Carbon Baseline Assessment

Stantec Steve Lobo P.E., ENV SP

Agenda

ITEM

1 Safety Moment

2 Introduction

3 Quantifying GHG Emissions

4 Case Study: Town of Cary Inventory

5 Discussion/Questions

Safety Moment: Beat the Heat

Health, Safety, Security, & Environment

SaferTogether

Know the Signs and Symptoms of Heat Stress:

- Dizziness, headache, nausea, blurred vision
- Weakness
- Rapid heartbeat
- Cramps
- Chest pain
- Labored beathing
- Loss of consciousness
- Impaired performance of skills, mental concentration, or vigilance

Beat the heat this summer with these safety tips:

- **Drink plenty of fluids**, it is important to stay hydrated anyway you can
- **Slightly increase your salt intake**
- **Dress appropriately** – wear light-colored and loose, breathable clothing (such as cotton) that does not leave too much skin exposed; wear hats and use sunscreen
- **Apply plenty of sunscreen**, numerous times throughout the day
- **Take it slow** – start the day slowly, take short frequent breaks throughout the day; gradually increase the frequency, intensity or duration of your tasks as your comfort level improves
- **Cool down** every chance you get
- **Stay out of the sun** whenever possible

If you have questions, please contact your supervisor, Office Safety and Environment Coordinator (OSEC), or local HSSE representative

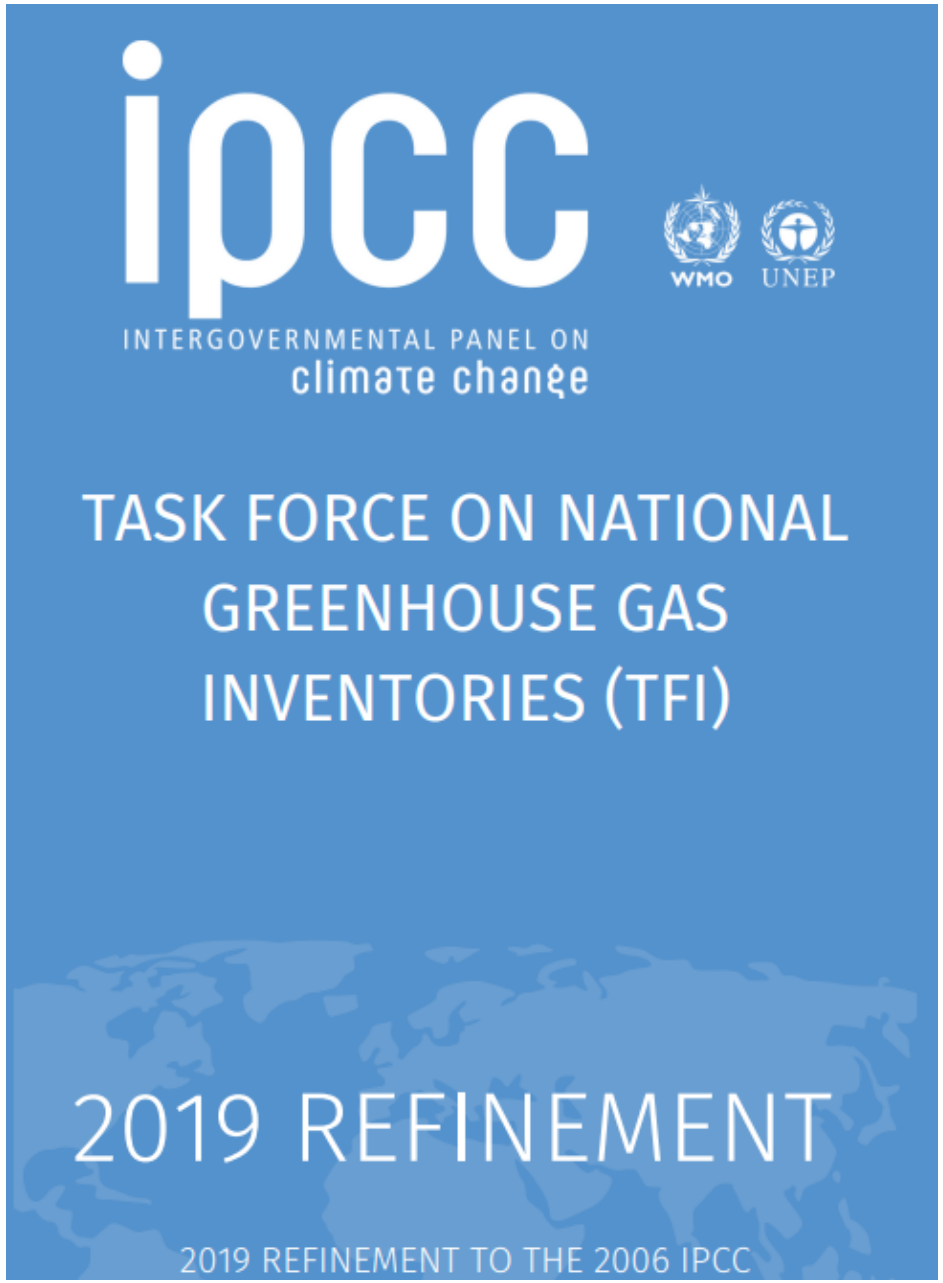
HSSE Stop & Talk are written for educational purposes and are not intended to replace safe work practices or procedures.
ver. July 2017

Stantec

Introduction

Greenhouse Gases & Climate Change

- Greenhouse Gas (GHG): Gas that absorbs and emits radiant energy as heat
- GHGs are released naturally and from human activity
- GHGs have varying warming impacts
- GHG impacts typically normalized to CO_2 equivalents
- Kyoto Protocol identified CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3 as GHGs of most concern



Greenhouse Gas Accounting

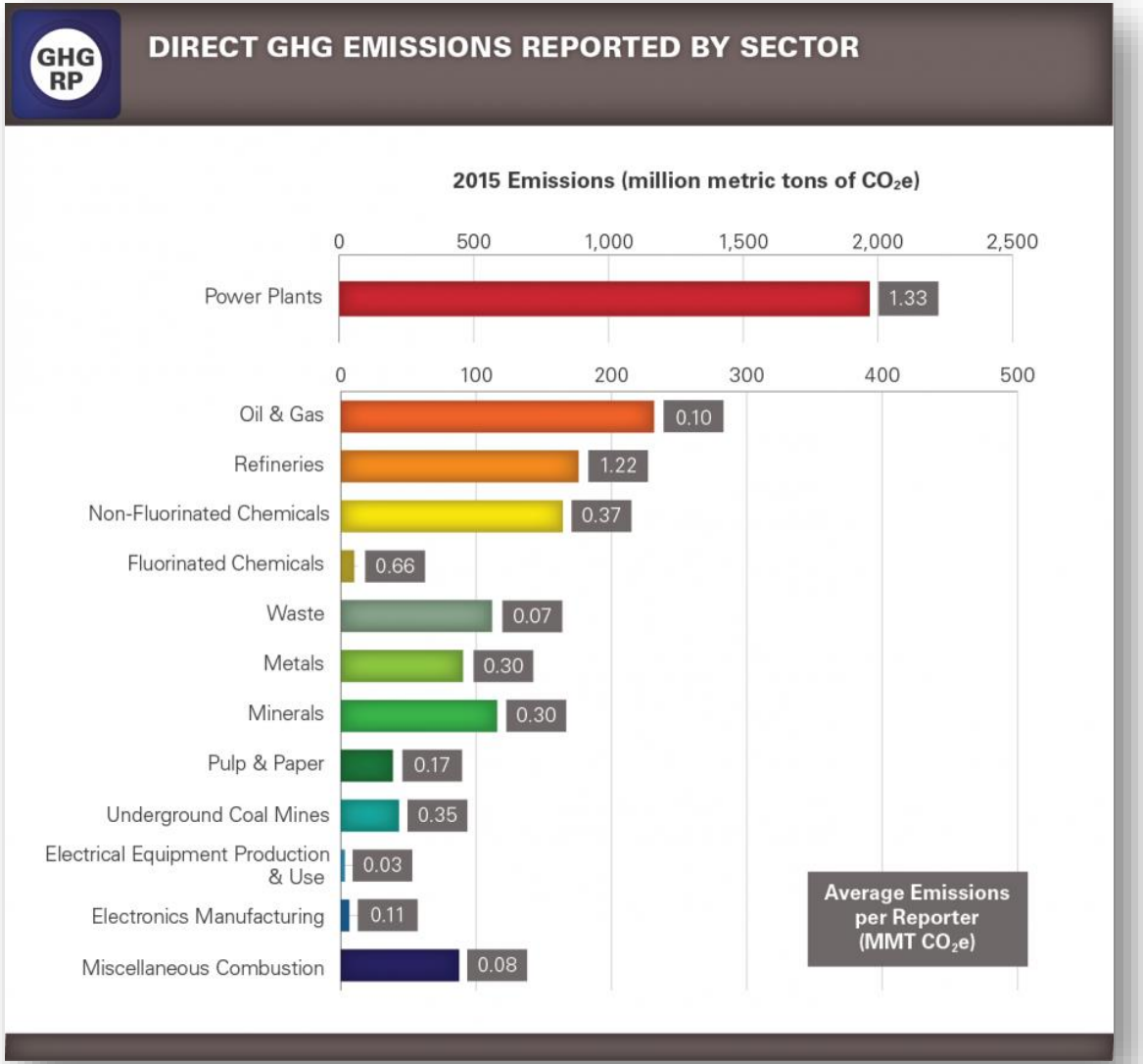
Intergovernmental Panel on Climate Change (IPCC)

- United Nations body for assessing science of climate change
- In 2006, released comprehensive guidance and calculation tools for national greenhouse gas inventories
- Produced by thousands of authors, editors, and reviewers
- Standard on which most calculation methods are built on

U.S. Policies

U.S. Greenhouse Gas Reporting Program

- Implemented in 2009
- Supported by Clean Air Act
- Requires annual reporting of GHG emissions to EPA for entities emitting <25,000 MTCDE
- Covers 85%-90% of US GHG emissions
- Currently only covers certain industrial wastewater treatment systems



