LIKE WATER FOR ENERGY: THE WATER-ENERGY NEXUS THROUGH THE LENS OF TAX POLICY

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When the well's dry, we know the worth of water.

—Benjamin Franklin[1]

Water is essential for life. Inadequate potable water supplies lead to poverty, disease, starvation, and civil strife. Climate change is likely to put more pressure on the world's supply of fresh water. Rising sea levels will introduce salt into some fresh water systems. As high mountain snow cover and glaciers decline, they will store less fresh water. As regions heat up, droughts will become more persistent. Producing energy uses water. How much water is used depends on the source of the energy. Yet in the rush to transition to a renewable energy economy, policy makers have paid little heed to the potential water consequences. Reducing CO_2 emissions will not help society if the alternative energy sources use more water than the traditional energy sources they replace. This Article examines the links between renewable energy tax incentives and water consumption. Tax incentives for renewable energy sources should account for water consumption as well as the potential for reduced CO_2 emissions. This Article begins with a review of water use statistics for traditional energy sources and a comparison of water use

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* Dean's Distinguished Faculty Fellow and Professor of Law, University of Oregon. Thank you to the University of Oregon School of Law for supporting my research. Thanks are also due to the participants at the 2009 Global Conference on Environmental Taxation, the participants at the University of Florida Levin College of Law Capstone Colloquium, and Professor Alyson Craig Flournoy for helpful comments. University of Oregon law students Meg Rowe and Holly Jacobsen provided research assistance and comments. The Honorable Earl Blumenauer and his assistant, Hillary Barbour, provided encouragement and inspiration. Finally, thanks to Professor and Deputy Solicitor General (Interior) Adell Amos, who was going to write this article with me and provide me with water law expertise, but could not because she was called to Washington to save the world.

1. BENJAMIN FRANKLIN, POOR RICHARD'S ALMANACK 48 (Peter Pauper Press 1983) (1746).

statistics from various renewable energy sources. Next, this Article analyzes the U.S. federal tax incentives for energy sources, paying particular attention to newer incentives for renewable sources and the water impact of those incentives. Finally, this Article provides some recommendations for legislative action.

INTRODUCTION

Water is essential for life.[2] Inadequate potable water supplies lead to poverty, disease, starvation, and civil strife.[3] Falling groundwater tables and surface water supplies that have not increased in the past twenty years foreshadow the coming crisis.[4] "Humanity presently uses an estimated 26 percent of total terrestrial evapotranspiration and 54 percent of runoff that is geographically and temporally accessible."[5] Climate change is likely to put more pressure on the world's supply of fresh water.[6] Rising sea levels will introduce salt into some fresh water systems.[7] As high mountain snow cover and glaciers decline, they will store less fresh water.[8] As regions heat up, droughts will become more persistent.[9]

Water and energy are inextricably linked. We use energy to produce water for food production and direct human consumption.[10] Energy limitations affect water policy, and water

2. NICK CASHMORE, CLSA ASIA-PAC. MKTS., REMAINING DROPS: FRESHWATER RESOURCES: A GLOBAL ISSUE 5 (2006), http://www.pacinst.org/reports/remaining_drops/CLSA_U_remaining_drops.pdf.

3. STEVEN SOLOMON, WATER: THE EPIC STRUGGLE FOR WEALTH, POWER, AND CIVILIZATION 4 (2010) ("Humanitarian crises, epidemic disease, destabilizing violence, and corrupt, failed states are already rife in the most water-deprived regions . . . .").

4. U.S. DEP'T OF ENERGY, ENERGY DEMANDS ON WATER RESOURCES: REPORT TO CONGRESS ON THE INTERDEPENDENCY OF ENERGY AND WATER 50 (2006) [hereinafter DOE, ENERGY DEMANDS].

5. Göran Berndes, *Bioenergy and Water—The Implications of Large-Scale Bioenergy Production for Water Use and Supply*, 12 GLOBAL ENVTL. CHANGE 253, 253 (2002). "Water vapor diffuses from inside the leafs [sic] to the atmosphere through the stomata, as carbon dioxide diffuses in the opposite direction. Water is also lost to the atmosphere through evaporation from the soil and from the plant leaves. These losses are collectively designated evapotranspiration losses." *Id.* at 258.

6. CASHMORE, *supra* note 2, at 11; *see also* COURTENAY CABOT VENTON, WATERAID, CLIMATE CHANGE AND WATER RESOURCES ¶ 1.1 (2007), http://www.wateraid.org/documents/climate_change_and_water_resources_1.pdf; *see also* DOE, ENERGY DEMANDS, *supra* note 4, at 12.

7. VENTON, *supra* note 6, ¶ 3.3.1.

8. *See id.* ¶ 2.2.

9. STEPHEN SAUNDERS ET AL., NATURAL RES. DEF. COUNCIL, HOTTER AND DRIER: THE WEST'S CHANGED CLIMATE 10–11 (2008), http://www.nrdc.org/globalWarming/west/west.pdf.

10. NATURAL RES. DEF. COUNCIL, WATER EFFICIENCY SAVES ENERGY: REDUCING GLOBAL WARMING POLLUTION THROUGH WATER USE STRATEGIES 1 (2009), *available at* http://www.nrdc.org/water/files/energywater.pdf.

limitations should affect energy choices.[11] We use water to produce energy for industry, electricity, and transportation.[12] Making electricity from coal or nuclear energy uses water.[13] Depending on the source of the electricity, plug-in hybrid vehicle technology may increase water consumption.[14] However, some renewable fuel sources, like biomass[15] and ethanol, use even more water.[16] Energy and water policies are rarely coordinated.[17] The challenge of climate change adds more complexity to the water-energy interaction.

Climate change and energy security concerns stimulated a shift of government support towards renewable energy sources rather than traditional fossil energy sources.[18] Yet in the rush to transition to a renewable energy economy, policy makers paid little heed to the potential water consequences.[19] Reducing greenhouse gas ("GHG") emissions to mitigate climate change will not help society if production of alternative energy sources exacerbates water shortages. The government has a number of policy tools available to encourage GHG reductions: it could regulate emissions; it could make carbon intensive fuel sources more expensive by imposing a carbon tax or implementing a cap-and-trade system; or it could make alternative energy sources less expensive by subsidizing them, either directly or through tax reductions. For the most part, the U.S. government uses the subsidy alternative for its energy policy.[20]

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11. Brian Hoyle, *The Energy-Water Nexus: Deja-vu All Over Again?*, NATURE REP. CLIMATE CHANGE, April 2008, at 46, 46–47 (2008), http://www.nature.com/climate/2008/0804/pdf/climate.2008.22.pdf.

12. *See* discussion *infra* Part I.A.

13. *See* discussion *infra* Parts I.B.3 (coal), I.B.4 (nuclear).

14. *See* discussion *infra* Part I.B.3.

15. Biomass is plant material, including wood and crop waste. DOE, ENERGY DEMANDS, *supra* note 4, at 18.

16. *See* discussion *infra* Parts I.C.1, I.C.3.

17. Hoyle, *supra* note 11, at 46.

18. SALVATORE LAZZARI, CONG. RESEARCH SERV., RL 33578, ENERGY TAX POLICY: HISTORY AND CURRENT ISSUES 1–2 (2008).

19. Hoyle, *supra* note 11, at 46. *But see* ANU MITTAL, U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-09-862T, ENERGY AND WATER: PRELIMINARY OBSERVATIONS ON THE LINKS BETWEEN WATER AND BIOFUELS AND ELECTRICITY PRODUCTION 1–2 (2009) (noting that the House Subcommittee on Energy and Environment, Committee on Science and Technology, asked the Government Accountability Office to consider the issue).

20. Congress has not succeeded in enacting comprehensive federal climate change legislation as of the end of 2010, and such legislation does not seem likely in the next two years. *See* John M. Broder, *The Night of the Living Lawmakers*, N.Y. TIMES GREEN BLOG (Nov. 19, 2010), http://green.blogs.nytimes.com/2010/11/19/the-night-of-the-living-congress-people/. The Environmental Protec-

It provides a majority of its support for energy through tax incentives rather than through direct government expenditures.[21] If the government is going to pick winners by designating certain energy technologies as worthy of tax incentives, it should consider the effect of those energy sources on water consumption as well as the potential for reduced CO_2 emissions.

In Part I, this Article will first review the water use statistics for traditional energy sources, then compare the water use statistics of various renewable energy sources. Next, in Part II, this Article will analyze the U.S. federal tax incentives for energy sources, paying particular attention to newer incentives for renewable sources. This Article will examine the impact that those incentives have on the water supply. Finally, in Part III, this Article will provide some recommendations for legislative action.

I. WATER FOR ENERGY: WATER USAGE STATISTICS FOR VARIOUS ENERGY SOURCES

Water is an integral element of energy resource development and use.[22] This part will provide an overview of different energy sources used in electricity and transportation, and then review water use statistics for energy sources used in transportation and electricity generation, comparing water use for renewable and non-renewable sources. Water is used in extraction, refining, and processing of transportation fuels. "Water is also an integral part of electric-power generation."[23] Roughly 70 percent of the energy used in the United States goes to either transportation (30 percent) or electricity generation (40

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tion Agency has announced plans to regulate GHG emissions of power plants. Matthew L. Wald, *E.P.A. Moving on Greenhouse Gasses*, N.Y. TIMES, Dec. 24, 2010, at A16; *see also* Massachusetts v. EPA, 549 U.S. 497 (2007) (authorizing the EPA to regulate GHG emissions under the Clean Air Act).

21. ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, FEDERAL FINANCIAL INTERVENTIONS AND SUBSIDIES IN ENERGY MARKETS 2007, at xi (2008), http://www.eia.doe.gov/oiaf/servicerpt/subsidy2/pdf/subsidy08.pdf [hereinafter EIA, FINANCIAL INTERVENTIONS].

22. Hoyle, *supra* note 11, at 46 ("Water supplies are at risk of drying up as the climate warms, but mitigating climate change could mean shifting to water-intensive alternative energy sources.").

23. DOE, ENERGY DEMANDS, *supra* note 4, at 9; U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-10-23, ENERGY-WATER NEXUS: IMPROVEMENTS TO FEDERAL WATER USE DATA WOULD INCREASE UNDERSTANDING OF TRENDS IN POWER PLANT WATER USE 5 (2009).

percent), so this Article will focus on energy sources for transportation and electricity.[24]

A. Water, Electricity, and Transportation

This section will describe water use for the energy sources most commonly used for electricity and transportation. Water use is significant in the electricity-generation sector. Coal, natural gas, nuclear power, and renewable energy produce 99 percent of electricity in the United States.[25] Coal produces the most electricity at 51 percent of the U.S. total; natural gas produces 23 percent; nuclear power produces 20 percent; renewables, including hydroelectric, geothermal, solar, wind, and biomass, produce 11 percent.[26] Most electricity is generated by rotating turbines that drive alternators.[27] Turbines are most commonly driven by steam produced by boiling water heated by fossil fuels or nuclear fission, but they can also be driven by moving water.[28] "Production of electrical power results in one of the largest uses of water in the United States and worldwide."[29] Water is used not only to make steam to drive turbines, but also to cool the power-producing equipment. In fact, most of the water is used for cooling.[30]

The United States used 408 billion gallons of water per day in 2000.[31] Thermoelectric power used 48 percent; agricultural irrigation used 34 percent; public water supply used 11 percent; industrial uses consumed 5 percent; and domestic wells,

24. ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, ANNUAL ENERGY REVIEW 2008, at 37 fig.2.0 (2009), http://www.eia.gov/FTPROOT/multifuel/038408.pdf [hereinafter EIA, ANNUAL ENERGY REVIEW 2008] (depicting primary energy consumption by source and sector in 2008). Of the remainder, 20 percent goes to industrial uses and 10 percent to residential and commercial uses. *Id.*

25. *Id.*

26. *Id.*

27. *Electricity Explained: Electricity in the United States*, U.S. ENERGY INFO. ADMIN.: INDEP. STATS. & ANALYSIS, http://tonto.eia.doe.gov/energy_in_brief/electricity.cfm (last updated Oct. 18, 2010).

28. DOE, ENERGY DEMANDS, *supra* note 4, at 18–19.

29. Howard Perlman, *Thermoelectric-Power Water Use*, U.S. GEOLOGICAL SURVEY, http://ga.water.usgs.gov/edu/wupt.html (last modified Mar. 30, 2010, 12:23 PM).

30. THOMAS R. KARL ET AL., U.S. GLOBAL CHANGE RES. PROGRAM, GLOBAL CLIMATE CHANGE IMPACTS IN THE UNITED STATES 52 (2009), http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf.

