

BEFORE THE NEW MEXICO PUBLIC REGULATION COMMISSION

IN THE MATTER OF PUBLIC SERVICE)
COMPANY OF NEW MEXICO'S)
CONSOLIDATED APPLICATION FOR)
APPROVALS FOR THE ABANDONMENT,) 19-_____-UT
FINANCING, AND RESOURCE REPLACEMENT)
FOR SAN JUAN GENERATING STATION)
PURSUANT TO THE ENERGY TRANSITION ACT)

DIRECT TESTIMONY

OF

WILLIAM KEMP

July 1, 2019

**NMPRC CASE NO. 19-____-UT
INDEX TO THE DIRECT TESTIMONY OF
WILLIAM KEMP**

**WITNESS FOR
PUBLIC SERVICE COMPANY OF NEW MEXICO**

I.	INTRODUCTION	1
II.	HISTORY OF BATTERY STORAGE IN THE UTILITY INDUSTRY	6
III.	EVOLUTION OF STORAGE USES	14
IV.	RISKS FROM EARLY TECHNOLOGY ADOPTION.....	20
V.	CONSIDERATIONS IN ASSEMBLING PNM’S INITIAL STORAGE PORTFOLIO.....	22
VI.	MAXIMIZING STORAGE VALUE FOR CUSTOMERS.....	27
VII.	CONCLUSIONS.....	30

PNM Exhibit WK-1	Resume of William Kemp
PNM Exhibit WK-2	Enovation Overview and Storage Qualifications
PNM Exhibit WK-3	Lazard LCOS Study
PNM Exhibit WK-4	Power Engineering Article

AFFIDAVIT

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

I. INTRODUCTION

Q. PLEASE STATE YOUR NAME, POSITION AND BUSINESS ADDRESS.

A. My name is William J. Kemp. I am a co-founder and Senior Managing Director of Enovation Partners, LLC (“Enovation”), which is a management consultancy focused on strategic and financial issues in the electricity and natural gas industries. My business address is 18 South Michigan Avenue, Suite 1200, Chicago, Illinois 60603.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS PROCEEDING?

A. My testimony is intended to provide a broader perspective for the members of the New Mexico Public Regulation Commission (“Commission”) and interested parties on electricity storage technology, economics, value and procurement, especially with respect to the nascent storage program of Public Service Company of New Mexico (“PNM”). My testimony also outlines how that broader industry perspective should inform PNM’s initial introduction of battery storage on its system.

To boil down my advice after considering the relevance of national experience on battery storage for New Mexico, the most important lessons are:

1. Location is important. Batteries add more value in strongly interconnected sites like major substations.

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

- 1 2. Avoid crash programs. Expand capacity incrementally as needed.
- 2 3. Minimize daylight between operations and ownership. Lean toward
- 3 utility ownership for the storage projects with the tightest system
- 4 integration.
- 5 4. Build the required skills. Ensure that the utility gains the experience
- 6 and knowledge to leverage future cost decreases and technology
- 7 advances.

8 Because storage is still a fairly new topic before the Commission, I have included

9 a number of citations and exhibits that provide useful background information on

10 the topic, as well as supporting particular statements in my testimony.

11

12 **Q. WHAT ARE YOUR RESPONSIBILITIES AT ENOVATION PARTNERS?**

13 **A.** My responsibilities include leadership of Enovation's regulatory, sustainability,

14 and strategy implementation practice areas. This includes consulting services in

15 areas such as strategic planning, business planning, resource planning, regulatory

16 strategy, transaction support, commercial due diligence, merger integration,

17 financial analysis, financing strategies, operations improvement, and litigation

18 support.

19

20 **Q. PLEASE BRIEFLY SUMMARIZE YOUR RELEVANT EDUCATION AND**

21 **WORK EXPERIENCE.**

22 **A.** My educational background includes a Bachelor of Arts *magna cum laude* in

23 Anthropology and Physics from Harvard University and a Master of Public Policy

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

1 from the Goldman School of Public Policy at the University of California at
2 Berkeley, with a focus on energy policy.

3
4 Prior to co-founding Enovation Partners, LLC in 2013, I served as Vice President
5 for Black & Veatch from 2005 to 2012, leading their strategic consulting services.
6 Before that, I co-founded and served as a Managing Director of Economists.com,
7 a management consultancy focusing on financial and technology issues in the
8 power, gas, and water industries. My previous consulting experience was
9 primarily with Deloitte Consulting. From 1986 to 1999, I held positions of
10 increasing responsibility in that firm's management consulting practice in the
11 energy industry, ultimately serving as one of three managing partners for the
12 worldwide practice. I was energy industry leader for the Asia-Pacific-Africa
13 region, based in Sydney, Australia and before that for the western U.S. region,
14 based in Portland, Oregon. I have directed over 300 consulting projects over my
15 career.

16
17 Earlier in my career, I held positions as Senior Wholesale Rate Engineer for
18 Pacific Gas & Electric Company, Regulatory Cost Analyst for Southern
19 California Edison Company, Research Specialist for Lawrence Berkeley
20 Laboratory in the U.S. Department of Energy, and Regulatory Economist for the
21 President's Council on Environmental Quality, Office of the White House.

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

1 I have testified personally or developed testimony for my clients on utility
2 ratemaking and resource planning issues in many regulatory proceedings, and also
3 on energy economics issues in a number of civil suits. My resume and testimony
4 experience are provided in PNM Exhibit WK-1.

5
6 **Q. PLEASE BRIEFLY SUMMARIZE THE RELEVANT EXPERIENCE AND**
7 **EXPERTISE OF ENOVATION PARTNERS, LLC.**

8 **A.** Enovation's professionals have served many of the leading companies throughout
9 the energy value chain. We have earned a reputation as experts in electricity
10 storage economics and strategy. Our team takes a global energy perspective,
11 supported by our experience in more than 30 countries during more than 600
12 engagements with utilities, governments, developers, suppliers, investors, and
13 private equity interests. We have offices in Chicago, San Francisco, New York,
14 Washington, DC, and London.

15
16 Enovation Partners has a long track record with regard to understanding the costs,
17 performance and utilization of energy storage technologies in restructured¹ and
18 vertically integrated electric markets.

19
20 In addition to the present matter, Enovation's more recent experience includes:

- 21
- For a large Northeastern wires utility:

¹ Refers to energy storage deployed in organized wholesale power markets, including PJM Interconnection, ISO-NE, NYISO, MISO, ERCOT, CAISO and SPP.

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

1 ○ Assessed economic viability and system benefits of energy storage
2 by use case and under increasing market saturation to determine the
3 “optimal” amount, location and timing of storage that should be
4 deployed by 2030.

5 ○ Designed and assisting in executing a large storage procurement
6 process.

7 • For San Diego Gas and Electric:

8 ○ Provided a storage revenue assessment in support of San Diego
9 Gas and Electric’s 2018 Energy Storage Procurement and
10 Investment Plan.²

11 • For Lazard Freres

12 ○ Continued management and execution of Lazard’s annual
13 Levelized Cost of Storage study, which is a respected industry
14 benchmark.

15 Enovation’s experience and expertise, especially on storage issues, is more fully
16 described in the attached PNM Exhibit WK–2.

17
18 **Q. WHAT ARE THE KEY ISSUES THAT YOU WILL ADDRESS?**

19 **A. My testimony will focus on these issues:**

20 • Are the size and pace of PNM’s storage program consistent with
21 prevailing utility industry practices?

² CPUC Docket A.18-02-016

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

- 1 • How can PNM use the results of its energy storage RFP to assemble a
2 storage portfolio that represents the best long-term value for PNM's
3 customers?
4

5 **II. HISTORY OF BATTERY STORAGE IN THE UTILITY INDUSTRY**

6 **Q. HOW MUCH BATTERY STORAGE CAPACITY HAS BEEN**
7 **INSTALLED TO DATE IN U.S. ELECTRICITY GRIDS?**

8 **A.** S&P estimates that as of early 2019 the United States has approximately 1
9 gigawatt (GW) of grid-connected battery energy storage capacity installed, and
10 expects that amount to increase seven-fold by 2022. Numerous announcements
11 around significant increases in the pipeline of planned projects provide a preview
12 to the industry of trends over the next five years in technology choice and pricing.
13 Since 2015, almost all of new electricity storage capacity has been provided by
14 battery energy storage systems, according to S&P Analytics.³ Please see PNM
15 Figure WK-1 for a graphic depiction of the deployment of energy storage by
16 utilities in the United States.
17

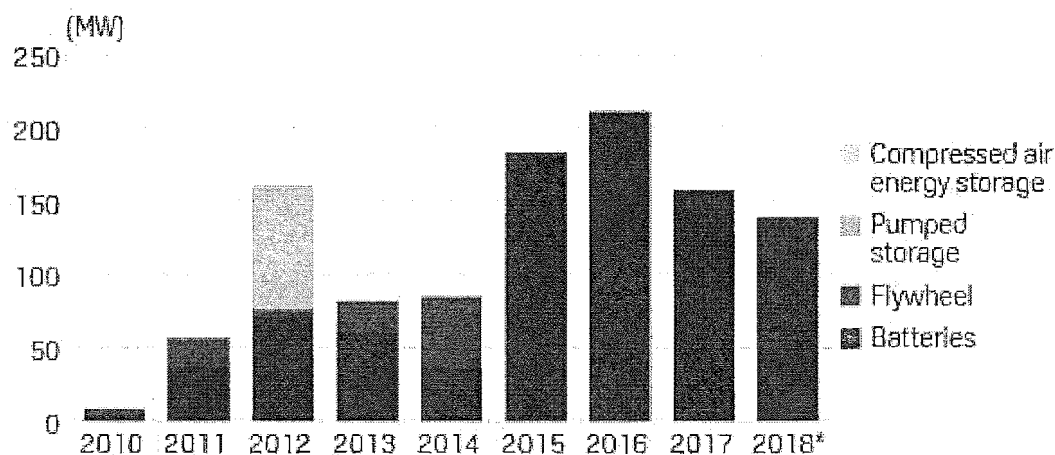
³ <https://blogs.platts.com/2019/03/28/us-expansion-power-battery-storage/>

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

1

PNM Figure WK-1

**ALMOST ALL NEW POWER STORAGE CAPACITY
PROVIDED BY BATTERIES SINCE 2015**



*Estimate

Source: S&P Global Platts Analytics

2

3 **Q. WHERE HAVE LARGE BATTERY ENERGY STORAGE SYSTEMS**
4 **BEEN INSTALLED?**

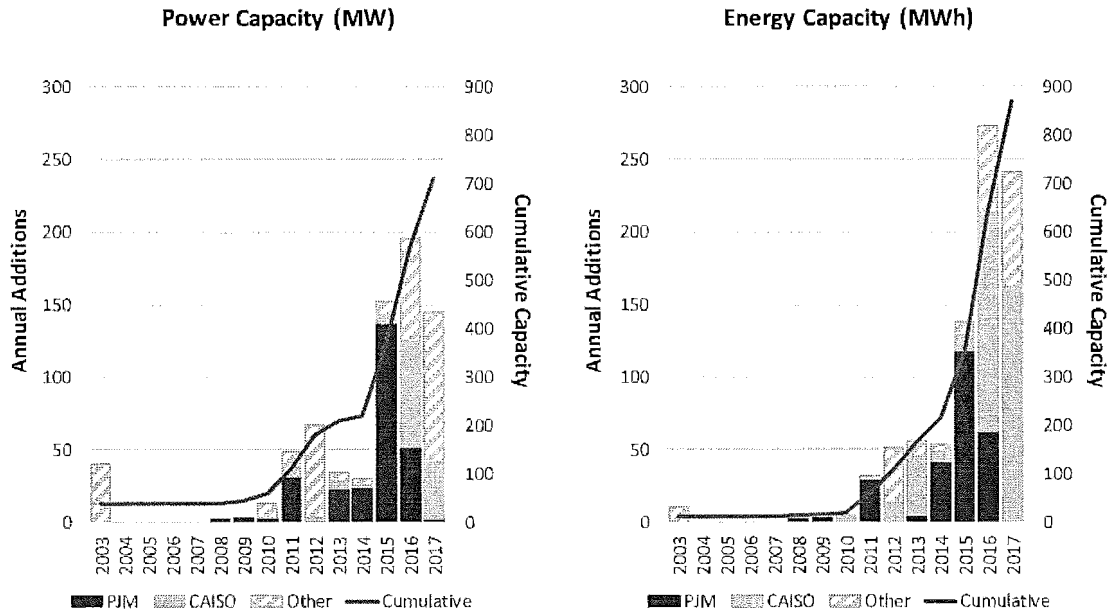
5 **A.** In the United States, the bulk of utility-scale battery energy storage systems have
6 been installed in two primary regions: California and within the PJM
7 Interconnection footprint.⁴ As illustrated in the below table from the Energy
8 Information Administration, battery energy storage systems have also been
9 installed elsewhere in the U.S., but not at significant scale. Of the current
10 deployments, about 90% of utility-scale battery energy storage systems have been
11 developed in regions covered by five of the seven organized regional transmission

⁴ A broad area including all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia.

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

organizations, along with Alaska and Hawaii. California and PJM account for 75% of battery storage energy capacity installed through 2017.⁵

PNM Figure WK-2⁶



Q. HOW DO UTILITIES TYPICALLY USE BATTERY ENERGY STORAGE SYSTEMS (“BESS”)?

A. Utilities use battery energy storage systems for a variety of reasons. The three broad categories of economic drivers for storage include deferral of transmission and/or distribution investment, generation firming⁷ (including time arbitrage and

⁵ https://www.eia.gov/analysis/studies/electricity/batterystorage/pdf/battery_storage.pdf

⁶ See 4. Other includes ISO-NE, MISO, ERCOT, Alaska and Hawaii

⁷ Largely generation firming of variable output from renewable resources

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

1 various ancillary services), and microgrid/islanding⁸ and pilots. Of the existing
2 utility-owned energy storage capacity, 34% is used for T&D deferral, 27% for
3 generation firming, 22% for microgrids, with the rest used as pilots.⁹
4

5 **Q. WHAT KIND OF TECHNOLOGY IS TYPICALLY USED FOR BATTERY**
6 **ENERGY STORAGE SYSTEMS?**

7 **A.** Over 80% of utility-scale battery storage system capacity is provided by batteries
8 utilizing lithium-ion chemistries.¹⁰ Other electrochemical¹¹ technologies exist
9 (e.g., flow batteries) but have not gained significant traction yet in the
10 marketplace.
11

12 **Q. WHAT ARE SOME OF THE OPERATIONAL RISKS OF LITHIUM-ION**
13 **CHEMISTRIES?**

14 **A.** The most significant risk of lithium-ion battery chemistries is thermal runaway.
15 Manufacturing defects or internal failures due to structural or operational stress
16 can cause an internal short circuit that suddenly releases the energy stored in one
17 or more battery cells. The temperature rises rapidly (within fractions of a
18 second), creating temperatures of around 400°C. The battery cell becomes
19 gaseous, and a fire erupts. If not isolated, this fire can spread quickly to adjacent

⁸ A small network of electricity users with a local source of supply that is usually attached to a centralized grid but is also able to function independently

⁹ Based on an Enovation Partners analysis

¹⁰ See footnote 3

¹¹ I use the terms “electrochemical storage” and “battery storage” as basically synonymous in current market conditions, although strictly speaking, battery storage is a subset of electrochemical storage.

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

1 cells, initiating a cascading chain reaction. Lithium-ion fires are difficult to
2 extinguish by conventional means. (This is one reason why airlines have banned
3 lithium-ion computer batteries from the cargo holds of their airplanes.) The
4 battery and utility industries have recognized the importance of preventing the
5 failure of one cell from progressing into the runaway failure and combustion of a
6 large pack of cells.¹²

7
8 **Q. HAVE THERE BEEN BATTERY FIRES AT U.S.-BASED BATTERY**
9 **ENERGY STORAGE SYSTEMS?**

10 **A.** Yes. There have been at least two well-publicized fires at utility-scale battery
11 energy storage systems in the United States. In August 2012, a 15 Megawatt
12 (MW) battery installed by Xtreme Power on the Hawaiian island of Oahu burned
13 for seven hours before firefighters could extinguish it.¹³ More recently, a battery
14 fire at a 2 MW Phoenix-area project owned by Arizona Public Service sent
15 several emergency responders to the hospital after suffering chemical burns.¹⁴

16
¹² <https://www.osti.gov/servlets/purl/1249044>

¹³ <https://www.hawaiinewsnow.com/story/19173811/hfd-battling-kahuku-wind-farm-blaze/>

¹⁴ <https://www.greentechmedia.com/articles/read/aps-and-fluence-investigating-explosion-at-arizona-energy-storage-facility#gs.kzezgp>

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

1 **Q. HAVE THERE BEEN BATTERY FIRES OUTSIDE THE UNITED**
2 **STATES?**

3 **A.**Yes. There have been at least 15 fires in battery energy storage systems in Korea
4 so far in 2019,¹⁵ and there was a fire at a lithium-ion battery energy storage
5 system in Belgium in November 2018.¹⁶
6

7 **Q. HAVE THERE BEEN OTHER OPERATIONAL ISSUES WITH U.S.-**
8 **BASED BATTERY ENERGY STORAGE SYSTEMS?**

9 **A.**Yes. Several battery energy storage systems installed in the PJM Interconnection
10 footprint suffered operational problems during early 2017 when PJM operators
11 increased the intensity of a frequency regulation dispatch signal. In some cases,
12 battery temperatures and cycling caused premature degradation and voided
13 manufacturer warranties.¹⁷
14

15 **Q BY PROVIDING THESE EXAMPLES OF BATTERY FIRES ARE YOU**
16 **SAYING THAT BATTERY TECHNOLOGY IS UNSAFE?**

17 **A.**No, but battery technology should be deployed and managed in a manner that
18 reduces risks and ensures PNM customers see the full benefits that battery storage
19 offers. As the industry matures, risks from deficiencies in design and
20 manufacturing will be reduced, operations and maintenance performance will be

¹⁵ <http://m.koreatimes.co.kr/pagsoes/article.asp?newsIdx=260560>

¹⁶ <http://www.energystoragejournal.com/2018/01/11/belgiums-li-ion-ess-fire-cause-still-unknown-two-months-later>

¹⁷ See FERC dockets EL-17-64-000 and EL 17-65-000.

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

1 honed, and optimal strategies for placement locations and dispatch will be
2 perfected.

3

4 **Q. GIVEN THE ABOVE ISSUES, WHAT RECOMMENDATIONS WOULD**
5 **YOU HAVE FOR PNM?**

6 **A.** Battery storage is obviously an important part of the future of the energy systems.
7 We recommend, however, that PNM enter this market on a measured basis to
8 allow the company to understand better the technology risks and how to manage
9 them, and to take advantage of the expected advancements in the storage
10 technology's safety and dependability rather than lock in existing technology that
11 rapidly becomes obsolete.

12

13 **Q. WHAT IS THE OUTLOOK FOR DEVELOPMENT OF ADDITIONAL**
14 **BATTERY ENERGY STORAGE SYSTEMS IN THE UNITED STATES?**

15 **A.** As stated earlier, analysts are projecting that the amount of electrochemical
16 storage installed on the grid to increase significantly. This is due to expectations
17 that system costs will continue to decline¹⁸, performance will improve, and
18 market rules will evolve to reduce barriers to full participation of battery energy
19 storage systems in wholesale electric markets.¹⁹

20

¹⁸ <https://www.lazard.com/media/450774/lazards-levelized-cost-of-storage-version-40-vfinal.pdf>, pages 14 and 15

¹⁹ FERC Order 841 (<https://www.ferc.gov/whats-new/comm-meet/2018/021518/E-1.pdf>)

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

**Q. HOW MUCH STORAGE HAVE EARLY ADOPTING UTILITIES
PROCURED IN RELATION TO THE SIZE OF THEIR SYSTEMS?**

A. As mentioned earlier, the battery storage industry is in the very early stages of growth in the industry and has not yet reached maturity. PNM Table WK-1 below details the battery storage penetration as a percentage of 2018 peak load for the 10 utility operating companies with the highest battery penetration. At 2.6% PG&E Corporation is the national leader in battery storage penetration on its grid.

PNM Table WK-1

Utility Operating Company	Battery Storage Operating or In Development (MW)	2018 Peak Load (MW)	% Penetration
Pacific Gas and Electric Company	449.5	17,263	2.60%
San Diego Gas & Electric Company	81.0	4,377	1.85%
Monongahela Power Company	31.5	2,090	1.51%
Southern California Edison Company	332.5	23,460	1.42%
Jersey Central Power & Light Company	39.8	5,977	0.67%
New York State Electric & Gas Corporation	20.0	3,061	0.65%
Commonwealth Edison Company	115.4	21,349	0.54%
Duke Energy Ohio, Inc.	4.0	1,062	0.38%
Arizona Public Service Company	10.0	7,253	0.14%
Portland General Electric Company	5.0	3,816	0.13%

**Q. HAVE SOME UTILITIES SET BATTERY PENETRATION GOALS
THAT EXCEED THESE PENETRATION RATES?**

A. Yes. Arizona Public Service, for example has stated a goal of 850 MW by 2025 or approximately 10% of its peak load. NV Energy recently announced intention

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

1 to build 560 MW by 2023 or approximately 7.5% of its load. PNM is
2 approximately one third the size of these utilities. Enovation Partners
3 recommends that PNM adopt a target penetration rate for its introductory storage
4 program phase that would place its system at the higher end of the above
5 percentages for current in-service capacity. Near-term penetration rates above
6 that level could foreclose the future opportunities discussed in this testimony. A
7 target battery storage penetration rate in the range of 2% - 5% of peak load for
8 this introductory phase of PNM's storage program would set a vigorous but
9 prudent pace. PNM will have significant opportunities with the next ten years to
10 add much more battery storage with improved technology and reduced pricing,
11 providing higher benefits to PNM's customers.

III. EVOLUTION OF STORAGE USES

14 **Q. HOW HAS THE USE OF ELECTROCHEMICAL STORAGE EVOLVED**
15 **IN THE UNITED STATES?**

16 **A.** Some utility systems have used pumped hydro storage for decades to store large
17 amounts of energy. However, that storage technology is very difficult to site and
18 has limited potential for most utilities. As the volume of renewable energy
19 production grew rapidly in the U.S. in the 2000-2010 period, attention turned to
20 other, more easily developed types of energy storage. Two policy actions early in
21 the current decade catalyzed development of the initial sizable battery energy

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

1 storage systems. In 2010, the state of California approved AB 2514²⁰, which was
2 the nation's first mandate for electric utilities to procure storage resources on the
3 grid. Two years later, the Federal Energy Regulatory Commission (FERC)
4 approved Order 755. Order 755 required that wholesale market operators
5 implement a "Pay for Performance" model that compensated owners of fast-
6 responding energy storage technologies such as batteries for providing frequency
7 regulation service.²¹

8
9 Shortly after that, a seminal 2015 study by the Rocky Mountain Institute (RMI)
10 raised the prospect that battery energy storage projects could provide a multitude
11 of services to the grid depending on where they were installed and how they were
12 operated. This led to the idea that energy storage resources could "stack" values
13 and improve the cost-effectiveness of the grid by reducing the need for single-use
14 assets.²²

15
16 **Q. PLEASE SUMMARIZE THE RANGE OF SERVICES THAT BATTERY**
17 **STORAGE CAN PROVIDE.**

18 **A.** PNM Table WK-2 below summarizes the potential services or use cases
19 electrochemical energy storage can provide at the utility level.

20
²⁰ <https://www.renewableenergyworld.com/articles/2016/11/at-the-halfway-point-the-effect-of-california-s-energy-storage-mandate.html>

²¹ <https://www.ferc.gov/whats-new/comm-meet/2011/102011/E-28.pdf>

²² <https://rmi.org/wp-content/uploads/2017/03/RMI-TheEconomicsOfBatteryEnergyStorage-FullReport-FINAL.pdf>

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

PNM Table WK-2 – Electrochemical Storage Grid Services / Use Cases

Bulk Power	Network
Time Shifting Energy (Energy Arbitrage)	Resource Adequacy
Spinning / Non-Spinning Reserves	Transmission System Investment Deferral
Frequency Regulation / Voltage Support	Transmission Congestion Relief
Black Start	Distribution System Deferral

Q. PLEASE DEFINE THE BULK POWER USES OF STORAGE IDENTIFIED IN PNM TABLE WK-2.

A. Time Shifting Energy: storing electricity when it is lower cost and injecting it into the grid when prices are higher.

Spinning Reserves: the extra generation capacity that is available by increasing the power output of generators that are already connected to the power system.

Non-Spinning Reserves: extra generating capacity that is not currently connected to the system but can be brought online after a short delay.

Frequency Regulation: When system operators instruct generators to increase or decrease output in order to maintain a 60 Hz on the grid.

Black Start: the process of restoring an electric power station or a part of an electric grid to operation without relying on the external electric power.

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

1 **Q. PLEASE DEFINE THE NETWORK SERVICES USES OF STORAGE**
2 **IDENTIFIED IN PNM TABLE WK-2.**

3 **A. Resource Adequacy:** Ensuring that utilities have acquired enough generation
4 plus a reserve margin to satisfy peak load or demand.

5 **Transmission System Investment Deferral:** Using energy storage to avoid
6 transmission investment, such as high voltage lines or substations.

7 **Transmission Congestion Relief:** Using storage to reduce transmission
8 constraints.

9 **Distribution Investment Deferral:** Using energy storage to avoid distribution
10 investments, such as feeders or substations.

11

12 **Q. PLEASE EXPLAIN THE CONCEPT OF STORAGE USE CASES.**

13 **A.**The ways in which utilities or energy consumers can use storage are now referred
14 to as energy storage use cases. Since particular energy storage technologies may
15 be better suited to serve the needs of particular use cases, Enovation Partners
16 recognized that comparisons of energy storage technology costs and performance
17 are more relevant when conducted within broad use cases. With the sponsorship
18 and participation of Lazard Freres, the well-known investment bank, Enovation
19 Partners now produces annually the Lazard Levelized Cost of Storage (LCOS)
20 study. This study incorporates data collected from over 300 interviews with
21 storage manufacturers, engineering companies and storage buyers. It is
22 recognized as the industry benchmark for current information on storage costs and

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

1 performance. The fourth and most recent LCOS study, from November 2018, is
2 attached as PNM Exhibit WK-3.

3
4 **Q. DID EARLY DEVELOPERS OF ELECTROCHEMICAL STORAGE**
5 **TECHNOLOGIES HAVE ALL THESE USE CASES IN MIND?**

6 **A.** No. As is the case with many new technologies, or existing technologies used for
7 very different new purposes, the electricity industry's understanding of uses of
8 electrochemical storage technologies expanded as more experience was gained.
9 Similar broadening of application scope happened with other fundamental
10 technologies such as lasers, semiconductors, the Internet and many others. The
11 electricity industry is figuring out new ways to add value through this very
12 flexible, modular resource.

13
14 **Q. TO WHAT EXTENT CAN ENERGY STORAGE OWNERS HARVEST**
15 **THE VALUE OF THE USE CASES IDENTIFIED IN PNM TABLE WK-2?**

16 **A.** The ability of energy storage owners to monetize the use cases (i.e., to earn
17 revenue from them) identified in PNM Table WK-2 is uneven, depending on
18 whether the asset is located in a restructured or vertically integrated market.
19 While this is expected to change in the near future²³, battery energy storage
20 resources as of today cannot participate independently in restructured markets for
21 wholesale energy and capacity markets, with the exception of the Resource

²³ FERC Order 841 requires regulated regional transmission organizations and independent system operators to develop an energy storage participation model that will enable those technologies to participate in energy and capacity markets.

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

1 Adequacy product in the CAISO market. Moreover, utility-owned energy storage
2 resources today in many cases are prevented from providing storage services at
3 market-based prices in restructured electricity markets.²⁴

4
5 **Q. IS IT EASIER FOR UTILITIES IN VERTICALLY INTEGRATED**
6 **MARKETS TO REALIZE THE VALUE OF THE USE CASES OUTLINED**
7 **IN PNM TABLE WK-2?**

8 **A.** Yes. It is much easier for utilities in vertically-integrated markets to harvest the
9 value of the range of utility-scale energy storage use cases outlined in PNM
10 Table WK-2. Vertically integrated utilities do not face restrictions on generation
11 ownership, nor do they require complicated solutions to calculate market values
12 for transmission and distribution services. Under vertically integrated utility
13 ownership, the resource can be dispatched as necessary for the specific service
14 that is needed. So long as the utility maintains a safe and reliable grid, the storage
15 resources under its control can provide generation, transmission, or distribution
16 services, and need not participate in bidding and dispatch of discrete storage-
17 related services as defined ISOs or RTOs.

18

²⁴ See CPUC rulemaking 15-03-011 on multiple use applications for energy storage. NYISO Market Issues Working Group:
<https://www.nyiso.com/documents/20142/5256593/DER+Energy+Market+Design+Dual+Participation+022819.pdf/cfaf3647-4b77-a706-b86d-24129d460ecf?version=1.2&download=true>

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

IV. RISKS FROM EARLY TECHNOLOGY ADOPTION

**Q. WHAT HAS THE ELECTRICITY INDUSTRY'S EXPERIENCE BEEN
WITH EARLY STAGE GENERATION TECHNOLOGIES?**

A. The industry has a great deal of experience with new technologies as well as major innovations of existing technologies. History has demonstrated that prudence is the best course of action when adopting a new generation technology. Experience with first generation nuclear plants bears this out. The Fermi 1 plant demonstrated a new nuclear technology: liquid metal cooled fast breeder reactor. It was constructed in 1963 and was expected to operate for 30 or more years. Due to several operational issues, the plant was forced to close prematurely in 1972.

**Q. ARE THERE EXAMPLES OF OPERATIONAL DIFFICULTIES EVEN IN
ADVANCED DESIGNS OF EXISTING GENERATION TECHNOLOGY?**

A. Yes. In the 1990's gas turbine manufacturers responding to market conditions introduced new large frame type machines, generically designated as F & G type turbines. Swift load growth and cheap natural gas prices created demand for these turbines. After going into commercial operation these turbines experienced a number of problems including turbine blade failures, compressor disk cracking, and other serious problems. PNM Exhibit WK-4, a 2003 article from Power Engineering entitled "Gas Turbines: Breaking Through the Barriers to Higher Reliability," details the issues these turbine designs had from every major turbine manufacturer. In the course of a decade, the turbine manufacturers fixed the

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

1 problems with the initial designs and eventually improved their efficiency and
2 operating cost.

3
4 Another example is wind generation. Early wind turbines for electricity
5 production had inefficient designs (e.g., the egg-beater) and were prone to metal
6 fatigue in the blades.

7
8 **Q. WHAT IS THE OUTLOOK FOR THE COST OF BATTERY STORAGE**
9 **SYSTEMS?**

10 **A.** As mentioned above, in the course of developing the annual LCOS studies for
11 Lazard Freres and the industry, Enovation Partners interviews hundreds of
12 industry participants including OEM's, developers, utilities, and financiers. Our
13 Analytics division performs all of the LCOS calculations and market value
14 snapshots. The 4.0 version of the study from November 2018 showed that the
15 industry expects lithium-ion battery storage system costs to decline at a rate of 8%
16 per year through 2022.

17
18 **Q. HAVE WE SEEN COST DECLINES LIKE THIS WITH OTHER**
19 **GENERATION TECHNOLOGIES?**

20 **A.** Yes. The PV solar industry experienced a similar rapid drop in cost from
21 approximately 2010 through today. Early adopters of PV solar power were
22 saddled with what are currently massively over-priced power contracts or
23 expensive utility owned generation. Lazard's Levelized Cost of Energy report

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

1 from November 2018, version 12 of this benchmark series that I helped start in
2 2007, found that the median levelized cost of utility scale solar PPAs in the U.S.
3 plummeted 88 percent from 2009 to 2018, from \$358/MWh in 2009 to \$43/MWh
4 in 2018.²⁵ That downward price trajectory has continued, as witnessed by the
5 levelized cost of solar of less than \$20/MWh that PNM recently received. Wind
6 energy has also experienced a significant cost decline in the U.S. Since 2010,
7 wind energy has declined from \$50-70/MWh to less than \$20/MWh owing to
8 significantly increased size and efficiency of individual wind turbines²⁶. Lithium-
9 ion battery storage will likely follow a similar downward cost curve in the coming
10 years, although the slope may not be quite as steep as with PV.

11
12 **V. CONSIDERATIONS IN ASSEMBLING PNM'S INITIAL STORAGE**
13 **PORTFOLIO**

14 **Q. WHAT ARE THE ADVANTAGES OF DEVELOPERS CO-LOCATING**
15 **BATTERY STORAGE WITH SOLAR FACILITIES?**

16 **A.** Co-locating with solar farms allows developers to take immediate advantage of
17 the Investment Tax Credit of up to 30% of the total capital cost as well as
18 accelerated depreciation.

19

²⁵ Lazard's Levelized Cost of Energy Analysis – Version 12.0, November 2018.

<https://www.lazard.com/media/450784/lazards-levelized-cost-of-energy-version-120-vfinal.pdf>

²⁶ U.S. DOE 2017 Wind Technologies Market Report; <https://www.energy.gov/eere/wind/downloads/2017-wind-technologies-market-report>

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

1 **Q. WHAT DISADVANTAGES DO THESE DEVELOPER CO-LOCATED**
2 **BIDS PRESENT TO PNM?**

3 **A.** The primary disadvantages are location and limited control and operational
4 ability. Since the batteries are being co-located with solar facilities, they are
5 located in areas with lower land costs away from the Albuquerque load center and
6 will provide limited reliability and system benefits. Another disadvantage is the
7 fact that they are co-located with solar and will rely on upon solar charging for the
8 first five years in order to qualify for the Investment Tax Credit. While solar
9 charging has a cost advantage, these solar plus storage facilities will be prevented
10 by the Investment Tax Credit rules from recharging with cheap excess wind
11 energy from the grid at night and will therefore be unable to support the morning
12 load ramp.

13
14 As discussed by PNM Witness Fallgren, the Brattle Group conducted a study that
15 estimated the reductions in benefits from PPA storage bids due to less valuable
16 locations and operational restrictions²⁷.

17
18 **Q. WHAT OTHER CONCERNS ARE RAISED BY THE PPA BIDS**
19 **RECEIVED FROM STORAGE DEVELOPERS?**

20 **A.** The sizes of the proposed storage facilities raise several issues. The lowest cost
21 bid received was for a battery storage project with a capacity of 150 MW, to be

²⁷ Brattle Locational Study, PNM Exhibit TGF-3.

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

1 co-located with a 300 MW solar facility in northwest New Mexico, the Arroyo
2 project. The largest battery storage facility operating in the U.S. right now is the
3 40 MW Vista Energy Storage facility connected to the SDG&E grid in California.
4 Clenera, the bidder on the 150 MW Arroyo storage facility, has never constructed
5 a battery energy storage facility before, much less what would currently be the
6 largest in the U.S by over a factor of three.

7
8 As mentioned above on page 9, a 2 MW BESS developed by Fluence in the
9 Arizona Public Service territory experienced a catastrophic thermal runaway and
10 fire in April 2019²⁸. Fluence is a joint venture between AES Corporation and
11 Siemens, two of the largest and most experienced players in electricity generation,
12 and has developed 766 MW of storage globally. Yet Fluence still had this failure.
13 The technology risk and risk of non-performance are real and deserve serious
14 consideration.

15
16 **Q. ARE THERE ADDITIONAL CONCERNS ASSOCIATED WITH THE**
17 **SIZE OF THE PROPOSED ARROYO BATTERY STORAGE FACILITY?**

18 **A.** Yes, such a large facility constructed far from the Albuquerque load center would
19 lock PNM into existing technology in a disadvantageous location for well over
20 5% of its balancing area peak capacity. PNM would be less able to take
21 advantage of projected declines in battery storage prices as well as inevitable

²⁸ See footnote 14 above

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

1 future technological innovations. Lastly, PNM would likely be forgoing other
2 advantages of ownership.

3
4 **Q. WHAT ARE THE ADVANTAGES OF UTILITY OWNERSHIP OF**
5 **STORAGE FACILITIES?**

6 **A.** Even though the PPA contract template in the recent storage RFP specifies that
7 PNM will have operational control of storage facilities, PNM would not be
8 responsible for maintaining the facility. Such a divorce of operational knowledge
9 and its impacts on maintenance requirements is sub-optimal for such a new
10 technology. Of course, since utility ownership would not require co-location with
11 solar facilities, PNM would be free to take advantage of the operational learnings
12 from optimizing location for grid and reliability benefits.

