

Scenario Analysis Profiles: Wind, Photovoltaic and Demand-Side programs

Methodology for Estimating Energy (KWH) Benefits of Wind and PV projects

- **To model energy requirements and capital-cost implications, need to determine:**
 - Amount of on-peak capacity assumed to be needed from investment in renewable capacity (i.e., 5400 MW)
 - Wind (on/off shore), PV, CHP, fuel cells, biomass, landfill gas, small hydro (675 MW each)
 - Given that amount of capacity, the amount and pattern of energy production across the hours/months of a year
 - The “fuel” for some renewables (e.g., wind, solar PV) is limited by natural conditions
 - Use of “profiles” to capture the amount of generation output assumed to be available from a project
 - ISO NE sought to develop composite energy production profiles based on actual wind and solar data

Observations Regarding Studies of Wind and PV Profiles

- Focus here is on energy production, not on-peak ability to provide capacity (“capacity value”)
- Wind:
 - 20 percent “capacity value” at time of peak discussed previously
 - Data suggests that each site is unique
 - Analysis of test sites suggest a higher capacity value (30+ percent) may be possible
 - This could require fewer wind turbines to achieve an effective capacity value of 675 MW
- PV:
 - Capacity value for PV not discussed previously
 - Data suggests similar capacity value at time of peak
 - Analysis of test site data suggests 50% capacity value

Observations Regarding Studies of Wind and PV Profiles

- To obtain 675 MW of “effective capacity” from the resource (from which KWH would be produced), need to add more capacity:
 - 3,375 MW nameplate for inland (assumed 20% effective rating)
 - 3,375 MW nameplate for offshore (assumed 20% effective rating)
 - 1,350 MW nameplate for PV (assumed 50% effective rating)

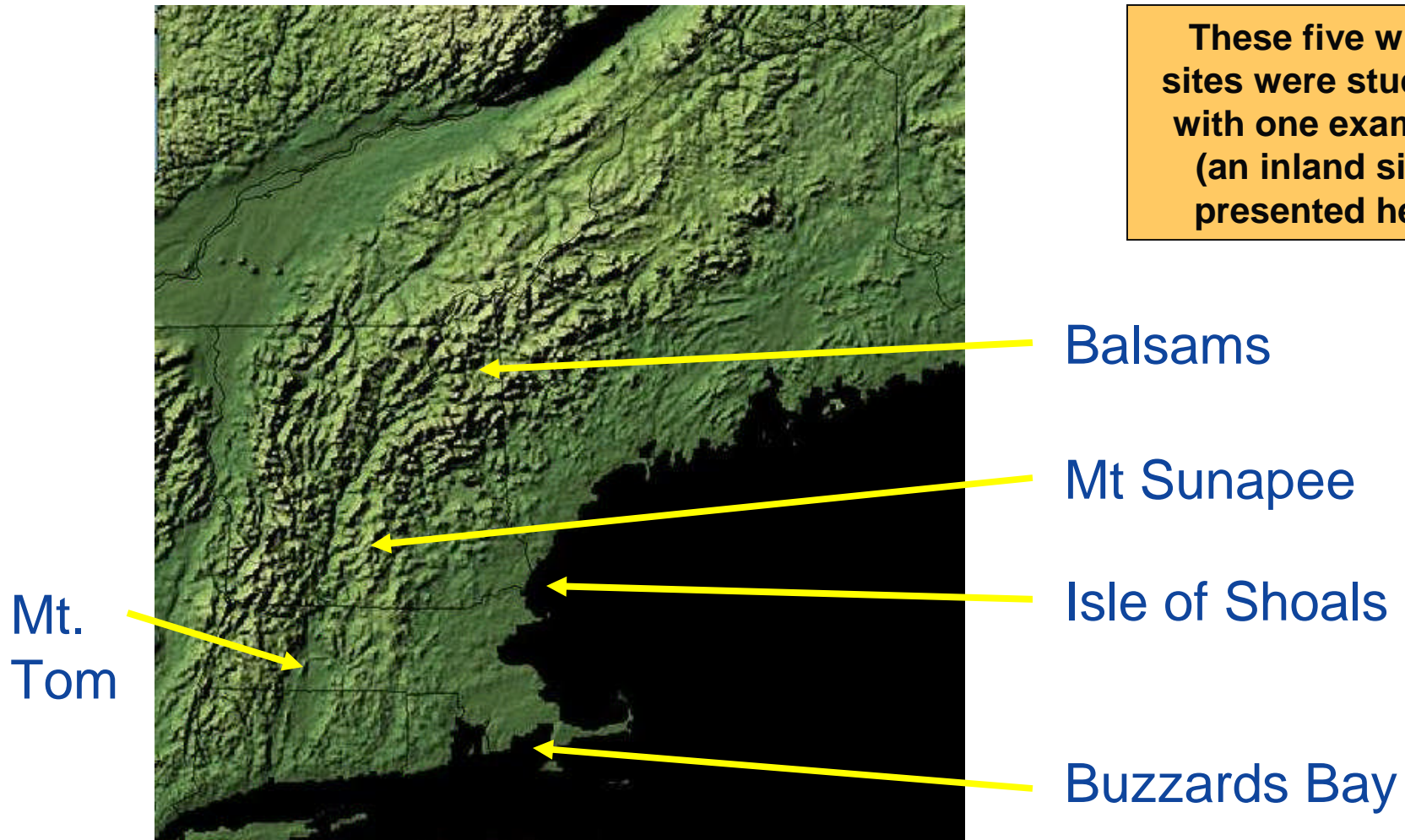
Assumptions regarding percent of resource that is treated as “effective capacity” come from studies in other regions.

