

# Increasing Grid Efficiency, Integrating Renewables, and Reducing CO<sub>2</sub> with a (not so new) Gas Technology

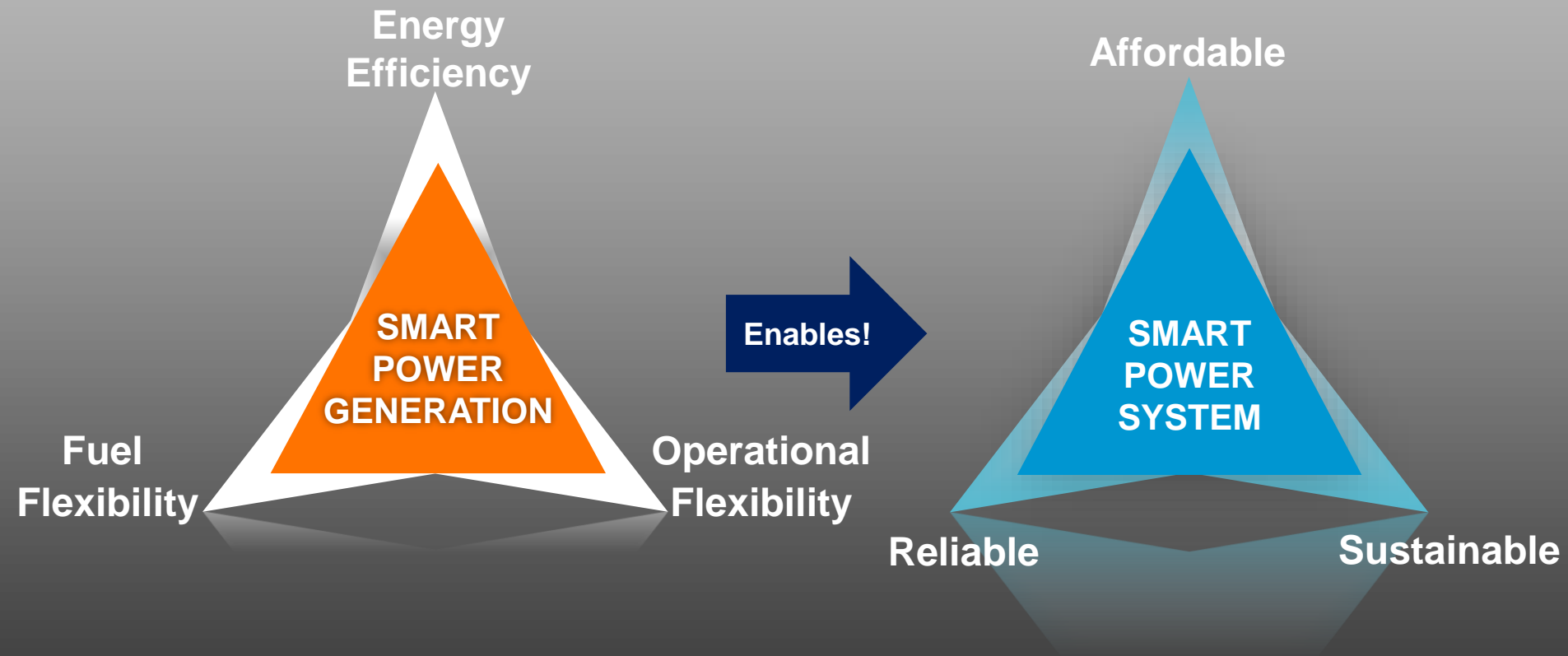
**Joseph Ferrari**  
**Market Development Analyst**  
**Wärtsilä North America, Inc.**

**US Association for Energy Economics, NCAC**  
**18<sup>th</sup> Annual Washington Energy Policy Conference**  
**Center for Strategic and International Studies**  
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- **Founded in 1834**
- **Headquarters in Helsinki Finland**
- **Net Sales € 4.7 billion (2012)**
- **Presence in 170 locations in 70 countries**
- **~ 19,000 people worldwide**
- **180+ GW installed globally**
- **54+ GW installed power plants**

