Future of Infrastructure podcast

Episode 15 – Charting the Future of Water

Host: Jeremy Goldberg

Guest: Peter Fiske

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**JEREMY GOLDBERG:** Welcome to the future of infrastructure. I’m Jeremy Goldberg, Worldwide Director of Critical Infrastructure at Microsoft, and I’m on a journey to learn more about how infrastructure is being built around the world, by talking with public servants, philanthropist, artists and place-makers who have spent their lives working in the public interest. This is a series to help us build things and plan for the future, while putting people first.

Thank you for joining us. Today, I am thrilled to have the executive director of NAWI, the National Alliance for Water Innovation, with us, Peter Fiske. Thank you, Peter, for being with us here in San Francisco today.

**PETER FISKE:** Thank you, Jeremy, good to meet you and good to be here.

**JEREMY GOLDBERG:** So for those of us that are not familiar with NAWI, or your career, and what you – what you’ve done and accomplished over your career, tell us a bit about yourself and why you were drawn to this field and this work that you do for the public good.

**PETER FISKE:** Sure. Well, for starters, NAWI is a sort of an unusual thing, Jeremy. It is a temporary organization. It was created by a group of us around the country responding to a call from the Department of Energy.

The U.S. Department of Energy creates these things called Innovation Hubs. They’re designed to be temporary organizations, five years of funding, and if you’re doing good, another five years of funding, and then they burn it down.

**JEREMY GOLDBERG:** What type of funding are we talking about?

**PETER FISKE:** We’re talking about five years, $110 million.

**JEREMY GOLDBERG:** Okay.

**PETER FISKE:** So roughly 25 million bucks a year.

**JEREMY GOLDBERG:** Okay.

**PETER FISKE:** So that’s enough to fund active researchers in a number of universities and national labs and industry around the country.

And so, the program, we were called to bring forth some innovation in desalination, which is the, you know, producing clean water from salty water sources. And so, the program is led at Lawrence Berkeley National Laboratory right across the bay in Berkeley, California, but we have national leadership through several of our other national labs, including the National Renewable Energy Laboratory in Golden, Colorado, and the Oak Ridge National Laboratory in Tennessee.

Together, we have organized a vision for dramatically lowering the cost and energy of desalination and water reuse, and then being able to fund researchers to advance the technology frontier, and end up with a new toolkit, where we will have new desalination technologies and systems that allow us to reuse water, ideally over and over and over again.

**JEREMY GOLDBERG:** Tell us a bit more about yourself.

**PETER FISKE:** Sure. It’s funny, Jeremy, and you probably reflect this yourself, that careers make sense, but kind of only in the rearview mirror.

**JEREMY GOLDBERG:** That’s right.

**PETER FISKE:** And when you are embarking on your career, even at an early stage or at any point, you’re faced with somewhat ambiguous choices. So I grew up always wanting to be a scientist, will admit Star Trek original series was an influencer.

**JEREMY GOLDBERG:** I was going to say, Mr. Wizard –

**PETER FISKE:** There you go.

**JEREMY GOLDBERG:** – but that one, Star Trek works.

**PETER FISKE:** Yeah. So I ended up pursuing a PhD in geology and material science, and then went on into a research career for a number of years.

But at a certain point, it was as if the shoes felt a little tight, and I then was very interested in the intersection of science and public service and public policy. And I went to do an extraordinary program called the White House Fellowship in 1996 and 1997, where they gather together early career people from a wide variety of kind of unusual backgrounds, and they literally plop you in D.C. for a year. And you are a special assistant to either the President, the Vice President, or one of the cabinet secretaries.

I was placed in the Pentagon, completely unfamiliar environment, but that taught me a lot about public service, and frankly, taught me a lot that I didn’t know about the extraordinary dedication and commitment that the armed services and the –

**JEREMY GOLDBERG:** Sure.

**PETER FISKE:** – warfighters’ place to, you know, to protect and defend us.

So after that, I got interested in the intersection of science and startups. My family had always come from a background of public service and science. Both my parents had worked in many years in the Smithsonian, and my sister is in city government in Seattle. So my family has always been at that intersection of public service and research, and exploration. And so, all that kind of seemed to make some sense for me to explore startups.

