

Integrated Resource Planning (IRP) for Renewables Options

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Industry Trends Suggest a Different Future

- The national average in reliability metrics over the last 5 years shows a 3% per year increase in outage duration and 4% per year increase in outage frequency.
- The businesses in the average State lose more than \$1B annually in revenue from outages and power quality events.
- Modern infrastructure and technology-rich regions draw business to themselves, an important driver for municipal economic development.
- The business as usual approach to electricity supply in the average State will lead to a 50% increase in electric bills over the next 7 to 10 years.
- The States have little chance of developing a renewables portfolio without the foundation supplied by a Smart Grid.



The Need for Renewables

- By far, the body of evidence related to climate change, energy independence and security, investment strategy, and consumer expectations strongly suggest that renewable power sources are an important part of the future of the US electricity industry.
- The recent IBM consumer survey “Plugging in the Consumer” found that “Almost 40 percent of consumers who can choose renewable energy do so – and more than 60 percent of those who do not currently have those options would like them.”



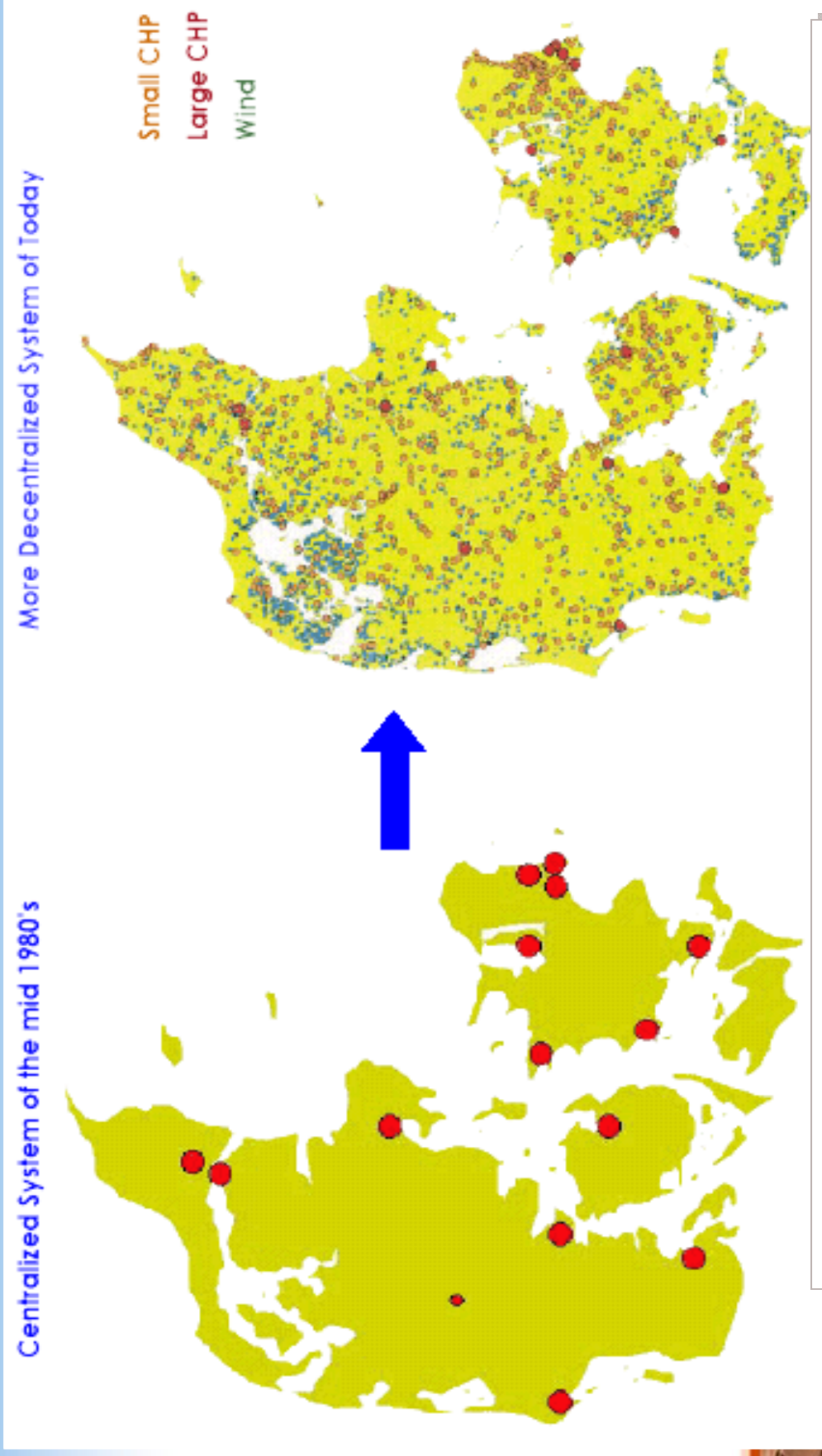
How Limiting are Variable Renewables?

