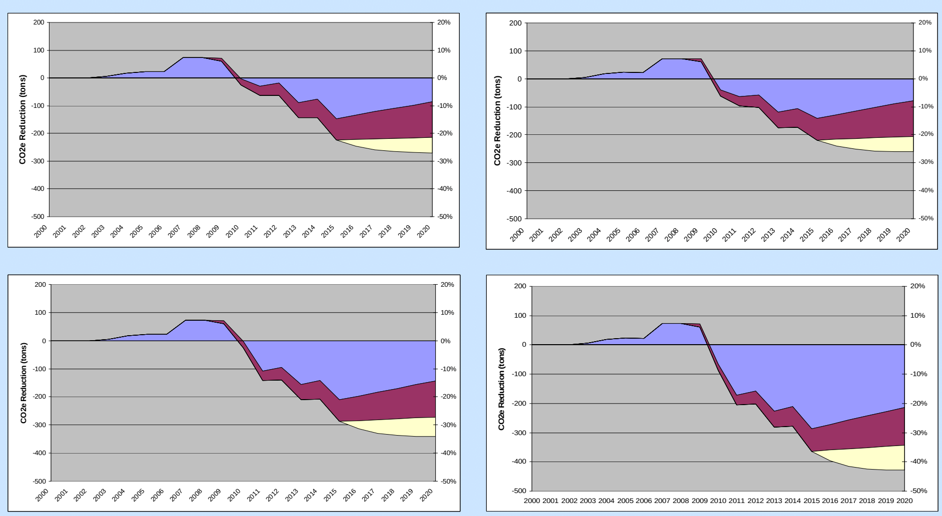
City of St Helena
Greenhouse Gas Emissions
Reduction Action Plan Analysis

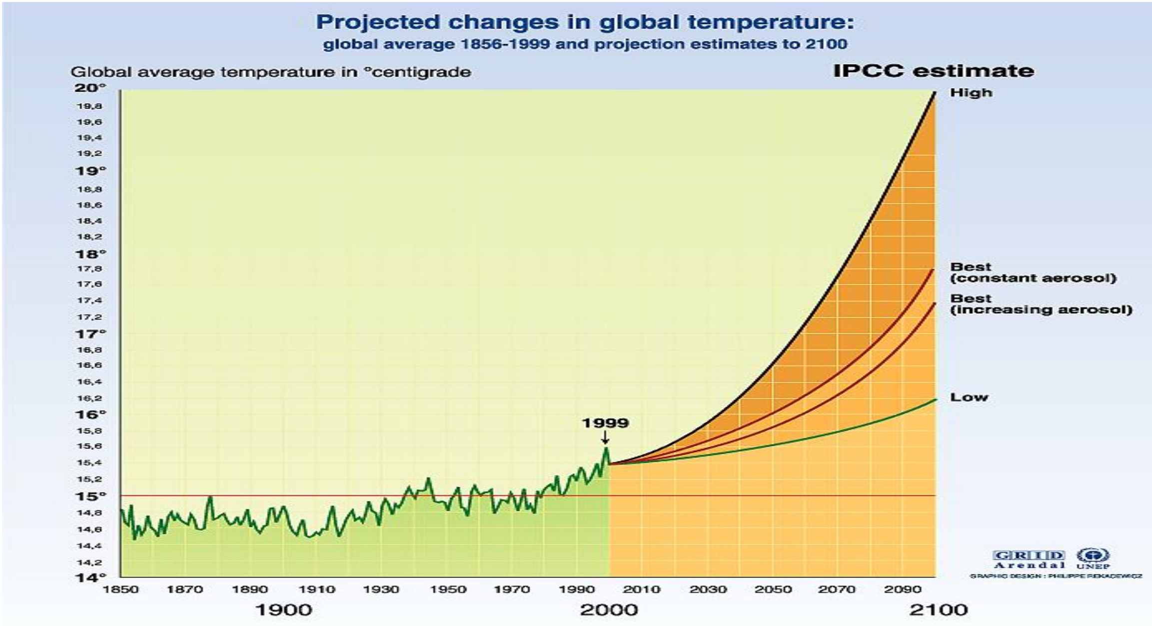
Final Report

April 22, 2009

Climate Protection Campaign



Prepared by Tellus Applied Sciences, Inc.
Under the direction of the Climate Protection Campaign,



Source : Temperatures 1856 - 1999: Climatic Research Unit, University at East Anglia, Norwich UK. Projections: IPCC report 95.

Acknowledgements

There were many individual contributors to the success of this project. The City of St Helena Staff provided the key information required to develop the measures in these Action Plans. Each city department provided the critical data needed to compile this analytical framework. The effort was effectively coordinated by the City Clerk Delia Guijosa. Most importantly, the active involvement of City Manager Bert Johansson has ensured the support of this project by the entire St Helena team. Great appreciation is offered to Ann Hancock, Executive Director of the Climate Protection Campaign whose inspiration is the driving force propelling this work forward. Finally, ultimate appreciation goes to the St Helena City Council for their vision for a stronger, more secure future for our community, expressed in many ways, including their support for this important work.

Definition of Terms[1]

CEC (California Energy Commission)
The CEC is California's primary energy policy agency. They are responsible for forecasting future energy needs, promoting energy efficiency through appliance and building standards, and supporting renewable energy technologies.

City Council
A city council is a local form of government, usually covering a city or other urban area.

City Staff
City staff encompasses any personnel employed by the city and assisted on the report.

CNG (Compressed Natural Gas)
Compressed Natural Gas is a substitute to gasoline, diesel, or propane fuel. It is made by compressed natural gas, mainly methane (CH4).

CO2e (Equivalent Carbon Dioxide)
Equivalent Carbon Dioxide is the concentration of carbon dioxide that would cause the same level of radiative forcing as a given type and concentration of greenhouse gas such as methane, perfluorocarbons, and nitrous oxide.

GHG (Greenhouse Gas)
Greenhouse gases are the gases in the atmosphere, which reduce the loss of heat into space and therefore increase global temperatures. Greenhouse gases include water vapour, carbon dioxide, methane, nitrous oxide, ozone, and chlorofluorocarbons.

ICLEI (International Council for Local Environmental Initiatives)
ICLEI was formed in 1990 and is an international association of local governments and national and regional local government organizations that have made a commitment to sustainable development.

IRR (Internal Rate of Return)
Internal Rate of Return is a budgeting metric used to decide whether to make an investment or not. It is an indicator of the efficiency of an investment. A larger IRR is a stronger investment.

kWh (kilowatt-hour)
A kilowatt-hour is used to express amounts of energy delivered by electric utilities. One watt hour is the amount of energy expended by a one-watt load drawing power for one hour.

Net Capital Cost
The net capital cost is the capital cost of a project minus incentives and rebates.

NPV (Net Present Value)
Net present value is a standard method for the financial appraisal of long-term projects. It measures the excess or shortfalls of cash flows, in present value terms, once financing charges are met. NPV indicated how much value an investment or project adds to the value of the business or firm.

O&M (Operations and Maintenance)
Operations and maintenance refers to the maintenance and fuel cost incurred by a unit of equipment. The O&M costs in this analysis are the additional operation costs associated with the efficiency measure.

PV (Photovoltaic)
Photovoltaic cells convert light energy into electricity. Also called solar power.

Public Jurisdiction
Public jurisdiction refers to cities or counties.

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[1] These definitions were derived from wikipedia, [1]http://en.wikipedia.org

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1.0 Executive Summary

The City of St. Helena is located in the center of the world famous wine growing Napa Valley, 65 miles north of San Francisco. The area was settled in 1834 as part of General Vallejo's land grant. The City of St. Helena was incorporated as a City on March 24, 1876 and reincorporated on May 14, 1889. Over the years, with the growth and development of the wine industry, the City has become an important business and banking center for the wine industry. The City also receives many visitors as a result of the wine industry and the area's scenic qualities. The main goal of the City is to maintain a small-town atmosphere and to provide quality services to its citizens. The official population of the City of St. Helena as of January 1, 2005 is 6,006. St. Helena is a full service City and encompasses an area of 4 square miles.[2]

The City of St Helena is implementing the ICLEI program to reduce the greenhouse gas (GHG) emissions from City controlled sources. This program has five steps, referred to as "Milestones." Milestone 1, creating the GHG inventory, and Milestone 2, setting a reduction target have been completed. Milestone 3 requires the creation of a plan to meet this target. This report and associated analysis provides the information necessary for addressing Milestone 2 and the roadmap to satisfy Milestone 3. This analysis provides five measure-specific plans to reduce emissions by more than 20%. Furthermore, the framework associated with this material will support the City in meeting the requirements of Milestone 4 (implementation) and Milestone 5 (monitoring and adjustment). The framework facilitates the integration of new and revised information, taking advantage of new opportunities and allowing adjustments to under performing initiatives.

The analysis, and resulting GHG emissions reduction plans, incorporates many opportunities in the various contributing sectors (Building Efficiency, Fleet, Commute, Water/Sewer, Streetlights, and Distributed Generation), as identified by the City Staff utilizing the best available information at the time of research. The results provide an emissions impact estimate for five plans with the corresponding financial analysis.

The results for each plan include the GHG emissions reduction expressed in tons CO2e (equivalent CO_2 emissions)[3] and as a percentage of the total City GHG emissions. These results are presented along with a number of other important metrics, including the Internal Rate of Return (IRR) and Net Present Value (NPV) of each plan. These are critical in the financial evaluation of the "investment". Other information includes the budget resources not sent to the utility company and the fuel companies, and the value of the resources redirected to local investments. Plan C, for example, results in over $6 million in local investment over the 25 year life of the plan.

The intent of this work is to allow the independent plans to be considered on their merits in numerous areas. This provides the capability to compare the comprehensive costs and benefits of competing paths, and thereby allow Policy Makers the ability to select the most appropriate path to reducing global warming pollution emissions in the City of St Helena. Five Action Plans are presented resulting in reductions from 21% to over 38% below 2000 levels by 2015. Each plan has advantages and challenges, which are described in the following sections of this report.

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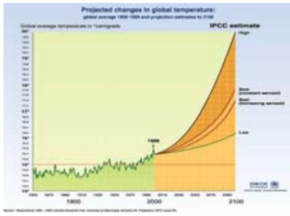
[2] http://city.ci.st-helena.ca.us/section.cfm?id=9, June 2007

[3] CO2e: Equivalent CO_2 in lbs or tons. The additional greenhouse gases such as methane are converted into the equivalent amount of CO_2 for analysis and clearer presentation.

1.1 Background



North Bay public jurisdictions (cities and counties) have adopted global warming pollution reduction targets and have committed to developing action plans to meet these targets. These initiatives coincide with aggressive actions by the State to address climate change.[4] The rules and potential mandates from the State are under development. While the specific requirements are not yet determined, it is clear that all sectors including local governments will be encouraged or even required to join the effort to reduce greenhouse gas emissions. North Bay governments are already demonstrating leadership by embracing the ICLEI program, setting reduction targets and developing GHG emissions action plans.

The first step, creating the inventory of emissions produced by the internal operations has been completed for the City of St Helena controlled equipment and operations. The total emissions for 2000 were roughly 1,007 tons of CO2e. In addition to this baseline, there were numerous changes in GHG emissions identified from the utility billing since the baseline year of 2000. These are consolidated and modeled in the analysis as the "End Use" entries in the table below.[5] These add another 83 tons to the reduction goal. This information was also used to generate the emissions trend associated with projected city growth from 2008 to 2020. These projected additional GHG emissions are included in the calculations of each Plan option as Future Trends. This trend adds 10.3 tons per year which is dependant on the projected population increase each year within the City.[6] A similar methodology was used to determine 1990 GHG emissions and to report the percentage reduction below 1990 for each plan of action.

Increases in Energy Consumption from 2000 to 2008				
End Use	**Year**	**kWh**	**Therms**	**Fuel (gals)**
City Offices and Firestation	2004	22,974	0	0
City Offices and Firestation	2002	22,974	0	0
Firestation, Library and Garage	2006	0	1,019	0
Stonebridge Well and Disposal Plant	2006	128,035	0	0
Recreational Outdoor Lighting	2005	-3,012	0	0
Employee Commute	2003	0	0	1,172
Employee Commute	2006	0	0	1,172

Table 1: Increases in Energy Consumption from 2000 to 2008

[4] California's major initiatives for reducing climate change or greenhouse gas (GHG) emissions are outlined in the 2006 legislation Assembly Bill 32 (signed into law), 2005 Executive Order and a 2004 ARB regulation to reduce passenger car GHG emissions. These efforts aim at reducing GHG emissions to 1990 levels by 2020 - a reduction of about 25 percent, and then an 80 percent reduction below 1990 levels by 2050.
[5] These End Uses represent 100% of the energy increases for all accounts as identified in the PG&E billing data. They are labeled as the accounts contributing most to the change and the year associated with the change.
[6] Projected to be 0.084% pre year through 2015. St. Helena Local Economy and Economic Development Background Report, Bay Area Economics, Oct 24, 2007

The City of St Helena emissions by sector are presented as a percentage of the total emissions in Figure 1 below.

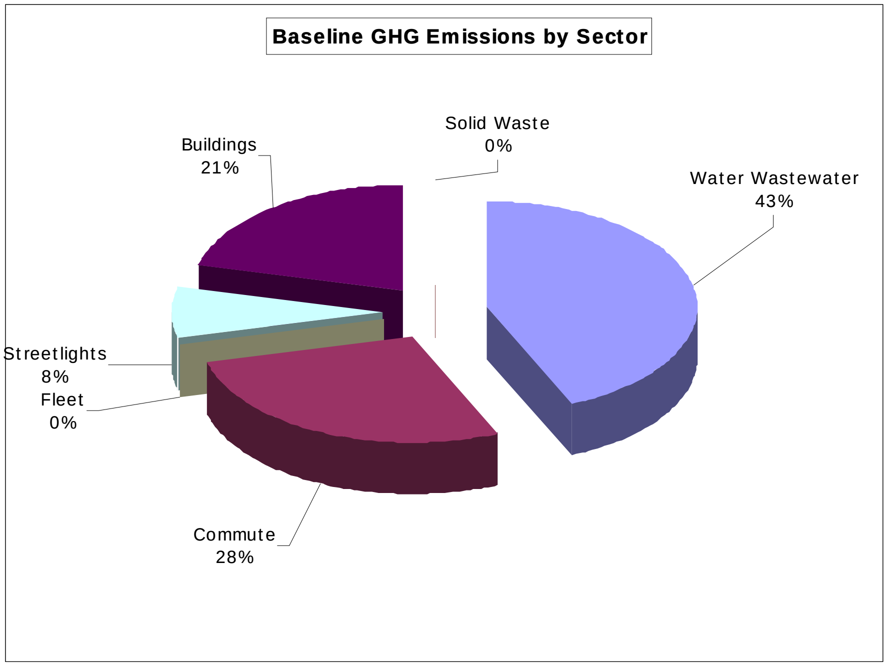


Figure 1: City of St Helena GHG Inventory as a Percentage of the 2000 Total

Many of the measures available to reduce GHG emissions also will reduce the City fuel, electricity and natural gas costs. These costs are a significant element of the municipal budget, and the potential volatility of their costs represents a threat beyond the control of City Staff. Figure 2 below provides the trends for the annual energy costs based on four rate escalation scenarios. The 3.5% escalation rate reflects the current trend in utility energy cost. The "current" cost trend for fleet fuel is 8% per year based on the costs from 1987-2006. These values are used in the cash flow projections for each GHG reduction plan. The fuel, electricity and natural gas related measures contained in this analysis will reduce the vulnerability to rising energy costs.

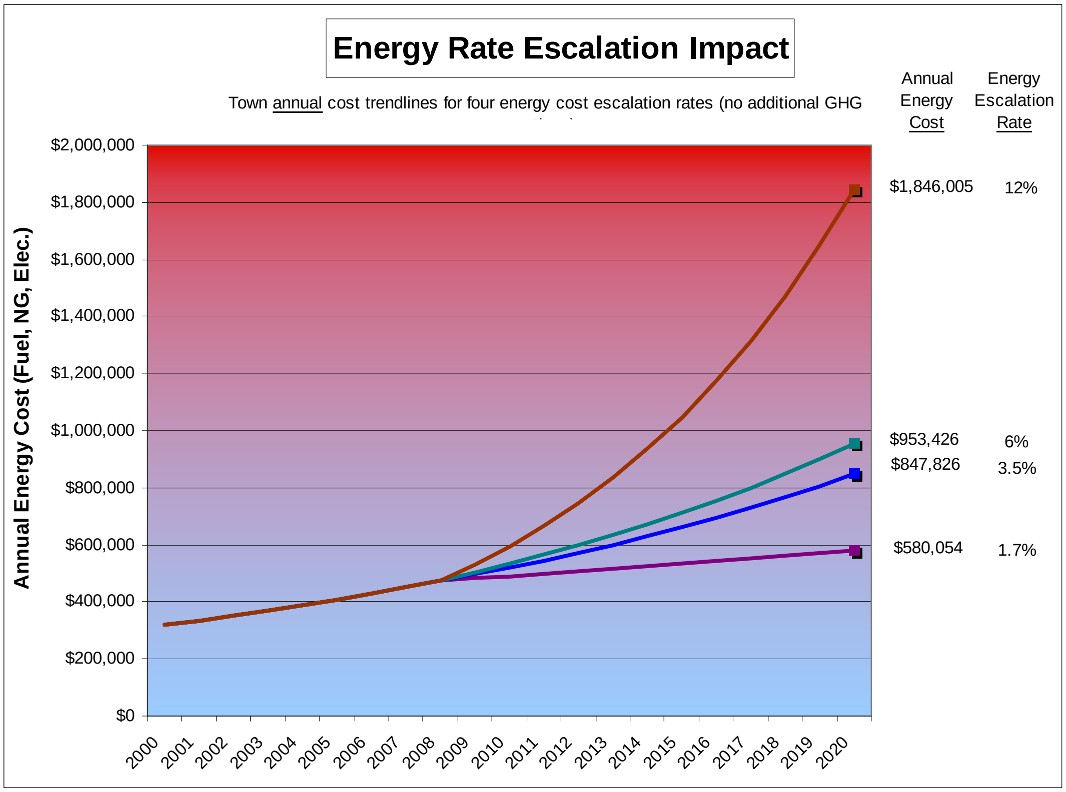


Figure 2: Energy Rate Escalation Scenarios

1.2 Methodology

The St Helena GHG emissions inventory for 2000 was documented in 2007 and provides a reference for the baseline inventory developed for this analysis.[7] The specific actions and events affecting this baseline from 2000 to 2008, either positive or negative, are factored into the inventory and the resulting trend. The greenhouse gas emissions trend documented in the 2000 inventory is provided in Figure 3 below.[8] The 2000 baseline details used in this analysis are available in the appendices. Note that the estimate has been adjusted to 1007 tons[9] from 2011 tons CO2e as stated in the Inventory report due to billing data interpretations.

[7] GHG Emissions 2000 Inventory City of St Helena, Sam Pierce, PE, Senior Engineer, Climate Protection Campaign, August 3, 2007.
[8] ibid
[9] Short tons (2000 lbs = 1 short ton)

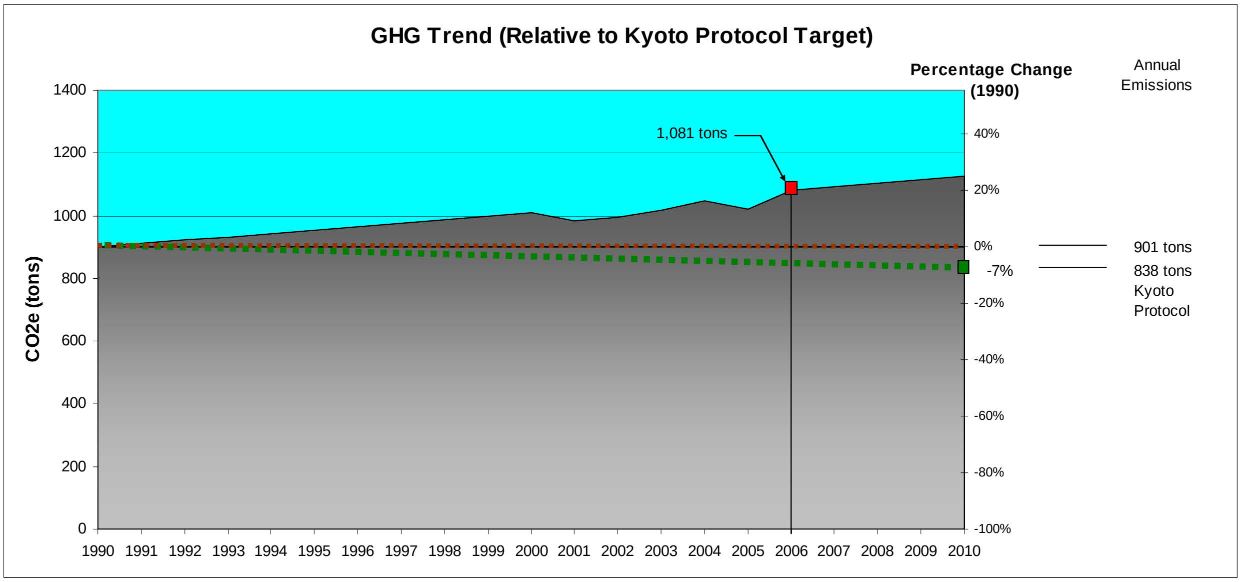


Figure 3: GHG trend from 1990 to 2010

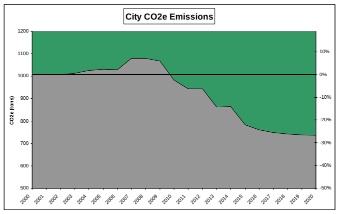
The options for future action by the City are comprised of measures applicable to building and equipment energy efficiency, fuel efficiency, alternative fuel options, and distributed energy generation. These options have been identified and quantified within this analysis. They are evaluated and presented as individual projects (measures), and as groups of measures (plans). Each is assigned a status (completed or future) and an implementation date to enable the calculation of cash flows over the life of the plans and the creation of energy cost trend graphs.

The measures are grouped to create comprehensive GHG emissions reduction plans. Each of the plans is analyzed to provide profiles enabling the evaluation of the plans individually and in comparison to the other plan options. Measures of specific data such as capital cost, year of implementation, financing, energy and cost savings were processed to provide the following information for the five action plans:

- Emissions reduction in tons CO2e avoided as a percentage of baseline
- CO2e reduction by sector
- Annual Cash Flow including debt service, replacement cost and incremental O&M costs
- Outstanding principal and debt service by year
- Simple Payback (SPB) for each plan
- Internal Rate of Return (IRR) for each plan
- Net Present Value (NPV) for each plan
- Avoided utility company payments (NPV over life of plan)
- Avoided fuel purchases (NPV over life of plan)
- Value invested locally in emission reduction projects

A measure evaluation matrix was employed to quantify subjective considerations to allow their inclusion in the planning process. The evaluation scoring contributes to the understanding of the opportunities but is not intended to provide a final ranking of the measures. The decision to include measures in each plan is dependent on its role in achieving the objective of that plan, and is therefore independent of any fixed criteria or ranking. The results of the evaluation are provided in the Appendices.

1.3 Results



Five plans have been created for consideration by the City of St Helena. These plans consist of numerous measures to reduce GHG emissions, reduce energy costs, address equipment issues, and reduce the uncertainty of the City's future annual energy costs. Summary financial information is provided in Table 2 below. The results contained in this table should be considered with the Action Plan Evaluations provided in the Appendices to understand the relative strengths of each combination of measures populating the Action Plans. Detailed information for each measure is provided within the Measure Details section of this report.

Plan Results and Comparison Tables

Table 2 provides important financial information for each plan including the net annual cash flow. The "% Reduction" is the amount of CO2e reduced as a percentage of the total City emissions. Plan A provides a reduction of 21% below the year 2000 (baseline) emissions. Plan E provides a strategy to reduce the City's emissions to 38% below 2000 emissions. These percentage reductions include the projected increased emissions from city growth from 2008 to 2020 (based on emissions data from 2000 to 2006 and projected population increases).

The financial analysis is provided with each plan. The critical metrics of Internal Rate of Return (IRR) and Net Present Value (NPV) provide important information to evaluate the worthiness of the investment from a cash flow perspective. It is important to note the large negative net cash flows in the later years of each plan represent reinvestment in photovoltaic (PV) systems (replacement of the inverters after 10 years).[10]

[10] The assumption is that the cost of inverters will increase at the generally assumed inflation rate of 3.5%. However likely advances in technology, and improved economies of scale for the industry suggest this is overly conservative.

GHG Action Plan Summary					
Analysis	**Plan A**	**Plan B**	**Plan C**	**Plan D**	**Plan E**
% Reduction below 2000 by 2015 (net)	21.1%	23.9%	29.3%	30.4%	38.4%
% Reduction below 1990 by 2015 (net)	1.5%	4.6%	10.7%	12.0%	21.0%
Simple Pay Back	NA	NA	19.1	14.8	9.9
Internal Rate of Return (IRR)	NA	NA	3.9%	7.8%	13.2%
Net Present Value of Investment (NPV)	($1,071,199)	($3,482,551)	($427,272)	$784,013	$1,689,821
Annual Cash Flow	**Plan A**	**Plan B**	**Plan C**	**Plan D**	**Plan E**
2009	$0	$0	($1,067,966)	($1,067,966)	($1,107,521)
2010	($50,326)	($280,714)	$78,987	$68,542	$54,339
2011	($169,185)	($236,502)	($33,587)	($21,371)	$104,841
2012	($217,296)	($234,116)	($26,560)	($63,916)	$109,866
2013	($167,856)	($441,739)	($226,506)	($8,645)	$117,871
2014	($215,978)	($437,473)	($266,668)	($50,733)	$123,786
2015	($165,740)	($576,935)	($227,487)	($13,545)	$113,417
2016	($163,778)	($571,024)	($216,520)	($4,641)	$120,764
2017	($161,747)	($564,906)	($205,169)	$4,575	$128,370
2018	($159,644)	($558,573)	($193,421)	$14,115	$136,243
2019	($157,467)	($880,800)	($181,261)	$23,990	$144,394
2020	($377,133)	($256,185)	($382,621)	($179,735)	$171,352
2021	$65,819	($237,990)	$78,707	$279,146	$198,946
2022	$70,695	($536,282)	($215,828)	$290,096	$207,988
2023	$73,197	$40,186	$379,397	$301,431	$229,672
2024	$75,787	($167,062)	$393,841	$313,162	$239,362
2025	$78,468	$238,245	$441,750	$358,265	$294,677

Table 2: GHG Action Plan Financial Results

Carbon Offsets

Carbon offsets are available as an alternative to specific reduction actions within the City facilities and equipment. The PG&E Climate Smart program launched is available, but has not been incorporated into these plans. This and numerous other programs are available offering a less cost intensive approach to GHG reduction than local project implementation. However, the offset typically must be renewed annually, doesn't offset energy use (and associated cost by the City), and doesn't reduce the future energy cost vulnerability (see Figure 4 below). More information on carbon offsets is provided in the Appendices, including a sample of programs available at the time of the research.

Energy Rate Escalation and Associated Budget Vulnerability

There is considerable discussion about the availability of fossil fuels in the near and middle term future (5 to 20 years). The "Peak Oil" movement suggests that we are at or near the point where our increased global demand for oil cannot be supplied from new petroleum discoveries, while production from existing oil fields is waning. Similar arguments are made for natural gas supply vs. demand. If demand outstrips supply, simple economics indicates that the cost to consumers will escalate rapidly, until the global demand is sufficiently dampened and realigns with available supply. The concern is significant enough to have prompted a US government sponsored study to determine the impacts of demand exceeding supply in the near future.[11] This issue has important implications for local North Bay jurisdictions. Forty percent of PG&E power is generated by natural gas[12]. A spike in the cost of this energy source will result in significant increases in the cost of electrical power, as well as increased volatility in the cost of natural gas used directly by the City.

Energy efficiency projects and distributed generation energy systems can play a significant role in moderating this vulnerability. Figure 4 below provides potential impact of energy efficiency strategies on the associated vulnerability. For example, under the 3.5% utility cost escalation rate scenario, the City would reduce its fleet fuel and utility payments by over $300,000 per year in 2020 by implementing the aggressive Action Plan E.

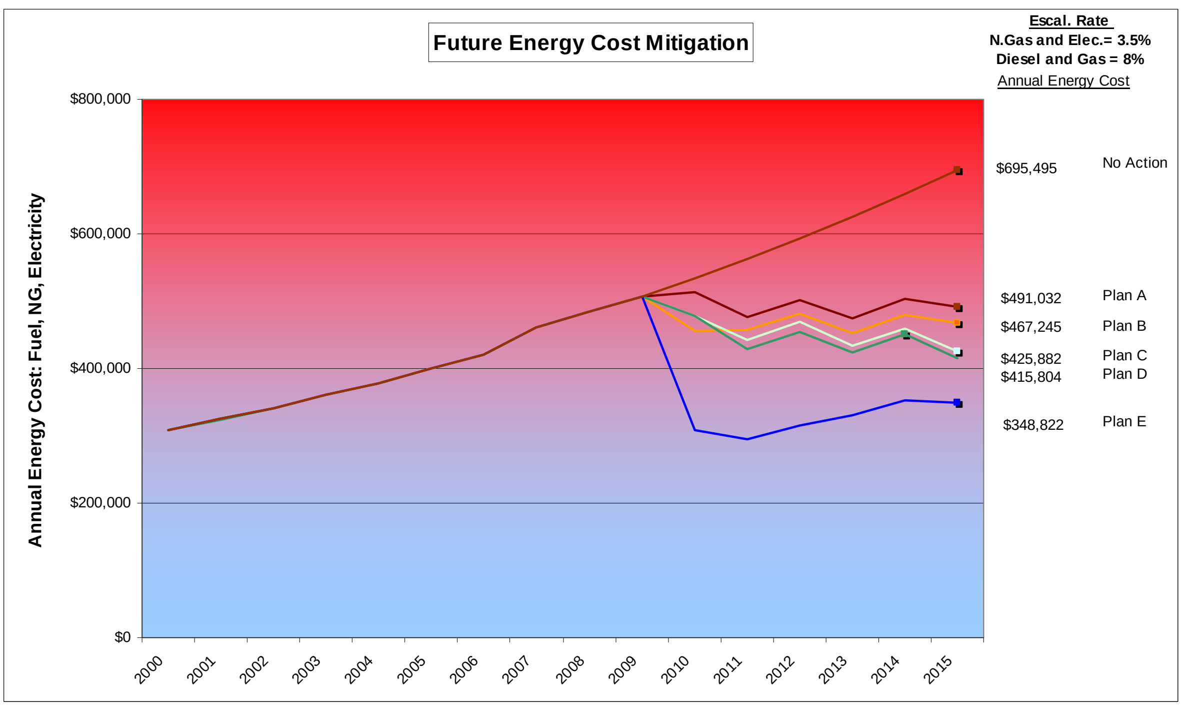


Figure 4: Annual Cost of Energy

[11] Hirsch, Robert. et al. (February 2005) "Peaking of World Oil Production: Impacts, Mitigation, & Risk Management." SAIC.

[12] PG&E Power Content: Eligible Renewables: 13%, Coal: 2%, Large Hydro: 17%, Natural Gas 44%, Nuclear: 23%, Other; 1%, California Energy Commission, www.energy.ca.gov/consumer, May 2007.

