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# Fracking vs Faucets: Balancing Energy Needs and Water Sustainability at Urban Frontiers

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Newly accessible shale deposits have dramatically increased global gas reserves and are touted as a bridge to a clean energy future. For example, in the U.S., where shale gas is projected to comprise 49% of national natural gas production by 2035, proponents argue that shale gas production can provide energy independence, create employment, and stimulate regional economies.[1] Amidst this optimism, however, are growing concerns about the effects of shale gas extraction, and, in particular, hydraulic fracturing or "fracking", on water resources[2]——concerns that are magnified in urban areas where human populations and extractive operations overlap. We believe that water conflicts arising from expansion of the U.S. shale gas industry foreshadow developments in other countries with cities situated over large shale-gas deposits, including Diyarbakir, Turkey; Ahmedabad, India; and Chongqing, China.

While much recent controversy over fracking and water resources is directed toward potential contamination, here we use the Dallas-Fort Worth (DFW) Metroplex, Texas, to illustrate challenges associated with balancing energy needs and water sustainability in cities with semiarid to arid climates. Along with one of the highest urban population growth rates in the U.S. (23.4%), the Barnett Shale underlying DFW represents the largest staging ground for shale gas extraction in the world.[3] Ninety percent of DFW's drinking water is supplied by surface runoff captured in 34 reservoirs, with municipalities and gas extractors consuming ~86% (~1.87 billion $m^3$) and <3% of the total water supply, respectively.[4] DFW also experiences recurrent drought, heightening anxieties over water availability. In 2011, we randomly surveyed 1000 DFW residents to evaluate public perceptions and knowledge of watersheds. Six questions dealt specifically with regional shale-gas extraction. Our survey reveals considerable public uncertainty regarding the effects of shale-gas extraction on fresh water availability: after drought, nearly one-third (27.7%) of respondents ranked gas drilling as the greatest hazard to the water supply in 2011. Unfortunately, public uncertainty diverts attention from the primary factor affecting water supply in expanding urban areas: increasing municipal water use.

We believe that DFW's situation holds important lessons for other cities faced with the prospect of expansive shale gas extraction, growing populations, and/or increasing aridity. First, in urban areas where municipal water use dominates water consumption, reduction in residential and commercial use has the potential to play a major role in urban water sustainability. Notwithstanding, strategies that figure prominently into plans to meet future water needs are often not sustainable (either for water provisioning or ecological systems) and merely increase resource capture rather than improve efficiencies or decrease per capita consumption. In Texas, water management strategies aim to add ~2.96 billion $m^3$ of water to the region's supply by 2060, at a price of $21.5 billion[4] (for comparison, China's Three Gorges Dam cost ~$25 billion). These include the construction of four new reservoirs, importation of surface water from other basins and districts, and water reuse (Figure 1). Together, these strategies are anticipated to comprise 87.5% of future water gains. Conservation initiatives account for just 12.3%, or 364 123 844 $m^3$ of additional water in 2060.[4]

Second, although municipal conservation is key to water sustainability, most urban residents have a limited understanding of the urban water cycle. For example, when asked if they lived in a watershed, 9.7% of our survey respondents answered "yes", 63.3% said "no", and 27.7% said "do not know". Respondents also were "not sure" (11.5%) or "did not know" (40.9%) the source of drinking water supplied to their home. This is likely due to "quality" rather than "quantity" of education: 54% of survey participants had a bachelor's degree or higher and yet were unfamiliar with the watershed concept. Clearly, as long as residents do not understand how they fit into the urban water cycle and fully recognize their role in water

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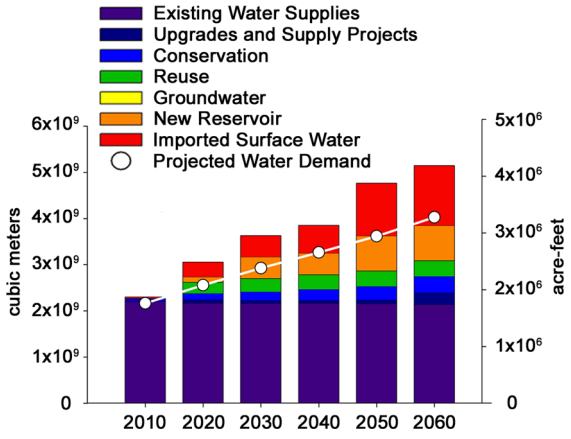


**Figure 1.** Existing water supplies, projected water demand, and proposed water augmentation strategies for the Dallas-Fort Worth (DFW) Metroplex. The Texas Water Development Board proposes $21.5b in water projects to add over 2.96 billion $m^3$ of water to the region by 2060. (Modified from ref 4).

conservation, it is unlikely that they will reduce their own water use.

Conservation education is thus essential to change household environmental behavior. In a recent study, 94% of school-aged children (5−10 years) signed commitment cards to turn water faucets off when brushing teeth after learning that this simple act can save 3.8 to 11.4 L of water per day per individual.[5] Assuming all students in the study keep their commitment, between 44 399 $m^3$ and 134 366 $m^3$ of water could be conserved annually.[5] Thus, small reductions in individual water consumption can lead to large water savings, particularly in arid urban areas with disproportionately high levels of residential water consumption. Scaling up to the DFW Metroplex, a one-quarter reduction in daily water consumption by all 6.5 million residents could save approximately 225 387 500 $m^3$, or decrease current municipal water demand by 12%. This is more than four times the estimated water use by shale-gas extractors in the region in 2010.

Conflicts arising as a result of competing demands for energy and water are of increasing global concern, especially in expanding urban areas. The international diffusion of shale gas extractive technologies is certain to heighten this potential in arid regions, where large cities must also contend with recurrent water shortage episodes. For this reason, we believe the situation in DFW, where uncertainty about the sustainability of water resources is entangled with residents' anxieties about gas extraction,[3] foreshadows probable scenarios in other global cities. Nevertheless, at present, the heated debate about water use for fracking is detracting attention from the primary issue affecting water availability in DFW and other metropolitan areas: rapid population growth and increasing municipal water use. Educational programs dedicated to improving residents' understanding of their role in the urban water cycle and enhanced water conservation efforts are urgently needed to refocus public attention toward actions and behaviors that may actually achieve water sustainability. A conservation-minded, water-consuming public intimately aware of its connection to the urban watershed is key to balancing energy needs and long-term water sustainability in urbanizing areas.

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### Notes

The authors declare no competing financial interest.

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