SMART POWER GENERATION®
INTEGRATING RENEWABLES AND REPLACING AGING INFRASTRUCTURE

WASHINGTON ENERGY SUMMIT

RONALD REAGAN BUILDING
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WAYNE ELMORE

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WÄRTSILÄ

About Wärtsilä

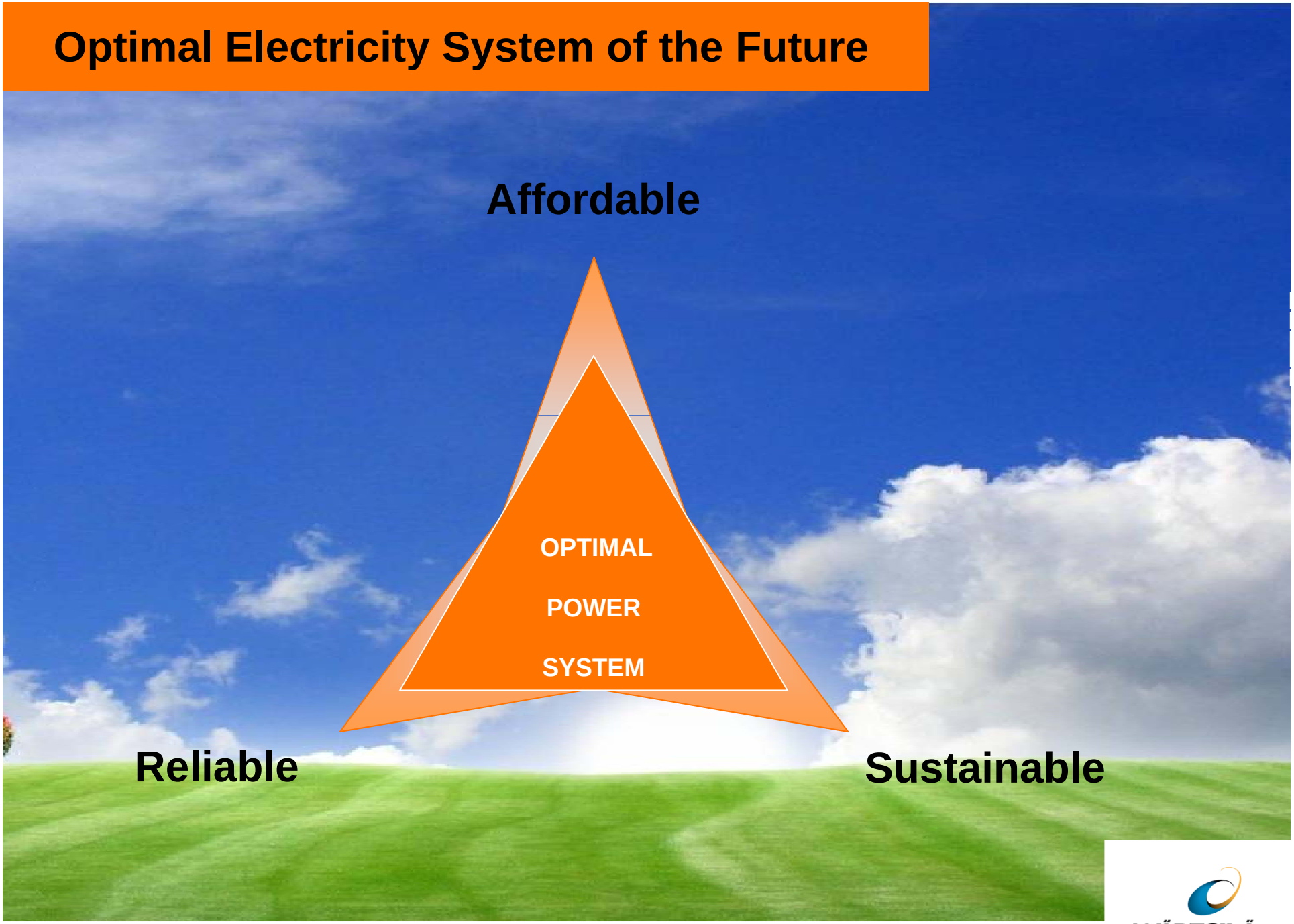
Power Plants

Marine

Service

Wärtsilä provides complete **lifecycle power solutions** for the marine and energy markets. In 2010, Wärtsilä's net sales totaled **US$ 6.5 billion** with approx. 17,500 employees. The company is based **Finland** and has operations **70 countries**. Wärtsilä is listed on the NASDAQ OMX Helsinki, Finland.

Optimal Electricity System of the Future



Elements of the Optimal System

Affordable

- **Less volatility**
  - local, low cost fuels
- **Competitive cost**
  - high efficiency
- **Optimized dispatch**
  - quick start capability
- **Modularity**
  - accommodate existing grid and affordable step-wise investment

Reliable

- **Decentralized generation**
  - efficient generation closer to loads
- **Minimized shaft risk**
  - generation dispersed over multi-engine installation
- **Reliable proven technology**
- **Dynamic capabilities**
  - overcome sudden system events