Action Plan Details

The measures used in this analysis are provided in the tables below. The first five columns indicate which measure is included in each Action Plan. More information on the measures is available in the Measure Details section of the report. The material that follows provides the results for each Action Plan. It is important to note that some measures are mutually exclusive. Measures 19 and 20, for example apply to the same set of equipment, the City fleet. Measure 20 is more aggressive affecting more vehicles. Only one of these measures would be selected.

Action Plan					Measure Number	Measure Name	Implementation Date	Financed (yes/no)
A	B	C	D	E				
n	n	y	y	y	1	Automated Water Meters (Community Wide Local Carbon Offset)	2009	no
y	y	y	y	y	2	Building Lighting Measures	2009	yes
n	n	y	n	y	3	Steetlighting HPS to LED A	2012	yes
n	n	n	n	y	4	Streetlighting HPS to LED B	2014	yes
n	n	y	y	n	5	Residential Streetlighting 1st 50%	2009	no
n	n	n	y	n	6	Residential Streetlighting 2nd 50%	2010	no
y	y	n	n	n	7	Reduce Streetlighting Lumins	2010	no
n	n	y	y	y	8	Waste Water Aeration Solar Bee™	2009	yes
y	y	n	n	n	9	Pump Efficiency A	2010	yes
n	n	y	y	y	10	Pump Efficiency B	2010	yes
y	n	y	y	n	11	PV on WstWtr Wtr Feed 200 kWAC (Chevron Energy Services measure)	2010	yes
n	y	n	n	n	12	PV 285 kWac	2009	yes
n	y	y	n	n	13	PV WstWtr Trmt Plant 265kWac	2012	yes
n	y	n	n	n	14	PV Stonebridge Well 185 kWac	2014	yes
y	n	n	y	n	15	PV WstWtr Trmt Plant 265kWac (PPA)	2012	no
y	n	y	y	n	16	PV Stonebridge Well 185 kWac (PPA)	2014	no
n	n	n	n	y	17	PV 950 kWac (PPA)	2009	no
n	n	n	n	n	18	PV 950 kWac (City Financed)	2009	yes
y	y	n	n	n	19	Fleet Replacements A	2011	yes
n	n	y	y	y	20	Fleet Replacements B	2014	yes
n	n	n	n	n	21	Biodiesel B05	2009	no
n	n	n	n	n	22	Biodiesel B20	2009	no
n	n	n	n	n	23	Biodiesel B50	2010	no
n	n	n	n	n	24	Biodiesel B99	2011	no
n	y	n	n	n	25	Biodiesel B20 Linked to Fleet A	2009	no
n	n	y	n	n	26	Biodiesel B50 Linked to Fleet A	2010	no
n	n	n	n	n	27	Biodiesel B20 Linked to Fleet B	2009	no
n	n	n	y	n	28	Biodiesel B50 Linked to Fleet B	2010	no
n	n	n	n	y	29	Biodiesel B99 Linked to Fleet B	2010	no
y	y	y	y	y	30	Efficiency Coordinator (.5 FTE)	2009	no
n	n	n	n	n	31	Parks Irrigation Control (Chevron Energy Services not quantified)	2008	yes
n	n	n	n	n	32	Library Grnd Srce Ht Pumps (Chevron Energy Services not quantified)	2008	yes
n	n	n	n	n	33	Fire Station Occ Climate Cntls (Chevron Energy Services not quantified)	2008	yes
n	n	n	n	n	34	Corp Yard Occ. Climate Cntrls (Chevron Energy Services not quantified)	2008	yes
n	n	n	n	n	35	City Hall Solar Cooing/Htng (Chevron Energy Services not quantified)	2008	yes
n	n	n	n	n	36	LED Street Tree Lights (Chevron Energy Services not quantified)	2008	yes
n	n	n	n	n	37	PV on Wtr Resv Floating Isles (Chevron Energy Services not quantified)	2008	yes

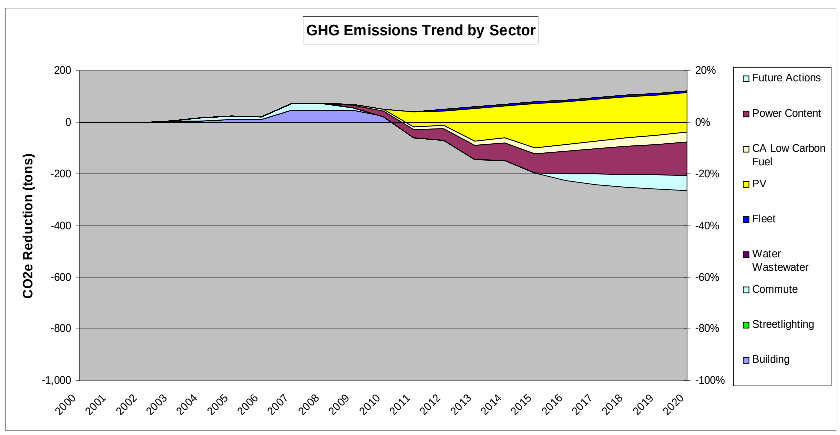
Table 3: Measures List

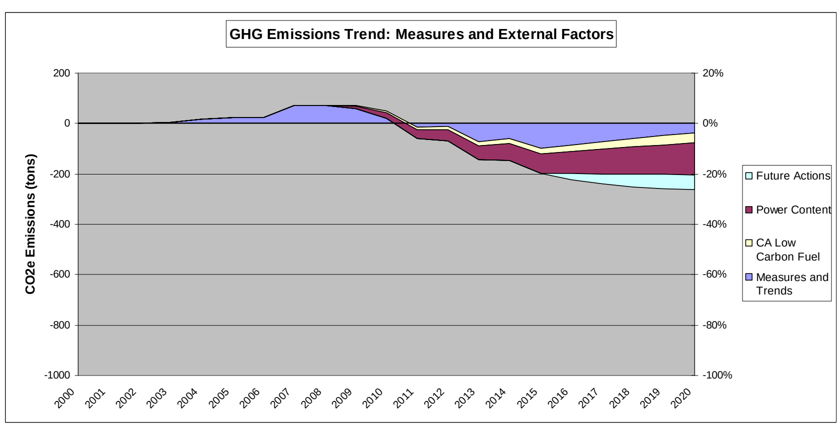
Plan A:	212	Tons CO2e Avoided	21.1%	% Reduction

Community Benefit (over 25 year life of plan)		Financial Metrics	
$$$ Avoided Utility Company Payments	$223,198	Jobs Created	95
$$$ Avoided Fuel Purchases	$24,635	IRR	NA
$$$ Invested Locally in GHG Projects	$5,129,530	NPV	($1,071,199)

Action Plan A: This plan has 8 specific actions and reduces the net GHG by 21% below 2000 levels. This plan utilizes a range of measures from building efficiency to water system pump and motor operation enhancements. This plan includes a less aggressive fleet replacement strategy including the purchase of hybrid vehicles, and includes a measure to reduce the streetlight intensity. There is a heavy reliance on photovoltaic systems financed using power purchase agreements (where the vendor owns the system and the City provides the location and agrees to purchase the power produced). The PPA approach requires no capital or O&M expenditures. The IRR for Plan A is reasonably attractive at just less than 10%. The Plan Details section lists the specific measures included in each plan and the Measures Results section provides the measure details. The building measures in all plans are based on the energy analysis provided by Chevron Energy Solutions. The resulting annual cash flow is the net income to the City (energy cost savings minus project debt service, replacement costs and associated O&M).

Year	Net Cash Flow
2009	$0
2010	($50,326)
2011	($169,185)
2012	($217,296)
2013	($167,856)
2014	($215,978)
2015	($165,740)
2016	($163,778)
2017	($161,747)
2018	($159,644)
2019	($157,467)
2020	($377,133)
2021	$65,819
2022	$70,695
2023	$73,197
2024	$75,787
2025	$78,468



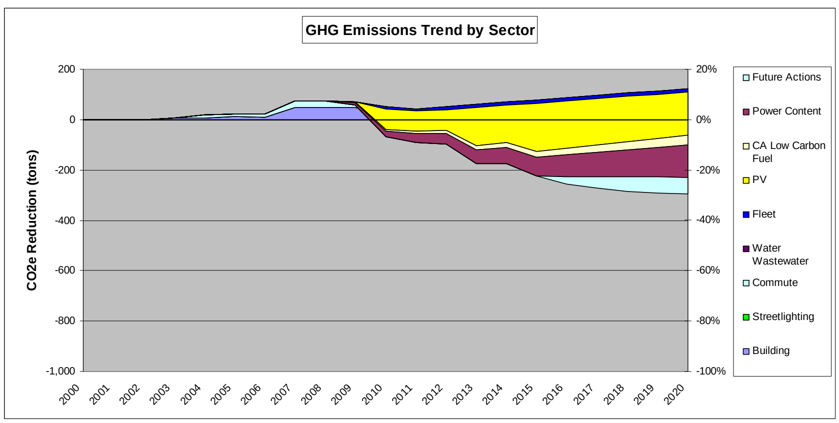


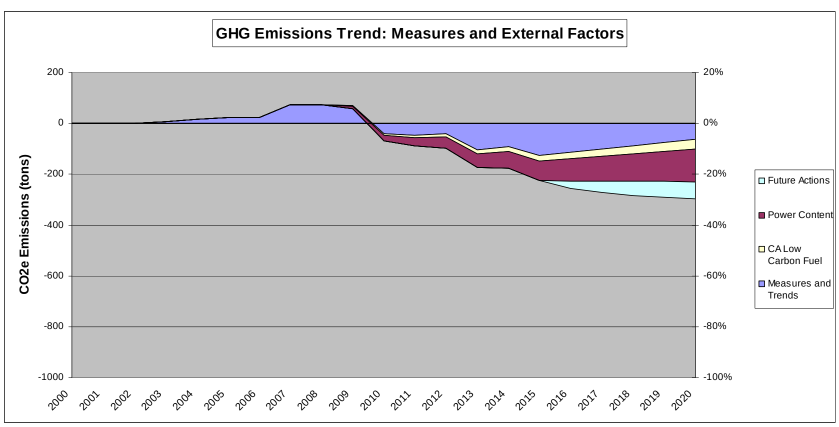
Emission Reductions Including Utility Power Content Trend and Assumed Future Actions

Plan B:	241	Tons CO2e Avoided	23.9%	% Reduction
Community Benefit (over 25 year life of plan)			**Financial Metrics**	
$$$ Avoided Utility Company Payments	$1,608,871		Jobs Created	105
$$$ Avoided Fuel Purchases	$20,578		IRR	NA
$$$ Invested Locally in GHG Projects	$6,429,962		NPV	($3,482,551)

Action Plan B: The plan includes a combination of 9 measures. A biodiesel measure is added. The photovoltaic systems included in this plan are the same capacity (kWac) as Plan A. Both plans result in approximately 900,000 kWh saved annually. However Plan B assumes the City will purchase and maintain the systems which greatly diminishes the internal rate of return (IRR) and net present value (NPV) of this strategy. All together, the measures in this plan allow the City to exceed the target of 20% GHG emissions reduction by 2015. The resulting annual cash flow is the net income to the City (energy cost savings minus project debt service, replacement costs and associated O&M). The large negative cash flow in 2020 reflects the assumed replacement of PV inverters after 10 years of service.

Year	Net Cash Flow
2009	$0
2010	($280,714)
2011	($236,502)
2012	($234,116)
2013	($441,739)
2014	($437,473)
2015	($576,935)
2016	($571,024)
2017	($564,906)
2018	($558,573)
2019	($880,800)
2020	($256,185)
2021	($237,990)
2022	($536,282)
2023	$40,186
2024	($167,062)
2025	$238,245





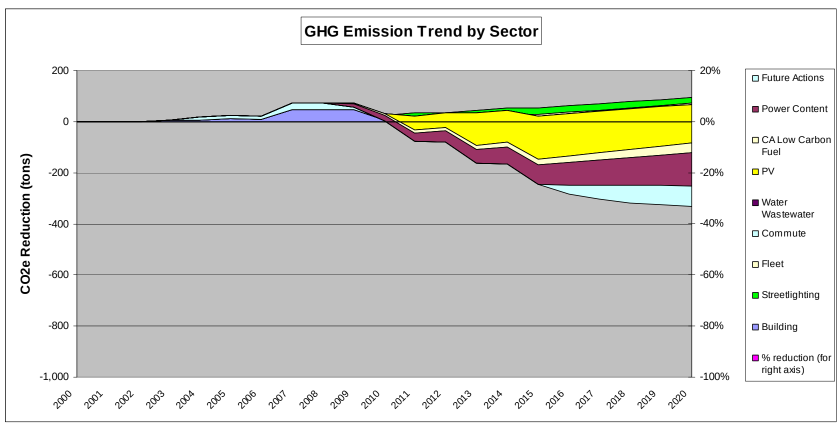
Emission Reductions Including Utility Power Content Trend and Assumed Future Actions

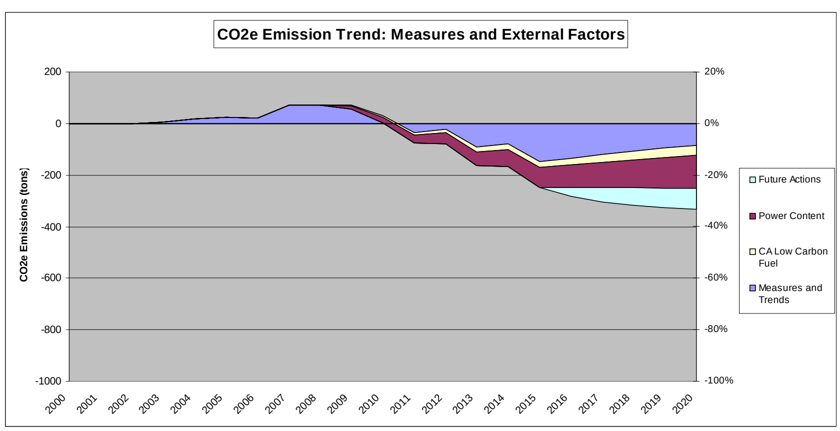
Plan C:	295	Tons CO2e Avoided	29.3%	% Reduction

Community Benefit (over 25 year life of plan)		**Financial Metrics**	
$$$ Avoided Utility Company Payments	**$1,390,163**	**Jobs Created**	**118**
$$$ Avoided Fuel Purchases	**$63,069**	**IRR**	**3.9%**
$$$ Invested Locally in GHG Projects	**$6,844,253**	**NPV**	**($427,272)**

Action Plan C: This plan includes 12 measures. In addition to most of the measures of Plan B, Plan C replaces the fleet replacement strategy with a more aggressive strategy that includes plug-in hybrids and diesel hybrids. Plan C exceeds the City target of 20% GHG emissions reduction by 2015 but yields challenging financial metrics. The Internal Rate of Return is 3.9% with a negative Net Present Value. The annual net cash flow (energy cost savings minus project debt service, replacement costs and associated O&M) is negative for a number of years. The large negative cash flow in 2022 reflects the assumed replacement of PV inverters after 10 years of service.

Year	Net Cash Flow
2009	($1,067,966)
2010	$78,987
2011	($33,587)
2012	($26,560)
2013	($226,506)
2014	($266,668)
2015	($227,487)
2016	($216,520)
2017	($205,169)
2018	($193,421)
2019	($181,261)
2020	($382,621)
2021	$78,707
2022	($215,828)
2023	$379,397
2024	$393,841
2025	$441,750





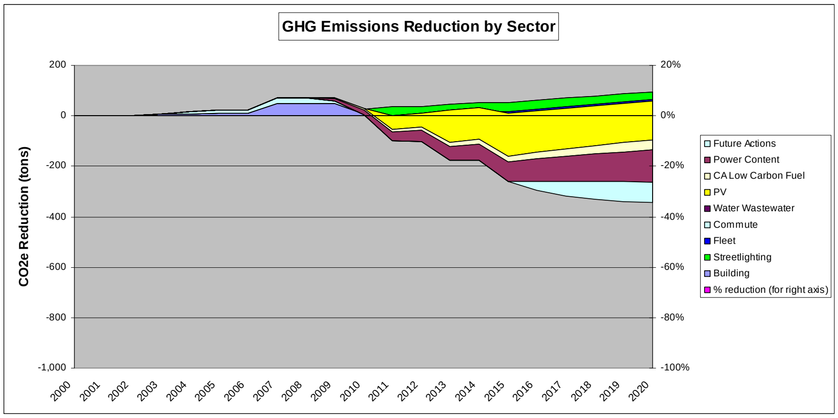
Emission Reductions Including Utility Power Content Trend and Assumed Future Actions

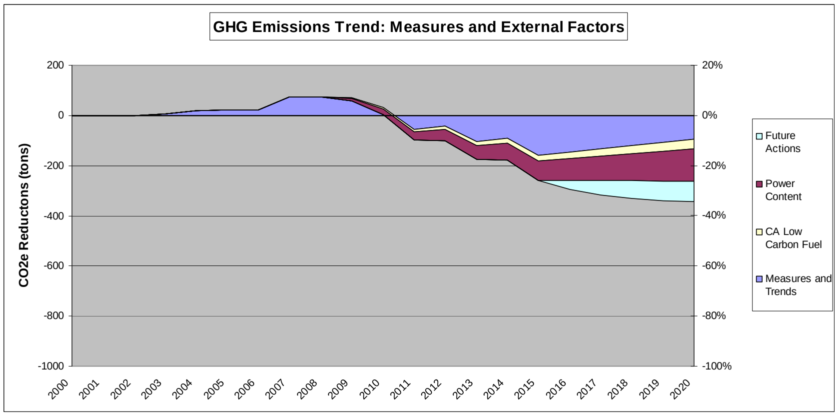
Plan D:	306	Tons CO2 Avoided	30.4%	% Reduction

Community Benefit (over 25 year life of plan)		**Financial Metrics**	
$$$ Avoided Utility Company Payments	**$828,248**	**Jobs Created**	**118**
$$$ Avoided Fuel Purchases	**$61,569**	**IRR**	**7.8%**
$$$ Invested Locally in GHG Projects	**$6,430,197**	**NPV**	**$784,013**

Action Plan D: The plan includes a combination of 12 measures. A second residential streetlighting reduction measure is added. The photovoltaic systems included result in approximately 800,000 kWh saved annually. The PV financing relies on a combination of outright purchase and power purchase agreements. All together, the measures in this plan allow the City to reduce emission by 30% GHG emissions 2000 by 2015. While the cash flow is negative in the early years, financial metrics of IRR and NPV are both relatively attractive. The addition of the water meter measure (#1) improves the cash flow considerably though the initial cost is over $1M. The resulting annual cash flow provided below is the net income to the City (energy cost savings minus project debt service, replacement costs and associated O&M).

Year	Net Cash Flow
2009	($1,067,966)
2010	$68,542
2011	($21,371)
2012	($63,916)
2013	($8,645)
2014	($50,733)
2015	($13,545)
2016	($4,641)
2017	$4,575
2018	$14,115
2019	$23,990
2020	($179,735)
2021	$279,146
2022	$290,096
2023	$301,431
2024	$313,162
2025	$358,265



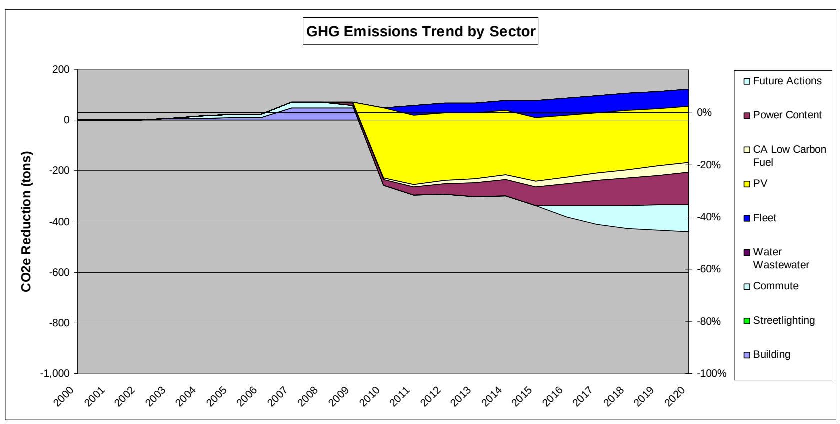


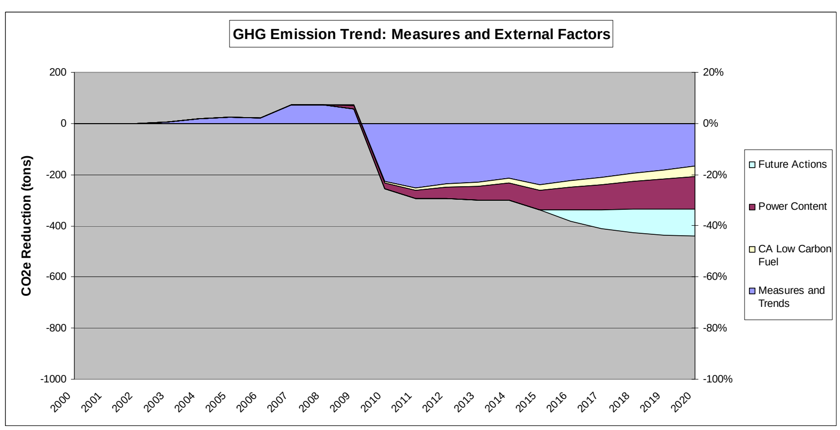
Emission Reductions Including Utility Power Content Trend and Assumed Future Actions

Plan E:	387	Tons CO2e Avoided	38.4%	% Reduction
Community Benefit (over 25 year life of plan)			**Financial Metrics**	
$$$ Avoided Utility Company Payments	($112,350)		Jobs Created	161
$$$ Avoided Fuel Purchases	$50,847		IRR	13.2%
$$$ Invested Locally in GHG Projects	$9,083,128		NPV	$1,689,821

Action Plan E: This plan includes 10 measures. In addition to most of the measures of Plan D, Plan E replaces the fleet fuel strategy with a more aggressive approach that specifies 99% biodiesel, and includes a 950kW PV system utilizing the power purchase agreement financing strategy. This plan replaces the residential streetlighting measures with a conversion to LED streetlighting systems (or equivalent technology projected to be available by 2012). Plan E pushes the GHG emissions reduction to 38% by 2015, with attractive financial metrics. The Internal Rate of Return is over 13% and the Net Present Value is roughly $1.6M over the term of the analysis (25 years). The annual net cash flow (energy cost savings minus project debt service, replacement costs and associated O&M) is strongly negative for the first 10 years. The negative net cash flow in 2022 reflects the assumed replacement of PV inverters after 10 years of service.

Year	Net Cash Flow
2009	($1,107,521)
2010	$54,339
2011	$104,841
2012	$109,866
2013	$117,871
2014	$123,786
2015	$113,417
2016	$120,764
2017	$128,370
2018	$136,243
2019	$144,394
2020	$171,352
2021	$198,946
2022	$207,988
2023	$229,672
2024	$239,362
2025	$294,677





1.4 Summary

A greenhouse gas (GHG) emissions reduction of 20% by 2015 can be achieved by a number of paths documented in this report. Each path, or Action Plan, is comprised of up to 12 individual measures. Each is evaluated for the financial costs and benefits they contribute to the overall strategy. The total "palette" of opportunities includes 35 measures. The analysis model underpinning these results will be available for incorporating new information and technologies as they come available, as well as truing the analysis with monitored data. The comprehensive approach to addressing this goal allows the City to meet a number of related goals, including improving the long term financial health of St Helena, reducing the budget vulnerability to future energy cost escalation, addressing the existing maintenance demands of aging equipment, and providing the public demonstration of commitment and progress in the highly visible challenge of greenhouse gas emissions reduction.

Additional consideration should be directed toward an employee commute program. The costs and benefits are not estimated in this analysis, but could be significant. The City may also consider the emerging opportunities with fleet management software. This may require a partnership with other Napa County jurisdictions to achieve reasonable economies of scale. Finally, Many cities are considering a reduced workweek (4/10 or 9/80) to reduce costs. These schedules will also reduce energy consumption and thereby contribute to the reduction of greenhouse gas emissions.

The information in this report allows the City to understand the challenges and opportunities available in reaching its goal. The evaluation matrix incorporates the many related issues not captured by the financial results or emissions reduction such as public visibility and the resolution of existing problems. The financial results provide information on the investment value of the various paths of action, along with the anticipated net cash flow over time. The ability to understand the complex context of greenhouse gas emissions reduction will allow policy makers to define expected outcomes and associated financial commitments to meet those outcomes. This provides city staff the flexibility needed to effectively implement the policy. The individual measures within each plan may be delayed, modified or replaced as appropriate while remaining faithful to the policy directive. This flexibility will be essential given the dynamic nature of the regulatory environment and the rapidly evolving financial and technological opportunities in California.

2.0 Introduction

Public jurisdictions (cities and counties) have adopted global warming pollution reduction targets and have committed to developing action plans. These detailed plans are required to provide a roadmap to meet the goals and a framework to track and verify the progress toward the goal over the life of the plan.

This report provides these capabilities by using an analysis method developed for North Bay cities and applied to the City of St Helena. This method incorporates all measures across the various sectors (Building Efficiency, Fleet, Commute, Water/Sewer, Streetlights, and Distributed Generation), and provides an emissions impact estimate and a comprehensive financial analysis. Furthermore, this analysis allows independent plans to be analyzed, providing the capability to compare the cost / benefits of competing paths to global warming pollution emissions reduction.

The first step, creating the inventory of emissions produced by the internal operations has been completed for all cities and the county. The total emissions for 2000 were roughly 1,007 tons of CO2e.

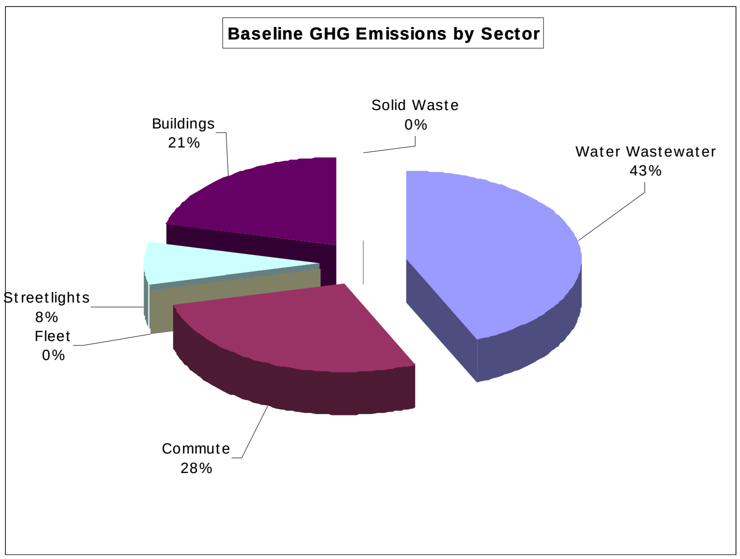


Figure 5: City of St Helena GHG Inventory as a Percentage of the 2000 Total

3.0 Methodology

3.1 Context

The St Helena GHG emissions inventory for 2000 has been completed and provides a reference for the baseline inventory developed for this analysis.[13] The specific actions and events affecting this baseline, either positive or negative, are factored into the inventory and the resulting trend. The baseline inventory has been reconstructed from information made available by Staff at the initiation of this work.

[13] GHG Emissions 2000 Inventory City of St Helena, Sam Pierce, PE, Climate Protection Campaign, Aug 3, 2007.

The total emissions for 2000 were roughly 1,007 tons of CO2e. There were numerous changes in GHG emissions identified from the utility billing since the baseline year of 2000. These are consolidated and modeled in the analysis as the "End Use" entries in the table below.[14] These add another 83 tons to the reduction goal. This information was also used to generate the emissions trend associated with city growth from 2008 to 2020. These projected additional GHG emissions are included in the calculations of each Plan option as Future Trends. This trend adds 10.3 tons per year which is dependant on the projected population increase each year within the City.[15] A similar methodology was used to determine 1990 GHG emissions and to report the percentage reduction below 1990 for each plan of action.

Increases in Energy Consumption from 2000 to 2008				
End Use	**Year**	**kWh**	**Therms**	**Fuel (gals)**
City Offices and Firestation	2004	22,974	0	0
City Offices and Firestation	2002	22,974	0	0
Firestation, Library and Garage	2006	0	1,019	0
Stonebridge Well and Disposal Plant	2006	128,035	0	0
Recreational Outdoor Lighting	2005	-3,012	0	0
Employee Commute	2003	0	0	1,172
Employee Commute	2006	0	0	1,172

Table 4: Increases in Energy Consumption from 2000 to 2008

The options for future action by the City are comprised of measures applicable to building and equipment energy efficiency, fuel efficiency, alternative fuel options, and distributed energy generation. These options have been identified and quantified within this analysis. They are evaluated and presented as individual projects (measures), and as groups of measures (plans). Each is assigned a status (completed or future) and an implementation date to enable the calculation of cash flows over the life of the plans and the creation of energy cost trend graphs. The "palette" of measures includes emerging technologies which are in the pilot project stage of implementation. These are included on the assumption that they or an equivalent technology will be available by the year of implementation.[16]

The measures are grouped to create comprehensive GHG emissions reduction plans. Each of the plans is analyzed to provide profiles enabling the evaluation of the plans individually and in comparison to the other plan options.

[14] These End Uses represent 100% of the energy increases for all accounts as identified in the PG&E billing data. They are labeled as the accounts contributing most to the change and the year associated with the change.
[15] St. Helena Local Economy and Economic Development Background Report, Bay Area Economics, Oct 24, 2007
[16] Example: A streetlighting measure is included which relies on LED technology. There are several pilot projects underway that utilize this technology. However, if this specific strategy does not perform as anticipated (light pattern uniformity has been a concern), this analysis assumes another streetlighting energy savings strategy of similar costs and benefits will be available by the implementation date of 2012.

Measure specific data such as capital cost, year of implementation, financing, energy and cost savings were processed to provide the following information for five action plans:

- Emissions reduction in short tons CO2 avoided as a percentage of baseline
- CO2 reduction by sector
- Annual cash flow including debt service and incremental O&M costs
- Outstanding principal and debt service by year
- Simple Payback (SBP) for each plan
- Internal Rate of Return (IRR) for each plan
- Net Present Value (NPV) for each plan
- Avoided utility company payments (NPV over life of plan)
- Avoided fuel purchases (NPV over life of plan)
- Value invested locally in emission reduction projects

The details of each measure are provided, such as the vehicle and pump lists provided in the Measure Details section. The generally applied assumptions, such as the discount rate, interest rate, escalation rate for the cost of utility supplied power and fuel, and the CO2e conversion factors for energy and fuel have also been reviewed and adjusted by City Staff. The values are provided in Table 5. These general values can be overridden at the measure level if necessary. For example, the term of financing is set to 10 years as a default value. CEC loans are based on generating a net cash flow close to zero for the first year and a positive cash flow over the life of the loan with a maximum value of 10 times the annual cost savings. Where appropriate, the term of the loan is adjusted at the measure level to meet this funding criterion.

3.2 Measure Identification

The list of measures has been generated from document reviews, past experience of other jurisdictions, and a review of the St Helena facilities completed by Chevron Energy Solutions. All measures included in this analysis have been reviewed for inclusion by City Staff. The following sources contributed to the information in this report.

