Appendix A: The Value of Saved Electricity to Hetch Hetchy Water and Power

Introduction:

Determining the supplier's marginal cost of energy is typically an essential element in energy planning. The marginal cost of energy is the cost to the supplier of producing the last kWh or the last kW of electricity to meet customer demand. This is typically the annualized cost of acquiring the last kWh or kW from the supply resource on the margin, which could come from increasing production of existing capacity (short run marginal cost), purchasing power from the energy market or building new generation capacity (long run marginal cost).

Determination of the marginal cost of energy aids energy planning because it helps the energy manager or planner quantify the relative tradeoffs between various supply-side and demand-side resource options. Having an idea of what the last kWh or kW is worth helps the planner determine what level of energy efficiency investment targeting what set of technologies is worthwhile to consider, and which supply resource should be considered for investment in the long run.

RMI's attempt to identify marginal cost of energy of San Francisco's municipal sector has been only partially successful. On one hand we have come a long way in understanding the City's energy services infrastructure such as the complex relationship of the City's various power contracts between the SFPUC and its various municipal customers. On the other hand, the identification of the SFPUC's marginal energy cost remains somewhat elusive.

One point of clarification at this point to stress that the marginal energy cost can refer to either the supply technology or transmission and distribution or both. Marginal distribution capacity and costs can help identify not only what supply is needed and how much, but also where and when targeted DG and DSM could provide cost savings in the distribution grid. In this appendix, we present only our analyses of San Francisco' marginal energy cost of generation resource options[1].

The charts in this appendix illustrate our understanding of San Francisco's energy supply obligations to the City's various municipal sector customers and give some indication of the City's marginal cost of energy. While CCSF's municipal energy service obligations are mandated by law, the form of the power contracts are subject to negotiation and can change in time. In fact, the SFPUC has successfully renegotiated its power contract with the Modesto Irrigation District, and is currently in the process of settling its power contract with the Turlock Irrigation District. Whatever its final outcome, these new contracts will enter into effect January 2008. Similarly, the SFPUC has an existing contract with Calpine for energy supply to supplement San Francisco's hydroelectric production at Hetch Hetchy, which varies monthly according to annual precipitation. The SFPUC also purchases additional energy from the power market when needed to meet customer demand. The graphical representation of the SFPUC's power contracts are provided here. A description of how the contracts work and its impacts on the SFPUC's income and revenue is provided in section # of Chapter #.

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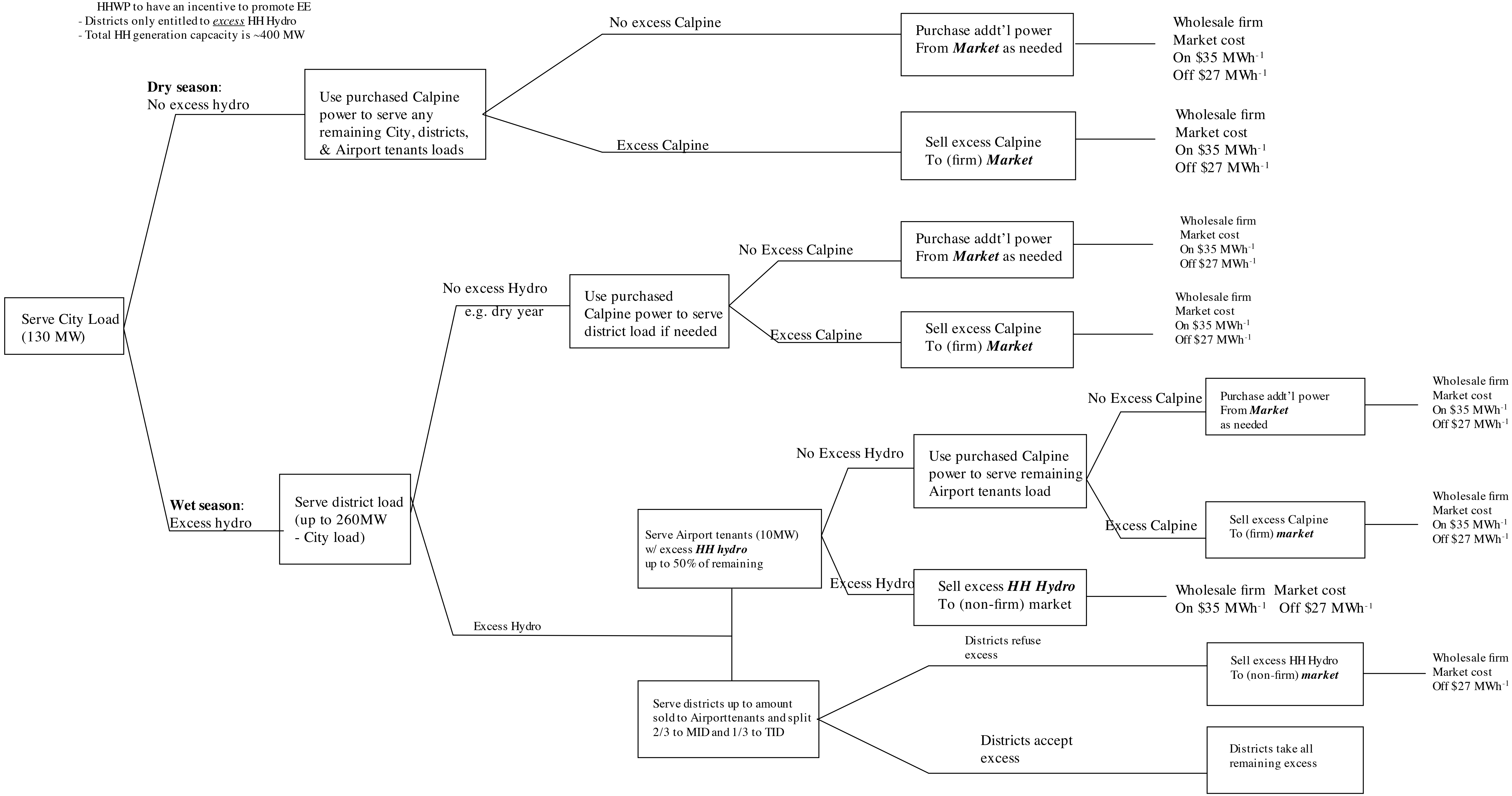
[1]We anticipated using marginal distribution capacity costs in our economic analysis of resource options. However, according to PG&E the short-to-medium-term, needs for distribution works in San Francisco are modest and unlikely to cause major cost differences between areas in the City. Gas transmission and distribution capacity appears adequate to accommodate the modest projected increases in demand. Thus, distribution capacity and costs were not considered in detail, but we recommend that this question should be revisited in the future.

Determining Type and cost of marginal power
HHWP 2004-2007

Notes:
- marginal energy is identified in bold-italics
- cost of marginal energy needs to be greater than cost of serving general fund customer for HHWP to have an incentive to promote EE
- Districts only entitled to <u>excess</u> HH Hydro
- Total HH generation capcacity is ~400 MW

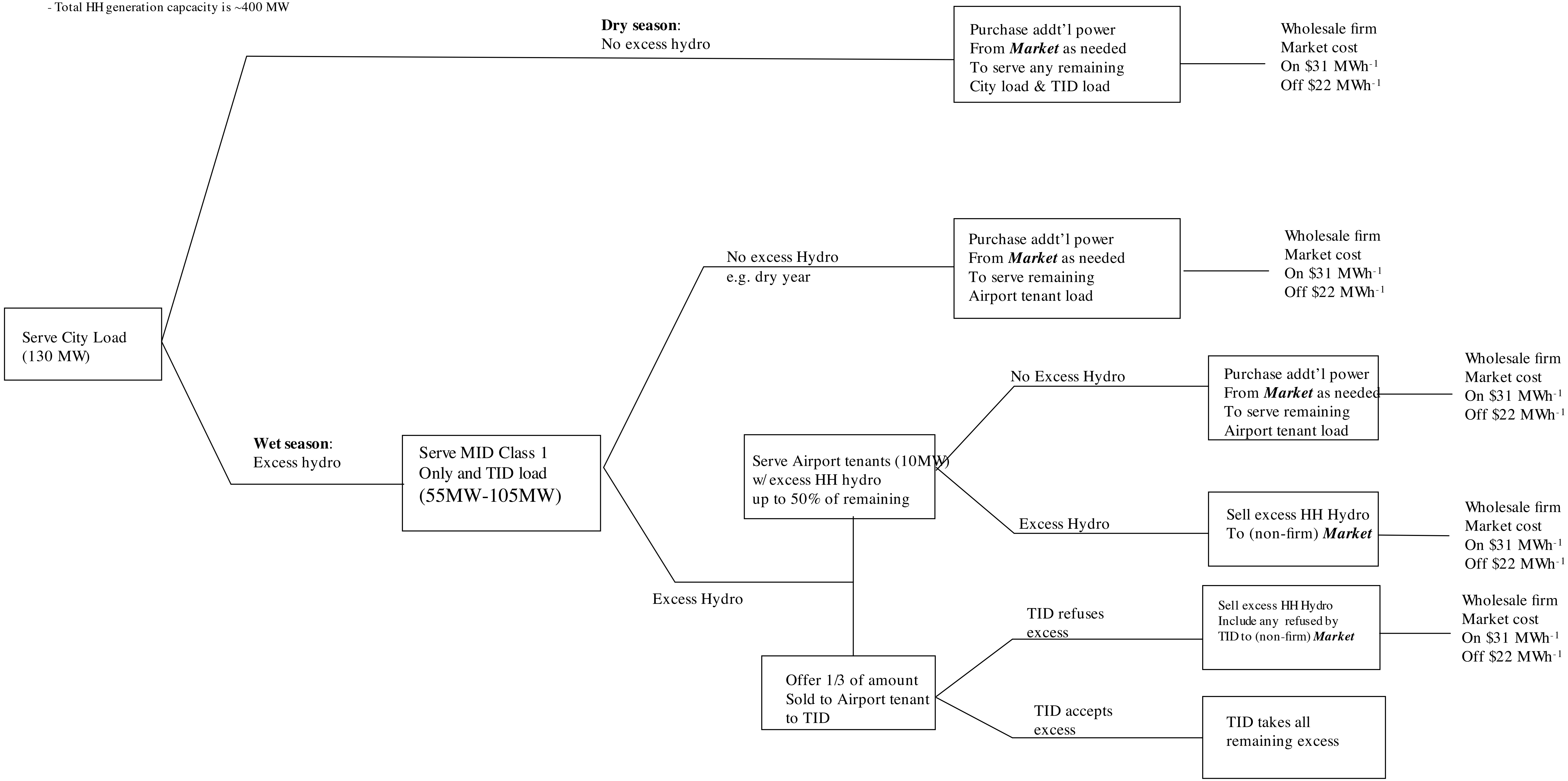
Energy at <u>the margin</u>

Cost of <u>Marginal energy</u>



Determining Type and Cost of marginal power 2008-2012
Scenario 1: stay with same TID contract

Notes: - marginal energy is identified in bold-italics
- cost of marginal energy needs to be greater than cost of serving general fund customer for HHWP to have an incentive to promote EE
- Districts only entitled to *excess* HH Hydro
- Total HH generation capcacity is ~400 MW

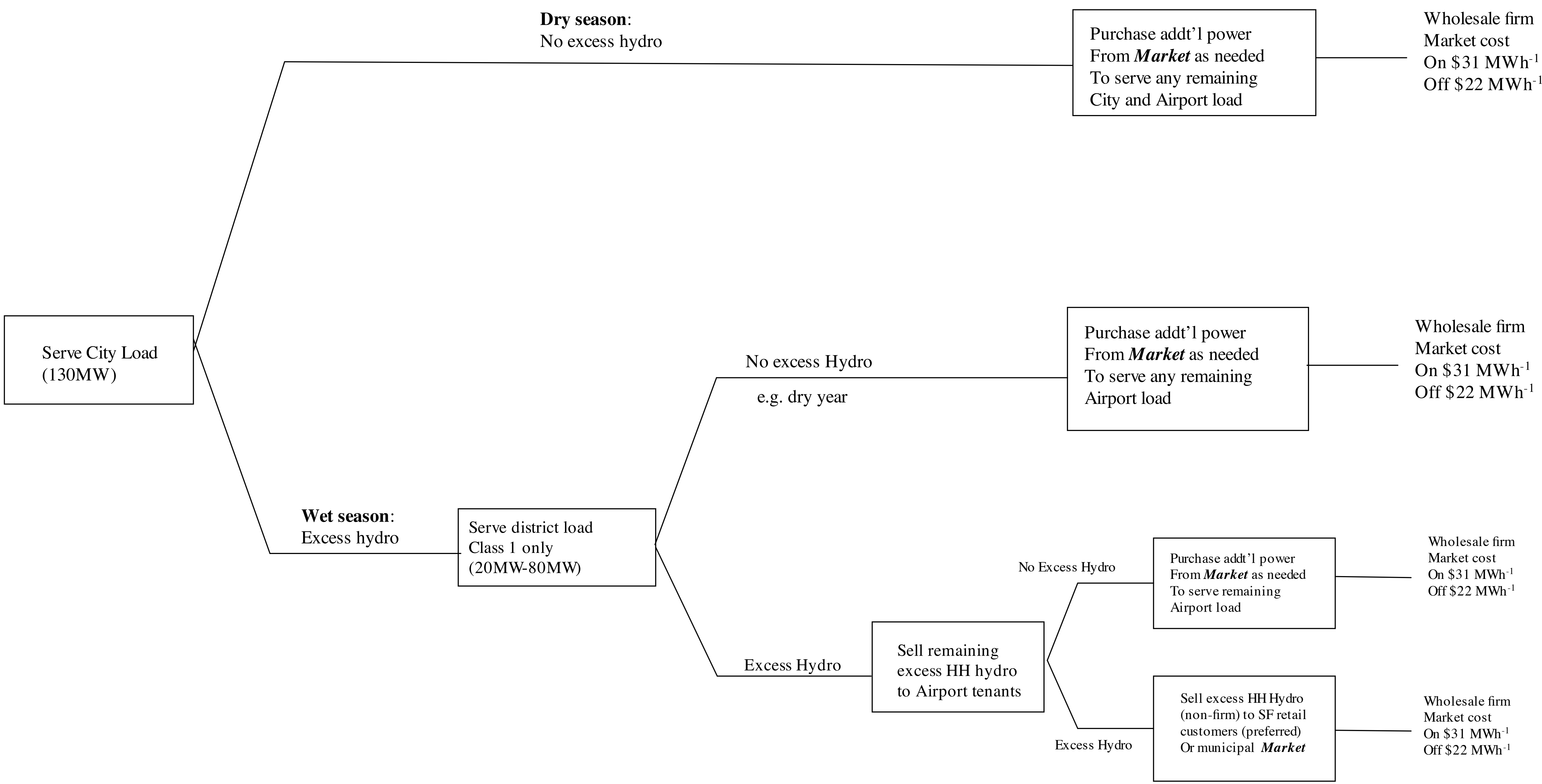


Determining Type and Cost of marginal power 2008-2012
Scenario 2: TID contract same as MID contract

Notes: - marginal energy is identified in bold-italics
- cost of marginal energy needs to be greater than cost of serving general fund customer for HHWP to have an incentive to promote EE
- Districts only entitled to *excess* HH Hydro
- Total HH generation capcacity is ~400 MW

Energy at
the margin

Cost of
Marginal energy



Appendix B: Fuel Cell Vehicles As Distributed Power Resources In San Francisco

Peter Light

11 November 2003

I. Introduction

Looking ahead to the electricity demands of the City of San Francisco in 2020, this report examines the prospect of employing parked fuel cell vehicles (FCVs) as distributed power sources for the city. In theory, the potential is enormous. 10,000 FCVs could add 1,314 GW-hours per year—nearly one quarter of the City's current demand—as new, distributed supply.[1] While we expect only a fraction of these vehicles to be online in 2020, mature scenarios, given the right technological and market conditions, offer a significant and compelling alternative the construction of new centralized generation and/or transmission. They also offer a way for vehicles to become income generators rather than mere depreciating assets, thus defraying the added expense of clean vehicles. But many technical and organizational hurdles remain.

