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Puente Power Project In Context of System-wide CH4 Emissions

To the California Energy Committee,

Below are comments by Todd Shuman, (2260 Camilar Dr. Camarillo, CA 93010, tshublu@yahoo.com, 805.987.8203) concerning the Puente Power Project, Docket # 15-AFC-01.

It is instructive to view the proposed Oxnard-area NRG natural gas-fired peaker power plant (Puente Power Project 15-AFC-01) as part of a larger system. While combustion of natural gas in a power plant produces substantially lower CO2 emissions than combustion of coal or petroleum, any reduction in GHG emissions relative to coal-fired or petroleum-fired power plant combustion is typically countered and neutralized by significant methane emissions in other parts of the natural gas power production system.

What are these other parts of the natural gas power production system?

1: Fugitive methane emissions from natural gas pipelines and associated pipeline components (such as compressors, pneumatic pumps, meter and regulator stations, and compressor rod packing) are the 4th largest source of methane emissions in California. In 2013, 360 million pounds of methane were emitted as fugitive natural gas pipeline emissions. [Source: CARB 2000-2013 GHG Inventory, page 37 -- 3.813 MMTCO2e (GWP-25), or 8.4 billion lbs. of CO2e using the 2007 IPCC 100-year methane GWP of 25. (3.813 X 10 to the sixth power X 2.204 X 10 to the third power = 8.4 X 10 to the ninth power. 84 X 10 to the eight power divided by 25 equals 3.6 X 10 to the eighth power, or 360 million pounds]

If a 2013 IPCC 20-year CH4 GWP is used, the carbon dioxide equivalency increases from 8.4 billion lbs. of CO2e (100-yr interval) to approximately 29 billion lbs. of CO2e (20-year interval). (CH4 GWP increases from 25 to 86 â€“ ratio of 1:3.44.)

Note: 8.4 billion lbs. of CO2 is the annual amount of CO2 emission by a yr 2010 coal-fired electricity-generating power plant. (Source: EPA)

2: Methane emissions from blown-out gas storage wells can be substantially greater than fugitive methane emissions from natural gas pipelines. As of 12/06/2015 at 11:59 pm, the methane release from the Aliso Canyon blown-out gas storage well had continued unabated for 50 days. The release of methane over a little more than a month and a half is conservatively estimated at 120 million pounds of methane emission, or a third of the annual 2013 fugitive methane emissions from natural gas pipelines! [100,000 pounds CH4 per hour X 24 hours per day X 50 days = 120,000,000 lbs. CH4.]

To provide some perspective, the cumulative atmospheric methane emission release from the Aliso Canyon storage well blowout as of December 12 (50 days) was equivalent to the annual amount of methane cumulatively released by 500,000 milking cows due to enteric fermentation.

A: Derivation train:

Aliso Canyon cumulative methane release over 50 days:

44,000-50,000 KG of CH4 per hour ----> approx. 100,000 lbs./hour ---> Multiply by 24 ---> approx. 2.4 million lbs./day

50 days multiplied by 2,400,000 lbs./day = 120,000,000 lbs. of CH4 released by blown-out well.

On an annual basis, one milking cow emits 240 lbs. of CH4 per year. Therefore,

120,000,000 lbs. of well-emitted CH4 /240 lbs. of CH4 per year emitted per milking cow = 500,000 milk cows

The daily Aliso Canyon natural gas storage well blowout methane emission amount is also equivalent to the daily amount of methane emitted by 3,650,190 milking cows.

B: Derivation train:

Alison Canyon Methane Emission Amount -- Daily:

44,000-50,000 KG of CH4 per hour ----> approx. 100,000 lbs./hour ---> Multiply by 24 ---> approx. 2.4 million lbs./day

Milking Cow Methane Emission Amount -- Daily:

One milking cow emits 109 KG of CH4/YR [1] ----> 240 lbs./YR ----> 240 lbs. per year/365 days per year = 0.6575 lbs./day ----> 0.6575 lbs. per day multiplied by an unknown # of milking cows = 2,400,000 lbs. of CH4 emitted per day by Aliso Canyon storage well ----> 2,400,000/0.6575 = 3,650,190 milking cows.