- City of Saint Helena Comprehensive Energy Analysis, Chevron Energy Solutions, date unidentified.
- GHG Emissions 2000 Inventory City of St Helena, Sam Pierce, PE, Senior Engineer, Climate Protection Campaign, August 3, 2007.

3.3 Measure Assumptions: General Variables

This report is based on a set of general inputs for the financial analysis. Each measure utilizes these general inputs unless they are overridden at the measure level. The general inputs are provided in Table 5 below. The values used for each measure are provided in the Appendices. These inputs include the following:

- Term of Analysis
- Term of Finance
- Discount Rate
- Energy Inflation Rate
- Energy Cost
- Interest Rate
- Inflation Rate

The conversions in the table below are based on the best available information. The values for natural gas, gasoline, and diesel fuel are consistent with the California Climate Action Registry values.[17] The value for 100% ethanol is calculated using data from research published by Argonne Labs.[18] The value used for CO2/kWh is based on the PG&E fuel mix and is different than the value specified in the Registry.[19] This analysis has modified the baseline results by using the current value to ensure an appropriate comparison.

The costs and benefits assumed for each of the measures is based on the best available information available at the time of research. Some measures have a highly reliable set of costs and energy reduction estimates due to the maturity of the strategy. Lighting retrofits fall into this category. Other measures rely on more vague data, such as the availability of LED streetlighting and the associated costs. The dynamic context for electric and hybrid vehicles is another example of firm possibilities with unconfirmed costs and benefits. The implementation dates of such opportunities are pushed out to 2010, 2012 or later to balance the uncertainty of the cost benefit data. The inclusion of these measures allows for a more complete set of plans and provides the framework for adjustments as more refined information becomes available.

The general assumptions and conversions used in this analysis are provided in the table below.

Metric	Values Used in Analysis
Term of Analysis (yrs)	25
Term of Financing (yrs)	10
Discount Rate	5.00%
kWh Energy Cost Escalation Rate	3.50%
Nat Gas Energy Cost Escalation Rate	3.50%
Vehicle Fuel Cost Inflation Rate	8.00%
Energy Cost ($/kWh)	$0.145
Energy Cost ($/Therm)	1.000
Interest Rate	3.95%
Inflation Rate	3.50%
Conversions	
CO2/kWh (lbs.)	0.489
CO2/Therm (#/Therm)	12.34
CO2e Gasoline (lbs/gal)	20.7
CO2e Diesel (lbs/gal)	21.0
BioDiesel (lbs/gal)	5.242
Ethanol (lbs/gal)	12.23
$/gal Gasoline	$3.08
$/gal Diesel	$3.08
$/gal Biodiesel	$3.38
$/gal Ethanol (equivalent gallon)	$4.00
$/Therm CNG Vehicles	$1.00
$/kWh Electric Vehicles	$0.145
Electric Vehicle Mileage	0.3
Electric Vehicle Mileage	0.2
Target (% of 2000)	20.0%
PPA Initial % Increase over Utility kWh	5.00%
PPA Energy Cost Escalation Rate	3.50%

Table 5: General Inputs

[17] California Climate Action Registry General Reporting Protocol, Version 3.0, April 2008.
[18] Effects of Fuel Ethanol Use on Fuel-Cycle Energy and Greenhouse Gas Emissions; M. Wang, C. Saricks, and D. D. Santini; Argonne Labs; January 1999.
[19] PG&E Power Content: Eligible Renewables: 13%, Coal: 2%, Large Hydro: 17%, Natural Gas 44%, Nuclear: 23%, Other; 1%, California Energy Commission, www.energy.ca.gov/consumer, May 2007.

3.4 Measure Specific Variables

The general inputs can be adjusted for each individual measure as appropriate. The other key individual inputs are listed below. The values for each measure are provided in the Appendices.

- Category (Building, Fleet, Commute, Distributed Generation, Water/Sewer)
- Status (Completed, Pending, and Future). Pending measures are defined as those provided by City Staff with identified funding.
- Financing: The cash flow is heavily dependent on whether or not the measures are financed. This funding decision is defined for each measure independently.
- Project Implementation Date
- Net Capital Cost
- Incremental Capital Cost associated with the cost premium associated with the improved efficiency. For Example: a hybrid compact vehicle is assigned a cost premium of $4000 over an equivalent standard vehicle.
- Rebates and incentives
- Annual O&M cost associated with the efficiency measure
- Incremental Replacement Cost
- Component Life
- Time of Use factor (Photovoltaic systems)

3.5 Financial Analysis Results

The analysis provides the financial information required for investment decisions. This includes the following:

- Non efficiency related capital costs satisfied by plans[20]
- Net Cash Flow for each year of the plans
- Debt load for each year of each plan
- Simple Payback for each plan
- Internal Rate of Return
- Net Present Value
- CO2e reduction for each plan

Financial Definitions[21]

Net Present Value (NPV):
Net Present Value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows. NPV is used in capital budgeting to analyze the profitability of an investment or project. NPV analysis is sensitive to the reliability of future cash inflows that an investment or project will yield.

$$\mathrm{NPV} = \sum_{t=1}^{n} \frac{C_t}{(1+r)^t} - C_0$$

[20] Example: a 30 year old Air Conditioner needs to be replaced. The cost of replacement typically has been included in the city Capital Investment Plan. However, the entire cost of replacement can be funded though energy efficiency resources (rebates and loans), but only a portion of the cost (30%) is a result of the efficiency enhancement.
[21] http://www.investopedia.com/terms, http://www.visitask.com

Where
t - the time of the cash flow
n - the total time of the project
r - the discount rate
C_t - the net cash flow (the amount of cash) at time t.
C_0 - the capital outlay at the beginning of the investment time ($t = 0$)

Internal Rate of Return (IRR):
The Internal Rate of Return (IRR) is the discount rate that generates a zero net present value for a series of future cash flows. This essentially means that IRR is the rate of return that makes the sum of present value of future cash flows and the final market value of a project (or an investment) equal its current market value.

Generally speaking, the higher a project's internal rate of return, the more desirable it is to undertake the project. As such, IRR can be used to rank several prospective projects under consideration. Assuming all other factors are equal among the various projects, the project with the highest IRR would probably be considered the best and undertaken first.

The IRR is based on the total investment and energy cost savings over the life of the investment, independent of the financing strategy for the investment.[22]

3.6 Community Benefit

The investments in the specific measures have positive local consequences. The community benefits are quantified and presented in the following outcomes:

1) $$$ Avoided Utility Company Payments: This is the Net Present Value (NPV) of all the avoided electricity and natural gas payments over the 25 year period of the analysis.
2) $$$ Avoided Fuel Payments: The NPV of the avoided gasoline and diesel fuel payments over the 25 year life of the analysis.
3) $$$ Invested Locally in GHG Projects: This is the total capital cost of the measures specified for the plan. This analysis does not attempt to separate labor, material, overhead or profit to more accurately identify the percentage of these investments likely to remain local. The inherent overstatement of this result is balanced to a significant degree by discounting the well-documented economic multiplier effect of local investment (no multiplier is used). Bio-diesel purchase is considered 100% local. In practice, this will depend on the supplier. Ethanol is not considered to be a local purchase.
4) Jobs Created: This is a simplified calculation using the methodology defined in the 2009 Federal Stimulus Package application procedures.

   The formula is: $1.0 Million in Capital Expenditure = 17 jobs created

   This methodology does not incorporate timing of the expenditure or duration.

[22] The IRR and NPV for the Plans are calculated from the cash flows of the individual measures included in the respective plan, independent of the implementation date of each measure. This strategy results in a first year "investment" required for the IRR calculation and a subsequent annual cash flow (the return on investment).

3.7 Measure Evaluation

The decision to include a measure in the action plan is based on a comprehensive appraisal of that measure and its impact on the overall cost/benefits of the Action Plan. To aid in the selection process, each measure has been evaluated and scored for eight metrics listed below. While informative, the scoring of the measures is not binding on the selection process. The results of the Measure Evaluation are presented in the Appendices.

1) Cost: The measure is scored by the magnitude of the net capital cost, independent of other considerations.
2) Financial Metrics: The measure is scored by the internal rate of return (IRR) and Net Present Value (NPV). IRR and NPV are determined from the investment required for the measure (Net Capital Cost), the annual cost savings and the resulting annual cash flow.
3) Resolution of Existing Problems: This metric evaluates how the measure solves existing problems, such as a failing air conditioning system. The replacement of old mechanical units will save maintenance staff time and associated costs (maintenance savings are not calculated in the cash flows).
4) GHG Impact: The measure is scored on its impact on the reduction of GHG emissions, relative to the other measures under consideration.
5) Public Visibility: Some measures provide an additional benefit by demonstrating to the general public the actions of the jurisdiction to address global warming. Measures such as Photovoltaic systems are scored high for Public Visibility.
6) Employee Impact: The additional burden or inconvenience imposed on City Staff is a consideration for any measure under consideration. This metric evaluates this impact. A photovoltaic system has no impact and receives a neutral score. New fleet vehicles will require a change from “business as usual” and results in a lower score. The Commute measure creates transportation options for the City Staff and receives a higher score.
7) Community Impact: The additional benefit, burden or inconvenience imposed on the community is a consideration as well. This metric evaluates this impact. The improvement of public facilities, lighting or HVAC for example, would result in a favorable score. The imposition of additional fees or hardship on the community would result in an unfavorable score.
8) Energy Cost Stabilization: Energy cost variability is a concern for all jurisdictions. The price volatility of natural gas and the spike in cost for electricity in 2000-2001 give reason to address this vulnerability. This metric evaluates the impact by measure on the City’s long term energy cost volatility. The highest value is assigned to energy efficiency measures. Energy saved by efficiency has an effective cost of $0 into the future, as long as the efficiency measure is in place.

3.8 California Low Carbon Fuel Standard

In the January 2007 State of the State, Governor Schwarzenegger asserted California's leadership in clean energy and environmental policy by establishing a Low-Carbon Fuel Standard (LCFS) by Executive Order. This first-in-the-world greenhouse gas (GHG) standard for transportation fuels will spark research in alternatives to oil and reduce GHG emissions.[23] The target GHG reduction is 20%. This analysis assumes the actual reduction will be 50% of the goal over 12 years. This would reduce the carbon density for gasoline from 20.968 lbs CO2e/gallons to 18.871 lbs CO2e/gallon with a similar reduction for Diesel.

3.9 PG&E Power Content

The sources of energy purchased by the utility determine the carbon density (lbs CO2e per kWh) of the electricity produced by the utility and used by the City. This "Power Content" is identified by the utility and reported by the CPUC on an annual basis. There is a requirement that the content rely on increasing percentages of renewable resources. As the power content carbon density decreases the emissions associated with electrical energy use decreases. Also as the carbon density decreases, the CO2e reductions per kWh displaced by photovoltaic and energy efficiency measures also decreases. Therefore a kWh saved in 2009 will be more significant than a kWh saved in 2015 if the Power Content is more "green" in 2015. This dynamic is factored into the analysis which is time dependent for both the implementation date of the measure and the reporting date for the reduction below 2000 levels. This relationship is represented by the "PGE mix" portion of the area graphs provided in the "CO2e reduction 2000 – 2020" figures for each Action Plan. The values assumed for the PG&E Power Content by year are provided in the table below. An adjustment of 50% is applied to the source material to acknowledge the perceived "optimistic" nature of projected renewable content.[24]

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Modified Power Content used in analysis	0.566	0.558	0.551	0.543	0.535	0.528	0.520	0.512	0.504	0.497	0.489	0.489	0.489	0.489	0.489	0.489	0.489	0.489	0.489	0.480	0.470	0.461	0.451	0.442	0.432
Methodology	Assumed linear from 1990 to 2000										Constant from 2000 to 2008								Assumed Linear						
CPUC Target Power Content	0.566	0.558	0.551	0.543	0.535	0.528	0.520	0.512	0.504	0.497	0.489	0.489	0.489	0.489	0.489	0.489	0.489	0.489	0.489	0.470	0.451	0.432	0.413	0.394	0.375

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Modified Power Content used in analysis	0.423	0.413	0.404	0.395	0.387	0.378	0.370	0.362	0.354	0.346	0.338	0.331	0.324	0.316	0.309	0.303	0.296	0.290	0.283	0.277	0.271
Methodology	Assumed constant % reduction based on 2014 / 2015 ratio																				
CPUC Target Power Content	0.356	0.338	0.321	0.305	0.289	0.275	0.261	0.247	0.235	0.223	0.212	0.201	0.191	0.181	0.172	0.163	0.155	0.147	0.140	0.133	0.126

Figure 6: Power Content Values for Converting kWh to lbs/CO2e

[23] California Energy Commission, http://www.energy.ca.gov/low_carbon_fuel_standard, March 2009

[24] The inclusion of the PG&E fuel mix has a significant impact on the greenhouse gas emissions of the City in future years. The California Public Utilities Commission (CPUC) has required the fuel mix to be increasingly renewable from 2008 forward. The value for lbs/kWh declines from 0.489 in 2008 to 0.356 in 2015 per calculations published by the Climate Protection Campaign in the Sonoma County Community Climate Action Plan issued in November 2008.

3.10 Future Actions

This analysis provides specific information on the impacts of discreet actions to reduce greenhouse gas emissions from City controlled equipment and operations. The last of these measures is implemented in 2014 for all plans. However, the trend of greenhouse gas emissions is provided to the year 2020, including the annual increase in emissions associated with projected city growth. To balance this structural increase from 2015 to 2020, and to acknowledge that the policy of action regarding greenhouse gas emissions will likely persist at the pace established by actions from 2009 to 2015, a "Future Actions" placeholder is included in the analysis and is represented in the "CO2e Reduction 2000 – 2020 (Net)" graph provided with each Action Plan. These are based on the level of reductions from 2009 to 2015 unique to each plan. These reflect a diminishing "rate of return" on emissions reduction actions of 40% per year. There are no costs calculated for these future actions. They are not included in the financial metrics or cash flows for each plan. They also do not contribute to the GHG reduction values or percentages reported with each plan. The emissions reporting date is 2015 which is prior to impact of the "future trends" element of the analysis.

4.0 Results

Five plans have been created for consideration by the City of St Helena. These plans consist of numerous measures to reduce GHG emissions, reduce energy costs, address equipment problems, and reduce the volatility of the City's annual energy costs. Summary information is provided below. The Action Plan Evaluation provided in the Appendices provides an analysis of the relative strengths of each combination of measures. Similar information for each measure is also provided.

4.1 GHG Impacts and Plan Financial Results

Table 6 below provides a comparison of each plan. The "% Reduction" is the amount of CO2e reduced as a percentage of the total City emissions. Each plan meets the goal by a unique set of measures. Plan E identifies the measures necessary to reduce the City's emissions by approximately 36% below year 2000 emissions. The financial analysis is provided with each plan. The IRR and NPV results are based on the 25 year term of the analysis, from 2009 to 2034.

GHG Action Plan Summary					
Analysis	**Plan A**	**Plan B**	**Plan C**	**Plan D**	**Plan E**
% Reduction below 2000 by 2015 (net)	21.1%	23.9%	29.3%	30.4%	38.4%
% Reduction below 1990 by 2015 (net)	1.5%	4.6%	10.7%	12.0%	21.0%
Simple Pay Back	NA	NA	19.1	14.8	9.9
Internal Rate of Return (IRR)	NA	NA	3.9%	7.8%	13.2%
Net Present Value of Investment (NPV)	($1,071,199)	($3,482,551)	($427,272)	$784,013	$1,689,821
Annual Cash Flow	**Plan A**	**Plan B**	**Plan C**	**Plan D**	**Plan E**
2009	$0	$0	($1,067,966)	($1,067,966)	($1,107,521)
2010	($50,326)	($280,714)	$78,987	$68,542	$54,339
2011	($169,185)	($236,502)	($33,587)	($21,371)	$104,841
2012	($217,296)	($234,116)	($26,560)	($63,916)	$109,866
2013	($167,856)	($441,739)	($226,506)	($8,645)	$117,871
2014	($215,978)	($437,473)	($266,668)	($50,733)	$123,786
2015	($165,740)	($576,935)	($227,487)	($13,545)	$113,417
2016	($163,778)	($571,024)	($216,520)	($4,641)	$120,764
2017	($161,747)	($564,906)	($205,169)	$4,575	$128,370
2018	($159,644)	($558,573)	($193,421)	$14,115	$136,243
2019	($157,467)	($880,800)	($181,261)	$23,990	$144,394
2020	($377,133)	($256,185)	($382,621)	($179,735)	$171,352
2021	$65,819	($237,990)	$78,707	$279,146	$198,946
2022	$70,695	($536,282)	($215,828)	$290,096	$207,988
2023	$73,197	$40,186	$379,397	$301,431	$229,672
2024	$75,787	($167,062)	$393,841	$313,162	$239,362
2025	$78,468	$238,245	$441,750	$358,265	$294,677

Table 6: Action Plan Financial Results

The financial analysis is provided with each plan. The critical metrics of Internal Rate of Return (IRR), and Net Present Value (NPV) provide important information to evaluate the worthiness of the investment from a cash flow perspective. It is important to note the large negative net cash flows for Plans in later years. These are incurred by substantial reinvestments in large photovoltaic (PV) systems (replacement of the associated inverters after 10 years). The assumption is that the cost of inverters will increase at the generally assumed inflation rate of 3%. However, likely advances in technology and improved economies of scale for the industry suggest this is overly conservative.

Finally, the actual net cash flow is also provided for each plan in Table 6. An expanded cash flow table is provided with each plan that breaks out the gross cash flow, annual debt service payment and outstanding principal for each year of the plan. This presentation allows a clear understanding of the impacts of a “financial decision” in 2009 over the life of the plan.

4.2 Action Plan Evaluations

The GHG Emission Reduction Action Plans involve more than CO2e reduction and cash flow. There are critical concerns that should be factored into the decision making process. These include the financial metrics of Internal Rate of Return (IRR) and Net Present Value (NPV) to evaluate the worthiness of the investment; the cost of implementing the measure, some measures come with a large price tag which will challenge liquidity; the degree to which the plan resolves existing problems, such as old, high maintenance air conditioning units; the visibility of the measures to the public, for example the photovoltaic systems are a physical example of actions taken the City and communicate action and commitment to the community. Other key considerations include the employee impacts of new equipment or procedures, which may generate internal opposition; and the impact on the variability of future energy costs and the associated budgetary vulnerability.

Each measure and the plans as a whole are evaluated by the following considerations:

- Net Capital Cost
- Financial Metrics (IRR and NPV)
- Resolution of Existing Problems
- GHG Impact
- Public Visibility
- Employee Impact
- Community Impact
- Energy Cost Stabilization

The results of the evaluation are provided in the Appendices. The individual scores for each category (cost, financial metrics, etc.) are aggregated to provide an overall score for that measure. While the results provide important information to be considered when selecting measures, the scores are advisory only. A relatively low score does not preclude a measure, nor should a high score guarantee inclusion of the measure in the Action Plans. There will always be additional considerations that are not reflected in the evaluation process.

4.3 Energy Rate Escalation and Associated Budget Vulnerability

There is considerable discussion about the availability of fossil fuels in the near and middle term future (5 to 20 years). The "Peak Oil" movement suggests that we are at or near the point where our increased global demand for oil cannot be supplied from new petroleum discoveries while production from existing oil fields is waning. Similar arguments are made for natural gas supply vs. demand. If demand outstrips supply, simple economics indicate that the cost to consumers will escalate rapidly, until the global demand is sufficiently dampened and realigns with available supply. The concern is significant enough to have prompted a US government sponsored study to determine the impacts of demand exceeding supply in the near future.[25] This issue has important implications for North Bay jurisdictions. Forty percent of PG&E power is generated by natural gas.[26] A spike in the cost of this energy source will result in significant increases in the cost of electrical power, as well as increased volatility in the cost of natural gas and fleet fuel used directly by the City.

[25] Hirsch, Robert. et al. (February 2005) "Peaking of World Oil Production: Impacts, Mitigation, & Risk Management." SAIC.

[26] PG&E Power Content: Eligible Renewables: 13%, Coal: 2%, Large Hydro: 17%, Natural Gas 44%, Nuclear: 23%, Other; 1%, California Energy Commission, www.energy.ca.gov/consumer, May 2007.

All of the measures available to reduce GHG emissions also will reduce the City energy costs. These costs are a significant element of the municipal budget, and the potential volatility of their costs represents a threat beyond the control of City Staff. Figure 7 below provides the trends for the annual cost of fleet fuel and utility supplied electricity and natural gas based on four rate escalation scenarios. The measures contained in this analysis will reduce the vulnerability to energy price increases. These trend lines assume that the City takes no further action to reduce or increase its reliance on fleet fuel, and utility supplied electricity and natural gas.

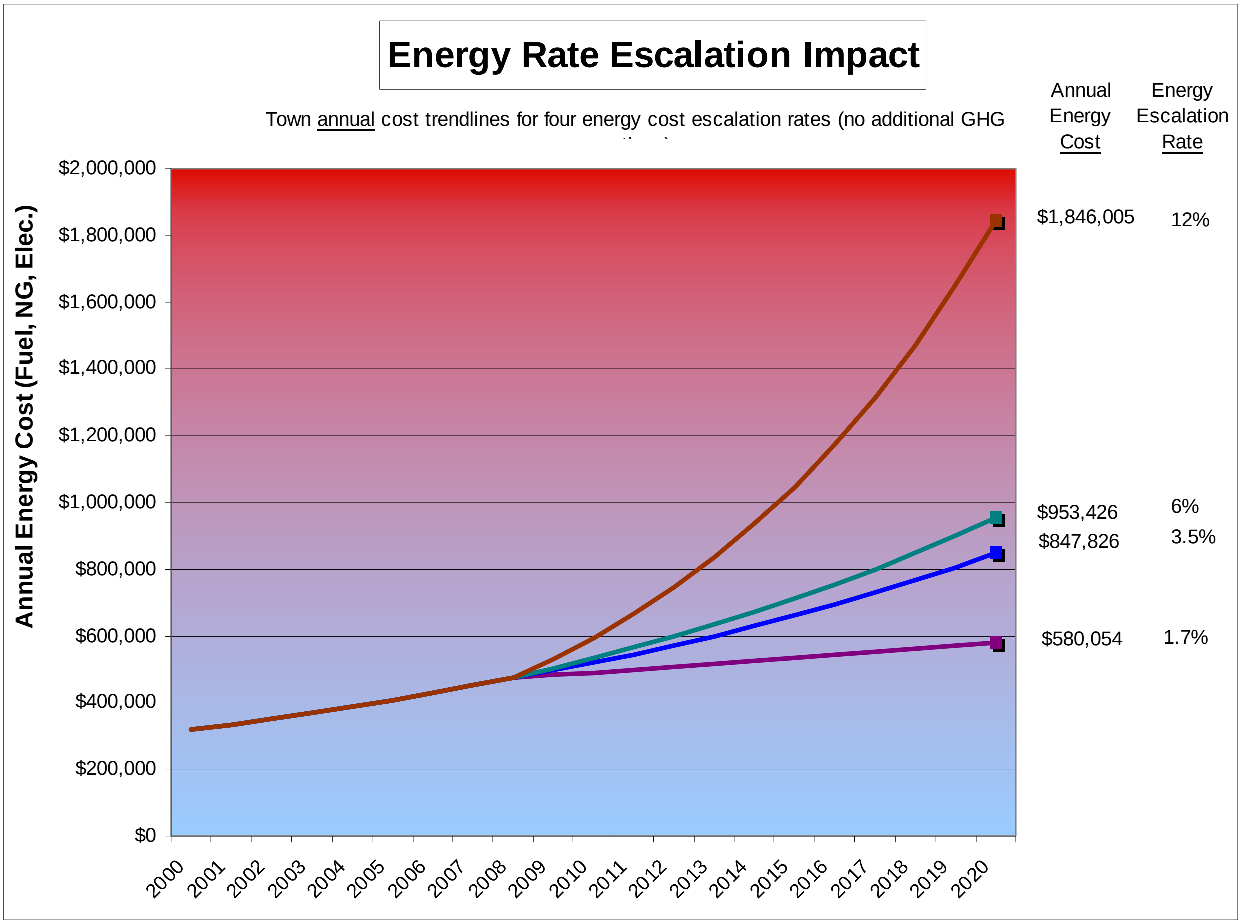


Figure 7: Energy Rate Escalation Scenarios

The future cost of vehicle fuel (gasoline and diesel) is much more volatile than the other energy sources. The cost of this resource has increased by 8% a year on average since 1987 (see the Appendices for further discussion on the cost trends of vehicle fuel). If fuel increases continue at the 8% rate, as they are now, the future cost will follow the "Current Trend" line in Figure 8 below. However, if prices increase at twice the past rate (represented by the "2 X Current Trend" line) then the annual cost of vehicle fuel will exceed $600,000 by 2020. This trend is discussed in greater detail in the Appendices.

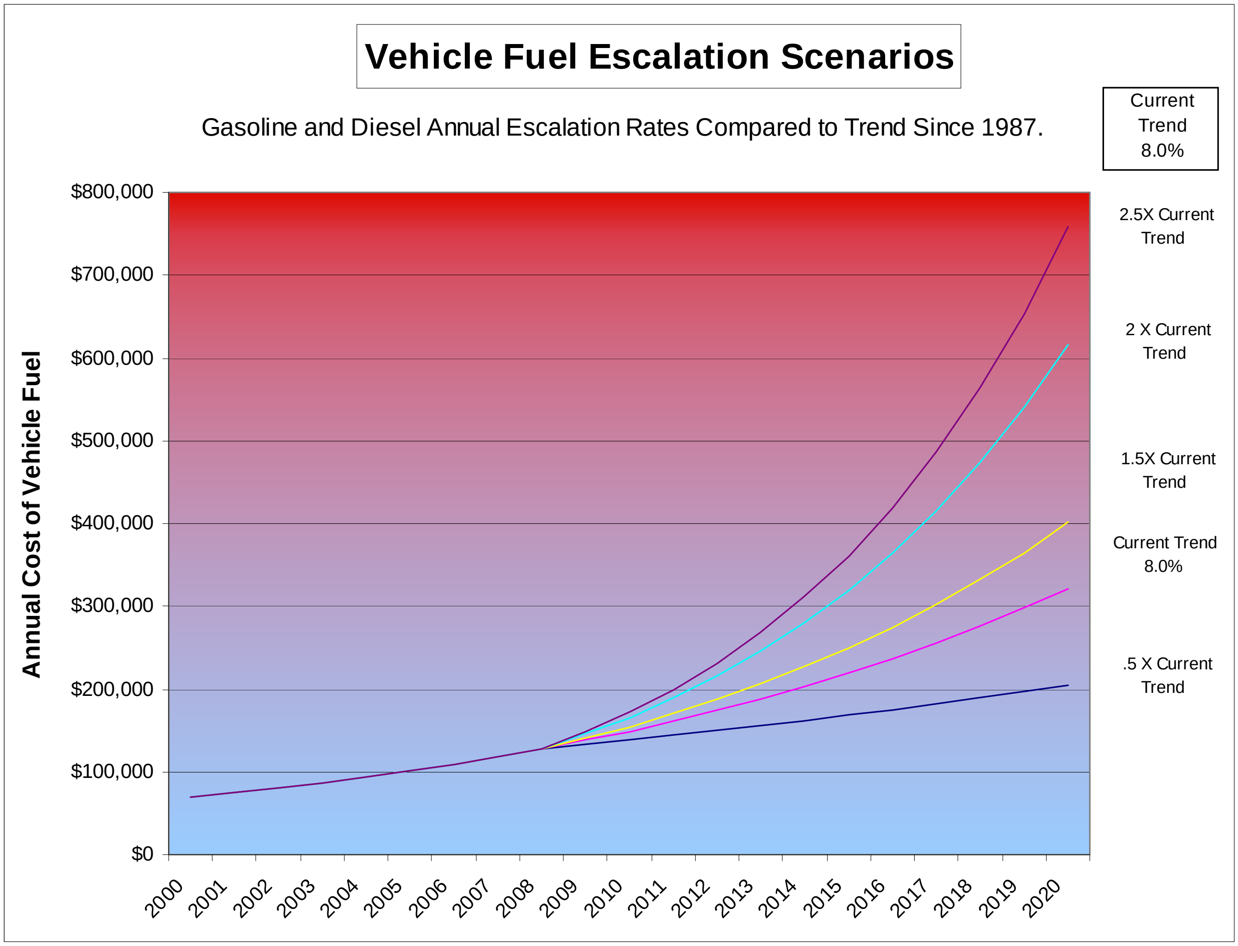


Figure 8: Annual Cost Trend of Vehicle Fuel Only

Energy efficiency projects and distributed generation energy systems can play a significant role in moderating this vulnerability. Figure 9 below provides potential impact of energy efficiency strategies on the associated vulnerability. For example, under the 3.5% escalation rate scenario, the City would reduce its fleet fuel and utility payments by over $400,000 per year in 2020 by implementing the aggressive Action Plan E.

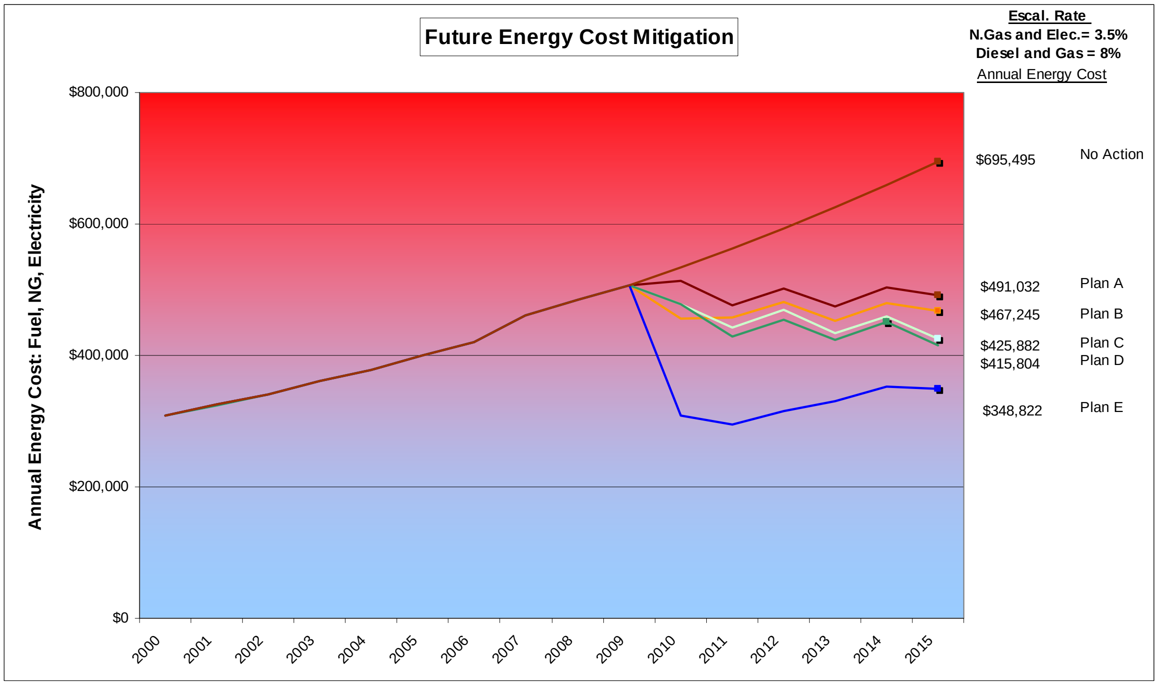


Figure 9: Annual Cost of Energy

The trend lines compare the outcomes for different approaches to energy savings with a 3.5% annual escalation of energy rates:

- No Action, $695,000 annual energy cost in 2020 (at a utility energy escalation rate of 3.5%) approximates the annual cost to the City if no actions are pursued to reduce energy consumption in the future.
- Plan B: $491,000 annual energy cost in 2020 at a utility energy escalation rate of 3.5% based on the actions contained in Action Plan B.
- Plan E: $348,000 annual energy cost in 2020 using the same escalation rate as above if the more aggressive measures contained in Action Plan E are pursued. This is a reduction of over $300,000 in energy budgeting uncertainty between Plan E and the "No Action" scenario for the annual utility escalation rate of 3.5%.

