AC 2012-4024: THE UNITED STATES ENERGY POLICY: AS DETERMINED BY NON-EXPERTS

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The Need for Technological Literacy in Environmental Policy

Abstract

There are many major environmental issues challenging the world today, including global warming and limited fossil fuel resources. Due to these issues, the methods used by the United States to produce energy and the technology behind these methods are becoming increasingly vital. There are several committees and departments whose role it is to choose what the United States will allow or invest in when it comes to producing and distributing energy to the citizens. These include the Senate Committee on Energy and Natural Resources, the Select Committee on Energy Independence and Global Warming, the House Energy and Commerce Committee, the Federal Energy Regulatory Commission, and the Nuclear Regulatory Commission. These organizations solicit advice from experts in the energy sector. Despite these expert opinions, sometimes energy policies clash with the very objectives they were designed to achieve. This paper seeks to examine the decisions being made in this political arena as well as the impacts of decisions made regarding these policies. The nature of the professional opinions that have been given are also addressed. This paper seeks to identify the value and importance of technological literacy in policy makers as can be achieved by encouraging technical literacy for non-engineering students in the classroom today.

The main Issue

For the past 10,000 years, geologists have called the Earth's unusual period of stability the "Holocene". The period was key to human development because it maintained regular temperatures and freshwater availability. This period of stability may be about to change. Human activities such as reliance on fossil fuels and industrialized agriculture are threatening to push us out of the Holocene state that was expected to continue to last several thousand years [1].

Atmospheric chemist, Paul Crutzen, first noted this change in 2000 [2]. He realized that we were no longer in the Holocene but entering the "Anthropocene": the age of man. During the Holocene, the Earth maintained itself but now, according to the article, "A Safe Operating Space For Humanity", "human actions have become the main driver of global environmental change." The hot button phrase of this shift to the Anthropocene that seems to be the cause of most concern is "global warming".

Global warming, according to Merriam-Webster's dictionary, is defined as "an increase in the earth's atmospheric and oceanic temperatures widely predicted to occur due to an increase in the greenhouse effect resulting especially from pollution". For millions of years our planet has been warmed through the natural process of the greenhouse effect, it has not been until recently that we have seen an amplified warming of our planet that has been linked back to human actions.

Simply put, the Earth is warmed by sunlight entering our atmosphere and bringing energy that is absorbed by the oceans and land. Heat in the form of infrared energy radiates outward from the warmed surface. Some of this energy is absorbed by greenhouse gases in the atmosphere, which

is re-emitted either back to the earth or into space. It is here where the amplified effect comes into play. As higher concentrations of CO_2 and other greenhouse gases exist in our atmosphere, they continue to trap more heat than normal raising the Earth's temperature. The Economist article states it best when they say, "It would be odd not to be worried" [3]

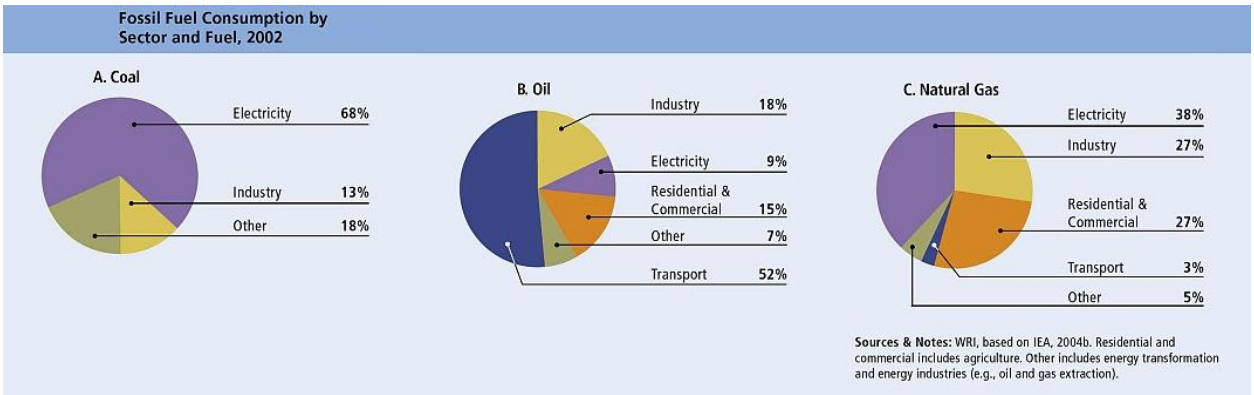
It is this rise in temperature that has gotten the attention of local and national law makers to create legislation to counter-act global warming in an effort to slow the human created harm on our atmosphere. In order to do this, lawmakers have passed many bills that create the current structure of the United States' policy on global warming and set goals for our reduction of greenhouse gasses and utilization of renewable energy. It is argued that these policies need to do more than just stop the amount of carbon dioxide in the atmosphere from increasing but, instead, to actively start decreasing it. "It means treating humans not as insignificant observers of the natural world but as central to its working, elemental in their force" [4].