Overview of Study of Wind and PV Profiles

- Tony Rogers (UMass) was contracted to study of wind profiles (as input to ISO calculation of energy output from composite wind projects)
 - Preliminary results for three inland sites
 - Mt Tom
 - Balsams (Dixville Notch, NH)
 - Mt Sunapee (NH)
 - Preliminary results for two offshore sites
 - Buzzards Bay
 - Isle of Shoals (offshore NH)
- PV systems also evaluated; preliminary results for 2 sites
 - Hartford
 - Boston
- Data from sites used as proxies for renewable projects, not actual output from individual plants

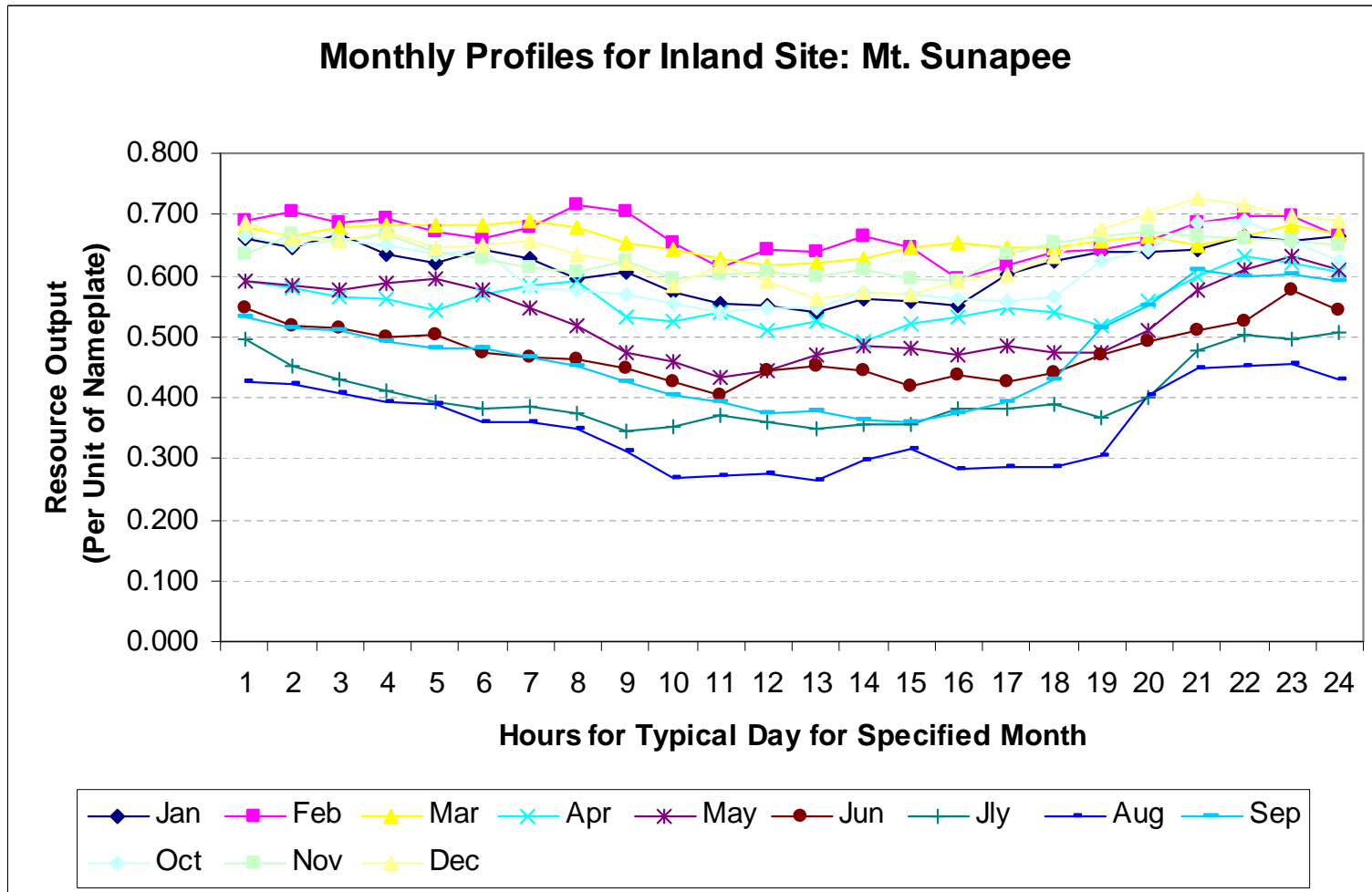
Location of Wind Sites Investigated

These five wind sites were studied, with one example (an inland site) presented here