31. SUSAN S. HUTSON ET AL., U.S. GEOLOGICAL SURVEY, U.S. DEP'T OF INTERIOR, CIRCULAR NO. 1268, ESTIMATED USE OF WATER IN THE UNITED STATES IN 2000, at 4 (rev. 2005), http://pubs.usgs.gov/circ/2004/circ1268/pdf/circular1268.pdf.

livestock, aquaculture, and mining used the remaining 2 percent.[32] In total, the United States used 195 billion gallons per day for thermoelectric power, of which 30 percent was saline.[33] The freshwater withdrawals amounted to "[39] percent of all fresh-water withdrawals in the United States, roughly equivalent to water withdrawals for irrigated agriculture."[34] The difference between agricultural water use and power-generation water use is that agricultural use consumes much more of the water withdrawn. In 1995, "agriculture accounted for 84 percent of total freshwater consumption . . . [while] [t]hermoelectric power accounted for 3.3 percent of total freshwater consumption . . . and represented over 20 percent of non-agricultural water consumption."[35]

The water consumption of thermoelectric power depends on the type of plant generating the power.[36] Older power plants use "once-through cooling," which returns most of the withdrawn water to the source, albeit at a higher temperature.[37] Power plants with once-through cooling account for 91 percent of the water withdrawals of thermoelectric power.[38] Newer power plants use "closed-loop cooling" and withdraw much less water, but consume most of what they withdraw through evaporative cooling.[39] In 2000, 75 percent of the closed loop systems reported water consumption rates greater than 50 percent.[40] Overall, the evaporation rate at thermoelectric power plants is 2.5 percent.[41]

Surprisingly, renewable hydroelectric power generation resulted in more evaporation than thermoelectric power generation. Thermoelectric power evaporated 0.47 gallons of fresh

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32. *Id.*
33. *Id.*
34. DOE, ENERGY DEMANDS, *supra* note 4, at 9.
35. *Id.*
36. *See* Berndes, *supra* note 5, at 260.
37. DOE, ENERGY DEMANDS, *supra* note 4, at 18; *see also* HUTSON ET AL., *supra* note 31, at 35.
38. HUTSON ET AL., *supra* note 31, at 35.
39. DOE, ENERGY DEMANDS, *supra* note 4, at 19; HUTSON ET AL., *supra* note 31, at 35.
40. HUTSON ET AL., *supra* note 31, at 35; *see also* Berndes, *supra* note 5, at 260 ("The water withdrawals are reduced when recycling in cooling towers or ponds is employed, but a higher share of the cooling water (usually more than 60 percent) is evaporated in such systems." (citation omitted)).
41. P. TORCELLINI ET AL., NAT'L RENEWABLE ENERGY LAB., U.S. DEP'T OF ENERGY, CONSUMPTIVE WATER USE FOR U.S. POWER PRODUCTION 8 (2003), http://www.nrel.gov/docs/fy04osti/33905.pdf.

water per kWh of end-use electricity ("GWK").[42] Hydroelectric power evaporated eighteen gallons of GWK, primarily due to increased evaporation in reservoirs necessary for hydroelectric power plants.[43] Climate change likely will reduce the productivity of hydroelectric plants. Particularly in the West, reservoirs serve multiple purposes: providing water for drinking, irrigation, recreation, and flood control, as well as producing power.[44] The reservoirs of the Colorado River basin can produce up to 10,000 gigawatt-hours of energy per year.[45] A 2004 study cited climate models forecasting a 14 to 18 percent reduction in Colorado River stream flow that could drain water storage by 32 to 40 percent, reducing hydroelectric productivity by 45 to 56 percent.[46] This prediction has already partially come true. In 2004, power-generating capacity at the Glen Canyon Dam fell to 60 percent of full capacity due to the ongoing drought that reduced Lake Powell water levels to 40 percent of capacity.[47]

In April 2009, the *Las Vegas Sun* reported that after nine years of drought, Lake Mead had reached its lowest level since 1965.[48] As of October 1, 2009, Lake Mead was at 42 percent of capacity and Lake Powell was at 64 percent of capacity.[49] Scientists predict hotter and drier conditions ahead for the West, with significant snowpack declines.[50] Drier conditions are occurring not only in the West. In 2007, a drought in the

42. *Id.* at 6.

43. *Id.*

44. Niklas S. Christensen et al., *The Effects of Climate Change on the Hydrology and Water Resources of the Colorado River Basin*, 62 CLIMATE CHANGE 337, 337–63 (2004); 3 ELEC. POWER RESEARCH INST., WATER & SUSTAINABILITY: U.S. WATER CONSUMPTION FOR POWER PRODUCTION—THE NEXT HALF CENTURY 2-1 (2002), http://mydocs.epri.com/docs/public/000000000001006786.pdf [hereinafter WATER & SUSTAINABILITY].

45. Christensen et al., *supra* note 44, at 357.

46. *Id.* at 359; *see also* Gigi Owen, *Impacts: Drought and People*, SOUTHWEST CLIMATE CHANGE NETWORK (Sept. 15, 2008), http://www.southwestclimatechange.org/impacts/people/drought.

47. *Plan Would Limit Fows* [sic] *from Lake Powell*, GREEN POWER & MARKET RES. NEWS (Aug. 23, 2004), http://www.wapa.gov/es/greennews/2004/aug2304.htm.

48. Jean Reid Norman, *Lake Mead Braces for Lowest Level Since 1965*, LAS VEGAS SUN (Apr. 24, 2009), *available at* http://www.lasvegassun.com/news/2009/apr/24/lake-mead-rangers-ready-docks-marinas-predicted-lo/.

49. BUREAU OF RECLAMATION, U.S. DEP'T OF INTERIOR, ANNUAL OPERATING PLAN FOR COLORADO RIVER RESERVOIRS 2010, 9 tbl.1 (2009), http://www.usbr.gov/lc/region/g4000/AOP2010/AOP10.pdf.

50. Jonathan Overpeck & Bradley Udall, *Dry Times Ahead*, 328 SCI. 1642, 1643 (2010).

South reduced hydropower production by 51 percent for Georgia Power, forcing the company to buy $33.3 million of coal and oil to replace the lost power.[51] Alternative cooling for thermoelectric power plants, wind power, and solar photovoltaics[52] could reduce water use in the electric sector.[53] The California Energy Commission found that wind uses less than 1/600 as much water per unit of electricity produced as does nuclear, and approximately 1/500 as much as coal.[54]

Water use in the extraction and processing of traditional transportation fuels is relatively small.[55] Petroleum products supply almost all of U.S. transportation energy needs.[56] Often, policies or regulations developed to support or enhance one area, such as increasing domestic energy supplies through enhanced oil recovery ("EOR"), could have unintended negative impacts on regional and national freshwater availability or water quality.[57] As the United States seeks to replace imported petroleum and natural gas with fuels from domestic sources, such as biofuels, synfuel from coal, hydrogen, and oil shale, the demand for water to produce energy fuels could grow significantly.[58]

The foregoing section gave a general overview of water use for commonly used energy sources. The following section will more closely examine particular fuel sources and their water

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51. Justin Rubner, *Drought Hits Hydropower*, ATLANTA BUS. CHRON. (Nov. 19, 2007, 12:00 AM), http://www.bizjournals.com/atlanta/stories/2007/11/19/story2.html.

52. "Photovoltaic devices use semiconducting materials to convert sunlight directly into electricity." *Solar Photovoltaic Cell/Module Manufacturing Activities*, ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY (Jan. 2010), http://www.eia.doe.gov/cneaf/solar.renewables/page/solarphotv/solarpv.html.

53. Overpeck & Udall, *supra* note 50, at 1643.

54. *Wind Energy FAQ: How Much Water Do Wind Turbines Use Compared with Conventional Power Plants*, AWEA: AM. WIND ENERGY ASS'N, http://www.awea.org/faq/water.html (last visited Oct. 28, 2010).

55. Carey W. King & Michael E. Webber, *Water Intensity of Transportation*, 42 ENVTL. SCI. & TECH. 7866, 7871 (2008) [hereinafter King & Webber I]; *see also* discussion *infra* Part I.B.

56. Ninety-five percent of U.S. transportation energy needs are met by petroleum products. *See* EIA, ANNUAL ENERGY REVIEW 2008, *supra* note 24, at 37 fig.2.0.

57. DOE, ENERGY DEMANDS, *supra* note 4, at 11.

58. *Id.* at 10; King & Webber I, *supra* note 55, at 7871 ("The historical use of petroleum-based fuels has had a small overall impact upon U.S. water resources, and the most plausible alternatives have higher water intensities. Moving to other fossil resources (coal, shale oil, tar sands), other than natural gas, to make liquid fuels approximately doubles the water consumption intensity, and the water used will likely be from inland sources where fresh water is already scarce.").

use, thereby enabling a comparison between traditional fuels and emerging renewable fuel sources. Understanding the water impact of fuels helps inform choices about policies for fuel-shifting.

B. Water Use for Non-renewable Fuels

This section will examine water use for various non-renewable fuels, including petroleum, natural gas, coal, nuclear, tar sands, and oil shale. Water use differs significantly depending on both the source of the fuel and the way it is processed. This section generally shows that non-conventional fossil fuels, such as liquid fuel from coal and tar sand, use more water than conventional fossil fuels such as petroleum-based gasoline.

1. Petroleum

As noted above, petroleum products satisfy 95 percent of U.S. transportation energy needs.[59] In the United States in 2007, 236 million cars, light trucks, and SUVs drove approximately 2.7 trillion miles and consumed 378 million gallons of gasoline per day.[60] Researchers Carey King and Michael Webber from the University of Texas recently published two detailed studies of water use for transportation fuels.[61] They

59. *See supra* note 56.

60. STACEY DAVIS, TRANSPORTATION DATA ENERGY BOOK 4-1 (28th ed.), http://cta.ornl.gov/data/Index.shtml; ENERGY INFO. ADMIN., PETROLEUM STATISTICS (2009), http://www.eia.doe.gov/basics/quickoil.html.

61. *See* King & Webber I, *supra* note 55, at 7866; *see also* Carey W. King & Michael E. Webber, *The Water Intensity of the Plugged-In Automotive Economy*, 42 ENVTL. SCI. & TECH. 4305, 4305 (2008) [hereinafter King & Webber II] ("Converting light-duty vehicles from full gasoline power to electric power, by using either hybrid electric vehicles or fully electric power vehicles, is likely to increase demand for water resources. In the United States in 2005, drivers of 234 million cars, light trucks, and SUVs drove approximately 2.7 trillion miles and consumed over 380 million gallons of gasoline per day. We compare figures from literature and government surveys to calculate the water usage, consumption, and withdrawal, in the United States during petroleum refining and electricity generation. In displacing gasoline miles with electric miles, approximately [2–3] times more water is consumed ([0.24] versus [0.07–0.14] gallons/mile) and over [12] times more water is withdrawn ([7.8] versus [0.6] gallons/mile) primarily due to increased water cooling of thermoelectric power plants to accommodate increased electricity generation. Overall, we conclude that the impact on water resources from a widespread shift to grid-based transportation would be substantial enough to warrant consideration for relevant public policy decision-making. That is not to say that the negative impacts on water resources make such a shift undesirable,

compared the water used per vehicle-mile traveled for gasoline and diesel derived from petroleum with the water use of several other alternative transportation fuels used in light duty vehicles ("LDVs").[62] King and Webber considered "three major factors affecting water usage: mining and farming of feedstock; processing and refining of feedstock to fuel; and efficiency of use of fuel in vehicle."[63] The ordinary consumer might not imagine that petroleum-based gasoline saves water compared to biofuels. King and Webber found that petroleum-based gasoline that fueled LDVs consume between 0.07 and 0.14 gallons of water per mile ("GWM").[64] Petroleum-based diesel vehicles consume slightly less water, between 0.05 and 0.11 GWM.[65] King and Webber concluded that "[t]he historical use of petroleum-based fuels has had a small overall impact upon U.S. water resources, and the most plausible alternatives have higher water intensities."[66] Citing energy security and climate change concerns, some policymakers have advocated a fuel shift from traditional petroleum-based transportation fuels to renewable alternatives such as ethanol.[67] King and Webber's studies show that water use should be a consideration in making this shift.

2. Natural Gas

Liquid fuels for transportation can be produced using fossil fuel sources other than petroleum. Texas oilman T. Boone Pickens advocates a shift to domestically produced fuel from natural gas.[68] King and Webber found that a shift to natural gas-based liquid fuels would double water use.[69] As conventional natural gas sources dwindle, producers have sought nat-

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but rather this increase in water usage presents a significant potential impact on regional water resources and should be considered when planning for a plugged-in automotive economy.") (figures corrected by author).

62. *See* King & Webber I, *supra* note 55, at 7866.

63. *Id.*

64. *Id.* at 7867.

65. *Id.*

66. *Id.* at 7871.

67. *See* Roberta F. Mann & Mona L. Hymel, *Moonshine to Motorfuel: Tax Incentives for Fuel Ethanol*, 19 DUKE ENVTL. L. & POL'Y F. 43, 51 (2008).

68. *See* Ryan Randazzo, *Oil Billionaire Revises Plan to Reduce Foreign Oil Imports*, ARIZ. REPUBLIC. (Nov. 12, 2008), http://www.azcentral.com/arizonarepublic/business/articles/2008/11/12/20081112biz-pickens1112.html.

69. *See* King & Webber I, *supra* note 55, at 7868 (finding that fueling the average LDV with natural gas converted to a liquid fuel using the Fischer-Tropsch (F-T) method would use between 0.12 to 0.43 GWM).

ural gas from shale deposits.[70] Producing natural gas from shale can result in gas infiltration into aquifers, polluting drinking water, and, in at least one case, cause explosions in residential neighborhoods.[71] Moreover, the process of extracting natural gas from shale, called "fracking," can take up to sixteen million liters of water per well.[72]

3. Coal

The Sierra Club calls liquid coal "arguably the dirtiest, most expensive energy gamble we could take."[73] In terms of water consumption, King and Webber found that producing liquid coal uses only modestly more water than producing liquid fuel from natural gas.[74] Coal mining also pollutes water.[75] Mercury emissions from coal-burning power plants affect fish and the humans who eat them.[76] As coal-burning power plants generate a majority of U.S. electricity, vehicles that use plug-in technology contribute to mercury pollution. A study by the Electric Power Research Institute, focusing on areas expected to add significant numbers of coal-fired steam plants, predicted increased freshwater consumption for power production in 2020.[77] King and Webber found that "[c]onverting light-duty vehicles from full gasoline power to electric power, by using either hybrid electric vehicles or fully electric power vehicles, is likely to increase demand for water resources."[78] In displacing gasoline miles with electric miles, almost three times more wa-

70. *See* Richard A. Kerr, *Natural Gas from Shale Bursts onto the Scene*, 328 SCI. 1624, 1625 (2010).

71. *See id.*

72. *See id.*

73. *Beyond Coal: Liquid Coal*, THE SIERRA CLUB, http://www.sierraclub.org/coal/liquidcoal (last visited Oct. 30, 2010) (noting that liquid coal releases almost double the GHG emissions per gallon as petroleum gasoline).

