# **General Electric's Future:** Entering the Flow Battery Industry via a Joint Venture

Aarthi Katakam, Derek He, Shraavasti Bhat, Dionne Yeung, Manya Gauba

# Roadmap

## Overview

General Electric and
the Flow Battery industry

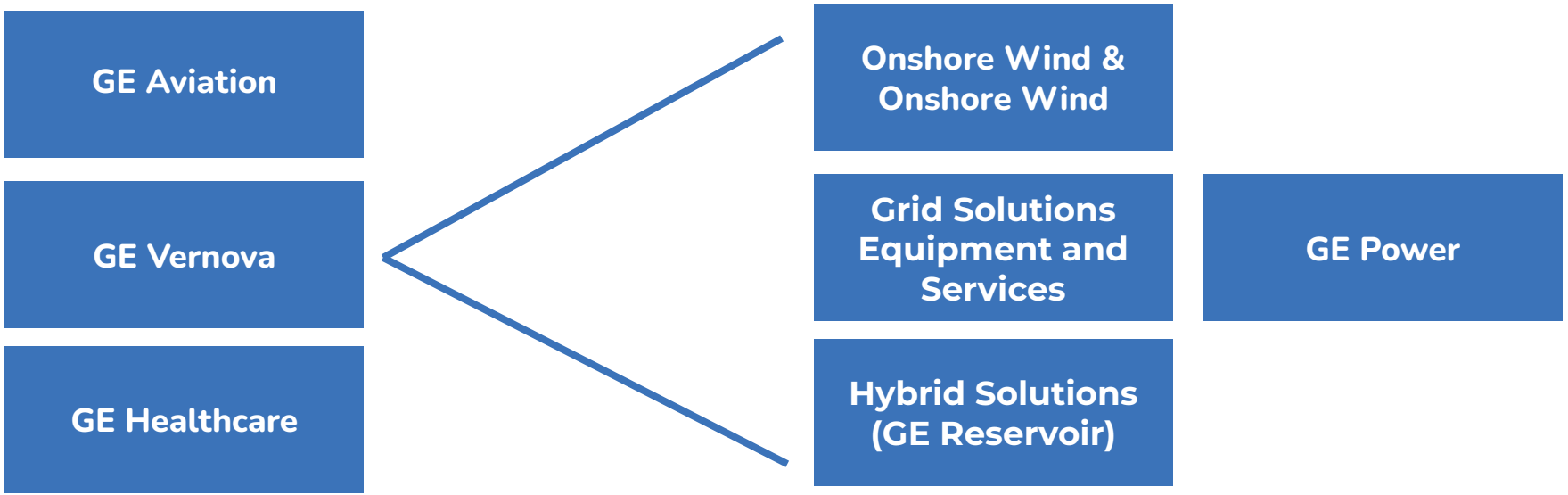
## Recommendation

How General Electric should enter
the Flow Battery industry
to maximize outcomes

# GE Business Lines and Restructuring

GE is spinning off **GE Vernova**, which houses **GE Renewable Energy** and **GE Power**, to achieve 3 key objectives:

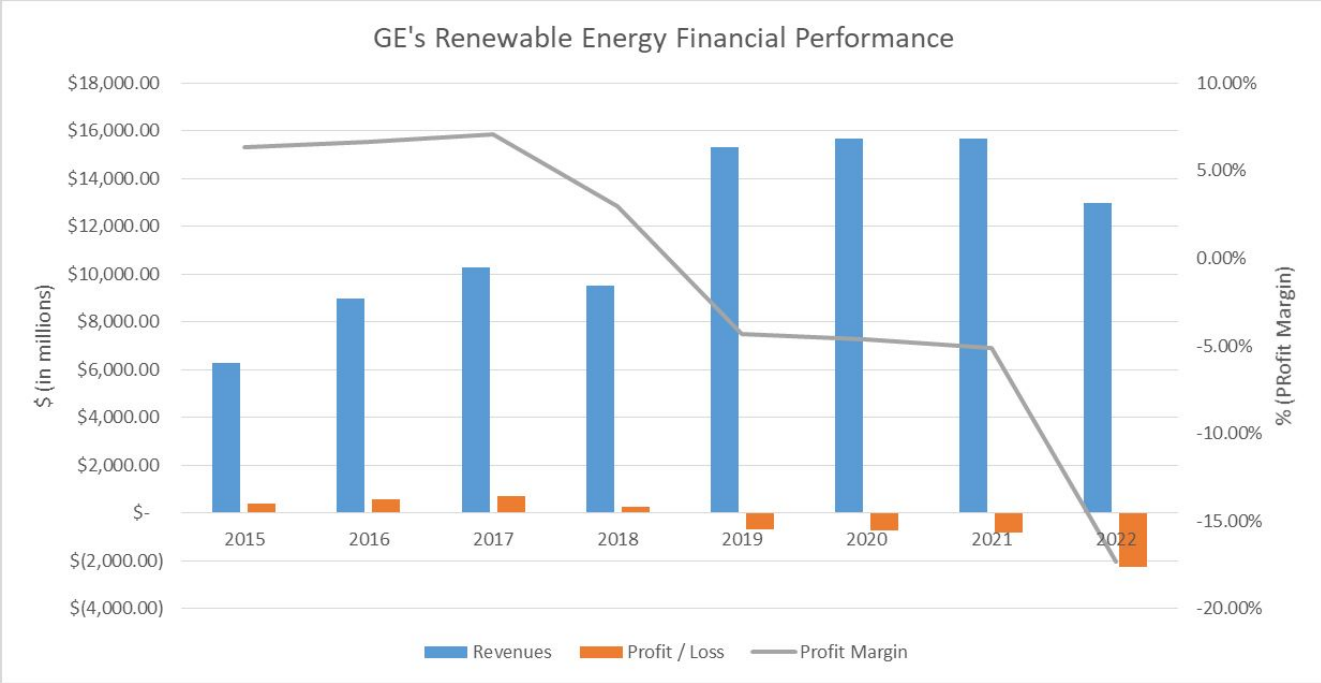
1) Make management **closer to customer**
2) **Reduce** the **operational complexity**, including reducing product lines
3) **Increase** geographic **specificity**, especially the US market



