WIKIMEDIA FOUNDATION 2019 CARBON FOOTPRINT

June 30, 2020

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WHAT IS A CARBON FOOTPRINT?

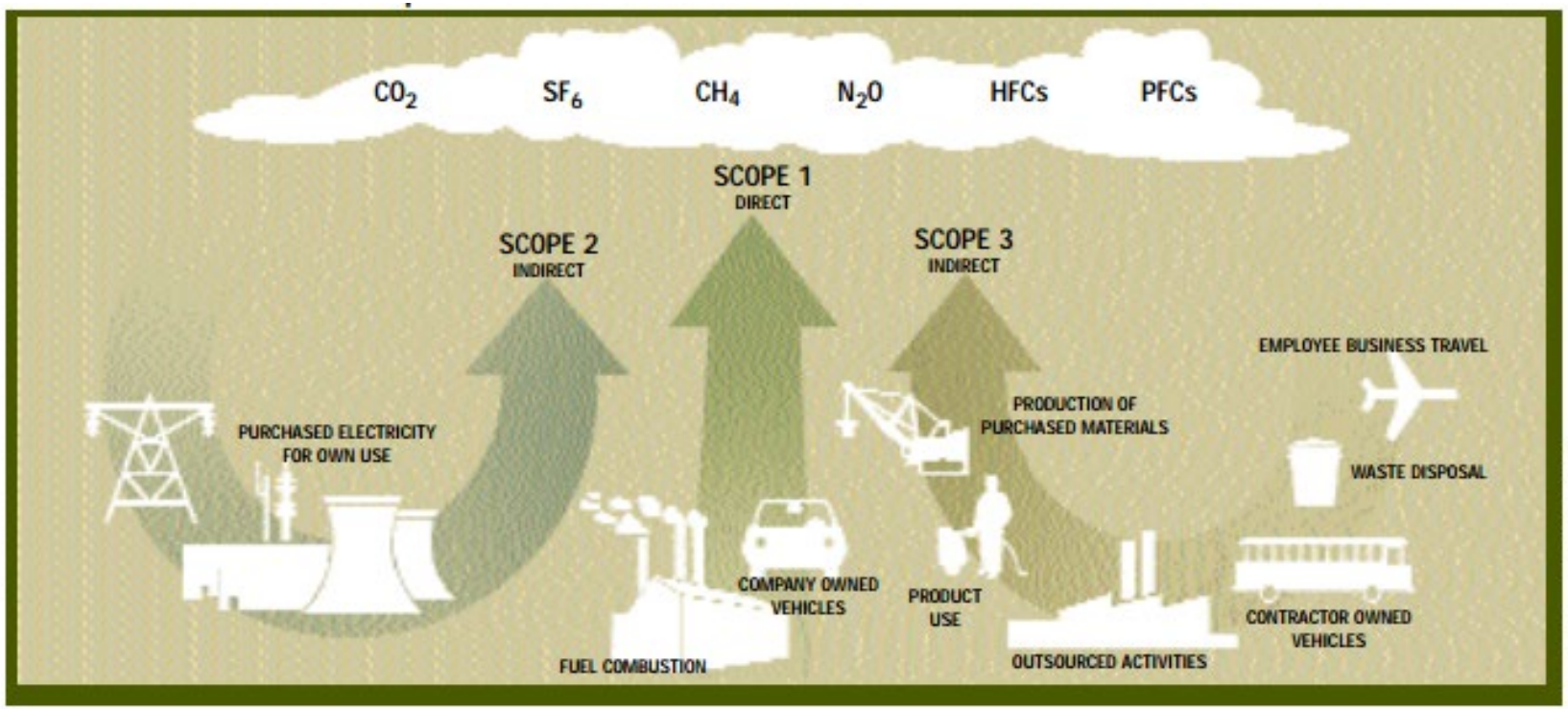
GREENHOUSE GAS PROTOCOL

A CO2 Footprint is a measure of the impact the activities of a company have on the environment translated into the amount of greenhouse gases (GHG) produced by these activities.

A CO2 Footprint is considered the "Best Practice" for measuring GHG gases for the following reasons:

It is a standard/generally accepted way of doing things in industry	There is a reliable methodology & preferred procedure for conducting the inventory (GHG Protocol Corporate Standard, and others, based on this Standard.)	It provides a general outline to address a variety of efficiency issues across multiple facilities within organizations.

CARBON FOOTPRINT METHODOLOGY



GREENHOUSE GAS PROTOCOL

A Corporate Accounting and Reporting Standard

IMPORTANT CHANGES TO DATA SOURCES AND METHODOLOGY FROM 2018 TO 2019

San Francisco Office

- The data collection period for carbon footprint calculations overlapped with COVID-19 building closures. As a result, WMF was unable to obtain 2019 data for building electricity, natural gas and refrigerants.
- We have used 2018 building data as a proxy for 2019 and will update the analysis once the 2019 data becomes available. We believe the impact to the overall calculations is negligible.

Data Centers & Servers

- In the last year, data center providers have increased the level of transparency of their environmental metrics, allowing us to more accurately assess their environmental performance.
- Data center providers have also ramped up their use of renewable energy (through renewable energy project as well as purchased renewable energy credits (RECs), further decarbonizing their energy use.
- Both changes allowed us to allocate a lower emissions factor to the electricity used at WMF data center and server locations for 2019.

Travel

- In 2018, travel emissions were calculated based on actual number of trips, but estimated travel distances (grouped into "short, medium, and long" distance categories). This was recognized as a significant gap in data.
- In 2019, data tracking was improved to include actual mileage for travel and divided into three types of travel:
  - **Internal Staff Convenings**, including All Hands, Offsites, Wikilead, and office visits/onboarding
  - **Community Convenings**, including Wikimania, Iberoconf, Wikimedia Tech Conf, Hackathon, Wikimedia Summit, etc. (This category includes not only staff bookings, but also volunteers and scholarship recipients who were booked by the Foundation.)
  - **Miscellaneous Business Travel**, including professional conferences, fundraisers, speaking engagements, etc.
- This update resulted in significantly higher quality results. It also revealed that we had underestimated travel distances in 2018.
- We have recalculated air travel emissions for 2018 using this better methodology, and the restated results are shown on the following slide.

