Estimating Annual Average Greenhouse Gas Emission Factors for the Electric Sector: A Method for Inventories

An EPIC Technical Working Paper

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About EPIC

The Energy Policy Initiatives Center (EPIC) is a non-profit research center of the USD School of Law that studies energy policy issues affecting California and the San Diego region. EPIC's mission is to increase awareness and understanding of energy- and climate-related policy issues by conducting research and analysis to inform decision makers and educating law students.

For more information, please visit the EPIC website at www.sandiego.edu/epic.

Table of Contents

1 Introduction 1

2 Background 2
2.1 General Conversion Factors 2
2.2 Types of Emissions Factors 3
2.3 Geographical Scope 3
2.4 Definitions of Electricity Usage Categories 4
2.5 Role of Private Supply 6
2.6 Customer Types 6
2.7 Treatment of System Losses 7

3 Method Overview 7

4 Emissions Factor for Electricity Supplied to SDG&E Bundled Customers 8
4.1 Emissions Factor for SDG&E-Owned Generation 8
4.2 Emissions Factor for Electricity from SDG&E Purchases 13
4.3 Annual Average Emissions Factor for SDG&E Bundled Electricity 19

5 Emissions Factor for Electricity Supplied to Direct Access Customers 20
5.1 Electricity Supplied by Direct Access Providers 20
5.2 Emissions from Electricity Supplied to Direct Access Customers 21
5.3 Comparison of Emissions from Direct Access 22

6 Private supply 22
6.1 PV Self-Serve 22
6.2 Non-PV Self-Serve 23

7 Summary of Annual Average Emissions Factors 23
7.1 SDG&E Service Territory 23
7.2 San Diego Region 24
7.3 Individual City Grid Emissions Factors 24

8 Limitations 25
8.1 Default Values 25
8.2 eGRID Values are Several Years Old 25
8.3 Private Supply Data Not Available by City 25

9 Summary of Data Sources 26

Executive Summary

This document provides a detailed description of the methodology used by the Energy Policy Initiatives Center (EPIC) to estimate an annual average greenhouse gas emissions factor for electricity supplied to the San Diego region and individual cities in the San Diego region for GHG inventory purposes. As electric sector accounts for approximately 25% of all greenhouse gas (GHG) emissions in the San Diego region, the electricity emissions factor is an important indicator in climate planning.

Electricity supplied to residents and businesses in the San Diego region and cities are from several sources. The local utility, San Diego Gas & Electric (SDG&E), generates, procures, and delivers electricity for its bundled customers. Other electricity service providers (ESPs) provide electricity for SDG&E Direct Access (DA) customers through SDG&E's transmission and distribution systems. Residents and businesses can also have private electricity supply from photovoltaics (PV) and non-PV sources.

The electricity emissions factors, expressed in pounds of carbon dioxide equivalent per megawatt-hour (lbs CO_2e/MWh), are developed for each source including: SDG&E-owned generation, net electricity procured by SDG&E for its bundled customer, and electricity procured for DA customers. The electricity emissions factor for the SDG&E service territory and San Diego region depends on the percentage of electricity from each source and emissions factor of each source in a given year. Depending on the power mix of electricity from each source, each city in the region will have its unique city specific electricity emissions factor.

Electricity Emission Factor in SDG&E Service Territory and San Diego region

Year	SDG&E Service Territory Emissions Factor (lbs CO2e/MWh)	San Diego Region Electricity Emissions Factor (lbs CO2e/MWh)
2010	691	694
2011	651	654
2012	763	765
2013	747	-
2014	665	-

1 Introduction

The electricity category accounts for approximately 25% of all greenhouse gas (GHG) emissions in the San Diego region[1]. As a result, the electricity emissions factor is an important indicator in climate planning. The electricity emissions factor is defined as the amount of GHG emissions per unit of generation measured in pounds of carbon dioxide equivalent per megawatt-hour (lbs CO_2e/MWh) or metric tons CO_2e per MWh (MT CO_2e/MWh). It is a critical variable to complete the following key elements in the climate planning process:

- Estimate the total GHG emissions from the electricity sector in an emissions inventory,
- Estimate baseline emissions levels,
- Develop business-as-usual projections of emissions into the future,
- Establish GHG emission reduction targets, and
- Quantify the GHG emissions reduced by actions and policies designed to reduce emissions (e.g., renewable portfolio standard or energy efficiency).

Many different emissions factors exist depending on the scope of analysis. Emissions factors exist for specific power plants, a specific electricity supplier like an electric utility, and a geographic region such as a county or state. For our purposes here, we are concerned with an emissions factor that represents the annual average emissions from a unit of electricity supplied to a geographic region or a group of customers. In our case, the weighted average electricity emissions factor for the San Diego County (San Diego region), a city in San Diego region, or customers with electricity supply from local utility. Many factors affect electricity emissions factor, including the quantity and fuel source of the following supplies of electricity:

- Power plants owned by the local utility,
- Purchased power by the local utility and supplied to customers,
- Supplied by other electric service provider (ESP) through Direct Access and Community Choice Aggregation, and
- Supplied by private supply.

For purposes of determining GHG emissions levels for an annual inventory, the emissions factor is an actual historical value. However, when determining the long-term GHG reductions from actions and policies, the emissions factor must be projected into the future and modified dynamically to reflect the impacts of other actions and policies.

This document provides a detailed description of the methodology used by the Energy Policy Initiatives Center (EPIC) to estimate an emissions factor for electricity supplied to individual cities in the San Diego region for a GHG inventory purposes. While this document focuses on a

[1] 2012 Greenhouse Gas Inventory for San Diego County and Projections. (2015). Prepared by EPIC for San Diego Association of Governments (SANDAG). Emissions from electricity category include emissions from electricity consumption in residential, commercial, industrial and other sectors. http://www.sdforward.com/pdfs/DraftAppendixD-2012GHGInventoryForSDCountyAndProjections.pdf

specific geographic area, its general approach could be used in most areas of California and the United States.

2 Background

This section provides general background information that is related to and supports the methods described here.

2.1 General Conversion Factors

EPIC used several general conversion factors including Global Warming Potentials (GWP) for primary greenhouse gases and mass conversion factors.

2.1.1 Global Warming Potentials (GWPs)

The primary greenhouse gases (GHGs) included in estimating the electricity emissions factor are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Each GHG has a different capability of trapping heat in the atmosphere, known as its global warming potential (GWP), which is normalized relative to CO2 and expressed in carbon dioxide equivalent (CO_2e). In general, the 100-year GWPs reported by the Intergovernmental Panel on Climate Change (IPCC) are used to estimate greenhouse gas emissions. The GWPs used in this document are 100-yr GWPs from the IPCC Fourth Assessment Report (AR4)[2] provided in Table 1.

Table 1 Global Warming Potentials for Primary Greenhouse Gases

Greenhouse Gas	Global Warming Potential (GWP)	
	100-yr	20-yr
Carbon dioxide (CO_2)	1	1
Methane (CH_4)	25	72
Nitrous oxide (N_2O)	298	289

2.1.2 Mass Conversion Factors

In this document, the electricity emissions factor is expressed in lbs CO_2e/MWh, all other mass units are converted to pounds (lbs) using Equation 1.