13
14 **Q. HOW SHOULD PNM APPROACH DEVELOPING ITS STORAGE**
15 **PROGRAM?**

16 **A.** PNM would be prudent to exercise some caution in the size of each location and
17 the overall storage build-out as a percentage of its peak load. An approach
18 characterized by taking on smaller facilities in multiple locations over a
19 reasonable period of time will allow PNM to gain the valuable knowledge and
20 experience related to both the operating control and maintenance of battery
21 facilities as well as their locational value to the grid and to system reliability.

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

1 **Q. DO YOU HAVE ANY SPECIFIC RECOMMENDATIONS FOR PNM'S**
2 **INITIAL IMPLEMENTATION OF ITS BATTERY STORAGE**
3 **PROGRAM?**

4 **A.** Yes, in addition to our previous recommendation of limiting the penetration of
5 this initial implementation to between 2% and 5% of system peak, we strongly
6 recommend limiting the size of individual facilities to between 10 MW and no
7 more than 40 MW. We acknowledge that PNM wants to make a material move
8 into increased integration of battery storage resources, a move that will bring
9 significant benefits to the grid and to customers, but it should do so in a prudent
10 manner.

11

12 **Q. HOW SHOULD PNM POSITION ITSELF FOR FUTURE BATTERY**
13 **INSTALLATIONS EITHER THROUGH A PPA OR UTILITY**
14 **OWNERSHIP?**

15 **A.** One of the key integration aspects for introducing batteries on the PNM system is
16 the control systems that both protect the battery systems and allow for the
17 maximum value of battery system to be realized across the PNM system. Our
18 contacts in the storage and utility industries consistently expect that significant
19 technology advances will be achieved in both control areas in the future. Utility
20 ownership of some battery storage facilities will be critical for PNM to understand
21 and gain experience in these areas to better inform future PPA or EPC contracts.

22

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

VI. MAXIMIZING STORAGE VALUE FOR CUSTOMERS

Q. WHAT MAJOR LESSONS FOR THE DESIGN OF PNM'S STORAGE PROGRAM CAN BE DRAWN FROM THE INDUSTRY'S PAST EXPERIENCE AND EXPECTED FUTURE TRENDS IN STORAGE?

A. My short list of major lessons learned includes:

1. Location is important. As the electricity industry has become more sophisticated in its understanding of how the speed of response and flexibility of electrochemical storage can be used, locational optimization has become more important. Storage can deliver much more value than merely the arbitrage gains of shifting energy delivery by a few hours. Costs of new T&D facilities can be deferred. A host of valuable ancillary services can be provided: spinning reserves, voltage support, fast/faster/fastest frequency regulation, black start, congestion relief, resource adequacy and others as shown in PNM Table WK-2 above. These services can improve customers' experience of power quality and reliability. But to harvest fully these types of value, storage facilities should be located close to major load centers – ideally adjacent to transmission substations with multiple distribution interconnections.

2. Avoid crash programs. Since storage costs are expected to decline substantially through the mid-2020s, utilities should proceed judiciously with their storage installations, and not build too far in

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

1 advance of need. A “just in time” approach to storage development
2 will reduce the NPV of storage program costs, leverage future
3 improvements in technology performance and safety, and increase the
4 long-term value for customers. It will also allow utilities to use the
5 experience they accumulate in their initial storage projects.

6 3. Minimize daylight between operations and ownership. The ownership
7 structure should not get in the way of system operator using the full
8 range of storage capabilities. The proportion of storage value derived
9 from short duration, fast reaction services is increasing. To harvest
10 that value, the electric system operator (or balancing authority in
11 organized markets) must have full automated control over storage
12 dispatch. Dispatch through manual, discrete transactions is too slow.
13 Furthermore, the operation and maintenance of storage assets should
14 be aligned fully with their optimal pattern of use. Restrictions in PPAs
15 on frequency and depth of discharge due to developer concerns about
16 warranties, or inadequate attention to maintenance or cell replacement
17 where needed, can erode the value delivered by storage assets.

18 4. Build the required skills. Utility ownership of some battery storage
19 facilities will be critical for PNM gaining valuable knowledge and
20 experience related to not only the operating control and maintenance
21 but also the locational value to the grid and system reliability, to better
22 inform it future storage program expansion.

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

1 In a nutshell, utility-scale storage delivers highest value to the host utility system
2 when it can be tightly integrated in both location and dispatch.

3
4 **Q. WHAT ARE THE IMPLICATIONS OF THESE LESSONS LEARNED**
5 **FOR PNM'S INITIAL STORAGE PROCUREMENTS?**

6 **A.** Given the results of PNM's storage RFP, the following implications from industry
7 lessons learned deserve consideration:

- 8 • PNM's system currently has a limited need for utility-scale storage. It
9 should not "overbuild" now to meet later long term needs with its initial
10 procurement. A smaller first bite would be wise.
- 11 • It does not make sense to locate a large portion of the long-term storage
12 capacity needs in a far corner of system at the end of long radial line, as
13 proposed in the Arroyo project. It will be less valuable in that location.
- 14 • While storage procured through the PPA model could in concept be sited
15 and dispatched with utility direction, the cost savings in the PPA model
16 (vs. the EPC model) are small could be outweighed by the reduced
17 benefits caused by transaction inefficiency in dispatch and misalignment
18 of asset management priorities.
- 19 • The best solution for customers is to allow PNM to own a substantial
20 portion of the ultimate storage asset portfolio - while requiring price-
21 competitive storage development costs. This would provide PNM with a
22 better opportunity to learn how to optimize the use of storage assets,

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

1 achieve full value from real-time dispatch of a variety of storage services,
2 and ensure safe and reliable operation.
3

VII. CONCLUSIONS

5 **Q. PLEASE SUMMARIZE YOUR CONCLUSIONS.**

6 **A.** My conclusions on the key issue I address are as follows:

- 7 • *Are the size and pace of PNM's storage program consistent with*
8 *prevailing utility industry practices?*

9 Yes. PNM's proposal in this filing for the first phase of its battery storage
10 program is consistent the direction of its peers in states with heavy
11 renewables penetration. Achieving cumulative storage capacity by 2022
12 that is in the range of two to five percent of its peak load sets a vigorous
13 but prudent pace.

- 14 • *How can PNM use the results of its energy storage RFP to assemble a*
15 *storage portfolio that represents the best long-term value for PNM's*
16 *customers?*

17 PNM should incorporate in its selection of proposed energy storage
18 projects an approach characterized by taking on smaller facilities in
19 multiple locations over a reasonable period of time. In addition to the
20 target capacity range, PNM should limit the size of individual facilities to
21 between 10 MW and no more than 40 MW. Finally, PNM should have the

**DIRECT TESTIMONY
OF WILLIAM KEMP
NMPRC CASE NO. 19-____-UT**

1 opportunity to gain valuable operations and maintenance experience with
2 storage assets.

3

4 **Q. DOES THIS CONCLUDE YOUR TESTIMONY?**

5 **A. Yes, it does.**

GCG#525653

Resume of William Kemp

PNM Exhibit WK-1

Is contained in the following 8 pages.



WILLIAM KEMP

+1.941.448.5674 wkemp@enovationpartners.com

MANAGING DIRECTOR

Focus Areas

Strategic planning and implementation

Competitive markets analysis

Technology economics

Pricing and regulatory strategy

M&A

Corporate transformation

Litigation support

Office

Tampa

Education

Master of Public Policy
**University of California,
Berkeley**

Bachelor of Arts magna
cum laude in Anthropology
and Physics
Harvard University

Bill is a co-founder of Enovation Partners. For more than 25 years, he has crafted and delivered solutions to energy and utility industry clients around the world on critical strategy, finance, operations, and technology issues. He has directed more than 400 consulting projects in the areas of strategic planning, strategy implementation, technology and market economics, marketing and trading, risk management, industry restructuring, regulatory strategy, M&A, competitive positioning, reengineering/cost management, and litigation support.

Bill has served in various leadership positions in the International Association for Energy Economics and contributes and speaks frequently to industry groups such as American Gas Association, Edison Electric Institute, International Gas Union, Western Energy Institute, Association of Metropolitan Water Agencies, and others.

RELEVANT ENGAGEMENTS

Following are snapshots of selected engagements that are particularly relevant to resource planning and technology economics issues in the energy industry:

- Developed for **Lazard Freres** a consistent methodology for comparing levelized cost of energy (LCOE) and levelized cost of storage (LCOS) across a broad range of generation and storage technologies and end uses, using detailed information gathered from industry participants. Annual reports became widely used reference benchmarks in electricity industry.
- Evaluated power trading operations and power supply portfolio for **Arizona Public Service**. Assessed capabilities and competitiveness of wholesale power contracting and trading functions. Also reviewed existing portfolio of physical and contractual power resources, defined alternative portfolios, analyzed likely cost and risk profile under a variety of market scenarios.
- Directed a regional project to model annually the resource plans, finances, and rates of over sixty Pacific Northwest utilities. Developed load/resource balance models, reviewed and revised load forecasts, developed resource stacks ordered by cost-effectiveness, projected long-term resource additions and financial impacts, analyzed key sensitivities.
- Advised major western U.S. electric utility on optimizing the over-market costs of its portfolio of older renewable PPAs. Analyzed existing PPA counterparties and the negotiating levers to buy out our restructure higher cost contracts. Reviewed options, including securitization, to reduce total portfolio cost. Advised on regulatory strategy.

PNM EXHIBIT WK-1

- Produced economic analyses of value of **Big Stone II** transmission project, as a path to market for wind power generation and efficient coal generation. Analyzed regional capacity and energy needs, assessed realistic costs of major resource alternatives, evaluated effects of carbon constraints on lifecycle costs of fossil fueled resources, developed regulatory approval strategy
- Advised **State Power Corporation of China** and State Economic and Trade Commission on market design and regulatory principles for competitive reform of Chinese power industry. Presented lessons learned from U.S., Europe, Australia, New Zealand, and Latin America, reviewed current operational and organizational issues in China, recommended optimal market and regulatory structure,
- Independently reviewed expected economic performance and implied asset value of numerous generating plants in the U.S. and overseas. Analyzed current and future market context, determined likely dispatch pattern, evaluated forecasts of fuel expense, O&M expense, capex, and product revenues, estimated intrinsic and extrinsic values, assessed major risk factors and mitigation options. Testified before civil and regulatory courts.
- Developed strategies for maximizing the value of **Statoil's** planned LNG imports to U.S. Modeled in detail the energy delivery systems in mid-Atlantic and Northeast gas and electricity markets, evaluated marketing strategies. Analyzed strategic benefits of business scope into transportation, storage, or generation.
- Assisted president and board of **Western Energy Institute** (representing almost all electric or gas utilities and gas pipelines in western North America) in formulating strategic plans for WEI to help address the most pressing industry issues facing the member companies. Facilitated six annual WEI board retreats in recent years, including leading a panel on the best decarbonization pathways for customers at the January 2019 board retreat.

MAJOR AREAS OF EXPERIENCE

Strategy and Finance

- Developed growth strategies for companies in energy, manufacturing, and software industries. Identified critical business issues, assessed core competencies and key assets, defined strategic vision, identified capability gaps and partnering opportunities, prioritized strategic and financial risks, analyzed business cases for investment, recommended near term tactics.
- Drove strategic plans through to successful strategy implementation. Deployed Accelerated Corporate Transformation© process architecture to achieve quick traction on most important initiatives. Improved clients' management capabilities for sustained progress on achieving strategic objectives.
- Developed long-term financial strategies for energy companies. Defined financial objectives, identified long-term market threats and opportunities, evaluated financing alternatives, recommended improvements to financial operations, advised on pre-IPO initiatives.
- Advised numerous energy industry clients in mergers and acquisitions, and post-transaction integration, both in US and internationally. Developed strategic framework, screened targets and management teams, evaluated strategic fit of customer/ resource portfolios, quantified synergies, assessed regulatory/ financial/operational risks. Established governance structure and policies for affiliated entity transactions. Set benefit goals, facilitated integration teams, implemented key IT systems, helped drive benefits realization
- Assisted numerous U.S.-based energy firms in acquiring in foreign assets. Analyzed relevant power/gas markets, identified potential acquisition targets, analyzed market and regulatory impacts on revenues and risks, coordinated expert teams in due diligence.

PNM EXHIBIT WK-1

- Determined appropriate valuations for production and distribution assets in various electricity or gas markets. Assessed upstream/downstream markets, regulatory issues, operating strategy.

Market Analysis, Marketing, and Pricing

- Advised governments and regulatory agencies on market liberalization policy and design of commodity markets. Clarified policy objectives, outlined optimal market and regulatory structure, designed market rules and business practices, analyzed market power issues, assessed technology platforms, recommended risk mitigators.
- Advised large private equity player on outlook for natural gas exports from North America and implications for midstream acquisition opportunities in Western Canada or US. Client closed quickly on substantial asset portfolio.
- Assisted in creation of start-up retailers of gas and electricity. Assessed market opportunities, defined business model, developed business processes, acquired human and IT resources, analyzed resource and customer portfolio risks, purchased customer bases, executed marketing campaigns.
- Assisted in enhancing revenues through service differentiation and unbundling, for suppliers of energy services. Segmented local markets, redefined service bundles, developed pricing. .
- Performed production and distribution cost studies for Northwest and Pacific utilities. Identified management objectives, analyzed historical and forecasted costs and loads, determined revenue requirement, allocated costs to products and customer classes, designed rates, and developed supporting testimony.

Operations and Performance Improvement

- Directed a large strategy development and implementation project to help a large Southeastern gas and electric utility move to the next stage of its development, using the Accelerated Corporate Transformation process architecture. Assisted in designing enterprise-level strategic initiatives and defining explicit success metrics for medium term strategic objectives.
- Directed enterprise transformation projects at major energy companies, including strategic planning, process visions and redesigns, technology implementations (ERP, CRM), change leadership, cost reduction targets, benefit realization.
- Assessed technical and economic feasibility of new CHP plant to be developed by large urban power and gas utility. Directed team that reviewed conceptual design, configuration, and all major systems (electrical, mechanical, civil), as well as site issues. Assessed draft business plan and financial projections, reviewed logic and assumptions, analyzed relevant regional power, gas, and heat markets.
- Assisted commodity producers in analyzing the operational economics of wholesale customers. Modeled customers' supply portfolios, customer demands, distribution operations, retail pricing, and finances. Analyzed impact of various wholesale contracting and pricing strategies.

Regulation and Litigation Support

- Served as expert witness or prepared expert testimony on various ratemaking issues (revenue requirements, forecasted sales, cost allocations, rate design) before numerous utility regulatory commissions or governing bodies.
- Served as expert witness in disputes regarding enforceability of commodity supply contracts in unusual market conditions. Identified key issues, used industry network and personal expertise to present compelling testimony.

PNM EXHIBIT WK-1

- Served as expert witness on energy-related issues in countervailing duty claims before international trade agencies. Analyzed cost basis and market context of contracts to purchase energy from foreign government-owned utilities. Quantified impacts of subsidized pricing.
- Served as expert witness in studies of energy industry practices in construction accounting, cost accounting, cost allocations to products and customers, and financial reporting.

PROFESSIONAL EMPLOYMENT

Enovation Partners

Founding Partner: Member of executive leadership team of management consultancy focused on helping clients thrive in the energy transition. Leader of strategy implementation and sustainable energy practices.

Economists.com

Managing Director: Responsible for strategic direction, sales and marketing leadership, alliance development, client relationship management, thought leadership, direct services to major clients. Grew firm to four offices.

Black & Veatch Management Consulting

Vice President, Strategy Solutions: Leader of Black & Veatch's strategy consulting services, including strategy development, customer strategy, mergers and acquisitions, power delivery strategy, sustainability assessment and strategy, and technology strategy, and Accelerated Corporate Transformation (a proprietary strategy implementation methodology). Also led internal strategic planning and headed up divisional thought leadership program.

Precise Power Corporation

President/Chief Operating Officer: Responsible for strategic direction, day-to-day operations, and financial and administrative management for this start-up manufacturer of high-tech electric motors and power quality equipment.

Deloitte Consulting

Managing Partner, Asia-Pacific-Africa Energy & Resources Practice; Lead Partner, U.S. West Energy Practice; Partner, U.S. Northwest Practice: As managing partner, responsible for management of one of three global regions in Deloitte's management consulting practice in Energy & Resources industry (oil, gas, electricity, water, mining). Served as CEO of Utility Consulting International, a successful joint venture among several national Deloitte & Touche consultancies and an additional outside consultancy. UCI served as a model for the international integration of Deloitte Consulting.

Pacific Gas and Electric Company

Supervising Wholesale Rate Engineer; Senior Regulatory Analyst; Fuel Economist

Southern California Edison Company

Regulatory Cost Analyst

Executive Office of the President, Council on Environmental Quality

Regulatory Economist

SUMMARY OF TESTIMONY EXPERIENCE

WILLIAM J. KEMP

JURISDICTION	CASE OR DOCKET NO.	PLAINTIFF / APPLICANT	CLIENT	YEAR	SUBJECT MATTER
Direct Expert Witness Services					
U.S. District Court – Eastern Washington	18-00390 RMF	Blocktree Properties et al	Blocktree Properties et al	2019	Discriminatory utility rates applied to class of cryptocurrency miners
U.S. District Court – Eastern North Carolina	4:17-CV- 141- D	Class of Injured Parties	PCL Construction	2018	Direct and business interruption damages to utilities and utility customers from transmission outage
Missouri Public Service Commission	EM-2017-0226	Great Plains Energy	Great Plains Energy	2017	Merger synergies, industrial logic, merger approval criteria
Kansas Corporation Commission	16-KCPE-593- ACQ	Great Plains Energy	Great Plains Energy	2016	Merger synergies, industrial logic, merger approval criteria
Guam Public Utilities Commission	11-09	Guam Power Authority	Guam Power Authority	2011	Transmission level cost-of-service analysis, standby rates, customer retention rates
Guam Public Utilities Commission	07-010	Guam Power Authority	Guam Power Authority	2007, 2009	Transmission level cost-of-service analysis, rate design

JURISDICTION	CASE OR DOCKET NO.	PLAINTIFF / APPLICANT	CLIENT	YEAR	SUBJECT MATTER
Missouri Public Service Commission	EM-2007-0374	Kansas City Power & Light Co.	Kansas City Power & Light Co.	2007	Merger synergies, allocation of merger benefits
Kansas Corporation Commission	07-KCPE-1064-ACQ	Kansas City Power & Light Co.	Kansas City Power & Light Co.	2007	Merger synergies, allocation of merger benefits
California Public Utilities Commission	U-902-E	San Diego Gas & Electric Co.	San Diego Gas & Electric Co.	2007	Economics of renewable generation development, need for transmission
U.S. District Court, Eastern Virginia	Civil Action No. 05-CV-34	Old Dominion Electric Cooperative	Ragnar Benson, Inc.	2006	Wholesale power markets, natural gas markets, generation project economics, transmission constraints
American Arbitration Association	Consolidated Case No. 53 Y 110 00521 03	Williams Service Group Inc. of Ohio	Williams Service Group Inc. of Ohio	2005	Wholesale power markets, natural gas markets, generation project economics, transmission constraints
FERC	EL02-56	Snohomish Public Utility District	Snohomish Public Utility District	2003	Wholesale market power, wholesale power contracts, credit terms, forward markets
Guam Public Utilities Commission	93-001	Guam Power Authority	Guam Power Authority	1995	Load study design and analysis, cost of service analysis
Guam Public Utilities Commission	92-001	Guam Power Authority	Guam Power Authority	1994	Transmission-level and retail cost of service analyses, interruptible rates, rate design
U.S. International Trade Commission	US-95-1257	Bethlehem Steel	Bethlehem Steel	1994	Steel production costs, electricity production costs, wholesale power contracts, steel markets

JURISDICTION	CASE OR DOCKET NO.	PLAINTIFF / APPLICANT	CLIENT	YEAR	SUBJECT MATTER
U.S. International Trade Commission	USA-92-1904-05	Gouvernement du Québec	Norsk Hydro Canada	1993	Aluminum production costs, electricity production costs, wholesale power contracts, aluminum markets
Guam Public Utilities Commission	92-003	Guam Power Authority	Guam Power Authority	1993	Transmission-level and retail cost of service analyses, interruptible rates, rate design, labor costs, performance standards
FERC	ER83-03	Bonneville Power Administration	Pacific Gas & Electric Co.	1983	Hydroelectricity economics, wholesale power markets
FERC	ER82-04	Bonneville Power Administration	Pacific Gas & Electric Co.	1982	Hydroelectricity economics, wholesale power markets
Bonneville Power Administration	1983 Rate Case	Bonneville Power Administration	Pacific Gas & Electric Co.	1983	Hydroelectricity economics, wholesale power markets
Bonneville Power Administration	1982 Rate Case	Bonneville Power Administration	Pacific Gas & Electric Co.	1982	Hydroelectricity economics, wholesale power markets

JURISDICTION	CASE OR DOCKET NO.	UTILITY/ORGANIZATION INITIATING PROCEEDING	CLIENT	YEAR	SUBJECT MATTER
Testimony Prepared on Behalf of Client Witnesses					
U.S. District Court - Southern New York	1:15-cv-04878	Merced Irrigation District	Merced Irrigation District	2017	Damages to participants in Western U.S. power market from market manipulation

JURISDICTION	CASE OR DOCKET NO.	UTILITY/ORGANIZATION INITIATING PROCEEDING	CLIENT	YEAR	SUBJECT MATTER
International Court of Arbitration	12 573/JNK	Kaiser Aluminum & Chemical Corp.	Kaiser Aluminum & Chemical Corp.	2003	Aluminum production costs, electricity production costs, wholesale power contracts, aluminum markets
California Public Utilities Commission	96-10-038	Pacific Enterprises	Pacific Enterprises	1997	Merger synergies for proposed merger of Pacific Enterprises and Enova
Washington Utilities and Transportation Commission	Various	Avista, Puget Sound Energy, PacifiCorp	Bonneville Power Administration	1987-1996	Power production costs, investment prudence, conservation/DSM, wholesale cost of service, merger synergies
Oregon Public Utilities Commission	Various	PacifiCorp, Portland General Electric	Bonneville Power Administration	1987-1996	Power production costs, investment prudence, conservation/DSM, wholesale cost of service, merger synergies
Idaho Public Utilities Commission	Various	Idaho Power	Bonneville Power Administration	1987-1996	Power production costs, investment prudence, conservation/DSM, wholesale cost of service, merger synergies
Montana Public Service Commission	Various	Montana Power	Bonneville Power Administration	1987-1996	Power production costs, investment prudence, conservation/DSM, wholesale cost of service, merger synergies
Colorado Public Utilities Commission	95A-531EG	Public Service Co. of Colorado	Public Service Co. of Colorado	1995	Merger synergies for proposed merger of Public Service Co. of Colorado and Southwestern Public Service
U.S. District Court, Alaska		North Pacific Seafoods	North Pacific Seafoods	1990	[Exxon Valdez oil spill] Fisheries industry economics, business interruption damages
U.S. District Court, North Texas		Lyon Productions	Lyon Productions	1989	Film/TV industry economics, revenue and cost unbundling

Enovation Overview and Storage Qualifications

PNM Exhibit WK-2

Is contained in the following 19 pages.



Accelerating Innovation in Energy and Infrastructure

Overview of Enovation Partners

June 2019

Enovation Partners

- **Focused on driving innovation to energy and infrastructure sectors**
 - Transition of electricity sector – Distributed and renewable, storage, mobility
 - Natural gas growth and innovation
 - Winner of Consulting Magazine’s 2017 “Seven Small Jewels” award
 - Named a Top Consulting Firm (Energy) by Forbes March 2019

- **Combine industry experience with advanced analytics to drive informed strategy**

- Boutique (offices in Chicago, London, San Francisco, Washington) focused on energy transition
- Leverage proprietary analytics, data and differentiated market insight
- Experienced team (former BCG, McKinsey, Booz, Deloitte) with extensive senior industry relationships

- **Acquired Cleantech Group in 2016 to provide corporate, investor communities front-row seat for global innovation in energy and adjacent sectors**

- 16 years of convening VC/CVCs and cleantech start-ups (annual events in SF, Europe, Singapore, China)
- I3: Cleantech’s online networking platform
- Proprietary, in-depth market insight and analysis



An experienced team, who have built and led practices within top consulting firms



**Bob
Zabors**

**Mike
Granowski**

**Dan
Gabaldon**

**Todd
Allmendinger**

**Bill
Kemp**

**Jim
Peters**

Director - CEO

Director - CFO

Director

Director

Director-CHRO

Director

Expertise

- Corporate strategy, M&A, innovation, renewables, sustain-ability, EVs, organizational design and change, performance management

- Financial and market advisory, M&A and transaction support, Innovation and new market entry, corporate and business unit strategy and execution

- Leads business unit and corporate strategy, performance improvement, innovation and new market entry for energy and infrastructure firms and investors worldwide

- Sustainable infrastructure development, innovations and technology commercialization, market assessment and research

- Delivers solutions to energy and water industry clients around the world on critical strategy, operations, regulatory, and technology issues. Has directed over 400 consulting projects

- Over 30 years as strategic problem solver and leader in transaction support, operations transformation, natural gas infrastructure, distribution, environmental

Previous

- Bridge Strategy – Founder, Energy Practice Leader
- Booz & Co
- Renaissance Worldwide
- CSC Planmetrics

- Bridge Strategy Group
- CRA
- Navigant Consulting
- Barrington Energy
- Metzler & Assoc
- Commonwealth Edison

- Boston Consulting Group
- Booz & Company
- Bridge Strategy Group
- U.S. Department of Energy

- CRA
- Emerging Energy Consulting and Emerging Energy Research
- Diamond Cluster
- US Navy

- Black & Veatch
- Deloitte Consulting
- Economists.com
- Precise Power Corporation
- PG&E
- Carter White House

- McKinsey
- Alix Partners
- Partners in Performance

Education

- BA, Computer Studies, Psychology, Northwestern University
- MBA, University of Chicago

- BS, Nuclear Engineering & BS, Physics, University of Wisconsin
- MBA, University of Iowa

- BSFS, Georgetown University; MA (ABD), Duke University
- MBA, University of Chicago

- BA, Political Science, University of Vermont
- MBA, Thunderbird University

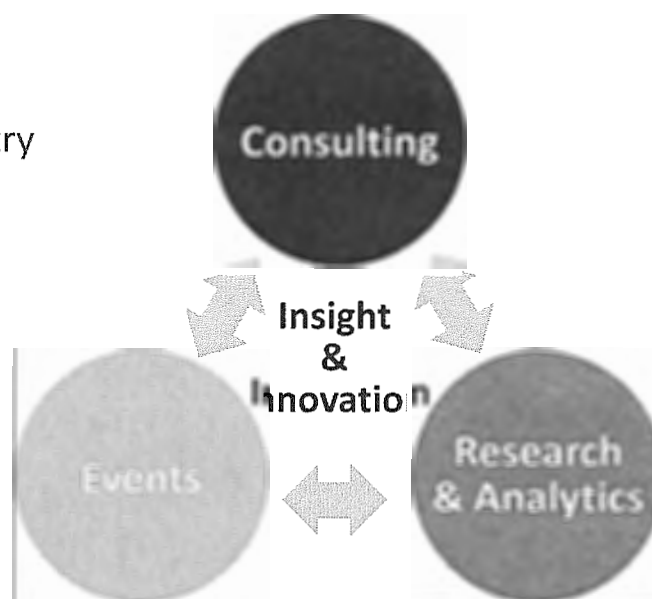
- BA, Anthropology & Physics, Harvard University
- MPP, UC-Berkeley

- BS, Chemical Engineering, Univ of Virginia
- MBA, Wharton, University of Pennsylvania

We deliver insights that leverage an integrated model of consulting, analytics and events

Consulting

- Corporate strategy
- Innovation & market entry
- Energy efficiency and sustainability
- Customer experience & engagement



Research & Analytics

- Growth oriented, sustainability-focused market insights:
- Proprietary algorithms, databases, & tools
 - Distributed energy resources: storage, solar, gas-fired, DR
 - Energy efficiency
 - Midstream assets
 - Gas infrastructure integrity
- Asset investment and portfolio support

Events

- International forums, programs, and networking events
- Over 32,000 members worldwide convene on-line and in-person
- Over 1,100 paid event participants annually; most are senior executives or investment principals

Enovation Partners: Trusted advisors helping an exceptional client base with their most challenging issues

Consulting Business Model

- Insight and relationship-driven sales and delivery model, increasingly differentiated by analytics and proprietary data, and participation across innovation ecosystem
- Leadership team with 250+ years combined experience in the energy industry as both advisors and executives
- C-level executive relationships – extensive trust-based network and access

Consulting Leadership



Bob Zabors



Todd Allmendinger



Dan Gabaldon



Mike Granowski



Bill Kemp



Jim Peters



Ron Bertasi



Natallia Pinchuk



Michael Nolan



Erin Sowerby

Primary Clients

- Investor owned and municipal utilities, energy retailers, IPPs, OEMs, PE funds, associations, large customers and growth-stage innovative companies
- Recent and/or prior work with many
 - US and Canadian electric and gas utilities
 - Large energy retailers and IPPs
 - OEMs in renewables, storage and transportation
 - International investors, family offices, large PE funds
 - Major industry associations

Selected Recent Work

- Corporate strategy development for IOUs, IPPs, Energy Retailers, OEMs and innovative technology companies
- Leading-edge strategy projects on topics including energy storage, electric vehicles, digital implications for energy retail, residential and community solar, natural gas, and biofuels
- Participation in M&A, including most of the recent large utility transactions
- OEM business unit and market entry strategies
- Diligence and deal sourcing support for range of PE firms, including several of the largest energy and infrastructure funds
- Innovative energy efficiency programs for C&I customers and utilities

Areas of Focus for Consulting

1. Corporate Strategy

- Enterprise, business unit, growth strategies
- Renewables, decarbonization strategies
- Regulatory & political strategy and support
- Strategy implementation and transformation
 - Strategy, screening, diligence, synergy assessment, regulatory strategy, communications support, integration planning, direct testimony
 - Specialize in mid cap transactions, and complex transactions, on buyer side
- Asset transactions
 - Storage
 - Midstream – ‘outside in’
 - Solar, wind, storage, gas, biomass, hydro

2. Innovation and Market Entry

- Innovative technology development and deployment
 - Operational improvement
 - Natural gas growth and integrity management
 - Combining strategy, OT and IT to improve major capital programs (e.g. natural gas construction)
- Market Entry
 - New technology adoption (e.g. DER, biomass, vehicles, hydrogen)
 - Renewables and natural gas displacement of other fossils fuels
 - New channels and positioning

3. Customer

- Experience
 - Digital and IoT
 - Electric vehicles
 - Residential PV and BTM storage
 - Payment
- Efficiency
 - Strategies and programs for large consumers (hospitals, industrials)
 - Program design and improvement for utilities

Enovation Partners has a long history supporting clients across the energy storage and DER ecosystems

Selected Projects (2015 to Present)

Client	Issue	Enovation Team Contribution
Lazard Freres	How to compare storage technology costs & use cases?	<ul style="list-style-type: none"> Led all analysis for Lazard's annual Levelized Cost of Storage survey (2015 to 2017) Estimated economic viability of storage across technologies, use case, and markets
>20 large energy clients <ul style="list-style-type: none"> Utilities OEMs Investors Energy retailers 	How big is market? Which segments, use cases, business models?	<ul style="list-style-type: none"> Modeled economics and adoption of various DER technologies (PV, reciprocating engines, storage) at highly granular level across US, Canada, Australia, Germany Profiled/developed detailed pro forma economics of contracts and business models
Multiple Developers & Infrastructure Financiers	Independent market and financial advisory support for financings	<ul style="list-style-type: none"> Independently validate dispatch optimization and market performance of storage and storage + renewable assets
Leading energy storage developer	How do we compare to competitors? How to differentiate?	<ul style="list-style-type: none"> Leveraged competitive assessment and benchmarking to inform market strategy and sustainable competitive advantage
Energy infrastructure developer	Where to participate in storage? How to grow a storage business?	<ul style="list-style-type: none"> How to build an energy storage business in US (CA, PJM, NYISO, ERCOT) Identified preferred technologies, partners as part of integrated business plan
Edison Electric Institute	When/where will DER threaten utilities?	<ul style="list-style-type: none"> Utilized proprietary analytics offering to evaluate DER attractiveness by zip code Developed sensitivities on when behind the meter resources would be in the money for residential and commercial customers.
Multiple U.S. Utilities	How will DER penetration impact my system? Business model? System & resource plans?	<ul style="list-style-type: none"> Defined scenario-driven DER penetration outlook and financial implications Assessed impact to IRP and grid planning activities Forecasted the impact to market prices Build multi-year stakeholder management, regulatory and legislative agenda

Project Example 1 – Energy Storage + PV in California

Similar Energy Storage Projects



TEP Solar Storage

- Location – Arizona
- 30MW / 120MWh
- Online Year – 2019
- Use cases – Renewable integration



Babcock Ranch

- Location – Charlotte County, Florida
- 10 MW / 40MWh
- Online Year – 2019
- Use cases –Renewable integration



Kauai

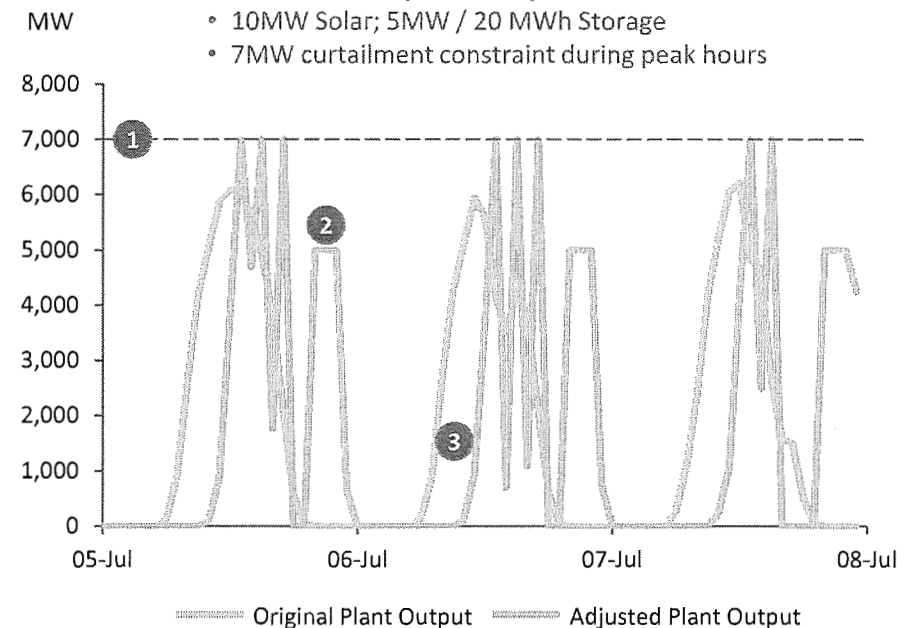
- Location – Kauai, Hawaii
- 20MW / 100MWh
- Online Year – Late 2018
- Use cases – Renewable integration, peaker replacement



Storage + PV Dispatch Profile

Project Example:

- 10MW Solar; 5MW / 20 MWh Storage
- 7MW curtailment constraint during peak hours



Source: DOE/Sandia, company websites, Enovation Partners analysis

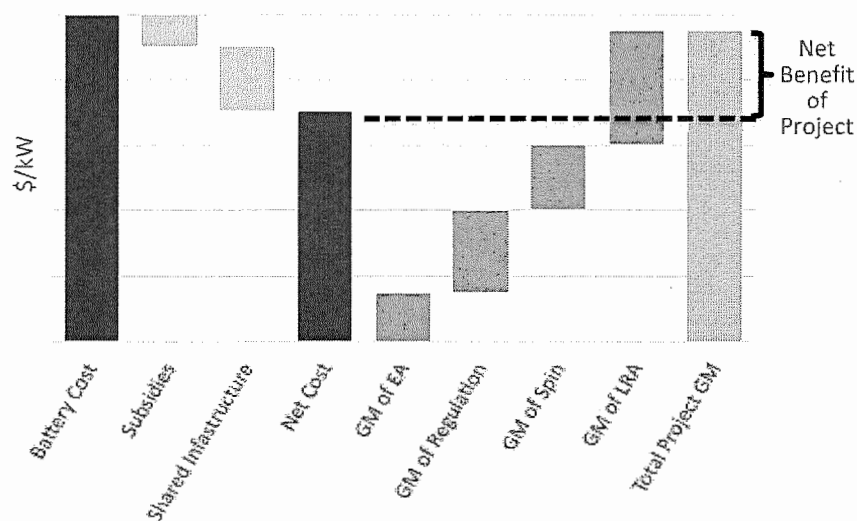
ENOVATION PARTNERS – PRIVILEGED AND CONFIDENTIAL

Energy Storage + PV – Illustrative Project Economics

Project Description

- Location: Addition to 30 MW solar facility in Bakersfield, CA
- Configuration: 10 MW/ 40 MWh lithium ion battery
- Installed Costs: \$385-489/kWh
\$15.4 – 19.6 M

Conceptual Project Economics



Key Economic Inputs

Savings from co-locating storage + PV

- In a DC-coupled system avoided battery storage cost are ~\$158/kW (see footnote link for report)
- The avoided cost falls to ~\$52/kW when the battery is an add-on to an existing solar project
- The biggest avoided cost in a shared solar + storage system is a second inverter, which is ~\$40/kW

Storage subsidies and incentives

- 1,325 MW storage procurement target by 2020
- ITC is available for solar plus storage projects if at least 75% of the storage charging energy is derived from solar

Potential revenue streams¹

- Energy arbitrage (EA) through participation in DA and RT energy markets. Estimated revenue potential ~ \$59/kW-year
- Regulation through both the Regulation Up and Regulation Down products. Estimated revenue potential ~ \$83/kW-year
- 10 minute synchronized reserves through the Spinning Reserve product. Estimated revenue potential ~ \$67/kW-year
- Local resource adequacy (LRA) revenues for battery storage projects are estimated between \$50-150/kW-year

Additional considerations

- CA – 50% RPS by 2030 and considering 100% RPS by 2045
- The benefits of energy storage are considered in the CAISO transmission planning process.
- Reduction of GHG emissions

Notes: 1) 2017 revenues. Revenues in this section are not additive. Energy arbitrage value assumes single hour daily cycling with perfect foresight. Regulation and spinning reserve values represent the maximum revenues available. Regulation represent the Reg Up revenues. GM – Gross margin and includes charging costs and operating expenses.