What are our energy options?

Non-Renewable Resources:

For hundreds of years mankind has been extracting energy from fossil fuels. From coal heated homes and gas streetlamps to the modern transportation industry we have been tapping this source of chemical energy stored in molecular bonds. In 2002 fossil fuels provided 85 percent of the world's energy needs, including electricity production, transportation fuels, industrial process energy, and home heating. For perspective, we currently produce five times more crude oil and seven times more coal by weight than we do steel [5, p300].

Electricity generation and transportation are the world's two biggest consumers of fossil fuels, as seen in the graphic below. Because of this, a majority of the focus towards sustainability and alternative energy focuses on these sectors. Hybrid cars and electric vehicles reduce the uses of oil in the transportation sector, but fully electric vehicles and plug-in hybrids increase electricity consumption. Therefore, it will be necessary to reduce our reliance on fossil fuels for electricity production in order to reduce fossil fuel use in the transportation industry.



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Many people see nuclear power as a good alternative to fossil fuels. Nuclear power is initially a nonpolluting source of energy. However, on-site storage for radioactive waste is dwindling and

currently no long term storage facility has been designated for these materials. Similar to fossil fuels, the materials used to fuel nuclear reactors are non-renewable resources that would eventually be used up.

Solar Energy

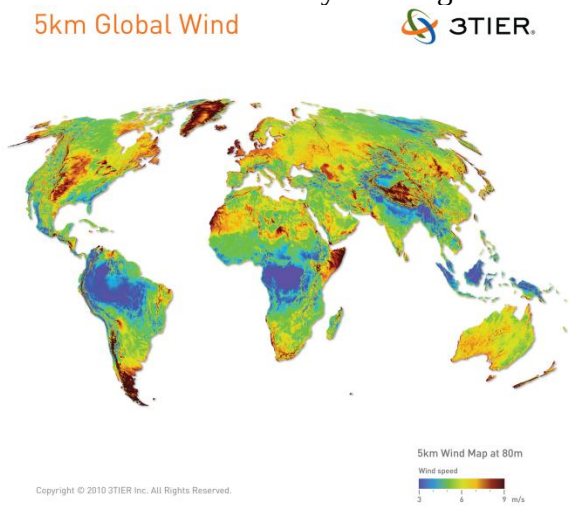
The sun is a source of energy that drives weather systems, ocean currents, the hydrologic cycle and most life on our planet. There are three ways we can directly harness this energy for our own use. Thermal energy can be harnessed in buildings to supplement space conditioning (heating and cooling), or in solar concentrators to be collected and converted to electricity. Photovoltaic devices can be used for the direct conversion of radiation to electricity [5, p544].

The amount of solar energy available at the earth's surface is diminished by the atmosphere based on latitude and weather conditions. The top of the atmosphere receives a total insolation of 1,354 W/m^2 (referred to as the solar constant) while the earth's surface will receive between 0 W/m^2 and 1050 W/m^2 depending on the time of day, time of year, latitude and local weather [5, p545]. The map below shows the average insulation at the earth's surface [7].

The effects of latitude and the time of day and year on the amount of insolation are predictable, and precise mathematical equations can account for changes. Local weather provides a measure of uncertainty to any prediction of how much solar energy will be available to a location at a given time. This makes it necessary for storage systems to accompany thermal or photovoltaic solar energy generation systems.

