# MGA Campus Building Greenhouse Gas Emissions Summary



# Prepared for MGA Entertainment

Date **4/16/2014** 

Prepared by



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<u>Disclaimer</u>: Brummitt Energy Associates, Inc. makes no guarantee that energy savings will be achieved as estimated, except that services or work product were performed pursuant to generally accepted standards of practice in effect at the time of performance. Any recommendations which may be made are for the consideration of the architect and engineers; they are not to be used instead of, or as a replacement for, licensed design. Many factors in the construction and operation of the building will affect the energy use, which are outside of Brummitt's ability to control. This report is based on our understanding of the building design at this time. These results are subject to change with changes to the current design.

# 1. Executive Summary

This report summarizes the results of a whole building energy model to estimate reduction in greenhouse gas emissions relative to a Business as Usual (BAU) case for the proposed MGA Campus.

The BAU case is defined by Title 24-2008. The Proposed building will be built at a minimum to Title 24-2013 standards.

The project target is to demonstrate a GHG emissions reduction of at least 20% compared to the BAU case. The energy model results confirm that GHG emissions can be reduced by an estimated 20% by designing to the following targets:

- Meet the Title 24-2013 standards that will be applicable to this project
- Design the existing building to meet Title 24-2013 standards with some additional energy efficiency improvements consistent with a LEED v3 Certified project
- Install a PV system of minimum size of 175 kW DC.

Percent reduction in GHG emissions associated with different sized renewable energy systems is shown in this report for reference.

## Estimated lbs CO2e/yr

	<b>Business as Usual</b>	Proposed
Nonresidential	3,516,604	3,061,940
Residential	4,704,878	3,935,085
Site	1,095,032	621,436
Subtotal	9,316,514	7,618,461
PV	0	-166,793
Total	9,316,514	7,451,668

Reduction = (9,316,514 - 7,451,668) / 9,316,514 = 20%

# 2. Greenhouse Gas Emissions Assumptions

This section summarizes the assumptions used for calculating GHG emissions. The assumptions are consistent throughout this report.

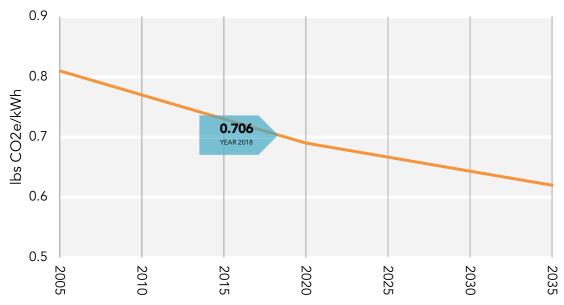
The source of GHG emissions values are from SCAG EIR scenarios, as modeled by Calthorpe Associates' using the Rapid Fire model.

http://rtpscs.scag.ca.gov/Documents/peir/2012/draft/2012dPEIR AppendixE GreenhouseGasAssumptions.pdf

Table 9 from Appendix E is reproduced below.

	2005	2020	2035
Electricity Emissions (lbs/kWh)	0.81	0.69	0.62
Natural gas emissions (lbs/therm)	11.7	11.7	11.7

Assuming a linear trend between years, GHG emissions rate from electricity consumption is estimated to be 0.706 lbs CO2e/kWh for the year 2018 (estimated buildout year).



# **Electricity Emissions (lbs CO2e/kWh)**

Based on this data, multipliers for greenhouse gas (GHG) emissions used in this analysis are as follows:

- Electricity: 0.706 lbs CO2e / kWh
- Natural gas: 11.7 lbs CO2e / therm

# 3. Summary of Business as Usual (BAU)

#### **Title 24-2008 Prescriptive Requirements**

The following table is a summary of the <u>Title 24-2008 Prescriptive Requirements for Climate Zone 9</u>, which defines BAU for this project.

