



JodiTM



Joint Organisations Data Initiative

Crude oil and petroleum product flows and related important statistics

Stève Gervais

Joint APEC-JODI Workshop on Oil and Gas Statistics

June 11-13, 2019, Tokyo



IEA



Key oil trends



Key concepts

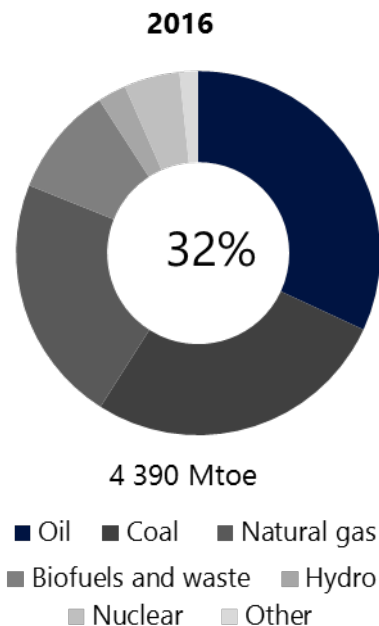


Key points for reporting monthly oil



Key oil trends

Largest source of primary energy in 2016



A changing production landscape...

2016

Producers	Mt	% of world total
Saudi Arabia	583	13.5
Russian Federation	546	12.6
United States	537	12.4
Canada	220	5.1
Islamic Rep. of Iran	200	4.6
People's Rep. of China	200	4.6
Iraq	191	4.4
United Arab Emirates	182	4.2
Kuwait	159	3.7
Brazil	135	3.1
Rest of the world	1 368	31.8
World	4 321	100.0

2016 provisional data

2017

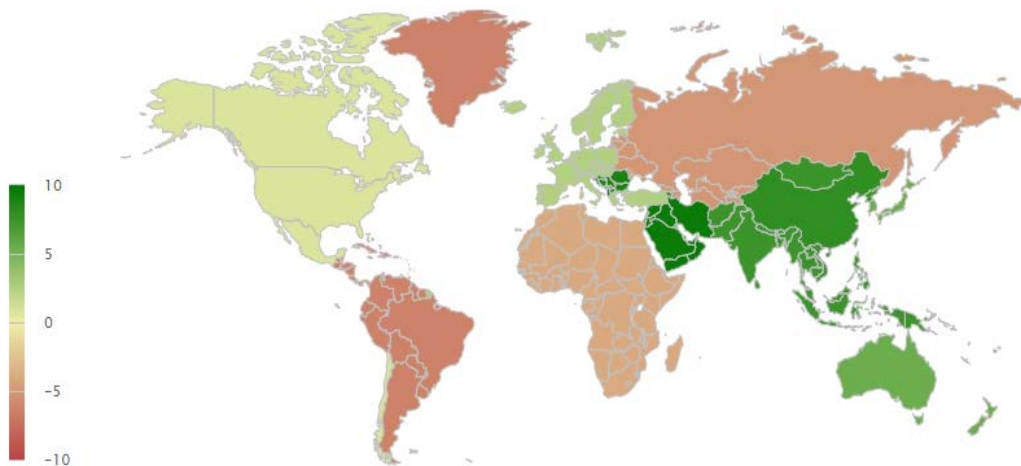
Producers	Mt	% of world total
United States	563	12.9
Saudi Arabia	560	12.8
Russian Federation	548	12.6
Canada	237	5.4
Islamic Rep. of Iran	229	5.2
Iraq	225	5.2
People's Rep. of China	192	4.4
United Arab Emirates	178	4.1
Kuwait	149	3.4
Brazil	137	3.1
Rest of the world	1 347	30.9
World	4 365	100.0

2017 provisional data

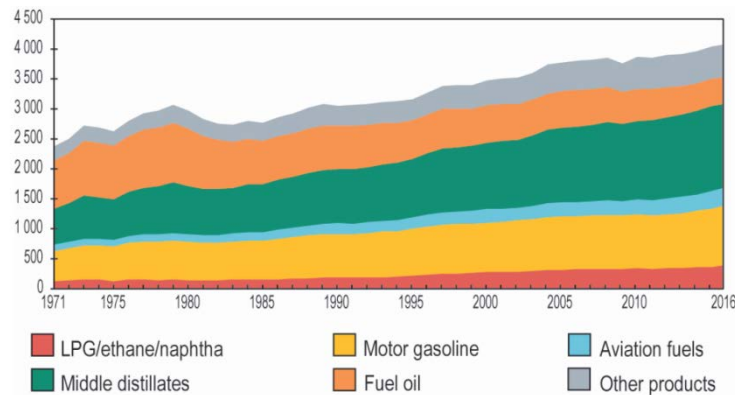
Most of the growth in refining has taken place in the Middle East and Asia Oceania.

Output of fuel oil and diesel is declining...

Refinery throughput growth in 2016



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

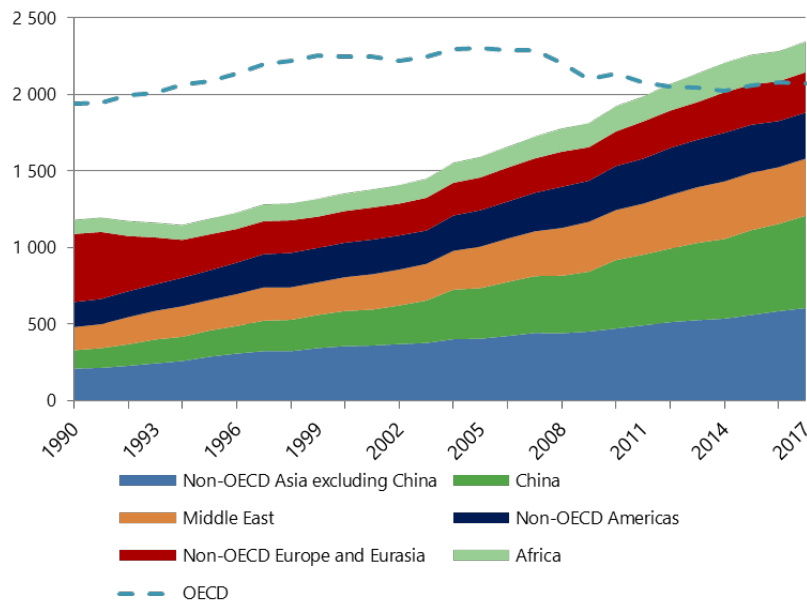


Key oil trends – Demand

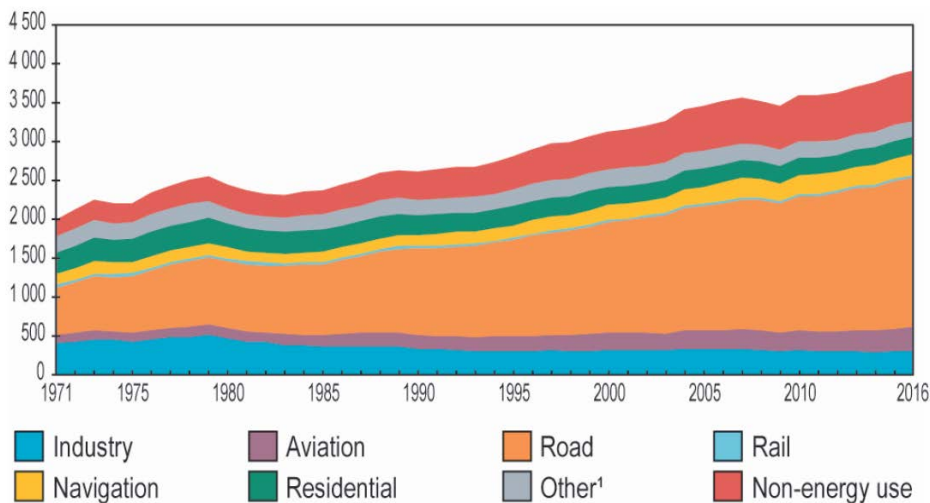
Growth in oil demand is driven by non-OECD countries

Oil product demand by geographical region

Million tonnes

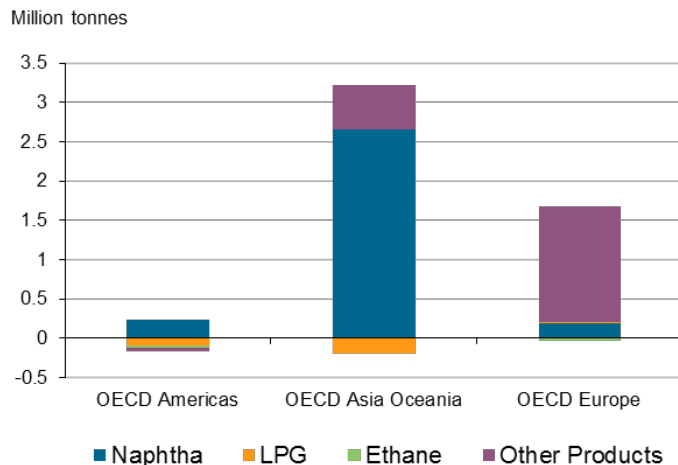


Key demand trends

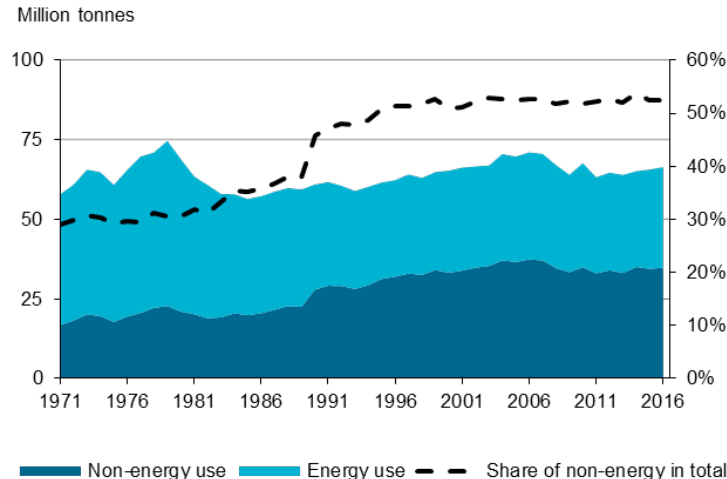


- By the end of 2019 it is expected that 13 MT/y of petrochemical capacity will come online.
 - This will impact demand for petrochemical feedstocks of oil origin, traditionally: **naphtha**, **LPG**, **ethane** and **other oil products**.

