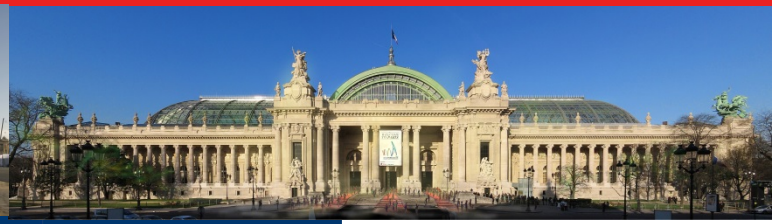
26th World Gas Conference

1 – 5 June 2015, Paris, France



Remote LNG (Study Group D1 Report)

Heinz Bauer
Linde Engineering

WGCPARIS2015
WORLD GAS CONFERENCE

Study group leads

- Jorge Gómez de la Fuente
  Repsol (2014-2015)

- Simon J Frost
  Repsol (2013-2014)

- Jean-Yves Capelle
  Total (2012-2013)

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(speaker)

Our definition of REMOTE

- Geographical **R** emoteness
- **E** xtreme climatic conditions
- **M** anpower problems
- **O** perational challenges / infrastructure
- **T** echnical hurdles
- **E** nvironmental sensitivity

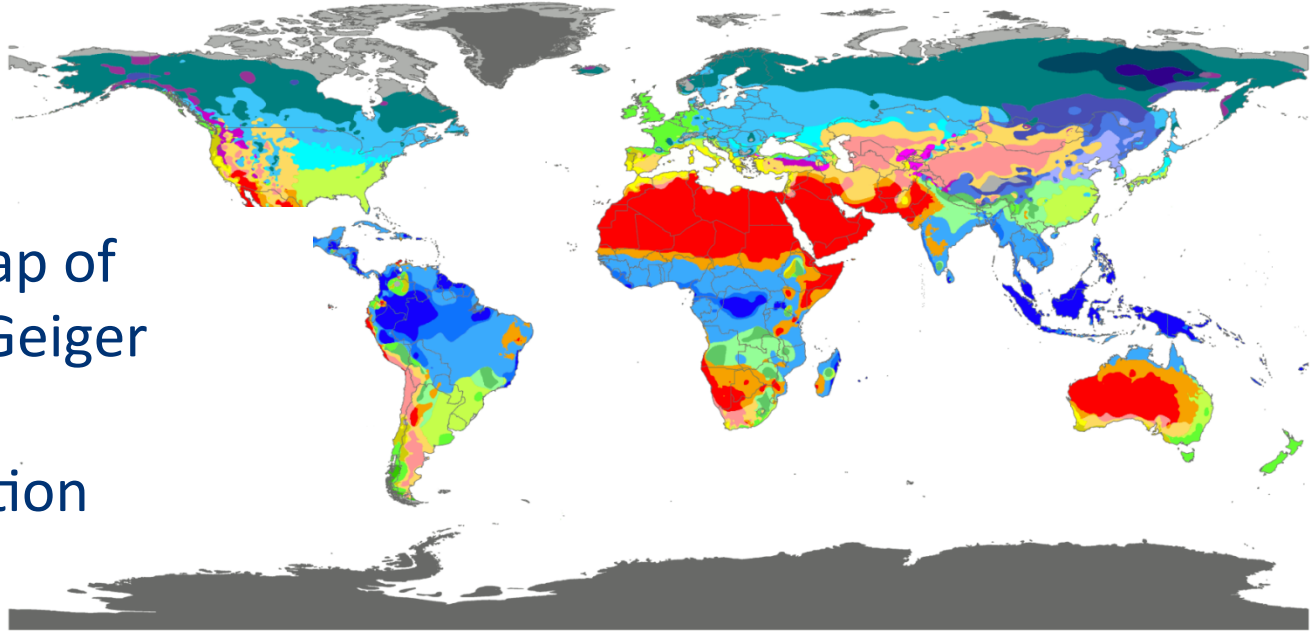
Remoteness Index (RI) criteria

Remoteness criteria	Geographical Remoteness	Extreme climatic conditions	Manpower problems	Operational challenges / infrastructure	Technical hurdles	Environmental sensitivity
Weighting	25%	15%	10%	20%	10%	20%
	Ease of access to site	Climatic classification	Availability of skilled labor	Complexity of operating a plant	Unproven concepts	Site impact
1 low	Uninterrupted access by land, air and sea	Humid moderate climate without dry seasons (Cf*)	Easy access to local skilled labor	No significant operational challenges	none or one non-critical	abandoned area
