A WINT White paper

The Carbon Impact of Water

OVERVIEW

Fresh water is a critical and rapidly dwindling resource. Worldwide water shortages have led the UN to define its sixth Sustainable Development Goal as "Ensuring the availability and sustainable management of water and sanitation for all people".[1]

But water quality and availability are not the only environmental challenges. ***Water use is also a major source of greenhouse emissions resulting from its production, treatment, and delivery.***

In fact, water-related energy use accounts for a full 13% of all US electricity consumption.[2] For many local governments, ***water and wastewater are the largest consumers of energy***, typically accounting for 30%-40% of total energy consumed, and in some cases reaching as high as 60%.[3]

13%

of electricity in the US is used for water delivery and treatment. For municipalities, water accounts for a full 30% - 60% of energy use.

The Water Life cycle

- Acquire ***Pump, desalinate, reclaim***
- Clean ***Filtration, chemical treatment***
- Distribute ***Energy, distance***
- Consume ***Homes, Offices, Industry***
- Collect Sewage ***Transfer***
- Treat Sewage ***Energy, Emissions***

Water production consumes this much energy because it is essentially a large-scale industrial process. Water is pumped from the ground, reservoirs, or other sources. Alternatively, it can be desalinated which is even more energy intensive. It is filtered and chemically treated, and then distributed to consumers — sometimes across long distances. All of this uses a lot of energy.

And water's journey doesn't end when it reaches the consumer; once used, water is transferred to sewage treatment facilities, consuming even more energy. Moreover, sewage treatment processes release large amounts of greenhouse gases. These emissions are some of the worst greenhouse gases, with ***a global warming impact that is hundreds of times more impactful than CO2***.

The total greenhouse emissions resulting from the use of water varies, depending on the water's source, distance to users and other factors. On average, every cubic meter of water consumed generates 23lb (10.6Kg) of carbon emissions. A detailed breakdown and analysis are discussed in the following sections.

WATER WASTE

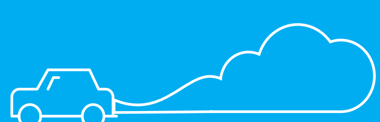
To make matters worse, we're not coming close to maximizing utilization of the water that does reach us. Here's another painful statistic: **Over 25% of the water entering a building, construction site or industrial facility goes to waste.** These inefficiencies worsen water scarcity, forcing adoption of water supply methods that require more energy and emit more greenhouse gases. Large canals, long delivery lines and desalination plants are just a few of the energy intensive solutions that inevitably increase emissions and climate change.

It's clear, then, that reducing water waste has a dual benefit: first, it reduces depletion of this scarce resource. Additionally, it decreases the amount of energy used and greenhouse gases emitted by the use of water.

Real-Life Examples

Experience consistently shows that practically every building, construction site or manufacturing plant wastes water. Even the best designed, newest facilities suffer from equipment malfunctions and human error. Water waste is often hidden from view and difficult to spot, so it may continue for months or years, with a significant carbon impact. The real-life examples below demonstrate the magnitude of greenhouse emissions that are a direct result of water waste.

One continuously running toilet has the same carbon footprint as the annual emissions of a passenger car .



LEAKY TOILET

A typical leaky toilet flows continuously at about 130 gallons (500 Liters) per hour, often for weeks and months. In a multi-restroom facility where, on average, one toilet is leaking at any time, the annual waste is 4.4 million liters of water, which emit 4.5 tons of greenhouse gases. This is similar to the annual emissions of a passenger car. Real-world observation shows that 2% - 4% of toilets in commercial buildings leak at any time. In other words, the water waste from toilets in a building with 100 toilet seats results in 13 tons of emissions every year - identical to the carbon footprint of 3 passenger cars.[4]

