



Sustainability: San Francisco's Transbay Terminal

Clark Bisel, WSP Flack + Kurtz







TRANSBAY TRANSIT CENTER

➤ Design Team Core Values

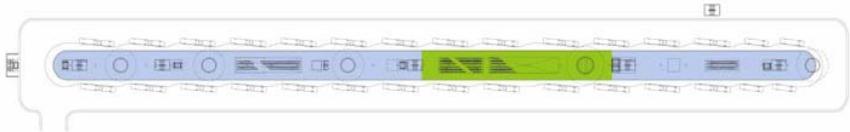
- Energy
- Water
- Transportation
- Sustainability

➤ Follow LEED, but use common sense first

TRANSBAY TRANSIT CENTER

Systems Design Overview:

- View the project as a whole – District energy potential
- Carefully define occupancy comfort needs (3 levels of occupancy)



Bus Level Zones



Concourse Level Zones



Ground Level Zones

- Natural Ventilated Transition Space
- Conditioned Transition Space with Higher Set Point
- Conditioned Space

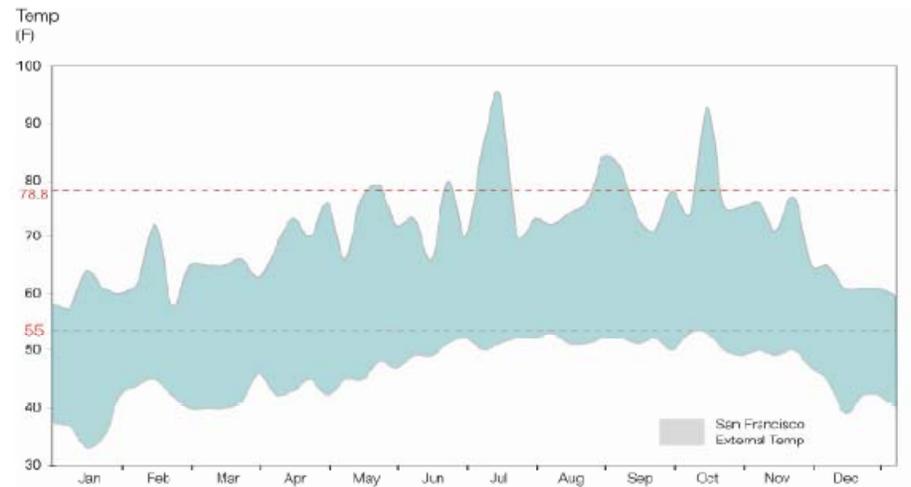
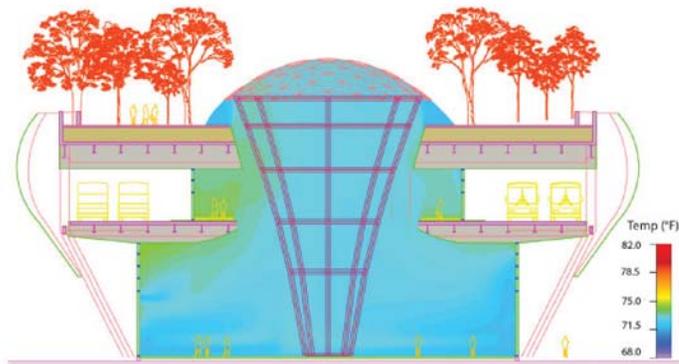
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Systems Design Overview:

- Use the natural environment
- ‘Control’ retail
- Reduce primary energy needs – thermal, lighting, ‘process’

REVISED

Transbay -Typcl Summer Updtd





Use of passive design techniques

Use of thermal mass
(+ the soil mass above)

Daylight penetration
reduces the centre
electrical energy
demand

Natural ventilation

Low energy radiant
Cooling and heating
embedded in the floor
system

“The Transit Center”

TRANSBAY TRANSIT CENTER

➤ Sustainable Aspirations (post-Concept Design):

- Implement Geothermal System
- Integrate Daylighting Solutions
- Explore Renewable Energy Systems

