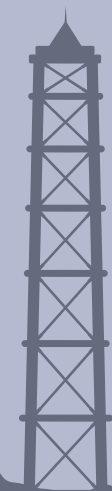


# THE QUEST PART II: SECURING THE SUPPLY

Scott Beckman  
Sydney McCarthy  
Austin Hull



# OVERVIEW

## CHAPTER II

Is the World Running  
Out of Oil?

## CHAPTER 13

The Security of  
Energy

## CHAPTER 15

Gas on Water

## CHAPTER 12

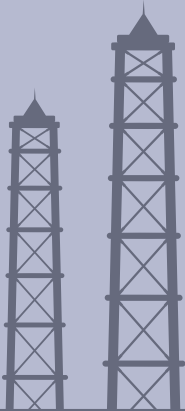
Unconventional

## CHAPTER 14

Shifting Sands in the  
Persian Gulf

## CHAPTER 16

The Natural Gas  
Revolution



# IS THE WORLD RUNNING OUT OF OIL?

CHAPTER II



**NO**



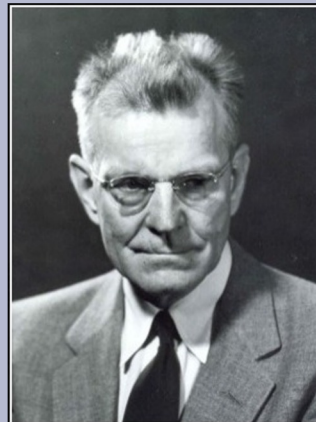
# CYCLE OF RUNNING OUT

1. Industry born Titusville 1859 ----->geologists feared exhaustion in 1885--->new fields discovered
2. WW1 importance of oil ---> demand grows ---> fear of exhaustion in 1920 --->oil in Iraq
3. WW2 ---> same story ---> US has to import from Middle East
4. 1970 ---> oil embargo -----> new sources (Alaska,North Sea)
5. China and growing global demand -----peak oil



# MARION KING HUBBERT

- PHD at University Chicago
- Professor at Columbia
- Political ideologies: engineers should be politicians
- Used Physics, Math, Chem for Geology --->wrote “The Mechanics of Hydraulic Fracturing”
- Projected the world running out of oil after the 60’s



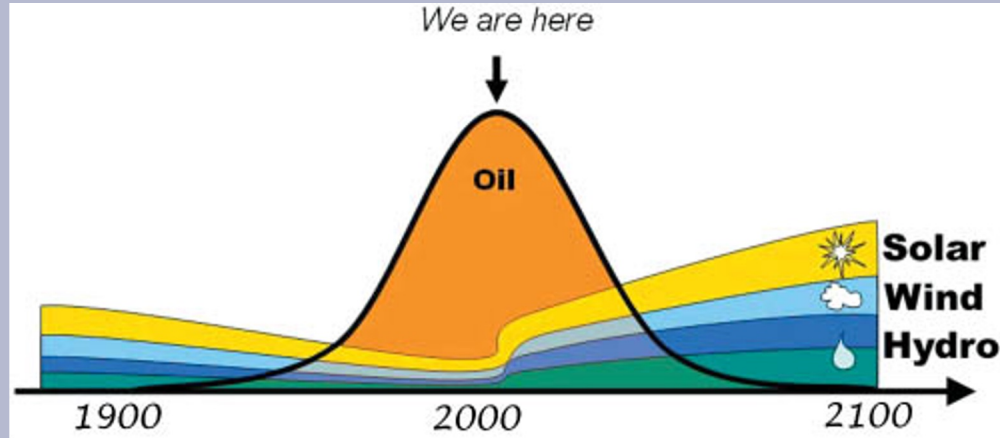
It is hard to know which is the more remarkable- that it took 600 million years for the Earth to make its oil, or that it took 300 years to use it up.

— *M. King Hubbert* —

AZ QUOTES

# PEAK OIL

- Hubbert states bell shape production curve
- Production falls off
- Fears of running out

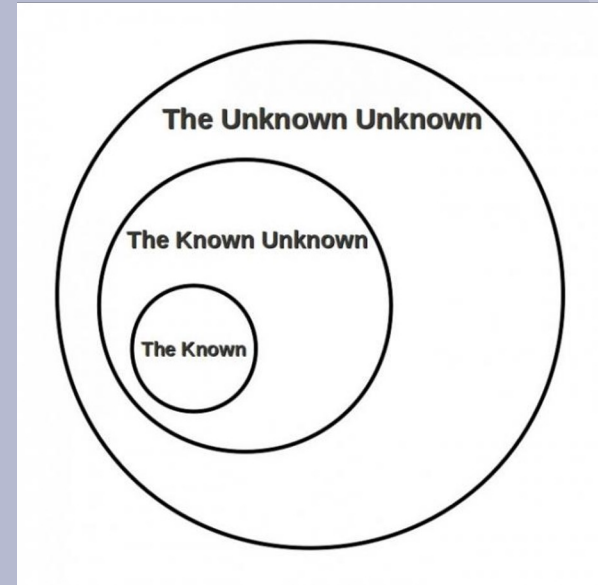
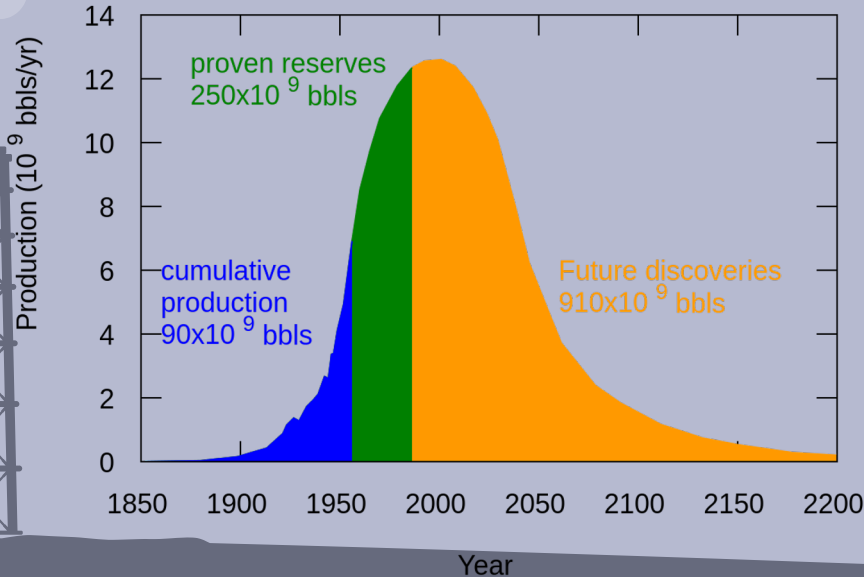






# DISCOVERIES VS ADDITIONS

- Little known about a field when first discovered
- More holes drilled ---->better understanding
- 86% of reserves from additions (USGS)



