

# NATURAL GAS PROJECT PREPARATION GUIDE



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# About USTDA

The U.S. Trade and Development Agency (USTDA) empowers U.S. industry to create U.S. jobs by exporting U.S. goods and services for priority development infrastructure projects in emerging economies.

For every \$1 programmed for emerging economies' infrastructure projects, the Agency generates \$111 in U.S. - manufactured goods and services exports. USTDA develops sustainable infrastructure and fosters economic growth in partner countries through project preparation and partnership-building activities. By funding these activities, USTDA links U.S. businesses to export opportunities. USTDA places a high priority on infrastructure sectors which are

important to its partner countries. These sectors include traditional energy and power, renewable energy, electricity transmission and distribution, telecom, surface transportation, and aviation. In recent years, demand has increased for project preparation funding for natural gas and liquefied natural gas (LNG) infrastructure projects.

USTDA awards grants to overseas project sponsors in emerging markets for a variety of project-preparation activities, including feasibility studies and technical assistance. The Agency also funds activities that facilitate a collaborative relationship between the U.S. and the overseas project sponsors.



# USTDA Project Preparation Tools

USTDA's project preparation tools aim to develop the information required to make a project bankable and to address any obstacles to successful implementation. Obstacles might include weak regulatory structures, insufficient institutional or managerial capacity, lack of proper financial and legal expertise, or the absence of adequate tariff structures.

## USTDA Project Preparation Tools

### Project Development Tools

Feasibility Study (FS)

Technical Assistance (TA)

Technical Training (TR)

### International Business Partnership Tools

Technical Workshops, Symposiums, and Conferences (TS)

Reverse Trade Missions (RTM)

## International Business Partnership Tools Link Project Sponsors and U.S. Industry



**Introduce overseas project sponsors to U.S. goods, manufacturers, service providers and best practices.**



**Provide overseas project sponsors with a platform to share project information with the U.S. industry and develop long-lasting partnerships.**



**Create a business environment for project sponsors and U.S. industry to share information on innovation technology and financing options.**

# USTDA Facilitates Strategic Partnerships

In partnership with public and private sector partners, USTDA funds long-term initiatives to advance its dual mission: advancing high-priority infrastructure projects in emerging markets while creating jobs at home through export development. USTDA and U.S. industry launched the U.S. Gas Infrastructure Exports Initiative to connect American companies to export opportunities across the gas value chain in emerging economies. The Initiative aims to advance gas infrastructure in partner countries by connecting project sponsors to cutting-edge U.S. technologies, equipment, and solutions.

“ LNG Allies was pleased to help USTDA launch their U.S. Gas Exports Infrastructure Initiative in November 2017. Our partnership with the agency is truly helping ‘to move the needle’ when it comes to creating new markets for U.S. liquefied natural gas. U.S. LNG can help lift millions out of poverty, improve global environmental conditions, and address climate change. We’re extremely proud of our work with USTDA and all that we’re accomplishing together.” Fred H. Hutchison, Founder, President, and CEO, LNG Allies, The U.S. LNG Association.

## U.S. Gas Infrastructure Exports Initiative

USTDA partnered with over 40 U.S. Businesses, Industry Associations, and Government Agencies to launch the U.S. Gas Infrastructure Exports Initiative.\*

### Co-Launch Partners



### U.S. Industry Partners



\*To learn more, please visit <https://ustda.gov/program/us-gas-infrastructure-exports-initiative>.

# INTRODUCTION

## About the Natural Gas Preparation Guide

The demand for natural gas and LNG is expected to increase in the foreseeable future for electric-powered generation, as a transportation fuel, and as a feedstock for the chemical and petrochemical industries. USTDA's Natural Gas Project Preparation Guide ("Guide") communicates lessons learned, case studies, and expertise in the natural gas sector. It also describes USTDA's project preparation tools and how U.S. industry and foreign project sponsors can engage with the Agency to support project development in emerging markets.

USTDA is the U.S. Government's project preparation assistance agency, tasked with connecting U.S. equipment, technologies and services infrastructure projects in emerging markets. As such, USTDA is well-positioned to speak to the relevant commercial challenges and innovations in developing bankable, natural gas

infrastructure projects. Since the early 1980s, USTDA has funded more than 295 activities across the natural gas value chain in more than 70 countries.

USTDA's experience shows that well-planned, natural gas sector projects produce strong results both at home and abroad. Through the Agency's work, U.S. companies export cutting-edge solutions, such as directional drilling and hydraulic fracturing (fracking) for shale gas exploration, high efficiency turbines for power generation, low BTU turbines and engines for coalbed and coal mine methane utilization, and services that support the gas life cycle from analyzing production techniques to initiating transportation plans to designing power plants.

To maintain this momentum, as the U.S. and its partner countries embrace natural gas use, USTDA developed this Guide to communicate lessons learned, over the past four decades along with information on how to leverage and deploy USTDA's project preparation tools at various phases of project development and implementation. With this Guide, USTDA hopes to empower foreign project developers, U.S. companies, financiers, and other stakeholders interested in supporting global natural gas growth.

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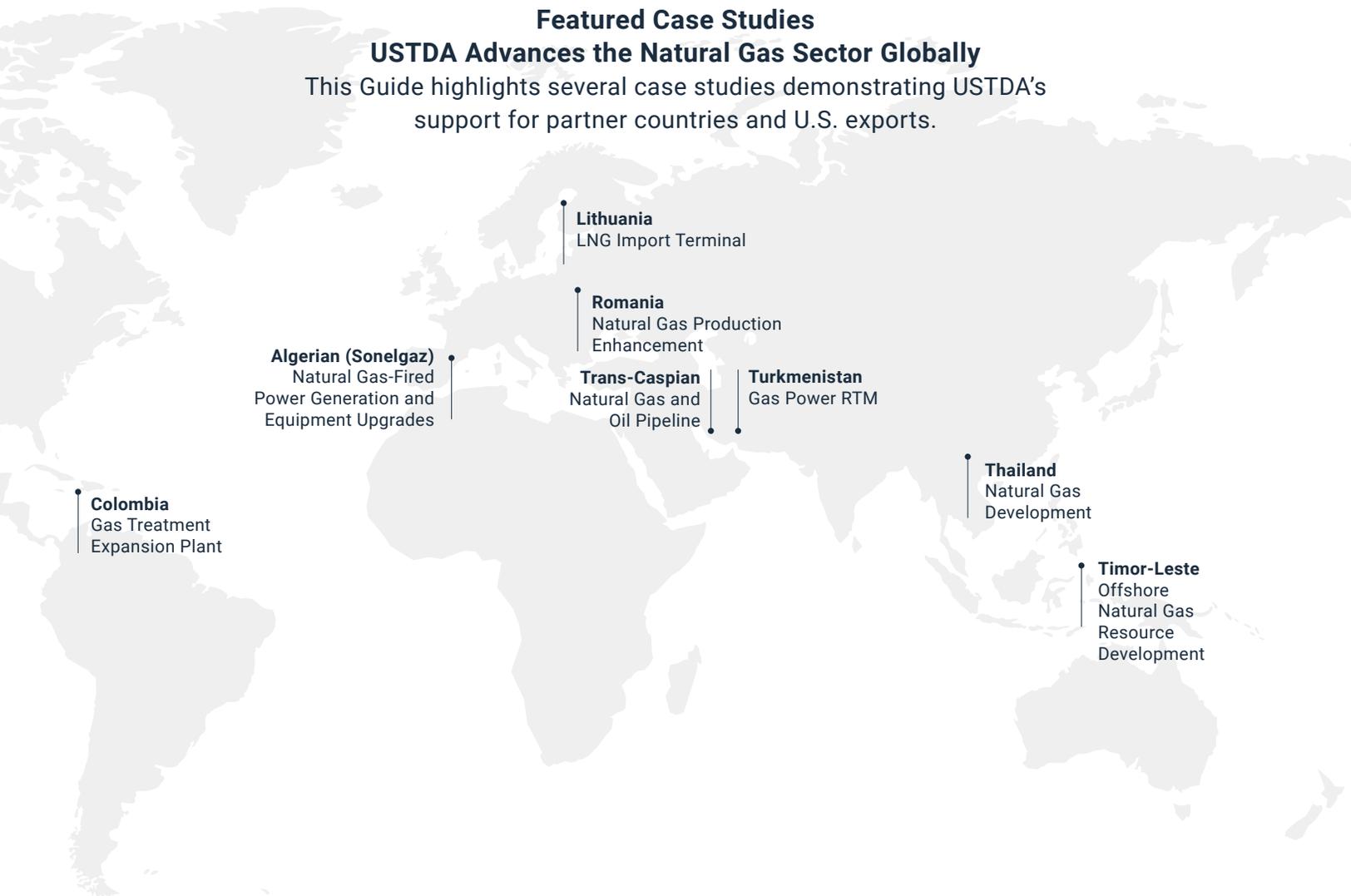
**Since the early 1980s, USTDA has funded 295+ activities across the natural gas value chain in more than 70 countries.**

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## Featured Case Studies

### USTDA Advances the Natural Gas Sector Globally

This Guide highlights several case studies demonstrating USTDA's support for partner countries and U.S. exports.



In addition to USTDA's lessons learned and project preparation tool information, the Guide includes information on the natural gas industry development and discusses USTDA activities, including objectives and results, in each of the four major project development and implementation phases.

The final section of this Guide provides a Project Proposal Tool Kit for public, private, foreign, and domestic project stakeholders. The Tool Kit describes how project stakeholders can engage USTDA, apply for project preparation grant funding and participate in international partnerships.



## USTDA's Natural Gas Project Activities



**70 Partner Countries**

**35+ Years of Natural Gas Project Preparation Support**

**295+ Activities Funded**

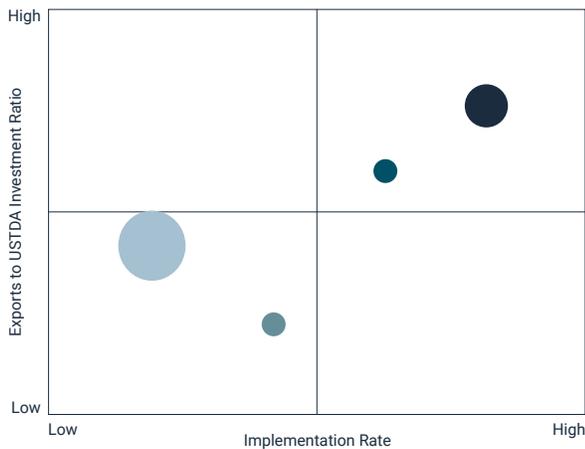
**\$8.3 Billion of U.S. Exports Generated**

## USTDA Success Metrics

CIRCLES INDICATE RELATIVE EXPORTS VOLUME

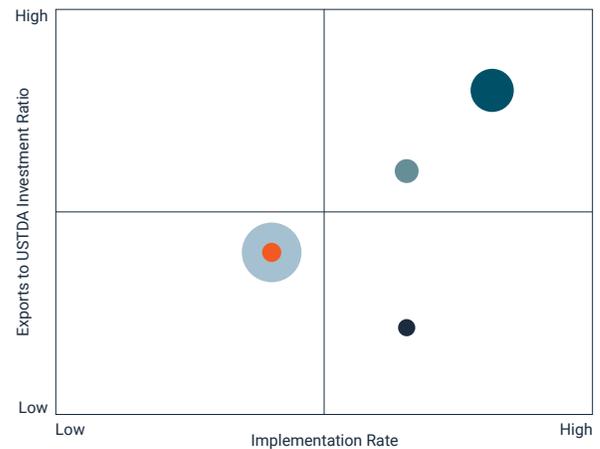
### Project Development Phases

- Project Conception and Preliminary Design
- Project Financing
- Project Design and Construction
- Project Commissioning and Operation



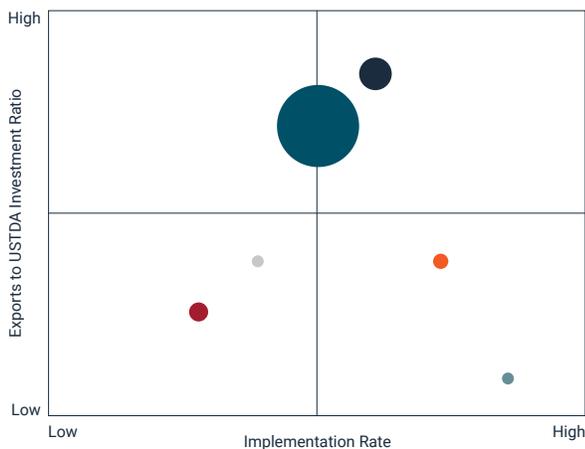
### Activities

- Feasibility Study
- Technical Assistance
- Technical Training
- Technical Symposium
- Reverse Trade Mission



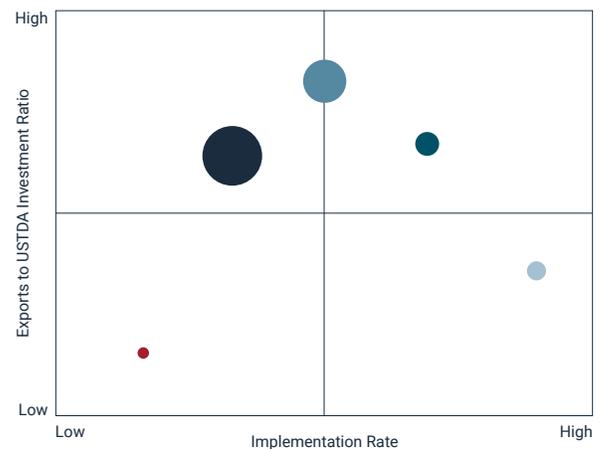
### Subsectors

- Coalbed & Coal Mine Methane
- District Heating
- Gas-Fired Power
- LNG Facility
- Gas Exploration and Production (E&P)
- Pipeline & Storage
- Others



### Regions

- East Asia
- Latin America & Caribbean
- Indo-Pacific
- Middle East, North Africa, Europe & Eurasia
- Sub-Saharan Africa (SSA)



## Four Major Phases of Project Development and Implementation



### PHASE I | 203 ACTIVITIES Project Conception and Preliminary Design

Provides grants for developing the required documentation for financing natural gas projects

#### TOTAL NUMBER OF ACTIVITIES

Reverse Trade Missions: 37 | 18%  
Feasibility Studies: 141 | 70%  
Technical Assistance: 15 | 7%  
Technical Training: 1 | 1%  
Technical Workshops and Symposiums: 9 | 4%

#### REGIONS

East Asia: 15 | Indo-Pacific: 32 | Latin America & Caribbean: 32 | MENA/EE: 82 | SSA: 39 | Worldwide: 3

#### SECTORS

Coal Bed Methane & Coal Mine Methane: 5  
District Heating: 12 | Gas-Fired Power: 77  
Gas E & P: 42 | Pipeline Storage: 32 | Others: 11



### PHASE II | 54 ACTIVITIES Project Financing

Provides grants for advisory services to derisk investment and procure financing for natural gas projects

#### TOTAL NUMBER OF ACTIVITIES

Reverse Trade Missions: 10 | 19%  
Feasibility Studies: 21 | 39%  
Technical Assistance: 18 | 33%  
Technical Training: 2 | 4%  
Technical Workshops and Symposiums: 3 | 5%

#### REGIONS

East Asia: 1 | Indo-Pacific: 16 | Latin America & Caribbean: 8 | MENA/EE: 27 | SSA: 2

#### SECTORS

Coal Bed Methane & Coal Mine Methane: 12  
District Heating: 5 | Gas-Fired Power: 5  
Gas E & P: 23 | Pipeline Storage: 8 | Others: 1



### PHASE III | 18 ACTIVITIES Project Design and Construction

Provides grants for developing procurement packages, preparing equipment specifications, and establishing best-international procurement practices

#### TOTAL NUMBER OF ACTIVITIES

Reverse Trade Missions: 8 | 44%  
Feasibility Studies: 3 | 17%  
Technical Assistance: 5 | 28%  
Technical Workshops and Symposiums: 2 | 11%

#### REGIONS

East Asia: 3 | Indo-Pacific: 4 | Latin America & Caribbean: 4 | MENA/EE: 6 | SSA: 1

#### SECTORS

Coal Bed Methane & Coal Mine Methane: 2  
Gas-Fired Power: 4 | Gas E & P: 8 | Others: 4



### PHASE IV | 20 ACTIVITIES Project Commissioning and Operation

Supports natural gas asset owners and operators to enhance the design, operation, and productivity of existing infrastructure

#### TOTAL NUMBER OF ACTIVITIES

Reverse Trade Missions: 1 | 5%  
Feasibility Studies: 13 | 65%  
Technical Assistance: 1 | 5%  
Technical Training: 5 | 25%

#### REGIONS

East Asia: 1 | Indo-Pacific: 4  
Latin America & Caribbean: 1 | MENA/EE: 14

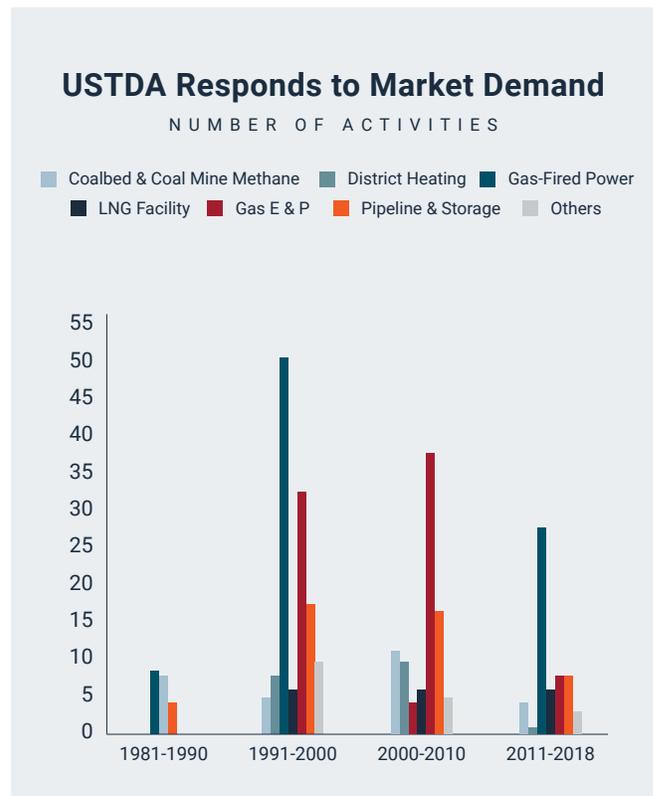
#### SECTORS

District Heating: 1 | Gas-Fired Power: 4  
Gas E & P: 11 | Pipeline Storage: 4

# USTDA Responds to Global Market Demand

Since the early 1980s, USTDA has supported natural gas market development, technology deployment, and project implementation by providing project preparation grant funding and connecting natural gas project sponsors with U.S. natural gas technology, equipment, and service providers. Over the last four decades, USTDA has responded quickly to a changing market demand as exemplified below:

- Recognizing and supporting the increasing global demand for natural gas, USTDA support for gas exploration and production projects increased from eight activities in the 1980s to 30 activities in the 1990s and to 39 activities in the 2000s.
- In the 2000s, USTDA also supported 12 coalbed and coal mine related activities, taking this recently commercially proven technology to emerging markets.
- USTDA support for power generation project development activities increased from eight in the 1980s to 50 in the 1990s as U.S. gas-fired power plant technology evolved.
- In the 2000s, as demand for renewables increased, demand for USTDA support for gas-to-power projects decreased. However, USTDA again saw an increased demand for gas-to-power generation projects starting in 2010 and funded 27 activities between 2010 and 2018 as global supply of clean, affordable natural gas increased.
- The 1990s and 2000s saw a flurry of projects focused on upgrading and improving district heating operations in response to increased power generation demand in the former Soviet Union states.
- USTDA has a long history of supporting LNG pipeline and storage projects, bringing its century-old experience and expertise to emerging markets worldwide, with three activities in the 1980s, 18 activities in the 1990s, 16 activities in the 2000s, and seven activities from 2010 to 2018.
- Over the last four decades, USTDA has also supported LNG import and export facilities development. USTDA support for LNG facilities projects steadily increased from five activities in the 1990s to 11 activities since 2010. The most recent activities have focused on developing LNG facilities to import low-cost U.S. LNG.



# The United States Has Been at the Center of the Gas Industry for Two Hundred Years



# Global LNG Outlook



In 2018 China, India, South Korea and Pakistan led LNG demand growth



1 BCM of LNG used on China's roads in 2018



20% growth for global natural gas demand from 3,736 in 2017 to 4,503 BCM



34 contracts signed in 2018 with an average length of more than 13 years



The U.S. is expected to be the world's largest exporter of LNG by 2025



U.S. LNG capacity nearly triples in 2019 to 252 MCMD



1,400+ spot cargo deliveries in 2018



With more than 26 million NGVs worldwide, economic and environmental benefits will make LNG an alternative road transport option



Over 51.5 BCM of LNG capacity added in 2018



700 BCM in estimated LNG demand in 2035 will make LNG the fastest growing gas supply source



# USTDA's Value Proposition



USTDA provides assistance to project developers in the emerging markets that need high quality solutions that could be provided by U.S. industry to meet their economic development. USTDA's value proposition in this sector derives from its unique ability to engage U.S. natural gas industry, an undisputed global leader, with vast experience, expertise and cutting-edge technologies, to advance deployment of natural gas infrastructure projects in emerging markets. For 40 years, USTDA has positioned itself at the nexus of U.S. industry and emerging markets public and private sector natural gas infrastructure development. In the process, it has established strong, longstanding relationships with U.S. industry, as demonstrated by participation of leading U.S. companies and associations in the U.S. Gas Infrastructure Exports Initiative, including LNG Allies, American Petroleum Institute (API), American Gas Association (AGA), the U.S.

Chamber's Global Energy Institute, Independent Petroleum Association of America (IPAA), and the Center for Liquefied Natural Gas (CLNG).

USTDA and its partners have deployed a large and diverse portfolio of natural gas projects globally. Building off of that project experience and based on the market demand, the Agency continuously refines its project preparation tools to address the specific needs of project sponsors throughout the project development value chain, from project conception through commissioning, and has proven that it can effectively advance projects over a variety of hurdles, including technical, financial, and procurement related issues. Evidence of USTDA's important role in emerging markets natural gas infrastructure planning and development can be found throughout this Gas Guide, including testimonials by U.S. natural gas industry leaders and project stakeholders.

# U.S. at the Center of Natural Gas Industry Development

Natural gas has been around for millions of years, but it is only recently that advanced methods for finding, recovering, and effectively utilizing it have been developed at today's industrial and commercial scale.

Since the early 1980s, USTDA has played a significant role in introducing innovative, U.S. - developed natural gas technologies and best practices to emerging markets. USTDA's work creates export opportunities for the U.S. industry along the supply chain, from conventional and unconventional natural gas exploration, production, and processing to end-use applications.



America's first natural gas well was drilled in 1821 by William Hart in Fredonia, New York. Building upon Hart's work, the first American natural gas distribution company was formed as the Fredonia Gas Light Company. In 1836, the city of Philadelphia, Pennsylvania was the first to create a municipally owned natural gas distribution company. Today, there are over 900 U.S. public

gas systems, with Philadelphia Gas Works being the largest and longest in operation.<sup>1</sup>

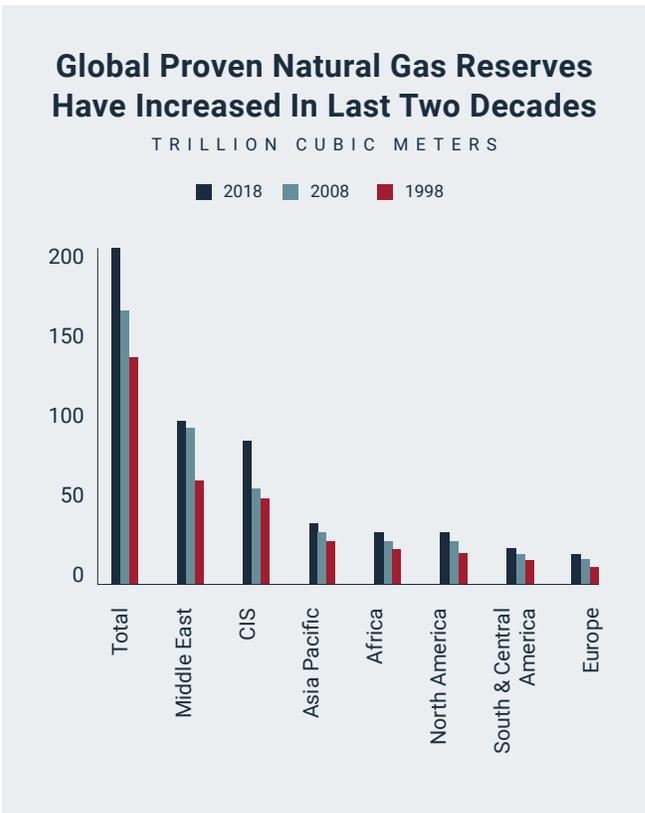
The 20th century ushered in the development of the natural gas transportation industry. The 1920s marked the beginning of the effort to build a significant pipeline infrastructure in the U.S. Following World War II, new advancements in pipe rolling, metallurgy, and welding allowed for thousands of miles of pipeline to be constructed worldwide.

The ability to efficiently transport natural gas allowed new uses for this energy resource to arise. Natural gas was used to heat homes and operate personal appliances, such as water heaters and ovens. Industries began using natural gas in manufacturing and processing plants. The pipeline expansion made gas easier to obtain and helped to establish it as a popular energy source.<sup>2</sup>

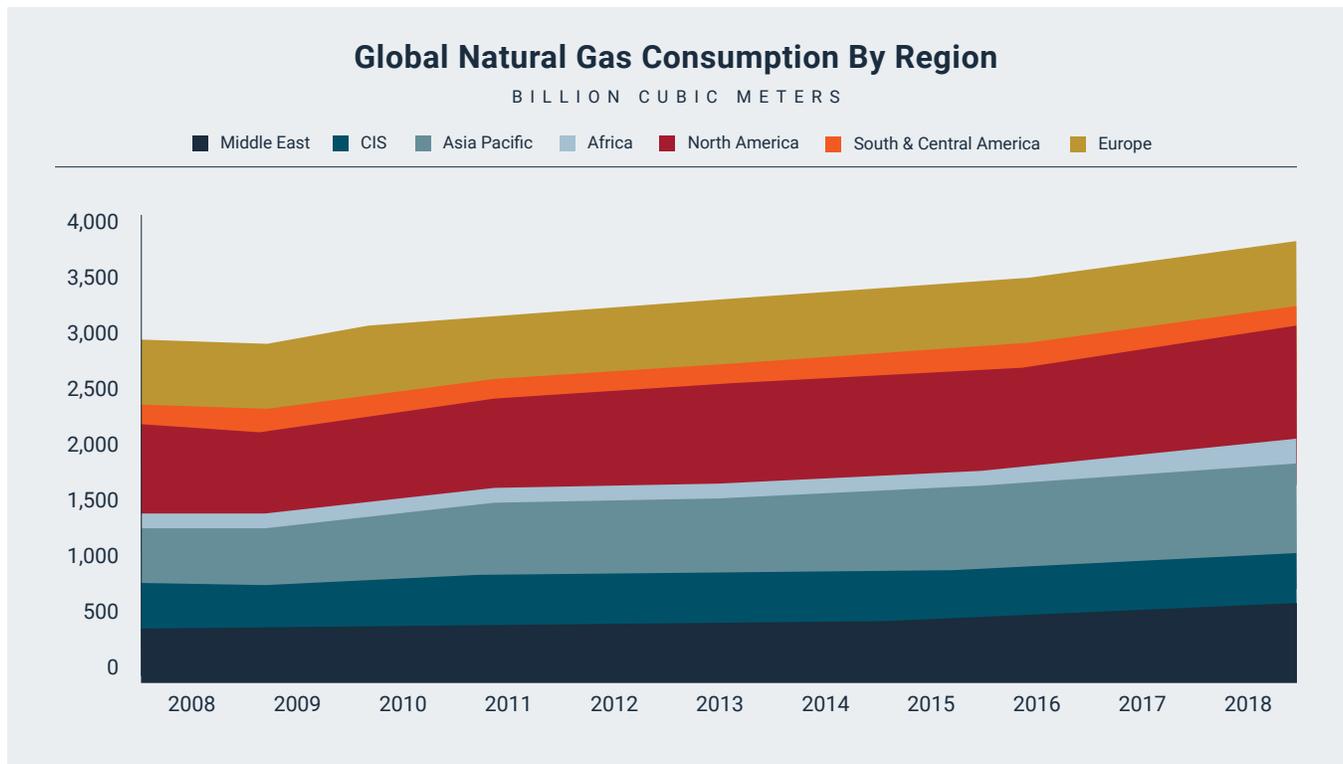
Regulation has been a constant feature in the natural gas industry. The U.S. first placed regulations on the industry in 1938 with the passing of the Natural Gas Act. Concerned with companies' monopolistic tendency to charge higher-than-competitive prices, among other potential abuses, the Act put into effect regulations and restrictions to protect the consumer.

The 1970s and 1980s saw several gas shortages and price irregularities. These events served as the catalyst for the movement toward deregulating the industry in the U.S. in the 1980s and 1990s, allowing for healthier competition and market pricing. The gas shortages and price irregularities also led to technological advancements and improvements in all parts of the natural gas supply chain. This allowed natural gas to be obtained in a more efficient, cost-effective manner.

