

2030 Distributed Electricity Environment

- independent, sustainable, and sassy

International Student Energy Summit

Presented by Steve Pullins, Modern Grid Team

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“A little revolution now and
then is a good thing.”

- *Thomas Jefferson, 1787*

Smart Grid video



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Stressing the System - Change



Baseload
Power

Need for Demand
Response (DR)

Peaking
Power

Variable Power from
Wind / Solar Farms

Small Wind
Solar
DG
PHEV / EV



Continued geo-
growth in urban /
suburban areas

Continued increase in energy
intensity (kwh/capita)

Changeover to more and
more digital loads

Consumer choices

Prices increasing, in some regions
faster than gasoline at the pump



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- **Consumer engagement with resources to solve power issues locally**
- **Two-way power flow in Distribution**
- **As prices increase, local renewables will increase in residential, commercial, and industrial**
- **Imperative to transform from passive to active control in Distribution**
- **New ways for Distribution to become a Transmission resource**



- **Technologies that enable two-way power flow control**
- **Technologies that ease the consumer integration to grid operations**
- **Technologies that accommodate, offset, or manage the exponential operational complexity coming**
- **Technologies and strategies that enable safely, operating closer to design limits**
- **Technologies that enable better, cheaper sensing of all the above**
- **Broadband, secure, robust, wireless communications infrastructure for all the above**



The Smart Grid is “transactive” and will:

- *Enable* active participation by consumers
- *Accommodate* all generation and storage options
- *Enable* new products, services and markets
- *Provide* power quality for the digital economy
- *Optimize* asset utilization and operate efficiently
- *Anticipate & respond* to system disturbances (self-heal)
- *Operate* resiliently against attack and natural disaster

