

# ADVANCED ENERGY 2010

## TRACK E – OFFSHORE WIND POWER

Tuesday, November 9, 2009

*“When offshore is finally on the grid”*

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*The issues & Answers*

*The Vision*

*The Research*



# *The Issues & Answers*

*NIMBY Factor*

*The Birds*

*The Radars*

*Grid Integration*

*Power Restoration After Blackout*



The Issue NIMBY [Not In My Back Yard] Factor:

The Answer:- Education

*Exploitation of fear of the unknown by the status quo proponents for their own commercial interests is the major force behind NIMBY. Educating the masses in schools and colleges to prepare the next generation for socially responsible energy conversion and consumption is needed.*



*The Issue: The Birds*

*The Answer:- Planning*

*Cleaner air is as important to birds as it is to humans. So, use of wind energy to minimize pollution from fossil fuel plants is in the best interests of the birds. With optimal planning and design, with respect to migration paths of the birds, harm to them can be minimized.*



## *The Issue: The Radars*

## *The Answer:- “Stealth turbines”*

*A world-leading Vestas research project is drawing on military expertise, in hiding ships and aircraft from radar, to make life easier for wind farm developers.*

*by Charles Butcher*

<http://www.vestas.com/en/media/article-display.aspx?action=3&NewsID=1956>



*The Issue:-The Grid Integration*

*The Answer:- Separate DC Bus*

*A separate HVDC transmission system for all large renewable energy, wind and solar, power plants would minimize dynamic fluctuations at the grid and allow for smoother integration with the existing transmission assets.*



*The Issue: Power Restoration After Blackout*

*The Answer:- Intelligent Substations*

*Intelligent substations with artificial neural network [ANN] control systems would be needed to monitor and control feeders at the substations supplying active and passive loads, which may include small wind and PV power plants at customer ends*

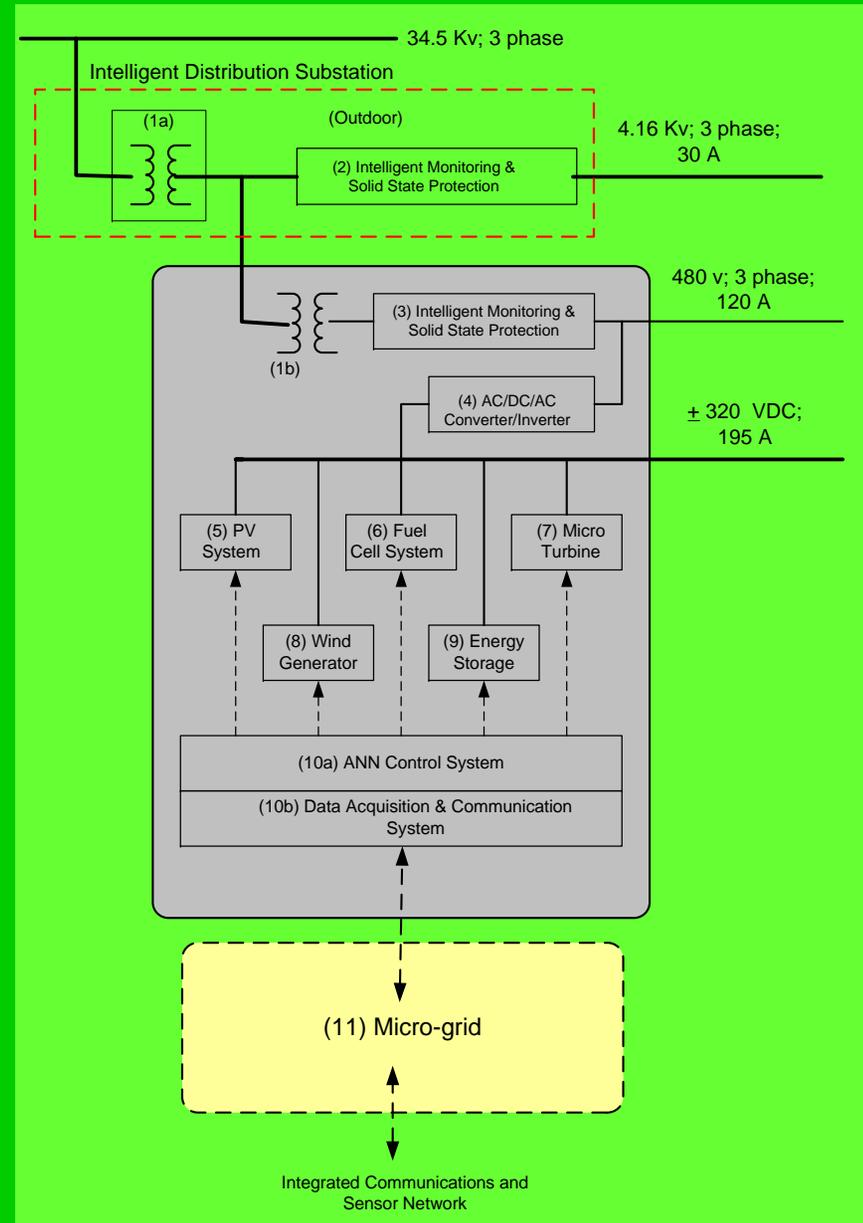


# Intelligent Substation

- ANN control system
- Energy storage
- Micro-grid network
- SCADA system
- AC-DC-AC converters
- Fuel Cells &  $\mu$  Turbines