# GE Vernova's Challenges

## GE's Renewable Business Became **Unprofitable Starting in 2019.**

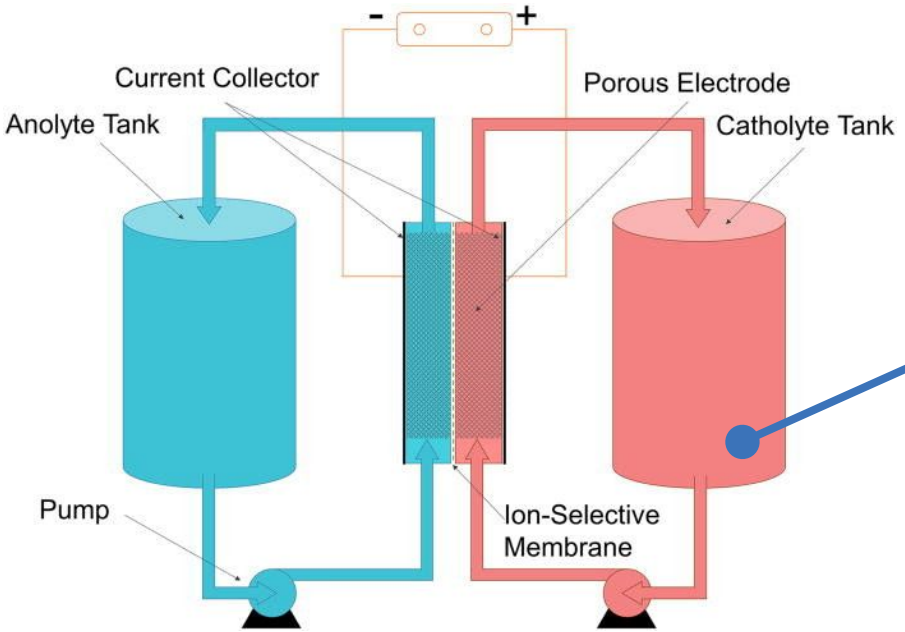
- **Supply chain challenges** caused cost inflation
- Unstable demand due to **expiring tax incentives**
- Risky revenue profile with **79% non-recurring revenue**



# What are Flow Batteries (Long Duration Energy Storage)?

**Increase value of renewable energy solutions** (extend **from ~25% to 80+%** capacity utilization)

Rechargeable batteries that store energy in liquid chemical solutions.

