Kentucky's Clean Energy Successes, Opportunities, and Challenges

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March 21, 2022 at the University of Kentucky

LG&E KU
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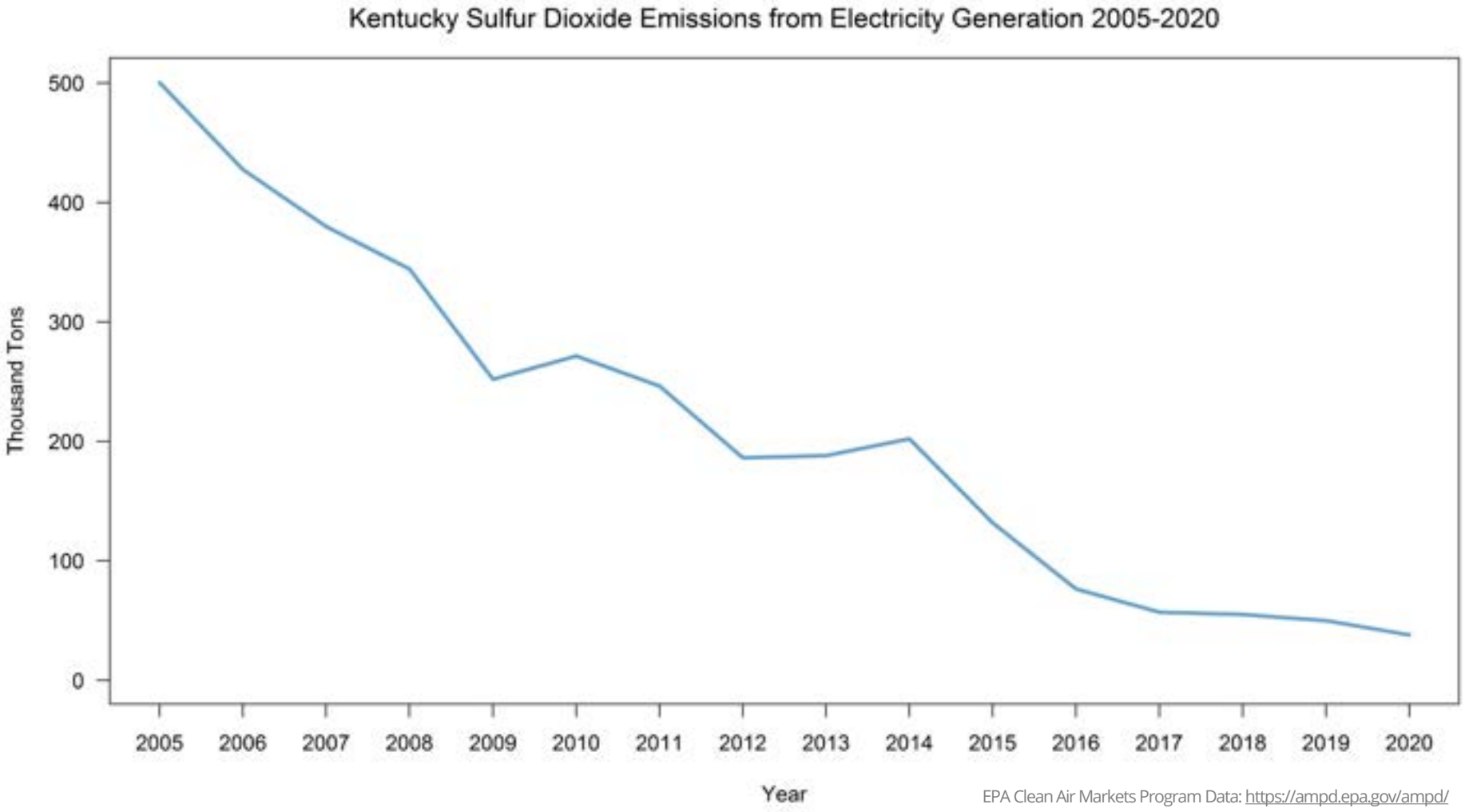
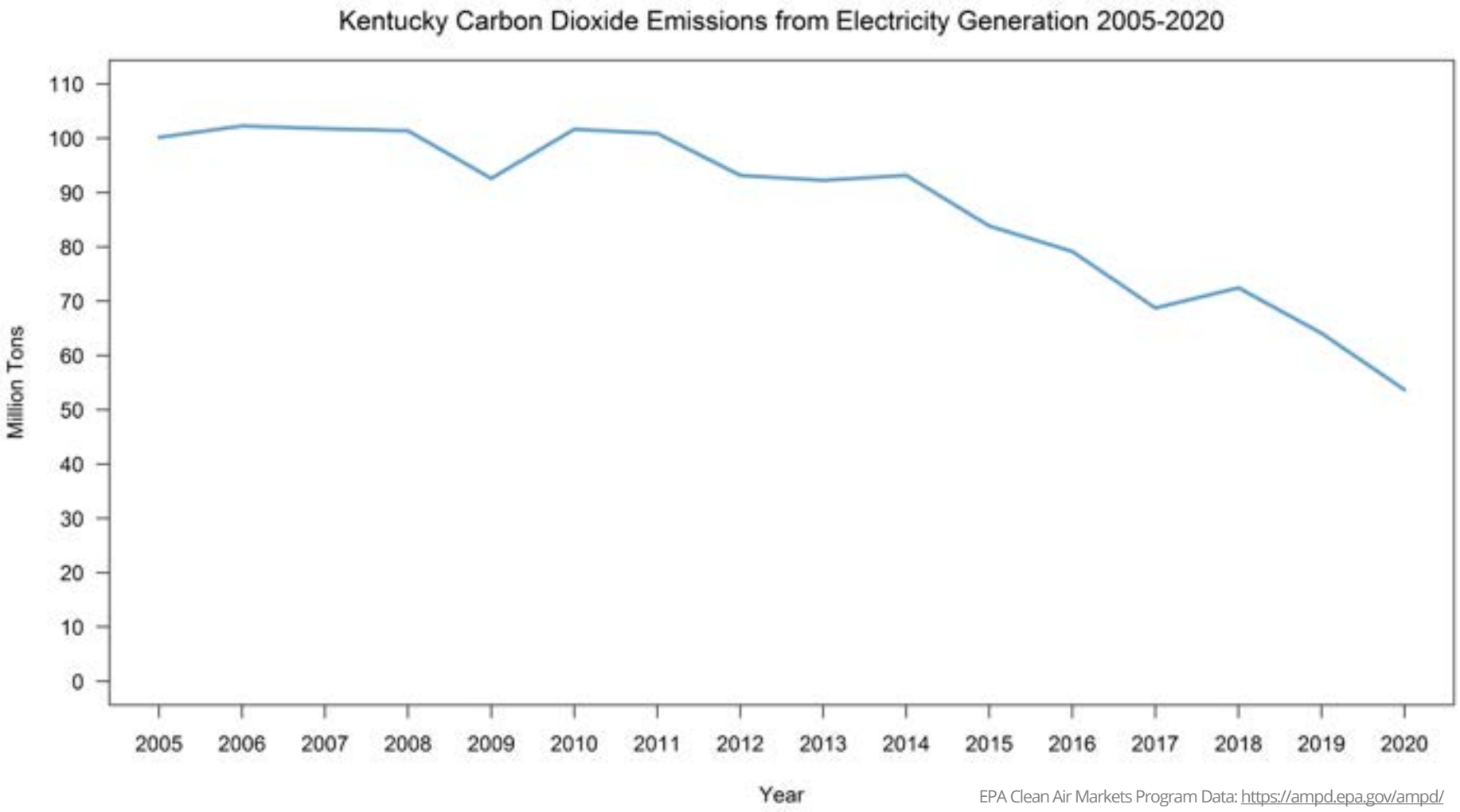
Kentucky's Clean Energy Successes

