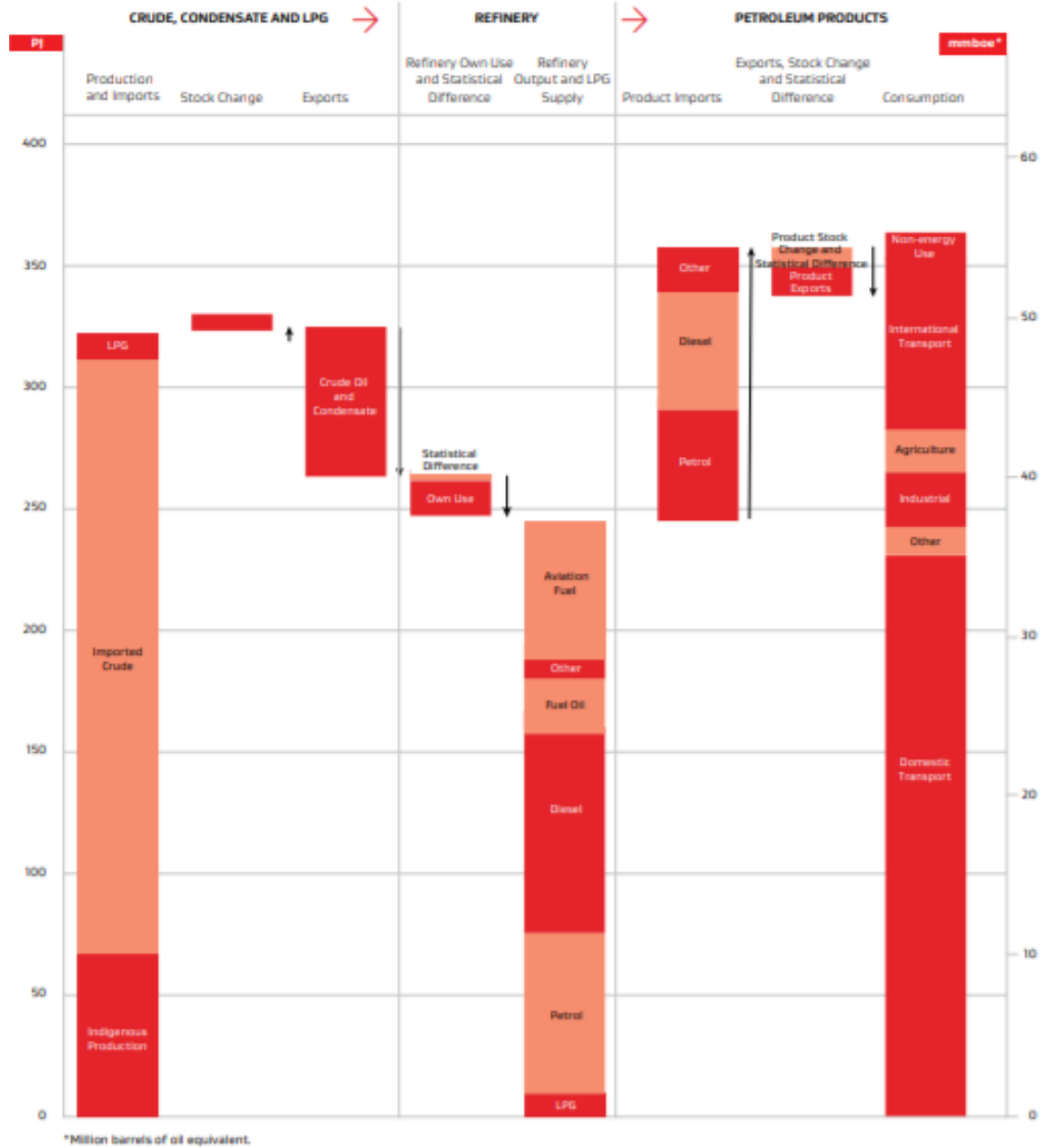MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT
HIKINA WHAKATUTUKI

