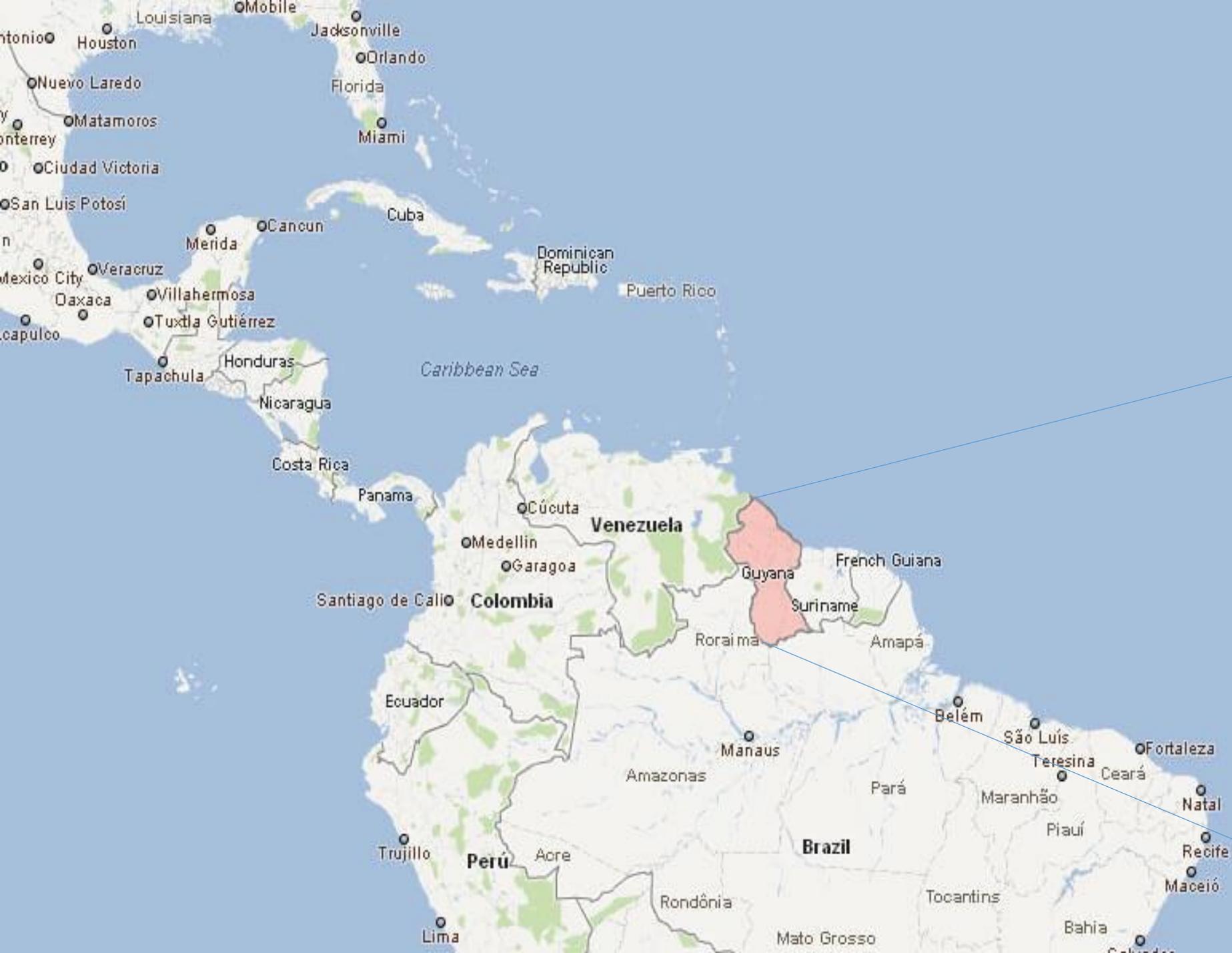


# Guyana's New Landscape

## *Preparing for the Future*

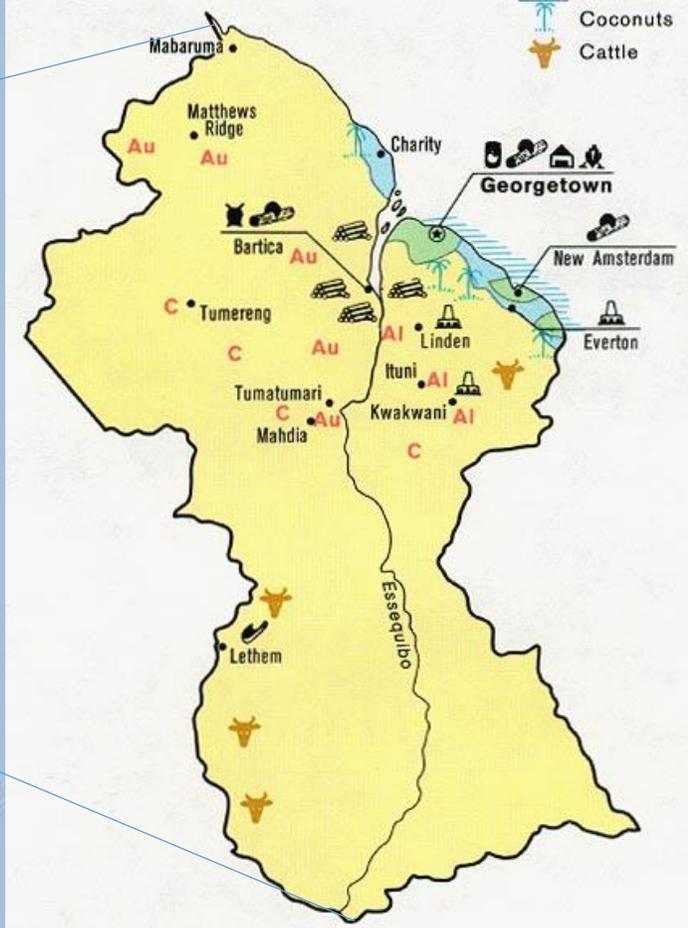
May 9, 2019  
Eric N. Smith  
Associate Director  
Tulane Energy Institute



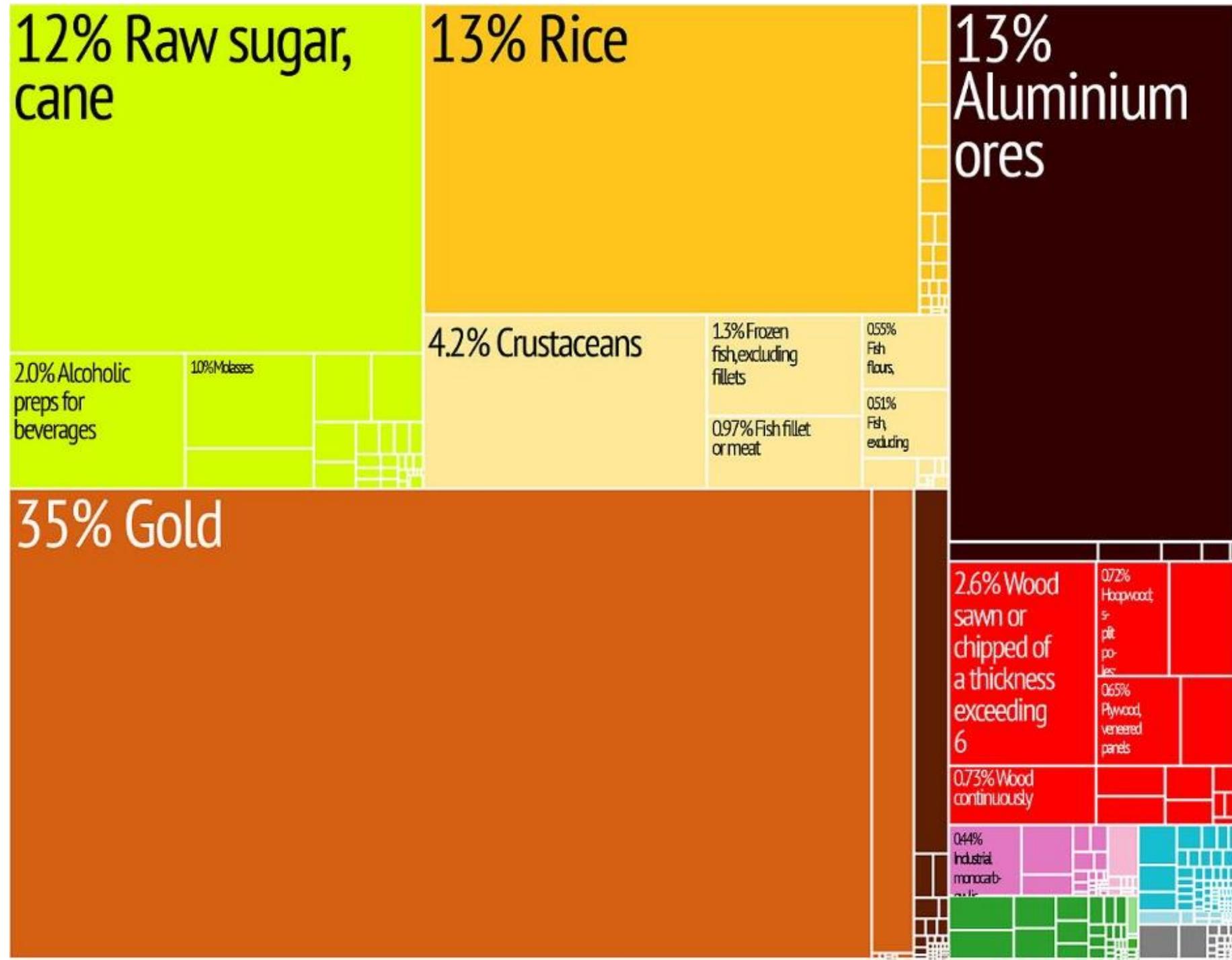


# Economic Activity

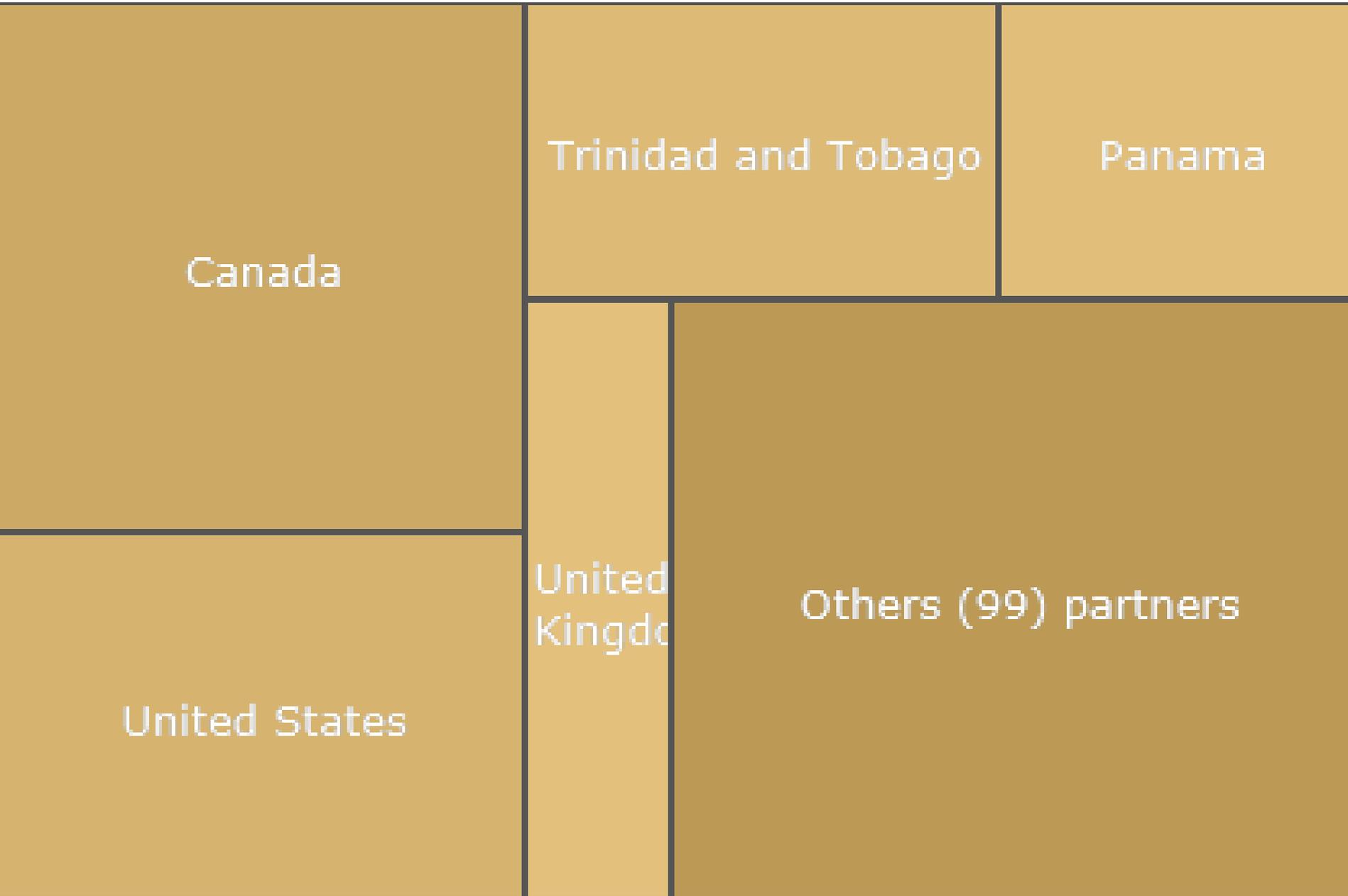
- | INDUSTRY |                          | MINING      |              |
|----------|--------------------------|-------------|--------------|
|          | Meat packing             | <b>Al</b>   | Bauxite      |
|          | Sugar milling            | <b>Au</b>   | Gold         |
|          | Food processing          | <b>C</b>    | Diamonds     |
|          | Sawmill; wood products   |             |              |
|          | Machine and metalworking | FISHING     |              |
|          | Bauxite processing       |             | Fishing area |
|          | Shipyards                | AGRICULTURE |              |
|          | Lumbering                |             | Sugar        |
|          |                          |             | Rice         |
|          |                          |             | Coconuts     |
|          |                          |             | Cattle       |



# The Existing Export Picture

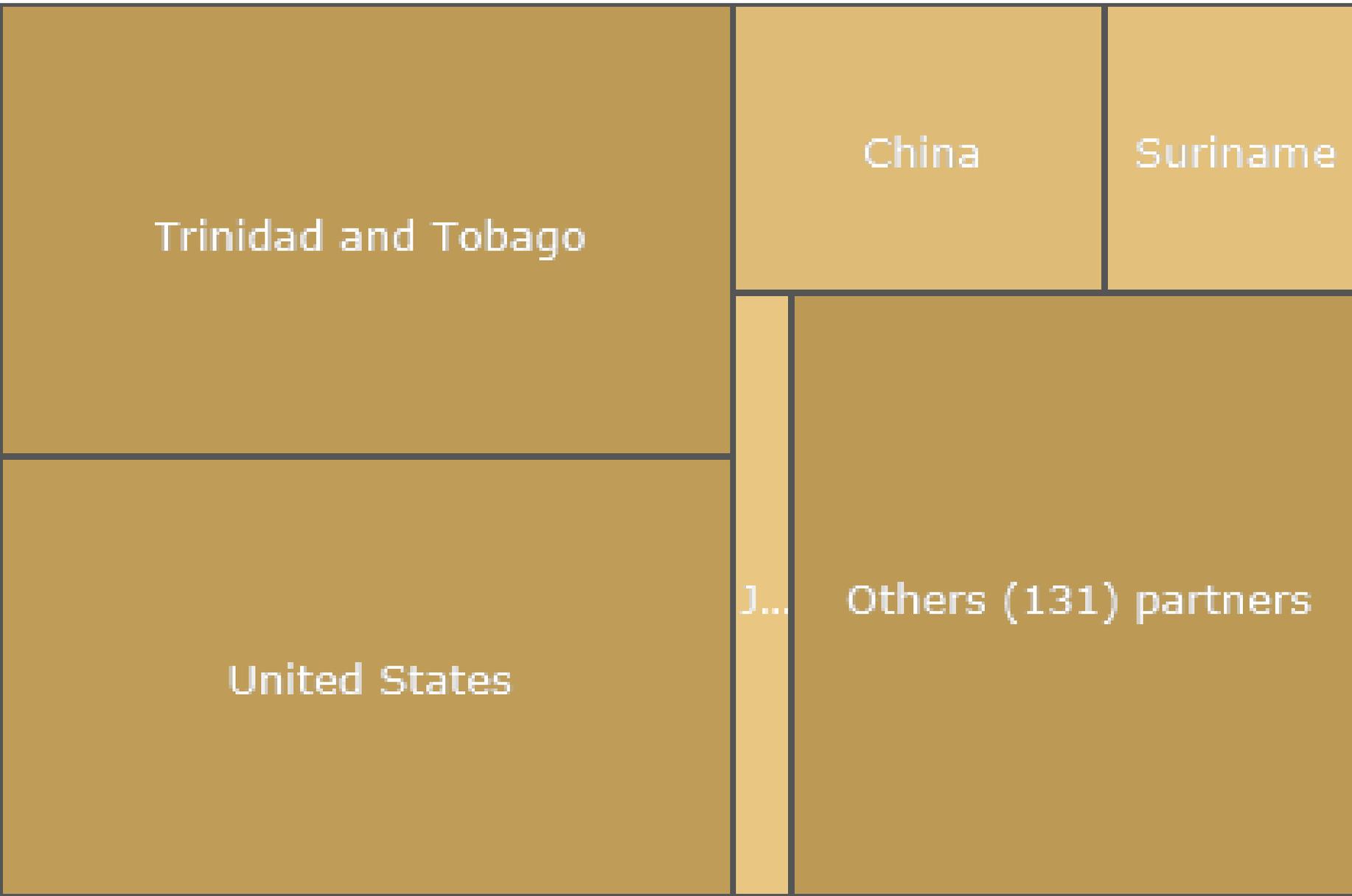


# Guyana 2017 Export Partner Share - All



Partner Name	Export (US\$ Thousand)
World	1,789,689.91
North America	695,597.66
Latin America & Caribbean	604,283.82
Canada	409,582.33
Europe & Central Asia	370,251.05
United States	285,446.43
Trinidad and Tobago	204,274.06
Panama	157,576.73
United Kingdom	127,299.92
Jamaica	87,723.56
Belgium	57,881.61
Middle East & North Africa	57,185.58
United Arab Emirates	53,737.86
Ukraine	47,892.34
East Asia & Pacific	47,807.16
Germany	42,359.50
Mexico	37,135.09
China	24,675.84
Spain	19,997.02
Switzerland	19,570.54
Venezuela	16,660.99
Barbados	16,166.75

# Guyana 2017 Import Partner Share - All



Partner Name	Import (US\$ Thousand)
World	1,761,552.83
Latin America & Caribbean	775,263.67
North America	493,025.66
Trinidad and Tobago	484,273.29
United States	466,170.25
East Asia & Pacific	286,730.95
Europe & Central Asia	160,495.66
China	157,076.94
Suriname	107,394.53
Japan	50,229.12
United Kingdom	36,862.71
Netherlands	31,061.48