	Residential	Nonresidential
Walls	• Wood frame U=0.059	<ul> <li>Metal frame U = 0.062</li> <li>Mass walls U=0.690</li> </ul>
		<ul> <li>Wass walls 0=0.070</li> <li>Wood frame U=0.059</li> </ul>
Roof	• U=0.028	• U=0.039, Cool roof
		• 3-year aged solar reflectance = 0.55
		<ul> <li>Thermal emittance = 0.75</li> </ul>
Floor/Soffit	• U=0.039	• U=0.071
Slab on Grade	• F=0.73	• F=0.73
Windows	<ul> <li>Approx 15% WWR</li> </ul>	<ul> <li>Approx 35% WWR</li> </ul>
	• U=0.47	• U=0.77
	• SHGC (North) = 0.61	• SHGC (North) = 0.61
	• SHGC (North) = 0.40	• SHGC (North) = 0.34
Skylights	• N/A	Approx 3% SRA
		• U=1.11
		• SHGC=0.40
HVAC	<ul> <li>Heat Pump, 13 SEER</li> </ul>	<ul> <li>Heat Pump, 13 SEER (small nonres)</li> </ul>
		<ul> <li>Packaged VAV units: 9.5 EER</li> </ul>
		<ul> <li>Boiler, 80% for reheat</li> </ul>
		<ul> <li>Constant speed HHW pumping</li> </ul>
Lighting	<ul> <li>Residential units – not regulated</li> </ul>	<ul> <li>Whole building office: 0.85 w/sf</li> </ul>
	<ul> <li>Corridors for residential: 0.60 w/sf</li> </ul>	
Site Lighting	<ul> <li>Covered Parking: 0.3 w/sf</li> </ul>	Covered Parking: 0.3 w/sf
	<ul> <li>Surface parking: 0.092 w/sf</li> </ul>	Surface parking: 0.092 w/sf
Domestic HW	• 80% Gas	• Electric, EF = 0.93
Renewable	• None	None

#### **BAU Results**

A project built to the standards summarized on the previous page, and using Title 24-2008 ACM Performance energy modeling guidelines is estimated to consume:

	kWh/yr	Therms/yr	lbs CO2e/yr
Nonresidential	4,796,311	11,146	3,516,604
Residential	5,245,599	85,597	4,704,878
Site	1,551,037	0	1,095,032
Subtotal			9,316,514
PV			
Total			9,316,514

Total GHG emissions of BAU design are estimated to be 9,316,514 tons CO2e/yr.

# 4. Summary of Proposed Project

#### **Proposed Project Features**

The project will be built to comply with, at a minimum, the Title 24-2013 energy code requirements. The major Proposed project features are summarized in the table below. All items are consistent with the Title 24-2013 Prescriptive requirements unless marked with an asterisk, which indicates that higher efficiency products are planned. These "higher efficiency" items were selected by the project team to help support a planned LEED certification for the existing building.

	Residential	Nonresidential
Walls	<ul> <li>Wood frame U=0.059</li> </ul>	• Metal frame U = 0.062
		<ul> <li>Mass walls U=0.690</li> </ul>
		• Wood frame U=0.059
Roof	• U=0.028, Cool roof	• U=0.039, Cool roof
	<ul> <li>3-year aged reflectance = 0.63</li> <li>Thermal emittance = 0.75</li> </ul>	<ul> <li>3-year aged solar reflectance = 0.63</li> <li>Thermal emittance = 0.75</li> </ul>
Floor/Soffit	• U=0.071	• U=0.071
Slab on Grade	• F=0.73	• F=0.73
Windows	Approx 15% WWR	Approx 35% WWR
	• U=0.46	• U=0.41
	• SHGC (All) = 0.26	• SHGC (All) = 0.26
Skylights	• N/A	Approx 3% SRA
		• U=0.58
		• SHGC=0.25
HVAC	Heat Pump, 14 SEER	<ul> <li>Heat Pump, 14 SEER (small nonres) with economizers</li> </ul>
		• (*) High efficiency water-cooled
		centrifugal chillers, VFD, NPLV=0.34
		• (*) Primary-variable CHW pumping
		CHW/HW VAV units
		CHW/HW fan coils with economizers
		• Boiler, 80% for reheat
		• (*) Variable speed HHW pumping
		Fault Detection & Diagnostics
Lighting	<ul> <li>Residential units – not regulated</li> </ul>	<ul> <li>Whole building office: 0.80 w/sf</li> </ul>
	<ul> <li>Corridors for residential: 0.60 w/sf</li> </ul>	
	Occ. sensors on all res. corridor lighting	
Site Lighting	<ul> <li>Covered Parking: 0.2 w/sf</li> </ul>	Covered Parking: 0.2 w/sf
	<ul> <li>Surface parking: 0.090 w/sf</li> </ul>	• Surface parking: 0.090 w/sf
	<ul> <li>Occupancy sensors - garage lighting</li> </ul>	<ul> <li>Occupancy sensors - garage lighting</li> </ul>
Domestic HW	• 80% Gas	• Electric, EF = 0.93
Renewable	None	• (*) Minimum 175 kW DC PV system
/	1 . 1	

(\*) Items marked with an asterisk are proposed improvements beyond the Title 24-2013 Prescriptive baseline requirements. These "higher efficiency" items were selected by the project team to help support a planned LEED certification for the existing building.