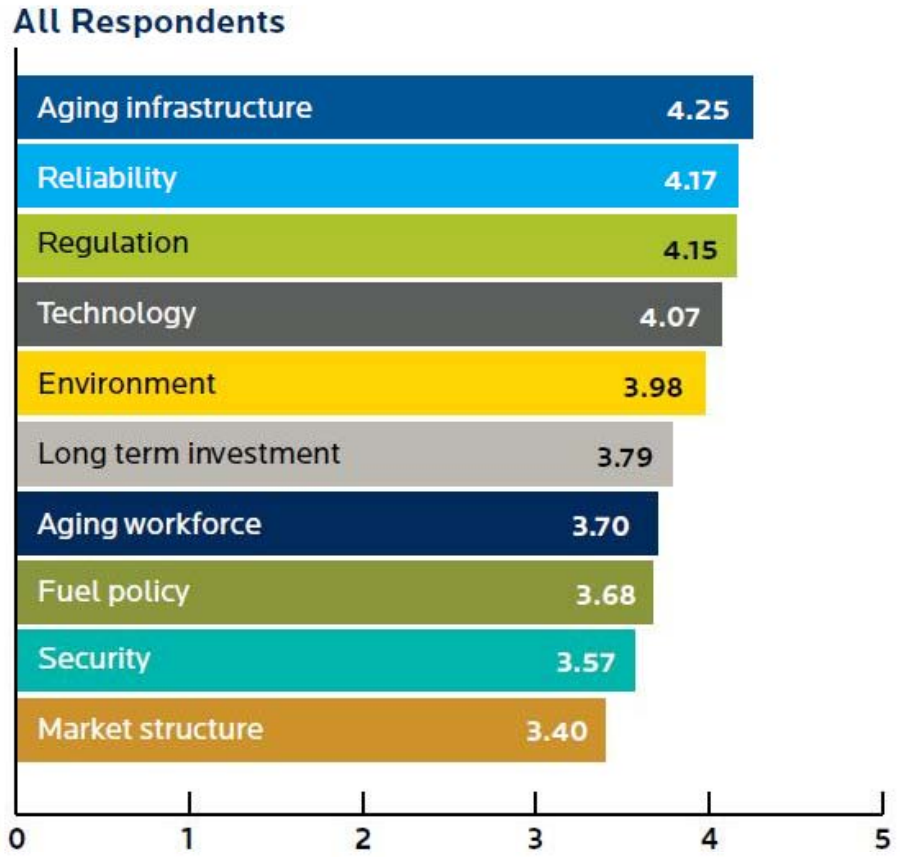
Sustainable

- **Enable high levels of renewables**
- **Effective integration of variable resources**
- **Lowered emissions through natural gas**
- **Eliminate / minimize use of water for power generation**
- **Flexibility to cope with changing market conditions**

Ideal Generation of Future: Combines all of these Features

Significant Issues Facing Utility Executives

Black & Veatch 2011 Strategic Directions Survey of Utility Executives



Source: Black & Veatch

Since the first survey in 2006, respondents were asked to rank the Top 10 issues. This year's results, shown above, identify how Investor-Owned Utilities (IOUs) and Public Power Respondents ranked the issues this year. The results were fairly consistent from year-to-year in prior surveys, mostly focusing on "Reliability" as either the No. 1 or No. 2 issue.

Challenges to Achieving the Optimal Electric Power System

And With Each Issue a Subset of Challenges

- Coal Plant Retirements ⇨ **Aging Infrastructure**
- Large Influx of Wind Generation ⇨ **Reliability**
- Nuclear viability
- Lack of Transmission Capacity
- Needed System Upgrades
- Stricter Water Regulations
- Gas Availability / Pricing
- Public Policy Uncertainty
- Regulatory Initiatives
- Capital Requirements
- etc.

Significant Near Term Challenges

Challenge 1: Coal Plant Retirements

Recent studies estimate 10-75 GW coal capacity at risk for retirement.

Study	Projected coal capacity to retire or "at risk"	Criteria to identify coal capacity at risk	Models future revenues from energy and capacity	Models future cost of coal operations?	Distinguish merchant vs. regulated units?
Brattle, November 2010	50-65 GW by 2020	Regulated units: 15-year PV of cost > replacement power cost from a gas CC or CT; Merchant units: 15-year PV of cost > revenues from energy and capacity markets	Yes, based on dispatch against projected hourly prices	Yes, based on dispatch against projected hourly prices	Yes
NERC, October 2010	10-35 GW by 2018	levelized cost @ 2008 CF > cost of replacement power from a gas CC ,or CT	No	no projections except for future equipment costs	No
ICF (October 2010)	75 GW by 2018	unknown	unknown	unknown	unknown
Credit Suisse, September 2010	60 GW	size and existing controls	No	No	No
ICF/INGAAA, May 2010	50 GW	age, efficiency and existing controls	No	No	No
ICF/EEI (May 2010)	25-60 GW by 2015	cost of retrofitting coal plant compared to cost of new gas CC	unknown	unknown	Yes

Aging Infrastructure

Response: Gas Replacement Power

New Paradigm

Levelized Cost of Electricity (2005 cents/kWH)

	Reference	Sensitivity
Coal	5.4	
Advanced Natural Gas (NGCC)	5.6	
Advanced Nuclear[2]	8.8	7.3
Coal/Gas with CCS[3]	9.2/8.5	6.9/6.6
Renewables		
Wind	6.0	
Biomass	8.5	
Solar	19.3	
Substitution elasticity (Wind, Biomass, Solar)	1.0	3.0
Wind+Gas Backup	10.0	

