Community Solar Value Project- Solar plus Demand Response

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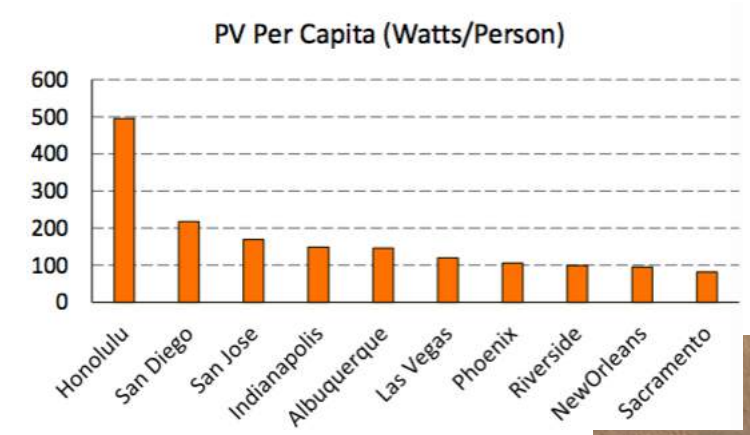
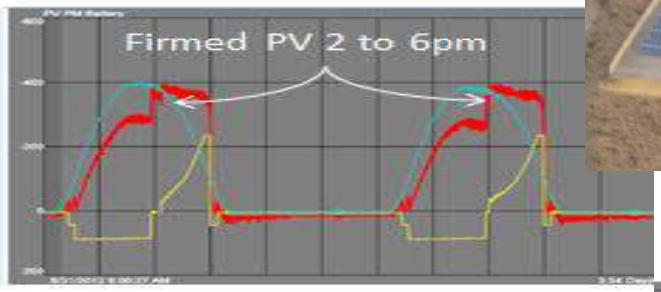
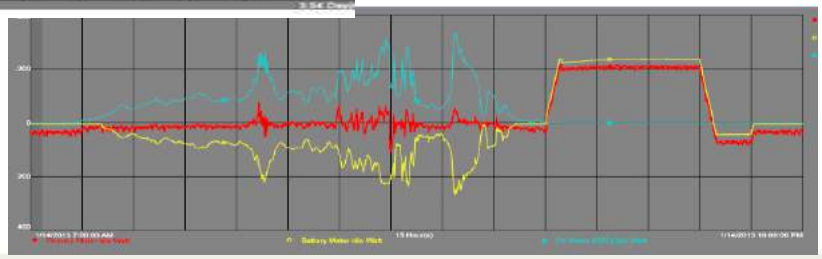
PNM WAS AN EARLY INVESTIGATOR OF BATTERY ENERGY STORAGE

- PNM's customers have a high interest in renewable energy
  - 100 MW of utility owned PV and growing
  - 70 MW of customer owned solar and growing
  - 2000 MW peak system
- Energy storage investigated as a possible solution to renewable challenges
- Energy storage site constructed in 2011
- Regulation (Smoothing) vs. Dispatch (Shifting)