2018 BASELINE RESULTS

W/ RESTATED AIR TRAVEL EMISSIONS

A significance test helps organizations focus their efforts on emissions categories that matter most. Significance is determined by calculating an individual GHG-emitting sources as a percentage of the total carbon footprint. Significance thresholds are:

- Less than 1% = insignificant (and excludable)
- Between 1% and 9% = low
- Between 10% and 19% = moderate
- 20% or greater = high

Functional Areas	tCO2-eq	% Contribution	Significance	2019 Status
Server - knams	1.16	0.05%	Insignificant	While emissions from these servers are insignificant to the total carbon footprint, we have included all data centers in the 2019 carbon footprint calculations.
Server - eqdfw	1.28	0.05%	Insignificant	
Server - eqord	1.58	0.06%	Insignificant	
WMF Server Room	5.82	0.23%	Insignificant	
Server - eqsin	22.34	0.87%	Insignificant	
Server - ulsfo	24.85	0.97%	Insignificant	
Server - esams	43.89	1.71%	Low	Included in the 2019 carbon footprint.
Server - codfw	385.81	15.00%	Moderate	Included in the 2019 carbon footprint.
Server - eqiad	677.42	26.34%	High	Included in the 2019 carbon footprint.
Telecommuting (outside of US)	8.51	0.33%	Insignificant	Because this data had a high level of uncertainty and was insignificant to the overall footprint, it was removed from 2019 carbon footprint scope.
Telecommuting (within US)	10.49	0.41%	Insignificant	Because this data had a high level of uncertainty and was insignificant to the overall footprint, it was removed from 2019 carbon footprint scope.
San Francisco Office	138.07	5.37%	Low	Included in the 2019 carbon footprint.
Miscellaneous Business Travel*	14.04	0.55%	Insignificant	Included in the 2019 carbon footprint.
Internal Staff Convenings*	554.56	21.57%	High	Included in the 2019 carbon footprint.
Community Convenings*	681.54	26.50%	High	Included in the 2019 carbon footprint.
Totals	2,571.37	100%		As a result of the restated travel emissions, the total carbon footprint for 2018 increased over the original calculations by 439.05 tCO2-eq, or 20.6%.

* Hotel/Lodging (included in Miscellaneous Business Travel, Internal Staff Convenings, and Commuting Convenings) data only covers July – December 2018.

SCOPE OF 2019 CARBON FOOTPRINT
BY ACTIVITY

Data with * is 2018 data used as a proxy for 2019.

Scope	Activity	Notes
1	Natural Gas	*San Francisco Office - Post Montgomery Center – Total Building Consumption Information prorated for WMF % of total area
1	Refrigerants	*San Francisco Office - Post Montgomery Center building is chilled via their Central Plant chilled water cooling system. WMF refrigerants are only used in their 2 heat pumps installed in their server room on their floor. These are small units that were installed in 2012, require only 2.4 lbs. of R410A each and did not require charging in 2018.
2	Electricity	*San Francisco Office : Post Montgomery Center - Consumption Information prorated for WMF % of total area. 2019 Data Centers: - Ashburn (Equinix): 137.8kW - Dallas (CyrusOne): 87.4kW - San Francisco (Digital Realty Trust): 3.4kW Realtime data: https://grafana.wikimedia.org/d/f64mmDzMz/power-usage?orgId=1&from=now-3_0d&to=now Other Data Center electricity consumption was provided by WMF IT Staff. - Data Center PUE was estimated from publicly available information from the hosting companies where available. Where PUE was not available, estimated based upon 'best in class' data (Google.)
2	Steam	*San Francisco Office - Post Montgomery Center – Total Building Consumption Information prorated for WMF % of total area
3	Water Usage	
3	WWT*	
3	Waste to landfill	
3	Recycling	
3	eWaste	*San Francisco Office - Actual weight provided by GreenCitizen
3	Commuting	2019 survey responses for mode, distance and % time commuting for ~ 43% of San Francisco-based workforce. Estimates based upon extrapolated data.
3	Business Travel - Air	2019 Data obtained from WMF Travel Department, categorized by Miscellaneous Business, Community Convenings and Internal Staff Convenings.
3	Business Travel - Lodging	

2019 CARBON FOOTPRINT

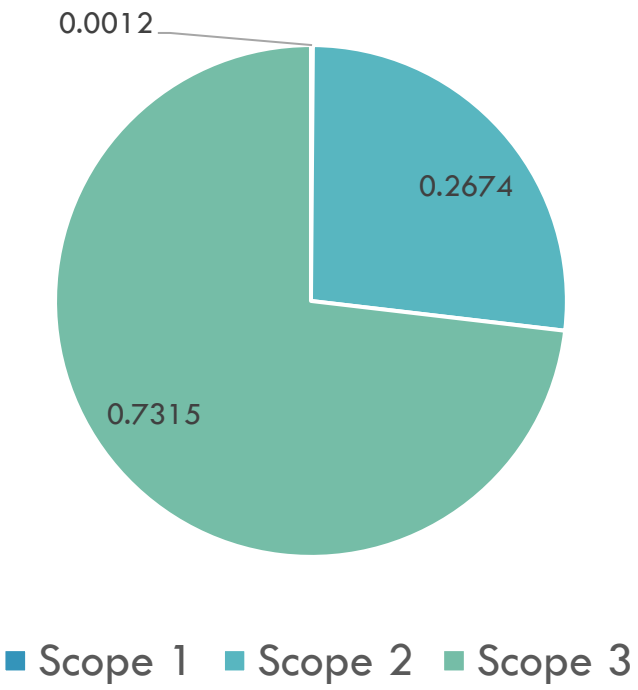
BY SCOPE

By the Numbers

Scope	tCO2-e	%
1 – direct (natural gas and refrigerants)	2.81*	0.12%
2 – indirect (electricity and steam)	649.92	26.74%
3 – indirect (everything else)	1,778.09	73.15%
Total	2,430.83	

Data with * is 2018 data used as a proxy for 2019

Pie chart



2018 – 2019 CARBON FOOTPRINT

COMPARISON BY SCOPE

Scope	tCO2-e (2018)	tCO2-e (2019)	% Change	Notes
1 – direct (natural gas and refrigerants)	2.81	2.81*	0.00%	* 2018 data was used as a proxy for 2019.
2 – indirect (electricity and steam)	1,219.07	649.92	-46.69%	Data center providers are much more transparent in reporting sustainability initiatives, leading to higher allocation of renewable grid mixes, waterless cooling and general improved equipment efficiency.
3 – indirect* (everything else)	1,349.49	1,721.70†	27.58%	Air travel increased for both Internal Staff Convening events (remote team get togethers) as well as Community Convening events (e.g. Wikimania). This is a result of the organization's 12% growth of staff and an increased number of events.
Total	**2,571.37**	**2,374.43**	**-7.66%**	

† Because selected Hotel/Lodging data was available for January – June 2018, all 2018-2019 comparative slides use full year data for all emissions activities except Hotel/Lodging, which uses the July – December period for 2018 and 2019. Hotel/Lodging is a Scope 3 activity. As a result, the 2019 Scope 3 totals on page 8 are slightly higher than the 2019 Scope 3 totals on page 9.

