

The background features a dark blue gradient with large, overlapping, semi-transparent shapes in shades of purple, pink, and orange, creating a modern, abstract design.

# AWS re:Invent

NOV. 27 – DEC. 1, 2023 | LAS VEGAS, NV



ENU203

# NextEra Energy & AWS: Renewable energy innovation & grid modernization

**Milan Davé**

Senior Director, Origination  
NextEra Energy Resources

**Joshua Gary**

Director, Enterprise Data  
NextEra Energy

**Alaina Bookstein**

Global Head of Strategic Partnerships  
AWS Energy



# Agenda

- 01 Changing energy landscape
- 02 Reinventing energy through cloud
- 03 Modernizing the grid to accelerate decarbonization
- 04 NextEra Energy
- 05 Complexity of decarbonization
- 06 Using data for accurate decarbonization journeys
- 07 What the future holds

# Cloud technologies are critical in supporting the energy transition and enabling a modern energy grid



**RAPID ENERGY DIVERSIFICATION**  
non-fossil fuel share of primary energy grows up to 34% by 2050



**INCREASING ELECTRIFICATION**  
global electricity generation will increase by up to 76% by 2050



**DECARBONIZATION**  
Global investment in clean energy is on course to rise to USD 1.7 trillion in 2023



**RAPIDLY EVOLVING**  
EV sales jumped from 9% in 2021 to 14% in 2022, a 10x increase from 2017

# Energy companies are reinventing themselves through cloud to help navigate the energy transition



Advanced analytics



AI/ML



HPC



IoT/Edge



Increase energy production



Lower costs



Lower emission



Reduce risk



Maximize safety & security

# Modernizing the energy grid to accelerate the energy transition

## GRID OPERATIONS



To meet national climate targets, grid investment globally needs to nearly double by 2030 to over USD 600 billion per year

## INTERCONNECTION



At least 3 000 gigawatts (GW) of renewable power projects, of which 1 500 GW are in advanced stages, are waiting in grid connection queues

## SIMULATION



To achieve a decarbonized electricity sector, the electric grid must expand 2-5 times, underscoring the need for planning & simulation technologies

## ENGAGEMENT



As customers become more informed, they are seeking energy management programs that can help drive decarbonization



# AWS for Energy

## Extensive energy industry expertise

- Geophysicists
- Geologists
- Sub-surface professionals
- Transmission operators

## AWS for Energy

## Unrivaled technology expertise

- Solution architects
- Cloud professionals
- Software development engineers
- Systems engineers
- Programmers
- Security professionals



**400+**  
Energy specialists



**17**  
Avg. years of energy experience



**7,000+**  
Industry customers



**200+**  
Energy solutions and accelerators



**100K+**  
Energy partners

# Leading energy companies across the value chain are successfully transforming on AWS



Increasing  
Production



Lowering  
Costs



Lowering  
Emissions



Maximizing  
Safety & Security





**We are at an inflection point for  
our commercial & industrial  
markets and the U.S. economy.**

***Decarbonization is everyone's legacy***

# NextEra Energy is a clean energy leader

COMPOSED OF TWO PRIMARY BUSINESSES



## NextEra Energy, Inc.

- Fortune 200 company<sup>1</sup>
- 95-year track record
- \$21B operating revenue<sup>2</sup>
- 67 GW in operation<sup>3</sup>
- NYSE: NEE

1. Fortune's 2023 Rankings
2. As of 12/31/22 Annual Report 2022 Form 10-K
3. Gigawatts shown include assets operated by Energy Resources, including those owned by NextEra Energy Partners as of 3/31/23; excludes assets which have been sold parties but continue to be operated by Energy Resources. Investor Report 2022.