Wind Energy

Mankind's use of wind energy began as early as 200 BC, continued up to and through the industrial revolution, and is undergoing increasing interest in modern applications [5, p614]. Wind is a derivative of solar power that is produced by uneven heating of the earth's surface. A majority of the power found in wind is at too high of an altitude to be easily harnessed, and only a few locations have strong, consistent winds that can be economically harvested. The map below demonstrates this by showing overland wind speeds 80 meters above the surface



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Hydroelectric Power:

Hydroelectric power comes from the potential energy in water flowing from upland areas toward the sea. This source of energy is also solar based, as the sun's energy is what drives the hydrologic cycle, evaporating ocean water to be precipitated inland as rain or snow. The energy in water is harnessed by storing potential energy behind a dam or tapping into the kinetic energy of flowing water, as in a water wheel. Water can also be used to store energy in a process called pumped storage, which will be addressed later.

Hydroelectric power plants can remain in operation for extended periods; some have been in place for over a century. They also have the capacity for very high energy production; "the ten largest electric power stations in the world today are hydroelectric [5, p521]. In addition, a great amount of the world's hydroelectric potential remains untapped. The World Energy Council estimates that there is 9,000 terawatt hours per year of technically and economically feasible energy worldwide. Current hydropower production is 2,600 terawatt hours, under a third of this total value, and accounts for 20 percent of worldwide electricity production. This potential growth is limited by capital and environmental factors [5, p522].

Oceanic Energy - Waves and Tides

There is a loose correlation between areas of high density wave energy and areas of high density wind energy along coastlines, an example being the Atlantic coast of Europe and the British Isles. There are many types of wave harnessing power plants. One type channels waves up ramps to fill reservoirs of water with potential energy. Another uses floats or buoys to capture up-and-down motions, creating mechanical work. Others use oscillating wave motion to work hydraulic pistons. This source of energy is attractive because of its capacity to do work, 50 kilowatt hours per meter of wavefront. Unfortunately, the complexities of hydrodynamics and vulnerability to storms cause difficulties for these systems [5, p597].

Tidal power comes from gravitational interactions with the moon and, less so, the sun. The potential for energy extraction varies by location, based on the difference in height between low and high tide. Examples of unusable tides include 0.5-meter differences on the open ocean and a change of a few centimeters on Nantucket Island. Some locations have much more potential, such as the record-breaking 16 meters of the Bay of Fundy. It is estimated that full exploitation of this resource could contribute tens of Gigawatts to the worldwide energy grid [5, p590].

Geothermal Energy

The term 'geothermal energy' is used to refer to the thermal energy that resides in the earth's crust. This includes natural features such as hot springs which, throughout the world, have an installed electrical generating capacity of over 10,000 megawatt hours and a direct use of over 100,000 thermal megawatts of power. Magma intrusion into the crust and concentrations of radioactive isotopes can create local hotspots; in general heat is transferred through convection and conduction through the earth's crust at a rate of 5.9×10^{-2} W/m^2 (compare to the maximum 1050 W/m^2 for solar radiation at earth's surface).

Certain conditions must be fulfilled in order for a geothermal resource to be economically viable. Depending on application different grades of temperature, depth, and porosity need to be achieved, with higher temperatures and porosities and lower depths preferred. "Reservoirs that spontaneously produce fluids of low salinity under artesian pressure and low concentrations of dissolved non-condensable gases are easier to exploit." [5, p454]

What are we doing about global warming?

Global warming policy dates all the way back to 1896 when Swedish scientists presented the idea that fossil fuels adding carbon dioxide to the atmosphere could increase global temperature. After this, scientists began to see upward trends of the temperatures in the North Atlantic in the 1930s and reports of the 1950s showed that greenhouse gas levels were increasing year after year. It wasn't until 1988 that the World Meteorological Organization and the United Nations Environmental Programme set up the Intergovernmental Panel on Climate Change to assess data on climate change and global warming.

International efforts to control greenhouse gas emissions started in the early 1990s with the United Nations Framework Convention for Climate Change's (UNFCCC) climate accord in 1992. The UNFCCC set to reduce emissions by setting voluntary targets. Failures of this led to the Kyoto Protocol in 1997 [9, p13].

