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Deriving the Future from the Past: Solar Energy and Its Potential

With regard to renewable solar energy, Cesare Silvi, an editor for *Climate Justice and Development*, mentions that it, “has been, is and will be the principal energy source on our planet”.[[1]](#footnote-1) In addition, Silvi adds that “[t]he use of solar energy is an age-old experience marked by milestones on the path that led human beings to convert it into other useful forms of energy: food, heat, fuel, and, more recently, electricity”.[[2]](#footnote-2) Solar energy, in its pure form is literally the battery of life. Specifically, it is the underlying natural process of many biological and chemical reactions. Its importance, however, has been outlined in humanity’s recent crisis of unsustainable development in the industrialized world. With our dependency on fossil fuels, and with that, the use of unrenewable resources that contribute to a copious amount of pollution and environmental degradation, it is clear that a shift in the way we create our energy is necessary. Solar energy, in that regard, is a clear choice of an efficient way of producing energy in an environmentally sound manner. Like any source of energy, however, there are many problems and existing boundaries to deal with in order for its use to become practical. Through the history of solar energy development throughout the world, there have been many environmental and economic benefits of its use. These positive effects, however, have been almost completely dependent on a certain role of government in its development. Ultimately though, the successes of the entire method of energy production can help create a model of development for the future.

Although our current methods of energy production are unsustainable, they certainly are not unfixable. Solar energy is simply a way to provide an abundance of the necessary energy needed around the world with very little environmental harm. According to Basar, an editor for the *IIE Annual Conference. Proceedings*, it is clear that the use of solar energy can help mitigate the harm on a local environment.[[3]](#footnote-3) Basar’s evaluation of Colorado’s development through time is an important factor in understanding the effects of nonrenewable energy. Specifically, Basar highlights the importance of sustainable development by mentioning that “Colorado is generating its electricity mostly from coal… However, these resources are affecting environmental sustainability in a negative way”.[[4]](#footnote-4) The editor goes on to mention that “…there is a huge potential in wind and solar energy, which are easy to install, their construction times are relatively shorter and they do not have a big negative impact on the environment”.[[5]](#footnote-5) In addition to the potential benefits of solar energy, Basar found that a total reduction of CO2 emissions through a garnered support of sustainable production had occurred in Colorado. Moreover, he mentions, “… the replacement between [solar energy] and non-renewable energy resources has been considered to analyze the effects on emission levels… it has been shown that coal fired capacity reductions or restriction for further constructions might greatly affect CO2 emission levels”.[[6]](#footnote-6) Overall the credibility of renewable energy has been shown through the various examples of economic transitions in the energy sector. Correspondingly, Basar’s findings showed that the change was relatively significant in a short period of time. The analysis of his studies, taken over years, suggests that there is also a necessary transition for local governments to take due to environmental restrictions. Overall, it seems that the structure of Colorado’s local economy adjusted accordingly to the requirements put in place for sustainable energy production.

Although the environmental benefits of solar energy are important against the mitigation of unsustainable practices, the economic benefits are the key incentive to sustainable development success. Looking at solar energy production, it is important to understand the cost of solar energy with other various forms of production. Specifically, Hudson, an editor for *The Energy Journal*, provided a data analysis in 1980 of actual energy production cost. His findings concluded that photovoltaic methods of energy production, of course derived from the concept of solar energy, were among the highest cost-effective ways of creating energy.[[7]](#footnote-7) The capital cost of its production in 2000 ($1972/KW) was among the lowest of all arbitrary possibilities in the chart. With respect to its low production cost as time progressed, the gross investment of solar energy had also steadily increased according to Hudson.[[8]](#footnote-8) From 1977-2000, the total investment of low, medium, and high penetration of solar energy had increased from a rate that was noticeable enough for stark investment. Ultimately, this suggests that the means of solar energy production had become more practical for capital investment.[[9]](#footnote-9) The transition, however, as Hudson notes, was considerably slow for decades.[[10]](#footnote-10) Specifically however, the increased viability of solar energy production and investment attests to its potential for future development in the energy sector.

