THE ROLE OF TECH INFLUENCERS IN THE DIFFUSION OF PHOTOVOLTAICS

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Innovation

October 25, 2018

Abstract

The question of whether renewable energy will be able to supply all of our energy needs in the near future becomes increasingly critical day by day. This research sets out to explore the importance of technology influencers or opinion leaders in the diffusion of photovoltaics. For this project, an emphasis has been placed on interviews, past diffusion research, and social media scanning. Major findings show that there is a high value in establishing enthusiastic networks and that individuals tend to adopt photovoltaics based on evaluations conveyed to them by others. These findings may inform the significance of creating a photovoltaic YouTube community to accelerate the rate of diffusion among individuals.

Research Plan

It becomes clearer each additional day we burn fossil fuels that we must transform our energy economy away from this dark, dirty era. At our current rate of consumption, scientists predict that we will deplete the world of oil in as soon as 40 years[1]. Not to mention, if we do continue on that path we will face severe environmental consequences. On a happier note, a vast amount of research has gone into renewable energy over the past decade (and still today) and many great technologies have emerged because of it. Furthermore, the prices of some renewable energy sources, especially photovoltaics, are dramatically falling and are even becoming competitive with oil and gas prices[2]. Yet, the United States still has such a far way to go with implementing these technologies, which is what prompted the interest in writing this paper.

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[1] Clemente, Jude. "How Much Oil Does the World Have Left?" Forbes. June 25, 2015. Accessed October 25, 2018.

[2] U.S. Energy Information Administration. *New York State Energy Profile Data.*

This paper will specifically look at the role of opinion leadership and argue that the rise of photovoltaics among social media influencers, especially “tech” YouTubers, would increase observability and subsequently escalate the rate of adoption by individuals. Three main research methodologies will be used to approach this topic, including interviews, past diffusion research, and social media scanning.

Research Insights

Past diffusion research provided critical insights that aided the research early on, in particular the United States Department of Energy’s Solar Energy Evolution and Diffusion Studies (SEEDS). In short, analysis of this research revealed that enthusiastic networks that convey positive evaluations help break down the radical, disruptive, and less compatible nature of photovoltaics[3]. Past diffusion research also shows that the imitation effect (when an individual observes and replicates someone else’s behavior) plays a large role in photovoltaic adoption[4]. Currently, a large percentage of photovoltaic adoption is because of opportunistic events and specific triggers[5].

Interviews with Erik Eibert, Assistant Director of Sustainable Initiatives at The New School, and Laurie Reilly, Director of Communications for Sustainable CUNY, also offered a lot of insight into the diffusion of photovoltaics. In New York City, large scale implementation of photovoltaics would not supply enough energy to meet consumption needs because of relatively

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[3] Rogers, Everett M. Diffusion of Innovations: 5th Ed. New York: Free Press, 2003.

[4] Department of Energy. *Understanding the Evolution of Customer Motivations and Adoption Barriers in Residential Solar Markets.*

[5] Ibid.

low roof space compared to energy consumption[6]. This has lead local New York City universities to create a coalition that is investing in the construction of renewable energy farms outside of the city[7]. This lack of space encourages institutions, like The New School, to purchase renewable energy certificates, a program designed to incentivize "renewable energy by providing a production subsidy to electricity generated from renewable sources."[8] In addition, the interviews affirmed that money is a key motivator in changing habits, at both the residential and non-residential level[9].

Lastly, social media scanning showed that there is a lot of content, notably on YouTube, around creating "free energy," installing DIY photovoltaics, and critical evaluations of the technology. Off grid solutions, tiny homes, and solar cell tutorials were other topics that came up a lot on YouTube, as well. Furthermore, there is a lot of interest in this topic based on high video views and comments. What this demonstrates is that individuals are interested in photovoltaics and are keen on ways to implement the technology in an easy and, most importantly, affordable manner.