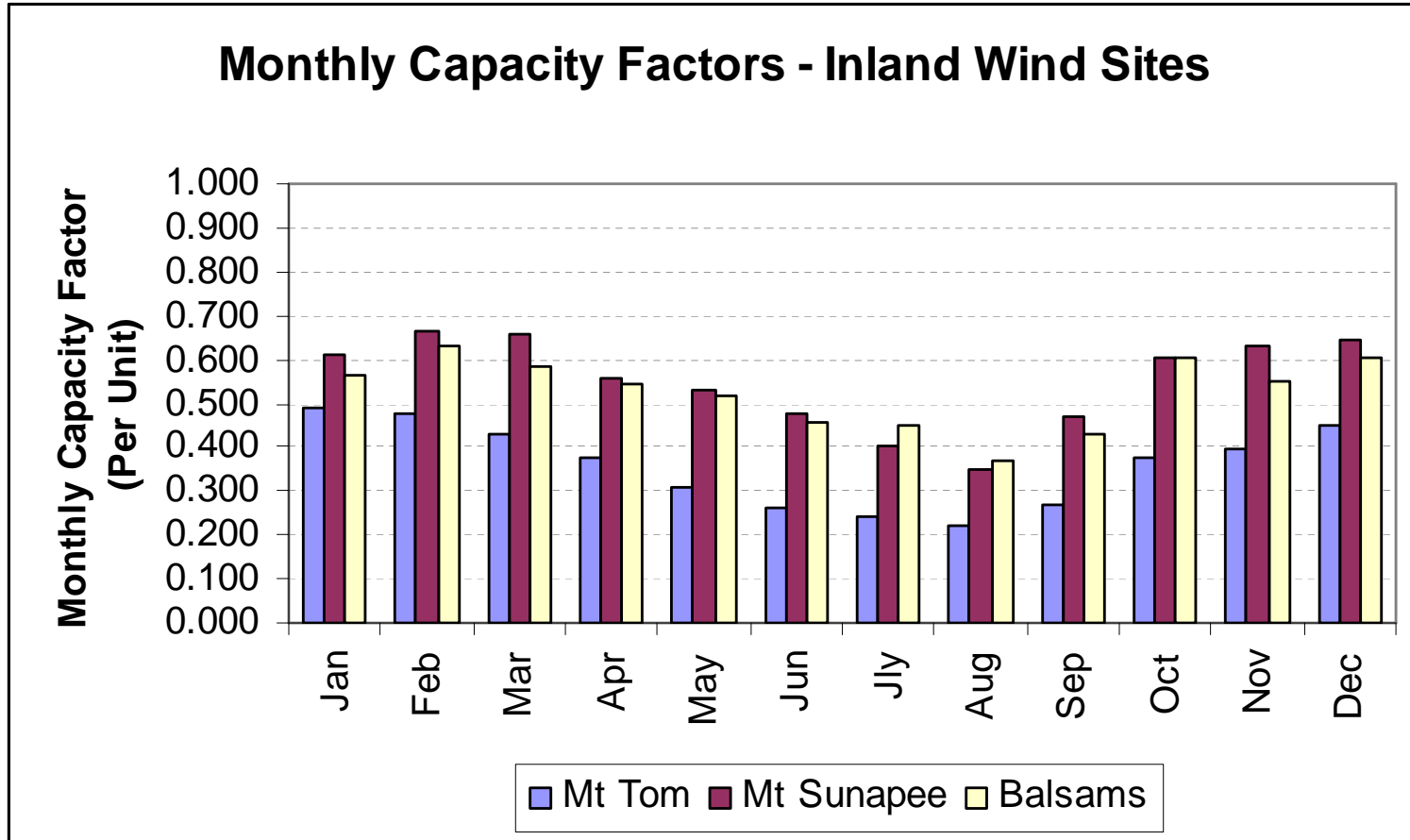


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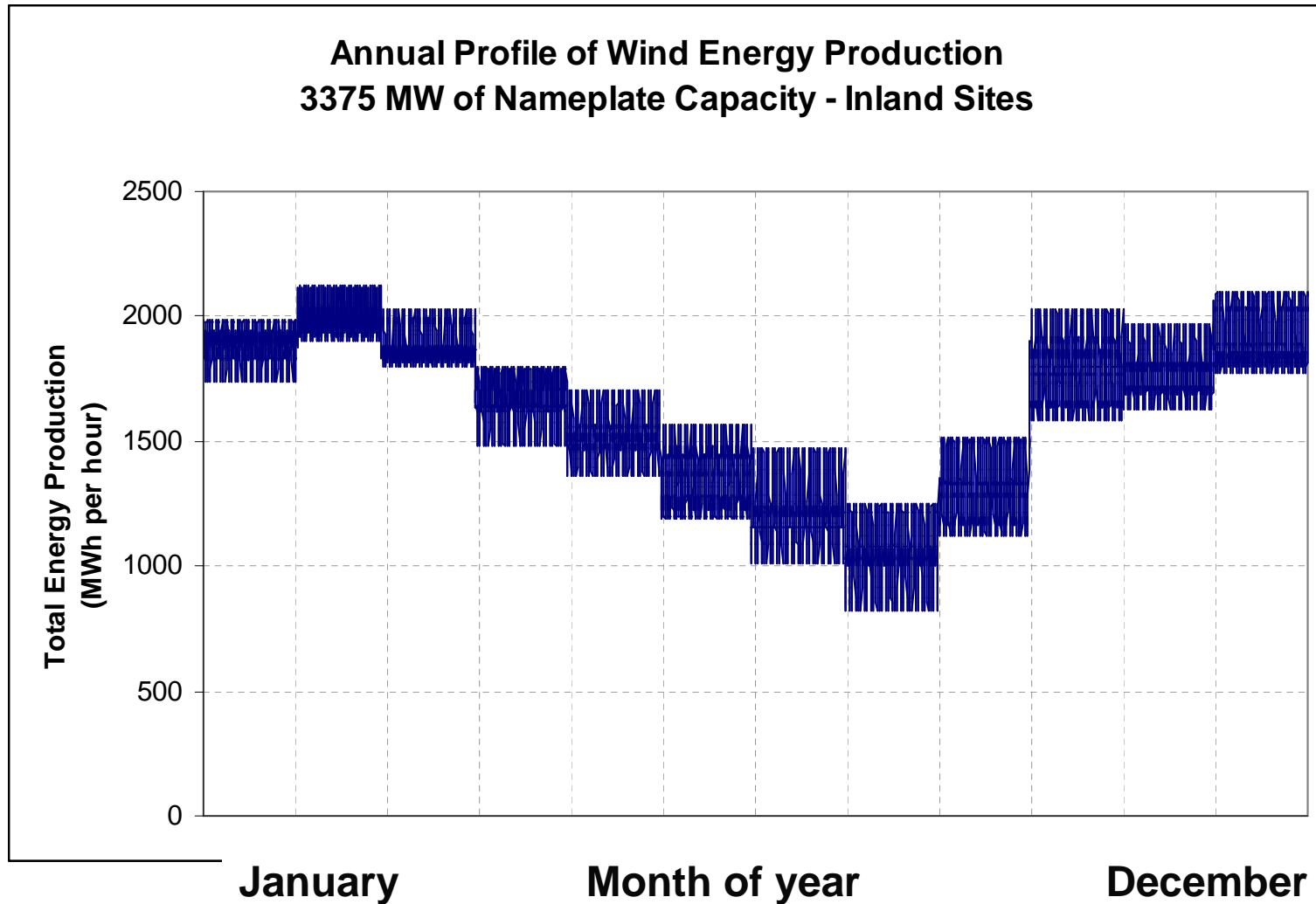
Mt Sunapee (NH) (inland)



