Wholesale Market Opportunities and Challenges

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Overview

- Trends in Wholesale Energy Markets
- Trends in Cost of Wind and Solar
- What it Would Take to Be Competitive Today
- Benefits of Wave Technology
- Food for Thought

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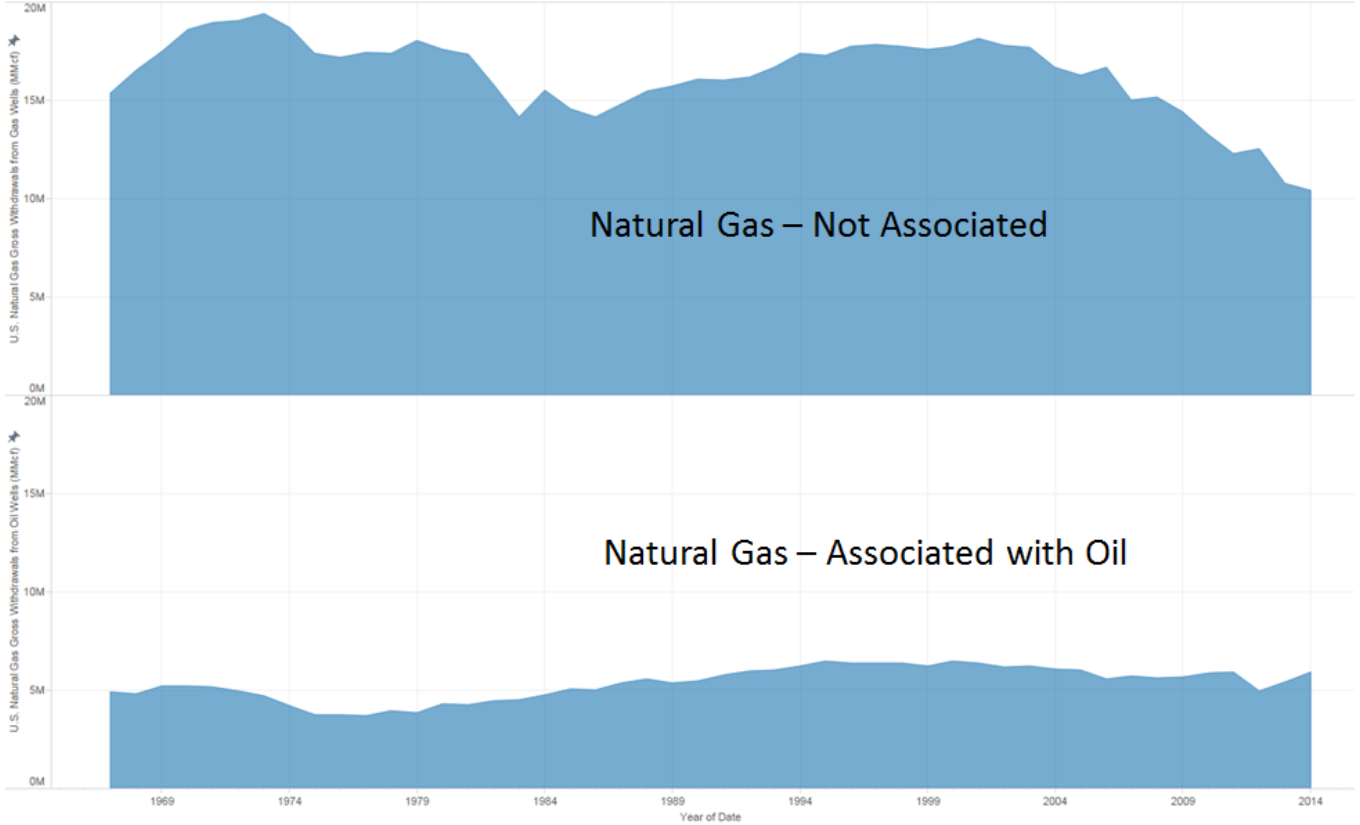
Remember the Days of Peak Oil !?!



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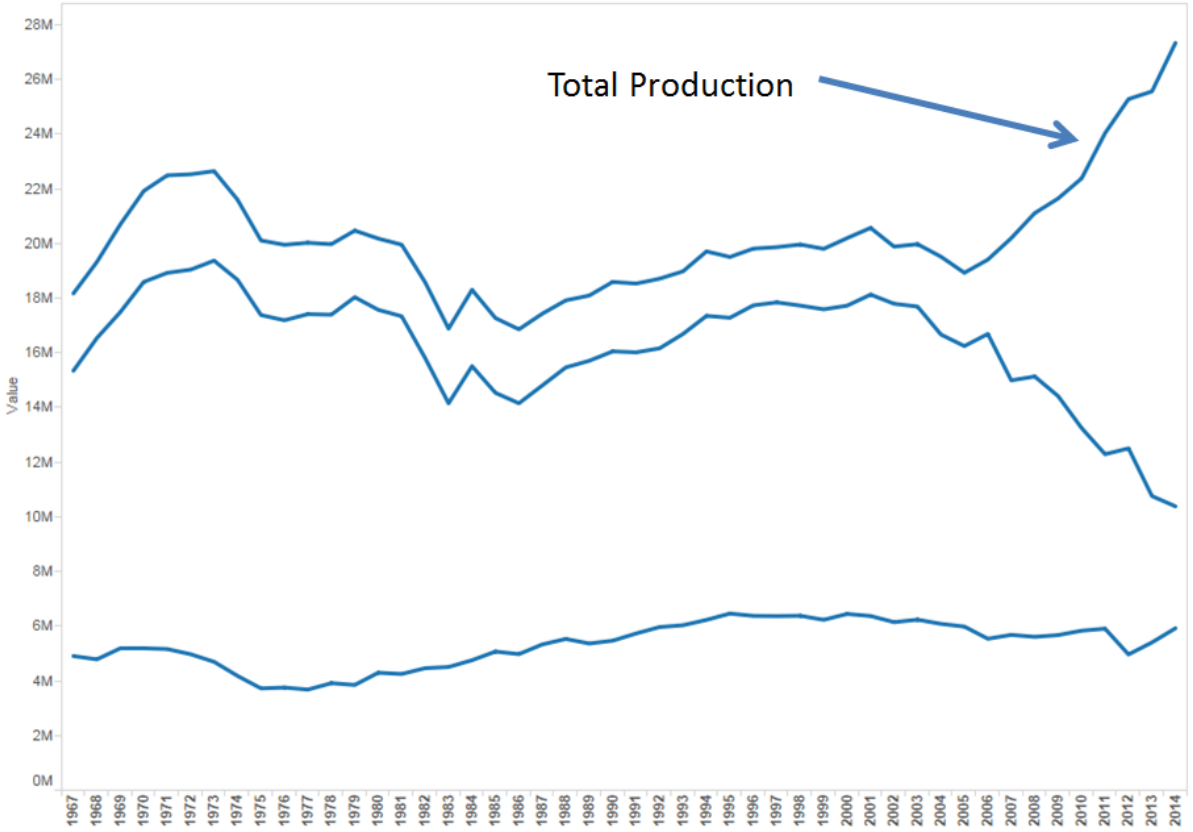
Total Nat Gas Production Increases!