Design Strategy

As of July 2018, 22.9% of electricity generated in New York state was from a renewable source. Photovoltaics made up just 2.5% of that[10]. It is important to note that out of all energy

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[6] Eibert, Erik. *Sustainable Initiatives at The New School.* Interview by author. October 18, 2018.

[7] Ibid.

[8] Ibid.

[9] Reilly, Laurie. *Evolution of Photovoltaics in New York City.* Telephone interview by author. October 19, 2018.

[10] U.S. Energy Information Administration. *Primary Energy Consumption Estimates, 2016 (Trillion Btu).*

consumed in New York state, less that 0.5% of that is photovoltaic[11]. That being said, this research supports the concept of creating and branding a YouTube community around the implementation of photovoltaics on an at home—do it yourself—scale. The social media scanning demonstrates that there is a market for individuals that have an interest in finding the means to install photovoltaics themselves. As a result of this, technology influencers would increase observability, which according to the diffusion theory framework would subsequently increase the rate of adoption. This venture would also strengthen the current communication channel on YouTube and decrease uncertainty around photovoltaics.

Research Reflection

Overall, I am satisfied with the research I was able to conduct and the insights I gathered. Interviewing Erik Eibert and Laurie Reilly proved to be very valuable and extremely informative for my research. All the methods I choose were beneficial in offering varied findings on photovoltaics. However, if I were to further this research in the future I would prioritize interviewing and surveying homeowners, as well as do more in depth social media scanning. Regardless, I am pleased with the design opportunity I have identified and believe it could have an impact on increasing the rate of adoption of photovoltaics.

[11] U.S. Energy Information Administration. *Primary Energy Consumption Estimates, 2016 (Trillion Btu).*

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U.S. Energy Information Administration. *Primary Energy Consumption Estimates, 2016 (Trillion Btu).*

Appendix

Interview with Erik Eibert, Assistant Director of Sustainable Initiatives, The New School

Question 1:
- Lead goal building (green roof, lights)
- Ice storage system, tanks of ice cubes insulated on the inside and this big machine freezes ice at night, night time electricity which is less carbon intensity
- Co – generation plant which generates electricity with turbines
- Waste heat is recovered and used to generate hot water in the building
- Carbon emissions reduction goal
- 40% reduction over 15 year period by 2030
- Have already reduced by 15 % over the last 3 years
- Heating system: burning oil to generate steam and heat the buildings
- Natural gas: transition fuel
- If you go upstream to where the natural gas comes from its eventually worse because its leaking gas into the atmosphere
- Natural gas if you let it out in its form its 85% worse than burning it
- So its better at the moment but not the solution.

Question 2: Renewables
- Renewable energy recs
- Buying certificates – even for buildings leased
- Upstate colleges are implementing
- Putting solar panels on the UC rooftop - It produce 2-5% of the electricity so they thought it was not worth it. Although 2/3 of all emissions are coming from electricity.
- Most roofs have generators, cooling towers, there isn't a lot of room for the roofs
- Universities are planning to jointly build a place upstate with solar panels

Carbon emissions on campus:
- Using electricity all generated from diff power plants
- 2/3 of all emissions are coming from electricity
- Projects for the future

Question 3:
- Heat pumps
- Geothermal wells
- Air source heat pump – more efficient to heat buildings with electricity
- The city is proposing to heat buildings without combusting fuel on site
- Arnold hall – installing a boiler that is 95% efficient – it uses oil now but will gas in the future
- Do we keep fixing this old system or make a big investment now and do the best we can with current technology (which is what they did)
- Some of these systems take really long to change

- The city put their money in the grid being renewable
- Solar panels and wind power – need to convert heating systems to electricity and if the grid is producing renewable electricity then it will be clean
- This only works if the grid becomes clean

Solar panels:
- Tall buildings using lots of energy and small roof spaces
- Roof space per energy consumption is small
- Wouldn't produce much here on campus