Equation 1 Mass Unit Conversion

$$1\ pounds\ (lbs) = 453.6\ gram\ (g) = 0.0005\ short\ ton = \ 0.0004536\ metric\ ton\ (MT)$$

[2] IPCC Fourth Assessment Report: Climate Change 2007. Direct Global Warming Potentials. (2013) https://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html

2.2 Types of Emissions Factors

There are several different types of electricity emissions factors each used for a different purpose. The two main types used in climate planning are average and marginal emissions factors.

2.2.1 Average Annual Emissions Factor

The most commonly used emissions factor used to estimate emissions from electricity is the average emissions factor, which represents the average CO_2 equivalent emissions per unit of total electricity delivered to customers over a given period. This report focuses on the annual average emissions factor for electricity.

2.2.2 Marginal Emissions Factor

To estimate the GHG impacts of reducing electricity use as a result of certain programs and policies (e.g., energy efficiency) a marginal emissions factor, which represents the CO_2 equivalent emissions associated with the next unit of electricity delivered, is normally used. This concept is sometimes called an avoided emissions factor. In general, electric sources are dispatched on an economic basis. That is, those with the lowest marginal cost are dispatched first, followed by sources with marginally higher costs. As an illustrative example, renewable energy sources like wind and solar have high capital costs but relatively low marginal costs, so they would typically be dispatched first. Nuclear might be dispatched next, followed by combined cycle gas turbines, and finally simple cycle gas peaker plants.

To estimate the GHG impacts of an energy reduction measure, understanding the average marginal electric resources that were avoided over the course of a year yields a more accurate value for that year than using the annual average value. While this report does not specifically address the marginal emissions factors, it is important to understand the different types of emissions factors and the role they play in climate planning.

2.3 Geographical Scope

The geographical scope of analysis is an important variable in determining the electricity emissions factor. Determining the annual average emissions factor for the Western Electricity Coordinating Council (WECC)[3] area is very different from determining one for the City of Chula Vista. It is possible to develop an emissions factor that is specific to the geographical scope, including state, region, and city.[4] Nonetheless, the methods described here for estimating an electricity emissions factor apply regardless of the geographic scope.

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[3] Western Electricity Coordinating Council (WECC) is the regional entity for the Western Interconnection. It includes 2 Canadian Provinces, 14 Western US States, and Northern Baja Mexico. https://www.wecc.biz/Pages/home.aspx

[4] The Climate Registry maintains the process for their-party verification of utility-specific electricity GHG emission factor. The utility-specific electricity GHG emission factors do not include the utility in San Diego religion, San Diego Gas & Electric (SDG&E). https://www.theclimateregistry.org/?s=general+reporting

It is important that the electric emissions factor represents to the extent possible the emissions caused by activities within the geographical scope of analysis. This not only allows a more accurate estimate of emissions but also allows for a more accurate depiction of the policies and actions implemented within the geographical scope. For example, one approach is to use the California Independent System Operator (CAISO)[5] territory emissions factor. This represents all the energy under CAISO control – a sort of pool of electricity. It would represent the average of all the sources of electricity within the control territory but would obscure how much renewable energy a particular load serving entity purchased.

2.4 Definitions of Electricity Usage Categories

The California Energy Commission (CEC) creates California Electricity Demand Forecast (CED Forecast) every two years to support the analysis and recommendations in the Integrated Energy Policy Report (IEPR). The CED Forecast provides a 10-year forecasts for electricity consumption, retail sales, and peak demand for the state and each of its five major electricity planning areas, including the San Diego Gas and Electric (SDG&E) planning area. The CED Forecast includes data in several different electricity usage categories: sales, consumption, net energy for load, and gross generation. We provide a definition of each category below:

- **Sales** – This is the total quantity of electricity sold to customers. This could be thought of as the annual quantity of electricity registered on the electric meter each year. Any private supply on the customer side of the meter would be reflected (i.e., already subtracted) in this amount.
- **Net Energy for Load** – This is sales plus the losses incurred in providing that quantity of electricity. Essentially, this is the total amount of electricity needed to serve the customer sales.
- **Consumption** – This is the total amount of electricity used by the customer including both sales and private supply. The private supply includes self-serve PV and self-serve Non-PV.
- **Gross Generation** – This is the total amount of electricity generation needed to supply consumption, including losses.

Figure 1 represents these categories graphically.

[5] California Independent System Operator operates a wholesale electricity market and manages the reliability of its transmission grid. http://www.ferc.gov/market-oversight/mkt-electric/california.asp

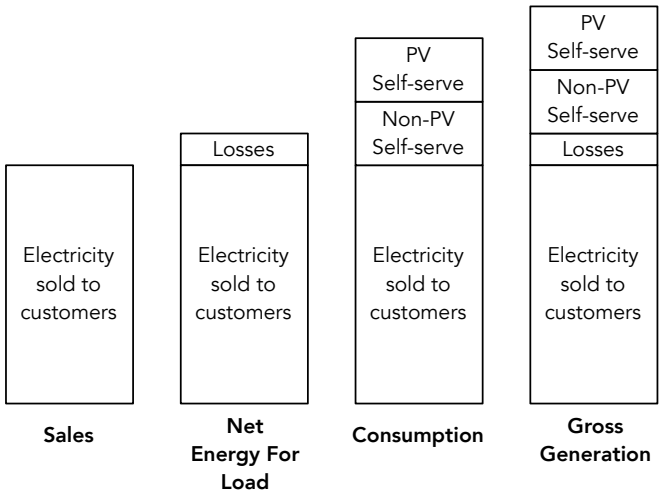

Figure 1 California Energy Commission Electricity Usage Categories

As an illustration of the different electricity categories,

Table **2** provides values for each electricity usage category in the SDG&E planning area from 2014.[6]

Table 2 Electricity Usage Categories in SDG&E Planning Area for 2014 (GWh)[7]

Category	Sales	Net Losses	Non-PV Self-Serve	PV Self-Serve	Total	Definition
Sales	20,116	-	-	-	20,116	Quantity of electricity sold to customers
Net Energy for Load	20,116	1,426	-	-	21,542	Electricity production required for sales to customers
Consumption	20,116	-	842	484	21,442	Quantity of electricity usage including private supply
Gross Generation	20,116	1,426	842	484	22,868	Electricity production required for consumption by all customers

[6] SDG&E Planning Area defined in the CED Forecast includes San Diego County and SDG&E service territory in Orange County.

[7] California Energy Commission. (2016) *Staff Report. California Energy Demand 2016-2026 Revised Electricity Demand Forecast. Volume 2.* SDG&E Planning Area. 2014 Data are actual historical values. http://docketpublic.energy.ca.gov/PublicDocuments/15-IEPR-03/TN207438_20160115T152222_California_Energy_Demand_20162026_Revised_Electricity_Demand_Fo.pdf

2.5 Role of Private Supply

This report focuses on estimating greenhouse gas emissions from the electricity sector. As such, the above electricity usage category used will affect the result. Gross generation is the most comprehensive value representing all the electricity usage in a given area. One complication is whether to treat private supply as a supply source or a demand reduction. For our purposes here it does not matter because the method to estimate electricity emissions factor applies to both cases. Section 6 discusses both cases in a greater detail.