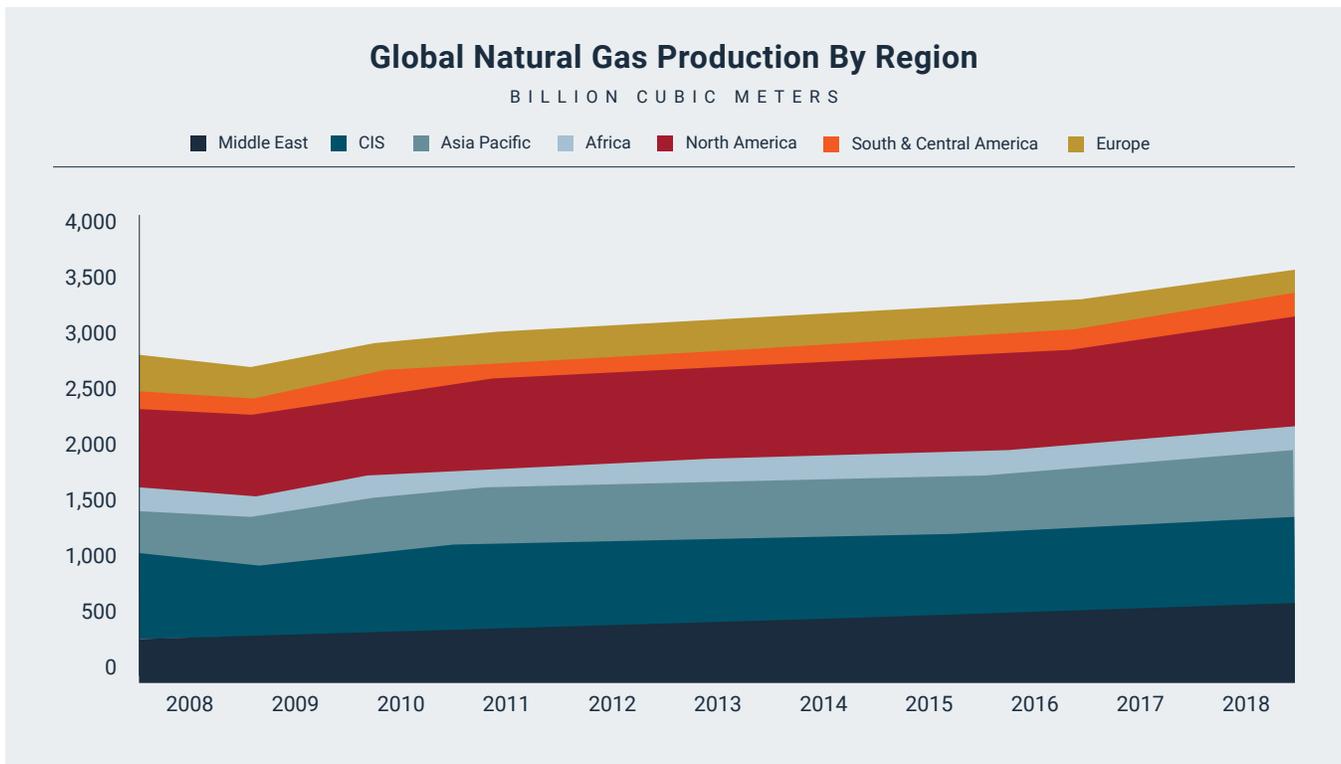
New technologies, such as fracking, made shale gas more accessible and contributed greatly to the increase in the global natural gas supply. Overall, these market and technology developments created an environment wherein more natural gas was discovered, produced, and consumed, while demand continued to exceed production in Asia Pacific and Europe.<sup>3</sup>



Data Source: BP Statistical Review of World Energy 2019; CIS: Commonwealth of Independent States.



Data Source: BP Statistical Review of World Energy 2019; CIS: Commonwealth of Independent States.



Data Source: BP Statistical Review of World Energy 2019; CIS: Commonwealth of Independent States.

In addition to the lower prices, the use of natural gas as a transitional, cleaner fuel for transportation and power generation contributed to the worldwide increased demand for natural gas. This increase in the global natural gas supply and demand is expected to continue over the next two decades.<sup>4</sup>

Due to regional supply and demand imbalances, LNG demand is expected to continue increasing into the year 2035. LNG's ease of transport has made natural gas more accessible. LNG's ease of transport has made natural gas more accessible and now, with its ability to produce natural gas from shale, the U.S. is able to support the supply of this valuable resource. Import facilities in the U.S. have been transformed into export facilities, additional export facilities are under construction and development, and the U.S., currently the fourth largest exporter of liquefied

natural gas, will surpass Malaysia, Australia and Qatar to become the world's largest exporter of LNG within five years, according to a recent International Energy Agency report.<sup>5</sup>

Liquefied natural gas is natural gas that has been cooled to a liquid state for both shipping and storage. In this liquid state, natural gas has a volume that is about 600 times smaller than its gaseous state. It is more economical to store and transport over long distances<sup>6</sup>. Overall, the LNG market is rapidly expanding, making natural gas use more economically feasible for countries and regions where it once was not. The U.S. industry has been instrumental in increasing and diversifying natural gas supply to Western Europe, the Baltic region countries, and Southeast Asia.

# PROJECT CONCEPTION AND PRELIMINARY DESIGN

**Project conception and preliminary design is the first phase in the natural gas project development and implementation cycle. USTDA-funded activities in support of natural gas projects at this early point in development and implementation validate the project's viability.\***

At the initial phase, the project's scope, technical, financial, commercial, environmental, and social risks are often not well understood. As such, support (financial or otherwise) from project sponsors and financial institutions may not be available. At this point, USTDA grants help project sponsors validate the project's viability using independent U.S. contractors with specialized technical expertise. This independent validation provides project sponsors and financial institutions with the necessary information regarding the project's measurable merits and risks, for decision making. The validation can also be applied to secure financing for the project's next phase in the development and implementation life cycle.

For the natural gas sector, project preparation activities in the project conception and preliminary design phase could include strategy, planning, and technical or environmental studies and reviews. Strategy and planning studies may consist of sector master planning, market assessment, and development of policy, pricing, or regulatory frameworks. Technical and environmental studies include conducting proof of concept and feasibility studies to evaluate project viability. Depending on the project, the technical scope may also include environmental impact and social assessments. The key objective of these studies is to assist the project sponsors in developing the required documentation to make a project bankable.

\*The term "activity" as used in this Guide refers to any initiative funded by USTDA (i.e., reverse trade mission, feasibility study, technical assistance, etc.) and "project" refers to what a project sponsor intends to implement (i.e. construction of an LNG terminal, natural gas pipeline, gas-to-power power plant, etc.).





design activities, 141 were feasibility studies, 37 were reverse trade missions, and the remaining activities consisted of technical assistance, technical symposiums, and training. Seventy-seven of the activities were in support of gas-fired power generation projects. Geographically, the majority of the project conception and preliminary design activities, 82, were in support of projects in the Middle East, North Africa, Europe, and Eurasia region. These projects were mostly pipeline and power projects.

Since 1981, USTDA has supported natural gas projects in exploration and production (E&P), LNG export and import, gas pipeline networks, gas-to-power and shale, coalbed methane (CBM), and coal mine methane (CMM) utilization. USTDA supports these projects through reverse trade missions, technical symposiums and workshops, technical assistance, feasibility studies, and technical training.

From 1981 through 2018, USTDA funded 203 natural gas project conception and preliminary design activities generating over \$4.3 billion\* in U.S. exports of goods and services. Of these 203 natural gas project conception and preliminary

Feasibility studies are the most successful activity to date in this phase of project development and implementation, heralding the greatest volume of U.S. exports, second-highest U.S. exports to USTDA investment rate, and third-ranked for implementation success. Across various natural gas subsectors, implementation of LNG facilities projects generated the greatest volume of U.S. exports. These projects also had the highest U.S. exports to investment ratio and the third-highest implementation ratio among subsector projects. Geographically, the Latin America and Caribbean region had the highest U.S. exports and the second-highest project implementation rate.

### USTDA's Natural Gas Activities in the Conception and Preliminary Design Phase



**203 Activities Funded**

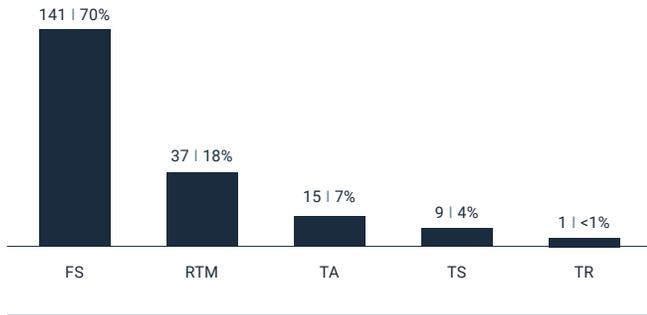
**Over \$4.3 Billion of U.S. Exports Generated**

\*Unadjusted for inflation.

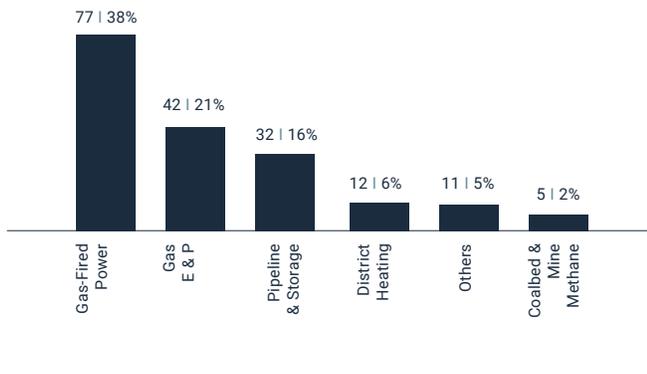
## USTDA Activities

1981 - 2018

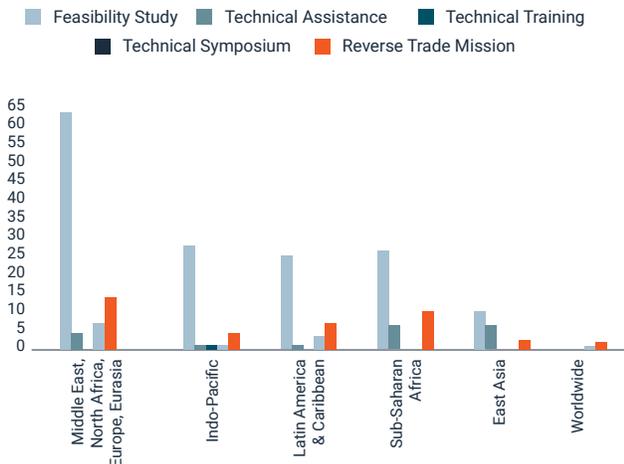
### Project Conception and Preliminary Design



### Subsectors



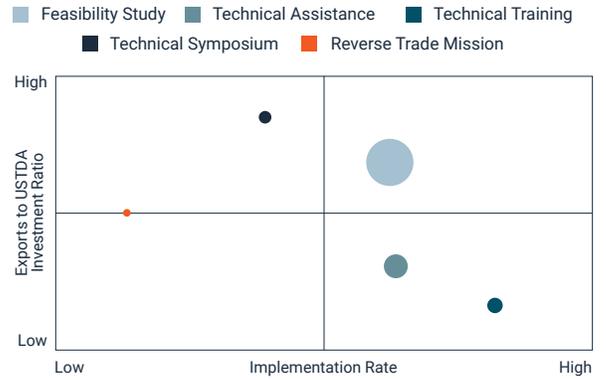
### Regions



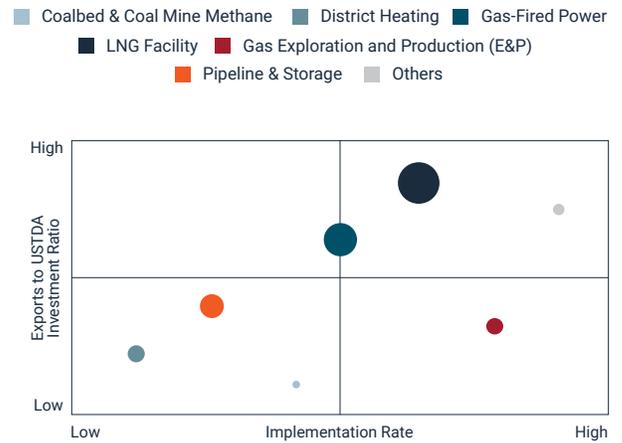
## USTDA Success Metrics

CIRCLES INDICATE RELATIVE EXPORTS VOLUME

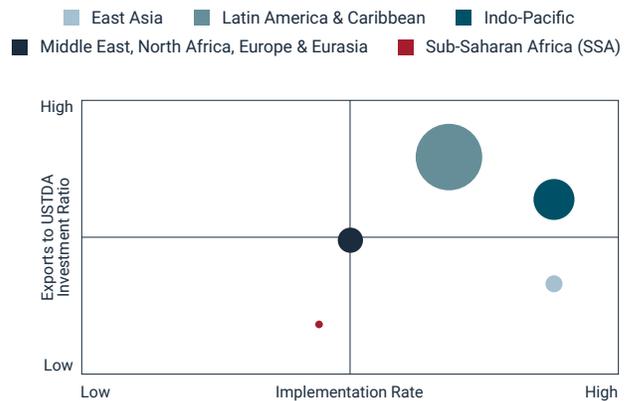
### Activities



### Subsectors



### Regions



# Projects Overview: USTDA Helps Project Sponsors Address Early Project Hurdles as They Adapt to Shifting Global Gas Markets

Projects in the conception and preliminary design phase have the highest risk profile in the project development life cycle. Although the projects put forward in this phase may be viable concepts and, in some cases, needed to meet domestic or market demand, many of the projects cannot secure financing due to real or perceived project risks such as:

- Potential negative environmental and social impacts
- Lack of technical qualifications and experience to manage the project development effort and/or construct and operate the project
- Lack of a supportive or well-defined regulatory environment

The type of support USTDA provides to the project sponsors or developers in this phase can broadly be divided into three groups:

**Strategic Support:** These activities support host governments or their agencies to develop national energy policy, pricing options, and/or regulatory frameworks.

**Planning and Marketing Support:** These activities support host governments, their agencies, and private sector gas market integrators or suppliers to develop natural gas utilization plans.

**Technical Support:** The projects receiving USTDA grant funding for feasibility studies form a large majority of the projects USTDA supports at the project conception and preliminary design phase. These studies provide technical, economic, environmental, financial, and commercial assessments, helping projects to secure financing.

USTDA project preparation activities exemplify how the Agency responds to changing market demand and supports project sponsors at the project conception and preliminary design phase. In the early 1990s, due to increased natural gas exploration and production, some exporting countries in emerging markets sought USTDA support for constructing LNG export terminals. In the early 2000s, due to abundance and low-price gas supplies, the emerging market natural gas consuming countries considered constructing LNG import terminals thus expanding their natural gas transportation network and allowing for the conversion of power plant and vehicle liquid fuels to natural gas. USTDA's support quickly shifted to follow these global trends, helped project sponsors meet their goals and created export opportunities for U.S. industry.

**Trinidad and Tobago**



**USTDA Support for Launch of LNG Industry Transformed Trinidad and Tobago Economy**

*When the U.S. was seeking out secure, long-term LNG supplies, this feasibility study assessed the viability of an LNG export terminal, enabling Trinidad to become the 8th largest LNG exporter in the world.*

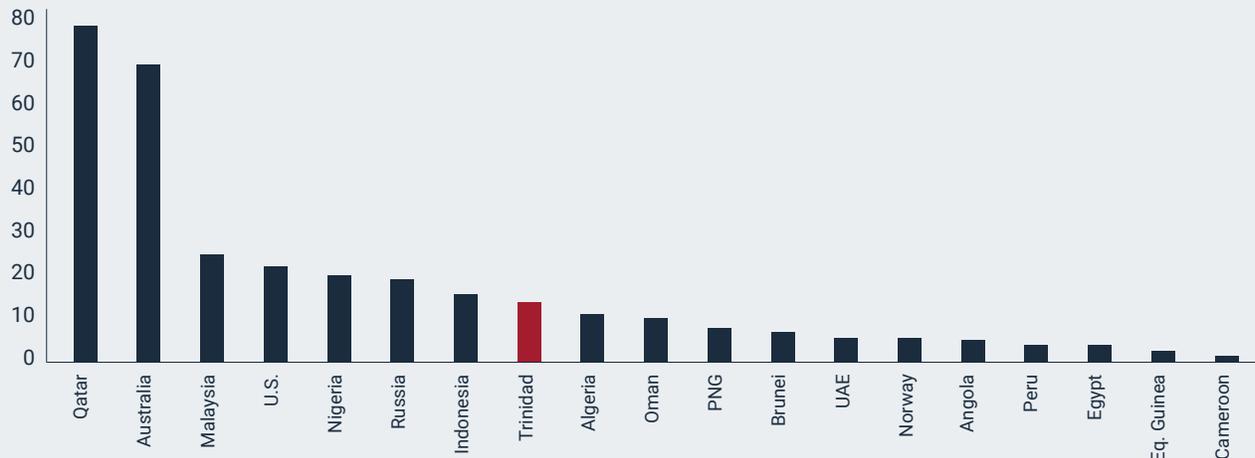
**Trinidad and Tobago LNG Upstream Production & Delivery System Feasibility Study<sup>1</sup>**

In 1991, Cabot LNG Corporation, which had an interest as a developer and investor in Trinidad and Tobago, requested a USTDA feasibility study grant to determine the viability of constructing an LNG export terminal. In the early 1990s, LNG export was limited to a few countries and was not as common as it is today. However, this project is an excellent example of how USTDA helped mitigate early project development financial risk by providing a grant for the project feasibility assessment. This study helped transform Trinidad and Tobago’s energy industry. In 1995, Cabot Corporation, the National Gas Company of Trinidad and Tobago (NGC), AMOCO, and British Gas formed the Atlantic LNG Company of Trinidad and Tobago (now known as Atlantic LNG) to finance and construct an LNG export terminal. By 2006, four LNG export trains were built with a total LNG production capacity of almost 15 million metric tonnes per annum (MTPA). Atlantic LNG expanded this facility during a second wave of the industry’s expansion in the 1990s with the goal of supplying North and South America. In March 2019, it exported the 4000th cargo of LNG.<sup>2</sup>

The 1991 feasibility study grant helped propel Trinidad and Tobago to become the eighth-largest LNG exporter in the world, accounting for about 4% of global LNG exports in 2018. The Atlantic LNG projects provided significant U.S. exports. In 2018, Atlantic LNG contributions to the local economy included \$251 million in local taxes and \$115 spending on local suppliers.<sup>3</sup>

**Trinidad is the World’s 8th Largest LNG Exporter**

2018 LNG EXPORTS - MILLION TONNES



Data Source: 2019 World LNG Report, International Gas Union

## Panama



### Feasibility Study Paves the Way for a Brighter, Cleaner Future for the Panama Canal

*This feasibility study supports the launch of a public tender for an LNG import terminal as Panama seeks to take advantage of increasing global LNG supplies.*

#### Panama Canal LNG Terminal and Power Generation, Panama<sup>4</sup>

The completion of the Panama Canal expansion in 2016 enabled more than 80% of the global LNG carriers to pass through the canal. USTDA, at the request of the Panama Canal Authority, Autoridad del Canal de Panamá (ACP), funded a feasibility study in 2015 to assess the viability of constructing an LNG import terminal. The feasibility study focused on developing an LNG terminal located at the canal and the use of LNG for power generation as fuel for the marine vessels (including tugboats and dredges) transiting it.

This study's report was issued in July 2017, and ACP recently announced plans for an international public tender to implement the LNG terminal project through a concession. ACP also has plans for building gas-fired power plants at the canal. When implemented, these projects could provide for economic development and improved air quality in Panama and substantial export potential for U.S. goods and services.





## Introduction of U.S. Technology Enables Thailand's Public Transportation System to Convert to Abundant Clean Natural Gas

*This feasibility study to support natural gas infrastructure ensures that almost every taxi runs on natural gas while enabling Thailand to capitalize on increasing natural gas production in the region.*

### Thailand Natural Gas Vehicle Infrastructure Feasibility Study<sup>5</sup>

Thailand embraced a low-carbon economy model as part of its sustainable development policies starting in 2002. One of the options for reducing carbon emissions was to promote the conversion of diesel-fueled vehicles to compressed natural gas (CNG) or LNG.

In 2002, USTDA approved a feasibility study grant for Thailand's state-owned oil and gas company, PTT Public Company Limited (PTT), to examine the required infrastructure, distribution networks, and equipment needs for CNG and LNG-powered vehicles. Many of the study's recommendations have since been implemented, and PTT procured U.S.-manufactured equipment, such as refueling systems, new vehicles, and vehicle fuel-conversion technologies. PTT continues to pursue CNG and LNG implementation projects.

As a result of this USTDA-supported initiative, almost every taxi in Thailand today runs on natural gas instead of diesel or gasoline. In 2018, Thailand was ranked among the top-10 countries in the world in terms of the number of Natural Gas Vehicles (NGV's) and refueling stations in a country.<sup>6</sup>





## USTDA Introduces U.S. Gas Trading Market Technologies to Advance Turkey's Role as an Energy Hub

*The reverse trade mission helped Turkish officials to better understand how an energy hub is set up and managed by introducing them to the most advanced gas transportation and trading market in the world.*

### Turkey Energy Hub Development Reverse Trade Mission<sup>7</sup>

Turkey became an important transit center for natural gas exports to Europe as pipelines were constructed to transport gas from the Caspian Sea region countries, Russia, and the Middle East to Europe. As Turkey's natural gas network expanded, the Ministry of Energy and other Turkish stakeholders became interested in establishing an energy hub to manage transactions. USTDA sponsored an reverse trade mission in April 2007 to bring together U.S. energy experts and Turkish Government officials to exchange ideas, with a focus on policy and technology transfer, for Turkey to manage and operate a natural gas hub. The delegation visited the Henry Hub, the delivery point for the New York Mercantile Exchange (NYMEX) natural gas future contracts, and the natural gas pipeline distribution network in Erath, Louisiana.

The reverse trade mission provided visiting Turkish officials with an understanding of how Henry Hub was set up and how its natural gas spot pricing works and also introduced U.S. companies to new project opportunities.





## USTDA Advances Gas Pipeline Infrastructure in Eastern Europe

*The U.S. natural gas pipeline network is a highly integrated network that moves natural gas throughout the continental United States, with 3 million miles of pipelines. This USTDA-funded feasibility study jump-starts two natural gas pipeline projects in Eastern Europe using U.S. technology and best practices.*

### Feasibility Study - Bulgaria-Romania-Hungary-Austria (BRUA) Connector & Tuzla-Podisor Pipeline Projects<sup>8</sup>

In 2015, at the request of Transgaz, the operator for the Romanian national gas transmission system, USTDA provided grant funding for a feasibility study to confirm the technical and economic viability of two pipeline projects. The study showed that the projects were technically and economically feasible.

The first project is the Bulgaria-Romania-Hungary-Austria (BRUA) Connector, a 479-km (about 298 miles) natural gas pipeline connecting Bulgaria to Austria via Romania and Hungary. The BRUA pipeline, to be complete in 2020, will connect eastern and central Europe to gas supply sources in the Caspian Sea and the Black Sea basins.

The second project, Tuzla-Podisor gas pipeline, is a 308-km (about 191 miles) long pipeline connecting gas fields in Romania's Black Sea to the Bulgaria-Romania-Hungary-Austria (BRUA) network. The Tuzla-Podisor pipeline will ensure Romania's offshore natural gas transport to Hungary and Bulgaria, as it is the missing link between offshore facilities and the BRUA pipeline. Romania has received financing for this pipeline from the European Bank for Reconstruction and Development (EBRD) and European Investment Bank (EIB), and the pipeline's design and construction work began in 2019.





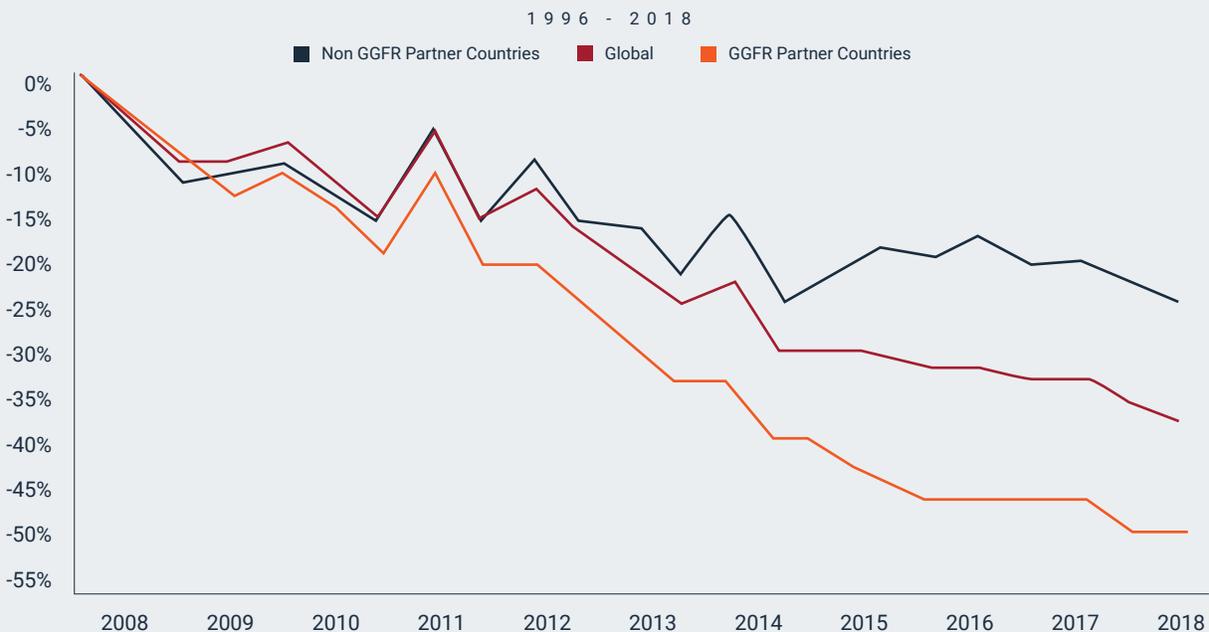
### USTDA Brings Clean Energy Best Practices to Reduce Gas Flaring in Nigeria

Over the last 20 years, although the production of oil grew by roughly 30%, the amount of associated gas flared decreased by 15%.<sup>9</sup> This USTDA study introduced the international best practices learned over this period for recovering and converting flare gas to CNG to support Nigeria’s initiative to increase natural gas use.

#### Flare Gas Recovery for Industry and Natural Gas Vehicle Use, Nigeria<sup>10</sup>

Nigeria’s 2017 Economic Recovery and Growth Plan includes a strategy to diversify its energy mix by reducing crude oil use and increasing the use of natural gas. The Ministry of Petroleum Resources identified the monetization of flare gas as a viable option to achieve the national energy objectives. Nigeria plans to make natural gas the primary source of energy for domestic use and to accelerate gas infrastructure development to support this policy. In support of this initiative, and at the request of the Ministry of Petroleum Resources, USTDA provided a grant to partially fund a feasibility study to evaluate the technical and economic viability of recovering and converting flare gas to CNG in late 2018. The project includes the development of several gas-transportation hubs and a virtual pipeline network for transporting CNG to end-users in the Niger Delta region. The study also includes a pilot hub to demonstrate the viability of transporting CNG to end users via a virtual pipeline in Nigeria.

#### Change in Global Gas Flaring Intensity from 1996



Source: World Bank Global Gas Flaring Reduction Partnership (GGFR); <http://pubdocs.worldbank.org/en/341191560185819266/pdf/Percent-change-flaring-intensity-from-1996-GGFR-partner-non-GGFR-partner.pdf>

# Case Studies

## Spotlight on Lithuania and Thailand: Using USTDA Funds to Minimize Initial Project Development Risk

The following two case studies below demonstrate how USTDA minimized initial project development risks and enabled project implementation. The first case study shows how USTDA helped Lithuania and other Baltic region countries mitigate risk to their economic growth by providing a feasibility study grant that helped them diversify their energy sources and enhance their energy security. The second case study demonstrates how USTDA developed a long-term partnership with the Government of Thailand to support the country's transformation to a clean energy-driven economy.

# Case Study: Lithuania LNG Import Terminal

Over the past several years, LNG has provided a flexible option for transporting gas from suppliers to consumers across the globe. It has become a vital component of a secure, global energy future for many countries, especially those with emerging economies. LNG has enabled gas to be traded as a true commodity, eliminating inflexible, long-term contracts, and prices that are artificially linked to oil prices. By encouraging LNG project development, USTDA has helped foster a world market for natural gas.

Importing LNG would end Lithuania's reliance on a sole source of imported gas, provide for its energy security, and develop a regional gas market. To support Lithuania's energy security strategy and promote U.S. firms in the LNG business sector, USTDA provided a feasibility study grant to Lithuania's Ministry of Energy in 2009. The study developed demand projections for natural gas in Lithuania and its neighboring countries and assessed potential terminal capacity, sites, and capital and operating costs, providing the Ministry of Energy the required information for decision making. Lithuania's Ministry of Energy's decision to build the import terminal at Klaipėda helped generate significant U.S. exports, including U.S.-sourced LNG.

In 2014, the Klaipėda LNG Terminal began commercial operation, allowing Lithuania to renegotiate its natural gas supply contract with Gazprom — resulting in substantial economic benefits for the country. The Klaipėda terminal

has also created a new market for U.S.-sourced natural gas.

