

Appendix N. Emission Benchmarks for Purchased Steam and Chilled/Hot Water

Use these emission factors to calculate the following:

- Indirect emissions from the consumption of purchased steam and hot/chilled water for emissions inventories.
- Reductions in indirect emissions resulting from the consumption of purchased steam and hot/chilled water.
- Avoided emissions resulting from the sale of steam and hot/chilled water to another entity.

Emission Factors for Steam and Chilled/Hot Water

Energy Product	Emission Inventory	Emission Reductions	
		Avoided Emissions	Indirect Emissions
Steam or Hot Water (kg CO ₂ e/MMBtu)	86.845 ^a	78.95 ^b	86.845 ^a
Chilled Water (kg CO ₂ e/Ton-hours Cooling)			
Absorption Chiller Using Natural Gas ^c	0.871		0.871
Engine-Driven Chiller Using Natural Gas ^c	0.581		0.581
Electric-Driven Chiller ^c	see notes below	see notes below ^d	see notes below

^a Weighted average based on Energy Information Administration's (EIA) 1998 Manufacturers Energy Consumption Survey data on the quantities of natural gas, coal, and residual and distillate fuel oils consumed as boiler fuel, carbon coefficients provided in EIA's Assumptions to the Annual Energy Outlook 2003, and EIA/OIAF efficiency assumptions of 80, 81, and 82 percent for natural gas, coal and petroleum boilers, respectively. Value also includes 10 percent loss during transmission.

^b Same methodology as emission inventory and indirect emission reductions factors but does not include transmission losses.

^c Chilled water efficiencies based on California Climate Action Registry, *General Reporting Protocol* (October 2002).

^d All avoided emission reductions are assumed to displace chilled water from electric driven chillers.

Source: U.S. Department of Energy, Office of Policy and International Affairs, *Technical Guidelines to the Voluntary Reporting of Greenhouse Gases (1605(b)) Program* (March 2006) p. 154-156.

Notes – Electric Driven Chiller Calculations:

The quantity of emissions associated with a unit of electricity varies on a regional basis according to the mix of electric power generators in a given region. When calculating indirect and avoided emissions associated with chilled water obtained from electric driven chillers, reporters should use regional electricity emission factors in Appendix F – Electricity Emission Factors that reflect their appropriate regional electricity emission rate. Reporters should use the formulas provided below to calculate appropriate emission factors (kg CO₂e/ton-hour Cooling) for electric-driven chilled water.

Chilled Water Emission Factor for Use in Calculating Indirect Emissions for Emission Inventories

Reporters should use this formula for determining an appropriate emissions factor for use in indirect emissions inventory calculations. It includes a 10 percent thermal loss factor in transmission, and makes use of the regional electricity emissions factors for emission inventories found in Appendix F:

$$EF_{\text{Chilled Water}} = 0.921 * EF_{\text{Electric/Inventory}}$$

Where:

$EF_{\text{Chilled Water}}$ = Emissions Factor, expressed in kg CO₂e/ton hour of cooling purchased

$EF_{\text{Electric/Inventory}}$ = Appropriate Regional Electricity Emissions Factor for Emission Inventory, expressed in MT CO₂e/MWh.

Chilled Water Emission Factor for Use in Calculating Reductions in Indirect Emission Reductions

Reporters should use this formula for determining an appropriate emissions factor for use in indirect emission reductions calculations. It includes a 10 percent thermal loss factor in transmission, and makes use of the regional electricity emissions factors for indirect emission reductions found in Appendix F:

$$EF_{\text{Chilled Water}} = 0.921 * EF_{\text{Electric/Indirect}}$$

Where:

- EF_{Chilled Water}** = **Emissions Factor, expressed in kg CO₂e/ton hour of cooling purchased**
- EF_{Electric/Indirect}** = **Appropriate Regional Electricity Emissions Factor for Indirect Emission Reductions, expressed in MT CO₂e/MWh.**

Chilled Water Emission Factor for Use in Calculating Avoided Emissions

Reporters should use this formula for determining an appropriate emissions factor for use in avoided emissions calculations. It does not include a thermal loss factor in transmission, and makes use of the regional electricity emission factors for indirect emission reductions found in Appendix F:

$$EF_{\text{Chilled Water}} = 0.837 * EF_{\text{Electric/Indirect}}$$

Where:

- EF_{Chilled Water}** = **Emissions Factor, expressed in kg CO₂e/ton hour of cooling purchased**
- EF_{Electric/Indirect}** = **Appropriate Regional Emission Electricity Emissions Factor for Indirect Emission Reductions from Appendix F, expressed in MT CO₂e/MWh.**