And so, in 2000, I actually left my science career and embarked on a series of startups, and the latest of which was a technology company in water. That company grew and we exited that company in 2017, at which point I was left sort of like, well, what do you do with your life next?

Well, it turns out that was when the Department of Energy was getting interested in water itself. And I, through a series of again, unusual circumstances that in hindsight look brilliant, but at the time, are mostly accidental, I ended up having the opportunity to lead this team. We competed for this funding, won the funding, and we created NAWI.

**JEREMY GOLDBERG:** Incredible story. There are so many headlines out there that are very daunting, and outright really kind of frightening when you – and I’ll just pull a few that came up, you know, ongoing mega drought puts the West, western part of the United States, in unchartered waters, right?

Or, on the other hand, you see these enormous investments from the infrastructure bill here out of Washington, water infrastructure $55 billion, and all these kind of big projects to modernize, you know, our infrastructure. And you think about that, and it’s scary to think because what’s happening today, right, that we’re not prepared for, that we’re trying to catch up. And so, when we think about, as we talk about desal – desalinization, we have these larger macro kind of like, you know, issues going on.

You know, give us your impressions, right, on some of these things that you’re seeing and hearing before we kind of dive into the desalinization discussion and topic and the reasons why it’s so important.

**PETER FISKE:** Yeah, you bet. Well, yes, you’re right, Jeremy, for starters, you glance at the headlines, and it can seem almost hopeless, right, mega droughts, unprecedented floods, et cetera, et cetera.

And one of the researchers that is in the climate environment said that the delivery vehicle for the effects of climate change will be water. And so, as you look around the world, that’s kind of what you see: the storms are stormier, the floods are bigger, and the droughts are longer and deeper.

And so, we, you know, as a species have the challenge to adapt and to build and rebuild our infrastructure in a way that it’s not just coping or somehow managing to get by, but maybe even, dare I say, embracing a more variable climate world.

And that’s some of the research we do at Lawrence Berkeley Lab. And certainly, while desalination is one piece, one Lego block in a whole city of innovation that we need to build, there is a lot that we can do even with the infrastructure we have today.

**JEREMY GOLDBERG:** So let’s jump into the desalinization topic. And you know, give us, if you can, a short overview of what it is, what you’re working on, and describe what even in layman’s terms the desalinization process is.

**PETER FISKE:** Sure. So desalination is the term that we use. And most people, when you hear the word, you think of desalinating ocean water. And in fact, something like 10 billion gallons of fresh water is made every day around the world by desalinating ocean water. And ocean water is great because it’s abundant. And in terms of a water supply, no matter what happens with drought, we will always have oceans. And so, there will always be that water supply.

The challenge is ocean water is pretty salty. It has 3.5% salt in it. In fact, it’s about twice as salty as soy sauce. So you know, you think about I’m not going to drink soy sauce.

**JEREMY GOLDBERG:** It’s pretty salty.

**PETER FISKE:** And so, the question is, how do we develop technologies to – to pull that water away from all that salt, and it actually requires a lot of chemical energy simply to separate the salt from that water. And that’s the term, desalination.

The earliest desalination technologies were used 5,000 years ago simply by boiling water, and taking the condensate and gathering the condensate, the distilled water, and drinking that. They did that on boats in the Greek seas.

But today’s desalination technologies don’t use heat. They’re using something called a reverse osmosis membrane. And the way this works is you have a membrane that can pass water. But you know the chemical drive is to push water into the salt. So you squeeze on the salty water at high pressure, and you force the freshwater through that membrane, sort of like a sieve. And that freshwater can then come out the other side and be used.

What you’re left with is an even more salty concentrate we call brine. If you’re by the ocean, you can take that brine and mix it up with extra seawater and discharge it safely. And that’s why most of the desalination today happens by the ocean. Most of our large desal plants in the United States and in the Middle East are all ocean desal plants.

NAWI’s program got interested in the fact that there’s lots of other salty water around the world. In fact, there’s groundwater around the United States that’s not as salty as seawater, but it’s too salty to use. That’s called brackish groundwater. And Jeremy, that represents a huge reservoir of water supply for the United States that is untapped.

**JEREMY GOLDBERG:** So what does this matter for let’s pick Oakland or San Francisco. So here we are in the Bay Area. Why does this process matter for people? Why is this effort important to them? Why should it be?