Harnessing the potential of parked electric-based vehicles (dubbed V2G: vehicle-to-grid) has been conceptually examined[2] and tested[3] in the real world. In particular, the potential for battery-electric vehicles (BEV) to offer regulation services—to essentially act as grid load-leveling devices—has been touted as their major financial breakthrough[4]. However, since we aim to evaluate clean and distributed *sources* of electricity for San Francisco, we will examine the potential of FCVs to supply peak daytime power while parked.

V2G is a particularly attractive for San Francisco because the city

- faces an impending electricity supply crunch that will have to be met with either new central generation, transmission, or distributed resources – all of which will require substantial investment,
- values progressive initiatives and seeks to lead municipal sustainability efforts,
- is disproportionately aware of energy issues in the wake of year 2000's rolling the blackouts and energy "crisis."

In addition, the city shares California's higher-than-average electricity costs, which allow budding technologies to compete sooner and more effectively. While V2G may prove to be a bedrock technology by 2020 or impossibly costly—it's too soon to tell—we guide this investigation as a branch of a larger report[5] on distributed electric resource options for the City. Working within this armature, we examine the potential of V2G to contribute 50 MW of peak power to San Francisco.

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[1] Lipman, Timothy, et. al. "FCVs as Distributed Generation Resources". Presentation to EVAA Electric Transportation Industry Conference, 12/2001. Assumes 30 kW output per vehicle and 50% vehicle availability to grid. (www.acpropulsion.com/ETI_2001/Lipman_EVAA_FCV_DG.PPT).
[2] Kempton, W. and Letendre S. "Electric Vehicles as a New Source of Power for Electric Utilities" Transportation Research 2(3): 157-175, 1999; Lovins A. B. and Williams B. "A Strategy for the Hydrogen Transition" 1999;
[3] www.acpropulsion.com
[4] Letendre & Kempton, "The V2G Concept: A New Model for Power?" *Public Utilites Fortnightly*, 2/15/02
[5] see "Scenario Analysis for Alternative Electric Resources for the City of San Francisco" (http://www.rmi.org/images/other/E-ScenarioAnalysisForSF.pdf)

Scenario planning is necessarily speculative. Accordingly, this report aims not to produce exact data, but rather to bracket future unknowns and to tease out the leverage points for a given scenario's feasibility. The ensuing chapters are:

II. Assumptions

We make the following assumptions about technologies and markets in 2020:

Fuel Cells

- Stationary fuel cells are prevalent throughout the city in commercial, municipal, and possibly residential applications. Some are bundled with enlarged hydrogen appliances that serve as small fueling stations for locally parked FCVs.

- Vehicles use proton-exchange membrane fuel cells (PEMs or PEMFCs). While these still cost some multiple of internal combustion engines (ICEs) on a per-kilowatt basis, their manifold benefits encourage their use.

- Vehicular PEM fuel cells run on pure or "neat" hydrogen (as opposed to "reformate" – a hydrogen-rich intermediate produced from hydrocarbons).

Hydrogen

- Hydrogen is primarily produced on-site via hydrogen appliances bundled with stationary fuel cells, though some centralized production exists. Hydrogen will not be trucked large distances as gasoline is today.

- Production of hydrogen via steam-methane reformation (SMR) predominates because it is cheaper, though electrolysis produces an increasingly large fraction of hydrogen. More intermittent renewable energy (e.g. wind) and greater time-of-use (TOU) pricing offers cheap power that will promote electrolysis.

Vehicles

- FCVs are commercially available, affordable, and publicly endorsed, though still a niche product. American automakers claim that their FCVs will be commercially available by 2010. Taking today's cumulative production of HEVs as a guide, a few hundred thousand FCVs would be on the road by 2015, and some multiple of that volume by 2020. Some international estimates are more optimistic.[6]

[6] Japan's Agency of Natural Resources and Energy predicts to see fifty thousand FCVs in Japan by 2010, five million by 2020.

- These FCVs are dramatically more efficient than today's vehicles (2.2-5 times[7]). They do not include on-board fuel reformers.

- FCVs are hybrids. Their battery (or load-leveling substitute) may range in size from that minimally necessary to optimize vehicle cost[8] to an array that can provide enough energy to run purely on electricity for local driving. See Appendix for more on this subject.

- The average MY 2020 FCV, our baseline vehicle, is powered by a 35kW-peak fuel cell.[9] This vehicle provides stationary power at an average of 10 kW.[10]

- Hydrogen-fueled buses and ICE vehicles, ostensibly hybrids, are prevalent.[11] These spur hydrogen infrastructure and public familiarity. Their hybrid battery or other load-leveling device may already be used in an ancillary services V2G scenario.

- As a matter of course, future vehicles employ GPS and wireless communication technologies. These can be used to remotely manage power discharge (e.g. by the relevant ISO) and for accounting purposes.

- California has set a goal of having 16% of new vehicles sold in the state be nonpolluting by 2018.[12] While similar goals have not been met in the past, this may be used as a rough guide to the number of electric-based vehicles on the road in 2020.

Energy Markets

- Natural gas prices are not dramatically affected by the fuel demands of an FCV fleet. It has been argued that Amory's friend at GM who analyzed that net NG may not substantially increase with more FCVs → less NG elec., less NG→H2→gasoline, etc.]

- Varying real-time electricity prices continue to become more transparent to medium- and large-scale consumers. Higher mid-day peaks and lower nighttime lows allow the peak-shaving benefits of daytime V2G to be ever more tangible.

We have aggregated diverse estimates of the incremental costs associated with a V2G programme. While the wide range of source research will hopefully lead us to a middle-of-the-road conclusion, myriad assumptions stated and unstated underlie the data we use, and apples are not always compared to apples. This is an inherent difficulty faced by researching nascent fields.

II. Potential Scenarios

[7] A fuel cell's inherently greater fuel efficiency (50% vs. 15-17% for an gasoline ICE) and a super-efficient platform, such as Hypercar, Inc.'s *Revolution* (www.hypercar.com), create this multiple.

[8] PEMFC's can follow real-time loads, and hence can power FCVs without batteries, hybridizing allows the use of smaller (=cheaper) fuel cells, in addition to other benefits. For a in-depth discussion, see (Hypercar MMPI?)

[9] See below in section *Fuel Cell Costs* for an analysis of this figure.

[10] 10 kW is 29% of peak load for a 35 kW fuel cell, which falls right in the narrow band of PEMFC peak operational efficiency. In addition to extracting the greatest value out of the fuel cell, it also mitigates the potential of a vehicular PEMFC overheating while serving stationary loads.

[11] see Sandy Thomas' "Hydrogen-Fueled Vehicles: Hybrids vs. Fuel Cells", 2003

[12] http://www.wired.com/news/autotech/0,2554,60258,00.html

Various investigations have explored residential V2G scenarios in which electric-based cars power homes and possibly the grid (via net metering) when parked at night. While these scenarios help us to understand the nuances of V2G dynamics, they do not provide power when it is most needed.[13] Because San Francisco's weekday peak electric load typically spans the ten hours between 9 a.m. and 7 p.m., we look to daytime V2G configurations. Many possibilities exist; the three below attempt to capture a range of suitable configurations.

Office Park

- Employees of companies whose buildings employ stationary fuel cells drive their FCVs to work, park near the building and plug in. The vehicle receives hydrogen from the building's enlarged SMR reformer or via stand-alone unit and provides peak electricity supply throughout the day.
- 5,000 FCVs provide peak power for 10 hours daily, 250 days/year. Alternatively, 6,250 FCVs could supply power for 8 hours per vehicle coordinated in sum to span the 10-hour peak.

Public Park

- A few, large city parking lots supply hydrogen to parked vehicles, sourced from SMR and/or night-time electrolysis. Cars then sell their power back to the grid at the highest bidding price, ostensibly in a quasi-real-time market.
- 5,000 – 10,000 FCVs park throughout the day and provide power to the grid during peak hours
- Industries develop to manage power sales (assuming V2G is lucrative)

City Park

- Grid connection stations are installed in premier, reserved parking spaces around town.
- 10,000+ cars supply power to the grid for only a few hours/day. No fuel is supplied to the cars; owners are allowed to set how much power they will sell back to the grid while parked.
- Wireless communication with car allows ISO or 3rd party to control the vehicle's power output.

Table 1: V2G Scenario Comparison

Scenario:	Office Park	City Park	Public Park
Peak Power Porduced, (MW)	50	50	50
Number of Vehicles	5,000	8,000	10,000
Connection Time of Day	9am-7pm	8am - 10pm	8am - 10pm
Hours per Day	10	6.25	5
Connected Days per Year	250	250	250
Average Vehicle Load, (kW)	10	10	10
Annual Energy Production, (GWh)	125	125	125

It may well be that the ideal scenario hybridizes the three above. *Office Park* currently appears the most practical, as both the hydrogen and electricity are supplied at the point of consumption. It also extracts the greatest value from the incremental costs of V2G. So in the interest of minimizing variables, this investigation will work within the *Office Park* scenario.

[13] It is also questionable that ultra distributed hydrogen production (via reformation or electrolysis in residential garages) will make sense, due in part to the difficulty of recovering the waste energy involved in fuel processing.

Residentially focused V2G analyses have noted that their scenarios face a density ceiling of excessive backflow to the grid. This will not apply to the relatively low density proposed in our scenarios, and in general is a design issue and not a permanent impediment faced by all distributed resources.

IV. V2G Hardware and Lifecycle Cost Estimates

Like other forms of distributed power generation, V2G will alter the playing field of the electricity business. Scenarios in which a typical car owner sells power wherever she parks and a typical corporation buys power from many different sellers create new markets and require novel regulation. These will likely face incumbent resistance as well as offer new entrepreneurial opportunities. For the moment, however, we will ignore the details of who pays and who profits, and seek to make the overall incremental costs as transparent as possible. We assume that no part will be actively subsidized, and that generally free, competitive market dynamics pervade.

A recent analysis of a FCV V2G scenario similar to *Office Park* determined that it would provide up to $1,500 per vehicle-year for 10 hours of daily office parking.[14] This estimate does not include the potential value of grid ancillary-services that most electric based vehicles can potentially provide[15]. In general, we must look to the net present lifecycle costs for the bottom line; while initial capital costs increase, net present costs of lifecycle may decrease with the right V2G scenario.

Incremental V2G costs can be divided into five categories:

- Connection hardware
- Fuel cell O&M costs
- Hydrogen infrastructure hardware
- Hydrogen fuel

A summary of costs is charted below, followed by a discussion of each component. We assume that our 35kW FCV experiences 2,500 hours of V2G load in addition to its 500 hours of transportation load annually, and at an average 10 kW load average over its 12-year life. This means that the FCV produces 300,000 kWh of electricity during its lifetime.

Table 2: Summary of Incremental V2G Costs

Item	Cost Estimate Range	Optimistic $/kWh	Moderate $/kWh	Conservative $/kWh
Assuming 10kW for 2500 hrs/yr for 12 years= 300,000 kWh total production per vehicle				
Connection Hardware	$550/$875/$1,200	$0.002	$0.003	$0.004
FC Refurbishment Costs	*see table 3*	$0.003	$0.013	$0.110
Fuel/kg	$1.36/$2.00/$3.38	$0.068	$0.100	$0.169
TOTAL		**$0.073**	**$0.116**	**$0.283**

Connection Hardware

[14] Lipman, Tim. 2001. Grid-Connected Vehicles as Supplementary Power Sources. Assumes $4/MBTU commercial natural gas prices.
[15] see Appendix

Equipping an FCV to produce power externally requires a DC→AC inverter, additional power conditioning, a conductive socket,[16] cables, plugs and fuses. AC Propulsion has studied these matters in depth, and they estimate a $300 per vehicle expense to produce their inverter/power-management system (the AC-150) in the thousands, and still less in automotive volumes.[17] Adding the necessary cables, fuses, plugs, etc. to reach the local load, Kempton et.al. arrive at a $500 total incremental vehicle hardware cost. Lipman et.al. spread this estimate into a $300 to $700 range,[18] which we use in our range of estimates as $300/$500/$700 for the optimistic, moderate, and conservative cases. These figures assume that the hardware would be designed and installed from the vehicle's inception and not added later.

Adding hydrogen fueling and the necessary safety equipment will add an additional $250 and $500 per vehicle.[19] Inserting a middle value, we use $250/$375/$500 for our three cases. That brings us to a range of $550 to $1,200 in full per-vehicle V2G connection hardware costs.

Dr. Lipman observed[20] that a vehicular PEMFC would face thermal management issues when operating continuously and at a standstill above 40% of its peak power. We currently assume that external cooling will not be necessary, as our 35 kW fuel cell will operate at less than one third of its peak power, and very near its peak efficiency (and corresponding waste-heat nadir).

The incremental costs of hardware that connects FCVs to the grid, and possibly supplies fuel, will vary widely across different scenarios. The more distributed scenarios like *City Park* will require systems for tracking a large number of small transactions (as wireless phone companies do now) and vehicle-grid interconnection standards. If V2G scenarios are economically attractive in the future, relevant companies and organizations will be incentivized to hammer out these kinks.

Fuel Cell O&M Costs

Fuel cell engines require much less routine maintenance than an ICE. We estimate that these procedures will cost roughly $200 annually, and will largely be incurred as a matter of course by the FCV owner. The real incremental V2G costs lie with fuel cell stack refurbishment. Scenarios such as *Office Park* demand some multiple of currently expected PEMFC lifetimes, thus requiring that the fuel cell be refurbished periodically through a V2G FCV's life. The cost of this refurbishment is calculated today as a percentage (25%-50%[21]) of the PEMFC's total cost. So we must first know this data point to be able to assess the incremental costs of V2G.

Estimates of future fuel cell costs vary widely. Today's vehicular PEMFCs are still prohibitively expensive—prices range in the several thousands of dollars per kilowatt, while today's internal-

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[16] BEVs in California have previously used inductive recharging "paddles" to exchange power externally, but the California Air Resources Board recently mandated that all EV interconnects be conductive, which allow bi-directional power flow, by 2006. More at http://www.arb.ca.gov/newsrel/nr062801.htm.

[17] Tom Gage of AC Propulsion (www.acpropulsion.com); personal communication

[18] Lipman, Tim, et.al., 2004. Fuel cell system economics: comparing the costs of generating power with stationary and motor vehicle PEM fuel cell systems. *Energy Policy* 32, pg. 116

[19] Kempton, Willet, et.al. 2001. Vehicle-to-Grid Power: Battery, Hybrid, andFuel Cell Vehicles as Resources for Distributed Electric Power in California. Inst. of Transportation Studies, University of California, Davis.

