Capacity Credit for Energy-Limited Resources

Use of ELCC in the PSCo ERP

ESIG Fall Conference

October 7, 2021

What We Are Discussing

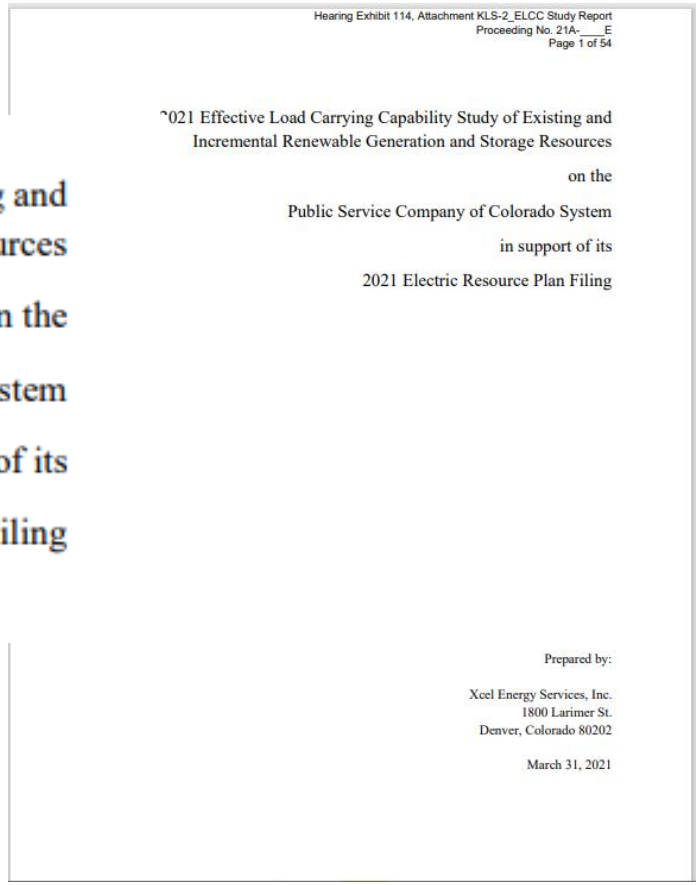
2021 Effective Load Carrying Capability Study of Existing and Incremental Renewable Generation and Storage Resources

on the

Public Service Company of Colorado System

in support of its

2021 Electric Resource Plan Filing



Hearing Exhibit 114, Attachment KLS-2_ELCC Study Report
Proceeding No. 21A-___E
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?021 Effective Load Carrying Capability Study of Existing and Incremental Renewable Generation and Storage Resources

on the

Public Service Company of Colorado System

in support of its

2021 Electric Resource Plan Filing

Prepared by:

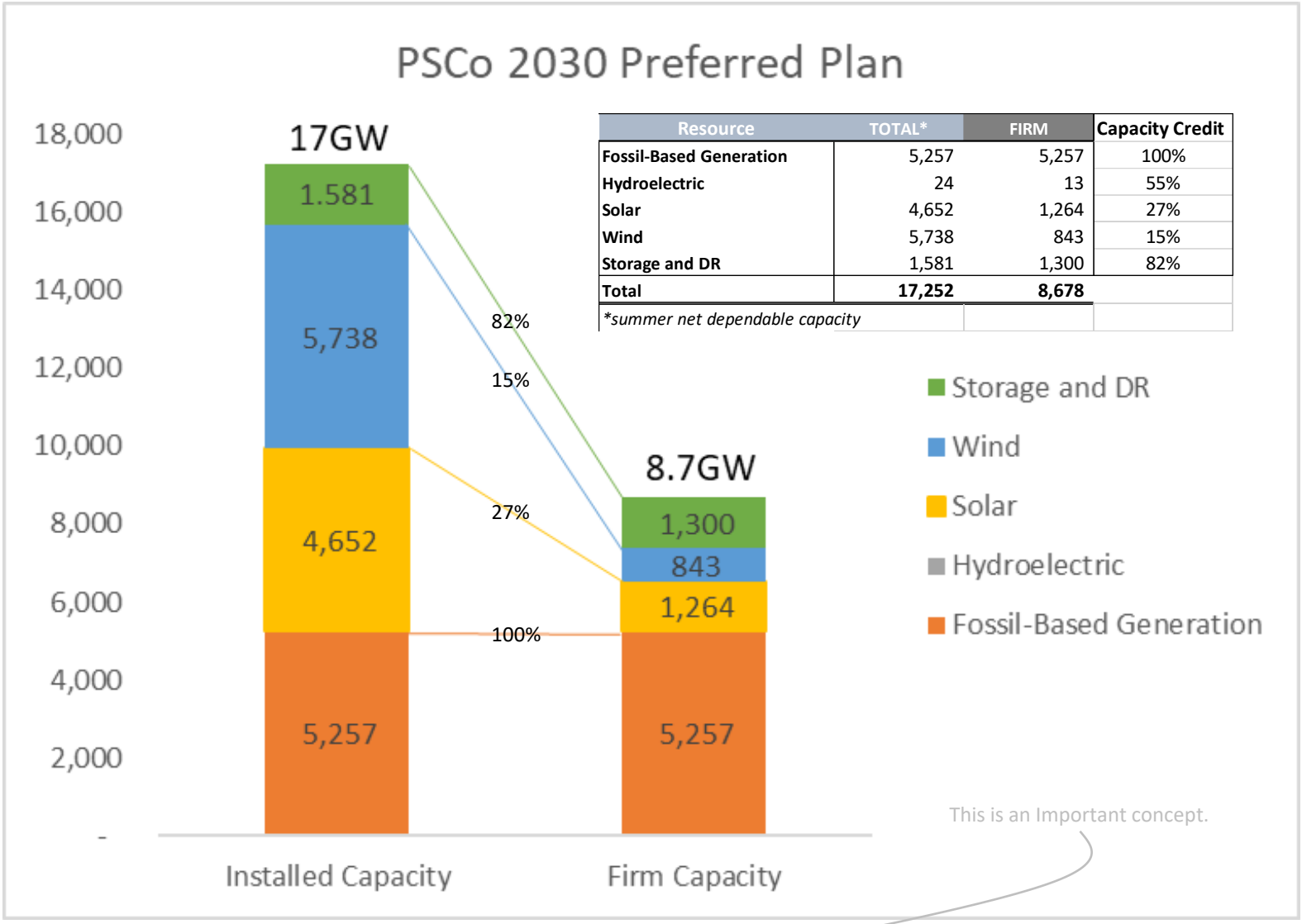
Xcel Energy Services, Inc.
1800 Larimer St.
Denver, Colorado 80202