**PETER FISKE:** It’s a great question. Even established municipalities like San Francisco or Oakland had their, early on 150 years ago, the cities found water supplies, in this case in the Sierra Nevada, and they pull that water all the way across the Central Valley here to the coast. But not all cities got so lucky. So later cities, more recent cities don’t have access to that original water supply, that surface water supply.

The other thing we think about with desalination is it’s unlikely and probably unaffordable for us to think of desalination as the main source of water in the United States. But as I said, desalination is a technology that is reliable no matter what happens with climate change.

And so, a city like for, example, San Diego has a portfolio of water supplies. They used to have just one, the Colorado River. And what they’re doing is they’re diversifying their water portfolio. And desalination is one of the tools that San Diego County is using to make a more climate resilient water supply for the people. So you don’t have to have all your water come from desalination, but having some fraction, it’s like having a bond in your retirement account. It gives your portfolio stability.

And then overseas we have countries like Saudi Arabia and Qatar that their dominant water supply is desalination. And originally the desalinated water was produced as a byproduct of energy production. So they would literally use the water that they’d use to cool the power plant and they’d pull some steam off and that would be the water supply.

In the Middle East now we’re also seeing a big transition towards reverse osmosis using these membranes. And that’s a frontier, so many of those desal plants are going to get more energy efficient as they convert from thermal energy to membrane reverse osmosis desalination.

**JEREMY GOLDBERG:** Those are interesting examples in Saudi and in Qatar, like because those are desert, you know, climates, right?

**PETER FISKE:** Yes, they are.

**JEREMY GOLDBERG:** So there are other factors or variables, I would imagine, that go into this, too, as these countries, you know, extreme heat that hits the country. I was in Doha in March, and it was a cooler time of year, but I know in the summer months it can be upwards of 120, 130 degrees.

What are some of the considerations that the, you know, public sector, the governments ought to be thinking about as it relates to, you know, the desalinization process and the water issues in their nations that are desert environments?

**PETER FISKE:** It’s a great question, Jeremy, because a lot of people don’t appreciate that while we look at the Middle Eastern nations as largely desert nations, we don’t appreciate that they get floods, too. And Saudi Arabia has had catastrophic floods. In fact, in Jeddah, in 2009, there was a catastrophic flood that killed hundreds of people.

So a lot of what we could do in terms of infrastructure design is, again, I say, designing for resilience at the outset. When we have periods of storm, and those storms are more violent, and we get all that runoff, we can now design our roads and our curbs to actually rather than funnel the water into a sewer and funnel it into a gutter, we can actually soak that water back in the ground. That’s called aquifer recharge.

**JEREMY GOLDBERG:** Fascinating.

**PETER FISKE:** And we can build streets that are like sponges, so that when that rain comes, you might only have one or two rainstorms in a year, but you might get 50% of the groundwater recharge in just those events, if we design the city to be like a sponge.

**JEREMY GOLDBERG:** Absolutely fascinating. I imagine there must be startups in this space that are doing some of that work, too.

**PETER FISKE:** There are some but, you know, it’s interesting, you know, we’re talking about civil infrastructure. And I’ve worked in, you know, the civil sector, and you’ve worked in the civil sector, and the civil sector, you know, embarks on technology development very cautiously. And it’s not because they got their head in the sand. These are very progressive and thoughtful people. But they have to be very concerned about making a choice today that ends up putting them into a box of technological obsolescence tomorrow.

**JEREMY GOLDBERG:** Indeed. That’s right.

**PETER FISKE:** And so, sometimes we see the municipal sector tenderly exploring with their feet, exploring things. But here in San Francisco, there’s a really interesting experiment going on right now.

**JEREMY GOLDBERG:** Okay.

**PETER FISKE:** It turns out that the city of San Francisco imposed a new ordinance on their building codes. They said that all new buildings, apartment buildings above, I think it was originally 250,000 square feet, now it’s down to 100,000 square feet, if you’re going to build a building here, you have to have premise-scale water reuse. That is to say, the building itself has to capture its wastewater, process it, and use it back in the toilets, et cetera.