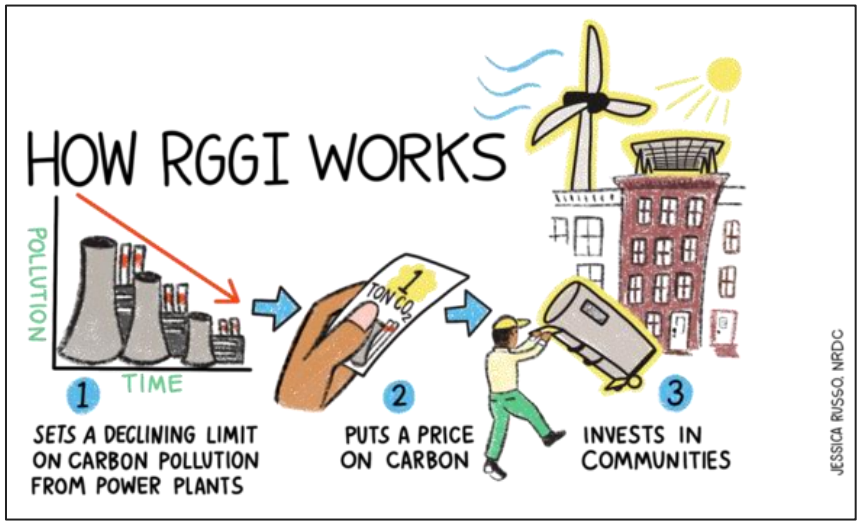
GHGRP Reported Emissions, 2015[1]

[1]https://climatechange.chicago.gov/ghgreporting/ghgrp-reported-data

State Programs

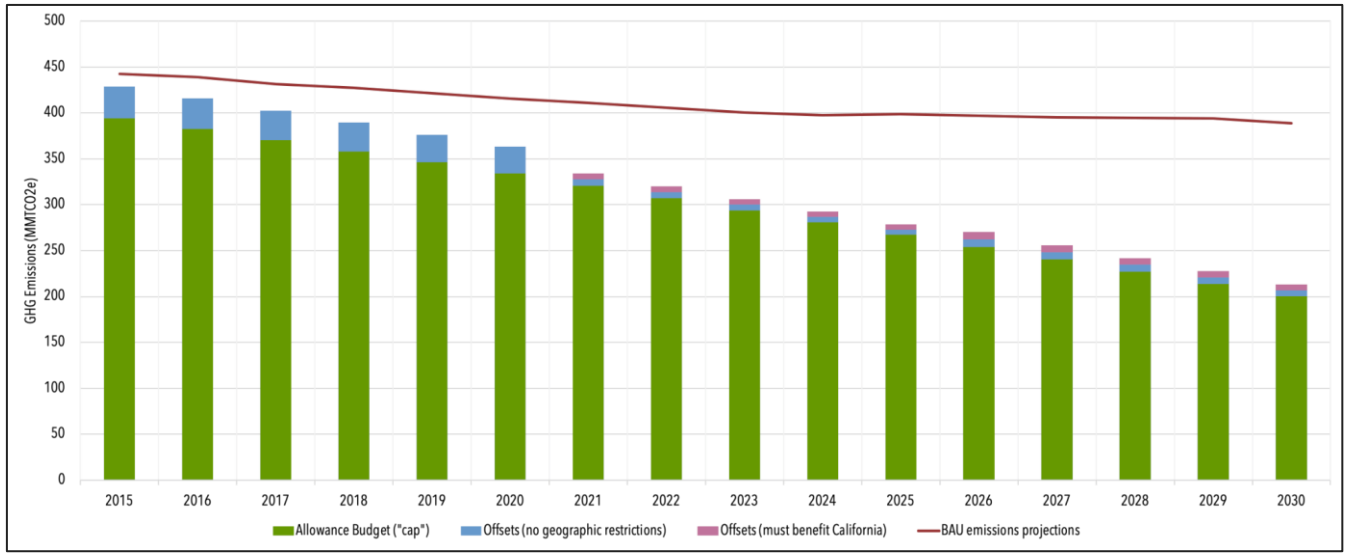
Regional Greenhouse Gas Initiative

- Cooperative effort among 11 eastern states to reduce emissions from power plants
- Power plants purchase emission allowances
- Emissions reduced by 50% since inception, with $4 billion invested into local communities



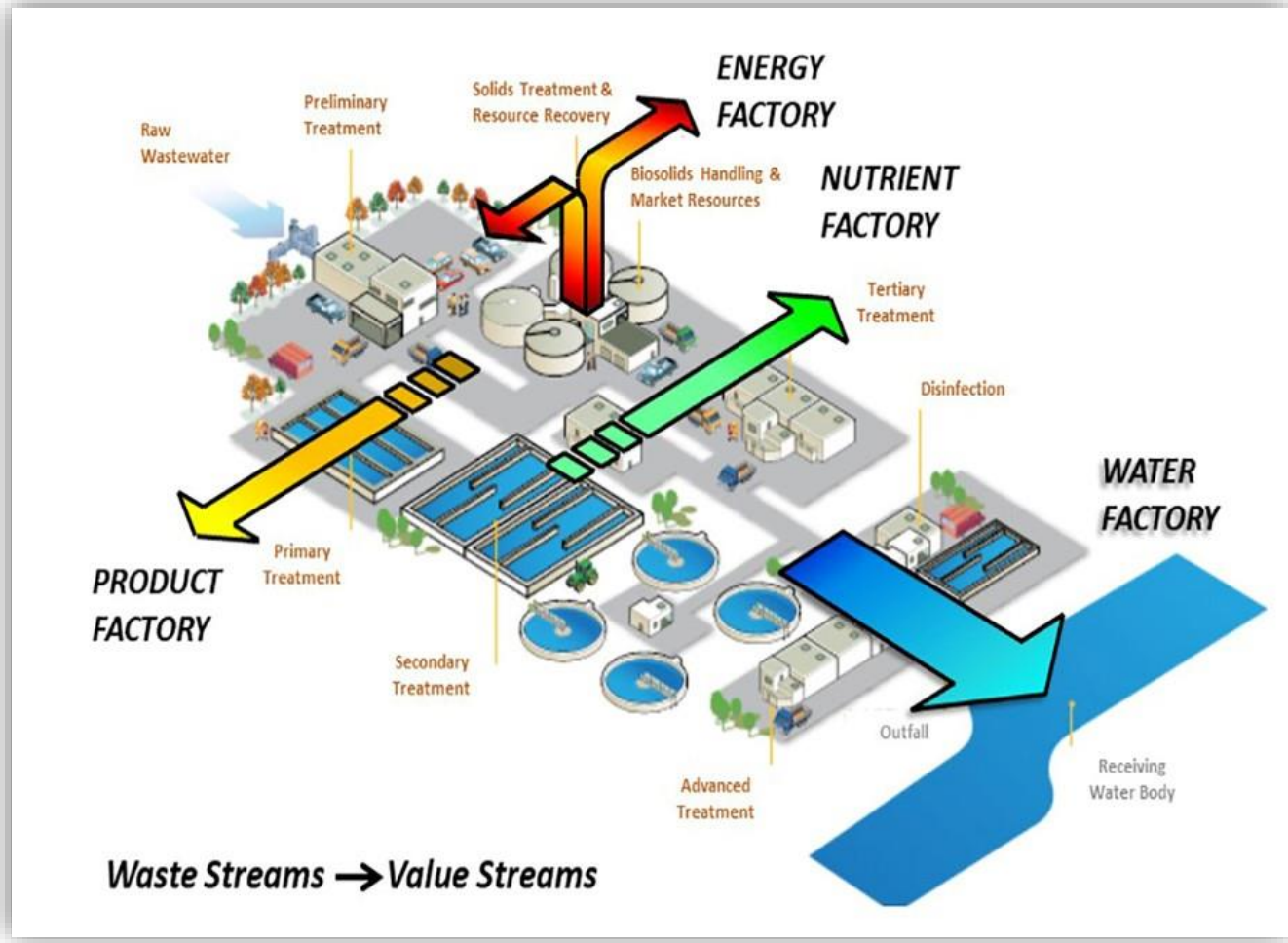
California Cap-and-Trade Program

- Similar structure to RGGI
- Linked with Québec's program
- Covers 80% of California's emissions
- Part of Western Climate Initiative trading system with Washington and Nova Scotia



GHGs in Water/Wastewater

- Water and Wastewater Treatment/Conveyance require massive amounts of energy, ~10% of global GHG emissions[1]
- For some municipalities, water sector can account for nearly 70% of total municipal emissions
- Energy consumption in the water sector is expected to increase by 80% over next 25 years, despite technology improvements[2]
- Industry shift from waste management to resource recovery



[1] Pinching, J. (2021, October 19). Xylem calls on water sector to join 'Race to Zero' emissions. *Sustainability Magazine*. Retrieved from https://sustainabilitymag.com/diversity-and-inclusion-dandi/xylem-calls-water-sector-join-race-zero-emissions

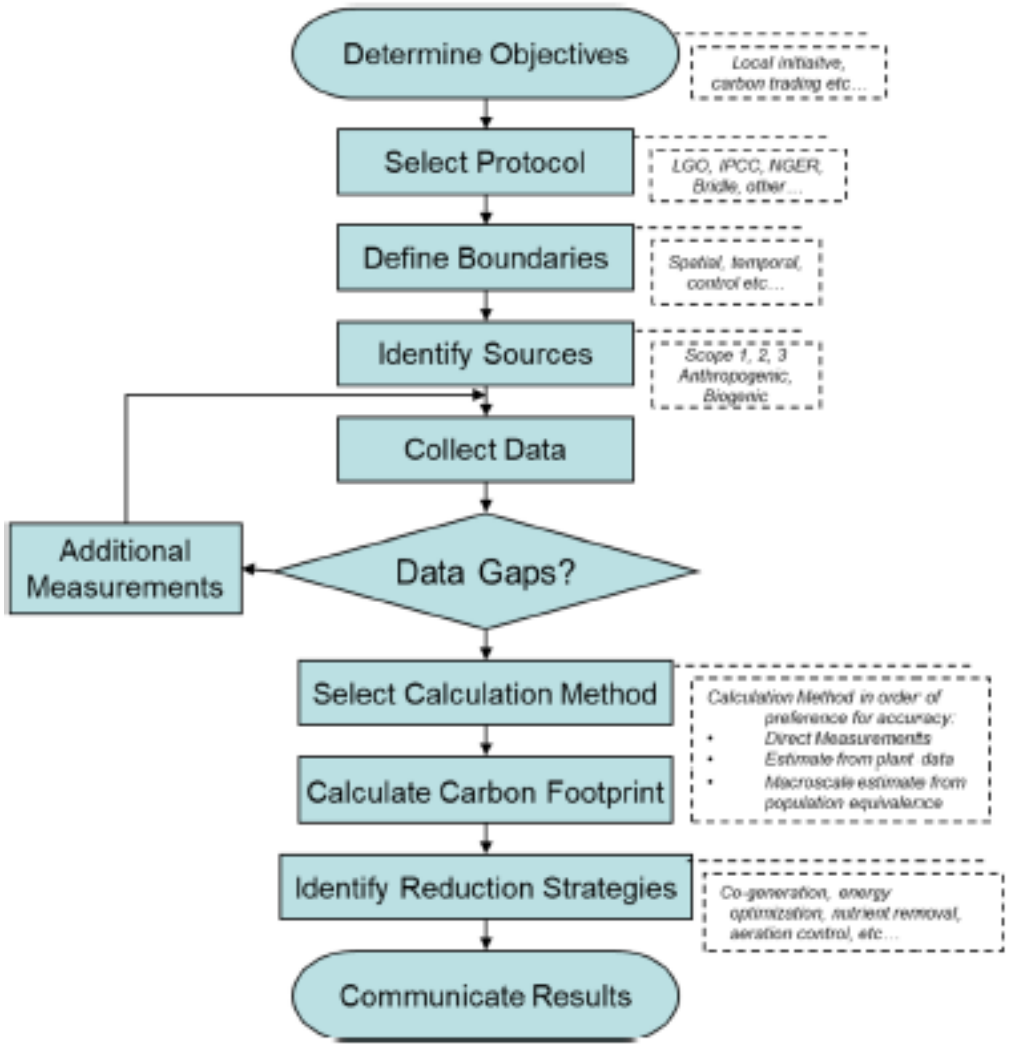
[2] Ren, Z. J., & Pagilla, K. (2022). Pathways to water Sector Decarbonization, Carbon Capture and Uttilization. IWA Publishing. Retrieved from https://library.oapen.org/handle/20.500.12657/54048