Water consumption:
- Saving water in Loeb hall but the value of water is low
- A lot of money to change toilets and the cost of water is so low, but water is a public resource we should value
- Think in the long run, don't think in a financial basis

Interview with Laurie, Director of Communications, Sustainable CUNY

Question 1:
- PV installation
- 2006 Solar
- Up to year to get a permit to install PV in 2006
- Same platform since 2006
- Now you can get it for less than a day
- Soft costs – balance of systems soft cost everything else besides hardware
- Built the new York city solar map, Gov requested they do it for the whole state
- New York city installer roundtable
- Started at 5 Pv companies and now there are over 90
- Solar is costly, worked with the department of energy to figure out where to put these installations
- Net metering – good for big projects
- Value of distributing energy resources
- Helping the city do this

Question 2:
- All demographic
- Business owners
- Uses calculator on the map
- Payback is 4-8 years
- Peak shaving – when its really hot a lot of energy is being used on AC the solar on the roof prevent people from spending more money on their utility bill

New school problem:
- Peak shaving
- Environmental justice
- Net metering

Community rooftop solar:
- NYC solar partnership
- Access solar
- NYCHA

Why is it on the decline:
- Net meting
- Early adopters jumped in 2015
- Grid ready got completed recently

Question 3:
- Project based project management v

Photovoltaics on a Million Roofs

Photovoltaic-generated electrical power has been strongly encouraged by the U.S. government in recent years, with a recent U.S. president unveiling a Million Roofs Initiative, seeking to populate one million rooftops across the nation with solar power by 2010. Clearly, if photovoltaics (PVs) are to play an important role in freeing America from dependence on Middle Eastern oil imports, utility companies must promote their diffusion. However, a national survey of these companies by Kaplan (1999) found that only 2.5 percent had adopted photovoltaic technology, even though most power company managers possessed a high level of technical knowledge about PVs. One reason for this KAP-gap is that photovoltaics are a misfit: "PVs are decentralized, modular, and easily disconnected from the utility grid" (Kaplan, 1999, p. 477). Power company managers *should* adopt photovoltaics, but they don't. These potential adopters have knowledge, but not experience, with this disruptive technology ("disruptive" in the sense that it is radically different from the usual operations of power companies). The more radical and disruptive an innovation and the less its compatibility with existing practice, the slower its rate of adoption (Walsh and Linton, 2000; Bower and Christensen, 1995).

Most individuals do not evaluate an innovation solely or perhaps at all on the basis of its performance as judged by scientific research. Rather, they decide whether or not to adopt on the basis of the subjective evaluations of the innovations conveyed to them by others like themselves (peers). Fortunately, a few power utilities have pioneered in adopting photovoltaic technology themselves or in promoting it for adoption by their customers. The Gainesville, Florida, power company raised funding by voluntary contributions from its customers and purchased a large PV system. The Sacramento city utility assists households to install photovoltaic panels on their rooftops. Many of the Hopi people in Arizona have installed PVs. A small trailer, provided by the Hopi Foundation, is equipped with photovoltaic equipment and is parked at the home of a potential adopter for a week to encourage adoption through increasing the trialability of PVs. Adoption of PVs is being pioneered in certain bright spots in the United States. Perhaps eventually these experiences will spread to other power utility companies and their customers (Kaplan, 1999), and PV adoption will become widespread.

*Building a Network for the Diffusion of Photovoltaics in the Dominican Republic**

In 1984, Peggy Lesnick, on an exploratory visit to the Caribbean area, installed a photovoltaic facility at a school in Jamaica to provide a solar-powered pump so that the schoolchildren could drink pure water. At about the same time, Richard Hansen walked past customs officials in the Dominican Republic with a photovoltaic panel under his arm, which he then installed on his residence so that he could enjoy electric lights and operate his television set. Photovoltaic is a renewable energy technology that uses semiconductor chips laced with conducting wires to convert electromagnetic radiation from sunlight into electricity. For example, many handheld calculators use photovoltaic power.