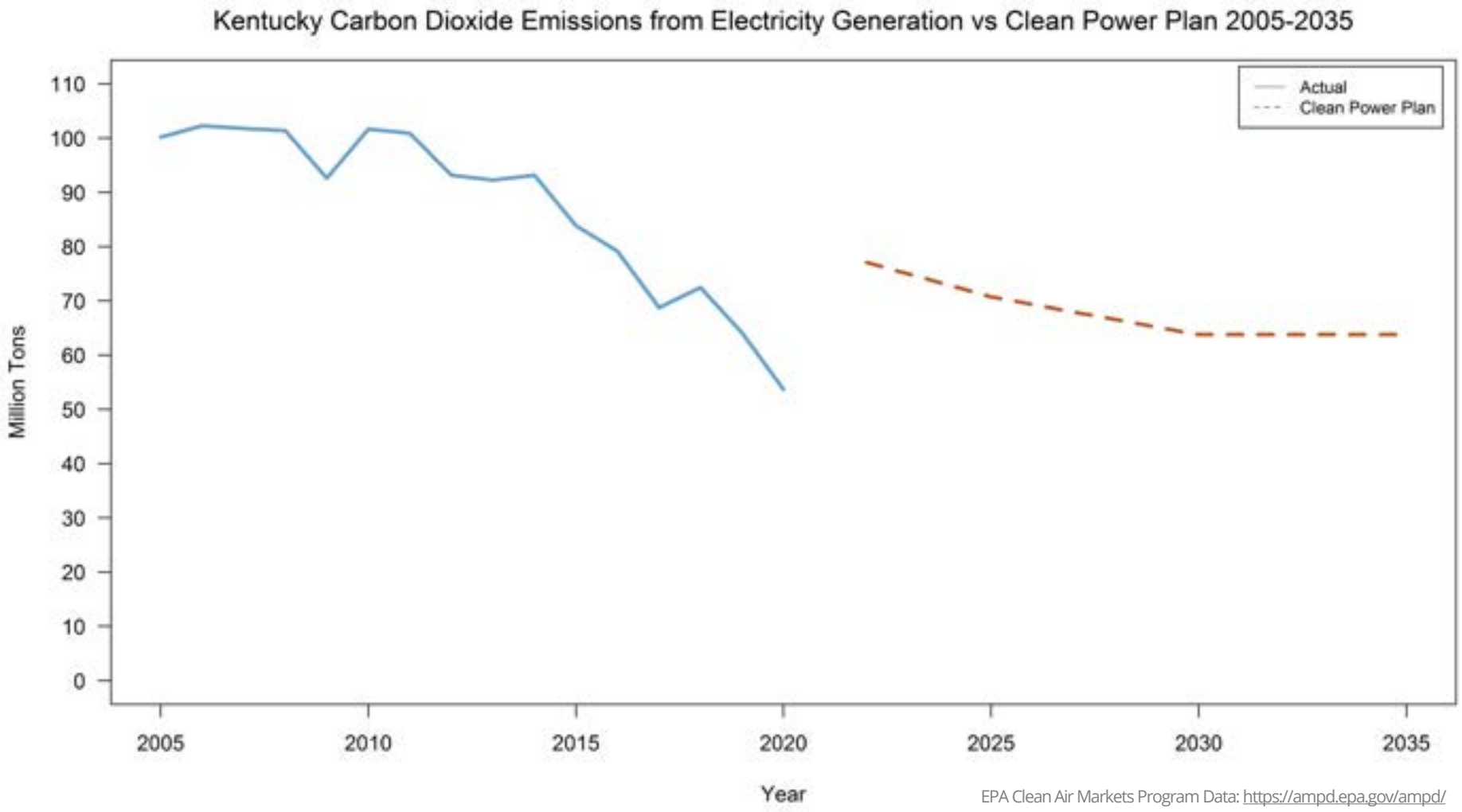
Sulfur dioxide emissions from electricity generation in Kentucky have decreased by 92% since 2005.



Carbon dioxide emissions in Kentucky have decreased by 46% since 2005.



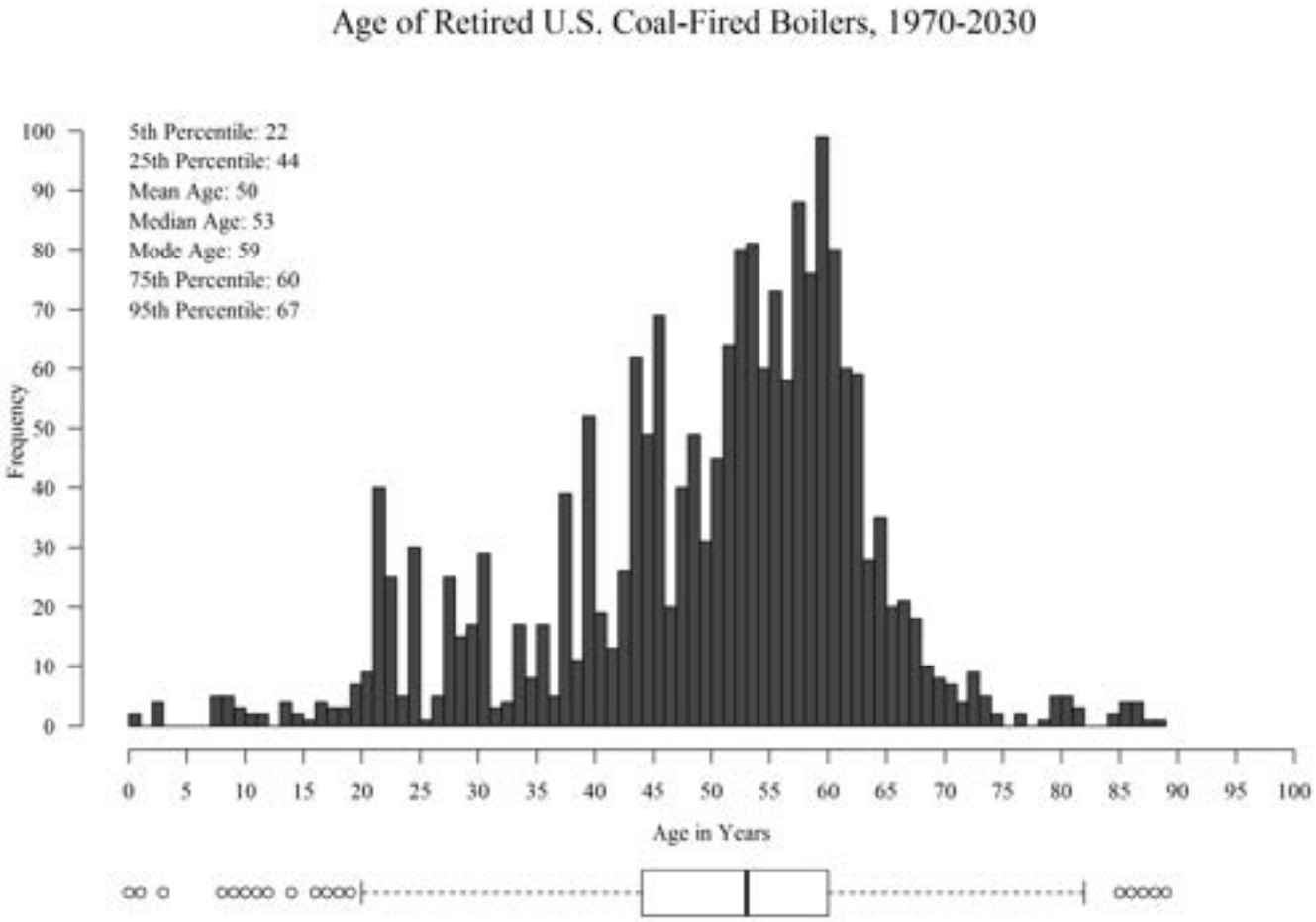
Kentucky has achieved Clean Power Plan targets more than 10 years ahead of schedule.



EPA Clean Air Markets Program Data: https://ampd.epa.gov/ampd/

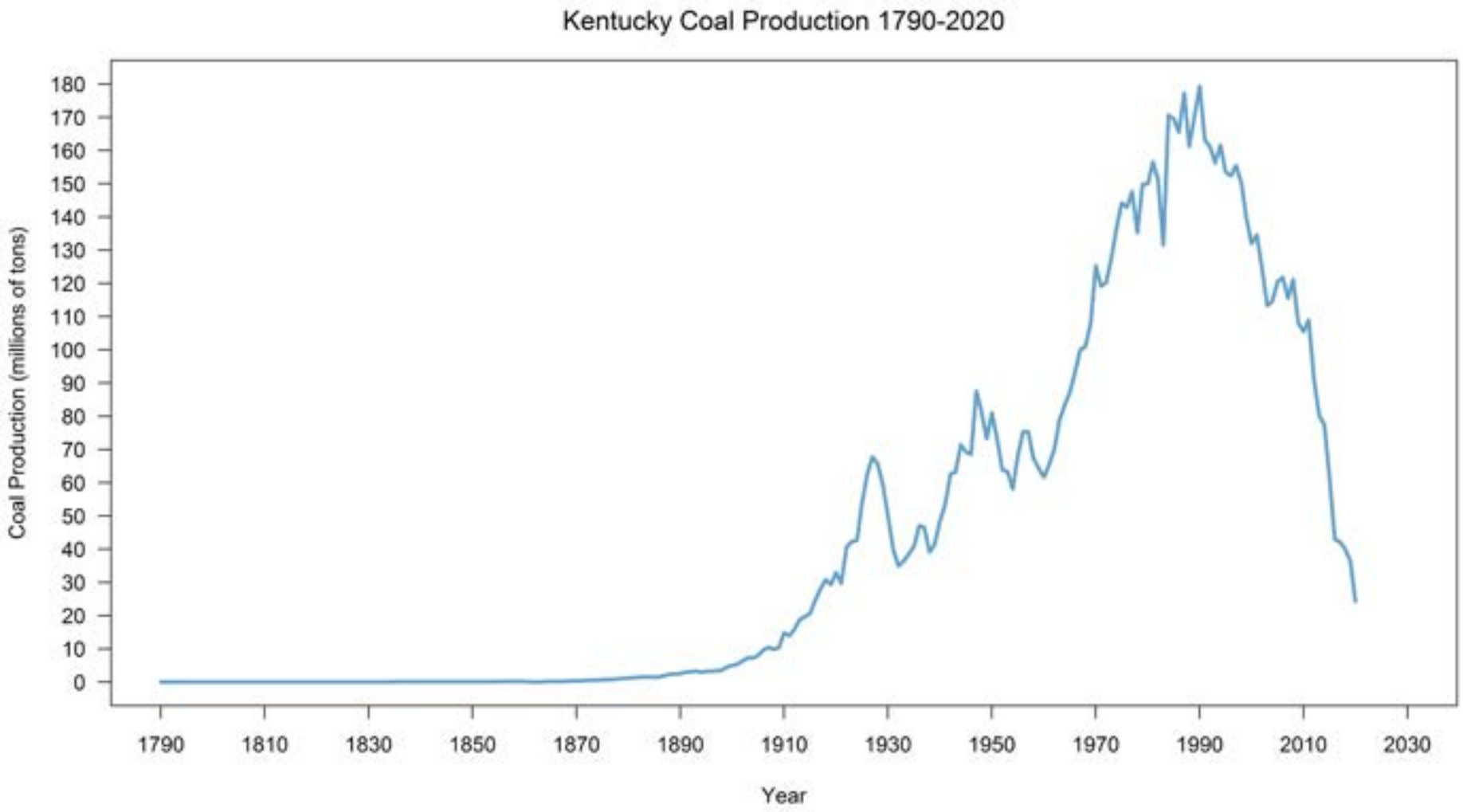
EPA Clean Power Plan Targets for Kentucky: https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/kentucky.pdf

The average age of coal capacity in Kentucky is 47 years old.
Coal plants usually last 50 to 60 years.
No coal plant built after 2010.