Refinery output of petrochemical feedstocks
growth between 2015 and 2016



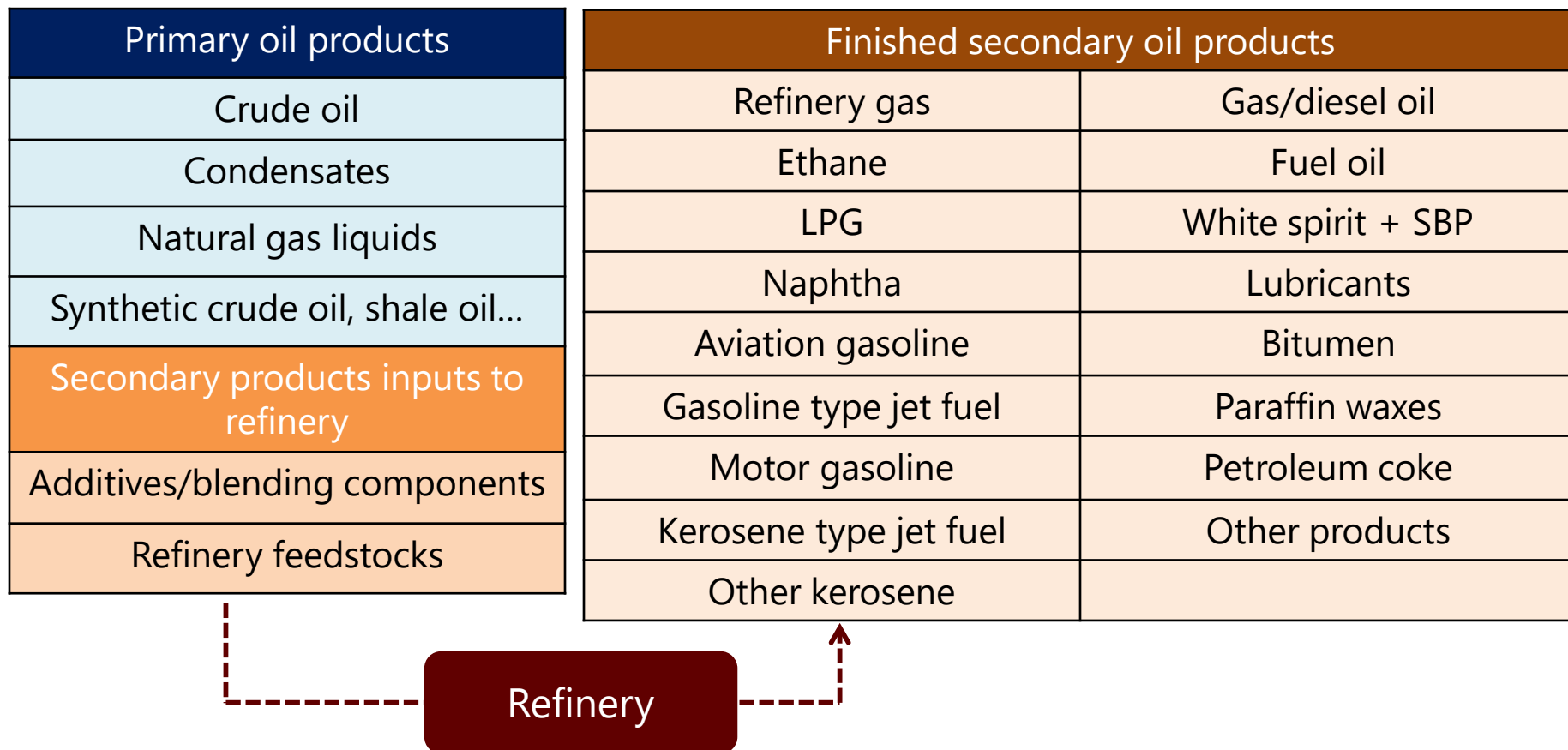
Global consumption of oil in industry





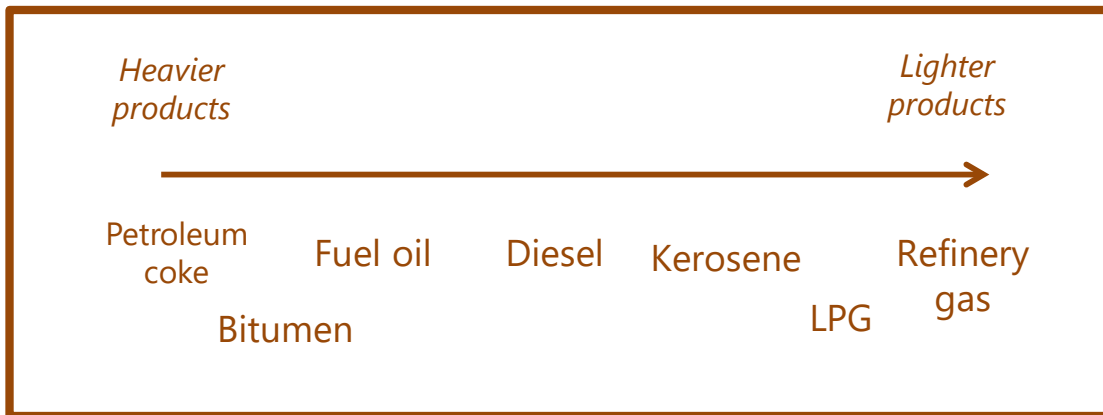
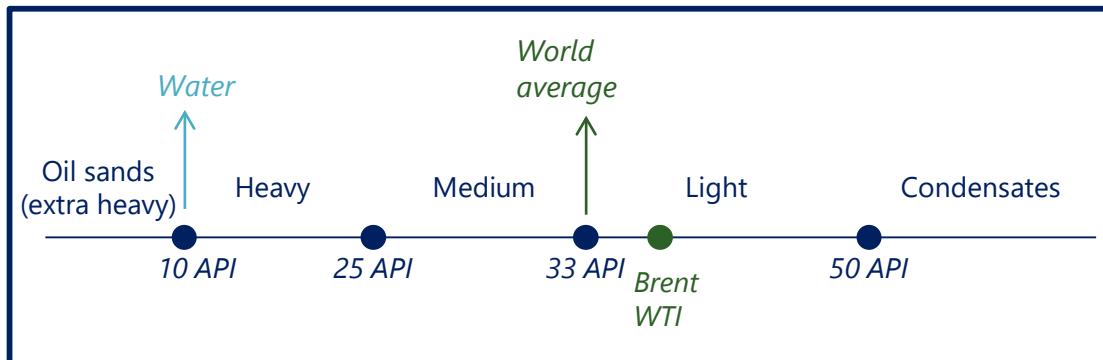
Key concepts

Oil classification – Primary and secondary oil products



Oil classification – Density

- Most oil is lighter than water, but extra heavy oils have higher density than water.
- The specific gravity or density of the liquid is needed to convert from mass to volume and vice versa.
 - The API gravity is commonly used to express the specific gravity of petroleum.



- **Condensate** is a *high-quality light oil* recovered from associated or non-associated gas reservoirs.
- In comparison to normal crude oil, condensate needs to undergo *fewer refining* processes and is therefore *versatile* and in *high demand*.
 - Condensate used directly (petrochemicals) or further processed to produce secondary oil products.



Field condensate

Recovered from associated and non-associated gas *fields* and is normally intermixed with the crude oil stream.

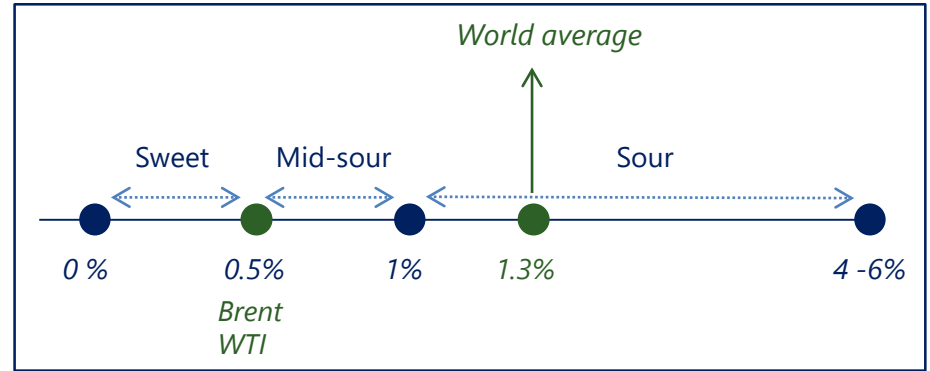


Plant condensate

Recovered in natural gas processing plants or separation facilities.

Oil classification – Sulphur content

- Sulphur content is another key characteristic of oil that serves to differentiate between products.
- From an average crude oil barrel, 70-80% of Sulphur has to be removed to meet product specifications.



Sulphur pyramids in Alberta, Canada

- Because oil products can vary greatly in their characteristics it is key to collect net calorific values information.
 - Production
 - Imports
 - Exports
- This information is essential to compile the energy balance and to derive CO₂ emissions.