March 31, 2021

aka "The ELCC Study"

Author: Kent Scholl

A Primer: Firm Capacity



Resource	TOTAL*	FIRM	Capacity Credit
Fossil-Based Generation	5,257	5,257	100%
Hydroelectric	24	13	55%
Solar	4,652	1,264	27%
Wind	5,738	843	15%
Storage and DR	1,581	1,300	82%
Total	**17,252**	**8,678**	
**summer net dependable capacity*			

This is an Important concept.

Installed Capacity x Capacity Credit = Firm Capacity

Capacity Credit

- The amount of the installed capacity that counts as firm capacity, often expressed as a percentage (firm/installed)

like this

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**summer net dependable capacity*			

- Could be a rule of thumb (4hrs = 100%)
- Regulatory designation
- Approximate Generation Method
- **Effective Load Carrying Capability (ELCC)**
  - This is the gold standard

ELCC is a mathematical method for determining a *reliability-based* capacity credit

The Dataset

- Effective Load Carrying Capacity...
  - 2023 thermal generation capacity, scheduled outages, Hx EFORs
  - Hourly load and renewable generation for six annual periods (2014-2019) carefully grown to 2023 levels and beyond
  - Hourly DR and storage dispatch to maximize LOLP reduction.
  - Calculations are for *incremental* resources of a system flush with wind, solar, and dispatchable energy-limited resources (ie DR, ES)