2 slight	Good land and sea access, occasionally no air access	Humid moderate Mediterranean climate, dry winter (Cw, Cs*)	Good basic local labor pool, training required	Minor operational challenges - easily overcome	several non-critical	industrial area
3 average	Temporary access inconveniences via land and air	Cold moderate climate (D*)	80/20 local/import labor	Some operational challenges	one critical	populated area
4 elevated	Extended land and air access interruptions	Tropical climate (A*)	Limited local labor available, depen-dence on import	Significant challenges	several or critical	recreational area
5 high	Severe difficulties, occasional zero access	Dry climate, desert, polar climate (B, E*)	No local labor available, rotational imports only	Severe operational issues, incl. seasonal	several and critical	nature reserve

*) classification adopted from Köppen-Geiger

Climatic conditions

World map of Köppen-Geiger climate classification



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Af	BWh	Csa	Cwa	Cfa	Dsa	Dwa	Dfa	ET
Am	BWk	Csb	Cwb	Cfb	Dsb	Dwb	Dfb	EF
Aw	BSh		Cwc	Cfc	Dsc	Dwc	Dfc	
	BSk				Dsd	Dwd	Dfd	

Contact : Murray C. Peel (mpeel@unimelb.edu.au) for further information

DATA SOURCE : GHCN v2.0 station data
Temperature (N = 4,844) and
Precipitation (N = 12,396)

PERIOD OF RECORD : All available

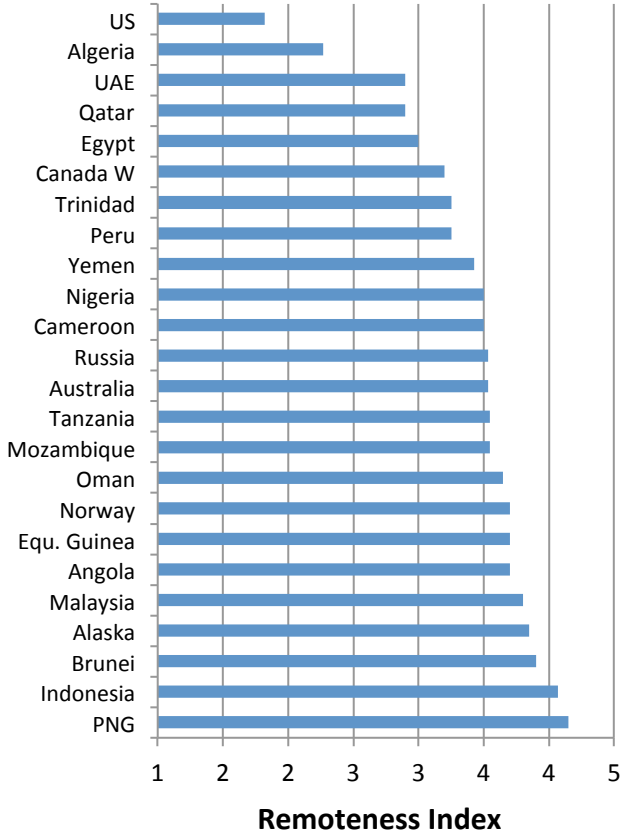
MIN LENGTH : ≥30 for each month.

