General Electric

The Industrial Internet
Defining the next energy decade

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What developments will define the next energy decade?

Defining the Energy Eras

Every era has its defining trend

Oil Shocks→
Energy Security

Reagan/Thatcher→
Deregulation

Climate Change→
Carbon control

1970s **1980s** **1990s** **2000s**

Source: GE Energy, Global Strategy and Planning, 2012

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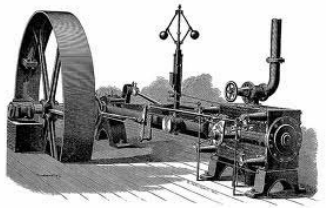
The Industrial Internet

Setting the stage
1750-present



1750-1950: Rise industrial machines, fleets and networks

1965-1980 Creation of ArpaNet and other precursors to the Internet

Big data and the cloud emerge

2012-and beyond: Expansion of the Internet across industrial enterprises

- Intelligent devices

- Intelligent networks

- Intelligent automation

1750 **1950** **1960** **2010** Future

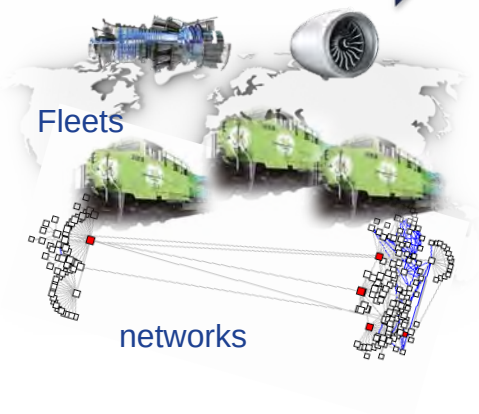
Industrial Revolution **Internet Revolution** **Industrial Internet**

continuous combustion engine that is the basis for the gas turbine

1950s: Rise of Mainframe computers

1990-2010: Rise of personal computers; World Wide Web, private networks; e-commerce and eventually social media

