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Sustainability-Efficiency Paradox: The Efficacy of State Energy Plans in Building a More Sustainable Energy Future

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Sustainability-Efficiency Paradox:
The Efficacy of State Energy Plans in Building a More Sustainable Energy Future

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Abstract

State energy plans are created at the request of a sitting governor or State Legislature in order to provide guidance set goals for the state’s energy sector. These plans will be critical indicators of energy trends such as the future market share of coal, natural gas, and renewables. If the future of energy in the United States is to be remotely sustainable, low-carbon policies must headline state plans. The strength of a state’s energy plan in terms of sustainability is directly related to that state’s willingness to prioritize and commit to incorporating energy sources that produce negligible carbon emissions. Questions about the role of efficiency can be answered by the political need for short-run payoffs that do not necessarily align with the long-term goals of sustainability (Kern & Smith, 2008). The nature of the American political system is that representatives want to be able to bring immediate results to their constituents, results that are usually shown in the short-run by efficiency programs. While the state energy plans in question (California, Arizona, Pennsylvania, Iowa, South Carolina, and Virginia) engage with sustainability at varying levels of strength, they deal mostly in weak sustainability by failing to commit to renewables. Historical reliance on energy efficiency and its accompanying theories of growth has created a climate in which state energy plans do not generally realize their enormous potential to lead the national transition away from fossil fuels.
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Chapter 1: Introduction

In 2004, California Governor Arnold Schwarzenegger ordered a hydrogen powered Hummer H2. The one-of-a-kind vehicle was delivered so that the politician could properly express his environmental concern alongside his taste for intimidating machinery. The prototype vehicle was not built to use the hydrogen fuel cells that are relatively common today, rather it was designed to burn compressed hydrogen through a modified internal combustion engine (Lienert, 2005). This unorthodox vehicle was meant to promote the state’s hydrogen infrastructure project, but it also exemplifies the extent to which sustainability has a performative dark-side that undermines the progress of well-intentioned individuals. Even now, hydrogen fueled vehicles can hardly be considered clean vehicles because the primary method of obtaining hydrogen is fossil fuel intensive. This was not a concern of the California Governor, who wanted to prove that he was thinking green by driving anything other than a gasoline or diesel vehicle. The Governor’s stunt was little more than a misguided attempt to have his cake and eat it too. In 2004, hydrogen’s shortcomings as a fuel were even more pronounced than they are today, but there was little concern that the Governor’s stunt would not succeed; what was important was the appearance. This reality exposes the problematic nature of efficiency as a tool of a sustainable agenda.

The politics of environmentalism continue to be perplexing. If the 2016 election cycle revealed anything, it is that the environmental movement cannot simply rely on the settled science of climate change to support a sustainable agenda. Over the past year and a half, it has become clear that evidence matters little in the face of the shareholders’ interests. Even in places

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1 See: Disaster, Hindenburg.
where corporate social responsibility (CSR) is being practiced, it has often produced results that leave us at best, unsatisfied and, at worst, outright misled. For years, “sustainability” has been environmentalism’s Holy Grail. Countless champions have embarked on the perilous journey to attain it, only to be beaten back by pragmatic conservatism and the paradoxes of human behavior. If sustainability is the Holy Grail, then efficiency is the map which we have followed for years in pursuit of it. It would be a great tragedy if the map was incomplete, concealing an alternate route which could bring us closer to our goal without constantly setting us back. Such a route does exist, and safe passage is largely dependent on the traveler’s use of efficiency in working towards sustainability.

State energy plans have the potential to provide the missing piece to the sustainability roadmap. State energy plans are most often created at the request of the sitting Governor or the Legislature, sometimes with the help of the U.S. Department of Energy. Most states have some type of plan, even if they are not considering sustainability, as it is an effective way to keep track of progress over time. As I intend to show, these plans have wide variance in their enforceability and comprehensiveness. I have analyzed six state energy plans in order to investigate their competing definitions of sustainability and efficiency. The state energy plans from California, Arizona, Iowa, Pennsylvania, South Carolina, and Virginia provide sufficient material for such an analysis.

For too long, efficiency has been allowed to serve as an end on its own, rather than a means of achieving an overall more sustainable planet. Focus on reducing the rate of energy usage, however, does not necessarily translate to a reduction in total usage. This means that, even while buildings, cars, and cities become individually less resource intensive, they are not making the progress necessary to avoid the worst effects of climate change. Sustainability must
be taken in a context that is beyond the generational view often quoted to students. It is not enough to leave a world that is livable for the next generation, we must also ensure that they have the tools to guarantee the same for their offspring. Only relatively recently have discussions of global carrying capacity forced us to seriously consider this notion as a driver of policy (Ress & Wackernagel, 1996; Arrow et al., 1995; Cohen, 1995). To adopt a new framework for a stronger sustainability, it is necessary to explore and evaluate past and present approaches to efficiency. The state energy plans in question engage with sustainability at varying levels of strength; they deal mostly in weak sustainability by failing to commit to renewables. Historical reliance on energy efficiency and its accompanying theories of growth has created a climate in which state energy plans do not generally realize their enormous potential. If executed with the strong-sustainability in mind, they have the potential to lead the national transition away from fossil fuels.

In order to align with stronger views of sustainability, energy systems will need to undergo some dramatic restructuring and employ new and innovative strategies along the way (Kern & Smith, 2008; Lund, 2007). Kern & Smith (2008) discuss the “transition management” model of environmental policy which stresses the need to pressure the status quo into a transition with the use of taxes and other tools of government. The theory goes that, by allowing space for alternatives and sustainable technologies and practices to flourish, such ideas will naturally emerge on top. This model aims to restructure energy systems in favor of sustainability by emphasizing learning processes in addition to pushing technological upgrades (Kemp & Loorbach, 2005; van de Kerkhof & Wieczorek, 2005; Kern & Smith, 2008). Such an approach is

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2 This common view comes from the Brundtland Commission’s report to the U.N, and it asserts that the goal of sustainability is “to ensure that [humanity] meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987).
important for the continued education of both the workforce and the general public; as sustainability become more deeply ingrained in people’s lives, it will be much easier to execute on a large scale. The biggest issue with the transition management model is that it requires long-term political stability, a luxury that the United States does not currently enjoy at the federal level. Questions about the role of efficiency can be answered by the political need for short-run payoffs that do not necessarily align with the long-term goals of sustainability (Kern & Smith, 2008). The nature of the American political system is that representatives want to be able to bring immediate results to their constituents, results that are usually shown in the short-run by efficiency programs. The ability of efficiency to deliver this type of result has been well established and could prove useful to even the strongest visions of sustainability.

**Background**

Energy in the United States consists of four major sources: Natural gas, petroleum, coal, nuclear power, and renewables (EIA, 2018j). Today, fossil fuels still account for approximately 81% of the national energy mix (EIA, 2018j). The United States still generates a tremendous amount of electricity from coal, the dirtiest of energy sources. To avoid the worst of climate change, this fossil fuel use must be dramatically curtailed. Thanks in part to the hard work of environmentalists, both the production and consumption of coal has dropped considerably over the past decade. According to the U.S. Energy Information Administration (EIA), coal consumption topped out at just over 105 million short tons in August of 2007, while production did the same in October of 2008 (EIA, 2018a). In April of 2016, both production and consumption hit historic lows, 48 and 43 million short tons, respectively, and the past decade shows a clear downward trend (Figure 1) (EIA, 2018a). Even with this downward trend, the
United States generates over 100 million MWh of electricity per month from coal sources; a sizeable portion of the nation still relies on coal to keep the lights on (EIA, 2018i).

**Table 6.1 Coal Overview**

![ Coal Overview Graph ]


As shown in Figure 1, current consumption and production rates for coal are nearing levels not seen since March of 1978 and February of 1977, respectively (EIA, 2018a). Despite claims to the contrary along the 2016 campaign trail, it is unlikely that the current downward trend will be reversed (Patzek & Croft, 2010).

While it may be true that coal is trending downward, it is critical that the production lost from coal is made up by renewable energy sources. Natural gas will almost certainly play a role

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3 This analysis for production excludes data points significantly impacted by miner strikes in 1974, 1978, and 1981, shown in Figure 1 as dramatic dips in the blue line.
in our energy future, but ideally as a gap-filler rather than a baseload source. While the newfound abundance of shale gas resources is projected to provide a cheap, domestic source of energy in the future, this growth must be carefully controlled. Without policies to incentivize low-carbon options, the current gas boom will only serve to increase consumption and leave us no closer to more sustainable energy sources (Kerr, 2010). The current political reality, one of weak federal leadership on climate issues, gives the states every opportunity to lead the way on this project. State energy plans will be a critical indicator as to how much market share natural gas will be allowed to take over. If the future of energy in the United States is to be remotely more sustainable, no-carbon policies must headline state plans.

It is not only important that the broad category of “renewables” gains favor for meeting U.S. energy needs but also that a diversity of these sources is represented. Renewables in the U.S. are made up of biomass, hydroelectricity, wind, solar, and geothermal, and with the highest potential for growth present in the latter three (EIA, 2018j). Solar, wind, or hydropower alone cannot hope to pick up the slack of a dying coal industry. Together, alongside geothermal, natural gas, and nuclear power, these sources can meet the nation’s energy needs in a way that is conscious of carbon emissions. The challenge is of such great interest because of the vast, untapped potential that lies with renewables, especially solar. Across the globe, solar has the capacity to provide energy at a rate of twenty-three times global consumption (de Vries et al., 2007). The fact that there seems to be negligible effort to realize this capacity is a failure. The sun represents no political party, it has no assets or debits, it ceaselessly generates more energy than we can hope to use and tosses it our direction as if to say that we will always be too stubborn to embrace it. The same phenomenon exists, at a slightly smaller scale, for wind power. Wind turbines are largely invisible to the daily lives of most people, and onshore wind
alone has the technical capacity to produce six times more energy than the world consumes (de Vries et al., 2007). It would take a substantial increase in the density of turbines before people started to notice that they were everywhere.⁴ Again, to even approach the full capacity of wind power would be to provide a significant portion of power for the United States. Geothermal has the capacity to revolutionize HVAC technologies, and should become standard practice on new homes and buildings in variable climate areas. While not a method of directly generating substantial electricity, geothermal heating and cooling will cut down significantly on the demand for power, especially as climate change causes more extreme weather patterns.

**Methodology**

In this study I perform qualitative analysis by exploring case studies through a combination of post-positivist and critical methodologies. The post-positivist focus on natural science and scientific objectivity is an important underpinning of this document, as well as my formation as a researcher. While acknowledging that it is not possible to be scientifically *certain* about anything, I have sought conclusions that are logically sound and scientifically corroborated. My educational history has made me familiar with the tools of critical analysis. Growing up in the San Francisco Bay Area and attending progressive institutions from a young age, I have learned to seek out and often attempt to dismantle the dominant narrative. As a relatively fortunate, white-male, I have the *de facto* benefit of representation in government, whether I voted or not. The people in power look like me, and in that way they will protect me even without my asking. The impending climate crisis will not affect me in the same way that it will

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⁴ There is an argument, however, that the birds and bats might notice such a dramatic increase in wind-turbine density.
affect countless others. This is why it is important for people like me to address these existing power structures. I believe that these power structures are hard at work in complicating the renewable energy transition. The omnipresence of energy in the lives of people makes this battle important, and today I hope to join the ranks.

It is a rare time when the context of a research question is not laden with relationships of power. Understanding these power relationships is key to answering important questions about the nature of a system; not only do they tell the researcher what cards each player holds, but why the cards were dealt that way in the first place. The system that I have chosen to evaluate is the production and delivery of energy in the United States, viewed in the context of several State Energy Plans. Federalism is unique in the autonomy it affords its regional officials, and has produced a wide set of plans from which to choose. I make a conscious effort to choose a sample that is diverse and interesting, and in my description of these cases I analyze them on their own and in the context of the literature discussed below. I outline the energy landscape in each state and compare it with that state’s goals and recommendations for the future. Using this information, my analysis provides insight towards the sustainability of state actions, finding that they are underwhelming in their sustainability initiatives.
Chapter 2: Literature Review

As sustainability has grown from a simple vocabulary word into a global basis for change, it has attracted the attention of many philosophers, environmentalists, and politicians who have tried to pin down its meaning. The thorough historical work of Jeremy Caradonna (2014) shows that, while the concept of sustainability has existed for some time, it did not become a part of scholarly discourse until the late 1970s and early 80s. Since then, its usage in the titles and keywords of academic work has skyrocketed (Caradonna, 2014). The cacophony of voices has made sustainability something of an enigma, with a definition that is hard to pin down, and easily made into something self-serving. Despite broad range of ideas represented by this influx, most definitions fall within two categories: those which place inherent limits on “traditional growth” (Robért, 2017; Heinberg, 2010; Bartlett, 1978, 1994; Caradonna, 2014), and those which embrace or are at least open to it (Dryzek, 2013; Brundtland Commission, 1987). This rift can also be considered in terms of varying levels of faith in technological and social innovation.

The “traditional growth” about which these authors are split represents hundreds of years of boundless consumerism and manifest destiny. It is rooted in the notion that Gross Domestic Product is a complete and accurate measure of progress, and that, without fail, where there is investment, there is innovation and improved quality of life. This understanding of growth is reliant upon “the assumption in classical economics and industrialism that nature is essentially a cornucopia, that natural resources can never run out (or that market prices and technology will always ‘save us’)” (Caradonna, 2014). By determining a person’s attitude towards this conception of growth and progress, one can make more meaningful use of that person’s accompanying definitions of efficiency and sustainability. This is precisely how I intend to
assess the existing literature on these topics, and this assessment will expose a great deal of conflict within academic discourse on sustainability.

The first group of authors, those who would inherently limit growth, offer generally consistent accounts of how efficiency is understood in the context of sustainability. These definitions are often concerned with value as a main factor, as well as a reduction of waste; they begin to tell a story of efficiency as a tool of “traditional growth” (Baumgartner & Quaas, 2010; Ehrenfeld, 2005; Huppes and Ishikawa, 2005; Derwall, Guenster, Bauer, & Koedijk, 2005; Glavič & Lukman, 2007). The second group of authors attempt to reconcile this version of efficiency with sustainability more generally, with varying degrees of success. These authors can be divided into the two categories described above. First, there are those who point out the imbalance, or ecological debt, created by humans, and declare that infinity is an unacceptable benchmark for progress (Robért, 2017; Heinberg, 2010; Bartlett, 1978, 1994; Caradonna, 2014). The remaining authors are those who believe that the traditional growth model is still compatible with human survival, or at least do not think it is inherently flawed (Dryzek, 2013; Brundtland Commission, 1987). These authors find tremendous hope in the potential for technological innovation, and advocate for independence as different nation-states chart their own path into the future. These ideas are particularly important to this thesis because they set the stage for an analysis of the interaction between sustainability and efficiency discourses, and, eventually, a discussion of several State Energy Plans in the context of said analysis.