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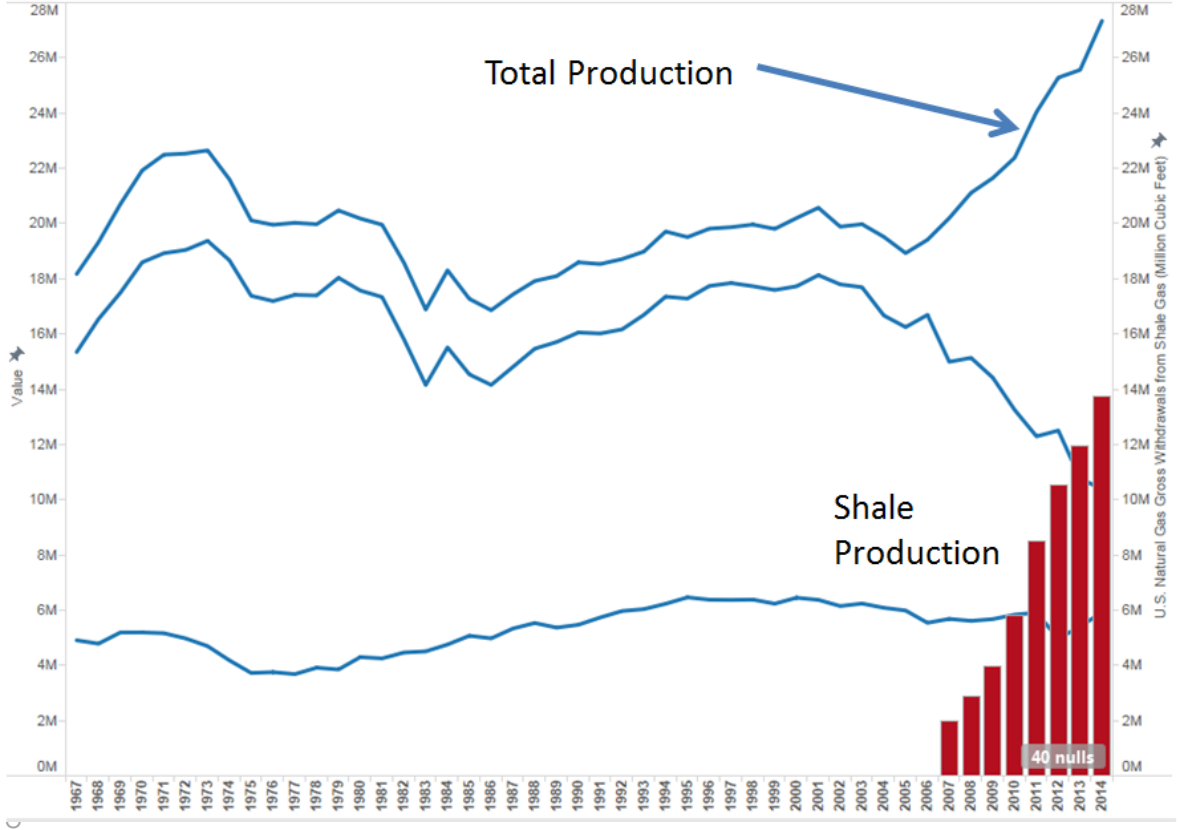
Technological Innovation Begets Shale Gas



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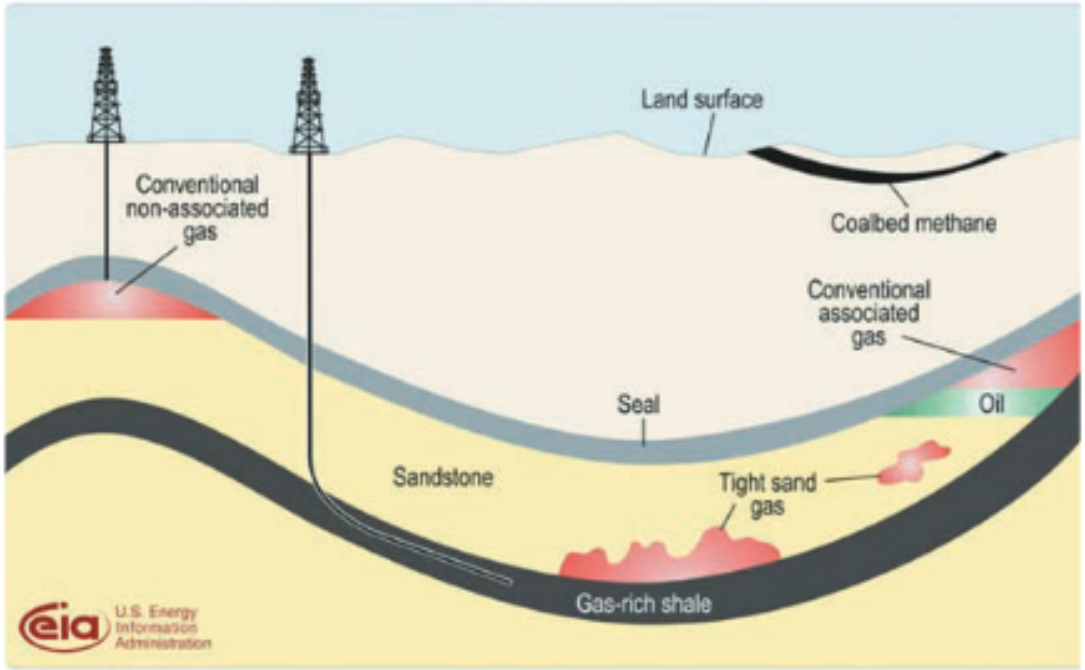
Sources of Natural Gas