Quantifying GHG Emissions

Objectives

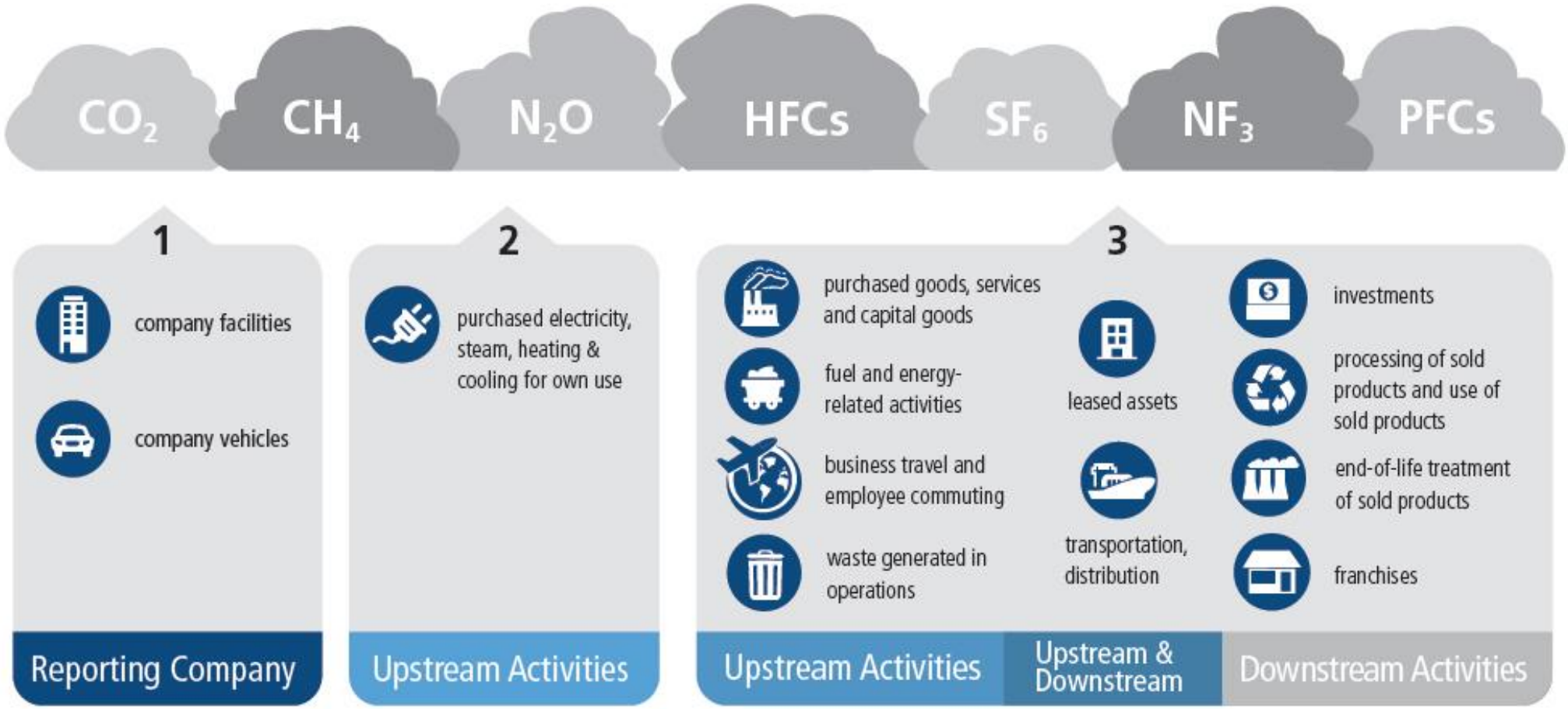
- What will your greenhouse gas inventory allow you to do?
  - Track emissions?
  - Operation/Expansion decisions?
  - Carbon trading?
  - Accreditation/Certification?
  - Regulation?

- Objectives will dictate the protocol you select and guidance you follow



IWA: Pathways to Water Sector Decarbonization, Carbon Capture, and Utilization

Scope Categories



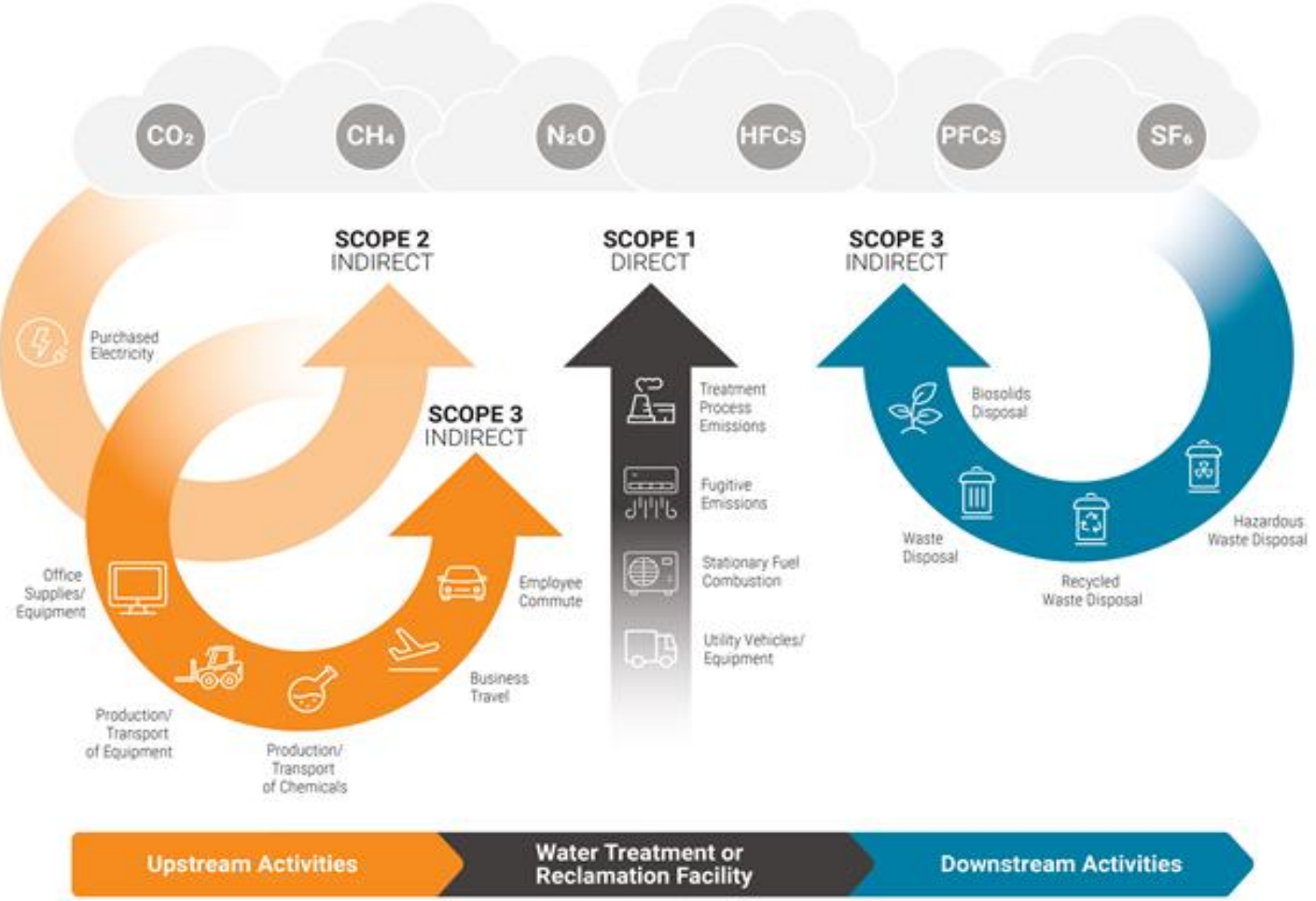
Scope 1: Direct
Greenhouse gas emissions from sources that are owned or controlled by a company.

Scope 2: Indirect
Greenhouse gas emissions resulting from the generation of electricity, heat or steam purchased by a company.

Scope 3: Indirect
Greenhouse gas emissions from sources not owned or directly controlled by a company but related to the company's activities.