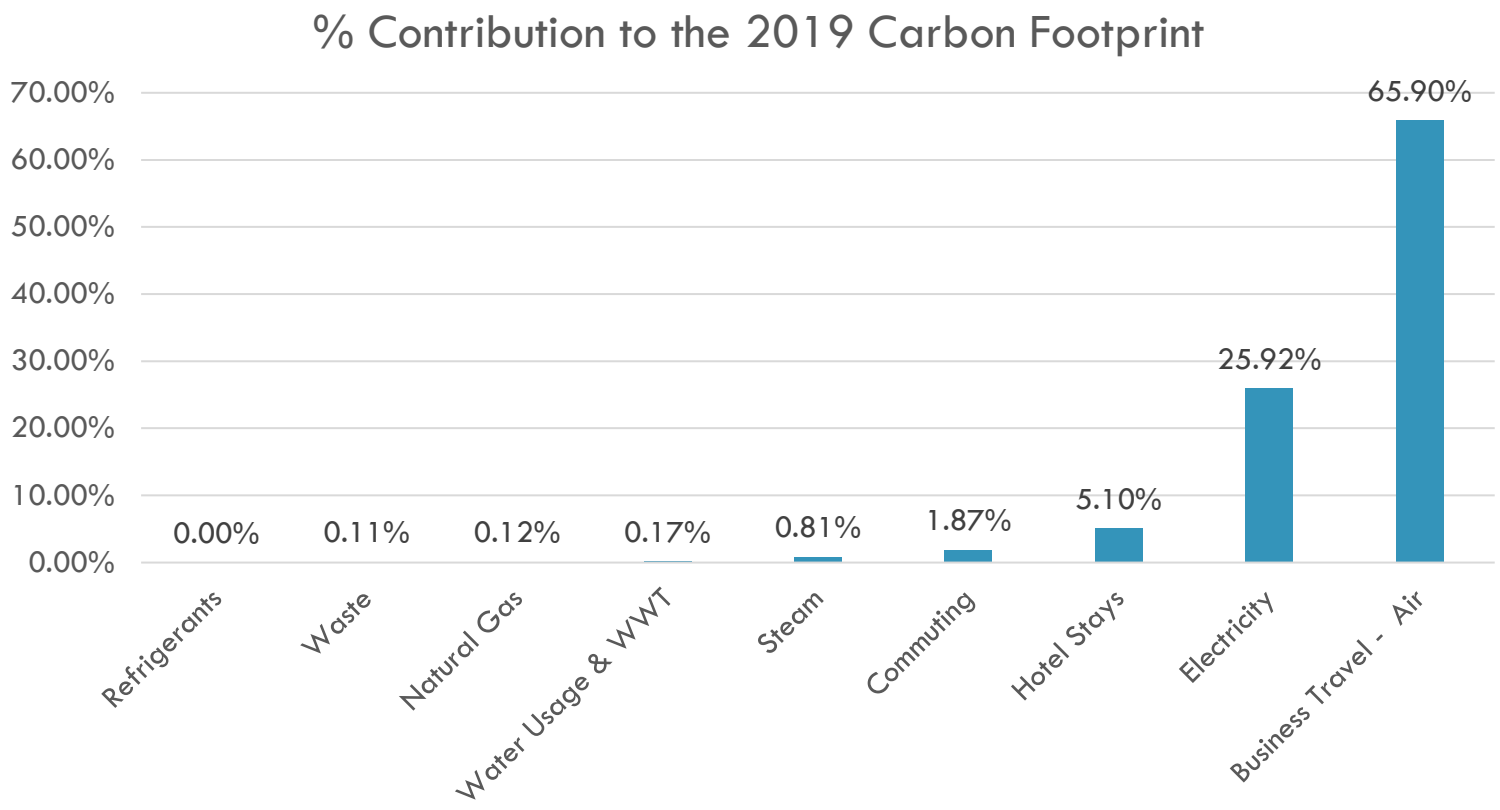
ACTIVITY DATA 2019

Data with * is 2018 data used as a proxy for 2019.

Activity	San Francisco Office	Data Centers and WMF Server	Travel: Internal Convenings	Travel: Community Convenings	Travel: Miscellaneous Business
Natural Gas Usage (kWh)	15,541.17*	N/A	included in Hotel emissions	included in Hotel emissions	Included in Hotel emissions
Refrigerants Usage (kg)	0*	N/A	N/A	N/A	N/A
Electricity Usage (kWh)	238,695.34*	2,641,350	included in Hotel emissions	included in Hotel emissions	Included in Hotel emissions
Steam (btus)	298,098,778.59*	N/A	included in Hotel emissions	included in Hotel emissions	included in Hotel emissions
Commuting (km)	575,650	N/A	N/A	N/A	N/A
Business Travel – Air (km)	N/A	N/A	7,666,263	4,935,308	3,563,665
Hotel Stays (# nights)	N/A	N/A	3,579	3,096	1,470
Water Usage (m3)	781.83*	21,071.91	N/A	N/A	N/A
WWT (m3)	781.83*	21,071.91	N/A	N/A	N/A
eWaste (t)	0.49	N/A	N/A	N/A	N/A
Waste – MSW (t)	4.34*	N/A	N/A	N/A	N/A
Waste – Recycled (t)	4.62*	N/A	N/A	N/A	N/A
Waste – Compost (t)	4.65*	N/A	N/A	N/A	N/A

2019 CARBON FOOTPRINT

BY ACTIVITY



2018 – 2019 CARBON FOOTPRINT

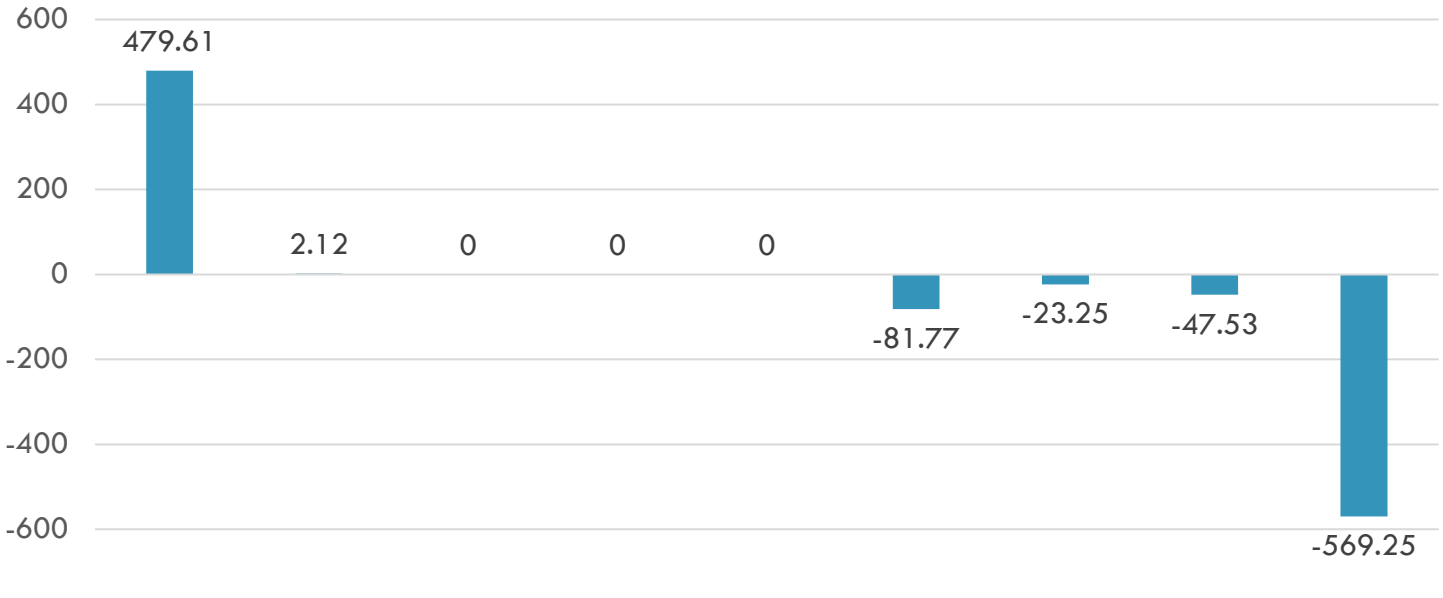
COMPARISON BY ACTIVITY

* 2018 data used as a proxy for 2019
** Mix of 2018 data (for San Francisco Office) and 2019 data (for data centers)

