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Costs and Benefits of Building Energy Efficiency Investments in Texas
POLICY SUMMARY

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Energy efficiency (EE) investments provide financial rewards and environmental benefits. At private lending rates for capital investments, efficiency measures pay back quickly, depreciate slowly, and deliver returns for decades. This study quantifies the capital costs and the benefits accrued to Texas from six commercial building and three residential building energy efficiency measures, as shown in Figures 1 and 2. In so doing, we introduce a modeling tool, the Texas Energy Efficiency Model (TEEM), that will be useful for exploring the economics and emissions effects of policies that influence building energy efficiency investment.

We find that considerable opportunity exists for Texas to use proven efficiency measures. Through moderately aggressive energy efficiency investments, Texas can save residential and commercial electricity consumers $10.9 billion and $6.7 billion, respectively, in 2030.[3] After subtracting capital costs, the net present value of avoided electricity bills can be $3.1 billion in the commercial sector and another $7.5 billion in residences *annually* by 2030.[4] This is a net savings of $760 per household, and over $11,000 for an average size commercial building.[5]

Figures 1 and 2 show that energy bill savings in commercial and residential buildings are similar to capital costs in the near term, but within a few years the energy savings accumulate dramatically. Table A summarizes the costs and benefits of EE investments for low, middle and high input values listed in Table B.

Midrange modeling assumptions indicate that emphasizing EE measures can avoid 97 million tons of commercial sector greenhouse gas emissions (i.e., $MMTCO_2Eq$) in 2030, and that the residential sector can avoid 128 million tons. Aggregated over the 20-year study period from 2010 thru 2030, building energy efficiency investments can avoid over 760 million metric tons of global warming pollution.

We also exercised a proprietary model of the Texas electricity supply system to study the implications of reduced electricity demand from EE measures. We find that EE investments in buildings can halve anticipated growth in electricity demand, thereby lowering utility sector capital investments and operating costs by $3 billion annually, and avoiding the need to construct the equivalent of twenty-five 1,000 MW power plants.

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[3] Avoided electricity bill figure is based on midrange electricity rate assumptions and are non-discounted $2008.
[4] Values are in $2008 dollars. Net present value calculation based on a 3% discount rate and midrange input values. TEEM also calculates net present values using a 7% discount rate. With net positive economic benefits, higher discount rates lower present values.
[5] Based on midrange input assumptions, a 3% discount rate. a 60,000 square foot business and an average home size of 1,800 square feet.

Methods

We estimated the capital costs, electricity demand, and power plant emissions associated with moderately high rates of investment in building energy efficiency by developing the Texas Energy Efficiency Model (TEEM). This econometric model forecasts commercial and residential sectors through 2030.

Our findings are based on conservative financial assumptions, as shown in Table B. For example, our midrange assumptions for the cost of capital are based on annualized payments on all of new capital assets at an interest rate of 10% and a payback period of five years. Lower interest loans and longer repayment schedules will generate even better financial returns. We calculate capital costs and annual electricity savings net of annualized capital loan repayments, and then discount the financial flows to arrive at the net present values shown in Figures 1 and 2.

Any attempt to forecast far into the future involves uncertainty. We represent uncertainty in two ways, but do not attempt to assign probabilities to forecasted outcomes. First, we develop low, middle and high range input assumptions. We also use ranges for individual technology costs, energy savings benefits, and capital rates of depreciation. Second, due to the importance of the discount rate on net present value calculations, we provide results for 3% and 7% discount rates to encompass a range of views about the most appropriate rate to use.

The model generates conservative estimates for two reasons: (1) only a subset of EE measures are modeled for homes and commercial buildings, and, (2) the measures are modeled with conservative assumptions. Several additional energy saving technologies and EE measures could be added to the model to make it more complete. Independent peer reviewers estimate that TEEM represents about 75% of available commercial building EE opportunities, and about 25% percent of residential EE potential. For example, we do not represent the potential dramatic benefits of light emitting diode (LED) systems for lighting.

Future Applications

The findings presented here demonstrate a tool, TEEM, that can be used to analyze the capital costs, electricity savings, and emissions benefits of efficiency measures at a variety of scales. Constructed purposefully to allow for easy input of commercial and residential building forecasts, TEEM can be adapted quickly to represent an individual building, a specific county or city, or the full state through 2030. TEEM can detail the economic dimensions of individual measures or a collection of measures. In addition, TEEM can simulate policies intended to influence the rates of market penetration of efficiency measures for both existing and new buildings. In this respect, TEEM can be used by Texans to understand how policy decisions will affect them both economically and environmentally, and can be connected to tangible results, such as avoidance of new fossil fuel based electricity supply capacity. The avoided costs of purchasing emissions allowances in a regional or national greenhouse gas emissions cap-and-trade program can also be estimated using TEEM. We hope that TEEM will be used to examine energy efficiency legislation and other investments in buildings that are part of "no regrets" strategies to fight global warming.