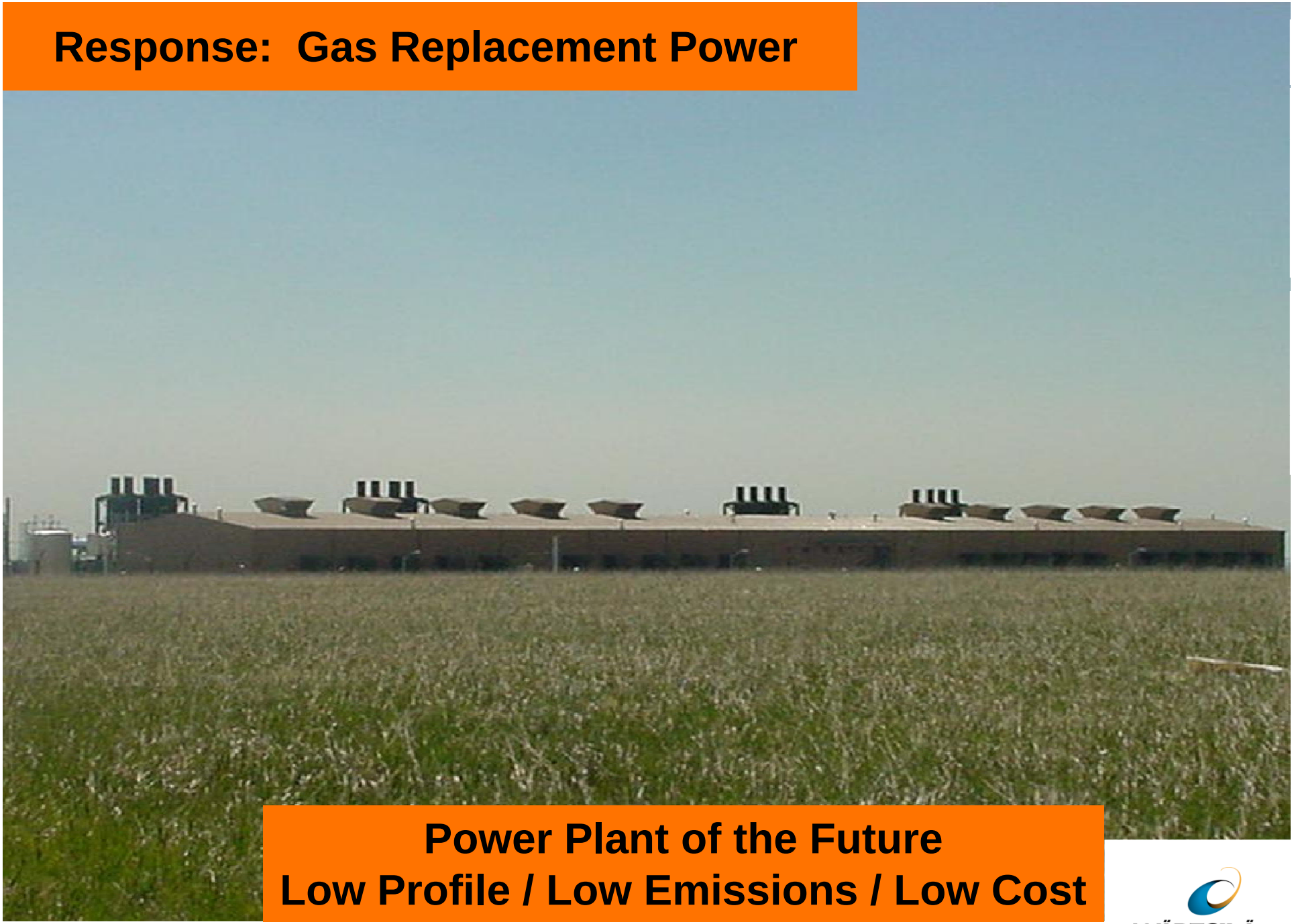
Source: EPPA, MIT

In the U.S., a combination of demand reduction and displacement of coal-fired power by gas-fired generation is the lowest cost way to reduce CO2 emissions by up to 50%. For more stringent CO2 emissions reductions, further de-carbonization of the energy sector will be required; but *natural gas provides a cost-effective bridge to such a low-carbon future.*

Source: MIT

Gas Power Generation is winner for dramatic pollutants reduction and cost effective energy

Response: Gas Replacement Power

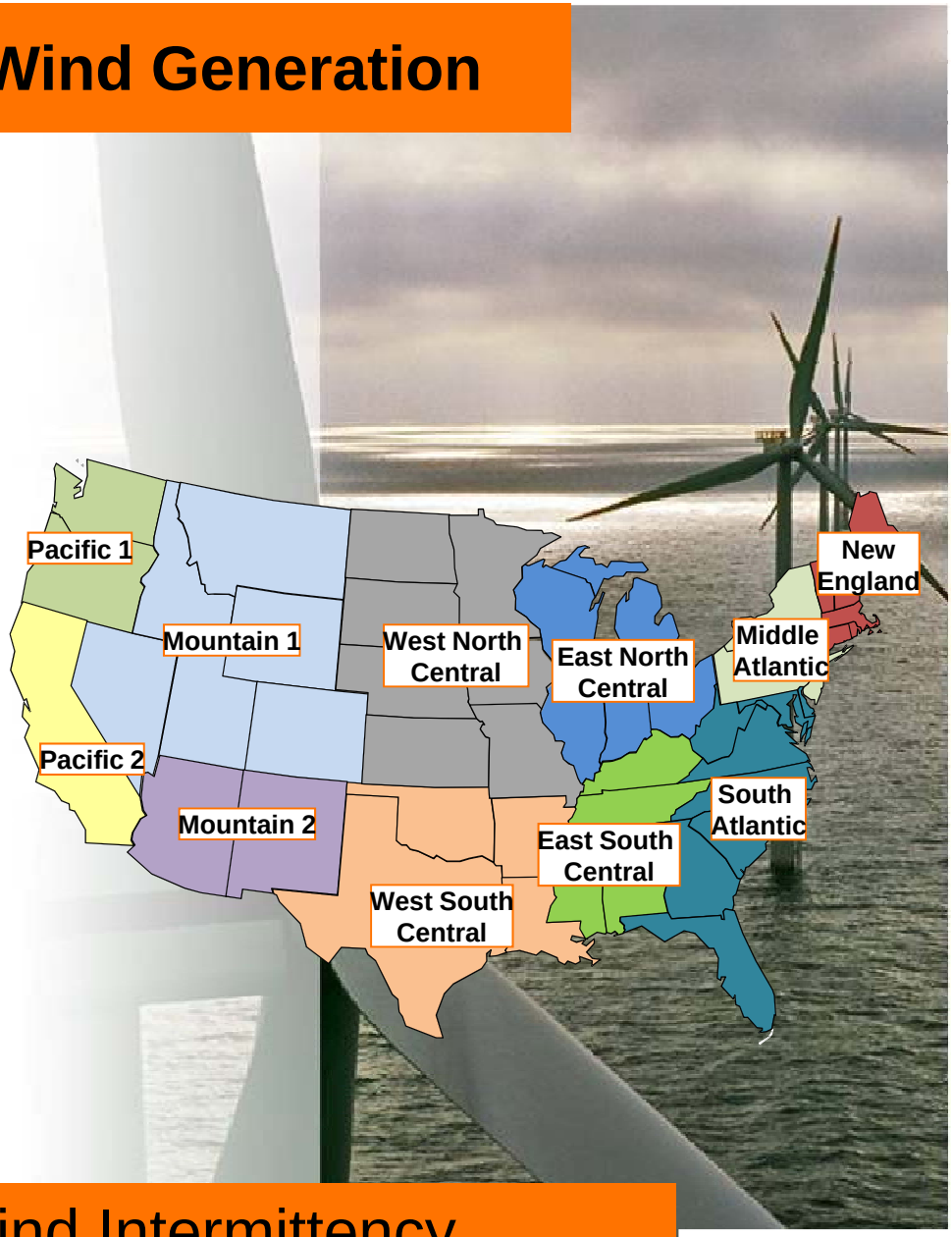


Power Plant of the Future
Low Profile / Low Emissions / Low Cost

Challenge 2: Large Influx of Wind Generation

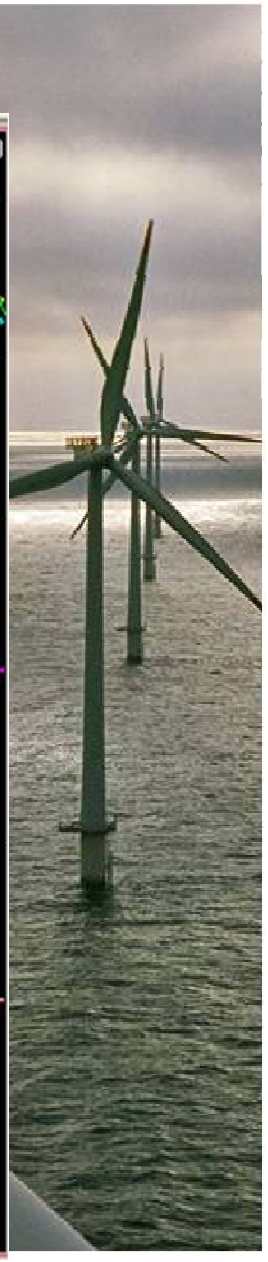
Cumulative Wind Capacity Additions (GW)			
	2015	2020	2025
New England	2.7	2.7	3.1
Middle Atlantic	6.2	6.3	7.3
South Atlantic	2.2	2.3	2.3
East North Central	3.9	6.2	10.0
West North Central	5.0	8.5	12.7
East South Central	0.0	0.0	0.1
West South Central	9.9	15.4	22.2
Mountain 1	11.6	14.6	17.3
Mountain 2	2.0	2.0	2.7
Pacific 1	2.3	2.3	4.5
Pacific 2	4.8	6.1	6.1
National Total	***50.7***	***66.5***	***88.3***

