SENATE BILL 184 REPORT

November 3, 2010

Ladies and Gentlemen:

As required by Senate Bill 184 in the 81st Regular Session, this report contains a list of strategies for reducing greenhouse gas emissions that result in net savings for Texas consumers or businesses; can be achieved without financial cost to consumers or businesses; or help businesses in Texas maintain global competitiveness.

Texas continues to demonstrate that a robust economy and efficient use of energy are compatible. The state's energy intensity (the amount of energy needed to produce one dollar's worth of goods) fell by about 50 percent between 1970 and 2003. Decreasing energy intensity shows greater energy efficiency as well as structural changes in the economy, such as growth in less energy-intensive industries. As directed by SB 184 and the 81st Legislature, the Texas Comptroller of Public Accounts organized an advisory committee to assist in identifying and evaluating "No Regrets" Greenhouse Gas Emission Reduction Strategies for the state of Texas. Following a four-stage development process beginning in September 2009, with input from interested stakeholders, including the public, industry and non-government agencies, those strategies are reflected in this report.

The strategies are reported as required by SB 184 and should not be construed as an endorsement or recommendation by this agency. The costs analysis is not specific for Texas, but is based on assumptions; further analysis is necessary. However, as required by the bill, the agency, along with the advisory committee, analyzed each strategy to identify potential costs to consumers or businesses in this state, including total net costs that may occur over the life of each proposed strategy.

Sincerely,

Susan Combs

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INTRODUCTION

Statement of Senate Bill 184

Effective date: Sept. 1, 2009

Senate Bill (SB) 184, authored by Senator Kirk Watson and sponsored by Representative Warren Chisum in the 81st Regular Session, amended the Government Code to require the Comptroller of Public Accounts, by Dec. 31, 2010, to prepare and deliver to each member of the Legislature a report on "No Regrets" Greenhouse Gas Emissions Reduction Strategies for the state of Texas.

SB 184 defined greenhouse gases as:

- Carbon dioxide
- Methane
- Nitrous oxide
- Hydrofluorocarbons
- Perfluorocarbons
- Sulfur hexafluoride

The bill required the Comptroller to appoint one or more advisory committees to assist in identifying and evaluating emission reduction strategies. The advisory committee was to include one representative from the Railroad Commission of Texas, the General Land Office, the Texas Commission on Environmental Quality, the Texas Department of Agriculture and a Texas institution of higher education.

Strategy Development

The Comptroller‘s office organized an advisory committee as directed to assist in identifying and evaluating “no regrets” greenhouse gas emission reduction strategies for the state of Texas.
SB 184 defines “no regrets” greenhouse gas emission reduction strategies as strategies that:

- result in net savings for consumers or businesses;
- can be achieved without financial cost to consumers or businesses; or
- help Texas businesses maintain global competitiveness.

The proposed strategies and this report were developed in four stages:

Stage I: September 2009 to January 2010

The advisory committee convened to establish roles, expectations and gather ideas on implementation and public outreach.

A webinar stakeholder meeting was conducted to explain the requirements of the bill and the implementation plan. The discussion included identification of criteria for the cost-benefit analysis to occur during Stage II.

Greenhouse gas emission control strategies were requested from stakeholders, including reduction strategies in place in other states and nations.

Fifty-four proposals were submitted.

Stage II: February to June 2010

The proposed strategies were posted for public review and comment at www.TexasNoRegrets.org and www.window.state.tx.us.

Another webcast meeting was conducted to present the emission reduction strategies to the advisory committee, with stakeholder input and debate on the technical feasibility, capital costs, operating costs, expected lifetime savings and how strategies met the "no regrets" spirit of the bill.

The advisory committee then met to review the submitted strategies and assign follow-up on cost-benefit analysis to eight subcommittees. These workgroups included members of the public as well as representatives from industry and non-government organizations.

Stage III: July to September 2010

The data, analysis and comments received in Phase I and II were compiled into a draft report for the advisory committee. The strategies in this report were organized into three broad categories based on the level of support the strategies received from the workgroups.

This draft report was made available for public comment. The public was asked to comment on the presentation and organization of the report, rather than on the information itself, which had already been vetted and debated in the workgroup process and during the first public comment period.

The draft report was discussed at the third and final advisory committee meeting.

Stage IV: October to November 2010

Final comments received on the draft report and proposed strategies were incorporated into this final report being delivered to the Legislature as directed by SB 184 before the end of December 2010.

Strategy Categories

The emission reduction strategies proposed in this report are grouped into three categories based on the level of support the strategies received from the workgroups.

Category 1 includes strategies that all of the workgroup members agreed qualify as “no regrets” strategies based on the information available to the workgroups.

Category 2 includes strategies supported by information that could qualify them as “no regrets” strategies but for which there was disagreement within the workgroups.

Category 3 includes strategies that were withdrawn from consideration by the submitter or were disqualified by the workgroups because they did not qualify as “no regrets” strategies or because additional research was needed to determine whether they qualified as “no regrets” strategies.

The emission reduction strategies are then organized into seven sub-categories, based on the type of strategy or the type of organization affected by the strategy:

1. Emission reduction targets
2. Energy-efficient buildings
3. Energy-efficient equipment
4. Oil and gas, refinery and fuels
5. Other industry
6. State and local government
7. Vehicles and transportation

Strategies in other states and nations and were also reviewed.

Cost-Benefit Analysis

In determining whether an emission reduction strategy results in a financial cost to consumers or to businesses in this state, the Comptroller directed the workgroups to consider the total net costs that may occur over the life of the strategy.

Therefore, for each identified emission reduction strategy in this report, cost-benefit analysis includes:

- initial, short-term capital costs that may result from the implementation of the strategy, delineated by the costs to business and the costs to consumers; and
- lifetime costs and savings that may result from the implementation of the strategy, delineated by the costs and savings to business and the costs and savings to consumers.

Strategy Overview

Exhibit 1 provides an overview of the strategies including the estimated greenhouse emission reduction, initial costs and lifetime net savings of each strategy.

Exhibit 1

Category 1 Strategies: Includes strategies that received full agreement that they qualify as "no regrets" strategies based on the information available to the workgroups.				
Strategy	**Greenhouse Gas Emission Reduction**	**Initial Costs**	**Lifetime Net Savings**	**Primary Reference(s)**
Energy-Efficient Buildings				
Existing Homes and Low-Income Homes	Carbon dioxide equivalent: 12.7 million metric tons annually in 2020	$2.086 billion annually through 2020	$507 million annually	McKinsey & Company
Existing Private Commercial Buildings	Carbon dioxide equivalent: 8.7 million metric tons annually in 2020	$771 million annually through 2020	$327 million annually	McKinsey & Company
Government Buildings	Carbon dioxide equivalent: 4 million metric tons annually in 2020	$274 million annually through 2020	$243 million annually	McKinsey & Company
Net-Zero Energy Homes	Carbon dioxide	Varies by location and utility, e.g. assuming $20 per square foot, $55,000 more for a $272,500 home	$40 per month net energy savings	Environment Texas
New Homes, Privately Owned New Buildings; Adopting 2009 Energy Codes	Carbon dioxide	$1,200 to $1,500 per home or building	$200 to $350 annually per home or building	Energy Systems Laboratory, Texas A&M University

Strategy	Greenhouse Gas Emission Reduction	Initial Costs	Lifetime Net Savings	Primary Reference(s)
Point-of-Sale Energy Retrofits	Carbon dioxide: 18% per home annually	Average $5,704 per home	Average $436 annually per home	U.S. Department of Energy
Revolving Loan Fund PACE	Carbon dioxide: 60-100 tons over useful life per standard retrofit package	Specific cost not provided	Standard retrofit project on a San Antonio household: $4,315	National Resources Defense Council
Energy-Efficient Equipment				
Community Infrastructure	Carbon dioxide: 751,500 tons per year (10% reduction) to 2,254,000 tons per year (30% reduction), methane	$584 million to $1.755 billion	$116 million to $350 million annually	Workgroup calculation
Energy Efficiency for Electrical Devices, Small Appliances, Lighting and Major Appliances	Carbon dioxide equivalent: 13.5 million metric tons annually	$152 million annually	$977 million annually	McKinsey & Company
Office and Non-Commercial Devices	Carbon dioxide equivalent: 8.7 million metric tons annually	$84 million annually	$517 million annually	McKinsey & Company
Residential Refrigeration Early Retirement Programs	Carbon dioxide and methane	Businesses (utilities): $85-$170 per refrigerator, Consumers: cost of replacement refrigerator	Consumers: Up to $150 or more	Austin Energy; CPS Energy Refrigerator Program; DOE Energy Star Refrigerator Retirement Savings Calculator
Other Industry				
Landfill Gas-to-Energy Incentives	Carbon dioxide: 858,694 metric tons annually, methane	$272 million	$2.5 billion	EPA Landfill Methane Outreach Program

Strategy	Greenhouse Gas Emission Reduction	Initial Costs	Lifetime Net Savings	Primary Reference(s)
State and Local Government				
Vehicle-Miles Traveled	Carbon dioxide equivalent: 3.4 million metric tons in 2020	$337 million annually	$1.05 billion annually beginning 2020	California Air Resources Board
Water Efficiency in Public Schools	Carbon dioxide	Varies depending on number and type of retrofit measures implemented	Statewide information for Texas not provided	North Carolina State Board of Education
Water Efficiency in State Buildings and Facilities	Carbon dioxide	Varies depending on number and type of retrofit measures implemented	Specific information not provided	North Carolina State Board of Education
Vehicles and Transportation				
Heavy-Duty Vehicle Aerodynamic Efficiency	Carbon dioxide	Varies depending on type of retrofit and vehicle	$4,000 - $5,700 per truck per year	California Air Resources Board
Increase the Use of Fuel-Efficient Tires	Carbon dioxide: 7,000 to 67,000 metric tons	$0.04 - $0.40 per tire	$2 million to $19 million in fuel costs each year	National Highway Traffic Safety Administration; California Energy Commission; U.S. Energy Information Administration
Medium and Heavy-Duty Vehicle Hybridization	Carbon dioxide: 1.8 million to 24.8 million tons annually	$35,400 - $210,462 per truck	$1,732 - 6,133 per truck per year	CALSTART; National Renewable Energy Laboratory; Inform; U.S. Dept. of Transportation; North Central Texas Council of Governments

Strategy	Greenhouse Gas Emission Reduction	Initial Costs	Lifetime Net Savings	Primary Reference(s)
Mileage-Based, Pay-as-You-Drive Insurance	Carbon dioxide: 1.6 million tons annually; hydroflourocarbons and methane	Variable	$3.5 billion	The Brookings Institution
Tire Pressure Program	Carbon dioxide: 0.4 million metric tons in 2020	$740 million total cost to automotive service providers 2010 through 2020	Consumers: $230 million annually	California Air Resources Board
Category 2 Strategies: **Includes strategies supported by information that could qualify them as "no regrets" strategies but for which there was disagreement within the workgroups. This section will contain both the emission and cost estimates by the proponents and a brief summary of the reason the opponents believe that the strategy does not qualify as a "no regrets" strategy.**				
Emission Reduction Targets				
Electricity Reduction Program, Utility Energy Efficiency Program, and Energy Efficiency Goals for Investor-Owned Utilities	Carbon dioxide equivalent: 10.3 million metric tons in 2020	$2.2 billion annually	$1.1 billion annually	McKinsey & Company; California Air Resources Board; iTron
	Summary of opponent analysis: The electricity reduction strategy lacks sufficient definition to qualify as "no regrets." There are no specifics to allow calculations of either costs or benefits.			
Implementation of a 500 Megawatt Non-Wind Renewable Portfolio Standard	Carbon dioxide: 1.25 million metric tons	$220 million at 50% capacity factor and renewable energy credit price of $100 per megawatt-hour	Slight increases in electricity costs may occur, but a more varied electricity market is likely to lower overall costs	Public Utility Commission of Texas; Environmental Defense Fund
	Summary of opponent analysis: This strategy does not qualify as a "no regrets" strategy because the additional cost to consumers will be from $1.1 billion to $1.78 billion in the first 10 years.			

Strategy	Greenhouse Gas Emission Reduction	Initial Costs	Lifetime Net Savings	Primary Reference(s)
Industrial-Sector Energy Efficiency	Carbon dioxide equivalent: 2.9 million metric tons in 2020	$1.2 billion annually	$3.4 billion annually	McKinsey & Company
	Summary of opponent analysis: This strategy does not qualify because it lacks sufficient specificity to meet "no regrets" standards; costs and alleged benefits cannot be calculated.			
Natural Gas Reduction (Efficiency) Programs	Carbon dioxide equivalent: 2.9 million metric tons annually	$649 million	$317 million net annual savings	California Air Resources Board
	Summary of opponent analysis: This strategy does not qualify as "no regrets" because the referenced materials only provide assumed net savings information based on predicted energy savings. Costs for actual items or systems are not provided.			
Oil and Gas, Refinery and Fuels				
Greenhouse Gas Leak Reduction from Oil and Gas Transmission, Reduce Methane Emissions from the Exploration and Production of Oil and Gas	Carbon dioxide equivalent: 11 million tons annually, methane	Variable, depending on technology and site specific conditions	24-month min. payback per site; $117 million annually statewide	EPA Natural Gas STAR; EDF analysis; Colorado Oil and Gas Commission
	Summary of opponent analysis: This strategy does not qualify as a "no regrets" strategy. Most companies participate in the EPA Natural Gas STAR program and have conducted emission reduction studies on a cost benefit basis and implemented projects providing the most cost-beneficial opportunities. Remaining opportunities for reductions are either much more expensive to implement and do not provide net savings or have other undesirable consequences.			
Low Carbon Fuel Standard	Carbon dioxide: 13 million metric tons annually by 2020	Not provided for Texas	$10 billion from 2010 to 2020	California Air Resources Board

<table>
<tr><th>Strategy</th><th>Greenhouse Gas Emission Reduction</th><th>Initial Costs</th><th>Lifetime Net Savings</th><th>Primary Reference(s)</th></tr>
<tr><td rowspan="2">Refinery Energy Efficiency Process Improvement</td><td>Carbon dioxide</td><td>Variable, depending on technology and site specific conditions</td><td>Variable, depending on technology and site specific conditions</td><td>California Air Resources Board</td></tr>
<tr><td colspan="4">Summary of opponent analysis: This strategy does not qualify as "no regrets" because: energy efficiency projects are site specific and most refineries do periodic reviews and implement the cost effective strategies; existing regulations already address most emissions; and, the report upon which this strategy relies most likely overestimates potential greenhouse gas emission reductions and underestimates costs.</td></tr>
<tr><td rowspan="2">Refinery Flare Recovery Process Improvement</td><td>Carbon dioxide</td><td>Variable, depending on site-specific conditions; $10 million for a typical system</td><td>Variable, depending on site-specific conditions; $6 million annual savings for a typical system</td><td>Tommy John Engineering, Inc.</td></tr>
<tr><td colspan="4">Summary of opponent analysis: The cost benefit analysis of flare gas recovery projects is site specific. Driven by ozone and nitrogen oxide regulations, most companies have already implemented refinery gas recovery projects that are economically feasible.</td></tr>
<tr><td rowspan="2">Stationary Internal Combustion Engine Electrification</td><td>Carbon dioxide equivalent: 200,000 metric tons annually</td><td>$12.1 million annually</td><td>$4.8 million annually</td><td>California Air Resources Board</td></tr>
<tr><td colspan="4">Summary of opponent analysis: This strategy does not qualify as a "no regrets" strategy because: replacing a natural gas engine driver in the field simply moves the point source of pollution from the field to a remote power plant, which is likely natural gas- or coal-fired; a noninterruptible energy source is needed for a reliable natural gas delivery system in the event of an electrical outage; and the strategy will result in a net cost to Texas businesses.</td></tr>
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Strategy	Greenhouse Gas Emission Reduction	Initial Costs	Lifetime Net Savings	Primary Reference(s)
Other Industry				
Increase Combined Heat and Power Use	Carbon dioxide: 25 million metric tons per year	The scenario in the report would cost $21 billion	The scenario in the report would save $3.4 to $4.5 billion annually	Summit Blue Consulting, LLC report to Public Utility Commission of Texas
	Summary of opponent analysis: This strategy does not qualify as a "no regrets" strategy because the proposal lacks sufficient specifics to allow calculations of either costs or alleged benefits.			
Industrial Boiler Efficiency	Carbon dioxide: 0.70 million metric tons in 2020	$15.4 million annually	$85.5 million annually	California Air Resources Board
	Summary of opponent analysis: This strategy does not qualify as "no regrets" because: operation of a boiler at peak efficiency should minimize greenhouse gas emissions; many industrial boilers are under a nitrous oxide control program which may conflict with energy efficiency efforts; the study overestimates the greenhouse gas reduction potential; and, energy efficiency needs to be analyzed on a case-by-case basis.			
Vehicles and Transportation				
Texas Emissions Reduction Plan for Black Particles	Black particles	No additional cost	Amount not specified	Public Citizen
	Summary of opponent analysis: The proposed strategy does not meet "no regrets" standards because black carbon is not one of the substances defined by Senate Bill 184 as a greenhouse gas.			

CATEGORY 1 STRATEGIES

Category 1 includes strategies that all of the workgroup members agreed qualify as "no regrets" strategies based on the information available to the workgroups.

ENERGY-EFFICIENT BUILDINGS

Strategy: Energy Efficiency for Existing Homes and Low-Income Homes

AT-A-GLANCE

- Consensus "no regrets" strategies
- Reduce carbon dioxide (CO_2) emissions
- Create net savings of $507 million annually
- Generate 38,300 net new jobs

Description

Energy efficiency programs focused on existing homes will reduce greenhouse gas emissions while simultaneously reducing consumer utility bills. The following strategies consist of a suite of programs that include public awareness campaigns, home labeling, voluntary standards, innovative financing mechanisms, rebates and incentives and building-retrofit mandates. Efficiency initiatives also have potential to create jobs in a variety of trades and industries in Texas. Several states, including North Carolina, Connecticut and California, have identified these strategies as "no regrets."[1]

Reduces greenhouse gases

These strategies will primarily decrease CO_2 emissions by reducing demand at fossil-fuel-burning power plants. McKinsey & Company estimates the averted CO_2 equivalent emissions will total approximately 12.7 million metric tons annually beginning in 2020.

Low-income homes are sometimes in poor condition because residents lack the upfront capital to undertake costly repairs. However, the energy efficiency potential of low-income residences represents four million of the 12.7 million metric tons of CO_2 equivalent emissions averted.[2]

Creates net savings for consumers or businesses in Texas

Net present value savings of capturing the energy efficiency potential of existing homes will total about $507 million annually. This estimate is based only on consumer savings, since the strategy focuses on residential homes, including single-family, multi-family and manufactured housing.

Low-income homes will experience a higher net present value savings of $359 million annually, compared with $148 million annually. This cost difference is due to the lower cost of efficiency improvements in low-income homes.[3]

Reduces emissions without financial cost to consumers or businesses in Texas

The cost of capturing energy efficiency potential in existing Texas homes is approximately $2 billion to consumers and businesses each year, with $486 million for low-income homes and $1.6 billion for other existing homes. (Note that the annual net present value savings of $507 million are savings above the costs estimated here.)[4]

The burden of cost varies by program. For example, utilities or governments could offset partial costs associated with rebates and low-interest loans for existing homes. Weatherization is typically offered for low-income homeowners, consisting of a suite of measures that are fully covered by entities other than the homeowner.

Helps businesses in Texas maintain global competitiveness

The energy efficiency work force spans several industries, including air conditioning installation and repair and window replacement. Energy efficiency improvements are not typically outsourced, as projects are completed onsite.

A 2007 report from the American Council for an Energy-Efficient Economy indicated that by meeting Texas' growing demand for electricity through energy efficiency initiatives, the state could net 38,300 new jobs. In this scenario, energy efficiency will reduce Texas' energy demand by 11 percent in 2023. [5] New jobs will occur not just in energy efficiency industries, but also among other industries as households reinvest cost savings back into the economy.

Cost-benefit analysis

Initial, short-term capital costs for businesses and consumers that may result from these strategies:

- These combined strategies will require $199 billion of incremental capital nationally through 2020. Adjusted for Texas, this cost is estimated at $2.086 billion annually. [6]

Lifetime costs and savings that may result for businesses and consumers from these strategies:

- Net present value savings over the lifetime of these combined strategies are $201 billion for the entire United States. Adjusted for Texas, this figure is an estimated $507 million annually.[7]

Strategy: Energy Efficiency for Existing Private Commercial Buildings

AT-A-GLANCE

- Consensus "no regrets" strategy
- Reduces carbon dioxide (CO_2) emissions
- Creates net savings of $327 million annually
- Helps meet increased energy demand

Description

Energy efficiency programs for existing private commercial buildings will reduce greenhouse gas emissions and help meet future energy needs by 2020. In 2008, more than 40 percent of national energy consumption and 10 percent of all the energy used in the world, or 3,560 trillion Btus of energy, went toward powering America's buildings.[8] End uses included heating, cooling, ventilation, lighting, water heating and other building-related electrical devices such as elevators.

These buildings offer energy efficiency potential to reduce overall building energy consumption 35 percent by 2030.[9]

Technology and work force skills exist to improve the energy efficiency of buildings while simultaneously improving comfort and affordability. In addition to analysis by McKinsey & Company, states such as North Carolina, California and Connecticut have identified energy efficiency measures that meet “no regrets” standards.[10] A March 2007 American Council for an Energy-Efficient Economy report shows that energy efficiency, renewable energy and expanded demand response (the reduction of energy consumption during times of high electricity demand) can meet Texas’ increasing demand for electricity over the next 15 years.[11]

Reduces greenhouse gases

Investing in energy efficiency for existing private commercial buildings will yield a 15 to 20 percent reduction in fossil fuel use for buildings by 2020.[12] Minimizing building energy consumption will also reduce greenhouse gas emissions from buildings almost 20 percent by 2020. This strategy is projected to reduce CO_2 equivalent emissions by a total of 110 million tons across the U.S. in 2020. Adjusted for Texas, this figure is estimated at 8.7 million metric tons annually in 2020. [13]

Creates net savings for consumers or businesses in Texas

A variety of both supply- and demand-side building retrofits deliver reasonable payback periods to meet “no regrets” standards for cost-effectiveness.

Net present value savings of pursuing energy efficiency goals in private commercial buildings will total an estimated $31 billion nationally by 2020, and $327 million annually in Texas.

According to the McKinsey & Company report, the following energy efficiency opportunities in the commercial sector carry positive net present values: [14]

- CFL and LED lighting
- Combined heat and power systems
- Water heaters
- Electronics/appliances
- Building shell improvements
- Refrigeration
- Fire and steam systems improvements
- Electric motor systems

Reduces emissions without financial cost to consumers or businesses in Texas

Nationally, unlocking the energy efficiency potential in existing private commercial buildings will require $73 billion of upfront investment through 2020. Adjusted for Texas, this figure is estimated at $771 million annually. Net present value savings of $327 million annually for Texas exceed the costs presented here over the lifetime of the strategy. [15]

Cost-benefit analysis

Initial, short-term capital costs for businesses and consumers that may result from these strategies:

- $73 billion of upfront investment through 2020. Adjusted for Texas, this figure is estimated at $771 million annually.

Nationally, lifetime costs and savings that may result for businesses and consumers from this strategy:

- Lifetime net present value savings of $31 billion through 2020. Adjusted for Texas, these annual savings are $327 million. [16]

Discussion

Achieving energy efficiency goals in existing private commercial buildings will require strong policies, many of which are developing, in pilot projects or proven to be successful:

- Mandating efficiency at the time of retrofit — Local, state or federal governments can require private buildings to meet an efficiency benchmark at point of sale, during a major retrofit or at a specified time interval. Results from these programs are unclear because annual turnover is relatively small, at 2.2 percent of building stock. [17] Variants of this approach linking enforcement to changes in tenancy, rather than ownership, may prove more effective. Enforcement will incur additional costs.

- Creating value with voluntary — Buildings meeting an efficiency standard show a six percent premium in effective rent and a 16 percent increase in value over similar, non-energy efficient buildings.[18] Effective rent is the average per square foot rent paid by a tenant over the term of a lease. It takes into account only free rent and stepped rents. It does not include allowances, space pockets, free parking and other similar landlord concessions. Benefits provided by adherence to a voluntary standard, applied to buildings and commercial equipment, offer financial returns for investments through increased rent and raising awareness of the benefits of efficient buildings.

- Financing through a public-private partnership — Interviews suggest that creating a credit-enhancement fund that, for a modest premium, shares the risk of default with the lender can enable private capital to flow into the energy efficiency market. Such an approach has proven successful in other markets, including student loans and housing mortgages. Combining this approach with alternative financing solutions, such as on-bill or tax-district financing, will also overcome agency barriers and provide a vehicle for monetary incentives through tax cuts or offsets to the principal amount.

- Providing monetary incentives — Public and private entities can provide monetary incentives to owners in several forms, including tax credits, tax deductions, rebates, or accelerated depreciation. Returning a higher percentage of the initial costs to owners who make deeper retrofits will make the deeper retrofits more cost effective.

- Benchmarking — Existing tools can provide voluntary or mandatory ratings with or without public disclosure. For example, the EPA provides a free benchmarking tool called Portfolio Manager, which lets building owners or managers track ratings of several types of commercial buildings. In addition, several utilities, both public and private, have developed tools to upload building energy consumption data into the Portfolio Manager.

- Aggregating — Establishing policies or business models that encourage utilities to aggregate retrofits of small buildings of less than 5,000 square feet. Aggregating smaller buildings under a single performance contract or verifying effects with random sampling across a portfolio, rather than directly measuring all improved buildings, can reduce these expenses by 5 to 10 percent.[19]

<u>Strategy:</u> Energy Efficiency for Government Buildings

AT-A-GLANCE

- Consensus "no regrets" strategy
- Reduces carbon dioxide (CO_2) emissions
- Creates net savings of $243 million annually

<u>Description</u>

Energy efficiency programs for government buildings will reduce greenhouse gas emissions and lower energy expenditures. Nationally, by 2020, federal, state and local government buildings will account for 1,180 trillion end-use Btus of energy consumption. Offices and educational facilities together will represent 63 percent of physical space and 53 percent of total consumption in the cluster.[20]

The incremental efficiency potential for this strategy is greatest in local-level government buildings, including schools, libraries and administrative offices, which represent 62 percent of government floor space. Nationwide, state buildings, excluding local government, offer 100 trillion end-use Btus of efficiency potential.[21] In addition to analysis by McKinsey & Company, several states, including North Carolina, California and Connecticut, have identified energy efficiency measures for government buildings that meet "no regrets" standards.[22]

<u>Reduces greenhouse gases</u>

This strategy is projected to reduce CO_2 equivalent emissions by 50 million tons across the U.S. in 2020. Adjusted for Texas, this figure is estimated to be 4 million metric tons annually in 2020.[23]

Creates net savings for consumers or businesses in Texas

By recognizing energy efficiency potential in government buildings, fossil fuel use for buildings can be reduced and energy expenditures lowered by 15 to 20 percent by 2020.[24] A variety of supply- and demand-side building retrofits deliver reasonable payback periods to meet "no regrets" standards for cost-effectiveness.

Nationally, by 2020 net present value savings of pursuing energy efficiency goals in government buildings will total an estimated $23 billion, and in Texas, $243 million annually.

According to a report issued by McKinsey & Company, the following energy efficiency tools carry positive net present values: [25]

- CFL and LED lighting
- Combined heat and power systems
- Water heaters
- Electronics/appliances
- Building shell improvements
- Refrigeration
- Fire and steam systems improvements
- Electric motor systems

Low-interest financing is already available exclusively to Texas state agencies and institutions of higher education through LoanSTAR revolving loans and Energy Savings Performance Contracts, which are programs administered by the State Energy Conservation Office (SECO) within the Texas Comptroller of Public Accounts.

Reduces emissions without financial cost to consumers or businesses in Texas

Unlocking energy efficiency potential in local-level government buildings nationally will require $19 billion of upfront investment through 2020. Adjusted for Texas, this figure is estimated at $274 million annually through 2020. Nationally, by 2020 net present value savings of $23 billion equate to $243 million in annual savings when adjusted for Texas.[26]

Cost-benefit analysis

Initial, short-term capital costs for businesses and consumers that may result from these strategies:

- $19 billion of upfront investment through 2020. Adjusted for Texas, this figure is about $274 million annually through 2020.

Lifetime costs and savings that may result for businesses and consumers from these strategies:

- Present value savings of $23 billion through 2020 nationally, and about $243 million in annual savings when adjusted for Texas.[27]

Discussion

State and local governments can seek energy savings performance contracts from energy efficiency service providers across the state. Many states and municipalities have successfully used these instruments to reduce energy expenditures without spending tax dollars, such as Hawaii, Pennsylvania and Washington.[28] Moreover, state buildings and facilities have an obligation to "lead by example" if other sectors are expected to pursue "no regrets" strategies.

By becoming energy efficiency leaders, local governments can show fiduciary responsibility with taxpayer dollars and set an example for individual consumers and business in adopting energy efficiency practices. Guidelines and examples of success are available from the SECO and ICLEI – Local Governments for Sustainability, an organization of more than 500 municipalities supporting sustainable policies in local governments.[29]

Strategies to achieve energy efficiency potential in local-level government buildings:

- **"**Mandating benchmarks or standards — Twenty-eight state governments mandate energy efficiency targets for state buildings, targeting up to a 35 percent reduction in energy use through 2020. The goal for Texas is currently at 5 percent reduction in energy use through 2020."
- **"**Addressing regulations that inhibit performance contracting — Private sector partnerships can include a streamlined process for performance contracting, allowing aggregation of multiple buildings in a single contract, clarifying accounting rules and creating an approved list of eligible service providers. In addition, state and local governments can require procurement departments to evaluate bids based on life-cycle costs rather than initial costs. They also can designate "champions of performance contracting" to provide strong executive support, an approach proven to increase penetration of energy efficiency strategies."
- "Collaboration to identify and convey the effect of debt incurred for energy efficiency improvements on participating governments."[30]

- Strengthening House Bill 1831 (81R) and House Bill 4409 (81R) passed in the 2009 session, to include provisions that require combined heat and power system feasibility studies for certain government facilities prior to construction or renovation. Energy security provisions in these bills currently lack enforcement mechanisms and state oversight.

Strategy: Net-Zero Energy Homes

AT-A-GLANCE

- Consensus “no regrets” strategy
- Reduces carbon dioxide (CO_2) emissions
- Reduces dependence on fossil fuels
- Can lower energy costs to zero

Description

Texas can significantly cut CO_2 emissions by adopting new, high-performance home designs that consume less electricity and gas. Using energy-efficient technology and small-scale solar energy systems, homes can generate as much energy as they consume, achieving “net zero” performance.

Net-zero energy homes can help Texas become less dependent on fossil fuels while reducing emissions associated with energy production. Energy savings help offset upfront costs of the home’s solar energy system and construction. While rebates and incentives are currently needed to deliver overall net savings, experts predict by 2015 the cost of solar photovoltaic systems will decline to the point where net-zero energy homes cost less to own than standard homes.[31] The energy savings and emission reductions of a net zero strategy meets “no regrets” standards.

Reduces greenhouse gases

An October 2009 analysis of the environmental and economic benefits achieved through a net-zero energy home strategy, released by the Environment Texas Research and Policy Center, anticipates Texas will build nearly 2.2 million additional single-family homes from 2010 to 2030 to accommodate population growth. These homes represent an enormous energy savings opportunity. If all new homes are built for net-zero energy performance by 2020, Texas will avoid the need to build seven new, large power plants and will reduce annual emissions equivalent to that of more than three million Texas cars and trucks by 2030.[32]

Creates net savings for consumers or businesses in Texas

Net-zero energy homes can generate as much energy as they consume, greatly reducing monthly utility bills. A Houston-area homeowner will pay $2,400 less per year for utility services in a net-zero energy home than in a standard home. In Amarillo, which experiences cooler average temperatures, a homeowner can save up to $3,000 per year. On average, a net-zero home in Texas will save $40 per month in total homeownership costs after incentives.[33]

Net-zero homes reduce the need for expensive power lines and power plants. They reduce demand for and potentially the overall price of electricity and natural gas. These homes also decrease emissions, reducing costs to public health and the environment.

If all new homes in Texas achieve net-zero energy performance by 2020, Texas homeowners will save an estimated $5.4 billion on utility bills by 2030. Over the entire 20-year analysis period, net total homeownership savings will total $1.1 billion in 2009 dollars.[34]

The potential for these homes to deliver savings will increase over time. The U.S. Department of Energy predicts the installed cost of a solar photovoltaic system will decline 50 percent by 2015.[35] When this milestone is achieved, a net-zero home will generate even more savings.

Reduces emissions without financial cost to consumers or businesses in Texas

The high-quality construction, efficient appliances and solar photovoltaic system of a net-zero energy home adds to construction costs. Efficient appliances and lighting can cost hundreds of dollars more than standard versions. A solar hot-water system can cost several thousand dollars, and a 5-kilowatt solar photovoltaic system, at $7.50 per watt installed, costs $37,500.[36] Altogether, these features add to the per-square-foot price of a net-zero energy home; however, incentives and rebates cut these incremental costs in half, making net-zero energy homes more economically attractive.[37]

Assuming $20 per square foot is added to a standard home of $272,000, a net-zero energy home costs 20 percent, or $55,000, more. The exact combination of available federal, state, utility and manufacturer incentives will depend on where in Texas the net-zero energy home is built. A representative package of incentives and rebates can reduce the incremental cost by more than half, to $26,400.[38]

Although payback periods vary based on the size of the investment and the incentives available, a net-zero energy home saves a net $40 per month in operating costs. In the future, homeowner savings will increase.[39]

Cost-benefit analysis

Initial, short-term capital costs for businesses and consumers that may result from these strategies:

- Unlocking the energy efficiency potential in a new net-zero energy home can add $20 per square foot, or $55,000, to a standard home of $272,000. The exact combination of available incentives and rebates to help offset the higher upfront costs depend on where the net-zero energy home is located in Texas and by which utility it is served. A representative package of incentives and rebates can reduce the incremental cost by more than half to $26,400.[40]

Lifetime costs and savings that may result for businesses and consumers from this strategy:

- Although payback periods vary based on the size of the investment and the incentive programs available, a net-zero energy home will cost about $40 per month less to operate than a standard home.[41]

Discussion

Net-zero energy homes can help Texas become less dependent on fossil fuels

If all new single-family homes in Texas achieve net-zero energy performance by 2020, Texas will save more than 15 billion kilowatt-hours (kWh) of electricity per year by 2030. At current consumption patterns, that amount of electricity will power all residences in the greater metropolitan areas of San Antonio, Austin and Corpus Christi combined, or 1.1 million Texas homes.

Solar energy systems on these homes will generate another 10 billion kWh of electricity per year by 2030 — equivalent to nearly 3 percent of Texas' current annual electricity consumption. [42]

Together, these homes will save more than 25 billion kWh of electricity per year and 500 trillion Btu of natural gas per year by 2030. That reduction eliminates the need to build seven large coal-fired power plants. The amount of gas saved in this strategy meets the annual needs of more than 1 million Texas homes.

By displacing fossil fuels, net-zero energy homes will also prevent 18 million metric tons of greenhouse gas emissions, 7.5 million pounds of smog-forming nitrogen oxides emissions and nearly 400 pounds of mercury emissions in 2030. The impact is equivalent to making more than 3 million vehicles, or one out of every six cars and trucks in the state, emissions-free.

Net-zero energy homes will also save nearly 10 billion gallons of water in 2030 that would otherwise be used to generate steam in fossil-fuel-fired power plants. That much water meets the domestic needs of a city of more than 400,000 people. [43]

Implementation

Incorporating energy-efficient features during construction allows some homes to use two-thirds less energy than a typical home. For example:

- Improved insulation, tight construction, high-efficiency windows and light colored "cool roofs" can drastically improve thermal efficiency, enabling the use of smaller cooling and heating equipment. Together, these measures can cut the energy needed for cooling and heating by more than 75 percent.

- Efficient lighting systems and home appliances deliver the same convenience and comfort while using far less electricity. Compact fluorescent or LED bulbs reduce lighting energy use by more than 70 percent. Efficient clothes washers, dishwashers, dryers and refrigerators cut electricity use by more than 50 percent compared with standard versions.

- A net-zero energy home's solar energy system can generate enough electricity and hot water to offset the remaining home energy use.

- A 5-kilowatt home solar photovoltaic system produces 5,800 kWh per year in hot, humid locations, such as Houston, and up to 7,000 kWh per year in a hot and dry climate like that of Midland. An energy-efficient home will use only about 5,000 kWh of electricity per year. [44]

- An efficient water heater, supplemented by a roof-mounted solar hot water system, can cut the amount of natural gas needed for a typical home by about two-thirds.[45]
- Other sources of renewable energy can deliver cooling, heating and electricity, including geothermal heat pumps and small-scale wind turbines.

Rebates and incentives

The technology needed to build net-zero energy homes is currently available. It is not yet in widespread use due to a variety of market barriers, including lack of familiarity and upfront costs. To unlock the potential of high-performance homes, the state can work to overcome these barriers and encourage the spread of efficient home designs and small-scale renewable energy technologies.

Rebates and incentives for this strategy can be funded through expansion of existing programs run by electric utilities. These costs are generally passed on to ratepayers; however, because net-zero energy homes deliver many benefits, ratepayers will recoup their investment. By reducing peak demand, net-zero energy homes reduce the need to build and operate expensive peaking power plants and new transmission lines, making electricity service cheaper. By reducing the demand for electricity and natural gas, net-zero energy homes can lower the price of these commodities on a large scale.

Net-zero energy homes reduce the need to purchase electricity and natural gas from utility companies. Efficiency measures save energy, directly translating into lower electricity and gas bills. Compared with a typical new home in Houston, a net-zero energy home will require two-thirds less electricity and natural gas. Additionally, through net metering, electricity produced by a solar photovoltaic system and fed into the electricity grid can be counted as a credit on a utility bill.[46]

Texans who build or purchase net-zero energy homes receive very little compensation for the benefits they provide to the rest of society. This is one reason Texas has far fewer net-zero energy homes than is generally considered optimal. To help correct this market failure, federal and state government agencies and utility companies offer a variety of incentives and rebates to reduce the initial purchase price of a net-zero energy home. These incentives also help to bring new technologies to the marketplace, increasing the number of companies with expertise in building net-zero energy homes and, over time, delivering better products that cost less.

These incentives include:

- A federal tax credit of up to $1,500 for the purchase of high-efficiency home heating and cooling equipment (set to expire at the end of 2010).
- A federal tax credit of 30 percent of the installed cost of residential solar photovoltaic or solar water heating systems (set to expire at the end of 2016). [47]
- A state property tax exemption for all renewable energy equipment, including solar photovoltaic and solar water heating systems. [48]

- Utility and product manufacturer incentives for the purchase of high-efficiency equipment.[49]

- Utilities offer rebates on the purchase of solar energy systems, or for efficiency measures that help to reduce peak demand. Oncor, for example, offers a rebate of $2.46 per watt for consumers installing solar photovoltaic systems — the program's budget is limited to $16 million over the next four years.[50] Many other major utility companies in Texas offer rebates for solar installation, including Austin Energy, CPS Energy, American Electric Power Company and Bryan Texas Utilities. Additionally, all utilities in competitive areas are required to offer incentives for energy efficiency measures under Texas' Energy Efficiency Resource Standard.[51]

Affordability

If the higher cost of a net-zero energy home is wrapped into a home mortgage, those energy savings can offset the higher monthly payment. Available incentives and rebates tip the balance into net savings.

