# COMMENTARY 20170218

## Peak Electricity Demand

February 18, 2017

***Researchers from Michigan, Berkeley and Stanford estimate that peak electricity demand will rise 7 per cent by the turn of the century despite substantial emissions reductions, and 18 per cent if emissions continue to rise, even without economic growth and population increases. Peak demand matters because, unless storage technology improves, we can only guarantee supply with non-renewable energy sources, namely gas and coal.***

---

Research by the National Academy of Sciences provides new evidence on the impact that climate change will have on peak electricity demand.[1] Researchers from The University of Michigan[2], UC Berkeley and Stanford University estimated the impact on peak daily demand by the end of the century under two climate change scenarios – a modest change from pre-industrial levels and a substantial change. The modest change scenario roughly corresponds to the climate we will observe if average temperature increases of around 2 degrees Celsius relative to pre-industrial levels are achieved. This is the target of the Paris Agreement, signed by the United States last year. That will require large emissions reductions from current levels. The substantial change scenario roughly corresponds to the climate we will observe if emissions continue to rise. It is a business as usual case.

The researchers focus on peak electricity demand because infrastructure needs to cater to peak demand rather than average demand. As the increased frequency of hot days increases – that is, temperatures above 70 degrees Fahrenheit – and as the hottest point on those days rises, the more generation and transmission infrastructure is required. This is not offset by the reduction in investment needed to cater for cold days, because electricity demand does not respond in the same way to lower versus high temperatures.

The researchers estimate that, under the modest climate change scenario, there is a an average 7 per cent increase in the 95th percentile of the daily peak load. The daily peak load is the hour of the day with the highest electricity consumption. This means that, if we examine the hour of each day with the highest

---

[1] Maximilian, A., P. Baylis, and C.H. Hausman, 2016, "Climate change is projected to have severe impacts on the frequency and intensity of peak electricity demand across the United States," Proceedings of the National Academy of Sciences, approved for publication on December 23, 2016. http://www.pnas.org/content/early/2017/01/31/1613193114

[2] For comments directly from Professor Hausman at UM, see http://record.umich.edu/articles/electricity-costs-likely-surge-new-ways-warming-world

demand, and take the top 5 per cent of those hours, there is an additional 7 per cent electricity consumed. In contrast, average electricity consumption across all hours would increase by just 3 per cent.

The researchers' estimates of increased demand do not account for changes in technology, such as improved energy storage. They also do not account for consumer response to prices set according to demand. But in the absence of technological change or a demand response to rising prices, the analysis implies that investment of $70 billion would be required just to cater to the increased number of very warm days under a modest climate change scenario. This is based upon the researchers' rule of thumb that every 1 per cent increase in average peak demand at the 95th percentile corresponds to $10 billion of investment. Under the more extreme climate change scenario – in which we do not have reductions in emissions – the researchers project an 18 per cent average increase in the 95th percentile of the peak daily load. This would require $180 billion of investment.

The relevance for Michigan is less extreme, given that the largest impacts occur in the warmer states to the south and west. For Michigan, average peak demand at the 95th percentile is projected to rise from 1 per cent to 5 per cent depending upon the region within the state, compared to 7 per cent nationally. This means that Michigan would require $1 billion to $2 billion of additional investment, out of the nationwide figure of $70 billion.

The research has an important policy implication. Policy makers are attempting to decide what the appropriate level of emissions should be and what is the most economically efficient means to achieve that end result. In answering these questions we cannot assume that increased generation from renewable energy directly leads to lower investment in generation and transmission from non-renewable sources. The grid needs to cater to peak demand and unless storage technology improves, we cannot assume that wind and solar energy will satisfy peak demand. We will have the same investment in non-renewable electricity supply in order to guarantee supply on the hottest days. This will affect the mix of gas versus renewable energy supply that is most economically efficient to achieve a given emissions target.