

Appendix C

Appendix C: City and County of San Francisco Community GHG Inventory Review, IFC International, August 1, 2008.



City and County of San Francisco

Community GHG Inventory Review

August 1, 2008

Prepared for
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1. Overview

ICF International was recently hired by San Francisco's Department of the Environment to review the community greenhouse gas (GHG) inventory for the City and County of San Francisco (CCSF). This inventory was compiled by CCSF for 1990, 2000, and 2005 years. This activity expands on earlier efforts by CCSF that led to the creation of the city's Climate Action Plan (CAP) as well as the development of the municipal operations emissions inventory that has been verified by ICF and registered with the California Climate Action Registry (CCAR).

At the outset of this review, CCSF provided 94 files containing calculations, assumptions, and other background information for the community inventory. Although all files were reviewed, two key documents in particular are referenced throughout this document: the guidance manual entitled, "CCSF GHG Emissions Inventory Guidance" as well as the overall community inventory spreadsheet "FINAL UPDATE DATA".

The documentation and quantification of activity levels from all major sources of emissions that fall within a community's boundaries is generally more complicated than a smaller range or subset, such as for an industrial inventory. It is clear that this undertaking must have been marked by an intensive information gathering and coordination effort between different agencies around San Francisco and the Bay area at large, followed by an iterative analysis and calculation process. CCSF's efforts are also impressive given that there does not currently exist a standard, comprehensive protocol for a community-wide GHG inventory.

CCSF's community GHG inventory represents an excellent attempt at capturing major emission sources and calculating resultant activity levels. It appears that all of the key stationary and mobile categories have been accounted for and appropriated quantified, which at a community-wide level is certainly a challenging task. The current version of the inventory, which has been revised slightly to account for immediate improvements and resolution of discrepancies, provides a credible compilation of the community emissions.

This remainder of this report is structured along the following key sections:

- Part 2 ("Revisions to Community Wide Inventory") contains a list of improvements that have been made as a result of ICF's review and discussion with CCSF.
- Part 3 ("Minor Points of Clarification") contains minor points (defined as <5% share of a given year's total emissions) requiring clarification, mostly in regard to unclear sourcing of data and/or available documentation. We urge CCSF to address these for purposes of full documentation.
- Part 4 ("Areas of Future Improvement") is a list of suggested future improvements for CCSF's consideration, including further accuracy of calculations, completeness of emitting sources, and more efficient organization of data collection and results.

2. Revisions to Community Wide Inventory

A. Electricity Emissions Factors (EFs): CCSF's approach to determine an accurate electricity EF through a weighted calculation of imported power, locally generated power, and direct access is commendable given that many entities use a single utility, state-wide, or even national EF (which in some cases can mask and even distort the true carbon intensity of electrical power, especially if there are different calculation methods). However, a few discrepancies were noted which led to the following improvements.

- i. **Revised EFs for SFPUC (1990, 2000, and 2005):** Minor errors in the calculations of the Hetch Hetchy emissions factor were noted (such as in the treatment of transmission and distribution losses). A more accurate treatment of these issues led to improved SFPUC EFs. A comparison of the revised EFs vs. previous EFs is as follows:

Year	Previous SFPUC EF (lbs CO ₂ / MWh)	Revised SFPUC EF (lbs CO ₂ / MWh)
1990	145.19	154.75
2000	149.57	158.57
2005	125.11	151.30

- ii. **Revised Overall Electricity EFs (1990, 2000, and 2005):** The revisions of the SFPUC EFs (noted above) led in turn to revisions of the overall electricity EFs for each of the three years. A comparison between the revised EFs vs. previous EFs is as follows:

Year	Previous Total Electricity EF (lbs CO ₂ / MWh)	Revised Total Electricity EF (lbs CO ₂ / MWh)
1990	870.4	871.2
2000	791.7	792.8
2005	658.4	661.9

B. 2005 Municipal Natural Gas: In the final inventory spreadsheet, "FINAL UPDATE DATA", the 2005 municipal natural gas number was indicated as 15,736,253 therms. However, a cross-referencing with the 2005 CCAR report indicated this figure to be 19,448,695 therms (summation of DGS core, DGS non-core, PG&E, and SPURR natural gas figures for 2005). The 2005 municipal natural gas figure was thus revised to the higher figure, based on the evidence available (see table below for changes):

Year	Previous Municipal Natural Gas (therms)	Revised Municipal Natural Gas (therms)
2005	15,736,253	19,448,695

- C. 2000 Municipal Electricity:** The final inventory spreadsheet, “FINAL UPDATE DATA” indicated this category to be 823,073 MWh, which was taken as a proxy from the average of FY 01-02 data. However, the file, “kWhCompFY97-06_MUNI” showed an average of 938,133 MWh for 99/00 and 00/01 years. As this was considered to be a more accurate approach (closer to the year 2000), the higher number was chosen.

