EDAPT Example Project  
1123 W 3rd Ave, Denver, CO 80223

Xcel Energy’s Energy Design Assistance Program

Final Energy Analysis Report

June 29, 2013

**Prepared for:**

Mr. Customer

XYZ Inc.

1234 Sesame St, Denver, CO 80223

(303) 275-4568

mrcustomer@xyz.com

**Prepared by:**



Xcel Energy

1800 Larimer St. Ste. 1500

Denver, CO 80202

**Energy Consultant:**

testec

(252) 626-8842

testec@gmail.com

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Energy Design Assistance Program Process & Timeline

Xcel Energy’s Energy Design Assistance (EDA) process is designed to assist the Owner and Design Team in making decisions concerning energy-efficiency measures for the project. The main steps of the process are as follows.

|  |  |  |
| --- | --- | --- |
| **Construction stage** | ENERGY DESIGN ASSISTANCE STATE | **DATE** |
| **aPPLICaTIon**  **Design phase** | Step 1: APPLICATION  Complete application  Xcel Energy accept/reject of application | **June 29, 2013** |
| **PRE/EARLY SCHEMATIC DESIGN PHASE** | Step 2: INTRODUCTION  Introductory meeting  EDA Program overview  Energy efficiency measure discussion  Begin collection of building and incremental cost data  Submit introductory report | **July 15, 2013** |
| **Schematic Design phase** | Step 3: PRELIMINARY ENERGY ANALYSIS (PEA)  Early massing, HVAC, daylighting (Enhanced Track only)  Preliminary energy analysis meeting  Review of analysis results in PEA report  Selection of measures to be included in final energy analysis  Submit PEA report | **June 29, 2013** |
| SD completion | |  |
| **Design Development phase** | Step 4: FINAL ENERGY ANALYSIS (FEA)  Final energy analysis meeting  Review of updated whole building analysis in FEA report  Review of program incentives  Introduction to verification process  Customer selects an energy design alternative, showing an intent to move forward with selected measures |  |
| DD completion | |  |
| **Construction Document phase** | Step 5: CONSTRUCTION DOCUMENT (CD)  Customer sends final design CDs to EDA Verification Consultant  **EDA Verification Consultant:**  Confirms measures included in final design documents. Sends to EDA  Modeling Consultant to update model  Submits CD report with updated model results and incentive  EDA consultant complete green certification docs (Enhanced Track only)  Design team completes documentation for fee reimbursement |  |
| **CD Completion** | |  |
| **Construction** | **Construction Occurs. Estimated construction completion date** |  |
| **Construction ends** | |  |
| **Post-Occupancy** | EDA Verification Consultant conducts:  On-site measurement and verification. Sends M&V results to EDA Modeling Consultant to update model  Submits M&V report with updated model results and incentive |  |
| **Incentive payment to customer is received approximately two months post-verification** | | |

Xcel Energy, through the Energy Design Assistance program, has qualified energy consultants to provide our customers with a service that includes an integrated design process. This integration includes using an energy model to predict energy savings. The energy model itself is an instrument to project results and review different energy efficiency opportunities. The results of these models belong to Xcel Energy and their customers as participants through the Energy Design Assistance program.

Xcel Energy customers participating in the Energy Design Assistance program may distribute the results of their model to anyone they choose.  Xcel Energy will not release this information unless written permission from the customer has been obtained.  As a result of this permission, two reports will be provided: the Preliminary Energy Analysis Report and the Final Energy Analysis Report. Xcel Energy also cautions the use of these reports; data is based on an analysis done for a specific time frame.  Buildings naturally adjust as occupancy reaches its full potential, causing variations from pre-construction data.