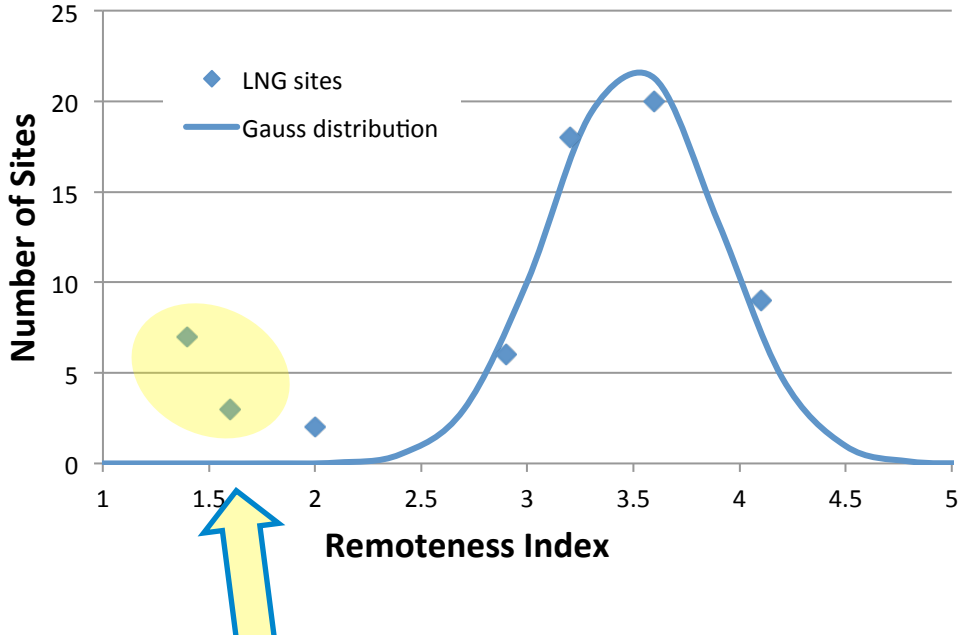
RESOLUTION : 0.1 degree lat/long

Highly REMOTE LNG plants

Country	Highly Remote Plants Project Name	Start Year	Geographical Remoteness	Extreme climatic conditions	Manpower problems	Operational challenges	Technical hurdles	Environmental concerns	Remoteness Index
Alaska	**Alaska LNG**	2023	4	5	4	4	4	5	**4.4**
Indonesia	**Bontang LNG**	1977	4	4	5	4	4	5	**4.3**
PNG	**PNG LNG**	2014	5	4	5	3	2	5	**4.2**
PNG	**Gulf LNG**	2021	5	4	5	3	2	5	**4.2**
Indonesia	**Arun LNG**	1978	4	4	5	4	4	4	**4.1**
Russia W	**Yamal LNG**	2020	5	5	4	4	3	3	**4.1**
Indonesia	**Natuna D Alpha**	2025	3	4	4	4	5	5	**4.1**
Indonesia	**Tangguh LNG**	2009	5	4	5	2	2	5	**4.0**
Indonesia	**Donggi-Senoro LNG**	2014	5	4	5	2	2	5	**4.0**

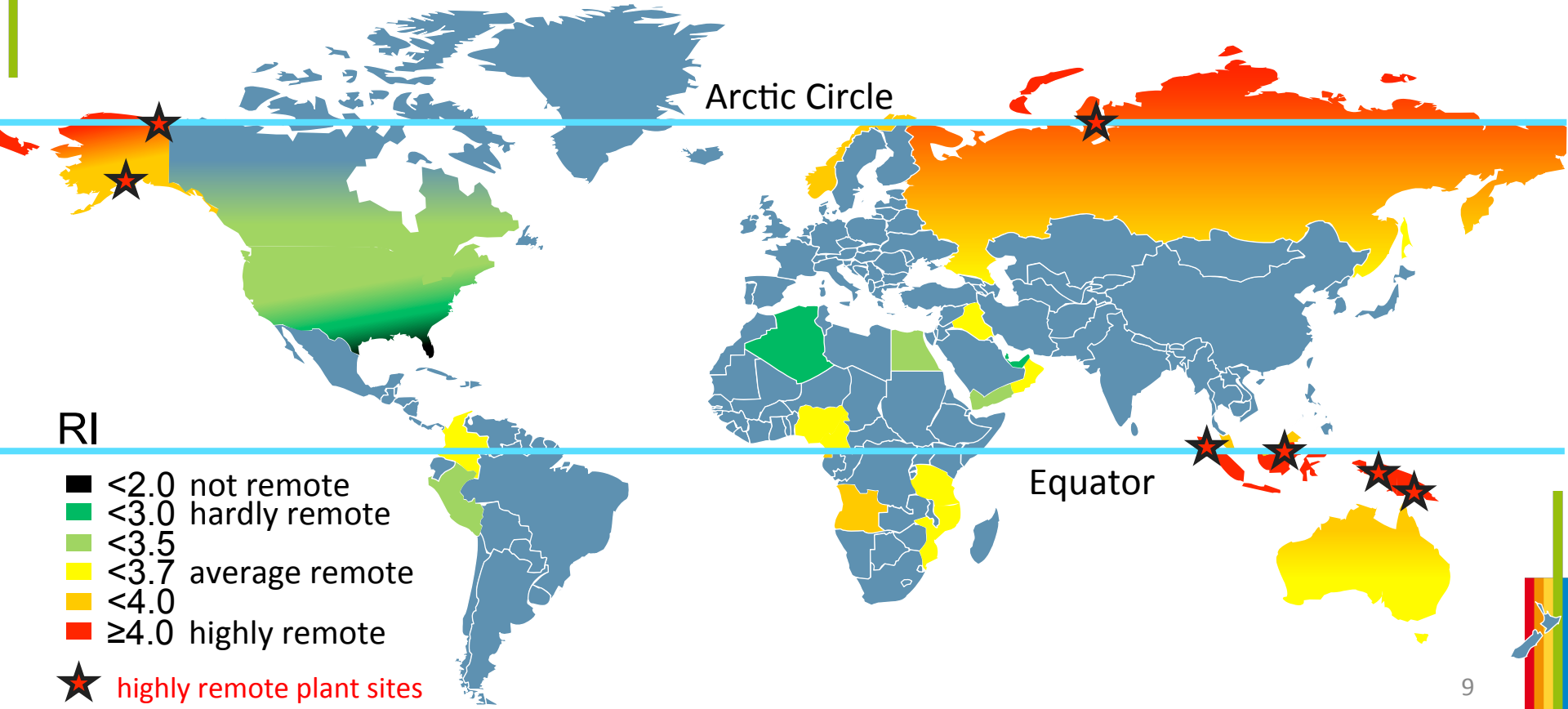
Geographical and statistical distribution of RI