The increased investment potential of solar energy is shown through other important instances of economic relevance as well. Kobos, at the time a graduate student publishing an approved dissertation, gives a model overview of the curves in a “dynamic simulation modeling framework”.[[11]](#footnote-11) His data concluded that “[t]he initial technology lifetime for wind, solar photovoltaic, concentrated solar power and geothermal technologies is 20, 25, 25 and 30 years, respectively”[[12]](#footnote-12) in a given data set. With respect to potential technological and engineering advancements, the chart provided with his dissertation shows that capital costs for solar photovoltaic technology will decrease from five-thousand to a mathematical limit of one-thousand dollars/kw.[[13]](#footnote-13) Additionally, the levelized energy cost for solar photovoltaic capital costs decreases starkly as well.[[14]](#footnote-14) Ultimately, the data concludes that solar energy investment is becoming more practical as technological advancement occurs. It is cost-effective for potential business investment. Namely, the underlying potential of solar energy in a developing economy is in competition with unrenewable energy production.

Although the environmental and economic benefits are obvious with regard to solar energy, it is unclear if the source of energy could survive without government funding. Ultimately, it seems that the importance of federal subsidies has played a key role in the development of its more efficient factor. The amount of difference federal funding has made, however, is seemingly significant, while also appropriate. According to Yokell, an editor for *The American Economic Review*, “[a] number of federal policy instruments and programs [have been] appropriate for subsidizing the development and application of solar energy technologies”.[[15]](#footnote-15) The clear benefits of subsidies, in addition to Yokell’s reasoning of the past, is demonstrated through the ultimate outcomes it has achieved. Durham, an editor for *Land Economics*, emphasizes the necessity of government funding for solar powered projects and devices. She says, correspondingly, that “[t]ax credits have been shown to substantially reduce the cost of [appliances like] solar water heaters”.[[16]](#footnote-16) Her example of the mitigation of a product’s price is important because it shows how government funding can make solar energy use more competitive. This is relevant, as she notes, on an economics level because “[i]ncome tends to be … related to installation of energy-conserving structural devices, including solar heating units… only price consciousness is significant in predicting household energy conservation”.[[17]](#footnote-17) In other words, for the public to seriously consider energy-efficient appliances, there most exist a way to offset its expensive cost to the consumer.

In addition, within a general data analysis, there also seemingly exists a national effect on solar energy appliances and its industry in general when subsidies are applied. Durham found, in respect to just a single appliance example, that the whole development of solar energy was dependent on a great deal of funding throughout history. Interestingly enough, the energy prices ultimately were greatly affected. Specifically, there was a significant reduction in the cost of solar energy production due to the government’s involvement in its production. This cost was most likely necessary, according to Durham, to make solar energy a competitive industry.[[18]](#footnote-18) In addition, the backing of the government also eliminated market volatility in investment. Without subsidies, Durham mentions, the solar energy industry would carry a great deal of risk for its investors.[[19]](#footnote-19) Overall, the government seemingly has played a crucial role in the development of solar energy industry. Its development, perhaps, was almost solely dependent on the public funding it received. Like any source of energy, it needs to be competitive with output and efficiency. The government simply played an important role in these factors.

Because of the overall positive effect government has had on the solar energy industry, it is clear that the future of sustainable development is dependent on more public funding. To truly create an energy industry that is competitive, the investment in new technology needs to be made. These investments will help mitigate total production costs throughout time and ultimately, the cost of production with regard to renewable resources may become competitive without any sort of public funding. The mitigation of public subsidies towards solar energy, corresponding to that idea, shows that the industry is almost efficient enough to self-operate without the public’s help.