Now, that was a choice of policy first. And you could imagine all the real estate developers were like, oh, what are we doing, it’s already so expensive, and a lot of complaints. But what you did with that policy experiment was you created a small tide pool of innovation, and you allowed startups to come to San Francisco to develop and build these first premise-scale reuse systems.

Once you have that traction, and then the city of San Jose and the city of Los Angeles can come up here to San Francisco and see that there’s functioning infrastructure, not a risk, but actually demonstrated infrastructure. That’s when you start to see the turnaround, and then you see other municipalities adopting similar changes.

**JEREMY GOLDBERG:** You’re absolutely right. So we’ve started, we’re surfacing some of the desired or desirable impacts of this work that you’re doing in desalinization, and a few other areas, too. Let’s pick, let’s really focus in terms of evaluation of success, right? What does that look like in the work that you’re doing? And how is it being measured to that accountability point?

**PETER FISKE:** That’s a great question. And of course, the Department of Energy and Lawrence Berkeley Lab, look, we are scientists. We measure things. So we want to understand that what we’re embarking on, and even in early stage applied research, is driving towards something with demonstrable quantitative gains.

So the obvious first thing to look at is, well, how much does it cost to produce water? It’s called the levelized cost of water. And the answer is often it depends. You can have some water supplies that are very cheap. But as you look at a city, for example, or a county like San Diego County that’s reaching its limited capacity for water supply, you ask, what’s the next marginal cost? Like to get the next 1,000 gallons of water, how much is that marginal cost? That’s where you see a huge wall and that’s where we intend to develop technologies.

One of the key insights we made through the NAWI team, and this was not NAWI, this was the entire NAWI community, which is made up of hundreds of researchers around the United States, we realized that a lot of people look at the cost of producing the water itself, but not the energy spent moving the water around in pipes. You have hilly cities like San Francisco, or Oakland. My wife and I live at 1,100 feet elevation. The energy spent just lifting the water from the treatment plant up to our house is the same amount of embedded energy as if that water was desalinated.

That’s where we see part of the future for resilient infrastructure, because just as we did with the power sector, we used to generate electricity with these large, centralized treatment plants. Really there’s one per city. They generate all the power. And it went down, everything goes dark, right? Today, we still have that centralized infrastructure, but people are adopting solar panels and batteries, which means we have a hybrid system of both central and distributed.

The water sector we see has the potential for the same transformation. We could see a future in which buildings themselves cleanse and reuse 80% of their water. It still has a centralized supply, but the net volume of water that’s needed is much lower, because the water is being used more efficiently in the building,

**JEREMY GOLDBERG:** You’re talking about quite a few areas around operational challenges, right, to implement –

**PETER FISKE:** That’s right.

**JEREMY GOLDBERG:** – some of these things that you face.

Let’s talk about overcoming some of those, right – let’s – a bit further. So when you think about the example that you talk, you know, around you and your wife living at 1,100 feet, or another example, how do you, are you – are you referencing past projects? Are you looking at other examples in terms of operationally speaking, to get beyond that, right? What is it that you’ve done, or you’ve experienced to get to the point where you’re like, we’ve succeeded; now we’re in the next phase of that innovation?

**PETER FISKE:** Well, I think that in the water sector, it’s really helpful for us to look at our brothers and sisters in the power sector, because in some respects, they have gone further in terms of distributed power generation and distributed power management.

And so, for example, I’m an all-electric family now. So we have all electric vehicles. We have a charger system at home, and it dynamically participates in the grid. So actually, I get money, because my car waits until 2 a.m., or 3 a.m., to charge itself. I am waiting to get a vehicle that will actually be able to flow power out of the car back into my house in case we actually have to turn down power, which happens in California occasionally.

So one of the things that is clear in this world, is that a lot more data are going to be inherently flowing back and forth. And we’re going to have to be looking at systems that are clusters, and then clusters of clusters. And that data management and the modeling associated with that’s really critical.

One key area of research that we’re doing is in something called digital twins, I don’t know if any of your guests have talked about digital twins. Digital twins are essentially a computer model that accurately replicates the performance of a system. And in the case of water treatment, we have not really had digital twin. So our operators are men and women, who are there producing your clean water every day, are using clipboards and Excel spreadsheets.