If a prospective homebuyer finances a $272,000 home through a 30-year loan at 5.75 percent interest with $50,000 down, a standard home will have a monthly mortgage payment of $1,295.53.[52] On top of that, the homeowner can expect to pay $205.60 on the average monthly energy bill, and $38.53 monthly in property taxes.[53] With the incentives listed above, a net-zero energy home will cost about $10 per square foot more. The monthly mortgage payment for this net-zero home will then be $1,449.73, with an energy and tax bill under $50 per month. At this level, the net-zero energy home will save a homeowner $40 per month compared with a standard home. In this example, when the incremental cost per square foot of the net-zero energy home falls to $12.23, either through incentives, design improvements or future economies of scale, the energy savings of the home will closely match the difference in mortgage payment, making the net-zero energy home effectively cost the same as a standard home.[54]

As the manufacturing of solar energy systems increases and as energy-efficient building practices become more widespread, costs are expected to decline. The Florida Solar Energy Center, the builder of a net-zero energy home in Florida in 1998 that achieved an 82 percent electricity savings over a conventional home, estimates that the average current incremental cost of a net-zero home at about $16 per square foot. As the technology matures, the additional cost is projected to fall to $9 per square foot.[55]

At $16 per square foot, the net-zero energy home modeled in this report will cost about $60 more per month than a standard home, without incentives. However, at $9 per square foot, this home will deliver net savings of more than $50 per month. The solar photovoltaic system carries the highest price tag and is a significant factor in the cost of a net-zero energy home.[56]

The price of solar photovoltaic panels continues to decline. Prices have fallen by more than 80 percent since 1980, and continue to decline as public policies encourage capacity growth in solar panel manufacturing, distribution and installation and because of reduced demand in Spain after government subsidies were reduced.[57]

The net-zero energy home modeled in this report will begin to deliver net savings for the homeowner, even without incentives, if the installed cost of solar panels falls to about $3.50 per watt.[58] This price benchmark is quickly approaching. The Department of Energy forecasts the installed cost of solar photovoltaic systems will fall below $3 per watt by 2015, representing a cost decrease of 50 percent or more.[59] After this milestone is reached, net-zero energy homes are likely to become increasingly widespread. The number of such homes will no longer be limited by the availability of incentive or rebate funding.[60]

Next step for Texas

The federal government has announced an ambitious goal for all new federal buildings that enter the planning process in 2020 to achieve net-zero energy performance by 2030.[61] Texas can embrace this goal and develop its own plan to achieve this benchmark by 2020.

As a first step, Texas can require local jurisdictions to strengthen building energy codes, ensuring all new homes across the state meet or exceed the 2009 International Energy Conservation Code.

Texas can provide financial incentives and technical assistance to encourage high-performance new construction and the deployment of solar energy systems.

For example:

- Texas can establish a statewide solar rebate incentive program.
- Cities can help residents install solar energy systems by offering loans paid back via property taxes, as authorized by House Bill 1937 (81R).
- Texas can require true "net metering" — the process of removing limitations of homeowners seeking fair compensation by utilities for excess electricity they feed into the power grid.
- Texas utilities can expand incentive programs to encourage the construction of net-zero energy homes.

Energy efficiency and renewable energy technologies can benefit all sectors of the Texas economy. To fully capture these resources, Texas can require electric utilities to increase their investment in energy efficiency programs, such as rebates for ENERGY STAR® homes, so that 1 percent of the state's annual electricity consumption is further offset by 2015, and 2 percent annually by 2020 and thereafter.

<u>Strategies:</u> Energy Efficiency for New Homes and Privately Owned New Buildings
Adopting 2009 Energy Codes for New Buildings

AT-A-GLANCE

- Consensus "no regrets" strategy
- Reduces carbon dioxide (CO_2) emissions
- Creates net savings of $200 to $350 annually per home or building
- Reduces energy use 15 percent or more

Description

Adopting the 2009 International Energy Conservation Code (IECC) as the Texas Energy Building Performance Standard for construction of new homes and buildings will reduce greenhouse gas emissions and lower utility bills for customers. Austin, San Antonio, and Waco have voluntarily adopted the 2009 code over the 2000-2001 version, because the energy efficiency measures reduce energy use. Several Texas cities are incorporating other energy efficiency measures into their code adoption programs.

The Energy Systems Laboratory (ESL) at Texas A&M University has provided an analysis identifying the energy-saving potential of individual measures. This analysis guided the selection of measures achieving 15 percent above-code annual energy savings in residential buildings. Jurisdictions can implement these measures individually or in combination with other measures for building envelope and/or HVAC system measures, saving 15 percent or more in total energy use.[62]

In March 2010, ESL published the results of a statewide survey of Texas jurisdictions with a population greater than 25,000. The survey revealed that at least 17 cities have voluntarily proceeded with early adoption of the 2009 energy codes, with some local amendments invoking even more stringent above-code measures.[63]

Reduces greenhouse gases

Texas will reduce CO_2 greenhouse gas emissions associated with electricity use and other pollutants including nitrogen oxides (NO_x) and sulfur oxide (So_x), by adopting the 2009 IECC as the building performance standard. These reductions are related to the implementation of each energy efficiency measure and are provided in terms of pounds per year.

Creates net savings for consumers or businesses in Texas

This strategy will result in a net savings of approximately $200 to $350 annually for Texas businesses and consumers per newly constructed house or building, depending on the climate zone and type of energy systems used.[64]

Reduces emissions without financial cost to consumers or businesses in Texas

Adopting the 2009 IECC will marginally increase initial costs for building components, including window glazing with an improved solar heating gain coefficient, improved lighting, and more efficient water heaters and ductwork. Implementing the components of this strategy will require an increased upfront investment of $1,200 to $1,500. The payback period for these efficiency improvements is less than seven years.[65]

Helps businesses in Texas maintain global competitiveness

This strategy will help Texas businesses reduce annual electricity costs.

Cost-benefit analysis

Initial short-term capital costs that may result from the implementation of the strategy delineated by the costs to business and the costs to consumers:

- To achieve the benefits of this strategy, an increased upfront investment of $1,200 to $1,500 per newly constructed home or building may be required for more energy efficient building components.[66]

The lifetime costs and savings that may result from this strategy:

- $200 to $350 annually per newly constructed home or building, depending on the climate zone and type of energy systems used.[67]

Discussion

The 2009 IECC implements several energy efficiency measures that improve upon 2001 standards:

- Building envelope components: The 2009 IECC has more stringent specifications for window glazing, exterior walls, and slab-on grade for appropriate climate zones.
- Air infiltration: The 2009 code requires a more stringent air exchange rate for houses and calls for reducing duct leakage.
- Calculating internal heat gain: The 2009 code calculation incorporates house size and number of bedrooms as compared with a fixed number that was prescribed by the 2001 IECC. Depending on this calculation, fluorescent lamps may be recommended.
- Water heaters: The 2009 code requires a higher efficiency for water heaters.

Additionally, the 2012 IECC will involve further energy saving measures as states strive to move beyond the 2009 code.

Strategy: Point-of-Sale Energy Retrofits

AT-A-GLANCE

- Consensus "no regrets" strategy
- Reduces carbon dioxide (CO_2) emissions
- Saves $436 annually on homeowner energy bills
- Decreases energy consumption

Description

A strategy that requires point-of-sale energy audits and encourages energy retrofits for existing residential and commercial buildings will reduce energy consumption, energy costs and greenhouse gas emissions. Estimates show Texas buildings will consume a total of 1.2 x 10^{15} Btu of energy in 2009, costing each Texan $664.92 and creating 169 million metric tons of greenhouse gas emissions.[68] While new buildings can be designed to minimize energy use from the start, substantial gains could be made by increasing the efficiency of existing structures.

Many existing buildings are poorly insulated or rely on outdated technologies for lighting, heating and cooling.

Implementing mandatory point-of-sale energy audits, similar to those of the City of Austin and encouraging energy retrofits qualifies as a "no regrets" strategy.

Reduces greenhouse gases

Retrofitting an existing home will decrease per unit energy consumption by 22 percent and CO_2 emission by 18 percent annually.[69]

Creates net savings for consumers or businesses in Texas

An investment of $5,704 to retrofit an existing home will decrease energy consumption and save an average of $436 on energy bills annually.[70]

Reduces emissions without financial cost to consumers or businesses in Texas

Implementing policies that encourage retrofitting of commercial and residential buildings is a difficult task, requiring a significant upfront investment to achieve high levels of energy efficiency. The payback on this investment, however, could continue for years.

More immediate decreases in energy consumption and CO_2 emissions can be achieved through energy efficiency retrofits. The Department of Energy's Weatherization Assistance Program (WAP) invested an average of $5,704 to retrofit existing low-income homes, decreasing energy consumption by 29 MBtu, cutting CO_2 emissions 2.65 metric tons, and saving an average of $436 on heating and cooling bills.[71]

Cost-benefit analysis

The initial short-term capital costs that may result from the implementation of the strategy delineated by the cost to business and the costs to consumers:

- A significant upfront investment to maximize energy efficiency. On the consumer level, for example, retrofitting an existing home will require an average investment of $5,704.

The lifetime costs and savings that may result from the implementation of the strategy delineated by the costs and savings to businesses and the costs and savings to consumers:

- An average of $436 on annual energy bills, with an upfront investment of $5,704 for energy efficiency retrofitting of an existing home.[72]

Discussion

Most homeowners, renters and business owners are unaware of the potential incentives and cost benefits of energy efficiency improvements. An official energy audit is the first step to improving efficiency across sectors. The City of Austin's 2009 Energy Conservation Audit and Disclosure Ordinance requires single-family properties that are at least 10 years old and are served by Austin Energy to undergo an energy audit prior to the time of sale. Audit results must be shared with prospective buyers.[73]

By mandating an energy audit at the point-of-sale, buyers are informed of energy usage, options for retrofits and the cost and savings involved. Buyers then have the opportunity to increase the energy efficiency of the building, potentially qualify for state and federal incentives and possibly roll the cost of retrofitting into the mortgage.

The Austin ordinance sets voluntary, phased-in targets for energy efficiency retrofits identified through these energy audits. The ordinance calls for approximately 35 percent of all eligible properties to undergo energy efficiency upgrades within the first year of enactment. That number increases to 45 percent in the second year, 65 percent in the third year and 85 percent in the fourth year. The audits required at the time of sale detail the energy consumption levels of the property and outline means through which that consumption level can be improved. This allows buyers to consider relative energy costs and maximize the property's energy efficiency.

The Austin ordinance also requires all multi-family and commercial properties to undergo an energy audit, regardless of whether the property is up for sale, within two years of the ordinance's effective date. After the initial audit, apartment complexes and commercial properties that use 50 percent more electricity than the average property, as determined by Austin Energy, are required to undergo energy efficiency upgrades.

According to Austin Energy and the Austin Energy Efficiency Upgrade Task Force, the retrofit program will reduce annual CO_2 emissions by 365,000 metric tons and save $555 million in reduced energy bills during the next ten years. On average, the upgrades would pay for themselves within 2.25 years through savings made through energy bills.[74]

This program can be adapted for statewide application. At the point of sale, Austin Energy requires the seller to provide a copy of the energy audit to both the buyer and to Austin Energy. Across Texas, sellers will do the same by providing a copy of the audit to their local utility. If the utility buys electricity from the competitive market, audits will be sent to the retail energy providers. Those providers will then collect and send the findings of energy audits to the local transmission distribution utility, which manages energy efficiency programs for those consumers.

The United States building sector accounts for more than 40 percent of energy use, and Texas is ranked 32nd in the country for energy efficiency.[75] Several states and cities have programs designed to increase building efficiency through audits and retrofits (**Exhibit 2**).[76]

Exhibit 2
Building Efficiency Programs – Other States and Cities

Cities/States	Requires Audits	Retrofit Rebates/ Incentives	Year Implemented	Types of Properties Included
Ann Arbor, MI	Yes, point of sale	Yes	2010	Rental properties, Commercial
Berkeley, CA	Yes, point of sale	Yes, some mandatory	1984	Residential
Boulder, CO	No, subsidized	Yes	2006	Residential, Commercial
Burlington, VT	Yes, point of sale	Yes, some	1991	Rental properties,

		mandatory		Commercial, Residential
California	Yes, point of sale	Yes, most mandatory	1989	Government, Commercial, Residential
Denver, CO	Pilot program	Yes	2008	Residential
Missouri	Tax deductible	Tax deductible	2009	Residential
Nevada	Yes, point of sale	Yes, both	2007	Residential
New York, NY	Yes, every 10 years	Required on some properties	2009	Various properties
Oregon	Yes, point of sale	Yes, incentives & some retrofits mandatory	2010	Various Properties
San Francisco, CA	Yes, point of sale	Yes, some mandatory	1982	Residential, some commercial and industrial
Seattle, WA	Yes, every 3 years	Yes, most retrofits mandatory & now expanding incentives	2009	Commercial, Residential
Washington	Yes, point of sale	Yes, residential retrofits, baseline is mandatory	2007	Non-residential
Washington, D.C.	Yes, annually	Yes, both	2008	Commercial
Wisconsin	Yes, point of sale	Yes, mandatory retrofitting for state buildings & incentives for other various types	2006	Rental properties, Commercial, Residential

Source: Environment Texas.

<u>Strategy:</u> Revolving Loan Fund PACE

AT-A-GLANCE

- Consensus “no regrets” strategy
- Reduces carbon dioxide (CO_2) emissions
- Lowers energy usage

<u>Description</u>

This strategy pertains to a number of financial mechanisms that can reduce greenhouse gases by encouraging energy efficiency improvements and renewable energy technologies at no net cost to Texas consumers. Examples include property-assessed clean energy (PACE) programs and revolving loan programs. Texans will also benefit from resource conservation and lower energy usage.

Revolving Loan Fund

Since 1988, the state of Texas has successfully offered the Texas Loans to Save Taxes and Resources (LoanSTAR) Program to finance energy efficiency and renewable energy projects in public buildings. Initially capitalized with federal funds, the program’s revolving loan mechanism allows it to continue indefinitely. The program is currently limited to public buildings; expanding it to other buildings will benefit more Texans.

Property-Assessed Clean Energy (PACE)

The PACE program is an innovative method for municipalities to encourage renewable energy and energy efficiency projects for residential, commercial and industrial properties without incurring additional financial obligations.

PACE utilizes the structure of a land-secured financing district, with property owners paying multi-year special assessments as part of their property tax bills to cover the costs of the financed renewable energy or energy efficiency projects, as well as any associated program costs. Payments are secured by a lien on the subject property. PACE programs in Texas were authorized in the 81st legislative session by House Bill 1937 (81R).

To promote the growth of PACE programs and other related financial mechanisms that provide comparable benefits, the state of Texas can take the following “no regrets” actions as part of a comprehensive strategy:

- Legislation — The Texas Legislature can clarify statutory ambiguities by enabling legislation for PACE in Texas and considering additional legislation to expand the use of revolving loan funds and other comparable financing mechanisms.
- Publishing PACE guidelines — The State Energy Conservation Office (SECO) and the Attorney General can jointly issue and disseminate guidelines for municipalities on how to appropriately and effectively structure PACE programs.

- Coordinating Programs — Better economies of scale are achieved if demand is aggregated among municipalities, as compared with a series of city-by-city or county-by-county programs. Both California and Colorado are coordinating statewide PACE programs that individual municipalities can opt into, resulting in lower interest rates and shared administrative costs. LoanSTAR is already a statewide program, and a number of other states are involved in similar programs. SECO can play a useful role in coordinating programs, aggregating demand and providing templates for municipalities and councils of government.

- Expanding the scope of LoanSTAR — SECO used federal American Recovery and Reinvestment Act funds in 2009 to create a complementary Building Energy Retrofit loan program, significantly expanding the reach of the LoanSTAR program. By identifying additional funding streams or by reclassifying a portion of existing streams, SECO can extend the benefits of LoanSTAR.

- Buying-down interest rates — Earlier this year, Austin and San Antonio received federal Recovery Through Retrofit awards to set up a fund to cover loans not paid back or to buy-down interest rates on loans for energy efficiency and renewable energy improvements.[77] State energy offices have been eligible for similar awards, and other states have been using eligible funds from their state treasuries to subsidize loans for citizens, such as Pennsylvania's Keystone HELP. SECO can maximize the availability and usage of these types of funding streams for Texans.

- Educating consumers — SECO has published reports quantifying the benefits of energy efficiency and renewable energy projects for consumers, including the 2008 Home Energy Efficiency Report.[78] By continuing to educate citizens on the benefits of these projects, and taking steps to encourage programs facilitating their adoption, SECO can play a key role in reducing greenhouse gas emissions.

Adopting any or all of these actions as part of a comprehensive plan will qualify as a "no regrets" strategy.

Reduces greenhouse gases

A standard retrofit package in a home can reduce CO_2 emissions between 60 and 100 tons over its useful life. In Texas, a standard retrofit package in San Antonio will reduce CO_2 emissions by 70 tons. Multiplied by the number of participating homes industrial and commercial properties, PACE holds the potential for massive reductions of CO_2 and ancillary pollution from energy production. Penetration rates of 1 to 5 percent of eligible homes and buildings have been achieved in pilot PACE programs.[79]

In addition to CO_2 reductions, energy efficiency programs lead to a reduction in other non-greenhouse gases, including nitrogen oxides (NO_x). According to a 2009 report published by the Electric Utility Marketing Managers of Texas, the nine investor-owned utilities (IOU) in Texas reduced peak demand by 202 megawatts and 581 gigawatt-hours of energy use through energy programs in 2008.[80]

These energy savings correspond to a reduction of 882,519 pounds of NO_x emissions per year.[81] The utility programs implemented after electric industry restructuring in Texas for the years 1999 through 2008 have put measures in place that reduced peak demand by 1,125 megawatts and saved 3,014 gigawatt-hours of electricity in 2008. This translates to approximately 3,490 tons of NO_x emissions reductions.[82]

The Texas IOU energy efficiency programs spent approximately $100 million in 2008. San Francisco's PACE program provides $150 million in financing to participants.[83]

<u>Creates net savings for consumers or businesses in Texas</u>

As reported in the 2008 Home Energy Efficiency Report issued by the Comptroller's office, the U.S. Department of Energy claims that, in addition to the benefits of resource conservation and emissions reductions, many households can save 20 to 30 percent on their home energy bills by implementing energy efficiency solutions.[84] The report indicates that in 2006 the average monthly bill for residential electricity in Texas was $149.29; an efficiency gain of the minimum average projection of 20 percent at 2006 rates represents a $29.86 monthly savings for electricity. With the typical home ownership period of five to seven years, that $29.86 monthly savings is equivalent to $1,791 to $2,507 to homeowners over that period if just 20 percent efficiency is achieved. With 87 percent of the state's 6.3 million homes valued at $200,000 or less, these savings can be significant for many Texas families.[85]

The projected affects of a standard retrofit package on a household in San Antonio are shown in **Exhibit 3**.[86]

Exhibit 3
Projected Savings of Standard Retrofit in San Antonio

Year 1 Savings	$150
Year 10 Savings	$228
Year 20 Savings	$325
Cumulative Savings	$9,518
Net Present Value	$4,315

Source: The National Resources Defense Council, PACE Now, Renewable Funding, LLC, and The Vote Solar Initiative

The program could also be applied to commercial and industrial properties.

<u>Reduces emissions without financial cost to consumers or businesses in Texas</u>

Energy efficiency programs have well-established criteria ensuring that program costs are not greater than the cost of comparable energy generation. In addition, financial mechanisms such as revolving loan funds and PACE programs are particularly attractive to consumers because they eliminate upfront costs and provide cost savings that are usually greater than annual payment amounts.

Helps businesses in Texas maintain global competitiveness

By ensuring business facilities in Texas are more energy efficient and by providing innovative financial mechanisms to help business owners make improvements, the competitive position of Texas businesses is strengthened. In addition, the cost of living in Texas will be reduced through energy efficiency and resource conservation.

Cost-benefit analysis

Initial short-term capital costs for businesses and consumers that may result from the implementation of these strategies:

- Unlocking the energy efficiency potential in homes and businesses by expanding state and municipal financing programs will require no upfront investment for the state or municipality with the exception of nominal administrative fees. In the case of PACE financing, municipalities may need to offer bond financing, but these include revenue bonds that do not incur financial obligations against general funds or can serve as interim financing instantly purchased by third parties. In addition, improvements funded by these programs provide cost savings to businesses and homeowners that are usually greater than annual payment amounts.

ENERGY-EFFICIENT EQUIPMENT

<u>Strategy:</u> Community Infrastructure

AT-A-GLANCE

- Consensus "no regrets" strategy
- Reduces carbon dioxide (CO_2) and methane emissions
- Creates net savings of $116 million to $350 million annually
- Five-year payback less than the 10-year life of the measures

<u>Description</u>

Energy efficiency programs focused on existing municipal buildings and infrastructure will reduce greenhouse gas emissions and result in net energy savings. To capture the potential of this strategy, benchmarks and standards similar to the U.S. Environmental Protection Agency's Portfolio Manager, a management tool to monitor energy and water use, are required for community energy use.

Community infrastructure targeted by this approach includes municipal and school district buildings, traffic and streetlights, water and wastewater facilities, and municipal parks. Energy improvements include efficient lighting and HVAC systems, motion sensors, LED and high-efficiency lighting, improved pumping and leak detection/prevention equipment, and water conservation measures.

All improvements are required to pass a cost-effectiveness test. This is similar to the language in section 388.005 of the Health and Safety Code enacted under Senate Bill 5 (77R).[87] The language was recently extended by the 80th Legislature to Texas institutions of higher education and state agencies as part of House Bill 3693.[88] Including a cost-effectiveness test for existing municipal buildings and infrastructure will enable communities to account for growth while also improving energy efficiency and reducing emissions.

This strategy ensures that the projects benefit taxpayers and local governments through net savings. Similarly, it prevents such a requirement from penalizing communities already invested in energy efficiency.

Communities may need access to upfront funding for energy efficiency upgrades. The state can encourage expanded use and increased funding for the LoanSTAR program, federal funds or other incentives to provide upfront money to local communities.

The expected life of such measures is 10 years or more. Statewide savings are estimated at $116 million to $350 million annually.[89] Costs statewide to implement are estimated at $584 million to $1.755 billion. [90]

The five-year payback is expected to be less than the 10-year life of the measures. This strategy meets the "no regrets" standard.

Reduces greenhouse gases

By saving electricity throughout the year, this strategy will reduce greenhouse gas emissions including CO_2 and methane. During the winter heating season, this strategy will also decrease greenhouse gas emissions associated with the extra heating energy needed to replace the heating effect of the electricity saved, including CO_2 and methane.

Expected savings are estimated to be between 751,500 tons of CO_2 per year, at a 10 percent reduction, and 2,254,600 tons of CO_2 per year, at a 30 percent reduction. [91]

Creates net savings for consumers or businesses in Texas

By recognizing energy efficiency potential in existing community infrastructure, savings statewide are estimated between $116 million and $350 million annually.[92] The five-year payback is expected to be less than the 10-year life of the measures. The strategy will result in a net savings for consumers and businesses in Texas.

Reduces emissions without financial cost to consumers or businesses in Texas

Statewide implementation costs are estimated at $584 million to $1.755 billion. [93] Only a cost-effective measure, or a combination of measures meeting that test, will be implemented.

Helps businesses in Texas maintain global competitiveness

The strategy will help Texas businesses maintain global competiveness by reducing electricity costs. Lower utility costs for public infrastructure can also help ease pressure to increase taxes.

Cost-benefit analysis

Initial, short-term capital costs for businesses and consumers that may result from these strategies:

- Unlocking the energy efficiency potential in existing community infrastructure will require an estimated $584 million to $1.755 billion in capital costs.[94]

Lifetime costs and savings that may result for businesses and consumers from the implementation of the strategy:

- Net present value savings statewide are estimated between $116 million and $350 million annually.[95] The five-year payback is expected to be less than the 10-year life of the measures.

Discussion

In 2002, College Station used 35.5 million kilowatt-hours (kWh) of energy (**Exhibit 4**). [96]

Exhibit 4
College Station Community Energy Use, 2002

Facility	Kilowatt-hours
Municipal buildings (14 buildings)	4.6 million
Streetlights (1,500 lights)	2.6 million
Traffic lights (50 intersections)	0.9 million
Water supply (3.5 billion gallons)	2.9 million
Wastewater (2 plants)	5.9 million
Parks (418 acres)	2.1 million
Independent School Districts (9 schools)	16.1 million
Total	**35.5 million**

Source: Sung, Y., Texas A&M University

For a population of 75,000, the 35.5 million kWh represent 47.3 kWh per person per year. At $0.10 per kWh, the energy cost per person equals $47.33 per year.

Using this data as a model, potential energy savings for the entire state using the 2009 population total of 24.7 million is as follows:

10 percent reduction

A 10 percent reduction in energy use yields $4.73 savings per person per year. Statewide, this totals $116.8 million saved per year with a reduction of 751,500 tons of CO_2 annually. The estimated cost of this strategy of $548 million is recouped in approximately five years.

30 percent reduction

A 30 percent reduction in energy use yields $14.20 savings per person per year. Statewide, this totals $350.5 million saved per year with a reduction of 2,254,600 tons of CO_2 annually. The estimated cost of this strategy of $1.8 million is recouped in approximately five years.

<u>Strategy:</u> Energy Efficiency Appliance Standards for Electrical Devices, Small Appliances, Lighting and Major Appliances

AT-A-GLANCE

- Consensus "no regrets" strategies
- Reduce carbon dioxide (CO_2) emissions
- Creates net savings of $977 million annually
- Decreases energy consumption

<u>Description</u>

Electrical devices and small appliances provide 590 trillion end-use Btus of positive net present value potential, accounting for 19 percent of residential energy efficiency potential and 44 percent of residential electricity potential in 2020.[97] The average household spent $330 in 2008 on energy for "plug load," with an expenditure growing at an annual rate of 2 percent. The U.S. Energy Information Administration forecasts the increased penetration of electronic devices will drive consumption from 500 terawatt-hours of electricity in 2008 to 630 terawatt-hours by 2020, rising from 35 percent end-use residential electricity consumption to 40 percent in 2020. [98] Analysis by McKinsey & Company and several states such as North Carolina, California and Connecticut, identifies energy efficiency measures for electrical devices and small appliances as meeting "no regrets" standards. [99]

Lighting and major appliances constitute 30 percent, or 3,420 trillion end-use Btus, of residential consumption in 2020. Consumption is expected to decline at 0.3 percent per year over the next 10 years, reflecting the 2007 Energy Independence and Security Act provisions that address lighting consumption, and the phasing out of incandescent bulbs in 2012. This cluster accounts for 11 percent of total residential energy savings potential in 2020, or 340 trillion end-use Btus.[100]

Lighting constitutes 15 percent of energy consumption in this cluster, but 82 percent of its savings potential at 80 terawatt-hours, or 9 percent of total residential potential. Water heating constitutes 50 percent of consumption in this cluster, and 13 percent, or 40 trillion end-use Btus, of saving potential. Analysis by McKinsey & Company and states including North Carolina, California and Connecticut, identifies energy efficiency measures for lighting and major appliances as meeting "no regrets" standards.[101]

<u>Reduces greenhouse gases</u>

Implementing energy efficiency standards for electrical devices and small appliances will reduce CO_2 equivalent emissions by 110 million tons nationally in 2020. Adjusted for Texas, this figure is estimated at 8.7 million metric tons annually. [102]

Implementing energy efficiency standards for lighting and major appliances will reduce CO_2 equivalent emissions by 60 million tons nationally in 2020. Adjusted for Texas, this figure is estimated at 4.8 million metric tons annually. [103]

Creates net savings for consumers or businesses in Texas

Implementing energy efficiency standards for electrical devices and small appliances will create an estimated net savings for the entire U.S. of $61.6 billion in 2020. Adjusted for Texas, this figure is $650 million annually.[104]

Implementing energy efficiency standards for lighting and major appliances will create an estimated net savings of $31 billion for the entire U.S. in 2020. Adjusted for Texas, this figure is $327 million annually.[105]

Reduces emissions without financial cost to consumers or businesses in Texas

The strategy to capture the energy efficiency potential of electrical devices and small appliances through the adoption of voluntary or mandatory standards will reduce CO_2 equivalent emissions by 8.7 million metric tons annually. For Texas, it will create a net savings of $650 million annually by 2020.[106]

The strategy to capture the energy efficiency potential of lighting and major appliances through the adoption of voluntary or mandatory standards will reduce CO_2 equivalent emissions by 4.8 million metric tons annually, and will create a net savings for Texas of $327 million annually by 2020.[107]

Cost-benefit analysis

Initial, short-term capital costs for businesses and consumers that may result from the implementation of these strategies:

- Capturing the potential for energy efficiency in electrical devices and small appliances will total about $3.4 billion through 2020 nationally. For Texas, this will total $36 million annually from 2010 through 2020. In dollars not adjusted for inflation, a 10-year investment totaling $360 million will result in a net savings of $650 million annually by 2020.
- Capturing the potential for energy efficiency in lighting and major appliances nationally will total an estimated $11 billion through 2020 for the entire U.S. For Texas, this will total $116 million annually.[108]

Lifetime costs and savings that may result for businesses and consumers from this strategy:

- Net present value savings of this strategy are an estimated $61.6 billion through 2020 nationally. For Texas, this figure is $650 million annually.
- Ninety percent of this potential will have a payback period of less than two years. These investments will continue to provide benefits beyond 2020.
- Net present value savings are about $31 billion through 2020 nationally. For Texas, the net present value is $327 million annually, with an annual payback three times greater than the investment.[109]

<u>Discussion</u>

Voluntary Standards

Voluntary standards will facilitate implementation of future mandatory standards by developing testing procedures, building manufacturer relationships and generating consumer awareness. The U.S. Environmental Protection Agency (EPA) reported a savings of 159 terawatts in 2008 through voluntary commercial and residential appliance standards, with one-third of that savings coming from more energy-efficient lighting.[110] One factor driving success of the EPA's ENERGY STAR® program may be its simple messaging: awareness of the ENERGY STAR® brand is high, at more than 75 percent of households.[111] Voluntary standards are particularly cost-effective — according to the National Renewable Energy Laboratory, ENERGY STAR® has saved energy at a cost of roughly $0.09 per one million Btus.

Education and Awareness

Public awareness programs focusing on reducing plug-load consumption can overcome many barriers. Marketing, education and outreach are core strategies of California's energy efficiency "big bold strategy," including a vision that "Californians are engaged as partners in the state's energy efficiency, demand-side management and clean energy efforts." [112]

Monetary Incentives and Rebates

Incentives to consumers and suppliers can help overcome adoption and efficiency challenges. In Efficiency Vermont's compact fluorescent (CFL) buy-down program, consumers purchased 580,000 CFLs in 2007, or 74 percent of all CFLs sold in the state. The program reported a cost of $1 million with savings of approximately 263 gigawatt-hours, for a per-kilowatt-hours cost of $0.004.[113]

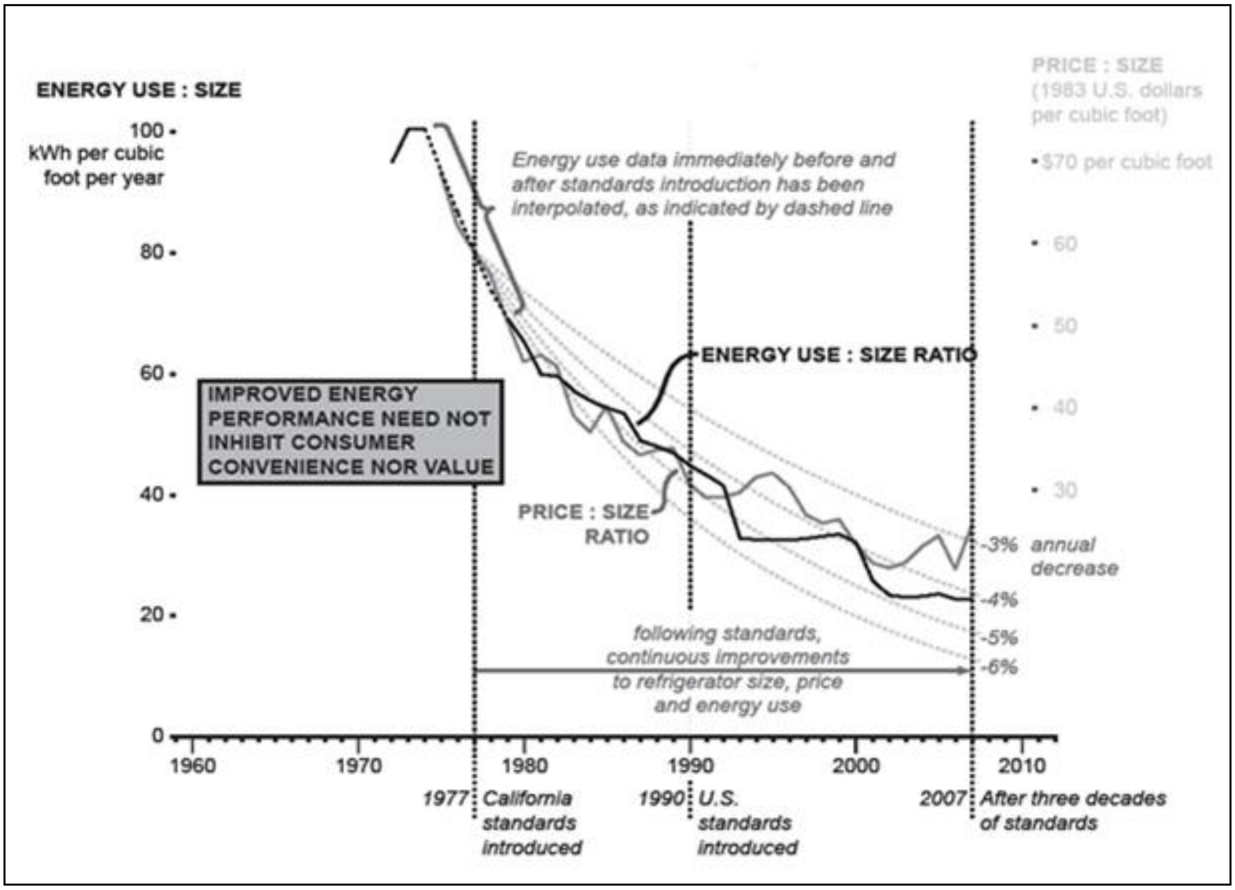
Mandatory Standards

For the largest plug-load categories, specific energy efficiency standards are feasible. Factors including product differentiation and incremental cost are important to consider. Setting mandatory standards at the positive net present value level for the five largest categories of these types of devices, including televisions, computers, microwaves, ceiling fans and DVD players, will save 210 trillion end-use Btus, or 36 percent, of this cluster's potential.[114] To go beyond the top energy-consuming categories would be difficult and costly.

Standby power in many devices consumes an estimated 6 to 8 percent of residential electricity, or 130 to 170 terawatt-hours per year. Standby power can account for up to 90 percent of a device's total consumption. A "standby" standard can reduce standby consumption by roughly two-thirds, yielding 90 to 110 terawatt-hours in savings. While manufacturers may oppose a standby standard because of incremental costs to their products, many plug-load devices can meet a standby standard with incremental costs of less than $0.50 per unit. At that level, the cost of avoided power for all devices would be $2.10 per megawatt-hour.

Exhibit 5 illustrates efficiencies in refrigerator energy use have increased while prices have declined.

Exhibit 5
U.S. Refrigerator Price, Size and Energy Use
(Averages per refrigerator)



Source: Fine, Gabriel and McAuliffe, (2009) Clean Growing California, Environmental Defense Fund. Data from Rosenfeld, (1999), The Art of Energy Efficiency. Annual Review of Energy and Environment, 24:33-82.

If Texas adopted specific appliance efficiency standards for appliances not covered by federal standards, there could be savings (**Exhibit 6**).[115]

Exhibit 6
Texas Energy Efficiency Standards Benefits – 2010 Model Bill
(Effective Date – 2013)

Products	Annual Savings per Unit (kWh)	Incremental Cost per Unit ($)	Pay Back Period (Years)	Benefit/Cost Ratio	Net Present Value (2009 $)	Cumulative Energy Savings through 2030 (Tbtu)
Hot food holding cabinets	1,815	$453	2.3	4.5	$6.5	1.3
Pool pumps	1,241	$452	2.8	2.7	$303.1	67.4
Portable electric spas	250	$100	3.1	2.5	$11.2	2.6
Portable lighting fixtures	22	$2	0.5	14.1	$259.0	39.7
Televisions	167	$0	NA	NA	$1,608.2	227.1
Water dispensers	266	$12	0.4	15.4	$15.3	2.9
Total					**$2,203**	**341**

	Annual Savings in 2020				Annual Savings in 2030			
Products	**Electricity (GWh)**	**Primary Energy (Bbtu)**	**Summer Peak Capacity (MW)**	**Value of Bill Savings ($ Million)**	**Electricity (GWh)**	**Primary Energy (Bbtu)**	**Summer Peak Capacity (MW)**	**Value of Bill Savings ($ Million)**
Hot food holding cabinets	5.8	60.9	1.9	$0.6	11.7	117.6	3.8	$1.2
Pool pumps	0.4	3.9	85.8	$39.7	0.5	5.0	114.4	$63.8
Portable electric spas	14.6	152.0	3.4	$1.9	19.4	195.5	4.5	$2.5
Portable lighting fixtures	226.4	2,360.3	33.7	$24.1	286.8	2,884.1	42.6	$36.8
Televisions	1,256.9	13,101.6	26.3	$133.9	1,675.8	16,852.0	35.1	$215.0
Water dispensers	18.4	191.6	2.5	$2.0	19.6	197.2	2.7	$2.1
Total	**1,522**	**15,870**	**154**	**$202**	**2,014**	**20,251**	**203**	**$321**

	Emissions Reductions in 2020			Emissions Reductions in 2030		
Products	**$C0_2$ 1000 MT**	**NO_x Tons**	**SO_2 Tons**	**CO_2 1000 MT**	**NO_x Metric Tons**	**SO_2 Metric Tons**
Hot food holding cabinets	3.1	3.4	15.7	7.2	6.8	31.5
Pool pumps	198.0	217.8	1,003.8	306.5	290.3	1,338.4
Portable electric spas	7.7	8.5	39.2	12.0	11.3	52.3
Portable lighting fixtures	120.2	132.2	609.2	176.7	167.4	771.7
Televisions	667.0	733.6	3,381.8	1,032.7	978.2	4,509.1
Water dispensers	9.8	10.7	49.5	12.1	11.4	52.8
Total	**1,006**	**1,106**	**5,099**	**1,547**	**1,466**	**6,756**

Source: Appliance Standards Awareness Project.

Effects

Texas does not mandate energy efficiency standards for electrical devices, appliances or lighting. As such, it is not possible to project the exact effects of such standards on Texas manufacturers.

Analyses show that the U.S. Department of Energy (DOE) and others overestimated the impact that the federal standards effective in the 1990s would have on product prices, sales volume and manufacturer finances. For the first energy efficiency standards for furnaces, DOE overestimated the cost by a factor of six, while the Alliance for an Energy-Efficient Economy overestimated by a factor of two.[116]

A 2004 study by the Lawrence Berkeley National Laboratory (LBNL) found that sales did not decline following implementation of the 1990 federal standards, as was predicted. Another LBNL study determined the DOE overestimated costs in the six rulemakings that were reviewed — by 20 to 310 percent. Four factors explaining these overestimates are general increases in productivity, technological change leading to lower costs for improved efficiency, lower profit margins and economies of scale. [117]

California has conducted multiple analyses on the effects of standards. The California Energy Commission determined no adverse economic effects to California businesses from new television efficiency standards due mainly to the ability to use existing technologies.[118]

The size and direction of the financial affects on manufacturers can be debated, and are generally determined by whether a new standard causes the cost of manufacturing to increase, and if so, how effectively those costs are passed on to consumers.

