# KEYNOTE ADDRESS: 2017 VJEL SYMPOSIUM

***Dan Reicher****

Pat Parenteau, thank you so much. What an inspirational opening and thank you for your kind introduction of me. What my wife says is-I can't keep a job so that's the real story-but I am so thrilled to be among so many people who are such good friends here. It starts with Pat; but, [also] Steve Dycus, whom I worked with long ago at the Natural Resources Defense Council. Peter Bradford who I've known for years and years, who's on the faculty here as well. Michael Dworkin-Michael will be here later-[I've] known for years and years. And, I actually have a boss-an old boss-in the room, Tony Roisman. I didn't know Tony was here, I didn't know he's heading up-that he's chairing-the Vermont Public Service Board, the Public Utility Commission here. I worked for him as a lowly paralegal at the Justice Department, I don't know, 75 or 80 years ago-Tony, it must have been, something like that. Then, I also want to thank Russell King and Elizabeth Doherty for helping me get here and helping to put on this whole wonderful event. You guys have been great and I appreciate it.

I didn't get too lost getting here this morning. It's also great to be back in Vermont. I lived over in Norwich not too many years ago. [I] still have a home up in the Mad River Valley and have some unusual things that happened to me and my family here, which I will get to in a moment.

So, my job this morning is not to talk about solar, and wind, and all those good things-which I do love-but, to talk about the real workhorse in all of this which is energy efficiency. And I'd like to do that for about 40 minutes and then take your questions, any that you have, any good jokes—I'm looking for whatever you have.

So, let's dive in. So, Pat put it well—*we have storms on steroids*. The future is in fact not what it used to be, and you need only look at Houston or Florida or the real sadness in Puerto Rico, to kind of get a sense about what

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we're up to right now. And, of course, it all does come back to our global carbon footprint. We can debate how big a cause all of those sorts of things that the scientists are debating but when it comes right down to it the emissions that we're seeing from carbon are having a profound effect and the three biggest emitters are China, the U.S., and India.[1]

We are the heel, we're the heel in this diagram,[2] [and] I'm not sure how they picked that for our position, but—and then there's much of the rest of the world that makes this up—but, this is kind of the root cause of so much of what we're seeing. It also though, creates the great opportunity and that's part of what I want to talk to you about today. There is an extraordinary opportunity in going out and not just transitioning our energy system, but, fundamentally rebuilding it in so many different ways. So, if the future is not what it used to be, the best way to predict the future is to invent it—and that's what I find so exciting about this moment that we find ourselves in. There is a lot of doom and gloom but there's an extraordinary opportunity to basically build the future that we want in the energy area, in this energy transition as you're calling it today.

This not how we're going to get there, for those of you who can't read it, "Sorry, Harold, but I'm reducing our carbon footprint."[3] That's the way we're not going to get to a clean energy future nor from the academy is this it. Whoops. "Then a miracle occurs." (These are two Stanford or Vermont Law School talking to each other.)

In fact, how we're going to get there, in my view, is this: This is my favorite triangle (there is a rumor at Stanford I have this tattooed on my back). I will not either confirm nor deny that this morning. But, if we're going to build a more sustainable energy future, it's about technology, policy, and finance. And technology is science. Technology [is] engineering. Policy is law; policy—and all those related areas; and, finance is economics, marketing, business, finance-you name it-but, these are how I have crystallized these. What I say to friends, colleagues, students is—if you're interested in this whole area, get good at one point of this triangle; but, do not ignore the other two. I've seen so many people invent technologies all over this country—really interesting, compelling technologies—but, [they] stumble in the law and policy world. [They] find themselves unable to raise

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1. U.S. ENVTL. PROTECTION AGENCY, GREENHOUSE GAS EMISSIONS: GLOBAL GREENHOUSE GAS EMISSIONS DATA, https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data [https://perma.cc/3M47-7U9Y] (last visited Apr. 20, 2018).

2. David Wogan, *U.S. Energy Transitions in One Graph*, SCIENTIFIC AMERICAN: PLUGGED IN (July 8, 2013), https://blogs.scientificamerican.com/plugged-in/u-s-energy-transitions-in-one-graph/ [https://perma.cc/B5GA-HNEN].

3. Lee Lorenz, *Wife About To Shoot Husband*, NEW YORKER CARTOON (July 2, 2007) (photo licensed from the Conde Nast Collection, home of The New Yorker, Vogue).

early stage capital, or down the road from there, to secure project finance—to actually get full-scale deployment with technology.

We've got to integrate across this triangle; and, as you go out into the world as students, you might be here—but, be sure you have some understandings about those other two points if you want to work in this whole area of sustainable energy. So, I'm going to walk you around this triangle with respect to energy efficiency and then take your questions. So, just a few fundamentals, because I understand there's some folks who don't come directly from the energy world, some of you come from the environmental law world so I just wanted to talk about a few things that will set the stage a little bit for my talk but also for today.

The first is no surprise, energy sources evolve over time. We were a largely wood or biomass powered world, this goes all the way to the 1800s. Coal came in, pushing a big amount of that biomass out. From there, we went to oil; natural gas came in; the era of hydro began to take some piece of this; nuclear arrived; and then, that small, little [bit] up there-called other renewables. This is a chart from 2013, it would be a bigger slice today and it's a fast-growing one-still not huge but, a fast-growing one.[4] So, this is kind of the evolution.

I want to tell you you're sitting in a state that I think was the birthplace of modern renewable energy[, Vermont]. Seventy-five years ago, last October, the first megawatt scale wind turbine in the world, the first wind turbine hooked up to a large-scale utility grid was built on a mountain called Grandpa's Knob in southern Vermont.[5] It's a great, great story; there's a book you ought to read called *Power from the Wind* written in 1948.[6] The plan with this-but for World War II-this was put up in 1941. The plan was to put another 10 to 15 turbines along the ridge of the Green Mountains, and I would make the case that we would be 30 or 40 years further ahead in the wind industry had that happened. But, World War II intervened; coal came in, in a much bigger way; the nuclear era began; and, we didn't get back to a megawatt scale wind turbine until the 1970s.[7] It was a brilliant team that put

4. U.S. ENERGY INFO. ADMIN., *Energy Sources Have Changed Throughout the History of the United States*, Independent Statistics & Analysis: Today In Energy (July 3, 2013), https://www.eia.gov/todayinenergy/detail.php?id=11951 [https://perma.cc/JGL2-6VZQ].

5. Dan Reicher, *Renewable Energy On A Mountain Top in Vermont–75 Years Ago Today*, STAN. L. SCH. BLOG: LEGAL AGGREGATE (Oct. 19, 2016), https://law.stanford.edu/2016/10/19/the-unlikely-birth-of-modern-renewable-energy-on-a-mountain-top-in-vermont-75-years-ago-today/ [https://perma.cc/GMP9-7FKC].

6. PALMER COSSLETT PUTNAM, POWER FROM THE WIND (Van Nostrand Reinhold ed., 1948).

7. Reicher, *supra* note 5.

this together and it was an interesting fork in the road when it comes to the history of energy technology.

And now, [as] we're going to see, I am involved with a floating offshore wind company.[8] We're not only putting turbines on the bottom, in the shallow water; we're now beginning to put turbines in deep water—20, 30, 40, 50 miles offshore. This is this 50, 60, 70-year evolution of technology, that Pat rightly said, we got to speed up. The good news is though, (a lot of this is speeding up)-and this is one of those in the North Sea off the coast of Norway[9]-in a hurricane, [this turbine] does very well, and I can tell you about that later if anyone's interested. Full-scale project now being built off the coast of Scotland.[10] Very deep water, massive winds, and the best off-shore wind resource in the United States is off the coast of California, the deep water, and in the Great Lakes, who would've thought.[11] So, that's a little bit about technology transition.