Source: EIA

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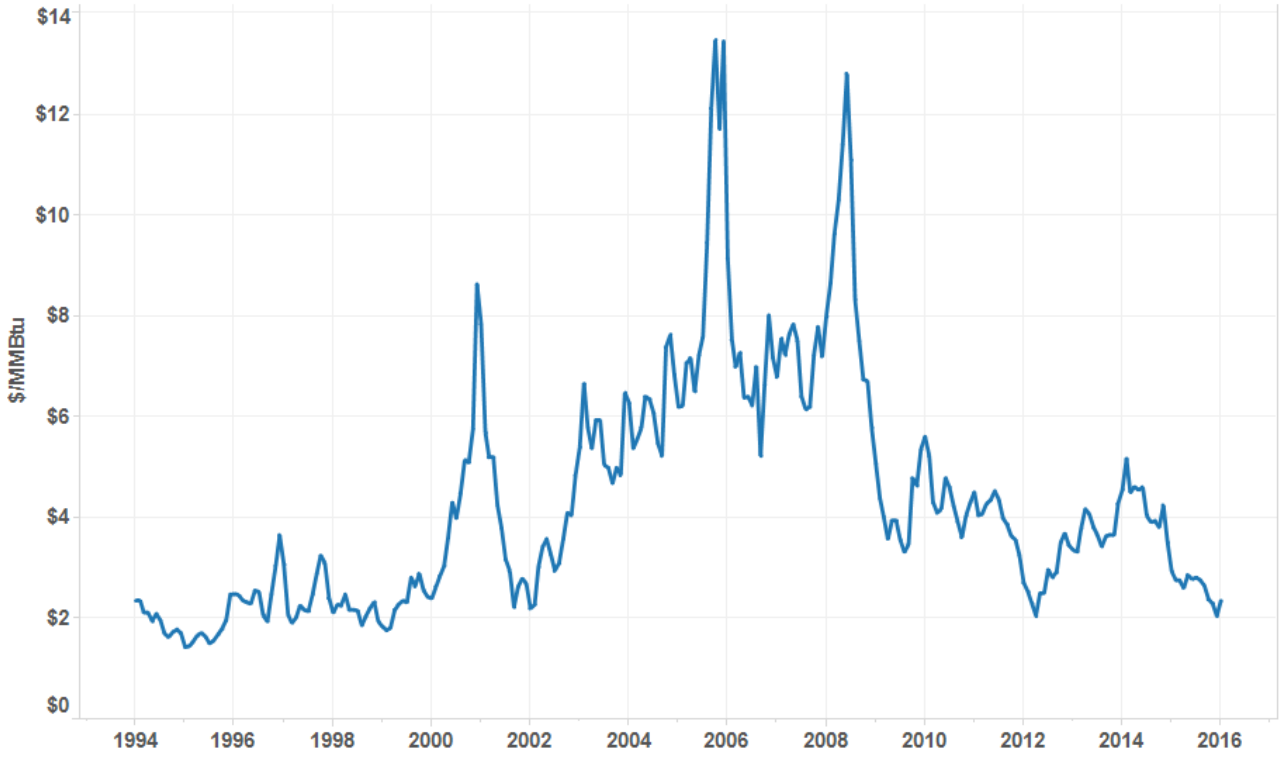
Natural Gas Spot Prices Since 1994



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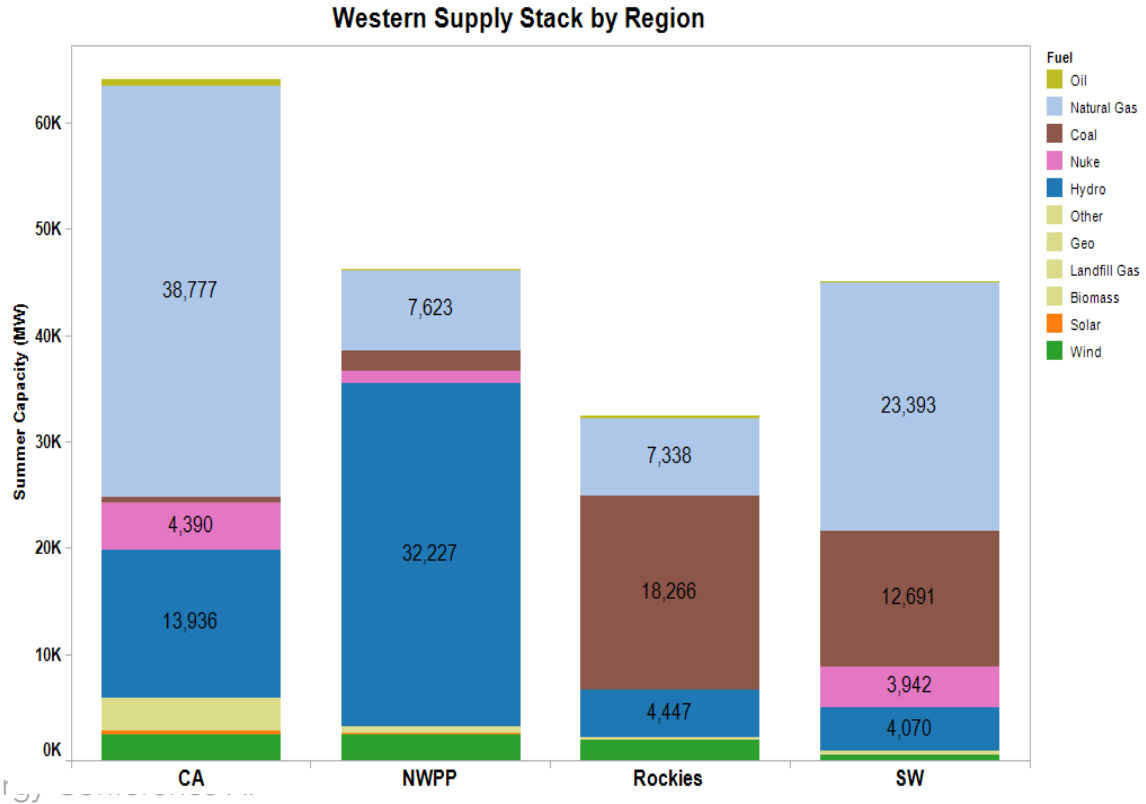
Nat Gas "on the margin" throughout WECC