Net national economic benefits are estimated at between $10 billion to $53.5 billion.[119] The DOE estimates manufacturer costs at $4 million to $62 million. The DOE's estimated benefit-to-cost ratios do not include large environmental and energy system benefits resulting from standards, which, if included, would only increase the positive difference. For example, the 2007 final rule for distribution transformers estimates that transformer owner savings outweighed worst-case manufacturer losses by 150 to 1.[120]

<u>Strategy:</u> Office and Non-Commercial Devices

AT A GLANCE

- Consensus "no regrets" strategy
- Reduces carbon dioxide (CO_2) emissions
- Creates net savings of $517 million annually
- Voluntary standards already proven effective

<u>Description</u>

Electricity consumption from office and non-commercial devices is growing at a rate of 3.6 percent per year in the United States. McKinsey and Company forecasts this equipment group to consume 1,980 trillion end-use Btus in 2020, in the form of 580 terawatt-hours of electricity.[121] Several states, including North Carolina, California and Connecticut, have identified energy efficiency measures for office and non-commercial devices that meet "no regrets" standards.[122]

Reduces greenhouse gases

McKinsey and Company projects this strategy will reduce CO_2 equivalent emissions by 110 million tons across the U.S. in 2020. In Texas the strategy could reduce emissions by 8.7 million metric tons annually beginning in 2020.[123]

Creates net savings for consumers or businesses in Texas

By recognizing the energy efficiency potential in office and non-commercial devices, McKinsey and Company estimates the combined net savings at $49 billion nationally in 2020. In Texas the savings could be $517 million annually beginning in 2020.[124]

Office and non-commercial devices include hundreds of device types. The California Energy Commission maintains an appliance efficiency database developed from decades of independent testing of appliance performance. At $2.70 per million Btus of end-use energy, the net present value of this opportunity is among the most cost-effective. The strategy can contribute 570 trillion end-use Btus of positive net present value potential. [125]

Reduces emissions without financial cost to Texas consumers or businesses

McKinsey and Company estimates that this strategy could reduce greenhouse gas emissions by 8.7 million metric tons and create a net present value savings of $517 million for Texas annually beginning in 2020.[126]

Cost-benefit analysis

Initial, short-term capital costs for businesses and consumers that may result from the implementation of these strategies:

- McKinsey and Company estimates that the capital investment required to capture the potential benefit of this strategy is $8 billion through 2020. In Texas this investment would be $84 million annually.[127]

Lifetime costs and savings that may result for businesses and consumers from the implementation of the strategy:

- This strategy creates net present value savings of $49 billion through 2020. In Texas the savings would be $517 million on an annual basis.[128]

Discussion

The California Energy Commission estimates that its standards for buildings and appliances have reduced Californians' electricity bills by $56 billion. [129] According to the commission, approximately 31 percent, or 17,896 gigawatt-hours, of California's energy savings in 2009 were achieved through appliance efficiency standards. This equates to $2.5 billion in savings on electrical bill each year.[130]

These benefits are spread across hundreds of appliance categories. ENERGY STAR® estimates energy management software for computers and monitors alone could save households $75 annually on energy bills.[131]

Strategies to capture this potential

- Introducing or expanding mandatory minimum standards — Three equipment categories with the office and non-commercial devices cluster must adhere to federal mandatory standards, but most categories are not subject to standards. A standby standard for electric devices used in residential settings may further impact in this cluster. For data centers, one potential approach is to set Corporate Average Data-Center Efficiency or Power Usage Effectiveness standards.[132]
- Promoting voluntary standards — The U.S. Environmental Protection Agency is developing a benchmarking tool for data centers through its Portfolio Manager.[133]

Impacts

Texas does not set standards for office and non-commercial devices; the exact impact of such standards on Texas manufacturers cannot be estimated.

Analyses show that the U.S. Department of Energy (DOE) and others overestimated the impact that the federal standards effective in the 1990s would have on product prices, sales volume and manufacturer finances. For the first energy efficiency standards for furnaces, DOE overestimated the cost by a factor of six, while the Alliance for an Energy-Efficient Economy overestimated by a factor of two. [134]

A 2004 study by the Lawrence Berkeley National Laboratory (LBNL) found that sales did not decline following implementation of the 1990 federal standards. Another LBNL study determined the DOE overestimated costs in the six rulemakings that were reviewed — by 20 to 310 percent. Four factors explaining these overestimates are general increases in productivity, technological change leading to lower costs for improved efficiency, lower profit margins and economies of scale. [135]

The size and direction of the financial impact of energy efficiency standards on manufacturers can be debated. Impacts generally depend on whether a new standard causes the cost of manufacturing to increase, and if so, how effectively those costs can be passed on to consumers.

Net national economic benefits are estimated at $10 billion to $53.5 billion. The DOE estimates manufacturer costs at $4 million to $62 million. DOE estimated ratios of benefits-to-costs do not include large environmental and energy system benefits resulting from standards, if included, these would only increase the positive difference. For example, the 2007 final rule for distribution transformers estimates that transformer owner savings outweighed worst-case manufacturer losses by 150 to 1.

A study by California utility Pacific Gas and Electric estimates both the direct product costs and the lifecycle costs and benefits for several appliances. The benefits of avoided energy costs dramatically outweigh incremental capital costs. Capital costs are expected to be small; many products will require only one-time design decisions within existing redesign schedules.[136]

<u>Strategy:</u> Residential Refrigeration Early Retirement Programs

AT A GLANCE

- Consensus “no regrets” strategy
- Reduces carbon dioxide (CO_2) emissions
- Creates consumer savings of up to $150 or more
- Successfully implemented in some areas of the state

<u>Description</u>

This strategy would encourage businesses and homeowners to retire and recycle old refrigerators rather than continue to use less-efficient models.

When purchasing a new refrigerator, consumers often keep older refrigerators to avoid the cost of disposal. These older units often are placed in the garage or other non-air conditioned space, further increasing their energy use. Consumers may not be aware of the costs of running a second refrigerator or freezer, which are estimated to be as high as $150 per year.[137] Recycling the older, inefficient unit also ensures that it is not resold and reused.

A program to encourage the proper disposal of these inefficient units could include a consumer incentive as low as $35 to recycle the old refrigerator, and a fee of $50 to $100 per unit for a recycling company to collect and properly recycle the unit. Cash incentives combined with consumer convenience and the avoided disposal cost should encourage consumer participation. The program could further encourage participation by providing a rebate for the purchase of ENERGY STAR® refrigerators and freezers.[138] ENERGY STAR® refrigerators and freezers use less than half the energy of units made between 1993 and 2000.[139]

A residential refrigeration early retirement program meets “no regrets” standards based on the savings exceeding the costs of the programs to both business and consumers.

<u>Reduces greenhouse gases</u>

This strategy would reduce greenhouse gas emissions associated with electricity generation, including CO_2, methane and nitrous oxides. The strategy also would reduce emissions of refrigerant greenhouse gases such as chlorofluorocarbon and hydrochlorofluorocarbons. Ancillary CO_2 reductions would include emissions from recycling steel, copper and other metals from the refrigerators.

Austin Energy recycled 3,157 refrigerators in fiscals 2008 and 2009 combined, avoiding the release of 1,602 metric tons of CO_2.[140] The U.S. Environmental Protection Agency Responsible Appliance Disposal Program collects and summarizes emissions reductions from recycling programs such as the city of Austin’s.[141]

<u>Creates net savings for consumers or businesses in Texas</u>

Recycling an unneeded second refrigerator can save its owner between $75 and $150 per year, depending on the refrigerator’s size and model year. Replacing a refrigerator manufactured between 1993 and 2000 with an ENERGY STAR® unit can save a consumer or business at least $35 for each year of the appliance's life, or more than $400 on average. The savings vary according to the size of the refrigerator and the model year replaced.[142] According to the U.S. Department of Energy (DOE), the price premium for an ENERGY STAR® refrigerator is approximately $30 to $100.[143]

Austin Energy's program demonstrates that refrigerator recycling can be a cost-effective strategy, based on an assumed avoided cost of energy capacity of $750 per kilowatt. Avoided cost means that the utility and its ratepayers avoid the cost of building a new power plant that would have been necessary had the reduction in energy use and demand not occurred. An Austin Energy report shows a demand reduction expense ranging from $455 to $719 per kilowatt from 2005 to 2009. The same report shows a benefit-to-cost ratio of 4.38 for the utility and 1.65 for the program participants. The benefits outweighed the costs for the utility by more than fourfold; for every dollar spent by a consumer, the consumer realized $1.65 in savings.[144]

Oncor's 2010 Program Manual states a value of $405 per kilowatt for the savings due to replacement and recycling of an older refrigerator with an ENERGY STAR® model. This is well below the cost effectiveness standard ("avoided cost") established by the Public Utility Commission of Texas for utility energy efficiency programs. Therefore, refrigerator recycling programs result in a net savings for the utility administering the program. [145]

CPS Energy recently launched a refrigerator recycling program after conducting cost-effectiveness studies. CPS is limiting the program to refrigerators manufactured before 2001, but is also including an incentive for the purchase of ENERGY STAR® refrigerators.[146]

<u>Reduces emissions without financial cost to consumers or businesses in Texas</u>

This strategy would reduce greenhouse gas emissions at no initial cost to consumers for refrigerator collection and recycling. DOE estimates the additional costs of purchasing an ENERGY STAR® refrigerator rather than a standard refrigerator at between $30 and $100.[147]

<u>Helps businesses in Texas maintain global competitiveness</u>

There would be no anticipated effect on Texas' global competitiveness.

<u>Cost-benefit analysis</u>

Initial, short-term capital costs for businesses and consumers that may result from this strategy.

The utility would incur administrative costs. The initial program costs are estimated at:

- between $25 and $50 per refrigerator for consumer incentives
- between $10 and $20 per refrigerator for program administration
- $50 to $100 per refrigerator for recycling fee[148]

Consumers would not incur costs for collection and recycling. Incremental costs to purchase an ENERGY STAR® refrigerator rather than a standard refrigerator are estimated at between $30 and $100.[149]

Lifetime costs and savings that may result for businesses and consumers from the implementation of the strategy:

- Consumers would not incur an initial cost for recycling an old refrigerator and might receive a cash incentive payment from the utility. Consumer expenditures on electricity would be reduced by $100 annually if the older unit is not replaced. Savings for consumers would increase significantly if the older unit was in a non-air conditioned space such as a garage.[150]

- Replacing an existing refrigerator with an ENERGY STAR® unit would provide consumers with an energy bill reduction of more than $37 per year, with total savings of more than $400 over the average refrigerator lifespan of 13 years. If the initial cost differential for an ENERGY STAR® refrigerator is assumed to be $50, the consumer will see a net savings within two years.[151] Actual savings would vary depending on the size of the refrigerator and the age of the unit recycled.

- Savings for utilities would exceed the costs of power or power plant capacity. Austin Energy's refrigerator recycling program has proven to be cost-effective.[152] The Public Utility Commission has determined through its approved deemed savings calculations for utility Standard Offer programs that refrigerator retirement and recycling is cost-effective.[153]

<u>Discussion</u>

Specific measures to implement this strategy:

- encouraging utilities to offer financial incentives to recycle old refrigerators and freezers;
- encouraging retailers to establish recycling programs for consumers purchasing new appliances;
- publicizing programs that encourage the proper disposal and recycling of older units; and
- publicizing the benefit of ENERGY STAR® refrigerators and freezers.

While programs to recycle old refrigerators and freezers have proven successful in some areas of the state, other programs have not succeeded due to the difficulty of promoting the Standard Offer programs that are administered by transmission and distribution companies. Publicizing such a program to electrical consumers in all areas of the state would be necessary to ensure its cost effectiveness. Promoting recycling at the point of purchase or delivery is worth examining as well.

Refrigerator recycling programs involving retailers could facilitate customer knowledge. These programs could incorporate the collection of old units for recycling at the time newer units are delivered. A program administered by a third party could avoid costs to retailers for unit storage and collection. Free transport and dispose of older units could increase the sales of new refrigerators and freezers.

A successful program must be adapted to local markets, consumer preferences and the needs of local retailers. Similarly, program marketing should be flexible for different areas of the state.

OTHER INDUSTRY

Strategy: Landfill Gas-to-Energy Incentives

AT-A-GLANCE

- Consensus “no regrets” strategy
- Reduces carbon dioxide (CO_2) emissions
- Creates $2.5 billion in lifetime savings for businesses and consumers
- Proven technology

Description

A landfill gas-to-energy strategy recovers methane from landfills and uses it for on-site fuel or makes it available for sale. Methane, when consumed as a fuel, produces greenhouse gases, including CO_2. However, as a greenhouse gas, methane is considered up to 21 times more potent than CO_2.[154] Methane that is captured and combusted produces a significant reduction in the emission of greenhouse gases. Since a positive economic return is likely required for any specific landfill gas-to-energy project to proceed, there are no costs to consumers to implement this strategy.[155]

This strategy meets the “no regrets” requirements.

Reduces greenhouse gases

For landfills not already equipped with gas collection systems, this strategy will prevent methane from escaping into the atmosphere. For landfills already equipped with gas collection systems, this strategy reduces greenhouse gases by recovering the energy value of the methane collected from the landfill. Methane from landfill gas can be used to generate electricity, offsetting electricity generation elsewhere. As calculated below, capturing gas-to-energy potential at 54 candidate-landfills in Texas will reduce CO_2 emissions by about 858,694 metric tons annually.

Creates net savings for consumers or businesses in Texas

The benefits of the landfill gas-to-energy method have been proven by private and public landfill operators in Texas. The initial capital cost with capturing gas from the 54 candidate-landfills is about $272 million.[156] Total annual earnings of the power generated from the landfill gas are $122.5 million, with a payback period of about three years and net operation and maintenance costs of about $29 million.

If federal tax credits and renewable energy credits are included, estimated at $11 per megawatt-hour (MWh) and $1 per MWh respectively, the payback period is shortened to 2.5 years.[157]

Since a positive economic return is likely required for any specific landfill gas-to-energy project to proceed, there are no costs to consumers to implement this strategy.

Reduces emissions without financial cost to consumers or businesses in Texas

This strategy meets the criteria for a "no regrets" measure based on its demonstrated ability to return the capital investment and reduce greenhouse gas emissions.

Cost-benefit analysis

Implementing these strategies will have the following short-term costs for businesses and consumers:

- $272 million: cost of implementation at 54 candidate landfills.

Savings include:

- $2.5 billion in lifetime savings for businesses and consumers based on the assumptions of 20 years of operation. Landfill gas projects typically recover power on a long-term basis.[158]

Discussion

According to the Environmental Protection Agency's (EPA) Landfill Methane Outreach Program (LMOP), there are 24 existing landfill gas-to-energy systems in Texas and another 54 candidate-landfills.[159] Private companies and local governments with landfill gas recovery projects have presumably justified the projects based on positive economic returns, including fuel and electricity sales, offset fuel costs and the sale of environmental attributes (carbon credits and renewable energy credits).[160]

The economics of landfill gas-to-energy projects are complex. Projects generate income from not only the sale of landfill gas, but also from the sale of renewable energy credits and carbon credits sold on voluntary carbon markets. Fuel sales and cost offsets typically represent the greater economic return on investments in landfill gas recovery. Benefits depend largely on natural gas prices. While the economic rationale may vary in degree with market prices, this strategy meets "no regrets" standards based on its demonstrated ability to return the capital investment and reduce greenhouse gas emissions.

Landfill gas-to-energy projects face significant challenges. Projects require significant capital expenditures. In many cases, landfills are owned by municipalities rather than private companies; capital expenditures can cost several times the annual operating budget of a city's entire solid waste division. Many municipalities with existing landfill gas-to-energy projects overcome this challenge by partnering with a private developer. The developer pays upfront capital costs in exchange for some or all of the subsequent revenue generated by the project.

Private developers often face challenges in securing investors. This is due largely to high volatility and uncertainty in voluntary carbon markets. Investors generally won't consider the value of those sales in deciding whether to fund a particular project. Additionally, the value of renewable energy certificates has historically been low. Investors attribute little or no value to these certificates.

The Public Utility Commission of Texas proposed rulemaking to increase the non-wind renewable portfolio standard may affect the economics of these projects.[161] If landfill gas-to-energy projects remain eligible under the proposed rule, the value of renewable energy certificates may increase and provide a reliable revenue stream that appeals to investors.

Texas can take additional steps to make landfill gas-to-energy projects more attractive to investors while encouraging the development of additional projects. One such step is to provide loan guarantees for project development, which lets municipalities self-fund projects and entice developers and investors.

Since a positive economic return is likely required for development of any specific landfill gas-to-energy project to proceed, there are no costs to consumers to implement this strategy.

Assumptions

Landfill gas-to-energy is a proven technology utilized by both private and public landfill operators in Texas. This economic analysis is based primarily on information provided by EPA's LMOP and certain reasonable assumptions.[162]

- There are 24 existing landfill gas-to-energy systems in Texas, and another 54 candidate-landfills. This analysis covers the cost associated with developing all of the candidate-landfills; cost-benefit analysis may vary for conversion of individual landfills.
- Landfill gas has the heating value of 40 to 60 percent of natural gas.
- Landfill gas-to-energy systems require a gas collection system. In most situations, existing regulations require the collection and flaring of landfill gas in order to eliminate volatile organic compounds (VOC) if it is calculated that VOC levels will be more than 50 megagrams per year. For this economic analysis, it is assumed that all of the landfills will eventually be required to install a collection system; costs associated with the collection system are not included. Having the collection system in place significantly reduces the initial capital cost. At landfills with an existing system, the additional greenhouse gas benefit comes from CO_2 saved by displacing fuel with methane. Using methane to replace natural gas for heating and combined heat and power greatly enhances the benefit. Pipelines several miles long have been built in Texas to supply users. Other options include using methane to generate power on-site, or upgrading the gas to pipeline-quality for greater distribution. While this is a more expensive option, there are several plants in Texas capable of upgrading methane.
- EPA's LMOP reports a 95 percent capacity factor for estimating megawatts of electric generating capacity from waste by tonnage. The 95 percent factor is based on a reliable and continuously working collection system.
- Each landfill will require a process for cleaning methane, as well as a pipeline to ship the gas directly to a user or an electric generator to convert the gas to electricity on-site. Electric power generation can be universally adopted and is the basis for estimating the economic impact of this strategy. Further analysis of each landfill may show improved economics through other gas-to-energy strategies.
- Power generation qualifies for a federal tax credit of about $0.011 per kWh.
- State renewable energy certificates are assumed to be valued at $1 per MWh.

Analysis

According to the EPA's LMOP, the 54 candidate-landfills contain about 206 million tons of waste.[163] Each million tons of waste represents the potential to generate 0.78 MW of electricity, or a total of 160 MW.[164] The initial capital cost to capture landfill gas from that waste is estimated at $1,700 per kilowatt, or $272 million. [165] Operation and maintenance costs are estimated at $180 per kWh (**Exhibit 7**).[166]

Assuming reciprocating engines are used to convert the landfill gas to power, and a capacity factor of 95 percent, 1.3 million MWh of power would be generated annually. The value of this power is estimated to be $91.7 per MWh, based on the average U.S. Energy Information Administration (EIA) forecast for industrial power for the South Central U.S. from 2012 to 2035.[167]

The total annual value of power generated from landfill gas is calculated at $122.5 million, with a payback period of 2.9 years and net operation and maintenance costs of $29 million. If the federal tax credit and state renewable energy credit values are included, payback is shortened to 2.5 years.[168]

The resulting CO_2 reduction is estimated at 858,694 metric tons annually, based on the average ERCOT emission rate of 1,417 pounds per MWh.[169]

In general, projects identified by the EPA's LMOP are economically justifiable and provide a positive return on investment. The benefit is significantly dependent on current natural gas prices. While the economic rationale may vary in degree with market prices for traditional gas sources, a landfill gas-to-energy strategy is a qualified "no regrets" strategy.

Exhibit 7
Summary of Analysis of Landfill Gas to Energy

Candidate Landfills		**Source of information**
Waste In Place	205,758,488 Tons	EPA LMOP
MW/Million Tons	0.78	EPA LMOP
Power	160 MWh	
Capacity Factor	95%	Assumed
Annual Output	1,335,611 MWh	
Economics		**Source of information**
Capital	$1,700/kW or $ 272.84 million	EPA LMOP

O&M	$180/kW-yr, $28.89 million/ yr	EPA LMOP
Power	$91.70/MW, $122.47 million /yr	EIA
Net Annual savings	$93.58 million per year	
Simple Payback	2.9 years	
Federal PTC	$11/MWh, $14.69 Million/yr	EPA LMOP
Texas REC	$1/MWh, $1.34 Million/yr	Assumed
Net Annual savings with credits	$109.61 Million/yr	
Simple Payback	2.5 years	
ERCOT Avg. CO_2 Emissions	1,417 lbs/MWh	EIA
Annual CO_2 Reduction	858,694 Metric Tons	

Source: Tommy John Engineering, Inc.

STATE AND LOCAL GOVERNMENT

Strategy: Vehicle-Miles Traveled

AT-A-GLANCE

- Consensus "no regrets" strategy
- Reduces carbon dioxide (CO_2) emissions
- Creates net savings of $1.05 billion annually
- Improves coordination of transportation organizations

Description

A strategy focusing on vehicle-miles traveled will improve coordination between state and regional transportation organizations while decreasing overall vehicle-miles traveled through more efficient planning. Change in land-use patterns and more efficient use of transportation will result in significant reductions in greenhouse gases and substantial financial savings resulting from more efficient use of transportation.

Under this measure, regional transportation planning organizations are encouraged to establish targets for reduced regional greenhouse emissions from passenger vehicles. This measure reduces vehicle use, improves air quality, extends vehicle life and reduces CO_2 emissions.

Local and regional government barriers often complicate urban planning efforts to support high-density dwellings, transit-oriented plans and mixed-use development. These efforts are necessary components of strategies to reduce vehicle-miles traveled. State support and proactive transportation measures help regions overcome these governmental barriers.

This strategy meets "no regrets" standards, as analysis indicates savings far outweigh upfront costs.

Reduces greenhouse gases

This strategy is projected to reduce CO_2 and other emissions through reduced vehicle-miles traveled.

Creates net savings for consumers or businesses in Texas

Recognizing the potential energy savings of a vehicle-miles traveled strategy will result in reduced fuel consumption and net savings for businesses and consumers.

Analysis indicates savings far outweigh upfront costs.

Reduces emissions without financial cost to consumers or businesses in Texas

A vehicle-miles traveled strategy could reduce CO_2 equivalent emissions by about 3.4 million metric tons in 2020, with a small reduction in particulate matter and nitrogen oxide emissions.[170]

Cost-benefit analysis

Initial, short-term capital costs for businesses and consumers that may result from these strategies:

- $337 million in annual Texas energy efficiency savings.

Lifetime costs and savings from this strategy:

- $1.05 billion in net present value savings beginning in 2020.[171]

Discussion

A vehicle-miles traveled strategy will reduce CO_2 emissions by reducing the vehicle-miles traveled across Texas regions. Based on California Air Resources Board (CARB) analysis, scaled to the gross domestic product of Texas, this strategy will reduce CO_2 equivalent emissions by about 3.4 million metric tons in 2020.

A collateral benefit of this measure is a small reduction in emissions of particulate matter and nitrogen oxides. Although these effects have not been calculated for Texas, CARB projects that a 4 percent statewide reduction in vehicle-miles traveled by 2020 will result in an 8.7 tons-per-day decrease of nitrogen oxides, a reduction of 12.9 tons-per-day of reactive organic, and 1.4 tons per day of particulate matter.

Though CARB does not specify capital costs for this strategy, it estimates the total annualized operating and maintenance costs of vehicle-miles traveled reduction programs to be $500 million. Adjusted for Texas, this figure is $337 million annually. The net savings to California drivers from this strategy is projected as $1.5 billion annually beginning in 2020. Adjusted for Texas, net savings as calculated by the Environmental Defense Fund are $1.05 billion annually.[172]

A vehicle-miles traveled strategy results in reduced fuel consumption and greenhouse gas emissions. Analysis indicates savings far outweigh upfront costs.

Strategy: Water Efficiency in Public Schools

AT-A-GLANCE

- Consensus “no regrets” strategy
- Reduces carbon dioxide (CO_2) emissions
- Reduces water and energy demand

Description

This strategy to improve water efficiency for public schools in Texas establishes a goal of reducing school district annual water consumption 20 percent by 2020. Saving water saves energy and reduces greenhouse gas emissions.

Energy and water use are interrelated. Water is used for hydroelectric power generation at major dams and as a coolant for thermoelectric power plants. Thermoelectric power plants that use nuclear, coal, natural gas, solar thermal or biomass fuels are the single largest consumers of water in the United States.[173]

Similarly, energy in the form of electricity is used to produce, deliver, heat and treat water and wastewater supplies. Each year, Texas uses about 2.1 to 2.7 terawatt-hours of electricity for water systems, and 1.1 to 2.2 terawatt-hours for wastewater systems — enough electricity to meet the needs of about 100,000 people for one year.[174]

By recommending water efficiency measures in public schools and generating a net savings within a seven-year period, this strategy meets the "no regrets" standard.

Reduces greenhouse gases

This strategy is projected to reduce CO_2 emissions by reducing energy demand through improved water efficiency. Savings depend on many regional factors.[175]

Creates net savings for consumers or businesses in Texas

To recognize the potential for increased water efficiency in public schools, total net costs will vary considerably based on the retrofit opportunities available in each school and district. Plumbing in Texas public schools has not been comprehensively analyzed. Congress passed the 1992 Energy Policy Act mandating that, beginning in 1994, flush-toilets use only 1.6 gallons of water per flush instead of the standard 3.5 to 5 gallons.[176] Unless schools have performed retrofits, including toilet replacement, significant indoor and outdoor water savings are available for schools built prior to 1992. Water efficiency retrofits can be limited to those generating a net savings within seven years.

Reduces emissions without financial cost to consumers or businesses in Texas

Reducing water use in public schools reduces energy demand, thus lowering greenhouse gas emissions. Water efficiency retrofits at public schools can be limited to those generating a net savings within seven years.

Cost-benefit analysis

Short-term costs for unlocking the water efficiency potential in Texas public schools will vary based on the number and types of retrofit measures implemented. Costs will vary based on age of the school.

There is not enough information to make specific cost statements.

Water efficiency measures resulting in net savings for school districts can be achieved without financial cost. For each efficiency measure identified, lifetime costs and savings can be calculated. This strategy recommends implementing measures resulting in a total net savings within a seven-year period.

Discussion

With an upfront cost of $200, low-flow toilets reduce water use by up to 3.5 gallons per flush. For an additional $50 to $100, a dual-flush toilet uses less water for liquid waste, saving approximately 30 percent more water per flush.[177] Many states including Texas have dual-flush retrofit incentive and rebate programs that lower the cost substantially. Other available water efficiency retrofits include waterless urinals and motion-sensor faucets.

A study by the state of North Carolina reports that toilets at a typical middle school flush 6,000 gallons of water each day. If these are older toilets, and they are replaced with 1.5-gallon low-flush toilets, water use would be reduced to 2,500 gallons for the same number of flushes, 3,500 fewer gallons every day.[178]

Assuming city of Austin water rates of roughly $0.01 per gallon, $35 would be saved each day, or $7,000 per year, at each school — enough to pay for 31 low-flush toilets. Dual-flush toilets cost slightly more, but also save more water, resulting in a more consistent payback period.

San Antonio has retrofitted many of its public schools, saving an estimated 2.9 gallons of water per flush. Assuming 50 flushes per unit per day and 200 school days per year, San Antonio's water savings total 29,000 gallons per unit each year.[179]

Low-flow aerators are the easiest and least expensive devices to install and most are available at a per-unit cost of $5 to $10. Standard pre-rinse kitchen sprayers can be replaced with low-flow pre-rinse sprayers. For $100 to $150, sprayer flow can be reduced from 6 gallons per minute to slightly more than one gallon per minute. Old icemakers can also be replaced with more efficient units. In addition, cleaning protocols for floors and walkways can be shifted away from water-spraying to broom-sweeping.[180]

HVAC system efficiency can also be improved by capturing condensate as reuse for on-premise landscaping. Although these measures have higher upfront costs, these systems can be installed in new schools and as old systems are replaced.

Water could also be saved in landscaping. Turf grass can be replaced with drought-resistant plants or artificial turf, saving water, energy and labor costs. Artificial turf, while costly at the outset, can reap dividends during periods of drought. "Smart" irrigation systems measure soil moisture content and water only as needed. Further, rainwater harvesting can be installed at schools with the added benefit of use as an educational tool.

<u>Strategy:</u> Water Efficiency in State Buildings and Facilities

AT-A-GLANCE

- Consensus “no regrets” strategy
- Reduces carbon dioxide (CO_2) emissions
- Leads by example

<u>Description</u>

This strategy to improve water efficiency for state buildings and facilities in Texas establishes a goal of reducing annual water consumption 20 percent by 2020. Saving water saves energy and reduces greenhouse gas emissions.

Energy and water use are interrelated. Water is used for hydroelectric power generation at major dams and as a coolant for thermoelectric power plants. These plants, by using nuclear, coal, natural gas, solar thermal or biomass fuels, are the single largest consumer of water in the United States.[181]

Similarly, electricity is used to produce, deliver, heat and treat water and wastewater. Each year Texas consumes about 2.1 to 2.7 terawatt-hours of electricity for water systems and 1.1 to 2.2 terawatt-hours for wastewater systems, enough electricity to meet the needs of about 100,000 people for one year.[182] By recommending water efficiency measures in state buildings and facilities, and by generating a net savings within a specific payback period, this strategy meets the “no regrets” standard.

<u>Reduces greenhouse gases</u>

This strategy is projected to reduce CO_2 emissions by reducing energy demand through improved water efficiency. Greenhouse gas savings depend on many regional factors, and as a result, no single figure is available.[183]

<u>Creates net savings for consumers or businesses in Texas</u>

To recognize water efficiency potential in state buildings, total net costs will vary considerably based on the retrofit opportunities available at each facility. There is no comprehensive analysis of plumbing systems in public buildings. The 1992 Energy Policy Act mandates that flush-toilets designed after 1994 use only 1.6 gallons of water per flush instead of the standard 3.5 to 5 gallons.[184] Unless retrofits such as toilet replacement have been performed, large indoor and outdoor water savings are available for facilities built before that time. Water efficiency retrofits can be limited to those generating a net savings within a set period.

<u>Reduces emissions without financial cost to consumers or businesses in Texas</u>

Reducing water use in state buildings and facilities reduces energy demand, thus lowering greenhouse gas emissions. Water efficiency retrofits can be limited to those generating a net savings within a set period.

Cost-benefit analysis

Short-term costs for unlocking the water efficiency potential in state buildings and facilities will vary based on the number and types of retrofit measures implemented.

Water efficiency savings for state facilities can be achieved without financial cost. For each efficiency measure identified, the initial, short-term capital costs and lifetime costs and savings can be calculated.

This strategy implements measures resulting in a total net savings within a payback period to be determined by the State Energy Conservation Office (SECO).[185] Measures in the water conservation guidance manual for new or existing state buildings being prepared by SECO can be given priority.

Discussion

For an upfront cost of $200, low-flow toilets reduce water use by up to 3.5 gallons per flush. For an additional $50 to $100, a dual-flush toilet uses less water for liquid waste, saving approximately 30 percent more water per flush.[186] Many states including Texas have dual-flush retrofit incentive and rebate programs that lower the cost substantially. There is no data to show how many flushes occur on an average day at a state facility.

HVAC system efficiency can be improved and condensate captured as reuse for on-premises landscaping. Although these measures have higher upfront costs, these systems can be installed in new facilities and as old systems are replaced.

Many of these measures are included in the recent draft report prepared by SECO titled “Water Efficiency Standards for State Buildings and Institutions of Higher Education Facilities.” The standards in the report are for new buildings and major renovations; similar protocols can be included for systematic retrofits of existing buildings.[187]

VEHICLES AND TRANSPORTATION

Strategy: Heavy-Duty Vehicle Aerodynamic Efficiency

AT-A-GLANCE

- Consensus “no regrets” strategy
- Reduces carbon dioxide (CO_2) emissions
- Creates net savings of $4,000 - $5,700 per truck per year
- Decreases fuel demand

Description

This strategy increases the fuel efficiency of heavy-duty long-haul trucks through technologies that reduce aerodynamic drag and rolling resistance. California has adopted a similar regulation requiring use of U.S. Environmental Protection Agency (EPA) SmartWay technologies.[188] An initial step toward full implementation in Texas will require transportation service providers to meet SmartWay standards through applicable state government contracts. Because the lifetime savings are greater than the up-front costs, this strategy qualifies as “no regrets.”

Reduces greenhouse gases

This strategy is projected to reduce CO_2 emissions through improved aerodynamic efficiency for heavy-duty, long-haul trucks by 17.64 CO_2 tons per year per tractor, if 1,588.9 gallons/tractor are saved per year via upgrades, or about 326,000 CO_2 tons per year for the state if half of all Texas registered class 8 tractors are upgraded.[189]

Creates net savings for consumers or businesses in Texas

An annual net savings of $5,561 per truck is realized after a retrofit payback period of 2.1 years, assuming today's technology prices and a 7 to 10 percent fuel economy gain. A fleet-wide aerodynamic retrofit has a payback range of between 1 to 2.5 years for long-haul, class-8 tractors averaging at least 50 mph. If combined with a low rolling-resistance tire upgrade, the fleet payback period is about four years. Payback periods will be shorter at higher fuel costs, higher mileage, lower technology costs or other factors such as carbon tax credits. [190]

Reduces emissions without financial cost to consumers or businesses in Texas

Greenhouse gas emissions are reduced with no direct cost to consumers. Fuel savings allow a truck owner to recover initial capital and maintenance costs for one tractor and one trailer in less than 1.5 years. These savings are unlikely to affect consumer prices. [191]

Helps businesses in Texas maintain global competitiveness

Aerodynamic retrofits and low rolling-resistance tires will help insulate long-haul, class 8 tractor owners from diesel price fluctuations. Members generally affix the SmartWay logo on their website and marketing materials, suggesting a competitive advantage by promoting sustainability. To encourage adoption, shipper strategies include giving preference to SmartWay carriers in business operations. [192]

Cost-benefit analysis

Initial, short-term capital costs for businesses and consumers:

- According to California Air Resources Board (CARB) analysis, this strategy will affect trucking businesses that own tractors and 53-foot or longer box-type trailers subject to the proposed regulation. While compliance with the proposed regulation requires an initial capital investment, increased fuel efficiency and decreased fuel usage will lower operating costs. The average retrofit cost for SmartWay aerodynamic devices and low-rolling resistance tires is $2,100 per tractor and $2,900 per trailer. Annual maintenance costs for inspection and repair of aerodynamic technologies and replacement and retread costs for low rolling-resistance tires is estimated at $143 for a tractor and $120 for a trailer. The initial capital cost for a tractor-trailer combination will average $5,000, with an annual increased maintenance cost of $263. With an industry average trailer-to-tractor ratio of 2.5-to-1 per owner, this translates into a cost per owner of $9,200.[193]

- A fleet-wide aerodynamic retrofit has a payback range of between 1 to 2.5 years for long-haul class-8 tractors that average at least 50 mph. If combined with a low rolling resistance tire upgrade, the fleet payback period is about four years. [194]

Lifetime costs and savings that may result from this strategy:

- According to CARB analysis, a tractor-trailer combination will realize a 7 to 10 percent fuel economy gain depending on improvements; fuel savings are between $4,000 and $5,700 per year. This calculation assumes a baseline fuel economy of 5.8 miles per gallon, an average long-haul mileage accrual rate of 125,000 miles per year, with 84 percent of the vehicle-miles traveled at highway speed benefitting fully from the aerodynamic devices, and a projected diesel fuel cost of $3.14 per gallon. If the cost per gallon is higher, fuel savings increase proportionately.[195]

  Business owners can recover initial capital and maintenance costs for both the tractor and trailer in less than 1.5 years via fuel savings. If an owner has more trailers than tractors, more time will be required for payback. Businesses required to equip trailers with aerodynamic technologies and low rolling-resistance tires that do not own or operate tractors, including owners of trailer fleets and certain shippers, may not directly recoup initial costs if they do not directly pay for fuel. However, it is anticipated at least some of the fuel savings from trailers equipped with SmartWay devices and tires will be indirectly shared through improved price structures.

Discussion

More than 2,500 companies and organizations have joined the EPA SmartWay Transport Partnership, including 1,900 truck carriers — the companies actually investing in SmartWay technologies. [196]

Cost savings are realized only when the technologies are used in the appropriate applications.

- The standards are applicable only to class 8 long-haul tractor-trailers — trucks that travel at high speeds for long distances. The EPA has verified fuel economy savings only for this category of vehicle. Affects on short-haul trucks will not be as beneficial, but have not been verified.

- Only certain aerodynamic technologies and low rolling resistance tires have been verified to produce the fuel savings essential to overall economic benefits.[197] The EPA is very specific about individual manufacturers and products qualifying for its own funding, a possible indicator of the products tested.

Cost Variances

The Environmental Defense Fund's proposed costs, based on CARB analysis, are significantly lower than what the North Central Texas Council of Governments has experienced. This may indicate the need for additional analysis of Texas-specific costs.

Invoices and quotes for low rolling-resistance tires and aerodynamic technologies received by the North Central Texas Council of Governments under a grant from the National Clean Diesel Funding Assistance Program:

- Tires, installed: $450 per tire; eight tires per tractor and 10 per trailer; totals $3,600 per tractor and $4,500 per trailer.

- Aerodynamic sets, including gap fairing, side fairing and trailer fairing, installed: $3,500 per trailer.

- Total retrofit cost per 2.5 trailers and one tractor: $22,250.[198]

<u>Greenhouse Gas Emissions Benefits</u>

CARB analysis projects a reduction of 1 million metric tons of CO_2 equivalent in 2020. These reductions will extend beyond state borders as interstate trucks travel outside California. In addition, out-of-state trucks that travel on California highways are subject to the proposed regulation. Nationwide, benefits include 6.7 million metric tons of CO_2 equivalent emissions averted in 2020. From 2010 to 2020, the cumulative benefits are estimated at 7.8 million metric tons statewide and 52.1 million metric tons nationwide.[199]

Reducing aerodynamic drag and rolling resistance will also reduce statewide nitrogen oxide emissions.[200] While the proposed measure applies only to heavy-duty long-haul trucks, other opportunities for efficiency are available for medium-duty trucks.[201]

California Mandate Reactions

Initial stakeholder reaction regarding the aerodynamic tractor-trailer retrofit mandate in California:

> "The California Air Resource Board (CARB) has sought industry input, yet it seems a charade...They propose to implement regulations that most small business truckers will not be able to financially comply with."
>
> "CARB's proposed SmartWay program requirement plan suggests giving truckers financial incentives, yet admits that the technology may not work at many loading docks, provides fuel savings only for long-haul trucks, and doesn't address how trucks that don't haul their own trailers will be fitted." [202]

While there are stipulations under the California law, many trucking companies traveling into California will invest in aerodynamics by the end of 2013. This will include carriers who do business in Texas.

Strategy: Increase the Use of Fuel-Efficient Tires

AT-A-GLANCE

- Consensus "no regrets" strategy
- Reduces carbon dioxide (CO_2) emissions
- Estimated savings of $2 million to $19 million in fuel costs each year
- Improves fuel efficiency

Description

This strategy combines a tire-rating system with a consumer education program to increase awareness of fuel-efficient automobile tires. Reducing the rolling resistance of tires by 10 percent increases fuel efficiency 1 to 2 percent, resulting in decreased greenhouse gas emissions.[203] The National Highway Traffic Safety Administration (NHTSA) and the California Energy Commission are developing similar programs. Texas can engage in the program design and rulemaking, and also promote the program once established.