Advanced machines



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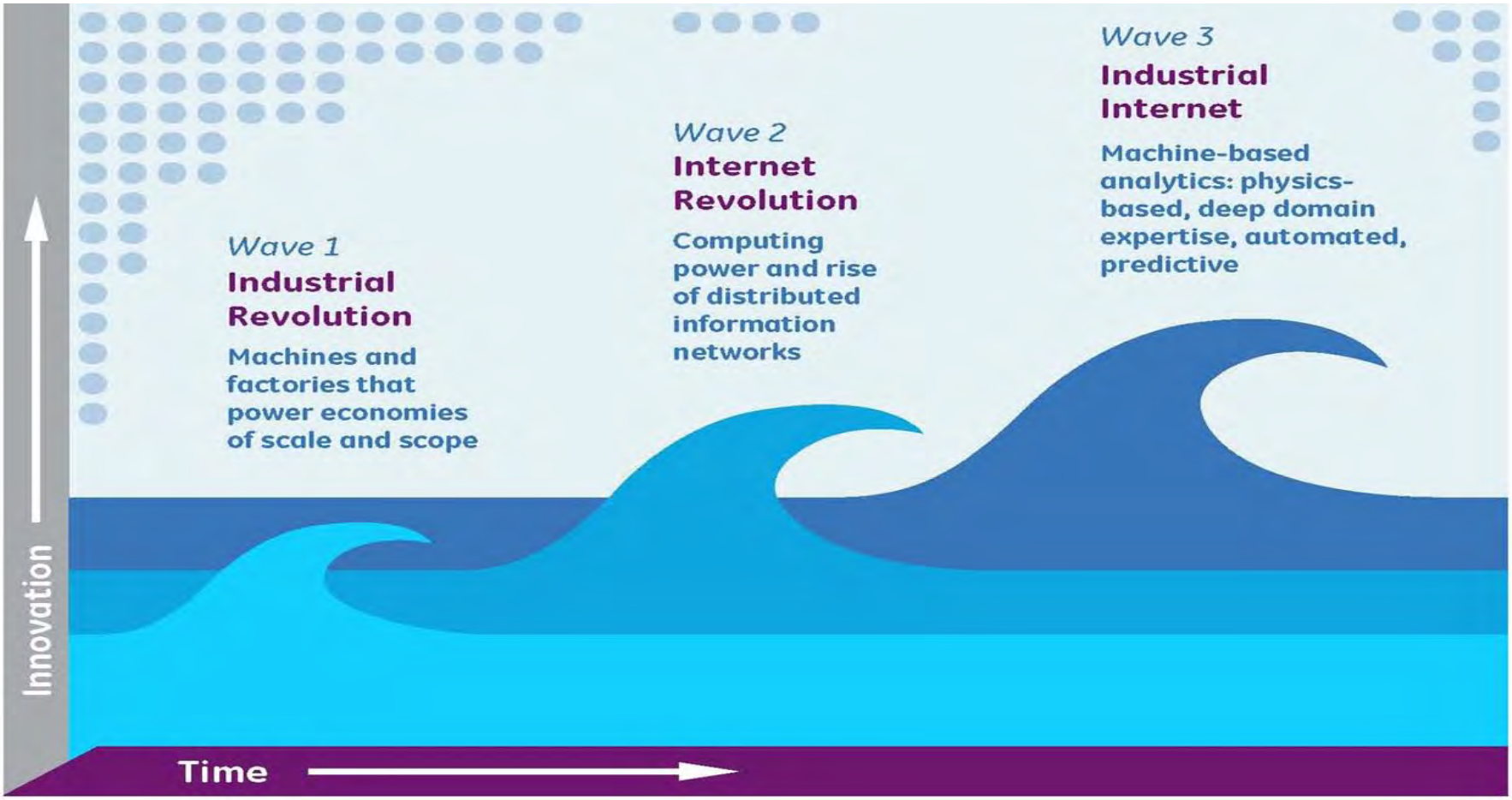
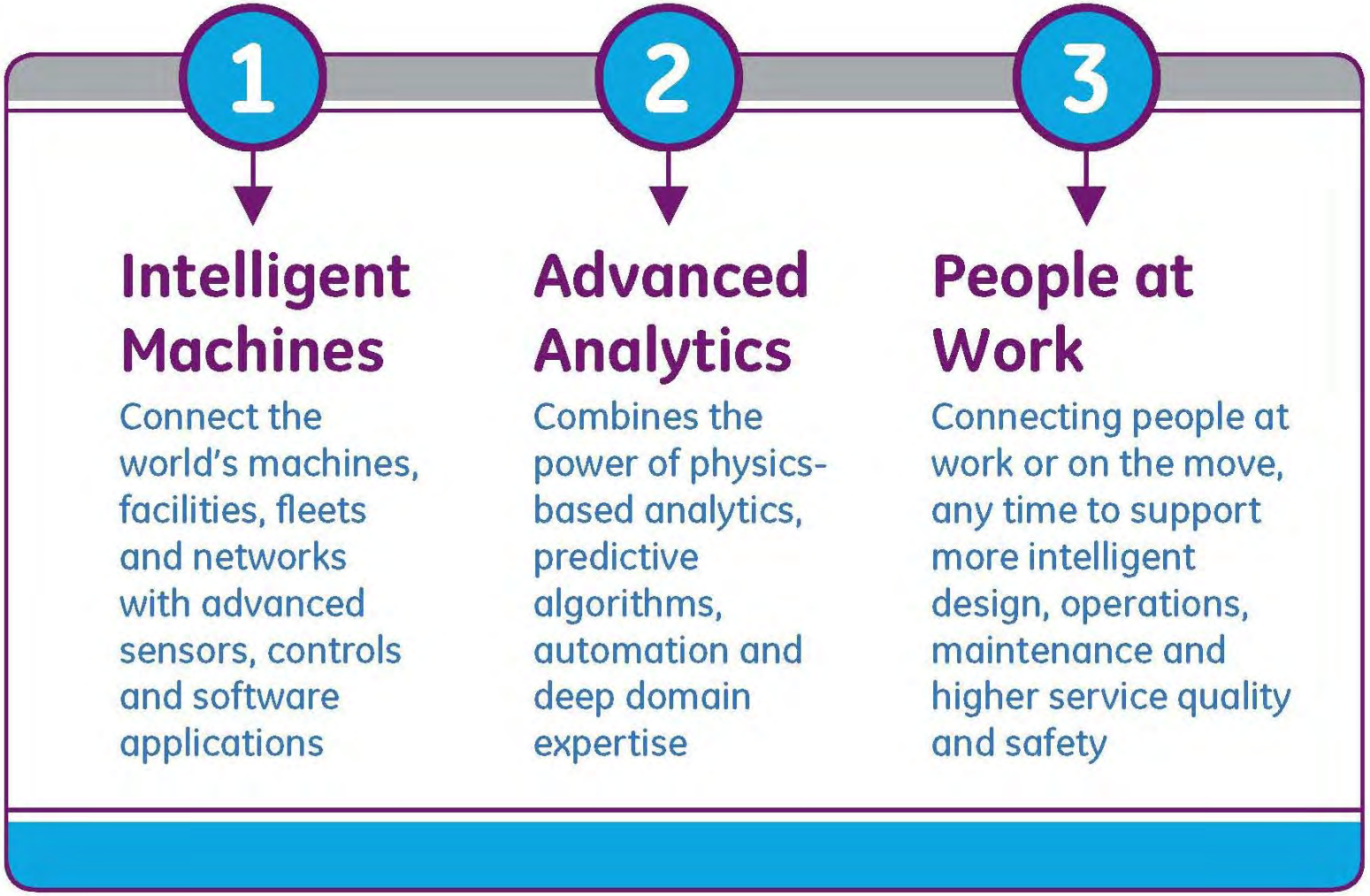
Historic Waves of Innovation