Don't get too scared about this chart, this is the ultimate wiring chart of U.S. energy consumption put together annually,[12] I recommend it to you, if you really want to understand where energy goes in our economy in the U.S. So, you start with petroleum; most of it goes into transportation, some of it goes into industrial use, [and] literally none of it, almost none of it goes into electricity production.[13] We don't make electricity from oil in this country anymore.[14] Natural gas, on the other hand, goes into the industrial sector, the commercial sector, residential sector, and we make a lot of electricity.[15] Take nuclear: [it] all goes into electricity, none goes into these other sectors of the economy.[16] So, that's the wiring diagram.

Why do I show you all this? Well, first, I think it's important to understand where these different sources go in our economy. But, the second is, of all this energy that goes in, a hundred quadrillion BTUs or a hundred quads, a little under 40 comes out as useful energy, and guess what, the other

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8. *See Dan Reicher*, STAN. L. SCH., https://law.stanford.edu/directory/dan-reicher/ [https://perma.cc/M76K-ZQ4Y] (last visited Apr. 20, 2018) (detailing biographical information of author as Senior Advisor to the Atlantic Wind Connection project).

9. *See generally* DIEDERIK KLIP, THE NORTH SEAS OFFSHORE GRID: A PRAGMATIC ANALYSIS OF RECENT RESEARCH (describing the background and benefits of the North Sea countries' Offshore Grid Initiative).

10. *Id.*

11. *Id.*

12. *U.S. Energy Facts Explained*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/energyexplained/?page=us_energy_home [https://perma.cc/5LRE-9AKC] (last updated May 19, 2017).

13. *Id.*

14. *Id.*

15. Mark Golden, *What is the Future for Energy Policies?*, STAN. NEWS (Nov. 10, 2016), https://news.stanford.edu/2016/11/10/future-energy-policies/ [https://perma.cc/W2WN-JUVX].

16. U.S. ENERGY INFO. ADMIN., *supra* note 4.

60 comes out as rejected energy, the energy we waste.[17] That's why we're talking about energy efficiency. Hundred quads of energy in, 40 outperforming useful work, and 60 gets thrown away. That's why energy efficiency is so important in our economy and why yes solar, yes wind, yes to all the renewables—but, we [have] got to start with energy efficiency.

For climate, we need all of these renewables—carbon capture, changing the fuels in power plants, and use fuel switching; and then this big one—the biggest one of all—at 38% according to the International Energy Agency—that's energy efficiency.[18] The brown segments here are where energy efficiency makes up big chunks of what we got to get done. Efficiency's needed in industry, it's needed in transportation, it's needed in our buildings, and it's needed in a host of other sorts of things.[19] So, energy is the big dog in all of this when it comes to this energy transition and I think that's why we're starting out with energy efficiency this morning.

The good news regarding "EE," or energy efficiency, is [that] it's our lowest cost resource.[20] It's cheaper than wind or natural gas or all of these other things. These are the standard kind of cost numbers that one of the big investment banks in New York, Lazard, puts together on a regular basis and look where energy efficiency comes out.[21] This is in cents per kilowatt hour—this is the cheap stuff.[22] So, what do we say? We say, efficiency first-and I love what Amory Lovins has to say about [this], "All people want is cold beer and hot showers."[23] We want the services energy provides, [and] if we can do it with less energy, we're going to save in our pocketbook, we're going to save in a climate context. So, we want the services and the less we can provide those services, the less energy, the better off we're going to be.

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17. *Id.*

18. Samantha McCulloch & Eric Masanet, *Energy Technology Perspectives 2017: The Global Outlook* (July 10, 2017), https://www.iea.org/media/etp/etp2017/ETP_webinar_10_July.pdf [https://perma.cc/9DD5-ERGV].

19. *Energy Efficiency*, ENVTL. & ENERGY STUDY INST., http://www.eesi.org/topics/energy-efficiency/description [https://perma.cc/AL8W-PQME] (last visited Apr. 22, 2018).

20. *See New Report Finds Energy Efficiency is America's Cheapest Energy Resource*, AM. COUNCIL FOR AN ENERGY-EFFICIENT ECON. (Mar. 24, 2014), http://aceee.org/press/2014/03/new-report-finds-energy-efficiency-a [https://perma.cc/5JTZ-HW24] (providing a graph that illustrates the lost cost of energy efficiency in comparison to the cost of alternative new electricity resource options).

21. *See, e.g.*, *Levelized Cost of Energy 2017*, LAZARD (Nov. 2, 2017), https://www.lazard.com/perspective/levelized-cost-of-energy-2017/ [https://perma.cc/WCX8-GEPM] (providing the latest annual Levelized Cost of Energy analysis).

22. *New Report Finds Energy Efficiency is America's Cheapest Energy Resource*, *supra* note 20.

23. *See, e.g.*, Martin Rosenberg, *Insurgents Rule, Says Amory Lovins*, ENERGY TIMES (Aug. 16, 2017), http://www.theenergytimes.com/new-utility-business/insurgents-rule-says-amory-lovins [https://perma.cc/22J3-4AL9] (providing an example of when Amory Lovins said people want cold beer and hot showers).

Another complicated chart-but, this is the famous McKinsey curve for what the cheap and the expensive stuff is when you're going to fix climate change.[24] This is all the cheap stuff, the low cost, and in fact-in many ways, negative cost: insulation, fuel-efficient vehicles, lighting, air conditioning, water heating.[25] It doesn't get much more boring than that, but, this is-this is the important stuff when it comes to energy efficiency-and, I want to focus for a second on lighting. This is of course the LED.[26] This is the highly efficient technology developed decades ago but now coming into its own. These are those old fashioned incandescent bulbs, lumens per watt is how we measure light per unit of power, very inefficient, thirteen to eighteen lumens.[27] Compact fluorescents, those curly ones, somewhere in the 55 to 70 lumens per watt.[28] And, LEDs in the old days couldn't really beat compact fluorescents, but now they're rising.[29]

The amount of light you get out for the amount of energy you put in, gets better and better and better; and, the great news is [that] they used to be extremely expensive-LEDs-but, they've come down radically in cost. I was at a hardware store a couple months ago (and it was a real freight for an energy nerd like myself)—[it] was exciting to go in and see that I could buy four LEDs for the same price as buying four old-fashioned, old fashioned incandescents. The same price you would have gone into a hardware store not too many years ago and they would have been five or six or eight times as expensive. So, this has become not only a great technology, but a cheap one.

I owned a house over in Norwich, Vermont-I guess John Echeverria almost bought this house as it turns out-and, I learned about another energy technology called the blower door test.[30] What the heck is that? Well, houses in cold and hot places leak a lot of energy if they're not well-insulated; and, what you do is, you essentially put a giant fan in the door and you blow air out-having sealed up the whole house and closing off everything. So, this guy comes over and he does the blower door test; and, 20 or 30 minutes later, he comes back and he says "You know, I've never had a house that failed this test so miserably." He said, "I can't get this thing to depressurize at all"-because you depressurize it, and then all the cold air starts coming in, and

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24. MCKINSEY & CO., IMPACT OF THE FINANCIAL CRISIS ON CARBON ECONOMICS: VERSION 2.1 OF THE GLOBAL GREENHOUSE GAS ABATEMENT COST CURVE 8 (2010).

25. *Id.*

26. *Id.*

27. Owen Comstock, *LED Light Bulbs Keep Improving in Efficiency and Quality*, U.S. ENERGY INFO. ADMIN. (Nov. 4, 2014), https://www.eia.gov/todayinenergy/detail.php?id=18671# [https://perma.cc/P3PC-AUVK].

28. *Id.*

29. *Id.*

30. *Blower Door Tests*, U.S. DEP'T ENERGY, https://www.energy.gov/energysaver/blower-door-tests [https://perma.cc/BJ4F-JLSM] (last visited Apr. 22, 2018).

you can identify it with all sorts of things. He says, "I can't get this to do anything!"

Now, the rule is, the auditor will need to close all exterior doors and windows, open all interior doors, close any fireplace damper, doors, and woodstove air inlets. We did everything! But, we couldn't get it done. I said, "What do we do?" He said, "I don't know." He came back a half an hour later though, and he said, "How many chimneys do you think you have in this house?" I said, "Two?" He said, "Well actually, you've got a third." He discovered a third chimney—and for the last seventy years, it was open. Just leaking all of the heat in the house, and [now] we finally knew why this house was so cold and so expensive. [So], I said, "Is it a big job to fix it?" He said, "No." Five minutes, a bunch of insulation, and some foam, and it was done. So, some of this stuff is really cheap and really effective!