Source: CAISO, Lazard, NREL (<https://www.nrel.gov/docs/fy17osti/69061.pdf>), Enovation Partners analysis

ENOVATION PARTNERS – PRIVILEGED AND CONFIDENTIAL

Project Example 2 – Energy Storage for T&D Deferral in Massachusetts

Similar Energy Storage Projects



Storage on Demand (N.Y.C.)

- New York, New York
- 1MW / 4MWh
- Online Year – Summer 2018
- Use cases – T&D deferral, peak demand reduction



Punkin Center

- Punkin Center, AZ
- 2MW / 10MWh
- Online Year – Early 2018
- Use cases – T&D deferral, peak demand reduction



Nantucket

- Nantucket, MA
- 6MW / 48MWh
- Online Year – 2019
- Use cases – T&D deferral, back-up power



Opportunity for T&D Deferral in New England

- States in New England have committed to aggressive renewable energy goals:
 - MA: Proposal for 40% clean energy by 2030, 1,600 MW in-state solar by 2020
 - CT: 28% RPS by 2020
 - NH: 25.2% RPS by 2025
 - ME: 40% RPS by 2017
 - VT: 75% RPS by 2032
- New transmission builds and/or distribution upgrades required for renewable energy to reach load centers
- These new transmission build are costly and have faced issues getting built
 - \$1.6 billion Northern Pass project to bring hydro into MA from Canada on hold after being rejected by NH.
- States in New England are committed to looking at energy storage as a resource to address various grid needs, including T&D deferral
 - MA: 200 MWh storage target by 2020, \$20 million in state grants for energy storage demonstration projects
 - CT: RFPs including call for storage stand-alone or paired with renewables. Demonstration projects to include storage
 - ME: Pilot project including Non-Transmission Alternative (NTA): PV, batteries, thermal (ice) storage

Source: DOE/Sandia, company websites, DSIRE, State of Massachusetts, Enovation Partners analysis

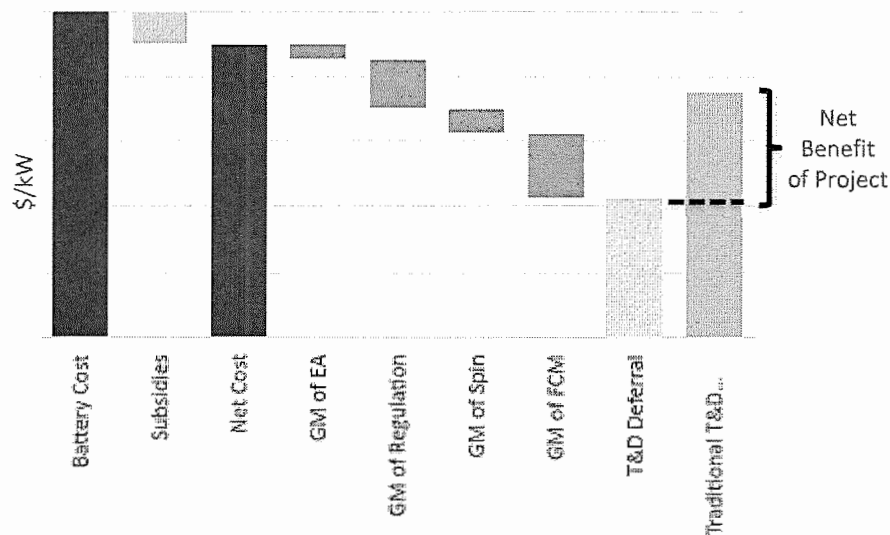
ENOVATION PARTNERS – PRIVILEGED AND CONFIDENTIAL

Energy Storage for T&D Deferral– Illustrative Project Economics

Project Description

- Location: Load sited and strategically located in Massachusetts
- Configuration: 10 MW/ 60 MWh lithium ion battery
- Installed Costs: \$368-472/kWh
\$22.1 – 28.3 M

Conceptual Project Economics



Key Economic Inputs

- Storage subsidies and incentives
 - 200 MWh storage target by 2020
 - \$20 million in state grants for energy storage demonstration projects. Requests for proposals included utility, distribution system, and BTM application scales
 - ITC is available for storage projects if at least 75% of the storage charging energy is derived from solar
- Potential revenue streams¹
 - Estimated value of T&D deferral in ISO-NE ~ \$50-120/kW-year
 - Energy arbitrage (EA) through participation in DA and RT energy markets. Estimated revenue potential ~ \$20/kW-year
 - Regulation as alternative technology regulation resource (ATRR) in the regulation market. Estimated revenue potential ~ \$49/kW-year
 - 10-min spinning reserve market. Estimated revenue potential ~ \$24/kW-year
 - ISO-NE Forward Capacity Market (FCM) – \$111/kW-year²
 - Starting in June 2018 the FCM is moving to a performance based system with high penalties for failure to deliver (\$2,000/MWh). Could affect ES willingness to participate.
- Additional considerations
 - MA – 15% RPS by 2020 with additional 1% each year thereafter
 - 80% reduction in GHG emissions below 1990 levels
 - ISO-NE does not yet consider energy storage as part of the Transmission Planning Process

Notes: 1) 2017 revenues. Revenues in this section are not additive. Energy arbitrage value assumes single hour daily cycling with perfect foresight. Regulation and spinning reserve values represent the maximum revenues available

2) FCM revenues are the average of the 2017/18- 2020/21 auctions. GM – Gross margin and includes charging costs and operating expenses. Subsidies for energy storage across entire systems may be as high as \$300/kW-year

Source: ISO-NE, Lazard, State of Massachusetts, Enovation Partners analysis

ENOVATION PARTNERS – PRIVILEGED AND CONFIDENTIAL

Project Example 3 – Energy Storage for fossil augmentation in Southern California

Example Projects



LM6000 Hybrid EGT – Center

- Location – Norwalk, CA
- GT Capacity – 50 MW
- Storage – 10 MW / 4.3MWh
- Online Year – 2017
- Use cases –Spinning Reserves, Regulation



LM6000 Hybrid EGT – Grapeland

- Location – Rancho Cucamonga, CA
- GT Capacity – 50 MW
- Storage – 10MW / 4.3MWh
- Online Year – 2017
- Use cases –Spinning Reserves, Regulation



Discussion

Cost savings

- Several improved operating parameters were observed before and after the installation of storage at the GE sites
- Conservatively, ~50% of observed improvement values were modeled
 - Heat rate: 1.2% improvement from 10,203 to 10,083
 - Non-Fuel Variable O&M: 24% improvement from \$39.76 to \$30.12/MWh
 - Fixed O&M: 17% improvement from \$18.07 to \$14.92/kW-yr.

Incremental revenue

- Receive full value of GT capacity in spin relative to non-spin
- Improved GT strike price results in more cleared hours
- Storage participation in wholesale markets during remaining hours

Potential Environment Profile

- Improved emissions profile
- Reduced in water consumption / injection rate

Dispatch

- Dispatch of the fossil unit takes the best available value stream in any hour before/after storage inclusion to calculate optimal gross margin
- Best value streams looked at the potential revenue vs potential operating cost, with adjustments to reserve markets that do not dispatch in all hours
- The dispatch profile shifts after storage to generate for energy markets more and to operate in more lucrative spin markets, previously unavailable, rather than non-spin

Sources: DOE, GE press releases, Energy Nest, Enovation Partners analysis

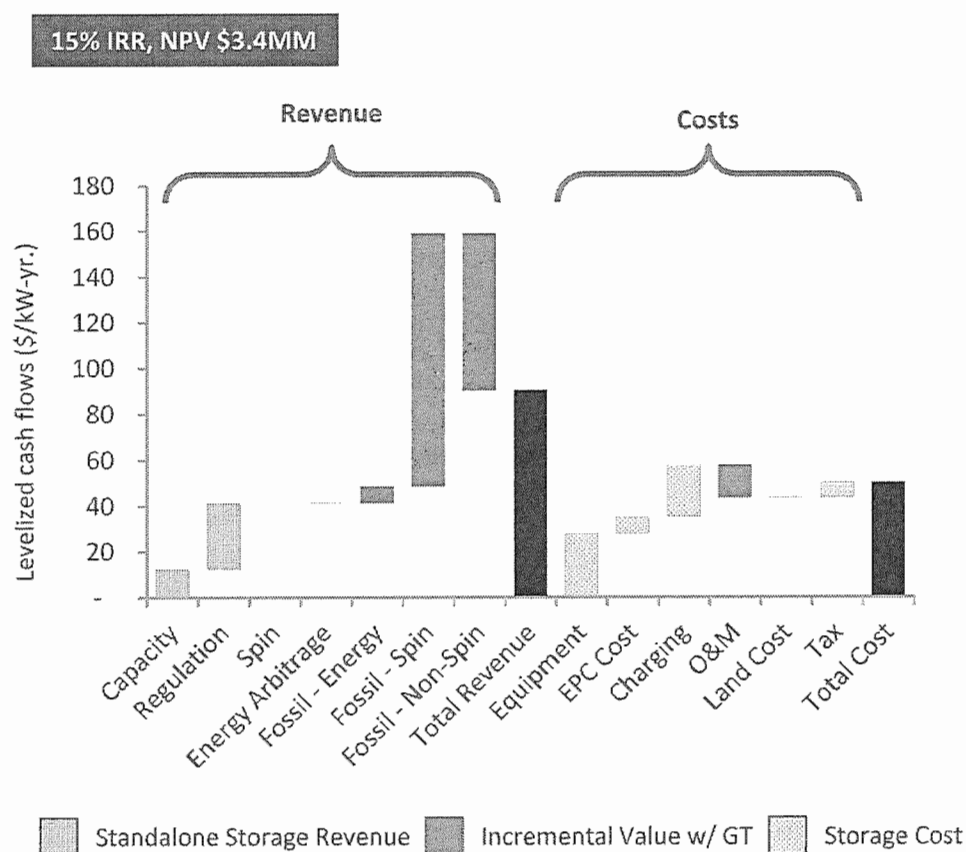
ENOVATION PARTNERS – PRIVILEGED AND CONFIDENTIAL

Fossil augmentation economics are premised on storage's ability to unlock incremental revenue and cost savings from a GT unit

Fossil Augmentation Use Case Example

(New York City example; 16 MW; 16 MWh)

Discussion



- Configuration
 - Storage units sized to 20% of fossil plant nameplate
 - One-hour durations determined to be optimal
- Revenues
 - Incremental Energy / Spin from Fossil:
 - ~50% of revenue, includes GT revenue delta between non-spin and spin participation
 - Increased participation hours in energy markets via lower O&M, heat rate and improved availability
 - Regulation w/ Storage: ~37% of revenue
 - Capacity w/ Storage: ~16% of revenue; excludes value of incremental reliability of GT
- Costs
 - 15 – 20% O&M cost savings for GT
 - No savings in storage EPC or equipment are assumed as a result of collocation with fossil plants

Notes: 1) Fossil augmentation revenue is gross margin added to the fossil plant by storage enabling O&M improvements and additional ancillary revenue

Sources: Enovation Partners analysis

ENOVATION PARTNERS – PRIVILEGED AND CONFIDENTIAL

Enovation Analytics: Creating and leveraging insights for rapid growth



Analytics Business Model

- Shaping strategic decisions and investments through custom and subscription-based analytics
- Insights from proprietary data sources and consulting experience
- Team includes consultants, data scientists and developers

Primary Clients

- Targeting marketing & sales/business dev groups and strategy groups among utilities, developers, OEMs, EPS/EE firms, and retailers
- Serve the regulatory, finance, and planning groups of utilities
- Serve commissions, industry associations, and investors

Analytics Leadership



Mike Granowski



Dan Gabaldon



Natallia Pinchuk



Ray Xia



Cristian Cocheci



Simon Greenburg



Jules Besnainou



Ben Lowe

Selected Recent Work

- **Lazard:** Support the annual Levelized Cost of Storage (LCOS) with our highly accurate energy storage cost database and storage economic impact algorithms
- **Edison Electric Institute:** Developed a national heatmap for BTM DER economics over time predicting the viability of solar, solar + storage, gas-fired and fuel cell applications using our proprietary DER cost/performance databases and DER economics algorithms
- **Top 5 US combination IOU:** Utilized our DER economics algorithms to support a DER market entry strategy development effort
- **Top 5 energy retailer:** Utilize our Demand Response (DR) market database to support a national market sizing, prioritization, and go-to-market strategy
- **Leading EU solar developer:** Utilized our regulatory and incentive database to prioritize US markets

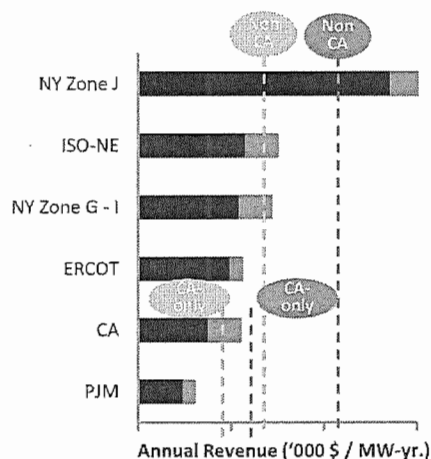
Enovation Analytics: a Distributed Energy Market model and economics platform for detailed views on renewables and storage adoption

DER Economic Tools - Storage

- Incorporate multiple revenue streams from market facing products and services
- Optimize participation in DR, capacity/reserve, economic energy markets
- Layer utility system benefits into the optimization; infrastructure deferral, etc.
- *Ensure the project has maximum access to revenue sources and value*

Selected Combined BTM Use Cases

Observations



- Within each market, there are multiple – technically and contractually compatible – combined use cases available for BTM storage
 - Participation in existing DR programs
 - Occasionally, participation in multiple utility programs
 - Specifics of event timing, pricing limit range of combinations
- Appropriate battery management and DERMS software and associated business processes are critical but available
 - Generally requires longer duration storage chemistries
 - Load and pricing forecasting as well as BMS optimization needed
- Standardizing product offering, project development, financing and minimizing origination costs are key obstacles



DER Penetration Tools

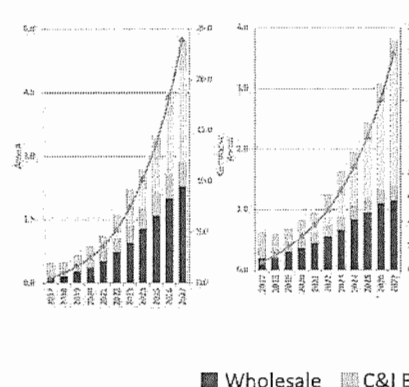
- Combine current as-built with propensity to adopt to identify addressable market
- Identify attractive markets by potential project volume and capacity
- *Identify markets to serve and develop a view towards the potential impact of DER market penetration*

US – Large Scale Energy Storage Installation Outlook Market Outlook Summary (2017 – 2022)

Base Scenario – By Use Case (\$B)

Capacity

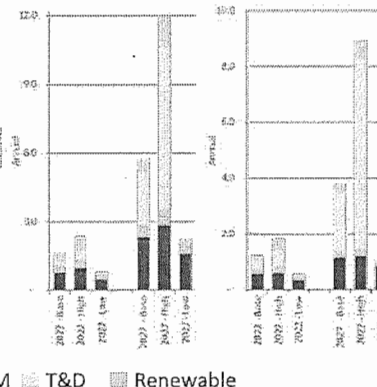
Expenditures¹



Scenarios (\$B)

Capacity

Expenditures



■ Wholesale ■ C&I BTM ■ T&D ■ Renewable

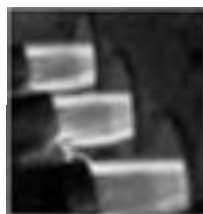
1. For all countries: expenditures include upfront capital & EPC costs of new projects; does not consider operating costs, warrantee, etc.
Source: Enovation Partners

Our strategic partner, the Gas Technology Institute (GTI), enables us to provide a new level of technical depth and insight



Unconventional Gas

- Shale reservoir analysis
- Water management



Energy Efficiency

- Industrial equipment
- Commercial & residential appliance



Infrastructure

- Pipeline inspection
- Operator tools



Energy Conversion

- Gas to liquids
- Gas processing and clean-up



Natural Gas Vehicles

- Engine development & testing
- Demonstration & training



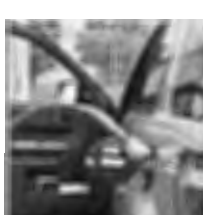
Pipeline Integrity

- Models
- Testing/analysis
- Materials research



LNG

- Small scale liquefaction
- Modeling
- Interchangeability



Transportation

- Fueling systems
- Advanced storage
- LNG for marine and rail



Biology

- Methanotrophic microbes
- Renewables



Gasification

- Coal to gas
- Biomass and gas blends



Power Generation

- Combined heat & power
- Low NOx equipment



Hydrogen

- Generation and dispensing
- Fuel cells

Cleantech Group: Charting the leading edge of global innovation and finance, and facilitating future investment and growth



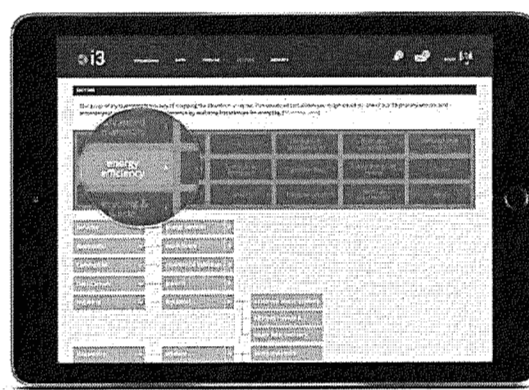
- Hosting, monitoring and shaping the rapidly evolving Resource Efficiency ecosystem
- 15+ year track record of leadership in the space; coined the term 'Cleantech'
- Thousands of executives have been involved, and remain engaged through events
- Maintain index for top-performing Cleantech ETF (NYSE:PZD), with \$125mm AUM



Forums & Programs

Engage with industry leaders and innovators from across the breadth of the global sustainable innovation ecosystem. Find capital, advisors, partners and/or co-investors.

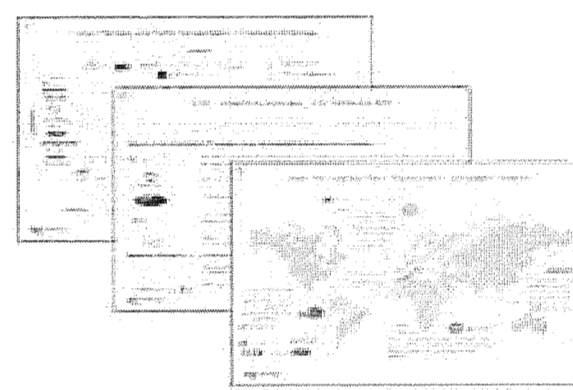
Over 1,100 annual attendees, most have attended several events



CTG Monitor – powered by i3

Keep your finger on the pulse of who and what is happening through our flagship online subscription service

Hundreds of large corporate subscribers, annual renewals



Intelligence & Custom Research

Access in-depth coverage of key trends. Evaluate and connect with specific companies that fit your strategies and criteria.

Fast growing service offering, initial engagements lead to much more

Consulting Magazine
named Enovation Partners
one of the “7 Small Jewels”
of the Consulting industry



Enovation Partners was
recognized by Forbes in March
2019 as one of “America’s Best
Management Consulting Firms”



We are among the youngest firms on the list.

Energy + Innovation = Results

Lazard LCOS Study

PNM Exhibit WK-3

Is contained in the following 60 pages.

LAZARD'S LEVELIZED COST OF STORAGE ANALYSIS—VERSION 4.0

LAZARD

LAZARD

Table of Contents

I	INTRODUCTION	1
II	EXECUTIVE SUMMARY AND KEY FINDINGS	2
III	OBJECTIVES, SCOPE AND METHODOLOGY	4
IV	LAZARD'S LEVELIZED COST OF STORAGE ANALYSIS V4.0	
	A Overview of Selected Use Cases	9
	B Lazard's Levelized Cost of Storage Analysis v4.0	11
V	LANDSCAPE OF ENERGY STORAGE REVENUE POTENTIAL	16
VI	ENERGY STORAGE VALUE SNAPSHOT ANALYSIS	21
	APPENDIX	
	A Supplementary LCOS Analysis Materials	26
	B Supplementary Value Snapshot Materials	30
	C Supplementary Energy Storage Background Materials	44

I Introduction



Introduction

Lazard's Levelized Cost of Storage ("LCOS") analysis⁽¹⁾ addresses the following topics:

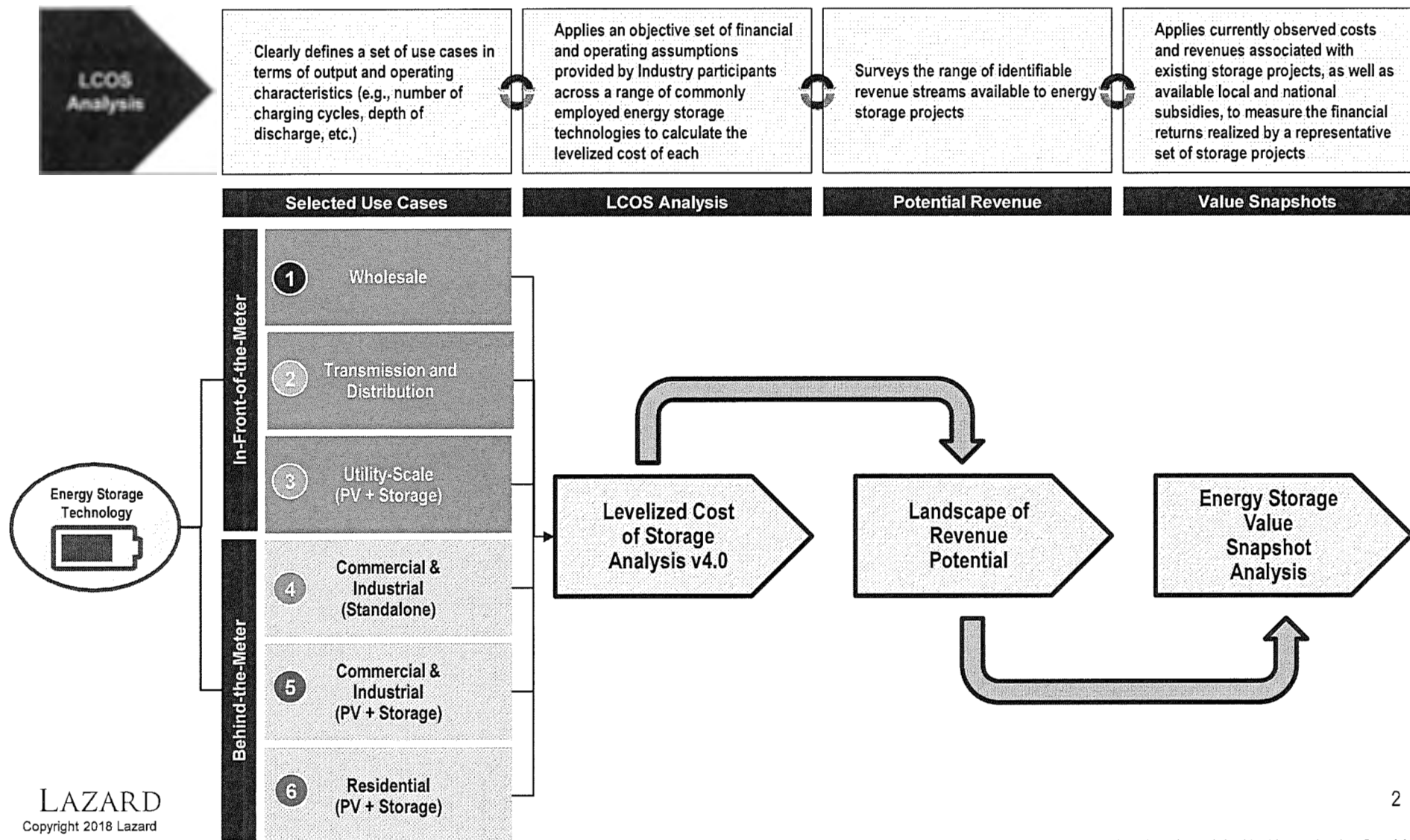
- **Executive Summary and Key Findings**
 - Overview of Lazard's LCOS analysis
 - Summary of key findings from Lazard's LCOS v4.0
- **Objectives, Scope and Methodology**
 - Overview of key objectives and scope of our LCOS analysis
 - Summary of selected limitations of our LCOS analysis, including an overview of what the LCOS does and does not do
 - Methodological overview of our approach to the LCOS analysis
 - Methodological overview of our approach to the Value Snapshot analysis
 - Overview of the evolution of Lazard's LCOS and a summary of key changes year-over-year
- **Lazard's LCOS Analysis**
 - Overview of the use cases analyzed in our LCOS analysis
 - Description of the operational parameters of selected energy storage systems for each use case analyzed
 - Comparative LCOS analysis for various energy storage systems on a \$/MWh and \$/kW-year basis for the use cases analyzed
 - Comparison of capital costs for various energy storage systems on a \$/kW basis for the use cases analyzed
 - Illustration of the expected capital cost declines by technology
 - Overview of historical LCOS declines for select use cases using lithium-ion technologies
- **Landscape of Energy Storage Revenue Potential**
 - Overview of quantifiable revenue streams currently available to deployed energy storage systems
 - Overview of the universe of potential sources of revenue for various use cases
 - Description of revenue streams available from wholesale markets, utilities and customers
- **Energy Storage Value Snapshot Analysis**
 - Overview of the Value Snapshot analysis and description of energy storage system configurations, cost and revenue assumptions
 - Description of the Value Snapshot analysis and identification of selected geographies for each use case analyzed
 - Summary results from the Value Snapshot analysis
 - Comparative Value Snapshot analysis reflecting typical economics associated with energy storage systems across U.S. and international geographies
- **Selected appendix materials**



II Executive Summary and Key Findings


What Is Lazard's Levelized Cost of Storage Analysis?

Lazard's LCOS report analyzes the observed costs and revenue streams associated with commercially available energy storage technologies and provides an overview of illustrative project returns. The LCOS aims to provide a robust, empirically based indication of actual cash costs and revenues associated with leading energy storage technologies, which leads to a preliminary view of project feasibility



Summary of Key Findings from Lazard's Levelized Cost of Storage v4.0

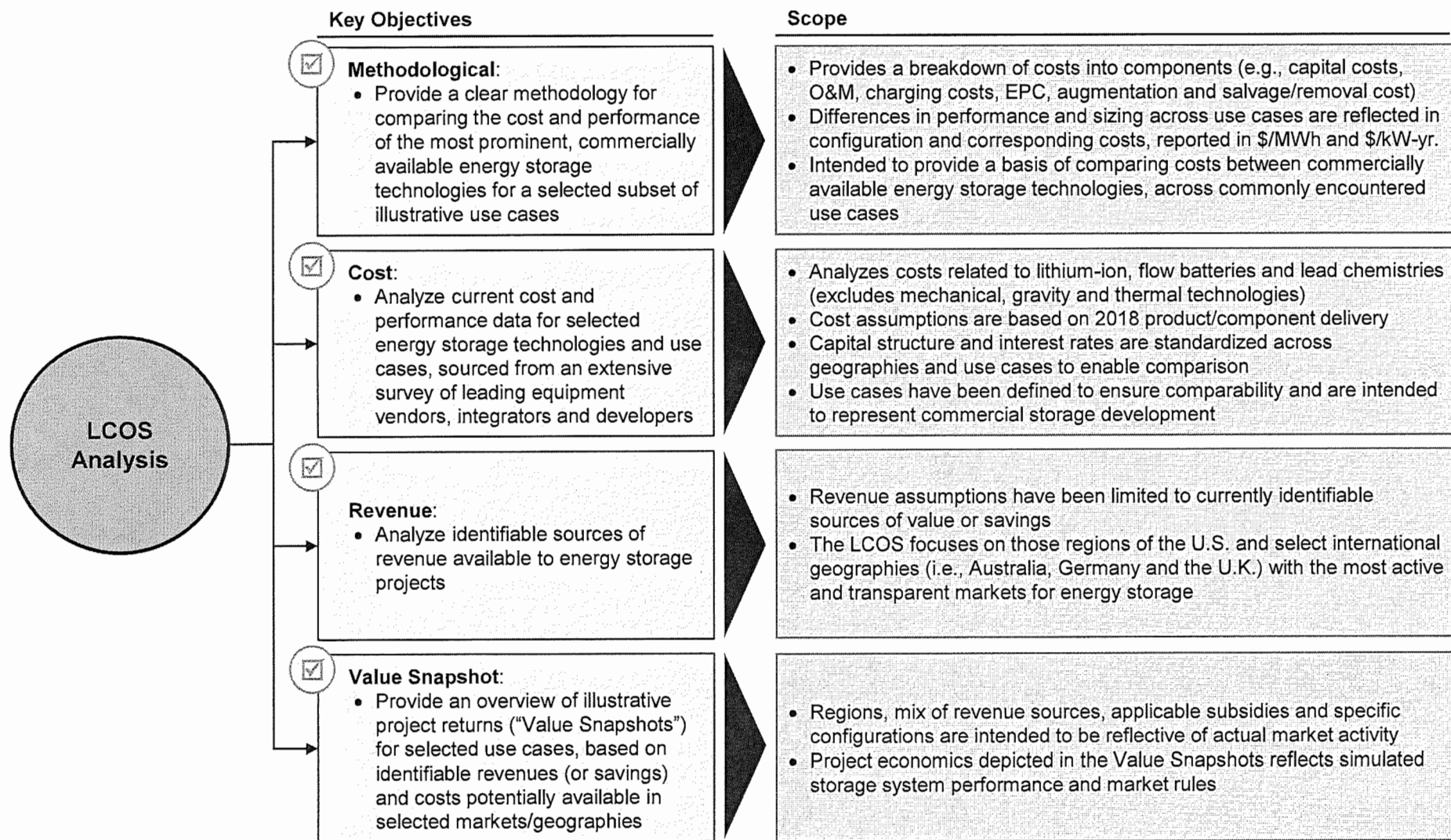
1	Continued Decreasing Cost Trends	<ul style="list-style-type: none"> • LCOS v4.0 has revealed significant cost declines across most use cases and technologies; however, Industry participants noted rising cost pressures for future deliveries of lithium-ion storage systems due to higher commodity pricing and tightening supply <ul style="list-style-type: none"> – Sustained cost declines have exceeded expectations for lithium-ion technologies, while cost declines for flow batteries are less significant but still observable – Future declines in the cost of lithium-ion technologies are expected to be mitigated by rising cobalt and lithium carbonate prices as well as delayed battery availability due to high levels of factory utilization • Consistent with prior versions of the LCOS, shorter duration applications (i.e., 4 hours or less) remain the most cost effective for the commercially prominent energy storage technologies analyzed <ul style="list-style-type: none"> – The underlying costs and performance of commercially available energy storage technologies continue to make them most attractive for applications which improve the grid's ability to respond to momentary or short duration fluctuations in electricity supply and demand (e.g., wholesale services such as frequency regulation and spinning reserves and use cases serving the C&I segment such as demand charge mitigation)
2	Improving Project Economics	<ul style="list-style-type: none"> • Project economics analyzed in the Value Snapshots have revealed a modest improvement year-over-year for the selected use cases, primarily reflecting, among other things, improved costs rather than rising revenues <ul style="list-style-type: none"> – As costs continue to come down, particularly for shorter duration lithium-ion applications, returns have incrementally improved year-over-year; however, in most geographies, project economics depend heavily on subsidized revenues or related incentives – Among the currently identifiable revenue sources available to energy storage systems, ancillary service products (such as frequency regulation, spinning reserves, etc.), demand response and demand charge mitigation represent potentially attractive revenue opportunities in selected geographies
3	Solar PV + Storage Viability	<ul style="list-style-type: none"> • Project economics analyzed for solar PV + storage systems are attractive for commercial use cases but remain challenged for residential and utility-scale projects <ul style="list-style-type: none"> – Combining energy storage with solar PV can create value through shared infrastructure (e.g., inverters, interconnection), reducing the need to curtail production by delaying the dispatch of electricity onto the grid and/or by capturing the value of "clipped" solar production (e.g., solar PV output that is in excess of the system inverter) – Energy storage is increasingly being sold with commercial and residential solar PV systems to provide for potentially increased customer reliability benefits and to enable customers to use solar PV production to avoid demand charges – The Value Snapshot analysis suggests commercial use cases for solar PV plus storage provide moderately attractive returns in the markets assessed (e.g., California and Australia) while residential solar PV plus storage and utility-scale solar PV + storage remain modest for those projects analyzed



III Objectives, Scope and Methodology

Key Objectives and Scope of Lazard's Levelized Cost of Storage Analysis

The intent of our LCOS analysis is to provide an objective, transparent methodology for analyzing the cost effectiveness, identifiable revenue potential and underlying value of various energy storage technologies within a range of applications



Selected Limitations of Lazard's Levelized Cost of Storage Analysis

Our LCOS report analyzes the observed costs and revenue streams associated with the leading energy storage technologies and provides an overview of illustrative project returns; the LCOS is focused on providing a robust, empirically based indication of actual cash costs and revenues associated with leading energy storage technologies

- Our LCOS does not purport to measure the full set of potential benefits associated with energy storage to Industry participants or society, but merely those demonstrable in the form of strictly financial measures of observable costs and revenues

What Our LCOS Analysis Does

- ☑ Defines operational parameters associated with energy storage systems designed for a selected subset of the most prevalent use cases of energy storage
- ☑ Aggregates cost and operational data from original equipment manufacturers and energy storage developers, after validation from additional Industry participants/energy storage users
- ☑ Analyzes, based on the installed cost, what revenue is required over the indicated project life to achieve certain levelized returns for various technologies, designed for a selected subset of identified use cases
- ☑ Provides an “apples-to-apples” comparison among various technologies within a selected subset of identified use cases
- ☑ Aggregates robust survey data to define a range of future/expected capital cost decreases by technology
- ☑ Surveys currently available revenue streams associated with each use case across selected geographies
- ☑ Profiles the economics of typical examples of each use case, located in geographic regions where they are most common, providing a Value Snapshot of the associated financial returns

What Our LCOS Analysis Does Not Do

- ☒ Identify the full range of potentially viable energy storage technologies (e.g., mechanical, gravity and thermal)
- ☒ Identify the full range of use cases available to energy storage systems
- ☒ Provide precise inputs for actual project evaluation or resource planning studies, which would require case-specific system configurations and project/plan-specific procurement and installation costs, among other things
- ☒ Authoritatively establish or predict prices or subsidies for energy storage projects/products
- ☒ Identify and quantify all potential types of benefits provided by energy storage for power grids or consumers
- ☒ Provide a definitive view of project profitability, overall or to specific individuals/entities, for the various use cases across all potential locations and specific circumstances
- ☒ Provide an “apples-to-apples” comparison to conventional or Alternative Energy generation

Levelized Cost of Storage Analysis—Methodology

Our Levelized Cost of Storage analysis consists of creating an energy storage model representing an illustrative project for each relevant technology and solving for the \$/MWh figure that results in a levered IRR equal to the assumed cost of equity (see appendix for detailed assumptions by technology)

		Peaker Lithium—Low Case Sample Calculations						
Year ⁽¹⁾		0	1	2	3	4	5	20
Capacity (MW)	(A)		100	100	100	100	100	100
Total Generation ('000 MWh) ⁽²⁾	(B)*		140	140	140	140	140	140
Levelized Storage Cost (\$/MWh)	(C)		\$203.5	\$203.5	\$203.5	\$203.5	\$203.5	\$203.5
Total Revenues	(B) x (C) = (D)*		\$28.5	\$28.5	\$28.5	\$28.5	\$28.5	\$28.5
Total Charging Cost ⁽³⁾	(E)		(\$5.4)	(\$5.4)	(\$5.4)	(\$5.5)	(\$5.5)	(\$6.0)
Total O&M ⁽⁴⁾	(F)*		(5.7)	(5.8)	(7.3)	(7.3)	(7.3)	(8.0)
Total Operating Costs	(E) + (F) = (G)		(\$11.1)	(\$11.2)	(\$12.7)	(\$12.8)	(\$12.8)	(\$14.0)
EBITDA	(D) - (G) = (H)		\$17.4	\$17.3	\$15.8	\$15.7	\$15.6	\$14.5
Debt Outstanding - Beginning of Period	(I)		\$22.8	\$22.3	\$21.8	\$21.2	\$20.5	\$2.1
Debt - Interest Expense	(J)		(1.8)	(1.8)	(1.7)	(1.7)	(1.6)	(0.2)
Debt - Principal Payment	(K)		(0.5)	(0.5)	(0.6)	(0.6)	(0.7)	(2.1)
Levelized Debt Service	(J) + (K) = (L)		(2.3)	(2.3)	(2.3)	(2.3)	(2.3)	(2.3)
EBITDA	(H)		\$17.4	\$17.3	\$15.8	\$15.7	\$15.6	\$14.5
Depreciation (7-yr MACRS)	(M)		(27.9)	(19.9)	(14.2)	(10.2)	(10.2)	0.0
Interest Expense	(J)		(1.8)	(1.8)	(1.7)	(1.7)	(1.6)	(0.2)
Taxable Income	(H) + (M) + (J) = (N)		(\$12.3)	(\$4.4)	(\$0.2)	\$3.8	\$3.8	\$14.4
Tax Benefit (Liability)	(N) x (Tax Rate) = (O)		\$4.9	\$1.8	\$0.1	(\$1.5)	(\$1.5)	(\$5.7)
After-Tax Net Equity Cash Flow	(H) + (L) + (O) = (P)	(\$91.2)⁽⁷⁾	\$20.0	\$16.8	\$13.5	\$11.8	\$11.8	\$6.5
IRR For Equity Investors			12.0%					

Key Assumptions ⁽⁵⁾	
Power Rating (MW)	100
Duration (Hours)	4
Usable Energy (MWh)	400
100% Depth of Discharge Cycles/Day	1
Operating Days/Year	350
Capital Structure	
Debt	20.0%
Cost of Debt	8.0%
Equity	80.0%
Cost of Equity	12.0%
Taxes	
Combined Tax Rate	40.0%
Contract Term / Project Life (years)	20
MACRS Depreciation Schedule	7 Years
Total Initial Installed Cost (\$/MWh)⁽⁶⁾	
O&M, Warranty & Augmentation Cost (\$/MWh)	\$43
Charging Cost (\$/kWh)	\$0.033
Charging Cost Escalator (%)	0.55%
Efficiency (%)	87%

Source: Lazard and Enovation Partners estimates.