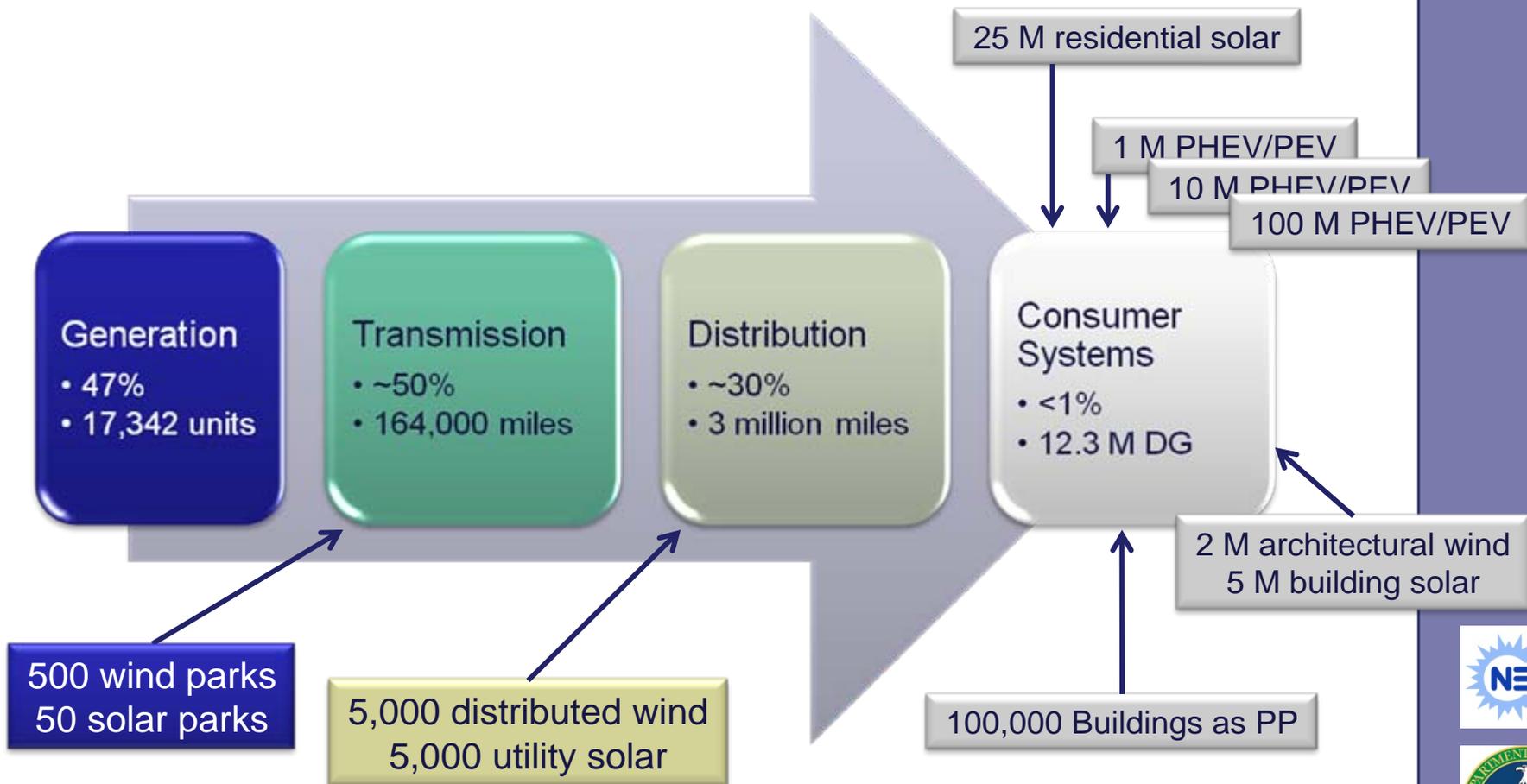


Under the “Business As Usual” approach over the next 20 years, the U.S. electric industry will spend more than \$5 trillion on fuel, capital construction, and consumer business losses.



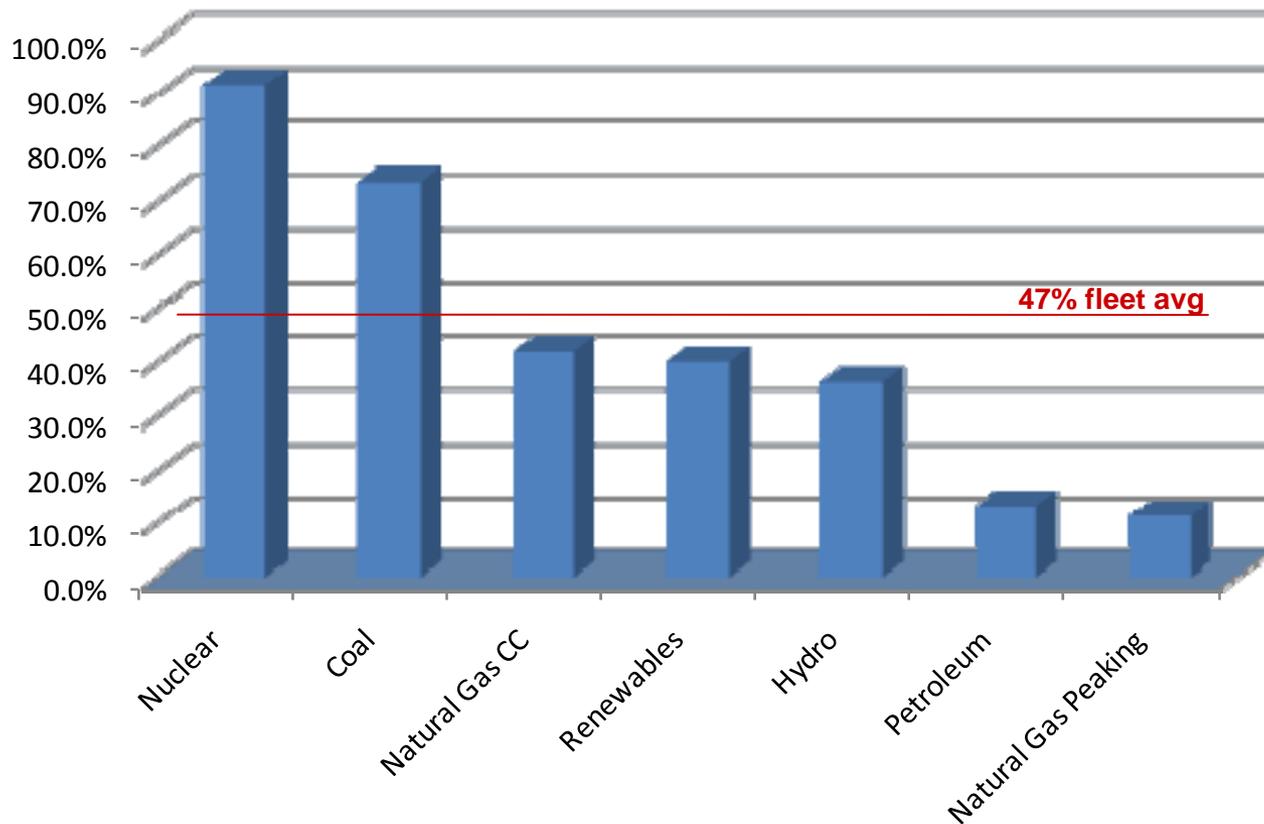
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2009 Electric Grid and then?



