Sustainable Fuels & Reciprocating Engines

Bhawramaett Broehm
Wärtsilä Market Growth & Development
Bhawramaett.Broehm@wartsila.com
+1 443-972-0197

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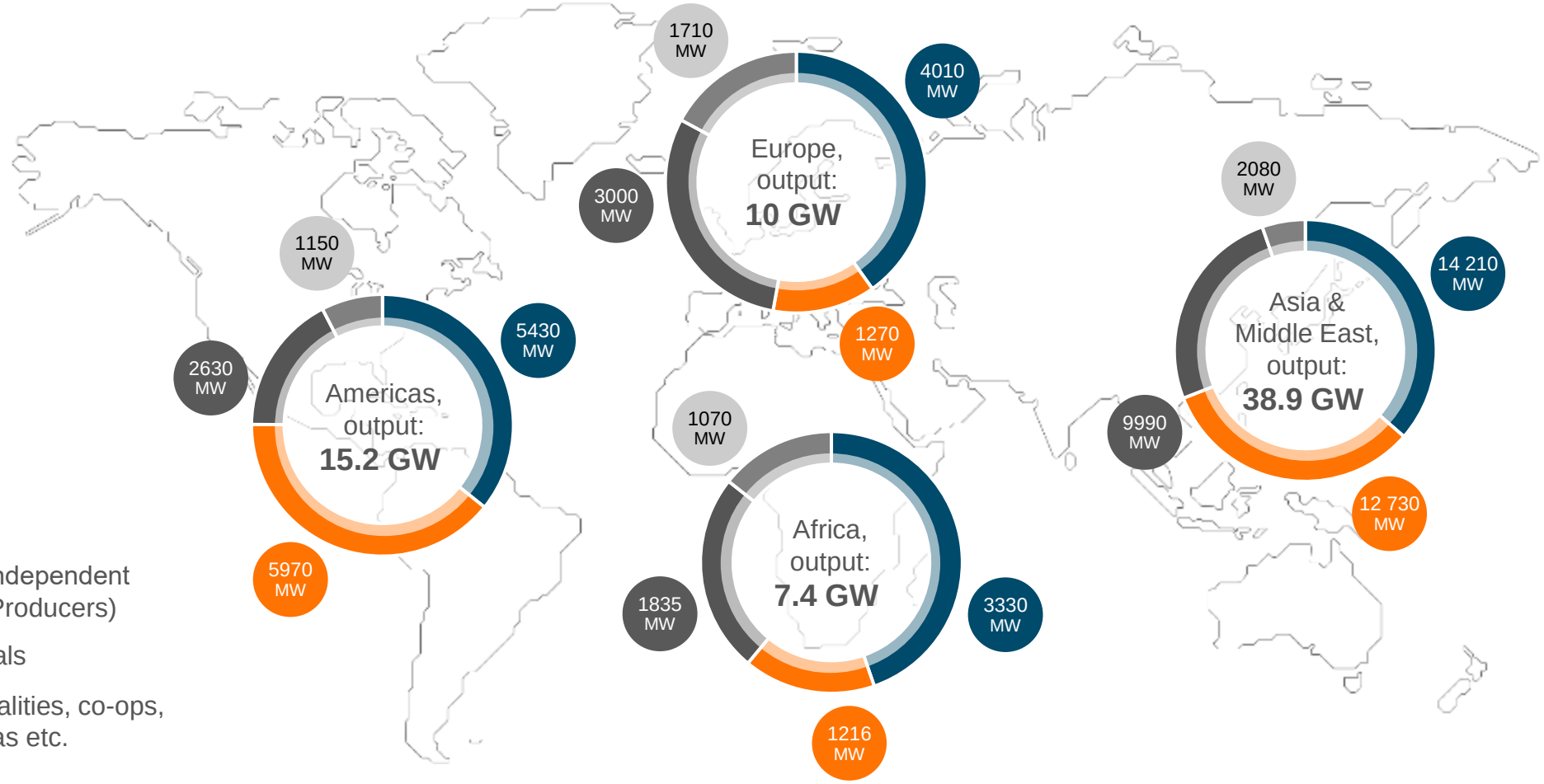
DELIVERED 76 GW POWER PLANT CAPACITY IN 180 COUNTRIES AROUND THE WORLD



Clean, reliable, affordable power requires portfolio diversity

Battery storage is not a one-size fits all solution

+ Fast and efficient
+ Affordable option for intraday energy balancing
+ Pairs well with solar

