Oil & Gas

and

Security/Resiliency

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What is O&G

- Oil and Gas is a huge industry with many players, big and small and many different types of operations
- There is not a single type of entity

Sectors

The American Petroleum Institute (API) divides the petroleum industry into 5 sectors:

1. upstream

   (exploration, development and production of crude oil or natural gas)
2. downstream

   (oil tankers, refiners, retailers and consumers)
3. pipeline
4. marine
5. service and supply

Supermajors

- BP plc (UK)
- Chevron Corporation (USA)
- ExxonMobil Corporation (USA)
- Royal Dutch Shell plc (Netherlands & UK)
- Total SA (France)
- Eni (Italy)
- ConocoPhillips (USA)

- Supermajors only control 6% of reserves
- 90% OPEC cartel and State-Owned-Nationals

Midstream Firms

- Midstream is a portion of downstream activity and is typically specialized

- Gathering – connecting wells to processing
- Processing/Refining
- Transportation
- Storage
- Technological Applications – specialty services such as flow controls, leak detection

Midstream Firms

- Enbridge Energy Partners - pipelines
- Enterprise Products Partners – pipelines, storage, drilling, production
- Genesis Energy - storage
- Inergy Midstream - propane
- Kinder Morgan Energy Partners - pipelines
- Oneok Partners – natural gas
- TransCanada – pipelines, gas storage
- Williams Companies - natural gas processing and transportation

O&G economics

- Price of oil is tied to US Dollar, so as the dollar moves, so does the price of oil
- Boom and Bust cycles
- 1980's bust was devastating
- Firms learned and changed
- Current Bust Cycle
  - »60% price drop
  - »30% employment drop
  - »Consolidation

Facts

- The U.S. has over 200,000 miles of oil pipelines within its borders.
- Texas, Louisiana and California account for over half of all domestic refining capacity.
- Numbers are big

Profits – 2015 ExxonMobil

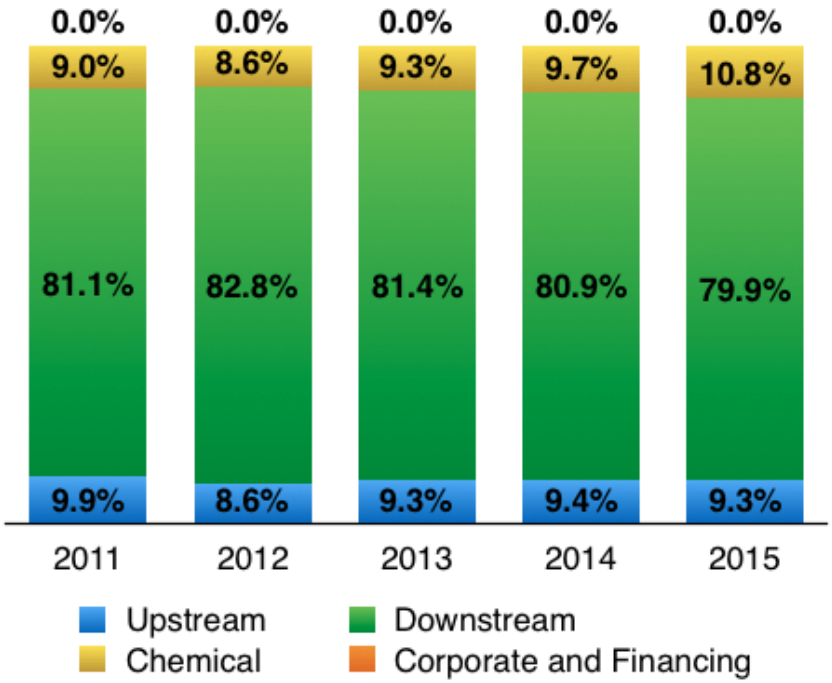
Of the total revenues of $259 B generated

- $24 billion, 9.3%, from Upstream.
- $207 billion, 79.9%, from Downstream.
- $28 billion, 10.8%, from Chemical.

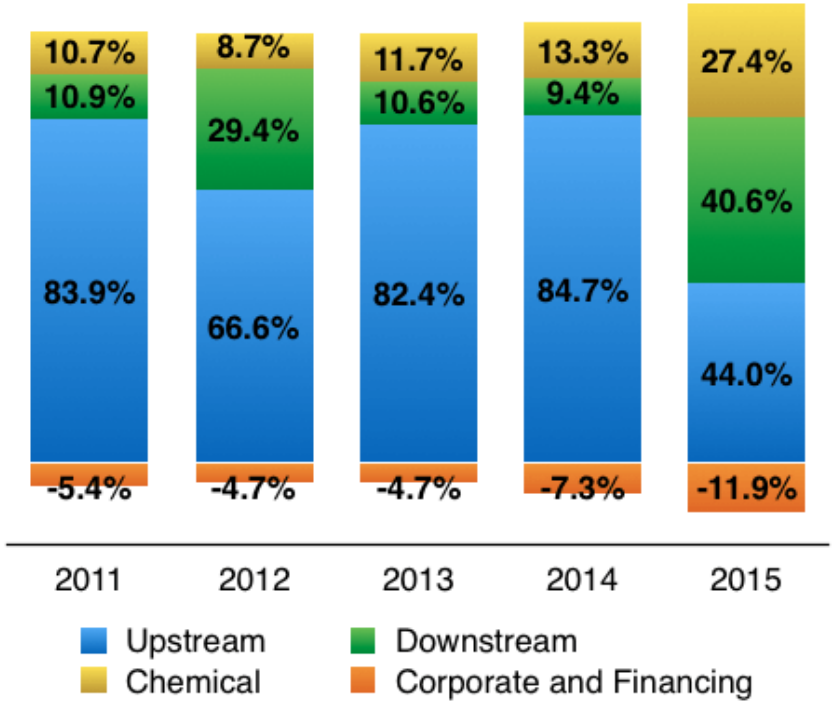
Of the total net profit of $16 B generated

- $7 billion, 44.0%, from Upstream.
- $7 billion, 40.6%, from Downstream.
- $4 billion, 27.4%, from Chemical.
- $2 billion net loss, -11.9%, from Corporate and Financing.

