Impact of Storage Dispatch Assumptions on Resource Adequacy Assessment: Preliminary Work

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Method Classification

Three dimensions for classifying methods of including dispatch of energy-limited resources in resource adequacy studies:

1 – Presence or absence of feedback

- Does the dispatch decision consider the resource's own impact on system conditions?
- Example: price-taker vs market participant / economic dispatch model
- Likely the least interesting of the three dimensions as absence of feedback is only viable at very low penetrations of energy-limited resources

Method Classification

Three dimensions for classifying methods of including dispatch of energy-limited resources in resource adequacy studies:

2 – Dispatch signal / objective

- What is the dispatch schedule trying to accomplish?
- Example: peak load shaving vs price arbitrage / system cost minimization vs shortfall minimization
- Difference in RA contribution between shortfall-minimizing dispatch (most conservative) and cost-minimizing / profit-maximizing is an interesting question
- If unit commitment (non-convexity) is neglected and available capacity distribution (COPT) is fixed, price / load / shortfall risk increase monotonically with respect to each other, and dispatches should be similar if not identical

Method Classification

Three dimensions for classifying methods of including dispatch of energy-limited resources in resource adequacy studies:

3 – Expectation vs realization dispatch

- Is dispatch determined a priori on an expected value basis, or does it depend on the realized / sampled system state?
- Example: discharging in high LOLP periods vs periods with actual realized shortfall (given sampled outages)
- For computational convenience, charge/discharge profiles are often computed in advance and used to pre-adjust net load
  - This is obviously not realistic, and systematically undervalues the resource (see next slide)
  - But perhaps it's "good enough"?

Expectation vs Realization Impacts: Toy Example

- Two time periods
- 20 MW generator @ 10% FOR
- 10 MW, 10 MWh storage device (fully charged in t_0)

	t_1	t_2
Net Load (MW)	10	15

Expectation vs Realization Impacts: Toy Example

- Two time periods
- 20 MW generator @ 10% FOR
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		t_1	t_2
Net Load (MW)		10	15
Available Capacity (MW)	A (1%)	0	0
	B (9%)	0	20
	C (9%)	20	0
	D (81%)	20	20

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		t_1	t_2
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Available Capacity (MW)	A (1%)	0	0
	B (9%)	0	20
	C (9%)	20	0
	D (81%)	20	20

		Baseline	
		t_1	t_2
Shortfall (MW)	A (1%)	10	15
	B (9%)	10	0
	C (9%)	0	15
	D (81%)	0	0
LOLP		0.1	0.1
LOLE (h/2h)		0.2	
LOLE-based EFC (MW)		-	
LOLE-based EFC (%)		-	
EUE (MWh/h)		1.0	1.5
EUE (MWh/2h)		2.5	
EUE-based EFC (MW)		-	
EUE-based EFC (%)		-	
Expected Resource Energy Remaining (MWh)		-	

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		Baseline		Expectation Dispatch	
		t_1	t_2	t_1	t_2
Shortfall (MW)	A (1%)	10	15	10	5
	B (9%)	10	0	10	0
	C (9%)	0	15	0	5
	D (81%)	0	0	0	0
LOLP		0.1	0.1	0.1	0.1
LOLE (h/2h)		0.2		0.2	
LOLE-based EFC (MW)		-		[0, 10)	
LOLE-based EFC (%)		-		[0%, 100%)	
EUE (MWh/h)		1.0	1.5	1.0	0.5
EUE (MWh/2h)		2.5		1.5	
EUE-based EFC (MW)		-		5	
EUE-based EFC (%)		-		50%	
Expected Resource Energy Remaining (MWh)		-		0.0	

Expectation vs Realization Impacts: Toy Example

- Two time periods
- 20 MW generator @ 10% FOR
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		t_1	t_2
Net Load (MW)		10	15
Available Capacity (MW)	A (1%)	0	0
	B (9%)	0	20
	C (9%)	20	0
	D (81%)	20	20

		Baseline		Expectation Dispatch		Realization Dispatch	
		t_1	t_2	t_1	t_2	t_1	t_2
Shortfall (MW)	A (1%)	10	15	10	5	0	15
	B (9%)	10	0	10	0	0	0
	C (9%)	0	15	0	5	0	5
	D (81%)	0	0	0	0	0	0
LOLP		0.1	0.1	0.1	0.1	0.0	0.1
LOLE (h/2h)		0.2		0.2		0.1	
LOLE-based EFC (MW)		-		[0, 10)		[10, 15)	
LOLE-based EFC (%)		-		[0%, 100%)		[100%, 150%)	
EUE (MWh/h)		1.0	1.5	1.0	0.5	0.0	0.6
EUE (MWh/2h)		2.5		1.5		0.6	
EUE-based EFC (MW)		-		5		9.5	
EUE-based EFC (%)		-		50%		95%	
Expected Resource Energy Remaining (MWh)		-		0.0		8.1	

Takeaways and Next Steps

- Multiple ways to incorporate dispatch of energy-limited resources into RA studies, some better than others
- A priori “expectation” dispatch *might* not be a great idea
  - Great work from others in the WG this year to prove optimality of simple, efficient “realization” dispatch policies for energy-limited resources!
- Well-known but worth repeating: LOLP/LOLE is a problematic metric, [N]EUE has nicer properties
- Ongoing efforts to understand the RA impacts of different dispatch assumptions on larger systems (RTS-GMLC + real systems)
- Future work planned on efficient (simplified) intertemporal economic dispatch in a Monte Carlo framework, to understand differences between shortfall minimization and reduced-foresight cost minimization assumptions

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