INDUSTRY NEEDS

Society can save significant capital by retrofitting portfolios of buildings (city, federal, corporate).

INDUSTRY NEEDS

ENERGY AUDIT PROCESS

1) A 4-phase project development process helped guide progress.

Activities (audits, workshop, analyses, and reports.)

	Phase I: Inventory & Programming	***Phase II: Design Development***	***Phase III: Design Documentation***	***Phase IV: Final Documentation***
Activities	• *Building Walk through* • *EPA Measurements* • *Utility Use Analysis* • *End use Analysis* • *Capital Project Review* • *Documentation Review*	• *Energy Measure Development*	• *Schematic Scope of work for each Energy Measure* • *Schematic Budget for Each Energy Measure* • *Payback Calculation*	• *Report preparation*
Outputs	• *Baseline Capital Projects* • *Energy Star* • *Baseline Energy*	• *Energy Measure Listing*	• *Energy Measures defined and budgeted.*	• *Survey Report* • *Owner / Manager review meeting.*

Types of Energy Conservation Measures to include;

- Lighting
- HVAC
- Control Systems & Integration – BAS/CMMS/BIM
- Water Conservation
- Renewables – Solar/Wind/Geo/Biomass
- Retro-Commissioning
- Power Management
- Water Meters
- Technology Enhancements

PROJECT DEVELOPMENT PROCESS

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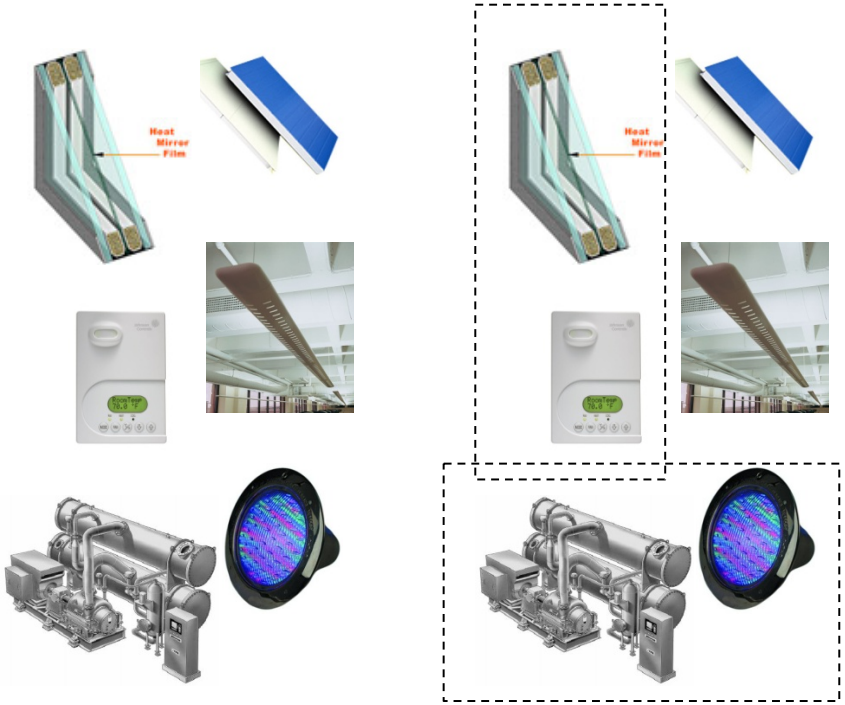
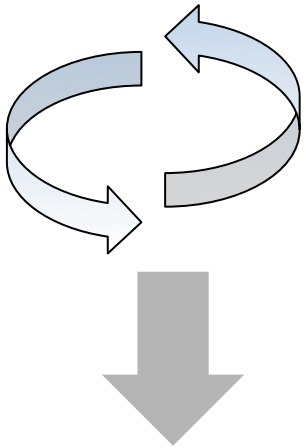
Determining the optimal package of retrofit projects involved identifying opportunities, modeling individual measures, and modeling packages of measures.