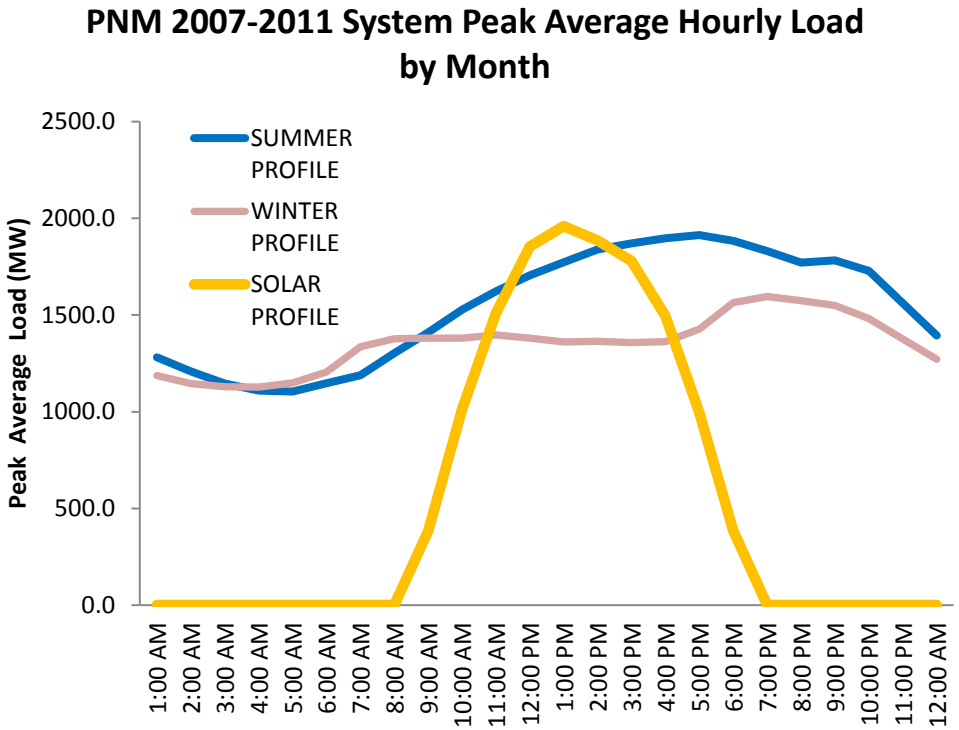




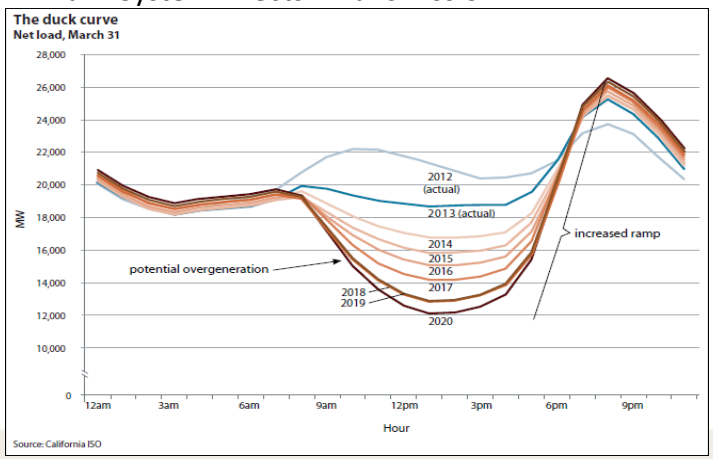


WHAT PROBLEM ARE WE TRYING TO SOLVE?

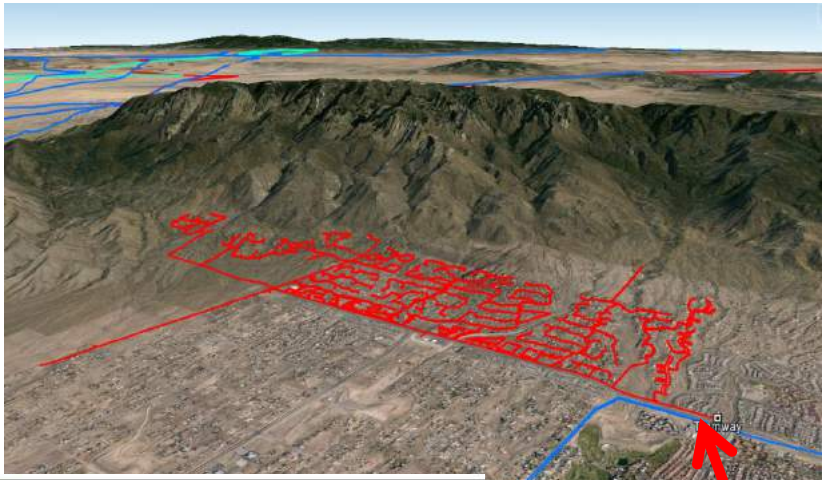
- Costs of battery energy storage high (but decreasing)
- Looking for an alternative to high cost battery storage for the energy challenges for PV – while developing a concept for the DOE SHINES FOA (2014/2015)
- PNM also interested in applications of community solar, further increasing PV penetration on the system