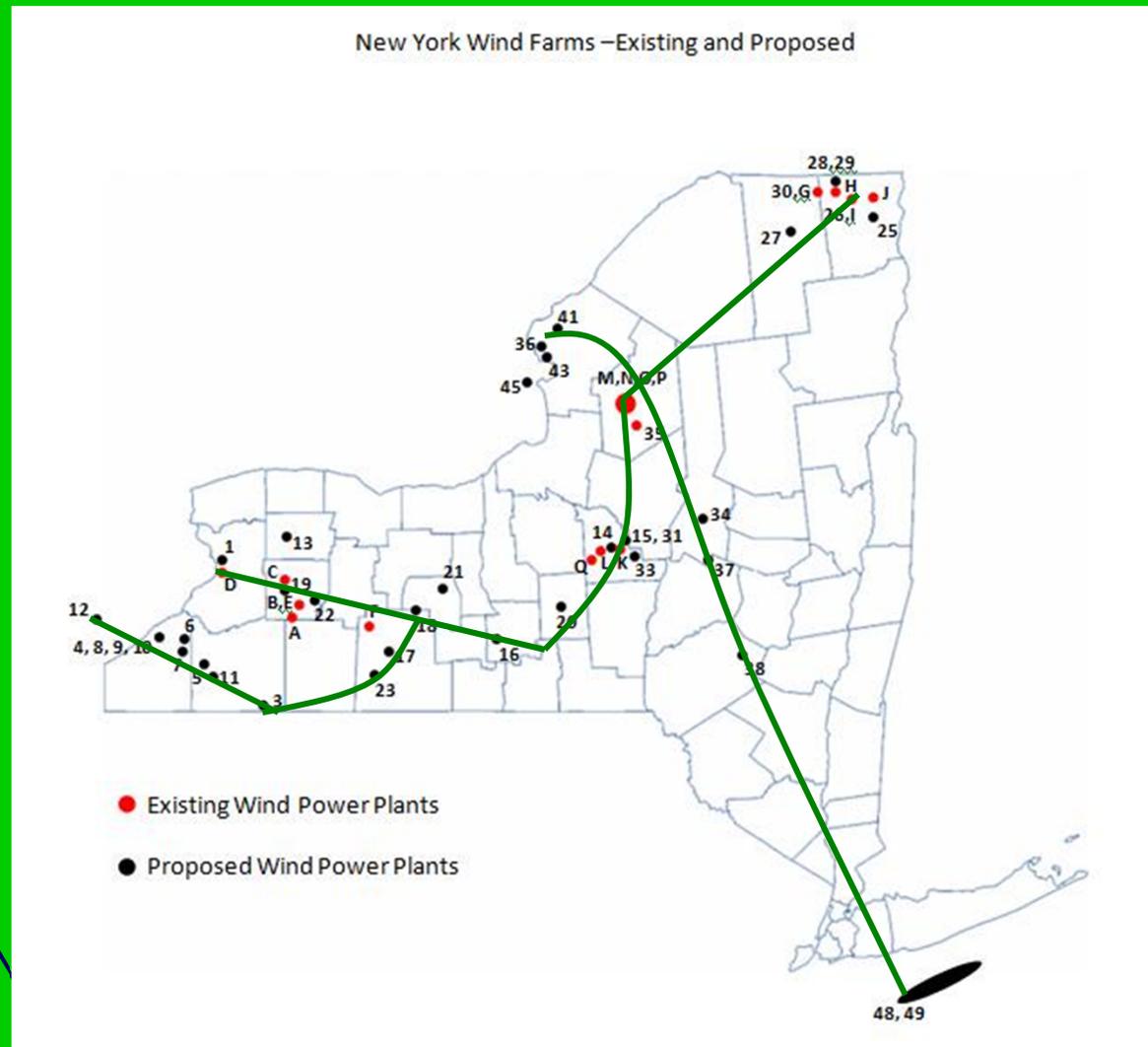
<http://www.commentvisions.com/>

June 2010 Discussion



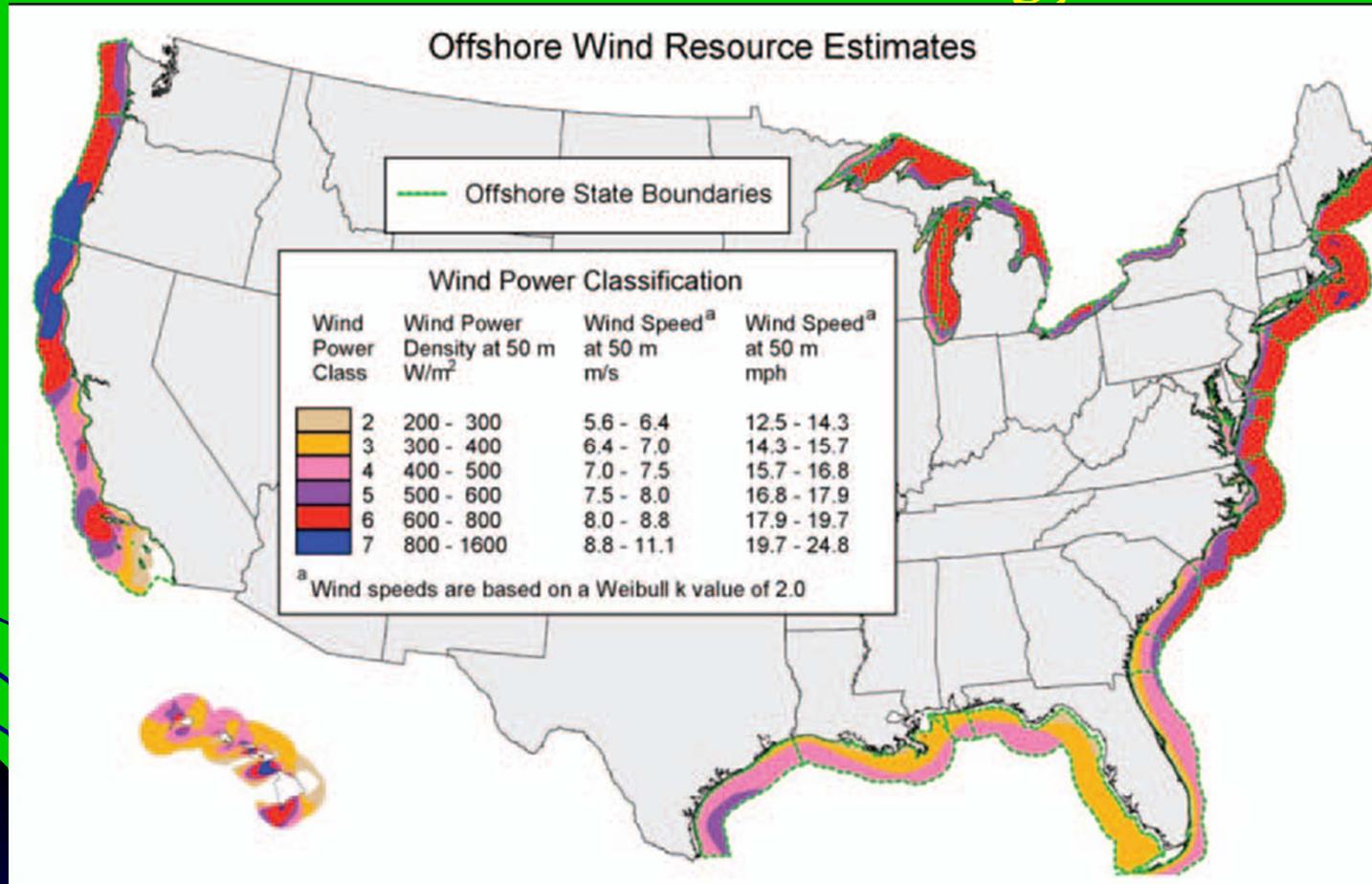
# The Vision

## New York Renewable Energy Grid



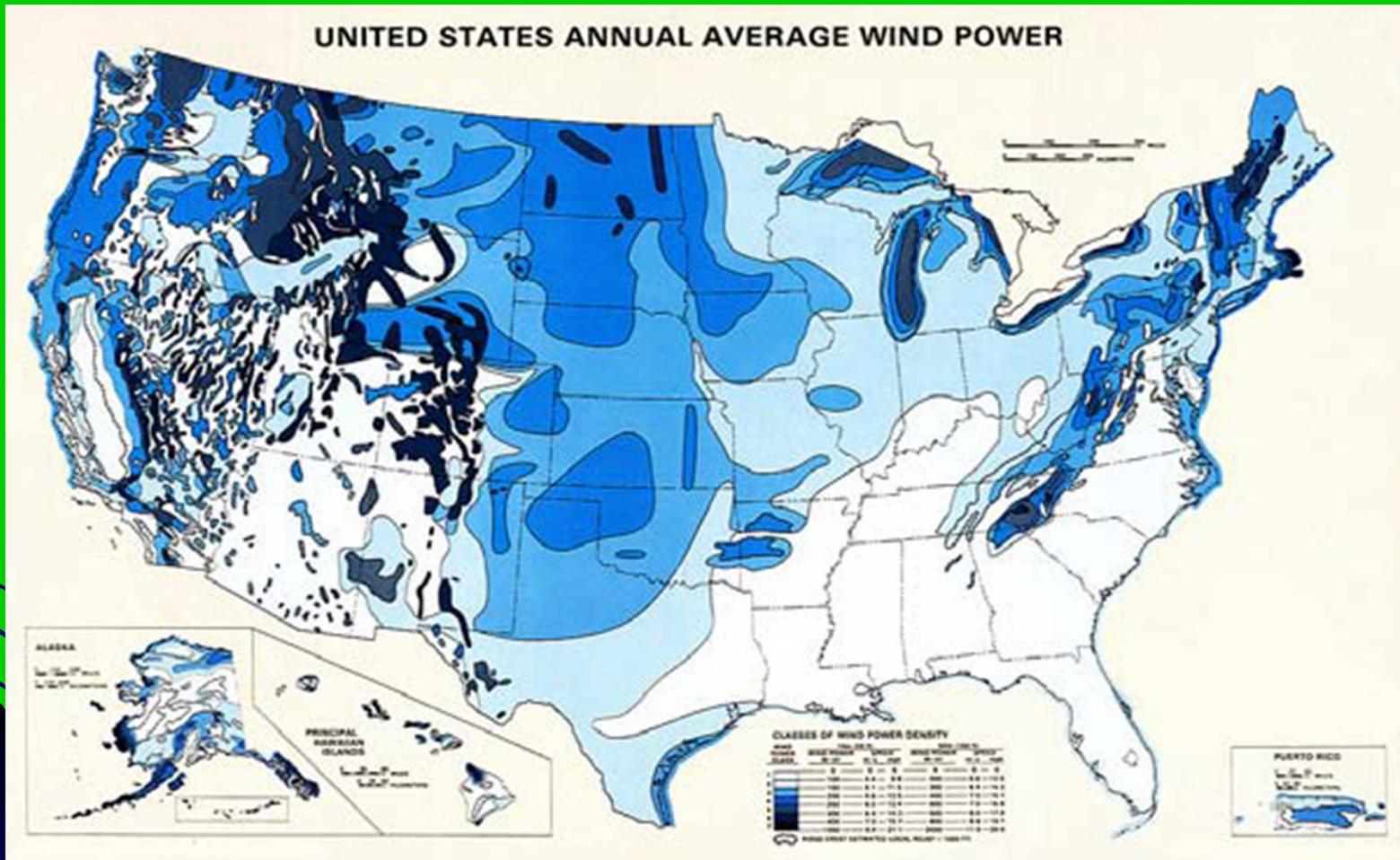
