Four Minutes for $150 million -

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…**Four Minutes for $150 million**…

South Australia installed battery storage supplied by Musk for an estimated cost of $150 million.

With a rating of 100MW/129MW, the storage can, on the face of it, provide 100 MW for approximately 1hour 18 minutes. However, the battery is partitioned into a 70 MW and 30 MW section where each provides different services, such as frequency control or storage.

Another person observed that the South Australia 100 MW/129 MW battery could provide South Australia's electricity needs for four minutes. Whether precisely accurate or not, this estimate demonstrates the futility of believing renewables, i.e., wind and solar, can supply 100% of the world's electricity.

It's not that storage is useless, it's not, because it can provide power for short periods of time and also provide auxiliary services such as frequency control.

What it does highlight is that it is futile to think that storage will allow wind and solar to replace fossil fuels for generating electricity.

It not only cannot replace fossil fuels, the costs are astronomical for even attempting to replace a large percentage of fossil fuel generated electricity.

The purpose of this article is not to provide precise cost estimates, but to illustrate in simple terms how much it is likely to cost if the world were to try to eliminate fossil fuels and rely entirely on wind and solar for generating electricity.

This article is an overview of the steps required to attempt to achieve a grid that's supplied 100% by wind and solar together with a look at the cost of doing so.

The current cost of Li-Ion battery storage is around $200 / kWh. This is based on the cost of Li-ion batteries used in battery-powered vehicles, such as the Bolt or Tesla. Assuming the cost can be cut in half, the cost of storage using Li-ion batteries would be $100 /kWh.

The United States consumes 3,911 billion kilowatt-hours annually or an average of 11 billion per day.

The cost of storage to supply this amount of electricity for one day, when no other source was available, would be $1.1 trillion, or $2.2 trillion at the current cost of Li-ion batteries.

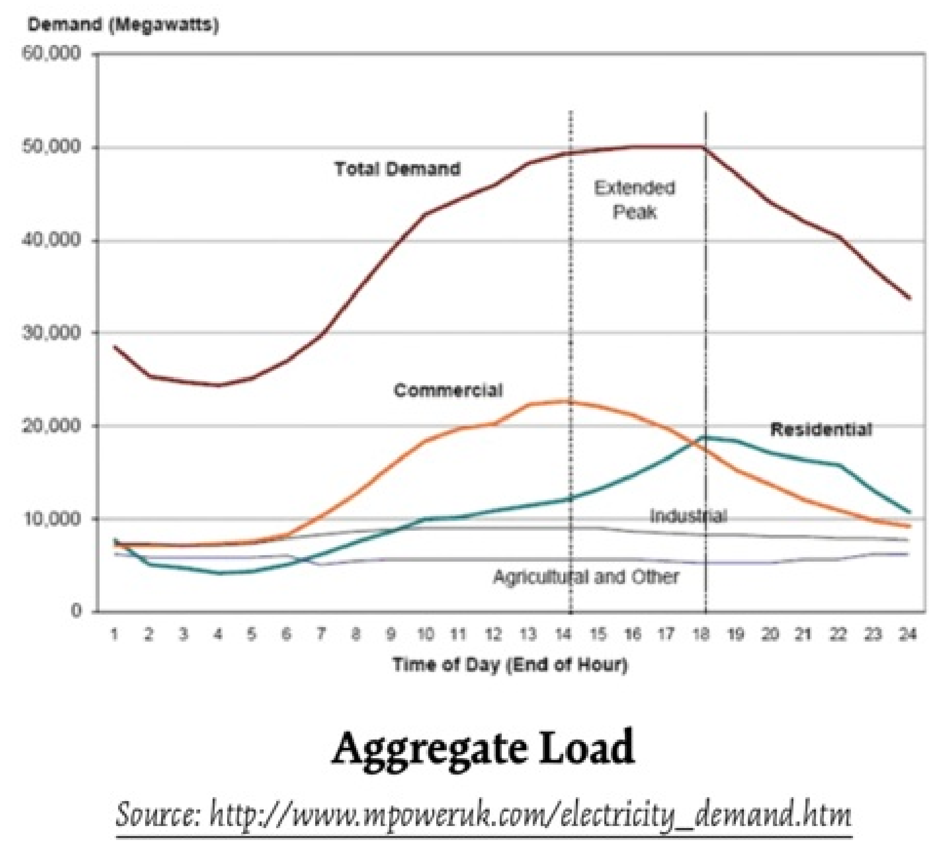
(The usage and storage would be spread across the country and the lack of sun and wind for generating electricity would likely be restricted to regions so the entire country wouldn't be affected simultaneously, but, all regions would have to make the necessary investment in anticipation of cloudy and windless days.)

