Renewable Energy Supply as a System of Systems: Offshore Wind and Onshore Solar

Southeastern Virginia

ENERGY TECHNOLOGY PARTNERSHIP FORUM

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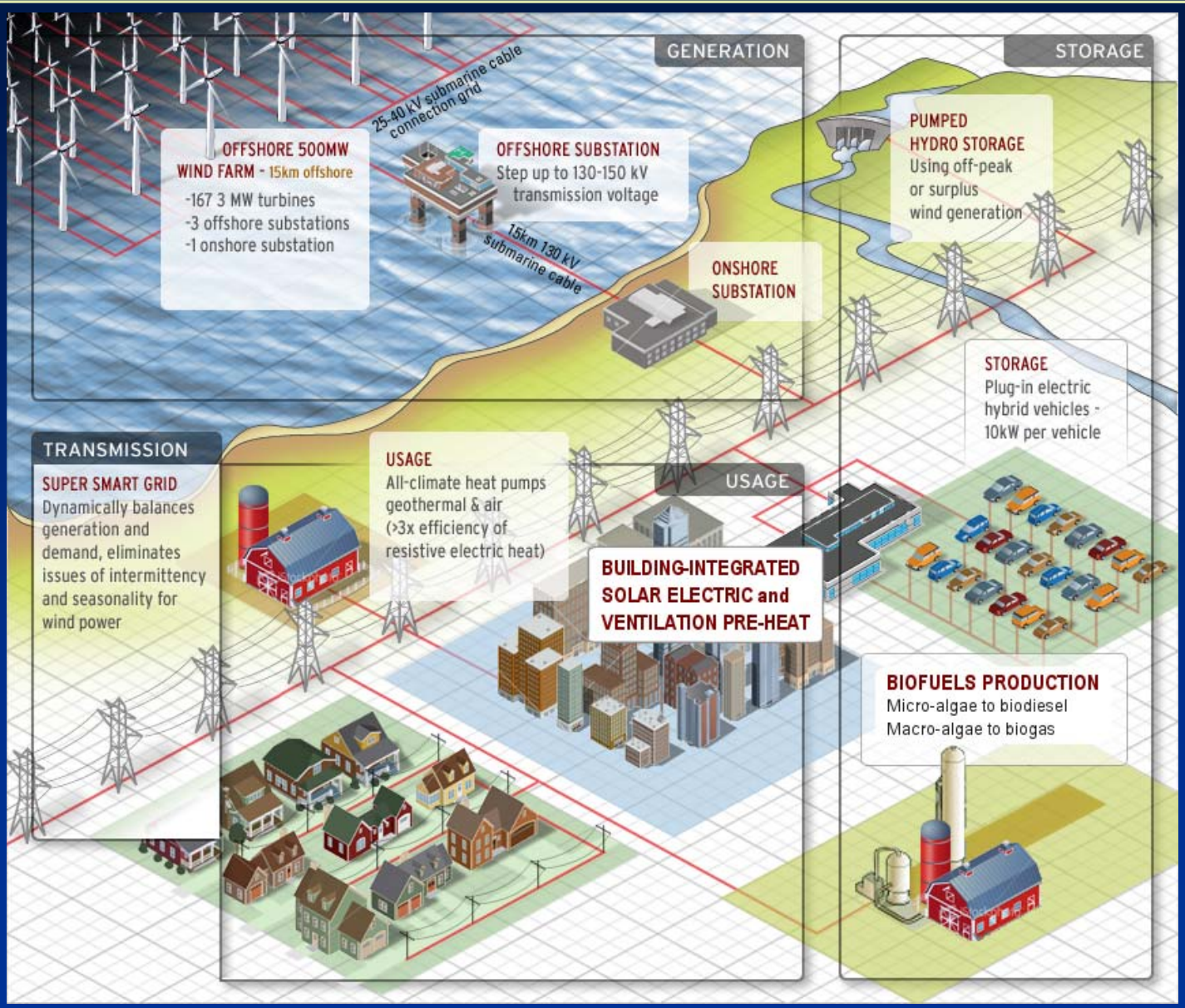