# Smart Power Generation



## State of the Art, Medium Speed Gas Engines

- **Modular** – Plant size to 500+ MW, 10 - 20 MW increments
- **Efficient** – 45+% net, 50+% in CC
- **Fast**
  - Ramp Rates of 70% to 100% per minute
  - Start time 1 – 5 minutes
- **Min up time 1 min or less, min down time 5 minutes**
- **Zero Start Costs (no EOH penalties)**
- **Min load ~ 30% of 1 engine (3-6 MW min load for 300+ MW plant)**
- **VOM (\$/MWh) ~ GT alternatives**
- **CAPEX (\$/kW) ~ Aero GTs, Combined Cycle ~ GTCCs**
- **Proven track record (Wärtsilä leading supplier, 54 GW installed, 2.7GW in USA)**



# The Value of Smart Power Generation

Smart Power Generation can bring value on different levels of our industry.

**Power System  
(ISO)**

**Utility Portfolio**

# System Scale Optimization (Dispatch Modeling)

Technologies that are

- More Efficient

- More Flexible

- Competitive (EPC, VOM, FOM) and

- Reliable

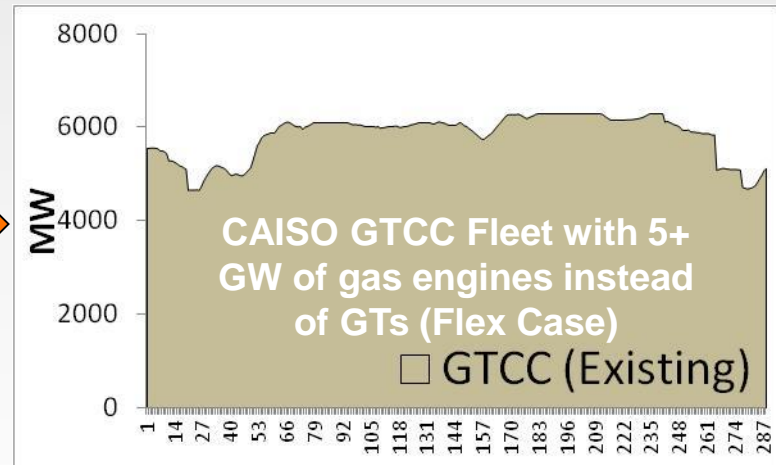
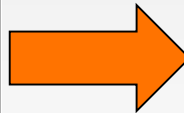
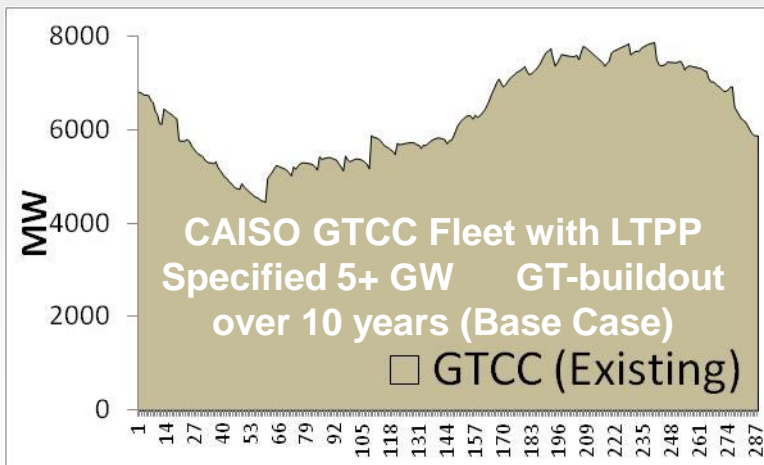
*e.g., Utility Scale (50-500MW gas engine plants)*

Improve efficiency, reduce costs and CO<sub>2</sub> at the *system* scale

System	Gas Engine (%) of Capacity	System OPEX Savings (%)*	Source
<i>Spain</i>	8	6	Wärtsilä
<i>United Kingdom</i>	5	3 - 5	RedPoint**
<i>CAISO</i>	~7	4 - 12	DNV Kema**, Energy Exemplar