The change in energy production, because of our current environmental issues, needs to also happen rapidly. Renewable sources of energy are a vital step in our hopeful future of a sustainable environment. This is why it is imperative to encourage the removal of fossil fuels in a timely fashion. With that concept, the transition in our energy sector can only be encouraged through making renewable energy sources competitive and practical for everyday consumer use. This implies that the cost of energy annually, along with its capital cost, most be equal or less than that of nonrenewable energy. Ultimately, the rise of renewable energy must be economically feasible and competitive for the future. If the production factor of renewable energy is too expensive, the development will simply not occur.

Overall, solar energy has been shown as a legitimate and practical alternative to our current means of production. It seems that the development of solar energy has had both environmental and economic benefits in total. The environmental benefits of solar energy are shown through the reduction of CO2 emissions in Colorado along with the overall pollution reduction that corresponds with its use. In addition, the economic feasibility of solar energy has grown noticeably from decades ago. The reduction in cost for capital and its manufacturing shows that solar energy can exist in an economy as a genuine alternative to nonrenewable ways of energy production. This competitiveness, however, was, throughout history, dependent on government funding. The overall reduction of reliance on the government in the solar energy industry, in addition, shows that technological innovation will eventually make the competiveness of solar energy possible without funding. In total, the feasibility and importance of solar energy shows that the future of our energy sector could largely rely on its production of green energy.

Works Cited

Silvi, Cesare. "History and Future of Renewable Solar Energy." Development, Suppl. Climate

Justice and Development 51, no. 3 (September 2008): 409-14. Accessed April 5, 2016.

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32E1466B924A1CPQ/1?accountid=10610.

The author talks about solar energy and how its use has changed throughout history. For example, the author mentions that the world’s energy requirements were met with solar energy alone while today only 13.5 percent of the world energy consumption is from solar energy. Fossil fuel energy is criticized by the author because of the long-term negative environmental effects it has caused. With respect to their criticism of easy energy, the author says that solar energy is a practical alternative that will mitigate environmental problems. Ultimately, the author acknowledges that a transition into solar energy is difficult for a society that is largely dependent on fossil fuels but still believes that a transition is possible because of the environmental problems we, as a society, face. In conclusion, the viability of solar energy is shown through its development from the past along with its potential for future uses. Seemingly, the author largely encourages innovation in the field of solar energy while also acknowledging how much of a transition is still necessary for societies to become solar-energy dependent. Largely, there is little bias in this source. The argument does, however, fit into my argument by conveying the problems of fossil fuel energy and why a transition into renewable energy is necessary for future sustainable development.

Strum, Harvey, and Fred Strum. "American Solar Energy Policy, 1952-1982." Environmental

Review 7, no. 2 (1983): 135-54. Accessed April 5, 2016.

http://www.jstor.org/stable/3984497

Harvey and Fred describe the development of solar energy from 1952-1982 in the article. They mention the economic reactions to such an idea with regard to the private and public sector. N.A.S.A., as Harvey and Fred note, was excited about the idea of Solar Energy for developmental purposes. The authors go on to mention that our foreign entanglement with foreign oil has denigrated the potential for innovation and development in the solar energy field. Naturally, solar energy was ultimately funded by government programs to encourage its implementation as a viable energy source in the United States. One of these programs, according to the authors was ERDA. According the authors, ERDA dealt with various uses of nuclear energy and solar energy. They were a vital key in large amounts of innovation for both fields of renewable energy. Throughout the rest of the article, Harvey and Fred describe the public opposition to solar energy due to potential job loss and a variety of other factors. The authors are mostly unbiased and only present their facts in an objective way. Looking at the previous development of the renewable energy sector, this source ties into my argument of how solar energy can be used as a tool in industrial innovation.

Lof, G. O.g. "Solar Energy: An Infinite Source of Clean Energy." The ANNALS of the

American Academy of Political and Social Science 410, no. 1 (1973): 52-64. Accessed

April 5, 2016. doi:10.1177/000271627341000106.