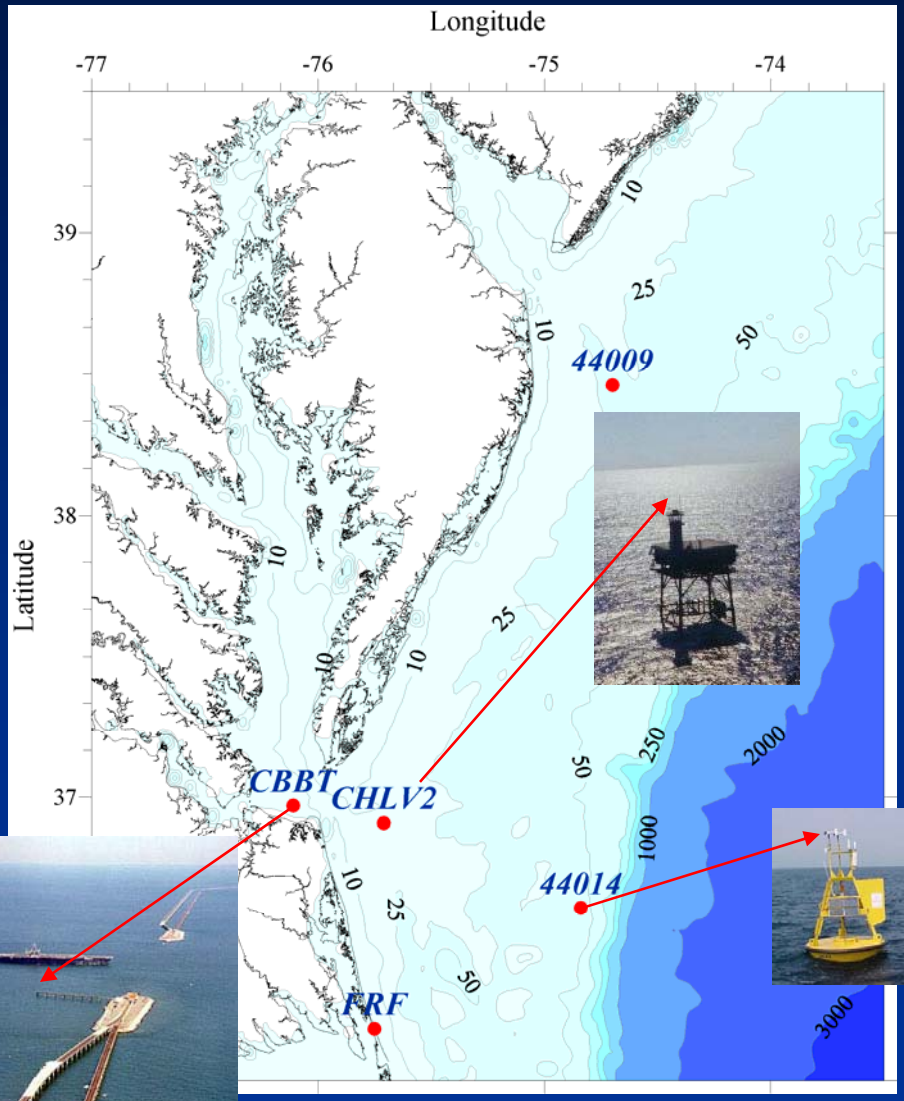
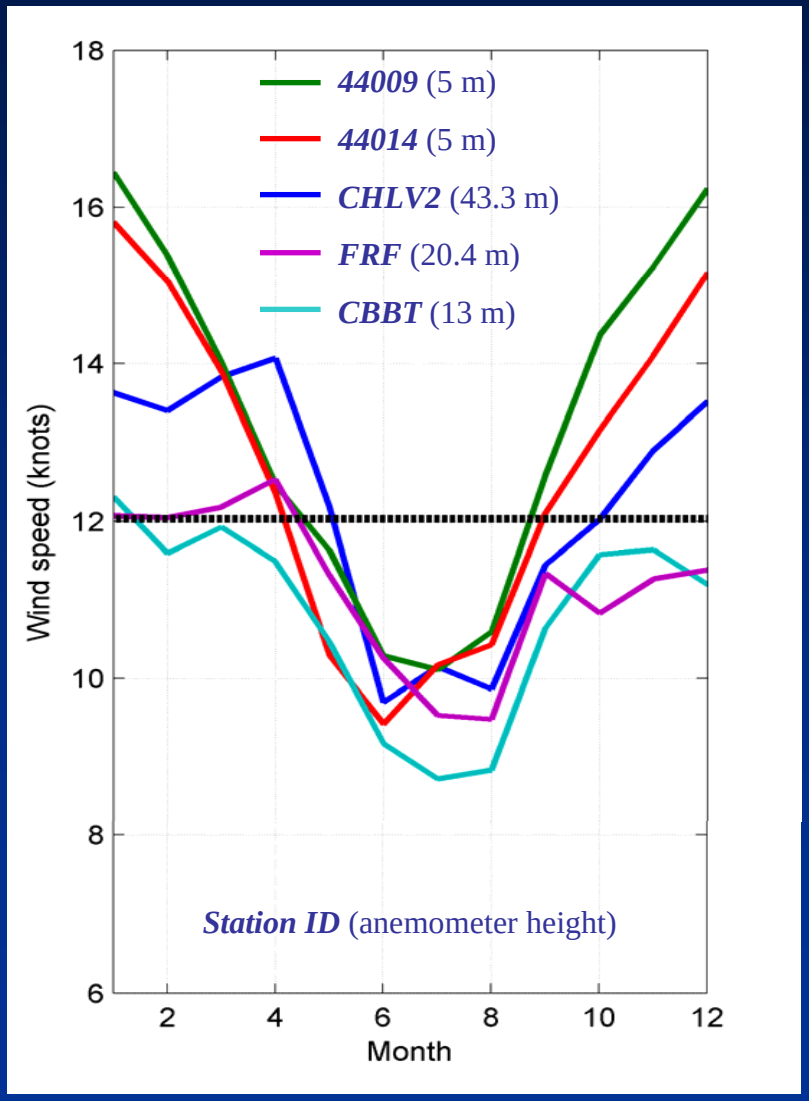
Offshore Wind and Onshore Solar can be Cornerstones of a Larger, Integrated Energy System