## NextEra Energy Resources, LLC

- World's largest generator of renewable energy from the wind and sun
- 34 GW net generating capacity<sup>2</sup>
- Operating in 40 states & Canada<sup>2</sup>



## Florida Power and Light (FPL)

- One of the largest U.S. electric utilities<sup>2</sup>
- 5.8MM customer accounts<sup>2</sup>
- 31 GW net generating capacity<sup>2</sup>

# NextEra Energy's goals

OUR GOAL IS TO BE COMPLETELY CARBON EMISSIONS FREE BY NO LATER THAN 2045

1

Decarbonize our  
own business

2

Decarbonize the  
U.S. power sector

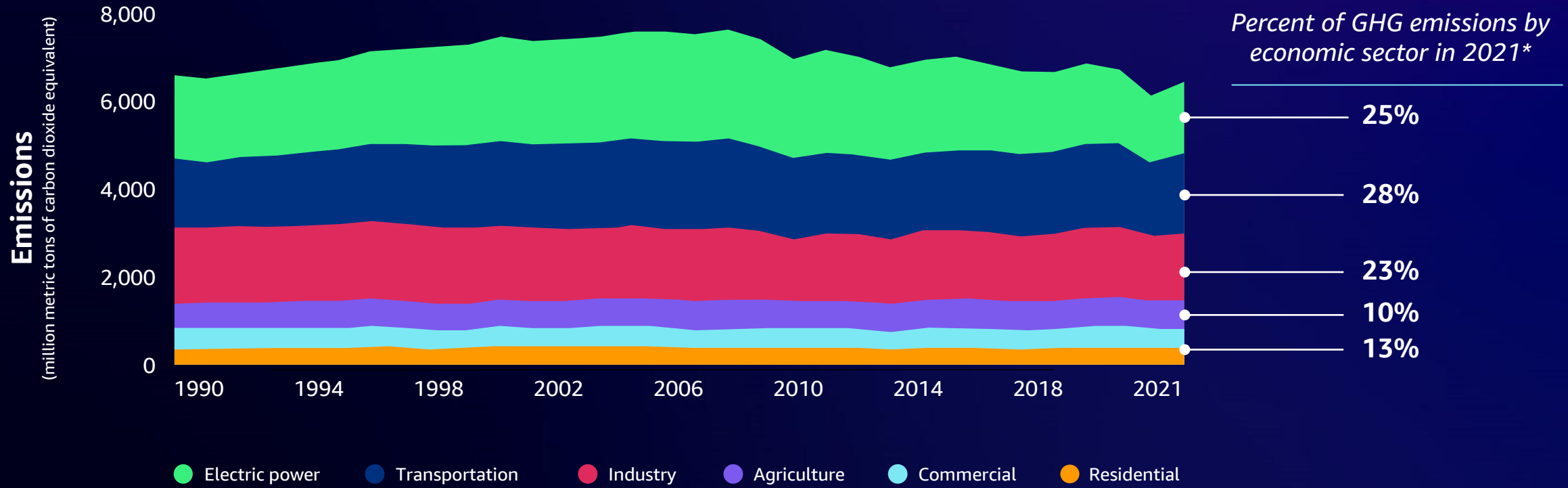
3

Lead the  
decarbonization of  
the U.S. economy

# Let's zoom in for a minute: We are making progress in lowering carbon emissions

BUT THERE IS MORE WORK TO BE DONE

### U.S. greenhouse gas (GHG) emissions by economic sector, 1990–2021



Source: Environmental Protection Agency