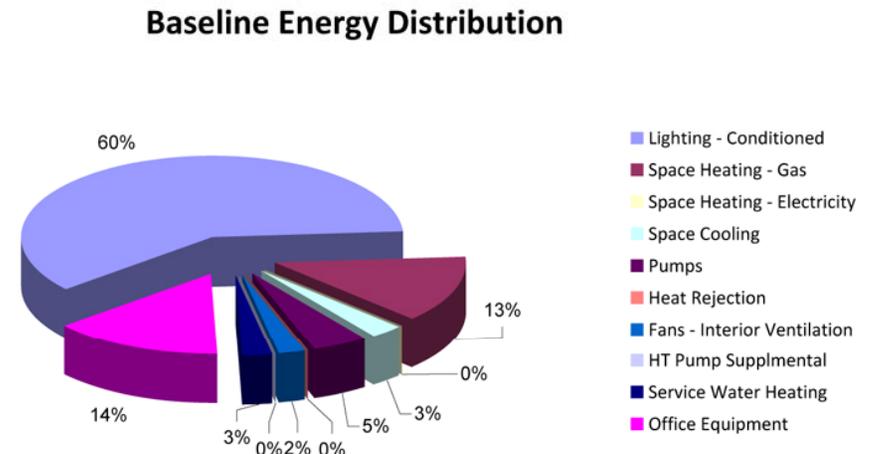


Renewable Energy Systems

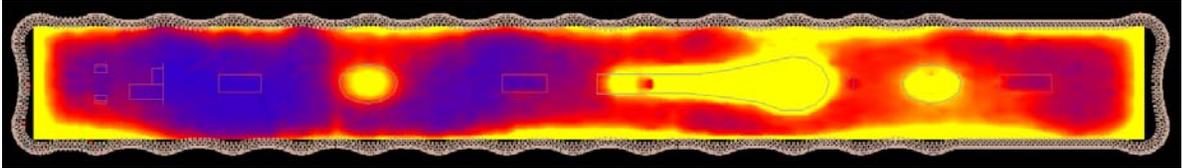
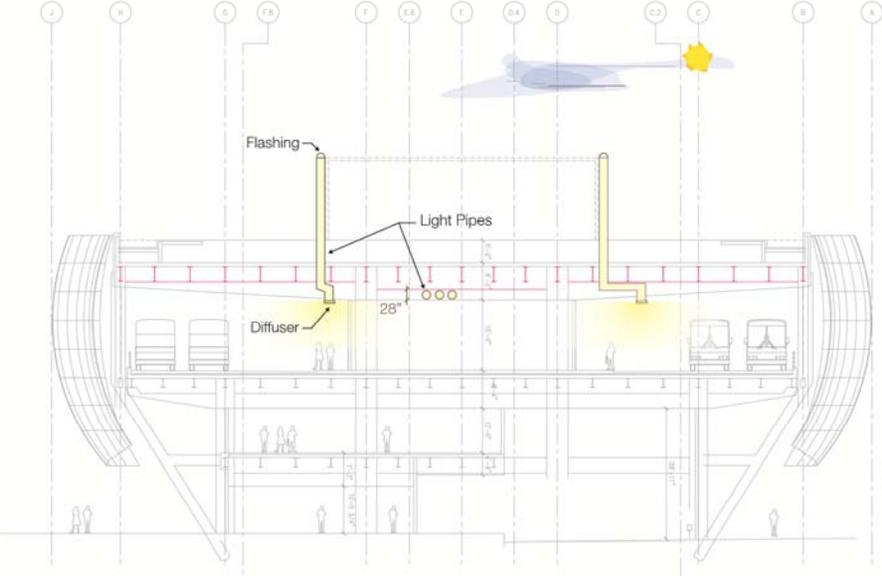


Transbay Transit Center – Lighting

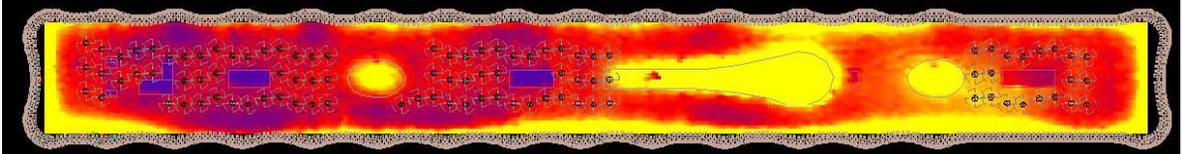
- Artificial lighting is provided throughout and is a dominant energy use.
- Lighting control allows dimming of artificial lighting in response to actual daylight.
- Opportunity to completely turn off artificial lighting during the day.