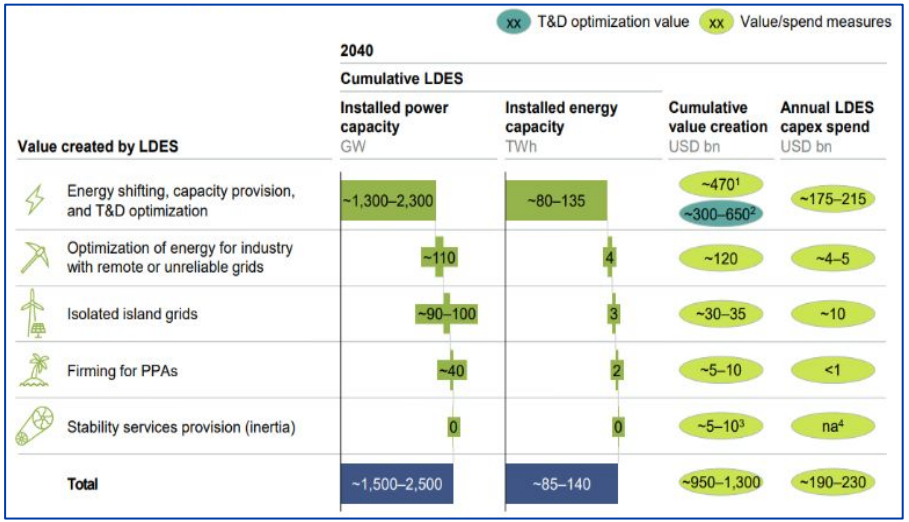


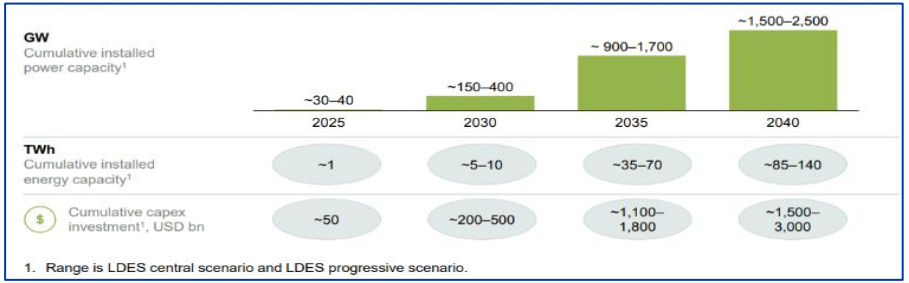

**Easy to scale** by adjusting the tank size. This feature makes it suitable for **Long Duration Energy Storage (LDES)**

Able to **separate energy storage capacity from power output**

# LDES primarily creates value for the grid, with a TAM of ~$200B and CAGR of ~32% until 2040

- **Utility-scale applications** like energy shifting, capacity provision, and T&D optimization **have ~90% of TAM**
- Energy shifting, capacity provision are **service-based revenues**
- Expected **~65 - 140 TWh installed by 2040**
- **~32% CAGR** for battery demand by 2040




(Source: McKinsey LDES Whitepaper)

# Research Question

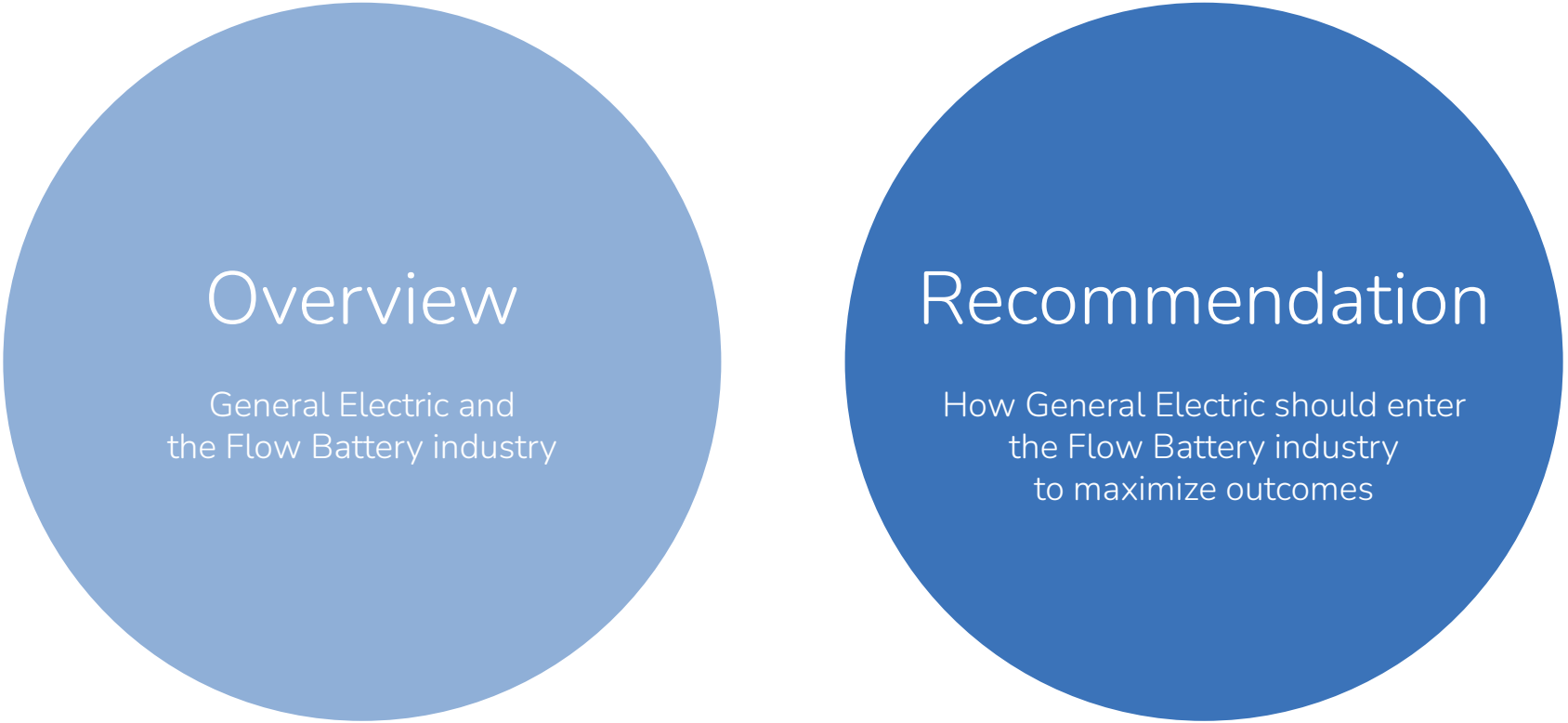
What strategies should General Electric pursue to **increase profitability** and **establish a sustainable competitive advantage** using flow battery technology in the utility-scale storage market?