"If you can't measure it, you can't improve it." This is Lord Kelvin as in the Kelvin scale. We call this "ET meets IT," energy technology meets information technology. This is a very exciting area, something we spend a lot of time at Google on—there's lots of start-up companies, lots of big companies. We developed something called the "Google power meter,"[31] our tagline was, "Knowledge is less power."[32] And, we gave people real time information on their kitchen counter with a little meter… what was going on every moment of the day.

My then-seven-year-old ran down one morning and he said, "How does this work?" I said, "Go put some bread in the toaster and make some toast." And he saw the thing shoot up. And [then] he ran all over the house, turning things on and off, running down to the kitchen, and-I swear-after about twenty minutes, he knew more about energy use in a home than about 95 percent of Americans. This thing kind of worked. Unfortunately, many other people thought it as well. "Began using Google PowerMeter yesterday. Time to buy a more-efficient clothes dryer today." Unfortunately, Google did not go ahead [with the meter], but the good news is—there's lots . . . .

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. . . might have argued they could have saved 2.9 billion had we gone on with power meter, but that's another story for another day.

Alright, there is one energy number people do know-one energy number we all know-and people really focus on, and that's the cost of gasoline. I know this for a very peculiar reason, because my third child was born at a Shell station on a cold day in April in Waterbury, Vermont. We made it to the hospital, the doctor sent us home, we drove 50 miles home, we went, we had to go back, and we didn't make it. So, every year, we go back to this

31. Google Developers, *Google I/O 2010-Exploring Google PowerMeter API*, YOUTUBE (May 28, 2010), https://www.youtube.com/watch?v=_V04BGs6vX4 [https://perma.cc/XF2L-5EPV].

32. *Id.*

same gas station and take his picture as he grows up. His nickname is indeed, "Car-son."

Alright, let's keep going. So, what's been not driving our improvement in automobile fuel economy for years has been the CAFÉ requirement.[33] I'm going to talk a little about that in a few minutes but we are finally now, as many of you know, on a path where, as a result of regulation set in the Obama administration, we're on our way to fifty-four and a half miles per gallon.[34] From where we were stuck at about 27 miles per gallon for years and years and years.

How are we going to get there? This is not going be the answer. [As] much as some people like to think that you could do this. But, in fact, it's cars like this. You know, everybody's favorite—Prius. Chevy now-with not only the Volt-but, the Bolt is now out. You know, thirty-five thousand dollars, two-hundred and twenty mile range—this is a big, big deal. And, of course, everybody's favorite car in California—the Tesla. This is the "S," but, coming soon is the "3"-also 35,000; we put our thousand dollars down, we are number 278,451 on the list. Sometime between now and 2020, we may get this car, but I'll have to tell you, I'm a little nervous about this car. This is the dashboard. There are no dials on the dashboard. And I said to my kids, "How am I going to drive this thing? I gotta keep doing this." They said, "You'll figure it out." So, we'll see.

Anyway, the great thing about these plug-in cars, is that they can integrate themselves with the grid, not only taking electricity from the grid but sending electricity back to the grid. And, at Google, we did some early work on this two-way flow of electricity between a plug-in vehicle and the electric grid. And why would that be interesting? Well, you know, on a day when, the, we're, we're facing brown outs in California, the two much of a draw from the grid as a result of serious air conditioning load, if you've signed up some of those cars you could say, "You know that power that, ugh, that power that you bought for four cents a kilowatt hour? Um, we'd like some of that and we'll pay you three times what you paid—send that back to us." And you can-you can move this in two directions, and that's what very exciting about this whole opportunity with plug-in vehicles.

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33. *Corporate Average Fuel Economy (CAFE) Standards*, U.S. DEP'T TRANSP., https://www.transportation.gov/mission/sustainability/corporate-average-fuel-economy-cafe-standards [https://perma.cc/26B4-US4N] (last visited Apr. 22, 2018).

34. Matthew Stevens, *Gas Mileage: Which Car Manufacturer Was Fined Over $250 Million?*, FLEETCARMA (Aug. 1, 2012), https://www.fleetcarma.com/gas-mileage-car-manufacturer-paid-cafe-standards-fines/ [https://perma.cc/3466-35KV]; *Obama Administration Finalizes Historic 54.5 MPG Fuel Efficiency Standards*, WHITE HOUSE: OFF. PRESS SEC'Y (Aug. 28, 2012), https://obamawhitehouse.archives.gov/the-press-office/2012/08/28/obama-administration-finalizes-historic-545-mpg-fuel-efficiency-standard [https://perma.cc/HE9Q-4S47].

So, where did this take us? Not to tomorrow's smart grid, and we actually used to talk about tomorrow's smart grid, but we really are looking at today's smart grid with renewables, advanced transmission and distribution, an increasingly smart home, with the sort of metering that I talked about, and then a plug-in vehicle. All of this is here today-all of this is rapidly advancing lots of small companies and big companies in this, in this game and moving forward quite smartly.

So, policy. That was a quick run through technology, now let's get to the next point of the triangle. And, I don't- I'm not going to use an energy efficiency example, I'm going to use a wind example. Policy really, really, really does matter-as most of you in this room knows-when it comes to energy and environment. This is a chart of the wind production tax credit;[35] this is the tax credit that has driven wind deployment of the United States since the 1990s.When it's in place, we see substantial wind deployment.[36] When it expires, as it regularly does, we see massive drops, and the biggest was in 2012.[37] 13,000 megawatts built in 2012, the credit expired, and look where we ended up-at about a thousand.[38]

Policy really matters. Fortunately, [we] moved forward in 2015; and, as some of you know, both the solar tax credit and the wind tax credit were extended over five years, but the wind tax credit is now coming down,[39] but that's a predictable decline. That's the way it was set by Congress. It wasn't a one-year authorization, so policy really can make a big difference and I always have thought this is a-this is quite a-quite a visible example of that.

I want to talk about two issues regarding energy efficiency and the policy context that is low consumer demand, in the finance context that is investor concerns about risk. I think these are the two fundamental problems that we face with energy efficiency today, so let's talk about those. "This is fundamentally a demand challenge." This comes from a building energy efficiency specialist at the Lawrence Berkley National Lab. "People just don't care that much about their energy use. . . . You've got to solve a problem people feel like they have." And, I really think that's one of the

35. Jennifer Cregar, *Green Mountain Blog, Part 2: Purchasing RECs Supports Renewable Energy* Projects, GREEN MOUNTAIN ENERGY, https://www.greenmountainenergy.com/2014/10/part-2-purchasing-recs-supports-renewable-energy-projects/ [https://perma.cc/T255-JQ2E] (last updated Dec. 22, 2014).

36. *See id.* (showing that when the production tax credit is in place, wind production increases).

37. *Id.*

38. *Id.*

39. Jennifer Runyon, *Making Sense of the Tax Credit Extensions for Wind, Solar (and Bioenergy, too)*, RENEWABLE ENERGY WORLD (Dec. 16, 2015), https://www.renewableenergyworld.com/articles/2015/12/making-sense-of-the-itc-extension-for-wind-solar-and-bioenergy-too.html [https://perma.cc/AP9L-SD78].

things we're up against when it comes to selling this cheap energy resource called energy efficiency. Our cheapest energy "resource."

Now, President Obama did think that insulation is "sexy stuff."[40] I kind of love that quote. I started to talk about it—but most people do not think that insulation is sexy stuff. Our current President—well, I won't go into that.

Alright, so let me ask you, what's cooler? The Vermont house with solar panels or the high efficiency furnace in your basement? Yeah. I mean, this is a fundamental problem. If I could get solar panels on my house, boy that would be exciting, I'd love to do that. I'll struggle to do that. I'll go online. A high efficiency furnace? It doesn't get much more boring than that. And I say that because I think this is one of our problems in selling energy efficiency. And we're up against this across pretty much the entire range of energy efficiency technologies.