The LNG terminal in Lithuania is one of the most important facilities in securing Lithuania's national energy independence. The terminal enabled a natural gas market to form in Lithuania and the Baltic states.

The LNG import in 2014 was Lithuania's first non-Russian natural gas supply, and the Klaipėda import terminal has the capacity to meet all of Lithuania's natural gas demand, diminishing Gazprom's monopoly in Lithuania's natural gas market. In 2018, Amber Grid of Lithuania and Gaz-System of Poland signed an agreement<sup>11</sup> to invest in Gas Interconnection Poland-Lithuania (GIPL), also known as the Lithuania–Poland pipeline. This pipeline will transport gas to the Baltic countries and Poland, potentially creating a new market for U.S. LNG exports.

## Project Background<sup>12</sup>

Prior to 2009, Lithuania, one of the Baltic states in Eastern Europe, had only two primary sources of energy supply: Russian natural gas by pipeline and the Ignalina nuclear plant. Until 2009, Ignalina met a third of Lithuania's energy needs and 70% of its electrical power needs. However, as part of its accession agreement with the European Union, Lithuania had to decommission the Ignalina nuclear plant in 2009, which required Lithuania to import electricity to meet its demand.





The National Energy Strategy of 2007, which extends through 2025, identified importing LNG as a strategic solution to the country's energy shortage. Diversification of its imported energy resources became Lithuania's key energy strategy.

In 2009, the Lithuania Ministry of Energy requested, and was granted, a USTDA-funded feasibility study to develop the LNG terminal project scope and assess its viability. The scope of the feasibility study considered demand scenarios and determined the LNG terminal's required capacity, the technology options, the terminal locations, and the terminal's capital and operating costs. The study<sup>13</sup> was completed in March 2011.

Following the completion of the feasibility study, the Government of Lithuania decided to develop an LNG import terminal. Importing LNG was seen as the only way to guarantee the security of Lithuania's gas supply by having access to global LNG supplies and pricing.

### **USTDA Study Findings**

The energy demand of any country depends on its economy's growth forecast. The feasibility study developed several scenarios of economic growth and, based on historical energy demand, econometric models were used to establish a natural gas demand forecast for 2011 through 2025. This energy demand forecast was used to determine the LNG import terminal's capacity.

#### *Terminal Capacity*

Given Lithuania and the Baltic region's natural gas demand projections, the study considered four LNG import capacities ranging from 1 billion cubic meter per annum (BCMA), which is about 30% of Lithuania's demand, to 10 BCMA, which would provide for 100% of the Baltic states' demand and provide some LNG for import to Europe.

#### *Terminal Technology*

LNG import terminals receive LNG in liquid form, which is then stored and, when required,

converted into gas and sent through a pipeline to consumers. All LNG import terminals are similar in design and include tanker berthing, unloading facilities, storage tanks, a regasification system, and delivery infrastructure.

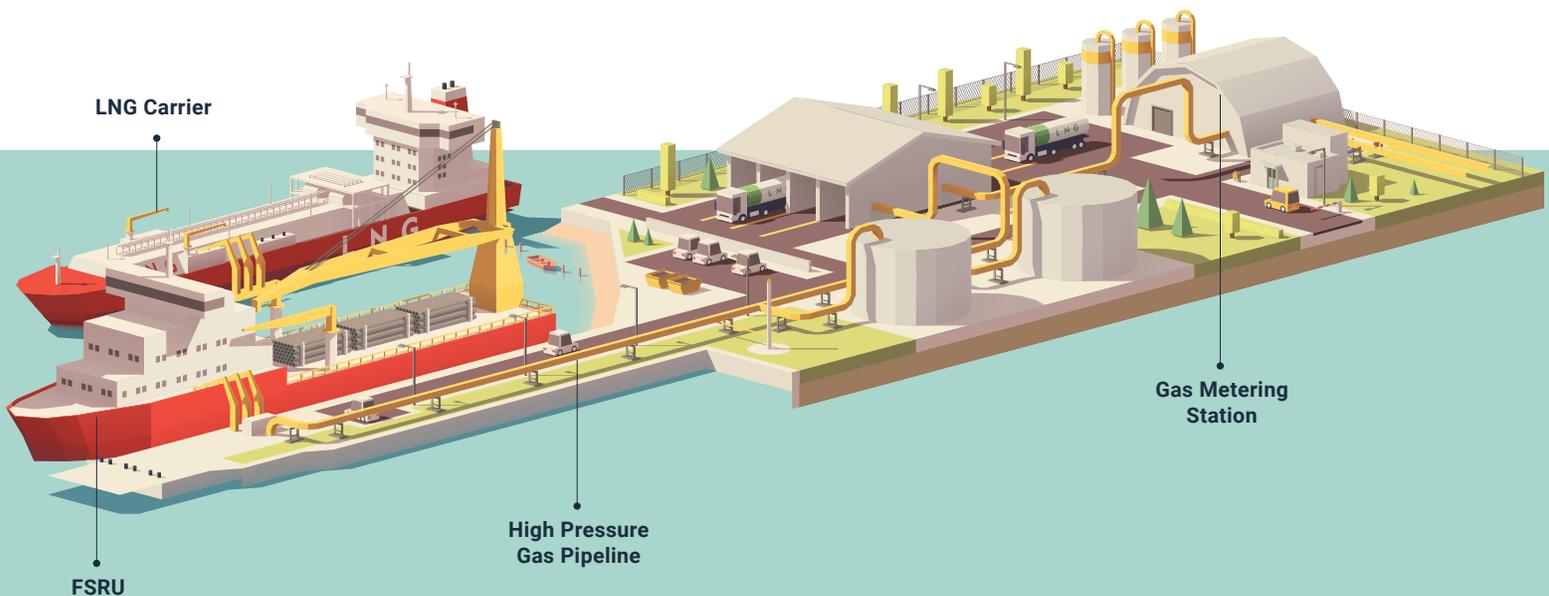
Although shore-based terminals form the majority of the world's LNG import capacity, the contractor recommended an offshore terminal for Lithuania due to safety and economics. The offshore terminal consists of a Floating Storage and Regasification Unit (FSRU), a 290-meters long, permanently-moored, double-hulled vessel that is designed and fabricated using conventional shipbuilding practices. Cost, delivery speed, and flexibility are the main advantages of FSRUs.

### *Terminal Cost Estimates*

The study developed capital and operating cost estimates for several options based on terminal capacity, terminal sites, and terminal technology type (i.e., onshore and FSRU).

To adequately compare LNG terminal technology and site options, the study analyzed capital and operating costs and compared these costs over the life of the project, including estimated annual debt payments and required investor returns. The analysis showed that the conventional terminals had a higher capital cost but lower annual operating expenses, whereas the FSRU had lower capital cost but higher operating costs.

## LNG Receiving, Unloading, Storage, and Regasification Arrangement



### Terminal Location

Two locations were considered for the terminal in Lithuania: Klaipėda State Seaport and Būtingė terminal area. Klaipėda Seaport is located in the southernmost region of the Lithuanian coast, while the Būtingė terminal area is in the northern part of Lithuania. The study identified five options: three in the Port of Klaipėda area and two near Būtingė. In February 2010, a Lithuania LNG Committee, headed by the Lithuanian Ministry of Energy, selected two of the onshore options in Klaipėda for further evaluation.

Key conclusions from these studies were:

- An LNG import terminal in Lithuania would be viable and would also benefit the other Baltic states
- An LNG import terminal at the jetty provided better security for the LNG carrier than an import terminal

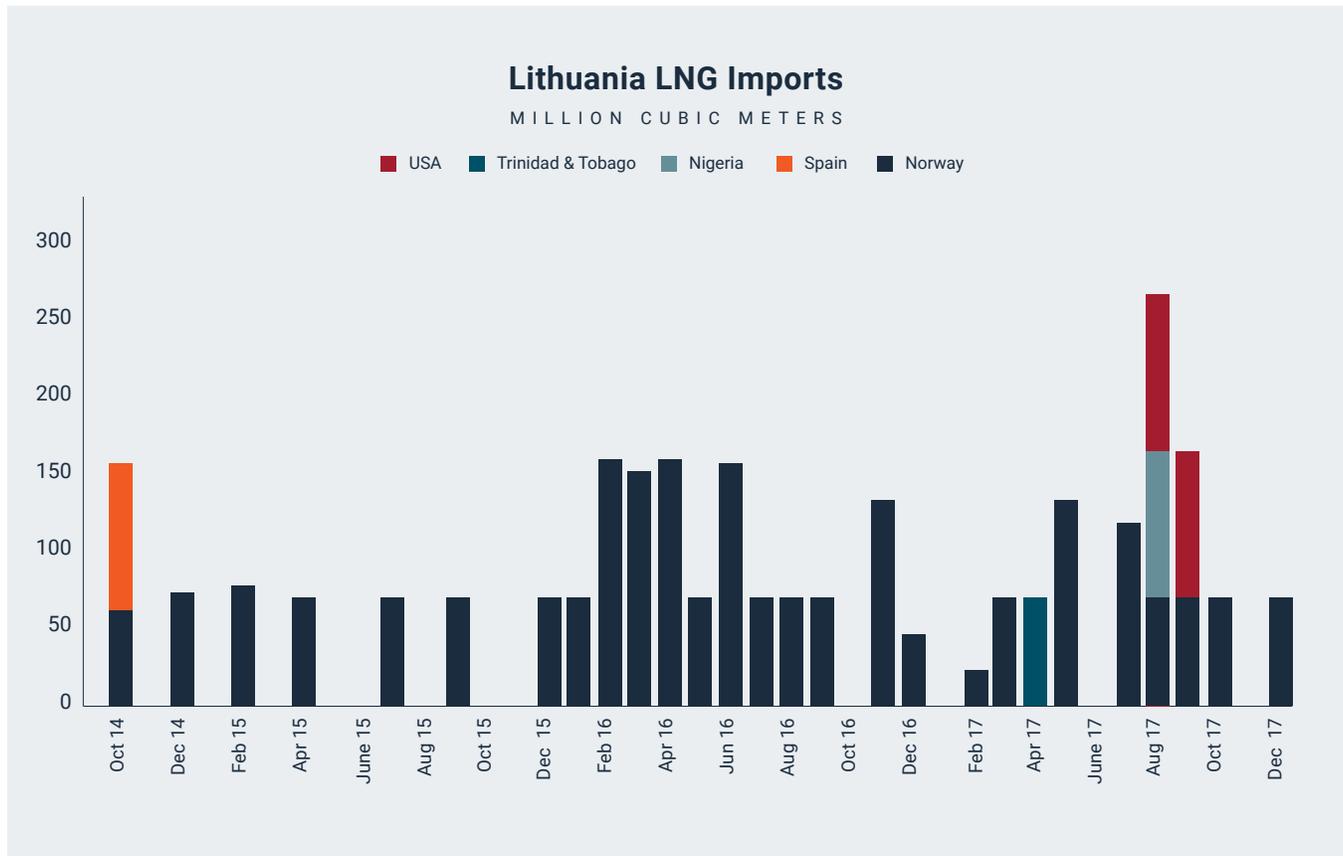
- Importing LNG could raise the natural gas price in Lithuania by 3%
- Lack of an alternative gas supply source would adversely impact the economy in case of a disruption in gas supply from Russia

### Outcomes

Upon the study's completion, Lithuania proceeded to implement an offshore LNG import terminal at Klaipėda using an FSRU named *Independence*.

The FSRU, moored to a berth in the Klaipėda Seaport, receives LNG from the LNG carriers, stores it, re-gasifies it, and transports the gas through an 18 km pipeline to the on-land gas distribution system.<sup>14</sup>

The terminal, commissioned in 2014, is operated by Klaipėdos Nafta (KN). Lithuania has imported

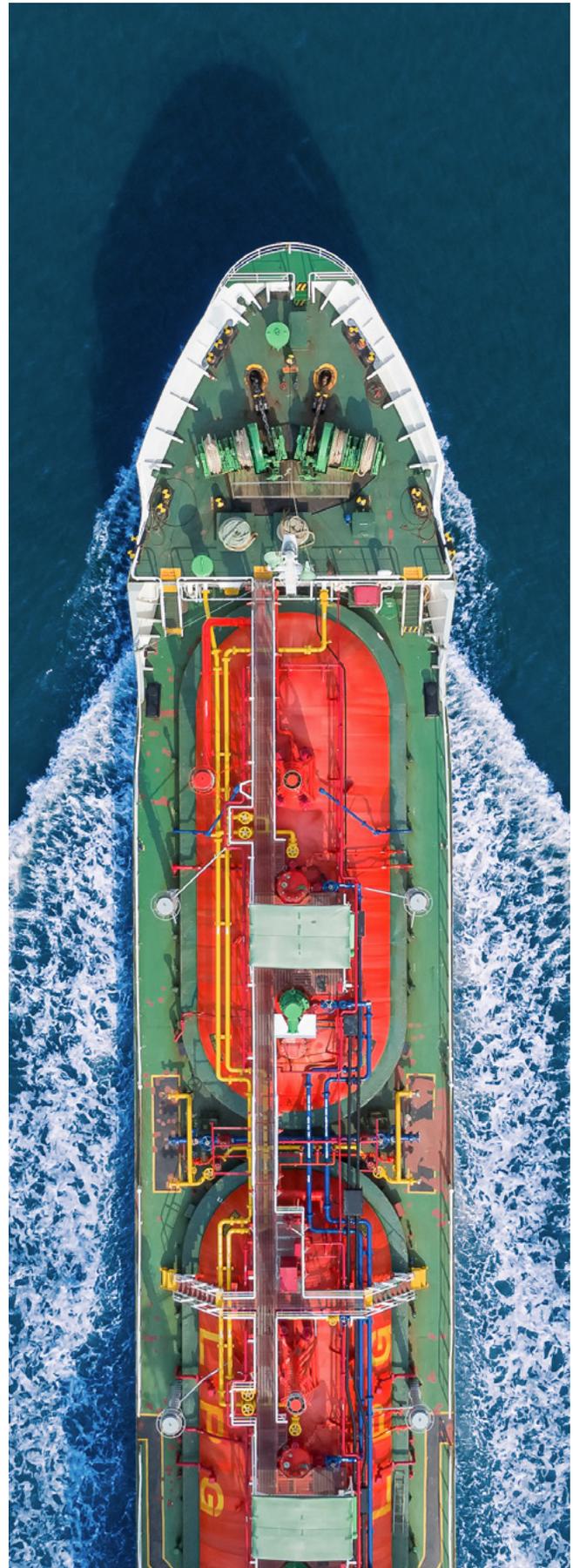


Source: Pöyry, April 2018

most of its LNG from Norway, although, it began importing some LNG from the U.S. in 2017.<sup>14</sup>

By coordinating with the U.S. Embassies in the Baltic states and in-country U.S. Government agencies, such as the Department of State and the Department of Commerce, USTDA gained insight into Lithuania and the other Baltic countries' energy security status. This coordination enabled it to make the right decision at the right time and to help develop the study's scope.

Although the project sponsor's initial request was focused on meeting Lithuania's energy needs, USTDA worked with the project sponsor to broaden the study's scope to include assessing gas demand in the Baltic states and Europe. By doing so, we were able to consider various options for supplying gas to Lithuania and other Baltic countries; this helped the project sponsor mitigate the project risk of relying on a single LNG off-taker, thereby making it easier for the project to secure financing.



# Case Study: Natural Gas Development in Thailand

USTDA's long-term partnerships with host governments help these governments achieve their energy security and development goals by providing project preparation grant funding for a diverse array of natural gas projects at the early stages of development.

Since the mid-1980s, USTDA has supported Thailand in finding efficient ways to use natural gas. This support extended to include cleaner and more efficient power generation, improving the country's gas transportation networks, developing infrastructure for natural gas vehicles, and developing an LNG import terminal to meet Thailand's growing gas demand.

Although each of these USTDA-supported projects differed in scope and were evaluated for grant funding based on their merit, together, they helped Thailand manage its natural gas resources for economic growth and a better environment.

Between 1971 and 1982, the price of oil in Thailand increased tenfold (from 0.40 in Thai baht per liter to four Thai baht per liter). This price increase significantly affected electricity generation because it accounted for 70% of the country's oil demand. In response, under the direction of the Government of Thailand, the National Energy Policy Council developed a plan aimed at reducing oil consumption in the power sector. Around the same time, natural gas was discovered in the Gulf of Thailand and, later, onshore.

However, Thailand's economy continued to expand, requiring the construction of more power plants to meet the country's increased electricity demand. Recognizing a unique opportunity to assist Thailand, and responding to market demand, USTDA provided grant funding for several project activities there between 1987 and 1999. These projects included fuel conversion from oil to natural gas at some of the existing plants and constructing new, more efficient, and environmentally cleaner plants using natural gas.

One study<sup>16</sup>, funded in 1987, helped lead to the implementation of a 600 MW gas turbine combined-cycle power plant at Bang Pakong Power Station. This project not only helped Thailand meet its electric power requirements and reduce air pollution but also led to the export of U.S. - manufactured power generation equipment and related services.

Natural gas consumption has continued to increase in Thailand, and it is becoming the predominant fuel source for power generation.<sup>17</sup> In 1989, USTDA also granted feasibility study funding to PTT, which selected Fluor-Daniel, a U.S. firm, to develop a plan for expanding Thailand's gas transmission system, identifying high-priority projects, and assessing those projects' feasibility.<sup>18</sup>

This study successfully laid the foundation for Thailand's energy security. PTT implemented two pipeline projects as a result of this USTDA-



funded study. The Bongkot-Erawan-Khanom Pipeline was placed in operation in 1994, and the second pipeline, named Natural Gas Pipeline, began operating in 1996. These projects provided natural gas access to end-users and encouraged power plants to switch fuel from oil to natural gas.

In 1999, USTDA also provided grant funding to the Electricity Generating Authority of Thailand (EGAT) for a study to convert and upgrade a 238 MW oil-fired plant at North Bangkok to a 700 MW gas-fired plant using the latest technology.<sup>19</sup> However, a plant life assessment analysis concluded that upgrading and extending the life of the existing plant was not economical and recommended building a new plant. As a result, EGAT built a new gas-fired power plant, saving limited resources in the long-term.

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### Map Ta Phut LNG Import Terminal

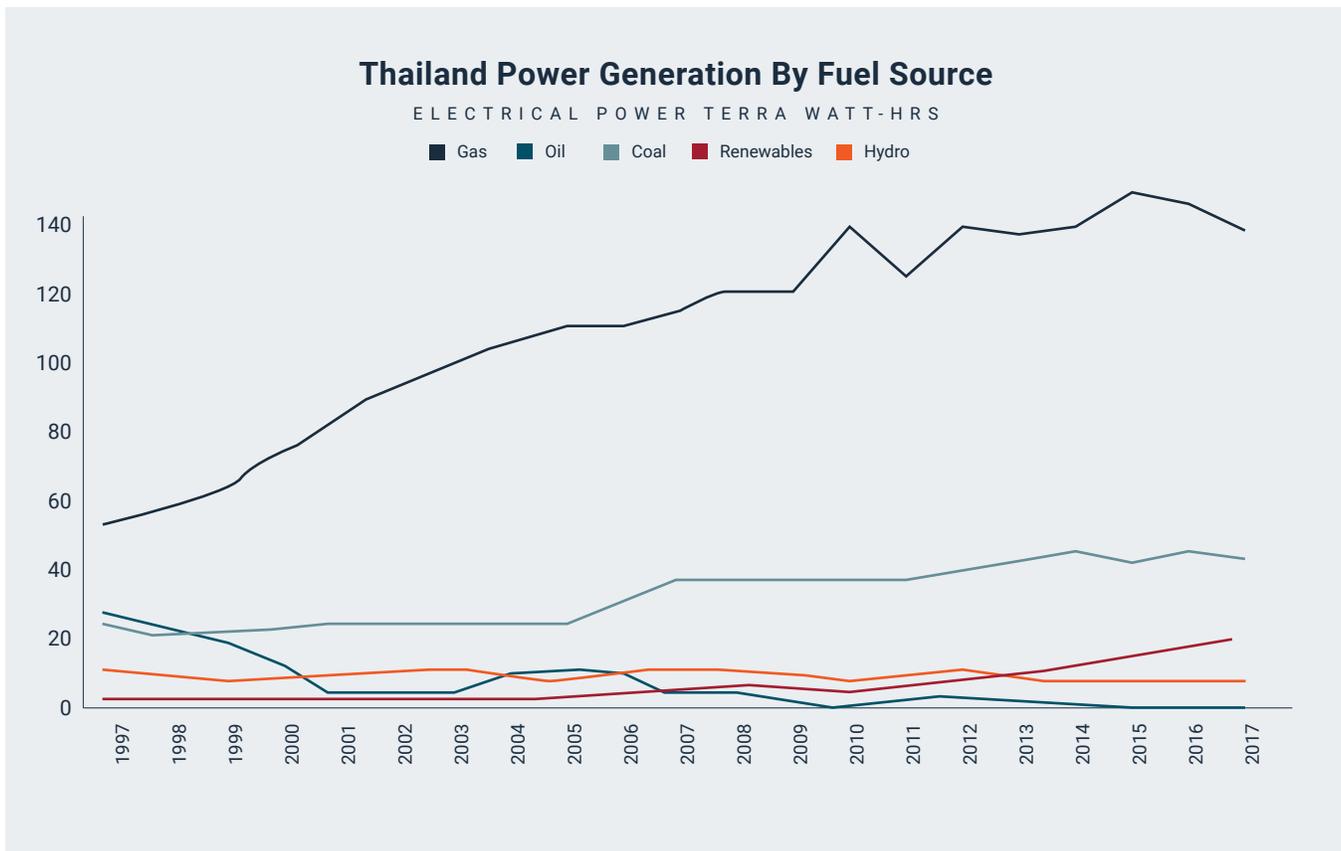
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Another significant project implemented in Thailand with support from USTDA is the 5 MTPA LNG Import Terminal at Map Ta Phut.<sup>20</sup> This project was implemented by PTT at the cost of \$880 million<sup>21</sup> and began commercial operation in June 2011. The 5 MTPA LNG Import Terminal helped Thailand meet its demand for natural gas as domestic production began to decline. PPT has since built a second LNG terminal in the eastern province of Rayong. The Map Ta Phut terminal implementation also resulted in significant U.S. exports, benefiting many U.S. companies in many states.

### Project Background

Thailand's natural gas consumption began to outpace domestic production in 1999, and the country started importing natural gas from





Data Source: BP Statistical Review of World Energy, 2019

neighboring Burma (Myanmar) via pipeline. Consumption was primarily driven by an increase in natural gas demand for electric power generation.

While gas consumption increased, domestic supply and imports via pipeline started to decline, creating an urgent need to locate other natural gas sources to ensure energy security. The worldwide increase in the LNG supply presented an opportunity for Thailand to consider LNG imports.

In support of this opportunity, and at the request of PTT, USTDA provided feasibility grant funding to PTT in 2005.

The scope of this study was to evaluate the technical, environmental, and economic feasibility of an LNG-receiving terminal in Thailand.

### USTDA Study Findings

Several parameters, such as capacity, location, and technology are required to prepare the design parameters for an LNG terminal. Among these, the size or capacity is the most important as it affects all the others. Determining the terminal size requires a clear understanding of the project sponsor's objectives. For Thailand, the increase in natural gas demand and the decline of local gas supply, determining the terminal size required a good basis for forecasting the future power demand, the status of Thailand's producing gas fields, and the natural gas import potential via pipelines from the regional exporters.

The study provided all the required information, which included the projected natural gas demand, providing PPT and other project stake



holders what they needed for decision making and implementation.

### *Gas Market Assessment*

EGAT (the primary electricity company in the country), PTT (the state-owned oil and gas company), and EPPO (Thailand's Energy Policy and Planning Office) provided the natural gas supply and demand data used for the study. A review of the data allowed the study's contractor and the project's sponsor to conclude that gas demand would exceed supply starting in 2010. To alleviate this shortfall, the study's contractor concluded and recommended that an import terminal for LNG should be in operation by 2010 to 2011.

### *Technology Selection*

The major components of an LNG import facility include the LNG berthing and transfer system, storage, and the vaporization process. The key factors in selecting the technology are safety, environmental impact, costs, and reliability. Deciding to locate the terminal facilities onshore or off-shore is a major decision. The study's contractor addressed all these issues and recommended an off-shore, floating LNG storage and regasification technology due to its proven safety, environmental impact, and life cycle cost considerations.

### *Site Selection*

The Map Ta Phut Industrial Port is located in the Gulf of Thailand, about 220 km (137 miles) from Bangkok. It is an enclosed harbor constructed on reclaimed land. The study considered three locations: two in Map Ta Phut Industrial Port and the third in Rayong, some 30 km (18.6 miles) east of Map Ta Phut Industrial Port.

Based on qualitative analysis, and using parameters such as safety, cost, proximity to population and end-users, and expandability and constructability, the study recommended the Map Ta Phut Industrial Port site in the northern half of the reclaimed land. Discussions with port authorities confirmed the port would be able to manage the LNG carrier traffic safely.

### *Outcomes*

The study recommended a shore-based terminal at Map Ta Phut Industrial Port with an initial capacity of 5 MTPA of LNG expandable to 10 MTPA. The expanded terminal would require three, 140,000 cubic meter LNG storage tanks and a single berth capable of loading at 5,000 cubic meters per hour from LNG carriers ranging from 125,000 to 264,000 cubic meters in size.

These parameters were used to develop the project's detailed design and scope of work. The project was completed in 2010 at the cost of \$880 million.

The project helped Thailand meet its demand for natural gas and electric power, benefit from the development of new natural gas infrastructure and technology transfer, and build human resources and skills. Additionally, the project created export opportunities for at least 22 U.S. companies in 13 states. The U.S. exports provided engineering services and material and

equipment, such as insulation, safety valves, cryogenics pumps, lighting fixtures, junction boxes, flame and gas detectors, process monitoring and control systems, leak detection systems, fire and security equipment, emergency rescue equipment, seawater chlorination packages, and emergency generators.

Due to continuing gas demand, PTT LNG Company Limited, a wholly-owned subsidiary of PTT, increased the regasification capacity at Map Ta Phut from 10 MTPA to 11.5 MTPA in 2018. The Thai Government has also approved a second 5 MTPA LNG import terminal in Rayong

province, which is expected to be ready for commercial operation by 2022.

The successful implementation of this and other USTDA-supported projects in Thailand are attributed to:

- Close alignment of USTDA grant objectives with those of the Thai Government
- Early engagement and the cooperation of all the stakeholders, including EGAT, PTT, EPPO, Map Ta Phut Industrial Port authorities, and others, with a common objective – to implement the project

## USTDA's Value Proposition

The early stages of the natural gas development cycle are made of many components and may not be fully understood. USTDA helps project sponsors better understand project scope, objective, and risk. USTDA assists in better defining and derisking their projects while providing opportunities for U.S. natural gas businesses through its proven preparation tools. At the project conception and preliminary design phase, USTDA provides the platform to achieve project objectives through feasibility studies, technical assistance, technical symposiums, and reverse trade missions. These tools introduce U.S. natural gas industry players to host country decision-makers at a time when key decisions have not yet been made. The project owners gain a better understanding of the latest industry trends, technology options, and best industry practices that they should consider for their projects.

As demand increases for natural gas and LNG over the next two decades, USTDA is well-positioned to help both U.S. natural gas industry players, as well as overseas project sponsors, derisk their projects. USTDA also helps develop the information required by the various project stakeholders: project sponsors, equity and debt financiers, regulatory and permitting agencies, and others. USTDA's project preparation tools support natural gas projects including, exploration, unconventional gas production and utilization, LNG import/export terminals, developing natural gas transportation networks, and gas-to-power transportation. At the project conception and preliminary design phase, USTDA's project preparation tools also assist sector master plan development, market assessment, and development of policy, pricing, or regulatory frameworks for natural gas and LNG-funded studies. USTDA's objective in supporting projects at this early stage of development is to assist project sponsors in developing the required documentation and the business and regulatory frameworks that make projects bankable.

# PROJECT FINANCING

**Project financing activities for natural gas are typically associated with natural gas infrastructure projects that have advanced past the project conception and preliminary design phase. However, these projects still require due diligence in order to derisk investment and secure financing for construction and subsequent operation. USTDA provides project preparation funding for due diligence activities to support natural gas projects in the finance phase of project development.**

USTDA assists host countries and asset owners, developers, and operators to derisk the investment potential of developing natural gas infrastructure, natural gas-to-power, and LNG projects. USTDA accomplishes this by providing grant funding to conduct critical technical, legal, commercial, and financial due diligence studies and corresponding advisory services to the stakeholders.

The host country benefits include:

- Infrastructure development
  - Increased gas exploration and production facilities
  - Improved gas transportation and/or storage systems
  - Improved power delivery and continuity of service
- Economic development
- Transfer of skills and know-how
- More effective markets and sector governance
  - Adoption of new laws and/or regulations that support effective governance
  - Adoption of international best practices in energy infrastructure design, construction, and operation
  - Development of safer or more secure energy infrastructure control systems and operations
  - Improved investment climate



Over the last 40 years, projects that received USTDA support at the project financing phase and were successfully implemented generated over \$400\* million in exports of U.S. goods and services.

The number of USTDA activities supporting project financing is substantially lower than the number of USTDA activities supporting project conception and preliminary design. Most project developers or sponsors anticipate the project financing requirements and develop the required information with feasibility studies during the project conception and preliminary design phase of the project's development and implementation.

