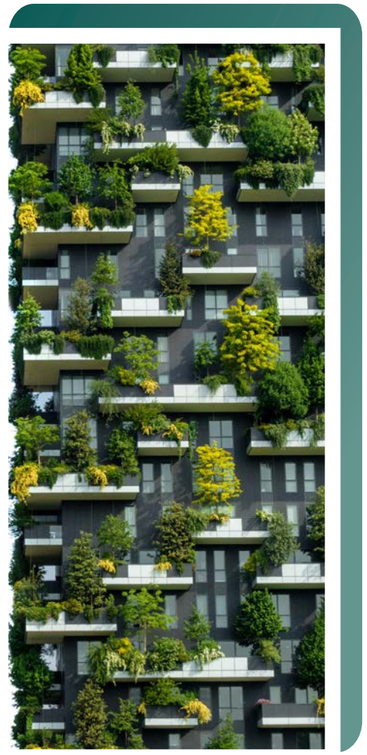
GREENVIEW

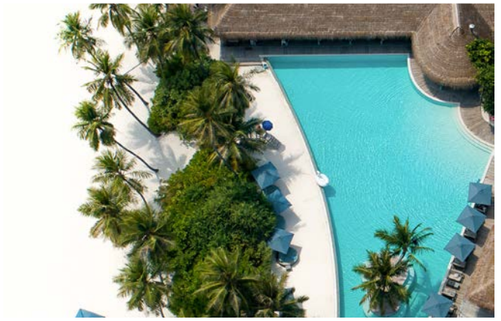
NET ZERO METHODOLOGY FOR HOTELS

2ND EDITION • JUNE 2023

APPENDIX J

THE PURCHASED CHILLED WATER CONUNDRUM





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J.1 BACKGROUND

Most HVAC hotel systems use onsite boilers and chillers for the heating and cooling of the building, either through boilers and centralized chillers that pump chilled water throughout the building, or decentralized air conditioner units in each room (or a combination of both). Some hotels do not produce heating or cooling on their own, but instead purchase steam and chilled water from a utility provider.

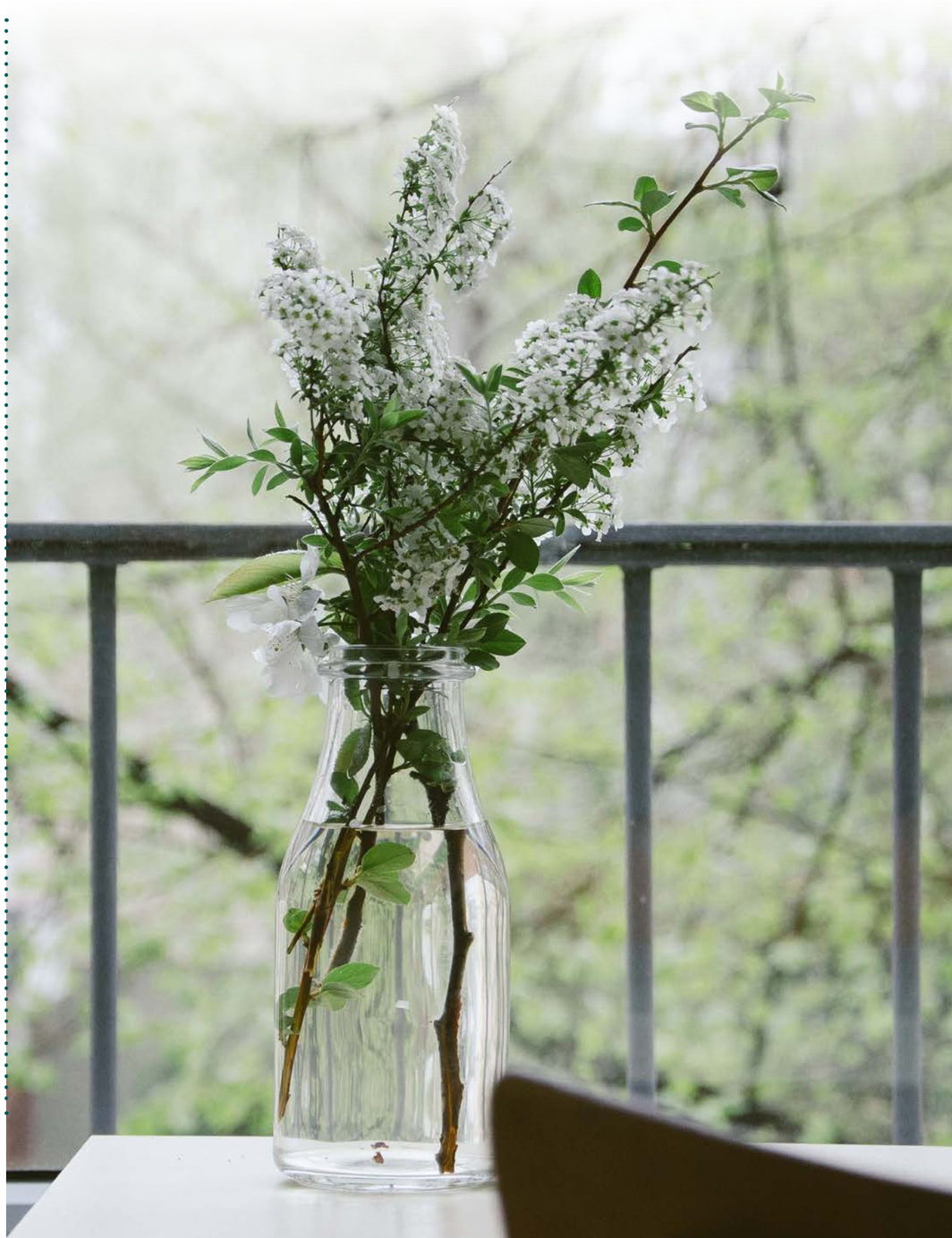
For inventory calculation and decarbonization targets, purchased heating and cooling can be problematic and presents two challenges. The first challenge is that because they are categorized as Scope 2 emissions per definition of the GHG Protocol, these sources are grouped together with electricity, even though functionally purchased steam serves the same purpose as a hotel's Scope 1 emissions, as does purchased chilled water in the case of the building using a gas-driven chiller. In terms of approaches to decarbonization, market-based renewable energy certificate mechanisms for their purchase are rare. The Sectoral Decarbonization Approach outlines specific decarbonization pathways for commercial buildings for Scope 1 and Scope 2. When purchased heating and cooling form part of a hotel's Scope 2, it will be more challenging to decarbonize as rapidly as electricity is. To address this, the SBTi criteria actually indicates that companies can treat purchased heating and cooling as Scope 1 in their calculation and reduction pathways. Though it is in contradiction to the GHG Protocol, it points to a better approach managerially for buildings of bifurcating energy as "electric" and "non-electric".