**Restore previous ATH net margins of 8%**

**Increase service-based revenue to 50%**

**Sustainable competitive advantage through 2040**

# Roadmap


Overview
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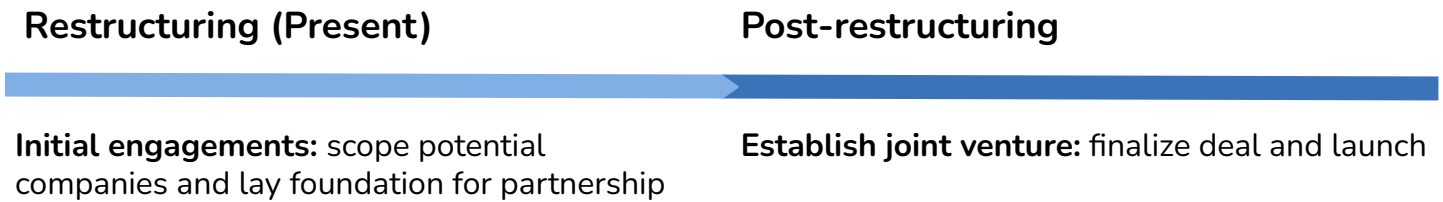
General Electric should pursue **initial engagements** of forming a **joint venture** with LDES companies **for after restructuring is complete.**



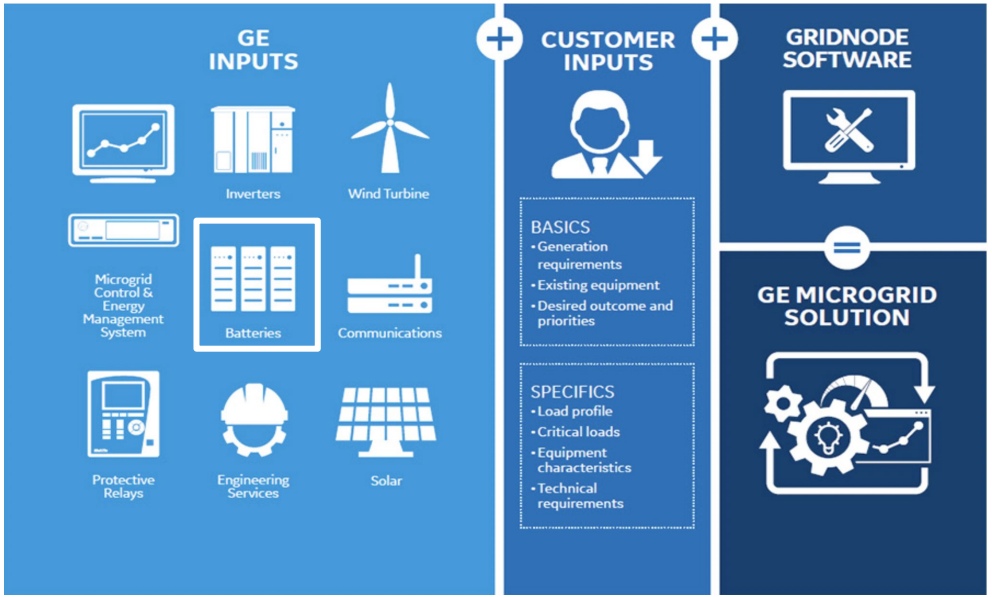
# Implementation: Seek to establish a Joint Venture (JV) with an LDES company