***Example** net calorific values of United States crude oil.*

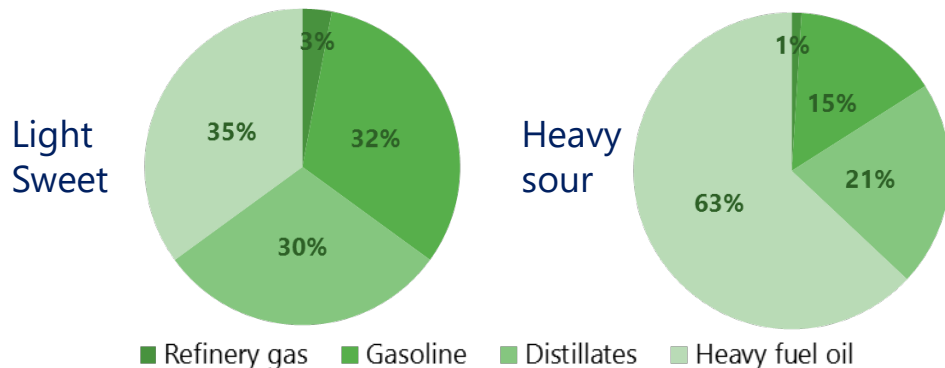
Flow	kj/kg
NCV Production	42 679
NCV Imports	43 604
NCV Exports	42 694
Average NCV	42 871

**Weighted
average!**

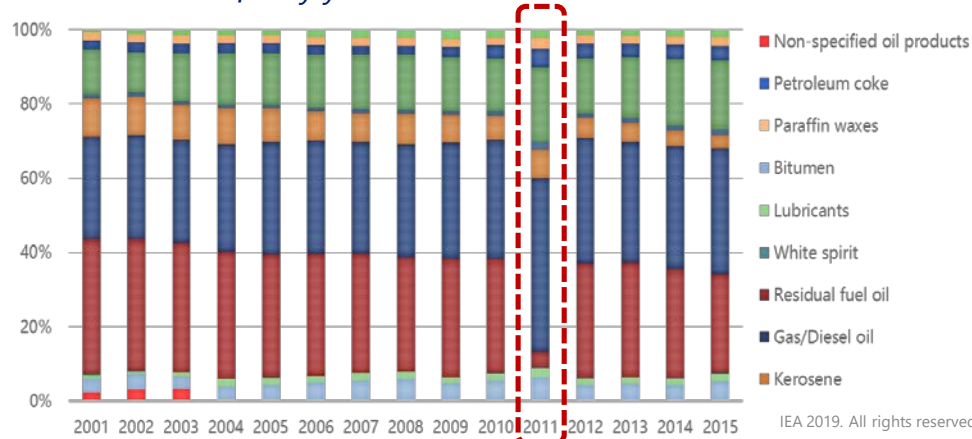
Oil classification – Density, Sulphur and refinery yields

- Crude oils have a wide range of physical and chemical properties.
- Refinery specifications determine the type of input and output (refinery yield)
 - Reconfiguring a refinery is expensive, so refinery yields tend to remain stable over time

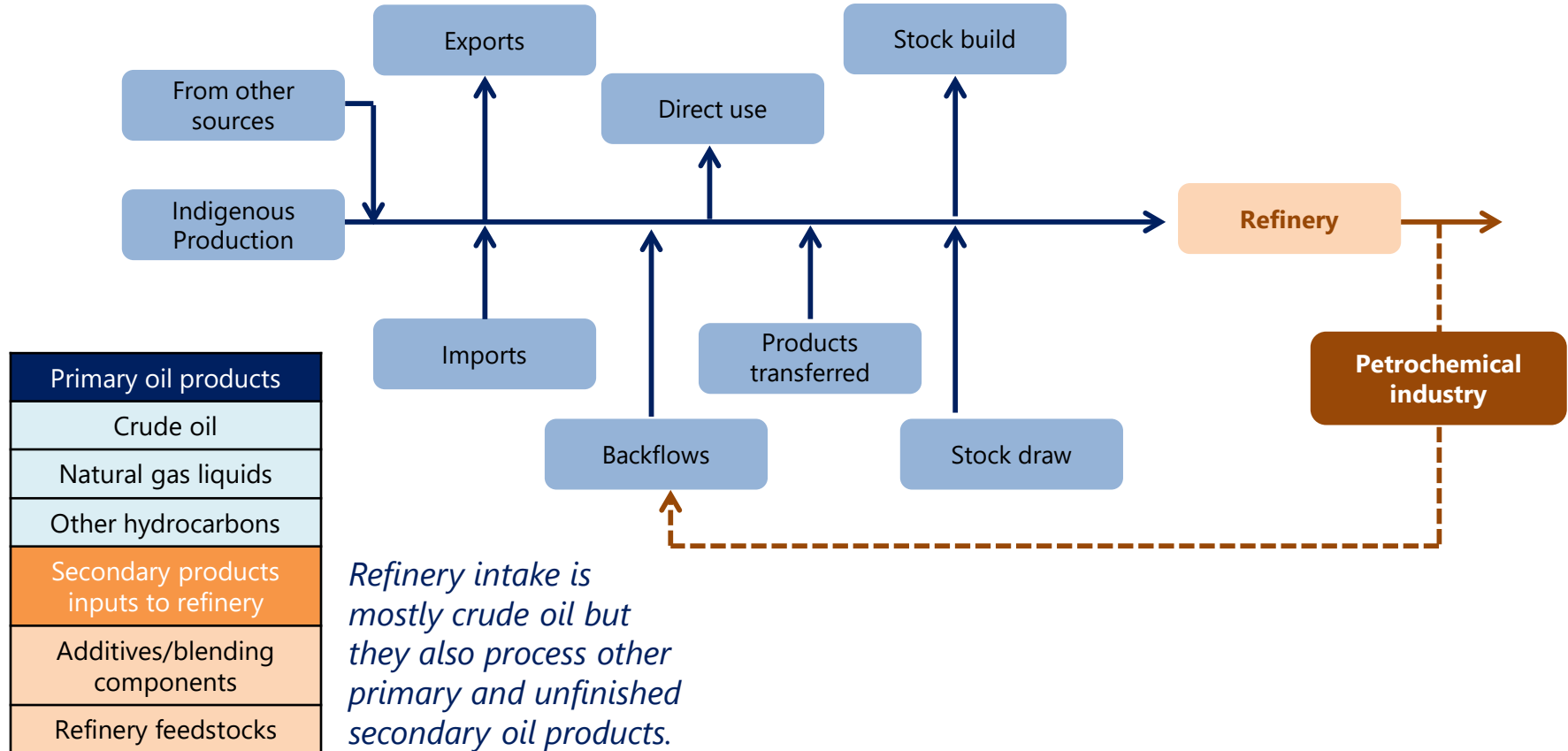
Example of inherent yields from different crude oil types



As a result refinery yields are consistent over time...

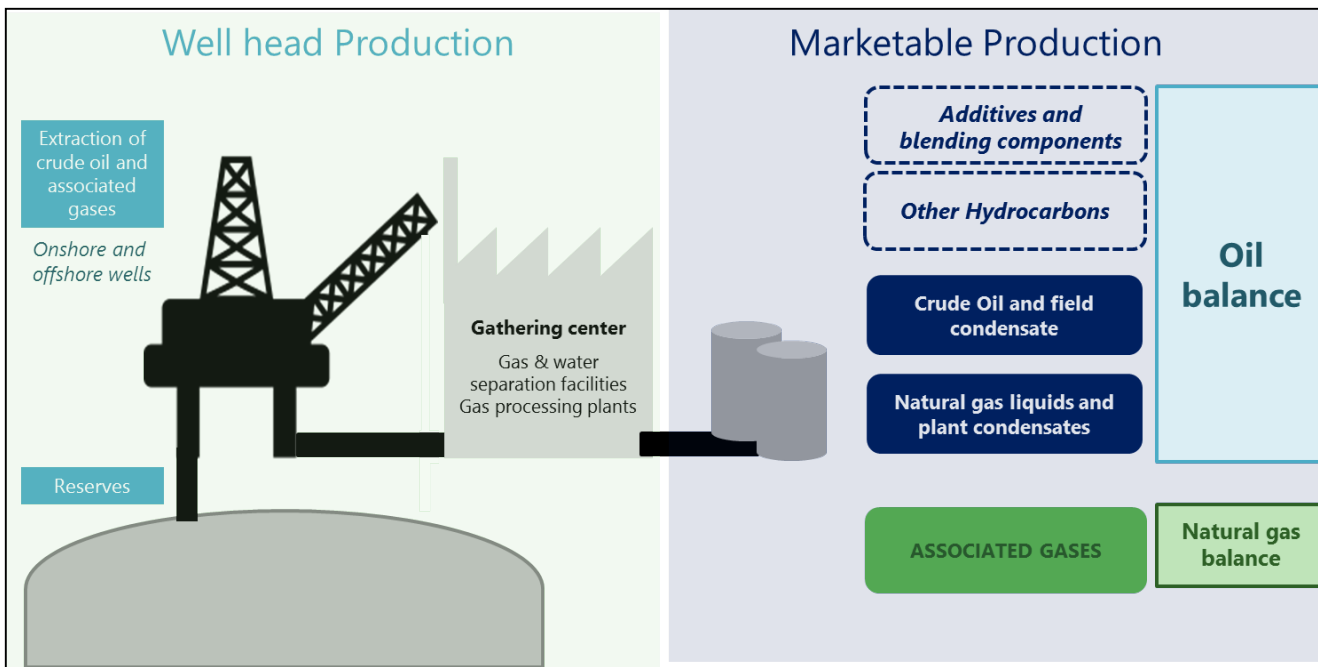


Oil balance – Supply of primary oil products



Oil balance – Indigenous production

- Production should include both onshore and offshore production and exclude amounts returned to formation.
- It is important to determine the point of measurement of production.



- As well as oil products, receipts from other fuel sources can enter the refinery process.

Solid fuels

For example liquids produced from coal liquefaction plants.

Natural gas

Natural gas can be used to :

- upgrade synthetic crude oil and petroleum products.*
- manufacture of synthetic gasoline in the petrochemical sector.*

Biofuels

Amounts of biofuels for blending with transport fuels (bio gasoline, bio diesel, bio jet kerosene)

- Stocks are held for three main reasons: logistics, security and business.
- Stocks can be divided into three categories:

Primary stocks

Held in the **supply chain** (producers, importers, refiners, etc.) and for **strategic purposes** by government or stock holding organizations.