Project Summary

|  |  |
| --- | --- |
| Project Name | EDAPT Example Project |
| Xcel Energy Project # |  |
| Location | 1123 W 3rd Ave, Denver, CO 80223 |
| Building Type | Hotel |
| Conditioned Floor Area | 52,000 |
| Unconditioned Floor Area | 0 |
| Above-Grade Stories | 3 |
| Below-Grade Stories | 0 |
| Electricity Provided by Xcel | Yes |
| Natural Gas Provided by Xcel | Yes |
| District Heating **Gas Provided by Xcel** | Yes |
| District Cooling **Electricity Provided by Xcel** | Yes |
| EDA Baseline | ASHRAE 90.1-2007 |
| Track (Basic or Enhanced) | Basic |
| Early Analysis (Enhanced Only) |  |
| Certification (Enhanced Only) | USGBC LEED Silver |
| Estimated Savings (vs. baseline) |  |
| Demand (kW) | 20 |
| Energy (kWh) | 100,000 |
| Gas (Dth) | 200 |
| Estimated Construction Completion Date | June 29, 2313 |
| Estimated 80% Occupancy Date |  |
| Estimated Verification Date |  |

|  |  |
| --- | --- |
| Customer incentive calculations are based on the following dollar amounts | |
| Demand ($/kW) | $ 400 |
| Energy ($/kWh) | $ 0.04 |
| Gas ($/Dth) | $ 4 |

Project Participants

Project participants at the meeting included:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Name | Company | Role | E-Mail | Phone | In Attendance |
| John Doe | The Best Architects | Architectural Firm | john.doe@arch.com | (252) 626-8842 |  |
| Jim Smith | The Best Mechanical Engineers | Mechanical Engineer | jim.smith@contractor.com | (252) 626-8842 |  |

Changes to the Model from Preliminary Energy Analysis Report

The following changes were made to the model since the PEA report:

No changes were made to the baseline model between the PEA report and now.

# Design Alternatives

The following are design alternatives as compared to the baseline(s). For this project, the following alternatives were considered.

Max Guestroom Efficiency and Max Envelope Changes and Rotation

|  |
| --- |
| 30% EPD Reduction in Guest Rooms |
| 20% LPD Reduction in Guest Rooms |
| R-20 Exterior Wall Insulation |
| R-50 Roof Insulation |
| Rotate Building 90 Degrees |

Max Guestroom Efficiency and Max Envelope Changes

|  |
| --- |
| 30% EPD Reduction in Guest Rooms |
| 20% LPD Reduction in Guest Rooms |
| R-20 Exterior Wall Insulation |
| R-50 Roof Insulation |

# Design Alternative Results - Overview

Figure 2‑1 Whole-Building EUI (kBtu/ft2-year)

Figure 2‑2 Annual Energy Costs By Fuel Type ($/year)

# Design Alternative Results - Details and Incentives

Table 3‑1 EDA Baseline Annual Information

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Energy  Cost  ($) | EUI  (kBtu/ft2-yr) | Peak  Demand  (kW) | Electric  Consumption  (kWh) | Natural Gas  (Dth) |
| $146,465 | 102.21 | 136.340 | 645,181 | 1,567.366 |

Table 3‑2 Design Alternatives - Annual Savings vs. EDA Baseline

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Design Alternative | Energy Cost Savings  ($) | EUI Reduction  (kBtu/ft2-yr) | Peak  Demand Savings  (kW) | Electric  Consumption Savings  (kWh) | Natural Gas Savings  (Dth) | Incremental Capital Cost  ($) | Estimated Incentive\*\*  ($) | Simple Payback\*  (years) |
| Max Guestroom Efficiency and Max Envelope Changes and Rotation | $28,060 | 15.98 (19%) | 28.594 (21%) | 125,547 (19%) | 202.019 (13%) | $80,865 | $23,975 | 2 |
| Max Guestroom Efficiency and Max Envelope Changes | $25,366 | 10.28 (11%) | 27.209 (20%) | 114,511 (18%) | 128.274 (8%) | $456536 | $17,307 | 2 |

\*Simple payback includes reduction of incremental capital cost by estimated Xcel incentive.

\*\*This incentive is calculated using un-rounded energy modeling results.  Because of rounding error, hand-calculation may be off by up to $1.