LG&E and KU 2018 IRP: https://psc.ky.gov/pscecf/2018-00348/rick.lovekamp%40lge-ku.com/10192018102925/5-LGE_KU_2018_IRP-Volume_III.pdf#page=71

Kentucky coal production in 2020 has decreased 87% percent since peaking in 1990.



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Kentucky Coal Facts: https://eec.ky.gov/Energy/News-Publications/Pages/Coal-Facts.aspx

Kentucky's Largest Solar Farm

https://lge-ku.com/live-solar-generation

Kentucky's Largest Solar Farm Built in 2016

- Proposed by LG&E and KU in 2013
- State approved in 2014
- Construction Finished in 2016
- Kentucky's first utility-scale solar site
- Kentucky's largest solar site to date
- 50 acres at the LG&E-KU E.W. Brown
- 44,500 315 W DC fixed-tilt solar panels
- Combined DC output of 14 MW DC
- 10 DC to AC Inverters
- Total combined output of 10.24 MW AC

Kentucky's Largest Solar Farm Built in 2016

Kentucky's Largest Solar Farm Built in 2016

Kentucky's Largest Battery

https://lge-ku.com/research

Kentucky's Largest Battery Built in 2016

- 1 Megawatt
- 2 Megawatt-hours
- Three testing bays
- Modular construction

- 1.2 MVA resistive, inductive, capacitive (RLC) load bank
- Grid-connected or islanded (micro-grid).
- High accuracy metering and data logging

Open Rack of Battery Modules inside Container 1

4,760 Cells

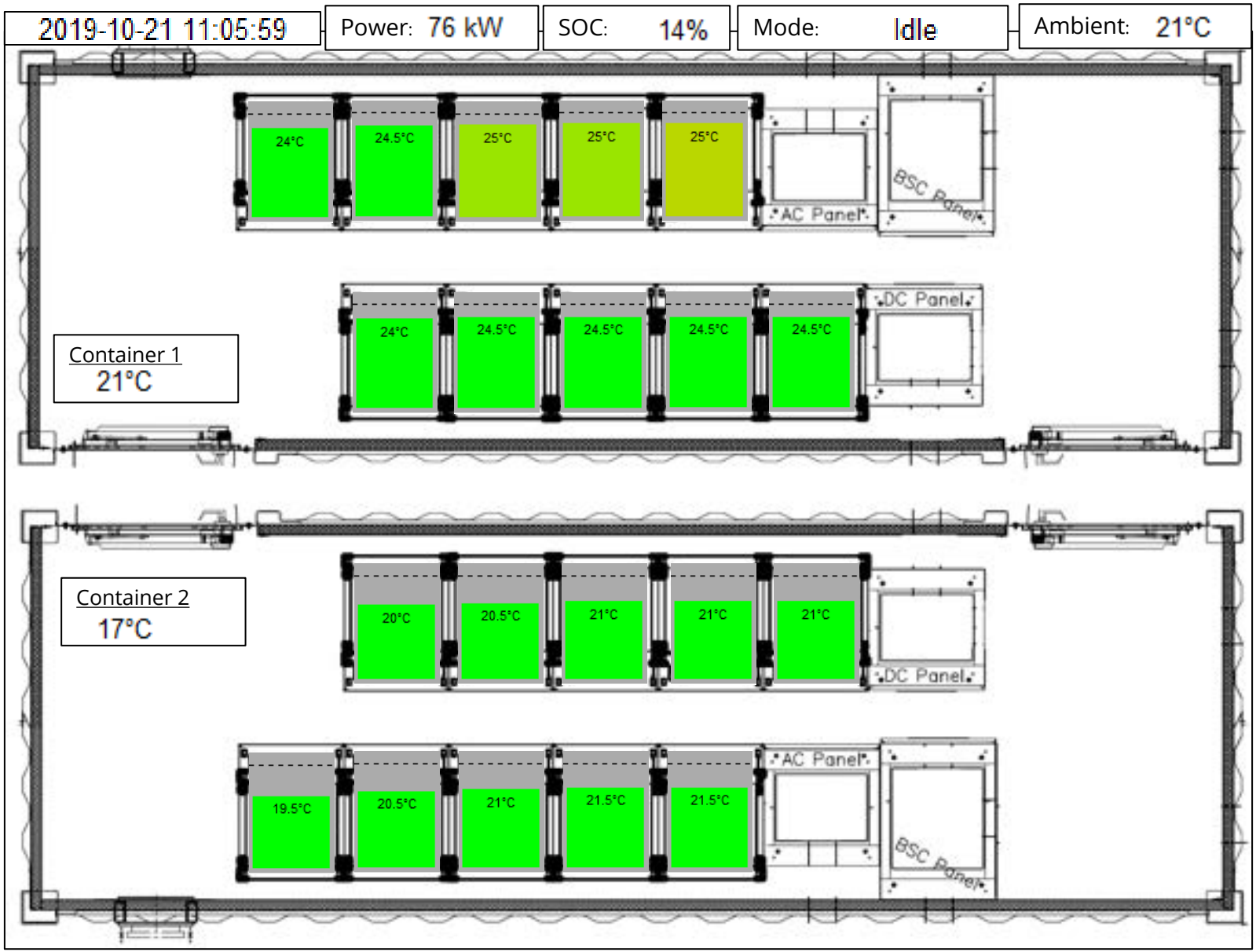
14 Cells per Module

17 Modules per Rack

10 Racks per Container

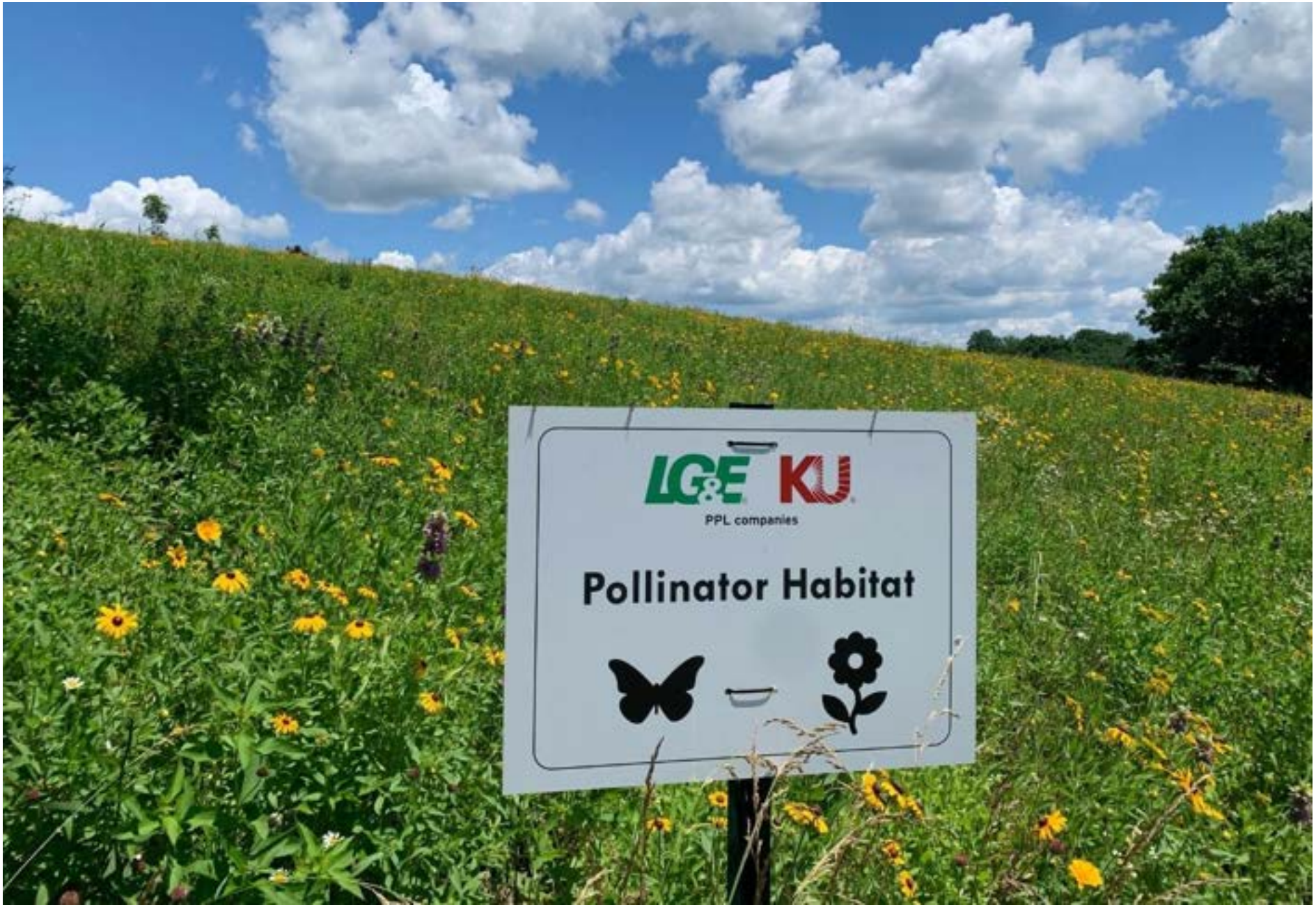
2 Containers

Battery Module Temperature



Solar Pollinator Habitats

http://lge-ku.com/research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Pollinator Habitat