Efficiency

Before diving headlong into the debate over sustainability, it is necessary to learn where efficiency sits amongst these competing ideas. Understanding historical notions of efficiency,
and its close link to economics, is key to understanding contemporary visions of sustainability. A 2010 paper from Baumgartner & Quaas (2010) posits that efficiency is primarily understood as non-wastefulness and that sustainability economics, as it were, entails a concern for efficiency “in the allocation of natural goods and services as well as their human-made substitutes and complements” (p. 446). Most ways of describing efficiency present an image that is quite pleasant. After all, non-wastefulness seems like a pretty good standard to live by, and “natural goods and services” ought not be wasted. Baumgartner and Quaas, however, provide the closest thing there is to a sustainability-friendly definition of efficiency, as it is not primarily focused by concepts of value or growth.

Other authors consider and analyze the term eco-efficiency. Definitions vary slightly but imply some manner of balance between the economic and environmental pillars of sustainable development (Ehrenfeld, 2005). This balance can be understood as a ratio calculation that places, perhaps symbolically, economic value over environmental impact, or in some cases, waste (Huppes and Ishikawa, 2005; Derwall, Guenster, Bauer, & Koedijk, 2005). Growth is the foremost objective for these authors, with success only to be divided by the degree of environmental impact. Glavič & Lukman (2007) define eco-efficiency as, “the delivery of competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life cycle” (P. 1878). This is a particularly ambitious assessment of what efficiency alone is capable of; such overselling may begin to explain efficiency’s shift from method to end-goal. When these growth oriented concepts become the end-goal of sustainability, rather than a means, sustainability is weakened substantially.
Sustainability

Karl Henrik Robért, the founder of The Natural Step, maintains that there are four conditions that must always be met for a “sustainable” society to exist. \(^5\) His body of work is built upon these conditions, laid out in a 2000 article:

In a sustainable society, nature is not subject to systematically increasing (1) concentrations of substances extracted from the earth’s crust (digging), (2) concentrations of substances produced by society (dumping), (3) degradation by physical means (destroying), and (4) people are not subject to conditions that systematically undermine their capacity to meet their needs (Robért, 2000, p. 245).

These conditions make no specific mention of growth, but the omission speaks just as loudly. Robért’s direct consideration of the planet and the people leaves little room to doubt his expressed priorities, and makes implicitly clear growth’s role in a sustainable society. The key to understanding Robért’s position is the phrase, “systematically increasing”; a scheme of “systematically increasing” digging, dumping, destroying, and poverty bears a tremendous resemblance to traditional notions of growth in the western world. Robért identifies this systematic increase as harmful, creating a stance that strongly limits growth.

Jeremy Caradonna makes a similar observation in more general terms in his 2014 book: “‘Sustainability’… is a way of acknowledging how humankind has created an imbalance.” The imbalance, towards which Caradonna alludes, invokes images of environmental philosophers like Barry Commoner, who championed the idea that humankind has worked itself deep into an environmental “debt” that would soon come due. Beyond the general directionality, Caradonna (2014) identifies four major pillars of sustainability as follows: “[1] Human society, the economy, and the natural environment are all interconnected… [2] A Society will respect ecological limits or face collapse… [3] A Society that hopes to stick around long term needs to

\(^5\) Robért founded The Natural Step, a non-profit organization, in 1989 with the goal of bringing about a “sustainable society”.

plan wisely for the future… [4] Localize, decentralize”. Caradonna’s definition contains a clear repudiation of traditional growth in the second point, on which he elaborates on the necessity of limits. Caradonna points out that by placing limits on ourselves, humanity is rejecting traditional growth as it presupposes a nature of inexhaustible resources. In addition to directly rejecting the idea of infinite growth, Caradonna makes a further note about the role of technology. Technology cannot, in his view, be counted on to bail humans out of some of the limits. To throw that balance back in favor of the survival of humankind, Caradonna implores us to do more than innovate technologically; we must change the way we live in accordance with what we know about our planet.

Another definition of sustainability, courtesy of Richard Heinberg (2010), includes more technical description than the rest, but nonetheless provides useful context. Below are Heinberg’s five “Self-evident truths” of sustainability:

1. Any society that continues to use critical resources unsustainably will collapse.
2. Population growth and/or growth in the rates of consumption of resources cannot be sustained.
3. To be sustainable, the use of renewable resources must proceed at a rate that is less than or equal to the rate of natural replenishment.
4. To be sustainable, the use of nonrenewable resources must proceed at a rate that is declining, and the rate of decline must be greater than or equal to the rate of depletion.
5. Sustainability requires that substances introduced into the environment from human activities be minimized and rendered harmless to biosphere functions (Heinberg and Lerch, 2010, p. 13-24).

Heinberg appears to use the term sustainability in its own definition, and his talk of “rates” is noteworthy, but his word-choice indicates that he is calling for a decrease in total resource use over-time, as opposed to an efficiency-based decrease per unit of work. He gets partially into lower-level description with points 3 and 4, but they are not as trivial as they seem. In fact, their significance is more obvious when their order is reversed. Point 4 suggests that, not only should non-renewable resources be phased out completely, but that it should happen at a rate which exceeds the rate of use. This necessarily constitutes the eventual elimination of non-renewable
resource use, which brings us to point 3. In the absence of non-renewables, renewable resource use may not exceed the rate of natural replenishment. This sounds straightforward, but the implications are far reaching with regards to the limits it places on growth. Heinberg’s “truths” necessarily limit growth by the earth’s natural rates of recycling, in agreement with Caradonna (2014) regarding the balance of the planet. One aspect of this definition that is conspicuously absent is a discussion of social equity. In other cases, this is considered an important part of the definition of sustainability.

Albert Bartlett (1994) remarks that the concept of “sustainable growth” is an oxymoron. The idea that any earthly system might grow to an infinite size for an infinite time is absurd, but Bartlett argues that this is the logical conclusion of the term “sustainable growth”: “If we accept the idea that ‘sustainable’ means for long indefinite periods of time, then we can see that ‘sustainable growth’ implies ‘increasing endlessly,’ which means that the growing quantity will tend to become infinite in size” (Bartlett, 1994, p. 7). Given the known limits of our planet’s resources, it would seem thoughtless to propose a “solution” that suggested that possibilities were limitless. Looking farther back into Bartlett’s work, his earlier (1978) suggestion that we “make [economic] growth pay for itself” can be seen not as an inclusion of economic values on par with environmental ones, but a call to entirely reimagine economic “growth” as a net-zero proposition (p. 884). Regarding energy, Bartlett makes another compelling point:

The larger the global total daily demand for energy, the smaller is the probability that a new energy source or technology will be found that will have the potential of being developed sufficiently to meet an appreciable fraction of the global daily energy demand for any extended period of time (Bartlett, 1994, p. 28).
Bartlett makes the case that, not only do growth and sustainability clash on the philosophical level, but also on the practical level when it comes to the energy sector. Bartlett also critiques other academic writing that takes a different view of growth as a facet of sustainability.

One piece with which Bartlett takes issue is the oft-cited U.N. Report known commonly as *Our Common Future*, created by the Brundtland Commission in 1987. Perhaps the most famous part of the report is the assertion that “Humanity has the ability to make development sustainable—to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987). So famous is this definition that I have already used it in earlier sections of this document as a generally-applicable and accepted baseline. While this piece of the report appears progressive and has been well-received, it is underlain by dissonant rationale. The report notes that:

> The concept of sustainable development does imply limits - not absolute limits but limitations imposed by the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the effects of human activities. But technology and social organization can be both managed and improved to make way for a new era of economic growth (WCED, 1987, n.p.).

In contrast to the previous authors, the Brundtland Commission feels that humanity is destined to achieve a “new era of economic growth.” Not only is economic growth the most desirable outcome, but the path towards it is paved with the sound social and technological management. In this way, the authors place tremendous faith in humanity’s ability to innovate its way out of the current crises, rather than automatically limiting the potential for growth.

In John Dryzek’s 2005 book, he finds little use in attempting to define sustainability in a way that can be applied around the globe. He is drawing on what has become incredibly clear in recent years: if you have solved a problem in one part of the world, you are not necessarily any closer to solving it anywhere else. To this end, Dryzek remarks:
Sustainability, like democracy, is largely about social learning, involving decentralized, exploratory, and variable approaches to its pursuit. Sustainable development (unlike survivalism) can be a multilayered and multifaceted enterprise. Rather than try to impose a common definition replete with an associated set of precise goals (which is what administrative rationalists would do), a ‘decentered’ approach would stress pluralistic and local experimentation (Dryzek, 2005, p. 16).

Such an approach to sustainability is valuable conceptually, as it allows for some much-needed flexibility in a field that is becoming increasingly rigid. Most importantly, Dryzek’s work opens the door to diverse and competing forms of growth. By ensuring that communities control their own future, they will be free to throw off the often-oppressive yoke of global economic pressure, especially when it comes to Global North and South power-dynamics. In a similar fashion, however, a completely decentralized approach may lack the synchronicity to be effective, as some communities may opt for less-than-ideal paths of action.

**Discussion**

The conceptions of both sustainability and efficiency are split over the prioritization of traditional growth. It is important to ask, then, what this means for how energy has been used in the past and how it might be better used in the future. In answering this question, it is necessary to more deeply analyze the key principles of efficiency and its proper place within concepts of sustainability.

**Efficiency**

The 19th century economist William Stanley Jevons, in his 1865 paper entitled: *The Coal Question: Can Britain Survive?*, identified a major problem with efficiency. As Great Britain and the world were reliant on coal to meet energy needs, Jevons set out to explore the possibility that it could be replaced in any significant capacity by another power source. One of Jevons’ main
findings is now known as the “Jevons Paradox,” named because of its seemingly nonsensical conclusion. Jevons determined that improvements in energy efficiency would not provide reductions in energy consumption and the consequent total consumption of the energy resource (Jevons, 1865). Jevons’ final determination, that coal would reign as the world’s dominant and only energy source until it ran out, causing the collapse of modern society, was clearly mistaken. However, even as his larger argument fell apart (due to his inability to conceive of a replacement fuel), the basic precepts of his paradox stand firm and continue to nip at the heels of sustainability-inclined individuals. Environmentally-concerned people ought to consider the gravity of Jevons’ claims that not only are efficiency improvements unhelpful for reducing greenhouse gas emissions, but they can be dramatically counter-productive (Sorrell, 2009).

Jevons argues that improvements in the efficiency of steam engines would lead to cheaper coal, steel, rail transport, and steam, which would create a positive feedback loop, improving engine efficiency and driving further consumption (Jevons, 1865). As coal operations became more profitable, they would become targets for investment and enlarged economies of scale would lead to even greater consumption of coal (Jevons, 1865; Sorrell, 2009). Despite the technological advances in steam engines that many thought would enable them to use less coal, people found themselves using more. It is this phenomenon that has earned the Jevons Paradox a second-order nickname: The myth of technological liberation (Polimeni & Polimeni, 2006).

It seems that efficiency, far from being the environmentally-friendly idea that it is given credit for, is better described as a harbinger of growth. Energy’s ability to affect the economy has been traditionally undervalued and consistently falling energy prices may be critical to sustained economic growth (Ayres et al., 2007). In this way, the Jevons Paradox is not a strange twist, but a central pillar of contemporary growth understandings. The problem the world faces
today is that many electricity generation processes have achieved their theoretical limits of efficiency, and energy prices can decrease no further (Ayres et al., 2007). Ayres believes that combined heat and power (CHP) installations on a large scale is one way to continue improving efficiency and its accompanying growth. Reducing wastefulness is not exclusively part of the sustainability toolbox, and it is a key component of capitalism in general. William Stanley Jevons shows that humankind was concerned about efficiency long before humanity knew of its global climate crisis. Given this reality, and efficiency’s established ties to both growth and conceptions of sustainability, it is not hard to see how efficiency has become a key principle of institutions aiming to increase profits and market share while appearing environmentally friendly. It is at this point, commonly known as greenwashing, that efficiency becomes an end rather than a means. If institutions are able pass sustainability muster on this low standard, then it is not much use at all.

Rather than seek a rate-reduction, it may be more in line with sustainability goals to make source reduction the top priority. The concept of efficiency reveals that, in dealing with energy, most people are looking for a rate reduction; the aim being to decrease the amount of energy required to perform a given amount of work. As Jevons showed us, this process does not always translate cleanly into reducing consumption. Source reduction is outlined as a way of “redesigning products or patterns of reduction and consumption” in a way that reduces the overall energy that is used for a certain process (Glavič & Lukman, 2007). For example, rather than simply require that new buildings use efficient lighting fixtures, create a lighting energy cap for such buildings. In this scenario, the most efficient technology is used (assuming a reasonable

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6 Reducing waste is key to capitalism because it underlies the maximization of profits and production. The idea of maximization is closely tied with the idea of efficiency.
cap), but the ghost of William Stanley Jevons can haunt us no more. There is, it should be obvious, a place for efficiency within sustainability, but the systems to which it is applied will be on a much different scale.

As opposed to paying back our debts to the planet, as Barry Commoner would have us do, it is possible to wait out our great creditor. The earth will outlive humankind, and that its great life-giving cycles operate on a longer scale than the beings it hosts. If, however, humans were to make it far enough to allow some of those cycles to turn over, we would have the closest thing to full debt forgiveness that the planet has ever seen. This is a big if, and it relies on humankind’s ability to build a more sustainable society. This, in turn, will rely on the successful incorporation of efficiency into the desired sustainability framework. As Ayres et al. (2007) demonstrated, the energy sector is running out of room to grow, and rather than keep trying to carve out space in the changing world for natural gas power plants and incandescent bulbs, it is time that the industry underwent some change from within. This change can come from a different common understanding of sustainability, one that treats efficiency as a stepping stone rather than a job well done.

Since efficiency is not an ideal indicator of sustainability, more comprehensive metrics are necessary for building a sustainable energy system. One of the main shortcomings of efficiency as a metric is its position as a measure of rate. This echoes the concerns of Hanley et al. (2009), who wrote that caution must be used when such a “relative” indicator of sustainability is used; success measured by such an indicator does not preclude the dangerous rebound effect discussed above. Instead, Hanley et al. recommends that more “absolute” indicators be utilized in order to achieve sustainability. Indicators such as total electricity usage and total use of non-electricity energy would be a more effective way of ensuring that consumption decreases.
absolutely. Combining those measures with the share of electricity generated by renewables will
give a sense of how much emissions and resource consumption will actually decrease. Of
course, it is still important to keep track of rates, and the relative sustainability of the economy
can be approximated by looking at GDP per unit of energy, for example (Pearce, 2001). Such a
metric is a useful tool for sustainability, it is simply a lower priority in this view. These different
methods of measuring progress produce not only varying pictures of success, but entirely
different concepts of sustainability.