There are several advantages to considering private supply as a supply source. The final emissions factor will be more accurate, particularly if there is a significant amount of non-PV self-serve. Also, as private supply increases it becomes a more significant portion of the supply mix. Finally, as the number of supply sources increases (e.g., utilities, direct access providers, community choice aggregation programs, private supply, etc.), accounting for each source allows for more flexibility and accuracy when estimating the GHG emissions reduction measures in a climate action plan. In the latest CED forecast mid demand case, PV self-serve is expected to increase its contribution from 2% in 2014 to 9% in 2026 of gross generation.[8] Also, as the grid supply gets cleaner due to the Renewable Portfolio Standard, Non-PV self-serve technologies such as cogeneration will emit more than grid electricity per unit of electricity. Breaking out all supply sources helps to understand such effects from different mitigation measures.

2.6 Customer Types

SDG&E generates and procures electricity and then delivers the electricity to most customers in its service territory through its transmission and distribution systems. This type of customer is known as a SDG&E bundled service customer – the electricity is "bundled" with the delivery. SDG&E bundled electricity includes the electricity from SDG&E owned power plants and its net electricity purchases.

Direct Access (DA) allows certain customers the option to purchase electricity from electricity service providers (ESPs) other than SDG&E, but SDG&E still provides transmission and distribution service of the electricity.[9] The California Public Utilities Commission (CPUC) issued Decision D.10-03-022 approving a limited re-opening for non-residential customers to elect DA service up to a load allowance.[10] Currently, no residential customers are eligible for the DA re-opening, however, customers currently on DA may remain. The sources of electricity supplied

[8] California Energy Commission. (2016) *Staff Report. California Energy Demand 2016-2026 Revised Electricity Demand Forecast.* SDG&E Planning Area Form 1.2 Mid-Case. http://www.energy.ca.gov/2015_energypolicy/documents/2015-12-17_mid_case_final_baseline_demand_forecast.php

[9] List of Electric Service Providers (ESPs) serve customers in the SDG&E service territory. California Public Utilities Commission. https://ia.cpuc.ca.gov/esp_lists/esp_udc.htm Accessed on 04/11/2016.

[10] CPUC Decision 10-03-022. March 11, 2010. http://docs.cpuc.ca.gov/WORD_PDF/FINAL_DECISION/114976.PDF Accessed on 04/11/2016.

to DA customers are different from SDG&E's generation and procurement, so the electricity has a different emissions factor from electricity supplied to bundled customers.

2.7 Treatment of System Losses

System loss refers to the transmission and distribution loss during the process of transporting power from generation facilities to end-use sectors. In general, system loss is reported as a loss factor, the ratio of end-use demand (retail sales to customers) to net energy for load (electricity production needed for sales to customers).

For purposes of estimating an emissions factor, it is not necessary to account for transmission and distribution losses because the emissions factor is estimated at the generation facility level (power plant level) based on the total electricity and emissions produced at the facility. Considering total emissions and electricity produced at the facility is sufficient as it represents the total emissions even though the total quantity of electricity does not reach the ultimate end consumer due to losses. However, when estimating the total GHG emissions from the electricity sector for purposes of an inventory, it is important to include system losses in the total quantity of electricity considered. While not addressed specifically here, it is also important to include losses when considering the GHG emissions impacts of climate action plan measures to reduce emissions.

EPIC uses a transmission and distribution loss factor that is consistent with the loss factor in the latest CED Forecast. The loss factor, 1.068, is calculated by dividing the net energy for load by sales in a given year from SDG&E Mid Case Baseline Demand Forecast Form 1.2.

3 Method Overview

This document provides a detailed discussion of the methods used to estimate electricity emissions factor. While the examples provided are specifically relevant to the San Diego region, the underlying logic and methods can be applied to any geographical area (see Section 2.3). The final emissions factor for the San Diego region[11] is the weighted average of several separate elements: electricity supplied by SDG&E to bundled customers; electricity supplied by other ESPs to DA customers; and private electricity supply, either for onsite consumption or to be purchased by SDG&E to supply to regional customers. These elements have distinct yet overlapping methods. Because each element has a different emissions factor it is necessary to consider each to obtain an accurate estimate. Figure 2 provides an overview of the main variables considered to estimate the emissions factor for electricity.

[11] The San Diego region comprises all of San Diego County, including the 18 cities and the unincorporated County of San Diego.

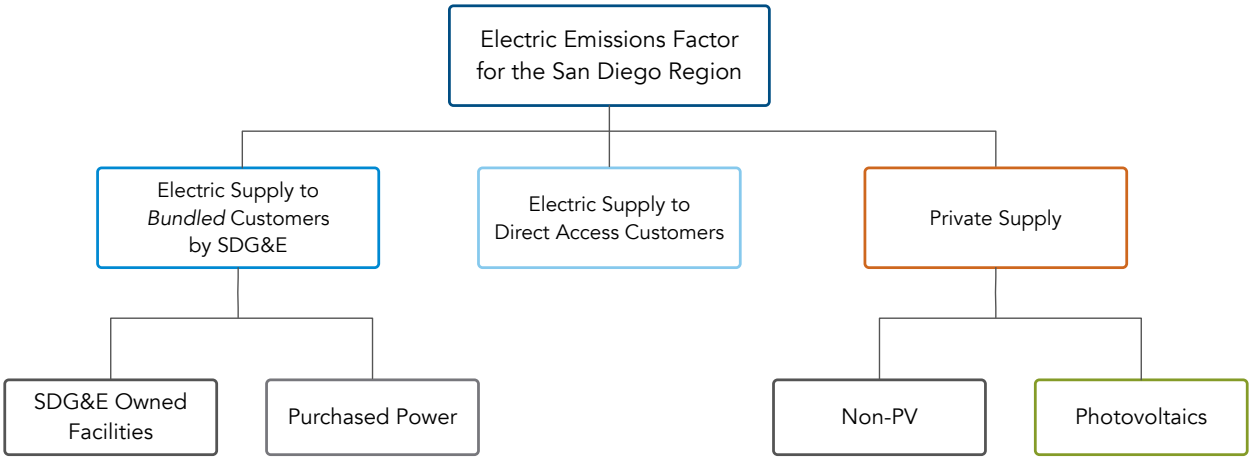

Figure 2 Main Variables for Estimating Electric Emissions Factor

The total emissions factor is weighted by the relative quantity of electricity provided by each electricity supply source. The following sections provide a detailed description of the methods used to determine the emissions factors for electricity supplied by SDG&E, DA providers, and private supply.

4 Emissions Factor for Electricity Supplied to SDG&E Bundled Customers

Electricity supplied to SDG&E bundled customers comprises two main parts: electricity generated by SDG&E-owned power plants and delivered to customers (Section 4.1) and electricity purchased by SDG&E and delivered to customers (Section 4.2).

4.1 Emissions Factor for SDG&E-Owned Generation

4.1.1 Electricity from SDG&E Owned Generation

SDG&E owns power generation facilities both inside and outside its service territory. A list of the facilities with their locations, fuel types and properties as of 2015 is provided in Table 3.

