

Wärtsilä Corporation

LNG to POWER in remote area

FLNG Global 2017

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Marine & Offshore

Power Generation

SOLUTIONS FOR



18,000 Professionals / 200 locations / 70 countries



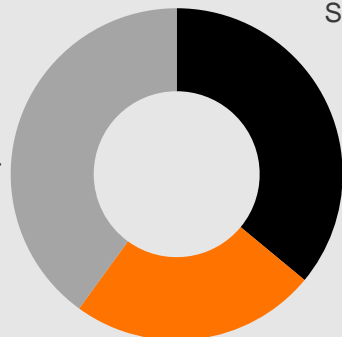
Net sales
by business
2016

Services
46%

Marine
Solutions
34%

Energy
Solutions
20%

Listed in Helsinki
4.9 billion € turnover
Solid financial
standing



LEADER IN



EFFICIENCY



FLEXIBILITY



ENVIRONMENTAL
SOLUTIONS

What we bring to the market & what we offer to our customers



ENGINE POWER PLANTS



LNG INFRASTRUCTURE



SOLAR PV SOLUTIONS



ENERGY STORAGE



DEVELOPMENT & FINANCIAL SERVICES



PROJECT MANAGEMENT



LIFECYCLE SOLUTIONS

Climate change and scarcity of natural resources are affecting our operating environment

CHANGING ENERGY NEEDS



INCREASING DEMAND FOR NATURAL GAS



ENVIRONMENTAL AWARENESS



GROWTH OF RENEWABLE ENERGY



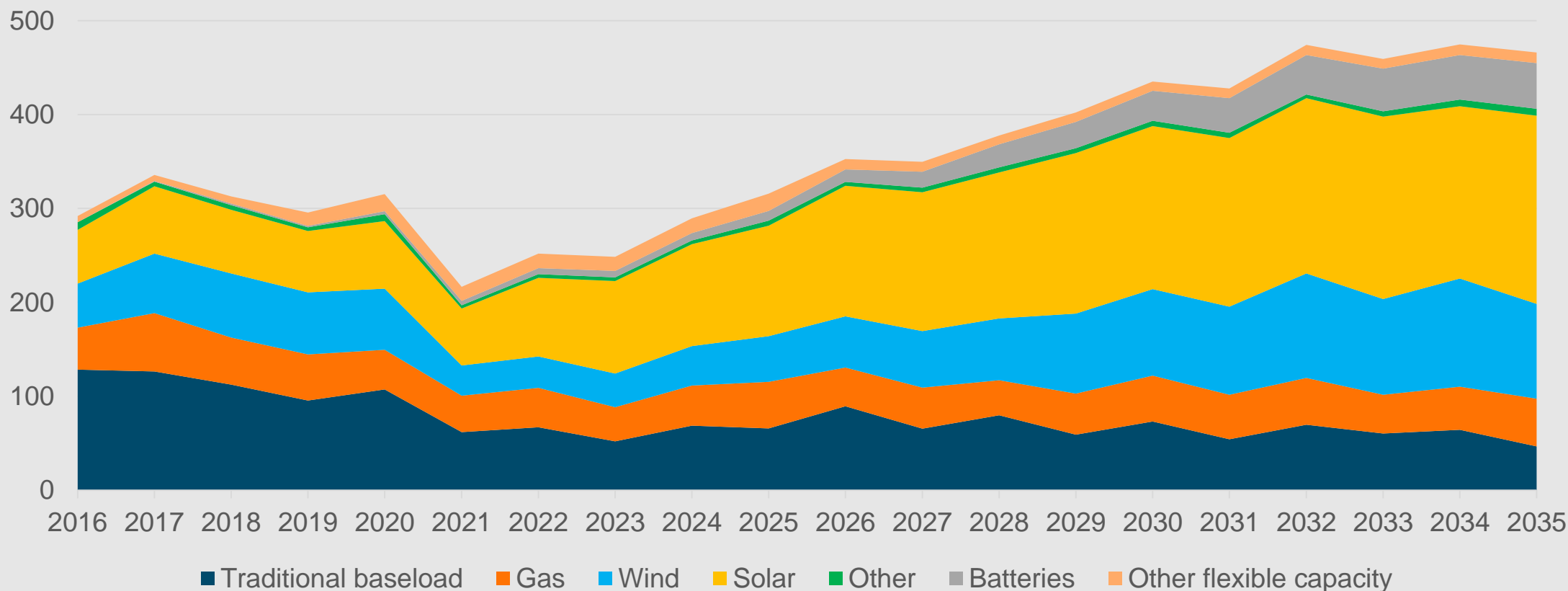
Market trends & drivers

- Electricity generation paradigm changing → renewables new baseload
- Storage systems needed in order to support renewable intermittent energies
- Growth in sustainable energy, reducing carbon emissions
- Rapid growth of intermittent renewable generation and escalating demand fluctuation
- Ageing installed capacity driving investments in new technologies
- Natural gas replacing other fossil fuels
- Economic growth, electrification and improving standard of living