In summary, an aggressive energy strategy could significantly reduce the City's exposure to the rapidly escalating costs. The investments in energy efficiency and distributed generation will reduce the uncertainty in future energy cost supporting long term budget planning.

4.4 Incremental Capital Cost of Efficiency Measures

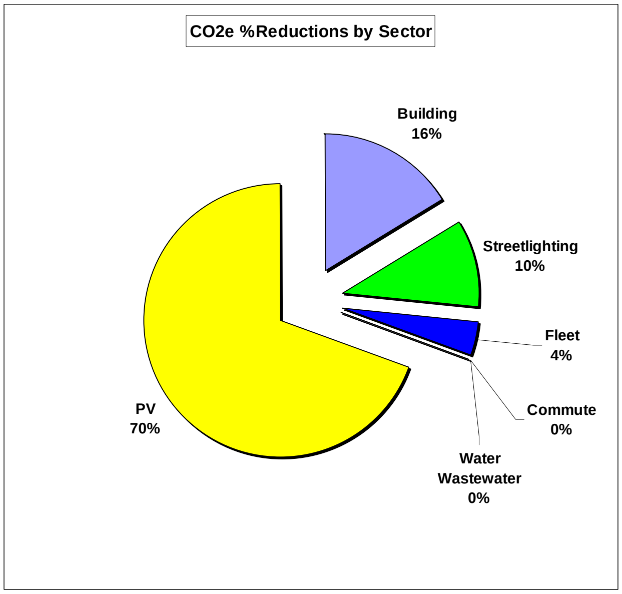
Many of the opportunities to reduce energy consumption, and thereby reduce greenhouse gas emissions, involve the replacement of old, poorly performing equipment. In many cases this equipment is at the end of its useful life and is scheduled to be replaced independently of this analysis. In these situations this analysis includes only the incremental cost for exceeding the efficiency of a standard unit or approach. There are two common examples where this issue comes into play. The cost associated with replacing the package HVAC units is the additional cost incurred for purchasing SEER 15 units over the purchase of the standard SEER 13 units. This incremental cost depends on the cooling capacity of the unit, but is in the range of 3-10% of the cost of the unit. “Cool Roof” reflective coatings add an incremental cost of roughly $1.5 per sqft to the overall reproofing project cost. This incremental value is utilized in the analysis. The cost assumed for the fleet replacement strategies are another example of the use of incremental capital cost.

It should be noted that the energy efficiency packages identified in these plans can be financed using California Energy Commission energy efficiency loans, including the non-incremental costs. These loan packages are typically structured to have a net zero cash flow (energy savings = loan payment). The replacement of air conditioning equipment that is beyond its useful life would be one application of this opportunity.

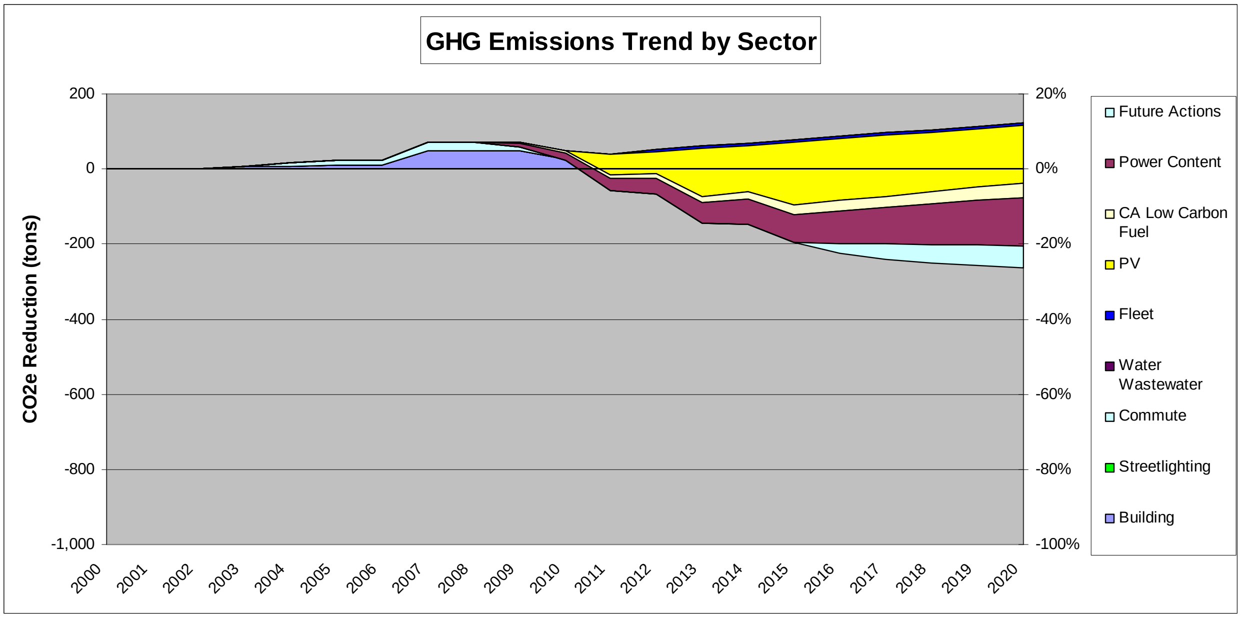
4.5 Plan Details

Plan A:	212 Tons CO2e Avoided	21.1%	% Reduction
Community Benefit (over 25 year life of plan)		**Financial Metrics**	
$$$ Avoided Utility Company Payments	$223,198	Jobs Created	95
$$$ Avoided Fuel Purchases	$24,635	IRR	NA
$$$ Invested Locally in GHG Projects	$5,129,530	NPV	($1,071,199)

Action Plan A: This plan has 8 specific actions and reduces the net GHG by 21% below 2000 levels. This plan utilizes a range of measures from building efficiency to water system pump and motor operation enhancements. This plan includes a less aggressive fleet replacement strategy including the purchase of hybrid vehicles, and includes a measure to reduce the streetlight intensity. There is a heavy reliance on photovoltaic systems financed using power purchase agreements (where the vendor owns the system and the City provides the location and agrees to purchase the power produced). The PPA approach requires no capital or O&M expenditures. The IRR for Plan A is reasonably attractive at just less than 10%. The Plan Details section lists the specific measures included in each plan and the Measures Results section provides the measure details. The building measures in all plans are based on the energy analysis provided by Chevron Energy Solutions. The resulting annual cash flow is the net income to the City (energy cost savings minus project debt service, replacement costs and associated O&M).



Measure Name	Impl. Date	Financed	Power Purchase Agreement
Building Lighting Measures	2009	yes	no
Reduce Streetlighting Lumins	2010	no	no
Pump Efficiency A	2010	yes	no
PV on WstWtr Wtr Feed 200 kWAC (Chevron Energy Services measure)	2010	yes	no
PV WstWtr Trmt Plant 265kWac (PPA)	2012	no	yes
PV Stonebridge Well 185 kWac (PPA)	2014	no	yes
Fleet Replacements A	2011	yes	no
Efficiency Coordinator (.5 FTE)	2009	no	no



Emission Reductions Including Utility Power Content Trend, CA Low Carbon Fuel and Assumed Future Actions

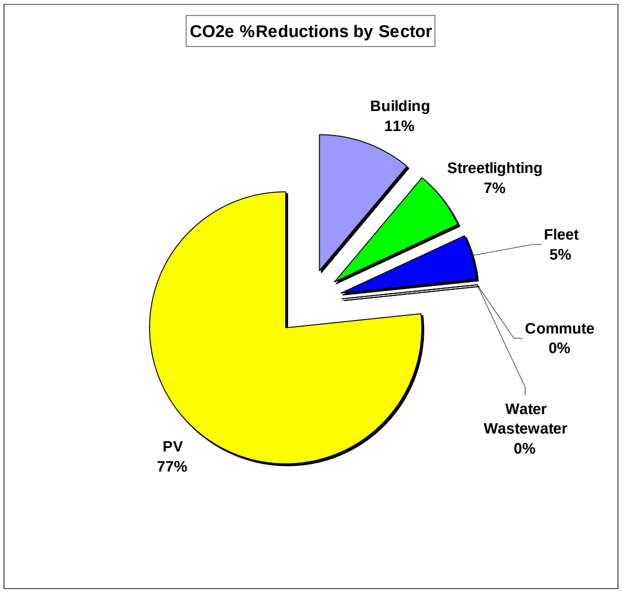
Year	Cash Flow (Annual Cost and Savings)	Annual Debt Service Payments	Net Cash Flow	Outstanding Principal
2009	$0	$0	$0	$85,756
2010	($39,780)	($10,547)	($50,326)	$1,771,100
2011	$49,513	($218,698)	($169,185)	$1,642,361
2012	$3,861	($221,158)	($217,296)	$1,486,076
2013	$53,302	($221,158)	($167,856)	$1,323,619
2014	$5,180	($221,158)	($215,978)	$1,154,744
2015	$55,417	($221,158)	($165,740)	$979,199
2016	$57,379	($221,158)	($163,778)	$796,720
2017	$59,410	($221,158)	($161,747)	$607,033
2018	$61,513	($221,158)	($159,644)	$409,853
2019	$63,691	($221,158)	($157,467)	$204,884
2020	($166,522)	($210,611)	($377,133)	$2,366
2021	$68,279	($2,460)	$65,819	$0
2022	$70,695	$0	$70,695	$0
2023	$73,197	$0	$73,197	$0
2024	$75,787	$0	$75,787	$0
2025	$78,468	$0	$78,468	$0

Detailed Cash Flow by Year

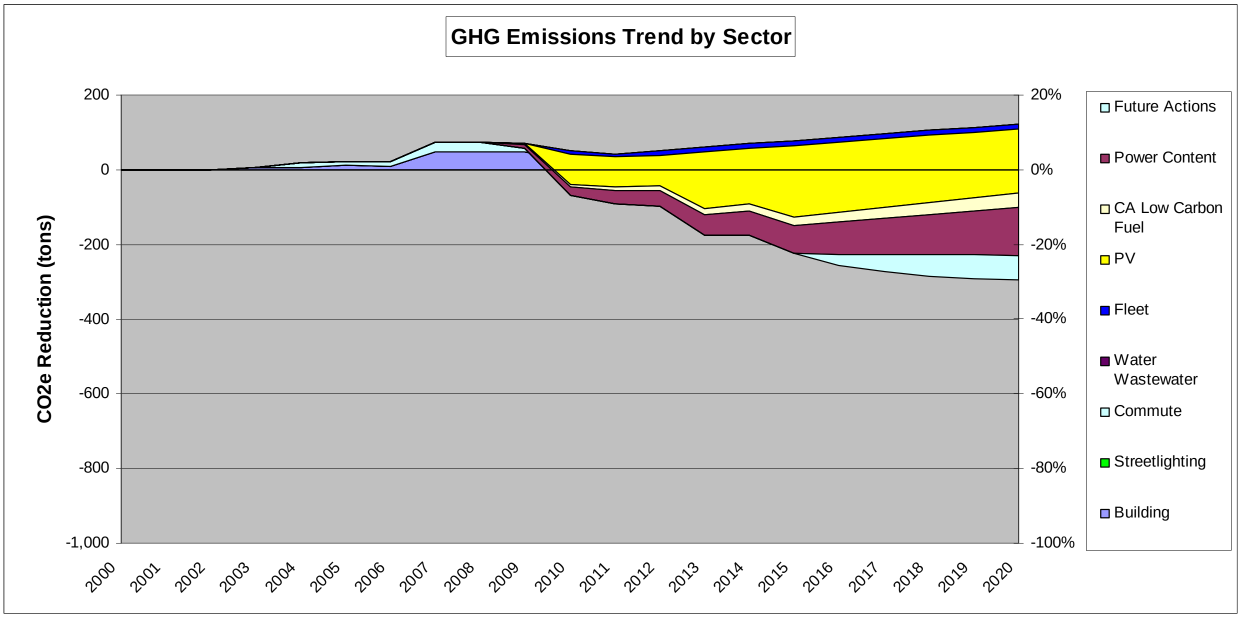
Plan B:	241	Tons CO2e Avoided	23.9%	% Reduction

Community Benefit (over 25 year life of plan)		Financial Metrics	
$$$ Avoided Utility Company Payments	$1,608,871	Jobs Created	105
$$$ Avoided Fuel Purchases	$20,578	IRR	NA
$$$ Invested Locally in GHG Projects	$6,429,962	NPV	($3,482,551)

Action Plan B: The plan includes a combination of 9 measures. A biodiesel measure is added. The photovoltaic systems included in this plan are the same capacity (kWac) as Plan A. Both plans result in approximately 900,000 kWh saved annually. However Plan B assumes the City will purchase and maintain the systems which greatly diminishes the internal rate of return (IRR) and net present value (NPV) of this strategy. All together, the measures in this plan allow the City to exceed the target of 20% GHG emissions reduction by 2015. The resulting annual cash flow is the net income to the City (energy cost savings minus project debt service, replacement costs and associated O&M). The large negative cash flow in 2020 reflects the assumed replacement of PV inverters after 10 years of service.



Measure Name	Impl. Date	Financed	Power Purchase Agreement
Building Lighting Measures	2009	yes	no
Reduce Streetlighting Lumins	2010	no	no
Pump Efficiency A	2010	yes	no
PV 285 kWac	2009	yes	no
PV WstWtr Trmt Plant 265kWac	2012	yes	no
PV Stonebridge Well 185 kWac	2014	yes	no
Fleet Replacements A	2011	yes	no
Biodiesel B20 Linked to Fleet A	2009	no	no
Efficiency Coordinator (.5 FTE)	2009	no	no



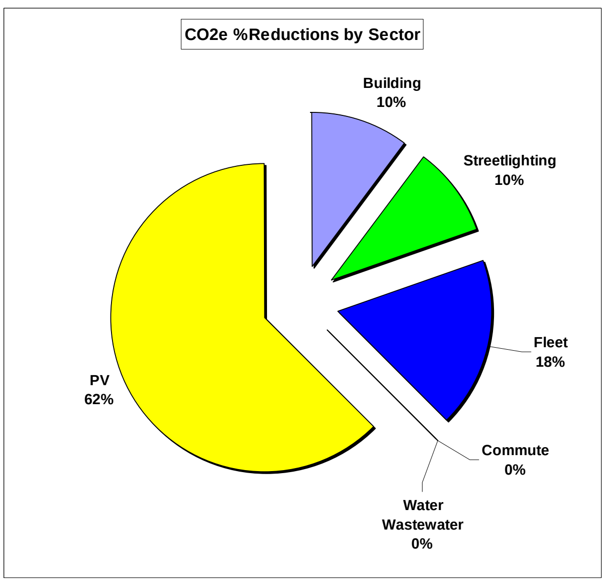
Emission Reductions Including Utility Power Content Trend, CA Low Carbon Fuel and Assumed Future Actions

Year	Cash Flow (Annual Cost and Savings)	Annual Debt Service Payments	Net Cash Flow	Outstanding Principal
2009	$0	$0	$0	$2,350,303
2010	$8,336	($289,050)	($280,714)	$2,244,950
2011	$63,723	($300,225)	($236,502)	$2,053,401
2012	$68,568	($302,684)	($234,116)	$3,953,469
2013	$121,874	($563,613)	($441,739)	$3,546,018
2014	$126,140	($563,613)	($437,473)	$4,604,116
2015	$168,897	($745,832)	($576,935)	$4,040,146
2016	$174,808	($745,832)	($571,024)	$3,453,900
2017	$180,926	($745,832)	($564,906)	$2,844,498
2018	$187,259	($745,832)	($558,573)	$2,211,023
2019	($134,968)	($745,832)	($880,800)	$1,552,527
2020	$200,596	($456,782)	($256,185)	$1,157,070
2021	$207,617	($445,607)	($237,990)	$757,168
2022	($93,135)	($443,147)	($536,282)	$343,928
2023	$222,405	($182,219)	$40,186	$175,295
2024	$15,157	($182,219)	($167,062)	$0
2025	$238,245	$0	$238,245	$0

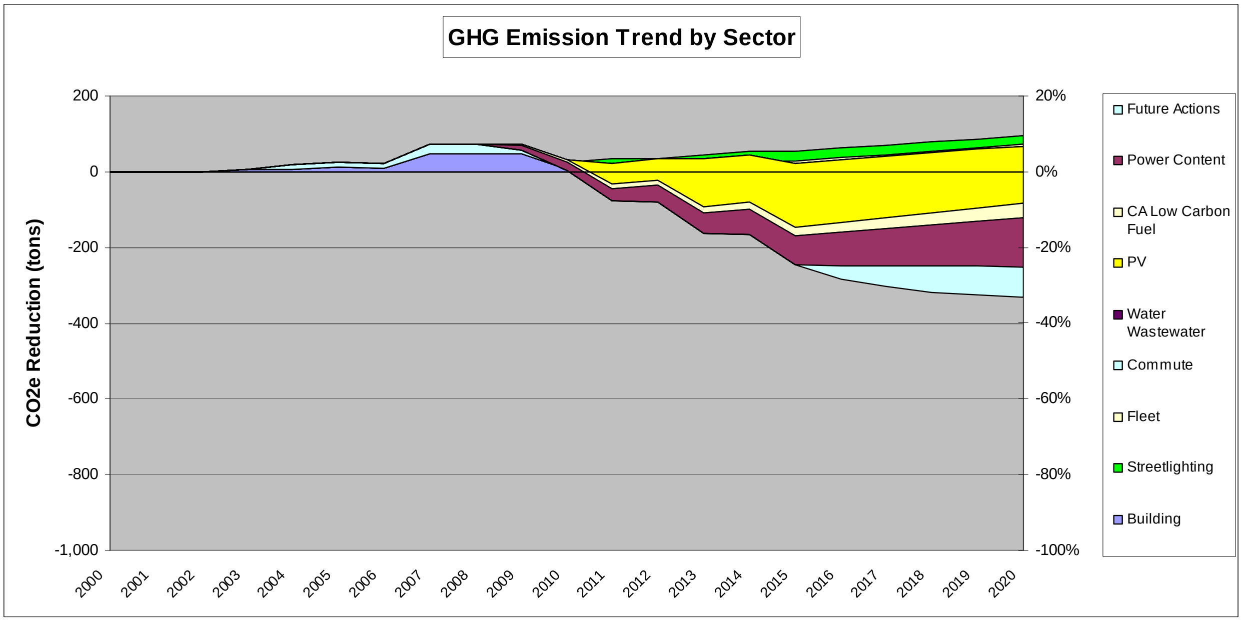
Detailed Cash Flow by Year

Plan C:	295	Tons CO2e Avoided	29.3%	% Reduction
Community Benefit (over 25 year life of plan)			**Financial Metrics**	
$$$ Avoided Utility Company Payments	$1,390,163		Jobs Created	118
$$$ Avoided Fuel Purchases	$63,069		IRR	3.9%
$$$ Invested Locally in GHG Projects	$6,844,253		NPV	($427,272)

Action Plan C: This plan includes 12 measures. In addition to most of the measures of Plan B, Plan C replaces the fleet replacement strategy with a more aggressive strategy that includes plug-in hybrids and diesel hybrids. Plan C exceeds the City target of 20% GHG emissions reduction by 2015 but yields challenging financial metrics. The Internal Rate of Return is 3.9% with a negative Net Present Value. The annual net cash flow (energy cost savings minus project debt service, replacement costs and associated O&M) is negative for a number of years. The large negative cash flow in 2022 reflects the assumed replacement of PV inverters after 10 years of service.



Measure Name	Impl. Date	Financed	Power Purchase Agreement
Automated Water Meters (Community Wide Local Carbon Offset)	2009	no	no
Building Lighting Measures	2009	yes	no
Steetlighting HPS to LED A	2012	yes	no
Residential Streetlighting 1st 50%	2009	no	no
Waste Water Aeration Solar Bee™	2009	yes	no
Pump Efficiency B	2010	yes	no
PV on WstWtr Wtr Feed 200 kWAC (Chevron Energy Services measure)	2010	yes	no
PV WstWtr Trmt Plant 265kWac	2012	yes	no
PV Stonebridge Well 185 kWac (PPA)	2014	no	yes
Fleet Replacements B	2014	yes	no
Biodiesel B50 Linked to Fleet A	2010	no	no
Efficiency Coordinator (.5 FTE)	2009	no	no



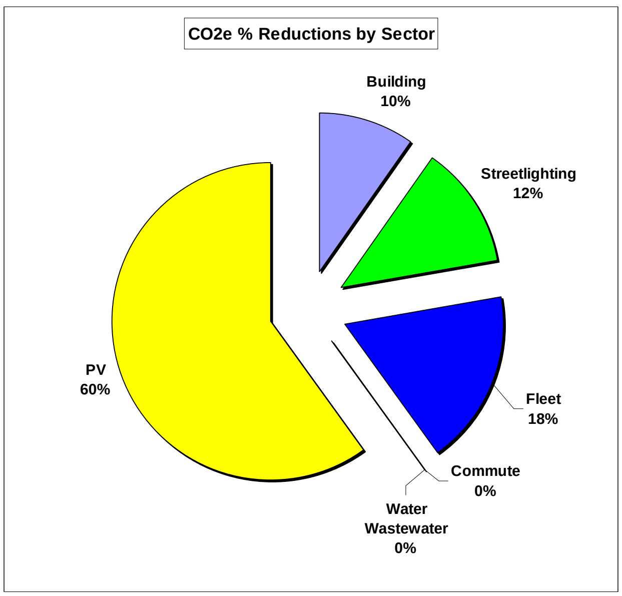
Emission Reductions Including Utility Power Content Trend, CA Low Carbon Fuel and Assumed Future Actions

Year	Cash Flow (Annual Cost and Savings)	Annual Debt Service Payments	Net Cash Flow	Outstanding Principal
2009	($1,067,966)	$0	($1,067,966)	$150,596
2010	$97,508	($18,521)	$78,987	$1,893,008
2011	$200,770	($234,356)	($33,587)	$1,733,425
2012	$207,797	($234,356)	($26,560)	$3,789,386
2013	$281,102	($507,609)	($226,506)	$3,431,458
2014	$240,941	($507,609)	($266,668)	$3,327,392
2015	$313,081	($540,568)	($227,487)	$2,918,256
2016	$324,048	($540,568)	($216,520)	$2,492,959
2017	$335,399	($540,568)	($205,169)	$2,050,862
2018	$347,147	($540,568)	($193,421)	$1,591,303
2019	$359,307	($540,568)	($181,261)	$1,113,591
2020	$139,426	($522,047)	($382,621)	$635,531
2021	$384,919	($306,212)	$78,707	$354,422
2022	$90,383	($306,212)	($215,828)	$62,210
2023	$412,357	($32,960)	$379,397	$31,707
2024	$426,800	($32,960)	$393,841	$0
2025	$441,750	$0	$441,750	$0

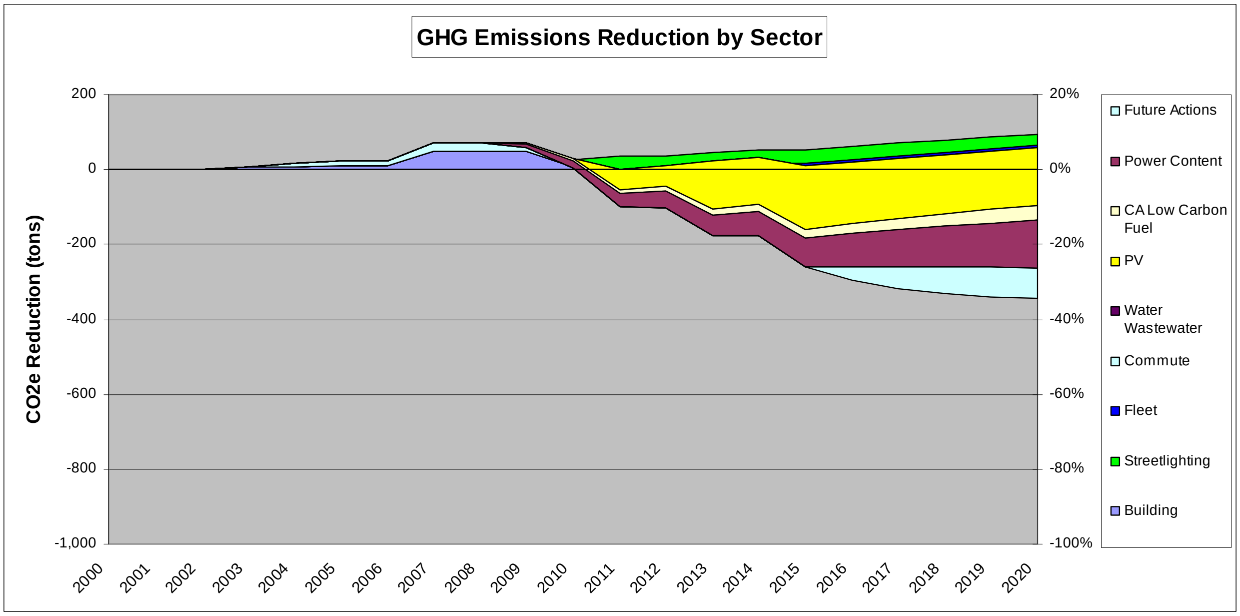
Detailed Cash Flow by Year

Plan D:	306 Tons CO2 Avoided	30.4%	% Reduction
Community Benefit (over 25 year life of plan)		**Financial Metrics**	
$$$ Avoided Utility Company Payments	$828,248	Jobs Created	118
$$$ Avoided Fuel Purchases	$61,569	IRR	7.8%
$$$ Invested Locally in GHG Projects	$6,430,197	NPV	$784,013

Action Plan D: The plan includes a combination of 12 measures. A second residential streetlighting reduction measure is added. The photovoltaic systems included result in approximately 800,000 kWh saved annually. The PV financing relies on a combination of outright purchase and power purchase agreements. All together, the measures in this plan allow the City to reduce emission by 30% GHG emissions 2000 by 2015. While the cash flow is negative in the early years, financial metrics of IRR and NPV are both relatively attractive. The addition of the water meter measure (#1) improves the cash flow considerably though the initial cost is over $1M. The resulting annual cash flow provided below is the net income to the City (energy cost savings minus project debt service, replacement costs and associated O&M).



Measure Name	Impl. Date	Financed	Power Purchase Agreement
Automated Water Meters (Community Wide Local Carbon Offset)	2009	no	no
Building Lighting Measures	2009	yes	no
Residential Streetlighting 1st 50%	2009	no	no
Residential Streetlighting 2nd 50%	2010	no	no
Waste Water Aeration Solar Bee™	2009	yes	no
Pump Efficiency B	2010	yes	no
PV on WstWtr Wtr Feed 200 kWAC (Chevron Energy Services measure)	2010	yes	no
PV WstWtr Trmt Plant 265kWac (PPA)	2012	no	yes
PV Stonebridge Well 185 kWac (PPA)	2014	no	yes
Fleet Replacements B	2014	yes	no
Biodiesel B50 Linked to Fleet B	2010	no	no
Efficiency Coordinator (.5 FTE)	2009	no	no



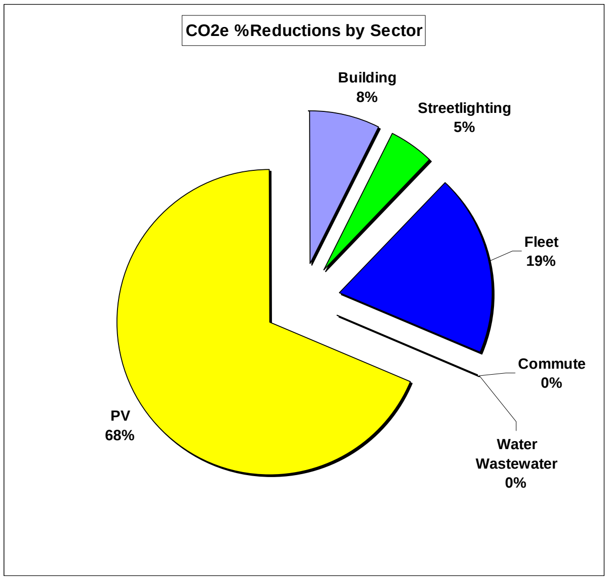
Emission Reductions Including Utility Power Content Trend, CA Low Carbon Fuel and Assumed Future Actions

Year	Cash Flow (Annual Cost and Savings)	Annual Debt Service Payments	Net Cash Flow	Outstanding Principal
2009	($1,067,966)	$0	($1,067,966)	$150,596
2010	$87,063	($18,521)	$68,542	$1,893,008
2011	$212,986	($234,356)	($21,371)	$1,733,425
2012	$170,440	($234,356)	($63,916)	$1,567,539
2013	$225,711	($234,356)	($8,645)	$1,395,101
2014	$183,623	($234,356)	($50,733)	$1,483,851
2015	$253,771	($267,316)	($13,545)	$1,275,147
2016	$262,675	($267,316)	($4,641)	$1,058,199
2017	$271,892	($267,316)	$4,575	$832,682
2018	$281,431	($267,316)	$14,115	$598,256
2019	$291,306	($267,316)	$23,990	$354,571
2020	$69,060	($248,795)	($179,735)	$119,782
2021	$312,106	($32,960)	$279,146	$91,553
2022	$323,056	($32,960)	$290,096	$62,210
2023	$334,390	($32,960)	$301,431	$31,707
2024	$346,122	($32,960)	$313,162	$0
2025	$358,265	$0	$358,265	$0

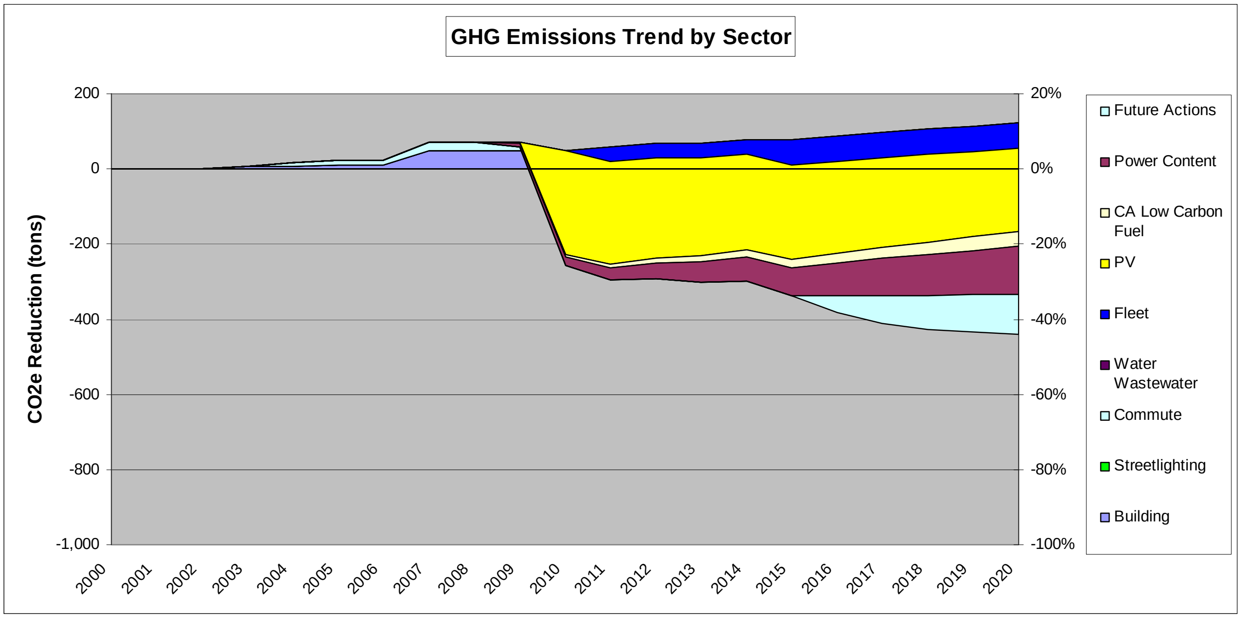
Detailed Cash Flow by Year

Plan E:	387	Tons CO2e Avoided	38.4%	% Reduction
Community Benefit (over 25 year life of plan)			**Financial Metrics**	
$$$ Avoided Utility Company Payments	($112,350)		Jobs Created	161
$$$ Avoided Fuel Purchases	$50,847		IRR	13.2%
$$$ Invested Locally in GHG Projects	$9,083,128		NPV	$1,689,821

Action Plan E: This plan includes 10 measures. In addition to most of the measures of Plan D, Plan E replaces the fleet fuel strategy with a more aggressive approach that specifies 99% biodiesel, and includes a 950kW PV system utilizing the power purchase agreement financing strategy. This plan replaces the residential streetlighting measures with a conversion to LED streetlighting systems (or equivalent technology projected to be available by 2012). Plan E pushes the GHG emissions reduction to 38% by 2015, with attractive financial metrics. The Internal Rate of Return is over 13% and the Net Present Value is roughly $1.6M over the term of the analysis (25 years). The annual net cash flow (energy cost savings minus project debt service, replacement costs and associated O&M) is strongly negative for the first 10 years. The negative net cash flow in 2022 reflects the assumed replacement of PV inverters after 10 years of service.