New Zealand's contribution and challenges in JODI reporting

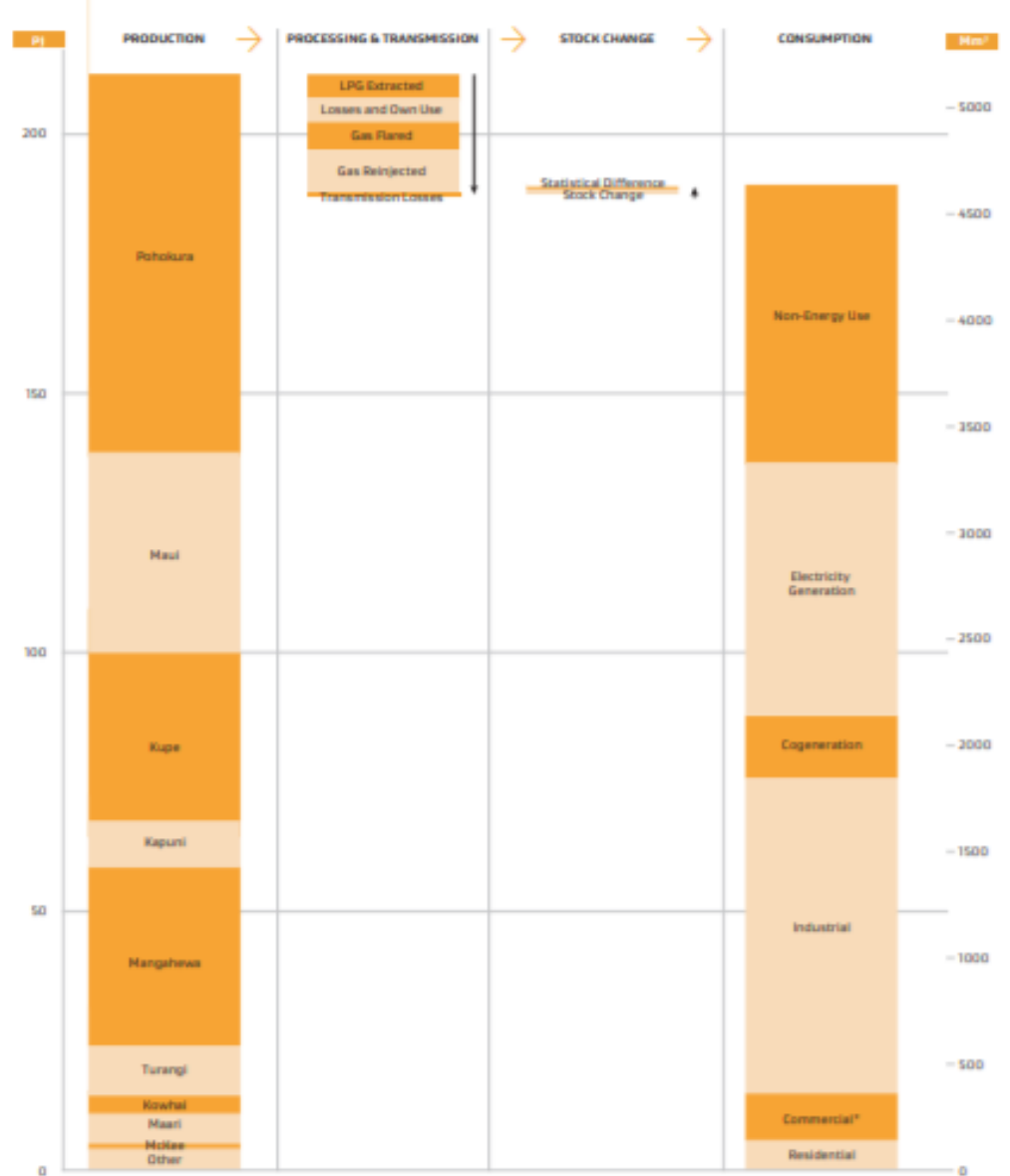## 17th APEC Workshop on Energy Statistics
11-13 June 2019, Tokyo, Japan.