Neuberger Berman (nb.com)

Water Treatment & Reclamation Emissions



Category	Scope Category
Stationary Combustion Emissions	Scope 1
Mobile Combustion Emissions	Scope 1
Refrigerant Fugitive Emissions	Scope 1
Wastewater Process Emissions	Scope 1
Electricity Consumption Emissions	Scope 2
Chemicals/Fuels Transport Emissions	Scope 3
Mobile Fugitive Emissions	Scope 3
Biosolids Land Application Emissions	Scope 3

Resources for the U.S. Water Sector

Name	Description	Focus	Details
Biosolids Emissions Assessment Model (BEAM) (SYLVIS, 2009)	Estimates emissions associated with solids management and biosolids application	Wastewater and agriculture sectors	Calculation tools and user's manual
Carbon Footprint Registry (The Climate Registry, 2022)	Reporting protocol for North American organizations created by the non-profit organization, the Climate Registry.	All sectors	Step-by-step guidance, verification, calculation tools, performance tracking
European Union Emissions Trading System (EU ETS) (European Commission, 2022)	Carbon trading commodity market launched in 2005 as a major component of the EU Energy Policy. Operates under 'cap and trade' principle. Based on GHG Protocol and IPCC guides	All sectors	Carbon trading method with standardized guidance, tracking, verification, and policy
Greenhouse Gas Emissions Calculator for the Water Sector (Blickenstaff, 2013)	U.S. DOI and California-developed tool that determines water supply and energy demands, in addition to GHG emissions	Potable water treatment and groundwater extraction	Calculation tools and user's manual
Greenhouse Gas Equivalencies Calculator (EPA, 2022)	Provides U.S. nationwide average energy conversion factors to convert energy use into CO_2 emissions	Energy and fuel consumption. Some factors only consider CO_2 emissions.	Carbon conversion formulas
Greenhouse Gas Protocol (WRI & WBCSD, n.d.)	The Greenhouse Gas Protocol provides standards, guidance, tools, and training for businesses and governments to measure and management climate warming emissions.	All sectors	Step-by-step guidance, verification, performance tracking, reduction targets
Greenhouse Gas Protocol for the U.S. Public Sector (Russell, Sotos, & Bostock, 2010)	Similar to GHG Protocol Corporate Standard with changes in content and structure	Public sector activity in the U.S.	Step-by-step guidance, verification, performance tracking, reduction targets
Intergovernmental Panel on Climate Change (IPCC) (IPCC, 2008)	Comprehensive guidelines and calculation formulas for developing national greenhouse gas inventories	All sectors	Guidance, calculation tools, and user's manual
Local Government Operations Protocol (CARB et al., 2010)	Specifically designed to calculate emissions of U.S. municipal governments	All municipal operation sectors	Step-by-step guidance, calculation tools
Local Greenhouse Gas Inventory Tool (EPA LGHGIT, 2022)	Designed for governments interested in completing quick and simple GHG inventories	All municipal operation sectors aside from water treatment and conveyance	Calculation tools and user's manual
Mackay Carbon Calculator (Department for Business, Energy & Industrial Strategy, 2020)	Webtool developed by the Department of Business, Energy and Industrial Strategy to calculate UK emissions and future carbon pathways to show how decisions affect UK emissions	Public sector activity in the UK	Calculation tools with easy web interface
Science Based Targets Network Protocol (SBTN, 2022)	Reporting protocol similar to the Science Based Targets Initiative that focuses on organizations' impact on nature, including biological diversity, sustainable forest, oceans management, reversing land degradation, etc.	All sectors	Step-by-step guidance, verification, performance tracking for nature-related goals
UK Water Industry Research (UKWIR) Carbon Accounting Workbook (Water UK, 2021)	Specific review of water sector's process emissions based on water treatment and wastewater process emission factors and technologies used in the calculation of greenhouse gases. Follows IPCC guidance	UK Water and wastewater sector specific	Standardized guidance for estimating operational greenhouse gas emissions
U.S. EPA Center for Corporate Climate Leadership (EPA, 2021)	Resource center for organizations to calculate and manage GHGs, including a calculator for small businesses and low emitter organizations	All sectors	Simplified carbon calculator for small businesses and low emitter organizations

Calculation Resources

Primary Protocol
Local Government Operations Protocol

Wastewater Process Emissions
IPCC Guidelines Chapter 6, 2019 Refinement

Biosolids Land Application Emissions
Biosolids Emissions Assessment Model

Emission Factors
EPA GHG Emission Factors Hub

EPA CENTER FOR CORPORATE
CLIMATE LEADERSHIP
U.S. Environmental Protection Agency

Local Government Operations Protocol (LGOP)

- Primary guidance and calculation resource
- Designed specifically for developing municipal GHG inventories
- Four gases evaluated in this inventory
  - Carbon Dioxide – CO_2
  - Methane – CH_4
  - Nitrous Oxide - N_2O
  - Hydrofluorocarbons – HFCs
- Informed inventory boundaries and identification of emission sources
- Provided emission formulas for stationary & mobile combustion, fugitive refrigerants, and electricity consumption

IPCC Guidance for National GHG Inventories

- Guidelines report released in 2006
- Updated in 2019 with additional calculations for CH_4 emissions
- Utilized for Scope 1 process emissions at WRFs where LGOP lacked computational formulae

Biosolids Emissions Assessment Model (BEAM) & EPA Waste Reduction Model (WARM)

- BEAM was developed to quantify emissions from wastewater solids management
  - Detailed emissions analysis of solids management processes
  - Excel-based calculation tool
  - Only “Land Application” formulas used in this study
- WARM allows for the calculation of life-cycle emissions for a wide array of waste streams and waste processing methods.
- LGOP lacks guidance on calculating emissions for composting

EPA Greenhouse Gas Emissions Factor Hub

- Emission factors sourced from EPA Center for Corporate Climate Leadership's (EPACCCL) Greenhouse Gas Emission Factors Hub
- Emission factors designed for the U.S.
- Used in emission calculations for
  - Stationary and mobile refrigerant fugitives
  - Stationary and mobile combustion
  - Electricity consumption
- Global warming potentials (GWP) utilized in this study for non-CO_2 GHGs
- Regularly updated

Table 1 Stationary Combustion

Fuel Type	Heat Content (HHV)	CO_2 Factor	CH_4 Factor	N_2O Factor	CO_2 Factor	CH_4 Factor	N_2O Factor
	mmBtu per short ton	kg CO_2 per mmBtu	g CH_4 per mmBtu	g N_2O per mmBtu	kg CO_2 per short ton	g CH_4 per short ton	g N_2O per short ton
Coal and Coke							
Anthracite Coal	25.09	103.69	11	1.6	2,602	276	40
Bituminous Coal	24.93	93.28	11	1.6	2,325	274	40
Sub-bituminous Coal	17.25	97.17	11	1.6	1,676	190	28
Lignite Coal	14.21	97.72	11	1.6	1,389	156	23
Mixed (Commercial Sector)	21.39	94.27	11	1.6	2,016	235	34
Mixed (Electric Power Sector)	19.73	95.52	11	1.6	1,885	217	32
Mixed (Industrial Coking)	26.28	93.90	11	1.6	2,468	289	42
Mixed (Industrial Sector)	22.35	94.67	11	1.6	2,116	246	36
Coal Coke	24.80	113.67	11	1.6	2,819	273	40
Other Fuels - Solid							
Municipal Solid Waste	9.95	90.70	32	4.2	902	318	42
Petroleum Coke (Solid)	30.00	102.41	32	4.2	3,072	960	126
Plastics	38.00	75.00	32	4.2	2,850	1,216	160
Tires	28.00	85.97	32	4.2	2,407	896	118
Biomass Fuels - Solid							
Agricultural Byproducts	8.25	118.17	32	4.2	975	264	35
Peat	8.00	111.84	32	4.2	895	256	34
Solid Byproducts	10.39	105.51	32	4.2	1,096	332	44
Wood and Wood Residuals	17.48	93.80	7.2	3.6	1,640	126	63
	mmBtu per scf	kg CO_2 per mmBtu	g CH_4 per mmBtu	g N_2O per mmBtu	kg CO_2 per scf	g CH_4 per scf	g N_2O per scf
Natural Gas							
Natural Gas	0.001026	53.06	1.0	0.10	0.05444	0.00103	0.00010
Other Fuels - Gaseous							
Blast Furnace Gas	0.000092	274.32	0.022	0.10	0.02524	0.000002	0.000009
Coke Oven Gas	0.000599	46.85	0.48	0.10	0.02806	0.000288	0.000060
Fuel Gas	0.001388	59.00	3.0	0.60	0.08189	0.004164	0.000833
Propane Gas	0.002516	61.46	3.0	0.60	0.15463	0.007548	0.001510
Biomass Fuels - Gaseous							
Landfill Gas	0.000485	52.07	3.2	0.63	0.025254	0.001552	0.000306
Other Biomass Gases	0.000655	52.07	3.2	0.63	0.034106	0.002096	0.000413

Direct Process Emissions

- CO_2 emissions from wastewater treatment are biogenic, thus not included in inventory
- CH_4 and N_2O emissions from wastewater treatment arise from 2 pathways
  - Wastewater Treatment

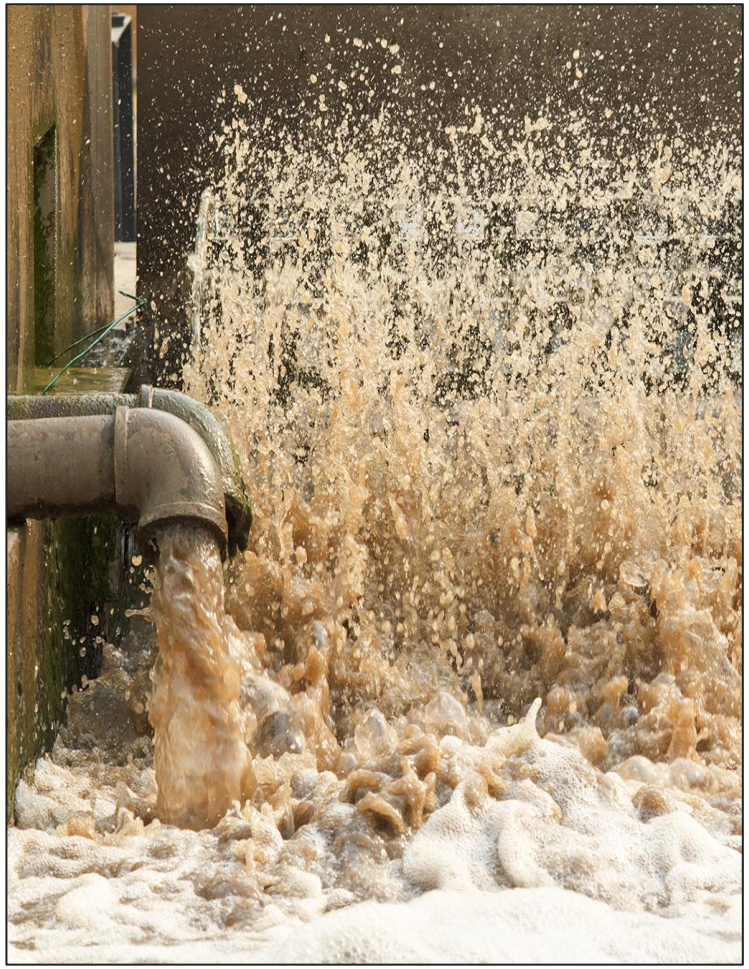
$$BOD_{Treatment}(\frac{kg}{yr}) = \sum_{i=1}^{365}[Q_{in,i} * BOD_{in,avg}] - S$$

    - S is the BOD removed in the form of sludge

  - Wastewater Discharge

$$BOD/TN_{Discharge}(\frac{kg}{yr}) = \sum_{i=1}^{365} Q_{out,i} * BOD/TN_{out,avg}$$