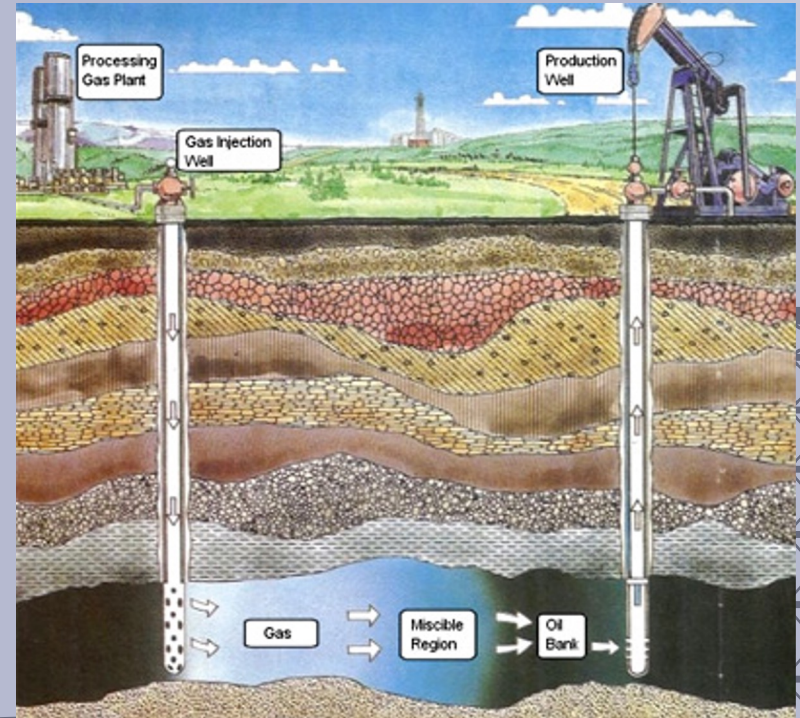
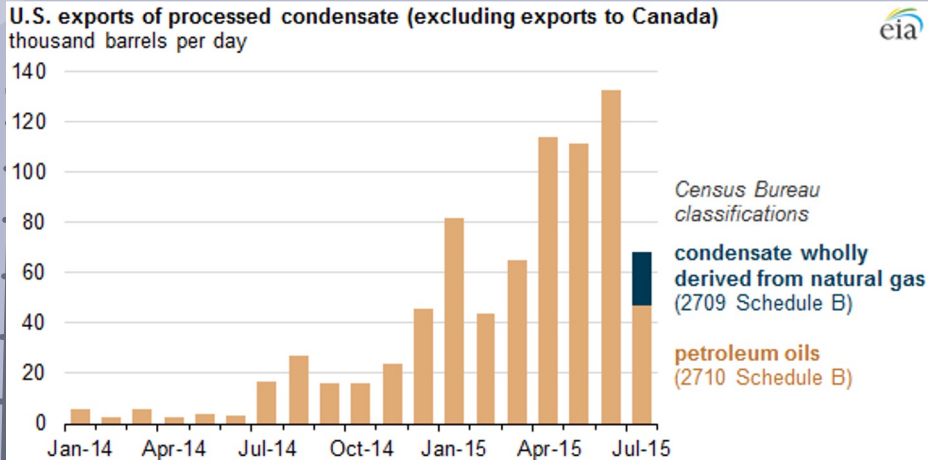
# UNCONVENTIONAL

## CHAPTER 12



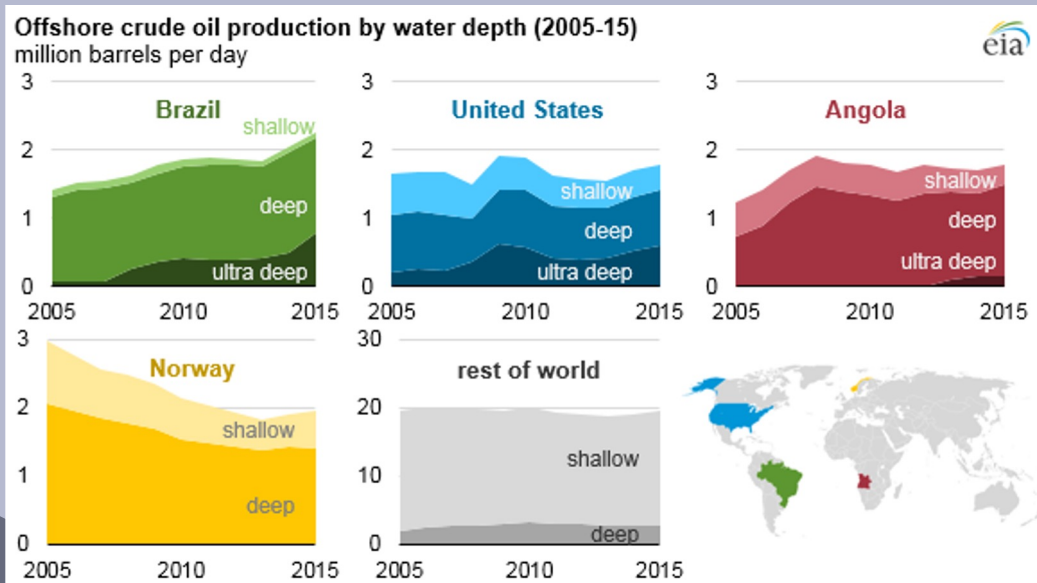
# OIL CONDENSATES

- Come with natural gas production
- Separated out
- High quality light oil



# OFFSHORE

- Started in lakes
- Kerr-Mcgee first to find oil in the gulf
- Debate over who governs those waters (tax revenue)
- Major discovery in the North sea (during oil embargo)



# OFFSHORE CONT.

- Petrobras in Brazil pushes limits of depth
- Shell does same in Gulf of Mexico
- Thousands of feet of water

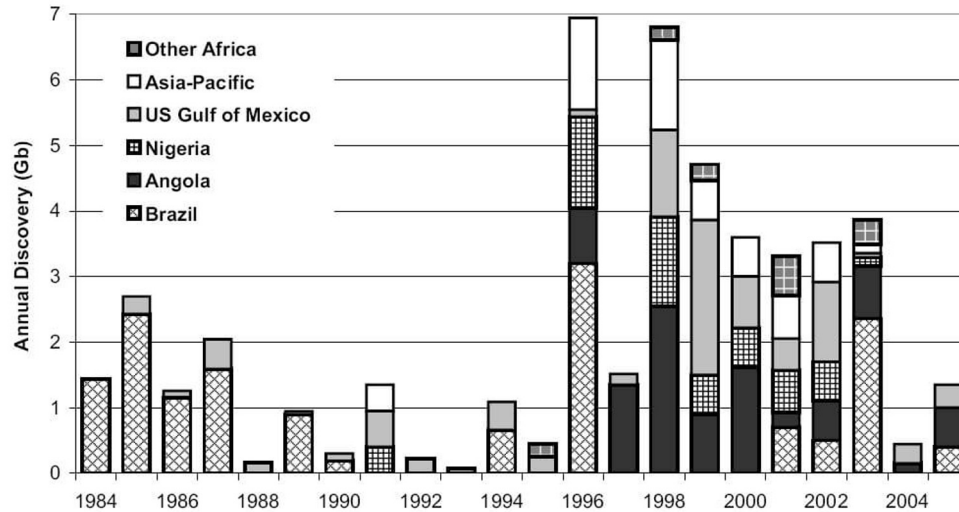
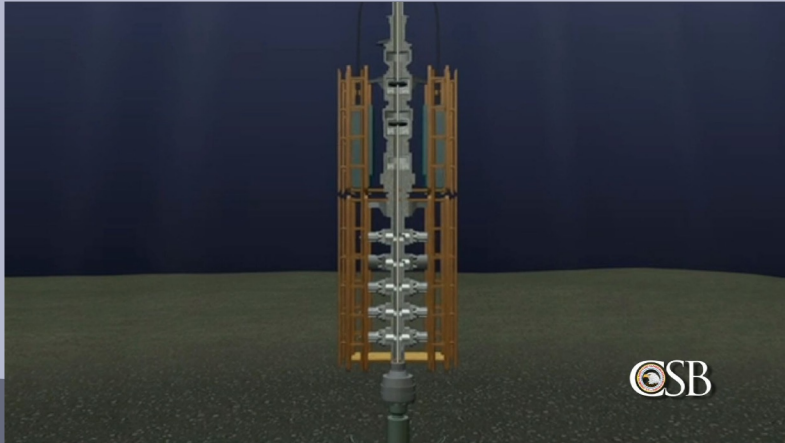


Figure 7.4: Annual global deepwater discovery in billion barrels (Gb) (OFN).