Table 3 SDG&E Owned Power Generation Facilities

Facility Name	Location	Fuel Type	Type of Plant and Properties
San Onofre Nuclear Generation Station (SONGS)	Pendleton, CA	Nuclear	- SDG&E has 20% minority ownership, Majority owner and operator is Southern California Edison (SCE) - Plant permanently retired in 2013[12]
Palomar Energy Center[13]	Escondido, CA	Natural Gas	- Started service in 2006 - Combined-Cycle, All water used for producing electricity is local reclaimed water
Miramar Energy Facilities (I & II)	San Diego, CA	Natural Gas	- Peaker plant - Two gas turbine generators
Cuyamaca Peak Energy Plant	El Cajon, CA	Natural Gas	- Formerly CalPeak Power El Cajon - Gas turbine
Desert Star Energy Center[14]	Boulder City, NV	Natural Gas	- Purchased by SDG&E in 2011 - Combined-Cycle

Net electricity generation from SDG&E-owned facilities can be found and compared from two sources: (1) SDG&E annual report to the California Energy Commission (CEC) Power Disclosure Program, and (2) Federal Energy Regulation Commission (FERC) FORM 1 Electricity Annual Report.

California Energy Commission: Power Disclosure Program

A result of Senate Bill 1305, this program requires electricity suppliers to report the types of resources used to generate electricity. All retail suppliers must submit the report in June every year. Only the power mix (percentages) is listed in the CEC website, the detailed report with electricity generation, net procured from each facility (kWh), can be obtained separately.

[12] Edison Notifies SDG&E of Decision to Permanently Retire San Onofre Nuclear Power Plant. July 2013. http://www.sdge.com/newsroom/press-releases/2013-06-07/edison-notifies-sdge-decision-permanently-retire-san-onofre

[13] Palomar Energy Center Fact Sheet. http://www.sdge.com/sites/default/files/newsroom/factsheets/Palomar%20Energy%20Center%20Fact%20Sheet.pdf

[14] Desert Star Energy Center Fact Sheet. April 2013. http://www.sdge.com/sites/default/files/newsroom/factsheets/Desert%20Star%20Energy%20Center%20Fact%20Sheet.pdf

Federal Energy Regulation Commission (FERC) FORM 1 – Electricity Annual Report[15]

FERC FORM 1 includes the Steam-Electric Generating Plant Statistics for large plants (402-403a). Net generation, exclusive of plant use [kWh] for each plant, is reported.

Both FERC Form 1 and the CEC Power Disclosure Program report net generation for each facility in service in the reporting year, both data are the same and can be used for estimating net generation. An example of the total and breakdown of electricity from SDG&E owned facilities in 2014 is given in Table 4.

Table 4 Total and Breakdown of Electricity from SDG&E Owned Facilities (2014)

Facility	Net Generation, Exclusive of Plant Use (kWh)
San Onofre Nuclear Generation Station	-
Miramar Energy Facilities	89,445,894
Palomar Energy Center	2,594,710,277
Desert Star Energy Center	1,538,091,324
Cuyamaca Peak Energy Plant	23,352,707
Total	4,245,600,202

4.1.2 Emissions from SDG&E Owned Generation

The GHG Emissions from SDG&E-owned facilities can be calculated based the amount of fuel used in each facility (Table 3), average heat content, and carbon content of the fuel.

Quantity of Fuel Burned

The Steam-Electric Generating Plant Statistics for large plants (402-403a) in FERC Form 1 includes the quantity of fuel burned at each facility. In this case, the fuel is natural gas in MCF (thousand standard cubic feet).

Average Heat Content of Fuel Burned

For natural gas, based on EPA Emission Inventories,[16] the average heating value is 1,020 Btu/SCF (standard cubic feet).

[15] FERC FORM 1. http://www.ferc.gov/docs-filing/forms/form-1/viewer-instruct.asp. Note SONGS is included here because it was still in operation and affected several of the emissions factors provided.
[16] EPA Emission Inventories. http://www.epa.gov/ttnchie1/ap42/ch01/final/c01s04.pdf

Carbon Content of Fuel Burned

For natural gas, the carbon content is calculated based on Documentation of California's 2000-2013 GHG Inventory – Index, California Air Resource Board (CARB).[17] The annual fuel CO_2, N_2O, and CH_4 emissions (grams/BTU) from in-state electricity generation are reported in Annex 1A. Electricity and Heat Production – In State (IPCC 1A1a) of the Technical Supporting Document.[18] Using the Global Warming Potential (GWP) of each GHG (Table 1) and the emissions from each GHG (grams/BTU), the carbon content of natural gas (gram CO_2e/BTU) can be calculated. In 2013, the carbon content of natural gas used in SDG&E owned facilities was 0.0537 grams CO_2e/BTU.

Emissions Calculation from Fuel Burned

The emissions from fuel burned can be calculated based on the above fuel properties and Equation 2 below.

Equation 2 Emissions From Fuel Burned (Natural Gas)

$$Emissions\ [CO_2\ e\ lbs] = Quantity\ of\ Fuel[MCF] * Heat\ Content\ \left[\frac{BTU}{SCF}\right] * Carbon\ Content\ \left[\frac{CO_2\ e\ g}{BTU}\right] * \left[\frac{SCF}{MCF}\right] * \left[\frac{CO_2\ lbs}{CO_2\ g}\right]$$

For example, the total emissions in 2013 from the Palomar Energy Center, one of SDG&E's owned facilities, is calculated in Equation 3.

Equation 3 Total Emissions from Palmar Energy Center (2014)

$$Emission\ [CO_2\ lbs] = 17{,}747{,}426[MCF] * 1{,}020\ \left[\frac{BTU}{SCF}\right] * 0.0537\ \left[\frac{CO_2\ e\ g}{BTU}\right] * \left[\frac{1{,}000\ SCF}{MCF}\right] * \left[\frac{CO_2\ lbs}{453.6\ CO_2\ g}\right] = 2{,}143{,}109{,}913\ CO_2\ e\ lbs$$

The total emissions from all owned facilities is the sum of the emissions from each facility. An example of the total emissions in 2014 from SDG&E owned facilities are given in Table 5.

[17] California Air Resources Board Inventory. http://www.arb.ca.gov/cc/inventory/doc/doc_index.php.
[18] Annex 1A. Electricity and Heat Production – In State (IPCC 1A1a) to the Technical Supporting Document. http://www.arb.ca.gov/cc/inventory/doc/methods_00-12/annex_1a_electricity_and_heat_production_in_state.pdf

Table 5 Total Emission from SDG&E Owned Generation (2014)

Facility	GHG Emissions (lbs CO2e)
San Onofre Nuclear Generation Station	-
Miramar Energy Facility	105,913,362
Palomar Energy Center	2,143,109,913
Desert Star Energy Center	1,323,420,901
Cuyamaca Peak Energy Plant	30,906,920
Total	3,603,351,096

4.1.3 Comparison of Emissions Factors from SDG&E-owned Generation Facilities

Electricity emission factors can be calculated based on the net electricity generation in Section 4.1.1 and total emission in Section4.1.2, for each facility and for all owned facilities. An example of the emission factor calculation for all SDG&E-owned generation facility in 2014 is given in Equation 4.

Equation 4 Emission Factor Calculation for All SDG&E-owned Generation Facility (2014)

$$Emission\ Factor\ \left[\frac{CO_2e\ lbs}{MWh}\right] = \frac{3{,}630{,}351{,}096[CO_2e\ lbs]}{4{,}245{,}600{,}202\ [kWh]} * \left[\frac{1000kWh}{MWh}\right] = 849\frac{CO_2e\ lbs}{MWh}$$

Table 6 shows the comparison of emission, net electricity generation and emission factors from all owned facilities in Year 2010-2014, the large increase in emission factor from 2011 to 2012 is due to the retirement of SONGS, which produced about half of the electricity in 2010 and 2011 without any CO_2 emission. The SONGS electricity supply was replaced by other natural gas-fired power plant sources that resulted in the higher emissions factor.