    - Values used with IPCC equations/factors to calculate emissions

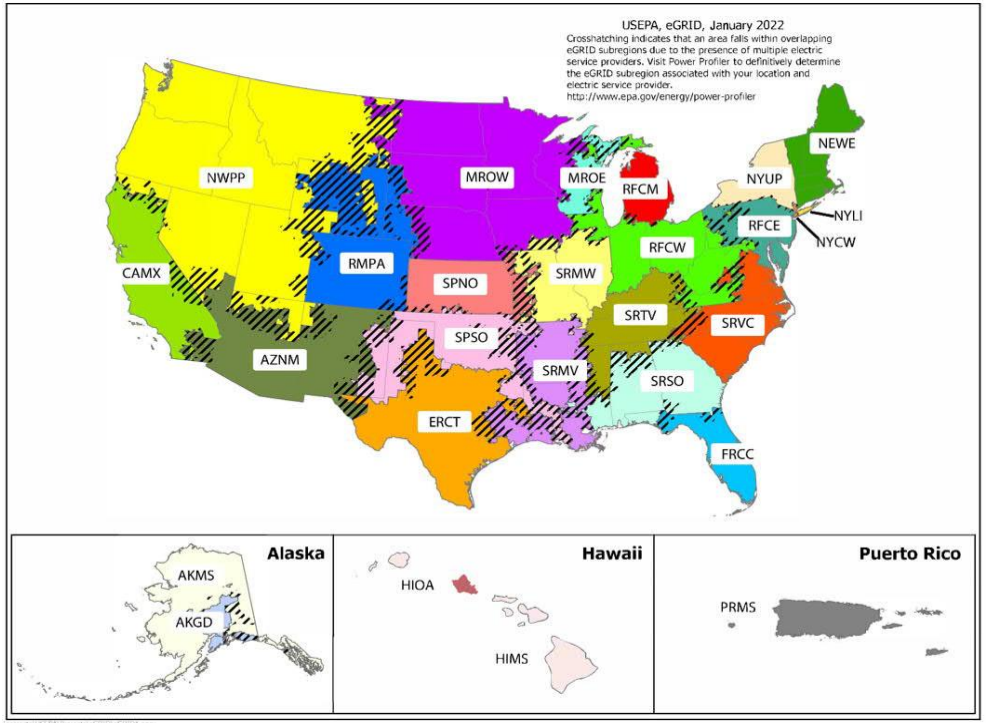


Refrigerant Fugitive Emissions

- Stationary Equipment
  - LGOP – Equipment Inventory and Refrigerant Use Approach
  - Contacted manufacturers using model and serial numbers to request full charge capacities
  - Full charge multiplied by an emission factor specific to equipment type to determine the quantity of refrigerant emitted over one year
  - Any units installed in 2021 used an additional factor to account for leakage during installation
- Mobile/Vehicular Equipment
  - LGOP – Fleet Inventory Approach
  - Full refrigerant charge for every vehicle's AC system researched and recorded
  - Full charge capacities multiplied by emission factor specific to mobile air conditioning units to estimate yearly refrigerant leakage
  - Any units purchased in 2021 used an additional factor to account for leakage during installation

Electricity Consumption Emissions

- Calculated following LGOP guidance
- Metering data multiplied by emission factors to estimate CO_2, CH_4 and N_2O emissions
  - Power facility-specific emission factors sourced from EPA's eGRID system



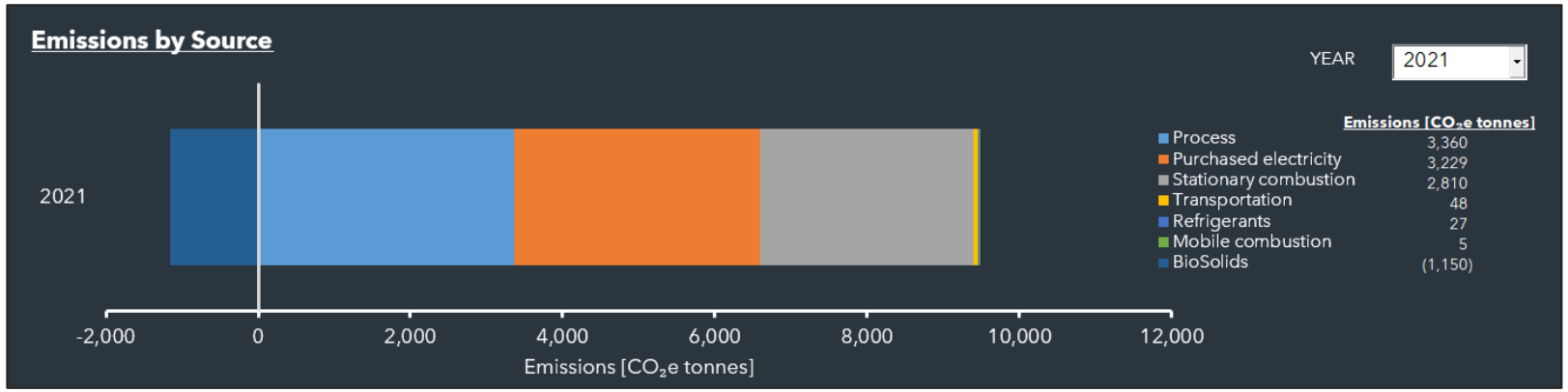
Chemicals/Fuel/Waste Transport Emissions

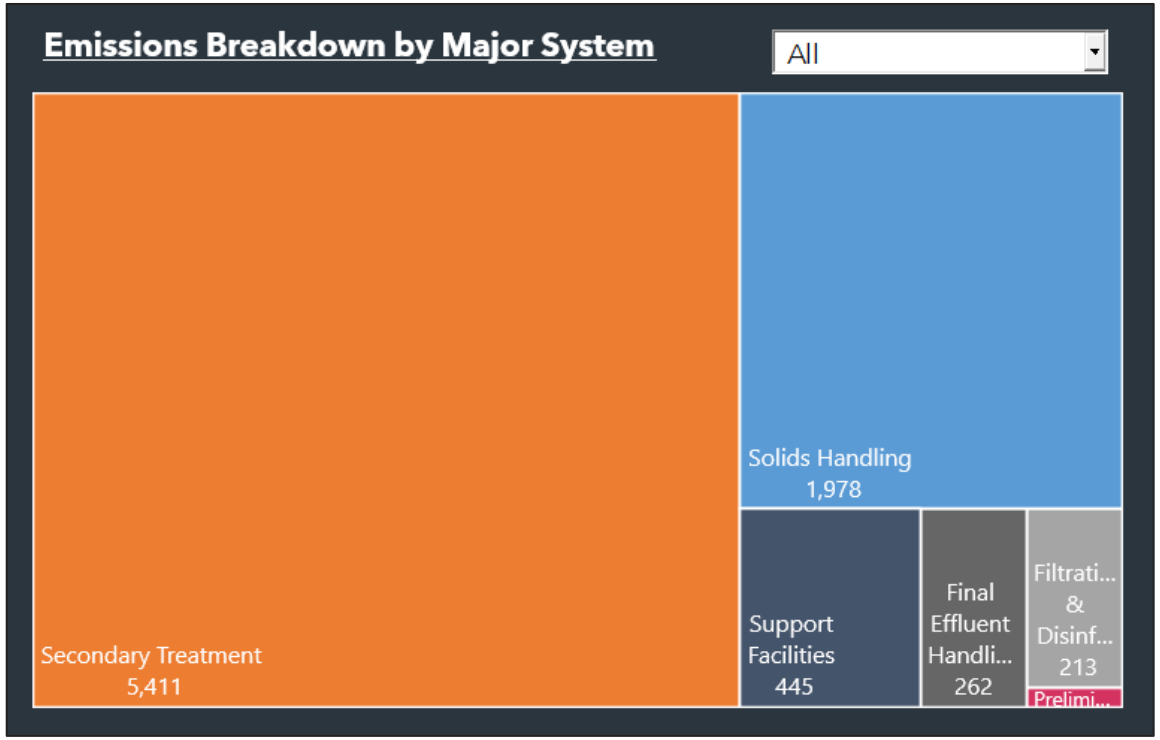
- Transport mileage was estimated by assuming a round-trip distance between the chemical, fuel, or waste facility and the Cary facility
  - If distance wasn't given, Google Maps was used to determine the distance between the two facilities
  - Assumed standalone route rather than part of a larger pickup route
- Emission factors from EPA CCCL's GHG Emission Factors Hub were used to calculate emissions based on miles driven
  - All delivery vehicles assumed to be Medium- and Heavy-Duty Trucks

Waste Stream	Distance from Facility to Destination (mi)	Total Distance for Collection Trip (mi)	Number of Collections in 2021	Total Miles Driven (mi)
General Waste	16.5	33	75	2475
Wood	28.2	56.4	2	112.8
Non-Metal Recyclables	8.9	17.8	26	462.8
Metals	16.4	32.8	4	131.2
Used Oil	37.2	74.4	1	74.4
Sludge Hauling to SCWRF	16.6	33.2	2620	86,984

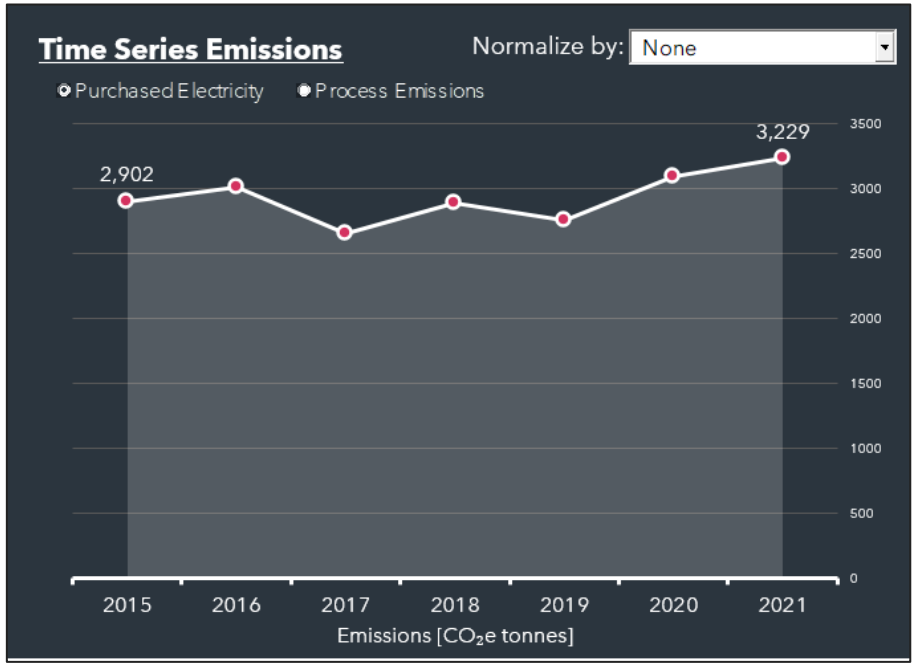
Emission Tool

- User-friendly Excel-based tool that can be regularly updated and data can be extracted for reporting/ verification
- Calculations performed using Excel's Visual Basic for Applications (VBA)
- Currently converting to a cloud-based system