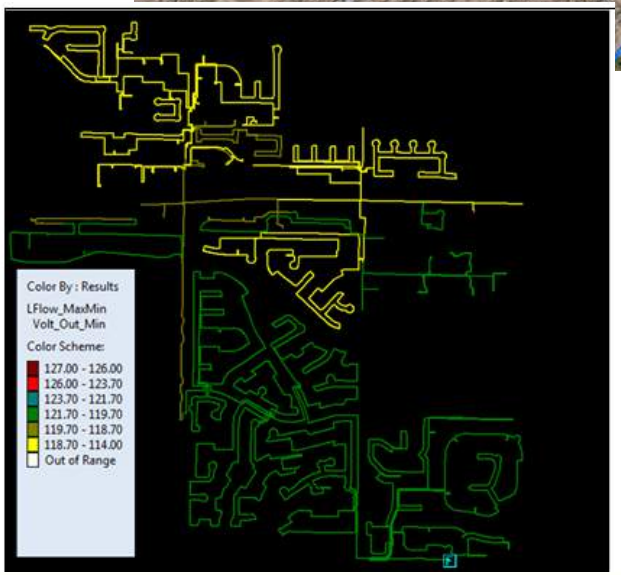


Bulk System Effects - Transmission



CHALLENGES NOT JUST AT BULK LEVEL- DISTRIBUTION

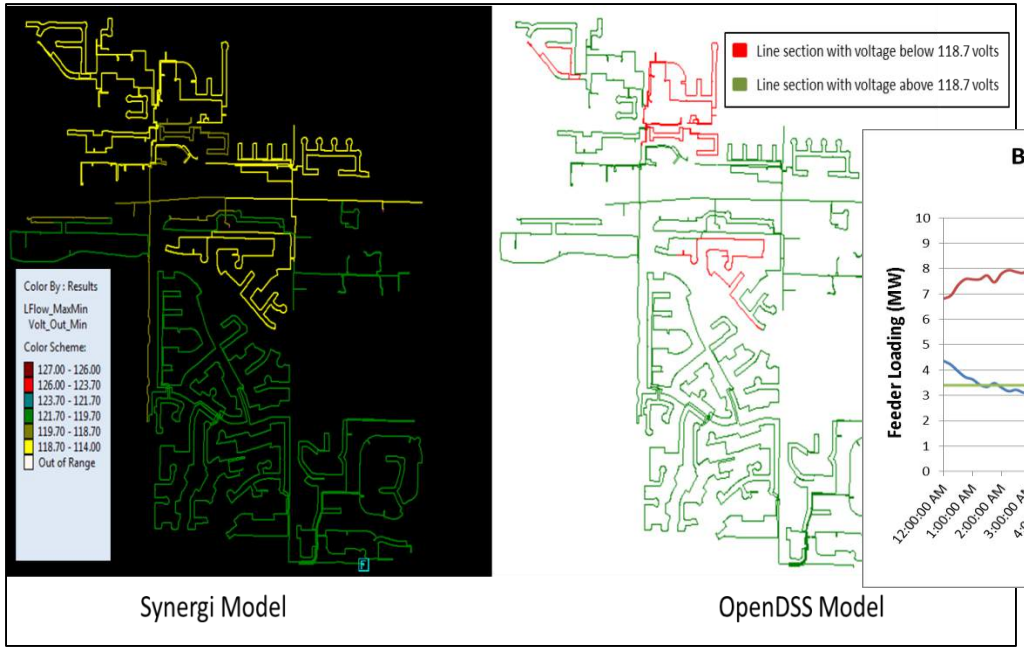


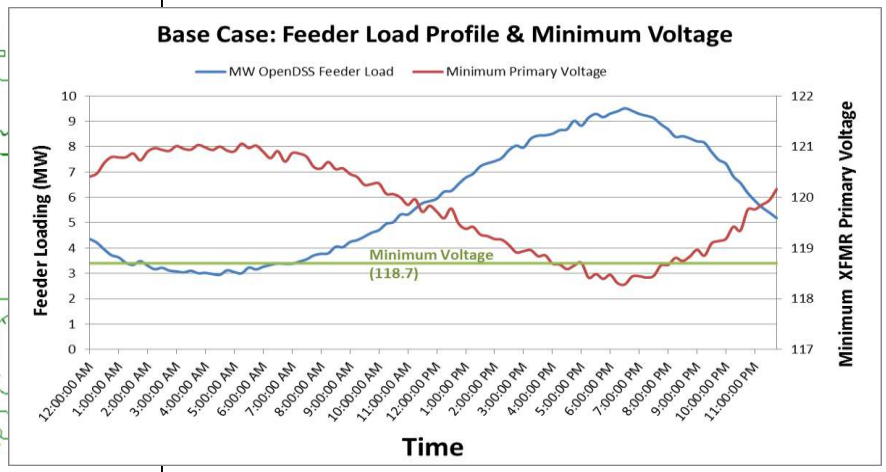


We know and/or manage the characteristics (Voltage, Current, Power) typically only at this point.

