Pumped Hydro
Lost Opportunity

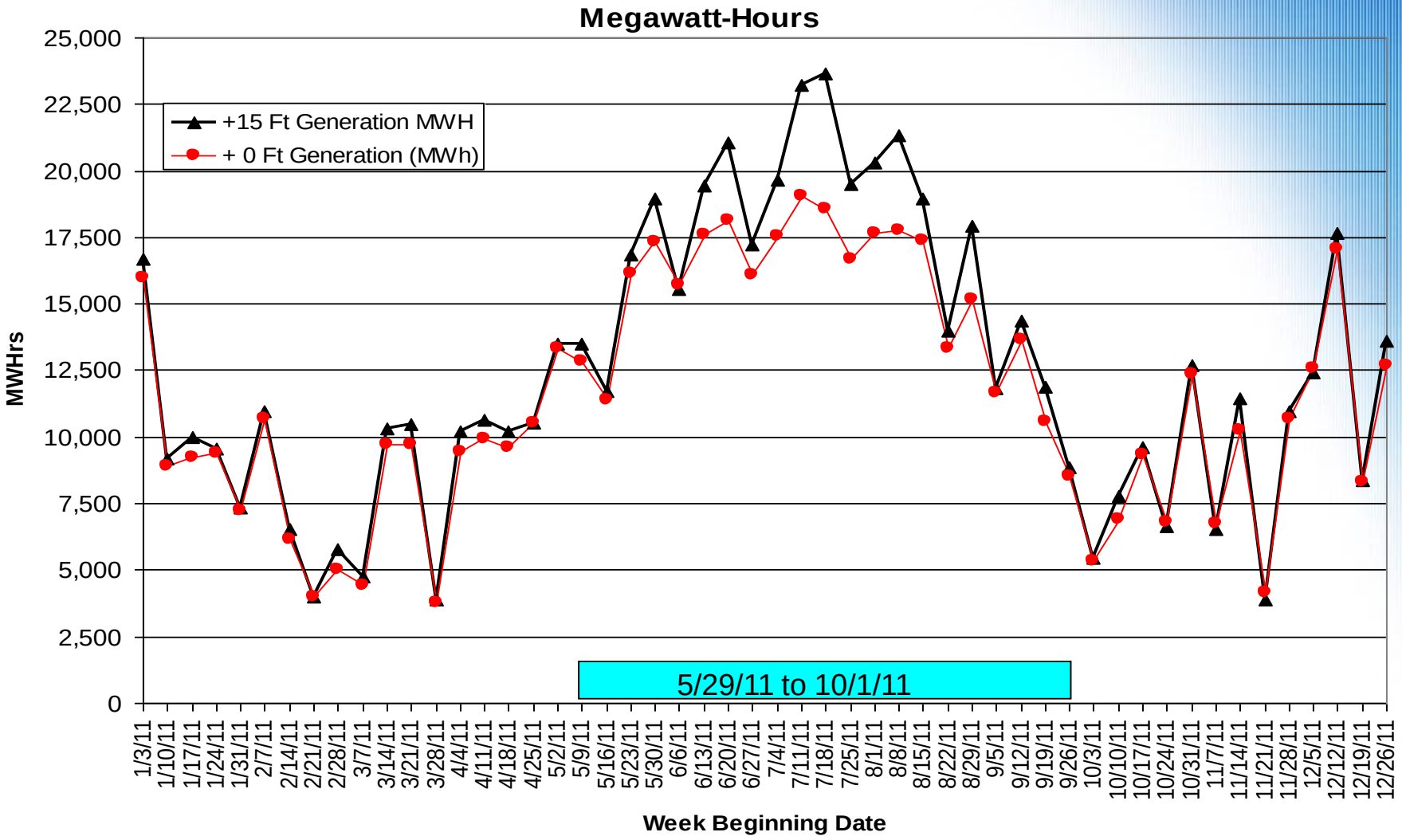
Model Assumptions

- Optimize plant generation and pumping to maximize financial margin
  - Analysis of reservoir with current limitations
  - Analysis of reservoir with an added water capacity in feet
  - LMP values were historical from Nov. 2009 to Oct. 2010

Model Output

- Difference between cases
  - MWH about 50,000
  - Margin/Lost Opportunity was positive and will be shown later in the presentation

Megawatt-hour (weekly)



Model Development

- Appears to be site characteristic specific
  - Reservoir volume
  - Generating capacity
  - Pumping capability
  - Pump efficiency
- One model/equation may not represent all pumped hydro units

Pumped Hydro Characteristics

- Water capacity in feet
- Generating rate in MW per foot of water
- Daily generating capacity in MWH
- Generating capacity of installed units
- Hours/time available to run at full load
- Pumping capacity in feet per hour per pump
- Hours/time required to fill the Reservoir

Days available to drain the reservoir, Base case + 15 Ft

- On an annual basis using an LMP $/MWH value as the indicator for the number of days when the reservoir could be emptied yielded 50 opportunities/days
- In the time frame of May 29 to Oct 1 a total of 40 opportunities/days were identified where the reservoir could be emptied based on LMP

LMP determination

- The average Off Peak LMP value was calculated based on standard off peak hours (8)
- The average On Peak LMP value was based on the highest 8 hours of LMP for the day since the reservoir can be drained in just under 8 hours at full load

Findings/Results

- Using the equation:

$/Year = Lost MWH * (On peak LMP – Off peak LMP/pump efficiency)

Where Lost MWH are defined as:

Lost MWH = # of days/year * 50 MW/ft * 15 ft

The values shown below are representative but are for example use only.

Using this equation for the annual and summer cases the following results are achieved:

Annual ➔ 50 days/yr * 50 MW/ft * 15 ft * (80.00 – 40.00/.7)$/MWH = $857,143

Summer ➔ 40 days/yr * 50 MW/ft * 15 ft * (81.00 – 38.00/.7)$/MWH = $801,429