— Not a generator
— Duration limited
— Performance depends on state of charge

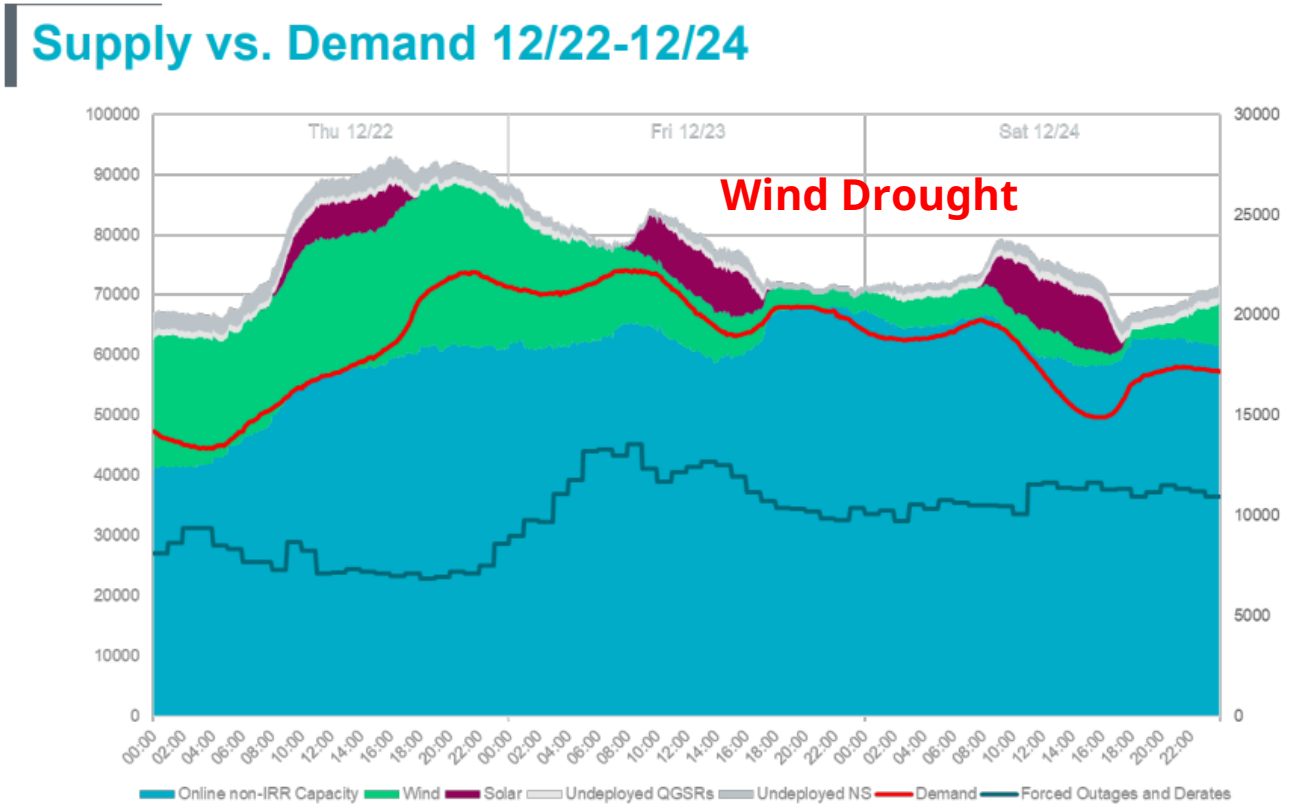
+ Duration unlimited
+ Fuel flexible
+ Fast and efficient
+ Pairs well with wind