Future energy investments will favor renewable power production

Global annual gross capacity additions, GW



Source: Bloomberg New Energy Finance

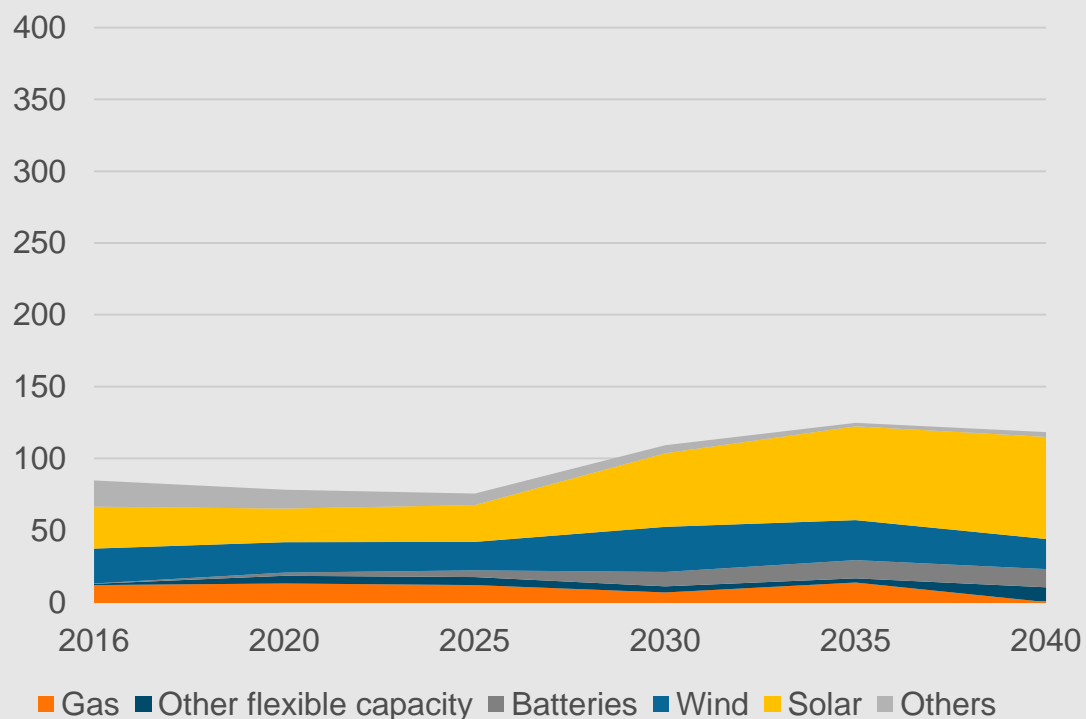
Traditional baseload = coal, oil, nuclear, hydro

