*Jesabel Rivera: I am Jesabel Rivera. And I am from San Juan, Puerto Rico. And I was raised in the barrio. It's called Barrio Sabana Llana. And I was raised by my grandmother, who was a community organizer and... it was normal to me to — like — there's something going on in the community, so we have to organize and help.*

*Eddie Guerra: My name is Eddie Guerra and I was born and raised in a small town in the west of Puerto Rico. It’s called San Sebastian. So I grew up about a little bit about my family. I grew up in a Pentecostal, very religious family, very conservative family. My father was a chaplain also, and I've always been very involved in my church. And it was very important to me.*

**Hey Outside/In listeners. Meet Jesabel and Eddie.**

**Like many great love stories, theirs starts… somewhere romantic**

*Eddie Guerra: It was October 23rd of 2008 when I gave a — we — I organized a —*

*Jesabel Rivera: … public speaking and technical writing…*

*Eddie Guerra: ...public speaking. Yeah, technical writing session — event.*

*Jesabel Rivera: Workshop.*

*Eddie Guerra: Right. Workshop. And I was by then I was a person of a student organization for the American Concrete Institute. All right. And it was part of my civil engineering program. And that night I met her. But it was more of a ‘hello, how are you?’ And that's it. But very professional, right? Very boring, I would say.*

*Jesabel Rivera: I was on mission. I was like I'm a president. This would be — this this topic is interesting — it's interesting for my students, though, like I was on mission. So I think I — we talked and…*

*Eddie Guerra: It was all business, right?*

*Jesabel Rivera: It was all business, Yes.*

*Eddie Guerra: Yeah. No, no. Nothing else. Very boring We didn't see each other again, until my last day, my very last day, I finished classes, I finished finals. And then I saw her at the at the —*

*Jesabel Rivera: In the streets, yeah…*

*Eddie Guerra: Where everybody gathers in the town of Mayaguez, when they're done with finals, I saw her dancing salsa in the streets.*

*Jesabel Rivera: But my side of the story is that between that workshop and the time that we we saw each other in the streets.* *I had already checked you on Facebook and like I did my FBI work, I work like, who is this guy?*

*Eddie Guerra: The first time I danced salsa was when I met Jesabel. It was forbidden to dance salsa in my home.*

*Jesabel Rivera: And then my name is Jesabel.*

**Remember, Eddie grew up a preacher’s son in the pentacostal church.**

*Eddie Guerra: Well, Jesabel was a wicked queen from the from the Old Testament. You see.*

*[music*

*Eddie Guerra: That was December 16th, 2008. Since that day, we have been talking every day.*

*Jesabel Rivera: Yeah.*

**Like I said, this is a love story. But in this love story… it’s not just boy meets girl, the two fall in love… it’s boy meets girls and the two fall in love with one of the most controversial proposed solutions to climate change… nuclear energy.**

**[56:37]**

*Eddie Guerra: [1:12:54] We learned that it’s not too much about the technology. It’s about trust.*

*Jesabel Rivera: That’s true.*

[Outside/In Theme Music]

**This is Outside/In a show about the natural world and how we use it. I’m Sam Evans-Brown. Today on the show: inside a grassroots effort to convince Puerto Rico to build a nuclear power plant. A nuclear power plant… on an island that’s right in the middle of the Atlantic Hurricane track. Is that a good idea? It’s a question that gets to the heart of one of the most heated debates in environmentalism today… what will our transition to a low-carbon future ACTUALLY look like?**

[Theme musicfades down]

**Eddie and Jesabel’s story gets all tangled up in nuclear power after college. Eddie majored in civil engineering, where he learned all about protecting big structures from earthquakes.**

*Eddie Guerra: And I graduated 2009, 2010 timeframe, where, you know, just recently the market had crashed, and there were no new buildings being built in Puerto Rico, so in the U.S! So it was the worst time for a structural designer to graduate with that degree. So all my goodness, I've had about 8 interviews and what the hell's going on?*

**As he left grad school, Jesabel had just finished undergrad and been accepted to the University of Pittsburgh for her masters. Eddie moved there to join her…**

*Jesabel Rivera: The next weekend, we went to this Latin-American picnic and you met somebody there that said, actually, we're looking for an engineer with your background.*