# Major Segments in the World of Energy



# Major Segments in the World of Energy

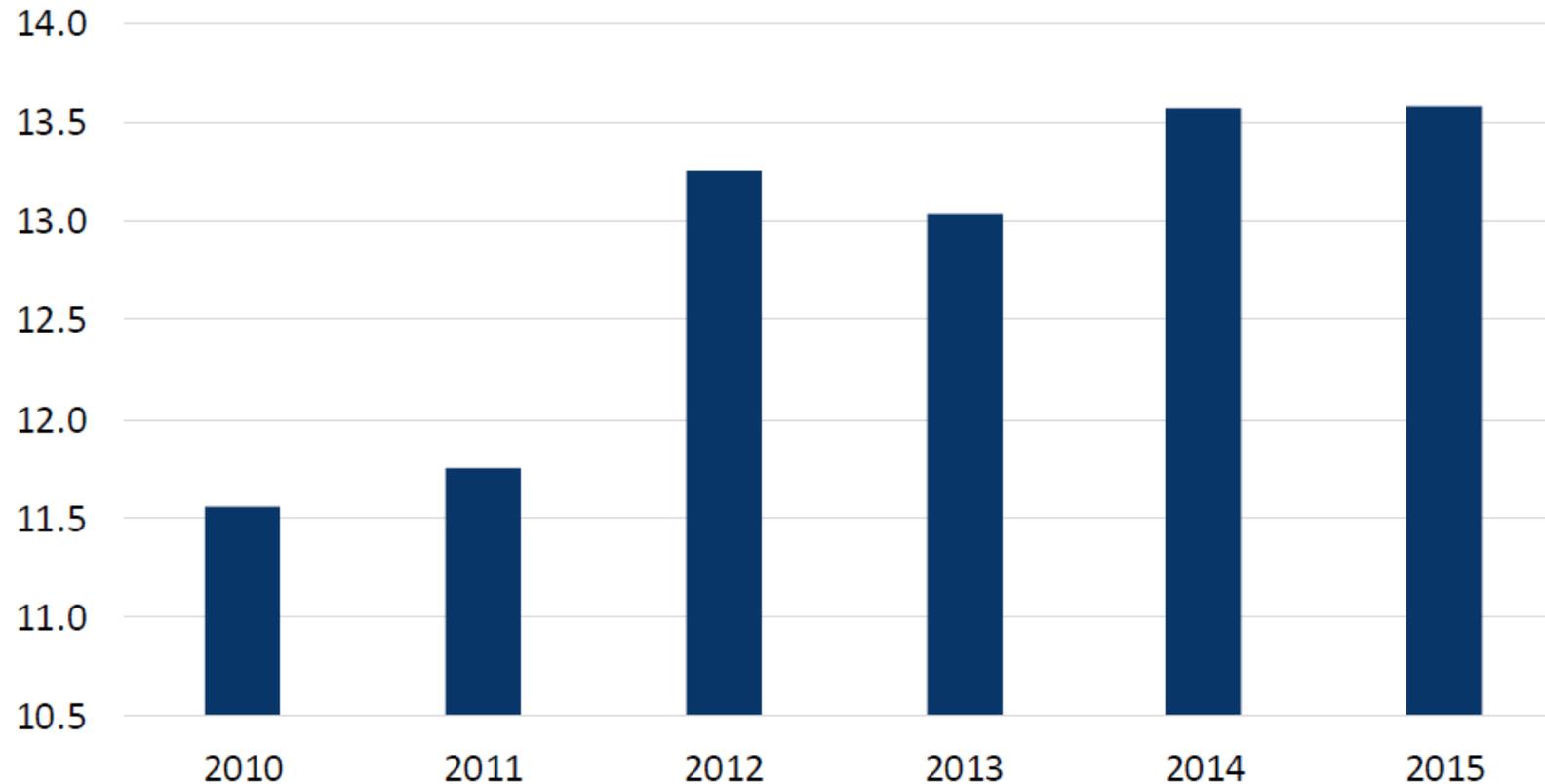


# Guyana's Petroleum Products<sup>1</sup> Demand



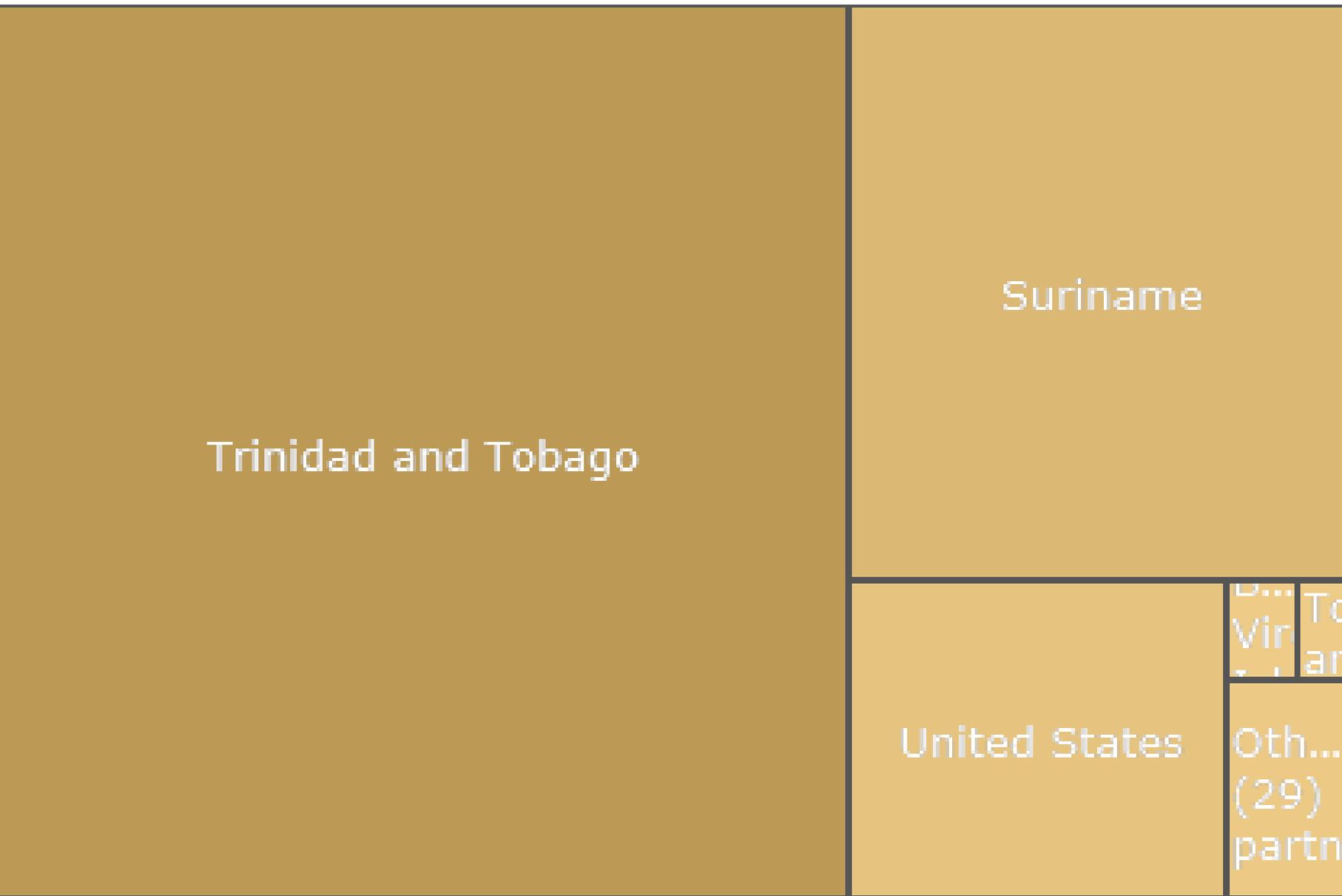
- Guyana's petroleum products demand increased more than 17% between 2010 and 2015, but the growth appears to have slowed

## Guyana Petroleum Products Demand (MBD)



1: Petroleum products include: mogas, gasoil, kerosene, jet fuel, fuel oil, LPG and aviation gasoline  
Source: Guyana Energy Agency

# Guyana 2017 Import Partner Share - Fuels



Country : **Guyana** Year : **2017** Trade Flow : **Import**

Partner Name	Import (US\$ Thousand)
World	379,099.58
Latin America & Caribbean	330,703.34
Trinidad and Tobago	239,559.20
Suriname	89,795.91
North America	37,441.20
United States	37,430.77
Europe & Central Asia	5,298.95
Sub-Saharan Africa	2,352.23
British Virgin Islands	2,211.50
Sao Tome and Principe	1,650.64
Oth... (29) partn	



# Guyanese Petroleum Product Imports



- Given Guyana's lack of domestic crude oil refining, the country depends entirely on petroleum product imports
- Historically PDVSA has supplied over 50% of Guyana's imports through the PetroCaribe agreement, but now Petrotrin accounts for about half of the import volume

## Guyana Petroleum Products Imports

	PDVSA		Petrotrin		Other	
	B/D	%	B/D	%	B/D	%
2012	6,915	52%	2,212	17%	4,131	31%
2013	4,376	34%	4,221	32%	4,445	34%
2014	4,794	35%	4,563	34%	4,215	31%
2015	2,285	17%	6,420	47%	4,870	36%

# Comparative Regulatory Environment

## Relevant US Regulators

**DOE's** mission is to ensure **America's security** and prosperity by addressing its energy, environmental and nuclear challenges through transformative science and technology solutions. Catalyze the timely, material, and efficient transformation of the nation's **energy system** and secure U.S. leadership in **energy** technologies.

The Department of Energy Organization Act of 1977 established **EIA** as the primary federal government authority on energy **statistics** and analysis, building upon systems and organizations first established in 1974 following the oil market disruption of 1973.

**PHMSA** (The Pipeline and Hazardous Materials Safety Administration) mission is to protect people and the environment by advancing the safe transportation of energy and other hazardous materials that are essential to our daily lives. **PHMSA** works in partnership with State and local regulators, first responders, and industry to ensure dangerous products move safely and without incident. **PHMSA** is responsible for the oversight of more than 40,000 shippers and more than 2.7 million miles of pipeline.

**DOI** **BSEE's** responsibilities include assessments of emerging or improved technologies, inspection and regulation of offshore facilities, and collaboration with industry to improve oil and gas recovery and ensure accurate production measurement.

**BOEM** manages the Nation's OCS resources to ensure environmentally and economically responsible production and drilling and the timely removal of decommissioned production facilities.

**ONRR** manages and ensures full payment of revenues owed for the development of the Nation's energy and natural resources on the Outer Continental Shelf and onshore Federal and Indian lands.

**FERC** The Federal Energy Regulatory Commission, or **FERC**, is an independent agency that **regulates** the interstate transmission of electricity, natural gas, and oil. **FERC** also reviews proposals to build liquefied natural gas (LNG) terminals and interstate natural gas pipelines as well as licensing hydropower projects.

## The Coast Guard

Homeland security **missions** include: Ports, waterways, and **coastal** security (PWCS); drug interdiction; migrant interdiction; defense readiness; and other law enforcement. A given unit within the **Coast Guard** may be carrying out several **missions** at once. A unique branch of the US military responsible for an array of maritime duties, from ensuring safe and lawful commerce to performing rescue missions in severe conditions, the nearly 42,000 men and women are actively serving in the Coast Guard to defend America's borders and protect the maritime environment.

The Coast Guard performs 11 official missions including: [Port & Waterway Security](#), [Drug Interdiction](#), [Aids to Navigation](#), [Search & Rescue](#), [Living Marine Resources](#), [Marine Safety](#), [Defense Readiness](#), [Migrant Interdiction](#), [Marine Environmental Protection](#), [Ice Operations](#), [Law Enforcement](#)

## Relevant National Regulators

- **DOE** — Head is Minister Mark Bynoe is President's personal representative on petroleum matters including local content options. In terms of local content, Fuel supply and Food show progress so far.
- **CARICOM**-Caribbean common market made up of 15 countries. May have potential for joint security regulation since their have been two violations of national sovereignty by Venezuela, once with Anadarko in 2013 and more recently with Exxon. This would be in addition to promoting inter country trade (eg Guyana Bauxite for Trinidad LNG and Refined products). The secretariat for the Capricom is located in George Town.
- **GGMC**- Analogous to US BSEE, included Guyanese trained engineers on staff who have also had foreign training.
- **EPA**-Minister of Natural Resources and Environment. Also involved in push for 3<sup>rd</sup> party insurance for oil spills.
- **MARAD** responsible for all "in water" activity, historically focused on drilling and seismic. Requires notification and approval prior to action, posts mandatory exclusion zones. Also manages customs and provides routine notices to mariners.
- **GDF**
  - Air – Bristow Helicopters
  - Water (Coast Guard)
    - Inshore
    - Offshore

The Maritime Administration Department's mandate exceeds more than being responsible for vessels along the various rivers of Guyana. In fact, such department was established according to the 1998 Shipping Act, Section 4, which states "There shall be a Maritime Administration Department herein after referred to as the "Department". The function of which shall be to administer this act.

Some of the major areas of MARAD'S responsibility includes:

- Registering and licensing of ships
- Certifying officers on sea, including masters or any other category of crew
- Ensuring the welfare of seamen, issuing of discharge books (for local registration)
- Implementing and enforcing maritime codes, conventions and practices
- Prevention of accidents
- Surveying of ships on port to ensure safety practices are upheld
- Determine or investigate the amount or type of bulk cargoes and dangerous goods
- Investigate wreck and salvage of mariner's accidents
- Assist in search and rescue operations
- Prevention of pollution on ships
- Ensure ports comply to security regulations
- Provide pilot service
- Dredging /hydrographical surveying
- Collection of harbour dues
- Control and manage the lighthouse and the Berbice Pilot station

Those persons who share interest in the operations of the Maritime Administration are, those ship and boat owners, seafarers, shipping companies, shipping agencies, terminal operators, importers and exporters, the Guyana Revenue Authority, the Guyana Police Service, the Guyana Energy Authority, Customs Anti-Narcotics Unit(CANU) and the Environmental Protection Agency (EPA).

This department operates in accordance with the International Maritime Organization (IMO) and was established and regulated in 2003 under the 1997 Merchant Shipping Act.

According to its Director Claudette Rogers, the department embraces the motto – safer ships, cleaner oceans.

Key responsibilities include:

- Registering and licensing ships
- Pilotage Hydrographic surveys
- Accident Investigation
- Search and Rescue recovery

Due to the inundation of ships to Guyana's shores, MARAD is party to a number of IMO Conventions that include Safety of Life At Sea (SOLAS); Standard of Training, Certification and Watch keeping Of Seafarers (STCW) and Marine Pollution (MAR), among others.

The Department also offers around-the-clock pilotage service.

# The Guyana Defense Force Coast Guard

is the naval component of the Guyana Defence Force.

The Coast Guard operates:

- GDFS Essequibo - [River-class minesweeper](#) (UK)
- 1 River patrol boats - 890 tons full load - commissioned 1985
- 8 T-44 patrol boats - 18 tons full load
- 1 [Kimbala class LCU](#) (Netherlands)



The Defense force air wing was formed in 1968 and was then renamed the Guyana Defense force air command in 1973.

The GDF currently operates three fixed-wing aircraft and four helicopters.

The **University of Guyana**, in [Georgetown](#), [Guyana](#), is Guyana's sole national higher education institution. It was established in April, 1963. The University of Guyana offers more than 60 under-graduate and graduate (post- graduate) programs, including in [Natural Sciences](#), [Engineering](#), [Environmental Studies](#), [Economics](#), and [Law](#). Several online programs are available, as are extramural classes through the IDCE at four locations—in the city of Georgetown and the towns of Anna Regina, Essequibo, Linden, New Amsterdam, and Berbice.

The institution had a 2016 enrollment of some 8,000 students, and it has graduated more than 20,000 students, who have gone on to successful careers locally, regionally and internationally in all professional fields of endeavor. The University also is a major contributor to the public and private sectors and to the national economy of Guyana.

The Department of Business and Management Studies, the largest unit in the Faculty of Social Sciences, offers three programs; Accounting, Banking and Finance, and Marketing. As well, it has about 1,500 students, the single largest group in the Faculty of Social Sciences, and 15 faculty (10 full-time and 5 part-time). Moreover, it jointly manages the licensed Commonwealth of Learning Masters in Business Administration, and Public Affairs (CMBA/PA).

<b>Motto</b> in English	To discover, generate, disseminate, and apply knowledge of the highest standard for the service of the community, the nation, and of all mankind within an atmosphere of academic freedom that allows for free and critical enquiry.
<b>Type</b>	Public University
<b>Established</b>	1963
<b>Chancellor</b>	E. Nigel Harris
<b>President</b>	Prof. Ivelaw Lloyd Griffith
<b>Location</b>	<a href="#">Georgetown, Guyana</a>
<b>Campus</b>	Turkeyen Campus, Berbice Campus
<b>Colours</b>	Green
<b>Nickname</b>	UG
<b>Affiliations</b>	IHSE, <a href="#">Caribbean Community</a>
<b>Website</b>	<a href="http://uog.edu.gy">http://uog.edu.gy</a> 

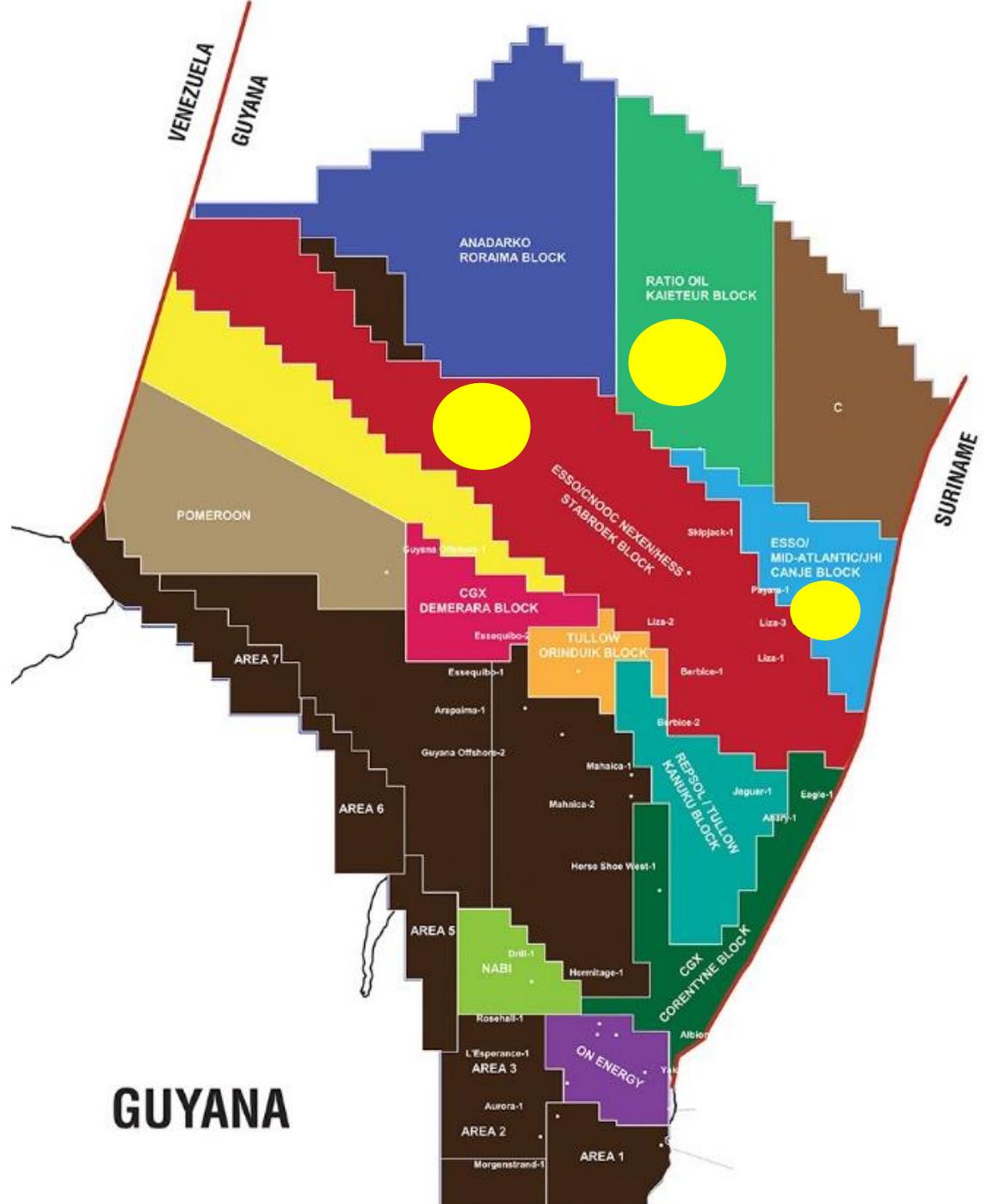


**THE FACULTY OF TECHNOLOGY**  
HAS BEEN RENAMED THE  
**Faculty of Engineering  
and Technology**

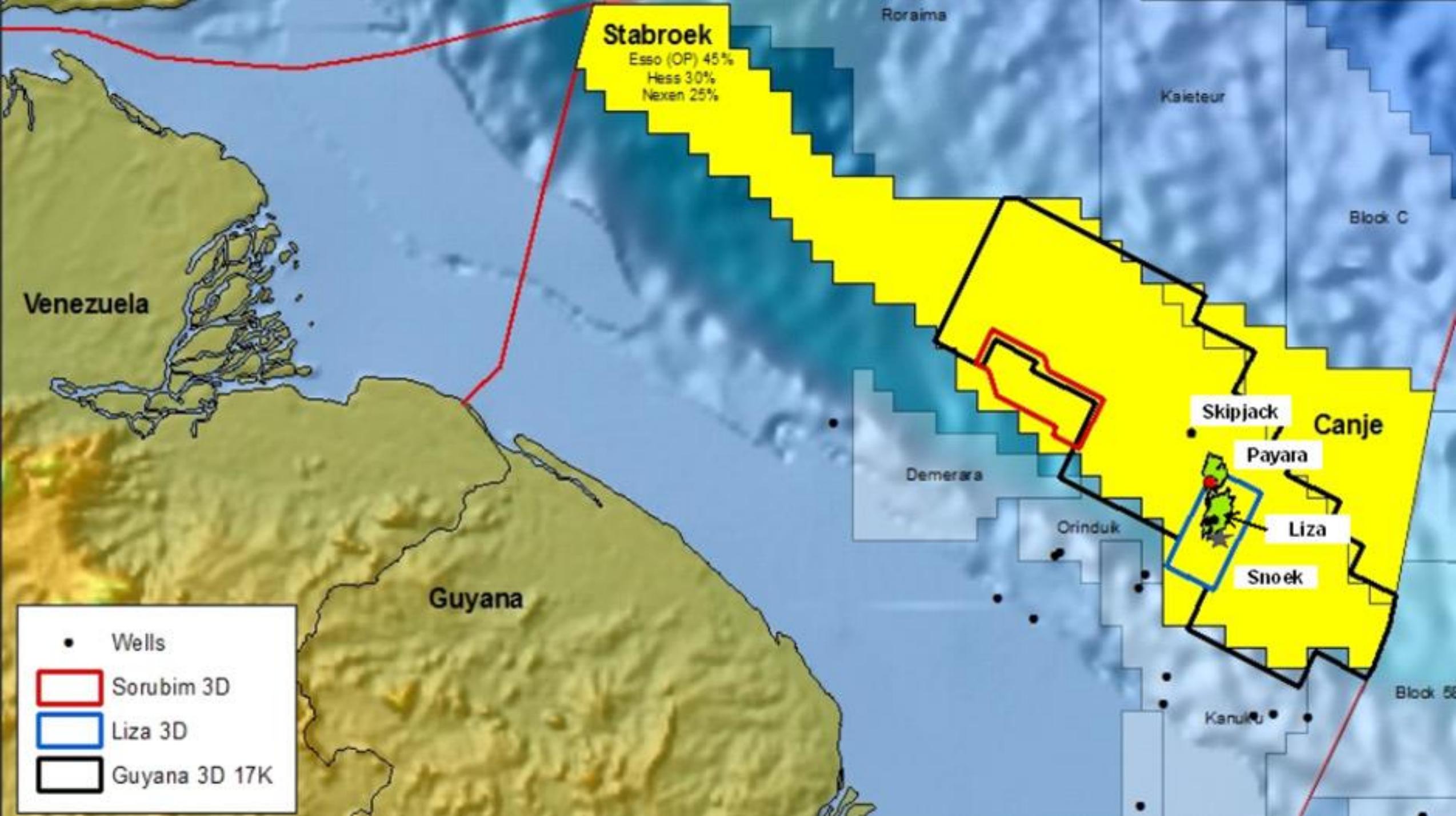
**A**dditionally:

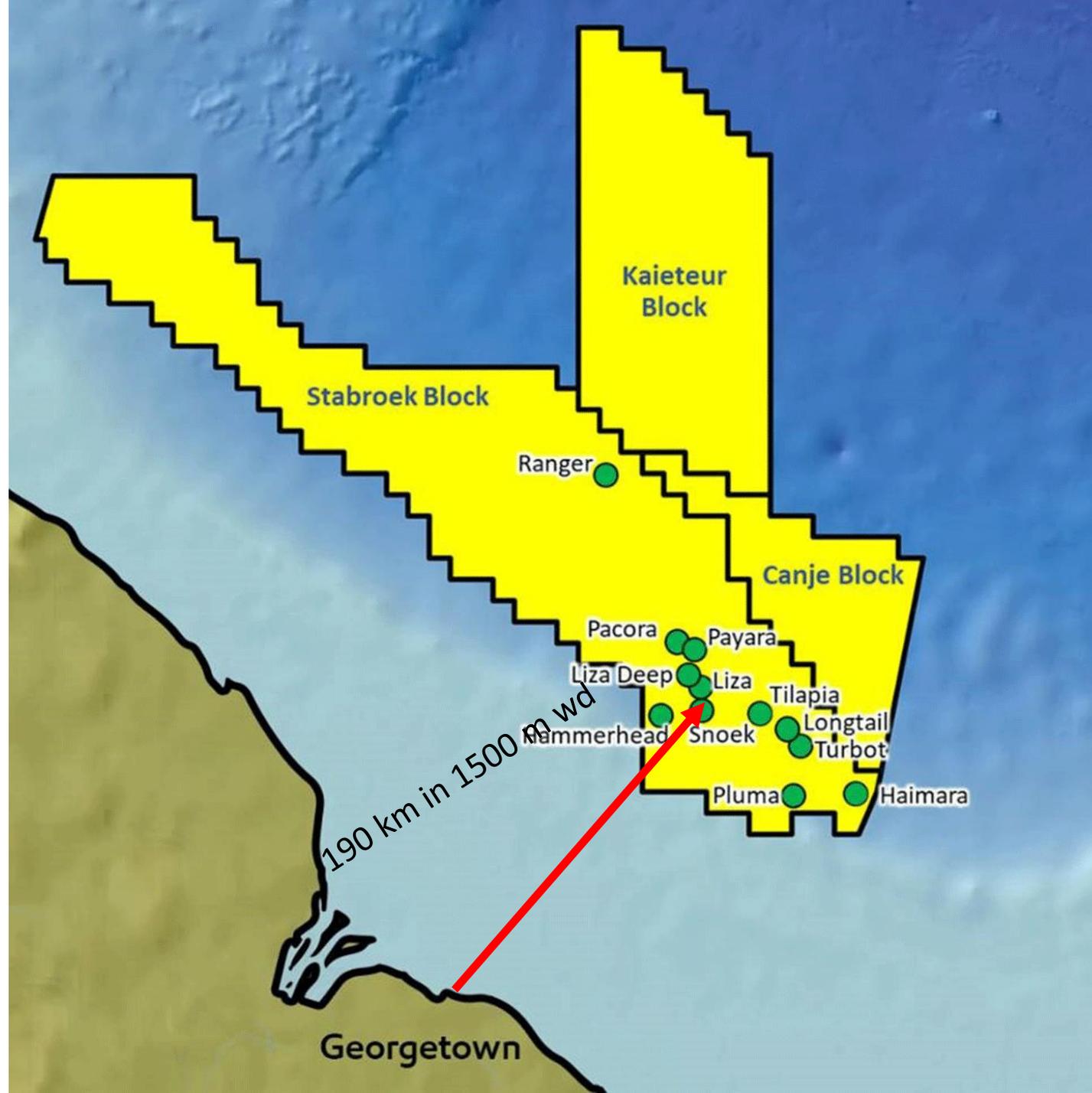
- A new **Department of Petroleum and Geological Engineering** in the Faculty of Engineering & Technology is being planned for operation from January 2019.
- A Consortium of Post-secondary Institutions — **The Higher Education Consortium on Engineering and Mining**—is being established to streamline and strengthen educational delivery and
- **New Associate and Masters degree programmes in Petroleum Engineering** will be offered from January 2019 in conjunction with The University of Trinidad and Tobago and The University of the West Indies.

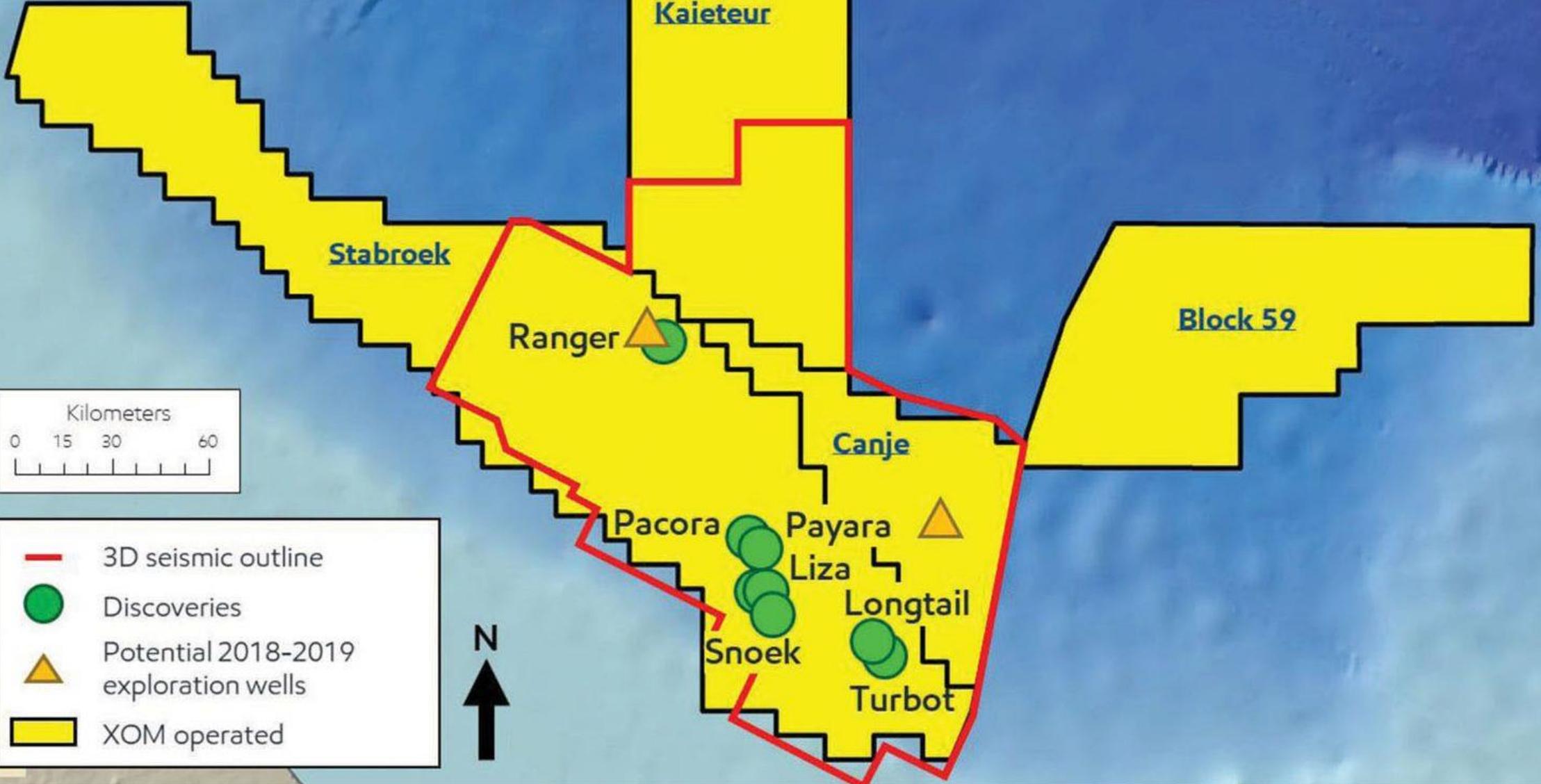












- 3D seismic outline
- Discoveries
- ▲ Potential 2018-2019 exploration wells
- XOM operated



ORINDUIK

Pacora

Payara

Liza Field

Snoek

Longtail

Turbot

Hammerhead

JAG-1

Atlantic



# Drilling activity in the Stabroek Block

- Liza-1 well discovery was announced in May 2015
- Liza-2 well was drilled and tested in July 2016
- Liza-3 well was drilled in October 2016, confirming a world-class resource discovery in excess of 1 billion oil-equivalent barrels
- Liza-4 well was drilled in March 2017 and encountered more than 197 feet of high-quality, oil-bearing sandstone reservoirs, which will underpin a potential Liza Phase 2 development
- Appraisal drilling at Liza 3 identified an additional high quality deeper reservoir directly below the Liza field, which is estimated to contain resources between 100 and 150 million oil-equivalent barrels
- Skipjack-1 was drilled in September 2016; this did not encounter commercial quantities of hydrocarbons
- Payara-1 well discovery was announced in January 2017. Payara is ExxonMobil's second oil discovery on the Stabroek Block and was drilled in a new reservoir — encountering more than 95 feet of high quality, oil bearing sandstone reservoirs

- Payara-2 well discovery was announced in July 2017. Payara-2 encountered 59 feet (18 meters) of high-quality, oil-bearing sandstone reservoirs
- Snoek-1 well discovery was announced in March 2017. Snoek is ExxonMobil's third oil discovery on the Stabroek Block and was drilled in a new reservoir — encountering 82 feet (25 meters) of high-quality, oil-bearing sandstone reservoir
- Turbot-1 well discovery was announced in October 2017. Turbot is ExxonMobil's fifth oil discovery on the Stabroek Block and was drilled in a new reservoir — encountering approximately 75 feet (23 meters) of high-quality, oil-bearing sandstone reservoir
- Ranger-1 well discovery was announced in January 2018. Ranger is ExxonMobil's sixth oil discovery on the Stabroek Block and was drilled in a new reservoir- encountering approximately 230 feet (70 meters) of high-quality, oil-bearing carbonate reservoir
- Pacora-1 well discovery was announced in February 2018. Pacora is ExxonMobil's seventh oil discovery on the Stabroek Block and was drilled in a new reservoir — encountering approximately 65 feet (20 meters) of high-quality, oil-bearing sandstone reservoir
- Sorubim-1 was drilled in April 2018; this did not encounter commercial quantities of hydrocarbons
  - Longtail-1 well discovery was announced in June 2018. Longtail is ExxonMobil's eighth oil discovery on the Stabroek Block and was drilled in a new reservoir — encountering approximately 256 feet (78 meters) of high-quality, oil-bearing sandstone reservoir

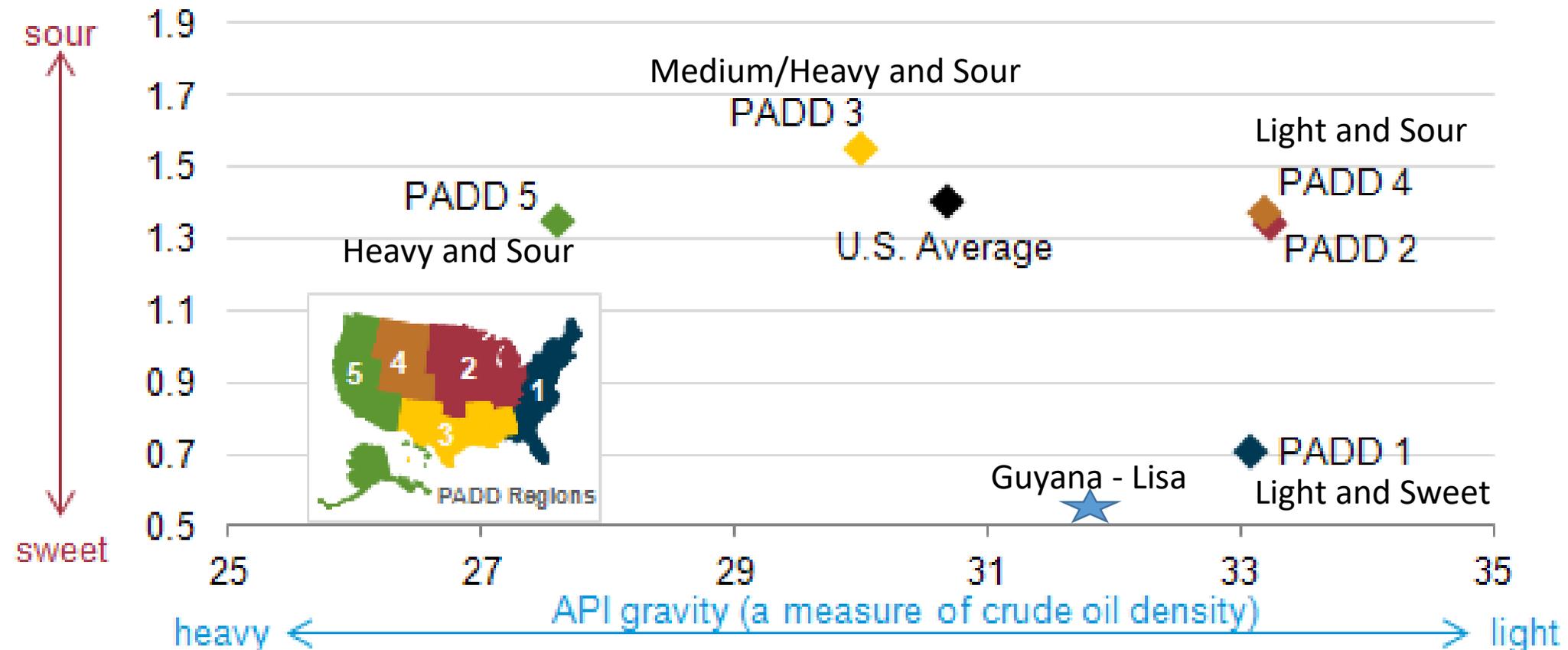
- Sorubim-1 was drilled in April 2018; this did not encounter commercial quantities of hydrocarbons
  - Longtail-1 well discovery was announced in June 2018. Longtail is ExxonMobil's eighth oil discovery on the Stabroek Block and was drilled in a new reservoir — encountering approximately 256 feet (78 meters) of high-quality, oil-bearing sandstone reservoir
- Hammerhead-1 well discovery was announced in August 2018. Hammerhead is ExxonMobil's ninth oil discovery on the Stabroek Block and was drilled in a new reservoir — encountering approximately 197 feet (60 meters) of high-quality, oil-bearing sandstone reservoir
- Pluma-1 well discovery was announced December 2018. Pluma is ExxonMobil's tenth on the Stabroek Block and was drilled in a new reservoir — encountering approximately 121 feet (37 meters) of high-quality hydrocarbon-bearing sandstone reservoir
- Tilapia-1 well was announced in January 2019. Tilapia-1 encountered approximately 305 feet (93 meters) of high-quality oil-bearing sandstone reservoir
- Haimara-1 well discovery was announced in January 2019. Haimara-1 encountered approximately 207 feet (63 meters) of high-quality, gas-condensate bearing sandstone reservoir
- The gross recoverable resource for the Stabroek Block is now estimated to total more than 5 billion oil equivalent barrels, including Liza and other successful exploration wells on Payara, Liza deep, Snoek, Turbot, Ranger, Pacora, Longtail and Hammerhead

# Attributes of crude oil at U.S. refineries vary by region

## Density and sulfur content of crude oil by PADD and U.S. average, 2011



sulfur content (percentage)



Source: U.S. Energy Information Administration, [Petroleum Navigator](#).

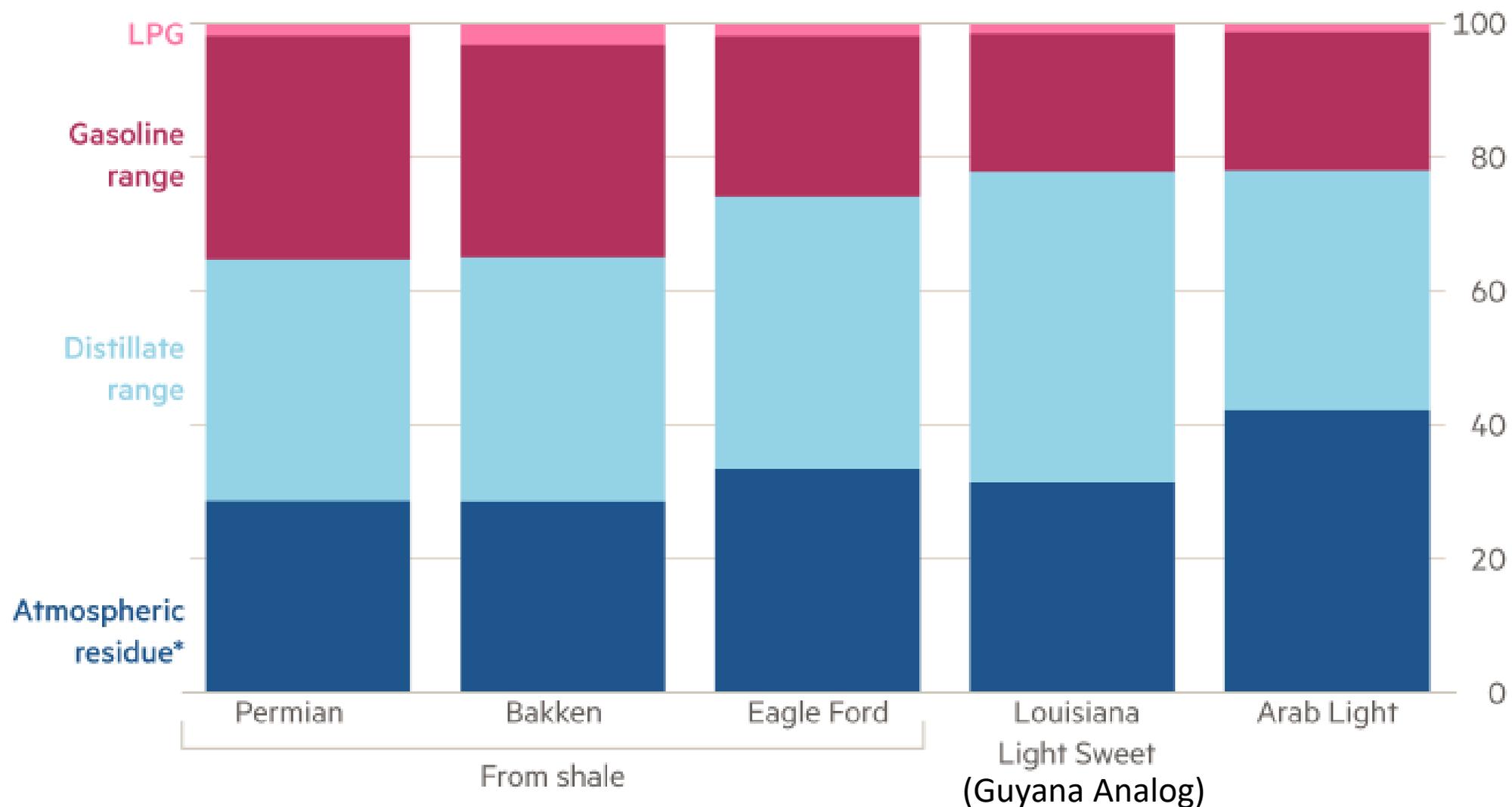
Note: PADDs (Petroleum Administration for Defense Districts) are geographic aggregations that [allow regional analysis of petroleum markets](#).

Note: Sweet refers to the absence of hydrogen sulfide ( $H_2S$ ) in crude oil, which typically corresponds to low sulfur content.

Sour refers to high  $H_2S$  content, and a typically high sulfur content.