[20] Lipman, Tim. 2001. Grid-Connected Fuel Cell Vehicles As Supplemental Power Sources

[21] Lipman, Tim, et.al., 2004. Fuel cell system economics: comparing the costs of generating power with stationary and motor vehicle PEM fuel cell systems. *Energy Policy* 32, pg. 116

combustion engines are manufactured for $25-40/kW.[22] To highlight the range of predicted future costs, we summarize analyses from public and private sources.

A Japanese analysis based on learning curves[23] constructed three technological development scenarios, and its middle-of-the-road scenario to reach $38/kW at five million units cumulatively produced (see table 3 below). This target number of FCVs was obtained from a Japanese governmental estimate for 2020. While no one can say how many will be produced by that date, we are currently less optimistic. A more conservative estimate gives us an order of magnitude less PEMFCs produced; this learning curve framework prices these fuel cells at $79/kW.

Table 3 Scenario MB: Moderate with Medium Power Density

		Case: Moderate with Medium Power Density (MB)								
		Cost ($/m2)				Platinum				
Year	Number of FC Vehicles	Proton Exchange Membran	Electrode	Bipolar Plates	Peripherials	Pt Weight (g/m2)	Pt cost ($/m2)	Power density (kW/m2)	Assembly Cost ($/50kw)	Total ($/kW)
	E	82	82	82	95	92		96	92	
	-r	-0.286	-0.286	-0.286	-0.074	-0.120		-0.059	-0.120	
2000	40	500	1,423	1,650	15	4.00	62	2.00	385	1,833
2001	82	408	1,160	1,345	15	3.67	56	2.09	353	1,438
2002	167	332	946	1,097	14	3.37	52	2.18	324	1,129
2003	340	271	771	894	13	3.09	48	2.27	297	886
2004	693	221	629	729	12	2.84	44	2.37	273	697
2005	1,414	180	513	595	12	2.60	40	2.47	250	548
2006	2,885	147	418	485	11	2.39	37	2.57	230	431
2007	5,887	120	341	395	11	2.19	34	2.68	211	340
2008	12,011	98	278	322	10	2.01	31	2.80	194	268
2009	24,506	80	227	263	10	1.85	28	2.92	178	212
2010	50,000	65	185	214	9	1.70	26	3.04	163	167
2011	79,245	57	162	188	9	1.60	25	3.13	154	144
2012	125,594	50	142	165	8	1.52	23	3.21	146	124
2013	199,054	44	124	144	8	1.44	22	3.30	138	107
2014	315,479	38	109	126	8	1.36	21	3.39	131	92
2015	500,000	34	96	111	8	1.29	20	3.49	124	79
2016	792,447	29	84	97	7	1.22	19	3.58	117	68
2017	1,255,943	26	73	85	7	1.15	18	3.68	111	59
2018	1,990,536	23	64	75	7	1.09	17	3.78	105	51
2019	3,154,787	20	56	65	7	1.03	16	3.89	99	44
2020	5,000,000	17	49	57	6	0.97	15	3.99	94	38

- Extracted from "Fuel Cell Cost Study by Learning Curve" by Tsuchiya, H., et. al. 6/02

Hypercar, Inc. studied this matter in depth to conceptually flesh out the design and cost of their *Revolution* FCV. They specified a PEMFC cost of $100/kW for 50,000-vehicle production run. While this estimate depends on units produced and not on a date, the company assumes that these production levels would occur well before 2020, implying that PEMFCs would be cheaper by our timeframe.

The USDOE's FreedomCAR initiative aims for a fuel cell cost of $45/kW by 2010, and a 2015 commercialization target of $30/kW. This datum assumes 500,000 PEMFCs produced annually, each with a 5000-hour life. In 2001 the USDOE estimated a cost of $35/kW by 2008[24]. Judging

[22] Keep in mind that power cost isn't the last word; a FCVs dramatically increased efficiency allows it to economically offer the same service at a far greater cost per kW. See Design and Manufacture of an Affordable Advanced-Composite Automotive Body Structure for a detailed discussion of this subject.
[23] Learning Curves (or "Experience Curves") are a well-studied artifact of technological development. Prices falling by 15-30% for each doubling of cumulative units produced have been observed in a wide variety of industries. Note that costs decline with experience, which incidentally progresses with time.
[24] P. Davis, J. Milliken, D. Ho, N. Garland, Opening Presentation at Kick-Off Meeting for Cooperative Agreements Awarded Under Solicitation DE-RP04-01AL6705, 30. Oct 2002, U.S. Department of Energy, Office of Energy

from our previous research, we find these targets to be inspirational but also very optimistic. However, they do highlight the common assumption that prices will continue to fall as the technology matures, implying that the refurbishment price will decline over the life of the vehicle as well. This stair-stepped pricing should be considered in future analyses when more accurate new-PEMFC pricing data becomes available.

PEMFC Longevity

V2G economics may be more affected by the PEMFCs longevity than its price-per-kilowatt. Common estimates of a vehicular PEM lifetime range from 4,000 to 5,000 hours, even though they last for about 1,000 hours today. These estimates derive in part from what reasonably *would have to be designed for* a typical FCV lifecycle; 5000 hours would deliver roughly 200,000 miles over the life of a FCV. Yet if we expect a vehicle to produce V2G power for 10 hours per day, 250 days per year, that will require an *additional* 2500 hours annually. Operating at these loads, the 5000-hr fuel cell stack will need to be refurbished 6-8 times over the life of the vehicle. While this procedure should cost only $300-$400[25]—similar to a 30,000-mile tune-up today—the real cost will lie with the stack, which typically makes up 25% to 50% of a fuel cell's total cost.[26]

Lifetimes of up to 10,000 hours are expected[27], though these will likely come with larger pricetags. PEMFC catalyst degradation necessarily climbs as platinum loadings fall (which is the principal way to decrease price/kW), and the electrolytic membrane naturally looses its conductivity as vapor passes through the system. The latter can be overcome by employing a thicker membrane, but efforts to increase PEMFC power density seek to thin it. Other commonly aimed initiatives such as increasing operating temperatures and decreasing cell humidity also exacerbate fuel cell degradation.

In theory, however, a V2G fuel cell may last longer than a purely vehicular fuel cell. The operational stresses of load cycling and cold starts[28] experienced during vehicular operation are particularly damaging; these would not be experienced by the fuel cell while plugged in. This led Dr. Timothy Lipman to assume a 40,000-hour lifetime in his V2G cost analyses, which we find to be very unlikely given our (and his) operating conditions.[29] Determining how mixed use will affect fuel cell life will depend upon more accurate, standardized load profiles and methods to reliably fast-forward longevity testing. Both are now in development. In the long term, however, a V2G-optimized PEMFC will differ from a FCV-only PEMFC, perhaps only in design and not in cost. The challenge will then be to get automakers to make V2G-optimized fuel cells available in their cars.

The bottom line is that today there is a fundamental lack of understanding of the roles played by the various modes of catalyst and membrane degradation and how to feasibly address them, which is further complicated by how the fuel cell will be used.[30] Multiply this with the wide

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[25] Engineers from Hypercar, Inc. note that this procedure should be straightforward if it is considered during the vehicle's design process.

[26] Lipman, Tim, et.al., 2004. Fuel cell system economics: comparing the costs of generating power with stationary and motor vehicle PEM fuel cell systems. *Energy Policy* 32, pg. 116

[27] http://www.engr.psu.edu/h2e/Pub/Mench_2.htm

[28] e.g. liquid water accumulation and dryout, temperature transience and local non-uniformity, and accelerated catalyst dissolution and migration

[29] Lipman, Timothy. "Grid-Connected Fuel Cell Vehicles As Supplemental Power Sources", 2001. Dr. Lipman footnotes his assumption that low-power operation would afford a 40,000 lifetime, though his most relevant scenarios operate the fuel cell at 75% of peak power.

[30] Patrick Davis from the DOE's Office of Hydrogen, Fuel Cells and Infrastructure Technologies notes in a personal communication that, "Curiously, while automotive applications have trouble attaining more than 1000 or 2000 hours durability right now, stationary applications seem to be much more durable, although

variation in estimates of PEMFC cost/kW we are left with a wide range of incremental V2G fuel cell costs.

Table 3: Incremental V2G PEMFC Refurbishment Costs

Scenario:	Optimistic	Moderate	Conservative
Size (kW)	35	35	35
FC Peak-Power Cost ($/kW)	38	79	200
New FC Total Cost ($)	1,330	2,765	7,000
Lifetime (hrs)	20,000	10,000	3,500
Average Load (kW)	10	10	10
Total Energy per FC (kWh)	200000	100000	35000
Refurb. Cost as % of New	25%	35%	50%
Degradation Cost ($/kWh)	**0.0017**	**0.0097**	**0.10**
Replacement Costs:			
Driving Load (hrs/yr)	500	500	500
V2G Load (hrs/yr)	2500	2500	2500
FC Replaced Every (years)	6.7	3.3	1.2
Times Replaced Over 12-yr Life	1.8	3.6	10.3
Replacement Procedure ($)	350	350	350
Total Replacement Cost ($)	630	1260	3600
Replacement Procedure Cost ($/kWh)	**0.0018**	**0.0035**	**0.01**
Total Cost ($/kWh)	**0.003**	**0.013**	**0.110**

Hydrogen Infrastructure

The cost of hydrogen very much depends on the cost of its production infrastructure. But we separate the two here to reflect the expected market structure in which distinct players purchase the fuel and the fueling station. It appears today that most hydrogen produced in 2020 will derive from natural gas via steam methane reformation (SMR), though greater time-of-use electricity price transparency will encourage nighttime production of hydrogen via electrolysis—most likely powered by renewables.[31] A migration towards the latter is the ultimate goal of a clean, renewable hydrogen energy economy.

Steam methane reformation produces most of today's hydrogen at large industrial refineries. The technology is well understood, though small-scale reformers for distributed use are currently prototypes. They are the core of the greater hydrogen-fueling appliance (HFA), which includes the reforming system, hydrogen compressor, storage tanks, and a dispenser. Natural gas and water are fed in to produce hydrogen stored at 5,000psi, ready to be dispensed to FCVs.

Supported by DOE funding, Directed Technologies, Inc. studied the costs and performance of HFAs in depth. They evaluated HFA development from the ground up, specifying costs for materials, manufacturing, assembly, and markup for four types of SMR. Each HFA was scaled to serve 183 vehicles, and economically evaluated in batches of 250 annually. This production volume would serve 45,750 vehicles per year, which falls within the range of expected FCV proliferation before 2020. They calculate their best HFA would cost $253,014; San Francisco would require 27 of these to service 5,000 vehicles, a $6.8 million dollar investment.

still falling short of our 40,000 durability target for distributed generation. This is true even though the membranes are essentially the same."

[31] Wind power typically produces significant energy at night, and San Francisco could feasibly import this off-peak power.

H2Gen Innovations, Inc. makes the *HGM* and they have studied the economics of SMR in depth. Dr. Sandy Thomas, President of H2Gen and former employee of Directed Technologies, estimates that their HGM, which can service 1,440 FCVs, will cost $760,000 in low-scale production.[32] This naturally leads us to a per-vehicle cost calculation; the smaller HFA examined by Directed Technologies comes to $1383 per FCV, while H2Gen's *HGM* amounts to $530 for each new FCV sold.[33] While these figures give us a better sense of the required FCV infrastructure costs compared to the price of the vehicles themselves, this price should not be tacked onto the incremental costs of V2G, as entrepreneurs or existing industries would bear those costs to sell hydrogen at a profit. For reference, consider that the estimated capital investments required to maintain the existing gasoline infrastructure weigh in at $1,230 for each new car sold today.[34]

The preceding analyses examine stand-alone HFAs, though combining an enlarged reformer to co-generate hydrogen for both the building's stationary fuel cell and its FCV fleet would be favorable in scenarios like *Office Park*. This setup offers the economic benefits of increased HFA scale and additional heat-capture synergies, improving overall system efficiency. In addition, stationary fuel cells (and their reformers) will be underutilized at night when demand for power is low. Adding hydrogen compression, storage and dispensing facilities will allow the reformer to make hydrogen at night, thus increasing the ROI of the complete system. Sandy Thomas examined the tradeoff between hydrogen and electricity prices in such a scenario. It uses a 50kW stationary fuel cell with an oversized reformer that could fuel 200 FCVs (see figure 8). Dr. Thomas explains:

[32] Thomas, C.E. "Hydrogen and Fuel Cells: Pathway to a Sustainable Energy Future". 2002.
[33] Assumes contemporaneous lifetimes for the HFA and FCVs.
[34] Thomas, C.E., et. al. "Distributed Hydrogen Fueling Systems Analysis". Proceedings of the 2001 DOE Hydrogen Program Review

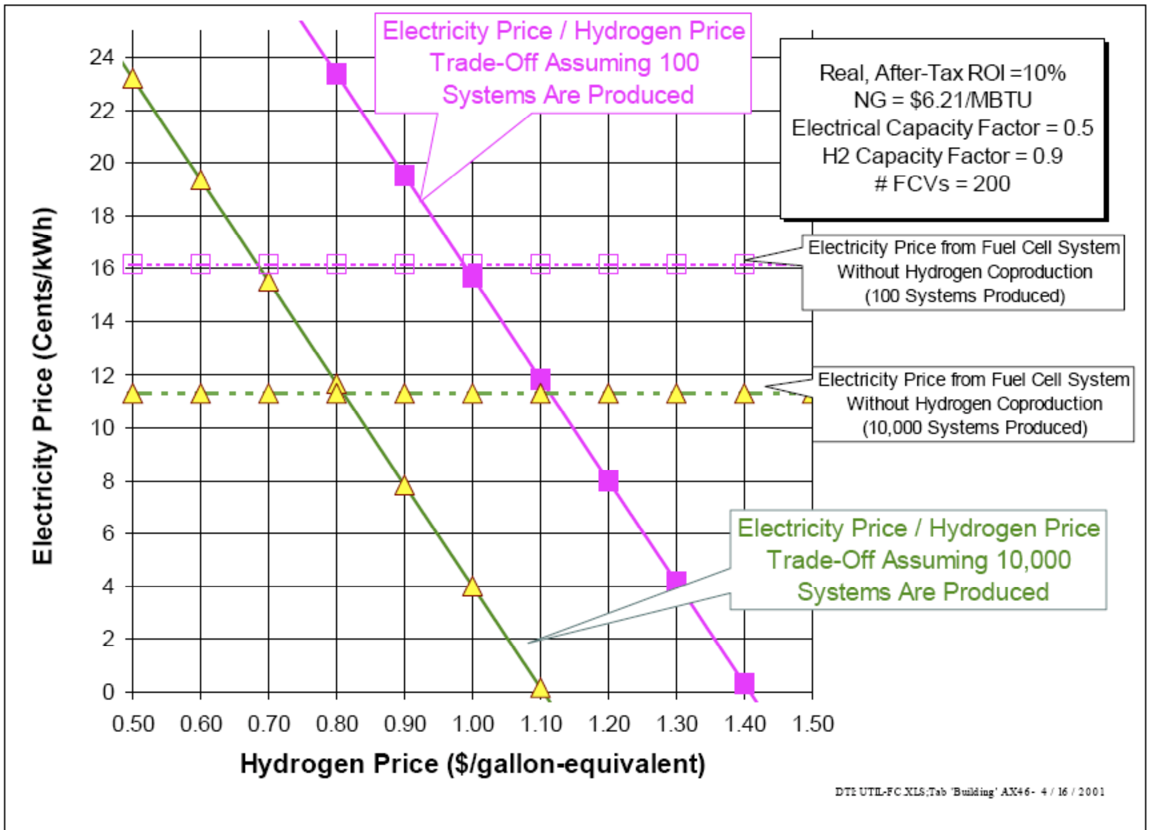

Figure 8. Illustration of trade-off between hydrogen price and electricity price for a 50-kW stationary fuel cell system co-producing hydrogen.