Activity	tCO2-e (2018)	tCO2-e (2019)	tCO2-eq change	Notes
Electricity	1,199.28	630.03**	-569.25	In 2019, WMF data centers reported higher uses of renewable energy, waterless cooling and overall equipment efficiency, leading to a 47.47% decrease in related carbon emissions.
Hotel Stays	128.90	67.64	-60.452	Because selected Hotel/Lodging data was not available for January – June 2018, this comparative slide uses full year data for all emissions activities except Hotel/Lodging, which uses the July – December period for both 2018 and 2019. While absolute number of hotel stays increased from 2018 (3,506) to 2019 (4,895), the average hotel stay had a lower carbon footprint. In addition, the removal of estimated hotel water- and meal-related emissions (determined by a rough estimate in 2018, and ultimately deemed too uncertain to include in 2019) decreased reported carbon emissions in the 'hotel stays" category by 50.70%.
Commuting	56.22	45.35	-19.34	Improved commuting data – only accounted for commuting to the office and eliminated the uncertain data of staff at the San Francisco Office traveling to another location on the days that they telecommuted. led to a 19.34% decrease in related carbon emissions.
Water Usage and WWT	26.42	4.19**	-22.23	Water consumption and efficiency practices improved at WMF's data centers, resulting in an 84.14% decrease in water use and wastewater-related emissions for 2019.
Refrigerants	0	0*	0	No change: these activities are focused on San Francisco Office, whose 2019 building data was unavailable during the data collection time period because of COVID-19.
Natural Gas	2.81	2.81*	0	
Steam	19.79	19.79*	0	
Waste	0.58	2.7*	2.12	While waste activity was steady at WMF, in 2019 the emissions factors for waste were updated in the carbon footprint software – resulting in a 365.52% increase in waste-related emissions. Overall, however, waste's contribution to the total carbon footprint is still insignificant (e.g. <1%).
Business Travel - Air	1,122.23	1,601.82	479.59	As a result of 12% staff growth and additional events, air travel emissions grew 42.7% from 2018 to 2019 for both internal staff and community convenings.

CARBON SHIFTS BY ACTIVITY

CHANGES IN TCO2-EQ 2018 → 2019



	Business Travel - Air	Waste	Steam	Natural Gas	Refrigerants	Water Usage and WWT	Commuting	Hotel Stays	Electricity
tCO2-eq	479.61	2.12	0	0	0	-81.77	-23.25	-47.53	-569.25

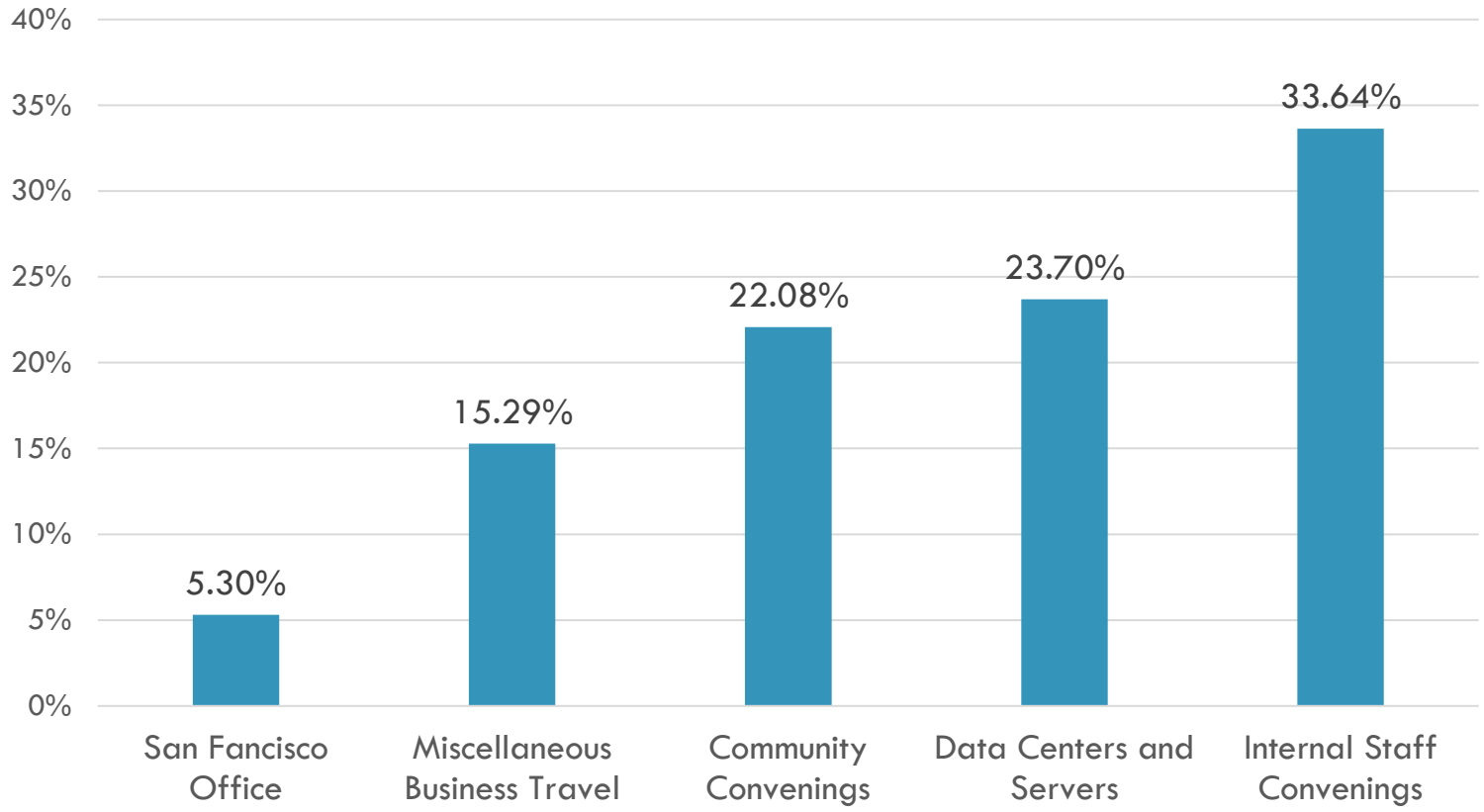
* Because Hotel/Lodging data was not available for January – June 2018, this comparative slide uses full year data for all emissions activities except Hotel/Lodging, which uses the July – December period for both 2018 and 2019.