# Shale crudes produce more gasoline and less heavier refined products

Average yields (%)



Source: Wood Mackenzie  
© FT

\* Atmospheric residue can be upgraded by complex refineries into transportation fuels or used as heavy fuel oil



# Guyana Crude Oil Valuation (2/2)

## Benchmark Crude Specifications

Crude	Origin	API (°)	Sulphur (%)
Guyana Crude	Guyana	32.1	0.51
Cabinda	Angola	32.2	0.15
Bonny Light	Nigeria	35.1	0.15
Light Louisiana Sweet (LLS)	Louisiana	35.6	0.40
Brent	United Kingdom	37.5	0.40

## Guyana Crude Netbacks

Region	2016 Netback (USD/B)
PADD_1	\$46.53
PADD_3	\$46.62
NWE	\$46.47
<b>Average</b>	<b>\$46.54</b>

Note: Using routes to Venezuela as proxy to those to Guyana  
Source: Hartree Analysis, S&P Global Platts "Methodology and Specifications Guide Crude Oil". 2016

# Alternative Commercial Options



## International trade of crude and products

- Ensuring Guyana Government is maximizing their income from commercializing crude oil
- Securing an efficient and secure supply of products delivered into Guyana

## Converting Guyanese crude oil to products in the international market

- Selling crude and purchasing products
- Swapping crude oil for products
- Tolling crude for products

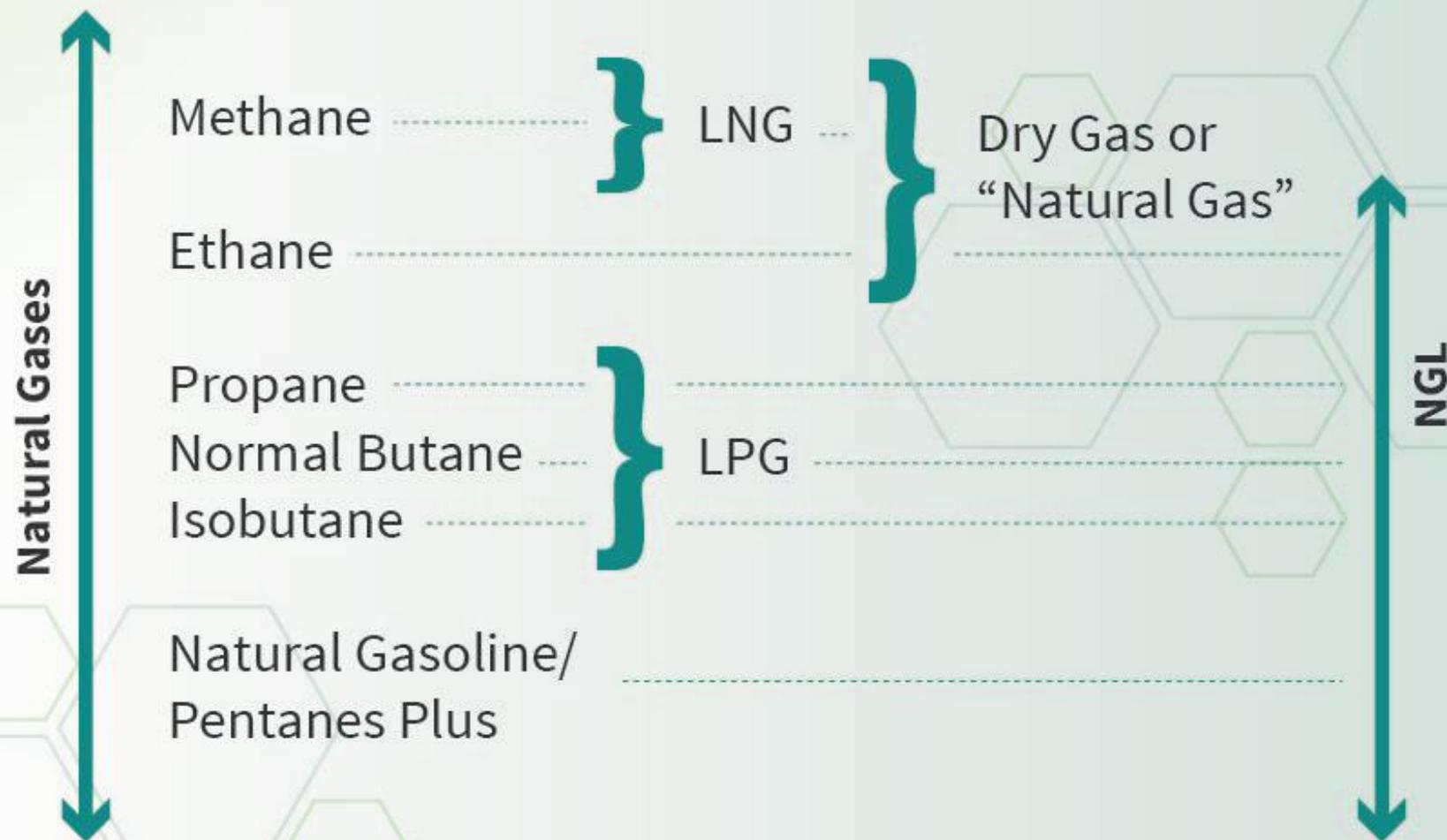
## Acquiring exposure to refining economics

- Joint venturing an offshore refinery (and tolling)
- Acquiring stock in refining companies

## Managing financial exposure to hydrocarbon downside

- Manage crude length
- Manage product short

# NGLs LPGs and LNG



# Intermediate Term Economic Development

## Current Drilling Activity-LISA 1&2

- Two going to three DP-3 Drillships
- Existing vessels supported by 16 OSVs using T&T and Port Fourchon, La. as support bases
- Addition of third drillship may increase that to ~24 OSVs
- Once FPSOs are in place, one OSV can probably support 2 FPSOs
- Each OSV requires a marine crew of ~28 people, all “below deck” crew
- Other specialized vessels will be used to support offshore construction and installation crews.
- Guyana needs increase its onshore base infrastructure, including dredging

## Supply of offshore gas to onshore infrastructure

- Support power generation
- Support Propane and Butane extraction
- Support existing industry by improving energy sourcing and utilization
- Develop in country gas demand
- Convert existing generators to gas
- Add new gas turbine generation
- Selectively add to service segment
- Learn from successful transitions
  - Trinidad and Tobago provide a model
  - Senegal-Mauritania provide a model

## Liza Phase 1 project - Development description

- The Liza Phase 1 development is approximately 190 kilometers offshore in water depths of 1,500 – 1,900 meters
- The development plan includes completion of a floating production, storage and offloading (FPSO) vessel designed to produce up to 120,000 barrels of oil per day
- Four drill centers are envisioned with 17 wells in total; eight production wells, six water injection wells, and three gas injection wells

# ExxonMobil

## Liza Destiny FPSO

(Spread Moored)

### Gas separation

Gas is separated from the oil and injected back into reservoir

### Water cleaning

Water is separated from the oil and cleaned to international standards

### Oil storage

1.6 million barrels, enough to fill up 5.5 million average car tanks

Length:

1115 ft (340 m)

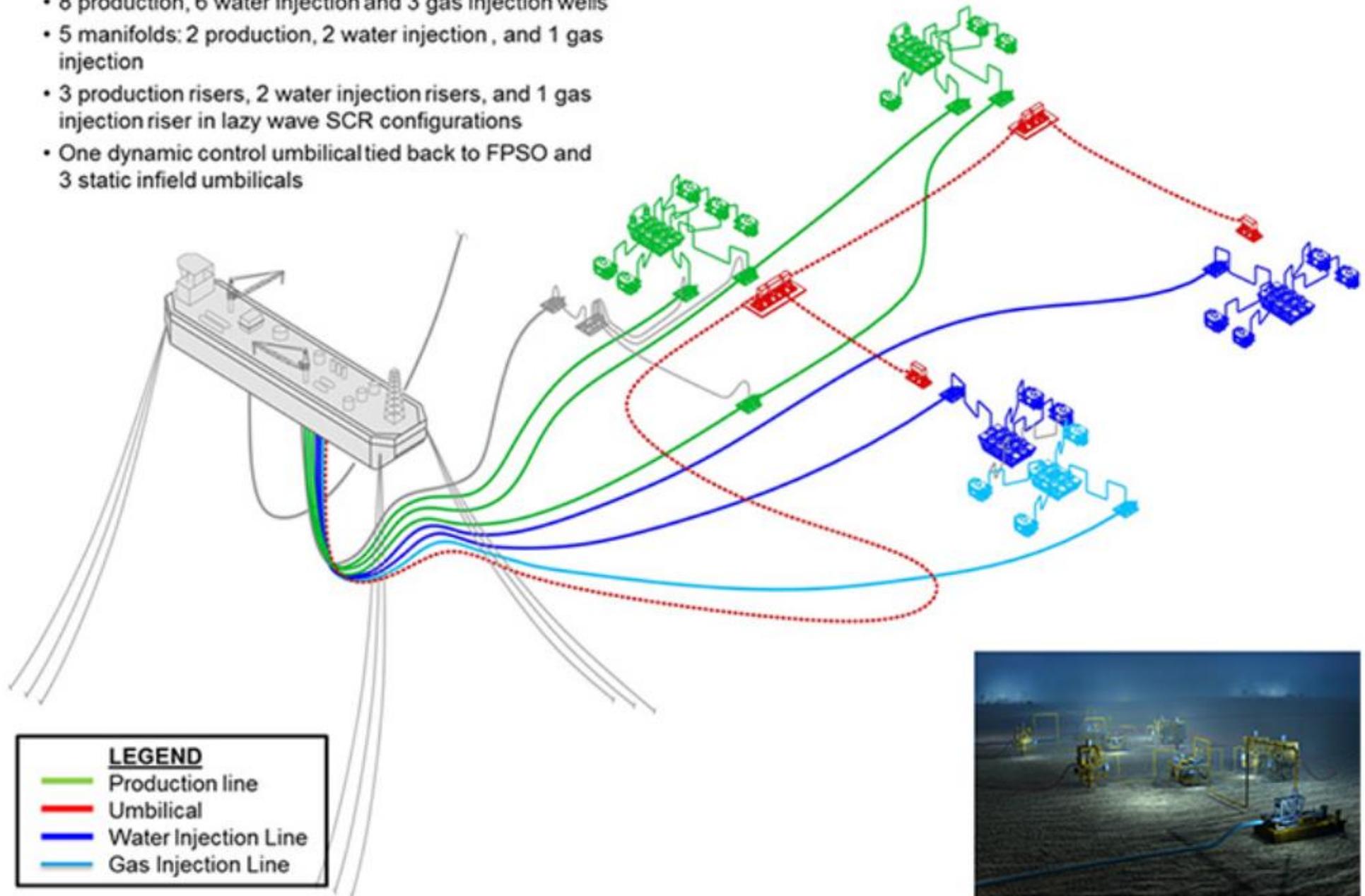
Wide:

190 ft (60 m)



## 17 well subsea system tied back to FPSO:

- 8 production, 6 water injection and 3 gas injection wells
- 5 manifolds: 2 production, 2 water injection, and 1 gas injection
- 3 production risers, 2 water injection risers, and 1 gas injection riser in lazy wave SCR configurations
- One dynamic control umbilical tied back to FPSO and 3 static infield umbilicals

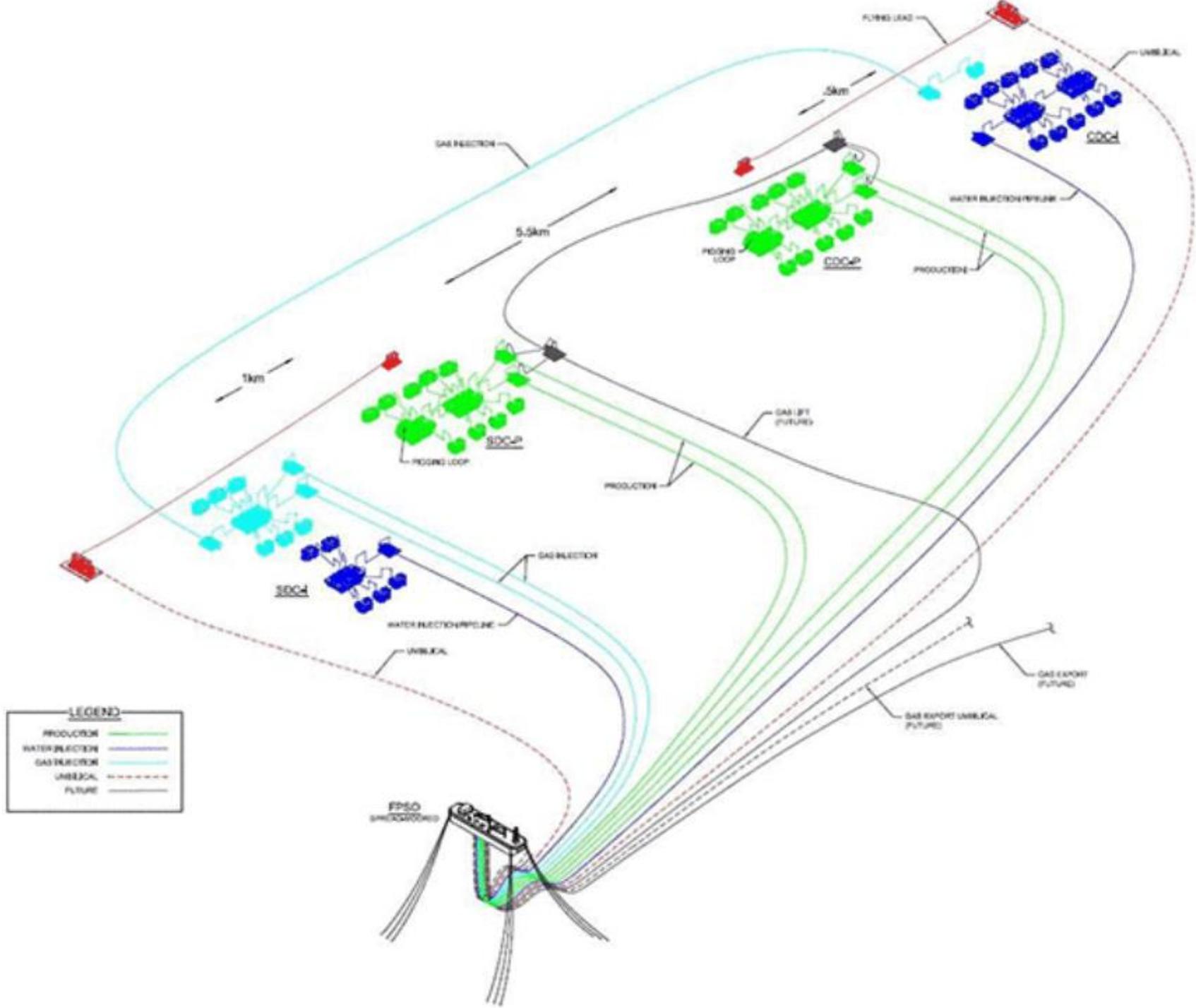


## Liza Phase 2 - Development description

The development plan involves a second floating, production, storage and offloading vessel (FPSO) and related subsea equipment, umbilical, risers and flowlines.

The development concept is similar to that of Liza phase 1. Approximately 35-40 wells may be drilled at two subsea drill centers which will consist of a combination of producers and injectors to support production of oil, injection of water, and reinjection of associated gas.

The FPSO will have an estimated production capacity of approximately 190,000 to 220,000 barrels of oil per day.





## Supplier development

Local suppliers are strategically important to the success of our operations. We are committed to working with them, and other stakeholders, to develop local companies and a competitive industrial base.

ExxonMobil Guyana has established the **Centre for Local Business Development**. The Centre provides a space for local firms to learn about opportunities in the oil and gas sector, strengthen their competitiveness, and prepare to supply the oil and gas sector with various services. They maintain a database which is used to identify possible suppliers, contractors and subcontractors who could potentially participate in the project.

ExxonMobil Guyana will favor suppliers and contractors that are able to effectively support the following project objectives in order of priority

- **Safety and health:** Provide for the safety and health of all personnel involved in the Project and the safe operation of the completed facilities to achieve zero lost-time incidents.
- **Environmental and regulatory compliance:** Conduct all activities and operations in full compliance with applicable laws, rules, regulations and guidelines.
- **Quality:** Ensure that quality during design, engineering, fabrication and construction is consistent with best international petroleum industry practices and applicable standards.
- **Maximize effectiveness and control cost:** Commitment to the success of the Project by optimizing investment and operating cost while maximizing and accelerating revenue.
- **Business practices:** Comply with generally recognized business standards, and exhibit fairness and consistency in contractor selection, bid evaluation and contract award process.
- **Achieve scheduled completion:** Opportunities to capture and retain schedule advantage.

## **TechnipFMC Awarded Subsea Contract for ExxonMobil Liza Phase 2 Project**

10.23.2018

LONDON & PARIS & HOUSTON--(BUSINESS WIRE)--Oct. 23, 2018-- TechnipFMC (NYSE:FTI) (Paris:FTI) (ISIN:GB00BDSFG982) has been awarded a contract by an affiliate of ExxonMobil Corporation (NYSE: XOM) for the engineering of the subsea system for the proposed Liza Phase 2 project.

Following engineering and subject to requisite government approvals, project sanction and an authorization to proceed with the next phase, TechnipFMC will then manufacture and deliver the subsea equipment. Delivery would include 30 enhanced vertical deep water trees and associated tooling, as well as eight manifolds and associated controls and tie-in equipment.

In support of this project, TechnipFMC will continue hiring and training Guyanese engineers.

## Saipem's Liza deals

The Italian company Saipem was awarded an EPCI contract for the SURF package on the Liza I project operated by Esso Exploration and Production Guyana Limited, an affiliate of ExxonMobil, back in [May 2017](#).

Saipem's duties under the contract include engineering, procurement, construction, and installation of risers, flow lines, and associated structures and jumpers.

The award also includes the transportation and installation of umbilicals, manifolds, and associated foundations for the production, and water and gas injection systems.

Saipem was awarded the contract for the second phase of the Liza field development in [August 2018](#). Once the Liza 2 has been sanctioned, Saipem will perform tasks on the Liza II project identical to those described in the Liza I deal.



## Shawcor Energy services company

has been assigned work from Saipem valued at approximately C\$110 million (\$85M) on the Exxon-operated Liza I and II deepwater development projects located offshore Guyana.

Shawcor said on Thursday that the company's pipe coating division would provide thermal insulation and anti-corrosion coating services for the Liza I and II projects offshore Guyana.

The company added that the coating work for the Liza I project began in March 2018 at Shawcor's Channelview (Texas) facility and additional work would be completed at Shawcor's facility in Veracruz, Mexico.

According to Shawcor, work on Liza I is expected to be completed during the first quarter of 2019.

Coating work under the larger Liza II project, is also expected to be executed at the Veracruz and Channelview facilities.

## Workforce development

In conjunction with our contractors, we are providing Guyanese personnel with the technical and professional skills they need for existing and future operations.

We are committed to fostering an environment of diversity and inclusion. Our intent is to reach out to a diverse pool of highly qualified employment candidates who are dedicated to integrity, high-quality work and good corporate citizenship.

# Comparative Regulatory Environment

## Relevant US Regulators

**DOE's** mission is to ensure **America's security** and prosperity by addressing its energy, environmental and nuclear challenges through transformative science and technology solutions. Catalyze the timely, material, and efficient transformation of the nation's **energy system** and secure U.S. leadership in **energy** technologies.

The Department of Energy Organization Act of 1977 established **EIA** as the primary federal government authority on energy **statistics** and analysis, building upon systems and organizations first established in 1974 following the oil market disruption of 1973.

**PHMSA**(The Pipeline and Hazardous Materials Safety Administration) mission is to protect people and the environment by advancing the safe transportation of energy and other hazardous materials that are essential to our daily lives. **PHMSA** works in partnership with State and local regulators, first responders, and industry to ensure dangerous products move safely and without incident. **PHMSA** is responsible for the oversight of more than 40,000 shippers and more than 2.7 million miles of pipeline.

**DOI** **BSEE's** responsibilities include assessments of emerging or improved technologies, inspection and regulation of offshore facilities, and collaboration with industry to improve oil and gas recovery and ensure accurate production measurement.

**BOEM** manages the Nation's OCS resources to ensure environmentally and economically responsible production and drilling and the timely removal of decommissioned production facilities.

**ONRR** manages and ensures full payment of revenues owed for the development of the Nation's energy and natural resources on the Outer Continental Shelf and onshore Federal and Indian lands.

**FERC** The Federal Energy Regulatory Commission, or **FERC**, is an independent agency that **regulates** the Interstate transmission of electricity, natural gas, and oil. **FERC** also reviews proposals to build liquefied natural gas (LNG) terminals and interstate natural gas pipelines as well as licensing hydropower projects.

## The US Coast Guard

Homeland security **missions** include: Ports, waterways, and **coastal** security (PWCS); drug interdiction; migrant interdiction; defense readiness; and other law enforcement . A given unit within the **Coast Guard** may be carrying out several **missions** at once. A unique branch of the US military responsible for an array of maritime duties, from ensuring safe and lawful commerce to performing rescue missions in severe conditions, the nearly 42,000 men and women are actively serving in the Coast Guard to defend America's borders and protect the maritime environment. The Coast Guard performs 11 official missions including: [Port & Waterway Security](#), [Drug Interdiction](#), [Aids to Navigation](#), [Search & Rescue](#), [Living Marine Resources](#), [Marine Safety](#), [Defense Readiness](#), [Migrant Interdiction](#), [Marine Environmental Protection](#), [Ice Operations](#), [Law Enforcement](#)

## Relevant National Regulators

- **DOE** – Head is Minister Mark Bynoe is President's personal representative on petroleum matters including local content options. In terms of local content, Fuel supply and Food show progress so far.
- **CARICOM**-Caribbean common market made up of 15 countries. May have potential for joint security regulation since their have been two violations of national sovereignty by Venezuela, once with Anadarko in 2013 and more recently with Exxon. This would be in addition to promoting inter country trade (eg Guyana Bauxite for Trinidad LNG and Refined products). The secretariat for the Caricom is located in Georgetown.
- **EPA**-Minister of Natural Resources and Environment. Also involved in push for 3<sup>rd</sup> party insurance for oil spills.
- **GGMC**- Analogous to US BSEE, included Guyanese trained engineers on staff who have also had foreign training.
- **MARAD** responsible for all "in water" activity, historically focused on drilling and seismic. Requires notification and approval prior to action, posts mandatory exclusion zones. Also manages customs and provides routine notices to mariners.
- **GDF**
  - Air – Bristow Helicopters
  - Water (Coast Guard)
    - Inshore
    - Offshore



## MINISTRY OF NATURAL RESOURCES CO-OPERATIVE REPUBLIC OF GUYANA

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### Energy Governance and Capacity Initiative (EGCI)

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The Energy Governance Capacity Initiative (EGCI) is a United States Department of State, Bureau of Energy Resources (ENR) – led effort that provides U.S interagency and expert independent advisory services in countries across the globe on a wide range of capacity- building related to hydrocarbon and mineral sector’s oversight and governance. Countries receiving EGCI assistance have world-class hydrocarbon and mineral resources and the potential to receive sizable financial windfalls from the development and export of these resources. Through the EGCI, the department of state works closely with governments to build the institutional and human resource capacity needed to manage their resources responsibly for the benefit of long-term national economic development.

EGCI utilizes the U.S government’s considerable expertise and capabilities, as well as highly-specialized and flexible skill sets obtained through direct contracting and agreements with top U.S academic institutions. Assistance is tailored to the specific needs of individual countries.

Source: <https://www.state.gov/documents/organization/264507.pdf>

# Something to Keep in Mind

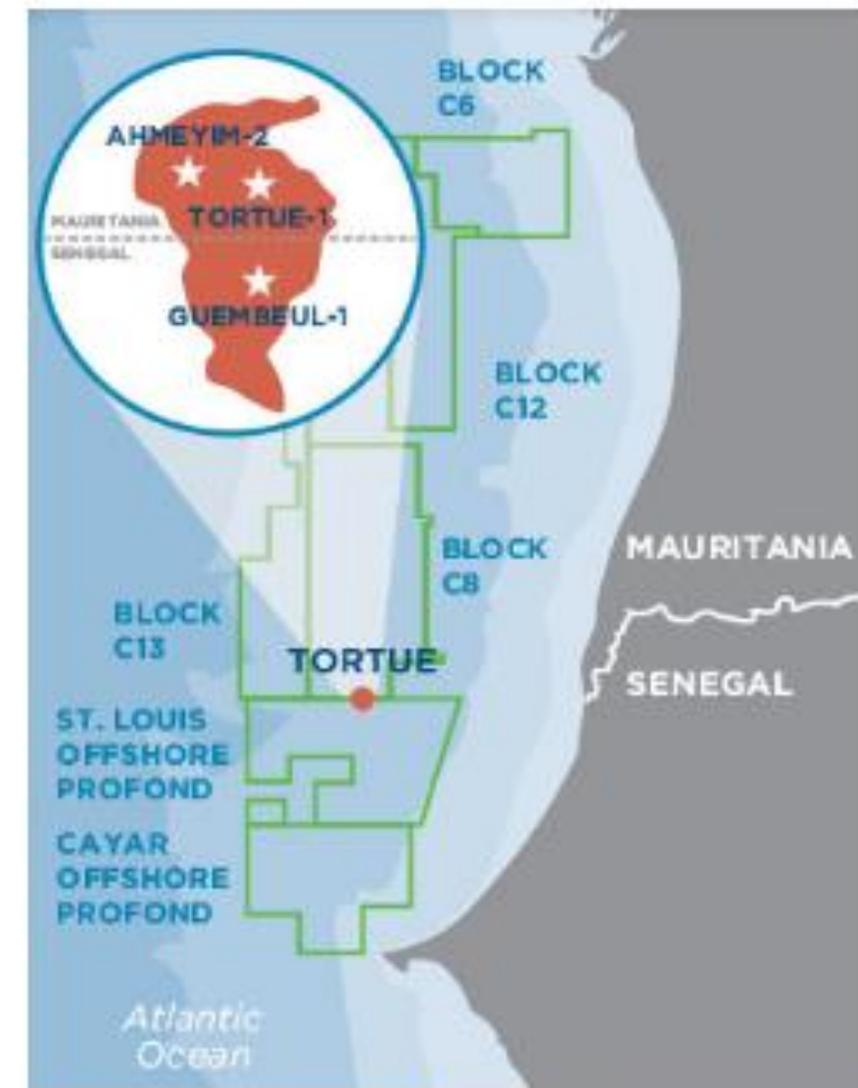
Expected to begin production in 2022, Gimi will liquefy gas as part of the first phase of the project. It is designed to produce an average of approximately 2.5 mtpa of LNG using Black and Veatch's PRICO liquefaction process.