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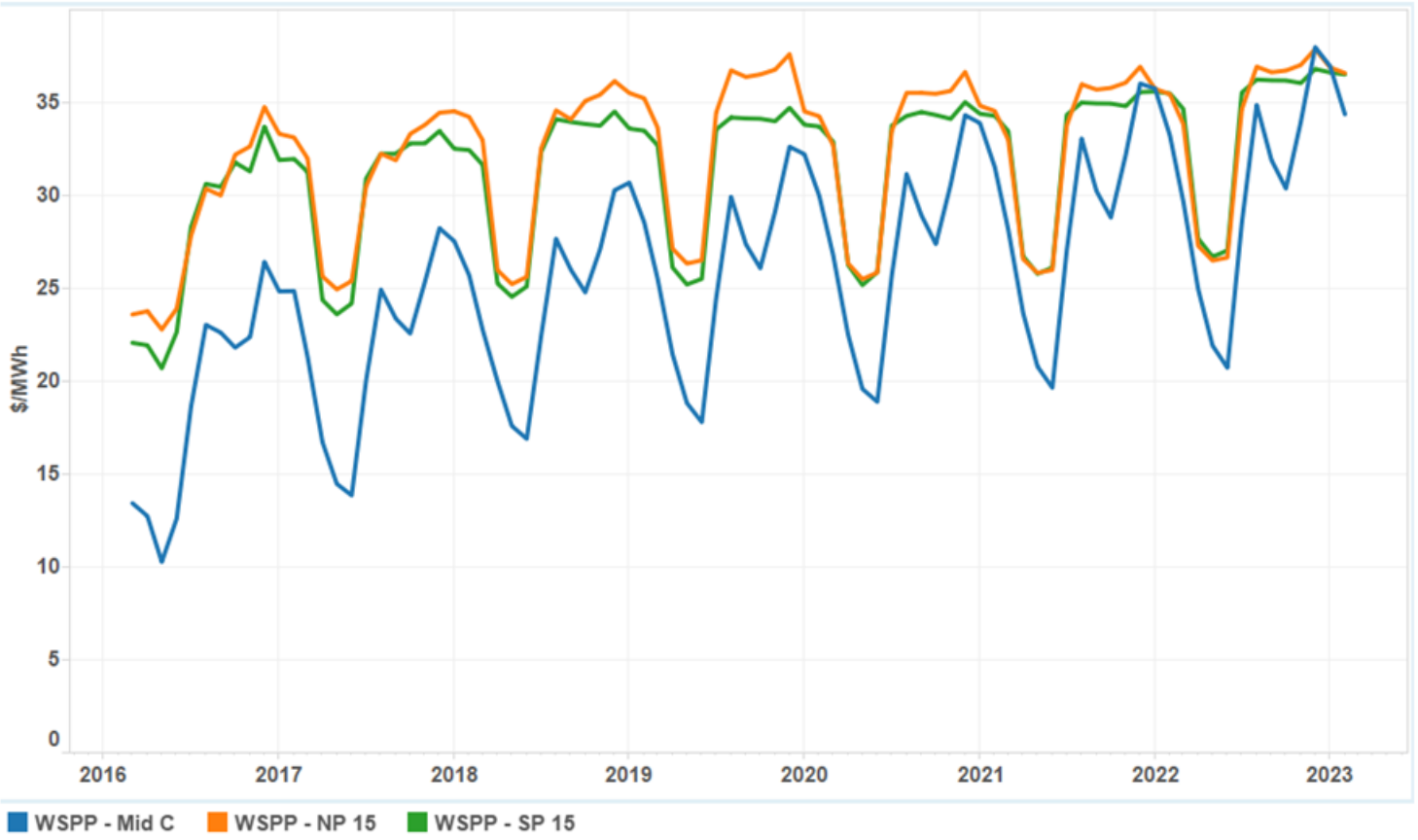
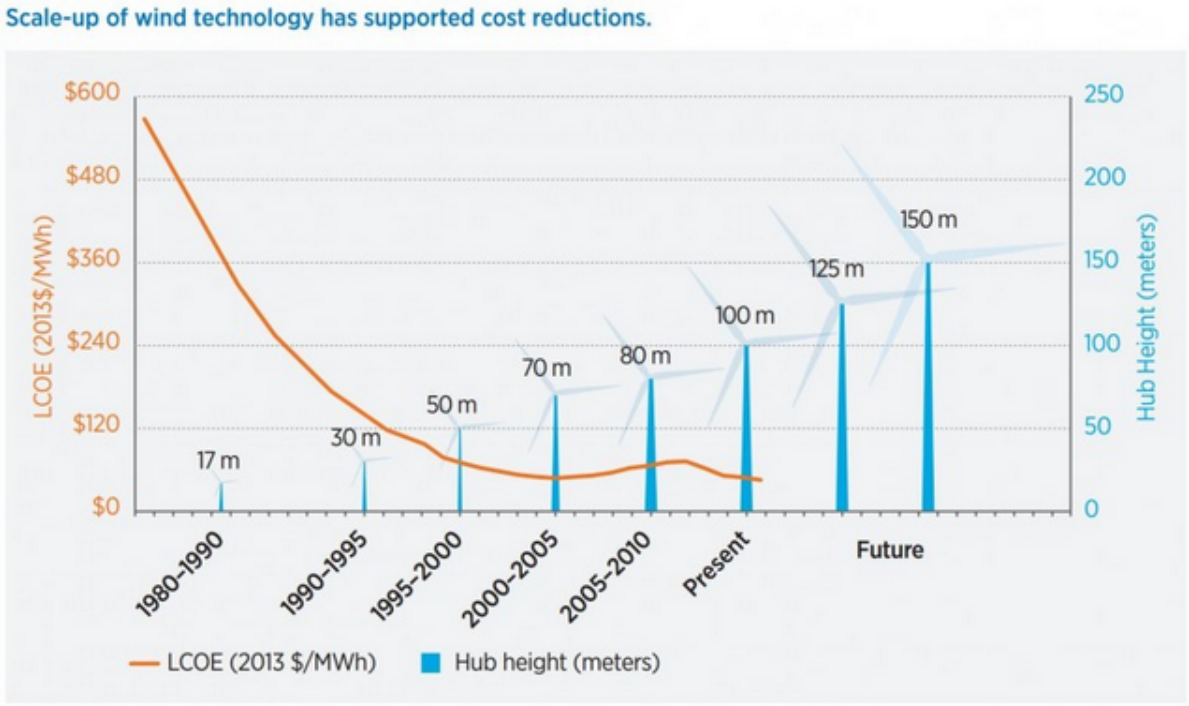
Western US Electricity Forward Prices