Measure Name	Impl. Date	Financed	Power Purchase Agreement
Automated Water Meters (Community Wide Local Carbon Offset)	2009	no	no
Building Lighting Measures	2009	yes	no
Steetlighting HPS to LED A	2012	yes	no
Streetlighting HPS to LED B	2014	yes	no
Waste Water Aeration Solar Bee™	2009	yes	no
Pump Efficiency B	2010	yes	no
PV 950 kWac (PPA)	2009	no	yes
Fleet Replacements B	2014	yes	no
Biodiesel B99 Linked to Fleet B	2010	no	no
Efficiency Coordinator (.5 FTE)	2009	no	no



Emission Reductions Including Utility Power Content Trend, CA Low Carbon Fuel and Assumed Future Actions

Year	Cash Flow (Annual Cost and Savings)	Annual Debt Service Payments	Net Cash Flow	Outstanding Principal
2009	($1,107,521)	$0	($1,107,521)	$150,596
2010	$72,860	($18,521)	$54,339	$291,365
2011	$142,221	($37,380)	$104,841	$265,494
2012	$147,245	($37,380)	$109,866	$338,806
2013	$167,574	($49,703)	$117,871	$302,485
2014	$173,489	($49,703)	$123,786	$632,934
2015	$208,404	($94,986)	$113,417	$562,949
2016	$215,751	($94,986)	$120,764	$490,199
2017	$223,356	($94,986)	$128,370	$414,576
2018	$231,230	($94,986)	$136,243	$335,965
2019	$239,380	($94,986)	$144,394	$254,250
2020	$247,818	($76,465)	$171,352	$187,827
2021	$256,552	($57,607)	$198,946	$137,640
2022	$265,595	($57,607)	$207,988	$85,470
2023	$274,955	($45,283)	$229,672	$43,563
2024	$284,645	($45,283)	$239,362	$0
2025	$294,677	$0	$294,677	$0

Detailed Cash Flow by Year

5.0 Measure Details

Table 7 below provides a complete list of the measures considered in this analysis along with the financial data and results for each. The individual measures are described in the Measure Results section of this report.

Measure Number	Measure Name	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	IRR	NPV	%GHG
1	Automated Water Meters (Community Wide Local Carbon Offset)	2009	no	no	$1,057,521	($119,370)	$0	0.00	8.9	14.2%	$1,362,818	0.00%
2	Building Lighting Measures	2009	yes	no	$85,756	$0	$19,703	31.48	4.4	27.1%	$309,504	3.12%
3	Steetlighting HPS to LED A	2012	yes	no	$100,204	($14,615)	$0	8.98	6.9	18.0%	$194,744	0.89%
4	Streetlighting HPS to LED B	2014	yes	no	$100,204	($14,615)	$0	8.60	6.9	18.0%	$194,744	0.85%
5	Residential Streetlighting 1st 50%	2009	no	no	$10,445	($11,936)	$0	19.73	0.9	121.8%	$227,021	1.96%
6	Residential Streetlighting 2nd 50%	2010	no	no	$10,445	($11,936)	$0	19.34	0.9	121.8%	$227,021	1.92%
7	Reduce Streetlighting Lumins	2010	no	no	$29,122	$0	$12,804	19.37	2.3	49.0%	$226,476	1.92%
8	Waste Water Aeration Solar Bee™	2009	yes	no	$64,840	$0	$21,511	34.37	3.0	37.8%	$365,338	3.41%
9	Pump Efficiency A	2010	yes	no	$90,860	$0	$11,306	17.11	8.0	15.6%	$137,943	1.70%
10	Pump Efficiency B	2010	yes	no	$153,341	$0	$12,920	19.55	11.9	10.5%	$110,469	1.94%
11	PV on WstWtr Wtr Feed 200 kWAC (Chevron Energy Services measure)	2010	yes	no	$1,601,643	$4,000	$38,386	58.08	46.6	NA	($1,096,289)	5.76%
12	PV 285 kWac	2009	yes	no	$2,264,547	$5,657	$52,454	83.80	48.4	NA	($1,586,300)	8.32%
13	PV WstWtr Trmt Plant 265kWac	2012	yes	no	$2,121,643	$5,300	$54,484	73.84	43.1	NA	($1,380,150)	7.33%
14	PV Stonebridge Well 185 kWac	2014	yes	no	$1,481,643	$3,700	$40,745	49.38	40.0	-2.7%	($910,186)	4.90%
15	PV WstWtr Trmt Plant 265kWac (PPA)	2012	no	yes	$50,000	$0	($3,557)	73.84	-14.1	NA	($91,974)	7.33%
16	PV Stonebridge Well 185 kWac (PPA)	2014	no	yes	$50,000	$0	($2,483)	49.38	-20.1	NA	($78,583)	4.90%
17	PV 950 kWac (PPA)	2009	no	yes	$50,000	$0	($12,796)	282.40	-3.9	NA	($207,170)	28.03%
18	PV 950 kWac (City Financed)	2009	yes	no	$7,628,861	$19,065	$176,772	282.40	48.4	-3.0%	($4,015,792)	28.03%
19	Fleet Replacements A	2011	yes	no	$20,000	$0	$2,527	6.75	7.9	15.8%	$31,118	0.67%
20	Fleet Replacements B	2014	yes	no	$268,000	$0	$13,202	33.24	20.3	5.2%	$6,880	3.30%
21	Biodiesel B05	2009	no	no	$0	$0	($77)	1.83	0.0	NA	($1,532)	0.18%
22	Biodiesel B20	2009	no	no	$0	$0	($309)	7.31	0.0	NA	($6,128)	0.73%
23	Biodiesel B50	2010	no	no	$50,000	$0	($833)	18.27	-60.0	NA	($64,166)	1.81%
24	Biodiesel B99	2011	no	no	$50,000	$0	($1,782)	36.16	-28.1	NA	($83,002)	3.59%
25	Biodiesel B20 Linked to Fleet A	2009	no	no	$0	$0	($309)	7.31	0.0	NA	($6,128)	0.73%
26	Biodiesel B50 Linked to Fleet A	2010	no	no	$50,000	$0	($833)	18.27	-60.0	NA	($64,166)	1.81%
27	Biodiesel B20 Linked to Fleet B	2009	no	no	$0	$0	($358)	8.47	0.0	NA	($7,102)	0.84%
28	Biodiesel B50 Linked to Fleet B	2010	no	no	$50,000	$0	($966)	21.17	-51.8	NA	($66,794)	2.10%
29	Biodiesel B99 Linked to Fleet B	2010	no	no	$53,500	$0	($1,912)	41.91	-28.0	NA	($88,920)	4.16%
30	Efficiency Coordinator (.5 FTE)	2009	no	no	$0	$30,000	$0	0.00	0.0	NA	($595,622)	0.00%
31	Parks Irrigation Control (Chevron Energy Services not quantified)	2008	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
32	Library Grnd Srce Ht Pumps (Chevron Energy Services not quantified)	2008	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
33	Fire Station Occ Climate Cntls (Chevron Energy Services not quantified)	2008	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
34	Corp Yard Occ. Climate Cntrls (Chevron Energy Services not quantified)	2008	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
35	City Hall Solar Cooing/Htng (Chevron Energy Services not quantified)	2008	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
36	LED Street Tree Lights (Chevron Energy Services not quantified)	2008	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
37	PV on Wtr Resv Floating Isles (Chevron Energy Services not quantified)	2008	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 7: Results by Measure

5.1 Measure Selection

Each Plan is comprised of measures from the tables above. The makeup of each plan is provided in the table below. A "y" in the column under the Action Plan (A –E) in the first five columns indicates that the measure is included in that plan. The total number of measures for each plan is provided at the bottom of Table 8. Action Plan A contains 35 measures. Action Plan E is comprised of 41 individual measures.

Action Plan					Measure Number	Measure Name	Implementation Date	Financed (yes/no)
A	B	C	D	E				
n	n	y	y	y	1	Automated Water Meters (Community Wide Local Carbon Offset)	2009	no
y	y	y	y	y	2	Building Lighting Measures	2009	yes
n	n	y	n	y	3	Steetlighting HPS to LED A	2012	yes
n	n	n	n	y	4	Streetlighting HPS to LED B	2014	yes
n	n	y	y	n	5	Residential Streetlighting 1st 50%	2009	no
n	n	n	y	n	6	Residential Streetlighting 2nd 50%	2010	no
y	y	n	n	n	7	Reduce Streetlighting Lumins	2010	no
n	n	y	y	y	8	Waste Water Aeration Solar Bee[TM]	2009	yes
y	y	n	n	n	9	Pump Efficiency A	2010	yes
n	n	y	y	y	10	Pump Efficiency B	2010	yes
y	n	y	y	n	11	PV on WstWtr Wtr Feed 200 kWAC (Chevron Energy Services measure)	2010	yes
n	y	n	n	n	12	PV 285 kWac	2009	yes
n	y	y	n	n	13	PV WstWtr Trmt Plant 265kWac	2012	yes
n	y	n	n	n	14	PV Stonebridge Well 185 kWac	2014	yes
y	n	n	y	n	15	PV WstWtr Trmt Plant 265kWac (PPA)	2012	no
y	n	y	y	n	16	PV Stonebridge Well 185 kWac (PPA)	2014	no
n	n	n	n	y	17	PV 950 kWac (PPA)	2009	no
n	n	n	n	n	18	PV 950 kWac (City Financed)	2009	yes
y	y	n	n	n	19	Fleet Replacements A	2011	yes
n	n	y	y	y	20	Fleet Replacements B	2014	yes
n	n	n	n	n	21	Biodiesel B05	2009	no
n	n	n	n	n	22	Biodiesel B20	2009	no
n	n	n	n	n	23	Biodiesel B50	2010	no
n	n	n	n	n	24	Biodiesel B99	2011	no
n	y	n	n	n	25	Biodiesel B20 Linked to Fleet A	2009	no
n	n	y	n	n	26	Biodiesel B50 Linked to Fleet A	2010	no
n	n	n	n	n	27	Biodiesel B20 Linked to Fleet B	2009	no
n	n	n	y	n	28	Biodiesel B50 Linked to Fleet B	2010	no
n	n	n	n	y	29	Biodiesel B99 Linked to Fleet B	2010	no
y	y	y	y	y	30	Efficiency Coordinator (.5 FTE)	2009	no
n	n	n	n	n	31	Parks Irrigation Control (Chevron Energy Services not quantified)	2008	yes
n	n	n	n	n	32	Library Grnd Srce Ht Pumps (Chevron Energy Services not quantified)	2008	yes
n	n	n	n	n	33	Fire Station Occ Climate Cntls (Chevron Energy Services not quantified)	2008	yes
n	n	n	n	n	34	Corp Yard Occ. Climate Cntrls (Chevron Energy Services not quantified)	2008	yes
n	n	n	n	n	35	City Hall Solar Cooing/Htng (Chevron Energy Services not quantified)	2008	yes
n	n	n	n	n	36	LED Street Tree Lights (Chevron Energy Services not quantified)	2008	yes
n	n	n	n	n	37	PV on Wtr Resv Floating Isles (Chevron Energy Services not quantified)	2008	yes

Table 8: Measure Selections for All Plans

5.2 Measures Results

The measures considered for inclusion in the plans are described below. Each measure includes a table indicating which Action Plans include that measure. For example, Measure 2 – Lighting Measures is included in Plans A, B, C, D, and E as indicated by "y" under each plan ("n" indicating not included in the plan).

Action Plan				
A	B	C	D	E
y	y	y	y	y

The description of each measure also includes a table listing the results of the measure: the cost of implementation, the annual savings, the GHG impact and the financial metrics of Simple Payback, Internal Rate of Return (IRR) and Net Present Value (NPV). Again using Measure 2 – Lighting Measures as an example:

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
2	Lighting Measures	2009	yes	no	$85,756	$0	$19,703	31.48	4.4	27.1%	$309,504	3.12%

Finally, each measure description includes the Selection Evaluation table to enable a comprehensive appraisal and relational comparison of the benefits of each opportunity. The measure is scored for each evaluation metric. This score is totaled under "Measure Score". This measure score is modified by the metric weighting and results in the "Adjusted Measure Score". The complete table of measure evaluations is provided in the Appendices. The Selection Evaluation table for Measure 2 is provided below as an example:

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
Building Lighting Measures	-0.4	2.0	2.00	4.6	1.00	2.00	0.00	3.0	14.26	47.30

The metric weighting below is applied to each measure scoring.

Cost (relative)	Financial Metrics (relative)	Resolution of Existing Problem	GHG Impact	Positive Public Visibility	Employee Impact	Community Impact	Energy Cost Stabilization	total=24
2	5	2	3	4	2	2	4	24

The measures considered in this analysis are listed in the following pages, with a brief description of each. The background information for many of the measures is provided in the Appendices.

Action Plan				
A	B	C	D	E
n	n	y	y	y

1-Automated Water Meters

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
1	Automated Water Meters	2009	yes	no	$1,057,521	($119,370)	$0	0.00	8.9	14.2%	$1,362,818	0.00%

Automated Water Meters do not add greenhouse gas reduction but do improve the economics for all plans that include this measure. This description was provided by the vendor:

> *It is estimated that the current compound water meters produce an annual lose in revenue to the City of Saint Helena of about 8-12% due to inaccurate measurement of water consumption. The new Automatic Meter Reading (AMR) water meters installed under this program will correct this situation by providing more accurate readings of actual water usage. As agreed with the City, Chevron ES will use a 4% increase in total revenues as the savings provided by the new meters. There is also a labor savings component associated with the replacement of the City's existing meters. It currently takes 120 man-hours per meter reading cycle to read all of the City's residential water meters. This time should be reduced considerably, to less than 1 day's effort for one person, or 8 man-hours per meter reading cycle.*[27]

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
Automated Water Meters (Community Wide)	-3.0	1.1	2.00	0.0	0.00	-1.00	0.00	0.0	-0.94	1.32

[27] City of Saint Helena Comprehensive Energy Analysis, Chevron Energy Solutions, date unidentified.

Action Plan				
A	B	C	D	E
y	y	y	y	y

2-Building Lighting Measures

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
2	Lighting Measures	2009	yes	no	$85,756	$0	$19,703	31.48	4.4	27.1%	$309,504	3.12%

This set of lighting retrofits was recommended by Chevron Energy Solutions. The vendor's descriptions are provided below.[28] The tables detailing each recommendation are provided in the Appendices:

> ***Retrofit T12 Lamp with Magnetic Ballasts to Premium T8 Lamps and Premium Electronic Ballasts***
> *City of St. Helena buildings currently utilize a variety of lighting fixtures for areas depending on the activities performed in the area. T12 fixtures can be found at the corporation yard, and the recreation house facility. This ECM considers retrofitting these luminaries with long life T8 Premium Grade lamps and Premium universal fit high performance electronic ballasts. Reflectors will be used where required to maintain uniform lamp patterns in fixtures where the number of lamps is reduced. The new T8 lamps have a rated output of 2950 initial lumens, 24,000 average burn hours, and an efficacy of 100 lumens per watt.*
>
> ***Replace Metal Halide Fixtures with New Fluorescent Fixtures***
> *The public library and the Carnegie recreation facilities utilize metal-halide fixtures to provide indoor lighting. These fixtures are fairly efficient, but their starting characteristics prevent them from being switched off when they are not needed. The metal-halide lamps can take 10-15 minutes to reach operating full light output after they are switched on. This is otherwise known as re-strike time. With this long re-strike time, most occupants leave this type of fixture energized all day long. Metal-halide lamps often shift toward the green color spectrum as they age. The fixtures in these rooms will be replaced with new high efficiency T8 fluorescent fixtures. The fluorescent fixtures have no re-strike delay, so they may be turned off whenever they are not needed. Then they can be turned back on as needed. In addition to the savings in run-time, they also use less energy when they are energized. The existing 175 watt metal-halide fixtures will be replaced with lower wattage fluorescent lighting to provide comparable lighting in the spaces. The fluorescent lamps also maintain a constant color throughout the life of the lamp.*
>
> ***Occupancy Sensor Lighting Controls***
> *Many of the current lighting systems at City of St. Helena are controlled by occupancy sensors. The systems are working well where they are installed; however, they have not been implemented across all city facilities. The occupancy-based lighting controls will be implemented in similar fashion to the existing systems to the buildings where other retrofits are taking place. Occupancy sensors consist of an infrared motion sensor, which will control the operation of the light to match actual occupancy. In unoccupied mode, these areas will remain off. The infrared controller allows occupants to automatically bring lighting to 100% as they approach the dimly lit area. The sensor detects body heat to switch from unoccupied mode to occupied mode. The fixtures will turn off after the last occupant leaves. The time to shut off is adjustable from 1 to 30 minutes.*

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
Building Lighting Measures	-0.4	2.0	2.00	4.6	1.00	2.00	0.00	3.0	14.26	47.30

[28] City of Saint Helena Comprehensive Energy Analysis, Chevron Energy Solutions, date unidentified.

Action Plan				
A	B	C	D	E
n	n	y	n	y

3-Streetlighting HPS to LED A

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
3	Steetlighting HPS to LED A	2012	yes	no	$100,204	($14,615)	$0	8.98	6.9	18.0%	$194,744	0.89%

Streetlighting consumes over 268,000 kWh per year, representing a significant portion of the City total. This measure addresses 50% of the fixtures and assumes a 30% reduction in energy consumption for the fixtures affected. The broad demand for greater efficiencies in this sector is driving aggressive efforts to bring a new generation of streetlighting options to the market. The cities of Raleigh, NC, Ontario, Canada, Ann Arbor, Michigan, and Oakland, CA have pilot installations to test efficient products currently available. The analysis for this measure is based on the assumptions in the table below. A key step in the adoption of this measure will be the negotiation of a PG&E tariff that reflects this new technology. The implementation of this measure is delayed until 2012 to allowing for the maturation of this new technology.

Streetlight Retrofit Assumptions

265,354	kWh: Streetlight usage from St Helena 2006 billing data
39,803	kWh saved with this measure
668	Number of fixtures
50%	Percentage of fixtures in this measure
334	Number of fixtures affected
$300	Incremental cost per fixture
30%	Reduction in PG&E billing rate
$14,615	Maintenance Savings or LS tariff billing savings
Lamp Life	(for implementation schedule, reduced maintenance)
24,000	hours (HPS)
4380	annual hours of operation per year
5.5	years of operation
70,000	hours (LED)
4380	annual hours of operation per year
16.0	years of operation

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
Steetlighting HPS to LED A	-1.0	1.4	0.00	1.3	3.00	2.00	0.00	2.2	8.92	33.71

Action Plan				
A	B	C	D	E
n	n	n	n	y

4-Streetlighting HPS to LED B

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
4	Streetlighting HPS to LED B	2014	yes	no	$100,204	($14,615)	$0	8.60	6.9	18.0%	$194,744	0.85%

This measure addresses the second 50% of the fixtures, implemented by 2014 and also assumes a 30% reduction in energy consumption for the fixtures affected. The broad demand for greater efficiencies in this sector is driving aggressive efforts to bring a new generation of streetlighting options to the market. The cities of Raleigh, NC, Ontario, Canada, Ann Arbor, Michigan, and Oakland, CA have pilot installations to test efficient products currently available. The analysis for this measure is based on the assumptions in the table below. A key step in the adoption of this measure will be the negotiation of a PG&E tariff that reflects this new technology. The implementation of this measure is delayed until 2012 to allowing for the maturation of this new technology.

Streetlight Retrofit Assumptions

265,354	kWh: Streetlight usage from St Helena 2006 billing data
39,803	kWh saved with this measure
668	Number of fixtures
50%	Percentage of fixtures in this measure
334	Number of fixtures affected
$300	Incremental cost per fixture
30%	Reduction in PG&E billing rate
$14,615	Maintenance Savings or LS tariff billing savings
Lamp Life	(for implementation schedule, reduced maintenance)
24,000	hours (HPS)
4380	annual hours of operation per year
5.5	years of operation
70,000	hours (LED)
4380	annual hours of operation per year
16.0	years of operation

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
Streetlighting HPS to LED B	-1.0	1.4	0.00	1.3	3.00	2.00	0.00	2.2	8.87	33.54

Action Plan				
A	B	C	D	E
n	n	y	y	n

5-Residential First 50% Lamps Disabled

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
5	Residential 1st 50%	2009	no	no	$10,445	($11,936)	$0	19.73	0.9	121.8%	$227,021	1.96%

This measure "turns off" half of the residential streetlighting saving over 80,000 kWh annually. The large NPV for this measure is due to reduced annual tariff payment to the utility which would need to be negotiated. This measure can also be modified to reflect availability of devices designed to switch streetlights off for a portion of the early morning hours. The assumptions behind the costs and benefits calculation are provided in the table below.

Streetlight Retrofit Assumptions

245,139	kWh: Streetlight usage from St Helena 2006 billing data
67%	Residential kWh Percentage (based on residential percentages and l
50%	Percentage residential turned off
82,314	kWh saved with this measure
$35,545	Estimated Total Streetlighting Annual Cost
$11,936	Reduction in PG&E Costs
$50	Incremental cost per fixture
$0	Maintenance Savings

St Helena Streetlighting Assumed Base Count				
668	Total Streetlights (all HPS)			
582	Residential			
86	Intersection or Arterials			
Residential				67.2%
524	70	HPS	36,696	
29	100	HPS	2,910	
29	150	HPS	4,365	
Intersection and Arterials				32.8%
36	200	HPS	7,275	
36	250	HPS	9,094	
13	400	HPS	5,135	
			65,476	100%

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
Residential Streetlighting 1st 50%	2.6	3.0	0.00	2.9	0.00	-1.00	-2.00	1.8	7.31	30.19

Action Plan				
A	B	C	D	E
n	n	n	y	n

6- Residential Second 50% Lamps Disabled

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
6	Residential 2nd 50%	2010	no	no	$10,445	($11,936)	$0	19.34	0.9	121.8%	$227,021	1.92%

This measure "turns off" the remaining half of the residential streetlighting saving another 80,000 kWh annually. The large NPV for this measure is due to reduced annual tariff payment to the utility which would need to be negotiated. This measure can also be modified to reflect availability of devices designed to switch streetlights off for a portion of the early morning hours. The assumptions behind the costs and benefits calculation are provided in the table below.

Streetlight Retrofit Assumptions

245,139	kWh: Streetlight usage from St Helena 2006 billing data
67%	Residential kWh Percentage (based on residential percentages and l
50%	Percentage residential turned off
82,314	kWh saved with this measure
$35,545	Estimated Total Streetlighting Annual Cost
$11,936	Reduction in PG&E Costs
$50	Incremental cost per fixture
$0	Maintenance Savings

St Helena Streetlighting Assumed Base Count				
668	Total Streetlights (all HPS)			
582	Residential			
86	Intersection or Arterials			
Residential				67.2%
524	70	HPS	36,696	
29	100	HPS	2,910	
29	150	HPS	4,365	
Intersection and Arterials				32.8%
36	200	HPS	7,275	
36	250	HPS	9,094	
13	400	HPS	5,135	
			65,476	100%

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
Residential Streetlighting 2nd 50%	2.6	3.0	0.00	2.8	0.00	-1.00	-2.00	1.8	7.25	30.01

Action Plan				
A	B	C	D	E
y	y	n	n	n

7-Reduce Streeetlighting Lumins

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
7	Reduce Lumins	2010	no	no	$29,122	$0	$12,804	19.37	2.3	49.0%	$226,476	1.92%

This measure involves the reduction of streetlighting intensity by roughly 50% but within IESNA[29] lighting level recommendations. The assumptions used in quantifying the benefits are provided in the table below. There is no cost associated with this measure as the lamps are changed out upon burnout. The cost would increase if the schedule for implementation were accelerated.

Streetlight Retrofit Assumptions	
164,864	kWh: Streetlight usage from baseline worksheet
82,432	kWh saved with this measure
582	Number of fixtures
100%	Percentage of fixtures in this measure
582	Number of fixtures affected
$50	Incremental cost per fixture
50%	Reduction in consumption

St Helena Streetlighting Assumed Base Count				
668	Total Streetlights (all HPS)			
582	Residential			
86	Intersection or Arterials			
Residential				67.2%
524	70	HPS	36,696	
29	100	HPS	2,910	
29	150	HPS	4,365	
Intersection and Arterials				32.8%
36	200	HPS	7,275	
36	250	HPS	9,094	
13	400	HPS	5,135	
			65,476	100%

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
Reduce Streetlighting Lumins	1.8	3.0	0.00	2.8	0.00	0.00	0.00	2.0	9.65	35.07

29 Illuminating Engineering Society of North America, *www.iesna.org*

Action Plan				
A	B	C	D	E
n	n	y	y	y

8- Waste Water Pond Solar Bee™

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
8	Solar Bee	2009	yes	no	$64,840	$0	$21,511	34.37	3.0	37.8%	$365,338	3.41%

The SolarBEE™ wastewater lagoon aeration system significantly reduces the size of the pump motor combinations while providing equivalent results. This yields very large energy and cost savings. This measure has been evaluated by the Sonoma County Energy Watch for municipal applications in Sonoma County. The costs and benefits of this measure are based on a municipal application scaled by waste water energy consumption of each jurisdiction. The scaled costs were then multiplied by a factor of 2.5 to provide a significant margin of conservancy in the financial results.

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
Waste Water Aeration Solar Bee™	0.4	2.8	0.00	5.0	1.00	0.00	0.00	3.3	12.60	47.35

Action Plan				
A	B	C	D	E
y	y	n	n	n

9-Pump Retrofit (A) for Improved Efficiency

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
9	Pumps A	2010	yes	no	$90,860	$0	$11,306	17.11	8.0	15.6%	$137,943	1.70%

The Town operates a number of pumps that consume a considerable amount of energy annually according to the PG&E billing data. The approximate savings available for the specified pumps is based on the pump test reports completed for other jurisdictions. The cost for each is a rough estimate also based on experiences in other jurisdictions.

Included	Site (from PG&E Billing Data)	Electricity (kWh)	Estimated # of pumps from kWh	Modified	Type	Cost	Annual kWh savings	Annual Cost savings
y	STONEBRIDGE WELL	335,883	2.1	2	60hp	$63,000	64,471	$9,348
n	PUMP Set 1	26,217	1.0	1	30hp	$31,500	5,032	$730
y	PUMP NOT DR 92	43,343	1.0	1	50hp	$31,500	8,320	$1,206
n	PUMP Set 2	0	0.0	0	0	$0	0	$0
n	CHLOR PUMP	0	0.0	0	0	$0	0	$0
n	SEWER PUMP	10,965	1.2	1	10hp	$31,500	2,105	$305
n	PUMP Set 3	17,346	1.0	1	50hp	$31,500	3,329	$483
n	PUMP STATION	27,896	1.0	1	75hp	$31,500	5,354	$776

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
Pump Efficiency A	-0.6	1.2	1.00	2.5	0.00	0.00	0.00	1.7	5.79	21.07

Action Plan				
A	B	C	D	E
n	n	y	y	y

10- Pump Retrofit (B) for Improved Efficiency (more aggressive)

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
10	Pumps B	2010	yes	no	$153,341	$0	$12,920	19.55	11.9	10.5%	$110,469	1.94%

The Town operates a number of pumps that consume a considerable amount of energy annually according to the PG&E billing data. The approximate savings available for the specified pumps is based on the pump test reports completed for other jurisdictions. The cost for each is a rough estimate also based on experiences in other jurisdictions.

Included	Site (from PG&E Billing Data)	Electricity (kWh)	Estimated # of pumps from kWh	Modified	Type	Cost	Annual kWh savings	Annual Cost savings
y	STONEBRIDGE WELL	335,883	2.1	2	60hp	$63,000	64,471	$9,348
y	PUMP Set 1	26,217	1.0	1	30hp	$31,500	5,032	$730
y	PUMP NOT DR 92	43,343	1.0	1	50hp	$31,500	8,320	$1,206
n	PUMP Set 2	0	0.0	0	0	$0	0	$0
n	CHLOR PUMP	0	0.0	0	0	$0	0	$0
n	SEWER PUMP	10,965	1.2	1	10hp	$31,500	2,105	$305
n	PUMP Set 3	17,346	1.0	1	50hp	$31,500	3,329	$483
y	PUMP STATION	27,896	1.0	1	75hp	$31,500	5,354	$776

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
Pump Efficiency B	-3.0	0.8	1.00	2.9	0.00	0.00	0.00	2.0	3.64	16.49

Action Plan				
A	B	C	D	E
y	n	y	y	n

11-200 kWac Photovoltaic System on Waste Water Feed

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
11	200 kW on WstWtr Wtr Feed (Chevron unquantified measure)	2010	yes	no	$1,601,643	$4,000	$38,386	58.08	46.6	-3.1%	($892,756)	5.76%

This measure originally included by Chevron Energy Solutions, but not quantified, is a photovoltaic (200 kWac) system which would offset the kWh consumption of waste water feed system. This system will produce an average of 247,000 kWh annually. The low IRR and negative NPV reflect the diminishing CPUC incentives over the next few years. However, the CPUC may refund the PV incentive programs, which would improve the financial metrics of this opportunity. [30]

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
PV on WstWtr Wtr Feed 200 kWAC (Chevron unquantified measure)	-3.0	-3.0	0.00	6.0	6.00	0.00	0.00	5.3	11.28	42.13

[30] California Solar Initiative / Self-Generation Incentive Program Statewide Trigger Point Tracker, www.sjip-ca.com.