- **Collaborate** via joint venture with ESS Inc., a startup that pioneers iron flow batteries
- **Integrate** ESS's technology into GE's current grid offerings by complementing its lithium ion batteries with LDES

**Leverage core competencies of both companies**

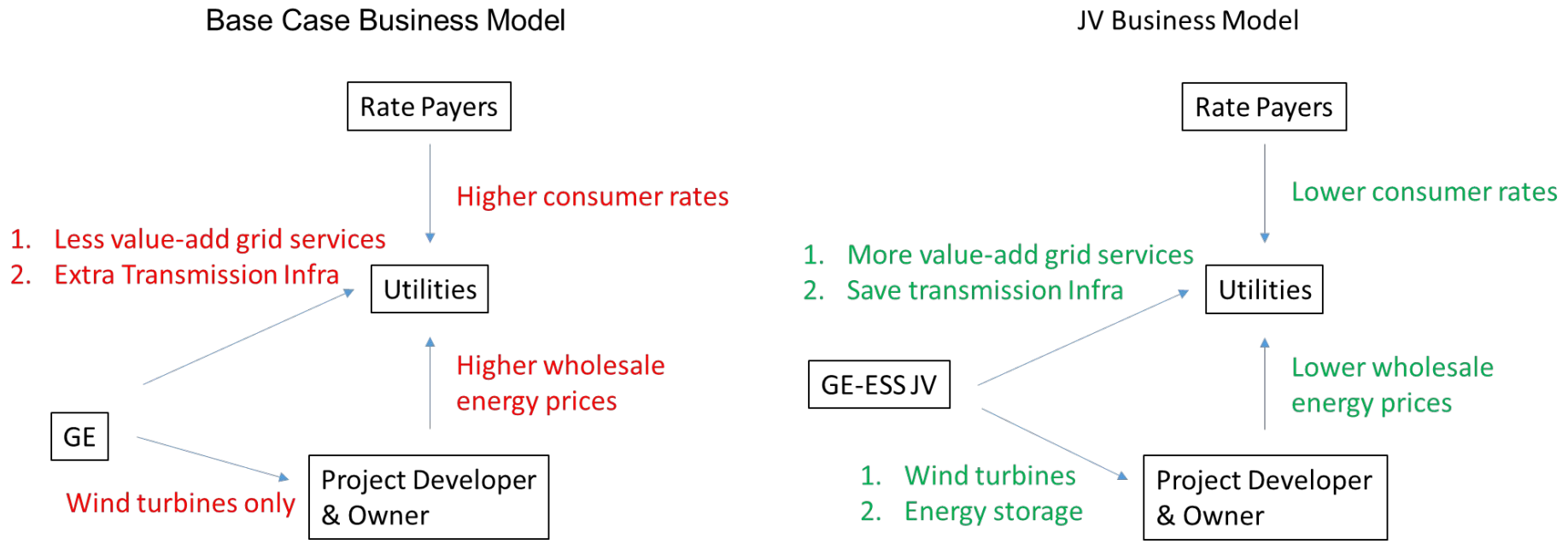
| General Electric | | ESS Inc. |
|---|---|---|
| • Holistic grid solutions (data services and T&D)<br>• Wind OEM |  | • Cutting-edge LDES technology<br>• Cost leadership |

