Powering the Dream: The History and Promise of Green Technologies
Alexis Madrigal , Evan O'Neil

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EVAN O'NEIL: Welcome to Just Business, a Carnegie Council series. I'm Evan O'Neil, editor of the Carnegie Council's online magazine, _Policy Innovations._ I'm speaking today with Alexis Madrigal, author of the new book _Powering the Dream: The History and Promise of Green Technology_, new from Da Capo Press.

Alexis, welcome.

ALEXIS MADRIGAL: Thanks for having me.

EVAN O'NEIL: This book is in itself very innovative. It's the first historical look at green technology. It reads like a museum of successes and failures, with an entrepreneurial spirit that seems to have driven them all.

Let's start with some basics. What was your inspiration in writing it?

ALEXIS MADRIGAL: I wanted to bring a new perspective on the environmental movement. For a long time the movement has been configured around stopping things from getting done. A lot of the things have been really good—land conservation and essentially derailing what would have been a disastrous dive into massive amounts of nuclear technology in the 1970s and 1980s. But I wanted to trace the shadow history of a different kind of environmentalist—the entrepreneurs who always wanted to tap into renewable energy.

I wanted to bring the ancestors of the current green technology movement into the discussion, not to forget the lessons that we have learned from the growth of the environmental movement in the middle of the century, but just to round it out a little. Without some resource that we could point to with the stories of these other people, they would continue to remain outside of the discourse.

I tried to just go and track down their stories. You can probably tell from the book that I found a lot of their ideas fascinating, because so many of them presaged what we thought were new ideas in the last decade.

EVAN O'NEIL: One of the frontlines in that battle you are describing today is out in California, with some of the solar developments. There is the Ivanpah Valley, where BrightSource is trying to build a massive solar thermal power plant. It has received a lot of investment and attention lately. But there is a small tortoise that is standing in its way, sort of a biological marvel impervious to heat that can go for a long time without water. And there are very few of them left.

Can you tell us a little bit about that story and the dialogue between the two stripes of environmentalism?

ALEXIS MADRIGAL: These solar thermal plants are not what you would think of as solar, if you are most people out there. It's not the sort of thing that you put on your house. These are huge plants that take up thousands of acres. In this particular formulation, there are these huge fields of mirrors that focus the sun's heat onto a boiler, which boils water and can be used to drive a traditional steam turbine. In order to get the most efficient production out of something like this, you need a broad, flat valley in a desert that gets sun all the time, so you can lay out all these mirrors and point them at this boiler.

Unfortunately, the desert tortoise happens to like broad, flat valleys in the desert. So you end up with this situation.

How many desert tortoises are there? You get down into methodologies of counting tortoises—season, the way

that you walk across the valley looking to count them, and all these sorts of things. But there are somewhere between 25 and 100 desert tortoises on this 4,000-acre tract of land out in the Mojave Desert. Their presence, because they are listed on the Endangered Species List, created all kinds of environmental problems.

It's fascinating to think that the biggest solar plant that would be in existence, a huge milestone for the solar industry, actually drew more interveners in the California Energy Commission process than any other power plant in the history of the state of California, including all of the nuclear power plants that were built there. Obviously, everyone is seeing this BrightSource plant out in the Mojave as a milestone and a defining moment.

Most recently, Google invested $170 million. Their largest investment in anything came in this plant. The reason is that they have this program, RE < C—renewable energy is less expensive than coal. They see this as one of the ways that we can get there.

There are a couple of fascinating things about the case. One is, the whole point for solar developers is to get to scale, as they say, to get big enough that the price of these plants comes down closer to the cost of materials that go into the plants. Environmentalists, on the other side, are worried precisely about scale. They are worried about having these plants all over the Mojave Desert and its ruining viewsheds and ecosystems.

The other fascinating thing, at least for me, is that the Endangered Species Act is such a weird way of protecting the land. You take this one animal and it becomes a stand-in for everything that could exist in the desert. These tortoises get moved, like little executives. They get a new pad built somewhere else, and they get placed in there.

The fact that one of the most important solar projects of all time hinges on a few dozen—however many—desert tortoises just strikes me as so bizarre, because the global environmental problem of climate change is conflicting with a local environmental problem. The relative ethics of this thing are that you need to try to get this industry to scale so that the millions of species around the world that will be impacted by climate change have a chance.

Some people would say that this is a false dichotomy. But, really, there's a solar power plant or there's no solar power plant. In this case, there really is this clear problem of 100 tortoises versus the plant. Obviously, you should do everything you can to mitigate the impact on tortoises, but that's really what it comes down to.