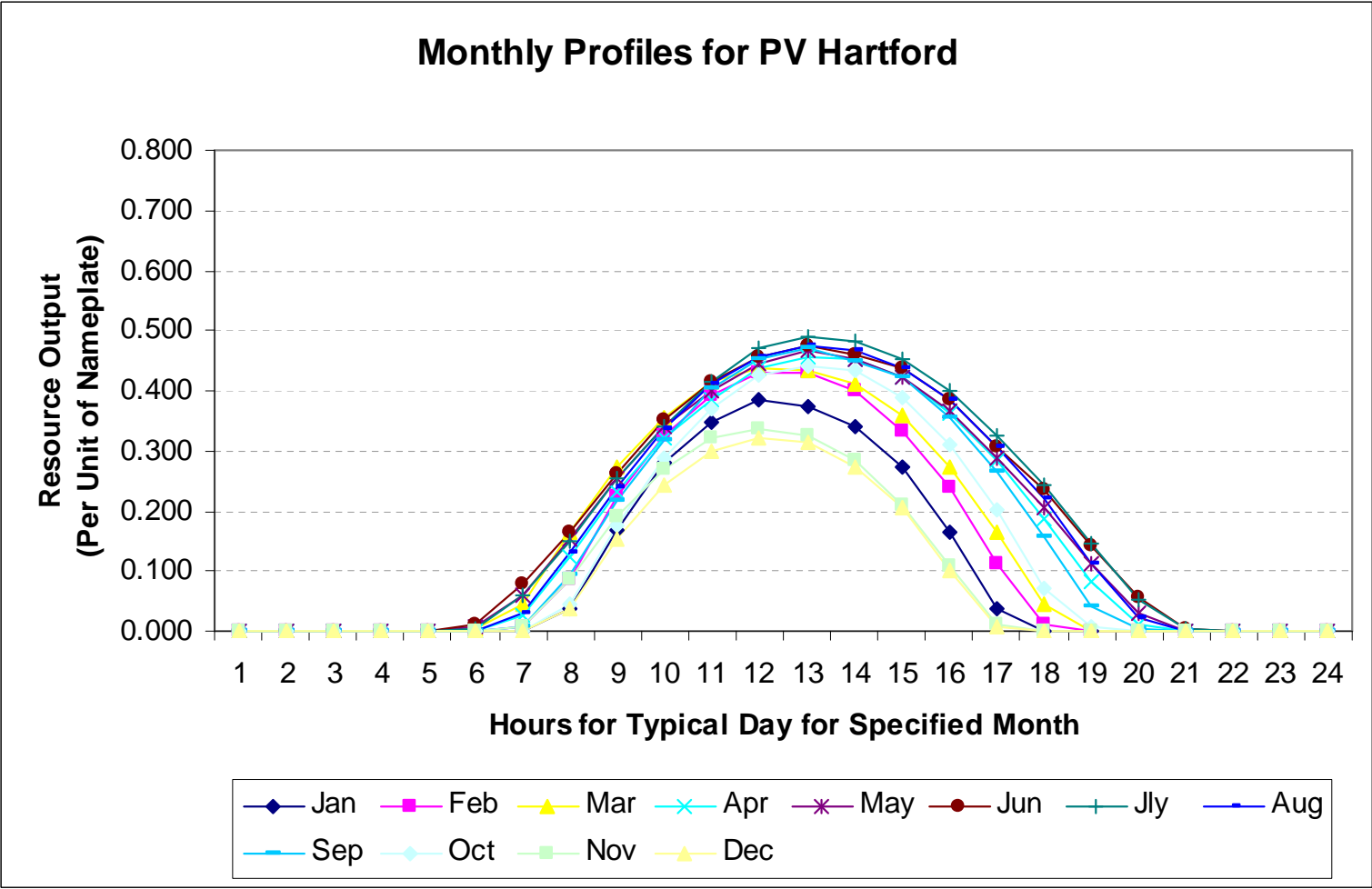
Monthly Capacity Factors – Inland Wind (by month of year)



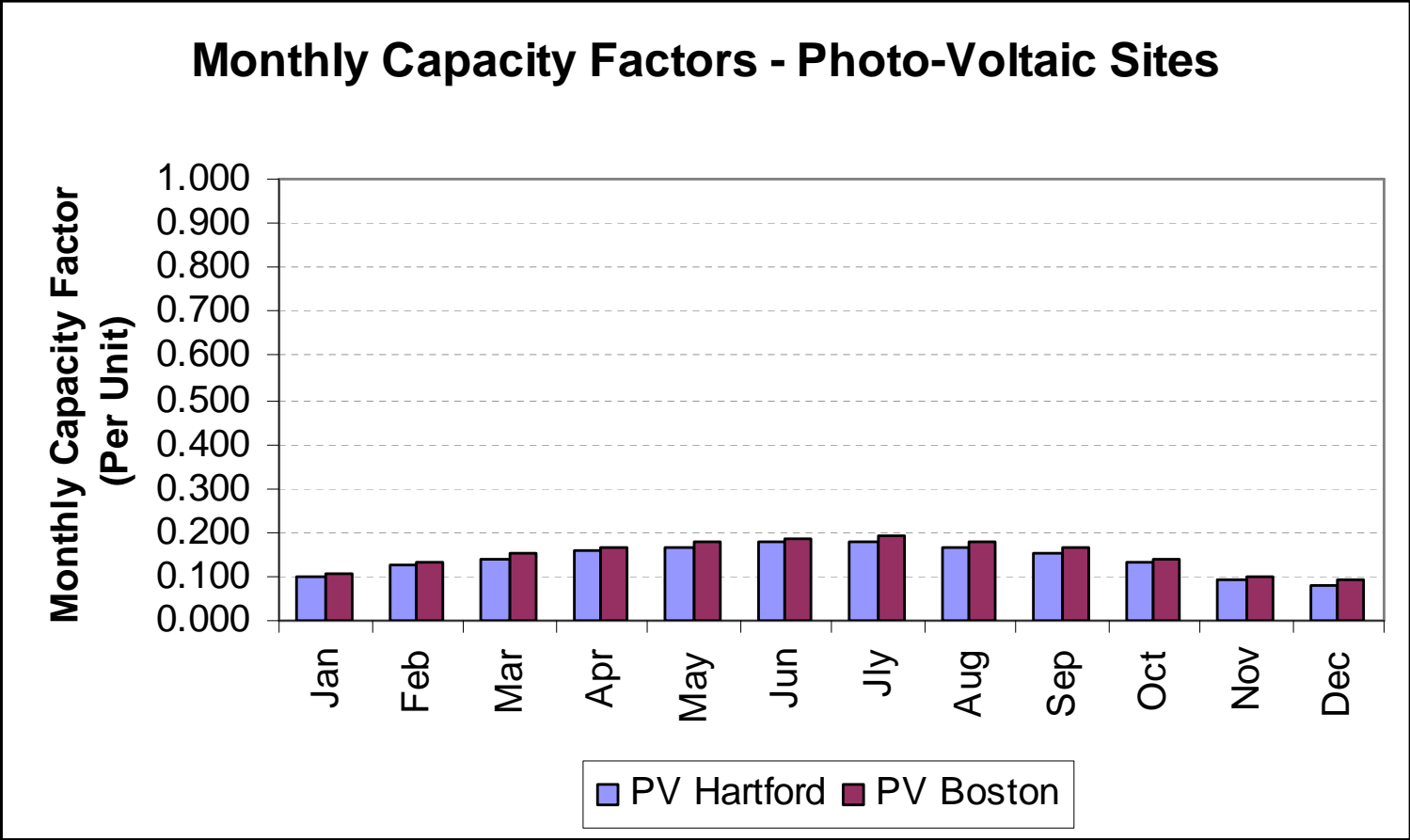
Annual Inland Wind Generation Profile (by month of year)