Declining Cost of Wind Power



http://rameznaam.com/2015/08/30/how-steady-can-the-wind-blow/

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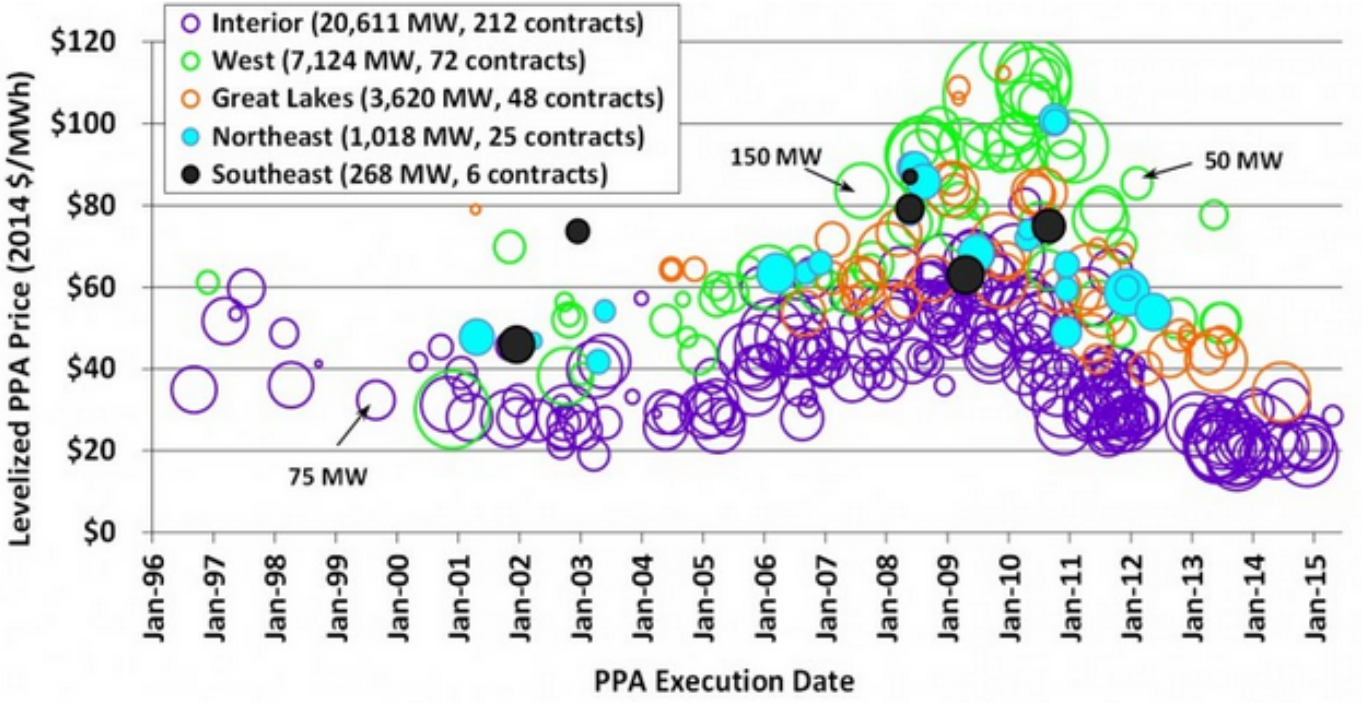
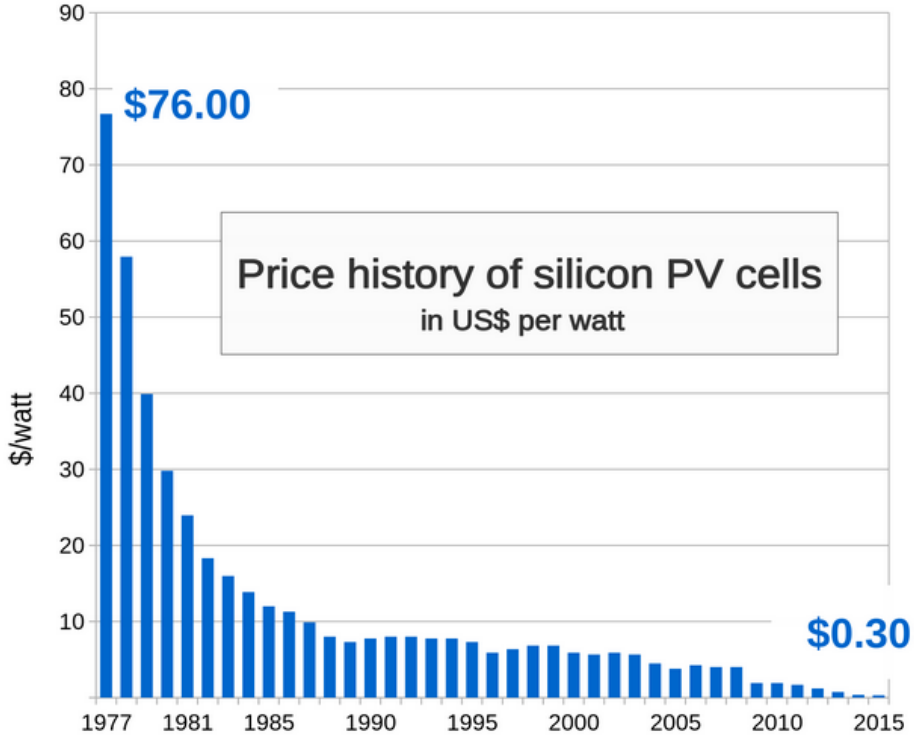
Wind PPA Rates Over Time