**Sustainability**

Sustainability’s relationship to economics can vary dramatically depending on the chosen
definition of sustainability. Sustainability can be characterized along a continuum from “weak”
to “very-strong” (van den Bergh, 2010). Weak sustainability, while well intentioned, relies on a
preservation-of-capital philosophy that makes one large account of natural and economic capital
(van den Bergh, 2010). This is considered weak, despite the fact that it *does* account for natural
capital, because it does not require natural capital preservation. As shown in Figure 2, weak
sustainability considers the interconnectedness of the economy, society, and the environment, but
it makes no presuppositions about the appropriate nature of those relationships. This is the type
of sustainability practiced by the second group of authors and it is often drawn out using growth
theory (van den Bergh, 2010; Hartwick, 1977).

Weak sustainability is opposed by both “strong” and “very strong” sustainability (van den
Bergh, 2010). Strong sustainability differs only slightly from its weaker counterpart in that it
considers both natural and economic capital, but requires that they be accounted for separately
(van den Bergh, 2010). This represents a stronger vision of sustainability because it does not
recognize the interchangeability that could allow one form capital to completely take over for the other. Referring again to Figure 2, strong sustainability views the environment as the foundation without with economy and society cannot exist. It acknowledges that once some natural systems reach a tipping point, they cannot always be brought back into equilibrium through external forcing. Very strong sustainability takes this philosophy of preservation one step further, applying it to “every component or subsystem of the natural environment, every species, and every physical stock” (van den Bergh, 2010). Very strong sustainability enjoys many parallels to deep ecology and would no doubt require a similarly dramatic viewpoint shift to be adopted in the mainstream. The main benefit of these stronger forms of sustainability is that they can soften the harmful impacts of the efficiency-driven economic rebound effect. However, this can only be the case if progressive action is taken quickly and on a large scale. To further illustrate the difference between these brands of sustainability, imagine a fishery, home to endemic species and subsistence fishing. A weak sustainability approach to managing that fishery might place limits on overall catch without discriminating between types of fish. A very-strong sustainability approach, on the other hand, would limit catch by species depending on the rate of reproduction and position in the food web. The concept applies to energy as readily as it does to conservation.

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7 Deep ecology is an environmental philosophy that stresses the intrinsic value of nature and calls on society to undertake significant change in its value systems.
Implications for Energy

There is no industry quite as ubiquitous in people’s everyday lives as energy. The energy industry of yesterday is not capable of carrying the project of sustainability forward any further; the future requires changes from this pillar of modern society. Lund (2007) offers a concrete set of energy strategies for a sustainable future; it should be no surprise that these strategies rely heavily on renewable energy resources. There are three types of changes in energy technology that fit into sustainability: demand-side energy savings, energy production efficiency improvements, and the transition to renewable fuel sources (Lund, 2007). A truly comprehensive energy plan should incorporate a balance of these strategies in a way that recognizes the primary importance of renewables; the integration of renewables can be eased considerably if demand reduction and efficiency measures are properly implemented. Even with the complimentary support of the other strategies, renewables face considerable challenges in
joining mainstream power generation sources. The most common complaint about renewables is their intermittency, which creates times of over and under-generation that require attention (Lund, 2007). There are two great ways to address this problem. In the first, states may consider utilizing the excess energy for energy-intensive processes such as desalinization or hydrogen production (Lund, 2007). The second requires a strategic minimization of efficiency programs in a way that makes the “excess” disappear (Lund, 2007). In addition, it costs nothing to ramp down production from renewable resources during peak generation periods, although it would be ideal to save the energy that can be produced. Strategically reducing excess is perhaps the most effective way of countering harmful rebound effects, clearly demonstrating that, while efficiency and sustainability can form a potent pair, there are times when they are best kept separate.
Chapter 3: State Energy Plans

The National Association of State Energy Officials (NASEO) has compiled a list of 42 state energy plans, of which I have chosen to evaluate six. NASEO is a non-profit association that is meant to facilitate information sharing between state energy offices (NASEO, 2018). The NASEO website has conveniently gathered the most up-to-date versions of each state’s energy plan, displaying them across a map of the U.S. that makes it easy to visualize. The sitting Governor or the Legislature requests the creation of these plans, sometimes with the help of the U.S. Department of Energy. As I intend to show, these plans have wide variance in their enforceability and comprehensiveness. Some plans, such as Mississippi and Wyoming, are fewer than 30 pages long, compared to the 100-400 page plans I analyze. I have chosen to evaluate the energy plans from California, Arizona, Iowa, Pennsylvania, South Carolina, and Virginia as since they provide a broad array of environmental, social, economic, political, and geographic circumstances. Each state contains important context in these areas that makes its energy plan unique. California is the most populous state in the union and the world’s fifth-largest economy. The state has a progressive political history and a recent track record of comprehensive environmental policy, including the elimination of coal as an electricity source. Arizona is geographically diverse but its landscape is dominated by sun-baked plateaus that beg for the placement of solar arrays; the historically conservative state is a major exporter of electricity. The dominance of agriculture in Iowa permeates the state’s energy policy. The least populous state under consideration, Iowa’s tremendous wind potential is crucial to the state’s energy future. Pennsylvania’s position atop the nation’s two largest shale formations and extensive history with coal and oil serve to complicate its ability to look forward. Virginia and South Carolina, with their plantation history and reliance on energy imports, are blank slates for
energy innovation. Together, these states make up a comprehensive cross-section of the nation: rich and poor, urban and rural, agricultural, urban, and industrial, democrat and republican, mountainous highland and coastal lowland. In selecting these states, I believe I have chosen a group that accurately demonstrates the full range of energy policy in the United States, which will allow me to better evaluate and understand energy in the nation as a whole.

It is important now more than ever to have a comprehensive energy plan that largely relies on renewable sources. As natural gas eats away at coal’s market share of energy production, we risk missing an opportunity to revolutionize the energy sector. The decline of coal has given the environmental sector a unique chance to put its money where its mouth is. For years, big talk of a sustainable future has been elbowed aside by reluctant pragmatism. Now, the United States has the opportunity to begin building that sustainable future. Before beginning construction, we must know on what foundation, and with what materials, building will take place. The previous discussion of efficiency and sustainability has supplied sufficient insight towards an analysis of the state energy plans. Using the work of authors before me to build a sustainability mold that properly deals with efficiency, the following analysis will evaluate the sustainability strength of each state’s energy plan. The insight gained from this evaluation will be valuable to future energy policymakers and industry leaders.
Energy in the West: California

The California Energy Commission (CEC) created the State of California’s 2015 Integrated Energy Policy Report (IEPR) in accordance with Senate Bill 1389. Since 2003, the CEC has been required to produce a biennial report that assesses major energy trends throughout the state and provides policy recommendations that best serve the people, economy, and environment of California; the 2015 IEPR marks the sixth report of this kind (CEC, 2015). Governor Jerry Brown’s 2015 executive order, B-30-15, created a statewide benchmark of reducing GHG emissions to 40% below 1990 levels by 2030, on the way to an 80% reduction by 2050. The implications for energy are clear, and were codified in the Clean Energy and Pollution Reduction Act of 2015 (SB 350). SB 350 set specific energy goals for the state, calling for an increase in renewable electricity procurement to 50%, as well as doubling energy efficiency savings, both with a target year of 2030 (CEC, 2015). Referring to the 80% GHG reduction goal, the report is candid, admitting that, “Meeting the 2050 goal will require a deep transformation of California’s energy system – it will require the innovation for which California is so well known” (CEC, 2015, p. 2).

In times devoid of federal climate leadership, California has long held a candle in the window of environmental protection. The innovation, to which the most recent report refers has been well documented; in the fallout of President Trump’s decision to withdraw from the Paris Agreement, Governor Brown has served as “America’s unofficial climate change ambassador”, traveling to China to speak with local leaders and announcing that San Francisco will host the 2018 Global Climate Summit (Mason, 2017; Megerian et al., 2017). With leadership of the world’s fifth-largest economy, international heads-of-state consider Governor Brown a climate change leader (Bureau of Economic Analysis, 2017; International Monetary Fund, 2017). This
international respect and cooperation is facilitated considerably by the state’s robust plan to slow the onset of global climate change.

California’s IEPR has two main areas of focus: Improving energy efficiency in new and existing buildings, and decarbonizing electricity generation throughout the state. The State’s Existing Buildings Energy Efficiency Action Plan is the key to the first focus, especially given that commercial and residential buildings account for approximately 70% of California’s electricity consumption and 55% of its natural gas consumption (CEC, 2015). In that context, it should be no surprise that such buildings represent 13.3% of statewide GHG emissions, a figure which includes on-site fuel consumption and upstream emissions from electricity (CEC, 2015, p. 18). While it is important that new buildings incorporate the most efficient systems available, California makes the prudent decision to focus on existing structures. While it may seem obvious, this is important because roughly 86% of existing buildings were built before the year 2000, and, perhaps more surprisingly, over 40% of existing buildings were constructed before 1971. The Action plan requires the CEC to establish annual targets for efficiency savings and demand reduction, resulting in a doubling of efficiency savings by 2030 (CEC, 2015). The focus on existing buildings is important for another reason: they are much harder to expand. This helps the state to avoid some of efficiency’s economy-of-scale issues that would be tempting during initial construction. Consider the problem in the following way, a developer that is handed light bulbs that are twice as efficient will be tempted to put twice as many light fixtures into a space, whereas the replacement of existing bulbs is far less likely to lead to such a change. In an effort to heed Jevons’ warning, to prevent efficiency from becoming the dominant sustainability metric, the State of California is doing well to focus on existing buildings. Given the speed at which the planet is changing, and the breakneck pace that technology must maintain
to keep ahead of this change, a program dedicated to upgrading existing buildings appears to be good policy.

California provides concrete aid in the form of Property Assessed Clean Energy (PACE) financing, which has provided over $1 billion in financing for improving efficiency and incorporating clean power projects (CEC, 2015). Projects that might fall under this program would include plug-load efficiency programs as well as strategies to offset natural gas usage. “Plug-load” devices are devices that consume power around the clock, even when not in use, simply as a result of being plugged in (CEC, 2015). Such devices have become increasingly common in the past 20 years, and, by some estimates, add up to nearly two-thirds of California’s residential electricity use and 23% of commercial energy usage (CEC, 2015). State-funding in this area has the potential to save tremendous amounts of energy. Similarly, the PACE financing could be used for clean power or combined heat and power (CHP) projects. These projects would produce electricity and direct natural gas savings, with a beneficial effect on energy-related GHG emissions. The funding could even apply to off-site facilities such as solar PV (standard solar panels) that would serve to offset on-site usage (CEC, 2015).

**Unintended Consequences**

California’s larger vision of “Zero Net Energy” (ZNE) buildings is a clear example of a state focusing on efficiency for growth rather than source reduction. According to the IEPR, “A ZNE Code Building is one where the value of the... energy produced by on-site renewable energy resources is equal to the value of the energy consumed annually by the building” (CEC, 2015, p. 41, emphasis original). Executive Order B-18-12, signed by Governor Brown in 2012, directs the State to ensure that new buildings and major renovations after 2025 have a ZNE
profile, as well as requiring that half of state-owned square footage be considered ZNE on the same timetable. ZNE is an intriguing concept, but California’s definition leaves some room for the program to be entirely ineffectual. The discussion of “value” rather than total usage is contradictory. It seems fairly misleading that a program entitled “Zero-net-energy” would have a metric other than net energy as its determining factor. By evaluating buildings by the value of the energy they consume and produce, varying price points and demand curves could lead to a disingenuous representation of which buildings are performing sustainably. The second, and perhaps more troubling, issue with California’s ZNE plan is not necessarily the fault of the program itself, but a symptom of larger problems. A focus on “net” energy means that, at the end of some arbitrary period of time, inputs must equal outputs. The issue is that this strategy places no concrete limits on the inputs, which means that, with carbon-intensive generation, environmental impacts will likely remain high. Even if the state’s building’s eventually return the energy they consume to the grid via solar panels, they are still relying on the initial electricity from carbon-intensive sources. Net-zero energy is an excellent strategy right up to the point where one realizes that it is not electricity use that causes climate change, but carbon emissions, and a zero-net emission policy would be more progressive in this regard.

This concern brings us to the second major point of California’s IEPR: decarbonizing electricity generation. In California, natural gas is responsible for just over 50% of electricity generation, approximately 7.2 million MWh (Energy Information Administration, 2017). If that figure remains in its current range, any efficiency project, such as the ZNE buildings mentioned above, will be severely limited in its ability to curtail GHG usage and make meaningful progress towards climate goals. The good news is that, between 2008 and 2013, California doubled renewable generation, and halved that of coal (CEC, 2015). In 2007, California created a goal of
installing 3,000 MW of commercial and residential solar capacity, which it surpassed in 2015, a year and a half ahead of schedule (CEC, 2015). This goal was structured to include secondary objectives for both public and state utilities, which is a positive sign for the electrification of overall generation capacity.

*The Trouble With Solar*

California’s demonstrated pivot towards renewables is not without its complications. As antiquated base-load power sources are taken offline, it must able to fill in that gap in a way that is reliable. The IEPR is candid about the reliability issues that plague renewable energy sources, most of which are based in the incompatibility of solar supply and peak demand curves. A common problem, known in California as the “duck curve” demonstrates just this issue. As shown in Figure 3, rising solar capacity has two dramatic effects.
Sustainability-Efficiency Paradox

Figure 3: The “duck curve” showing the over-generation risk that accompanies renewables. Source: U.S. Department of Energy, 2017.

First, peak generation, on top of base-loads, has the potential to overproduce during the middle of the day. This can cause prices to go briefly negative, which is not ideal for the solvency of utilities. The second issue occurs when the sun sets. By an unsurprising coincidence, the standard work day is the same for western adults as it is for the sun. At roughly the same time that workers finish being productive and go home to become consumers, the sun ceases to be productive, leaving other energy sources to pick up the slack in supply right as demand ramps to its daily peak. In California, that role is played by natural gas, which is relatively cheap to ramp up but expensive to run in the long-term. While natural gas is less carbon intensive than coal, its emissions are not to be ignored. These problems of supply and demand are joined by an equally disruptive problem of technology: battery storage. Battery technology has not followed the same
arc of exponential improvement that is enjoyed in other areas of innovation, and the batteries that
do exist are made from rare earth metals (Majeau-Bettez, Hawkins, and Strømman, 2011; Schlachter, 2013).

California has been progressive in its efforts to solve the problems of renewable reliability, with its suggestions falling into two major categories: Rethinking power distribution and rethinking end-uses. Both of these methods are discussed at length in the IEPR, followed by a final suggestion of action items moving forward. The Energy Imbalance Market (EIM) is the prevailing solution for distribution concerns, as it would allow peak generation in California to fuel peak demand farther east. Such a system, deployed across the country, would begin to smooth over the variability questions associated with wind and solar, and the plan reports that “substantial progress” has been made toward the development of an EIM (CEC, 2015, p. 61).

