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Where Water and Energy Meet

Within the context of our changing climate, it is becoming increasingly important to create a meaningful and transparent method for measuring and reporting the water–energy connection to achieve a sustainable supply of both. It generally takes water to make energy, and because treating and moving water is such an energy-intensive process, it has become apparent that water and energy are inextricably linked. In a fractured regulatory landscape, voluntary initiatives have been emerging as the go-to source for this information, but do they go deep enough? You can't manage what you don't measure, which raises an important question: Are we measuring the most important aspects of the water–energy nexus?

Beyond just presenting the public and decision-makers with pertinent information, disclosure is the first step in a process that can lead to a number of benefits, including system efficiency improvements and demand reductions. But what form does this disclosure take? Much like the emerging importance of advanced statistics and their acceptance in professional sports, stakeholders are beginning to demand a more detailed accounting of environmental impacts associated with water processing and delivery.

In spite of several studies on the subject, there is no definitive answer to the question of the environmental impacts associated with the provision of water services. Because the boundary for analysis of an entire water delivery system is so complex, the issue of embodied energy (or life-cycle assessment) has been mostly academic, with corporate and water reporting generally taking the form of associated greenhouse gas (GHG) emissions and water use or sometimes a series of questions and answers. To investigate the gap between approaches, we analyzed recent data from a voluntary registry and compared it with published life-cycle assessment studies.

REVIEWING GHG DATA

To the extent possible, our data review included all water agencies with verified GHG totals reported to The Climate Registry (www.theclimateregistry.org)

Identifying the Key Players in Water–Energy Reporting

CARBON DISCLOSURE PROJECT WATER DISCLOSURE

A questionnaire was sent on behalf of 470 institutional investors with assets of $50 trillion to the world's largest companies from industry sectors that are water-intensive or are particularly exposed to water-related risk in their supply chains. A key finding? That "[a] strikingly low proportion of North American companies report board-level oversight of their water policies, strategies or plans compared to European and Japanese companies."

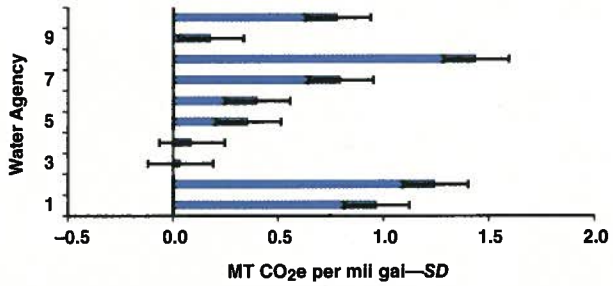
THE CLIMATE REGISTRY

A nonprofit agency focused on providing a platform for standardized reporting of greenhouse gas emissions, this registry consists of "organizations that demonstrate their environmental leadership by voluntarily committing to measure, verify, and publicly report their greenhouse gas emissions to The Registry. Members consist of corporate, nonprofit, and government entities."

US ENVIRONMENTAL PROTECTION AGENCY

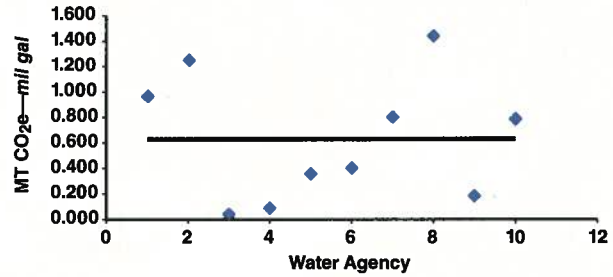
In addition to more traditional water concerns such as supply and quality, the agency has begun to recognize that "climate change poses such significant challenges to the nation's water resources that more transformative approaches will be necessary."

FIGURE 1 MT CO_2e per million gallons with SD



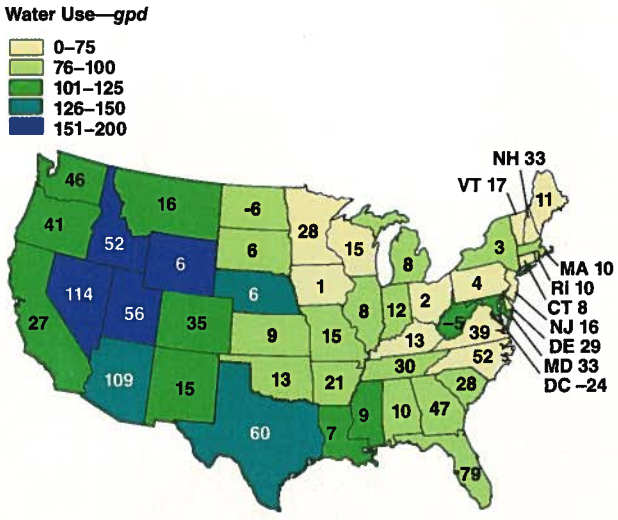
MT CO_2e—metric tons of carbon dioxide equivalent, SD—standard deviation