# GE Grid Solutions are enhanced with iron flow batteries

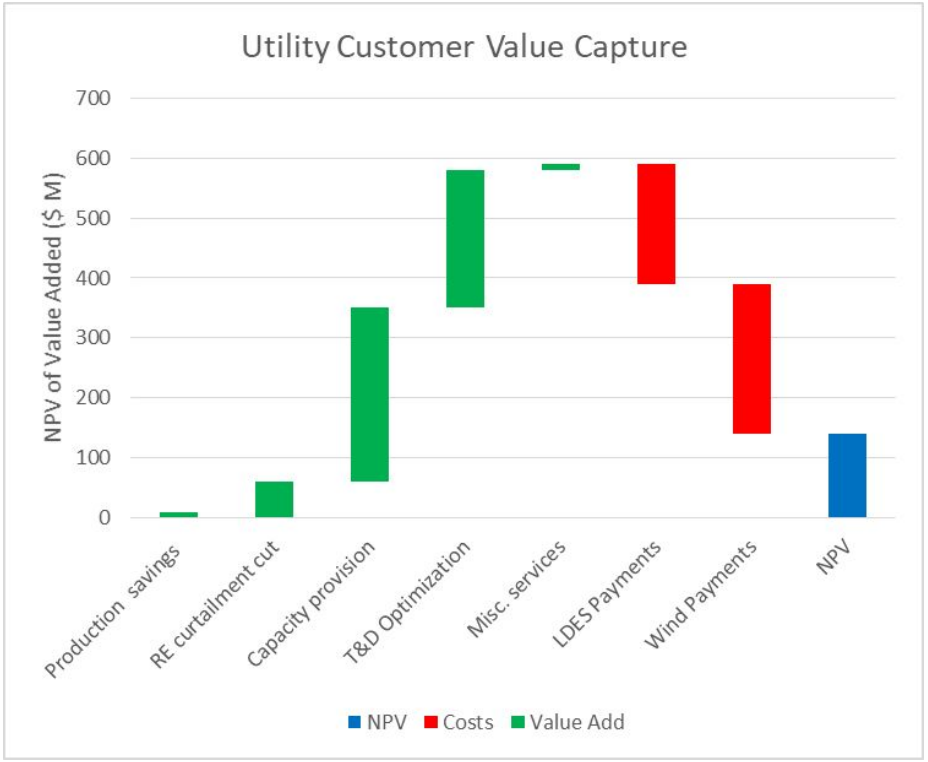


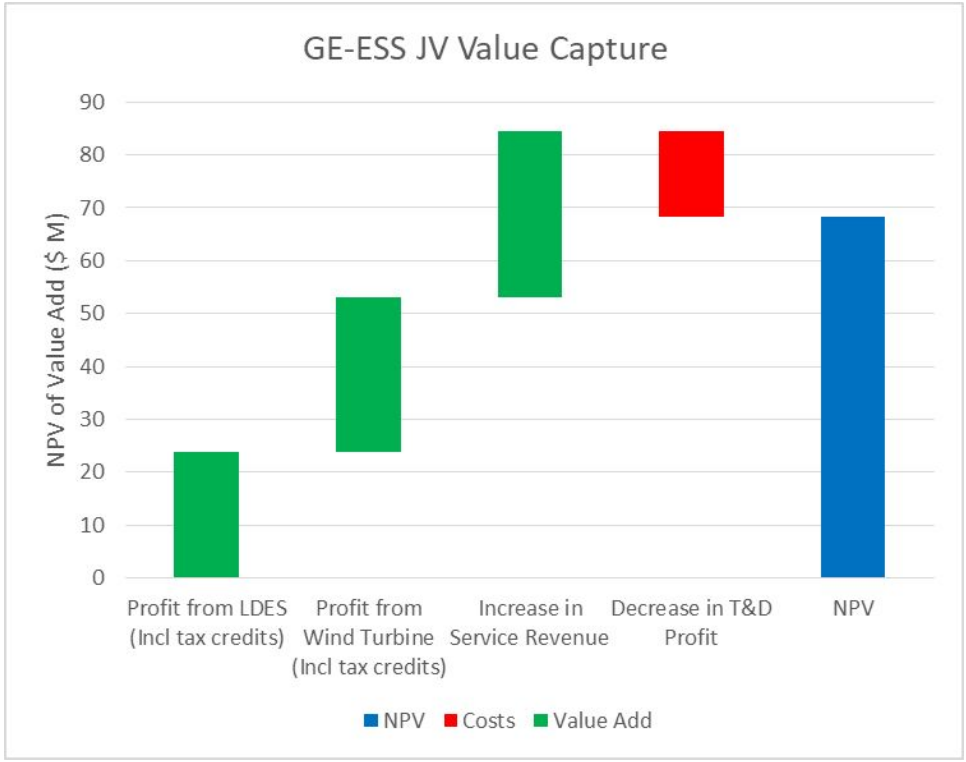

- **>15% improvement** in capital efficiency than lithium ion batteries
- **40% less** cost of ownership
- **Better performance:** no capacity degradation, unlimited cycling
- **Designed for a 25-year operating life**, which aligns with typical IPP and utility wind and solar project lifespans of 25+ years
- **Cleanest** and **most environmentally friendly**; made of iron, salt, and water

# Disruptive Business Model: Creates Value across Stakeholder Touchpoints



# Preliminary financials indicate significant upside potential of JV in 2025 (~9% IRR)



# Pursuing *initial engagements* to form the JV balances restructuring goals with long-term strategy

# Balancing Portfolios: GE's R&D aligns with JV

GE should prioritize Horizon 1 R&D on wind, data services, T&D infrastructure, with some Horizon 3 innovation on electrochemical R&D