Table 6 Comparison of SDG&E-Owned Facilities in Year 2010-2014

	2010	2011	2012	2013	2014
Emissions (lbs CO_2e)	2,736,894,600	2,167,008,863	4,748,246,634	5,651,101,648	3,559,869,317
Net Electricity (MWh)	6,039,318	6,149,934	5,627,216	6,706,429	4,245,600
Emission Factor (lbs CO_2e/MWh)	453	352	844	852	849

4.2 Emissions Factor for Electricity from SDG&E Purchases

4.2.1 Electricity from SDG&E Purchases

Estimating the electricity procured by SDG&E from other facilities and suppliers is a more complicated process than that used for SDG&E-owned facilities. It requires identifying the total quantity of electricity purchased by SDG&E on behalf of their bundled customers, the specific quantities purchased from each entity, and then identifying - if possible - the fuel source for each. Further, an additional complication is the treatment of cogeneration, which generates electricity and useful thermal energy.[19] Figure 3 below provides a generalized view of the subcategories within purchased power.

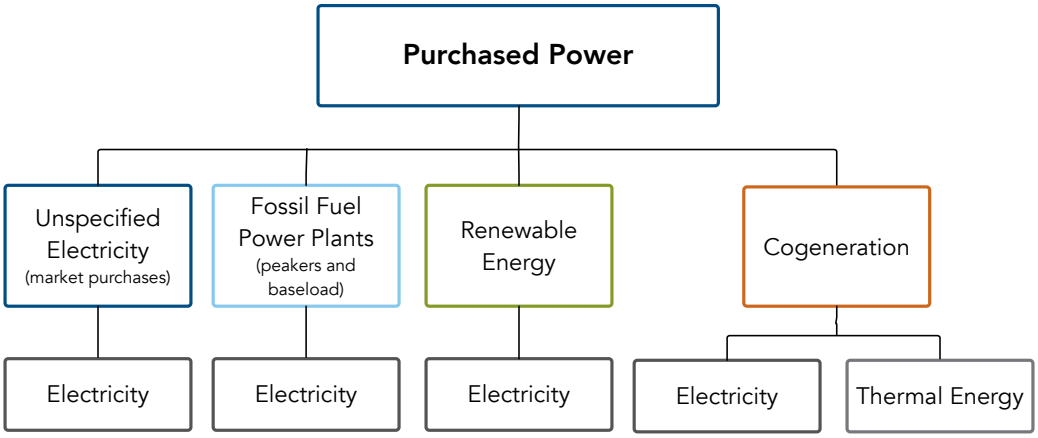

Figure 3 Subcategories within SDG&E Purchased Power

For all sub-categories of electricity supply, we determine the net electricity purchased by SDG&E after subtracting any electricity that was self-consumed or resold. For the cogeneration plants, only the electricity procured by SDG&E is included, the thermal energy is not included.

Electricity Generated with Specified Fuel Type (Fossil Fuel Power Plants and Renewable Energy)

SDG&E annual report to the CEC Power Disclosure Program, includes all the facilities it purchases electricity from, as well as the purchased amount, self-consumed and sold amount, net procured amount, and fuel type. Table 7 is an illustrative example of a facility in 2014. The net kWh procured electricity is the amount we used for electricity emissions calculation.

[19] For more information on cogeneration and thermal energy see Section 4.2.2.

Table 7 Example of SDG&E Electricity Procurement with Specified Source (2014)

Facility Name	Fuel Type	Gross kWh Purchased	kWh Resold or Self-Consumed	Net kWh Procured
Olivenhain Municipal Water District	Eligible Hydroelectric	1,234,680	1,135,000	99,680

For the electricity from traditional power plants, each facility is listed separately. For the electricity generated from renewable sources, all procured electricity can be categorized into six types: bio-gas/biomass, hydro, geothermal, solar, wind and others. The total electricity in each type (kWh) is used. Table 8 is an example of the total renewable energy procured by SDG&E in 2014.

Table 8 Total Renewable Energy Procured by SDG&E (2014)

Fuel Type	kWh
Bio-Gas/biomass	109,029,840
Geothermal	599,000
Eligible Hydroelectric	20,998,287
Solar	2,541,370,998
Wind	2,640,179,030

Electricity Generated with Unspecified Fuel Type (Unspecified Electricity)

SDG&E also purchases and resells electricity from market sources and the California Independent System Operator (CAISO) market for which data on the fuel type is not available. This unspecified power is included in SDG&E annual report to the CEC Power Disclosure Program. The following is an example of Market and CAISO purchase and resale in 2014. The net kWh procured electricity is the amount we used.

Table 9 Example of SDG&E Electricity Procurement with Unspecified Source (2014)

Facility Name	Fuel Type	Gross kWh Purchased	kWh Resold or Self-Consumed	Net kWh Procured
Market Purchases and Sales	Unspecified	1,089,617,000	79,531,064	1,010,085,936
CAISO Purchases and Sales	Unspecified	17,081,141,972	13,185,313,095	3,895,828,877

FERC Form 1 Purchase Power Report also includes the bundled electricity other than from SDG&E owned facilities, but it was reported by company or public authority names, not facility names. So it is hard to track back the power plant or fuel type used to generate the electricity sold by the companies. Electricity purchased from CAISO is reported in FERC Form 1 Purchase Power Report, but only the gross purchases not net procured electricity. After comparing the data, the data from SDG&E annual report to the CEC Power Disclosure Program are used for total electricity procurement calculation.

4.2.2 Emissions from SDG&E Electricity Purchases

The following sections provide details about the above categories. In the case of cogeneration, we exclude the emissions associated with the thermal energy created and used.

Emissions from Electricity Generated with Specific Fuel Type (Non-Renewable)

For suppliers that could be identified as using fossil fuel-based power plants, we multiplied the quantity of net energy procured by the specific emissions factor for the plant provided in eGRID to calculate the total emissions.[20]

Non-Cogeneration Power Plants

Environmental Protection Agency (EPA) eGRID 2012[21] reports annual net generation (MWh), CO_2 emission (tons), N_2O and CH_4 emission (lbs) for all power plants. Based on the list of facilities provided in CEC Power Disclosure Form, the specific power plants can be located from the eGRID data set. Table 10 is an example of Otay Mesa Energy Center plant information from eGRID, a natural gas plant that SDG&E purchases power from.

Table 10 Plant Information for Otay Mesa Energy Center (eGRID 2012)

Plant Name	Otay Mesa Generating Project
Plant Operator Name	Otay Mesa Energy Center
Plant annual net generation (MWh)	3,663,753
Plant annual CO_2 emissions (tons)	1,620,271
Plant annual N_2O emission (lbs)	63,416
Plant annual CH_4 emission (lbs)	6,353

In some cases, SDG&E purchases a portion of the electricity generated by a facility. In order to allocate the emissions associated with the amount of electricity SDG&E purchases, an emission factor specifically for the facility is used. The emission factor can be calculated based on GWPs in Table 1 and the above eGRID plant information, using the following Equation 5.