We owned a house in Washington, D.C., and when I was in the Clinton Administration, I decided it was time to walk—walk the talk. So, we did a renovation; we did a green renovation of this house in 1998. We did all of the sort of things you need to do. We put in a high efficiency CR-15 air conditioner, we redid the furnace, we put in insulation, all of that. But the cool part of it were the solar panels on the back. And you know, we got to write a piece for the Washington Post about it back then in the late 90s about actually selling power back to the local power company.[41] So I got a taste of that-you know, when it comes to the press, when it comes to a whole host of people-this is the exciting stuff. I will tell you, we had a two-and-a-half-foot snow storm in D.C. one night six months after these panels were put in. I heard a big boom on the roof, and I went out the next morning and the entire solar system had collapsed. Had the wrong rack, and it was destroyed, and my insurance agent said he had never heard of solar power before. That was our six-month first experience with solar on the roof.

One of the answers to this is psychology and behavior, and there's a whole group of people out in the world, an annual conference [was held] earlier this month [actually], [that] look[ed] at the relationship between behavior and energy use.[42] I'm not going to talk about this, but I do

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40. Mark Memmott, *Obama: 'Insulation is Sexy Stuff,'* NPR (Dec. 15, 2009), https://www.npr.org/sections/thetwo-way/2009/12/obama_insulation_is_sexy_stuff.html [https://perma.cc/37C3-WE49].

41. Carole Parker & Dan Reicher, Opinion, *We Sell Power to Pepco*, WASH. POST (July 29, 2001), https://www.washingtonpost.com/archive/opinions/2001/07/29/we-sell-power-to-pepco/719c84f5-deca-4b9c-a813-7c5080f404a3/?utm_term=.e98e4b74395d [https://perma.cc/ZZ4C-EJ3G].

42. *2017 Behavior, Energy and Climate Change Conference*, AM. COUNCIL FOR ENERGY-EFFICIENT ECON., https://aceee.org/conferences/2017/becc [https://perma.cc/3KQU-8T98] (last visited Apr. 19, 2018).

recommend this whole area to you if you really want to dig into the kind of-some of-the psychological and behavioral barriers we've got to moving energy efficiency forward.

What I do want to quickly go through, are some of the policy tools to stimulate energy efficiency demand. There's a whole set of tools we've put in place at the federal, state, and local level to stimulate energy efficiency. It was a recognition-decades ago-that energy efficiency wasn't going to sell itself very readily. So, let's walk through these.

The first are federal energy efficiency standards, this is the, the unsung work horse of federal energy policy, federal climate policy.[43] This is a long standing program at the Department of Energy now covering more than sixty products, a huge percentage of residential energy use, as well as fairly substantial commercial and industrial, things like washing machines, refrigerators, air-conditioning, pumps and motors, the efficiency of an electric motor, the efficiency of a pump.[44] This is also really boring stuff, but this is really gets deeply into energy use in this country. The savings over time as a result of these many standards have been very substantial. Remember, we use a hundred quadrillion BTUs in the US economy.[45] This is what we saved- it is well over one year's [worth] of overall energy use and seven billion metric tons more than what we annually emit in terms of carbon dioxide, so-over the life of these standards.[46]

The legal basis, these go way back to the 1975 Energy Policy Act[47] and the key is the Secretary of Energy sets them.[48] They have to be determined to be both technologically feasible and economically justified. [49] Technologically feasible and economically justified. Those are the two prongs, and we battle over that when each of these standards get set. There's a very elaborate process for setting these standards.[50] It generally takes three

43. *Federal Appliance Standards*, U.S. DEP'T ENERGY, https://www.energy.gov/savings/federal-appliance-standards [https://perma.cc/V6J9-MWYA] (last visited Apr. 19, 2018).

44. *Saving Energy and Money with Appliance and Equipment Standards in the United States*, U.S. DEP'T ENERGY (Jan. 2017), https://www.energy.gov/sites/prod/files/2017/01/f34/Appliance%20and%20Equipment%20Standards%20Fact%20Sheet-011917_0.pdf [https://perma.cc/VW7A-W4XP].

45. *U.S. Energy Facts Explained*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/energyexplained/?page=us_energy_home [https://perma.cc/TD7N-8Q6Z] (last updated May 19, 2017).

46. *Saving Energy and Money with Appliance and Equipment Standards in the United States*, *supra* note 46.

47. Energy Policy and Conservation Act, 42 U.S.C. §§ 6201–6422 (2012).

48. *Id.* § 6295.

49. *Id.* §§ 6295(o)(2)(A).

50. *Standards Development and Revision*, U.S. DEP'T ENERGY, https://www.energy.gov/eere/buildings/standards-development-and-revision [https://perma.cc/SV55-XK3R] (last visited Apr. 23, 2018).

or four years.[51] There can be litigation, but there's a lot of analytical work that gets done looking at all sorts of impacts: manufacturing impacts, consumer impacts, emissions related impacts.[52] There's a regulatory impact.[53] You put out a "NOPR," as you know, a notice of proposed rulemaking, lots of comments, and these get-these get adopted.

I had the honor of setting the 2001 U.S. Standard for refrigerators, and you can see where we were back in the early 70s.[54] Those refrigerators were using almost 2000 kilowatt hours a year on average in the United States. And, as a result of this standard, we were down at about 500.

Now, as I keep saying, this is pretty boring stuff. The Secretary of Energy at the time said we were going to do a little press conference on the release of these standards. And the Secretary at that time was a guy named Bill Richardson, the former governor of New Mexico, former U.N. Secretary. And he says to me, "So, what am I going to get up and say at this press conference, you know, who's going to write about energy efficiency of refrigerators?" So, I thought to myself very quickly. A few weeks earlier President Clinton had given his final State of the Union, and the theme of that was this transition we were making from '99 into 2000.[55] And he, he talked about building a bridge to the 21st century. So, I thought to myself quickly, I said to the Secretary, "Why don't you get up and announce that we're building a *fridge* to the twenty-first century." It was the quote of the week in Newsweek,[56] it was my greatest day as a bureaucrat. By far.

A few weeks later, we had to do a press-conference on an even more boring topic which is washing machines. So, he says, "Reicher, what am I going to say at this one?" And I thought fast, and I said, "Well, Mr. Secretary, why don't you announce that we're agitating for change." And he said, "No, you do that one."

So, I showed you this chart and these are these federal standards, and I want to point out very quickly because we will come back to this in a few

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51. *Id.*
52. *Id.*
53. *Id.*
54. Roland Risser, *The Proof is in the Pudding: How Refrigerator Standards Have Saved Consumers $Billions*, U.S. DEP'T ENERGY (July 11, 2011), https://www.energy.gov/articles/proof-pudding-how-refrigerator-standards-have-saved-consumers-billions [https://perma.cc/A3ZF-PC56].
55. *Transcript: Clinton's State of the Union Speech*, CNN (Jan. 20, 1999), http://www.cnn.com/ALLPOLITICS/stories/1999/01/19/sotu.transcript/ [https://perma.cc/D6WF-QJQC].
56. Elona Malterre, *Energy Infrastructure Offers Investors "Biggest Economic Opportunity," U.S. Expert Says*, ENVIROLINE NEWS (Mar. 24, 2013) http://www.envirolinenews.ca/news-analysis/news/2013/03/24/energy-infrastructure-offers-investors-biggest-economic-opportunity-u.s.-expert-says/ [https://perma.cc/R6WF-LL6E].

minutes: the actual original standards didn't come from the federal government, they came from the State of California.[57]

I also want to point out that the volume of these refrigerators has gone up; the price since 2014 has gone down. So, we're building bigger refrigerators, they hold more stuff, and they cost less than they used to cost. And they now talk to us. I mean these refrigerators—they have all sorts of smart features. I'm not so sure about *that* feature, but . . . . Alright!

So, that's one thing that we do. The second are these yellow energy guides, which I'm sure you've seen. This came early. One of the early laws, the Energy Policy and Conservation Act[58] basically said to the Federal Trade Commission, "At least tell people how much energy all these appliances and equipment use." And that is the yellow energy tag. Again, getting people engaged, getting them more interested, in energy use.