# The Vision

## National Renewable Energy Grid



<http://www1.eere.energy.gov/windandhydro/pdfs/41869.pdf>

# The Vision National Renewable Energy Grid

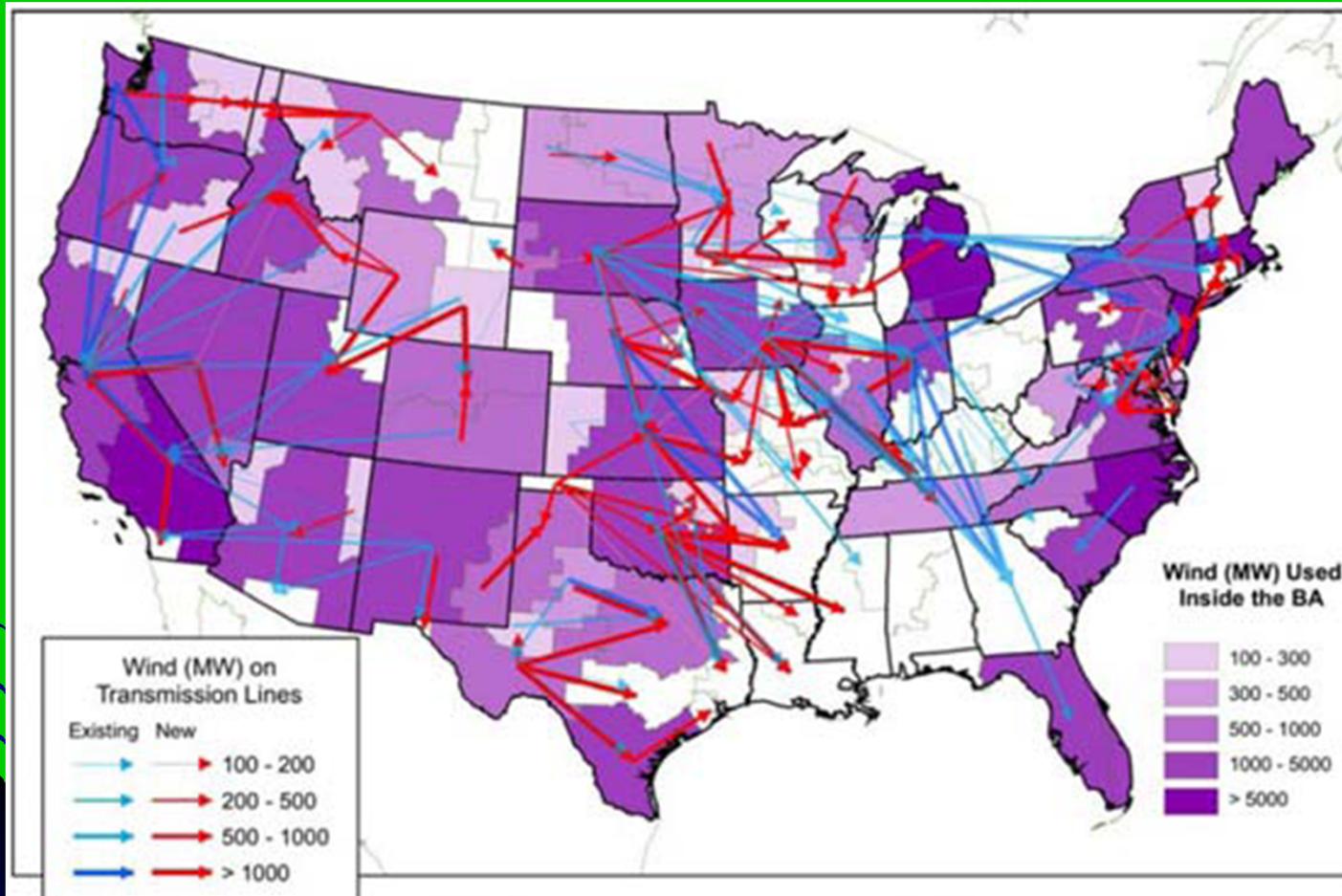


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## National Renewable Energy Grid