Other = geothermal, biomass, waste to energy, other REs

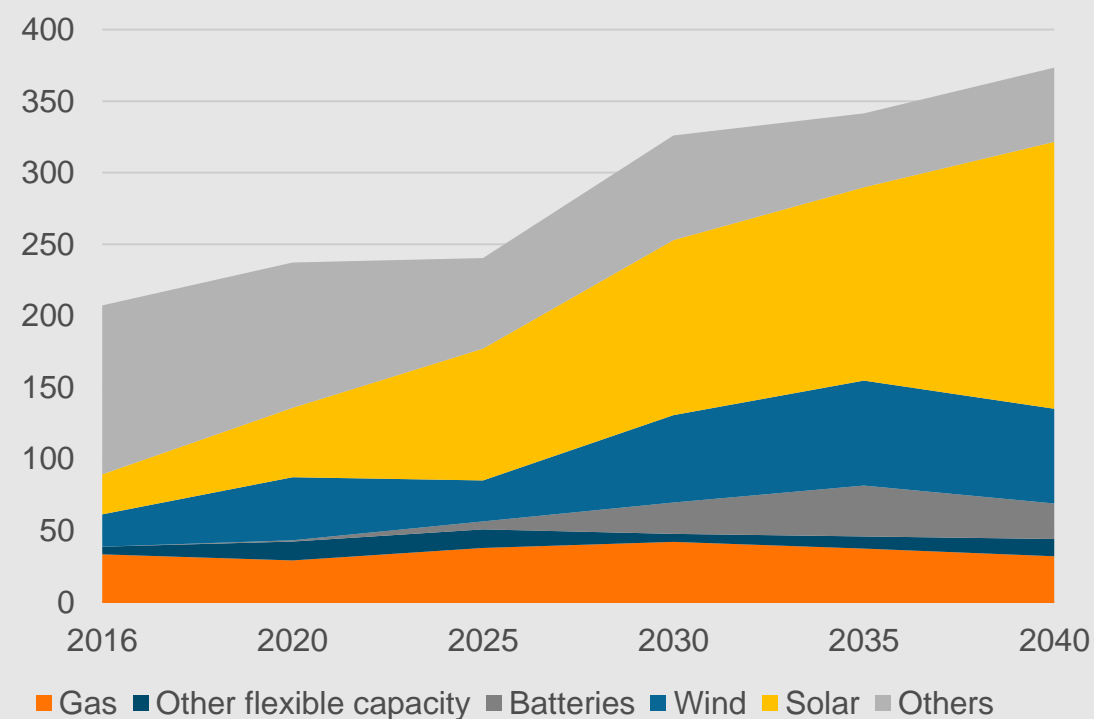
Other flexible capacity = demand response and other potential sources

Renewables rapidly increasing, Non-OECD countries dominate power plant investments

OECD Gross annual capacity additions (GW)

