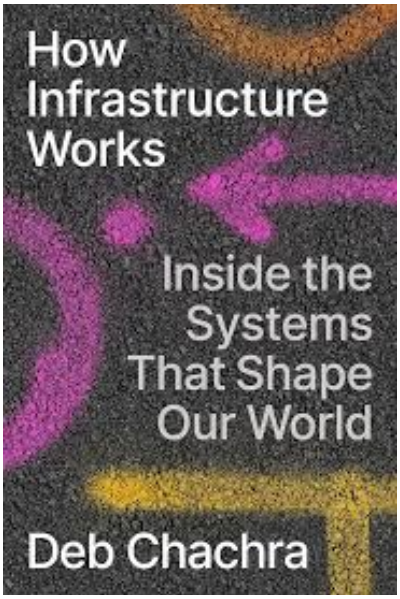
Atlanta Urbanist Book Group

How Infrastructure Works: Inside the Systems That Shape Our World

By Deb Chachra

The Atlanta Urbanist Book Group met on March 4, 2026 to discuss *How Infrastructure Works: Inside the Systems That Shape Our World*. Deb Chachra is an engineering professor and a writer about technology.



How Infrastructure Works has three aims: To help readers see the infrastructure systems around them, help them appreciate these systems' importance in their lives and show the challenges ahead, the greatest of which is adapting to climate change.

This sounds dour, but the book concludes with four strikingly optimistic messages. First, Chachra writes, we really do know how to make the transition to carbon-free energy, which will benefit all our infrastructure systems from electric power grids and water systems to transit and roads. Second, as we make this transition, we will learn there's an abundance of renewable sources, far more than is needed now or in the future.

Third, once these carbon-free systems are built, the energy they will produce will be so cheap that incremental costs will decline sharply. This will open the door, she says, to whole new uses of energy. Finally, the transition gives us an opportunity to think about whether existing infrastructure truly serves us well. Do we want more cars, even if they are electric powered? Or do we want the kinds of neighborhoods and cities that transit, cycling and pedestrian travel make possible?

It is a bold and positive vision of the future we could have, and how new forms of energy could shape the infrastructure systems we depend on. The biggest questions may be: How do we get there? And what could hold us back? These are the things we focused on in our discussion.

Five Big Ideas

The Atlanta Urbanist Book Group highlights ideas from books that we think could make Urban Atlanta better. Here are four big ideas drawn from *How Infrastructure Works* that we believe Urban Atlanta could benefit from:

1. There is abundant renewable energy available, and we know how to harness it.
2. Renewable energy can be generated in completely different ways than carbon-based energy, from rooftop panels and neighborhood installations to large solar farms. These sources will dramatically lower the environmental impact that energy production has today.
3. There are economic reasons for investing in renewable energy. The most important: It will greatly reduce the cost of energy, which will help with affordability.
4. Some forms of infrastructure benefit greatly from "network effects," which means that their importance grows with each place served or person added. An obvious example is transit, which is why efforts to expand MARTA and other regional transit systems are so important.
5. As we know all too well in Atlanta, not properly maintaining infrastructure systems can have disastrous consequences. As climate change advances, we need to invest more in maintenance and add redundancy to some systems.

Why Do These Things?

How Infrastructure Works offers an optimistic view of renewable energy's future along with a caution about taking infrastructure for granted. The book also makes clear that infrastructure is expensive to build. Why, then, should we invest in renewable energy and make our water, sewer and transit systems more resilient? Here's why:

- Climate change is upon us. Changing from our current system of energy production to renewables means it would not get worse.
- This is how you care for future generations.
- Renewable energy means cleaner air and better health for all.
- While the cost of building new energy production and distribution is high, it comes with the promise of much cheaper incremental costs. Translation: Once renewable energy repays its investment, it becomes a bargain. This will make life more affordable for families and businesses.
- We have a significant problem today with artificial intelligence data centers that consume enormous amounts of energy. By investing in renewables, we could provide the energy these centers require.
- Atlanta has a history of infrastructure failure due to poor maintenance and lack of redundancy. By investing more in upkeep and expanding our infrastructure systems to deal with climate change's alternating droughts and deluges, we can expand our ability to weather these crises.
- The history of infrastructure is often about responding to negative externalities, like disease and pollution. We have a chance now to create positive externalities, with inexpensive, renewable energy that will harm neither the environment nor people nearby. We should take advantage of this opportunity.

What Are the Obstacles? What Are Our Strengths?

Even the most worthwhile efforts create opposition. Our members discussed some of the obstacles or barriers the big ideas might face in Urban Atlanta. Here are some:

- Vested interests, such as Georgia Power, will not give up their monopolies in carbon-based electricity generation easily.
- These vested interests will fight renewable energy in the same way that the tobacco interests fought against the overwhelming consensus among doctors and public health officials that smoking was a health threat. They will feed skepticism through misinformation campaigns.

