Section 3

Evaluating the Energy-Water Connection and Greenhouse Gas Emissions

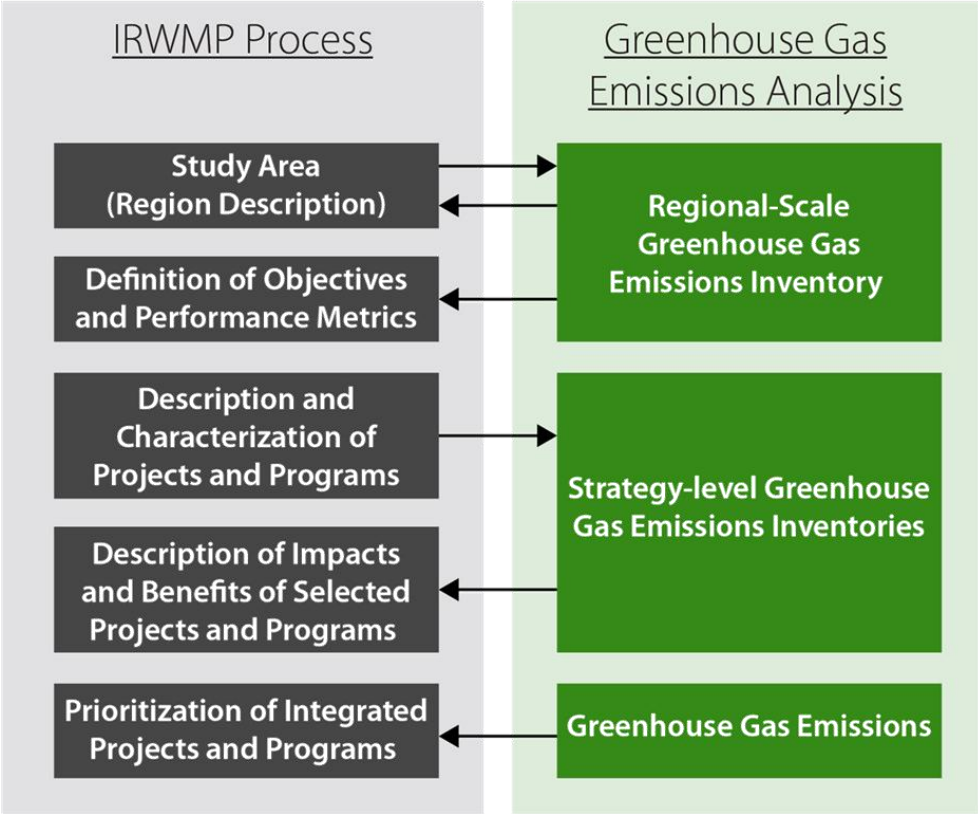


Figure 3-1. GHG Emissions Inventories and Emissions Reductions in IRWM Planning.

The water sector plays a significant role in California's energy consumption. In 2005, studies showed that 19% of the state's electricity was spent on water-related activities (CEC 2005). As discussed in Section 2, GHGs emitted into the atmosphere now and in the future will contribute to further impacts on climate and will likely result in more severe impacts in the latter half of the century (California Air Resources Board (CARB) 2008). Because the water sector is such a large user of electricity, it must play an important role in reducing energy demand and GHG emissions.

The IRWM guidelines, briefly described in Box 1-2, state: "The intent of the Climate Change Standard is to ensure that IRWM Plans … disclose, consider, and reduce when possible GHG emissions when developing and implementing projects." The IRWM program encourages minimizing GHG emissions to the extent practical; the IRWM Grant Program list of Statewide Priorities includes water management actions that lower energy use and reduce GHG emissions. The IRWM guidelines also include a project's contribution to reducing GHG emissions (as compared to other alternatives) as a factor in project evaluation (DWR 2010a).

The IRWM guidelines encourage consideration of GHG emissions consistent with California legislation, including Executive Order (EO) S-3-05, Assembly Bill (AB) 32, and the revised CEQA guidelines (discussed below). Several tools and protocols already exist to provide standardized methods for emissions evaluations and assessments. Discussion of how GHG emissions could be included with other planning objectives and metrics in overall project evaluation is included in Section 6, along with additional mitigation measures that could be considered in the planning process. Figure 3-1 depicts the relationship between GHG emissions inventories and IRWM planning. A baseline GHG emissions inventory could help describe a region's water resources, including identifying the largest sources of emissions, and could also be useful in defining planning objectives. Inventories at the project level could be useful in measuring performance metrics in the project evaluation process. Additionally, CEQA requires project-level inventories to be completed in order to evaluate the GHG-related impacts associated with construction and operation of a specific project. Calculated emissions values are also useful in describing project impacts and benefits, and in project prioritization.

This section focuses on:

- Summarizing the relevant legislation, policies, and plans governing the state of California which relate to GHG emissions,
- Clarifying the benefits to conducting both large-scale and project-scale GHG emissions inventories,
- Providing background on the carbon registries and other resources available when conducting an inventory, and
- Reviewing the major components of conducting a GHG emissions inventory, and providing resources for more detailed information.

3.1 Legislation, Policies, and Plans

The State of California has passed several laws requiring monitoring and reduction of GHG emissions. In addition, several regional air quality control districts and local governments have adopted policies and plans for reducing GHG emissions within their jurisdictions. Projects within these jurisdictions may be subject to additional regulation to comply with these policies and plans. The following review is a summary of the major legislation, policies, and plans specific to California. However, as new policies and plans are being developed constantly, planners may need to consider additional regulations not included in this handbook. Planning efforts in other regions in the United States will need to obtain equivalent information specific to their region.

Executive Order (EO) S-3-05 (2005)

California's EO S-3-05 (State of California, 2005) established statewide GHG reduction goals for California. Because EO S-3-05 only applies to state agencies, it is not binding for the broader economy. EO S-3-05 establishes the following GHG reduction goals:

- Reduce statewide emissions to 2000 levels by 2010,
- Reduce statewide emissions to 1990 levels by 2020, and
- Reduce statewide emissions to 80% below 1990 levels by 2050.

These ambitious emissions reduction goals are consistent with the IPCC estimates of emissions reductions required to stabilize long-term climate impacts (IPCC 2007a). The parties responsible for implementing EO S-3-05 formed the CAT (http://www.climatechange.ca.gov/climate_action_team/index.html). CAT is a work group with representatives from the California Environmental Protection Agency (CalEPA), the Business, Housing and Transportation Agency, the Department of Food and Agriculture, and many other state agencies. CAT develops sector-specific implementation plans for adapting to climate change in California and for reducing emissions. CAT also produces biennial reports that describe the potential impacts of climate change on key state resources, and reports on progress toward meeting the goals set forth in AB 32 (see below).

Assembly Bill (AB) 32 (2006)

AB 32 (California Health & Safety Code § 38500 et seq.; California State Assembly 2006, also known as the 2006 Global Warming Solutions Act), establishes a statewide mandate for reducing GHG emissions to 1990 levels by 2020. On December 12, 2008, CARB, the state agency tasked with developing the regulations to meet the GHG reduction goal, approved the final Climate Change Scoping Plan (Scoping Plan) for implantation of AB 32. The Scoping Plan includes recommendations for reducing GHG emissions statewide through a series of actions. Specific Scoping Plan actions which relate directly to the water sector and to water resource planning and management include (CARB 2008):

- Water use efficiency,
- Water recycling,
- Water system energy efficiency,
- Urban runoff reuse,
- Increase renewable energy production, and
- Public goods charge.