SCOPE OF 2019 CARBON FOOTPRINT
FUNCTIONAL AREAS

Grouping	Square Feet	# Staff	Notes
San Francisco Office	19,000	81	Total WMF staff and contractors count = 338, with 133 working remotely within the US and 124 working remotely internationally, and 81 working at the San Francisco Office. Of the 145 total responding to the commuting survey, 34 were from San Francisco Office, 23%. These survey responses were extrapolated for the entire San Francisco Office group.
Data Centers and Servers	N/A	N/A	8 Data Centers were reported. eGrid emission factors were selected based upon publicly available data for each Data Center location. The server room at San Francisco Office is metered separately, data was provided for that meter by the chief building engineer of Post Montgomery – 2018 data used for 2019 reporting.
Travel: Internal Convenings	N/A	Used total data	Air travel emissions factors are taken from EPA, March 2018. Hotel accommodation emission factors were based upon each event location. Hotel emission factors and water usage/room were calculated using the Hotel Sustainability Benchmarking Tool 2019: Energy, Water, and Carbon. https://www.hotelfootprints.org/.
Travel: Community Convenings	N/A	Used total data	
Travel: Miscellaneous Business Travel	N/A	Used total data	

2019 CARBON FOOTPRINT

BY FUNCTIONAL AREA



2018 – 2019 CARBON FOOTPRINT

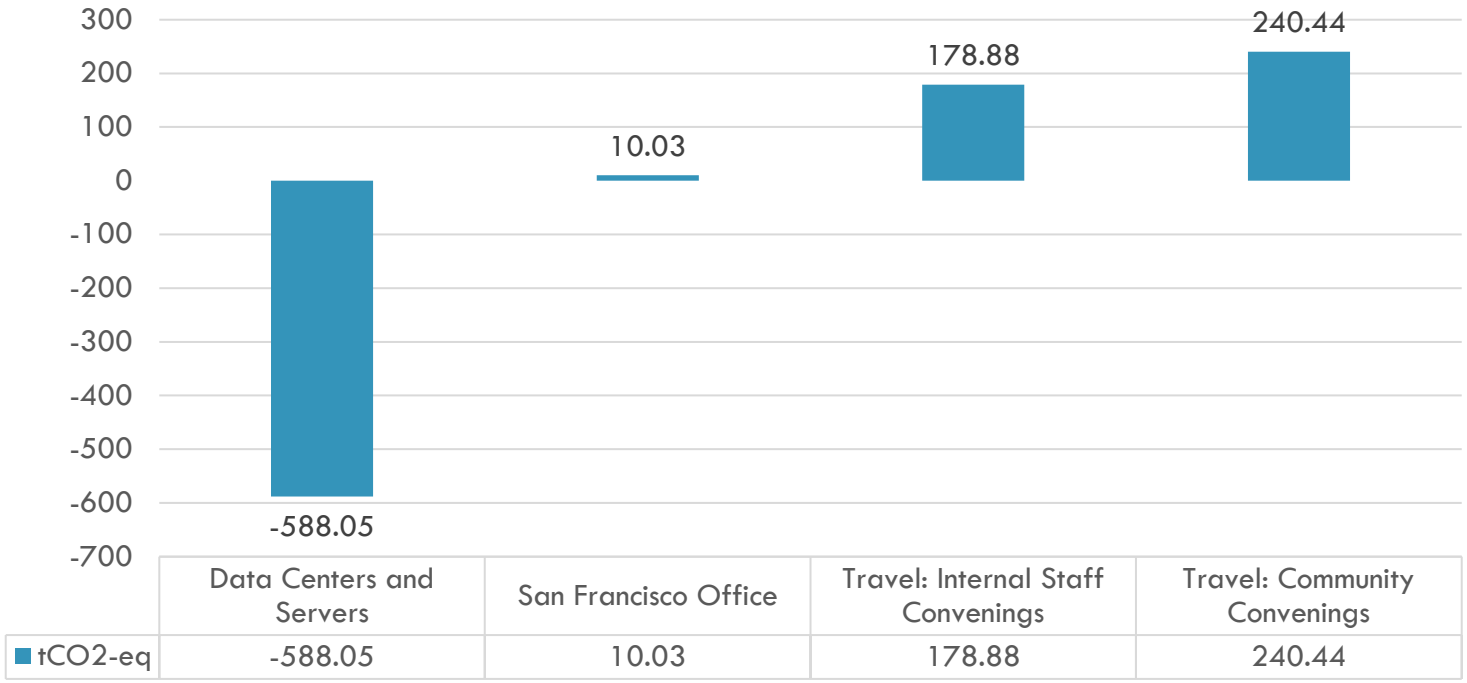
COMPARISON BY FUNCTIONAL AREA

Functional Area	tCO2-e (2018)	tCO2-e (2019)	% Change	Notes
San Francisco Office	138.07	148.1	7.26%	WMF grew its staff by 12% from 2018 → 2019. That, plus an updated waste emission factor (not increased waste generation per se), resulted in a modest increase in San Francisco Office-related emissions.
Data Centers and Servers	1,164.16	576.11	-50.51%	In 2019, WMF data centers reported higher uses of renewable energy, waterless cooling and overall equipment efficiency, leading to a sharp decrease in related carbon emissions.
Travel: Community Convenings*	695.58	874.46	18.92%	As a result of staff growth and additional events, air travel grew from 2018 to 2019 for both internal staff and community convenings. Note: Miscellaneous Business Travel is included with Community Convenings for this slide, because it was not separately tracked until 2019.
Travel: Internal Staff Convenings*	554.56	795.00	25.58%	

* Because Hotel/Lodging data was not available for January – June 2018, this comparative slide uses full year data for all emissions activities except Hotel/Lodging, which uses the July – December period for both 2018 and 2019. Hotel/Lodging is included in all Travel Categories.

CARBON SHIFTS BY FUNCTIONAL AREA

CHANGES IN TCO2-EQ 2018 → 2019



	Data Centers and Servers	San Francisco Office	Travel: Internal Staff Convenings	Travel: Community Convenings
tCO2-eq	-588.05	10.03	178.88	240.44

- Because Hotel/Lodging data was not available for January – June 2018, this comparative slide uses full year data for all emissions activities except Hotel/Lodging, which uses the July – December period for both 2018 and 2019. Hotel/Lodging is included in all Travel Categories.
- Note: Miscellaneous Business Travel is included with Community Convenings for this slide, because it was not separately tracked until 2019.