FIGURE 2 MT CO_2e per million gallons: TCR data review 2008–2011



MT CO_2e—metric tons of carbon dioxide equivalent, TCR—the Climate Registry

FIGURE 3 Domestic water use per person and projected percent population change by 2030



Source: US Geological Survey, 2005. Estimated use of water in the United States in 2005. Available from www.epa.gov/watersense/our_water/tomorrow_beyond.html (accessed Feb. 21, 2013).

Numbers associated with the map indicate percent population change.

(Figures 1 and 2). In some cases, water data were not available, so not all emissions reporters have been included in our analysis. Although these reports are constructed to follow a standardized reporting regime, not all agencies are created equal. For instance, some may have larger vehicle fleets or are responsible for a broader aspect of water quality/treatment (e.g., an agency tasked with treating wastewater as well as providing water for the community could reasonably be expected to have a higher emissions rate than a comparative agency that primarily pumps drinking water with no responsibilities for wastewater treatment).

As can be seen with the standard deviation in the figures (which shows how spread out the numbers are), there is some variability when it comes to the GHG emissions per gallon. In light of the caveats provided in the preceding paragraph, this is not unexpected. Because of local conditions (e.g., pumping requirements driven by elevation changes, local rainfall patterns), the water agencies in our sample dataset can reasonably be expected to show a high amount of variability.

What sort of conclusions can be drawn from this analysis? Most important, the analysis confirms that any sort of regulatory use of this metric would be difficult. Because there is such high variability in the data, it would be an understatement to say that structuring a regulatory regime or reporting system around GHG emissions per gallon would be problematic. Although viewing the information in this manner may be informative, the biggest takeaway appears to be that there is no "one size fits all" metric available for emissions per gallons provided.

Keeping in mind the small sample size, we are able to draw an average of approximately 0.61 metric tons of carbon dioxide (CO_2) equivalents per million gallons of water provided. Digging deeper into the data, we can examine a couple of the outliers to draw some conclusions.

The three highest values represent agencies that provide water services in Southern California. Pumping demands and the high population served may be forcing these agencies' emissions higher than the others included in our study, perhaps indicating that if emissions-per-gallon metrics are ever reported and tracked, it would be appropriate to group them regionally and/or by service areas.

The agencies with the cleanest emissions profile are located in areas with relatively "clean" electricity grids—meaning the power provided comes with a lower GHG emission burden. This will be an important aspect of the water–energy nexus to track moving forward. As our energy profile improves, the water sector should see an improvement in this area as well.

The largest decrease seen by a single agency (from 0.57 to 0.29 MT CO_2e per million gallons) appears to mostly be driven from low-carbon energy purchases (such as hydropower and wind power, as well as strategic use of local solar power for pumping).

CONCLUSIONS

When seeking to compare our derived average-emissions-per-gallon value with other studies, we are faced with a problem—namely, that there is no good answer to the question of how many GHG emissions per gallon are embodied in delivered water. Perhaps the question is too complex to fit into an overly simplified estimate, or perhaps we are asking the wrong question. The question we posed at the beginning of this article was whether we are tracking the right metrics to understand the water–energy nexus. On the basis of our review of the existing data, it is clear that the necessary information to create a discrete metric is available, but what we lack is a driver to encourage agencies and academics to create such a metric. However, on the basis of the variability of our dataset, it does not appear that this is a very valuable pursuit. For instance, knowing that your local water agency delivers water at a higher- or lower-than-average rate of GHG emissions should not be a prerequisite for requesting that it do better. For local operators of these systems, there are already a number of feedback mechanisms in place (most notably energy consumption).

Looking forward, we can see that per capita demand for water is rising. Additionally, climate change will continue to accelerate the pressures that make water a key concern for our society (Figure 3). Although it would certainly be informative to see water agencies disclose emissions per gallon, the call for action here appears to be in place. If reporting emissions metrics becomes a common practice, it will likely be most useful as a tracking tool for each agency, rather than for developing a global benchmark.

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