The Kyoto Protocol set to legally bind countries to reducing their greenhouse gas emissions below the 1990 levels by 2008-2012. In this, the European Union would be required to reduce its emissions by 8%, the United States by 7%, and Japan by 6%. Between 1997 and 2001 many ratifications were made on it and in 2001 the U.S. pulled out of the agreement due to issues with provisions for tradable emission permits and inclusion of allowances for "carbon sinks" [9].
In June of 2001, President Bush asked for the National Academy of Sciences to give him a report on climate change to double check what the U.N. Intergovernmental Panel on Climate Change had come up with. The study backed the report from the IPCC and the U.S. was forced to make policies of their own regarding climate change.

The first step that was taken was to have Washington work alongside major oil companies to research new techniques in carbon sequestration. The first technology researched was pulling carbon out of the air and injecting it back into coalmines and oil fields or the ocean [9, p.20]. The "Principles for Global Warming Legislation" that was released in the spring of 2008 now guides U.S. policies on global warming. It outlines four principles for legislation that include:

- Reduce emissions to avoid dangerous global warming
- Transition America to a clean energy economy
- Recognize and minimize any economic impacts from global warming legislation
- Aid communities and ecosystems vulnerable to harm from global warming [10]

Today there are many policies governing the United States on climate change, CO_2 emissions and other factors. One is President Obama's 2010 interagency taskforce on carbon capture and storage that continues on what was started in 2001. Coal combustion accounts for nearly 40% of all greenhouse gas emission so they are working to take CO_2 from there and pump it to

sequestering stations or pump it in to deep geological formations [11]. There are also many tax incentive programs for both companies and individuals as established in the Energy Provisions of the American Recovery and Reinvestment Act of 2009 including residential energy property credits, plug-in vehicle credits, and new clean renewable energy bonds.

One state that has really stepped up in global warming policy is California. Their Global Warming Solutions Act outlines a plan to reduce their state wide greenhouse gases and transition to a sustainable, clean energy economy. Their strategies and goals include achieving a statewide renewable energy mix of 33% by 2020, establish targets for transportation-related greenhouse gas emissions for regions throughout California, protecting public health and guaranteeing sound policy decisions.

What do these policies dictate?

When coming up with these policies, policy makers needed to be aware of the set goals of the established planetary boundaries that quantify the safe limits of many Earth-system processes. The Earth-system process and proposed boundaries are as follows:

- Climate change; CO_2 concentration (in ppm) 350,
- Rate of biodiversity loss: 10 extinct species per million,
- Nitrogen cycle: 35 million tons per year removed from the atmosphere,
- Phosphorus cycle: 11 million tons per year into the ocean,
- Stratospheric ozone depletion: 276 dobsons (1 dobson is $2.69*10^{20}$ ozone molecules/m^2)
- Ocean acidification: global mean saturation state of aragonite in surface seawater: 2.75
- Global freshwater use: 4000 cubic kilometers per year,
- Change in land use: 15% of land converted to cropland,
- Atmospheric aerosol loading: TBD, and
- Chemical pollution: TBD.

The boundaries of three of these have already been over-stepped by humans (climate change, rate of biodiversity loss, and the nitrogen cycle) and we are closing in on others at an alarming rate. This only fuels the fire for sound policy making. Experts have weighed in and have come up with ten policy suggestions for the President Obama's administration.

- Direct the Environmental Protection Agency to allow California to require carmakers to reduce emissions from cars sold in the state.
- Tell the EPA to declare carbon dioxide a pollutant under the Clean Air Act.
- Propose a cap-and-trade plan on global warming.
- Smartly apportion billions as part of an economic stimulus and recovery package.
- Make the White House as a case study in green living.
- Stimulate smart agriculture.
- Green America's fleet.
- Pave the way for clean tech.
- Make Big Oil pay.
- Modernize the grid.

Who are making these decisions?

Policy-makers include members of the executive and legislative branches of the federal government. Energy issues such as global climate change fall within the Department of Energy's responsibility as much as committees of both chamber of the United States Congress.

The current Secretary of Energy is Dr. Steven Chu. Secretary Chu is a well-known scientist, who received a Nobel Prize for Physics. Chu also educates the next generation of scientists as a university professor. Before President Obama appointed Chu to Secretary of Energy, Chu was a director of a national laboratory of the Department of Energy. As Secretary of Energy, Chu's main job is to implement President Obama's energy plans [12].