Action Plan				
A	B	C	D	E
n	y	n	n	n

12-285 kWac Photovoltaic System

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
12	PV 285 kWac	2009	yes	no	$2,264,547	$5,657	$52,454	83.80	48.4	-3.0%	($1,192,386)	8.32%

This 285 MW photovoltaic system would generate approximately 372,800 kWh per year. The low IRR and negative NPV reflect the diminishing CPUC incentives over the next few years. However, the CPUC may refund the PV incentive programs, which would improve the financial metrics of this opportunity.[31]

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
PV 285 kWac	-3.0	-3.0	0.00	6.0	6.00	0.00	0.00	6.0	12.00	45.00

[31] California Solar Initiative / Self-Generation Incentive Program Statewide Trigger Point Tracker, www.sjip-ca.com.

Action Plan				
A	B	C	D	E
n	y	y	n	n

13-265 kWac Photovoltaic System Supplying Waste Water Treatment System

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
13	PV WstWtr Trmt Plant 265kWac	2012	yes	no	$2,121,643	$5,300	$54,484	73.84	43.1	-2.8%	($1,209,825)	7.33%

This measure, included in the Chevron Energy Solutions recommendation is a photovoltaic (265 kWac) system which would offset the kWh consumption of the Stonebridge Well. This system will produce an average of 327,000 kWh annually. The low IRR and negative NPV reflect the diminishing CPUC incentives over the next few years. However, the CPUC may refund the PV incentive programs, which would improve the financial metrics of this opportunity. [32]

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
PV WstWtr Trmt Plant 265kWac	-3.0	-3.0	0.00	6.0	6.00	0.00	0.00	6.0	12.00	45.00

[32] California Solar Initiative / Self-Generation Incentive Program Statewide Trigger Point Tracker, www.sjip-ca.com.

Action Plan				
A	B	C	D	E
n	y	n	n	n

14-185 kWac Photovoltaic System Supplying Stonebridge Well

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
14	PV Stonebridge Well 185 kWac	2014	yes	no	$1,481,643	$3,700	$40,745	49.38	40.0	-2.7%	($910,186)	4.90%

Photovoltaic (PV) systems are available for electricity generation to offset the energy consumption of water pumping. This strategy has been successfully used within other North Bay enterprise funds, providing a near positive cash flow to the fund by financing the measure with an appropriately long term for repayment. The application of PV systems to water supply pumping situations is particularly attractive if the jurisdiction has the ability to schedule the majority of the pumping at night when energy rates are low (utilizing the capacity of the storage tanks). In this case the PV system generates electricity during the day when the energy is most valuable, and the pumps draw energy from the utility grid at night when it is least costly. Therefore the energy produced is much more valuable than the energy purchased from the utility for that meter.

This measure, included in the Chevron Energy Solutions recommendation is a photovoltaic (185 kWac) system which would offset the kWh consumption of the Stonebridge Well. This system will produce an average of 229,000 kWh annually. The low IRR and negative NPV reflect the diminishing CPUC incentives over the next few years. However, the CPUC may refund the PV incentive programs, which would improve the financial metrics of this opportunity. [33]

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
PV Stonebridge Well 185 kWac	-3.0	-3.0	0.00	6.0	6.00	0.00	0.00	5.7	11.69	43.76

[33] California Solar Initiative / Self-Generation Incentive Program Statewide Trigger Point Tracker, www.sjip-ca.com.

Action Plan				
A	B	C	D	E
y	n	n	y	n

15-265 kWac Photovoltaic System Supplying Wastewater Treatment Plant (PPA)

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
15	PV WstWtr Trmt Plant 265kWac (PPA)	2012	no	yes	$50,000	$0	($3,557)	73.84	-14.1	#DIV/0!	($91,974)	7.33%

This measure specifies a 265 kW system which is sized to offset energy associated with the wastewater treatment plant operations producing an average of 327,000 kWh per year. The Net Capital Cost reflects $50,000 expended to negotiate the PPA contract.

The costs reflect the assumption that a power purchase agreement (PPA) will be utilized to implement the system. A power purchase agreement is a long-term agreement between a power provider (the solar company) and a customer. The customer agrees to purchase energy from the provider at a fixed rate for the term of the agreement. This rate increases every year by an agreed percentage. The life of the agreement may be in the range of 20 years. At the end of the contract period the customer typically has the option to purchase the system at its value at that time. This analysis assumes the cost of energy would be 5% more than the current PG&E rate, and would escalate at 3.5% per year. The cost of energy specified in the contract will have significant influence over the financial metrics of the measure. The value used in this analysis (5% over present PG&E rates) is based on a large contract proposal presented to a public agency in Sonoma County in 2008. The assumed term of the contract matches the term of this analysis, 25 years.

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
PV WstWtr Trmt Plant 265kWac (PPA)	1.0	-1.0	0.00	6.0	6.00	0.00	0.00	6.0	18.01	63.02

Action Plan				
A	B	C	D	E
y	n	y	y	n

16-185 kWac Photovoltaic System Supplying Stonebridge Well Utilizing a Power Purchase Agreement.

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
16	PV Stonebridge Well 185 kWac (PPA)	2014	no	yes	$50,000	$0	($2,483)	49.38	NA	NA	($78,583)	4.90%

This measure identified by the Chevron Energy Solutions report specifies a 185 kW system which is sized to offset energy associated with the wastewater treatment plant operations producing an average of 229,000 kWh per year. The Net Capital Cost reflects $50,000 expended to negotiate the PPA contract.

The costs reflect the assumption that a power purchase agreement (PPA) will be utilized to implement the system. A power purchase agreement is a long-term agreement between a power provider (the solar company) and a customer. The customer agrees to purchase energy from the provider at a fixed rate for the term of the agreement. This rate increases every year by an agreed percentage. The life of the agreement may be in the range of 20 years. At the end of the contract period the customer typically has the option to purchase the system at its value at that time. This analysis assumes the cost of energy would be 5% more than the current PG&E rate, and would escalate at 3.5% per year. The cost of energy specified in the contract will have significant influence over the financial metrics of the measure. The value used in this analysis (5% over present PG&E rates) is based on a large contract proposal presented to a public agency in Sonoma County in 2008. The assumed term of the contract matches the term of this analysis, 25 years.

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
PV Stonebridge Well 185 kWac (PPA)	1.0	-1.0	0.00	6.0	6.00	0.00	0.00	5.7	17.70	61.78

Action Plan				
A	B	C	D	E
n	n	n	n	y

17- 950 kWac Photovoltaic System (PPA)

Measure Number	Measure Name	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
17	PV 950 kWac (PPA)	2009	no	yes	$50,000	$0	($12,796)	282.40	NA	NA	-$207,170	28%

This measure specifies a 950 kW system producing an average of 1,256,380 kWh per year. The Net Capital Cost reflects $50,000 expended to negotiate the PPA contract.

The costs reflect the assumption that a power purchase agreement (PPA) will be utilized to implement the system. A power purchase agreement is a long-term agreement between a power provider (the solar company) and a customer. The customer agrees to purchase energy from the provider at a fixed rate for the term of the agreement. This rate increases every year by an agreed percentage. The life of the agreement may be in the range of 20 years. At the end of the contract period the customer typically has the option to purchase the system at its value at that time. This analysis assumes the cost of energy would be 5% more than the current PG&E rate, and would escalate at 3.5% per year. The cost of energy specified in the contract will have significant influence over the financial metrics of the measure. The value used in this analysis (5% over present PG&E rates) is based on a large contract proposal presented to a public agency in Sonoma County in 2008. The assumed term of the contract matches the term of this analysis, 25 years.

The projected cash flow and energy savings are provided below.

Year	0	1	2	3	4	5	6	7	8	9	10	11	12
Net Cash Flow	($50,000)	($8,794)	($9,057)	($9,327)	($9,605)	($9,891)	($10,186)	($10,490)	($10,803)	($11,125)	($11,457)	($11,799)	($12,151)
Energy Generated (kWh)	1,256,380	1,250,099	1,243,848	1,237,629	1,231,441	1,225,283	1,219,157	1,213,061	1,206,996	1,200,961	1,194,956	1,188,981	1,183,036

Year	13	14	15	16	17	18	19	20	21	22	23	24	25
Net Cash Flow	($12,513)	($12,886)	($13,271)	($13,667)	($14,074)	($14,494)	($14,926)	($15,371)	($15,830)	($16,302)	($16,788)	($17,289)	($17,804)
Energy Generated (kWh)	1,177,121	1,171,236	1,165,379	1,159,553	1,153,755	1,147,986	1,142,246	1,136,535	1,130,852	1,125,198	1,119,572	1,113,974	1,108,404

Measure Evaluation Scores

Measure Name	Cost (relative)	Financial Metrics (relative)	Resolution of Existing Problem (cumulative)	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
PV 950 kWac (PPA)	1.0	-1.0	0.00	6.0	6.00	0.00	0.00	6.0	19.00	63.00

Action Plan				
A	B	C	D	E
n	n	n	n	n

18-950 kWac Photovoltaic System (City Financed at 3.5%)

Measure Number	Measure Name	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
18	PV 950 kWac (City Financed)	2009	yes	no	$7,628,861	$19,065	$176,772	282.40	48.4	-3.0%	($4,015,792)	28%

This measure specifies a 950 kW system producing an average of 1,256,380 kWh per year similar to the previous measure. However, this measure assumes ownership by the City. The low IRR and negative NPV reflect the diminishing CPUC incentives over the next few years. However, the CPUC may refund the PV incentive programs, which would improve the financial metrics of this opportunity.[34] This measure was not included in any of the plans due to the high cost and low return.

Measure Evaluation Scores

Measure Name	Cost (relative)	Financial Metrics (relative)	Resolution of Existing Problem (cumulative)	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
PV 950 kWac (City Financed)	-3.0	-3.0	0.00	6.0	6.00	0.00	0.00	6.0	13.00	45.00

[34] California Solar Initiative / Self-Generation Incentive Program Statewide Trigger Point Tracker, www.sjip-ca.com.

Action Plan				
A	B	C	D	E
y	y	n	n	n

19-Fleet Replacement Strategy A

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
17	New Fleet A	2011	yes	no	$20,000	$0	$2,793	6.75	7.2	17.3%	$36,403	0.67%

Measure 17 provides the cost/benefits of replacing vehicles with high efficiency alternatives. The table below provides the substitutions. While the vehicles specified may not require replacement by the 2011 implementation date, there may be opportunities to shift the existing vehicles and enabling this strategy when other vehicles require replacement. The project costs are the incremental cost associated with the purchase of the more efficient version over the standard version. The increasing cost of fuel results in very attractive financial metrics for this measure. The list of vehicles identified for this measure is provided in the Appendices. This list is derived from a list provided by City Staff. The fuel consumption values for this analysis are provided in either miles per gallon (MPG) or miles per kWh (MPkWh). The MPkWh is supplied for the electric vehicles.

Strategy				
Original	Replacement	Fuel	MPG/ MPkWh	Incremental Cost
CRN VIC	Chevy Impala	Gasoline	20	$0
Cultass Ciera	Prius	gasoline	46	$4,000
Impala	Prius	gasoline	46	$4,000
Suburban	Large SUV Hybrid	gasoline	21	$4,000
Taurus	Prius	gasoline	46	$4,000
Tracker	Small SUV Hybrid	Gasoline	30	$4,000
Tracker	Small SUV Hybrid	Gasoline	30	$4,000

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
Fleet Replacements A	2.2	-0.2	0.00	1.0	1.00	-1.00	0.00	0.4	3.37	9.85

Action Plan				
A	B	C	D	E
n	n	y	y	y

20-Fleet Replacement Strategy B

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
18	New Fleet B	2014	yes	no	$268,000	$0	$14,812	33.24	18.1	6.3%	$38,838	3.30%

Measure 18 is more aggressive than Fleet Replacement Strategy A and provides the cost/benefits of replacing more vehicles with high efficiency alternatives. The table below provides the substitutions. While the vehicles specified may not require replacement by the 2011 implementation date, there may be opportunities to shift the existing vehicles and enabling this strategy when other vehicles require replacement. The project costs are the incremental cost associated with the purchase of the more efficient version over the standard version. The increasing cost of fuel results in very attractive financial metrics for this measure. The list of vehicles identified for this measure is provided in the Appendices. This list is derived from a list provided by City Staff. The fuel consumption values for this analysis are provided in either miles per gallon (MPG) or miles per kWh (MPkWh). The MPkWh is supplied for the electric vehicles.

Strategy				
Original	Replacement	Fuel	MPG/ MPkWh	Incremental Cost
COLORADO	Electric SUT	Electric	2.1	$15,000
CRN VIC	chevy impala	Gasoline	20.0	$0
Cultass Ciera	Prius plugin	Electric	2.1	$11,000
F-150	Electric SUT	Electric	2.1	$15,000
F-250	diesel hybrid Pickup	diesel	21.0	$6,000
F-350	diesel hybrid Pickup	diesel	21.0	$6,000
F-350	diesel hybrid Pickup	diesel	21.0	$6,000
K2500	diesel hybrid Pickup	diesel	21.0	$6,000
RANGER	Electric SUT	Electric	2.1	$15,000
S-10	Electric SUT	Electric	2.1	$15,000
Silverado 3500	diesel hybrid Pickup	diesel	21.0	$6,000
SR-5	Electric SUT	Electric	2.1	$15,000
Suburban	Large SUV Hybrid	gasoline	21.0	$4,000
Taurus	Prius plugin	Electric	2.1	$11,000
Tracker	Small SUV Hybrid	Gasoline	30.0	$4,000

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
Fleet Replacements B	-3.0	-1.0	0.00	4.9	6.00	-1.00	0.00	2.3	8.17	34.81

Action Plan				
A	B	C	D	E
n	n	n	n	n

21-Biodiesel: 5% Blend

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
19	B05	2009	no	no	$50,000	$0	$0	1.83	NA	NA	($47,619)	0.18%

This measure proposes a minimal blend of Biodiesel (5%). It is not included in any of the Plans as the GHG impact is very limited.

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
Biodiesel B05	1.0	0.0	0.00	0.1	0.00	0.00	0.00	0.0	1.01	2.02

Action Plan				
A	B	C	D	E
n	n	n	n	n

22-Biodiesel: 20% Blend

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
20	B20	2009	no	no	$50,000	$0	$0	7.31	NA	NA	($47,619)	0.73%

This measure changes the fuel mix for all diesel vehicles to a 20/80% (biodiesel/diesel) blend for all fleet vehicles currently using diesel fuel. Biodiesel is now readily available at a reasonable price allowing rapid implementation of this GHG reduction strategy. This analysis assumes $3.74 per gallon and $50,000 for infrastructure improvements (tanks, etc). Prices are assumed to escalate at the same rate as petroleum based diesel fuel (8% per year). This analysis also uses the coefficient of 5.24 lbs CO2e per gallon of 100% biodiesel. While the use of biodiesel fuel created from waste oil (assumed to be available locally) would have close to zero emissions for the feedstock. The process requires that 20% of the feed stock is methanol, a petroleum product.

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
Biodiesel B20	1.0	0.0	0.00	1.1	0.00	0.00	0.00	0.0	1.01	2.02

Action Plan				
A	B	C	D	E
n	n	n	n	n

23-Biodiesel: 50% Blend

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
21	B50	2010	no	no	$50,000	$0	$0	18.27	NA	NA	($47,619)	1.81%

This measure changes the fuel mix for all diesel vehicles to a 50/50% (biodiesel/diesel) blend for all fleet vehicles currently using diesel fuel.[35] Biodiesel is now readily available at a reasonable price allowing rapid implementation of this GHG reduction strategy. This analysis assumes $3.74 per gallon and $50,000 for infrastructure improvements (tanks, etc). Prices are assumed to escalate at the same rate as petroleum based diesel fuel (8% per year). This analysis also uses the coefficient of 5.24 lbs CO2e per gallon of 100% biodiesel. While the use of biodiesel fuel created from waste oil (assumed to be available locally) would have close to zero emissions for the feedstock. The process requires that 20% of the feed stock is methanol, a petroleum product.

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
Biodiesel B50	1.0	0.0	0.00	3.1	3.00	-2.00	0.00	0.0	2.01	10.02

[35] The use of high percentage biodiesel must be coordinated with California Air Resource Board (CARB) requirements and vehicle warranty considerations.

Action Plan				
A	B	C	D	E
n	n	n	y	y

24-Biodiesel: 99% Blend

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
22	B99	2011	no	no	$53,000	$0	$0	36.16	NA	NA	($50,476)	3.59%

This measure changes the fuel mix for all diesel vehicles to a 99/1% (biodiesel/diesel) blend for all fleet vehicles currently using diesel fuel. Biodiesel is now readily available at a reasonable price allowing rapid implementation of this GHG reduction strategy. This analysis assumes $3.74 per gallon and $50,000 for infrastructure improvements (tanks, etc). Prices are assumed to escalate at the same rate as petroleum based diesel fuel (8% per year). This analysis also uses the coefficient of 5.24 lbs CO2e per gallon of 100% biodiesel. While the use of biodiesel fuel created from waste oil (assumed to be available locally) would have close to zero emissions for the feedstock. The process requires that 20% of the feed stock is methanol, a petroleum product.[36]

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
Biodiesel B99	0.9	0.0	0.00	6.0	6.00	-2.00	0.00	0.0	4.89	21.78

[36] The use of high percentage biodiesel must be coordinated with California Air Resource Board (CARB) requirements and vehicle warranty considerations.

Action Plan				
A	B	C	D	E
n	y	n	n	n

25-Biodiesel Applied After Fleet Replacement A: 20% Blend

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
23	B20 Linked to Fleet A	2009	no	no	$50,000	$0	$0	7.31	NA	NA	($47,619)	0.73%

This measure, applied after Fleet Replacement A changes the fuel mix for all diesel vehicles to a 20/80% (biodiesel/diesel) blend for all fleet vehicles currently using diesel fuel. Biodiesel is now readily available at a reasonable price allowing rapid implementation of this GHG reduction strategy. This analysis assumes $3.74 per gallon and $50,000 for infrastructure improvements (tanks, etc). Prices are assumed to escalate at the same rate as petroleum based diesel fuel (8% per year). This analysis also uses the coefficient of 5.24 lbs CO2e per gallon of 100% biodiesel. While the use of biodiesel fuel created from waste oil (assumed to be available locally) would have close to zero emissions for the feedstock. The process requires that 20% of the feed stock is methanol, a petroleum product.

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
Biodiesel B20 Linked to Fleet A	1.0	0.0	0.00	1.1	0.00	0.00	0.00	0.0	2.08	5.23

Action Plan				
A	B	C	D	E
n	n	y	n	n

26-Biodiesel Applied After Fleet Replacement A: 50%

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
24	B50 Linked to Fleet A	2010	no	no	$50,000	$0	$0	18.27	NA	NA	($47,619)	1.81%

This measure, applied after Fleet Replacement A changes the fuel mix for all diesel vehicles to a 50/50% (biodiesel/diesel) blend for all fleet vehicles currently using diesel fuel.[37] Biodiesel is now readily available at a reasonable price allowing rapid implementation of this GHG reduction strategy. This analysis assumes $3.74 per gallon and $50,000 for infrastructure improvements (tanks, etc). Prices are assumed to escalate at the same rate as petroleum based diesel fuel (8% per year). This analysis also uses the coefficient of 5.24 lbs CO2e per gallon of 100% biodiesel. While the use of biodiesel fuel created from waste oil (assumed to be available locally) would have close to zero emissions for the feedstock. The process requires that 20% of the feed stock is methanol, a petroleum product.

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
Biodiesel B50 Linked to Fleet A	1.0	-2.0	0.00	2.7	3.00	-2.00	0.00	0.0	2.69	8.05

[37] The use of high percentage biodiesel must be coordinated with California Air Resource Board (CARB) requirements and vehicle warranty considerations.

Action Plan				
A	B	C	D	E
n	n	n	n	n

27-Biodiesel Applied After Fleet Replacement B: 20% Blend

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
25	B20 Linked to Fleet B	2009	no	no	$50,000	$0	$0	8.47	NA	NA	($47,619)	0.84%

This measure, applied after Fleet Replacement B changes the fuel mix for all diesel vehicles to a 20/80% (biodiesel/diesel) blend for all fleet vehicles currently using diesel fuel. Biodiesel is now readily available at a reasonable price allowing rapid implementation of this GHG reduction strategy. This analysis assumes $3.74 per gallon and $50,000 for infrastructure improvements (tanks, etc). Prices are assumed to escalate at the same rate as petroleum based diesel fuel (8% per year). This analysis also uses the coefficient of 5.24 lbs CO2e per gallon of 100% biodiesel. While the use of biodiesel fuel created from waste oil (assumed to be available locally) would have close to zero emissions for the feedstock. The process requires that 20% of the feed stock is methanol, a petroleum product.

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
Biodiesel B20 Linked to Fleet B	1.0	0.0	0.00	1.1	0.00	0.00	0.00	0.0	1.01	2.02

Action Plan				
A	B	C	D	E
n	n	n	y	n

28- Biodiesel Applied After Fleet Replacement B: 50% Blend

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
26	B50 Linked to Fleet B	2010	no	no	$50,000	$0	$0	21.17	NA	NA	($47,619)	2.10%

This measure, applied after Fleet Replacement B changes the fuel mix for all diesel vehicles to a 50/50% (biodiesel/diesel) blend for all fleet vehicles currently using diesel fuel.[38] Biodiesel is now readily available at a reasonable price allowing rapid implementation of this GHG reduction strategy. This analysis assumes $3.74 per gallon and $50,000 for infrastructure improvements (tanks, etc). Prices are assumed to escalate at the same rate as petroleum based diesel fuel (8% per year). This analysis also uses the coefficient of 5.24 lbs CO2e per gallon of 100% biodiesel. While the use of biodiesel fuel created from waste oil (assumed to be available locally) would have close to zero emissions for the feedstock. The process requires that 20% of the feed stock is methanol, a petroleum product.

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
Biodiesel B50 Linked to Fleet B	1.0	-2.0	0.00	3.1	3.00	-2.00	0.00	0.0	3.11	9.33

[38] The use of high percentage biodiesel must be coordinated with California Air Resource Board (CARB) requirements and vehicle warranty considerations.

Action Plan				
A	B	C	D	E
n	n	n	n	y

29- Biodiesel Applied After Fleet Replacement B: 99% Blend

Measure Number	Measure Description	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
27	B99 Linked to Fleet B	2010	no	no	$53,500	$0	$0	41.91	NA	NA	($50,952)	4.16%

This measure, applied after Fleet Replacement B changes the fuel mix for all diesel vehicles to a 99/1% (biodiesel/diesel) blend for all fleet vehicles currently using diesel fuel. Biodiesel is now readily available at a reasonable price allowing rapid implementation of this GHG reduction strategy. This analysis assumes $3.74 per gallon and $50,000 for infrastructure improvements (tanks, etc). Prices are assumed to escalate at the same rate as petroleum based diesel fuel (8% per year). This analysis also uses the coefficient of 5.24 lbs CO2e per gallon of 100% biodiesel. While the use of biodiesel fuel created from waste oil (assumed to be available locally) would have close to zero emissions for the feedstock. The process requires that 20% of the feed stock is methanol, a petroleum product.[39]

Measure Evaluation Scores

Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
Biodiesel B99 Linked to Fleet B	0.9	-2.0	0.00	6.0	6.00	-2.00	0.00	0.0	8.87	29.74

[39] The use of high percentage biodiesel must be coordinated with California Air Resource Board (CARB) requirements and vehicle warranty considerations.

Action Plan				
A	B	C	D	E
y	y	y	y	y

30- Efficiency Coordinator (0.5 FTE)

Measure Number	Measure Name	Impl. Date	Financed	Power Purchase Agreement	Net Capital Cost	O&M incremental Cost	Annual Cost Savings	Annual CO2 Reduction	Simple Payback	Internal Rate of Return (IRR)	Net Present Value (NPV)	%GHG
30	Efficiency Coordinator (.5 FTE)	2009	no	no	$0	$30,000	$0	0.00	0.0	NA	($595,622)	0

The implementation and monitoring of an aggressive GHG emissions reduction program, and the associated energy cost savings, will be greatly enhanced with the dedicated time of a City Staff member. All plans include a 0.5 FTE position (City cost estimated to be $30k per year). The expense for this position is included in the financial analyses, and the net cash flow for each plan. Essentially, the cost savings for the added fulltime position are funded by the plans with a positive cash flow.

Action Plan				
A	B	C	D	E
n	n	n	n	n

LED Ornamental Lights for Street Trees

This measure was identified by City Staff as an implemented energy efficiency project. LED lighting reduces energy consumption by roughly 90% and have a significantly extended product life. The costs and benefits were not available for inclusion in this analysis.

Action Plan				
A	B	C	D	E
n	n	n	n	n

Additional Measures Identified in Chevron Energy Solution Report

These measures were identified in the Chevron Energy Solutions report to the City. The associated costs and benefits were not available for this analysis.

Parks Irrigation Control
Library Ground Source Heat Pump HVAC System Replacement
Fire Station Occupancy Based Climate Controls (HVAC)
Corporation Yard Climate Controls (HVAC)
City Hall Solar Cooling/Heating System (HVAC)
Photovoltaic System on Water Reservoir Floating Isles

Action Plan				
A	B	C	D	E
n	n	n	n	n

6.0 Summary and Conclusions

A greenhouse gas (GHG) emissions reduction of 20% by 2015 can be achieved by a number of paths documented in this report. Each path, or Action Plan, is comprised of up to 12 individual measures. Each is evaluated for the financial costs and benefits they contribute to the overall strategy. The total "palette" of opportunities includes 35 measures. The analysis model underpinning these results will be available for incorporating new information and technologies as they come available, as well as truing the analysis with monitored data. The comprehensive approach to addressing this goal allows the City to meet a number of related goals, including improving the long term financial health of St Helena, reducing the budget vulnerability to future energy cost escalation, addressing the existing maintenance demands of aging equipment, and providing the public demonstration of commitment and progress in the highly visible challenge of greenhouse gas emissions reduction.

Additional consideration should be directed toward an employee commute program. The costs and benefits are not estimated in this analysis, but could be significant. The City may also consider the emerging opportunities with fleet management software. This may require a partnership with other Napa County jurisdictions to achieve reasonable economies of scale. Finally, Many cities are considering a reduced workweek (4/10 or 9/80) to reduce costs. These schedules will also reduce energy consumption and thereby contribute to the reduction of greenhouse gas emissions.

The information in this report allows the City to understand the challenges and opportunities available in reaching its goal. The evaluation matrix incorporates the many related issues not captured by the financial results or emissions reduction such as public visibility and the resolution of existing problems. The financial results provide information on the investment value of the various paths of action, along with the anticipated net cash flow over time. The ability to understand the complex context of greenhouse gas emissions reduction will allow policy makers to define expected outcomes and associated financial commitments to meet those outcomes. This provides city staff the flexibility needed to effectively implement the policy. The individual measures within each plan may be delayed, modified or replaced as appropriate while remaining faithful to the policy directive. This flexibility will be essential given the dynamic nature of the regulatory environment and the rapidly evolving financial and technological opportunities in California.

7.0 Appendices

7.1 Basis for 2000 GHG Inventory
7.2 Action Plan Evaluations
7.3 Chevron Energy Solutions Lighting Recommendations
7.4 Vehicle Lists
7.5 Fleet Fuel Cost Trend
7.6 Carbon Credits
7.7 Electric Vehicles
7.8 Commute Programs
7.9 Grease to Gas Augmentation of Digester Gas

7.1 Basis for 2000 GHG Inventory

City of St Helena Greenhouse Gas Inventory

(Based on billing information and data received from City Staff)

Baseline Year 2000

	kWh	Therms	Energy Cost	Gasoline (gals/yr)	Diesel	eCO2 (tons)
Buildings						
HISTORICAL PARK	7,428	0	1,077			1.8
RESTRM	4,983	0	723			1.2
CITY HALL	66,821	0	9,689			16.3
QUIET AREA CRANE PK	442	0	64			0.1
LIBRARY	0	1,575	1,575			9.7
CITY HALL OFCS	47,760	2,930	9,855			30
CITY GARAGE	14,129	0	2,049			3
TEEN CTR	0	536	536			3
TEEN CTR MAIN	10,886	0	1,578			3
LIBRARY	212,560	0	30,821			52
REC BLDG E/PARK	0	421	421			3
VACANT SHOP	2,077	0	301			1
CITY/CORP YARD	12,111	0	1,756			3
LANDSCAPE IRIG CONTROL	2,100	0	305			1
CARNEGIE BLDG	20,655	0	2,995			5
CARNEGIE BLDG	0	627	627			4
CITY HALL OFC	0	0	0			0
SPRINKLER CONTROL	0	0	0			0
CITY GARAGE	0	257	257			2
SIREN	277	0	40			0
FIRE STATION	98,720	0	14,314			24
FIRE STATION	0	1,610	1,610			10
SHED BY TRACKS	40	0	6			0
SPRINKLER CONTROL	18,497	0	2,682			5
REC BLDG E/PARK	6,656	0	965			2
TEEN CENTER	0	0	0			0
OFC	7,736	0	1,122			2
Total	**533,878**	**7,956**	**$66,525**			**179.6**
Streetlights						
PGE Owned Street Lights	1,968	0	285			0
PGE Owned Street Lights	236,870	0	34,346			58
Outdoor Area Lighting Service	348	0	50			0
BOCCI-BALL CRT	3,222	0	467			1
CITY/WALKWAY LIGHTS	3,875	0	562			1
LIGHTS-CARY FIELD	685	0	99			0
TENNIS COURTS	21,398	0	3,103			5
Total	**268,366**	**0**	**$30,324**			**66**
Water/Sewer						
STONEBRIDGE WELL	275,285	0	39,916			67
PUMP	30,181	0	4,376			7
PUMP NOT DR 92	34,746	0	5,038			8
PUMP	1,379	0	200			0
TANK SITE	1,466	0	213			0
CHLOR PUMP	59	0	9			0
SEWER PUMP	8,547	0	1,239			2
PUMP	10,908	0	1,582			3
WWTP	121,760	0	17,655			30
DISPOSAL PLANT @ END	504,560	0	73,161			123
PUMP STATION	42,923	0	6,224			10
WATER TRTMT PLANT	475,600	0	68,962			116
STONEBRIDGE PARK PUMP	349	0	51			0
Total	**1,507,763**	**0**	**$170,370**			**369**
Commute						
Gasoline and Diesel				19,498	2,166	225
Total			**0**	**19,498**	**2,166**	**225**
Fleet						
Gasoline			30,960	9,106		94
Diesel			25,561		6,835	72
Total			**31,530**	**9,106**	**6,835**	**166**
Waste Total						**3**
Grand Total	**2,310,007**	**7,956**	**298,749**	**28,604**	**9,001**	**1,007**
Grand Total w/trend						**1,090**

Table 9: 2000 Greenhouse Gas Inventory

7.2 Action Plan Evaluations

The GHG Emission Reduction Action Plans involve more than CO2e reduction and cash flow. There are critical concerns that should be factored into the decision making process. These include the financial metrics of internal rate of return (IRR) and net present value (NPV) used to evaluate the worthiness of the investment; the cost of implementing the measure, some measures come with a large price tag which will challenge liquidity; the degree to which the plan resolves existing problems, such as old, high maintenance air conditioning units; the visibility of the measures to the public, for example the photovoltaic systems are a physical example of actions taken the City and communicate action and commitment to the community. Other key considerations include the employee impacts of new equipment or procedures, which may generate internal opposition; and the impact on the variability of future energy costs and the associated budgetary vulnerability.