Source: ICF International



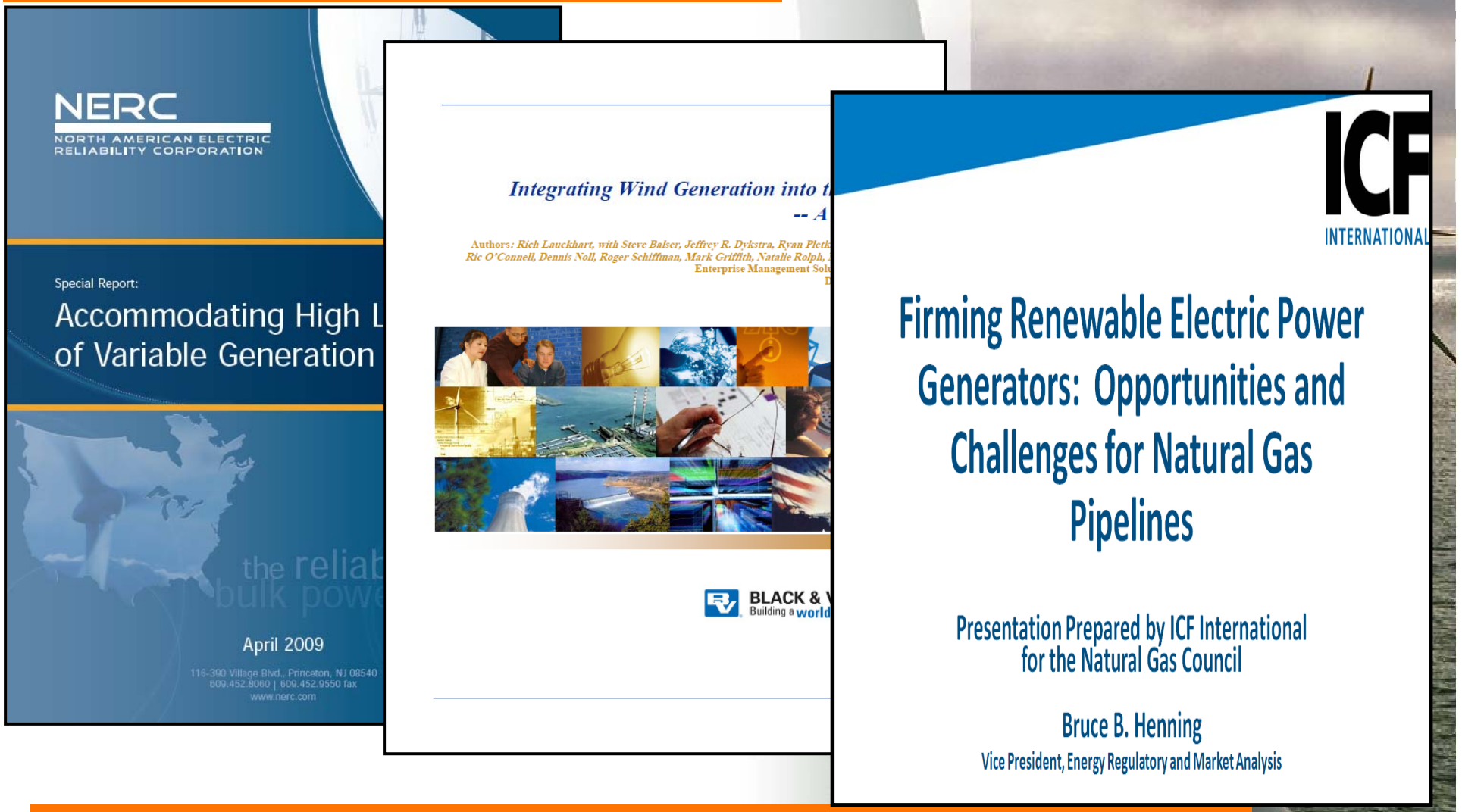
Wind Intermittency
Significant Grid Reliability Issues

Response: Wind Integration



400 MW Wind Generation Dropped from Grid in 1 hour
Wartsila Gas Power Rapidly Started to Maintain Load

Response: Wind Integration



Many Studies with <u>common Wind Integration conclusions</u>:
- need Balancing Area Consolidation, Short Term Energy Markets, Transmissions Upgrades, Better Forecasting and <u>Flexible Generation</u>.