> Under these conditions, the owner of the 50-kW fuel cell system would earn a 10% real, after-tax return on investment if the electricity were sold at 16 cents/kWh if 100 such systems were produced and no excess hydrogen was produced for sale. But with hydrogen cogeneration, the owner could reduce the cost of electricity along the sloped line of Figure 8 and still make his 10% return on investment. For example, if the owner could sell hydrogen to support 200 FCVs or 4 fuel cell buses at a price of $1.30/gallon of gasoline equivalent, then the electricity price to the building owner could be reduced to only 4 cents/kWh. These values assume that 100 fuel cell systems are produced. If 10,000 such systems were manufactured, then the costs could be reduced according to the lower two lines. Without hydrogen sales, an electricity price of 11.3 cents/kWh would be required for a 10% return.[35]

This assumes that the primary purpose of the unit is to sell electricity. Alternatively, we could assume the opposite: electricity is now the co-product for a 300-FCV hydrogen appliance that has been combined with a 75kW fuel cell (see figure 9). In this example, the owner could make 10% ROI selling hydrogen at $1/gallon of gasoline equivalent and on-peak electricity at 5 cents/kWh. Real-world prices for both would likely be much higher, thereby creating a hearty profit stream for the owner:

[35] Thomas, C.E. "Hydrogen and Fuel Cells: Pathway to a Sustainable Energy Future". 2002. pg. 19

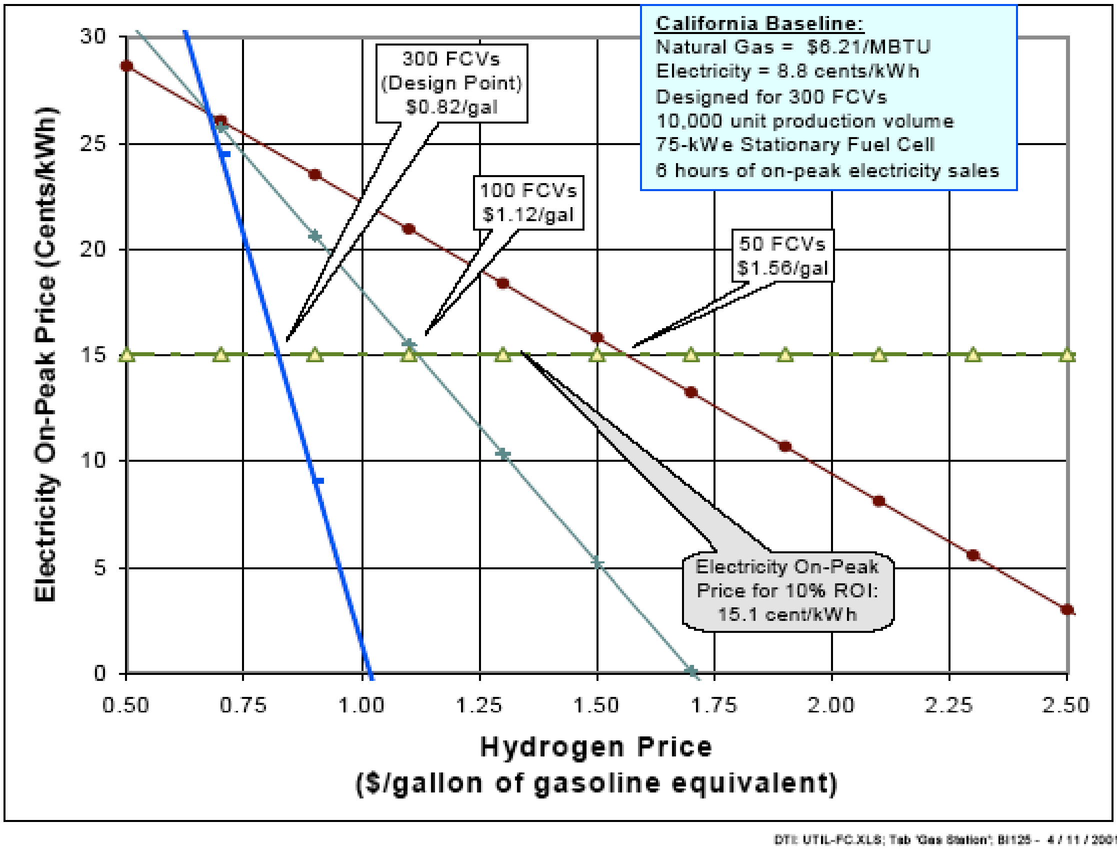

Figure 9. Illustration of price trade-off between on-peak electricity and hydrogen for a hydrogen fueling station with an auxiliary fuel cell for peak shaving only

A cornucopia of other hydrogen sources, ranging from carbon-sequestered coal to photosynthetic organisms to water split by solar heat, are all under investigation. Breakthroughs in these technologies are impossible to forecast, but may allow them to prevail within the next two decades.

Hydrogen Fuel Costs

Like fuel cell cost estimates, forecasted hydrogen prices vary widely. This range does not depend on varying confidence in future technological breakthroughs, but rather on projected HFA production volumes (derived from the number of FCVs on the road) and the price of natural gas. It has been observed that capital recovery of the HFA accounts for about half the cost of hydrogen, while NG prices, electricity, O&M, taxes, and insurance compose the remainder.[36] This means that economies of scale in HFA production will significantly lower the cost of hydrogen. Directed Technologies observed as much; their near-term, 183-vehicle HFA would produce hydrogen at $3.38/kg, but mass production of an enlarged 1,440-vehicle HFA (equivalent to today's typical gas station capacity) could bring this price down to $1.87/kg.[37]

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[36] Meyers, Duane, et.al. "Cost and Performance Comparison Of Stationary Hydrogen Fueling Appliances." Proceedings of the 2002 U.S. DOE Hydrogen Program Review NREL/CP-610-32405; Weiss, Malcom, et.al. "On the Road in 2020 – a life-cycle analysis of new automobile technologies". 2000.

[37] Assumes the $5.34/MBtu 19-yr national average price of natural gas, 10% ROI, 10-year life,

DOE estimates vary widely, and one must take care to distinguish targets from calculations. The FreedomCAR initiative aims for hydrogen costs to fall to $3/kg by 2008, and $1.50 by 2015.[38] Elsewhere we find that the Massachusetts Institute of Technology's Energy Laboratory estimated a hydrogen price of $2.28/kg in its "On the Road in 2020" report published in 2000.[39] At the bleeding edge, assuming a mature 1,440-vehicle HFA that enjoys industrial natural gas rates and cheap, off-peak electricity, the cost may be as low as $1.36/kg.[40]

In summary, estimates range from $1.36 to $3.38 per kilogram of hydrogen. That equates to $0.69 - $1.55 per gallon of gasoline.[41] Viewed in this light, the question shifts from "What will hydrogen cost?" to "What price will the market bear for hydrogen?". This should pique the interest of both entrepreneurs and city planners that seek to cross-subsidize early fuel cell installations with hydrogen sales.

We calculate the incremental costs of fuel by simply multiplying the energy of hydrogen, 33.4 kWh/kg, by the complete fuel cell system's electrical efficiency, which we estimate to be 60%. The cost per kilogram of hydrogen is then divided by this number to produce our fuel consumption $/kWh.

V. Incremental Demand for Natural Gas

At first glimpse, it may seem that this investigation entails the preposterous assumption of stable natural gas prices in the face of a large, novel demand for the fuel. But keep in mind that V2G power will predominately substitute for peak power that would otherwise be produced from natural gas. In fact, natural gas demand may fall with V2G, as a fuel cell produces electricity more efficiently than its combustion alternatives.

Consider the case in which our entire 2020 V2G fleet is powered by SMR-produced hydrogen. Assuming energy conversion efficiencies for the SMR reformer and fuel cell at 80% and 60%, respectively, we estimate the demand for natural gas from our *Office Park* V2G scenario as follows:

- To produce 125 GWh of electricity annually we need
- 125 GWh_e/60% = 208,300 MWh of hydrogen;
- 208,300 MWh_{H2}/80% = 260,400 MWh of NG;
- → 260,400 MWh_{NG} = 888,500 MBtu of natural gas demand.

By comparison, today's natural gas peaker plant operating at 25% electrical efficiency would require 1,706,000 MBtu of natural gas—nearly double the V2G requirement—to produce the equivalent power.

VI. Emissions

[38] Gronich, Sig & Garback, John. "Technology Validation" for DOE's Energy Efficiency and Renewable Energy/Hydrogen, Fuel Cells and Infrastructure Technology Program

[39] Weiss, Malcom, et.al. "On the Road in 2020 – a life-cycle analysis of new automobile technologies". 2000. pg. 54.

[40] Thomas, C.E. "Hydrogen and Fuel Cells: Pathway to a Sustainable Energy Future". 2002.

[41] Assumes a 2.2 efficiency gain by an FCV over a CV. Hypercar, Inc. expects a 5x gain in their Revolution, which would more than halve these gallon-gas-eqivalent prices.

The incremental air pollutants added by V2G scenarios will depend critically on the makeup of the hydrogen fuel stock. While tailpipe emissions of criteria pollutants (VOCs, NOx and CO) from FCVs will be virtually nonexistent, local air pollution will still arise from increased SMR hydrogen generation taking place within the city. Nonetheless, SMR criteria emissions will be substantially less than that of today's average conventional vehicle.

Producing hydrogen from clean, renewable sources (be they solar, thermal, biological, etc.) is the hydrogen economy's ultimate goal. On the road to get there, greenhouse gas (GHG) emissions will be cut by 40-45% if natural gas supplies the hydrogen. But if the average US grid-electricity mix were used to make hydrogen via electrolysis and used in FCVs, GHG emissions would more than double that of today's average car.[42]

VII. Conclusion

Employing fuel cell vehicles as distributed power resources is feasible and merits further study. But it's still too soon to tell whether it will be economically competitive in practice. Given the number and range of uncertainties, especially in fuel cell power cost and longevity, "too-cheap-to-meter" and "very expensive" lay within today's error bars.

The City of San Francisco has just received its first pair of Honda *FCX* FCVs, and like other municipalities, will test them in real world conditions. Similar testing of vehicular and stationary fuel cells is taking place worldwide. We will soon know a lot more about how these devices stand up to everyday use, and how subsequent PEMFC generations can be tailored to various load profiles and operating conditions. Data produced by this testing will allow us to more accurately predict the economics of V2G scenarios.

Evaluating the V2G concept involves other factors than the easily computable variables above. One must also take into account the value of clean air and climate change mitigation, as well as the premium service offered by a vehicle that does not need to go to a filling station. As Dr. Timothy Lipman and Daniel Kammen note, much of the economic benefit of these scenarios may be their ability to displace relatively costly construction of new power plants or transmission lines.

The City of San Francisco can facilitate the viability of V2G through early and deliberate action. Officials can promote and incentivize greater TOU price transparency, active awareness and participation by automakers, industrial electricians, and utilities, and V2G FCV taxes/rebates that structure the market to reflect the city's goals. Perhaps most importantly, V2G will require a massive campaign to initiate the public into an entirely new way of perceiving and using their automobiles.

[42] Thomas, C.E. "Hydrogen and Fuel Cells: Pathway to a Sustainable Energy Future". 2002.

VIII. Appendix: Plug-in Hybrids and Other V2G Scenarios

Many other potential V2G scenarios exist in addition to those sketched out here. Previous investigations have explored the possibility of using FCVs to provide power[43] (and potentially heat[44]) to homes. Of these, Dr. Timothy Lipman's recent article explains why these appear to be less economically attractive than scenarios like *Office Park* for supplying peak and/or base load power. These scenarios also face the simple yet significant hurdle that most vehicles are not parked at home during the daytime peak demand. However, new residential developments with local hydrogen networks and built-in V2G hardware may make these scenarios more compelling.

Fuel cell powered fleet vehicles that drive various routes by day and return to a centralized lot by night may become an attractive V2G candidate given cheap, long-lasting PEMFCs and favorable hydrogen and electricity prices. FCV car-share fleets or rental car fleets may similarly qualify. Yet the matrix of conditions that would make each of these scenarios viable would make *Office Park* scenarios a relative home run, so the latter will likely be the first best bet for V2G implementation.

Plug-In Hybrids (PHEVs)

Plug-in hybrids are hybrid vehicles powered by ICEs or fuel cells that employ an enlarged battery that allows them to operate emissions-free for some moderate distance. While the MY2003 Toyota *Prius* can travel only about 10 miles on it's batteries, PHEVs would be able to travel 20-60 miles as a battery-only zero emissions vehicle (ZEV). This would meet the daily demands of most commuters,[45] who would then plug in their PHEV at home to recharge it at night.

The core idea here is that utilities can produce electricity more cheaply and cleanly than a hybridized on-board engine can. While today's HEVs have electric motors, 100% of their energy ultimately comes from gasoline. PHEVs would be able to reap the benefits of pure BEVs without sacrificing the potential range of the vehicle.

PHEVs are not mutually exclusive with FCVs, but rather a fuel- and engine-agnostic, complementary technology that can dramatically reduce vehicle emissions in the very near term with largely extant technology and infrastructure. Greater TOU electricity price transparency at the residential level would offer cheaper nighttime power. In the long term, PHEVs may offer a way to offset the conversion losses faced by (renewably) electrolyzing and then recombining water in a fuel cell. In the short term, their design will permit further downsizing and enhanced efficiency engine operation.

Several groups are studying this matter intensely.[46] The greatest unknown today is the cost and durability of batteries that undergo many charge/discharge cycles, and if these batteries would need to be periodically replaced. While these enlarged battery arrays would increase the vehicle's initial cost, a PHEV may offer significantly lower net-present costs of ownership. Beyond offering improved fuel economy and reduced greenhouse and smog precursor emissions, PHEVs may also qualify for ZEV privileges such as premier parking and single occupancy access to HOV lanes. Perhaps most significantly, market research indicates that people really dislike

[43] Lipman, Tim, et.al., 2004. Fuel cell system economics: comparing the costs of generating power with stationary and motor vehicle PEM fuel cell systems. *Energy Policy* 32, pg. 101-125

[44] Kissock, J.K., 1998. Combined heat and power for buildings using fuel-cell cars. ASME International Solar Energy Conference, Albuquerque, NM.

[45] 90% of the cars in the U.S. travel 30 miles or less in a day, according to www.eaasv.org.