The second category of solutions are those which would use the excess power at times of over-generation. At its core, over-generation is not a bad problem to have, and these strategies take advantage of that fact. This is where California’s concern with plug-loads comes into play. Plug-loads are simply the electricity drawn out of power outlets in a building, and they often draw power even when not in use. A system of automated demand-response could sequester plug-loads and create an incentive system for using energy during certain hours and conserving in others. Other proposals include using the excess electricity to create hydrogen for fuel cells or to desalinate water for consumption. The benefit of these options is that they allow the State to mostly circumvent the battery problem by using excess energy in real time. However, none of them make it a goal that Californians use less energy as a whole. In its final recommendation for supporting renewable development, the State focuses on identifying new capacity, incentivizing construction, and facilitating integration for renewables (CEC, 2015). This is a strong
sustainability recommendation in the tradition of Lund (2007), which aims to build renewable capacity as broadly as possible. The state’s strong goals and benchmarks are good evidence of Kern & Smith’s (2008) transition management model, wherein the state takes advantage of its regulatory powers to encourage a transition. While the state does not adhere strongly to Glavič & Lukman’s (2007) source reduction philosophy, its work in the integration of renewables softens this error considerably.

Arizona

In 2013, the State of Arizona released *emPower Arizona*, the first statewide energy assessment since the state’s original 1990 energy plan. The original plan was brought on in the wake of the energy insecurity of the late 1980s, but its recommendations never took hold (MEPTF, 2013). The plan was the result of Governor Janice K. Brewer’s “Four Cornerstones or Reform,” in which the governor signed an Executive Order to form the Master Energy Plan Task Force (MEPTF). This task force created *emPower Arizona*, and in the process identified five executive level goals: (1) Increase solar development, (2 & 3) educate Arizona’s next generation of energy professionals through energy education and job-training, (4) reduce energy consumption, and (5) establish an energy advisory board to address energy issues on an ongoing basis (MEPTF, 2013). The Governor’s accompanying letter stresses that maintaining agency is an important aspect of this new plan, that it is an effort to define Arizona’s energy future on its own terms (MEPTF, 2013).

Energy consumed in Arizona is dominated by petroleum, coal, nuclear, and natural gas. Petroleum holds the largest share, at 29.1%, and is primarily used in transportation. The Arizona plan makes a point of sharing transportation’s role as way of explaining petroleum’s share of the
energy mix. This move comes off as defensive and it may represent political insecurity about the energy mix. The state’s electricity generation is dominated by the Palo Verde Nuclear Generating Station (PVNGS), which has a capacity of 3,900 MW. This makes PVNGS, which provides 19% of energy consumed in Arizona, the largest nuclear plant in the country, and the second largest power-plant of any kind (MEPTF, 2013). Arizona is also home to twenty-nine natural gas power plants, which provide 17.1% of the energy consumed in the state (MEPTF, 2013). Six coal powered plants and one major coal mine provide 26.8 of Arizona’s energy (MEPTF, 2013). The remaining 8% of energy is produced by renewables, highlighted by twelve hydroelectric plants that produce 62.5% of the renewable share. The remainder of renewable energy consumed in Arizona is the product of biomass (26.4%), solar (6.4%), wind (1.8%) and geothermal (0.2%) operations (MEPTF, 2013). By end-use, the majority (36%) of energy consumed goes towards “appliances”, which includes miscellaneous electronics as well as common household items such as pool pumps (MEPTF, 2013). Air-conditioning is the final destination for one-quarter of Arizona’s energy, with space-heating (15%), water-heating (17%), and refrigeration (6%) making up the final 44% (MEPTF, 2013).

Overall, the state is a net-exporter of electricity, sending roughly 25% of its generation to other states and Mexico (MEPTF, 2013). Combine this statistic with the fact that Arizona imports its natural gas (290 Trillion BTUs) and over 60% of its coal (285 Trillion BTUs), and a strange picture of the Arizona energy market begins to emerge. At the time that *emPower Arizona* was published, the state imported roughly 575 Trillion BTUs, but ended up exporting roughly 150 Trillion BTUs; nearly 26% of total imports were being turned right around and sent out of state.\(^8\) As of 2015, the state exported a total of 305.8 Trillion BTUs of electricity,

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\(^8\) It may be argued that this is the state’s way of dealing with regional demand fluctuations. If this is the case, then Arizona is already employing the type of innovative energy sharing that will be required by large-scale renewables.
compared to the 385.8 Trillion BTUs generated by coal. There are few reasonable explanations for such a grossly inefficient system other than a politically motivated propping up of coal and natural gas in a way that makes little economic or environmental sense to the independent observer. Arizona could dramatically reduce its carbon footprint tomorrow if it decided to stop acting as a way-station for 150 Trillion BTUs of fossil fuel-intensive energy. Indeed, since the state’s plan was published, utility operators voted to close the 2250 MW Navajo Generating Station (NGS) upon expiry of the lease in 2019 (Randazzo, 2017). This would drop the total amount of coal-fired capacity in Arizona by 40% (EIA, 2018e). Even in the absence of this action, Arizona’s executive goals and detailed energy plan provide a course of action that is the generally quite friendly to the desired sustainability goals. I will go over that aspects of the executive goals which make the plan particularly attractive from a sustainability perspective. Of course, no plan is perfect, and *emPower Arizona* is no exception. I will address specific, unfavorable trends as they arise, as I have done above with Arizona’s penchant for importing fossil fuels and exporting electricity.

**Arizona’s Executive Goals: Renewables**

Arizona begins with its first executive goal: “Increasing Solar Energy Development through Best Practices and Leading by Example” (MEPTF, 2013, p. vi). It specifically names the type of renewable energy it aims to incorporate and then expresses a desire to identify best practices and lead by example. There is no linguistic trickery of the “alternative energy sources,” only a direct desire to make the best use of the states geographic and climatic conditions. There is significant action already to back up this goal; the state is second in the nation in solar installations (MEPTF, 2013). Arizona has become a leader in the solar heating
and pumping of water, an activity which otherwise uses over 80% of a home’s electricity (MEPTF, 2013). The state has encouraged the development of solar on a grand scale, and the world’s largest solar PV generating facility the Agua Caliente Solar Plant, resides in Yuma, AZ, with a capacity of roughly 250 MW. A variety of technologies are represented in the plan, as demonstrated by the Solana Generating Station, a 280 MW Concentrated Solar Power (CSP) plant. In addition to encouraging the growth of commercial solar generation, Arizona is making it easier for residents to install solar while maintaining the solvency of its public utilities. The state’s simple, yet innovative, policy requires solar customers to pay a small monthly fee ($5-$7) in order to ensure cash flow for the maintenance and upkeep of utility infrastructure that its citizens rely on (MEPTF, 2013).

In this way, Arizona has addressed one of the principle concerns with increased renewables on the grid, that customer bills will no longer be a reliable source of revenue. This enables them to guarantee more revenue up front, and keep their doors open through highly variable conditions. Arizona utilities have employed this same principle with the small flat fee for solar users, who still use the infrastructure but are not paying monthly bills as reliably as they once were. It is politically difficult to push a policy that would effectively put an entire sector out of business, regardless of its environmental wisdom. Even though Arizona does not emphasize economic growth in the same way that several other states do, its importance to citizens cannot be understated.

The state has taken steps to address the economic side on behalf of commercial and residential consumers. The state estimates that its 2010 solar tax-incentive program has translated to over $1.2 billion of economic investment (MEPTF, 2013). The friendly regulatory environment has produced a litany of solar-promoting projects such as the Renewable Energy
Standard and Tariff (REST) goals, Renewable Energy Tax Incentives Program (RETIP), Renewable Energy Production Tax Credit, and Commercial/Industrial Solar Energy Tax Credit Program (MEPTF, 2013). This environment has fostered job creation and sector growth while building the nation’s second-highest capacity solar marketplace. Where many other states claim the existence of a zero-sum game between renewables and economic growth, Arizona has pushed ahead, much to the benefit of the 275 companies and 10,000 employees along the solar supply chain (MEPTF, 2013). In an effort to trim some of the bureaucratic red-tape, and its associated cost for consumers, the state has undertaken to eliminate overlap between the various approval processes and allow localities to develop their own requirements to maximize solar potential (MEPTF, 2013).

The full extent of solar power’s advantages often go unrealized due to the nation’s antiquated grid infrastructure, which is unable to handle many of the quirks of renewable energy. As with many aspects of our daily lives, the electricity grid requires a rethinking if it is to serve us well into the new millennium. These innovative grid solutions are known as smart-grid technologies. The state of Arizona has encouraged the co-innovation of solar and smart-grids, and could serve as a good example for many other states in the future. The technologies that have been put to work include remote and automated systems, smart metering technology, infrastructure upgrades, and better demand management (MEPTF, 2013). Automation, such as the EWeLiNE software being employed in Germany, is capable of making predictions and reacting to stimuli in a more precise way than human operators (Thompson, 2016). Combined with real-time data visibility, this is a powerful tool that can give utilities time to ramp other energy sources up or down in advance of renewable supply swings. Smart meters are necessary in a place that practices net metering, and they can also provide consumers with valuable data,
enabling them to conserve energy more easily. Demand-response is a smart-grid tool with high potential, as discussed in the California section, and, as I have begun to show, Arizona hopes to take advantage of this potential without relying on it. The state’s technical improvements would mean nothing without something reliable to connect them. For this reason, optical ground wires have been installed to ease the transfer of data throughout the grid.

In addition to these innovations, Arizona has identified microgrids and energy storage as areas of “emerging technology”. Microgrids have enormous potential given the decentralization of the energy system that will come with the phasing-out of fossil fuels. These microgrids can be connected to a larger networks, but function mostly as closed systems. Currently, they are ideal for areas that lack connection to the main grid and as a second option for consumers who want to have more agency over their energy source. Traditional energy grids consist primarily of transmission and transformation resources, rather than energy storage. Given what is known about the variability of renewable energy supply, and its conflict with contemporary demand patterns, energy storage should be a primary concern of any future-oriented energy plan. Arizona’s Solana Solar Plant, mentioned above, can store roughly six hours of energy using thermal storage (MEPTF, 2013). With battery technology lagging behind most other areas of technological advance, it is critical that states foster and develop alternative storage techniques. These techniques will benefit every renewable energy source, not just solar.

While Arizona has only made a strong commitment to solar, it has been involved in developing other renewable technologies. As the coal fired power plants of antiquity close down for good, every MW of renewable energy is crucial in replacing the lost capacity. When it comes to hydropower, what the state has not done is just as important as what it has done. Citing “environmental issues”, the Arizona plan states that “future development of new hydroelectric
generation in Arizona is likely to be smaller, more localized projects” (MEPTF, 2013, p. 29).

Fifty-two years removed from the flooding of Glen Canyon and in the presence of clear evidence of the ecological detriment of dams, the state is adopting a new approach to this energy source (Garcia, et al., 2011). In the face of climate change, it would be easy to call for more and larger dams in the way that many in California’s central valley have done, but the state appears committed to limiting such development on environmental grounds. Arizona’s geothermal development is trending much in the same direction: smaller and smarter. These small-scale direct uses include the use of high-temperature resources as well as geothermal heat pumps, which take advantage of relatively stable underground temperatures to maintain climate control in a building. If such resources were to become widespread, large scale savings on both utility bills and greenhouse gas footprints would quickly follow.

One area in which Arizona has been surprising is in its lack of development of wind energy resources. The state’s wind energy potential is estimated at over ten-thousand MW. Of this tremendous capacity, only 2% (238 MW) has been installed. The report asserts that wind energy will require significant transmission upgrades because it is usually generated far from population centers (MEPTF, 2013). These reports are disappointing in light of the state’s willingness to innovate on solar. Given that the state is already engaged in transmission-infrastructure improvements and that these projects would provide economic stimulus, there

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9 The Glen Canyon Dam was completed in 1966 as an alternative to the Echo Park Dam project in Utah’s Dinosaur National Monument, which was brought to a halt by the fledgling environmental movement. The natural beauty and ecological wonder that was Glen Canyon was only realized after this compromise was made, making it one of the greatest regrets of many in the early environmental movement (Billington et al., 2005).

10 Strung along a 250-mile stretch of I-5 in California are a series of signs making incendiary claims about the origins of the state’s prolific drought and the failure of state officials to properly address it. The content of these signs includes the message that “Congress created [this] dust bowl”, and asks drivers “Is growing food wasting water?” and to choose between “Dams or Trains: Build Water Storage Now.”

11 The state does operate the 50 MW Hudson Ranch 1 geothermal generating station, but has focused largely on “direct-use applications” such as building heating, greenhouse climate control, and aquaculture.
ought to be little standing in the way of a significant wind energy investment in Arizona. The state’s vast expanses of unoccupied land lend themselves well to such development, and the power is still needed to offset fossil fuels. This is especially true considering the fact that wind energy generation consumes no water, an invaluable bonus in the arid southwest.

**Arizona’s Executive Goals: Education**

After its first goal of increasing solar energy development, the state’s second and third executive goals include “Educating our next generation of energy professionals,” and “Making Arizona a leader in energy-sector workforce development” (MEPTF, 2013, p. vii-viii). These goals touch upon a less-flashy aspect of sustainability: ensuring that people are trained to meet the goals. Arizona claims a commitment to a stronger energy workforce and smarter energy consumers, and emphasizes the importance of sector-based training (MEPTF, 2013, p. viii). The inclusion of “smart” consumers serves as reassurance that the state is not engaged in maintenance of the status quo, but encourages that people change their habits. Such assurance is further delivered by an emphasis on “succession planning by power plants and utilities”, which shows an ability to look past existing infrastructure and attempt to make the unknown known (MEPTF, 2013, p. viii). Arizona’s concern for the energy workforce of the future, and its methodology for expressing such concern, is supportive of its other energy goals and in the spirit of sustainability.

Arizona’s fourth executive goal represents another dramatic departure. In “Fostering statewide coordination to reduce energy consumption,” the state makes a move that few others have been willing to make (MEPTF, 2013, p. ix). Rather than be satisfied with efficiency as a measure of sustainable progress, the state of Arizona has made explicit its desire to “reduce
energy consumption”. Efficiency is, as it should be, an important step towards achieving this goal, but here it is employed merely as a means to an end. The state expresses a desire to “use [its] current resources more efficiently rather than building more traditional supply-side resources,” providing a critical qualifier that places efficiency and consumption at odds rather than in harmony. Rather than playing a central role in the state’s goals, efficiency is actually listed in the table of contents under the “Arizona Energy Resources” section, alongside the renewable energy sources discussed above. Energy efficiency is much more friendly to sustainability when it is couched within a greater goal of reduced consumption. The state stresses the importance of common sense efficiency improvements and adds that such development “provides benefits to the local economy by supporting local contractors and producing bill savings for customers who take advantage of efficiency measures” (MEPTF, 2013, p. 41). It is important to the state of Arizona that consumers and businesses are given the tools they need to cut their consumption; among the challenges for efficiency that the state identifies are an unaware public and an ill-equipped system of evaluation (METP, 2013). Arizona’s approach to energy efficiency is critical in achieving its consumption goals, but the prescribed changes will not happen at once and require observation and updating.