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Average Capacity Factor by Type

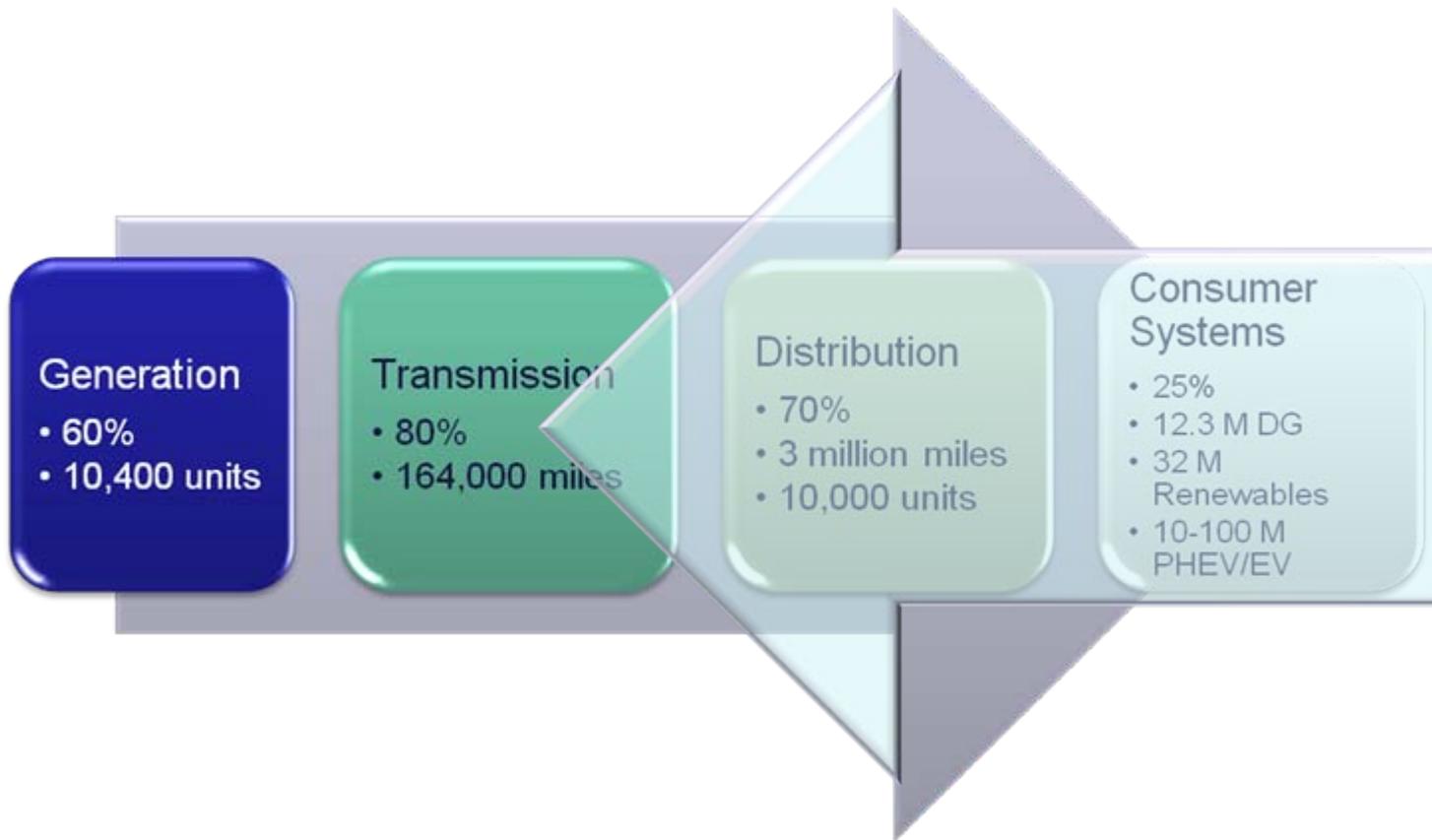


Source: EIA Electric Power Annual, Jan 2009



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2030 Electric Grid – One Scenario