# DEEPWATER HORIZON

- Routine discovery drilling
- Plug fails and leak turns into a blowout
- Blowout preventer failed to fully cut into pipe
- Escaping gas ignited from a spark
- Crew abandons rig
- No established methods for spills like this ----> 3 months to drill relief well
- Major industry reform



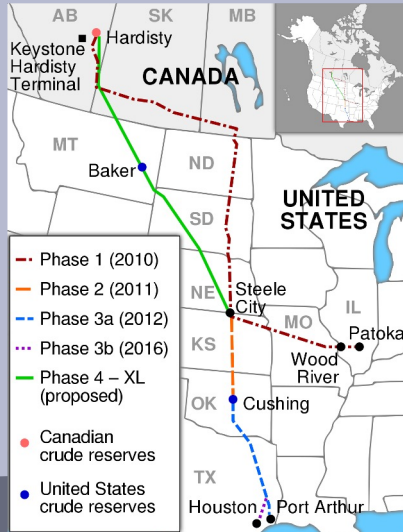
# BRAZILIAN PRESALT

- Oil below salt layer in Santos Basin
- Using algorithms to look through the salt layer
- Technological and political reform needed
- Supergiant field with potential to outperform Venezuela



# CANADIAN OIL SANDS

- Tremendous quantities but originally too expensive to exploit
- Originally sand was mined then treated above ground
- New method using natural gas to produce hot steam underground
- High CO2 emissions
- Keystone XL cancelled





# ABOVE GROUND RISKS

- Orinoco Belt Venezuela
- Too challenging to produce
- Chavez invites western companies
- Take over western companies
- Companies from China, Russia, and Vietnam move in



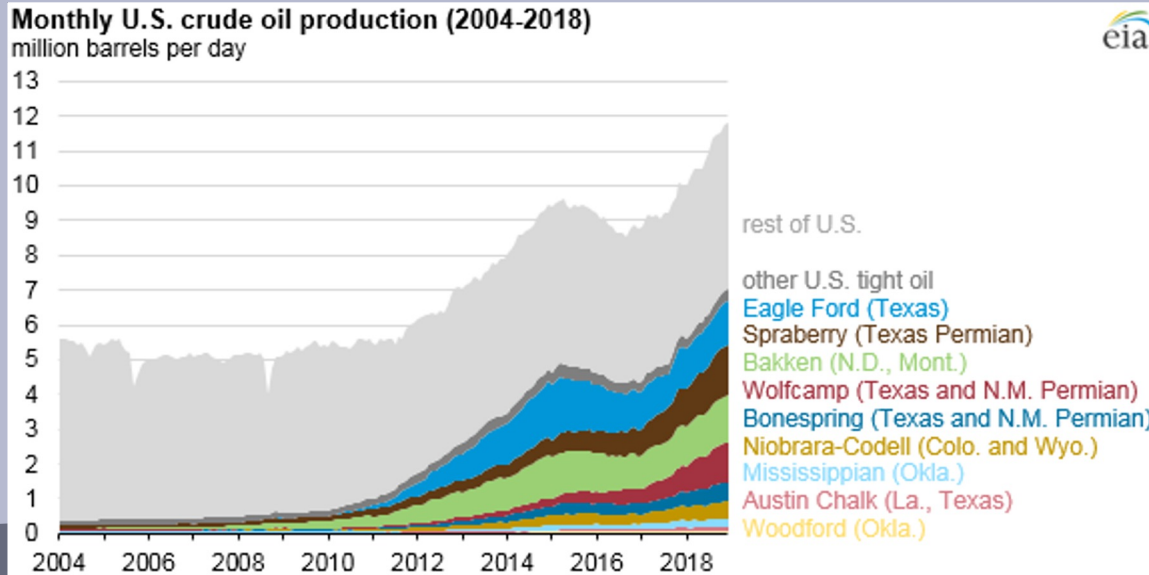
## VENEZUELA'S ORINOCO BELT



Source: US Energy Information Administration

# SHALE OIL

- Dying industry in Bakken shale fields
- Discovery of fracking and horizontal drilling for gas
- Hess applies to oil production
- 5 million barrels per day for U.S.



# THE SECURITY OF ENERGY

CHAPTER 13



# DIVERSIFICATION - DON'T PUT ALL YOUR EGGS IN ONE BASKET

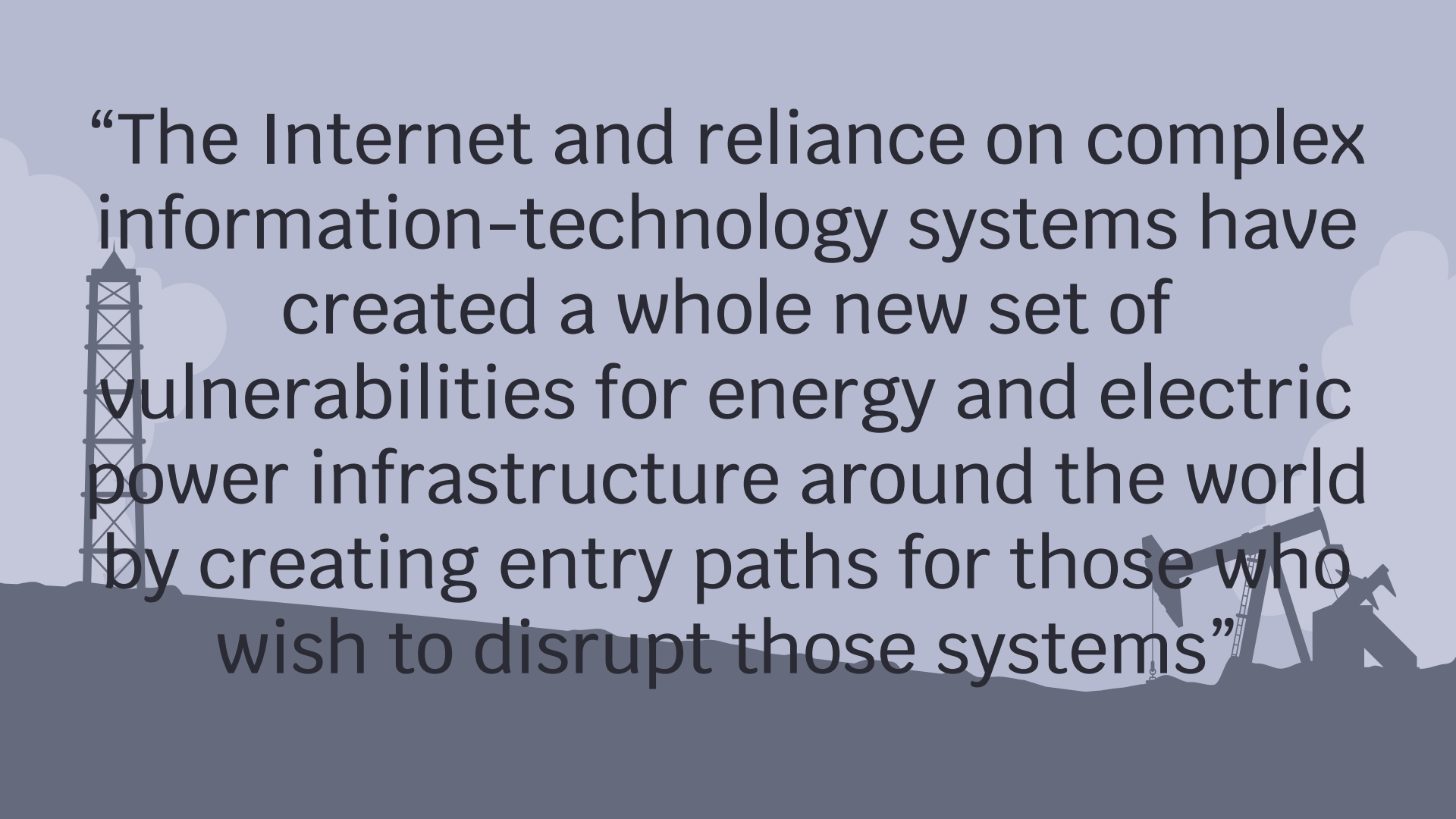
- Energy security with international relations
- WWI Naval Race, Britain and Germany
- 1911 - Churchill's Naval Supremacy
- Convert from coal to oil based battleships
- Churchill's Solution



# THE RETURN OF ENERGY SECURITY

- Stresses of Energy Security
  - Price fluctuations
  - Constriction of markets
  - Internal Instability
  - Import Costs
  - Geopolitical Rivals
  - Terrorism
- Our reliance on energy
- Times of Disaster



The background features a stylized illustration of an oil pumpjack on the right and a power transmission tower on the left, set against a light blue sky with soft white clouds. The foreground is a dark grey silhouette of a landscape.

