

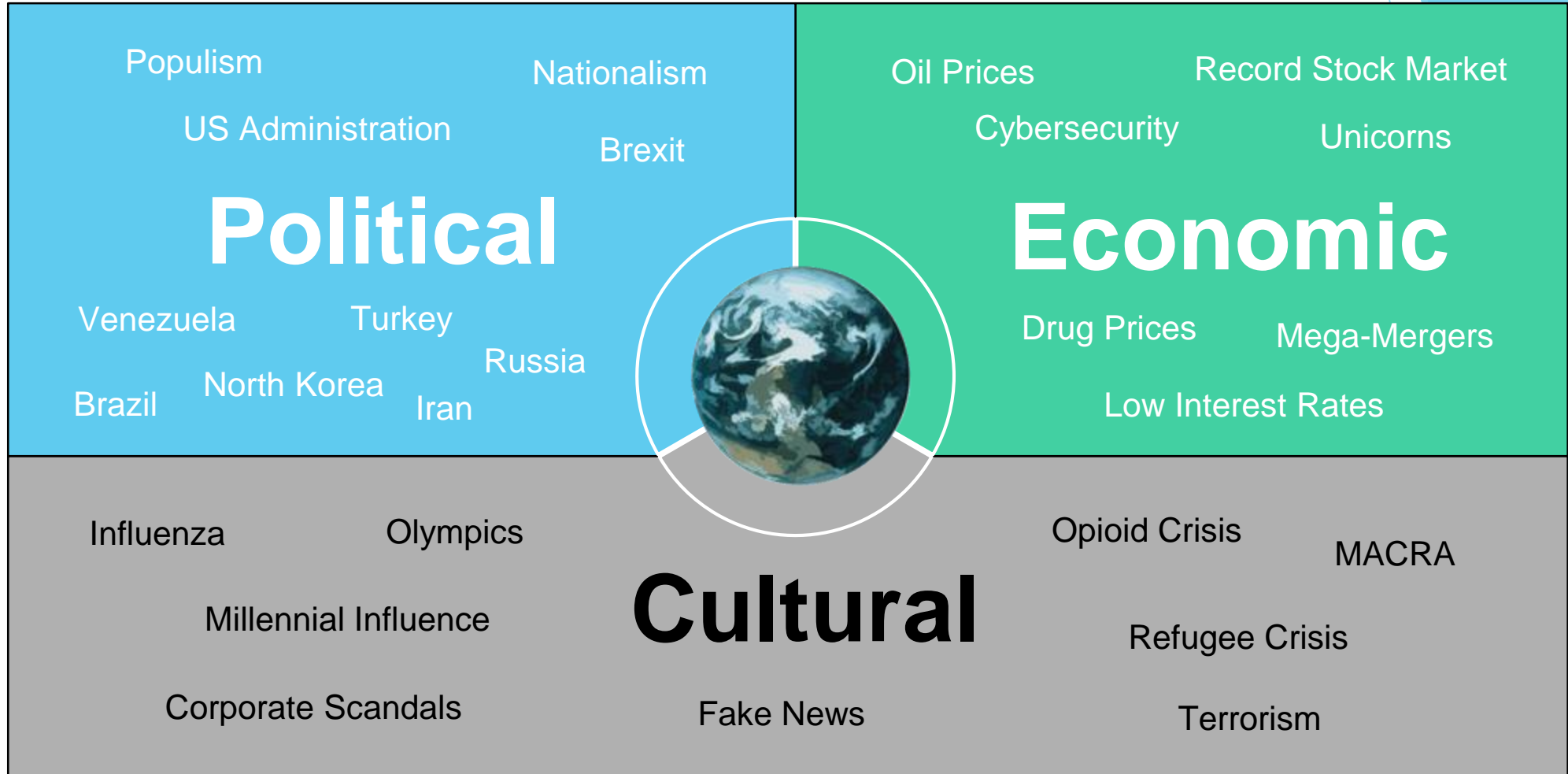
The World Cannot Wait: Innovations for the Energy Transition