Figure 3‑1 Peak Electric Demand (kW)

Figure 3‑2 Electric Consumption (kWh)

Figure 3‑3 Gas Consumption (Dth)

# Results by Individual Measure

Table 4‑1 EDA Baseline Annual Information

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Energy  Cost  ($) | EUI  (kBtu/ft2-yr) | Peak  Demand  (kW) | Electric  Consumption  (kWh) | Natural Gas  (Dth) |
| $146,465 | 102.21 | 136.340 | 645,181 | 1,567.366 |

Table 4‑2 Measures - Annual Savings vs. EDA Baseline

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Measure | Energy  Cost  Savings  ($) | EUI  Reduction  (kBtu/ft2-yr) | Peak  Demand Savings  (kW) | Electric  Consumption Savings  (kWh) | Natural Gas Savings  (Dth) | Incremental Capital Cost  ($) |
| 20% EPD Reduction in Guest Rooms Only | $9,068 | 2.47 (2%) | 10.809 (8%) | 42,861 (7%) | -24.041 (-2%) | $19,899 |
| 30% EPD Reduction in Guest Rooms Only | $13,587 | 3.69 (4%) | 15.180 (11%) | 64,272 (10%) | -36.849 (-2%) | $29,849 |
| 10% LPD Reduction in Guest Rooms Only | $3,690 | 1.03 (1%) | 6.856 (5%) | 16,967 (3%) | -6.826 (-0%) | $3,690 |
| 20% LPD Reduction in Guest Rooms Only | $7,366 | 2.06 (2%) | 11.649 (9%) | 33,925 (5%) | -13.936 (-1%) | $89,571 |
| Reduce Infiltration by 10% Only | $66 | 0.14 (0%) | 2.075 (2%) | 83 (0%) | 7.300 (0%) | $3,807 |
| Reduce Infiltration by 20% Only | $124 | 0.30 (0%) | 2.111 (2%) | 167 (0%) | 15.234 (1%) | $7,614 |
| R-15 Exterior Wall Insulation Only | $607 | 1.12 (1%) | 2.664 (2%) | 1,531 (0%) | 51.931 (3%) | $1,851 |
| R-20 Exterior Wall Insulation Only | $738 | 1.36 (1%) | 2.795 (2%) | 1,881 (0%) | 62.928 (4%) | $2,468 |
| R-30 Roof Insulation Only | $4,075 | 2.69 (3%) | 0.101 (0%) | 17,119 (3%) | 81.282 (5%) | $5,250 |
| R-50 Roof Insulation Only | $4,319 | 3.29 (3%) | 5.419 (4%) | 17,386 (3%) | 111.267 (7%) | $8,750 |
| 0.35 WWR on E Facade Only | $563 | 0.65 (1%) | 2.288 (2%) | 2,275 (0%) | 14.514 (1%) | $-164 |
| 0.2 WWR on E Facade Only | $2,198 | 2.49 (2%) | 2.827 (2%) | 9,061 (1%) | 56.292 (4%) | $-655 |
| Rotate Building 90 Degrees Only | $2,703 | 5.52 (6%) | 1.043 (1%) | 11,108 (2%) | 74.901 (5%) | $0 |
| Low U-Factor Windows Only | $895 | 3.68 (4%) | 2.301 (2%) | -692 (-0%) | 198.085 (13%) | $-8,288 |

1. Modeling Inputs and Assumptions
   1. Location and Climate Data

|  |  |
| --- | --- |
| Weather File | Denver-Stapleton CO USA TMY--23062 WMO#=724690 |
| Latitude [deg] | 39.76 |
| Longitude [deg] | -104.9 |
| Elevation [m] | 1611.00 |
| Hours Simulated [hrs] | 8760.00 |

* 1. Utility Rates

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  | | --- | --- | --- | |  | Meter | Annual Cost ($) | | SECONDARYGENERALLOWLOADFACTOR | ELECTRICITYPURCHASED:FACILITY | 138,568.21 | | INTERRUPTIBLEINDUSTRIALG | GAS:FACILITY | 7,896.89 | |