- Wind farms have presented a challenge in most countries where penetration is measureable.

Region	Wind Penetration When Instabilities Identified / Experienced	Source
WECC / BPA	6%	Analysis
WECC / CAISO	3%	Analysis
Germany	12%	Actual
Austria	12%	Actual
Spain	13%	Actual
Denmark	32%	Actual



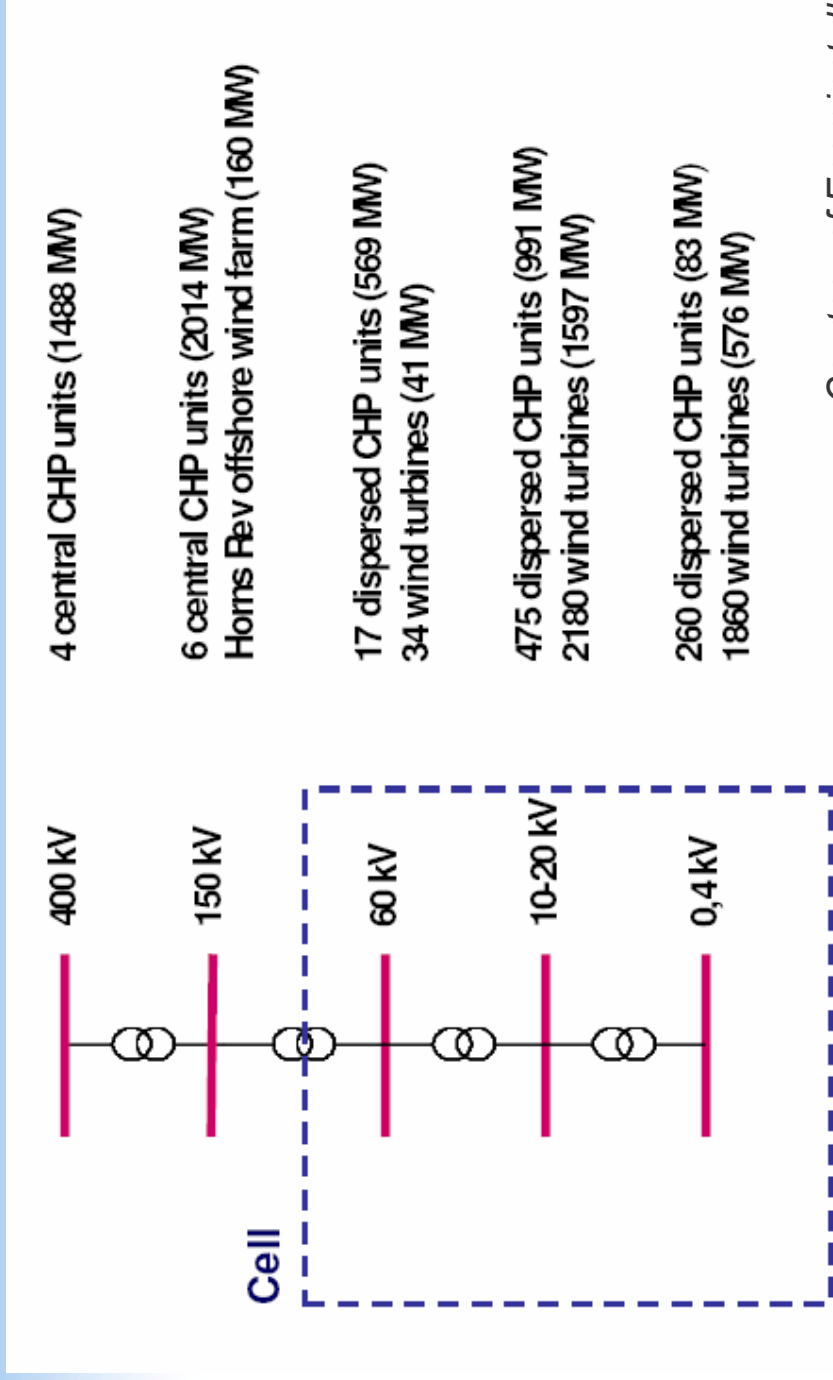
Denmark Changed in Two Decades



McAdams Second Theorem:

Nothing is impossible which is currently taking place.

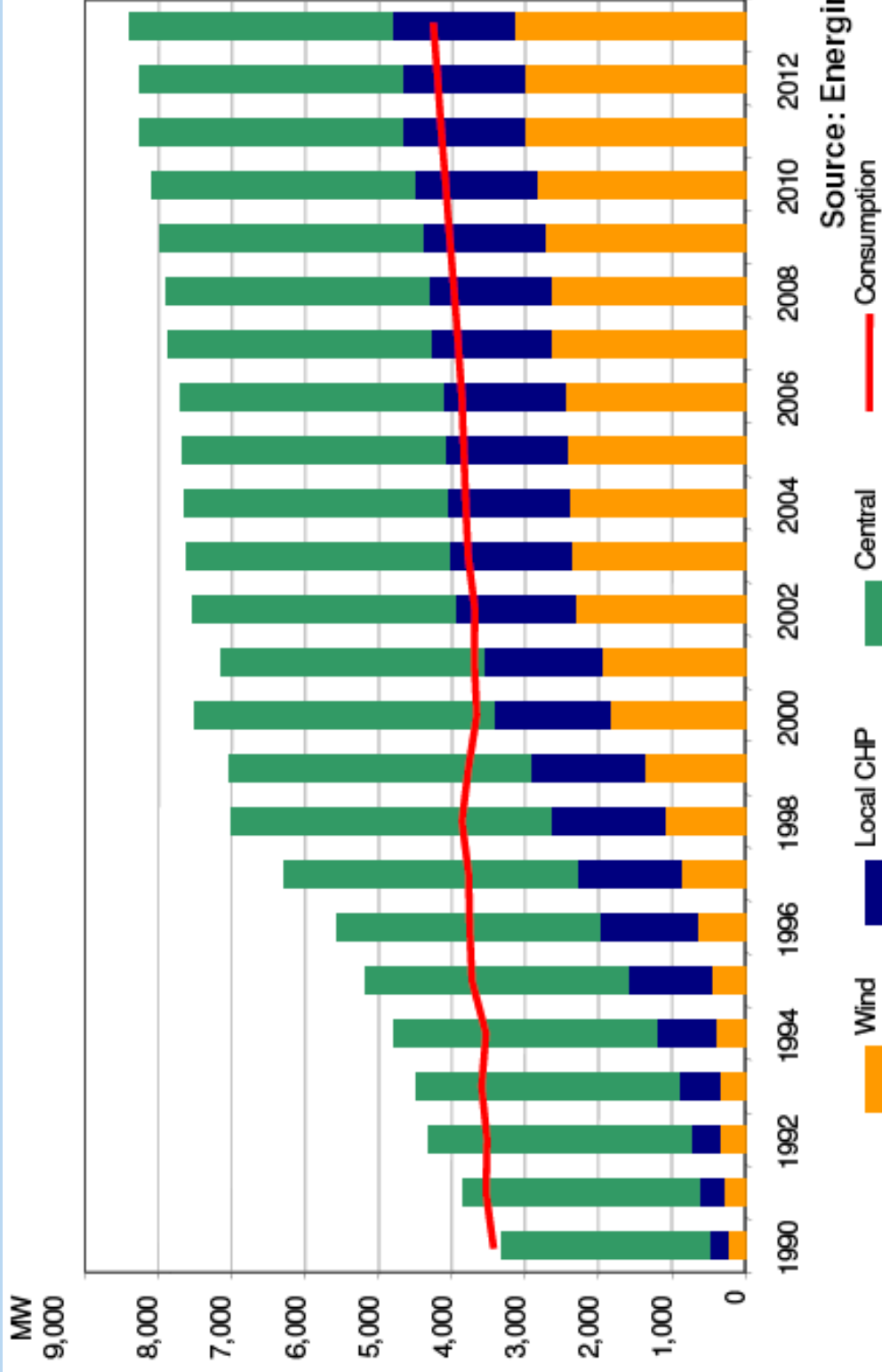
Denmark DG Penetration and Cell Structure