\*Residential and commercial are combined

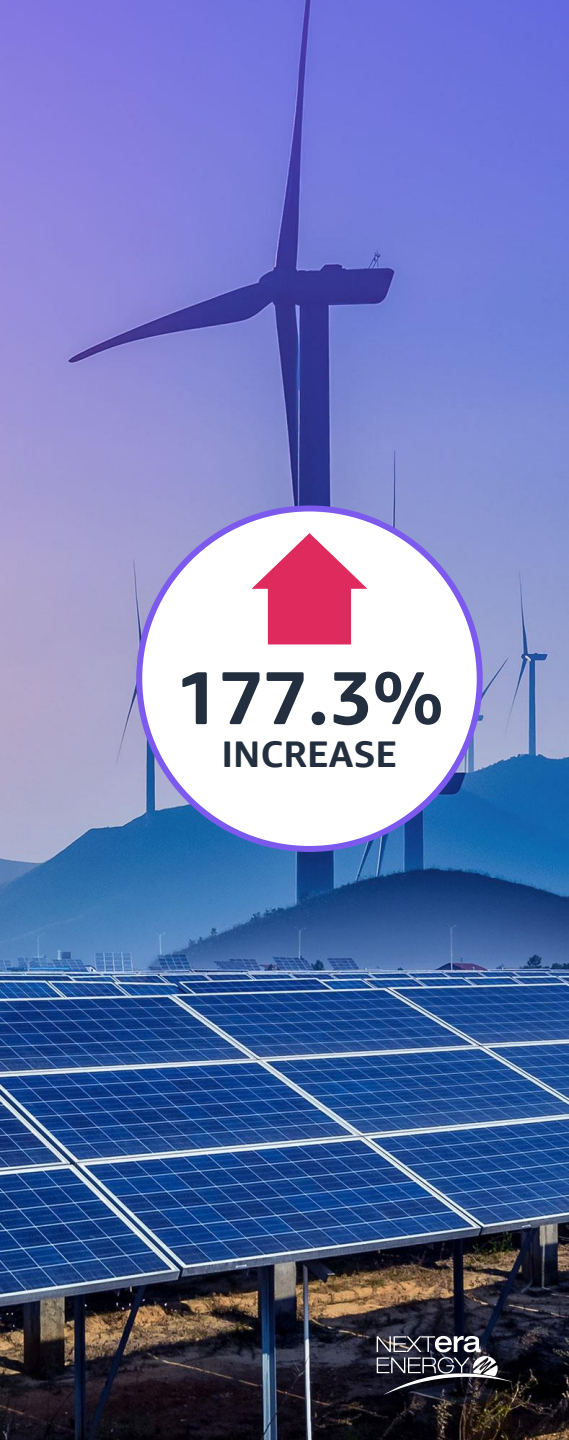


# Setting decarbonization goals has been increasing

More companies making commitments to decarbonize, which increases overall market complexity



**177.3%**  
INCREASE





# How we can decarbonize the U.S. economy

MULTIPLE SOLUTIONS ARE PACKAGED TOGETHER TO REDUCE EMISSIONS

Goals	Onsite, offsite backup generation & energy storage	Energy analytics & software	Energy consulting	Energy efficiency solutions	Fleet electrification & EV infrastructure	Energy supply	Green hydrogen & renewable fuels	Renewable energy credits & carbon offsets	Water reclamation
Reduce energy cost	✓	✓	✓	✓	✓	✓			
Reduce carbon emissions	✓	✓	✓	✓	✓	✓	✓	✓	
Improve resiliency/ power quality	✓	✓	✓	✓	✓		✓		
Improve company/ investor image	✓	✓	✓	✓	✓	✓	✓	✓	✓



