

Sustainable Development from the Perspective of Renewable Energy

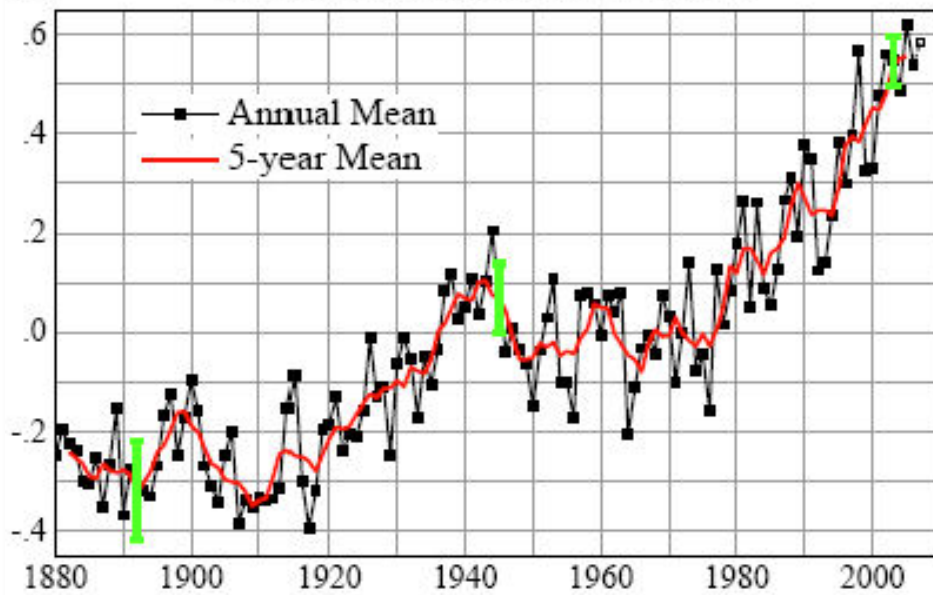
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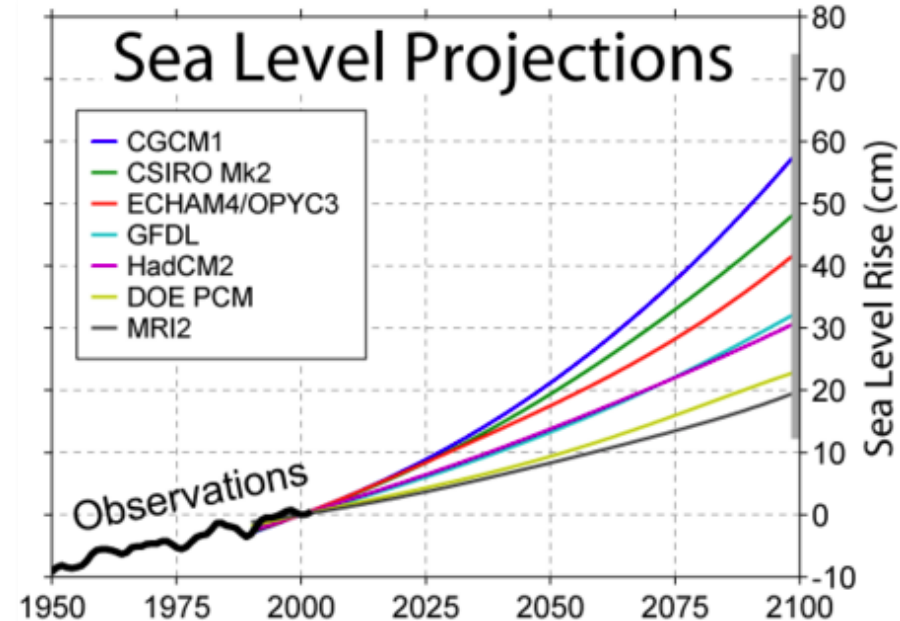
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Global Warming

Global Temperature Change (°C)



Sea Level Projections



Consequences?