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# The Vision

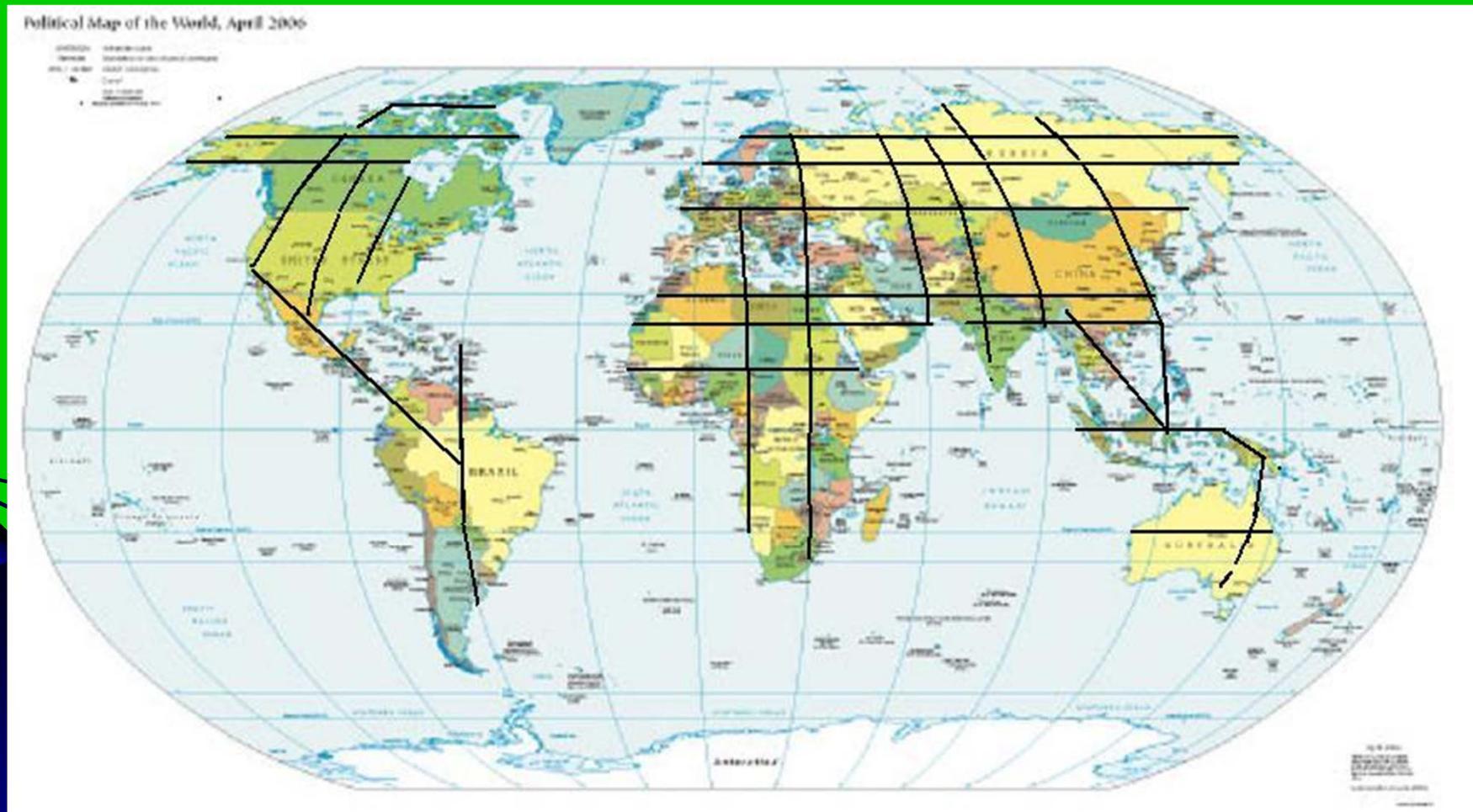
## National Renewable Energy Grid

### National Renewable Energy Transmission Fund



# The Vision

## Global Renewable Energy Grid



# *The Vision*

## *Global Renewable Energy Grid*

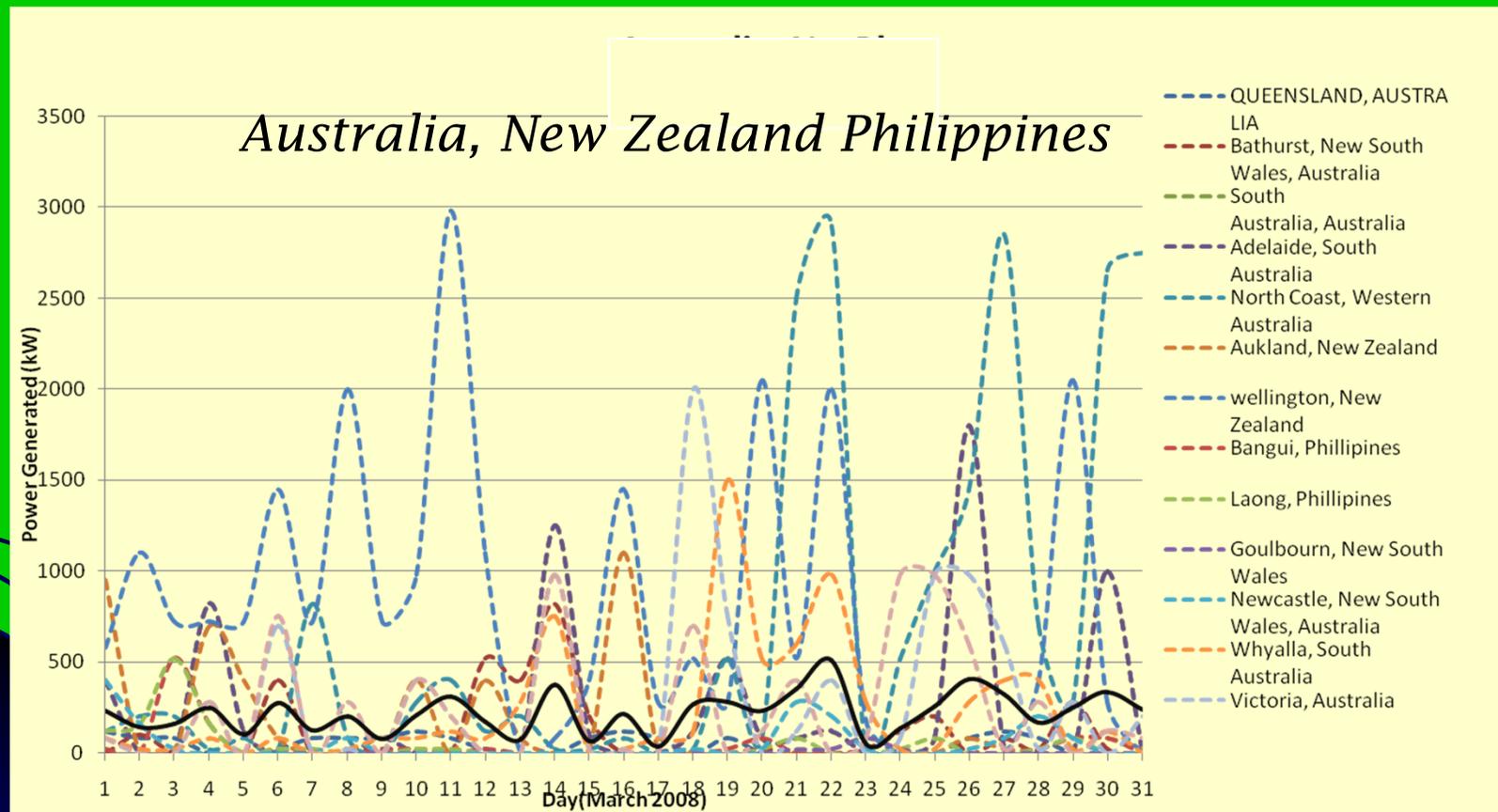
*Wind data studied for five regions- March 2008*

- Australia, Philippines, New Zealand*
- Central Africa*
- India*
- Russia*
- Scandinavia*