“

**The complex decarbonization journey needs a tailored, data-driven design to effectively reduce emissions.**



# Using data for accurate decarbonization journeys



# Increasing resolution

EVERY BREAKTHROUGH IN HISTORY HAS BEEN ACHIEVED BY INCREASING RESOLUTION



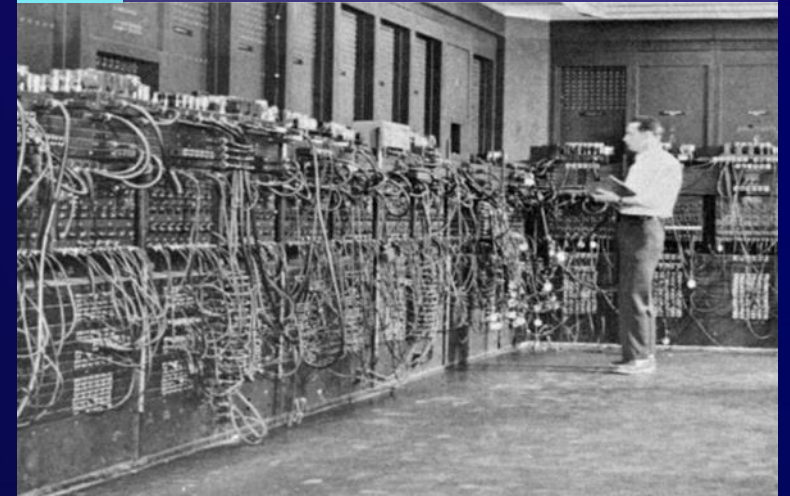
## ASTRONOMY



## MICROBIOLOGY



## COMPUTING



# A multidimensional problem

WEATHER IMPACTS RESOURCE, GENERATION IS DISTRIBUTED, AND LOAD IS CONTROLLABLE



# Central availability of clean, accessible and highly performant data is critical to solving this problem



← Enterprise Data Platform (EDP) on AWS →

CAPTURE    INGEST    STORE    CLEAN    INTEGRATE    ORGANIZE    DELIVER    CONSUME



# NextEra Analytics Generation Entitlement (GenE)

TO SOLVE A MULTIDIMENSIONAL DATA CHALLENGE, WE HAVE USED OUR IN-HOUSE PATENTED ALGORITHM CALLED GEN-E

Every day, NextEra Analytics analyzes over 20B data points from nearly 24,000 generators representing 30 GW of installed capacity

- Improves performance and reliability
- Provides feedback into design decisions (HUGE!)
- Example: Learned that industry needs to use **minute-level solar modeling** instead of hourly to make investment decisions

---

Built on AWS, the data and insights gained allow us to improve our tools and innovate on new products that unlock even more business value

---



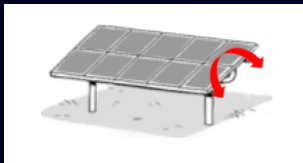
# Better solar

CAPITALIZING ON MINUTE-BASED ANALYSIS: ASSESSING AND DESIGNING A SOLAR PROJECT IS A COMPLEX ENDEAVOR WITH MULTIPLE CONFLICTING DECISIONS

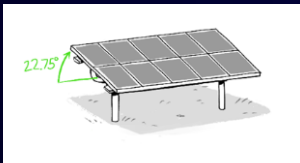
$$\text{Project layout economics} = f \left[ \text{Energy yield}, \text{Costs}, \text{Market price} \right]$$



