



# energy

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**REPUBLIC OF SOUTH AFRICA**

INTEGRATED ENERGY PLAN



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# **DEVELOPMENT OF THE INTEGRATED ENERGY PLAN**

## ***PRESENTATION AT STAKEHOLDER CONSULTATION WORKSHOPS***

***DECEMBER 2016***

# PROBLEM STATEMENT



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- Energy is the life blood of the economy which impacts on all sectors as well as individual livelihoods. Integrated energy planning is required to ensure that current and future energy service needs can be met in the most cost effective, efficient and socially beneficial manner while also taking into account environmental impacts.
- A lack of coordinated and integrated national planning for the energy sector has led to underinvestment in much needed energy infrastructure.
  - There is currently inadequate supply in both the electricity and liquid fuel industries due to a lack of timely investments in new capacity.
  - Electricity generation is constrained due to insufficient capacity and inadequate availability of existing infrastructure.
  - There is a high dependence on import of liquid fuels as the current production capacity does not meet national and export demand. No investments have been made in new capacity since the start of the new democracy.
- Planning at individual organisation level is commercially driven and therefore investments which are required in order to ensure that the policy objectives of the country have been left under invested.
- The IEP aims to guide future energy infrastructure investments, identify and recommend policy development to shape the future energy landscape of the country.



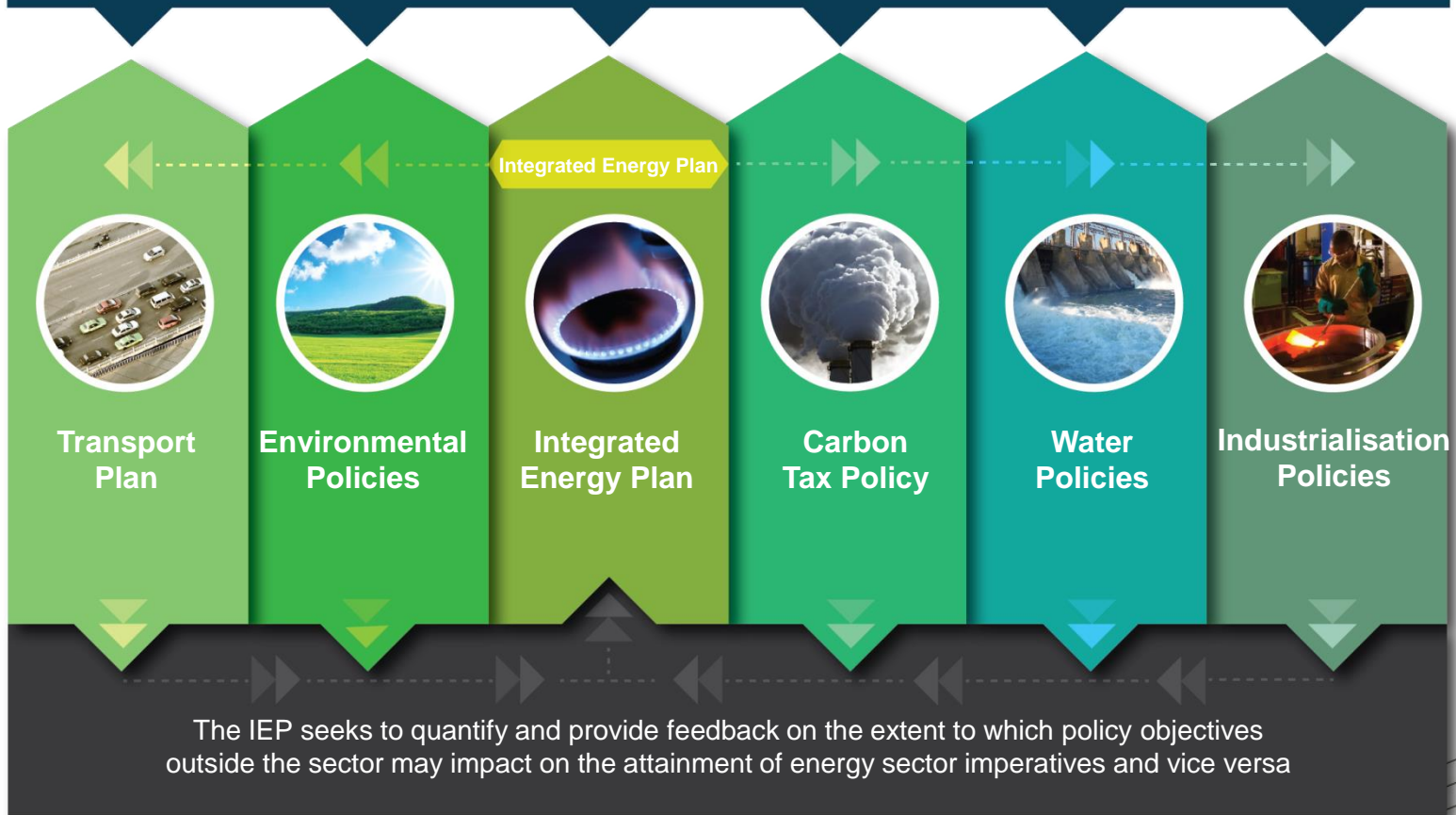
# ENERGY WHITE PAPER (1998)