1750-present

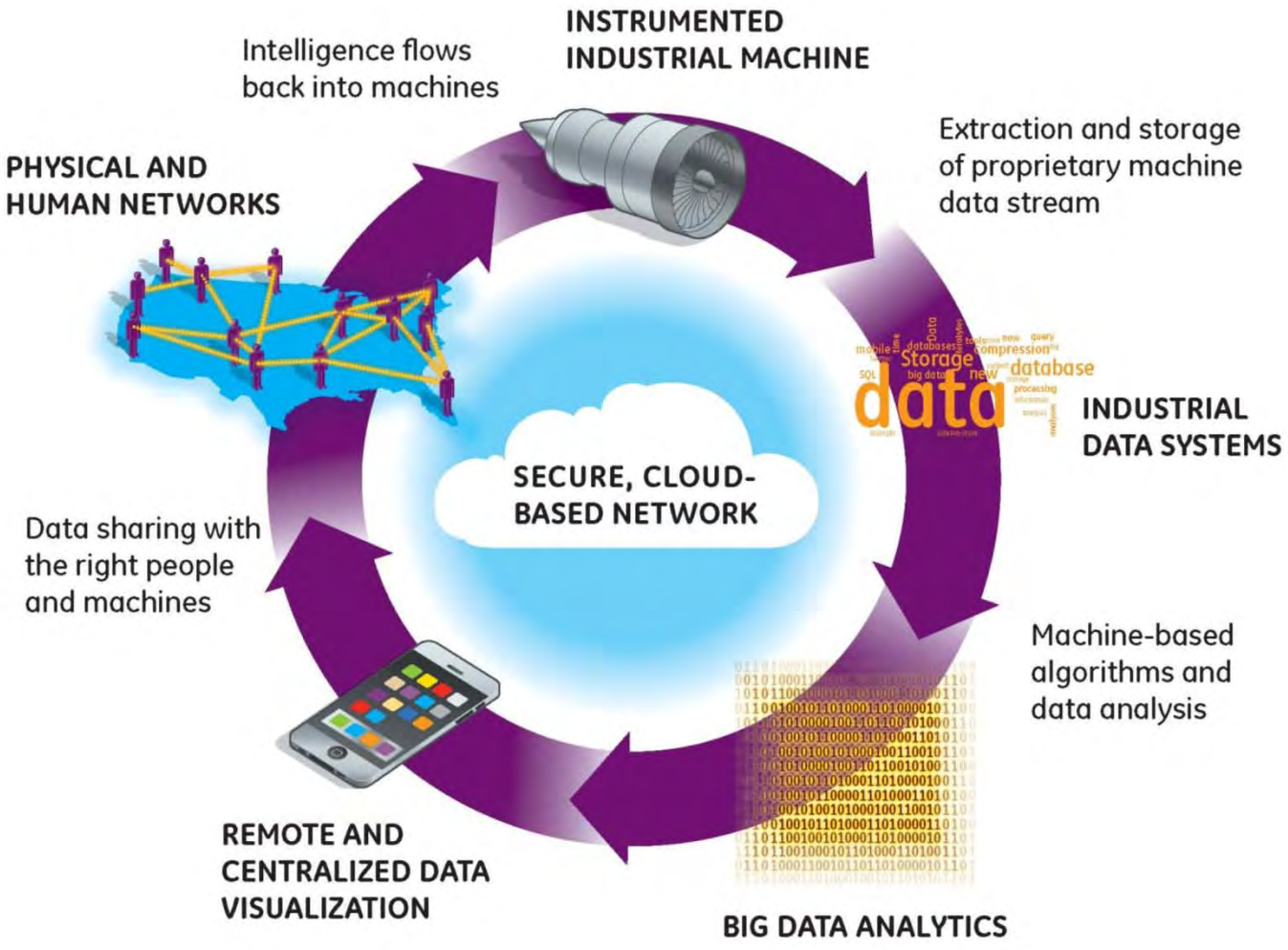


Industrial Internet...the next wave



Industrial Internet data loop

From instrumentation to intelligence and back



Transforming Asset Management Strategies

- Replace Run-to-Failure strategies of the past
- Automation, sensors, communication, and analytics keep assets running without tying up limited personnel resources
- Lower maintenance costs – service to need, not to calendar
- Extend productive life of assets already beyond their resign age

