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Introduction to the Smart Grid

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Greening of the Electric Grid Symposium

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Structure of Present Electrical Power System

The present power system structure comprises:

- Large Centralized Generating Plants
- Primarily Fossil-Fueled (mostly coal and natural gas but also some oil) (70%) and some Nuclear and Hydropower (approx. 30%)
- A few large-scale utility companies
- Long transmission lines
- An interconnected utility grid

Structure of Present Electrical Power System (cont'd)

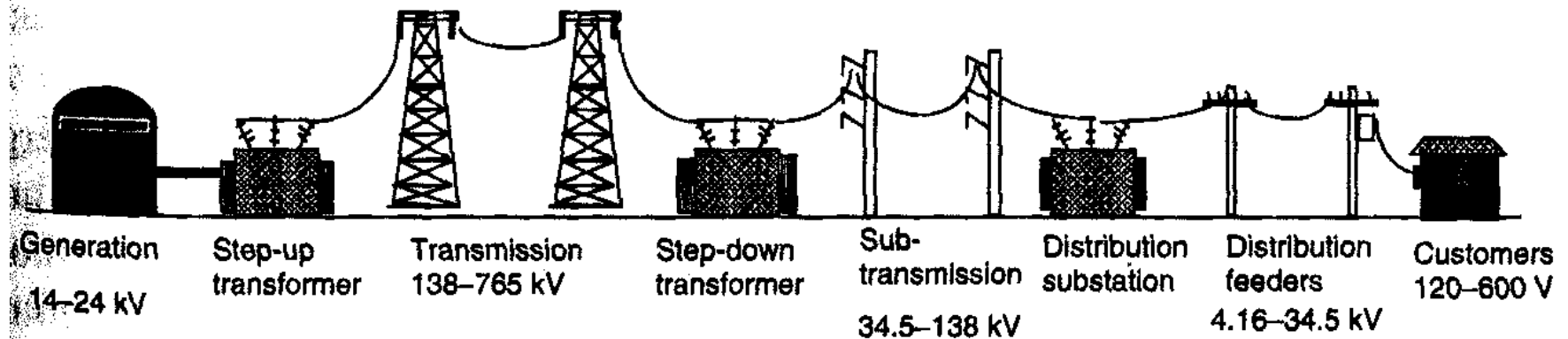
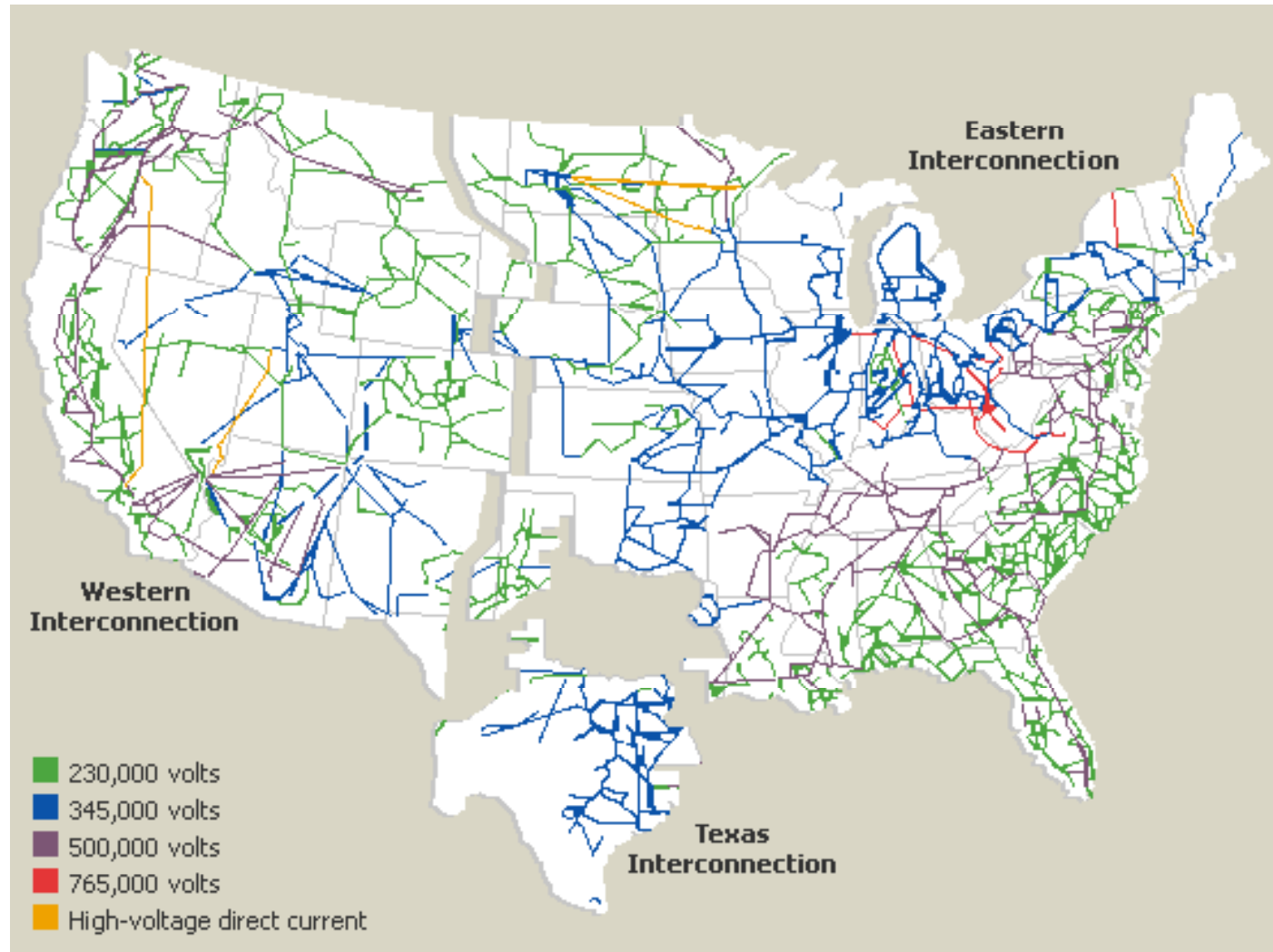