Oil transformation in New Zealand

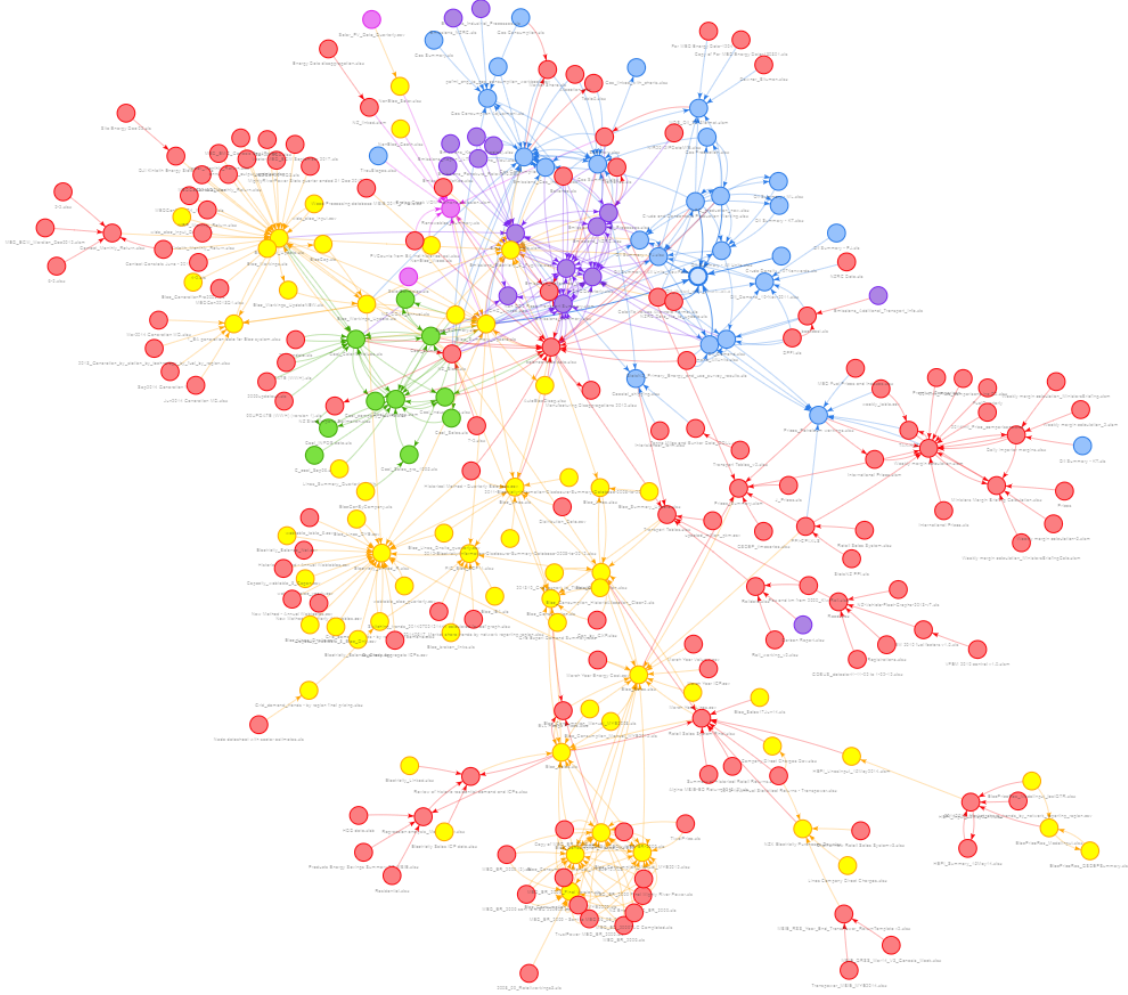# Gas transformation in New Zealand

* Includes transport, agriculture, forestry and fishing.