And don’t get me wrong, I love Excel, great product, but they don’t have access to predictive models to help them understand, given the weather tomorrow –

**JEREMY GOLDBERG:** That’s right.

**PETER FISKE:** – what is my water demand going to be? What is my water quality going to be? And what’s the optimal set of systems I can use at my treatment plant to produce that water?

**JEREMY GOLDBERG:** That’s right. That’s digitalizing your business process, right? Because we’ve got a lot of these technologies that are out there but taking something like a digital twin – and this isn’t – we’re not diving into these products today.

**PETER FISKE:** Yeah, yeah.

**JEREMY GOLDBERG:** But it’s absolutely right. And you know, and I’m interested, you referenced something earlier around buildings. And how – and I think the digital twin has probably been – the use cases have been applied in the building and construction space and design space for a number of years. So I could see where those things are converging, right, with what you’re talking about with water –

**PETER FISKE:** That’s right.

**JEREMY GOLDBERG:** – and the digital twin. What are some things that you would advise our audience or Government leaders, you know, as they’re thinking about implementing these projects that can seem very – they’re very complex, there are a lot of partners involved there, whether it be federal, state and local, a couple of, one to three different kinds of points of like lessons learned of what to do or not to do.

**PETER FISKE:** Yeah. Okay. So I’ve got maybe let’s try three different levels –

**JEREMY GOLDBERG:** Sure.

**PETER FISKE:** – of engagement. Let’s start with the individual. As you know, Jeremy, and as I know, and your audience knows, democracy is not a spectator sport. It’s about engagement. The simple thing is, if people want to see resilient infrastructure in their towns and communities, they have to simply send an e-mail to their city manager and say, where the hell is my permeable paver? Or where the hell are my chargers?

And, again, I think that people tend to view public request as sort of, oh, it’s – yeah, it’s kind of troublesome; I’m being a problem person. This is actually what your public leaders need. They need the feedback and the encouragement from you to then go to their town councils, to then go to their budgeting process and say, look, we’re hearing this request; this is the thing we have to respond to. So that’s everybody listening can do that because everybody’s a citizen somewhere.

**JEREMY GOLDBERG:** Yep, active participant.

**PETER FISKE:** For the people who are working in city government in particular, and these are my friends and colleagues, and when I was working at my company PAX Water, we dealt with these honestly, practically heroic people all the time. They are so busy, and so much of what they struggle with is just getting their job done. It’s very hard for them to carve away time to be curious, to simply spend some time and look out at what might be happening.

So a really good piece of advice I got from a very successful individual was something called the 80/10/10 rule. 80% of her time, she spends focused on being as effective as she can in her job. 10% of her time, she’s focuses solely on her own personal and professional development, reads outside her fields, visit other colleagues. And the final 10% of her time, telling her management what a good job she’s doing the 80% of the time she’s doing her job.

**JEREMY GOLDBERG:** That’s right.

**PETER FISKE:** But unless you as an active professional, which a lot of the people listening are, unless you carve out some portion of your week to do that exploratory work, that honestly goofing off, browsing the web, going to a conference, these are all really nourishing things for you as a professional. But I think public sector officials in particular always just struggle with the amount of workload they have and the time, the precious time they have. So that’s the second level.

The third level is, you know, elected leadership. We’ve actually seen some of the most hopeful signs of climate-resilient infrastructure and water innovation actually coming from elected leadership.

**JEREMY GOLDBERG:** Good. Where?

**PETER FISKE:** And this – well, for example, even in a municipalities like Hampton Roads, which is in –

**JEREMY GOLDBERG:** Virginia.

**PETER FISKE:** – Virginia, they have one of the most progressive water utilities, and they are active participants in research projects around the country. They have PhD scientists from around the country come to Hampton Roads to partner with them in the research, in the work that they’re doing. And that was supported and encouraged by past mayors and city councils.

So when you have as an elected leader, special parts of your city team, making sure that they know that it’s safe and encouraged for them to innovate, for them to explore, and that you’ve got their back, that’s a really important thing.

**JEREMY GOLDBERG:** Absolutely. You hit on the exploration piece and that partnership piece, right? In that instance, in Hampton Roads with academia. And those partnerships go a very long way from the research and the application, right, of the work. And I love these examples and very clear on those three examples.