- Wires that feed neighborhoods can be many circuit miles long (example: Far North East heights of ABQ - 75 miles long serving 1888 customers)
- Distributed generation can cause localized Voltage issues
- Community solar size could contribute to these localized conditions
- Question: Can we pair the solar resource with other technologies (storage or demand response to better manage localized conditions?

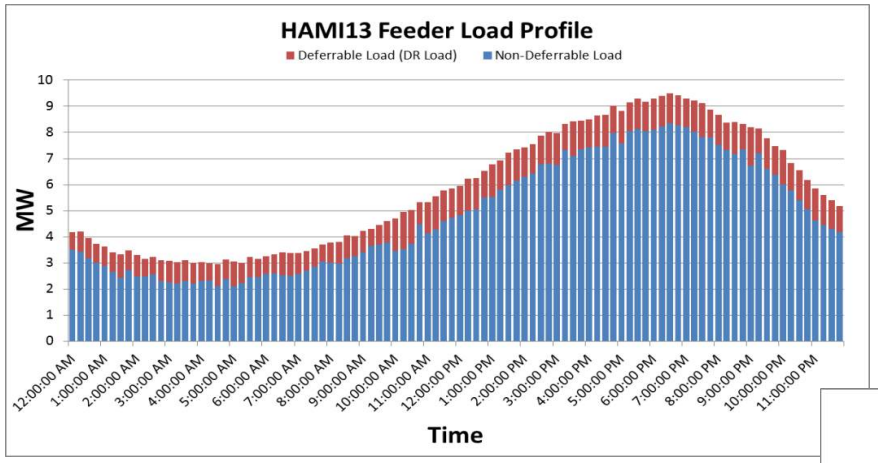
MODELING STUDY – COMMUNITY SOLAR WITH DEMAND RESPONSE (DR)