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Founder, DF Strategies LLC

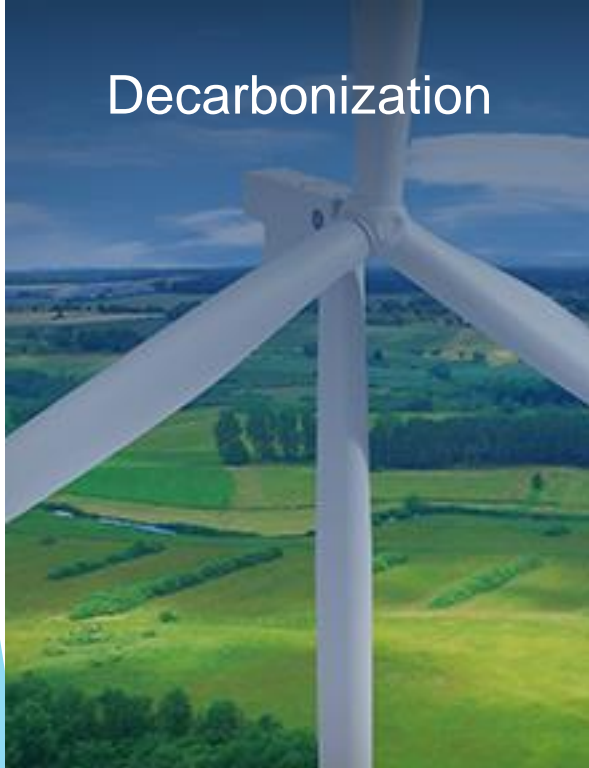
April 19, 2018

Energy transition continues amidst uncertainty

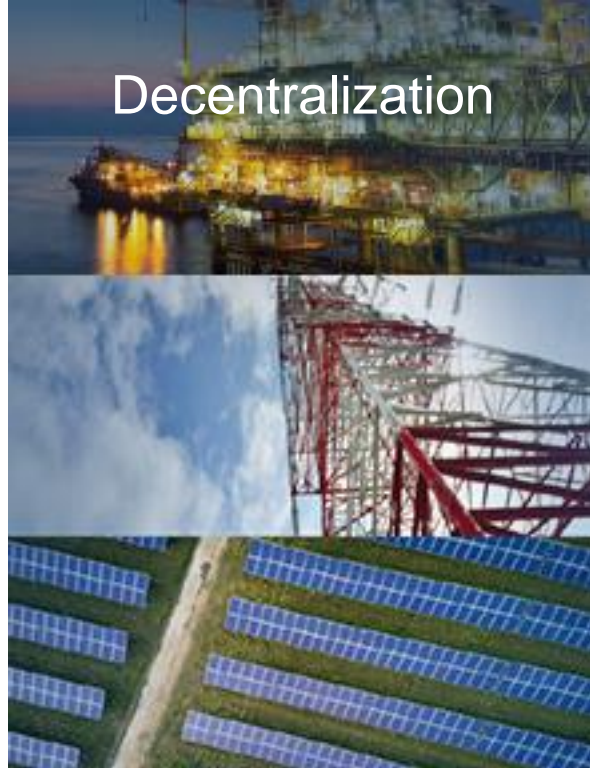


Drivers of the energy transition

Decarbonization



Decentralization



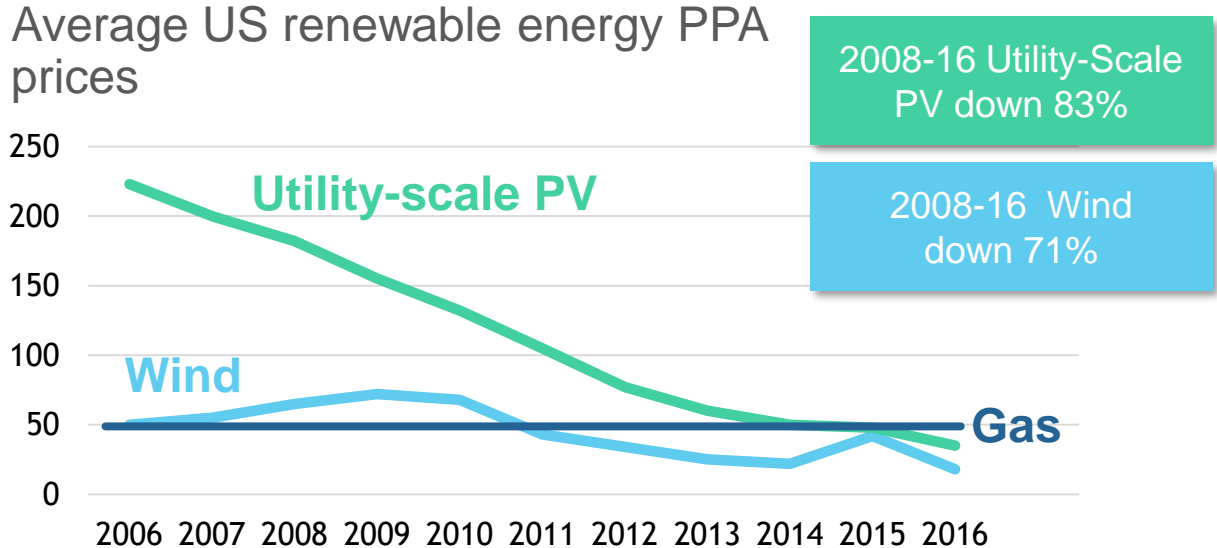
Digitization