- The 1998 White Paper on the Energy Policy of the Republic of South Africa (Energy White Paper) is the primary policy document which guides all subsequent policies, strategies and legislation within the energy sector. It provides specific policy statements on what government intends for the energy system as a whole and sets out five key objectives. These objectives have subsequently formed the foundation and informed the development of energy policy in South Africa and still remain relevant. Various other energy policies have been developed and are in different stages of implementation.
  - Increasing access to affordable energy services
  - Improving energy governance
  - Stimulating economic development
  - Managing energy-related environmental impacts
  - Securing supply through diversity



# ENERGY PLANNING WITHIN THE NATIONAL POLICY FRAMEWORK

NATIONAL DEVELOPMENT PLAN, NEW GROWTH PATH, 9-POINT PLAN



The IEP seeks to quantify and provide feedback on the extent to which policy objectives outside the sector may impact on the attainment of energy sector imperatives and vice versa

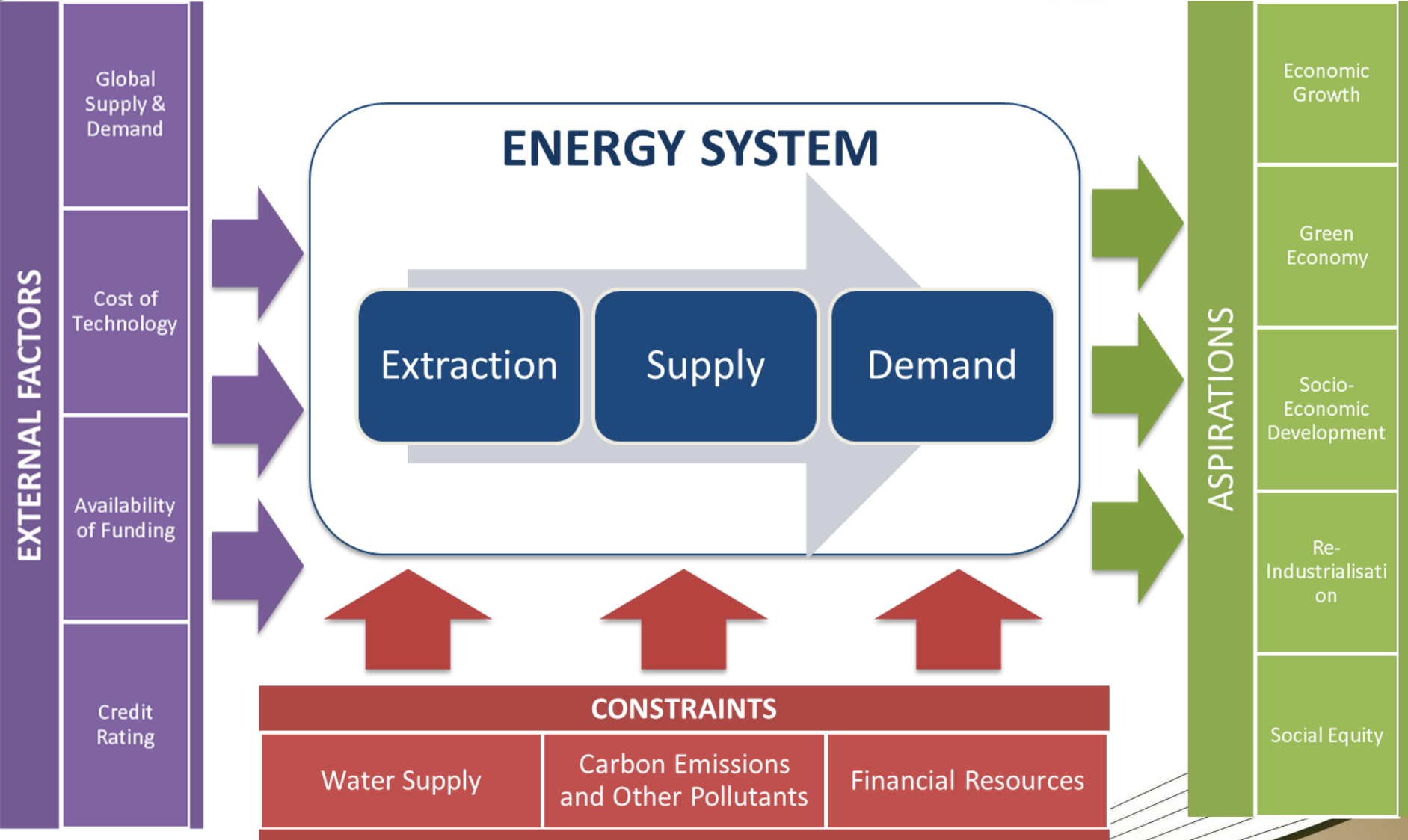
# ENERGY PLANNING PROCESS



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# ENERGY PLANNING SCOPE