Keppel will fabricate the vessel at its shipyard in Singapore. The company previously partnered with Keppel on the FLNG Hilli Episeyo, the world's first FLNG conversion project. Hilli Episeyo has maintained 100% uptime since beginning commercial operations offshore Cameroon in June 2018.

The total gas resources in the field are estimated to be around 15 Tcf. Construction of the unit is expected to cost around \$1.3 billion.

The Greater Tortue Ahmeyim project will produce gas from an ultra Deep water subsea system and mid-water FPSO vessel that will process the gas, removing heavier hydrocarbon components. The gas will then be transferred to the Gimi, which will be situated at a nearshore hub **located on the maritime border of Mauritania and Senegal.**

BP announced FID for Phase 1 of the development in December 2018. It is the first major gas project to reach FID in the basin. BP Gas Marketing was selected as the sole buyer for the LNG offtake from Tortue Phase 1.



**The Greater Tortue Ahmeyim project will be located on the maritime border of Mauritania and Senegal in West Africa.**

*Source: Kosmos Energy*

Marine Transport  
of  
Refined Products and Crude Oil



# Average Freight Rate Assessment (AFRA) Scale - Fixed



Cargo type

Vessel class, capacity (thousand deadweight metric tons)



Source: U.S. Energy Information Administration, London Tanker Brokers' Panel

Note: AFRAMAX is not an official vessel classification on the AFRA scale but is shown here for comparison.

**PAA St. James  
Terminal**

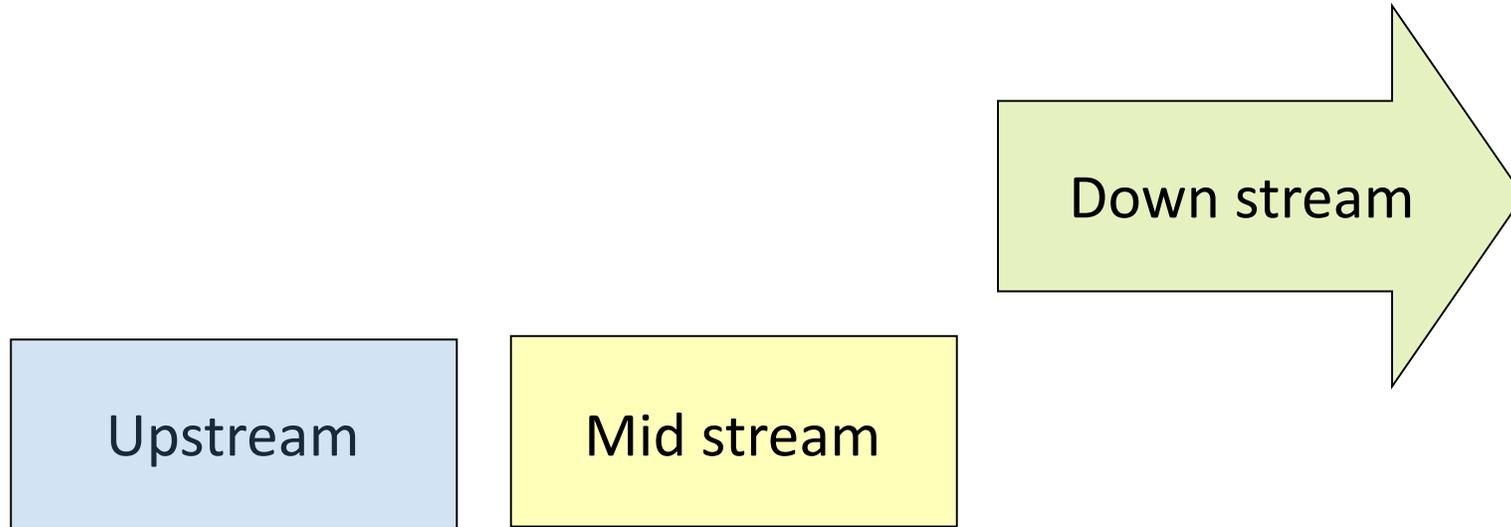
St. James Oil Terminal on the Mississippi

**Barge Dock  
(shore-side)**

**Ship Dock**



# Major Segments in the World of Energy



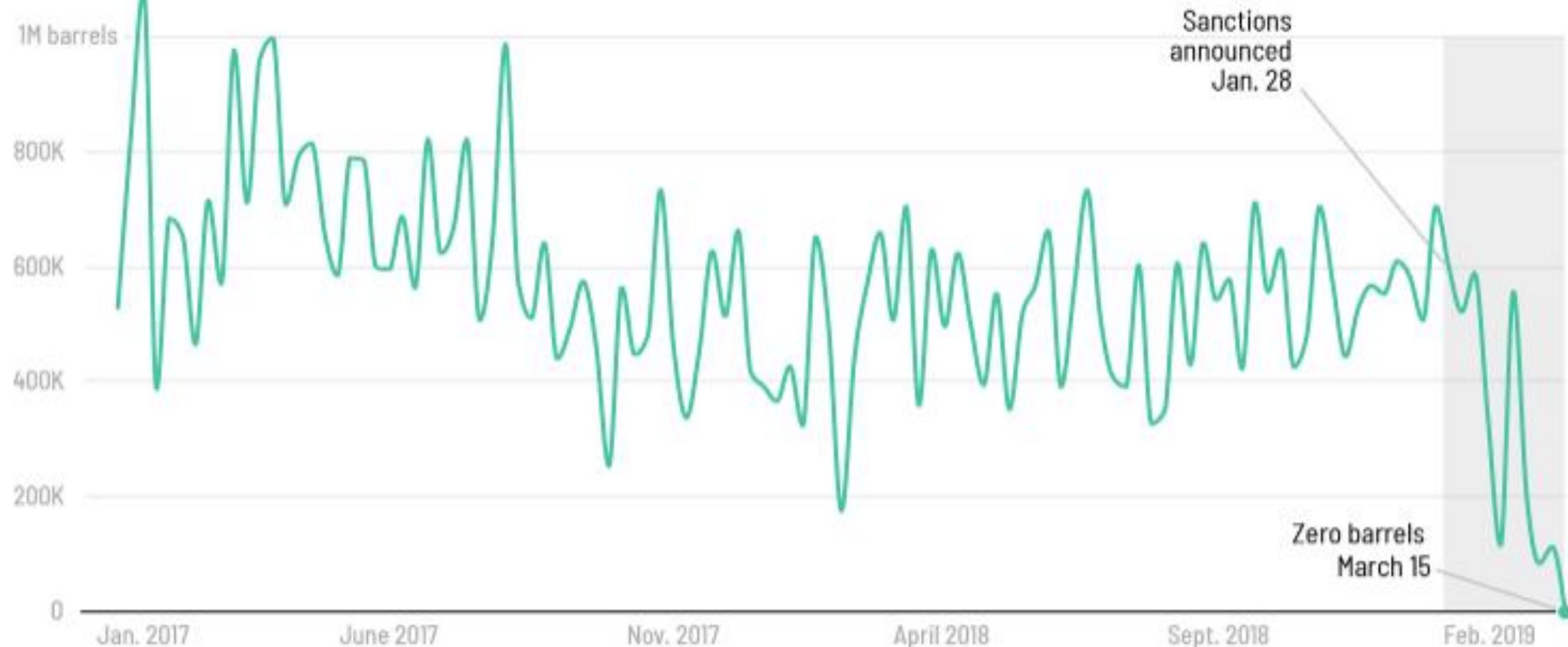
# Petroleum product imports and exports by region (2014)

thousand barrels per day



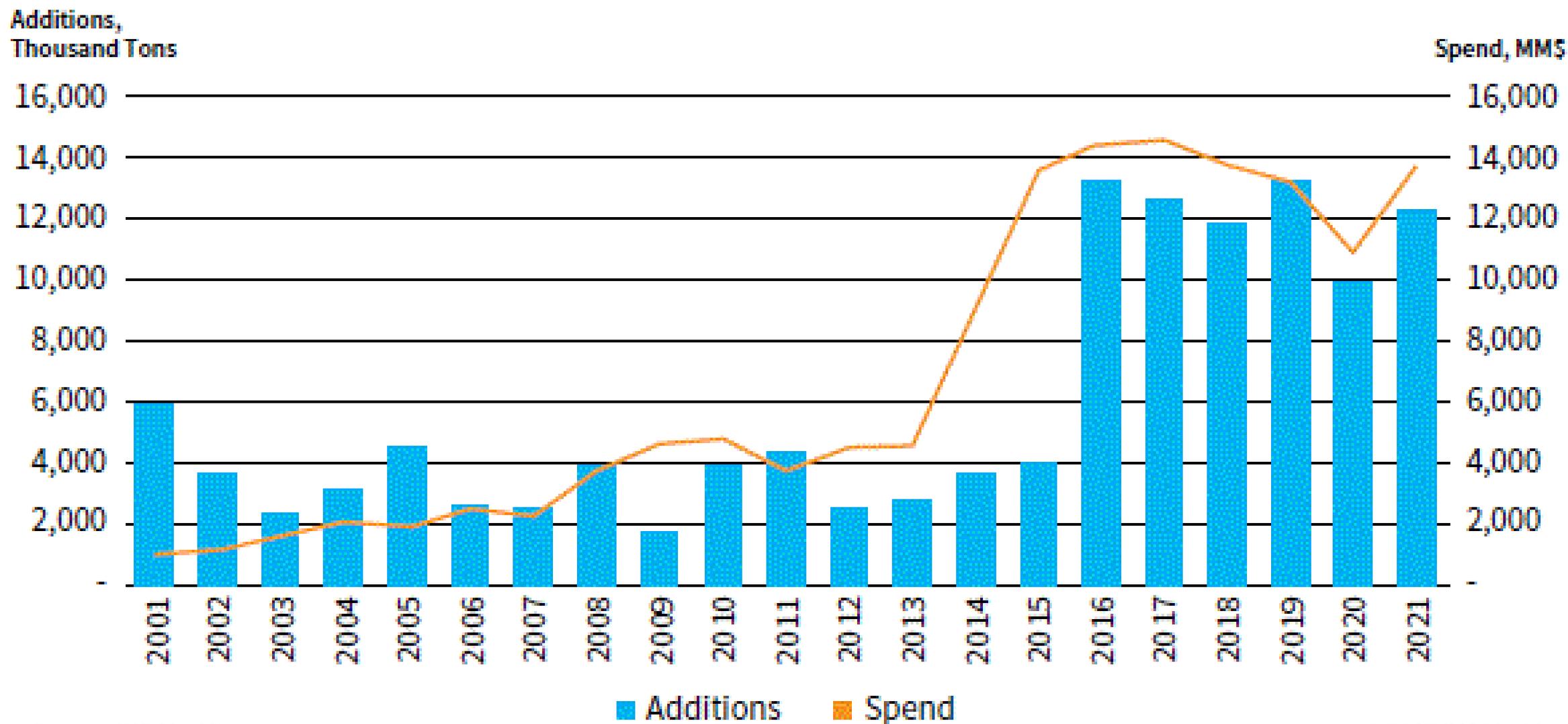
# US oil imports from Venezuela go to zero

Weekly shipments have disappeared since US sanctions were announced on January 28, 2019



Source: US Energy Information Administration  
Graphic: Matt Egan/Paul Martucci CNN

# U.S. Chemical Capacity Additions and Spending (Planned and Forecast)



Source: IHS Markit

© 2017 IHS Markit

Figure 1. U.S. Chemical Capacity Additions and Spending

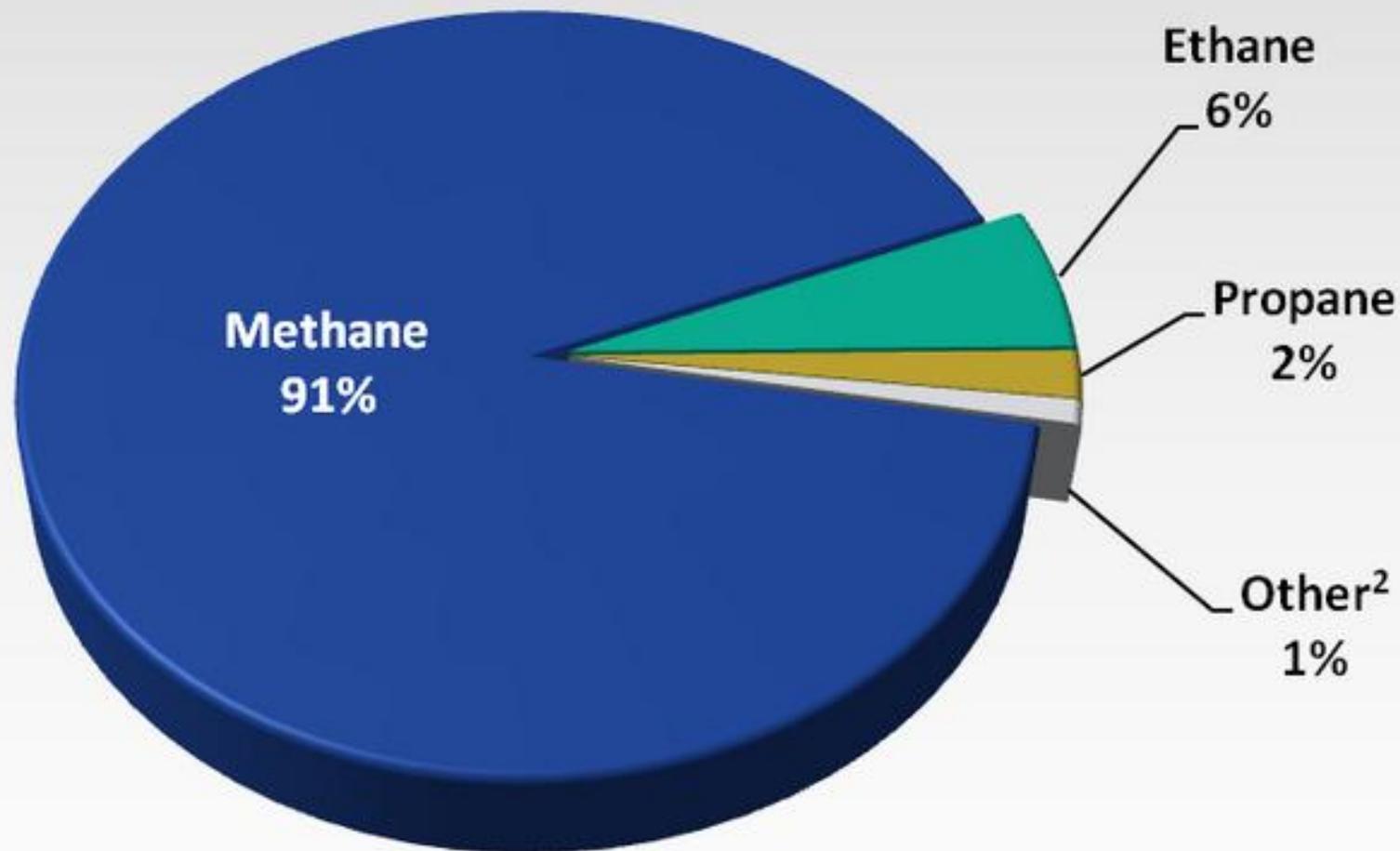


# LNG Exports



# What's in LNG

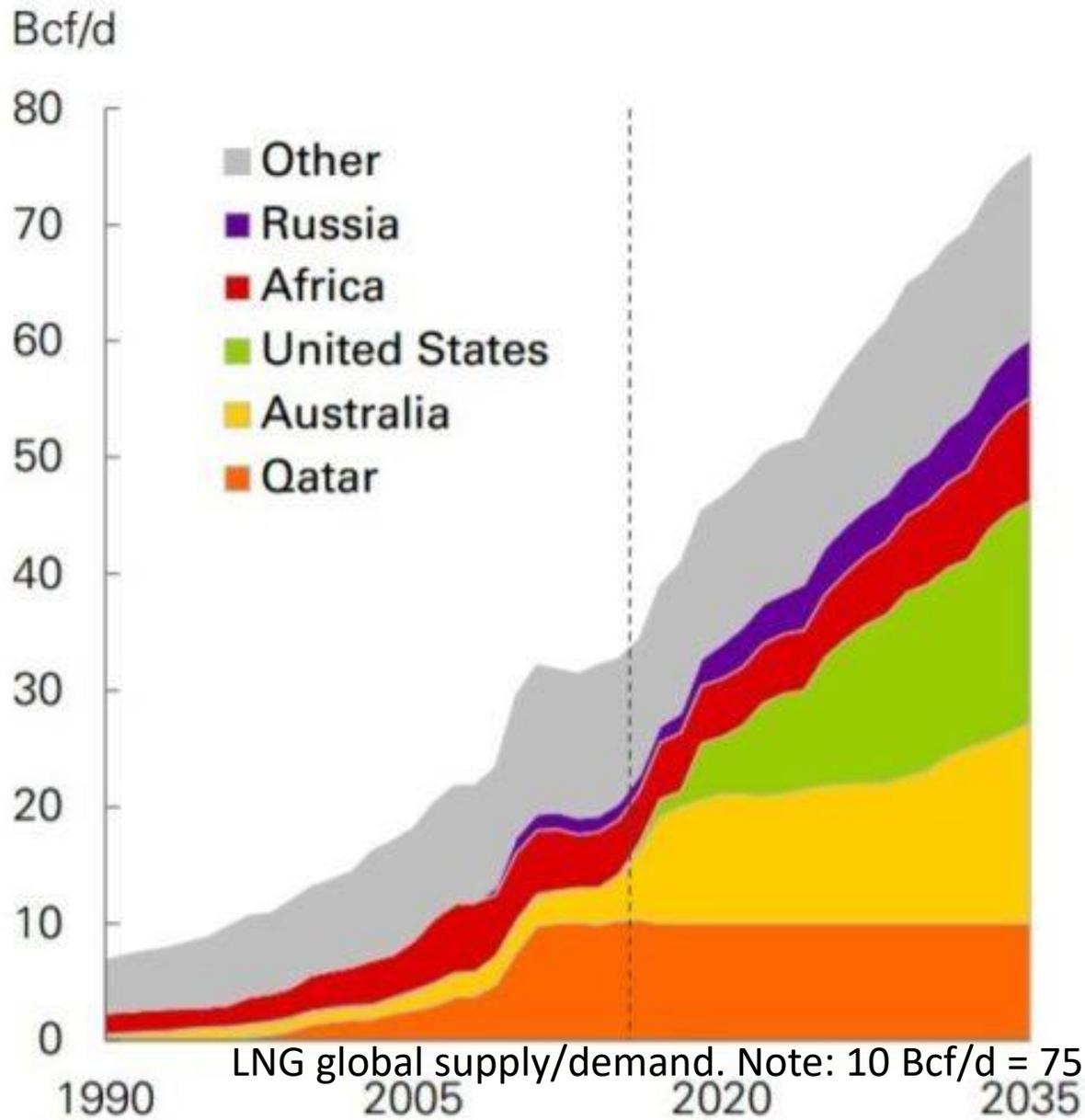
A typical blend of the world's LNG<sup>1</sup>



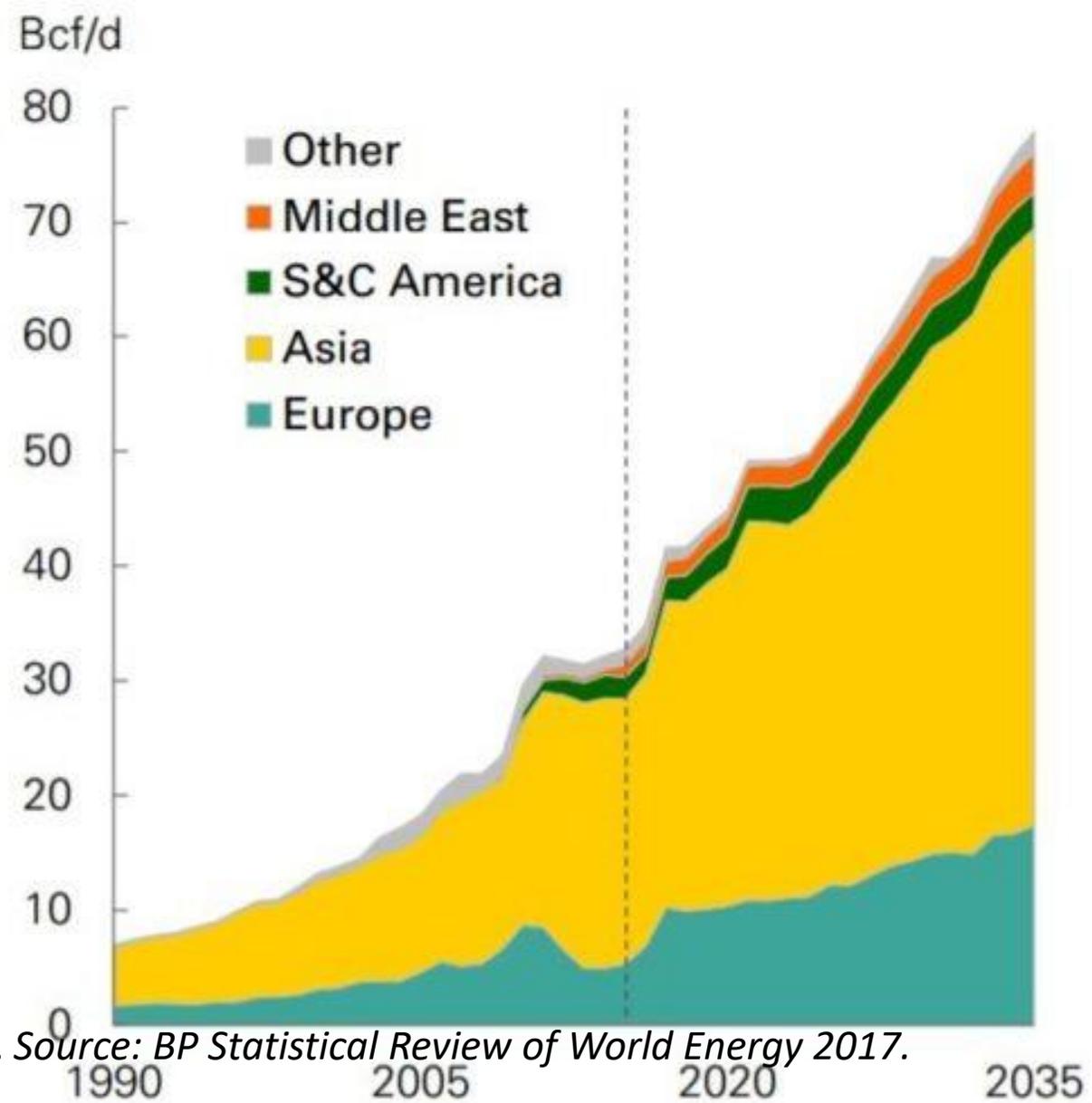
<sup>1</sup> Each country's mix is a little different. Methane content last year ranged from 83% in Libya to 99.7% in Nikiski, Alaska.