EVAN O'NEIL: Speaking of coal and Google's formulation about renewable energy being cheaper than it, it reminds me of a passage from your book about Pittsburgh, which obviously is very important to the Carnegie history. You contrasted the environment and the industry there to what was going on in Lowell, Massachusetts. In Pittsburgh, you indicated that coal and dirtiness was money. It was the ethical value at the time in that location, whereas in Lowell they were trying to create more of a social utopia using renewable power.

Can you describe the contrasting history between those cities and their power resources?

ALEXIS MADRIGAL: To provide a little context to this story that might make it more interesting for people, the climate change debate is really difficult, because people in West Virginia and Texas—people in places where fossil fuels are produced, made, and mined—tend to think of climate change legislation as an attack on their way of life. It's not that they somehow want global warming, but they see fossil fuels as a key part of their conception as communities and as people.

The interesting thing here is that this stems from this Pittsburgh mentality. There are these two cities in the 19th century, Lowell and Pittsburgh, and they were both visited by lots of people because they were essentially the industrial centers of mid-19th-century America. It's hard to think of Lowell, Massachusetts, as being a globally famous city, but I'm talking about British diplomats, French diplomats, Davy Crockett, every president. It was called the City of Spindles, and it was famed for its water power.

Pittsburgh, on the other hand, was famed for its steel industry. What we had in that situation was a bunch of other travelers going there to see this amazing industry.

But the descriptions are really different. In Lowell, it's light and airy. There are all these descriptions of the colors, particularly of the female workers in the Lowell mills—the blues and greens of their outfits. Meanwhile, in Pittsburgh you actually had fashion changing, people wearing grays and blacks because the entire town was covered in soot and smoke. You have travelers saying things like, "In Pittsburgh, he whose hands are the sootiest makes the most money," and telling us stories like we hear about China now, putting pieces of paper on the windowsill and having them be covered by coal ash and soot within minutes.

You really have in these two cities a metaphor for American industrialization. People at this time knew what had happened in England. Think of this as like Dickens-era England—Tiny Tim, "May I have some more, sir?", and a lot

of these kinds of stories. People knew about them in the United States, and they wanted a better kind of industrialization. At least some of them did. That's really where Lowell comes out of. Lowell was this transfusion of these utopian experiments that were going on during that time period, as people were trying to figure out—"Wait. Industrial capitalism is dislocating our entire society. What do we do?"

Lowell was a response to that. Granted, it was an accident of geography that they didn't have coal there; they had water power, so they used water power. But it ends up working into the image of Lowell as a morally upstanding place, because it was clear, it was airy, it was healthful, in a way that Pittsburgh could never be.

I found, in that, hope, because that really appealed to a lot of Americans, to have a better kind of progress and industrialism, even back at the very birth of industrialism in this country.

EVAN O'NEIL: Now the primary industrial impetus is in China and places like that, and they are charting their own courses of development. In countries like China and India, there are still many people with zero access to electricity of any sort. There is an ethical development question in this: What technologies will they get? What infrastructure will they be locked into in terms of the next ten, 20, 30 years?

Economist Hans Rosling gives the example of the washing machine and how this is a labor-saving device for a lot of women in the developing world. How could we deny them this kind of technology and innovation, which would free them to educate themselves, have smaller families, and maybe even eventually consume less energy per capita?

What technologies do you see as leapfrogging for these people who may have access to a cell phone, but not to a toilet yet?

ALEXIS MADRIGAL: It's worth, if not challenging, at least questioning the assumption that labor-saving devices on their own, like the washing machine, or electricity on its own is going to allow women to educate themselves. The causality might run the other way and that, as women become more educated, they reach out for the technologies that they find most helpful.

There is some controversial but really interesting research that was done in the history of technology around, did women's number of household hours of work go down in the era of labor-saving technologies? The answer is basically no. Society adjusted upwards its expectations of cleanliness, as opposed to just saying, "Oh, well, you've met the goals of 1890s America for cleanliness." Instead we just got cleaner and cleaner and cleaner, and the next thing you know, you have antibacterial soap.

But to answer the broader question of what technologies could work, thinking about the U.S. system, it took this incredible build-out of great infrastructure, paired with the incredible build-out of this really historically specific moment for utility use and our ideas about how companies should work, to come up with the American system of having private utilities running the quasi-shared grid. It's really a byzantine operation.

One good thing is that it would almost be impossible to develop the American system again. You had a time when, just by pure happenstance, utilities were growing at a moment when many people in America felt like any combination for just getting bigger and bigger was a good thing. Even the socialists of the time saw the world as—there is a famous example in Edward Bellamy's *Looking Backward*, which was an incredibly influential book. Essentially it was an argument for the ultimate centralization of every single technical function in society into one huge corporation. This wasn't Marxist. No, there is really going to be just one huge company, and everyone is going to work for them. That's just what would happen.