[46] View http://www.calcars.org/resources.html for a variety of resoureces.

going to go to the gas station, and are willing to pay a sizeable premium for a vehicle that needs refueling much less frequently.[47]

[47]http://www.epri.com/OrderableitemDesc.asp?product_id=000000000001000349&targetnid=258092&value=MEMBER&marketnid=255855&oitype=1&searchdate=7/19/2001

IX. Glossary

CV	Conventional Vehicle
DOE	(US) Department of Energy
FCV	Fuel Cell Vehicle
GHG	Greenhouse Gas
HFA	Hydrogen Fueling Appliance
HEV 20	Hybird-Electric Vehicle with a 20 mile range running on batteries as a ZEV
HOV	High Occupancy Vehicle (2-3 or more in the Bay Area)
ICE	Internal Combustion Engine
NG	Natural Gas (principally methane)
O&M	Operations and Maintenance
PEMFC	Proton Exchange Membrane Fuel Cell
PHEV	Plug-in Hybrid Vehicle. See Appendix.
PSA	Pressure Swing Adsorption (a method of SMR hydrogen purification)
SMR	Steam-Methane Reformation
ZEV	Zero Emission Vehicle

APPENDIX C:
EXEMPLARY ENERGY EFFICIENCY PROGRAMS
RECOMMENDATIONS FOR CITY OF SAN FRANCISCO

ROCKY MOUNTAIN INSTITUTE

DECEMBER 2003

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INTRODUCTION

San Francisco is subject to a constrained electrical distribution system, and continues to be affected by California's volatile and uncertain electricity marketplace generated during the state's electricity deregulation. Furthermore, the existing power plants in the city, Hunter's Point and Potrero, are operating past their designed lifetime and emit a substantial amount of pollution. In order to close Hunter's Point by 2005, either new generation and transmission capacity must be built, the city's demand must decrease, or a combination of both must occur.

Through its Pilot Program with PG&E, San Francisco was recently allocated $16 million in state funds to implement energy efficiency specifically for City residents and businesses. This program will be designed and marketed by the City's Department of the Environment (SFE). Additional efforts to improve the efficiency of the City's public buildings and facilities are pursued by the San Francisco Public Utilities Commission (SFPUC). Hetch Hetchy Water and Power (HHWP) department within the SFPUC provides electric power for all of San Francisco's municipal electric needs. HHWP's involvement in the electricity needs of the City's private residences and businesses are minimal, and its efficiency projects are directed mainly at city facilities. HHWP's efficiency projects are ongoing on a building-by-building basis. Ideas presented in this report hopes to inform HHWP's efforts in administering and implementing additional efficiency projects as well has city-wide efficiency programs.

The following report highlights innovative efficiency programs applicable to the city. The following examples are intended to support San Francisco's efforts to create a set of programs to reduce the city's demand, in both private and city government facilities, thereby facilitating the shut down of Hunter's Point and potentially Potrero in the intermediate term, as well as the continued reduction of the city's demand further into the future. The programs in this report are organized into three main categories:

1. Programs addressing the city's efforts in general
2. Programs addressing the non-residential sector
3. Programs addressing the residential sector

Within each category the programs are further classified according to program type - for example, comprehensive (either covering multiple sectors or whole building systems) city programs, re-commissioning and design assistance for commercial buildings, multi-family programs and appliance recycling for the residential sector.

The specific examples were selected for their exemplary and noteworthy ability to achieve cost effective energy and demand savings, the innovativeness of the program design, their potential to overcome barriers applicable to San Francisco, and the addressing of needs not previously covered by other existing or active programs in the City.

Examples for the City

I. Comprehensive Programs

The programs in the Comprehensive category are classified as such because they can be applied to all three economic sectors – commercial, industrial, and residential. The first two examples both come from Vermont. They represent two entirely new models of how San Francisco can operate: first as a business with efficiency-driven revenues. Secondly, as a capital provider of efficient technologies, incentivized not by rebates, loans or leases, but by a pay-as-you-save model.

Vermont's Energy Efficiency Utility

Vermont's 'efficiency utility' is one of the most impressive examples of the gathering of programs from different government and private agencies under one umbrella organization For several years, Vermont's various electric utilities had offered a wide range of energy efficiency services to their customers. These different and often unconnected programs created confusion among customers and product vendors, limited some customers' access to service, and increased the cost of delivering energy efficiency. After careful consideration, the Vermont Public Services Board, utilities, and consumer and environmental groups agreed to develop a consistent, comprehensive, and integrated delivery system. The efficiency utility model has also been successfully adopted by State of Oregon as the Energy Trust of Oregon. Some of the programs administered by the Energy Trust of Oregon are highlighted in this report as well.

Program Administrator:	**Program Title, Start Date:**	**Targeted or Eligible Population:**	**Participation Rate:**
Vermont Public Service Board	Efficiency Vermont; 1999	Residential, commercial, and industrial customers	
Funding Source:	Public benefits funds		
Description:			
The Public Benefits funds collected from Vermont electricity customers are distributed to Efficiency Vermont to administer energy efficiency programs independently from the state's electric utilities. Currently, Vermont Energy Investment Corporation (VEIC), a Burlington-based not-for-profit energy services organization, has the contract to operate Efficiency Vermont. VEIC operates the program under a three-year performance contract. Efficiency Vermont consolidates and enhances most of the programs previously offered by the state's electric utilities and provides a more streamlined and coordinated approach to energy efficiency. It is also expected to increase participation in these programs by those who want to reduce their electric bills through improving their energy efficiency. Efficiency Vermont offers comprehensive suite of energy-savings programs for existing and new construction in			

private and public sector residential and commercial facilities. EV provides technical advice and financial incentives for all counties throughout the state.	
Program Performance, Outcome, Recognition:	**Lessons Learned**
In 2002, Efficiency Vermont worked with 32,311 customers save over 39.5 GWh/yr totaling $26 million. The savings cost the tax payers 53% less than utilities would have paid to supply the energy service. These annual savings are estimated to persist for 14.5 years on average. These results surpassed EV's 2002 targets by 64% and its three-year contract target by 18%.	
Why SF should adopt this Program:	**Contact/Website:**
While the transfer of PG&E's public good funds to an independent entity such as an efficiency utility may face legal obstacles, a variation of this program could still be highly beneficial to the City, as it would offer a central organization for customers to go to for all the programs available to SF residents and businesses. Having such a clearinghouse of information also provides continuity and clarity of the available programs.	http://www.efficiencyvermont.com/ http://www.newrules.org/electricity/efficiencyvt.html

New Hampshire's Pay-As-You-Save (PAYS) program

The Pay-As-You-Save™ (PAYS®) program has been a highly successful pilot in New Hampshire operated by two distribution utilities: New Hampshire Electric Coop (NHEC) and the Public Service Company of New Hampshire (PSNH). PSNH offers the program only to municipal customers while NHEC offers it to all customers with a focus on smaller business customers. The PAYS® approach can also be applied to distributed generation.

The primary advantages of the PAYS® model is that it is designed to be a market based approach that does not rely on a system benefits fund. To a large extent PAYS® can be designed to be self-funding as measures are paid back through the savings created by efficient technology. PAYS is not a loan, since the customer relinquishes responsibility for payment of permanent measures if he or she moves out of a building before the measure is paid for. The measures are tied to the meter rather than an individual customer. There is no customer debt obligation. This enables local, state and federally owned buildings to make improvements without voter or special budget approvals (and eliminates concerns about debt to equity ratings). The new occupant assumes the responsibility of paying for the cost effective measure while he benefits from the energy savings. PAYS can be used for any proven measure that is cost effective based on retail rates (although incentives can be used to make more measures, including renewable measures, cost effective). The PAYS program model also overcomes the split incentive problem of multi-family and other rental units (where the owner will not invest in the efficiency measure, as he does not pay the energy bill, and the renter will not invest in the efficiency measure, as he does not own the property).

Program Administrator:	**Program Title, Start Date:**	**Targeted or Eligible Populations:**	**Participation Rate (through 6/30/03):**
PSNH & NHEC	Pay-As-You-Save™ (Pilot Study); 2001 - 2003	PSNH: Municipal customers. NHEC: residential (weatherization and CFLs), and Commercial customers (HVAC & lighting).	104 municipal projects ($1,081,212); 12 Commercial ($128,618) 7 Residential weatherization and more than 2,000 CFLs
Funding Source:	Vendor or third party (in pilots Utilities fronted costs and "own" measures until paid off)		
Description:			
Vendors market products to Customer who selects PAYS® purchase option for (qualifying) measures. A third party (in the pilot the utilities) certifies that there will be immediate net savings and the measure is appropriate. The vendor or a third party provides the up-front cost (in the pilot by the utilities) and is repaid by charges added to the customer's electricity or other utility bill, allowing customers to pay back the investment over time in the form of a fraction of the estimated savings over a fraction of the equipment's life. The program offers both portable measures (when the customer leaves the location, they take the measure with them and assign the charge to their next location or pay off the balance) and permanent measures (when a customer leaves, the measure remains and the customer is no longer responsible for payment).			

Program Performance, Outcome, Recognition:	**Lessons Learned:**
PSNH: 104 projects submitted, from 25+ municipalities; 37 completed, 22 in process and 45 waiting town or utility approvals ($1081,212); est. lifetime savings 33,446,713 kWh; est. lifetime dollar savings $4,233,049. Two year overhead only $143,000 (including billing changes). 2003 budget subscribed by mid-year. **NHEC:** 7 residential weatherization ($7,693 for gas heating customers saving $1,689 annually); 12 commercial ($128,618 saving $42,678 annually) and 2,000 + CFLs. Two year overhead $90,828.	**PAYS is working largely as expected:** vendors are interested in offering technology options; utilities can take care of the bill payment issues; all PDCs have been paid on time so far –(guarantee fund not tapped yet). **PAYS does overcome barriers:** local government "gets it" and likes it; required payback does not scare off customers. **Pilot Experience:** if rebates are big enough (30-50%) PAYS can't compete; it is possible to incorporate rebates to make more measures cost effective; running program by IOUs can add issues of priorities: it's not a mortgage, not a loan, but a PAYS product.
Why SF should adopt this Program:	**Contact/Website:**
Highly powerful tool for assisting SF in all sectors to overcome barriers to increasing energy efficiency	Harlan Lachman, PAYS America , Inc. Colchester, VT 802-879-8895. Commissioner Nancy Brockway, NH Public Utilities Commission 603-271-6001

	Commission, 603-271-6001 nbrockway@puc.state.nh.us nbrockway@aol.com

Seattle's Comprehensive Energy Efficiency Program

Seattle has long been a leader in the realm of efficiency, using a comprehensive approach. The example of their success in creating an inclusive program for all market sectors can assist San Francisco in bypassing potential hindrances and taking advantage of opportunities that may otherwise be overlooked.

Program Administrator:	**Program Title, Start Date:**	**Targeted or Eligible Population:**	**Participation Rate:**
Seattle City Light	Comprehensive Energy Efficiency Program; Since 1977, Seattle's municipal utility has maintained an energy conservation effort.	Commercial, Industrial and Residential customers	Conservation services were delivered to 71% of all customers during the energy crisis in 2001.
Funding Source:	Funded through the utility rate base, with some assistance from Northwest Energy Efficiency Alliance; Bonneville Power Administration purchases energy savings (reduced loads) from Seattle City Light		
Description:			
Incentives, rebates, grants and loans for energy efficiency measures are employed as tools under this program. Services offered include: design assistance, audits, facility assessment, commissioning and re-commissioning, low-cost product giveaways, and customized agreements			

Program Performance, Outcome, Recognition:	**Lessons Learned**
Some recent accomplishments: Implementation of Seattle MeterWatch, allowing large commercial and Industrial customers to monitor their energy consumption on a 15-minute interval. Their 10 + 10 program resulted in a doubling of the number of Commercial and Industrial projects being contracted.	An appreciation and understanding that continuity within a program is a key to success. Partnerships and leveraging resources are also key. Understanding and buy-in of city staff of the value of efficiency is also critical
Why SF should adopt this Program:	**Contact/Website:**
Provides valuable knowledge of creating a comprehensive efficiency program and mobilizing city employees and citizens around the goal of energy efficiency	Marya Castillano 206-684-3740 www.cityofseattle.net/light/conserve

II. Motivating City Employees—"Mining for kilowatts" in City Buildings

'Mining for kilowatts' is the practice of proactively seeking out opportunities for energy efficiency and implementing them. The following programs are excellent examples of how cities can create a drive among their employees to find these opportunities, and how city departments can be organized so as to more efficiently realize these efficiency opportunities. These programs produce the double-benefit of reduced energy consumption in municipal buildings as well as providing an opportunity for city employees to take initiative to make a difference in their own immediate work environment.

City of Portland's Green Team

Such an example of mobilizing city staff to 'mine for kilowatts' within these facilities is provided by the City of Portland Oregon's Green Team. Organizing an employee exchange program with the City of Portland's Green Team may be beneficial. Such an exchange creates two avenues for learning. The first is the SF employees observing and participating first hand in an established, successful city employee efficiency initiatives. Secondly, Portland employees can interact and actively participate in San Francisco's efforts in creating and implementing the pilot programs.

Program Administrator:	**Program Title, Start Date:**	**Targeted or Eligible Population:**	**Participation Rate:**
City of Portland - Office of Sustainable Development	Green Team	City employees	
Funding Source:	City employees volunteer their time and the city reaps the rewards		
Description:			
The Green Team is an ad hoc group of City employees who volunteer their time to implement the City of Portland's Sustainable City Principles. The Team promotes environmentally sustainable operating practices for the City government by reducing waste, conserving energy and water, promoting sustainable purchasing practices, and encouraging the use of alternative transportation.			
Program Performance, Outcome, Recognition:		**Lessons Learned**	
The program has raised awareness and educated employees, promoted activities that save resources and money, identified ways to improve workplace sustainability, and provided a place for employees to share ideas and get things done.		Active involvement is critical to the level of success realized by this program	
Why SF should adopt this Program:		**Contact/Website:**	

Provides an example of involving city employees at all levels of the effort to achieve greater efficiency. City employees, as user of the city's facilities, can be in the best position to provide suggestions for increasing efficiency.	http://www.sustainableportland.org/default.asp?sec=energy&pg=home

City of Portland's City Energy Challenge

Also from Portland is an example of positioning one city bureau, the Office of Sustainable Development's Energy Division, as the lead agency and clearinghouse of information for increasing overall city efficiency. Combining the Green Team, the city's cross-sectional volunteer group, with the Energy Division, which possesses the technical know-how and authority, proved very successful. In particular, the division can provide valuable insight into organizing other city bureaus and employees, as well as creating a pool of internal knowledge readily accessible to decision-makers. San Francisco has designated the San Francisco Environment (SFE) Department as its lead agency for efficiency, similar to Portland's Energy Division.