Offshore Wind is a Winter-Peaking Resource

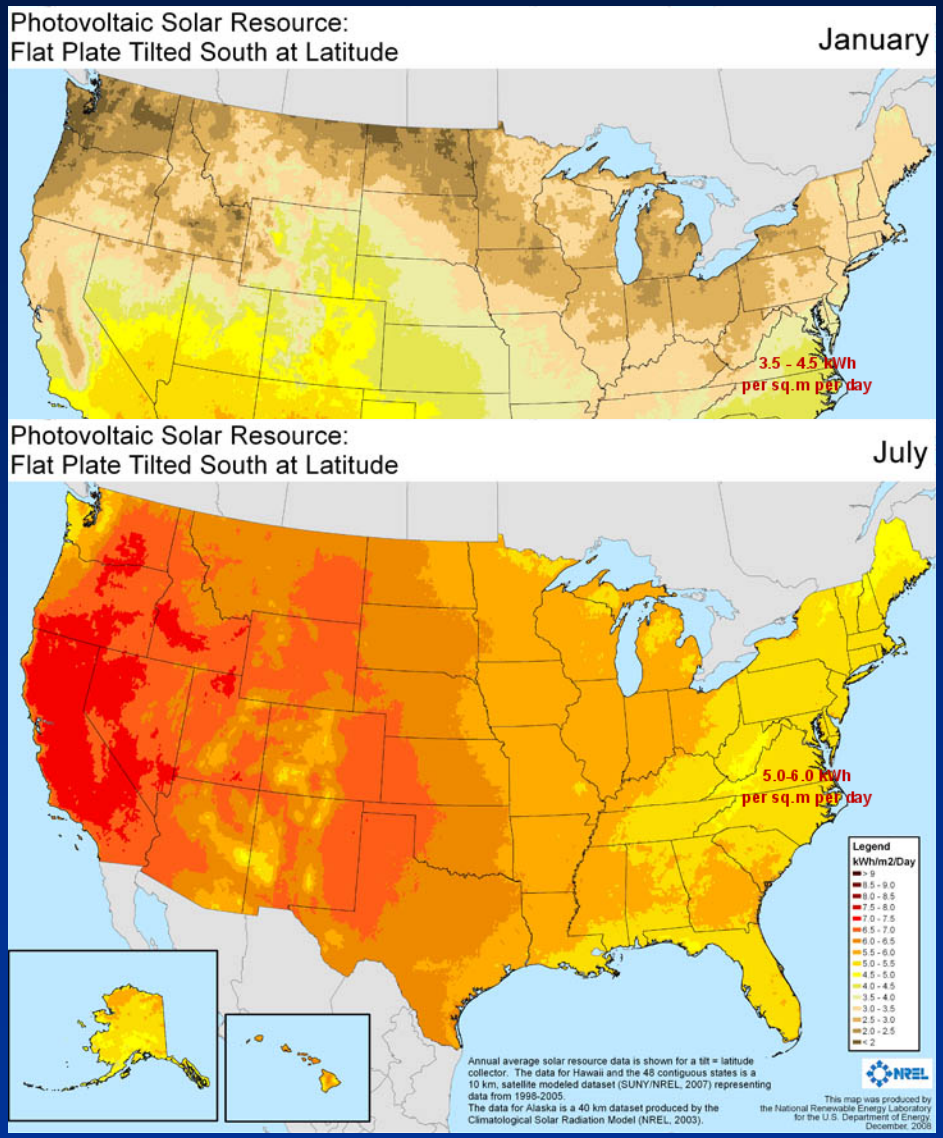


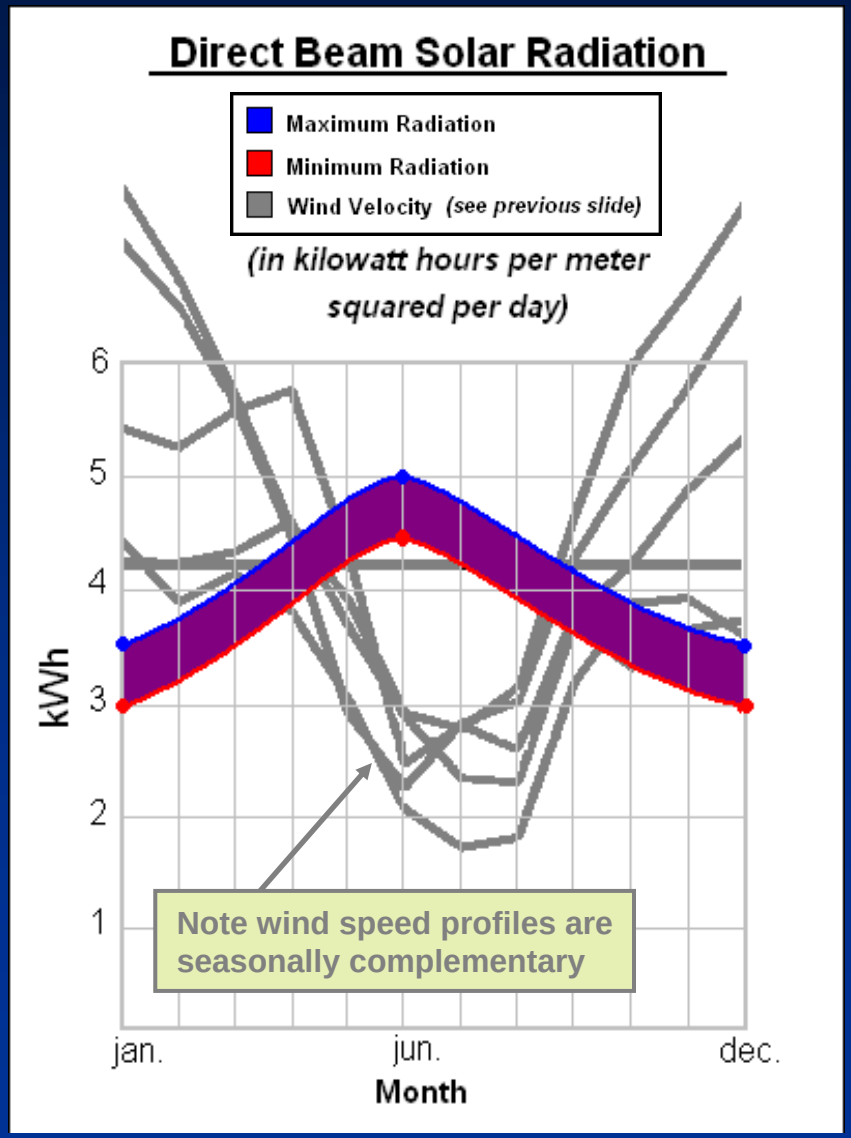


Offshore Wind Turbines are Commercially Available Now

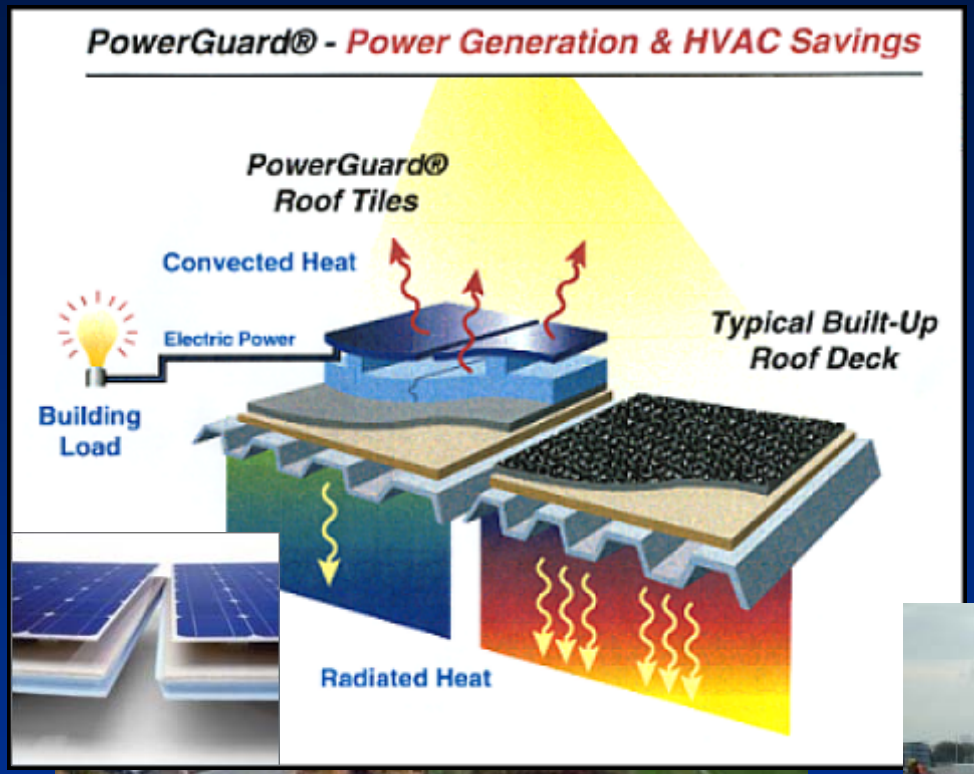
Left photo is of Vestas 3 MW turbines with 90-m rotor diameter and 70-m hub height on steel