Secondary stocks

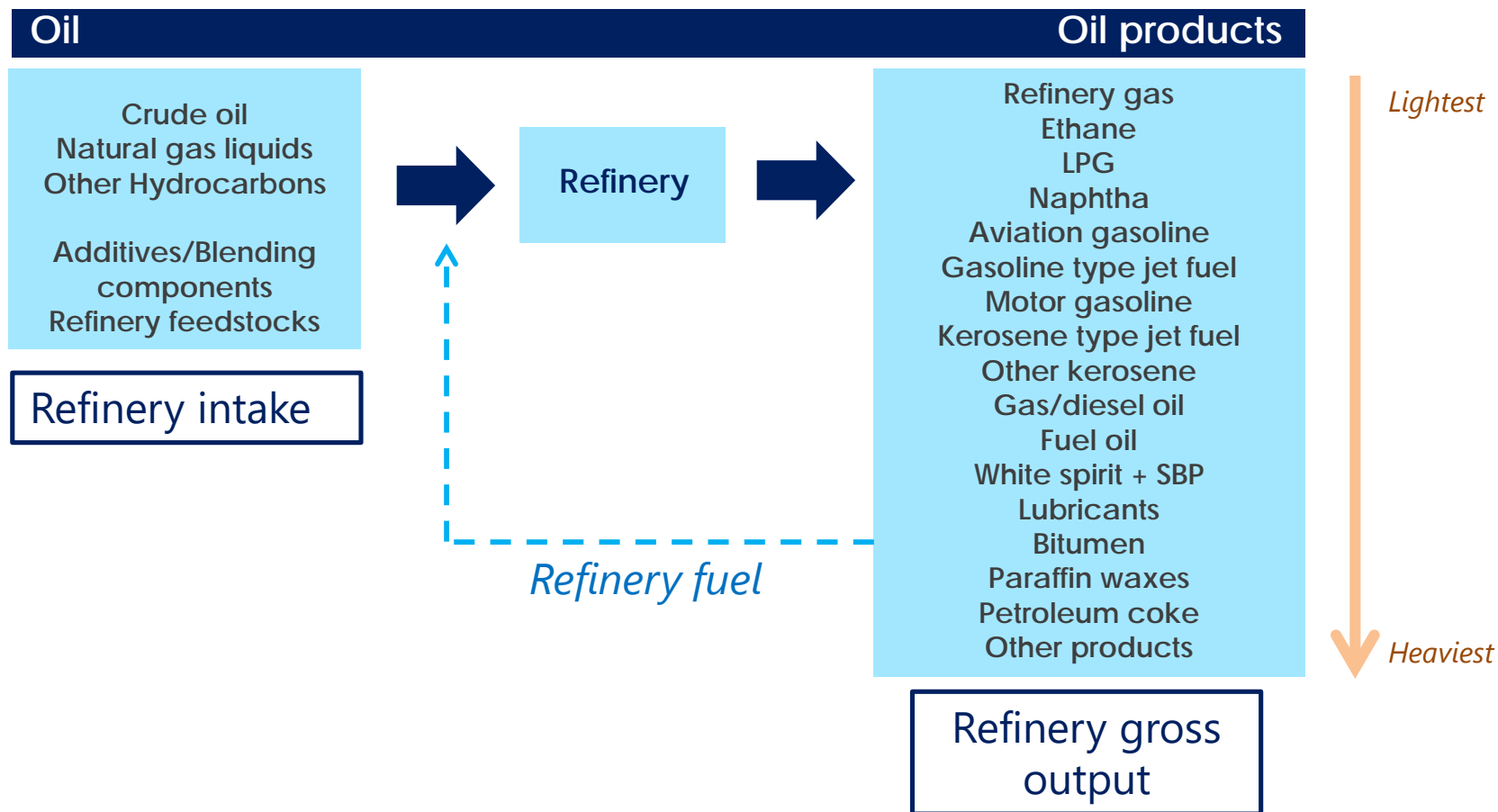
Held in small bulk plants (marketing facilities below a certain capacity) and retail establishments.

Tertiary stocks

Held by final end-consumers (power plants, industrial entities, or consumers in the residential/commercial sector)

- They can be further divided based on the stockholding structure: industry stocks, government stocks and agency stocks.

Oil balance – Transformation



Oil

Primary oil products
Secondary oil products (input
to refinery)



Refinery



Secondary finished oil
products

Refinery intake

Refinery gross output

Losses can occur during the refining process due to evaporation.

When refinery intake > refinery gross output =
refinery losses.

When refinery intake < refinery gross output =
refinery gains.

The units matter!

Mass units – small losses with no gains.

Volume units – gains are likely because lighter products are produced.

Energy units – small losses with no gains.

$$\text{Refinery Yield (\%)} = \frac{\text{Refinery Output of Total Secondary Products}}{\text{Refinery Intake of Total Primary Products}} \times 100$$

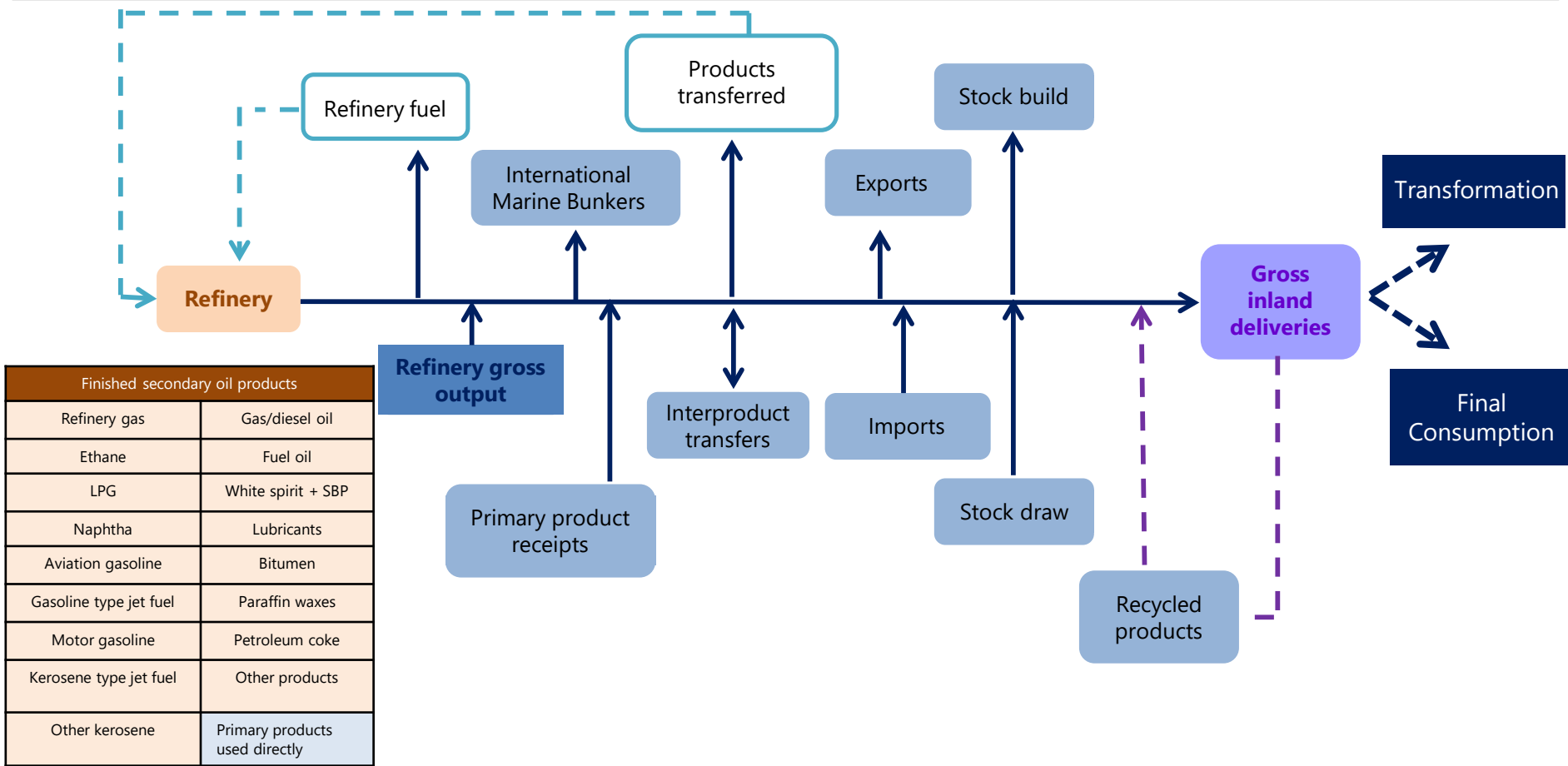
Refinery yield < 100% = Losses

Refinery yield > 100% = Gains

- Reclassification of products within a refinery is common.
 - Change in **specification**
 - **Blended** into other products.
- We refer to these as **inter-product transfers**, this does not involve further processing.
- The *density* and *value* of the oil products will impact the reclassifications.
- When products are *reprocessed* in a refinery we consider these “**products transferred**”, these products are not delivered to the market.

Possible	
Kerosene to gasoil Jet kerosene to diesel	Naphtha to gasoline Diesel to fuel oil
Possible but not very likely	
Fuel oil to gasoil	Kerosene to LPG
Not likely	
Gasoline to naphtha LPG to fuel oil	Diesel to jet kerosene
More generally heavy to light products	

Oil balance – Supply of secondary oil products



- This flow covers the deliveries of oil to:
 - Ships of **all flags** undertaking an **international** voyages.
- Domestic navigation and consumption by fishing vessels are covered elsewhere in the balance.

