



Delis T. Zambrana

Natalia Martínez Lugo

PREPA's designated Procurement Representatives

Dear Madam, Sir,

The AES Corporation ("AES") is pleased to provide this response to the Request for Proposals ("RFP") issued by Puerto Rico Electric Power Authority ("PREPA") dated July 2018. AES has a long-term commitment with Puerto Rico's power sector since 2002 as one of the most important private providers of low cost energy to the island.

As PREPA will see through this document, AES has a successful track record of delivering LNG to power projects (both greenfield and brownfield from conversion of existing units) and is keen to use our experience to convert San Juan Units #5&6 to operate on natural gas with proven technology, leveraging our global expertise in power generation with a reliable supply source of LNG from one of the most important LNG players in the world.

AES and TOTAL have entered into partnership agreements with the aim to develop sales of natural gas and LNG in the Caribbean and Central America region. This partnership offers a fully secured supply solution to customers, thanks to TOTAL's existing and diversified portfolio of LNG supplies and AES experience in generation assets and strong presence in the local markets, such as Puerto Rico.

Our indicative proposal is being made solely on behalf of AES and considers several inputs from our preliminary discussions with TOTAL regarding a potential collaboration to supply LNG to Puerto Rico. As so, the attached proposal is provided for discussion purposes only and is not a legally binding agreement or an offer by AES to negotiate a legally binding agreement or an offer that is capable of acceptance. Any agreement between the parties with regards to the matters in this RFP is subject to the execution of a legally binding agreement. Our response to this RFP shall not be considered as to the final terms and conditions which will govern the transaction contemplated hereby, as many aspects of the proposal need to be further analyzed prior to making a binding offer.

Based on the preliminary analysis performed, AES concluded that a **conventional FSRU import scheme solution on an offshore port** is the most suited solution for the conversion of natural gas of the power generators in the San Juan area. The main reasons to justify our conclusion are:

- FSRUs are proven LNG import solutions which have been successfully implemented to open new gas markets in the world, included in the USA. The technology is mature with numerous market players allowing cost competition.

- With regards to LNG supply solution, PREPA can access a diversified portfolio of non-US LNG sources on the global market, therefore increasing supply security while also not relying on any Jones Act waiver.
- AES trusts that a conventional LNG FSRU scheme should ultimately provide PREPA with a competitive, flexible and secure supply solution. In addition, it provides the option for PREPA to convert/renew other units in San Juan and Palo Seco from liquid fuels with a cleaner and more competitive fuel supply.
- By using a FSRU, and thanks to the economies of scale generated by additional LNG demand, the average price of gas imported into Puerto Rico would further reduce, increasing costs savings for the island.
- Proven technology and a subsea marine pipeline will allow the FSRU to be moored outside the San Juan port, with minimal intervention to port facilities, traffic or current operations.

Due to the very limited time frame provided in the RFP, we have not been able to follow the set out tender procedures fully and further analysis would be needed in order to be able to present PREPA a binding offer from AES, including formal confirmation from TOTAL that the terms and conditions presented here will be valid.

We highly encourage PREPA to consider this RFP as the first stage of a process for identifying and selecting the most convenient solution from a technical and economic standpoint and carefully evaluate the potential counterparties based on their experience, financial strength and proven capabilities.

We remain keen to continue to support the PREPA efforts to diversify its fuel base and therefore extend an invitation to PREPA to visit our LNG facilities in either Dominican Republic or Panama, where we have great success stories to share.

I hereby certify that I am fully authorized to submit the attached non-binding proposal on behalf of AES, and that I will continue to be the designated contact person for any matters in relation to this RFP.



Freddy Obando

AES LNG Marketing and Origination Vice President

The AES Corporation



Proposal for the RFP No. 81412
Puerto Rico Electric Power Authority

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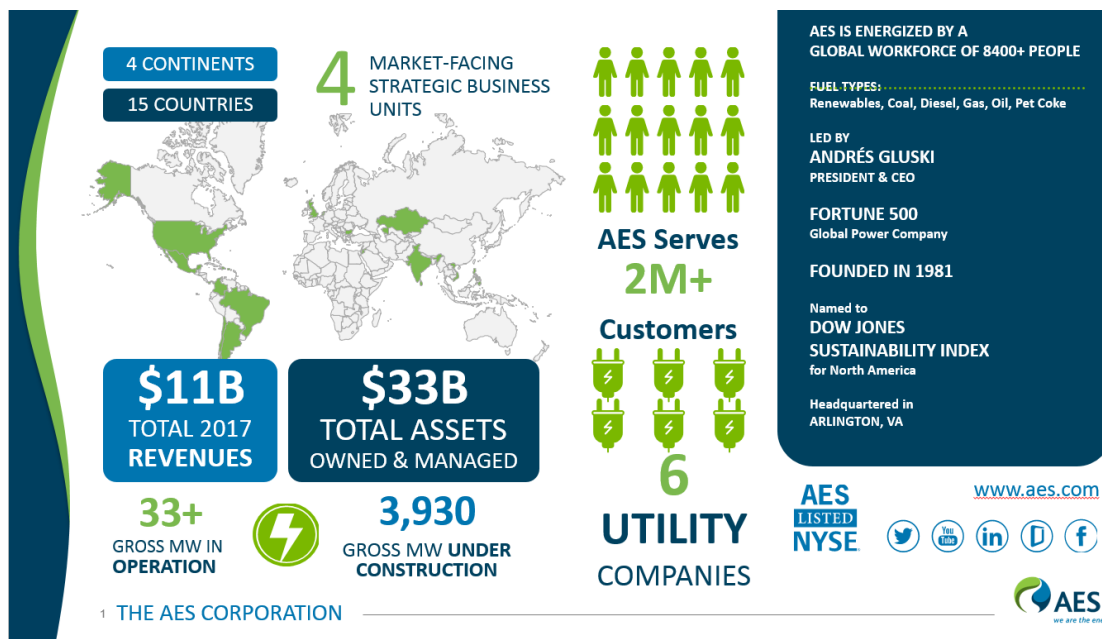
1. Overview of Bidder and Local Presence

The AES Corporation (NYSE: AES) is a Fortune 500 global power company. AES provides affordable, sustainable energy to 15 countries through our diverse portfolio of distribution businesses as well as thermal and renewable generation facilities. Our workforce of 9,000 people is committed to operational excellence and meeting the world’s changing power needs. AES 2017 revenues were \$11 billion and currently owns and manages \$33 billion in total assets.

Our Mission

Improving lives by providing safe, reliable and sustainable energy solutions in every market we serve.

We are dedicated to improving the lives of our customers by leveraging our energy solutions that encompass a broad range of technologies and fuel types, including coal, diesel, gas, oil, pet coke and renewables. Our people share a passion to help meet the world’s current and increasing energy needs, while providing communities and countries the opportunity for economic growth due to the availability of reliable, affordable electric power.



AES was one of the first Independent Power Producers in the US and we have financed over \$24 billion in the past five years and have broad access to global capital markets to offer efficient project financing structures.



Annual report and historical reports, which describes AES activities and capabilities in detail as well as financial strength. The report can be viewed here: <https://www.aes.com/investors/financial-reports-summary/default.aspx>

Local Presence

AES Corp. began developing AES Puerto Rico, LP (AES-PR) in 1993. In November 2002, it inaugurated its plant in Guayama, from where it generates and distributes electric power through a 25-year contract with the Electric Power Authority. AES-PR uses clean coal technology known as fluidized bed boilers (CFB). This allows the plant to process Coal in a manner consistent with the protection of the environment while generating electricity in an economical and reliable way. The combination of advanced technologies makes the Guayama plant one of the cleanest thermoelectric plants in the world and laid the foundation for the lowest emissions in the entire United States.

AES has long term commitments in Puerto Rico since 2002 as the largest private provider of lowest cost energy to the island along with being also a renewable energy provider with its Ilumina solar plant. Lately, our company has made public its interest on providing a solution with greater resilience and island-wide power quality at lower cost based on solar + storage solutions. Currently AES Puerto Rico LTD manages over 115 employees. AES has the capability to provide technical local personnel with high safety operations standard to support the conversion of the San Juan 5 and 6 power plant.

2. Experience

a) AES's Natural Gas and LNG Experience

AES currently owns, operates more than 11,000MW gas fired power plants globally and has both acquired and overseen the construction and conversion of CCGT countries such as US, Mexico, Argentina, Chile, Panama, Dominican Republic and Netherlands and many more.

Both in the Dominican Republic and Panama, AES has been selected as a winner of international competitive tenders to be the lowest cost solution to bring LNG into such nations. Furthermore, AES hasn't not only been awarded, but has also delivered two full scale LNG terminals to such countries, within the original timeline while many other LNG projects in the region has been announced and later cancelled.

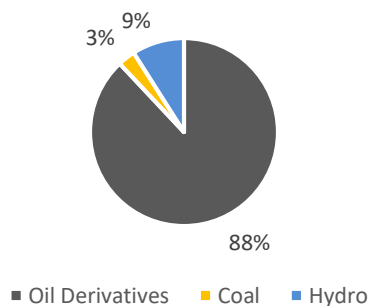
AES has a proven expertise in the Dominican Republic in relation of successfully converting units into natural gas operation from its original diesel operation to natural gas. DPP units V and VI are two 118 MW gas turbines, currently operating in a combined cycle mode in the DR using natural gas as fuel. Additional background on the conversion available upon request.

Dominican Republic - AES Andres LNG Receiving Terminal -

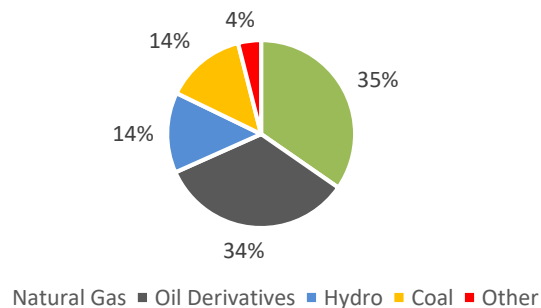
AES Andres in the Dominican Republic is a world class LNG terminal and regasification facility that has been operating since 2003 and receives between 14 and 17 full size LNG cargoes deliveries per year from Trinidad, United States, West Africa and Qatar.

AES began operations in the Dominican Republic in 1997 with the firm conviction of adding value to be national energy market and contributing to the development of the communities it serves. Today AES

Dominican Republic
Generation Matrix 2000



Dominican Republic
Generation Matrix 2017





Dominicana is positioned as the principal private investor group with modern energy facilities, with the latest generation technology, and the most price-competitive array of fuels used in the generation of electricity in the Dominican market.

AES Dominicana is the only company with local operations that has two deep draft port infrastructures. The Liquid Natural Gas terminal, located in the AES Andrés energy park, is the exclusive entry for natural gas into this country, while the Itabo International Port is the only port that receives coal and other types of bulk materials in Panamax size. The two investments have completely reshaped the dominican generation mix.

The 160,000cbm AES Andres receiving terminal has been a success story in the Dominican Republic where the terminal not only supplies the directly adjacent AES Andres 318MW CCGT but is also connected with AES DPP 350MW CCGT. That same pipeline also supplies a 110MW power plant owned by a third party. In 2010 an LNG truck loading facility was added to the terminal and was by 2017 supplying 65 industrial clients and 15,000 vehicles with natural gas.

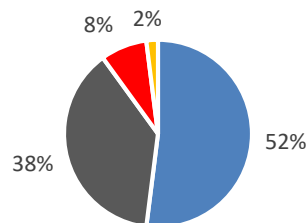
AES Dominicana's investments exceed US\$800M, and have a direct impact on the lives the 300 workers. This group constitutes one of the principal supports for the National Interconnected Electrical System (NIES) supplying around 40% of the country's energy demand.

AES Dominicana supports the growth of the company on pillars such as Corporate Social Responsibility; care for the Environment and for its People, which it considers its main asset. In the same manner the company works in abidance with the global principles of being a socially responsible company through the AES Dominicana foundation which addresses those areas which suffer from the most precarious conditions, such as education and child health.

AES Costa Norte LNG Receiving Terminal – Panama

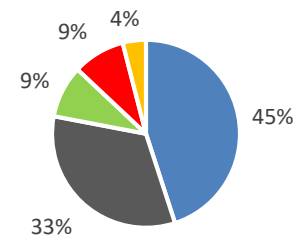
AES Colon facility in Panama was inaugurated on August 17th with the milestone of being the first LNG facility and first gas power plant in Central America. AES Colón will provide a cleaner alternative to petroleum-based fuels in Central America and the Caribbean. The inauguration of AES Colón is a significant step toward diversifying the energy mix in Central America and the Caribbean, introducing cleaner alternatives in Panama and beyond.