Key challenges in MOS reporting

- Excel spreadsheet system

- Data sources

- Troublesome commodities
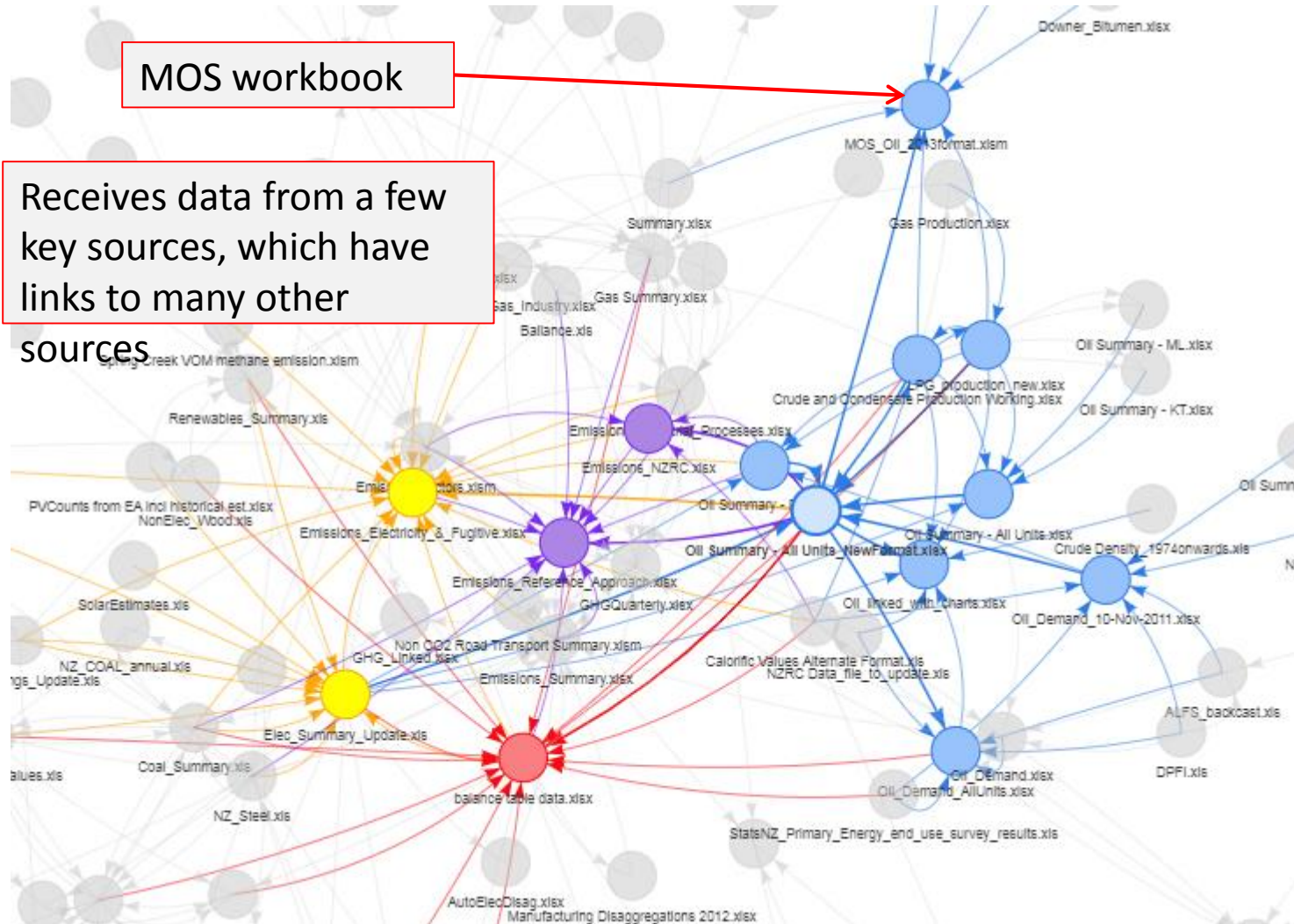
- Our new data system

Excel spreadsheet system

Excel spreadsheet system

MOS workbook

Receives data from a few key sources, which have links to many other sources

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Excel spreadsheet system

- Every coloured dot in the previous graphic represents a single Excel spreadsheet