74. *See* King & Webber I, *supra* note 55, at 7868 (noting that fueling the average LDV with liquid coal would use between 0.19 and 0.58 GWM).

75. *See* OAK RIDGE NAT'L LAB. & RES. FOR THE FUTURE, U.S. DEP'T OF ENERGY & COMM'N OF THE EUR. CMTYS., ESTIMATING EXTERNALITIES OF COAL FUEL CYCLES, REPORT NO. 3, at 8-20 (Sept. 1994).

76. *See generally* JAMES E. MCCARTHY, CONG. RESEARCH SERV., RL32868, MERCURY EMISSIONS FROM ELECTRIC POWER PLANTS: AN ANALYSIS OF EPA'S CAP-AND-TRADE REGULATIONS (2005); *cf.* SIERRA CLUB, TOXIC SELENIUM: HOW MOUNTAINTOP REMOVAL COAL MINING THREATENS PEOPLE & STREAMS 1 (Apr. 2009), http://www.sierraclub.org/coal/downloads/Seleniumfactsheet.pdf (noting that one of the leading sources of selenium contamination is coal mining, and that selenium is extremely toxic to people).

77. WATER & SUSTAINABILITY, *supra* note 44, at 6-1.

78. King & Webber II, *supra* note 61, at 4305.

ter is consumed.[79] Advanced coal-plant technology, such as integrated gasification combined cycle ("IGCC"), may considerably reduce water use.[80] On the other hand, capturing carbon from conventional coal plants is predicted to increase water use significantly, primarily because of increased energy used by the carbon capture technology.[81]

4. Nuclear

After coal and natural gas, nuclear power is the largest source of electrical generation. Some view nuclear power as the ideal energy source because it does not emit GHG.[82] "Water is the nuclear industry's Achilles' heel. . . . You need a lot of water to operate nuclear plants."[83] The Environmental Protection Agency notes, "nuclear power plants use large quantities of water for steam production and for cooling."[84] The volume of water used by a thermoelectric power plant depends on three factors: efficiency, thermal loss, and the type of cooling system used.[85] Because nuclear power plants are less efficient than comparable fossil-powered plants, they use more water—between 19 and 65 percent more cooling water per unit of generation.[86] Nuclear power plants also discharge into receiving waters between 20 percent and 69 percent more heat per kilo-

79. *Id.* at 4309.

80. *See* WATER & SUSTAINABILITY, *supra* note 44, at 3-6. *But cf.* ERIK SHUSTER, NAT'L ENERGY TECH. LAB., ESTIMATING FRESHWATER NEEDS TO MEET FUTURE THERMOELECTRIC GENERATION REQUIREMENTS 22 (Sept. 2008), http://www.netl.doe.gov/technologies/coalpower/ewr/pubs/2008_Water_Needs_Analysis-Final_10-2-2008.pdf [hereinafter SHUSTER] (noting that IGCC plants, unlike conventional coal plants, must use fresh (not saline) water).

81. SHUSTER, *supra* note 80, at 28.

82. *See, e.g.,* Jack Ohanian, *Climate Change Pushes Nuclear Power*, THE LEDGER, July 10, 2009, *available at* http://www.theledger.com/article/20090710/COLUMNISTS/907105009?Title=Climate-Change-Pushes-Nuclear-Power; *cf.* THOMAS L. FRIEDMAN, HOT, FLAT AND CROWDED 264 (2008) ("The threat of a nuclear leak, with today's new technology, is much less serious than the threat from climate change.").

83. *Drought Could Shut Down Nuclear Power Plants*, MSNBC (Jan. 23, 2008), http://www.msnbc.msn.com/id/22804065// (quoting Jim Warren, executive director of N.C. Waste Awareness and Reduction Network, an environmental group critical of nuclear power).

84. *Nuclear Energy*, EPA, (Mar. 8, 2010), http://www.epa.gov/cleanrgy/energy-and-you/affect/nuclear.html.

85. *See* LINDA GUNTER ET AL., LICENSED TO KILL: HOW THE NUCLEAR POWER INDUSTRY DESTROYS ENDANGERED MARINE WILDLIFE AND OCEAN HABITAT TO SAVE MONEY 118 (2001), http://www.nirs.org/reactorwatch/licensedtokill/Liscensed[sic]toKill.pdf [hereinafter GUNTER ET AL.].

86. *See id.*

watt hour ("kWh") than fossil powered plants.[87] This release of heat is inefficient:

> The amount of heat released by the fission reaction for the sole task of boiling water is an inefficiency of colossal proportions—a huge proportion of heat is generated simply as waste. For each watt of electricity generated by an atomic reactor, two watts of heat energy are rejected to the environment. This task of boiling water by splitting the atom has been compared to "using a chainsaw to cut butter" or "ringing a doorbell with a cannonball."[88]

Both removing water from a lake or ocean and discharging it back after use have negative impacts on water quality and aquatic life.[89] Most of the 104 nuclear power plants in the United States are built on the shores of lakes and rivers, and not for the view.[90] They rely on those water sources to withdraw billions of gallons of water. The intake pipes suck in fish, manatees, turtles, and an occasional diver.[91] Aquatic life is first "entrained" (sucked in) and then may be "impinged" (trapped against screens designed to protect the power plant).[92] Even if aquatic life escapes actually being sucked into the water intakes, the heated water discharged by the nuclear plant may be deadly. Thermal discharge from the Diablo Canyon nuclear plant led to the "near obliteration of the already threatened black and red abalone populations."[93]

5. Tar Sands & Oil Shale

The energy component of tar sands is bitumen, which is combined with clay, sand, and water.[94] The clay, sand, and water must be removed before the tar sands can be processed

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87. *See id.*
88. *Id.* at 115.
89. *See Nuclear Energy*, *supra* note 84.
90. *See* DAVID LOCHBAUM, UNION OF CONCERNED SCIENTISTS, GOT WATER? 1 (2007), http://www.ucsusa.org/assets/documents/nuclear_power/20071204-ucs-brief-got-water.pdf.
91. *See* GUNTER ET AL., *supra* note 85, at 5–7, 27.
92. *See id.* at 3.
93. *See id.* at 4.
94. *See* OFFICE OF NAVAL PETROLEUM AND OIL SHALE RESERVES, U.S. DEP'T OF ENERGY, SECURE FUELS FROM DOMESTIC RESOURCES 6 (June 2007), http://fossil.energy.gov/programs/reserves/npr/Secure_Fuels_from_Domestic_Resources_-_P.pdf.

into liquid fuel.[95] Oil shale is a rock that contains oil within its chemical structure.[96] Oil shale development requires extensive water for mining and drilling, as well as related activities.[97] Liquid fuel from oil shale and tar sands uses ten times the water of conventional petroleum.[98] This calculation does not take into account the water that is not consumed, but is irretrievably polluted. In the Athabasca Valley, in Alberta, Canada, each day more than a million tons of tar sands are crushed and mixed with more than 200,000 tons of water to extract the bitumen.[99] The wastewater from this process goes into tailings ponds to be reused.[100] The tailings ponds, polluted with toxic chemicals, are separated from the Athabasca River by earthen dams.[101] Canadian biologists estimate that 45,000 gallons of contaminated water leak daily into the river.[102] King and Webber concluded that fossil fuel alternatives to oil would exacerbate water shortages, stating that "[m]oving to other fossil resources (coal, shale oil, tar sands), other than natural gas, to make liquid fuels approximately doubles the water consumption intensity, and the water used will likely be from inland sources where fresh water is already scarce."[103] Citing concerns about dependence on foreign oil, some policymakers have advocated a fuel shift from traditional petroleum-based transportation fuels to alternatives such as liquid coal.[104] King and Webber's studies show that water use should be a consideration in making this shift.

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95. *See* Lorne Taylor, *Water Challenges in Oil Sands Country: Alberta's Water for Life Strategy*, POLICY OPTIONS, July–Aug. 2009, at 44, 46.

96. *See* JOHN R. DYNI, U.S. GEOLOGICAL SURVEY, U.S. DEP'T OF THE INTERIOR, GEOLOGY AND RESOURCES OF SOME WORLD OIL-SHALE DEPOSITS 1 (2005), http://pubs.usgs.gov/sir/2005/5294/pdf/sir5294_508.pdf.

97. *See* LAWRENCE J. MACDONNELL, W. RES. ADVOCATES, WATER ON THE ROCKS: OIL SHALE WATER RIGHTS IN COLORADO 1 (2009), http://www.westernresourceadvocates.org/land/wotrreport/wotrreport.pdf.

98. *See* King and Webber I, *supra* note 55, at 7867–68 (noting that liquid fuel from oil shale uses 0.71 to 0.86 GWM and that liquid fuel from tar sands uses 0.76 to 0.95 GWM).

99. *See* Robert Kunzig, *Scraping Bottom: The Canadian Oil Boom*, NAT'L GEOGRAPHIC (Mar. 2009), http://ngm.nationalgeographic.com/print/2009/03/canadian-oil-sands/kunzig-text.

100. *See id.*

101. *See id.*

102. *Id.*

103. King & Webber I, *supra* note 55, at 7871.

104. *See* Roberta F. Mann, *Another Day Older and Deeper in Debt: How Tax Incentives Encourage Burning Coal and the Consequences for Global Warming*, 20 PAC. MCGEORGE GLOBAL BUS. & DEV. L.J. 111, 132 (2007).

C. Water Use for Renewable Fuels

In general, fuels more directly derived from fossil fuels are less water-intensive than those derived either indirectly from fossil fuels or directly from biomass. The lowest water consumptive and water withdrawal rates are for LDVs using conventional petroleum-based gasoline and diesel, nonirrigated biofuels, hydrogen derived from methane or electrolysis via nonthermal renewable electricity, and electricity derived from renewable and nonsteam generation.[105] Three Dutch researchers recently set out five global implications of biofuel production on water use: (1) increased demand for irrigation water; (2) increased demand for water in ethanol processing factories; (3) pollution of groundwater through increased use of pesticides; (4) destruction of natural forests and related disrupted water functions; and (5) possible impact of future (second generation) biofuel technologies.[106]

Water competition with food crops presents another significant issue. When agriculture grows bioenergy crops, it needs additional water that competes with water for food production. "Water use for a specific crop does not depend on whether the crop is for energy or for food."[107] As bio-based fuels substitute for fossil fuels, either future water demand will increase or food production will decrease.[108] Although processing of biomass involves removing water from the plant material, the water lost by processing is small in comparison to the water used to grow the bioenergy crops.[109] The following subsections will examine the water use statistics for specific renewable fuels: (1) ethanol; (2) biodiesel; (3) biomass; (4) wind; (5) solar; (6) geothermal; and (7) marine.

105. *See* King & Webber I, *supra* note 55, at 7866. Nonsteam generation refers to electricity generation without steam, such as photovoltaic solar or wind.

106. GERDIEN MEIJERINK ET AL., BIOFUELS AND WATER: AN EXPLORATION 3 (2008), http://edepot.wur.nl/718.

107. Winnie Gerbens-Leenes et al., *The Water Footprint of Bioenergy*, 106 PROC. OF THE NAT'L ACAD. OF SCIS. 10219, 10222 (2009), *available at* www.pnas.org/cgi/doi/10.1073/pnas.0812619106.

108. *See id.*

109. *See* Berndes, *supra* note 5, at 259.

1. Ethanol

In the United States, corn constitutes 95 percent of the feedstock for ethanol production.[110] Growing corn requires considerable amounts of water, but just how much depends on which state the corn is grown in.[111] Irrigated feedstocks result in high water usage per mile.[112] University of Texas researchers estimated that ethanol made from corn grain would use twenty-eight GWM, almost 200 times as much as petroleum gasoline.[113] However, University of Minnesota researchers found that "the national average is not relevant in understanding bioethanol's water implications . . . ."[114] Rather, regional irrigation differences should be taken into account, and ethanol production should be promoted "in the states with lower irrigation rates and with less fossil groundwater use."[115] Even after the corn has been grown, ethanol production also requires significant amounts of water. One study found that a biorefinery that produces 100 million gallons of ethanol per year would use as much water as a town of about five thousand people.[116] Of course, using corn for ethanol production competes with food uses for corn. The amount of corn necessary to make enough ethanol to fill an SUV fuel tank—once—contains enough calories to feed a person for an entire year.[117] Similarly, using water for ethanol production competes with water for corn used for food production. In regions of the country where aquifers are already being used intensively for food crop production, using those same aquifers for fuel production may exceed their capacity.[118]

2. Biodiesel

Biodiesel, like ethanol, uses much more water than petroleum-based fuels. Studies have differing estimates of the water

110. BRENT D. YACOBUCCI, CONG. RES. SERV., RL 33290, FUEL ETHANOL: BACKGROUND AND PUBLIC POLICY ISSUES 2 (2008).

111. *See* Yi-Wen Chiu et al., *Water Embodied in Bioethanol in the United States*, 43 ENVTL. SCI. & TECH. 2688, 2688 (2009).

112. King & Webber I, *supra* note 55, at 7869.

113. *See id.*

114. Chiu et al., *supra* note 111, at 2691.

115. *Id.*

116. U.S. NAT'L RESEARCH COUNCIL, WATER IMPLICATIONS OF BIOFUELS PRODUCTION IN THE UNITED STATES 5 (2008).

117. Jeff Goodell, *The Ethanol Scam*, ROLLING STONE, Aug. 9, 2007, at 48.

118. King & Webber I, *supra* note 55, at 7871.

footprint of biodiesel.[119] King and Webber estimate that biodiesel made from soybeans uses eight GWM.[120] Other researchers found the water footprint of biodiesel to be greater than that of ethanol.[121] Like ethanol, the water impact of biodiesel depends upon the feedstock used and whether it is irrigated.[122]

3. Biomass

Burning biomass directly to make electricity is more efficient than turning it into a liquid fuel.[123] In part, this increased efficiency results because the entire plant is used, whereas in biofuel manufacture only the starch or oil contained in the plant is used.[124] "Electricity generation based on biomass and nuclear/fossil fuels involves several similar basic steps, and the change in specific water consumption due to a fuel shift from nuclear or fossil fuels to biomass" depends more on technology choices, such as once-through versus closed-loop cooling, rather than on the fuel shift.[125]

4. Wind

Wind turbines generate electricity without combustion. Accordingly, water consumption for wind energy is significantly lower than for thermoelectric or hydroelectric power plants. "Wind energy does not use or consume water during electricity generation."[126] The only water used in wind power generation is to clean the wind turbine rotor blades as necessary.[127] In comparison, hydropower uses eighteen GWK and thermoelectric power uses 0.47 GWK.[128] In a 2008 study, the U.S. De-

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119. King & Webber I, *supra* note 55, at 7869; Gerbens-Leenes et al., *supra* note 107, at 10222; Berndes, *supra* note 5, at 259.