[20] Note that eGrid provides both CO2 and CO2e data. We used CO2e data here.
[21] EPA eGRID2012. Released 10/08/2015. http://www.epa.gov/cleanenergy/energy-resources/egrid/

Equation 5 Facility-Specific Emission Factor Calculation using eGRID Plant Information

$$Emission\ Factor\ \left[\frac{lbs\ CO_2e}{MWh}\right] = \frac{GWP_{Co_2} * CO_2\ [tons] * [\frac{lbs}{tons}] + GWP_{CH_4} * CH_4\ [lbs] + GWP_{N_2O} * N_2O\ [lbs]}{Net\ Generation\ [MWh]}$$

*

For example, the emission factor for Otay Mesa Energy Center is calculated in Equation 6.

Equation 6 Emission Factor for Otay Mesa Energy Center (eGRID 2012)

$$Emission\ Factor\ \left[\frac{lbs\ CO_2e}{MWh}\right] = \frac{1 * 1{,}620{,}271\ [tons\ CO_2\ ] * \left[\frac{2000\ lbs}{tons}\right] + 25 * 6{,}353[lbs\ CH_4] + 298 * 63{,}416[lbs\ N_2O]}{3{,}663{,}753\ [MWh]}$$

$$= 885\ lbs\ CO_2e/\ MWh$$

For the power plants SDG&E purchases power from not on the eGRID list, a weighted average emission factor is used. The weighted average emission factor is calculated based on the annual generation and emission factor of all power plants SDG&E purchases power from. One thing to notice is that the emissions factor is weighted based on the total generation of the power plant not the power SDG&E purchased. The following Equation 7 is used to calculate the weighted average emission factor.

Equation 7 Weighted Average Emission Factor Calculation for Facilities SDG&E Purchased From

$$Weighed\ Average\ Emission\ Factor\ \left[lbs\frac{CO_2e}{MWh}\right] = \frac{\sum(Generation\ [MWh] * Emission\ Rate\ \left[lbs\ \frac{CO_2e}{MWh}\right])}{\sum Generation\ [MWh]}$$

To calculate the total emissions from the electricity SDG&E purchased, Equation 8 is used with the net electricity [kWh] SDG&E purchased (Section 4.1) and the emission factor for the facility or the weighted average emission factor (Equation 5 or Equation 7) as inputs.

Equation 8 Emission Calculation for Specific Fuel Type (Non-Renewable)

$$Emission\ from\ Non-Renewable\ Fuel\ [lbs\ CO_2e] = Net\ electricity\ purchased\ [kWh] * Emission\ Factor\ \left[lbs\frac{CO_2e}{MWh}\right] * \left[\frac{MWh}{kWh}\right]$$

Using Otay Mesa Energy Center as an example, the emission associated with the electricity purchased by SDG&E in 2014 is calculated in Equation 9.

Equation 9 Example of Emission Calculation For Specific Fuel Type (Non-Renewable)

$$\begin{aligned} &Emission\ from\ Otay\ Mesa\ Energy\ Center\ in\ 2014\ [lbs\ CO_2e] \\ &= 3{,}703{,}704{,}000\ [kWh] * 885\ \left[lbs\frac{CO_2e}{MWh}\right] * \left[\frac{MWh}{1000\ kWh}\right] \\ &= 3{,}277{,}778{,}040\ lbs\ CO_2e \end{aligned}$$

Cogeneration Power Plants

To estimate emissions of electricity purchased from cogeneration power plants, we multiplied the emissions factor calculated using Equation 5 for a particular plant by the net electricity purchased by SDG&E from that plant.

Since emissions reported in eGRID represent electricity generation only, emissions associated with useful thermal output – the amount of heat produced in a cogeneration facility that is used for purposes other than making electricity – are excluded from the adjusted emissions (eGRID 2012). eGrid provides an electric allocation factor, which is the percentage of emissions associated with electricity. eGrid also reports unadjusted emissions that include emissions related to thermal energy.[22] With this information we can calculate the emissions associated with thermal energy. The breakdown of total unadjusted emissions should equal the following Equation 10.

Equation 10 Breakdown of Total Unadjusted Emissions

$$Total\ unadjusted\ emissions\ = Total\ Electric\ Emissions\ +\ Total\ Thermal\ Emissions$$

$$where,$$

$$Total\ Electric\ Emissions\ =\ Total\ Unadjusted\ Emissions\ x\ Electric\ Allocation\ Factor$$

$$Total\ Thermal\ Emissions = Total\ Unadjusted\ Emissions\ x\ (1 - Electric\ Allocation\ Factor)$$

Emission from Specific Fuel Type (Renewable)

For electricity generated by renewable source, including solar, wind, geothermal, hydro, and biogas/biomass, the emission factor is considered zero, as we are only considering the power generation phase not the entire life cycle.

One complication arises when a utility contracts for out-of-state renewable energy that is not delivered directly into California; that is only the renewable attributes - or renewable energy credits - were purchased. In this case, we follow the CARB RPS adjustment approach based on their Mandatory Reporting Regulation [MRR]. In relevant part, the CARB regulation reads: "[t]he quantity of emissions included in the RPS adjustment is calculated as the product of the

[22] U.S Environmental Protection Agency (2014). *The Emissions & Generation Resource Integrated Database Technical Support Document for the 9th Edition of eGRID with Year 2010* Data. Contract #EP-D-08-100 Work Assignment No. 4-23. Note the unadjusted emissions are shown only in the plant file and eGRID's methodology is designed to share CHP's efficiency gains between electricity and useful thermal output. (p. 15 of the Technical Support Document)

default emission factor for unspecified sources, pursuant to MRR, and the reported electricity generated (MWh) that meets the requirements of this section, 95852(b)(4)."[23]

Since the emission factor for renewable source is zero, there are no emissions from purchased electricity from renewables.

Emission from Unspecified Fuel Type

For the purchases from CAISO and market with unspecific fuel type, the default emission factor of 0.428 MT of CO_2e/MWh (943.6 lbs CO2e/MWh) is used based on the Mandatory Reporting of Greenhouse Gas Emissions from California Air Resources Board (ARB).[24]

Emission Calculation from Purchased Power

Emission from Purchased Power with Specified Fuel Type (Renewable)

There is no emission from purchased electricity from renewable sources.

Emission from Purchased Power with Unspecified Fuel Type

For emission from unspecified fuel type (CAISO and market purchases), the net electricity and the ARB default emission factor are used to calculate the emissions amount using Equation 11.

Equation 11 Emission Calculation for Unspecified Fuel Type

$$Emission\ from\ Unspecified\ Fuel\ Type\ [lbs\ CO_2e] = Net\ electricity\ [kWh] * 943\ \left[lbs\frac{CO_2e}{MWh}\right] * \left[\frac{MWh}{kWh}\right]$$

Total Electricity, Emission and Emission Factor from Purchased Power

Overall, the total emissions from purchased power is calculated summing up emissions from net procurement with non-renewable and unspecified fuel types (Equation 12).

Equation 12 Total Emission Calculation for Purchased Power

$$Emissions\ from\ Purchased\ Power\ [lbs\ CO_2e] = Emissions\ From \sum (Non-Renewable, Unspecified\ Fuel)$$

Similarly, total net electricity procured from purchased power is calculated by summing up procurement from all fuel types (Equation 13).