## Horizon 1

- **Process innovation** improving **performance** and **scalability** of core competencies
  - Onshore wind, offshore wind, T&D infrastructure, energy storage, digital solutions, and cybersecurity
- Digital software patents

## Horizon 2

- Investing in **different sources of renewable energy** to improve diversification of power generation
  - Nuclear and other clean energy fuels

## Horizon 3

- Ambitious research projects to set new industry trends, such as immortal and **self-healing lithium ion batteries**
- Electrochemical flow batteries

# Ambidexterity: Pursuing *initial engagements* for a JV maximizes technological compatibility

## Cons of Launching JV During Restructuring

Joint ventures are a large management burden, which is **misaligned with the goals of restructuring.**

Flow battery technology is **still in R&D-phase.**

## Initial Engagements During Restructuring:

GE has **clear visibility** into future reduced restructured product lines

**Flow battery development** can be **tailored to GE hardware.**

Flow battery technology will **improve in cost and performance by the end of GE's restructuring.**

## Cons of Engagements After Restructuring

Lack of early-planning creates **technological compatibility risk**, creating hardware integration challenges.

**Competition from other renewable energy OEMs** for leading LDES technologies.

# Managerial Levers Allow for Organizational and Cultural Compatibility Post-Restructuring

## Goal alignment & Communication

Set up an **incentive structure**, **performance plan,** and profit shares

**Short duplicated communication channels** between two organization

## Bridge cultural differences

JV aligns with GE's goal to **focus on US market over international customers** after restructuring

**Emphasize shared values**: Environmental, sustainability, lean culture and transparency

## Maintain "lean" & customer centricity

**Partially restaff employees** on LDES-GE technology alignment

**Flat organizational structure**

JV **increases GE's customer centricity** due to deals using more customer pain points

# Conclusion

By pursuing **initial engagements** for a **joint venture** with LDES companies until restructuring is complete, GE can **balance their restructuring goals with long-term strategy** to maximize outcomes.

# Thank you

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# Appendix

# Presentation outline

1. Introduce GE and its problem:
2. Introduce LDES, value proposition, and its general market potential, research question
3. Recommendation Description
    a. **Implementation** / Recommendation: Target to establish a Joint Venture with LDES companies, where GE specializes in the grid software, integrative hardware, and renewable energy generation while the partner specializes in the LDES hardware technology
    b. **Business Model Selection** / Business Case
    c. Financial Analysis
4. **Recommendation Justification / Compatibility**
    a. **Balancing Portfolios** / Core Competencies and their horizons
    b. **Ambidexterity** / Technical Compatibility: Pursue initial engagements with LDES companies to establish future joint ventures during GE's restructuring
    c. **Managerial Levers** / Cultural and Organizational Compatibility:
5. Summary

# LDES Value Proposition

## Assessment of LDES-driven business cases

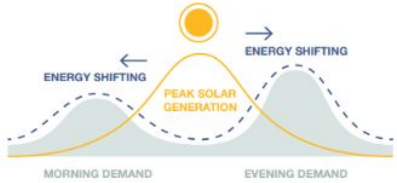
| Application | Case example | Customer example | IRR (potential improvement) | Value drivers for LDES | Key unlocks |
|---|---|---|---|---|---|
| **Energy shifting, capacity provision, and T&D optimization** | **US-based utility** | Integrated utilities with significant RE build-out and transmission bottlenecks between generation and demand | **~3%** (+11%) | T&D optimization<br>Capacity provision<br>$CO_2$e cost savings<br>RE curtailment reduction | Market mechanisms enab remuneration of $CO_2$e bene-fits for LDES asset owners<br>Regulatory options or incentives ensure WACC commensurate with RE development<br>Sustained carbon price in line with NDCs[1] |
| **Stability services provision** (eg, inertia) | | | | | |
| **Firming for PPAs** | **RE developer in Australia** | RE developers or owners looking to serve corporate RE PPAs with firmed capacity | **~7%** | Firmed capacity RE PPA premiums | Increase certainty for LDE developers through long-term contracting |
| **Isolated island grid optimization** | **Isolated island integrated utility in the US** | Integrated utilities serving isolated island power systems with decarbonization ambitions but limited interconnectivity | **~7%** (+5%) | Production cost savings<br>$CO_2$e cost savings | Regulatory options or incentives ensure WACC commensurate with RES development |
| **Optimization of energy for industries with remote/ unreliable grids** | **Diesel-powered copper mine in Chile** | Industrial customers looking to reduce the costs of energy supply and reduce carbon footprint of products | **~15%** (+4%) | Production cost savings<br>$CO_2$e cost savings | Market mechanisms enab remuneration of $CO_2$e benefits for LDES asset owners |
| **On-demand RE peak power** | **RE developer in India** | RE developer in India providing morning and evening peak supply as well as off-peak generation | **~10%** (+2%) | Peak and off-peak power supply | Increased electricity pricin spread and higher need f clean dispatchable peakin power |

1. Nationally determined contributions.

## Overview of LDES applications

### Energy shifting, capacity provision, and T&D optimization

Peak generation from renewables does not align with peak demand for electricity. LDES can play a role in shifting electricity from times of high supply to times of high demand.