## **Proposed Project Results**

A project built to the standards summarized on the previous page, using the same energy modeling methodologies as described for the BAU case, is estimated to consume:

	kWh/yr	Therms/yr	lbs CO2e/yr
Nonresidential	4,235,786	6,109	3,061,940
Residential	4,156,119	85,544	3,935,085
Site	880,221	0	621,436
Subtotal			7,618,461
PV	-236,250		-166,793
Total			7,451,668

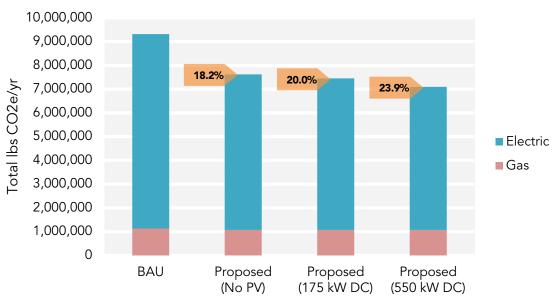
Total GHG emissions of Proposed design are estimated to be 7,451,668 tons CO2e/yr.

Reduction below BAU = (9,316,514 - 7,451,668) / 9,316,514 = 20%.

#### Summary of PV Benefit

The following chart shows the percent reduction in GHG gas emissions with three varying PV scenarios: No PV, 175 kW DC, and 550 kW DC.

- 175 kW DC is chosen as it represents the minimum required to achieve 20% GHG emissions reductions relative to BAU.
- 550 kW DC is chosen as it represents a conservative prediction of what could reasonably fit on the roof.



Percent GHG Reduction vs PV Size

- Without PV, GHG emissions reduction is estimated at 18.2%
- With 175 kW DC PV, GHG emissions reduction is estimated at 20%
- With 550 kW DC PV, GHG emissions reduction is estimated at 23.9%

# Appendix A: Energy Modeling Summary Output

The following attachments are the energy model outputs (UTIL-1 Summary) for:

- 1) Residential areas
- 2) Nonresidential areas
- 3) Site (parking garage and site lighting)