What you will learn…

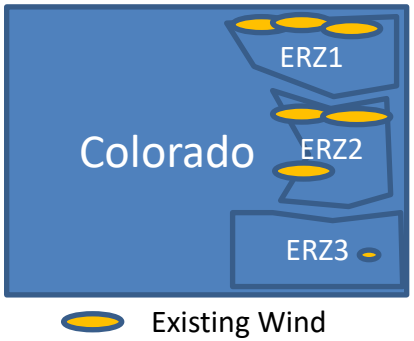
Like Effects Like

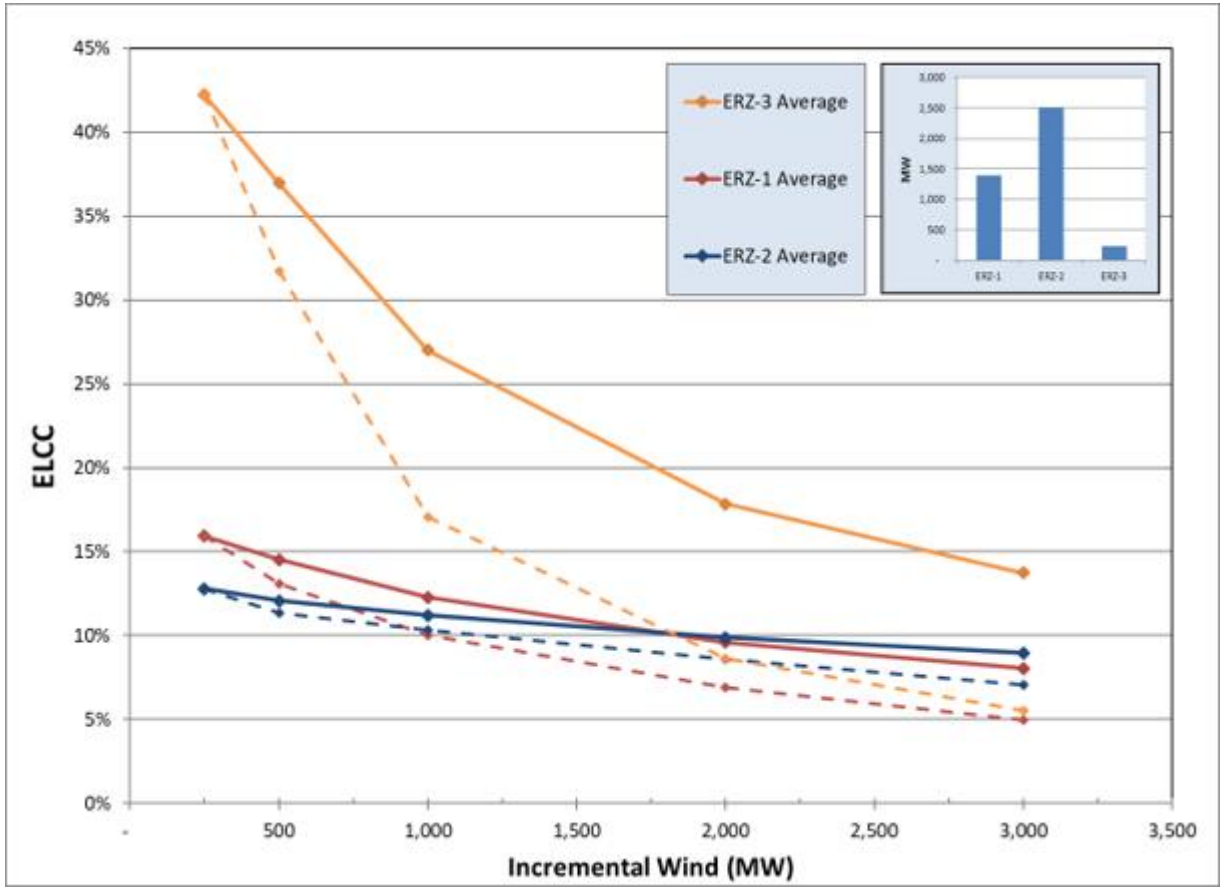
ELCC changes with increasing penetration of like resource

Diversity Matters

RE sited in the same location drives down ELCC faster than a geographically diverse portfolio.