Response: Wind Integration

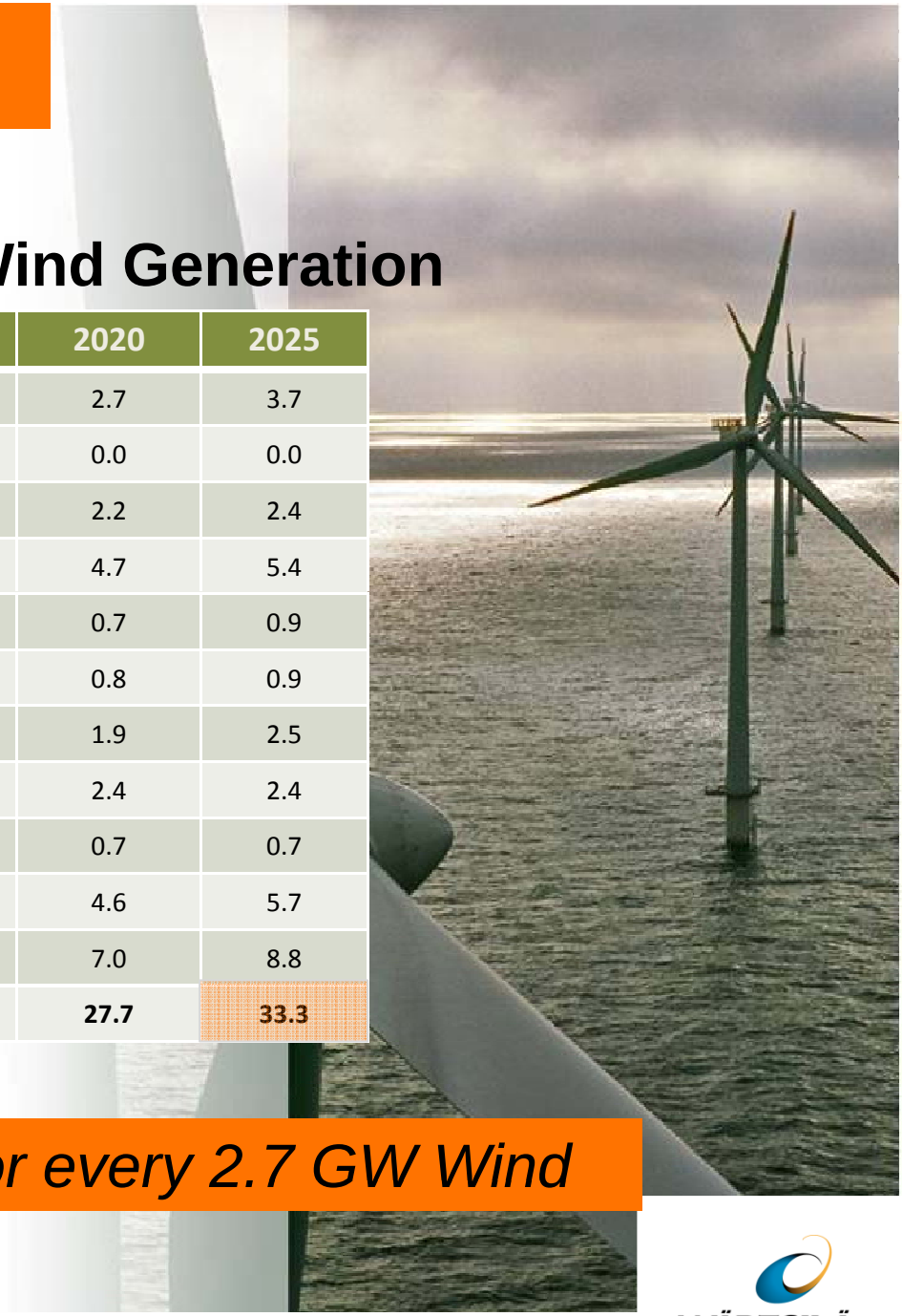
Gas Needed for Firming Wind Generation

Gas Capacity (GW)

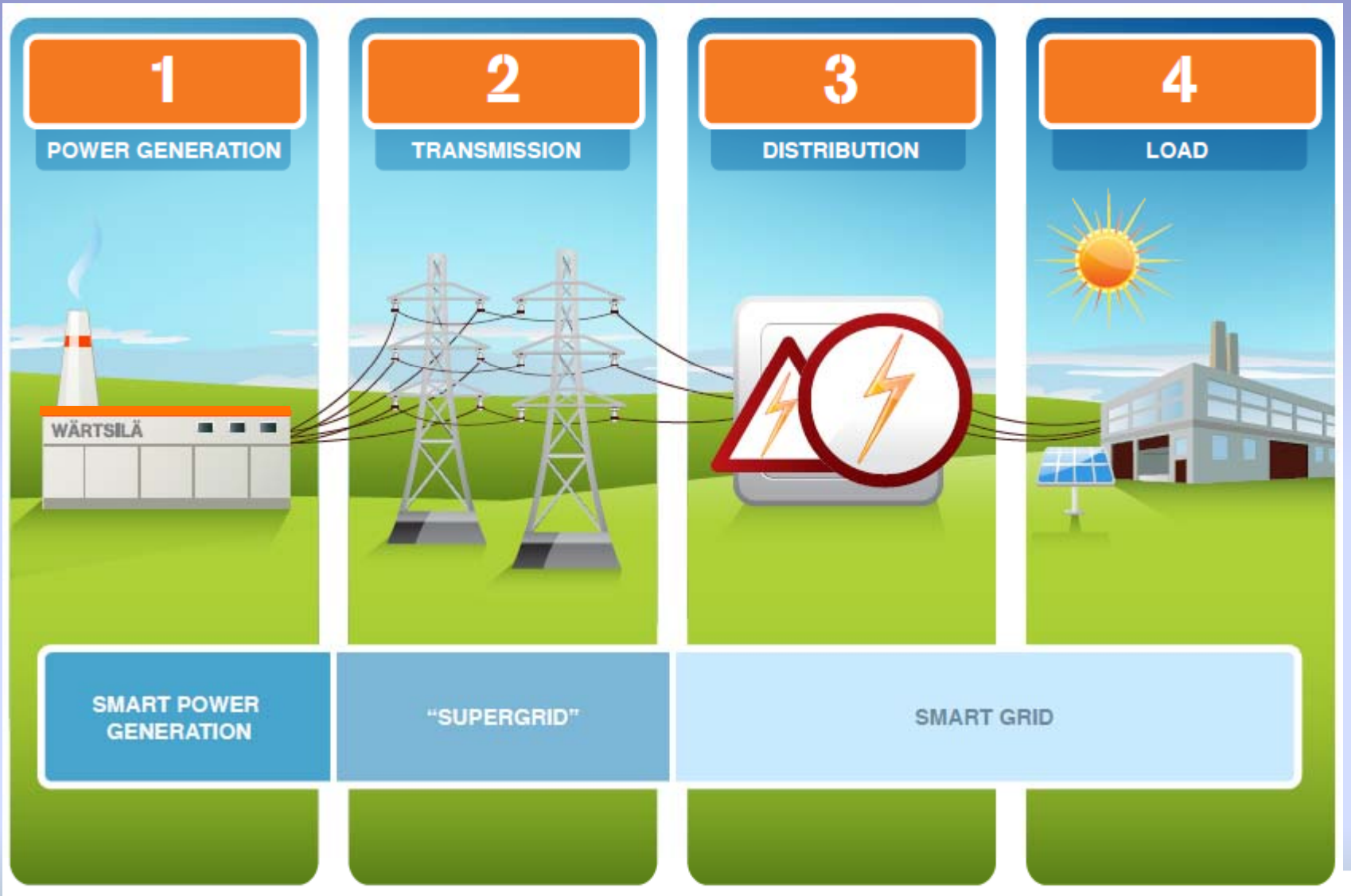
	2010	2015	2020	2025
East North Central	1.1	2.1	2.7	3.7
East South Central	0.0	0.0	0.0	0.0
Mid-Atlantic	1.3	2.1	2.2	2.4
Mountain 1	1.5	3.9	4.7	5.4
Mountain 2	0.2	0.7	0.7	0.9
New England	0.1	0.8	0.8	0.9
Pacific 1	1.3	1.9	1.9	2.5
Pacific 2	1.1	2.0	2.4	2.4
South Atlantic	0.2	0.7	0.7	0.7
West North Central	2.4	3.7	4.6	5.7
West South Central	3.0	5.6	7.0	8.8
U.S. Lower-48	**12.1**	**23.6**	**27.7**	**33.3**