Courtesy of Energinet.dk and Spirae



Denmark Energy Contribution



The times, they are a changin'



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Renewables Growth


Renewable Portfolio Standards
Wind Resources in Use
Solar Resources in Use

Wind Power:

U.S. Installed Capacity (Megawatts)
1981-2005

Year	MW
1981	101
1982	70
1983	240
1984	597
1985	1,039
1986	1,222
1987	1,356
1988	1,396
1989	1,403
1990	1,525
1991	1,575
1992	1,584
1993	1,617
1994	1,656
1995	1,697
1996	1,698
1997	1,706
1998	1,848
1999	2,511
2000	2,578
2001	4,275
2002	4,686
2003	6,353
2004	6,725
2005	9,149

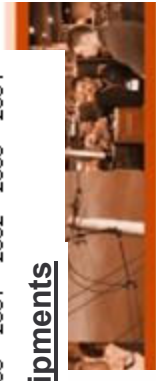
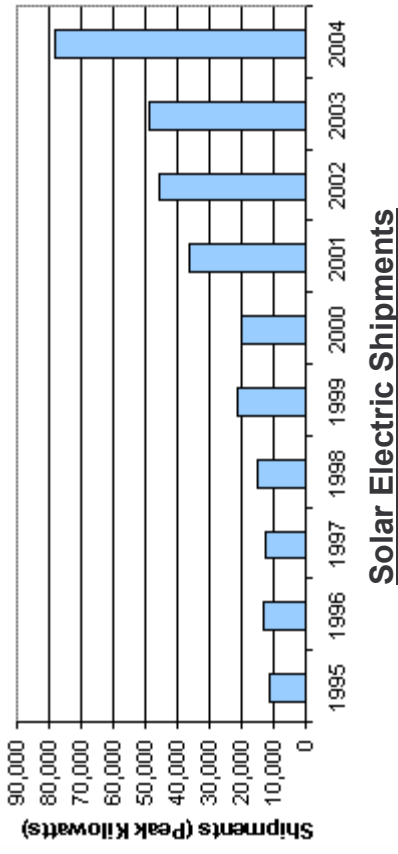
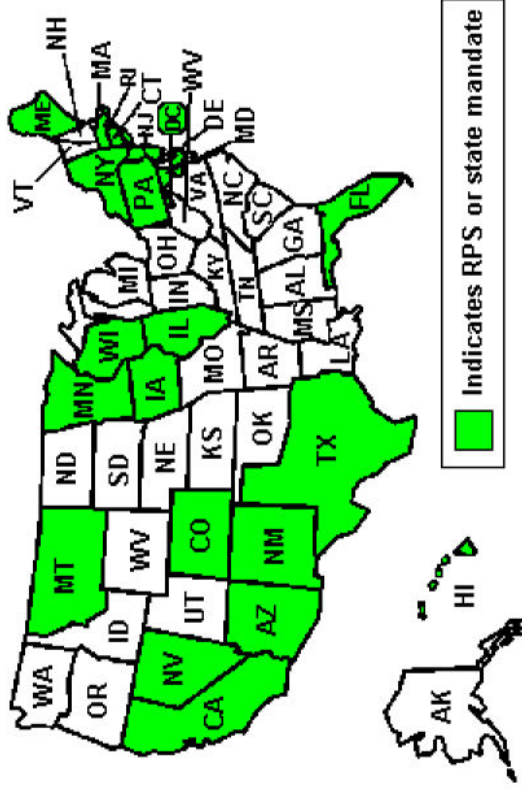