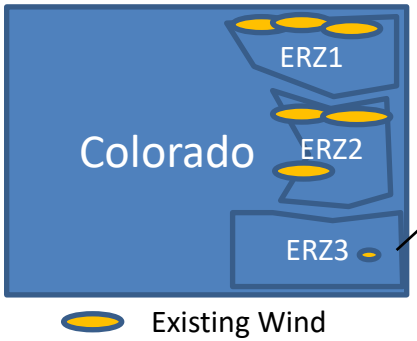
Incremental Wind

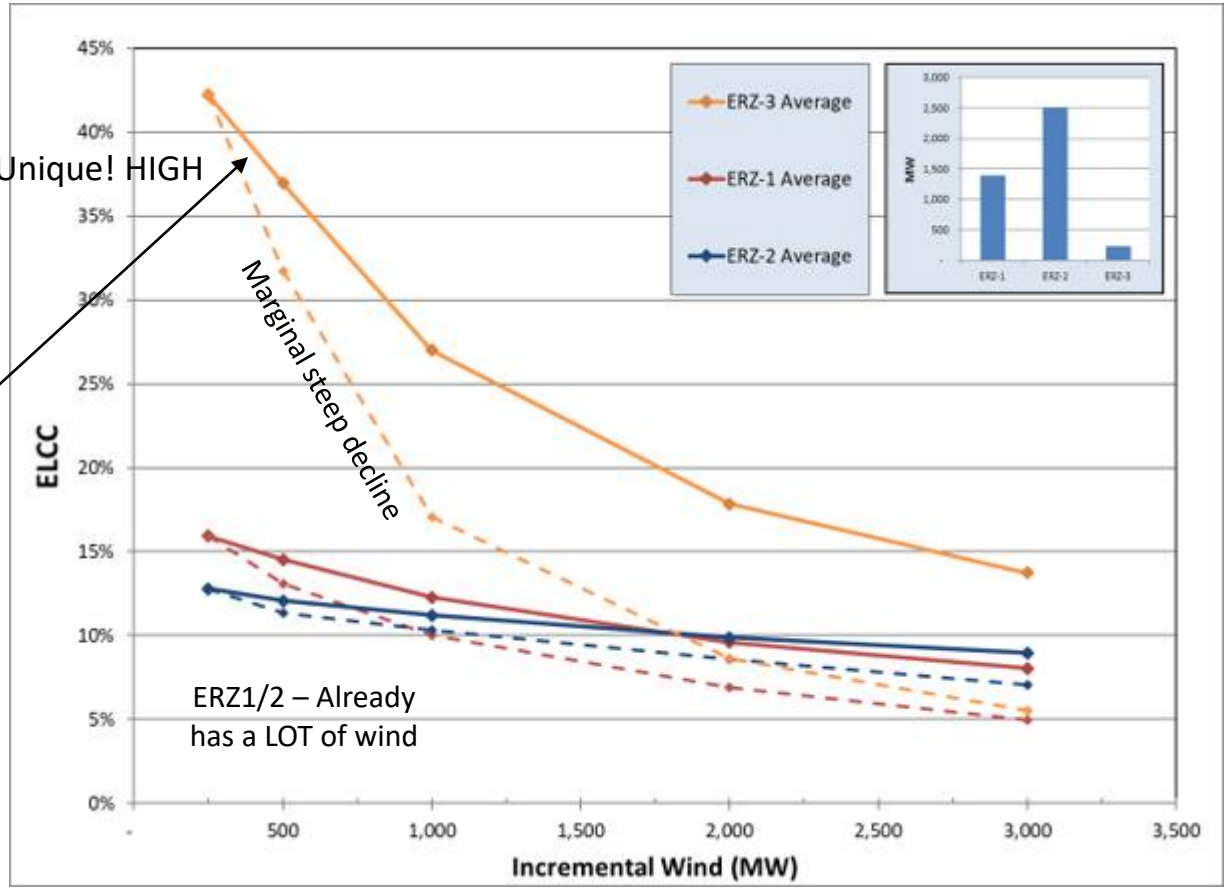




Incremental Wind

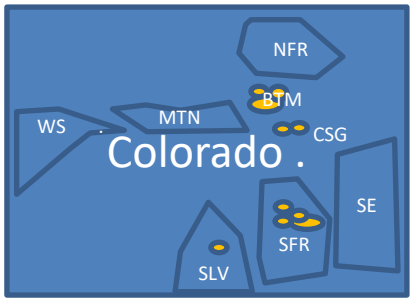
ERZ3 – Diverse! Unique! HIGH