The state’s fifth and final executive goal is to establish an “Energy Advisory Board” to monitor and evaluate future energy needs (MEPTF, 2013, p. x). In 2014, this board was established by executive order and is meant to “ensure a timely, ongoing discussion with experts about energy status, outlooks, technology developments and issues” (MEPTF, 2013, p. x). This goal is consequential for its eye towards the future, and acknowledgement that the energy picture is constantly evolving. The advisory board is meant to consolidate its information into biannual
updates to the 2013 *emPower Arizona* document, providing an ever clearer picture of the state’s progress towards the rest of its goals.

Overall, Arizona has placed itself ahead of the competition with its sustainability friendly energy plan. There exist some inconsistencies that detract slightly from the general progressiveness of the plan, but the state has done a good enough job at setting its executive-level goals that it is difficult to read them as more than inconsistencies. The most perplexing issue in this regard is the state’s continued use of coal resources in the face of a history of over-generation and electricity exporting. The state reports “decreasing demand” as a challenge that faces renewable sources such as solar and wind, which appears to be a problem solved easily by scaling back coal (MEPTF, 2013, p. 32). If the state uses its workforce initiatives to retrain coal employees, the economic impacts of this transition could hardly be felt. This could even be done while maintaining the state’s electricity surplus by incorporating natural gas as a more reliable base-load source to smooth out renewable intermittency. Aside from the strange question of Arizona’s coal use and perhaps the lack of wind development, the plan lays out a set of goals which are largely supportive of a properly sustainable energy transition. The state takes direct advantage of its geographic and climatic conditions to make solar its top priority, specifically naming it where other states make vague commitments to explore alternative sources. The state’s commitment to building tomorrow’s energy work force and continued monitoring of the energy landscape are areas of underappreciated importance for executing any plan in a sustainable way. The most important section of the plan is the goal of reducing consumption overall. This is a key area of contention within the literature and it deserves recognition as a point of diversion from other plans. Perhaps surprisingly, the perennially conservative state of
Arizona has authored an energy plan that is quite friendly to a progressive vision of sustainability.
Energy in the Mid-West and Northeast: Pennsylvania

In 2014, the Pennsylvania Department of Environmental Protection (DEP) published the Pennsylvania State Energy Plan (PSEP) in coordination with the Federal Department of Energy (DOE). Since 2010, Pennsylvania has received $11.4 million from the federal State Energy Program (U.S. DOE, 2018). The report, entitled Energy = Jobs, outlines the state’s energy philosophy and lays out an action plan for taking advantage of Pennsylvania’s plentiful energy opportunities. In a preface to the plan, then Governor Tom Corbett wrote that the state’s “abundant natural resources” make it uniquely positioned to drive a “new industrial revolution” (DEP, 2014, p. 1). The state’s energy policy is characterized by the moniker “All of the Above – and Below”, which demonstrates an emphasis on making the best use of all the resources at the state’s disposal. This policy is supported by four basic precepts which form a strong philosophy of government: (1) Embracing Free Markets, (2) Energy Independence Leads to Security, (3) Abundant, Affordable, and Domestic [Energy], and (4) Enhancing Our Environment (DEP, 2014). These ideas are woven throughout the plan, though the fourth appears mostly to be an afterthought. The purpose of the plan is to provide “key business decision-makers – and all Pennsylvanians – with the information needed to demonstrate the competitive advantages Pennsylvania has to offer”. The dominant narrative throughout the plan is the idea of Pennsylvania’s energy abundance, and the state’s plentiful resources are a highlight.

The claims of tremendous energy opportunity in the state of Pennsylvania are the result of the geographic borders of the state containing the world’s second-largest energy field (DEP, 2014).12 The state is home to the nation’s first coal mine and oil well, and is steeped in the

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12 In addition to being the nation’s premier reserve of anthracite coal, Pennsylvania lays almost entirely atop the Marcellus and Utica shale formations from which natural gas is abundant.
traditions of the industrial revolution, and America’s foreign and domestic military operations (DEP, 2014). By source, Pennsylvanians’ energy consumption consists of 29.4% coal, 29.5% petroleum, 20% Natural Gas, 18.3% Nuclear, and 2.8% renewables (DEP, 2014). From the outset, the state does not employ a high percentage of renewables and the PSEP does not necessarily place them at the forefront for the future. Electricity generation accounts for 37.6% of energy consumed in the state; by source, Pennsylvania’s electricity comes from 48% coal, 34% nuclear power, 15% natural gas, 1% hydroelectric, and 2% “renewable sources” (DEP, 2014). Pennsylvania has the second highest net electricity generation in the nation. Much like Arizona, however, Pennsylvania is a major exporter of electricity. In fact, Pennsylvania is the nation’s largest exporter of electricity. While the state does not import as many energy resources as Arizona, its reliance on coal remains perplexing in the face of the nation’s highest electricity exports.

Pennsylvania is the only state in the U.S. to produce anthracite coal, and its 277 ton output in 1918 set a record that stood until 1996 (DEP, 2014). In addition to the obvious greenhouse gas effects from the states 600 active coal mines, the PSEP admits that past coal operations have left roughly 250,000 acres of abandoned land holding over 2 billion tons of waste and impacting 5,500 miles of waterways (DEP, 2014). The state claims to have a reclamation project in place for such abandoned land, one which has won national awards for wetlands and elk habitat restoration. Other mitigation efforts include acid-drainage hydro and refuse-to-energy facilities. The state has invested over a half a billion dollars into coal research and development, including efforts to “export the equipment and license clean coal technologies to other countries, where coal-fired electricity production is quickly rising” (DEP, 2014, p. 12). The state is taking advantage of acid drainage from its coal mines to turn hydroelectric turbines
that, ostensibly, clean the water in the process. While the ingenuity of this program is admirable, it would seem an interesting place to be devoting resources. Equally interesting is the state’s refuse-to-energy program. The program consists of 15 facilities totaling 1,451 MW of capacity that have removed over 200 million tons of coal refuse and, according to the state, has provided over $200 million in reclamation value to taxpayers (DEP, 2014). The twist here is that the Alternative Energy Portfolio Standards law recognized coal refuse-to-energy as an “alternative” energy source, which allows the state to meet its goals while installing questionable renewable energy sources.

As of 2016, however, coal has declined to roughly 25% of electricity generation, and natural gas has increased to around 30% (EIA, 2017a). This change has less to do with a disfavoring of coal, and more with recent breakthroughs in unconventional natural gas extraction. Over two-thirds of the state is underlain by the Marcellus and Utica Shale formations, and the state government feels that “tremendous reserves of natural gas put the Commonwealth at the center of the push to make America truly energy independent, while providing affordable, domestic, clean-burning fuel to power an American manufacturing renaissance” (DEP, 2014, p. 13). Embedded within this quote is the desirability of independence from foreign fuel sources, as well as an assertion that natural gas represents a “clean-burning” fuel of the future. Pennsylvania is committed to building a natural gas economy, in just five years (2006-2011) the state went from importing 75% of its natural gas, to becoming a net exporter of the resource (DEP, 2014). While the state claims to have a relatively clean safety record for the transportation and storage of liquid fuels, it is clear that the technology to prevent groundwater contamination from oil and gas activities does not function reliably (Parker, 2004). Since the start of 2017, there have been at least twelve incidents involving oil and gas
infrastructure, mostly pipelines, that led to injuries or evacuations, and the groundwater contamination from hydraulic fracturing in the United States is of great concern to scientists (PHMA, 2018; Brantley et al., 2013). The numbers that the state would rather focus on are economic, and tell the story of 570,000 new shale gas development jobs by 2020. No doubt this would be a positive development, but if the marquee feature of a future-oriented plan is judged only by its appearance on the balance book then that plan is not likely to support even weak sustainability. While efforts to incorporate compressed and liquid natural gas into the state’s transportation sector are productive in the interest of diversity, they mean little in the context of Pennsylvania’s gas boom (DEP, 2014). Much in tune with the rest of the plan, the state’s interest in natural gas is economic, geopolitical, and only marginally environmental.

The state of Pennsylvania does acknowledge the difference between alternative and renewable energy sources. The fact that this distinction exists on paper represents a tacit admission of their fundamental difference. The Alternative Energy Portfolio Standards Act of 2004 (AEPS) requires that 18% of all energy generation come from alternative and renewable sources by 2021, and of this, 45% must be renewable and 55% alternative (DEP, 2014, p. 21). According to the state, renewable sources include solar photovoltaic energy, low-impact hydropower, solar thermal, geothermal energy, wind power, fuel cells, biomass energy, and large-scale hydropower. The state does employ a net metering policy to incentivize residential power generation, and the AEPS set a commercial requirement of 860 MW of solar PV capacity by 2021 (DEP, 2014). Pennsylvania has experienced its most rapid growth in the wind sector, with annual increase of nearly 70% between 2000 and 2010 (DEP, 2014). It is estimated that wind could provide Pennsylvanians with 6.4% of their power (DEP, 2014). The state does not spend much time on geothermal technology, noting only that its resources should be better
assessed and the data made public. Pennsylvania’s seventeen large hydroelectric plants take advantage of a self-proclaimed water-abundant environment and produce over 2,000 MW (DEP, 2014). The state identifies further development in the form of micro-hydropower turbines which produce dramatically lower environmental impact; smaller hydro systems are far less disruptive to the upstream migration of aquatic species. The state’s biomass policy is conscious of the energy-food conflict ignored by Iowa and is focused on the use of woody biomass and other sources of cellulosic ethanol. As a part of its independence initiative, Pennsylvania’s Biofuel Development and In-State Production Act sets the goal of 1 billion gallons of biofuels produced annually, enough to offset the fuel usually purchased from OPEC sources by Pennsylvanians (DEP, 2014). In addition, the state is home to the nation’s largest biodiesel industry, with a capacity of 82 million gallons (DEP, 2014). Pennsylvania lauds the environmental benefits of fuel cell technology and boasts that world-class manufacturing facilities are already sited in the state.

As has been previously discussed, the placement of biofuels and fuel cells as “renewable” is questionable. The state’s treatment of the above renewable sources appears to be nothing other than exploratory. As the plan shows again and again, Pennsylvania seems unwilling to force the energy industry to change its plan, and uses carefully qualified language when discussing renewables: “Pennsylvania will continue to support market-based decisions that increase the use of naturally regenerative and domestic energy resources” (DEP, 2014, p. 27, italics added). This support might take place in the form of state investments into various technologies and “high-growth companies” and its final goal is to “bolster growth and create jobs in Pennsylvania,” a strange end-point for a renewable energy program (DEP, 2014, p. 57). The state will provide passive support for actions that reduce its carbon footprint but only if those
actions do not unduly burden the beneficiaries of the status quo. The question is, what will the state do to ensure that it has a future as an energy powerhouse?

**Contradictory Outcomes**

The final section of the PSEP, *Leveraging Pennsylvania’s Energy Opportunities*, offers clear insight as to how the state plans on moving into the future. The state’s “opportunities” can be read as a list of desired outcomes for the state’s energy future and are accompanied by several suggestions for how to best achieve that outcome. The opportunities that the state identifies can be separated into two categories: those which are wholly contradictory to achieving sustainability, and those which are admirable in theory but lacking in execution. The opportunities identified by the state paint a picture of an economy-focused, efficiency-driven plan that is of little use as a blueprint for future sustainability.

Only a small number of contradictory outcomes lay in this category, but, in a strong sustainability plan, that number ought to be zero. The state hopes to advance its opportunities to create competitive energy markets by “Continu[ing] to support electric and natural gas choice for Pennsylvania’s citizens and businesses” (DEP, 2014, p. 61). The state suggests again that a market-based approach will ensure lower energy prices while encouraging innovation, making it clear that it views competition on the free market as its most prized resource. If renewables are going to become dominant in the necessary time frame, something more robust than the invisible hand will have to take over. The most optimistic climate scenarios require *immediate* action to curb fossil fuel emissions, and those are the ones that project a remotely familiar planet to the one we live on today. Competition amongst renewable sources may prove constructive, but to
insist that anything resembling fair competition would take place between renewables and status-quo technology is, at best, a misguided view of the situation.

The second and final counterproductive opportunity that Pennsylvania is committed to pursuing is “Attract[ing] new business investment by taking full advantage of Pennsylvania’s energy portfolio” (DEP, 2014, p. 61). Similar to the first example, this outcome is desired because of its benefits for economic development. The state is interested in making itself a desirable location for new and expanding business by offering an unparalleled access to energy resources. It should not be difficult to spot the problematic nature of the word “full” in the above quotation. The implication is that, where some states might limit resource extraction for environmental reasons, Pennsylvania will not be troubled to lose its competitive edge. It is essentially the state-level incarnation of prominent concerns over global climate agreements. Many in American politics are hesitant to enter into global agreements because no serious enforcement method exists and heavy emitting rivals such as China and India cannot be counted on to comply, giving them an edge in global geopolitical battles. The worry, that someone is always going to try and game the system to get ahead, exists within the United States as well. That someone is, in this case, Pennsylvania, which has committed to extracting every last ounce of fossilized energy from within its borders rather than let it go to waste. If that is not a golden example of an efficiency-first ethos, then none exists.

**Well Intended, Poorly Executed**

Most of the energy opportunities identified by the state have potential to be truly useful tools for building a sustainable energy future. There are differing interpretations as to the best methods for taking advantage of these opportunities and the state has erred in making its choices.
One theme which has recurred throughout the PSEP is the importance of establishing energy independence. The first opportunity identified by the state is “continu[ing] to advance our nation’s energy independence” (DEP, 2014, p. 61). While this is quite a lofty goal to place within a state energy plan, it is no less logical from an energy reliability standpoint. The state makes no mention of renewable technology in its plan to achieve this goal. On the contrary, the state hopes to “support advancements in coal technology…[.] make natural gas vehicles commonplace…[, and] back the resurgence of refineries made possible by natural gas” (DEP, 2014, p. 61). It is easy to see the thread of the two counterproductive goals poisoning the well from which the goals are drawn. This thread is pulled tightly through the opportunity for improving energy infrastructure by “continu[ing] to support improvements to make our energy more affordable, reliable, and efficient” (DEP, 2014, p. 62). Despite this being another seemingly reasonable end-goal, the only resource called out by name in the action plan is natural gas. The state again unnecessarily limits itself in its failure to bet on renewable resources. Without a strong commitment to back renewables in general, it is quite difficult to make progress towards sustainable energy.