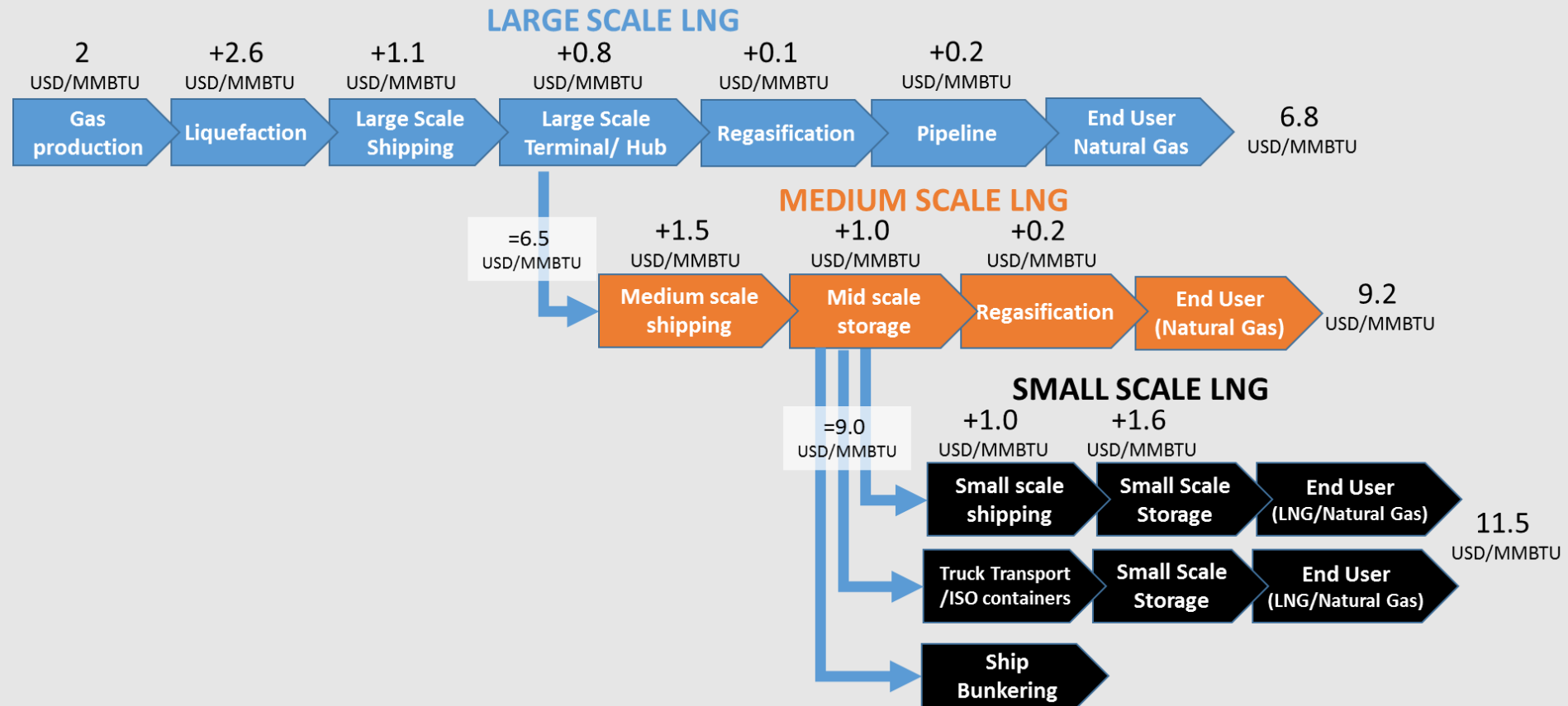


Non-OECD Gross annual capacity additions (GW)



Source: Bloomberg New Energy Finance

Note: Flexible capacity includes power storage, demand response and other potential resources. Others include: coal, oil, nuclear, hydro and other renewables than wind or solar



- The world is experiencing a global transition to gas
 - The long-term price of gas is expected to be more favourable than alternatives because of the large reserves available
 - Gas is the cleanest fossil fuel
- LNG grows both in volume and share of total gas consumption
 - Supply and demand cannot always be connected by pipeline
 - LNG infrastructure reduces dependence on a single pipeline supplier
 - Increasing use as fuel in vessels, trucks and heavy equipment
- LNG is evolving from large-scale facilities to small-scale
 - Oversupply of LNG until 2025 makes large-scale suppliers more willing to invest in downstream and small-scale to create more gas consumption
 - Smaller markets want LNG and therefore need small-scale solutions
 - Marine emissions regulations make LNG bunkering capabilities a must-have in the competition between ports
 - Increased interest in monetizing small sources of gas creates demand for smaller LNG plants



On-Shore



Off-Shore (Power Barge)



Project logistics

Site	Site 1. Medium size town (100,000 habitants) with basic industry and some tourism.	Site 2: Small village (5,000 habitants) with substantial and growing tourists business.	Site 3: Small town (30,000 habitants) with large tourist centre & 30MW Solar Park.	Site 4: Large town (250,000 habitants) with minor industry but major tourist business.
Power Need	100MW at 75%Pf	30 MW at Pf 33%	60 MW at 33% Pf	120 MW at 50% Pf
Power LNG Consumption	105,500 TPA	14,300 TPA	28,500 TPA	86,300 TPA
Other LNG consumers	40,000 TPA (Industry)		5,000 TPA (Marine)	30,000 TPA (Industry)
Total LNG Consumption	145,500 TPA	14,300 TPA	33,500 TPA	116,300 TPA
Tank size	Min. 25,300 = 30,000 m ³	Min. 1,990 = 2,000 m ³	Min. 5,140 = 5,000 m ³	Min. 17,800 = 18,000 m ³
Load	Quite stable	Daily on-off	Varies a lot from day to day	Regular daily variation
Site type	Hard soil	Very soft soil	Very soft soil	Very soft soil
Harbour	Existing jetty with 5-10m depth	Jetty not available, 2-4 m depth	Existing harbour 3-8m depth, no jetty	Existing fishing harbour 5-8m depth
Local Infra	Good availability	Good 50 km away.	Not available, Tourist centre only	Some availability
Proposed power plant	100MW Flexible Baseload Gas Plant (6 x 18V50SG)	30 MW flexible Gas Plant (3 x 20V34SG)	60MW peaking plant (6 x 20V34SG)	120 MW Power Barge- Flexible Gas plant (12x 20V34SG)
Proposed Tank size	30,000 m ³ , Flat bottom, full containment.	2 x1,000 m ³ Pressurized steel tank. Tapping from Site 1, with Truck	5 x 1,000 m ³ pressurized steel tanks	18,000 m ³ , LNG storage and re-gasification barge
Site work	Major, preparing on-shore for heavy construction. Utilizing existing jetty with some dredging to 10 m.	Minimal, prepare site for light constructions only. No off-shore activities	Minimal on-shore preparation. Light construction only. Extensive off-shore work with extension of jetty and dredging to min 10m.	Minimal on-shore preparation. Light construction only. Extend jetty out and dredging to min 10 m.