INTENSITY METRICS

Impact	Methodology	2018	2019
Total carbon footprint	Total Scope 1, Scope 2 and Scope 3 tCO2-eq emissions for all functional areas	2,697.55	2,430.69
Office-related carbon footprint	tCO2-eq of San Francisco office (building + commuting) / # of SF-based employees and contractors	1.70	1.83
Product-related carbon footprint	kgCO2-eq of data center emissions / 1M pageviews on all Wikimedia projects, including Wikipedia	4.89 kgCO2-eq/1M pageviews	2.33 kgCO2-eq/1M pageviews
	kWh for data center electricity / 1M pageviews on all Wikimedia projects, including Wikipedia	11.89 kWh/1M pageviews	10.78 kWh/1M pageviews
Travel-related carbon footprint	tCO2-eq of travel (air travel + hotels)/ # of event attendees for internal convenings	3.21 tCO2-eq/ attendee	1.65 tCO2-eq /attendee
	tCO2-eq of travel (air travel + hotels)/ # of event attendees for community convenings	N/A	2.10 tCO2-eq/attendee

KEY TAKE-AWAYS

Carbon emissions associated with **travel** increased 1,669.49 tCO2-eq from 2018 → 2019. On page 20, we dive deeper into what's behind this increase.

Carbon emissions associated with **data centers and servers** decreased 50.51% from 2018 → 2019. On page 26, we take a closer look at the factors driving data center decarbonization.

Because the data for **San Francisco Office** was largely unavailable, a deeper analysis of changes from 2018 → 2019 is not included at this time. An analysis of commuting patterns, however, is included on page 36.

TRAVEL IMPACTS

Internal Staff Convenings

Community Convenings

Miscellaneous Business Travel

TRAVEL: INTERNAL STAFF CONVENINGS

	2018	2019	% Change
Air Travel (km)	5,459,304	7,666,263	40.43%
Air Travel tCO2-eq	544.77	762.50	39.97%
# Hotel Nights*	632	2,384	277.22%
Hotel tCO2-eq*	23.83	32.50	36.38%
# Events*	19	26	36.84%
N-days*	96	143	48.96%
# Attendees*	N/A	486	N/A

* Because selected data for 2018 was not available for January – June 2018, the * rows shows a comparison of July – December 2018 vs. July – December 2019. Full 2019 year data is available on page 10, and full year-on-year comparisons will be used going forward.

TRAVEL: COMMUNITY CONVENINGS

	2018	2019	% Change
Air Travel (km)	5,703,.440	4,935,308	-13.47%
Air Travel tCO2-eq	577.34	489.04	15.29%
# Hotel Nights*	2,874	2,090	-27.28%
Hotel tCO2-eq*	106.52**	29.02	-72.76%**
# Events*	7	7	0.00%
N-days* (# days of events)	35	38	8.57%
# Attendees*	N/A	379	N/A

* Because selected data for 2018 was not available for January – June 2018, the * rows shows a comparison of July – December 2018 vs. July – December 2019. Full 2019 year data is available on page 10, and full year-on-year comparisons will be used going forward.
**WikiMania 2018 - South Africa – very high CO2-eq/day - >62 kg CO2-eq/day

TRAVEL: MISCELLANEOUS BUSINESS

	2018	2019	% Change
Air Travel (km)	*included in community convening travel	3,563,665.35	NA
Air Travel tCO2-eq	*included in community convening travel	350.28	NA
# Hotel Nights*	*included in community convening travel	421	NA
Hotel tCO2-eq*	*included in community convening travel	6.12	NA

* Because selected data for 2018 was not available for January – June 2018, the * rows shows a comparison of July – December 2018 vs. July – December 2019. Full 2019 year data is available on page 10, and full year-on-year comparisons will be used going forward.

TRAVEL INTENSITY METRICS

Event Type	Methodology	2018	2019	% Change
Internal Convening	tCO2-eq of travel (air travel + hotels)/ # of event attendees	3.21 t CO2-eq/event attendee	1.65 t CO2-eq/event attendee	-48.60%
	tCO2-eq of travel (air travel + hotels)/ # of events	29.93 t CO2-eq/event	30.58 t CO2-eq/event	2.17%
	tCO2-eq of travel (air travel + hotels)/ # of event days	5.92 t CO2-eq/event day	5.56 t CO2-eq/event day	-6.08%
Community Convening	tCO2-eq of travel (air travel + hotels)/ # of event attendees	N/A	2.10 t CO2-/eq/event attendee	N/A
	tCO2-eq of travel (air travel + hotels)/ # of events	97.69 t CO2-eq/event	113.57 t CO2-eq/event	16.26%
	tCO2-eq of travel (air travel + hotels)/ # of event days	19.54 t CO2-eq/event day	20.92 t CO2-eq/event day	7.06%

Selected Hotel/Lodging data for 2018 was not available for January – June 2018. To maintain an accurate year-over-year comparison, this slide reflects the full year of air travel emissions for 2018 and 2019, but only the July – December periods in 2018 and 2019 for Hotel/Lodging emissions activities.