Along similar lines, Pennsylvania’s commitment to “mak[ing] today’s cutting edge technologies commonplace in the future” rings hollow. Again, this type of technological progression is an important goal, but it suffers from an irredeemable lack of breadth in the plan. The only fuel source identified by name in this portion is biofuels, which merits no further discussion in this document, as biofuels are simply not a large-scale transportation solution. Other action items identified by the state embrace efficiency wholeheartedly, but tend to miss the forest for the trees. Co-generation and Combined Heat and Power are excellent technologies, but their efficiency gets us nowhere if the coal is the energy source. The state also suggests using
hydropower to treat acid mine drainage. No doubt this is an efficient use of resources, but certainly it would be easier to stop creating the problem than to come up with more solutions. In other words, why spend the resources to develop a way to clean up acid mine drainage with hydropower when you could simply stop creating acid mine drainage? This concept is also prevalent in the state’s desire to “encourage energy efficiency and storage efforts that prevent energy waste” (DEP, 2014, p. 62). This opportunity specifically mentions efficiency as a desirable end-goal and, in context, it cannot be seen as a strong sustainability measure. It is not the fact that efficiency is discussed that brings this section under fire, but the fact that there is little to accompany the state’s desire for efficiency. Despite the fact that this section contains language encouraging energy conservation as well as efficiency, it clearly holds efficiency as a source of growth in a way that is incompatible with strong sustainability. This suite of solutions focuses too tightly on being efficient without considering the possibilities for radical change that might redistribute problems and solutions.

Pennsylvania’s “All of the above—and below” energy philosophy appears to be in conflict with sustainability. Between the state’s wholehearted embrace of free-markets and its commitment to make the absolute most out of the resources within its borders, Pennsylvania is on a growth-oriented path that leaves little room for sustainable practices to edge their way into the mainstream. Much like Arizona, Pennsylvania could dramatically lower its carbon footprint be ending its coal life-support program. However, the state is devoting serious time and resources into ensuring that coal’s only limitations are naturally occurring. In much the same vein, the state intends to take full advantage of the natural gas boom brought on by hydraulic fracturing technology. Its position atop both the Marcellus and Utica shale formations makes the opportunity too good for state officials to pass on the potential benefits. The state’s only
renewable policy guideline, the Alternative Energy Portfolio Standards, sets unimpressive goals for reducing fossil fuel usage, and contains loopholes that prevent renewable sources from receiving the full support of the state. When it came time to make commitments for the future, Pennsylvania’s action plan is lackluster at best. The proposed actions included items that were either entirely unsupportable under a sustainability framework or executed in the least sustainable way. Pennsylvania may be resource rich now, but it will soon be left behind as the nation transitions away from fossil fuels.

**Iowa**

The most recent plan under consideration is the Iowa Energy Plan (IEP), published in 2016 by the Iowa Economic Development Authority (IEDA) and the Iowa Department of Transportation (IDOT). This is distinct from the Energy Independence Plans that have been published since 2007. State actors firmly believe that Iowa is among the national and global leaders in progressive energy initiatives and the plan, the state’s first, was created in the hopes of solidifying that standing. This confidence is rooted in the State’s various accomplishments in renewable energy technology, headlined by the fact that Iowa was the first state to establish a renewable portfolio standard (RPS) (IDOT, 2016). In 2016, the state set a high watermark as the first state to generate over 35% of its energy from wind, putting the 2020 target of 40% well within reach (IDOT, 2016).

Iowa’s plan emphasizes that increasing and diversifying energy capacity are among the most critical actions in which a state can engage. In accordance with this belief, Iowa is committed to several alternative fuel sources, the most prominent of which is biofuel. The state produces more ethanol than any other state and continues to invest heavily in more advanced
biofuel technology. This has been accomplished alongside the fact that Iowa has become the third-cheapest state for energy, and ninth-cheapest for electricity, in the country (IDOT, 2016). The state is concerned with energy for its potential to affect the economy, and holds continued growth up alongside, and occasionally above, environmental quality as motivation for such accomplishments. With its energy plan, Iowa hopes to achieve a “prosperous energy future that capitalizes on [the] state’s resources” (IDOT, 2016, p. 1). Additional stated goals include the reliability and affordability of future energy, which are consistent with other states’ concerns regarding renewable energy integration. These accomplishments, however impressive they seem, do not exist in a vacuum, and must be taken in the context of Iowa’s steep energy deficit. Iowans consume nearly double the amount of energy they produce, which muddles the statistics when it comes to source-control. Despite not hosting a single coal-fired power plant, 59% of Iowa energy comes from coal (EIA, 2017b). Similar sleight of hand occurs in the power-production sector. While 93% of the energy Iowa produces is considered “renewable”, roughly 74% of that is biofuels, which arguably do not deserve such classification because the source is food stocks.

The IEP is organized into four “Energy Pillars” which demonstrate the state’s priorities: (1) Economic Development and Energy Careers, (2) Energy Efficiency and Conservation, (3) Iowa’s Energy Resources, and (4) Transportation and Infrastructure (IDOT, 2016). The State of Iowa has created an equally revealing, “vision statement” to accompany its energy pillars. The vision statement consists of the following three commitments: (1) to develop affordable, reliable, and sustainable energy that “maximized economic benefits” for the state, (2) to embrace energy efficiency, a mix of energy resources and technologies in the interest of future growth, and (3) to “drive innovation, foster research and development, create business and career opportunities and
promote environmental stewardship” from its position as “clean energy leader” (IDOT, 2016, p. 12). In contrast with California’s plan, which had some troubling details buried within a largely sustainability-oriented document, it should already be clear that the IEP has, even on the surface, areas of significant tension with sustainability. The state’s vision statement makes no mistake about it, economy is supreme, and the energy sector will be subservient. The three statements include nods towards “maximized benefits,” “future growth,” and “business opportunities,” but only tacit acknowledgement of “environmental stewardship.” In addition, a “mix” of energy resources is less an invitation for renewable developers and more a blank check to corn farmers who can convert their surplus into biofuel. As a self-proclaimed “clean energy leader” one would expect the state to be more concerned with securing clean energy as a matter of policy.

The IEP contains a series of ten guidelines to follow in achieving its vision, only one of which make even remote reference to building a system of renewable energy. The guideline is as follows: “Support alternative energy resources, technology, and fuel commercialization in proven, cost-effective applications” (IDOT, 2016, p. 13). There are several troubling points in this statement that are worth diving into. Immediately, the use of “alternative” as opposed to renewable suggests non-commitment to actually addressing GHGs. At the very least, this gives the state wiggle room to funnel most of its resources into biofuels, which is not likely to provide the necessary boost (Wenzel, 2009). The second troubling part of this guideline is the qualification of “proven, cost-effective applications”. In the absence of strong State or Federal action, the only proven, cost-effective applications of anything are going to serve the fossil fuel-burning status quo. The remainder of the IEP is divided into a series of energy “Objectives” which are either useful to our established definition of sustainability, counterproductive, or unrelated. In the interest of brevity, the unrelated objectives will not be discussed below.
Iowa Energy Objectives: Counterproductive

The aspects of the Iowa Energy Plan which cause issues fall within two categories: failure to prioritize conservation over efficiency and failure to prioritize renewable resources in the energy mix. The first objective in the Energy Efficiency and Conservation section of the document falls into the prior category, and states that Iowa should “Increase the energy efficiency and decrease the operating costs of Iowa’s existing and new buildings in all sectors” (IDOT, 2016, p. 34). Much like California, Iowa is right to make a point of improving the energy performance of existing buildings, but the action items within this objective make it appear that this point is nominal. The first two items are primarily concerned with stabilizing utility rates and do not address energy directly. The second two offer incentives and suggestions for improving the efficiency of buildings in the state. The proposal to invest funds from public buildings’ energy savings into infrastructure projects is promising, as is the pledge to investigate the expansion of CHP technologies, but neither addresses total energy use and they could be used as vehicles towards greater overall consumption. It bears repeating ad nauseam, efficiency is not a standalone measure for sustainable performance. The fifth and final action item under this objective is the only one that directly addresses energy use in buildings. Unfortunately, the state does calls for more strict compliance with current energy codes, as opposed to proposing revised codes.

The remaining problematic objectives are those which fail to prioritize renewable resources in the energy mix. The first one makes no mistake about the state’s priorities, stating a desire to “Increase biofuel production and usage in Iowa” (IDOT, 2013, p. 58). The state’s forty-seven ethanol, four cellulosic-ethanol, and twelve biodiesel plants stand to benefit from such a
policy at the direct cost of increased greenhouse gas emissions. The problem here is that, while biofuels provide a modest decrease in emissions per-unit of energy, their highest estimated capacity is 50% of current fossil fuel usage (Wenzel, 2009). Wenzel (2009) argues that this high mark ignores land-use and food scarcity issues, which brings the real number somewhere in the neighborhood of 13% at the absolute highest. The reality is that putting humans in direct competitions with our own vehicles for fuel is a bad enough idea in the context of “it’s me or my car,” let alone “it’s you or my car”. The state proposes using the Renewable Fuels Infrastructure Program to expand on existing biofuel transportation systems, as well as advocating for the development and demonstration of more High-Octane Fuel Vehicles, which can burn increasingly high blends of ethanol, up to 40%. Even cellulosic ethanol, which burns cleaner and has fewer negative externalities does not make sense as a major source of fuel (Hill et al., 2009). Given the marginal benefits and clear drawbacks of a biofuel-dependent transportation infrastructure, it is clear that this objective does not support sustainability in any significant way.

The second objective that impedes the progress of renewables is Iowa’s stated interest in “Encourag[ing] the prudent maintenance and development of energy delivery infrastructure” (IDOT, 2016, p. 70). While this appears to be a progressive policy, one’s optimism wears off quickly. Improving “energy delivery infrastructure” is a critical component of implementing renewables on a larger scale, but this particular objective makes no reference to renewables whatsoever. The four strategies included in this objective involve (1) natural gas, (2) crude oil and biofuels, (3) ethanol, and (4) propane. The strategies are made up mostly of pipeline proposals and other infrastructure suggestions that would facilitate the consumption and distribution of the listed fuels. The state’s focus in this objective appears to be investing in long-term futures for less sustainable fuel sources. This directly relates to the Iowa’s final counter-
productive energy objective: “Encourage[ing] the expansion and diversification of energy resources, incentives, and programs” (IDOT, 2016, p. 42). Nowhere in this section does the state call specifically for expanding renewable resources. Rather, the diversification of energy sources is called for, which robs the objective meaningful direction towards more sustainable sources. While a diversity of sources is absolutely a critical component of a sustainable energy plan, when a state refuses to narrow the options, as Iowa has clearly done, such diversity is of little value.

**Iowa Energy Objectives: Useful**

The state’s positive energy objectives fall into two categories: facilitating improvements to new and existing buildings and supporting non-biofuel renewables. The positive objectives that I will look at fall under the Economic Development and Energy Careers Pillar of the IEP. Iowa is interested in “Facilitat[ing] the development of diverse financing options for widespread adoption of energy efficiency and renewable energy practices and technologies” (IDOT, 2016, p. 18). This objective has potential to be extremely useful as a way of incentivizing sustainable best practices for energy. Using resources such as lease purchase agreements, solar tax credits, and on-bill financing, Iowa helps its citizens build a compelling model for energy use across the nation. The IEP also suggests that the state begin distributing some of its $31.15 million Federal Qualified Energy Conservation Bond (QECB) allocation and gives the example of efficiency retrofits and fleet upgrades as good places to start. Unfortunately, in an act of foreshadowing, the report acknowledges the withdrawal-risk involved in leaving such funds unspent. The 2018 Tax Cuts and Jobs Act eliminated the QECB, along with Clean Renewable Energy Bonds (CREBs) as a part of its provision to repeal tax-credit bonds (Brady, 2017). Nationwide, only
31% of allocated funds had been spent at the time of publication (IDOT, 2016). Despite the loss of QECB funds, Iowa has identified other ways to incentivize clean energy systems. In 2016, the state began providing a 10% tax credit for residents to install geothermal heat pumps, and undervalued technology that has proven savings. The lease purchase agreement is a tool that the IPE strongly recommends for use, as it allows for the government to borrow money to pay the up-front cost of a project and pay back the loan using savings from the improved energy-efficiency. On-bill financing operates on a similar principle, but is geared towards non-government consumers, as the utility bears the cost, and then makes money on the consumer’s bill. Iowa already offers a Solar Energy System Tax Credit which allows claims worth up to 60% of the Federal Investment Tax Credit (FITC), but the IEP recommends that the state incentive be decoupled from the federal figure, allowing for more local certainty and flexibility to market demands and industry conditions. In the current political climate, anything a state can do to become independent of the Federal Government on environmental issues is good policy.

The next positive objective in Iowa’s plan is its commitment to “Lead by example in Iowa’s government practices” (IDOT, 2016, p. 45). The way that Iowa intends to lead is by focusing on buildings in a way that that fosters improved performance. The two action items include a public building benchmarking program and high-performance leasing. The benchmarking program will provide critical data and foster better awareness around energy conservation, giving the state a basis from which to measure future improvements. In the modern political era, it is critical that as much data be collected as reliably as possible. High-performance leasing will allow tenants and property-owners to bear equally the cost and benefit of minimizing the energy profile of a building, where there would otherwise be little incentive
for one to bear the full cost. As these programs make it easier for individuals and small commercial operations to conserve energy according to their own interests, they provide a great service to the state. These small, individual contributions to sustainability, while important, cannot have nearly as much impact as institutional changes that lead the state away from fossil fuels in the energy mix.

The remaining positive energy objectives aim to accomplish just such a goal, and the first one is explicit about its intentions in this regard. The state’s commitment to “Support distributed renewable energy generation including wind, solar, and other clean energy resources in Iowa” is unique in that most of the document refrains from specifically mentioning wind and solar so as to leave the door open for biofuels (IDOT, 2016, p. 55). Like the previous objective, it focuses on making it easier to bring renewable technologies online. However, this objective is focused on best practices at the level of local government. Resources such as the Iowa Energy Center Solar PV Guide can help make solar more approachable to the people of Iowa, which is a step in the right direction. The plan also cites an expansion of the Iowa state code to allow institutions such as schools and nonprofits to take part in energy and facilities sharing that currently only occurs between government entities. Iowa has shown that it is not afraid to blur the lines between public and private in its policy prescriptions. In 2016, the state directed its two largest utilities to expand renewable opportunities, giving them a goal of 105 MW of additional capacity (IDOT, 2016). They compounded this by allowing customers to enjoy the benefits of net metering and doubling the previous net metering cap. As far back as 2004, electric utilities in the state have been required to offer “green power” options to their customers. While the overall expansion of renewables is notable, one thing that renewable growth cannot live without is grid reorganization. Renewable energy sources place a different set of demands on a power grid than
their fossil-fuel cousins. While there is no question that using renewable sources will reduce the carbon footprint of energy, there are many remaining questions as to the best way to integrate them into the grid. The state’s focus on grid modernization is well placed, and a grid that is more “efficient, flexible, and distributed” will help the state serve the needs of its people while simultaneously becoming more sustainable (IDOT, 2016, p. 68).