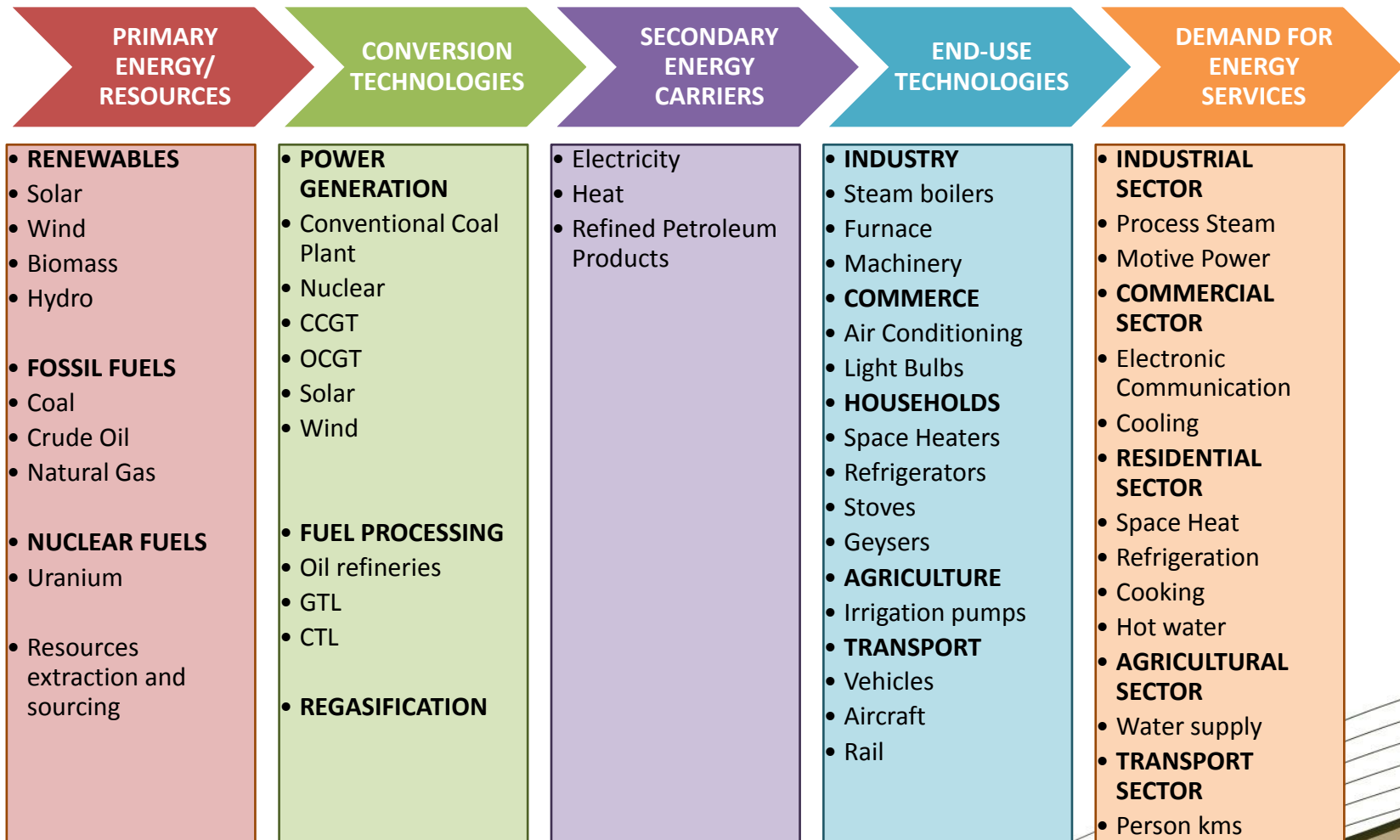


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The Energy Planning Framework considers all energy carriers, all technology options and all key national policy imperatives and proposes an energy mix and policy recommendations which ensures that the energy sector can help achieve these in the most optimal manner.

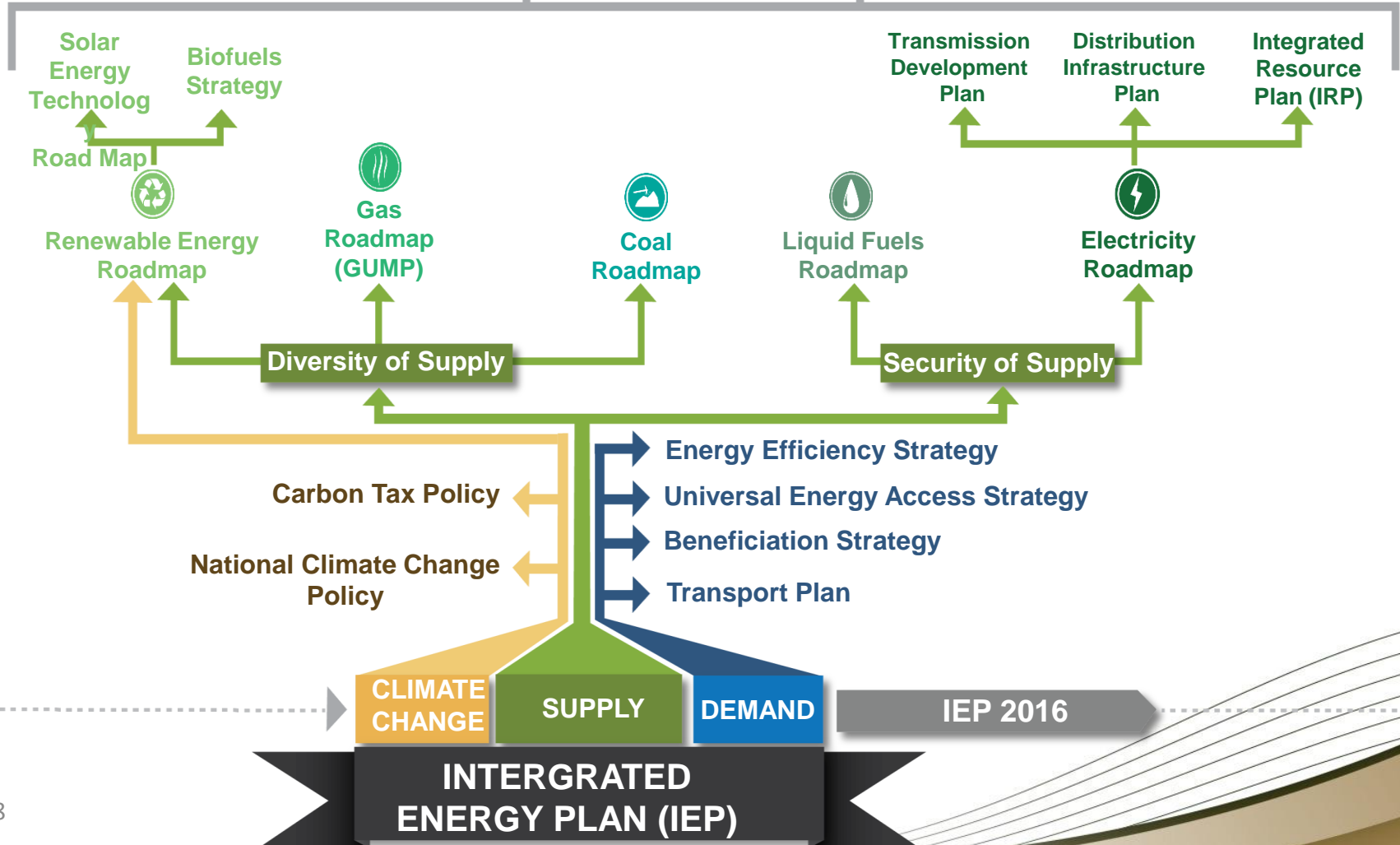




# IEP AND OTHER PLANS

The IEP takes into consideration existing policies

- Informs development of future energy sector roadmaps
- Provides feedback to development & review of external policies