Seychelles might
be under water

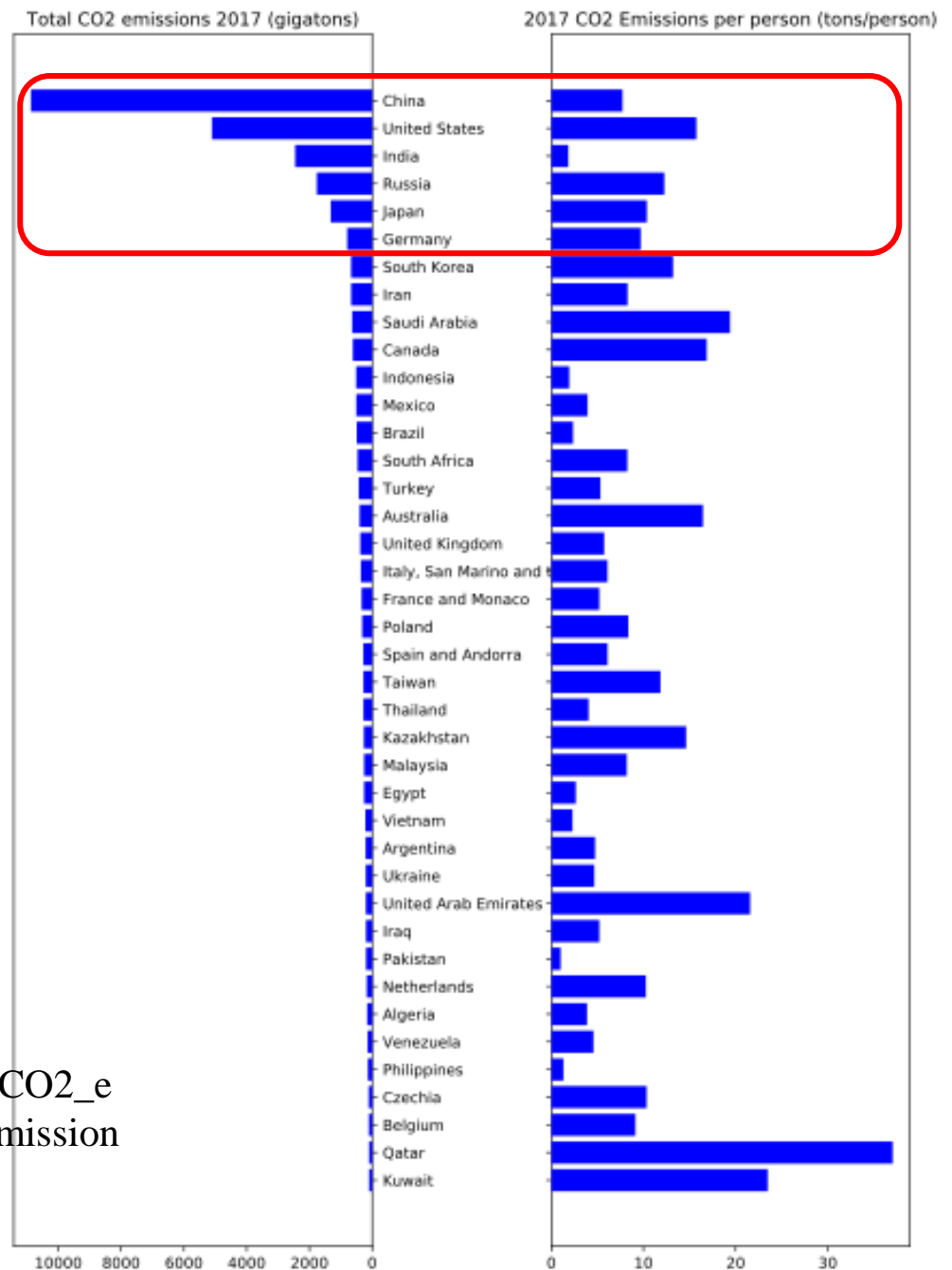
Many places in the world will become Venice. Do you like that?