Sources: U.S. Department of Energy Wind Energy Program & AWEA

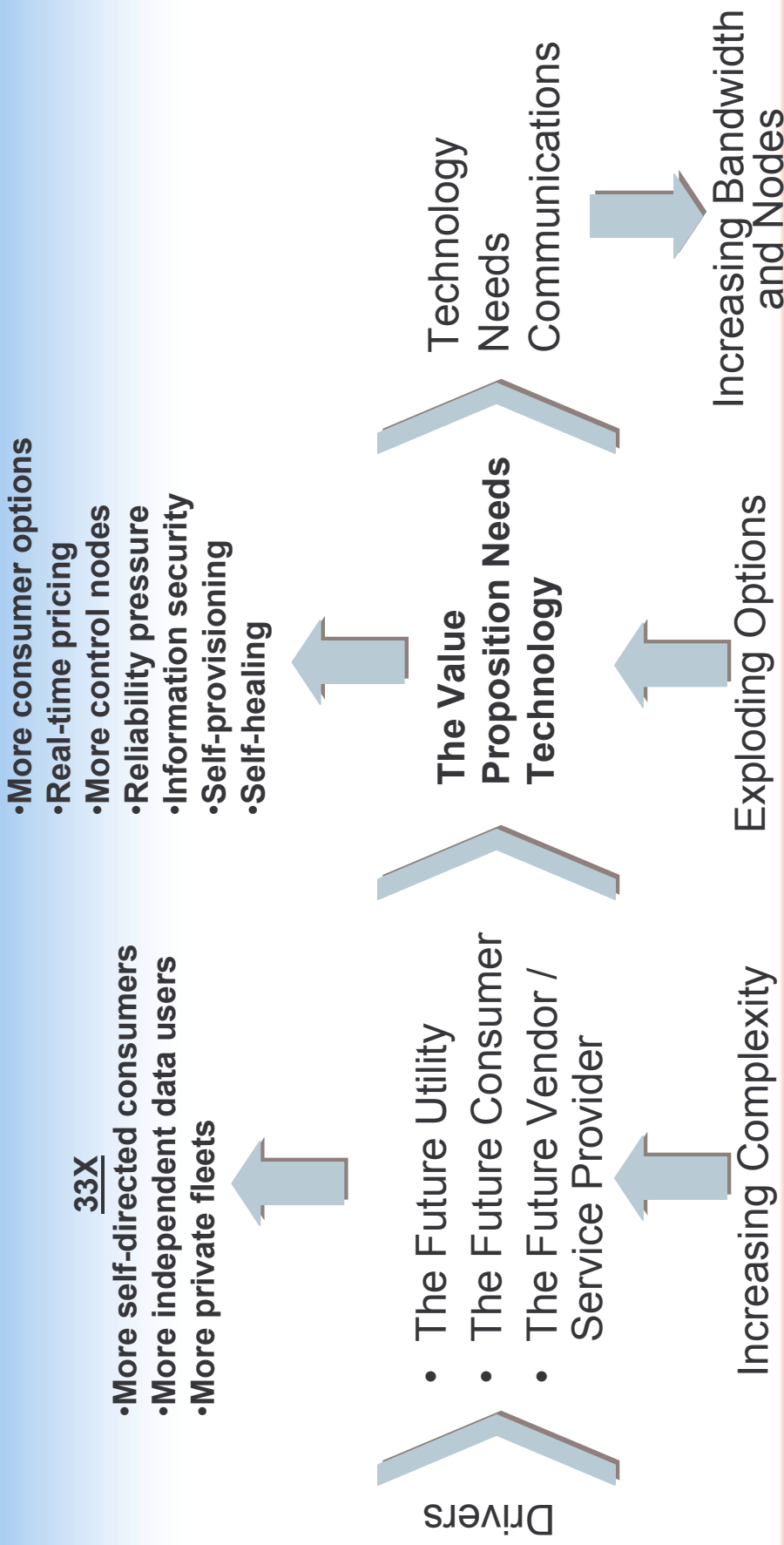
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What Business Models Are Emerging?