- Lots of linkages, each populating the MOS workbook in some way

- Data brought into the MOS workbook through formula references

- These formulae are very difficult to debug and can lead to errors

Excel spreadsheet system

=ROUND(SUMPRODUCT(--(INDIRECT(C$3&"[_Date_]")='Table 1'!$F$3),--(INDIRECT(C$3&"[og_cat_desc]")=C$4),--(INDIRECT(C$3&"[IEA Name]")=$A87),INDIRECT(C$3&"[Imports(kt)]")),0)

+SUMPRODUCT(--(INDIRECT(C$1&"[Date]")='Table 1'!$F$3),--(INDIRECT(C$1&"[Fuel]")=C$2),--(INDIRECT(C$1&"[[Record import origin]]")=$A87),--(INDIRECT(C$1&"[Import or Export]")="Import"),--(INDIRECT(C$1&"[Arrival of Import recorded this month?]")="No"),INDIRECT(C$1&"[Quantity (kt)]"))

-SUMPRODUCT(--(INDIRECT(C$1&"[Date]")=DATE(YEAR('Table 1'!$F$3),MONTH('Table 1'!$F$3)-1,1)),--(INDIRECT(C$1&"[Fuel]")=C$2),--(INDIRECT(C$1&"[[Record import origin]]")=$A87),--(INDIRECT(C$1&"[Import or Export]")="Import"),--(INDIRECT(C$1&"[Arrival of Import recorded this month?]")="No"),INDIRECT(C$1&"[Quantity (kt)]"))

+SUMPRODUCT(--(INDIRECT(C$1&"[Date]")='Table 1'!$F$3),--(INDIRECT(C$1&"[Fuel]")=C$2),--(INDIRECT(C$1&"[[Record import origin]]")=$A87),--(INDIRECT(C$1&"[Import or Export]")="Import"),--(INDIRECT(C$1&"[Arrival of Import recorded this month?]")="Early"),INDIRECT(C$1&"[Quantity (kt)]"))

-SUMPRODUCT(--(INDIRECT(C$1&"[Date]")=DATE(YEAR('Table 1'!$F$3),MONTH('Table 1'!$F$3)+1,1)),--(INDIRECT(C$1&"[Fuel]")=C$2),--(INDIRECT(C$1&"[[Record import origin]]")=$A87),--(INDIRECT(C$1&"[Import or Export]")="Import"),--(INDIRECT(C$1&"[Arrival of Import recorded this month?]")="Early"),INDIRECT(C$1&"[Quantity (kt)]"))

Excel spreadsheet system

- One of the most troublesome formulae in use in our system is the IFERROR formula

- We have found this formula in use extensively through the old system

- Some of the problems caused included:
  - Setting a value to zero if there was an error
  - Setting a value to the value from the same month in the previous year if there was an error

Case study

- In 2016, a major oil company left the NZ market.

- Our old spreadsheet still included references to this company, which meant that there were now errors each month after their departure.

- The IFERROR statements simply carried forward monthly data for each month of the previous year for this company.

- This error was not discovered until 18 months after the company had left NZ.

- Thankfully, the part of the spreadsheet that was affected was not part of our IEA reporting.

Excel spreadsheet system

- Some parts of our MOS spreadsheet system use lookups of specific values kept in individual cells

- This can cause problems because it is easy to overlook a single cell reference if you don't know it is a precedent of another cell

- This has led to undercounting of stock tickets because a single cell did not contain a value when we had purchased stock tickets of a particular type. Fuel oil in this case.