ExxonMobil Business Segments Revenue Share



ExxonMobil Business Segments Net Profit Share



What about regulation

- Refinery

- EPA
- State Environmental Quality
- CFATS
- DHS (pipelines)
- Transportation of hazardous materials
- Virtually every aspect of an O&G company is regulated

Electricity

- O&G companies understand electricity
- Most refineries have co-gen facilities
- Refining/processing takes energy

Standards

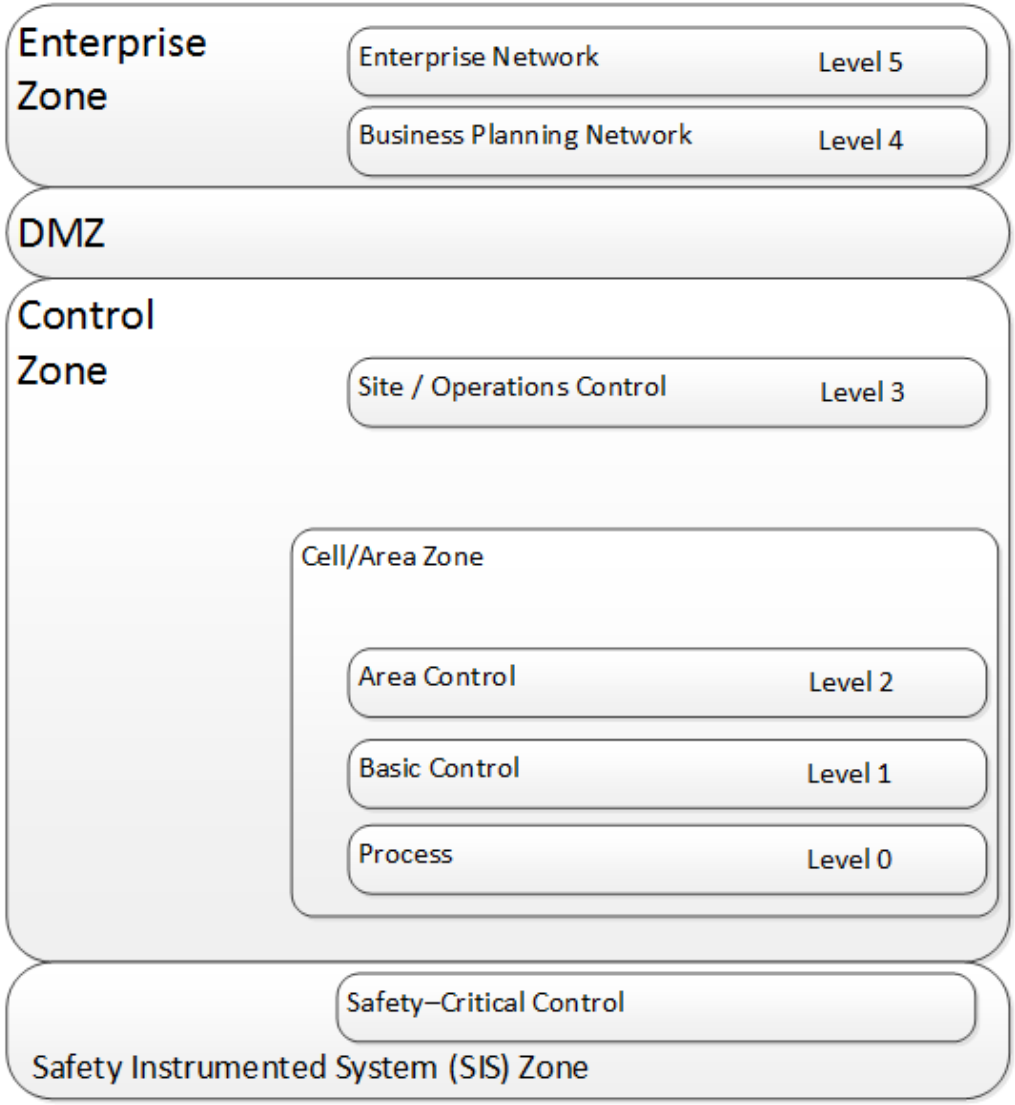
- Too many to list, but main drivers
- ISA/IEC-62443 (formerly ISA-99)
- NIST 800 series
- CFATS
- Myriad of stovepipe industry specific standards for included services
  - »Electricity
  - »Gas
  - »Pipelines
  - »Water

Protocols

- Modbus & Modbus TCP
- DNP3
- ProfiBus/Profinet
- CIP
- Ethernet/IP
- Serial Protocols
  - »Encapsulated in IP
- Service Request Transport Protocol (GE-SRTP)
- Hart
- And more (think each vendor)
- And network protocols

Purdue Model

- Network Model for OT
  - »Enables what is needed
  - »Segregates what isn't
  - »Enables network security monitoring



How to think about O&G

- Think of the industry as a community of collective industries working to deal with petroleum and related products
- Bigger than petroleum itself
- Challenges in all aspects of the business
- Big move to do digital energy

Major Concerns

- Safety
- Safety
- Safety

- Economic resilience

- Stability/Efficiency

Questions