That's kind of what happened with utilities. We had this idea during that time that we should just centralize everything. At the very least, that idea has fractured a little. Maybe it makes sense to centralize in some ways and decentralize in others. That's ultimately what is going to be important for the developing world, their looking at, do they build this huge centralized infrastructure or do they go with a more decentralized program, where maybe you are using combined heat and power in cities, maybe you have solar in places where it makes sense, and you have small wind in places where it makes sense.

The biggest overarching point is that we know a lot more about the environment now and the energy potential of any particular environment now than we could have ever known in 1950 or 1900, because we have all this computing power to be able to model the way that energy flows are going. What that means is that people can take better advantage of those potentials in a decentralized way. My hope would be that inside those countries people will reach out for the kind of sensor and modeling technology that they need.

I have a lot of friends who work in the humanitarian design field. Their take is that the programs of the 1950s and 1960s of trying to bring solar cookers to northern Mexico were such an abysmal failure that everyone is very

afraid of trying to bring energy technologies, outside of cook stoves.

You start getting into that cook stove world, which seems so simple. It's a stove and you put whatever available material in, you burn it, and you cook stuff. But it turns out that if you don't make that thing perfectly culturally and geographically appropriate, then no one uses it. Even if you do, they might not use it because it's not local to the place.

The good thing is that we probably won't really get to make the decision about what people in those places will end up doing.

EVAN O'NEIL: The cultural aspect was one of the most interesting parts of your book. One could look at the title and assume that there is this deterministic element to it: Our technologies control what happens to our future, and some of our choice is maybe taken away from us. But, really, in many of the examples that you give, choice and preference and the culture was the dominant force.

You had this great quote from Woodrow Wilson, "Nothing has spread socialistic feeling in this country more than the use of automobiles," which is kind of ironic because today everybody associates the automobile with American capitalistic freedom. He was basically channeling the sentiments of the people at the time, where rich playboys were riding around and harming people with their vehicles, at a time when a minority of people owned them.

Fast-forward 100 years, and hippie communists are basically the stereotype of what environmentalists are today.

How do we get from one to the other? Is there an embodied ethics in our technologies?

ALEXIS MADRIGAL: It's an interesting question. I actually want to take this to the 1970s, because the idea that everyone involved in alternative energy was a hippie is something that really needs to change. It's one of the best caricatures, in the sense that it was really effective. But it really was just totally untrue. That's actually how that happens. Being able to define anyone who is interested in alternative energy as somehow countercultural worked really well for Reagan, in particular, in gaining public support for destroying renewable energy programs in this country.

There is something to the idea that decentralized energy technologies—and in this case, really what we are talking about here is not quite off-grid, but just generating some part of your own power—are somehow very democratic and a little bit countercultural. But it's not all hippie countercultural. There are other ways of being opposed to the dominant culture.

A way of getting at the idea of what is embodied in one of these technologies—particularly when utility prices were going up in the 1970s and you couldn't get away from them, and there were these huge bureaucracies, it just started to feel like the movie *Brazil*, where the corporation is controlling everything that you are doing. It just became this huge symbol of corporate power. Being able to say, "Hey, man, half of my energy production doesn't come from this corporate entity, which is controlling things in a way that I don't want it to"—that is a really radical social idea.

We underestimate how much the systems that we are a part of impact our overall ethical impact on the world. It's so easy to say, "Well, I live in the Washington State exurbs," where I grew up. I drove, like, 50 miles a day growing up. That's not a good thing, and I recognize that now. But I was part of that technical and social system that was so thoroughly shaping what I could do. That creates a kind of politics, too, because the price of gas is so important when you are driving 50 miles a day and you are from a family that doesn't have a lot of money. So that actually mattered. That's what we don't always understand.

If you look at the politics of America right now, people who live in cities are overwhelmingly liberal and people who live outside of cities are overwhelmingly conservative. Policies that drive people out of cities, policies that drive people into cities, are also political policies, even if they look like land use and energy policies. That is a fundamentally important thing to recognize when we think about how much we have subsidized the suburbanization of America over the last 50 years.

EVAN O'NEIL: That's the contrast between what you call our industrial constitution and our actual Constitution. You say that the one has been vetted in terms of its principles much more than the other, and that we need an ethical investigation into our technologies to push us into a renewable future—to power the dream, as you say.

ALEXIS MADRIGAL: Yes.

EVAN O'NEIL: And government certainly has an influence on this. Many people don't want it to, from their perspective, meddle in the so-called free market. But you say that in many cases the government has done a lot of good to help us use energy in smarter ways.

ALEXIS MADRIGAL: Yes. There are a couple of things to say about that. The first is that there is really no free-market for energy. There are regulated utilities. Most of the world's oil supply is controlled by state governments of various types across the world.