However, due to some projects' complexity, such as project ownership changes, a lack of transparent regulatory environment, perceptions of critical project risks, or a lack of adequate funding for project preparation, some projects may require additional support at the project financing phase.

USTDA supported project financing primarily by

providing funding for 21 feasibility studies, and 18 technical assistance grants. Gas exploration and production accounted for the majority of USTDA activities (23 activities). The demand for USTDA support in project financing was most significant in USTDA's Middle East, North Africa, Europe, and Eurasia region (27, or 50%, of USTDA-funded activities).

In this phase of project development, feasibility studies generated the highest volume of U.S. exports. However, feasibility studies ranked third in the exports to investment ratio and had the lowest project implementation rate. Technical assistance activities did not result in any project implementation. Coalbed and coal mine methane projects generated the highest U.S. export volume and had the highest exports to the USTDA investment ratio and second-highest implementation rate. Across the regions, the Indo-Pacific region's projects generated the highest amount of exports and had the second-highest exports to USTDA investment and project implementation ranking.

### USTDA's Natural Gas Activities in the Project Financing Phase



**54 Activities Funded**

**Over \$400 Million of U.S. Exports Generated**

\*Unadjusted for inflation.

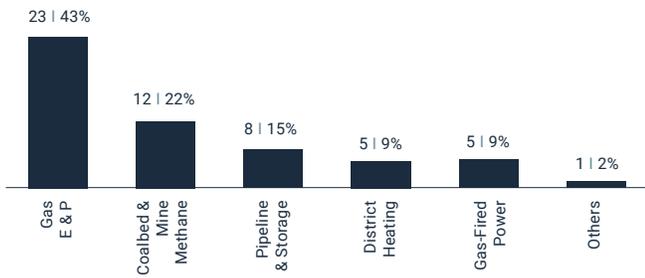
## USTDA Activities

1981 - 2018

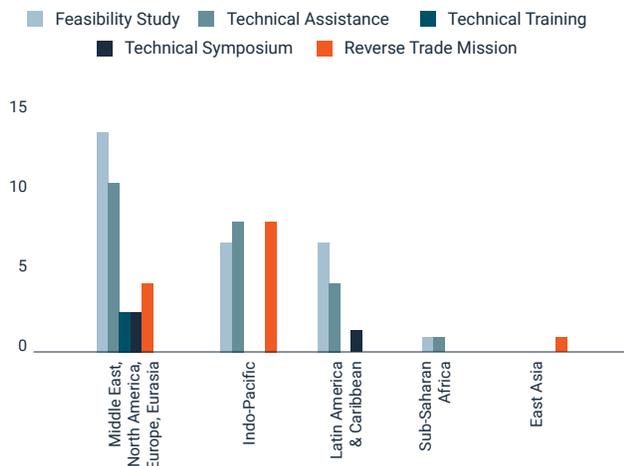
### Project Financing



### Subsectors



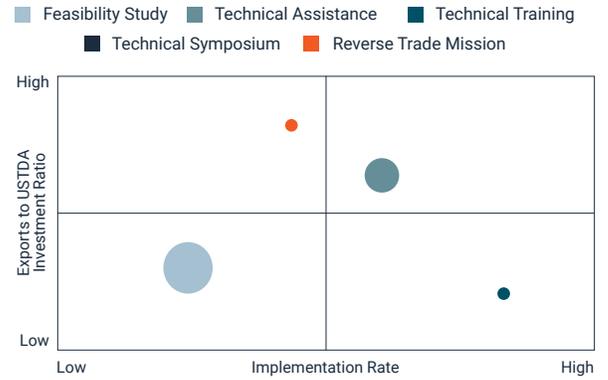
### Regions



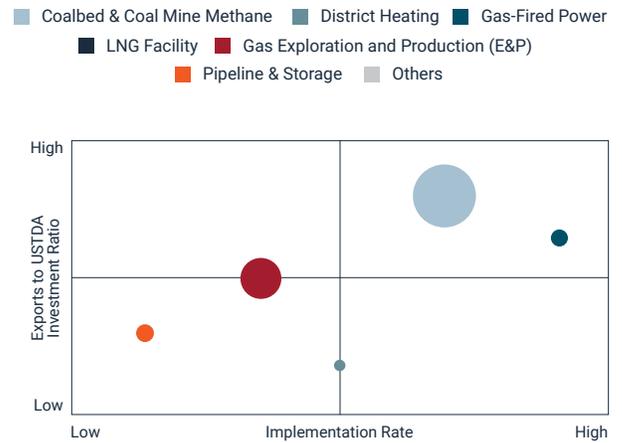
## USTDA Success Metrics

CIRCLES INDICATE RELATIVE EXPORTS VOLUME

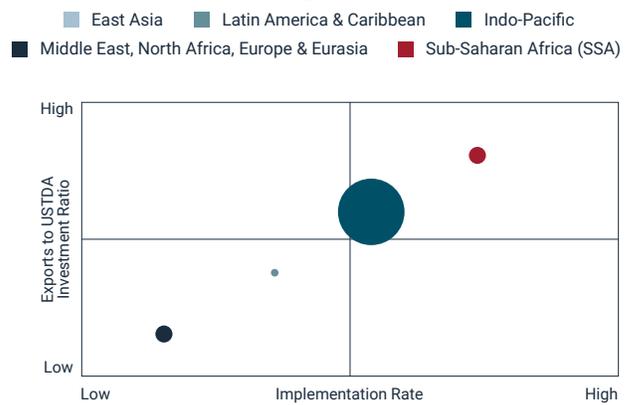
### Activities



### Subsectors



### Regions



# Projects Overview: USTDA Derisks Projects in the Project Finance Phase

Projects in the project finance phase need due diligence reviews to provide stakeholders with information for investment decision making. USTDA-supported projects at the project finance phase are diverse and include gas-fired power plants, natural gas pipeline and storage facilities, LNG terminals, natural gas exploration and production, and unconventional gas resource development and utilization.

Project financing activities and studies are to provide investors, developers, owners, and operators of infrastructure assets:

- As much assurance as reasonably possible that risks to financial and economic returns are mitigated or minimized
- Affirmation that project risks are assigned to the project stakeholders best equipped to handle them

These activities are particularly vital for natural gas infrastructure assets due to their complexity and large capital requirements. It is common in project finance for a comprehensive project due-diligence process to include many overlapping activities. For example, a resource production due-diligence assessment may include the review and assessment of resource adequacy, site control documents, regulatory permitting, end-use market analysis, commercial contracting, technical design and costing, project finance, and/or legal structures.

USTDA's support for natural gas projects at the financing phase can broadly be grouped into the following areas:

**Resource Development:** For natural gas exploration and production projects to be successfully financed, geologic assessments, engineering designs, and the economic, financial, legal, environmental, and technical feasibility of producing natural gas resources must be considered. Understanding these issues is necessary to support sound investment decisions associated with midstream or downstream infrastructure projects that depend on an adequate, economically viable upstream resource.

**Site Control Documentation:** Site control documentation support could include site suitability analysis, drafting or review of agreements for land purchase/lease, mineral extraction rights, and, in some cases, providing advice on preparing the documentation necessary for obtaining regulatory authorizations and permits.

**Intergovernmental Arrangements for Cooperation in Cross-Border Energy Infrastructure and Commercial Market Development:** These efforts help ascertain the potential economic feasibility and degree of exposure to country risk for investors, developers,



owners, and operators of interregional (cross-jurisdictional) infrastructure projects (such as gas pipelines and related facilities).

**Natural Gas End Use Market Analysis and Forecasting:** These efforts ensure a long-term market exists for the anticipated products at projected prices.

**Sector and/or Subsector Policy and Regulation Development, Review, and Analysis:** These efforts are undertaken to ensure a predictable, sustainable, and legally viable environment exists or can be developed for the project's development, implementation, and operation.

**Power Purchase Agreements (PPAs) and Interrelated Sale and Purchase Agreements (SPAs) for Natural Gas-Fired Power Plants:** These efforts assure the legal and commercial viability of a gas-fired, power generation asset. Activities may include drafting and negotiating PPAs and SPAs, harmonizing them, and developing mitigating strategies, as much as reasonably possible, against potential challenges (i.e., lack of gas supply, lack of

demand for power, changes in government policy, etc.) over the project life.

**Vendor and Contractor Selections:** These efforts aim to competitively select reputable and experienced equipment suppliers and service providers to ensure efficient, safe, and cost-effective design, construction, and operations of natural gas infrastructure. These selections minimize economic, operational, and legal risks to asset developers, investors, owners, and operators.

**Financial Advisory Services:** These services help project developers and sponsors develop revenue generation models, strategies, and finance structures. They also assist in drafting and negotiating financing and related legal agreements.

Projects supported by USTDA at the project financing phase demonstrate how USTDA responded to market changes in conventional gas exploration, unconventional gas exploration, and supply-source diversification.



### Essar Oil & Gas Exploration & Production Ltd. Coalbed Methane Production (EOGEPL)<sup>1</sup>

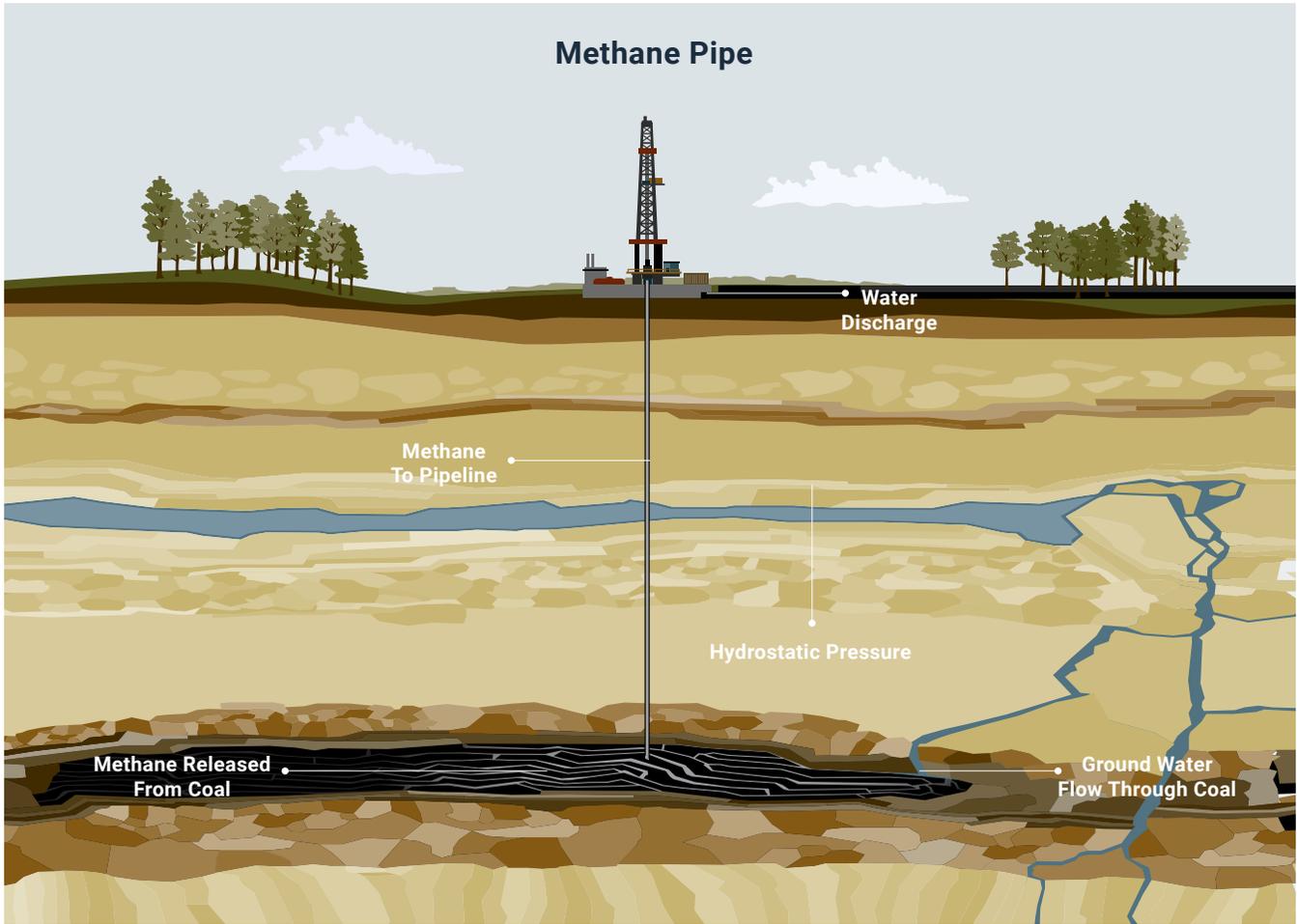
*In the U.S., breakthroughs in hydraulic fracturing technology enabled a surge in coalbed methane (CBM) production beginning in the early 1990s, with over 35 trillion cubic feet (TCF) of CBM produced over the past 25 years.*

In the late 1990s, the Government of India and public and private sector Indian energy companies sought new indigenous resources to fuel the country's rapidly growing economy. Beginning in 2001, USTDA funded several reverse trade missions to introduce Indian Government and private sector stakeholders to the U.S. CBM industry. In 2002, one of the companies participating in those reverse trade missions, Essar Oil Limited (predecessor to Essar Oil & Gas Exploration & Production Ltd., EOGEPL, or Essar), requested and was awarded a feasibility study grant to demonstrate the technical and economic viability of CBM commercial development production in the Mehsana coal mine area (in North Gujarat, India). The study, including a preliminary resource assessment critical to secure financing, was completed in 2004, and Essar began drilling production wells based on the study's recommendation. This study exposed Essar to CBM exploration and production methods for the first time. Now, Essar is the leading producer of CBM in India.<sup>2</sup>

Essar has since invested in additional CBM operations. As of 2018, Essar operates over 300 producing wells in Mehsana and Raniganj East, a major coal mine area in East Bengal. Essar plans to invest in CBM production and drill additional wells in these coal fields.

Due to USTDA-funded reverse trade missions and exposing the Indian industry to CBM capture technology, other coal mine operators have also considered CBM capture and utilization, including Reliance Industries, Limited. Reliance has also become a major CBM producer in India.

The Essar project implementation resulted in substantial U.S. exports of goods and services including, drilling equipment and engineering services. Additionally, Essar and India benefited from increased rates of gas production, new infrastructure development, technology transfer, and new skill and know-how development. The Mehsana coal mine is reported to have 0.5 Tcf of recoverable CBM.<sup>3</sup> Since the USTDA-funded study's completion, attempts by Essar and others have brought about government policy changes. These changes allow simultaneous exploration of unconventional hydrocarbon resources, such as CBM and shale gas, and conventional resources to increase domestic production and investment in the sector.



### Introduction of U.S. Technology Drives India's Unconventional Gas Sector



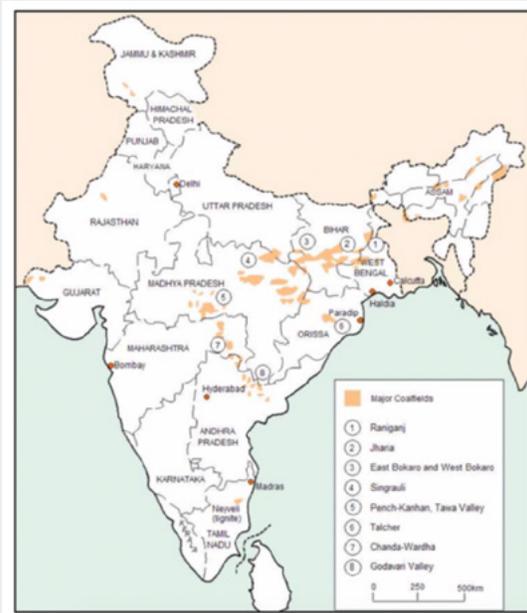
#### EOGEPL

Over 300 wells drilled and producing; 150 more wells planned; current production is 35+ million cubic feet per day



#### Reliance Industries Limited

250 wells drilled, started selling gas into the pipeline in early 2019





## USTDA Support Helps Afghan Government Lease Oil and Gas Fields

*A study funded by USTDA led to oil and gas resource discovery within the Amu Darya and Afghan–Tajik basins in Northern Afghanistan, leading to international firms being awarded oil and gas exploration and production rights for five fields.*

### Afghanistan Resource Recovery<sup>4</sup>



In 2003, USTDA provided funding for assessing the geology and engineering of undiscovered oil and gas resources within the Amu Darya and Afghan–Tajik basins in Northern Afghanistan. U.S. Geological Survey (USGS) carried out the study in coordination with Afghanistan’s Ministry of Mines and Petroleum. The study was completed in 2007. USTDA funding provided for a hydrocarbon resource survey to comprehensively assess potential oil and gas resources within the basins based on a detailed study of geochemistry, oil and gas reservoir geology, and tectonics.

A fact sheet, published by USGS in January 2012, states, “The mean volumes [of hydrocarbons] were estimated at 962 million barrels of crude oil, 52 trillion cubic feet of natural gas, and 582 million barrels of natural gas liquids for Amu Darya Basin Province and at 946 million barrels of crude oil, 7 trillion cubic feet of natural gas, and 85 million barrels of natural gas liquids for the Afghan-Tajik Basin Province.”<sup>5</sup> Since the conclusion of the USTDA-funded study, and based on its results, Afghanistan has held several tender rounds in which oil and gas exploration and production rights for five fields were awarded to international firms.

Activity on some of the leased fields, such as the Kashkari and Angot, produced impressive results. Both fields have been active since 2012 and, as of 2016, have produced 823,469 barrels of oil. This project supported U.S. exports, including drilling equipment. It benefited Afghans through increased oil and gas production, much-needed foreign exchange and revenues, permanent jobs and training, and support of effective governance through the adoption of new laws, regulations, and international best practices.



## USTDA-Funded Activities Revitalized Peru's Natural Gas Sector

*USTDA's activities in Peru spurred resource identification in the country's onshore basins leading to increased investor confidence.*

### Perupetro S.A. Petroleum Sector Exploration and Investment Promotion<sup>6</sup>

From 2003 to 2006, USTDA funded a series of activities to support Perupetro S.A., the Peruvian state-owned enterprise responsible for the promotion of private investment in the hydrocarbon sector, to:

- Conduct a comprehensive review of onshore oil and gas resource data
- Revitalize and grow the Peruvian oil and gas exploration market
- Develop an integrated geochemical database for investors
- Facilitate investment in the Peruvian hydrocarbon sector

USTDA-supported activities resulted in assessing prospective exploratory opportunities in four onshore basins: Huallaga, Titicaca, Ucayali, and Marañón. These activities also facilitated Perupetro's role in marketing and licensing state-owned exploration sites. This is Perupetro's core function and is a key step in the overall development of the national hydrocarbon exploration, extraction, and refining sectors. By early 2006, all eight fields identified for exploration had been offered for international bidding by Perupetro. By 2009, they were under contract for exploration.

USTDA-funded activities were instrumental to Perupetro's larger efforts to revitalize the sector. Peru's oil and gas exploration and extraction sector performance has substantially improved, international bidding and licensing of exploration sites have increased, and the Peruvian government has increased the supply of crude oil for refinement in its domestic market. The crude oil supply increased the potential for domestic consumption of refined fuels as well as the export of numerous refined products.



## USTDA-Funded Technical Assistance Enabled Development of Natural Gas Market Reform in India

*USTDA's assistance developed market-enhancing regulatory reform, providing opportunities for U.S. manufacturers, engineering companies, and technology suppliers to participate in a more open and competitive market.*

### Oil and Gas Regulatory Development in India<sup>7</sup>

In 2008, USTDA provided grant funding for technical assistance to India's Petroleum and Natural Gas Regulatory Body (PNGRB) (established in 2006) to develop and consolidate regulation of India's growing oil and gas market. This activity, completed in 2010, increased interaction between the U.S. natural gas and petroleum regulatory bodies and PNGRB. The technical assistance (TA) provided for capacity building for PNGRB personnel and developed market-oriented regulatory reform recommendations that would allow PNGRB to update or enhance regulations, laws, and mechanisms for regulating the midstream and downstream gas market.

As a result, PNGRB was able to gain:

- First-hand knowledge of U.S. gas market best practices
- An understanding of the interaction between natural gas transport and distribution utilities and the regulatory agencies
- An appreciation for, and ability to assimilate, consumer protection principles in the regulatory framework
- A better understanding of the:
  - Rules governing gas pipelines and transmission tariffs
  - Importance of gas storage on price stability
  - Need for local distribution companies to develop their storage capacities

This TA also fostered better opportunities for U.S. manufacturers, engineering companies, and technology suppliers to participate in a more open and competitive market.





## USTDA Funded Feasibility Study Moved Botswana Toward CBM-Based Power Generation

*This USTDA activity introduced project stakeholders and decision makers to U.S. CBM technologies and know-how, project financing options, and policy and regulatory requirements for project implementation.*

### Botswana Development Corporation CBM Development Project<sup>8</sup>



In 2003, at the Botswana Development Corporation's (BDC) request, USTDA provided grant funding for a CBM feasibility study. The objective of the study was to evaluate the CBM development potential in eastern Botswana to meet growing domestic and regional demand for low-cost, clean, and efficient fuel for power generation and feedstock for industrial processes. BDC is Botswana's

primary commercial and industrial development agency. The study was completed in 2005 and was followed by a 2005 reverse trade mission to introduce the project stakeholders and decision-makers to U.S. CBM technologies and know-how, project financing options, and policy and regulatory requirements for project implementation.

The feasibility study and reverse trade mission helped Botswana establish proven CBM reserves and slate CBM as a fuel source for two power plants: the 90-MW Orapa Power plant and the proposed 180-MW Mmashoro Power plant. The Orapa Power plant, owned by Karoo Sustainable Energy (KSE), the first independent power producer (IPP) in Botswana. The power plant began commercial operation in 2011 and uses GE's dual-fuel turbines, which can run on CBM and diesel fuel.<sup>9</sup>

“ The USTDA study really set the CBM industry in Botswana into motion. It's what attracted all comers to the market and proved that there is gas in the region. ” According to Julain Scales, Kalahari Energy managing director.

## Case Studies

# Spotlight on Timor-Leste and Azerbaijan: Highlighting USTDA Due Diligence Success

The following two case studies demonstrate how USTDA supports project sponsors to attract financing for project implementation. The first case study shows how USTDA provided the Government of Timor-Leste with a technical assistance grant to help the Government create a stable business environment to attract investors. The second case study highlights how USTDA provided a grant to the State Oil Company of the Azerbaijan Republic (SOCAR) for a feasibility study that provided SOCAR comprehensive due diligence information required to derisk the planned financing, construction, and operation of oil and natural gas transmission lines. The SOCAR project is part of an overall Caspian pipeline initiative that demonstrates the comprehensive manner in which USTDA supports the financing, development, and operation of stand-alone, but interrelated, regional energy infrastructure projects. The SOCAR study and other studies contributed to demonstrating the financial viability of the entire system as investors and project financiers require comprehensive due diligence across the supply chain.

# Case Study: Timor-Leste Offshore Natural Gas Resource Development

In 2002, USTDA provided a TA grant to the newly-formed Government of Timor-Leste (East Timor) to help manage the development of the nation's newly emerged offshore oil and gas resources, including the Bayu-Undan condensate gas field, to supply the Darwin LNG export facility in Australia<sup>10</sup>. Another objective of the TA was to establish a new Ministry of Petroleum that promulgated laws, regulations, and commercial contracts for the oil and gas sector.

The TA was designed to help the Government create a stable business environment, derisk the gas sector, and make it more attractive to investors. The successful implementation of this USTDA-funded activity led to significant hydrocarbon resource development in offshore sites, including the Bayu-Undan gas condensate field. The TA also led to significant natural gas infrastructure development, shared skills and know-how, and the support of effective markets and governance in Timor-Leste.

The project has generated billions of dollars in taxes and other payments to the national and local Governments, created employment and training opportunities for the citizens, and provided for community investments. It also has led to substantial U.S. exports.

## Project Background

Timor-Leste gained independence from Indonesia in 2002. The newly formed government identified the development of the country's vast oil and

gas reserves as a priority initiative for generating revenue and creating jobs, but as a newly established and impoverished nation recovering from more than three years of unrest, Timor-Leste did not have the institutional capacity to manage developing its hydrocarbon resources. Several U.S. companies expressed interest in partnering with the Timor-Leste Government in this initiative. To support the Timor-Leste Government, and to facilitate establishing partnerships between the U.S. industry players and Timor-Leste Government agencies, USTDA quickly responded to the Timor-Leste Government's request for support. USTDA provided a TA grant that helped the Government establish a stable and predictable investment environment in the sector by:

- Building institutional and regulatory capacity
- Supporting the creation of a new Ministry of Petroleum
- Promulgating petroleum-sector laws and regulatory and contract frameworks
- Supporting negotiations with Australia regarding Timor-Leste's rights to extract natural gas from the Bayu-Undan field

## USTDA Study Scope

The scope of the TA's efforts included a thorough review of Timor-Leste's oil and gas policies and structures; providing recommendations on legislation, regulations, and petroleum policy; preparing model commercial contracts and aiding in the establishment of a Ministry of Petroleum and Minerals (Autoridade Nacional do Petróleo E Minerais - ANPM) for the country. USTDA also

provided support during negotiations concerning the development of an LNG terminal in Darwin, Australia, that would receive gas resources from the Bayu-Undan field.

USTDA provided assistance to the Government of Timor-Leste in promulgating its first laws, regulations, and contracts for:

- Developing the country's petroleum sector
- Helping the country with the design and implementation of its first, and ultimately successful, natural gas exploration licensing round

### Outcomes

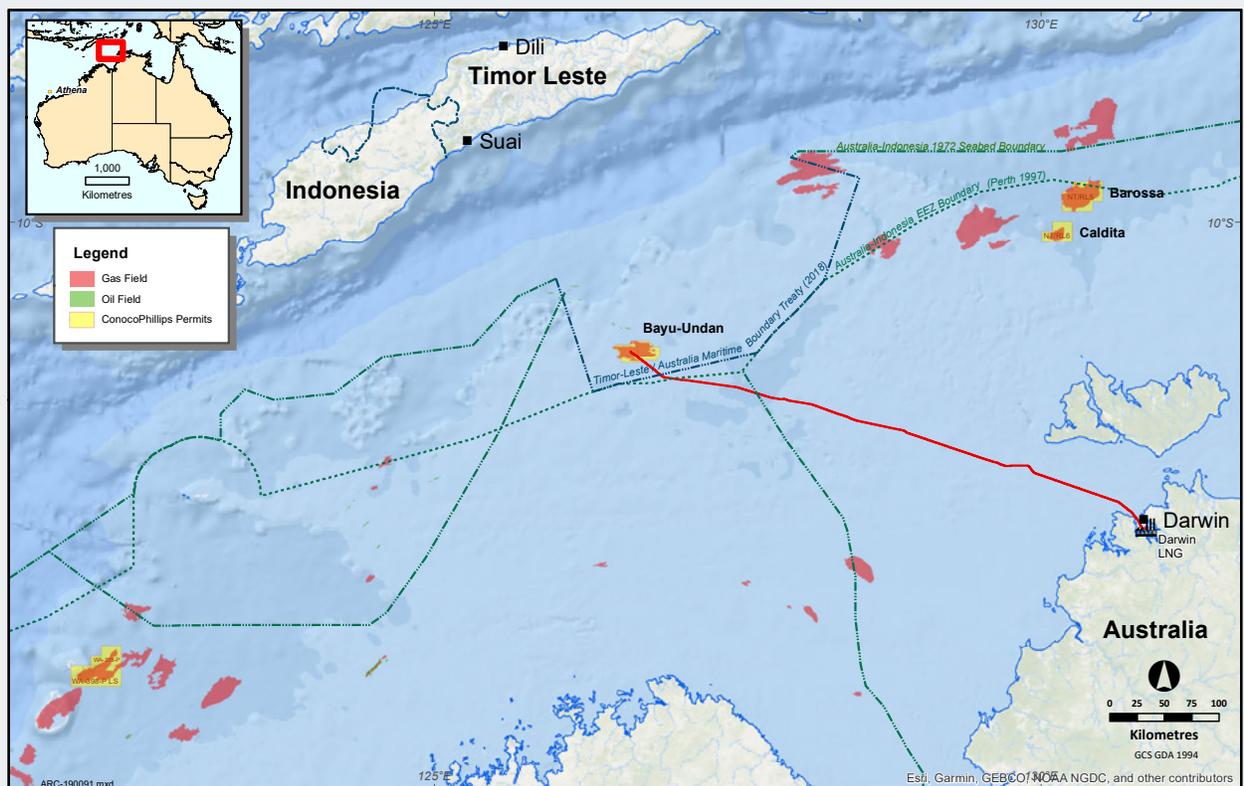
The USTDA-funded study supported the building of the institutional capacity needed to develop significant hydrocarbon resources in offshore

sites that included territories dually claimed by Timor-Leste and Australia (including the offshore Bayu-Undan gas condensate field).

The study achieved a significant success in assisting Timor-Leste's negotiations with Australia regarding the rights to extract natural gas and transport it to an LNG processing facility in Darwin, Australia that was being developed by ConocoPhillips. The Government of Timor-Leste also selected ConocoPhillips to operate the Bayu-Undan field and began producing gas from it in 2004 after the USTDA-funded effort helped derisk the undertaking.