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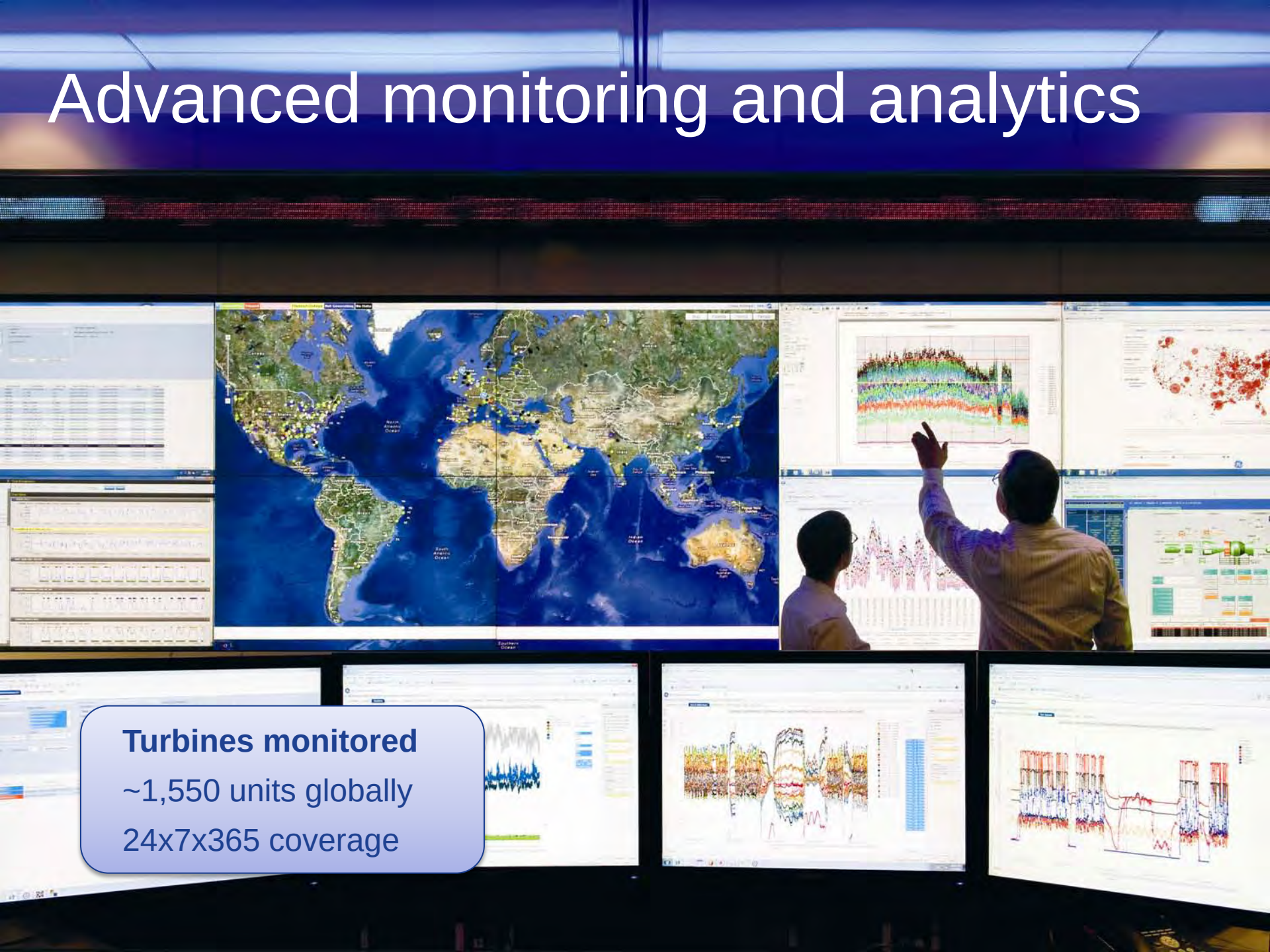
Advanced monitoring and analytics



Turbines monitored

~1,550 units globally

24x7x365 coverage

Things that spin…

Combined cycle gas-fired electricity generation segment

Today	186,000	
Next 15 yrs.	+ 210,000	
By 2025	396,000	rotating machines

Note: Today there are ~4,178 units of gas-fired combined cycle plants worldwide equal to 564 GW of installed capacity. Another ~2,000 units or 638 GW will be added between 2011 and 2025.