*Eddie Guerra: Yeah. Yeah. And he… approached me and I met him and… yeah… to my surprise, there was one industry that was hiring. And that was the nuclear industry.*

**[music]**

*Eddie Guerra: Yeah. That was October 5th is when I finally started. But then in 2011, the Fukushima Daiichi accident happened. And it was the earthquake, that 9.0 magnitude earthquake that triggered this tsunami of more than 40 feet tall — tsunami that really wiped to out and flooded the emergency diesel generators off the Fukushima Daiichi plant. So that was a very, very scary moment. And the whole world paralyzed in that day. Then the U.S. —- the U.S. Congress mandated all U.S. nuclear licensees to perform seismic evaluations of all the reactors here in the U.S. And that's that's what got me into the details of the nuclear systems.*

 **What are the odds right? Eddie graduated with a degree that he though he would use to protect bridges and sky scrapers from earthquakes in LA or something. Instead, he lands in the nuclear industry JUST FIVE MONTHS BEFORE an EARTHQUAKE exactly the type of risk he studied... causes the worst nuclear accident in a generation.**

*Jesabel Rivera: And it took you around the world. You you went to South Africa, Argentina...*

*Eddie Guerra: Yeah. Yeah. Then the rest is history. And I was so lucky that I was one of the first engineers to do these evaluations after Fukushima. And I saw by the numbers how safe, resilient, and rugged our existing plants are against earthquakes.*

**Sam: And what are the odds of this too - that a disaster, a massive safety failure, would lead Eddie to eventually believe that Nuclear… is much, much safer than than he ever knew.**

*Now, I'm moving on into this new reactor technology that is way, more — way safer with additional safety barriers*

**This is how Eddie and Jesabel would come to find themselves in the midst of what has become one of the biggest wedges that divides the many groups of people who all call themselves environmentalists.**

**Way back before James Hansen — who famously brought climate change to the center of our political discourse — way before climate change was a glimmer in his computer models... opposition to nuclear power was a central tenet of American environmentalism. Greenpeace, the Sierra Club, Friends of the Earth, the Union of Concerned Scientists — all of these groups have been either actively opposed to nuclear power, or at least skeptical of societies need for it.**

**But as we’ve drifted further and further downstream towards the falls of some of the more dramatic impacts of climate change, advocates for the technology have begun to multiply.**

**And some old nuclear opponents, like James Hansen himself, have even flipped, and become advocates.**

**The question the movement writ-large is actively wrestling with is can… or SHOULD we try to design a zero carbon future that ignores nuclear power… or does it have to be part of the solution?**

**[mux]**

**Now before we get back to Jesabel y Eddie, let’s just do a bit of Nuclear 101. The new reactors Eddie learned about while traveling all over the world about are — collectively — referred to as ADVANCED nuclear power.**

**The nuclear reactors you’ve heard of, which are probably the ones that have had catastrophic or near catastrophic accidents — Chernobyl, Three Mile Island, fukushima — are likely all LIGHT WATER reactors.**

*Jessica Lovering: Light water just means regular water... so water cooled.*

**This is Jessica Lovering. She researches and works on nuclear energy. She’s wrapping up her PhD at Carnegie Mellon University.**

 **R**

**Nuclear fission generates a lot of heat… that’s what makes it dangerous… a nuclear meltdown literally means the uranium is allowed to get so hot that it melts and burns through steel and concrete and anything else in it’s way.**

**To keep it under control, light-water reactors just pump a ton of water. If you can’t keep the pumps going, the water boils off, and the core gets really hot.**

*Jessica Lovering: water boils at pretty low temperatures relatively. And so it's always an issue when you're trying to cool a reactor. How do you keep the water from boiling? How do you contain the high pressure of the steam? And how do you keep pumping in that water?*

**Advanced nuclear designs, the ones that got Eddie excited… they ditch water all together.**

*For a lot of these designs, they just can't have those meltdowns that we've experienced with Three Mile Island and Chernobyl and Fukushima.*

**There are a whole slew of these advanced, water-free designs, but just one example is one called a molten-salt reactor: Instead of water, it cools with liquid salt, which never gets hot enough to boil off.**

*Jessica Lovering: The reactor can sort of cool itself through natural processes… through convective cooling like, uh… soup in a pot.*

**The elegance of these new designs is what Eddie fell in love with. This is what led him to start assembling his dream-team: nuclear engineers who were all part of the Puerto Rican diaspora…**

*Eddie Guerra: I immediately reach out to a couple friends of mine from Puerto Rico, and that also worked in the U.S. nuclear industry. And I told the guys these small reactors are something so different. Why not present these this option to the current energy crisis going on in Puerto Rico?*

**Generating electricity on islands is a constant struggle: fuel has to come in on a boat, connecting to nearby neighbors to import or export power is expensive or impossible. And that drives up costs... Puerto Rico has some of the highest electricity prices in the United States.