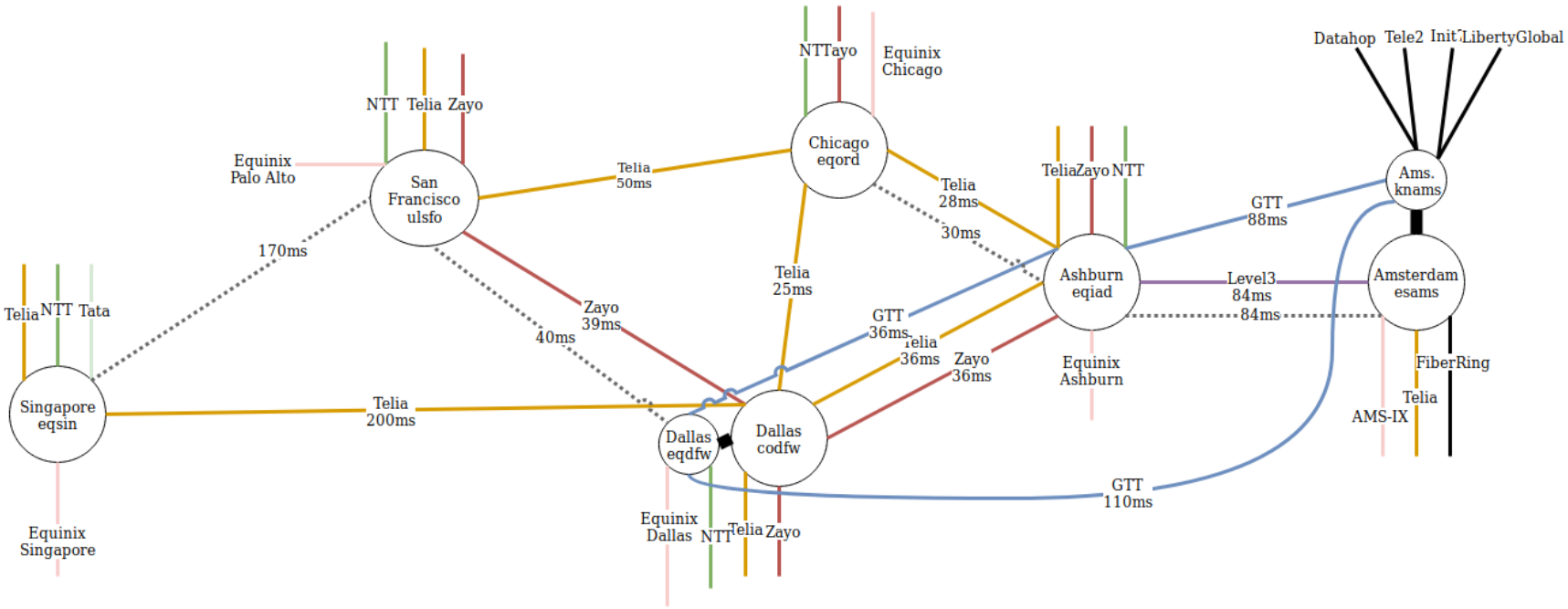
MAKING SENSE OF THE NUMBERS

Looking at the second halves of 2018 and 2019 (where we have consistent data for an apples-to-apples comparison) we see an:

- Increase in the number of internal staff convenings: 37%
- Increase in the number of event-days: 49% for internal staff convenings and 9% for community convenings and miscellaneous busines travel

The increase in travel-related carbon emissions is primarily driven by air miles (65.9% of total carbon) rather than hotel nights (5.1% of total carbon). To achieve carbon reductions, focus on reducing air travel by:

- Decreasing the number of individual events or combining trips to decrease travel legs
- Decreasing the number of attendees traveling to participate
- Choosing event locations to minimize travel needs



DATA CENTERS

2019 Review and Analysis

Server	Location	Provider	Purpose	PUE	Estimated H2O Consumption	Average Estimated Total Facility Po Consumption (kWh)	% kwh change from 2018	tCO2-eq	% tCO2-eq change from 2018
eqiad	Virginia, USA	Equinix	Application Services	1.4	2,972.64	1,636,017.60	-10.18%	166.57	-75.41%
codfw	Texas, USA	CyrusOne	Application Services	1.11	0.00	846,925.56	1.4%	389.59	0.98%
esams	Haarlem, Netherlands	IronMountain	Caching	1.2	139.43	76,737.60	4.29%	0.15	-99.66%
ulsfo	California, USA	DigitalRealty	Caching	1.12	0.00	32,376.96	-2.94%	6.06	-75.61%
eqsin	Singapore	Equinix	Caching	1.4	83.34	45,867.36	-2.53%	7.68	-65.62%
eqord	Illinois, USA	Equinix	Networking	1.4	2.23	1,226.40	-55.70%	0.19	-87.97%
eqdfw	Texas, USA	Equinix	Networking	1.4	2.23	1,226.40	-55.70%	0.15	-88.28
knams	Amsterdam, Netherlands	Interxion	Networking	1.11	1.77	972.36	-50.0%	0.00	-100%

2019 DATA CENTER OVERVIEW

DATA CENTER TRENDS

From 2018 to 2019, WMF's data centers reported:

- 84.81% decrease in water consumption.
- 50.5% decrease in carbon emissions

Why?

Data centers are rapidly improving their performance (and being more transparent about their progress) in three key areas:

Expanding access to renewables

Grid mix is improving
Flexibility to add renewable options outside of the grid

Increasing focus on water consumption

Explicit move to waterless cooling

Overall efficiency improvements

Building efficiency improvements
Equipment efficiency improvements

The data center industry continues to make improvements in energy efficient operations.

WHY ARE DATA CENTERS ACTING ON SUSTAINABILITY NOW?

Investment firms and asset managers have been aggressively pushing companies to address their climate change risks:

- 2018: Ernst & Young survey finds the majority of investors now consider sustainability ESG factors alongside other business and market factors in their decision-making
- 2019: Goldman Sachs announces plans to invest $750 Billion in sustainable finance, including climate transition
- 2020: Blackrock puts sustainability and climate change at the center of its investment strategy

Big companies have substantial climate change exposure through their data centers, making it a key opportunity for carbon reduction. For example, 43% of Bloomberg's electricity use comes from its data centers and data center efficiency is one of its sustainability priorities (see its 2019 Impact Report, pages 32-41).

This pressure from investors and customers to improve the climate change profiles of data centers has created a swell of momentum. According to AFCOM's 2018 State of the Data Center Industry report, approximately 42% of respondents have or are planning to deploy a renewable energy over the next year. And 60% of those respondents indicated that this new renewable energy source will help them lower overall TCO of their data center while helping them achieve green initiatives.

DATA CENTER SUSTAINABILITY SNAPSHOT

An examination of data center provider's sustainability initiatives reveals that there are two general strategies:

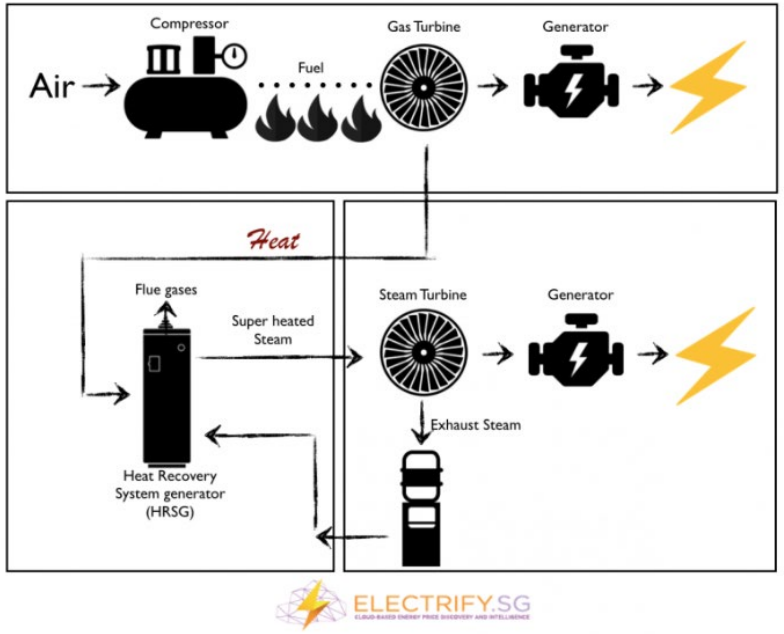
- Increasing the renewable energy proportion of their energy sources, through renewable energy projects or the purchase of renewable energy credits (RECs).
- "Greening" the operations, including LEED certification of the facility, water efficiency initiatives, etc.