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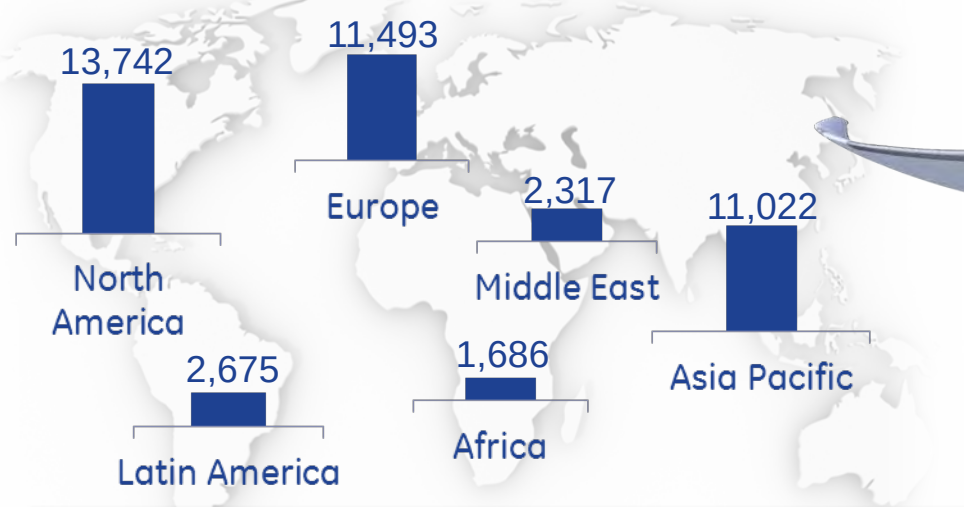
Things that spin…

Global commercial aviation

Today	128,805	
Next 15 yrs.	+	96,940
By 2025	225,745	rotating machines

Number of Aircraft Engines by Operator Area



Note: Today there are 19,975 commercial aircrafts in service worldwide with 42,935 engines. Another 32,314 engines will be added in the next 15 years. In each engine we consider to be three types of rotating equipment: a turbo fan, compressor, and turbine.