Note: Wholesale Lithium—Low LCOS case presented for illustrative purposes only. Assumptions specific to Wholesale Lithium Low Case.

* Denotes unit conversion.

(1) Assumes half-year convention for discounting purposes.

(2) Total Generation reflects (Cycles) x (Capacity) x (Depth of Discharge) x (1 - Fade). Note for the purpose of this analysis, Lazard accounts for Fade in Augmentation costs (included in O&M).

(3) Charging Cost reflects (Total Generation) / [(Efficiency) x (Charging Cost) x (1 + Charging Cost Escalator)].

(4) O&M costs include general O&M (1.3% of BESS equipment and 1.7% of PCS equipment, yearly at 2.5%), augmentation costs (4.2% of ESS equipment) and warranty costs (1.5% of BESS equipment and 2.0% of PCS equipment, starting in year 3).

(5) Reflects a "key" subset of all assumptions for methodology illustration purposes only. Does not reflect all assumptions.

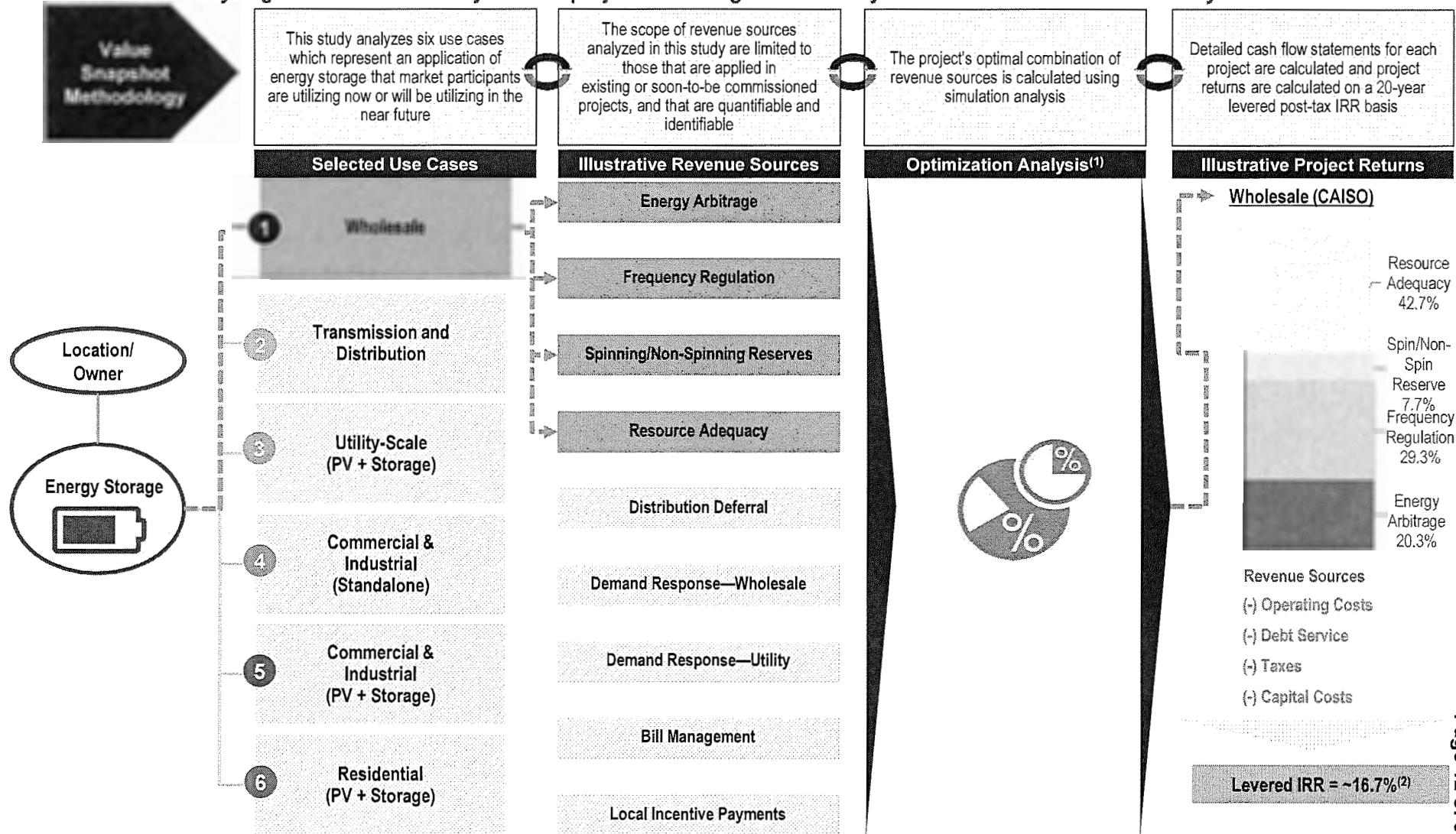
(6) Initial Installed Cost includes Inverter cost of \$49/kW, Module cost of \$205/kWh, Balance of System cost of \$27/kWh and a 16.7% engineering procurement and construction ("EPC") cost.

(7) Reflects initial cash outflow from equity sponsor.

This study has been prepared by Lazard for general informational purposes only, and it is not intended to be, and should not be construed as, financial or other advice. No part of this material may be copied, photocopied or duplicated in any form by any means or redistributed without the prior consent of Lazard.

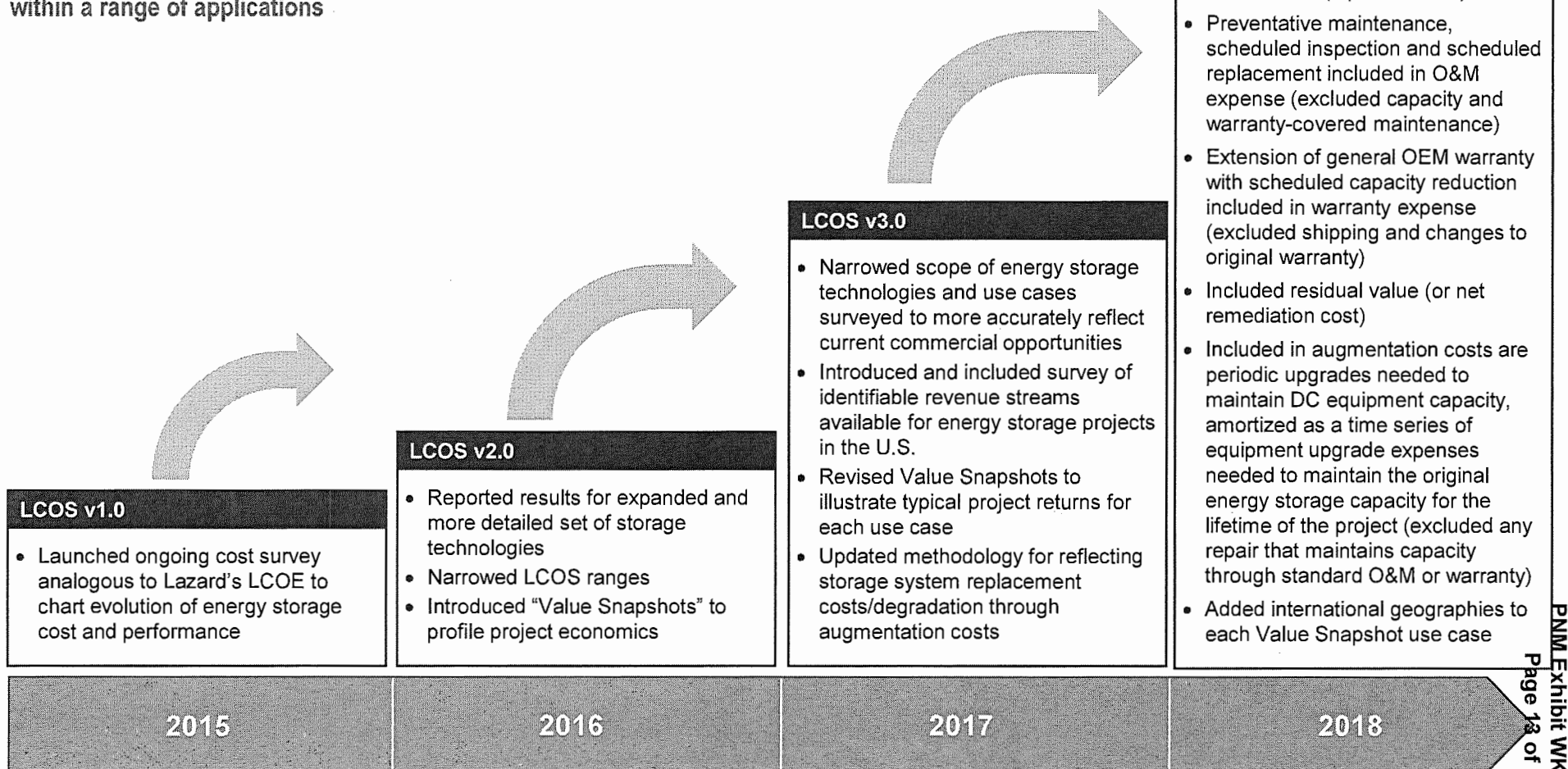
Illustrative Value Snapshots—Methodology


Our Value Snapshot analysis consists of creating a financial model representing an illustrative energy storage project designed for a specific use case and analyzing the financial viability of such project assuming commercially available revenue streams and system costs



Evolution of Lazard's Levelized Cost of Storage Analysis

As the energy storage Industry continues to mature, Lazard continues to make incremental improvements to the LCOS analysis; however, we remain cognizant that changes between versions need to balance the requirement of accurately depicting current commercial practices with a desire to enable year-over-year comparisons of observed costs, identifiable revenue potential and underlying value of various energy storage technologies within a range of applications





IV Lazard's Levelized Cost of Storage Analysis v4.0



A Overview of Selected Use Cases

Energy Storage Use Cases—Overview

Numerous potential applications for energy storage technologies have been identified and piloted; for the purposes of this assessment, we have chosen to focus on a subset of use cases that are the most identifiable and common. Lazard's LCOS examines the cost of energy storage in the context of its specific applications on the grid and behind-the-meter; each use case analyzed herein, and presented below, represents an application of energy storage that market participants are utilizing now or will be utilizing in the near future

		Use Case Description	Technologies Assessed
In-Front-of-the-Meter	1 Wholesale	<ul style="list-style-type: none"> Large-scale energy storage system designed to replace peaking gas turbine facilities; brought online quickly to meet rapidly increasing demand for power at peak; can be quickly taken offline as power demand diminishes 	<ul style="list-style-type: none"> Lithium-Ion Flow Battery-Vanadium Flow Battery-Zinc Bromide
	2 Transmission and Distribution	<ul style="list-style-type: none"> Energy storage system designed to defer transmission and/or distribution upgrades, typically placed at substations or distribution feeder controlled by utilities to provide flexible capacity while also maintaining grid stability 	<ul style="list-style-type: none"> Lithium-Ion Flow Battery-Vanadium Flow Battery-Zinc Bromide
	3 Utility-Scale (PV + Storage)	<ul style="list-style-type: none"> Energy storage system designed to be paired with large solar PV facilities to improve the market price of solar generation, reduce solar curtailment and provide grid support when not supporting solar objectives 	<ul style="list-style-type: none"> Lithium-Ion Flow Battery-Vanadium Flow Battery-Zinc Bromide
Behind-the-Meter	4 Commercial & Industrial (Standalone)	<ul style="list-style-type: none"> Energy storage system designed for behind-the-meter peak shaving and demand charge reduction services for commercial energy users <ul style="list-style-type: none"> Units typically sized to have sufficient power/energy to support multiple commercial energy management strategies and provide the option of the system to provide grid services to a utility or the wholesale market 	<ul style="list-style-type: none"> Lithium-Ion Lead-Acid Advanced Lead (Lead Carbon)
	5 Commercial & Industrial (PV + Storage)	<ul style="list-style-type: none"> Energy storage system designed for behind-the-meter peak shaving and demand charge reduction services for commercial energy users <ul style="list-style-type: none"> Units typically sized to have sufficient power/energy to support multiple commercial energy management strategies and provide the option of the system to provide grid services to a utility or the wholesale market 	<ul style="list-style-type: none"> Lithium-Ion Lead-Acid Advanced Lead (Lead Carbon)
	6 Residential (PV + Storage)	<ul style="list-style-type: none"> Energy storage system designed for behind-the-meter residential home use—provides backup power, power quality improvements and extends usefulness of self-generation (e.g., “solar PV + storage”) <ul style="list-style-type: none"> Regulates the power supply and smooths the quantity of electricity sold back to the grid from distributed PV applications 	<ul style="list-style-type: none"> Lithium-Ion Lead-Acid Advanced Lead (Lead Carbon)

Energy Storage Use Cases—Operational Parameters

For comparison purposes, this study assumes and quantitatively operationalizes six use cases for energy storage; while there may be alternative or combined/"stacked" use cases available to energy storage systems, the six use cases below represent illustrative current and contemplated energy storage applications and are derived from industry survey data

= "Usable Energy" ⁽¹⁾		Project Life (Years)	Storage MW ⁽²⁾	Solar PV MW	MWh of Capacity ⁽³⁾	100% DOD Cycles/ Day ⁽⁴⁾	Days/ Year ⁽⁵⁾	Annual MWh	Project MWh
In-Front-of-the-Meter	1 Wholesale	20	100	--	400	1	350	140,000	2,800,000
	2 Transmission and Distribution	20	10	--	60	1	250	15,000	300,000
	3 Utility-Scale (PV + Storage)	20	20	40	80	1	350	28,000	560,000
Behind-the-Meter	4 Commercial & Industrial (Standalone)	10	1	--	2	1	250	500	5,000
	5 Commercial & Industrial (PV + Storage)	20	0.50	1	2	1	350	700	14,000
	6 Residential (PV + Storage)	20	0.01	0.02	0.04	1	350	14	280

(1)

Usable energy indicates energy stored and able to be dispatched from system.

(2)

Indicates power rating of system (i.e., system size).

(3)

Indicates total battery energy content on a single, 100% charge, or "usable energy." Usable energy divided by power rating (in MW) reflects hourly duration of system.

(4)

"DOD" denotes depth of battery discharge (i.e., the percent of the battery's energy content that is discharged). Depth of discharge of 100% indicates that a fully charged battery discharges all of its energy. For example, a battery that cycles 48 times per day with a 10% depth of discharge would be rated at 4.8 100% DOD Cycles per Day.

(5)

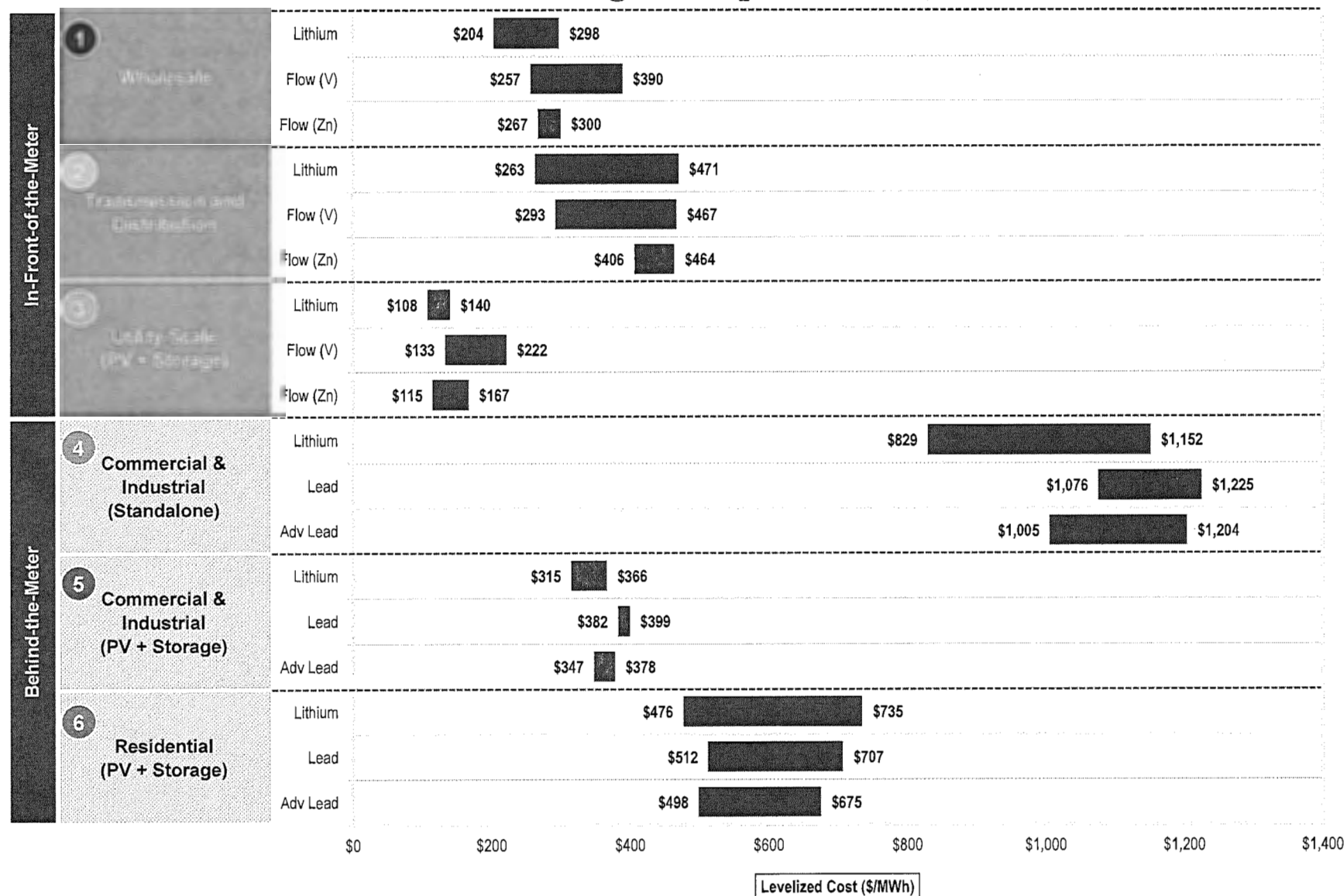
Indicates number of days of system operation per calendar year.

This study has been prepared by Lazard for general informational purposes only, and it is not intended to be, and should not be construed as, financial or other advice. No part of this material may be copied, photocopied or duplicated in any form by any means or redistributed without the prior consent of Lazard.



B Lazard's Levelized Cost of Storage Analysis v4.0

Unsubsidized Levelized Cost of Storage Comparison—\$/MWh

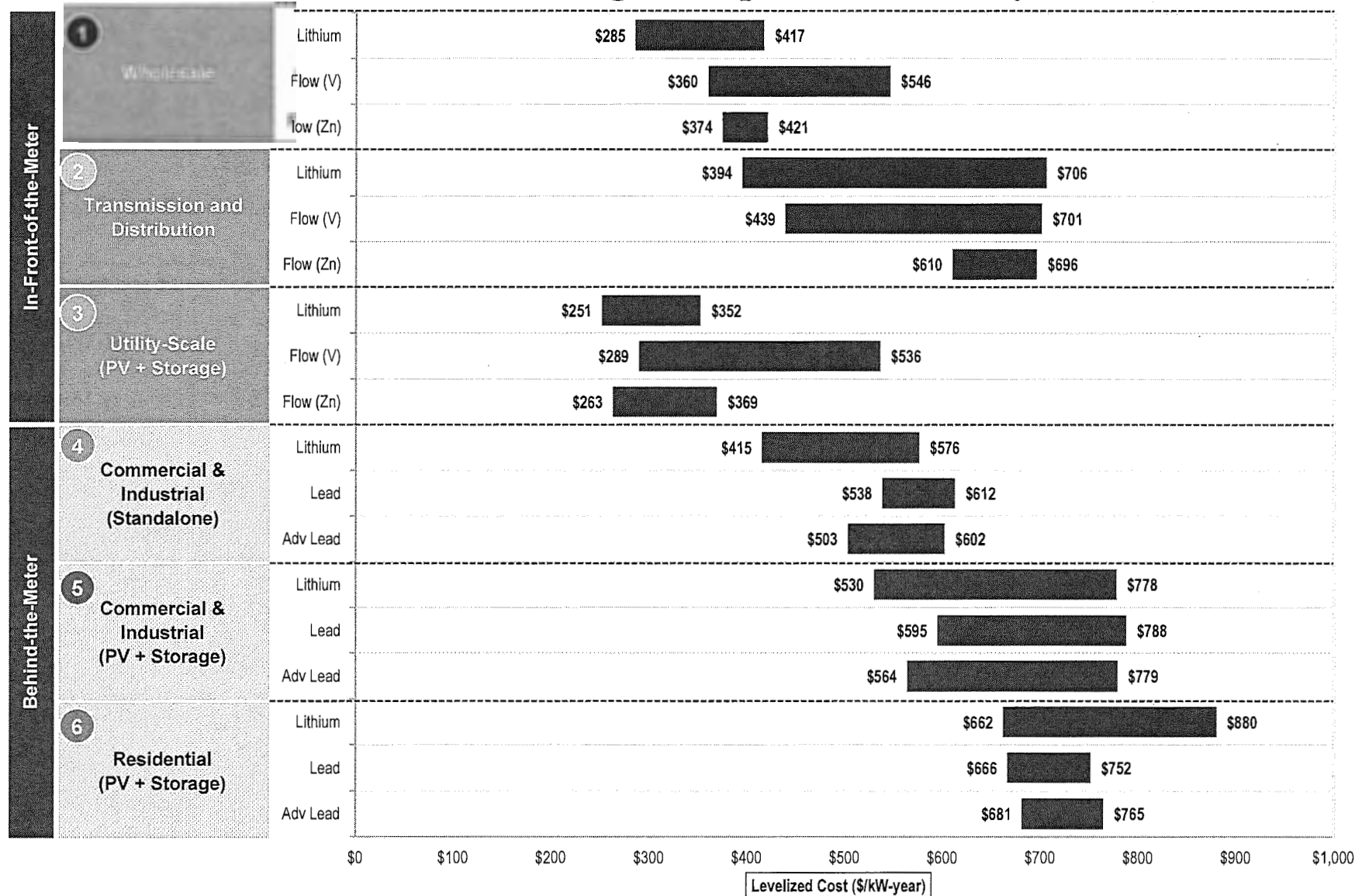


Source: Lazard and Enovation Partners estimates.

Note: Here and throughout this presentation, unless otherwise indicated, analysis assumes 20% debt at an 8% interest rate and 80% equity at a 12% cost of equity. Flow Battery Vanadium and Flow Battery Zinc Bromide denoted in this report as Flow (V) and Flow (Zn), respectively.

This study has been prepared by Lazard for general informational purposes only, and it is not intended to be, and should not be construed as, financial or other advice. No part of this material may be copied, photocopied or duplicated in any form by any means or redistributed without the prior consent of Lazard.

Unsubsidized Levelized Cost of Storage Comparison—\$/kW-year

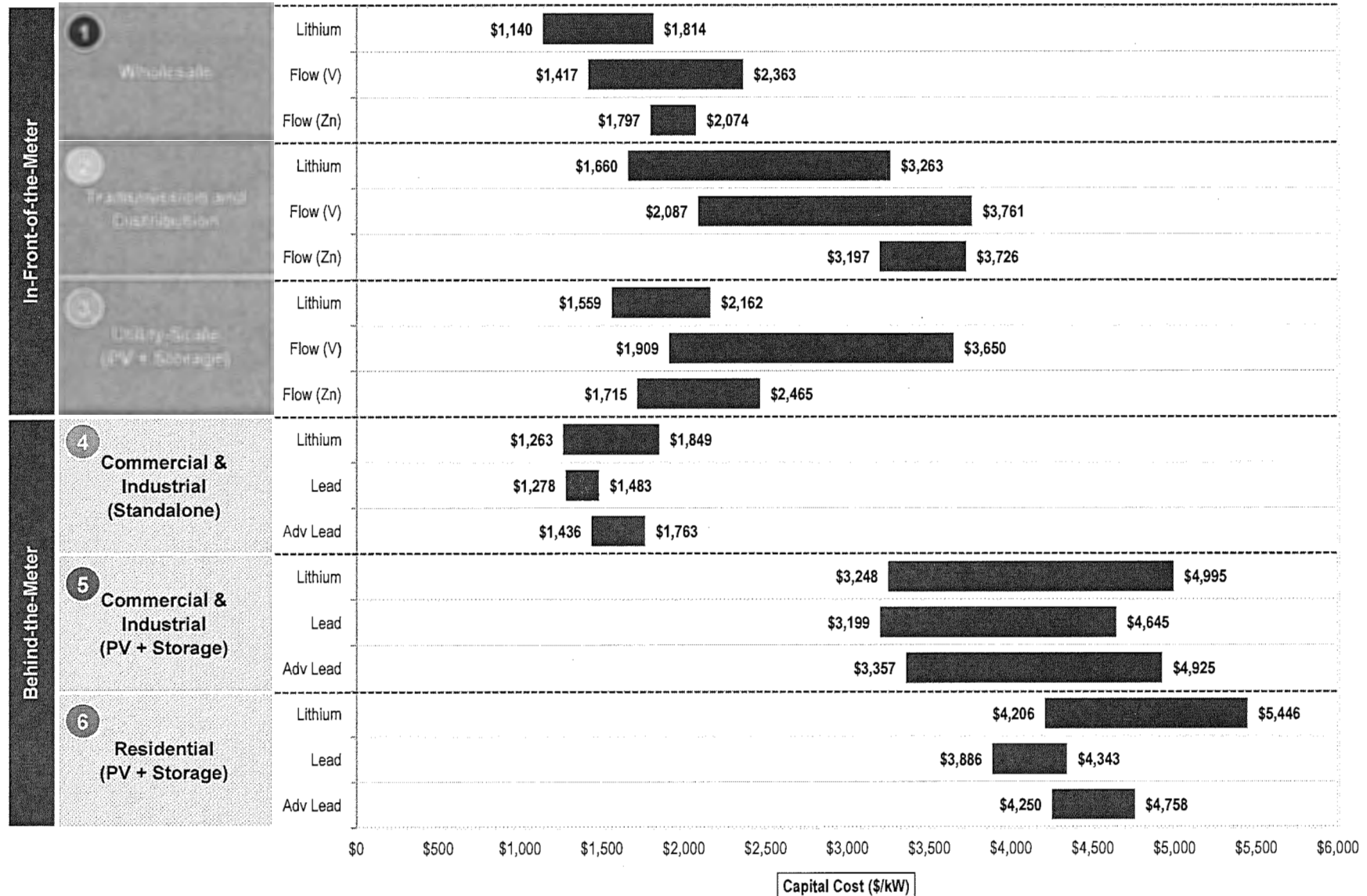


Source: Lazard and Enovation Partners estimates.

Note: Here and throughout this presentation, unless otherwise indicated, analysis assumes 20% debt at an 8% interest rate and 80% equity at a 12% cost of equity. Flow Battery Vanadium and Flow Battery Zinc Bromide denoted in this report as Flow (V) and Flow (Zn), respectively.

This study has been prepared by Lazard for general informational purposes only, and it is not intended to be, and should not be construed as, financial or other advice. No part of this material may be copied, photocopied or duplicated in any form by any means or redistributed without the prior consent of Lazard.

Capital Cost Comparison—\$/kW



Source: Lazard and Enovation Partners estimates.

Note: Capital costs represent costs of equipment only. This excludes augmentation costs that represent the energy storage capacity required to maintain the full usable energy storage capacity (MWh) over the life of the unit. These augmentation costs vary due to different usage profiles and lifespans. Capital cost units are the total investment divided by the greater of solar PV nameplate capacity or low-end battery capacity. This excludes considerations for additional value provided by avoiding curtailment on the solar PV component of the system (where applicable).

This study has been prepared by Lazard for general informational purposes only, and it is not intended to be, and should not be construed as, financial or other advice. No part of this material may be copied, photocopied or duplicated in any form by any means or redistributed without the prior consent of Lazard.

Capital Cost Outlook by Technology

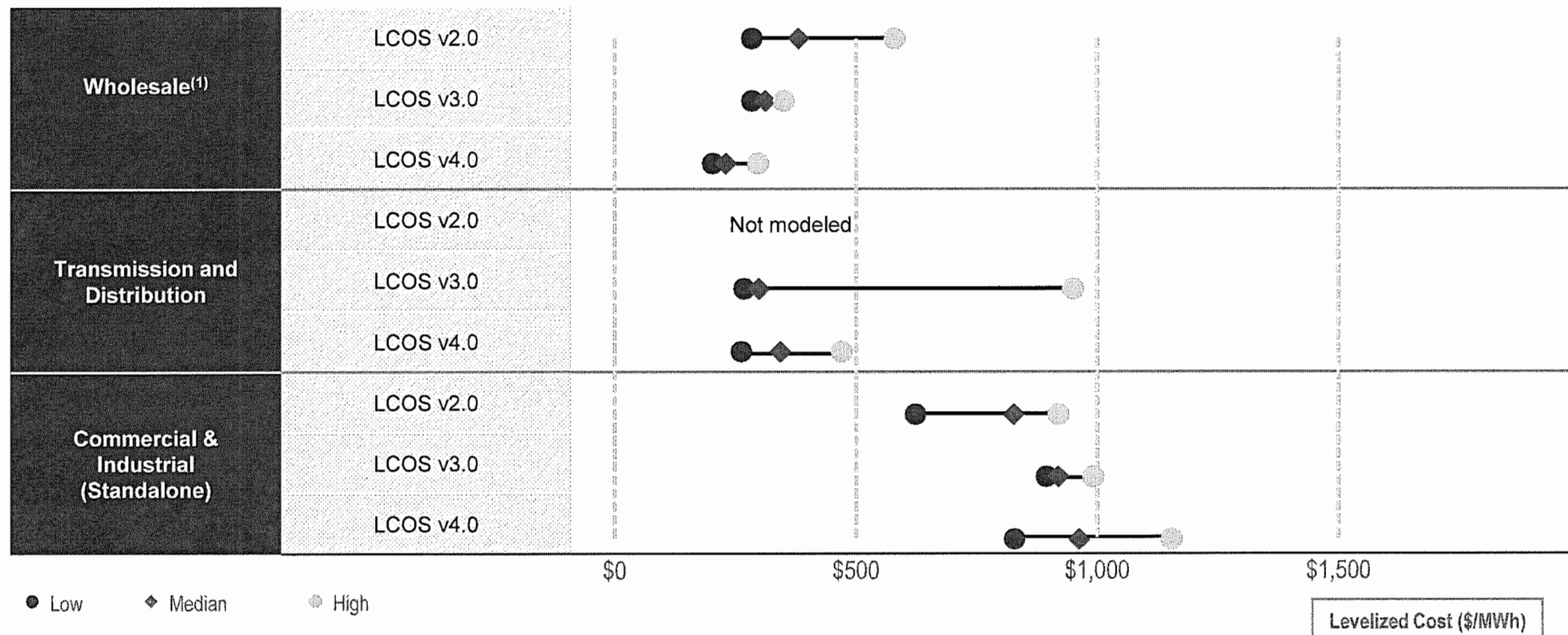
The average capital cost outlook accounts for the relative commercial maturity of different offerings (i.e., more mature offerings influence the cost declines per technology)

	Capital Cost (\$/kWh)		Average	Technology Trends & Opportunities
Lithium-Ion		CAGR	(8%)	<ul style="list-style-type: none"> Increased variation in magnitude of cost declines going forward Battery OEMs reduce proportion of cobalt to mitigate higher raw material Potential volatility from near-term capacity tightness, followed by multiple new production lines and price-based competition from new entrants Slower cost declines in BOS, EPC and PCS costs, which represent increasing share of total system cost
		5-Year	(28%)	
Flow Battery–Vanadium		CAGR	(11%)	<ul style="list-style-type: none"> Cost declines through increased manufacturing scale and energy densities Long-term contracts with vanadium providers to make costs more predictable Focus on providing plug and play (e.g., turnkey) units to keep EPC costs down
		5-Year	(38%)	
Flow Battery–Zinc Bromide		CAGR	(14%)	<ul style="list-style-type: none"> Cost declines through increased manufacturing scale and increased densities (e.g., thicker zinc plating) Reduced cost through more widely available components (e.g., pumps and valves) Expectations of reductions in EPC and PCS costs
		5-Year	(45%)	
Lead		CAGR	(3%)	<ul style="list-style-type: none"> Limited usability and performance translates into high levelized cost Limited cost improvement expected
		5-Year	(13%)	
Advanced Lead		CAGR	(4%)	<ul style="list-style-type: none"> Greater performance than typical lead-acid options Cost reduction and performance improvements expected to continue OEMs looking to use this class to address larger commercial systems not typically served by lead acid
		5-Year	(17%)	

Historical LCOS Declines—Lithium-Ion Technologies

Lithium-ion equipment cost declines contend with system scale, installation and operating realities

- Lithium-ion equipment costs continue to decline based on product design improvements (including continued progress on energy density, cell life, reduced BOS costs, etc.), scale and learning curve improvements
- Industry concerns over rising commodity prices (i.e., lithium and, in particular, cobalt), tariffs and product availability are not fully reflected in LCOS v4.0, primarily because a majority of 2018 deliveries were contracted and priced during the previous two years, which was prior to recent cost pressures
- Generally tighter ranges in LCOS values are observable as the Industry matures, supplemented by a more accurate representation of price differences due to location, bargaining power of buyer, etc.