Program Administrator:	**Program Title, Start Date:**	**Targeted or Eligible Population:**	**Participation Rate:**
City of Portland - Office of Sustainable Development	City Energy Challenge; 1991	City owned facilities	Across city bureaus
Funding Source:	City funded		
Description:			
To meet the city's component of the 1990 Energy Policy, a goal was set to cut City government energy bills by $1 million within ten years. The Office of Sustainable Development's Energy Division partnered and worked collaboratively with other City bureaus to identify energy-saving opportunities, assist in securing project funding, and provide technical assistance including facility energy audits, project bids, cost-benefit analyses, and product testing. The Division also continues to function as a "gate keeper" for vendors selling the latest efficiency devices. In this capacity, the Division removes the responsibility of choosing efficiency measures from the separate bureaus and places it in the hands of qualified and knowledgeable employees.			
Program Performance, Outcome, Recognition:	**Lessons Learned**		
As a result of this program, city energy bills were reduced by $1.1 million annually.			
Why SF should adopt this Program:	**Contact/Website:**		
An example of organizing city bureaus to ensure success and adequate flow of accurate information.	http://www.sustainableportland.org/default.asp?sec=energy&pg=home		

III. Private Sector Partnerships

Enlisting the support of local businesses to address San Francisco's efficiency efforts can provide an effective delivery mechanism. By partnering with local businesses, the city gains new avenues both for educating the public on the pros and cons of varying energy efficient devices, and for providing rebates or incentives at the time of purchase. The Northwest Energy Efficiency Alliance, the Program Administrator of the following program, has successfully worked with manufacturers, distributors and retailers to transform the lighting appliance market in the Pacific Northwest.

Program Administrator:	**Program Title, Start Date:**	**Targeted or Eligible Population:**	**Participation:**
The Northwest Energy Efficiency Alliance (NEEA)	ENERGY STAR Residential Lighting Program; July 2000	Residential customers of the Northwest (Oregon, Washington, Montana and Idaho)	130 utilities, 100 manufactures, the Bonneville Power Administration, 1711 retailers
Funding Source:	11 electric utilities, the Bonneville Power Administration and public benefit funds from Montana and Oregon.		
Description:			
The program works to promote ENERGY STAR-qualified lighting products in the Northwest. It coordinates with manufacturers, distributors and retailers to support market transformations.			

Program Performance, Outcome, Recognition:	**Lessons Learned**
The program participants used its infrastructure to respond to the 2001 energy crisis and save 44 MW. The program achieved these savings in the short-term, providing much needed relief. Between 2001 and 2002 sales (of energy efficient lighting increased 600 percent over the previous year.	Services must maintain consistent visibility to ensure awareness. Smaller hardware and specialty stores must be actively engaged, along with larger stores. Retailers must be supported even after a marketing campaign, such as coupons, ends.
Why SF should adopt this Program:	**Contact/Website:**
Wintertime evening peak is considerable within SF. The contributing devices to this peak include inefficient lighting. The NEEA's program has provided an example of how to form a coordinated effort to address a specific issue such as this.	Lois Gordon 503-525-2700, www.ecosconsulting.com

IV. Community Cooperatives

Chicago Community Energy Cooperative

The Chicago cooperative has begun a first-of-its-kind program providing real-time pricing information for residential customers. As evening winter-time peak in San Francisco is believed to be composed mostly of residential consumption, making such a program available to San Francisco residents could prove valuable in responding to peak-time shortages. Also, if the San Francisco Cooperative (see description below) were to become more inclusive of city neighborhoods throughout San Francisco, the Chicago coop could serve as an excellent model for its structure and operation as well.

Program Administrator:	**Program Title, Start Date:**	**Targeted or Eligible Population:**	**Participation Rate:**
Community Energy Cooperative	Community Energy Cooperative (CEC) Energy-Smart Pricing Plan (ESPP) (real time electricity pricing); 2000	Open to members living in the state of Illinois	In its first year, the ESPP made 1000 slots available, and 800 were filled. The program is now accepting applications again.
Funding Source:	ComEd, City of Chicago and Illinois Department of Commerce and Community Affairs		
Description:			
The Community Energy Cooperative was founded in January, 2000 by the Center for Neighborhood Technology. It is a non-profit membership organization that assists consumers and communities in finding the information and services required to control their energy costs. The Cooperative The Cooperative's goals are to decrease customer's costs, reduce energy waste and pollution, increase reliability and earn money for community development. The Energy-Smart Pricing Plan is the first of its kind, providing information to residential customers that allows them to respond to real-time market signals by altering their consumption.			

Program Performance, Outcome, Recognition:	**Lessons Learned**
The Cooperative has successfully proven that community-based cooperatives can be an effective curtailment tool by making information available to residential customers	
Why SF should adopt this Program:	**Contact/Website:**

This is a great example of a local utility and its communities forming a mutually beneficial partnership to realize increased efficiency. SF has a community Cooperative currently operating, but it is limited only to the communities around Potrero Point. If SF chooses to expand the program to include additional SF area communities, the Illinois example can serve as valuable source of information.	http://www.energycooperative.org/about

San Francisco Community Cooperative

In 2001 San Francisco founded a Community Cooperative for the Bayview, Hunters Point and Potrero residents and businesses that is modeled after the Chicago Community Energy Cooperative. The SF Coop was initially established through a $1.5 million grant from the San Francisco Department of the Environment to help residents and businesses in the SE area of the city to reduce their electricity consumption. Currently, the Coop is funded mostly through Foundation grants to support research into better understanding the characteristics of the community it serves, and to support advocacy efforts surrounding the local power plants. It also collects dues from its organization members.

The SF Coop facilitates audits and provides rebates, giveaways, and discounts for energy efficient light bulbs, occupancy sensors, refrigerators, floor lamps, low-flow showerheads, sink aerators, and weatherstripping. Additional incentives are sometimes available for low-income members of the community. It provides efficiency information for its members and publishes a quarterly newsletter updating its members on the status of the City's plans for Hunter's Point and Potrero.

The SF Coop is also working towards establishing critical peak pricing in the same vein as the Energy-Smart Pricing Plan (described above) established by the Chicago Coop, to induce residents to curtail their consumption during peak electricity periods in the city. The SF Coop is working with PGE on a pilot study for this effort. The project was launched in June 2003 and is expected to present results at the end of the year. The SF Coop has recruited approximately half of the planned 150 resident participants to have advanced meters installed at their homes, and hope to complete the enrollments by the end of July 2003. The SF Coop is also working on a demand-response program for businesses, and has enrolled a handful of businesses in this initiative.

The SF Coop makes an effort to keep track of efficiency programs offered by other City and State organizations such as the SFE, SFPUC, and CEC, and announces the programs to its members through its newsletter. When applicable, the Coop participates as a partner in these other programs and contributes some of its funds to leverage additional energy savings for its members. The Coop has also formed some initial partnerships with several retailers in its member community to sell efficient light bulb and lighting controls.

The SF Coop appears to be already doing many of the tasks that an efficiency clearinghouse for the City would perform, albeit at a small scale. There is potential for the SF Coop to expand its scope to cover more neighborhoods in San Francisco or perhaps even eventually serve the entire city. It could continue its tasks on a larger scale and work with the SFE and SFPUC to market, coordinate, and troubleshoot for residents the various efficiency initiatives currently applicable to the city.

V. Addressing Water Efficiency to Reach Greater Energy Conservation

The level of water consumption directly impacts pumping and processing costs and the electricity use associated with these. For this reason, pursuing water efficiency in the use of both fresh and wastewater could serve as a very effective internal efficiency program for the City. The Upper San Gabriel Valley Municipal Water District offers an example of a successful program that takes advantage of this energy efficiency opportunity.

Upper San Gabriel Valley Water Efficiency Programs

<table>
<tr><td>Program Administrator:</td><td>Program Title, Start Date:</td><td>Targeted or Eligible Population:</td><td>Participation Rate:</td></tr>
<tr><td>Upper San Gabriel Valley Municipal Water District</td><td>Water Efficiency Programs</td><td>Residential, Commercial and Institutional customers</td><td></td></tr>
<tr><td>Funding Source:</td><td colspan="3">Internally funded, decreased pumping costs contribute to offsetting the cost of the program</td></tr>
<tr><td colspan="4">Description:
The water district has instituted several water saving programs such as the High Efficiency Clothes Washer Rebate Program to assist residential, commercial and institutional customers.</td></tr>
<tr><td colspan="2">Program Performance, Outcome, Recognition:</td><td colspan="2">Lessons Learned</td></tr>
<tr><td colspan="2">The energy saved in water pumping costs helped reduce demand in the district, and obviated need to purchase power from the market. The water utility calculated that each acre-foot of water requires app. 3,000 kWh to be pumped into the valley. Each high efficiency washer saves 7,000 gallons of water and 213 kWh per year. During FY 2002-2003, 1,124 high efficiency washers were distributed, saving 362 acre-feet of water over the products’ lifetimes and over 1 million kWh in pumping requirements.</td><td colspan="2"></td></tr>
<tr><td colspan="2">Why SF should adopt this Program:</td><td colspan="2">Contact/Website:</td></tr>
<tr><td colspan="2">SF has a considerable number of water pumping stations that consume a sizable amount of electricity. The potential for savings should be investigated.</td><td colspan="2">626-443-2297
http://www.mwdh2o.com/mwdh2o/pages/conserv/conserv01.html</td></tr>
</table>

COMMERCIAL PROGRAMS

I. Comprehensive Programs

National Grid's Energy Initiative Custom Program

Installing new, higher efficiency equipment can be cost effective even if the equipment that is being replaced has not yet reached the end of its functional lifetime. Aside from its unusual design, the following program takes advantage of partnerships with merchants in the local community to assist with marketing, outreach, and implementation. The National Grid markets the Energy Initiative program through extensive personal communications with customers, vendors, and contractors. Information about the program is also passed on through numerous seminars, training sessions, and other direct marketing approaches. The program's commissioning element helps ensure that the designs and systems operate as intended by the design professionals.

Program Administrator:	**Program Title, Start Date:**	**Targeted or Eligible Population:**	**Participation Rate:**
National Grid	Energy Initiative Custom Program	Commercial, Industrial and Government facilities	Approx. 55% of National Grid's eligible population
Funding Source:	System benefits charge		
Description:			
The program focuses on still functioning but outdated, inefficient equipment. The program has two modes of addressing this equipment: 1) a prescriptive approach to efficient lighting, high-efficiency HVAC controls, VFDs, and premium-efficiency motors 2) a custom approach for manufacturing process equipment upgrades, specialized HVAC and unusual motor systems. Many new technologies are introduced through this custom approach first, then become prescriptive once the technology is proven. In addition to electric energy savings, the program quantifies savings in raw material, scrap, water and labor when an industrial process improvement is proposed. The program provides financial incentives, technical assistance, training, and commissioning. Financial incentives are in the form of rebates that will cover 50% of the installation cost.			
Budget:	2000: $6.5M utility cost, $6.5M customer cost 2001: $11.3 utility cost, $11.3M customer cost 2002: $5M utility cost, $5M customer cost		
Program Performance, Outcome, Recognition:		**Lessons Learned:**	

The Energy Initiative Custom Program may be the leading program in the country for promoting chillers retrofits. Approximately 5,000, or 55% of National Grid's customers have participated in the program since 1989. Since 1994, approximately 1.6GWh and 55 MW of savings have been achieved. The program eceived 2003 ACEEE Commercial/ Industrial Custom and Comprehensive Exemplary Program recognition.	More of the Initiative's projects are custom rather than prescriptive. The custom track offers a superior opportunity to test new equipment and to capture opportunities previously unavailable.
Why SF should adopt this Program:	**Contact/Website:**
The program can provide additional information to SF in their effort to increase the efficiency of commercial customers and reduce their demand, especially during seasonal peak periods	Tom Coughlin 508-421-7239

II. Building Commissioning

Over the past 15 years, building commissioning has been gaining recognition as a highly cost effective process for achieving energy efficient and health-promoting buildings, with simple paybacks of 1.5 years or less. Commissioning ensures that a building's various energy systems and equipment, such as lighting and space conditioning, operate according to design intent. In the industry jargon, commissioning for existing buildings includes retro-commissioning, which applies to buildings that never have been commissioned and re-commissioning, which applies to buildings that have been commissioned in the past three to five years. Continuous commissioning of a building is typically performed on an annual, bi-annual, or ongoing basis. It is becoming a standard practice that new buildings are commissioned prior to being "put in service" for the first time. LEED-rated new buildings require commissioning before many points (approx. 1/3 of the available points, all the points in the energy and atmosphere section) become available. A LEED rated building may also earn an extra credit for commissioning planning during the design stage and preparations for re-commissioning following project completion to ensure that energy savings persist. Building commissioning has proven to be cost effective method not only for saving energy but also improving building air quality and occupant comfort. Measures range from simple solutions such as recalibrating equipment and controls schedules or set points to opportunities for installing higher efficiency equipment, yielding reduced building operating costs and superior service.

Portland's Existing Building Commissioning

Portland General Electric has long been a leader in providing and a proponent of, building re-commissioning services. Currently, this program is undergoing a period of transition because the state's efficiency utility, Energy Trust of Oregon, is taking over the utilities' efficiency programs.

<table>
<tr><td>Program Administrator:</td><td>Program Title, Start Date:</td><td>Targeted or Eligible Population:</td><td>Participation Rate:</td></tr>
<tr><td>Portland General Electric (PGE)</td><td>Existing Building Commissioning; 1998</td><td>Large commercial and Industrial Customers</td><td></td></tr>
<tr><td>Funding Source:</td><td colspan="3">Funded through rates.</td></tr>
<tr><td colspan="4">Description:
The program is set up to help building owners/operators to achieve and maintain optimum performance in their buildings. The program compensates for the commissioning service that is performed by a contractor, after PGE has concluded through their initial assessment that the building is suitable for recommissioning.</td></tr>
<tr><td colspan="2">Program Performance, Outcome, Recognition:</td><td colspan="2">Lessons Learned</td></tr>
<tr><td colspan="2">Frequently, additional opportunities are identified through commissioning which qualify for incentives under other programs. Savings from the program have been difficult to anticipate, as savings are unpredictable. It is difficult to estimate what opportunities will be identified. This program has been PGE's most cost effective effort. Also of note, this program created a market for recommissioning by educating the building owner's of the benefits of recommissioning. Received ACEEE 2003 Commercial/Industrial HVAC Honorable Mention recognition.</td><td colspan="2">Although Oregon is known for having contractors aware and qualified to re-commission buildings, the biggest problem faced by the program is finding qualified consultants to meet the large demand. Oregon's electric deregulation resulted in the creation of a new entity to administer electric efficiency programs of the state's IOUs. Currently, there is not a replacement for this program within the state's new program administrator</td></tr>
<tr><td colspan="2">Why SF should adopt this Program:</td><td colspan="2">Contact/Website:</td></tr>
<tr><td colspan="2">A lack of commissioning activities has been identified within SF. PGE's efforts can prove useful in SF's efforts to enhance their building commissioning plans.</td><td colspan="2">Janice Peterson 503-603-1624</td></tr>
</table>

SCE and California Building Energy Initiative

The California Building Energy Initiative is a pilot program funded by Southern California Edison and the State of California to retrocommission between 9 and 12 buildings in the Southern California Edison service territory. The program objective was to prove the cost-effectiveness of offering free engineering services aimed at identifying cost-effective measures that reduce energy consumption and demand. Architectural Energy Corporation implemented and evaluated the program, the details and results of which are summarized below.

Program Administrator:	Program Title, Start Date:	Targeted or Eligible Population:	Participation Rate:
Southern California Edison	California Building Energy Initiative; 2001	Medium to large commercial customers	Eleven buildings totaling 2,055,908 ft^2 were recruited for participation in this program, far exceeding the program goal of 1,200,000 ft^2. The selected buildings ranged in size from 60,000 ft^2 to 473,000 ft^2, and involved office buildings, university buildings, and worship facilities.