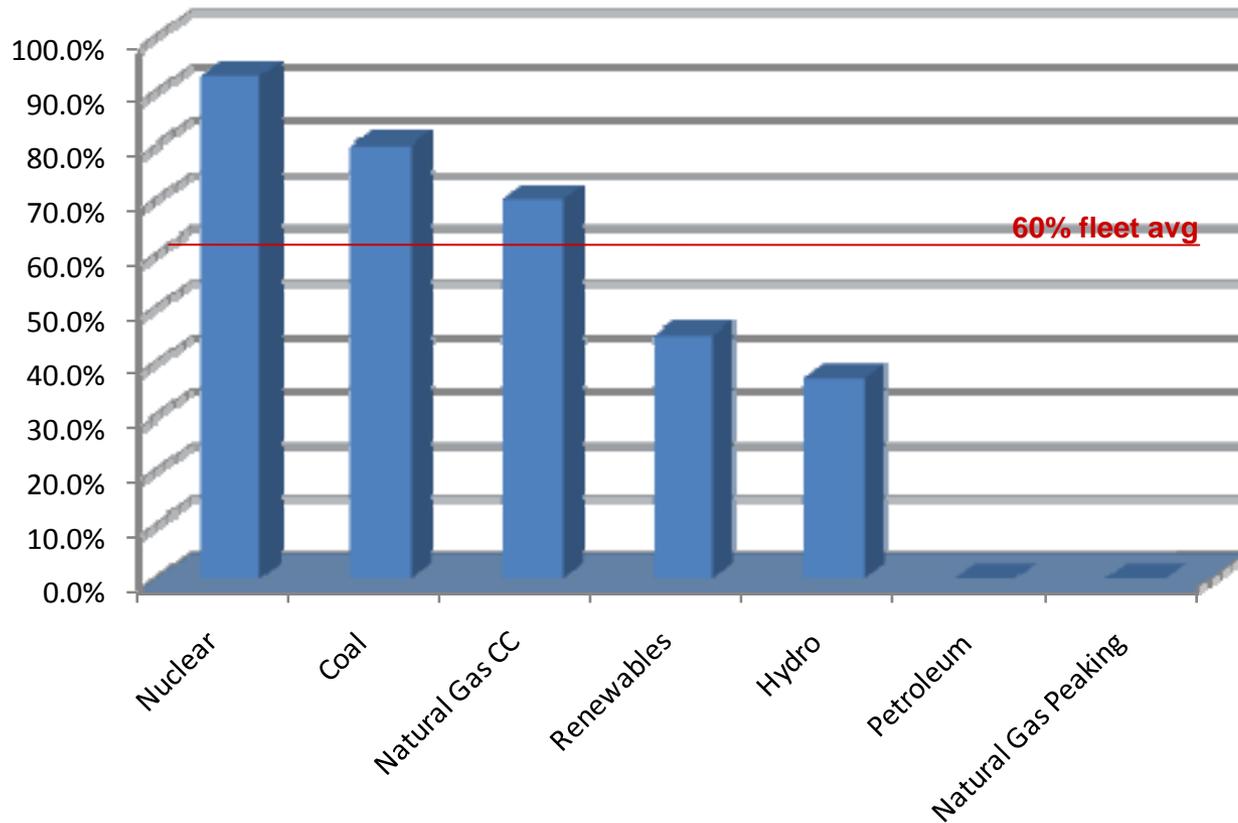


A much more efficient system with a lower carbon footprint than 2009.



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Average Capacity Factor by Type



A much more efficient system with a lower carbon footprint than 2009.



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McAdam's 2nd Theorem: Nothing is impossible which is currently taking place.