To ensure the availability of electricity, there would have to be enough storage to provide electricity for several days when solar and wind power were not available, such as for cloudy and windless days. Is it credible there could be an entire week without sun or wind, such as during the winter?

Yes, so more than a week's supply of electricity would have to be stored to try to ensure reliability. For purposes of this exercise, we will assume that ten days of storage would guarantee availability of electricity, in which case the cost would be $11 trillion.

This is based on average demand, but daily demand peaks above the average with the daily peak typically higher in the summer than winter. **As a result, storage costs will be substantially higher than $11 trillion to meet peak demand, or approximately $18 trillion.**

The cost of storage would be six times California's GDP of 2.7 trillion, which is the fifth largest economy in the world … Repeated every ten years, the life of the batteries.



Graph shows demand curve where the average is around 29,000 MW and peak demand, including a margin for unexpected events, is around 58,000 MW

But this is only part of the story since there would need to be a surplus of solar and wind generating capacity for recharging the batteries after they have been depleted.

The amount of additional investment in wind and solar generating capacity would depend on an evaluation of whether it's possible for there to be another period of cloudy and windless weather immediately following a ten-day period where electricity couldn't be generated.

It's conceivable that it would be necessary to double the capacity of installed generation to ensure the ability to recharge all the storage batteries.

It would cost $4,940 billion, using the following assumptions, to double the installed generation capacity in the United States.

- Total installed non-wind or solar capacity is currently approximately 988 GW
- Capacity Factor used for estimating required new wind and solar generation to replace 988 GW

of power generation from other sources was a conservative 20%. This assumes a roughly even amount of solar and wind capacity. While solar can be fairly predictable, it's impossible to predict when the wind will blow so there will probably be greater reliance on solar resulting in a larger investment.

- Cost of new capacity at $1,000 per KW. (Typical for solar, but only two-thirds the cost of wind.)

Depending on assumptions about risk and reliability, it's possible only 30% additional capacity would be required, which would bring the cost of increasing generation capacity down to $1,480 billion.

Therefore, the total cost for storage and new capacity would be nearly $19 trillion. This is three times the total U.S. federal, state and local revenue in 2017 of $6.08 trillion.

It is also nearly equal to the US National Debt of $19.9 trillion.

The above costs are merely for the United States.

Worldwide electricity consumption is about five time that of the United States, i.e., 21,153 GWh compared with 3,911 GWh for the United States.

Worldwide costs for relying solely on wind and solar would, therefore, be about 5.3 times U.S. costs.

Logic Summary

To ensure reliability where blackouts are very rare, the following steps are required:

- Install sufficient battery storage to meet peak demand for the entire area covered by a grid. The storage must be large enough to supply electricity for an extended period of time when demand can't be met by solar and wind power generation.
- Install enough new solar and wind power generation in excess of daily needs to fully recharge storage batteries.
- Provide sufficient storage for ancillary services such as frequency control.

Conclusion

Several costs have been omitted from the above estimates. For example, there is the cost of building additional transmission.

It does not include any increase in electricity consumption which could result from supplying electricity to people who currently don't have an adequate supply of electricity, such as those in undeveloped countries, or for using battery-powered vehicles.

Assumptions about the amount of storage required and the amount of additional capacity needed to recharge batteries are crucial for determining an acceptable level of reliability for the United States.

The above estimates are conservative and the actual costs to ensure required reliability are probably higher.

Another person, Roger Andrews, did a more technically based calculation for Germany and other specific situations and his article can help focus more sharply on why wind and solar can't replace fossil fuels for generating electricity. See, http://bit.ly/2EXWYcI

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