<sup>2</sup> Mostly butane

## LNG supply



## LNG demand



LNG global supply/demand. Note: 10 Bcf/d = 75 mtpa. Source: BP Statistical Review of World Energy 2017.

# ExxonMobil, Eagle LNG and Crowley join forces on LNG fuel

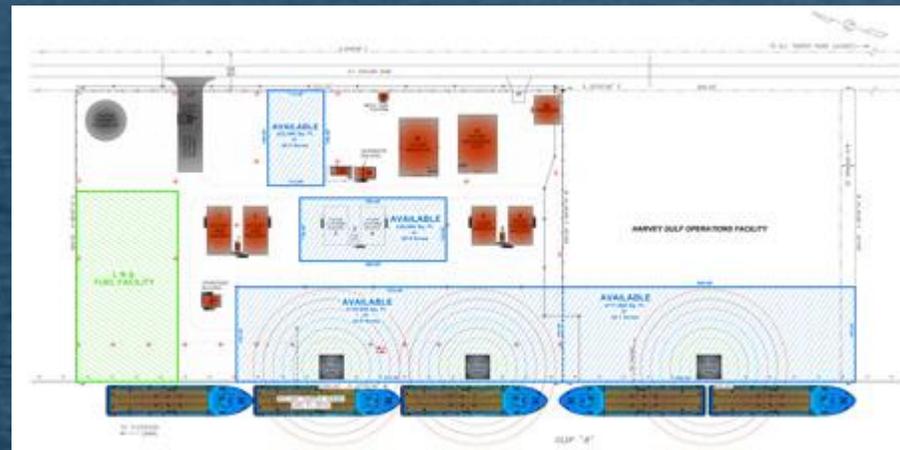


Image courtesy of Crowley

# EAGLE

LNG PARTNERS





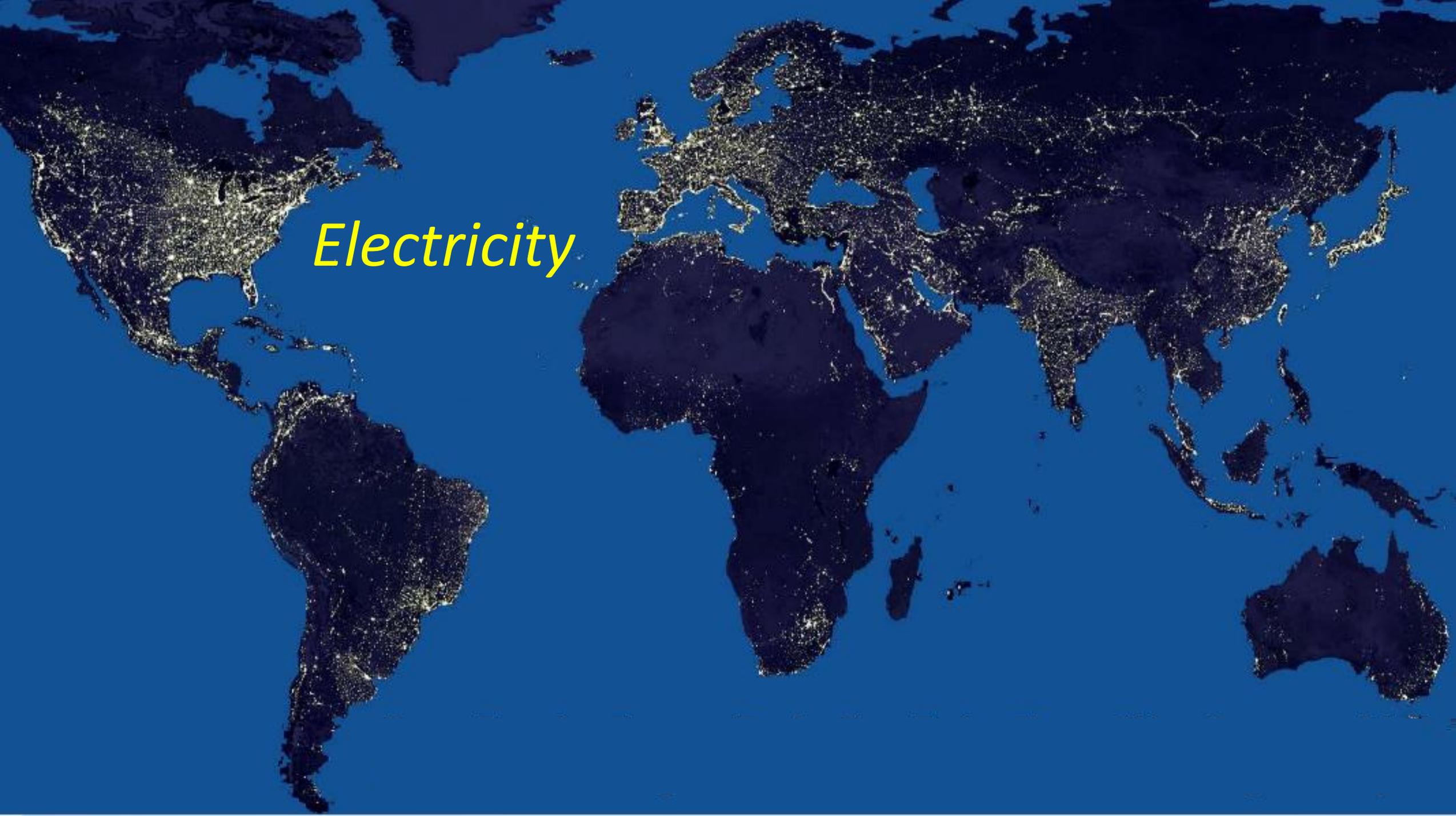




# DEME holds naming ceremony for its 1st LNG-powered dredger

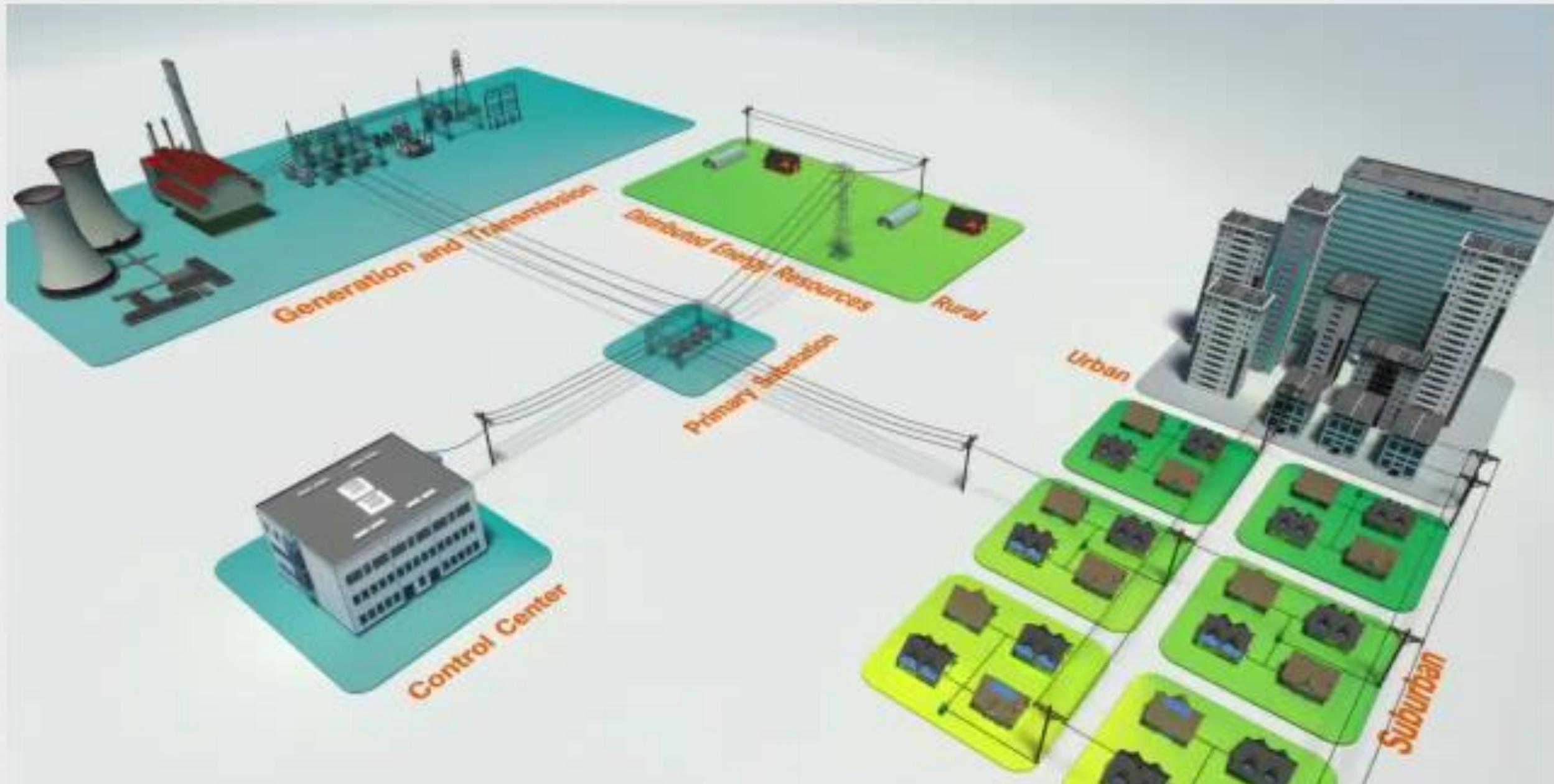


Besides Minerva, IHC has been previously contracted by DEME to build LNG-powered trailing suction hopper dredger Scheldt River, LNG-powered cutter suction dredger Spartacus and LNG-ready Bonny River.

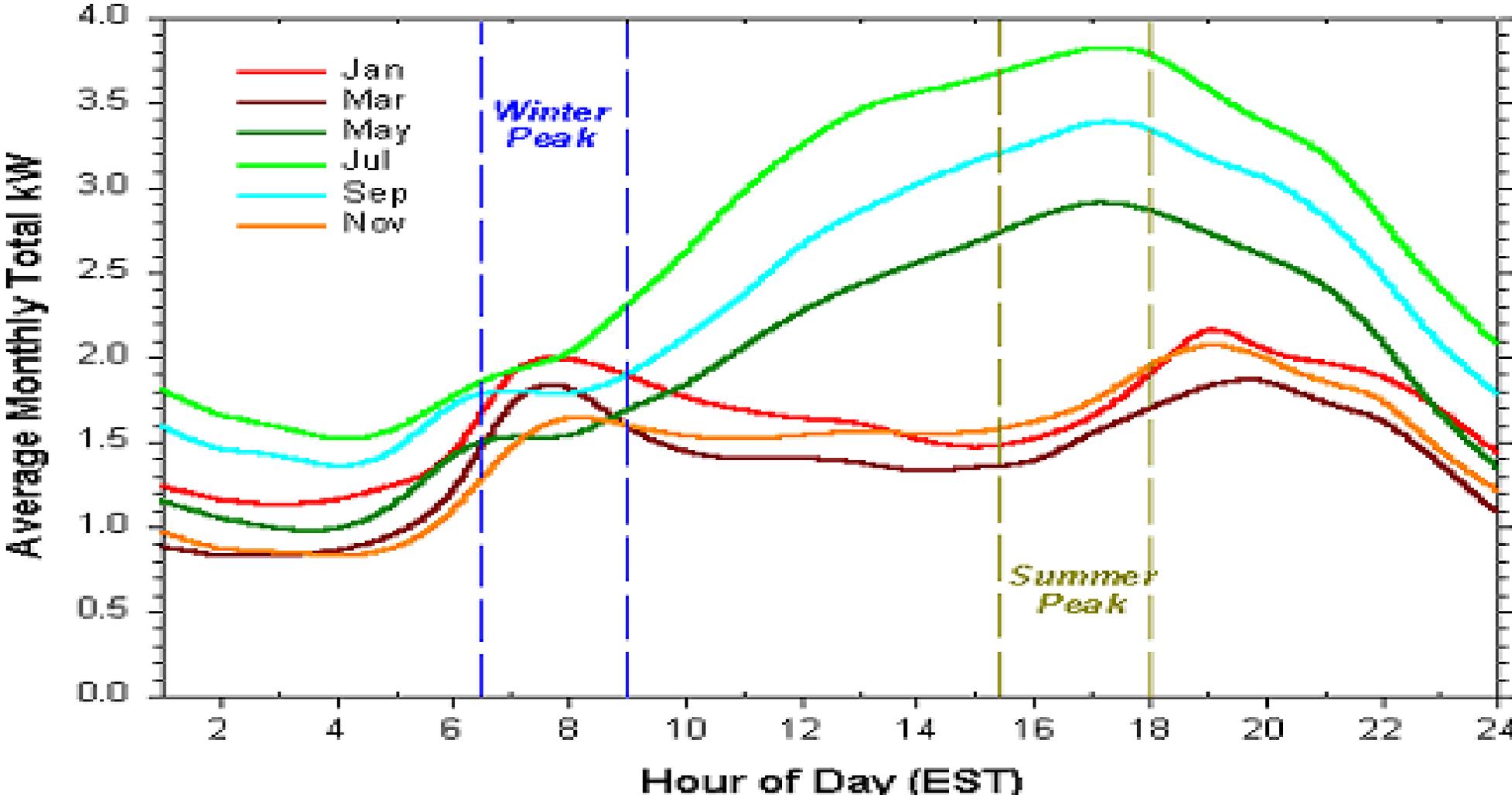


*Electricity*

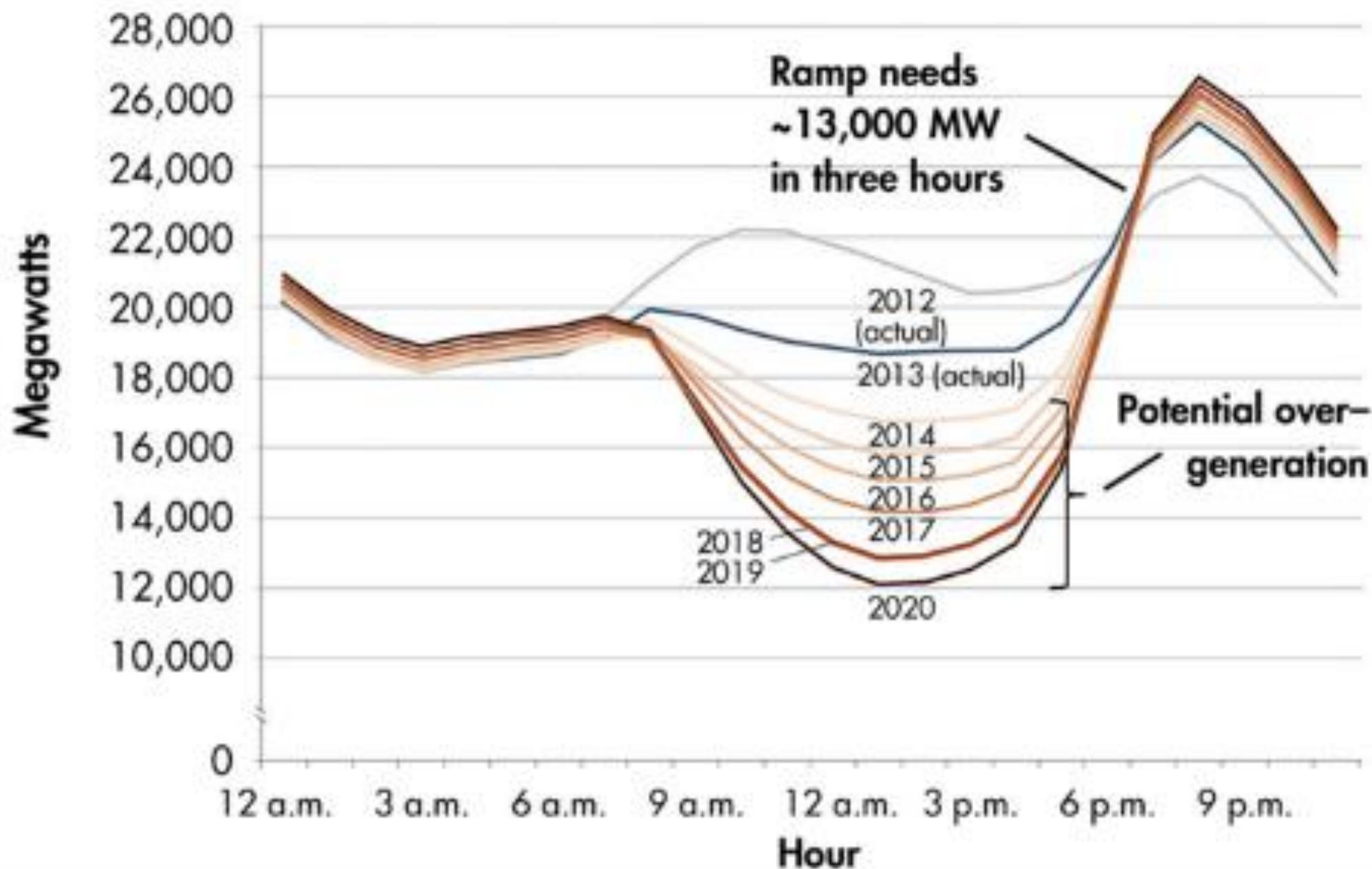
# The Electric Grid



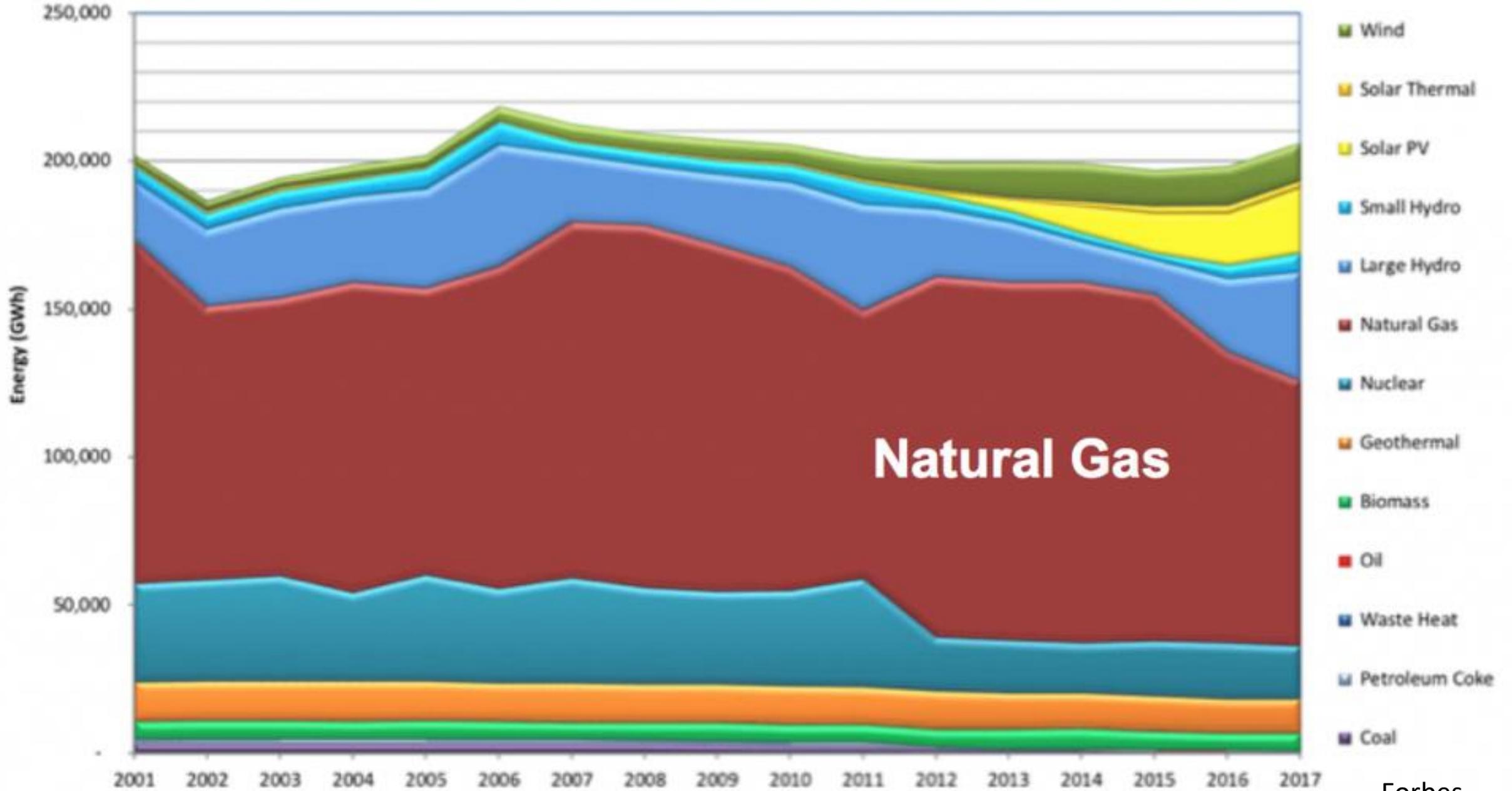
The Load profile changes during the year  
Note the average usage by hour for a sample of metered homes in Florida during key months