Daylighting Solutions



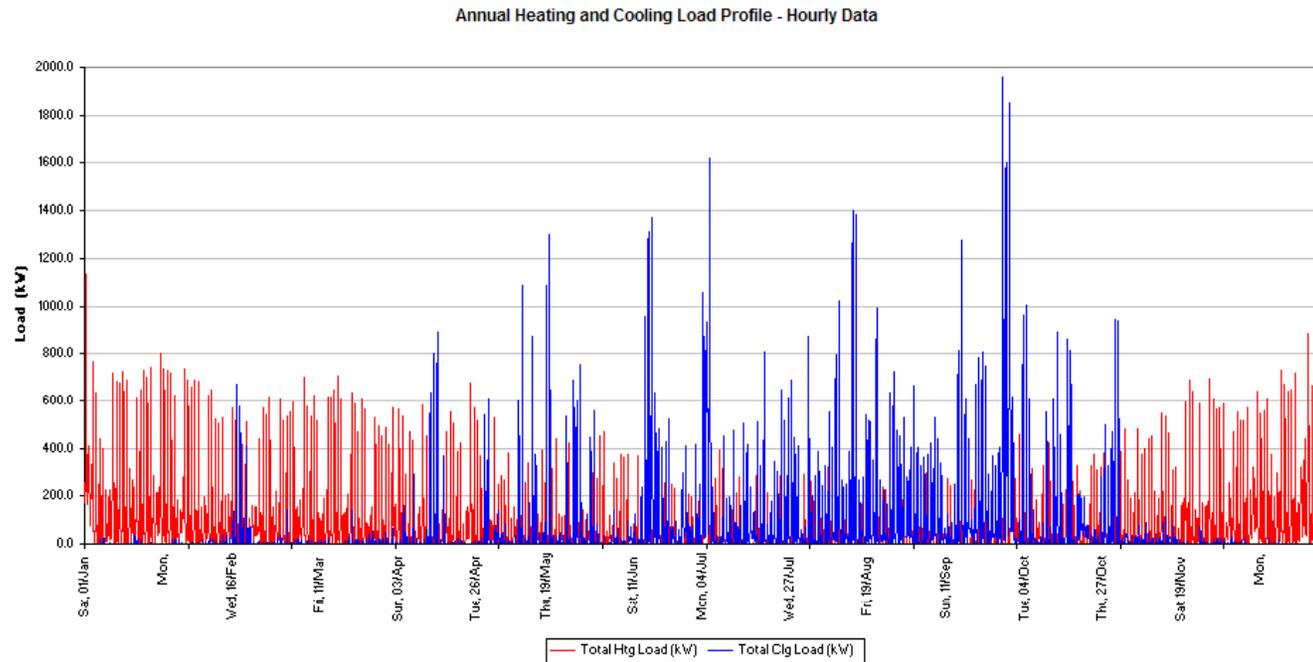
Without light tubes



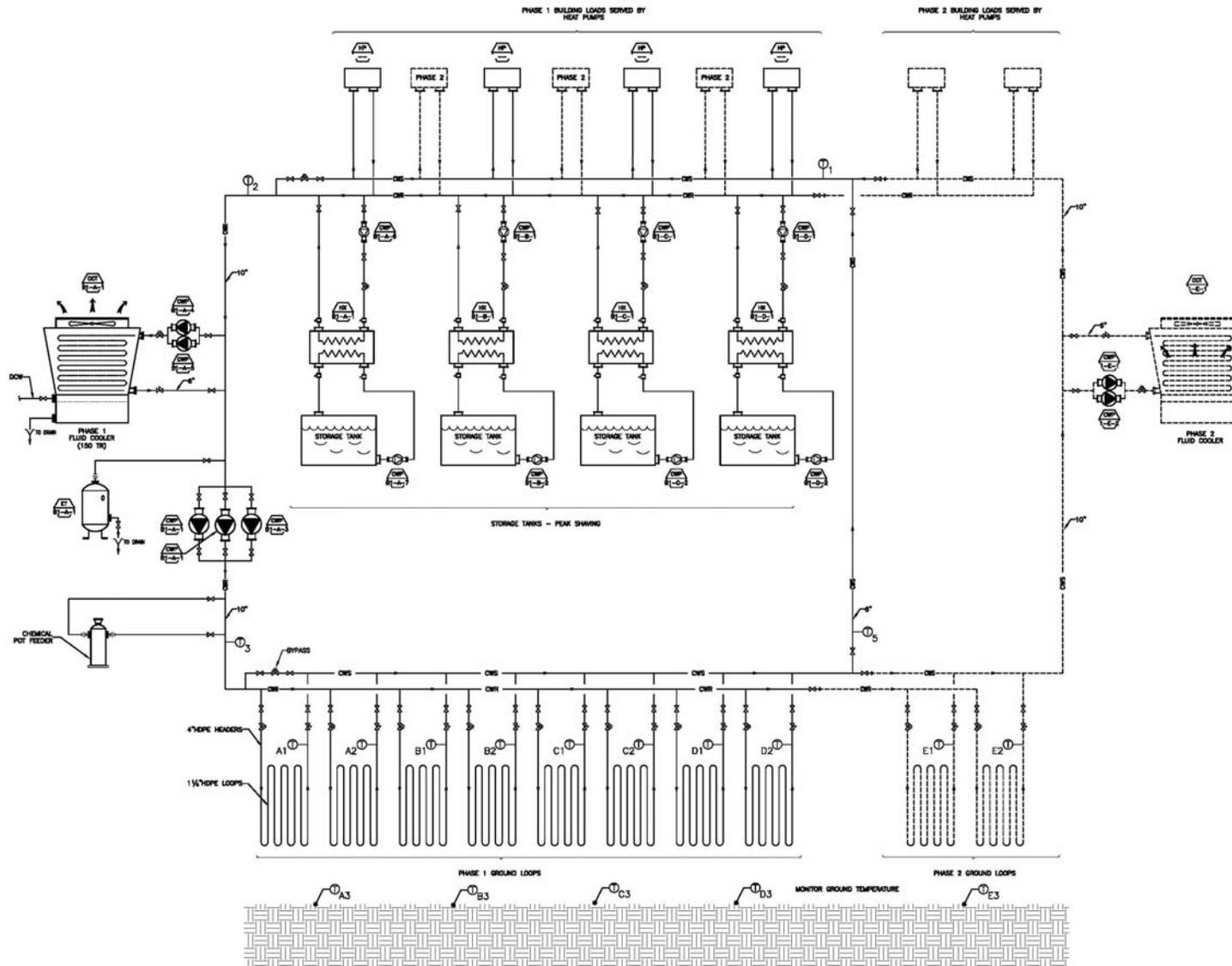
With light tubes

Geothermal / Graywater System

- The geothermal system - serve base thermal loads over long time periods.
- The greywater/stormwater tanks (like a battery) - serve intermittent thermal loads



Geothermal / Graywater System



Geothermal / Graywater System

- Qualitative Review – a scoring of these factors was completed.
- Life Cycle Cost Review – an analysis was completed and approved.
 - Construction cost differential – a consensus opinion between project cost consultant, general contractor, and design team.
 - Incentive payment (lump sum) – Savings by Design
 - Incentive payment (annually – based on performance) – CCX
 - Annual energy use is substantially reduced.
 - Annual chemical use is substantially reduced.
 - Annual water use is substantially reduced.
 - Annual sewer use is substantially reduced.
 - Annual operating labor is substantially reduced.
 - Annual maintenance is substantially reduced.
 - Replacement savings for tower, boiler, and piping
 - Phase 1 / Phase 2 impacts (temporary tower)