**DC size**  
Number of panels



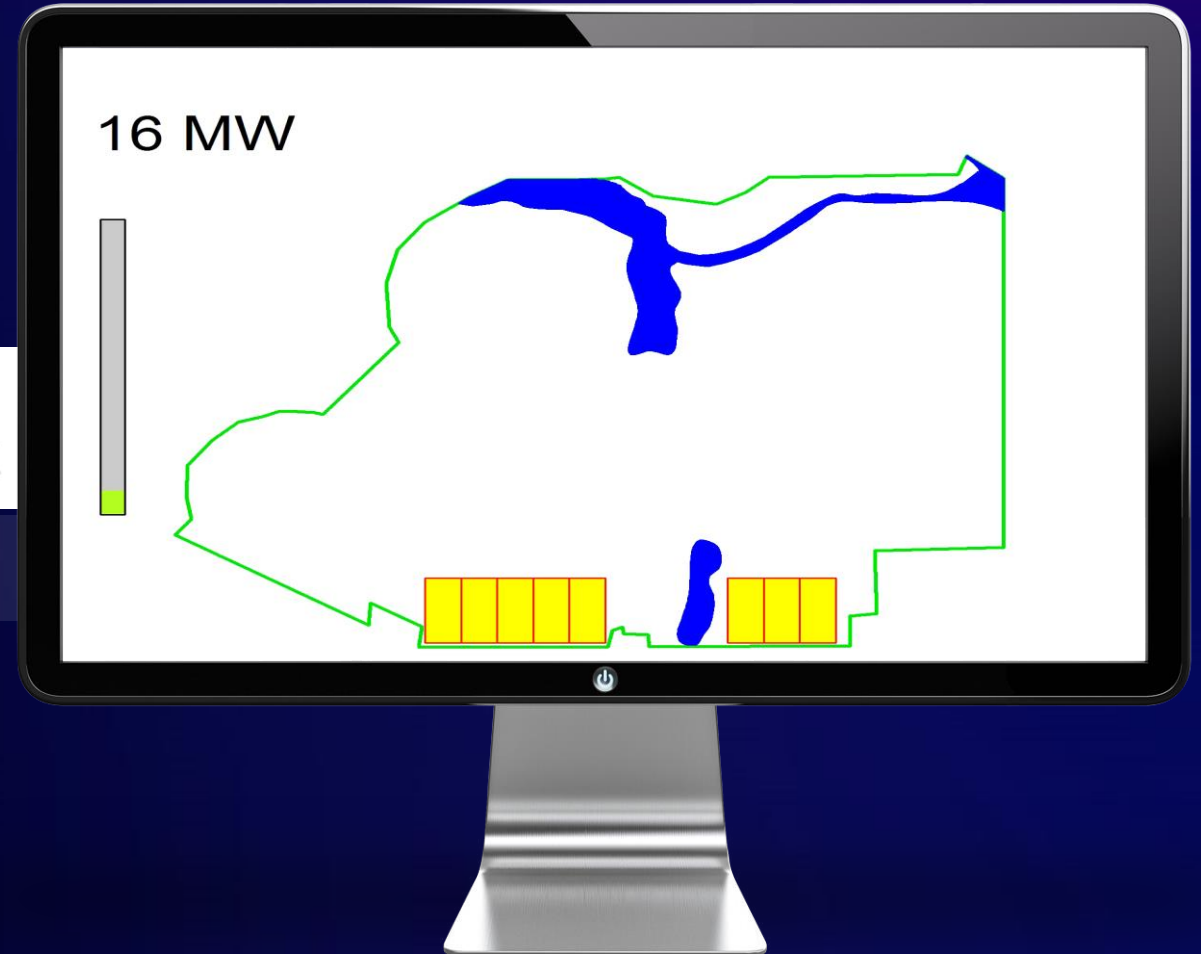
**Rack system**  
Tracking or fixed



**Tilt degree**  
Fixed angle to the Sun



**Spacing**  
Ground coverage





# Improving wind farm design

LET'S UNDERSTAND THE DIFFERENCES BETWEEN DESIGNING SOLAR AND WIND

## Typical solar project:

- Measures 1–2 miles across
- Generally has 5–10 obstacles
- Compact block
- Contains “constant” resource

## Typical wind project:

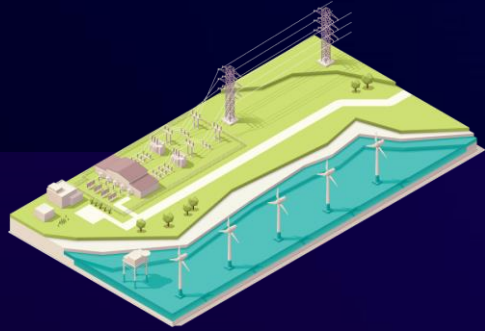
- Measures 10–20 miles across
- Generally has 10–30K obstacles
- Interwoven with community
- Variable resource