In addition to the actions described in the Scoping Plan, a number of near-term implementation plans have been developed by CAT. The Water-Energy Subgroup of the Climate Action Team

(WET-CAT) has taken the lead on developing near-term plans to aggressively increase water use and energy efficiency in the water sector. Below are the key plans that have been developed related to the water sector:

- 20X2020 Near-Term Implementation Plan: http://www.climatechange.ca.gov/climate_action_team/reports/catnip/water_energy/Water%201%20-%2020x2020%20Reduction%20CATNIP.pdf
- Water Recycling Near-Term Implementation Plan: http://www.climatechange.ca.gov/climate_action_team/reports/catnip/water_energy/Water%202%20-%20Water%20Recycling%20CATNIP.pdf
- Low Impact Development Near-Term Implementation Plan: http://www.climatechange.ca.gov/climate_action_team/reports/catnip/water_energy/Water%203%20-%20Low%20Impact%20Development%20CATNIP.pdf
- Improved Monitoring Near-Term Implementation Plan: http://www.climatechange.ca.gov/climate_action_team/reports/catnip/water_energy/Water%204%20-%20Improved%20Monitoring%20CATNIP.pdf

More information on AB 32 is available at http://www.arb.ca.gov/cc/ab32/ab32.htm.

Senate Bill (SB) 97 (2007)

In 2007, the California Legislature recognized the need for guidance on the analysis of climate change for CEQA compliance, and with SB 97 (California Public Resources Code - Section 21083.05; California State Senate 2007), directed the Natural Resources Agency, in coordination with the Governor's Office of Planning and Research, to develop amendments to the CEQA Guidelines. As a result of SB 97, new CEQA Guideline amendments provide direction to lead agencies about evaluating, quantifying, and mitigating a project's potential GHG emissions. The new regulations are viewable at: http://www.ceres.ca.gov/ceqa/guidelines/ and have also been codified under Title 14 of the California Code of Regulations.

Local and Regional Policies and Plans

Unlike many other states, California's air quality and GHG emissions are managed at the regional level by 35 local air districts. Each air district is responsible for establishing how it will evaluate the significance of GHG emissions within its region. While the air districts are not required to adopt district-specific procedures and standards for determining the significance of GHG emissions, several air districts have developed their own standards.

Air districts that have adopted CEQA thresholds of significance for GHG emissions and methods for evaluating impacts include:

- Bay Area Air Quality Management District (AQMD),
- Sacramento Metropolitan AQMD,

- San Diego Air Pollution Control District (APCD),
- San Joaquin Valley APCD,
- Santa Barbara County APCD,
- South Coast AQMD, and
- Tehama County APCD.

Some air districts have adopted quantitative thresholds of significance (e.g., Bay Area AQMD and South Coast AQMD both use 10,000 metric tons of carbon dioxide equivalents per year as the significance threshold for industrial sources), while other air districts, like the San Joaquin Valley APCD, use a qualitative approach, such as requiring Best Performance Standards in project design. It is critical that agencies check with their local air district about standards for assessing the significance of GHG emissions before commencing new projects.

Additionally, several cities, counties, and other land use jurisdictions require GHG reductions or have been proactive in creating climate action plans to guide emissions reductions. For example, the City of Los Angeles released its climate action plan (Green LA) in 2007, which sets a goal of reducing the City's GHG emissions to 35 percent below 1990 levels by 2030. Agencies should also be cognizant of local GHG reduction goals that may affect proposed projects.

3.2 Greenhouse Gas Emissions Inventories

Regions are encouraged to conduct a region-wide inventory (or several smaller inventories by agency) of the water sector as part of the IRWM regional description process. This type of analysis informs potential emissions reductions and regional planning objectives. Inventories can be performed on a project level as well to establish carbon credits and to aid in project evaluation; this type of analysis is also required as part of the CEQA process and regions are encouraged to combine analyses where possible.

3.2.1 Carbon Registries

Protocols created by carbon registries can help with GHG emissions inventories, whether at the regional level or the project level. While there are benefits to becoming members of a climate registry, this action would also commit the agency to completing annual GHG emissions inventories and would have financial obligations. Carbon registries also require entity-wide disclosures of emissions and are not tuned to project-level emissions inventories. While it may not be practical for a region or agency to become a member of a carbon registry, the resources available from the registries can be instructive. Carbon registries are organizations that provide guidance in measuring and reducing GHG emissions. They also provide an accepted platform for measuring and reporting emissions. Most registries either:

1. Provide agencies with a method of inventorying and reporting emissions, such as The Climate Registry (TCR); or

2. Serve as a basis for developing GHG emissions reductions, potentially at the project level, such as the American Carbon Registry (ACR) and the Climate Action Reserve (CAR).

This handbook does not necessarily recommend that agencies become members of reporting registries like TCR; however, the protocols and methods established by the registries serve as a useful basis for completing GHG emissions inventories.

3.2.1.1 Emissions Inventories Registries – Organization-Level

Function of Registries

Registries that provide inventorying methods allow agencies to voluntarily commit to annually reporting GHG emissions. This helps identify areas where mitigation measures may be implemented, emissions reductions documented, and carbon offsets obtained. When the voluntary carbon registries were first established, GHG management in California was still in its infancy. Without rules and regulations dictating how carbon would be managed, the registries served an important function by documenting the early actions taken by organizations to reduce GHG emissions. CARB publicly stated that it would work with registries to allow organizations to take "credit" for their voluntary early actions and to partially shield them from further emissions reduction requirements under future regulatory regimes.

While reporting registries like TCR can help identify areas where carbon offsets could be attained, they are not platforms for actually obtaining carbon offsets. Rather, projects must be submitted through registries like ACR or CAR to obtain quantifiable carbon offsets that could then be sold on the open market.

The GHG Protocol Initiative and TCR

The GHG Protocol Corporate Standard (World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD)) and TCR's GHG reporting protocols are voluntary reporting standards that focus solely on inventorying emissions, rather than generating carbon offsets. Both systems provide a transparent and standardized method of inventorying emissions.

TCR is a non-profit organization whose board is comprised of representatives from over 41 states, all 13 Canadian Provinces and territories, six Mexican states, and four native sovereign nations. TCR empowers organizations to assess and reduce their GHG emissions by providing the tools to measure and manage them, including the Local Government Operation Protocol – a GHG reporting protocol developed in partnership with the California Climate Action Registry (CCAR), TCR, ICLEI-Local Governments for Sustainability, and CARB. TCR is the current North American standard for GHG emissions inventories and public reporting, other than the state and federal mandatory programs, and is recommended if an organization chooses to voluntarily assess its emissions. Organizations looking to inventory their GHG emissions should report

their 2010 and later emissions data to TCR. Even if an agency elects to not become a member of TCR, its protocols can be used to develop GHG emissions inventories.

The GHG Protocol Initiative provides an accounting framework for agencies to quantify and manage GHG emissions. Representing a partnership between WRI and WBCSD, the GHG Protocol works with businesses, governments, and environmental groups to create consistent methods for estimating GHG emissions. The GHG Protocol provides useful tools and resources including spreadsheets to aid in GHG emissions calculations, but does not provide a reporting platform.