Transbay Transit Center Geothermal System Selection September 14, 2009											
Issue	Issue Weight	Alternative 0 - Conventional Cooling Towers and Boilers				Alternative 1 - Geothermal					
		1-10	Score 1-5	Remarks	Score 1-5	Remarks					
Occupant Comfort											
Comfort	No Difference		0			0					
Indoor Air Quality	No Difference										
MPOC/American Legion	No Difference										
First Cost											
Markets of Cost	5	5	5.0		2	16					
MARKETS/Financing											
Installation											
Construction Cost	1	4	4		5	5					
Electrical Cost	3	4	4		5	5					
Architectural Cost	3	4	4		4	12					
Operational Treatment	1	3	3		5	5					
Operative - Occupancy	2	0	0		5	10					
Operative - Security	3	2	4		5	15					
Other	10	0	0		5	50					
Life Cycle Cost											
Life Cycle Cost	5	3	15		5	45					
Equipment	6	3	18		4	24					
Operative - Occupancy	4	3	12		4	16					
Operative - Security	10	0	0		5	50					
Other											
Other	4	3	12		4	16					
Operative - Occupancy	6	3	18		4	24					
Operative - Security	4	3	12		4	16					
Other											
Other	5	3	15		3	15					
Operative - Occupancy	2	0	0		2	10					
Operative - Security	4	2	8		5	20					
Other	4	3	12		5	20					
Operative - Occupancy	2	0	0		2	10					
Operative - Security	5	2	10		5	25					
Other											
Other	2	5	10		4	20					
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Operative - Security	5	2	10		5	25					
Other											
Other	2	5	10		4	20					
Operative - Occupancy	5	2									

Geothermal / Graywater System

Transbay Transit Center

Life-Cycle Costing Review - Composite - Geothermal + Greywater Systems

ANALYSIS PERIOD: 25 YEARS
DISCOUNT RATE: 5.5%

Construction Estimate \$3,000,000
PG&E Savings by Design (see notes) (\$200,000)
NET FIRST COST: \$2,800,000