Equation 13 Total Electricity Procurement Calculation for Purchased Power

[23] 17 CA ADC § 95852 (b)(4). Barclays Official California Code of Regulations.

[24] California Air Resources Board Regulation for Mandatory Reporting of Greenhouse Gas Emissions Section 95111(b)(1). Available at http://www.arb.ca.gov/cc/reporting/ghg-rep/regulation/mrr-2013-clean.pdf . Included as 0.428 metric tons of CO2e/MWh. Conversion to pounds yields 943.6 lbs CO2e/MWH.

$$Electricity\ from\ Purchased\ Power\ [MWh] = Electricity\ From \sum (Non-Renewable\ , Renwable, Unspecified\ Fuel)$$

Total emission factor from purchased power is calculated based on the following Equation 14.

Equation 14 Emission Factor Calculation for Purchased Power

$$Total\ Emission\ Factor\ from\ Purchased\ Power\ \left[lbs\frac{CO_2e}{MWh}\right] = \frac{Emissions\ from\ Purchased\ Power\ \ [lbs\ CO_2e]}{Electricity\ from\ Purchased\ Power\ [MWh]}$$

4.2.3 Comparison of Emissions Factors from SDG&E Purchased Power

Table 11 shows the comparison of emission, net electricity procurement and emissions factors from all purchased power in Year 2010-2014. The decrease in emissions factor is due to the increasing share of renewable energy in the purchased power. In 2014, approximately 30% of the purchases power came from renewable source.

Table 11 Comparison of Purchased Power in Year 2010-2014

	2010	2011	2012	2013	2014
Emissions (lbs CO_2e)	8,127,170,163	8,777,697,039	9,300,494,096	7,661,654,188	8,679,517,886
Net Electricity (MWh)	11,144,008	11,603,154	12,526,667	10,667,048	13,909,232
Emissions Factor (lbs CO_2e/MWh)	729	756	742	718	624

4.3 Annual Average Emissions Factor for SDG&E Bundled Electricity

The annual average emissions factor for SDG&E bundled electricity can be calculated by using the total electricity supplied to SDG&E bundled customer and emissions from the electricity (Table 6 and Table 11), as shown in Equation 15.

Equation 15 Emission Factor Calculation for SDG&E Bundled Electricity

$$Emission\ Factor\ for\ SDG\&E\ Bundled\ Electricity\ \left[lbs\frac{CO_2e}{MWh}\right] = \frac{Total\ \ Emission\ from\ \ Electricity\ Procurement\ for\ Bundled\ Customer\ [lbs\ CO_2e]}{Total\ Electricity\ Procurement\ for\ Bundled\ \ Customer\ [MWh]}$$

The annual average emission factors for SDG&E bundled electricity from 2010 to 2014 are given in Table 12.

Table 12 Comparison of SDG&E Bundled Electricity Emission Factor (2010-2014)

Year	SDG&E Bundled Electricity Emission Factor (lbs CO2e/MWh)
2010	664
2011	616
2012	750
2013	729
2014	630

The large increase in emission factor from 2011 to 2012 is due to the retirement of SONGS as discussed in Section 4.1.3. In 2012, SONGS electricity supply was replaced by other natural gas-fired power plant sources that resulted in the higher emissions factor. After 2012, more purchased renewable sources were added in the mixed. In 2014, eligible renewable represents 32.2% of SDG&E's power mix.[25]

5 Emissions Factor for Electricity Supplied to Direct Access Customers

5.1 Electricity Supplied by Direct Access Providers

As discussed in Section 2.6, a portion of customers in the San Diego region purchase electricity from a provider other than SDG&E. Under the Direct Access (DA) program, customers have the option to purchase electricity from electricity service providers (ESPs) other than SDG&E, but SDG&E still provides transmission and distribution service of the electricity. About 15% of all the electricity consumed in San Diego County is provided by direct access providers.

Electricity delivered by SDG&E to DA customers is reported in SDG&E's Form 10-K annual report, available every year in late February. The report from February in the current year includes data from the previous three years. For example, in the Form 10-K published February 2015,[26] SDG&E electric distribution and transmission for DA in 2012-2014 are reported. Table 13 shows electricity SDG&E transmitted and distributed for DA Customers in Year 2010 – 2014.

[25] California Energy Commission. SDG&E Power Content Label.2014. http://www.energy.ca.gov/pcl/labels/2014_labels/all_labels/San_Diego_Gas_and_Electric_(SDGandE).pdf

[26] SDG&E Company Filling, http://investor.shareholder.com/sre/sec.cfm

Table 13 Electricity from Direct Access (Million kWh) in Year (2010-2014)

	2010	2011	2012	2013	2014
Direct Access (Million kWh)	3,202	3,265	3,399	3,593	3,648

5.2 Emissions from Electricity Supplied to Direct Access Customers

Little information is publicly available about the emissions or emissions factors for electricity provided through direct access. To estimate the greenhouse gas emissions associated with direct access electricity, we multiplied the emissions factor by the total quantity of electricity provided to DA customers. This rate is applied to the proportion of energy consumed in San Diego County via direct access, which was provided by SDG&E as a result of a data request.

The emission factor for electricity from DA is adopted based on CPUC Decisions D.14-12-037, which provides GHG allowance revenue allocation formulas and distribution methodologies for emission-intensive and trade-exposed (EITE) customers.[27] This decision is employed by California's investor-owned electric utilities (IOUs) including SDG&E. The decision assigned an emission factor of 0.379 MT CO_2e/MWh (836 lbs CO_2e /MWh) for EITE electricity purchase from all IOUs for the purpose of allocating allowance revenue. Even though this value was cited in a 2014 CPUC decision, the original value was from an earlier decision in 2011[28], therefore, it is reasonable to use it for 2010, 2011, and 2012. This value is slightly lower than the value used previously by CARB to account for the increase use of renewable energy since the original value was developed.

The total emissions from electricity supplied to DA customers are calculated based on the following Equation 16.

Equation 16 Emission Calculation for Electricity Supplied to DA Customers

$$Emission\ from\ DA\ [lbs\ CO_2e\ ] = Electricity\ [kWh] * Emission\ Factor\ \left[\frac{lbs\ CO_2e}{MWh}\right] * [\frac{MWh}{1000kWh}]$$

An example of the total emissions from electricity supplied to DA customers is given in .

Equation 17.

Equation 17 Emissions from Electricity Supplied to DA Customers (2013)

$$Emission\ from\ DA\ in\ 2013\ =$$

[27] CPUC Proceedings and Documents Related to GHG Cap-and-Trade, Decision 14-12-037 (pg 87- 88) December. 2014, http://www.cpuc.ca.gov/PUC/energy/capandtrade/Proceedings.htm.

$$3{,}593{,}000{,}000\ [kWh]*836\ \left[\frac{lbs\ CO_2e}{MWh}\right]*\left[\frac{MWh}{1000kWh}\right] = 3{,}002{,}134{,}671\ [lbs\ CO_2e\ ]$$

$$= 1{,}361{,}747\ [MT\ \ CO_2e\ ]$$

5.3 Comparison of Emissions from Direct Access

Table 14 shows the comparison of emission, net electricity generation and emission factors from DA in Year 2010-2014. The emission factor stays constant from 2010 to 2014, so the emissions only depends on the net electricity generation.