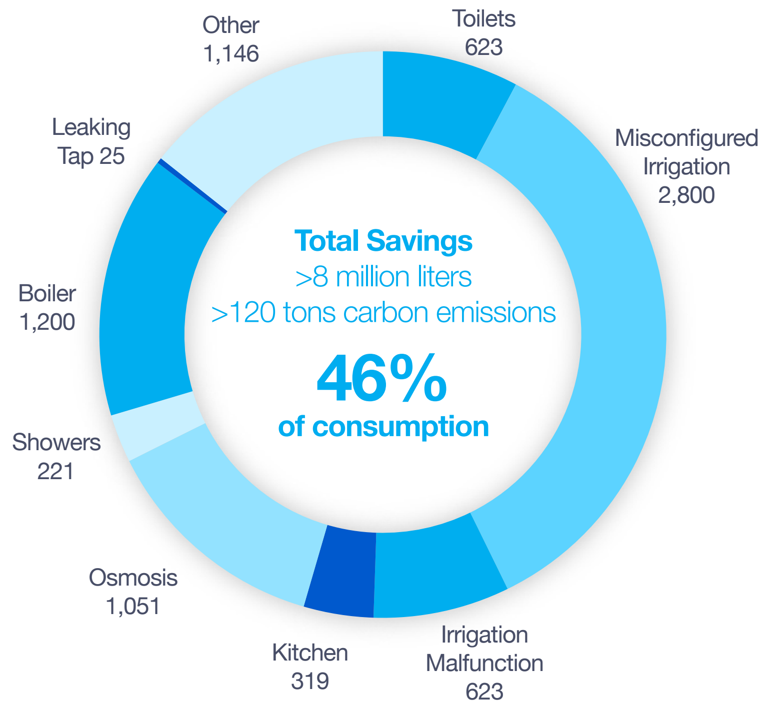
OFFICE BUILDINGS

Waste from hidden leaks plagues practically every office building, even those built for maximal sustainability. These leaks are caused by malfunctioning equipment, misconfiguration, incorrect operation, and the difficulty to detect over-consuming equipment.

For example, the WINT water monitoring platform was installed in a brand new, Gold LEED facility. Over the course of 8 months, issues were identified in the facility's boiler, irrigation systems, kitchen, reverse osmosis system, toilets, a tap, and the showers. The facility is located in an arid region which uses desalinated water, so its carbon footprint is particularly high. Total waste: over 8 million liters; total greenhouse emissions: over 120 metric tons, at a rate of 180 tons per year.

This example demonstrates the challenges of reducing consumption due to the hidden nature of wasteful leaks and their carbon impact. Moreover, this facility is exceptionally well maintained and incorporates the most advanced sustainability technology. The impact in less advanced facilities is significantly greater.

Waste detected in a LEED gold-certified building over 8 months (000's of liters)



COOLING TOWERS

Cooling towers are a critical component of many large air-conditioning systems and are notorious for their immense use of water. Unfortunately, they are based on 19th century technology that's prone to malfunctions which are extremely difficult to diagnose. These malfunctions waste huge amounts of water with an equally dramatic carbon footprint.

One such example is a high-rise building in Manhattan. A WINT system installed at the building detected a leak running at just over 3,000 L/h (13GPM), amounting to a total of 27,000,000 liters per year. The carbon footprint of this one incident alone was 342 tons per year, identical to the carbon emissions of flying 170 people from London to New York.[5]

The water lost to one cooling tower malfunction generates the same emissions as flying

170

People from NY to London

Detailed Analysis: Carbon Footprint

To understand exactly how wasted water affects the environment, let's review a deeper analysis of the various greenhouse emissions of the water-consumption life cycle.

PUMPING, CLEANING AND DISTRIBUTION

Water supplies consume energy throughout the delivery process: pumping, cleaning, and distribution – each with energy requirements that vary according to the water's source. For example, pumping groundwater from wells uses 27% more energy than drawing surface water. Surface water, however, requires additional cleaning and chemicals, resulting in 31% more indirect use of energy. And producing drinkable from saltwater through desalination is especially energy intensive, requiring 14 times more energy than surface water. Once pumped and cleaned, water is distributed to consumers, sometimes across hundreds of miles. This distribution consumes substantial energy, with longer pipelines consuming more.

