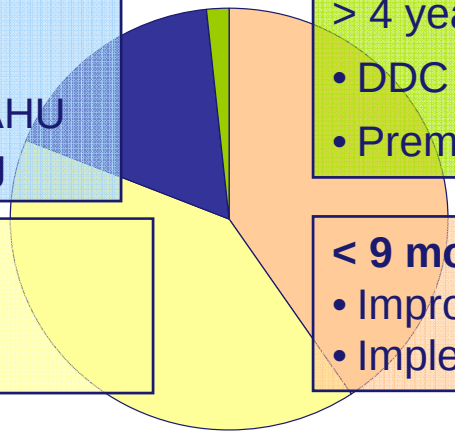
Selected Measure (Y)	ECM #	Measure Description	Annual Electric Savings (kWh/yr)	Annual Gas Savings (Therms)	Energy Cost Savings ($)	Implementation Cost (estimate)	Simple Payback (years)	Estimated Completion Date
Y	1	Implement Optimum Start on AHU Fans	173,964	7,890	$12,287	$1	0.00	5/26/2013
N	2	Repair Electric Radiant Floor Heating Controls	62,458	0	$4,574	$6,600	1.44	7/25/2013
Totals (for all selected (Y))			173,964	7,890	$12,287	$1	0.00	
Totals (All measure combined)			236,422	7,890	$16,861	$6,601	0.39	

2 – 4 years
- Balance AHU's
- Install VFD drives on AHU
- CO_2 Sensor/monitoring

> 4 years
- DDC Controls
- Premium Efficiency Pump/Motor upgrade

9 mo. – 2 years
- Lighting Controls
- Lighting Upgrade

< 9 months
- Improve insulation
- Implement steam trap program



Estimated Payback Periods for Recommended Actions

Note: When more than one measure is installed, the total energy savings will not necessarily be the sum of the savings from the measures if they had been installed individually.

ECM Report

- ECM Report
  - ECM description
    - Existing Conditions
    - Assumptions
    - Proposed Change
  - ECM Matrix
  - Energy savings calculation and cost estimate
  - Assumptions
  - Implementation Plan
- Presenting the Business Case for Proposed ECM

Thank You!

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