Reduces greenhouse gases

Based on projections by the NHTSA, when adjusted for Texas, this strategy is projected to reduce CO_2 emissions by 7,000 to 67,000 metric tons annually.[204] When based on analysis by the California Energy Commission, up to 2 million metric tons of CO_2 emissions are avoided annually.[205] The benefits to Texas will likely fall somewhere between these estimates.

Creates net savings for consumers or businesses in Texas

An April 2006 report from the Transportation Research Board and the Board on Energy and Environmental Systems concludes that a 10 percent reduction in average rolling resistance of replacement tires was feasible. Such a reduction would increase fuel economy of passenger vehicles by 1 to 2 percent, saving up to 2 billion gallons of fuel per year nationwide.[206]

The NHTSA fuel-efficient tire program requires manufacturers to rate replacement tires for fuel efficiency, safety and durability based on specified test procedures. Testing is underway to explore consumer comprehension of the three rating categories. The program will begin in 2012.

Reduces emissions without financial cost to consumers or businesses in Texas

With programs already in development, there are no costs to Texas to develop its own data infrastructure and marketing strategies.[207] With minimal cost to the state, information can be adapted as needed and disseminated to Texas consumers.

Cost-benefit analysis

Initial, short-term capital costs for businesses and consumers that may result from the implementation of these strategies:

- Tire manufacturers will bear a small cost for testing tire resistance, and these costs may be passed on to consumers. The California Energy Commission estimated these costs to be about $25 million, which translates to 0.03 to 0.3 percent of total sales or between $0.04 and $0.40 per tire.[208]

Lifetime costs and savings that may result for businesses and consumers from the implementation of the strategy:

- A fuel-efficient tire and consumer education program will create net savings of up to $600 million annually.[209]

Discussion

Changes in consumer behavior, as well as the reduction in rolling resistance among improved tires, are difficult to project as evidenced by the range of benefits noted in two differing analyses.

The NHTSA estimates benefits using a range of hypothetical assumptions. If 2 to 10 percent of targeted tires are improved with an average reduction in rolling resistance of between 5 and 10 percent, 7.9 million to 78 million gallons of fuel can be saved, preventing 76,000 to 757,000 metric tons of CO_2 emissions annually. Estimated fuel savings of between $22 million and $220 million are projected at a 3 percent discount rate, and between $20 million and $203 million at a 7 percent discount rate.[210]

Using these projections and applying the national benefits to Texas using the U.S. Energy Information Administration estimate of an 8.8 percent share of the nation's fuel consumption for Texas, the fuel-efficient tire and consumer education program each year will save:[211]

- 0.7 to 7 million gallons of fuel;
- 7,000 to 67,000 metric tons of CO_2 emissions; and
- $2 million to $19 million in fuel costs at a 3 percent discount rate.

However, the state of California is developing its own program that, in addition to consumer education, includes a rating system analogous to the ENERGY STAR® program. To simplify the consumer purchasing decision and drive the market to create demand to develop increasingly efficient tires, this rating system will designate the top 15 percent most efficient tires in each class.[212] Based on the California Energy Commission's high-end estimates for fuel efficiency improvements of 2 percent, annual benefits can be achieved in Texas (**Exhibit 8**).[213]

Exhibit 8
Savings from Increased Use of Fuel Efficient Tires

Annual California Savings (based on vehicle total)	Annual Texas Savings (at 67 percent of California vehicle total)
300 million gallons of fuel	200 million gallons of fuel
$900 million in fuel costs	$600 million in fuel costs
3.3 million metric tons of CO_2	2 million metric tons of CO_2

Source: California Energy Commission.

The actual benefits for Texas will likely fall somewhere between the National Highway Traffic Safety Administration and California Energy Commission estimates.

<u>Strategy:</u> Medium- and Heavy-Duty Vehicle Hybridization

AT-A-GLANCE

- Consensus "no regrets" strategy
- Reduces carbon dioxide (CO_2) emissions
- Net savings will vary from fleet to fleet based on several variables, most notably vehicle duty cycle, years of ownership and fuel costs. Simple payback may be as short as 6 years.
- No direct costs to consumers

<u>Description</u>

A transition to hybrid technology for certain medium- and heavy-duty vehicle fleets can significantly reduce greenhouse gas emissions and result in net savings. Hybridization technologies includes hybrid-electric, plug-in hybrid-electric, battery electric, mild electric power take-off and hydraulic hybrid.[214] Each type presents its own advantages for different end uses. Hybrid technology yields the most cost-effective benefits when deployed in vehicles with a significant amount of stop-and-go driving or idle time, such as refuse haulers, utility trucks and delivery trucks.

Hybridization of medium- and heavy-duty vehicles is already gaining significant momentum. The number of medium- and heavy-duty hybrid trucks in use in the U.S. is expected to grow to about 20,000 in 2015, up from 200 trucks in 2006.[215] Within five years, hybrid vehicles will represent 8 percent of all North American fleet sales.[216] The anticipated market penetration of hybrid technology is indicative of the benefits hybrid users realize, underscoring the strategy's feasibility.

This strategy does not result in any direct costs to consumers, but it does create additional upfront capital costs for fleet owners. Since lifetime costs of hybrids may result in net savings through reduced operating costs based on use and length of ownership, this strategy meets "no regrets" standards in certain vehicle applications.

Reduces greenhouse gases

This strategy reduces CO_2 emissions and fuel use through improved engine efficiency and decreased idle and standing start engine operation. For each gallon of diesel fuel conserved, approximately 22.2 pounds of CO_2 emissions are avoided.[217] According to Texas Department of Transportation records for 2009, approximately 412,000 heavy-duty vehicles, defined as those weighing more than 8,500 pounds in gross vehicle weight, are registered in Texas.[218] A transition of only 10 percent of this fleet to hybrid technology will yield annual CO_2 reductions ranging from 1.8 million to 24.8 million tons, depending on specific vehicle application.

Hybridization will also reduce emissions of criteria pollutants, including nitrogen oxides (NO_x), a factor in ground-level ozone formation which will be beneficial in areas that are out of compliance with federal ambient ozone standard.[219]

Creates net savings for consumers or businesses in Texas

This strategy does not result in any direct costs to consumers. To achieve this strategy's potential, fleet owners will incur additional upfront capital costs. However, lifetime costs of hybrids may result in net savings through reduced operating costs based on application and length of ownership.

Reduces emissions without financial cost to consumers or businesses in Texas

Implementation of hybrid technology reduces emissions proportional to reductions in fuel consumption, with no direct costs to consumers. Businesses will incur short-term capital costs associated with the incremental costs of hybrid versus conventional vehicle technology, but long-term savings may offset these costs.

Cost-benefit analysis

Short-term capital costs are limited to the price of the hybrid vehicle. Currently, the incremental cost associated with medium- and heavy-duty hybrids ranges from approximately $35,400 for a refuse hauler to $210,462 for a transit bus.

Incremental costs continue to decline rapidly as this industry matures. Prices are expected to be significantly lower within a few years.

Although up-front costs are higher, hybrid vehicles may produce savings through reduced maintenance and operating costs. Many variables and uncertainties impact lifetime costs and savings, most notably vehicle activity rates (i.e. duty cycle, fuel consumption, and mileage), fuel costs and length of ownership.

This report estimated lifetime costs and savings through a years-to-payback calculation, which eliminates the uncertainty associated with length of ownership. Based upon current incremental costs, the payback period ranges from six years for a refuse hauler to 41 years for a school bus. If incremental cost was reduced to only $10,000 per vehicle, the payback period would range from two to 9 years. The payback period also decrease as the cost of fuel increases. Details are outlined in **Exhibit 7** and **Exhibit 8**.

Discussion

This strategy is limited to hybridization. Cost of hybrid technology, duty cycle, annual mileage and fuel consumption, and fuel cost factors vary over time and across vehicle applications. Some vehicle types show a quick return on investment. Current cost variables indicate that hybridization qualifies as "no regrets" for refuse haulers and shuttle bus applications but does not yet qualify for transit bus or school bus applications without financial incentives (**Exhibit 9**).

Exhibit 9
Detailed Lifetime Costs and Savings

Application	**Utility Truck**[220]		**Delivery Truck**[221]		**Refuse Hauler**[222]		**Transit Bus**[223]		**Shuttle Bus**[224]		**School Bus**[225]	
Incremental Cost	Regular	Hybrid	Regular	Hybrid	Regular	Hybrid	Regular	Hybrid	Regular	Hybrid	Regular	Hybrid
Current Incremental Cost	NA	$50,000	NA	$40,000	NA	$35,400	NA	$210,462	NA	$40,427	NA	$65,700
One-Time Battery Replacement Cost	NA	$5,000	NA	$5,000	NA	NA - Hydraulic Hybrid (no battery)	NA	$5,000	NA	$5,000	NA	$5,000
Total Incremental Cost	NA	$55,000	NA	$45,000	NA	$35,400	NA	$215,462	NA	$45,427	NA	$70,700
Estimated Fuel Economy (miles/gallon)	7.70	10.78	10.20	13.10	3.00	3.75	3.86	4.58	9.00	12.60	7.00	9.80
Estimated Annual Mileage	20,000	20,000	20,000	20,000	25,000	25,000	39,186	39,186	25,000	25,000	11,182	11,182
Estimated Fuel Economy Improvement	NA	40.00%	NA	28.90%	NA	25.00%	NA	18.65%	NA	40.00%	NA	40.00%
Estimated Annual Fuel Savings (gallons)	**NA**	**6,493.51**	**NA**	**6,896.55**	**NA**	**33,333.33**	**NA**	**54,425.00**	**NA**	**6,944.44**	**NA**	**3,993.57**
Estimated Annual CO_2 Reduction (tons)	**NA**	**72.08**	**NA**	**76.55**	**NA**	**370.00**	**NA**	**604.12**	**NA**	**77.08**	**NA**	**44.33**
Estimated Fuel Cost (per gallon)	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50
Estimated Maintenance Cost (per mile)	$0.15	$0.14	$0.15	$0.14	$0.15	$0.14	$0.15	$0.14	$0.15	$0.14	$0.15	$0.14
Estimated Annual Fuel Cost	$9,090.91	$6,493.51	$6,862.75	$5,343.51	$29,166.67	$23,333.33	$35,531.35	$29,945.63	$9,722.22	$6,944.44	$5,591.00	$3,993.57
Estimated Annual Maintenance Cost	$3,040.00	$2,800.00	$3,040.00	$2,800.00	$3,800.00	$3,500.00	$5,877.90	$5,603.60	$3,800.00	$3,500.00	$1,699.66	$1,565.48
Total Annual Operating Cost	$12,131	$9,294	$9,903	$8,144	$32,967	$26,833	$41,409	$35,549	$13,522	$10,444	$7,291	$5,559
Annual Hybrid Savings	NA	$2,837	NA	$1,759	NA	$6,133	NA	$5,860	NA	$3,078	NA	$1,732
Years to Payback with Current Incremental Costs	NA	**19**	NA	**26**	NA	**6**	NA	**37**	NA	**15**	NA	**41**
Years to Payback Assuming $10,000 Incremental Cost	NA	**5**	NA	**9**	NA	**2**	NA	**3**	NA	**5**	NA	**9**

Source: North Central Texas County of Governments.

Hybrids for utility- and delivery-trucks may qualify depending on specific fleet characteristics. However, rapidly falling incremental costs and commercialization of hybrid technology likely will result in the strategy meeting "no regrets" criteria across all applications within only a few years.

Analysis by CalStart shows significant lifecycle savings for both delivery trucks and long-haul trucks ranging from $10,942 for a delivery truck, assuming a 12-year life cycle, to $120,096 for a class 8 long-haul truck, assuming an eight-year life cycle.[226] These numbers likely overestimate actual savings; the study assumes mature hybrid market prices with much lower incremental costs than those currently experienced.

Aerodynamic technology use is also included in these costs and assumptions. Current incremental costs result in simple payback periods ranging from six to 41 years (**Exhibit 10**). However, as the hybrid industry continues to mature and become more commercialized, the incremental costs for this technology will decrease significantly, resulting in payback periods of only a few years. If incremental costs of $10,000 per vehicle are assumed, consistent with the costs used in the CalStart study, the simple payback period drops to between two and nine years.

Exhibit 10
Impact of Changing Costs on Simple Payback Period in Years

	Utility Truck*	Delivery Truck* (Class 6/7)	Refuse Hauler	Transit Bus[227]	Shuttle Bus*	School Bus*
Assume Current Incremental Cost; Fuel Cost of $3/Gallon	22	29	7	43	17	47
Assume Current Incremental Cost; Fuel Cost of $3.50/Gallon	19	26	6	37	15	41
Assume Current Incremental Cost; Fuel Cost of $4/Gallon	17	23	5	32	13	36
Assume $10,000 Incremental Cost, Fuel Cost of $3/Gallon	6	10	2	3	6	10
Assume $10,000 Incremental Cost, Fuel Cost of $3.50/Gallon	5	9	2	3	5	9
Assume $10,000 Incremental Cost, Fuel Cost of $4/Gallon	5	8	1	2	4	8

Source: North Central Texas Council of Governments.

The "current incremental costs" referenced in this table are equal to the incremental costs outlined in **Exhibit 11**.

Exhibit 11
Capital Costs of Hybrid Vehicle Purchase

Application	Utility Truck*	Delivery Truck (Class 6/7)*	Refuse Hauler	Transit Bus[228]	Shuttle Bus*	School Bus*
Estimated Baseline Cost	$103,500	$63,900	$200,000	$321,143	$62,166	$79,500
Estimated Hybrid Cost	$153,500	$108,900	$235,400	$531,605	$102,593	$145,200
Estimated Incremental Cost	$50,000	$45,000	$35,400	$210,462	$40,427	$65,700

Source: North Central Texas Council of Governments.
**Costs for these vehicle types are based on bids or quotes received in the past three years by the North Central Texas Council of Governments as a part of various funding programs for fleets operating in and around the Dallas-Fort Worth area.*

The school bus sector is one example of rapidly declining incremental costs for heavy-duty hybrid vehicles. The North Central Texas Council of Governments obtained price estimates of approximately $225,000 in January 2008 for a hybrid school bus. In the fall of 2009, Fort Worth Independent School District purchased hybrid school buses for $145,200 each, representing a 35 percent cost decrease in less than two years. [229] The U.S. hybrid industry includes at least 25 truck manufacturers and 15 hybrid system developers.[230] This large supply base is likely to result in additional competition, driving prices down in coming years. Although this strategy poses financial challenges in the immediate future, market development is likely to drive prices down within a few years, resulting in net lifecycle savings for businesses investing in hybrid vehicles.

Confidence in the future of hybridization is apparent by investment of several major U.S. companies, including FedEx, Coca-Cola Enterprises, PepsiCo, Waste Management Inc. and UPS. [231] Recently, UPS announced plans to deploy 200 additional hybrids in eight cities. UPS noted that incentives are still needed to assist with incremental costs, but as hybrid costs decline they anticipate reduced operating costs will ease additional investment for hybrid technology.[232]

In addition to declining incremental costs, external factors will reduce payback time and overall costs to businesses. Fuel costs, duty cycle, annual mileage and typical fuel consumption affect the cost effectiveness of investment in hybridization. When fuel consumption and cost increases during operation, such as during significant periods of engine idling to run power take-off, so do the fuel economy and idle reduction benefits of a hybrid.

Financial incentives create an even faster return on investment. Federal tax credits exist for medium- and heavy-duty hybrids. Some grant programs, such as the Texas Clean Fleet Program, also reduce upfront costs.[233] A carbon cap and trade system or tax will result in additional savings or marketable credits based upon the amount of CO_2 reduced. This will drastically improve the business case for medium- and heavy-duty hybrid vehicles, resulting in larger net savings.

Although hybrid vehicles have a higher initial cost, operating costs are lower due to higher fuel economy and lower maintenance costs, offering potential lifetime savings for the fleet user, depending upon length of ownership.

Assumptions for both the delivery truck and transit bus applications are sourced from studies performed by the National Renewable Energy Lab and Federal Transit Administration. As per-mile maintenance costs are the same for both applications, the same per-mile maintenance cost is used for all applications. Other inputs are specific to each application.

Strategy: Mileage-Based, Pay-As-You-Drive Insurance

AT-A-GLANCE

- Consensus "no regrets" strategy
- Reduces carbon dioxide (CO_2) emissions
- Potential net savings of $3.5 billion
- Decreases fuel demand

Description

By encouraging people to drive less, a mileage-based or pay-as-you-drive (PAYD) insurance strategy reduces greenhouse gas emissions and other pollutants. This strategy also creates a more equitable insurance pricing structure in Texas. Recent studies show the volume of insurance claims increases the more miles a driver travels.[234]

However, total annual mileage is not always a factor in determining insurance premiums under the traditional policy structure. Drivers traveling the fewest miles subsidize those who drive the most, even though low-mileage drivers represent lower risk. Because of the net cost savings for consumers and businesses, optional mileage-based insurance qualifies as a "no regrets" strategy.

Reduces greenhouse gases

The Federal Highway Administration estimates vehicle-miles traveled in Texas at 243 billion miles in 2007.[235] In calculating the amount of emissions reduced by PAYD insurance pricing, miles traveled by light-duty personal vehicles is conservatively estimated at 50 percent of the total, with heavy-duty and commercial vehicles excluded.

Based on a pilot program administered from 2006 to 2007 by the North Central Texas Council of Governments, vehicle-miles traveled can be reduced by 5 percent, or approximately 560 miles per vehicle, per year, per driver resulting in a significant reduction in mobile-source emissions.[236]

Extrapolating data for the entire state and assuming 25 percent of Texas drivers will chose a mileage-based insurance option, more than 1.6 million tons of CO_2 emissions are avoided per year.[237] These results are similar to a Brookings Institution study that projected up to an 8 percent emissions reduction resulting from mileage-based insurance.[238]

Emissions of hydrofluorocarbons, methane, nitrogen oxides and volatile organic compounds are also reduced, helping urban counties in Texas attain National Ambient Air Quality Standards. Reducing vehicle-miles traveled has the added benefit of reducing congestion and stop-and-go traffic, resulting in improved fuel economy and reduced greenhouse gas emissions.

Creates net savings for consumers or businesses in Texas

A detailed analysis by the Brookings Institution concludes California's pay-as-you-drive insurance option reduces light-duty vehicle-miles traveled by 8 percent, for an estimated annual savings of $414 per vehicle, or $11 billion annually based on 2006 driving levels.[239] The top three factors — individual insurance savings, external insurance savings and reduced congestion — account for 85 percent of these savings.[240] Additional savings are achieved through reduced local pollution, CO_2 emissions and oil dependence.

A conservative assumption for Texas represents at least one-third of the projected California savings, or $3.5 billion.

Reduces emissions without financial cost to consumers or businesses in Texas

With this strategy, drivers save on fuel costs by driving fewer miles, leading to fewer accidents and reduced emissions and congestion. Insurance companies save money through a reduction in accidents and claims filed, leading to lower rates for consumers.

Cost-benefit analysis

Costs for a "mileage-based insurance" start-up company are not anticipated to be higher than those associated with starting up a new "traditional insurance" company. For existing companies, there may be costs associated with marketing PAYD and costs associated with implementing mileage tracking technology, depending on the systems used. This cost may range from a few dollars per vehicle for an auditing type system to pull records of odometer readings from annual vehicle inspections to several hundred dollars per vehicle for the latest on-board technology. However, costs associated with on-board technologies are expected to diminish under economies of scale.[241]

Net savings depends on the amount of miles a driver reduces. For the average driver, a change in premiums is likely to be negligible if annual mileage remains constant. However, if the average driver reduces annual mileage, savings will be directly related to the number of miles reduced. The average driver in the Dallas-Fort Worth area travels 15,225 miles per year. If this driver were to reduce his or her annual mileage to 12,500 miles — an 18 percent reduction — annual savings would be about $688 when taking into account reduced insurance premiums ($205) as well as reduced fuel and maintenance costs ($347 and $136, respectively). [242] This will result in annual fuel savings of 135 gallons and 1.3 tons of CO_2 eliminated, based on an average fuel economy rating of 20.4 miles per gallon.[243]

Discussion

A mileage-based insurance option for Texas consumers reduces emissions and saves consumers money. Drivers still may opt to keep traditional insurance. Pay-as-you-drive policies consider the same risk factors as traditional insurance policies, including age, driving history and rural versus urban driving. Low-risk drivers will pay less per mile than high-risk drivers. Because the per-mile premium is assessed based on risk, a driver traveling 20,000 miles in rural areas may pay less than a person traveling 10,000 miles in an urban area, assuming all other factors are the same (**Exhibit 12**).

Exhibit 12
Cost Comparison – Rural vs. City Drivers

Type of Driver	Risk	Cost/Mile	Miles/Year	Insurance Cost/Year
Rural Driver	Low	$0.04	20,000	$800
City Driver	High	$0.11	10,000	$1,100

Source: North Central Texas County of Governments.

Insurance companies encouraging reductions in driving by offering mileage-based policies provide an uncompensated benefit to other insurance companies. Conversely when all insurance companies provide pay-as-you-drive products, all insurance companies mutually benefit.

Because of the large number of uninsured motorists in Texas, many drivers are faced with the financial burden of carrying uninsured/underinsured motorist insurance. This need is minimized by pay-as-you-drive strategies. Many low-income individuals are also low-mileage drivers. Under the current pricing structure, it is often too expensive for these drivers to obtain insurance coverage. By allowing low-mileage drivers to buy insurance on a per-mile basis, it may lead to more affordable insurance rates, reducing the number of uninsured drivers on the road and the cost of insurance for all Texas drivers.

Three insurance carriers offer mileage-based insurance in Texas, including Progressive, MileMeter and OnStar. [244] Progressive and OnStar use wireless on-board vehicle technology; MileMeter depends on self-reporting with periodic audits.

Savings

Mileage-based insurance generates potential savings compared to traditional insurance (**Exhibit 13**). With traditional insurance, the fewer miles one travels, the higher the cost of insurance per mile. Pay-as-you-drive reduces mileage, resulting in direct savings to drivers by reducing fuel costs. Per-mile insurance further rewards this behavior, bringing insurance costs in line with other vehicle operating expenses.

Some costs may be associated with developing mileage-based insurance policies, marketing new policy options, and installing tracking devices, software and infrastructure depending on the data collection method. Costly tracking devices may not be required as mileage data is already collected during annual safety inspections. As insurance companies move toward tracking driver behavior and other parameters besides mileage, devices may soon be a normal part of the insurance process. To meet “no regrets” standards, this strategy does not consider these policy administration costs.

The spike in oil prices in 2008 and the resulting decrease in miles traveled shows that drivers often modify their driving behavior when the price of operating a vehicle increases. The more fuel-efficient cars become, the less fuel prices will affect driver behavior. With the 2016 federal Corporate Average Fuel Economy standards, the amount of money spent on fuel will decrease by nearly 30 percent. [245] Mileage-based insurance acts as a continual incentive to decrease vehicle-miles traveled regardless of fuel prices and fuel economy, providing long-term savings.

While some high-mileage drivers may pay more for auto insurance under a mileage-based structure, the overall cost to consumers and insurance companies will decrease due to fewer claims. Drivers will have more control over the cost of operating a vehicle, and will save money by choosing to drive fewer miles.

Exhibit 13
Potential Cost Savings of PAYD vs. Traditional Insurance

	2010			
	15,225 Miles/Year		12,500 Miles/Year	
	Traditional Insurance	PAYD	Traditional Insurance	PAYD
Average Maintenance per year ($0.05/mi):	$761	$761	$625	$625
Traditional Insurance Costs ($90/mo):	$1,080	n/a	$1,080	n/a
PAYD Insurance Costs ($0.07/mi):	n/a	0.07	n/a	0.07
Cost of Fuel per Gallon:	$2.60	$2.60	$2.60	$2.60
Average Miles per Gallon:	20.4	20.4	20.4	20.4
Annual Fuel Costs:	$1,940	$1,940	$1,593	$1,593
Annual Insurance Cost:	$1,080	$1,066	$1,080	$875
Cost Per Mile (Fuel + Insurance + Maintenance):	0.25	0.25	0.26	0.25
TOTAL Costs Per Year	**$3,781**	**$3,767**	**$3,298**	**$3,093**
Savings		$14		$205
			$483	
				$688

Source: North Central Texas County of Governments.

Strategy: Tire Pressure Program

AT-A-GLANCE

- Consensus “no regrets” strategy
- Reduces carbon dioxide (CO_2) emissions
- Creates net savings of $230 million annually
- Improves road safety

Description

A strategy to require automotive service providers to check and inflate passenger vehicle tires during regular maintenance and servicing reduces greenhouse gas emissions and creates a net savings for consumers through improved fuel efficiency and vehicle performance. The California Air Resources Board (CARB) adopted a similar measure in February 2010 that became effective on Sept. 1, 2010.[246] While the proposed regulatory program qualifies as “no regrets,” alternative, non-regulatory programs may achieve some portion of the benefits can also qualify as “no regrets” with a reduced administrative burden.

Reduces greenhouse gases

This measure reduces CO_2 emissions by improving fuel efficiency for passenger vehicles. Proper tire inflation decreases tire-rolling resistance and reduces fuel consumption. Based on analysis by CARB, scaled to the population of Texas, this strategy will reduce CO_2 equivalent emissions by 0.4 million metric tons in 2020.[247]

A collateral benefit of this measure is small reductions in emissions of particulate matter and nitrogen oxides, helping Texas meet air quality standards. Properly inflated tires provide additional safety benefits for motorists, such as improved vehicle handling and fewer crashes from blowouts.

Creates net savings for consumers or businesses in Texas

A tire-inflation requirement for automotive service providers results in net savings for consumers by reducing fuel consumption and prolonging tire life. The California program anticipated additional costs to automotive service providers of no more than $4 per vehicle, per year, passed on to customers through increased service rates or environmental fees.[248] As a result of improved fuel efficiency and longer tire life, the measure will have a small affect on gasoline and tire sales. The number of tires entering the waste stream also will be reduced.

Reduces emissions without financial cost to consumers or businesses in Texas

The benefits of reduced emissions and improved fuel efficiency outweigh the tire service cost of no more than $4 per vehicle, per year, passed on to consumers by automotive service providers.[249]

Cost-benefit analysis

Initial, short-term capital costs for businesses and consumers that may result from the implementation of these strategies:

- Based on data from CARB, discussed below and adjusted to Texas based on population, the total labor, capital and operating costs to all automotive service providers for the period 2010 through 2020 was estimated to be $740 million (as calculated in 2008 dollars). On an annualized basis, the total cost is approximately $69 million (2008 dollars). These costs also include the cost of programming and record keeping applicable to all facilities.

Lifetime costs and savings:

- Based on a similar 2008 California program, adjusted for Texas, the net benefits to consumers total $230 million per year.[250]

Discussion

According to 2008 analysis by CARB, automotive service providers incur minor capital and operating costs for the required ANSI B40.1 Grade B specified tire-pressure gauges. These gauges cost approximately $25 each and have an estimated life expectancy of two years. Cost calculations assume most service providers purchase one tire gauge per service bay; larger operations incur slightly higher capital costs.[251]

> "Facilities also are required to have updated annual tire inflation reference manuals. These reference manuals list the recommended tire pressures for most model year vehicles, as well as load/inflation tables to determine proper pressure for non-original wheels/tires. The reference manual can be purchased for $50, with replacement every three years."
>
> "Upfront engineering costs for automotive service providers without compressed air lines are $100 per compressor per facility, or $150 for an average 1.5 compressors per facility. All facilities are expected to own compressors, so no additional capital expenditures related to compressor purchases are anticipated. The differential compressor operating costs are minor."[252]

The annualized cost to all facilities for initial and replacement tire gauges, tire inflation reference manuals and minor engineering is between $60 and $70 per facility, or $2.8 million per year.[253] For the estimated 38,000 to 41,000 automotive service providers in Texas, program costs for the period 2010 to 2020 are estimated at $31 million.[254]

To estimate labor costs, the CARB assumed no more than five additional minutes per vehicle are required for the tire pressure check and inflation service. The board also assumed a designated tire service specialist performs the tire service 50 percent of the time. Remaining checks are performed by the mechanic who services the vehicle. Based on 2008 California wage rates, the mean total compensation rate is $21.94 per hour. The resulting labor costs for tire service are $1.83 per vehicle, per visit. Total annual labor costs to check and service tires on all affected California registered vehicles is estimated at $98 million per year the period between 2010 to 2020.[255]

California passenger vehicles will consume about 15 billion gallons of fuel in 2010. The tire check and inflate program will create fuel savings from properly inflated vehicle tires of about 0.6 percent, or roughly 75 million gallons per year. The annual per- vehicle savings is $9, based on average fuel costs of $3.40 per gallon. The annual economic benefit for California is estimated at $250 million. For the period 2010 through 2020, the total economic benefit is $2.7 billion.[256]

The program also will prolong tire life by 1,600 to 7,800 miles for most vehicles. The program will reduce tire waste by 700,000 tires annually, or by a total of 7.8 million tires between 2010 and 2020. Vehicle owners in California will save $90 million in tire replacement costs annually, and $980 million dollars over the ten-year period.[257]

The total benefit to each California driver from fuel and tire savings is $12 per vehicle, per year, or $340 million statewide per year. Total savings from 2010 to 2020 is $3.7 billion.[258]

The costs and savings expected from the California program are detailed in **Exhibit 14.**[259] Texas values can be estimated by scaling the California values by 0.67, based on relative population size.

Exhibit 14
Costs and Benefits for Proposed Regulation

Estimated Total Costs for Proposed Regulation					
Period	**Labor Costs for All Facilities (2008 dollars)**	**Smog Check Centers Costs (2008 dollars)**	**Auto Service Providers Costs (2008 dollars)**	**Programming & Record keeping Costs (2008 dollars)**	**Total Cost of Regulation (2008 dollars)**
2010-2020	$1.1 billion	$1.4 million	$31 million	$25 million	$1.1 billion
Average Annual Costs	$98 million	$128,000	$2.8 million	$2.3 million	$103 million
Total Benefits of Proposed Regulation					
Year	**Total Annual Fuel Savings (gallons)**	**Annual savings from Reduced Fuel Consumption (2008 dollars)**	**Reduction in Annual Tire Waste Generation**	**Estimated Savings Due to Reduction in Premature Tread Wear (2008 dollars)**	**Total Annual Savings from Proposed Regulation (2008 dollars)**
2010	89,366,609	$272,713,886	756,996	$95,670,176	$368,384,061
2020	60,315,404	$222,004,073	667,783	$83,810,413	$305,815,086
Average Annual Savings	~75 million	~250 million	~700,000	$90 million	$340 million

Source: California Air Resources Board.

CATEGORY 1
ADDITIONAL RESOURCES

Community Infrastructure

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[246] California Air Resources Board," Tire Inflation Regulation," http://www.arb.ca.gov/regact/2009/tirepres09/tirepres09.htm. (Last visited October 1, 2010.)

[247] California Air Resources Board, *Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Proposed Regulation for Under Inflated Vehicle Tires* (February 2009), p. 21, http://www.arb.ca.gov/regact/2009/tirepres09/tireisor.pdf. (Last visited October 1, 2010.); U.S. Census Bureau, "Quick Facts," http://quickfacts.census.gov/qfd/index.html. (Last visited October 1, 2010.); and adjusted for Texas by Environmental Defense Fund based on population.

[248] California Air Resources Board, *Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Proposed Regulation for Under Inflated Vehicle Tires*, p. ES 3.

[249] California Air Resources Board, *Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Proposed Regulation for Under Inflated Vehicle Tires*, p. ES 3.

[250] California Air Resources Board, *Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Proposed Regulation for Under Inflated Vehicle Tires*, p. 32; and adjusted for Texas by Environmental Defense fund based on population.

[251] California Air Resources Board, *Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Proposed Regulation for Under Inflated Vehicle Tires*, p. 23.
[252] California Air Resources Board, *Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Proposed Regulation for Under Inflated Vehicle Tires*, p. 31.
[253] California Air Resources Board, *Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Proposed Regulation for Under Inflated Vehicle Tires*, p. 31.
[254] Environmental Defense Fund estimate based on the number of automotive service providers in Texas.
[255] California Air Resources Board, *Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Proposed Regulation for Under Inflated Vehicle Tires*, p. 30.
[256] California Air Resources Board, *Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Proposed Regulation for Under Inflated Vehicle Tires*, p. ES-3-4.
[257] California Air Resources Board, *Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Proposed Regulation for Under Inflated Vehicle Tires*, p. ES-4.
[258] California Air Resources Board, *Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Proposed Regulation for Under Inflated Vehicle Tires*, p. ES-4.
[259] California Air Resources Board, *Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Proposed Regulation for Under Inflated Vehicle Tires*, p. 32 and 39.

CATEGORY 2 STRATEGIES

Category 2 includes strategies supported by information that could qualify them as "no regrets" strategies but for which there was disagreement within the workgroups. All analyses were provided by the workgroups. Workgroup members who submitted comments supporting these strategies as ones that do not qualify as "no regrets" are identified in the report.

EMISSION REDUCTION TARGETS

Strategies: Electricity Reduction Program
Utility Energy Efficiency Program
Energy Efficiency Goals for Investor-Owned Utilities

Description

The first of three related strategies to reduce greenhouse gas emissions discussed here, an electricity reduction program, proposes an increase in statewide energy efficiency goals similar to the program already in place, but with further cost-effective deployment. The second measure, a utility energy efficiency program, addresses a subset of the market and can be adopted as a part of the statewide program or as its own measure. The third strategy affects another subset, investor-owned utilities, and is similar to the current energy efficiency program, but with changes to its structure.[1]

No consensus was reached on whether these strategies meet the "no regrets" standards.

Analyses from McKinsey & Company, the California Air Resources Board (CARB) and iTron indicate substantial potential exists within Texas for more cost-effective energy efficiency goals. In fact, two municipal utilities have achieved energy efficiency goals exceeding the standard for the entire state – Austin Energy (600 MW by 2003) and San Antonio City Public Service (142 MW in 2008 and 2009).[2] Those goals are met through energy efficiency measures required to meet avoided cost standards.

Overall costs and carbon dioxide (CO_2) equivalent impacts are discussed below in the context of the first strategy, a statewide electricity reduction program, due to the lack of available and discrete data needed to avoid double counting. However, the costs and savings apply to each strategy in a roughly proportional fashion; consideration of the combined measures relates directly to consideration of the measures separately.

Analysis supporting the strategy as "no regrets"

Reduces greenhouse gases

The three strategies in aggregate can reduce CO_2 emissions by reducing the consumption of electricity in Texas. Based on CARB analysis, scaled for Texas, the three strategies potentially could reduce emissions by roughly 10.3 million metric tons of CO_2 equivalents in 2020. [3] This is for the one overarching measure, Electricity Reduction Program. The other measures in this proposal are for more limited sectors of the utility industry and a smaller portion of the total gains. A collateral benefit could be a small reduction in emissions of particulate matter and nitrogen oxides, contributing to attainment of air quality standards in Texas.

Creates net savings for consumers or businesses in Texas

A statewide electricity reduction program results in net potential savings for businesses and residents in the state due to decreased fuel consumption and increased boiler performance. There are potential upfront costs to businesses and customers; however, the total net impact of the strategy could reduce energy costs by $1.1 billion annually based on Environmental Defense Fund calculations.[4]

Cost-benefit analysis

Analysis by CARB of a similar program in California estimated a net savings of $1.7 billion annually. Adjusted for Texas, potential total savings are estimated at $3.4 billion, with net savings of $1.1 billion annually. Annualized costs are estimated to be $2.2 billion annually, adjusted for Texas.[5]

A study from iTron commissioned by the Public Utility Commission of Texas (PUC) found potential annual electricity savings of 20 to 25 percent in the residential sector, 20 percent in the commercial sector and 11 percent in the industrial sector. These potential savings include only those efficiency measures that are cost effective using iTron's cost thresholds. Additionally, iTron found average annual revenue impacts to be approximately half of the average potential annual bill savings in both high- and low-rate scenarios.[6]

Analysis supporting the strategy as one that does not qualify as "no regrets"

Comments from the Texas Association of Manufacturers

The electricity reduction strategy discussed above lacks sufficient definition to qualify as "no regrets." There are no specifics to allow calculation of either costs or benefits.

To the extent that all three strategies involve mandates for increased energy efficiency, these do not qualify as "no regrets" strategies. The very nature of a mandate is that its costs cannot be overcome through the normal economic calculus.

Using energy more efficiently does not necessarily mean using less electricity overall. A key goal of any economy is growth. In general, economic growth requires growth in energy usage. As an economy produces more goods and services, it uses more energy. Likewise, as an economy creates more jobs, necessitating growth in work force, energy usage increases. Accordingly, any strategies to reduce electricity usage should not be undertaken in a manner that thwarts economic or job growth.

There are no barriers today to customer-initiated energy efficiency measures; numerous private companies already market energy efficiency measures. To the extent that a project or measure has benefits in efficiency and emissions outweighing its costs, customers are able to implement those strategies. Mandates invariably harm certain companies not offering the preferred efficiency programs, as their competitors are subsidized through the mandated program based on some administrative determination. This market harm is almost never factored in to the evaluation of these programs. Moreover, mandates often take dollars away from more beneficial efficiency measures. The mandates are measured in yearly reductions to demand growth, but significant projects often have 5-, 10- or even 20-year paybacks; they reduce energy usage over the long-term. Mandates tend to discourage these longer-term investments despite the fact they are often more efficient. Requiring companies to fund energy efficiency measures for other companies reduces the dollars available for their own investments, which often results in higher costs and less overall energy efficiency. Accordingly, a mandate-based program does not meet "no regrets" standards.

Regulated utilities currently offer energy efficiency options in addition to those offered by the market. The case for expanding utility-based efficiency programs is questionable. The cited iTron report relies on outdated energy cost data to justify program expansion. In the recent PUC rulemaking on energy efficiency expansion, the PUC recognized that certain years, out of step with current energy costs, should not be used to justify energy efficiency investments.[7]

While all customers eligible for energy efficiency measures pay for the programs, not all can take advantage. This means, for most customers, the implementation of these mandates is not a "no regrets" strategy; paying customers who do not receive the efficiency subsidies regret these strategies very much. This is borne out by the fact that virtually all the ratepayer groups active in the current PUC project to amend energy efficiency goals oppose the expansion of these programs.

In the final analysis, mandates for energy efficiency do not meet "no regrets" standards. The measures interfere with the market, where providers and customers themselves decide what measures make sense for them. The measures then are implemented only when the costs to the customer in real dollars are outweighed by the economic, environmental and social benefits as calculated by the customer.

Strategy: Implementation of the 500 Megawatt Non-Wind Renewable Portfolio Standard

Description

This strategy recommends implementation of a 500-megawatt non-wind renewable portfolio standard to reduce carbon dioxide (CO_2) emissions, reduce energy costs for consumers and create jobs and new industry potentials for Texas.

No consensus was reached on whether this strategy meets the "no regrets" standards.

Senate Bill 20, passed by the Texas Legislature and signed by the Governor in 2005, increases the state's goal for renewable energy.[8] That law, and subsequent decisions by the Public Utility Commission of Texas (PUC) enabling investment in transmission lines, has played a key role in the development of wind power in Texas. Senate Bill 20 also included a target, not yet implemented, to develop 500 megawatts of non-wind renewable energy technologies by 2015. PUC staff recently proposed amendments to Commission rules that would create additional incentives to help promote development of solar and other emerging, non-wind renewable technologies.[9]

Texas has vast untapped reserves of solar, biomass and geothermal energy. By expeditiously developing these clean resources, the state can maintain its status as a worldwide energy leader and help protect the environment. Implementing the PUC rule is an important first step toward this goal, making Texas more competitive in attracting renewable energy manufacturers to the state. It also could help the dozens of renewable energy companies and suppliers already located in the state by creating jobs and boosting the Texas economy.