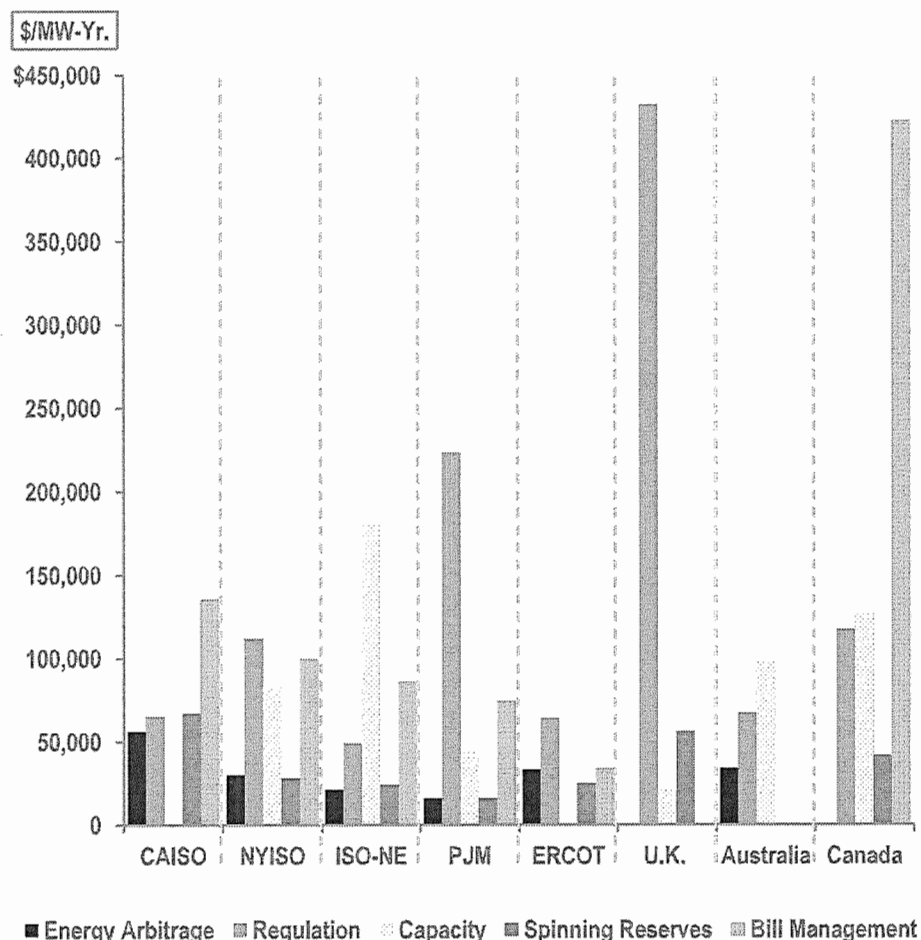


V Landscape of Energy Storage Revenue Potential

Overview of Energy Storage Revenue Streams

As the energy storage market continues to evolve, several forms of potential revenue streams have emerged in select U.S. and other markets; Lazard's LCOS analyzes only those revenue streams that are quantifiable from currently deployed energy storage systems

Energy Storage Revenue Streams by Market & Use Case (2017)



What Determines Available Revenues for Energy Storage?

- Enabling policies:** Include explicit targets and/or state goals incentivizing procurement of energy storage
 - Example—California energy storage procurement targets (e.g., AB2514) requires 1,325 MW by 2020
- Incentives:** Upfront or performance-based incentive payments to subsidize initial capital requirements
 - Example—California Self-Generation Incentive Programs ("SGIP"): \$450 million budget available to behind-the-meter storage
- Market fundamentals:** Endogenous market conditions resulting in higher revenue potential and/or increased opportunity to participate in wholesale markets
 - Example—Daily volatility in energy prices lead to arbitrage opportunities worth ~\$56/kW and \$33/kW in CAISO and ERCOT respectively
 - Example—Constrained conditions resulted in capacity price of \$180/kW in ISO-NE for new resources
- Favorable wholesale/utility program rules:** Accessible revenue sources with operational requirements favoring fast-responding assets
 - Example—PJM regulation: average prices of \$16.78/eff. MW in 2017, with significant revenue upside for performance for storage under RegD signal
 - Example—U.K. utilities required to procure enhanced frequency reserves for fast response assets under 4-year contracts. Short contract term requires asset to be amortized for fewer years, driving prices up
- High Peak and/or Demand Charges:** Opportunities to avoid utility charges through peak load management during specified periods or system peak hours
 - Example—SDG&E demand charge of \$49/kW, one of the highest in the U.S.

Landscape of Energy Storage Revenue Potential

Numerous potential sources of revenue available to energy storage systems reflect system and customer benefits provided by projects

- The scope of revenue sources is limited to those actually applied in existing or soon-to-be commissioned projects. Revenue sources that are not identifiable or without publicly available price data are not analyzed

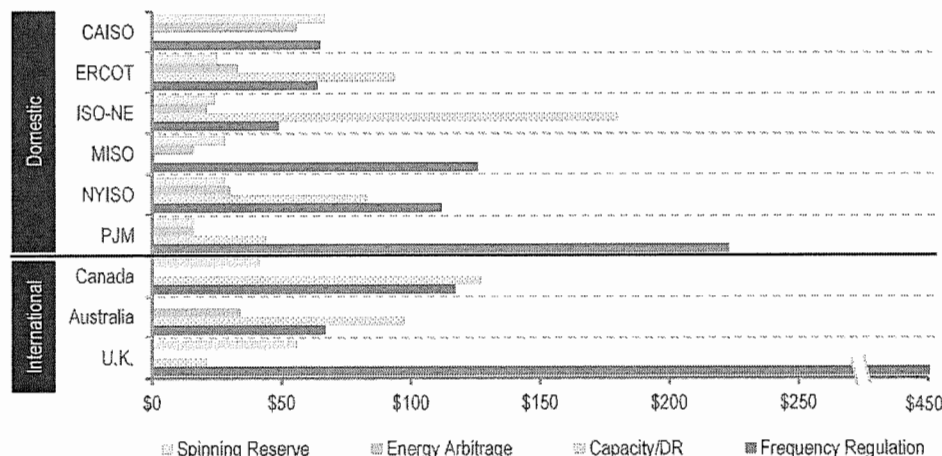
		Description	Use Cases ⁽¹⁾					
			Wholesale	T&D	Utility (PV + S)	Commercial (Standalone)	Commercial (PV + S)	Residential (PV + S)
A	Wholesale	Demand Response–Wholesale				✓	✓	✓
		Energy Arbitrage	✓	✓	✓			
		Frequency Regulation	✓	✓	✓	✓	✓	
		Resource Adequacy	✓	✓	✓	✓	✓	
		Spinning/Non-Spinning Reserves	✓	✓	✓	✓	✓	
B	Utility	Distribution Deferral		✓				
		Transmission Deferral		✓				
		Demand Response–Utility				✓	✓	✓
C	Customer	Bill Management				✓	✓	✓
		Backup Power				✓	✓	✓

Page 26 of 6

Wholesale Market Revenue Streams

Availability and value of wholesale market products to energy storage varies based on ISO rules and project specifications

2017 Wholesale Revenue Streams (\$/kW-year)



Resource Adequacy ("RA") Revenue Streams

- **CAISO: Distributed resources in CAISO can access resource adequacy payments through one of two auction programs run by the IOUs**
 - Local Capacity Resource ("LCR") Auction
 - IOUs acquire RA and DR-like capabilities from bidders in a pay-as-bid 10-year contract auction
 - Focused on providing capacity to constrained zones
 - Demand Response Auction Mechanism ("DRAM") Pilot
 - IOUs acquire RA for 1 – 2 years and Distributed Energy Resources ("DERs") assets are given a type of must-bid responsibility in the wholesale markets
 - Focused on creating new opportunities for DERs to participate in wholesale markets
- Estimate of \$35/kW-year – \$60/kW-year
- **MISO: Energy storage can qualify in MISO as behind-the-meter generation and participate alongside all conventional resources in public Planning Resource Auction ("PRA")**
 - Estimate of \$0.55/kW-year based on the notably poor 2017 auction

Assumptions Employed

Energy Markets	<ul style="list-style-type: none"> • Assumed perfect foresight • Daily charging at the minimum price, discharge at maximum
Frequency Regulation	<ul style="list-style-type: none"> • Assumed participation in day ahead market(s) and fast response, energy neutral and continuous market where available • Assumed either 90% performance factor or ISO-wide average performance if reported • Assumed system average mileage ratio (fast resources where available)
Spinning Reserves	<ul style="list-style-type: none"> • Assumed capable to participate in spinning reserve market • Self scheduled/price taker in the day ahead market
Capacity/ Demand Response	<ul style="list-style-type: none"> • Revenue estimates are based on direct or DR program-enabled participation in the capacity markets (NYISO, PJM, ISO-NE, Canada and U.K.), responsive reserve service (ERCOT), planning resource auction (MISO) and reserve capacity mechanism (Australia)

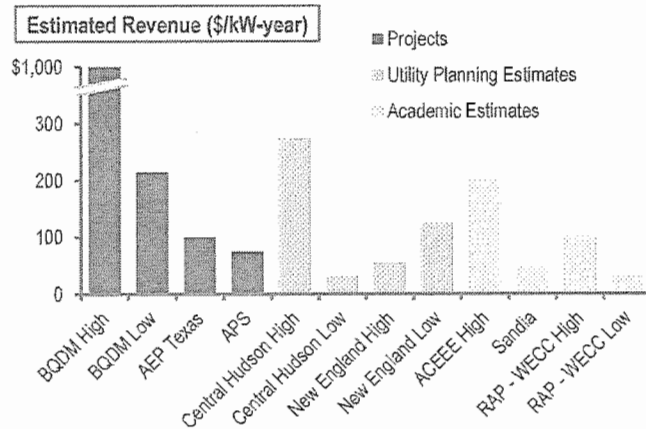
Technical Factors Impacting Value/Availability of Wholesale Revenue

Minimum Size	<ul style="list-style-type: none"> • There is a minimum size to qualify as a generator, under which the asset must qualify through an ISO DR program or by aggregation 	All
Energy Neutrality	<ul style="list-style-type: none"> • Some ISOs provide FR signals that are energy neutral over a set time period and thus allow energy storage assets to perform better 	Frequency Regulation
Performance	<ul style="list-style-type: none"> • The ability to accurately follow the AGC signal and the energy to meet performance standards throughout the course of an hour will have a strong impact on payment from the FR market 	Frequency Regulation
Qualification Method	<ul style="list-style-type: none"> • If an energy storage asset qualifies for the wholesale markets through a DR program, there may be limitations placed on the asset or additional revenues sources available (beyond capacity) 	DR Programs
Congestion Constraints	<ul style="list-style-type: none"> • The Locational Based Marginal Pricing ("LBMP") for an energy storage asset will be different from the system-wide energy price (used here), as will the spread between daily high and daily low price 	Energy Arbitrage

B Utility Revenue Streams

Utilities provide valuable revenue sources in exchange for location-based grid services, with most common applications being in utility DR programs and T&D deferral applications

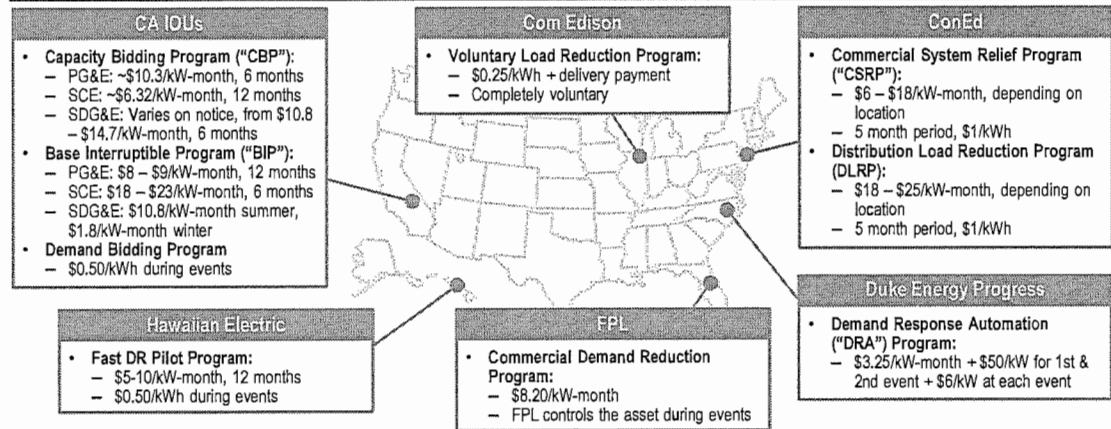
Value of Deferral



Selected Observations

- Jurisdictional and regulatory concerns have limited deployment thus far
- Transacted values do not typically equal price; in most installations value substantially exceeds price
- Assets are typically transacted as a capital purchase by utilities
- Asset value is highly location dependent
- Deferral length varies based on factors independent of the battery
- Projects are rarely transacted in absence of other revenue streams

Utility Funded Demand Response Programs—Selected Examples



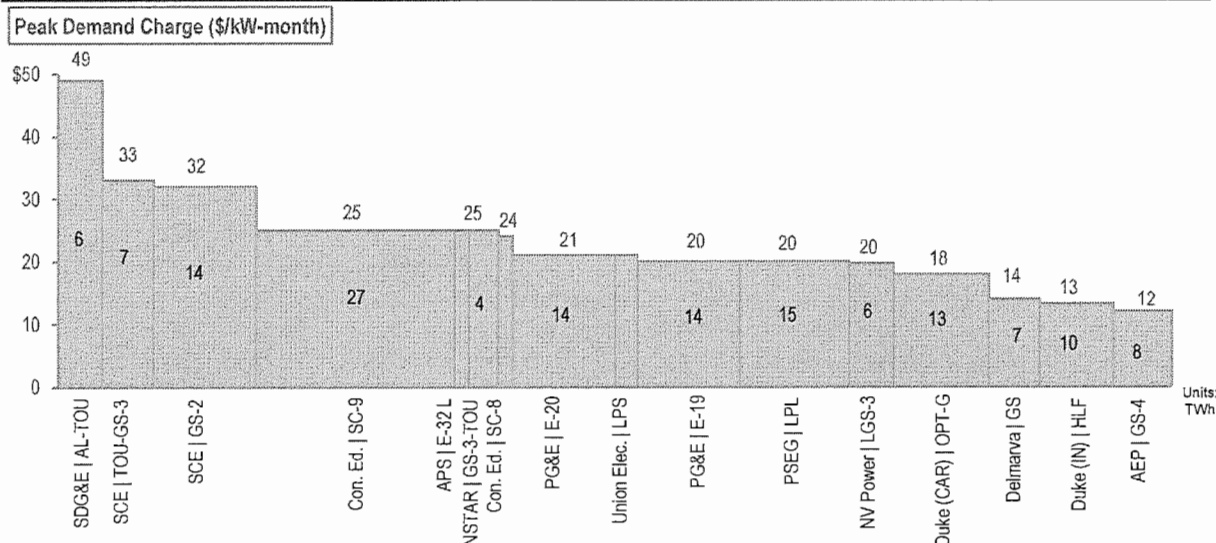
Selected Observations

Capacity Type Programs	<ul style="list-style-type: none"> – Paid a substantial standby payment to be available on a monthly or seasonal basis – Paid a comparatively lower rate per energy reduced when called – Calls are typically mandatory – Tend to have harsher penalties for underperformance
Energy Type Programs	<ul style="list-style-type: none"> – Paid only based on energy reduced – No capacity payment, often DR calls are not mandatory – Penalties are rare and when they do exist, tend to be less severe than in capacity type programs
Common Issues to DR Programs	<ul style="list-style-type: none"> – Length of notice – Payment size and ratio of capacity to energy payments – Frequency of calls – Call trigger (supply economics or emergency situation) – Severity of penalty – Baseline methodology (how the demand reduction is calculated based on prior energy usage)

Customer Revenue Streams

Utility bill management is a key driver of returns for behind-the-meter energy storage projects; project-specific needs for reliability and microgrid integration can be significant, but are rarely monetized

Representative Utility Demand Charges & Reported Volumes (2017)⁽¹⁾⁽²⁾



Utility Demand Charges

United States	<ul style="list-style-type: none"> Demand charges are widely used in the U.S. for C&I customers. (See chart to left for examples)
Australia	<ul style="list-style-type: none"> Demand charges are common in Australia and vary widely by utility and region (surveyed demand charges range from \$6.3 – \$131.5/kW-month)
Other International	<ul style="list-style-type: none"> Demand charges are a not common part of utility bills in most countries

Additional Avoidable Retail Electricity Charges

Type	Example	Description	Charge (2017 \$/kW-yr.) ⁽³⁾
Capacity	PJM GENCAP	Applied to average load usage during PJM's 5 noncoincident peak; referred to as 5CP hours	<ul style="list-style-type: none"> RTO: 59 EMAAC: 80
Transmission	ERCOT 4CP	Applied to average load during system coincidental peaks occurring in June, July, August and September	<ul style="list-style-type: none"> CNP: 8 Oncor: 18 TNMP: 18
Other	Ontario/IESO Global Adjustment	Annual determination of coincident peak demand specifies share of GA costs	<ul style="list-style-type: none"> Class A: 422

Reliability Benefits

- Behind-the-meter reliability
 - Behind-the-meter energy storage installations designed to provide outage protection are challenged by the high overall reliability of the grid
 - Storage units sized to provide other benefits (e.g. demand charge reduction) often are too small to provide long-term reliability
 - Best example of payment for long-term reliability is from Texas, priced at \$8 – \$10/kW-month

Source: FERC Form 1 Filings, PUC of TX, PJM RPM, utility tariffs, OpenEI, Lazard and Enovation Partners estimates.

- (1) Demand charges are fixed, monthly costs typically limited to commercial customers. The rate is typically a function of a customer's peak demand as measured over a predefined period. Energy storage can enable customers to save money through reducing peak consumption, lowering their demand charge.
- (2) Non-exhaustive list based on FERC Form 1 total reported TWh by tariff, sorted by highest total demand charges during peak periods.
- (3) Values based on PJM 17/18 DY Reliability Pricing Model results & Transmission Cost Recovery Factors for customers with >5kVA demand in ERCOT.

This study has been prepared by Lazard for general informational purposes only, and it is not intended to be, and should not be construed as, financial or other advice. No part of this material may be copied, photocopied or duplicated in any form by any means or redistributed without the prior consent of Lazard.



VI Energy Storage Value Snapshot Analysis

Illustrative Value Snapshots—Introduction

In addition to the LCOS methodology, which provides a cost focused “apples-to-apples” comparison between use cases, Lazard has included several illustrative “Value Snapshots” that reflect typical economics associated with merchant behind-the-meter and in-front-of-the-meter storage applications across various geographies in the U.S. and internationally

Configurations	<ul style="list-style-type: none"> Value Snapshot configurations are based on illustrative energy storage applications that have been designed to capture value streams available in a number of ISOs/RTOs and international markets, including: <ul style="list-style-type: none"> Serving RTO markets (i.e., energy arbitrage, frequency regulation, spinning/non-spinning reserves and demand response) Serving utilities (i.e., demand response, transmission deferral and distribution deferral) Serving customers (i.e., bill management and backup power) Behind-the-Meter load profiles are based on a U.S. DOE medium/large-sized commercial building profile and an illustrative residential profile Specific tariff rates reflect medium or large commercial power with peak load floors and caps of 10 kW and 100 kW, respectively; applies demand charges ranging from \$4 – \$53 per peak kW, depending on jurisdiction and customer type Combined/stacked revenue streams are based on optimal combination of available options, given the energy storage system’s performance constraints, applicable contractual rules and assuming perfect foresight with respect to future prices and load Analysis assumes state-level, non-tax-oriented incentive payments (e.g., LCR/SGIP in California) are treated as taxable income for federal income tax purposes⁽¹⁾
Cost Estimates	<ul style="list-style-type: none"> Cost estimates⁽²⁾ are based on the LCOS framework (i.e., assumptions regarding O&M, warranties, etc.) but sized to reflect the system configuration described above System size and performance adjusted to capture multiple value streams and to reflect estimated regional differences in installation costs⁽³⁾ System costs are based on individual component (lithium-ion battery, inverter, etc.) sizing and are based on the needs determined in the analysis Operational performance specifications required to serve various modeled revenue streams, based on lithium-ion systems in the LCOS (cycling life, depth of discharge, etc.)
Results	<ul style="list-style-type: none"> System economic viability is illustrated by a levered IRR⁽⁴⁾

Note: All Value Snapshots assume lithium-ion batteries.

(1) Based on discussions with developers of merchant storage projects in New York and California.

(2) Costs for illustrative Value Snapshots denote actual cost-oriented line items, not “LCOS” costs (i.e., \$/MWh required to satisfy assumed equity cost of capital).

(3) Based on survey data and proprietary Enovation Partners case experience.

(4) This report does not attempt to determine “base” or “typical” IRRs associated with a given market or region. Results and viability are purely illustrative and may differ from actual project results.

This study has been prepared by Lazard for general informational purposes only, and it is not intended to be, and should not be construed as, financial or other advice. No part of this material may be copied, photocopied or duplicated in any form by any means or redistributed without the prior consent of Lazard.

Illustrative Value Snapshots—Overview

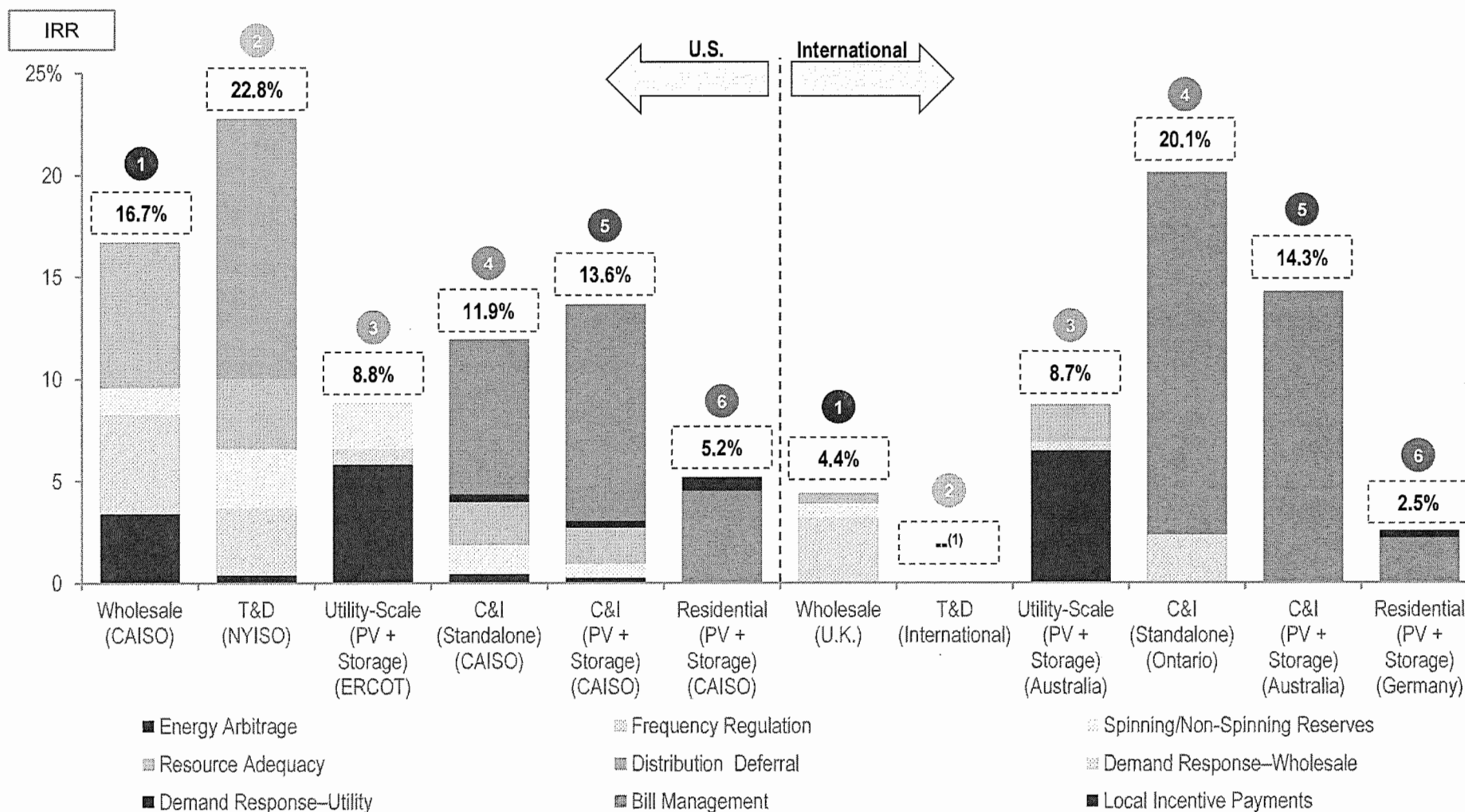
Our Value Snapshots analyze the financial viability of illustrative energy storage systems designed for selected use cases. The geographic locations, assumed installed and operating costs and associated revenue streams reflect current energy storage market activity

- Actual project returns may vary due to differences in location-specific costs, revenue streams and owner/developer risk preferences

Use Case	U.S. Location	International Location	Owner	Revenue Streams
1 Wholesale	CAISO (SP-15)	U.K.	<ul style="list-style-type: none"> • IPP in a competitive wholesale market 	<ul style="list-style-type: none"> • Wholesale market settlement • Local capacity resource programs
2 Transmission and Distribution	NYISO (New York City)	--(1)	<ul style="list-style-type: none"> • Wires utility in a competitive wholesale market. 	<ul style="list-style-type: none"> • Capital recovery in regulated rates, avoided cost to wires utility, avoided cost incentives
3 Utility-Scale (PV + Storage)	ERCOT (West Texas)	Australia	<ul style="list-style-type: none"> • IPP in a competitive wholesale market 	<ul style="list-style-type: none"> • Wholesale market settlement
4 Commercial & Industrial (Standalone)	CAISO (San Francisco)	Ontario	<ul style="list-style-type: none"> • Customer or financier in a competitive wholesale area 	<ul style="list-style-type: none"> • Wholesale market settlement, tariff settlement, DR participation, avoided costs to commercial customer, local capacity resource programs
5 Commercial & Industrial (PV + Storage)	CAISO (San Francisco)	Australia	<ul style="list-style-type: none"> • Customer or financier in a competitive wholesale area 	<ul style="list-style-type: none"> • Wholesale market settlement, tariff settlement, DR participation, avoided costs to commercial customer, local capacity resource programs
6 Residential (PV + Storage)	CAISO (Los Angeles)	Germany	<ul style="list-style-type: none"> • Customer or financier 	<ul style="list-style-type: none"> • DR participation, tariff settlement, avoided costs to residential customer and incentives

Illustrative Value Snapshots—Summary Results

Project economics analyzed in the Value Snapshots have revealed a modest improvement year-over-year for the selected use cases, primarily reflecting, among other things, improved costs rather than rising revenues



Illustrative U.S. Value Snapshots—Detailed Results



Revenue Sources

Energy Arbitrage	20.3%	1.6%	65.6%	3.5%	1.7%	--
Frequency Regulation	29.3%	14.3%	8.7%	--	--	--
Spinning/Non-Spinning Reserves	7.7%	12.8%	25.7%	11.8%	5.0%	--
Resource Adequacy	42.7%	15.3%	--	17.7%	13.0%	--
Distribution Deferral	--	55.9%	--	--	--	--
Demand Response—Wholesale	--	--	--	--	--	--
Demand Response—Utility	--	--	--	3.2%	2.4%	--
Bill Management	--	--	--	63.7%	77.9%	86.8%
Local Incentive Payments	--	--	--	--	--	13.2%

Energy Storage Configuration

Battery Size (MWh)	400	60	80	2	2	0.04
Inverter Size (MW)	100	10	20	1	0.5	0.01
C-Rating	C/4	C/6	C/4	C/2	C/4	C/4
IRR	16.7%	22.8%	8.8%	11.9%	13.6%	5.2%

Source: Lazard and Enovation Partners estimates.

Note: Percentages represent allocation of battery's useful life dedicated to each revenue stream.

Illustrative International Value Snapshots—Detailed Results

	1	2	3	4	5	6
	Wholesale	Transmission and Distribution	Utility-Scale (PV + Storage)	Commercial & Industrial (Stand-alone)	Commercial & Industrial (PV + Storage)	Residential (PV + Storage)
Region	U.K.	—	Australia	Ontario	Australia	Germany
Revenue Sources						
Energy Arbitrage	--	--	73.8%	--	--	--
Frequency Regulation	71.3%	--	5.2%	--	--	--
Spinning/Non-Spinning Reserves	16.9%	--	--	--	--	--
Resource Adequacy	11.8%	--	21.0%	--	--	--
Distribution Deferral	--	--	--	--	--	--
Demand Response—Wholesale	--	--	--	11.5%	--	--
Demand Response—Utility	--	--	--	--	--	--
Bill Management	--	--	--	88.5%	100.0%	85.2%
Local Incentive Payments	--	--	--	--	--	14.8%
Energy Storage Configuration						
Battery Size (MWh)	400	--	80	2	2	0.04
Inverter Size (MW)	100	--	20	1	0.5	0.01
C-Rating	C/4	--	C/4	C/2	C/4	C/4
IRR	4.4%	--	8.7%	20.1%	14.3%	2.5%

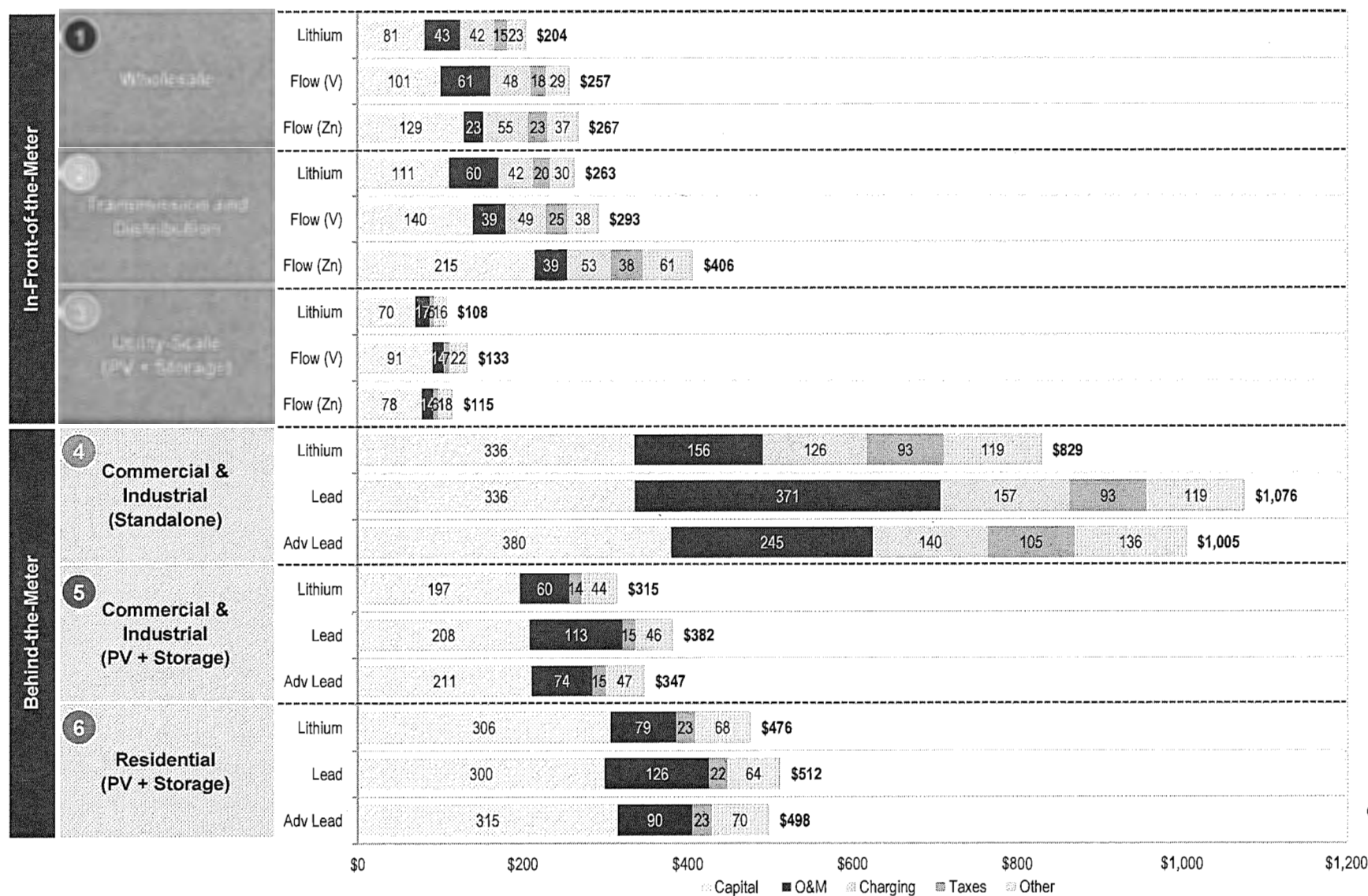
Appendix





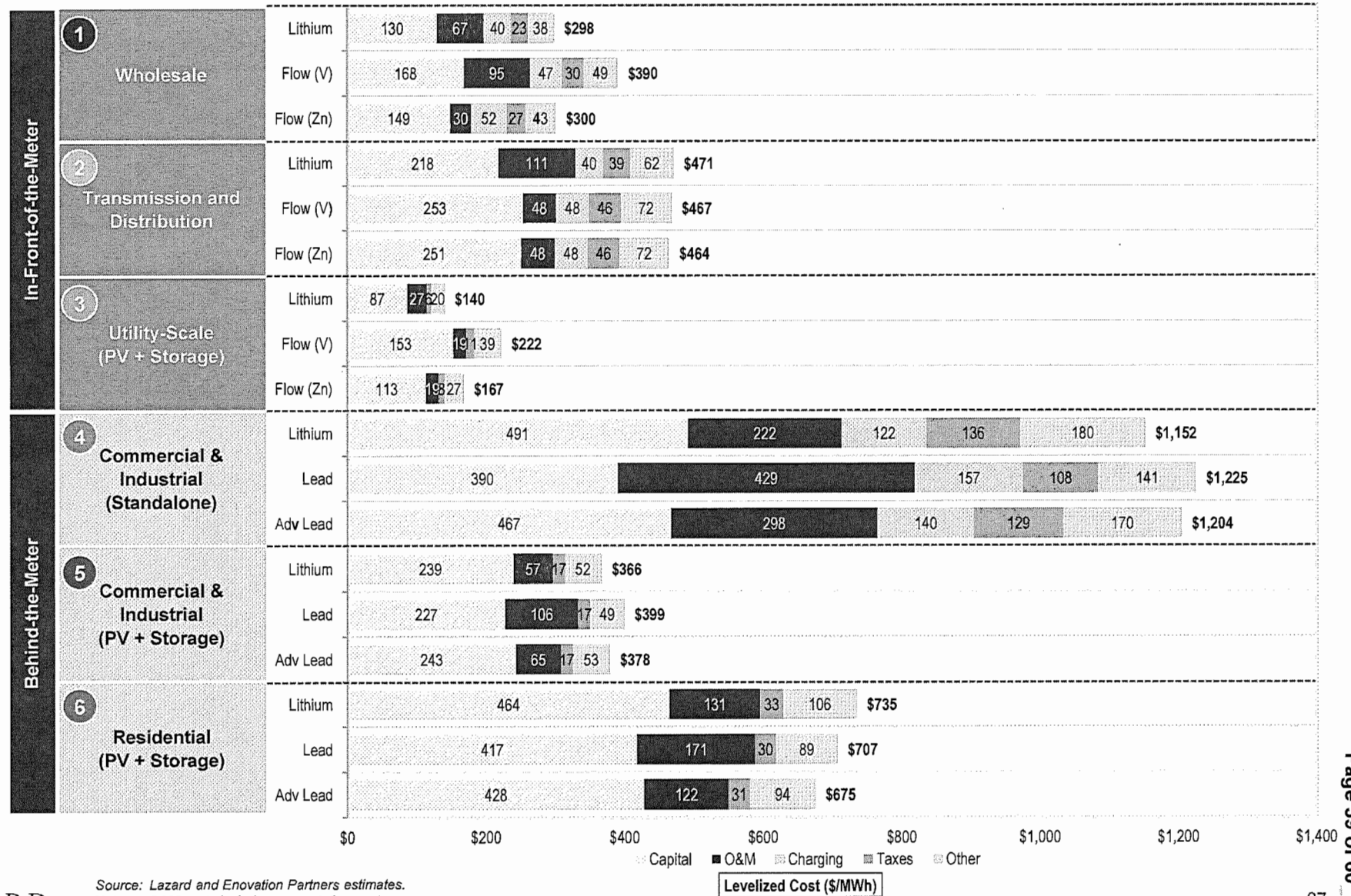
A Supplementary LCOS Analysis Materials

Levelized Cost of Storage Components—Low



Source: Lazard and Enovation Partners estimates.
 Note: O&M costs include augmentation costs.