monopile foundations at Thanet 300 MW project off southeastern England. Right photo is of Siemens 2.3 MW turbines with 83-m rotor diameter and 69-m hub height on concrete gravity base foundations at 166 MW Nysted project off Denmark.

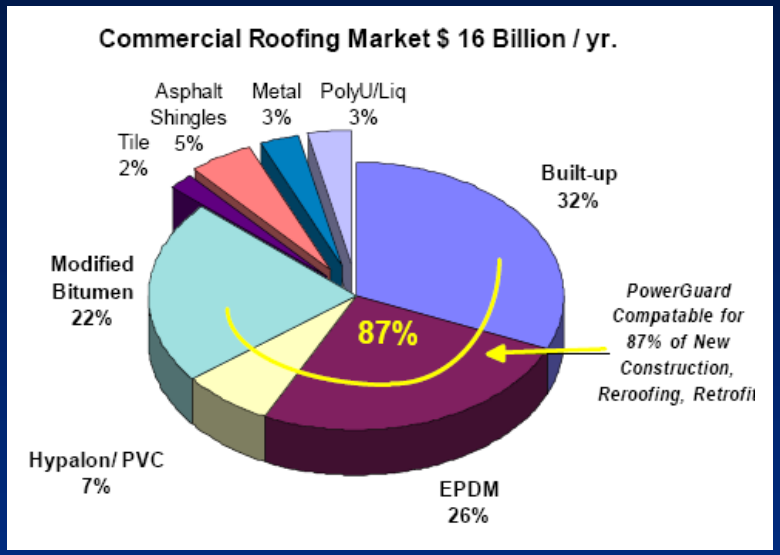
Onshore Solar is a Summer-Peaking Resource