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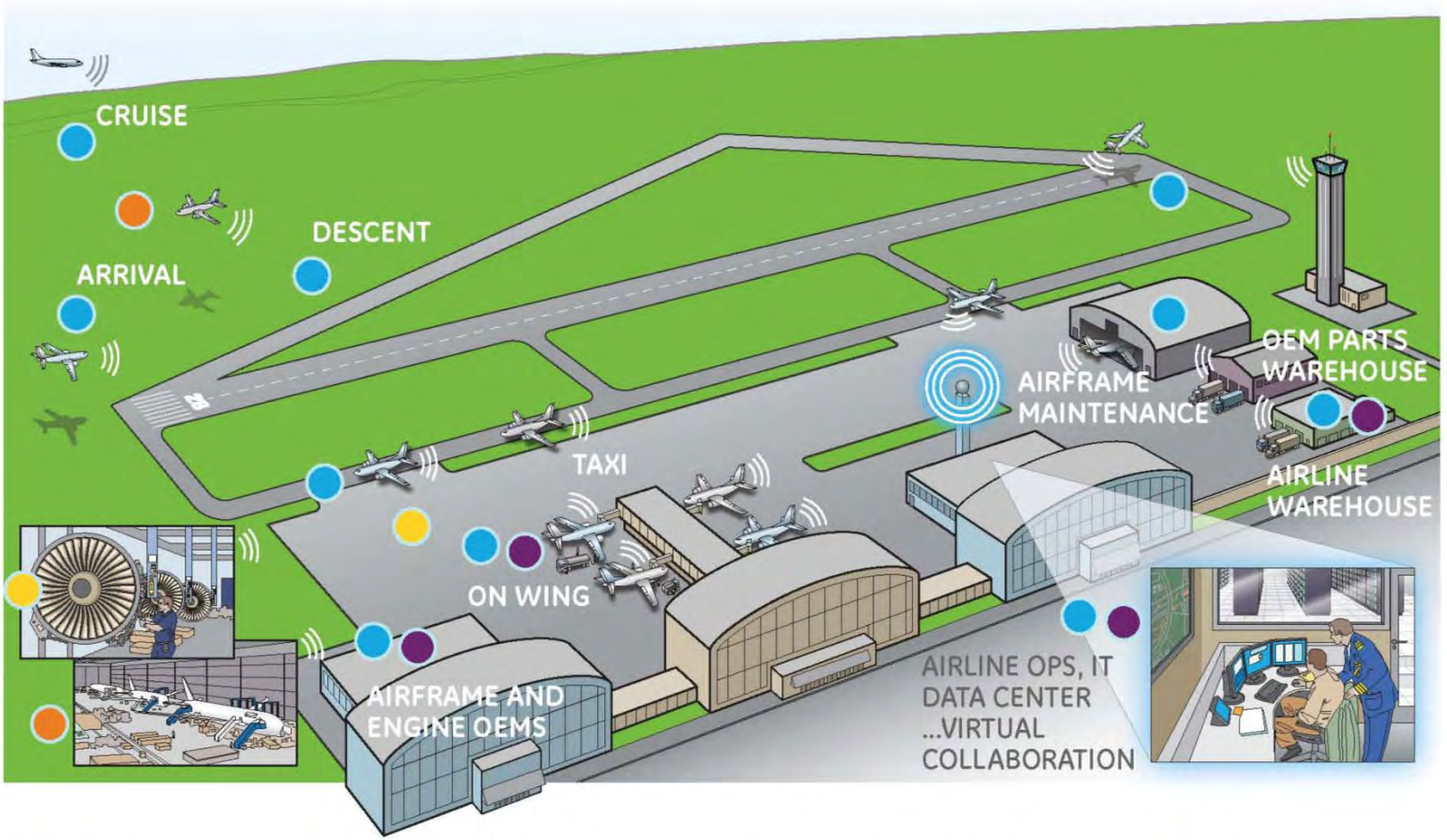
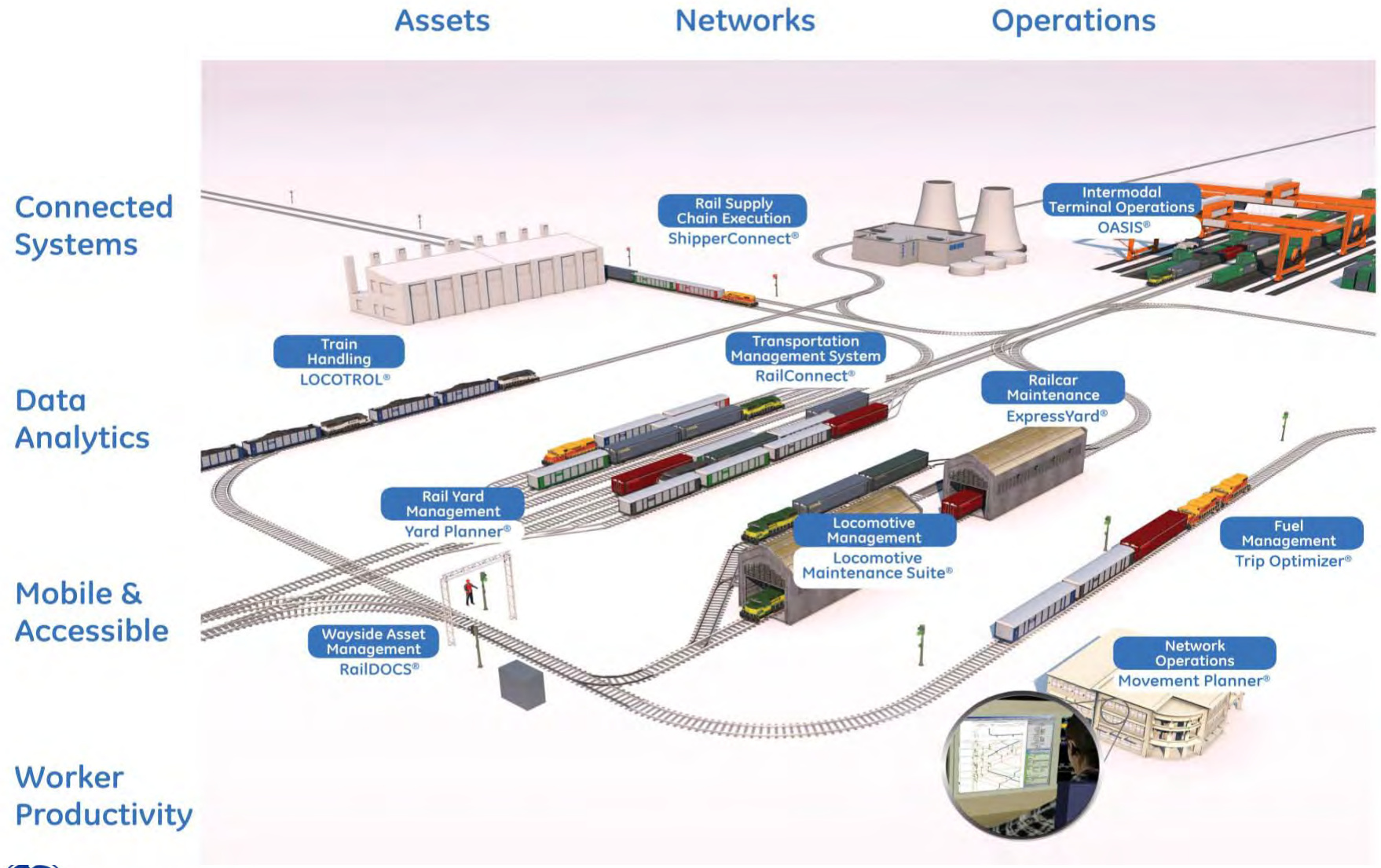
Aviation network optimization