The Bayu-Undan field is in the Timor Sea, 250 km (155 miles) south west of Suai in Timor-Leste and 500 km (310 miles) north west of the

## Timor Sea Joint Petroleum Development Area





Northern Territory in Australia. Natural gas is sent via a 502-km pipeline from the Bayu-Undan field to the Darwin LNG plant at Wickham Point, where it is converted into liquefied natural gas and shipped to Japan. ConocoPhillips, the field operator, states that Bayu-Undan has contributed more than \$19 billion in taxes and other payments to the Timor-Leste Petroleum Fund since 2004.<sup>10</sup> Additionally, ConocoPhillips has also invested \$99 million through local content activity, including employment and training, procurement of goods and services, and community investments.

“The funds from Bayu-Undan have allowed the Government to educate thousands of young Timorese, provide hundreds of tractors to assist the lives of Timorese farmers, equip our security forces to ensure stability in the country

and provide financial assistance to our veteran fighters who dedicated their lives to liberate the country, just to name a few of the programs.”<sup>11</sup> According to Alfredo Pires, Minister for Natural Resources, Republic of Timor-Leste.<sup>11</sup>

Timor-Leste’s former Prime Minister Alkatiri stated, “With the assistance provided by USTDA, Timor-Leste has, in a short period of time, made great progress.”<sup>12</sup> Similarly, World Bank stated, “Parliament’s unanimous adoption of the Petroleum Fund Act embodies state-of-the-art petroleum revenue management arrangements for Timor-Leste’s rapidly growing petroleum revenues.”<sup>13</sup>

# Case Study: Trans-Caspian Natural Gas and Oil Pipelines

The Baku-Tbilisi-Ceyhan pipeline has historic ties to the goal of developing a natural gas pipeline system that connects Central Asia gas production fields to European gas markets. The pipeline is an example of USTDA's innovation in addressing the dynamic realities of such complex undertakings through effective application of its project preparation tools, facilitating design, financing, development, and operation of energy projects in support of regional oil and gas pipelines.

USTDA's support for multiple Caspian pipeline initiatives demonstrates how USTDA uses its project preparation tools to leverage the alignment of mutually beneficial interests and goals of numerous host countries and the United States.

The Caspian pipeline initiative also demonstrates the comprehensive manner in which USTDA supports the financing, development, and operation of stand-alone, but interrelated, regional energy infrastructure projects. These studies show the financial viability of the entire system as investors and project financiers require comprehensive due diligence across the supply chain.

Other USTDA-funded studies supporting the Caspian pipeline initiative include:

- Gas storage feasibility
- Optimization of design and implementation of operational best-practices of interconnected pipelines and related infrastructure
- Gas transportation tariff modeling

These activities demonstrate USTDA's ability to tailor its approach while maintaining its commitment to support U.S. policy objectives and the host country's developmental goals. USTDA managed to support various pipeline-related projects amid changing market drivers, geopolitical climate and governmental agendas, and commercial goals and strategies within the Caspian region and in specific countries. The case study will evaluate a few of USTDA's activities supporting the Caspian pipeline initiative.

## Summary

In 2006, USTDA provided a grant to the State Oil Company of the Azerbaijan Republic (SOCAR) for a feasibility study that evaluated the technical, economic, and regulatory feasibility of two pipeline projects: the Trans-Caspian Natural Gas Pipeline (TCGP) and the Trans-Caspian Crude Oil Pipeline (TCOEP). Both pipelines included a subsea segment across the Caspian Sea.<sup>14</sup> The study provided SOCAR with the comprehensive due diligence information required to derisk the planned financing, construction, and operation of oil and natural gas transmission lines.

The study effectively revisited an earlier (1990s) concept, supported by the U.S. and USTDA, for developing an interregional oil and gas pipeline system linking Central Asian production fields with European markets. This oil and gas pipeline sought to bypass Russia's and Iran's territorial jurisdiction and provide Europe with an alternative to the monopolistic Russian energy supply.





The countries in the area surrounding the Caspian Sea, which are the focus of the activities discussed in this case study, include Kazakhstan, Uzbekistan, Turkmenistan, Azerbaijan, Georgia, and Turkey (referred to collectively here as the “Caspian Region”).

The proposed pipelines evaluated in the 2006 study originated in western Kazakhstan and travel across the Caspian Sea to Azerbaijan in the vicinity of Baku. The oil pipeline would connect with the existing Baku-Tbilisi-Ceyhan (BTC) oil pipeline that runs through Azerbaijan, Georgia, and Turkey and connect to oil pipeline(s) to Europe. The gas pipeline would parallel the route of the existing BTC oil and South Caucasus gas pipelines and connect to Europe via the proposed Nabucco Gas Pipeline.

### Project Background

The confluence of host country and U.S. commercial and political mutual interests is evident in the history of the multifaceted “Caspian Pipeline” endeavor. The 2006 feasibility study grant to SOCAR is an example

of USTDA assistance to develop regional energy infrastructure projects in emerging markets and supporting U.S. private-sector jobs through the export of goods and services while aligning with U.S. foreign policy priorities.

Following the restructuring of the former Soviet Union in 1991, the U.S. focused increasing attention toward assisting the newly independent states of the Caspian Region in attaining effective geopolitical and socioeconomic sustainability, especially in the energy sector. In the early 1990s, USTDA commenced working collaboratively with the Caspian Region and European countries interested in developing infrastructure (oil and gas, electric power generation, water treatment, telecommunications and other utilities, air and road transportation, etc.) to enable broad-based development in the Black Sea, Caspian Sea, and Caucasus regions.

The Caspian Region countries also had and continue to have, the desire to monetize their oil and gas resources by accessing European markets.



In the early-to-mid 1990s, the U.S., its European partners, and select Caspian Region countries began discussing the concept of transporting oil and gas from the Central-Asian production fields directly to European Union member countries, while circumventing both Russia and Iran. USTDA played a vital role in the U.S. Government interagency initiative to support what initially became known as the Trans-Caspian Oil Pipeline (TCP) and the Trans-Caspian Gas Pipeline (TCGP).\*

Initially, USTDA's activities focused on establishing the proposed oil and gas pipeline links between Turkmenistan and Azerbaijan across the Caspian Sea to Baku, Azerbaijan, and on to Erzurum, Turkey, as the first segments in a pipeline system capable of supplying oil and gas to Europe. However, Turkmenistan's support for the project began to wane as the governments of Russia and Iran made their opposition to it clear, and a legal dispute over Caspian Sea territorial boundaries between Azerbaijan and Turkmenistan could not be resolved.

The political challenges to the initially proposed oil and gas pipelines across the Caspian Sea, together with the subsequent discovery and development of Azerbaijan's Shah Deniz gas field, finally led to the indefinite postponement of the submarine segments of both pipelines in 2000. These challenges prevented connecting the oil and gas production fields in Turkmenistan to oil and gas pipelines in Azerbaijan. However, the overland oil and gas pipelines across Azerbaijan, Georgia, and Turkey were subsequently developed and put into operation in 2006. The oil pipeline connects Baku oil fields in Azerbaijan through Tbilisi, Georgia, and Ceyhan, Turkey, to Erzurum, Turkey – a system known as the Baku-Tbilisi- Erzurum Pipeline (BTE) oil pipeline. The gas pipeline connects the Deniz gas field in Azerbaijan to Erzurum, Turkey. It is referred to as South Caucasus Pipeline (SCP), the Baku– Tbilisi–Erzurum Pipeline (BTE), or the Shah Deniz Pipeline. A future gas pipeline between Turkey and Europe that could connect to the SCP system at Erzurum.

\*Currently it is the gas pipeline that is more commonly referred to as the Trans-Caspian Pipeline. In this Natural Gas Project Preparation Guide, "TCP" refers to the gas pipeline unless otherwise noted.



As a lack of interest in constructing pipelines across the Caspian Sea became evident, USTDA shifted focus and successfully assisted the overland segments of the oil and gas pipeline development. The USDTA did so by providing TA grant funding to the Turkish state-owned oil company (BOTAS)<sup>15</sup> and to the Georgian International Oil Corporation (GIGC)<sup>16</sup> in support of pipeline development. The support to BOTAS provided advisory services for:

- Structuring and financing the pipeline segment in Turkey
- Negotiating with potential investors interested in developing the interregional pipeline system
- Developing a gas transportation tariff model that would assist in negotiating and monitoring natural gas purchase and sale transactions

Similarly, the TA grant to GIGC provided advisory services for:

- Negotiations with the chosen consortium to construct the segment of the pipeline system through Georgian territory

- Evaluating potential underground gas storage facilities

In 2006, the stand-alone BTC and SCP pipelines were completed, creating a much-needed revenue stream for the countries involved in oil and gas production and transport through these pipelines. The pipelines were major contributors to the host countries' local economic growth, increasing Government revenue generation, creating sustainable regional energy projects, and enhancing transparency and accountability in oil and gas resource and fiscal management. Additionally, pipeline segment construction in Georgia and Turkey generated exports of U.S. goods and services, such as pipe-laying equipment, gas conditioning plants, compressor stations, metering equipment, and engineering services.

Around the time the BTC and the SCP pipelines were completed, interest was rekindled in the strategic development of oil and gas pipelines

connecting Central Asian oil and gas production fields with European energy-consuming markets. Then, in 2006, Russian gas supplies to Ukraine and Europe were disrupted. Over the winter of 2005-2006, Russia experienced record cold weather, which resulted in unusually high domestic natural gas demand. Simultaneously, the Russian energy monopoly, Gazprom, was renegotiating its gas supply contract with Ukraine. At an impasse in the negotiations, Gazprom cut off natural gas deliveries to Ukraine. The combination of the two events created reduced pipeline pressures and gas deliveries, which resulted in gas shortages, not only in Ukraine but also in several European nations.

The resulting disruption of Russian gas supplies to western Europe served as a reminder of the vulnerability in being dependent upon monopoly energy suppliers. USTDA responded to the Caspian Region market demand, which included a renewed focus on the potential to develop an interregional pipeline system to transport Central Asian oil and gas supplies to Europe. USTDA was able to react quickly to policy and priority changes, tailoring its programs to meet the challenges of a still-evolving economic and political environment.

USTDA, using its project preparation tools, responded by:

- Supporting the key developmental priorities of strong partners in the region
- Connecting U.S. firms with overseas commercial opportunities associated with establishing the necessary natural gas and oil infrastructure for long-term development in the Caspian Region

In 2006, Daniel D. Stein, former USTDA Regional Director for Europe and Eurasia, stated, “The countries in Europe and Eurasia vary greatly in their levels of economic and political development.

One of USTDA’s strengths is its ability to tailor its program to carefully meet individual country needs and requirements. The common thread for the Agency throughout the region, however, remains the desire to bring private sector solutions to development challenges.”<sup>17</sup>

### USTDA Study Findings

In 2006, USTDA provided a second feasibility study grant to SOCAR to evaluate the viability of transporting natural gas from production fields in northwest Kazakhstan across the Caspian Sea to the vicinity of Baku, Azerbaijan. The new pipeline would parallel the existing BTC oil pipeline and connect to the European gas pipeline systems through the proposed Nabucco gas pipeline. The feasibility study also evaluated the feasibility of a Trans-Caspian Oil Export Pipeline (TCOEP) that would transport oil from Kazakhstan to Baku, Azerbaijan, and on to Turkey via the existing BTC oil pipeline.

This study is an example of the Agency fulfilling its objective to “promote global energy security” by helping to diversify Europe’s oil and gas supplies through pipeline development that would bring Central Asian oil and gas across the Caspian Sea and through Azerbaijan, Georgia and Turkey and into European markets.<sup>18</sup>

The overall USTDA value proposition in supporting the development of this pipeline was to provide SOCAR with the comprehensive due diligence information required for derisking the potential financing, constructing, and operating these natural gas and oil pipeline systems. The in-depth SOCAR feasibility study addressed critical project finance due-diligence factors such as:

- Evaluation of the gross oil and gas production and exports potential of regional producers (Kazakhstan, Turkmenistan, and Azerbaijan)

- Forecasts of oil and gas supply, demand, and pricing
- Engineering design for the pipeline systems to accommodate the projected export volumes and annual oil and gas throughputs
- Environmental assessments
- Evaluation of alternatives for connecting the pipelines to existing and proposed pipeline systems serving European energy markets
- Review of the laws and regulations (including definitions of technical specifications and standards) of the regulatory and administrative bodies that would have jurisdiction over the construction and operation of the pipelines
- Development of cost estimates of constructing and operating the pipelines
- Development of cost recovery tariff structures
- Suggested financing, asset ownership, and operations business structures

### Outcomes

The study, completed in 2011, recommended the construction of the TCP and comprehensively addressed technical, commercial, economic, and regulatory issues regarding gas pipeline's financing, construction, and operation. However, several regional political challenges arose that indefinitely postponed construction of TCP. These included:

- SOCAR became increasingly less interested in the pipeline proposals, primarily due to strong political objections to the development of the pipelines from Russia, which also led to a lack of political support for the project in Kazakhstan
- Kazakhstan passed a law requiring new pipelines in Kazakhstan be controlled by the Kazakh Government, which conflicted with the ownership arrangement desired by SOCAR
- The decision by the Shah Deniz gas consortium (a group of companies that operate the Shah Deniz gas fields in Azerbaijan, of which SOCAR

is a member) to favor the Anatolia Gas Pipeline (TANAP) for accessing European markets instead of the proposed NABUCCO pipeline, upon which construction of the TCP was contingent

To date, the European Union, U.S., Kazakhstan, Turkmenistan, and Azerbaijan continue to support, in varying degrees, TCP's development. The prospect for constructing such a pipeline has also improved since Azerbaijan, Iran, Kazakhstan, Russia, and Turkmenistan signed the Convention on the Caspian Sea's Legal Status in August 2018. The Convention, among other things, endorsed the construction of subsea pipelines.<sup>19</sup>

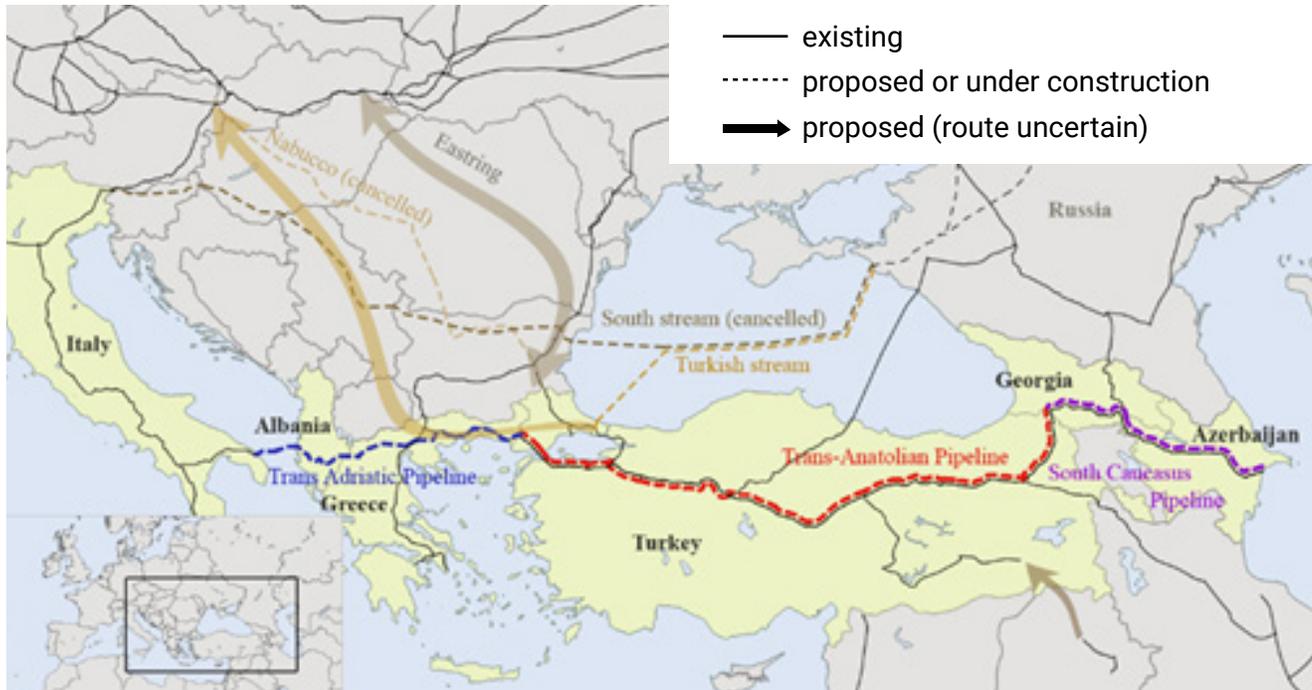
A 2017 Eurasian Research Institute article stated, "There is strong political momentum to launch the Trans-Caspian Gas Pipeline. Thus, the EU will not give up the idea to connect energy-rich Turkmenistan and possibly Kazakhstan with Europe via sub-sea and onshore pipelines. Turkmenistan is also interested in diversifying its export routes in order to avoid dependence only on China."<sup>20</sup>

### Current Status of Gas Pipelines from Central Asia to Europe

The Shah Deniz field, which is about 40 miles southeast of Baku in the Caspian Sea, contains most of Azerbaijan's natural gas. Until the 2018 completion of the TANAP gas pipeline to Europe, this natural gas was marketed only in Azerbaijan, Georgia, and Turkey.

In mid-2018, the field's second stage of development, Shah Deniz 2, came online and gas flowed through the expanded SCP system and on to Europe via the TANAP system. The U.S. Energy Information Administration (EIA) reports that volumes of natural gas shipped via TANAP

## Central Asia to Europe Gas Pipelines



reached 0.1 billion cubic feet per day (BCFD) in 2018 and are expected to increase to 0.2 BCFD in 2019.<sup>21</sup> The Trans Adriatic Pipeline (TAP), connecting with TANAP at the Turkey-Greece border, will transport Shan Deniz gas to Italy starting in 2020.

### Conclusion

USTDA's multifaceted, natural gas-related activities in the Caspian Region, since the 1990s, directly and indirectly, facilitated the development of "important pieces" of the puzzle, culminating in the interregional gas pipeline system that connects Central Asian production fields to European energy markets. USTDA's support for gas-related developments in the region has helped to develop natural gas infrastructure, host-country economies, energy policy, and market reforms. This support also helped bring U.S. energy experts together with host-country partners, providing avenues for exports of U.S. goods and services that provide development benefits to those receiving them.

The 2006 SOCAR feasibility study grant funding serves as an example of how USTDA's project preparation tools can provide comprehensive, pre-finance due diligence for a complex project. The project also serves as a "historic-anchor point" within the context of the many other natural gas-related USTDA activities conducted in the same Caspian Region since the early 1990s restructuring of the former Soviet Union.

USTDA's Caspian Region natural gas activities collectively assist in developing and monetizing the region's indigenous energy resources, and the development of related natural gas infrastructure (pipelines, storage, etc.) in the emerging energy market. These activities also demonstrate USTDA's ability to use all of the tools at its disposal to leverage and align the mutually beneficial interests, needs, and goals of multiple stakeholders.



## USTDA's Value Proposition

USTDA adds value to energy infrastructure development projects once they have advanced beyond the project conception and preliminary design phase. It does this by introducing U.S. energy experts who conduct all aspects of comprehensive due-diligence tasks necessary for derisking investments in and securing financing for project completion to the project sponsors and developers.

Through the deployment of its various project preparation tools, USTDA helps:

- Assist project sponsors to:
  - Identify, quantify, and develop new natural gas resources
  - Incrementally increase production of existing gas reserves
  - Procure technical, commercial, and legal advisory services needed to secure financing for production-related infrastructure development
- Assist governments in using best practices in updating their energy-development and energy market regulatory processes and policies; this minimizes economic risks to investors, owners, and operators of natural gas infrastructure along the entire value chain, including upstream production, midstream processing and storage, and downstream distribution facilities
- Provide commercial, technical, and legal assistance in identifying and developing new natural gas off-take markets to support the financing, development, and operations of upstream and midstream infrastructure assets
- Assist state-owned enterprises and private sector enterprises in formulating, structuring, negotiating, and implementing financeable, legal, and commercial contracts necessary for project implementation and operations



The CEO of the Deep Industries Ltd.'s Exploration & Production Division, Premsingh Sawhney, is one of the foremost CBM experts in India. Sawhney led the development of three out of the four commercial discoveries moved into development in the country, totaling 5.75 TCF or 70% of India's established CBM resources, all with USTDA's support.

“ USTDA's contribution to the CBM industry in India has been tremendous. The technical studies funded by USTDA were an eye opener for the industry to begin seriously evaluating this important indigenous resource. It took a long time to take off, but with the long-term support of USTDA and U.S. industry, with their leading technologies and services, we now have close to 100 MCMD of gas being delivered for fertilizer production, local industrial facilities, and into the national gas grid. CBM is now making a significant contribution to India's growing, energy deficit economy.” Stated Mr. Sawhney.

“ When Advanced Resources International (ARI) started working in India about 15 years ago, there were a number of companies interested in CBM development, but there were no viable projects. Presently, through the completion of several technical and economic feasibility studies supported by USTDA, over 600 CBM wells have been drilled in the country with production approaching 100 million cubic feet per day. U.S. companies, including ARI, supplied specialized technology and services, such as hydraulic fracturing equipment, drilling rigs, and compressors. We are optimistic that India will soon be developing another unconventional gas resource now that the Government of India has finalized the regulations for shale gas development. CBM producers are excited about the potential for co-developing CBM and shale gas resources.” According to Mr. Jonathan Kelafant, Sr. Vice President at Advance Resource International.

# PROJECT DESIGN AND CONSTRUCTION

**USTDA funds project preparation activities to support natural gas projects that advance to the design and construction phase, the third phase of the project implementation life cycle. At this point, the project has secured financing. Projects in this phase of development may need USTDA funding support to perform front-end engineering design (FEED), develop engineering, procurement, and construction (EPC) requests for proposals (RFPs), prepare technical specifications and standards for major equipment, and/or establish best procurement practices.**

After conceptual analysis confirms project viability, FEED is typically performed for major natural gas projects in lockstep with project financing efforts, but before the project is presented for the final investment decision to project owners, financiers, and other stakeholders. FEED is usually performed for a single concept. Its deliverables provide information that confirms the project's technical, economic, and commercial viability with some level of certainty that is acceptable to the project owners and financiers. The main objective of developing RFP for EPC, and selecting an EPC contractor, is to create detailed engineering designs from which executable drawings and procurement ready specifications are developed, and the project is constructed.

At the Project Design and Construction Phase, USTDA has supported project sponsors in particular areas, such as FEED, detail design to build (e.g., equipment inspection and testing, developing equipment specification, confirming construction strategy, and commissioning plans), and procurement planning.

At this phase of the project development and implementation cycle, demand for project preparation funding is low because most projects have been adequately derisked and have or are about to secure project financing before proceeding to the design and construction phase. Therefore, USTDA receives fewer requests for project preparation funding for projects at this phase of the project development compare to the earlier stages.



USTDA project preparation tools are used at this phase to:

- Bring foreign project decision-makers to the United States to understand the potential advantages of using U.S.-made products and services in their gas projects before making procurement decisions. USTDA’s strategically planned reverse trade missions present excellent opportunities for U.S. businesses to establish new, or enhance existing, relationships with prospective overseas customers.
- Develop equipment design and performance specifications, construction codes, and standards that reflect U.S. natural gas industry best practices, which project sponsors could then use in their project procurement package(s)
- Help establish market rules, create an conducive investment environment, and develop a competitive and transparent procurement process

**USTDA Engagement Helps Project Procurement**

Out of 295 USTDA-funded activities in the natural gas sector since 1981, 18 were for projects at the design and construction phase. These activities were generally designed to support project procurement. Reverse trade missions accounted for the highest number of activities that USTDA funded in this phase of development.

USTDA provided feasibility study grant funding for three projects at this phase of development. These included developing a procurement plan for a gas distribution network in Indonesia,

performing FEED for the expansion of a gas treatment facility in Colombia, and supporting a U.S. technology provider, active in China’s power generation market, to demonstrate the technical and economic viability of their newly developed equipment for power generation using coal mine methane.

Gas exploration and production projects accounted for most (eight) of USTDA-supported projects in this phase. Natural gas sector activities in the Middle East, North Africa, Europe, and Eurasia region accounted for six of the USTDA design and construction activities, at this phase of project development, USTDA had only one activity in the Sub-Saharan Africa region. However, demand for the USTDA project preparation funding in this phase, as well as other stages of project development, has increased in recent years, primarily due to the Power Africa initiative.

Among USTDA activities in this phase, feasibility studies generated the highest volume of exports, had the highest project implementation rate, and the third-highest exports to the USTDA investment ratio. Technical assistance activities had the highest exports to the USTDA investment ratio. Coalbed and coal mine methane projects generated the highest volume of exports and had the highest exports to the USTDA investment ratio and implementation rate. The East Asia region produced the highest export volume and had the highest project implementation rate.

**USTDA's Natural Gas Activities in the Project Design and Construction Phase**



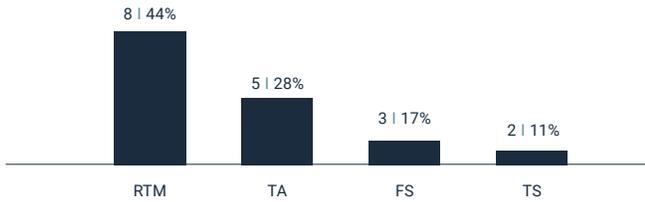
**18 Activities Funded**

**\$514 Million of U.S. Exports Generated**

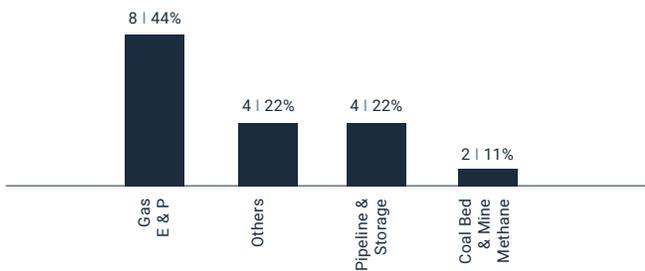
## USTDA Activities

1981 - 2018

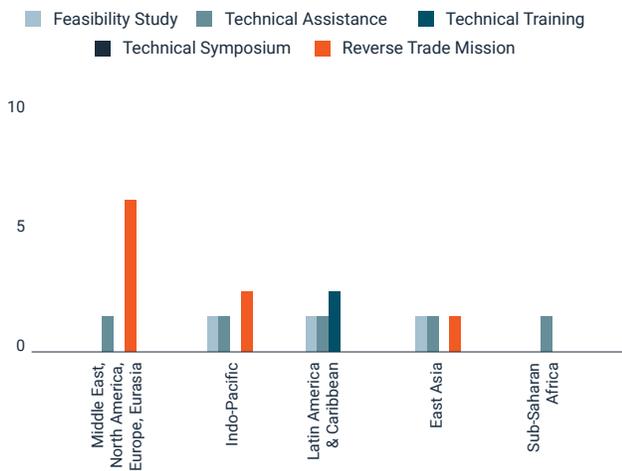
### Project Design and Construction



### Subsectors



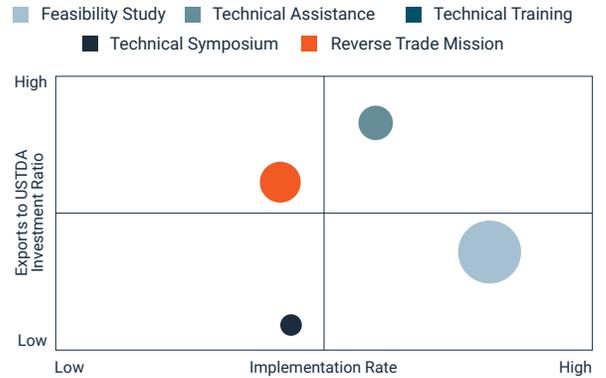
### Regions



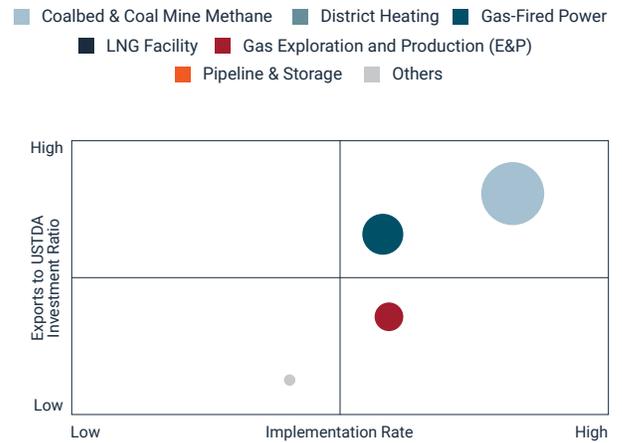
## USTDA Success Metrics

CIRCLES INDICATE RELATIVE EXPORTS VOLUME

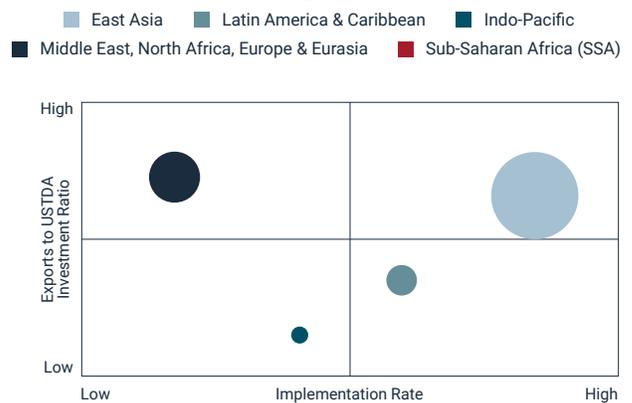
### Activities



### Subsectors



### Regions



# Projects Overview: USTDA Supports U.S. Industry Participation in Emerging Markets as Projects Move to Design and Construction

Major natural gas projects are large, complex, involve many stakeholders, and are capital intensive. These projects take a long time to evaluate for commercial viability, finance and build. USTDA's project preparation funding for projects in the design and construction phase can be divided broadly into the following categories:

**Front-end Engineering Design (FEED):** Qualified engineering contractors develop FEED along with a project owner's multi-disciplined team or their appointed representatives. USTDA provides funding for U.S. experts to perform FEED, assist the project owner's team, or conduct specialized related studies, which may not be in the FEED scope.