Emission Tool



Results Summary Table

Scope	Activity Type	2015	2016	2017	2018	2019	2020	2021
Scope 1	Stationary combustion	-	-	-	-	-	-	2,810.27
	Mobile combustion	-	-	-	-	-	-	5.41
	Refrigerants	-	-	-	-	-	-	26.97
	Process	-	1,965.58	2,370.63	3,273.32	2,919.48	3,645.81	3,360.40
	Sum of Scope 1	-	-	-	-	-	-	-
Scope 2	Purchased electricity	2,901.80	3,004.22	2,648.93	2,889.74	2,751.68	3,092.69	3,229.24
Scope 3	Transportation	-	-	-	-	-	-	48.05
	BioSolids	-	-	-	-	-	-	(1,149.64)

Stationary Combustions

Process Inputs							GHG Emissions
Year	Process	Major System	Fuel Type	Fuel	Amount of Fuel	Units	Total CO_2e [tonnes]
2021	Sum of Generators 3 - 5	Support Facilities	Petroleum Products	Distillate Fuel Oil No. 2	28,347	US gallons (gal)	**290.39**
2021	Dryer Fuel Combustion	Solids Handling	Natural Gas	Natural Gas	474,421	therm (thm)	**2,519.88**

EmissionWise

Overview

Data Entry

Emission Types by Facility

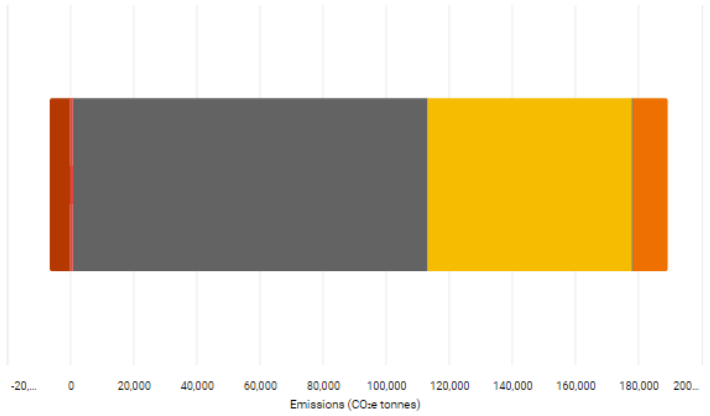
Facility	Emission Type	Year
Beaver Creek Pump Station (BCPS)	Mobile Combustion	2021
Beaver Creek Pump Station (BCPS)	Refrigerants	2021
Beaver Creek Pump Station (BCPS)	Transportation	2021
Beaver Creek Pump Station (BCPS)	Purchased Electricity	2021
Beaver Creek Pump Station (BCPS)	Mobile Fugitives	2021
Cary/Apex Water Treatment Facility (CAWTF)	Mobile Combustion	2021
Cary/Apex Water Treatment Facility (CAWTF)	Transportation	2021
North Cary Water Reclamation Facility (NCWRF)	Stationary Combustion	2021
North Cary Water Reclamation Facility (NCWRF)	Mobile Combustion	2021
South Cary Water Reclamation Facility (SCWRF)	Purchased Electricity	2021
South Cary Water Reclamation Facility (SCWRF)	Mobile Fugitives	2021
Cary/Apex Water Treatment Facility (CAWTF)	Stationary Combustion	2021
Cary/Apex Water Treatment Facility (CAWTF)	Refrigerants	2021
Cary/Apex Water Treatment Facility (CAWTF)	Purchased Electricity	2021
Cary/Apex Water Treatment Facility (CAWTF)	Mobile Fugitives	2021
North Cary Water Reclamation Facility (NCWRF)	Refrigerants	2021
North Cary Water Reclamation Facility (NCWRF)	Process	2021
North Cary Water Reclamation Facility (NCWRF)	Transportation	2021

Data Visualization & Results

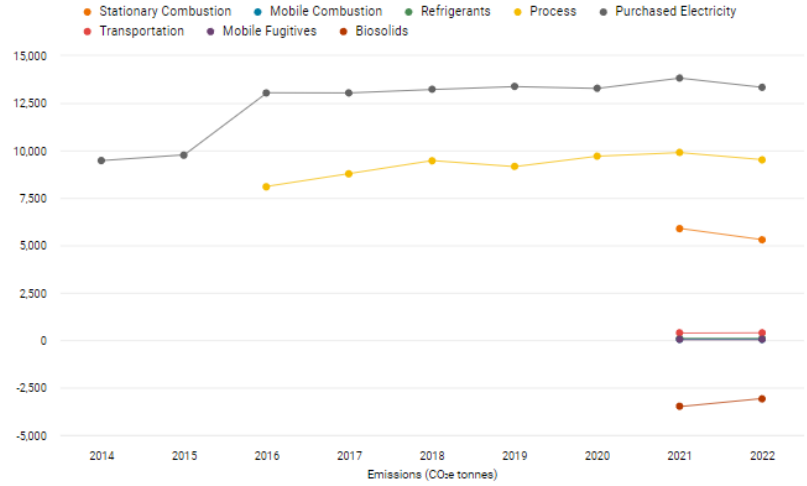
Steven Lobo
Customer

Emissions by Source

Stationary Combustion: **11195.15** Mobile Combustion: **121.56** Refrigerants: **202.68**
Process: **64637.32** Purchased Electricity: **112347.23** Transportation: **765.85**
Mobile Fugitives: **52.43** Biosolids: **-6571.99**



Time Series Emissions



Emission Breakdown by Major Systems

Support Facilities: **320** Secondary Treatment: **3794** Solids Handling: **2356**

Results Summary Table

Facility	Scope	Emission Type	2014	2015	2016	2017	2018	2019	2020	2021	2022	2030
WWRWRF	1	Stationary Combustion	-	-	-	-	-	-	-	2810.27	2629.57	-
		Mobile Combustion	-	-	-	-	-	-	-	5.41	5.50	-
		Refrigerants	-	-	-	-	-	-	-	26.72	26.46	-
	2	Process	-	-	1965.58	2370.63	3273.32	2919.48	3645.81	3360.40	3793.50	-
		Purchased Electricity	-	-	3004.42	2649.10	2889.93	2751.86	3092.89	3229.46	3168.46	-
	3	Transportation	-	-	-	-	-	-	-	44.91	11.77	-
		Mobile Fugitives	-	-	-	-	-	-	-	3.09	3.43	-
		Biosolids	-	-	-	-	-	-	-	-1656.79	-1303.60	-
		Net Annual Emissions	-	-	**4970.00**	**5019.74**	**6163.25**	**5671.34**	**6738.70**	**7823.46**	**8335.10**	-
		Stationary Combustion	-	-	-	-	-	-	-	1233.36	1178.79	-

Data Request Form

Data Request Form created to request only data necessary to update calculations

- Simplifies and streamlines data collection and logging process
- Easy copy and paste from form into cloud tool

Data Entry Year:	2022

0.0 General Facility Information

Description	Value	Units	NOTES / GUIDANCE
Total Annual Influent Volume	2,509	Million Gallons (MG)	
Total Annual Effluent Volume	2,392	Million Gallons (MG)	
Total Annual WAS Flow Volume	69	Million Gallons (MG)	Sum total volume of WAS wasted over inventory year
Annual Average Flow	7	Million Gallons Per Day (MGD)	Average of Average Daily Flows
Service Population	109,500	QTY per 10,000	

Question	Response (Y/N)	If (Y), provide make and model number
Was a new HVAC unit/unit that uses refrigerants installed this year?		
Did any refrigerant leaks occur or were any units recharged this year?*		

*Please send all documentation of leak/recharge to steven.lobo@stantec.com

1.0 Scope 1 Emissions - Stationary Combustion

Subsystem	Description	Fuel Type	Volume of Fuel Consumed	Units	NOTES / GUIDANCE
Solids Handling	Dryer Fuel Combustion	Natural Gas	442,544	therm (thm)	
Support Facilities	Generators 3-5	Distillate Fuel Oil No. 2	27,236	US gallons (gal)	
[Input new]	[Input new]	[Input new]	[Input new]	[Input new]	

2.0 Scope 1 Emissions - Mobile Combustion

Subsystem	Description	Fuel Type	Total Annual Distance Traveled	Units	NOTES / GUIDANCE
Support Facilities	2013 Ford F-150 (0017)	Gasoline	3,231	Miles	Difference between vehicle odometer reading between start and end of year
Support Facilities	2014 Ford Fusion (0019)	Gasoline	1,932	Miles	Difference between vehicle odometer reading between start and end of year
Support Facilities	2014 Ford F-150 (0133)	Gasoline	2,370	Miles	Difference between vehicle odometer reading between start and end of year
Support Facilities	2014 Ford F-150 (0133)	Gasoline	4,066	Miles	Difference between vehicle odometer reading between start and end of year
Support Facilities	2016 Ford F-250 (0201)	Gasoline	1,552	Miles	Difference between vehicle odometer reading between start and end of year
Support Facilities	2006 Chevy C5500	Diesel	45	Miles	Difference between vehicle odometer reading between start and end of year
[Input new]	[Input new]	[Input new]	[Input new]	Miles	Difference between vehicle odometer reading between start and end of year

3.0 Scope 1 Emissions - Process Emissions

Subsystem	Parameter	Concentration (mg/L)	Calculated Mass	Calculated Value	Units	NOTES / GUIDANCE
Secondary Treatment	Average Annual Influent BOD	278	Total Influent Organics	2,611,431	kilograms (kg)	= Average Annual Influent BOD (mg/L) * Total Annual Influent Volume (MG) * (3,785 L/gal)
Secondary Treatment	Average Annual Effluent BOD	3	Total Effluent Organics	27,429	kilograms (kg)	= Average Annual Effluent BOD (mg/L) * Total Annual Effluent Volume (MG) * (3,785 L/gal)
Secondary Treatment	Average Annual Influent TN	68	Total Influent Nitrogen	643,396	kilograms (kg)	= Average Annual Influent TN (mg/L) * Total Annual Influent Volume (MG) * (3,785 L/gal)
Secondary Treatment	Average Annual Effluent TN	2	Total Effluent Nitrogen	22,088	kilograms (kg)	= Average Annual Effluent TN (mg/L) * Total Annual Effluent Volume (MG) * (3,785 L/gal)
Secondary Treatment	Average Annual WAS TSS	8,707	Total Dry Solids Removed	2,266,425	kilograms (kg)	= Average Annual WAS TSS (mg/L) * Total Annual WAS Flow Volume (MG) * (3,785 L/gal)

4.0 Scope 2 Emissions - Purchased Electricity

Subsystem	Description	Value	Units	NOTES / GUIDANCE
Purchased Electricity	Electricity Consumed	1,139,867	kilowatt hours (kWh)	
Purchased Electricity	Electricity Produced	[Input new]	kilowatt hours (kWh)	
Purchased Electricity	Emission Factor for Inventory Year	[Input new]	lbs/MWh	1. Go to https://residential-carbon-tool.duke-energy.app/residential/signin 2. Continue as Guest and input zip code of facility. 3. Scroll down to find "Emission Factor (lbs/MWh)