- There will be upfront costs, from homeowners installing solar panels on their roofs to large “solar farms” that will require land, equipment and distribution infrastructure.
- There will be some negative externalities with renewables. We’ll need to build new distribution lines and locate batteries that can store energy during the evening hours. There will be resistance to these lines and sites in neighborhoods.
- The professionals we might depend on to support the transition, such as engineers, have not yet accepted the enormous potential of renewable energy.
- We don’t have the political will to focus on the best interests of future generations. Our political leaders care more about the short term.
- As the book makes clear, density lowers the cost of infrastructure. The Atlanta area has low density in many places.

Urban Atlanta has strengths that could help us with some of the obstacles. We discussed Urban Atlanta’s strengths. Here are a few:
- We have many buildings that could host solar panels, from school buildings to recreation centers.
- We have many sunny days.
- Atlanta has a substantial tax base that could finance the investments we need.
- There are many universities in Atlanta that could help citizens and leaders understand the opportunities of renewable energy and combat the inevitable misinformation campaigns.
- In general, there is a great desire for change. People feel there has to be something better than surrendering to climate change and the ever-growing cost of carbon energy. And they are right.

Ways Around the Obstacles

These are difficult obstacles and impressive strengths. Here are some ideas our members offered for overcoming the barriers, using our strengths:
- As we have seen in recent elections, citizens are aware of high energy costs. They are open to a cleaner and ultimately cheaper form of energy production.
- Universities could help explain the economics of renewable energy and how solar and wind energy will benefit families and businesses.
- We could open the Georgia Power monopoly to other forms of energy production. This would require a change in the Public Service Commission and perhaps in the General Assembly, but we have seen the beginning of this change.
- We should give local governments a stake in solar power generation by covering public buildings, from schools to maintenance depots, in solar panels. Then let these cities, counties and school boards lobby the General Assembly for legislation allowing them to sell their energy to the Georgia Power grid. The benefit to taxpayers could be significant.
- Good place to start: Let’s inventory all public buildings in Atlanta for their suitability for solar.
- There is a need to demonstrate solar’s potential to neighborhoods and homeowners. Let’s launch some demonstration projects for neighborhood-scale solar. Georgia Tech would be a good partner in this.
- Renewable energy will benefit everyone by offering lower energy costs, cleaner air and less climate change. These are good reasons for the state offer tax breaks to homeowners and commercial building owners to invest in solar.
- We could create common sense rules for data centers. One rule could to be for them to invest in renewable energy generation so they take no more from the grid than they add in clean energy.

A Synopsis of *How Infrastructure Works*

How Infrastructure Works: Inside the Systems That Shape Our World is 283 pages with 11 chapters, not including acknowledgments, notes, an index and a list of further readings. It was published in 2023.

Deb Chachra is a professor of engineering at Olin College of Engineering in suburban Boston and a frequent writer about technology and society.

As mentioned above, the book has three aims: To help readers see the infrastructure systems around them—roads, transit, water, sewer, electricity, the internet and so on—help them appreciate the importance of these systems in our lives and show the challenges ahead.

It ends with an optimistic view of the future. Renewable energy is cheap and getting much cheaper, Chachra writes. We know how to harness it. When we do, we will find surprising new uses for energy.

This is important to infrastructure, she goes on, because energy is involved in every form of infrastructure, from electric grids and transit systems to water and sewer lines. Her boldest message: When we make the transition to renewables, we'll find such an abundance of cheap energy, it will change how we think about things."Rather than focusing on *reducing* our energy usage—a scarcity mindset—we instead can focus on *increasing* the amount of energy that comes from renewable sources," she writes.

And those sources, she goes on, are both infinite and cheap. If you wanted to power every household in the world with the same amount of energy that households and industries in North America consume, you would need to produce 2.4×10^{21} joules of power per year, she calculates. (A joule is a unit of energy equivalent to the effort needed to create one watt of power for one second.) That, she continues, would be 10 times the amount of energy that is generated worldwide today.

How much radiant energy does the sun bath the Earth in today? It's 5.5×10^{24} joules each year, Chachra says. This is less than one-tenth of one percent of what we could ever conceivably use. And this counts only solar energy and not other renewables like wind, water and geothermal.

If it's possible to change our infrastructure systems and if these changes would result in a more stable climate AND much cheaper energy, why aren't we moving as fast as possible toward creating carbon-free infrastructure systems? Because, she says, there are major economic and political interests that will lose in this transition. It is in their interest to deny the need for change, cast doubt on its feasibility or say the fault for climate change lies elsewhere.

So, what would it take to rally the political, civic and social forces to take on these interests and make the transition? It would help if we could picture the scale of change that's ahead of us and the benefits it will bring. For that, Chachra suggests, you must begin by understanding how infrastructure systems work now and how these systems shape our lives. The first half of *How Infrastructure Works* is about these things.