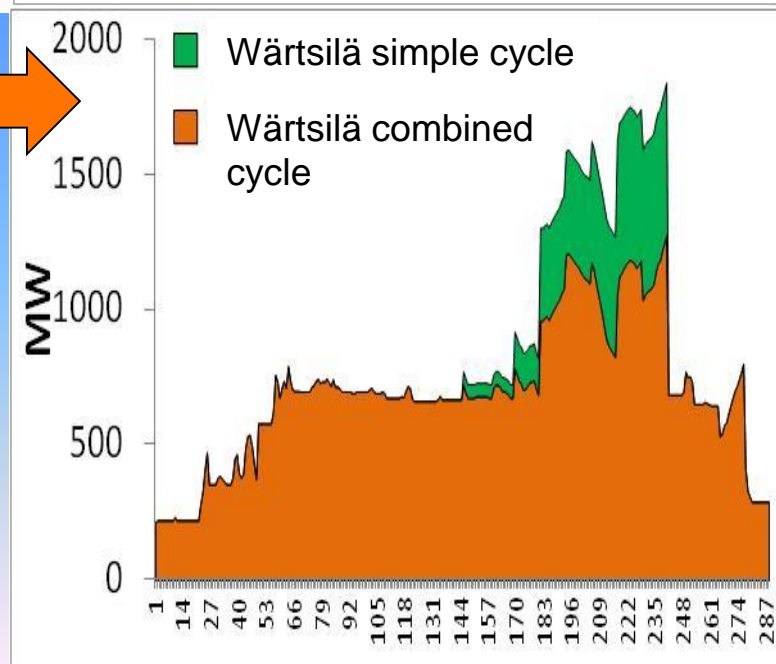
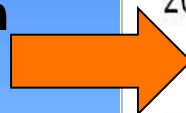


# Hows gas engines reduce system costs?



## Wärtsilä as Smart Power Generation

- Individual Units cycle w/o added cost
- Part Load Efficiency ~ Full Load
- Take over ancillary service provision (ramping, load following, regulation)
- **Reduce Cycling (cost!) on other system components**



# Wärtsilä Reduces Cost through System Optimization

Energy + AS	Base	Flex	Savings
Gross savings at marginal cost (BUSD/a) <sup>1, 2)</sup>	\$9.46	\$8.89	6.0%

**In CAISO System, in 2022 if @ 6% of capacity were flexible gas engines instead of gas turbines....**

- **6.0% decrease in annual ratepayer costs**
- Existing Combined Cycle starts (\$) reduced by 20%
- Existing Combined Cycle capacity factor increases (from 50% to 53%)
- System Efficiency increases, CO<sub>2</sub> generation reduced 1.1%
- System reliability increased- Ancillary Service shortfalls cut by 50-70%.

1) All shortfalls @ \$15k/MWh, acc to [http://www.naruc.org/grants/Documents/Economics%20of%20Resource%20Adequacy%20WhitePaper\\_Astrape\\_Final.pdf](http://www.naruc.org/grants/Documents/Economics%20of%20Resource%20Adequacy%20WhitePaper_Astrape_Final.pdf)

2) LFUp @ \$50k/MWh acc to [http://ethree.com/documents/E3\\_REFLEX\\_CAISO\\_2013-12-31\\_FINAL.pdf](http://ethree.com/documents/E3_REFLEX_CAISO_2013-12-31_FINAL.pdf) and other acc to 1)



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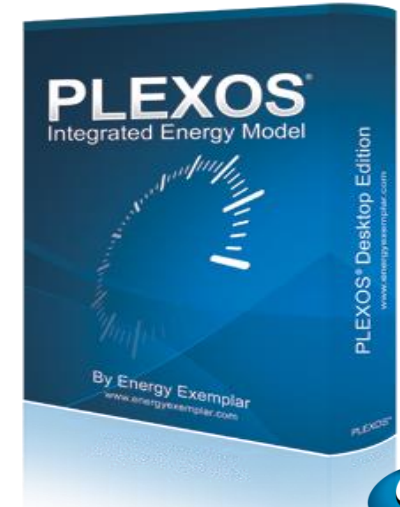
**Utility Portfolio**