Panama Generation Matrix
2016



■ Hydro ■ Oil Derivatives ■ Wind ■ Solar

Panama Generation Matrix
2018



■ Hydro ■ Oil Derivatives ■ Gas ■ Wind ■ Solar

Panama and specifically Colon are already benefiting from one key impact, jobs. AES hires Panamanian personnel at all levels, creating jobs not just at the entry level, but developing Panamanian talents for employment as senior managers. AES Colón was completed in 27 months, and during construction, the project created more than 2,500 jobs. Once in operation, the facility will create about 200 jobs.

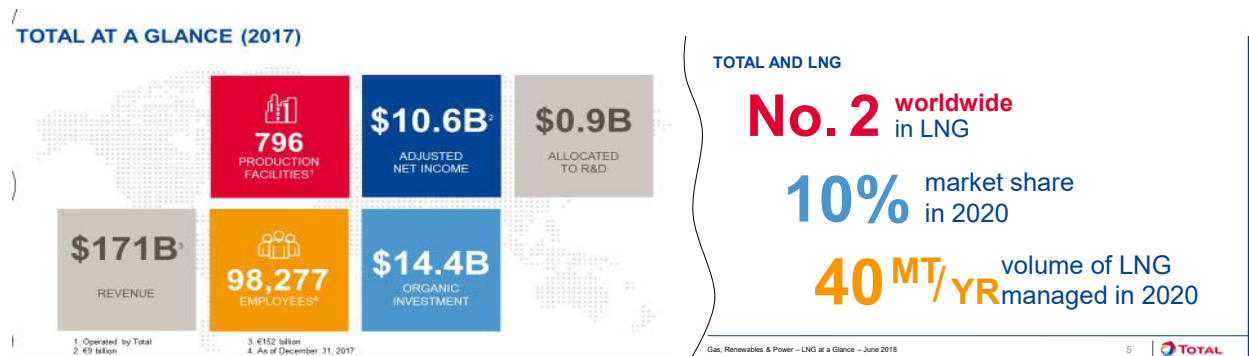
AES Panama Quick facts



- Location: Telfers Island, Colón, Panama
- Installed capacity: 381MW net
- Technology: Combined cycle (3 + 1)
- Terminal: Input / output terminal
- Tank: 180,000 m3
- PPAs: 350 MW for 10 years
- Total investment: US \$ 1,150 million
- Investors: AES(50.1%) Inv.Bahia (49.9%)
- COD: Aug 2018
- Tank Completion: Mid 2019

b) Total's LNG Experience

TOTAL is second largest LNG player in the world with a combined portfolio of approximately 10% of the global supply. TOTAL has successfully supplied gas to power projects across the globe with a proven record of safety and reliability. A more descriptive document with TOTAL's capabilities will be found attached to this document as Appendix 3.



AES is working with TOTAL to develop a competitive solution for Puerto Rico. TOTAL capabilities and their existing portfolio provides the confidence, the flexibility and the support needed from a trusted supplier to develop a large FSRU project.

TOTAL's expertise in developing fully permitted FSRU solutions in the United States is providing us with a unique opportunity to deploy a quick solution for supply San Juan Units and later, to increase the supply to other PREPA units in the area.

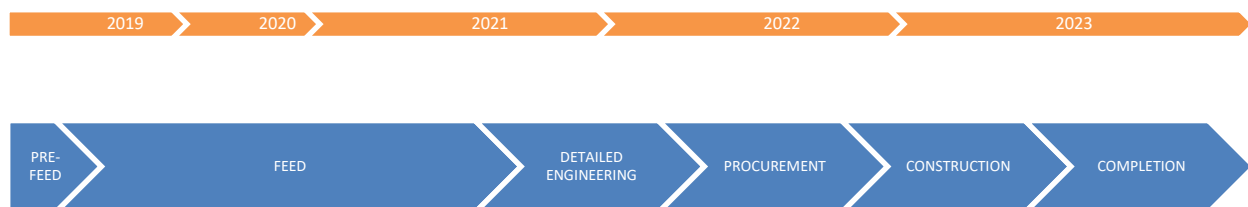
3. LNG Supply and Conversion Scheme Proposed

a) LNG Supply Solution

AES is proposing a full scale FSRU solution on an off-shore port and connected with a sub-sea pipeline to the San Juan Units. Please refer to Appendix 2 for the full description of the solution.

b) FSRU Implementation Plan Proposed

In order to implement an FSRU solution, the following phases must be completed. A typical project will take up to 4 years to complete, considering required permitting, engineering, procurement and construction of the facilities.



Please refer to Appendix 2 for a more detailed implementation scheme.

c) FSRU Operations & Maintenance.

Please refer to Appendix 2.

d) FSRU References

Please refer to Appendix 2.

e) Conversion Scheme Proposed

Dual fuel conversion of San Juan units 5&6

AES has received budgetary offer from Mitsubishi Hitachi power Systems Americas (MHPS-AMER) for the conversion of San Juan units 5&6 to dual fuel. The two W501FC gas turbines at San Juan generation station currently operate solely on No.2 fuel oil and utilize steam injection for emissions control. The proposal from MHPS-AMER proposes several modifications to convert the turbines to operate primarily on natural gas while retaining the capability to run on No.2 fuel oil for emergency backup.

Dual fuel operation demands precise control of the fuel and compressor air flow in order to be able to respond to rapid changes in in fuel selection. MHPS-AMER has therefore suggested to AES that the fuel oil system will be modified to remove the flow divider that regulates the amount of liquid fuel to each nozzle during low flow operation. By removing these components from the liquid fuel system higher unit availability and reliability can be expected.

With our highly skilled engineering team with experience from 11,000MW of natural gas generation currently being owned and operated by AES and MHPS-AMERs detailed knowledge of San Juan Units 5&6 the technical risk of the conversion would be practically eliminated.

Please see full scope of work and Schedule in Appendix 1.

4. Financial Strength and Price Proposal

AES has a proven track record for financing projects in the region, and especially in Puerto Rico. AES plans to finance this project through direct equity contributions from itself and partners and debt from local and international financial institutions.

a) AES Financial Experience Examples

Please see the link below that list AES' annual report from 2000 to 2017, which includes financial information on the company demonstrating revenue and current credit rating. It also highlights the depth of expertise and experience in executing world scale energy projects around the world.
<https://www.aes.com/investors/financial-reports-summary/default.aspx>



The AES Corporation owns and manages total assets over \$33 Billion, with another 3,930 MW under construction, in which different financing schemes have been used, according to the requirements of each project.

- In 2017 AES secured \$2.0 Billion in Non-Recourse Financing for 1.4 GW Southland Repowering Project in Southern California:
- 1,284 MW of combined cycle gas capacity and 100 MW of battery-based energy storage under 20-year contracts with Southern California Edison (SCE).

In particular for the region of Mexico, Central America and the Caribbean, in the period 2014-2018, the following successful financing experiences should be highlighted:

1. Expansion Project of the Combined Cycle to Natural Gas DPP (Dominican Power Partners) Los Mina from 210 to 320 MW - Dominican Republic (2014), for an amount of 260 MM \$, to finance 100% of the project which was the main challenge for this finance transaction with a union of 15 local banks and international The project was successfully completed in 2017. The Power Plant operated in the country since 2003.

Contact available upon request.

2. Construction Project for a LNG Ship Reception, Regasification and Storage Terminal as well as a 381 MW Generation Plant in the Province of Colón, Panama (2016), for a financed amount of 535 MM \$ of a total of 995 MM \$. The Sponsors of the loan were AES CORP (51%) and Inversiones Bahia (49%).The financing was extended for a period of 18 years with the participation of Multilateral Banking (CABEI, IFC) and Local Banking (Banco General, Global Bank, BAC, Banitsmo and Bancolombia). The main challenge of this project was to obtain a financing period longer than the duration of the PPA associated with the plant (which was 10 years, compared to the 18-month period granted in the loan). In addition, the limited construction period for the project that considered millionaire penalties for delays in the commercial operation, limited the period of time for the financial closing of the project and the beginning of the order to proceed to the contractor due to the tied construction schedule (26 months).

The project expects to reach commercial operation in the month of August,2018 for the Generation Plant and the Regasification Terminal has already entered into operation with a first stage for vessel reception and re-gasification and continues the construction of storage facilities until July 2019. The project was recognized by the Infrastructure Journal and Project Finance Magazine (IJGlobal) with the award for the 'Best Energy Transaction in Latin America in 2016'.

Contact available upon request.

<https://ifcextapps.ifc.org/IFCExt/Pressroom/IFCPressRoom.nsf/0/06C6411636BC96CF85258003004CA296>

3. Bosforo Solar Farm Construction Project (2017) with a capacity of 100 MW distributed in 10 small PV solar farms in 3 stages in El Salvador, for a financed amount of 110 MM \$ of the total of 160 MM \$ for a period of 18 years.

The sponsors were: AES Corporation which will indirectly own 50% of the Borrower and CMI Solaris Investments S.L., a limited society organized and existing under the laws of Spain, which is privately held and will own 50% of the Borrower.

The biggest challenge for this project was obtaining a medium-term credit in a country with a low credit rating (B-) and possible default risks, which was compensated with solidity and a reputation for operating the largest energy distribution company in the country, which generated confidence in the financial sector for the lifting of the operation.

The project is currently under construction, with a total duration of 24 months. The participating banks in the financing structure were CABEI, FIN-Fund, FMO, OPIC.

Contact available upon request.

<https://www.fmo.nl/project-detail/51220>

<https://renewablesnow.com/news/aes-cmi-to-develop-100-mw-solar-project-in-el-salvador-585295/>

4. Mesas la Paz Project, Wind Generation Farm with a 306 MW Capacity, spread over 213ha, in Llera municipality with a financed amount of 304 Million, compared to a total project cost of 535 MM \$. The loan was managed as a structured bond with Private Institutional Investors and is currently in execution.

The big achievement of this project was receiving an S&P Global Ratings Green Evaluation of E1/91.

E1 is the strongest Green Evaluation score and the 2044 bond also achieved “an excellent aggregated score” of 80 for transparency, 95 for governance and 92 for mitigation according to Standard & Poor’s S&P.

The Eólica Mesa La Paz wind farm will be built in Tamaulipas state, using 85 pieces of Vestas turbines. It has a 25-year power purchase agreement (PPA) with Fuentes de Energía Peñoles SA, supply under which starts on April 1, 2020. The PPA is for 80% of the power, while the rest will be sold on the spot market.

Contact available upon request.



<https://renewablesnow.com/news/bond-for-306-mw-wind-farm-in-mexico-gets-sps-top-green-score-609708/>

As can be seen, the experience of AES as a corporation has organized each of its regions, particularly that of Mexico, Central America and the Caribbean to meet and provide the financing services required by its different businesses, in the particular case of AES Puerto Rico, the financial team of the project will receive the support and structure of the region to achieve its objectives.

These cases show that the trajectory and solidness of AES as a sponsor of financial transactions, as well as its capacity to create key strategic partnerships with local actors, have been key factors for the creation of successful financing mechanisms for its different financial vehicles.

b) Term, Volumes and Pricing

The following indicative pricing proposal is based on preliminary analysis of the offshore FSRU solution and contains cost estimates for the subsea pipeline, required mooring systems, engineering and permitting among other assumptions. This proposal is intended to provide a high-level cost estimated of our current view of the LNG supply solution and conversion costs of San Juan Units 5 and 6.

Further analysis is required to provide a binding capacity payment offer. As for the unitary fuel price, AES is using TOTAL's non-binding estimate reflecting current market conditions, which may also change during the process of developing the final proposal.

If shortlisted, AES is committed to dedicate resources on the development tasks of this project with a specialized team to work with PREPA towards a definition of a binding offer among the prequalified proponents after a reasonable time to prepare such.

Term

Term: 10 years from mid-2023 – in line with permitting timeline.