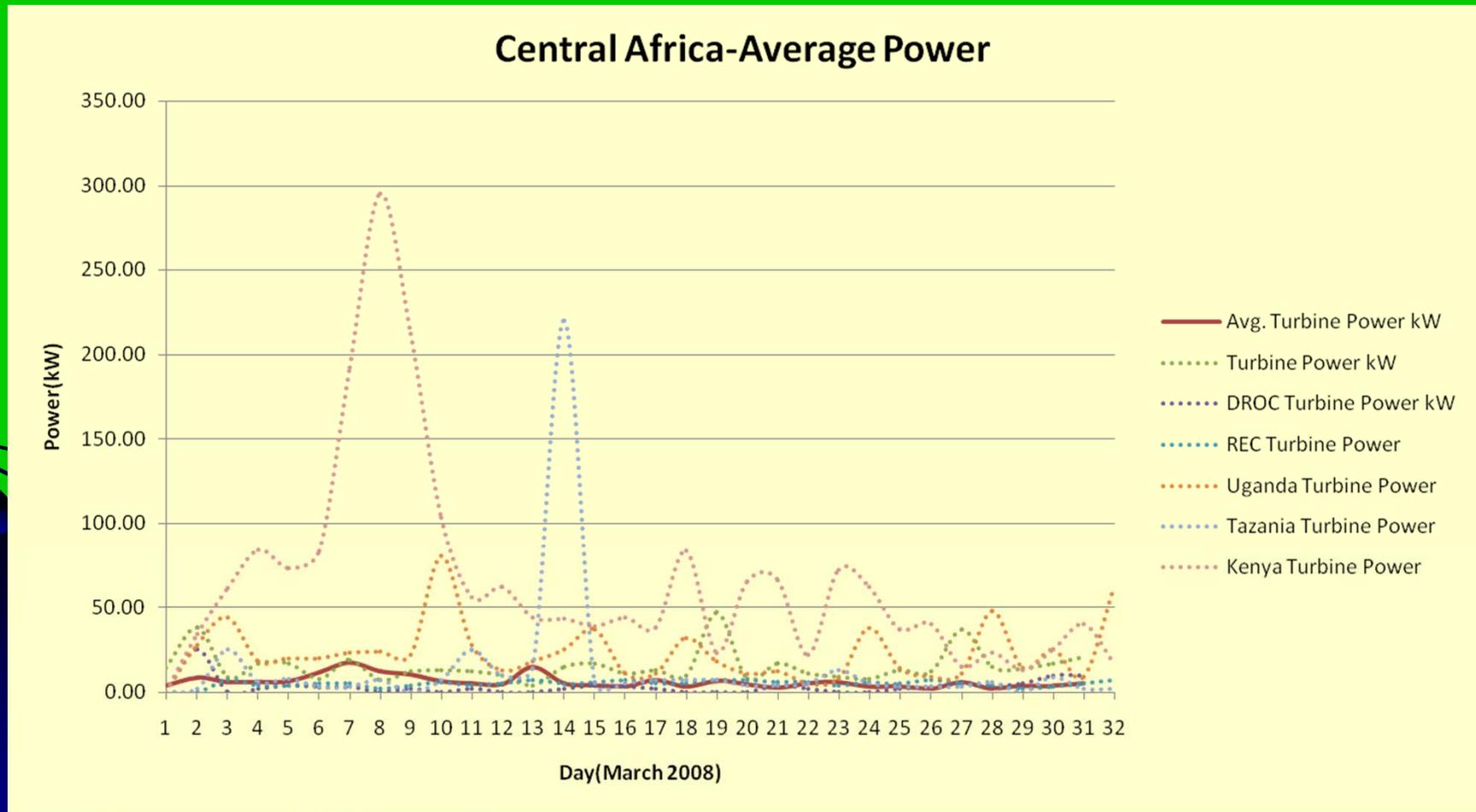
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## Global Renewable Energy Grid