The domestic/international split should be determined on the basis of **port of departure and port of arrival.**










Why it matters:

- Important **outlet** for the **refining industry**.
- Important part of **demand** for oil in a country.
- 80% of global trade in physical goods is done by sea – key to track **policy impact**.
- The distinction between national and international navigation matters for **emissions** calculations (they are excluded from national inventories).

- Due to their specific properties, different oil products have specific uses.

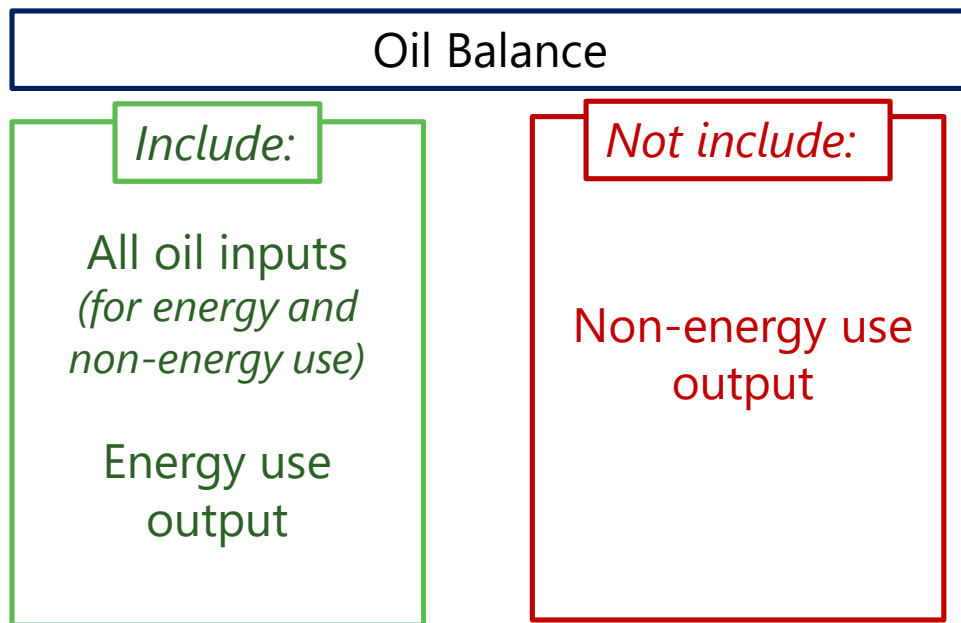
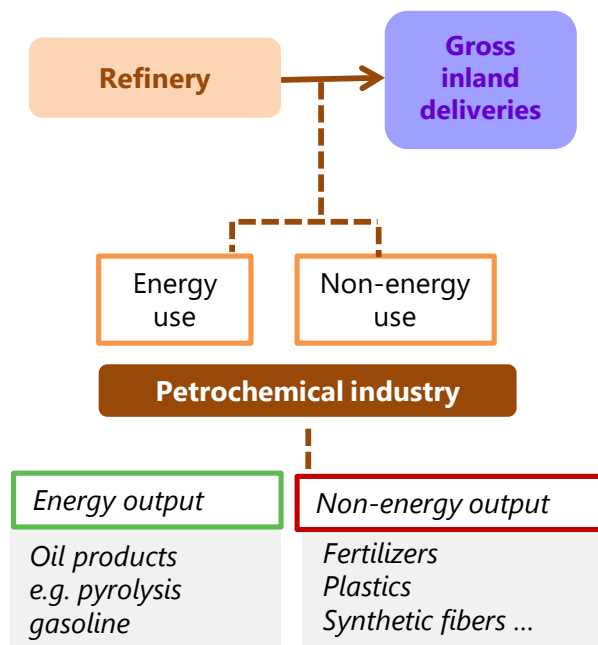
Examples of the types of oil products one can expect to find in different consumption sectors

Electricity plants	Chemical and Petrochemical	Aviation	Road transport	Navigation	Residential	Non-energy use
Crude oil Diesel	Naphtha Diesel LPG Ethane Kerosene Other products	Jet kerosene	Gasoline Diesel	Heating oil* Fuel oil	Naphtha Kerosene Heating oil	Bitumen Paraffin waxes
						

**The category Heating oil includes marine diesel and diesel used in rail traffic.*

Oil balance – The petrochemical sector

- The petrochemical industry is a special case as it is not only a large consumer of oil but also a producer of oil products. As such it is an integral part of the oil balance.



Oil data sources – Where does it all come from?

Supply Data



Producers, oil terminals, importers/exporters or customs data, refiners.
Surveys, company reports, etc.

Demand Data



Energy Consumers, wholesalers.
End-use survey for households and enterprises, sales data, etc.

Integrated Approach



Using existing surveys, direct measurement, estimation and modelling

Surveys



Enterprise
Household

Administration data



Energy regulator, custom office, excise tax records etc.
Industry associations, chamber of commerce etc.

Estimation/modelling



e.g. NGL production-> LPG exports/refinery output

Beyond data collection



Annual and quarterly Publications

Fuel Information books, World energy statistics & balances, CO₂ emissions...



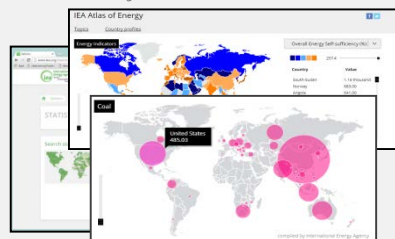
Data support

Oil Market Report, World energy outlook...



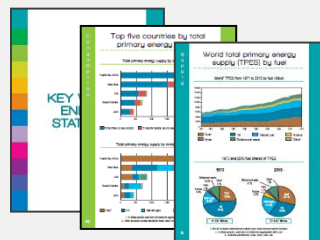
IEA website

Atlas, Sankey flows...



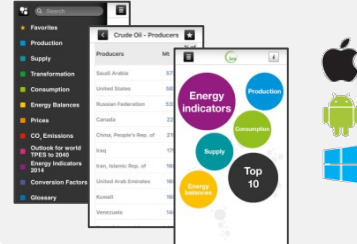
Booklet

Key World Energy Statistics



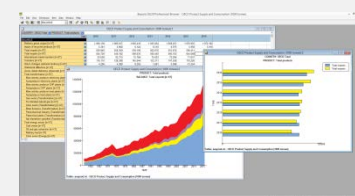
Mobile App

Android, apple and windows



Electronic data files

Online data service





Key points for reporting monthly oil

Why collect monthly oil data?



Transparency in the oil market

Improved analysis and policies

Energy security

Alberta wildfires prompt oil firms to suspend production and evacuate staff

At least 233,000 barrels per day of oil sands production have been halted as government of Canadian province says 66 forest fires are burning

Hurricane Harvey Forces Even More Texas Oil Refineries To Close

Fire halts operations at Pemex's Salina Cruz refinery

Shell Nigeria Declares Force Majeure On Nigerian Light Oil Exports

Oil rises as Kuwaiti strike cuts output for third day

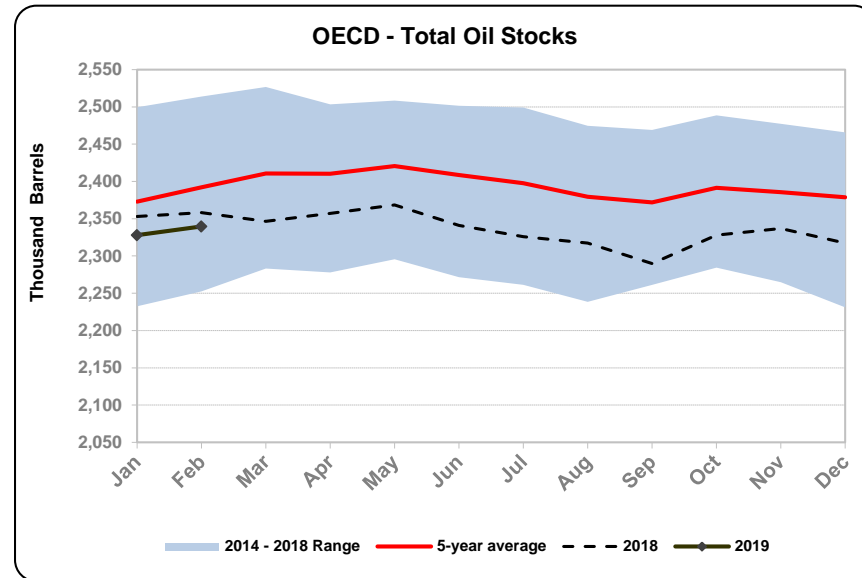
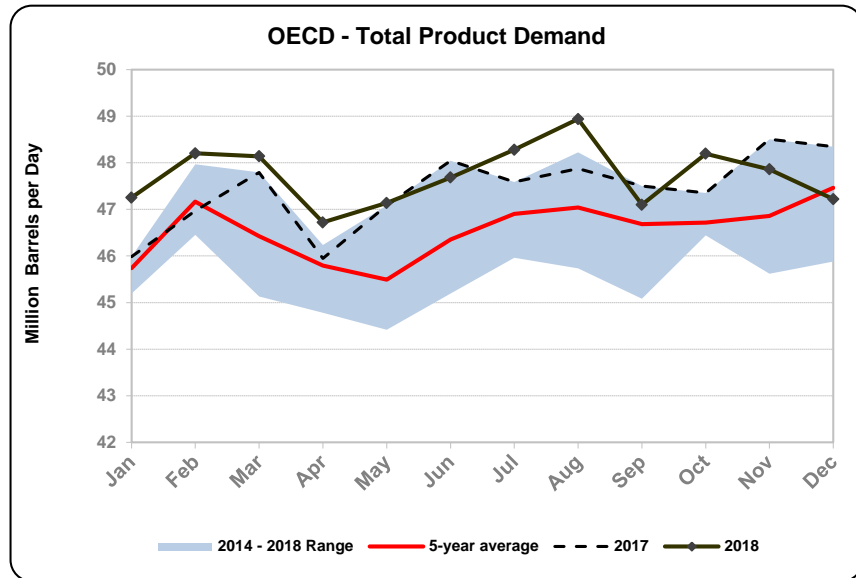
Why collect monthly oil data?