Analysis supporting the strategy as "no regrets"

Though consensus has not been reached on whether the strategy qualifies as "no regrets," proponents argue the strategy can lead to net benefits for ratepayers, given the likelihood of higher costs for fossil fuel-generated electricity under new U.S. Environmental Protection Agency rules regulating greenhouse gas emissions.

Assuming 500 megawatts of non-wind renewable energy results from the PUC rule, and that capacity runs at 50 percent, 2.2 million MWh (MWh) of electricity would be generated from non-wind renewable energy sources in 2015. Texas electricity producers sold 405 million MWh of electricity in 2007, producing 255 million metric tons of CO_2; 2.2 million MWh of renewable energy would reduce emissions by an estimated 1.25 million metric tons.

Non-wind renewable energy facilities, such as solar energy, do not produce CO_2 emissions, while other non-wind renewable resources, such as biomass, are carbon neutral. Depending upon the growth in electricity demand, these resources may reduce demand on existing natural gas and coal facilities.

Creates net savings for consumers or businesses in Texas

Developing 500 MWh of non-wind renewables would help reduce wholesale electricity prices by decreasing reliance on natural gas. According to the PUC in its 2009 Scope of Competition report, the Independent Market Monitor for the Electric Reliability Council of Texas (ERCOT) found that wind generation has had the effect of reducing wholesale and retail prices of electricity, and that for each additional 1,000 megawatts of wind produced during certain intervals in the first 10 months of 2008, the average price of balancing energy in the ERCOT market fell by $2.38.[10]

According to a study by General Electric International, Inc., the existing renewable portfolio standard for wind already has reduced costs for Texas consumers.[11] The creation of new energy sources will further reduce costs for Texas consumers.

The cost to implement a portfolio standard is based on the requirement for retail electric providers and certain electric utilities to purchase renewable energy credits produced by the renewable resource generators. Retail providers and utilities would pass these costs on to their customers. Assuming the maximum allowable cost of a credit is $100 per megawatt-hour, the full cost of 500 megawatts at a 50 percent capacity factor is estimated to be $220 million, leading to approximately $22 dollars in extra electricity costs, or about $2 per month, to pay for this development. However, the actual price for renewable energy credits is determined in the marketplace based on the relative supply and demand. Experience with wind energy in Texas shows the price of credits has declined significantly over time as wind technology costs have decreased and wind energy supply has increased.

Exhibit 15

Average Monthly Bill Impact from Renewables Programs

Emerging Renewables Goal	**Residential**	**Commercial**	**Industrial**
Highest Possible Cost	$0.76	$3.83	$31.43
Projected Cost (costs decline as technology improves)	$0.42	$2.12	$17.45
Projected Cost if U.S. Adopts CO_2 Cap	$0.20	$1.00	$8.22

Source: Environmental Defense Fund.

The development of 500 megawatts of non-wind renewables would create local jobs in construction and maintenance and potentially will produce manufacturing jobs. By actively moving toward solar power, the University of Texas' IC^2 Institute estimates Texas can generate 123,000 new high-wage, technology-related, advanced manufacturing and electrical services jobs by 2020.[12]

If Texas does not open a market for solar and other new technologies, it will miss out on the development of these resources, as companies will choose to go to other states. By setting a reasonable target, such as 500 megawatts by 2015, Texas will open up a new industry. In 2005, the Texas Legislature set a goal that the installed renewable generation capacity in the state shall total 5,880 megawatts by Jan. 1, 2015; however, wind alone has exceeded that target by more than 3,000 megawatts. A small non-wind renewable portfolio standard mandate can create a much bigger industry. Texas companies also can directly manufacture some of the products going into these new power plants.

<u>Analysis supporting the strategy as one that does not qualify as "no regrets"</u>

Comments from the Texas Association of Manufacturers

The 500-megawatt non-wind renewable portfolio standard does not qualify as a "no regrets" strategy.

A straw man 500-megawatt non-wind renewable portfolio standard rule PUC released for comment in January 2010 included alternative compliance payments set at $100 for a Tier 1 renewable energy credits and $40 for Tier 2 credits.[13] An analysis of that straw man proposal estimates that the cost to consumers would be an additional $1.1 billion in the first 10 years.[14]

In response to renewable generation companies complaining that the alternative compliance payments were not high enough to result in the installation of non-wind generation, the current draft rule raised those amounts. The new alternative compliance payments included in a draft proposal $120 and $60 respectively. A study by J.Pollock, Inc. estimates the cost to comply with the revised non-wind renewable portfolio standard proposal in this strategy would be approximately $1.78 billion in the first 10 years.[15]

Mandates such as this one interfere with the market and the ability of companies to make cost-effective investments in other emissions reduction strategies. Given the alternative compliance payment structure, the new portfolio standards may not result in any non-wind renewable energy generation. Given that multiple federal bills have capped carbon prices at between $10 and $20, under no circumstances will a renewable energy credit costing between $40 and $120 constitute a "no regrets" emissions reduction strategy. Further, there are serious questions as to the effectiveness of a renewable portfolio standard in reducing emissions as reported in a recent study by BENTEK Energy, LLC.[16]

To the extent these mandates result in additional biomass installations, those subsidized installations will compete for fuel with current installations, possibly rendering current investments uneconomic. These new subsidized facilities also will compete with other uses for wood waste, further harming certain manufacturers.

Strategy: Industrial-Sector Energy Efficiency

Description

This strategy to reduce greenhouse gas emissions incorporates a number of measures addressing industrial-sector energy efficiency, including:

- promoting energy management practices;
- providing energy assessment and training tools;
- offering monetary incentives; and
- establishing efficiency targets or equipment standards.

Two recent reports point to these approaches as keys to developing cost-effective energy efficiency in the industrial sector.[17] According to the Environmental Defense Fund (EDF), monetary incentives and energy efficiency targets have been applied successfully to other sectors of the Texas economy such as the residential and commercial sector. This suggests that opportunities for reducing emissions and saving money in the Texas industrial sector are rich as well.[18]

No consensus was reached on whether this strategy meets the "no regrets" standards.

Analysis supporting the strategy as "no regrets"

Reduces greenhouse gases

Improving industrial-sector energy efficiency reduces carbon dioxide (CO_2) emissions by decreasing consumption of fuel and electricity in industrial processes. Based on a CARB analysis, scaled to the state gross domestic product of Texas, this strategy is estimated to have the potential to reduce CO_2 equivalent emissions by roughly 2.9 million metric tons in 2020. A collateral benefit could be a small reduction in emissions of particulate matter and nitrogen oxides (NO_x), helping attain air quality standards.

Creates net savings for consumers or businesses in Texas

An industrial-sector energy efficiency strategy could result in net savings for businesses benefiting from reduced fuel consumption and increased boiler performance. While there could be additional costs to businesses in the state, EDF calculations indicate that those costs are far outweighed by the savings, which EDF estimates to be $3.4 billion annually.[19]

Cost-benefit analysis

Although industry continues to improve efficiency in some facilities, these measures have the potential to substantially improve both efficiency and greenhouse gas avoidance in Texas. Two recent studies show the focus of large industry on quarterly and near-term profits comes at the expense of long-term gains in efficiency.[20] Despite substantial potential savings, accounting methodologies and corporate structures used by industry may have the unintended consequence of masking those potential savings.

A study by McKinsey & Company reported industrial-sector efficiency projects suffer from a lack of senior management awareness and attention. The industrial sector faces an elevated hurdle as a result of processes that separate operations and maintenance budgets from capital improvement budgets; costs for projects reside in a different budget than the offsetting benefits. A survey in the study shows 43 percent of industrial-sector energy managers indicate a payback period of less than three years is needed for efficiency projects. Under difficult economic conditions, this may shrink to 18 months. Requiring a 2.5-year payback reduces identified potential in the industrial sector by 46 percent. McKinsey projects that if it takes full advantage of positive net present value energy efficiency opportunities, the industrial sector could save 18 percent of its forecast energy consumption in 2020.[21]

Savings for this strategy are calculated by EDF using McKinsey & Company data. Capturing this potential will cost an estimated $1.2 billion annually. Present value savings of $4.7 billion annually result in a net savings of $3.4 billion annually.[22]

Strategies to capture this potential

- "Promoting energy management practices (proven/piloted) – The studies show that strong company-wide energy management practices supported by part-time or full-time on-site energy managers achieve greater energy efficiency. Energy managers play a decisive role in capturing 1,730 trillion end-use Btus of energy potential, 47 percent of the potential in these clusters or 8 percent of total end-use consumption. This potential is captured by implementing process and support system measures, such as improving monitoring and control, improving operating practices and assuring timely repair and regular maintenance. Implementing these measures could require an estimated $39 billion of upfront investment. This strategy directly addresses the awareness and attention of product availability barriers by giving primary responsibility to an individual or group. As of 2002, fewer than 2 percent of facilities had on-site energy managers, despite the clear example of companies reducing energy costs between 20 and 30 percent through effective energy management. The ENERGY STAR® Partnership focuses on helping industrial companies develop and refine corporate energy management programs through guidelines that include assessment, benchmarking, energy management planning and progress evaluation. Plant certifications, similar to U.S. Occupational Safety and Health Administration programs, encourage adoption."[23]

- "Providing energy assessment and training tools (proven/piloted) – Subsidized assessments and distribution of training materials can increase awareness of energy-saving opportunities. The U.S. Department of Energy's industrial technology program Save Energy Now represents a national initiative to drive a 25 percent reduction in industrial energy intensity in 10 years. It already has helped 2,100 manufacturing facilities save an average of 8 percent of total energy costs through 200 assessments of steam systems and process heat systems across 40 sites in 2006, 257 in 2007 and 301 in 2008. More than 90 percent of participants found assessments play an influential or highly influential role in energy-saving project implementation. Assessing a single establishment costs approximately $10,000, including two full-time equivalent weeks. The ENERGY STAR® Industrial Partnership, through the Lawrence Berkeley National Laboratory and other organizations, offers subsector- and technology-focused guidebooks highlighting operations best practices and provides tools for conducting energy saving assessments."[24]

- "Monetary incentives (piloted/emerging) – Monetary incentives can address capital allocation and availability concerns, shorten payback times and help overcome product availability barriers by reducing procurement challenges."

- "Establishing efficiency targets or equipment standards (piloted/emerging) – Agreements tailored to a subsector help raise awareness of energy efficiency among top management in the industrial sector. Such agreements can increase capital allocations, lengthen allowed payback times, build awareness at the line level and increase product availability as management drives the organization to meet targets. Voluntary agreements include industry covenants, negotiated and long-term agreements, codes of conduct, benchmarking and monitoring schemes."[25]

Analysis supporting the strategy as one that does not qualify as "no regrets"

Comments from the Texas Association of Manufacturers and Texas Oil and Gas Association

This strategy lacks sufficient specificity to be considered as meeting "no regrets" standards; potential costs and benefits cannot be calculated.

Industry has every incentive to implement cost-effective energy efficiency strategies necessary to maintain global competitiveness and to control energy costs, often the single largest cost of manufacturing. Energy efficiency mandates disrupt the efficient deployment of these technologies, often requiring piecemeal efficiency measures that are far less effective than measures that companies implement themselves. In addition, subsidies for energy efficiency cause energy prices to rise, harming manufacturing and production, stunting job creation and economic growth.

Studies conducted to justify increased mandates for industrial efficiency often are based on administrative determinations of costs and benefits. Companies operating in the real world have a better sense of the complexity inherent in these calculations. If a project can return real benefits in excess of its costs, it will be implemented; there is no barrier to these types of installations.

Both the CARB and McKinsey studies are flawed. For example, the December 2008 CARB Scoping Plan assumptions, economic analysis and accompanying appendices were found to be deficient by the CARB Economic and Allocation Advisory Committee. With public input, an updated scoping plan and economic analysis was published in March 2010. A strategy based on data, assumptions or economic analysis in the December 2008 plan is inaccurate. The McKinsey study suffers from equally flawed assumptions.[26]

Mandates for combined heat and power create similar problems. These mandates often are accompanied by a credit and trading program, adding inordinate costs to large energy users such as manufacturers. Forcing combined heat and power installations invariably takes dollars away from more efficient investments that companies make to lower energy costs and enhance competitiveness.

To the extent this strategy for industrial sector energy efficiency contemplates mandates and forced subsidies, it does not qualify as a “no regrets” strategy.

Strategy: Natural Gas Reduction (Efficiency) Programs

Description

To decrease greenhouse gas emissions, this strategy recommends reductions in natural gas use through improved efficiency. A simple, outright reduction in natural gas use does not meet “no regrets” standards. It negatively affects in-state natural gas producers and natural gas utility sales volumes while potentially increasing the use of dirtier energy sources, such as coal. On the other hand, efficiency implies waste is minimized in the combustion and delivery of natural gas, a relatively clean-burning fossil fuel. Long-term natural gas supply availability will comprise a large percentage of statewide base-load electricity generation with projected long-term price stability for consumers. Natural gas inefficiency results from unused or uneconomic heat wasted upon release into the environment. Wasted heat results from inefficiencies in commercial and residential natural gas appliances and from the failure to capture and reuse waste heat as thermal energy at the generation site.

No consensus was reached on whether this strategy meets the “no regrets” standards.

Workgroup A contentions, no consensus:

- Utilities will only support natural gas energy efficiency programs if revenue loss is offset by revenue recovery mechanisms.
- Revenue recovery programs funded through customer surcharges violate the “no regrets” standard of avoiding cost increases for any stakeholder group.

Workgroup B contentions, no consensus:

- Natural gas efficiency programs qualify as "no regrets" by delivering economic benefits to suppliers and end-users, and by delivering environmental benefits to society.

- Inevitably, utilities must shift from a commodities-based business model to an energy services business model.

- The conventional utility business model does not preclude long-term goals of improved energy efficiency and reduced environmental impacts. Energy efficiency programs do not necessarily require revenue recovery to become profitable. Regulated entities, other stakeholders and regulators weigh many issues in developing policies to suit overarching, long-term goals. Regulatory agencies are equipped to address funding issues when efficiency programs are implemented. Concerns about revenue recovery for utilities need not preclude all gas efficiency programs from being considered "no regrets." Nonprofit and private resources also are available to help utilities, retailers and other energy service providers understand and manage these changes. Combined heat and power is an example of natural gas efficiency that arguably meets "no regrets" criteria. The estimated savings potential of combined heat and power in Texas is 13,400 megawatts by 2023, significantly reducing greenhouse gas emissions and costs to consumers while providing natural gas utilities with new revenue sources. [27] Natural gas utilities adopting energy efficiencies move the industry to bundled services offerings consistent with a 21st century energy network industry.

Analysis supporting the strategy as "no regrets"

Reduces greenhouse gases

A similar gas efficiency program proposed in 2008 by the California Air Resources Board (CARB) estimated reductions in carbon dioxide (CO_2) equivalent emissions at 4.3 million metric tons annually in 2020. Adjusted for Texas, the estimated reduction is 2.9 million metric tons annually. [28]

Creates net savings for consumers or businesses in Texas

A CARB analysis estimates that natural gas efficiency generates a net savings of $470 million annually. Adjusted for Texas, the potential net savings are estimated to be $317 million annually. Annualized short-term capital costs are estimated at $963 million for California and $649 million when adjusted for Texas. Estimate lifetime costs in California are $1.43 billion by 2020. Adjusted for Texas, this figure is $966 million.[29]

Cost-benefit analysis

In most cases, more efficient use of existing energy resources is more economical than new infrastructure construction to produce and distribute greater quantities of energy.[30]

Any conservation and energy efficiency program enacted in the state can be designed to distribute the economic benefits to all stakeholders. The gas efficiency resource standard being considered by the Railroad Commission of Texas can be modeled after the state's successful renewable portfolio standard.[31]

A gas efficiency resource standard has the potential to have a greater impact with lower costs than a centrally administered program such as the Energy Efficiency Incentive Program. A Texas gas efficiency program can generate tradable energy efficiency credits for each million Btu saved by an investment in allowable gas efficiency measures. For adopters of energy efficiency technologies, the sale of efficiency credits to natural gas distribution companies produces a project incentive equal to the market clearing price. Requiring natural gas distribution companies to seek efficiency savings can stimulate natural gas conservation and efficiency while allowing the market to choose the best technologies to accomplish the goal.

A gas efficiency program also can be designed to stimulate investments in waste heat reduction and recovery technologies, including high-efficiency boilers, improved water heaters and more efficient heating and cooking appliances. The program can encourage recovery of waste heat produced by large natural gas engines at pipeline compressor stations, water pumping stations, combined heat and power installations, inefficient industrial processes and inefficient power plants.

Analysis supporting the strategy as one that does not qualify as “no regrets”

Comments from the Texas Oil and Gas Association and the Texas Association of Manufacturers

This strategy includes a comprehensive commitment to reduce the use of natural gas across the state. This includes new standards for buildings such as using green energy or building to zero energy, employing passive solar design, using solar energy, applying more stringent appliance energy standards and other measures. Goals would be achieved through voluntary options with incentives and mandatory standards. In this strategy, utility providers would be required to implement energy efficiency improvements; new homes would be required to have an energy use monitor and display.

This strategy does not qualify as “no regrets.” Projected reductions of greenhouse gas emissions are based on assumed energy savings and switching to green energy sources. Investments to meet new higher energy standards and retrofit existing structures will come at a high cost with no assurance of a net savings as compared with today’s standards. The strategy and referenced materials only provide assumed net savings information based on predicted energy savings. Costs for actual items or systems are not provided. The December 2008 CARB Scoping Plan assumptions, economic analysis and accompanying appendices are deficient, as found by the California Air Resources Board’s own Economic and Allocation Advisory Committee. With public input, the board published an updated plan and economic analysis in March 2010. Any data, assumptions and economic analysis based on the 2008 scoping plan and accompanying appendices is inaccurate.[32]

Comments from the Texas Pipeline Association

The proposed natural gas reduction strategy lacks the details necessary to qualify it as “no regrets.” Natural gas is a preferred fuel and is the cleanest burning fossil fuel used for power generation today. If used to make electricity, natural gas produces 40 to 50 percent fewer emissions than other fossil fuels.[33] As the demand for energy increases, use of natural gas, instead of more polluting energy sources, can help improve air quality across Texas.

Though entitled Natural Gas Reduction Programs, the proposal's language describes the strategy as a "measure [that] would reduce greenhouse gas emissions by increasing statewide energy efficiency for natural gas beyond current demand projections." As originally proposed, the strategy uses the terms "reduction" and "efficiency" interchangeably. A strategy aimed at reducing the use of natural gas across the state is quite distinct from a strategy aimed at minimizing the amount of waste in the combustion and delivery of natural gas. Adding to this confusion, the proposal fails to provide any tangible strategies qualifying as "no regrets," whether natural gas reduction or natural gas efficiency strategies. It is difficult to understand exactly what the strategy entails, much less perform an economic analysis to determine if it meets "no regrets" standards.

On top of a failure to distinguish reduction from efficiency, and a failure to identify actual strategies, the estimated savings to Texas of $317 million annually are not supported by any economic analysis. Estimates of short-term capital costs, lifetime savings and potential reductions in CO_2 equivalent emission in Texas are included as overall benefits from this strategy based on the 2008 CARB; however, the underlying assumptions used in the calculation and the methods used to adjust the figures for Texas are not provided.

OIL AND GAS REFINERY AND FUELS

Strategies: Greenhouse Gas Leak Reduction from Oil and Gas Transmission
Reduce Methane Emissions from the Exploration and Production of Oil and Gas

Description

This combined strategy would require, under suitable circumstances, technologies or practices to reduce methane emissions from common sources involved in upstream and midstream oil and gas activities (i.e., exploration/production and transmission).

No consensus has been reached on whether the combined strategies meet "no regrets" standards.

Analysis supporting the strategies as "no regrets"

Methane is a potent greenhouse gas and the second-largest contributor to climate change after carbon dioxide (CO_2). Methane has a warming potential 25 times that of CO_2 over a 100-year period. In addition to climate impact, methane emissions contribute to higher global background levels of ozone pollution.[34] Of particular interest in Texas, the myriad of reactive organic gases often co-emitted with methane can lead to local and regional increases in ozone levels. This strategy principally consists of "changing operating practices while taking compressors off-line," which accounts for almost all of the estimated emissions reduction attributed to the strategy.[35]

Reducing methane emissions from select sources in upstream and midstream oil and gas service would require, under suitable circumstances, the use of a limited number of proven technologies or practices already developed, tested and promoted by oil and gas companies and service providers in coordination with the U.S. Environmental Protection Agency (EPA) through the Natural Gas STAR Program. The measures have been selected because of the simple payback periods of 24 months or less as reported by partners to the Natural Gas STAR program.[36]

The recommended technologies and practices include:

- replacing or retrofitting high-bleed pneumatics with low- or no-bleed components;
- replacing gas in pneumatic devices with air;
- employing "green" or reduced emissions well completions;
- using well automation, including plunger lifts, to reduce well unloading methane emissions;
- optimizing glycol circulation rates on glycol dehydrators;
- replacing glycol dehydrator with desiccant dehydrator;
- using pipeline pump-down techniques to lower gas line pressure before maintenance;
- requiring directed inspection and maintenance programs at compressor stations;
- using vapor recovery units on condensate and crude oil storage tanks;
- installing certain automatic gas valves on heater treaters, dehydrator reboilers and process heaters;
- replacing compressor rod packing on reciprocating compressors or wet seals on centrifugal compressors;

- reducing emissions when taking compressors off-line by keeping compressors pressurized, pressurized and routing gas to fuel gas systems, or pressurized and installing static seal;
- routing wet seal oil venting to a low-pressure system;
- replacing gas-assisted glycol pumps with electric pumps;
- using composite wrap for non-leaking pipeline defects; and
- installing flash tanks on dehydrators. [37]

By requiring the techniques above, only when site-specific circumstances result in a simple payback of less than 24 months, this measure ensures that only the most cost-effective reductions are made at facilities with the greatest opportunity to reap the benefits. For example, the criteria to determine whether installing a vapor recovery unit meets the payback test include: current and projected venting rates, composition and Btu content of vent gas, market value of the recovered gas and liquids and capital and operating cost of the equipment. A simple look-up table can help identify situations when installation of the equipment leads to simple paybacks of less than 24 months. Because controls or practices are required only when a simple payback of 24 months or less is achieved, the strategy qualifies as “no regrets.”

<u>Reduces greenhouse gas emissions</u>

The Railroad Commission of Texas reports total natural gas production in Texas was 7.3 trillion cubic feet in 2008.[38] The Environmental Defense Fund (EDF) projects methane lost during production is 1 percent of the total volume of natural gas sold, or 73 billion cubic feet in 2008.[39] The Texas Commission on Environmental Quality (TCEQ) estimates methane emissions from storage tanks used in crude oil production at 5 billion cubic feet.[40] Other aspects of oil production also may result in methane emissions but are not included in the strategy calculations. Combining emissions from natural gas exploration and production with crude oil storage tanks yields estimated total methane emissions in Texas in 2008 of 78 billion cubic feet, or 1.5 million metric tons of methane. Converting this estimate to equivalent tons of CO_2 equals an emissions estimate of 37 million metric tons. Using the recommended technologies or practices could potentially reduce these emissions by 30 percent over the next 10 years, an achievable target for Texas resulting in annual CO_2 equivalent emissions reductions of an estimated 11 million metric tons.[41]

<u>Creates net savings for consumers or businesses in Texas</u>

This combined strategy could result in net savings for Texas businesses. Consumers who are royalty owners may see increased payments from the implementation of this measure. For other consumers in the state, there is no direct effect. There may, however, be indirect benefits from the moderating effect on natural gas prices due to additional gas delivered to pipelines and the increased state revenues from royalties and severance tax payments.

A recent study estimates methane losses during well completions, production, processing and transmission in the Barnett Shale alone at 13 billion cubic feet annually, or about 1 percent of total gas production.[42] At $5 per thousand cubic feet, this totals $65 million per year in potential lost revenue for producers and $4.9 million in potential lost severance tax payments to Texas. The Barnett Shale represents about 25 percent of statewide production; the projected losses in revenue and tax would be much larger if all natural gas production in Texas was considered, as well as natural gas associated with oil production. Assuming a 30 percent reduction from baseline methane emissions of 78 billion cubic feet, total savings or revenues for producers could reach an estimated $117 million per year at a natural gas price of $5 per thousand cubic feet. Because only measures with simple paybacks of 24 months — or less — would be required, savings would exceed costs in less than two years. Thereafter, producers would continue to accrue the revenues from increased gas sales.

Cost-benefit analysis

By recommending certain technologies for site-specific circumstances leading to a simple payback of 24-months or less, this combined strategy qualifies as "no regrets."

The following information on some of the technologies referenced above illustrates the broad potential for economic and environmental benefits in Texas.

- Reduced Emissions Well Completions

  Devon Energy, the largest producer in the Barnett Shale, won several awards from the Natural Gas STAR program for its work to reduce methane emissions using similar practices. A representative from Devon told the Texas Senate Committee on Natural Resources during a Sept. 9, 2008, interim hearing that it had captured 10.7 billion cubic feet of gas since 2004 by employing reduced emission completions. Across all production operations, using reduced emission completions and other technologies, Devon claims it prevented more than 6.4 billion cubic feet of methane from being released in 2007 alone, generating an additional $38 million in revenue from increased sales of natural gas.[43] Between 1990 and 2008, Devon reports total natural gas savings of 42 billion cubic feet with a value of approximately $125 million.[44]

  A Colorado cost-benefit analysis cites a presentation at the 2007 Natural Gas STAR Production Technology Transfer Workshop that included cost information associated with green completions conducted in the Piceance Basin from 2002 through 2006. The average methane recovery cost was $17.41 million. The average total revenue was $159.13 million. For every dollar spent on green completions, a payback of $9.14 was received.[45]

- Vapor Recovery Units for Storage Tanks

  Storage tanks are a promising source category for methane reduction "no regrets" technologies. The TCEQ estimated methane emissions in 2008 from oil and gas production storage tanks in Texas were 5.3 billion cubic feet for crude oil production and 3 billion cubic feet for condensate production. Two other Texas studies of the amount of gas vented from oil and condensate tanks measured site-specific values as high as 150 thousand cubic feet per day.[46]

  A TCEQ report presented at an oil and gas workshop provided a case study for capturing emissions. A storage tank battery in North Texas released 190 million cubic feet per day of methane, with a heat content of 2,400 Btu, or 2.4 times higher than standard natural gas. Capturing the gas could result in an extra $68,000 per month, assuming a natural gas price of $5 per thousand cubic feet, adjusted for the higher heat content of the captured vent gas. In this case, the simple payback period for a $32,000 vapor recovery unit is 14 days.[47] Some vapor recovery technology vendors also offer alternative financing options to the outright purchase of the equipment, including providing the equipment at no up-front cost in return for a share of the recovered product.

- Replace or Retrofit Pneumatics

  Pneumatic devices powered by pressurized natural gas are widely used in the industry as liquid level controllers, pressure regulators and valve controllers. Methane emissions from pneumatic devices, estimated at 51 billion cubic feet per year in the production sector, are one of the largest sources of vented methane emissions from the natural gas industry. Reducing these emissions by replacing high-bleed devices with low-bleed devices, retrofitting high-bleed devices and improving maintenance practices can be profitable. According to the EPA, replacing a high-bleed pneumatic device with a low-bleed device can yield annual savings of more than $1,000 with payback periods ranging from one to 14 months.[48]

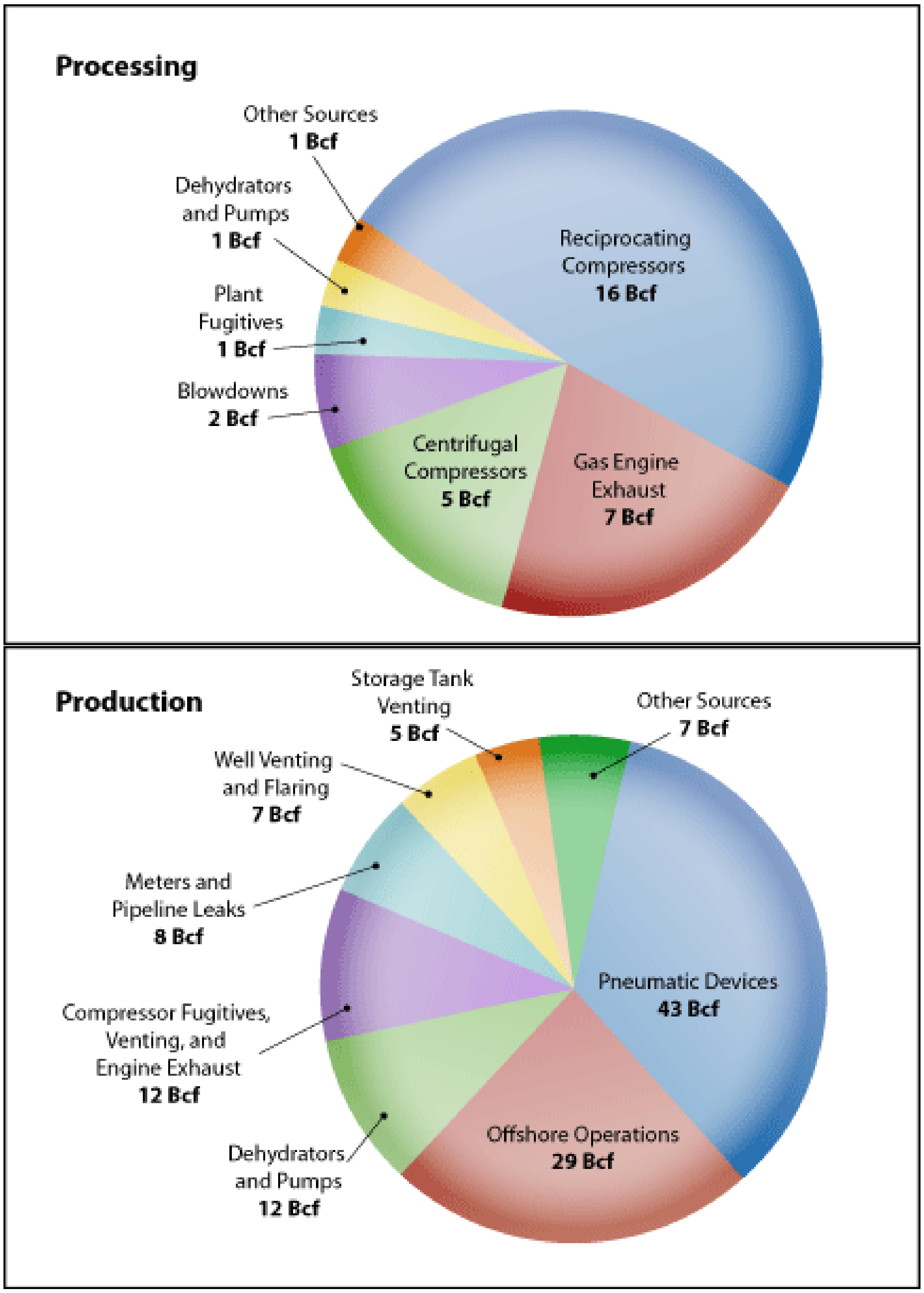
The proposed methane reduction technologies and practices, in addition to creating valuable revenues for producers, may also result in two other important benefits. The state would receive increased revenues from natural gas production taxes and/or royalty payments, and there would be fewer emissions of volatile organic compounds released to the air.

<u>Additional Technical Background</u>

Oil and gas operations are the second-largest contributor of U.S. methane emissions, accounting for 23 percent of methane emissions, or 2 percent of total U.S. greenhouse gas emissions in 2007.[49] The estimated 133.5 million metric tons of CO_2 equivalent is equivalent to the emissions of 31 coal plants.[50]

Methane emissions occur throughout the production life cycle of natural gas and oil. Numerous individual components are prone to leaks, including pumps, flanges, valves, gauges, pipe connectors, compressors and tanks. Routine wear, rust and corrosion, improper installation or maintenance, or overpressure of the gases or liquids in the piping can cause leaks.[51] A number of sources intentionally vent gas during well completions, by design from pneumatic valves, from well unloading and from oil and condensate storage tanks. Pneumatic valves operate on pressurized natural gas and bleed small quantities of natural gas during normal operation. Within the oil sector, nearly all methane emissions come from production fields in the form of venting from oil wells, storage tanks and processing equipment.[52] EPA's estimated U.S. emissions from this sector in 2007 are illustrated in **Exhibit 16**.[53]

Exhibit 16
Sources of Methane Emissions (Billion cubic feet)



Source: U.S. Environmental Protection Agency.

Methane emissions are unique in that they are the equivalent of lost product, as well as being harmful greenhouse gases and air pollutants. Methane is the primary component of natural gas and every time equipment results in fugitive methane emissions, or an operator intentionally vents methane, a valuable source of energy is wasted. Conversely, the methods to capture or prevent fugitive emissions and venting also result in a greater amount of gas sent to pipelines.

More gas equals greater profits, which in turn yields greater state tax revenues and increased royalty payments, as well as decreased dependence on foreign energy.

The Environmental Defense Fund's original submission contains summaries of regulatory actions taken in key oil and gas producing states in the West (i.e., California, Colorado, New Mexico, Montana and Wyoming) that require some of the recommended technologies in this measure. Such regulations show emissions from oil and gas production can be controlled, and health and welfare concerns can be sufficient to warrant the use of such controls.

Analysis supporting the strategies as ones that do not qualify as "no regrets"

Greenhouse Gas Leak Reduction from Oil and Gas Transmission

Comments by the Texas Oil and Gas Association

This combined strategy proposes mandates for reductions in greenhouse gas leaks during transmission of oil and gas, and in methane emissions during exploration and production. The EPA's Natural Gas STAR Program is a flexible, voluntary partnership encouraging oil and natural gas companies, both domestically and abroad, to adopt cost-effective technologies and practices improving operational efficiency and reducing emissions of methane, a potent greenhouse gas and clean energy source. These strategies propose mandating the currently voluntary program.

This strategy proposes mandatory leak detection and repair programs for natural gas transmission facilities. A comprehensive leak detection and repair program similar to that required for many refinery and chemical operations is not cost effective for such geographically widespread facilities; only innovative technologies such as the gas-find infrared camera might be feasible.

The energy industry has actively participated in the Natural Gas STAR Program since its inception and continues to install these technologies where cost-effective for methane emissions reductions. The first years of implementation yielded the low hanging fruit, the most cost-effective technology applications. Going forward, payout periods for Natural Gas STAR technologies will get longer and the quantities of methane available for mitigation will decrease.

Replacement and maintenance of pipeline components is costly and not likely to yield cost-effective methane emissions reductions. Pipeline companies have invested in appropriate methane emissions reduction technology, such as elimination of pneumatic valves, installation of low-emission components and seals and other practices and technologies recommended by the Natural Gas STAR program. Pipelines are inspected quarterly as required by U.S. Department of Transportation regulations, and gas is required to be odorized if it passes through any population. Leaks are detected and repaired when parts per million or parts per billion levels of odorant and gas are apparent. Natural gas systems are less prone to leakage than refinery fuel gas or other systems; natural gas is dry and contains only minute quantities of corrosive sulfur.

Analysis of leak detection and repair cost-effectiveness revealed the following:

- Costs are incurred for increased tagging, monitoring, component purchases and repairs.
- Costs are calculated at $230 per metric ton of equivalent CO_2 emissions avoided.
- Results show minimal effectiveness in reducing greenhouse gas emissions.

- The proposed scoping plan identifies a reduction of only 0.03 percent, or 0.01 million metric tons of CO_2 equivalent, out of the refinery total of 35.2 million metric tons.
- A million metric tons of CO_2 equivalent emissions is only 0.002 percent of the projected 596 million metric tons of CO_2 equivalent emissions in the year 2020.
- A million metric tons of CO_2 equivalent emissions from all 21 California refineries combined is far less than the applicability threshold for each individual refinery of 20,000 metric tons.[54]

Comments from the Texas Pipeline Association

The Greenhouse Gas Leak Reduction from Oil and Gas Transportation strategy is unlikely to meet "no regrets" standards. EDF's proposal vaguely refers to measures aimed at reducing fugitive emissions from the transmission and distribution of natural gas throughout Texas. According to the proposal, such emissions come from venting, accidental releases of greenhouse gases and leaks from flanges, valves and other fittings, all of which occur along pipelines. The proposal calls upon owners and operators to improve operating practices and to replace older flanges, valves and fittings.

There are three main reasons why the proposal, given its lack of specificity, is highly unlikely to qualify as "no regrets:"

- The replacement of flanges, valves and fittings represents a huge capital investment; there are hundreds of thousands of such devices.
- Potential savings will not offset such an enormous expenditure; there is very little pipeline leakage in the first place. According to Federal Energy Regulatory Commission Form 2 data, the unaccounted-for gas volume through transmission pipeline networks in the United States averages approximately 0.35 percent.[55] This very small figure covers both fugitive emissions and mistaken calculations.
- Substantial emissions tend to occur during the process when flanges, valves and fittings are replaced. There is a significant question as to whether replacement of hundreds of thousands of flanges, valves and fittings will result in any appreciable net reduction in emissions.

Reduce Methane Emissions from the Exploration and Production of Oil and Gas

Comments from the Texas Oil and Gas Association and the Texas Association of Manufacturers

This strategy does not meet "no regrets" standards.

Most companies voluntarily participate in the Natural Gas STAR program. Most upstream and pipeline operations in Texas have conducted emission reduction studies on a cost benefit basis and implemented projects providing the most cost-beneficial, low-hanging fruit opportunities.

Remaining opportunities for reductions are either greatly more expensive to implement and do not provide net savings, or have other undesirable consequences such as increased costs, creation of other types of emissions or waste or decreased operational control of reliability.

Upstream and pipeline operations in Texas are always seeking opportunities to improve emission reductions and economic competitiveness, as well as continually implementing cost-effective changes. These operations will voluntarily continue to study emission reduction opportunities without regulatory requirements to keep competitive with cost of production. Opportunities found do not always cover the costs of the studies, much less implementation.

Due to the wide diversity of situations in upstream operations, costs can vary widely. Smaller remote operations are not likely to offset the higher cost of more stringent inspection and maintenance programs.

An analysis of projects must be undertaken considering cost, locations, access to capital and emissions reduced. Lifetime cost and savings depend on the efficiency improvement opportunities found.

Comments from the Texas Pipeline Association

More specificity is needed to assess the proposed strategy. As originally proposed, the measures are so vaguely stated that it is difficult to assess the merit or potential qualification as “no regrets.” It is not possible to determine whether the undefined “directed inspection” and unspecified “maintenance programs” will result in net costs to Texas businesses. Any proposal that fails to include at least some level of specificity concerning the particular means by which the goal of emissions reduction will be achieved should be rejected.

In connection with a brief discussion of vapor recovery units for storage tanks, the Environmental Defense Fund cites a draft report by Hy-Bon Engineering Company.[56] No reliance should be placed on the report; as it contains many flaws:

- The report assumed, without basis, that any inconsistency between measured rates and modeled rates was the result of modeling error.
- Crucial input data were not tested or verified, but were simply assumed to be correct; the report inexplicably failed to consider uncertainty and variations in daily production.
- Assumptions regarding tank temperature and back pressure are incorrect.
- The report was not based on a representative sample of sites.
- Vent gas flow rates appear to have been outside of the range of the flow meter used by Hy-Bon.
- The report contained numerous conflicting statements.
- The report left certain important questions unanswered, even though the answers could have affected the reliability of the report.[57]

Vapor recovery units for storage tanks tend to be very expensive to install and operate. Installation costs are currently running at about $100,000 per unit. These units tend to require a substantial amount of maintenance. In most cases, the installation of a vapor recovery unit will not meet “no regrets” standards.