(Note: 3.65 million is over twice the number of producing milking cows in California, as of 01/14. [2] It is as if the already gigantic milking cow population in California has suddenly tripled in size with respect to daily atmospheric methane release.)

Alternatively, the daily Aliso Canyon natural gas storage well blowout methane emission amount is equivalent to the annual amount of methane collectively emitted by 10,000 milking cows.

C: Derivation train:

Milking Cow Methane Emission Amount -- Annual:

240 lbs. per year per milking cow X 10,000 milking cows = 2,400,000 lbs. of CH4

Footnotes:

1: Each milking cow emits CH4: 109 kg/cow/yr, or 239.8 pounds per year. See K. A. Johnson and D. E. Johnson, â€œMethane Emissions from Cattle,â€ Journal of Animal Science 73(8) (1995): 2483â€“92.
2: 1.81 million dairy cows and 583,000 beef cows in California (CA Beef Council, Jan 1, 2014) http://www.cfaitc.org/factsheets/pdf/Beef.pdf)

Additional submitted attachment is included below.

To the California Energy Commission,

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What are these other parts of the natural gas power production system?

1: Fugitive methane emissions from natural gas pipelines and associated pipeline components (such as compressors, pneumatic pumps, meter and regulator stations, compressor rod packing) are the 4th largest source of methane emissions in California. In 2013, **360 million pounds** of methane were emitted as fugitive natural gas pipeline emissions. [Source: CARB 2000-2013 GHG Inventory, page 37 -- 3.813 MMTCO2e (GWP-25), or **8.4 billion lbs.** of CO2e using the 2007 IPCC 100-year methane GWP of 25. (3.813 X 10 to the sixth power X 2.204 X 10 to the third power = 8.4 X 10 to the ninth power. 84 X 10 to the eight power divided by 25 equals 3.6 X 10 to the eighth power, or 360 million pounds]

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2: Methane emissions from blown-out gas storage wells can be substantially greater than fugitive methane emissions from natural gas pipelines. As of 12/06/2015 at 11:59 pm, the methane release from the Aliso Canyon blown-out gas storage well had continued unabated for 50 days. The release of methane *over a little more than a month and a half* is conservatively estimated at **120 million pounds** of methane emission, or **a third of the annual 2013 fugitive methane emissions from natural gas pipelines! [100,000 pounds CH4 per hour X 24 hours per day X 50 days = 120,000,000 lbs. CH4.]**

To provide some perspective, the cumulative atmospheric methane emission release from the Aliso Canyon storage well blowout as of December 12 (50 days) was equivalent to the **annual** amount of methane cumulatively released by 500,000 milking cows due to enteric fermentation.

A: Derivation train:

Aliso Canyon cumulative methane release over 50 days:

44,000-50,000 KG of CH4 per hour ----> approx. 100,000 lbs./hour ---> Multiply by 24 ---> approx.

2.4 million lbs./day

50 days multiplied by 2,400,000 lbs./day = 120,000,000 lbs. of CH4 released by blown-out well.

On an annual basis, one milking cow emits 240 lbs. of CH4 per year. Therefore,

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The daily Aliso Canyon natural gas storage well blowout methane emission amount is also equivalent to the **daily** amount of methane emitted by **3,650,190 milking cows.**

B: Derivation train:

Alison Canyon Methane Emission Amount -- Daily:

44,000-50,000 KG of CH4 per hour ----> approx. 100,000 lbs./hour ---> Multiply by 24 ---> approx. 2.4 million lbs./day

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(Note: 3.65 million is over twice the number of producing milking cows in California, as of 01/14. [2] It is as if the already gigantic milking cow population in California has suddenly tripled in size with respect to daily atmospheric methane release.)