**Design-to-Build:** Detail design is carried out by engineering and construction contractors that have the experience and personnel to conduct detail design, procure equipment, and construct the facilities. USTDA support provides funding for U.S. experts to develop equipment specifications, the project owner's team to visit potential equipment supplier manufacturing facilities, and to conduct equipment inspections or special studies that may not be in the detail design scope.

**Procurement Planning:** The project owners' team spends significant time preparing procurement plans to ensure equipment and services meet design and performance specifications and are competitively procured. USTDA provides funding for technical assistance to project sponsors for developing procurement strategies and documents and training of the project sponsors personnel in best procurement practices.

By the time projects proceed to the design and construction phase, most projects have been adequately derisked and have, or are about to secure, project financing. However, natural gas projects are large, complex, involve many stakeholders, and are capital intensive. Some projects may require FEED, Design-to-Build, or procurement planning funding before they can proceed to the implementation phase. In some cases, funding may be required just to bring together qualified service providers or technology suppliers with the project sponsors.

## Indonesia



### Indonesia Addressed the Need to Further Develop its Natural Gas Sector

*This USTDA-funded feasibility study helped the Indonesian Government develop a plan to procure transmission and distribution infrastructure.*

#### **Feasibility Study Grant Funding for Natural Gas Utilization in Indonesia and Development of a Procurement Plan for Natural Gas Transmission Infrastructure<sup>1</sup>**

In 1999, USTDA, in response to a request from the Ministry of Mines and Energy of Indonesia, provided a grant to partially fund a feasibility study. The study identified and prioritized possible investment opportunities under a national plan to substitute oil use with domestic gas not suitable for export; and prepared a procurement plan for the development of natural gas transmission and distribution infrastructure in West Java and South Sumatra.

Gas Technology Institute (GTI), a U.S. research organization, completed the study in 2003. The study helped the Government identify the need to develop a natural gas master plan to support its natural gas industry further.





## U.S. Technology Improved Safety and Reduced Greenhouse Gas Emissions in China

*This USTDA-funded feasibility study helped Caterpillar export low-BTU engines for coal mine methane (CMM) power generation.*

### Feasibility Study Grant Funding for Power Generation Using CMM<sup>2</sup>

In 2004, USTDA approved a grant to the Shanxi Provincial Government and Jinchang Anthracite Mining Group Co. Ltd. (JAMG) for a CBM and CMM gas power generation technical assistance. In 2009, USTDA partially funded a CMM gas-power generation feasibility study for China United Coalbed Methane Corporation (CUCBM). Both the technical assistance and the feasibility study evaluated the commercial viability of a new technology developed by a U.S. equipment manufacturer, Caterpillar, for electricity generation from low-BTU CMM gas and the technical, economic, and commercial viability of implementing Caterpillar's CMM technology at two coal mines. The USTDA feasibility study also provided funding for Caterpillar to conduct training workshops in China and arrange for visits by Chinese investors, design institutions, industry representatives, and local government officials to Caterpillar's manufacturing facility in the U.S.

Since the completion of these USTDA-funded activities, a significant number of CMM projects using Caterpillar technology have been implemented in China. The implementation of these projects has resulted in infrastructure development, transfer of knowledge and skills, coal mine operational safety, reduction in greenhouse gas emissions, and U.S. exports of gas processing and power generation equipment and engineering services.





## U.S. Company Partnered with Local South African Companies to Win Power Plant Award

*This USTDA-funded technical assistance demonstrates how USTDA uses its project preparation tools to support not only the U.S. industry but also overseas small businesses and host governments' economic development goals.*

### Khanya Consortium Power Plant Tender, South Africa<sup>3</sup>



Like other developing economies, adequate electricity underpins the growth and development of South Africa. The Government of South Africa, through the Department of Mining and Energy (DME), launched a competitive tendering process to procure electric power through independent power producers in 2005. One of those tenders was for two, open cycle gas turbine plants in the Eastern Cape and Kwa Zulu Natal provinces. AES Corporation, a major U.S. power company, was interested in building, owning, and operating these two plants.

AES formed a consortium, known as the Khanya Consortium, with two domestic enterprises, Mbane Power and Tiso Energy, to meet the Broad-based Black Economic Empowerment (BEE) Act of 2003 requirements of the tender. The Act requires that any government-sponsored project must have BEE participation of 33% at all levels of the project development, ownership, and operation. USTDA provided TA grant funding to Tiso Energy, partially supporting Khanya's project development effort to conduct the necessary studies and prepare and submit a proposal for the project to DME, enabling the South African companies to meet their contribution to project development. On August 7, 2007, DME announced that Khanya Consortium had been selected to build, own, and operate the power plants. This was the first significant step and a key milestone in the opening up of the country's power market. This project, due to various reasons, couldn't secure financing and was canceled in 2008. However, it demonstrates USTDA's commitment to supporting both host country and U.S. business partnerships and their participation in local economic growth. It also illustrates how USTDA effectively uses its project preparation tools to help small or disadvantaged businesses overseas.

A blue-tinted photograph of an industrial facility, likely a gas processing plant. The image shows a complex network of large, white-painted pipes and valves. In the foreground, a large horizontal pipe with a handwheel valve is prominent. To the right, a vertical stack of pipes and valves rises. The background shows more industrial structures and a clear sky. The overall scene is clean and well-maintained.

## Case Studies

# Spotlight on Colombia and Turkmenistan: Highlighting USTDA Design and Construction Success

The following two case studies demonstrate how USTDA support provides U.S. companies opportunities to participate in the project design and construction phase. The first case study shows how a USTDA-funded study led to a contract for U.S. export of equipment and EPC services and an increase in Colombia's natural gas production. The second case study demonstrates how a strategically designed USTDA reverse trade mission introduced Turkmenistan officials to U.S. technologies and best practices for their procurement making decisions. Reverse trade missions introduce U.S. best practices, know-how, technology, and services to the project sponsors in emerging markets so they can benefit from U.S. gas industry experience, knowledge, and business-to-business relationships.

# Case Study: Colombian Gas Treatment Expansion Plant EPC and Natural Gas Production Increase

The Colombia Gas Treatment Expansion Plant exemplifies how USTDA's project preparation tools can help develop and expedite natural gas infrastructure project implementation at the design and construction phase.<sup>4</sup>

The Cusiana and Cupiagua oil and gas fields are located 15 kilometers (9.3 miles) apart in Colombia's Casanare province. Most of the gas production from these fields was reinjected into the reservoir for pressure maintenance for many years. At their peak in 1999, the two fields produced 480,000 barrels a day (BPD) of light crude or 60% of Colombia's output, but subsequent oil production declined to the point that natural gas production was more economical than oil. At the same time, Colombia expected natural gas supply shortages, and these fields were the only likely new source of natural gas. However, the gas contained impurities such as CO<sub>2</sub> and H<sub>2</sub>S, which had to be removed before pipeline-quality gas could be produced and injected into the national pipeline system.

In October 2002, USTDA approved a grant to Ecopetrol S.A., Colombia's field operator and state-owned oil company, for a FEED study to develop the required information for expanding the Cusiana Central Processing Facilities (CCPF). This included gas treatment units for removing contaminants, enabling the production of pipeline-quality gas. Ecopetrol contracted the U.S. firm, Alliance Engineering Group (AEG), to perform the FEED study.

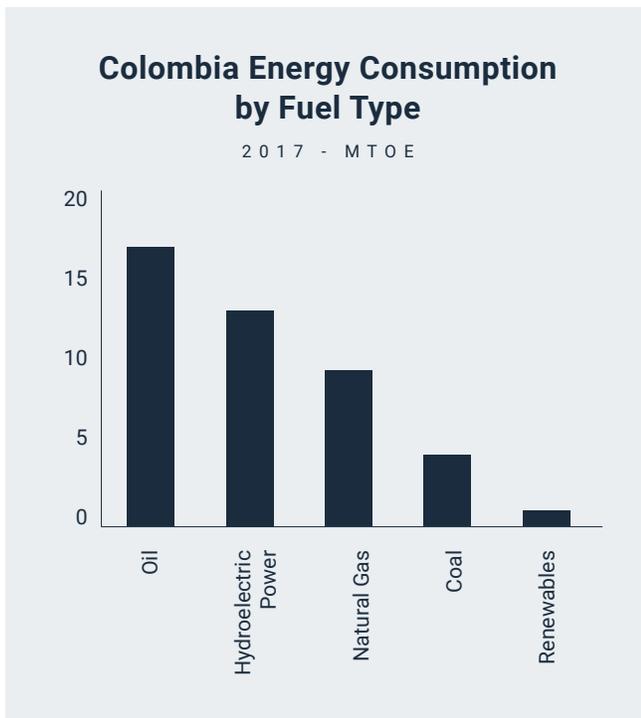
The FEED study, completed in 2003, prepared the project expansion scope, identified the gas treatment technology, and developed equipment design and performance specifications, design drawings, and other deliverables for the project's implementation. The FEED study established a design basis to treat produced gas for removing CO<sub>2</sub> and H<sub>2</sub>S and delivering 180 MSCFD (thousand standard cubic feet per day) of pipeline-quality gas for sale. The new facilities were fully operational in July 2005. The project was implemented expeditiously, within 33 months from the start of the FEED study to operations.

## Project Background

As of 2017, Colombia, the fourth largest country in South America, had 1.7 billion barrels of proven oil reserves and 3.7 trillion cubic feet (TCF) of gas reserves. In 2017, oil provided 39% of total energy demand, and natural gas accounted for 20%.<sup>5</sup>

Natural gas supplies are highly concentrated onshore at the Cusiana–Cupiagua fields and offshore at the Chuchupa fields. Although gross gas supplies have been decreasing, net amounts (i.e., gas to end-users) have been increasing due to reducing gas reinjection levels at the Cusiana–Cupiagua fields.

Natural gas production and consumption have remained relatively balanced in Colombia for much of the last 20 years. However, early in the previous decade, Colombia began investigating



Data Source: BP Statistical Review of World Energy, 2019

options to increase domestic natural gas exploration and production to meet projected gas shortages as a result of increasing economic growth.

In the early 2000s, the Colombian Government considered the option of expanding the CCPF. The expansion could enable CCPF to process increased gas production (due to reduced gas reinjection levels at the Cusiana–Cupiagua fields) and treat it for the removal of impurities to produce a pipeline-quality gas.

In 2003, CCPF produced stabilized oil for export, along with water and gas. The gas was mostly reinjected into the reservoir for oil recovery, but 80 MSCFD was provided for sale. The scope of the FEED study was to increase the gas treatment and processing capacity at CCPF to 180 MMSCFD of pipeline-quality gas. The gas would be treated to remove gas impurities, CO<sub>2</sub> and H<sub>2</sub>S, to accomplish this.

### USTDA Study Scope

As part of the FEED, AEG carried out process design studies, determined the optimum gas treatment technology, prepared design drawings, developed equipment specifications, estimated capital and operating costs, and developed procurement and project execution plans for the project. FEED activities also included safety and environmental assessments and developing mitigation options for the identified safety and environmental risks. The study also included integrating the new plant with the existing facilities.

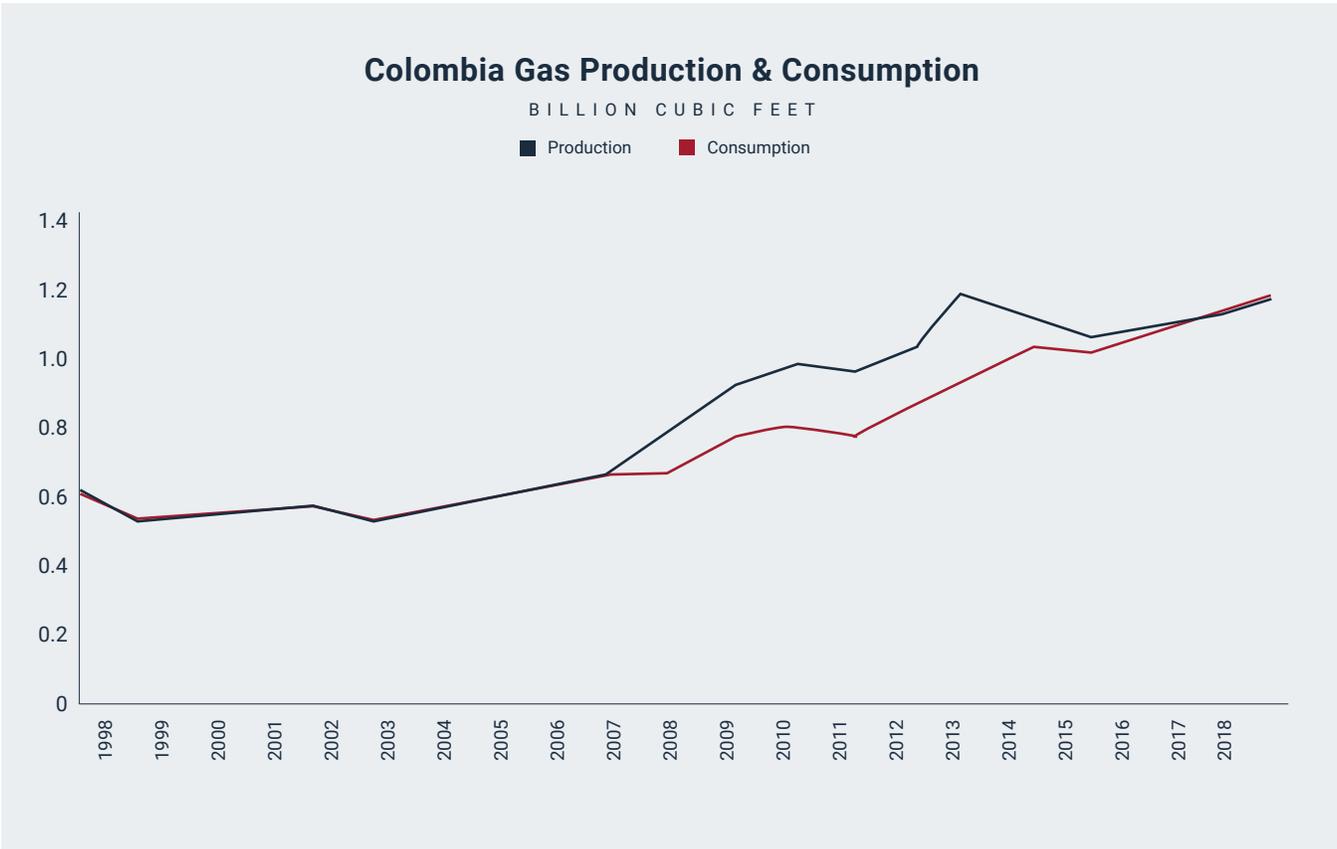
### Outcomes

After the FEED study was completed in 2003, Ecopetrol and its partners at the time, BP and Tepma, a subsidiary of Total SA, awarded an EPC contract to a U.S. firm, Chicago Bridge & Iron (CBI), for the CCPF expansion. In March 2004, the plant expansion project was completed, and CCPF was placed into commercial operation in 2005.

Following the success of this expansion project, and with continued gas demand, in 2010, Ecopetrol announced plans to upgrade CCPF and increase treatment capacity by an additional 70 MSCFD. The original plant was designed to accommodate this expansion, and the project was completed relatively quickly and placed into operation in 2011.

In 2010, Ecopetrol also announced that it would build a new gas processing facility at the Cupiagua field with an initial capacity of 140 MSCFD expandable to 210 MSCFD. The project was in operation by December 2012. The gas plant includes a transfer line between the Cupiagua and Cusiana fields, to enable Cupiagua gas to enter the national transportation system in Cusiana.





Data Source: BP Statistical Review of World Energy, 2019

The initial CCPF expansion project provided export opportunities for U.S. firms, such as CBI, for EPC services and equipment providers, such as Pall Corporation (for gas purification equipment) and Universal Compression (for acid gas compressors). Post construction, Pall Corporation continued to export gas purification products and related equipment for facilities operation and maintenance.

These projects allowed Colombia to meet its increased demand for clean natural gas to power its economy. The increased use of natural gas changed the country’s energy mix and reduced demand for oil and coal.

An important feature of the FEED study was recognizing the future potential plant expansion

need and designing the plant to accommodate the expansion.

The contributing factors to this project’s successful implementation include:

- Alignment of the project sponsor and USTDA objectives, including a transparent and internationally-competitive EPC contract procurement process
- The U.S. contractor’s effective FEED study performance and U.S. industry engagement through the USTDA-funded study
- The Colombian Government and Ecopetrol’s commitment to the project, including a willingness to provide funding for project implementation

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# Case Study: Support for the Turkmenistan Mary-3 Combined-Cycle Power Plant

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The 1,574 MW Mary-3 Combined-Cycle Power Plant in Turkmenistan<sup>6</sup> demonstrates how USTDA uses reverse trade missions as a project preparation tool to facilitate natural gas project development and implementation in emerging markets.

Turkmenistan is one of the five Caspian Sea countries with large volumes of oil and natural gas reserves. Prior to its independence from the Soviet Union in 1991, Turkmenistan was not a major player in the energy market due to a lack of infrastructure and limited export capabilities. Since then, however, the country has increased investment in the sector to develop reserves and export more natural gas.

As a former Soviet Union state, Turkmenistan's electricity infrastructure was also severely outdated and needed upgrades and modernization if it was to make economic progress and improve its citizens' standard of living. One economic development path was to use natural gas to improve power generation capacity and reliability. It was the realization of this vision that encouraged USTDA to fund an reverse trade mission for officials from the Turkmenistan Ministry of Energy and Industry, state electric company (Turkmenenergo), the national gas company (Turkmengaz), and the Mary Power Institute to the United States in 2015.

USTDA's objective was to:

- Introduce Turkmenistan decision makers to U.S. natural gas-to-power generation and electric power transmission-and-distribution technology, know-how, best practices, and equipment suppliers and service providers
- Introduce U.S. companies to business opportunities in Turkmenistan
- Facilitate developing partnerships between U.S. and Turkmenistan natural gas sector players

The reverse trade mission helped develop and implement a 1,574 MW power plant in the city of Mary in southeastern Turkmenistan. The plant construction was successfully completed and began operation in late 2018. The project provided economic growth, new jobs, and skills in Turkmenistan. Additionally, it supported the exports of U.S. manufactured power generation equipment, supporting U.S. jobs.

## Project Background

Located in central Asia, Turkmenistan borders the Caspian Sea between Iran and Kazakhstan, with a population of 5.4 million. Turkmenistan is largely a desert country with significant natural gas and oil resources. In 2018, Turkmenistan's proven hydrocarbon reserves<sup>7</sup> were 600 million barrels of oil and 688 TCF of gas. Turkmenistan is ranked fourth in the world by proven gas

reserves and accounts for almost 10% of proven global gas reserves. Since 2008, its proven gas reserves have increased by almost 250%.

Over the past 20 years, Turkmenistan's natural gas production has exceeded domestic consumption resulting in a significant surplus of gas volumes.<sup>8</sup> In 2018, over 50% of its produced gas was exported. Natural gas almost entirely fuels electricity generation. Turkmenistan's electricity generation exceeds domestic consumption, and the country exports electric power to Afghanistan, Iran, Turkey, and other countries in the region. The Ministry of Energy and Industry controls Turkmenistan's electricity sector.

Turkmenistan embarked on a modernization program to use its plentiful natural gas for its economic development in 2010. The gas modernization program had three components, export, industrialization, and power generation, which helped the country use its gas resources more effectively.

In 2013, the Government of Turkmenistan approved an initiative to upgrade the country's electric grid by 2020. In the first phase of the initiative, from 2013 to 2016, the country installed nine gas-turbine generators and new high-voltage power lines. In the second stage, from 2016 to 2020, the Government plans to build six additional power plants and convert some gas turbines to combined-cycle operations.

USTDA recognized this as an excellent opportunity to expose Turkmenistan decision-makers to U.S. electrical power-sector best

practices and know-how and to help open this market to interested U.S. industry players. USTDA saw this as a win-win opportunity for both Turkmenistan and the U.S. – supporting Turkmenistan to identify high-quality goods and services to meet its developmental goals and U.S. industry to export U.S. manufactured equipment and create jobs.

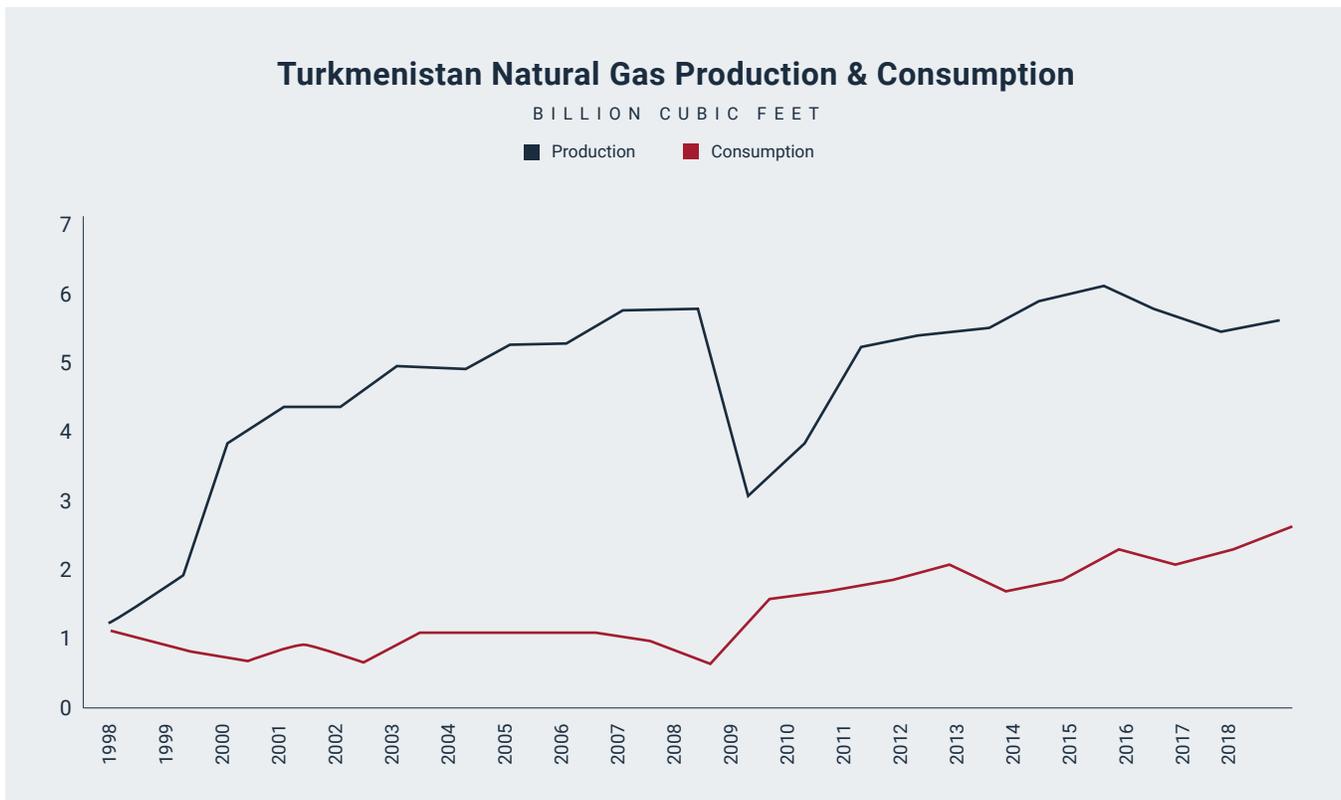
### Reverse Trade Mission Scope

In 2014, USTDA approved funding for an reverse trade mission, which took place in March 2015. The reverse trade mission helped familiarize the Turkmenistan delegates with U.S. electricity transmission and distribution systems. It also introduced them to power plant suppliers that could provide the necessary equipment for the country's planned power plant upgrades. The mission included site visits to electrical power system manufacturers and to one of the largest U.S. electric utilities. In addition to introducing U.S. technologies and services to the delegation, the reverse trade mission was an excellent opportunity for U.S. businesses to develop new, or enhance existing, relationships with the decision-makers in the Turkmenistan power sector.

### Outcomes

The Mary-3 Combined-Cycle Power Plant is a next-generation facility with a capacity to generate 1,574 MW. At completion in 2018, this plant was the largest power facility in the region. It consists of four gas turbines, each with a capacity of 263 MW, and two steam turbines with a capacity of 261 MW each. The plant was completed and placed in operation in September 2018. Gas turbines for the project





Data Source: BP Statistical Review of World Energy 2019; CIS: Commonwealth of Independent States.

were supplied by GE, a U.S. company, supplied gas turbines for the project.

At the opening ceremony of the Mary-3 Combined-Cycle Power Plant in September 2018, the European Director of the Swiss Federal Institute of Technology, Andreas Yanzen, said that “By all standards the project meets the state-of-the-art and advanced standards.”<sup>9</sup>

During the reverse trade mission, Turkmen decision-makers visited U.S. manufacturing facilities, meeting with U.S. technology developers and suppliers. This exposure to the U.S. natural gas industry increased their awareness of U.S. technologies, services, and best practices. The reverse trade mission also revitalized the relationships between U.S. businesses and the Turkmenistan Government ministries and organizations’ decision-makers.

USTDA’s visit and the successful implementation of the Mary-3 Combined-Cycle Power Plant, exemplifies that:

- Reverse trade missions are an effective partnership development tool, especially when targeted to help meet a specific need
- USTDA facilitates relationship building between U.S. industry players and project sponsors and to enable exports of high-quality U.S. goods and services while helping project sponsors meet their developmental goals
- USTDA tailors reverse trade missions according to the host country’s goals. Similarly, the host country delegation must include key industry experts and decision makers



## USTDA's Value Proposition

USTDA provides significant value to natural gas projects at the design and construction phase of development, bringing high-quality, efficient, applicable, and relevant U.S. industry know-how, best practices, and technology to each project. Engagement with U.S. industry practitioners and goods and services suppliers provides project owners an opportunity to improve their design, procurement, and construction plans. In turn, this reduces project execution risks and improves project performance results. Although the projects' fundamental design parameters may be pre-established, project design and construction present an opportunity to firm-up and incrementally improve those parameters.

Procurement planning is a critical activity during the design and construction phase. USTDA, through its Global Procurement Initiative (GPI), works with its overseas partners to strengthen their procurement practices through customized activities based on each country's unique needs. The GPI's activities include training on acquisition planning, market research, and tender development that teach how to implement international best practices utilizing best-value determinations and life-cycle analysis to plan for and purchase high-quality infrastructure.

# PROJECT COMMISSIONING AND OPERATION

**USTDA project preparation funding supports projects that are being commissioned or made operational. Support in this phase is typically provided to optimize existing infrastructure assets' operational performance or to train project sponsor personnel to operate and maintain new, U.S. industry-supplied infrastructure assets and management practices. Projects in this phase of the development and implementation cycle are low risk relative to the other stages due to the fact that existing assets are nearing commercial operation or are already in commercial operation.**

USTDA supports asset owners and operators to enhance the design, operation, and productivity of existing natural gas infrastructure. USTDA support for projects in the project commissioning and operation phase has typically addressed:

- Asset and facility management
- Energy management
- System or asset performance and efficiency improvements
- Operational data collection and automation management (asset-performance monitoring, billing and collection systems, etc.)
- Training needs



USTDA's goal in providing support for projects in this phase of development is to enhance an asset's operational efficiency and revenue generation for the host country project owner, or sponsor, while enhancing opportunities for exports by U.S. industry. These activities led to the implementation of projects that benefited the host countries in a number of ways, including:

- Infrastructure development and efficiency gains
  - Increased gas production
  - Improved gas transportation system
  - Improved power delivery and continuity of service
  - Economic growth
  - Shared skills and know-how
- Promoting effective markets and governance
  - Adoption of laws and or regulations that support effective governance

### USTDA Engagement in the Project Commissioning & Operation Phase

USTDA funded 20 activities supporting natural gas sector projects in the project commissioning and operation phase between 1981 and 2018. These activities generated over \$3 billion in U.S.

exports. The 20 gas sector activities funded in this phase includes 13 feasibility studies, five technical trainings, and one each TA and reverse trade mission. Gas exploration and production projects accounted for the most projects receiving USTDA support at this phase of development, followed by pipeline and storage and gas-fired power projects. The Middle East, North Africa, Europe, and Eurasia region had the greatest demand for USTDA commissioning and operation activities.

Among USTDA activities in this phase, technical training generated the highest volume of U.S. exports, had the highest exports to the USTDA investment ratio, and the fourth-highest implementation rate. Across subsectors, gas-fired power projects generated the highest volume of U.S. exports and had the highest exports to the USTDA investment ratio and the third-highest implementation rate. Regionally, the Middle East, North Africa, Europe, and Eurasia region generated the highest volume of U.S. exports and had the highest export to the USTDA investment ratio and the fourth-highest implementation rate. Sub-Saharan Africa did not have any activities in this phase.