AES considers that at a minimum, 10 years of contract length should be provided to amortize all the required conversion and infrastructure cost. Extension options to be discussed

Volume

Annual volume: **ACQ up to 25 TBtu /year and a minimum ACQ to be discussed.**

Component 1 – Annual Capacity Payment

Annual capacity payment of \$53million US + \$8m x CPI n/CPI2018

AES considers that due to PREPA request for a flexible supply, all the infrastructure cost (and not only the unit's conversion cost) should be included in the Annual Capacity Payment in order to minimize the risks on the infrastructure and provide a leveled field to compare the supply costs.

The order of magnitude for the estimated capital cost for the total investment is approximately \$120 million US, including the plant conversion based on the MHPS quote, sub-sea marine infrastructure, sub-sea pipeline, horizontal drilling at the pier and engineering, permits, etc. In addition, annual OPEX to cover for the FSRU has been incorporated in the annual capacity payment (O&M and boil off included).



Component 2 – Unit Cost Pricing Formula (\$/MMBtu)

The Contract Price, or “P” in any given month m during the Contract Term, in US\$/MMBtu, of all quantities sold and delivered, shall be determined in accordance with the following formula:

$$P = 118.56\% \text{ HH} + 3.30 + 1.03 \times \text{CPI}_n / \text{CPI}_{2018}$$

Please note that this proposal is based on estimated market prices for a 10-year period starting in 2023 and considers non Jones Act LNG supply. In the case Puerto Rico obtains a waiver for Jones Act compliance, AES would be willing to reopen the Contract Price P.

Contract Price P reflects an indication for the price of gas delivered at the inlet of the power plant and includes regasification services and transportation from the FSRU to land.

Contract Price P doesn't include any applicable taxes in Puerto Rico, if any.

Component 3 – Indices to be applied to the delivered unit cost to account for variation in rate of inflation, fuel price fluctuations etc.

Where “HH” means the final settlement price (in USD per MMBtu) for the New York Mercantile Exchange’s Henry Hub natural gas futures contract for the month in which natural gas is delivered to Buyer at the Delivery Point. For the avoidance of doubt natural gas delivered in July would be priced on the New York Mercantile Exchange’s Henry Hub natural gas futures contract for the month of July, which generally is settled on the day that is three business days prior to first calendar day of the month of July.

“CPI” means, as of any day, the United States Consumer Price Index (Consumer Price Index – All Urban Consumers, U.S. city average for all items, not seasonally adjusted (base period: 1982-1984 = 100)), as published from time to time by the Bureau of Labor Statistics of the U.S. Department of Labor. Where:

$\text{CPI}(j-1)$ = CPI corresponding to June of the previous year (j-1); and

$\text{CPI}(2018)$ = CPI corresponding to September 2018.

c) Savings Determination Exercise

Based on our proposal, San Juan Units 5 & 6 will end up with a **variable production cost of approx. 60\$/MWh and an all-in cost of approx. 80\$/MWh**, including the amortization of the conversion and required infrastructure cost. As a result, AES expects **PREPA to reach yearly savings in the 130+ MMUS\$ range**.

For illustration purposes, please find below a simplified calculation of the value of the AES proposal. Note that we used internal assumptions and benchmarks for constructing such estimation.

		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Accumulative CPI Adj	%	3%	3.90%	4.80%	5.70%	6.60%	7.50%	8.40%	9.30%	10.20%	11.10%
Diesel Price											
FOB Price	US\$/MMBTU	14.68	14.47	14.48	14.72	14.97	15.23	15.49	15.75	16.02	16.30
CIF Premium	US\$/MMBTU	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Diesel Price at San Juan Plant	US\$/MMBTU	15.38	15.17	15.18	15.42	15.67	15.93	16.19	16.45	16.72	17.00
Natural Gas Price											
Nymex HH Price	US\$/MMBTU	2.64	2.72	2.80	2.89	2.97	3.06	3.15	3.25	3.28	3.34
Natural Gas Price at San Juan Plant	US\$/MMBTU	7.49	7.59	7.70	7.81	7.92	8.03	8.16	8.28	8.32	8.40
San Juan Expected Production*	GWh	3,200.00	3,200.00	3,200.00	3,200.00	3,200.00	3,200.00	3,200.00	3,200.00	3,200.00	3,200.00
Heat Rate Using Diesel	MMBTU/MWh	7,740.0	7,740.0	7,740.0	7,740.0	7,740.0	7,740.0	7,740.0	7,740.0	7,740.0	7,740.0
Heat Rate Using Nat Gas*	MMBTU/MWh	7,623.9	7,623.9	7,623.9	7,623.9	7,623.9	7,623.9	7,623.9	7,623.9	7,623.9	7,623.9
Variable Production Cost - Diesel	US\$/MWh	119.04	117.45	117.47	119.36	121.32	123.30	125.32	127.36	129.44	131.60
Variable Production Cost - Nat Gas	US\$/MWh	57.13	57.87	58.71	59.55	60.39	61.23	62.19	63.10	63.44	64.03
Fuel Consumption Diesel	TBTU	24.77	24.77	24.77	24.77	24.77	24.77	24.77	24.77	24.77	24.77
Fuel Consumption Nat Gas	TBTU	24.40	24.40	24.40	24.40	24.40	24.40	24.40	24.40	24.40	24.40
Total Fuel Cost Diesel	MM US\$	380.93	375.83	375.89	381.95	388.23	394.57	401.03	407.55	414.21	421.12
Total Fuel Cost Nat Gas	MM US\$	182.82	185.19	187.88	190.55	193.26	195.95	198.99	201.92	203.02	204.89
Fuel to Fuel Savings	MMUS\$	198.11	190.64	188.01	191.41	194.97	198.62	202.04	205.63	211.19	216.23
Gas Infrastructure Cost	MMUS\$	(61.24)	(61.31)	(61.38)	(61.46)	(61.53)	(61.60)	(61.67)	(61.74)	(61.82)	(61.89)
Net Savings	MMUS\$	136.87	129.32	126.63	129.95	133.44	137.02	140.37	143.89	149.38	154.34
All in Monomic Cost- Nat Gas**	US\$/MWh	76.27	77.03	77.89	78.75	79.62	80.48	81.46	82.39	82.76	83.37
*Estimated Values											
** Excludes O&M, and non fuel variable costs											

Appendix 1 - Scope of work Conversion

AES is using the SoW package created by MHPS-AMERA for this RFP process.

Fuel Oil System
Demo of existing system or individual Components
*MHPS-AMERA - TGE and all internal components X
*Other - Components external to TGE
Design of interconnect piping from fuel oil HP pump skid to metering skid
Supply of interconnect piping from fuel oil HP pump skid to metering skid
Installation of interconnect piping from fuel oil HP pump skid to metering skid
Fuel Oil Metering Skid (Design/supply/install)
Foundation / anchoring / site / civil needs for skid
Provide common skid connection points for power and ground
Design power and grounding to skid
Supply & install power and grounding to skid
Design and supply of Instrument air
Cable, conduit / cable tray from skid to control cabinet
Loop checks
Design of vents and drain connections
Supply and installation of vents and drain
Layout of control oil system piping from control oil skid to Fuel Oil Metering Skid
Design, Supply, Installation of hydraulic lines from control oil skid to Fuel Oil Metering Skid
Design of interconnect piping from fuel oil metering skid to distribution manifold (Primary + Secondary)
Supply of interconnect piping from fuel oil metering skid to distribution manifold (Primary + Secondary)
Installation of interconnect piping from fuel oil metering skid to distribution manifold (Primary + Secondary)
Design of GT Manifolds / Pigtailed to fuel nozzles + supports
Supply of GT Manifolds / Pigtailed to fuel nozzles + supports
Installation of GT Manifolds / Pigtailed to fuel nozzles + supports
Duplex Oil Nozzles (at GT combustors)

Fuel Oil PCV (Supply)
<i>Demo Existing</i>
<i>Cap Instrument Air lines</i>
<i>Modify existing piping and supports for new PCV</i>
<i>Layout of control oil system piping</i>
<i>Supply & installation of hydraulic lines and supports</i>
<i>Design cable, conduit / cable tray from skid to control cabinet</i>
<i>Supply & install cable, conduit / cable tray from skid to control cabinet</i>
<i>Loop checks</i>

Fuel Gas System
Fuel gas filter separator (Design/supply)
Install filter separator
Design filter separator foundation
Supply and install filter separator foundation
Design grounding to filter separator
Supply & install grounding to filter separator
Design cable, conduit /cable tray from filter separator to control cabinet
Supply & install cable, conduit /cable tray from filter separator to control cabinet
Loop checks
Fuel gas metering Skid (Design/supply/install)
Mezzanine level platform design (above oil skid - Turbine left)
Supply and installation of mezzanine level platform (above oil skid - Turbine left)
Design piping from fuel conditioning skid to fuel gas metering skid
Supply piping from fuel conditioning skid to fuel gas metering skid
Install piping from fuel conditioning skid to fuel gas metering skid
Coriolis Meter, FG (Design/supply) X
Design valves and piping for Coriolis meter isolation/bypass
Supply & install valves and Piping for Coriolis meter isolation/bypass
Design connecting piping and supports for Coriolis meter
Supply & install connecting piping and supports for Coriolis meter
FG Manifold / Pigtails (Design / Supply)
Design of FG Manifold / Pigtails to fuel nozzles + supports
Supply of FG Manifold / Pigtails to fuel nozzles + supports
Installation of FG Manifold / Pigtails to fuel nozzles + supports
Design piping from metering skid to ring (distribution) manifolds

Supply piping from metering skid to ring (distribution) manifolds
Installation of piping from metering skid to ring (distribution) manifolds
Cable, conduit / cable tray from skid to control cabinet
Loop checks
Design, Supply, Installation of Instrument air supply
Design, Supply, Installation of Vents to ATM
Design, Supply, Installation of Drains / oil water / turbine drains
Provide common skid connection points for power and ground
Design power and grounding to skid
Supply & install power and grounding to skid
Layout of control oil system piping

Control Oil System
Hydraulic Control Oil Pump Skid (Design/Supply)
Design foundation and anchoring
Supply and install foundation and anchoring
Provide common skid connection points for power and grounding (Desing)
Design power and grounding to skid
Supply & install power and grounding to skid
Design cable, conduit / cable tray to and from skid to control cabinet
Supply & install cable, conduit / cable tray to and from skid to control cabinet
Loop checks
Design drains and vents
Supply and install drains and vents
Layout of control oil system piping
Supply & install control oil system piping
Design, Supply, Installation of Control Oil connections from Control Oil (HPU) Pump Skid to Hydraulic systems of the following:
<i>Fuel Gas Metering Skid</i>
<i>Fuel Oil Metering Skid</i>
<i>Fuel Oil PCV</i>
<i>Steam Injection FCV</i>
<i>IGV Actuator</i>
<i>Accumulator</i>
Accumulators installations

Sweep Air System
Sweep Air System Design (Partially located on Gas skid - Partially shipped loose)
Modifications to GT Manway / compressor combustor wrapper (design/supply/install)
Piping from GT take off to Fuel Gas skid (design/supply/install)
Piping from Fuel Gas system to Primary and Secondary fuel oil manifolds (design/supply/install)
Valve Mounting and Supports (design/supply/install)
Instrument Air (design/supply/install)
Cable, conduit / cable tray from Gas skid to control cabinet (design/supply/install)
Loop checks

Purge Air System
Purge Air System (Design/supply/install)
Valve supply
Valve Mounting and Supports (design/supply/install)
Design, supply, installation of interconnection piping & sup- ports to Fuel Gas Metering and Fuel Oil Metering
Cable, conduit / cable tray from skid to control cabinet
Loop checks
Drain connections / Turbine Drains (design/supply/install)
Vents to ATM (design/supply/install)
Instrument air (design/supply/install)

Other Items
Steam Injection Throttle Valve (Design/supply/install)
<i>Hydraulic Connections</i>
<i>Piping Modifications (design/supply/install as needed)</i>
<i>Cable, conduit / cable tray from skid to control cabinet</i>
<i>Loop checks</i>
<i>Insulation</i>
IGV Actuator (Design/supply/install)
<i>Demo Existing</i>
<i>Cap Instrument Air lines</i>
<i>Install mounting bracket / IGV / Turnbuckle & mechanical</i>
<i>Layout of control oil system piping</i>
<i>Supply & installation of hydraulic lines and supports</i>