Year	Previous Municipal Electricity (MWh)	Revised Municipal Electricity (MWh)
2000	823,073	938,133

- D. Steam:** 2000 and 2005 figures were noted to be 12,567,755 therms. The 1990 level was noted in the Guidance Manual to be $\frac{3}{4}$ of 2000 levels. Hence, the 1990 level should be 9,425,816 therms. Although this was correctly noted in one of the various draft inventory spreadsheets, this was not indicated in the final inventory spreadsheet “FINAL UPDATE DATA” (the latter instead contained 12,567,755 therms). This was resolved by inserting in the correct 1990 level of 9,425,816 therms.
- E. 1990 Commercial Natural Gas (80,797,796 therms) and 1990 Industrial Natural Gas (31,472,238 therms):** Although the PDF file “1990 CCSF_NG” contained a fax from PG&E on 1990 data that indicated the categories of commercial and industrial were aggregated to 80,797,796, it was noted that CCSF instead took only commercial natural gas to be 80,797,796 and industrial natural gas to be the category noted as “interruptible” for a figure of 31,472,238 therms. This discrepancy was discussed with CCSF and resolved through confirmation from PG&E that “interruptible” indeed refers to industrial customers and that the “commercial and natural” category on the fax should in fact be only commercial customers; hence, the final inventory numbers matched up with PG&E’s explanation.
- F. Overall Changes in Community-wide Inventory Numbers:** The above changes were reflected in the “FINAL UPDATE DATA” inventory spreadsheet. A comparison of previous inventory numbers with revised ones indicates slight changes (mostly due to minor increases in the electricity EF, as well as other increases noted in points B-E above):

Year	Previous Total Community Wide GHG Emissions (million short tons of CO ₂ equivalent)	Revised Total Community Wide GHG Emissions (million short tons of CO ₂ equivalent)
1990	8.26	8.26
2000	8.49	8.49
2005	7.78	7.82

3. Minor Points of Clarification

G. The following points should be clarified by CCSF:

i. **2005 Inventory Numbers**

- ♦ **Muni buses** (5,481,161 gallons of diesel fuel used)—Although the source of this data is clear, a clear calculation of the number would be useful.
- ♦ **Municipal fleet emissions** (36,870.56 tons of CO₂ eq.)—Although the source of this data is clear, a clear calculation of the number would be useful.

ii. **2000 Inventory Numbers**

- ♦ **RCI (residential, commercial, and industrial) Natural Gas** (295,000,000 therms)—A 1998 CEC report projected natural gas usage of 293,000,000 therms for the County of San Francisco. It is possible that the 295,000,000 therms figured used in the inventory was a more up-to-date and accurate reflection of natural gas usage in 2000, but the relevant documentation needs to be properly referenced.
- ♦ **Municipal Natural Gas**—It is noted that in the “FINAL UPDATE DATA” spreadsheet (under the 2000 tab in cell K10) that 5% of the RCI natural gas figure is municipal natural gas. Hence, the municipal natural gas appears to be part of the RCI natural gas category. The 5% figure is noted to be an estimate based on 1997 municipal usage. A reference for the 1997 usage and an explanation for why municipal natural gas is not in turn listed as a separate category in the 2000 inventory would be useful.
- ♦ **BART Electricity** (268,130 MWh)—It should be noted in the spreadsheet/guidance manual that this number is derived by taking 2002 figures as a proxy (as 2000 data was apparently unavailable).

iii. **1990 Inventory Numbers**

- ♦ **Residential, Commercial, and Industrial Electricity**—All of these numbers as listed in the “FINAL UPDATE DATA” spreadsheet under the 1990 tab mostly match up with those in the “Electric and Nat Gas Use” spreadsheet (the latter appear to be rounded). We understand that the following numbers come from PG&E; going forward, it would be useful to have the documentation for this set of 1990 numbers as part of the inventory:
 - Residential: 1,174,168 MWh.
 - Commercial: 1,877,573 MWh.
 - Industrial: 1,297,195 MWh.
- ♦ **BART Electricity** (206,254 MWh)—It should be noted in the spreadsheet/guidance manual that the 2000 level is derived by taking a 30% increase from 1990 levels.
- ♦ **MUNI Diesel Emissions** (51,430.79 tons of CO₂ eq.)—Although the source of the data is clear, a clear calculation of the number would be useful.
- ♦ **Municipal Fleet Emissions** (64,229 tons of CO₂ eq.)—Although the source of the data is clear, a clear calculation of the number would be useful.