It means that things that might not make economic sense on the mainland, can pencil out on islands… they can be laboratories for solutions that are ALMOST cheap enough for mainstream, but not quite...**

*Eddie Guerra: This was 2015, Sam. So I reach out to good friends of mine, people who work as operators for Excelon, which is one of the biggest corporate nuclear operators in the nation. People who work for the Bechtel, for example, who is one of the biggest deciders of nuclear power plants. So we got together. We said no one had to convince us that from a technical point of view, this makes sense. We were convinced because we were in the trenches, we did the work. No one had to convince us.*

*Jesabel Rivera: And this is the part that I always like to talk about, because Eddie's having this — this is this is happening at our dinner table. OK. So on one side, Eddie's having all these conversations with his, you know, his colleagues and, you know, all his papers. And then on the other side of the table, I am planning events and doing community engagement projects.*

**This might be a good place to note that a lot of people are really freaked out by nuclear power. And the first skeptic that Eddie had to convince was Jesabel.**

**Remember, Jesabel had worked in community organizing. She went on to get her degree in public health.**

*Jesabel Rivera: Eddie’s somebody that, you know, whatever he's into, it's a good thing. So you should follow, Right? But then this time — this what this time was difficult because we were talking about like nuclear in Puerto Rico. what would happen if, you know, there's an earthquake and what would happen if you know, it would explode and where would people go? And, you know, why do we need nuclear? We have solar and wind and all the renewables that we can do? I mean, like I had all these different questions. So I went and started finding, you know, information on my own. And I couldn't find a reason not to like nuclear. So that's when I started telling, you know, Eddie, like, okay, we need to talk about this differently.*

**If Eddie brought the enthusiasm for the technology. Jesabel brought the savvy to know that the technology has baggage.**

*Jesabel Rivera: Like everybody has watched The Simpsons. And it was like my favorite one. So that's I mean, number one that's like how it works for me, right? Like, I'm thinking that it shines, you know, green and is like a liquid. And like you have an operator that doesn't care, you know, like all the different things. Like, that's what I had in my mind. And but then, of course, I also think about your novel. Of course, I also think think about Fukushima. And then that's it. Right? But then remember that I come in from the public health standpoint and then I'm doing a lot of social justice kind of work. So in social justice kind of work, we are kind of — against anything that is an elite. Right? So the rich white people are the ones that, you know, never want to really do something for the community. Right? So nuclear, that's the image that I had, too. And that was also something that I said no. Like, it does just it doesn't fit in Puerto Rico. And we have been very particular on who and how we bring people into this project, because it has to be somebody that really cares about, you know, the community and really wants to make a difference.*

**The organization they create together — the Nuclear Alternative Project — is designed to be the opposite of what has driven the creation of nuclear power plants previously.**

**Instead of top-down, it would be bottom up: the organization is all volunteer. Instead of prescriptive, it would be collaborative: they want conversation and study on the nuclear question… a discussion of whether and how and where the technology could fit on the island. And instead of driven by colonial urges, it would be local: all of the members were born in Puerto Rico but had to move away.**

*Jesus Nuñez: Hello, my name is Jesus M. Nuñez.. I was born and raised in Puerto Rico.*

*Olga Marie Toledo: My name is Olga Marie Toledo. Born and raised in the beautiful island of Puerto Rico,*

*Luis Rodríguez: I am Luis Rodríguez. I am a person that was born in Puerto Rico.*

*Olga Marie Toledo: Ever since I left Puerto Rico in 2011, I was longing for an opportunity to give back to Puerto Rico with my professional background.*

*Luis Rodríguez: Since I learned about the effort. I have contacted many of my friends and other residents in Puerto Rico.*