3.2.1.2 Emissions Credits Registries – Project-Level

For specific mitigation projects, ACR and CAR can be used to document GHG emissions reductions for the purpose of generating tradable emissions credits or offsets. These carbon offsets can then be bought or sold on the open market. Offsets generated through the CAR program may also be used in the cap-and-trade program that California intends recently adopted. ACR works individually with agencies to conduct a GHG emissions inventory and regular monitoring protocol. The case study at the end of this section describes a monitoring protocol developed by the Inland Empire Utilities Agency (IEUA) for a digester project using the ACR protocol.

For potential project evaluations, a project-level inventory may be conducted based on the protocols available through an emissions credit registry, and a final selected project alternative may be registered in an emissions credit registry like CAR, if practical, to aid in documenting emissions savings and obtaining carbon offsets.

3.2.1.3 Additional Registry and Inventory Information

Accessing Registry Resources

Regardless of whether agencies and water resource entities join a registry, agencies and regions are encouraged to consider the principles outlined by emissions inventory protocols in the planning process, to the extent practical. The following web links are useful for finding out more information about the various carbon registries:

- The Climate Registry (http://www.theclimateregistry.org/),
- The Greenhouse Gas Protocol Initiative (http://www.GHGprotocol.org/),
- The American Carbon Registry (http://www.americancarbonregistry.org/aboutus), and
- The Climate Action Reserve (http://www.climateactionreserve.org/).

Large-Scale Inventories

Statewide or national GHG emissions inventories may also be useful; however, these inventories are typically created using coarse data about inputs and outputs from each sector of the economy to estimate gross emissions from the sector. For regional entities, this coarse data is not typically available. References to state-level and national inventories are provided below:

- The 2010 state-level inventory for California includes emissions for years 2000 to 2008 http://www.arb.ca.gov/cc/inventory/inventory.htm,
- The nation-wide inventory http://www.epa.gov/climatechange/emissions/usinventoryreport.html , and
- All state-level GHG emissions inventories http://www.epa.gov/statelocalclimate/state/state-examples/ghg-inventory.html.

Other Resources

Several resources are also available in the literature. For example, the California Air Pollution Control Officers Association (CAPCOA)'s "Quantifying Greenhouse Gas Mitigation Measures" (2010, http://www.capcoa.org/wp-content/uploads/2010/11/CAPCOA-Quantification-Report-9-14-Final.pdf) can be used to estimate the effectiveness of various GHG mitigation measures. Other sources are also listed in the literature review in Appendix A of this handbook. It should also be noted that climate change literature is in a continued state of evolution, so regions are encouraged to conduct their own investigation to make sure that the methodologies they use are up to date.

ICLEI – Local Governments for Sustainability (http://www.icleiusa.org) is a membership association of local governments that are committed to reducing GHG emissions and practicing sustainability. While ICLEI is geared towards cities, towns, and counties, several of its tools could be useful for the creation of a GHG emissions inventory. Many tools, including the Clean Air & Climate Protection Software, can only be assessed by member governments and so may not be available to water agencies. The Local Government Operations Protocol, which was created in partnership with CARB, CCAR, ICLEI, and TCR, is a useful document for creating GHG emissions inventories.

3.2.2 Measuring Emissions

The organizations mentioned in the previous section provide standardized instructions for conducting a GHG emissions inventory for an IRWM region or for a potential project. Whether emissions calculations are for a project or for an entire region, the general steps involved in measuring carbon emissions are the same:

1. Define inventory/project boundaries,
2. Define all relevant GHG sources and sinks,
3. Obtain emissions measurements and convert all GHGs to a CO_2 equivalent value based on their global warming potential[1], and
4. Verification of calculation by a third party (optional).

[1] The concept of a global warming potential (GWP) was developed to compare the ability of each greenhouse gas to trap heat in the atmosphere relative to another gas. The definition of a GWP for a particular greenhouse gas is the ratio of heat trapped by one unit mass of the greenhouse gas to that of one unit mass of CO_2 over a specified time period" (EPA, 2011). Because different gases have different GWPs, carbon dioxide equivalents represent GHGs in terms of their GWP. This allows emissions of different GHGs to be compared with one another.

A description of each step is provided below:

1. Define project boundaries. While most protocols give detailed information about defining boundaries, the required information for most water agencies can be simplified. Generally, when completing an emissions inventory, regardless of the type or purpose, a water agency should consider all points that would be involved with delivering water. As a starting point, an agency should consider all direct and indirect emissions that could occur from combusting fuel or using electricity. Stationary sources like engines, generators, anaerobic digesters, and boilers should be considered, as well as mobile sources including agency owned or leased vehicles and forklifts. Emissions associated with worker transportation, water pumping for groundwater extraction and for conveyance, water and wastewater treatment, should all be included in a regional inventory. In conducting an agency- or system-wide inventory, care must be taken to account for GHG emissions associated with any water imported into the region.

   Institutional boundaries define which organizations' activities will be included in the analysis. For example, a region may decide to include emissions released by certain water-related agencies. Emissions related to water end-use (such as domestic water heating) may be beyond the institutional boundaries set by the inventory.

   It is also important to define which gases to record. Most inventories should include, at a minimum, carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), especially if combustion sources are used by an agency or if indirect emissions from purchased electricity could occur. These three pollutants are consistently required to be reported in various voluntary and mandatory reporting regulations and should not be excluded, even if emissions may seem to be negligible.

2. Define all GHG sources and sinks inside the project boundaries, such as:

   a. Electricity use (and source mix of electricity),
   b. Fuel generation (for instance, from digesters),
   c. Carbon sequestration,
   d. Transportation of materials and people, and
   e. Fuel consumption (from equipment/machinery use).

It is important to know what mix of energy sources (e.g., the percentage of electricity supplied from renewable sources, coal, natural gas, etc.) is used to produce any electricity consumed for the project. The Emissions & Generation Resource Integrated Database (eGRID) is an excellent resource to determine emissions from electricity in a particular region and to determine the region's fuel mix (http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html). Utilities that report emissions to TCR or have previously reported to the CCAR are encouraged to use the CO_2[(2)] emission factor (i.e., CO_2/Megawatt hour of generation) from these public reports instead of the eGRID emission factor.

Some sources and sinks, such as sequestration via photosynthesis, may be more difficult to quantify. The EPA also provides a summary of agricultural and forestry practices that sequester carbon. This summary is provided in Tables 3-1 and 3-2. The EPA website on sequestration practices also provides reference carbon sequestration rates for some specific forestry and agricultural practices (http://www.epa.gov/sequestration/practices.html). The CAR also provides protocols for quantifying sequestration rates for forests, urban forests, landfills and other projects (http://www.climateactionreserve.org/how/protocols/). Not all sequestration practices have established carbon sequestration rates. Certain practices may require a detailed literature review or may need to be discussed qualitatively. The tables below may also help inform land use planning where carbon sequestration and/or GHG emissions reductions are a planning objective.

[2] The public reports only include CO_2 emission factors; therefore, CH_4 and N_2O emission factors should still be obtained from eGRID.