<u>Strategy:</u> Low Carbon Fuel Standard

<u>Description</u>

This strategy proposes to reduce greenhouse gas emissions by reducing the carbon content of transportation fuels based on a lifecycle (well-to-wheel) estimate of average fuel carbon intensity (AFCI). This measure would be modeled after California's Low Carbon Fuel Standard (LCFS) goal of reducing the AFCI of transportation fuels in the state by 10 percent by 2020. One standard is established for gasoline and the alternative fuels that can replace it. A second standard is set for diesel fuel and its replacements. Reformulated gasoline mixed with corn-derived ethanol at 10 percent by volume and low sulfur diesel fuel represent the baseline fuels. Lower carbon fuels may be ethanol, biodiesel, renewable diesel or blends of these fuels with gasoline or diesel as appropriate. Compressed natural gas and liquefied natural gas also may be low carbon fuels. Hydrogen and electricity are also low carbon fuels and result in significant reductions of greenhouse gases when used in fuel cell or electric vehicles due to significant vehicle power train efficiency improvements over conventionally-fueled vehicles. As such, these fuels are included in the LCFS as low carbon options. Other fuels may be used to meet the standards and are subject to meeting existing requirements for transportation fuels.[58]

No consensus has been reached on this strategy meeting the "no regrets" standards.

<u>Analysis supporting the strategy as "no regrets"</u>

<u>Reduces greenhouse gas emissions</u>

The primary greenhouse gas benefit is the reduction of carbon dioxide (CO_2) from the combustion of transportation fuel. The California Air Resources Board (CARB) projects that this strategy will reduce CO_2 emissions in California by 14 million metric tons annually beginning in 2020. Adjusted for Texas based on total energy used in the California and Texas transportation sectors, Environmental Defense Fund (EDF) estimates approximately 13 million metric tons reduction in CO_2 emissions annually by 2020.[59]

<u>Cost-benefit analysis</u>

The LCFS will help diversify our fuel supply and dampen the effects of petroleum market swings on Texas' economy. Demand for conventional fuels will continue to rise, once our economy begins to rebound. Recent reports of increased "proven" oil and gas reserves are largely the result of increased oil exploration in response to extreme oil and natural gas price shocks in 2008 and serendipitous technical innovation which recently reduced the cost of producing shale gas. Production increases will not likely keep pace with increased demand as economic growth returns and reserves become ever more expensive to access. The BP oil spill in the Gulf of Mexico is a reminder of the social costs associated with intensified efforts to meet growing demand for petroleum.

The LCFS will make consumers less vulnerable to the petroleum market, stabilize fuel prices, and increase the proportion of fuels produced domestically. Investing in low carbon fuel supply infrastructure will provide fuel supply security, will stop the flow of Texas dollars to fossil fuel importers, and will create state jobs.

CARB estimates that the LCFS will result in overall savings in California of up to $11 billion from 2010 through 2020, but this savings estimate is based on a low range of future conventional fuel prices.[60] Adjusted for Texas based on total energy used in the California and Texas transportation sectors, the net present value of a Texas LCFS with goals and timelines identical to California's is approximately $10 billion. If future crude oil prices are higher, then the benefits of the LCFS will be greater. Specifically, CARB uses a 2020 price range for crude oil of $66 to $88 per barrel, but the U.S. Department of Energy Annual Energy Outlook forecasts a midrange reference price of $114, and a high price of $181.[61] The LCFS will also reduce the risks of international oil price shocks for the Texas economy, but this type of benefit has not been quantified, and is not represented when CARB staff use the AEO price forecasts in their evaluation.

Based on a five percent capital cost recovery factor and revised assumptions for ethanol (that it will be more expensive than conventional fuels), CARB estimates annualized investments and operating costs to be $512 million.[62] CARB estimates that California refining capacity in 2020 will be in the range of 1.5 billion gallons of ethanol and 0.8 billion gallons of biodiesel. Such capacity is suggestive of 25 large-scale, commercial biorefineries at a cost of approximately $174 million per facility. In addition, costs associated with modified or new distribution stations are incorporated into CARB's economic evaluation. CARB details feedstock and production costs by production pathway, but do not consider significant production cost declines realized from learning and increasing scales of production. Private financing will provide the basis for capital investments, since the refineries will recoup their capital costs from fuel sales while California drivers "should see no significant changes in fuel prices to some savings," depending on the actual fuel prices. If the upside savings were realized in 2020 (i.e., conventional world oil prices are at the high end of the AEO forecast and alternative fuels at the low end of projections), then California drivers could save $11 billion in 2020, and even more going forward. On the other hand, if fuel prices remain toward the low end of the AEO forecast, and alternative fuels remain costly to produce, then CARB's analysis indicates that the LCFS will be economically neutral for consumers. That is, CARB forecasts that there is only an upside for the LCFS. [63]

CARB's estimate of annual capital costs ($512 million) is based on a 10-year loan period, a real discount rate of 8 percent and a capital recovery factor of 14.9 percent, which are attractive terms for investors. As well, CARB has used conservative assumptions for 2020 conventional fuel prices. Nevertheless, the LCFS is forecasted to be net positive economically. In reality, the benefits may exceed costs much more significantly. CARB estimates an $11 billion potential upside by 2020.

The benefits of the investments for the LCFS will continue far beyond the 2020 timeframe. The economic analysis, by using a capital recovery period of 10 years, frontloads program costs and understates long-term benefits. While it is true that capital costs will be repaid after ten years, that same capital will generate revenues for fuel producers for much longer.

One example of how CARB findings are conservative is that meeting the 2020 LCFS goal will position Texas to achieve even higher integration – and more benefits – from low carbon fuels going forward. Starting now with the LCFS will give Texas a head start on attracting alternative fuel innovators– and their infrastructure investments – for an industry poised to grow dramatically in the coming decades. Accordingly, an LCFS goal could also boost Texas's chances of meeting the Senate Bill 184 goal of helping businesses in the state maintain global competitiveness.

<u>Analysis supporting the strategy as one that does not qualify as “no regrets”</u>

Comments from Texas Oil and Gas Association and Texas Association of Manufacturers

<u>Description</u>

This strategy requires a low carbon-intensity standard for transportation fuels sold in Texas of at least 10 percent by the year 2020 to reduce greenhouse gas emissions. This strategy would require the use of various biofuels to meet the standard. A LCFS regulation is under development in California; the reduction pathways are being analyzed. Utah, North Carolina and Connecticut have found that similar low carbon fuel initiatives and pilots created a net benefit for residents.

<u>Reduces greenhouse gas emissions</u>

Though the combustion of low carbon fuels produces fewer greenhouse gas emissions than other fuels, the total net effect is less certain; the production of low carbon fuels may increase greenhouse gas generation.

<u>Creates net savings for Texas consumers or businesses</u>

This strategy does not result in a net savings for consumers or businesses in the state. Low carbon fuels provide much less energy per gallon; more fuel is burned to provide the same energy. The CARB 2008 Scoping Plan, using optimistic costs and liberal benefit savings, estimates costs for low carbon fuel standards at $11 billion for California, with no net savings.[1]

<u>Reduces emissions without financial cost to Texas consumers or businesses</u>

Low carbon fuels receive tax exemptions and provide less revenue to states and the federal government; this loss of revenue must be made up with alternative revenues. Requiring low carbon fuels would make the use of Canadian crude less desirable, spurring the consumption of other, more costly sources of crude. Similarly, increased demand for ethanol, a low carbon fuel, would drive up costs for the food crops used to produce the ethanol.

The California State Alternative Fuel Plan has concluded that alternative fuels, including low carbon fuels, cannot compete with conventional gasoline until gasoline prices reach $3.50 to $5 per gallon. Government financial and regulatory incentives are required to offset market cost; these costs ultimately would be borne by the consumer.[64]

<u>Helps Texas businesses maintain global competitiveness</u>

This strategy does not help maintain global competitiveness. The LCFS was removed from proposed federal climate change legislation.

<u>Cost-benefit analysis</u>

The December 2008 CARB Scoping Plan and its accompanying assumptions, economic analysis and appendices are deficient, according to the board’s own Economic and Allocation Advisory

Committee. With public input, the board published an updated scoping plan in March 2010. *Data, assumptions and economic analysis based on the 2008 plan are inaccurate*.

This strategy, as originally proposed, cites the California scoping plan as support for a no-cost impact to consumers. No underlying information in the plan supports this assertion, however; the plan merely *assumes* alternative fuels can be produced competitively.[65]

Producing low carbon fuels in refineries would likely require expensive modifications, similar to those used to produce low sulfur fuels. Many alternative fuels produce different toxic byproducts and do not deliver the same energy, requiring more volume to be burned for the same energy delivered.

Studies by Charles River Associates and Sierra Research show a large disparity in CARB cost assumptions, resulting in increased fuel costs of between $100 and $200 per ton of CO_2 removed. Accounting for what are likely to be higher costs for obtaining and delivering advanced low carbon fuels to the California fleet adds $20 billion to $40 billion to the overall program cost.[66]

Sierra Research analyzed California's recently adopted low carbon fuel standard and estimated increased fuel costs of $3.7 billion annually by 2020 and increased nitrogen oxide emissions, with no detectable change in climate (**Exhibit 17**).[67]

Exhibit 17
Estimated Costs/Benefits of LCFS

CARB	Sierra Research
$3.4 billion in annual cost savings by 2020	Fuel costs increase by $3.7 billion per year in 2020
Net reduction in criteria pollutants	NO_x emissions increase by more than 5 tons per day
Significant reduction in greenhouse gas emissions	No detectable change in climate

Source: Western States Petroleum Association.

<u>Strategy:</u> Refinery Energy Efficiency Process Improvement

<u>Description</u>

This strategy to reduce greenhouse gas emissions requires Texas refineries to identify opportunities to reduce fossil fuel consumption across refinery processes, including process heaters, boilers, fluid catalytic crackers and hydrogen plants. Increased refinery energy efficiency improvements will reduce greenhouse gas emissions and have a positive net present value for Texas business, helping maintain global competitiveness. Consensus has not been reached on this strategy meeting the "no regrets" standards.

There are 23 petroleum refineries in Texas, representing 4.75 million barrels per day of capacity. These refineries range in size from the ExxonMobil Baytown refinery, the largest in the U.S. producing 572,500 barrels per day, to the AGE refinery in San Antonio, which produces 14,000 barrels per day.[68] Refineries are complex facilities with a number of process units and integrated operations constantly changing under market supply and product conditions. Refining is energy intensive with a large need for thermal energy, much of it at high temperature and power. There are, however, many opportunities to reduce energy consumption, ranging from housekeeping items such as repairing leaks, to major process and equipment improvements. A comprehensive plan for energy reduction is important; piecemeal projects are counterproductive. There are many engineering tools that can optimize energy consumption, including process simulation, pinch point analysis, models for analyzing and managing complex steam and fuel systems, and advanced process control.

Continued emphasis on good operating and maintenance practices is important, but the full potential for improvement cannot be realized without major capital investment. Though consensus was not reached on this strategy meeting "no regrets" standards, potential projects include the following:

- increasing heater efficiency by adding heat transfer surfaces, including air preheating;
- replacing mechanical drives with higher efficiency motors or turbines;
- improving heat recovery by adding heat exchange surfaces;
- adopting combined heat and power;
- replacing tower internals with more efficient mass-transfer devices;
- installing more efficient process technology in new units and upgrading existing units;
- improving instrumentation and controls;
- using variable speed motor drives;
- improving cooling system efficiency;
- improving compressor efficiency;
- using heat pumps; and
- recovering flue gas through fluid catalytic cracking.

Combined heat and power, for example, is a very effective way to reduce energy use. The typical balance of thermal energy and power requirements for a refinery allows for efficient generation of much more power than is consumed on site. Combined heat and power currently generates electricity at 14 Texas refineries; about half are designed to export power.[69]

Analysis supporting the strategy as "no regrets"

Reduces greenhouse gas emissions

The primary greenhouse gas benefit is the reduction of carbon dioxide (CO_2) from the combustion of fuel for thermal energy and power. Refinery energy conservation reduces other emissions from combustion, including volatile organic compounds, carbon monoxide, nitrogen oxides (NO_x) and particulate matter.

Creates net savings for consumers or businesses in Texas

Studies support the potential for effective energy conservation programs at Texas refineries, some with little or no capital and with rapid payback. [70] Energy reductions of 10 percent or more can be achieved with minimal capital investment. If capital is available, more energy can be saved. Capital availability is a major constraint for the industry. Financial policies leave refiners with little to spend on discretionary cost-saving projects after spending for mandated environmental, health and safety measures. Case studies of several representative energy reduction projects indicate varying emissions reductions (**Exhibit 18**).

Exhibit 18
Emission Reductions from Energy Reduction Projects

	Capital Cost	Internal Rate of Return	CO_2 Reduced Metric Tons per Year
Crude Unit Heat Exchange	$19.5 million	12%	27,247
Vacuum Tower Ejectors	$2.8 million	19%	6,649
Diesel HDS Hot Feed	$3.2 million	55%	14,489
FCC Power Recovery	$40 million	14%	140,708

Source: Hydrocarbon Processing.

In addition, the internal rate of return for adding air preheat to improve the efficiency of existing process heaters ranges from 11 to 21 percent for a process duty range of 50 million to 250 million Btu per hour.[71] It is unlikely these projects will meet the financial hurdle rate of a refiner, although all demonstrate a positive life cycle cost and significant CO_2 reduction. Refineries also present the opportunity for large and cost-effective combined heat and power.

Increased refinery energy efficiency improvements will reduce greenhouse gas emissions and create a positive net present value for Texas business, helping to maintain global competitiveness.

Analysis supporting the strategy as one that does not qualify as "no regrets"

Comments from the Texas Oil and Gas Association and the Texas Association of Manufacturers

This strategy projects a reduction in greenhouse gases by reducing energy use, presuming the energy production processes generate greenhouse gas emissions. If improvements in operations or facility upgrades for older industrial boilers will provide a true no net cost for the business, companies would already choose that option.

Existing regulations to reduce NO_x are driving upgrades and efficient operations of older boilers. In some cases, sites have invested in additional NO_x controls in other facilities rather than upgrade burners in older systems. This proposed strategy would reduce the flexibility of some sites to meet the NO_x reductions required.

The California Air Resources Board (CARB) estimates of greenhouse gas emissions reductions achieved through repowering, retrofitting, replacing and/or repairing existing equipment likely overestimate potential reductions and underestimate potential costs. Many companies already have installed and maintain energy efficient equipment, conducting ongoing maintenance and replacement programs to maintain the highest levels of efficiency. While energy efficiency standards should be applied to all production operations as appropriate, a company generally runs generators at high efficiency, controls and monitors oxygen continuously, and keeps the generators well tuned. Emissions are checked regularly to ensure compliance with existing air quality regulations. The greenhouse gas reduction target of 0.5 million to 1.5 million metric tons of equivalent CO_2 by 2020 is an overestimate that depends on the actual amount of fuel gas consumed and the overall efficiency improvement opportunity. For example, the benefit associated with the economizer is roughly a 1 percent fuel savings for every 10 degrees Fahrenheit of temperature rise provided to the feedwater. The quoted 4 to 5 percent efficiency gains from adding the economizer implies there is a 200 to 250 degree Fahrenheit opportunity to reduce stack temperatures. Stack temperatures are typically lower; therefore, this is not a potential greenhouse gas reduction opportunity.[72]

As with refineries, upstream emissions reductions are already addressed through existing regulation. For example, the possible gains are going to be an order of magnitude less than the stated CARB estimates since required low- NO_x retrofits are already in place. The retrofits reduce both NO_x and greenhouse gas emissions; boilers redesigned to achieve low- NO_x emissions, used near their design capacity, are more efficient than pre-retrofit boilers, resulting in lower fuel use per unit of steam**.**

Remaining opportunities for improvements in energy efficiency are either greatly more expensive to implement and do not provide net savings, or have other undesirable consequences, such as creation of other types of emissions or waste, or decreased operational control of reliability.

Refineries will continue voluntary periodic studies of energy efficiency opportunities to improve competitiveness without regulatory requirements. A good example of this is the large number of cogeneration projects implemented over the last few years. Other opportunities found do not always cover the costs of the studies.

<u>Strategy:</u> Refinery Flare Recovery Process Improvement

<u>Description</u>

This strategy proposes to reduce greenhouse gas emissions by increasing the efficiency of the flare gas recovery process. A flare gas recovery unit collects the gas, compresses it, cools it and then sends it back to a refinery process, where the recovered gas can be used as refinery fuel gas or refinery feedstock. This happens before the gases are combusted by the flare, minimizing emissions.

No consensus has been reached on this strategy meeting the "no regrets" standards.

The primary purpose of a flare system is emergency relief, sized for a worst-case event such as a plant-wide power failure or loss of cooling. A secondary purpose is the safe disposal of flammable gas from routine operations, including small process vents, clearing equipment for maintenance, startup and shutdown of processes, and recovery from process upsets. The flow rate of normal flaring is small compared with the capacity of the system. Flare gas flows and composition are extremely variable.[73] With a careful review of operating data for the flare system, a reasonably sized flare recovery system can be designed to capture between 90 and 95 percent of the annual flare flow; high flow events are rare. Some refineries have multiple flare systems.

The systems include a water seal drum located immediately upstream of the flare to maintain positive pressure at the suction of one or more compressors.[74] When flow in the flare header exceeds the capacity of the compressors, gas bubbles through the water seal and is safely consumed in the flare. Liquid ring compressors are typically used because liquids condensing in flare systems do not damage them. Liquid ring compressors, however, are much less efficient than other types of compressors. It is important to optimize capacity to avoid the waste of power.

<u>Analysis supporting the strategy as "no regrets"</u>

<u>Reduces greenhouse gas emissions</u>

The primary greenhouse gas benefit is the reduction of CO_2 from the combustion of the wasted fuel. There is also a small amount of methane emissions reduction; since methane has a lower destruction efficiency than heavier hydrocarbons. A flare recovery system can be effectively used with a flare management program to dramatically reduce flaring. For example, the Flint Hills refinery in Corpus Christi reports operating 168 consecutive days without flaring.[75]

In addition, a flare recovery system reduces other emissions, including volatile organic compounds, carbon monoxide, nitrogen oxides and particulate matter. Community noise problems also are abated by a reduction in flaring.

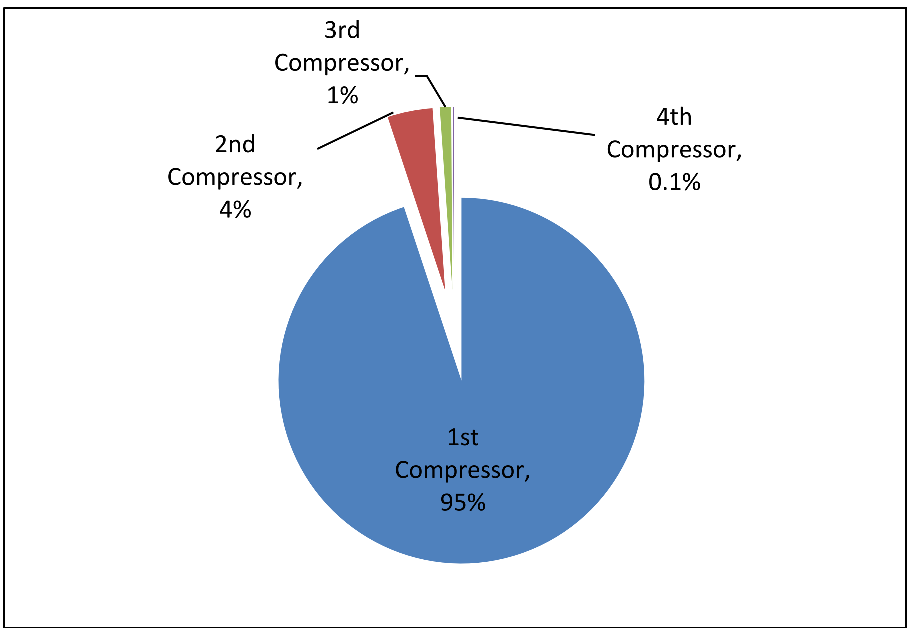
<u>Cost-benefit analysis</u>

Flare recovery systems have proven to be economical and beneficial, but must be sized carefully and designed for each unique application. Over-sizing results in wasted compressor power and is environmentally counterproductive. A typical system will have a capacity of 3,000 standard cubic feet per minute, cost about $10 million installed, have a 50 to 70 percent capacity factor, recover about 95 percent of the total gas in the flare system and have a positive lifecycle cost. The primary benefit is recovery of waste gas for fuel and, in some cases, product can be recovered, enhancing the environmental and financial benefits. In addition, reducing steam used for smokeless flare operation saves energy. The primary operating cost is electric power for the compressors. For a fuel value of $6 per million Btu and a 50 percent capacity, the example cited above will save about $6 million, reduce CO_2 by 50 thousand metric tons per year and pay out in less than two years.[76]

One vendor alone has provided 11 flare recovery systems to seven of the 23 refineries in Texas. There is no readily available information about the number of large flare systems in Texas that do not have flare recovery systems. Projecting the initial cost and benefits statewide would be speculative.

Adding compressors beyond the optimum is not beneficial. The Western States Petroleum Association conducted a study on California refineries flare gas recovery efficiency and found additional backup compressors are not cost-effective. **Exhibit 19** illustrates adding compressors to a system sized to recover 95 percent of the flared gas results in low capacity factors; the additional compressors cannot be justified.[77]

Exhibit 19
Example Flare Gas Recovery



Source: Western States Petroleum Association.

In a worst-case scenario, a large refinery could invest between $15 million and $30 million that would never pay out.[78]

<u>Analysis supporting the strategy as one that does not qualify as "no regrets"</u>

Comments from the Texas Oil and Gas Association and the Texas Association of Manufacturers

The ability to utilize recovered gas from a flare system is limited by the capacity of the site system and processes. Larger flare gas system flows often occur at times when the process or fuel systems are not at peak capacity or demand. Studies of refinery flaring from the Texas Commission on Environmental Quality indicate that improving process reliability and avoiding upsets achieves greater reductions than trying to handle greater flare gas streams. Greenhouse gas emissions may even increase due to the energy necessary to run the additional recovery compressors in standby mode, even though not needed at the time.

Most refineries in Texas have already implemented projects providing the low-hanging fruit opportunities to reduce flare waste streams and utilize recovered gases where economically feasible. This has been driven by ozone non-attainment regulations and nitrogen oxides reduction regulations.

It is not feasible to keep recovery compressors online to handle larger surge loads that infrequently occur. The cost to install and operate a recovery system is not always offset by the value of the recovered material. Remaining opportunities for recovery and utilization of flare gas streams are either greatly more expensive to implement and do not provide net savings, or have other undesirable consequences such as creation of other types of emissions or waste, or decreased operational control of reliability.

Refineries will continue voluntary periodic studies of flare gas reduction opportunities to remain competitive without regulatory requirements. Emissions from flaring have steadily shown reduction over the past 10 years. Other opportunities found do not always even cover the costs of the studies.

Initial short-term capital costs depend on the flare gas reduction opportunities found. Typical costs for flare gas recovery system expansions are in the millions of dollars. Cold gas systems and systems requiring significant compression are the most expensive. An estimated $3.75 million cost per compressor adds 2 million cubic feet per day of capacity. The capacity to capture large surges would be between five and 10 times greater. Lifetime cost and savings depend on the flare gas recovery opportunities found. The cost of keeping flare gas recovery compressors readily online is often greater than the actual value of the recovered material. Each system is specifically designed for maximum recovery, usually 95 percent or better. The use of additional compressors to capture the remainder is not cost-effective. The Western States Petroleum Association conducted a study on California refineries flare gas recovery efficiency and found additional back up compressors were not cost effective. A worst-case scenario will cost a large refinery between $15 million and $30 million, and will not recover costs.[79]

<u>Strategy:</u> Stationary Internal Combustion Engine Electrification

<u>Description</u>

To reduce greenhouse gas emissions, this strategy recommends electric motors replace internal combustion engines of more than 50 horsepower used in industrial and commercial operations as a primary power source, excluding those used for emergency power generation. Consensus has not been reached on whether this strategy meets the “no regrets” standards.

<u>Analysis supporting the strategy as “no regrets”</u>

<u>Reduces greenhouse gas emissions</u>

The use of an electric motor instead of a gas-fired engine to drive gas compression eliminates combustion emissions from the wellhead or compressor station, reducing carbon dioxide (CO_2) equivalent emissions by 300,000 tons annually in 2020, according to the California Air Resources Board (CARB). Adjusted for Texas, this emission reduction is estimated at 200,000 metric tons annually.[80] Electric-powered compression has a long-term potential for decreased climate impact as non-fossil fuel alternatives for grid electricity generation expand in the future.

<u>Creates net savings for consumers or business in Texas</u>

According to an analysis by CARB, this strategy is estimated to have a net savings of $7.1 million annually. The estimated short-term capital costs are $50.7 million. When combined with operating costs, an annualized total cost of $17.9 million results. [81] Adjusted for Texas, this figure is $12.1 million annually.

Using sample values for capital, and operating and maintenance costs, and assuming 500-horsepower capacity for a gas compressor operating 8,000 hours per year, at a 0.55 load factor, CARB calculates a slight cost benefit of around $12,000 per year for generating the compression power with an electric motor instead of an internal combustion engine (**Exhibit 20**).[82]

Exhibit 20
Sample Cost Values

Costs	Internal Combustion Engine ($/year)	Electric Motor ($/year)
Energy (Natural Gas or Electricity)	$136,000	$174,000
Operations and Maintenance	$35,000	$6,200
Capital	$74,000	$52,000
Total	**$245,000**	**$232,000**

Source: California Air Resources Board.

<u>Cost-benefit analysis</u>

According to the CARB, short-term capital costs are estimated at $50.7 million. When combined with operating costs, an annualized total cost of $17.9 million results. Adjusted for Texas, this figure is $12.1 million annually. [83]

The lifetime cost savings, derived primarily from reduced natural gas and diesel use, is estimated as a net savings of $25.0 million, resulting in a net savings of $7.1 million annually. Adjusted for Texas, this figure is $4.8 million annually. [84]

Analysis supporting the strategy as one that does not qualify as "no regrets"

Comments from the Texas General Land Office

Replacing a natural gas engine driver in the field simply moves the point source of pollution from the field to some remote power plant. The predominant fuel sources used for electrical power generation in Texas, ranked in percent of power produced, are natural gas (42 percent), coal (37 percent) and nuclear (14 percent).[85] Replacing a reciprocating natural gas engine with a natural gas-fired furnace or natural gas turbine does not reduce the overall carbon footprint if the same fuel type is burned at a remote site and if electric generation and transmission line losses are considered in the comparison. If a coal-fired electric plant provides the electric power, then the overall carbon emissions actually increase. The user has no control of what fuel is used or where the power created comes from, nor the age, efficiency and condition of the power plant. The user only knows power is made available by the electric distribution system.

The natural gas supplied to oil or gas field lease compressors is frequently provided for free, or at the oil and gas lease price net royalty interest. The gas supply price is much lower than the cost applicable to the natural gas-fired electric plant. By replacing natural gas engines in the field, the disparity in fuel gas costs will significantly affect the overall economics. The Electricity Reliability Council of Texas (ERCOT) oversees the reliability of the electric grid and its operation. ERCOT maintains a reserve margin of 12.5 percent, ensuring system brownouts or blackouts do not occur. Extensive grid modifications will be necessary to supply power to the typical remote compressor installations in the oil and gas fields of Texas. Unlike California, these fields are dispersed throughout the state and encompass large geographic areas. The conversion of gas engine drivers will require the construction of high-voltage power lines and substations, and possibly the addition of power plants to serve those installations since they are remote from large cities. Any additional power required, and the cost to add infrastructure, will be borne by all ratepayers in that area of the electric grid. Additionally, a power or utility company must pay a tariff to the owner of the electrical transmission line to transport the power if the distribution system is not owned by that utility company.

Significant capital expenditures will be necessary to replace existing natural gas engines with electric motor drivers. Motor controls, power supplies, transformer and capacitor banks, and transmission lines will be required to retrofit existing systems. Compressor stations and lease compressors, frequently at remote locations, will require transmission systems to traverse long distances at great expense. The capital to retrofit these systems at each facility simply may not be available to independent producers and small to midsized upstream and midstream companies. The owners of the electric transmission system may not have sufficient capital to extend the distribution system to the typically remote compressor station and/or lease facility compressor due to higher priority projects in areas with greater population density and needs.

Comments from the Texas Pipeline Association

Electric motor technology is not free from the generation of greenhouse gas emissions. Plants that generate power for electric motors emit significant levels of greenhouse gases. Emissions from these plants will vary depending on the fuel source used for power generation, but in general, an expectation of substantial net reductions in greenhouse gas emissions from implementing this proposal is misdirected and misleading.

A non-interruptible energy source is needed for a reliable natural gas delivery system. If delivery of natural gas were dependent on electric generation, a power outage due to a storm or hurricane would result in unreliable delivery of natural gas and would require flaring of trapped gas. Moreover, connecting distribution lines to the remote compressor station locations would be time consuming and expensive, thereby increasing power costs for both consumers and operators.

The return on investment and recovery of the capital cost of this proposal are highly dependent on the value of gas saved with electric motor installation. The cost per year of electricity needed to generate power for the proposed electric motors could easily be greater than the fuel cost savings per year. It is not clear how the substantial expense of purchased electricity and attendant generation of greenhouse gas emissions is considered in this proposal's evaluation, if at all.

Comments from the Texas Oil & Gas Association and the Texas Association of Manufacturers

Any reductions in emissions at the compressor engine will be more than increased at a generation facility. This moves a point source from the field to a generation facility.

Significant capital expenditures will be necessary to replace natural gas compressor engines with electric engines and to bring power to remote locations where compressor engines are generally located.

Natural gas-fired compressor engines are very efficient and expensive to replace with electric engines. Most engines are fueled with lease gas at little to no cost. Operational maintenance is generally less than half the cost of an electric engine. Compressor engines are often located in remote areas where no electrical connections exist; additional cost will be incurred to lay power lines to bring electricity to the engine. This can be very expensive. This does not work on an offshore platform retrofit. This does not work on a blow-down heat recovery system; the recovered vapors have nowhere to go.

The December 2008 CARB Scoping Plan, assumptions, economic analysis and accompanying appendices are deficient as found by CARB's own Economic and Allocation Advisory Committee. With public input, an updated scoping plan was published in March 2010. [86] Any data, assumptions and economic analysis based on the 2008 plan and accompanying appendices are inaccurate.

OTHER INDUSTRY

Strategy: Increase Combined Heat and Power Use

Description

To reduce greenhouse gas emissions, this strategy recommends the increased use of combined heat and power in the industrial, commercial and institutional sectors in Texas. Consensus has not been reached on this strategy meeting the "no regrets" standards.

Combined heat and power (CHP) refers to an electric power plant located in proximity to a facility that uses steam in its operation, so most of the heat normally wasted from the generation of power, typically 50 to 70 percent, can be captured for reuse. CHP uses proven technology in applications ranging from below 1 megawatt to hundreds of megawatts. In addition to saving energy and reducing emissions, CHP reduces water consumption, provides economic stability to enterprises, increases the reliability of critical infrastructure, reduces electric loads on the transmission and distribution system and reduces energy prices. Texas is the national leader in CHP with about 17,000 megawatts capacity, representing 20 to 25 percent of the total CHP capacity in the U.S., and producing about 20 percent of the electricity in Texas. A Public Utility Commission of Texas (PUC) report requested by the 80th Texas Legislature concludes the potential statewide CHP capacity amounts to an additional 13,400 megawatts.[87]

CHP can use any fuel including biomass. Biomass generation is generally less efficient than fossil fuel generation due to size and combustion characteristics. With more waste heat available for recovery, CHP biomass is more beneficial.

Analysis supporting the strategy as "no regrets"

Reduces greenhouse gas emissions

Carbon dioxide (CO_2) is the primary greenhouse gas reduced by CHP. Since natural gas is typically the marginal power generation and thermal energy fuel, and since most CHP systems use natural gas, CO_2 reduction comes primarily from reduced consumption of natural gas. In addition, the greater efficiency of CHP makes natural gas fueled CHP competitive with coal during low demand hours, further reducing CO_2 emissions. The statewide reduction in CO_2 emissions from existing CHP operations is estimated at 50 million metric tons per year.[88] Furthermore, the 13,400 megawatts of statewide potential for CHP could reduce CO_2 emissions by an additional estimated 25 million metric tons per year. The efficiency of CHP reduces other combustion-related emissions including nitrogen oxides (NO_x) and sulfur oxides. A recent study on CHP-related NO_x emissions in the city of Houston, conducted by the Houston Advanced Research Center, drew conservative estimates that widespread deployment of CHP in Houston alone will result in NO_x savings of between 2.9 and 9.4 tons per day from the commercial sector, and roughly 10 tons per day from the industrial sector.[89] Biomass-fueled CHP also carries environmental benefits. A biomass CHP plant consuming 100,000 dry tons per year of wood waste can reduce CO_2 emissions by 77,000 metric tons per year.

Cost-benefit analysis

House Bill 3693 (80R), a comprehensive energy efficiency bill, included a requirement that the PUC study the potential for CHP in Texas.[90] The report concluded there is potential for 13,400 megawatts of additional economic CHP capacity (**Exhibit 21**).[91]

Exhibit 21
Base Case Technical and Economic Capacity Potential in 2023

		Technical	Economic	% Economic
Commercial/Institutional	**<1 MW**	1,172	110	9%
	1-10 MW	752	240	32%
	>10 MW	0	0	N/A
Total Commercial/Institutional		*1,924*	*350*	*18%*
Industrial	**<1 MW**	1,959	668	34%
	1-10 MW	6,102	5,630	92%
	>10 MW	6,874	6,759	98%
Total Industrial		*14,935*	*13,057*	*87%*
Commercial/Institutional and Industrial	**<1 MW**	3,131	778	25%
	1-10 MW	6,855	5,870	86%
	>10 MW	6,874	6,759	98%
Total Industrial and Commercial/Institutional		***16,859***	***13,407***	***80%***

Source: Summit Blue Consulting.

The report prepared for the PUC is a credible source of information with respect to the "no regrets" criteria for the following reasons:[92]

- The report is an economic study to provide information about the amount of cost-effective CHP in Texas. It is not a market study. Though the study acknowledges non-economic factors that are barriers to CHP development, economic criteria are used to determine CHP potential. Therefore, it is consistent with the "no regrets" requirements.

- The report specifically addresses Texas issues and was conducted under the supervision of a Texas state agency with public input from a variety of Texas interests.

- CHP potential is based on both large and small sites with sufficient thermal load to support an efficient CHP plant, thereby reducing statewide fuel consumption and CO_2 emissions. The report specifically excludes thermally activated cooling; with its low efficiency, fuel consumption is not reduced and the economic value is limited compared with heating applications.[93]

- The report offers a conservative estimate of the potential for cost-effective CHP. The largest CHP plants, with capacities greater than 100 megawatts, were not considered. The potential for CHP in commercial and institutional applications is underestimated. The average cost of natural gas for that market segment was used, which is 50 to 60 percent higher than for other power plant customers. Local gas distribution companies have the flexibility to price base-load gas to make CHP competitive.

While the report considers only natural gas CHP, biomass is considered carbon neutral. Its use in CHP facilities will benefit Texas in locations with a ready supply of biomass, particularly from waste disposal. A report by the Texas Forest Service estimates 4.3 million and 1.6 million dry tons per year of biomass-appropriate waste are available in East and Central Texas, respectively.[94] In addition, an estimated 3.7 million dry tons per year of urban wood waste is available.[95]

Biomass generation is generally less efficient than fossil fuel generation due to size and combustion characteristics. With the exception of landfill gas to electricity plants, which benefit from regulatory requirements and federal tax credits, there are no other biomass power plants in the state. Several biomass facilities are in various stages of development; however, due to the economics, these projects will not advance without a customer who is willing to pay a premium for green power.

More waste heat available for recovery makes biomass CHP more beneficial. There are currently eight biomass CHP plants in Texas with a total capacity of 177 megawatts. These plants were built without subsidies.[96] A Texas CHP Initiative case study of a plant consuming 100,000 dry tons a year of wood waste shows a positive payout, but not for power generation only.[97] Simple payback is about two years with federal incentives and renewable energy credits, and 6.5 years without incentives (**Exhibit 22**). [98] Although it is economical, the total potential for development of biomass CHP is uncertain. A large amount of biomass is available, but for it to be used economically, it must be within 50 to 75 miles of a large user of thermal energy.

The increased use of CHP will result in net savings for businesses in this state. Consumers will benefit from the lower cost power generated by CHP plants. CHP increases efficiency and reduces costs for many businesses, helping maintain global competitiveness.

Exhibit 22
Biomass CHP example

Biomass Fuel Consumption	100,000 tpy (dry)
Capacity Factor	85%
Biomass Heating Value (LHV)	7,866 Btu/lb
Steam Conditions	850 psig, 800°F
Steam Generation	116,000 pph
Boiler Efficiency	73%
Biomass	$2.9/MMBtu
Natural Gas	
–Cost	$8/MMBtu
–Combined cycle heat rate	7,000 Btu/kwh (49%)
–Boiler efficiency	83%
Renewable Energy Credit (REC)	$10/MWH
Power Credit	$75/MWH

Net Power	4,358 KW
Thermal Energy	149 MMBtu/Hr
Natural Gas Saved	1,283 MMcf/Yr
Carbon Dioxide Reduction	76,800 Metric Tons/Yr
Capital	$25 Million
Biomass Crop Assistance Program	$9 Million
ARRA Biomass Credit	$7.5 Million
REC Value	0.3 $mm/Yr
Power Revenue	2.4 $mm/Yr
Thermal Revenue	7.8 $mm/Yr
Biomass Fuel	4.5 $mm/Yr
O & M Cost	1.9 $mm/Yr
EBITDA	4.1 $mm/Yr
Payout	2.1 Years
Payout Without Incentives	6.5 Years

Source: Tommy John Engineering.

Implementation

The study of CHP potential prepared for the PUC extrapolates project implementation over a period of several years.[99] The capacity based on the project sizes estimated in **Exhibit 21** represents an investment of $21 billion, financed primarily by project developers and other businesses. CHP projects typically have project lives of 20 years. For an average natural gas price of $8 per million Btu, annual energy savings alone are $4.5 billion per year, with a simple payback of 4.6 years and total savings of $91 billion. If natural gas prices average only $6 per million Btu, annual energy savings are $3.4 billion per year, with a simple payback of 6.2 years and total savings of $68 billion.[100]

Adopting the following statewide policies will address regulatory and market barriers to CHP while meeting "no regrets" criteria:

- Improve air quality rules for small electric generating units. The current TCEQ standard permit needs more specificity for location and size to make it usable for smaller CHP projects.[101]

- Improve access to markets for small power generators. The current commercial platform is overly complicated for small resources and discourages participation.

- Expand the Energy Efficiency Incentive Program, which is administered by utilities and overseen by the PUC, to encourage fuel savings. CHP is a powerful energy conservation measure, but the current energy efficiency program in Texas targets reducing electrical demand, not primary energy use.

- Adopt a portfolio standard that includes high efficiency CHP. A standard encourages utilities, marketers and developers to seek CHP opportunities, including expanding the output of existing plants. Because of the large statewide potential for additional CHP, any cost will be very nominal compared with the benefits.

- Encourage aggregation of thermal and electrical load. Larger, more efficient CHP facilities can be developed if barriers are removed to interconnecting electrical and piping between nearby facilities.