Overall, Iowa provides us with a mixed bag of policies that are difficult to gauge. The state’s commitment to biofuels serves to complicate discussions of a diverse energy mix, and the classification of such fuels as renewable is distracting, at best. In several areas Iowa makes the mistake of relying on efficiency as a measure of success, which carries perplexing consequences, described above. These consequences are made more difficult to avoid given the position of biofuels as renewables and the heavy economic interests in their success. The IEP, however, does provide a silver lining to this story, with several target objectives for expanding renewables and redesigning the electricity grid to handle them. If the state can realize its capacity, especially in wind power, it has a chance to become a national leader, and erase coal from its books in the process.
Energy in the South: South Carolina

One of the most recent state energy plans comes from South Carolina, where the South Carolina Office of Regulatory Staff (SCORS) published its plan in 2016. The State’s first plan came in 1992, at the request of the General Assembly. Executive Director of the SCORS Energy Office, C. Scott Dukes, acknowledges, in the preamble to the plan, that the national energy landscape has changed dramatically in recent years and will continue to do so well into the future. He explains that it is important for a state energy plan to “coalesce the many and often competing interests into a unified vision for our future” (SCORS, 2016, p. 4). The plan “maximize[s] (to the extent practical) reliability, environmental quality, energy conservation and energy efficiency while minimizing the cost of energy throughout the state” (SCORS, 2016, p. 10). Where most of the plans begin with an energy overview of some kind, the South Carolina plan, entitled Energy In Action, straightaway provides policy recommendations followed by a discussion of the state’s energy landscape, and finishes with a series of projections for the future. The language of the plan is direct and future-oriented. While the plan’s internal calculus slightly minimizes reliability, environmental quality, energy conservation, and efficiency in relation to cost, it says the right things about environmental protection and renewable energy. The plan describes continued economic growth and the meeting of energy needs as its primary purpose but recognizes that “less dependence on fossil fuels preserves our resources and results in less[sic] environmental impacts” (SCORS, 2016, p. 30). In this way, the South Carolina plan may come off as gilded in progressive language that its actions do not always support, but the state seems nonetheless to be making strides in the right direction.

South Carolina is home to 46 electric and 16 natural gas distribution utilities that run the ownership-spectrum from state utility to electric cooperative (SCORS, 2016). These utilities rely
on a century-old transmission system that was designed to carry electricity hundreds of miles from centralized generation facilities to consumers across the state, and the nation. South Carolina produces no natural gas and relies on four major pipelines for its continued supply, as well as one propane pipeline and one underground cavern storage facility (SCORS, 2016). The state acknowledges that growth in the extraction of shale gas will change the distribution landscape on a national level, and it intends to take advantage of the increased supply of natural gas. In 2015, electricity generated in South Carolina came from 56.8% nuclear power, 24.1% coal, 16.1% natural gas, 1.1% biomass, 1.1% hydroelectric, and less than 1% each from pumped storage and solar power (SCORS, 2014). North and South Carolina share two interstate utilities, which means that South Carolina consumers use a mix that is different from the one generated in-state. The difference is significant, as South Carolinians consume 37.7% coal, 32.8% nuclear power, 25.5% natural gas, and 2.3% hydropower (SCORS, 2016). Immediately, it is clear that the state relies almost entirely on nuclear power, coal and natural gas. In the state’s projected generation mix for 2025, this is still the case, but one can see the beginnings of a change. The biggest gains in the 2025 projection are nuclear (+8.4%) and pumped storage (+1.6%), while the biggest losers are coal (-8.9%) and natural gas (-1.8%). It is important to remember that these percentages represent a share of the total electricity generation, not total resource use, but the projections begin to tell the story of a pivot away from carbon-intensive fuels, especially coal. The missing numbers, however, are cause for some concern. Could South Carolina really plan on receiving less than 1% of its electricity from renewable sources in 2025? If the above projections are to be taken seriously, then the answer may be yes, despite a number of programs designed to encourage renewable technology.
The state has identified programs in energy efficiency and renewable energy as keys to moving away from coal in the future. Growing population means that rising energy demand will make it difficult to decommission fossil fuel burning facilities without both finding new power-sources and developing demand-side solutions. The South Carolina State Legislature has passed efficiency-based laws as far back as 2008. The resulting programs have encouraged utilities to practice on-bill financing and engage in special low-interest loan programs for residents who need capital to make efficiency upgrades (SCORS, 2016). Through such programs, the largest state utility, Santee Cooper, has loaned over $41 million for efficiency improvements and renewable energy installations (SCORS, 2016). The plan suggests that further action should be taken to improve efficiency, even going so far as to call for price manipulation in support of demand-side solutions. This is a step that several states have not been willing to take, preferring to defer to the judgement of the invisible hand rather than force the issue. State law, in general, “encourages the development and use of indigenous, renewable energy resources and the state has even undertaken a study of the technical capacity of various renewable energy sources (SCORS, 2016, p. 60). The major highlights of this report, embedded in the state plan, include a 70,000 MW capacity for offshore wind, and a 51,000 MW capacity for solar PV. While South Carolina does not support as broad a suite of renewable technology as possible, the state has engaged in some legislative support for wind and solar generation.

Act 318 created the Wind Energy Production Farms Feasibility Study Committee, that gathers information for the above report and makes judgements as to the suitability of South Carolina to utility scale wind electricity-generation. The Federal Bureau of Ocean Energy Management (BOEM) South Carolina Renewable Energy Task Force was established for much

It is notable, of course, that this has come in the form of loans, which will be paid back with the addition of interest.
the same purpose, while accounting for environmental sensitivity and land use conflicts. Once feasibility was established, federal standards, such as the Outer Continental Shelf Renewable Energy Program, provided guidance on leasing and permitting for non-oil & gas energy sources (SCORS, 2016). Unfortunately, the state’s projections betray a lack of confidence in this swarm of committees and task forces to create meaningful opportunities for wind in South Carolina.

Solar energy is at least included, albeit minutely, in the energy projection, and the state acknowledges a wide range of solar technology, including solar heating, solar PV, solar thermal electricity, solar architecture, and artificial photosynthesis (SCORS, 2016). The 2014 Distributed Energy Resource Program Act (DERPA) has been the most helpful de facto legislative asset for solar development. Although DERPA encourages only the inclusion of renewable sources more generally, solar has emerged as the favorite. The act requires that new renewable energy facilities be built in the state by 2021 and that they have a capacity of no less than 2% of the previous year’s average peak demand (SCORS, 2016). The act goes further, simply to ensure that a variety of small and large facilities are constructed, presumably in an effort to diversify the solar portfolio. Much like wind power, solar has received much nominal support from the South Carolina legislature, but it is unclear just how significant an impact it will have on its current course. The state has the courtesy, or perhaps the cunning, to pay lip service to these renewable sources where Pennsylvania simply ignored the issue.

One area where the state appears to be making genuine efforts to conserve is transportation.14 The Energy for Transportation section of the plan discusses not only the importance of diverse fuel sources, but also considers density and mobility in a way that other plans to do not. Of course, the most obvious solution to the carbon impact of transportation is to

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14 One of the reasons for this is that it is likely to entice industry into the state; BMW currently constructs electric vehicles in a South Carolina plant and a similar plant for Volvo is in the works.
transition away from fossil fuels entirely. To this effect, the state has recognized the importance of renewable fuels; over half of the state’s alternative fueling stations are for battery-electric vehicles (SCORS, 2016). Even if the state is successful in providing infrastructure for vehicles powered by renewable energy, it is still important, necessary even, that the demand-side strategies applied to electricity consumption be applied to transportation as well. The state identifies opportunities to improve land use, mass transit, and rideshare programs as a way of decreasing the energy demand of the transportation sector (SCORS, 2016). South Carolina notes that long distances between employment and residences and reliance on highways forces people to drive more miles than they otherwise would and that planning more compact and accessible urban spaces would greatly reduce those miles. South Carolina hopes to start tackling this issue by installing more than 7,000 miles to its bike-lane infrastructure and increasing the density of commuter rideshare hubs. These types of programs are instrumental to reducing demand and creating enough slack in the transportation system for renewables to catch up and eventually take over.

A Good Start, A Poor Finish

State utilities are required to prepare and update an Integrated Resource Plan (IRP) to allow for the continuous recalibration of priorities. Utilities conduct this exercise to ensure that they will be able to meet future demand with planned generation capacity. Legislative action such as the Base Load Review Act (BLRA) helps utilities finance the costs for additional baseload electricity sources, and is one of the reasons why nuclear power is expected to increase its share of generation over the next decade (SCORS, 2016). The difficulty of fitting renewable sources into the traditional baseload niche is one of the greatest obstacles facing the technology,
but policies like the BLRA could be construed in such a way as to drive investment and innovation in those fields with state funds. It does not appear that South Carolina has any interest in following this path, but it has already laid the groundwork if there is ever a change in philosophy. Indeed, the state acknowledges that its future relies on “increasing the amounts of non-greenhouse gas emitting sources” and that “with proper planning, system upgrades, and integration with the electric grid, [renewable] resources can play a very positive role in furthering energy diversity and lessening environmental impacts” (SCORS, 2016, p. 72,73). Again, South Carolina says just enough about renewables to keep a flicker of hope alive that the plan is on a path towards sustainability. In fact, in many places it says more about the importance of renewables than other plans, but it is important to look towards the state’s action and recommendations rather than relying on its rhetoric.

A Mixed Bag

The state’s recommendations are difficult to make sense of in terms of sustainability because the language is so carefully measured. The state’s most common concrete recommendation is for the formation of a task force or committee for further study and informed decision making. This is South Carolina’s method of kicking the can down the road on IRPs, building efficiency standards, energy-efficiency revenue streams, and state vehicle fleets. While I acknowledge throughout this study that gathering good data for informed decision-making is a critical part of building a sustainable energy system, the circumstances in South Carolina give reason for pause. In particular, it is worth briefly revisiting the state’s 2025 energy projections, which are good for their scaling back of coal but lack any real progress on renewables. It goes without saying that renewables are a critical part of a sustainable energy future and, despite
South Carolina’s inclusive language and renewable-friendly policies, the state does not seem truly committed to overseeing a full energy transition.

Despite this reality, the state has performed admirably in several areas that did not garner much attention in the other plans. For example, South Carolina was the only state to include a section devoted to Environmental Justice (EJ). Given the state’s conservative tilt and Environmental Justice’s more liberal values, this fact was surprising. The state recommends establishing “a statewide environmental justice advisory panel” to weigh in on energy and transportation decisions if an Environmental Justice interest is identified (SCORS, 2016, p. 22). The second recommendation in this category is determining the state’s needs for adaptation and integration of renewables. The only electricity source even tangentially related to renewables that increases its share of generation in the state’s 2025 projection is pumped storage. Several of South Carolina’s hydroelectric turbines have the capability to spin in reverse, pumping water uphill. The state has taken advantage of this capability by reversing the turbines during times of over-generation, essentially turning its reservoirs into batteries that store the gravitational potential energy of water. This system, on a large scale, would assuage the most important concerns with renewables and make their incorporation much simpler if the state were to seriously pursue implementation. The state’s apparent unwillingness to do so, however, represents a serious blow to its ability to create a sustainable energy plan.

Virginia

The inaugural Virginia Energy Plan was produced in 2014 by the Virginia Department of Mines, Minerals, and Energy (DMME) in adherence with Chapter 2 of Title 67 of the Code of Virginia. Governor Terence McAuliffe wrote a short preamble that establishes the state’s energy
mantra: grow, strengthen, diversify. The governor lays out three main ways in which the state aims to live by that philosophy: “[1] Diversify[ing] the economy by strategically growing the energy sector… [2] innovate[ing] to reduce greenhouse gas emissions and lower[ing] energy consumption… [and, 3] strengthening the business climate by investing in reliable and resilient energy infrastructure.” (DMME, 2014). The plan is divided into 12 sections that discuss the states various energy resources, infrastructure, and efficiency programs, and then offers its recommendations for fulfilling the above goals. Much like the State of Pennsylvania, Virginia has adopted an “all of the above” energy strategy that is meant to include both traditional and renewable sources while encouraging energy efficiency. Virginia also talks, albeit more reservedly, about the importance of the energy independence which worried Pennsylvania so deeply. While the two states employ similar language in general, the State of Virginia has shown a much stronger commitment to building a sustainable energy future.

In 2012, the State of Virginia generated 71 million MWhs of energy, primarily from nuclear power (41%), natural gas (35%) and coal (20%) (DMME, 2014). The remaining 4% of generation was attributed to petroleum, hydroelectric, and “other”, in descending order. It is clear to see that renewables are not high on this list, and the state acknowledges as much, identifying renewables as an area of great potential for future growth. In the state’s own words: “A signal must be sent that Virginia is supportive of and enthusiastic about the role of renewable energy in the economy” (DMME, 2014). In a departure from the Pennsylvania framework, Virginia at least shows interest in how renewables could fit into a diverse energy system.

Electricity in Virginia is generated “115 coal, nuclear, natural gas, hydro, oil, and biomass

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15 The Virginia Energy Plan lacks consistent and meaningful pagination.
16 A fourth pledge, to “prepare Virginia’s workforce to drive the energy economy into the future”, is included, but not addressed here. The merits and drawbacks of similar programs have been discussed above.
fueled electric power plants” (DMME, 2014). The electricity is distributed via 60,000 miles of transmission line, throughout the southern portion of the PJM Interconnection System, which connects parts of 11 states in the Appalachian and Great Lakes regions (DMME, 2014). The state imports just over half of its energy, no doubt enjoying the benefits of overproduction in Pennsylvania and South Carolina (DMME, 2014). Sporting an energy deficit gives Virginia considerably better standing to pursue energy independence, as the resources to self-supply are not already in place. The motivation to produce renewables ought to be even stronger in a state that imports energy, as increased renewable capacity could represent an area to cut significant future cost without substantial environmental impact.

Virginia energy policy up to this point has been moderately friendly to renewable development. Utilities in the state are permitted to add fees on top of the base rate for, among other things, energy efficiency and peak shaving programs, demand response programs, environmental and reliability improvements, and the cost of new offshore wind generation facilities (DMME, 2014). It is notable that offshore wind is the only renewable source explicitly named under this policy, but peak shaving and demand response programs are tailor-made for the highly variable production of renewable resources. Similarly, renewable resources are the obvious beneficiaries of “environmental improvements”. In addition to these rate controls, the state further incentivizes renewables by allowing utilities to charge a monthly stand-by fee, similar to Arizona, that allows the utilities to recover some of the costs of infrastructure and maintenance while supporting customers with distributed generation capabilities. The state has embraced distributed generation, noting that it can fill small niches which are not feasible for traditional centralized generation and that it can be installed incrementally alongside demand increases (DMME, 2014). Further downstream, the state’s electric cooperatives use renewable
energy certificates (RECs) to offer a 100% renewable option to its customers, giving consumers more agency in their disapproval of GHGs. While REC programs may have the primary effect of moving emissions around, rather than reducing them, their popularity indicates a willingness on the part of individuals, businesses and government to seek renewable solutions.