120. King & Webber I, *supra* note 55, at 7869.

121. Gerbens-Leenes et al., *supra* note 107, at 10222.

122. *See* King & Webber I, *supra* note 55, at 7869; Berndes, *supra* note 5, at 262 ("The relative importance of biomass production versus processing for total water withdrawals depends on how much of the crop water requirements that are met by means of irrigation.").

123. *See* Gerbens-Leenes et al., *supra* note 107, at 10222.

124. *Id.* at 10222.

125. Berndes, *supra* note 5, at 262.

126. U.S. DEP'T OF ENERGY, THE WIND/WATER NEXUS (2006), *available at* http://www.nrel.gov/docs/fy06osti/37790.pdf.

127. *Clean Energy: Water Resource Use*, EPA (Dec. 28, 2007), http://www.epa.gov/cleanenergy/energy-and-you/affect/water-resource.html.

128. TORCELLINI ET AL., *supra* note 41, at 6.

partment of Energy estimated that increasing wind-generated electricity to 20 percent of the total U.S. electricity supply by 2030 could reduce water consumption in the electric sector by 17 percent.[129]

Opponents to offshore wind farms have expressed concerns about the impact on aquatic life.[130] The Danish Energy Authority published a study in 2006 that found little adverse effect on fish, birds, or marine mammals, other than during the construction of the wind farms.[131] Marine mammals were most affected, with porpoises showing slow recovery to pre-construction levels.[132]

5. Solar

Electricity may be generated by solar photovoltaic panels, or the sun's power can be used to run a thermoelectric plant.[133] Solar thermoelectric plants use about as much or more water as fossil-fueled thermoelectric plants.[134] Solar photovoltaic panels use very little water, about 0.03 GWK.[135] However, the manufacture and disposal of solar panels can generate toxic waste products, including mercury, chromium, and cadmium, that can leach into groundwater.[136]

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129. U.S. DEP'T OF ENERGY, 20% WIND ENERGY BY 2030: INCREASING WIND ENERGY'S CONTRIBUTION TO U.S. ELECTRICITY SUPPLY 16 (2008), http://www1.eere.energy.gov/windandhydro/pdfs/41869.pdf.

130. *See, e.g.*, John Spears, *Offshore Wind Farm Stirs Up a Tempest*, TORONTO STAR, Nov. 25, 2008, at A1, *available at* http://www.thestar.com/news/gta/article/542858.

131. DANISH ENERGY AUTHORITY & DANISH FOREST AND NATURE AGENCY, DANISH OFFSHORE WIND: KEY ENVIRONMENTAL ISSUES 13–15 (2006), *available at* http://www.ens.dk/graphics/Publikationer/Havvindmoeller/havvindmoellebog_nov_2006_skrm.pdf.

132. *Id.* at 14.

133. *See generally* MARTIN PASQUALETTI & SCOTT KELLEY, ARIZ. WATER INST., THE WATER COSTS OF ELECTRICITY IN ARIZONA (2007), http://www.azwaterinstitute.org/media/Pasqualetti%20fact%20sheet.

134. *Id.*

135. *See id.*

136. SILICON VALLEY TOXICS COAL., TOWARD A JUST AND SUSTAINABLE SOLAR ENERGY INDUSTRY 20 (2009), http://www.svtc.org/site/DocServer/Silicon_Valley_Toxics_Coalition_-_Toward_a_Just_and_Sust.pdf?docID=821.

6. Geothermal

Geothermal energy is the heat under the earth's crust.[137] It can be used to create electricity or used directly as a heating source.[138] While some have characterized geothermal energy as a "nonconsumptive" use of water,[139] other sources indicate otherwise. In Inyo County, California, a permit allowing a local geothermal plant operator to pump water from a local aquifer angered a hunting club who relied on the wetlands fed by the aquifer.[140] The geothermal plant operator needed the water to improve efficiency at the plant.[141] The U.S. Department of Energy noted that geothermal plants, like all power plants, need abundant water for cooling processes.[142] The U.S. Geological Survey found that most of the available geothermal resources are located in the Western United States,[143] an area not known for abundant water. One geothermal plant plans to solve this problem by recharging existing reservoirs with treated wastewater.[144] Other environmental concerns include the discharge of heated water into rivers, which in addition to thermal pollution can contain trace toxins such as mercury and arsenic.[145]

137. *How Geothermal Energy Works*, UNION OF CONCERNED SCIENTISTS (Dec. 16, 2009), http://www.ucsusa.org/clean_energy/technology_and_impacts/energy_technologies/how-geothermal-energy-works.html.

138. *Id.*

139. Joe Gelt, *Geothermal—Using Water to Generate Energy and Provide Heat*, 14 ARIZ. WATER RESOURCE, no. 6, July–Aug. 2006, *available at* http://ag.arizona.edu/AZWATER/awr/julyaugust06/feature1.html.

140. Danny Bradbury, *Californian Groups Clash Over Geothermal Water Use*, BUSINESS GREEN (Mar. 13, 2009), http://www.businessgreen.com/business-green/news/2238455/californian-green-groups-clash.

141. *Id.*

142. NAT'L RENEWABLE ENERGY LAB., U.S. DEP'T OF ENERGY, ENERGY CONVERSION 2 (1998), *available at* http://www1.eere.energy.gov/geothermal/pdfs/conversion.pdf.

143. COLIN F. WILLIAMS ET AL., U.S. GEOLOGICAL SURVEY, ASSESSMENT OF MODERATE- AND HIGH-TEMPERATURE GEOTHERMAL RESOURCES OF THE UNITED STATES 1 (2008), *available at* http://pubs.usgs.gov/fs/2008/3082/pdf/fs2008-3082.pdf.

144. NAT'L RENEWABLE ENERGY LAB., U.S. DEP'T OF ENERGY, ENHANCED GEOTHERMAL SYSTEMS 4 (2004), *available at* http://www.nrel.gov/docs/fy04osti/36317.pdf.

145. *Geothermal Development Planned for Western Public Lands*, ENV'T NEWS SERV. (Oct. 22, 2008), http://www.ens-newswire.com/ens/oct2008/2008-10-22-092.asp.

7. Marine Renewable Energy

Tidal power is one of the oldest forms of renewable energy.[146] Water is not consumed in harvesting tidal power, but depending on the technology, aquatic life may be harmed.[147] A recent California study on another form of ocean energy, wave energy, predicted that fish may be affected by exposure to electromagnetic fields,[148] and birds and mammals may be harmed by collision with wave energy converters.[149]

8. Summary of Water Use

As shown by the foregoing discussion, the amount of water used by different energy sources varies considerably. Hydroelectric and nuclear power use the most water for electricity generation, although thermoelectric power generation uses substantial amounts of water, whatever the fuel. Wind and solar PV-generated energy are the most water efficient. Fossil-based transportation fuels use less water than plant-based transportation fuels. The next part will discuss tax incentives for different energy sources. This Article contends that when government provides a subsidy for using a particular fuel, it should consider the impact of the fuel on water resources. As will be shown below, the government does not consider water resources when creating energy incentives.

146. *Tidal Energy*, OCEAN ENERGY COUNCIL, http://www.oceanenergycouncil.com/index.php/Tidal-Energy/Tidal-Energy.html (last visited Nov. 1, 2010) ("[T]ide mills, in use on the Spanish, French and British coasts, date back to 787 A.D. Tide mills consisted of a storage pond, filled by the incoming (flood) tide through a sluice and emptied during the outgoing (ebb) tide through a water wheel. The tides turned waterwheels, producing mechanical power to mill grain. . . . Most modern tidal concepts employ a dam approach with hydraulic turbines.").

147. *Energy Savers: Ocean Tidal Power*, U.S. DEP'T OF ENERGY, http://www.energysavers.gov/renewable_energy/ocean/index.cfm/mytopic=50008 (last updated Oct. 20, 2010).

148. Peter A. Nelson, *Ecological Effects of Wave Energy Conversion Technology on California's Marine and Anadromous Fishes*, *in* DEVELOPING WAVE ENERGY IN COASTAL CALIFORNIA: POTENTIAL SOCIO-ECONOMIC AND ENVIRONMENTAL EFFECTS 100, 100 (2008), *available at* http://www.energy.ca.gov/2008publications/CEC-500-2008-083/CEC-500-2008-083.pdf.

149. Sarah Ann Thompson et al., *Wave Energy Conversion Technology Development in Coastal California: Potential Impacts on Marine Birds and Mammals*, *in* DEVELOPING WAVE ENERGY, *supra* note 148, at 123.

II. TAX INCENTIVES FOR TRANSPORTATION, ELECTRICITY GENERATION, AND CONSERVATION

The federal government has long provided tax incentives for energy. The term "tax incentives" refers to provisions in the Internal Revenue Code that reduce the tax burden on income generated by favored industries or activities.[150] A tax incentive, also called a tax expenditure, is a government subsidy delivered through the tax system.[151] Tax incentives can take the form of tax credits, accelerated deductions, or exclusions from income.[152] The U.S. government provides more support for energy through tax incentives than through direct government expenditures.[153] Until recently, fossil fuels reaped most of the benefit from energy tax incentives.[154] For 2007, federal support for the energy sector totaled $16.6 billion, with $10.4 billion coming in the form of tax incentives.[155] The tax subsidy for fossil fuels dropped from over 60 percent of total tax subsidies for energy in 1997 to under 50 percent in 2007.[156] Legislation in 2008 and 2009 added $40 billion of climate related tax expenditures.[157] This part of the Article reviews tax incentives for energy. Beginning with transportation tax incentives, this part will cover tax incentives for oil, efficient vehicles, ethanol, and other alternative fuels. Next, this part will cover incentives for electricity generation, including coal, nuclear, and

150. *See* Roberta F. Mann, *Back to the Future: Recommendations and Predictions for Greener Tax Policy*, 88 OR. L. REV. 355, 358 (2009).

151. *See* STAFF OF J. COMM. ON TAXATION, JCX-37-08, A RECONSIDERATION OF TAX EXPENDITURE ANALYSIS 2 (2008); *see also* SIMA J. GANDHI, CTR. FOR AM. PROGRESS, AUDIT THE TAX CODE: DOING WHAT WORKS FOR TAX EXPENDITURES 1 (2010), *available at* http://www.americanprogress.org/issues/2010/04/pdf/dww_tax_framing.pdf.

152. Mann, *supra* note 104, at 127.

153. EIA, FINANCIAL INTERVENTIONS, *supra* note 21, at xi.

154. Gilbert E. Metcalf, THE MANHATTAN INST., *Taxing Energy in the United States: Which Fuels Does the Tax Code Favor?*, ENERGY POL. & ENV. REP., Jan. 2009, at 13, *available at* http://www.manhattan-institute.org/html/eper_04.htm [hereinafter Metcalf, *Tax-Favored Fuels*].

155. EIA, FINANCIAL INTERVENTIONS, *supra* note 21, at xi.

156. Metcalf, *Tax-Favored Fuels*, *supra* note 154, at 13.

157. JOINT COMM. ON TAXATION, JCX-19-09, ESTIMATED BUDGET EFFECTS OF THE REVENUE PROVISIONS CONTAINED IN THE CONFERENCE AGREEMENT FOR H.R. 1, THE "AMERICAN RECOVERY AND REINVESTMENT ACT OF 2009" 3 (2009) (adding approximately $20 billion in energy tax expenditures); JOINT COMM. ON TAXATION, JCX-78-08, ESTIMATED BUDGET EFFECTS OF THE TAX PROVISIONS CONTAINED IN AN AMENDMENT IN THE NATURE OF A SUBSTITUTE TO H.R. 1424, SCHEDULED FOR CONSIDERATION ON THE SENATE FLOOR ON OCT. 1, 2008 1–6 (2008) (containing numerous energy-related tax incentives).

renewables. Finally, this part will cover tax incentives for conserving energy, including incentives for homeowners, home builders, and commercial buildings. It will become obvious that the tax system has not considered water use in crafting its energy incentives.

A. Transportation

1. Oil

In September 2010, nearly five months after the Deepwater Horizon oil well exploded, it finally stopped leaking millions of gallons of crude oil into the Gulf of Mexico.[158] The massive oil leak fouled miles of beaches in five states and killed over 2,000 birds.[159] In light of this unprecedented disaster, it is difficult to argue that oil use has minimal effect on water. Nonetheless, as noted above, petroleum products consume less water per mile than the likely alternatives. The tax system is still providing incentives for production of fossil fuels for transportation, although President Obama has proposed eliminating certain oil and gas tax subsidies.[160] Repealing these subsidies would raise about $26 billion over the next decade.[161]

The oil and gas benefits the administration recommended repealing include: the enhanced oil recovery credit;[162] the marginal well tax credit;[163] the expensing of intangible drilling costs;[164] the deduction of tertiary injectants;[165] the passive loss exception for working interests in oil and gas properties;[166]

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158. *See* Tom Zeller, Jr., *Federal Officials Say They Vastly Underestimated Rate of Oil Flow Into Gulf*, N.Y. TIMES, May 28, 2010, at A15; Henry Fountain, *Former Runaway Well in Gulf Is Declared 'Effectively Dead'*, N.Y. TIMES, Sept. 20, 2010, at A14.