Final question I have for you today, I’m sure you read quite a lot. You talked about, you know, making time to browse the web. Is there something that you’ve listened to lately or read lately that’s had an impact? And I would say around technology and infrastructure, but just more so interested in the way that you’re thinking about problem-solving or tackling many of these challenges.

**PETER FISKE:** I suspected you’d to ask me a question like this, and I always get, you know, embarrassed because you’re like, oh, this is an erudition test. And the fact is, I actually am – most of what I’m reading right now is blogs or literally some of the frontier research reports that I am getting at Lawrence Berkeley Lab, as well as publications. And so, I would say I don’t have a good like Rosetta Stone for you, Jeremy.

**JEREMY GOLDBERG:** That’s okay.

**PETER FISKE:** But I do say that I learn a lot by reading, but I often find that the random act of being curious to people is something that is a really good habit for me. So I am a chatty guy. So I will chat somebody up. I’ll ask her, I don’t know, how many donuts do you make in a day, or what tools do you use to lift that thing or that sort of thing? And for the most part, 90% of the time, people are happy to answer your question.

And so, I would say that whereas there are great books – I will say one. You know, Paul Hawken, have you guys interviewed Paul Hawken yet?

**JEREMY GOLDBERG:** No, I’ve not.

**PETER FISKE:** Oh, what a wonderful thinker.

**JEREMY GOLDBERG:** So we should.

**PETER FISKE:** Wonderful thinker, Paul has written a book called *Regeneration*. And the reason, I know Paul from some past work in the startup space, but Paul is a great thinker about this next generation.

And his book, which just came out, is essentially a step-by-step guide. Because as I said, it’s not a time for optimists to assume it’s all going to be done. It’s not a time for pessimists who assume it can’t be done. Paul, in his book, outlines the practical steps, and there are many, that will bring us into a sustainable future. And in fact, he calls it *Regeneration*, because it’s my daughters, who are 19 and 17, it’s their generation who’s going to be the greatest generation for us.

**JEREMY GOLDBERG:** Well, I’m sure Paul will appreciate the plug for his book, too, and we’ll check it out.

**PETER FISKE:** So I also find, because my work at NAWI intersects science and technology, it also brushes up against the frontier of innovation and entrepreneurship. And so, one of the things that’s really exciting is that there are a number of startup incubators and accelerator programs that are really helping identify extraordinary leaders at a very early stage.

So one is the Elemental Accelerator, which operates with a focus on helping climate sustainability-oriented startups that need to demonstrate their technology at scale. That’s a particular focus for that accelerator. And they do a great job of identifying companies and giving them the both the capital and the advice to move forward.

Morgan Stanley has the Sustainable Solutions Consortium, and that program is, again, a means of identifying small stage companies from around the world, and giving them startup advice, as well as access to the Morgan Stanley network. So these are places where we’re seeing these innovations, not just in technology, we’re seeing innovations in how we innovate, and that’s super helpful.

The U.S. Department of Energy and the National Science Foundation has a program called the Innovation Corps or I-Corps program. This takes scientists who have never gone out to do product development research, and in eight weeks forces them to do more than 100 customer discovery interviews, which at the outset, they seem, absolutely agonizing. By the end, these scientists and engineers are fundamentally transformed in how they view the opportunity that their research needs to address.

And so, these are great, hopeful signs in terms of tools and resources, and you can learn about those on the web.

**JEREMY GOLDBERG:** Peter Fiske, thank you for joining us here in downtown San Francisco today, talking about your work with NAWI, and so many other different areas, so much that we learned, and I know that our audience will have a lot of great takeaways.

And so, for until next time, this is the Future of Infrastructure. Thank you, Peter.

**PETER FISKE:** Thank you, Jeremy. And anybody who wants to find me, I’m at Lawrence Berkeley National Laboratory.

**JEREMY GOLDBERG:** Thanks for listening to this episode, and being a part of the Future of Infrastructure, and for joining me on this journey to meet and learn from the people improving life in their communities. If you liked today’s episode and want to help other people find it, please take a moment to share, rate, and review the show.

To learn more, visit us at wwps.microsoft.com, or find me on LinkedIn and Twitter at Jeremy M. Goldberg.

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