The current Chairman of the Senate Energy and Natural Resources Committee is Senator Jeff Bingaman, a Democrat from New Mexico. Senator Bingaman graduated with degrees in government and law. After working for the Army Reserves and practicing private law, Bingaman entered politics. He has served on a number of committees before chairing the Senate Energy and Natural Resources Committee; however, he has no industrial work experience in the fields of energy or natural resources [13].

Representative Edward J. Markey, a Democrat from Massachusetts, is considered the national leader on energy and the environment with a lifelong political career in environmental activism. He is the current Chair of the Select Committee on Energy Independence and Global Warming and the Energy and Environment Subcommittee of the Energy and Commerce Committee. Like Senator Bingaman, Markey has a law degree, practiced law, and worked in the Army Reserves before becoming a politician. However, Markey has no work experience within the field of energy but has extensively worked as an activist for the environment [14].

The current Chairman of the Committee on Energy and Commerce is Fred Upton, a Republican from Michigan. Upton has a degree in journalism and started working in politics as a staff member of a Michigan Congressman. Under President Ronald Reagan's presidency, Upton worked in the Office of Management and Budget. While serving as a Congressman, Upton has worked on quite a few committees. Upton's push for energy policy continues to make a difference in the daily lives of Americans, as he was the primary supporter for changing daylight saving time back in 2005 and promoting the switch to fluorescent light bulbs. Upton does not personally have any industry experience in the field of energy. It is also interesting to note that Upton's grandfather is the founder of Whirlpool Corporation [15].

The current chair of the Federal Energy Regulatory Commission is Jon Wellinghoff, an energy law specialist with more than thirty-four years of experience. Chairman Wellinghoff practiced private law for federal agencies, renewable developers, large consumers of power, energy efficient product manufacturers, and clean energy advocacy organizations. Wellinghoff has also written energy law and is credited as the primary author of the Nevada Renewable Portfolio Standard Act. He also has experiencing creating and chairing committees and commissions in and outside of the government [16].

Dr. Gregory B. Jaczko is the current Chairman of the United State Nuclear Regulatory Commission. As chairman, his responsibilities include conducting administrative, organizational, long-range planning, budgetary, and certain personnel functions of the agency, and serving as the authority for Nuclear Regulatory Commission functions pertaining to a potential emergency involving a licensee of Nuclear Regular Commission. Prior to the Chairmanship, Dr. Jaczko served as the appropriations director and science policy advisor for Senator Harry Reid as well as a congressional science fellow for Representative Markey. Chairman Jaczko has a Bachelor's Degree in Physics and Philosophy and a Doctorate Degree in Physics. He also serves an adjunct professor at Georgetown University teaching science and policy. Jaczko's professional career has been devoted to science and its and impact in the public policy arena [17].

Policy-makers can be split between two groups. The first group of policy makers includes Dr. Chu, Chairman Wellingoff, and Chairman Jaczko. They have worked within and formally studied the fields of science and technology. Senator Bingaman, Representative Markey, and Representative Upton belong to the other group of policy makers, those who studied law to enter politics and through committee work, have learned about energy issues. There is a substantial difference in electing engineers to political positions and electing technologically literate individuals to these positions.

Is there any real problem with these Decisions?

A mix of legislators, special interest groups, scientists, engineers, and private citizens influence current national energy policy decisions. A member or small group of members typically introduces a bill, and then it is passed through and voted on in Congress. Special interest groups come into play by trying to persuade politicians to favor sides or to amend the bill to provide high business incentives for whole industries. Because legislators could not possibly be experts on all political issues relating from health care and financial reform to agriculture and energy policy, politicians and group members also seek expert advice from industry professionals such as scientists and engineers. Specific to the energy policy, scientists and engineers provide their expert opinions on a variety of topics such as acceptable levels of pollutants, industry procedures, quantities available, risks associated, and issues necessary for new technologies. Because legislators are not completely informed about all topics, and they are conscious about getting votes and staying in office, and often make policy decisions for the wrong reasons.

Policy makers in the United States tend to focus on short-term issues and solutions opposed to looking at longer-term issues such as energy and global climate change. The short-term perspective of politics is a direct consequence of the technological illiteracy of the American people. If voters were technologically literate, they would more likely elect technologically literate politicians. However, lobbyists and special interest groups still can influence the decisions of policy makers [18].