Levelized Cost of Storage Components—High



Levelized Cost of Storage—Key Assumptions

		Wholesale			Transmission & Distribution			Utility-Scale (PV + Storage)		
	Units	Lithium	Flow Battery-Vanadium	Flow Battery-Zinc Bromide	Lithium	Flow Battery-Vanadium	Flow Battery-Zinc Bromide	Lithium	Flow Battery-Vanadium	Flow Battery-Zinc Bromide
Power Rating	MW	100 – 100	100 – 100	100 – 100	10 – 10	10 – 10	10 – 10	20 – 20	20 – 20	20 – 20
Duration	Hours	4 – 4	4 – 4	4 – 4	6 – 6	6 – 6	6 – 6	4 – 4	4 – 4	4 – 4
Usable Energy	MWh	400 – 400	400 – 400	400 – 400	60 – 60	60 – 60	60 – 60	80 – 80	80 – 80	80 – 80
100% Depth of Discharge Cycles/Day		1 – 1	1 – 1	1 – 1	1 – 1	1 – 1	1 – 1	1 – 1	1 – 1	1 – 1
Operating Days/Year		350 – 350	350 – 350	350 – 350	250 – 250	250 – 250	250 – 250	350 – 350	350 – 350	350 – 350
Solar PV Capacity	MW	0.00 – 0.00	0.00 – 0.00	0.00 – 0.00	0.00 – 0.00	0.00 – 0.00	0.00 – 0.00	40.00 – 40.00	40.00 – 40.00	40.00 – 40.00
Annual Solar PV Generation	MWh	0 – 0	0 – 0	0 – 0	0 – 0	0 – 0	0 – 0	119,136 – 80,592	119,136 – 80,592	119,136 – 80,592
Project Life	Years	20 – 20	20 – 20	20 – 20	20 – 20	20 – 20	20 – 20	20 – 20	20 – 20	20 – 20
Memo: Annual Used Energy	MWh	140,000 – 140,000	140,000 – 140,000	140,000 – 140,000	15,000 – 15,000	15,000 – 15,000	15,000 – 15,000	28,000 – 28,000	28,000 – 28,000	28,000 – 28,000
Memo: Project Used Energy	MWh	2,800,000 – 2,800,000	2,800,000 – 2,800,000	2,800,000 – 2,800,000	300,000 – 300,000	300,000 – 300,000	300,000 – 300,000	560,000 – 560,000	560,000 – 560,000	560,000 – 560,000
Initial Capital Cost—DC	\$/kWh	\$232 – \$368	\$314 – \$550	\$409 – \$478	\$190 – \$442	\$271 – \$550	\$456 – \$544	\$293 – \$265	\$550 – \$819	\$381 – \$456
Initial Capital Cost—AC	\$/kW	\$49 – \$81	\$0 – \$0	\$0 – \$0	\$60 – \$151	\$0 – \$0	\$0 – \$0	\$79 – \$33	\$0 – \$0	\$0 – \$0
EPC Costs	\$	\$16 – \$16	\$16 – \$16	\$16 – \$16	\$5 – \$5	\$5 – \$5	\$5 – \$5	\$5 – \$5	\$5 – \$5	\$5 – \$5
Solar PV Capital Cost	\$/kW	\$0 – \$0	\$0 – \$0	\$0 – \$0	\$0 – \$0	\$0 – \$0	\$0 – \$0	\$1,250 – \$950	\$1,250 – \$950	\$1,250 – \$950
Total Initial Installed Cost	\$	\$114 – \$181	\$142 – \$236	\$180 – \$207	\$17 – \$33	\$21 – \$38	\$32 – \$37	\$80 – \$85	\$99 – \$109	\$86 – \$80
O&M % of BESS	%	1.28% – 0.76%	1.01% – 0.58%	0.78% – 0.67%	2.28% – 0.98%	1.72% – 0.85%	1.02% – 0.86%	2.00% – 2.31%	1.16% – 0.78%	1.67% – 1.40%
O&M % of PCS	%	1.71% – 1.01%	1.35% – 0.77%	1.04% – 0.88%	3.05% – 1.31%	2.28% – 1.13%	1.38% – 1.14%	2.86% – 3.08%	1.54% – 1.04%	2.23% – 1.86%
Extended Warranty Start	Year	3 – 3	3 – 3	3 – 3	3 – 3	3 – 3	3 – 3	3 – 3	3 – 3	3 – 3
Warranty Expense % of BESS	%	1.50% – 1.50%	1.50% – 1.50%	1.50% – 1.50%	1.50% – 1.50%	1.50% – 1.50%	1.50% – 1.50%	1.50% – 1.50%	1.50% – 1.50%	1.50% – 1.50%
Warranty Expense % of PCS	%	2.00% – 2.00%	2.00% – 2.00%	2.00% – 2.00%	2.00% – 2.00%	2.00% – 2.00%	2.00% – 2.00%	2.00% – 2.00%	2.00% – 2.00%	2.00% – 2.00%
Investment Tax Credit	%	0.0% – 0.0%	0.0% – 0.0%	0.0% – 0.0%	0.0% – 0.0%	0.0% – 0.0%	0.0% – 0.0%	0.0% – 0.0%	0.0% – 0.0%	0.0% – 0.0%
Production Tax Credit	\$/MWh	\$0 – \$0	\$0 – \$0	\$0 – \$0	\$0 – \$0	\$0 – \$0	\$0 – \$0	\$0 – \$0	\$0 – \$0	\$0 – \$0
Charging Cost	\$/MWh	\$33 – \$33	\$33 – \$33	\$33 – \$33	\$33 – \$33	\$33 – \$33	\$33 – \$33	\$0 – \$0	\$0 – \$0	\$0 – \$0
Charging Cost Escalator	%	0.55% – 0.55%	0.55% – 0.55%	0.55% – 0.55%	0.55% – 0.55%	0.55% – 0.55%	0.55% – 0.55%	0.00% – 0.00%	0.00% – 0.00%	0.00% – 0.00%
Efficiency of Storage Technology	%	87% – 90%	74% – 77%	67% – 70%	86% – 90%	74% – 77%	69% – 75%	90% – 84%	72% – 72%	76% – 69%
Levelized Cost of Storage	\$/MWh	\$204 – \$298	\$257 – \$360	\$267 – \$300	\$263 – \$471	\$283 – \$467	\$406 – \$464	\$108 – \$140	\$133 – \$222	\$115 – \$167

Source: Lazard and Enovation Partners estimates.

Note: Assumed capital structure of 80% equity (with a 12% cost of equity) and 20% debt (with an 8% cost of debt). Capital cost units are the total investment divided by the storage equipment's energy capacity (kWh rating) and inverter rating (kW rating). Wholesale and Transmission & Distribution charging costs use the EIA's "2017 Wholesale price \$/MWh - Wtd Avg Low" price estimate of \$33.48/MWh. Escalation is derived from the EIA's "AEO 2018 Energy Source—Electric Price Forecast (10-year CAGR)" and is 0.55%. Systems with PV do not charge from the grid.

Levelized Cost of Storage—Key Assumptions (cont'd)

		Commercial & Industrial (Standalone)			Commercial & Industrial (PV + Storage)			Residential (PV + Storage)		
Units		Lithium		Lead	Advanced Lead		Lithium	Lead	Advanced Lead	
Power Rating	MW	1	–	1	1	–	1	0.5	–	0.5
Duration	Hours	2	–	2	2	–	2	4	–	4
Usable Energy	MWh	2	–	2	2	–	2	2	–	2
100% Depth of Discharge Cycles/Day		1	–	1	1	–	1	1	–	1
Operating Days/Year		250	–	250	250	–	250	350	–	350
Solar PV Capacity	MW	0.00	–	0.00	0.00	–	0.00	1.00	–	1.00
Annual Solar PV Generation	MWh	0	–	0	0	–	0	1,752	–	2,190
Project Life	Years	10	–	10	10	–	10	20	–	20
Memo: Annual Used Energy	MWh	500	–	500	500	–	500	700	–	700
Memo: Project Used Energy	MWh	5,000	–	5,000	5,000	–	5,000	14,000	–	14,000
Initial Capital Cost—DC	\$/MWh	\$335	–	\$580	\$343	–	\$387	\$422	–	\$537
Initial Capital Cost—AC	\$/kW	\$158	–	\$254	\$158	–	\$254	\$191	–	\$292
EPC Costs	\$	\$0	–	\$0	\$0	–	\$0	\$0	–	\$0
Solar PV Capital Cost	\$/kW	\$0	–	\$0	\$0	–	\$0	\$1,900	–	\$3,270
Total Initial Installed Cost	\$	\$1	–	\$2	\$1	–	\$1	\$3	–	\$5
O&M % of BESS	%	3.98%	–	2.34%	3.91%	–	3.08%	3.32%	–	2.46%
O&M % of PCS	%	5.30%	–	3.11%	5.21%	–	4.12%	4.43%	–	3.30%
Extended Warranty Start	Year	3	–	3	3	–	3	3	–	3
Warranty Expense % of BESS	%	1.50%	–	1.50%	1.50%	–	1.50%	1.50%	–	1.50%
Warranty Expense % of PCS	%	2.00%	–	2.00%	2.00%	–	2.00%	2.00%	–	2.00%
Investment Tax Credit	%	0.0%	–	0.0%	0.0%	–	0.0%	0.0%	–	0.0%
Production Tax Credit	\$/MWh	\$0	–	\$0	\$0	–	\$0	\$0	–	\$0
Charging Cost	\$/MWh	\$107	–	\$107	\$107	–	\$107	\$0	–	\$0
Charging Cost Escalator	%	0.50%	–	0.50%	0.50%	–	0.50%	0.00%	–	0.00%
Efficiency of Storage Technology	%	91%	–	94%	72%	–	72%	82%	–	82%
Levelized Cost of Storage	\$/MWh	\$829	–	\$1,152	\$1,076	–	\$1,225	\$1,005	–	\$1,204

Source: Lazard and Enovation Partners estimates.

Note: Assumed capital structure of 80% equity (with a 12% cost of equity) and 20% debt (with an 8% cost of debt). Capital cost units are the total investment divided by the storage equipment's energy capacity (kWh rating) and inverter rating (kW rating). C&I charging costs use the EIA's "EIA Average Commercial Retail Price 2017" price estimate of \$106.80/MWh. Escalation is derived from the EIA's "AEO 2018 Commercial Electric Price Forecast (10-year CAGR)" and is 0.50%. Systems with PV do not charge from the grid.

This study has been prepared by Lazard for general informational purposes only, and it is not intended to be, and should not be construed as, financial or other advice. No part of this material may be copied, photocopied or duplicated in any form by any means or redistributed without the prior consent of Lazard.



B Supplementary Value Snapshot Materials

Illustrative U.S. Value Snapshots—Assumptions

	Revenue Source	Description	Modeled Price	Annual Rev. (\$/kW-year)	Cost Assumptions
1	Wholesale	<ul style="list-style-type: none"> Energy prices based on 2017 CAISO SP-15 real-time Annual escalation of 1.8% 	Hourly LMP	\$56.28	
	Frequency Regulation	<ul style="list-style-type: none"> Includes Reg-Up and Reg-Down products; participation based on hourly price and battery state of charge 	Reg Up: \$9.71/MWh Reg Down: \$5.49/MWh	\$80.76	<ul style="list-style-type: none"> AC system: \$16/kWh DC system: \$283/kWh EPC: 14% Efficiency: 87% Augmentation Costs: 4.2% of ESS
	Resource Adequacy	<ul style="list-style-type: none"> Assumes participation in SCE Local Capacity Resource programs Reliability (\$/kW-month) payment amounts vary by contract and are not publicly available Estimates assume a modified Net CONE methodology based on assumed technology costs and other available revenue sources 	\$11.87/kW-month	\$142.50	
2	Transmission and Distribution	<ul style="list-style-type: none"> Includes combined regulation product; participation based on hourly price and battery state of charge 	\$5.19/MWh	\$66.74	<ul style="list-style-type: none"> AC system: \$19/kWh DC system: \$284/kWh EPC: 25% Efficiency: 87% Augmentation Costs: 4.1% of ESS
	Capacity	<ul style="list-style-type: none"> NYC Zone J ICAP annual estimates 	Summer: \$8.5/kW-month Winter: \$3.5/kW-month	\$71.25	
	Brooklyn-Queens Demand Management (BQDM)	<ul style="list-style-type: none"> Program based on deferred \$1.2 billion substation upgrade, driven by contracts for demand reductions and distributed resource investments Estimates based on program expense and capacity 10 year contract modeled 	\$4,545.45/kW ⁽¹⁾	\$431.82	
3	Utility-Scale (PV + Storage)	<ul style="list-style-type: none"> Energy prices based on 2017 ERCOT (West) real-time Annual escalation of 2.0% 	Hourly LMP	PV: \$75.89 Storage: \$73.87	<ul style="list-style-type: none"> AC system: \$26/kWh DC system: \$296/kWh EPC: 20% Efficiency: 87% Augmentation Costs: 4.3% of ESS
	Frequency Regulation	<ul style="list-style-type: none"> Includes Reg-Up and Reg-Down products; participation based on hourly price and battery state of charge 	Reg Up: \$7.65/MWh Reg Down: \$6.10/MWh	\$29.92	
	Spinning Reserve	<ul style="list-style-type: none"> ERCOT responsive reserve product; participation based on hourly price and battery state of charge 	\$9.58/MWh	\$95.69	

Source: ISO/RTO markets, DOE, Lazard and Enovation Partners estimates.

Note: Capital cost units are the total investment divided by the storage equipment's energy capacity (kWh rating) and inverter rating (kW rating).
(1) Represents lifetime costs.

This study has been prepared by Lazard for general informational purposes only, and it is not intended to be, and should not be construed as, financial or other advice. No part of this material may be copied, photocopied or duplicated in any form by any means or redistributed without the prior consent of Lazard.

Illustrative U.S. Value Snapshots—Assumptions (cont'd)

	Revenue Source	Description	Modeled Price	Annual Rev. (\$/kW-year)	Cost Assumptions
4	Commercial & Industrial (Standalone)	<ul style="list-style-type: none"> IOUs acquire RA from bidders in a pay-as-bid contract auction Focused on providing capacity to constrained zones Discounted because of duration of battery 	\$75kW-year	\$71.25	<ul style="list-style-type: none"> AC system: \$108/kWh DC system: \$437/kWh EPC: 40% Efficiency: 91% Augmentation Costs: 5.0% of ESS
		<ul style="list-style-type: none"> Year-round, event-based program; credited for 50% – 200% of event performance; no underperformance penalties 	\$0.5/kWh	\$13.00	
		<ul style="list-style-type: none"> Reduction of demand and energy charges through time shifting Modeled PG&E E-19 TOU rate Annual escalation of 2.5% 	PG&E E-19 TOU Tariff	\$219.32	
5	Commercial & Industrial (PV + Storage)	<ul style="list-style-type: none"> IOUs acquire RA from bidders in a pay-as-bid contract auction Focused on providing capacity to constrained zones 	\$150kW-year	\$142.50	<ul style="list-style-type: none"> AC system: \$64/kWh DC system: \$510/kWh EPC: 38% Efficiency: 91% Augmentation Costs: 4.9% of ESS
		<ul style="list-style-type: none"> Year-round, event-based program; credited for 50% – 200% of event performance; no underperformance penalties 	\$0.5/kWh	\$26.00	
		<ul style="list-style-type: none"> Reduction of demand and energy charges through time shifting Modeled PG&E E-19 TOU rate Annual escalation of 2.5% 	PG&E E-19 TOU Tariff	\$363.40*	
6	Residential (PV + Storage)	<ul style="list-style-type: none"> Provides incentives to support DER projects via performance-based rebates for qualifying distributed energy systems System under 30 kW receives entire incentive upfront 	\$0.35/Wh	\$997.50	<ul style="list-style-type: none"> AC system: \$49/kWh DC system: \$743/kWh EPC: 10% Efficiency: 88% Augmentation Costs: 4.9% of ESS
		<ul style="list-style-type: none"> Reduction of energy charges through time shifting Modeled SCE TOU-D (Option 4-9 PM) rate Annual escalation of 2.5% 	SCE TOU-D (Option 4-9 PM) Tariff	\$355.65*	

Source: ISO/RTO markets, DOE, Lazard and Enovation Partners estimates.

Note: Capital cost units are the total investment divided by the storage equipment's energy capacity (kWh rating) and inverter rating (kW rating).

* Calculated based on size of the solar system.

Illustrative International Value Snapshots—Assumptions

	Revenue Source	Description	Modeled Price	Annual Rev. (\$/kW-year)	Cost Assumptions
1	Wholesale (U.K.)	<ul style="list-style-type: none"> Four-year enhanced frequency reserve contract for fast response assets Contract does not renew after expiration in year 4 Short-term operating reserve payment 	\$447.81/kW-year	\$447.81	<ul style="list-style-type: none"> AC system: \$16/kWh DC system: \$283/kWh EPC: 14% Efficiency: 87% Augmentation Costs: 4.2% of ESS
		<ul style="list-style-type: none"> Value stream isn't captured until year 5, after expiration of enhanced frequency reserve contract Annual escalation of 2.0% 	\$61.67/kW-year (starting in year 5)	\$61.67	
		<ul style="list-style-type: none"> Participation in U.K. capacity market auction Annual escalation of 3.0% 	\$19.74/kW-year	\$19.74	
2	Transmission and Distribution ⁽¹⁾	--	--	--	--
3	Utility-Scale (PV + Storage) (Australia)	<ul style="list-style-type: none"> Energy prices based on 2017/2018 Queensland region Assume discharge of battery in top 4 hours of each day Annual escalation of 3.0% 	Hourly LMP	\$164.62*	<ul style="list-style-type: none"> AC system: \$26/kWh DC system: \$296/kWh EPC: 20% Efficiency: 87% Augmentation Costs: 4.3% of ESS
		<ul style="list-style-type: none"> Participation in Queensland ancillaries (Lower & Raise, 6sec, 5min, Reg, Restart, Reactive) Benchmark Reserve Capacity Price from AEMO 	\$10.56/MW	\$22.78	
		<ul style="list-style-type: none"> DR-3 program from Ontario Power Authority 	\$56/kW-year	\$56.45	
4	Commercial & Industrial (Standalone) (Ontario)	<ul style="list-style-type: none"> Ontario/IESO "Class A" Global Adjustment charge Annual escalation of 3.0% 	\$433kW-year	\$433.03	<ul style="list-style-type: none"> AC system: \$108/kWh DC system: \$437/kWh EPC: 40% Efficiency: 91% Augmentation Costs: 5.0% of ESS
		<ul style="list-style-type: none"> Ausnet utility in Victoria, AU Reduction of demand and energy charges through time shifting Modeled NSP56 rate 	Ausnet NSP56 Tariff	\$621.56*	
5	Commercial & Industrial (PV + Storage) (Australia)	<ul style="list-style-type: none"> Ausnet utility in Victoria, AU Reduction of demand and energy charges through time shifting Modeled NSP56 rate 	Ausnet NSP56 Tariff	\$621.56*	<ul style="list-style-type: none"> AC system: \$64/kWh DC system: \$510/kWh EPC: 38% Efficiency: 91% Augmentation Costs: 4.9% of ESS
6	Residential (PV + Storage) (Germany)	<ul style="list-style-type: none"> German Development Bank, KfW Incentive program Reduction of energy charges through time shifting 	13% of Capex	\$1,261.80	<ul style="list-style-type: none"> AC system: \$49/kWh DC system: \$743/kWh EPC: 10% Efficiency: 88% Augmentation Costs: 4.9% of ESS
		<ul style="list-style-type: none"> Survey respondent estimated German residential rate Annual escalation of 3.0% 	Retail Electric Rate: \$0.36/kWh	\$377.31*	

Source: Lazard and Enovation Partners estimates.

Note: Capital cost units are the total investment divided by the storage equipment's energy capacity (kWh rating) and inverter rating (kW rating). All figures presented in USD using the following exchange rates: AUD/USD 1.38, CAD/USD 1.29, EUR/USD 0.85, GBP/USD 0.76.

* Calculated based on size of the solar system.

Lazard's Value Snapshot analysis intentionally excluded a Transmission and Distribution use case from its international analysis.

This study has been prepared by Lazard for general informational purposes only, and it is not intended to be, and should not be construed as, financial or other advice. No part of this material may be copied, photocopied or duplicated in any form by any means or redistributed without the prior consent of Lazard.

1 Illustrative Value Snapshot—Wholesale (CAISO)

(\$ in thousands, unless otherwise noted)

California	2018	2019	2020	2021	2022	2023	2028*	2033*	2038*
Total Revenue	\$ -	\$ 30,084.1	\$ 30,966.4	\$ 32,423.6	\$ 32,774.7	\$ 32,850.5	\$ 34,536.1	\$ 36,078.6	\$ 37,510.2
Energy Arbitrage	-	5,628.2	5,908.4	6,345.5	6,507.5	6,604.3	7,195.1	7,763.9	8,258.5
Frequency Regulation	-	8,076.2	8,553.9	9,359.1	9,509.8	9,493.2	10,357.8	11,129.4	11,869.8
Spinning/Non-Spinning Reserves	-	2,129.7	2,254.2	2,469.0	2,507.4	2,503.0	2,733.2	2,935.4	3,132.0
Resource Adequacy	-	14,250.0	14,250.0	14,250.0	14,250.0	14,250.0	14,250.0	14,250.0	14,250.0
Distribution Deferral	-	-	-	-	-	-	-	-	-
Demand Response—Wholesale	-	-	-	-	-	-	-	-	-
Demand Response—Utility	-	-	-	-	-	-	-	-	-
Bill Management	-	-	-	-	-	-	-	-	-
Local Incentive Payments	-	-	-	-	-	-	-	-	-
Total Operating Costs	\$ -	\$ (8,553.5)	\$ (8,678.3)	\$ (10,633.0)	\$ (10,767.1)	\$ (10,906.2)	\$ (11,336.2)	\$ (11,787.6)	\$ (12,219.0)
Storage O&M	-	(1,312.2)	(1,345.0)	(1,378.7)	(1,413.1)	(1,448.5)	(1,638.8)	(1,854.1)	(2,097.8)
Storage Warranty	-	-	-	(1,825.3)	(1,825.3)	(1,825.3)	(1,825.3)	(1,825.3)	(1,825.3)
Storage Augmentation Costs	-	(4,984.6)	(4,984.6)	(4,984.6)	(4,984.6)	(4,984.6)	(4,984.6)	(4,984.6)	(4,984.6)
Solar O&M	-	-	-	-	-	-	-	-	-
Storage Charging	-	(2,256.7)	(2,348.7)	(2,444.5)	(2,544.2)	(2,647.9)	(2,887.5)	(3,123.6)	(3,311.4)
EBITDA	\$ -	\$ 21,530.6	\$ 22,288.1	\$ 21,790.6	\$ 22,007.6	\$ 21,944.3	\$ 23,199.9	\$ 24,291.0	\$ 25,291.2
Less: MACRS D&A	-	(137,275.1)	-	-	-	-	-	-	-
EBIT	\$ -	\$ (115,744.5)	\$ 22,288.1	\$ 21,790.6	\$ 22,007.6	\$ 21,944.3	\$ 23,199.9	\$ 24,291.0	\$ 25,291.2
Less: Interest Expense	-	(2,196.4)	(2,148.4)	(2,096.6)	(2,040.6)	(1,980.1)	(1,597.0)	(1,034.2)	(207.1)
Less: Cash Taxes	-	-	-	-	-	-	(6,045.3)	(6,508.1)	(7,019.4)
Tax Net Income	\$ -	\$ (117,940.9)	\$ 20,139.7	\$ 19,694.0	\$ 19,967.0	\$ 19,964.2	\$ 15,557.6	\$ 16,748.7	\$ 18,064.6
MACRS D&A	-	137,275.1	-	-	-	-	-	-	-
EPC	(17,748.5)	-	-	-	-	-	-	-	-
Storage Module Capital	(96,693.3)	-	-	-	-	-	-	-	-
Inverter / AC System Capital	(6,479.5)	-	-	-	-	-	-	-	-
Balance of System Capital	(16,353.8)	-	-	-	-	-	-	-	-
Solar Capital	-	-	-	-	-	-	-	-	-
ITC	-	-	-	-	-	-	-	-	-
Debt	27,455.0	-	-	-	-	-	-	-	-
Principal	-	(600.0)	(647.9)	(699.8)	(755.8)	(816.2)	(1,199.3)	(1,762.2)	(2,589.2)
After-Tax Levered Cash Flow	\$ (109,820.1)	\$ 18,734.2	\$ 19,491.7	\$ 18,994.3	\$ 19,211.2	\$ 19,148.0	\$ 14,358.3	\$ 14,986.5	\$ 15,475.4
Levered Project IRR	16.7%								
Levered Project NPV	34,326,697								

Model Assumptions							
Storage Size (MW)	100.000	Storage Extended Warranty (%)	1.5%	Debt	20%	Combined Tax Rate	28%
Storage Capacity (MWh)	400.000	Storage EPC Cost (%)	15.7%	Cost of Debt	8%	Charging Cost Escalation	1%
Solar Sizing (MW)	0.000	Storage O&M Cost (%)	1.1%	Equity	80%	O&M Escalation	2.5%
Full DOD Cycles Per Year	244	Storage Efficiency (% RT)	87.4%	Cost of Equity	12%	Regional EPC Scalar	1.09
Depth of Discharge (%)	100%	Solar Fixed O&M (\$/kW-yr.)	\$0.00	WACC	11%	Useful Life (years)	20

Source: Lazard and Enovation Partners estimates.

Note: Extended warranty costs represent coverage provided beyond the initial two-year product warranty (included in equipment capital costs); charging costs are based on real-time SP-15 price forecasts; 100% of 7 year MACRS taken in the first year; regional EPC scalars are adjustment factors for the national averages, determined by Bloomberg estimates and Labor Department statistics.

This study has been prepared by Lazard for general informational purposes only, and it is not intended to be, and should not be construed as, financial or other advice. No part of this material may be copied, photocopied or duplicated in any form by any means or redistributed without the prior consent of Lazard.

Illustrative Value Snapshot—Transmission and Distribution (NYISO)

(\$ in thousands, unless otherwise noted)

New York	2018	2019	2020	2021	2022	2023	2028*	2033*	2038*
Total Revenue	\$ -	\$ 6,369.6	\$ 6,438.7	\$ 6,644.9	\$ 6,729.7	\$ 6,760.0	\$ 7,098.5	\$ 2,844.4	\$ 3,037.2
Energy Arbitrage	-	75.2	81.1	81.9	85.9	93.0	98.3	107.4	116.9
Frequency Regulation	-	667.4	684.5	779.2	831.9	824.0	858.0	933.7	1,035.6
Spinning/Non-Spinning Reserves	-	596.3	613.9	696.2	743.3	736.3	769.5	834.3	925.3
Resource Adequacy	-	712.5	741.0	769.5	750.5	788.5	1,054.5	969.0	959.5
Distribution Deferral	-	4,318.2	4,318.2	4,318.2	4,318.2	4,318.2	4,318.2	-	-
Demand Response—Wholesale	-	-	-	-	-	-	-	-	-
Demand Response—Utility	-	-	-	-	-	-	-	-	-
Bill Management	-	-	-	-	-	-	-	-	-
Local Incentive Payments	-	-	-	-	-	-	-	-	-
Total Operating Costs	\$ -	\$ (1,147.1)	\$ (1,160.1)	\$ (1,452.3)	\$ (1,466.3)	\$ (1,480.8)	\$ (1,528.5)	\$ (1,589.6)	\$ (1,657.5)
Storage O&M	-	(289.0)	(296.2)	(303.6)	(311.2)	(318.9)	(360.9)	(408.3)	(461.9)
Storage Warranty	-	-	-	(278.7)	(278.7)	(278.7)	(278.7)	(278.7)	(278.7)
Storage Augmentation Costs	-	(751.9)	(751.9)	(751.9)	(751.9)	(751.9)	(751.9)	(751.9)	(751.9)
Solar O&M	-	-	-	-	-	-	-	-	-
Storage Charging	-	(106.2)	(112.0)	(118.1)	(124.5)	(131.3)	(137.1)	(150.7)	(165.0)
EBITDA	\$ -	\$ 5,222.5	\$ 5,278.7	\$ 5,192.7	\$ 5,263.5	\$ 5,279.2	\$ 5,570.0	\$ 1,254.8	\$ 1,379.7
Less: MACRS D&A	-	(23,966.1)	-	-	-	-	-	-	-
EBIT	\$ -	\$ (18,743.6)	\$ 5,278.7	\$ 5,192.7	\$ 5,263.5	\$ 5,279.2	\$ 5,570.0	\$ 1,254.8	\$ 1,379.7
Less: Interest Expense	-	(383.5)	(375.1)	(366.0)	(356.3)	(345.7)	(278.8)	(180.6)	(36.2)
Less: Cash Taxes	-	-	-	-	-	(116.0)	(1,382.8)	(280.7)	(351.1)
Tax Net Income	\$ -	\$ (19,127.1)	\$ 4,903.6	\$ 4,826.7	\$ 4,907.2	\$ 4,817.5	\$ 3,908.3	\$ 793.5	\$ 992.4
MACRS D&A	-	23,966.1	-	-	-	-	-	-	-
EPC	(5,768.6)	-	-	-	-	-	-	-	-
Storage Module Capital	(14,685.1)	-	-	-	-	-	-	-	-
Inverter / AC System Capital	(1,144.3)	-	-	-	-	-	-	-	-
Balance of System Capital	(2,368.0)	-	-	-	-	-	-	-	-
Solar Capital	-	-	-	-	-	-	-	-	-
ITC	-	-	-	-	-	-	-	-	-
Debt	4,793.2	-	-	-	-	-	-	-	-
Principal	-	(104.7)	(113.1)	(122.2)	(131.9)	(142.5)	(209.4)	(307.6)	(452.0)
After-Tax Levered Cash Flow	\$ (19,172.9)	\$ 4,734.3	\$ 4,790.5	\$ 4,704.5	\$ 4,775.3	\$ 4,675.0	\$ 3,698.9	\$ 485.8	\$ 540.4
Levered Project IRR	22.8%								
Levered Project NPV	8,679,758								

Model Assumptions							
Storage Size (MW)	10.000	Storage Extended Warranty (%)	1.5%	Debt	20%	Combined Tax Rate	26%
Storage Capacity (MWh)	60.000	Storage EPC Cost (%)	33.8%	Cost of Debt	8%	Charging Cost Escalation	1%
Solar Sizing (MW)	0.000	Storage O&M Cost (%)	1.5%	Equity	80%	O&M Escalation	2.5%
Full DOD Cycles Per Year	78	Storage Efficiency (% RT)	87.5%	Cost of Equity	12%	Regional EPC Scalar	1.25
Depth of Discharge (%)	100%	Solar Fixed O&M (\$/kW-yr.)	\$0.00	WACC	11%	Useful Life (years)	20

Source: Lazard and Enovation Partners estimates.

Note: Extended warranty costs represent coverage provided beyond the initial two-year product warranty (included in equipment capital costs); charging costs are based on real-time NYISO Zone J price forecasts; 100% of 7 year MACRS taken in the first year; regional EPC scalars are adjustment factors for the national averages, determined by Bloomberg estimates and Labor Department statistics.

This study has been prepared by Lazard for general informational purposes only, and it is not intended to be, and should not be construed as, financial or other advice. No part of this material may be copied, photocopied or duplicated in any form by any means or redistributed without the prior consent of Lazard.

3 Illustrative Value Snapshot—Utility-Scale (PV + Storage) (ERCOT)

(\$ in thousands, unless otherwise noted)

Texas	2018	2019	2020	2021	2022	2023	2028*	2033*	2038*
Total Revenue	\$ -	\$ 6,878.7	\$ 7,016.5	\$ 7,157.0	\$ 7,300.2	\$ 7,446.2	\$ 8,221.2	\$ 9,076.9	\$ 10,021.6
Energy Arbitrage	-	4,513.1	4,603.4	4,695.4	4,789.3	4,885.1	5,393.6	5,955.0	6,574.8
Frequency Regulation	-	598.5	610.2	622.1	634.5	647.2	714.6	789.0	871.1
Spinning/Non-Spinning Reserves	-	1,767.1	1,802.9	1,839.5	1,876.3	1,913.9	2,113.0	2,332.9	2,575.7
Resource Adequacy	-	-	-	-	-	-	-	-	-
Distribution Deferral	-	-	-	-	-	-	-	-	-
Demand Response—Wholesale	-	-	-	-	-	-	-	-	-
Demand Response—Utility	-	-	-	-	-	-	-	-	-
Bill Management	-	-	-	-	-	-	-	-	-
Local Incentive Payments	-	-	-	-	-	-	-	-	-
Total Operating Costs	\$ -	\$ (1,956.6)	\$ (1,980.1)	\$ (2,365.5)	\$ (2,390.3)	\$ (2,415.6)	\$ (2,552.3)	\$ (2,707.0)	\$ (2,882.0)
Storage O&M	-	(522.4)	(535.5)	(548.9)	(562.6)	(576.7)	(652.5)	(738.2)	(835.2)
Storage Warranty	-	-	-	(361.2)	(361.2)	(361.2)	(361.2)	(361.2)	(361.2)
Storage Augmentation Costs	-	(1,014.1)	(1,014.1)	(1,014.1)	(1,014.1)	(1,014.1)	(1,014.1)	(1,014.1)	(1,014.1)
Solar O&M	-	(420.0)	(430.5)	(441.3)	(452.3)	(463.6)	(524.5)	(593.4)	(671.4)
Storage Charging	-	-	-	-	-	-	-	-	-
EBITDA	\$ -	\$ 4,922.1	\$ 5,036.4	\$ 4,791.5	\$ 4,909.9	\$ 5,030.6	\$ 5,668.9	\$ 6,369.9	\$ 7,139.6
Less: MACRS D&A	-	(50,472.7)	-	-	-	-	-	-	-
EBIT	\$ -	\$ (45,550.6)	\$ 5,036.4	\$ 4,791.5	\$ 4,909.9	\$ 5,030.6	\$ 5,668.9	\$ 6,369.9	\$ 7,139.6
Less: Interest Expense	-	(1,153.7)	(1,128.5)	(1,101.2)	(1,071.8)	(1,040.1)	(838.9)	(543.2)	(108.8)
Less: Cash Taxes	-	-	-	-	-	-	-	(1,223.6)	(1,476.5)
Tax Net Income	\$ -	\$ (46,704.3)	\$ 3,907.9	\$ 3,690.3	\$ 3,838.1	\$ 3,990.5	\$ 4,830.0	\$ 4,603.1	\$ 5,554.3
MACRS D&A	-	50,472.7	-	-	-	-	-	-	-
EPC	(4,443.6)	-	-	-	-	-	-	-	-
Storage Module Capital	(20,266.0)	-	-	-	-	-	-	-	-
Inverter / AC System Capital	(1,265.1)	-	-	-	-	-	-	-	-
Balance of System Capital	(2,129.2)	-	-	-	-	-	-	-	-
Solar Capital	(44,000.0)	-	-	-	-	-	-	-	-
ITC	21,631.2	-	-	-	-	-	-	-	-
Debt	14,420.8	-	-	-	-	-	-	-	-
Principal	-	(315.1)	(340.3)	(367.6)	(397.0)	(428.7)	(629.9)	(925.6)	(1,360.0)
After-Tax Levered Cash Flow	\$ (36,052.0)	\$ 3,453.3	\$ 3,567.6	\$ 3,322.8	\$ 3,441.1	\$ 3,561.8	\$ 4,200.1	\$ 3,677.5	\$ 4,194.3
Levered Project IRR	8.8%								
Levered Project NPV	(5,240,060)								

Model Assumptions							
Storage Size (MW)	20,000	Storage Extended Warranty (%)	1.5%	Debt	20%	Combined Tax Rate	21%
Storage Capacity (MWh)	80,000	Storage EPC Cost (%)	19.8%	Cost of Debt	8%	Charging Cost Escalation	0%
Solar Sizing (MW)	40,000	Storage O&M Cost (%)	2.2%	Equity	80%	O&M Escalation	2.5%
Full DOD Cycles Per Year	43	Storage Efficiency (% RT)	87.2%	Cost of Equity	12%	Regional EPC Scalar	0.95
Depth of Discharge (%)	100%	Solar Fixed O&M (\$/kW-yr.)	\$10.50	WACC	11%	Useful Life (years)	20

Source: Lazard and Enovation Partners estimates.