Funding Source:	SCE

Description:

The program contractor, Architectural Energy Corporation, developed a pilot program focused on retrocommissioning heating, ventilating, and air-conditioning (HVAC) equipment. The program offered free building evaluation, engineering services sponsored by SCE, and participants would pay to make the improvements to their buildings. Examples of recommended improvements include: upgrading building controls from pneumatic to direct digital control (DDC) or expanding existing DDC capabilities, staging chillers to allow for full load operation, raising the chilled water supply set point, reducing or resetting returning condenser water temperature, variable frequency drives on cooling tower fans, and more. Building operations personnel were also trained on commissioning concepts and on how to perform continuous commissioning.

Program Performance, Outcome, Recognition:	Lessons Learned
Numerous studies have shown that retro-commissioning of HVAC systems can reduce energy consumption by up to 20%. Energy savings in this program averaged 13.3%. Total savings for all eleven buildings was $506,000 and implementation cost was $641,000, yielding an avg. simple payback for all buildings of 1.3 years. Payback periods for each building ranged from 0.2 to 4.9 years.	Retrocommissioning is a cost-effective method of producing energy savings. Customers are more willing to participate if they are freed of financial obligation whether or not the recommended measures are implemented. Training is more effective if done after the participants observe real energy savings. Continuous commissioning is more difficult and requires dedicated personnel, as it can be difficult to commit staff resources without prior compensation. Cost effectiveness of implementing measures depends more on cost of energy ($/sf-yr) for a building than on a building's size (sq. ft.)

Why SF should adopt this Program:	Contact/Website:
A lack of commissioning activities has been identified within SF. PG&E's efforts can prove useful in SF's efforts to enhance their building commissioning plans.	Don Frey, Architectural Energy Corporation, (303) 444-4149. www.archenergy.com.

III. Load Control (Demand Response)

The region's electricity market has moved from regulated vertically integrated monopolies only to a mixture of regulated and competitive components. The wholesale market, in spite of questions raised by the price volatility of 2000-2001, is generally agreed to have moved farthest towards competition. The retail market, in contrast remains mostly a regulated monopoly market. Load control or demand response is one method of giving the retail market a market-based character. It begins with providing customers with a *differentiated pricing signal* such that when supplies are short, prices rise to induce energy conservation and when supplies are ample, prices moderate to allow for greater energy consumption[1]. Load control/demand response is generally activated a handful of times per year and last up to a few hours.

California has endorsed the concept of load control/demand response as a resource for competitive electricity markets. The state and each of its investor-owned utilities have active demand response programs. San Francisco could easily adopt or adapt a form of these existing programs and help promote or market these existing programs to, commercial, residential, and even its municipal customers[2]. Load control/demand response does not necessarily require capital-intensive investments, as minimum required equipment includes installation of a "smart" meter (around $500) and a telephone connection. On the utility side is providing the data processing and graphics software for program evaluation and savings verification. Below are three examples of load management and demand response programs in CA and elsewhere around the country.

US EPA's Energy Star Monitor Power Management Program

Program Administrator:	**Program Title, Start Date:**	**Targeted or Eligible Population:**	**Participation Rate:**
U.S. EPA	The ENERGY STAR Monitor Power Management Program; 2001	U.S. PC-intensive organizations: schools (K-12 and universities), government offices, and commercial businesses	
Funding Source:	U.S. EPA ENERGY STAR		
Description:			

[1] Other load control strategies are not market based on the retail end, but rather on the wholesale end. These strategies include buybacks or incentive payments to the customer to curtail their load during critical times. The burden is on the power supplier who must either pay higher prices during supply shortages on the wholesale market or incentivize their customer to consume less.

[2] See profile in this report of the San Francisco Community Cooperative that is currently working on establishing a critical peak pricing program for residents.

The ENERGY STAR Monitor Power Management (MPM) Program assists computer-intensive organizations to manage the electrical consumption of their computer monitors. This is accomplished through free software tools and services that automatically place active monitors in sleep mode (a reduction in consumption from 60-90 watts to 2-10 watts for a "sleeping") monitor. The MPM program can save an organization with 1000 computers on average 200,000 kWh per year.	
Program Performance, Outcome, Recognition:	**Lessons Learned**
By the end of 2002, the program had managed or committed to manage 1,200,000 monitors equaling a savings of approx. 240 million kWh per year. The program gained support from NEEP, Efficiency Vermont, NYSERDA, Citigroup and Computer Associates (second largest system integrator).	IT managers can be a bottleneck in implementing this software (inadequate time to deploy the software, not committed to energy efficiency, unsupportive because of the past failed PC box power management). Upper Management has also proven resistant to such efforts. To address these issues the following actions were initiated: 1) education materials making it easy to recognize cost-free methods to save energy quickly and easily were produced; 2) software tools were created, making organization-wide monitor power management quicker and easier for IT staff; 3) public relations campaigns were run to publicize an organization's participation in the program targeting upper management.
Why SF should adopt this Program:	**Contact/Website:**
SF's downtown corridor is occupied by several large commercial entities, employing large quantities of computers. The MPM program, by reducing non-working hour electrical consumption, con prove effective in addressing peak load reduction (winter and summer).	Robert Huang 617-673-7117, www.energystar.gov/powermanagment

SCE's Small Commercial Demand-Response Pilot Program

In 2001 the CPUC directed SCE to implement the SCE Energy$mart ThermostatsSM Pilot Program to test the viability of demand responsiveness among small commercial customers through two-way communicating thermostats. The objectives of the program included studying consumer participation and behavior patterns, consumer satisfaction with newer interactive demand response technologies, responsiveness of small commercial customer load to price or system demand signals, and the ability of such programs to deliver reliable and verifiable energy and demand savings.

Program Administrator:	Program Title, Start Date:	Targeted or Eligible Population:	Participation Rate:
Southern California Edison	SCE Energy$mart Thermostat^{SM} Pilot Program; 2001/2002	Small commercial and nonprofit customers with less than 200kW maximum demand and 1 GWh annual energy usage	45,000 thermostats installed on small, one stage air conditioners
Funding Source:	SCE		
Description:			

The program provides small commercial customers in SCE's service territory with two-way communicating thermostats. When the curtailment is activated, SCE uses a radio signal to remotely raise the cooling set point of the thermostat by a specified number of degrees up to 4° F, thereby reducing the cooling load. The thermostat sends a radio signal back indicating it has received the signal and has implemented the temperature rollback. The thermostat reports any overrides by the participants and can collect and report the hourly run time of the controlled units. Each curtailment lasts at most four hours.

Each participant received one or more free thermostats (including installation) and a $300 annual incentive per thermostat for participating in the pilot program. The participant is penalized $5 if the participant chooses to override a particular curtailment.

Program Performance, Outcome, Recognition:	Lessons Learned:
Evaluation of the Pilot Program revealed that the typical four-degree, two-hour curtailment yielded a maximum reduction of approximately 10 MW. The first hour energy savings were between 6 and 7 MWh, and second hour energy savings of about 3 MWh. The average effective duration of the savings was about 55 minutes.	The study confirms that AC units increase energy consumption per ton of cooling output as outside temperature increases. Because the control strategy raises set point temperature rather than cycling the AC unit on and off, "snapback" or jumps in energy consumption is avoided. Savings are greater during the first hour of curtailment vs. the second hour as the temperature difference b/t the building space and A/C set point is greater during the first hour. The building space temp rises during the second and subsequent hours as a result of the set point increase.
Why SF should adopt this Program:	**Contact/Website:**
This powerful tool opens up real-time communication between a utility and the end user and allows for direct control of peaking loads during critical periods. This feature maximizes savings when coupled with time of use pricing strategies.	Mark S. Martinez, Southern California Edison Roger L. Wright, RLW Analytics, Inc., Sonoma, CA rlw@rlw.com 707-939-8823

Seattle's MeterWatch Program

Program Administrator:	**Program Title, Start Date:**	**Targeted or Eligible Population:**	**Participation Rate:**
Seattle City Light	Seattle Meter Watch; 2001/2002	Large commercial	155 customer sites to date or 92% of target market. Marketing efforts continue.
Funding Source:	Seattle City Light		

Description:
Seattle's first online energy consumption information service is offered free to large business customers with excess demand over 1MW. These large customers already have interval metering installed as they have demand charges that vary by time of day. The free SMW Internet service displays data from "load profile" meters that record consumption and demand every five minutes (converted to 15-minute intervals for storage in the database). The base program provides a monthly update and daily updates are available via nightly downloads on an additional phone line connection. The data is available on SCL's restricted access the next day. SCL staff may view the data for any enrolled customer, allowing them to work with their customers on the phone and simultaneously bring up the same screen the customer is viewing. Staff or customers may also use the SMW download feature to move the 15-minute or hourly interval data into a spreadsheet or other tool for further analysis. Users include Engineering Directors, Chief Building Engineers, Energy Managers, Building Operators, Plant Managers, Maintenance Superintendents, Business Managers, Electrical Consultants, and Accounting staff.

Program Performance, Outcome, Recognition:	**Lessons Learned:**
Program goal is to reach 100% of target customers and 92% has been achieved in three years. Savings for a participant sample of 15 buildings was approximately 13,000 MWh per year or 7% when compared to a control goup. Savings on energy bills are estimated to total $736,000 for the 15 users. Customers like the service and say that the value gained from the daily updates more than offset the cost of the phone line connection.	Most new participants had never seen their building's load profile before. Keeping track of the most frequent users helps SCL identify those people who are responsible for maintaining the optimal and efficient operation of the building systems. After having had experience with SMW, some of the largest customers wanted the capability of viewing all of the building meters, and to verify the energy usage readings against their monthly energy bill statements.
Why SF should adopt this Program:	**Contact/Website:**
This powerful tool opens up real-time communication between a utility and the end user and allows for direct control of peaking loads during critical periods. The data collection and graphing features permit building personnel to evaluate building usage	Linda Lockwood, Seattle City Light

and plan for long term efficiency savings.	

Rewarding Business for Their Efforts

Recognition can be another cost effective way of motivating energy efficiency improvements in other customers. Recognition programs focus on the positive and reward customers for a job well done. Positive reinforcement can help motivate other businesses to participate in an efficiency program and/or implement efficiency projects to save money, and possibly enhance the business' image or reputation in the hopes of attracting new customers.

Portland's BEST Program

Program Administrator:	**Program Title, Start Date:**	**Targeted or Eligible Population:**	**Participation Rate:**
City of Portland	Businesses for an Environmentally Sustainable Tomorrow (BEST) program	Commercial and industrial businesses	
Funding Source:			
Description:			
The Businesses for an Environmentally Sustainable Tomorrow (BEST) program celebrates Portland Businesses' accomplishments. The program rewards innovation at an annual awards program and documents success with case studies that describe the top resource conservation strategies			
Program Performance, Outcome, Recognition:		**Lessons Learned**	
BEST award winners annually save $11.7 million through efficiencies and upgrades.			
Why SF should adopt this Program:		**Contact/Website:**	
Offering funding to assist with efficiency upgrades is not the only way to incentivize businesses. As the City of Portland has discovered, providing public recognition for businesses' efforts serves to inspire others and highlights the savings associated with investing in efficient technologies.		http://www.sustainableportland.org/default.asp?sec=energy&pg=home	

Especially for Small Business

San Francisco has an impressive number of small businesses ranging from corner grocers and hardware stores to specialty shops. The SFE recognizes this and has elements of its new Pilot Program directed at this harder to reach sector. However, efficiency efforts focused on small businesses will need to continue once the Pilot Program ends. The program below provides an innovative strategy for targeting efficiency in small businesses.

City of Lodi's Small Business Energy Partnership

The City of Lodi's Small Business Energy Partnership encourages small businesses to suggest innovative efficiency improvements on their own in addition to qualifying prescriptive measures specified in the program for rebates. Such a program encourages innovation and the adoption of new, currently unrecognized technologies by the prescriptive measures.

Program Administrator:	**Program Title, Start Date:**	**Targeted or Eligible Population:**	**Participation Rate:**
City of Lodi Electric Utility	Lodi Small Business Energy Services Partnership	Small business customers	
Funding Source:	System benefit funds		
Description:			
Provides eligible customers with a direct cash incentive of up to $250 for the reimbursement of materials and/or services related to the implementation of specific energy conservation measures. This partnership requires implementation of any, or all, of the following energy conservation measures and applications: lighting retrofits, shade screens or awning covers, ceiling fans/attic ventilators, HVAC, refrigeration, insulation/weather stripping, special projects—other energy efficiency projects not listed above (e.g. system replacements or system upgrades)			
Program Performance, Outcome, Recognition:		**Lessons Learned**	
Why SF should adopt this Program:		**Contact/Website:**	
This program allows for flexibility in choosing the right efficiency measure for each business. Such a program gives the customer some latitude to qualify for a rebate and would allow SF to capture greater savings.		209-333-6815, Rob Lechner	

Existing CA State Programs Applicable to San Francisco Businesses

The CPUC's EnergySmart Grocer program, which packages Express Efficiency rebates specific to non-chain grocers with an on-site energy audit and analysis. Incorporating this program into the city's effort would enhance its coordinated and comprehensive offerings.

The CEC also offers programs not mentioned within the Pilot Program that could prove to enhance its overall goal: the ‘Cash for Kilowatts’ and the ‘Real Time or Time-of-Use Meters’ Programs.

PG&E offers the following programs: ‘Base Interruptible Program,’ ‘Demand Bidding Program,’ ‘Optional Binding Mandatory Curtailment Plan,’ and ‘Scheduled Load Reduction Program.’ All of these can prove useful in decreasing the city’s peak demand. These programs can be marketed to the city’s businesses along with other elements within the Pilot Program (because PG&E is the utility for San Francisco businesses, these programs will be available to them. However, the Pilot Program does not specifically mention their inclusion.).

Also worth consideration are the various programs that both PG&E and the CEC currently offer to provide incentives for the installation of renewable and distributed energy sources. PG&E offers the ‘Self-Generation Incentive Program’ that provides financial incentives to customers who install certain kinds and sizes (up to 1.5 megawatt) of clean, on-site distributed generation. Qualifying technologies currently include: fuel cells, microturbines, internal combustion engines, and small gas turbines operating both on renewable and non-renewable fuel, as well as wind turbines. The CEC program offers incentives for: fuel cells using renewable fuels, inverters, photovoltaic modules, small wind turbines, system performance meters and solar thermal systems.

RESIDENTIAL PROGRAMS

Comprehensive Programs

San Francisco has included a Codes and Standards element of the Pilot Program to ensure that energy efficiency is an integral component of building and purchasing decisions. Included are analyses and recommendations of efficiency ordinances applicable to new and existing structures that exceed current Title 24 requirements. Also included is the application of the LEED rating system to city buildings.

In the interest of creating a well-educated staff and a comprehensive set of programs and ordinances addressing efficiency, Austin Energy's *A Guide To developing Green Builder Programs*, could prove informative to SF. The guide describes program development and green building techniques and discusses issues, costs, technologies, availability, practicality and additional references, from framing materials to xeriscaping. The information is designed to provide officials a template of a green building program that can be easily customized.

Following are several examples of programs that merge green building principles into city building codes.

Austin's Green Building Program

Austin's Green Building program was one of the first programs of its kind in the county and has become its community's definitive resource for green building practices. The Austin Energy Green Building Program received the "Green Building Program of the Year" award from the National Association of Homebuilders (NAHB) during the 2002 National Green Building Conference. The city has also recently released "Green by Design" an interactive CD-ROM for use in public workshops, and has published a three-volume reference set called *The Sustainable Building Guidelines*. The first is specifically useful for department heads and other City officials, interested citizens, building professionals, and city staff concerned with sustainability.