### USTDA's Natural Gas Activities in the Project Commissioning and Operation Phase



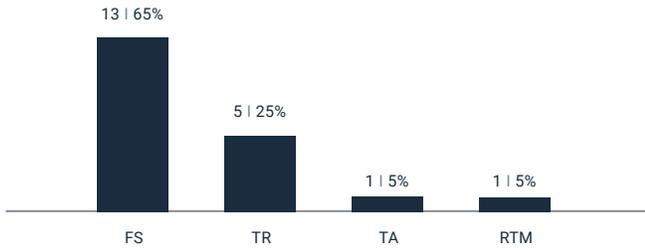
**20 Activities Funded**

**Over \$3 Billion of Exports U.S. Generated**

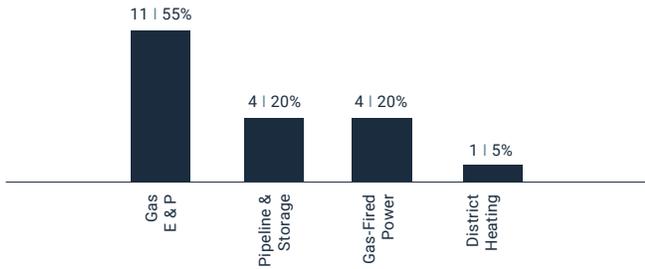
## USTDA Activities

1981 - 2018

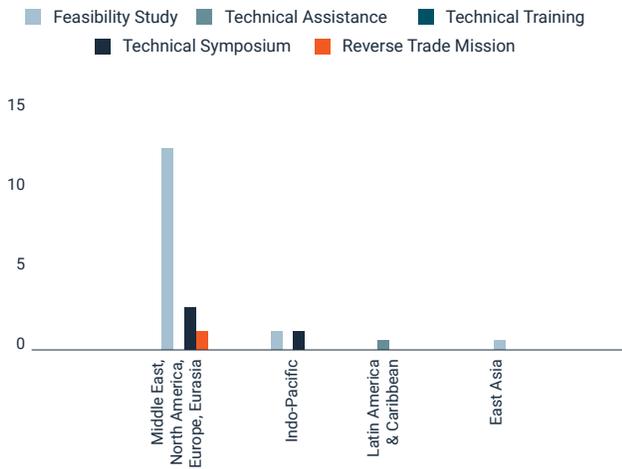
### Project Commissioning and Operation



### Subsectors



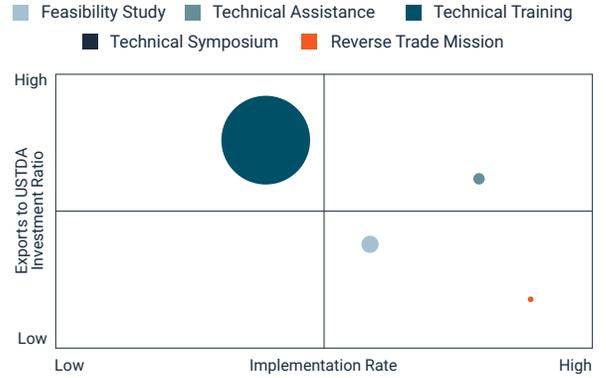
### Regions



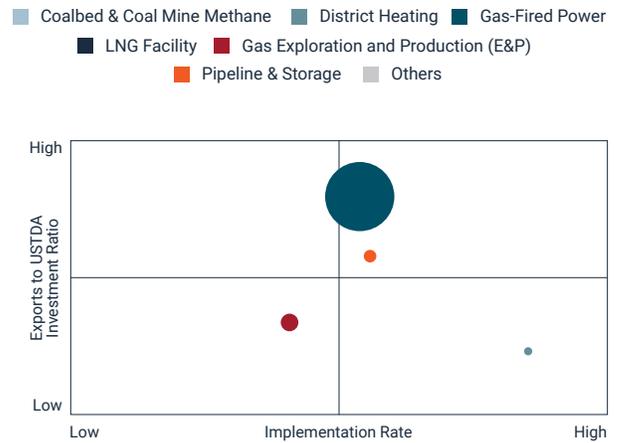
## USTDA Success Metrics

CIRCLES INDICATE RELATIVE EXPORTS VOLUME

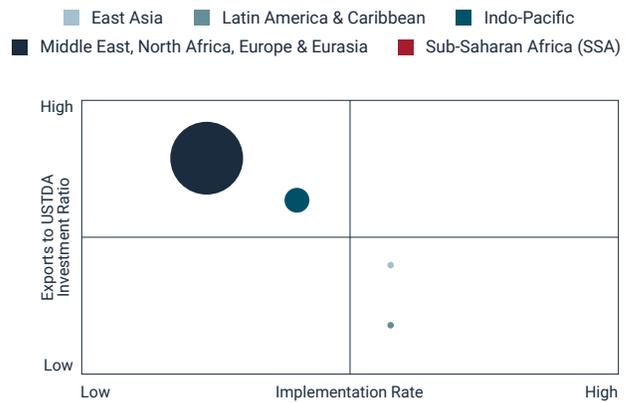
### Activities



### Subsectors



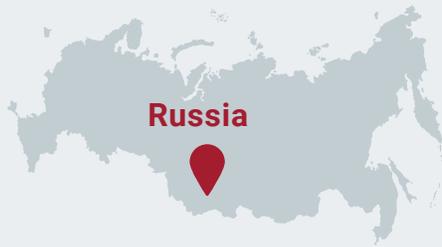
### Regions



# Projects Overview: USTDA Optimizes Project Performance in the Commissioning and Operation Phase

USTDA-supported projects in the project commissioning and operation phase are diverse and include gas-field expansion development planning, developing resource databases and energy company information technology (IT) systems, modernizing pipeline network automation and control systems, and gas-fired power plant conversions and facilities enhancements.





## USTDA Supported Foreign Investment in Post-Cold War Russia's Oil and Gas Sector

*Emerging from the Cold War, Russia needed foreign investment to develop its struggling economy. USTDA provided critical support to help open up the country's oil and gas sector through developing a resource management data collection and information system that enabled data sharing in accordance with the industry's international best practices.*

### Oil and Gas Resource Management and Assessment Project Implementation Feasibility Study<sup>1</sup>

In 1992, USTDA provided grant funding for a feasibility study to the Government of the Tyumen region of Russia to evaluate and make recommendations regarding a pilot oil and gas resource management and assessment project. The study objectives were to:

- Determine the nature and availability of information necessary for assessing the fields to be open to foreign investment
- Determine the requirements for implementing the "Alberta Model" of Resource Management in Siberia
- Establish a pilot Data Collection and Information System, including software, hardware, and technology
- Indicate whether the studied database model and related software could meet Russia's long-term requirements for information management in the sector
- Transfer information collection techniques to the Russian implementation teams
- Define the requirements for a follow-up resource and economic analysis study





## State of the Art U.S. Drilling Technology Increased Gas Production in Argentina

*U.S. industry has been a global leader in oil and gas drilling and extraction techniques for 200 years. USTDA provided technical assistance that helped optimize gas and oil production in Argentina that utilized cutting-edge U.S. technology and know-how from leading U.S. suppliers.*

### Multiple Fracture Treatment of Commingled Oil and Gas Wells Technical Assistance<sup>2</sup>

In 2001, USTDA partially funded a TA grant to Tecpetrol, an oil and gas exploration, production, and transportation multinational with operations throughout the Americas. The objective was to introduce Tecpetrol to U.S. technology and know-how for multiple fracture treatment of Tecpetrol's commingled oil and gas wells and to optimize potential production from existing and new wells in the Golfo de San Jorge basin in Argentina. Halliburton Energy Services completed the TA in 2003. Tecpetrol adopted all the recommendations, and the new fracturing methods were deployed.

The TA benefited Tecpetrol and Argentina by building personnel skills, technology transfer, and improved field productivity. Implementation of the project led to the export of U.S. hydraulic fracturing equipment, supplies, and services.





### USTDA Supported Implementation of a GIS System, Improving Oil and Gas Operational Efficiency in Morocco

*These USTDA-supported feasibility studies helped the Government of Morocco plan and later implemented a geographic information system (GIS) to support oil and gas exploration and production.*

#### Systeme D'Information de Exploration et de la Production Miniere et Petroliere Feasibility Study<sup>3</sup>

In 2001 and 2005, USTDA approved two grants to Morocco's Office National de Recherches et d'Exploitations Petrolieres (ONAREP), which later became Office National des Hydrocarbures et des Mines (ONHYM). The 2001 grant funded a feasibility study to:

- Review available information (ONAREP's organization and functions, IT structure, and IT plan)
- Conduct financial analysis
- Develop an implementation plan for a GIS and associated IT based on international industry practices

This study was completed in 2004. The following year, USTDA funded a TA grant to implement the feasibility study recommendations. The TA helped ONHYM to:

- Prepare tender documents for a national, GIS-based IT system called "Systeme D'Information de Exploration et de la Production Miniere et Petroliere" (SIEPMP), for the exploration and production of oil, natural gas, and minerals
- Evaluate technical proposals received in response to request for proposals
- Contract negotiations with the selected vendor
- Develop a project control methodology and validation (testing) of deliverables during project implementation
- Train ONHYM staff to operate and maintain the installed SIEPMP

Project implementation ended in early 2009. USTDA's support benefited Morocco by transferring technology that improved data collection and management for organizing geotechnical data, which opened up the country's petroleum exploration industry. This project also supported exports of U.S. hydraulic fracturing equipment and related engineering services.



## USTDA Supported Emerging Gas Industry in Post-War Iraq

*This training program helped the newly formed Iraqi Ministry of Oil to develop processes, policies, and procedures to improve oil and gas asset development and operation.*

### Iraqi Ministry of Oil Personnel Technical and Administrative Training<sup>4</sup>

In 2005, USTDA provided a grant to fund TA for the human resources training segment of the Iraq Oil Training Program (IOTP), a program that provided technical and ministerial training by U.S. oil and gas industry experts to their counterparts in the Iraqi Ministry of Oil (MOO). The goal was to assist the MOO in improving its management processes, policies, and procedures that would lead to enhanced oil and gas field asset development and operations. U.S. energy companies securing and conducting business in Iraq would benefit from exposing key decision-makers within the MOO to U.S. goods, services, technologies, and management practices during the training.

Today, Iraq's gas production of 1 MCFD is expected to triple to 3 MCFD by 2022. The increased gas production will allow the country to satisfy its own growing domestic gas demand and may potentially launch Iraq into the global market as a gas exporter for the first time.



# Case Studies

## Spotlight on Algeria and Romania: USTDA Success Stories at the Commissioning and Operation Phase

This section showcases two successful projects receiving USTDA project preparation funding at the project commissioning and operation phase. The first project (Algeria) received funding for training and the second (Romania) for a feasibility study. These activities demonstrate how USTDA's funding can support project implementation and enable U.S. export development even at this late stage of project development.

# Case Study: Algerian (Sonelgaz) Natural Gas-Fired Power Generation and Equipment Upgrades Technical Training<sup>5</sup>

USTDA provided grant funding for two technical training programs to the Algerian state-owned utility Sonelgaz in 2013 and 2017. The USTDA-sponsored technical training supported significant exports of U.S. gas turbine equipment and related services, led to the development of new utility management and operation and maintenance skills, and made the Algerian electric grid more reliable and efficient.

## Project Background

In 1998, USTDA provided a feasibility study<sup>6</sup> grant to Sonelgaz for assessing the technical, economic, and commercial viability of the proposed Hadret Ennass 1,200 MW greenfield Independent Power Producer (IPP) project. At the time, French firms were very active in Algeria's energy sector. The Algerian procurement laws were also written with a Euro-centric focus, resulting in the limited competition by international firms for projects in Algeria. The USTDA-funded study is credited with recommending and helping to codify a new, internationally applicable procurement standard, helping to open the Algerian market to international competition.

Following the opening of the Algerian power market, in 2013, USTDA provided a technical training grant<sup>7</sup> to Société Algérienne de Production de l'Électricité (SPE), part of the Algerian Sonelgaz Group, supporting U.S.

equipment manufacturer General Electric (GE) in supplying U.S.-manufactured natural gas turbines for combined-cycle (NGCC) power plants in Algeria. USTDA funding was for GE to provide specialized management, leadership, and business training to Sonelgaz executives and senior managers. In 2013, GE reported supplying gas turbines, steam turbines, and generators for Sonelgaz power plants, totaling \$2.7 billion.<sup>8</sup>

In 2017, Sonelgaz awarded a follow-on contract to GE to upgrade the company's existing NGCC power plants. Additional USTDA funding to extend the initial training grant was integral to the contractor's successful bid.

## USTDA Funded Training Scope

In response to increasing demand for electricity generation in Algeria, state-owned utility SPE, part of the Sonelgaz Group (Sonelgaz) responsible for electricity production and supply, released a tender for \$2.2 billion of turbines for its NGCC power plants in late 2012. Sonelgaz had indicated that specialized management, leadership, and business training to Sonelgaz executives and senior managers would be of great value to successful project implementation. GE was the only U.S.-based supplier competing for sale of equipment to Sonelgaz, and two foreign competitors were expected to offer training as part of their bids. GE



requested USTDA support in providing funding for the training. GE also obtained significant senior-level advocacy in support of its bid from the White House, the U.S. Department of State, the U.S. Department of Energy, and the U.S. Department of Commerce.

USTDA offered to support Sonelgaz in training its workforce to manage and operate the U.S.-made equipment and to upgrade its electric generation grid should they select a U.S.-made solution.

The training grant funded five Sonelgaz executives' travel to the U.S. to attend GE's Global Customer Training Program and for 25 Sonelgaz senior managers to attend GE's specialized management courses. The training programs were structured to occur on an annual basis for four years to strengthen leadership,

business, innovation, strategy, and project management skills of Sonelgaz's workforce.

### Outcomes

With USTDA's training grant support, GE successfully supplied equipment to six Algerian power plants. The plants, located in northern Algeria, began simple-cycle operation in 2015 and full combined-cycle service in 2017. Together, the plants added more than eight GW to Algeria's electricity generation capacity, enough to help meet the needs of eight million Algerian households. The technical training is credited with assisting Sonelgaz to build the leadership, business, innovation, strategy, and project management skills for its workforce while enhancing their technical capacity to manage the new investment in U.S. technology.





Building on the successful initial bid, GE initiated discussions with Sonelgaz in late-2015 for upgrading existing power plants to expand power generation capacity, while improving efficiency and ensuring proper servicing of previously installed gas turbines. The proposal, submitted to Sonelgaz in April 2016, included equipment and software upgrades and 20-year, long-term service contracts for upgrading the turbines. The equipment and software upgrades, along with the long-term servicing contracts, would enable the upgraded NGCC power plants to produce more power while using less fuel and help Sonelgaz accelerate the retirement of some of its older, less efficient, power plants.

In 2017, GE was awarded a follow-on contract with Sonelgaz to upgrade the company's existing NGCC power plants. Integral to GE's successful second bid was USTDA funding to extend the initial training grant, which included a follow-on annual management, leadership, and business training program over an extended two-year period for Sonelgaz executives.

USTDA's training program also helped to solidify a critical business relationship between Sonelgaz and GE further, setting a foundation for future success. The impacts of their successful partnership go far beyond increasing Algeria's access to electric power. GE and Sonelgaz formed a joint venture, GE Algeria Turbines (GEAT), to manufacture equipment, including spare parts for Algerian power plants.<sup>9</sup>

As of 2018, the USTDA training has supported building the power sector personnel capacity within the Sonelgaz workforce by providing leadership, business, strategy, and project management skills for 30 Sonelgaz personnel annually over six years. The training also reinforced the U.S. Government's commitment to Algeria's infrastructure development goals. It supported expanding Algeria's energy sector to meet energy generation needs, and it paved the way for a continued working relationship between Algeria and GE.

# Case Study: Romania Natural Gas Production Enhancement Feasibility Study<sup>10</sup>

In 2001, USTDA approved a feasibility study grant to Romgaz, S.A., Romania's largest gas producer and a state-owned enterprise, to evaluate how to enhance production at its Filitelnic gas field. The feasibility study, which was completed in 2004, supported derisking gas field investment and increasing production by 8 BCM, from 9.5 BCM to 17.5 BCM, over a 30-year period. This could also increase the field's value by \$100 million (in 2004 dollars).

The study evaluated the causes for gas production decline, identified applicable new technologies for enhancing production, and developed procedures and management plans for rehabilitating the field. This activity led to successfully improving Romanian gas production efficiency and to the procurement of new U.S. gas compressors, associated equipment, and related U.S. services for upgrading the Filitelnic compressor station facilities.

## Project Background

In 2002, Romgaz's Filitelnic gas field, located within the Transylvanian Basin of Central Romania, included two compressor stations, Filitelnic and Tigmandru, one dehydration facility, a series of connecting pipelines, and over 300 active wells. It was the largest gas field in Romania. At the turn of the century, it was economically important to the country to

operate the Filitelnic gas wells at maximum possible production capacity, but the field was experiencing declining rates of production.

## Feasibility Study Scope

The USTDA-funded feasibility study included the analysis of available data to identify the cause of declining gas production, new technologies to enhance production, and developing procedures and management plans for Romgaz. The information was used to rehabilitate gas wells to increase the Filitelnic's production efficiency and reliability. The study:

- Assessed the technical, economic, and financial viability of rehabilitating the production wells
- Analyzed the environmental impact of the proposed rehabilitation
- Conducted a regulatory review of the gas sector
- Developed an implementation plan for the wells' rehabilitation

The available data at the time was not adequate to address all of the issues behind the decline in gas production. Instead, a series of tests were performed on the field's two largest producing wells, which supported recommendations for the well surveillance, testing, and rehabilitation programs.



## USTDA Study Findings

The study contractor, Gaffney, Cline & Associates, Inc., recommended to undertake an intensive well surveillance effort and estimated that production of the Filitelnic field could be increased by 8 BCM over a 30-year period through a sequential production enhancement program. The contractor also found that implementing the program could potentially increase the field's value by \$100 million (in 2004 dollars). The recommended production-enhancement program consisted of ongoing well surveillance, liquid removal, reservoir stimulation, and new drilling and well re-completions. The contractor also recommended accelerating plans to modernize the Filitelnic compressor station.

The contractor developed well testing procedures, made recommendations to replace existing tubing on some of the wells, and evaluated the potential for drilling new wells, conducting re-completion on some of the production wells, and removing wellhead choke restrictions, where possible.

### Outcomes

Romgaz implemented the contractor's recommendations and benefited from increased efficiency gains and natural gas production rates and technology and knowledge transfer.

Romgaz completed recommendations to conduct the well surveillance program, measuring well potentials using different flow or choke rates, conducting coiled-tubing nitrogen lift operations, and incorporating the contractor's recommendations into its field operations. Romgaz also modernized



the Filitelnic compression station. According to Romgaz's 2013 annual report, "...reservoir decline was largely mitigated. The average annual decline is around 1%–2% as compared to the natural decline of approximately 7%–10%."<sup>11</sup>

In 2008, Romgaz procured four U.S.-manufactured high pressure, natural gas-fueled compressors for the Filitelnic compression station. The compressors improved the Filitelnic field's natural gas outputs and helped ensure reliable natural gas transport.

USTDA's support for the Romgaz feasibility study effectively helped derisk investment in new infrastructure, improved facility operations, and asset optimization and provided new opportunities for exporting U.S. equipment and services.

Since the study's conclusion, Romgaz has redeveloped its natural gas fields through new reservoir modeling, well completion, and reservoir stimulation. The company has introduced a process monitoring system and acquired 3D-seismic data that outlines exploration and development targets in the Filitelnic field.



## USTDA's Value Proposition

USTDA adds value to existing energy infrastructure performance in partner countries by introducing qualified U.S. experts, who evaluate and assess natural gas asset performance and recommend technical and economic solutions. Through the deployment of its various project preparation tools, USTDA helps project developers and sponsors to:



Increase gas and oil production efficiency and rates in existing reservoirs by providing grant funding for studies to identify and implement technical solutions for well drilling, completion and related production, storage, and transportation asset enhancements;



Increase natural gas pipeline systems' operational safety and performance by providing grant funding for studies to identify and implement technical recommendations for pipeline monitoring and control systems;



Enhance gas-fired power generation facilities' economic performance, safety, and environmental compliance by providing grant funding for studies to identify technical recommendations for selecting generating equipment and upgrades; and



Improve the safety and efficiency of energy asset management through improvements in regulatory and corporate governance policies and technical training.

# PROJECT PROPOSAL TOOL KIT

**USTDA provides emerging Markets project stakeholders and U.S. industry players with a variety of tools to support project development in the natural gas sector. USTDA also funds long-term initiatives and forms strategic partnerships with other development agencies to advance emerging market high-priority infrastructure projects while creating jobs at home. This section describes USTDA's tools and how project stakeholders and U.S. companies may engage USTDA to advance the development of their natural gas projects.**

## USTDA Support is Mutually Beneficial to Partner Countries and U.S. Industry

USTDA works in emerging markets\* that can benefit from U.S. industry-provided, high-quality solutions that help them meet their economic development goals. USTDA's work is mutually beneficial: partner countries receive support to advance infrastructure priorities, while U.S. businesses gain access to new market opportunities. USTDA approaches its mission primarily by funding early-stage project preparation activities – taking early project development risks – helping to lay the groundwork for infrastructure project financing and implementation. However, later-stage project preparation funding is also available for project financing, design and construction, and commissioning and operation when support can overcome specifically identified project

development hurdles. Some late-stage funding examples include overcoming lack of funding for developing procurement packages, negotiating natural gas sales agreements, or conducting FEED studies for expanding an existing natural gas facility to get project financing.

USTDA is a market-driven agency responding to the infrastructure priorities of its partner countries. Demand for natural gas infrastructure has increased in recent years as natural gas prices have stabilized, supplies have increased, and it is now viewed as a clean and sustainable fuel, not only for power generation but also for transportation.

\*Overseas project sponsors and U.S. firms are urged to contact USTDA directly for information regarding the availability of USTDA's tools and programs in specific countries.



## Tools of the Trade

To accomplish its mission, USTDA provides tools to support project development through funding, grants, sponsorship, and relationship building. It funds project development tools, such as feasibility studies, technical assistance, and technical training and international business partnership tools, such as reverse trade missions, technical workshops, and symposiums. USTDA provides gap funding to help address obstacles that might prevent a project from successful implementation, such as weak regulatory structures, insufficient institutional or managerial capacity, lack of proper financial and legal expertise, and absent adequate tariff structures.

The Agency awards grants to overseas project sponsors in emerging markets to introduce those sponsors and other project stakeholders to U.S. design, manufacture and operation of goods, industry best practices, services, and service providers.

USTDA-sponsored activities help overseas partners get financing from a variety of sources, such as U.S. Government financial institutions, commercial banks, private equity funds, multilateral institutions, and local development banks. Multiple available financing resources increases the likelihood of



project implementation, which in turn increases the potential for greater developmental impacts and more U.S. exports.

USTDA activities connect U.S. companies and leading decision-makers from high-growth markets, promoting U.S. exports and advancing economic growth in developing and middle-income countries.

## USTDA Project Preparation Tools

### Project Development Tools

#### Feasibility Studies

Feasibility studies connect overseas project sponsors and developers with U.S. companies. The goal of these studies is to provide a comprehensive analysis required for major natural gas and LNG infrastructure investments to achieve financing and implementation. USTDA leverages the studies to demonstrate the effectiveness of commercially proven U.S. solutions and provides the analysis, evaluation, and empirical data needed for potential foreign projects to secure funding.

#### Technical Assistance

USTDA advances economic development in partner countries by providing technical assistance that supports legal and regulatory reform related to natural gas commercial activities and infrastructure development, the establishment of natural gas and LNG industry standards, and other market-opening activities. These technical assistance activities facilitate favorable business and trade environments for U.S. goods and services.

#### Technical Training

USTDA provides training for foreign decision-makers to introduce them to the U.S. natural gas best practices. USTDA training programs take place in either the U.S. or the host country. They typically focus on technology, or regulatory requirements, to provide project sponsors with a better understanding of U.S. best practices, capabilities, and procurement opportunity-related expertise.

### International Business Partnership Tools

#### Technical Workshops, Symposiums, and Conferences

USTDA's workshops, symposiums, and conferences convene government and industry leaders to discuss business opportunities in high-growth markets. These events help U.S. and overseas partners build commercial partnerships by providing a platform for sharing innovative options for technology and financing.

#### Reverse Trade Missions

Reverse trade missions bring overseas decision-makers to the U.S., introducing them to the design, manufacture, and operation of U.S. goods and services. These delegations travel throughout the U.S. to identify potential U.S. solutions they can integrate into their major infrastructure investments.

# Strategic Initiatives and Partnerships Engage Stakeholders Across the Project Value Chain

In addition to project preparation tools, USTDA funds long-term initiatives and forms strategic partnerships with other development agencies to advance its dual mission: Advancing emerging market high-priority infrastructure projects while creating jobs at home.

## USTDA Long-Term Initiatives

**U.S. Gas Infrastructure Exports Initiative:** This initiative connects American companies to export opportunities across the gas value chain in emerging economies. The initiative aims to advance gas infrastructure in partner countries by connecting project sponsors to cutting-edge U.S. technologies, equipment, and solutions.

**Making Global Local:** This initiative establishes links between U.S. companies and foreign project sponsors, bringing private-sector solutions to development challenges abroad. Making Global Local endeavors to increase the number of U.S. businesses that benefit from the Agency's programs, enabling them to expand their exports to emerging markets and create high-paying jobs in their communities. To accomplish this goal, USTDA has forged innovative partnerships with business development and trade promotion organizations across the country.

**Global Procurement Initiative: Understanding Best Value:** For many years, partner countries expressed dissatisfaction with their





infrastructure investment outcomes. They often made significant investments in critical assets but frequently chose the lowest-cost solutions that were unsustainable, impeded fair competition, and prevented continuous economic growth. In response, USTDA launched the Global Procurement Initiative (GPI): Understanding Best Value. The GPI provides training for overseas procurement officials on best value for money determinations and life cycle cost analysis. By helping partner countries align their procurement criteria with value for money, the GPI helps them acquire smarter, longer-term investments with overall savings. Because of the GPI, U.S. companies are able to bid and qualify for more tenders, providing high-quality products at higher initial cost than their foreign competitors but at a lower life-cycle cost. Since launching the GPI in 2013, USTDA has established numerous overseas

partnerships and continues to receive interest from additional countries in the emerging markets.

### USTDA's Strategic Partnerships

*Power Africa:* Supporting development of energy projects in Africa. Power Africa brings together the world's top companies, political leaders, and financial institutions to help overcome Africa's energy crisis. Power Africa uses collective problem solving to enable African leaders to pave their own future.

*Partnership with the Development Bank of Southern Africa (DBSA) and the Industrial Development Corporation of South Africa (IDC):* Supporting broad-based energy project development, including development of large scale gas projects in Sub-Saharan Africa.

# How to Engage with USTDA

## Overseas Project Sponsors

Project sponsors can be private or public entities in emerging markets where USTDA works. Depending on project location, project developers or sponsors may engage with USTDA staff in that region to discuss their project and identify the USTDA-sponsored activity or program that best meets their needs. After these preliminary discussions, a concept paper, or white paper, may be submitted to USTDA that further describes the project, project development status and need, and requested USTDA support. Depending on the project's nature and the request, USTDA then works with project sponsors to develop the activity scope for funding under a grant agreement.

USTDA works with overseas project sponsors in emerging markets in Latin America and the

Caribbean, the Middle East, North Africa, Europe and Eurasia, the Indo-Pacific, and Sub-Saharan Africa to advance important development projects, including natural gas and LNG projects. USTDA's program success is due in large part to the dedication of the project sponsors. USTDA works with these project sponsors in host countries to make effective use of USTDA assistance.

USTDA's targeted grants provide overseas project sponsors access to U.S. private sector expertise in the pursuit of their infrastructure development objectives. Project sponsors must select U.S. firms to perform the USTDA grant-funded work. However, there is no further obligation to procure U.S. goods or services once a USTDA activity is completed.

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## Regions Where USTDA Works

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CLICK ON THE MAP BELOW TO LEARN MORE ABOUT USTDA'S REGIONS





### U.S. Firms

USTDA encourages U.S. consulting companies and U.S. exporters to engage with USTDA to learn more about upcoming events and export opportunities. U.S. exporters can visit the Business Opportunities section of USTDA's website regularly to view USTDA opportunities open for bid (<https://ustda.gov/business-opportunities/opportunities-ustda>).

The same website provides information on projects under development, grants, and contracts. This website provides the leads U.S. companies need for following up with either the

overseas project sponsors or the U.S. contractor doing the work. U.S. consulting firms interested in contracting opportunities with USTDA must register with the U.S. Government's Central Contractor Registration database (<https://www.sam.gov/SAM/>). USTDA offers a free monthly eNewsletter, TradePosts, that includes links to these opportunities and information on upcoming deal-making events. [Click here](#) to subscribe to TradePosts.

## USTDA's Grant Funding Criteria Helps Identify Potential Projects

USTDA grant funding for feasibility studies and technical assistance, including pilot projects, provides overseas project sponsors with critical, early-stage project preparation assistance to help attract financing and advance to project implementation. The project sponsor may be a government institution at the national, state, provincial, department, or municipal level, or a local private company. For sole source projects, both the overseas project sponsor and a U.S. firm must be identified and engaged before submitting a proposal to USTDA. USTDA grant amounts vary but are typically between \$500,000 and \$1,000,000 million.

USTDA provides project preparation funding for projects in emerging markets. USTDA encourages overseas project sponsors and U.S. firms to contact USTDA directly for information about available funding in specific countries.