<i>Cable, conduit / cable tray from skid to control cabinet</i>
<i>Loop checks</i>
GT Control system expansion (design/supply/install)
HRSB/STG/BOP Control System Evaluation - logic, graphics, upgrades (design/supply/install)
Fuel gas heating (to meet minimum absolute or dew point requirements, not GT heat rate improvement heating)
Fuel gas compression (not required)
Fuel gas conditioning (design)
Fuel gas conditioning (supply and install)
Identification of electrical supplies for new equipment
GT Enclosure Mod's (design/supply/install)
GT Enclosure Modifications for Skid Access (design/supply/install)
GT Enclosure Ventilation (Evaluate/modify and upgrade as needed)
GT Enclosure Hazardous Gas Detection (Evaluate/modify and upgrade as needed)
GT Enclosure Fire Protection (Evaluate/modify and upgrade as needed)
Hazardous Classification Review around new components (outside Enclosure) and any required modifications
Hazardous Classification Review around new components (inside Enclosure) and any required modifications
Instrument air vessel in enclosure
Upgraded ignitors / transformers (design/supply/install)
<i>Design cable, conduit / cable tray from skids to control cabinet</i>
<i>Supply & install cable, conduit / cable tray from skids to control cabinet</i>
<i>CTG performance testing – natural gas and fuel oil (development of test procedure, supply/install test instrumentation, test execution, test calculations/report)</i>
<i>CTG emissions testing – natural gas and fuel oil (development of test procedure, supply/install test instrumentation, test execution, test calculations/ report)</i>
<i>Ignitor leak air manifold</i>
<i>Piping Modifications Outside GT Enclosure (design, supply, install as needed)</i>
<i>Piping Modifications Inside GT Enclosure (design, supply, install as needed)</i>
Hydro / X-ray / other
Insulation
CTG fuel gas operation and maintenance training

Field Services
Provide Field Engineers and Specialists Required by Scope of work
Provide Qualified Labor and Perform Work Safely and Cleanly
Provide MHPS-AMER Tool Conex for Workforce
Provide Transportation for MHPS-AMER Tool Conex
GT Tuning Support
Control Engineer for Valve Calibrations
Vibration Analysis
Confined Space Monitoring Equipment
Confined Space Rescue Services and Rescue Equipment
Provide Safety Equipment (separate from PPE)
First Aid Facilities
Fire Protection Equipment
Disposal of Hazardous Waste
Trash Containers and Disposal Service
Asbestos Control, Removal and Disposal
Lead/Hazmat Control, Removal, and Disposal of Waste
Security for Personnel (for High Risk areas)
Machine Shop Services and Machinist(s)
equipment / Hardware Disposal
Expendable Materials (Rags, Cleaning Fluids, etc.)
Borescope Equipment
OEM Special Tools & Slings Purchased w/ Turbine Generator
Rotor Shipping Skid (if Required)
Scaffolding Contractor and Material
Insulation Contractor (Removal and Installation)
Dustblast Equipment and Supplies
Bolt Heating
Rotor Stands
NDE Equipment, Material and Technicians
Mobile Crane Service (with Operator)
Crane Operator(s) *for overhead and/or bridge cranes only
Consumable Gases (ex. Oxygen, Acetylene, Argon, etc.)
Forklift
Compressed Air (175 cfm @ 100 PSIG)
Temporary Lighting and Associated Fuel

Welding Services
Office Space or Office Trailer, Change Trailer
High Speed Internet
Sanitary Facilities *portable restrooms, wash stations/sinks
Potable Water / Ice / Water Cooler
Service Water
Cribbing / Pallets for Disassembled Parts
Lubricants as Necessary
I&C Technicians for Disconnects and Connections
Electricians for Disconnects and Connections
Electrical Power (120-220-480 VAC Single Phase / 480 VAC 3-Phase
Drain, Store and Refill Lube Oil Reservoir
Oil Circulation with Temporary Strainers
Transport to and from Laydown Area
Coupling Alignment
Internal Alignment
Bearing Alignment Pad and Valve Lapping Contact Blue-in n/a n/a
Parts (as indicated in this proposal) Transportation

Conversion Schedule

ID	Task	Task Name	Duration	Start	Finish	Predecessors	HW# 1, 2023
1	PREPA RFP	303 days	Mon 1/17/22	Wed 3/15/23			
2	Dual Fuel Conversion of two (2) W501FC Gas Turbines	303 days	Mon 1/17/22	Wed 3/15/23			
3	Contract Signature	2 days	Mon 1/17/22	Tue 1/18/22			
4	NTP to MHP5	1 day	Wed 1/19/22	Wed 1/19/22	4		
5	Procurement for conversion Equipment	180 days	Thu 1/20/22	Wed 9/28/22	4		
6	Transportation of Equipment	30 days	Thu 9/29/22	Wed 11/9/22	5		
7	Installation	60 days	Thu 11/10/22	Wed 2/1/23	6		
8	Commissioning	30 days	Thu 2/1/23	Wed 3/15/23			

Task	Project Summary	Inactive Task	Inactive Milestone	Inactive Summary	Manual Task	Duration only	Manual Summary Rollup	Start-only	Finish-only	External Tasks	External Milestone	Deadline	Progress	Manual Progress
Task Split Milestone Summary														

Page 1



INFORMATION FOR PREPA RFP

AGENDA

- LNG Supply and conversion scheme proposed
- Implementation plan proposed
- Operation & Maintenance
- References

Preliminary comment: all the below technical recommendations will be precised at pre-feed stage (after PREPA shortlist).

LNG SUPPLY AND CONVERSION SCHEME PROPOSED

FSRU: OFFSHORE VS *IN PORT* SOLUTION

	Existing Conventional FSRU	small scale chain : New build Floating storage+ regas
Site location	<ul style="list-style-type: none"> Offshore position without particular limitation 	<ul style="list-style-type: none"> Inside port
Units	<ul style="list-style-type: none"> 1 second hand FSRU Subsea gas pipeline to connect power plant 	<ul style="list-style-type: none"> 1 mid scale Floating storage barge 1 regas station onshore or offshore Short gas pipeline to connect power plant
Scalability	<ul style="list-style-type: none"> FSRU can process enough LNG to supply San Juan and Palo Seco and more. No infrastructure extra-cost required No shipping investment required <p>=> Reduced average unit gas price</p>	<ul style="list-style-type: none"> Design capacity fitted for initial purpose It will be managed by the increase of shuttle rotations – but potential limitation due to port traffic and storage size
Technology	<ul style="list-style-type: none"> Architecture proven many times All equipment are proven for years Multiple references around the world 	<ul style="list-style-type: none"> If technologies are proven, the barge concept itself inside a port, there are very few examples in operation.
Safety & operating risk	<ul style="list-style-type: none"> Mooring designed for rough meteocean conditions FSRU is an LNGC which is autonomous in case of emergency Offshore operation with no impact on port traffic 	<ul style="list-style-type: none"> Barge needs to be self propelled for emergency (or ATB) Impact on trafic of other vessel in port when LNG carrier transits and discharges cargo Safety distance around storage unit limits permanently navigation area and traffic in the port (esp. Puma terminal and Total Jetty).
Associated LNG Shipping	<ul style="list-style-type: none"> World wide liquid shipping market for LNG/C Access to non-US sources (no Jones Act constraints) 	<ul style="list-style-type: none"> Shipping risk: <ul style="list-style-type: none"> Only small scale vessels - limited fleet in the world Availability risk in case of unexpected damage to the floating barge and/or the small scale. Supply risk: <ul style="list-style-type: none"> Small scale vessel can only load in regional area No direct access to global market (reload hub necessary)
Permitting	<ul style="list-style-type: none"> FERC process 	<ul style="list-style-type: none"> Local permitting process only (to be confirmed)
COD after permitting	<ul style="list-style-type: none"> 18-24 months 	<ul style="list-style-type: none"> 20-24months (if newbuild barge) – less if second-hand units mobilized

OFFSHORE PORT

● Preliminary site screening

- Conventional onshore discarded due to lack of space onshore and inside the bay.
- When considering volumes and potential expansions is the only to be considered.
- San Juan bay is not suitable for conventional scale solution (location for 1FSRU+1LNG/C) hence Offshore
- The connected gas pipeline should avoid as far as possible to cross leaving area and its length should be minimized. In order to limit visual impact the west side of the mouth of the bay has been pre-selected.

● Compliance

- Focus has been put on US 33 CFR 148.720 criteria especially minimizing impact on existing traffic, environmental effects.
- Technical solution is designed to accommodate the specific local Metocean data of the site (harsh weather conditions).

● Location of the port (subject to permitting approval)

- The offshore port is expected to be located around the following point :
 - Lat: 18°28'55.19"N
 - Long: 66° 8'47.93"W
- The draft is about 30 meters
- Mooring system for floating and Storage and Regasification unit
 - No fixed piles, no offshore export platform or Jetty will be erected.
 - The FSRU will be moored with a multi-point mooring systems that moor vessels to the seabed using multiple mooring lines (spread mooring). To facilitate operations Conventional Buoy Mooring (CBM) is also preferred to lines directly attached to the hull. The FSRU can be moored up to Hs 6 to 8 m.
 - The arrangement of the lines will take into consideration the Shuttle vessel, that will perform ship to ship transfer. In parallel, the FSRU will be fitted especially with Quick Release Hooks and tension monitoring for STS operations and fender hanging-off support.



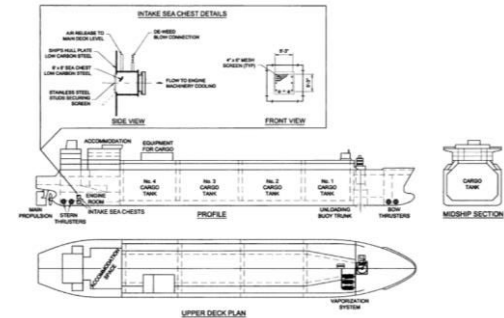
FSRU / DESCRIPTION

● Ship indicative description (Neptune, subject to availability)

- The FSRU is a conventional LNG/C carrier with Regas capabilities.
- The indicative dimensions are:
 - LOA : 280 m | Breadth: 43 m | Design draft: 11m
- The FSRU capacity is 145,000m³ @ 100% filling rate.
- The technology is GTT Mark III Membrane, that can accommodate elevated cargo holding pressures up to 700mbar.
- In case of emergency departure (ex: Hurricane), the ship is capable to sail at more than 15knots.
- In order to comply with the 7 days of strategic storage, a permanent heel will be maintained. The LNG SPA with the LNG supplier will guarantee that a minimum level of LNG remains in tank. The LNG cargo in transit also act as additional floating storage.
- The ship is equipped with an Integral Submerged Turret Loading (“STL”) structure to permit engagement with a submerged APL buoy.
- Emissions control equipment designed to meet federal and state standards.

● Boil Off Gas Management

- The vessel is fitted with Minimum Send Out compressor to handle the BOG generated during LNG unloading at 10,000 m³/h and 30 mmscf/d sendout, using the MSO in parallel to the pressure build-up.
- No venting is allowed. GCU use is to be avoided.
- As an option it can be fitted with reliquefaction system to limit the boil off gas and restrain warming up of the cargo./



Reference case: NEPTUNE SRV – the vessel and associated technical solution has already been approved by FERC for Neptune Deep water Port in in 2007.

FSRU / LNG DISCHARGE OPERATION



● Receiving LNG cargos

- Several cargoes will be discharged per year (depending on ACQ)
- Each operation will take about 24hours.
- These operations will be done simultaneously with Gas emission to shore.
- For this project 4 tugs (6000HP, incl. 2 Fire Fighting tugs) might be mobilized to ensure safe operation during LNG cargo operation. The choice between dedicated or shared tugs will be made later on. At this stage, shared tugs are considered available.