Photovoltaic Profile - Hartford

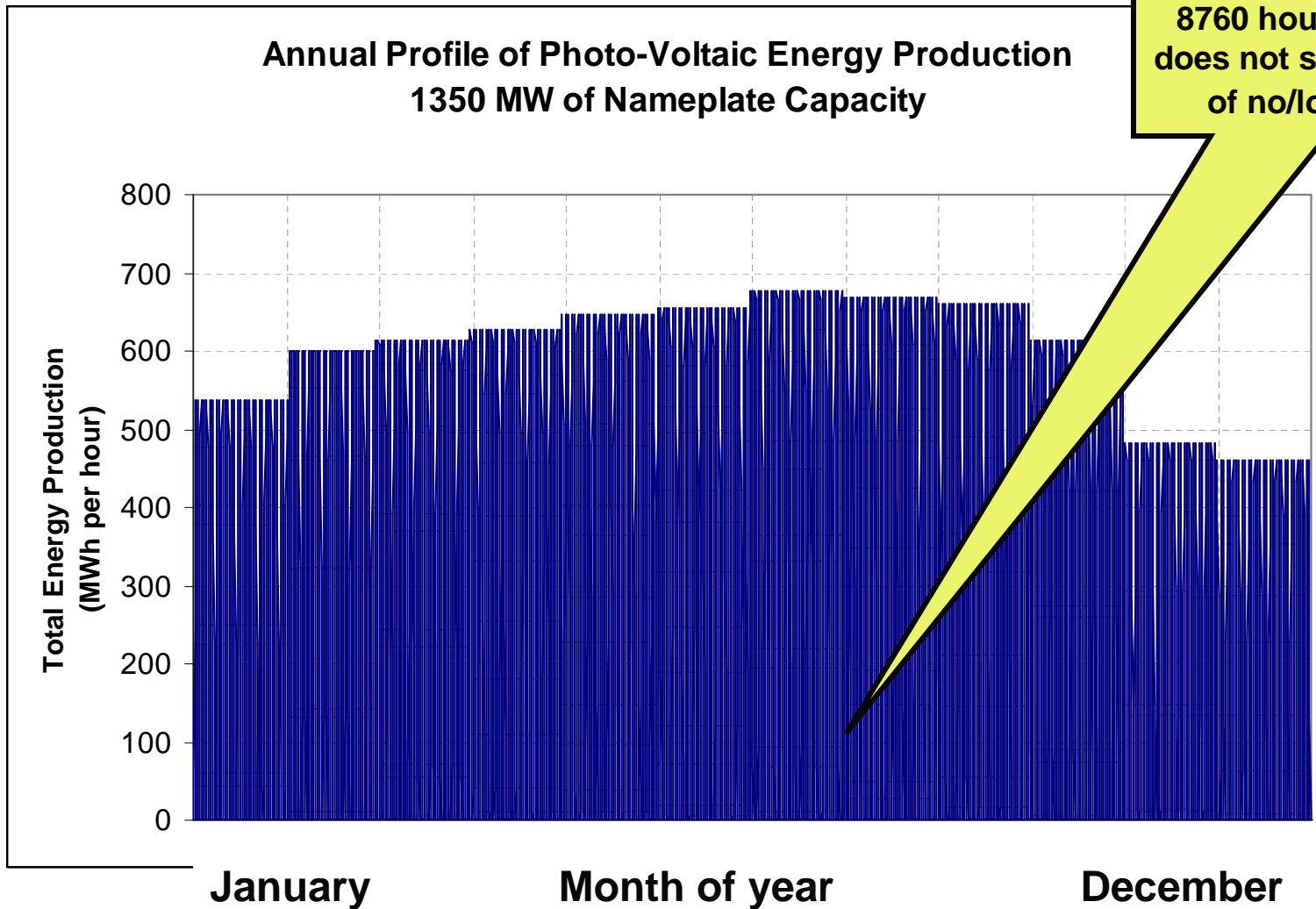


Monthly Capacity Factors – PV



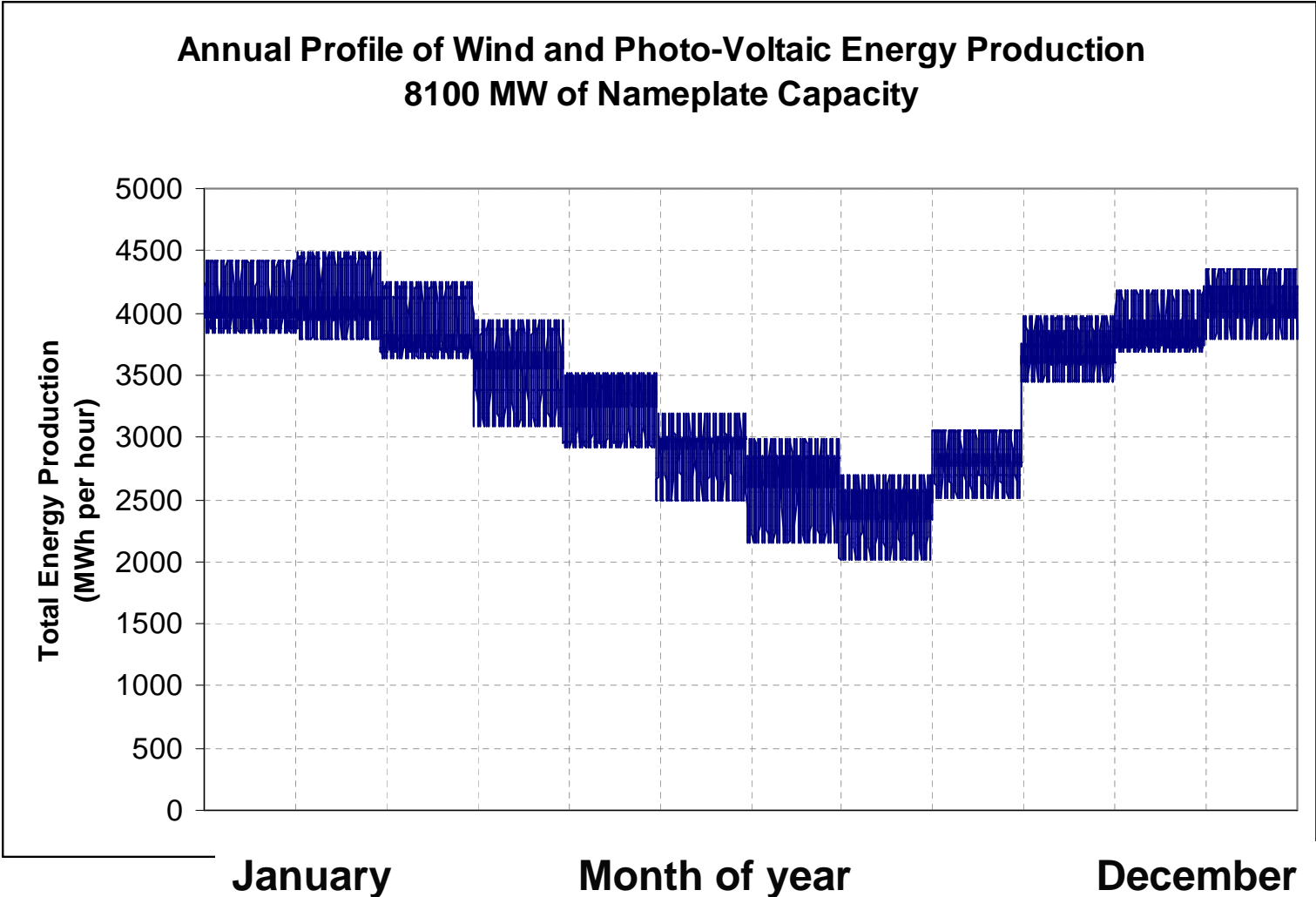
Annual PV Generation Profile

Annual Profile of Photo-Voltaic Energy Production