Energy consumption and carbon emissions to deliver water from different sources are summarized in the table, based on a study by researchers from the University of Florida[6,7] and the EPA:

Water source	Energy Consumption (KWh)		CO2 emissions (Kg) per cubic meter of water
	Per Cubic Meter	Per Gallon	
Desalinated	11.6	0.044	8.2
Recycled	4.5	.017	3.2
Surface	0.1	0.0003	70 gr
Imported (360 mile / 575 km pipe)	4.7	0.018	3.4
Average	5.2	0.02	3.7

Sources: University of Florida[6], Treehugger[7], US EPA[8]

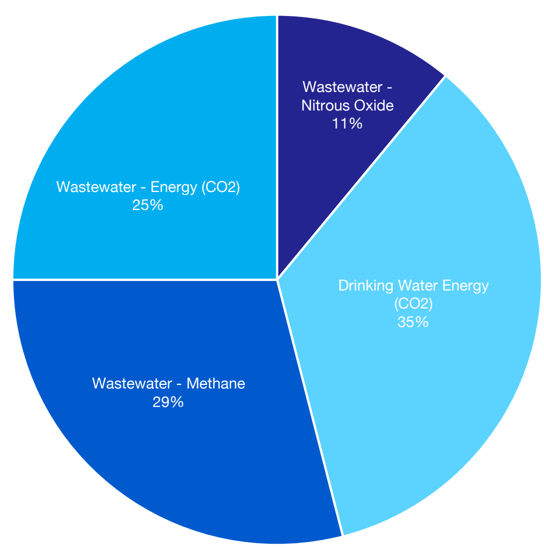
SEWAGE TREATMENT

Most of the water entering a facility – be it commercial, residential, or industrial, ends up as wastewater which then undergoes sewage treatment, using up more energy. Even worse, these processes themselves release significant amounts of greenhouse gases. The primary gases released are Nitrous Oxide (NO_2) and Methane (CH_4), both of which are extremely potent; Nitrous Oxide's greenhouse impact is 300 times that of CO_2 and Methane's is 25 times more.[9]

With pumping, cleaning and distribution generating an average of 3.7Kg per cubic meter (which are 35% of the total water emissions), we can easily calculate the emissions impact of sewage. The total emissions are 6.9 Kg per cubic meter, split as follows:

	% of total emissions	Kg emissions per cubic meter
Wastewater energy	25%	2.6
Wastewater – Methane	29%	3.1
Wastewater – Nitrous Oxide	11%	1.2
Total	65%	6.9 Kg

Greenhouse gas emissions from water use



Sources: Lawrence Berkley National Lab[10], and US DOE

TOTAL EMISSIONS

Combining the emissions from the water's different life cycle stages provides the following totals for the various types of water sources:

Water source	Total emissions (Kg per cubic meter of water)
Desalinated	15.1
Recycled	10.1
Nearby surface water	6.9
Imported (360 mile / 575 km pipe)	10.3
Average	10.6

Conclusions and Recommendations

Inefficient use of water is a significant source of carbon and other greenhouse emissions. A few key actions can significantly reduce waste and inefficiencies. Most often, these savings will more than return the investment through reduced utility bills. Consider the following actions:

1. Implement water saving devices such as low flow toilets, automated urinals, etc... These will reduce the amount of water used during proper operation.
2. Sub-metering will assign the cost of water to tenants. This will create awareness to leaks and waste.
3. Assume water appliances will malfunction. Moreover, a simple malfunction that continuously leaks will waste more water than the savings achieved by water-saving devices and should therefore be treated as high priority.
4. Use advanced technologies to identify waste, human errors and equipment malfunctions. These are by far **the biggest sources of waste** and are most often hidden and difficult to detect with human inspection. Advanced AI solutions such as WINT's can now detect anomalies and prevent them from becoming big sources of waste.

Final Words

The environmental impact of water misuse and waste is a critical challenge. Where in the past water was viewed as a scarce resource in some locations and as a plentiful asset in others, it can no longer be taken for granted. Inefficient use of this resource creates shortages and increases greenhouse emissions, sometimes more than notorious emitters such as cars or transatlantic flights.

It is our generation's responsibility to efficiently use the water we've been given, and to identify and curtail the unnecessary, expensive, and environmentally irresponsible waste of this precious resource.

wint Water Intelligence

ABOUT WINT

WINT is dedicated to helping businesses conserve water, reduce its waste and the resulting carbon emissions, and prevent the hazards and costs of water leak damage in facilities. Utilizing the power of artificial intelligence and IoT technology, WINT provides a solution for commercial facilities, construction sites and industrial manufacturers looking to cut water waste, reduce carbon emissions and eliminate the impact of water-leak disasters.

Sources

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