# Wind project optimization

A FULL WIND PROJECT DESIGN OPTIMIZATION REQUIRES EXTENSIVE COMPUTING POWER



Evaluates  
**30,000,000+**  
wind resource  
data points  
  
**10,000+**  
site-specific  
design constraints



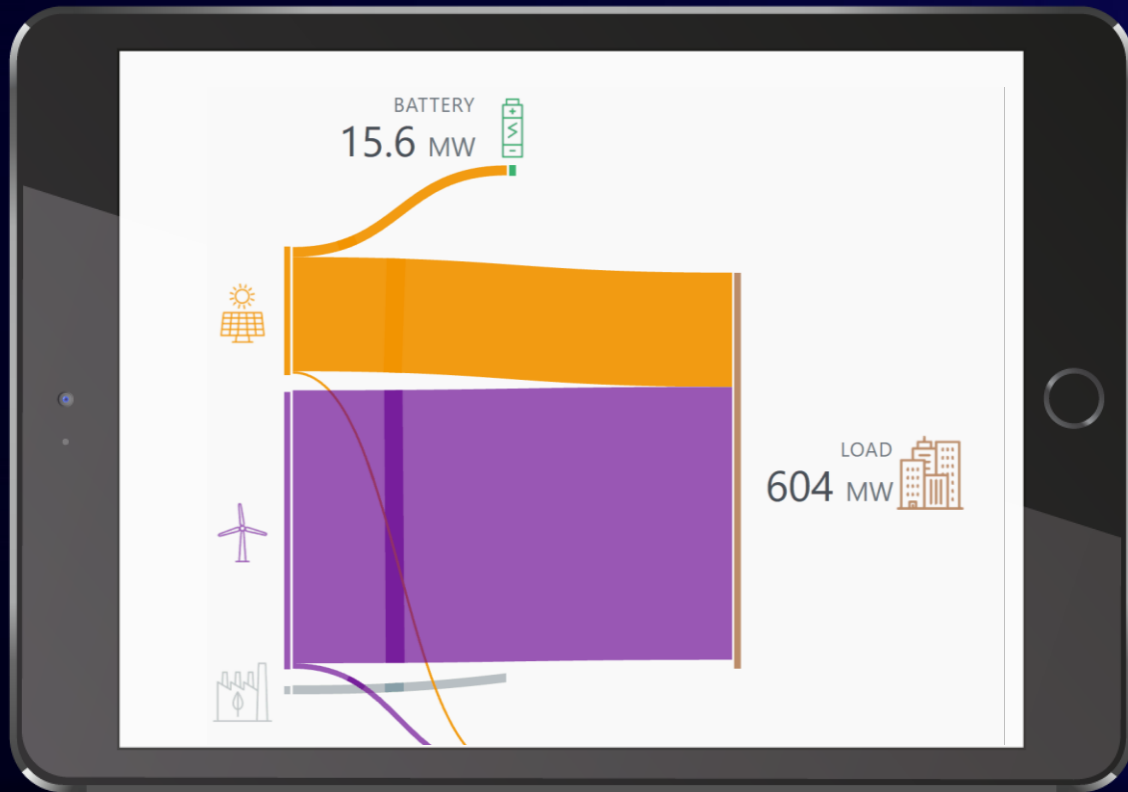
Evaluates  
**10,000,000+**  
turbine siting  
combinations



Complete in  
**~24 hours**  
  
5 designs  
would have taken  
~4 weeks in 2017

# Battery optimization

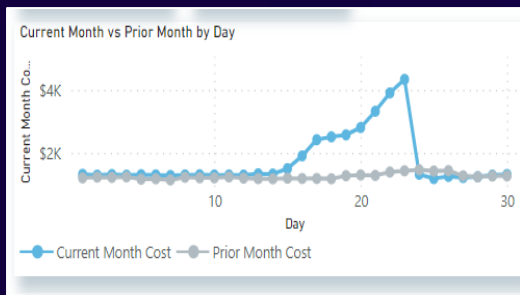
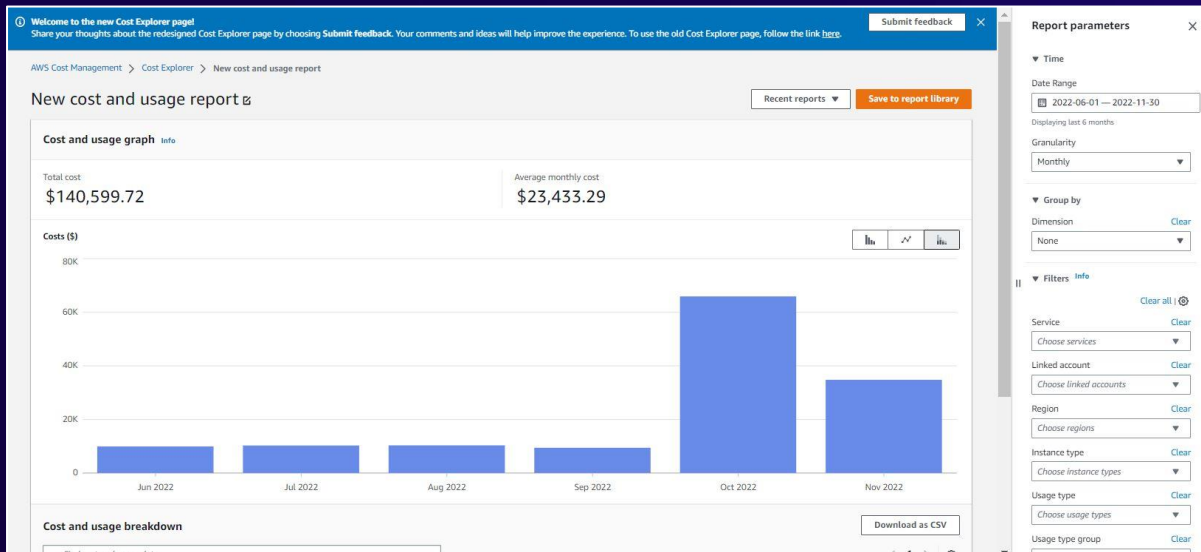
OPTIMIZING THE REAL-TIME SCHEDULING AND DISPATCH OF ENERGY AND LOAD, RESULTING IN TOTAL ENERGY COST SAVINGS