● Ship to ship transfer

- The solution is a transfer via Cryogenic flexible hoses with vapor return line as it is performed in most of FSRU projects in the world.
- The vessel will be fitted with :
 - ERC SIL2 certified, to prevent any loss of product while transferring LNG
 - ESD systems
 - *Ship to Ship communications* line
 - Fiber optic and pyle connection from FSRU to LNGC
- Custody transfer measurement system
 - LNG sampling points will be provided as part of the STS custody transfer for LNGC to FSRU loading. Measurement will allow density, heating value and methane number of LNG transferred to be calculated.
- Standard applied will be refer to EN 1474-3 and ISO 18683 and conforms to OCIMF, ISO, SIGTTO

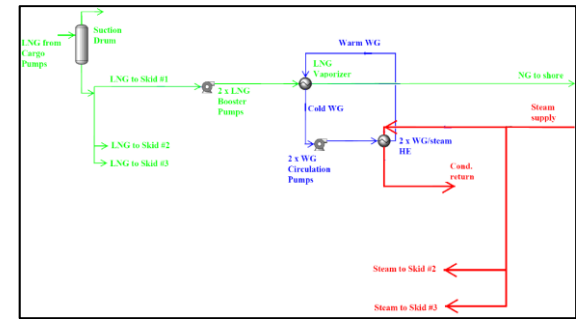
FSRU/ DESCRIPTION

● Regas Process

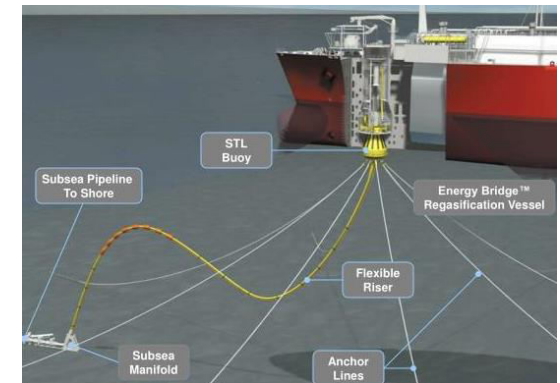
- A water-glycol closed loop as intermediate media is used to heat the LNG in Shell-and-tube heat exchanger. **This closed loop vaporization system avoids large quantities of seawater being pumped on board, hence minimizing the environmental impact to important local marine resources.** In order to ensure flexibility and availability, the vessel is fitted with several regas skids.
- Regas send out is designed for continuous use basis
 - Minimum: 30 mmscf/d
 - Maximum: 750 mmscf/d
- Normal operating modes will be:
 - Regas send out at zero, minimum, nominal & peak rates
 - Regas send out at zero, minimum, nominal & peak rates during large LNGC loading

● Gas export solution

- Base case is that the vessel is connected to the export HP gas pipe via an APL Buoy system).
- The connection between the ship and the sub sea pipeline could be a flexible riser or alternatively a jacket. This will be determined during PRE-FEED study

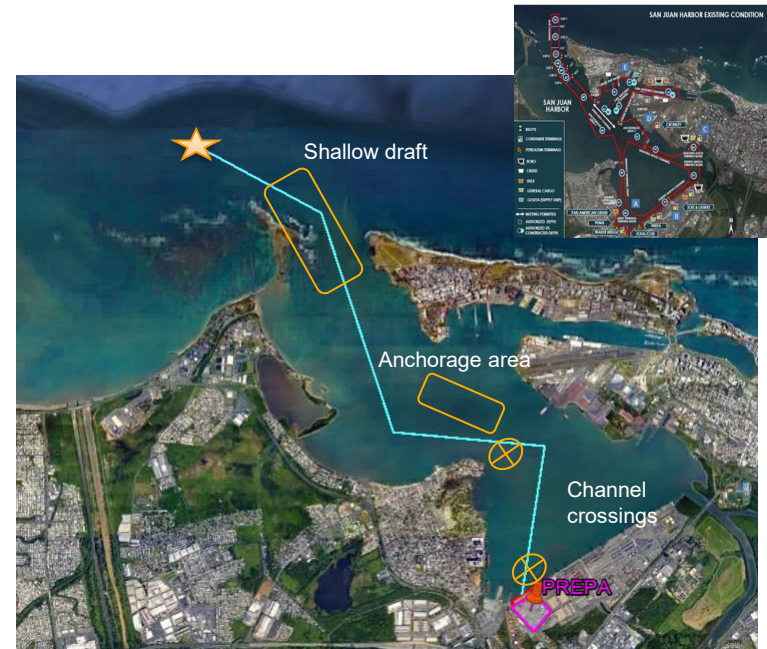


Water/Glycol Closed-Loop System



SUBSEA PIPELINE

- The Project pipelines consist of a 24-inch flowline approximately 9 km long from the riser manifold. Diameter of the pipeline takes into consideration the future increase of demand (can be improved after pre-feed)
- The pipelines would have a nominal outer diameter of 24 inches.
- Pipeline trenching and burial requirements will comply with 30 CFR 250 Subpart J. It would protect the flowline from potential damage and avoid potential fouling, loss, or damage of fishermen's trawls.
- Onshore receiving station (external or inside powerplant)
 - Fiscal metering measuring system
 - Preheating of natural gas
 - Pressure reduction from 700 to 350psi to comply with PREPA demand



Design Criteria	Value
Water depth range	100 to 10feet
Max Allowable Operating pressure	1,250psig
Normal operating pressure	700
Throughput range	30 to 90mmscf/d
Fabrication Method	Submerged arc welded
Steel unit weight	490lbs per cubic foot
Concrete weight coating density	190lbs per cubic foot
Design life	30years

More detail specifications on the whole subsea infrastructure will be issued at PRE FEED stage.



IMPLEMENTATION PLAN PROPOSED

PERMITTING: PROCESS



- **Puerto Rico background**

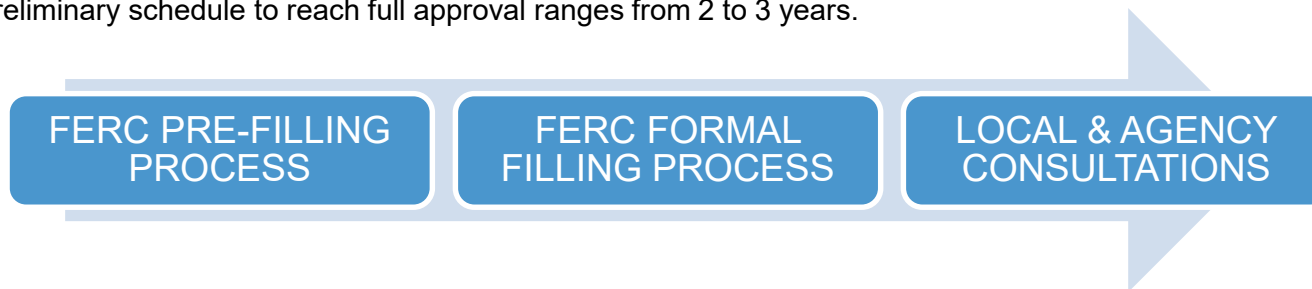
- Penuelas LNG terminal is in operation for several years. The plant is feeding gas fired power plant. Thus LNG as a dangerous oil product is not new to the island.
- Aguirre Offshore Gas Port (PREPA & Excelebrate project) completed the whole process. It has taken lot of time especially due to environmental impact.

- **San Juan Offshore port case**

- No sensitive marine life area has been identified which could hinder permitting like for Aguirre.
- The site location and the route to PREPA powerplant do not cross any protected area.
- The FSRU solution has a very limited impact on the traffic of the bay, a limited impact the bay itself and outside.

- **FERC process**

- As the project modifies the maritime domain an US Federal permitting process is necessary, governed by NEPA.
- This permitting process will be conducted by AES with the support from PREPA and port authorities
- The preliminary schedule to reach full approval ranges from 2 to 3 years.



- The project will hire a specialized consulting firm to assist all along the process: public hearings, reports that will feed Environmental Assessment and Environmental Impact Assessment,...

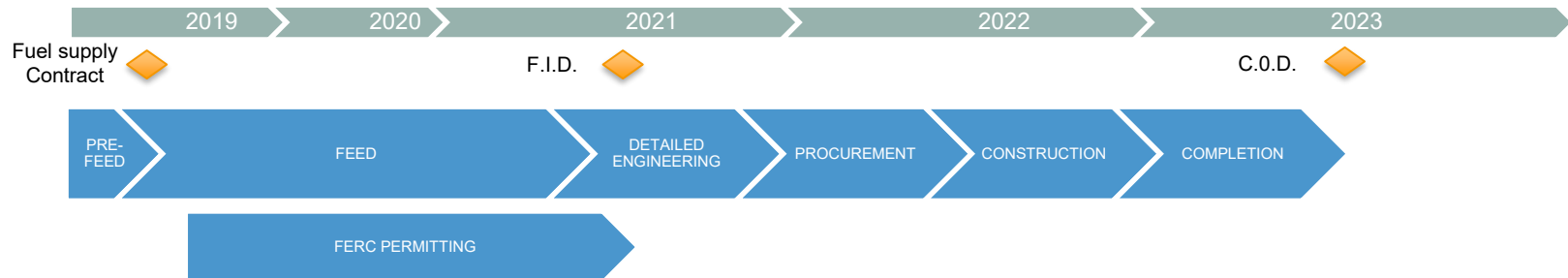
PERMITTING: INVENTORY

- The preliminary list of permits to obtain for the PREPA project.

	Permit	Regulatory body
	Order Granting Authorization	Federal Energy Regulatory Commission
Federal level	Section 10 Permit and 404 Permit	U.S. Army Corps of Engineers (“COE”)
	Letter of Recommendation	U.S. Coast Guard
	Biological Opinion (“BO”)	U.S. Fish and Wildlife Service (“USFWS”)
	Biological Opinion	National Marine Fisheries (“NMFS”)
	Approval	DOT – OFFICE OF PIPELINE HAZARDOUS MATERIAL SAFETY ADMINISTRATION (“PHMSA”)
Local level	Consistency Certificate	Puerto Rico Planning Board (“PRPB”)
	Determination of Environmental Compliance with Article 4.b.3	Puerto Rico Office of Permit Endorsement Management (“OGPe”)
	Management Consistency and Water Quality Certificate	Puerto Rico Department of Natural and Environmental Resources (“DNER”)
	Water Quality Certification upon public notice of the COE Section 404 permit	Puerto Rico Environmental Quality Board (“EQB”)
	Title V Operating Permit	Puerto Rico Environmental Quality Board (“EQB”)
	Issuance of its concurrence that the project is not likely to adversely affect the environment	State Historic Preservation Office (“SHPO”)

INFRASTRUCTURE SCHEDULE

- Following a standardized project management plan, the following phase will be implemented.



- **Schedule comments**

- On the critical path, the permitting is the key topic.
- Construction will include pipeline erection, offshore port installation but also some FSRU modifications if required by studies.
- All studies will be completed (including some of detailed engineering) prior issuance of final FERC approval.
- FID will launch detailed engineering phase and procurement process.

- **Estimated COD**

- From FID, 20 to 24 months will be necessary to finish commissioning and reach Commercial Operation Date.
- The overall schedule from contract awards from 4 to 5 years.

OPERATION & MAINTENANCE

OPERATIONS AND MAINTENANCE

- **Very high levels of availability**

- N+1 redundancy for critical process and function
- Each regas unit is independent and can be disconnected for maintenance and overhaul (if required).
- The ships will be delivered with onboard spare parts for two (2) years operation and tools in addition to the rule requirement or makers' recommendation.

- **Operations**

- The operation of the receiving station will be defined with PREPA depending operational requirements
- O&M of FSRU is provided by the ship manager. Crew onboard not only take care of the ship and current activities onboard but also supervise the operation of the pipeline.
- In total 30 to 35 people:
 - Approximately 2/3 of ratings (oilers, fitters,...) and the rest of officers.
 - Master, chief engineers, all cargo engineers and all deck officers shall be fluent in English. Other crew members shall also have a good working knowledge of English.
 - US officers can be provided if requested by PREPA

Detailed operations and maintenance plan is normally developed once the full technical and commercial specification for the FSRU terminal is known and agreed by all parties. This plan will thus be developed at a later stage

- No anticipated drydocking required during the term.

GAS PIPELINE MAINTENANCE

- As part of the cycle of planned maintenance and as a result of detailed inspection (pipeline and riser) and consideration of the long-term management of subsea assets.
- Subsea inspection of underwater facilities will be IMR-type (inspection, Maintenance and repair).
- A contractor will be hired to provide a range of ROV based maintenance services: Module replacement, Anode and Cathode protection replacement, remedial burial, removal of foreign objects, dredging operations, mattress laying.

HSE

Safety has always been paramount to TOTAL. As a leading player in the LNG industry, TOTAL have been leader in setting industry safety standards and forming industry associations to share best practice.

In the past five decades TOTAL has developed vast HSSE experience and expertise in all parts of the Oil and Gas chain.