Table 3-1: Agricultural Practices that Sequester Carbon and/or Reduce Emissions of Other Greenhouse Gases (Source: http://www.epa.gov/sequestration/ag.html)

Key Agricultural Practices	Typical Definition and Some Examples	Effect on Greenhouse Gases
Conservation or riparian buffers	Grasses or trees planted along streams and croplands to prevent soil erosion and nutrient runoff into waterways.	Increases carbon storage through sequestration.
Conservation tillage on croplands	Typically defined as any tillage and planting system in which 30% or more of the crop residue remains on the soil after planting. This disturbs the soil less, and therefore allows soil carbon to accumulate. There are different kinds of conservation tillage systems, including no till, ridge till, minimum till, and mulch till.	Increases carbon storage through enhanced soil sequestration may reduce energy-related CO_2 emissions from farm equipment, and could affect N_2O positively or negatively.
Grazing land management	Modification to grazing practices that produce beef and dairy products that lead to net greenhouse gas reductions (e.g., rotational grazing).	Increases carbon storage through enhanced soil sequestration, may affect emissions of CH_4 and N_2O.
Biofuel substitution	Displacement of fossil fuels with biomass (e.g., agricultural and forestry wastes, or crops and trees grown for biomass purposes) in energy production, or in the production of energy-intensive products like steel.	Substitutes carbon for fossil fuel and energy-intensive products. Burning and growing of biomass can also affect soil N_2O emissions.

Table 3-2: Forestry Practices that Sequester or Preserve Carbon (Source: http://www.epa.gov/sequestration/forestry.html)

Key Forestry Practices	Typical Definition and Some Examples	Effect on Greenhouse Gases
Afforestation	Tree planting on lands previously not in forestry (e.g., conversion of marginal cropland to trees).	Increases carbon storage through sequestration.
Reforestation	Tree planting on lands that in the more recent past were in forestry, excluding the planting of trees immediately after harvest (e.g., restoring trees on severely burned lands that will demonstrably not regenerate without intervention).	Increases carbon storage through sequestration.
Forest preservation or avoided deforestation	Protection of forests that are threatened by logging or clearing.	Avoids CO_2 emissions via conservation of existing carbon stocks.
Forest management	Modification to forestry practices that produce wood products to enhance sequestration over time (e.g., lengthening the harvest-regeneration cycle, adopting low-impact logging).	Increases carbon storage by sequestration and may also avoid CO_2 emissions by altering management. May generate some N_2O emissions due to fertilization practices.

3. Obtain emissions measurements and convert all GHGs to a CO_2 equivalent. For existing projects or regional inventories, records of electricity use, fuel consumption, etc., need to be assembled. For potential projects, these data will need to be estimated based on professional judgment. If construction will be involved for a proposed project, then construction-related emissions must also be estimated for CEQA.

   Many tools are available to help quantify GHG emissions. Some examples include:

   a. California's Regulation for the Mandatory Reporting of GHG Emissions contains methods to estimate emissions, specifically in §95105 for stationary combustion sources (http://www.arb.ca.gov/cc/reporting/ghg-rep/ghg-rep.htm).

   b. TCR's General Reporting Protocol contains methods for estimating emissions from stationary combustion, mobile combustion, and electricity use (http://www.theclimateregistry.org/resources/protocols/general-reporting-protocol/).

   c. The Local Government Operations Protocol expands on TCR's General Reporting Protocol and also includes methods for estimating emissions from power generation facilities, solid waste facilities, and wastewater treatment facilities (http://www.theclimateregistry.org/resources/protocols/local-government-operations-protocol/).

   d. Calculations based on electricity use and transportation are produced by the GHG Protocol: http://www.GHGprotocol.org/calculation-tools/all-tools.

   e. Detailed protocols for specific procedures can also be found through the USEPA at: http://www.epa.gov/climatechange/emissions/index.html.

   f. The Task Force on GHG Inventories for IPCC provides guidance on a larger, national scale: http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html.

4. Verify that GHG emissions calculations are conducted correctly. For mandatory emissions reporting, emissions calculations must be verified by an accredited verification body. The CARB provides guidance for verification at http://www.arb.ca.gov/cc/reporting/GHG-ver/GHG-ver.htm. Voluntary emissions reporting platforms also encourage verification. TCR requires that organizations who are publically reporting emissions go through third-party verification, and provides verification guidance for voluntary GHG reporting in its General Reporting Protocol (http://www.theclimateregistry.org/resources/protocols/general-reporting-protocol/).

While third party verification is an important process for validating an emissions inventory and ensuring its quality and accuracy, it may not be practical for planning evaluations. For GHG inventories that are not going to be publicly reported, verification also may not be cost effective. This process is also described in the IEUA and Sonoma County Water Agency (SCWA) GHG emissions inventory case studies (Boxes 3-1 and 3-2, respectively). The IEUA case study highlights an inventory developed for a complex dairy manure digester system used to power recycled water facilities. IEUA registered the project with the ACR. The SCWA inventory highlights an agency-level inventory conducted through TCR.

3.2.3 Monitoring

Consistent with the IRWMP Performance and Monitoring standard, regional emissions should be monitored regularly, as projects are implemented. This step may be simplified if either agencies in the region or projects being implemented are registered with one of the registries discussed in Section 3.2.1. The American Carbon Registry helps establish a protocol for monitoring and reporting for individual projects. WRI and TCR also have protocols for monitoring and reporting emissions over time. Ultimately, the registry an agency joins (if it chooses to do so) and monitoring method used depend on both the nature of the project(s) and the objectives of the region.

3.2.4 Using Project GHG Emissions in Planning

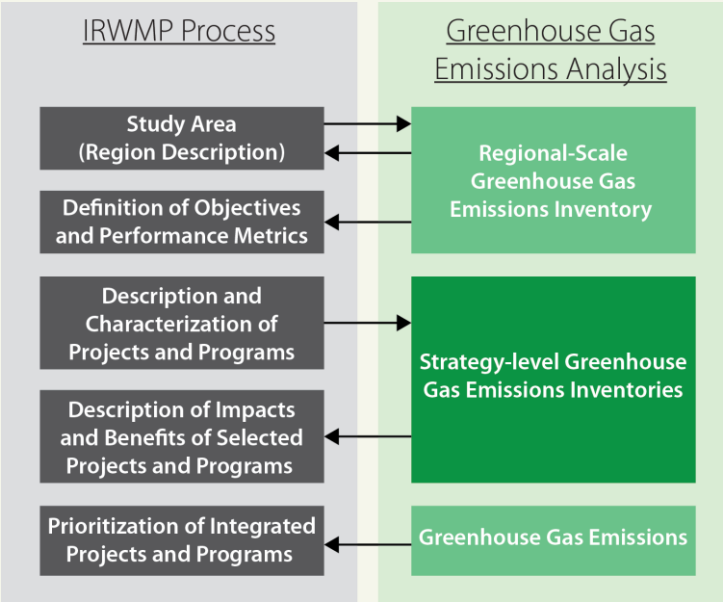
In California, IRWM guidelines state that in the project review process, project contribution to reducing GHG emissions (relative to other project alternatives) must be considered. This may be done by assessing the carbon emissions associated with one project alternative versus another.

Selection amongst IRWMP resource management strategies should consider the relative GHG emissions from different approaches to achieve the same water management objectives (i.e., surface storage vs. groundwater storage; drip irrigation vs. canal lining). Resource management strategies that provide similar water benefits may involve very different GHG emissions.

The information and resources provided in this section discuss *both* regional and project level inventories of GHG emissions. A regional inventory can contribute to the regional description in an IRWMP. Information from a regional inventory may also be used in the definition of regional objectives and performance metrics. Emissions inventories of individual potential projects can be used to evaluate potential projects, and can also be included in an IRWMP's description of the impacts and benefits from individual projects. The project evaluation process is discussed in more detail in Section 6.