— Fuel can be expensive
— Emissions intensity depending on fuel

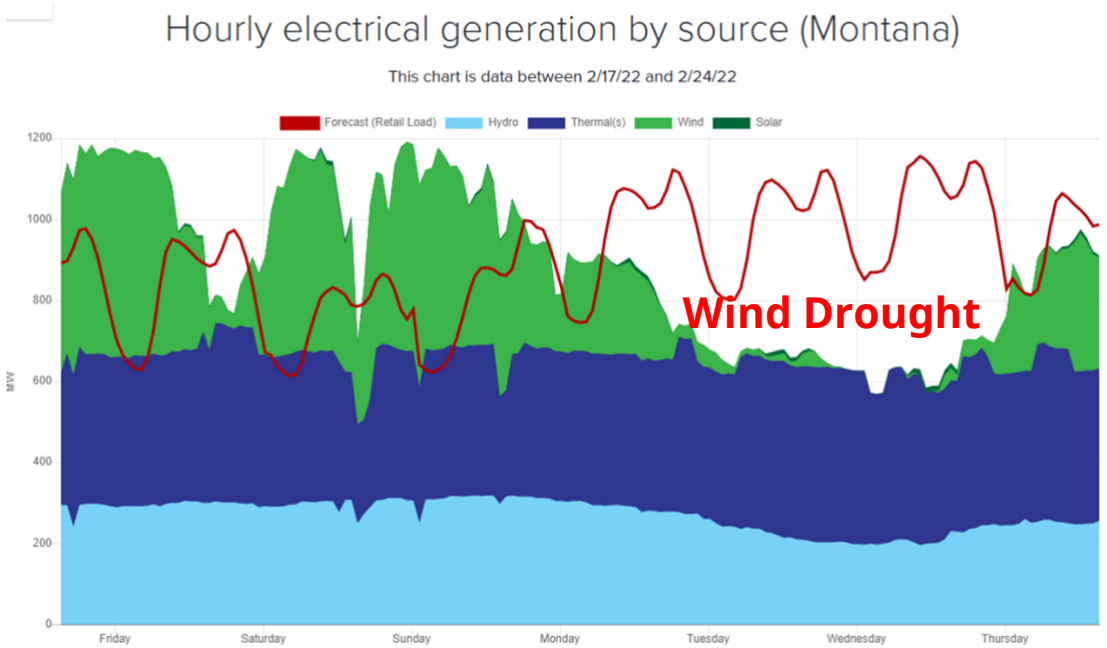
The *Dunkelflaute* problem

Grids large and small experience long wind droughts in the winter. The energy must come from somewhere!