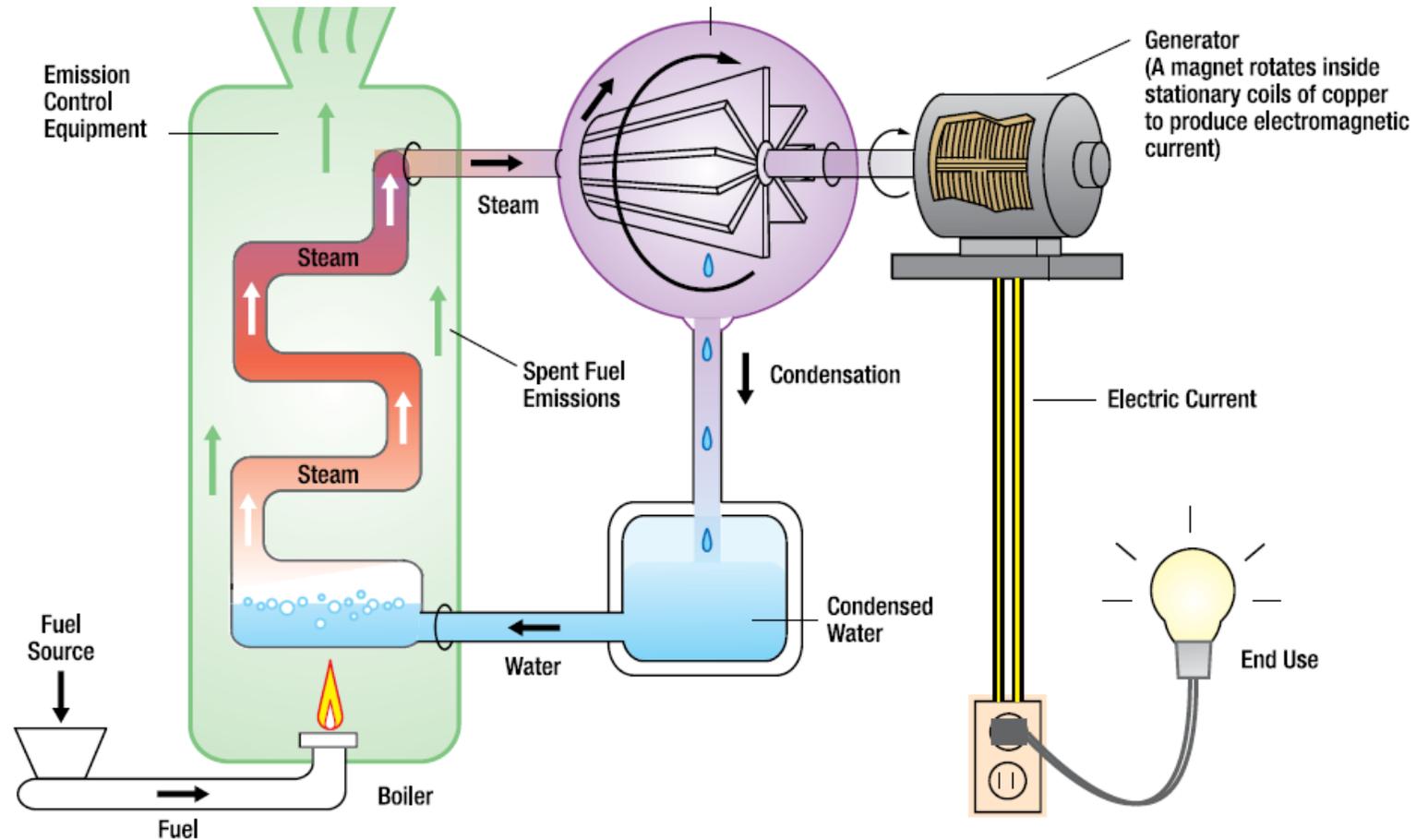
# Net Load – March 31



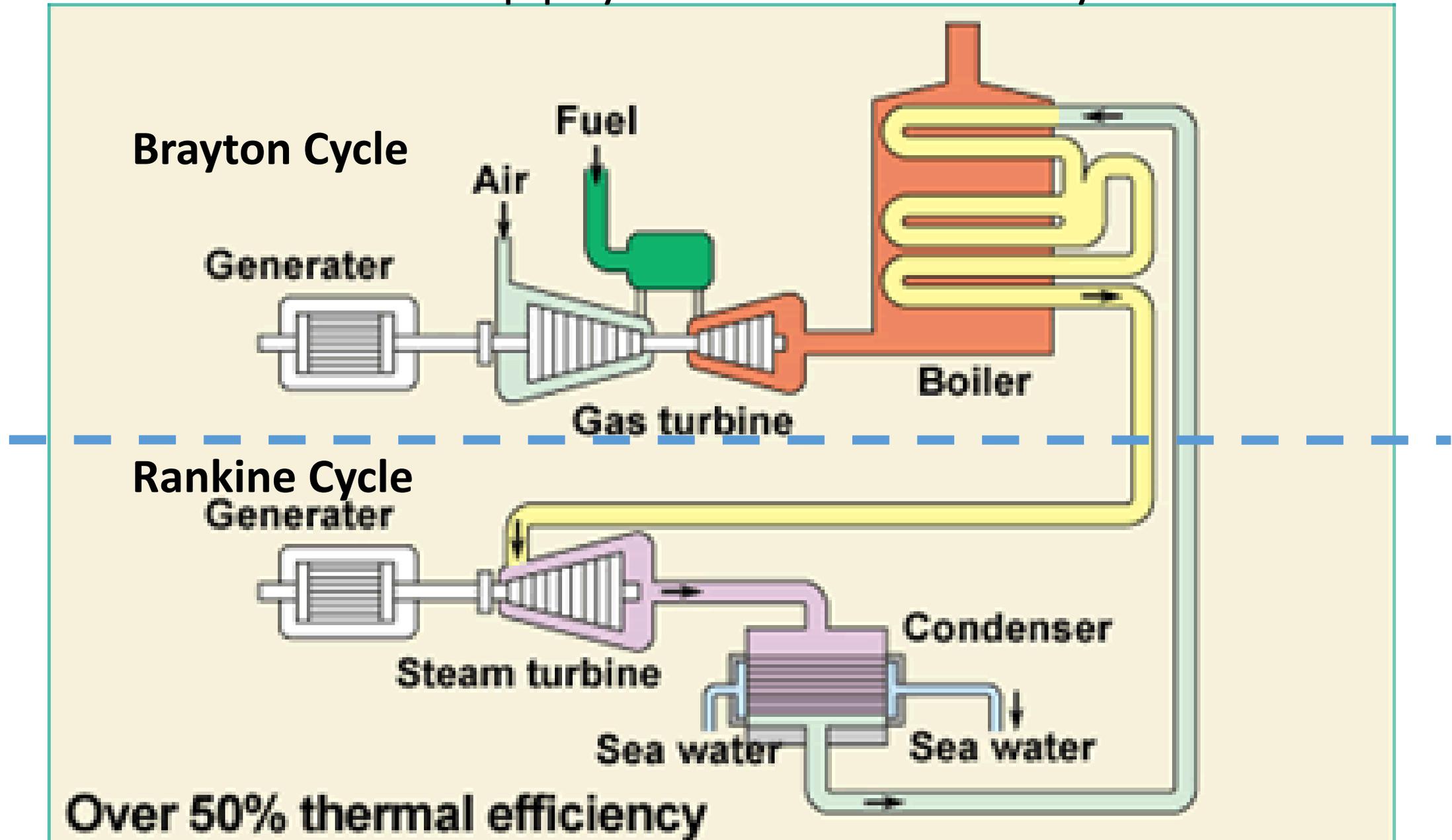
# California's In-State Electricity Generation by Source



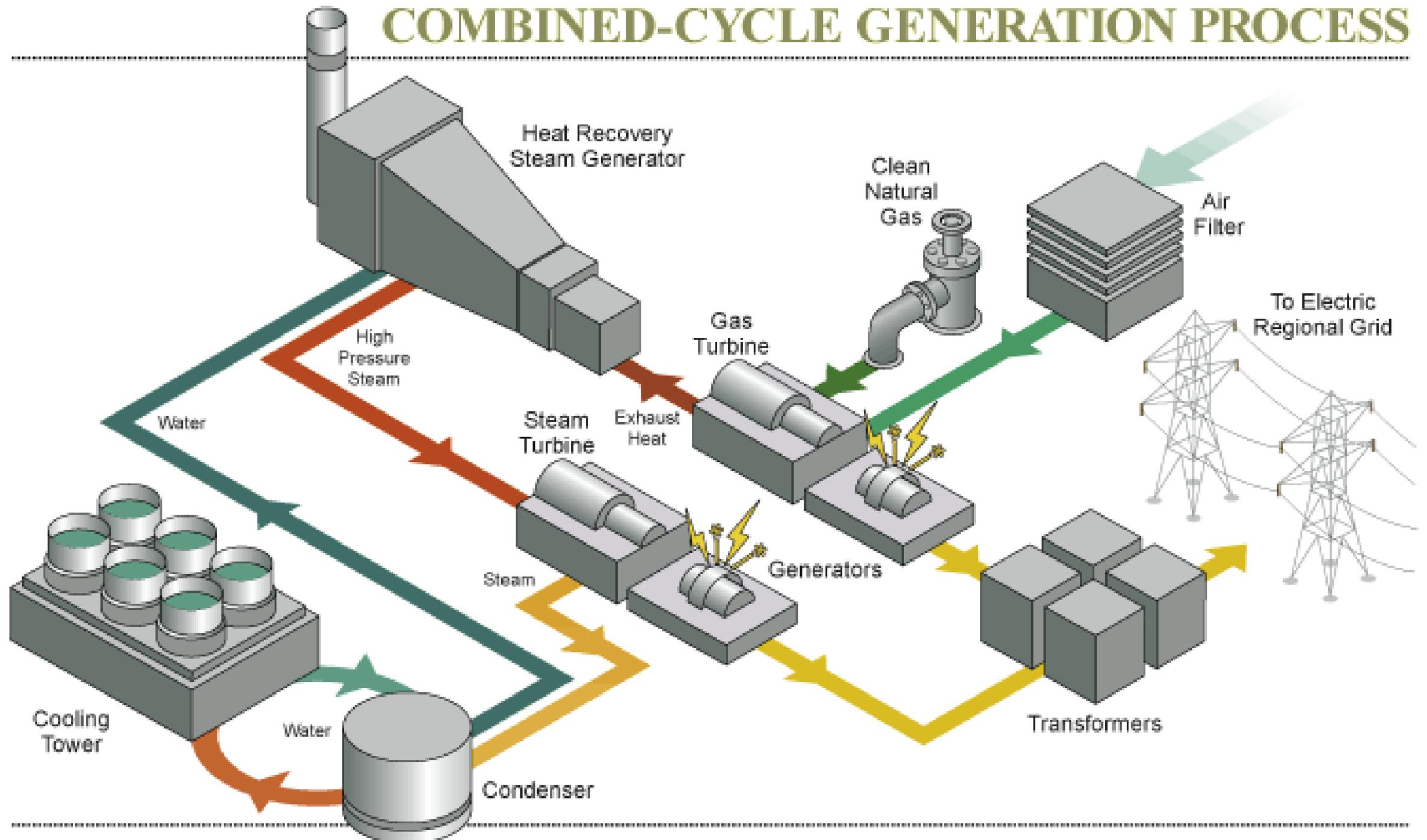
# Sources of Power Supply Fossil – fired Generation: Basic Steam (Rankine) Cycle



# Sources of Power Supply – Combined Cycle



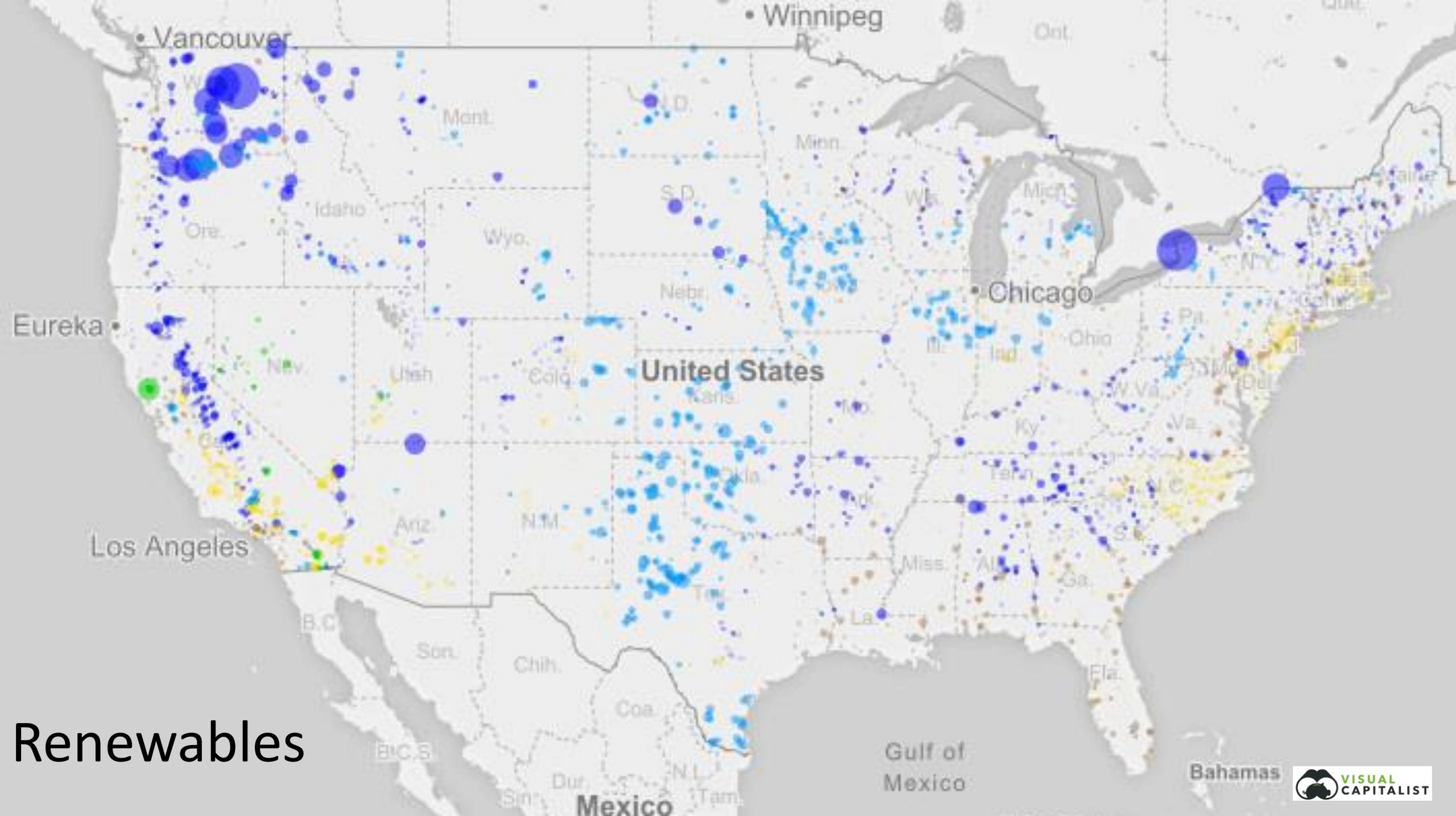
# COMBINED-CYCLE GENERATION PROCESS





# *Renewables*





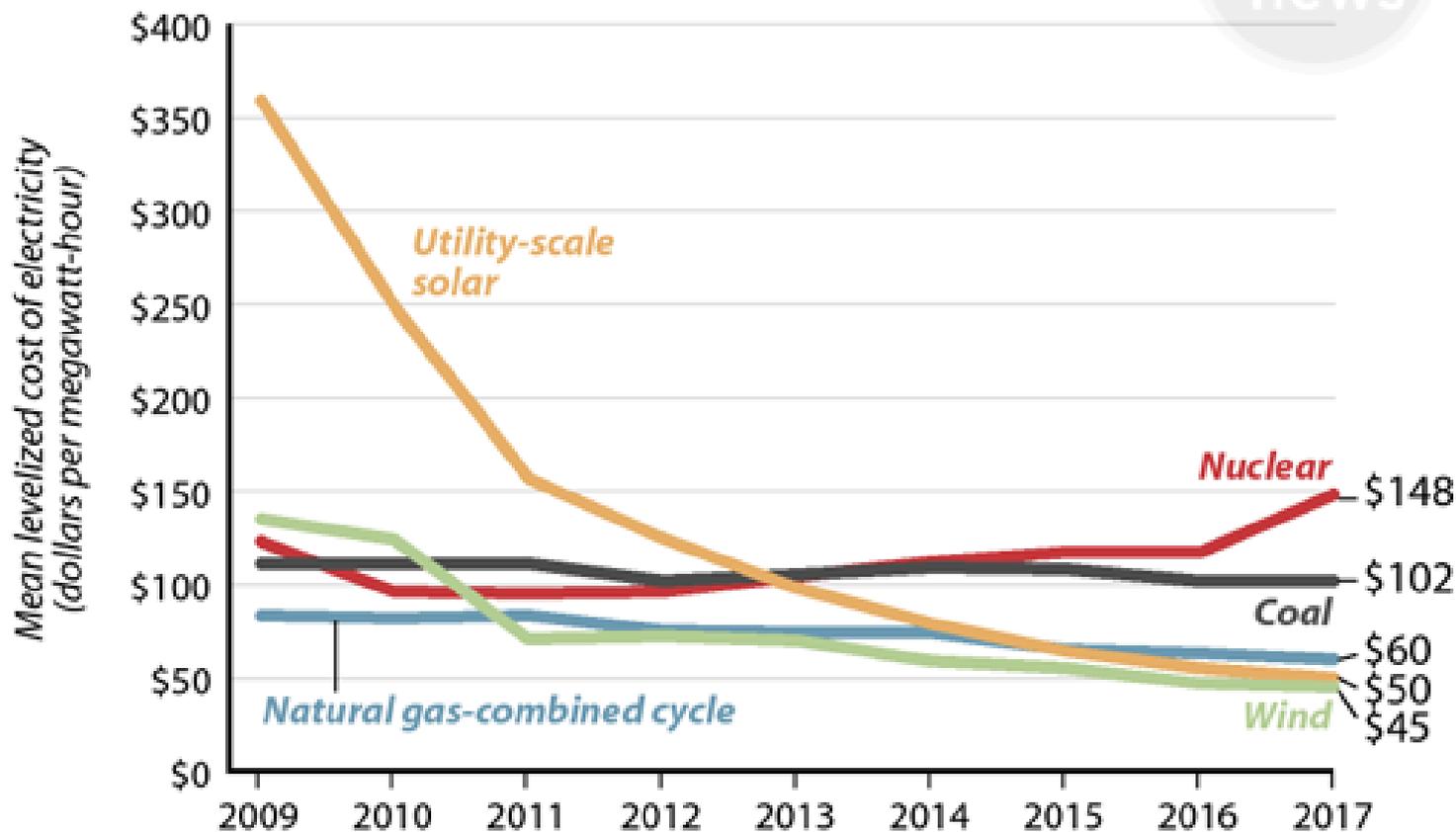
Renewables

# Renewable Energy Costs Are Falling

Analysts at Lazard compared the changing costs over time for generating a megawatt-hour of electricity from different energy sources, including coal, solar, wind, nuclear and natural gas.