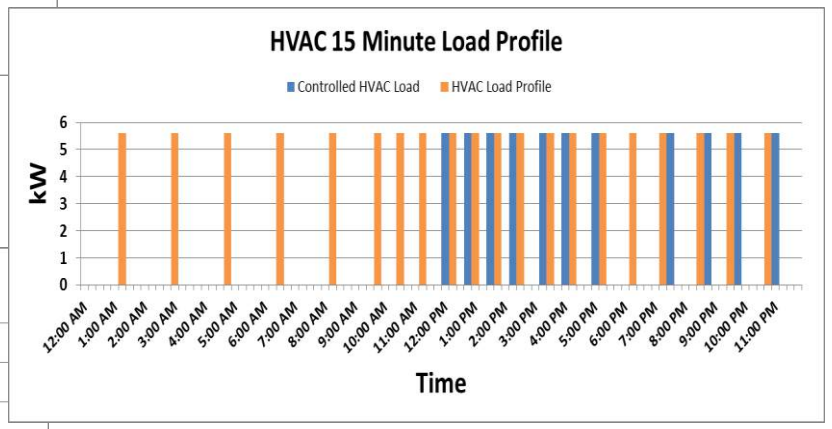


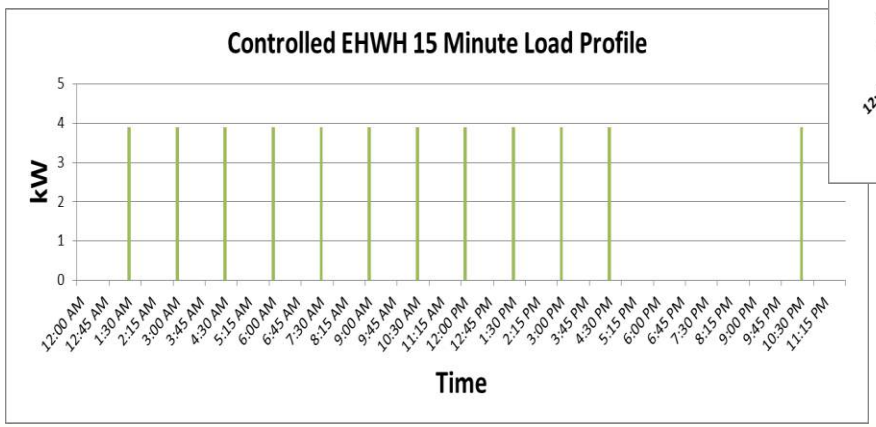
- Chose and existing feeder in Albuquerque that had identified low voltage issues (ANSI RANGE A – 116V to 126 V) – Phase A and Phase B laterals
- Two demand response resources were modeled – HVAC, Electric Hot Water Heaters
- 4.5 MW Community Solar installation (9 MW in solar only case)
- REALITY CHECK! - To correct this problem in the field – added 1800 kVAR cap bank, relocated a 1200 kVAR cap bank, and moved a loop on B Phase to A Phase