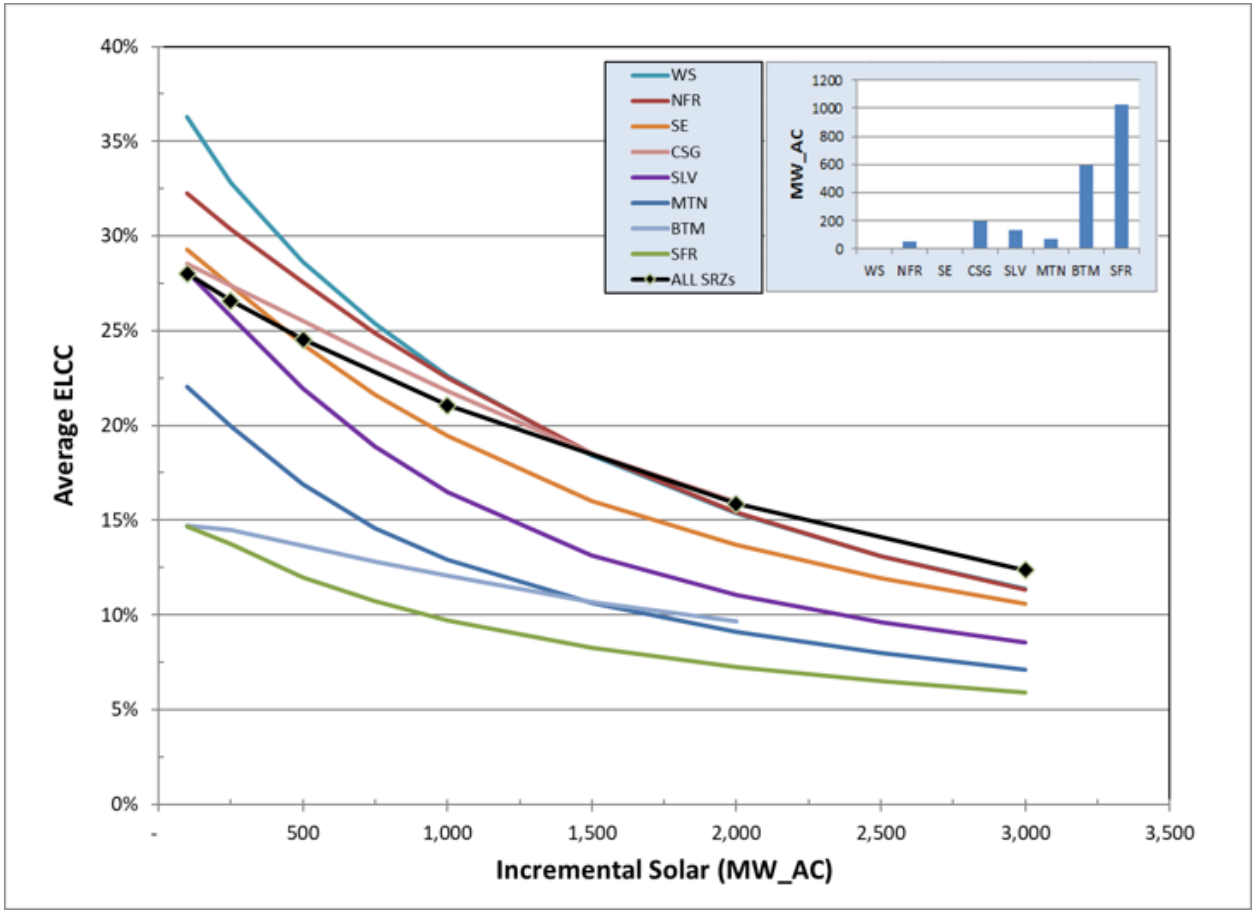


More Wind = Declining ELCC →

Incremental Solar

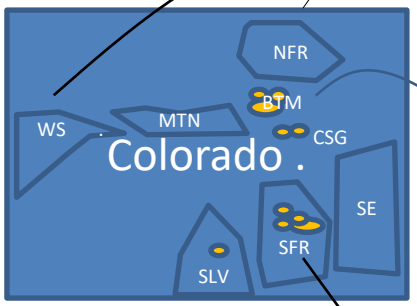


Existing Solar



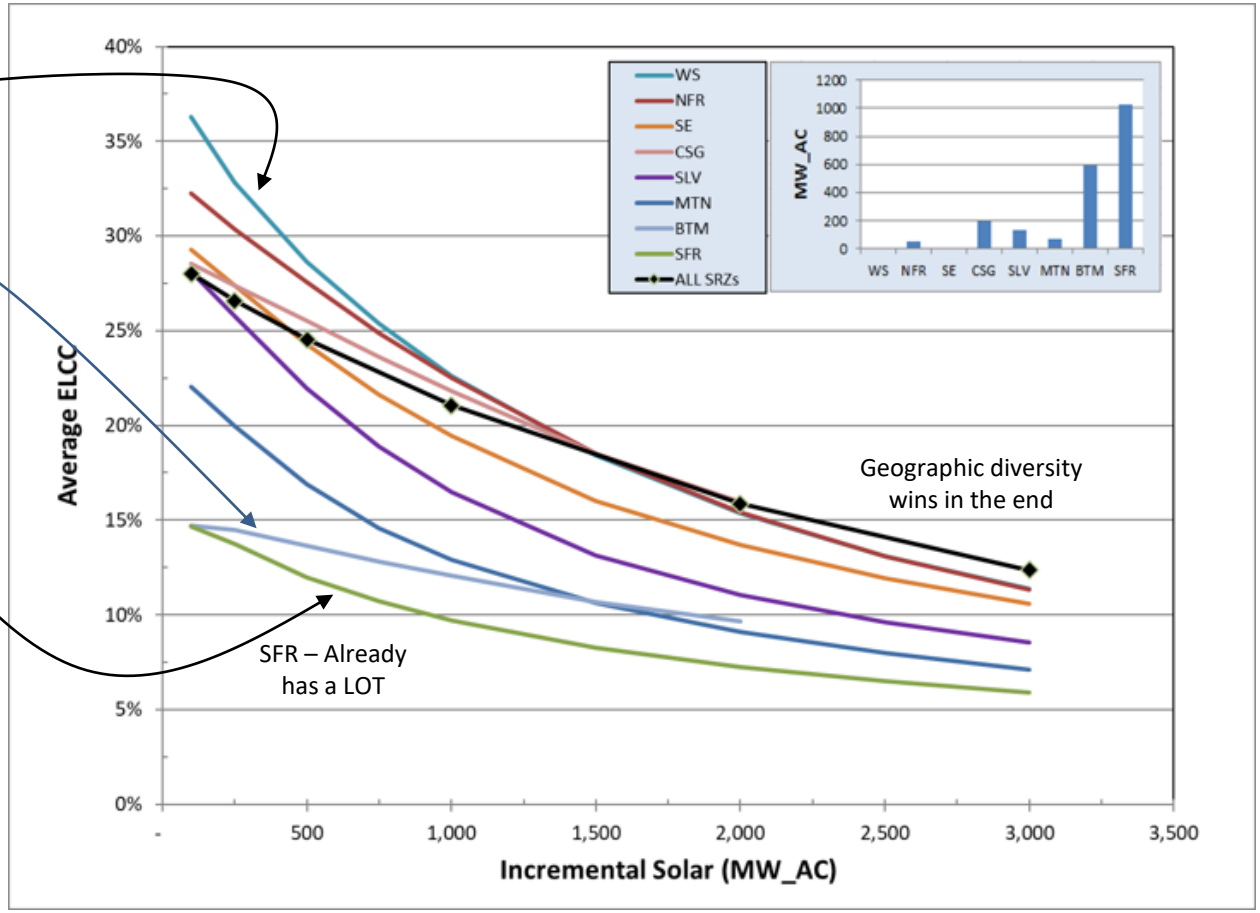
Incremental Solar