Figure 3.1 Conventional power generation, transmission, and distribution system.

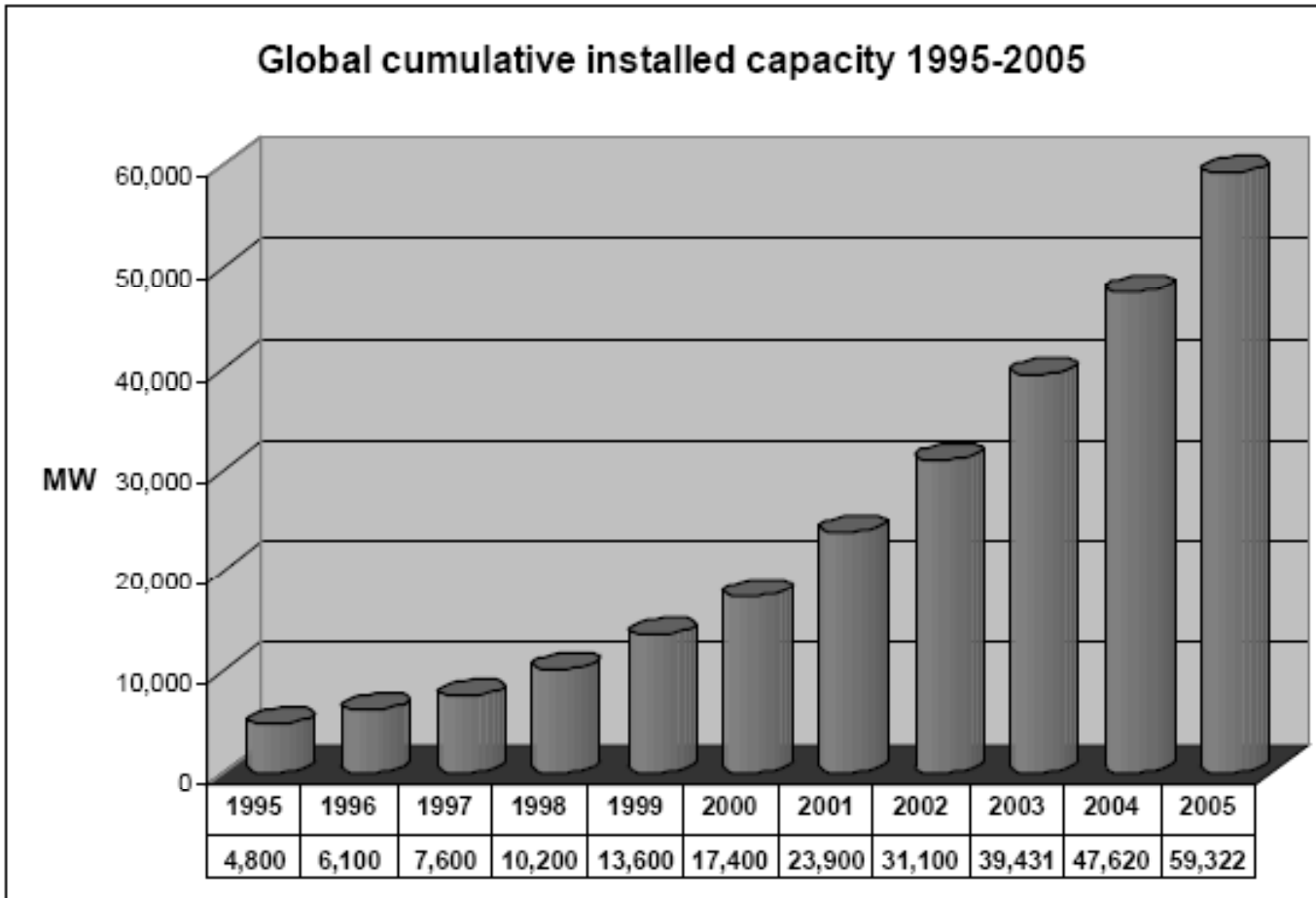
Ref: “Renewable and Efficient Energy Systems”, G. Masters