Case Study: Project GHG Inventories

Inland Empire Utilities Agency – Regional Digester Inventory
Inland Empire Utilities Agency, CA



Background:

- Inland Empire Utilities Agency (IEUA) is a regional utility providing imported and recycled water and wastewater services and treatment to the Cities of Chino, Chino Hills, Fontana, Montclair, Ontario, and Upland; the Cucamonga Valley Water District; and Montevista Water District (Figure 1). Major facilities include water recycling facilities, two biosolids handling facilities and a composting facility. The energy generated from digesters contained in the biosolids facilities (RP-1 and RP-5) is used to power water recycling facilities. The flow of materials and energy among the IEUA facilities is shown in Figure 2.
- **Anaerobic Digester Project:** The anaerobic digester project originally operated as a centralized manure management facility for local dairies, and is registered at the American Carbon Registry (ACR). Because the digesters generate electricity and reduce the overall carbon footprint of IEUA, annual emissions reports with the ACR report both overall emissions and emissions reductions associated with the digester project. The digester project currently operates primarily on food waste, but the original emissions evaluations as a manure handling facility are presented here.
- **Methodology:** The methodology of this inventory was developed by the Environmental Resources Trust and Eastern Research Group (prepared for the CEC and IEUA), and relies heavily on conversion factors and recommended assumptions made by the IPCC, the USDA, EPA, and others. These source materials are cited in the Literature Review presented in Appendix A, and are also cited in the documents listed at the end of this case study. The inventory itself was conducted through a spreadsheet-based model.

Figure 1: Inland Empire Service Area (Source: Jones and Matson, 2009). For larger image, please see http://www.ieua.org/news_reports/docs/reports/2009/CWEA_PresentationMay09.pdf.

Box 3-1

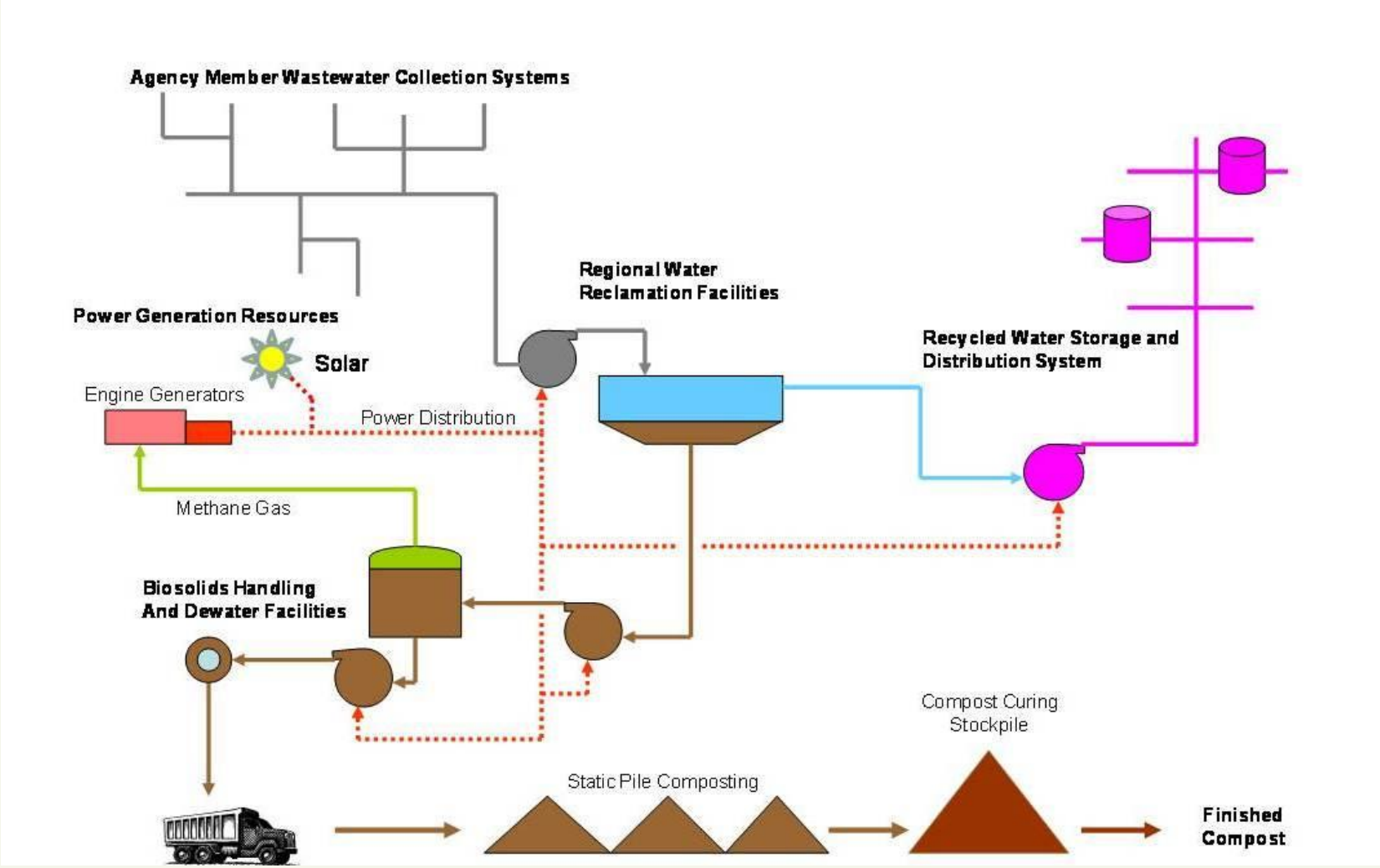


Figure 2: IEUA system flow diagram. (Source: http://www.ieua.org/facilities/img/Facilities-Overview.jpg)

Box 3-1 (Continued)

Step 1: Define Project Boundaries and Obtain Applicable Data

Boundaries Consist of:

- Facilities/activities of IEUA evaluated in this study
- Types of emissions included in this study

Data Consists of:

- Emissions source data
- Standard emissions estimates

Defining project boundaries is the first step in inventorying GHG emissions, and includes defining the processes that are considered in the inventory. Figures 3-5 depict the flow of methane for the "with project" scenario, and nitrous oxide and methane for the "baseline", no-project scenario.

Emissions Gases Included:

- Methane (direct emissions)
- Nitrous Oxide (indirect emissions)
- Ammonia (indirect Nitrous Oxide emissions)
- Carbon Dioxide (direct emissions)

Emissions Sources Included:

- All operations contained within the two solids handling facilities:
  - RP-1: flare, engine, boiler emissions
  - RP-5: flare, engine, water heater emissions
- Emissions from transporting manure to digester facilities
- *For baseline comparison*: baseline manure management and disposal processes
  - Dairy cattle enteric fermentation
  - Manure management in corrals and lagoons
  - Co-composting

Box 3-1 (Continued)