Alternatively, the daily Aliso Canyon natural gas storage well blowout methane emission amount is equivalent to the **annual** amount of methane collectively emitted by **10,000** milking cows.

C: Derivation train:

Milking Cow Methane Emission Amount -- Annual:

240 lbs. per year per milking cow X 10,000 milking cows = 2,400,000 lbs. of CH4

Footnotes:

1: Each milking cow emits CH4: 109 kg/cow/yr, or 239.8 pounds per year. See K. A. Johnson and D. E. Johnson, "Methane Emissions from Cattle," *Journal of Animal Science* 73(8) (1995): 2483–92.
2: 1.81 million dairy cows and 583,000 beef cows in California (CA Beef Council, Jan 1, 2014) http://www.cfaitc.org/factsheets/pdf/Beef.pdf)

IPCC AR 5th, 2013, Chapter 8, Table 8.SM.6 and Fig 8.32

Tabulated and calculated by Todd Shuman, 11/05/2015

Atmospheric Heating Agents	Unit	CO2	**CH4**	BC	Misc	Sub-Total	Total	Notes
Table 8.SM.6 * [Radiative Forcing Over the Industrial Era, 1750-2011]	RF in W m-2	1.68	0.97	0.64	0.714	3.29	4.004	Misc:N20, CFC, HCFCs, HFCs, CO, NMVOC
% of Sub-Total (CO2+CH4+BC)		51.06	29.48	19.45				
Aprox % of Sub-Total (CO2+CH4+BC)		50	30	20				
% of Total		41.96	24.22	15.98	17.73			
Aprox % of Total		42	**24**	16	18			
Fig 8.32 **- 10yr Time Horizon	Pg CO2 - eq	37	38	23	15	98	113	Pt=Petagram, or one billion metric tons; Misc includes CO, N20,NOX
% of Sub-Total (CO2+CH4+BC)		37.76	38.78	23.47				
Aprox % of Sub-Total (CO2+CH4+BC)		38	39	23				
% of Total		32.74	33.63	20.35	13.27			
Aprox % of Total		33	**34**	20	13			
Fig 8.32 - 20yr Time Horizon**	Pg CO2 - eq	37	31	13	8	81	89	Pt=Petagram, or one billion metric tons; Misc includes CO, N20,NOX
% of Sub-Total (CO2+CH4+BC)		45.68	38.27	16.05				
Aprox % of Sub-Total (CO2+CH4+BC)		46	38	16				
% of Total		41.57	34.83	14.61	8.99			
Aprox % of Total		42	**35**	15	9			
Fig 8.32 - 100yr Time Horizon**	Pg CO2 - eq	37	10	3	4	50	54	Pt=Petagram, or one billion metric tons; Misc includes CO, N20,NOX
% of Sub-Total (CO2+CH4+BC)		74	20	6				
Aprox % of Sub-Total (CO2+CH4+BC)		74	20	6				
% of Total		68.52	18.52	5.56	7.41			
Aprox % of Total		69	**19**	6	7			

* Section 8.SM.8: Table with Values and Uncertainties to Support Figure 8.17. Table 8.SM.6 [Radiative forcing (RF, in W m–2) by emitted components as shown in Figure 8.17] is located on page 13 of the Chapter 8 Supplementary Material (8SM). “Figure 8.17 shows the forcing over the Industrial Era by emitted compounds (see Supplementary Material Tables 8.SM.6 and 8.SM.7 for actual numbers and references).” (Page 697, Chapter 8, IPCC 2013.) “Figure 8.17 - RF bar chart for the period 1750–2011 based on emitted compounds (gases, aerosols or aerosol precursors) or other changes. Numerical values and their uncertainties are shown in Supplementary Material Tables 8.SM.6 and 8.SM.7.” (Page 698, Chapter 8, IPCC 2013.)

** “Figure 8.32 shows global anthropogenic emissions of some selected components weighted by the GWP and GTP.” (Page 718, Chapter 8, IPCC 2013.)

Note: CO2=Carbon Dioxide, CH4=Methane, BC=Black Carbon