Analysis supporting the strategy as one that does not qualify as "no regrets"

Comments from the Texas Association of Manufacturers

This strategy lacks sufficient definition to constitute a "no regrets" strategy. There are no specifics to allow calculations of either costs or alleged benefits.

Cost-effective, market-based CHP installations are supported. To the extent that this strategy constitutes a mandate or subsidy for CHP, it does not meet "no regrets" standards. Mandates for CHP result in inefficient installations and increase energy costs in a manner that harms energy-intensive manufacturing. Forcing CHP installations invariably takes dollars away from the more efficient investments energy companies make to lower energy costs, improve emissions and enhance competitiveness.

To the extent that a CHP mandate results in additional biomass installations, those subsidized installations will compete for fuel with current installations, possibly rendering current investments uneconomic. These new subsidized facilities also will compete with other uses for wood waste, further harming certain manufacturers.

The study prepared for the PUC and relied on for this strategy does not contradict the Texas Association of Manufacturer's position. The study uses an economic model that is admittedly not real world to develop economic CHP potential, and contains numerous measures that could be employed to increase CHP. However, the assumptions underlying the study's determination of potential CHP are not consistent with the "no regrets" test. Moreover, the report recognizes the largest hurdle faced by CHP systems is economic; the economics are not sufficient to result in investments. Ultimately, the study does not explain why some CHP investments are made and others are not; it does not capture the complexity of the costs and benefits of a particular investment decision.

There are simply no substantial barriers to the installation of cost-effective CHP today. Without any subsidies or mandates, Texas leads the nation in CHP installations. No government action is needed to continue Texas' leadership position on CHP.

As presented, this strategy does not meet "no regrets" standards.

Strategy: Industrial Boiler Efficiency

Description

This strategy is based on a California Air Resources Board (CARB) measure to reduce energy costs and greenhouse gas emissions by improving industrial boiler efficiency through:

- annual tuning of all permitted boilers;
- the installation of an oxygen trim system including parallel positioning and variable frequency drive on boilers rated at or more than 10 million Btu per hour;
- the installation of a non-condensing economizer to maximize efficiency on boilers rated at or more than 50 million Btu per hour; or
- replacing an existing boiler with a new one equipped with these two systems.[102]

No consensus was reached on this strategy meeting the “no regrets” standards.

Analysis supporting the strategy as “no regrets”

Reduces greenhouse gas emissions

This strategy reduces carbon dioxide (CO_2) emissions by decreasing the consumption of fuel used in industrial boilers. Based on CARB analysis, scaled for Texas based on state gross domestic product, CO_2 equivalent emissions are reduced by roughly 0.70 million metric tons in 2020.[103] A collateral benefit of this measure is small reductions in emissions of particulate matter and NO_x, contributing to attainment of air quality standards.

Creates net savings for consumers and businesses in Texas

The strategy results in net savings for businesses benefiting from reduced fuel consumption and better boiler performance. While there will be upfront costs to businesses, analysis indicates those costs will be far outweighed by the savings exceeding $85 million annually.[104]

While the industry continues to improve efficiency in some facilities, this strategy will result in substantial improvements in both efficiency and greenhouse gas emissions in Texas. Numerous studies and reports show that the focus of large industry on quarterly and near-term profits comes at the expense of long-term gains in efficiency. A McKinsey & Company report, "Unlocking Energy Efficiency in the U.S. Economy," finds efficiency projects in the industrial sector suffer from a lack of awareness and attention from senior management.[105] The industrial sector faces an elevated hurdle as a result of budgeting processes separating operation and maintenance budgets from capital improvement budgets; costs for projects reside in a different budget than the offsetting benefits. In a survey as part of the study, 43 percent of energy managers in the industrial sector indicate a needed payback period of less than three years for efficiency projects. Under difficult economic conditions, this may shrink to 18 months. Requiring a 2.5-year payback reduces identified potential for energy efficiency in the industrial sector by 46 percent.[106] These investments have productive life spans stretching well beyond the next few decades.

Cost-benefit analysis

Based on analysis by CARB, this strategy is estimated to have a net savings of $127 million annually. Adjusted for Texas, the estimate is $85.5 million annually. Capital costs are projected at $90.4 million, and when combined with operating costs, result in a total annualized cost of $22.86 million. Adjusted for Texas, total costs are estimated at $15.4 million annually. Cost savings are derived primarily from reduced natural gas and electricity use and are estimated at

$149.7 million, resulting in a net savings of $127 million annually. Adjusted for Texas, costs are estimated at $101 million with a net savings of $85.5 million annually.[107]

Boilers with relatively high efficiency that have not been retrofitted as specified in this measure will not receive the payback rate calculated below. No data has been provided by industry as to the efficiency ratings of existing boilers. The calculations indicate that even for more efficient boilers, improvements will result in a relatively short payback period, though perhaps not as short as those currently used in industry for low priority projects. Without specific information relating to the efficiency of boilers used by industry in Texas, it is only possible to estimate rough payback periods based on analysis from other states.

Detailed Assumptions for Costs and Savings

- Total Capital Cost (Estimated for California – $90 million)

  The capital cost is derived from the cost of purchasing and installing equipment retrofits required by the measure, multiplied by the approximate total number of installations. The total number of installations was estimated using engineering judgment, data from the California Emission Inventory Development and Reporting System (CEIDARS), air district databases and from information supplied by an industry sales representative and representatives of a consulting firm administering a commercial and industrial boiler efficiency program.[108]

- Annual tuning requirement = no capital cost
- Retrofit of 10 million Btu-per-hour boilers with oxygen trim, parallel positioning and variable frequency drive
- Equipment costs for retrofit assuming 600 boilers rated at or over 10 million Btu-per-hour with oxygen trim, parallel positioning and variable frequency drive ($96,000 per unit) = $57,600,000
- Assumed 60 percent (600) of the 1,000 boilers in CEIDARS inventory are not already equipped with oxygen trim, parallel positioning and variable frequency drive, and are in need of the retrofit.
- Capital costs for retrofit of 105 boilers rated at or more than 50 million Btu-per-hour with a non-condensing economizer ($200,000 per unit) = $21,000,000
- Assumed 60 percent (105) of the 175 boilers in California are not already equipped with a non-condensing economizer and need the retrofit. South Coast database shows that 70 boilers in the district are rated more than 50 million Btu-per-hour.
- Assuming South Coast has 40 percent of the inventory, the total number of boilers rated more than 50 million Btu-per-hour in California is 70/0.4 = 175 boilers
- Capital costs = $78,600,000
- Total installation costs (15 percent of capital costs) = $11,790,000
- Total capital and installation costs for boiler retrofits = $90,390,000
- Annual operating cost = ($15,610,000)
- Annual maintenance costs for boiler retrofits (assumed to be 10 percent of capital costs) = $7,860,000
- Annual tuning costs for 3,100 boilers ($2,500 per unit) = $7,750,000

- All costs for the tuning requirement are considered to be an annual maintenance cost. The 2004 CEIDARS NO_x inventory showed approximately 3,100 permitted natural gas boilers.
- Total annual operating costs (annual maintenance costs and annual tuning costs) = $15,610,000
- Lifetime expenditures, 2016 through 2020 = ($168,440,000)
- $90,390,000 + (5 years)($15,610,000) = $168,440,000
- Cost Savings = ($149,640,000)
- (There will also be an unknown electricity savings from the variable frequency drive.)
- (1 $MMTCO_2E$)(106 metric ton/MMT)/(0.05306 metric tons CO_2/MMBtu) = 18,846,588 MMBtu natural gas annual savings
- Annual fuel cost savings ($7.94/MMBtu)(18,846,588 MMBtu) = $149,641,908
- Lifetime cost savings 2016 through 2020
- (5 years) ($149,641,908) = $748,209,543

<u>Analysis supporting the strategy as one that does not qualify as "no regrets"</u>

Comments from Texas Oil & Gas Association

This strategy will result in little reduction of greenhouse gas emissions. Operation of a boiler at peak efficiency should minimize greenhouse gas emissions. Many industrial boilers are under a NO_x control program and must be operated continuously as required for limiting NO_x emissions. These controls may be functionally the same as the proposed thermal efficiency setting.

This proposed strategy does not result in a net savings for consumers or businesses in the state. Further:

- Some facilities have a NO_x control program to meet regulatory limits that includes reducing NO_x emissions at other sources rather than at an older boiler. Individually driving boiler upgrades or replacement for energy efficiency gains may interfere with that strategy for cost-effectively meeting NO_x regulations.

- The target greenhouse gas reduction of 0.5 million to 1.5 million tons of equivalent CO_2 by 2020 is an overestimate, and it depends on the actual amount of fuel gas consumed and overall efficiency improvement opportunity. For example, the benefit associated with the economizer is roughly a 1 percent fuel savings for every 10 degrees Fahrenheit of temperature rise provided to the feedwater. The quoted 4 to 5 percent efficiency gains from adding the economizer implies there is a 200 to 250 degree Fahrenheit opportunity to reduce stack temperatures. Stack temperatures are typically lower; this is not a potential greenhouse gas reduction opportunity for production operations.[109]

- As with refineries, upstream emissions reductions are being addressed already. For example, the possible gains are going to be an order of magnitude less than the stated CARB estimates since the required low- NO_x retrofits have already been put into place, reducing both NO_x and greenhouse gas emissions. Boilers redesigned to achieve low- NO_x emissions, and used near design capacity, are more efficient than pre-retrofit boilers, resulting in lower fuel use per unit of steam.

- Each potential project must be looked at on a case-by-case basis to determine if the project will result in a net savings.

Cost analysis:

The December 2008 CARB Scoping Plan, assumptions, economic analysis and accompanying appendices are deficient as found by the board's own Economic and Allocation Advisory Committee. With public input, an updated scoping plan was published in March 2010. [110] Any data, assumptions and economic analysis based on the 2008 plan are inaccurate.

Boiler replacement or upgrade is very capital-intensive. The estimated costs for the target greenhouse gas reduction appear to be unreasonable (**Exhibit 23**).[111] The basis for the estimate needs clarification to include the number of boilers, ratings and target improvements. Without any additional specific details, the California Air Resources Board estimate is not reliable.

Exhibit 23

Payback for Replacement of 100 MMBtu/hr Furnace of Current Efficiency with CA Costs of $32 Million (3 x DOE)		
Current Efficiency	Fuel saving at $9/MMBtu	Years to Simple Payback
75%	$1.92 million	10 to 20 years
80%	$1.22 million	20 to 30 years
85%	$0.60 million	30 to 60 years
90%	$0.05 million	400 to 700 years
Cost for Carbon Reduction for Replacement of 100 MMBtu/hr Furnace of Current Efficiency with CA Costs of $32 Million (3 x DOE)		
Current Efficiency	CO_{2e} Tons/yr Reduced	$/Ton
75%	11,279	$2,500 - $3,000
80%	7,163	$4,000 - $5,000
85%	3,531	$7,000 - $10,000
90%	303	$90,000 - $125,000

Source: Western States Petroleum Association.

VEHICLES AND TRANSPORTATION

<u>Strategy:</u> Texas Emissions Reduction Plan for Black Particles

<u>Description</u>

This strategy recommends expansion of the Texas Emissions Reduction Plan (TERP) to include black particle reduction achievable through the placement of diesel particulate filters, primarily on school buses, to trap soot emissions.

No consensus was reached on this strategy meeting the "no regrets" standards.

<u>Analysis supporting the strategy as "no regrets"</u>

This constitutes a "no regrets" strategy despite being somewhat unorthodox in the definition of what constitutes a greenhouse gas and "no regrets." Black carbon particles are not a gas; they are particulate matter. This is a prime example of acting ahead of federal legislation, which is one of the original goals in "no regrets." The intention is to use existing TERP funds to purchase the same filters federal climate legislation eventually will mandate to trap black carbon. Significant reductions in warming potential can be attained, along with additional early action credits or carbon credits, not through direct regulation of carbon dioxide (CO_2), methane or other greenhouse gases but through a secondary pollutant.

These effects are not small. Research by Professor V. Ramanthan of the University of California at San Diego shows black carbon may be the second largest contributor to manmade climate change.[112] Several Oxford professors claim short-lived pollutants have been largely overlooked in mitigating climate change.[113]

Several draft legislative proposals have included black carbon, so it may be wise for Texas to also consider a carbon reduction plan. For example, in July 2010 Senators John Kerry and Joseph Lieberman proposed that the U.S. Environmental Protection Agency (EPA) use its existing authority under the Clean Air Act to reduce black carbon emissions from diesel engines by using diesel particulate filters to trap soot emissions. [114] The bill would require EPA to publish a report on black carbon sources, impacts and reduction opportunities, and will establish an interagency process to facilitate fast mitigation strategies focusing on non-CO_2 warming agents. This will involve other agencies such as the U.S. Department of Energy.

In addition, carbon credits are being sold currently on the Chicago and European climate exchanges based on black carbon reductions.

Ahead of federal legislation, this strategy can be pursued as a simple, voluntary measure to reduce greenhouse gas emissions or equivalents using existing, successful programs and any unexpended budgets.

To qualify as "no regrets," this strategy must also result in net savings for consumers and businesses and be achieved without financial cost to businesses and consumers. Since TERP is an existing program, and it does not generally expend all of its funds, consumers or businesses will bear no additional fees or costs. The only cost is the opportunity cost of leaving unexpended funds sitting in TERP accounts. Savings are achieved by not having to control particulate matter in other ways and through the increased health of Texans.[115]

Analysis supporting the strategy as one that does not qualify as "no regrets"

Comments from the Texas Commission on Environmental Quality and the Texas Oil & Gas Association

The proposed strategy does not meet "no regrets" standards. Black carbon is not one of the substances addressed under Senate Bill 184. Greenhouse gases as defined by the legislation include CO_2, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride. The strategy does not result in net savings for consumers and businesses, and it cannot be achieved without financial cost to businesses and consumers.

The strategy calls for the placement of diesel particulate filters primarily on school buses to reduce black carbon emissions. Though black carbon is not addressed under SB 184, the Texas Commission on Environmental Quality's (TCEQ) Clean School Bus Program currently funds the retrofit of school buses with diesel particulate filters to reduce school children's exposure to particulate matter from school buses. Black carbon is a component of particulate matter and as such, the particulate filers funded by the program also reduce black carbon. Therefore, the aims of the strategy are already being realized through the existing TCEQ Clean School Bus Program.

Retrofitting school buses with the diesel particulate filters costs $15,000 each. [116] These filters also generally require ongoing maintenance of approximately $300 - $400 per year.[117] Even if the initial cost of the particulate filter is provided through the Clean School Bus Program, part of TERP, the program does not fund the necessary maintenance. TERP is funded through various fees, including a vehicle title transfer fee, fees on the sale of on-road and off-road diesel vehicles and equipment and vehicle registration and inspection surcharges; these fees represent some cost to both consumers and businesses.

Diesel particulate filters do not improve fuel efficiency; there are no monetary savings to be realized from installation of these devices on school buses or other diesel engines.

In summary, a strategy to expand TERP to cover black particle reduction does not meet the "no regrets" standard under Senate Bill 184.

CATEGORY 2
ADDITIONAL RESOURCES

Increase Combined Heat and Power Use

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Refinery Flare Recovery Process Improvement

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Stationary Internal Combustion Engine Electrification

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CATEGORY 3 STRATEGIES

Category 3 includes strategies that were withdrawn from consideration by the submitter or were disqualified by the workgroups because they did not qualify as "no regrets" strategies or because additional research was needed to determine whether they qualified as "no regrets" strategies.

EMISSION REDUCTION TARGETS

<u>Strategy:</u> Carbon Reduction Commitment Energy Efficiency Program

Submitted by Carbon Shrinks LLC

This proposal was to develop a program requiring mandatory annual reporting of electricity consumption and carbon (CO_2) emissions, part of the United Kingdom's Carbon Reduction Commitment. Accurate energy accounting and assessment of prime areas for energy efficiency improvements are considered to be prerequisites to a carbon reduction commitment. If savings outweigh the costs of energy efficiency programs, businesses are likely to undertake such programs without a government mandate. If the state establishes and provides oversight of such programs, it will incur costs that must be included in any evaluation of the strategy under the "no regrets" standards. If cost-effective energy-saving opportunities become apparent in annual reporting, and the energy source has associated greenhouse gas emissions, some emissions reductions may result.

The Emission Reduction Targets workgroup determined that the strategy could not be implemented without a cost to Texas consumers or businesses. Tracking, compiling and reporting energy usage on an annual basis would entail significant costs. Agencies would incur expenses to manage the programs. Mandatory reporting by all large energy consumers would drive energy costs above current levels. Energy-saving opportunities would have to be developed and evaluated to determine if savings offset reporting costs and project investments. Also, the U.S. Environmental Protection Agency and U.S. Department of Energy ENERGY STAR® program already offers energy savings resources to businesses.

<u>Strategy:</u> Climate Change Agreement Program

Submitted by Carbon Shrinks LLC

This strategy was to develop a program similar to the United Kingdom's Climate Change Agreement program in which the state would negotiate climate change agreements with energy-intensive industry groups. The industry group would agree that its members will set a greenhouse gas reduction target for a future year and agree to be contractually bound to meet it. In turn, the state would exempt industry group members from future state regulation involving greenhouse gas taxes or reduction requirements. The state would also support the industry group in seeking exemption from federal greenhouse gas taxes or reduction requirements.

The Emission Reduction Targets workgroup agreed that this strategy might result in some reduction of greenhouse gas emissions, but was not clear on how the state would negotiate any binding agreement with an industrial sector. Also, many of the promises to industry from such an agreement appear to be beyond the legal authority of state agencies.

The workgroup decided that this strategy could not be achieved without a cost to Texas consumers or businesses. Most savings or break-even projects to reduce emissions already have been identified and evaluated by industries needing offsets for modifications or expansions.

ENERGY-EFFICIENT EQUIPMENT

<u>Strategy:</u> Dimming/Daylight Harvesting Fluorescent Ballasts

Submitted by Axis Technologies, Inc.

This strategy recommended the installation of dimming/daylight-harvesting controls on all appropriate lighting fixtures statewide to reduce electricity use while maintaining necessary light intensity in the workplace. This strategy could reduce greenhouse gas emissions, including CO_2, methane and nitrogen oxide. However, this strategy would increase greenhouse gas emissions associated with the energy needed to replace the heating effect of the electricity to be saved, including CO_2 and methane, during the winter heating season.

The Energy Efficient Equipment workgroup determined that this device has potential to be a “no regrets” strategy, but further study is needed to verify the costs and potential savings.

OIL AND GAS, REFINERY AND FUELS

<u>Strategy:</u> Low-Friction Oil

Submitted by Environmental Defense Fund

This strategy would require the use of engine oils meeting certain low-friction specifications to increase vehicle efficiency. The American Petroleum Institute’s (API’s) energy-conserving designation would be used as a starting point for oil requirements under this strategy.

Though engine oils are designed to greatly reduce friction in an engine, the American Petroleum Institute does not maintain a list of low-friction motor oils. Almost all motor oils on the market today, with the exception of diesel oils and very heavy or viscous oils not designed for motor vehicle use, meet energy conservation ratings and carry an API service symbol. Oils meeting the engine protection and energy-conserving requirements of the International Lubricant Standardization and Approval Committee carry an API certification mark. Most auto manufacturers recommend oils carrying that certification mark.

Energy-conserving motor oils make up a vast portion of the motor oils available for sale and use today. Auto engine manufacturers certify engines using specific motor oils as found in the vehicle owner’s manual. These oils generally carry the API certification mark. Newer vehicles with engines meeting Corporate Average Fuel Economy (CAFÉ) and emissions standards are already using high-quality, energy conserving and emissions-reducing motor oils.

With no model program to follow, the strategy is not recommended for further consideration.

OTHER INDUSTRY

<u>Strategy:</u> Carbon-Intensity Standard for Cement Manufacturing

Submitted by Environmental Defense Fund

This strategy recommends an average carbon-intensity standard for cement manufacturing of 0.8 metric tons of CO_2 equivalent per ton of cement produced domestically or imported to a jurisdiction imposing the standard. The carbon-intensity standard is presumed to be met through the use of alternative fuels or energy efficiency measures at the cement plant.

The workgroup determined that this strategy does not meet “no regrets” standards because insufficient information was provided to demonstrate that this strategy would result in net savings for businesses. A carbon intensity standard of 0.8 metric tons of CO_2 equivalent per ton of cement produced is not based on actual kiln performance. The explanation for the strategy does not include any detailed analysis of alternative fuels or other efficiency measures applicable to specific kilns or typical kiln operations. It also fails to explain how any savings would be applied across types of kilns, sources of raw material, pollution control requirements and related energy demands.

A mandatory standard presumes the ability to comply and ignores the premise that “no regrets” strategies should produce a positive economic return without government mandate. Cement industry representatives suggest many alternative fuel proposals for kilns would require an almost complete facility replacement. The strategy does not suggest a mechanism for enforcing the standard against cement importers. The strategy should not be considered a “no regrets” strategy due to its upfront capital cost, unless those costs are offset by savings within a reasonable amount of time and based on a reasonable discount rate for the investment.

The analysis also does not address how current cement manufacturing practices in Texas would be affected by an arbitrary carbon-intensity standard. Particularly unclear is how the use of waste fuels and the inclusion of solid waste materials in cement, both of which produce positive economic benefits, would leave opportunity for economic benefit from other alternative fuels or efficiency practices that may require far greater capital investments.

In the absence of any detailed justification on how a standard for carbon intensity could be applied to Texas cement kilns that could reasonably return a positive economic benefit, this strategy does not meet “no regrets” standards.

<u>Strategy:</u> Closed-Loop Storage Tank Degassing

Submitted by Purgit Emission Controls

This strategy proposes that storage tank facilities use closed-loop degassing when tanks are taken out of service, in lieu of burning extracted vapors. The proposed system employs a condenser for vapor recovery, returning the remaining gases to the storage tank. This method avoids emissions of greenhouse gases, volatile organic compounds, and carbon monoxide. One vendor of such a system claims the closed-loop alternative is cost-competitive with the conventional vapor combustion option, but no data were supplied to support the claim.

Avoiding combustion of extracted vapors from storage tank degassing can reduce some greenhouse gas emissions. No information, however, has been supplied on emissions from the liquid nitrogen used for cooling in the closed-loop system or for the energy required to recover condensate, which most likely contains water vapor as well. The use of a closed-loop vapor recovery system for tank-cleaning operations may be a feasible alternative in some situations, but a thorough evaluation of net cost and emissions reduction must be performed on a case-by-case basis.

The workgroup determined that this strategy does not meet “no regrets” standards because insufficient information was provided to show net savings for businesses in the state. The strategy lacks data support on investment returns. A closed-loop refrigerated vapor recovery system might not be practical depending upon the size of tank and its contents. In cases where degassing is required by the Texas Commission on Environmental Quality, any control-efficient technology that reduces greenhouse gas emissions should be an acceptable strategy. Finally, many sites already have permanent control devices to reduce emissions from tank degassing. Requiring a company to hire a contractor to bring in a portable closed-loop vapor recovery system would create added costs.

Strategy: Waste Reduction in Concrete Use

Submitted by Environmental Defense Fund

This strategy would set a minimum waste standard to be imposed on concrete batch plants or establish fees to be levied on concrete that is produced by a batch plant in excess of what is actually used at a job site or other point of use.

The work group determined that this strategy is inconsistent with the SB 184 requirements and does not qualify as a "no regrets" strategy. The strategy would impose either mandates in the way of minimum waste standards or fees against business owners, both of which are inconsistent with the premise of SB 184. Mandates to force a company to take some action would be unnecessary if the action truly qualifies as a "no regrets" economic gain and the levy of a fee on its face is not a "no regrets" strategy. The costs associated with the presumed waste of concrete are born by the business delivering the concrete and not the entity responsible for ordering a certain amount to be delivered, and therefore, more responsible for any waste that results.

The strategy is based on a measure developed by the California Air Resources Board (CARB). CARB estimated that 5 to 8 percent of the concrete produced in California is returned to the batch plant of origin as waste but provided no basis for that estimate. Work group members familiar with the Texas concrete industry believe that a waste factor of 5 to 8 percent is not realistic.

The CARB analysis does not include many other operational and cost considerations that would have a material effect on its assumptions. The analysis ignores the fact that much concrete not used at a job site is recycled by the batch plant or other facility. The recycling of waste concrete is already incentivized because the practice avoids subsequent waste management, transportation, and disposal costs associated with concrete that cannot be re-used. Adding this requirement would result in an additional layer of regulation and administration that ultimately would diminish what the marketplace is already undertaking, and certainly would not result in net savings for producers or customers.

The imposition of such a strategy could result in incentives that are not consistent with good business practices or construction project management. If a job runs out of concrete, it can have huge economic and cost impacts, not to mention quality or safety challenges. In some cases, the entire placement must be removed and the pour started again. This would certainly have significant financial cost for business and consumers.

STATE AND LOCAL GOVERNMENT

Strategy: Reduce Electricity Pumping Costs and Greenhouse Gas Emissions at Texas Water Utilities

Submitted by Clean Water Pipe Council

This strategy recommends the replacement of polyvinyl chloride (PVC) water pipes in Texas water utilities with larger-diameter, sustainable pipe during maintenance or when installing new lines. PVC requires relatively thick walls for the same nominal pipe size compared to ductile iron or steel pipe. The smaller inside diameter of PVC pipe requires more energy to pump water through the system; this simple strategy would reduce the total energy required to deliver water to users.

More research would be needed to verify that the proposed strategy meets “no regrets” standards. The cost equation needs further development, including manufacturing cost differences between iron and plastic pipe and all the secondary impacts of energy inputs, production of source materials, transportation costs and other issues.

Life-cycle costs pertaining to plastic recycling technology are changing and developing, so absolute assumptions about our ability to recycle PVC may not be appropriate. If the cost difference and justification for iron pipe over PVC is the pumping cost associated with fixed diameter as a function of nominal size, the simplest answer could be to marginally increase the size of PVC pipe. Utility and civil engineering communities must be given considerable deference in the criteria used in the marketplace as to what constitutes the best product.

The workgroup determined that more research is needed to verify that the strategy meets “no regrets” standards.

Strategy: Shortened or Alternative Work Weeks

Submitted by Public Citizen

This strategy recommends that all non-essential state government agencies and services move to a Monday through Thursday schedule, with work hours of 7 a.m. to 6 p.m. or 8 a.m. to 7 p.m. This would remove government employees from the roads during the heaviest commuting times and reduce government energy expenditures, as state buildings would be closed on Fridays.

Though the strategy would reduce greenhouse gas emissions, it is not clear whether it would result in net savings for consumers or businesses or help Texas businesses maintain global competitiveness. A pilot program could help determine the strategy’s potential. Savings could be small initially; as programs are refined, success could be realized through increased energy savings.

The decision to implement a pilot must consider savings as well as the pilot agency’s ability to function normally under the new work schedule. Upon completion of the pilot program, the proposal could be reevaluated against “no regrets” standards.

VEHICLES AND TRANSPORTATION

Strategy: “Feebate” Program in Lieu of Emissions Standards

Submitted by Environmental Defense Fund

This strategy would establish a “feebate” program that would provide both incentives and disincentives to induce consumers to buy more energy-efficient vehicles and manufacturers to improve technology to reduce emissions. This proposal was removed from consideration because the U.S. Environmental Protection Agency and National Department of Transportation’s National Highway Traffic Safety Administration finalized a joint rule in April 2010 that would accomplish similar goals.

Strategy: Light-Duty Vehicle Greenhouse Gas Standards

Submitted by Environmental Defense Fund

This strategy would reduce greenhouse gas emissions from passenger vehicles through technological efficiency improvements or other actions. This proposal was removed from consideration because the U.S. Environmental Protection Agency and National Department of Transportation’s National Highway

Traffic Safety Administration finalized a joint rule in April 2010 establishing new standards for model year 2012-2016 light-duty vehicles to reduce their greenhouse gas emissions and improve fuel economy. These federal standards are equivalent to the greenhouse gas standards embodied in California's LEV II program, on which this recommended measure was based, which also includes emissions standards for criteria pollutants that may produce comparable benefits to the federal standards. However, California's LEV II program also includes emissions standards for criteria pollutants that may produce additional emission reduction benefits than the recently adopted federal standards. [1]

The state of Texas should continue to monitor and participate in the development of post-2016 emissions standards for vehicles. Over the lifetime of the vehicles sold during 2012-2016, the national program is projected to reduce U.S. greenhouse gas emissions by 960 million metric tons (21 percent by 2030) and save 1.8 billion barrels of oil, while consumers can expect to see fuel savings that exceed the anticipated increase in vehicle purchase prices.[2]

Strategy: Solar Reflective Automotive Paint and Window Glazing

Submitted by Environmental Defense Fund

This strategy would increase vehicle efficiency by reducing the engine load for air conditioning the passenger compartment.

This measure was recommended to be removed from consideration under SB 184 because the state of California, from whose analysis this measure was based, ceased rulemaking on its "Cool Cars" regulation due to a lack of consensus on the effect window glazing would have on the operation of electronic equipment inside cars. Further, California had earlier decided to suspend a requirement for reflective paints until more pigment development work was completed. The California Air Resources Board plans to incorporate a performance-based approach to cooling vehicle interiors into the next iteration of the light-duty motor vehicle greenhouse gas regulations for 2017 and later model years.[3]

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[2] U.S. Environmental Protection Agency, Office of Transportation and Air, "Finalize Historic National Program to Reduce Greenhouse Gases and Improve Fuel Economy for Cars and Trucks," http://www.epa.gov/otaq/climate/regulations/420f10014.pdf. (Last visited October 27, 2010.)

[3] California Air Resources Board, "Cool Cars and Reflective Glazing," April 2010, http://www.arb.ca.gov/cc/cool-cars/cool-cars.htm. (Last visited October 27, 2010.)

STRATEGIES IN OTHER STATES AND COUNTRIES

The Carbon Trust supplied the following information to describe their program in the United Kingdom.

In 1999, the United Kingdom (UK) Government announced its intention to introduce the climate change tax as part of its climate change program. This climate change tax, implemented in 2001, is a charge on energy purchased by non-domestic consumers.

The Carbon Trust was established by the UK Government in 2001 at the request of business, based on the recommendation of the Government's Advisory Committee on Business and the Environment. The committee wanted an independent organization to help business identify and implement energy efficiency measures and to share the risk associated with the research, development and deployment of new and emerging clean energy technologies.

The Carbon Trust was set up under UK Companies Act as an independent, not for dividend private company, limited by guarantee. It has no shareholders. Its mission is to accelerate the move to a low carbon economy. The board of the Carbon Trust comprises independent members and representatives from those government departments providing funds. The other board members are drawn from the retail, energy and manufacturing sectors, the Confederation of British Industry, and the university research sector.

The Carbon Trust's annual funding comes from the UK Government and the Devolved Administrations (Scotland, Wales and Northern Ireland). The Carbon Trust Board approves the funding for the respective business areas and activities of the Carbon Trust. Costs incurred on agreed activities are reimbursed monthly from the approved budget allocation. Any revenues generated by the Carbon Trust are reinvested to help improve energy efficiency, save money, reduce carbon emissions and develop clean energy technologies for the future.

The Carbon Trust is organized into five complementary business areas:

- Insights – Explains the opportunities surrounding climate change
- Solutions – Delivers carbon reduction solutions
- Innovations – develops low carbon technologies
- Enterprises – Creates low carbon businesses
- Investments – Finances clean energy businesses

The Carbon Trust – range of activities

The Carbon Trust provides specialist support to business and the public sector to help reduce carbon emissions, save energy and commercialize low carbon technologies. By stimulating low carbon action, the Carbon Trust contributes to key UK goals of lower carbon emissions, the development of low carbon businesses, increased energy security and associated jobs.

The Carbon Trust helps decrease carbon emissions, improve energy efficiency and save money by:

- providing expert advice and finance to help organizations cut carbon, and
- setting standards for carbon reduction.

The Carbon Trust helps reduce potential future carbon emissions by:

- opening markets for low carbon technologies;
- leading industry collaborations to commercialize technologies; and
- investing in early stage low carbon companies.

The Carbon Trust corporate brochure describes the company, its work and achievements in more detail, including for example, the energy efficiency loans scheme to small businesses; its incubation service to help new and emerging low carbon technology businesses; and accreditation schemes such as the Carbon Trust Standard for organizations wishing to obtain independent accreditation of their carbon performance and intention to reduce carbon emissions over time.

In addition, the Carbon Trust, to further its mission of moving toward the low carbon economy, has commenced working internationally. To date the company has established in conjunction with the Australian government an Australian Carbon Trust and has a joint venture with a government agency in China. In January, a U.S. operation was established which seeks to work with State Governments to accelerate the business community and the public sector in addressing energy and carbon reductions through access to the experience, data and expertise of the Carbon Trust.[i]

Focusing on how to improve energy efficiency in business and public sectors, and drawing on the experience and knowledge of the Carbon Trust since it started its energy efficiency programs in 2001, the company provides these comments:

- how the Carbon Trust approaches the challenge of improving energy efficiency in organizations;
- outline of the Carbon Trust's customer offerings, which have been tried, tested and shown to be effective;
- the Carbon Trust's achievements in energy, cost and carbon savings; and
- the Carbon Trusts' main findings and database assets.

From the Carbon Trust's understanding of energy use in Texas businesses and the public sector, the company thinks there are opportunities to implement cost-effective energy efficiency. Many measures will pay for themselves in less than three years. Longer payback measures may still be worthwhile in terms of the associated internal rates of return.

<u>Approaching the challenge of achieving commercially driven energy efficiency action</u>

According to the Carbon Trust, the ultimate goal of energy efficiency should be that, via a mixture of publicly funded pump-priming and market signals from the Texas Legislature (e.g. SB 184 [81R]), the provision of energy efficiency goods and services will be made available on a commercial basis. The first step is to understand why there is no significant market activity on energy efficiency. What are the gaps and barriers inhibiting the provision of energy efficiency goods and services on a willing-buyer willing-seller basis, at scale and available commercially across business and public sector organizations?

The main barriers to energy efficiency in the business community and in the public sector are:

- For many organizations, energy is not a big cost, and therefore, energy efficiency is not a priority.
- Management time and attention are in short supply.
- Identifying opportunities requires external professional advice.
- Money is tight. There is none left over for energy efficiency; the short payback criteria of businesses eliminate worthwhile energy efficiency measures.
- Confidence is lacking in energy efficiency savings claims.

<u>The Carbon Trust's approach is to devise ways to overcome these barriers</u>

Each barrier needs to be addressed through the design and provision of attractive customer offerings.

- Lack of understanding of energy efficiency opportunities is addressed through the provision of impartial, authoritative information and advice. The means can include: Web-based information, guides and case studies, customer helpline, independent energy efficiency surveys and follow-up to help management take action. Since 2001, the Carbon Trust has visited about 30,000 businesses and has helped them save $1.7 billion in energy costs. The trust responds to tens of thousands of inquiries each year. In addition, the Carbon Trust runs extensive energy efficiency training programs and events for energy managers.
- Lack of funds is addressed through interest-free loans for energy efficiency investments. This has proved to be very popular. Since starting the loan program in 2006, 4,000 businesses have taken out $123 million in loans, the majority of which have been repaid within two years. A typical loan is around $30,000 to $43,000.
- Lack of confidence in the claims of energy efficiency product manufacturers and consultants is addressed through the creation of an independently assessed list of good quality, commercially available energy efficiency products. The Carbon Trust has worked with the relevant government departments in the UK to create and run the Energy Technology List of best-in-class products, similar to the ENERGY STAR® program. To ensure businesses and the public sector have confidence in the recommendations made by energy consultants, the Carbon Trust has created an accreditation system to verify the competency and independence of the energy consultants it uses.
- Lack of awareness of energy efficiency opportunities can be successfully addressed with case studies, events and media promotion. Additionally, for those organizations that can demonstrate high standards of energy and carbon management, and that commit to reduce emissions year on year, they can apply for independent recognition of the Carbon Trust's Carbon Trust Standard. All this visibility for successful projects and energy efficient

organizations helps to promote the opportunities to others who have not yet considered how energy efficiency can help them be more profitable and reduce carbon emissions.

Exhibit 24
Case Study 1: Dupont Teijin Films

DuPont Teijin Films, Dumfries, Scotland

CARBON TRUST

- The Carbon Trust helped DuPont Teijin Films implement an automated energy monitoring & targeting system at their factory in Dumfries.
- Using information provided by the M&T system, the company has been able to target energy saving measures in specific areas, including auto turn-off of idle equipment and matching utility supply to production demand.
- The project cost for the M&T system was £34,000 which included the computer hardware and software as well as the modification of a number of meters together with wireless and network connections.

Savings through such measures are estimated to be £125,000 (at 2007 prices) in energy costs and in the order of 1,400 tonnes of CO_2 per year in emission reductions.

Source: The Carbon Trust

Exhibit 25
Case Study 2: Toughglass Ltd

Toughglass manufacturer of toughened safety glass

CARBON TRUST

- Energy survey showed that after raw materials and wages, energy bills were its biggest cost, averaging £500,000 pa.
- The existing primary and booster fans in the Toughglass manufacturing process used fixed speed drives which meant they operated at constant full capacity. These alone were responsible for energy costs of £58,000 pa.
- A £28k loan enabled the company to replace the existing fixed drives with variable speed drives. This saved £45,000 year on year, covering the monthly loan repayments more than three fold.

> "Getting a Carbon Trust Loan has made a real difference to our bottom-line. Not only will the savings we make cover the cost of the loan repayments, but we will actually add to our company profits." Peter O'Hara, Financial Director.

Source: The Carbon Trust

Exhibit 26
Case Study 3: JCB Construction and Agricultural Equipment

JCB – construction and agricultural equipment manufacturer

CARBON TRUST

- JCB decided to make energy efficiency part of its strategic planning process.
- A Carbon Trust survey within a Carbon Management service showed the company the way forward, including:
  - tighter controls on energy use - £287k pa savings;
  - encourage staff to take responsibility for energy efficiency action - £80k pa savings;
  - metering, monitoring and targeting identifies opportunities to reduce consumption - between 10% and 15%;
  - a one-off spend of £4,000 on a local compressor for testing new engines - £30,000 savings.
- In the first six months of implementation, JCB's energy costs were cut by £728,000, while its CO_2 emissions are expected to drop by 7,800 tonnes over the course of the year.
- Total project cost: £300,000; projected annual cost savings: £1,500,000; projected annual CO_2 savings: 7,800 tonnes

Source: The Carbon Trust.

Achievements, including energy cost savings

These customer offerings have been developed over nine years. More and more businesses and public sector organizations are seeing the benefits. Since 2001, the Carbon Trust has helped its clients save $1.7 billion through energy efficiency improvements for a capital investment of about $1.1 billion. The cumulative cost of stimulating this investment is less than $240 million. The capital investment of $1.1 billion represents not only the pathway to cost savings for businesses, but also the creation of jobs in the energy efficiency goods and services sector which otherwise would not have been stimulated.

Main findings and assets

Carbon Trust analysis of energy efficiency activities and experience to date has provided very useful insights which show how to improve the effectiveness of energy efficiency activities even further going forward. For example, work with thousands of UK organizations has confirmed that:

- Energy efficiency is a huge financial and environmental opportunity with potential annual savings of $4.4 billion and 29 metric tons of equivalent CO_2 emissions.
- Measures offer at least 11 percent savings opportunity with an overall internal rate of return of 43 percent.
- Approximately 80 percent of measures pay back in less than three years.
- Many organizations have made significant progress realizing that potential. Some leaders have implemented close to 100 percent of the identified opportunities.

In the Carbon Trust's opinion, the same scale of energy efficiency and cost savings potential could be available in Texas.