National Electric Grid



Ref: MSN Encarta

Installed Wind Capacity is Growing Worldwide

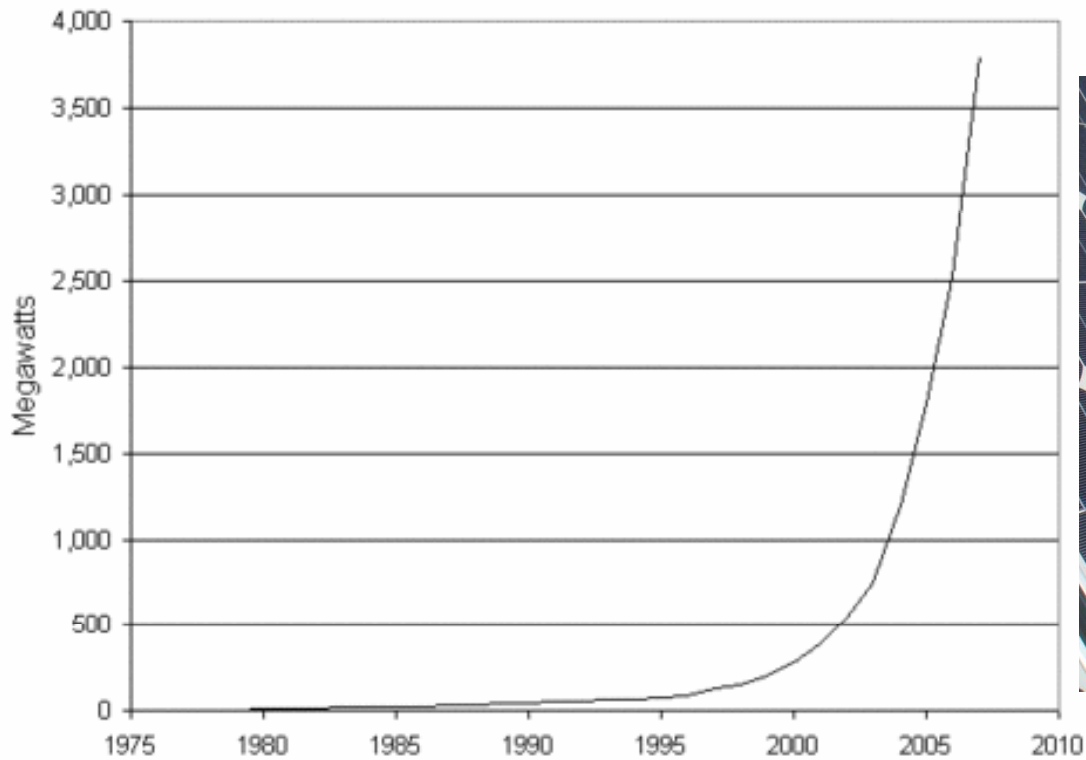


Offshore Wind Farm
Aalborg, Denmark

Source: European Wind Energy Association

Annual Solar Cell Production

World Annual Photovoltaic Production, 1975-2007



Source: Worldwatch; Prometheus Institute; REN21



Solar Panels on CEER

Federal Policy Framework for Spurring Renewable Energy Markets

- Energy Policy Act of 2005
 - RFS – 7.5B gallons by 2012
 - Tax credits
 - Extends production tax credit through 12/31/07 for wind and other facilities
 - Residential and commercial property solar tax credits
 - Alternative vehicle credits
- USDA Section 9006 Renewable Energy Program

Courtesy: Susan Hock, National Renewable Energy Laboratory

Federal Policy Framework for Spurring Renewable Energy Markets (cont'd)