4. Areas of Future Improvement

- H. Organizational and Operational Boundaries:** Boundaries have broadly been determined and considered for the purposes of the community GHG inventory in the CCSF guidance manual. However, clarifications / improvements on the following would be useful:
- i. **Municipal Emissions Inventory—Part 1:** On page 4 of the guidance manual, the facilities that fall within and outside of the municipal inventory are stated. As a point of precision, the document should explicitly mention which facilities are under “CCSF’s operational control.”
 - ii. **Community-wide Emissions Inventory Guidance—Part 2:** For the purposes of consistency, a section on boundaries and components that are included (as well as any notable ones that are excluded) should be inserted in this part (similar to the section on boundaries that already exists for Part 1).
 - iii. **Overall Document:** The guidance manual would benefit from the inclusion of a brief section upfront on a list and definitions of the main components that comprise the overall inventory, as well as those that are excluded (i.e., including notes from the summary tab of “FINAL UPDATE SUMMARY DATA” spreadsheet). Also, a map showing the city and county limits of San Francisco could serve to graphically illustrate the geographical boundaries of the inventory.
- I. Revised Natural Gas EF:** An EF of 11.732 lbs CO₂/therm is used in the community inventory. However, the CCAR GRP v. 3.0 (released in April 2008), with a factor of 53.06 kg CO₂/MMBTU, leads to a conversion to 11.6977 lbs/therm. Although this is a minor change and published after the community-wide inventory was developed, this revised factor could be reflected in the inventory in the future.
- J. Non-CO₂ Gases:** The guidance document clearly mentions the difficulty in accurately quantifying non-CO₂ emissions (which are likely very minor in any case in relation to CO₂). Although CH₄ and N₂O are included for transportation, the rest of the inventory does not include any non-CO₂ gases. These judgments appear reasonable for now, but non-CO₂ gases will be required starting year 3 of the CCAR submission (i.e., for the 2007 inventory).

Therefore, going forward, there are non-CO₂ gases (in addition to CH₄) that CCSF may wish to consider including in the inventory for further accuracy:

- Hydrofluorocarbons (HFCs), i.e. from chillers, refrigerators, vehicle air conditioners, etc.
- Nitrous oxide (N₂O), i.e. from fertilizer use.
- Sulfur hexafluoride (SF₆), i.e. from electrical transmission and distribution.

- K. Waste-related Emissions:** Although waste is noted as an information item in the guidance manual, waste-related emissions are not included formally in the inventory for various reasons that have been difficult to resolve, including differences between the CAP and Presidio School of Management approaches yielding different levels of emissions, issues of scope and attribution (i.e., should the waste-related emissions be accounted for in terms of siting, waste origination, or some hybrid approach), and the challenges of accounting for life-

cycle emissions. Once these issues have been resolved, a relevant waste-emissions level should be included in the inventory.

- L. Wastewater-related Emissions:** Although wastewater-related emissions are not included, approaches exist to quantify such emissions. One suggestion is the possible application of a methodology from the Kyoto Protocol's list of approved methodologies for the Clean Development Mechanism (CDM), namely ACM 0014 ("Mitigation of greenhouse gas emissions from treatment of industrial wastewater")¹ which includes CH₄ emissions.
- M. Direct Access:** We note under the Direct Access sub-spreadsheets for 1990, 2000, 2005 that disaggregation has been made for fuel sources and appropriate combustion EFs have been included for some sources but not for others (i.e., hydro, renewables). Going forward, CCSF may wish to consider existing international research studies² that treat EFs from a life cycle assessment perspective for non-fossil fuels.
- N. Transportation:** CCSF appears to have captured all of the major sources of transportation-related GHG emissions. The following areas could lead to further improvements:
- i. **BAAQMD EFs:** Using the EMFAC model, BAAQMD has supplied EFs for CO₂, CH₄, and N₂O (for 2005, 2000, and 1990) which CCSF has appropriately converted and added to CO₂ eq. to yield grams CO₂ / mile factors for intra-regional and road vehicles categories. If possible, it would be useful to transparently display BAAQMD assumptions behind the derivations for each of the factors.
 - ii. **Disaggregation of BAAQMD EFs between Different Types of Vehicles:** As EFs will vary between different types of vehicles (i.e., passenger vehicles and trucks), disaggregation to the extent possible between these 2 broad categories as well as within them (i.e., different classes of light duty and heavy duty vehicles) could improve accuracy and tracking of CO₂ calculations for intra-regional and SF road vehicles, especially for different vehicle classes.
 - iii. **SF Road Vehicles:** Reference is made primarily to the Excel file "San Francisco Road Vehicles" (and accompanying documents in the zip file). CCSF has taken a vehicle miles traveled (VMT) approach using 1990, 2000, and 2005 data from MVSTAFF_06 (a CALTRANS published document). A VMT approach can be a sufficient way to calculate transportation-related emissions, in the absence of more reliable data (i.e., vehicle fuel consumption figures not available in the MVSTAFF_06 document for 1990, thus preventing consistent comparisons between the 1990, 2000, and 2005 years). Although it is noted that the EMFAC model also contains daily figures of VMT, CO₂ tail pipe emissions, and gallons of fuel for San Francisco county, there are however some discrepancies between the CALTRANS document and the EMFAC model (such as for VMTs which have different trends between the years between the two sources) which are likely due to differing assumptions and variables. It is suggested that CCSF consult further with EMFAC and CALTRANS in the future to better understand these differing sets of data and to determine a more accurate approach.