This was the bigger one that came out of the EPA in 1992: Based on all the Department of Energy (DOE) data, we started to put the energy star label on the more efficient appliances and equipment. And this might be 20 or 30 percent better than the average-it might be the top five percent. There are various ways this gets measured. And we now also have an Energy Star buildings program.[59] [For] the most highly efficient [buildings]. Again, giving people some motivation; highlighting things that do better.

Now, going to the state-level, there is also a whole set of energy efficiency building codes that have been put in place over many decades by the American National Standards Institute;[60] and the Heating, Refrigerating and Cooling Association.[61] The white are states that haven't done anything on this in terms of this, in terms of energy efficiency codes, these are building codes.[62] The dark greens are the ones that are already using the most advanced codes. And these browns, these browns are kind of middle-tier. You can spend an entire career on this–and people do–but these codes have helped a lot when it comes to buildings and making sure that they're energy efficient. And some of the states have been real leaders.

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57. LEE SCHIPPER & JAMES E. MCMAHON, AMERICAN COUNCIL FOR AN ENERGY EFFICIENT ECONOMY, ENERGY EFFICIENCY IN CALIFORNIA: A HISTORICAL ANALYSIS 20 (1995).

58. *See* Energy Policy and Conservation Act of 1975 § 324, 42 U.S.C. § 6294 (2012) (directing the Federal Trade Commission to prescribe energy labeling rules).

59. Energy Policy and Conservation Act of 1975 § 324a, 42 U.S.C. § 6294a (2012) (establishing the Energy Star Program).

60. David Conover, Pacific Nw. Nat'l Lab., Slideshow: Background on Building Energy Codes (Aug. 14, 2012), at slide 3, (indicating that states requested a standard for new building energy efficiency that resulted in the development of ANSI/ASHRAE standard 90.1 and 90.2).

61. *Id.*

62. *Fast Track Energy Savings in Slow-to-Adopt-States*, CODE WATCHER (Nov. 3, 2017), https://codewatcher.us/codes/stretch-codes-offer-a-way-to-fast-track-energy-savings-in-slow-to-adopt-states/ [https://perma.cc/7436-FXK6].

We also have Energy Efficiency Resource Standards.[63] This is kind of energy-efficiency's version of a renewable portfolio standard, or "renewable energy standard." Again, [in] a fair number of states, some of these [efficiency standards] are combined with the renewable portfolio standards that have been adopted in various states; some have been set by public utility commissions; some have been set by state legislatures. The darker the color, the more the energy reduction on an annual basis. So again, another approach to this. And this says to utilities, "As you go out and do your work providing electricity in the state, we want you to work to cut energy use."

Going from the state to the city-level, there are now a variety of cities, around the U.S.–D.C., Austin, Washington, New York, Seattle, San Francisco, Philadelphia, and actually the entire state of California–that has adopted what are called "Energy Benchmarking and Disclosure."[64] This is essentially a system where commercial building owners have to become transparent about the energy use in their commercial buildings. So, it says to people out looking for commercial space, "You are moving into either an efficient or an inefficient one"; it sets up some competitive juices among commercial building owners—there are a whole host of things this can drive. So again, highlighting the energy efficiency situation that we find ourselves in, in commercial buildings, particularly in big cities.

And this is, maybe, my favorite. So, any of you who've bought a home know that you go through an appraisal, and then you go through mortgage underwriting. They see what you can qualify for when you go out to get a loan to purchase the house. Home appraisals typically look at all of these things: termites; lead paint; soil, you know-is it going to slip down a hillside; health and safety; water and sewage. But strangely, we haven't looked at energy use in a house, typically.

Similarly, when you go to get a mortgage, they want to make sure you can pay the monthly mortgage. So, they look at what the principle costs on the loan are going to be, what the interests, taxes, and insurance-the taxes on the house, the insurance on the house. But interestingly, we've never looked at energy. What's it cost, in a cold state like Vermont or a hot state like Arizona, to actually power the house? Electricity, heating, cooling, and all of that. This is called PITI,[65] it's a kind of common formula. We've said, "add

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63 . *Energy Efficiency Resource Standards (EERS)*, AM. COUNCIL FOR ENERGY-EFFICIENT ECON., https://aceee.org/topics/energy-efficiency-resource-standard-eers [https://perma.cc/ELL8-NALM] (last visited Apr. 23, 2018).

64. *Benchmarking and Disclosure*, CONSORTIUM FOR BUILDING ENERGY INNOVATION, http://cbei.psu.edu/benchmarking-and-disclosure [https://perma.cc/LU8W-U8CH] (last visited Apr. 23, 2018).

65. *Principal, Interest, Taxes, Insurance (PITI)*, INVESTOPEDIA, https://www.investopedia.com/terms/p/piti.asp [https://perma.cc/9276-XL54] (last visited Apr. 23, 2018).

the 'E' to it, add *energy* to it," and also, "Add energy to home appraisal." So, the tagline, "Buying an energy efficient home? Get a better mortgage!" Talk about motivation for people to think about energy efficiency!

Now, remember, we're trying to sell energy efficiency to people out in the marketplace. If you knew, first of all, *that* home is $5,000 a year to heat, cool, and provide electricity; *that* one is $1,500, and you're relatively indifferent as between the two. That $3,500 difference would qualify you for a bigger mortgage because you have less of a monthly or annual payment.

The Sensible Accounting to Value Energy Act[66]: Introduced in the U.S. Congress, it's originally in 2013, it is now in the pending Senate energy bill.[67] One of the two sponsors, Senator Isakson, a Republican from Georgia, is a former real estate agent. He got this, was not a hard sell at all. And it would basically say, "HUD–Housing and Urban Development–would provide criteria for appraisal and underwriting that would take energy savings of an efficient home into account, based on a qualified energy report." So, this would be injected into the federally regulated system of mortgages and underwriting, and you would get this cranked into the system. Again, *how do you get people to take a greater interest in efficiency than they normally do?*

Now, of course the new factor, [President Trump], when it comes to this whole policy realm-obviously, this [Paris Climate Accord – COP21] is a big question mark, where we're headed. But, I wanted to very quickly mention these three, the big three U.S. Energy Standards, and where we find ourselves. The first of course, as many of you know, is the Clean Power Plan.[68] I'm not going to spend any time on this, but this is the big one that is very much at risk right now.

This is the CAFE Standard.[69] On our way, as I said, to 54.5 miles per gallon by 2025. This I think is the single biggest environmental accomplishment of the Obama administration. Getting the EPA and the Department of Transportation to sit down with the Detroit Automakers and work out that very steep Green line—and they got it done. But, they agreed to a kind of mid-course review, which is what's happening right now.[70] President Obama, before he left, set this up well, and we probably would

66. Sensible Accounting to Value Energy Act of 2011, S. 1737, 112th Cong. (2011).

67. Energy and Natural Resources Act of 2017, S. 1460, 115th Cong. § 1501–1506 (2017).

68. *What Is the Clean Power Plan?*, NAT. RESOURCES DEF. COUNCIL (Sept. 29, 2017), https://www.nrdc.org/stories/how-clean-power-plan-works-and-why-it-matters [https://perma.cc/7RZZ-HW5G].

69. *Corporate Average Fuel Economy*, NAT'L HIGHWAY TRANSP. SAFETY ADMIN., https://www.nhtsa.gov/laws-regulations/corporate-average-fuel-economy [https://perma.cc/B77D-SLEN] (last visited Apr. 23, 2018).

70. Sonari Glinton, *Trump Administration Takes Key Step To Rolling Back Auto Fuel Standards*, NPR, Aug. 14, 2017, https://www.npr.org/2017/08/14/543474251/trump-administration-takes-key-step-to-rolling-back-auto-fuel-standards [https://perma.cc/DBQ9-SJGS].

have continued on this path, but the Trump administration has pulled back from that.[71] And this is very much a question mark, whether we're going to continue on to 54.5 miles per gallon.