“The Internet and reliance on complex information-technology systems have created a whole new set of vulnerabilities for energy and electric power infrastructure around the world by creating entry paths for those who wish to disrupt those systems”

# THE DIMENSIONS

## PHYSICAL SECURITY

## ACCESS TO ENERGY

Ability to develop,  
acquire energy  
supplies

## THE SYSTEM

Nat'l policies, int'l  
institutions  
Designed for  
response

## INVESTMENT

Lucrative business  
climate: support,  
promote, enhance

- Oil-importing and -exporting countries think differently on energy, security
- Importing - Security of supply
- Exporting - Security of demand

# THE U.S. GOAL FOR ENERGY INDEPENDENCE

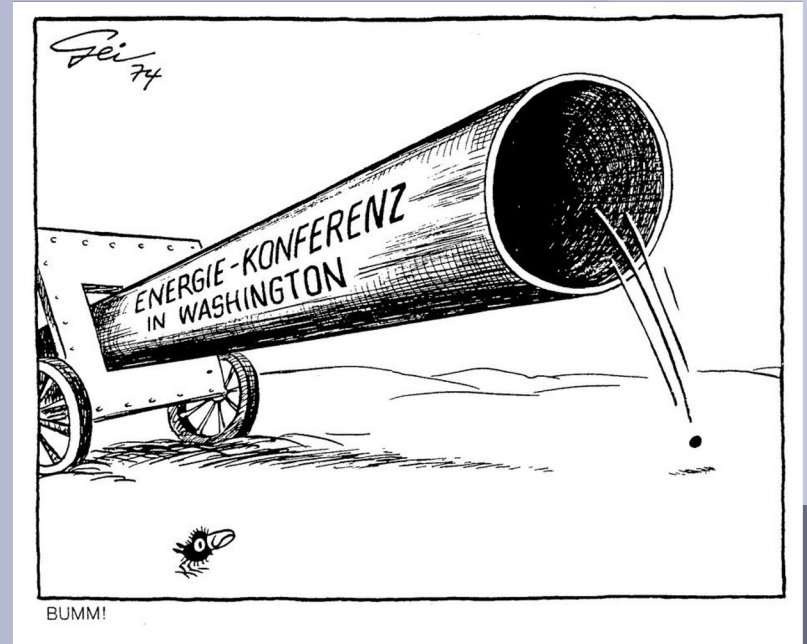
- 1973 energy scare - Arab oil exporters place embargoes
- Nixon response: U.S. must be energy independent
- “Project Independence”
  - Shaped around Apollo project, 7 years
- Unsuccessful, but progress in last 40 years
  - Increased exports, decreased imports





# “BONJOUR, LES TRAITRES”

- 1974, oil prices surge due to embargo
- Tension among western nations
  - Looking to pull ahead, take supplies
- Washington Energy Conference



# THE BALANCING ACT

- International Energy Treaty of 1974
- Guidelines for crisis
  - Coordination/cooperation between countries
- International Energy Agency, OPEC

The logo for the International Energy Agency (IEA) consists of the lowercase letters 'iea' in a bold, blue, sans-serif font. The letters are stylized, with the 'e' and 'a' having a unique, rounded shape.

International  
Energy Agency

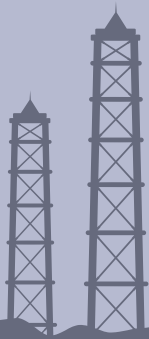
# RESPONSIBILITIES IN THE IEC

## EMERGENCY SUPPLIES

- Each member must stockpile
  - Government
  - Private Companies
- Share the stockpile
- Save for emergencies only

## USAGE OF IEC

- Not for small stabilization of pricing
- Harsh Judgement
- Three times of use
  - Gulf crisis
  - Katrina and Rita
  - Libyan Civil War



# PROMOTING DIALOGUE

- IEA's mission
  - ☒ Promote dialogue
  - ☒ Initiate conversation
- Shift to consumer-producer dialogue
- First major shift
  - ☒ After Gulf War
  - ☒ Mutually beneficial
  - ☒ OPEC led by Saudi Arabia
  - ☒ Increase production
- Transparency between *both* producers and consumers



# THE BAD NEW WORLD



# A NEW, OLD, RISK

- Open waters
- Cooperation between Pirates and terrorist groups
- Pirate attacks occur daily



# SHIFTING SANDS IN THE PERSIAN GULF

CHAPTER 14



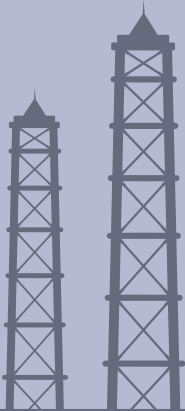
# **GEOLOGIC HISTORY OF THE PERSIAN GULF**

## **SHALLOW SEAS**

Cyclical rise and fall

## **TROPICAL FOREST**

## **PRESSURE AND HEAT**





# COUNTRIES USING OIL OF THE PERSIAN GULF



# MAKING THE U.S. BLEED TO BANKRUPTCY

- Al Qaeda in 1990s - opposed to targeting energy reserves
- 2004 - Osama bin Laden, goal to drive up oil prices
- Feb 2006 - Abqaiq, Saudi Arabia's largest oil field
  - 8% of world's oil supply
  - Failed, no trucks far past gate
- After Osama killed, more plans found in his Pakistan villa



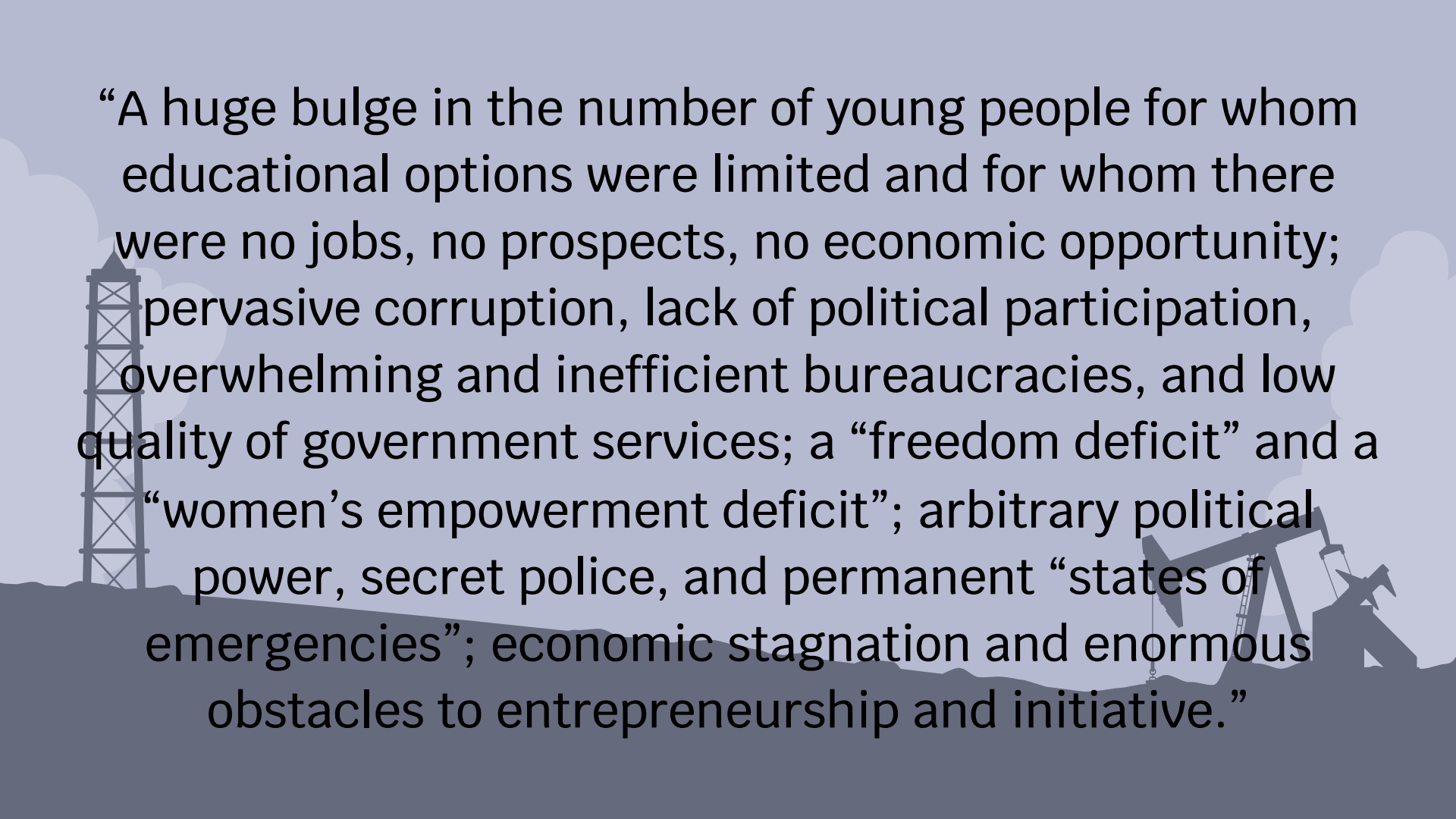
# THE ARAB SPRING



# THE MAN WHO LIT THE MATCH

- Mohammed Bouazizi
  - Street vendor
  - Humiliated by police
  - Turned away by the government
  - Lit himself on fire at the municipal building
    - Footage spread
  - Sparked movements and protests