Source: ICF International

1 GW Gas Generation for every 2.7 GW Wind



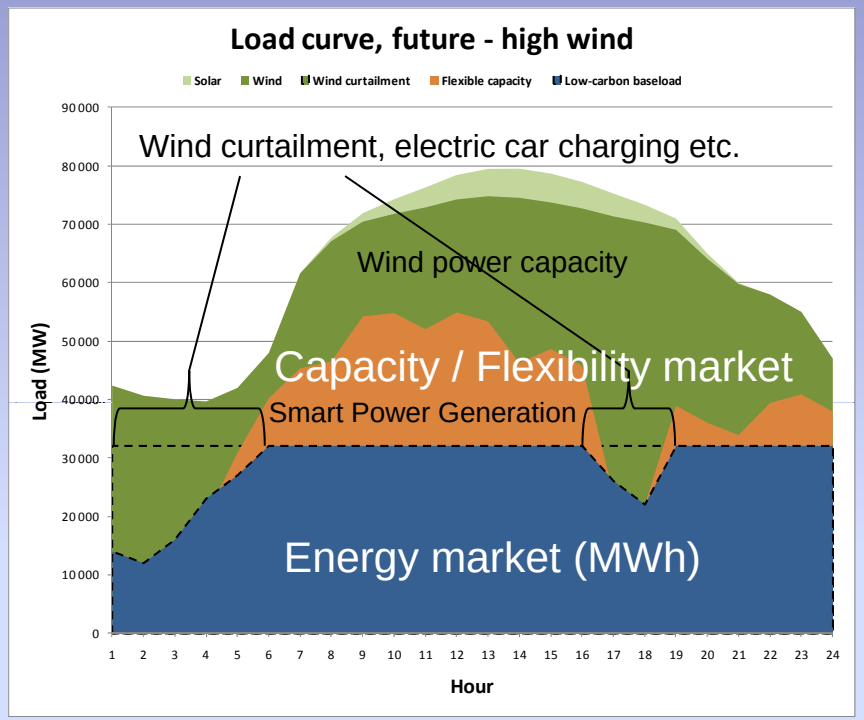
The Answer: Smart Power System



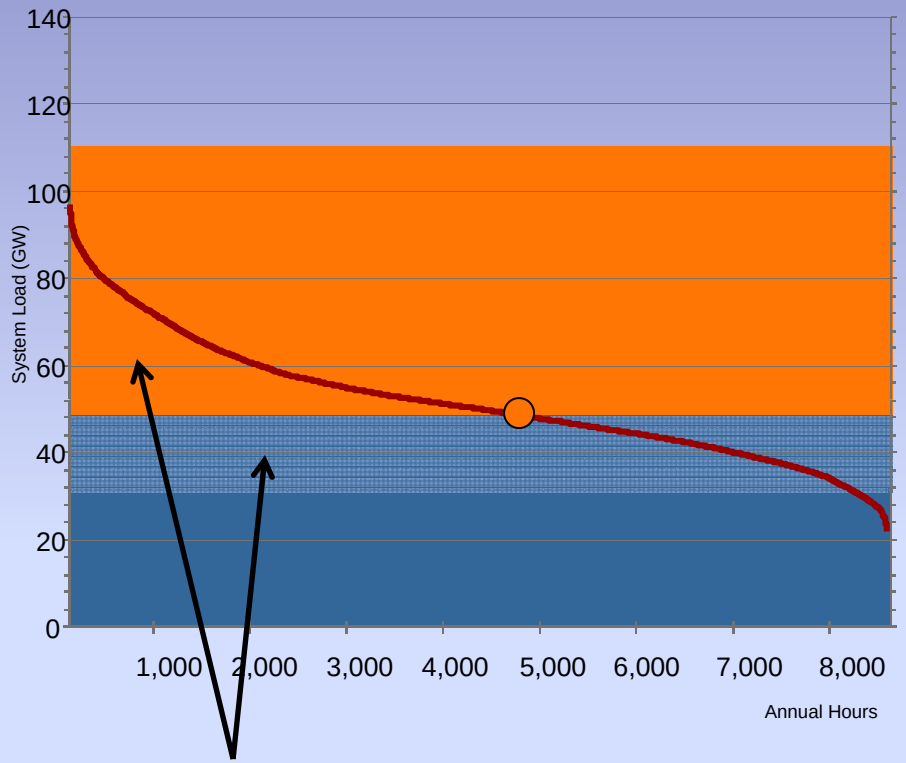
Optimal Power System

Power System of the Future

Daily system load curve and capacity dispatch



Annual system load duration curve and dispatchable capacity



System dispatching challenges

- Large wind generation > more than System night load!
- Wind speed change 7 → 9 m/s leads to a wind power output change of > 25%! Such wind speed changes happen all the time!
- System balancing will be a major challenge.

Smart Power Generation (BOTH)