How does the Smart Grid help renewable resources?

- Monitoring and Control
 - Variable resources require more grid visibility
 - Variable resources require more ways of control
- Volt and VAR Management
 - Signs of stress
 - Too few examples of advanced methods
- Addressing the Economics of Variability
 - The climbing costs of other generation types are closing the gap on variable renewable resources
 - Dispatchable, dispersed renewables offset other costs



Integrated Resource Planning Becomes More Important

Consider the integrated resource planning required to develop a long-term strategy like Denmark.



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Integrated Resource Planning

It's not about throwing out established processes, it's about adding options.



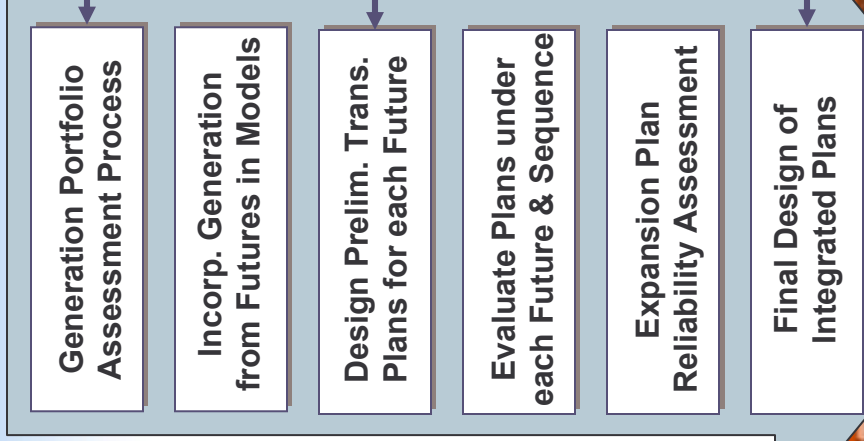
.....Integrated Regional Planning

Systems Approach to IRP

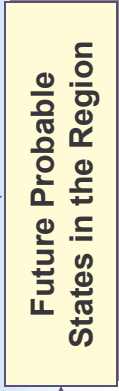
IRP

Determine long-term generation profiles by "Future"

Develop process to site generation in all models



Options



Conclusions

- Renewable resource (especially distributed ones) and smart grids add tools for the IRP toolbox, even more so when integrated.
- The industry needs to formulate real, complete comparisons of various resource options under an expanded IRP process.
- Distributed renewable generation programs like PGE make it economically viable for the top 400 hours of peak and shoulder operations.

