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Guest on THE INFRA BLOG

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Conversation with Steve Anderson, Managing Director, InfrastructureUSA

Transitioning to Electric Transportation
Our most recent efforts have been to identify how the process of transitioning to 100% renewable energy will impact society. And we look not just at the problem of energy supply, how to build enough solar panels and wind turbines, but also at how we use energy and how easy or difficult it will be to transition to the food system, the transportation system, manufacturing, and so on, to using renewable energy. Of course, solar and wind are direct sources of electricity so we will need to electrify as much of our energy usage as we can. But that presents a lot of problems in all of these sectors. In transportation for example, it's relatively easy to transition our automotive fleet to electric cars. It will take some time obviously and there will be a cost involved, but it certainly can be done. We have lots of electric cars already on the market. When it comes to trucking and shipping, that's a bigger problem. Batteries, which are the heart of an electric vehicle, have low energy storage by weight. That means that batteries are pretty heavy in comparison with the amount of energy that they store and convey. So batteries work well in relatively small, light vehicles like electric bikes and electric cars, but they don't work so well in heavy trucks. They are not going to work as primary sources of motive energy in ships or in passenger aircraft—maybe aircraft that carry one or two passengers, yes, but certainly not ones that carry 100-300 people. So that poses some problems. Not insurmountable problems, in principle, but definitely some practical hurdles—because while cars carry people, about 99.9% of the weight carried by transport means is stuff rather than people. All of the raw materials, manufactured goods and so on that we move go primarily by truck and ship. And if those are difficult to transition, well that's something that we need to give our attention to.

Highway Materials: Need for Innovation
Also the building of highways, which is a big part of infrastructure, is currently dependent on two materials that are problematic: one is concrete, and the other is asphalt. Asphalt, of course, is made directly from fossil fuels, namely low-grade oil. And concrete, its key ingredient is cement, which is produced at very high temperatures—about 1500 degrees Celsius—in giant kilns that are fired with fossil fuels—usually coal, sometimes natural gas. Now in principal it would be possible to make cement using renewable fuels or even using electricity or possibly even concentrated sunlight. But it's not done that way currently. We don't have any pilot projects, and the reason we don't is that it's likely to be a lot more expensive to produce cement using these alternative pathways as opposed to burning fossil fuels directly. So without concrete and asphalt, our future infrastructure is going to look very different from how it looks today.

Future-Minded Infra Investment
I think it's important when talking about infrastructure investments, at this point, to be thinking about what kinds of infrastructure actually make sense in the future. So much of our current infrastructure is reaching the end of its useful life and is needing updating or replacement, and that ranges all the way from bridges to natural gas pipelines and water pipes. So the question is what do we replace that with. If we're just imagining updating our infrastructure by replacing it with more of the same, then I think we're locking ourselves into investments that really don't have much of a future. We're going to have to think about what infrastructure makes sense in a future society that's largely powered by renewable energy sources that may be less mobile, and that we'll be using resources probably much more efficiently, and then invest accordingly.

Dropping Fossil Fuels: The Easy Way or the Hard Way
We are at the early stages of an energy transition. And it's hard in these early stages to imagine where we're going. Nevertheless it's pretty clear that our current energy regime doesn't have much of a future. Fossil fuels, which provide 85% of our current energy, suffer from two fatal drawbacks. One of which is the fact that they produce greenhouse gasses that are undermining the viability of our climate and therefore our future of industrial society. I mean, if you look at the likely consequences of climate change or sea level rise or food production for average temperatures for extreme weather events, it looks pretty catastrophic. The other drawback of fossil fuels is that fact that these are depleting, non-renewable resources. So even if we don't care about climate change, even if we don't believe in climate change, the fact remains that we're using energy sources that are finite and that we are harvesting according to a “low-hanging fruit” principal. So in the last 150 years we've extracted an enormous amount of oil from the Earth's crust. And we've gotten the easiest and best first, which means that even though a lot of oil remains to be extracted, most of what remains is at lower quality, will require far more investment capital per unit of production, and will entail higher environmental risks and costs. So one way or another we will be moving away from fossil fuels as time goes on, it's just a question of whether we do it in a planned and organized way, or just wait until we can no longer afford to extract the stuff that's left.

Bringing Renewables to the Grid
There's increasing experience with integrating higher levels of renewable energy into grid systems. This higher level of experience is taking place in European countries, in US States that have relatively high levels of renewable penetration, including California. But there are still challenges remaining. Because solar and wind are intermittent, we're going to have to have some combination of energy storage, capacity redundancy, and demand management to handle that intermittency. And we have yet to discover for each application and for each location what will be the optimum levels of storage, redundancy, and demand management to deploy. We concluded, my co-Author David Fridley and I, that it's likely that our biggest challenge in the transition will be the problem of scale. It's relatively easy to produce renewable energy at smaller scale and to integrate it into existing electrical grids. As the scale increases, that's when the problems arise. If our total energy demand were considerably smaller than it is now, then we could supplement intermittent sources like electricity, like solar and wind with

other renewable energy sources like micro hydro, geothermal, tidal, and so on to a much greater degree and balance out that intermittency relatively easily. The problem is that those alternative sources, geothermal, biomass and so on are not so scalable. That's why when most energy experts talk about the future of renewables they concentrate on solar and wind because those are scalable. But even though they're scalable they bring along these other problems associated with intermittency. So again if we could reduce the scale of our energy demand then that would reduce the scale of the challenges.

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