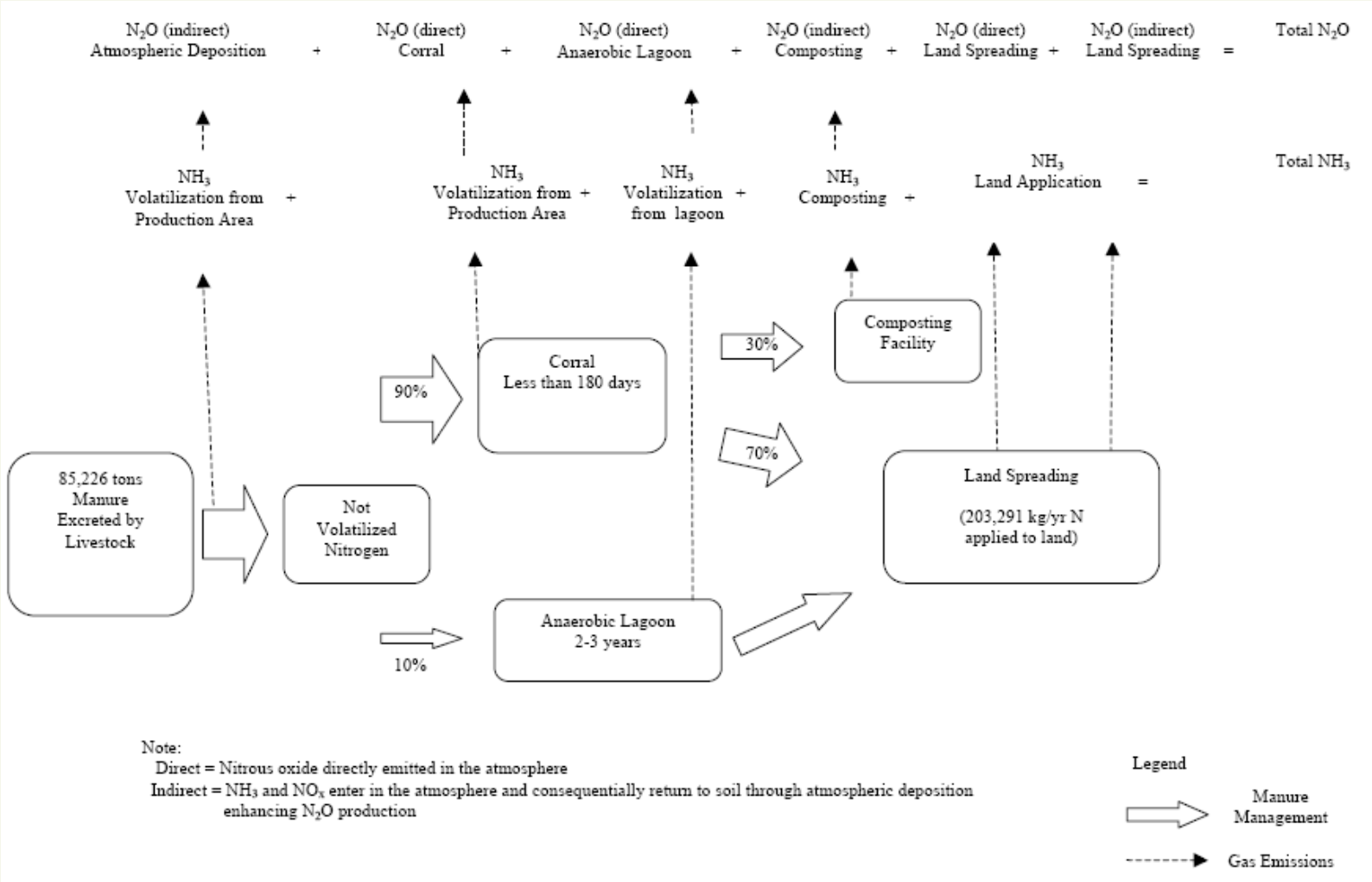


Figure 3: Inventory boundaries and N_2O pathways for baseline system. (Source: ERT, 2006)

Box 3-1 (Continued)

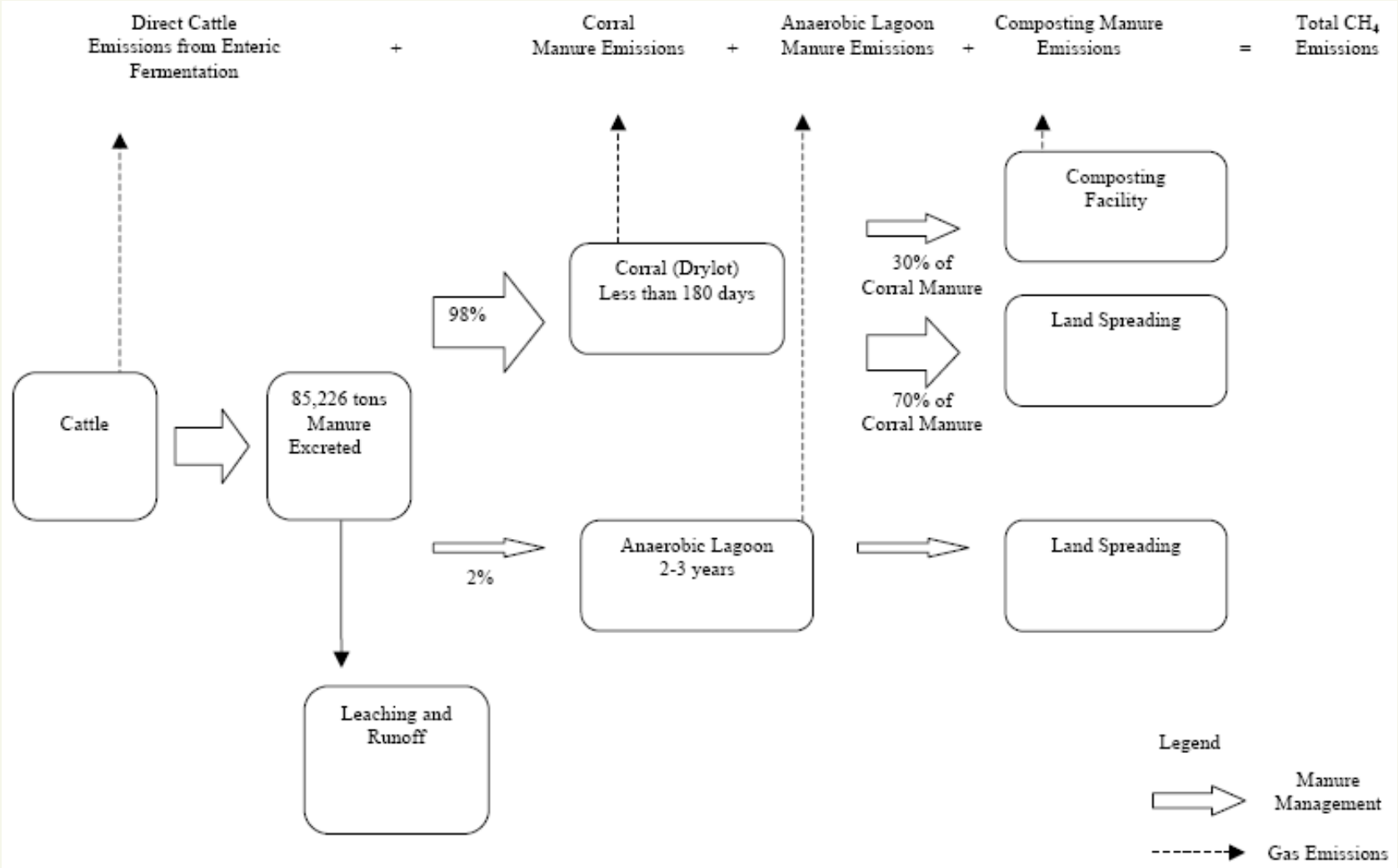


Figure 4: Inventory boundaries and CH_4 pathways for baseline system. (Source: ERT, 2006)

Box 3-1 (Continued)