Note: Incentives include ITC (30% of capital); extended warranty costs represent coverage provided beyond the initial two-year product warranty (included in equipment capital costs); charging costs are zero with all energy self-generated by the PV portion of the system; 100% of 5 year MACRS taken in the first year; regional EPC scalars are adjustment factors for the national averages, determined by Bloomberg estimates and Labor Department statistics.

This study has been prepared by Lazard for general informational purposes only, and it is not intended to be, and should not be construed as, financial or other advice. No part of this material may be copied, photocopied or duplicated in any form by any means or redistributed without the prior consent of Lazard.

Illustrative Value Snapshot—Commercial & Industrial (Standalone) (CAISO)

(\$ in thousands, unless otherwise noted)

California	2018	2019	2020	2021	2022	2023	2028*	2033*	2038*
Total Revenue	\$ -	\$ 353.5	\$ 361.9	\$ 372.7	\$ 379.4	\$ 385.1	\$ 422.1	\$ -	\$ -
Energy Arbitrage	-	11.6	12.4	14.1	14.2	14.0	15.0	15.8	16.1
Frequency Regulation	-	-	-	-	-	-	-	-	-
Spinning/Non-Spinning Reserves	-	38.3	41.9	48.1	48.4	47.4	50.5	51.2	52.3
Resource Adequacy	-	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2
Distribution Deferral	-	-	-	-	-	-	-	-	-
Demand Response—Wholesale	-	-	-	-	-	-	-	-	-
Demand Response—Utility	-	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
Bill Management	-	219.3	223.3	226.3	232.6	239.5	272.3	311.7	355.7
Local Incentive Payments	-	-	-	-	-	-	-	-	-
Total Operating Costs	\$ -	\$ (90.5)	\$ (91.4)	\$ (109.8)	\$ (110.7)	\$ (111.7)	\$ (116.9)	\$ -	\$ -
Storage O&M	-	(35.9)	(36.8)	(37.8)	(38.7)	(39.7)	(44.9)	-	-
Storage Warranty	-	-	-	(17.4)	(17.4)	(17.4)	(17.4)	-	-
Storage Augmentation Costs	-	(54.5)	(54.5)	(54.5)	(54.5)	(54.5)	(54.5)	-	-
Solar O&M	-	-	-	-	-	-	-	-	-
Storage Charging	-	-	-	-	-	-	-	-	-
EBITDA	\$ -	\$ 263.0	\$ 270.5	\$ 263.0	\$ 268.7	\$ 273.4	\$ 305.2	\$ -	\$ -
Less: MACRS D&A	-	(1,565.1)	-	-	-	-	-	-	-
EBIT	\$ -	\$ (1,302.1)	\$ 270.5	\$ 263.0	\$ 268.7	\$ 273.4	\$ 305.2	\$ -	\$ -
Less: Interest Expense	-	(25.0)	(23.3)	(21.4)	(19.4)	(17.3)	(3.5)	-	-
Less: Cash Taxes	-	-	-	-	-	-	(84.4)	-	-
Tax Net Income	\$ -	\$ (1,327.2)	\$ 247.2	\$ 241.5	\$ 249.2	\$ 256.2	\$ 217.3	\$ -	\$ -
MACRS D&A	-	1,565.1	-	-	-	-	-	-	-
EPC	(474.2)	-	-	-	-	-	-	-	-
Storage Module Capital	(662.7)	-	-	-	-	-	-	-	-
Inverter / AC System Capital	(216.7)	-	-	-	-	-	-	-	-
Balance of System Capital	(211.6)	-	-	-	-	-	-	-	-
Solar Capital	-	-	-	-	-	-	-	-	-
ITC	-	-	-	-	-	-	-	-	-
Debt	313.0	-	-	-	-	-	-	-	-
Principal	-	(21.6)	(23.3)	(25.2)	(27.2)	(29.4)	(43.2)	-	-
After-Tax Levered Cash Flow	\$ (1,252.1)	\$ 216.4	\$ 223.8	\$ 216.3	\$ 222.0	\$ 226.8	\$ 174.1	\$ -	\$ -
Levered Project IRR	11.9%								
Levered Project NPV	32,373								

Model Assumptions							
Storage Size (MW)	1,000	Storage Extended Warranty (%)	1.6%	Debt	20%	Combined Tax Rate	28%
Storage Capacity (MWh)	2,000	Storage EPC Cost (%)	54.2%	Cost of Debt	8%	Charging Cost Escalation	1%
Solar Sizing (MW)	0,000	Storage O&M Cost (%)	3.2%	Equity	80%	O&M Escalation	2.5%
Full DOD Cycles Per Year	440	Storage Efficiency (% RT)	91.1%	Cost of Equity	12%	Regional EPC Scalar	1.09
Depth of Discharge (%)	100%	Solar Fixed O&M (\$/kW-yr.)	\$0.00	WACC	11%	Useful Life (years)	10

Source: Lazard and Enovation Partners estimates.

Note: No incentive due to project receiving local resource adequacy payments; extended warranty costs represent coverage provided beyond the initial two-year product warranty (included in equipment capital costs); charging cost is embedded in the bill savings; 100% of 5 year MACRS taken in the first year; regional EPC scalars are adjustment factors for the national averages, determined by Bloomberg estimates and Labor Department statistics.

This study has been prepared by Lazard for general informational purposes only, and it is not intended to be, and should not be construed as, financial or other advice. No part of this material may be copied, photocopied or duplicated in any form by any means or redistributed without the prior consent of Lazard.

5 Illustrative Value Snapshot—Commercial & Industrial (PV + Storage) (CAISO)

(\$ in thousands, unless otherwise noted)

California	2018	2019	2020	2021	2022	2023	2028*	2033*	2038*
Total Revenue	\$ -	\$ 477.4	\$ 488.3	\$ 500.7	\$ 510.8	\$ 520.4	\$ 576.3	\$ 638.7	\$ 709.0
Energy Arbitrage	-	7.5	8.1	8.9	9.1	9.0	9.8	10.3	11.0
Frequency Regulation	-	-	-	-	-	-	-	-	-
Spinning/Non-Spinning Reserves	-	22.2	23.9	27.1	27.5	27.1	28.8	30.1	31.3
Resource Adequacy	-	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2
Distribution Deferral	-	-	-	-	-	-	-	-	-
Demand Response—Wholesale	-	-	-	-	-	-	-	-	-
Demand Response—Utility	-	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
Bill Management	-	363.4	372.0	380.3	389.9	400.1	453.4	514.0	582.4
Local Incentive Payments	-	-	-	-	-	-	-	-	-
Total Operating Costs	\$ -	\$ (109.5)	\$ (110.8)	\$ (130.1)	\$ (131.5)	\$ (132.9)	\$ (140.6)	\$ (149.4)	\$ (159.3)
Storage O&M	-	(35.9)	(36.8)	(37.7)	(38.7)	(39.7)	(44.9)	(50.8)	(57.4)
Storage Warranty	-	-	-	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)
Storage Augmentation Costs	-	(56.1)	(56.1)	(56.1)	(56.1)	(56.1)	(56.1)	(56.1)	(56.1)
Solar O&M	-	(17.5)	(17.9)	(18.4)	(18.8)	(19.3)	(21.9)	(24.7)	(28.0)
Storage Charging	-	-	-	-	-	-	-	-	-
EBITDA	\$ -	\$ 367.9	\$ 377.5	\$ 370.6	\$ 379.3	\$ 387.5	\$ 435.6	\$ 489.3	\$ 549.6
Less: MACRS D&A	-	(2,945.2)	-	-	-	-	-	-	-
EBIT	\$ -	\$ (2,577.3)	\$ 377.5	\$ 370.6	\$ 379.3	\$ 387.5	\$ 435.6	\$ 489.3	\$ 549.6
Less: Interest Expense	-	(67.3)	(65.8)	(64.3)	(62.5)	(60.7)	(48.9)	(31.7)	(6.3)
Less: Cash Taxes	-	-	-	-	-	-	(108.2)	(128.1)	(152.0)
Tax Net Income	\$ -	\$ (2,644.7)	\$ 311.6	\$ 306.4	\$ 316.8	\$ 326.9	\$ 278.5	\$ 329.5	\$ 391.2
MACRS D&A	-	2,945.2	-	-	-	-	-	-	-
EPC	(474.2)	-	-	-	-	-	-	-	-
Storage Module Capital	(742.9)	-	-	-	-	-	-	-	-
Inverter / AC System Capital	(127.6)	-	-	-	-	-	-	-	-
Balance of System Capital	(277.8)	-	-	-	-	-	-	-	-
Solar Capital	(2,585.0)	-	-	-	-	-	-	-	-
ITC	1,262.2	-	-	-	-	-	-	-	-
Debt	841.5	-	-	-	-	-	-	-	-
Principal	-	(18.4)	(19.9)	(21.4)	(23.2)	(25.0)	(36.8)	(54.0)	(79.4)
After-Tax Levered Cash Flow	\$ (2,103.7)	\$ 282.2	\$ 291.7	\$ 284.9	\$ 293.6	\$ 301.8	\$ 241.7	\$ 275.5	\$ 311.9
Levered Project IRR	13.6%								
Levered Project NPV	312,222								

Model Assumptions					
Storage Size (MW)	0.500	Storage Extended Warranty (%)	1.6%	Debt	20%
Storage Capacity (MWh)	2.000	Storage EPC Cost (%)	46.5%	Cost of Debt	8%
Solar Sizing (MW)	1.000	Storage O&M Cost (%)	3.1%	Equity	80%
Full DOD Cycles Per Year	78	Storage Efficiency (% RT)	90.5%	Cost of Equity	12%
Depth of Discharge (%)	100%	Solar Fixed O&M (\$/kW-yr.)	\$17.50	WACC	11%
				Useful Life (years)	20

Source: Lazard and Enovation Partners estimates.

Note: No incentive due to project receiving local resource adequacy payments; extended warranty costs represent coverage provided beyond the initial two-year product warranty (included in equipment capital costs); charging costs are zero with all energy self-generated by the PV portion of the system; 100% of 5 year MACRS taken in the first year; regional EPC scalars are adjustment factors for the national averages, determined by Bloomberg estimates and Labor Department statistics.

This study has been prepared by Lazard for general informational purposes only, and it is not intended to be, and should not be construed as, financial or other advice. No part of this material may be copied, photocopied or duplicated in any form by any means or redistributed without the prior consent of Lazard.

6 Illustrative Value Snapshot—Residential (PV + Storage) (CAISO)

(\$ in thousands, unless otherwise noted)

California	2018	2019	2020	2021	2022	2023	2028*	2033*	2038*
Total Revenue	10.0	\$ 7.1	\$ 7.3	\$ 7.5	\$ 7.7	\$ 7.9	\$ 8.9	\$ 10.0	\$ 11.4
Energy Arbitrage	-	-	-	-	-	-	-	-	-
Frequency Regulation	-	-	-	-	-	-	-	-	-
Spinning/Non-Spinning Reserves	-	-	-	-	-	-	-	-	-
Resource Adequacy	-	-	-	-	-	-	-	-	-
Distribution Deferral	-	-	-	-	-	-	-	-	-
Demand Response—Wholesale	-	-	-	-	-	-	-	-	-
Demand Response—Utility	-	-	-	-	-	-	-	-	-
Bill Management	-	7.1	7.3	7.5	7.7	7.9	8.9	10.0	11.4
Local Incentive Payments	10.0	-	-	-	-	-	-	-	-
Total Operating Costs	\$ -	\$ (2.6)	\$ (2.6)	\$ (3.1)	\$ (3.1)	\$ (3.2)	\$ (3.3)	\$ (3.5)	\$ (3.7)
Storage O&M	-	(0.6)	(0.6)	(0.7)	(0.7)	(0.7)	(0.8)	(0.9)	(1.0)
Storage Warranty	-	-	-	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)
Storage Augmentation Costs	-	(1.6)	(1.6)	(1.6)	(1.6)	(1.6)	(1.6)	(1.6)	(1.6)
Solar O&M	-	(0.4)	(0.4)	(0.4)	(0.4)	(0.4)	(0.5)	(0.6)	(0.6)
Storage Charging	-	-	-	-	-	-	-	-	-
EBITDA	\$ 10.0	\$ 4.5	\$ 4.7	\$ 4.4	\$ 4.5	\$ 4.7	\$ 5.6	\$ 6.6	\$ 7.7
Less: MACRS D&A	-	(68.1)	-	-	-	-	-	-	-
EBIT	\$ 10.0	\$ (63.6)	\$ 4.7	\$ 4.4	\$ 4.5	\$ 4.7	\$ 5.6	\$ 6.6	\$ 7.7
Less: Interest Expense	-	(1.6)	(1.5)	(1.5)	(1.4)	(1.4)	(1.1)	(0.7)	(0.1)
Less: Cash Taxes	(2.8)	-	-	-	-	-	-	-	(2.1)
Tax Net Income	\$ 7.2	\$ (65.2)	\$ 3.2	\$ 2.9	\$ 3.1	\$ 3.3	\$ 4.4	\$ 5.8	\$ 5.4
MACRS D&A	-	68.1	-	-	-	-	-	-	-
EPC	(3.3)	-	-	-	-	-	-	-	-
Storage Module Capital	(26.4)	-	-	-	-	-	-	-	-
Inverter / AC System Capital	(2.0)	-	-	-	-	-	-	-	-
Balance of System Capital	(3.3)	-	-	-	-	-	-	-	-
Solar Capital	(62.3)	-	-	-	-	-	-	-	-
ITC	29.2	-	-	-	-	-	-	-	-
Debt	19.5	-	-	-	-	-	-	-	-
Principal	-	(0.4)	(0.5)	(0.5)	(0.5)	(0.6)	(0.9)	(1.2)	(1.8)
After-Tax Levered Cash Flow	\$ (41.5)	\$ 2.6	\$ 2.7	\$ 2.4	\$ 2.5	\$ 2.7	\$ 3.6	\$ 4.6	\$ 3.6
Levered Project IRR	5.2%								
Levered Project NPV	(15,565)								

Model Assumptions							
Storage Size (MW)	0.010	Storage Extended Warranty (%)	1.5%	Debt	20%	Combined Tax Rate	28%
Storage Capacity (MWh)	0.040	Storage EPC Cost (%)	11.2%	Cost of Debt	8%	Charging Cost Escalation	0%
Solar Sizing (MW)	0.020	Storage O&M Cost (%)	1.9%	Equity	80%	O&M Escalation	2.5%
Full DOD Cycles Per Year	170	Storage Efficiency (% RT)	88.3%	Cost of Equity	12%	Regional EPC Scalar	1.09
Depth of Discharge (%)	100%	Solar Fixed O&M (\$/kW-vr.)	\$19.78	WACC	11%	Useful Life (years)	20

Source: Lazard and Enovation Partners estimates.

Note: Project receives 100% of SGIP benefit in the first year; extended warranty costs represent coverage provided beyond the initial two-year product warranty (included in equipment capital costs); charging costs are zero with all energy self-generated by the PV portion of the system; 100% of 5 year MACRS taken in the first year; regional EPC scalars are adjustment factors for the national averages, determined by Bloomberg estimates and Labor Department statistics.

This study has been prepared by Lazard for general informational purposes only, and it is not intended to be, and should not be construed as, financial or other advice. No part of this material may be copied, photocopied or duplicated in any form by any means or redistributed without the prior consent of Lazard.

1 Illustrative Value Snapshot—Wholesale (U.K.)

(\$ in thousands, unless otherwise noted)

United Kingdom	2018	2019	2020	2021	2022	2023	2028*	2033*	2038*
Total Revenue	\$ -	\$ 46,754.5	\$ 47,302.8	\$ 47,378.4	\$ 47,456.3	\$ 8,922.4	\$ 10,003.2	\$ 11,220.6	\$ 12,592.9
Energy Arbitrage	-	-	-	-	-	-	-	-	-
Frequency Regulation	-	44,780.8	44,780.8	44,780.8	44,780.8	-	-	-	-
Spinning/Non-Spinning Reserves	-	-	-	-	-	6,166.6	6,808.5	7,517.1	8,299.5
Resource Adequacy	-	1,973.7	2,521.9	2,597.6	2,675.5	2,755.8	3,194.7	3,703.5	4,293.4
Distribution Deferral	-	-	-	-	-	-	-	-	-
Demand Response—Wholesale	-	-	-	-	-	-	-	-	-
Demand Response—Utility	-	-	-	-	-	-	-	-	-
Bill Management	-	-	-	-	-	-	-	-	-
Local Incentive Payments	-	-	-	-	-	-	-	-	-
Total Operating Costs	\$ -	\$ (6,460.8)	\$ (6,496.9)	\$ (8,359.2)	\$ (8,397.1)	\$ (8,435.9)	\$ (8,644.7)	\$ (8,880.5)	\$ (9,146.6)
Storage O&M	-	(1,312.2)	(1,345.0)	(1,378.7)	(1,413.1)	(1,448.5)	(1,638.8)	(1,854.1)	(2,097.8)
Storage Warranty	-	-	-	(1,825.3)	(1,825.3)	(1,825.3)	(1,825.3)	(1,825.3)	(1,825.3)
Storage Augmentation Costs	-	(4,984.6)	(4,984.6)	(4,984.6)	(4,984.6)	(4,984.6)	(4,984.6)	(4,984.6)	(4,984.6)
Solar O&M	-	-	-	-	-	-	-	-	-
Storage Charging	-	(164.0)	(167.3)	(170.7)	(174.1)	(177.6)	(196.0)	(216.4)	(239.0)
EBITDA	\$ -	\$ 40,293.7	\$ 40,805.8	\$ 39,019.2	\$ 39,059.3	\$ 486.5	\$ 1,358.5	\$ 2,340.2	\$ 3,446.3
Less: MACRS D&A	-	(19,407.2)	(33,259.8)	(23,753.1)	(16,962.6)	(12,127.8)	-	-	-
EBIT	\$ -	\$ 20,886.5	\$ 7,546.1	\$ 15,266.1	\$ 22,096.6	\$ (11,641.3)	\$ 1,358.5	\$ 2,340.2	\$ 3,446.3
Less: Interest Expense	-	(2,173.0)	(2,125.5)	(2,074.2)	(2,018.8)	(1,959.0)	(1,580.0)	(1,023.1)	(204.9)
Less: Cash Taxes	-	(6,549.7)	(1,897.2)	(4,617.2)	(7,027.2)	-	-	-	-
Tax Net Income	\$ -	\$ 12,163.8	\$ 3,523.4	\$ 8,574.8	\$ 13,050.6	\$ (13,600.2)	\$ (221.5)	\$ 1,317.0	\$ 3,241.3
MACRS D&A	-	19,407.2	33,259.8	23,753.1	16,962.6	12,127.8	-	-	-
EPC	(16,283.0)	-	-	-	-	-	-	-	-
Storage Module Capital	(96,693.3)	-	-	-	-	-	-	-	-
Inverter / AC System Capital	(6,479.5)	-	-	-	-	-	-	-	-
Balance of System Capital	(16,353.8)	-	-	-	-	-	-	-	-
Solar Capital	-	-	-	-	-	-	-	-	-
ITC	-	-	-	-	-	-	-	-	-
Debt	27,161.9	-	-	-	-	-	-	-	-
Principal	-	(593.5)	(641.0)	(692.3)	(747.7)	(807.5)	(1,186.5)	(1,743.4)	(2,561.6)
After-Tax Levered Cash Flow	\$ (108,647.7)	\$ 30,977.4	\$ 36,142.1	\$ 31,635.5	\$ 29,265.5	\$ (2,280.0)	\$ (1,408.0)	\$ (426.3)	\$ 679.8
Levered Project IRR	4.4%								
Levered Project NPV	(9,932,582)								

Model Assumptions							
Storage Size (MW)	100.000	Storage Extended Warranty (%)	1.5%	Debt	20%	Combined Tax Rate	35%
Storage Capacity (MWh)	400.000	Storage EPC Cost (%)	14.4%	Cost of Debt	8%	Charging Cost Escalation	2%
Solar Sizing (MW)	0.000	Storage O&M Cost (%)	1.1%	Equity	80%	O&M Escalation	2.5%
Full DOD Cycles Per Year	55	Storage Efficiency (% RT)	87.4%	Cost of Equity	12%	Regional EPC Scalar	1
Depth of Discharge (%)	100%	Solar Fixed O&M (\$/kW-yr.)	\$0.00	WACC	11%	Useful Life (years)	20

Source: Lazard and Enovation Partners estimates.

Note: Extended warranty costs represent coverage provided beyond the initial two-year product warranty (included in equipment capital costs); charging costs are based on forward estimates of day-ahead baseload contracts (GB); 7 years MACRS; all figures presented in USD using the following exchange rate: GBP/USD 0.76.

This study has been prepared by Lazard for general informational purposes only, and it is not intended to be, and should not be construed as, financial or other advice. No part of this material may be copied, photocopied or duplicated in any form by any means or redistributed without the prior consent of Lazard.

Illustrative Value Snapshot—Utility-Scale (PV + Storage) (Australia)

(\$ in thousands, unless otherwise noted)

Australia	2018	2019	2020	2021	2022	2023	2028*	2033*	2038*
Total Revenue	\$ -	\$ 8,868.8	\$ 9,113.4	\$ 9,364.8	\$ 9,623.3	\$ 9,888.9	\$ 11,332.0	\$ 12,987.8	\$ 14,887.6
Energy Arbitrage	-	6,584.6	6,760.7	6,941.6	7,127.3	7,318.1	8,351.8	9,532.8	10,882.4
Frequency Regulation	-	455.6	469.3	483.4	497.9	512.8	594.5	689.2	799.0
Spinning/Non-Spinning Reserves	-	-	-	-	-	-	-	-	-
Resource Adequacy	-	1,828.5	1,883.3	1,939.8	1,998.0	2,058.0	2,385.7	2,765.7	3,206.2
Distribution Deferral	-	-	-	-	-	-	-	-	-
Demand Response—Wholesale	-	-	-	-	-	-	-	-	-
Demand Response—Utility	-	-	-	-	-	-	-	-	-
Bill Management	-	-	-	-	-	-	-	-	-
Local Incentive Payments	-	-	-	-	-	-	-	-	-
Total Operating Costs	\$ -	\$ (1,956.6)	\$ (1,980.1)	\$ (2,365.5)	\$ (2,390.3)	\$ (2,415.6)	\$ (2,552.3)	\$ (2,707.0)	\$ (2,882.0)
Storage O&M	-	(522.4)	(535.5)	(548.9)	(562.6)	(576.7)	(652.5)	(738.2)	(835.2)
Storage Warranty	-	-	-	(361.2)	(361.2)	(361.2)	(361.2)	(361.2)	(361.2)
Storage Augmentation Costs	-	(1,014.1)	(1,014.1)	(1,014.1)	(1,014.1)	(1,014.1)	(1,014.1)	(1,014.1)	(1,014.1)
Solar O&M	-	(420.0)	(430.5)	(441.3)	(452.3)	(463.6)	(524.5)	(593.4)	(671.4)
Storage Charging	-	-	-	-	-	-	-	-	-
EBITDA	\$ -	\$ 6,912.2	\$ 7,133.3	\$ 6,999.3	\$ 7,233.0	\$ 7,473.2	\$ 8,779.7	\$ 10,280.8	\$ 12,005.6
Less: MACRS D&A	-	(14,467.6)	(23,148.1)	(13,888.9)	(8,333.3)	(8,333.3)	-	-	-
EBIT	\$ -	\$ (7,555.4)	\$ (16,014.8)	\$ (6,889.5)	\$ (1,100.3)	\$ (860.1)	\$ 8,779.7	\$ 10,280.8	\$ 12,005.6
Less: Interest Expense	-	(1,157.4)	(1,132.1)	(1,104.8)	(1,075.3)	(1,043.4)	(841.6)	(545.0)	(109.2)
Less: Cash Taxes	-	-	-	-	-	-	-	(3,407.5)	(4,163.8)
Tax Net Income	\$ -	\$ (8,712.8)	\$ (17,146.9)	\$ (7,994.3)	\$ (2,175.6)	\$ (1,903.5)	\$ 7,938.1	\$ 6,328.3	\$ 7,732.7
MACRS D&A	-	14,467.6	23,148.1	13,888.9	8,333.3	8,333.3	-	-	-
EPC	(4,677.5)	-	-	-	-	-	-	-	-
Storage Module Capital	(20,266.0)	-	-	-	-	-	-	-	-
Inverter / AC System Capital	(1,265.1)	-	-	-	-	-	-	-	-
Balance of System Capital	(2,129.2)	-	-	-	-	-	-	-	-
Solar Capital	(44,000.0)	-	-	-	-	-	-	-	-
ITC	-	-	-	-	-	-	-	-	-
Debt	14,467.6	-	-	-	-	-	-	-	-
Principal	-	(316.1)	(341.4)	(368.8)	(398.3)	(430.1)	(632.0)	(928.6)	(1,364.4)
After-Tax Levered Cash Flow	\$ (57,870.2)	\$ 5,438.6	\$ 5,659.7	\$ 5,525.8	\$ 5,759.4	\$ 5,999.7	\$ 7,306.2	\$ 5,399.7	\$ 6,368.3
Levered Project IRR	8.7%								
Levered Project NPV	(8,544,983)								

Model Assumptions							
Storage Size (MW)	20.000	Storage Extended Warranty (%)	1.5%	Debt	20%	Combined Tax Rate	35%
Storage Capacity (MWh)	80.000	Storage EPC Cost (%)	20.9%	Cost of Debt	8%	Charging Cost Escalation	0%
Solar Sizing (MW)	40.000	Storage O&M Cost (%)	2.2%	Equity	80%	O&M Escalation	2.5%
Full DOD Cycles Per Year	350	Storage Efficiency (% RT)	87.2%	Cost of Equity	12%	Regional EPC Scalar	1
Depth of Discharge (%)	100%	Solar Fixed O&M (\$/kW-vr.)	\$10.50	WACC	11%	Useful Life (years)	20

Source: Lazard and Enovation Partners estimates.

Note: Extended warranty costs represent coverage provided beyond the initial two-year product warranty (included in equipment capital costs); charging costs are zero with all energy self-generated by the PV portion of the system; 5 years MACRS; all figures presented in USD using the following exchange rate: AUD/USD 1.38.

This study has been prepared by Lazard for general informational purposes only, and it is not intended to be, and should not be construed as, financial or other advice. No part of this material may be copied, photocopied or duplicated in any form by any means or redistributed without the prior consent of Lazard.

4

Illustrative Value Snapshot—Commercial & Industrial (Standalone) (Ontario)

(\$ in thousands, unless otherwise noted)

Ontario	2018	2019	2020	2021	2022	2023	2028*	2033*	2038*
Total Revenue	\$ -	\$ 489.5	\$ 502.1	\$ 515.1	\$ 528.4	\$ 542.0	\$ 615.7	\$ -	\$ -
Energy Arbitrage	-	-	-	-	-	-	-	-	-
Frequency Regulation	-	-	-	-	-	-	-	-	-
Spinning/Non-Spinning Reserves	-	-	-	-	-	-	-	-	-
Resource Adequacy	-	-	-	-	-	-	-	-	-
Distribution Deferral	-	-	-	-	-	-	-	-	-
Demand Response—Wholesale	-	56.5	57.9	59.3	60.8	62.3	70.5	79.8	90.2
Demand Response—Utility	-	-	-	-	-	-	-	-	-
Bill Management	-	433.0	444.3	455.8	467.6	479.7	545.2	619.8	704.6
Local Incentive Payments	-	-	-	-	-	-	-	-	-
Total Operating Costs	\$ -	\$ (148.0)	\$ (150.6)	\$ (170.8)	\$ (173.6)	\$ (176.4)	\$ (191.9)	\$ (87.0)	\$ (100.9)
Storage O&M	-	(35.9)	(36.8)	(37.8)	(38.7)	(39.7)	(44.9)	-	-
Storage Warranty	-	-	-	(17.4)	(17.4)	(17.4)	(17.4)	-	-
Storage Augmentation Costs	-	(54.5)	(54.5)	(54.5)	(54.5)	(54.5)	(54.5)	-	-
Solar O&M	-	-	-	-	-	-	-	-	-
Storage Charging	-	(57.5)	(59.3)	(61.0)	(62.9)	(64.7)	(75.1)	(87.0)	(100.9)
EBITDA	\$ -	\$ 341.5	\$ 351.5	\$ 344.3	\$ 354.8	\$ 365.6	\$ 423.8	\$ (87.0)	\$ (100.9)
Less: MACRS D&A	-	(218.1)	(373.7)	(266.9)	(190.6)	(136.3)	-	-	-
EBIT	\$ -	\$ 123.4	\$ (22.2)	\$ 77.4	\$ 164.2	\$ 229.3	\$ 423.8	\$ (87.0)	\$ (100.9)
Less: Interest Expense	-	(24.4)	(22.7)	(20.9)	(18.9)	(16.8)	(3.4)	-	-
Less: Cash Taxes	-	(34.6)	-	(4.0)	(50.8)	(74.4)	(147.2)	-	-
Tax Net Income	\$ -	\$ 64.3	\$ (45.0)	\$ 52.5	\$ 94.4	\$ 138.1	\$ 273.3	\$ (87.0)	\$ (100.9)
MACRS D&A	-	218.1	373.7	266.9	190.6	136.3	-	-	-
EPC	(435.0)	-	-	-	-	-	-	-	-
Storage Module Capital	(662.7)	-	-	-	-	-	-	-	-
Inverter / AC System Capital	(216.7)	-	-	-	-	-	-	-	-
Balance of System Capital	(211.6)	-	-	-	-	-	-	-	-
Solar Capital	-	-	-	-	-	-	-	-	-
ITC	-	-	-	-	-	-	-	-	-
Debt	305.2	-	-	-	-	-	-	-	-
Principal	-	(21.1)	(22.8)	(24.6)	(26.5)	(28.7)	(42.1)	-	-
After-Tax Levered Cash Flow	\$ (1,220.8)	\$ 261.3	\$ 306.0	\$ 294.8	\$ 258.5	\$ 245.7	\$ 231.2	\$ -	\$ -
Levered Project IRR	20.1%								
Levered Project NPV	399,363								

Model Assumptions							
Storage Size (MW)	1,000	Storage Extended Warranty (%)	1.6%	Debt	20%	Combined Tax Rate	35%
Storage Capacity (MWh)	2,000	Storage EPC Cost (%)	49.8%	Cost of Debt	8%	Charging Cost Escalation	3%
Solar Sizing (MW)	0,000	Storage O&M Cost (%)	3.2%	Equity	80%	O&M Escalation	2.5%
Full DOD Cycles Per Year	225	Storage Efficiency (% RT)	91.1%	Cost of Equity	12%	Regional EPC Scalar	1
Depth of Discharge (%)	100%	Solar Fixed O&M (\$/kW-yr.)	\$0.00	WACC	11%	Useful Life (years)	10

Source: Lazard and Enovation Partners estimates.

Note: Extended warranty costs represent coverage provided beyond the initial two-year product warranty (included in equipment capital costs); charging costs are based on Ontario Power Authority commercial rates; 7 year MACRS; all figures presented in USD using the following exchange rate: CAD/USD 1.29.

This study has been prepared by Lazard for general informational purposes only, and it is not intended to be, and should not be construed as, financial or other advice. No part of this material may be copied, photocopied or duplicated in any form by any means or redistributed without the prior consent of Lazard.

5 Illustrative Value Snapshot—Commercial & Industrial (PV + Storage) (Australia)

(\$ in thousands, unless otherwise noted)

Australia	2018	2019	2020	2021	2022	2023	2028*	2033*	2038*
Total Revenue	\$ -	\$ 621.6	\$ 650.8	\$ 682.6	\$ 704.7	\$ 727.9	\$ 859.2	\$ 1,021.4	\$ 1,222.3
Energy Arbitrage	-	-	-	-	-	-	-	-	-
Frequency Regulation	-	-	-	-	-	-	-	-	-
Spinning/Non-Spinning Reserves	-	-	-	-	-	-	-	-	-
Resource Adequacy	-	-	-	-	-	-	-	-	-
Distribution Deferral	-	-	-	-	-	-	-	-	-
Demand Response—Wholesale	-	-	-	-	-	-	-	-	-
Demand Response—Utility	-	-	-	-	-	-	-	-	-
Bill Management	-	621.6	650.8	682.6	704.7	727.9	859.2	1,021.4	1,222.3
Local Incentive Payments	-	-	-	-	-	-	-	-	-
Total Operating Costs	\$ -	\$ (109.5)	\$ (110.8)	\$ (130.1)	\$ (131.5)	\$ (132.9)	\$ (140.6)	\$ (149.4)	\$ (159.3)
Storage O&M	-	(35.9)	(36.8)	(37.7)	(38.7)	(39.7)	(44.9)	(50.8)	(57.4)
Storage Warranty	-	-	-	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)	(17.9)
Storage Augmentation Costs	-	(56.1)	(56.1)	(56.1)	(56.1)	(56.1)	(56.1)	(56.1)	(56.1)
Solar O&M	-	(17.5)	(17.9)	(18.4)	(18.8)	(19.3)	(21.9)	(24.7)	(28.0)
Storage Charging	-	-	-	-	-	-	-	-	-
EBITDA	\$ -	\$ 512.1	\$ 540.0	\$ 552.5	\$ 573.3	\$ 595.0	\$ 718.5	\$ 872.0	\$ 1,062.9
Less: MACRS D&A	-	(833.7)	(1,333.9)	(800.3)	(480.2)	(480.2)	-	-	-
EBIT	\$ -	\$ (321.6)	\$ (793.9)	\$ (247.8)	\$ 93.1	\$ 114.8	\$ 718.5	\$ 872.0	\$ 1,062.9
Less: Interest Expense	-	(66.7)	(65.2)	(63.7)	(62.0)	(60.1)	(48.5)	(31.4)	(6.3)
Less: Cash Taxes	-	-	-	-	-	-	(234.5)	(294.2)	(369.8)
Tax Net Income	\$ -	\$ (388.3)	\$ (859.1)	\$ (311.5)	\$ 31.1	\$ 54.6	\$ 435.5	\$ 546.4	\$ 686.8
MACRS D&A	-	833.7	1,333.9	800.3	480.2	480.2	-	-	-
EPC	(435.0)	-	-	-	-	-	-	-	-
Storage Module Capital	(742.9)	-	-	-	-	-	-	-	-
Inverter / AC System Capital	(127.6)	-	-	-	-	-	-	-	-
Balance of System Capital	(277.8)	-	-	-	-	-	-	-	-
Solar Capital	(2,585.0)	-	-	-	-	-	-	-	-
ITC	-	-	-	-	-	-	-	-	-
Debt	833.7	-	-	-	-	-	-	-	-
Principal	-	(18.2)	(19.7)	(21.2)	(22.9)	(24.8)	(36.4)	(53.5)	(78.6)
After-Tax Levered Cash Flow	\$ (3,334.7)	\$ 427.2	\$ 455.1	\$ 467.6	\$ 488.4	\$ 510.1	\$ 399.1	\$ 492.9	\$ 608.2
Levered Project IRR	14.3%								
Levered Project NPV	646,862								

Model Assumptions					
Storage Size (MW)	0.500	Storage Extended Warranty (%)	1.6%	Debt	20%
Storage Capacity (MWh)	2.000	Storage EPC Cost (%)	42.6%	Cost of Debt	8%
Solar Sizing (MW)	1.000	Storage O&M Cost (%)	3.1%	Equity	80%
Full DOD Cycles Per Year	250	Storage Efficiency (% RT)	90.5%	Cost of Equity	12%
Depth of Discharge (%)	100%	Solar Fixed O&M (\$/kW-yr.)	\$17.50	WACC	11%
				Combined Tax Rate	35%
				Charging Cost Escalation	0%
				O&M Escalation	2.5%
				Regional EPC Scalar	1
				Useful Life (years)	20

Source: Lazard and Enovation Partners estimates.

Note: Extended warranty costs represent coverage provided beyond the initial two-year product warranty (included in equipment capital costs); charging costs are zero with all energy self-generated by the PV portion of the system; 5 years MACRS; all figures presented in USD using the following exchange rate: AUD/USD 1.38.