WS/NFR – Diverse! Unique! HIGH



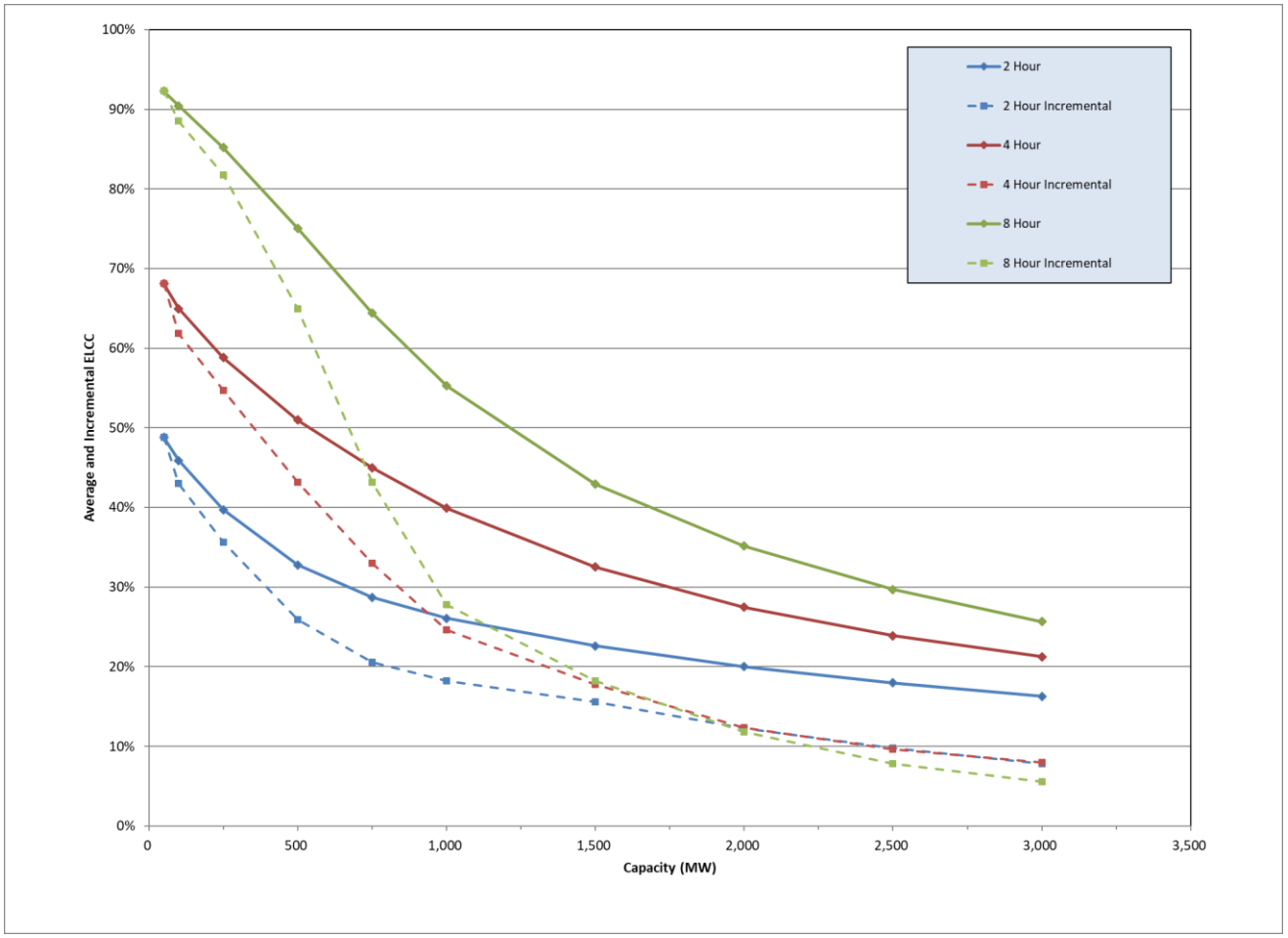
Existing Solar

BTM (behind the meter) – Concentrated in Denver Metro area; technology disadvantage (fixed pane)