ASSUMED LOAD PROFILES – AND CONTROLLABILITY

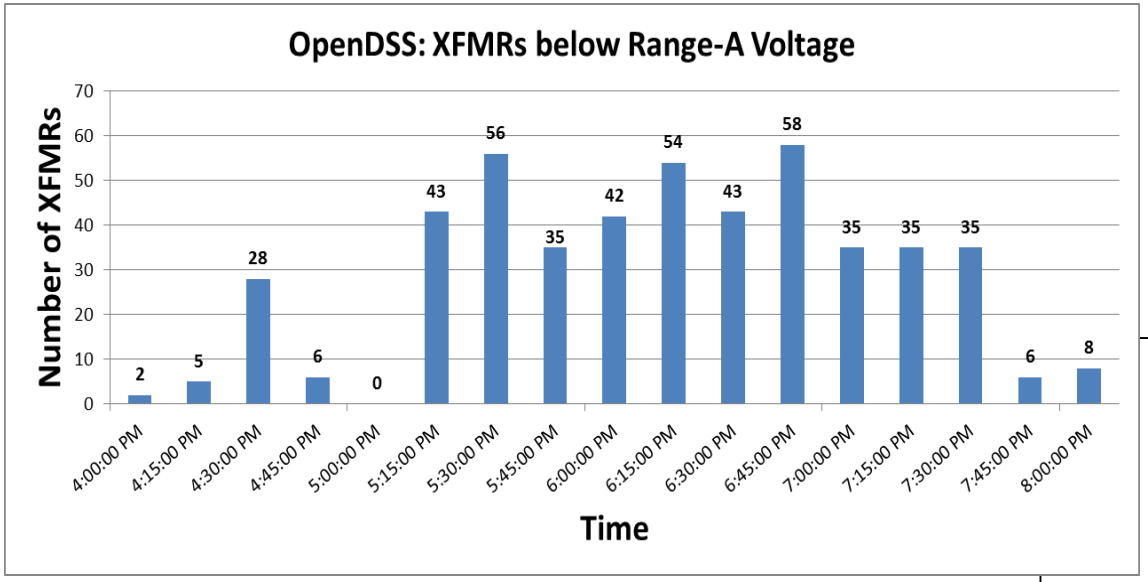


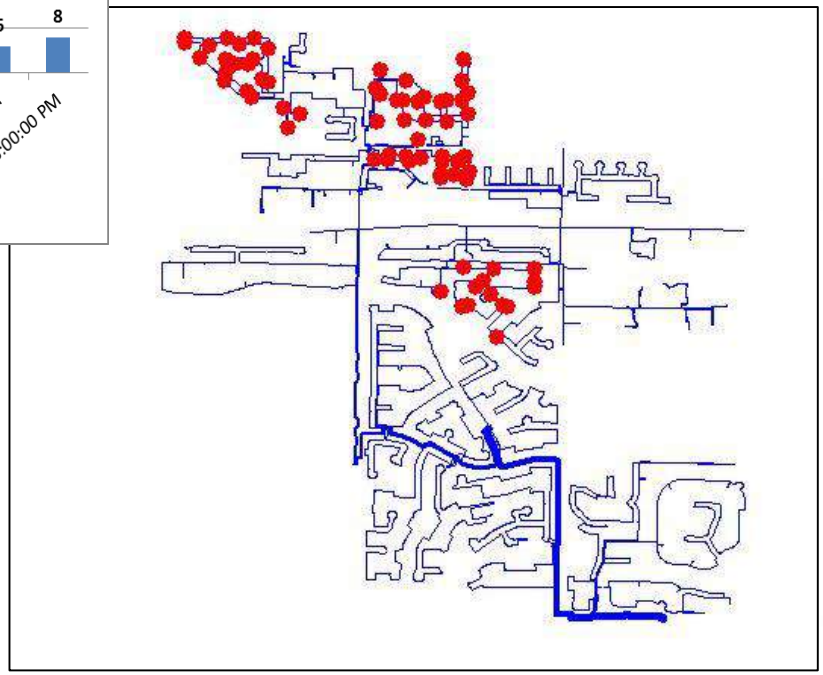
Future work could include more automated control over load side resources to better tailor the DR and PV with feeder load profile