Some fifteen years later, in 1999, when gathering data for her Ph.D. dissertation on the diffusion of photovoltaics, Peggy Lesnick returned to Jamaica. The principal, an enthusiast for photovoltaics, had left the school. The panel had been vandalized and the wiring ripped out. The schoolchildren had no clean water. But to Lesnick's surprise, in the nearby Dominican Republic, there were more than eight thousand photovoltaic adopters! The residents were among the poorest segment of the nation's population, living on the rural, remote North Coast. What factors explain this very different experience with photovoltaic diffusion in these two Caribbean nations?

Richard Hansen, with an engineering degree from MIT and an MBA, quit his job at the Westinghouse Corporation to move to the Dominican Republic in 1984. His use of photovoltaic technology aroused the curiosity of his neighbors, whose homes were lit with kerosene lamps and whose radios and television sets operated off car batteries, an inconvenient power source (as they did not have vehicles). Hansen installed photovoltaic panels for three of his neighbors, lending them the money needed to adopt (about $600 each) from his personal funds. The first adopter installed a photovoltaic panel on his rooftop as a surprise gift to his wife while she was away. When she came home that evening, she could not believe their brightly lit house. One of the early adopters said: "Where once there was total darkness, there is now light and opportunity" (quoted in Lesnick, 2000, p. 20). A twelve-by-forty-eight-inch photovoltaic panel on the rooftop of a village home in the Dominican Republic provided enough electrical power for five lights, a radio, a television set, and perhaps a blender and a fan. Hansen trained each of the first three adopters to become photovoltaic installers, and they soon diffused the innovation to twenty-seven other households, all within a fifteen-mile radius and most living along one main road.

These early adopters formed the Association for the Expansion of Solar Energy, which trained 150 installers, provided loans to adopters, and lobbied the national government to lower the 100 percent import tax on photovoltaic panels to 18 percent. A new adopter would make a down payment of $65 to the association and then pay off the rest of the loan over four or five years. The association fought off the national government's electrical power utility, which began to offer central station electricity at a cheap price to adopters of photovoltaics. People soon learned that photovoltaic electricity was better, once they experienced blackouts and other problems with the power utility. As one photovoltaic adopter stated, "PV [photovoltaic] never goes out. Plus, we own it" (quoted in Lesnick, 2000, p. 127). The empowering aspects of the photovoltaic technology were very important to the poor Dominicans who adopted this innovation.

Their enthusiasm for the innovation helped spread it over the impoverished North Coast of the island nation, with the association playing a key role in funding and providing technical support. Through their association, the Dominicans felt that they were in charge of the diffusion process, especially after Richard Hansen returned to live in the United States (he is a board member of the association and flies back to the Dominican Republic twice a month for board meetings). With his help, the association decided to go international. In 1999, the association launched a diffusion program for photovoltaics in the Central American nation of Honduras, and within a year there were more than one thousand adopters.

What explains the successful diffusion of photovoltaics in the Dominican Republic? One main reason was that the adopters organized a network (the Association for the Expansion of Solar Energy), which facilitated the spread of the innovation.