“A huge bulge in the number of young people for whom educational options were limited and for whom there were no jobs, no prospects, no economic opportunity; pervasive corruption, lack of political participation, overwhelming and inefficient bureaucracies, and low quality of government services; a “freedom deficit” and a “women’s empowerment deficit”; arbitrary political power, secret police, and permanent “states of emergencies”; economic stagnation and enormous obstacles to entrepreneurship and initiative.”



**H**  
HISTORY

# THE ARAB SPRING

# THE SMOKE

- Demonstrated the impact of social unrest
- Lack of oil production → oil prices rise



# THE REMAINING EMBERS

- Curse of the petro-states
  - Not many jobs
  - Lack of competition
- Oil production resumes

“As long as there was uncertainty about the Middle East, oil prices would reflect the risk premium”





# IRAQ'S POTENTIAL

- Was not living up to its oil producing potential
- Opened up bidding
  - Some companies were skeptical due to
    - Process of development
    - Political concerns

## Kurdistan

- Rich in oil
- Pipelines needed
- Tension between Kurdistan and Baghdad



# IRAN'S POTENTIAL

- Low oil production
  - Political unrest
  - Lack of investment
  - Tehran's stringent negotiations with international companies
  - International sanctions



# CONOCO AND IRAN

- 1998, Ali Khamenei becomes Supreme Leader of Iran
  - Hashemi Rafsanjani, president
- Ideals same as Clinton's
  - Use “economic engagement to improve relations with adversaries
- Oil contract may have gone to Conoco, but...
  - Iranian officials unwilling to work w/ U.S. company
  - Across Atlantic, unwilling to let U.S. company work w/ Iran
- Tensions continue, contract given to Total
- Terrorism primary cause for refusal



# BRIGHTER FUTURES?

- Mohammad Khatami elected president, 1997
- Wanted open dialogue w/ U.S.
  - “Dialogue of Civilizations” with Clinton
- After 9/11, Iran helped support U.S.
  - Opposed to threat of Taliban



# IRAN & NUCLEAR WEAPONS

**1980S**

Began seeking capabilities & information

**2002**

Iran was discovered to be developing nuclear weapons

**2006**

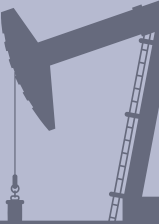
Many centrifuges were activated for enriching uranium

**2010**

Secret nuclear enrichment facility discovered & significant progress

**LATE 2010**

Iran's first large nuclear reactor was finished



# BUSH'S NEW AXIS OF EVIL



- Karine A interception
- New axis of evil
  - Iraq
  - North Korea
  - Iran



# ATTEMPTS OF PERSUASION

- US and European countries attempt persuasion
  - Offers
    - Expanded trade
    - Membership in the World Trade Organization
    - Support for Peaceful atomic energy
  - Sanctions
    - Investment
    - Trade
    - Flow of finance



# ATTEMPTS OF ACTION





**STILL A CHALLENGE  
TODAY**



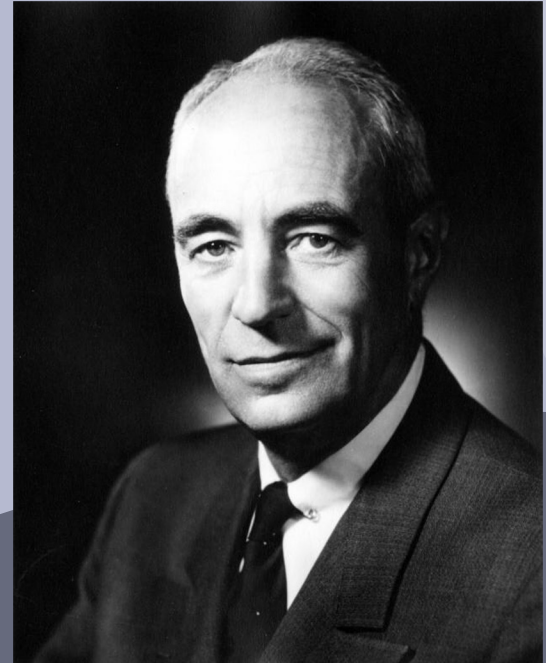
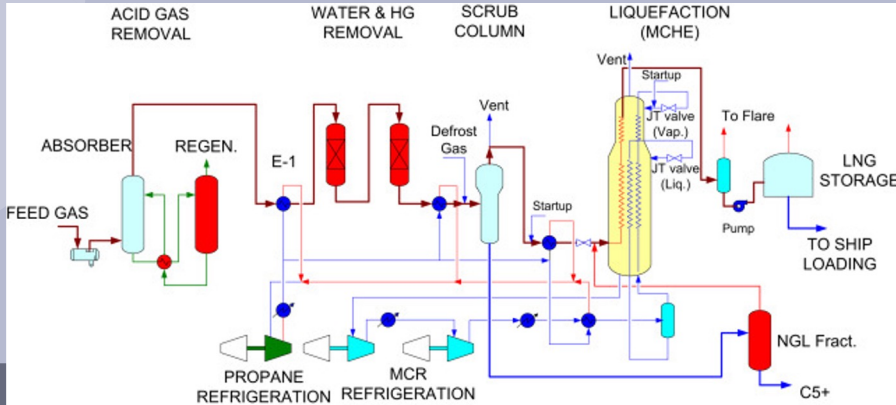
# **GAS ON WATER**

**CHAPTER 14**



# CABOT'S CRYOGENICS - A NEW DEVELOPMENT

- Michael Faraday, 1820s
- Carl von Linde, 1870s
- Godfrey and Thomas Cabot, Post-WWI
  - LNG Storage



# CABOT'S CRYOGENICS - EOGC DISASTER

- First plant 1939, East Ohio Gas Company
- Failed; Seeped into sewer, ignites, 129 killed
- Poor ventilation, insuf. Cont. measures, improper steel alloy
- Post-WWII, storage to transport



# KILLER FOG - LNG BEGINNINGS

- Dec. 1952, London
- Weather conditions, coal smoke
- Killed 1000s, more sick
- British Gas Council and America
  - *Methane Pioneer*, 1957
- Algeria produces for Europe, 1964