This study has been prepared by Lazard for general informational purposes only, and it is not intended to be, and should not be construed as, financial or other advice. No part of this material may be copied, photocopied or duplicated in any form by any means or redistributed without the prior consent of Lazard.

6

Illustrative Value Snapshot—Residential (PV + Storage) (Germany)

(\$ in thousands, unless otherwise noted)

Germany	2018	2019	2020	2021	2022	2023	2028*	2033*	2038*
Total Revenue	12.6	\$ 7.5	\$ 7.8	\$ 8.0	\$ 8.2	\$ 8.5	\$ 9.8	\$ 11.4	\$ 13.2
Energy Arbitrage	-	-	-	-	-	-	-	-	-
Frequency Regulation	-	-	-	-	-	-	-	-	-
Spinning/Non-Spinning Reserves	-	-	-	-	-	-	-	-	-
Resource Adequacy	-	-	-	-	-	-	-	-	-
Distribution Deferral	-	-	-	-	-	-	-	-	-
Demand Response—Wholesale	-	-	-	-	-	-	-	-	-
Demand Response—Utility	-	-	-	-	-	-	-	-	-
Bill Management	-	7.5	7.8	8.0	8.2	8.5	9.8	11.4	13.2
Local Incentive Payments	12.6	-	-	-	-	-	-	-	-
Total Operating Costs	\$ -	\$ (2.6)	\$ (2.6)	\$ (3.1)	\$ (3.1)	\$ (3.2)	\$ (3.3)	\$ (3.5)	\$ (3.7)
Storage O&M	-	(0.6)	(0.6)	(0.7)	(0.7)	(0.7)	(0.8)	(0.9)	(1.0)
Storage Warranty	-	-	-	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)
Storage Augmentation Costs	-	(1.6)	(1.6)	(1.6)	(1.6)	(1.6)	(1.6)	(1.6)	(1.6)
Solar O&M	-	(0.4)	(0.4)	(0.4)	(0.4)	(0.4)	(0.5)	(0.6)	(0.6)
Storage Charging	-	-	-	-	-	-	-	-	-
EBITDA	\$ 12.6	\$ 5.0	\$ 5.2	\$ 4.9	\$ 5.1	\$ 5.3	\$ 6.5	\$ 7.9	\$ 9.6
Less: MACRS D&A	-	(19.4)	(31.1)	(18.6)	(11.2)	(11.2)	-	-	-
EBIT	\$ 12.6	\$ (14.4)	\$ (25.9)	\$ (13.7)	\$ (6.1)	\$ (5.9)	\$ 6.5	\$ 7.9	\$ 9.6
Less: Interest Expense	-	(1.6)	(1.5)	(1.5)	(1.4)	(1.4)	(1.1)	(0.7)	(0.1)
Less: Cash Taxes	(4.4)	-	-	-	-	-	-	-	(3.3)
Tax Net Income	\$ 8.2	\$ (16.0)	\$ (27.4)	\$ (15.2)	\$ (7.5)	\$ (7.3)	\$ 5.4	\$ 7.2	\$ 6.1
MACRS D&A	-	19.4	31.1	18.6	11.2	11.2	-	-	-
EPC	(3.1)	-	-	-	-	-	-	-	-
Storage Module Capital	(26.4)	-	-	-	-	-	-	-	-
Inverter / AC System Capital	(2.0)	-	-	-	-	-	-	-	-
Balance of System Capital	(3.3)	-	-	-	-	-	-	-	-
Solar Capital	(62.3)	-	-	-	-	-	-	-	-
ITC	-	-	-	-	-	-	-	-	-
Debt	19.4	-	-	-	-	-	-	-	-
Principal	-	(0.4)	(0.5)	(0.5)	(0.5)	(0.6)	(0.8)	(1.2)	(1.8)
After-Tax Levered Cash Flow	\$ (69.4)	\$ 3.0	\$ 3.2	\$ 2.9	\$ 3.1	\$ 3.4	\$ 4.6	\$ 6.0	\$ 4.3
Levered Project IRR	2.5%								
Levered Project NPV	(36,513)								

Model Assumptions							
Storage Size (MW)	0.010	Storage Extended Warranty (%)	1.5%	Debt	20%	Combined Tax Rate	35%
Storage Capacity (MWh)	0.040	Storage EPC Cost (%)	10.3%	Cost of Debt	8%	Charging Cost Escalation	0%
Solar Sizing (MW)	0.020	Storage O&M Cost (%)	1.9%	Equity	80%	O&M Escalation	2.5%
Full DOD Cycles Per Year	250	Storage Efficiency (% RT)	88.3%	Cost of Equity	12%	Regional EPC Scalar	1
Depth of Discharge (%)	100%	Solar Fixed O&M (\$/kW-vr.)	\$19.78	WACC	11%	Useful Life (years)	20

Source: Lazard and Enovation Partners estimates.

Note: 13% German Development Bank, KfW incentive for renewable/DER technologies; extended warranty costs represent coverage provided beyond the initial two-year product warranty (included in equipment capital costs); charging costs are zero with all energy self-generated by the PV portion of the system; 5 years MACRS; all figures presented in USD using the following exchange rate: EUR/USD 0.85.

This study has been prepared by Lazard for general informational purposes only, and it is not intended to be, and should not be construed as, financial or other advice. No part of this material may be copied, photocopied or duplicated in any form by any means or redistributed without the prior consent of Lazard.

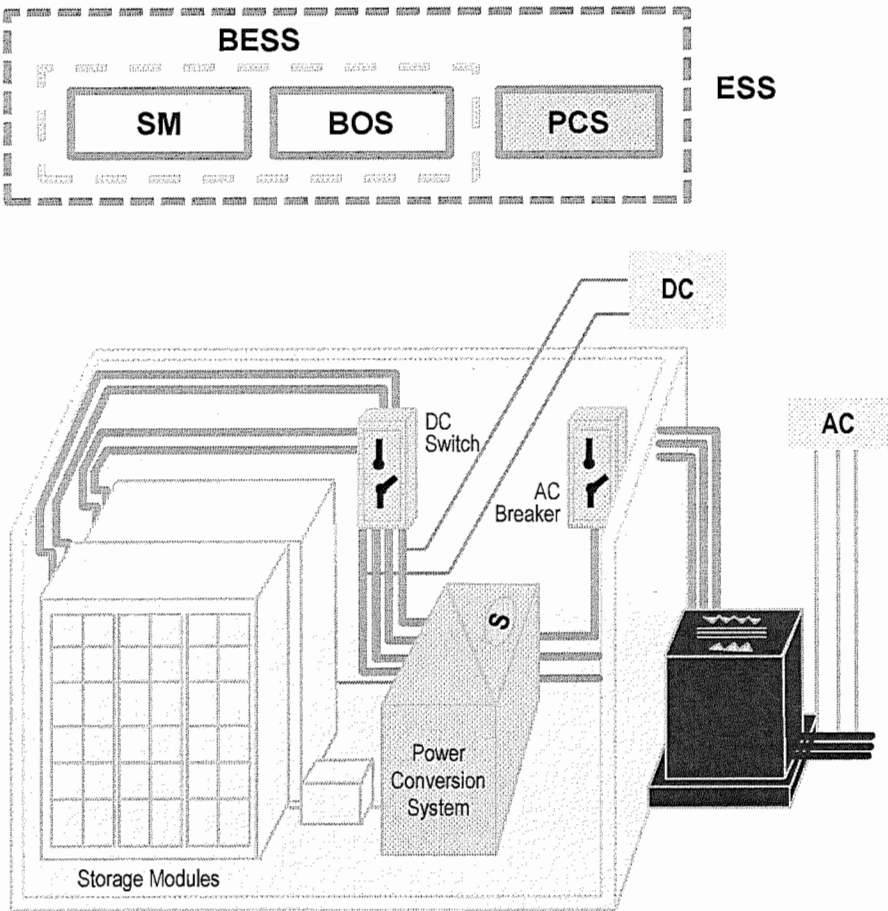


**C Supplementary Energy Storage Background
Materials**

Components of Energy Storage System Equipment Costs

Lazard’s LCOS study incorporates capital costs for the entirety of the energy storage system (“ESS”), which is composed of the storage module (“SM”), balance of system (“BOS” and, together with the SM, the Battery Energy Storage System “BESS”), power conversion system (“PCS”) and related EPC costs

Physical Energy Storage System



Selected Equipment & Cost Components

System Layer		Component
SM	Storage Module	<ul style="list-style-type: none">• Racking Frame/Cabinet• Battery Management System (“BMS”)• Battery Modules
BOS	Balance of System	<ul style="list-style-type: none">• Container• Monitors and Controls• Thermal Management• Fire Suppression
PCS	Power Conversion System	<ul style="list-style-type: none">• Inverter• Protection (Switches, Breakers, etc.)• Energy Management System (“EMS”)
EPC	Engineering, Procurement & Construction	<ul style="list-style-type: none">• Project Management• Engineering Studies/Permitting• Site Preparation/Construction• Foundation/Mounting• Commissioning
Other (not included in analysis)		<ul style="list-style-type: none">• SCADA• Shipping• Grid Integration Equipment• Metering• Land

Page 58 of 60

PNM Exhibit WK-3
Page 58 of 60

Overview of Selected Energy Storage Technologies

A wide variety of energy storage technologies are currently available or in development; however, given limited current or future commercial deployment expectations, only a subset are assessed in this study

		Description	Size (MW)	Selected Providers	Life (Yrs) ⁽¹⁾
Mechanical/Gravity/Thermal	Compressed Air	<ul style="list-style-type: none"> Compressed Air Energy Storage ("CAES") uses electricity to compress air into confined spaces (e.g., underground mines, salt caverns, etc.) where the pressurized air is stored. When required, this pressurized air is released to drive the compressor of a natural gas turbine 	150 MW+	Dresser Rand, Alstom Power	20 years
	Flywheel	<ul style="list-style-type: none"> Flywheels are mechanical devices that spin at high speeds, storing electricity as rotational energy, which is released by decelerating the flywheel's rotor, releasing quick bursts of energy (i.e., high power and short duration) or releasing energy slowly (i.e., low power and long duration), depending on short-duration or long-duration flywheel technology, respectively 	30 kW – 1 MW	Amber Kinetics, Vycon	20+ years
	Pumped Hydro	<ul style="list-style-type: none"> Pumped hydro storage uses two vertically separated water reservoirs, using low cost electricity to pump water from the lower to the higher reservoir and running as a conventional hydro power plant during high electricity cost periods 	100 MW+	MWH Global	20+ years
	Thermal	<ul style="list-style-type: none"> Thermal energy storage uses conventional cryogenic technology, compressing and storing air into a liquid form (charging) then releasing it at a later time (discharge). Best suited for large-scale applications; the technology is still emerging but has a number of units in early development and operation 	5 MW – 100 MW+	Highview Power	20+ years
Chemical	Flow Battery [‡]	<ul style="list-style-type: none"> Flow batteries store energy through chemically changing the electrolyte (vanadium) or plating zinc (zinc bromide). Physically, systems typically contain two electrolyte solutions in two separate tanks, circulated through two independent loops, separated by a membrane. Emerging alternatives allow for simpler and less costly designs utilizing a single tank, single loop, and no membrane. The subcategories of flow batteries are defined by the chemical composition of the electrolyte solution; the most prevalent of such solutions are vanadium and zinc bromide. Other solutions include zinc chloride, ferrochrome and zinc chromate 	25 kW – 100 MW+	Sumitomo, UET, Primus Power	20 years
	Lead Acid [‡]	<ul style="list-style-type: none"> Lead-acid batteries date from the 19th century and are the most common batteries; they are low cost and adaptable to numerous uses (e.g., electric vehicles, off-grid power systems, uninterruptible power supplies, etc.) "Advanced" lead-acid battery technology adds ultra-capacitors, increasing efficiency, lifetimes and improve partial state-of-charge operability⁽²⁾ 	5 kW – 2 MW	Energys, GS Yuasa, East Penn Mfg.	5 – 10 years
	Lithium-Ion [‡]	<ul style="list-style-type: none"> Lithium-ion batteries have historically been used in electronics and advanced transportation industries; they are increasingly replacing lead-acid batteries in many applications, and have relatively high energy density, low self-discharge and high charging efficiency Lithium-ion systems designed for energy applications are designed to have a higher efficiency and longer life at slower discharges, while systems designed for power applications are designed to support faster charging and discharging rates, requiring extra capital equipment 	5 kW – 100 MW+	LG Chem, Samsung, Panasonic, BYD	10 years
	Sodium [‡]	<ul style="list-style-type: none"> "High temperature"/"liquid-electrolyte-flow" sodium batteries have high power and energy density and are designed for large commercial and utility scale projects; "low temperature" batteries are designed for residential and small commercial applications 	1 MW – 100 MW+	NGK	10 years
	Zinc [‡]	<ul style="list-style-type: none"> Zinc batteries cover a wide range of possible technology variations, including metal-air derivatives; they are non-toxic, non-combustible and potentially low cost due to the abundance of the primary metal; however, this technology remains unproven in widespread commercial deployment 	5 kW – 100 MW+	Fluidic Energy, EOS Energy Storage	10 years



Technologies analyzed in LCOS v4.0.

‡ Denotes battery technology.

(1) Indicates general ranges of useful economic life for a given family of technology. Useful life will vary in practice depending on sub-technology, intensity of use/cycling, engineering factors, etc.

(2) Advanced lead acid is an emerging technology with wider potential applications and greater cost than traditional lead-acid batteries.

Overview of Selected Energy Storage Technologies (cont'd)

A wide variety of energy storage technologies are currently available or in development; however, given limited current or future commercial deployment expectations, only a subset are assessed in this study

		Selected Advantages	Selected Disadvantages
Mechanical/Gravity/Thermal	Compressed Air	<ul style="list-style-type: none"> Low cost, flexible sizing, relatively large scale Mature technology and well-developed design Proven track record of safe operation Leverages existing gas turbine technologies 	<ul style="list-style-type: none"> Requires suitable geology Relatively difficult to modularize for smaller installations Exposure to natural gas price changes Relies on natural gas
	Flywheel	<ul style="list-style-type: none"> High power density and scalability for short-duration technology; low power, higher energy for long-duration technology High depth of discharge capability Compact design with integrated AC motor 	<ul style="list-style-type: none"> Relatively low energy capacity High heat generation Sensitive to vibrations
	Pumped Hydro	<ul style="list-style-type: none"> Mature technology (commercially available; leverages existing hydropower technology) High-power capacity solution Large scale, easily scalable in power rating 	<ul style="list-style-type: none"> Relatively low energy density Limited available sites (i.e., water availability required) Cycling generally limited to once per day
	Thermal	<ul style="list-style-type: none"> Low cost, flexible sizing, relatively large scale Power and energy ratings independently scalable Leverages mature industrial cryogenic technology base; can utilize waste industrial heat to improve efficiency 	<ul style="list-style-type: none"> Technology is pre-commercial Difficult to modularize for smaller installations On-site safety concerns from cryogenic storage
Chemical	Flow Battery†	<ul style="list-style-type: none"> Power and energy profiles independently scalable for vanadium system Zinc bromide designed in fixed modular blocks for system design No degradation in "energy storage capacity" No potential for fire High cycle/lifespan 	<ul style="list-style-type: none"> Power and energy rating scaled in a fixed manner for zinc bromide technology Electrolyte based on acid Relatively high balance of system costs Reduced efficiency due to rapid charge/discharge
	Lead Acid†	<ul style="list-style-type: none"> Mature technology with established recycling infrastructure Advanced lead-acid technologies leverage existing technologies Low cost 	<ul style="list-style-type: none"> Poor ability to operate in a partially charged state Relatively poor depth of discharge and short lifespan Acid-based electrolyte
	Lithium-Ion†	<ul style="list-style-type: none"> Multiple chemistries available Rapidly expanding manufacturing base leading to cost reductions Efficient power and energy density Cost reduction continues 	<ul style="list-style-type: none"> Cycle life limited, especially in harsh conditions Safety issues from overheating Requires advanced manufacturing capabilities to achieve high performance
	Sodium†	<ul style="list-style-type: none"> High temperature technology: Relatively mature technology (commercially available); high energy capacity and long duration Low temperature technology: Smaller scale design; emerging technology and low-cost potential; safer 	<ul style="list-style-type: none"> Although mature, inherently higher costs—low temperature batteries currently have a higher cost with lower efficiency Potential flammability issues for high-temperature batteries Poor cycling capability
	Zinc†	<ul style="list-style-type: none"> Deep discharge capability Designed for long life Designed for safe operation 	<ul style="list-style-type: none"> Currently unproven commercially Lower efficiency Poor cycling/rate of charge/discharge

Technologies analyzed in LCOS v4.0.
Source: DOE Energy Storage Database.
† Denotes battery technology.

Power Engineering Article

PNM Exhibit WK-4

Is contained in the following 10 pages.



Gas Turbines: Breaking Through The Barriers to Higher Reliability

05/01/2003

By Douglas J. Smith IEng, Senior Editor

Recent-model large-frame gas turbines have experienced some growing pains, but modifications and upgrades have increased their reliability substantially.

Due to low natural gas prices, low capital costs, ease of permitting, quick installation, and the need to add capacity, the 1990s saw a dramatic increase in the market for gas turbines. To meet the demand all of the major gas turbine manufacturers developed gas turbines with larger capacities, higher efficiencies and low NOx emissions. Although some of these heavy frame gas turbines did not initially perform to the manufacturer's specifications and customer's expectations, subsequent design and operational changes have made them reliable elements of the turbine fleet.

After going into commercial operation the large Frame F and G gas turbines experienced a number of problems. These included:

- Turbine blade failures
- Compressor disk cracking
- Humming/Flashback
- Vibrations—rotors, compressor diaphragms

To overcome the initial design and operating problems with their large frame gas turbines the OEMs developed a range of design improvements to resolve the problems.

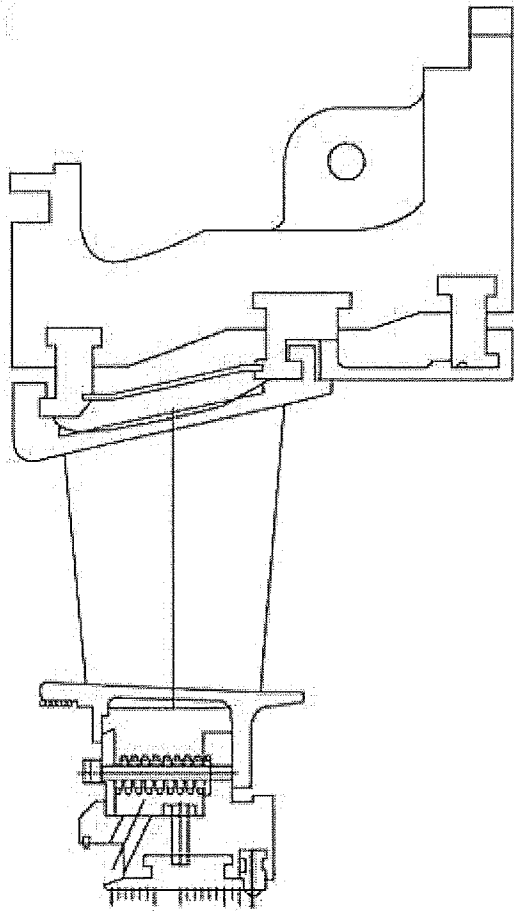
GT24 and GT26 Gas Turbines

The first ALSTOM GT24 gas turbine, installed in GPU's Gilbert station, went into commercial operation in 1996. Reliant Energy now owns the plant. Unlike other gas turbine designs where the OEM increased the firing temperatures to increase efficiency and capacity, the GT24 gas turbine uses sequential combustion. With sequential combustion, the fuel is injected twice into the gas turbine, and the capacity and efficiency are increased without significantly increasing the firing temperature. The GT24 60 Hz gas turbine is rated at 179 MW and the GT26 50 Hz machine is rated at 262 MW.

A German utility, EnBW Kraftwerke AG, repowered Unit 4 at its Rheinhafen power plant with a GT26 gas turbine. However, because of previous problems with blade rubbing of the high-pressure section of the compressor, the OEM recommended operational changes to the turbine to prevent the problem. Nonetheless, during startup of the plant in 1997, compressor blade rubbing still occurred.

The problem of blade rubbing was rectified by changing the blade clearances and adding abrasive heat shields in the 17th compressor blade row area. In addition, the bleed air segments of the 17th blade row were modified. According to the utility these modifications have been successful.

**FIGURE 1
SEAL HOUSING WITH
BRUSH SEALS**



Source: Siemens Westinghouse

[Click here to enlarge image](#)

By 2000, ALSTOM had developed an upgrade improvement package for the GT 24 and GT26 gas turbines and although the Rheinhafen unit was operating with few problems, the utility decided to upgrade their GT26 gas turbine. The upgrade package included a new combustor rear wall design that resolved several inadequate operating characteristics in the first combustion stage of the gas turbine. Some of the other modifications included temperature monitoring of the EV burner shells, improved blade cooling and modified flushing for the EV burner system.

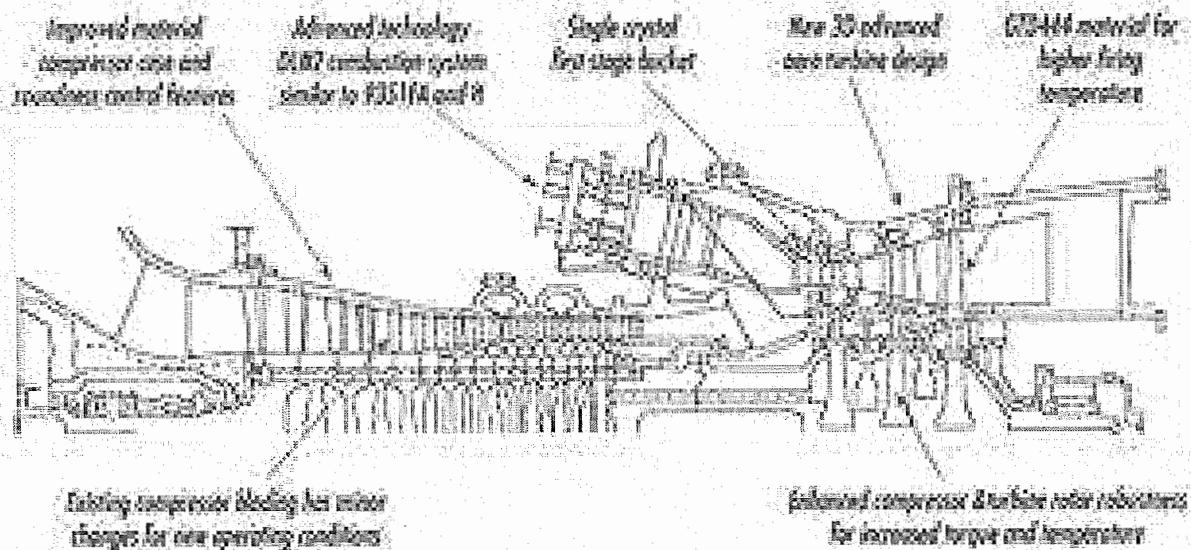
The first GT24 and GT26 gas turbines with the new design enhancements were installed in combined-cycle power plants in Agawam, U.S. and Enfield, England. Shortly after start up of the Agawam facility a boroscope inspection revealed that the locking piece on row 16 of the compressor had become loose. ALSTOM resolved the problem by modifying the locking pin so that it dovetailed into the first and last blades of row 16. This modification is now standard on the GT24 and GT26 gas turbines.

Another boroscope inspection, conducted at the Enfield plant after only a few hundred hours of operation, found that cracking had occurred in the EV outer liner. ALSTOM determined that the design changes made to the liner for the installation of the modified burner was the cause. According to ALSTOM, strengthening the components has rectified the problem.

In 1999, ALSTOM launched the more advanced GT24B gas turbine. Unfortunately, two problems occurred during the initial operation of the GT24B gas turbine. These were: Cracking of the EV combustor liner in early 2000 and deformation of the low-pressure turbine row two blade shroud in mid 2000.

According to ALSTOM, modifications to rectify the EV combustion liner problem were made to three field units and 32 units that were in the process of being manufactured. Since being modified no problems have been reported or detected with the liners.

FIGURE 2
7FB GAS TURBINE FEATURES



Source: GE Power Systems

[Click here to enlarge image](#)

Lack of impingement cooling from the heat shield, precipitated the deformation of the low-pressure turbine blade shroud. After drilling additional impingement cooling holes in the stationary shield the overheating problem has been resolved. All GT24B gas turbines, in the field, or ready for shipping, are being modified. The units that have been modified have run trouble free since 2000.

Enhancements to W501F Gas Turbines

Since its introduction in the early 1990s, Siemens Westinghouse has continued to improve the design of its W501F gas turbine. Over a ten-year period Siemens Westinghouse has improved the efficiency of the W501F gas turbine by 6 percent, increased power by 27 percent and reduced NOx emissions by 67 percent.

Improved efficiency of the compressor has been achieved by increasing the diameters of the first and second stages as well as incorporating new 3-D controlled diffusion blade path technology to optimize the air flow. To reduce corrosion, Sermatel 5380DP coating has been applied to some compressor components. However, the disc and rotor construction and the compressor blade and vane material has not been changed or modified.

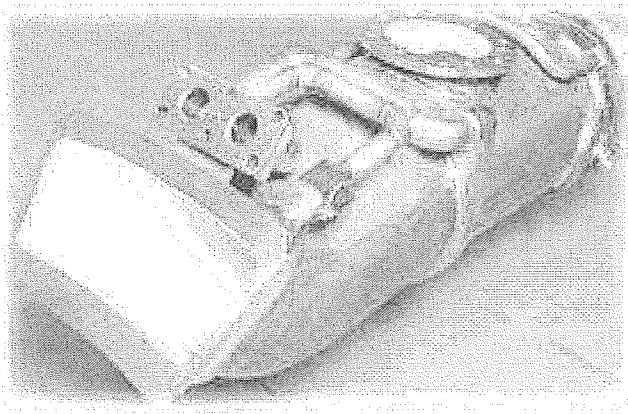


Figure 3. Mitsubishi steam cooled combustor. Source: Mitsubishi Heavy Industries

[Click here to enlarge image](#)

null

To meet the challenges of increased firing temperatures and reduced emissions, the W501F uses 16 individual Dry Low NOx (DLN) dual fuel can-annular combustors. Improvements in airflow management, coatings, fuel/air premixing and dynamic monitoring of the combustion system have enhanced emissions, operation and performance of the gas turbines.

The combustor air bypass system, used on the initial version of the DLN combustor, has been eliminated in the new design. Removing the bypass system has helped to improve the reliability, availability and maintainability of the combustion system.

Although the design changes to the turbine were minimal some enhancements have been made. In order to reduce wear, the turbine ring segments have been coated with a rub-tolerant coating. As a result, air leakage has been reduced and the efficiency and output of the gas turbine has been improved. Similarly, improvements have been implemented to reduce leakage and wear, Figure 1. In addition, the fourth stage turbine blade was redesigned to maximize the gas turbine's output during cold ambient temperatures. According to Siemens Westinghouse, the W501F gas turbines shipped since 2000 have a maximum power output of 215 MW.

Efficiency and emissions improvements were achieved in part due to cooling air optimization. With the original W501F design, the amount of cooling air for vane cooling was fixed, and therefore could not be optimized for specific site operating conditions. However, with the new design the cooling air is automatically modulated, thus optimizing the consumption of the cooling air.

Commercial Operation of W501G

In 1999, Unit 5 at Lakeland Electric's McIntosh facility, Florida, put the first Siemens Westinghouse W501G gas turbine into operation. During the commissioning period the unit experienced problems with compressor rubbing, high frequency dynamics and transition wear.

Since initial operation, Siemens Westinghouse, at their expense, have upgraded and made modifications to rectify the problems. According to Ed Colter, plant superintendent, McIntosh, the high frequency dynamics have been resolved by the installation of resonators on the transitions of the gas turbine. In addition, by changing the style of coatings, the life of the transitions has been extended.

After modifications and upgrading, the McIntosh gas turbine was put into simple-cycle operation in April 2001. Colter reports that since that time the unit has met the specifications for capacity but NOx emissions still need some improvement. Colter is also not convinced that the fixes to rectify the operating problems are long term. Overall Colter says that the gas turbine is operating very well and the only issue that still needs to be proven is the life of the components.

Over Seven Million Hours

As with the other major gas turbine manufacturers, GE experienced some problems with their large frame units. Early 7F (60 Hz) and 9F (50Hz) gas turbines had incidences of cracking in the aft compressor rotor structure in the turbine stage three-spacer disk. According to GE, the

cracks were related to thermal stresses induced during cold rotor start-ups and during rapid start-ups following a trip. Since design modifications no cracking of the rotor has occurred.

According to a recent GE news release, the installed fleet of over 500 F technology gas turbines has reached 7.1 million hours of commercial operation worldwide. Since the F technology was introduced a decade ago GE has incrementally improved the efficiency and output of the units. When first introduced in 1986, the Frame 7F had a simple-cycle rating of 135 MW. The more recent model, the 7FA, is rated at over 170 MW in simple-cycle operation.

One of the first upgrades to the 7F gas turbine involved improving the machine's performance through higher firing temperatures, higher cycle pressure ratios, reduced leakages and increased turbine cooling. With this upgrade the limits on metal temperature for the un-cooled last stage turbine bucket and exhaust frame were maintained.

Introduction of the 7FB

GE introduced the 7001FB, a 60 Hz gas turbine optimized for combine-cycle duty, in November 1999. Although the gas turbine package is basically unchanged from the 7001FA, the buckets and nozzles have been completely re-designed. According to GE, they have been able to increase the firing temperature while maintaining exhaust temperature at 7001FA levels.

Because of the increased pressure ratio and firing temperature of the 7001FB the compressor rotor bolting and turbine rotor disks were upgraded to a higher strength material. However, the compressor blading aerodynamic design remains essentially unchanged from the 7001FA.

To minimize thermal distortions, and to prevent problems with blade clearances and rubbing, the compressor and turbine casings were modified. These changes included improved air extraction geometry optimization, relocation of lifting lugs, the addition of false flanges to add symmetry to the split casing and the judicious use of insulation. Figure 2 summarizes design changes made to the 7FB gas turbine.

M501G in Operation Since 1997

The first Mitsubishi 254 MW M501G gas turbine was installed in Japan at Mitsubishi Heavy Industries' in-house power plant in 1997. Although the unit has been in commercial operation since that time, supplying power to a local utility, the plant has served as a test-bed to verify the long-term reliability and performance of the M501G gas turbine technology, says Vinod Kallianpur, vice president, Mitsubishi Power Systems.

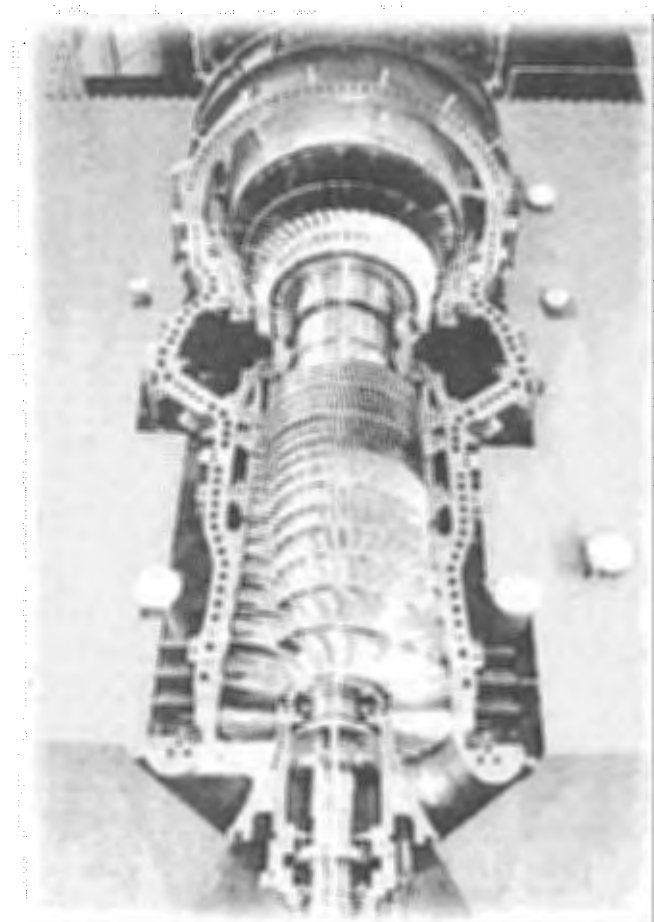
In addition to utilizing many of the design features of the F series of gas turbines the G heavy frame gas turbine utilizes advanced profile airfoils to increase the airflow in the compressor. This increased airflow has been achieved by incorporating multiple circular airfoils in the first

four stages of the rotating blades and controlled diffusion airfoils in the rest of the rotating blades and in all stages of the stationary vanes.

Because of the increased firing temperature, and in order to keep the same NO_x levels as the F series, a pre-mixed combustor with a closed steam cooling system was added to the M501G, Figure 3. The previous F series used a dry low NO_x air-cooled combustor. To prevent overheating of the turbine blades and vanes, Mitsubishi has applied advanced cooling technologies. These included full coverage film cooling, thermal barrier coating, new heat resistant materials and directionally solidified casting technology.

The rotating blades are made from MGA 1400, a nickel based super alloy. Another nickel based super alloy, MGA2400, is used for the stationary vanes. The MGA2400 super alloy has excellent resistance against thermal fatigue, oxidization and hot corrosion. It also has high creep strength and is easy to weld.

In October 1997, the M501G was removed from service for its first inspection. Except for some minor cracks in the combustor transition piece, the steam cooled combustor, air cooled vanes and blades were found to be in good condition. Subsequent inspections carried out in March 1998, November 1998, March 2000 and October 2000 found no problems with the gas turbine.



M501G compressor and rotor assembly. Photograph courtesy of Mitsubishi Heavy Industries.

[Click here to enlarge image](#)

null

During operation at the in-house power plant, Mitsubishi has continued to improve its operating performance. To optimize the flow pattern and reduce aerodynamic losses, the turbine's aerodynamics have been improved in the upgraded M501G1 gas turbine. The upgraded turbine has a capacity of 264 MW. Similarly, because the aerodynamic modifications required upgrading of the blades and vanes, their cooling system also required modification. In addition, an advanced lower NOx combustor was installed on the gas turbine.

Mitsubishi has recently completed the testing of an ultra dry low NOx combustor in Japan. During field testing, the gas turbine was able to operate with NOx emissions of 25 ppm at a firing temperature of 2732 F. According to Kallianpur, the ultra low NOx combustor is now available for the F and G machines at 15 ppm and 25 ppm, respectively.

Durability Still an Issue

According to a WEFA Inc. report "Banking on Advanced Gas Turbines: Prospects for a Financial Meltdown," around 60 to 70 percent of the non-fuel cost of F class gas turbines is consumed in the repair and replacement of hot gas path components. The report goes on to say that the worldwide OEM hot section replacement business exceeds \$1 billion annually and the profit margins for the parts are reported to be greater than the margins on the original gas turbine.

The WEFA report states that hot gas path components giving the most trouble are:

- Turbine blades and vanes
- Combustion liners
- End caps
- Fuel nozzle assemblies
- Turbine stationary slides.

Although OEMs have been very supportive and responsive in resolving the initial design problems with their gas turbines, end users must take a long-term view and will be closely watching the extended durability and maintainability of these complex machines.

BEFORE THE NEW MEXICO PUBLIC REGULATION COMMISSION

**IN THE MATTER OF PUBLIC SERVICE)
COMPANY OF NEW MEXICO'S)
CONSOLIDATED APPLICATION FOR)
APPROVALS FOR THE ABANDONMENT,) 19-_____-UT
FINANCING, AND RESOURCE REPLACEMENT)
FOR SAN JUAN GENERATING STATION)
PURSUANT TO THE ENERGY TRANSITION ACT)**

AFFIDAVIT

STATE OF FLORIDA)
) ss
COUNTY OF SARASOTA)

WILLIAM KEMP, Senior Managing Director, Enovation Partners, LLC
upon being duly sworn according to law, under oath, deposes and states: I have read the
foregoing **Direct Testimony of William Kemp** and it is true and accurate based on my
own personal knowledge and belief.

SIGNED this 24th day of June, 2019.

William J Kemp
WILLIAM KEMP

SUBSCRIBED AND SWORN to before me this 24th day of June, 2019.

Sherry L. Lane
NOTARY PUBLIC IN AND FOR
THE STATE OF FLORIDA

My Commission Expires:

07/24/2021