Table A: Costs and Benefits in 2030 with Low, Middle and High Input Assumptions

Commercial	Low	Mid	High
Capital Investments ($2008 Millions)	$43	$136	$129
Avoided Electricity Bills ($2008 Millions)	$2,700	$6,700	$39,900
Net Present Value (3% discount rate)	$1,400	$3,400	$20,700
Net Present Value (7% discount rate)	$600	$1,500	$9,000
Avoided GHG Emissions (MMTC Eq, 2030)	16.0	26.5	88.8
Avoided GHG Emissions (MMTC Eq, 2008-2030)	52.4	80.4	225.0
Avoided GHG Emissions (MMTCO2 Eq, 2030)	58.8	97.2	325.5
Avoided GHG Emissions (MMTCO2 Eq, 2008-2030)	192.2	294.9	824.9
Residential	Low	Mid	High
Capital Investments ($2008 Millions)	$694	$769	$537
Avoided Electricity Bills ($2008 Millions)	$4,100	$10,900	$27,800
Net Present Value (3% discount rate)	$1,900	$5,400	$14,400
Net Present Value (7% discount rate)	$800	$2,300	$6,200
Avoided GHG Emissions (MMTC Eq, 2030)	19.7	34.9	50.3
Avoided GHG Emissions (MMTC Eq, 2008-2030)	73.3	127.3	200.5
Avoided GHG Emissions (MMTCO2 Eq, 2030)	72.4	128.0	184.4
Avoided GHG Emissions (MMTCO2 Eq, 2008-2030)	268.9	466.7	735.2

Table B: Input Parameter Assumptions

Parameter	Low	**Mid**	High
Amortization Rate for Capital Loans (%/year)	12.0%	**10.0%**	8.0%
Length of Loan for Capital Investments (Years)	3	**5**	12
Electricity Rates ($/kWh) - Commercial	$0.087	**$0.109**	$0.131
Electricity Rate Growth (%/year) - Commercial	1.0%	**2.0%**	4.0%
Electricity Rates ($/kWh) - Residential	$0.107	**$0.134**	$0.161
Electricity Rate Growth (%/year) - Residential	2.0%	**4.0%**	8.0%
Commercial Market Share Growth Rate for New Buildings (%/year)	4.0%	**8.0%**	16.1%
Commercial Market Share Growth Rate for Existing Buildings (%/year)	3.5%	**6.9%**	13.9%
Residential Market Share Growth Rate for New Houses (%/year)	4.5%	**9.0%**	18.0%
Residential Market Share Growth Rate for Existing Houses (%/year)	2.5%	**5.0%**	10.0%
Emissions Factor (CO_2eq pounds per kWh)	1.42	**1.47**	1.52

Figure 1: Net Present Value of Commerical Measures
With Midrange Input Assumptions and 3% Discount Rate

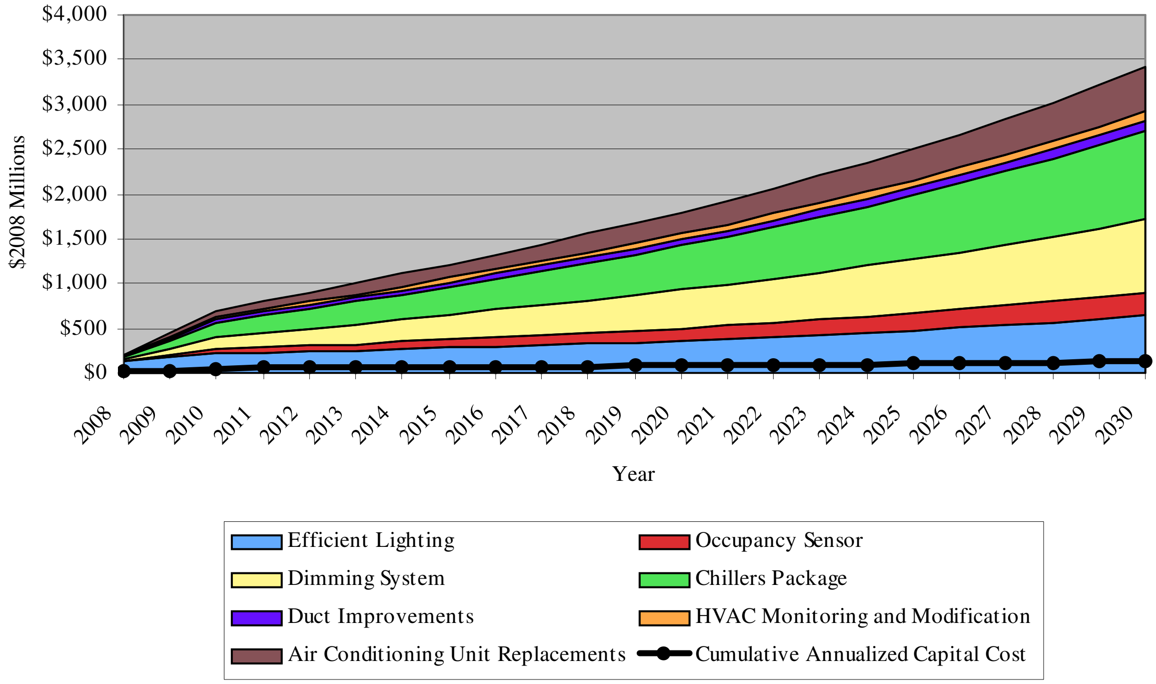

Figure 2: Net Present Value of Residential Measures
Midrange Input Values with 3% Discount Rate