Source: LBNL

Declining Cost of PV Cells



Source: Bloomberg New Energy Finance & pv.energytrend.com

Source: EDNE

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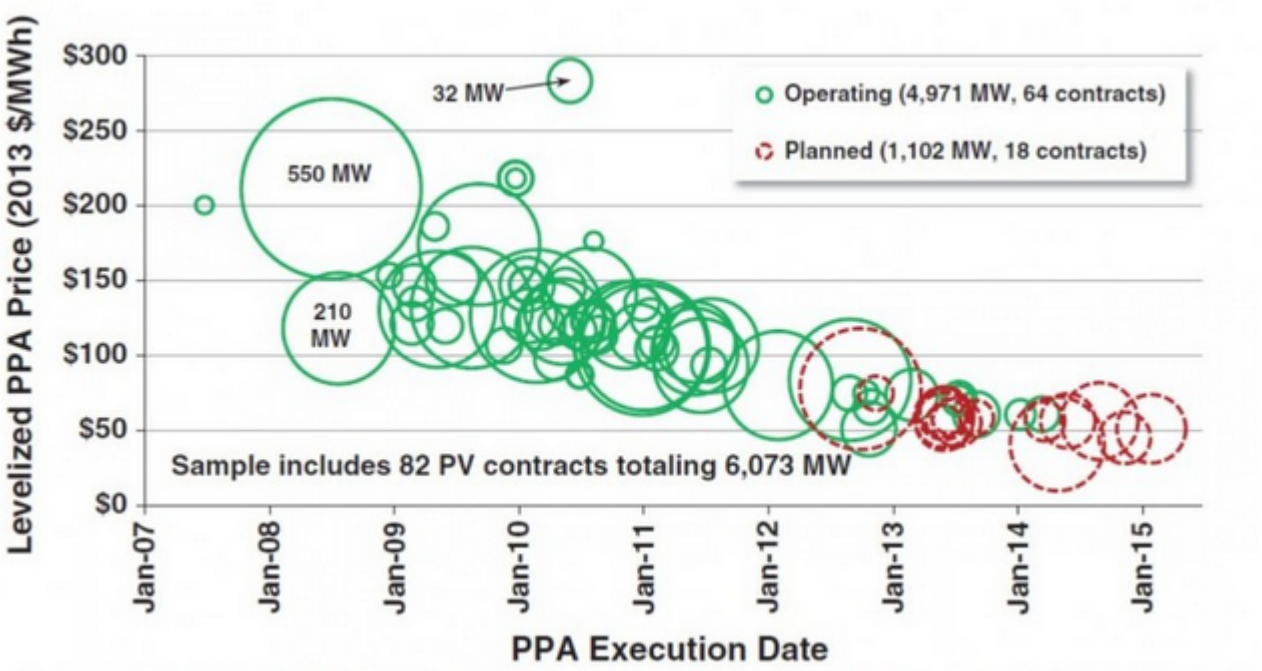
Levelized Utility Scale PV PPA Prices



Source: LBNL

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What's It Take to Be Competitive?

- Wind Examples:
  - Texas: Low $20's
  - California: Mid $40's
  - PNW: Mid $40's
- Solar Examples
  - Texas low $40's
  - California: Mid $40's
  - PNW: low $50's

Per MWh LCOE for 15 years

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Positive Attributes of Wave Technology

- Avoids Transmission Congestion
- Reliable and Predictable – Requires Fewer Reserves to Integrate
- Production Profile Balances Solar Production Profile

- (All In Addition to Green Power Attributes)

