

100% RENEWABLE VISION BUILDING: TREND TOWARD NEW TARGETS OF 100% RENEWABLE ELECTRICITY—AND HIGHER

Increasingly countries and regions are leapfrogging timid renewable targets and moving aggressively toward full 100% integration of renewables into the electricity supply. Some advocates are moving even further, suggesting 150%, even 300%, renewable electricity generation to meet not only electricity supply but also heat and transport.

How times have changed.

When I began my career three decades ago, our demands were modest if not meek. We could hardly imagine wind supplying more than 10% of electricity consumption. Then the California wind rush arrived in the early 1980s, and we realized that wind energy had indeed come of age as a commercial generating technology.

Our expectations increased accordingly. Wind penetration of 20% then began to seem a reasonable objective. But we stumbled badly here in the United States post California. Meanwhile, the Danes continued to erect ever more wind turbines throughout the 1990s. Soon Denmark was closing on 20% of supply from wind energy alone and it became apparent—again—that our targets were too modest.

Even then I remember writing that we were not suggesting that renewables would completely replace fossil fuels. No, I said, we'd always need fossil fuels for some portion of supply. Wind—and solar too—would just be parts of the resource mix, maybe a big part, but still just a part.

"Facts on the ground," as they say, were changing faster than my thinking of what was possible. Renewables were capable of growing much faster than any of us had ever anticipated. Reality was overtaking our imaginations.

In 2014 wind turbines generated 40% of Danish electricity. But of course that's not all. The Danes didn't stop with just wind. They've also been building hundreds of biogas digesters and waste-to-energy plants as well. Together, wind and biomass provide more than 50% of the electricity consumed by Denmark's nearly six million inhabitants.

All of this was accomplished with policies implemented before the climate crisis was fully felt—and well before Fukushima.

In retrospect, none of this should be surprising. After all, Norway has generated 97% of its electricity with hydro for decades, and tiny Iceland already generates 100% of its electricity with a mix of hydro and geothermal sources.

What is different is the realization that the rapid growth of new renewables can cut through the Gordian knot of what to do about fossil fuels in transportation and heating.

This was brought home to me when I listened to presentations by two longtime renewable energy pioneers, Preben Maegaard from Denmark and Johannes Lackmann from Germany. Independent of each other, both had come to the same conclusion. To address both climate change and energy security, we must move well beyond 100% renewable energy in electricity supply and build an integrated network capable of using more than 150% renewable energy, up to as much as 300% renewable energy to offset fossil fuels in transportation, and heating.

This is the kind of bold, visionary thinking that is now being debated. As more countries and regions adopt what was once unthinkable—100% renewable energy targets in electricity supply—others are asking questions about what it will take to go even further.

The most famous example of an ambitious target is Denmark. In the spring of 2012, the Danish energy minister and then holder of the EU presidency, Martin Lidegaard, issued the country's 100% Renewable Energy Declaration. Denmark proposes to meet 50% of its electricity supply with wind energy and 35% of its total energy consumption with all renewables by 2020. That's not all. The Danes plan to produce 100% of their electricity and heat with renewables by 2035 and 100% of the energy used in transport by 2050. "I think it's doable, I think it's necessary, and I think it's good for the economy," said Lidegaard in the declaration.

Closer to home, dissatisfaction with the typically timid targets found in state renewable portfolio standards has led new players in the renewable arena to challenge the traditional incremental approach. They argue that the times demand more aggressive action—and targets that are ambitious enough to elicit the dreams and hopes of North Americans with the policies to match them.

Some communities, such as Greensburg, Kansas, are taking matters into their own hands. After a tornado leveled the city in 2007, the community decided to do things differently when they rebuilt. One of their objectives was to rebuild with 100% renewable energy and most of that will be from wind.

Consequently, imagining what it would take to generate 75% of the US electricity supply with wind energy and another 25% for offsetting fossil fuels in transportation, in this chapter's example, is not as avant-garde as it seems. It's now respectably mainstream.

The budding movement toward 100% renewable energy could be just what's needed to reawaken North America's lagging can-do spirit.

supply to account for replacing fossil-fueled light vehicles with EVs.

Of course, we won't just use wind energy. We'll use other renewables as well. As energy analyst Toby Couture says, "It's all hands on deck." We'll need them all. Wind will be the workhorse, picking up about 60% of the load; solar and the other renewables will supply the remainder. This will cut the land area required for wind energy by about half. And we can cut the land area required by half again if we cut our consumption by 50%.

Sharing the load with other renewables and

reducing the amount of generation required makes moving the United States toward 100% renewable electricity far more manageable. It also reduces the amount of land needed for wind energy to slightly more than 2% of the lower 48 states. This is in line with studies in Germany that meeting 80% of their electricity supply there will require about 2% of their land area.

As mentioned in Chapter 15 on siting, Germany's Environment Agency (Umweltbundesamt) reported on a 2013 study of the country's wind energy potential on land. They found that nearly