# Optimized utility planning example

30 GW Utility with

- @ 50% capacity thermal, remainder renewables
- 9 GW of transmission
- RPS 30% renewables (GWh) in 10 years
- 6 GW of steam/boiler retirements in 10 years
- Using *advanced Chronological Capacity Expansion Modeling*

**Goal:** Meet system needs while minimizing NPV (Capex + Opex)



# Two Scenarios

## Base

- Aero GTs (50, 100 MW units)
- Frame GTs (200 MW units)
- GTCCs (300, 600 MW units)

## FLEX

- Aero GTs (50, 100 MW units)
- Frame GTs (200 MW units)
- GTCCs (300, 600 MW units)
- ***Wärtsilä gas engines***





# Gas Engines provide substantial benefits

MW Installed	BASE	FLEX
GTCC	3358	3358
GT Ind	2912	416
GT Aero (50MW)	49.37	0
GT Aero (100 MW)	419.6	0
Wartsila 34SG	0	92
Wartsila 50SG	0	2244.8
<b>Total MW installed</b>	<b>6738.97</b>	<b>6110.8</b>

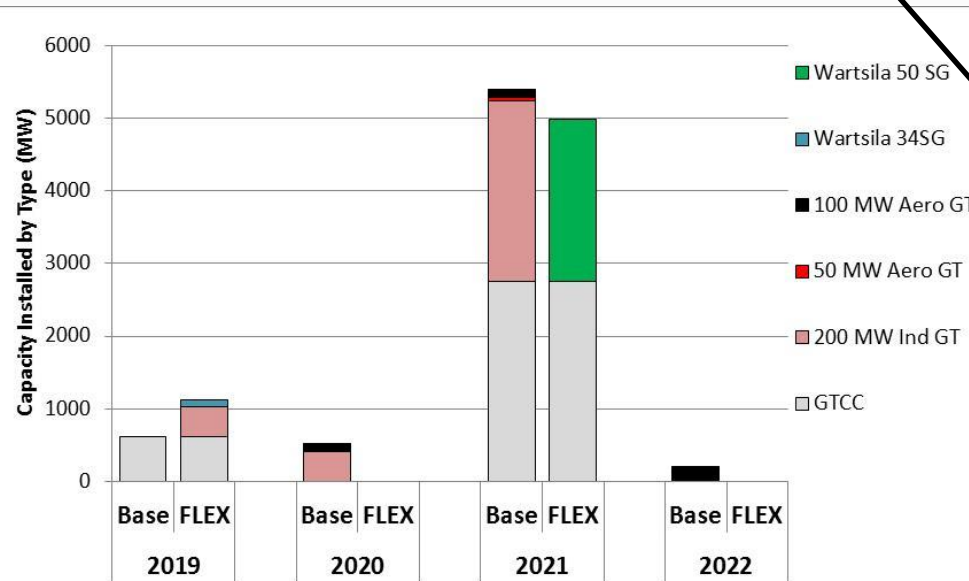
**In Flex Scenario, Gas Engines selected over Gas Turbines**

**In Flex Scenario, more than 1/3 new capacity are Gas Engines.**

**In Flex Scenario, @ 630 MW less capacity needed.**

**NPV(BUSD)**      **58.22**      **57.71**

**In Flex Scenario, NPV Savings more than 500 MUSD!**



# Medium Speed Gas Engines Improve our Systems

- Absorb fluctuations, ancillary service provision
- Reduce costs dramatically (ratepayer savings)
- Improve system efficiency & reduce greenhouse gas emissions
- Ultimately allow for greater amounts of renewables on the system



# Policy Issues

Smart Power Generation can help meet legislated goals (greenhouse gas, RPS, water conservation) and reduce costs simultaneously.

To unlock potential of Smart Power Generation, we need markets based on today's technology

And we need proper documentation of what's out there for use by consultants, gov. agencies, public utility commissions, etc. (e.g. WECC Generation Cost Report).





# Thank You

**Joseph Ferrari**  
**Market Development Analyst**  
**Wärtsilä North America**  
**410-573-2100**  
**[Joseph.Ferrari@wartsila.com](mailto:Joseph.Ferrari@wartsila.com)**

