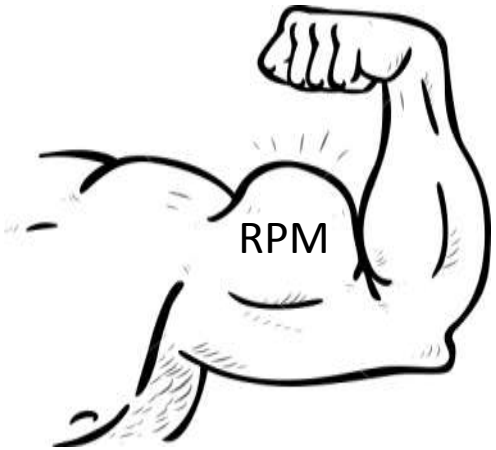
Calculating the Adequacy Reserve Margin (ARM)



SAAC/RAAC Joint Committee Meeting
Portland, Oregon
April 17, 2015

GENESYS vs. RPM

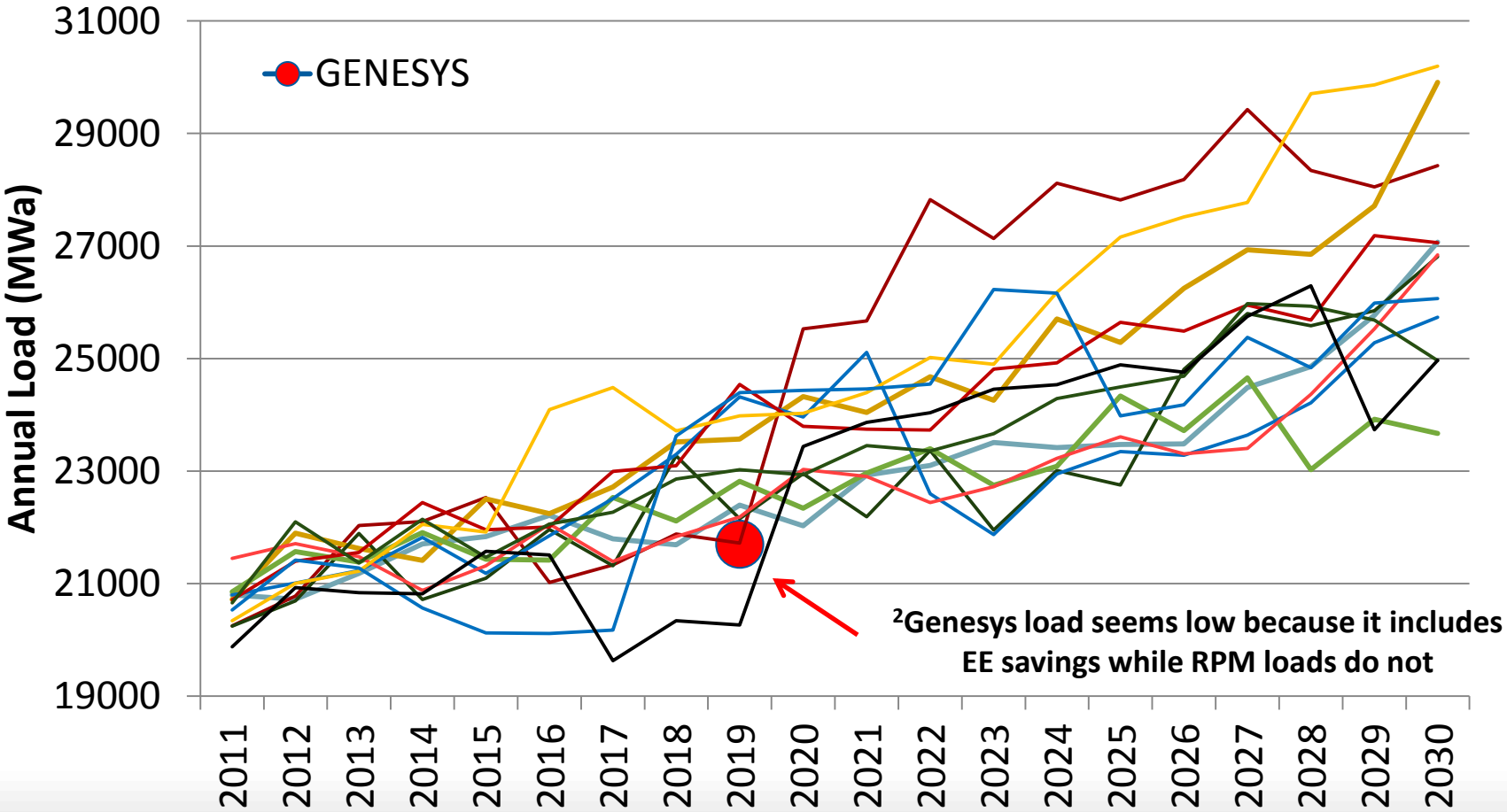
- GENESYS
  - Assesses power supply adequacy for 1 year
  - For a specific resource mix
  - Hourly time step