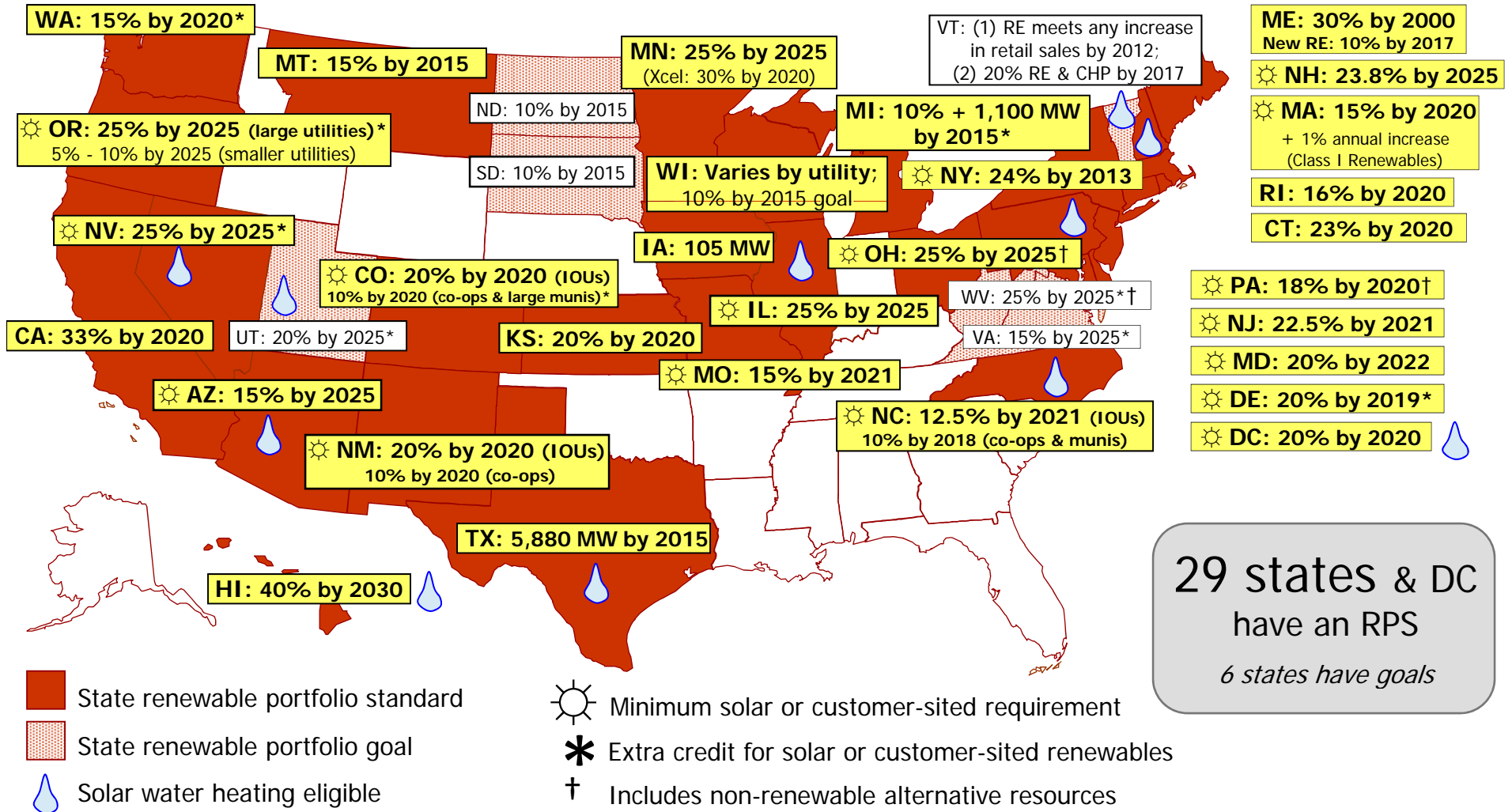
Established by the federal *Energy Policy Act of 2005*, the federal tax credit for residential energy property initially applied to *solar-electric systems, solar water heating systems and fuel cells*. [The Energy Improvement and Extension Act of 2008](#) (H.R. 1424) *extended the tax credit to small wind-energy systems and geothermal heat pumps, effective January 1, 2008*. Other key revisions included an *eight-year extension of the credit to December 31, 2016*, the ability to take the credit against the alternative minimum tax, and the *removal of the \$2,000 credit limit for solar-electric systems beginning in 2009*. The credit was further enhanced in February 2009 by [The American Recovery and Reinvestment Act of 2009](#) (H.R. 1: Div. B, Sec. 1122, p. 46), which *removed the maximum credit amount for all eligible technologies* (except fuel cells) placed in service after 2008.

http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US37F&re=1&ee=1

State Mandates for Renewables

Renewable Portfolio Standards

www.dsireusa.org / November 2009



29 states & DC have an RPS
6 states have goals

Issues and Opportunities

- **Technologies** (e.g. energy storage, smart appliances, communication devices, advanced controls)
- **Standards** (e.g. interconnection, power quality, smart meters, etc.)
- **New energy trading models**
- **Energy planning and control with intermittent sources**
- **Power network security**

... and many more!