Pollinator Habit Work Began in 2019 with RoundStone

Solar Sheep

https://lge-ku.com/sheep


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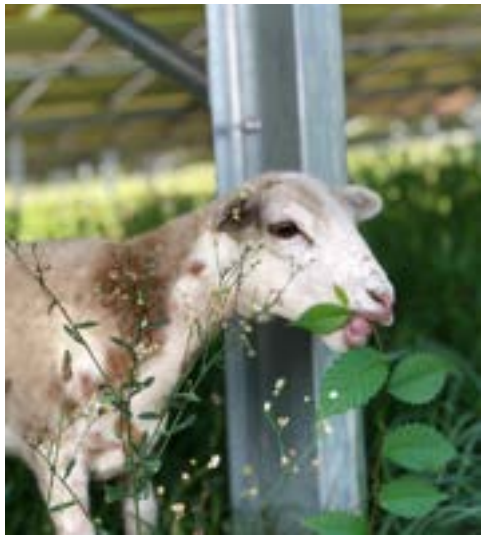
Solar Sheep Habitat
Caution: Electric Fence

We “hired” 35 sheep to graze our largest solar farm in 2020.



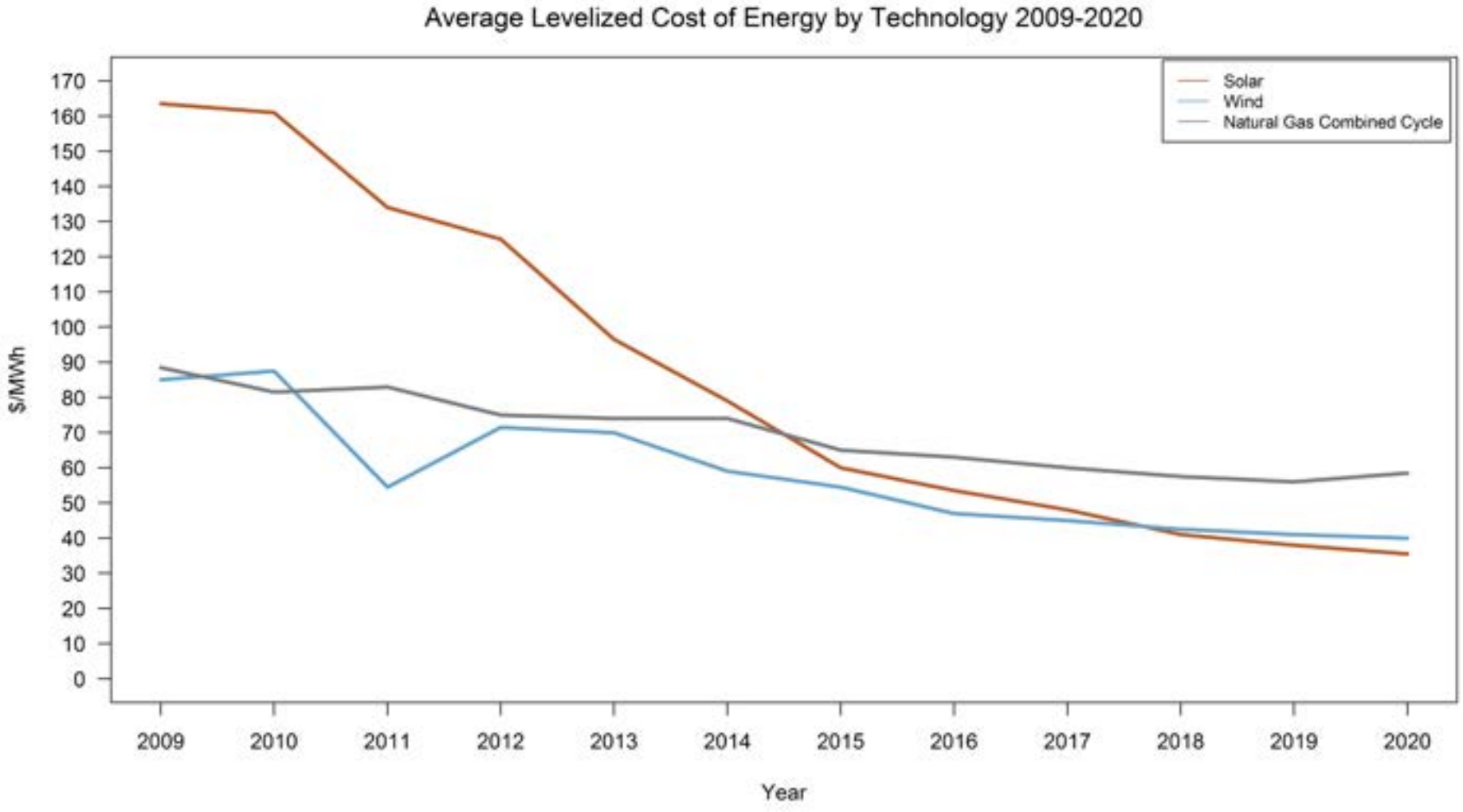
Sheep at Kentucky's Largest Solar Farm

Watch Our Sheep Live at: https://lge-ku.com/sheep

Video Overview

Kentucky's Clean Energy Opportunities

Average levelized cost of wind and solar have decreased since 2009.