1350 MW of Nameplate Capacity

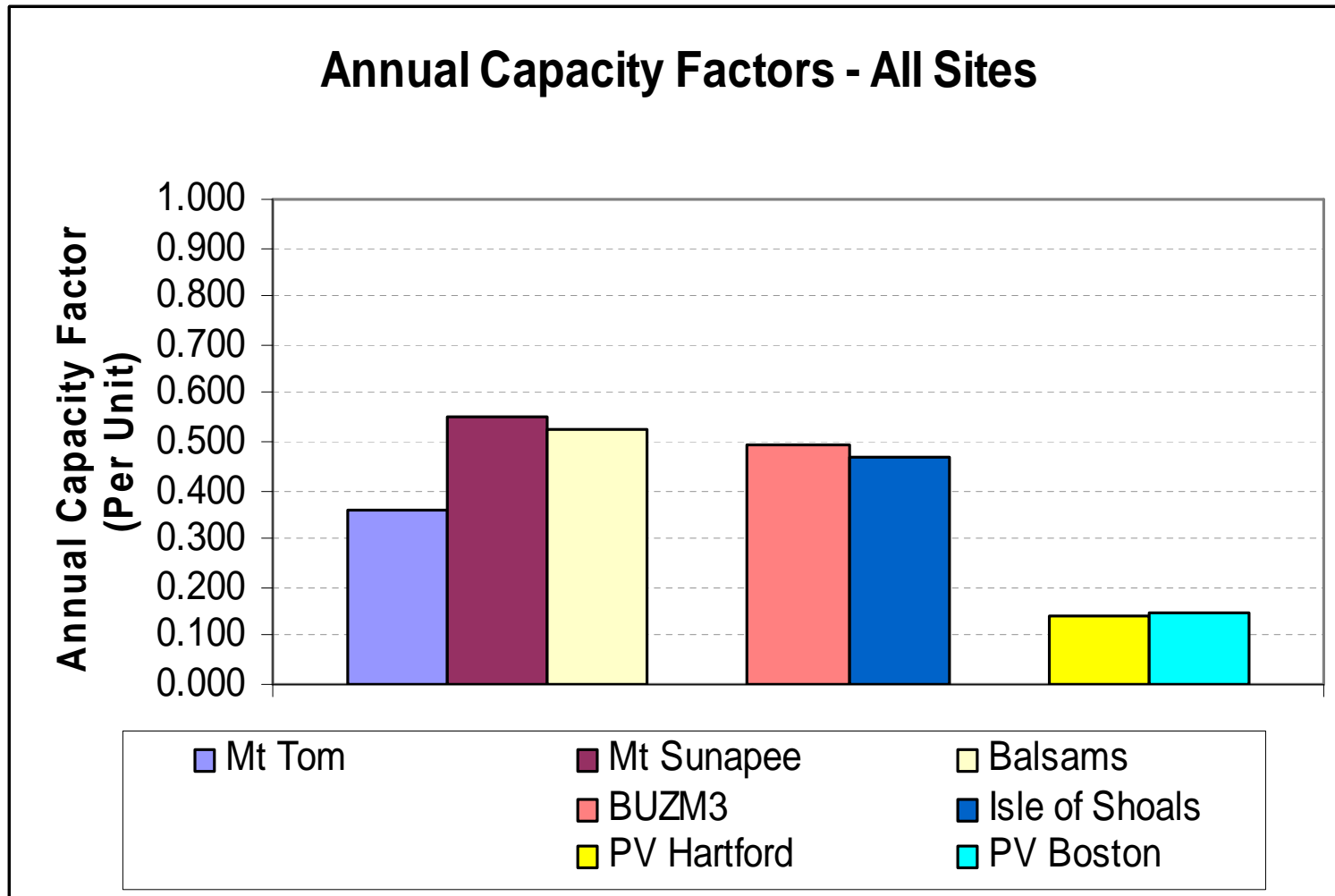


Note: Many hours have no PV energy production; but the plot of the data for 8760 hours on this chart does not show these hours of no/low PV output.