### Alongside this, LDES provides value in other ways, for example …

**Supporting island grids**

Power systems that are not connected to a large grid can use LDES to generate reliable power (e.g., a power grid on a small island).


**Providing stability services**

Electricity grids require stability. LDES can be used to correct instabilities (e.g., transmission outages can be rectified by LDES).

**Firming for RE PPAs**

Renewable power-purchase agreements can use LDES to ensure that businesses can procure 100% renewable electricity.


**Supporting industries wit remote or unreliable grid**

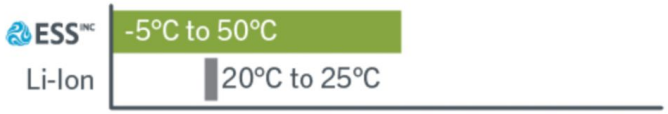
Large power users can use LDES ensure reliable power in areas whe they are isolated from the grid or t grid is unreliable (e.g., remote hea industry).

# ESS Performance Advantages

## Operational Flexibility


## Longer Asset Life

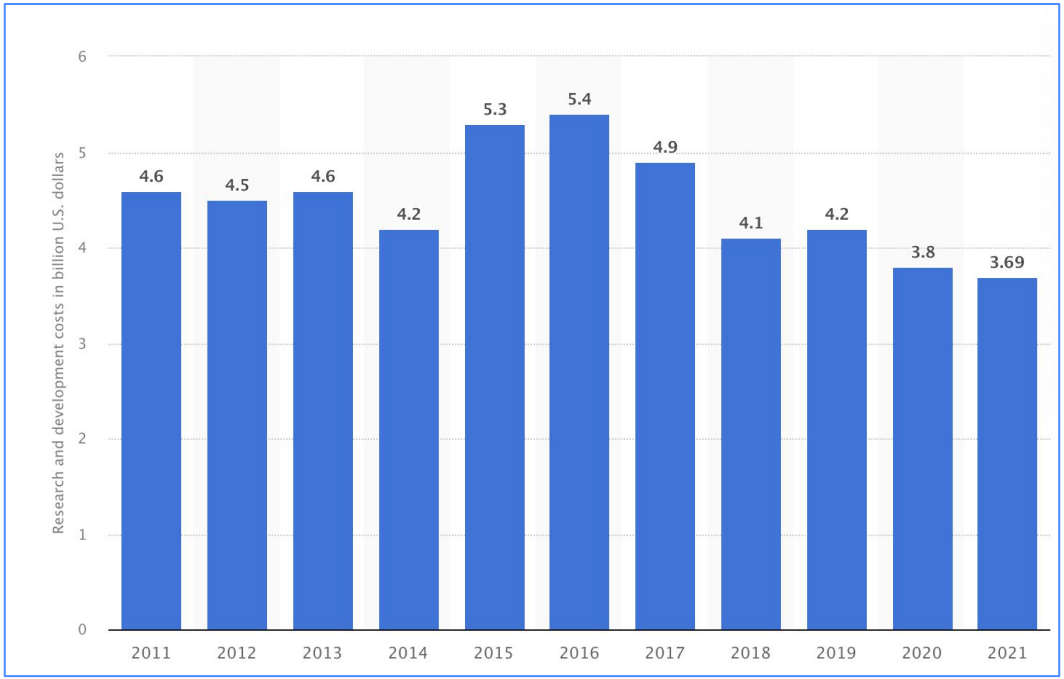

## Superior Ambient Operating Temperature




## Safety

# GE R&D Spend

GE's competitive advantage lies not in the hardware itself, but rather the full delivery of their grid solutions, with supporting hardware like transmission and distribution infrastructure, optimized systems performance, backed with data analytics.



# GE overview, challenges, restructuring, recommendation overview

GE is in the process of restructuring its core business. Spinning off GE Vernova, which houses GE Renewable Energy and GE Power.

The Covid-19 pandemic, supply chain disruptions, inflation, and political uncertainties have especially impacted wind power businesses across the renewable energy industry.

Improved energy storage offerings (LDES) can help mitigate price volatility and maintain margins.