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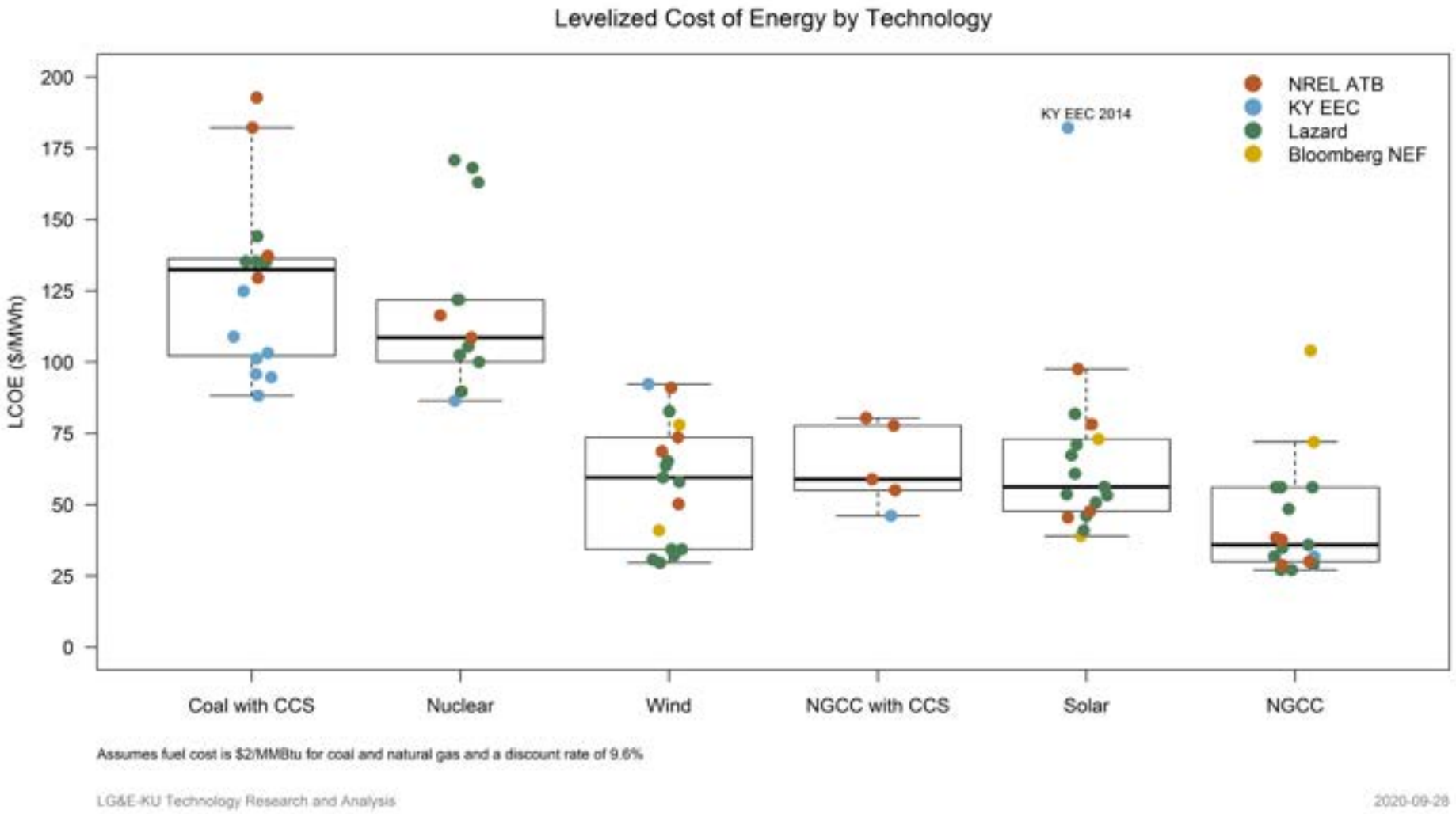
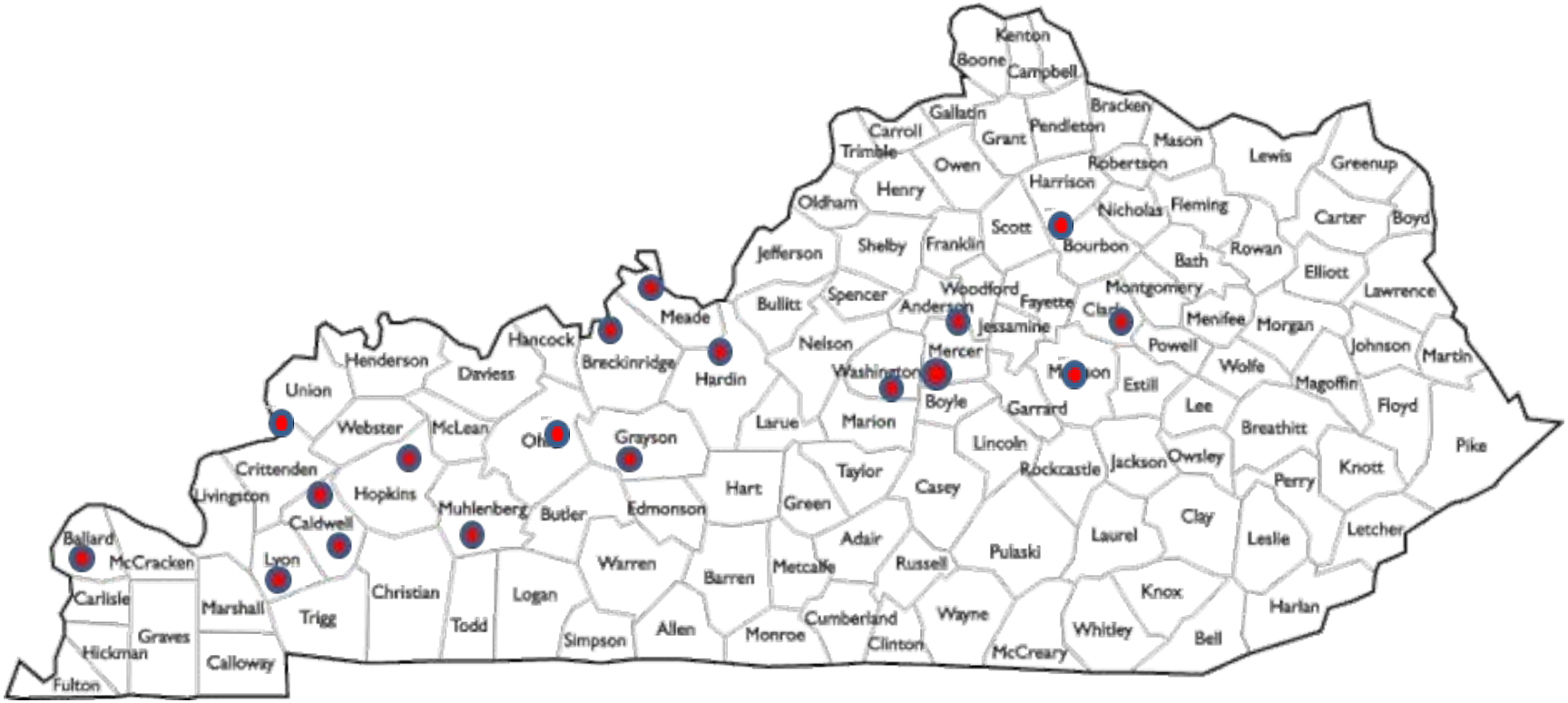
Lazard: https://www.lazard.com/media/451419/lazards-levelized-cost-of-energy-version-140.pdf

Natural gas, wind, and solar are cost competitive. Carbon capture and other technologies are not.



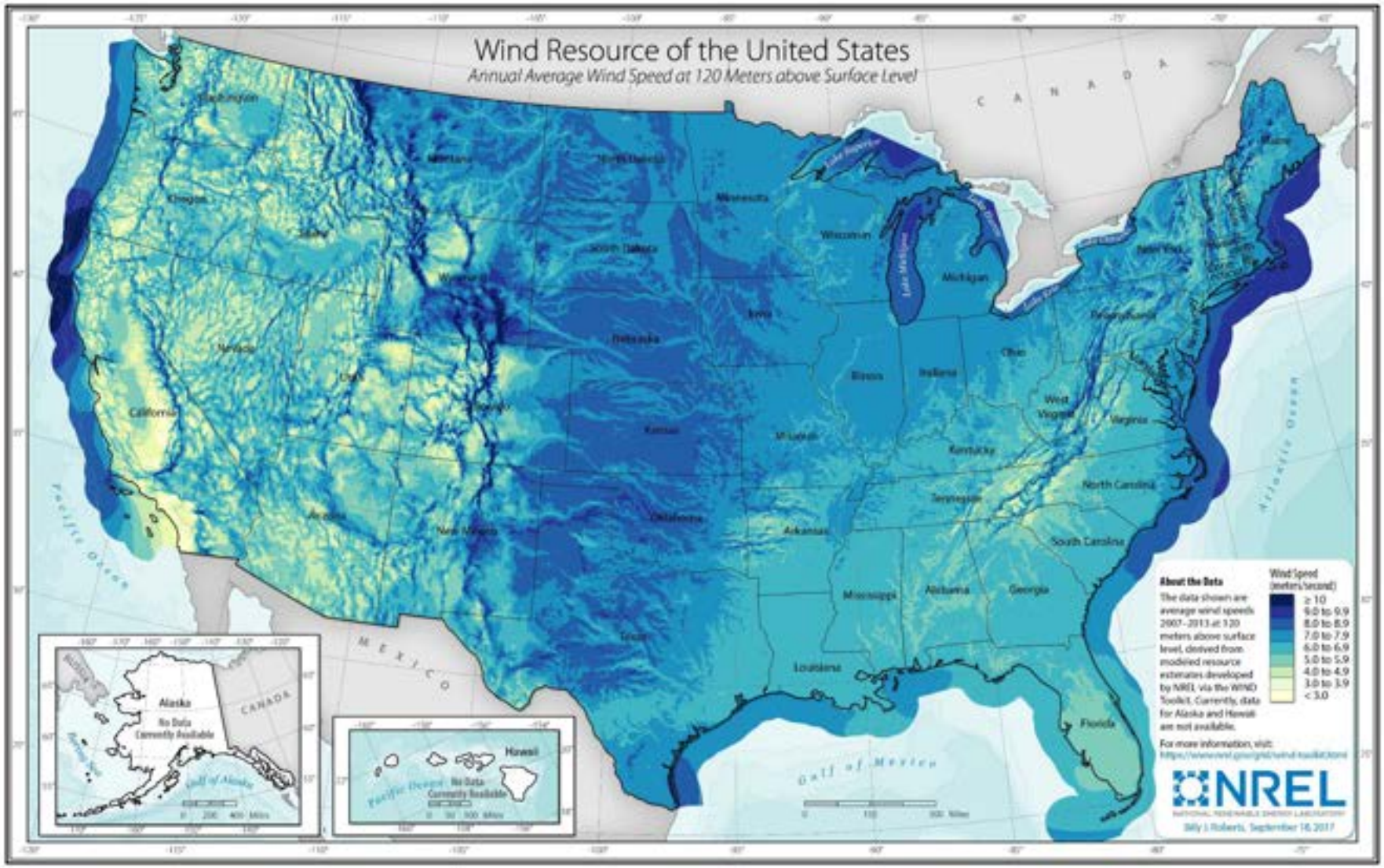
20 Future Solar Projects Proposed Across Kentucky



- Total of 20 proposed solar projects totaling 2 gigawatts of capacity
- Average project size is 100 megawatts
- Project sizes range from 9 to 200 megawatts.
- Projects are proposed in 16 counties