It turns out, there's much to learn about infrastructure and especially the economics of infrastructure systems and networks. First is that, in general, these systems cost a great deal to build but little to operate (their "incremental costs"). That's partly by design—water and sewer systems operate, for instance, through gravity in most cities—and because of the longevity of pipes, roads, train tracks and bridges. And it's partly because of the economies of scale.

Second, once an infrastructure system is built, it costs relatively little to add connections. And the denser the locations, the cheaper the cost. The great expense in the early 20th century was building electric power stations and stringing power lines along streets. Adding service to a single-family house

was a minor expense by comparison. Adding connections in an apartment building that housed a dozen families was even less per household.

Third, infrastructure works on standards. It's how electric utilities share power across large distances. Or highways are built so you can drive from one state to another hardly noticing the difference. Or how global commerce operates today using containers that move from trucks to ships to rail and back again to trucks without the goods inside ever leaving their enclosures.

Fourth, public infrastructure is "nonexcludable" and "nonrivalrous." This means, Chachra explains, it is designed so anyone can use it at little cost. And as they use it, so can others. Drinking water is a good example. Anyone can have the water he needs for drinking, cooking or cleaning (as long as he pays his bill). And as he does, his neighbor can have the water she needs. One use does not preclude the other. If anything, it tends to bring down costs for everyone.

Finally, there are two basic types of infrastructure, Chachra says. What distinguishes them is their "directionality." Many of the things we associate with infrastructure—water and sewer systems, electric and natural gas utilities and cable TV—are one-way systems. That is, they flow from a central place to your workplace or home.

But some infrastructure—telephones, streets, transit, mail, the internet—connects people. For that reason, "connected" infrastructure tends to grow in value as the system adds users. If Atlanta's water system never added another customer, it would not change your use of water. But if MARTA added new rail stations and bus lines—connecting new places—the value of transit to you would increase greatly.

This explains the operations and economics of infrastructure, but why did we need all these expensive-to-build, inexpensive-to-operate systems in the first place? For "agency," Chachra says, a term that refers to an individual's ability to do more things or do them faster, cheaper and better. To show how this works, she takes us into her apartment as she prepares dinner and, one chore at a time, shows us how having electricity, water, trash pickup, sewer connections, internet service and music on a stereo saves time and expense and makes everyday life more enjoyable.

If understanding and appreciating infrastructure takes up the first half of *How Infrastructure Works*, the second half focuses on problems and opportunities—and a path forward.

The problems are substantial. Already mentioned are climate change's likely impact on existing infrastructure and the need to rapidly move toward renewal sources of energy. Both are important and urgent, she says. "It's like having an overflowing bathtub," Chachra writes. "Yes, you absolutely need to start mopping up the floor to keep the water from getting into the walls and creating permanent damage, but your first priority has to be turning off the faucet."

But even if we did not have an epic global crisis staring us in the face, our infrastructure needs attention, and it is not getting it. The American Society of Civil Engineers does a survey of U.S. infrastructure every few years, state by state. In its most recent survey, it gave the U.S. overall a C minus, which Chachra calls "downright dismal."

And dangerous, because infrastructure can fail, sometimes spectacularly. We've seen it in the Atlanta area, with sewer systems that polluted the Chattahoochee River for years and water systems whose leaks created giant sinkholes. We've seen interstate highways collapse in Atlanta and Philadelphia and a bridge fall into the Mississippi River in Minneapolis, killing 13 people and injuring 145.

The cause of these failures is the lack of inspection and maintenance, Chachra writes. When an interstate collapses or a bridge falls into a river, state governments spend hundreds of millions of dollars rebuilding it. And, she goes on, "there's a strong incentive for large contracting firms to bid on projects like these, and to pay lobbyists to help make sure they get funded and built. In contrast, the financial

benefits of routine inspection, maintenance and renewal are diffuse—anyone directly involved might make a steady salary, but no one is likely to make a windfall profit. That society bias toward making and novelty and away from caregiving and maintenance is reflected in who makes money and how."

How, then, do we build support for maintenance and repair as we create new forms of energy and harden new and existing systems? Chachra has some engineering advice: Make infrastructure resilient through redundancy, build for flexibility, be sure all are served and consider government or cooperative ownership of some privately owned systems.

About the Atlanta Urbanist Book Group

Our mission at the Atlanta Urbanist Book Group is to introduce new ideas to Urban Atlanta by reading recent books about cities, identifying the ideas we think would work in Atlanta, and offering civic leaders a guide to these ideas.

We define "urbanism" broadly. We are reading books about transportation, land use, housing, public safety, government reform, neighborhoods, social infrastructure, education, economic development, regionalism, diversity, politics, arts and culture, volunteerism, and more.

Our aim isn't to review books but to **show how their ideas apply to Atlanta today** and suggest ways of moving from good ideas to good actions.

You can learn more about the Atlanta Urbanist Book Group at atlantaurbanist.com.