YEAR	CAPITAL COST	CCX ANNUAL INCENTIVE SAVINGS	PHASE 1 ENERGY HVAC / DHW SAVINGS	ESC RATE	PHASE 2 ENERGY HVAC / DHW SAVINGS	ESC RATE	WATER / SEWER SAVINGS	ESC RATE	CHEMICAL SAVINGS	ESC RATE	OPERATING LABOR SAVINGS	ESC RATE	MAINTENANCE SAVINGS	ESC RATE	REPLACEMENT SAVINGS	ESC RATE	TOTAL ANNUAL SAVINGS	DISCOUNTED ANNUAL SAVINGS (NPV)	YEAR
1	(\$2,800,000)	\$300	\$36,238	6.5%	\$0	6.5%	\$76,777	7%	\$2,500	5%	(\$4,840)	3%	\$3,000	3%	\$0	3%	(\$2,686,024)	(\$2,545,995)	1
2		\$300	\$38,594	6.5%	\$0	6.5%	\$82,152	7%	\$2,625	5%	(\$4,985)	3%	\$3,090	3%	\$0	3%	\$121,775	\$109,409	2
3		\$300	\$41,103	6.5%	\$0	6.5%	\$87,902	7%	\$2,756	5%	(\$5,135)	3%	\$3,183	3%	\$0	3%	\$130,109	\$110,803	3
4		\$300	\$43,774	6.5%	\$0	6.5%	\$94,055	7%	\$2,894	5%	(\$5,289)	3%	\$3,278	3%	\$0	3%	\$139,013	\$112,214	4
5		\$300	\$46,620	6.5%	\$0	6.5%	\$100,639	7%	\$3,039	5%	(\$5,447)	3%	\$3,377	3%	\$0	3%	\$148,527	\$113,643	5
6		\$3,300	\$49,650	6.5%	\$0	6.5%	\$107,684	7%	\$3,191	5%	(\$5,611)	3%	\$3,478	3%	\$0	3%	\$161,691	\$117,266	6
7		\$3,465	\$52,877	6.5%	\$37,543	6.5%	\$115,222	7%	\$3,350	5%	(\$5,779)	3%	\$3,582	3%	\$0	3%	\$210,260	\$144,540	7
8		\$3,638	\$56,314	6.5%	\$39,983	6.5%	\$123,287	7%	\$3,518	5%	(\$5,953)	3%	\$3,690	3%	\$0	3%	\$224,478	\$146,269	8
9		\$3,820	\$59,975	6.5%	\$42,582	6.5%	\$131,918	7%	\$3,694	5%	(\$6,131)	3%	\$3,800	3%	\$0	3%	\$239,657	\$148,019	9
10		\$4,011	\$63,873	6.5%	\$45,350	6.5%	\$141,152	7%	\$3,878	5%	(\$6,315)	3%	\$3,914	3%	\$0	3%	\$255,863	\$149,790	10
11		\$4,212	\$68,025	6.5%	\$48,297	6.5%	\$151,032	7%	\$4,072	5%	(\$6,505)	3%	\$4,032	3%	\$0	3%	\$273,166	\$151,582	11
12		\$4,422	\$72,446	6.5%	\$51,437	6.5%	\$161,605	7%	\$4,276	5%	(\$6,700)	3%	\$4,153	3%	\$0	3%	\$291,639	\$153,397	12
13		\$4,643	\$77,155	6.5%	\$54,780	6.5%	\$172,917	7%	\$4,490	5%	(\$6,901)	3%	\$4,277	3%	\$0	3%	\$311,362	\$155,233	13
14		\$4,876	\$82,170	6.5%	\$58,341	6.5%	\$185,021	7%	\$4,714	5%	(\$7,108)	3%	\$4,406	3%	\$0	3%	\$332,420	\$157,092	14
15		\$5,119	\$87,511	6.5%	\$62,133	6.5%	\$197,973	7%	\$4,950	5%	(\$7,321)	3%	\$4,538	3%	\$0	3%	\$354,903	\$158,973	15
16		\$5,375	\$93,200	6.5%	\$66,172	6.5%	\$211,831	7%	\$5,197	5%	(\$7,541)	3%	\$4,674	3%	\$0	3%	\$378,908	\$160,877	16
17		\$5,644	\$99,258	6.5%	\$70,473	6.5%	\$226,659	7%	\$5,457	5%	(\$7,767)	3%	\$4,814	3%	\$0	3%	\$404,538	\$162,805	17
18		\$5,926	\$105,709	6.5%	\$75,054	6.5%	\$242,525	7%	\$5,730	5%	(\$8,000)	3%	\$4,959	3%	\$0	3%	\$431,903	\$164,756	18
19		\$6,223	\$112,580	6.5%	\$79,932	6.5%	\$259,502	7%	\$6,017	5%	(\$8,240)	3%	\$5,107	3%	\$0	3%	\$461,121	\$166,732	19
20		\$6,534	\$119,898	6.5%	\$85,128	6.5%	\$277,667	7%	\$6,317	5%	(\$8,487)	3%	\$5,261	3%	\$541,833	3%	\$1,034,151	\$354,433	20
21		\$6,860	\$127,692	6.5%	\$90,661	6.5%	\$297,104	7%	\$6,633	5%	(\$8,742)	3%	\$5,418	3%	\$0	3%	\$525,627	\$170,756	21
22		\$7,203	\$135,992	6.5%	\$96,554	6.5%	\$317,901	7%	\$6,965	5%	(\$9,004)	3%	\$5,581	3%	\$0	3%	\$561,192	\$172,805	22
23		\$7,564	\$144,831	6.5%	\$102,830	6.5%	\$340,154	7%	\$7,313	5%	(\$9,274)	3%	\$5,748	3%	\$0	3%	\$599,166	\$174,880	23
24		\$7,942	\$154,245	6.5%	\$109,514	6.5%	\$363,965	7%	\$7,679	5%	(\$9,552)	3%	\$5,921	3%	\$0	3%	\$639,713	\$176,981	24
25		\$8,339	\$164,271	6.5%	\$116,632	6.5%	\$389,442	7%	\$8,063	5%	(\$9,839)	3%	\$6,098	3%	\$0	3%	\$683,007	\$179,107	25
TOTAL	(\$2,800,000)	\$110,618	\$2,134,000		\$1,333,395		\$4,856,084		\$119,318		(\$176,463)		\$109,378		\$541,833		\$6,228,163	\$1,266,368	

This scheme saves approx. 1.25 million dollars (on an NPV basis) over its lifetime.

NOTES:

Taxable effects are ignored.
PG&E Savings by Design Incentive is approximation, prior to any negotiation / discussion.