Lof talks specifically about solar energy and its potential of becoming an infinite source of clean energy. To start out, the idea of fuel shortages and cost increases of energy around the world, Lof says, is enough to take a serious look at an alternative type of energy. The effects of environmental degradation, for example, act against a viable future for the human race which is why, as Lof also notes, solar energy is a practical and important idea. As a Professor of Civil Engineering at Colorado State University, Lof outlines the engineering possibilities with photovoltaic solar cells. The history and characteristics of earlier solar energy methods importantly highlight his vision for future possibilities in the industry of renewable energy as well. After explaining the history and characteristics of solar energy, Lof goes on to actually describe the engineering process behind the scenes. By doing this, he is able to suggest future changes to the technology that may have major impacts on its viability in an economy as big as the United States. Lof, of course, is completely unbiased throughout the article because of his clear presentation of facts and statistics to back up his argument. Lof’s portrayal of the possibilities of solar energy are important to the very foundation of my argument. Specifically, the past innovation and ideas on how to improve energy provides hope for the future development of its implementation. His ideas of how solar energy can act as an infinite source of clean energy specifically attests to most modern sustainability movements.

Basar, Gulsevi, and Leonardo Bedoya-Valencia. "Modeling of Renewable and Non-Renewable

Energy Resources and Their Long-Term Effects on CO2 Emissions in Colorado." IIE

Annual Conference, 2014, 2725-734. Accessed April 5, 2016.

<http://search.proquest.com.authenticate.library.duq.edu/pqcentral/docview/1622308513/6>

157587DEAC5494EPQ/1?accountid=10610.

The authors convey that CO2 Emissions are becoming a large problem in Colorado as a result from traditional energy extraction. The authors first talk about the electricity market in Colorado by describing the annual electric costs as low. Mitigation of the overall cost of electricity is viable, according to the authors, by implementing various renewable energy production plants in the state. They go on to give an overview of GHG emissions by suggesting that there is simply too much CO2 emissions in the atmosphere. To counter their problems, the authors suggest using the system dynamics methodology and the modeling methodology to mitigate the amount of CO2 in the atmosphere. Their in-depth analysis of technological development throughout the modern age shows that a transition to renew types of energy is practical. At the end, the authors provide an analysis of actual facts derived from the implementation of non-renewable energy and suggest that switching to renewable energy could have a positive environmental and an economic impact. The author is, of course, non-biased. Saying that, the argument that the authors make with renewable energy’s economic potential is important to my argument. Not only for new potential jobs, but also for the complete change of our energy sector. It is abundantly clear that renewable sources of energy will eventually become more efficient and cost-effective than non-renewable energy.

Cerovic, Ljerka, Dario Maradin, and Sasa Cegar. "From the Restructuring of the Power Sector to

Diversification of Renewable Energy Sources: Preconditions for Efficient and

Sustainable Electricity Market." International Journal of Energy Economics and Policy 4,

no. 1 (2014): 599-609. Accessed April 5, 2016.

<http://search.proquest.com.authenticate.library.duq.edu/pqcentral/docview/1619896868/6>

9E25071FD804EEDPQ/1?accountid=10610.

The authors start out by talking about the economic potential of solar energy. Specifically, how there is a definite need to bring solar energy to the private market. The authors go on to mention that, although the environment matters, there needs to be some sort of viable way for businesses to invest in new types of energy. In following, they argue that there is both environmental and economic potential for the investment in renewable energy. In other words, sustainable development is a practical concept with the right kind of investment. With regard to the power sector, the authors argue that more efficiency in energy production would be desirable for profitability. Although the current means of producing energy is not entirely perfect, the authors also argue that with new technology, there could be an overall decrease in pollution caused from energy production. Overall, as they note, renewable energy is mostly environmentally friendly. Their outlined advantages to renewable energy attest to the importance of such a transition in the energy market. Largely, the authors are non-biased. Their argument, however, makes an important case. The place of solar energy in the private market has now expanded. The potential for businesses to make the investment is widening, and it is clear that sustainable development practicality is now on the horizon.