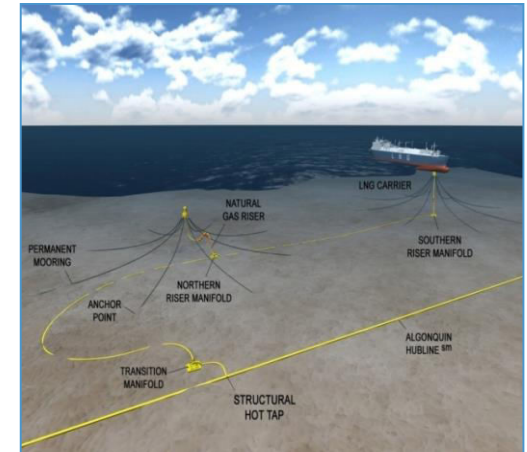
Total HSE policy has a single aim: To ensure that every executive, manager and employee is a stakeholder committed to his or her own health & safety and to that of others.

REFERENCES

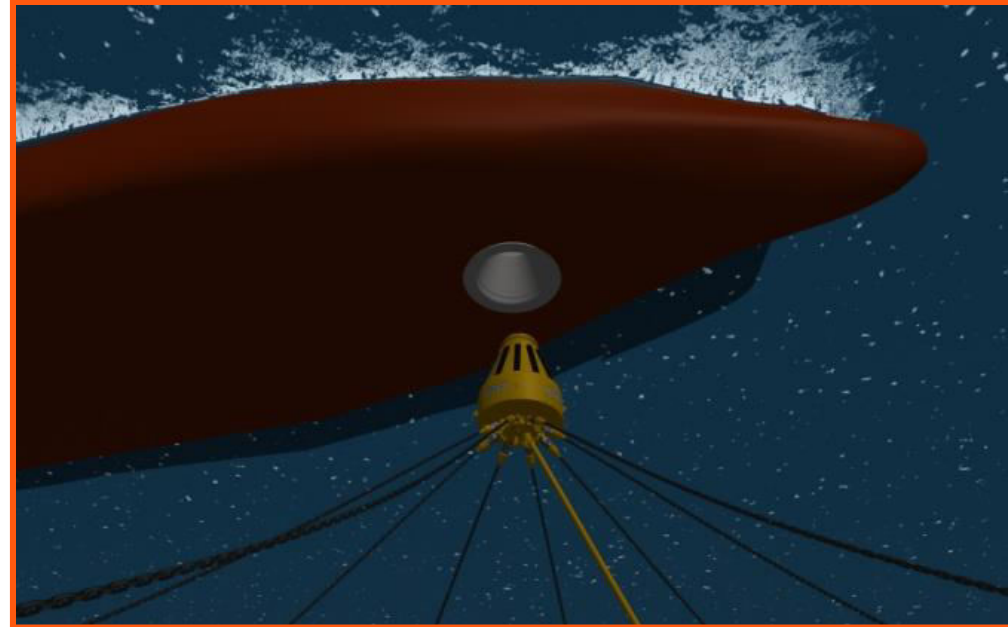
FSRU - NEPTUNE DEEPWATER PORT



- 22 miles off the coast of Boston, the Neptune LNG deep water port consisting of a twin buoy system where vessels moor and discharge vaporized LNG using onboard vaporization system
- The natural gas is then transported via subsea pipeline into the existing local grid in Massachusetts and New England, USA.
- The buoy system allows a fast-track project to be developed without many of the delays normally associated with the onshore terminals. The terminal is located in an environmentally sensitive area, and therefore the facility and its associated LNG vessels were specially designed to minimize their environmental impact and to meet the strict regulatory requirements in place.
- Regasification capacity is 2.9 mtpa with an average of 400mmscfd and a peak of 750 mmscf/d



NEPTUNE DEEP WATER PORT UNLOADING BUOY



- The submerged buoys are approx. 2.3 miles apart.
- When not connected to an SRV, the unloading buoy is suspended approximately 100 ft below the ocean surface. Each buoy is held by its mooring lines until arrival of the next SRV.

NEPTUNE DEEP WATER PORT UNLOADING BUOY

- Submerged Turret Loading or STL turret mooring and transfer system designed by Advanced Production Loading of Norway.
- SRV able to connect with the buoy in up to 12 ft wave height.
- The system is designed to weathervane and send-out natural gas in up to 33 ft seas.
- The technology has proven reliability through many years of nearly un-interrupted operation in the North Sea in extremely harsh weather conditions.



** Photos courtesy of Höegh LNG*

IVORY COAST LNG

- Total operator with 34%

The **CI-GNL (Ivory Coast LNG) consortium led by Total** has been awarded the rights to **build and operate** a liquefied natural gas (LNG) re-gasification terminal in Ivory Coast with a capacity of **3 Mtpa**.

Shareholders:

- **Total**, which will operate the project with a **34% interest**
- **National companies PetroCI (11%) and CI Energies (5%)**
- **SOCAR (26%),**
- **Shell (13%)**
- **Golar (6%)**
- **Endeavor Energy (5%)**

Total will use the terminal to supply LNG volumes from its global portfolio in proportion to its participating interest in the project.

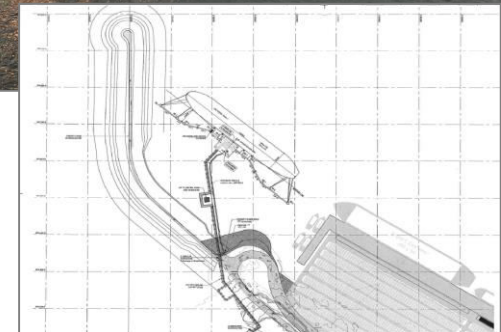
The re-gasification terminal project is expected to become operational by 2020.



FSRU - JAIGARH PROJECT - INDIA (CAPE ANN)



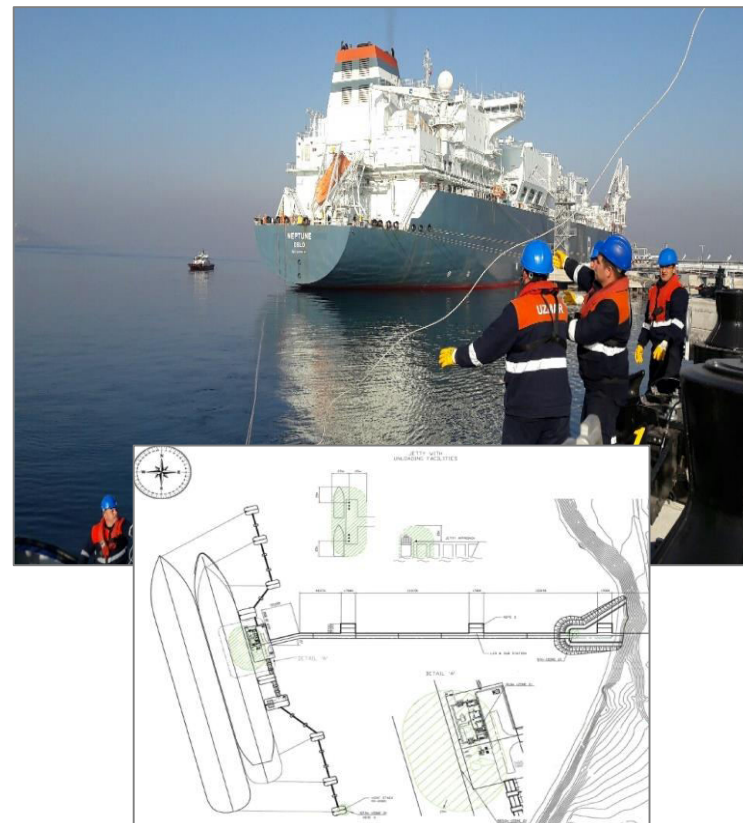
- H-Energy is developing a near shore FSRU terminal in Jaigarh Port. The project will be implemented in two phases.
- Phase 1 consists of a Jetty based FSRU of ~ 4mmtpa capacity.
- The terminal was inaugurated in May 2018 and operational start-up is expected by the end of 2018.
- Total is chartering the Cape Ann SRV to H-Energy
 - FSRU: 145,000 m³ capacity
 - Ship-to-ship transfer using hoses
 - Option for shoreside LNG sendout for onshore trucking & for small scale STS reloading



FSRU - ETKI TURKEY (NEPTUNE)



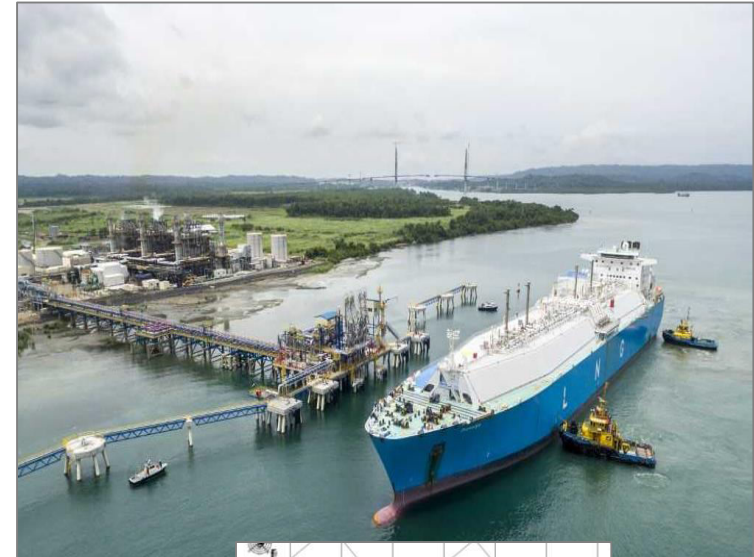
- Developers Kolin and Kalyon selected Total to provide the FSRU for this fast-track Floating Storage and Regasification Unit (FSRU) based solution. Total committed the Neptune, one of the two FSRU of its fleet, to the project.
- The overall infrastructure developed by Kolin and Kalyon includes a jetty and an onshore gas pipeline to connect the terminal to the national gas transport grid, operated by BOTAS.
- From final investment decision to completion, record breaking terminal project development took only 6.5 months and a total of 8 months from first contact with TOTAL to commercial operations
- The *Neptune* vessel arrived at ETKI LNG terminal berth on December 11th fully loaded with LNG and proceeded immediately with commissioning operations.
- FSRU: 145,000 m³ capacity
- Ship-to-ship transfer using hoses,
- Commenced operations in Q4 2016
- Bridge solution : Neptune will depart in 2019 and be replaced by a new built FSRU



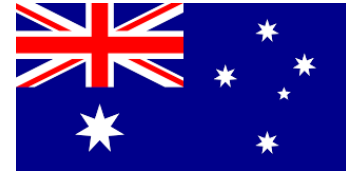
FSU – COSTA NORTE, PANAMA



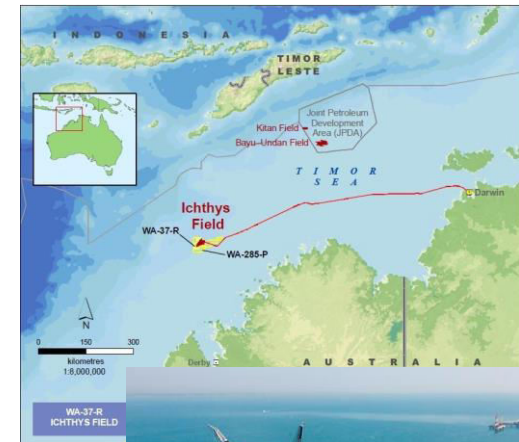
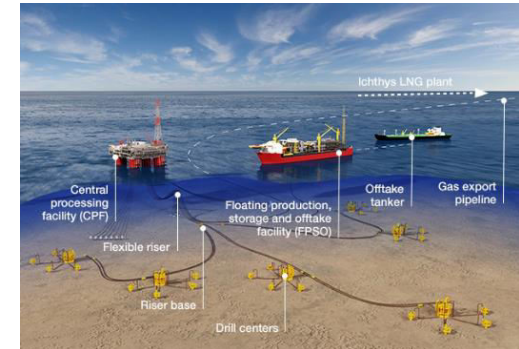
- Costa Norte integrated LNG to power project developed by AES and Inversiones Bahia at the entrance of the Panama Canal (with 380 MW CCGT). TOTAL will supply the LNG for the CCGT.
- The terminal started operations in June 2018- One of TOTAL's vessel is used as a Floating Storage Unit unit the 180,000 m³ onshore tank is completed in 2019
 - 153,500 m³ ship capacity
 - Shore connexion with rigid arms
 - LNG discharged with stripping pumps for low send out (135m³/h)
 - Project team supported initial concept evaluation and operational readiness



ICHTHYS LNG - AUSTRALIA



- Total is a major partner in this liquefaction project operated by INPEX
- The gas and condensate are extracted from the Ichthys field in the Browse Basin, located 200 kilometers off the northern coast of Western Australia. They are initially processed on a semi-submersible platform known as a central processing facility (CPF), where the gas and liquids are separated. The CPF is the largest in the world, weighing in at some 120,000 metric tons.
- A colossal gas pipeline transports the gas to the liquefaction plant. Stretching across 882 kilometers of sea and eight kilometers of land, the pipeline is the longest in the Southern Hemisphere.





