i-PCGRID Workshop 2014

Emerging Transmission Issues on DG and Renewables Integration

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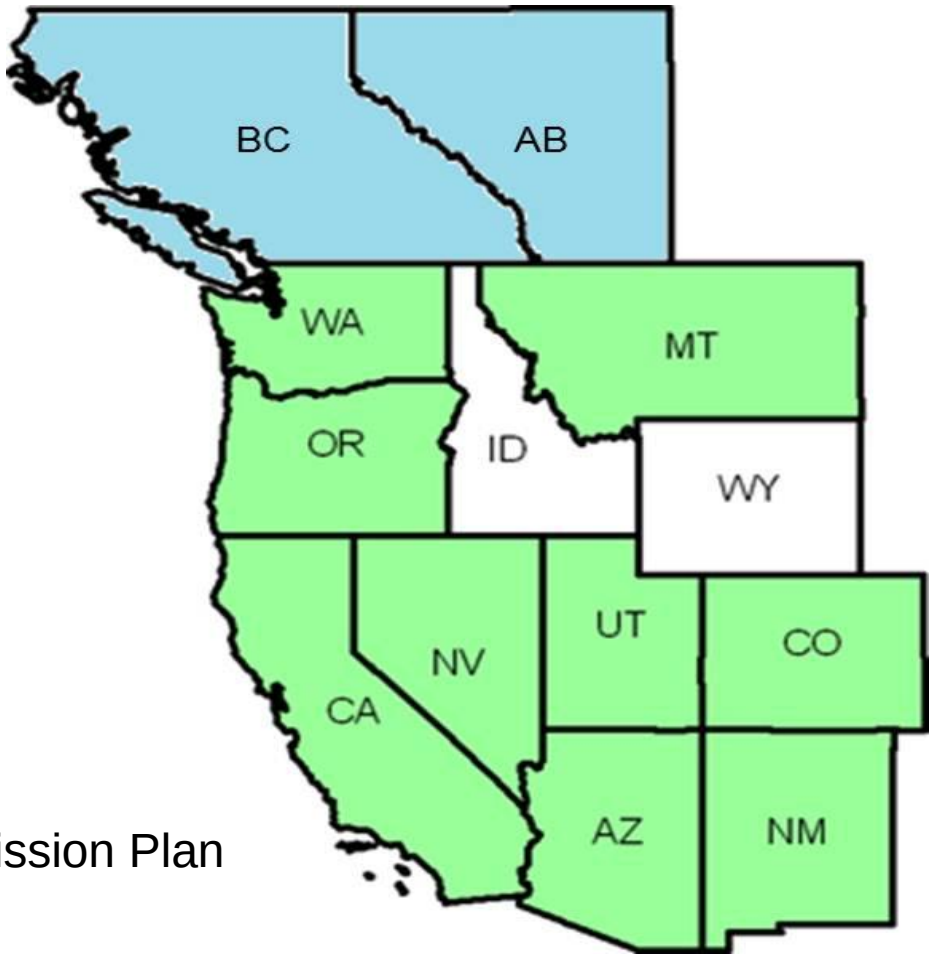
Power flow control for the Grid