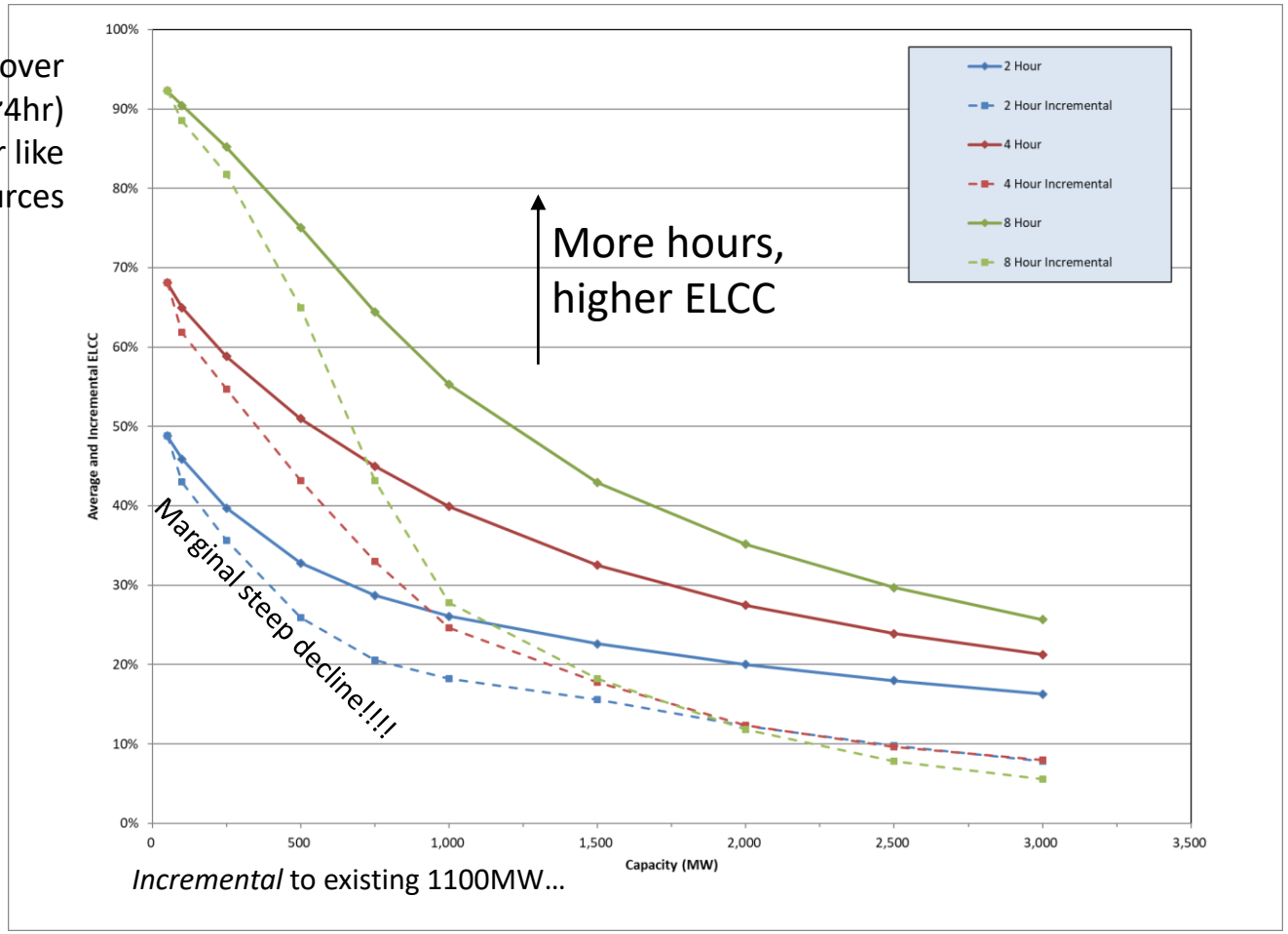
More Solar = Declining ELCC →

Incremental Storage



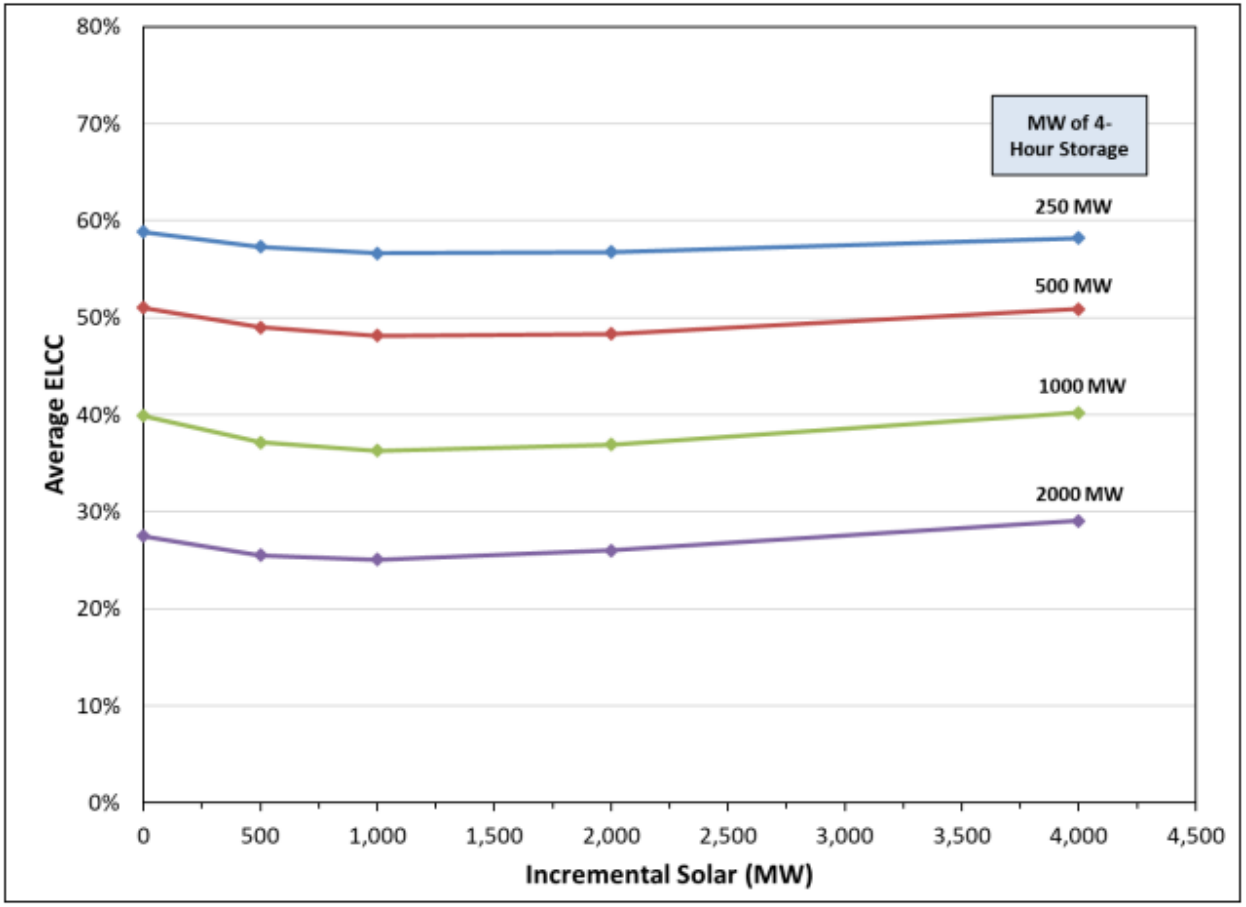
Incremental Storage

Already have over 1100MW of (~4hr) energy storage or like resources