- Rapid Start Peaking
- Flexible Intermediate Combined Cycle

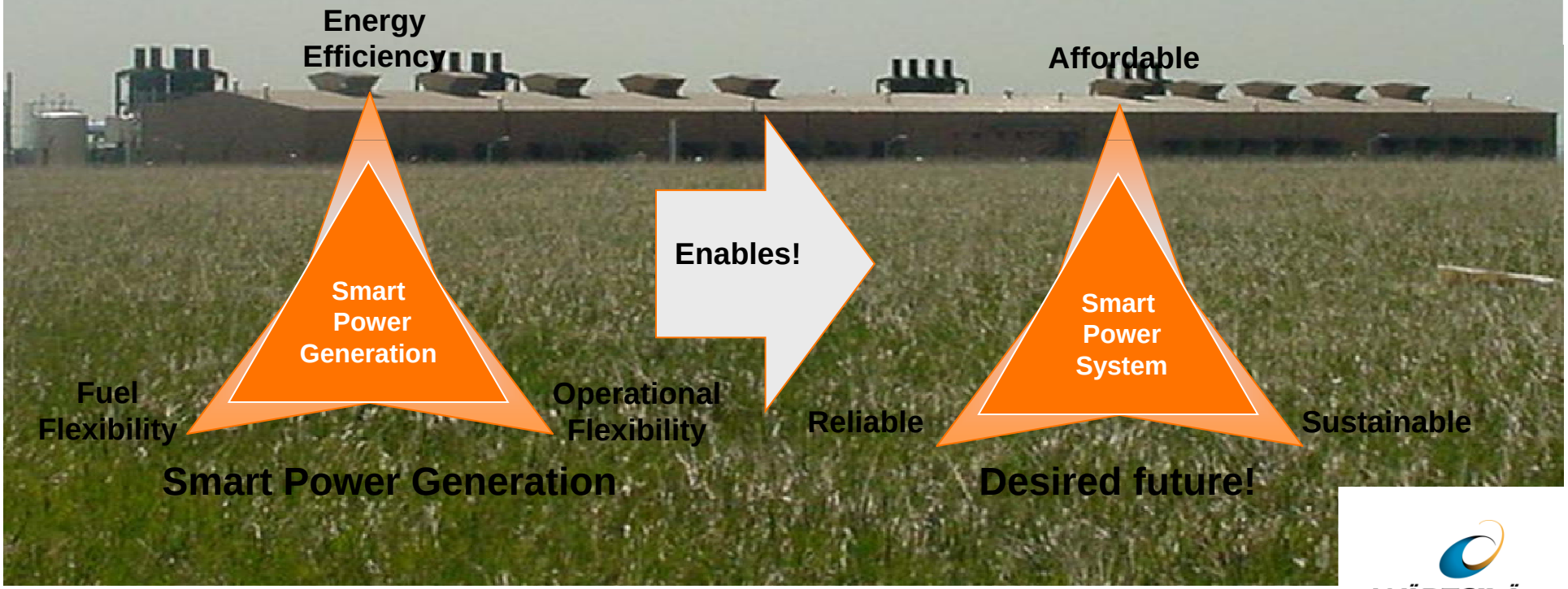
Wartsila FLEXICYLCE – ALL IN ONE!

What is Smart Power Generation?

The missing piece in the low carbon power system puzzle!

Smart Power Generation:

- efficient base/intermediate load power production **AND** fast dynamic system balancing,
- solving **BOTH** the coal plant replacement and wind intermittency challenges
- new, unique solution for flexible power generation,
- essential part of tomorrow´s optimized low carbon power systems,
- improving the system total efficiency (enabling renewables & lowering cost).



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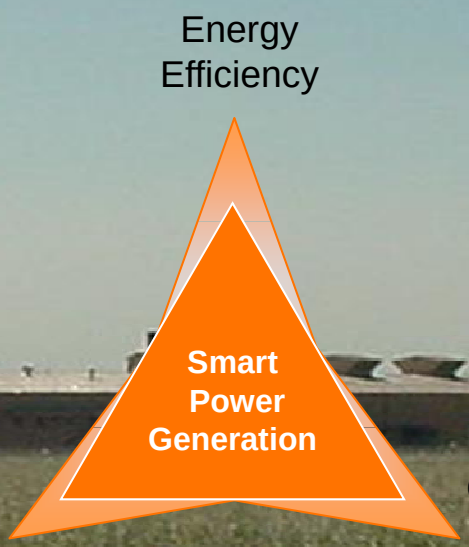
Smart Power Generation – Features

All in One!

- Both Base Load and Peaking with High efficiency
  - . base load (50+%) and peaking modes (46%)
- Operational flexibility (Quick Start)
- High energy efficiency over wide load range
- Gas / Liquid Fuel flexibility
- Decentralized – security / efficiency / reliability
- High plant reliability and availability
- Optimum plant location and size
- Low environmental impact / Low Emissions
- No water
- Easy maintenance



Smart Power Generation is the most valuable asset in the coming low carbon power markets.

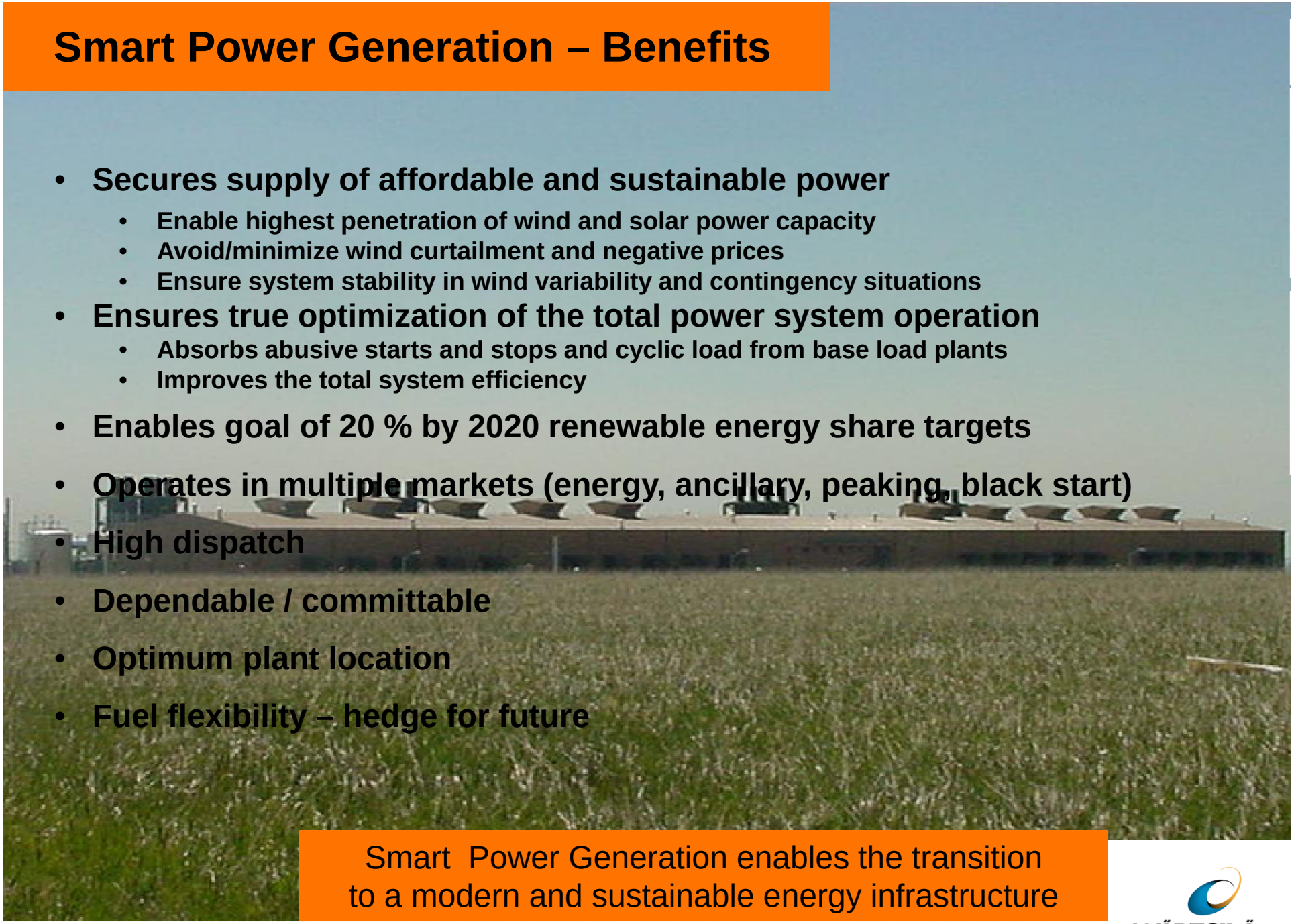
Smart Generation – Multiple Operation Modes