¹ Available at: <http://cdm.unfccc.int/UserManagement/FileStorage/X8HENK3S83UU66XCU23VLRDRNKEX5D>.

² Examples include studies from University of California at Berkeley and the United Nations

- iv. **Intra-regional Vehicles—Travel to/from Other Counties:** Reference is made to the Excel file “SF intraregional car_truck emissions” (and accompanying documents in the zip file). The use of average trip length of home-based work trips (i.e., using Table 7 figures) is a reasonable approach. The subsequent deduction of 2 miles to avoid double-counting travel within San Francisco is also a reasonable assumption. This spreadsheet covers travel to/from nearby counties. However, there is also commercial and personal travel from other hubs (e.g., Los Angeles, other parts of California, West Coast, the rest of the country) to/from San Francisco. Commodity flows databases (such as from ICF) to/from major cities exist and can assist in adding travel to/from other areas that involve San Francisco as an origin/destination point if CCSF wishes to account for these flows in the future.
- v. **Caltrain:** Reference is made primarily to the Excel file “Caltrain_update_data” (and accompanying documents in the zip file).
 - ♦ **“Off” AND “On” instead of “Off” OR “On”:** The methodology as it stands considers only riders that get off (“deboard”) at the 4 San Francisco stations. This could be a reasonable approach but we note that it differs in methodology from the BART approach (which considers both “on” and “off”). Further explanation would be useful.
 - ♦ **Further Attribution of Ridership with Distance Traveled:** Although it may not be possible to get this degree of detail, it would bring further accuracy if the rider count was further disaggregated in terms of the distance that each rider traveled to/from the four San Francisco stations to/from other stations, as possible.
- vi. **BART—EFs:** We understand from CCSF that BART has been using nearly 100% clean power in the last two years. When this information becomes available to CCSF, we suggest that an appropriately lower EF be then used for BART.
- vii. **Ferries—Confirmation of Extrapolation of Data to Bay Area:** Reference is made to the Excel file “Final estimation” (and accompanying documents in the zip file). It is understood that ferry diesel usage estimations are difficult to obtain and as such, the approach followed leads to a reasonable estimate. Going forward however, it would lead to further accuracy if an appropriate percentage attributable to San Francisco boundaries was chosen and applied to the Bay Area estimate (e.g., such as the BART approach).
- viii. **Non-ferry Ships:** Other non-ferry ships such as cargo, fishing, personal, etc. are not included. If they are in the harbor/within the vicinity of San Francisco, ships docked at the port should be included, as bringing them into the boundaries would allow for sharper quantification.
- O. Clearer links to data sources:** For the purposes of ensuring full transparency and credibility, tracking emissions in the future, as well as making it easier for third-party verifiers to corroborate calculations, it is useful to have clearly laid-out components and sub-components of the inventory which are linked to each other (e.g., between the FINAL UPDATE DATA spreadsheet number and their sources). Some of the points of clarification regarding derivation/sourcing that we have noted in this document may be avoided in the future if there was a final single spreadsheet that clearly described key sections in tabs such as:

- ♦ **Summary** data, graphs, and tables—various metrics can be applied here, e.g., absolute CO₂ eq. emissions per year of interest, % change, % of direct/indirect or scope 1/2/3, intensity metrics, etc.
- ♦ Main **components** and sub-components—these can be sliced again in a number of ways; for the purposes of the CCSF community inventory, one broad-level suggestion is having stationary and mobile, and residential/commercial/industrial/municipal/etc. Also some further fragmenting between electricity, natural gas, steam, etc. would be useful at the stationary level, as well as for various mobile categories.
- ♦ **Activity data levels** for each of the above components, supplemented with clearly outlined assumptions and data sources.
- ♦ Consolidated, separate spreadsheet(s) of **emissions factor** used, supplemented with clearly outlined assumptions and sources.
- ♦ Consolidated, separate spreadsheet(s) of **conversion units** employed throughout the calculations.

5. Conclusions

CCSF's community-wide GHG inventory is an excellent attempt at capturing the main emissions sources and calculating the relevant emissions levels. The methodology that has been employed is sound and relevant. Clarifications and suggestions have been made in the earlier sections on what could be done better to improve the inventory in the future.