1. **Supply optimization** – AI-powered tools to design a renewable solution that matches load at the lowest COE
2. **Net demand forecasting** – detailed and aggregate net forecast of load and generating facilities
3. **Procurement optimization** – machine learning algorithms deliver savings by identifying procurement opportunities in day-ahead and real-time markets
4. **Load modification** – reduce supply cost by optimizing load shape to reduce demand charges, shift peaks or minimize shape risk with forward hedges
5. **Portfolio monitoring** – transparency into real-time energy performance

# Financial discipline along the journey

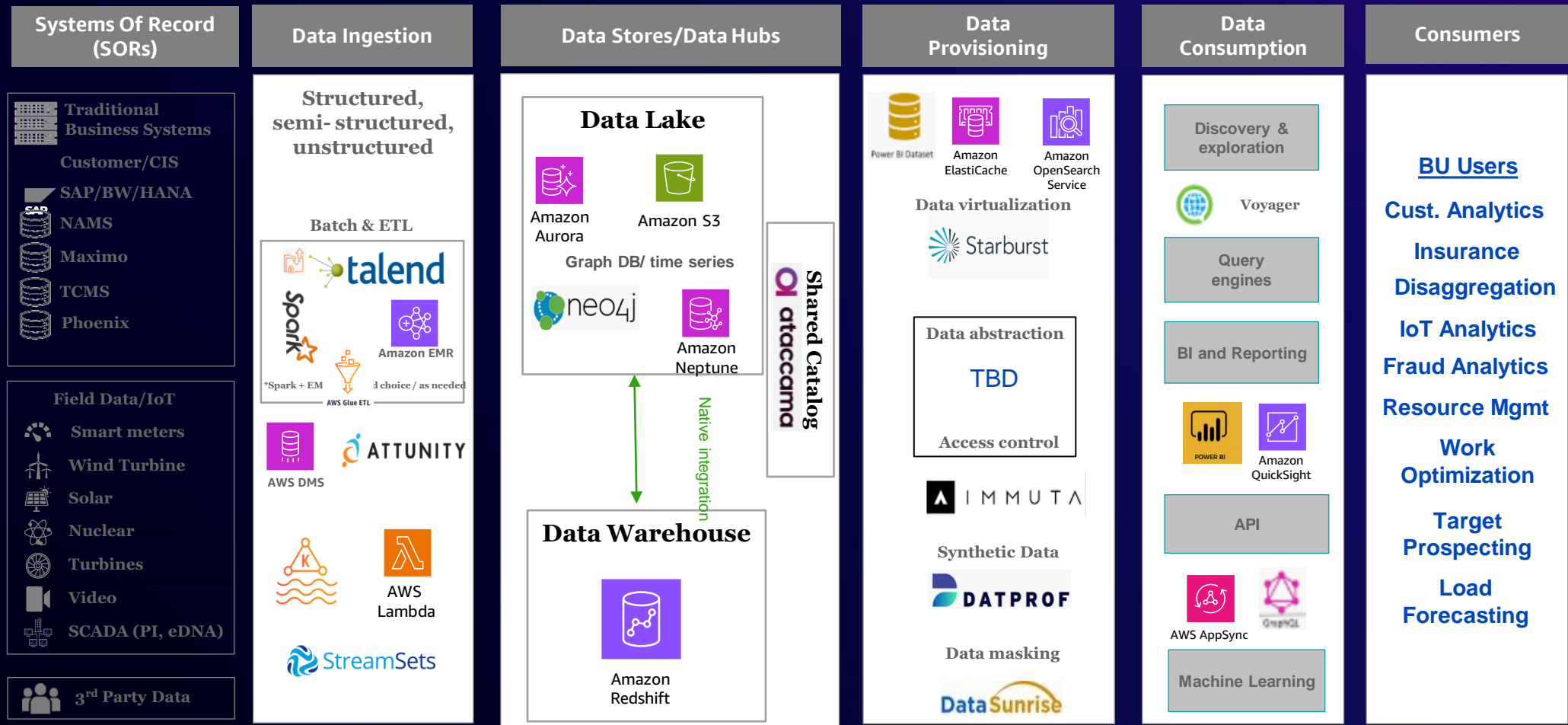
ENABLING THIS KIND OF INNOVATION REQUIRES DELIBERATE ATTENTION ON BUILD AS WELL AS OPERATIONAL MAINTENANCE COSTS IN THE CLOUD