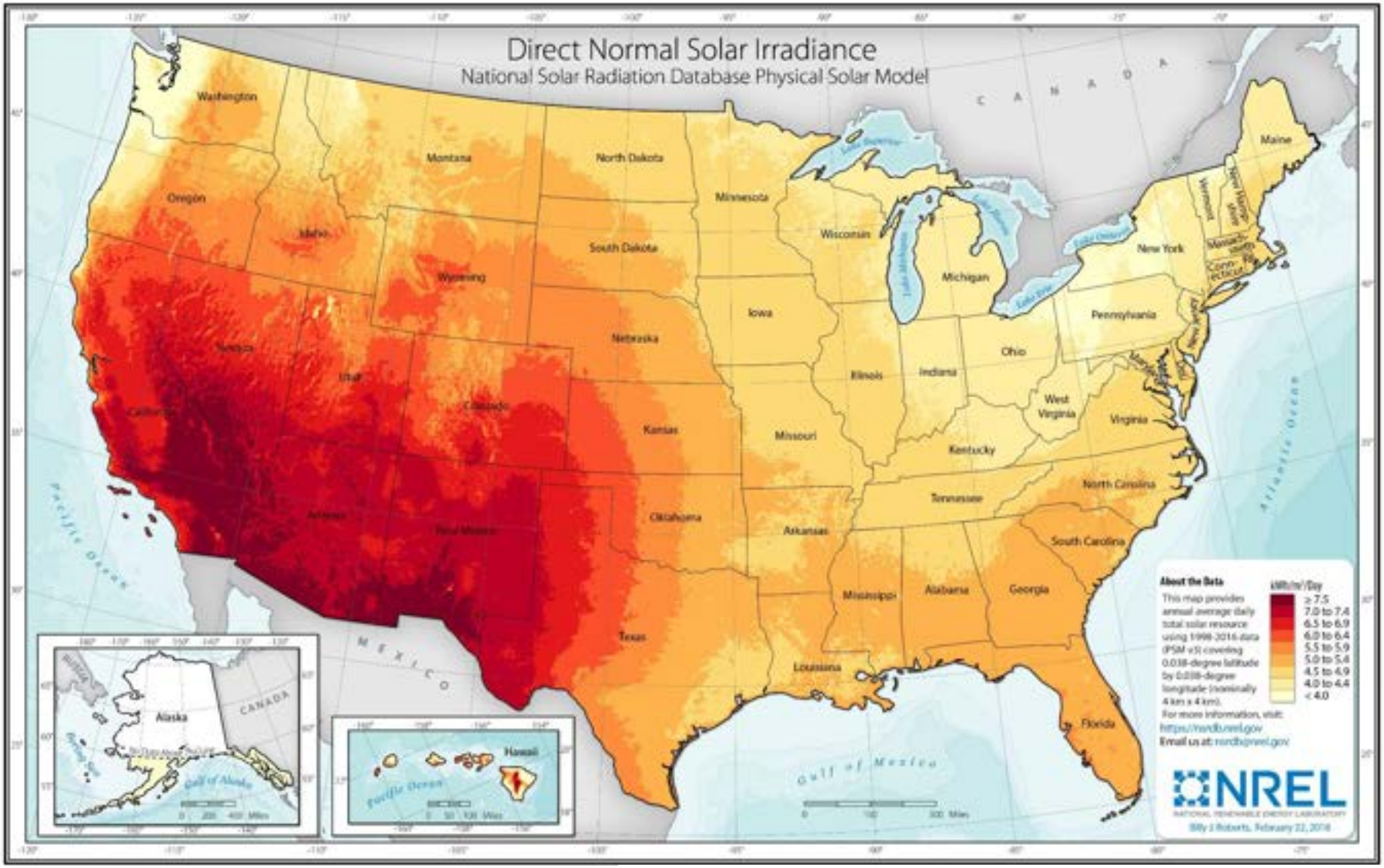
Public Interconnection Queue:
https://www.oasis.oati.com/woa/docs/LGEE/LGEEdocs/LGE_and_KU_GI_Queue_Posting_March_18,_2021.pdf