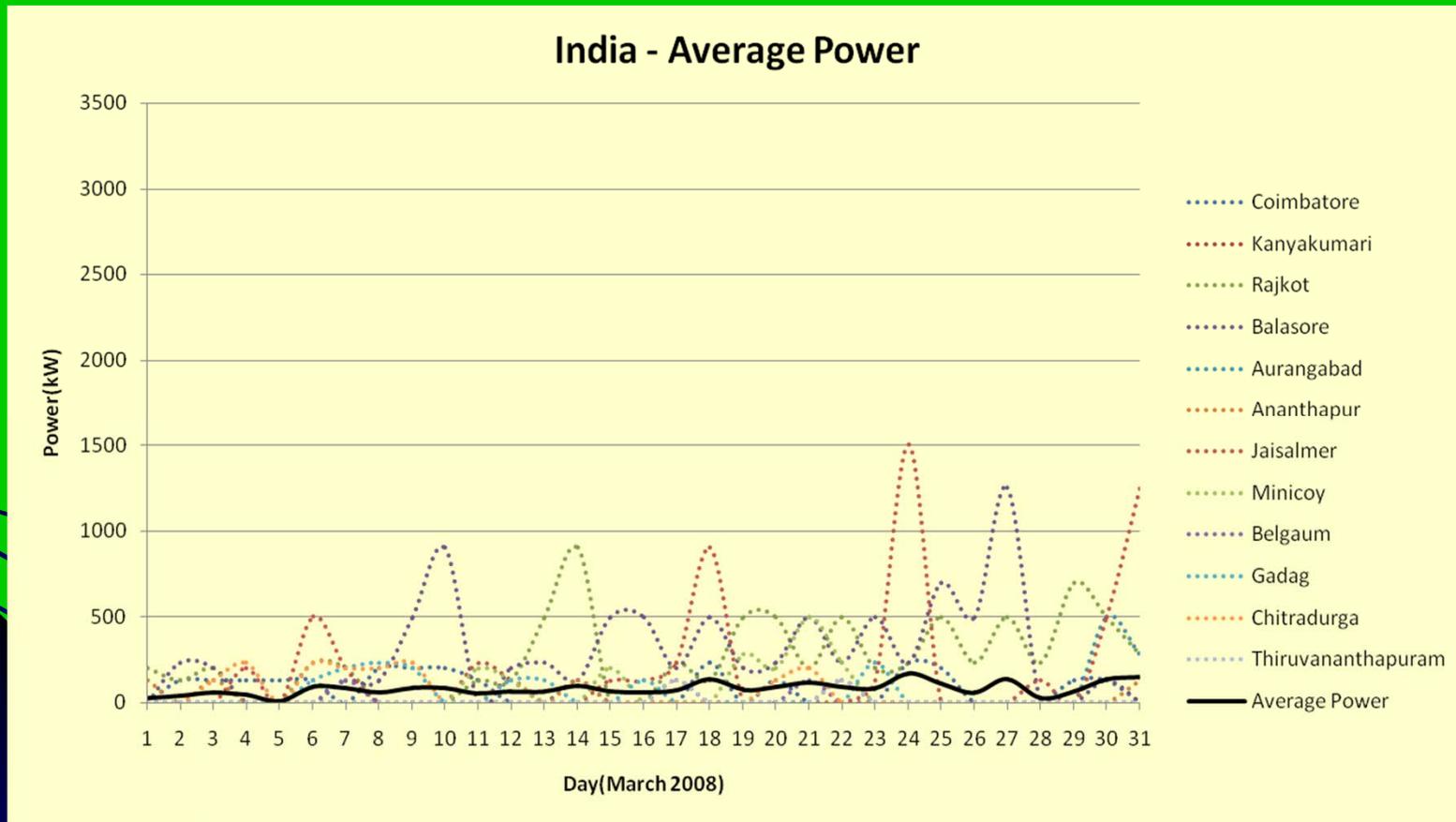
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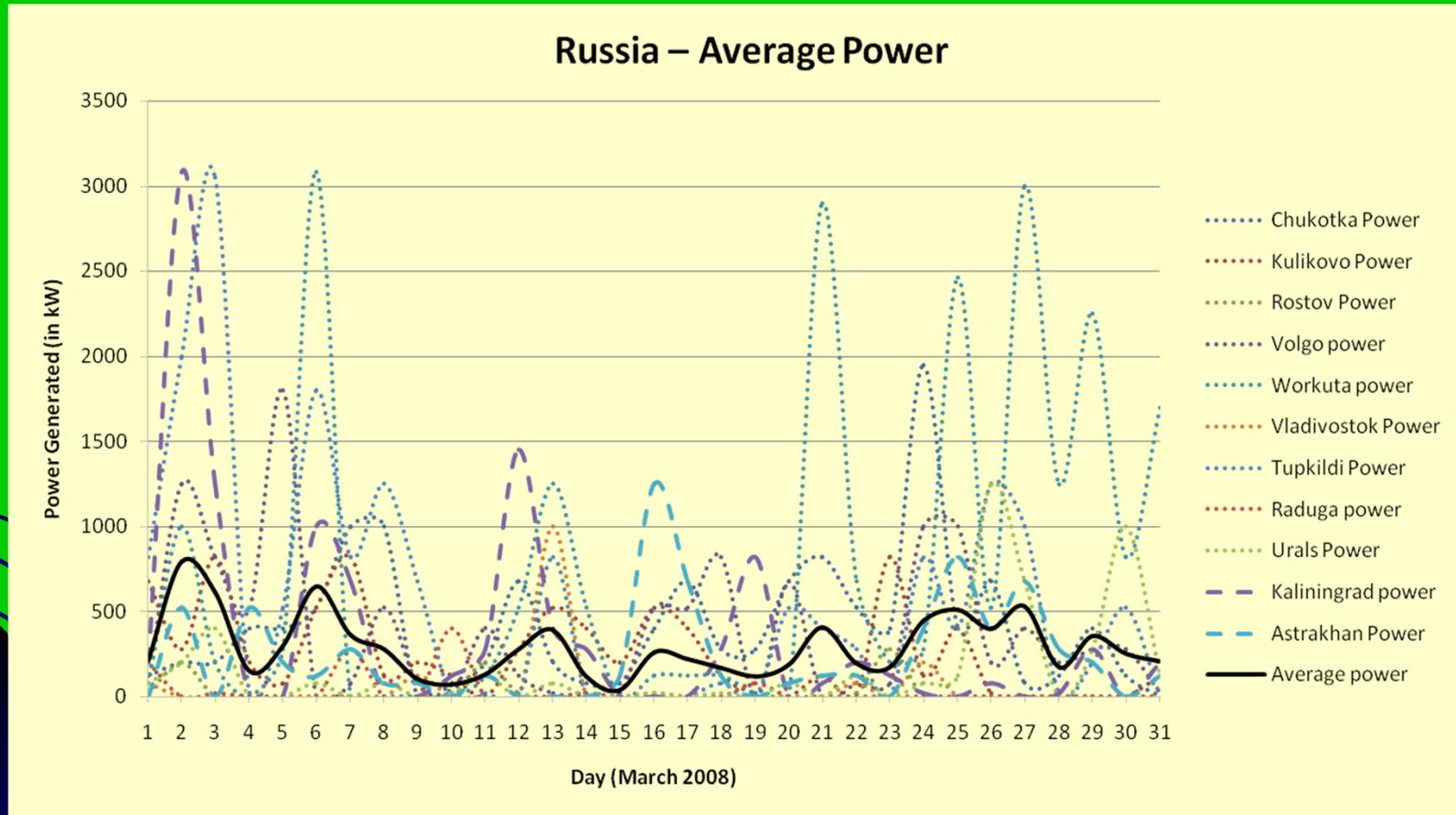
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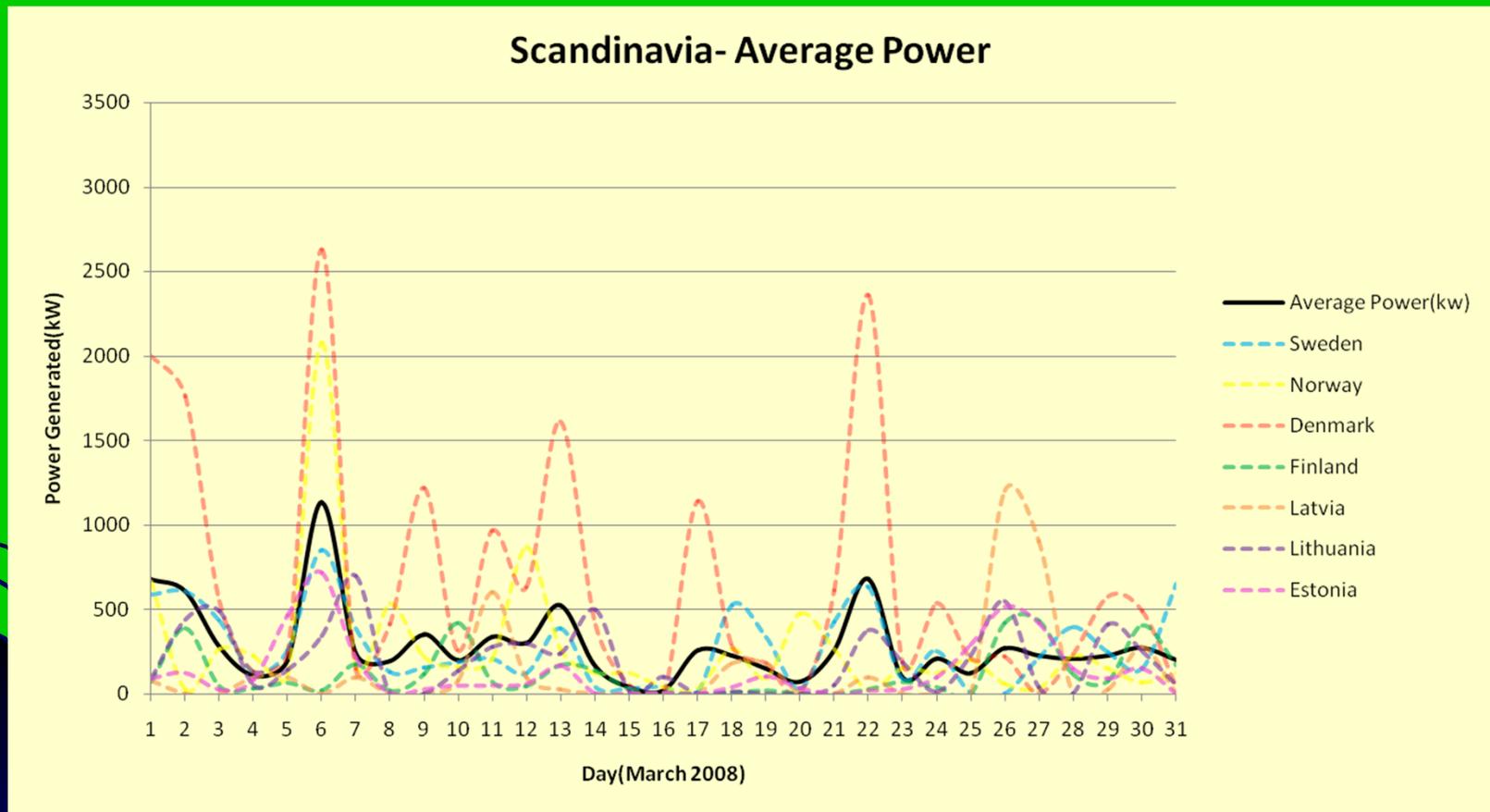
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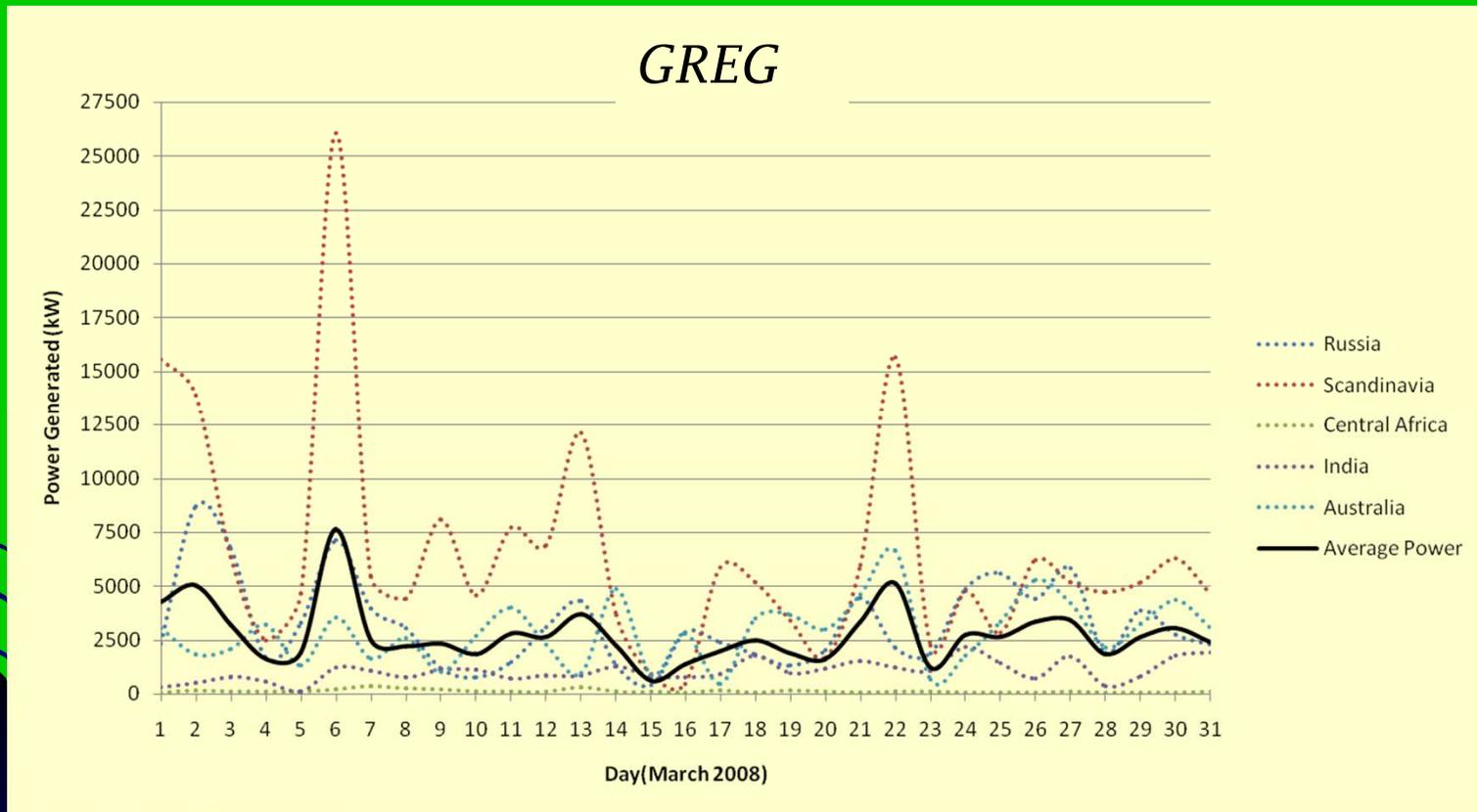
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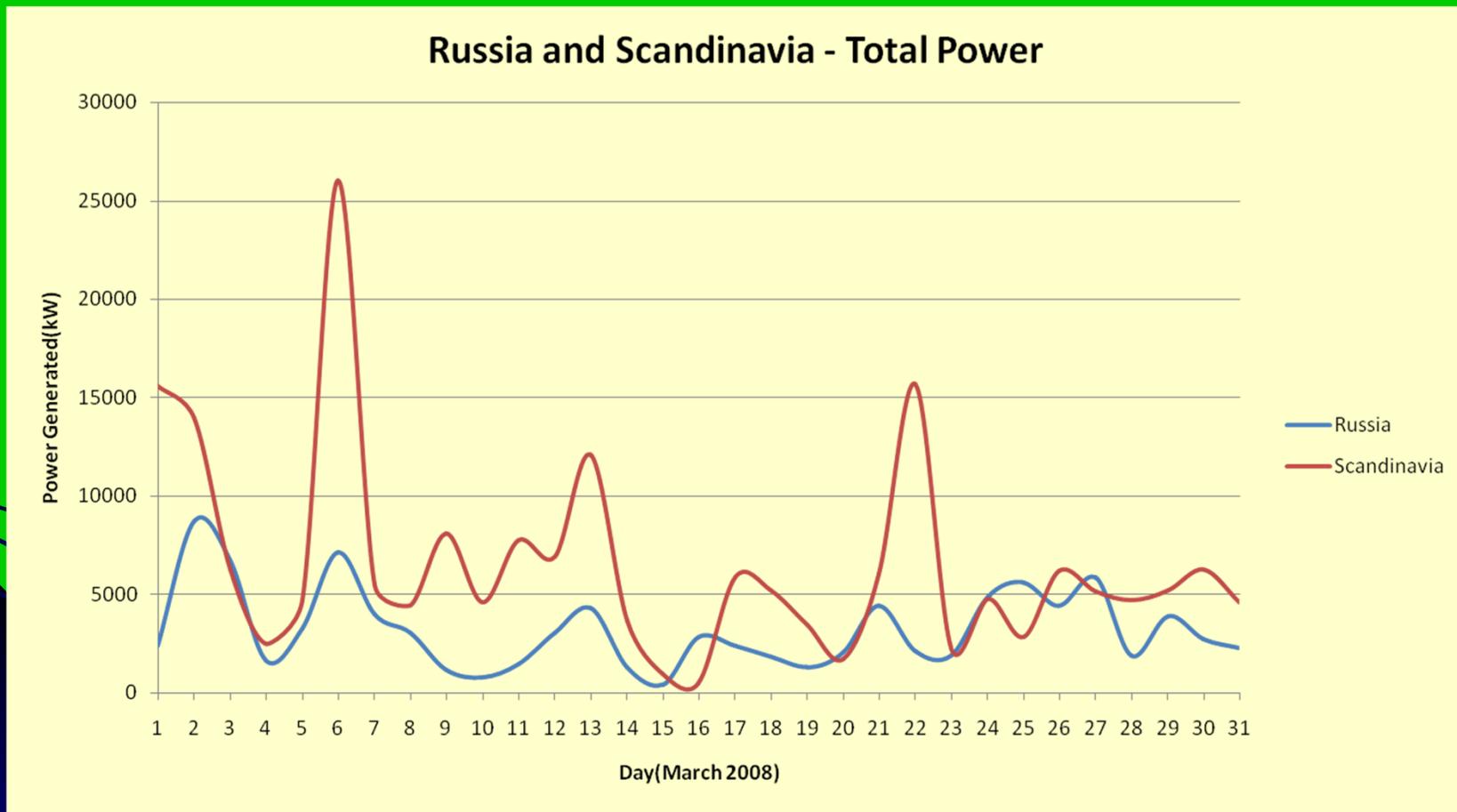
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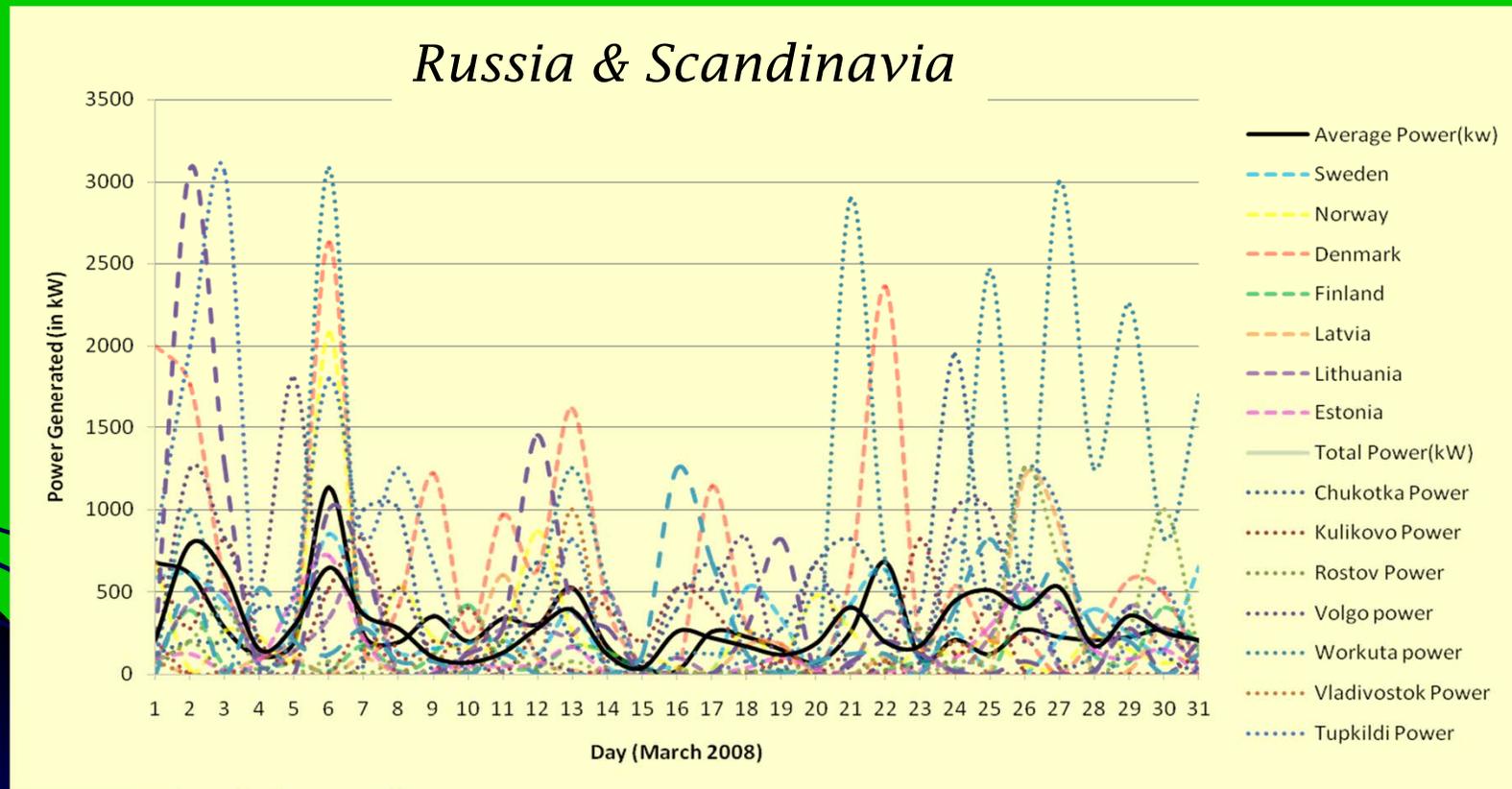