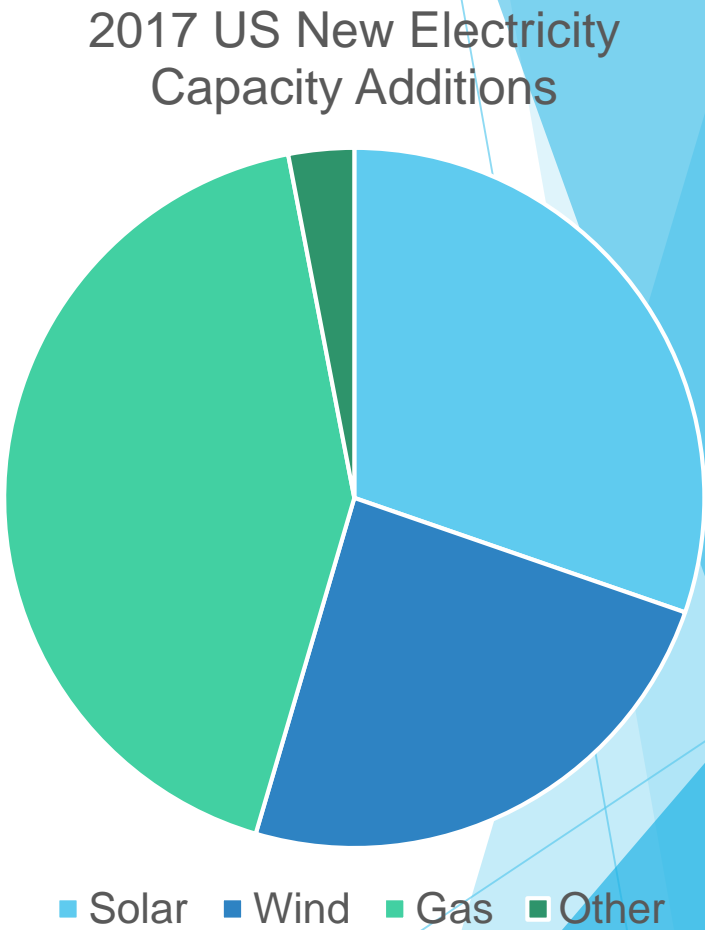
Mobility Disruption



Decarbonization – competitive clean energy



Note: Levelized, time-of-day adjusted contract price shown in real 2015 USD. 2016 PV PPA price based on preliminary data and subject to review. Source: U.S. Department of Energy (LBNL), Bloomberg New Energy Finance.



Source: SEIA 2018

December 2017 Solicitation:

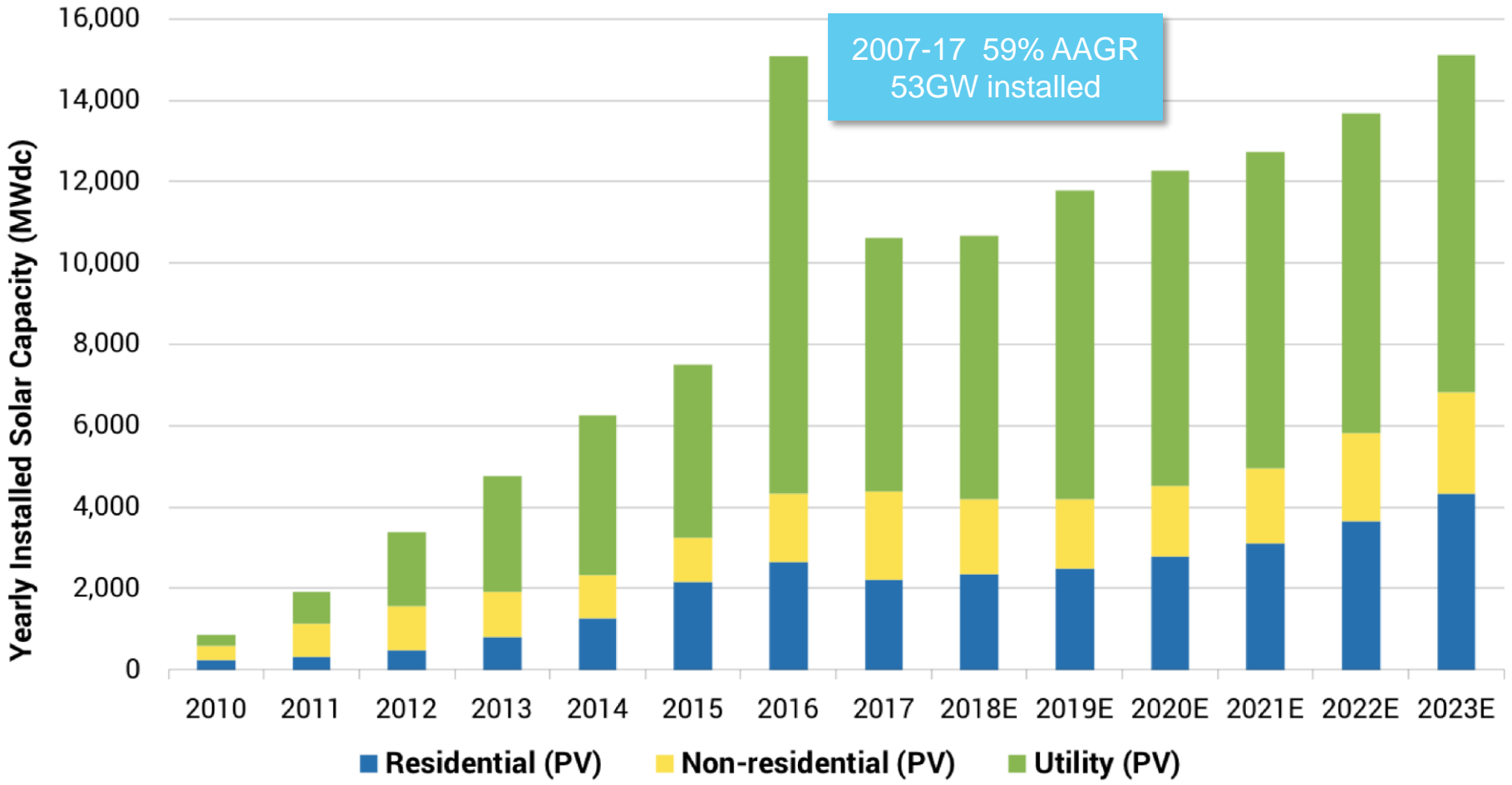


- 400 Bids
- \$21/MWh median wind+storage bid
- \$36/MWh median solar+storage bid

Source: Xcel Energy

Decentralization –distributed energy accelerating

U.S. Solar PV Deployment Forecast



2007-17 59% AAGR
53GW installed

Source: SEIA 2018

Digitization – maximizing operational efficiency

Industry

Cost Savings (\$B)

Carbon Reduction (Mt/y)



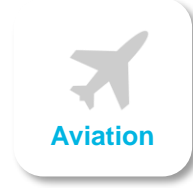
\$14

495



\$30

132



\$14

45



\$3

19



\$20

132

Close the global carbon gap by almost **30%**

C02 emissions could be reduced by **823Mt** annually

Industry could save **\$81B** per year in fuel cost

Source: "Digital Efficiency: Driving Decarbonization and Unlocking Business Value Across Industries" whitepaper, GE and Intel