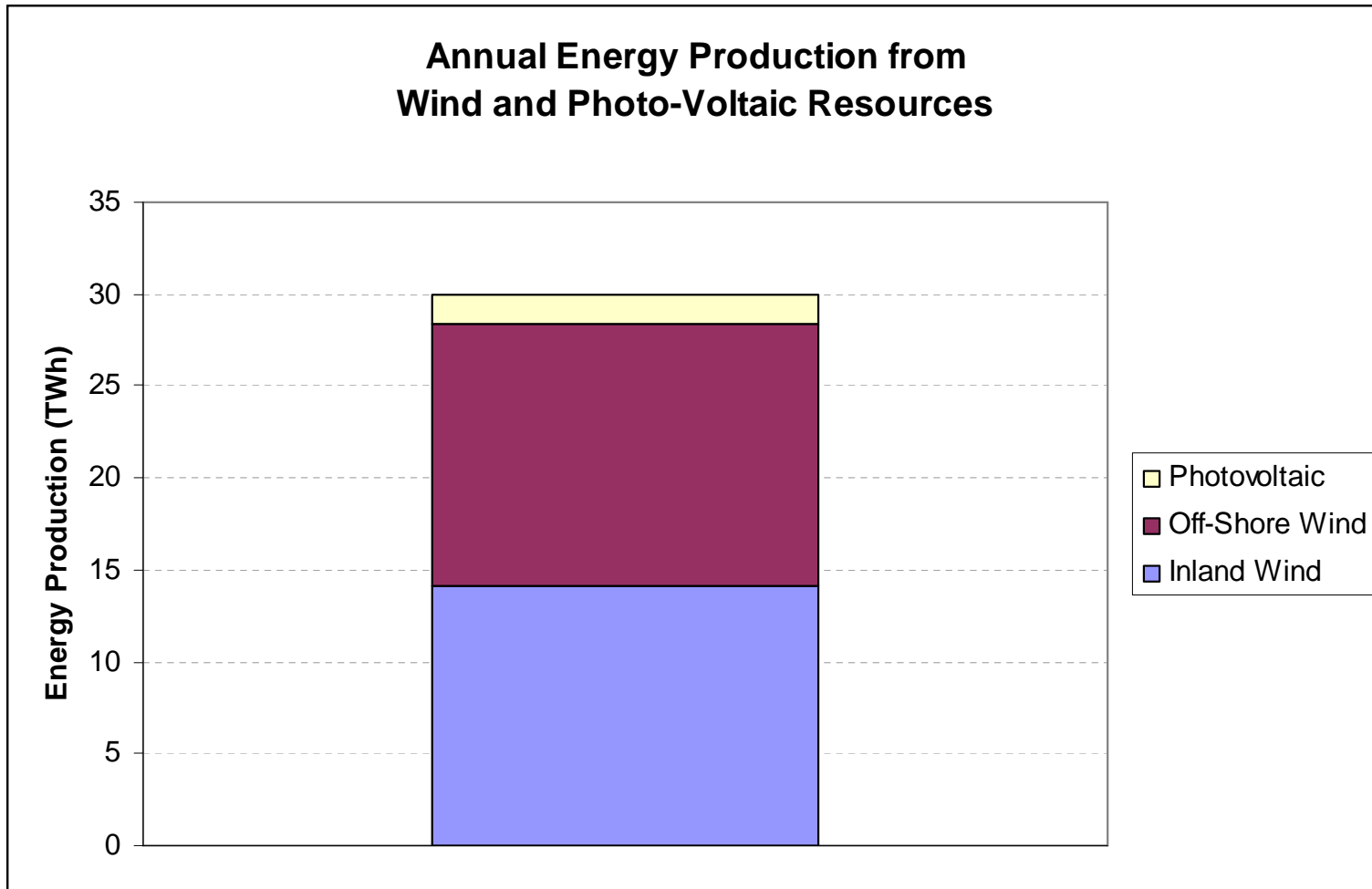
Combined Wind and PV Profile



Annual Capacity Factors – All Sites (Wind & PV)



Annual Energy From Wind and PVs



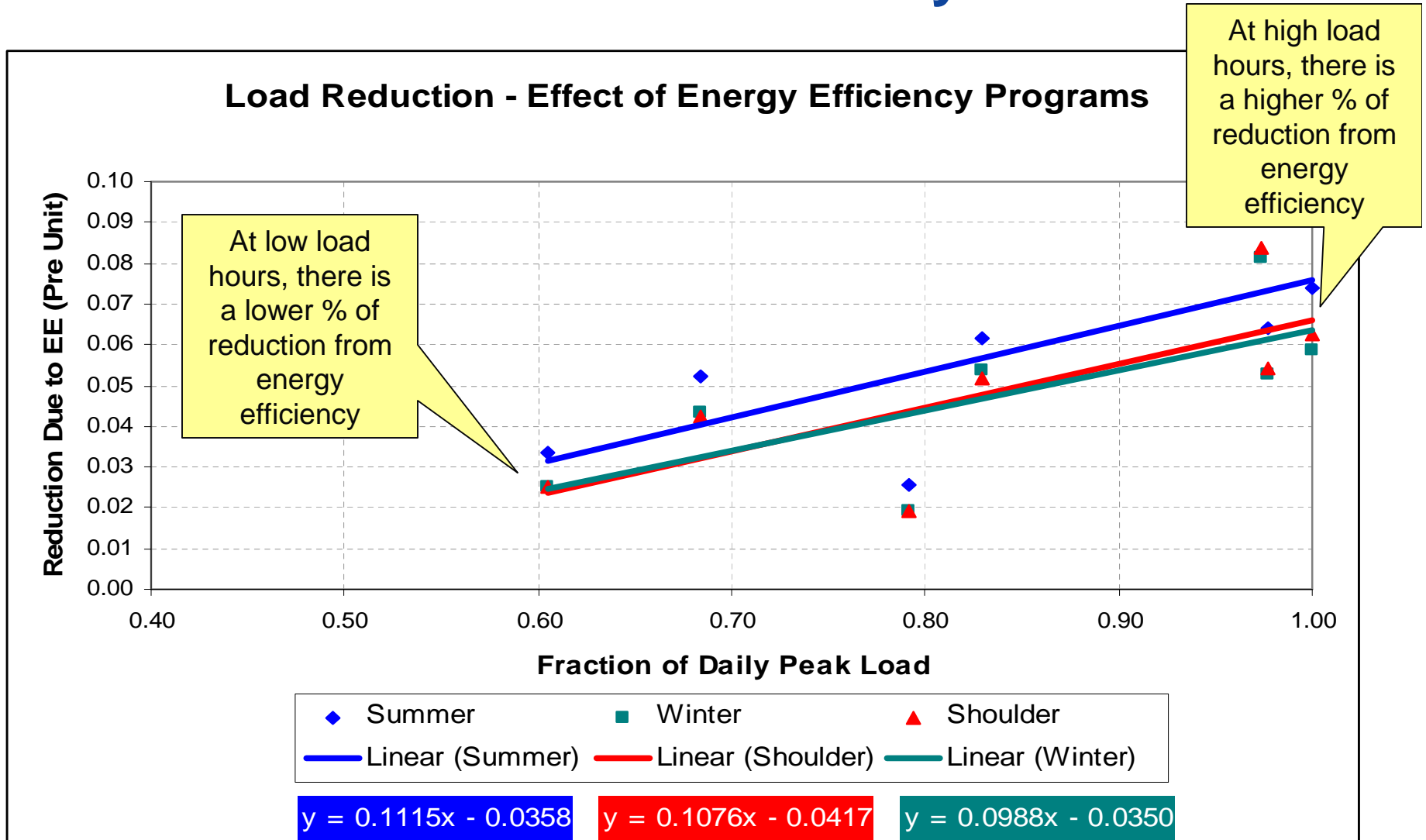
Demand Response and Energy Efficiency: Load Profiles