Rail network optimization



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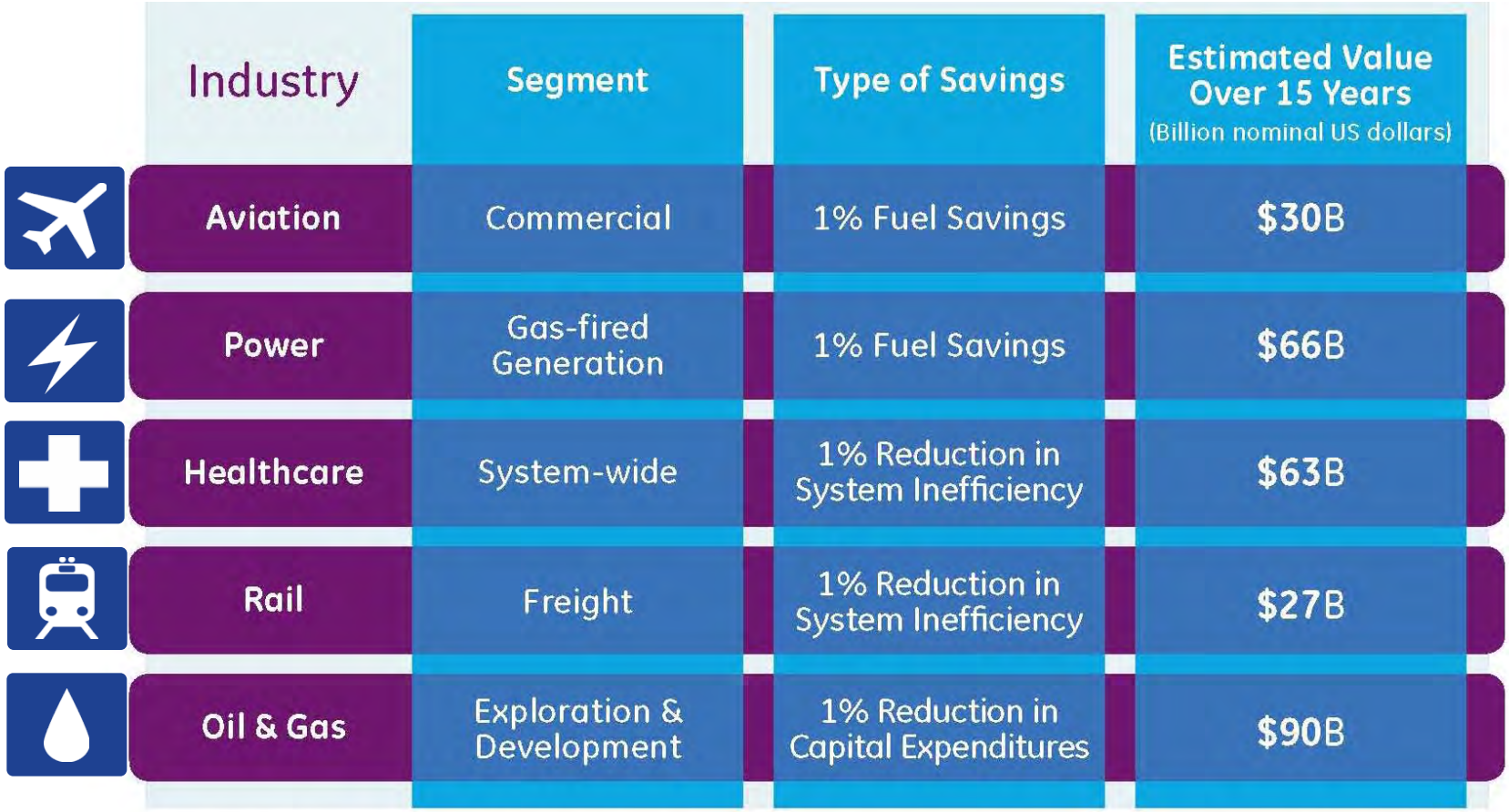
Power of 1%