TRANSFORMING THE GRID

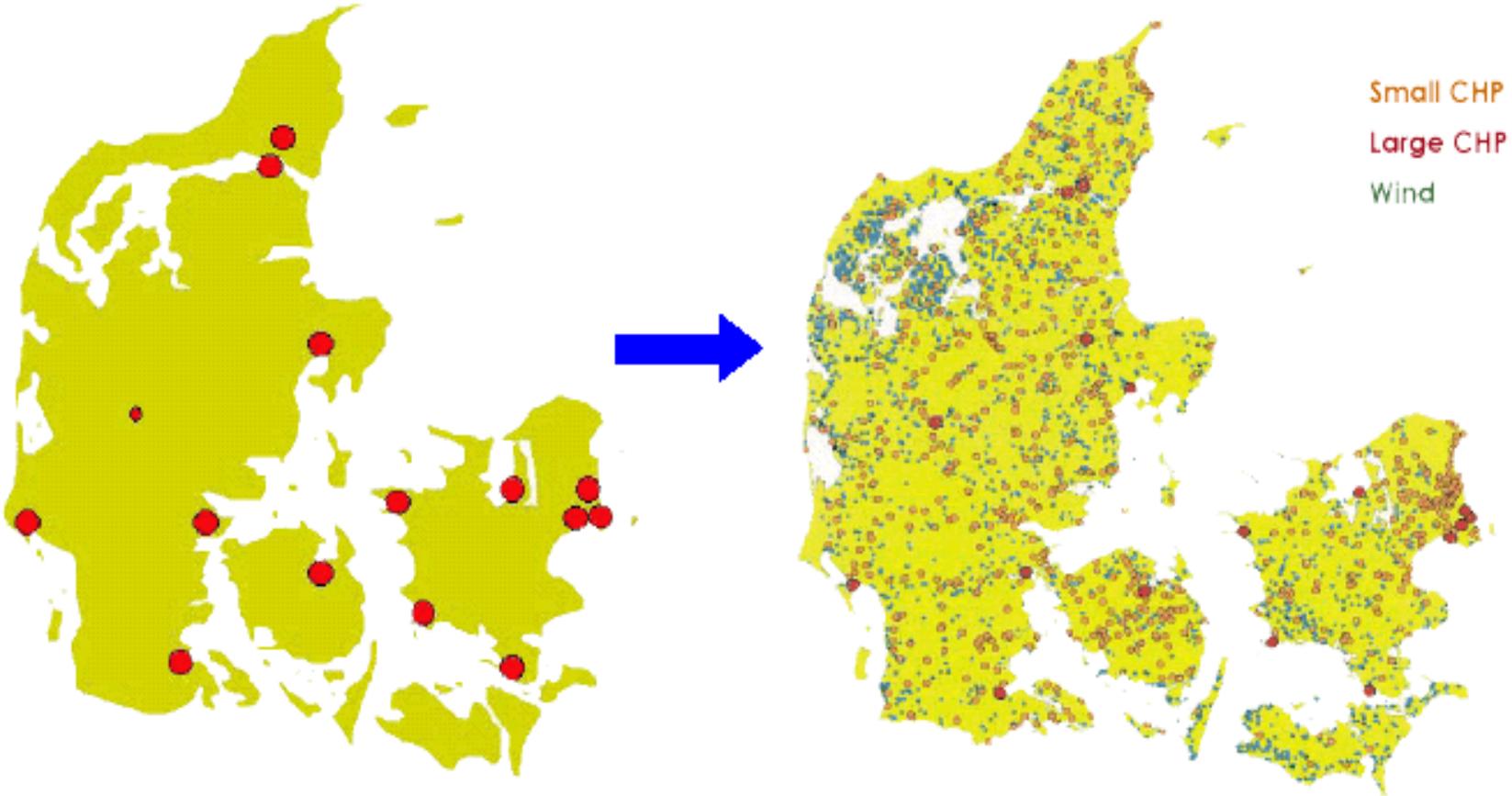


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Denmark Changed in Two Decades