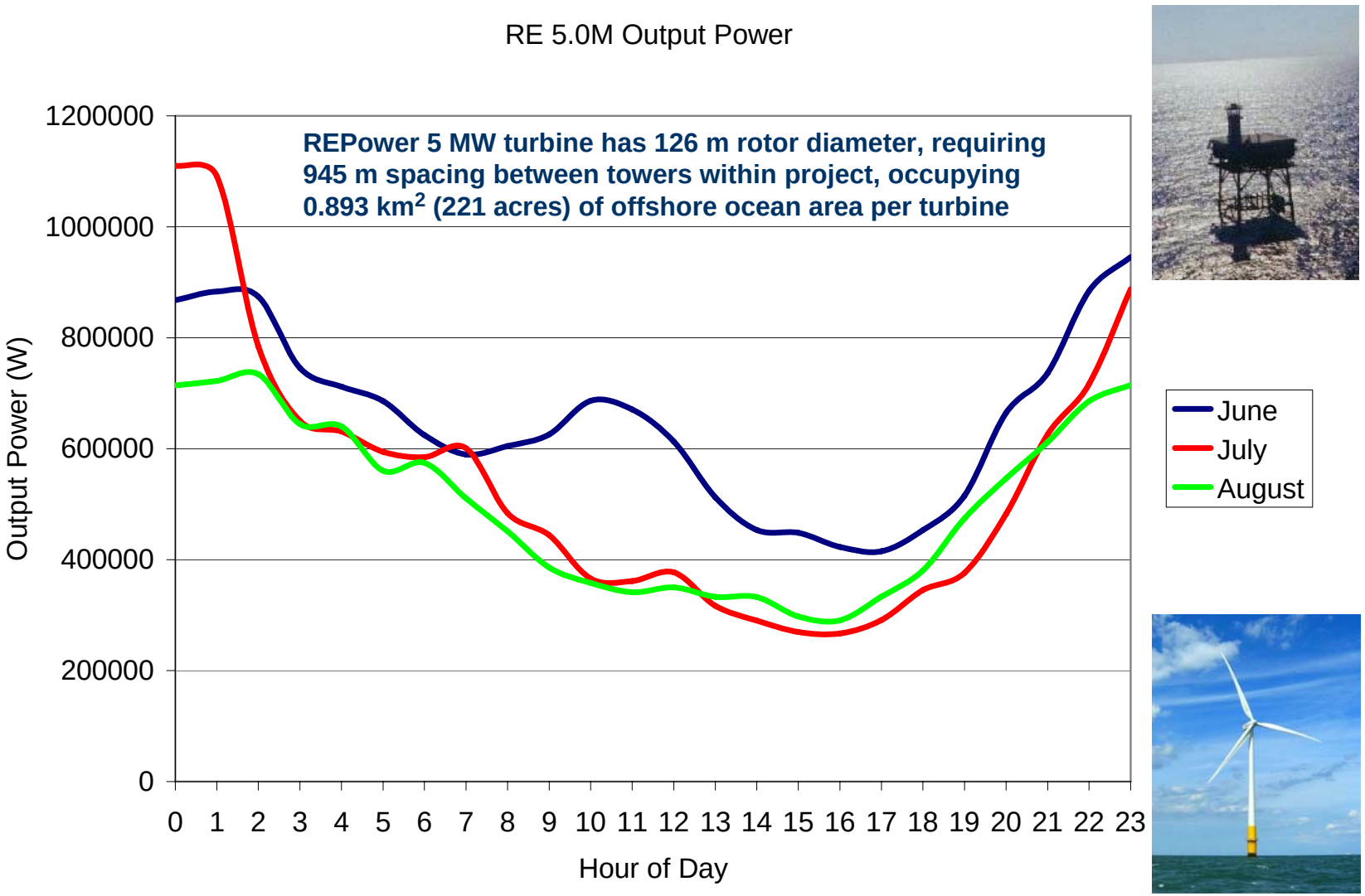


Building-Integrated Photovoltaic Roofing Tiles are