Impacts of Current Electricity Storage Implementations

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Current state of advanced storage

- Is Advanced storage a viable solution?
  - Storage has many potential applications and there is often confusion as to whether the technology is viable or not
    - For specific applications, advanced storage is a viable solution choice
    - Outside of these applications, storage can be “too expensive,” “a couple years away” or “require another major technology advancement”
  - As presenters rarely specify they are examining one of many potential applications, contradictory statements are often made about electricity storage potential on succession panel discussion

- Advanced storage is currently being implemented in the field as a viable solution choice
  - Lessons learned from these applications are essential to expanding the number of applications and identifying areas for improvement

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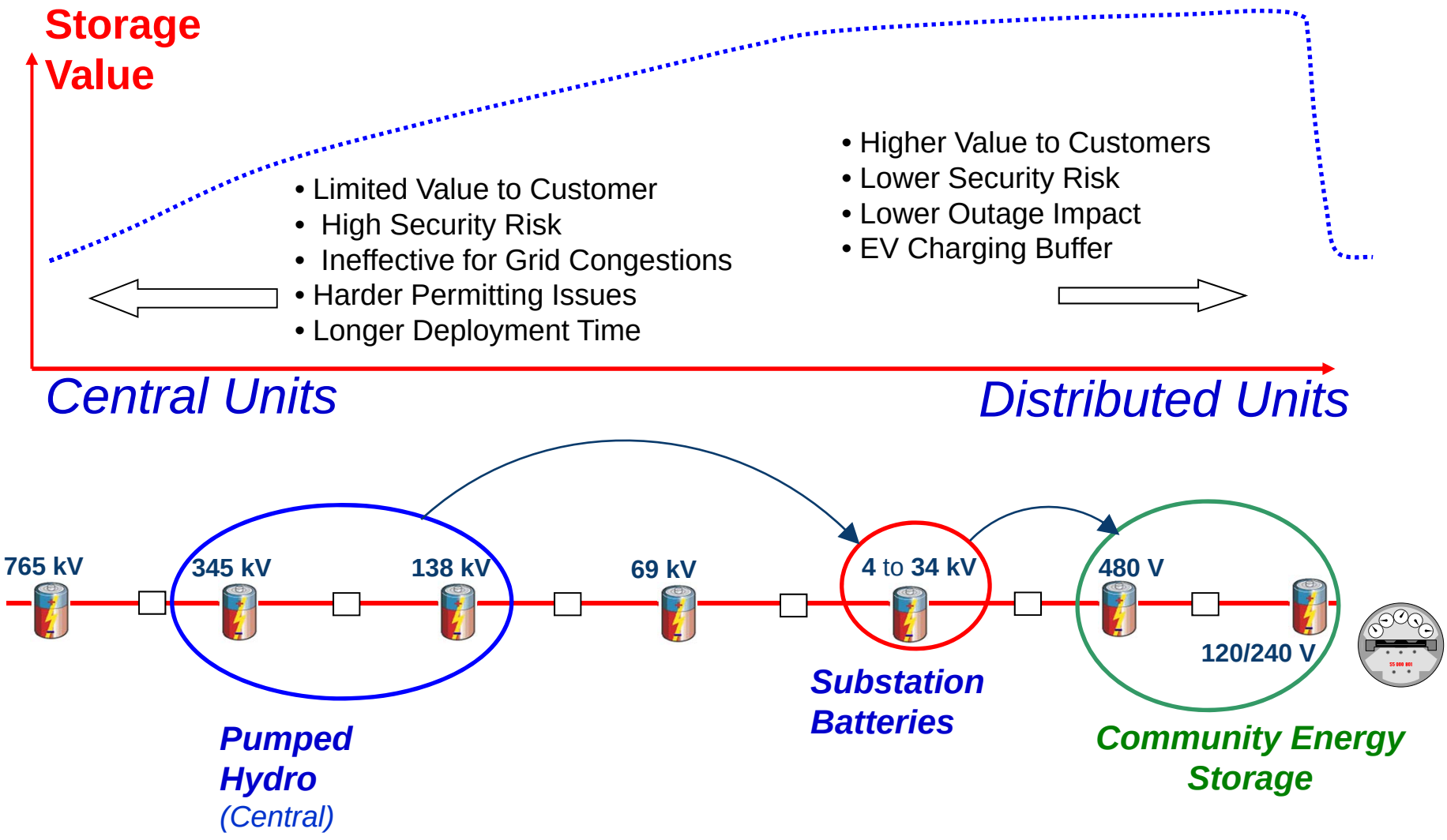
We are seeing storage activity across three main categories