## **Nonresidential Areas**

Proper Name     Date       MCAC Campus - Nonresidential     2492.014       Step 1     ANNUAL TOV ENERGY USE (kBur/sqft-yr)     Adjusted TOV Energy Use       ENERGY COMPONENT     Standard     Proposed       Space Cooling     124.76     42.33       Indoor Fans     44.69     46.72       Heat Rejection     0.00     21.13     21.13       Domestic Hot Water     27.89     0.00       TorALS:     339.27     34.63       Process Lighting     0.00     21.13       Process Lighting     0.00     0.00       TorALS:     339.27     34.637       Average 2pm - 5pm     Standard     Proposed       Pask Demand (kW)     1.44     Proposed       1.424 0     1.44     Proposed       1.424 0     1.44     1.144       Pask Demand (kW)     Standard     Proposed       Space Heating     53.77     34.637       Space Heating     6.637     0.00       Space Heating     6.637     0.00       Space Cooling     1.344     1.144       Porposed     Energing analysis that uses The 24       Pask Demand (kW)     1.244     Proposed       Space Heating     6.537     0.00       Space Heating     6.537     <	Savings By Design UTILITY INCENTIVE WORKSHEET UTIL-1							
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Pumps       1.36       13.44       -12.09       Margin       Standard       % Below         Domestic Hot Water       27.88       0.00       0.00       348.58       =       15.4 %         Receptacle       77.39       70.47       67.19       3.28       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00 <t< td=""><td></td><td>0.00</td><td>21.13</td><td>-21.13</td><td></td><td></td><td></td></t<>		0.00	21.13	-21.13				
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Dominant Number       No         Receptacle       72.39       72.39       72.39       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00								
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Drocess Lighting       0.00       0.00       0.00       0.00         TOTALS:       395.27       341.57       53.70       Conditioned Floor Area =       284.467.01 <sup>e</sup> sq. ft.         Step 3         ANNUAL SITE ENERCY USE         Average 2pm - 5pm       Standard       Proposed       Margin       The values shown here are based upon the results of an EnergyPro Complexe energy analysis that uses Title 24 manual.         ENERGY COMPONENT       Electricity       Natural Gas       Proposed       Margin       Electricity       Natural Gas         Space Heating       6.697       11.146       Electricity       Natural Gas       Electricity       Natural Gas         Space Heating       6.697       11.146       Electricity       41.027       6.007       4.0.01       5.0.07       6.007       4.0.01       5.0.07       6.007       4.0.01       5.0.07       6.007       4.0.01       5.0.07       6.007       4.0.01       5.0.07       6.007       4.0.01       5.0.07       6.007       4.0.01       5.0.07       6.007       4.0.01       5.0.07       6.007       4.0.01       5.0.07       6.007       4.0.01       5.0.07       6.007       6.007       6.007       6.	·				Owner Ir	icentive (>=10%)		
TOTALS:       395.27       341.57       53.70       Conditioned Floor Area       284.467.0F sq. ft.         Step 3       ANNUAL SITE ENERGY USE       The values shown here are based upon the results of an EnergyPro Compliance energy analysis that uses Title 24 profiles as specified in the Alternative Calculation Method market.         Average 2pm - 5pm       Standard       Proposed       Margin       EnergyPro Compliance energy analysis that uses Title 24 profiles as specified in the Alternative Calculation Method market.         Peak Demand (kW)       Electricity       Natural Gas       Proposed       Margin       Electricity       Natural Gas       Saturat       Natural Gas								
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(from step 2)Rate(from Step 3)SubtotalImage: Line colspan="2">Image: Line colspan="2" (from Step 3)Image: Line	Step 4 POTENTI				Incentiv	ve Savinos	3	
The Gas CompanyElectricity (kW) $kWh$ $kWh$ $\swarrow$ Electricity (kW) $=$ $100.00$ $\times$ $290.1$ $=$ $$29,010$ $\checkmark$ Sempra Energy utility"Natural Gas $=$ $100.0$ $\times$ $5,037$ $=$ $$5,037$ Owner IncentiveOwner Incentive(\$150,000 max) = $$120,368$ Potential incentives indicated on this report are available only through the Whole Building Approach Element of the Savings By Design Program for new construction and are NOT GUARANTEED. Projects MUST receive prior, written approval from The Utility during conceptual or early design development and must meet all other program requirements to qualify. Potential incentives are subject to program limitations based upon the incremental cost of the measures. "% Below in this equation is limited to 30"			(fro	om step 2)	Rate	(from Step	o 3) Subtotal	
Gas CompanyElectricity (kW)= $100.00$ × $290.1$ = $$29,010$ Sempra Energy utility"Natural Gas= $100.00$ × $5,037$ = $$5,037$ Owner Incentive(\$150,000 max) = $$120,368$ Potential incentives indicated on this report are available only through the Whole Building Approach Element of the Savings By Design Program for new construction and are NOT GUARANTEED. Projects MUST receive prior, written approval from The Utility during conceptual or early design development and must meet all other program requirements to qualify. Potential incentives are subject to program limitations based upon the incremental cost of the measures. "% Below in this equation is limited to 30"		Electricity (kWh)	)	15.4 %			525 = \$86,321	
Sempra Energy utility" Natural Gas $=$ 100.0 × 5,037 $=$ \$5,037 therm $($150,000 \text{ max}) =$ $$120,368$ Potential incentives indicated on this report are available only through the Whole Building Approach Element of the Savings By Design Program for new construction and are NOT GUARANTEED. Projects MUST receive prior, written approval from The Utility during conceptual or early design development and must meet all other program requirements to qualify. Potential incentives are subject to program limitations based upon the incremental cost of the measures.	Gas	Electricity (kW)				_	90.1 = \$29,010	
Owner Incentive (\$150,000 max) = \$120,368 Potential incentives indicated on this report are available only through the Whole Building Approach Element of the Savings By Design Program for new construction and are NOT GUARANTEED. Projects MUST receive prior, written approval from The Utility during conceptual or early design development and must meet all other program requirements to qualify. Potential incentives are subject to program limitations based upon the incremental cost of the measures. "% Below in this equation is limited to 30"	A Sempra Energy utility <sup>®</sup> Natural Gas = 100.0 × 5,037 = \$5,037							
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*% Below in this equation is limited to 30	Potential incentives indicated on this report are available only through the Whole Building Approach Element of the Savings By Design Program for new construction and are NOT GUARANTEED. Projects MUST receive prior, written approval from The Utility during conceptual or early design development and must meet all other program requirements							
	*% Below in this equation is limited to 30%.							