- Transparency in the oil market
 - Short-term/Trend indications
 - Seasonality
 - Impact of events (planned or unplanned)
 - Data validation
- Improved analysis and policies
 - Preliminary source of information
 - Basis for comparison with annual data
- Energy security purposes
 - Recent/quick assessment of markets
 - Size of a supply disruption
 - Ad-hoc assessment
 - Monitoring of a country's ability to face a disruption

Why collect monthly oil data – Transparency in the oil market



Short term – Trend indicators

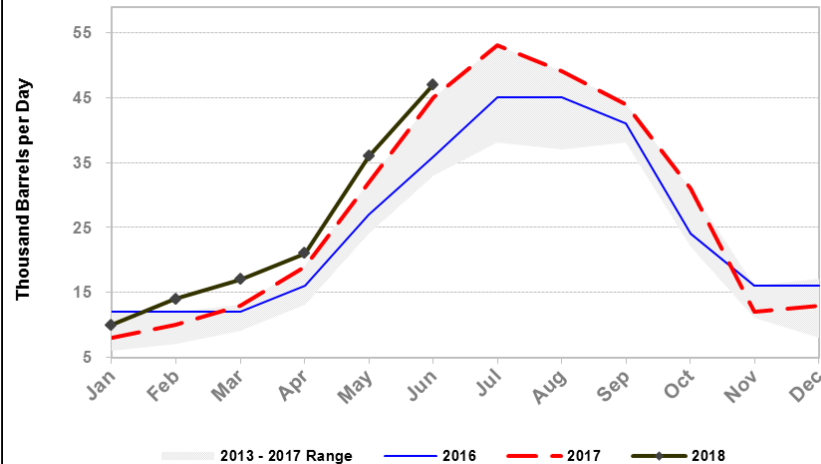


Why collect monthly oil data – Transparency in the oil market

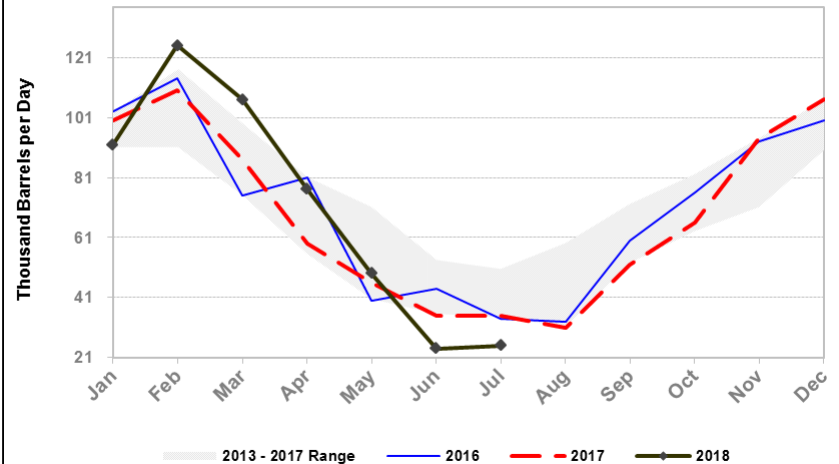


Seasonality

Greece – Jet Kerosene Demand

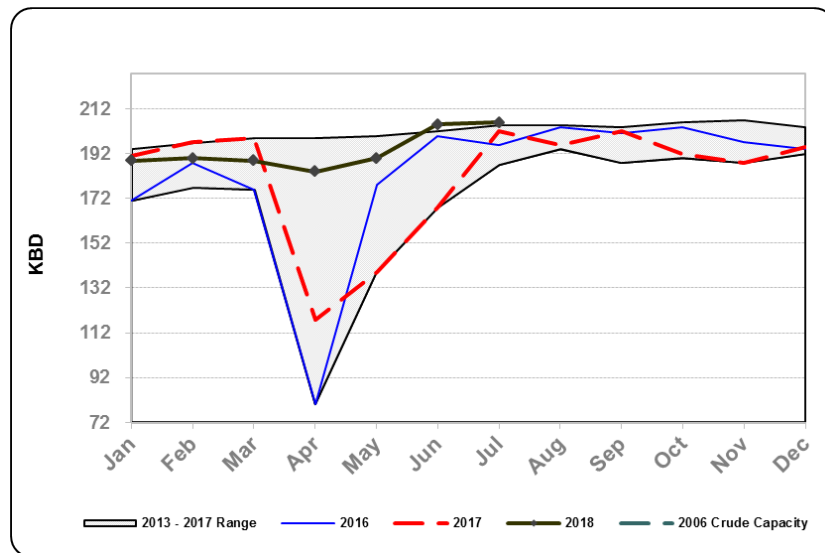


UK – Other Kerosene Demand

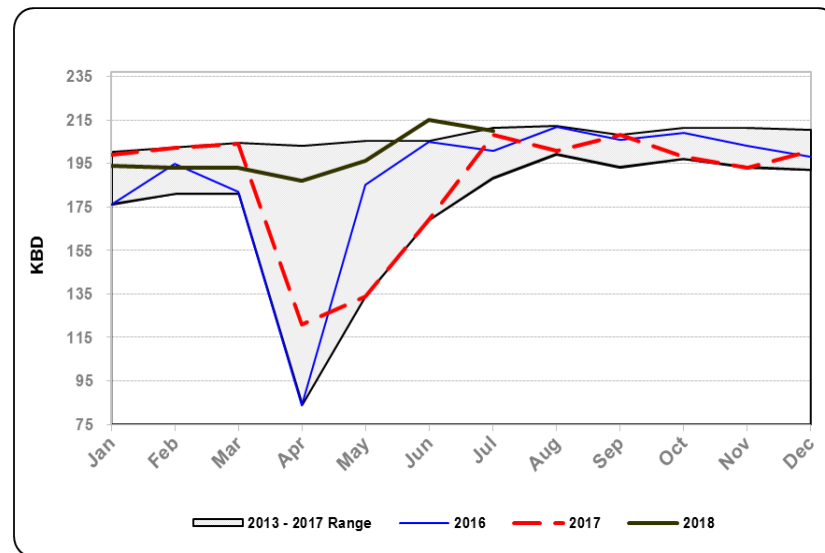


Impact of events - Scheduled maintenance

**Austria – Crude, NGL + Feedstocks
Refinery Intake**



**Austria – Total Products
Refinery Gross Output**



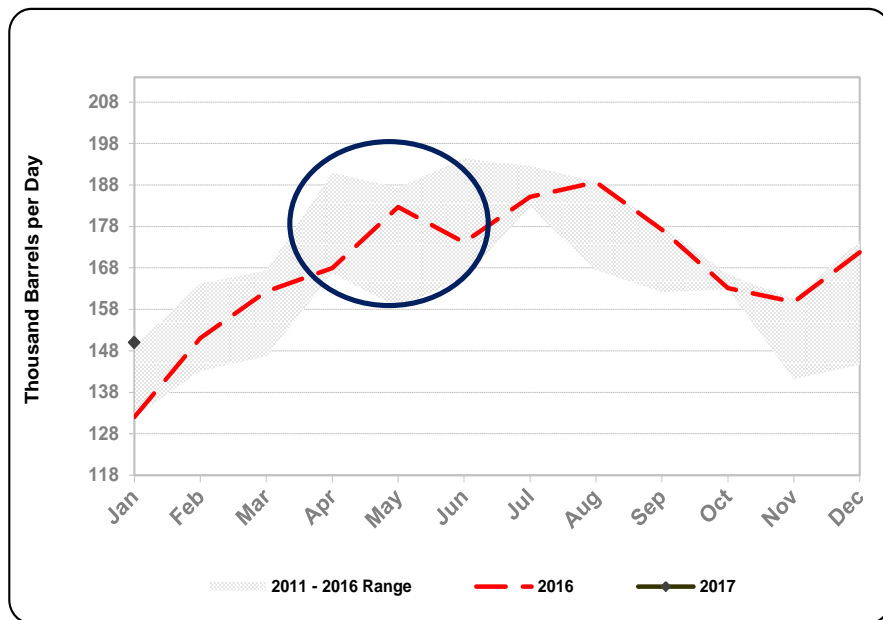
Why collect monthly oil data – Transparency in the oil market



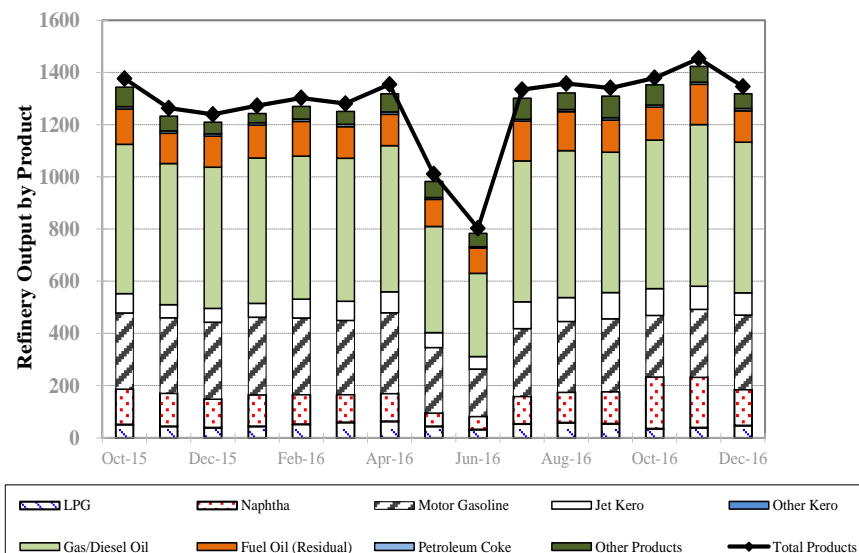
Impact of events - Detailed visualization of the effects of unplanned events