- RPM
  - Calculates average cost and tail-end cost
  - For various resource plans over 20 years
  - Quarterly time step

Future Uncertainties Modeled

Uncertainty	GENESYS	RPM
80-Year Hydro	Yes	Yes
Wind variation	Yes, temp correlated	No
Solar variation	No	No
Thermal Forced Outages	Yes	Yes
Temp variation in load	Yes	Yes
Long-term load growth	No	Yes
Fuel prices	No	Yes
Carbon tax	No	Yes
Tax credits	No	Yes
Construction costs	No	Yes
EE costs	No	Yes

RPM vs. GENESYS Loads[1,2]



[1]Sample of 11 futures out of 750

Adequacy Test in RPM

- Council's standard is 5% maximum LOLP
- Difficult to implement dynamic[1] LOLP calculation into RPM
- Need to translate probabilistic LOLP into deterministic metric that can be used dynamically
- LOLP ⇨ Adequacy Reserve Margin

[1]Means calculating LOLP as the RPM steps through study years.

Adequacy Reserve Margin

- From a GENESYS run that just meets the 5% LOLP standard

- ARM_E (energy) = (quarterly energy – quarterly load)/quarterly load
- ARM_C (capacity) = (peak capacity – 1-hour load)/1-hour load

- Resources: rate-based[1] generation capacity and energy
  - Hydro
    - Energy: FELCC (1937 hydro year generation)
    - Capacity: 10-hour sustained peak capacity for lowest monthly hydro generation
  - Wind
    - Energy: 30% of nameplate
    - Capacity: 5% of nameplate

- Loads: weather-normalized quarterly and 1-hour-peak loads

- Use winter quarter ARM values for the adequacy test

[1]Means only "firm" resources.

ARM_C (Capacity)

Resource Type	Adequacy Reserve Calc	Winter Quarter (Q1)
Thermal	Winter Capacity * (1 – FOR)	12,539
Wind	5% Nameplate	227
Hydro	10-hr Sustained Peak	16,490
Firm contracts	1-Hour Peak	-167
Total Resource		**29,089**
Load	1-Hour (weather normalized)	29,202
ARM Capacity	**(Resource - Load)/Load**	**-0.4%**

ARM_E (Energy)

Resource Type	Adequacy Reserve Calc	Winter Quarter (Q1)
Thermal	Winter Cap * (1–FOR) * (1–Maint)	11,608
Wind	30% Nameplate	1360
Hydro	Critical Period (1937)	10,642
Firm contracts	Quarterly Average	-200
Total Resource		**23,409**
Load	Q Average (weather normalized)	23,518
ARM Energy	**(Resource - Load)/Load**	**-0.5%**

Example of How the ARM_C Works (For 1year in 1game)

RPM Resource Need Example	Winter Quarter Value (Q1)
RPM Total Rate-based Critical Resource	28,654
RPM Peak Capacity Load	30,485
Implied RPM Adequacy Reserve	(28,654 – 30,485)/ 30,485 = -6.0%
GENESYS ARM Capacity Minimum	-0.4%
Conclusion: RPM ARM too low	RPM resources not adequate
Action: RPM needs more resource	
Resource needed = (ARM * Load) + Load	(-0.004 * 30,485) + 30,485 = 30,363
Incremental resource need	30,363 – 28,654 = 1,709 MW