What if… potential performance gains



Industry	Segment	Type of Savings	Estimated Value Over 15 Years (Billion nominal US dollars)
Aviation	Commercial	1% Fuel Savings	$30B
Power	Gas-fired Generation	1% Fuel Savings	$66B
Healthcare	System-wide	1% Reduction in System Inefficiency	$63B
Rail	Freight	1% Reduction in System Inefficiency	$27B
Oil & Gas	Exploration & Development	1% Reduction in Capital Expenditures	$90B

Note: Illustrative examples based on potential one percent savings applied across specific global industry sectors
Source: GE estimates

Large potential economic benefits

Over $15 trillion in gains to GDP output 2012-2030

Source: GE projections.

What will it take to realize?

Enablers, catalysts, and legal foundations

Cyber Security Management

- Security processes and controls should include vulnerability lifecycle management, endpoint protection, intrusion detection/prevention systems, firewalls, logging visibility, network visibility, and security training
- Protection of sensitive and valuable information, with broad engagement from technology vendors, asset owners, regulators, international organizations and academia

Innovation and Deployment

- Continued innovation is essential to reach the full potential of the Industrial Internet
- Deployment must be broad-based involving not just the industrial world but also the emerging markets which have become an increasingly important part of the global industrial system and will see the largest share of capex in the coming decades

Talent

- The creation of new talent … new technical, analytical, and leadership roles that are explicitly cross-discipline
- Flexible labor markets, training programs and new academic programs

Next gen critical infrastructure

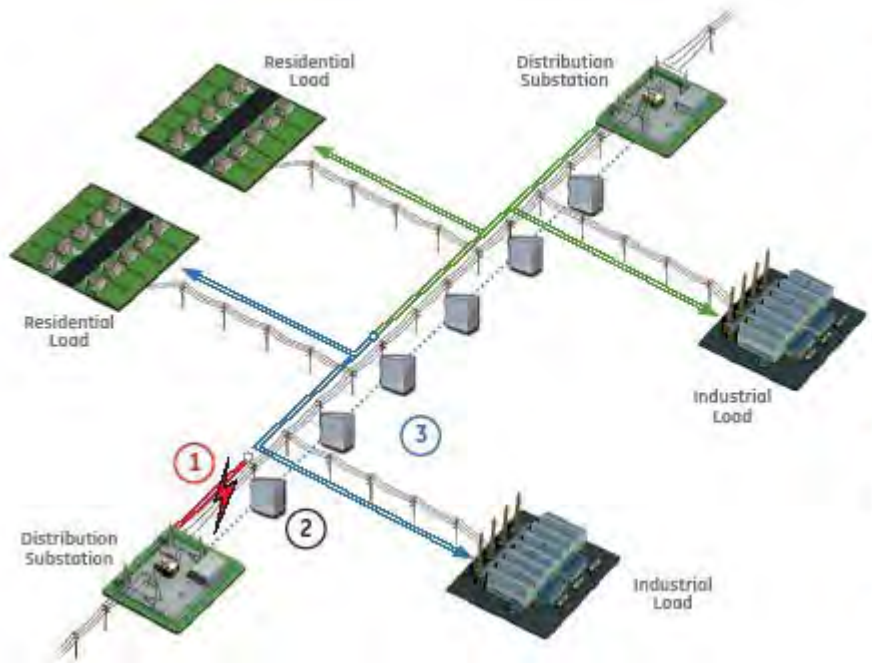
Resilient-sustainable infrastructure (RSI)

US natural disasters 2012

Over $107 billion in overall losses*

*Source: Munich Re NatCatService 2013

Deployment of intelligent automation of grid networks to reduce customer outages



Jobs of the future

New technical, analytical, and leadership roles

Wanted

Digital-Mechanical Engineers

Industrial Internet

Next wave of productivity gains

Intelligent machines… advanced analytics… people at work

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