Each measure and the plans as a whole are evaluated by the following considerations:

- Measure Capital Cost:
- Financial Metrics (IRR and NPV)
- Resolution of Existing Problems
- GHG Impact
- Public Visibility
- Employee Impact
- Community Impact
- Energy Cost Stabilization

Table 11 below provides the evaluation results for each measure by individual criteria. The individual scores for each category (cost, financial metrics, etc) are summed to provide an overall score for that measure. While this table provides important information to be considered when selecting measures, the scores are advisory only. A relatively low score does not preclude a measure, nor should a high score guarantee inclusion of the measure in the Action Plans. There will always be additional considerations that are not reflected in the Selection Evaluation process. The "adjusted measure score" reflects the relative weighting of the evaluation criteria as presented in Table 10 below.

Cost (relative)	Financial Metrics (relative)	Resolution of Existing Problem	GHG Impact	Positive Public Visibility	Employee Impact	Community Impact	Energy Cost Stabilization	total=24
2	5	2	3	4	2	2	4	24

Table 10: Evaluation Criteria Weighting

Measure Number	Measure Name	Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Existing Problem (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Cost Stabilization (cumulative)	Measure Score	Adjusted Measure Score
15	PV WstWtr Trmt Plant 265kWac (PPA)	1.0	-1.0	0.00	6.0	6.00	0.00	0.00	6.0	18.01	63.02
16	PV Stonebridge Well 185 kWac (PPA)	1.0	-1.0	0.00	6.0	6.00	0.00	0.00	5.7	17.70	61.78
8	Waste Water Aeration Solar Bee™	0.4	2.8	0.00	5.0	1.00	0.00	0.00	3.3	12.60	47.35
2	Building Lighting Measures	-0.4	2.0	2.00	4.6	1.00	2.00	0.00	3.0	14.26	47.30
12	PV 285 kWac	-3.0	-3.0	0.00	6.0	6.00	0.00	0.00	6.0	12.00	45.00
13	PV WstWtr Trmt Plant 265kWac	-3.0	-3.0	0.00	6.0	6.00	0.00	0.00	6.0	12.00	45.00
14	PV Stonebridge Well 185 kWac	-3.0	-3.0	0.00	6.0	6.00	0.00	0.00	5.7	11.69	43.76
11	PV on WstWtr Wtr Feed 200 kWAC (Chevron unquantified measure)	-3.0	-3.0	0.00	6.0	6.00	0.00	0.00	5.3	11.28	42.13
7	Reduce Streetlighting Lumins	1.8	3.0	0.00	2.8	0.00	0.00	0.00	2.0	9.65	35.07
18	Fleet Replacements B	-3.0	-1.0	0.00	4.9	6.00	-1.00	0.00	2.3	8.17	34.81
3	Steetlighting HPS to LED A	-1.0	1.4	0.00	1.3	3.00	2.00	0.00	2.2	8.92	33.71
4	Streetlighting HPS to LED B	-1.0	1.4	0.00	1.3	3.00	2.00	0.00	2.2	8.87	33.54
5	Residential Streetlighting 1st 50%	2.6	3.0	0.00	2.9	0.00	-1.00	-2.00	1.8	7.31	30.19
6	Residential Streetlighting 2nd 50%	2.6	3.0	0.00	2.8	0.00	-1.00	-2.00	1.8	7.25	30.01
27	Biodiesel B99 Linked to Fleet B	0.9	-2.0	0.00	6.0	6.00	-2.00	0.00	0.0	8.87	29.74
22	Biodiesel B99	0.9	0.0	0.00	6.0	6.00	-2.00	0.00	0.0	4.89	21.78
9	Pump Efficiency A	-0.6	1.2	1.00	2.5	0.00	0.00	0.00	1.7	5.79	21.07
10	Pump Efficiency B	-3.0	0.8	1.00	2.9	0.00	0.00	0.00	2.0	3.64	16.49
21	Biodiesel B50	1.0	0.0	0.00	3.1	3.00	-2.00	0.00	0.0	2.01	10.02
17	Fleet Replacements A	2.2	-0.2	0.00	1.0	1.00	-1.00	0.00	0.4	3.37	9.85
26	Biodiesel B50 Linked to Fleet B	1.0	-2.0	0.00	3.1	3.00	-2.00	0.00	0.0	3.11	9.33
24	Biodiesel B50 Linked to Fleet A	1.0	-2.0	0.00	2.7	3.00	-2.00	0.00	0.0	2.69	8.05
23	Biodiesel B20 Linked to Fleet A	1.0	0.0	0.00	1.1	0.00	0.00	0.00	0.0	2.08	5.23
19	Biodiesel B05	1.0	0.0	0.00	0.1	0.00	0.00	0.00	0.0	1.01	2.02
20	Biodiesel B20	1.0	0.0	0.00	1.1	0.00	0.00	0.00	0.0	1.01	2.02
25	Biodiesel B20 Linked to Fleet B	1.0	0.0	0.00	1.1	0.00	0.00	0.00	0.0	1.01	2.02
1	Automated Water Meters (Community Wide)	-3.0	1.1	2.00	0.0	0.00	-1.00	0.00	0.0	-0.94	1.32

Table 11: Measure List and Evaluations

The table below compiles the scoring for each measure included in each plan and yields a relative score for each metric. As with the previous table, a higher score indicate more a more favorable evaluation for that metric or plan.

Evaluation Summary					
Metric \ Plan	**A**	**B**	**C**	**D**	**E**
Cost	-2.0	-16.0	-16.8	-7.6	-36.2
Financial Metrics	10.1	-9.9	20.5	23.7	-17.8
Resolution of Existing Problem	10.0	10.0	10.0	10.0	10.0
GHG Impact	86.9	90.1	108.9	132.7	149.9
Public Visibility	80.0	80.0	104.0	116.0	176.0
Employee Impact	0.0	0.0	-2.0	-8.0	4.0
Community Impact	0.0	0.0	-4.0	-8.0	0.0
Energy Cost Stabilization	99.4	99.4	105.4	124.9	152.2
Total	**284.4**	**253.6**	**326.0**	**383.7**	**438.2**

Table 12: Evaluation Matrix

This analysis is intended to provide an overview of the effectiveness of each plan. While it should encourage a more comprehensive review of the cost/benefits of each strategy, these quantitative results are based on subjective judgments and are advisory only. They should be only one consideration in the selection of the most appropriate plan for the City of St Helena.

7.3 Chevron Energy Solutions Lighting Recommendations

The following description and tables are drawn from the vendor's report.[40]

> *A room-by-room inventory was taken in each building that detailed the type, quantity, and level of lighting in use. Based on the information gathered, a spreadsheet was developed that calculated the wattage (in kW) of the lighting in use throughout the facilities. Lighting hours of operation were determined from data obtained from other facilities with similar usage patterns adjusted with information provided by St. Helena's staff. Applying the hours of operation to the wattage in place in the buildings gives an estimate of the electricity consumed by lighting at each city building (in kWh). Once the existing lighting consumption has been calculated, retrofit or replacement of fixtures can be proposed. The post-retrofit wattage of the facilities is based on the retrofits/replacements designed. The hours of operation are re-evaluated – decreasing burn hours, adding occupancy sensors, or making no change as necessary. The new lighting wattage (in kW) combined with the revised hours of operation will determine the post-retrofit potential estimation of energy consumed in kWh. The pre- and post-retrofit numbers can then be compared to determine the potential lighting energy savings.*

Metal Halide Lamp Retrofits

BLDG.	Room Description	ECM QTY	Fixture Type	Existing Fixture Description	Retrofit Code	Proposed ECM Description
Public Library	Stacks	18	Round	Low Bay 175w Metal Halide	NFF8-6	New Finelite Fixture Eight foot-Six lamp T8 with Electronic Ballast
Carnegie Recreation Facility	Classroom	9	Round	Low Bay 175w Metal Halide	NFF8-6	New Finelite Fixture Eight foot-Six lamp T8 with Electronic Ballast
Public Library	Stacks	2	Round	Low Bay 175w Metal Halide	NFF4-3	New Finelite Fixture Four foot-Three lamp T8 With Electronic Ballast

T12 Lamp Retrofits

BLDG.	Room Description	ECM QTY	Fixture Type	Existing Fixture Description	Retrofit Code	Proposed ECM Description
Corporation Yard	Office	20	2x4 troff	Troffer w/2 34w 4' T12 lamps	D4S	4 - F32T8/XL/HL lamp, (2) 2-lamp LP Elec Ballast
Corporation Yard	Restroom	3	1x4 troff	Troffer w/1 34w 4' T12 lamps	A1	1 - F32T8L (1) 1-lamp Elec Ballast (BF .78) Rest Rooms
Corporation Yard	Garage	2	2x8 strip	8' Industrial Hooded w/2 T12 HO lamps	G	Eight Foot Retrofit Kit, two lamps, L ballast
Recreation House	Classroom	17	2x8 strip	Strip w/2 4' 34w T12 lamps	B	2 - F32T8/XL/HL lamp, (1) 2-lamp LOW Elec Ballast.
Recreation House	Garage	3	2x8 strip	Strip w/2 4' 34w T12 lamps	B	2 - F32T8/XL/HL lamp, (1) 2-lamp LOW Elec Ballast.

[40] City of Saint Helena Comprehensive Energy Analysis, Chevron Energy Solutions, date unidentified.

Occupancy Sensor Lighting Controls

BLDG.	Room Description	ECM QTY	Fixture Type	Existing Fixture Description	Retrofit Code	Proposed ECM Description
City Hall	Office	3	2x4 troff	Troffer w/2 32w 4' T8 lamps	PW-200	Wall switch PIR sensor, Passive Infrared Dual Relay Wall Switch Sensor, Watt-Stopper
City Hall	Kitchen	1	2x4 troff	Troffer w/4 32w 4' T8 lamps	PW-200	Wall switch PIR sensor, Passive Infrared Dual Relay Wall Switch Sensor, Watt-Stopper
City Hall	Open Cubicle	1	2x4 troff	Troffer w/2 32w 4' T8 lamps	DT-300	Ceiling mount PIR and Ultrasonic sensor, Dual Technology Ceiling sensor, Watt-Stopper
City Hall	Office	7	2x4 troff	Troffer w/2 32w 4' T8 lamps	PW-100	Wall switch PIR sensor, Passive Infrared Wall Switch Sensor, Watt-Stopper
City Hall	Office	1	2x4 troff	Troffer w/2 32w 4' T8 lamps	DT-300	Ceiling mount PIR and Ultrasonic sensor, Dual Technology Ceiling sensor, Watt-Stopper
City Hall	Hallway	3	2x4 troff	Troffer w/4 32w 4' T8 lamps	DT-300	Ceiling mount PIR and Ultrasonic sensor, Dual Technology Ceiling sensor, Watt-Stopper
City Hall	Hallway	1	2x4 troff	Troffer w/4 32w 4' T8 lamps	PW-100	Wall switch PIR sensor, Passive Infrared Wall Switch Sensor, Watt-Stopper
City Hall	Storage	1	2x4 troff	Troffer w/2 32w 4' T8 lamps	DT-300	Ceiling mount PIR and Ultrasonic sensor, Dual Technology Ceiling sensor, Watt-Stopper
City Hall	Conference	1	2x4 troff	Troffer w/4 32w 4' T8 lamps	DT-300	Ceiling mount PIR and Ultrasonic sensor, Dual Technology Ceiling sensor, Watt-Stopper
City Hall	Lobby	1	2x4 troff	Troffer w/4 32w 4' T8 lamps	DW-200	Wall switch PIR and Ultrasonic sensor, Dual Technology Dual Relay Wall Switch Sensor, Watt-Stopper
City Hall	Mezzanine	1	2x4 troff	Troffer w/4 32w 4' T8 lamps	UT-300	Ceiling mount 360 Ultrasonic Sensor, Ultrasonic Ceiling Sensor, Watt-Stopper
City Hall	Mezzanine	1	2x4 troff	Troffer w/2 32w 4' T8 lamps	DT-300	Ceiling mount PIR and Ultrasonic sensor, Dual Technology Ceiling sensor, Watt-Stopper
City Hall	Office	2	2x4 troff	Troffer w/4 32w 4' T8 lamps	PW-100WM	Wall switch PIR sensor, Passive Infrared Wall Switch Sensor, Watt-Stopper, Wire Mold
City Hall	Hallway	2	2x4 troff	Troffer w/4 32w 4' T8 lamps	CI-355WM	Ceiling mount 360 IR sensor, line volt Watt-Stopper
City Hall	Electrical Room	1	2x4 troff	Strip w/2 4' 34w T12 lamps	PW-100	Wall switch PIR sensor, Passive Infrared Wall Switch Sensor, Watt-Stopper
City Hall	Office	1	2x4 troff	Troffer w/4 32w 4' T8 lamps	PW-200WM	Wall switch PIR sensor, Passive Infrared Dual Relay Wall Switch Sensor, Watt-Stopper, Wire Mold
City Hall	Office	1	2x4 troff	Troffer w/4 32w 4' T8 lamps	PW-200WM	Wall switch PIR sensor, Passive Infrared Dual Relay Wall Switch Sensor, Watt-Stopper, Wire Mold
City Hall	PD Storage	4	2x4 troff	Troffer w/2 32w 4' T8 lamps	DT-300	Ceiling mount PIR and Ultrasonic sensor, Dual Technology Ceiling sensor, Watt-Stopper
City Hall	Storage	1	2x4 troff	Troffer w/4 32w 4' T8 lamps	PW-200	Wall switch PIR sensor, Passive Infrared Dual Relay Wall Switch Sensor, Watt-Stopper
Police Station	Lobby	3	2x4 troff	Troffer w/4 32w 4' T8 lamps	PW-200	Wall switch PIR sensor, Passive Infrared Dual Relay Wall Switch Sensor, Watt-Stopper
Police Station	Office	3	2x4 troff	Troffer w/4 32w 4' T8 lamps	PW-100	Wall switch PIR sensor, Passive Infrared Wall Switch Sensor, Watt-Stopper
Police Station	Office	3	2x4 troff	Troffer w/4 32w 4' T8 lamps	PW-200	Wall switch PIR sensor, Passive Infrared Dual Relay Wall Switch Sensor, Watt-Stopper
Police Station	Office	1	2x4 troff	Troffer w/4 32w 4' T8 lamps	PW-100WM	Wall switch PIR sensor, Passive Infrared Wall Switch Sensor, Watt-Stopper, Wire Mold
Police Station	Printer	1	2x4 troff	Strip w/1 4' 32w T8 lamp	PW-100	Wall switch PIR sensor, Passive Infrared Wall Switch Sensor, Watt-Stopper
Police Station	Cafeteria	1	2x4 troff	Troffer w/4 32w 4' T8 lamps	PW-200	Wall switch PIR sensor, Passive Infrared Dual Relay Wall Switch Sensor, Watt-Stopper
Police Station	Storage	1	2x4 troff	Troffer w/4 32w 4' T8 lamps	PW-200	Wall switch PIR sensor, Passive Infrared Dual Relay Wall Switch Sensor, Watt-Stopper
Police Station	Locker	2	2x4 troff	Troffer w/4 32w 4' T8 lamps	PW-200	Wall switch PIR sensor, Passive Infrared Dual Relay Wall Switch Sensor, Watt-Stopper
Police Station	Restroom	1	2x4 troff	Troffer w/4 32w 4' T8 lamps	PW-200	Wall switch PIR sensor, Passive Infrared Dual Relay Wall Switch Sensor, Watt-Stopper
Fire Station	Office (103)	1	4' strip	Strip w/2 4' 32w T8 lamps	PW-200WM	Wall switch PIR sensor, Passive Infrared Dual Relay Wall Switch Sensor, Watt-Stopper, Wire Mold
Fire Station	Office (103)	1	round	Round fixture w/2 26w CFL	DW-200	Wall switch PIR and Ultrasonic sensor, Dual Technology Dual Relay Wall Switch Sensor, Watt-Stopper
Fire Station	Office (104 and 106)	1	4' strip	Strip w/2 4' 32w T8 lamps	PW-200	Wall switch IR sensor, line volt, 4-lvl fresnel Lens, Watt-Stopper. Dual Load Switching
Fire Station	Storage (112)	1	2x2 troff	Troffer w/2 32w 4' T8 lamps	PW-200	Wall switch PIR sensor, Passive Infrared Dual Relay Wall Switch Sensor, Watt-Stopper

7.4 Vehicle Lists

Dept.	Make	Year	Model	Desc	Fuel Type	MPG	2000 Miles/Year (estimate)	2000 Fleet	2008 Fleet
Building Inspector	Chev	2002	Tracker	SUV	gasoline	24	6000	y	y
Buildings	Chev	2000	S-10	Pickup	gasoline	22	6000	y	y
Buildings	GMC	1995	G3500	van	gasoline	15	6000	y	y
Fire Services	Ford	1985	Beck	pumper	Diesel	8	3500	y	y
Fire Services	Chev	1988	Rescue Unit	Rescue	Diesel	8	3500	y	y
Fire Services	VAN PELT	1941	White	Fire Truck	Diesel	8	3500	y	y
Fire Services	Schneer	1917	Fire Truck	antique	Diesel	8	10	y	y
Fire Services	International	1994	Fire Truck	Fire Truck	Diesel	8	3500	y	y
Fire Services	PIERCE	1995	Lance Pumper	Pumper	Diesel	8	3500	y	y
Fire Services	Ford	1999	F-350	Pickup	gasoline	15	3500	y	y
Fire Services	Peterbilt	1998	Water Tender	Fire Truck	Diesel	8	3500	y	y
Fire Services	Pierce	2001	Aerial	Fire Truck	Diesel	8	3500	y	y
Fire Services	Chev	2004	Suburban	SUV	gasoline	16	3500	y	y
Garage	Toyota	1988	SR-5	Pickup	gasoline	25	6000	y	y
Parks	Bilt Rite	1990	trailer	Trailer	gasoline	NA	NA	y	y
Parks	Ford	1996	F-250	Pickup	gasoline	15	3000	y	y
Parks	Ford	1997	Ranger	Pickup	gasoline	23	3000	y	y
Parks	Ford	1998	F-150	Pickup	gasoline	18	3000	y	y
Parks	Chev	2006	S-10	Pickup	gasoline	22	3000	y	y
Pool	Oldsmobile	1995	Cultass Ciera	Pool Car	gasoline	20	6000	y	y
Public Safety	Ford	1998	CRN VIC	Sedan	gasoline	18	7500	y	y
Public Safety	NA	NA	Radar Trailer	Radar Trailer	gasoline	NA	NA	y	y
Public Safety	Ford	1999	Taurus	Sedan	gasoline	23	7500	y	y
Public Safety	Chev	2000	IMPALA	Police Chief	gasoline	21	7500	y	y
Public Safety	Chev	2000	IMPALA	Patrol	gasoline	21	7500	y	y
Public Safety	Chev	2001	IMPALA	Patrol	gasoline	21	7500	y	y
Public Safety	Chev	2001	IMPALA	Patrol	gasoline	21	7500	y	y
Public Safety	Harley Davidson	2002	Police MC	Motorcycle	gasoline	18	7500	y	y
Public Safety	Chev	2003	IMPALA	Patrol	gasoline	21	7500	y	y
Public Safety	Ford	2006	CRN VIC	Patrol	gasoline	18	7500	y	y
Public Safety	Chev	2005	Colorade	Police Pickup	gasoline	18	7500	y	y
Public Works	not available	1987	Dump Truck	Dump Truck	Diesel	8	6000	y	y
Public Works	Jacobs	1993	Equipment Trailer	trailer	gasoline	NA	NA	y	y
Public Works	Chev	1994	Suburban	SUV	gasoline	13	6000	y	y
Public Works	John Deere	2004	310G	Backhoe	Diesel	5	500	y	y
Sewer O&M	Wells Cargo	1996	Trailer	Trailer	gasoline	NA	NA	y	y
Sewer O&M	Chev	2003	Silverado 3500	Utility	gasoline	14	6000	y	y
Streets	GMC	1994	C3500-HD	Dump	Diesel	8	6000	y	y
Streets	International	1975	CS1610B	Pipe Cleaning	Diesel	8	6000	y	y
Streets	Chev	1996	S-10	Pickup	gasoline	22	6000	y	y
Streets	Five Star	2002	Five Star Air Cub	Street Sweeper	Diesel	8	6000	y	y
Streets	Chev	2006	S-10	Pickup	gasoline	22	6000	y	y
Water O&M	Chev	1990	C3500	Utility Truck	Diesel	15	3500	y	y
Water O&M	Chev	1995	S-10	Pickup	gasoline	18	3500	y	y
Water O&M	Ford	1997	Ranger	Pickup	gasoline	23	3500	y	y
Water O&M	Ford	1986	F-6	Dump Truck	Diesel	8	3500	y	y
Water O&M	Ford	2003	F-150	Pickup	gasoline	16	3500	y	y
WTP	Ford	1997	Ranger	Pickup	gasoline	23	3000	y	y
WTP	Ford	1998	Ranger	Pickup	gasoline	23	3000	y	y
WWTP	Chev	1990	K2500	Pickup	gasoline	14	3000	y	y
WWTP	Chev	1995	S-10	Pickup	gasoline	18	3000	y	y
WWTP	Chev	2001	S-10	Pickup	gasoline	22	3000	y	y

Table 13: Vehicle List

7.5 Vehicle Fuel Cost Trends

Petrofuel Price Trends and Future

Jim Housman, PE (retired)
11/19/07

There are a number of factors that contribute to the cost of gasoline at the pump. According to the U.S. Energy Information Agency (EIA) the price of gasoline can be broken down as follows:

Crude Oil:	64%
Refining (including additives)	13%
Distribution and Marketing	9%
Taxes:	14%

It should be clear from the attached graph that the major factor driving gasoline prices is the price of crude oil. There have been two distinct issues driving the price of crude in the past five years, geo-political issues and geological issues.

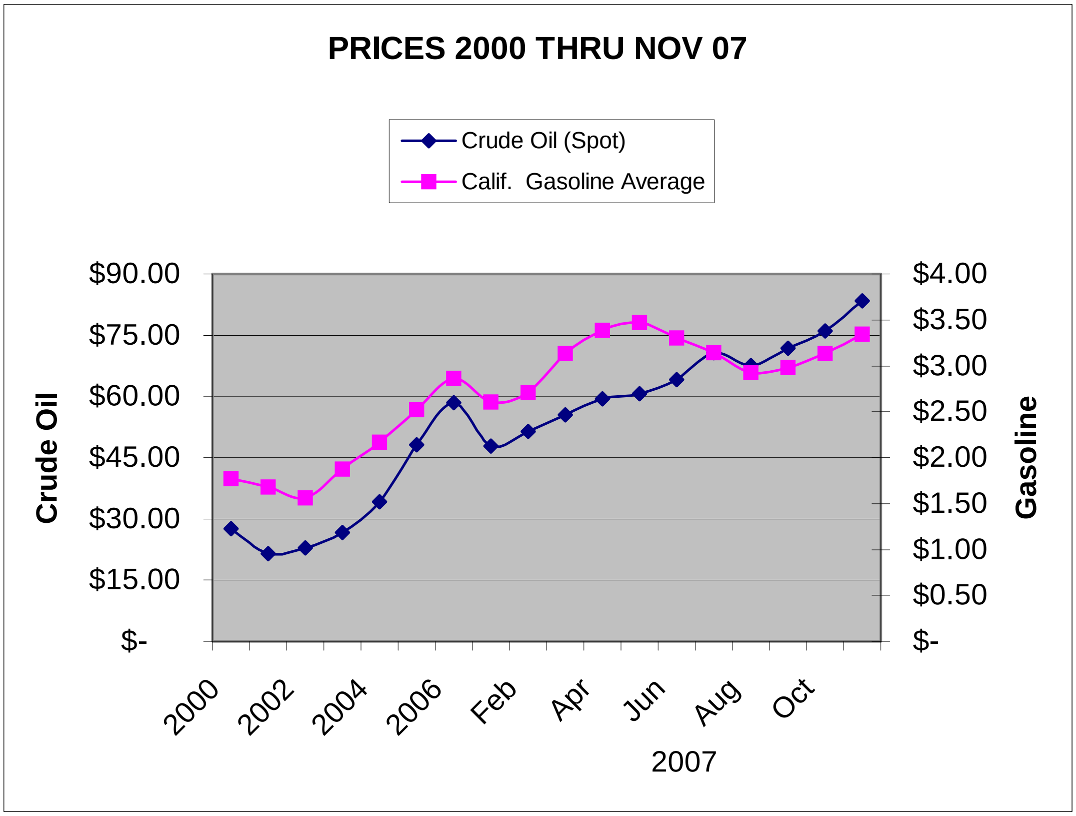
The geo-political issues driving oil prices are primarily the declining value of the dollar, the rapid growth in demand, primarily in Asia, and the economic uncertainty caused by military conflict. An additional geo-political factor is the shift in oil resources from the control (primarily) of privately owned multinational oil companies to being owned and managed by national oil companies. The motivation of shareholder owned companies is largely short term profits, driving the producers to produce the maximum amount of oil in the shortest time. National oil companies, while depending on oil revenue for investment capital, may be motivated to invest a significant portion of their income in non-oil related programs decreasing their ability to increase production as existing oil fields decline. Oil can also be used as a diplomatic tool, punishing enemies and rewarding friends. Short term decisions made by national oil companies for political reasons may have long term economic effects on oil using societies.

Geologically the oil industry is shifting from an environment where a relatively small number of oil fields are each producing very large quantities of oil to one where a very large number of oil fields are each producing a relatively small amount of oil. For example twenty years ago there were 15 oil fields in the world producing over one million barrels per day. Today there are only four, and at least one of those fields (Cantarell in Mexico) is in significant decline. Two thirds of the fields in the oil producing nations in the world are in decline. Not a single field discovered in the past ten years is capable of producing a million barrels per day. (reference 4)

In 1987, after the oil industry recovered from the turmoil caused by the Iran revolution, the price of gasoline in the United States averaged under 70 cents per gallon. In that same year the spot price of crude oil (the price quoted in the news) was about $13.40. In November of 2007 those prices were $3.40 for gasoline in California and $83.03 for crude oil.

In planning for future energy costs we can extrapolate these numbers to estimate gasoline cost in 2008 and future years.

In the simplest terms the cost of gasoline has grown, on average, at about 8% a year over the past twenty years. However if we look at just the past five years, from 2002 to 2007, the price of gasoline has escalated more like 17% each year. In 2012 the difference between those growth rates will be the difference between gasoline at $5.00 per gallon or $7.45 per gallon. Given the political and geological issues faced by the oil industry it would be prudent to assume that oil prices will continue their upward momentum.



Sources:

1. http://publications.uu.se/abstract.xsql?dbid=7625

2.http://tonto.eia.doe.gov/dnav/pet/pet_pri_wco_k_w.htm

3.http://tonto.eia.doe.gov/dnav/pet/pet_pri_gnd_a_epm0_pte_cpgal_w.htm

4. http://tonto.eia.doe.gov/oog/info/gdu/gasdiesel.asp

5. http://www.simmonsco-intl.com/files/giantoilfields.pdf

7.6 Carbon Credits

Carbon Offsets/Green Tags
Prepared by Peter Spencer

The David Suzuki Organization defines a carbon offset as "an emission reduction credit from another organization's project that results in less carbon dioxide or other greenhouse gases in the atmosphere than would otherwise occur. Carbon offsets are typically measured in tons of CO2-equivalents (or 'CO2e') and are bought and sold through a number of international brokers, online retailers, and trading platforms."
http://www.davidsuzuki.org/Climate_Change/What_You_Can_Do/carbon_offsets.asp

A green tag is a specific type of carbon offset also referred to as Renewable Energy Certificates (RECs). According to the Environmental Protection Agency, "Renewable Energy Certificates represent the environmental, social, and other positive attributes of power generated by renewable resources."

The carbon offset is a generic term for all types of purchasable GHG reduction programs sold in the market. For example, CO2 emissions can be offset by paying a group to plant trees anywhere in the world. The green tag, a subset of carbon offsets, is specific to electricity generation. To offset CO2 emissions with a green tag, a purchase is made which supports renewable electricity generation and consumption somewhere else. That green-generated electricity becomes part of the total pool of power and thereby reduces emissions from overall electricity production.

Individuals and organizations can purchase carbon offsets to reduce climate impacts from their activities. When carbon emissions are too difficult or costly to avoid, it's possible to pay someone else to reduce GHG. Dozens of companies, both commercial and nonprofit, offer a variety of offset types and prices.

The most common type of offset involves trees, either reforestation or avoided deforestation. Other common offsets are renewable energy and energy conservation projects. Prices for offsets/green tags vary widely from $3.56 to $30.00 per metric ton. (See survey in appendix) These prices are low compared to many other mitigation measures.

Renewable energy offsets, sold as green tags, fund wind, solar, biomass, and biodiesel projects worldwide. For every megawatt of power produced by a renewable source, one green tag is issued to the producer. The green tags can be sold to raise profits from renewable energy generation thus making it more competitive in the market. Energy conservation offsets often involve purchasing a GHG emission allowance from a company on the Chicago Climate Exchange. This "retires" the allowance preventing others from purchasing it to emit GHG.