So to be against meddling when it's all meddling is insane and totally irrational. It's also completely ahistorical. We have supported the oil industry with billions of dollars in incentives. For literally decades all of the drilling that they did could be written off as a business expense. That's a huge tax break.

Maybe that's actually a good idea. In some ways, you want the U.S. to have oil. It certainly helped us grow into a big industrial power. If we didn't have it, it's hard to know what the U.S. would have looked like, but it certainly would have looked a lot different.

Or take the support of nuclear power. From 1940 to 1980, there was incredibly strong, consistent support at every level, in soft and hard ways, to support the development of commercial nuclear power, largely for geopolitical reasons, not for technical ones.

In fact, one of the most fascinating bits of information that I came across—we think of nuclear power as having taken off, right? It provides 20 percent of the electricity in this country. But from about the 1950s—the kind of "Atoms for Peace" Eisenhower speech—up until 1965, the utilities were not biting on buying nuclear reactors, despite all the incentives. It took essentially selling them below cost for a long time, and losing billions, which would be tens of billions of dollars in our money, in order to push those things out.

So, yes, the role of government should be what the role of government has been in most major technological developments, like with the Internet—that is, providing long-term, consistent support and designing whatever types of winners we pick, which is just inevitable and possibly even desirable. We pick them with maximum social value built in.

One of the best things about the way the Internet was designed is that it's decentralized. It allows lots of people to use it in many different ways. When you are picking energy technologies to support, you would pick foundational things that can be built on by lots of other people. In my mind, that would be like supporting materials science in a really hardcore way, because the materials that come out of these things are the substratum of the material invention, and they really help innovators dream. They're, like, "If I had a material that could do this," and then there it is; there's the material and they can go with it from there.

There is a lot more we could get into about innovation ecosystems. Trying to pick winners that are more open system based than closed system based would be one way of bringing the government in, in a positive way.

EVAN O'NEIL: Who was your favorite innovator that you researched? You have a lot of characters that appear in the book of various technological and entrepreneurial bents. They all have an interesting history. Who shines the brightest for you?

ALEXIS MADRIGAL: One would be Palmer Putnam. He was responsible for creating the first megawatt wind turbine.

EVAN O'NEIL: What year was that?

ALEXIS MADRIGAL: It was in 1941 that they completed it. It was ten times larger than anything that had been built before. Only one machine was even at that other level of 100 kilowatts, and that was this Russian machine that was built in Yalta that no one had even seen.

They were doing this completely unprecedented thing in the late 1930s. Palmer Putnam is the son of G.H. Putnam. He was a publishing magnate who left a bunch of money behind. Palmer, who had been running around Central America getting an MIT master's in volcanology or geology, wrote a master's thesis called *The Reconnaissance among the Volcanoes*. He decided to come back and run his dad's publishing business, and runs it right into the ground.

So he's sitting there, bankrupt, at some family home in Cape Cod. He was a big sailor. He was thinking about the wind and he actually said this; he wrote a book about it—"What if I could harness that to reduce my electricity bill"—clearly a bankruptcy-inspired thought. "What if I didn't have to pay anyone for this because I'm making it myself?"

So he goes out with that man-of-action, sort of 1940s spirit and says, "I'm Putnam. I'd like to sell you on this wind project." Using the language of sailing, he goes out and sells to all of these rich guys and also brings in Vannevar Bush, who is FDR's science adviser, who ends up getting behind the project. So you have Caltech, Harvard, and MIT— the elite of the nation. General Electric ends up hooking them up with this turbine maker, and they put together this incredible project, against all odds.

Unfortunately, they had to make a few decisions—keep in mind, they were calculating the stresses on this wind machine by hand. They didn't really know how well it was going to work. Also World War II was approaching, so they had to put in a lot of orders for this big, heavy machinery before they knew everything.

The machine does work. It gets in *Time* magazine. It's all over the place. People are imagining that these might be spread all over the hills of New England.

Then World War II starts. A ball bearing goes bad within the machine. It would normally be no big deal to fix it, but it's World War II. So it kind of sits there for a couple of years while Putnam goes off and designs the amphibious landing vehicle, the DUKW, which is now used to give amphibious tours to drunken frat boys around the country. Then he returns to the project and they run it a few more times, and it tosses a blade and the thing fails.

But what I love about what he did and what the project did was that they failed really well. They took all that information that they had learned and they put it into the public domain in the form of a book. That is something that in the future I hope more energy startups do—share their data. If they believe what they are saying about wanting to have a better world, then one of the ways that they could create that world is, if they go under, to make their intellectual properly available for other people to use.

EVAN O'NEIL: Alexis Madrigal, author of *Powering the Dream: The History and Promise of Green Technology*, thank you for joining us on Just Business.

ALEXIS MADRIGAL: Thanks for having me on.