159. NOAA, *NRDA by the Numbers—December 1, 2010*, in DEEPWATER HORIZON SPILL: NATURAL RESOURCE DAMAGE ASSESSMENT (NRDA) (2010), *available at* http://www.gulfspillrestoration.noaa.gov/wp-content/uploads/2010/12/FINAL-NRDA-by-the-Numbers-for-12-1-10.pdf

160. DEP'T OF THE TREASURY, GENERAL EXPLANATIONS OF THE ADMINISTRATION'S FISCAL YEAR 2010 REVENUE PROPOSALS 59–69 (2009), *available at* http://www.treas.gov/offices/tax-policy/library/grnbk09.pdf [hereinafter GREENBOOK].

161. *Id.* at 128 (reflecting approximately $31.5 billion total savings for elimination of oil and gas company preferences less $5.3 billion levy on offshore oil and gas production).

162. I.R.C. § 43 (West 2007).

163. *Id.* § 613A.

164. *Id.* § 263(c).

165. *Id.* § 193.

166. *Id.* § 469.

percentage depletion;[167] and the domestic manufacturing deduction for oil and gas production.[168]

Twenty-six billion dollars over ten years does not sound like much in the days of trillion-dollar bailouts. In fact, elimination of the tax preferences for oil and gas would have little effect on the industry.[169] Over ten years, the tax subsidy to natural gas and petroleum liquids decreased from 59 percent of the total energy tax subsidies to 20 percent.[170] The decrease in the share of tax subsidy does not represent a significant decline in the dollars of tax subsidy going to the oil and gas industry; rather, total tax expenditures for energy have more than tripled since 1999, rising from $3.2 billion to more than $10.4 billion in 2007.[171] Although oil-based transportation fuels are lighter water users, I do not recommend continuing the tax subsidies. The oil industry is mature and does not need subsidies.[172] Creating artificially low prices for petroleum products by subsidizing oil production is clearly inconsistent with the goal of moving energy policy in the direction of renewable sources.[173] Rather, Congress should continue to provide incentives for efficient use of petroleum products. Some hope that climate change legislation and elimination of subsidies for oil and gas could be the positive outcome from the Gulf oil spill.[174]

167. *Id.* §§ 611–13.

168. *Id.* § 199.

169. *See* ROBERT PIROG, CONG. RESEARCH SERV., R40715, OIL INDUSTRY TAX AND DEFICIT ISSUES 7 (2009) ("[T]he real effects of these proposals on oil production, consumption, and imports are likely to be small relative to both the federal deficit and the revenues of the oil industry.").

170. Metcalf, *Tax-Favored Fuels*, *supra* note 154, at 4.

171. EIA, FINANCIAL INTERVENTIONS, *supra* note 21, at xi.

172. Editorial, *Big Oil's Good Deal*, N.Y. TIMES, July 12, 2010, at A18 ("No industry enjoys the array of tax breaks and subsidies that the oil and gas industry does. No industry needs them less.").

173. *See* Roberta Mann, *Waiting to Exhale?: Global Warming and Tax Policy*, 51 AM. U. L. REV. 1135, 1219–20 (2002) ("It is hard to see what could be less economically efficient than paying for both incentives to use and incentives to stop using fossil fuels.").

174. *PBS NewsHour: Explorer Jean-Michel Cousteau Probes Depths of Oil Spill's Impact* (PBS television broadcast June 8, 2010) (interview by Jeffery Brown with Jean-Michel Cousteau in Wash., D.C.), *available at* http://www.pbs.org/newshour/bb/environment/jan-june10/cousteau_06-08.html ("My hope is that this is the kick in the butt that we needed to change . . . and make . . . strong decisions to create a system which will protect us, which will protect nature, because we depend on nature for our own survival and well-being.").

2. Efficient Vehicles

Congress has continued to add incentives for energy efficient vehicles. Purchasers of new hybrid vehicles have enjoyed a tax credit since 2005.[175] The credit was capped at 60,000 units per manufacturer.[176] The credits are no longer available for vehicles manufactured by Toyota.[177] The hybrid vehicle credits expired for all manufacturers at the end of 2010.[178]

The Emergency Economic Stabilization Act of 2008 added the newest tax credit, for plug-in hybrid vehicles.[179] The credit applies to purchasers of new "qualified plug-in electric drive motor vehicles."[180] The provision defines a "qualified plug-in electric drive motor vehicle" as a four-wheeled vehicle propelled by a battery with at least four kilowatt-hours of electricity that can be charged from an external source.[181] The amount of the credit ranges from $2,500 to $15,000, depending on the excess battery capacity and the weight of the vehicle.[182] The credit cap drops to $7,500 for years after 2009, and there is a 200,000 vehicle per manufacturer limitation. Congress also added a credit for used vehicles that have been converted to plug-in electric drive vehicles.[183] The credit is 10 percent of the conversion costs, up to $4,000.[184] Taxpayers may obtain the credit until the end of 2011. A 10 percent credit of up to $2,500 is available for electric-drive, low-speed, motorcycle, and three-wheeled vehicles.[185] Plug-in hybrid technology may have a greater impact on water use than conventionally fueled vehicles, depending on the source of the electricity.[186]

Congress also provides tax credits for the purchase of fuel-cell vehicles, lean-burn vehicles, and alternative-fuel ve-

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175. Energy Policy Act of 2005, Pub. L. No. 109-58, § 1341(a), 119 Stat. 593, 1038 (codified as amended at I.R.C. § 30B (West 2010)).

176. I.R.C. § 30B(f).

177. *See 2008 Hybrids Certified As Tax Credit for Toyota and Lexus Comes to an End*, INTERNAL REVENUE SERV. NEWSWIRE, Nov. 8, 2007, http://www.irs.gov/newsroom/article/0,,id=175518,00.html (noting that no credit is allowed for purchase of Toyota or Lexus hybrid vehicles after Sept. 30, 2007).

178. I.R.C. § 30B(k)(3).

179. Emergency Econ. Stabilization Act of 2008, Pub. L. No. 110-343, § 205, 122 Stat. 3765, 3835 (codified as amended at I.R.C. § 30D).

180. I.R.C. § 30D(d)(1), (2).

181. *Id.*

182. *Id.*

183. *Id.* § 30B(i).

184. *Id.*

185. *Id.* § 30.

186. *See* King & Webber II, *supra* note 61; *see also* discussion *supra* Part I.B.

hicles.[187] These credits have complex requirements for fuel used, fuel efficiency, and weight classes, as well as varied expiration dates.[188] The water impact of these incentives depends upon the particular alternative fuel.

3. Ethanol

Congress also provides tax incentives for using alternative fuels. Ethanol reaps the most benefit from the tax system. The excise tax credit for ethanol ("Volumetric Ethanol Excise Tax Credit" or "VEETC") is the single largest energy tax expenditure.[189] Ethanol also enjoys a collection of income tax credits.[190] In addition to its huge water impact,[191] corn is not an efficient producer of fuel. According to studies, the net energy benefit of corn ethanol is only slightly positive.[192] Recent legislation has somewhat reduced the tax subsidies for corn ethanol and increased subsidies for cellulosic ethanol.[193] Cellulosic crops, such as switchgrass, do not need irrigation and offer a promise of more efficient and less environmentally damaging production of ethanol.[194] Cellulosic ethanol is not

187. I.R.C. § 30B.

188. *See* JOINT COMM. ON TAXATION, JCX-25-09R, TAX EXPENDITURES FOR ENERGY PRODUCTION AND CONSERVATION 6–8 (2009) [hereinafter JOINT COMM. ON TAXATION, TAX EXPENDITURES], *available at* http://www.jct.gov/publications.html?func=startdown&id=3555.

189. I.R.C. § 6426; *see also* Mann & Hymel, *supra* note 67, at 50.

190. I.R.C. § 40 (West 2010); *see also* Mann & Hymel, *supra* note 67, at 47.

191. *See* discussion *supra* Part I.C.1.

192. *See* HOSEIN SHAPOURI ET AL., U.S. DEP'T OF AGRIC., THE ENERGY BALANCE OF CORN ETHANOL: AN UPDATE 9 (2002), *available at* http://www.transportation.anl.gov/pdfs/AF/265.pdf.

193. The formerly $0.51 per gallon income or excise tax credit for ethanol will be reduced to $0.45 per gallon if designated U.S. ethanol production thresholds are exceeded. In tax years after December 31, 2000, if the alcohol is ethanol, the excise tax amount is the blender amount for alcohol that is at least 190-proof and the low-proof blender amount for alcohol that is at least 150-proof but less than 190-proof. The blender amount is $0.51 for 2005 through 2008 and $0.45 for 2009 through 2010. The low-proof blender amount is $0.3778 for 2005 through 2008 and $0.3333 for 2009 through 2010. The blender amount for 2009 and 2010 will revert to $0.51 if the Secretary of the Treasury determines, in consultation with the EPA, that fewer than 7.5 billion gallons of ethanol (including cellulosic ethanol) have been produced in or imported into the United States in a calendar year. In 2008, Congress also provided a $1.01 per gallon tax credit for cellulosic ethanol. Food, Conservation, and Energy Act of 2008, Pub. L. No. 110-246, §§ 15321, 15331, 122 Stat. 1651, 2274, 2277 (codified as amended at I.R.C. § 40 (West 2010)).

194. Robert F. Service, *Another Biofuels Drawback: The Demand for Irrigation*, 326 SCI. 516, 517 (2009).

yet widely available.[195] However, Congress's action to specify a higher tax credit for cellulosic ethanol is a step in the right direction.[196]

4. Other Alternative Fuels

Other forms of alternative fuels also receive support from tax subsidies. The biodiesel and renewable diesel producer credit was recently increased from $0.50 to $1 per gallon.[197] Other alternative fuels eligible for an excise tax credit include liquefied petroleum gas, compressed or liquefied natural gas, liquefied hydrogen, liquid fuel from coal, and compressed or liquefied biomass.[198] The Emergency Economic Stabilization Act of 2008 ties the excise tax credit for liquid fuel derived from coal to carbon sequestration.[199] Beginning on October 1, 2009, liquid fuel derived from coal through the Fischer-Tropsch process must be produced at a facility that separates and sequesters at least 50 percent of its CO_2 emissions to qualify for the per-gallon alternative fuel incentives.[200] Then, starting on December 31, 2009, this requirement increased to 75 percent of CO_2.[201] As noted previously, liquid fuels from coal and biomass are water intensive.

B. Electricity

This section will address tax incentives for electricity generation, beginning with coal and nuclear power. Tax incentives for renewable power present special issues because of the choice of incentive: taxpayers can use a production tax credit ("PTC"), investment tax credit ("ITC"), or a grant in lieu of an

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195. *See* Matthew L. Wald & Alexei Barrionuevo, *Chasing a Dream Made of Waste*, N.Y. TIMES, Apr. 17, 2007, at C1, *available at* http://www.nytimes.com/2007/04/17/business/17ethanol.html; *see also* Ian Austen, *Shell's Cellulosic 'First' Is More of a Second*, GREEN: A BLOG ABOUT ENERGY AND THE ENVIRONMENT (June 13, 2009, 9:19 AM), http://greeninc.blogs.nytimes.com/2009/06/13/shells-cellulosic-first-is-more-of-a-second (describing Shell's announcement of the sale of the "first" gasohol blended with cellulosic ethanol).

196. *See* Martin A. Sullivan, *Economic Analysis: A Better Way to Subsidize Ethanol*, 113 TAX NOTES 16, 27 (2006).

197. Economic Stabilization Act of 2008, Pub. L. No. 110-343, § 202, 122 Stat. 3765, 3832 (codified as amended at I.R.C. § 40A).

198. I.R.C. § 6426(d)(2).

199. Economic Stabilization Act of 2008, Pub. L. No. 110-343, § 204, 122 Stat. 3765, 3834 (codified as amended at I.R.C. § 6426(d)(4)).

200. *Id.*

201. *Id.*

ITC. This section will address the implications of the choice of tax incentive.

1. Coal

Coal is a favored fuel for electricity generation because it is relatively cheap and available. In 2007, the average price of generating a million British Thermal Units ("BTUs") from coal was $1.78, as compared with $7.02 for natural gas and $14.77 for petroleum.[202] However, coal emits more CO_2 than any other fuel—between 205 and 227 pounds per million BTUs.[203] In contrast, natural gas emits 117 pounds of CO_2 per million BTUs.[204] Electricity generated from nuclear, wind, solar, or hydroelectric power has no direct CO_2 emissions.[205] In addition to GHG emissions and water pollution concerns, coal's other adverse environmental consequences include environmental degradation of coal mining communities and the health effects

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202. ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, ANNUAL ENERGY OUTLOOK 2009: WITH PROJECTIONS TO 2030 114 tbl.A3 (2009), *available at* http://www.eia.doe.gov/oiaf/aeo/pdf/0383%282009%29.pdf.

203. *Frequently Asked Questions—Environment*, ENERGY INFO. ADMIN. (Jan. 15, 2010), http://tonto.eia.doe.gov/ask/environment_faqs.asp#CO2_quantity.