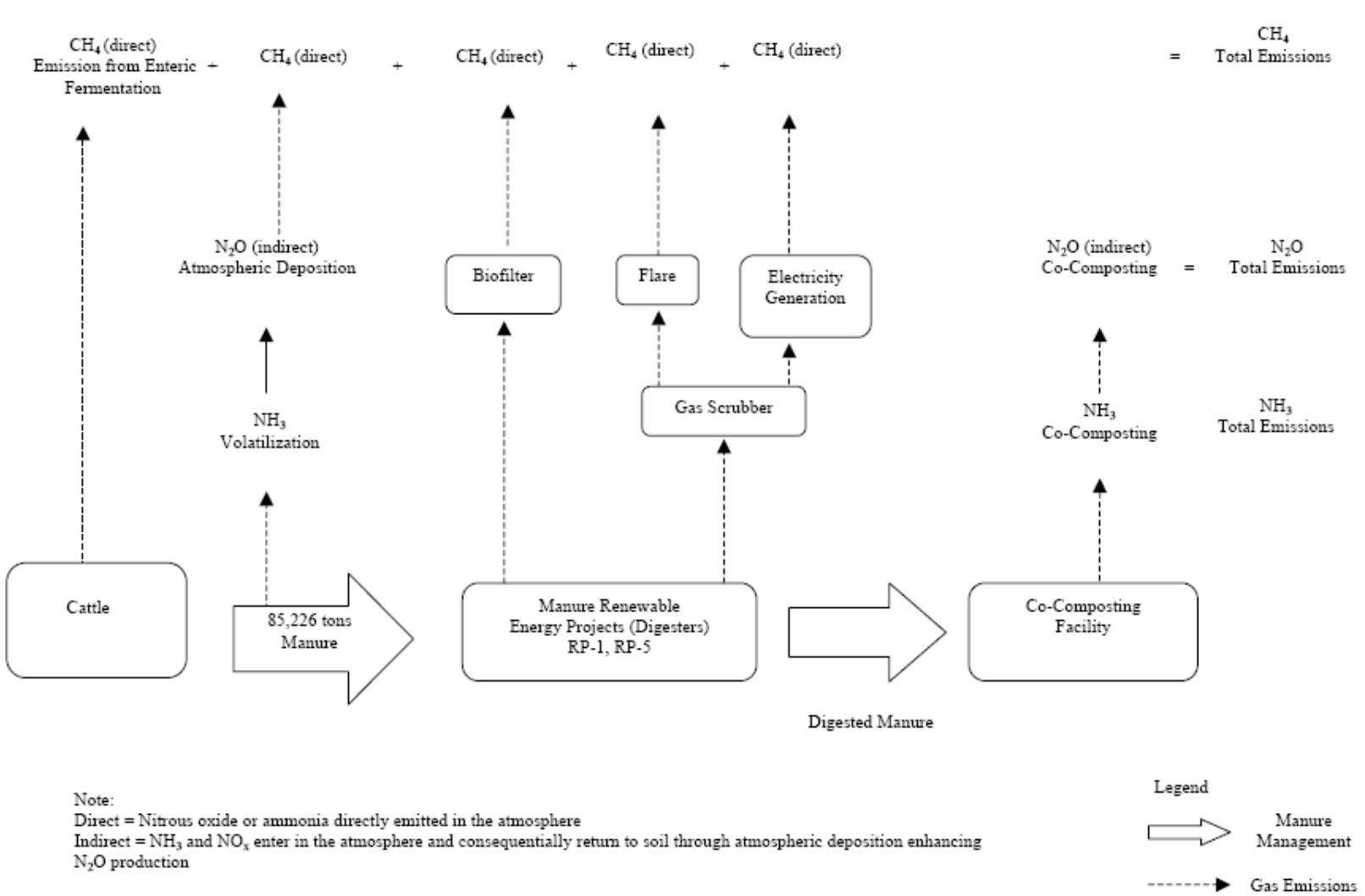


Figure 5: Inventory boundaries and GHG pathways for digester system. (Source: ERT, 2006)

Box 3-1 (Continued)

Data Obtained:

- Daily records of manure delivery to digesters, volatile solids content
- Biogas production
- Biogas use at flares and other on-site uses
- Biogas exported
- Flare operation
- Transportation data
- *For baseline*: manure loadings to corrals, lagoons, composting facility

Conversion Factors and GHG Emissions Estimates Assembled:

- Emissions associated with consuming biogas - based on measured data from digesters. The composition is constantly being measured, so changes over time can be included.
- Emissions associated with manure management process: lagoons, corrals, composting
- Emissions associated with vehicle transportation

Step 2: Baseline and Project GHG Emissions

Results Assessed:

- Absolute emissions of CO_2 equivalent
- Reductions in CO_2 emissions resulting from project

2003 Emissions Totals

	CH_4 Emissions (tons)	N_2O Emissions (tons)	Total GHG Emissions CO_2 equivalent (tons)
Baseline	337	23	14,245
"With Project"	280	1	6,221
Project Emissions Reduction	57	22	8,023

Source: ERT, 2006.

*Emissions from dairy manure processing were **reduced by 56%** for the year 2003. Power from the digesters also supplies other facilities within IEUA.*

IEUA System-Wide Inventory

Using similar techniques, IEUA has also conducted a GHG emissions inventory extending over all of IEUA (excluding emissions associated with imported water). Some summary information is provided below.

Emissions Gases Included:

- Methane
- Nitrous Oxide
- Carbon Dioxide
- Hydrofluorocarbons
- Sulfur Hexafluoride

Emissions Sources Included:

- All water recycling facilities
- All company vehicle use
- The headquarters building
- Purchased electricity and gas
- Digester facilities

Box 3-1 (Continued)

Results:

Major emitting facilities for IEUA are the recycled water and desalting facilities, even with power provided by the IEUA digesters taken into account. The major source of emissions in the treatment system is purchased electricity. It is important to note that this system-wide inventory only includes processes associated with IEUA's footprint specifically, not the overall regional footprint. If imported water were included in this inventory, it would be possible to compare emissions from recycled water treatment with emissions from imported water delivery.

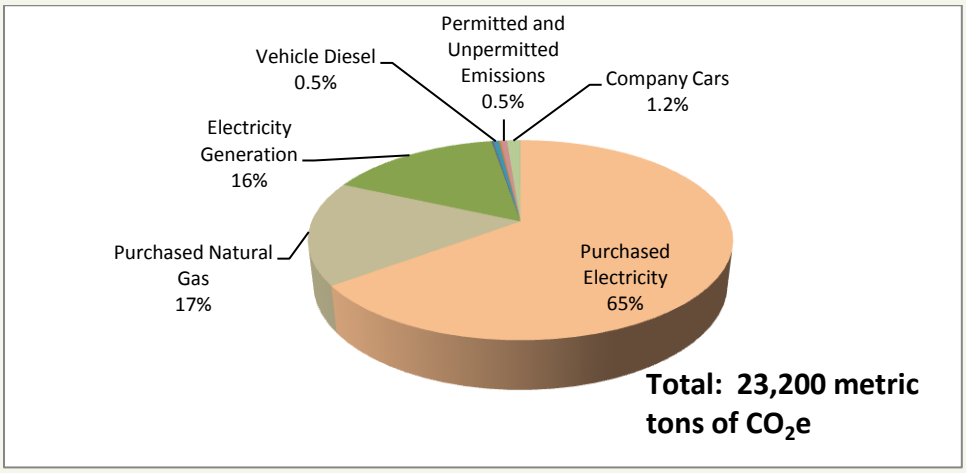


Figure 6: IEUA system-wide emissions by facility in 2003. (Data Source: Arifian and Swenson, 2008)