* 1. Building Envelope Model Inputs

**Opaque Exterior**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Construction | Reflectance | U-Factor with Film [W/m2-K] | Gross Area [m2] | Cardinal Direction |
| SURFACE 25 | 90.1-2004 NONRES 5B EXT SLAB UNHEATED - 4IN SLAB WITH CARPET | 0.30 | 1.862 | 943.23 |  |
| SURFACE 14 | 90.1-2004 NONRES 5B EXT WALL MASS | 0.08 | 0.698 | 202.69 | E |
| SURFACE 13 | 90.1-2004 NONRES 5B EXT SLAB UNHEATED - 4IN SLAB WITH CARPET | 0.30 | 1.862 | 222.88 |  |
| SURFACE 8 | 90.1-2004 NONRES 5B EXT WALL MASS | 0.08 | 0.698 | 115.82 | N |
| SURFACE 7 | 90.1-2004 NONRES 5B EXT SLAB UNHEATED - 4IN SLAB WITH CARPET | 0.30 | 1.862 | 118.41 |  |
| SURFACE 20 | 90.1-2004 NONRES 5B EXT WALL MASS | 0.08 | 0.698 | 115.82 | S |
| SURFACE 19 | 90.1-2004 NONRES 5B EXT SLAB UNHEATED - 4IN SLAB WITH CARPET | 0.30 | 1.862 | 118.41 |  |
| SURFACE 2 | 90.1-2004 NONRES 5B EXT WALL MASS | 0.08 | 0.698 | 202.69 | W |
| SURFACE 1 | 90.1-2004 NONRES 5B EXT SLAB UNHEATED - 4IN SLAB WITH CARPET | 0.30 | 1.862 | 222.88 |  |
| SURFACE 44 | 90.1-2004 NONRES 5B EXT WALL MASS | 0.08 | 0.698 | 202.69 | E |
| SURFACE 38 | 90.1-2004 NONRES 5B EXT WALL MASS | 0.08 | 0.698 | 115.82 | N |
| SURFACE 50 | 90.1-2004 NONRES 5B EXT WALL MASS | 0.08 | 0.698 | 115.82 | S |
| SURFACE 32 | 90.1-2004 NONRES 5B EXT WALL MASS | 0.08 | 0.698 | 202.69 | W |
| SURFACE 90 | 90.1-2004 NONRES 5B ROOF IEAD | 0.30 | 0.357 | 943.23 |  |
| SURFACE 74 | 90.1-2004 NONRES 5B EXT WALL MASS | 0.08 | 0.698 | 202.69 | E |
| SURFACE 78 | 90.1-2004 NONRES 5B ROOF IEAD | 0.30 | 0.357 | 222.88 |  |
| SURFACE 68 | 90.1-2004 NONRES 5B EXT WALL MASS | 0.08 | 0.698 | 115.82 | N |
| SURFACE 72 | 90.1-2004 NONRES 5B ROOF IEAD | 0.30 | 0.357 | 118.41 |  |
| SURFACE 80 | 90.1-2004 NONRES 5B EXT WALL MASS | 0.08 | 0.698 | 115.82 | S |
| SURFACE 84 | 90.1-2004 NONRES 5B ROOF IEAD | 0.30 | 0.357 | 118.41 |  |
| SURFACE 62 | 90.1-2004 NONRES 5B EXT WALL MASS | 0.08 | 0.698 | 202.69 | W |
| SURFACE 66 | 90.1-2004 NONRES 5B ROOF IEAD | 0.30 | 0.357 | 222.88 |  |