204. *Id.*

205. *See* CONG. BUDGET OFFICE, PUB. NO. 2986, NUCLEAR POWER'S ROLE IN GENERATING ELECTRICITY 2 (2008), *available at* http://www.cbo.gov/ftpdocs/91xx/doc9133/05-02-Nuclear.pdf. A study by Australian researchers Gavin Mudd and Mark Diesendorf found potential for significant CO_2 emissions associated with uranium mining. Gavin M. Mudd & Mark Diesendorf, *Sustainability of Uranium Mining and Milling: Toward Quantifying Resources and Eco-Efficiency*, 42 ENVTL. SCI. & TECH. 2624, 2624 (2008). Uranium is the raw material for nuclear power. Plant and component manufacturing and transportation for nuclear, wind, solar, and hydroelectric power may result in CO_2 emissions. *See* Kurt Kleiner, *Nuclear Energy: Assessing the Emissions*, 2 NATURE REP. CLIMATE CHANGE 130 (Sept. 24, 2008), http://www.nature.com/climate/2008/0810/full/climate.2008.99.html. For carbon emission risks of dam building, *see* David Biello, *The Dam Building Boom: Right Path to Clean Energy?*, YALE ENV'T 360, (Feb. 23, 2009), http://e360.yale.edu/content/feature.msp?id=2119. For an analysis of carbon emissions of wind energy, *see* S.W. WHITE & G.L. KULCINSKI, FUSION TECH. INST., UNIV. OF WIS.-MADISON, NET ENERGY PAYBACK AND CO_2 EMISSIONS FROM WIND-GENERATED ELECTRICITY IN THE MIDWEST 29 fig.9 (1998), *available at* http://icf4.neep.wisc.edu/pdf/fdm1092.pdf ("Wind Farm CO_2 Emissions are Dominated by Materials Procurement."); *see also LCA in Wind Energy*, WIND ENERGY: THE FACTS, http://www.wind-energy-the-facts.org/en/environment/chapter-1-environmental-benefits/lca-in-wind-energy.html (last visited Nov. 15, 2010). For an analysis of carbon emissions from solar panel production, *see* KEIICHARO ASAKURA ET AL., CO_2 EMISSION FROM SOLAR POWER SATELLITE THROUGH ITS LIFE CYCLE 2 (2000), *available at* http://policy.rutgers.edu/cupr/iioa/AsakuraCollinsNomuraHayami&Yoshioka_LifeCycleCO2.pdf.

caused by toxic emissions such as sulfur dioxide and mercury.[206]

The chairman of the Federal Energy Regulatory Commission recently said that no new nuclear or coal plants may ever be needed in the United States, stating that renewables like wind, solar, and biomass will provide enough energy to meet future demand.[207] Commentator Gregg Easterbrook notes that "[e]nvironmentalists who correctly point out there can never be absolutely 'clean coal' thus end up in the position of opposing coal that's far cleaner than what we are using."[208] In Easterbrook's opinion, green power cannot grow quickly enough to eliminate the need for coal.[209]

Whether new coal plants are needed or not, the tax system contains a number of incentives for using coal to produce electricity. Congress provided $2.55 billion in tax credits for investments in clean coal facilities[210] and $600 million in tax credits for gasification projects, including coal gasification.[211] Over the next five years, Congress will also provide $100 million in production tax credits to refined coal production facilities[212] and $100 million in production tax credits to Indian coal production facilities.[213] In 2007, the Energy Information Ad-

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206. *See* Mann, *supra* note 104, at 119–21.

207. Noelle Straub & Peter Behr, *Energy Regulatory Chief Says New Coal, Nuclear Plants May Be Unnecessary*, N.Y. TIMES GREENWIRE (Apr. 22, 2009), http://www.nytimes.com/gwire/2009/04/22/22greenwire-no-need-to-build-new-us-coal-or-nuclear-plants-10630.html.

208. Gregg Easterbrook, Op-Ed., *The Dirty War Against Clean Coal*, N.Y. TIMES, June 29, 2009, at A21, *available at* http://www.nytimes.com/2009/06/29/opinion/29easterbrook.html.

209. *Id.*

210. I.R.C. § 48A(d)(3) (West 2010). For a description of the clean-coal tax credits, *see* Mann, *supra* note 104, at 131. The amounts of the credits have been amended by the Economic Stabilization Act of 2008, Pub. L. No. 110-343, § 111, 122 Stat. 3765, 3822 (codified as amended at I.R.C. § 48A).

211. I.R.C. § 48B(d)(1).

212. The tax code defines "refined coal production facility" as:

> (A) with respect to a facility producing steel industry fuel, any facility (or any modification to a facility) which is placed in service before January 1, 2010, and
>
> (B) with respect to any other facility producing refined coal, any facility placed in service after the date of the enactment of the American Jobs Creation Act of 2004 and before January 1, 2010.

I.R.C. § 45(C)(8). For the five-year cost estimate, see GREENBOOK, *supra* note 160, at 110–12 tbl.9.

213. The tax code defines "Indian coal" as "coal which is produced from coal reserves which, on June 14, 2005–

> (i) were owned by an Indian tribe, or
>
> (ii) were held in trust by the United States for the benefit of an In-

ministration ("EIA") of the U.S. Department of Energy determined that refined coal received a higher level of government subsidy per unit of energy produced than any other electric-generating fuel, $29.81 per megawatthour ("MWh").[214] Emerging renewable technologies such as solar ($24.34 per MWh)[215] and wind ($23.37 per MWh)[216] are not far behind, but coal (even refined coal) is a mature technology that should not need subsidies.[217] The EIA did not analyze subsidies for clean coal because clean coal has not produced energy in significant amounts.

Clean coal technologies include IGCC, which provides a more efficient way of reducing GHG emissions.[218] There are currently only two commercially-sized IGCC plants operating in the United States.[219] IGCC plants are significantly more expensive to build than conventional pulverized coal plants. While the capital cost to build a conventional coal plant ranges from $1,347 to $1,511 per KW, the capital cost to build an IGCC plant ranges from $1,670 to $2,350 per KW.[220] Although the projects eligible for the first tranche ($1.3 billion) of the clean coal credits need not remove GHG emissions, projects that have GHG capture capability receive priority in credit allocation.[221] To be awarded credits from the second tranche ($1.25 billion) of the clean coal credits, a project must include equipment that separates and sequesters at least 65 percent of its total carbon dioxide emissions.[222] If all of the first tranche credits have not been allocated, those credits may be reallocated and those projects receiving reallocated credits must include equipment that separates and sequesters at least 70 per-

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dian tribe or its members."

I.R.C. § 45(c)(9). The code defines "Indian coal production facility" as a facility producing Indian coal that is placed in service before January 1, 2009. *Id.* § 45(d)(10). For the five-year cost estimate, *see* GREENBOOK, *supra* note 160, at 110–12 tbl.9.

214. EIA, FINANCIAL INTERVENTIONS, *supra* note 21, at xvi.

215. *Id.*

216. *Id.*

217. *See* Mann, *supra* note 104, at 113.

218. *See id.* at 117.

219. *About IGCC Power,* CLEAN-ENERGY.US, (Mar. 27, 2009), http://www.clean-energy.us/facts/igcc.htm.

220. EPA, ENVIRONMENTAL FOOTPRINTS AND COSTS OF COAL-BASED INTEGRATED GASIFICATION COMBINED-CYCLE AND PULVERIZED-COAL TECHNOLOGIES A-3 (2006), *available at* http://www.epa.gov/air/caaac/coaltech/2007_01_epaigcc.pdf.

221. I.R.C. § 48A(e)(3)(B) (West 2010).

222. *Id.* § 48A(e)(3)(G).

cent of such projects' total carbon dioxide emissions.[223] The second tranche of credits and the reallocation rules were added by the Emergency Economic Stabilization Act of 2008 ("EESA 2008").[224] EESA 2008 also increased the incentive to sequester carbon dioxide in gasification projects (not IGCC) by requiring that $250 million of the tax credits allocated to gasification projects be awarded to projects that separate and sequester 75 percent of such projects' total carbon dioxide emissions, and by directing that projects with the greatest separation and sequestration percentages receive priority in the award process.[225] A recent study by the Massachusetts Institute of Technology concluded that there is no justification for government support of coal projects that do not include carbon capture and storage ("CCS").[226] Clean coal technologies may significantly reduce water use over conventional coal power plants.[227]

2. Nuclear

As noted previously, nuclear power plants waste water, degrade water quality, and harm aquatic creatures, but produce no direct carbon emissions. Nuclear power has been viewed with suspicion in the United States since the near meltdown of the Three Mile Island reactor in 1979.[228] Other countries find nuclear power more acceptable. For example, nuclear power provides over 75 percent of France's electricity.[229] After being left out of the energy tax subsidy party for many years, in 2005, the Energy and Investment Tax Act added a 1.8 cent per kWh production tax credit for energy produced from qualified advanced nuclear facilities.[230] A taxpayer operating a qualified facility may claim no more than $125 mil-

223. *Id.*

224. Emergency Economic Stabilization Act of 2008, Pub. L. No. 110-343, § 303(111)(a)–(d), 122 Stat. 3765, 3822 (2008).

225. *Id.* § 303(112)(a)–(e), 122 Stat. 3765, 3824 (codified as amended at I.R.C. § 48B(d)(1)(B), (d)(4) (West 2010)).

226. *See* JOHN DEUTCH ET AL., THE FUTURE OF COAL: OPTIONS IN A CARBON-CONSTRAINED WORLD 99 (2007), *available at* http//web.mit.edu/coal/The_Future_of_Coal_Chapters_6-8.pdf, [hereinafter DEUTCH, MIT STUDY].

227. WATER & SUSTAINABILITY, *supra* note 44, at 3–6.

228. *See generally*, WORLD NUCLEAR ASS'N, THREE MILE ISLAND ACCIDENT (rev. 2010), *available at* http://www.world-nuclear.org/info/inf36.html.

229. WORLD NUCLEAR ASS'N, NUCLEAR POWER IN FRANCE 1 (rev. 2010), *available at* http://www.world-nuclear.org/info/inf40.html.

230. Energy Policy Act of 2005, Pub. L. No. 109-58, § 1306, 119 Stat. 594, 997–99 (2005) (codified as amended at I.R.C. § 45J (West 2010)).

lion in tax credits per 1000 megawatts of allocated capacity in any one year of the eight-year credit period.[231] An advanced nuclear facility is any nuclear facility for the production of electricity that has a reactor design which was approved after 1993 by the Nuclear Regulatory Commission.[232] To receive the credit, the facility must be placed in service after August 8, 2005, but before January 1, 2021.[233] As of December 31, 2008, the last date for application for the credit, twenty-six facilities had filed construction/operating licenses with the Nuclear Regulatory Commission ("NRC").[234] Like clean coal, capital costs are the single most important cost component for nuclear power.[235] A 2004 University of Chicago study found that an investment tax credit of $18 per MWh (equivalent to 1.8 cent per kWh) would reduce the levelized cost of electricity ("LCOE") generated from nuclear power from $53 per MWh to $38, which is competitive with coal and gas generation.[236] The study also found that nuclear power is competitive with coal-fired generation if there is a price on GHG emissions.[237] Thus, the study illustrates that clean energy can be made cost-competitive by either subsidizing clean energy or by making dirty energy more expensive. Nuclear energy is a big water user because of the intense heat it generates.[238] Of course, if the true environmental cost of the water used or degraded by coal or nuclear energy was added to its price, the United States would have a different energy mix.

3. Renewable Energy Tax Incentives

Renewable energy consumption amounts to 7 percent of the total U.S. energy supply.[239] Renewable energy may be such

231. I.R.C. § 45J(c) (West 2010).
232. *Id.* § 45J(d).
233. *Id.*
234. *See* Katarina O. Savino, *The Case for Nuclear Power Tax Incentives*, 122 TAX NOTES 329, 335–36 (2009).
235. GEORGE S. TOLLEY & DONALD W. JONES, THE ECONOMIC FUTURE OF NUCLEAR POWER, at S-3 (2004), *available at* http://www.ne.doe.gov/np2010/reports/NuclIndustryStudy-Summary.pdf.
236. *Id.* at S-14. The LCOE is the price at the busbar needed to cover operating costs plus annualized capital costs. *Id.* at S-1.
237. *See id.* at S-16.
238. *See* discussion *supra* Part I.A.4.
239. ENERGY INFO. ADMIN., DEP'T OF ENERGY, RENEWABLE ENERGY ANNUAL 2008, at 7 (2010), *available at* http://www.eia.doe.gov/cneaf/solar.renewables/page/rea_data/rea.pdf [hereinafter REA 2008].

a small part of our energy supply not only because fossil energy got a head start, but also because renewable power technologies are capital-intensive, usually with relatively high construction costs and low operating costs.[240] The largest component of renewable energy is biomass (52 percent), followed by hydroelectric (34 percent), wind (7 percent), geothermal (5 percent), and solar (1 percent).[241] In 2008, 52 percent of renewable energy was used for electricity generation.[242] Within renewable energy electricity generation, hydropower generated 69 percent, biomass 12 percent, wind 10 percent, geothermal 9 percent, and solar less than 1 percent.[243] Renewable energy enjoys federal tax benefits primarily through the production tax credit[244] and the investment tax credit.[245] ITC-eligible renewable power projects are to receive a cash grant of equivalent value instead of the ITC.[246]

The ITC provides a tax credit of 10 or 30 percent of the project cost for "energy property."[247] Energy property includes property that generates electricity by solar,[248] wind,[249] closed-loop biomass,[250] open-loop biomass,[251] geothermal,[252] land-fill

240. MARK BOLINGER ET AL., PTC, ITC OR CASH GRANT 1 (2009), *available at* http://eetd.lbl.gov/ea/emp/reports/lbnl-1642e.pdf.

241. REA 2008, *supra* note 239, at 1.

242. *Id.*

243. *Id.* at 8 (author's calculations based on Table 1.2).

244. I.R.C. § 45 (West 2010).

245. *Id.* § 48.

246. American Recovery and Reinvestment Act of 2009, Pub. L. No. 111-5, § 1603, 123 Stat. 115, 364–66 (2009). The Tax Relief, Unemployment Insurance, Reauthorization, and Job Creation Act of 2010, Pub. L. No. 11-312, § 707 (2010), extended the grant program until the end of 2011.

247. I.R.C. § 48(a)(2).

248. *Id.* § 48(a)(3)(A)(i).