*Jesus Nuñez: We borricuas are very resistive to change, especially when it comes from outsiders. I believe that the discussion is deferred because we are born and raised in Puerto Rico and we also put our passion and commitment to this project because we want the best for our family members who are still living in there.*

*Olga Marie Toledo: So I really look forward for many more borricuas to learn about all that nuclear power has to offer and to like me realize it is possible and it would be of great benefit to the island.*

**Before we go any farther, we need just a splash more context. On top of having the expensive electricity challenge that all islands have, Puerto Rico has its own challenges unique to its history.**

**To give us kinda of the pocket… postcard version of how Puerto Rico’s grid got the way it is today, we’re going to turn to Javier Rua: he is a lawyer from the island who has worked for government regulators, and is now working for a renewable energy company.**

*Javier Rua: Puerto Rico’s electric company has been, you know, or had been a self regulated monopoly for all of its life.*

**Puerto Rico has just one electric company - PREPA. It’s owned and operated by the puerto rican government. Back before the infamous arab oil embargoes of the 1970s the oil-embargo, Puerto Rico had a bunch of oil refineries in the south of the island.**

*Javier Rua: But those things just became dinosaurs after the oil embargo and all that demand that was lost.*

**But… a bunch of power plants had already been built down there to power the refineries. Meanwhile… most of the people live in the North.**

*Javier Rua: Meanwhile, most of the people live in the north and and and you have to transmit that power over mountains, you know, 60, 70 miles of cables.*

**That’s the first ingredient… the long fuse in a coming disaster. a heavy reliance on long distance poles and wires. The second ingredient was political… and economic.**

*Javier Rua: But Rico's economic development has been, you know, based for for most of its history on tax breaks, section 936, which was a federal tax break. And when those tax breaks were starting to be seen by Congress, as kind of li ke corporate welfare. They were — they started to be phased out.*

**This was under Bill Clinton, in the late 90s**

*Javier Rua: And as they were phased out, at least at least a third of our industrial base left.*

**We’re talking about factories closing en masse and moving elsewhere. All of PREPA’s customers disappearing. When this happens in the electricity business, there are two options: raise rates... which is super unpopular... or don’t spend money on trimming trees, replacing and fixing old leaning utility poles, shoring up old infrastructure.**

*Javier Rua: And then you had the system that was was and is cash strapped that couldn't really do significant infrastructure maintenance. And it starts becoming really old.*

**So Puerto Rico had an old-fashioned system that requires a lot of upkeep - but a single utility that couldn’t afford to maintain it. There are a lot of ways that you could quantify this, but here’s one number that blew me away. When you transmit electricity from one place to another, some of it is lost along the way. On the continental US, we waste about 5% of the electricity we generate.**

**In Puerto Rico, it’s more like 17 percent.**

**That’s ingredient number 2. Old infrastructure..**

*Javier Rua: And then you’re hit by a storm.*

**[Pause]**

**What did hurricane Maria do to Jesabel and Eddie’s campaign to bring nuclear to the island? That’s after a break.**

**<<<<<<<<<<<<<<<BREAK>>>>>>>>>>>>>>>>>**

*Eddie Guerra: Hurricane Maria happened in September 2017. October 2017, I went to Puerto Rico and I took supplies and food to my father and my mother and my family in my hometown of San Sebastian. It was for the first time my dad called me to tell me, Eddie, if have some water, just let us know because we that difficult to find water here. And that scared me. And I said, Wow! This time is different.*

**This part of the story you know. Thousands died. It took almost a full year to restore power to the last home.**

**But at the same time… something else was happening**

*Jesabel Rivera: The the solar industry really saved people in Puerto Rico. Let's put it out there. You can not take that away. And it really solved an issue that was you know, that was immediate. There was an emergency. And and this technology really responded the way that it needed.*

**The number of rooftop solar installations on the island doubled in the 12 months after Hurricane Maria. And politically it was a huge moment for renewable energy advocates.**

*Jesabel Rivera: Maria, what it did was like it just everybody was on fire. Everybody was like, you know, traumatised of everything that's happening. So these groups were already pushing for renewables and these groups were already looking for this independence. So Maria happens and then all these groups came together and started pushing. Let's move to 100 percent renewable because that's the solution.*

[Music]