Commercially Available Now

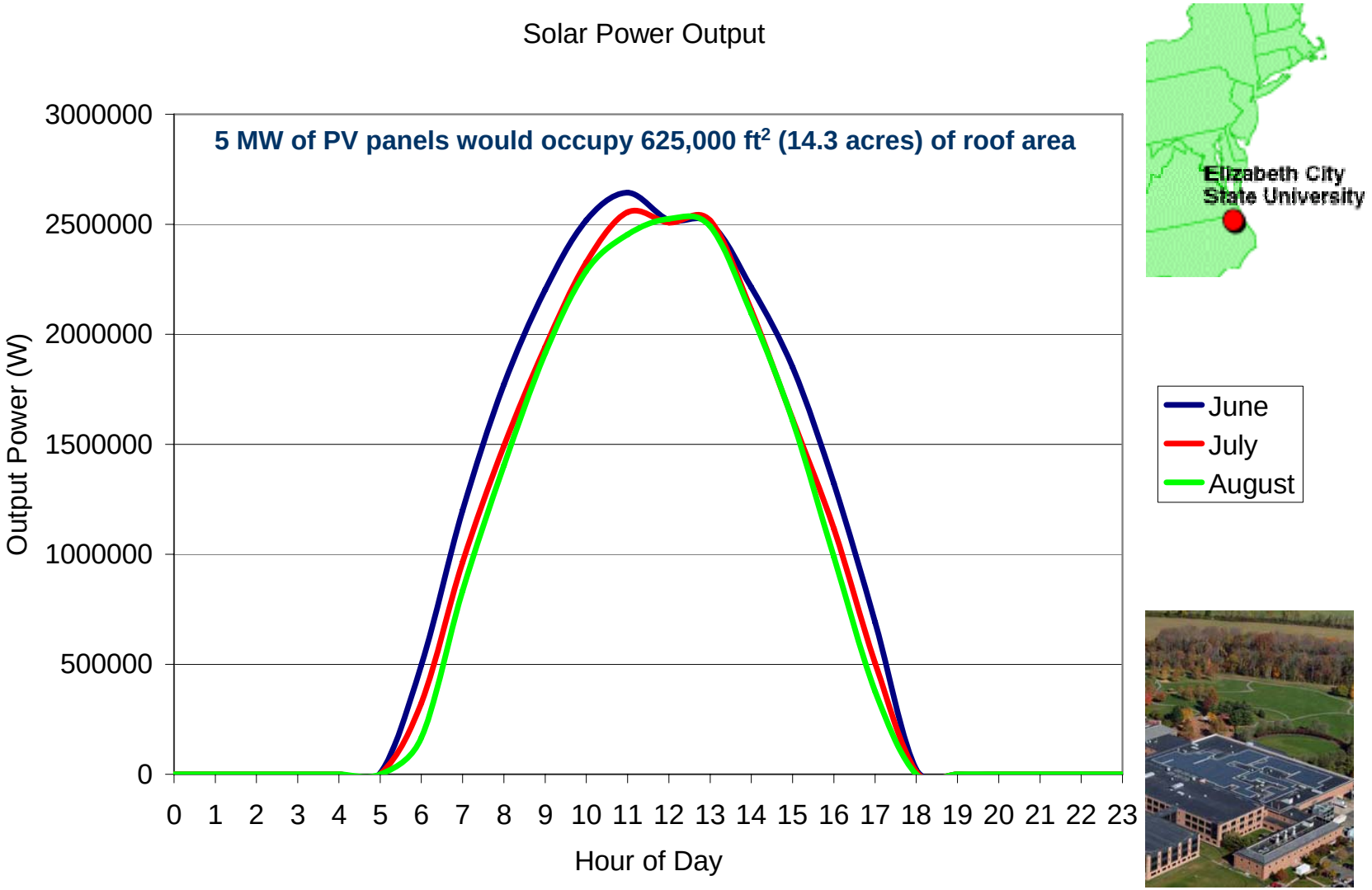