249. "Qualified small wind energy property" is eligible for the 30 percent credit under I.R.C. § 48(a)(2)(A)(i)(IV). A "small wind energy property" creates electricity using a "qualifying small wind turbine," *id.* § 48(c)(4)(A), which is defined as a wind turbine with a nameplate capacity of not more than 100 kilowatts, *id.* § 48(c)(4)(B). Larger wind facilities are also eligible for the 30 percent credit through § 48(a)(5)(C)(i), which cross-references § 45(d).

250. The ITC is available to closed-loop biomass through I.R.C. § 48(a)(5)(C)(ii), which cross-references § 45(d)(2). I.R.C. § 45(c)(2) defines "closed-loop biomass" as organic material from a plant, which is planted exclusively for purposes of being used to produce electricity.

251. The ITC is available to open-loop biomass through I.R.C. § 48(a)(5)(C)(ii), which cross-references § 45(d)(3). Open-loop biomass is almost any organic waste material, including agricultural livestock waste nutrients, wood by-products such as slash or brush, and crop residue. *Id.* § 45(c)(3).

252. The ITC is available to geothermal through I.R.C. § 48(a)(5)(C)(ii), which cross-references § 45(d)(4).

gas,[253] trash,[254] hydropower,[255] or marine and hydrokinetic renewable energy.[256] As this list shows, the tax system does not differentiate between energy sources that guzzle water and those that sip. The depreciable basis of a project must be reduced by half the value of the ITC.[257] As most business property may be fully depreciated (i.e., the owner may deduct the full cost of the property over time), this may reduce the overall tax benefit from the project.[258] The ITC provides up front tax benefits: all the tax benefits of the ITC occur as soon as the project is placed in service.[259] However, if the project is sold within five years, the ITC must be recaptured.[260] Recapture means that the taxpayer's taxable income will increase in the amount of the ITC previously taken. In contrast, the PTC reduces tax liability over the ten-year period after the project begins producing electricity, and is based on the amount of electricity produced, rather than on the cost of the property.[261] New solar electric projects are no longer eligible for the PTC.[262] Ultimately, the relative financial value of the tax incentive (whether it be the PTC or the ITC) depends on two project-specific factors: installed project costs and expected capacity factor (i.e., production).[263] Projects with higher capacity factors and lower installed costs would prefer the PTC over the ITC because more capacity means more production, while lower installed costs mean that the value of those PTCs will add up to a higher percentage of installed costs. [264]

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253. The ITC is available to land-fill gas through I.R.C. § 48(a)(5)(C)(ii), which cross-references § 45(d)(6).

254. The ITC is available to trash through I.R.C. § 48(a)(5)(C)(ii), which cross-references § 45(d)(7).

255. The ITC is available to hydropower through I.R.C. § 48(a)(5)(C)(ii), which cross-references § 45(d)(9).

256. The ITC is available to marine and hydrokinetic renewable energy facilities through I.R.C. § 48(a)(5)(C)(ii), which cross-references § 45(d)(11). Marine and hydrokinetic energy includes energy derived from (1) waves, tides, and currents; (2) free-flowing water in rivers, lakes, and streams; (3) free-flowing water in canals or man-made channels; or (4) differentials in ocean temperature (ocean thermal energy conversion). I.R.C. § 45(c)(10).

257. I.R.C. § 50(c)(3).

258. *See id.* §§ 167, 168.

259. *Id.* § 48(a)(1).

260. *See id.* § 50; *see also* Treas. Reg. § 1.47-6(a)(2) (1960), providing that recapture will apply if a partner in a partnership that owns the facility reduces its interest in the partnership by more than a third.

261. *See* I.R.C. § 45(a).

262. *Id.* § 45(c).

263. BOLINGER ET AL., *supra* note 240, at 4.

264. *Id.* at 6.

The prevailing economic climate also affects the choice of subsidy. The ITC and the PTC created financing options for renewable energy projects via "tax equity investors," who bought into the projects through complex partnership and lease transactions to reap the tax benefits.[265] With their own losses and few profits to be taxed, banks and corporate investors have no need for renewable energy tax benefits.[266] Researchers at the National Renewable Laboratory noted:

> The number of tax equity investors active in the renewable power market has declined precipitously, however, as a result of the financial crisis that began unfolding across the globe in the summer of 2008. The resulting shortage and increased cost of project financing has, in turn, slowed the development of new renewable power projects, leading to layoffs throughout the entire industry supply chain.[267]

The cash grant option reduces the need for tax equity investors, but may not eliminate it. First, the cash grant is not paid until the project is placed in service.[268] Developers typically need to line up financing before beginning the project. Second, most renewable energy projects are eligible for another tax benefit—accelerated depreciation deductions—and usually generate tax losses during the first six or seven years of operation.[269] The government anticipates transferring more value through grants than through ITCs over the next five years: $3.6 billion in grants[270] and less than $200 million in ITCs.[271]

If the public policy goal is to increase the supply of renewable energy, the PTC is better than the ITC because it provides

265. *See* Keith Martin et al., *How the Final Stimulus Bill Will Affect Renewable Power Projects*, PROJECT FIN. NEWS BLOG (Feb. 17, 2009, 8:03PM), http://renewableprojectfinance.blogspot.com/2009/02/how-final-stimulus-bill-will-affect.html.

266. *See* Andy Stone, *Glory Days May Be Gone for Green Energy*, FORBES.COM (June 9, 2009), http://www.forbes.com/2009/06/08/solar-wind-green-business-energy-banks.html.

267. BOLINGER ET AL., *supra* note 240, at 1.

268. American Recovery and Reinvestment Act of 2009, Pub. L. No. 111–5, § 1603(a), 123 Stat. 115, 364 (2009).

269. JOHN GIMIGLIANO & KATHERINE BREAKS, ENERGY PROVISIONS IN THE AMERICAN RECOVERY AND REINVESTMENT TAX ACT OF 2009 5 (2009) (on file with author).

270. DEP'T OF TREASURY, AMERICAN RECOVERY AND REINVESTMENT ACT AGENCY PLAN 1 (2010), *available at* http://www.treas.gov/recovery/docs/ARRA%20Agency%20Plan%206%201%2010-afc.pdf.

271. *See* JOINT COMM. ON TAXATION, TAX EXPENDITURES, *supra* note 188, at 111.

continuing incentives to produce renewable energy, rather than providing an incentive to invest capital in a renewable project.[272] The cash grant is economically equivalent to the ITC.[273] The Tax Policy Center found that "the production credit for renewable energy may be relatively more cost-effective than [other energy incentives] because it subsidizes output of a broad range of technologies that displace fossil fuels in electricity generation, without biasing choice towards one energy solution or altering relative prices of capital and labor in production."[274] However, even under the PTC, not all renewable energy sources are treated equally. The Joint Committee on Taxation found that per unit of energy, wind and geothermal receive the highest credit amount, $6.15 per million metric BTUs ("MMBTU"), while open-loop biomass only receives $2.93 per MMBTUs.[275] In terms of tons of CO_2 avoided, the PTC delivers $7.74 per ton to geothermal and $12.28 per ton to wind.[276] In terms of water wasted, it seems appropriate that wind receives more subsidy per unit of energy, as wind uses the least amount of water per kWh of other sources of electricity. However, there is no evidence that Congress thought of the water issue. There is also considerable dispute about what should be considered "renewable." Attracted by the tax benefits enjoyed by renewable energy, lobbyists at both the state and federal level have sought to expand the definition to include nuclear energy and advanced coal.[277] While federal assistance in moving to a more climate-friendly energy policy may seem welcome, using renewable energy tax incentives is at best a mixed blessing, particularly because it may exacerbate water scarcity.

C. Conservation Tax Incentives

Encouraging efficiency and conservation offers the greatest potential for reducing GHG emissions as well as the greatest

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272. *Tax Stimulus Report Card*, *Conference Agreement*: *Renewable Energy Incentives*, TAX POLICY CTR., http://www.taxpolicycenter.org/taxtopics/conference_renewable_energy.cfm (last visited Oct. 22, 2010).

273. BOLINGER ET AL., *supra* note 240, at 2.

274. *Tax Stimulus Report Card*, *supra* note 272.

275. JOINT COMM. ON TAXATION, TAX EXPENDITURES, *supra* note 188, at 118.

276. Gilbert E. Metcalf, *Tax Policies for Low-Carbon Technologies* 12 (May 6, 2009) (unpublished manuscript prepared for 39th Annual Spring Symposium, Nat'l Tax Ass'n) (on file with author).

277. Felicity Barringer, *With Billions at Stake, Trying to Expand the Meaning of "Renewable Energy"*, N.Y. TIMES, May 25, 2009, at A9.

opportunity to save water.[278] If energy need not be generated, then water need not be used to generate it. The conservation tax credits fall into three general categories: credits for homeowners, credits for vehicle owners, and credits for manufacturers.[279] The vehicle credits were previously discussed. The non-business energy credit is a 10 percent credit for the sum of the cost of qualified energy efficiency improvements and residential energy property expenditures.[280] The non-business energy property credit applies to amounts spent on the taxpayer's principal residence to improve the energy efficiency of the building envelope.[281] To qualify for the credit, the improvements, including windows, insulation, roofing, and certain heating and cooling equipment, must meet standardized efficiency criteria.[282] Furthermore, if a public utility gives a subsidy to a consumer for the purchase of an energy conservation measure, the subsidy will be excluded from the consumer's gross income for tax purposes.[283]

The manufacturer's tax credits apply to builders of new energy-efficient homes and energy-efficient appliances, which also must meet standardized efficiency criteria.[284] In particular, the clothes washer and dishwasher must be not only energy efficient but also water efficient.[285]

Owners of commercial buildings can also receive tax savings by improving the energy efficiency of their buildings. The energy-efficient commercial buildings deduction allows an additional deduction of $1.80 per square foot of commercial property that exceeds certain energy efficiency standards.[286] The American Council for an Energy-Efficient Economy found that

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278. *See* John Dernbach et al., *Stabilizing and Then Reducing U.S. Energy Consumption: Legal and Policy Tools for Efficiency and Conservation*, 37 ENV. L. REP. 10003, 10003 (2007).

279. I.R.C. §§ 25C; 30; 45M (West 2010).

280. *Id.* § 25C.

281. *Id.* The "building envelope" refers to the separation between the interior and the exterior environments of a building, including the roof, walls, and foundation. *See* Pew Ctr. on Global Climate Change, *Building Envelope*, *in* CLIMATE TECHBOOK 1 (2009), *available at* http://www.pewclimate.org/docUploads/BuildingEnvelope-Fact-Sheet_0.pdf.

282. Pew Ctr. On Global Climate Change, *supra* note 281, at 1.

283. I.R.C. § 136.

284. *Id.* § 45M(b).

285. *Id.* § 45M. Congress extended the manufacturer's credits until the end of 2011 in section 709 of the Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010, Pub. L. No. 111-312, 111th Cong., 2d Sess. (Dec. 17, 2010).

286. I.R.C. § 179D.

the tax incentive for energy-efficient commercial buildings had the best cost-benefit ratio of the energy tax incentives it studied.[287]

Although intuitively energy savings will result in saving water used in generating energy, the energy conservation tax incentive requires purchasing energy-efficient products, which must be manufactured. To accurately measure the water impact of energy-efficiency tax incentives, the water impact of manufacturing new insulation, roofing, windows, and appliances should be compared to the water savings from the energy reduction.[288]

A few tax provisions may directly impact water use. The federal government provides cost-sharing payments to farmers for a variety of activities, including those that conserve water and reduce water pollution.[289] These cost-sharing payments are excluded from the farmer's gross income for tax purposes.[290] Farmers can take a deduction for soil and water conservation expenditures.[291] These provisions are minimal in terms of their water impact, and do not change the ultimate conclusion that the tax code does not take water considerations into account.

III. CONSIDERATIONS AND RECOMMENDATIONS

This Article has discussed the water impact of energy for power and transportation. The federal government encourages energy choices through tax incentives, but the tax incentives do not take water impact into account, and may, in some circumstances, actually exacerbate water waste. This part will present recommendations for policy action, beginning with an examination of the tools that the government can use to promote change by influencing behavior. The government can influence behavior through economic instruments or the regu-

287. PATRICK QUINLAN ET AL., AM. COUNCIL FOR AN ENERGY EFFICIENT ECON., TAX INCENTIVES FOR INNOVATIVE ENERGY-EFFICIENT TECHNOLOGIES (UPDATED) 27 (2001), http://www.aceee.org/sites/default/files/publications/researchreports/e013.pdf.

288. I have not found any studies on the water impact of manufacturing insulation, roofing, windows, or appliances. Such studies would be useful.

289. I.R.C. § 126.

290. *Id.* § 126(a).

291. *Id.* § 175.

latory process.[292] Economic instruments harness market forces to change behavior. Economic instruments can either encourage activity by reducing its cost or discourage activity by increasing its cost. The two leading policy options for discouraging carbon intensive behavior are a carbon tax or a cap-and-trade system.[293] Both options increase the cost of GHG-intensive activities, like burning fossil fuels. Discouraging "bad" behavior allows the market to pick the replacement behavior. On the other hand, tax incentives reduce the cost of favored energy sources.[294] By focusing on encouraging "good" behavior, the tax incentive model picks "winning" technology. Tax subsidies distort investment decisions,[295] and it would be more economically efficient to directly tax energy fuels than to subsidize a particular method of achieving conservation measures.[296] Generally, members of Congress are not experts in assessing which technologies are the most cost-effective, so the decision to subsidize a particular technology is based on political rather than economic or environmental considerations.