# KILLER FOG - EUROPEAN TRADING

1964 - Arzew, Algeria ships to Canvey Island, Lower Thames; Le Havre, France

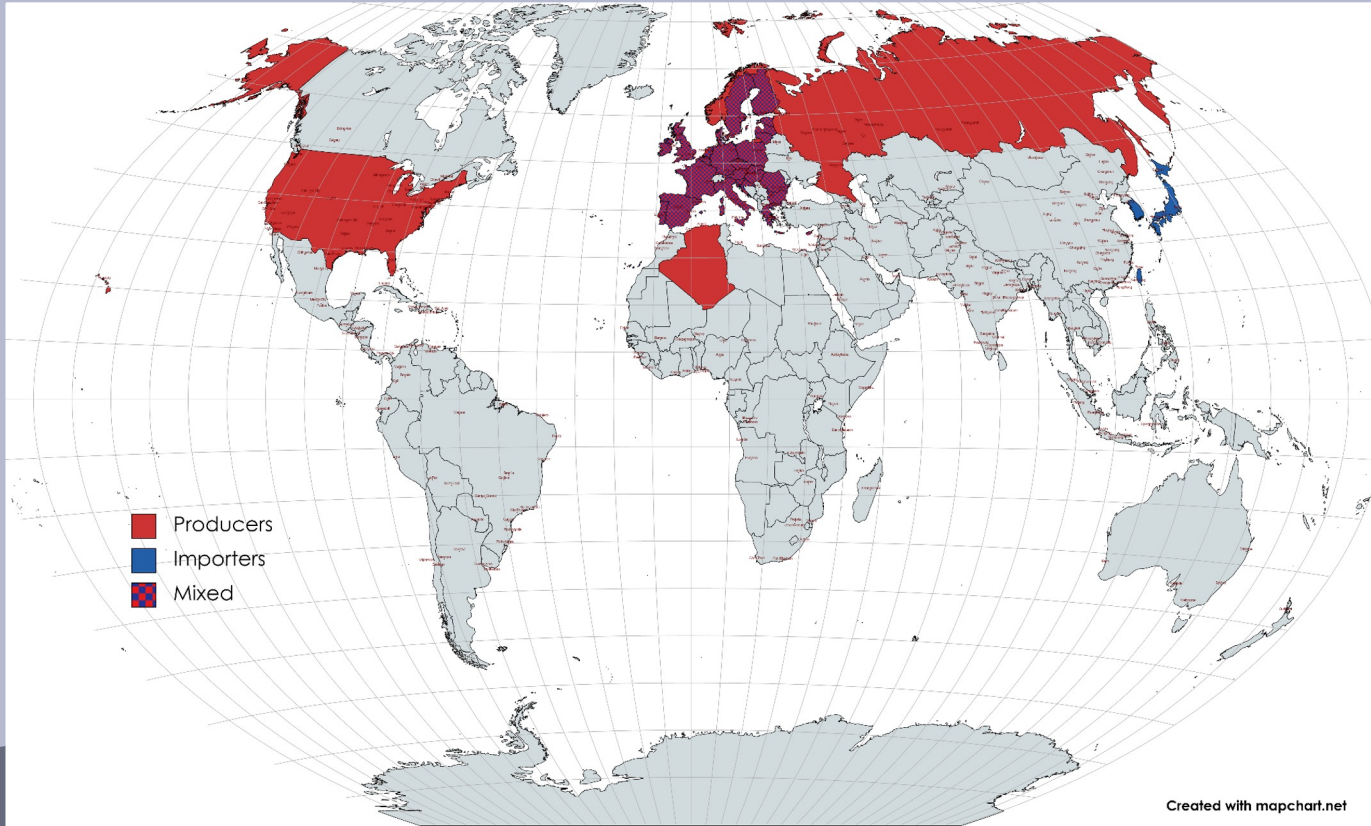


# KILLER FOG - LNG DEVELOPMENT

- High LNG price requires predictability of price and market
- European consumer boom slowed
  - Natural Gas in Netherlands, 1959
  - North Sea deposits in 1965
  - Soviet Union, Norway; 1965
- 1969-70s, Japan imports from US
- South Korea, Taiwan



# LNG MAJOR PRODUCERS AND IMPORTERS





# THE “FUEL NON-USE” ACT - CAUSE

- True long-distance transport in US, post-WWII
  - SW → NE; West Texas/New Mexico → California
- 25% US electricity by 1970s
- Shortage in 1976-77 shut down schools, factories
- Cause manmade: unreasonably low price set by Federal Gov't
- 1978 Political battle over deregulation
- Natural Gas policy Act of 1978, Fuel Use Act
  - Heating/cooling, cooking, industrial processes

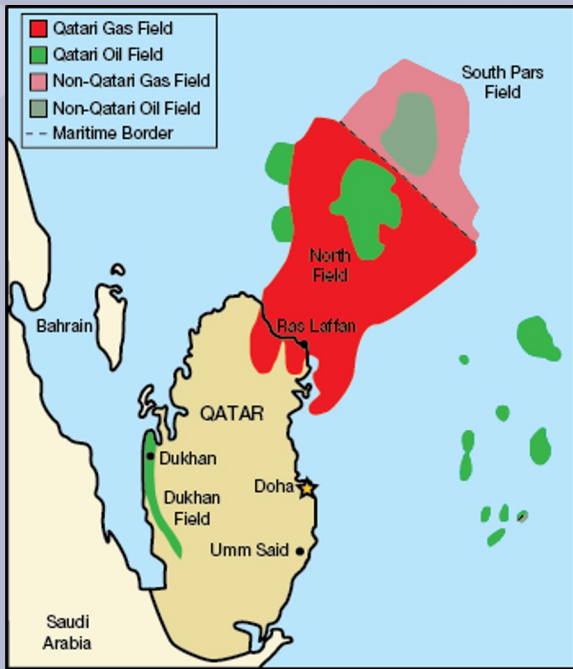


# THE “FUEL NON-USE” ACT - AFTERMATH

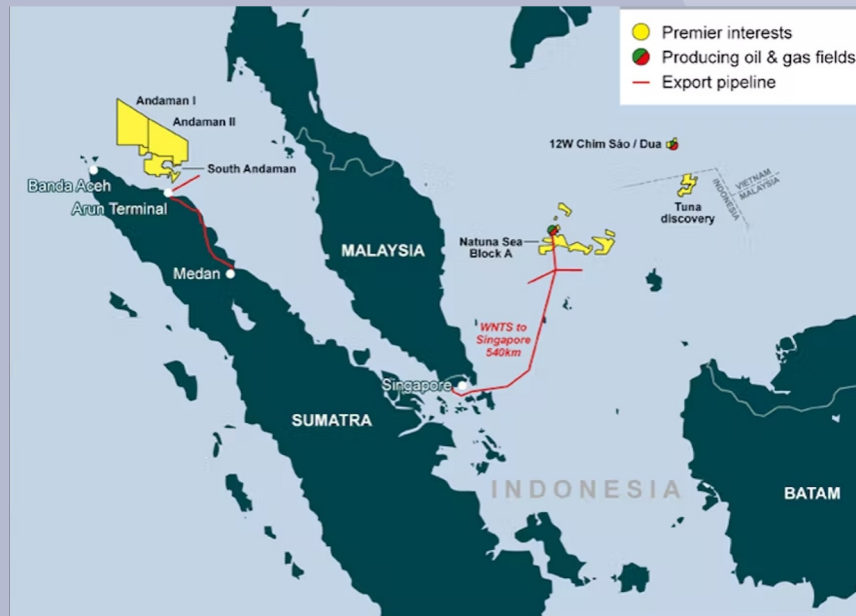
- Oversupply without price increase; Gas Bubble
- Bust: projects cancelled, companies default contracts, teeter on bankruptcy
- Prohibition lifted in 1990s, cleaner/cheaper
- Supply stagnates, demand increases
  - Increased prices, loss of competition w/ Middle East
- Cabot Company and LNG innovations
  - Simplified design, competitive bidding