All in one!

- **Flexible base / intermediate load generation – Coal Replacement**
  - Technology is proven in base load applications with 47,000 MW of references worldwide
- **Rapid load following in the morning – Wind Firming**
  - Starting and loading units one by one along with growing load
- **Peaking during high electricity demand periods**
- **Balancing wind power i.e. "Wind Firming"**
  - Starting, loading and stopping rapidly when wind conditions change
- **System balancing**
  - Fast frequency regulation and efficient spinning reserve
- **Ultra fast zero-emission Non-Spin grid reserve for any contingency**
  - Starting and producing power in just 1 minute, and full power in 5 minutes
- **Fast grid black start in case of a power system black out**

UNIQUE

Smart Power Generation – Benefits



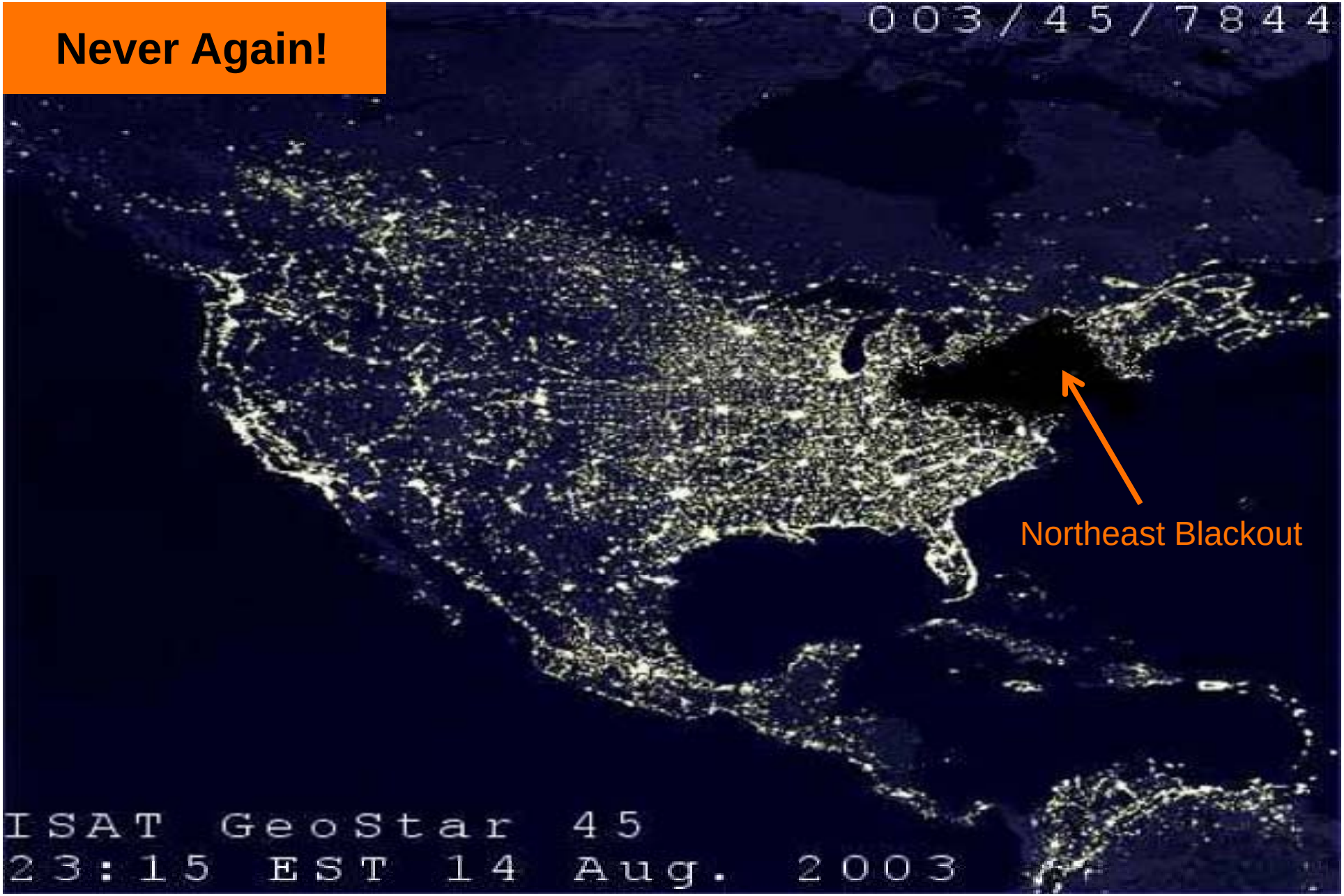
- **Secures supply of affordable and sustainable power**
  - **Enable highest penetration of wind and solar power capacity**
  - **Avoid/minimize wind curtailment and negative prices**
  - **Ensure system stability in wind variability and contingency situations**
- **Ensures true optimization of the total power system operation**
  - **Absorbs abusive starts and stops and cyclic load from base load plants**
  - **Improves the total system efficiency**
- **Enables goal of 20 % by 2020 renewable energy share targets**
- **Operates in multiple markets (energy, ancillary, peaking, black start)**
- **High dispatch**
- **Dependable / committable**
- **Optimum plant location**
- **Fuel flexibility – hedge for future**

Smart Power Generation enables the transition to a modern and sustainable energy infrastructure

Modularity & Scalability, 360MWe (16 x 18V50SG+CC)

Wärtsilä
Smart power generation

Never Again!



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