This Article advocates governmental attention to water scarcity when considering energy tax provisions. Encouraging renewable energy is a rational response to climate change. Arguably, renewable energy sources need economic encouragement because of market barriers, technological challenges, and start-up costs.[297] However, certain sources of renewable ener-

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292. *See* Edward Kleinbard, *The Congress Within the Congress: How Tax Expenditures Distort Our Budget and Our Political Processes*, 36 OHIO N.U. L. REV. 1, 11 (2010) ("The fact is that the Government has multiple levers through which it can influence the behavior of the private sector. The Government can use the tax system, either as an incentive . . . or as a deliberate incremental cost (for example, to internalize negative externalities). Alternatively, the Government can impose mandates through regulation; from the perspective of the private sector, these mandates impose costs that function much like taxes on the burdened sectors. Or, the Government can appropriate funds to spend on awards, grants, below-market loans, or similar subsidies for favored activities.").

293. *See* Roberta F. Mann, *The Case for The Carbon Tax: How to Overcome Politics and Find Our Green Destiny*, 39 ENV. L. REP. 10118, 10120 (2009).

294. *See* Metcalf, *supra* note 276, at 5.

295. *See, e.g.*, Amity Shlaes, *Disincentives for Tax Incentives*, 125 TAX NOTES 1025 (Nov. 30, 2009) ("The greatest problem with tax incentives is that they distort the economy in ways that hurt us all in the long run.").

296. *See, e.g.*, Eric Toder, *Energy Taxation: Principles and Interests*, TAX NOTES: ENERGY 93, 95–96 (Nov. 26, 2009), *available at* http://www.urban.org/uploadedpdf/1001077_energy_taxation.pdf.

297. "The high capital costs for renewable and alternative energy technologies, and market uncertainty . . . act as barriers to the development and commercialization of these technologies. However, the incentive effects of the investment tax credits might lead to technological innovations that may reduce the costs of the

gy may increase water consumption. The situation begs the question: which is more important, reducing GHG emissions or conserving water? How can the two concerns be reconciled?

No simple calculus exists for reconciling the need for GHG reductions and water conservation. Two issues dominate: (1) how should the behavior-inducing instrument be designed and (2) at what level of government should it be applied? Scholars have long advocated reducing or eliminating the use of tax incentives to encourage behavior.[298] If policymakers move from the current tax incentive approach to energy policy towards using economic disincentives such as cap-and-trade or a carbon tax, then a water price should be imposed together with the carbon price. Using economic disincentives has the salutary effect of taking the government out of the business of picking winners. Much research has been done on pricing carbon.[299] Pricing water, on the other hand, presents challenges.[300] While the efficient water price may be defined as the long-run marginal cost of supply, reflecting the full economic cost of transport, treatment, storage, and opportunity costs is difficult to quantify.[301] Water, like the atmosphere, is a common good. Unlike air, which cannot be physically controlled, control of water throughout history has meant political and financial power.[302] On the one hand, cheap water invites overuse.[303] In

subsidized technologies and (eventually) make them more competitive (or at least, less uneconomical)." S. COMM. ON THE BUDGET, 110TH CONG., TAX EXPENDITURES: COMPENDIUM OF BACKGROUND MATERIAL ON INDIVIDUAL PROVISIONS 192 (2008).

298. *See, e.g.*, GANDHI, *supra* note 151.

299. NICHOLAS STERN, THE ECONOMICS OF CLIMATE CHANGE: THE STERN REVIEW 349 (2007), *available at* http://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/stern_review_report.htm. ("Putting an appropriate price on carbon, through taxes, trading or regulation, means that people pay the full social cost of their actions.").

300. Sheila M. Olmstead & Robert N. Stavins, *Comparing Price and Non-Price Approaches to Urban Water Conservation* 2 (Fondazione Eni Enrico Mattei Working Paper No. 66, 2008), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1147188.

301. *Id.* ("Implementation of efficient water prices would be challenging, to say the least. Some of the opportunity costs of urban water supply are exceedingly difficult to quantify."). Congress has considered imposing an excise tax on certain water users to create a "Clean Water Trust Fund" to pay for aging municipal water treatment systems. U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-09-657, CLEAN WATER INFRASTRUCTURE (2009).

302. STEVEN SOLOMON, WATER: THE EPIC STRUGGLE FOR WEALTH, POWER, AND CIVILIZATION 24 (2010).

303. Sheila M. Olmstead, W. Michael Hanemann & Robert N. Stavins, *Water Demand Under Alternative Price Structures*, 54 J. ENVTL. ECON. & MGMT. 181, 193 (2007); Olmstead & Stavins, *supra* note 300, at 2; Ariel Dinar et al., *Water*

the United States, the average cost per gallon of water from a municipal water system is less than one cent.[304] On the other hand, water is priceless. We cannot survive without clean water. Because of recent water privatization abuses, international organizations have rejected the "economic good" model of water distribution and recognized access to water as a "social and cultural right."[305] Many countries consider the right to control access to water resources to be a sovereign right, held as common heritage for the benefit of the people.[306] Conflicts between access to clean water for agriculture, municipal use, fishing, recreation, and habitat protection continue to occur. Should water be priced differently depending on its use? Is it more valuable for food production and human consumption than for energy generation? These are questions that should be considered by policymakers, even though the answers may be hard to find.

Using the government's current approach of tax incentives can avoid the issue of pricing water, at least in the context of water used to generate energy. Rather than pricing water, the government can pick technology "winners" that both reduce GHG emissions and save water. To avoid the winners being selected on the basis of having the most effective lobbyists, the government can rely on independent experts to make the analysis. The non-business energy efficient tax credit provides a precedent for using scientific and industry expertise to direct award of tax benefits.[307] The non-business energy tax credit is only available for investment in technologies that meet or exceed industry efficiency standards. [308] A matrix and rating system could assist in deciding how rich a tax benefit the technology deserves. Each technology could be rated on GHG emis-

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Allocation Mechanisms: Principles and Examples 3 (World Bank Policy Research Working Paper No. 1779, 1997), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=615000.

304. *See* EPA, INTERNATIONAL EXPERIENCES WITH ECONOMIC INCENTIVES FOR PROTECTING THE ENVIRONMENT 8 (2004).

305. Erik B. Bluemel, *The Implications of Formulating a Human Right to Water*, 31 ECOLOGY L.Q. 957, 967 (2004).

306. Dinar et al., *supra* note 303, at 9.

307. I.R.C. § 25C (West 2010).

308. To qualify for the credit, the building envelope component must meet or exceed the prescriptive criteria established by the International Energy Code or Energy Star program requirements. *Id.*

sions and water efficiency.[309] A sample matrix follows, showing wind and solar photovoltaic energy most deserving of subsidy:

Technology	**Lifecycle GHG emissions per unit of energy**	**Water consumption per unit of energy**	**Water pollution factor**
Wind	Zero	Low	Low
Coal (no sequestration)	High	Medium	High
Coal (CCS)	Low	High	High
Solar (Photovoltaic)	Zero	Low	Low
Solar (Thermoelectric)	Zero	Medium	Low

The federal government is the appropriate level of government to impose energy policy,[310] but may not be the best level of government to determine water savings. Unlike atmospheric GHG, water supply is significantly influenced by local and regional conditions.[311] If the government is to consider the water use of different energy sources, the policy decision may be best made at the state level. For example, the average water consumption per mile of ethanol fuels depends on whether the ethanol was made from an irrigated crop.[312] Corn needs no irrigation in Minnesota, but must be irrigated in California.[313] Thus, Minnesota should encourage ethanol use, but California should not. If technology improves to allow ethanol

309. *See* Samuel K. Moore, *CO_2 vs. H_2O in Power Production*, IEEE SPECTRUM (June 2010), http://spectrum.ieee.org/energy/environment/co2-vs-h2o-in-power-production).

310. There are many reasons for energy policy to be implemented at the national level, including the need to coordinate technology (smart grid), the development of national markets (alternative fuel vehicles), and avoiding the negative impact of a patchwork of state and local regulations on interstate commerce. *See* Mann, *supra* note 104, at 122.

311. DOE, ENERGY DEMANDS, *supra* note 4, at 14.

312. King & Webber I, *supra* note 55, at 7866.

313. Phil McKenna, *Measuring Corn Ethanol's Thirst for Water*, TECH. REV. (Apr. 14, 2009), http://www.technologyreview.com/energy/22428 (noting that the amount of water used in ethanol production varies hugely from state to state).

production from low water-use plants, then the determination may change. The federal government could provide the funding and set the standards for energy technology, with the determination of the particular winning technology to be made at the state level. The Internal Revenue Code contains a model for this sort of allocation—the low-income housing credit.[314] A low-income housing project receives the tax credit only after a state housing credit agency allocates a specified dollar amount of credit to the project.[315] The state agency makes the determination whether the project is appropriate and is also responsible for monitoring whether the project continues to comply with federal rules.[316] In effect, the state is distributing federal funds in the form of tax savings. In the water-energy context, using a similar model would allow state agencies to decide what sort of energy mix works best with its water resources.[317]

The foregoing discussion about which level of government should be involved in water policy raises a question about government generally. Winston Churchill famously said, "democracy is the worst form of Government except for all those other forms that have been tried . . . ."[318] One problem with the democratic process is that future generations cannot vote. Thus, the democratic process favors current financial benefit over protecting future generations from harm.[319] Human psy-

314. I.R.C. § 42 (West 2010).

315. *Id.* § 42(h).

316. Treas. Reg. § 1.42-5(a) (2010).

317. It should also be noted that the low-income housing tax credit is not an example of a simple solution to a complex problem. "The statutory provisions governing the low-income housing tax credit are among the most complex provisions in the Code and the details for qualifying are frightful." BORIS I. BITTKER, MARTIN J. MCMAHON & LAWRENCE A. ZELENAK, FEDERAL INCOME TAXATION OF INDIVIDUALS ¶20.07 (3d ed. 2002). It should be noted that water tables do not respect state lines, and that water use is a matter of negotiation between states. That issue, however, is beyond the scope of this Article.

318. CHURCHILL BY HIMSELF 573 (Richard M. Langworth ed., 2008). Thomas L. Friedman mused that if America could be China for "just one day," we could "cut through . . . all the pleading special interests, all the bureaucratic obstacles, all the worries of a voter backlash, and simply order top-down the sweeping changes in prices, regulations, standards, education, and infrastructure [reflecting] . . . China's long-term strategic national interests—changes that would normally take Western democracies years or decades to debate and implement." THOMAS L. FRIEDMAN, HOT, FLAT AND CROWDED 372–73 (2006). Being China has not saved China from water scarcity. On the North China Plain, farmers are irrigating rice fields with 30,000-year-old water from a "fossil" aquifer. *See generally* Li Jiao, *Water Shortages Loom as Northern China's Aquifers are Sucked Dry*, 328 SCI. 11462 (2010).

319. *See, e.g.*, Dennis F. Thompson, *Representing Future Generations: Political Presentism and Democratic Trusteeship*, 13 CRITICAL REV. OF INT'L SOC. & POL.

chology also favors the present and immediate concerns over the concerns of the future.[320] Businesses, while aware of future risks, also have incentives to consider the short-term financial benefit of shareholders. Even if the public showed concern about water resources, the specific pleas of special interest groups tend to have more salience with politicians than the dispersed needs of the public.[321] While state governments and associated agencies might have better knowledge about state water resources, state political structures might be more subject to industry capture than the federal government. In the federal government, each state only has a limited number of representatives in Congress and two Senators to protect the interests of local businesses, but all of the state legislators are subject to local business pressures.[322] However, differing water rate policies among the states indicate that the drier states have acted to conserve water.[323]

CONCLUSION

The main goal of this Article is to raise awareness of the interaction between the looming problems of climate change and water scarcity. Renewable energy can be a bridge to a low carbon future. The federal government has invested heavily in renewable energy subsidies through the Internal Revenue Code, without an apparent thought to water impact. Rather than the government picking technology "winners" by targeted tax subsidies, the government could put a price on carbon intensive activities. However, putting a price on carbon may not

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PHIL. 17, 17 (2010) ("Democracy is prone to what may be called presentism—a bias in the laws in favor of present over future generations.").

320. The well-known phenomenon of "loss aversion" causes people to be unwilling to sacrifice present benefits for future benefits. *See* David Gal, *A Psychological Law of Inertia and the Illusion of Loss Aversion*, 1 JUDGMENT AND DECISION MAKING 23, 23 (2006), *available at* http://journal.sjdm.org/vol1.1.htm.

321. *See* Elizabeth Garrett, *Harnessing Politics: The Dynamics of Offset Requirements in the Tax Legislative Process*, 65 U. CHI. L. REV. 501, 522 (1998).

322. For example, Senator Charles Grassley of Iowa, the number-one corn-producing state, has been outspoken in his support of ethanol. *See* Mann & Hymel, *supra* note 67, at 72–73. Senator John McCain of Arizona, a state with no significant commercial corn production, criticized ethanol subsidies, at least until he became a presidential candidate. *See* Shailagh Murray, *Ethanol Undergoes Evolution as a Political Issue,* WASH. POST, Mar. 13, 2007, at A6.

323. Drier states like California and Arizona have increased water rates, CAL. WATER CODE §§ 10620, 10632(h) (West 1992); Kris Mayes, *Encouraging Conservation by Arizona's Private Water Companies: A New Era of Regulation by the Arizona Corporation Commission*, 49 ARIZ. L. REV. 297, 314 (2007).

save water. The government need not choose between conserving water and reducing GHG emissions—it can have both, if we pick the right technology. The government can continue to use the most popular energy policy tool—tax incentives—and pick winners that consider both water consumption as well as the potential for reduced CO_2 emissions. Given the stalemate in Congress over climate change policies, using tax incentives may be the only feasible action.[324] Attention to climate change is long overdue, but policymakers must start considering the water impacts of their subsidized energy choices before there is no more water under the bridge.

324. Carl Hulse & David M. Herszenhorn, *Democrats Call Off Climate Bill Efforts*, N.Y. TIMES, July 23, 2010, at A18; Lee Wasserman, *Four Ways to Kill a Climate Bill*, N.Y. TIMES, July 26, 2010, at A23; Paul Krugman, *Who Cooked the Planet*, N.Y. TIMES, July 26, 2010, at A15.