- Example: France 2016 - Impact of strike on oil markets / oil industry

Gasoline demand



Refinery outputs

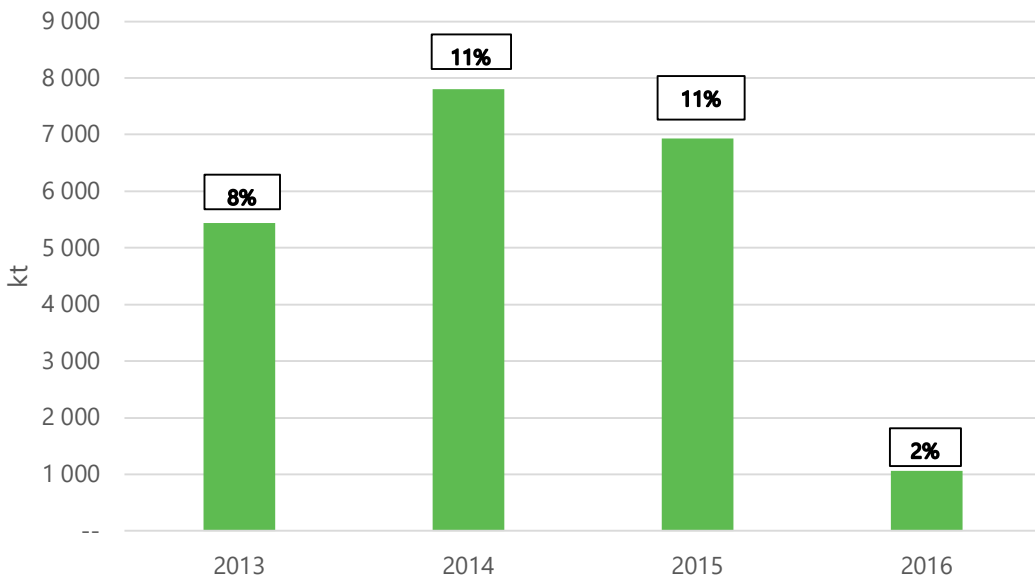


Why collect monthly oil data – Transparency in the oil market



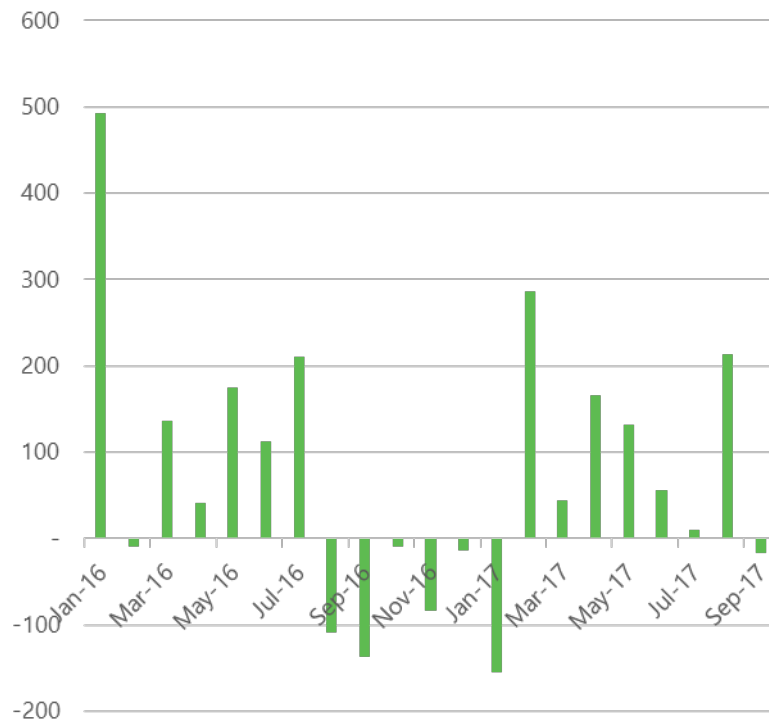
Data validation - Detailed visualization of possible data issues

Refinery Losses (Annual data)



% - Refinery losses as a percentage of refinery intake
A **negative** refinery loss implies a refinery **gain**

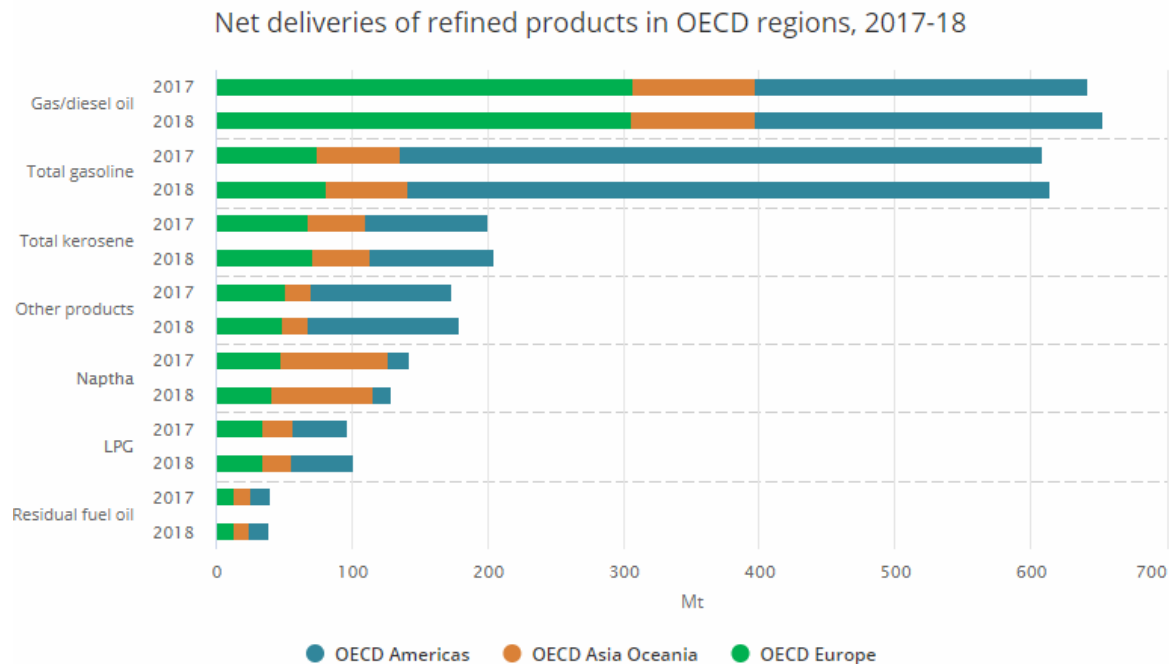
Refinery Losses (monthly data)



Why collect monthly oil data – Improved analysis and policies



Preliminary source of information

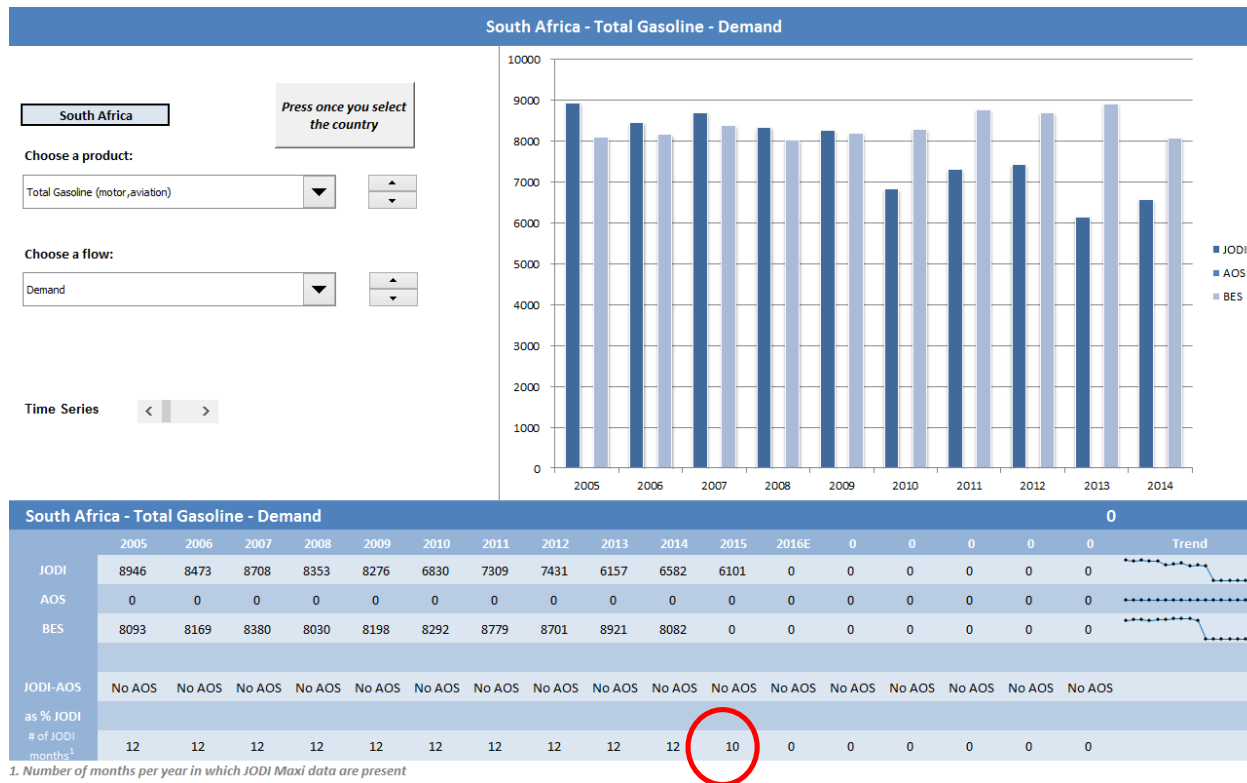


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<https://www.iea.org/newsroom/news/2019/april/key-oil-trends-2018.html>