Consumption & Expenditures

Summary	New York	U.S. Rank	Period	
Total Consumption	3,661 trillion Btu	8	2016	find more
Total Consumption per Capita	185 million Btu	50	2016	find more
Total Expenditures	$ 50,061 million	4	2016	find more
Total Expenditures per Capita	$ 2,524	51	2016	find more
by End-Use Sector	**New York**	**Share of U.S.**	**Period**	
Consumption				
» Residential	1,035 trillion Btu	5.2%	2016	find more
» Commercial	1,112 trillion Btu	6.2%	2016	find more
» Industrial	381 trillion Btu	1.2%	2016	find more
» Transportation	1,133 trillion Btu	4.1%	2016	find more
Expenditures				
» Residential	$ 15,533 million	6.5%	2016	find more
» Commercial	$ 13,859 million	7.7%	2016	find more
» Industrial	$ 2,840 million	1.7%	2016	find more
» Transportation	$ 17,829 million	3.9%	2016	find more
by Source	**New York**	**Share of U.S.**	**Period**	
Consumption				
» Petroleum	252.9 million barrels	3.5%	2016	find more
» Natural Gas	1,294.9 billion cu ft	4.7%	2016	find more
» Coal	1.2 million short tons	0.2%	2016	find more
Expenditures				
» Petroleum	$ 21,760 million	4.0%	2016	find more
» Natural Gas	$ 8,125 million	6.3%	2016	find more
» Coal	$ 88 million	0.3%	2016	find more
Consumption for Electricity Generation	**New York**	**Share of U.S.**	**Period**	find more
Petroleum	72 thousand barrels	4.3%	Jul-18	find more
Natural Gas	51,037 million cu ft	4.1%	Jul-18	find more
Coal	49 thousand short tons	0.1%	Jul-18	find more
Energy Source Used for Home Heating (share of households)	**New York**	**U.S. Average**	**Period**	
Natural Gas	59.4 %	48.0 %	2017	
Fuel Oil	20.5 %	4.7 %	2017	
Electricity	11.9 %	39.0 %	2017	
Propane	4.0 %	4.7 %	2017	
Other/None	4.2 %	3.6 %	2017	

Environment

Renewable Energy Capacity	**New York**	**Share of U.S.**	**Period**	find more
Total Renewable Energy Electricity Net Summer Capacity	7,134 MW	3.3%	Jul-18	
Ethanol Plant Operating Capacity	179 million gal/year	1.1%	2018	
Renewable Energy Production	**New York**	**Share of U.S.**	**Period**	find more
Utility-Scale Hydroelectric Net Electricity Generation	2,500 thousand MWh	10.5%	Jul-18	
Utility-Scale Solar, Wind, and Geothermal Net Electricity Generation	346 thousand MWh	1.4%	Jul-18	
Utility-Scale Biomass Net Electricity Generation	202 thousand MWh	3.7%	Jul-18	
Distributed (Small-Scale) Solar Photovoltaic Generation	177 thousand MWh	5.6%	Jul-18	
Ethanol Production	4,110 Thousand Barrels	1.1%	2016	
Renewable Energy Consumption	**New York**	**U.S. Rank**	**Period**	find more
Renewable Energy Consumption as a Share of State Total	11.7 %	19	2016	
Ethanol Consumption	13,433 thousand barrels	4	2016	
Total Emissions	**New York**	**Share of U.S.**	**Period**	find more
Carbon Dioxide	168.0 million metric tons	3.2%	2015	
Electric Power Industry Emissions	**New York**	**Share of U.S.**	**Period**	find more
Carbon Dioxide	31,295 thousand metric tons	1.6%	2016	
Sulfur Dioxide	18 thousand metric tons	1.0%	2016	
Nitrogen Oxide	32 thousand metric tons	2.0%	2016	


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Project Profile: Understanding the Evolution of Customer Motivations and Adoption Barriers in Residential Photovoltaics Markets

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How Much Oil Does the World Have Left?

Jude Clemente Contributor

Energy

I cover oil, gas, power, LNG markets, linking to human development.

SWOT Analysis

Strengths • Sustainability • Lower energy bill cost • Low Maintenance Costs • Efficiency	**Weaknesses** • Accessibility • Installing it is expensive • Convenience • Weather Dependent • Solar Energy Storage Is Expensive
Opportunities • It can instigate a change for people to use more renewable energy • It can bring down electricity costs and usage for the people of New York	**Threats** • Stubborn city officials are hesitant to change habits • If the profitability of solar energy is less than that of natural gas, the city will have less motivation to convert to renewable energy • The process of converting to solar energy could take a long time and not be a main priority for the city government

Stakeholder Map