Disruption – big in mobility

Connected

- Ride sharing
- Fleet & logistics
- Autonomy
- Electrification



Energy transition needs innovation from everywhere

Corporations



Build Your Dreams

Startups



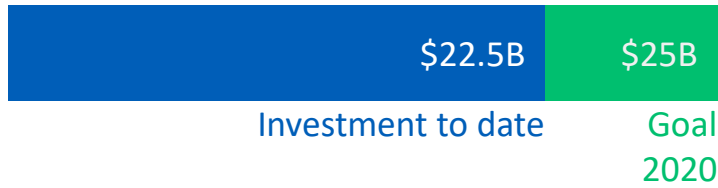
Government



Corporate innovation: Ecomagination case study

Investment

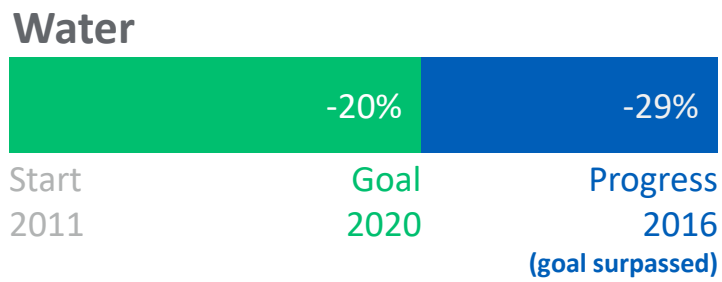
Ecomagination R&D investment commitment:



Ecomagination solution revenue to date:
\$300B

Environmental Impact

GHG emissions and reduction progress:



Solutions

80 Ecomagination qualified Solutions:



Delivering economic and environmental outcomes for customers and the world

Ecomagination solutions drive customer outcomes

GE Healthcare | GE Aviation (GE Aviation) | GE Power (GE Power)

Safer health care with less medical waste

THE CHALLENGE
The industry's 4.5 million medical waste containers were inefficient, bulky, and difficult to handle, posing a significant safety and environmental risk. GE Aviation's GE Healthcare solution replaced 4.5 million containers with 1.9 million containers, reducing weight and volume by 60%.

GE SOLUTION
GE Aviation's GE Healthcare solution replaced 4.5 million containers with 1.9 million containers, reducing weight and volume by 60%.

THE IMPACT
1.9 million containers replaced
60% weight and volume reduction
\$250 million saved

GE Transportation | GE Power (GE Power)

Illuminating the future today

THE CHALLENGE
Lighting technology on railroads, which is essential for the safety of passengers and freight, is aging and inefficient.

GE SOLUTION
GE Transportation's GE Power solution replaced 6,400 conventional railcars with 1.9B LED lights, saving energy and reducing maintenance costs.

THE IMPACT
6,400 conventional railcars replaced
1.9B LED lights installed
5,000 tons of SO₂ emissions avoided
3,000 tons of NO_x emissions avoided
4 million gallons of water saved

GE Transportation | GE Power (GE Power)

The most technologically advanced, diesel-electric, heavy-haul locomotive in the world

THE CHALLENGE
The GE Transportation GE Power solution replaced 4.5 million gallons of fuel with 1.9 million gallons of fuel, saving energy and reducing maintenance costs.

GE SOLUTION
GE Transportation's GE Power solution replaced 4.5 million gallons of fuel with 1.9 million gallons of fuel, saving energy and reducing maintenance costs.

THE IMPACT
4.5 million gallons of fuel replaced
1.9 million gallons of fuel saved
5,958 tons of CO₂ emissions avoided
\$2.1 million saved

GE Renewable Energy | GE Power (GE Power)

Harnessing the power of wind

THE CHALLENGE
The GE Renewable Energy GE Power solution replaced 200 million hours of wind turbine downtime with 1.9 million hours of wind turbine uptime, saving energy and reducing maintenance costs.

GE SOLUTION
GE Renewable Energy's GE Power solution replaced 200 million hours of wind turbine downtime with 1.9 million hours of wind turbine uptime, saving energy and reducing maintenance costs.

THE IMPACT
200 million hours of wind turbine downtime replaced
1.9 million hours of wind turbine uptime
160 million kWh of electricity generated
4 million gallons of water saved
600 tons of CO₂ emissions avoided
568 tons of steel saved

GE Power | GE Power (GE Power)

Industry-leading, high-efficiency, air-cooled gas turbine

THE CHALLENGE
The GE Power GE Power solution replaced 139 million kWh of electricity generated with 1.9 million kWh of electricity generated, saving energy and reducing maintenance costs.