Coming back to this: The Federal Energy Efficiency Standards. Through thick and thin, Democratic and Republican administrations, back to the 1970s, have been putting out these standards. The Little Engine That Could.[72] But, there is a real risk that we now have an administration that won't. These have to come out of DOE, as I said, and then they have to be reviewed by OMB, the Office of Management and Budget. And, there is a real risk that the many standards that are pending–several of which are actually *required* standards–are not going to find their way out of the U.S. federal government. And that would be a real shame because this is kind of the unsung energy efficiency success story of the U.S. federal government.

Alright, California to the rescue: The sixth largest economy in the world;[73] an aggressive climate program;[74] a 50% RPS (we may well move to 100%)[75]; and even independent climate agreements with other states and nations.[76] Governor Brown and the Premier of China reached an agreement in June on climate change.[77] But, here is what I wanted to quickly focus on: California both has independent authority for energy efficiency standards, and independent authority for fuel economy standards. The two things we just talked about.

So, remember I told you: California actually was ahead of the federal government–ahead of federal regulation–so [it] actually has independent

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71. *Id.*

72. Letter from Dan W. Reicher et al. to Mike Simpson, Chairman of the U.S. House Subcomm. on Energy and Water Dev. & Lamar Alexander, Chairman of the U.S. Senate Subcomm. on Energy and Water Dev. (June 8, 2017); Marianne DiMascio, *How Your Refrigerator Has Kept Its Cool Over 40 Years of Efficiency Improvements*, ACEEE BLOG (Sept. 11, 2014, 11:21 AM), http://aceee.org/blog/2014/09/how-your-refrigerator-has-kept-its-co [https://perma.cc/8FUM-4HRD] (indicating that the U.S. adopted appliance efficiency standards in 1990, 1993, 2001, and 2014).

73. Robin Respaut, *California Surpasses France as World's Sixth-Largest Economy*, REUTERS, (June 17, 2016), https://www.reuters.com/article/us-california-economy/california-surpasses-france-as-worlds-sixth-largest-economy-idUSKCN0Z32K2 [https://perma.cc/T47N-N9CL].

74. Katie Fehrenbacher, *Climate Goals: Inside California's Effort to Overhaul Its Ambitious Emissions Plan*, THE GUARDIAN (June 20, 2017), https://www.theguardian.com/sustainable-business/2017/jun/20/california-climate-change-emissions-program-cap-trade [https://perma.cc/5QNN-B4Z7].

75. Rob Nikolewski, *Can California Really Hit a 100% Renewable Energy Target?*, SAN DIEGO UNION TRIBUNE (June 9, 2017), http://www.sandiegouniontribune.com/business/energy-green/sd-fi-california-100percent-20170601-story.html [https://perma.cc/EA7V-VXGJ].

76. *Collaboration on Climate Change*, CAL. CLIMATE CHANGE, http://climatechange.ca.gov/climate_action_team/partnerships.html [https://perma.cc/9ZKN-JRU5] (listing the climate change international agreements to which California is a signatory).

77. *China and California Sign Deal to Work on Climate Change Without Trump*, ASSOCIATED PRESS (June 6, 2017) https://www.theguardian.com/us-news/2017/jun/07/china-and-california-sign-deal-to-work-on-climate-change-without-trump [https://perma.cc/YSR4-F2GK].

authority that it could continue to assert, even if the Trump administration puts a big "X" through the current DOE energy efficiency standards program. And, a number of states are following California's lead on the corporate average fuel economy,[78] because again, California was there earlier. So, we may see–we *are* seeing–even if the Trump administration does not continue on this 54.5 mile per gallon path, we may well see California and this group of states continue. I was speaking in Minnesota a few weeks ago. They're not on this list and there is a big debate there about whether Minnesota ought to sign up for the same agreement,[79] with the same authority.

Alright, the final stop on our tour around my favorite triangle. Let's talk about *finance*. Don't get nervous, you can handle this. Alright, here are some really, really, really important numbers. This is what we're spending globally on all clean energy, according to the International Energy Agency. The average between 2010 and 2015—750 billion dollars a year on all clean energy . . . 750 billion dollars a year on all clean energy globally.[80] This is not just solar and wind, this is all of the zero-carbon sources, including energy efficiency and low carbon sources.[81] This is what the International Energy Agency says we should be spending—very quickly—if we want to have any chance of staying in the 450-parts per million, 2ºC that Pat Parenteau talked about.[82] We need to very quickly–like right away–triple current global spending on clean energy.

I used to take great comfort that there was a lot of money on the planet that institutional capital as we call it–the big pension funds; insurance companies; mutual funds; sovereign wealth funds, which is like Saudi Arabia's oil fund, the Norwegian's oil fund; and then lots of billionaires–the total is about $100 trillion dollars.[83] And I used to say, until I met a very smart guy from Goldman Sachs, "We got plenty of money." It turns out, that's the wrong number. This is the right number, this is what's available annually—the investable capital as they call it—on everything globally.[84] Investment in transportation, in IT, you name it; this is the rough number that we've got to

78. Timothy Gardner, *U.S. States Vow to Defend Auto Fuel Efficiency Standard*s, REUTERS, (Apr. 3, 2018, 2:32 PM) https://www.reuters.com/article/us-usa-epa-autos/u-s-states-vow-to-defend-auto-fuel-efficiency-standards-idUSKCN1HA2DI [https://perma.cc/A3XT-GX4X].

79. ENVIRONMENT CALIFORNIA, FACT SHEET: THE CALIFORNIA CLEAN CARS PROGRAM 2 http://cdn.publicinterestnetwork.org/assets/t7oFiTG-2MdTF4T7J-lJ8g/Fact-Sheet---CA-Clean-Cars-Program.pdf [https://perma.cc/ER7F-U6UX].

80. INT'L ENERGY AGENCY, WORLD ENERGY OUTLOOK 2016 82 (2016).

81. *Id.*

82. *Id.*

83. *Institutional Investors: The Unfulfilled $100 Trillion Promise*, THE WORLD BANK (June 18, 2015), http://www.worldbank.org/en/news/feature/2015/06/18/institutional-investors-the-unfulfilled-100-trillion-promise [https://perma.cc/5BN3-633T].

84. DAN REICHER ET AL., DERISKING DECARBONIZATION: MAKING GREEN ENERGY INVESTMENTS BLUE CHIP 4 (2017).

spend on everything. Set that aside, set that next to the 2.3-trillion-dollar need that I just talked about, and what you're beginning to see is that what we've got to be spending on clean energy to have a shot at dealing with climate, is a pretty big percentage of this–of *all* the capital–that's available annually.

A complicated chart, but what the story is here, this is a breakdown of all the pension fund investments.[85] Anyone who's got a pension fund, you've got people in New York who are out investing your pension fund, and they put it into mutual funds, and government bonds, and private bonds, and shares of public companies. It turns out, a very tiny slice of that is even available to go into energy. And it's not just an 8% slice, it's a much smaller slice of that.[86] In part because of the risk that comes with much of the energy investing globally.[87]

What do I mean by that. We talk about four big risk categories when it comes to investing in energy projects around the world: there's policy risk, emissions rules, trade policy (we've got a big mess right now in Washington that may result in a solar tariff. If you're an investor, and you're looking out at the prospect of a big tariff being placed on solar, you're saying to yourself, "well that's a risky investment."), low and unstable electricity prices, low and volatile natural gas and oil prices. We've got cheap natural gas.[88] What if it becomes expensive natural gas? We've got cheaper oil,[89] what if it changes? Over-generation and curtailment; this is, we've got a problem in California now where in certain parts of the day, certain seasons, we're producing more electricity than we can use, we are over-generating, and we are curtailing the solar and wind projects that are producing more than we can use.[90] That does not sit well with an investor in a solar or wind project, the prospect that you may not get paid at all for some of the electricity you're producing.