Verification and accounting systems for offsets differ and there are currently no accepted standards. There is a wide variation of GHG baseline calculations for activities and also for the calculations of GHG reductions from projects. However, many providers make a good effort to ensure their product's value and provide documentation. The Green-e program is the most accepted certification program and referenced by the EPA. (http://www.green-e.org/)

Arguments in favor of Carbon Offsets:

- Supports growth of the renewable energy industry
- Compensates for GHG emissions which are too difficult or costly to avoid
- Lowers cost of GHG reductions
- Provides a market-based system for GHG reduction
- Can benefit poor countries with investments
- Positive PR for organizations that reduce emissions
- Raises awareness and encourages public policy changes

Sources of supportive information:

An excellent resource for consumers with ratings for top providers:
A Consumer's Guide to Retail Offset Providers
Clean Air-Cool Planet:
http://www.cleanair-coolplanet.org/ConsumersGuidetoCarbonOffsets.pdf

EPA description of various green purchasing options:
Guide to Purchasing guide for Green Power
Environmental Protection Agency:
http://www.epa.gov/greenpower/pdf/purchasing_guide_for_web.pdf

Realistic assessment supportive of offsets with large number of links:
How the Retail Carbon Offsets Market Can Further Global Warming Mitigation Goals
EM Market Insights:
http://conserveonline.org/workspaces/climate.change/carbonmarkets/em_going_carbon_neutral.pdf

Arguments against Carbon Offsets:

Trees:
- Trees store carbon, but don't reduce total biological carbon brought to the earth's surface in fossil fuels
- Planting releases carbon from the soil
- An unrealistic amount of trees would need to be planted to be effective
- Most projects are planting monocultures causing ecosystem problems
- Predicting the carbon performance of trees is not possible
- Increasingly challenged by scientists as unsuccessful strategy

All methods:
- Don't address the fundamental problem of emissions
- Makes it easy to avoid measures reducing emissions
- Removes money from local economy
- Poor accountability
- No proof that there is an overall improvement in the climate with offset system
- Short-term solution with little direct benefit to offset purchasing organization
- May ignore local problems such as air pollution or need for more power plants
- Questionable future of unregulated and unproven strategies in new offset industry

- Doesn't create lasting benefit for organization

Ecobusinesslinks.com Carbon Offset Survey

Carbon Offset Provider	Price (US$/Metric	Non-profit	Projects Types	Project Choice	Offset Types	Product Certification/ Verification
AtmosClear Climate Club **US**	$3.56[a] - $25.00	No	Methane	No	Car, Home	Environmental Resources Trust
Carbonfund.org **US**	$4.30[b] - 5.50	Yes	Renewables, Efficiency, Reforestation	Yes	Home, Car, Air, Events, Business	Green-e, Chicago Climate Exchange, Environmental Resources Trust
e-BlueHorizons **US**	$5.00	No	Renewables, Reforestation	No	Home, Car, Air	Chicago Climate Exchange, Environmental Resources Trust
Terrapass **US**	$7.35[c] - 11.00	No	Renewables, Efficiency	No	Car, Air, Events, Business	Green-e, Chicago Climate Exchange, Center for Resource Solutions
DriveNeutral.org **US**	$7.50 & up	Yes	Efficiency	No	Car	Chicago Climate Exchange
Native Energy **US**	$13.20	No	Renewables	Yes	Home, Car, Air, Events, Business	Green-e
The CarbonNeutral Company **UK**	$14.00-18.00	No	Renewables, Efficiency, Reforestation	Yes	Business, Home, Car, Air, Events	KPMG, Edinburgh Centre for Carbon Management, Independent Advisory Committee
Climate Friendly **Aus**	$16.00-19.00	No	Renewables	No	Home, Car, Air, Business	Office of the Renewable Energy Regulator, NSW Government, Ernst & Young.
Sustainable travel International **US, Switzerland**	$18.00	Yes	Renewables	No	Air, Car, Home, Hotel	See Myclimate
Bonneville Environmental Foundation **US**	$29.00	Yes	Renewables	No	Home, Air, Business, Event	Green-e
Myclimate **Switzerland**	$30.00	Yes	Renewables	No	Air, Events, Business	Designated Operational Entity
Global Cool **UK**	£20.00 ($39.48)	Yes	Renewables, Efficiency	No	n/a	CDM
Services for which independent product certification or verification information not available						
Carbon Offset Provider	**Price (US$/Metric ton CO2)**	**Non-profit**	**Projects Types**	**Project Choice**	**Offset Types**	**Product Certification/ Verification**
DrivingGreen **Ireland**	$8.00	No	Renewables	No	Car, Air, Events	n/a
Solar Electric Light Fund **US**	$10.00	Yes	Renewables	No	External Calculators	n/a
Carbon Clear **UK**	$17.00	No	Reforestation	No	Home, Car, Air, Babies	n/a

a: Atmos Clear - Low price for 25 Ton option at $89
b: Carbonfund.org - Low price for ZeroCarbon tags option: 18 Ton + 5 Ton match, pay $99 for $23 Ton
c: Terrapass - Low price when purchasing 204 metric ton of carbon offsets for $1,499.95
1. Offset Types: There are hundreds of potential offset types. We have limited our survey to just the most common.
2. Verification: "n/a" means we were unable to determine a third-party verification body. The projects may, however, be verified.
3. Choice: refers to whether customers may choose between project types and/or specific projects.
4. Price: prices change and exchange rates fluctuate. The data listed was first gathered from the respective websites July 21, 2006
5. Other offset providers may exist. This survey provides a cross section of the industry, projects may be added or removed over time.
6. Some information may be incomplete or has changed. We welcome updates.

Sources of Offset critical information:

The most complete, well-written analysis of climate science and offsets: **Carbon Trading: A Critical Conversation on Climate Change, Privatization and Power**
Dag Hammarskjöld Centre:
http://www.dhf.uu.se/pdffiler/DD2006_48_carbon_trading/carbon_trading_web.pdf

Excellent analysis from a sustainability perspective:
The International Challenge of Climate Change
United Kingdom, Environmental Audit Committee:
http://www.defra.gov.uk/environment/climatechange/pubs/eac/pdf/cc-govres.pdf

Scientific paper explaining why reforestation won't help climate change:
Planting trees will not cancel out climate change:
Nature:
http://www.scidev.net/pdffiles/nature/nature04486.pdf

Short negative view of green tags:
The wooly world of green tags
out of Kirby Mountain:
http://kirbymtn.blogspot.com/2006/04/woolly-world-of-green-tags.html

In-depth assessment of trading systems and their limitations:
Is the US Experience with Pollution Markets Really an Argument for Global Carbon Trading?
McGill International Journal of Sustainable Development, Law and Policy, fall 2005:
http://www.fern.org/media/documents/document_3657_3658.pdf

Good short summary of why offsets don't work:
Carbon 'offset' - no magic solution to 'neutralize' fossil fuel emissions
Forests and the European Union Resource Network:
http://www.fern.org/media/documents/document_884_885.pdf

Strong short letter opposing carbon trading:
We must reduce fossil fuel use, not trade carbon:
Financial Times:
http://www.fern.org/media/documents/document_3634_3635.pdf
(Source: http://www.ecobusinesslinks.com/carbon_offset_wind_credits_carbon_reduction.htm)

For the most complete and up to date list of green tag products and marketers, visit the Green Power Network, part of the U.S. Dept of Energy, Energy Efficiency and Renewable Energy Office.

http://www.eere.energy.gov/greenpower/markets/certificates.shtml?page=0

For a detailed report on the status of green power marketing, check out the following publication from the National Renewable Energy Laboratory:

http://www.eere.energy.gov/greenpower/resources/pdfs/40904.pdf

7.7 Electric Vehicles

Electric Vehicle Current Status

Jim Housman, P.E. (retired)
May 7, 2007

Battery powered electric vehicles pose opportunities for cost savings and enhanced convenience in an increasing number of applications where their unique properties can be used to advantage. While gasoline as a motor fuel has significantly higher energy density and lower cost per unit of energy, when the overall "well-to-wheel efficiencies of electrical power are taken into account it can be advantageous to operate electrical vehicles in place of their gasoline or diesel counterparts.

The majority of electric vehicles available today, not including hybrids, are classified as "Neighborhood Electric Vehicles" (NEV). In general these vehicles are limited to a top speed of 25 miles per hour and are only permitted on public roads with speed limits below 35 miles per hour. They have minimal requirements for lighting and passenger protection in keeping with their low speed nature. Some of the larger manufacturers of NEVs are listed on the following web site:

http://www.eere.energy.gov/afdc/afv/elec_vehicles.html

In a recent study (2001) the Department of Energy [41] evaluated the performance of 348 NEVs operated in 15 automotive fleets. The fleets included in the study belonged to military, commercial, least expensive NEVs, resembling golf carts can be purchased for less than $5000. Used but functional vehicles are generally available under $1000.[42] Because of the simplicity of the electric power train vehicle maintenance costs are a fraction of that required for gasoline or diesel engines. There is no oil to change, no sparkplugs, filters or coolant issues. The light weight of most electrical vehicles also means that brakes, tires and suspension components are very durable.

Currently one of the most conventional appearing NEVs is the Zenn. While still relying on traditional lead-acid battery technology the Toronto Canada based company has created an unusually sophisticated NEV using a small urban vehicle built in France and converted in Canada to electric power. Because of the volume production already in place with the basic car (originally diesel powered) Zenn has managed to price the vehicle just above the "golf cart" market while delivering a vehicle with both the style and convenience of a small gasoline powered vehicle.

The majority of NEVs currently on the market use technology that has not changed significantly for the past half century. They use lead-acid batteries, DC motors and simple control systems. A new regime of electrical vehicles are appearing in the market in the very near future, most likely prompted by the rapidly increasing price of fossil fuels and the increased awareness of

[41] http://avt.inel.gov/pdf/nev/nevstudy.pdf

[42] http://www.eaaev.org/eaalinks.html

Americans that our access to fossil fuels is becoming precarious. One of these new electrical vehicles, the Tesla roadster, is a technological showcase in the form of a high performance sports car. Another, the Phoenix SUT (sport utility truck), also uses state-of-the-art technology in a practical utility vehicle.

Both vehicles use sophisticated AC motors, Lithium ion batteries, heat pump HVAC systems, regenerative braking and computerized control systems. Both are advertising operating ranges of over 100 miles on a single charge and, based on the battery technology, charge times of under 30 minutes should be expected. Early test data on both vehicles describe performance equal to comparable gasoline powered vehicles. In the case of the Tesla roadster that means acceleration to 60 miles per hour in less than 6 seconds and a top speed of 130 miles per hour.[43] The Phoenix SUT boasts a 1000 pound payload, 90 mile per hour top speed and 60 mile an hour in less than 10 seconds
and low energy density prevented the development of electric vehicles even moderately competitive with liquid fueled vehicles. In the late 1990s electric car and hybrid-electric car developers began investigating the advances made in battery technology for use in portable computers and other electronic devices.

The first of these technologies evaluated for vehicle use was the Nickel-Metal Hydride battery. This battery was promising enough to be used in the second generation EV1 electric car developed by General Motors for compliance with the proposed California Zero Emissions Standard. While not significantly lighter than the lead-acid battery it replaced, the increased energy-to-size ratio allowed for a significantly increased range for the EV1.

Since that time electric car enthusiasts have turned their attention to the Lithium ion battery. These batteries have both significantly better energy-to-weight and energy-to-volume municipal, rental and transportation organizations. The NEVs were found to be successful replacements for gasoline powered vehicles in most circumstances. Success was indicated by satisfied users, improved economy and reliability of the vehicles.

The study did find some areas where improvements could be made. Higher speed capability and improved range were listed as desirable. In addition users would have liked improved passenger protection, including solid doors and roll down windows. Both were lacking in the majority of the fleet vehicles. While the study found that 91% of the vehicles had operated without problems there were some reliability issues. Fourteen vehicles had battery packs replaced, Five had problems with switches and four controllers were replaced.

By a large majority the study found that fleet owners were satisfied with the performance of their vehicles. Some were used only on public roads, some were never used on public roads and some were used under both circumstances. Specific uses included police work, material handling, towing, personnel transportation and community shopping uses.

A large market currently exists for this type of vehicle permitting competitive pricing. The most sophisticated of the NEVs retail in the $10 to $15 thousand dollar range. At the higher end of this range will be found vehicles with features and styling that compare favorably with conventional automobiles but lacking only the gasoline engine performance. The simplest and characteristics. Early versions of these batteries were sensitive to high discharge rates and to

[43] http://www.teslamotors.com/

certain manufacturing defects which resulted in a number of fires occurring in portable computers using this technology. Since that time changes in the cathode material, manufacturing improvements and the development of external control methods have potentially eliminated the problem. As a result a new wave of enthusiasm for electric vehicles is developing. Both the high performance Tesla Roadster sports car and the Phoenix Sport Utility Trucks (SUT) are designed around the latest versions of the Lithium ion battery.[44]

Phoenix Motorcars plans to sell approximately 500 Sport Utility Trucks in 2007 to selected fleet operators. One such operator is Pacific Gas and Electric, the northern California utility company. Phoenix plans to begin selling to individual users in 2008 and estimates that it will sell 6000 vehicles in that year. Pricing for the 2008 model year should be in the $40 to $50 thousand range. [4] First shipments of the Tesla Roadster are scheduled for August 2007.

Technological changes are appearing rapidly. Recently EEStor, a Texas company has announced a breakthrough battery/ultra-capacitor system that may leapfrog the Lithium ion battery technology with improved storage capacity, discharge rate and cost. Zenn motorcars has signed an exclusive agreement with EEStor to provide storage systems for their next generation of electric vehicles[45]. Regardless of the success of such efforts it is an indication of a growing interest in non-fossil fueled power systems.

For short distance, light load applications electric powered vehicles are the right choice for a large number of applications. The long charging times needed by lead-acid batteries limit the application of these vehicles to under fifty miles per day in most cases. For those fleet applications that can justify the high first cost Phoenix Motorcars SUTs are a practical vehicle available this year. With the rapid changes taking place in battery, motor and motor controller technologies look for increased choices in the zero emission vehicle market.
While these vehicles are especially designed for specific audiences they represent logical entry points for new technologies into an existing, mature, market. The Tesla roadster is aimed at the wealthy car enthusiast who is willing to pay above market price for the uniqueness of an electric powered performance car. The Phoenix is marketed to fleet purchasers who value their environmental image above the short term ownership cost. Success in these two markets will work as both test beds for these technologies in real operating environments and as bootstrapping operations to bring down the cost of these technologies as production volumes increase.

For the past one hundred years battery technology has been the limiting factor in keeping electric powered vehicles from competing with fossil fuel powered vehicles. For most of this time the only practical battery technology for use in electric cars was the same lead-acid battery used for starting power in conventional automobiles. The combination of high weight, slow re-charging,

[44] http://en.wikipedia.org/wiki/Altairnano

[45] http://www.technologyreview.com/Biztech/18086/page1/

Further Reading

The GM EV1:
http://www.thejaffes.org/rory/ev1/ev1.pdf

The French postal service plans to order 10,000 electric vehicles:
http://www.autobloggreen.com/2007/04/18/the-french-postal-service-plans-to-order-10-000-electric-vehicle/

Nissan and NEC to produce electric-car batteries:
http://www.detnews.com/apps/pbcs.dll/article?AID=/20070413/UPDATE/704130433/1148/rss25

Electric car batteries might serve as reservoirs of green power?:
http://www.edn.com/index.asp?layout=blog&blog_id=1470000147&blog_post_id=1170007917

Basic battery technology:
http://www.batteryuniversity.com/index.htm

Battery data:
http://en.wikipedia.org/wiki/Nickel_metal_hydride_battery
http://en.wikipedia.org/wiki/Lithium_ion
http://en.wikipedia.org/wiki/Lead_acid

Specs on Altair nano battery:
http://www.altairnano.com/documents/NanoSafe_Datasheet.pdf

Johnson Controls reveals new hybrid-electric car batteries:
http://wistechnology.com/article.php?id=1485

Altairnano lithium ion battery system:
http://www.azonano.com/news.asp?newsID=1967

Safety of lithium ion batteries:
http://www.technologyreview.com/read_article.aspx?id=17250&ch=biztech

Lithium ion battery improvements:
http://www.technologyreview.com/read_article.aspx?id=16384&ch=biztech

7.8 Commute Programs

Commute Programs: Examples of Success

6/17/07
Jim Housman, PE

The United States of America consumes 9.2 million barrels of gasoline every day, approximately 25% of all the gasoline consumed in the world.[46] Yet the United States contains only 4.5% of the world's population. We drive bigger vehicles and we drive them farther each year than any other society. We have the cheapest gasoline of any nation that imports more petroleum than it exports (excepting China and Thailand)[47]. Americans are used to using their cars for virtually 100% of their transportation needs. We have built our cities, and even our small towns, around the assumption that everyone who wants to go anywhere will drive. Our driving has been cheap and convenient. But in recent years that has begun to unravel. As our homes have become farther away from our workplaces and as our need to import oil has increased driving has become more and more expensive and more irksome. And in spite of spectacular efforts to reduce pollution our driving has continued to be a major factor in environmental degradation.

Slowly over time these factors have been at the root of a change in behavior that is taking place all over the continent. In all 50 states, and in Canada, programs are arising to limit the number of automobiles on the road during peak driving hours. A number of states have established transportation demand management (TDM) legislation to reduce public road usage. In addition, local governments have established regional traffic mitigation programs to assist local employers in encouraging their workforce to stop driving to work alone. Often these programs enable groups of employers to share incentives and facilities to enhance the commuter experience while reducing costs for both employer and employee. California has no state wide traffic mitigation program, however the recently passed AB1431 (Vehicle Greenhouse Gas Emissions) will almost certainly address the effects of commuting on greenhouse gases.

The US Department of Transportation has created a program dubbed "Best Workplaces for Commuters" (BWC) to acknowledge those employers that have done the most to make alternate commute options work the best for their employees. As of June 2007 the site has over 1,400 employers listed as meeting the department's stringent standard for inclusion on the list. Typically to win acknowledgement employers must provide emergency ride home capabilities for transit and car/van pool commuters, provide some kind of subsidy or support for those not driving to work alone and commit to having 14% of employees participate in the program within 18 months. In addition to the BWC program the Internal Revenue Service permits employers to pay for certain commute benefits with pre-tax dollars, saving money for both employers and employees.[48]

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46 http://www.eia.doe.gov/neic/quickfacts/quickoil.html

47 http://europe.theoildrum.com/node/2653

48 http://www.bwc.gov/

Commute programs exist at the federal, state, county and jobsite levels because they work. In a survey funded by the US Department of Transportation (DOT) in 2004 found that well designed commute programs reduced vehicle trips by an average of 15.3%.[49] That kind of reduction pays off. It pays off in savings to the employer, government at all levels and the employee.

Most employers are probably so accustomed to providing parking spaces for employees that it is not considered to be a real cost of doing business. Yet some employers must set aside more land for parking than is used for generating income. The Victoria (B.C.) Transport Policy Institute estimated in 2000 that parking lot construction costs can vary between $1500 (US) and $1900 (US) per space. That cost is in addition to the value of the unimproved land. When parking structures become necessary per space costs can exceed $9000 per space. In addition there are annual maintenance costs.[50] One estimate of the value to U.S. employers of this unproductive land placed the rental value nationwide at over 35 billion dollars.[51]

DOT estimates that current freeway construction costs exceed one-quarter million dollars per lane-mile with a continuing cost of about one percent of that amount for annual maintenance. While this cost is not apparent directly to the taxpayer it is there and as more roadways are constructed to accommodate peak traffic loads for commuters both the capital costs of construction and the annual maintenance costs are an increasing burden on taxpayers and on the local officials who must negotiate to find the funds.[52]

Commute costs to employees is more than the obvious. A UC Berkeley study in 1990 indicated that the average Bay Area one-way commute distance increased between 1980 and 1990 from 10.6 miles to 11.8 and the average duration from 27.7 minutes to 29.0 minutes. Over a 50 week working year that amounts to 5900 miles per year and 242 hours on the road. With per-mile driving costs approaching 50 cents employees are spending almost $3000 per year just to get to work. Since employers do not pay for the time that commuters sit in their cars in heavy traffic it is the individual worker whose time is wasted crawling through traffic. According to the Texas Transportation Institute California commuters who have recently moved to a metropolitan area spend, on average, 250 hours per year in commuter traffic.

There are great success stories in communities developing programs to reduce vehicle miles traveled (VMT). Boulder, Colorado has a program called Ride Arrangers that reports having saved 28 million VMT in 2006. Ride Arrangers has 6,000 people in their carpool database, 380 people vanpooling with a waiting list to fill 10 more vans. There are 4,000 "teleworkers" and 11,000 families enrolled in the "schoolpool" database. In the annual Bike to Work Day in 2006 there were 20,000 participants. [53]

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[49] Mitigating Traffic Congestion; Association for Commuter Transportation; PO Box 15542, Washington, DC 20003-0542;2004

[50] Todd Litman; Parking Management Strategies, Evaluation and Planning; Victoria Transport Policy Institute; 2006

[51] http://72.14.253.104/search?q=cache:biyCdgRbNHQJ:www.commuterchoice.gov/pdf/sanfran/bwc-present-sfa.ppt+sonoma+best+workplaces&hl=en&ct=clnk&cd=2&gl=us&lr=lang_en

[52] http://www.publicpurpose.com/hwy-fy$.htm

[53] Linda Dowlin, Denver TDM Manager; personal communication; 6/11/07

In the Bay area Contra Costa county reports that their SchoolPool program has reduced VMT by 4 million miles in 2002[8]. The San Mateo County Commute Alternatives Program has mailed 80,000 Commuter Checks to employees of 3,200 employers in the county since 1991.[54] C2HM Hill reports a 115,000 mile reduction in VMT in 2002 at a single worksite in Denver. In Seattle the University of Washington estimates that the UPASS program has eliminated 91 million vehicle trips since it was established in 1991[4]. These examples show that in a large variety of environments and over long periods of time employers, employees, taxpayers and the environment are benefiting from well designed commute programs.

Today, more than ever in the past, it makes sense to create programs allowing commuters to get out of their cars and find more appropriate ways to get to and from work. The ability of the modern passenger vehicle to take us anywhere we want, when we want is at its least beneficial when we are traveling the same path at the same time of day over many months and years. The rising cost of operation, the increasing time spent unproductively and the anger and frustration so often connected with present day commuting will continue to get worse in the future. We cannot pave the entire nation to enable every person to drive effortlessly where ever they want to go at any time of day. It follows that community leaders in every American community should be emulating the examples of those communities that have gained so much by instituting these programs.

54 http://www.smccap.org/index.jsp

FURTHER READING

1. MASSRides, Massachusetts Office of Transportation; http://www.commute.com/
2. Burby, John; The Great American Motion Sickness (or Why You Can't Get There From Here), Little, Brown and Co., New York; 1971
3. Yergin, Daniel; The Prize; Simon & Schuster, New York; 1991
4. Meadows, Donella et al; The Limits to Growth; The New American Library, New York; 1971
5. Commuter Connections, Metropolitan Council of Governments; Washington DC; http://www.mwcog.org/commuter/ccindex.html
6. Census Bureau Study of Commute Distances; http://www.census.gov/Press-Release/www/releases/archives/american_community_survey_acs/001695.html
7. Santa Cruz Commute Solutions; http://www.commutesolutions.org/
8. Commuter Calculator; http://www.rideworks.com/rwcalc2.htm
9. Strategies for Increasing the Benefits of Commuter Benefits Programs; TCRP Report 87; Transportation Research Board; 2003
10. Commuter Check; Section 132 (f) pre-tax transportation benefit program; http://www.commutercheckpremium.com/
11. Bay Area Commuter Comments; http://www.ibabuzz.com/transportation/
12. Westchester County New York Commute Program: http://www.westchestergov.com/smartcommute/programs_services.htm
13. TDM Case Studies and Commuter Testimonials; Transportation Demand Management Institute of the Association for Commuter Transportation
    1518 K St., N.W., #503; Washington, DC 20005; 1997
14. Washington State Commute Trip Reduction Program; http://www.pewclimate.org/states.cfm?ID=14
15. Boulder, CO "GOBoulder program: http://www.bouldercolorado.gov/index.php?option=com_content&task=view&id=705&Itemid=311
16. Accordia Northwest, Inc., Seattle WA; Commute Trip Reduction Program;
17. http://www.commuterchallenge.org/cc/daw99acordia.html
18. Sustainable Transportation Success Stories; Smart Communities Network; http://www.smartcommunities.ncat.org/transprt/trsstoc.shtml
19. Ride Solutions; Mid Ohio Regional Planning Commission; http://ridesolutions.morpc.org/
20. City of Palo Alto Way 2 Go Program; http://www.city.palo-alto.ca.us/transportation-division/commute-index.html
21. Washington D.C.; Capital Rideshare Program; http://capitolrideshare.com/index.htm

Examples of Successful Programs

			% of Transit Population Participating												
Program name	**Location**	**Demographics**	**Car pool**	**Van pool**	**Transit pass**	**Car/Van Parking**	**Guaran. Ride Home**	**Tele commute flextime**	**Work week**	**Shuttle**	**Bicycle/ Walk**	**Other**	**BWC(@)**	**% Participating**	**Control ($)**
Upass	U. of Washington	39,000 students	x		x	x							Yes		Univ.
SchoolPool	Contra Costa Cty, CA	157,000 students	x		x								No		County
Transportation Options	Aspen, CO	15,000 residents	x			x				x			Yes		Blanket
TNT/TMA	Lake Tahoe Basin	56,000 residents, large tourist influx			x							x	No		Govt
Vanpool Program	Bal Harbour Village, FL	3309 pop.		x									Yes		Govt
Calibre Transportation Benefits	Alexandria, VA	na	x		x			x			x	x	Yes		Corp
C2HM Hill Telework & Flextime	Denver, CO	na	5.0%		3.0%			8.0%			0.5%		No	16.5%	Corp
Georgia Power Smartride	Atlanta, GA	5,500 employees	7.0%	6.0%			x	20.0%		x			Yes	33.0%	Corp
Transit Plan	Hennepin County, MN	13,000 county employees	15.0%	2.0%	15.0%			8.0%					Yes	40.0%	Blanket
Johns Manville tbp	Denver, CO	est. 400 empl Denver only	x	0.5%	44.0%	x						0.5%	Yes	45.0%	Corp
Nike TRAC Program	Beaverton, OR	5,000 employees	10.0%		5.0%		x	5.0%			2.0%	Prizes	Yes	22.0%	Corp
Overlake Christian Church tbp	Redmond, Wash	109 employees	26.0%		1.0%			12.0%	8.0%		1.0%		No	48.0%	Corp
Simmons College tbp	Boston, MA	740 faculty & staff			27.0%		x			x		32.0%	Yes	59.0%	Corp
Swedish Medical Center tbp	Seattle, WA	758 staff & dr	19.0%	2.0%	23.0%	x	x	2.0%	x				Yes	46.0%	Corp
Texas Children's Hospital tbp	Houston, TX	758 staff & dr	10.0%		10.0%	x	x	x		x			Yes	20.0%	Corp
King County TOD	Seattle, WA	metro Seattle	x		x	x						car share	No		Blanket
Acordia Northwest Inc.	Seattle	118 employees	x	x	x		x	x					No		Corp
GO Boulder	Boulder, CO	County employees	x	x	x		x	x			x	4100 bikers, walkers, transit riders	No		Blanket
Commute Alternatives Program	San Mateo, CA county	City and surrounding area	x	x	x	x	x						Yes		Blanket
Ride Arrangers	Denver, CO	School, city & business employees	x	x			x	x			x		No		Blanket
GoGreen	Vancouver BC	906,000 pop	x	x	x			x			x		No		Blanket
Smart Commute Program	Westchester County, NY		x	x	x	x	x	x	x				Yes		Blanket
CTR	Redmond Wash	23,500 pop											No		Blanket
RideSolutions	Mid-Ohio Regional Planning Comm.	11 counties around Columbus, OH	x	x	x		x				x		No		Blanket
Employee Commute Program	Palo Alto		x	x	x		x			x	x		No		Blanket
Travel Reduction Program	Greater Tucson area	486669	x		x						x		No		Blanket
Capital Rideshare	Phoenix, AZ	4,000 state employees plus 50 companies.	x	x	x	x	x	x	x		x		No		Blanket

This program is an umbrella function for all Wash state programs
Commute Trip Reductic State of Wash

This program is an umbrella function for all Wash state programs
MassRides State Of Mass.

*Note corp participation is voluntary so financial benefits are at employer discretion

$ Control refers to the type of organization sponsoring the program.
Blanket refers to a government sponsorship organization that helps other organizations to form commute programs.

@ BWC= Listed on federal program called "Best Workplace for Commuters"

7.9 Grease to Gas Augmentation of Digester Gas

(Note: This opportunity requires a waste digester which requiring collaboration with other county jurisdictions)

"Grease to Gas"
Restaurant Trap Grease Collection and Augmentation of Digester Gas

Excerpts from Riverside "Project Description" Document dated 4/17/07
Jim Housman, PE (retired)
4/17/08

Summary:

1. Capital cost apparently very low due to use of contracting company picking up and delivering waste to facility. Total expenditures for labor, equipment and laboratory analysis were $85,000 at time of report minus a potential $16k grant from the PUC.
2. Because the city already operated a treatment facility with methane capture, capital investment was only required to adapt the existing system to accept the waste grease.
3. The additional amount of methane gas generated by the addition of the grease wastewater has been as high as 493,000 cubic feet. This is the same as 4,930 therms of natural gas.
4. City receives $6500/mo. in disposal fees from delivery company ($21,000 in 2007)
5. Sewage systems overflows caused by grease trap problems was reduced
6. Biosolids production in the city's digesters was reduced saving $48,000/month
7. Fuel savings obtained at the site were as high as $85,000/mo.
8. Total savings were over $1M for 9 months.

The city of Riverside, California operates a publicly owned treatment works (POTW) capable of handling 40 million gallons per day. The treatment process is fully tertiary utilizing anaerobic digestion and treats an average daily flow of 35 MGD. The City's POTW has a cogeneration facility that has the capability of generating about 3 megawatts of power. This cogeneration facility has three internal combustion (IC) engines that use the methane gas produced by the digesters as a fuel source. In addition to the IC engines, the City will be installing a one-megawatt fuel cell that will use digester gas to produce electrical power.

The City's Public Utilities Department (PUD) was informed of the Grease to Gas project and was quite interested due to the renewable energy source created by the processing of the grease wastewater. The PUD also oversees a grant program for renewable energy resources. The Grease to Gas project qualified for a grant and the PUD prepared a report for the Utilities Board for approval of $16,237 to cover the costs of laboratory services and analyses and equipment purchases and installation. The grant was approved on June 29, 2005. The total costs to date for labor, laboratory analyses, and equipment is approximately $85,000.

The company agreed to charge City restaurants $0.10/gallon to pump the grease interceptors (underground tanks connected to the restaurant wastewater drains). Other vacuum companies were charging $0.15 to $0.20/gallon to pump the interceptors. The contracted company also brings grease wastewater from other areas throughout southern California, from Santa Barbara to San Diego and from Los Angeles to Blythe. The City charges the company $0.01/gallon ($0.03/gallon in 2007) to receive the wastewater for disposal and receives about $6,500/month in disposal fees. The project currently receives about 30,000 gallons per day of grease wastewater from restaurants in the southern California and, since March 27, 2006 has processed 6,800,000 gallons of grease wastewater.

The additional amount of methane gas generated by the addition of the grease wastewater has been as high as 493,000 cubic feet. This is the same as 4,930 therms of natural gas (100 therms per cubit foot). This is enough gas generated in one day to supply the winter needs of 101 homes in Riverside and the summer needs of 340. In one month, the gas generated at the treatment plant can be as high as 17,898,961 cubic feet or 178,989 therms. This is enough gas to supply the winter needs of 3,674 homes in Riverside and the summer needs of 13,055 homes in Riverside. The daily electrical generation of 1.5 megawatt-hours is enough electrical power to supply the needs of 1,128 homes in Riverside.

The effects on the sewer system were equally favorable. The sanitary sewer overflows (SSOs) caused by restaurant grease blockages were reduced from 30% of all calls to less than 1%.

An additional benefit of the project was the observed reduction in the amount of biosolids created from the treatment process. Since the introduction of grease wastewater into the digester, the number of methane forming bacteria has increased dramatically. These bacteria are also better adapted to metabolize solid organic material in the digester. As a result of the increased bacterial population, the overall biosolids production has been reduced by about 25%. This has reduced the average monthly wet tons produced from 5,000 to about 4,000. The disposal fee is $48/ton and a reduction of 1,000 tons per month saves $48,000/month.

One goal of this project is to achieve energy independence from natural gas. The project has reduced the natural gas requirements of the cogeneration power plant by 80%. This yielded a monthly savings ranging from $80,000 to $85,000 per month. The energy costs savings, reduced costs for biosolids disposal, and wastewater treatment charges created by this project have saved the City over $1,000,000 in nine months.