TOTAL AND LNG



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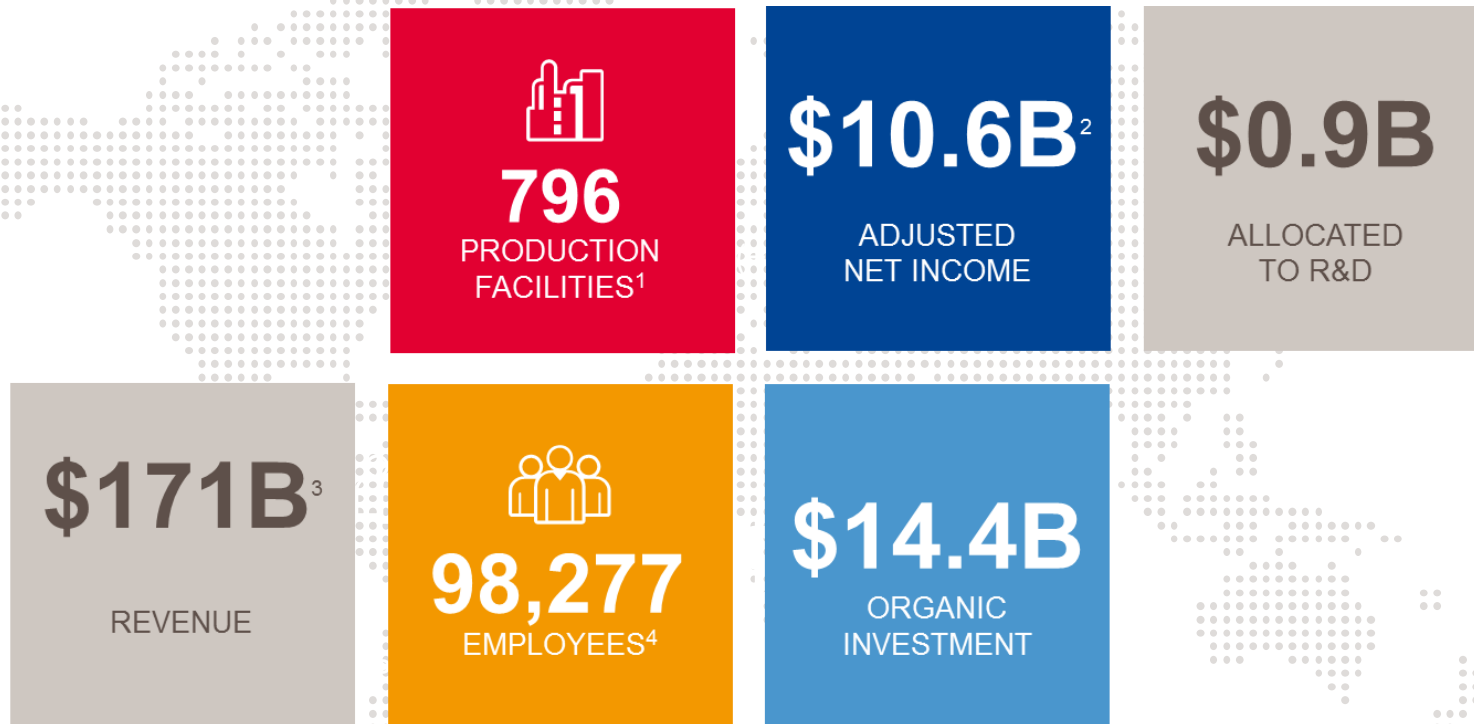
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TOTAL AT A GLANCE (2017)




1. Operated by Total
2. €9 billion

3. €152 billion
4. As of December 31, 2017

OUR CHALLENGES FOR THE NEXT 20 YEARS


Meet the energy demand of a **larger population.**

A red rectangular panel containing the text "Meet the energy demand of a larger population." in white. Below the text is a grid of 48 white human icons arranged in 4 rows and 12 columns. To the right of the text, there are three individual human icons stacked vertically.

Protect the planet and **limit** global warming.

A dark blue rectangular panel containing the text "Protect the planet and limit global warming." in white. To the right of the text is a white icon of a globe on a stand. There are four small white cloud icons with "CO2" written inside, scattered around the globe.

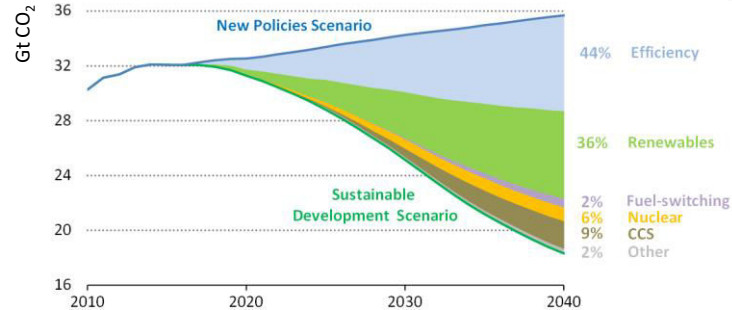
Adapt to new practices and **stay ahead** of market trends.

An orange rectangular panel containing the text "Adapt to new practices and stay ahead of market trends." in white. At the bottom right of the panel is a white icon of a stopwatch with motion lines to its left.

OUR AMBITION: BECOME THE RESPONSIBLE ENERGY MAJOR



Total's strategy reflects
**the IEA's* Sustainable
Development Scenario**
for altering the trajectory of energy-related
CO₂ emissions:



Improving
the carbon intensity
of our current
production mix



Developing
renewable
energies



Improving
energy
efficiency

* International Energy Agency.

THE ADVANTAGES OF NATURAL GAS



AVAILABLE, RELIABLE ENERGY
TO MEET GROWING DEMAND



THE FOSSIL FUEL WITH THE LOWEST GHG* EMISSIONS,
A KEY ENERGY RESOURCE FOR FAST CLIMATE ACTION



GAS OFFERS CONSIDERABLE FLEXIBILITY FOR BOTH
TRANSPORTATION AND USE, ESPECIALLY WHEN
LIQUEFIED (LNG)

* Greenhouse gas

CENTRAL TO THE ENERGY TRANSITION

Reduce GHG emissions
and improve air quality

50%

50 to 60% less CO₂ than coal for power generation. Almost no air pollutants (NO_x and SO_x) or fine particulate matter.

5 Gt

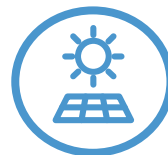
Replacing coal in power generation would reduce emissions by 5 Gt/CO₂eq/year (10% of overall emissions related to human activities).



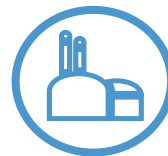
Natural gas and LNG are supported by international organizations and local and national energy policies.

Support the growth
of renewable energies

Natural gas is an essential partner to allow renewables — inherently variable — to grow.



An abundant, available resource with low emissions, natural gas is renewable energies greatest ally.



Gas-fired power plants are quicker to start up again and can ramp up to full capacity twice as fast as coal-fired power plants. This flexibility offsets the variability of renewables.

* Greenhouse gas

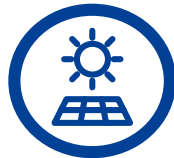
LNG, PIVOTAL TO ENERGY SECURITY



Quick way to **address declining domestic production** and/or **meet sharp rises in energy demand** in a country or region.



Alternative to gas pipelines and their drawbacks, such as cost, maintenance and geopolitical risks.



More environmentally friendly source of energy and **ideally suited to partner renewable energies for their growth.**



Increasingly competitive solutions thanks to joint initiatives by gas players to reduce technical and logistics costs, *including less expensive liquefaction and regasification units, modular liquefaction trains, flexibility, optimization and trade-offs.*

TOTAL AND LNG



TOTAL AND LNG

No. 2 worldwide
in LNG

10% market share
in 2020

40^{MT}/YR volume of LNG
managed in 2020

AN INTEGRATED PLAYER WITH A GLOBAL PORTFOLIO



Exploration & Production

Gas, Renewables & Power

LIQUEFACTION

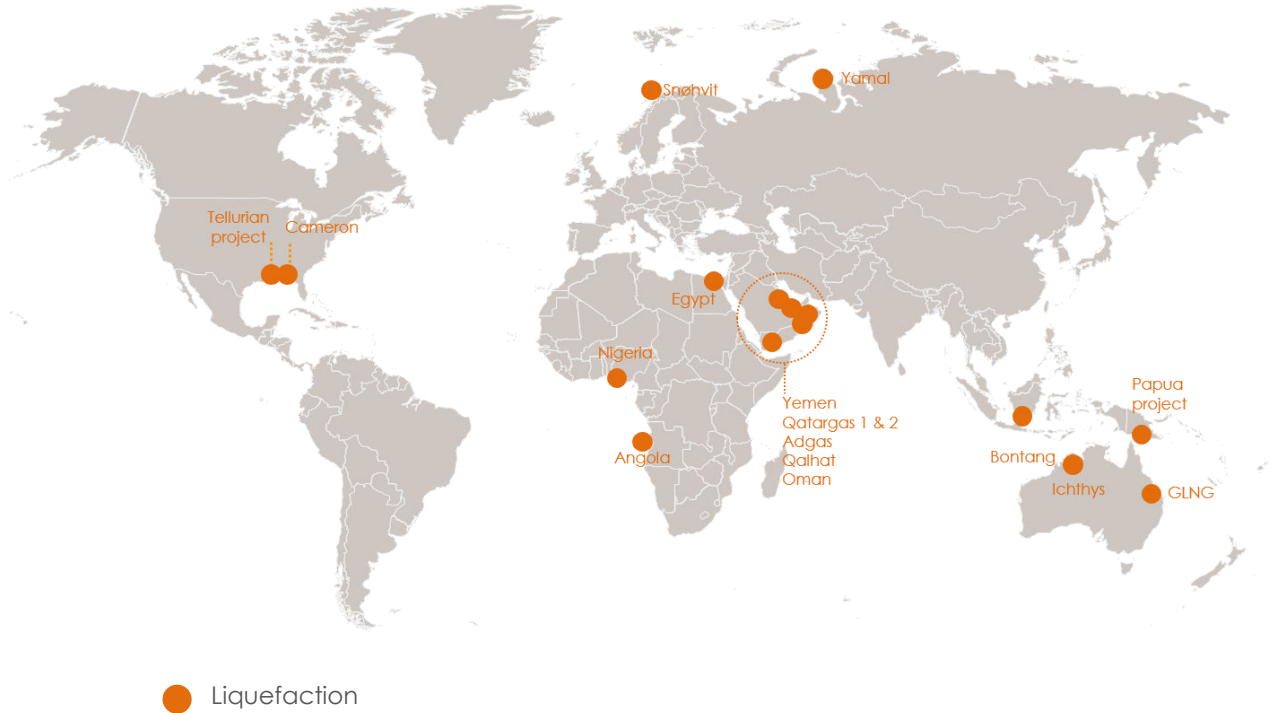
ADAPT LNG CONFIGURATIONS TO LOWER COSTS



Interests in
14 liquefaction plants
in operation or under
construction



















~23 Mt/year*
of liquefaction capacity
(equity share) in 2020



*incl. Yemen LNG

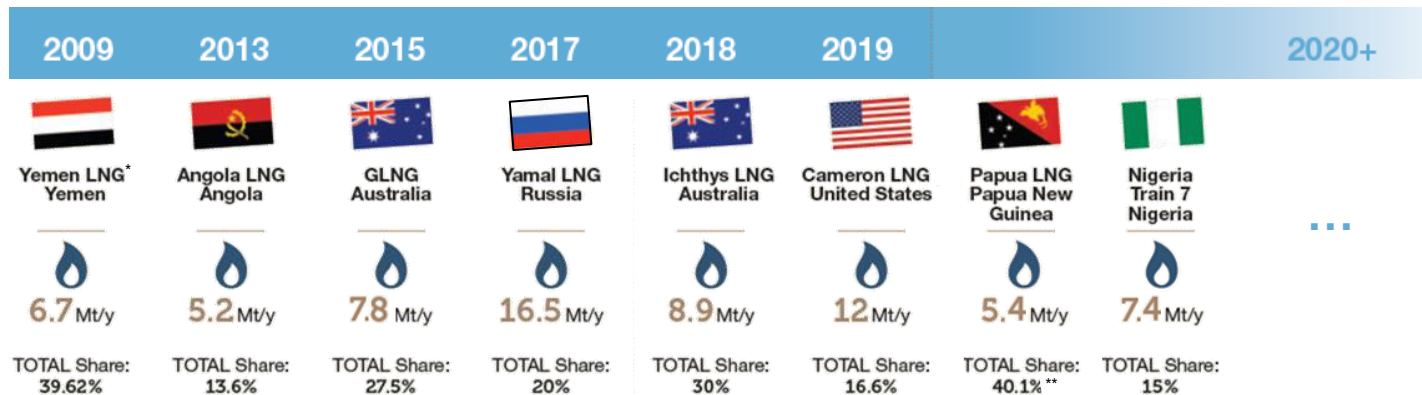
LIQUEFACTION OUR ASSETS

1977	1996	1999	2000	2005	2005	2007	2009
							
Adnoc LNG (Adgas) Abu Dhabi	Qatargas 1 Qatar	Nigeria LNG T1-T6 Nigeria	Oman LNG Oman	Qalhat LNG Oman	Idku LNG* Train 1 Egypt	Snohvit LNG Norway	Qatargas 2 Train 5 Qatar
							