shale gas based projects in the US

Remoteness Index world map



Yamal LNG as example for Arctic conditions

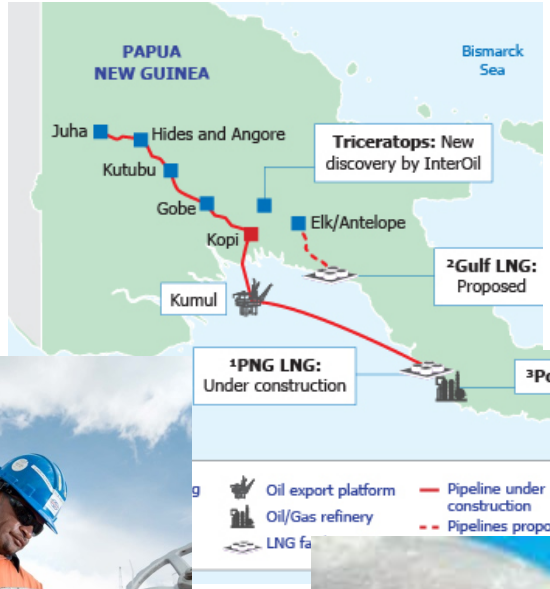
Remoteness Criteria

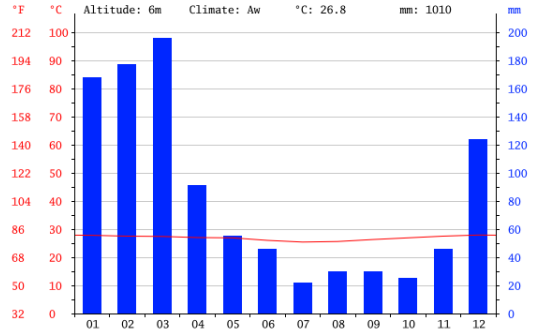
- 5 Geographical Remoteness
- 5 Extreme climatic conditions
- 4 Manpower problems
- 4 Operational challenges / infrastructure
- 3 Technical hurdles
- 3 Environmental sensitivity

PNG LNG as example for Tropical conditions

Remoteness Criteria

- 5 Geographical Remoteness
- 4 Extreme climatic conditions
- 5 Manpower problems
- 3 Operational challenges / infrastructure
- 2 Technical hurdles
- 5 Environmental sensitivity





Conclusions

- **Geographical and climatic conditions**
  Infrastructure will develop over the years, adverse climatic conditions cannot be changed by mankind; thus, this aspect will remain a significant indicator for a competitive, sufficient profit generating LNG liquefaction project
- **Social and environmental issues**
  While people may assimilate to changes in their social and cultural life within decades, the environment needs much longer periods to recover from imprudent disturbances
- **Technical and operational challenges**
  No project as yet has been shelved due to purely the lack of technological solutions, but due to the lack of economical sense of the required technological solutions
- **Cost impact of Remoteness Index**
  A clear view on correlation between remoteness and cost looks as likely to be as absent for future projects as has been the case up until now
- **Usage of Remoteness Index**
  The Remoteness Index can be taken as an indication about how challenging can be a new LNG project due to its location

- **PLEASE READ THE FULL REPORT**