1. Community scale (Community Energy Storage)
   - 25-100kW devices sited on the low side of the distribution substation by utilities
   - Devices still in development phase but being demonstrated by AEP, DTE Energy, So Cal Edison
2. Utility scale – emphasis on renewables and ancillary services
   - 250kW to 2 MW Modules — this is where “advanced technologies” reside and in the field today
   - Focus on renewable integration, ancillary services, back-up
3. Bulk storage
   - Above 50 MW
   - Pumped Hydro & CAES — above ground being

Why community storage?



Great promise, but few demonstrations to date

- Community Energy Storage
  - Who is demonstrating
  - → AEP, DTE Energy, So Cal Edison

Courtesy of Red Flow
- Zinc Bromide units

- Little data has been accumulated on operations of the unit

- Need for testing of devices?
  - Well trodden path for all new applications
  - Testing & demonstrating an essential component for advanced energy products
  - Negative ramifications for failure in the field will be severe to manufacturer
  - Negative ramifications for failure in the field will be severe for CES concept

Conceptual design of CES

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Utility-scale systems

- Recent lab or field demonstration activities
  - Altairnano confirming performance capability for frequency regulation at IPL
  - Xtreme Power working with Wind Farms
  - Zinc-Air long duration battery (US) currently being tested in KEMA labs
- Leads to successful deployments of applications
  - First 12 MW “Spinning Reserve” application (Chile)

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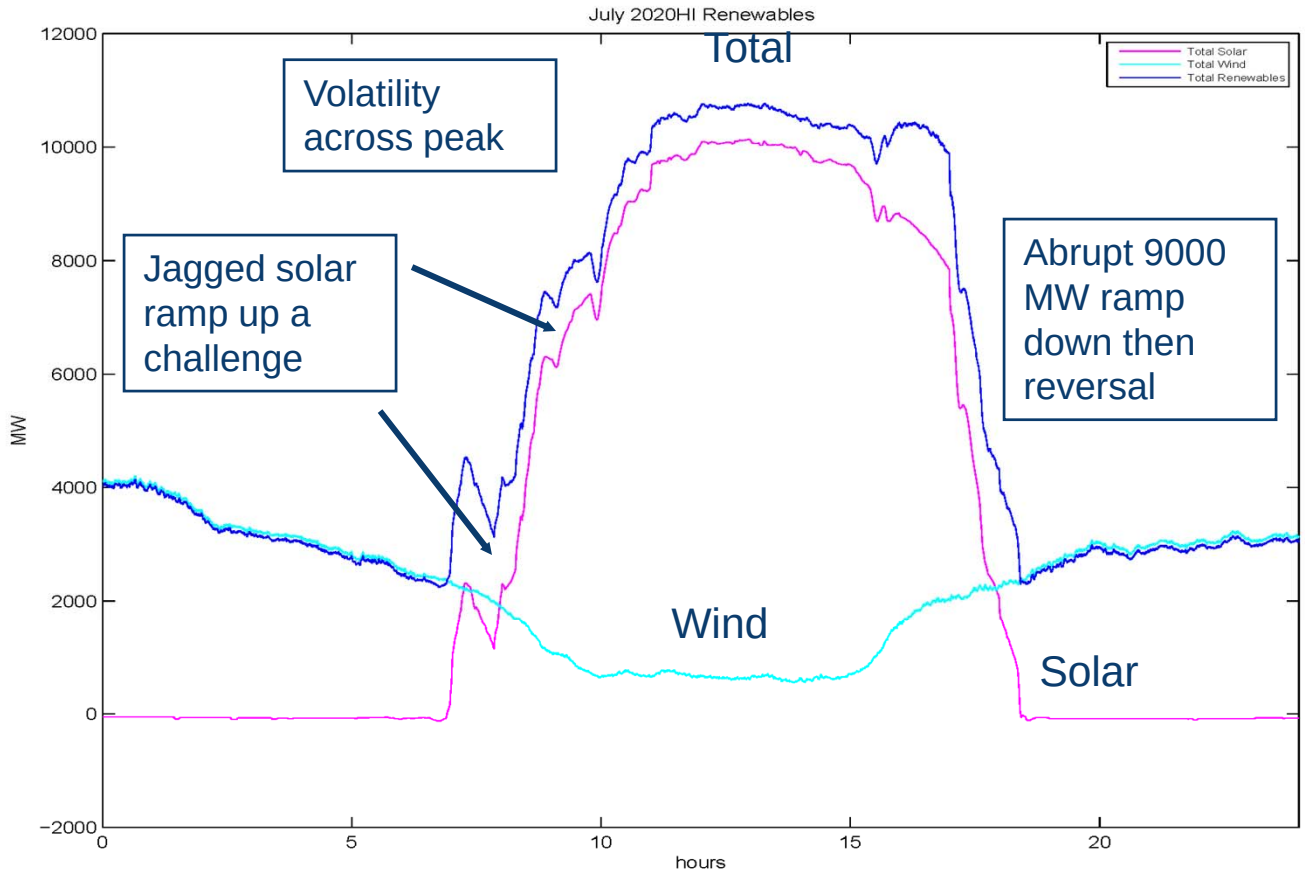
Drivers confirmed through modeling – summary of California ISO-CEC Study