# “THE CROWN JEWELS” - DISCOVERY



North Field, Qatar  
Shell



Arun Field, Sumatra, Indonesia  
Mobil Oil

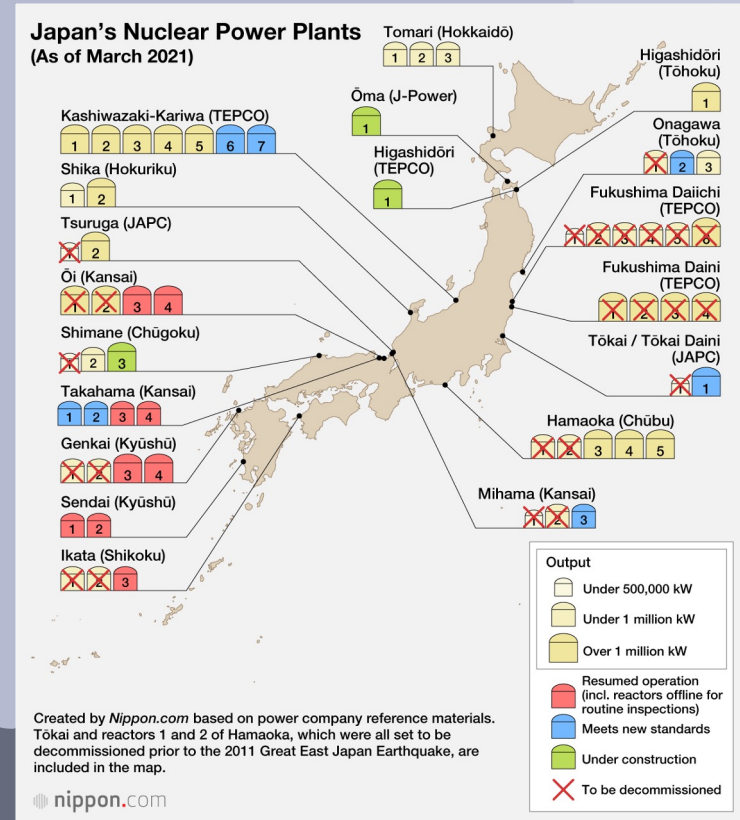
# “THE CROWN JEWELS” - EXXON-MOBIL

- Mobil Oil makes deal w/ Qatar (North Field)
  - Qatargas, RasGas
  - Supply to Asia, Europe, America
- Expensive, needs larger ships, liquefaction trains, turbines
- Possible after merger w/ Exxon in 1999
- Qatar competitor by 2002
- #1 LNG supplier by 2007
  - Surpassed Indonesia and Malaysia
- Global trading, Japan

The Exxon logo is displayed in a bold, red, sans-serif font. The letter 'x' is stylized with a diagonal slash through it. A small trademark symbol (TM) is located at the top right of the word.The Mobil logo is displayed in a bold, blue, sans-serif font. The letter 'o' is stylized with a red vertical bar through its center. A small trademark symbol (TM) is located at the top right of the word.

# “THE CROWN JEWEL” - GLOBAL TRADING

- Qatar competitor by 2002
- #1 LNG supplier by 2007
  - 1/3 total supply
  - Surpassed Indonesia and Malaysia
- Price decrease, global trade network
- Japan nuclear reactors
  - Quick diversion of LNG



# THE NATURAL GAS REVOLUTION

CHAPTER 14

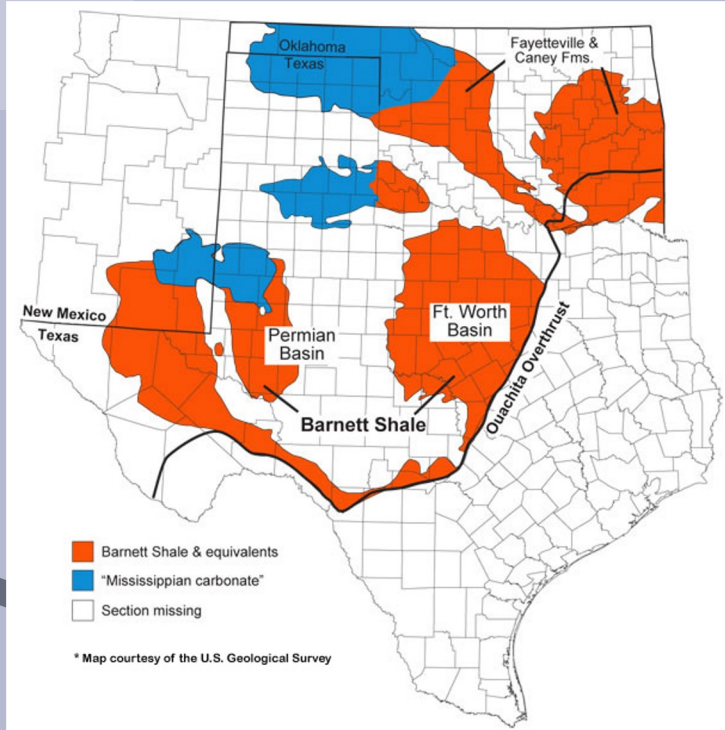


# BREAKTHROUGH - UNCONVENTIONAL GAS

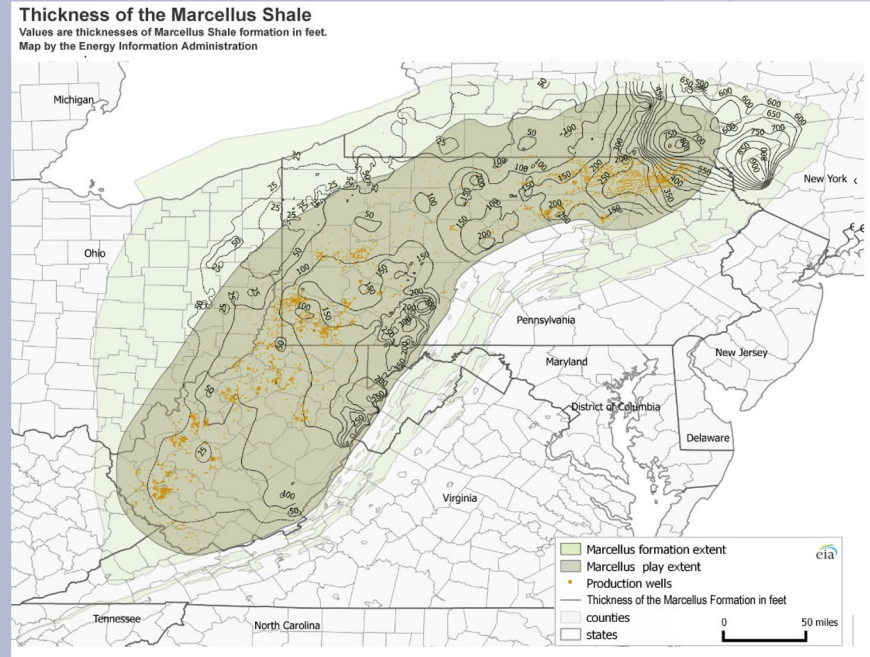
- Fracking since 1940s; Inject water to increase pressure
  - Fracture rock, release trapped gas/oil
- George P. Mitchell read 1982 report on natural gas in shale
- Mitchell Energy experimented with extracting shale gas
  - Barnett Shale success in 1998
- Acquired by Devon Energy in 2001 (\$3.5 billion)
- 55 more wells constructed



# BREAKTHROUGH - SHALE GAS RESERVOIRS



Barnett Shale

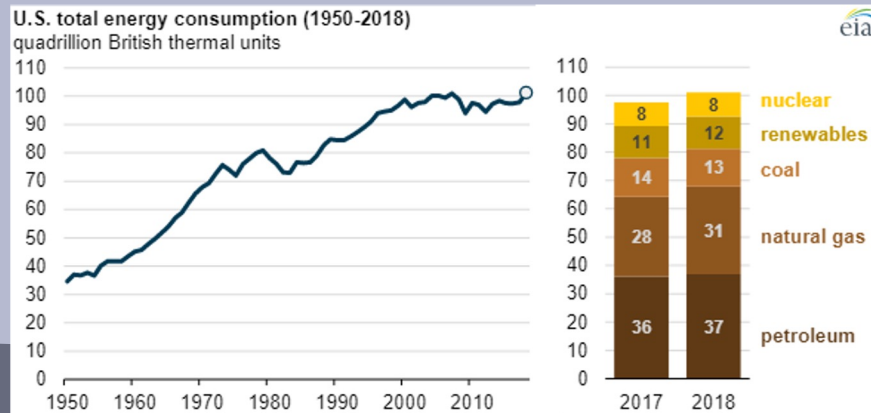


Marcellus Shale



# THE “SHALE GALE” - BACKGROUND

- Uncon. Gas breakthrough increased supply with lower price
  - 2% of supply in 2000; 37%, 2012
  - Up to 65% by 2030
- Increased use in electric power
- 3,400 Trillion ft<sup>3</sup> of shale gas in North America
  - Current levels for 100+ years