**Exterior Fenestration**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Construction | Glass Area [m2] | Glass U-Factor [W/m2-K] | Glass SHGC | Glass Visible Transmittance | Cardinal Direction |
| SUB SURFACE 12 | ASHRAE 90.1-2004 EXTWINDOW CLIMATEZONE 4-6 | 81.08 | 3.241 | 0.385 | 0.311 | E |
| SUB SURFACE 4 | ASHRAE 90.1-2004 EXTWINDOW CLIMATEZONE 4-6 | 46.33 | 3.241 | 0.385 | 0.311 | N |
| SUB SURFACE 8 | ASHRAE 90.1-2004 EXTWINDOW CLIMATEZONE 4-6 | 46.33 | 3.241 | 0.385 | 0.311 | S |
| SUB SURFACE 9 | ASHRAE 90.1-2004 EXTWINDOW CLIMATEZONE 4-6 | 81.08 | 3.241 | 0.385 | 0.311 | W |
| SUB SURFACE 11 | ASHRAE 90.1-2004 EXTWINDOW CLIMATEZONE 4-6 | 81.08 | 3.241 | 0.385 | 0.311 | E |
| SUB SURFACE 3 | ASHRAE 90.1-2004 EXTWINDOW CLIMATEZONE 4-6 | 46.33 | 3.241 | 0.385 | 0.311 | N |
| SUB SURFACE 10 | ASHRAE 90.1-2004 EXTWINDOW CLIMATEZONE 4-6 | 46.33 | 3.241 | 0.385 | 0.311 | S |
| SUB SURFACE 1 | ASHRAE 90.1-2004 EXTWINDOW CLIMATEZONE 4-6 | 81.08 | 3.241 | 0.385 | 0.311 | W |
| SUB SURFACE 2 | ASHRAE 90.1-2004 EXTWINDOW CLIMATEZONE 4-6 | 81.08 | 3.241 | 0.385 | 0.311 | E |
| SUB SURFACE 7 | ASHRAE 90.1-2004 EXTWINDOW CLIMATEZONE 4-6 | 46.33 | 3.241 | 0.385 | 0.311 | N |
| SUB SURFACE 5 | ASHRAE 90.1-2004 EXTWINDOW CLIMATEZONE 4-6 | 46.33 | 3.241 | 0.385 | 0.311 | S |
| SUB SURFACE 6 | ASHRAE 90.1-2004 EXTWINDOW CLIMATEZONE 4-6 | 81.08 | 3.241 | 0.385 | 0.311 | W |
| Total or Average |  |  | 3.241 | 0.385 | 0.311 |  |
| North Total or Average |  |  | 3.241 | 0.385 | 0.311 |  |
| Non-North Total or Average |  |  | 3.241 | 0.385 | 0.311 |  |

* 1. Lighting and Internal Load Inputs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Zone | Lighting Power Density [W/m2] | Zone Area [m2] | Hours/Week > 1% [hr] | Full Load Hours/Week [hr] |
| THERMAL ZONE: STORY 1 EAST PERIMETER SPACE | 11.8403 | 222.88 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 1 WEST PERIMETER SPACE | 11.8403 | 222.88 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 2 CORE SPACE | 11.8403 | 943.23 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 2 EAST PERIMETER SPACE | 11.8403 | 222.88 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 2 NORTH PERIMETER SPACE | 11.8403 | 118.41 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 2 SOUTH PERIMETER SPACE | 11.8403 | 118.41 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 2 WEST PERIMETER SPACE | 11.8403 | 222.88 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 3 CORE SPACE | 11.8403 | 943.23 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 3 EAST PERIMETER SPACE | 11.8403 | 222.88 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 3 NORTH PERIMETER SPACE | 11.8403 | 118.41 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 3 SOUTH PERIMETER SPACE | 11.8403 | 118.41 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 3 WEST PERIMETER SPACE | 11.8403 | 222.88 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 1 SOUTH PERIMETER SPACE | 12.9167 | 118.41 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 1 NORTH PERIMETER SPACE | 11.8403 | 118.41 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 1 CORE SPACE | 8.6111 | 943.23 | 168.00 | 58.70 |
|  | 11.2420 | 4877.41 |  |  |

* 1. HVAC & DHW Inputs

This baseline building is a simple rectangular core-and-perimeter shape, with 5 zones per floor. These zones are served by three separate VAV systems, one for each floor. The first floor has hot and chilled water provided by district heating and cooling plants. The second and third floor share a hot water loop heated by a gas-fired boiler and a chilled water loop cooled by a water-cooled chiller.