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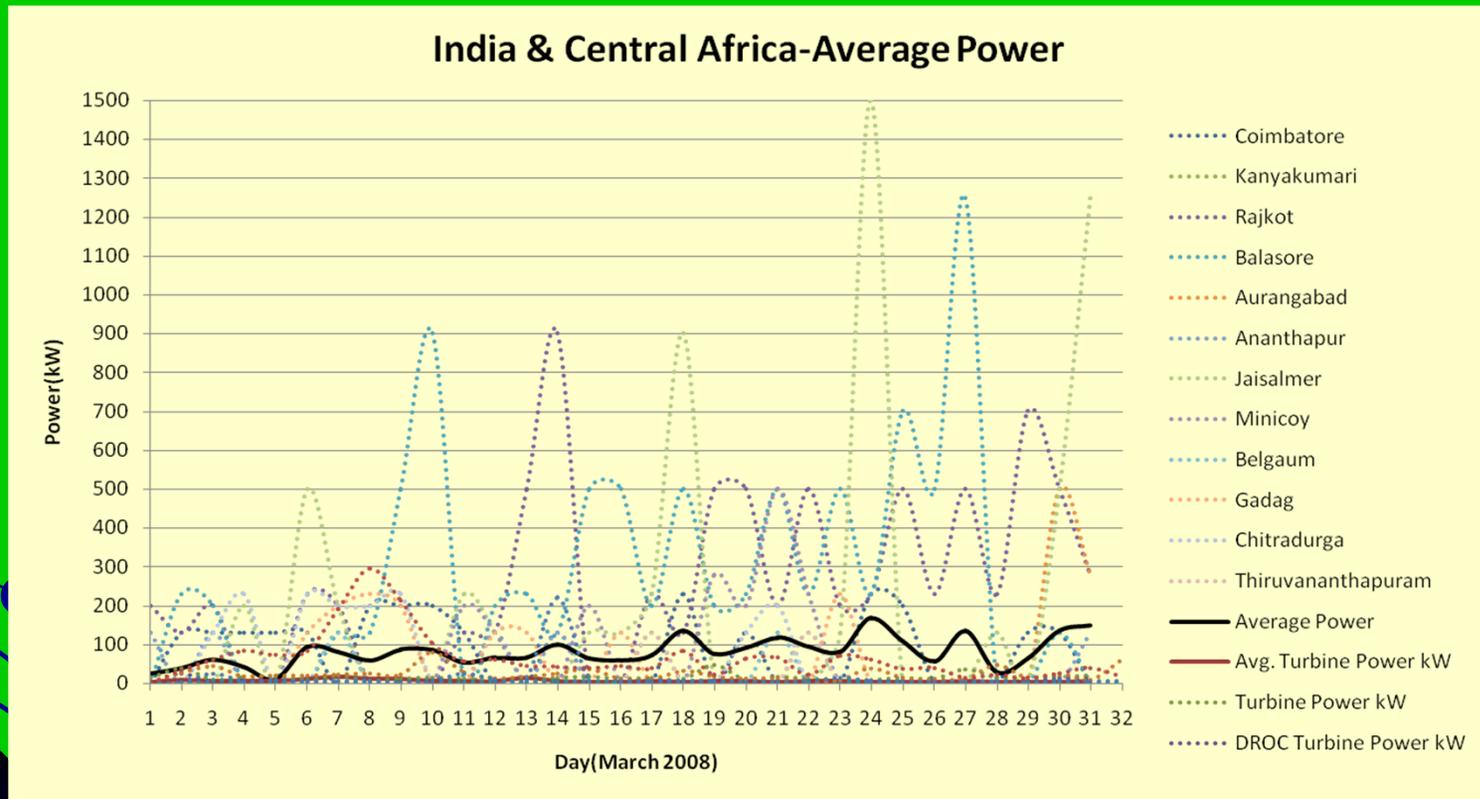
# The Vision

## Global Renewable Energy Grid



# The Vision

## Global Renewable Energy Grid



# *The Research*

*ANN based peak power shaver for intelligent substations*

*ANN based fault detection for HV transmission lines with thyristor controlled series capacitors*

*Solid-state circuit breakers [SSCB] for AC and DC power delivery systems*

*Optimal higher frequency interface between wind turbines & the grid*





*You see things, and say,  
“Why?”*

*But I dream of things  
that never were,  
and say, “Why not?”*

*George Bernard Shaw  
Back to Methuselah [circa 1921]*

## References

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G. A. Carpenter and S. Grossberg; “*The ART of adaptive pattern recognition by a self-organizing neural network*”, IEEE Computer, March 1988, pp.77-88.

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