Centralized System of the mid 1980's

More Decentralized System of Today

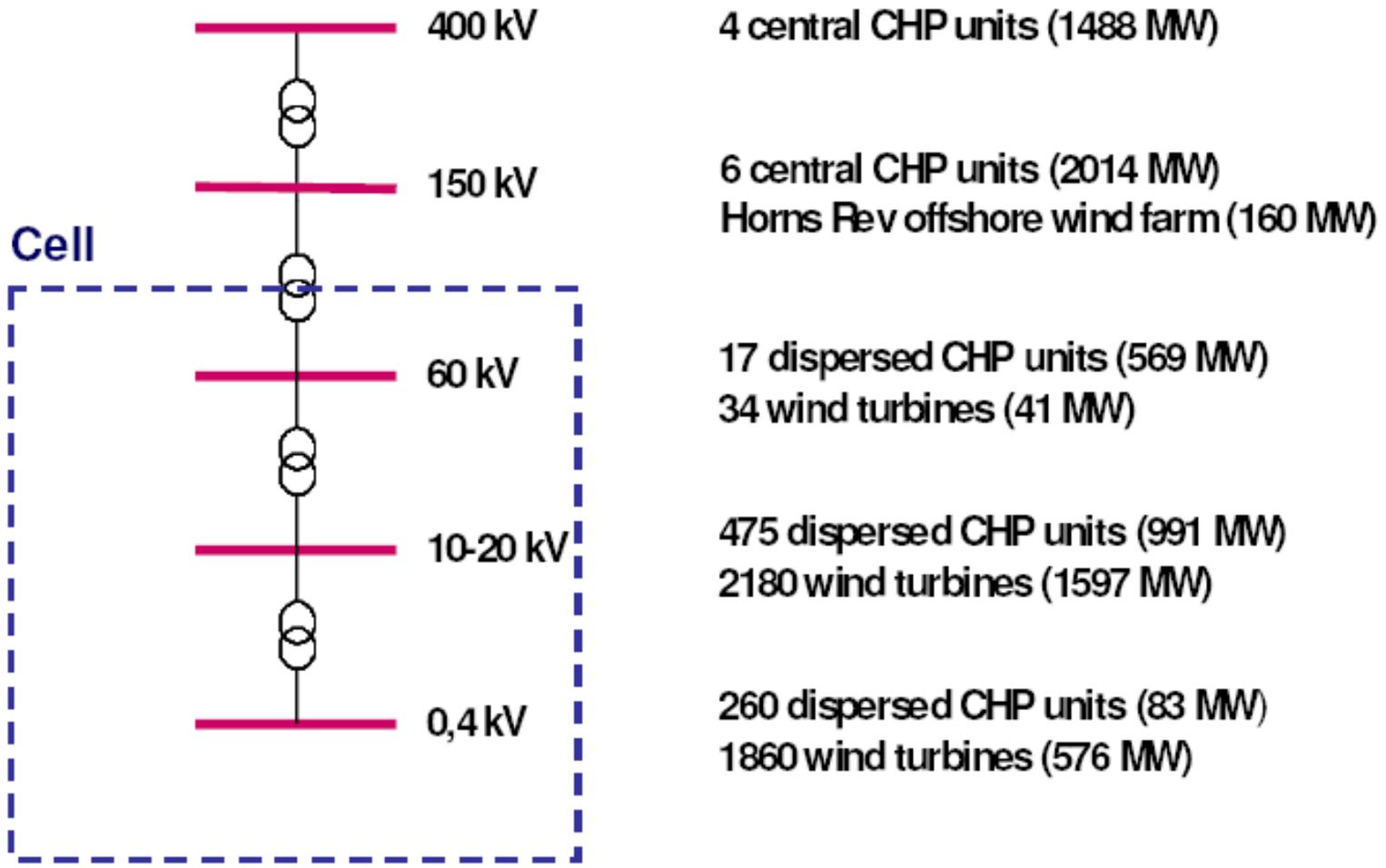


Source: Danish Energy Center

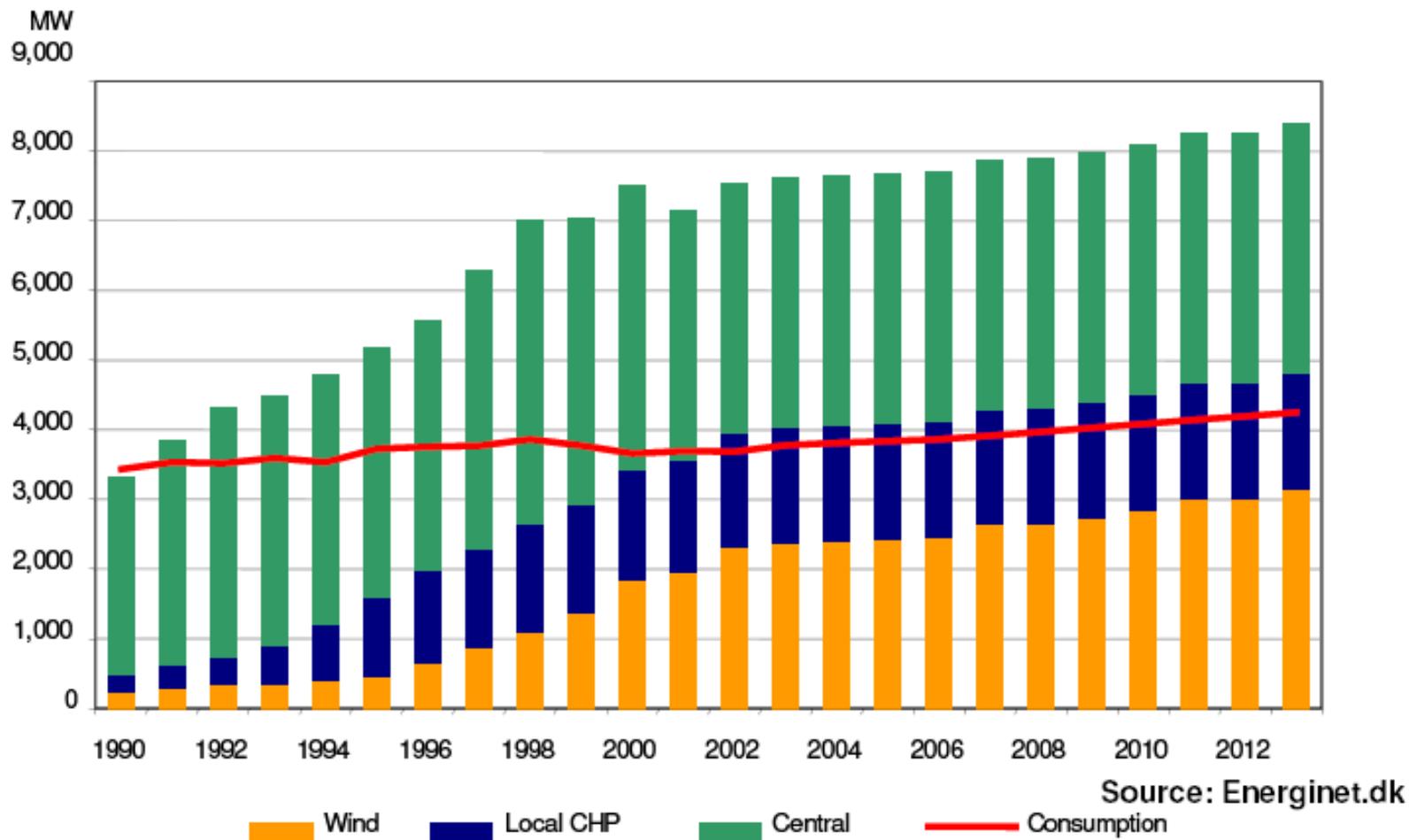


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Denmark DG Penetration and Cell Structure



Denmark Energy Contribution



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WHERE DOES THIS LEAD?



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- **Revamping the operating paradigm and culture**
- **Imperative for different policy and regulation**
- **Change from physically-centric technology to information-centric technology**
- **Education of everyone**
- **Different decision paradigm on capital resources with limited capital**
- **A different knowledge worker in the future marginalizing today's corporate knowledge**



Industry Staff Today

- Electro-Mechanical controls
- Large power plants
- High voltage transmission
- Construction
- Fossil and nuclear technologies
- Home grown applications
- Regulated rate making

Industry Staff Tomorrow

- Digital controls and web services
- Integration and interoperability of multiple systems
- Peer-to-peer and agent communities
- Wind and solar technologies
- Explosion of applications
- Flexible and complex rate structures

Opportunity for entry and creativity.



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- **A distributed electricity environment will:**
 - Support energy independence
 - Lower the carbon footprint
 - Support a better sustainable business climate
 - Create flexibility and new businesses
- **The change will be radical, revolutionary, and necessary for economic survival**
- **Information, innovation, and integration will rule the industry**
- **The next 20 years will be fun!**



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For additional Information, contact

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<http://www.netl.doe.gov/moderngrid>

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Links:

- [The Modern Grid Strategy](#)
- [Smart Grid Newsletter](#)
- [EPRI Intelligrid](#)
- [Galvin Electricity Initiative](#)
- [GridWise Alliance](#)
- [GridWise Architecture Council](#)
- [European SmartGrid Technology Platform](#)



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