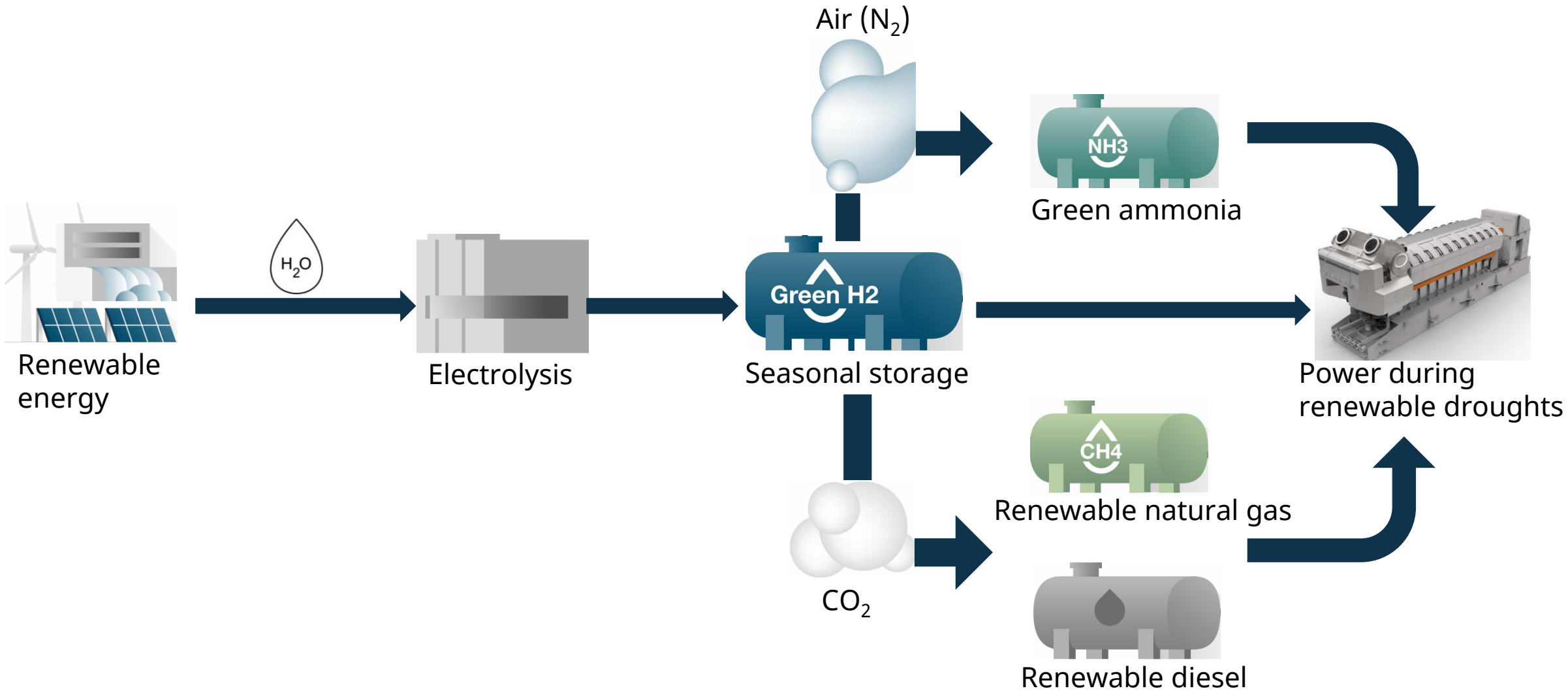
ERCOT: Winter Storm Elliott 2022



NorthWestern Montana, February 2022



Many sustainable fuel pathways exist, but a clear “winner” has not yet emerged



The best fuel will depend on the problem we are trying to solve

Fuel flexibility provides optionality as objectives change

Opportunities and Challenges

Hydrogen

+ Production eligible for $3/kg IRA subsidies
+ Can blend with (renewable) natural gas
— Requires new transportation and storage infrastructure
— Explosive and leakage prone

Ammonia

+ Established transportation and storage infrastructure
+ Can blend with (bio)diesel
— Efficiency losses when converting from hydrogen
— Highly corrosive

Biodiesel

+ Available today
+ High energy density
+ Easily stored and transported
+ Can blend with other liquid fuels
— Fuel availability/scalability
— Air pollutant

Wärtsilä Capabilities

Hydrogen

- 25% blends with natural gas today
- 100% H_2 engine by 2026
- Conversions for existing engines by 2030

Ammonia

- 15% blends today with diesel
- 100% NH_3 engine by 2028

Biodiesel

- Existing Wärtsilä engines operate on 100% biodiesel today

Final Thoughts

Capacity is needed today

- Load growth (EVs, data centers, heat pumps)
- Retirement of existing generators

Portfolio diversity is important

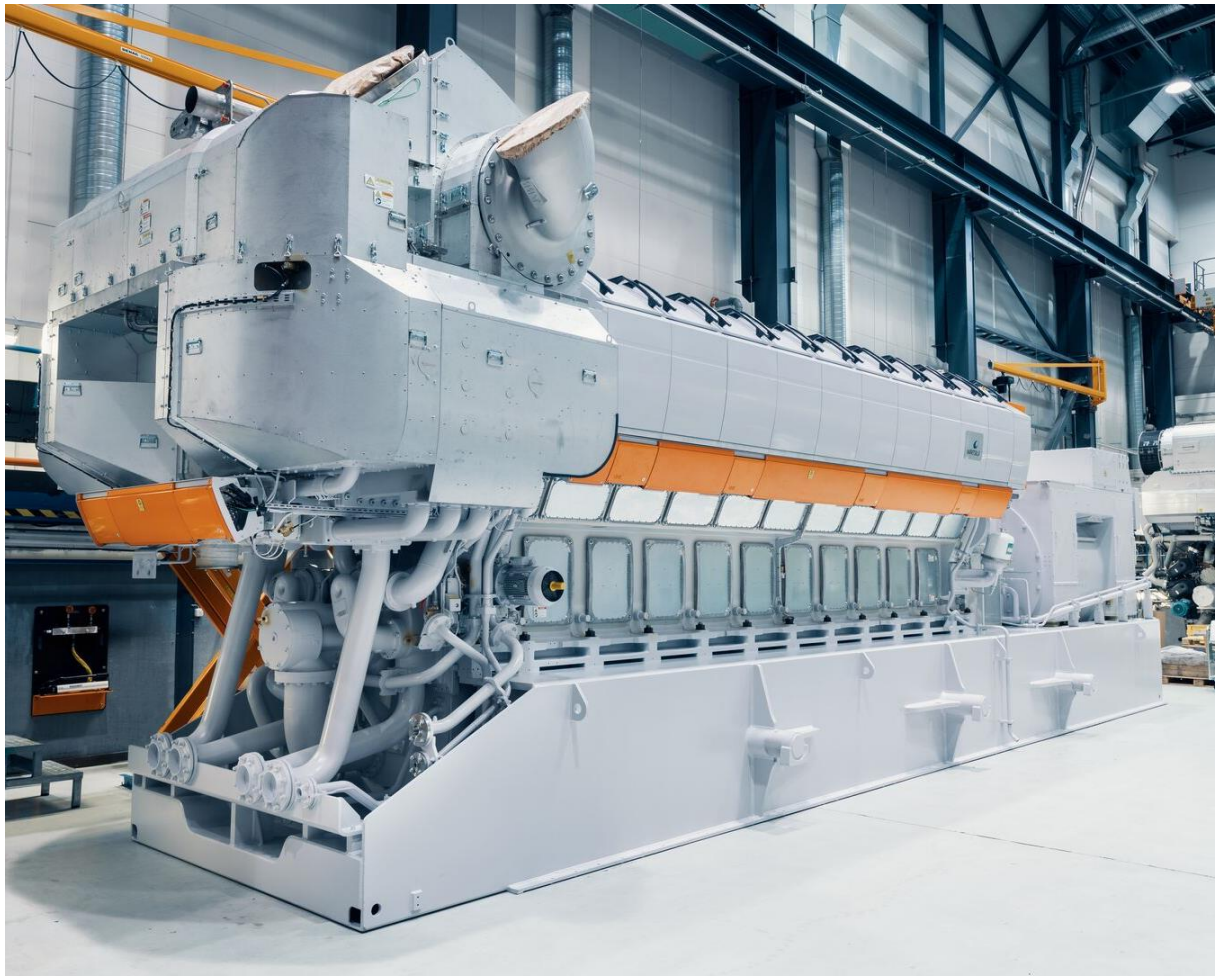
- A complementary set of resources is needed to mitigate technology-specific risk
- What attributes are important?