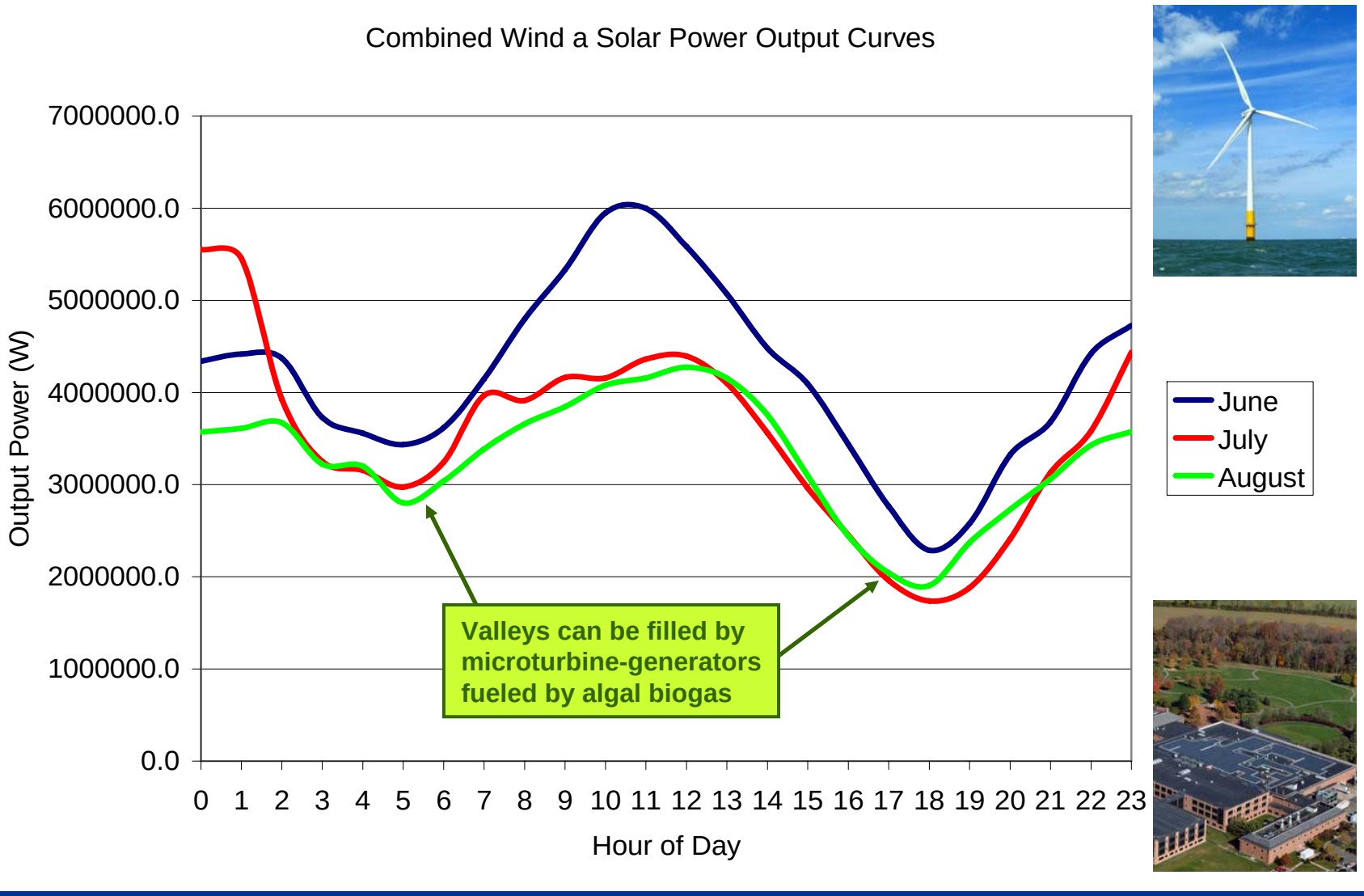
Hourly Output Profile of One 5 MW Offshore Wind Turbine in Summer