SWG

States/Provinces with Renewable Portfolio Standard Requirement or Goal



Source: WECC TEPPC 2013 Interconnection-wide Transmission Plan Summary

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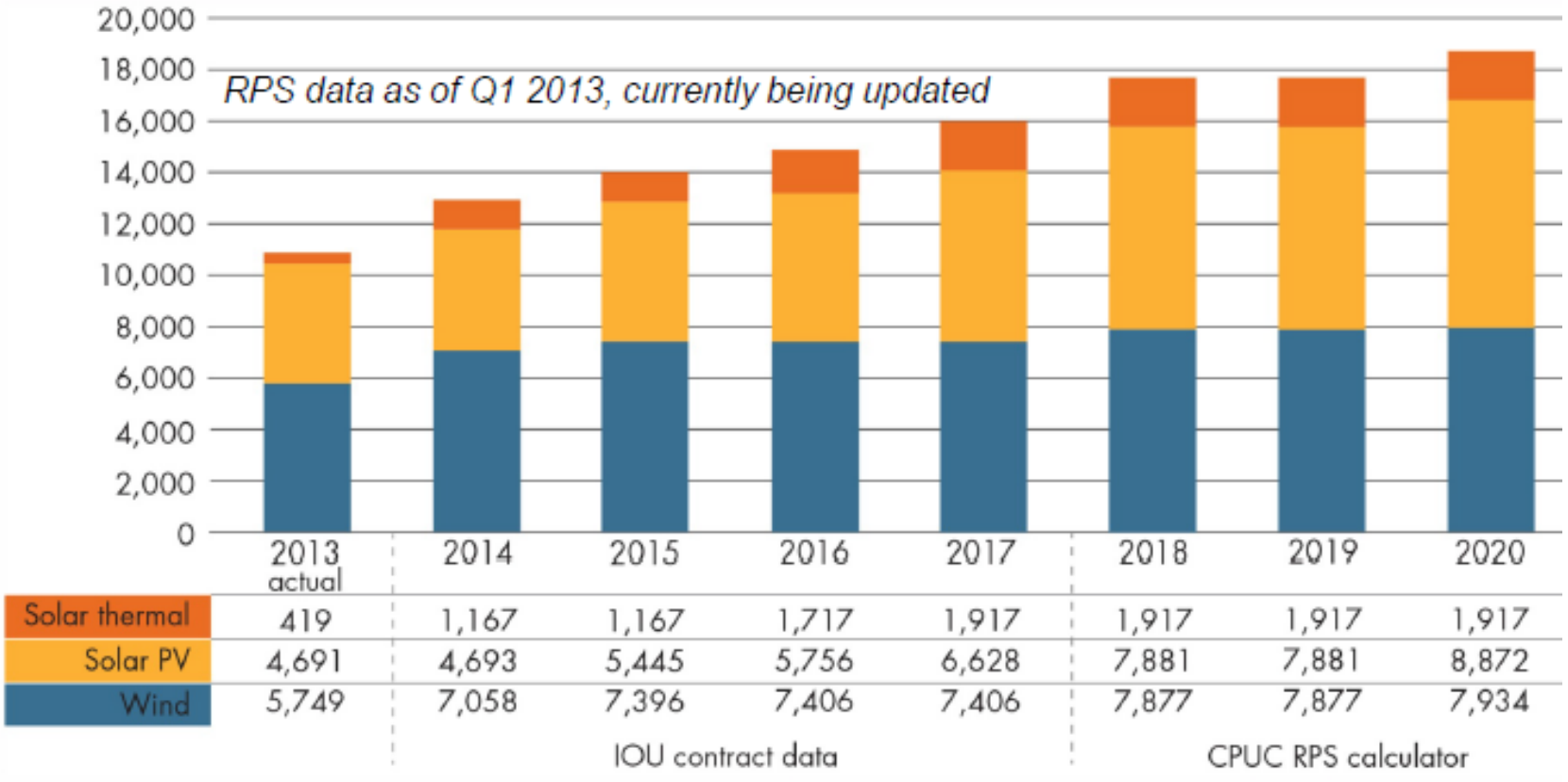
Expected variable energy resources build out supporting 33% RPS



	2013 actual	2014	2015	2016	2017	2018	2019	2020
Solar thermal	419	1,167	1,167	1,717	1,917	1,917	1,917	1,917
Solar PV	4,691	4,693	5,445	5,756	6,628	7,881	7,881	8,872
Wind	5,749	7,058	7,396	7,406	7,406	7,877	7,877	7,934
		IOU contract data				CPUC RPS calculator		

Wind peak production: 4,244 MW on 6/17/2013
Solar peak production: 4,143 MW on 3/16/2014