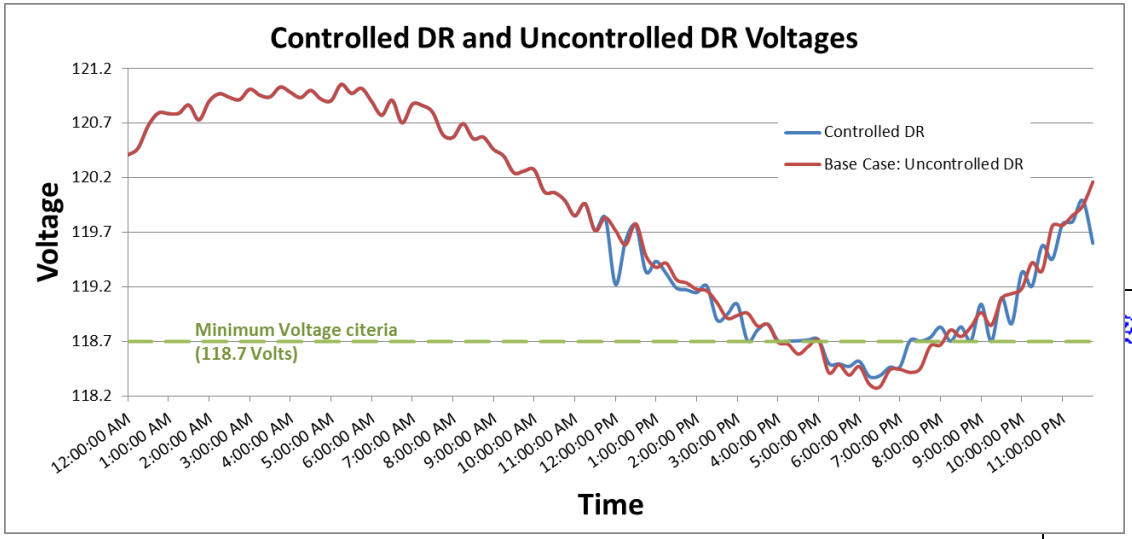


INITIAL MODEL OF TRANSFORMERS OUTSIDE ANSI RANGE A



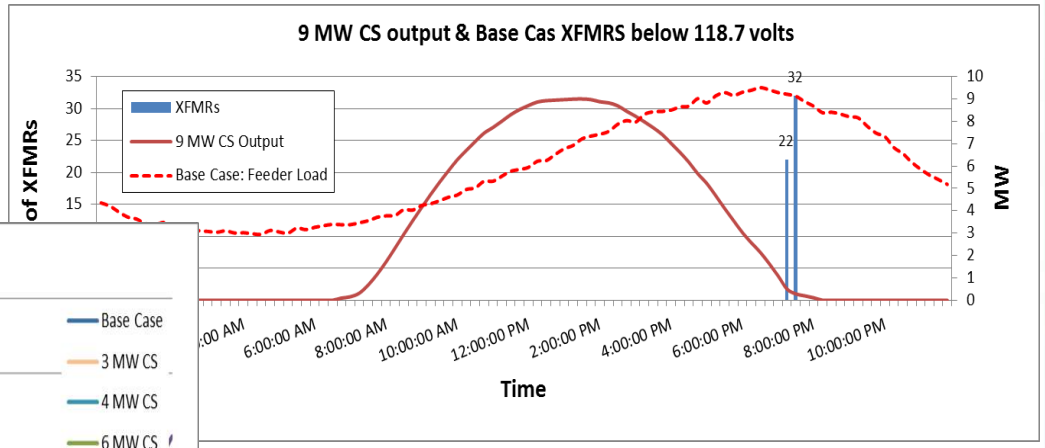


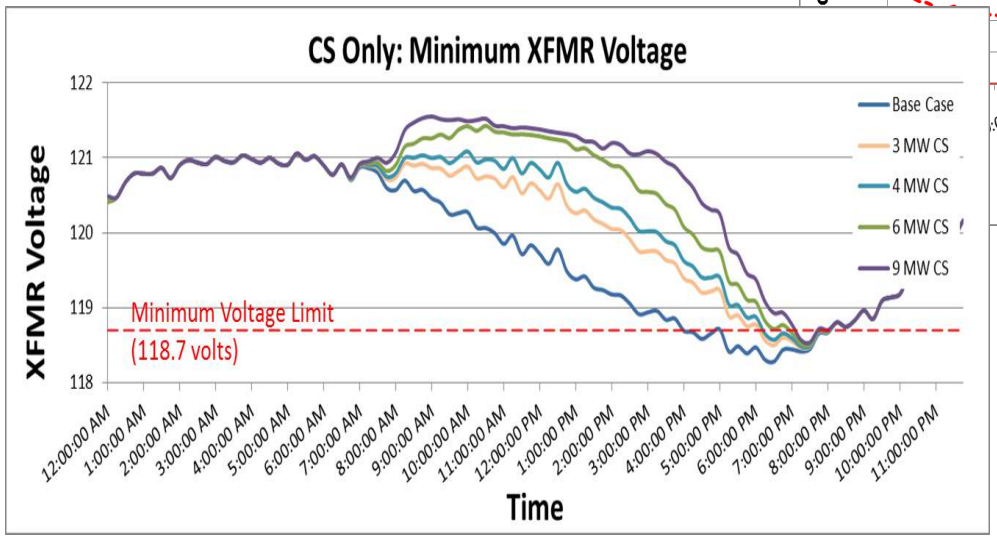
UTILIZING DR ONLY TO IMPROVE VOLTAGE



DR improved only Phase B Voltages in the model

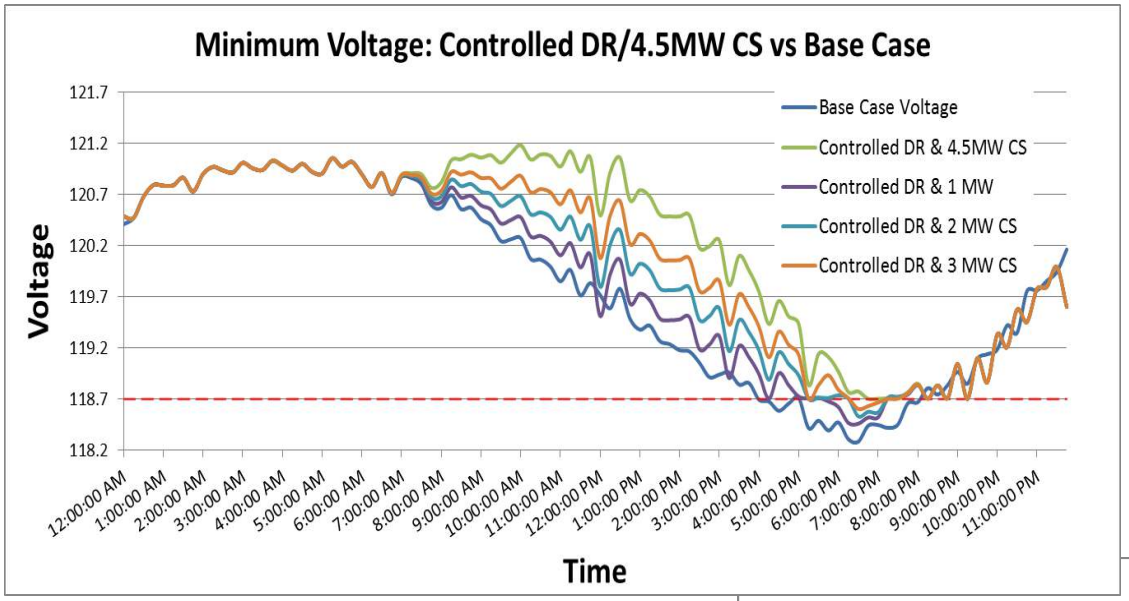
COMMUNITY SOLAR MODEL





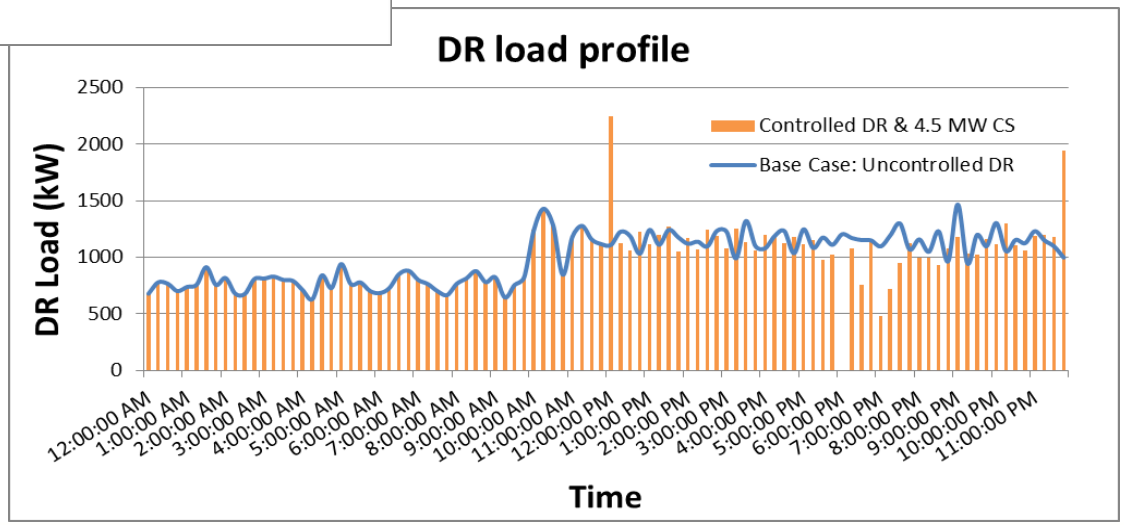
- Size of array varied in the model to find a solution that would mitigate the low voltage on its own
- 9 MW mitigated all voltage issues until 7 PM at which time we still saw voltage below ANSI Range A. However this size installation is probably considerably larger than we would consider for a community solar project.
- Peak solar output and feeder peak are offset by approx. 5 hours

COMMUNITY SOLAR WITH DR



- Community Solar (4.5 MW) with DR mitigated all low voltage conditions on the feeder
- Loads shifted off peak to PV production time

4.5 MW still probably too large for a community solar



CONCLUSIONS AND FUTURE QUESTIONS

- Solar alone has been seen as a possible resource to possibly defer feeder upgrades. In this model, the solar installation did mitigate some low Voltage issues, but fell short as the sun was setting when we began to again see the Voltage issues we were trying to mitigate.
- Demand response, traditionally used as a peaking resource for the bulk system, only did a marginal job on mitigating voltage issues on the distribution feeder.
- In the real world this voltage issue was mitigated by installing a cap bank, moving another one, and transferring some load to another phase.
- So, would adding a large solar array and demand response program be a cost effective solution in the distribution planning world? In a word… No. **HOWEVER**
- It is important to look at programs like this holistically (TEAR DOWN THE SILOS!).
  - Does the utility desire a community solar program? Distributed solar program?
  - Does the utility have energy efficiency desires or requirements?
  - Are their program objectives that need to be met for State requirements (solar, energy efficiency)?
  - Does the utility have an electrification initiative? GHG initiative?
  - Does your Integrated Resource Plan call for more DR or Renewable resources?

Thank you