NextEra Analytics applies a rigorous set of cost management techniques against cloud resources to ensure maximum cost performance and triple 9 reliability, while maintaining near-infinite scale with the power of AWS

1. **AWS Cost Explorer** → Out-of-the-box functionality allows incredible transparency to current spend
2. **NEE Cost Copilot** → Custom algorithms proactively monitor and self-heal resources that deviate from expected performance and cost
3. **Strategic account consolidation** → Gives the flexibility to bundle services to achieve the maximum discounts offered by AWS
4. **Dedicated FinOps teams** → Tightly aligned with AWS technical and account management groups to provision and enable new services to continue to drive down cloud costs

# AWS Quickly became the technical backbone of EDP (Enterprise Data Program)



# Leveraging AWS offerings and services

AS THE PROGRAM HAS GROWN, AWS HAS SUPPORTED NEXTERA ENERGY'S ENTERPRISE DATA JOURNEY WELL BEYOND INFRASTRUCTURE



## CONSULTING & BEST PRACTICES

- Cloud data expertise
- Standards and governance
- Leveraging the partner ecosystem



## INDUSTRY NETWORKING

- Introductions to clients
- Facilitating knowledge sharing



## NEW SERVICES & TESTING

- Beta test opportunities
- Early access to understand upcoming features



## COST MANAGEMENT

- Proactive reporting
- Guidelines for migrating to AWS

# Centralized data analytics

CONTINUES TO ENABLES NEW VALUE MORE QUICKLY THAN PLANNED



## Predict and secure demand

- Clean energy solutions
- Lead profiling
- Land acquisition



## Build assets

- Drones
- AI/ML
- Automation



## Customer analytics

- Fraud detection & prevention
- Proactive monitoring
- IvR & customer experience



## Resource management

- Onboarding
- Access management
- Learning and development



## Weather impact

- Impact planning
- Load forecasting
- Damage modeling



## Asset intelligence

- Smart outages
- Predictive maintenance
- Value-based decisions

“

**Decarbonization is everyone's legacy and requires collaboration.**

***How will you leverage data and analytics to reach your goals?***



# Thank you!



Please complete the session survey in the mobile app

**Milan Davé**

milan.dave@nexteraenergy.com

**Joshua Gary**

joshua.gary@fpl.com

**Alaina Bookstein**

albookst@amazon.com