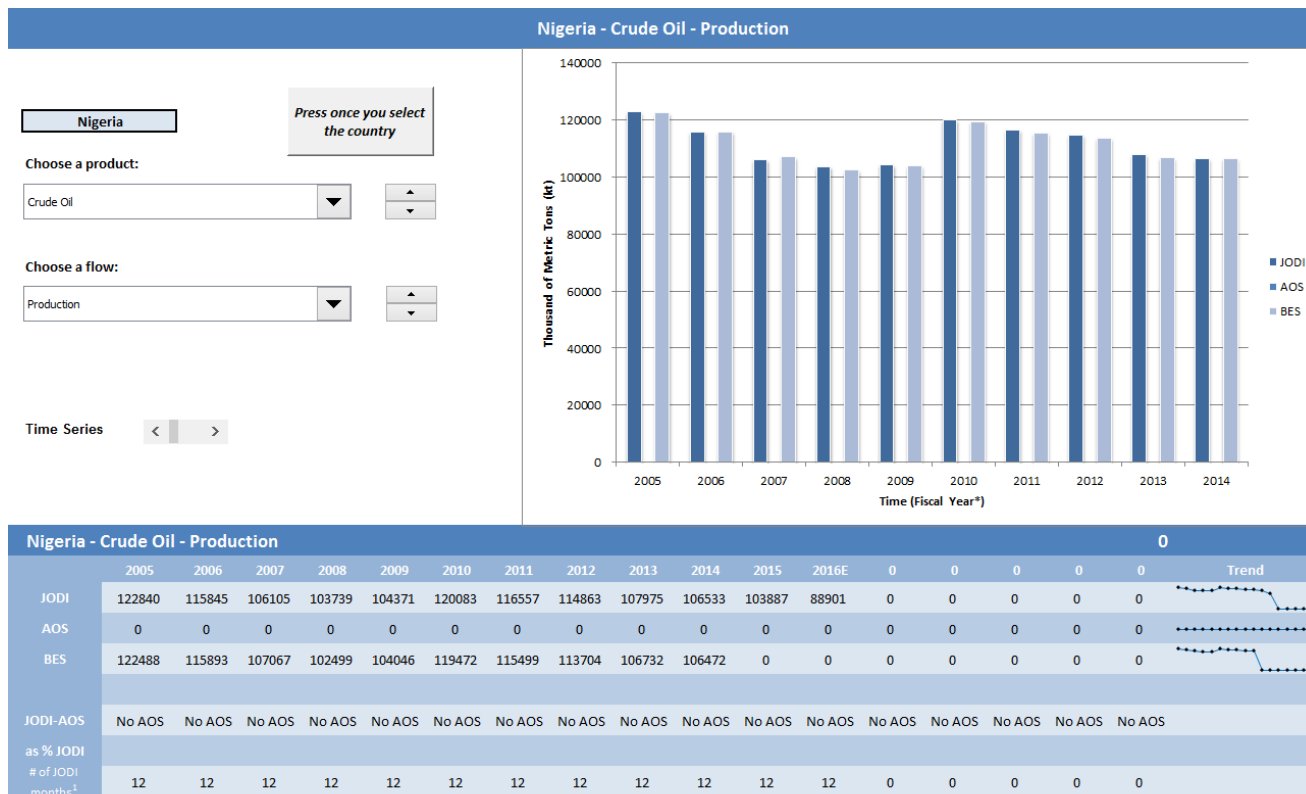
Why collect monthly oil data – Improved analysis and policies

Basis for comparison with annual data



Why collect monthly oil data – Improved analysis and policies

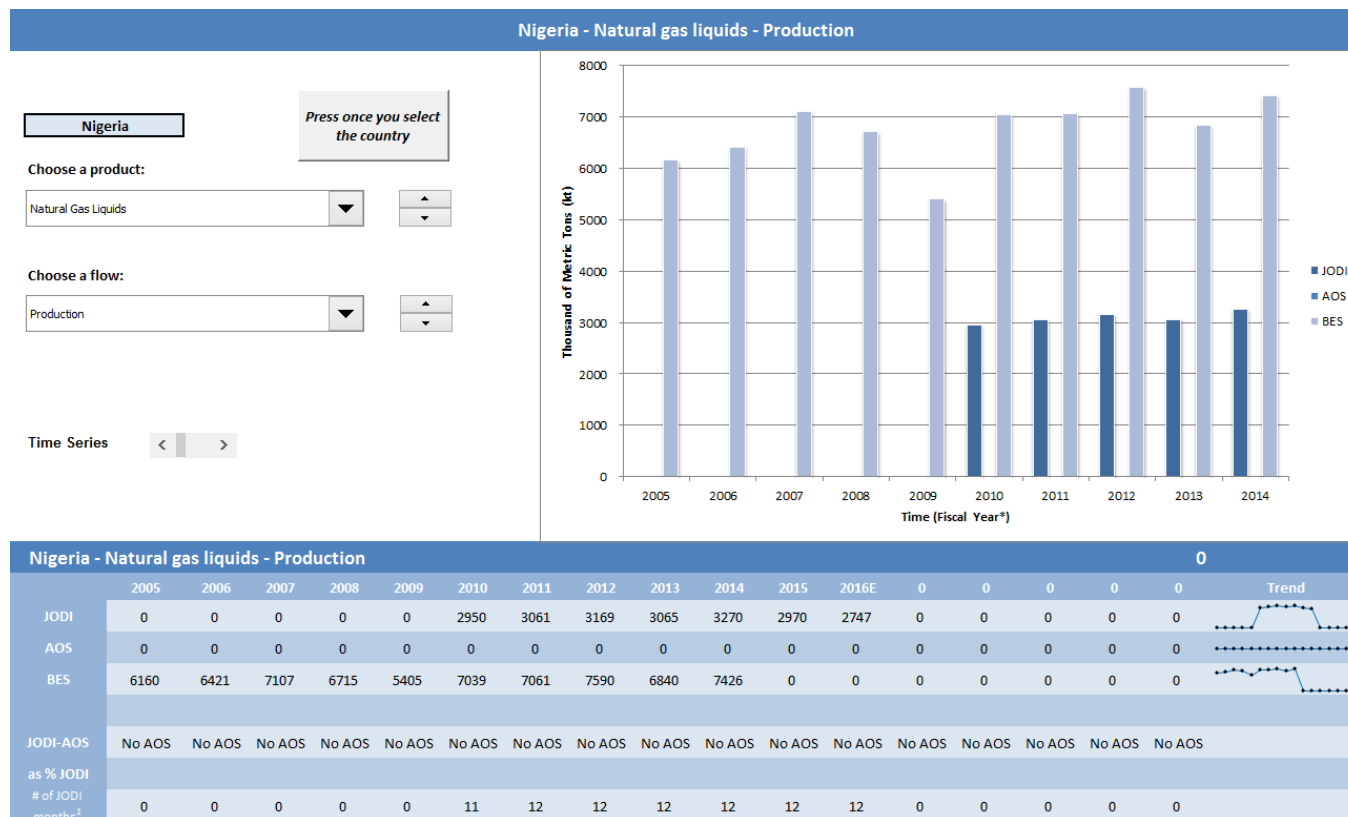
Basis for comparison with annual data



1. Number of months per year in which JODI Maxi data are present

Why collect monthly oil data – Improved analysis and policies

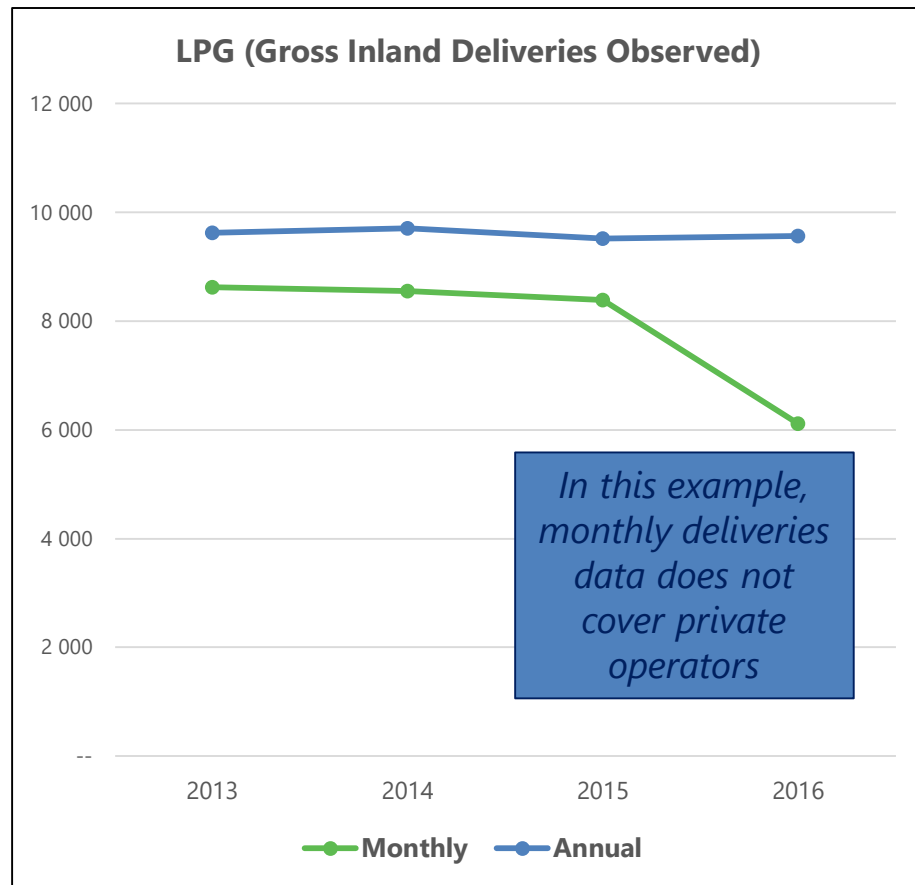
Basis for comparison with annual data



1. Number of months per year in which JODI Maxi data are present

Challenges in collecting monthly data

- Timeliness can be a factor
- The data collection system of a country also matters (voluntary v. mandatory)
- Confidentiality issues





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