Kobos, Peter Holmes. "The Implications of Renewable Energy Research and Development:

Policy Scenario Analysis with Experience and Learning Effects." Rensselaer Polytechnic

Institute, 2002. Accessed April 5, 2016.

<http://search.proquest.com.authenticate.library.duq.edu/pqcentral/docview/305500642/63>

4128130BF94696PQ/1?accountid=10610.

Kobes starts out by analyzing the current and potential future costs of renewable energy technology. That very same future, however, needs to overcome legislative heaps if anybody expects it to become effective, as Kobes mentions. With that idea, Kobes says that investments from businesses in the renewable energy realm are possible if the U.S. government is willing to provide incentives. These incentives, as Kobes says, must exist in the form of technical development and tax incentives. There’s a simple need for more discoveries in all types of renewable energy and as it stands right now, Kobes mentions, the technology for solar energy is too expensive. In addition, Kobes also argues that the cost may have been altered due to past production efforts. The stark cost of discovering new ways of production, in other words, can become costly. Throughout the analysis of previous energy innovations, Kobes makes it abundantly clear that a transition in the private market place will take lots of money and time. Kobes is largely objective in this article. Interestingly enough, Kobes argument of pragmatism in renewable energy implementation is important to my argument in the idea that sustainable development will not happen overnight. It will take time, like most major changes do.

Hudson, Edward A. "Economic Effects of Increased Penetration of Solar Energy." The Energy

Journal 1, no. 3 (July 1980): 97-111. Accessed April 5, 2016.

http://www.jstor.org/stable/41321471

Hudson provides an in-depth analysis of energy and its favorability to the economy by measuring a variety of factors. For example, he mentions that new-technology sources of supply are considered at each of three levels of penetration where these levels correspond to energy output. This is important because the figures show that renewable energy can be more efficient and productive than non-renewable energy. Interestingly enough, solar energy had the highest output possibility in a given yield with regard to Btu’s where coal, on the other hand was of the lowest. Along with other various comparisons of benefits to the implementation of renewable energy, Hudson also mentions the capital and investment effects of new technologies. New types of energy, Hudson adds, requires a significant amount of capital. Capital, of course, that is ultimately available would suffice for high-priority investment. The downfall, as Hudson notes, is that only certain companies are able to invest in new types of energy. Hudson concludes by conveying the macro-economic effects of solar energy. Notably, most of the effects were positive. Hudson is largely unbiased and, as a result, makes a very interesting argument. These numbers are definitively important to my argument largely because Hudson makes the case for sustainable development. It is possible, in other words, to derive positive production figures from solar energy in the energy sector. The high yields and productivity of solar energy make its viability abundantly clear.

Durham, Catherine A., Bonnie G. Colby, and Molly Longstreth. "The Impact of State Tax

Credits and Energy Prices on Adoption of Solar Energy Systems." Land Economics 64,

no. 4 (1988): 347. Accessed April 5, 2016. doi:10.2307/3146307.

Durham discusses the effects of basis tax credits on solar systems. To start out, she provides an analysis of previous research on solar adoption. She mentions that tax credits have been shown to substantially reduce the cost of solar water heaters and various other solar-bounded appliances. This is largely important because of the high-cost of solar energy materials. Her example of solar heating systems becoming more effective than electric systems shows that solar energy, in some manner, can become competitive with various other kinds of energy. Importantly, she notes, there are many factors that determine what effects tax credits can accomplish. Even with the reduction and price, many systems have proven too expensive in the free market. Unfortunately, while maintaining a sense of pragmatism, solar energy has a long way to go before any serious use of its implementation is practical on a larger scale. To conclude, Durham found that state tax credits and conventional energy costs significantly affect the probability of solar installation. Durham was unbiased in her research largely. Her points, however, are important to the development of my argument with regard to her emphasis on the government’s role in solar energy use. Clearly, there needs to exist some sort of buffer system to encourage the industry to make advancements in technology while also encouraging people to use their products.