California ISO
Shaping a Renewed Future

Source: CAISO Renewable Integration Update, March 2014

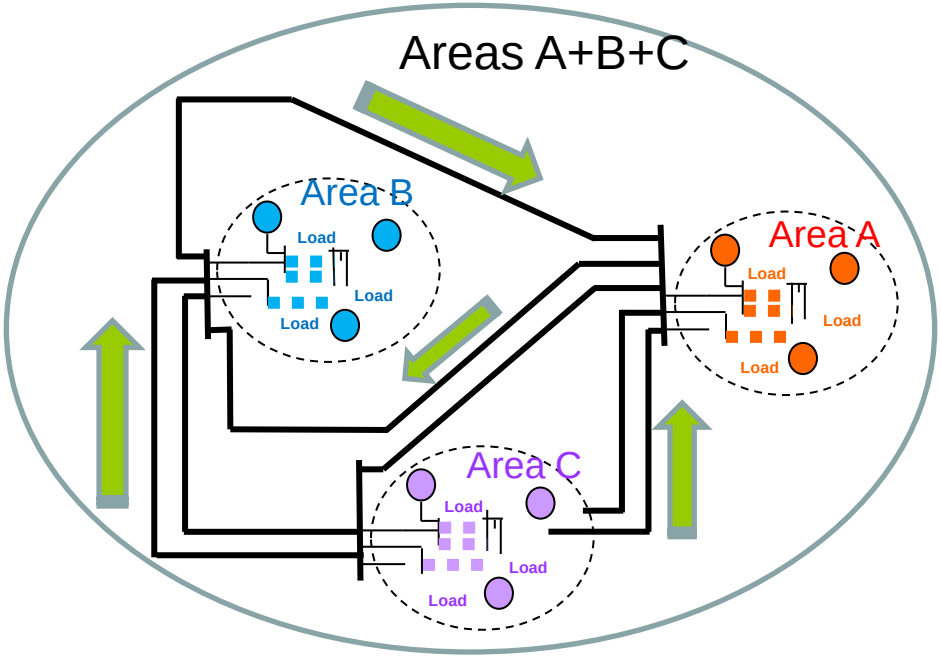
Potential Issues

- ***Fewer synchronous generators at load centers***
  - ***Reduces system's ability to maintain dynamic stability => wide-spread blackouts***
- ***Utility-scale renewables are typically located remote from load centers => Increased electrical distances to loads:***
  - ***High voltage at the remote generators => impact safety***
  - ***Low voltage at the load centers => wide-spread blackouts***
- ***Increased variability of loads from Distributed Generation***
  - ***Decreased power flowing into Load Centers when DG is high***
  - ***Increased power flowing into Load Centers when DG is low***

Potential Issues

- ***Fewer controllable and dispatchable resources visible to the system operator***
  - ***Increases chance in real-time of operating under conditions that have not been previously studied***
  - ***Reduced situation awareness***
    - ***Place system at risk***
    - ***Restrict future operations***

- ***Diversity of variable resource locations could smooth out total power injection into the system, BUT also:***
  - ***Increases power flow over specific transmission facilities due to generators ramping in various locations***
  - ***Increases chance of "local" problems***



Potential Issues

- ***Increased Uncertainty in planning for transmission upgrades***
- ***Long lead-time requires decision to be made years ahead of time***

Potential Solutions

- ***Better data acquisition and analytic tools***
- ***Increase relay protection system and telecommunication capabilities***
  - ***Increased visibility and control***
- ***Better generator and load models in planning and operation studies***
- ***Improve forecast on locations and technologies of future renewable resources***
- ***Increase the flexibility of the system by use of FACTS devices and new technologies => modeling of new technologies***

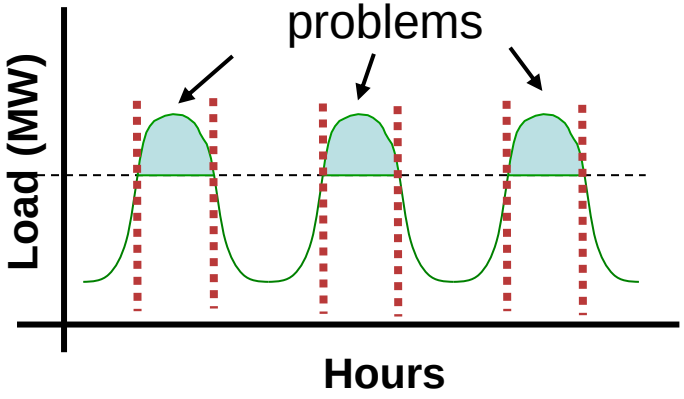
Potential Solutions

- ***Require for all transmission level power plants:***
  - ***Reactive capability range***
  - ***voltage control by the system operator***
- ***Enhance use of existing pumped storage devices***
- ***Add voltage support devices around system***
- ***Plan / build transmission projects that can serve multiple purposes***