LNG “add on costs” contribution in USD/MMBTU

(Excluding all taxes and import duties)

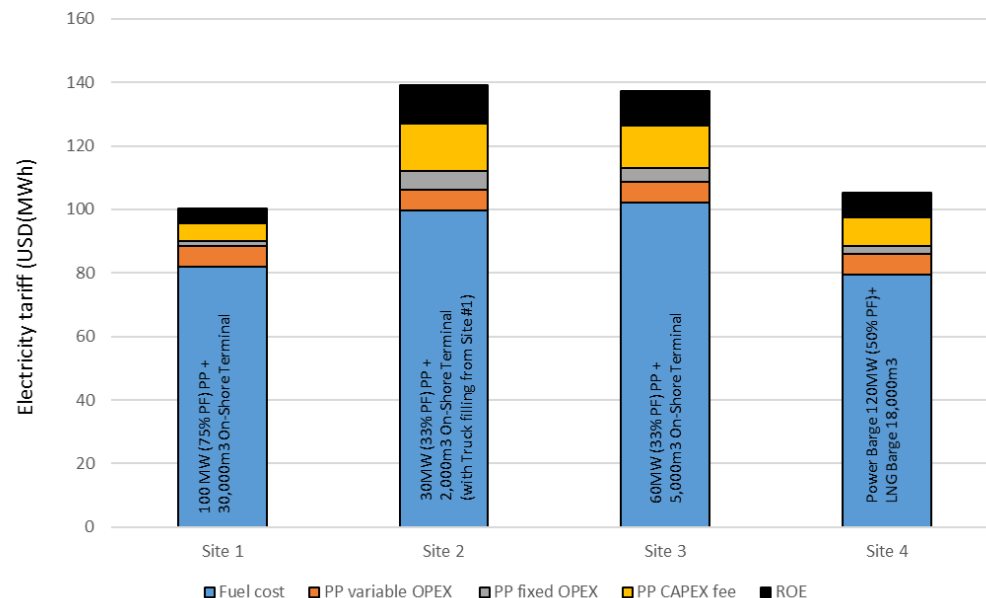
	Site 1	Site 2	Site 3	Site 4
LNG FOB	9	11,55	9	9
Tank size	30,000 m3	2 x 1,000 m3	5 x 1000m3	18,000m3 barge
Shipping	0,33	0,64 (Truck)	2,82	0,35
Terminal CAPEX fee	1,99	1,29	2,03	1,51
LNG inventory	Incl. in above	Incl. in above	Incl. in above	Incl. in above
Terminal OPEX	0,23	0,19	0,16	0,19
Cost of Gas at PP inlet (USD/MMBTU)	11,55	13,67	14,01	11,05

Electricity tariff calculation USD/MWh

(Excluding grid connection costs, all taxes & import duties)

	Site 1	Site 2	Site 3	Site 4
LNG cost (USD/MMBTU)	11,55	13,67	14,01	11,05
Power Plant	100 MW at 75% PF	30 MW at 33% PF	60 MW at 33% PF	120 MW at 50% PF
LNG converted into Fuel cost	86,25	107,32	109,99	85,69
PP CAPEX fee	6,31	16,99	15,14	10,08
PP fixed share	1,52	5,77	4,32	2,28
PP variable OPEX	6,53	6,53	6,53	6,53
ROE	5,21	14,04	12,51	8,33
Total cost of Power	105,83	150,65	148,48	112,91

Electricity Tariff results

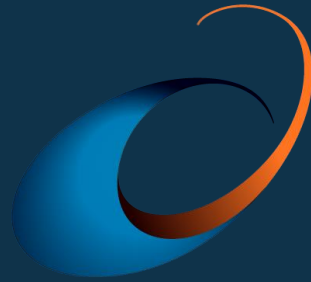


1 For Site 2, due to low volume, it is more feasible to transport LNG from site 1 with truck.

2 Shipping “add on cost” is extremely low due to:
 -Clubbing 4 sites together served by one 30,000m3 LNG carrier doing a “milk run”.
 -LNG carrier chartered only 180 days per year

- **Power can be produced with LNG in a remote or isolated location at a competitive price:**
- **Key parameters:**
 - Finding a competitive small-mid scale LNG provide
 - Clustering a few sites/consumers together
 - Sharing one larger LNG carrier doing a "milk run"
 - "Smart" chartering of LNG carrier
 - Suitable site for Terminal (Water depth, Soil quality, Natural Breakwater etc..)
 - Selecting the right terminal solution (Off-shore vs Onshore)
 - Selecting the right Power Plant technology (Flexibility, Efficiency, On-shore vs Off-Shore)
 - Optimized logistics – Consumption vs. Tank size vs. Refilling rate vs. Ship Size





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