Yokell, Michael D. "The Role of the Government in Subsidizing Solar Energy." The American

Economic Review 69, no. 2 (May 1979): 357-61. Accessed April 5, 2016.

http://www.jstor.org/stable/1801673.

Yokell starts out by debating if the federal government should even subsidize solar energy. With weighing the pros and cons, Yokell suggests that it is definitely worth it. He cites that innovation needs to become encouraged through the government to eliminate corruption, the risk factor is extremely high for investors, and that private willingness to purchase a product would be raised to high levels if risk could be pooled. Seemingly, the argument Yokell makes throughout his article is that there is a high risk to solar energy therefore subsidizing it makes sense. Without the government’s hand, in other words, there may exist major problems with product production and safety for people purchasing the product and the investors. They act, in essence, as a buffer system for private investors and the companies as well. Along with debating the actual issue itself, Yokell goes on to convey how the current subsidies have worked out so far. Through analysis, it seems that the solar energy field has grown because of the government’s help. Ultimately, Yokell closes by saying solar energy would not have developed much without the help of subsidies. In the article, Yokell is largely unbiased throughout. In addition to Durham, Yokell provides an even broader foundation to the government’s role in encouraging solar energy. The whole argument of sustainable development and government interventionism in innovation is an important idea that largely extends into my research.

1. Cesare Silvi, "History and Future of Renewable Solar Energy." Development, Suppl. Climate Justice and Development 51, no. 3 (September 2008): 409. ProQuest Central. [↑](#footnote-ref-1)
2. Ibid., 409. [↑](#footnote-ref-2)
3. Gulsevi Barar and Leonardo Bedoya-Valencia, "Modeling of Renewable and Non-Renewable Energy Resources and Their Long-Term Effects on CO2 Emissions in Colorado." IIE Annual Conference, 2014, 2725. ProQuest Central. [↑](#footnote-ref-3)
4. Ibid., 2726. [↑](#footnote-ref-4)
5. Ibid., 2727. [↑](#footnote-ref-5)
6. Ibid., 2727. [↑](#footnote-ref-6)
7. Edward A. Hudson, "Economic Effects of Increased Penetration of Solar Energy." The Energy Journal 1, no. 3 (July 1980): 97. http://www.jstor.org/stable/41321471 [↑](#footnote-ref-7)
8. Ibid., 106. [↑](#footnote-ref-8)
9. Ibid., 106. [↑](#footnote-ref-9)
10. Ibid., 107. [↑](#footnote-ref-10)
11. Peter Holmes Kobos, "The Implications of Renewable Energy Research and Development: Policy Scenario Analysis with Experience and Learning Effects." Rensselaer Polytechnic Institute, 2002. 97. ProQuest Central. [↑](#footnote-ref-11)
12. Ibid., 97. [↑](#footnote-ref-12)
13. Ibid., 101. [↑](#footnote-ref-13)
14. Ibid., 102 [↑](#footnote-ref-14)
15. Michael D. Yokell, "The Role of the Government in Subsidizing Solar Energy." The American Economic Review 69, no. 2 (May 1979): 359. http://www.jstor.org/stable/1801673. [↑](#footnote-ref-15)
16. Durham, Catherine A., Bonnie G. Colby, and Molly Longstreth. "The Impact of State Tax Credits and Energy Prices on Adoption of Solar Energy Systems." Land Economics 64, no. 4 (1988): 348. Accessed April 5, 2016. [↑](#footnote-ref-16)
17. Ibid., 349. [↑](#footnote-ref-17)
18. Ibid., 352. [↑](#footnote-ref-18)
19. Ibid., 354. [↑](#footnote-ref-19)