**Residential Areas** (See common residential corridors on following page)

				VE WORKSHEET UTIL-	
Project Name	5			Date	
MGA Campus - Residentia				4/9/2014	
Step 1 ANNUAL T	DV ENERGY	USE (kBtu/sqf	t-yr)	Step 2 PERCENT BELOW TITLE 24	
ENERGY COMPONENT	<u>Standard</u>	Proposed	<u>Margin</u>	Adjusted TDV Energy Use (Excludes Process Energy)	
Space Heating	0.02	0.19	-0.18		
Space Cooling	54.40	29.66	24.74	Standard Proposed Design Design Margin	
Indoor Fans	10.53	6.71	3.82	155.15 - 127.03 <b>=</b> 28.12	
Heat Rejection	0.00	0.00	0.00		
Pumps	2.90	3.18	-0.28	Standard         % Below           Margin         Design         Title 24*	
Domestic Hot Water	20.12	20.11	0.01	28.12 / 155.15 <b>=</b> 18.1 %	
Lighting	33.59	33.59	0.00	Incentive Eligibility Yes No	
Receptacle	33.59	33.59	0.00	Owner Incentive (>=10%)	
Process	0.00	0.00	0.00		
Process Lighting	0.00	0.00	0.00		
TOTALS:	155.15	127.03	28.12	Conditioned Floor Area = 696,006.5 ft <sup>2</sup> sq. ft.	
Step 3 ANNUAL S	ITE ENERGY	USE			
Average 2pm - 5pm	Standard	Proposed		The values shown here are based upon the results of an EnergyPro Compliance energy analysis that uses Title 24	
Peak Demand (kW)	1.034.1	729.3	204.0	profiles as specified in the Alternative Calculation Method	
	Stand	lard		manual. posed Margin	
ENERGY COMPONENT	Electricity	Natural Gas	Electricity	Natural Gas Electricity Natural Gas	
Crease Liesting	(kWh)	(therms)	(kWh) 6.829	(therms) (kWh) (therms)	
Space Heating Space Cooling	569 1,552,789	0	6,829 816,811	0 -6,260 0 0 735,977 0	
Indoor Fans	314,735	0	192,462	0 122,272 0	
Heat Rejection	0	0	0		
Pumps	92,487	0	104,657	0 -12,169 0	
Domestic Hot Water	0	85,597	0	85,544 0 53	
Lighting	1,143,190	0	1,143,190	0 0 0	
Receptacle	1,143,190	0	1,143,190	0 0 0	
Process	0	0	0	0 0 0	
Process Lighting	0	0	0	0 0 0	
TOTALS:	4,246,959	85,597	3,407,139	85,544 839,820 53	
Step 4 POTENTIA	L OWNER INC		CULATION	Incentive Savings	
The Gas	lectricity (kWh	(fro	18.1 %	$\begin{array}{c} \textbf{Rate} \\ \hline 18.1 \\ \text{$\xi/kWh} \end{array} \times \begin{array}{c} (from \text{ Step 3}) \\ 839,820 \\ kWh \end{array} = \begin{array}{c} \text{Subtotal} \\ \$152,007 \\ \$Wh \end{array}$	
CompanyElectricity (kW)= $100.00$ × $304.9$ =\$ $30,490$ A Sempra Energy utility"Natural Gas= $100.0$ × $53$ =\$ $53$					
¢/therm therm (\$150,000 max) = \$150,000					
Potential incentives indicated on this report are available only through the Whole Building Approach Element of the Savings By Design Program for new construction and are NOT GUARANTEED. Projects MUST receive prior, written approval from The Utility during conceptual or early design development and must meet all other program requirements to qualify. Potential incentives are subject to program limitations based upon the incremental cost of the measures. <i>EnergyPro 5.1.9.2 by EnergySoft</i> User Number: 4921 A <b>RunCode: 2014-04-09T14:49:48</b> ID: Page 1 of 1					

Unconditioned common corridors for residential

#### BAU Summary

	Area Estimate (sf)	Lighting watts/sf	Hours/yr	kWh/yr
Corridors	190,000	0.6	8,760	998,640

## Proposed Summary

	Area Estimate (sf)	Lighting watts/sf	Hours/yr	kWh/yr
Corridors	190,000	0.6	6,570 (*)	748,980

(\*) Occupancy sensors required in 2013 code. 25% savings in Corridors from 2013-2014 Statewide Customized Procedures Manual for Business - Section 2, Estimating Energy Savings

## Site Energy Use

#### BAU Summary

	Area Estimate (sf)	Lighting watts/sf	Hours/yr	kWh/yr
Covered Parking	588,995	0.3	8,760	1,547,879
Exposed Parking	7,837	0.092	4,380	3,158
Total				1,551,037

#### Proposed Summary

	Area Estimate (sf)	Lighting watts/sf	Hours/yr	kWh/yr
Covered Parking	588,995	0.2	7,446 (*)	877,131
Exposed Parking	7,837	0.090	4,380	3,089
Total				880,221

(\*) Occupancy sensors required in 2013 code. 15% savings in Corridors from 2013-2014 Statewide Customized Procedures Manual for Business - Section 2, Estimating Energy Savings