Now, the good news is there's opportunities for storage that are coming down the road. You can build more transmission, but all of that's complicated and that has its own set of costs.[91] Permitting: it's tough to get certain projects

85. *Id.* at 6.
86. *Id.*
87. *Id.*
88. Mark Perry, *The Real Cause of Coal's Collapse*, U.S. NEWS & WORLD REP. (Mar. 9, 2017, 9:35 AM), https://www.usnews.com/opinion/economic-intelligence/articles/2017-03-09/abundant-cheap-natural-gas-is-the-real-reason-for-the-demise-of-coal [https://perma.cc/M534-4LHP].
89. Clifford Krauss, *Oil Prices: What to Make of the Volatility*, N.Y. TIMES (June 14, 2017), https://www.nytimes.com/interactive/2017/business/energy-environment/oil-prices.html [https://perma.cc/WR9A-EPKM].
90. Ivan Penn, *California Invested Heavily in Solar Power. Now There's So Much That Other States Are Sometimes Paid to Take It*, L.A. TIMES (June 22, 2017), http://www.latimes.com/projects/la-fi-electricity-solar/ [https://perma.cc/VP6E-APV2].
91. REICHER, *supra* note 93, at 40.

permitted in this country and a lot of places around the world.[92] Transmission: we've used up a lot of the good transmission and interconnection sites for a lot of projects in the U.S. and in some countries they don't exist in the first place.[93] And then, a whole set of things, the investment regime, unstable currencies, for example, in the developing world, you put dollars in, if you're a foreign investor, you get their currency back, what if it's volatile? Again, these are the sort of complexities that make much of the investment in clean energy projects around the world not the sort of risk that a lot of investors want to take, and it's what gets you into that pretty small slice of the pension fund pool that I mentioned a few minutes ago.

Now, there's good news here: we know how to fix a lot of these things, and we have a project at Stanford that's digging into each one of these investment risks and what can be done.[94] We're working with some of the big investment banks, we're working with governments, we're working with a variety of people. How can we lower the risk that attends many of these kinds of clean energy projects? And I want to be clear, I'm not just talking about solar and wind projects, I'm talking about the rest of the renewables, I'm talking carbon capture, nuclear projects, and even energy efficiency. There are a variety of challenges with energy efficiency as we've talked about a little bit.

So, what happens is, these four risks compound and make a desirable investment—nice tall green bar and a nice short red one, it makes the green bar drop and the red ones go up—CO2 prices unstable, electricity prices unstable, an uncertain EPC (that means an Engineering, Procurement, and Construction Contract), you have a technology that's not fully ready, the contractor's going to say, "Sorry, it's going to cost you more to get it done," and then the debt term, you'd like a nice long term loan of 25 years, but if you've got a risky project, the lender may say: "I'll give you seven years."[95] That raises the price.

That's the bad news. The great news is this is a massive economic opportunity. We're going to spend, one way or another, about 50 trillion

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92. *Id.* at 5.
93. *Id.*
94. *Id.* at 2.
95. Wendy N. Duong, *Partnerships with Monarchs-Two Case Studies: Case Two Partnerships with Monarchs in the Development of Energy Resources: Dissecting an Independent Power Project and Re-Evaluating the Role of Multilateral and Project Finance*, 26 U. PA. J. INT'L ECON. L. 69, 75 (2005) ("From the lender's perspective, under Project Finance principles, when it is contractually established that the project can pay for itself over an extended period of time, bankers may be persuaded to make loans based on demonstration of the project's long-term self-sustaining capabilities and economic viability.").

dollars between now and 2035 on energy — and I didn't say clean energy.[96] We're going to make that choice, how clean or not clean it is. But we're going to be spending tens of trillions of dollars building and rebuilding global energy infrastructure. So, it's a massive economic opportunity. And some, like the International Energy Agency, call it the biggest economic opportunity of the 21st century, bar none.[97]

The great news is that energy efficiency has nice returns and relatively low risk. So not only is it cheap, as we saw at the beginning, but among investors, it's looked at as a pretty attractive investment given its relatively low risk.[98] You pretty much know that if you put in this advanced lighting system, it's probably going to work, and you've got a lot of experience with it. And again, we saw this before: a low levelized cost of electricity.

We're spending about 230 billion dollars a year on energy efficiency globally,[99] and what that original chart I showed you from the International Energy Agency says is, we've got to multiply that by 5 or 6.[100] It's the single biggest increment of increased investment that we need if we're going to have a shot, again, at staying within that 450 parts per million, 2 degrees centigrade.[101]

Here's an interesting example of the U.S. efficiency opportunity—a 300 billion dollar investment opportunity.[102] This is Deutsche Bank; [they] looked at this. A trillion dollars in energy savings over ten years—and you could cut about 10 percent of U.S. climate emissions.[103] That's a pretty sweet deal. The capital is there in the United States, but it is not flowing. So, three percent of existing commercial space is renovated each year.[104] Just one-tenth include a state-of-the-art energy efficiency upgrade.[105] And it's even lower, people, you know, the granite counter tops are much more interesting than the efficient furnace. That's our basic dilemma.

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96. *World Needs $48 Trillion in Investment to Meet Its Energy Needs to 2035* (June 2014), INT'L ENERGY AGENCY (June 2014), https://www.iea.org/newsroom/news/2014/june/world-needs-48-trillion-in-investment-to-meet-its-energy-needs-to-2035.html [https://perma.cc/MA8T-QMZR].

97. *Id.*

98. Peter Sweatman, *Energy Efficiency is a 'Win-Win' for Investors*, GREENBIZ (July 11, 2017, 1:15 AM), https://www.greenbiz.com/article/energy-efficiency-win-win-investors [https://perma.cc/9E3C-SE5W].

99. INTERNATIONAL ENERGY AGENCY, ENERGY EFFICIENCY MARKET REPORT 2016 (2016) ("In 2015, investors directed USD$221 billion into incremental energy efficiency improvements – up 6% from 2014.")

100. *Id.*

101. *See* United Nations Paris Agreement (2015).

102. DEUTSCHE BANK, UNITED STATES BUILDING ENERGY EFFICIENCY RETROFITS: MARKET SIZING AND FINANCING MODELS 3 (2012).

103. *Id.*

104. *Id.*

105. *Id.*

This is the second issue: We talked about low consumer demand in the policy context; let's finish up talking about investor concerns about risk. There's three kinds of risks. There's credit risk (think-*Is the borrower, the person who's borrowed the money, likely to pay you back?*), and that comes up in both the residential and commercial contexts.[106] "MUSH" means "municipalities, universities, schools, and hospitals," this is another category of investment opportunities where energy efficiency is a big deal.[107] Asset risk, are we going to compromise the value of the property if we make an energy efficiency upgrade? And, what the heck do I mean by that? Well, we've had experiences for example, where you tighten up a house too much and you have indoor air quality problems; you put in windows that don't quite work; there's a variety of things you can do. I don't want to overstate this problem, the asset risk problem, but investors do take a serious look at it. And then this [performance risk] is a big one. The engineer tells you, you make the following five improvements and you're going to get a 34 percent decrease in energy use, but when you actually go in and measure it, it's 27 percent. That's a real problem for a financial model for an investor. He or she wants to know: are you really going to get 34 percent, because if you don't, and I'm six percentage points below that, this investment doesn't look very good.

So, there's again, just like we saw the policy tools to stimulate demand, there's a whole set of tools to stimulate efficiency investment, I'm going to go through these fast, because I want to be sure we have some time for questions. The first are energy efficiency tax credits. Not many people know that they exist. They're pretty modest, but they do, or I should say, they did exist.[108] When the solar and wind tax credits were extended,[109] there are the orphan tax credits that didn't get extended: geothermal, biomass, energy efficiency.[110] All of these got left on the cutting room floor. The only ones

106. *See Investor Alerts and Bulletin: The ABCs of Credit Ratings*, SEC. & EXCHANGE COMMISSION (Oct. 12, 2017), https://www.sec.gov/oiea/investor-alerts-and-bulletins/ib_creditratings [https://perma.cc/Y4GU-JDKZ] (explaining credit ratings, the "assessment of an entity's ability to pay its financial obligations").

107. *See generally* OFFICE OF INVESTOR EDUC. & ADVOCACY, SEC. & EXCHANGE COMMISSION, SEC PUB. NO. 134, MUNICIPAL BONDS: UNDERSTANDING CREDIT RISK (2012) (discussing municipal bonds).