A good example of this is Vice President Dick Cheney's Energy Task Force in 2001. It was revealed that previous to introducing the National Energy Policy, Vice President Cheney and his aides had already had at least 40 meetings with interest groups. In total, almost 300 groups and individuals met with staff members of the Energy Task Force and even Vice President Cheney

himself in order to influence the impact of the proposed energy policy. Private meetings were held with industry heads such as Exxon Mobile VP James J. Rouse, Kenneth L. Lay of Enron Corp., as well as representatives of other companies such as Duke Energy, National Mining Association, Natural Gas Association of America, and British Petroleum. U.S. Energy policy incentives allow for companies to strategically develop certain industries that plan to reduce America's dependence on foreign petroleum products and create jobs and industries the government chooses to subsidize. Federal tax incentives are put in place for industries to quickly adopt, create jobs, and encourage investment in research and development [19].

Many times, The Environmental Protection Agency creates and introduces the "necessary" bill to congress as well as administers many of the environmental and energy laws. Organizations, special interests groups, and even entire industries are spending a large amount of money on lobbyists in order to influence politicians to support particular legislation. The nuclear industry, which spent some $71,405,955 lobbying Capitol Hill in 2004, would get $7.37 billion in tax breaks and projects, including federal funds to construct a $1 billion nuclear plant in Idaho. After a bill is passed, the EPA is then authorized to implement the law by creating regulations that apply to individual, business, state or local government.

A study by the nonpartisan General Accounting Office last year found that Vice President Dick Vice President Cheney's energy task force, a private committee of Washington officials, received advice from private "energy stakeholders," mainly the petroleum, coal, nuclear, natural gas, and electricity industries [20]. Other records were released under court order that showed 15 energy-related entities known to have contact with the task force ended up winning provisions in the energy policy that would benefit them.

- The Edison Electric Institute, which had contact with the task force 14 times and spent $12 million lobbying Washington in 2003, secured a historic deregulation of the electricity industry analysts say could be worth millions.
- The Nuclear Energy Institute, which won billons in tax credits and projects, had 19 contacts with the task force and dumped $1,280,000 into lobbying efforts in 2003.
- Members of the American Petroleum Institute, which had contact at least six times and spent $3,140,000 lobbying in 2003, would be eligible for billions in tax breaks and subsidiaries to encourage domestic oil production. [21].

After Vice President Cheney's task force issued its recommendations, the job of drafting the bill went to the House and Senate committees, where Republican majority kept many of the proposals intact. Then in hopes of forging an agreement between the House and the Senate, congressional leaders appointed members to a conference committee. The conference committee then began to add projects that had never appeared in either version of the bill and lobbyists peppered members of the committee with requests to get favored projects [22].

Policy is determined by our policy makers, who vote not only out of their own convictions, but also (hopefully) in the best interests of their substituents. However, not all of the policy makers nor all of the voting citizens are experts in the field in which they influence policy. The information in which they make decisions must come from somewhere. The information

providers must have some bias when they present their information. (IE a solar panel producing corporation does not want to say that they have a low efficiency, nor would they want to say that another form of energy has a much greater energy production/amount of resources used). Due to these types of bias, there are myths abound when it comes to the arguments for and against renewable energies, as well as global warming.

Take for instance Time's Magazine, which published an article March 2008 entitled "The Clean Energy Scam". This article focuses on the increasing investment and production of bio-fuels. They proclaim that although bio-fuels are touted as a cleaner alternative to regular gasoline, they may in fact have a more negative impact on the environment and economy. Their logic is as follows: the government(s) provide subsidies to farmers willing to produce crops for bio-fuel production. Farmers not only provide more of their crop for fuel rather than food, but also feel the need to expand their operations to increase profitability. In many areas, these farms are expanding into areas with lush vegetation (such as the Amazon rainforest in Brazil). Not only is extra carbon emitted into the atmosphere for the clearing of the area, but natural carbon capturing vegetation is destroyed in the process. And the combustion of bio-fuels will still produce carbon emissions!

"The Clean Energy Scam" also asserts that as farmers provide more of their crop for fuel instead of food, the price of food sources will also increase. This may not affect the environment, but it does have a negative impact on consumers. The authors summarize that while bio-fuels advocates claim that it is the responsible choice for moving towards cleaner energy and environment, it may actually be more damaging than good [23].