**This past spring, Puerto Rico passed a law calling for the island to be powered by 100 percent renewable energy by 2050. That means, explicitly not nuclear energy. Nuclear doesn’t emit carbon dioxide, but it still uses a fuel, uranium, that we dig up from underground: it’s not part of this definition.**

**You might think that this would have been the death knell for Jesabel and Eddie’s project. But they haven’t given up.**

*Jesabel Rivera: But what Maria did in Puerto Rico is that it made people look at each other and say, we can do this on our own. We don't need the government. We can do this on our own. And it's just like it really created and brought all this power that was asleep in the people. So it created this beautiful thing. And that's why, you know, I am not against renewable whatsoever. What I am against is that the renewable industry really saw an opportunity here to push the entire agenda. But interestingly, we have pharmaceuticals and manufacturing and energy intensive industries that need a different kind of energy as well.*

**Puerto Rico gets a lot of sun, and it’s not hard to get a solar and battery array that can provide most or all of your day-to-day power. But what if you’re manufacturing drugs… have three shifts working to keep that factory going around the clock? What if you’ve got a factory that needs megawatts of power, 24/7**

**Jesabel and Eddie are saying, renewables are fine… but we want more.**

*Eddie Guerra: We know that Puerto Rico is not a third world country. We know the huge potential in Puerto Rico to be kind of, you know, the Singapore of the Caribbean. That's how we see it. So when we see from an engineering and technical point of view that a vision, a strong modern economy like that is proposed to be sustained by renewables from an engineering and technical point of view, we see huge inconsistencies.*

**PREPA—the one electric company on Puerto Rico— just released their plan for the next twenty years, it involves shutting down power plants that burn coal and oil, and replacing them solar power and natural gas. It calls for two new terminals to import liquefied natural gas, and replace a whole fleet of almost two dozen small natural gas fired plants scattered all over the island.**

**Rather than taking aim at the renewable energy part of that equation… Jesabel and Eddie are taking aim at the natural gas part of that plan.**

[music fades]

**Now… you might think… ok, we’ve spent this whole episode talking about this grand vision of nuclear energy powering the Singapore of the Caribbean… but you haven’t even mentioned the fact that many people are terrified of this technology and want it no-where near them.**

**And while that’s true, there’s actually a reason that nuclear might not have a future on the Puerto Rico… or anywhere for that matter… that actually kinda trumps the whole fear thing.**

*Sam Evans-Brown When we think about why it's necessary to come up with with these new designs. I mean, I guess the question is like what? What is the question they're trying to answer, is it really safety?*

*Jessica Lovering: No. Yeah, I think the big challenge of nuclear and the big obstacle is actually cost. It's not safety.*

**That’s Jessica Lovering of Carnegie Mellon University again.**

*Jessica Lovering: And and the two are are related in some ways. It can be very expensive to guarantee safety if you're doing it in inefficient ways through lots of backup systems and redundant safety systems that you have to engineer to really precise levels relative to other sources.*

**Relative to other sources, here’s not much nuclear power being built in the western world right now, and among the plants that are being built, there have been some spectacular cost overruns.**

**A huge plant in Georgia was first proposed at $14 billion, but at last check was expected to cost $25 billion.**

**Another underway in Great Britain was expected to cost 16 billion pounds, but has since ballooned to 22 billion pounds.**

**A third, in France, was first pitched at $3.3 billion euros, and was planned to open in 2012. As of last month, the new cost r estimate is over 12 billion… four times as much… and it’s still not finished.**

**In other words, before we even get to the point where plants get proposed and people get freaked out by them, they need to be cheap enough that someone’s got to be willing to pay for them. And for these “next generation” advanced reactors to take off, the biggest hurdle they have to overcome is this history the industry has totally blowing their budgets.**

*Jessica Lovering: And if they're not competitive, then they won't happen. And so I think they're with more — in the anti-nuclear crowds — you see this concern of like, oh, we don't want the government funding another nuclear boondoggle. And, you know, they're right.*

**Jessica says historically, there have been a few countries, in a few times in history, that have managed to build cost-effective nuclear power industries — France in 70s… South Korea right now — and the lesson from those countries is you have to go b ig: building a lot of plants allows the industry to figure out how to make them efficiently.**