Excel spreadsheet system

Lookup values for stock ticket types

If these cells did not contain a value, then we would count the associated stock tickets for that fuel as 0. This led to a significant undercount of fuel oil in 2018

Data sources

- MBIE collects data from multiple sources.
    - 19 oil and gas fields
    - 1 oil refinery
    - 4 fuel companies (provides monthly data, and quarterly data reconciled to economic sector deliveries)
    - 1 logistics company that supplies data on petroleum storage in all coastal terminals
    - 2 major consumers (bitumen, petcoke)
    - 4 LPG retailers
    - 1 LPG association (overall LPG deliveries by type)
    - NZ Customs (source of our lubricants, solvents, and minor petroleum imports)

Troublesome commodities

- Two specific commodity types have caused problems in our oil accounting in the past. These are:
    - Fuel oil
    - Intermediate stocks

Fuel oil

- New Zealand oil companies maintain industry stocks under a system called borrow and loan.

- This allows a company to effectively borrow stocks from another oil company if they don't have sufficient at a particular terminal at any one time.

- When a company borrows stock it is reflected as negative stocks.

- Over the last few years, a few of the oil companies in NZ have reported large negative balances of fuel oil.

Fuel oil

- This has led to NZ undercounting the actual amount of fuel oil present in our coastal terminals.

- We now only report terminal fuel oil volumes reported by a company called Coastal Oil Logistics Limited. This has solved the issue of relying on oil companies for month-end stock levels of fuel oil.

Intermediate stocks

- New Zealand has a single refinery which provides a data submission to MBIE every month.

- This submission includes intake, production and losses figures.

- The refining process includes intermediate products that must be counted each month.

Intermediate stocks

- Our refinery reports intermediates as outputs.

- Sometimes an intermediate stock is reported as a negative production figure. This represents a net intake of that commodity for the month.

- Since intermediates were previously categorised as the fuel type they would eventually produce, these negative volumes led to errors in our overall volumes.

Intermediate stocks

- Some intermediate stocks, such as Cut Back Asphalt, have not been categorised as intermediate stocks at all. Cut Back Asphalt is an intermediate stock in the production of fuel oil.

- This has led to some instances where we have dramatically undercounting volumes of fuel oil output from the refinery.

Intermediate stocks

- The old system only aggregated intermediate stocks into the respective final products, which did not provide adequate visibility of the refining process.

- Our new system correctly treats intermediate products as "Other Products" and shows the appropriate flows through interproduct transfers when there is an output or associated refinery intake.

Our new data system

- New Zealand has been developing a new data system to replace the existing set of networked Excel spreadsheets.

- This system uses the R statistical programming language.

- The new system will dramatically improve our ability meet deadlines and quality standards in international reporting.

Our new data system

- General approach:
  - Data submissions from operators are read by a series of scripts in bulk. This allows for easy updating of our records. No more manual updates, or individual monthly updates are required.
  - Our main data tables are then updated using a simple filtering and aggregating script.
  - MOS output file is constructed using a final set of scripts that incorporates all the MOS consistency checks

Our new data system

- Key benefits of the new system include:
  - Bulk reading of raw returns.
    - No more need to do individual manual updates one month at a time
  - Built in diagnostics
    - Checks for missing values, new fuel types, incorrect date formats, and unknown points of origin.
    - These are all flagged for attention before further analysis takes place

Our new data system

- Key benefits of the new system include:
  - Data cleaning algorithms
    - Some of our data includes occasional errors. We have included a method that allows us to identify and remove these outliers and replace with a reasonable estimator
  - Updated fuel properties
    - Our old system used largely static densities for many commodities. The new system has a more comprehensive library of densities and calorific values split by fuel type and year. These are updated automatically as part of the data reading process.

Our new data system

- Key benefits of the new system include:
    - New data source to identify early ship arrivals
        - We have sourced data from the Marine Traffic service that shows the exact time a vessel arrived in NZ waters. This data, coupled with a new script we have written, allows us to identify the exact time imports of crude oil arrived in NZ waters.
    - Improved classification of flows
        - We have improved the way we deal with intermediate stocks and imported feedstocks.
        - This means we will now be able to show the actual transfers of oil and products through the refining process more accurately.

Our new data system

- Future work
  - Improved diagnostics to identify statistical outliers
  - Forecasting to better estimate future demand and hence understand stock ticket requirements
  - Incorporation of an oil and gas model to estimate potential supply scenarios
  - Construction of output scripts for annual oil and gas questionnaires