2015 United Nations Climate Change Conference \Rightarrow **The Paris Agreement**

https://en.wikipedia.org/wiki/2015_United_Nations_Climate_Change_Conference 1/

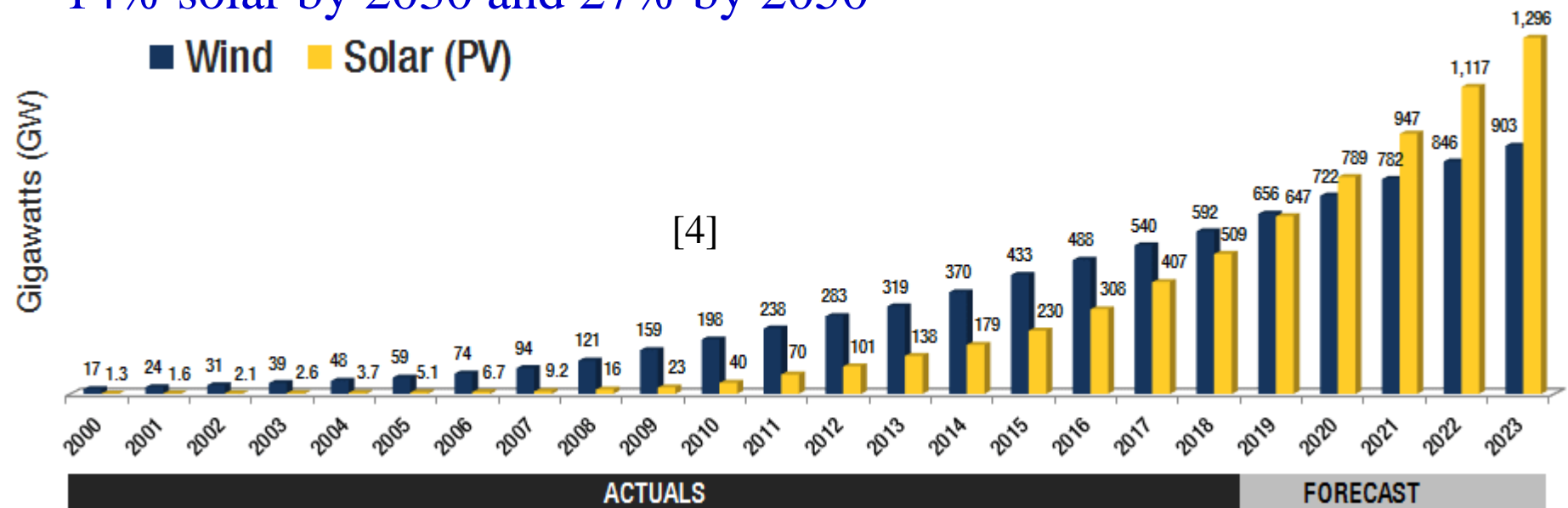
Are the US and European countries to be blamed?
What can be done?

[https://commons.wikimedia.org/wiki/File:Total_CO2_emissions_by_country_in_2017_vs_per_capita_emissions_\(top_40_countries\).svg](https://commons.wikimedia.org/wiki/File:Total_CO2_emissions_by_country_in_2017_vs_per_capita_emissions_(top_40_countries).svg)



Renewable Energy?

- Paris Agreement: Reduce carbon output “as soon as possible” and promote universal access to sustainable energy through the enhanced deployment of renewable energy ^[1] (2015 UN Climate Change Conference)
- U.S. Dept. of Energy’s goal: 20% wind by 2030, 35% by 2050 ^[2]; 14% solar by 2030 and 27% by 2050 ^[3]