Provider	Server	Strengths	Weaknesses
Equinix	eqdfw, eqiad, eqord, eqsin	Robust Sustainability Reporting, 100% renewable energy goals /	Lower PUEs than some, "Our current goals range from 1.29-1.40", lack of reporting on water consumption.
CyrusOne	codfw	CyrusOne WaterLess Cooling initiative - The chilled water loop for a 4.5 MW data center is filled once with less than 8,000 gallons, the permanent water supply can be provided by a single tanker truck. No new water or sewer lines need to be run out to the data center. Local officials do not need to plan for the byproducts of a massive release of toxic water into their sewer system.	Their eGrid – as advertised on their site – is the ERCT grid – very little mentioned about renewable energy initiatives especially as they are in TX – a leader in renewable wind energy.
IronMountain	esams	Newly introduced Green Power Pass program. PUE as low as 1.2.	
DigitalReality	ulsfo	PUEs as low as 1.12. Utilize water-efficient and free cooling technologies and tap into reclaimed water supplies where available to minimize their use of potable water. Pairing of facilities with sources of renewable energy. LEED Certified facility in SF. Robust Sustainability Reporting. Waterless cooling systems.	Still low on renewable energy mix – reported as somewhere both 22% and 33%.
Interxion	knams	100% of their energy is from renewable sources.	

RENEWABLE ENERGY – SINGAPORE

Approximately 95% of electricity in Singapore is produced from natural gas. Other sources of energy for generating electricity include coal, petroleum products (e.g. diesel, fuel oil) and other energy products. While natural gas is considered the cleanest form of energy source, Singapore continues using other sources to ensure energy security.

Source: https://electrify.sg/content/articles/electricity-generation-singapore/



RENEWABLE ENERGY – NETHERLANDS - TENNET

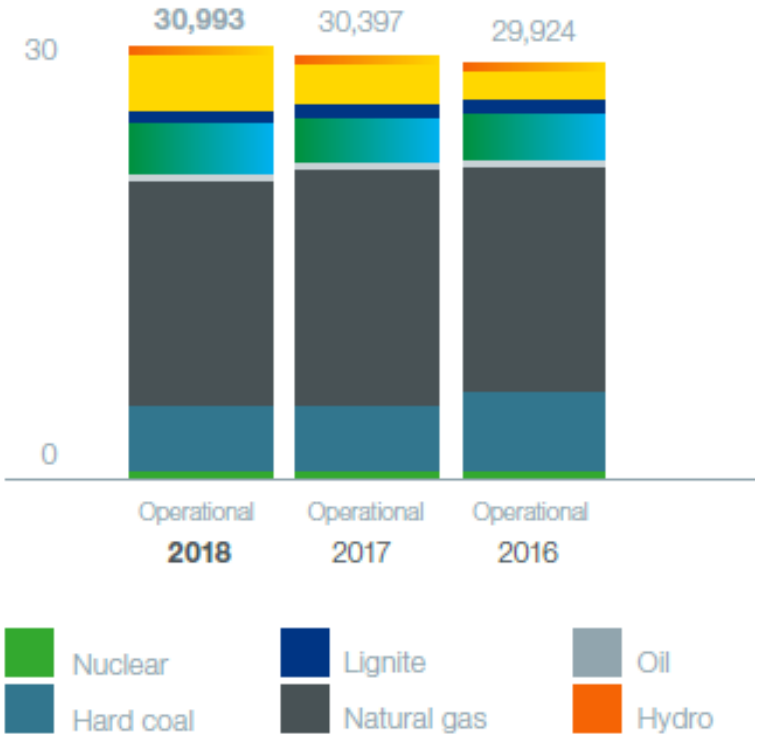
In the Netherlands TenneT is the sole grid operator

The EU's 2030 Energy Objectives:

- At least a 40% reduction in greenhouse gas emissions (from 1990 levels);
- At least 27% share for renewable energy;
- At least 27% improvement in energy efficiency

(Source: TenneT Holding B.V. Integrated Annual Report 2018*)

* Awaiting updated 2019 report



ASSUMPTIONS & LIMITATIONS
GENERAL

Data Center emissions do not include Scope 1 diesel combustion from back-up generators.

- In areas with unreliable grids, data centers may rely disproportionately on back-up generators.

Emissions do not include embedded carbon relating to facility construction.

- Data Center co-location sites in VA may have different embedded carbon due to the conversion of abandoned warehouses and factory sites being used for this new purpose/function/business vs. new construction.

ASSUMPTIONS & LIMITATIONS

RENEWABLE AND NON-RENEWABLE ELECTRICITY RESOURCES

Equinix (eqdfw, eqiad, eqord, eqsin)

Equinix has made claims of 100% renewable energy achievable via RECs.

- Their 2019 CDP Climate Change Survey (based on 2018 data) indicates Scope 2 (electricity) emission factors are based upon both market and location based.
  - GHG Scope 2 Guidance: A location-based method reflects the average emissions intensity of grids on which energy consumption occurs (using mostly grid-average emission factor data). A market-based method reflects emissions from electricity that companies have purposefully chosen (or their lack of choice). It derives emission factors from contractual instruments, which include any type of contract between two parties for the sale and purchase of energy bundled with attributes about the energy generation, or for unbundled attribute claims. Markets differ as to what contractual instruments are commonly available or used by companies to purchase energy or claim specific attributes about it, but they can include energy attribute certificates (RECs, GOs, etc.), direct contracts (for both low-carbon, renewable, or fossil fuel generation), supplier-specific emission rates, and other default emission factors representing the untracked or unclaimed energy and emissions (termed the residual mix) if a company does not have other contractual information that meets the Scope 2 Quality Criteria
- The CDP report did not include actual electricity emission factors in their CDP reporting, but, make the claim that "Americas are 73% renewable, Asia-Pacific is 65% and EMEA is 89% renewable."
- Based upon that claim, the Scope 2 emissions for each Equinix co-located server was adjusted to reflect those consumption levels of renewable sources in tandem with the local eGrid mix for the balance.

ASSUMPTIONS & LIMITATIONS

RENEWABLE AND NON-RENEWABLE ELECTRICITY RESOURCES

DigitalReality (ulsfo)

- 22% renewables with 78% from the local eGrid mix
- https://www.digitalrealty.com/about/sustainability/clean-energy

CyrusOne (codfw)

- Renewables claim is based upon the local eGrid renewables according to EPA reporting.
- https://cyrusone.com/locations/texas/dallas-texas-carrollton/

IronMountain (esams)

- 100% renewables
- https://www.ironmountain.com/digital-transformation/data-centers/about/green-data-centers

Interxion (knams)

- 100% renewables
- https://www.interxion.com/why-interxion/sustainability

COMMUTING

Commuting patterns and the impact of a remote workforce

COMMUTING MODES AT SAN FRANCISCO OFFICE

BY TOTAL ANNUAL DISTANCE COMMUTED

In 2019, the average 1-way commute was 26 km (16 miles), and the average annual commute was 7,107 km (4,416 miles).

Mode	Annual distance (person*km)	% of total distance	kgCO2-eq per person*km	Total tCO2-eq
BART	361,017	62.71%	0.06	20.76
Personal vehicle	96,850	16.82%	0.22	20.87
Bus	60,838	10.57%	0.03	2.13
Bike/Walk	37,127	6.45%	0.00	0.00
Subway/MUNI	15,838	2.75%	0.07	1.18
Carpool	3,981	0.69%	0.10	0.42