

Preliminary Estimate of Cost Savings in NPCC System With Wind Generation

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Motivation

- Asses the potential generation cost savings in existing power grid
- Projection on Wind plant expansion by means of cost benefit analysis
- Cost / Benefit analysis: Investment decisions by utilities and the Market

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The Main Idea

- Given wind power forecast and the forecasted load profiles; Perform Economic Dispatch (ED) to minimize total system generation cost
- The effect of increasing wind capacity in ED and total system savings
- Cost benefit estimates for building a plant
- Breakeven wind plant size for optimal future grid expansion

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Approach

The problem of minimizing total generation cost is posed as a basic Economic Dispatch optimization problem as follows:

- Given a total system load P_L and the available power plants P_{Gi} (already ON), where:

$$PG_{iMIN} \leq PG_i \leq PG_{iMAX}$$

- Given an approximated linear cost function

$$C_i(PG_i) = A_i PG_i + B_i$$

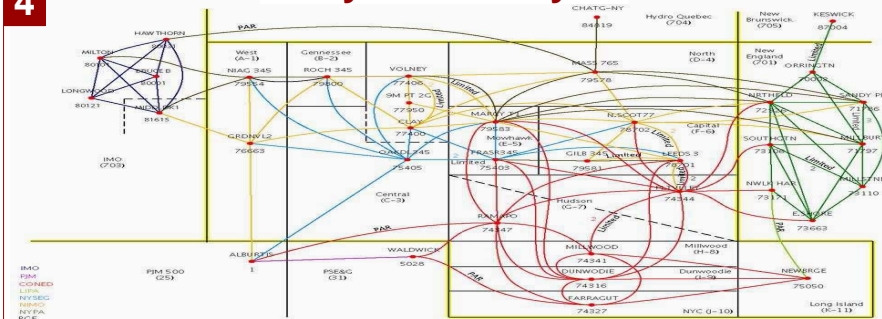
- Decide how much to schedule PG_i 's So that:

$$\underset{PG_i}{MIN} \sum_{i=1}^{t=4380} \sum_{i=1}^{NG} C_i(PG_i) \quad \text{so that} \quad \sum_i PG_i = P_L$$

- Note that in ED, results are obtained by assuming wind power is available at the time period being simulated.

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System Study



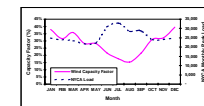
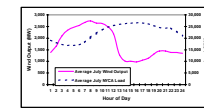
NPCC US Bulk Power System: Emphasis on NY

Source: Eric. Allen, Jeffrey H. Lang, Marija Ilić, "A combined Equivalenced-Electric, Economic & Market representation of the Northeastern Power Coordination Council US Electrical power system"

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Cost Savings

% Wind Energy	1.60%	5%	10%	15%
Generation cost (\$)	\$6,918,295	\$6,588,648	\$6,259,069	\$5,929,456
Cost savings (\$)	\$0.00	\$329,647	\$659,226	\$988,839



NPCC US Bulk Power System: The effect of 5%, 10% and 15%wind power increase

Source: www.nyiso.com

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Potential Decisions

% Wind	1.60%	5%	10%	15%
Wind Capacity MW	2346	7331.25	14662.5	21993.7
Fixed Avg. Capital Cost=ACC	\$17,595.0	\$54,984.4	\$109,969	\$164,953
Wind Gen. Cost	\$23,460.0	\$73,312.5	\$146,625	\$219,937
Total cost	\$41,055.0	\$128,297	\$256,594	\$384,891
Rev	\$93,840.0	\$293,250	\$586,500	\$879,750
Break even MW cover VC	586.50	1,832.81	3,665.63	5,498.44
Break even MW cover TC	1,026.38	3,207.42	6,414.84	9,622.27

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Future Work

- Short term wind forecasting and ED with transmission congestion
- Frequency control and AGC with wind

Potential Wind Generation by Zone

Zone A	4016 MW
Zone B	515 MW
Zone C	922 MW
Zone D	433 MW
Zone E	2683 MW
Zone F	703 MW
Zone G	154 MW
Zone H	0 MW
Zone I	0 MW
Zone J	0 MW
Zone K	903 MW
Total	10026 MW



Source: www.nyiso.com

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