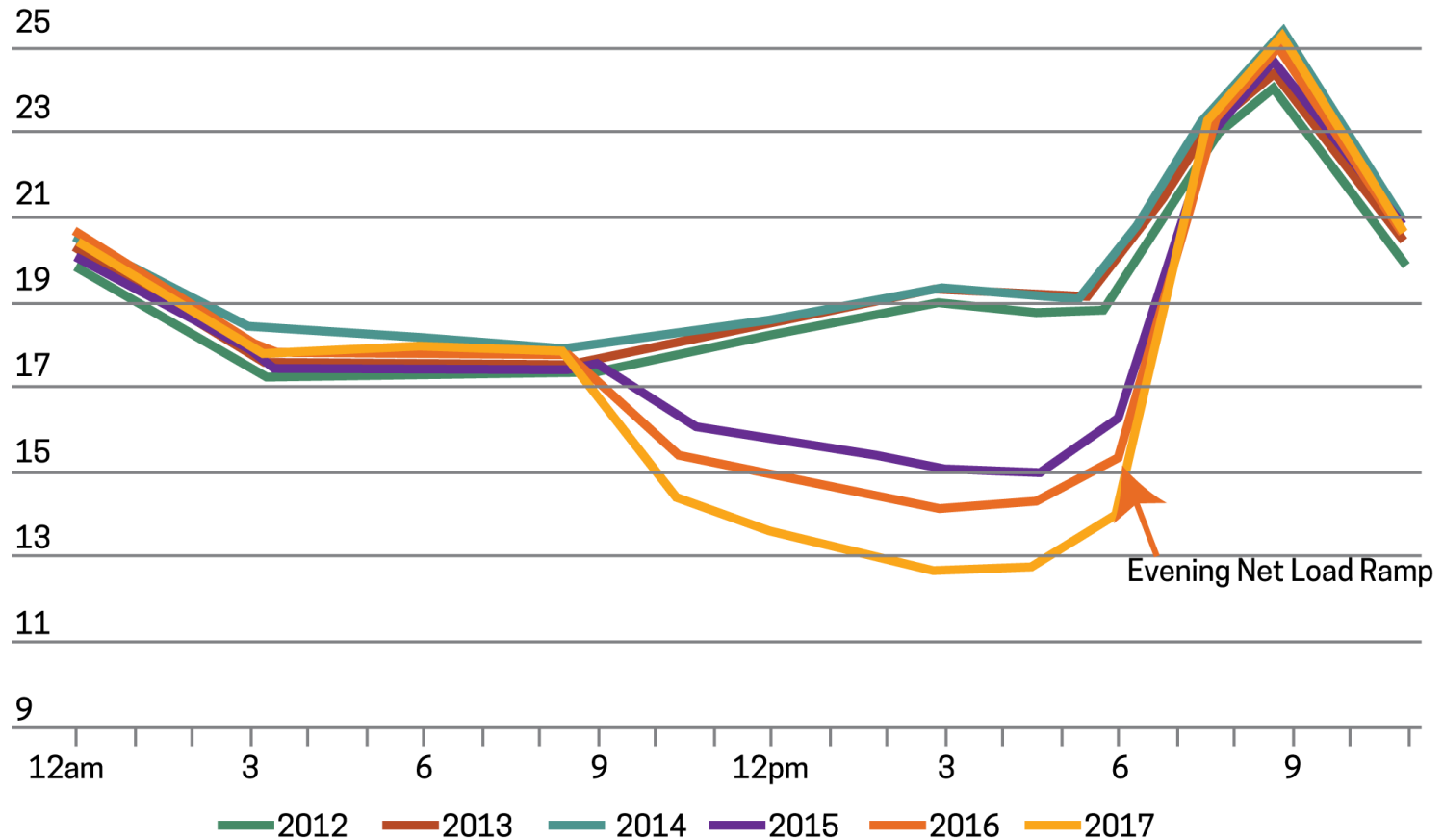


1. United Nations Framework Convention on Climate Change, “Adoption of the Paris Agreement,” Dec. 2015. <http://unfccc.int/resource/docs/2015/cop21/eng/109r01.pdf>
2. <https://www.energy.gov/eere/wind/maps/wind-vision>
3. <https://www.energy.gov/eere/solar/path-sunshot>
4. Global Wind Energy Council, “Global wind report – Annual market update 2014,” Brussels, Belgium, March 2015

The Famous “Duck Curve”?

27 Thousand Megawatts

CALIFORNIA'S ELECTRICAL GRID THROUGHOUT THE DAY

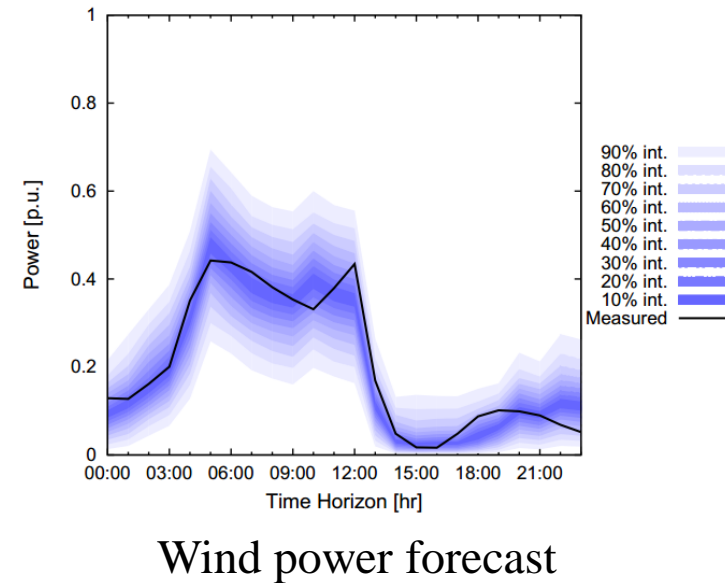


California electricity demand reshaped by PV

<https://annedminster.com/is-there-such-a-thing-as-too-much-pv-on-your-roof/>

A Rosy Picture?

- Intermittent/uncertain nature of wind generation
 - In Spain, an unprecedented decrease in wind generation in Feb. 2012 was equivalent to the sudden down of 6 nuclear plants
 - 4 is not unusual ~ Hidden secret of intermittent renewables



- Similar for solar \Rightarrow The hidden secret of renewable energy
- Solutions: Utility-scale batteries, microgrids with fuel cells and batteries, and advanced R&D to tame renewable energy and beyond

R. J Bessa, V. Miranda, A. Botterud, Z. Zhou, and J. Wang, "Time-adaptive quantile-copula for wind power probabilistic forecasting," *Renewable Energy*, Vol. 40, No. 1, pp. 29-39, 2012.

- R&D at UConn Electrical & Computer Engineering:
 - Smart Grid – Intermittent renewable (wind and solar) integration to the grid; optimized operations of electrical power systems; the consideration of batteries and frequencies; and microgrids with renewables or fuel cells with battery storage
 - Smart and Green Buildings – Optimized energy management; HVAC fault detection and diagnosis, crowd guidance in building emergencies; and eco communities
- Working with utilities and Independent System Operators (ISOs) with major breakthroughs

Conclusion

The choice is here and now,
and is critical

Contribute whatever you can



Thank You!