By design, USTDA activities facilitate U.S. private sector participation in overseas projects that have the potential to generate substantial exports of U.S. goods and services. The activities promote U.S. exports of commercially available technologies and equipment. USTDA does not provide grant funding for the potential



export of non-commercial scale technologies or for research and development activities.

Both the U.S. firm and the overseas project sponsor involved in a project must show experience by providing a record of success in similar or closely related projects and by providing three years of audited financial statements that show a record of successful business operations. USTDA activities support projects with a reasonable likelihood of obtaining project implementation financing. The U.S. firm and the overseas project sponsor should identify likely sources of debt or equity financing (such as the Export-Import Bank of the United States, Overseas Private Investment Corporation, multilateral development banks, commercial banks, or other institutions) and gain an expressed interest in the financing from a financial institution.

Other USTDA funding criteria\* for grants are as follows:

- The prime contractor must be a U.S. Firm
- The U.S. firm may subcontract with other U.S. firms without limitation
- The U.S. firm's employees must meet USTDA's nationality requirements (i.e. be U.S. citizens, lawfully admitted for permanent residence in the U.S., or non-U.S. citizens lawfully admitted to work in the U.S.)
- Up to 20% of the USTDA grant amount can be allocated for sourcing work from the country's nationals (i.e. the host country) where the project is located
- The host country's subcontractors are only to be used for specific services in accordance with the Terms of Reference identified in the

grant agreement

- Subcontractors from outside the host country and the U.S. are not allowed
- Goods purchased to perform the study and associated delivery services (e.g. international transportation and insurance) must be of U.S. origin. However, goods and services incidental to the study's support (e.g. local lodging, food, and transportation) in the host country are not subject to U.S. origin requirements
- USTDA grant funds cannot be allocated for purchasing equipment, computer software, or simulation programs

For sole source proposals, USTDA requires the U.S. firm(s) to share the cost of the project development activity with USTDA and the U.S. firm is typically asked to participate in a success fee program.<sup>3</sup> The funding provided by the U.S. firm, as their cost-share amount, is not subject to the above USTDA funding criteria.

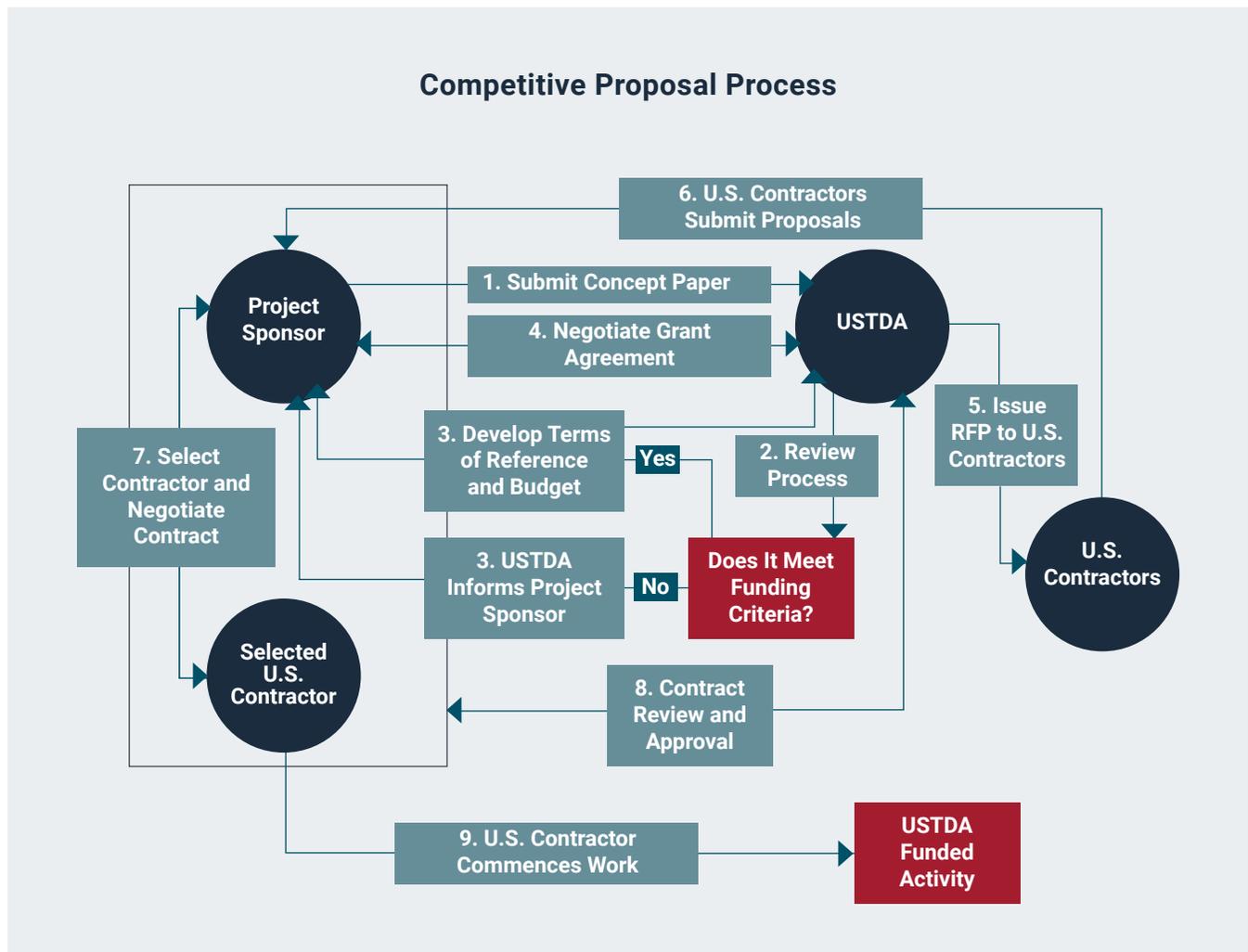
If a U.S. firm commercially benefits from a USTDA-funded activity, success fees are used to recoup USTDA's grant funding. Examples of commercial benefits include project investment, return on financing, and revenue generation from the sale of goods and services. The U.S. firm's obligation to pay a success fee is triggered if and when the U.S. firm earns revenue from any related project work after the completion of the USTDA-funded activity.

\*Funding criteria for grants are subject to change. Please contact USTDA for most recent information.

# USTDA Awards Grant Funding In Two Ways

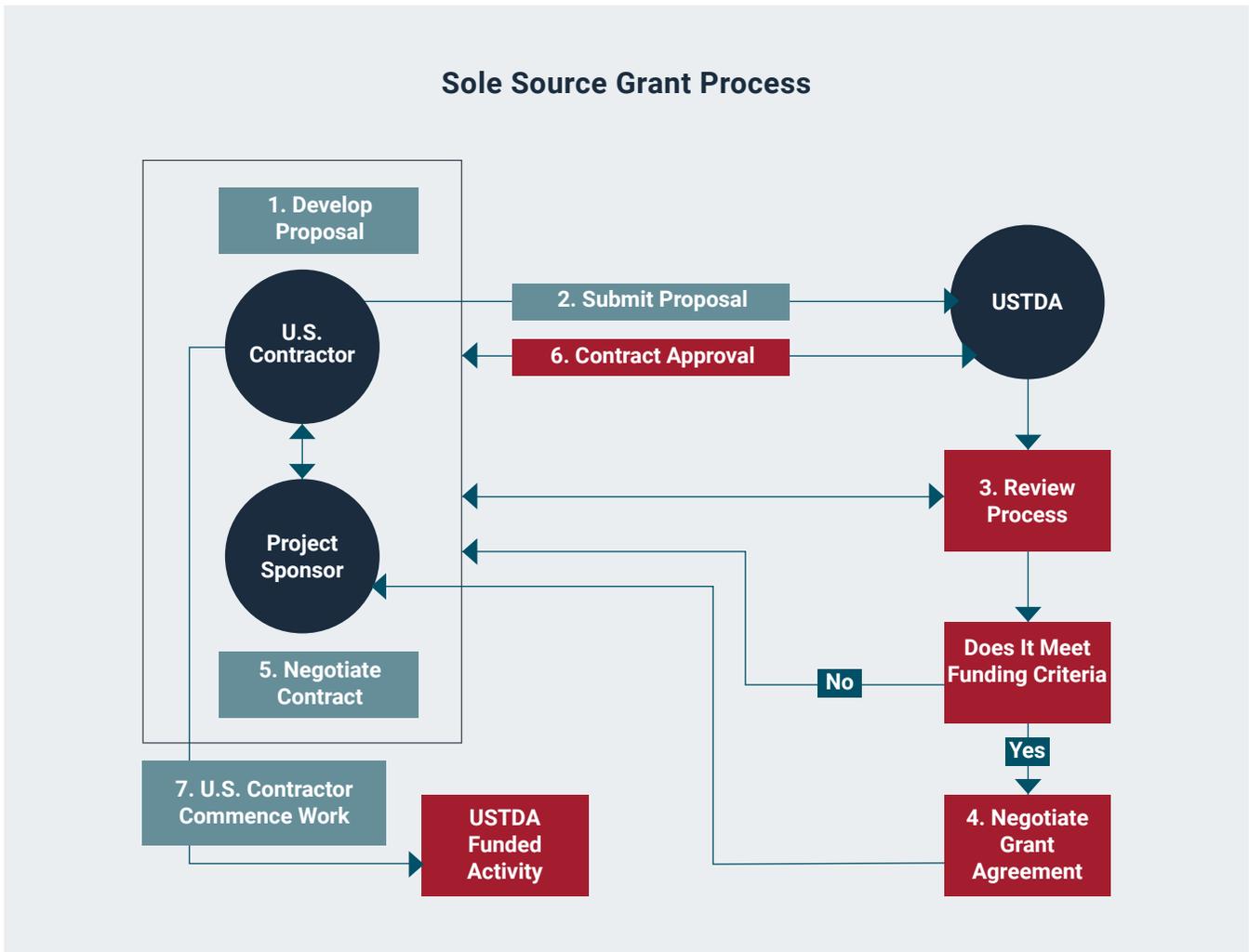
## Competitive Proposal Process

A competitive proposal process is for project sponsors that have identified a project that could benefit from USTDA’s project preparation funding but have not yet identified a U.S. firm to perform the proposed activity. After the USTDA reviews and approves the project sponsor’s concept, USTDA posts the proposed activity on the Federal Business Opportunity Website (<https://fbohome.sam.gov>) on the project sponsor’s behalf. All qualified and interested U.S. firms can then submit their proposal to the project sponsor. The project sponsor reviews and selects the U.S. firm to perform the work. USTDA may require project sponsors to cost-share the proposed activity.



### Sole Source Proposal Process

Sole source proposals are for project sponsors that have identified a U.S. company as a partner or preferred supplier on the project or when a U.S. company has identified a project and project sponsor overseas. A U.S. company performing the work under a “sole source” grant is expected to submit a separate, detailed technical and cost proposal to USTDA for the proposed work. The U.S. company typically shares the cost of the work with USTDA and participates in a success fee program. USTDA eligibility requirements for sole-source grants can be found on USTDA’s website: [www.ustda.gov/program/project-proposals](http://www.ustda.gov/program/project-proposals).



# USTDA Provides a Standard Format for Proposals

## Proposal Development

USTDA provides a general outline for proposals<sup>4</sup>, which can be found at <https://ustda.gov/program/guidelines-sole-source-project-proposals>. Proposals generally include the following types of information:

**Executive Summary:** Provides an overview of the proposed USTDA-funded activity, covering the key areas of the proposal, such as project description, overseas project sponsor capabilities, the U.S. firm's background and qualifications, implementation financing, and U.S. export potential.

**Project Description:** Describes the proposed project, covering the following key areas (as applicable to the project):

- Project location
- Economic fundamentals, such as estimated capital costs, operational costs, life-cycle costs, and anticipated revenues
- Equipment and technology requirements
- Legal and regulatory considerations, such as permits and licenses
- Explanation of how the requested USTDA funding would support the project development and implementation
- Any other key areas that the U.S. firm considers critical to the proposed project

## Overseas Project Sponsor's Capabilities and

**Commitment:** Describes the overseas project sponsor's demonstrated commitment and ability to implement the project, any related business experience or government authority, and track record on implementing similar projects.

## U.S. Company's Capabilities and Commitment:

Describes the U.S. firm's demonstrated commitment and ability to carry out the proposed USTDA-funded activity, related technical and business experience, a proven track record on implementing similar activities and projects, and any business development efforts for the project to date.

**Implementation Financing:** Discusses the financing options for project implementation, including:

- Overall project cost estimate, proposed ownership, and financing structure
- A project implementation schedule and procurement plan following the USTDA-funded activity
- Evidence that project financing is available or likely to be available, including a description of discussions with representatives of potential lenders and other financing entities



**U.S. Export Potential:** Provides a best estimate of U.S. goods and services potential procurement for project implementation. The estimates should be broken down by category and include the dollar value of the goods and services likely to be made in the U.S. and exported to the foreign country during project implementation. Also provides a list of potential U.S. suppliers of the goods and services, likely to be sourced from the U.S., along with a description of any anticipated foreign supplier competition. From foreign suppliers. Details of how procurements are typically conducted in the foreign country or overseas project sponsor should be provided.

**Evaluation Strategy:** Provides a recommendation on how to monitor and evaluate the USTDA-funded activity's effectiveness and results, including recommending benchmarks to measure project implementation. Details to include here are the anticipated project implementation timeline, how the project would likely be developed (EPC, turnkey, BOT,

BOO, etc.), potential project implementation difficulties the overseas project sponsor might encounter, and examples of mitigating these difficulties. If applicable, include information about which regulations must be in place pre-project implementation and list any other entities involved in authorizing or approving project implementation.

**Terms of Reference for the Activity:** Provides a detailed description of the tasks the U.S. firm will perform to complete the USTDA-funded activity, including objectives, deliverables, reports, and timeline.

**Estimated Activity Budget:** Provides a detailed line-item budget, task breakdown, and budget narrative. All costs in the estimated budget should be reasonable and allocable to the work being performed to complete the Terms of Reference. The budget should provide sufficient detail to enable USTDA to understand the budgeted amounts and the methodology that justifies them. U.S. firms may not include fees or profit in the labor rates. USTDA's funds cannot cover the cost of equipment or equipment shipping to the host country. Additionally, no more than 20% of USTDA's grant amount may be used to pay for work performed by host country subcontractors. Subcontractors from countries other than the U.S. or the host country may not be used.

**Additional Document Forms:** Provides forms required by USTDA, such as U.S. Firm Form, a Private Sector Grantee Form, and a Parastatal Grantee Form. These are available at [www.ustda.gov](http://www.ustda.gov).

# The USTDA Proposal Evaluation Process

## 1 Proposal Submission

Either USTDA receives a project proposal from the U.S. firm or USTDA's regional staff receive a project concept from an overseas project sponsor for review. USTDA preserves the confidentiality of any privileged or confidential commercial or financial information, which is clearly designated as such in the project proposal or concept, in accordance with applicable law.

## 2 Technical Review

USTDA conducts a technical review of the project proposal or concept. USTDA may also hire a technical/industry expert (a "Desk Study" or "Definitional Mission" consultant) to evaluate the proposal. A technical/industry expert may also further develop a project concept into a project proposal by working with the project sponsor and then recommend whether USTDA should provide a sole source grant.

## 3 Due Diligence

USTDA conducts a due-diligence review of the proposed overseas project sponsor and the U.S. firm (including its parent companies and U.S. private firms, its principal officers, directors, shareholders, and subcontractors) to ensure that USTDA works with reputable and solvent entities.

## 4 Grant Funding Review

Upon receipt of the technical reviewer's (Desk Study or Definitional Mission consultant's) recommendations and the due-diligence review completion, USTDA will formally consider the activity for grant funding. If approved, USTDA authorizes grant funding and informs the overseas project sponsor and the U.S. firm.

**5  
Success Fee/  
Cost Share  
Agreement**

USTDA and the U.S. firm reach agreement on the terms of the Success Fee and Cost Share Agreement and sign the Agreement.

**6  
Grant  
Agreement**

Once the Success Fee and Cost Share Agreement is signed, USTDA and the overseas project sponsor reach agreement on the terms of the Grant Agreement and sign it. A draft Grant Agreement can be found at [https://ustda.gov/sites/default/files/pdf/program/grants/USTDA\\_GrantAgreement\\_CostShare.pdf](https://ustda.gov/sites/default/files/pdf/program/grants/USTDA_GrantAgreement_CostShare.pdf).

**7  
Contract**

Once the Grant Agreement is signed, the overseas project sponsor and the U.S. firm finalize contract negotiations for the contractor to do the work and submit the contract to USTDA for review and approval prior to signature. Once approved, USTDA informs the overseas project sponsor and the U.S. firm and the parties sign the Contract. A model contract agreement is available at <https://ustda.gov/program/propose-project>.

**8  
Commencement  
of the Work**

Once the Contract is approved by USTDA, the U.S. firm begins performing the USTDA-funded activity under the terms of the Contract.

# USTDA Identifies Stakeholder Roles in the Grant Process

## Grantee's Role

USTDA grants are provided under a Grant Agreement that funds the costs of a contract ("Contract") between the Grantee (overseas project sponsor) and the Contractor (U.S. firm) who performs the work.

The Grantee undertakes its best efforts to provide reasonable support for the Contractor, such as local transportation, office space, and secretarial support. In certain circumstances, the Grantee may provide more details about what they can provide. It is the Grantee's role to oversee the Contractor work and ensure its work is in accordance with an agreed-upon Terms of Reference, as stated in the Grant Agreement and the Contract. It is the Grantee's role to review and approve the Contractor's invoices for USTDA payment. USTDA pays the Contractor directly on behalf of the Grantee.

USTDA is not a party to the Contract between the project sponsor and the U.S. Contractor. However, USTDA reserves certain rights, such as the right to approve the terms of the Contract, assignments, the selection of all contractors, the Terms of Reference, the final report, and all documents related to any Contract funded under a Grant Agreement. USTDA acts solely as a financing entity to assure the proper use of U.S. Government funds, and any decision by USTDA to exercise or refrain from exercising these approval rights is made as a financier for the USTDA-funded activity.

## U.S. Contractor's Role

Per the Contract and its Terms of Reference, the U.S. Contractor performs the work and prepares and delivers the contracted deliverables to the Grantee. The Contractor is also required to prepare and deliver a substantive and

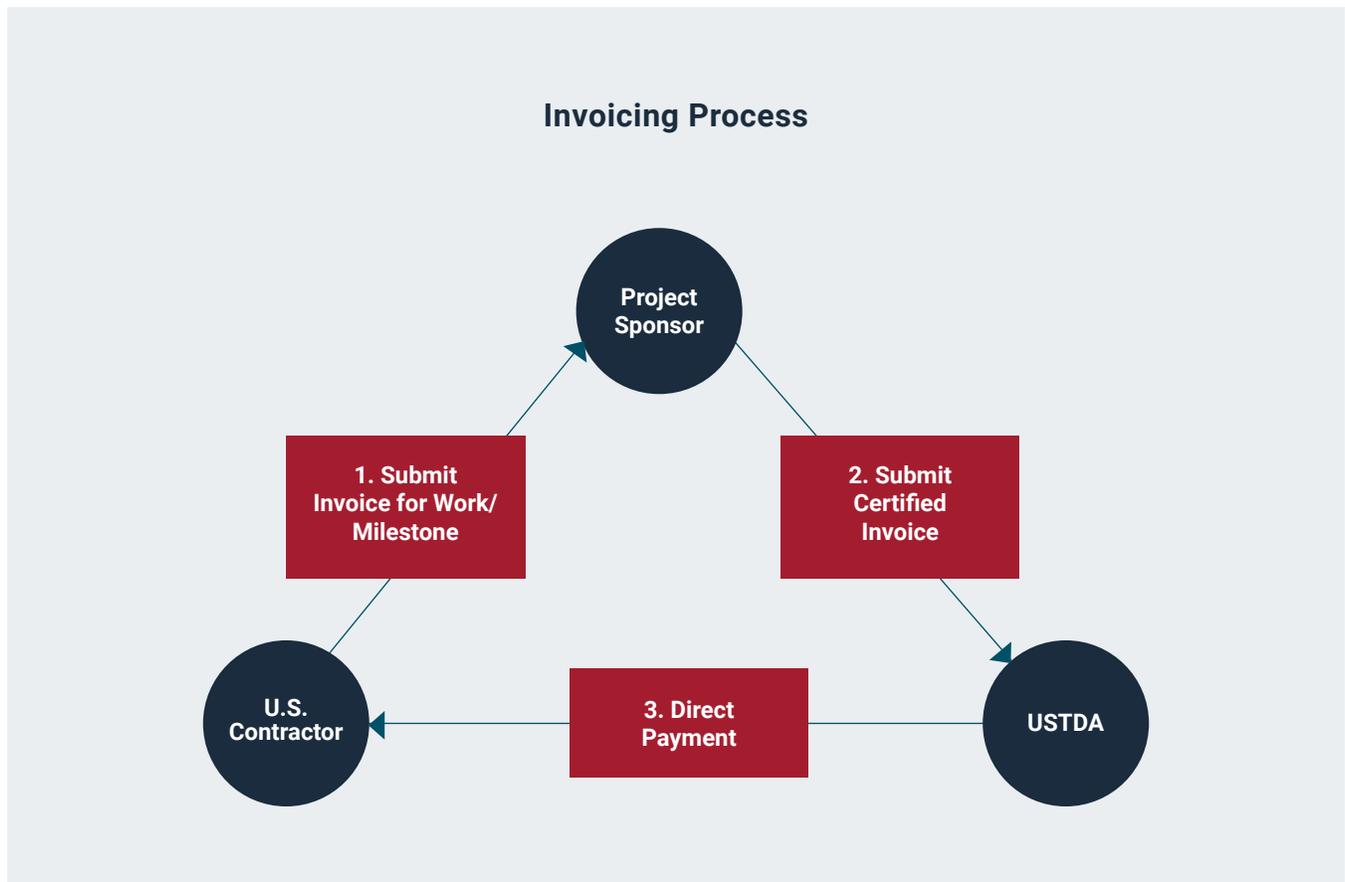


comprehensive final report (“Final Report”) to the Grantee and USTDA outlining all work performed under the Terms of Reference. The report should include all deliverables and documents that have been provided to the Grantee.

After completing the Final Report, the Contractor is required to annually advise USTDA about the Project status for a period of two years after the Study’s completion. Additionally, if at any time the Contractor receives follow-on work from the Grantee, the Contractor must notify USTDA and designate the Contractor’s contact, including name, telephone, fax number, and email address. Since this information may be made publicly available by USTDA, the Contractor must designate and provide any

confidential information separately to USTDA. USTDA maintains the confidentiality of such information in accordance with applicable law. The Contractor and all subcontractors are responsible for complying with U.S. export licensing requirements, if applicable, in performing any USTDA-funded work.

The Contractor and any subcontractors must also comply with the requirements of the Foreign Corrupt Practices Act, as amended (15 U.S.C. §§ 78dd-1 et seq.). USTDA pays the Contractor directly upon the Grantee’s approval of the Contractor’s work. To receive the final payment of USTDA grant funds, the Contractor must provide a final invoice to USTDA, accompanied by a cost-share certification, if applicable.



# Resources

**Website ([www.ustda.gov](http://www.ustda.gov)):** USTDA's website provides comprehensive information on its programs, current business opportunities, upcoming events, completed activities, Agency news, and recent publications.

**Requests For Proposals (RFP):** USTDA posts RFP announcements for current business opportunities with the Agency at <https://fbohome.sam.gov> and with its overseas grant recipients at <https://ustda.gov/business-opportunities>.

**Contractor Registration:** Many USTDA activities are reserved exclusively for small businesses. Small and large U.S. businesses interested in being considered for contracting opportunities with USTDA should register with the U.S. Government's System for Award Management (SAM) website at <https://www.sam.gov/SAM/>.

**USTDA Library:** USTDA's library maintains final reports of the Agency's funded activities and can provide electronic copies of those reports upon request by emailing [library@ustda.gov](mailto:library@ustda.gov). USTDA also posts new reports directly on its website at [www.ustda.gov](http://www.ustda.gov).

**USTDA Publications:** USTDA distributes a free biweekly eNewsletter, TradePosts, to provide information about USTDA's activities and

events. Visit USTDA's website to sign up to receive TradePosts.

**Questions About USTDA:** To make general inquiries about USTDA's programs, call (703) 875-4357, email [info@ustda.gov](mailto:info@ustda.gov), or complete the Contact Us form on the Agency's website.

**USTDA Program Staff:** To contact USTDA's program staff, call (703) 875-4357 or email:

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Office of Program Monitoring and Evaluations:

[Evaluation@ustda.gov](mailto:Evaluation@ustda.gov)

# ACRONYMS

ACP	Autoridad del Canal de Panamá (Panama Canal Authority)	EGAT	Electricity Generating Authority of Thailand
ANPM	Autoridade Nacional do Petróleo E Minerais (Ministry of Petroleum and Minerals)	EIA	U.S. Energy Information Administration
ARI	Advanced Resources International	EIB	European Investment Bank
BCE	Before Christ Era	EOGPL	Essar Oil & Gas Exploration & Production Ltd
BCFD	Billion Cubic Feet Per Day	EPC	Engineering, Procurement and Construction
BCMA	Billion Cubic Meter Per Annum	EPPO	Thailand's Energy Policy and Planning Office
BDC	Botswana Development Corporation	EU	European Union
BEE	Broad-based Black Economic Empowerment	E&P	Exploration and Production
BOO	Build Operate Own	ExIm	Export-Import Bank of the United States
BOT	Build Operate Transfer	FBO	Federal Business Opportunities
BOTAS	BOTAŞ Petroleum Pipeline Corporation	FEED	Front-End Engineering & Design
BPD	Barrels Per Day	FS	Feasibility Study
BRHA	Bulgaria-Romania-Hungary-Austria	FSRU	Floating Storage and Regasification Unit
BTC	Baku–Tbilisi–Ceyhan	GE	General Electric
BTE	Baku–Tbilisi–Erzurum	GEAT	General Electric Algeria Turbines
CBI	Chicago Bridge & Iron	GGFR	Global Gas Flaring Reduction
CBM	Coalbed Methane	GIGC	Georgian International Oil Corporation
CCPF	Cusiana Central Processing Facilities	GIS	Geographic Information System
CIS	Commonwealth of Independent States	GPI	Global Procurement Initiative
CMM	Coal Mine Methane	GW	Gigawatts
CNG	Compressed Natural Gas	H2S	Hydrogen Sulfide
CO2	Carbon Dioxide	IDC	Industrial Development Corporation of South Africa
CUCBM	China United Coalbed Methane Corporation	IOTP	Iraq Oil Training Program
DBSA	Development Bank of Southern Africa	IPP	Independent Power Producer
DME	South Africa Department of Mining and Energy	IT	Information Technology
EBRD	European Bank for Reconstruction and Development	KM	Kilometer
		KN	Klaipėdos Nafta
		KSE	Karoo Sustainable Energy

Ktoe	Kilo Tonne of Oil Equivalent	SCP	South Caucasus Gas Pipeline
LNG	Liquid Natural Gas	SIEPMP	Systeme D'Information de Exploration et de la Production Miniere et Petroliere
MCFD	Million Cubic Feet Per Day (Volume Measurement)	SOCAR	State Oil Company of Azerbaijan Republic
MCMD	Million Cubic Meters Per Day	SOE	State-Owned Enterprises
MOO	Iraq Ministry of Oil	SPA	Interrelated Sale And Purchase Agreements
MTPA	Million Tonnes Per Annum	SPE	Société Algérienne de Production de l'Electricité
MW	Megawatt	SSA	Sub-Saharan Africa
NGC	National Gas Company of Trinidad and Tobago	TA	Technical Assistance
NGCC	Natural Gas Turbines for Combined-Cycle	TANAP	Anatolia Gas Pipeline
NGV	Natural Gas Vehicles	TAP	Trans Adriatic Pipeline
NYMEX	New York Mercantile Exchange	TCF	Trillion Cubic Feet
ONAREP	Morocco's Office National de Recherches et d'Exploitations Petrolieres	TCGP	Trans-Caspian Natural Gas Pipeline
ONHYM	Office National des Hydrocarbures et des Mines	TCOEP	Trans-Caspian Crude Oil Pipeline
OPEC	Organization of the Petroleum Exporting Countires	TCP	Trans-Caspian Oil Pipeline
OPIC	Overseas Private Investment Corporation	TOR	Terms of Reference
PNGRB	India's Petroleum and Natural Gas Regulatory Body	TR	Technical Training
PPA	Power Purchase Agreements	TS	Technical Symposium
PPAC	India's Planning Analysis Cell	Turkmenenergo	Turkmenistan Ministry of Energy and Industry, State Electric Company
PSE	Private-Sector Enterprises	Turkmengaz	Turkmenistan National Gas Company
PTT	PTT Public Company Limited, formerly Petroleum Authority of Thailand	U.K.	United Kingdom
RFP	Requests For Proposals	U.S.	United States
RTM	Reverse Trade Mission	USGS	U.S. Geological Survey
SAM	U.S. Government's System for Award Management	USTDA	United States Trade and Development Agency
SC	South Carolina	WW	Worldwide

# END NOTES

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# Natural Gas Project Preparation Guide

## Photographs and Maps

Photographs and maps for the Guide were contributed by the following:

Cover Page:	LNG Tanker at the Gas Terminal and Gas Storage Sphere Tanks and Pipeline; Shutterstock; Photoshop by Tuatara Group
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