Identify Opportunities → *Model Individual Measures* → *Create Packages of Measures* → *Model Iteratively*

4	Chiller-4	CW Waterside economizer for year round cooling for all zones
5	Chiller-5	Multiple Tonnage Chiller Sizing
6	Chiller-6	Best Practice Cooling Tower Sizing and Efficiency Pumping
7	Chiller-7	Chilled water temperature reset
8	CHW Pumping -1	Variable Flow CHW Pumping
9	CW Pumping-1	VFD on CW Pumps, Flow Control
10	CW Pumping-2	Best Possible Pumping Design - Reduced Pressure Drop and Max Pump Ef
11	Heating-1	Heat Recovery from Broadcast Floors
12	Heating-2	Run Around Glycol loop to preheat OA to observatory
13	Heating-3	Basecase w/ electric reheat (space heaters)
14	AHU-1	Install new VFD AHUs
15	AHU-2	Best Practice AHU (Low dP,Higher Fan Eff)
16	AHU-3	Underfloor/Displacement Air Distribution
17	AHU-4	Install Low dP VFD AHUs
18	AHU-5	Move to Central OA Supply
19	AHU-6	Core Space Conditioning - Dedicated Unit
20	AHU-7	Core Space Conditioning - Shared Unit (Cascade)
21	AHU-8	Nighttime Purge to Precharge Thermal Mass
22	AHU-9	Natural Ventilation.
23	AHU-10	Eliminate local AHU and use chilled beams and radiant.
24	Controls-1	Chiller Plant
25	Controls-2	Controls - Chiller sequencing
26	Controls-3	Controls - Optimized Start/Stop
27	Controls-4	Controls - Variable Primary/Secondary control
28	Controls-5	Radiator Control
29	Controls-6	Radiator Control/Window Opening
30	Controls-7	ESB Local HVAC Equip. (Air cooled chiller, CHW AHUs tied to ACC, DX AF
31	Controls-8	Old AHUs Control (S/S, OA Damper, CHW Valve, Zone Temp
32	Controls-9	New AHUs Control (S/S, OA Damper, CHW Valve, Zone Temp)
33	Controls-10	New VFD AHUs Control (S/S, OA Damper, CHW Valve, Zone Temp,VFD)
34	Controls-11	New VFD AHUs with OA Demand Control
35	Controls-12	Thermal Comfort Space Temperature Control (ASHRAE 55)
36	DHW-1	Electric Instantaneous DHW 19+/LL-18 Heat Recovery
37	Envelope-1	Install Window Film
38	Envelope-2	Install New Window Glazing Option A
39	Envelope-3	Install New Window - Glazing Option B
40	Envelope-4	Install Thermally Broken Frames
41	Envelope-5	Provide and install insulated sheet metal barriers behind each radiator.
42	Envelope-6	Provide furring strip insulation on Perimeter Walls
43	Envelope-7	Install Green Roof
44	Envelope-8	Install White Roof
45	Cogen-1	Steam driven back-pressure turbine/Absorption Chiller/DHW/Electric Chiller
46	Cogen-2	Install Fuel Cell/DHW Heat Recovery/Absorption Chiller
47	Lighting-1	Lighting -Restrooms Occ Sensor Commission
48	Lighting-2	Lighting - Restrooms Lighting Retrofit
49	Lighting-3	Lighting - ESB Common Hallways Retrofit
50	Lighting-4	Lighting - Tenant Space Rebuilt





Outcome:
Package of measures with best economic & environmental benefits

PROJECT DEVELOPMENT PROCESS

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Industry standard and newly developed design tools, decision-making tools, and rating tools helped to evaluate and benchmark existing and future performance.

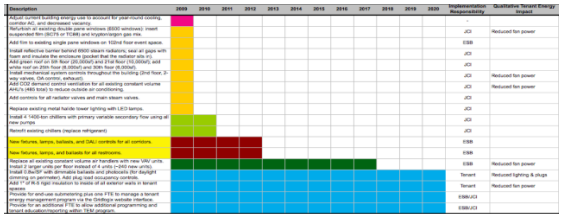
Design Tools

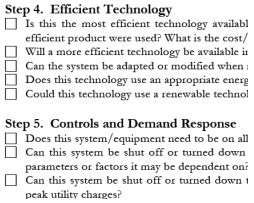
eQUEST

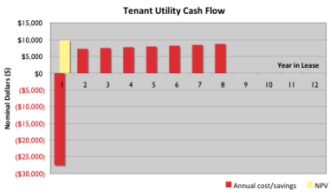
AGI32

Google SketchUp

Decision-Making Tools







Rating Tools

Quantification of Sustainability Tool*

ENERGY STAR

U.S. GREEN BUILDING COUNCIL LEED CERTIFIED 2007

GREEN GLOBES