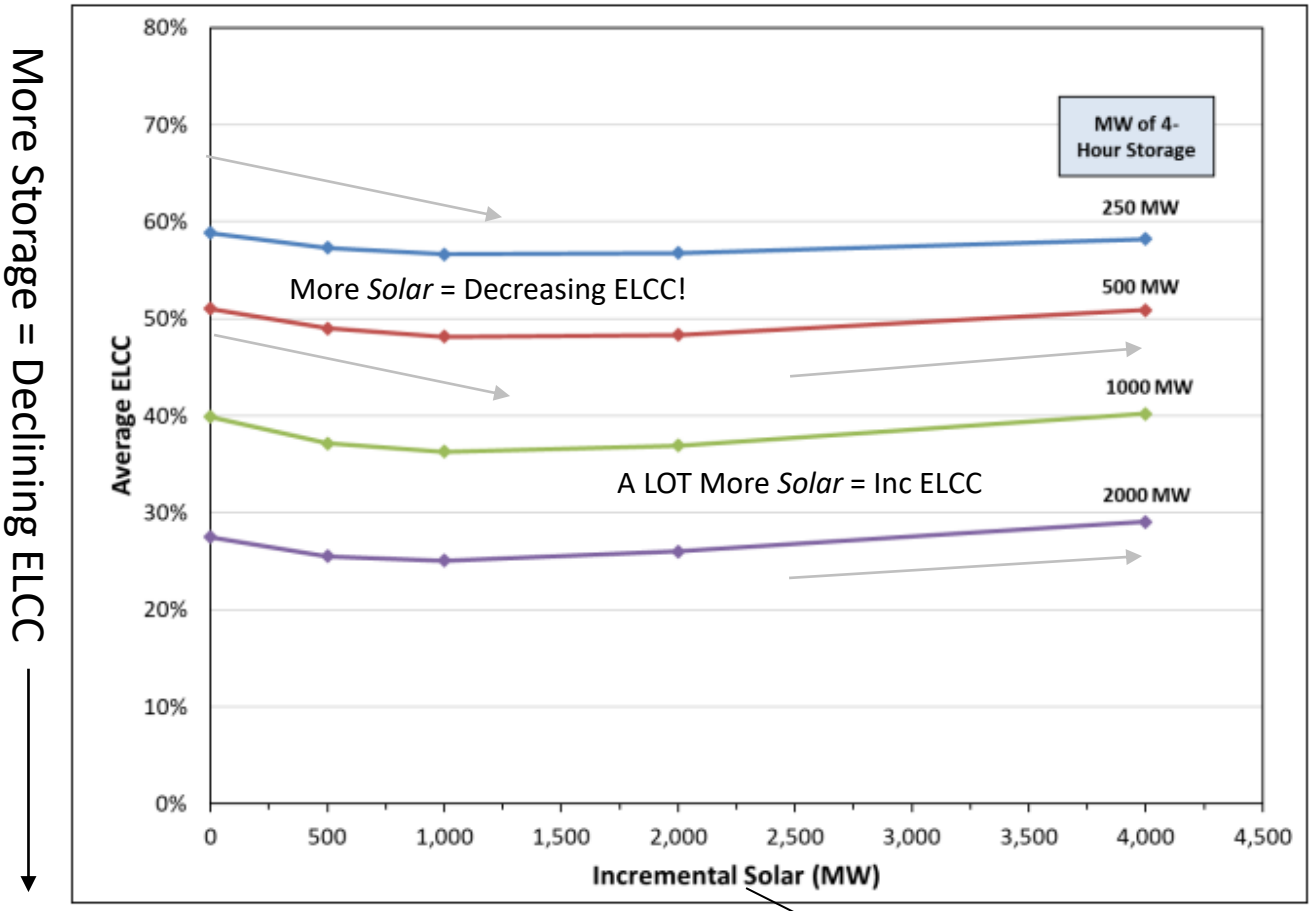


More Storage = Declining ELCC →

Storage and Solar



Storage and Solar



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