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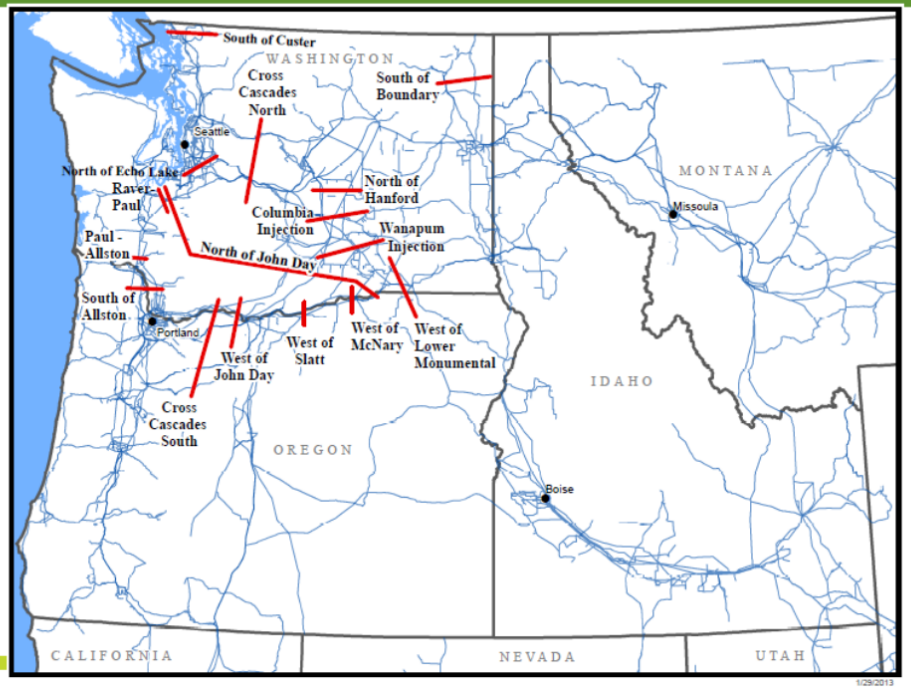
Downstream of Transmission Constraints

2013 Flowgates Map



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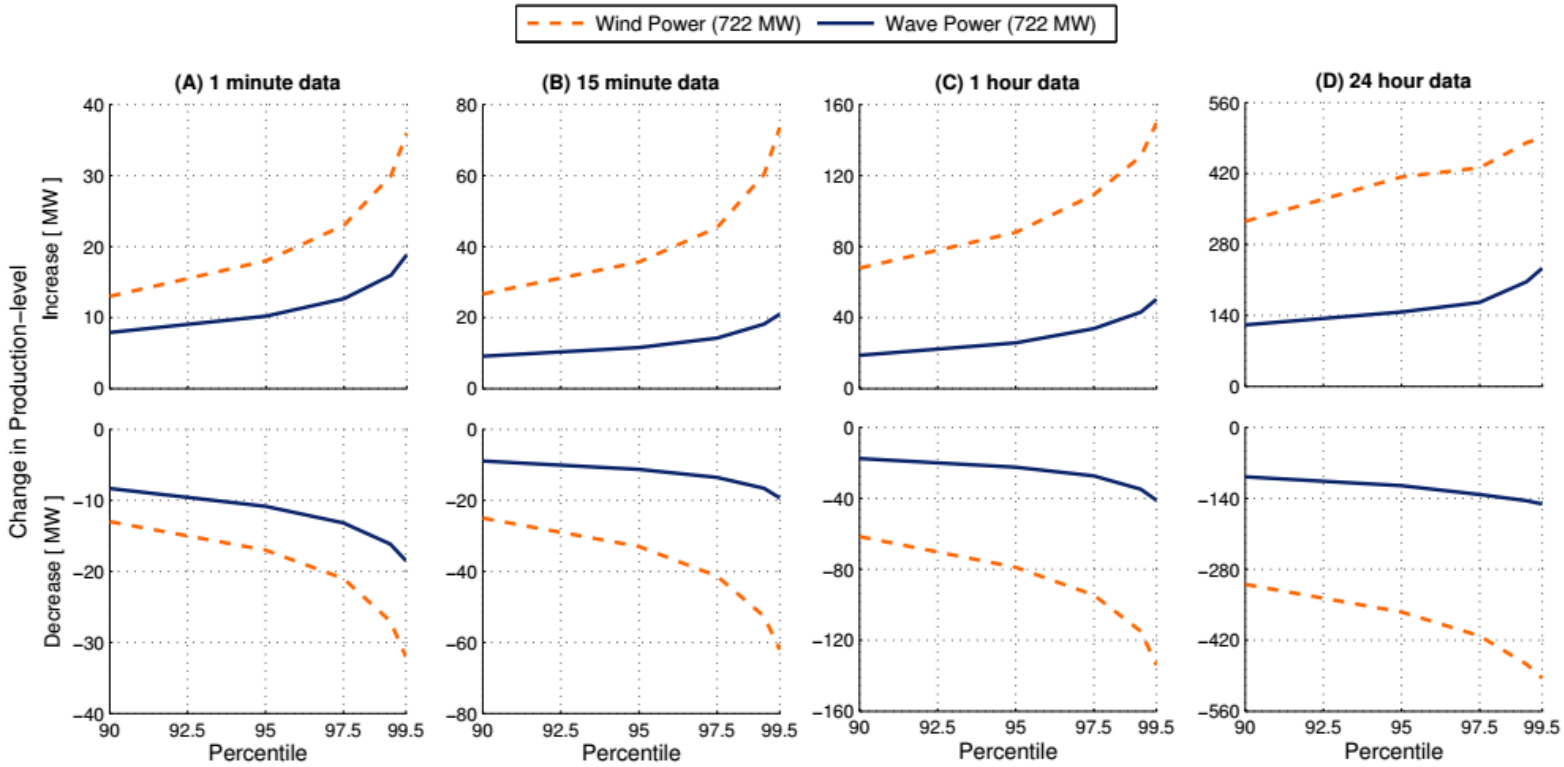
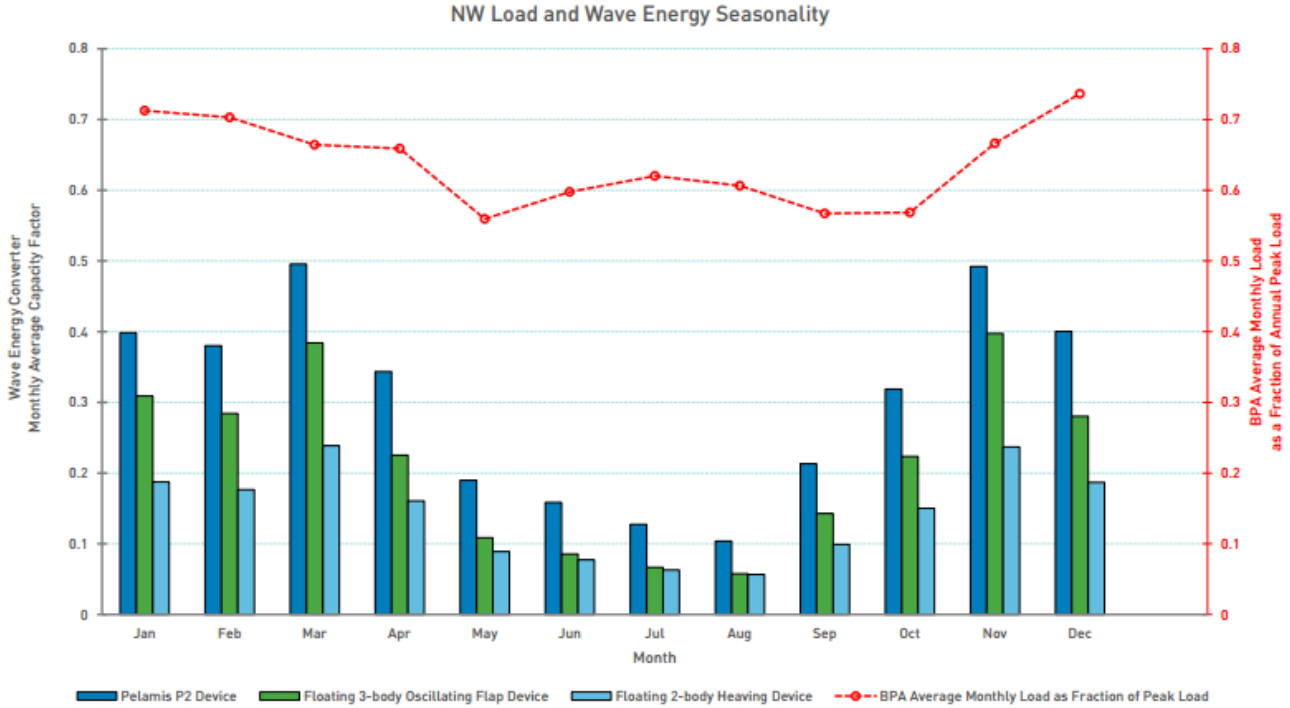
Approximately ¼ The Variability of Wind