## HISTORICAL AVERAGE LEVELIZED COST OF ELECTRICITY

2009-2017



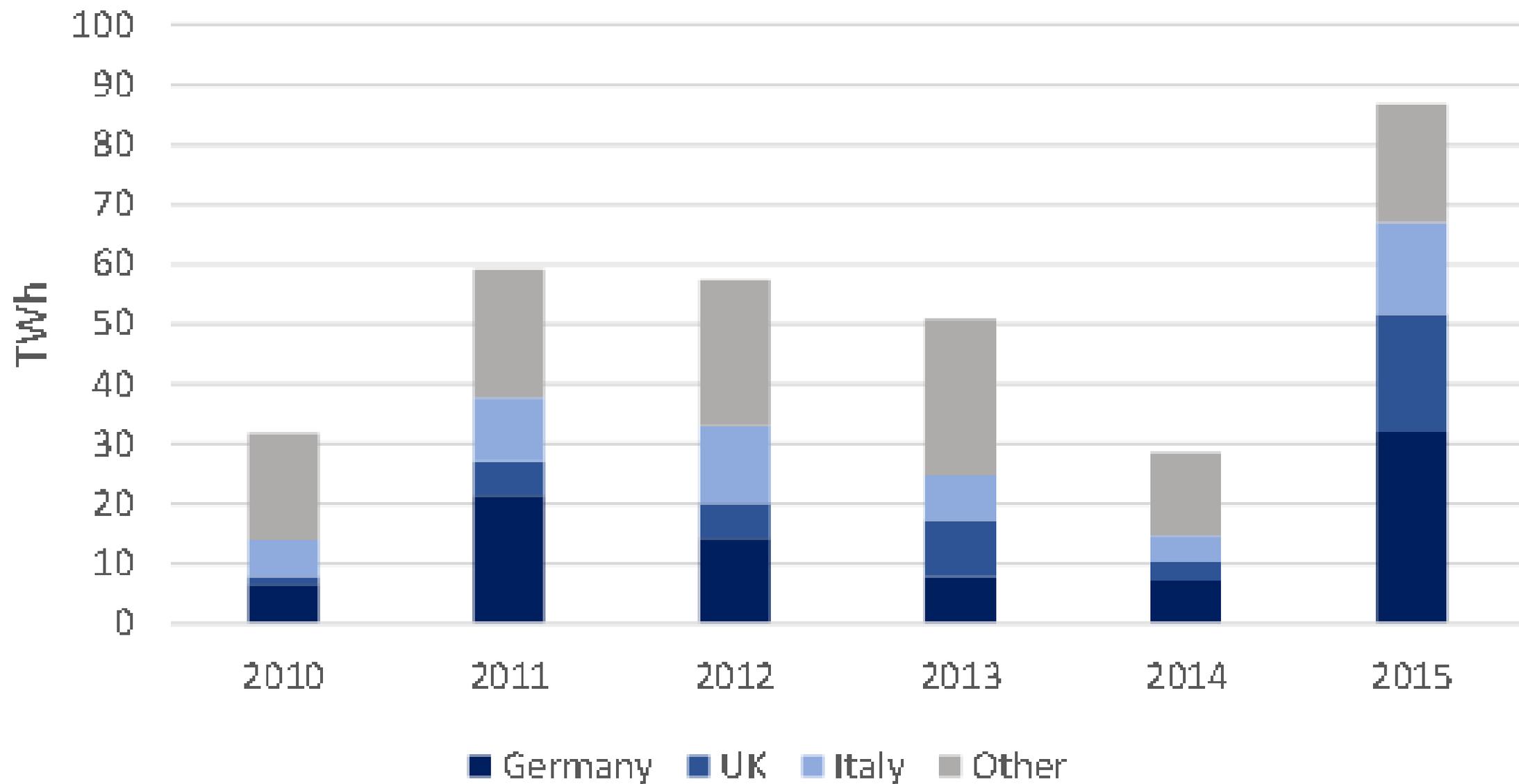
Notes: Reflects average of unsubsidized high and low levelized cost of energy range. Primarily related to North American alternative energy landscape, but reflects broader global cost declines.

American Electric Power last week abandoned its plan to build the largest wind farm in the United States (2,000 MW, \$4.5 b), a victim of a complex mix of political, regulatory and market challenges.

Wind Catcher needed regulatory approval from Texas and three other states: Arkansas and Louisiana, which gave it the green light, and Oklahoma, which had not yet decided.

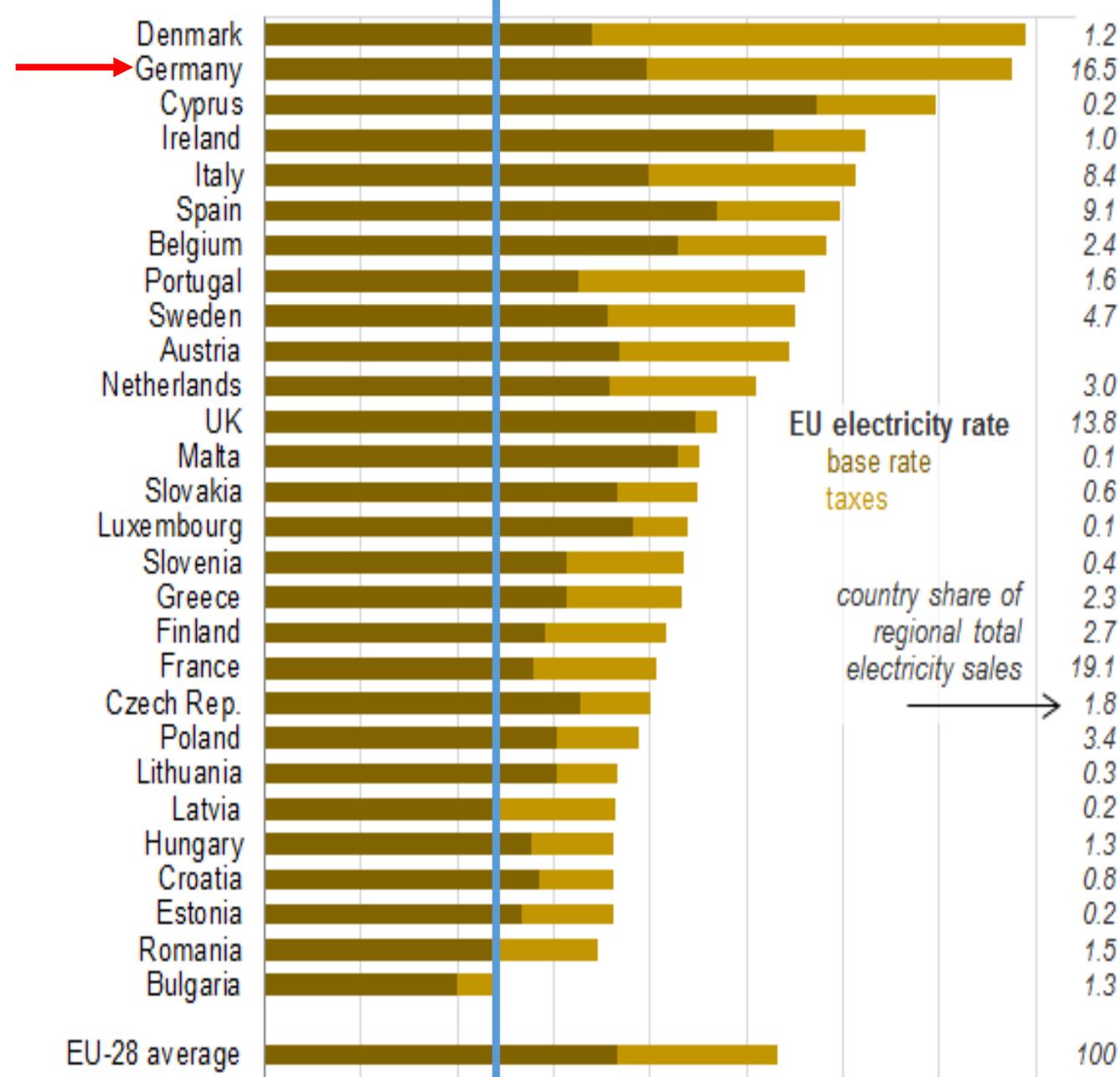


# Annual Increase in Renewables Generation

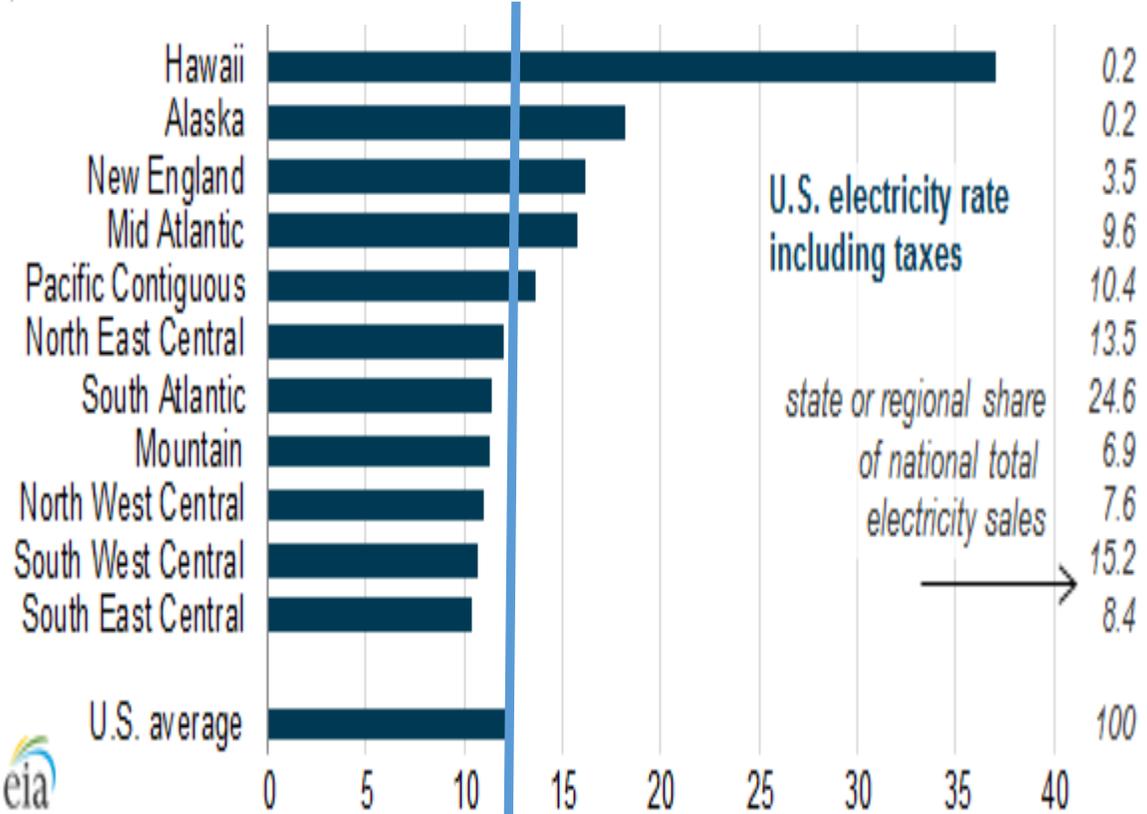


# Residential electricity prices in Europe and the United States in 2013

U.S. cents per kilowatthour (weighted average) share of total sales



U.S. cents per kilowatthour (weighted average) share of total sales

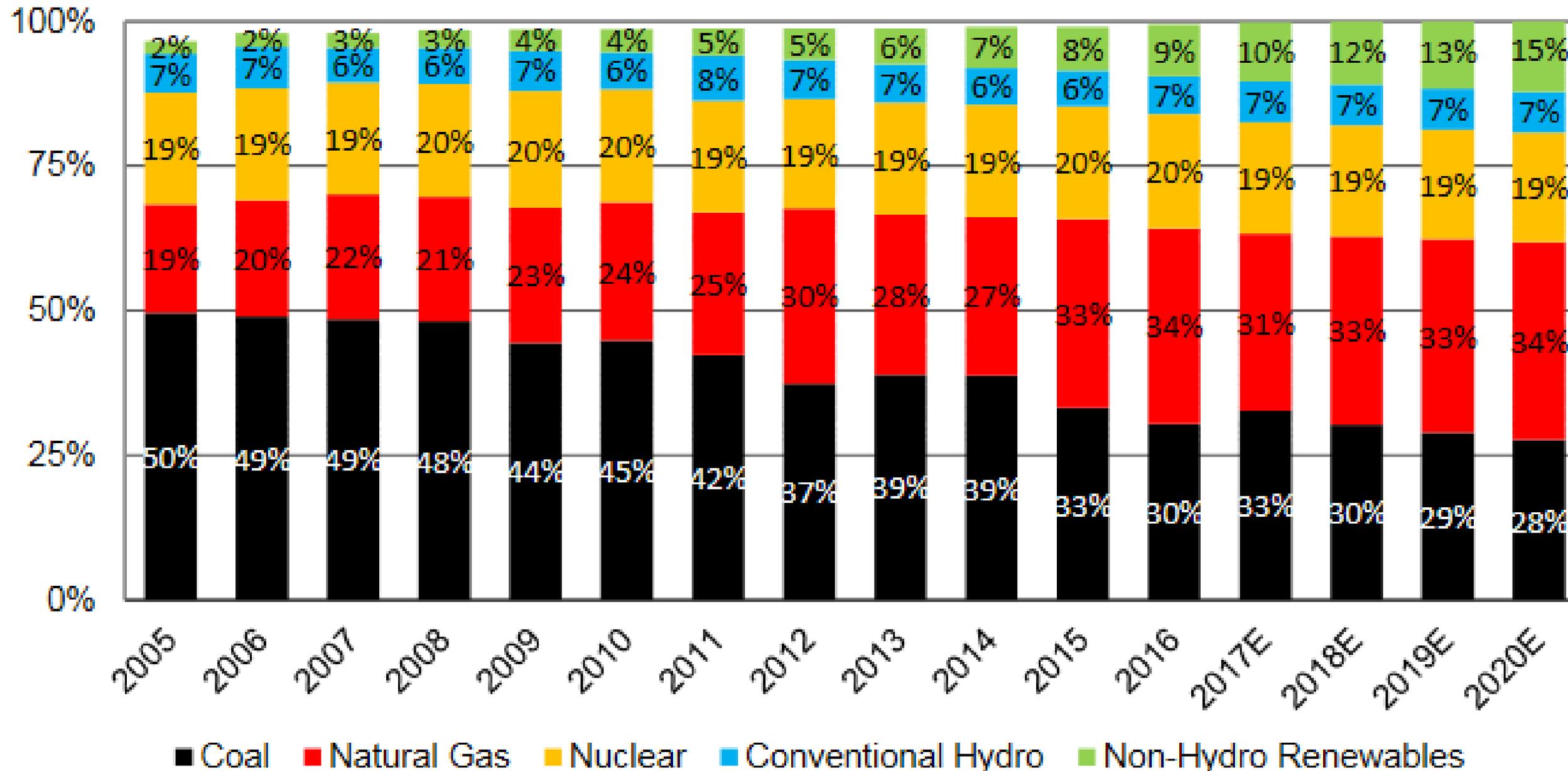


Source: U.S. Energy Information Administration, Electric Power Monthly; Eurostat  
 Note: A conversion factor of 1.328 Euros/USD was used. Percent share of residential sales are 2012 values.

# Downstream Energy Issues

- EPA limits on CO<sub>2</sub> for power plants
- EPA limits on CO<sub>2</sub> for refineries and chemical plants
- EPA promotion or reduction of Ethanol mandates
- Government R&D on Renewables vs. Hydrocarbons
- Potential WOTUS restrictions
- Effect of Crude Exports on crude and refined product prices
- As crude prices drop, the commercial rationale for switching Steam Crackers from Naphtha to Ethane fades
- Activist efforts to dismantle integrated petrochemical companies
- Impact of trade disputes on US petroleum, LNG and petrochemical exports.

# U.S. Electric Power Generation - Market Share by Source



Coal
  Natural Gas
  Nuclear
  Conventional Hydro
  Non-Hydro Renewables

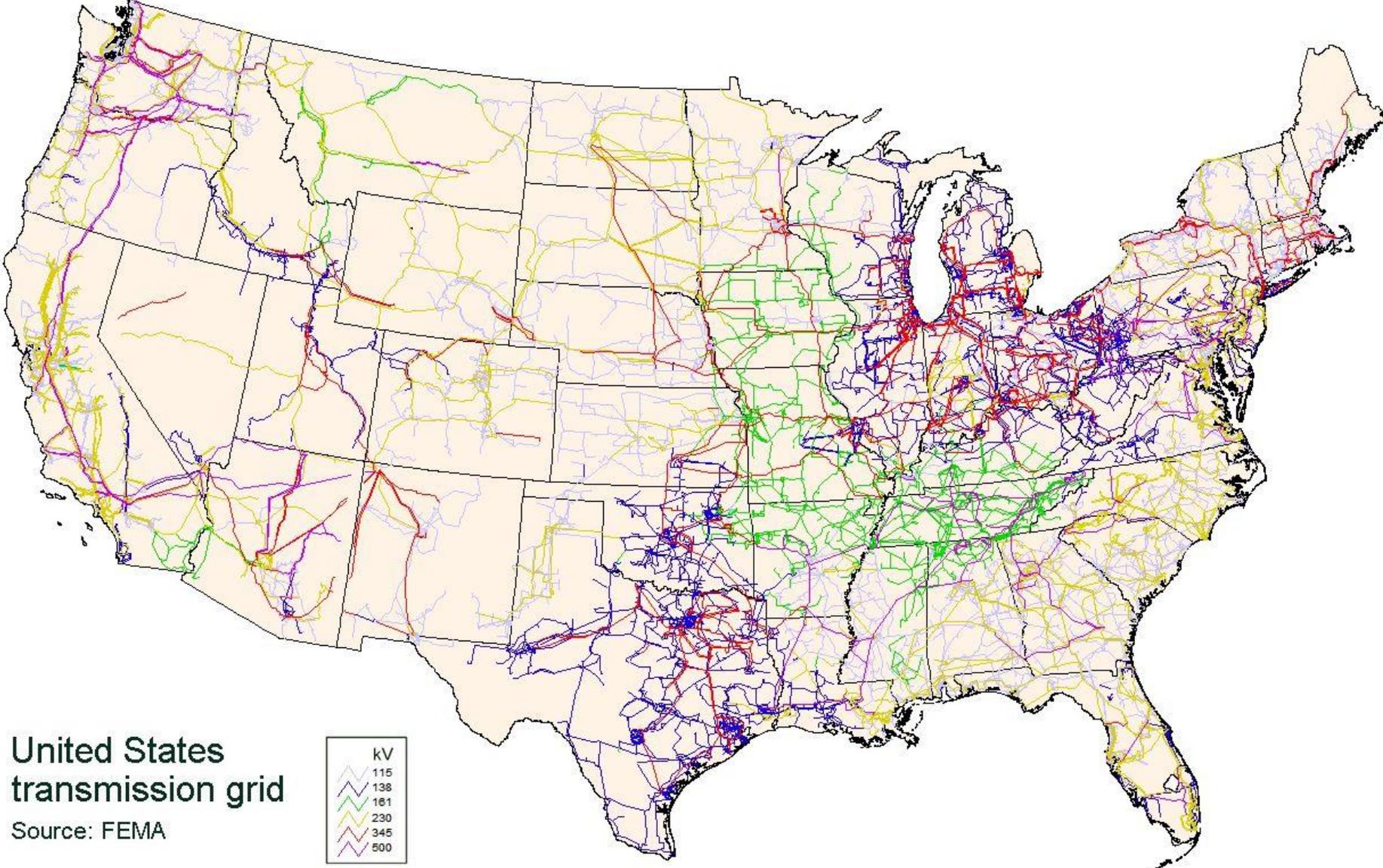
Source: EIA, Raymond James research

# High Voltage transmission

A network of metallic cable transporting electrical energy from the generating units to distribution stations and transmission customers.



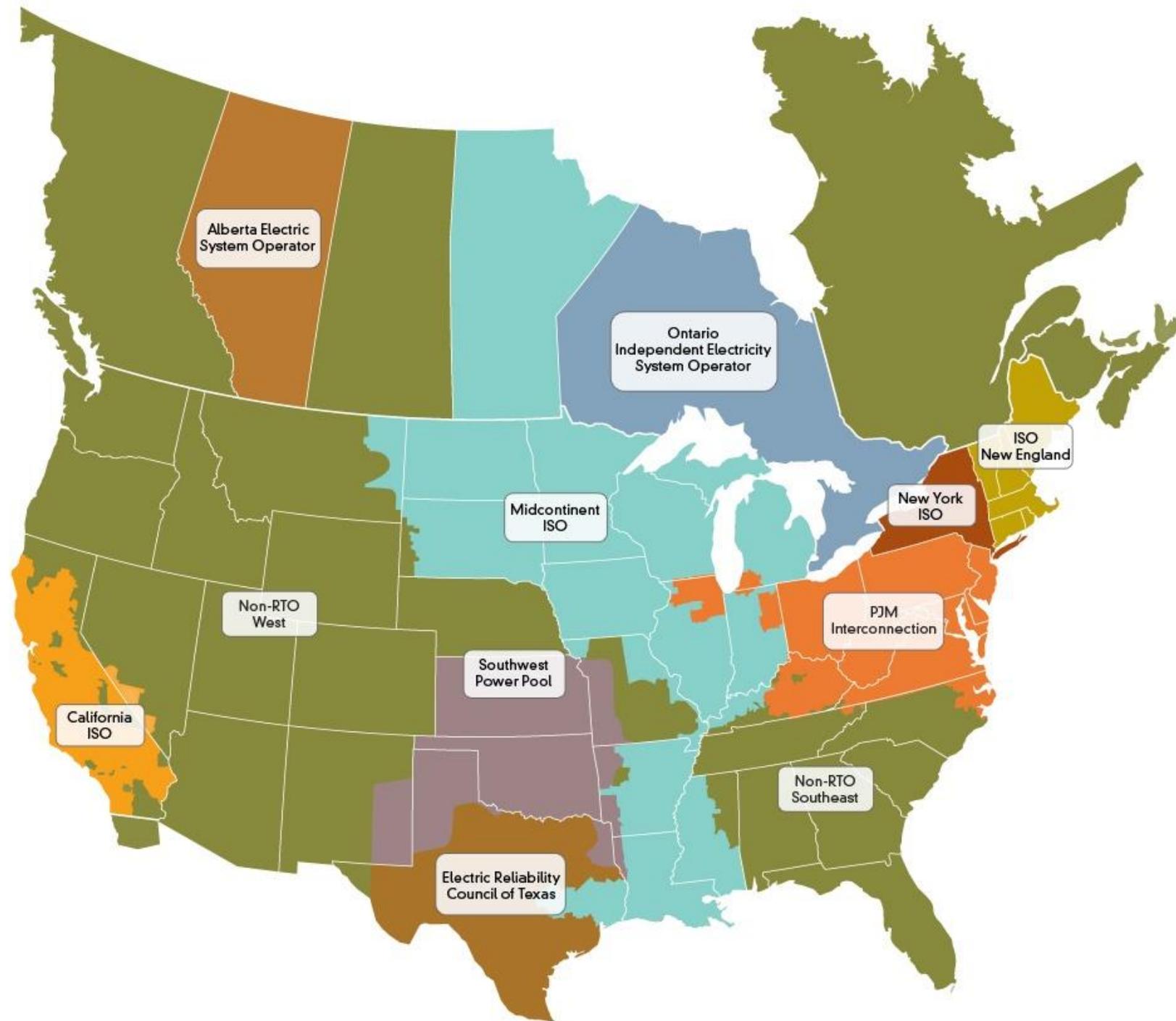
# Transmission grid is a massive interconnected network



Nine organized wholesale markets serve two thirds of US electric customers and one –half of Canadian customers

MISO, the Midcontinent ISO is the largest in terms of area.

Note the transmission choke point between MISO North and MISO South





A view of the control room from an overlook room shows the power grid in 2018 at the California Independent System Operator in Folsom. Renee C. Byer [rbyer@sacbee.com](mailto:rbyer@sacbee.com)