5.6 Mt/y	9.9 Mt/y	22 Mt/y	7.2 Mt/y	3.7 Mt/y	3.6 Mt/y	4.2 Mt/y	7.8 Mt/y
TOTAL Share: 5%	TOTAL Share: 10%	TOTAL Share: 15%	TOTAL Share: 5.54%	TOTAL Share: 2.04%	TOTAL Share: 5%	TOTAL Share: 18.4%	TOTAL Share: 16.7%

...

* subject to pre-emption rights from other shareholders

LIQUEFACTION OUR ASSETS



*Because of security conditions around Balhaf, Yemen LNG declared force majeure in 2015. The plant is in preservation mode. ** Net working interests post-FID: 31.1%.

TRADING & SHIPPING

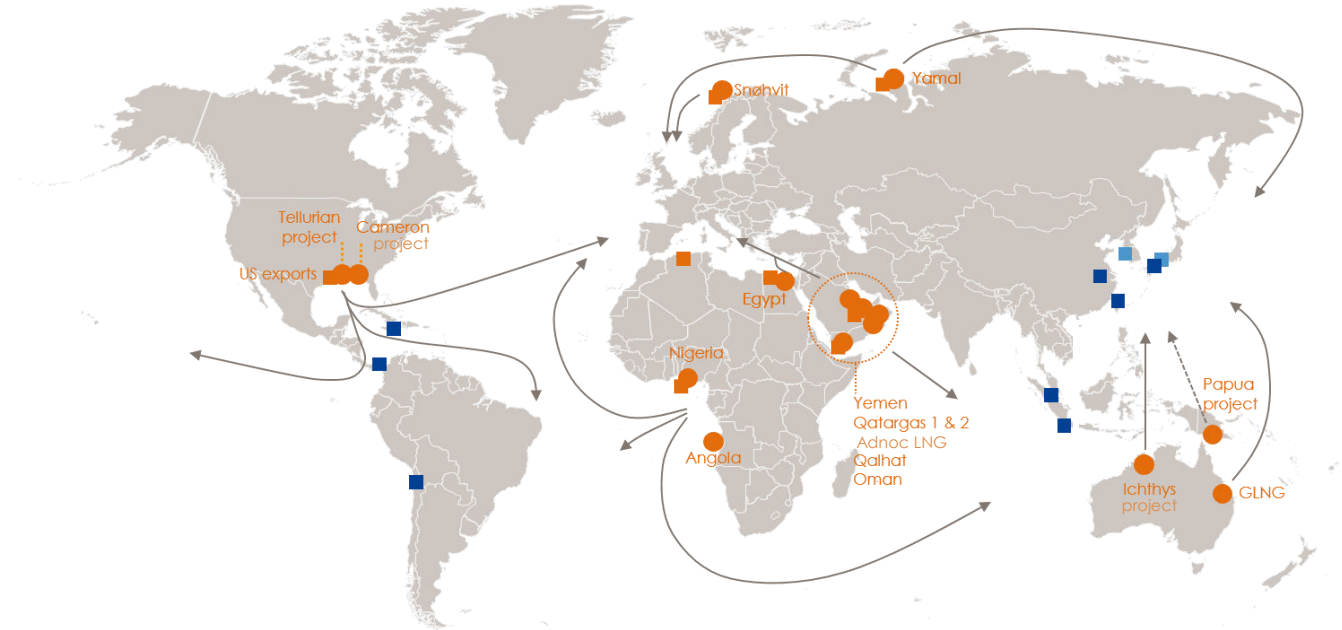
CAPTURE MARKET OPPORTUNITIES WITH INCREASING FLEXIBILITY



A fleet of
18 LNG carriers



28 Mt/year*
trading portfolio
(equity share)
in 2020



- Liquefaction
- Long-term purchases
- LNG flows
- - - - -> Potential LNG flows
- Existing and post-2016 long-term sale and purchase agreements

* Excluding Yemen LNG

TRADING & SHIPPING

OUR FLEET



Arctic Lady
145,000 cu. m



Meridian Spirit
165,000 cu. m



SK Audace
180,000 cu. m



SK Resolute
180,000 cu. m



Gaslog Hong Kong
174,000 cu. m



HHI 3020
174,000 cu. m



HSH 8006
174,000 cu. m



Energy*
74,130 cu. m



BW Boston*
138,000 cu. m



Gaselys*
154,500 cu. m



Provalys*
154,500 cu. m



BW Everett
138,000 cu. m



BW Tulip
173,400 cu. m



BW Brussels
162,400 cu. m



Point Fortin
154,200 cu. m



Neptune
145,000 cu. m



Cape Ann
145,000 cu. m



LNG Jurojin
153,000 cu. m

* Owned or jointly owned.

REGASIFICATION

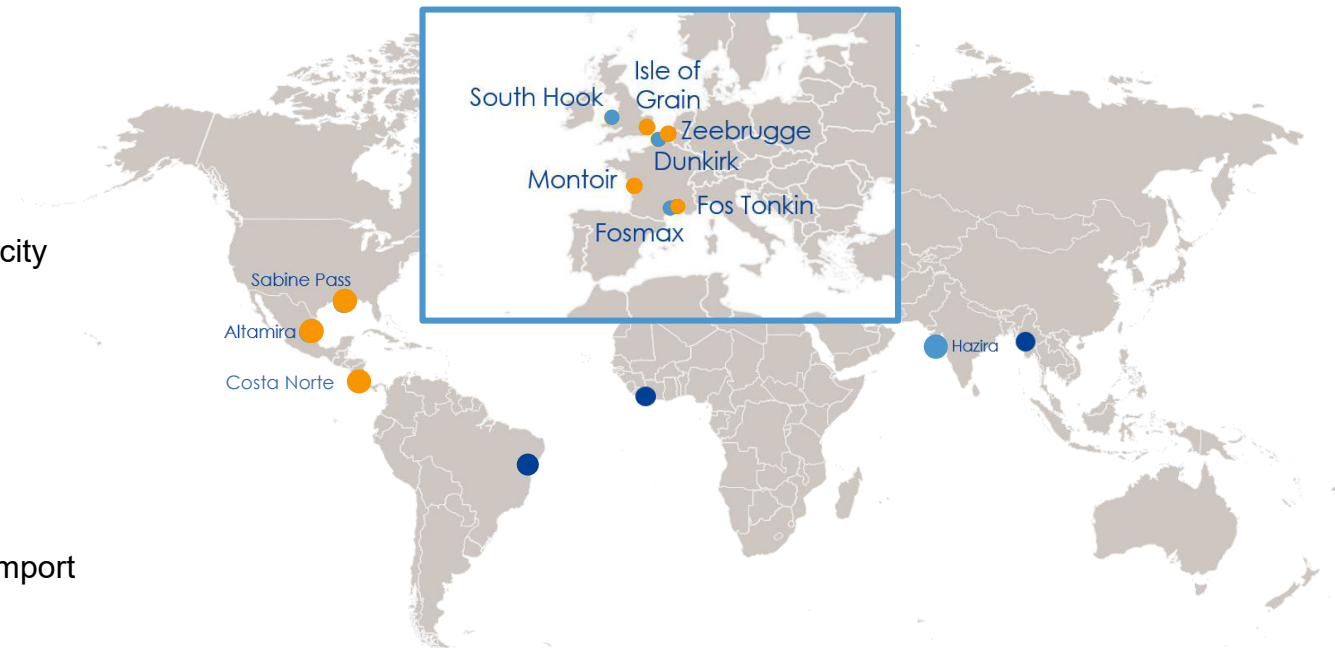
DEVELOP MARKETS TO MAKE GAS AVAILABLE TO AS MANY PEOPLE AS POSSIBLE



18 Mt/year
of regasification capacity



Develop
Fast, flexible LNG import
solutions



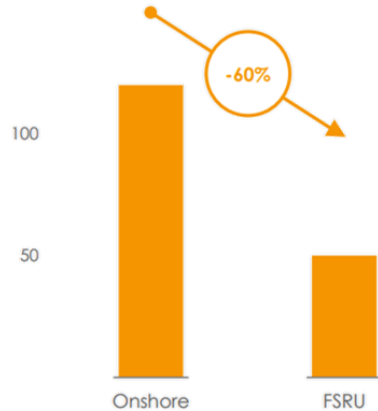
- Existing regasification terminals in which Total has an interest and access to regas capacity
- Existing regasification terminals in which Total has access to regas capacity
- Planned regasification terminals

POWER GENERATION

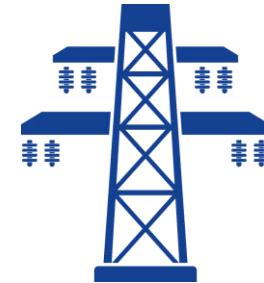
OPEN NEW MARKETS FOR LNG

OFFER COMPETITIVE LNG IMPORT SOLUTIONS

Regasification unit cost
\$/t, capex



INVEST IN POWER PLANTS DOWNSTREAM FROM REGASIFICATION TERMINALS



MARKETING

DEVELOP NEW USES FOR GAS, ESPECIALLY IN TRANSPORTATION



SHIPPING



Signature of first agreements to supply liquefied natural gas as a fuel in Europe and Asia, with shipper CMA CGM and Brittany Ferries.



Signature of agreements with Pavilion Energy to develop LNG bunker in Singapore.



Promote the growth of LNG as a marine fuel with a comprehensive line of solutions compliant with the new regulation on marine fuel sulfur content that will come into force in 2020.



GROUND



Acquisition of PitPoint B.V. and acceleration of Total's growth in natural gas for vehicles (NGV) in Europe.



Acquisition of an interest in Clean Energy and launch of a large-scale leasing program in the United States.



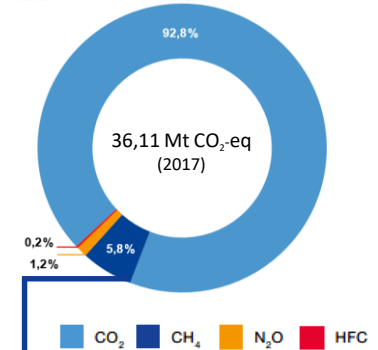
Fast-track the deployment of a dense enough network to meet the needs of our customers.

APPENDIX

REDUCE METHANE EMISSIONS

- Total has been tracking its methane emissions since 2006. They accounted for around 6% of the Group's greenhouse gas emissions in 2017.
- Member of the Global Gas Flaring Reduction Partnership's "Zero Routine Flaring" by 2030 initiative.
- As part of the Climate and Clean Air Coalition, participation in the Oil & Gas Methane Partnership to promote the measurement, control and reporting of methane emissions.
- Through the OGCI, help finance studies on systems to measure methane emissions.

Total's GHG emissions (operated scope)



Direct methane (CH₄) emissions associated with Total's gas production (operated scope)