100% won’t happen overnight

- What happens between now and 2045?
- Pilot programs are essential for learning

Be ready to adapt

- We can’t always “wait and see”
- Reliability-driven decisions of today should not compromise the decarbonization goals of tomorrow
- Wärtsilä engines are a “no regrets” solutions



Wartsila Gas Engine Specifications

Engine Model	20V34SG	20V31SG	18V50SG	16V46TS-SG
Output	9.37 MW	11.35 MW	18.82 MW	20.32 MW
Heat Rate (BTU/kWh) LHV HHV Net HHV	 7,439 8,256 8,442	 7,039 7,778 7,953	 7,324 8,128 8,311	 7,126 7,899 8,077
Speed	720 rpm	720 rpm	514 rpm	600 rpm
Dimensions (L/W/H) **Dry Weight** (US tons)	42'x 11' x 15' 143	48 x 13 x 17 199	63' x 18' x 21' 391	62' x 19' x 23' 433
Synchronization (sec) **Full Load** (minutes) **Min to Max Load** (sec)	30 2 40	30 2 60	30 5 60	30 5 60
Minimum Load	10%	10%	10%	10%

- Can use R-LNG, LPG and/or ethane as a backup/emergency fuel
- Parasitic load - Approximately 2.2% to high side of GSU
- Output & Heat Rate - measured at generator terminals (pf 0.8, 0% tolerance)

Wartsila Dual Fuel Engine Specifications

Dual Fuel	20V34DF	20V31DF	18V50DF
Output	9.37 MW	11.36 MW	18.13 MW
Heat Rate (BTU/KWh) LHV HHV Net HHV	 7,555 7,991 8,575	 7,272 7,713 8,252	 7,423 7,731 8,424
Speed	720 rpm	720 rpm	514 rpm
Dimensions (L/W/H) **Dry Weight** (US tons)	42'x 11' x 15' 143	48'x 13' x 17' 199	63' x 18' x 21' 391
Synchronization (sec) **Full Load** (minutes) **Min to Max Load** (sec)	30 2 50	60 5 60	60 5 60
Genset Minimum Load	40%	50%	40%

Output and Heat Rate are measured at the generator terminals (pf 0.8, 0% tolerance). Higher minimum loads may be required with certain applications using SCR modules with oxidation catalyst.

- Dual Fuel (DF) engines can use ULSD diesel as backup/emergency fuel, and switch fuel while operating.