United States Wind Resource Map



NREL Map: https://www.nrel.gov/gis/assets/images/wtk-120m-2017-01.jpg

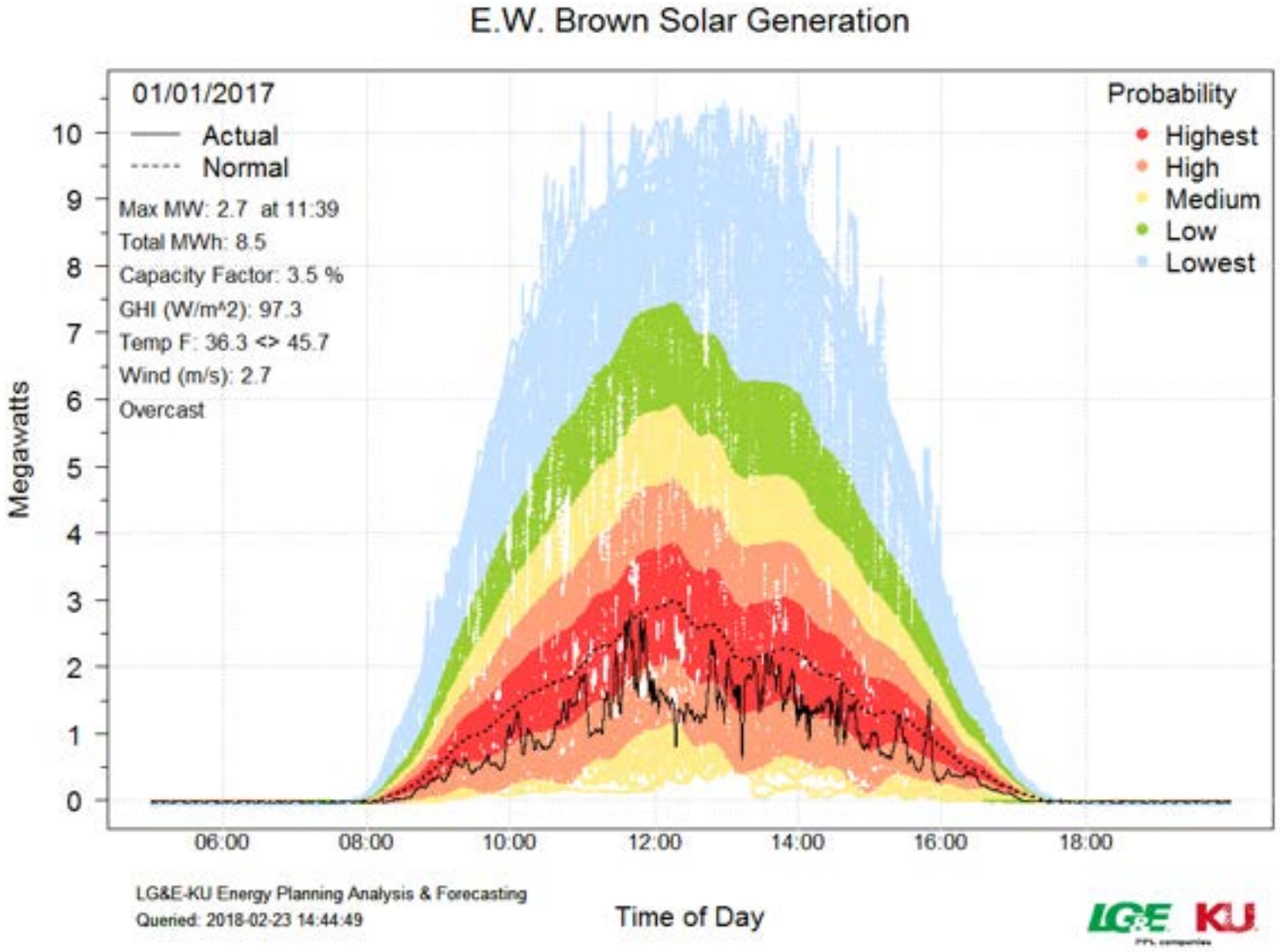
United States Solar Resource Map



NREL Map: https://www.nrel.gov/gis/assets/images/solar-annual-dni-2018-01.jpg

Kentucky's Clean Energy Challenges

Solar Generation is Intermittent



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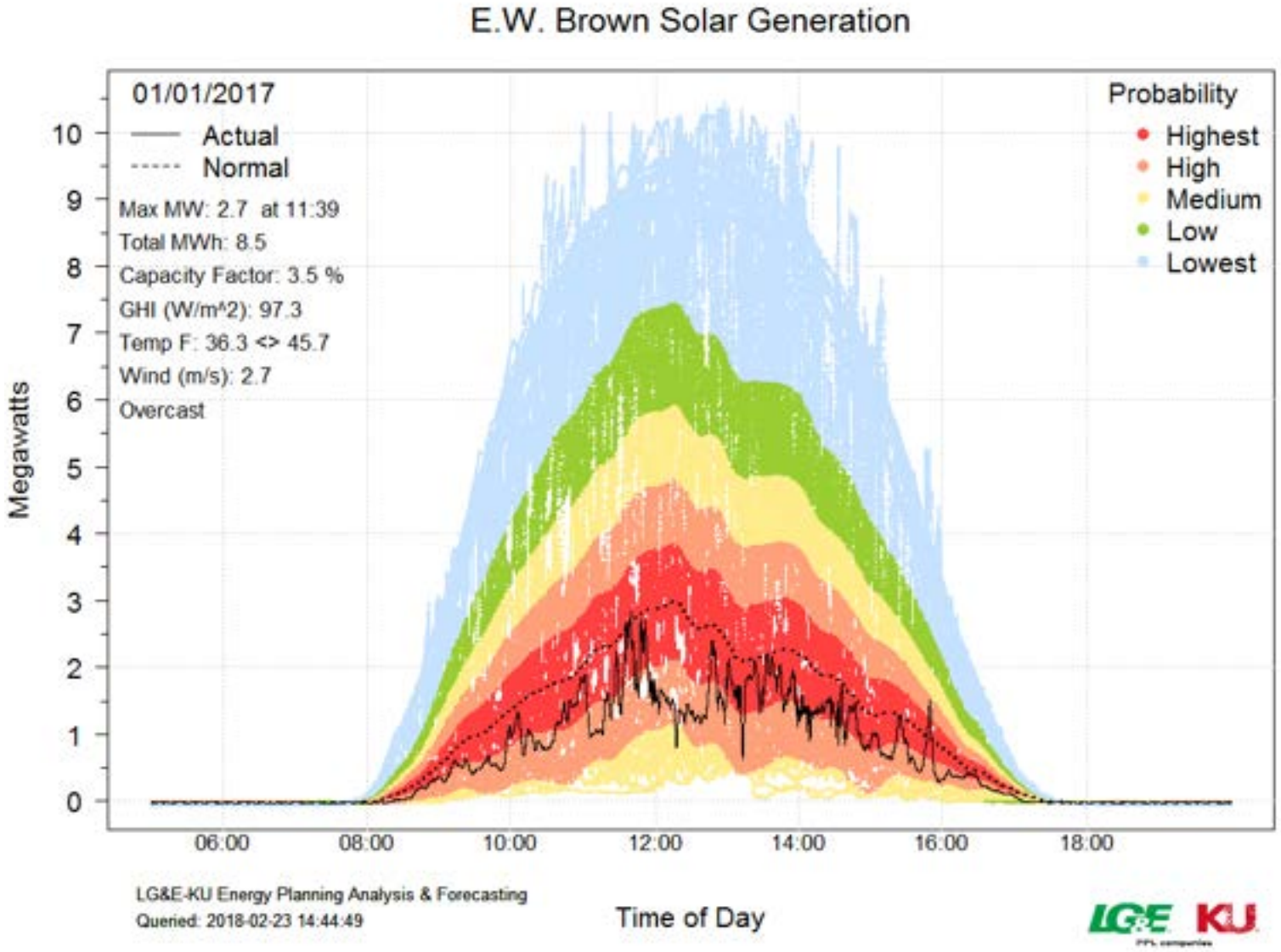