GE SOLUTION
GE Power's GE Power solution replaced 139 million kWh of electricity generated with 1.9 million kWh of electricity generated, saving energy and reducing maintenance costs.

THE IMPACT
139 million kWh of electricity generated replaced
1.9 million kWh of electricity generated
7 million gallons of water saved
181 tons of CO₂ emissions avoided
\$814 million saved

GE Aviation | GE Aviation (GE Aviation) | GE Power (GE Power)

The cleanest, quietest, most in-demand high-thrust jet engine

THE CHALLENGE
The GE Aviation GE Aviation solution replaced 781 million gallons of fuel with 1.9 million gallons of fuel, saving energy and reducing maintenance costs.

GE SOLUTION
GE Aviation's GE Aviation solution replaced 781 million gallons of fuel with 1.9 million gallons of fuel, saving energy and reducing maintenance costs.

THE IMPACT
781 million gallons of fuel replaced
1.9 million gallons of fuel saved
4 million gallons of water saved
32 million gallons of CO₂ emissions avoided
419 million gallons of fuel saved
684 million gallons of fuel saved

GE Power | GE Power (GE Power)

Taking speed, flexibility and ultra-low emissions to a new level

THE CHALLENGE
The GE Power GE Power solution replaced 1.1 million gallons of water used with 1.9 million gallons of water used, saving energy and reducing maintenance costs.

GE SOLUTION
GE Power's GE Power solution replaced 1.1 million gallons of water used with 1.9 million gallons of water used, saving energy and reducing maintenance costs.

THE IMPACT
1.1 million gallons of water used replaced
1.9 million gallons of water used
1,700 tons of CO₂ emissions avoided
41,000 tons of CO₂ emissions avoided
2 million gallons of water saved

GE Aviation | GE Aviation (GE Aviation) | GE Power (GE Power)

The cleanest, quietest, most in-demand high-thrust jet engine

THE CHALLENGE
The GE Aviation GE Aviation solution replaced 781 million gallons of fuel with 1.9 million gallons of fuel, saving energy and reducing maintenance costs.

GE SOLUTION
GE Aviation's GE Aviation solution replaced 781 million gallons of fuel with 1.9 million gallons of fuel, saving energy and reducing maintenance costs.

THE IMPACT
781 million gallons of fuel replaced
1.9 million gallons of fuel saved
4 million gallons of water saved
32 million gallons of CO₂ emissions avoided
419 million gallons of fuel saved
684 million gallons of fuel saved

GE Power | GE Power (GE Power)

Flexible, efficient and environmentally friendly gas engine

THE CHALLENGE
The GE Power GE Power solution replaced 700 million kWh of electricity generated with 1.9 million kWh of electricity generated, saving energy and reducing maintenance costs.

GE SOLUTION
GE Power's GE Power solution replaced 700 million kWh of electricity generated with 1.9 million kWh of electricity generated, saving energy and reducing maintenance costs.

THE IMPACT
700 million kWh of electricity generated replaced
1.9 million kWh of electricity generated
3 million gallons of water saved
7.6 million gallons of fuel saved
7,194 tons of CO₂ emissions avoided

GE Power | GE Power (GE Power)

The world's first battery storage and gas turbine hybrid

THE CHALLENGE
The GE Power GE Power solution replaced 1,887 million kWh of electricity generated with 1.9 million kWh of electricity generated, saving energy and reducing maintenance costs.

GE SOLUTION
GE Power's GE Power solution replaced 1,887 million kWh of electricity generated with 1.9 million kWh of electricity generated, saving energy and reducing maintenance costs.

THE IMPACT
1,887 million kWh of electricity generated replaced
1.9 million kWh of electricity generated
48,904 tons of CO₂ emissions avoided
\$18 million saved
355 million gallons of water saved

Environmental Benefit

5.5 gt CO₂

1.3B gal water

\$3.5 billion

Economic Benefit

THE IMPACT

Ecomagination innovation spans industry



Digital Wind Farm

Combines GE's modular 2MW turbine platform with robust digital infrastructure to increase production by 20%.