Hourly Output Profile of Ten 500 kW Photovoltaic Roofs in Summer



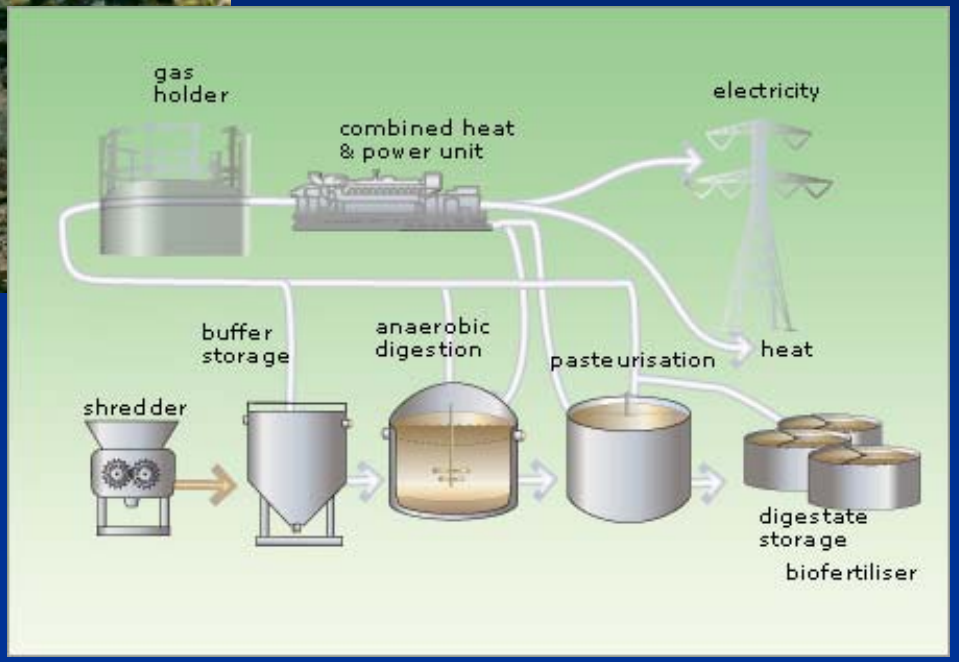
Hourly Output Profile of Combined Offshore Wind Turbine and PV Roofs in Summer



Algal Biogas for Electric Power in the Future

Anaerobic digestion of seaweed naturally produces methane

Replicating the same process for combined heat and power



Candidate Seaweed Species Native to the Mid-Atlantic Coastal Region

- Along Mid-Atlantic and Southeastern beaches *Gracilaria* and *Ulva* can wash ashore and pile up in windrows where natural decomposition produces methane and hydrogen sulfide
- *Ulva* expected to yield 214,400 ft^3 of methane per acre of pond area per year
- *Gracilaria* expected to yield 514,500 ft^3 of methane per acre of pond area per year

Tokyo Gas 10 kW Demonstration Project

After two weeks in anaerobic digester, one dry ton of *Ulva* yields 600 cubic feet of biogas (60% CH_4 and 40% CO_2), which supplies a 9.8 kW micro-turbine generator

Thank You!

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