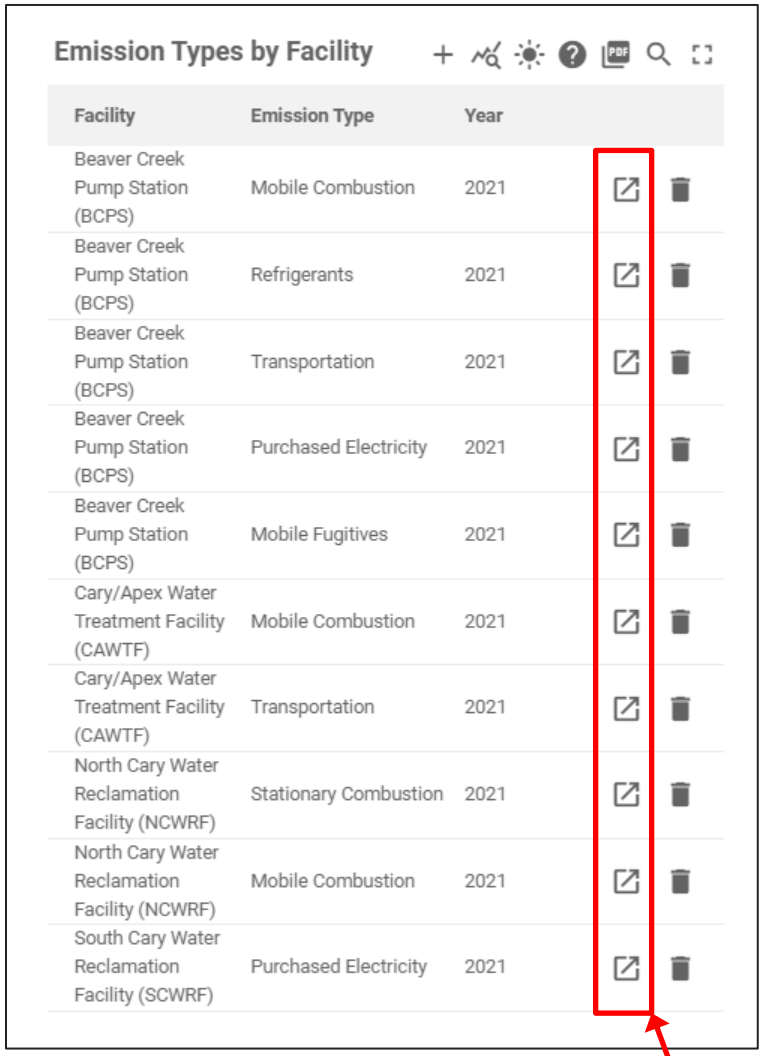
5.0 Scope 3 Emissions - Material Transportation

Subsystem	Description	Distance to Supplier/Disposal Site	Roundtrip Distance to Supplier/Disposal Sit	Units	QTY of Deliveries/Collections	Total Annual Distance Traveled	NOTES / GUIDANCE
Support Facilities	Hypochlorite	73.1	146.2	miles	5	731.0	Google Maps driving distance from Cary Facility to Supplier/ Disposal Site. Use wei
Support Facilities	Acid Magic	75.0	150.0	miles	2	300.0	Google Maps driving distance from Cary Facility to Supplier/ Disposal Site. Use wei
Support Facilities	Polymer	340.0	680.0	miles	3	2,040.0	Google Maps driving distance from Cary Facility to Supplier/ Disposal Site. Use wei
Support Facilities	Diesel	20.0	40.0	miles	9	360.0	Google Maps driving distance from Cary Facility to Supplier/ Disposal Site. Use wei
Support Facilities	Gasoline	20.0	40.0	miles	2	80.0	Google Maps driving distance from Cary Facility to Supplier/ Disposal Site. Use wei
Support Facilities	General Waste	9.0	18.0	miles	104	1,872.0	Google Maps driving distance from Cary Facility to Supplier/ Disposal Site. Use wei
Support Facilities	Non-Metal Recyclables	9.0	18.0	miles	52	936.0	Google Maps driving distance from Cary Facility to Supplier/ Disposal Site. Use wei
Support Facilities	Metals	25.0	50.0	miles	1	50.0	Google Maps driving distance from Cary Facility to Supplier/ Disposal Site. Use wei
[Input new]	[Input new]	[Input new]		miles	[Input new]		
Solids Handling	Biosolids Hauling to Agricultural Sites	N/A	N/A	miles	N/A	[Input new]	Review biosolids hauling logs. Sum annual total miles driven. Multiply tota

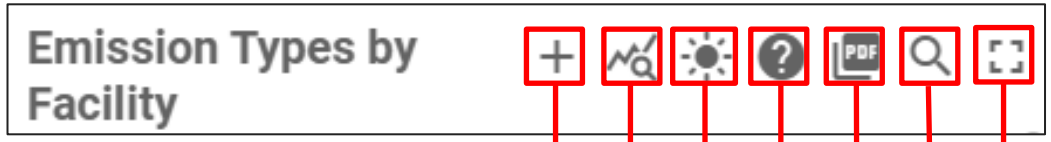
6.0 Scope 3 Emissions - Biosolids Land Application

Subsystem	Description	Wet Tons of Biosolids Sold Annually	Wet Application Rate (wet-tonnes/day)	Solids Content (%)	Density (lbs/ft³)	Total Nitrogen (%)	Total Phosphorus (%)	Total Volatile Solids (%)
Solids Handling	Biosolids	497	1.234	92.0%	43.00	7.0%	5.0%	65.0%

Data Entry



Edit existing emission entries



- *Add new emission entry*
- *View/edit annual facility stats*
- *View/edit electricity usage breakdown*
- *Request new features*
- *Generate PDF report*
- *Search*
- *Expand to Fullscreen*

Case Study: Town of Cary Inventory

Cary, NC and Drivers

- Located 10 miles west of Raleigh, NC
- Population ~ 175,000, 29.2% increase from 2010
- Regional leader in solar energy production
- History of evaluating and advancing energy efficient system implementations
- Cary Goal: Reduce GHG emissions by 25% by 2025 and 100% by 2040
- 2011 GHG inventory indicated 2/3 of town's emissions were from water and wastewater

Cary Utilities Water Facilities

- North Cary WRF ~ 7 MGD
- South Cary WRF ~ 5.5 MGD
- Western Wake Regional WRF ~ 7 MGD
  - Beaver Creek Pump Station ~ 7 MGD
- Cary/Apex WTF ~ 29 MGD

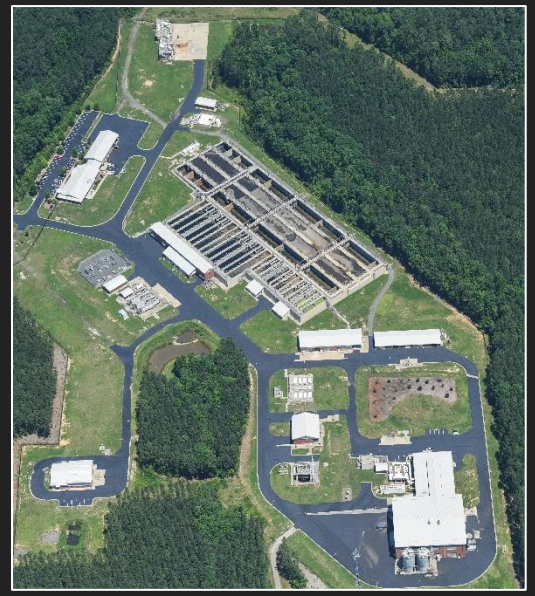
Key Considerations:

- WRFs produce Class A Biosolids
- Sludge hauled from NCWRF for processing at SCWRF

Goals:

- Baseline Energy and GHG Inventory
- Annual calculator updates
- Identify and understand trends