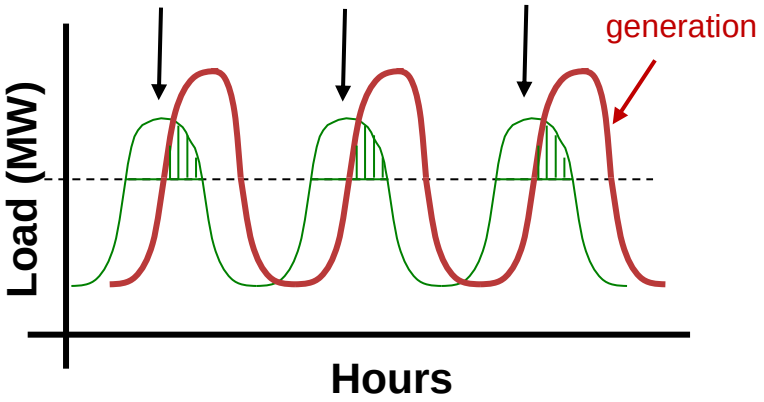
Potential Solutions

- ***Add Controllable Distributed Generation – design considerations***
  - Location and Magnitude
  - Coincidence with occurrence of transmission problem
  - Pre-contingency/post contingency
  - Speed
  - Interconnection requirements
  - System Impacts
  - Islanding issues
  - Communication Requirements
- ***Add Storage – design considerations***
  - All of the above plus
  - Transmission capacity to support charging

Generator must be running to avoid transmission problems



Generation cannot avoid transmission problem



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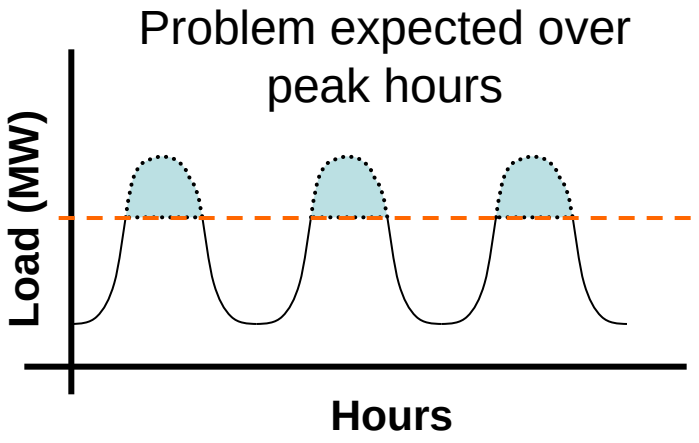
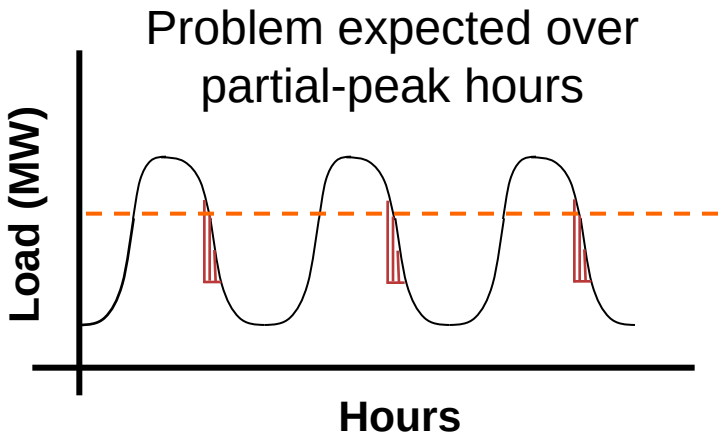
Potential Solutions

- ***Add Demand Response – design considerations***
  - Location(s) and Magnitude
  - Timing (e.g., peak vs. off-peak)
  - System impacts
  - Pre-contingency/Post-contingency
  - Speed
  - Frequency and Duration
  - Voluntary/Involuntary
  - Load restoration
  - Hardware requirements
  - Communication requirements





Question?