Conversely, in "Four myths surrounding U.S. biofuels" the authors address the assertion that biofuel production is going to increase food prices. They assert that while in the short term this may be true, they rely on economic relationships relating the price of fuel and the price of food. They assert that the increase of costs previously seen has more to do with the increase in the price of fuel than the increase in biofuel production [24].

Also, in "Bioalcoholic fuels", the authors show that although biofuel produced from cellulose of food sources may or may not be taking over vegetation and destroying carbon-sequestering plant life; it appears that there are other forms of biofuels being researched and produced which do not rely on food sources, and can be produced in a laboratory environment [25].

Clearly, the argument for or against biofuels is a complex one. If we insist on using combustion fuels, we must develop one which is clean. Bioethanol as it is now is not a complete solution.

In "Myths and facts about electricity in the U.S. South", Brown et al examine six myths they believe are holding back the (defined by the U.S. Census) Southern states from producing more renewable energy based electricity. The authors find these important, as the 16 Southern states included in the study account for 42% of national energy consumption and 45% of national electricity use, while at the same time consumers see cheaper electricity rates than the national average. The authors propose that this price comfort enables the Southern consumers to worry less about where their electricity and energy come from. The author suggests that this allows an attitude of unlimited consumption and no regard for conservation to permeate [26].

With this type of mindset, it is no surprise that this set of myths prevails. First, the author examines the myth "energy efficiency and renewable energy alone cannot meet the South's growing electricity demand". Both Lee Raymond (former CEO of ExxonMobil) and the Center for Energy and Economic Development (supported by coal and utilities industries) claim that non-hydro renewable energies are a niche market and will not be able to meet the energy needs of the United States, and that the future remains in fossil fuels. Two Southern utilities companies also state that they do not believe renewable energies can supply the proposed increase in energy demand as time goes on. The author meets these criticisms with the idea that by conservation and increasing energy efficiency alone, these demands may just about be met. By incorporating clean renewable energies such as wind power, the demand would certainly be met [26].

Another Southern myth is that those states do have the resources to meet the proposed Federal Renewable Electricity Standard. Georgia's Public Service Commissioner Stan Wise states "Georgia simply doesn't have the wind, solar, or biomass resources required…for renewable energy generation". Senator Lindsay Graham of South Carolina stated "we can't meet the targets in the Southeast". The author proposes that the demand from the RES can definitely be met by the South. Their research indicates that the South could meet these demands by utilizing wind and biopower by utility companies, and CHP and solar panels by the consumer. To support this change they refer to energy credits that are provided in the American Clean Energy and Security Act of 2009.

One major myth which permeates outside of the South is that renewable energies cannot be implemented without rising electricity rates. Senator Jeff Sessions of Alabama claimed that passing the RES would cause individuals to pay "a lot more" for electricity to reach the standard. Entergy Louisiana states that "renewable generation alternatives generally are more costly than conventional generation alternatives" and this would most likely result in increased utility rates for customers if implemented. Also Duke Energy Carolinas, Georgia Power Company, and Progress Energy Carolinas agree that implementing renewable energy would result in a price premium for the consumer. The idea that implementing renewable energies would result in an appreciable price increase has been a major reason for lawmakers and utilities to oppose a Federal Renewable Electricity Standard, as well as renewable energy incentives.

Renewable energies are not the only type of energy generation which has myths pervade within political arena and public mindset. The largest of which is the coal mining industry and the quest for "clean coal" [27].

Recommendations

Although engineers are good with numbers and problem solving, history shows engineers are not popular as politicians in the United States. Traditionally, Western democracy prefers who can debate and are great orators, and people with those qualities are usually lawyers [28].

Technologically literate policy makers understand technological concepts and can sort through conflicting claims made by various stakeholders on an issue. Technologically competent

engineers are traditionally known as experts of technology but may not necessarily think about the larger sociopolitical and ethical consequences of engineering activity. Technologically literate policy makers would have a better understanding of critical thinking and engineering processes.

Policy makers however, are elected by the constituents of the state. Without a technologically literate voting public, the level of technological literacy for a given policy maker will be inconsequential. To ensure that the most well informed and well intentioned policy makers are elected, we must have a technologically literate public. In order to do so, as a nation we must teach students not just to use and know the lingo of technology that is blossoming around them, but also how and why technology changes and the implications of its use.

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