NCWRF



WWRWRF

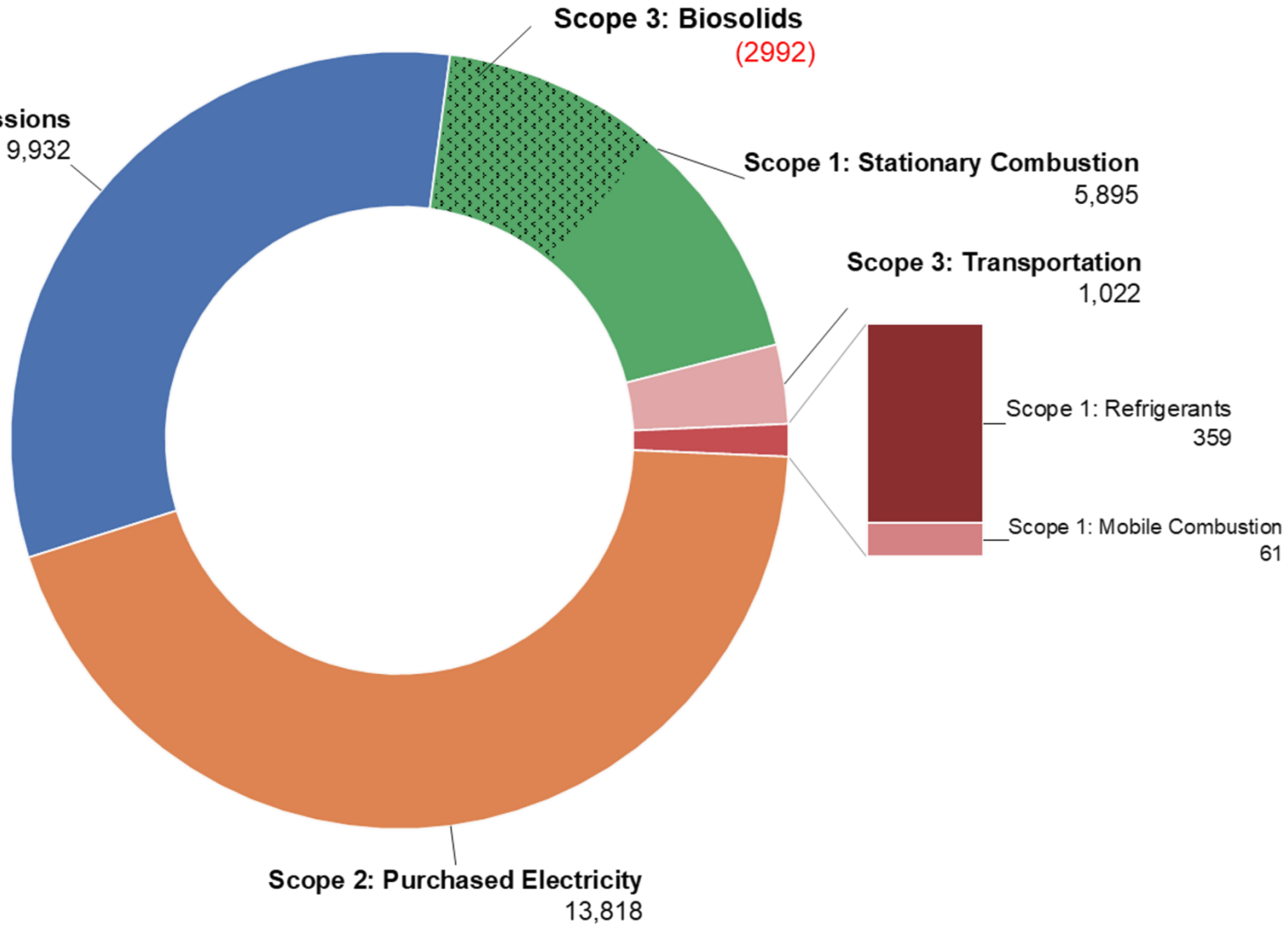
SCWRF

BCPS

CAWTF

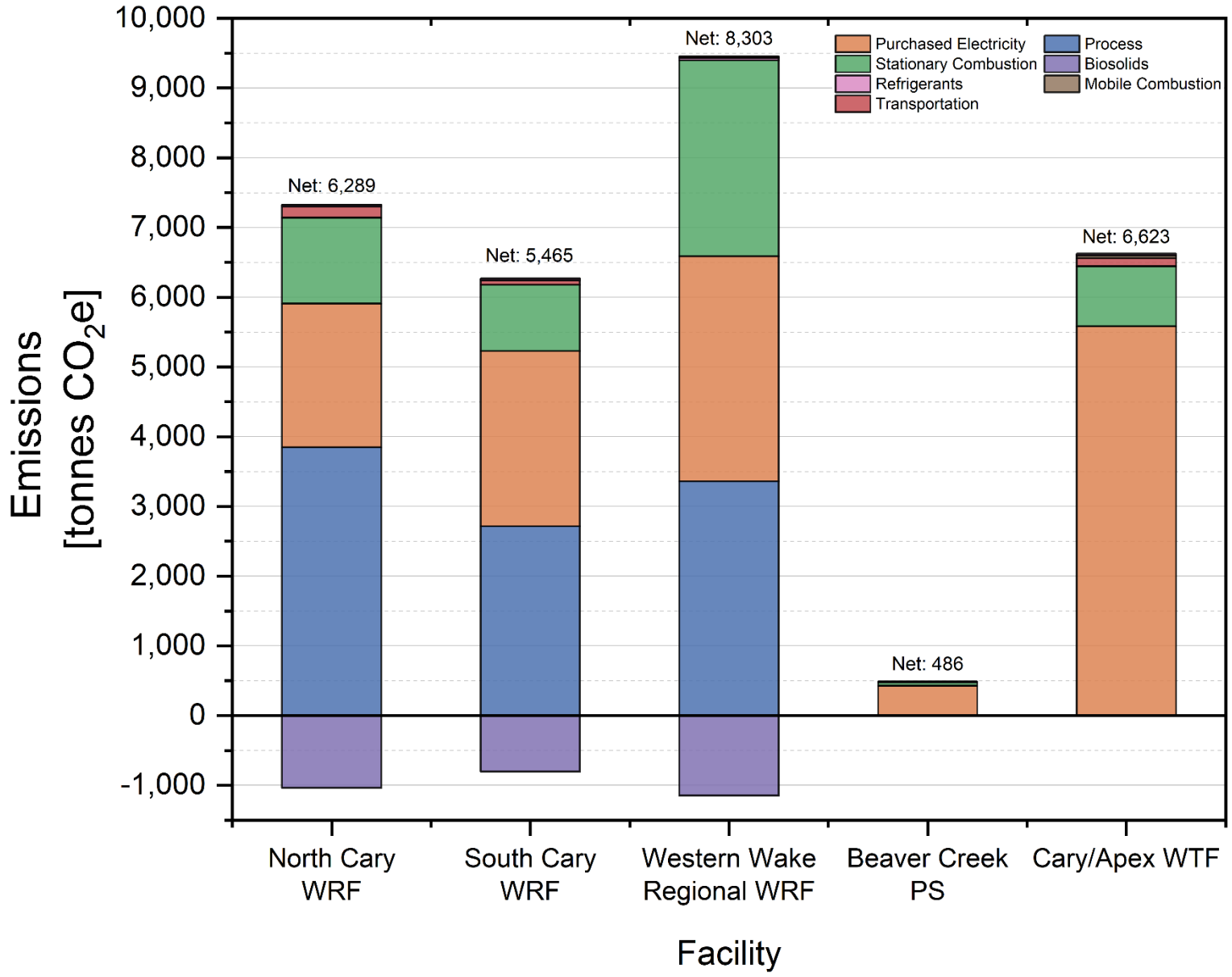
Town of Cary Utilities Emissions - Overview

- Purchased electricity is largest emission source (44%) followed by wastewater process emissions (32%)
- Land application of biosolids reduced total emissions by 12%-14% at WRFs
- Mobile Combustion is smallest emission category by far



Town of Cary Utilities Emissions – Emission Sources

- Purchased electricity represents ~90% of emissions for BCPS and CAWTF
- Higher generator use at WWRWRF compared to other WRFs
- Higher Transportation emissions at NCWRF due to sludge hauling to SCWRF
- Highest process emissions at NCWRF

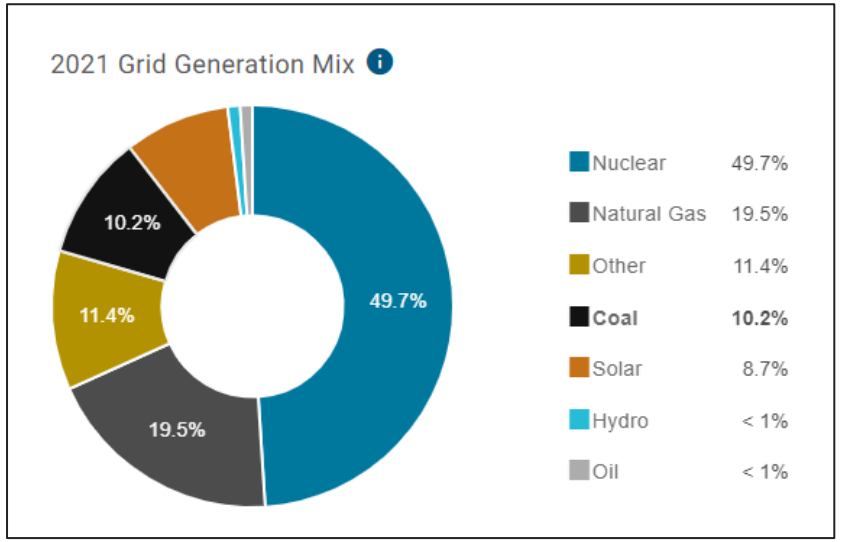


BCPS Peak Shaving

- Pump station currently uses diesel generators during times of increased power demand – peak shaving
- 95% of generator use is for peak shaving
- Given energy mix of electricity provider, peak shaving results in more emissions than remaining on grid

Emission Type	Peak Shaving	No Peak Shaving
Generator Emissions (MTCDE)	43.94	2.31
Electricity Emissions (MTCDE)	1.99	39.88
Diesel Transport Emissions (MTCDE)	0.05	0.02
Total (MTCDE)	45.98	42.22

Power Source	Emission Intensity (MTCDE/MWh)
Electricity (Duke Energy Progress East)	0.229932
Diesel Combustion	0.253292



Benchmarking

- WRF's most comparable to Fort Collins & Denver, CO study, based on facility size and resources used
- Simplified studies produced lower emission intensities when compared to more detailed studies
- Simpler studies undercount emissions
- CAWTF operating well when compared to larger JWC study
- If studies are detailed then as facility process more water, emissions intensity decreases

Facility	Emission Intensity (MTCDE/MGD)
NCWRF	884
SCWRF	989
WWRWRF	1,201
BCPS	72
CAWTF	229

Plant Name/Location	Average Daily Flow (MGD)	Scopes Captured	Total GHGs (tonnes CO_2e)	Emissions Intensity (tonnes CO_2e / MGD)
Ann Arbor, MI Community-Wide Greenhouse Gas Inventory (2019)	Water- 50 Wastewater- 29.5	1, 2	Water- 7,368 Wastewater -10,190	Water- 147 Wastewater- 345
Eugene-Springfield Water Pollution Control Facility Eugene and Springfield, Oregon (2018)	Wastewater- 35	1, 2, 3	Wastewater -21,386	Wastewater- 611
Fort Collins, CO Water Reclamation Facilities (2009)	**DWRF- 23 MWRF - 6**	**1, 2, 3**	**DWRF- 19,719 MWRF- 7,101**	**DWRF – 857 MWRF – 1,184**
Joint Water Commission Hillsboro, Forest Grove, and Beaverton, OR and Tualatin Valley Water District (2009)	**Water- 75**	**1, 2, 3**	**20,931**	**279**
Robert W. Hite Treatment Facility Denver, CO (2015)	**Wastewater- 148**	**1, 2, 3**	**66,966**	**453**
ReWa System Wide Greenhouse Gas Emission Study and Energy Benchmark (2020)	Durbin Creek WRRF- 1.67 Georges Creek WRRF- 1.78 Gilder Creek WRRF- 5.09 Lower Reedy WRRF- 6.78 Maudlin Road WRRF- 18.12 Pelham Road WRRF- 11.71 Piedmont Reg. WRRF- 1.82	1, 2	Durbin Creek WRRF- 596 Georges Creek WRRF- 411 Gilder Creek WRRF- 2,087 Lower Reedy WRRF- 3,505 Maudlin Road WRRF- 5,990 Pelham Road WRRF- 3,331 Piedmont Reg. WRRF- 653	Durbin Creek WRRF- 358 Georges Creek WRRF- 231 Gilder Creek WRRF- 410 Lower Reedy WRRF- 517 Maudlin Road WRRF- 330 Pelham Road WRRF- 284 Piedmont Reg. WRRF- 359

Challenges & Lessons Learned

- Not many studies of comparable detail
- Calculation resources can be unclear and confusing
- Plant data compliance with calculation formulas is key
- Streamline data management for easier annual updates

Summary

- Water & Wastewater treatment facilities represent majority of municipal GHG emissions for many towns/cities
- Secondary treatment generates large amounts of “process emissions” of methane and nitrous oxide at WWTPs
- No standardized methodology for water & wastewater facilities to follow to develop GHG inventories
- Facilities should focus on electricity efficiency, process emission mitigation, fuel use reduction, and beneficial reuse of waste streams

Discussion / Questions