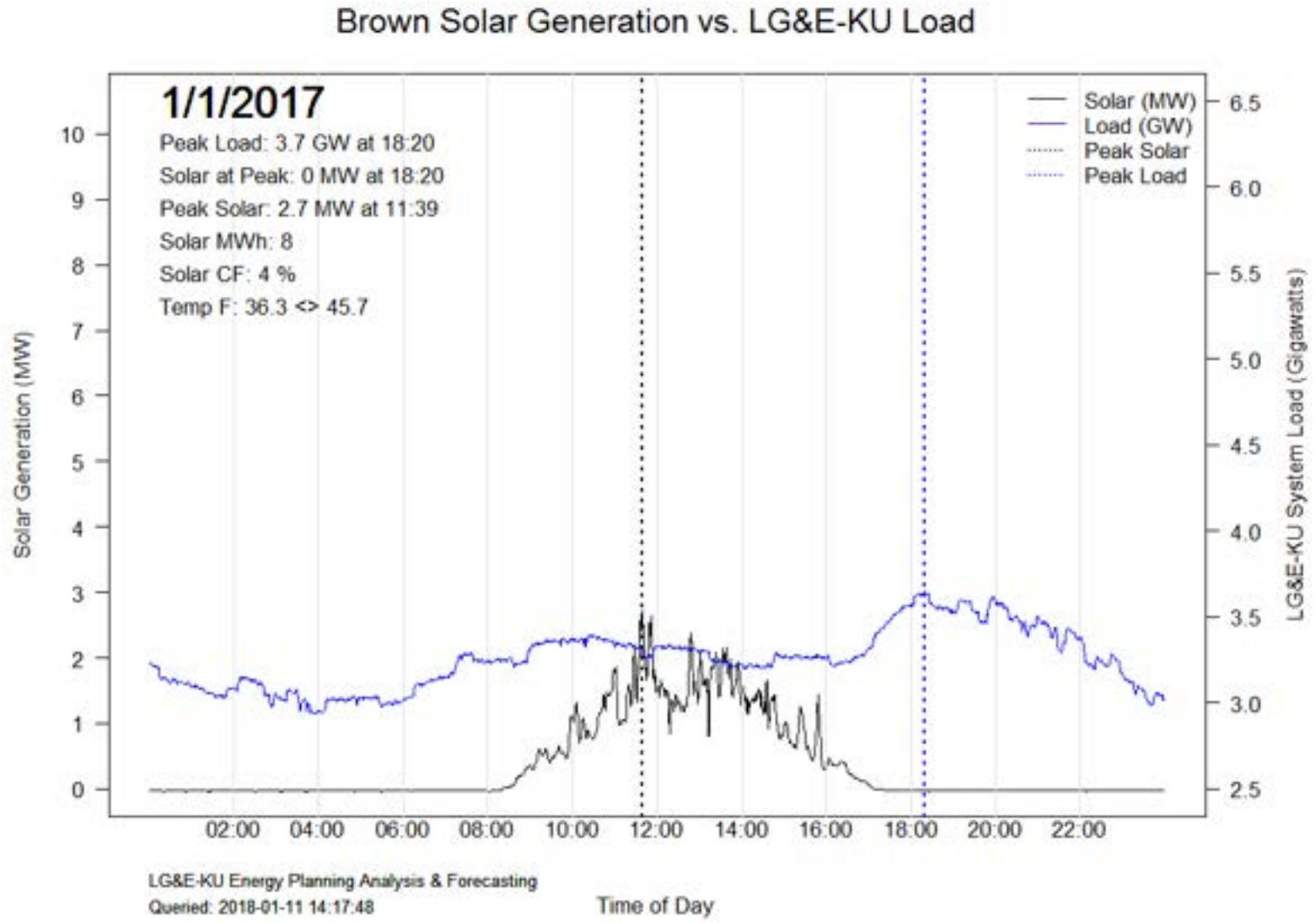
Solar Generation is Intermittent

View live public solar dashboard:
https://lge-ku.com/live-solar-generation

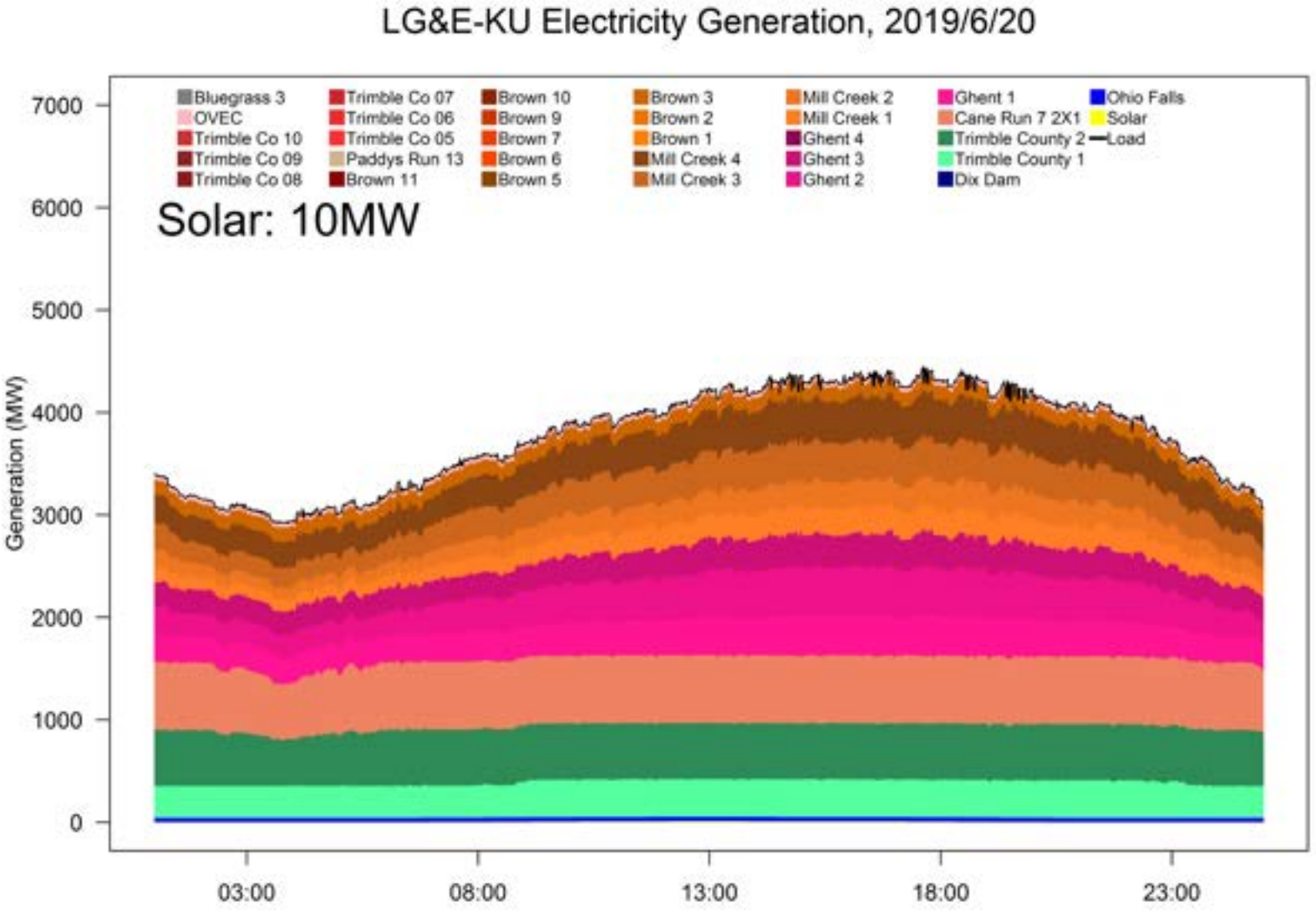
Intermittent Renewable Integration

https://www.mdpi.com/945692

Solar Generation is Intermittent



Example Solar Impact by Unit – June



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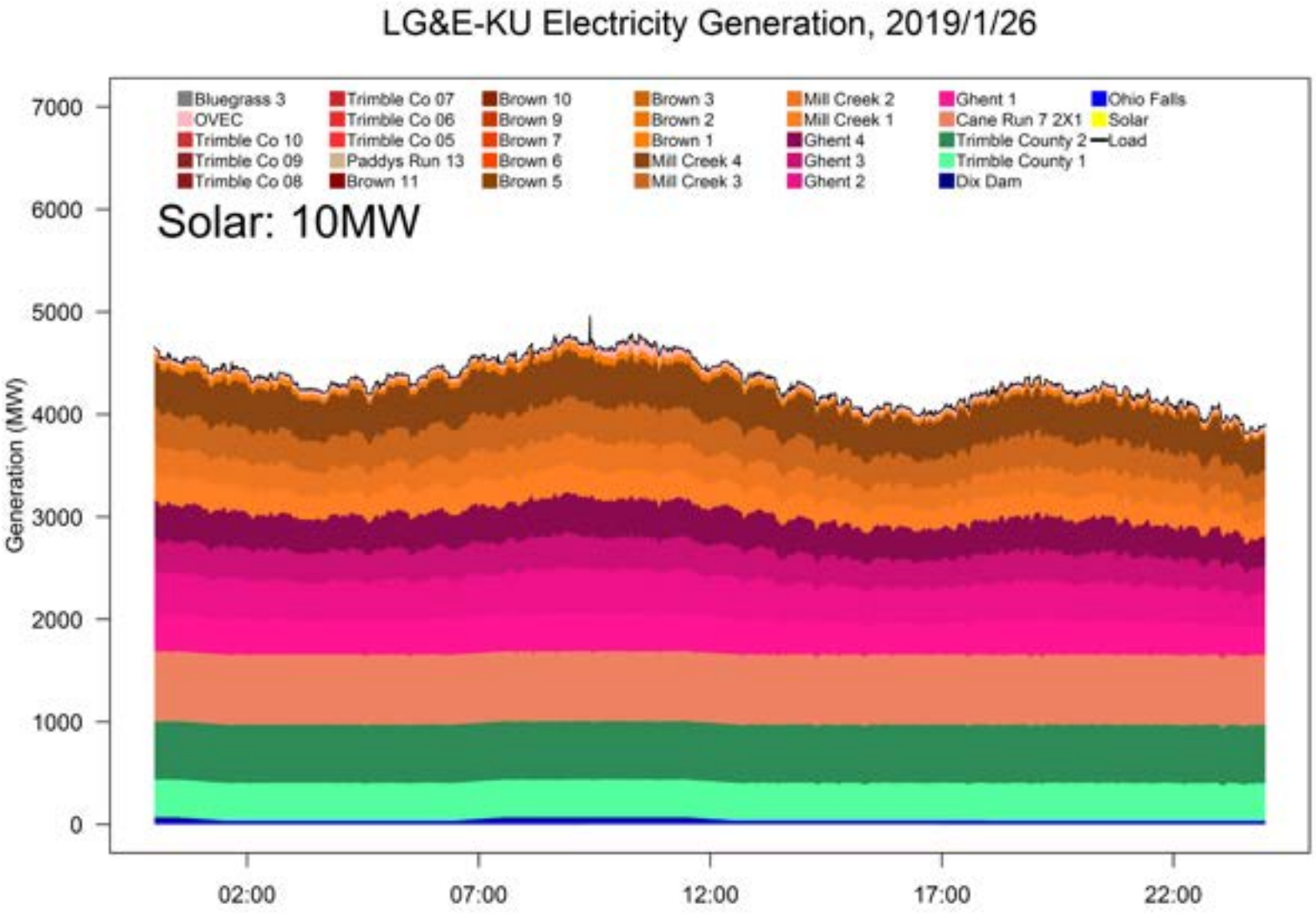
Read our Report: https://uknowledge.uky.edu/ece_facpub/40/

Example Solar Impact by Unit – January



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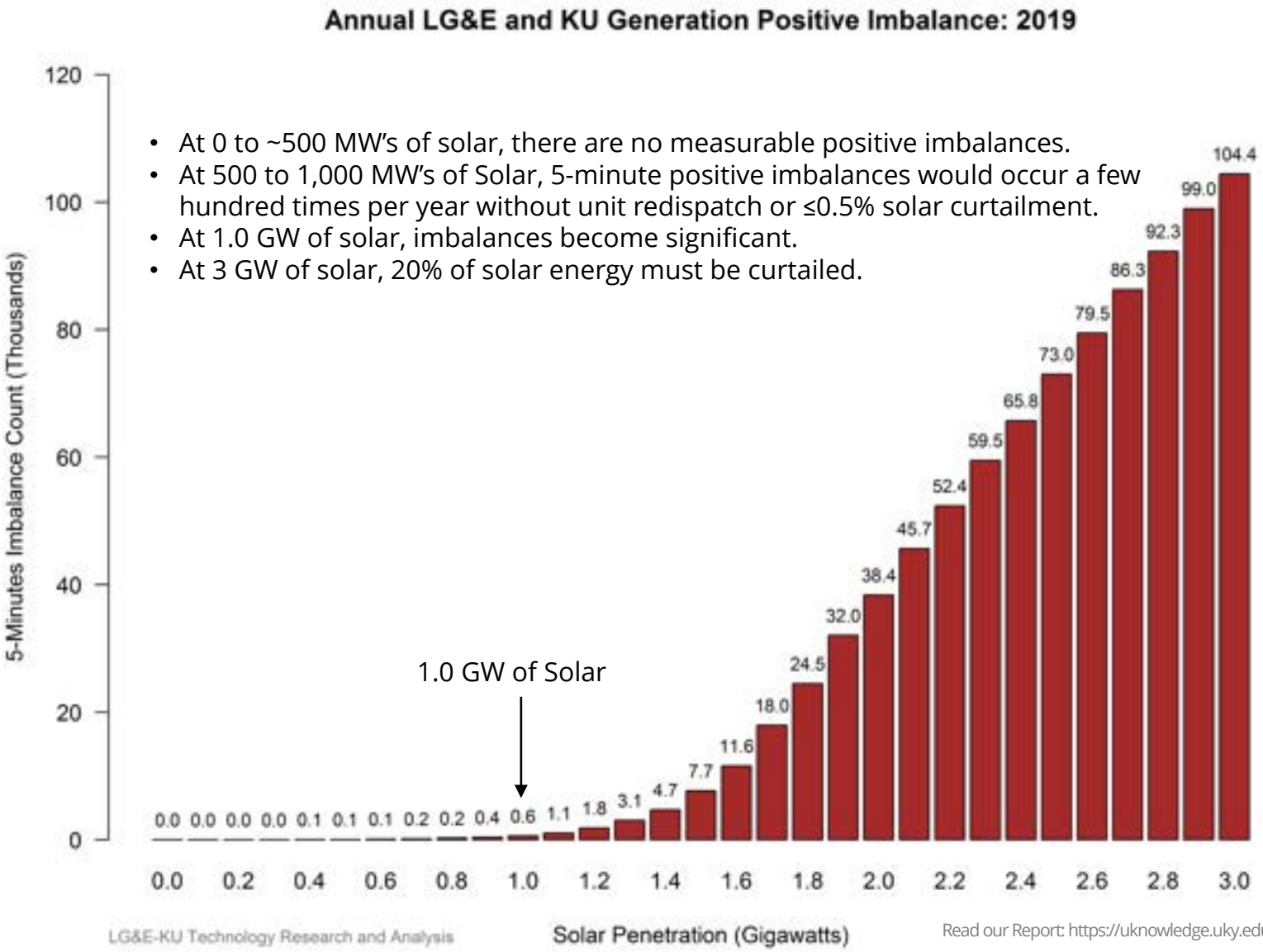
Annual 5-Minute Imbalances by Solar Penetration



- At 0 to ~500 MW's of solar, there are no measurable positive imbalances.
- At 500 to 1,000 MW's of Solar, 5-minute positive imbalances would occur a few hundred times per year without unit redispatch or ≤0.5% solar curtailment.
- At 1.0 GW of solar, imbalances become significant.
- At 3 GW of solar, 20% of solar energy must be curtailed.

Read our Report: https://uknowledge.uky.edu/ece_facpub/40/

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