The second challenge of purchased chilled water is that the cooling energy content of the water received by the hotel is not the same as the amount of energy used to produce the chilled water. The cooling energy content of the water received is much greater than the amount of energy it takes to produce it. This is because of the closed loop system that enables the cooling effect to continue being distributed and circulated.

Purchased chilled water utility data is often provided in a flow rate unit of ton-hours, with 1 ton-hour being equivalent to 0.012 MMBtu or 3.51685 kWh. The utility data provides the precise amount of cooling energy content of the purchased water and needs to be converted to kWh to calculate carbon emissions.

This is known as the Coefficient of Performance (COP) in engineering systems. Chilled water can be generated using electricity or natural gas, each carrying a different COP range and set of conversions. Assuming that electricity was used and the chiller has a COP of 4.0, the energy content of the chilled water is four times of the energy needed to produce the chilled water. Simply put, 1 kWh of electricity will produce the equivalent of 4 kWh of cooling energy for a building.

It is important to note that while energy is related to carbon, the **carbon emission of purchased chilled water,** and the **energy of purchased chilled water** are two different quantities. Likewise, calculating the footprint of a building vs. benchmarking against other buildings are different approaches.



J.2 CALCULATION CHALLENGE

applying the COP. The emission factors (Efs) for purchased chilled water are not widely or publicly available. Only a few countries provide Efs that are updated regularly such as the US, Canada and France. Difficulty has been observed in attempts to obtain supplier-specific emission factors, where providers have indicated they do not have this information, or are unwilling to share it. For proxy calculations, the US Energy Information Agency Form 1605(b) Appendix N remains the most commonly cited reference for how to generate emission factors despite being released in 2010.

The next issue arises from the lack of clarity on when and how COP can be applied, if needed at all, when quantifying carbon emissions. The different purchased chilled water EF references have different methodologies, and a deep understanding of each reference is needed to understand all the assumptions. For example, the purchased chilled water Efs provided in the US Energy Information Agency Form 1605(b) Appendix N have already applied a fixed but unspecified COP that generally calculates out to 4.2. While this makes calculating carbon emissions convenient, it may either lead to an under or overestimation given that there is a wide range of chiller efficiencies and thus a wide range of COPs in reality. Likewise, a COP should not be applied to the energy figures in ton-hours prior to using the methodology in the US EIA or other sources.

J.3 REPORTING VS BENCHMARKING

The different methodologies available to quantify carbon emissions has implications on how hotels report and benchmark their emissions among peers. When hotels are reporting their carbon emissions, they can decide how to apply COP. However, for benchmarking purposes, a uniform COP has to be agreed upon to normalize the carbon emissions associated with purchased chilled water. Otherwise, there would not be a fair comparison between hotels that generate chilled water onsite (Hotel A) and hotels that purchase chilled water (Hotel B) as illustrated in Table J.1.

▼ **Table J.1** Comparison between Hotels that Generate and Purchase Chilled Water

	HOTEL A – GENERATE OWN CHILLED WATER	HOTEL B – PURCHASE CHILLED WATER
Utility Data	*Purchased Electricity utility data in kWh used to generate chilled water* 100,000 kwh	*Purchased Chilled Water utility data in ton-hours* 113,738 ton-hours
Cooling Energy of Chilled Water	*With COP of 4.0* 100,000 x 4 = **400,000 kWh**	*Given that 1 ton-hour = 3.516852842 kWh* 113,738 x 3.516852842 = **400,000 kWh**
Addition to Energy Footprint	**100,000 kwh**	**400,000 kWh**
Addition to Carbon Emissions *Assuming 1kgCO2e of a kWh of electricity = 0.837kgCO2e of a ton-hour of purchased chilled water*	Equivalent of 100,000 kwh = **100,000 kgCO2e**	■ Without COP applied: Equivalent of 400,000 kWh = **400,000 kgCO2e** ■ With COP of 4.0 applied: Equivalent of 113,738 ton-hours = 0.837 x 113,738 = **95,200 kgCO2e**