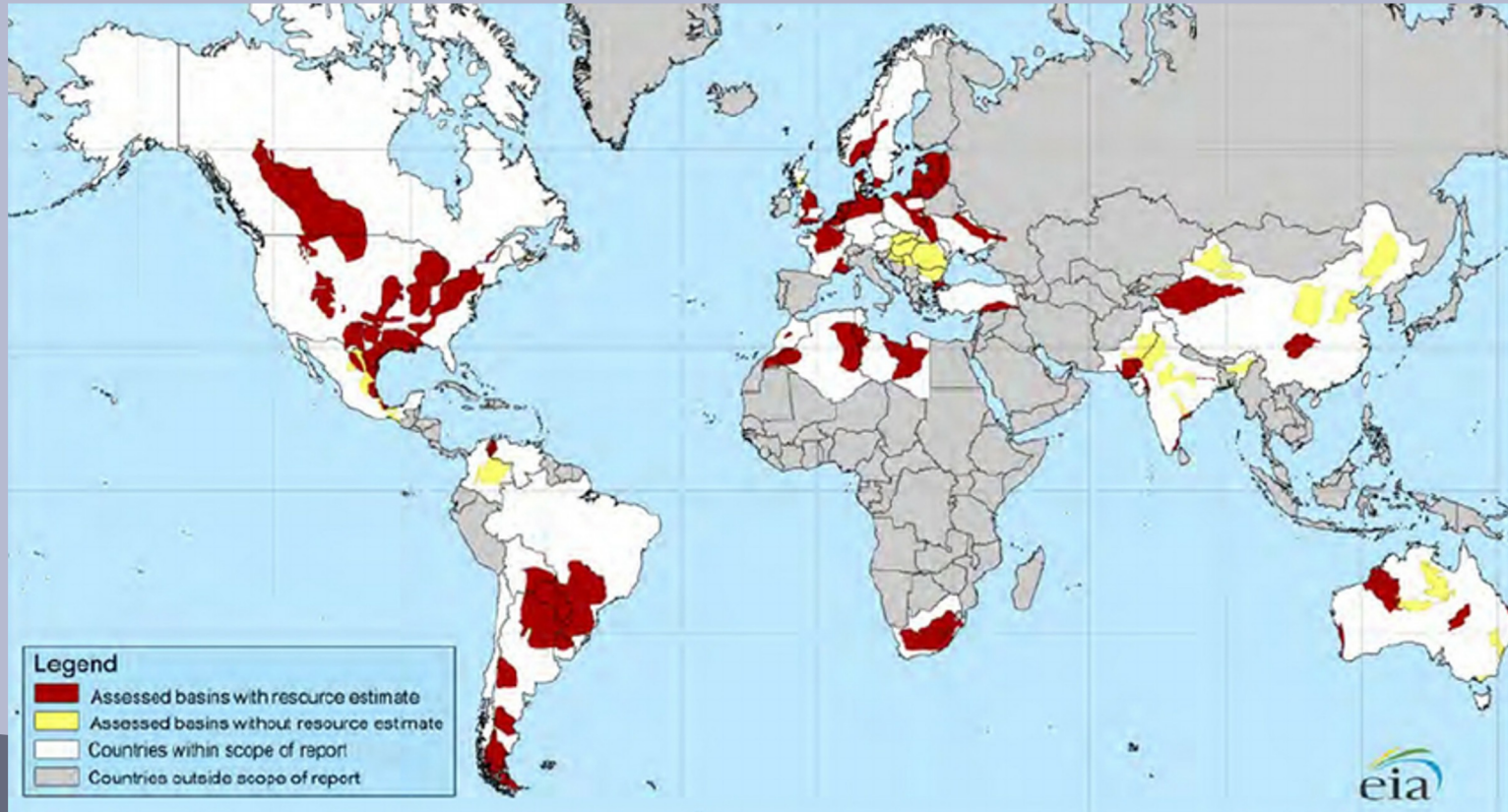


# THE “SHALE GALE” - ISSUES AND REGULATIONS

- Surge in drilling, truck traffic unwelcome
  - Densely populated areas
- Flow back needs disposed or recycled
  - Large scale treatment recycles 70-80%
- Drilling and fracking regulated by states
- Back flow regulated by federal gov't
  - Some authority delegated to states
- Improved regulations could benefit production, economy



# THE “SHALE GALE” - OTHER RESERVOIRS



# GLOBAL GAS

- Buildup of shale gas and LNG
  - Qatar - 27% LNG in 2010
  - Australia 2nd highest producer
- America exporting LNG now; More at sea
  - Europe and China
- European gas market in 1960s a web of pipelines
- Soviet gas reaches Europe in 1970
  - Germany, reduce Cold War tensions



# “WOUNDED BY A FRIEND”

- Soviet Union surpassed US production in 1980s
- 3700-mile pipeline proposed, West Siberia to Europe
- Reagan embargos US and European companies
  - European nations supplied anyway
- Urengoy pipeline built, doubled gas flow
- Continued through 1990s, after SU collapse



# THE EMERGENCE OF GAZPROM

- Russian gas company, after Soviet collapse
- Produces 80% natural gas output
- Joint marketing with German company Wintershall, 1993
- 27 EU members, new members former Soviet satellites
- Dependence on Russian gas made relations tricky
- EU wants to break up companies that built market
  - North Sea gas declining
  - Large LNG volumes

# UKRAINE VERSUS RUSSIA

- At odds over gas pricing/supply, control of pipeline
  - 80% of gas from Russia to Europe
- Ukraine dependant on Russia's gas
- Gazprom and Ukraine debate over \$3 billion subsidies
- Jan 1, 2006 - Gazprom cuts gas to Ukraine, Europe
- Resumed a few days later
  - Showed dangers of Russian dependance to Europe



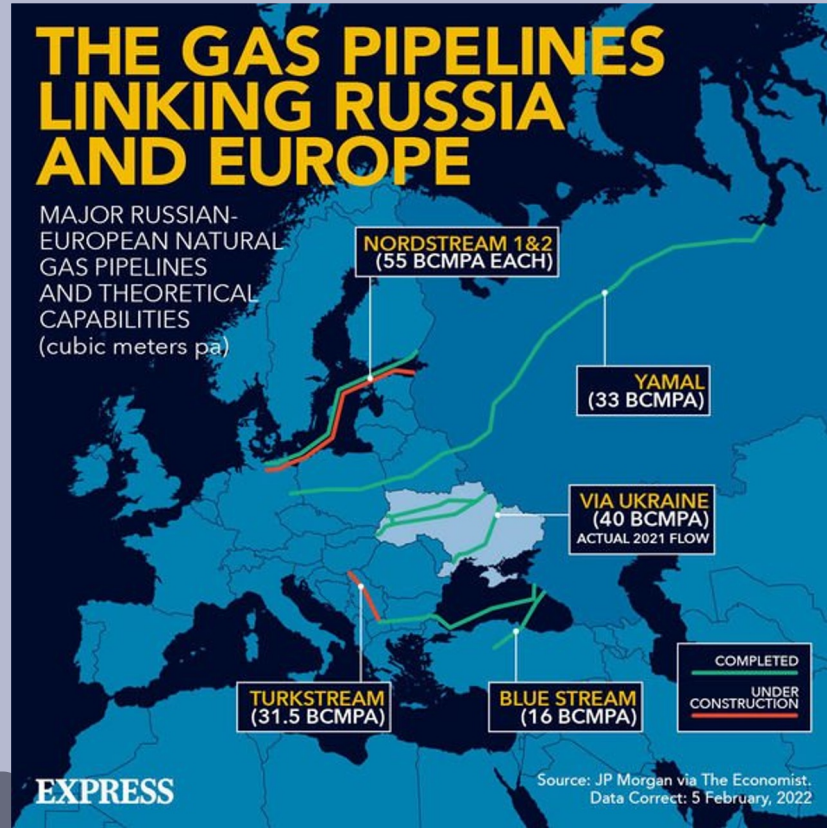
# DIVERSIFICATION - LOOKING PAST RUSSIA

- Russia look to get around Ukraine, Poland
- Gazprom, ENI build Blue Stream (Russia → Turkey)
  - South Stream:
  - Nord Stream:
- EU looking to diversify, avoid Russia southern border
- European shale reservoirs as big as NA
  - Pop. density, opposition make difficult
  - Poland, Ukraine could develop





# DIVERSIFICATION - RUSSIAN PIPELINES



# A FUEL FOR THE FUTURE

- World consumption tripled in 30 years
  - Demand could grown 50% in 20 yrs
- Technology makes gas more accessible
  - Transport, storage, unconventional
- LNG recent focus, shale gas new
- Emergence in NA introduced new market