108. Bipartisan Budget Act of 2018, PL 115-123, February 9, 2018, 132 Stat 64 (ending the home energy efficiency tax credit set forth in 26 U.S.C. § 45L effective December 31, 2017).

109. 26 U.S.C. § 48 (codifying the solar energy business investment tax credit). *See also* Consolidated Appropriations Act of 2016, Pub. L. No. 114-113 (December 18, 2015) (extending the solar energy investment tax credit).

110. 26 U.S.C. § 45 (codifying the energy production tax credit available to various kinds of renewable energy projects.). *See also* 26 U.S.C. § 45(d)(4)(B) (ending the energy production tax credit for geothermal projects commencing construction after January 1, 2018).

that got extended were solar and wind.[111] The orphan tax credits, and this is one of them, was a really unfortunate result, and there's all sorts of finger pointing about why it happened, but what we need to do, is in this current tax discussion in Washington, we should put these orphan credits back in place like we did in solar and wind.

Alright, these are complicated, so I'm going to go through them fast. There's lots of ways to make it easier for people to renovate in an energy efficient way, either a residential or commercial building. One is, let them pay it back on their energy bill, their electricity bill. Give them a loan, and this is a monthly payment they make anyway, put it on that bill, and that can help the investor say: "Ah ha, I have a better assurance this is actually going to get paid." Another one, Property Assessed Clean Energy, is put it on the annual property tax bill.[112] Essentially float the loan and have it paid back on the property tax bill. We call that PACE, and there's something called the PACE Assessment.[113] [There are] lots of complexities in this one, it works in a commercial space, but Fannie Mae and Freddie Mac have problems in the residential area, I won't get into it, but it's an interesting concept and it's getting some traction.[114]

This is one of my favorites, called Energy Savings Performance Contracts (ESPCs).[115] This is where big companies, you've probably heard of a company like Honeywell, it takes its own money, goes into a building (commercial building, and frequently a federal building), does the energy retrofit under a contract, and pays itself back, well, let me say it this way, the company that owns the building or the federal agency pays this back, but has already achieved some savings, so this is the debt service, and this is the reduced energy bill, but it's already saving. And then when the contract is over, when Honeywell has been fully paid back, you have a big, a much-

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111. 26 U.S.C. § 48 (codifying the solar energy business investment tax credit). *See also* Consolidated Appropriations Act of 2016, Pub. L. No. 114-113 (December 18, 2015) (extending the solar energy investment tax credit).

112. KACIE PETERS ET AL., SOLAR ENERGY INDUSTRY ASSOCIATION ET AL., OPENING C&I SOLAR MARKETS WITH C-PACE 3 (2017) (highlighting an underutilized financing tool that can help boost solar development nationwide).

112. *Id.*

113. *Id.*

114. *Selling Guide: Eligibility*, FANNIE MAE, www.fanniemae.com/content/guide/selling/b5/3.4/01.html [https://perma.cc/XVB5-ET9C] (last visited Apr. 23, 2018) (noting one inhibiting factor of PACE financing being that "Fannie Mae will not purchase mortgage loans secured by properties with an outstanding PACE loan unless the terms of the PACE loan program do not provide for lien priority over first mortgage liens").

115. *See* OFFICE OF ENERGY EFFICIENCY & RENEWABLE ENERGY, UTILITY ENERGY SERVICE CONTRACT GUIDE: A RESOURCE FOR CONTRACTING OFFICERS WORKING ON UESC, available at www.energy.gov/eere/femp/downloads/utility-energy-services-contracts-guide-0 [https://perma.cc/9WP7-C5KP].

reduced energy bill. So, the company puts the money in, and it essentially pays itself back out of the savings, and the owner of the building five or ten years later, gets a vastly cheaper building to operate. Utilities also do something like this, a version of the ESPC; it's called utility energy service contracts.[116]

And then this last one is a purely private sector approach that's being advanced by a variety of companies, one is a small one in Washington D.C. called Sparkfund.[117] Actually some students who came out of Middlebury and Dartmouth who set this company up a few years ago, and it's doing very, very well, with something called the "technology subscription service," and they've raised lots of money and they've got lots of clients.[118] So, yet another approach to this.

Now the exciting thing for me, because this is where things get really well-integrated, was when Solar City announced, "we're coming over to your house anyway, why don't we also do the energy efficiency upgrade." Lyndon Rive, the CEO, says: "our goal is to manage all the energy needs of the home."[119] They got a loan from a bank in Boston and they started to do this. Unfortunately, nine months later, they gave up on it, because, they realize, that unlike putting panels on the roof, going in and doing efficiency retrofits to homes was a lot more complicated. Every home is different. And it just was taking time and money they couldn't spend. And, they didn't say this, but of course, if you cut the electricity load in a home, what happens to your solar panel sales? So that didn't work very well for Solar City either. So, this was a bright and shining moment, but I think we can get back to this, I think there are ways to do it, and I think that's ultimately providing an integrated solution, solar on the roof, that new furnace in the basement, insulation in the walls, there's a whole variety of ways to do that.

This State, [Vermont], has the first Energy Efficiency Utility, Efficiency Vermont, that has been pioneering a lot of very important mechanisms for getting this done. The State Public Utility Commission, you have current and former commissioners sitting here [who have] done a lot of very creative things to get things done in this way.[120] So, I would give Vermont a lot of

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116. *Id.*

117. SPARKFUND, www.sparkfund.com [https://perma.cc/UNW5-EEM5] (last visited Apr. 23, 2018).

118. Press Release, Sparkfund, SparkFund Raises $7 Million to Transform Access to Energy Technology (Feb. 2, 2017) (available at http://www.marketwired.com/press-release/sparkfund-raises-7-million-to-transform-access-to-energy-technology-2193034.htm [https://perma.cc/HB5Q-Y5MW]).

119. X

120. *See, e.g.*, In re Energy Efficiency Plan, 196 P.U.R.4th 476 (Sept. 30, 1999) (Vermont Law School Professor Michael Dworkin establishing the nation's first energy efficiency utility as Chairman of the Vermont Public Service Board).

credit for being a very pioneering state when it comes to what we can do with energy efficiency.

And then the last one is the biggest user of energy of all, on the planet. And that is the U.S. Federal Government. 23-billion-dollar energy bill.[121] 400,000 buildings. Even more vehicles. Lots and lots of energy efficiency tools: federal procurement, federal finance, technology demonstrations, these energy savings performance contracts, a whole host of other things.

I co-chaired a report last year, that we submitted to the Secretary of Energy, about all these opportunities in federal energy management to pioneer some of the things we need to be able to do in energy efficiency. And, I did a piece in *The Hill*, just after Trump was elected, saying as President, Trump will be CEO of U.S. Energy Incorporated.[122] And I pointed out to the President (I don't think he read it), but he owned a mere two million square feet of real estate, he was now taking over an empire with three billion square feet of real estate.[123] And I thought it was a great opportunity for the President to step up, take a look at this report we did, and really do some great things in the federal context.

So, the biggest economic opportunity of the twenty-first century, and the way I will leave this for you is, it's an unprecedented chance to do good and do well. And I think it's that intersection that's going to motivate people more than anything else when it comes to moving the unprecedented amounts of capital that is going to have to start flowing if we're going to fix this problem. So, don't forget the triangle as you go out. And with that, I thank you and I would be happy to take your questions.

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121. *Energy Consumption by U.S. Government at Lowest Level Since at Least 1975*, U.S. Energy Info. Admin. (Feb. 4, 2015), https://www.eia.gov/todayinenergy/detail.php?id=19851 [https://perma.cc/4U6R-6ESA].

122. Dan W. Reicher, *As President, Trump Will be CEO of 'US Energy Incorporated,'* HILL (Nov. 28, 2016, 4:50 PM), http://thehill.com/blogs/pundits-blog/the-administration/307719-as-president-trump-will-be-ceo-of-us-energy [https://perma.cc/GMZ5-ZMBY].

123. *Id*.