Solar Inverter

New 1.5kV solar inverters, using silicon carbide to reduce the size of a 1MW inverter by 40% and boost power conversion efficiency of 99%.



9H Gas Turbine

3000+ sensors collecting data. Flexibility for changing power demand – 62% efficiency.



Brilliant Manufacturing

Combines GE's lighting & Predix platform with Intel's chips & computing power to improve manufacturing productivity.

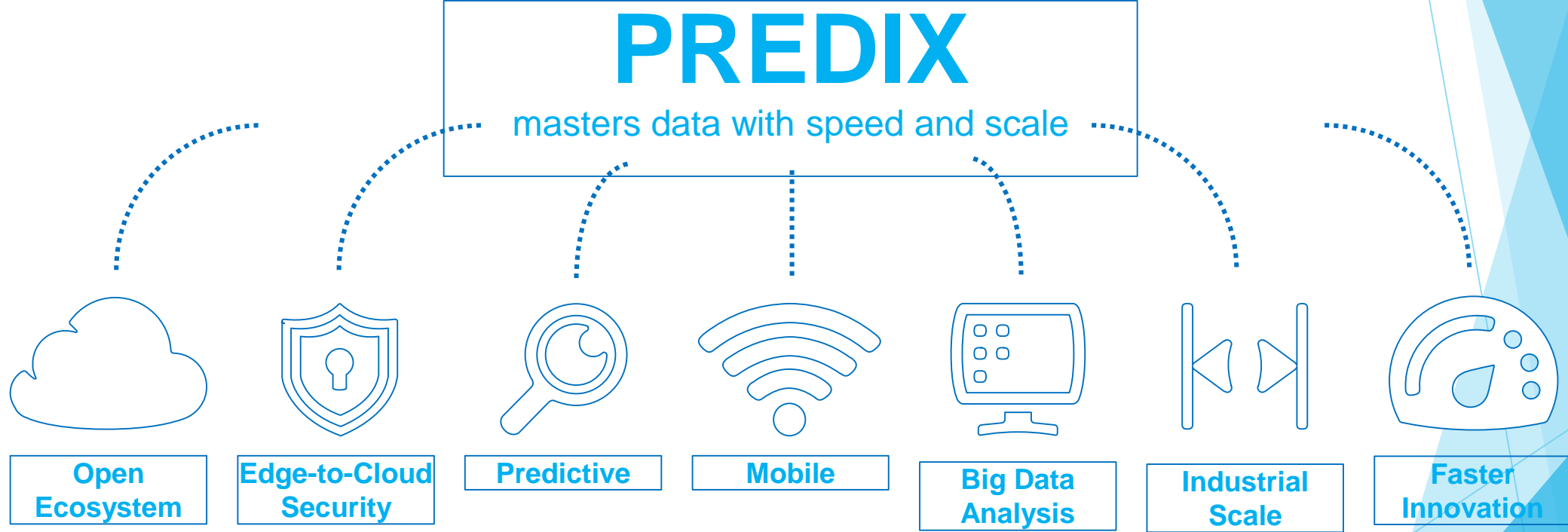


Supercritical CO₂ Turbine

New smaller-sized turbine that uses supercritical CO₂ to provide comparable power output with the potential for 50% efficiency.

Digital solutions accelerate efficiency & decarbonization

Combining industrial hardware with internet-enabled software



Networks create collaboration opportunities

Partners



- **Commercial Partnerships** – co-develop new technology solutions, new business models, test and scale existing solutions
- **Collaborative Innovation** – partner on open innovation challenges or hackathons to solve tough challenges
- **Ecomagination Treasure Hunts** – collaborate to identify opportunities to deploy solutions to reduce energy and water waste
- **Energy Ventures** – provide capital, technical and commercial expertise to support scaling startup companies

Customer case study



Bringing Ecomagination plus an innovative network to realize LStar's vision for a smart, sustainable, innovative and inclusive city



Advanced Microgrid Solutions



GREENTOWNLABS



Ecomagination

Key Highlights

- ✓ Align strategy to transformation drivers – 4D's
- ✓ Innovation comes from everywhere
- ✓ Corporative innovation critical, drives scale and impact
- ✓ Platforms accelerate digital transformation
- ✓ Networks create collaboration opportunities
- ✓ Massive opportunity remains... *world cannot wait*

Thank you!