- **Two types of customer load effects**
 - **Energy Efficiency – All hours assumed to be affected**
 - **Demand Response – Only hours of peak use are affected**
 - **Top 2700 MW served by Demand Response**
 - **Assumed to occur after Energy Efficiency adjustment is taken**

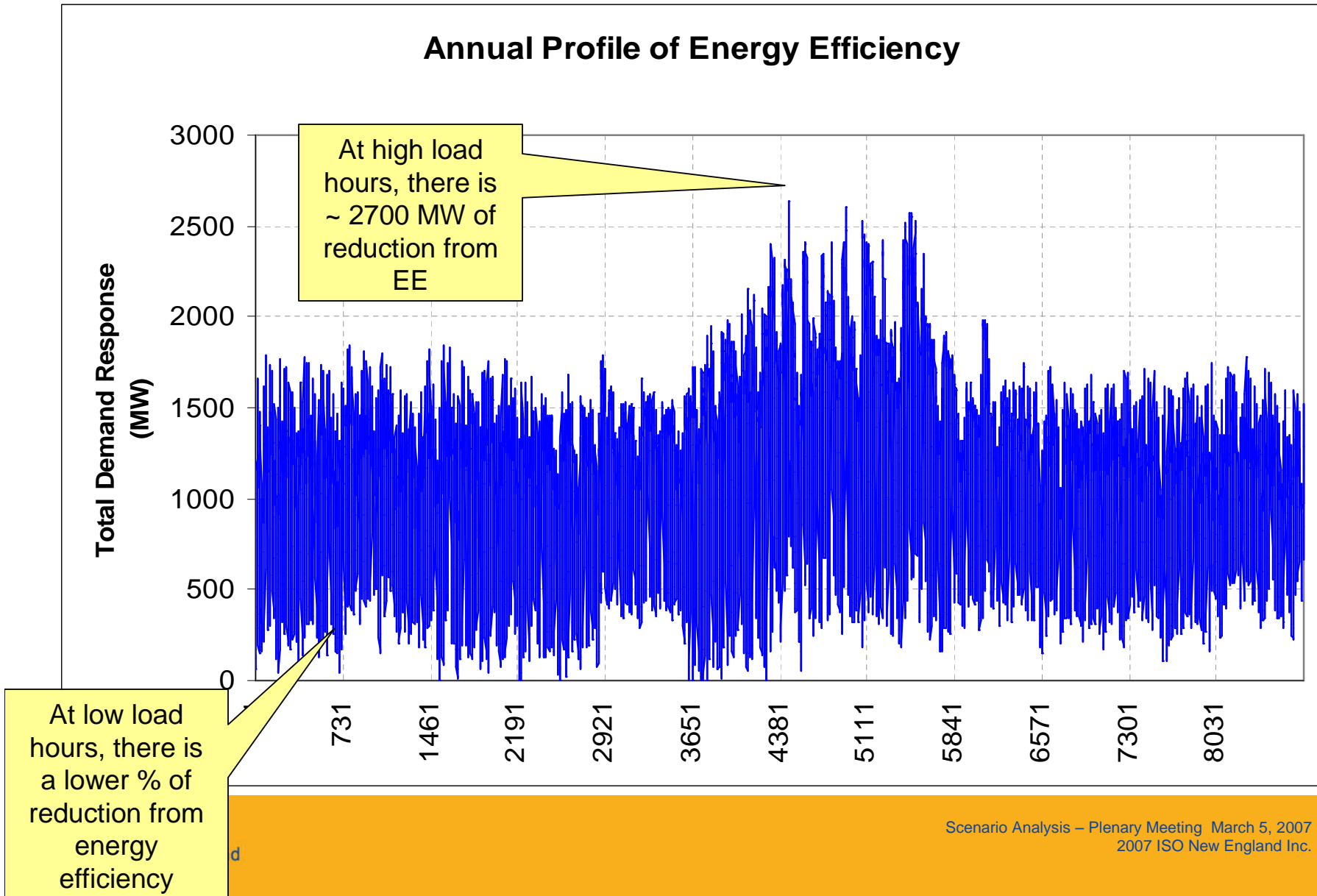
Demand Response and Energy Efficiency: Load Profiles

- Energy Efficiency
 - Developed EE profile in conjunction with Demand-Response Working Group (DRWG)
 - Requested to provide input to Scenario Analysis
 - Comments received for typical summer, winter and shoulder seasons
 - Original assumption:
 - 7.7% of load in every hour of the year (2700 MW at peak load of 35000 MW)
 - DRWG comments suggested lower percentage reductions in off-peak
 - Developed a linear approximation of New England load and EE
 - Captures both on-peak and off-peak characteristics

Reductions as a Function of Hourly Load



Annual Profile of Energy Efficiency



Demand Response Occurs With High Loads