Major conclusions from the study

- In the 2020 33% high renewable capacity case the system may require 3000 – 4000 MW of regulation & reserves
- 3000 MW / 6000MWH of storage will suffice
- Storage requires an aggregate ramping capability of 0 – 100% in 5 minutes in the 33% scenario
- System requires > 800 MW regulation in 2012 and approx. 1600 MW in 2020 for “normal” (non-ramping) periods
- Storage equivalent to 110 MW CT appears to range between 30
  - This needs to be taken into consideration in cost evaluation!
- Use of CT’s for increased regulation (forced commitment) increases overall system emissions approximately 3% vs. Using storage
  - Combustion turbines may not be allowed to be the answer

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Future challenges for storage – cost and regulations

- To date, advanced storage is successful in niche markets
  - Cost will need to decrease in order for storage to cross into all potential applications
    - Storage isn't simply one or two options, there are many, all of which are targeting necessary cost points
      - A clear difference between some advanced energy technologies in the past
    - But cost issue may not be a simple a volume issue, may need to have Generation II technologies entering marketplace
  - This advancement is not far off, these devices are already in labs and being tested

- Regulation and Rules
  - Storage capabilities still outpacing current regulations
  - Not just market rules for ancillaries, but how to capture multiple application capability of storage

Future challenges for storage - testing

- Testing standards are still being developed, but in addition to safety testing and factory acceptance testing, emphasis will need to be placed on:
  - Performance testing
    - Efficiency, response rate, duration
  - Application Testing
    - Single Roles or ability to perform multiple roles
    - Ability to integrate into current communication systems
  - Life-cycle Testing
    - How many applications should a device perform based on the impact on the life-cycle of the battery?
    - Linking to secondary-life applications from EVs
  - Independent Verification of System Performance

- Confirming all the capabilities will be essential before letting a client or end-user test the device in the field
  - Manufacturers can not afford to “learn” in the field with a customer

How are challenges being addressed?

- Storage groups and consortiums are key to solving issues and advancing technologies

- NY-BEST
  - NY Battery and Energy Storage
  - Subcommittee to address testing and standards
  - Advancing applications in New York

- ESA – Electricity Storage Association
  - National organization to promote storage
  - Helping to promote education and outreach among many activities