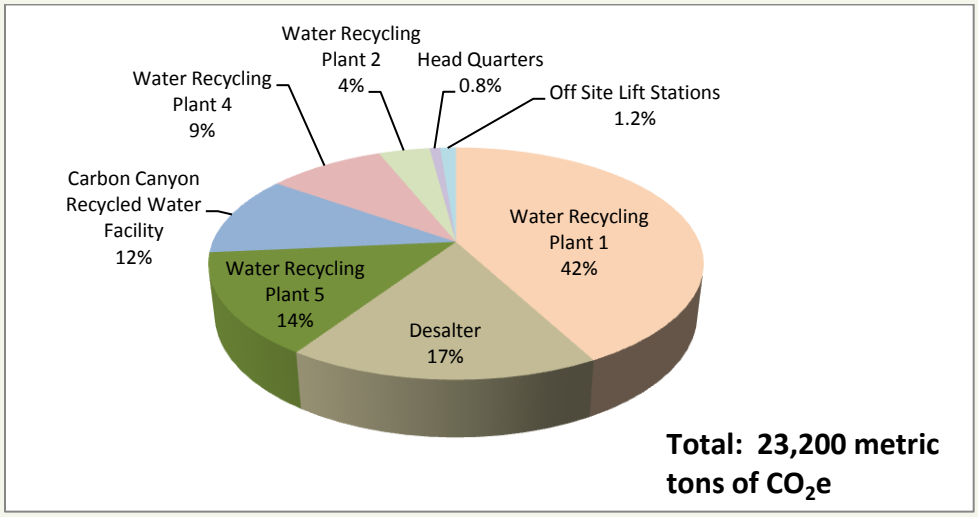


Figure 7: IEUA system-wide emissions by emission source type in 2003. (Data source: Arifian and Swenson, 2008)

Box 3-1 (Continued)

For More Information

Jones, Amy and Mike Matson. (2009). Maximizing a Valuable Resource – IEUA Recycled Water Program. Available: http://www.ieua.org/news_reports/docs/reports/2009/CWEA_PresentationMay09.pdf

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Environmental Resources Trust, Inc. (ERT). (2006). Monitoring, Reporting and Verification Protocol for IEUA Anaerobic Digester Project. Prepared for Inland Empire Utilities Agency. January 24, 2006. Available: http://www.americancarbonregistry.org/carbon-registry/projects/inland-empire-utilities-agency-anaerobic-digester-project/Inland_MRV_Protocol_01-24-2006.pdf/view.

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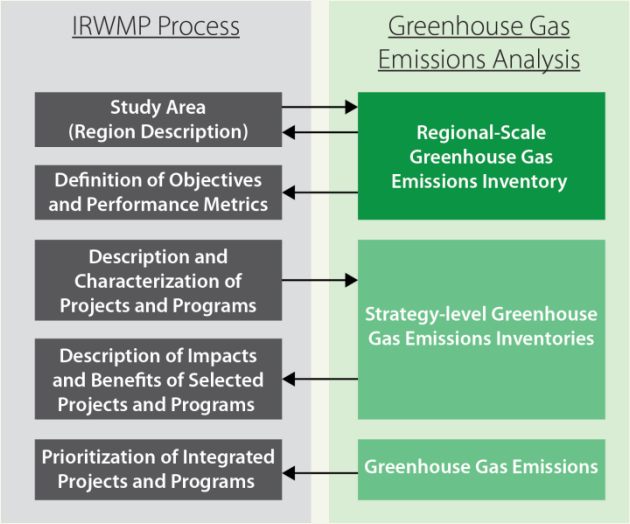
Bartram, D. and W. Barpour. (2004). Estimating Greenhouse Gas Reductions for a Regional Digester Treating Dairy Manure. Proceedings of the 13th International Emission Inventory Conference: "*Working for Clean Air in Clearwater*". Available: http://www.epa.gov/ttn/chief/conference/ei13/ghg/bartram.pdf.

Box 3-1 (Continued)

Case Study: Agency GHG Inventories



Sonoma County Water Agency – Agency-wide Carbon Footprint
Santa Rosa, CA

Background:

- The Sonoma County Water Agency (SCWA) provides wholesale water supply, flood control, stream maintenance services, and sanitation services to 600,000 people in portions of Sonoma and Marin Counties. As one of the largest energy users in Sonoma County, SCWA is actively working to reduce its carbon footprint. In 2006, SCWA committed to achieving a carbon-free water system by 2015. To help achieve that goal, SCWA has registered with The Climate Registry (TCR) and reports agency-wide emissions on an annual basis.

Step 1: Define Project Boundaries

Boundaries based on facility types

The water agency's GHG inventory is framed around facility types, which include:

- water supply,
- wastewater processing
- administrative facilities, and
- vehicle fleet.

The largest sources of emissions are fleet vehicles and electricity use for water transmission, transmission booster pumps, and wastewater treatment.

Institutional Boundaries: Members of The Climate Registry determine which facilities, operations, and sources to include within their organizational boundary and how to account for those emissions. SCWA chose to report using operational control, which means it reports for emissions from facilities where it has control over the operating policies.

Operational Boundaries: GHG emissions are divided into three scopes to provide a comprehensive accounting framework for managing and reducing direct and indirect emissions. In 2010, SCWA's GHG inventory included the following emissions:

Scope 1:

- Natural gas combustion
- Diesel combustion
- Fleet vehicles
- Fugitive emissions from building and vehicle air-conditioning
- Process emissions from wastewater treatment

Scope 2:

- Electricity purchase from Power and Water Resources Pooling Authority
- Electricity purchase from PG&E
- Biogenic emissions: biodiesel fleet vehicles

Box 3-2

Step 2: Baseline and Project GHG Emissions

Results assessed: direct and indirect emissions of CO_2 equivalent

Compiling Data and Calculating Emissions:

SCWA's electricity manager provides electricity consumption data from electricity bills on an annual basis. GHGs are pre-calculated from electricity use using formulas outlined in TCR's General Reporting Protocol (GRP) and a utility-specific emission factor from SCWA's local utility. This allows SCWA to determine its own power mix and purchase electricity that comes from renewable sources.

SCWA's fleet manager collects fuel consumption data from fuel purchase and mileage records on a monthly basis. GHG totals are calculated using GRP methodologies and EPA mileage estimates for each vehicle type.

SCWA managers track and organize data in an Excel spreadsheet. They also use the built-in calculators in TCR's reporting software to calculate GHG totals from certain data sources.

Verification:

After inputting the data, an accredited third party verifies the inventory.

Results:

Table 1 shows the results from SCWA's 2010 inventory. The largest emissions are from vehicles and from electricity for water and wastewater transmission and treatment.

Generating the verified GHG inventory costs SCWA about $25,000 each year.

Table 1

	Metric Tonnes CO2 Equivalent		
	Direct Emissions	Indirect Emissions	Biogenic Emissions
Water Supply	130.6	2505.92	-
Wastewater Processing	725	1004.1	-
Administrative	270.8	105.8	-
Fleet Vehicles	922.8	-	18
Total	**2049.2**	**3615.82**	**18**

A detailed report of SCWA's 2010 emissions can be obtained from The Climate Registry's web site: https://www.crisreport.org/web/guest.

For More Information

SCWA web site: http://www.scwa.ca.gov/index.php

The Climate Registry web site: http://www.theclimateregistry.org/

SCWA and other TCR annual reports: https://www.crisreport.org/web/guest

Box 3-2 (Continued)