Source: Parkinson, Dragoon, et. al. 2013, Fig. 7

Complements Solar Production Profile



Source: Dragoon, Eckstein, et. al., 2015 Figure 3

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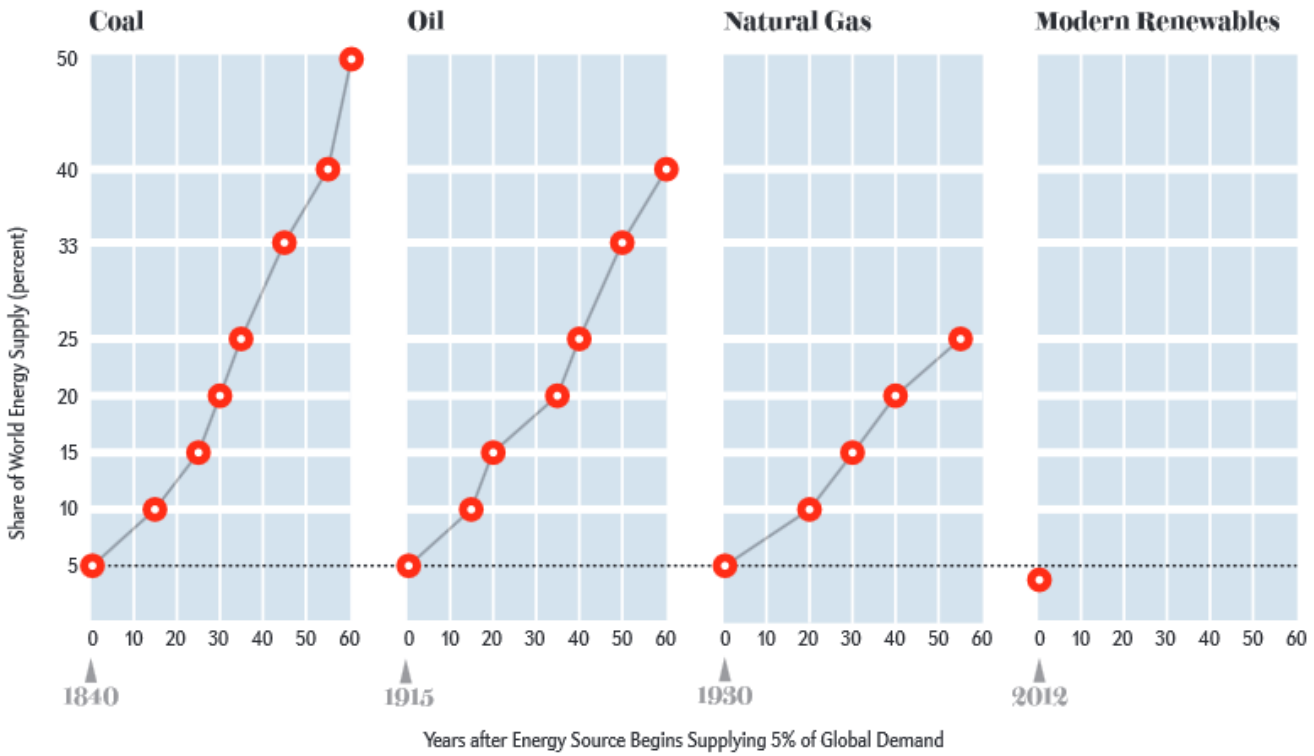
Food for Thought from Vaclev Smil



http://www.vaclavsmil.com/publications/

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