Program Administrator:	**Program Title, Start Date:**	**Targeted or Eligible Population:**	**Participation Rate:**
Austin Energy	Green Building Program; Major activities began in 1992	Residential (single and multi-family dwellings), commercial and industrial new construction	In FY2002, 19 commercial projects totaling 1.1 million square feet where consulted on, and 57% of new single-family dwellings have been rated

Funding Source:	Austin Energy: 97% City of Austin Water and Wastewater/Solid Waste Depts. : 3%
Description:	
The City of Austin has developed a first-of-its-kind rating system for green buildings. The program rates new and retrofit construction in the areas of energy conservation, water conservation, sustainable materials, health and safety, and community. The program also provides a full range of consulting services to help construction professionals design and build better buildings that are durable and energy efficient. Financial incentives are given to design teams that incorporate sustainable methods and materials in new construction and renovation projects. Memberships are offered to building professionals who have made a commitment to build green. The Public Works Department requires that all architectural firms working on city projects demonstrate a strong working knowledge of green building practices. The 14 staff members of the Green Building program have become expert resource for the community, promoting sustainable building through consumer marketing, education, and technical training of building professionals.	
Budget:	$1.2 million annually

Program Performance, Outcome, Recognition:	**Lessons Learned**
In 2002, 57 percent of all new home construction projects in the Austin Energy service area were rated. In FY2000 peak demand for all customers was reduced by 6.5 MW and consumption reduced by 11,698 MWh. During the program's life, more than 3100 single-family homes and 6,000 units of multifamily housing have received ratings. Also recognized by ACEEE as Residential New Construction Exemplary Program.	Design the program to be user friendly; train the trainer; easy entry; sell the benefits not the features; gain buy-in without shaming people into being energy efficiency conscious; make changes to the program as the market matures.
Why SF should adopt this Program:	**Contact/Website:**
Austin's Green Building Program was the first. As such, the trials and challenges faced by these early adopters can help SF bypass early problems associated with such a transition and expedite the creation of a knowledge-building department.	Richard Morgan 512-505-3709 OR www.ci.austin.tx.us

City of San Jose's Green Building Program

The city of San Jose, California has recently implemented a Green Building Program using the LEED rating system. Through its engagement with the building community, it is providing a positive force and leadership toward green building practices within the San Jose community.

Program Administrator:	**Program Title, Start Date:**	**Targeted or Eligible Population:**	**Participation Rate:**

Administrator:	Start Date:	Population:	
City of San Jose, Environmental Services	Green Building Program	City owned facilities	Nine facilities have been chosen for early adoption
Funding Source:	City funded		
Description:			
In addition to requiring City buildings to be designed and built using Green Building principles, the City of San José encourages building owners, architects, developers, and contractors to incorporate meaningful sustainable building goals early in the building design process. The Leadership in Energy and Environmental Design (LEED^{TM}) rating system is a key component of this effort.			
Program Performance, Outcome, Recognition:	**Lessons Learned**		
The City of San José Green Building Program achieved honorable mention in the 2002 Business Environmental Awards. The program has resulted in nine City projects being identified for early application of the adopted Green Building Policy and for the evaluation of potential cost impacts. These projects included eight public works projects (four branch libraries, three community centers, and the Civic Center) and one redevelopment agency project (Pala Youth Center)			
Why SF should adopt this Program:	**Contact/Website:**		
The program has only recently been adopted by the city of San Jose, but has received recognition for its achievements. The program provides a local example of the hurdles and barriers that must be crossed to create a successful Green Building Program for city buildings.	http://www.ci.san-jose.ca.us/esd/GB-HOME.HTM		

Portland's G/Rated Program

Portland's 'G/Rated' program has successfully mobilized city bureaus as advocates in achieving the goal of greater efficiency. The program serves not just the city staff, but the general community and building professionals.

Program Administrator:	Program Title, Start Date:	Targeted or Eligible Population:	Participation Rate:
City of Portland, Green Building Division	G/Rated Program	Commercial, residential and mixed use building constructers, developers, building owners and users	Value as a resource extends beyond the city of Portland

Funding Source:	
Description:	
An innovative program promoting high performance, resource-efficient and healthy development practices coordinating the expertise and resources of six City bureaus. The program offers a variety of guidelines, case studies, technical briefs, and reports developed by G/Rated staff. It also serves as a clearinghouse of green building policies, economic and productivity benefits studies, advocacy organizations, journals, and news services. The program maintains a collection of green building rating systems, LEED resources, LCA tools, model specifications, product databases, local regulations, and assistance programs. Also provided is a comprehensive list of green building strategy-specific technical resources, best practices, and related websites. This program sets aggressive goals and recommends a carefully selected set of strategies to leverage local expertise and develop cost-effective solutions for builders, developers, building owners and users.	
Program Performance, Outcome, Recognition:	**Lessons Learned**
G/Rated has grown to be one of the most comprehensive and credible resources for green building practices and research in the US. Over the last two years, as of February 2003, forty-one commercial and mixed-use buildings totaling 3.1 million square feet have implemented green building design and construction practices. Portland's Green Investment Fund and the Portland Development Commission's green affordable housing requirements add another 1314 units of efficient, durable, and healthy housing to the mix. Also, more than thirty affordable housing projects with almost 2000 units are in financing and pre-design phase. Other accomplishments include the adoption of two green building policies for city-owned facilities and city-funded, private sector development.	
Why SF should adopt this Program:	**Contact/Website:**
The City of Portland has an international reputation for successfully balancing community development, growth management, and environmental stewardship. This program can serve to inform SF's efforts to enhance the Codes and Standards of the city, and provide an example of incorporating the LEED rating system.	http://www.green-rated.org/g_rated/grated.html

Multi-Family Dwellings

Within the Pilot Programs is an element for addressing the city's multi-family dwellings. Three established programs have been recognized for delivering excellent services with equally favorable results to multi-family housing unit managers and owners.

All three programs share certain characteristics. They coordinate programs that are offered to multi-family units, they act as a partner to owners or managers in following through with recommended actions, and lastly they provide continuous management and informational support in fulfilling all requirements for successful completion of the project.

Efficiency Vermont's Low-Income Program: Comprehensive Multifamily

Efficiency Vermont's 'Multifamily Low-Income Program' is innovative in that it sponsors comprehensive, fuel-blind building efficiency packages, rather than providing incentives on a prescriptive measure-by-measure basis. By targeting both new and existing multi-family housing through this program, Efficiency Vermont is now recognized as a valuable technical resource for the vast majority of owners and developers of low-income multifamily housing in Vermont. Through this experience, Efficiency Vermont has developed a *Design Guide for Energy Efficient Multi-Family Housing*, which is used as a teaching guide for architects and engineers.

Program Administrator:	**Program Title, Start Date:**	**Targeted or Eligible Population:**	**Participation Rate:**
Efficiency Vermont	Multi family Low-Income Program, March 1997	New and existing multi-family low-income buildings	90% participation of new construction or major rehabilitation projects, approx. 25% of existing units participate in retrofits
Funding Source:	Initial development funded by DOE grant through Rebuild America. Operations funded by four Vermont Utilities and administered by the State Weatherization Program 1997-2000. Since March 2000 funding is via an Energy Efficiency Utility (EEU) charge attached to all Vermont's electric bills. This charge was mandated by the Vermont Public Service Board's creation of an *Efficiency Utility* contract.		
Description:			
The program offers comprehensive support of energy-saving measures for building owners. Incentives are specifically allocated for comprehensive approaches that encourage adoption of all cost-effective measures, as opposed to a prescriptive measure-by-measure basis that focuses on quick payback measures, which a building owner is likely to do on their own without incentives. Efficiency measures include building shell measures, lighting, appliances, high-efficiency space heating and cooling systems, high-efficiency water heating systems, ventilation, and fuel substitution where applicable in existing buildings.			
Budget:	2001: $836,149 2002: $1,525,000 2003: $1,123,337		

Program Performance, Outcome, Recognition:	Lessons Learned
This program has been very successful in leveraging investments in efficiency. Less than 50% of investment in efficiency has been provided through the EEU funds. Since 1997, approx. 6,000 multi-family dwellings have participated, yielding 12,291 MWh in savings and a total demand reduction of 525MW since 2000. Efficiency Vermont developed a *Design Guide for Energy Efficient Multi-Family Housing*, which is used as a teaching guide for architects and engineers.	Actors within the multi-family market sector are also actors within other sectors. Building relationships with these participants - suppliers, designers, contractors, etc. - through training, education, and partnerships in the multi-family programs provides an opportunity to influence other market segments as well.
Why SF should adopt this Program:	**Contact/Website:**
This program can serve to further inform SF's plans to address efficiency in the multi-family dwelling sector.	Jennifer Chiodo, Director of Business Energy Services, 802-860-4095 OR www.efficiencyvermont.com

Oregon Energy Trust's MAP: Turnkey Program for Multifamily Housing

The city of Portland, Oregon has a long history of successfully creating novel programs to address opportunities for greater efficiency within the city. To address the opportunities within Portland's multi-family dwellings, the city created the Multi-family Assistance Program (MAP), which markets, bundles and coordinates programs for multi-family buildings. The MAP program is in essence a turnkey program for multi-family housing. Oregon's program has proven successful in marketing and bundling program offerings from two investor owned utilities and can inform San Francisco's efforts to do the same.

Program Administrator:	Program Title, Start Date:	Targeted or Eligible Population:	Participation Rate:
City of Portland	Multifamily Assistance Programs	Residential customers of one of the two utilities	
Funding Source:	Energy Trust of Oregon		
Description:			
The City of Portland's Office of Sustainable Development brings rental property owners a one-stop-shop Multifamily Assistance Program (MAP) to make property improvements that save energy and water. MAP works with the State's new Energy Trust, which is similar to Vermont's Efficiency Utility, to provide information and referral on a variety of resource efficiency opportunities, financial incentives, and other programs designed to help property owners. MAP helps get the audit process started, explains the audit recommendations, provides technical assistance, identifies financial incentives, helps with contractor selection, fills out paperwork and performs any other tasks that an owner might need to keep their project on track.			
Program Performance, Outcome, Recognition:	**Lessons Learned**		

Why SF should adopt this Program:	**Contact/Website:**
The CCSF-PG&E partnership poses many opportunities as well as challenges. Program administrators must have an intimate understanding of each other's programs in order to eliminate duplication and capitalize on synergistic relationships. They must then effectively articulate the opportunities to targeted sectors within SF. Portland's example of navigating inter-agency programs, bundling and communicating all relevant programs to the owners of multi-family dwellings can further inform SF's efforts in targeting multi-family dwellings.	503-823-0530 or 1-800-813-2201 OR http://www.sustainableportland.org/default.asp?sec=energy&pg=home

Alameda Power and Telecom: Downloadable Rebates from the Internet

The single-family component of the Pilot Program is for direct install items. An effective method for delivering the rebates to the customs comes from Alameda Power and Telecom. Their Great White Light sale has proven to be their most cost effective. An online program delivery system could enhance San Francisco's system for distributing rebates for all targeted appliances, not just for CFLs.

Program Adminstrator:	**Program Title, Start Date:**	**Targeted or Eligible Population:**	**Participation Rate:**
Alameda Power and Telecom	Great White Light Sale (CFL discounts)	Residential customers	APTs most popular program
Funding Source:	Funded through rates		
Description:			
Downloadable coupon to receive $2.00 off the purchase of an Energy Star qualified compact florescent lamp			

Program Performance, Outcome, Recognition:	**Lessons Learned**
Over the past 11 years this program has resulted in the conservation of over 1 million MWh	
Why SF should adopt this Program:	**Contact/Website:**

The city of Alameda is also faced with a predicted gap between demand and supply. Like SF, the city of Alameda is mining for kWs through efficiency as a means of closing this gap. A few of their programs address targets also applicable to SF such as lighting and electric space heat within multi-family dwellings. This program is regarded as one of their most successful in ease of distribution, consumer involvement and MWs saved.	http://www.alamedapt.com/electricity/whitesale.html

Private Sector Partnerships/Appliance Recycling

NYSERDA's Keep Cool Program

NYSERD's 'Keep Cool' Program is an excellent example of harnessing the resources of the retailer and manufacturer industries to facilitate market transformation. Having run other efficiency programs since 1998 for NYSERDA, Aspen Systems had already established relationships with retailers and manufacturers. Operating the Keep Cool program further strengthened existing relationships and led to the development of new private sector relationships. Through incentives such as co-op advertising (sharing cost of advertising) and providing point of purchase (POP) materials such as program signage next to the products in the store, Aspen Systems was able to draw retailers to the program. By working together with the local recycling companies to pick up A/C units at designated pick up sites, the Keep Cool program was able to put 217,000 old units out of service. Additionally, the A/C units are disassembled and reusable parts are salvaged.

Program Administrator:	**Program Title, Start Date:**	**Targeted or Eligible Population:**	**Participation Rate:**
NYSERDA	Keep Cool, 2000	Residential customers	193,687 customer applications received and almost 1000 retailer and manufacturer partners
Funding Source:	System benefits funds		
Description:			
The goals of the program are to permanently increase the market share of ENERGY STAR products in New York State, reduce peak load, and increase general awareness of ENERGY STAR products. Residents receive $35 for turning in an old, working room air conditioner in exchange for a new, more efficient A/C unit from a participating retailer. To participate as a qualified retailer, they must have 2 or more POPs and 4 or more E-Star appliance on their shelves, agree to abide by the DOE guidelines for advertising E-Star products, and agree to submit sales and inventory information to Aspen Systems. Marketing materials were printed in both English and Spanish, and a toll-free number and web site were made available to residents for answering their questions. Field personnel and 'mystery shoppers' are deployed			

for program quality control, to ensure that retailers are fulfilling the agreements.	
Program Performance, Outcome, Recognition:	**Lessons Learned**
193,687 customer applications received and almost 1000 retailer and manufacturer partners recruited between 2001 and 2002. Approx. 2,000 phone calls per day, 7 days/week received via toll-free number in inquiries about the program. Approx. $15 million in bounties paid for the turn-in since 2000, resulting in 62 MW of summer 2002 peak reduction.	Program administrator generally heard about problems with a retailer or program via the toll-free number. Rules must be clear and easy for customers to understand. Automate processes as much as possible. Work through corporate headquarters to get national chain retail/manufacturer buy-in. Work program education into new employee training courses.
Why SF should adopt this Program:	**Contact/Website:**
	Lisa hammer, Aspen Systems Corporation (301) 519-6264 Jamie Lalos, NYSERDA (518) 862 – 1090

Existing CA State Programs Applicable to San Francisco Residents

The CEC provides an additional set of program offerings in the form of incentives for the purchase and installation of home distributed generation systems. Included technologies are inverters, photovoltaic modules, small wind turbines, system performance meters, solar thermal, and fuel cells using renewable fuels.

Also for SF's consideration is the use of property taxes. The installation of a DG system can increased the assessed value of a home, which translates to higher property taxes. Delaying this increase can serve to remove a barrier from home owners and perhaps encourage the immediate consideration of a home DG system, particularly if the delay was advertised to be available for a short time.