The principal assets created over the past nine years include the following:

- A database of more than 100,000 energy efficiency recommendations obtained from tens of thousands of visits to organizations across the UK. This database can be used to analyze energy efficiency opportunities by company size, by energy efficiency action taken or not taken and by main business activity. It is highly likely that companies engaged in similar business activities will have similar energy efficiency opportunities, irrespective of location. Those companies that have taken little or no action are likely to have similar opportunities to improve energy efficiency compared with other companies, irrespective of location. The energy efficiency database can now provide insights into the popular energy efficiency measures; and after taking action to reap the low-hanging fruit, what energy efficiency investment opportunities remain. Systematic assessment of energy efficiency opportunities holds the potential for cost-effective assessment of simple energy efficiency opportunities.
- A capability in program design and execution
- A brand that is internationally recognized as synonymous with quality, business focus, independence and effective delivery.

Closing comments

These comments outline the way the Carbon Trust has approached the challenge of stimulating energy efficiency action to help organizations save money, reduce energy waste and reduce carbon emissions, where there is a policy interest to do so. Through this experience and analysis, the company is acquiring the necessary information and operating experience to underpin the commercialization of the provision of energy efficiency goods and services. At this time, the Carbon Trust is exploring, through a formal expression of interest process, how it can commercialize the energy efficiency loans.

It is the company's view that it can help Texas design and execute energy efficiency programs to achieve the objectives inherent in the implementation of SB 184 "no regrets" legislation. The Carbon Trust is interested in assisting to accelerate the process of designing energy efficiency interventions. The company can help execute these interventions so they are more effective; and can work with the state, the business community and the energy efficiency goods and services sector to create and expand the market for energy efficiency goods and services so that, in due course, the initial publicly funded pump-priming helps create a self-sustaining energy efficiency goods and services industry.

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[i] Carbon Trust, "Working with you to open up low carbon opportunities," UK, January 2010, *http://www.carbontrust.co.uk/Publications/pages/publicationdetail.aspx?id=CTC763*. (Last visited November 1, 2010.)

APPENDIX A:

Environmental Defense Fund Methodology

Introduction

Texas is the country's second largest economy and the largest emitter of greenhouse gasses. These two facts point to tremendous opportunities within the state to reduce our emissions of carbon dioxide, methane and other greenhouse gases (GHG). As a part of the Senate Bill 184 process, Environmental Defense Fund (EDF) is submitting a collection of recommended measures, each of which will reduce GHG emissions and save Texans money. Due to the complex nature of these measures, at this time we are providing basic information to support a conclusion that the measure qualifies as “no-regrets.” In our analyses and summaries of existing research from other states and organizations, we have been as specific as currently possible and our assumptions are detailed throughout this submission. As the review process proceeds, we would welcome the opportunity to work with CPA staff to develop more specific quantification.

Summary of Findings

Our survey focused on three areas of opportunity in the Texas economy: the industrial sector, energy efficiency and the transportation sector. Additional measures are proposed for water efficiency; however the lack of substantial analysis in this sector precludes any quantitative expectations related to water efficiency. This is an area where we would welcome the opportunity to expand the base of knowledge by working with CPA staff to develop innovative "no regrets" approaches to conserving water in Texas.

As the table below shows, no-regrets actions taken in these sectors combined offer net annualized savings of more than $22 billion for Texans. GHG emission reductions from these measures are remarkable, with a combined impact of 115 million tons of CO_2E (CO_2 & equivalent greenhouse gases). To provide some sense of the magnitude of emissions savings achievable in Texas, the EPA's greenhouse gas equivalencies calculator estimates the average annual carbon emissions of a single coal plant to be 3.85 million metric tons. Thus, implementing the measures proposed would be the equivalent of permanently removing 30 coal plants.

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Summary of Net Annualized GHG Emissions and Financial Savings for Texas*

	2020 CO_2E Saved (MMT)	Annualized Costs (Million $)	Annualized Savings (Million $)	Net Annualized Savings (Million $)
Industrial Sector				
1: Reduce Methane Emissions From the Exploration and Production of Oil and Gas[2]	15	TBD	$ 390	TBD
2: GHG Leak Reduction from Oil and Gas Transmission	0.6	0.3	11.9	11.6
3: Refinery Flare Recovery Process Improvements	0.2	4.5	31.1	26.6
4: Carbon Intensity Standard for Cement Manufacturers	1.3	13.1	15.4	2.3
5: Waste Reduction in Concrete Use	0.8	37.1	56.0	18.9
6: Refinery Energy Efficiency Process Improvement	2.3	43.5	279.9	236.4
7: Industrial Boiler Efficiency	0.7	15.4	101.0	85.5
8: Stationary Internal Combustion Engine Electrification	0.2	12.1	16.9	4.8
9: Industrial Sector Energy Efficiency[1]	2.9	1192.7	4665.4	3472.7
Subtotal	**24**	**$ 1,319**	**$ 5,568**	**$ 3,859**
Energy Efficiency				
10: Electricity Reduction Program 32,000 GWH reduced	10.3	$ 2,294	$ 3,416	$ 1,122
11: Utility Energy Efficiency Programs	2.5	$ 666	$ 800	$ 134
12: Existing Non-Low-Income Homes[1]	1.1	$ 1,615	$ 1,763	$ 148
13: Existing Low-Income Homes[1]	0.5	$ 486	$ 844	$ 359
14: New Homes[1]	0.3	$ 169	$ 433	$ 264
15: Electrical Devices and Small Appliances[1]	1.1	$ 36	$ 686	$ 650
16: Lighting and Major Appliances[1]	0.6	$ 116	$ 443	$ 327
17: Existing private commercial buildings[1]	1.1	$ 771	$ 1,098	$ 327
18: Government buildings[1]	0.5	$ 274	$ 517	$ 243
19: Privately owned new buildings[1]	0.4	$ 158	$ 369	$ 211
20: Office and non-commercial devices[1]	1.1	$ 84	$ 602	$ 517
21: Community Infrastructure[1]	0.6	$ 42	$ 475	$ 433
22: Increase Combined Heat and Power Use	4.5	$ 244	$ 1,128	$ 884
23: Natural Gas Reduction Programs (800 Million Therms saved)	2.9	$ 649	$ 966	$ 317
24: Residential Refrigeration Early Retirement Program	0.07	$ 13	$ 17	$ 4
Subtotal	**13**	**$ 2,501**	**$ 6,619**	**$ 4,119**
Transportation Sector				
25: Light-Duty Vehicle GHG Standards	21	$ 1,326	$ 8,784	$ 7,458
26: GHG Feebate Program in Lieu of GHG Standards	21	$ -	$ -	$ -
27: Low Carbon Fuel Standard	10	$ 7,419	$ 7,419	$ -
28: Local Government Actions and Targets (Vehicle Miles Traveled Reduction)	3	$ 337	$ 1,385	$ 1,048
29: Pay-As-You-Drive Car Insurance[2]	3	$ -	$ 3,500	$ 3,500
30: Tire Pressure Program	0.4	$ 103	$ 151	$ 49
31: Tire Tread Program	0.2	0.405	$ 83	$ 83
32: Low Friction Oil	2	$ 351	$ 776	$ 425
33: Solar Reflective Automotive Paint and Window Glazing	0.6	$ 243	$ 247	$ 4
34: Heavy-Duty Vehicle GHG Emission Reduction (Aerodynamic Efficiency)	0.6	$ 1,090	$ 1,441	$ 351
35: Medium and Heavy-duty Vehicle Hybridization	0.3	$ 63	$ 119	$ 57
Subtotal	**42**	**$ 10,931**	**$ 23,905**	**$ 12,974**
Grand Total	115	$ 19,867	$ 43,030	$ 22,773

*: Unless otherwise noted figures in this table are from the California Air Resource Board's, "Climate Change Proposed Scoping Plan Appendices" Vol. I & II. Figures from this study are adjusted to compensate for the difference in state GDPs between California and Texas.

1: From McKinsey & Co's "Unlocking Efficiency in the U.S. Economy" and are adjusted for differences between the U.S. GDP and Texas GDP. Figures are also annualized over 10 years using a 5% discount rate.

2: Calculated by Environmental Defense Fund based on analysis noted in the description for the related measure.

Analysis Resources and Methodology

In our survey of existing research on measures considered to be "No Regrets," two studies served as primary resources for many measures: “Unlocking Energy Efficiency in the U.S. Economy” by McKinsey & Company and the California Air Resource Board's "Climate Change Proposed Scoping Plan" Appendices, Volume I: SUPPORTING DOCUMENTS AND MEASURE DETAIL,” December 2008 and “VOLUME II: ANALYSIS AND DOCUMENTATION," October 2008.

In presenting findings from various studies over different time frames costs, benefits and GHG emission impacts have been annualized using methodologies and assumptions from the California Air Resource Board's analysis. Unless otherwise noted, cost for a measure is the sum of the annualized capital cost and program maintenance costs. Annualized Capital Cost is defined as the product of the capital expenditure and the capital recovery amortized over a specified period of time at an annual discount rate of 5%. The capital recovery factor (CRF) is calculated using the formula:

$$\text{Capital Recovery Factor} = \frac{i(1+i)^n}{(1+i)^n - 1}$$

Unlocking Energy Efficiency in the U.S. Economy

“Unlocking Energy Efficiency in the U.S. Economy” by McKinsey & Company is a comprehensive analysis of energy efficiency opportunities throughout the U.S. The findings in this study are related to the entire U.S. and provide net present valuations over 10 years. For the purposes of this submission, we have focused only on those efficiency measures for which the 10 year net present value represents a savings for Texans. In addition, we examined selected states’ climate change action plans to identify potential cost-saving measures.

In order to help make those findings more relevant to Texas, EDF has adjusted both the carbon dioxide reductions and the financial savings by Texas' percentage of the national GDP (~9% in 2008). While this does not represent a thorough analysis of the impact of those specific measures in Texas, it provides a sense of scale of the opportunities in our state. An earlier Texas-specific report by the American Council for an Energy Efficient Economy recommended specific policies that would create about 38,000 new jobs by 2023, while saving Texans $37 billion on their electric bills over that same period.[1] Environmental Defense Fund would welcome the opportunity to work with CPA staff to develop more up-to-date evaluations for Texas.

California Air Resource Board: "Climate Change Proposed Scoping Plan"

In 2008, California's Air Resource Board (CARB) released their "Climate Change Proposed Scoping Plan" which contained a large number of measures that are considered "no regrets" by California. States such as Utah, North Carolina, Connecticut, Maine and New

Mexico have undergone processes similar to the Texas "No Regrets" policy. Measures that have been identified by those states as "no regrets" have been noted and the report from the state is referenced as well.

Due to the thorough nature of California's analysis and the adaptability of their approach to other analyses used, in most cases the CARB report has been used to summarize the GHG impacts and net savings. In order to help make those findings more relevant to Texas, EDF made similar adjustments as in the report from McKinsey & Company. Specifically, EDF has adjusted both the carbon dioxide reductions and the financial savings by the ratio of Texas' GDP to California's (~67% in 2008).

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[1] American Council for an Energy-Efficiency Economy, *The Economic Benefits of an Energy Efficiency and Onsite Renewable Energy Strategy to Meet Growing Electricity Needs in Texas*, by John A. Laitner, R. Neal Elliott and Maggie Eldridge (September 1, 2007), http://aceee.org/pubs/e076.htm. (Last visited October 27, 2010)

APPENDIX B:

Comments Relating to Environmental Defense Fund Submissions

TEXAS OIL & GAS ASSOCIATION

August 19, 2010

Mr. David C. Schanbacher, P. E.
Division Director – Natural Resources Policy
Texas Comptroller of Public Accounts
Post Office Box 13528
Austin, Texas 78711-3528

Submitted Via Email to: TexasNoRegrets@cpa.state.tx.us

RE: Senate Bill 184 – Greenhouse Gas Emissions Reduction Proposed Strategies

Dear Mr. Schanbacher:

The Texas Oil & Gas Association (TxOGA) is the largest and oldest petroleum organization in Texas, representing over 4,000 members. The membership of TxOGA produces in excess of 90 percent of Texas' crude oil and natural gas, operates nearly 100 percent of the state's refining capacity, and is responsible for the vast majority of the state's pipelines. According to the most recent data, the oil and gas industry employs 189,000 Texans, providing payroll and benefits of over $24 billion in Texas alone. In addition, associated large capital investments by the oil and gas industry generate significant secondary economic benefits for Texas.

We appreciate the opportunity to comment on SB 184, the "no regrets" greenhouse gas emissions reduction proposed strategies. TxOGA supports the efforts of the Texas Comptroller's SB 184 Advisory Committee to identify strategies that can meet the criteria under SB 184 legislation.

A majority of the proposed SB 184 strategies are "Complementary Measures" to California's AB 32 Global Warming Solutions Act of 2006. These strategies are based on the December 2008 California Air Resources Board (CARB) Scoping Plan, assumptions, economic analysis and accompanying appendices, which was found to be deficient even by the CARB Economic and Allocation Advisory Committee (EAAC). Consequently, the data used, assumptions made and economic analysis based on the December 2008 CARB Scoping Plan and accompanying appendices are inaccurate.

Proponents of these California inspired control measures ignore basic cost/benefit analysis. The underlying information submitted to support many of these proposed strategies was largely based on broad studies in other geographic locations and does not accurately represent the emissions reductions or costs specific to sources in Texas. Certainly, the adjustment of emission reductions and costs from other states by simply applying a relative percentage factor of GDP does not truly account for the real differences between states' industrial emission situations and economies.

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TxOGA would like to submit the following facts concerning the CARB AB 32 coping Plan Economic Analysis.

During the December 11, 2008 CARB Board meeting, the Board adopted Resolution 08-47, which adopted the Scoping Plan and directed staff to provide an updated economic analysis by the end of 2009 and to also foster opportunities for other economic analysis by other parties. CARB also approved a separate, independent study by Charles River Associates (CRA).

The reason for this direction was negative reviews by an independent peer review panel, stakeholders and by the California Legislation Analyst (LAO) Office. *CARB Climate Change Scoping Plan Resolution 08-47* *http://www.arb.ca.gov/cc/scopingplan/document/final_sp_resolution.pdf*

According to the April 14, 2010 California LAO Policy Brief, Implementation of AB 32—Global Warming Solutions Act of 2006

> ***Scoping Plan Developed on Time.*** *In December 2008, ARB adopted the AB 32 Scoping Plan which contains a list of 72 proposed measures and regulations intended to meet the state's 2020 GHG emission reduction target. The scoping plan documentation included an analysis of the economic impacts of the plan. The ARB released an update of this economic analysis in late March of this year, attempting to respond to critiques of its initial economic analysis that found it deficient on a number of fronts.*

CARB staff along with EAAC and with public input developed the Updated AB 32 Scoping Plan and Economic Analysis, which was published in March 2010. *Updated AB 32 Scoping Plan Economic Analysis* *http://www.arb.ca.gov/cc/scopingplan/economics-sp/economics-sp.htm*

After the Updated AB 32 Scoping Plan Economic Analysis was released and reviewed, problems remain. For example, the economic conclusions based on the 2008 CARB scoping plan economic analysis showed a slight economic savings. The updated CARB economic report shows costs and not net savings for climate change policies. The updated economic analysis presented during the April 2010 Board meeting shows a negative impact on the economy ranging from -.2% to -1.4% of Gross State Product. *AB 32 Scoping Plan Economic Analysis April 21, 2010 California Air Resources Board* *http://www.arb.ca.gov/cc/scopingplan/economics-sp/meetings/042110/arb.pdf*

The Charles River Associates March 2010 report showed a negative impact on the economy of $25 - $125 billion. *Analysis of the California ARB's Scoping Plan and Related Policy Insights, Charles River Associates, March 24, 2010* *http://www.crai.com/uploadedFiles/analysis-of-ab32-scoping-plan.pdf*

Analysis of the California ARB's Scoping Plan and Related Policy Insights, Charles River Associates, April 21, 2010 *http://www.arb.ca.gov/cc/scopingplan/economics-sp/meetings/042110/bernstein.pdf*

When analyzing the CARB Low Carbon Fuel Standard (LCFS), studies by Charles River Associates and Sierra Research show a large disparity in CARB Cost Assumptions resulting in increased fuel costs. Cost estimates range from $100 - $200/ton of CO2 removed.

Charles River Associates study on the Updated CARB Scoping Plan estimates that "accounting for likely higher costs or procuring and delivering advanced low carbon fuels to the California fleet adds $20 to $40 billion dollars to the overall program (AB 32) costs." *Charles River Associates Analysis of the California ARB's Scoping Plan and Related Policy Insights. March 25, 2010* *http://www.crai.com/uploadedFiles/analysis-of-ab32-scoping-plan.pdf*

Sierra Research analyzed the recently adopted CARB Low Carbon Fuel Standard (LCFS) and estimates "fuel costs increase by $3.7 billion per year in 2020, with NOx emissions increasing and no detectable

change in the climate." *Preliminary Review of the CARB Staff Analysis of the Proposed Low Carbon Fuel Standard (LCFS) Sierra Research, Inc. April 8, 2009*
http://www.ab32ig.com/documents/LCFSSRReview0409.pdf

The California Legislative Analyst's Office (LAO) reviewed the AB 32 Scoping Plan throughout its progress and provided periodic reports, policy briefs and responses to legislative inquiry.

The LAO has been providing fiscal and policy advice to the Legislature for more than 65 years. It is known for its fiscal and programmatic expertise and nonpartisan analyses of the state budget. The office serves as the "eyes and ears" for the Legislature to ensure that the executive branch is implementing legislative policy in a cost efficient and effective manner. The LAO is overseen by the Joint Legislative Budget Committee, a 16-member bipartisan committee. The office currently has a staff of 43 analysts and approximately 13 support staff.

Below are excerpts of various California Legislative Analyst's Office studies, reports and correspondence concerning the CARB AB 32 Scoping Plan and Economic Analysis. These can be located at the LAO website: *http://www.lao.ca.gov/laoapp/main.aspx?type=3&CatID=12*

LAO's Critique of the AB 32 Scoping Plan Economic Analysis
November 21, 2008

California LAO was asked to report on the draft scoping plan of the Air Resources Board (ARB) for implementation of the Global Warming Solutions Act of 2006 (Chapter 488, Statutes of 2006 [AB 32, Núñez]). We conclude that (1) the scoping plan's overall emissions reductions and purported net economic benefit are highly reliant on one measure—the Pavley regulations, (2) the plan's evaluation of the costs and savings of some recommended measures is inconsistent and incomplete, (3) Macroeconomic modeling results show a slight net economic benefit to the plan, but ARB failed to demonstrate the analytical rigor of its findings, (4) economic analysis played a limited role in development of scoping plan, and (5) despite its prediction of eventual net economic benefit, the scoping plan fails to lay out an investment pathway to reach its goals for GHG emissions levels in 2020.

The plan's evaluation of the costs and savings of some recommended measures is inconsistent and incomplete. *The plan does not reflect the costs and savings of all of the emissions reduction measures that it recommends. This is because, in some cases, ARB has intentionally excluded the costs and savings associated with certain measures, such as the "million solar roofs" program. In other cases, including the proposed cap-and-trade program, ARB has yet to develop the costs and savings associated with its measures. For one measure—the low-carbon fuel standard—ARB acknowledges that the assumptions behind its estimates of costs and savings are weak at present, even though this measure represents a significant portion of the plan's direct costs and savings.*

Economic analysis played a limited role in development of scoping plan. *It appears that ARB selected measures for inclusion in the scoping plan and then conducted its economic analysis of the plan as a whole after the fact. Selection of particular measures and the mix of measures appear not to have been directly influenced by cost-effectiveness considerations or macroeconomic analysis. In fact, ARB deemed all measures included in the plan "cost effective" simply because they reduce GHG emissions, whatever the cost.*

**Summary of ARB Responses to LAO's Questions on the AB Scoping Plan
December 16, 2008**

On November 17, 2008, we reported on the draft scoping plan of the Air Resources Board (ARB) for implementation of the Global Warming Solutions Act of 2006. After reviewing both (1) the response of the ARB (dated November 26, 2008) to the questions we asked about the proposed scoping plan to reduce greenhouse gas emissions on October 3 of this year and (2) ARB's response to the peer review of the scoping plan, our office continues to conclude that ARB's economic analysis of the AB 32 scoping plan lacks a sensitivity analysis and fails to lay out an investment pathway for the scoping plan.

**LAO's Critique of the AB 32 Scoping Plan Economic Analysis
March 9, 2009 presented to Assembly Natural Resources Committee**

Issue #1: Inconsistent and Incomplete Evaluation of Costs and Savings

Issue #2: Macroeconomic Modeling Lacks Analytical Rigor

Issue #3: Limited Role of Economic Analysis in Scoping Plan Development

Issue #4: Failure to Lay Out an "Investment Pathway"

***AB 32: Analysis of the Net Impact on California Jobs
March 4, 2010***

This responds to Senator Cogdill's request for an analysis of the net impact on jobs in California that would occur as a result of the implementation of AB 32 (Núñez), the Global Warming Solutions Act of 2006, Chapter 488, Statutes of 2006. In our response, we briefly summarize the basic provisions of AB 32 and its planned implementation through the California Air Resources Board's (CARB's) Scoping Plan (SP), discuss the avenues by which the SP would potentially affect California jobs, and present the jobs-related effects of the SP as estimated by CARB. We then comment on CARB's analysis and offer our own view about how the SP might affect jobs.

Principal LAO Findings. *The effects of the SP on California jobs are difficult to accurately predict but would be mixed, with gains in some occupations and industries (including so-called "green" jobs) and losses in others (primarily involving fossil fuel-related energy production). On balance, however, we believe that the aggregate net jobs impact in the near term is likely to be negative, even after recognizing that many of the SP's programs phase in over time. Reasons for this include the various economic dislocations, behavioral adjustments, investment requirements, and certain other factors that the SP would entail. In the longer term, its net effect on jobs—potentially either positive or negative—is unknown and will depend on a variety of factors.*

AB32: Letter to Assembly Member Dan Logue Regarding Potential Economic Leakage
May 13, 2010

This responds to Assembly Member Logue's request that we conduct a qualitative analysis of the costs of California taking actions to address the climate change issue, without there being a shared consensus and involvement across the nation in terms of how the issue is addressed. Specifically we were asked to look at the costs California would likely incur following the implementation of AB 32 through the California Air Resource Board's Scoping Plan, compared to states that do not have similar policies in place.

Principal Findings. *California's economy at large will likely be adversely affected in the near term by implementing climate-related policies that are not adopted elsewhere. This is in large part because such policies will tend to raise the state's relative prices for energy, such as electricity. This, in turn, will adversely impact the state's economy through such avenues as causing the prices of goods and services to rise; lowering business profits; and reducing production, income, and jobs. These adverse effects will occur in large part through economic leakage, as certain economic activity locates or relocates outside of California where regulatory-related costs are lower. While it is true that there will be both winners and losers under the SP, including gains in so-called "green" jobs, the net economy-wide impact in the near term of implementing the SP in the absence of like policies in place elsewhere will in all likelihood be negative. Compared to the size of California's economy, however, these adverse impacts likely will be relatively modest. However, for certain industries and firms, the negative impacts could be more significant.*

AB32: Letter to Assembly Member Dan Logue Regarding Evaluation of the ARB's Updated Economic Analysis
June 16, 2010

This responds to Assembly Member Logue's request that we provide an evaluation of the updated economic analysis prepared by the California Air Resources Board of its Scoping Plan for implementing AB 32 (Núñez).

Principal LAO Findings

New Analysis Is Improved but Problems Remain. *Although ARB's updated economic analysis represents a credible effort and an improvement over its initial economic analysis issued in September 2008, the revised version still exhibits a number of significant problems and deficiencies that limit its reliability. These include shortcomings in a variety of areas including modeling techniques, identification of the relative marginal costs of different SP measures, sensitivity and scenario analyses, treatment of economic and emissions leakages, identification of the market failures used to justify the need for the regulations selected, analysis of specific individual regulations to implement certain SP measures, and various data limitations.*

The SP May Not Be Cost-Efficient. *Given these and other issues, it is unclear whether the current mix and relative importance of different measures in the SP will achieve AB 32's targeted emissions reductions in a cost-efficient manner as required.*

Legislative Oversight and Policy Direction for AB 32 Implementation. *We have identified a number of opportunities for the Legislature to exercise oversight and provide policy direction as the administration moves forward with implementation of the SP. Specifically, the Legislature should consider holding hearings to direct ARB to fill the most crucial information gaps in its economic analyses supporting the SP. Legislative evaluation of the quality and comprehensiveness of statutorily required economic and fiscal analyses for major AB 32 regulations would also prove useful. Based on the results of further analysis conducted at the Legislature's direction, the Legislature could potentially direct that changes be made to individual AB 32 regulations (modifications or even repeal) and to the SP's mix of measures. The goal of such direction would be to improve the overall effectiveness and cost-efficiency of AB 32 implementation.*

Thank you for the opportunity to submit comments on SB 184, the "no regrets" greenhouse gas emissions reduction proposed strategies. Please don't hesitate to contact me if I may provide additional information. I can be reached via email at dhastings@txoga.org or call 512.478.6631.

Sincerely,

Debbie Hastings
Vice President for Environmental Affairs
Texas Oil & Gas Association

APPENDIX C:

Responses to Comments Relating to Environmental Defense Fund Submissions

Responses to Comments Relating to EDF Submissions for Senate Bill 184

In commenting on SB 184 strategies, some commenters tended to repeat factually incorrect or misleading assertions, and in some cases provide no supporting evidence for their opposition. Specifically the comments of TAM and TXOGA, jointly in some cases and individually in others, include a number of such assertions. While this response addresses some of their comments specifically it is also intended to address similarly deficient comments from other groups.

TAM/TXOGA claim California Air Resource Board's Scoping Plan was deemed deficient and subsequently updated, but that is not true. TAM/TXOGA lament that CARB estimates are based on assumptions and are "inaccurate" but this ignores decades of scholarly, peer-reviewed, documented research to support well-informed rulemaking with reliable expectations that the value of energy savings will exceed capital costs. To help the CPA and the SB184 advisory committee avoid wasting precious staff time pursuing these spurious arguments any further, we consolidate our responses here.

Before we discuss flawed assertions made by TAM, TXOGA and others, EDF would like to note that in the comments reviewed thus far regarding submissions from EDF, <u>no evidence or data is provided when asserting that measures should be removed from the No regrets list</u>. Rather than offering alternative scholarly analyses, TAM/TXOGA simply claim, with no justification, that the carefully developed evidentiary basis already on record should not be trusted and is "inaccurate." This reasoning seems to be either mistaken or misleading and rejects science-based policy making in favor of deferring to unverified statements. In this document we highlight the useful and detailed data included in our original submissions in addition to providing further substantiating analysis from the strong body of work on these topics.

In the following comments we address a list of assertions made by TAM/TXOGA and in some cases others, and then address each one after highlighting the lack of evidence provided to back these assertions.

1. Assertion: The Scoping Plan was deemed deficient and was updated. As a result any data used, assumptions made and economic analysis based on the December 2008 CARB Scoping Plan and accompanying appendices upon which this strategy was submitted is inaccurate.
2. Assertion: If no regrets measures are so attractive economically, there should be no need to make them mandatory.

3. Assertion: The McKinsey Study is flawed and should not be relied on.
4. Assertion: The iTron report used in support of energy efficiency related measures is hopelessly out of date and should not be relied upon.
5. Assertion: Certain measures lack specific enough cost data to be evaluated as no regrets.

Assertion: The Scoping Plan was deemed deficient and was updated subsequently. As a result, any data used, assumptions made and economic analysis based on the December 2008 CARB Scoping Plan and accompanying appendices upon which this strategy was submitted is inaccurate .(TAM/TXOGA comments on numerous measures, including but not limited to 5, 30, 15, 23, 26, 35, 36)

Response: EDF notes that the title of the document in question is in fact "Updated Economic Analysis of California's Climate Change Scoping Plan", and that the updated economic analysis does not include significant updates to the cost-effectiveness evaluations of the Scoping Plan measures used in our original submission. TAM/TXOGA representatives may be unaware of this important distinction but EDF finds this conflation of the two analyses misleading. At best, TAM/TXOGA do not seem to have read CARB's Updated Economic Analysis, much less the underlying Scoping Plan itself which includes references and substantive analysis in support of most measures.

The assertions by TAM/TXOGA imply that the EAAC has found the analysis supporting various measures in CARB's Scoping Plan to be "deficient". In fact, that analysis (as used in submissions from EDF to the No regrets Advisory Board) was never found to be deficient, as demonstrated by the fact that the Scoping Plan was not updated. Rather, it was adopted by the Board in December, 2009. Only the supporting macroeconomic impact has been updated subsequently. The updated analysis includes a number of measures not recommended by EDF as No regrets legislation and evaluates the total impact of all measures combined on the economy of California.

EAAC worked closely with CARB staff when they updated the economic impact analysis for the Scoping Plan adopted by CARB in December, 2009. After staff released the Updated Economic Analysis, EAAC wrote a review of the effort[1] finding:

- "A main conclusion from the ARB's updated analysis is that the net impact of AB 32 on the California economy will be small. We find that the ARB has provided significant evidence to support this conclusion." (pg2. 2-3)
- "The ARB has assembled a very impressive data set to investigate the impacts of AB 32. To our knowledge, it employs the most detailed data on technology options by California producers of any analysis of the California economy." (pg 3)
- "There is no obvious overall bias to the results." (pg. 11)

[1] Available at http://climatechange.ca.gov/eaac/documents/eaac_reports/2010-04-19_EAAC_REPORT_Appendix.pdf (last visited June 28, 2010).

- "The numerical modeling work is competent, and the report is careful to interpret the results fairly and openly." (pg. 18)

The EAAC also found that CARB did a commendable job recognizing uncertainties by assessing costs under a range of scenarios. Furthermore, CARB's findings presented in the Updated Economic Analysis were corroborated by other research undertaken concurrently with two other modeling platforms and identical input assumptions. Dr. David Roland-Holst (DRH) executed the BEAR and EAGLE models, while Charles Rivers Associates (CRA) ran its' MRN-NEEM model.[2] Like CARB's revised analysis, both the CRA and DRH studies linked an energy model with a macroeconomic model. While results differed slightly, the three studies generally concur that California can achieve significant GHG emissions reductions by 2020 while the state's economic output also grows dramatically.

CARB's Updated Economic Analysis includes revisions to forecasted 2020 gross state product and the business-as-usual scenario to reflect the recent economy-wide recession. Consequently, the expected CO_{2e} reductions to be achieved from Scoping Plan measures are also updated, but the relative balance of annualized capital investments and savings (from avoided fuel expenditures) has not changed substantively.

CARB (with help from its sister agencies and determined advice from the Economic Evaluation and Allocation Committee and its Climate Action Team) estimated that several core measures, including energy efficiency investments, vehicle emissions standards, and planning to reduce vehicle miles of travel will save drivers, consumers, commercial and industrial operations, and households significantly more than they will cost to implement.

The benefits estimated by CARB are not hypothetical, but rather build upon four decades of research and successful policymaking. The California Energy Commission has documented billions of dollars in consumer benefits from decades of building and appliance energy efficiency standards, as well as electricity supply "loading order" rules that put efficiency and demand response first.[3]

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[2] To view the CRA results, go to http://www.crai.com/uploadedFiles/analysis-of-ab32-scoping-plan.pdf (last visited June 28, 2010).

[3] For a recent report on energy savings by Independently Owned Utilities, see California Energy Commission, Achieving Cost Effective Energy Efficiency for California: Second Annual AB 2021 Progress Report, December 2008, CEC-200-2008-007, at http://www.energy.ca.gov/2009publications/CEC-200-2009-008/CEC-200-2009-008-SD.PDF (last viewed June 28, 2010). Note that utilities exceeded their efficiency mandates in 2006, 2007 and 2008, as shown in Tables 1 and 2, pg. 4. Energy savings from Publicly Owned Utilities are shown in total (Figure 3, pg. 13) and in terms of avoided peak power (Figure 4, pg. 14). For an insider's view of California's successes, see Rosenfeld, A. The Art of Energy Efficiency: Protecting the Environment with Better Technology. Annual Review of Energy and Environment. 1999. 24:33–82, detailed descriptions of the economic benefits (and costs) of exemplary standards are provided in Table 1, pgs. 54-55.

Assertion: "No regrets" measures need not be mandatory because economically attractive actions will be undertaken anyway. Additionally, some comments assert that any measure including a mandate is inconsistent with the assumption that "no regrets" strategies should return a positive economic benefit in the absence of market distortions or regulatory requirements. (TAM/TXOGA comments and comments of others on numerous measures, including but not limited to 2, 5, 30, 15, 23, 26, 29, 35, 36)

Response: First, EDF notes that nothing in the text of S.B. 184 or any of the public meetings relating to the bill limits measures to voluntary actions or indicates that mandatory measures conflict with the stated purpose of S.B. 184. There is ample theory and experience to support to need for government regulation when the mandated actions are net economically positive. Those who argue that economically beneficial actions needed not be mandated because market incentives will be sufficient to inspire them generally fail to consider the reality of known market failures and cannot explain why known opportunities are not being utilized. The comments indicating that no regulation could produce net economically positive results implicitly base their assertion on the existence of a perfectly competitive marketplace.

Perfectly competitive markets require that all economic actors have complete information, are exchanging homogeneous goods, and are not subject to threat making. An understanding of real-world markets must realize that such theoretical constructs as complete information do not always exist and as a result real-world markets are sometimes in need of regulation to correct for market failures. Outside of the context of no regrets measures, the recession beginning in 2007 has provided stark examples both of market failures and the consequences of leaving such failures unaddressed.

Returning to the assertion that mandates should not be needed for no regrets measures, we observe that many potentially beneficial measures are not being undertaken for a variety of well understood reasons that include:

- Information gaps: people aren't aware of the opportunity
- Budget constraints: people can't afford the initial capital investment, even where a relatively short payback period justifies the expense
- Split-incentives, and principle agent conflicts: people don't enjoy the (full) benefits of actions that they undertake because they are renters, or otherwise don't own the investments/rewards
- Conservation ethic: people believe that it is better to continue to continue using wasteful products because they still perform the service even if a new version will pay for itself quickly

When perfectly competitive markets are considered in the context of energy use, we instantly observe that the causes of market failures, in addition to concerns about open access goods, is rationale for regulatory mandates. The good news is that these regulations can save society, and in many cases private actors, more than they cost to implement, notably through avoided energy use. It is only in such cases that EDF submitted measures for consideration as no regrets strategies.

The challenge of split incentives is obvious for renter-landlord situations when the landlord must purchase the more efficient appliance, but the renter enjoys the benefit of lower energy bills. Such disconnects exist in commercial settings as well. For example, speculative home builders have incentive to keep construction costs low to maximize profit for a given sale price. But the new home owner/occupant would benefit from higher upfront building costs for insulation and efficiency improvements that lower the operating cost of the home. Similarly, beverage companies may provide the cooler displays for their drinks, but it is the shop owner who pays the cooler's electricity bill. The beverage company has no incentive to invest in energy efficient coolers, but certainly the shop owners would benefit from such investments. These are just a few examples of well-understood market failures and inefficiencies that careful regulation can help to correct.

In another example of the well-understood opportunity presented by imperfect markets, McKinsey and Company (2009) examined the potential for economic gains from energy efficiency studies, as well as barriers to their implementation, finding:

> *"Energy efficiency offers a vast low-cost energy resource for the U.S. economy – but only if the nation can craft a comprehensive and innovative approach to unlock it. Significant and persistent barriers will need to be addressed at multiple levels to stimulate demand for energy efficiency and manage its delivery…If executed at scale, a holistic approach would yield gross energy savings worth more than $1.2 trillion, well above the $520 billion needed through 2020 for upfront investment in energy efficiency measures" (Pg. 1).*[4]

Assertion: The McKinsey Study is flawed and should not be relied on. (Comments from TAM on measure 15)

Response: This assertion is particularly notable in its lack of substantiating evidence. McKinsey and Company is an internationally respected management consulting firm with highly regarded expertise in the fields of energy efficiency as well as the oil & gas, pulp & paper, chemical and other manufacturing industries represented by TAM. Further, the McKinsey study used in support of a number of measures proposed by EDF is largely the outcome of continuing work with and for manufacturers such as Honeywell, and Shell.[5] Given the lack of any detailed critique EDF finds it difficult to respond to this contention and feels that the reputation of McKinsey and Company as well as their analysis remains intact notwithstanding TAM's assertion.

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[4] McKinsey & Co., Unlocking Energy Efficiency in the U.S. Economy, Executive Summary. http://www.mckinsey.com/clientservice/electricpowernaturalgas/US_energy_efficiency/ (last visited June 28, 2010)

[5] http://www.mckinsey.com/clientservice/sustainability/greenhousegas.asp

Assertion: The iTron report used in support of Measures 15 is hopelessly out of date and the Commission recognized that certain years should not be used to justify energy efficiency investments. (Comments from TAM on measure 15)

Response: Several reports formed the basis of this submission including a study from McKinsey & Company, analysis from CARB and the iTron report. The iTron report specifically forms the basis for much of the impetus and decision making behind the PUC's Staff Proposal for Adoption in PUC Project No. 37623 noted in TAM's comments. Although EDF has not been able to find any comments from the Public Utilities Commission regarding the exemption of specific years, it is important to note that such comments have not impacted the Commission's overall use of the iTron report.

Assertion: Measures lack specific costs for actual items or upfront capital cost estimates in order to be verified as no regrets. (Including but not limited to TAM/TXOGA comments on measures 30 and 15)

Response: The Scoping documents referenced in this measure both establish documentation and link to the macroeconomic analysis that is the basis for the assumed cost savings. To quote from Appendix A: California Air Resource Board, "Climate Change Proposed Scoping Plan Appendices, 2008 and "VOLUME II: ANALYSIS AND DOCUMENTATION," October 2008:

> **"Staff estimated the cost and savings from energy efficiency using the Climate Action Team Updated Macroeconomic Analyses Final Report.119 Costs (2006$) of $217 per ton and savings of $323 per ton of CO2E reduced as derived from the CAT report are used to calculate the net annualized cost for both electricity and natural gas efficiency.**
>
> **The net cost and savings per MTCO2E are derived from the average cost and savings in the CAT Macroeconomics report for building and appliance standards and IOU efficiency programs. The values in the 2007 CAT report are 2006$ and are updated to 2007$ here by multiplying the 2006$ by a Consumer Product Index of 3.3% (1.033). Staff estimates the cost for additional efficiency under evaluation is 50% greater than the cost for the preliminarily recommended efficiency measures (i.e. $224/MT x 1.5 = $336/MT)."**

The referenced document is linked to in the report at: http://www.climatechange.ca.gov/events/2007-09-14_workshop/final_report/2007-10-15_MACROECONOMIC_ANALYSIS.PDF.

In addition, such savings are documented in myriad settings via a broad diversity of measures and scales. In terms of appliances, the CEC DEER database is an example of the depth of our well-documented experience. There is tremendous evidence at the building scale, notably codified in California's Title 24 building standards. More holistically, at an organizational scale, EDF continues to document massive EE savings in our Corporate Partnership Program.

In response to TAM/TXOGA's assertion that Initial Short Term Capital Cost was not submitted for measure 30, EDF notes that the original submission for the measure as posted on the Comptroller's No regrets website includes short term capital costs in the submission estimated at $649 million per year. It is unclear to EDF why TXOGA/TAM claims that short term capital costs clearly included in our original submission were not available, but would welcome the opportunity to clarify this data for TXOGA/TAM. This short term capital cost is derived from the process noted above which offers substantial analysis and supporting evidence for costs.

CONTRIBUTORS

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Railroad Commission of Texas

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