**And she thinks that’s one of the reasons that building smaller plants, like the kinda Eddie and Jesabel are promoting… might actually help drive costs down.**

*Jessica Lovering: While the U.S. has a long history with nuclear… France has a long history with nuclear... They really haven't been building that much in the past that, you know, these plants that are under construction at Georgia sort of the first ones in 30 years. And so it's you're sort of starting all over again. So you lost a lot of that knowledge and expertise and sort of capabilities to build these plants. So if their reactors get smaller, the market can stay the same size, but it means you're getting more multiples of that factory fabrication. So you're getting more learning by doing. It's not just about getting one project belt. It's about setting up the regulation and the market incentives so that you're going to build many of these over time. And when they're really small, it helps you get those many lined up to go.*

**So that’s the bullish case, on why advanced nuclear *might* work out… assuming it can ACTUALLY drive down costs…**

**But even if it can do so, people in Puerto Rico still might not go for it. Why?**

*Javier Rua: Ok, so here's my recent backup history, which is that the times that my grid has gone down...*

**This is Javier Rua again, the former regulator. Now he works for a renewable energy company, Sunrun, that also sells backup battery systems. He pulled up his smartphone app, and read to me all of the outages his home had recently.**

*Javier Rua: November 11th, 6 minutes, Nov. 6, 5 minutes, November 4th, 5minutes, November 3rd, 30 minutes, November 3rd, one minute, November 3rd. Again, 4 minutes. November 2nd, five minutes, October 31st, seven minutes. And it keeps on going. And then, it is kind of like every day or every two days. October 11th there was a two hour outage. October 8th. There was a two and a half hour outage and it keeps them going until since I installed my system.*

**The lights are on again in Puerto Rico… but the island’s grid is still very fragile… and so-called blue sky outages, happen almost every week.**

**Puerto Ricans spend about 5 times more hours without electricity than your average mainland customer.**

**So, Puerto Ricans are already voting with their feet… installing solar panels and batteries at a pretty impressive clip. And this, again, means there are fewer customers paying for PREPA’s old gasping poles and wires… those same poles and wires that are already failing every other day and dropping people’s poweR**

*Javier Rua: Everybody suffered after Maria. You know, it all social classes. We all we all learned what it means to not have power for months. And because we understand, we've suffered rights, we know what power is. We know not only the cost of power, but the value of it. You know, solar and storage is just a proposal that really has met you know it’s price point and now are getting better and better and better.*

**It might It just doesn’t seem like PREPA is poised to be on the cutting edge of anything right now. If anything, they’re facing a decades-long slog to work their way back out of bankruptcy.**

**It’s a lot...**

**But Jesabel and Eddie are a long way from giving up.**

[Sound from presser]

**And this fall, kinda against all odds... they achieved a major milestone in injecting nuclear back into the conversation…**

[Muy buenos días todos y todas...]

**… the Nuclear Alternative Project, Jesabel and Eddie’s all volunteer collection of diaspora nuclear engineers, won a grant from the United States Department of Energy.**

**More than $800,000 to do a feasibility study the feasibility of advanced nuclear power on the island. This was the press conference they called in San Juan.**

*Jesabel Rivera: We’re not going to build a plant, we’re not going to push the envelope, we are going to find information if nuclear is feasible to be part of this discussion of how to get to our goals…*

[Applause]

**Who knows if they stand a chance of convincing Puerto Rico to give advanced nuclear a chance… But as it stands, they’re not getting much help from the mass media. The freelancer we hired to go to this press conference was the only reporter in the audience…**

**Then again… Maybe we’re not the audience that matters.**

**[Music]**

*Jesabel Rivera: We have this idea of where we want to go. You know, in terms of communities, we want to make sure that we're going to the plazas and we are having models, seeing the plazas and are with the people and they can see it. They can touch it, they can break it down. You know, we we we have a clear vision of where we want to go. But at the same time, we're just grasping the opportunity as it comes, because there's a lot out there that that can happen that we just need to be flexible.*

*Eddie Guerra: In my view, the technology is not the roadblock in Puerto Rico, but we need to engage the public. We need to use this. The results of this feasibility study, as Jesabel said, to engage the people from the beginning, led them feel that they are the main stakeholder in this process. From there, Sam, you know, many things can happen.*

**[Outside/In Theme Music]**