Table 14 Comparison of Direct Access Emissions from 2010-2014

	2010	2011	2012	2013	2014
Emissions (lbs CO_2e)	2,676,872,000	2,729,540,000	2,841,564,000	3,002,134,671	2,662,052,195
Net Electricity (MWh)	3,202,000	3,265,000	3,399,000	3,593,000	3,648,000
Emission Factor (lbs CO_2e/MWh)	836	836	836	836	836

6 Private supply

6.1 PV Self-Serve

In general, EPIC considers PV self-serve as a supply source that affects the overall emissions factor for electricity as opposed to as a demand reduction action that does not affect the rate of emissions.

For purposes of estimating total emissions from the electric sector for an emissions inventory, excluding electricity from distributed solar photovoltaics does not affect the result. That is, if you include electricity from distributed solar to the overall electricity and calculate the overall weighted emissions factor, the total emissions would be the same as multiplying grid electricity and grid electricity emission factor with the same total emissions.

Table 15 below shows an example of two calculation methods with the same total emissions.

Table 15 Example of Total Emission Calculation with and without Distributed Solar Supply

Category	Electricity (MWh)	Emission Factor (lbs CO2e/MWh)	Total Emissions (MT CO2e)
Grid Supply	92	665	28
Distributed Solar	8	0	0

Supply			
Overall Supply	100	612	28

6.2 Non-PV Self-Serve

Electricity from non-PV self-serve is not captured in SDG&E's electricity supply. Unlike electricity from PV self-serve, it has emissions. Emissions from these sources that combust fossil fuels, such as natural gas, are included in the natural gas inventory category to some extent. This supply category is further complicated by cogeneration systems that also produce useful heat, which is not allocated to the electricity sector. More work is required to properly account for and allocate emissions from non-PV self-serve generation to the electricity sector.

7 Summary of Annual Average Emissions Factors

The annual average electricity emissions factor varies by region and city. The following sections provides the emissions factor for several geographic areas, and the equations used to calculate each. The overall emissions factor for the region or city will also depend on the amount of private supply.

7.1 SDG&E Service Territory

For the bundled and DA customers in SDG&E service territory the annual average emission factor can be calculated by using the total emissions and net electricity for both customer groups combined. The percent of electricity supplied to DA customers may vary annually. Total emission factor for SDG&E Service Territory is calculated based on the following Equation 18.

Equation 18 Emission Factor Calculation for SDG&E Service Territory

$$Emission\ Factor\ for\ SDG\&E\ Service\ Electricity\ \left[lbs\ \frac{CO_2e}{MWh}\right] = \frac{Total\ \ Emission\ from\ Electricity\ Supplied\ to\ Bundled\ and\ DA\ Customer\ [lbs\ CO_2e]}{Total\ Electricity\ Supplied\ to\ Bundled\ and\ DA\ Customer\ [MWh]}$$

The weighted average for emissions factor for electricity consumed in the SDG&E service territory based on the methods described above are provided in Table 16.

Table 16 Comparison of Emission Factors in SDG&E Service Territory (2010-2014)

Year	SDG&E Service Territory Emission Factor (lbs CO2e/MWh)
2010	691
2011	651

2012	763
2013	747
2014	665

7.2 San Diego Region

The grid emissions factors from 2010 to 2012 for the portion of electricity supplied to San Diego region are included in Table 17, calculated using Equation 18. They vary only slightly from the values for the SDG&E service territory. The difference is due to the proportion of electricity provided by SDG&E bundled and DA being slightly different from that of San Diego region. Electricity use totals from 2010 to 2012 for San Diego County were provided by SDG&E as a result of a data request. We used the San Diego region emission factor for SANDAG's 2012 Greenhouse Gas Inventory for San Diego region.

Table 17 Comparison of Emission Factors in San Diego Region (2010-2012)

Year	San Diego Region Electricity Emissions Factor (lbs CO_2e/MWh)
2010	694
2011	654
2012	765

7.3 Individual City Grid Emissions Factors

For the individual cities in the San Diego region, a city specific emission factor can be calculated if the specific electricity supplied to SDG&E bundled and DA customers in the city are available separately. An example of calculating city-specific annual average electricity emission factor is given in Table 18.

Table 18 Example of City-Specific Electricity Emission Factor Calculation

Supply	Power Mix	Emission Factor (lbs CO2e/MWh)	City-Specific Emission Factor (lbs CO2e/MWh)
SDG&E Bundled	a%	b*	a%*b + c%*836
Direct Access	c%	836	
Total	100%	-	

*Emission Factor for SDG&E Bundled Electricity can be found in Table 12

The emissions factor in Table 18 only applies to the electricity supplied by SDG&E for its bundled and DA customers, excluding electricity from private supply. For the individual cities in the San Diego region that do not have city-specific power mixes available, we used annual average emission factors for SDG&E service territory (Table 16) as proxy.

When applying the emission factors, it is important to first determine if the electricity data are either end-use consumption level (sales) or net-energy for load level (sales plus transmission and distribution losses). If the electricity data are at end-use level, the system loss factor (Section 2.7) needs to be applied first to convert to net energy for load. The methods used in this document to calculate emission factors are at power plant level (electricity generation level), and should be applied to net energy for load (electricity needed for sales to customers) to be consistent.

8 Limitations

The method described here to estimate the annual average emissions factor for electricity has limitations.

8.1 Default Values

Due to lack of data, in several instances we used default values for several electricity sources, include the default emission factors for unspecified import power (Section 4.2.2) and default emission factors for DA program (Section 5.2). The default emission factor for unspecified power from CARB was developed in 2011 for the Mandatory GHG Reporting program and have not been updated since. Similarly, the default emission factor used for Direct Access electricity is based on CPUC Decisions D.14-12-037, which was adopted in 2011. The default value may also be old and need to be updated. In general, there is a lack of available data on direct access supplies. Where data is available much of the energy supplied is categorized as “unspecified.”

8.2 eGRID Values are Several Years Old

The latest version of eGRID2012, which was available in October 2015, only provided data for 2012. It is likely that emissions factors for power plants do not change significantly year to year, but having actual emissions factors for power plants for each year of the analysis would be more accurate.

8.3 Private Supply Data Not Available by City

Private electricity supply from PV and non-PV are not available by city in the San Diego region. For example, the fuel consumption (natural gas) provided to cogeneration plants is available for the San Diego region but not individual cities. Similarly, PV self-serve capacity and electricity are provided in CED Forecast for the SDG&E Planning area only. Depending on the percentage of private supply as off total electricity, the emissions factor for all electricity supply may vary. More work is needed to develop estimates of private supply by city. This information could allow for more tailored emissions factors that show the effects of private supply.

9 Summary of Data Sources

A summary of the primary data source used in Section 4 and 5 to estimate the annual average emissions factor for electricity is given in Table 19.

Table 19 Primary Data Source to Estimate Annual Average Emissions Factor

Category			Electricity	Emissions	Emission Factor
SDG&E Bundled	SDG&E Owned Generation		FERC Form 1 CEC Power Disclosure Form	Calculation Based on FERC Form 1	-
	SDG&E Procurement	Specific Fuel Type	CEC Power Disclosure Form	-	Calculation based on eGRID Plant Info
		Unspecific Fuel Type	CEC Power disclosure Form	-	CARB MRR
SDG&E DA Program			Sempra Form 10-K	-	CPUC Decisions D.14-12-037