The state does appear to be seeking renewable solutions and has created a set of “Voluntary Renewable Energy Goals” that set baseload benchmarks through 2025. In addition to providing numerous tax credits and subsidies, the state hopes to generate 15% of its base load from renewable sources by 2025, not including nuclear power’s share of baseload. This is a powerful caveat that softens the impact of this policy decision, since nuclear accounts for significant capacity (35.7%) of electricity generated in Virginia. Removing nuclear power from the calculations means that the meeting of the state’s 15% goal actually only accounts for 9.6% of total baseload. Further descriptions of the voluntary goals reveal that the state intends to count the most environmentally friendly sources (onshore wind, solar power, and facilities fueled from animal waste biomass) for double their actual capacity, while offshore wind receives credit for triple. At first, this seems like a great way to encourage utilities to take advantage of renewable resource and meet the goals, but it is perhaps too focused on latter over the former. Counting solar power for double credit means that only half of the solar installations required to meet the demand will actually be built. Ignoring the offshore wind credit for the moment, this means that the 9.6% of baseload generation for which the state will be given credit will only produce 4.75% of the baseload. The state’s commitment to renewables is not as robust as it seems, but it remains more open to the possibility than many comparable states. The largest electricity generation facility (by capacity) in the state is a pumped storage and hydroelectric plant which boasts the same capacity (~3000 MW) as the state’s two nuclear power plants.
combined (DMME, 2014). The benefits of pumped storage and its compatibility with renewable power sources have already been discussed in the South Carolina section and it should be clear that this is an excellent buffer for renewable technology to be integrated into today’s grid. Despite this potential, the state has substantial plans for coal and natural gas in the future.

Natural gas is very much in the plans for Virginia’s future as shale gas has become cheap and plentiful in recent years. One state utility has plans for six new natural gas fired power plants by 2020, and it is likely that the others will follow suit (DMME, 2014). The state does produce about 40% of the natural gas it consumes, but it does so in an unconventional manner, in the form of coal bed methane (DMME, 2014). The state has estimated that its current reserves will last for 22 years but identifies offshore natural gas as a potentially untapped resource (37.51 trillion cubic feet) that would bring in substantial capacity (DMME, 2014). Previous discussion of liquid fuels’ dismal safety record on land applies equally to endeavors at sea, and efforts to expand offshore drilling of any kind will not advance the state’s sustainability standing.

Transportation is an area of interest for natural gas development, and Virginia is home to large-scale military operations which operate sizeable fleets of CNG vehicles (DMME, 2014). While the military has often been a shadow advocate of renewable technology in the United States, its influence here is not particularly helpful. The existing infrastructure makes natural gas an easy choice to succeed coal and oil resources, and Virginia is following the path of least resistance in this regard. The negative environmental impacts of coal operations are well known. Despite Virginia’s stated support for coal workers and industry standards, the state requires coal mining companies to pay a “severance” rate of 2% of the coal’s value to the county in which the coal is mined (DMME, 2014). The state estimates that world coal reserves could supply an additional 129 years of business-as-usual consumption (DMME, 2014). The 2014 plan gives the reader the
sense that the state is well aware of coal’s impending peril, and the recommendations will give a sense of how the state plans to handle this outcome.

Before investigating the recommendations, it is important to highlight the energy efficiency discussion which takes place in the penultimate section of the plan. Virginia has endeavored to establish a meaningful difference between conservation and efficiency where no other state has. For this, the state deserves tremendous credit. The state first supplies the standard EIA definition of efficiency: “a ratio of service provided to energy input (e.g., lumens to watts in the case of light bulbs)” (DMME, 2014). Then, the state takes a critical leap forward, across a precipice which causes the other states to shudder and cling to the handrails: “Energy conservation is broader than energy efficiency. It includes active efforts to reduce energy consumption through behavior change, technological developments and policies that encourage such efforts” (DMME, 2014). The state exposes the key difference between these two often-confused concepts; conservation requires “behavior change”. People must alter the way they live their lives and what they expect from the world, if they are to conserve in a meaningful way. “Unlike conservation,” the state continues, “which involves some reduction of service, energy efficiency provides energy reductions without sacrifice of service” (DMME, 2014). Not only does the state acknowledge the value of conservation, but it pinpoints the very same problem with efficiency that made William Stanley Jevons famous: “Increasing energy efficiency, especially in newer homes, tends to reduce the amount of energy needed per household unit. These newer homes, however, are also significantly larger than older homes have typically been. This has the effect of increasing energy use per housing unit” (DMME, 2014). Having successfully understood what is essentially the key takeaway of this document, it is interesting to
see how well the state’s recommendations fit into this realization or whether, like South Carolina, the plan is all bark and no bite.

Strategic Energy Growth

Virginia’s recommendations are organized by the executive goals outlined in the preamble; they have the potential to be executed in a sustainable manner. As has been the theme of this section, the state does an overall-mediocre job of making suggestions that encourage such sustainable execution. The state’s first goal was a pledge to “Diversify our economy by strategically growing the energy sector” and the operative word here is strategically (DMME, 2014). Unsurprisingly, the state’s “all of the above” energy strategy has led to mixed results in this instance. On the positive side, the state acknowledges the connection between renewable development and “long-term economic health” while pledging to continue its simultaneous efficiency and conservation efforts. The state recommends establishing a Solar Energy Development Authority modeled after the existing wind power entity, as well as making itself into a host for the manufacture and operation of renewable infrastructure. It is critical that states recognized, like Virginia has, that renewable energy will represent a formidable industry and it will be far easier to get in on the ground floor. Further recommendations to establish the Virginia Board of Energy Efficiency and engage local municipalities in Energy Performance Contracting (EPC), alongside the state’s demonstrated awareness of efficiency’s shortcomings, are excellent steps towards sustainability.

This section of recommendations also included several regressive items which could derail all of the potential progress discussed above. The downside to Virginia’s vision of “strategic energy growth” includes goals of bringing its coal expertise and resources to a wider
global audience, and pursuing offshore oil and gas reserves. The Pennsylvania plan included a similar desire to outsource its coal knowledge and resources to developing nations that still rely almost entirely on the resource for their energy needs. The state’s recommendations of providing technical assistance and funding research into the deployment of global “clean coal” technologies will serve only to move negative environmental effects out-of-sight, and exacerbate global quality of life disparities for which the United States is largely responsible in the first place. The commitment to pursue offshore oil and gas resources in a “safe manner that is protective of Virginia’s coastal environment” is oxymoronic at best (DMME, 2014). The ability of the state to grow its energy sector will depend on its willingness to let old technologies go, and it cannot expect major growth in renewables alongside a continued boom for fossil fuels.

**Reducing Emissions, Lowering Consumption, Improving Infrastructure**

The state’s second executive goal is to “reduce greenhouse gas emissions and lower energy consumption throughout the commonwealth” (DMME, 2014) The recommendations in this category are underlain by a lesser-of-two-evils philosophy, rather than a progressive one. The state focuses on general infrastructure improvements here, when it had an opportunity to make a strong statement on the future of renewables. Because of this, discussion of the third executive goal of investing in “reliable and resilient energy infrastructure” has been included (DMME, 2014). Of course renewables will require infrastructure improvements as well, but Virginia is more interested in expanding and streamlining existing services and making the minor alterations necessary to make natural gas a transportation fuel. The third executive goal deals exclusively in the language of “alternative” energy vehicles, and makes no commitment to renewables. There is no question that natural gas emits fewer toxic byproducts into the air than
coal and oil, but to invest beyond a basic level of CNG infrastructure would place an
unnecessary cap on the state’s ability to improve. The other major recommendation that Virginia
makes is to support nuclear generation, which does not fall neatly into the fossil fuel-renewables
binary that I have relied on. For these reasons, natural gas vehicles and nuclear power do not
represent an impressive method of reducing consumption and GHG emissions to their lowest
potential.

The state recognizes the fact that, as non-renewable resources become prohibitively
expensive in the future, something will have to pick up the slack. Whatever that thing is will not
just provide the world with power, it will also enjoy all of the profits left behind. It is, perhaps, a
major shortcoming of all of the plans that they do not envision this scenario in its entirety. The
nature of a transition is that the mainstreaming of renewable energy will come at the cost of
productivity from other industries. Virginia starts off on a promising path with its commitment
to grow renewables but, like most states, refuses to consider the implications for conventional
energy sources. It is said colloquially that when one door closes, another door opens, with the
understanding that if both doors are open, there is going to be a draft in the house. Virginia could
be counted on to place a wind turbine in the path of such a draft, but not, it appears, to see that it
is dealt with.

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17 I have by and large avoided discussion of nuclear power in this document, and will continue to do so other than to
reiterate that sustainability requires us to look much further into the future than we traditionally have.
Chapter 4: Conclusion

In reviewing these state energy plans, it has become clear that there is wide variability in the strength of sustainability across the U.S. For the most part, state energy plans are not advocates for very-strong sustainability in a way that would be transformative for the energy sector. The plans show weakness when it comes to fully discontinuing the use of fossil fuels and each state, even Pennsylvania, has flashes of brilliance. It is tempting to rank each state’s projected environmental performance based on the goals, or lack thereof, established just a few short years ago. To do this, however, would be to egregiously misplace several of the states, as the states have not been entirely predictable in this sense. For the most part, the states performed consistently with regard to expectations about coal and natural gas. California is the only state with no coal use to begin with, but all others, aside from Pennsylvania, recognize that coal’s current downturn is likely the beginning of the end. To be sure, this is mostly good news given coal’s enormous carbon footprint. When it comes to natural gas, states are taking advantage of the cheap and plentiful resources flowing from domestic shale formations.

Only California, and to a lesser extent, Arizona, make claims that could be associated with strong sustainability regarding their carbon emissions from energy. California’s renewable energy goals are the strongest, with a statutory requirement to reach 50% renewables by 2030, while Arizona hopes to achieve a more modest 15% by 2025. The Pennsylvania State Legislature set a standard of 18% by 2021, but over half of that is to be filled by alternative
Figure 4: Most recent electricity generation data for the states under review. Source: EIA, 2018c-h.
Virginia has enacted voluntary benchmarks for its utilities with goals akin to Arizona, 15% renewables by 2025. The remaining states, Iowa and South Carolina, had no official goals of any kind for renewable technology. With these goals in mind, some states have raised eyebrows by meeting or exceeding expectations, while others have underperformed. California has proven up to the task so far, generating over 3.6 million MWh of electricity from non-hydro renewables in December of 2017. Including hydroelectric, California today receives over 37% of its electricity from renewables (EIA, 2018c; Figure 4; Figure 5). This commitment to renewables is impressive, however, there is another state that generates an even higher percentage of its electricity (41%) from renewable sources: Iowa (EIA, 2018d). While it is true that California’s renewable sector produces more electricity than the entire state of Iowa, Iowa’s robust wind industry has set an example for the more market-inclined states in the nation. The state’s largest utility has set a goal to deliver 100% renewable electricity to consumers, more than can be said for any other state’s utility (Gross, 2016). The remaining states do not boast impressive figures, led by Arizona’s 9% renewables, and followed by Virginia (6%), South Carolina (5%), and Pennsylvania (4%) (EIA, 2018e; EIA, 2018f; EIA, 2018g; EIA, 2018h).

It should be obvious that no state is perfect, even the strongest of energy plans under consideration has clear weaknesses. When looking at total energy, Iowa’s biofuels policy makes the state’s plan less attractive overall, with roughly 70% of energy produced (over 500 Trillion BTU) coming from the state’s agricultural fields in the form of ethanol (EIA, 2018d; Figure 5).

Pennsylvania’s definition of alternative energy does not inspire visions of sustainable energy: “Alternative energy can either be a renewable or nonrenewable energy source, but it is used in a way that differs from traditional energy technology” (DEP, 2014, p. 20). Replacing a coal-fired power plant with natural gas, for example, appears to satisfy these conditions.
Figure 5: Most recent energy production estimates for the states under review. Source: EIA, 2018c-h.

California’s kryptonite is its crude oil production, good for more than 1.1 quadrillion BTU in 2015 (EIA, 2018c; Figure 5). As shown in figure 5, this represents half of the energy produced
in-state, but is part of a more diverse energy mix than Iowa offers. It is no surprise that Pennsylvania, the most prolific energy producer among the states in question, also has the highest reliance on carbon-based sources. Pennsylvania produces roughly as much energy in coal as California does with crude oil (1.3 quadrillion BTU) in addition to natural gas production at five times that rate (5.1 quadrillion BTU). The two energy behemoths occupy opposite ends of the sustainability spectrum, with California boasting strongest of the plans, and Pennsylvania lucky to be printed next to the word sustainability.

The strength of a state’s energy plan in terms of sustainability is directly related to that state’s willingness to prioritize and commit to incorporating energy sources that produce negligible carbon emissions. These sources are mostly familiar to us in solar, wind, hydroelectric, geothermal, and, under certain circumstances, biomass and hydrogen fuel cells. Alternative fuel options for transportation, such as natural gas, only serve to draw out the transition away from fossil fuels that has already begun, while ethanol places an ethical burden on a world that knows tremendous food shortage (Cassman & Liska, 2007; Pimentel, 1991; Tenenbaum, 2008).

The strongest plans (California and Arizona) treat efficiency as a tool with which to enhance sustainability, rather than a goal with which to be satisfied. The reality of a rapidly growing population means that people will have no choice but to become more efficient, even in a fossil-fuel-free world. When considering our environment, wasting not will always be of paramount concern. When the world’s energy is derived entirely from the solar panels, wind & hydro turbines, and geothermal pumps that are so painfully obvious, it will still be a great service to use less. One fewer field of turbines and one fewer solar roof means one more outdoor recreation area and one more rooftop garden. Surely, the intrinsic valuation of the environment
underlies the strongest definitions of sustainability. Maintaining this intrinsic value as a matter of policy runs contrary to common understandings of efficiency, which makes it exceedingly rare. Only the state of California approaches this level of sustainable policy, and still it leaves room for dramatic improvement. Efficiency is so deeply ingrained into states like Pennsylvania that its plan makes it sound downright foolish to leave a drop of oil in the ground, a speck of shale un-fracked. Generally speaking, the states have succumbed to varying degrees of the same idea, leaving the state energy plan mostly untapped as a tool of dramatic reform. In order to be transformative, a state energy plan must set ambitious goals, goals that require changing mindsets and methodologies to achieve. Rather than waiting for technological liberation that may never come, a strong sustainability plan will force current stakeholders to take a strong stance for the environment, or be overtaken by someone who will.
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