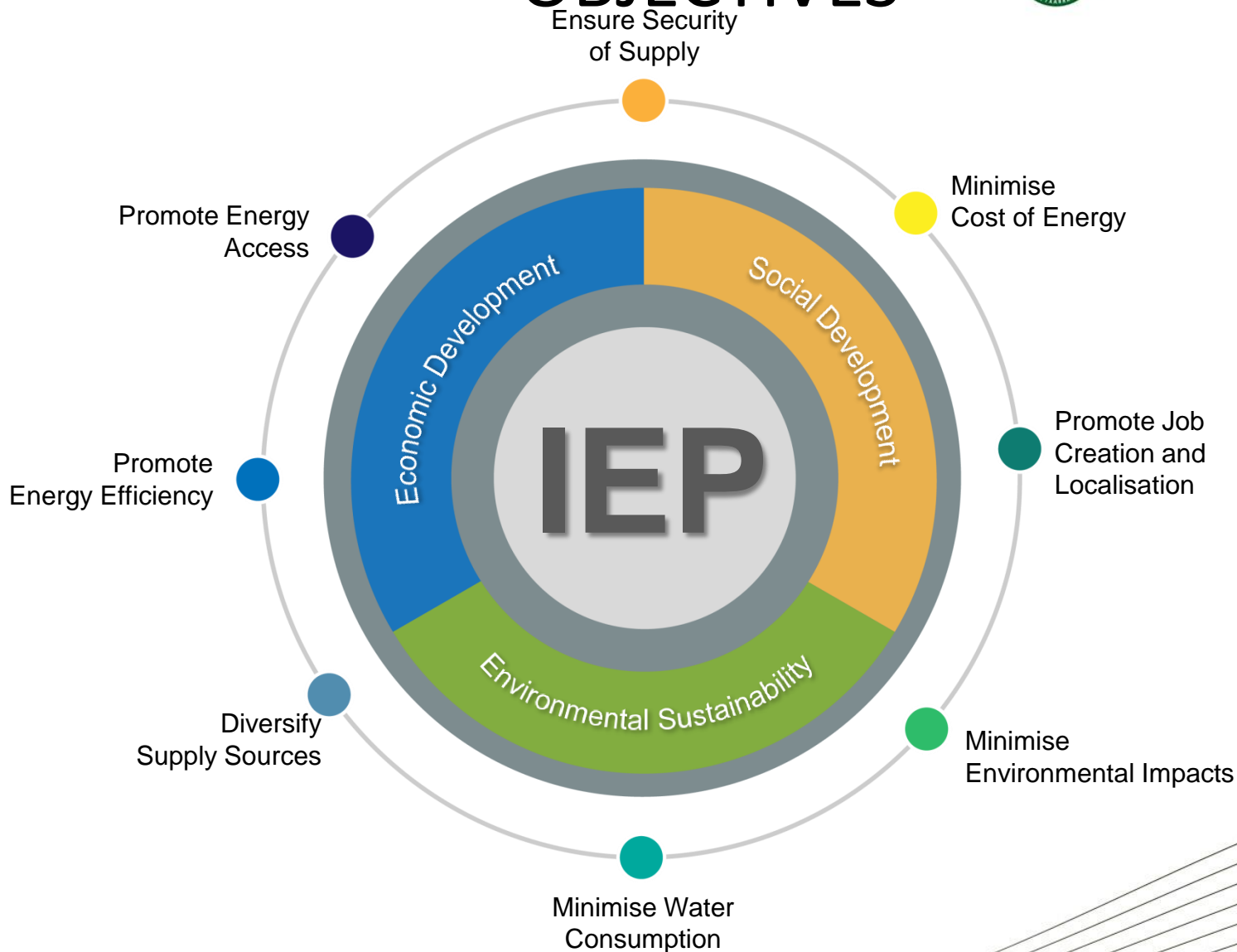
# 8 KEY ENERGY PLANNING

## OBJECTIVES



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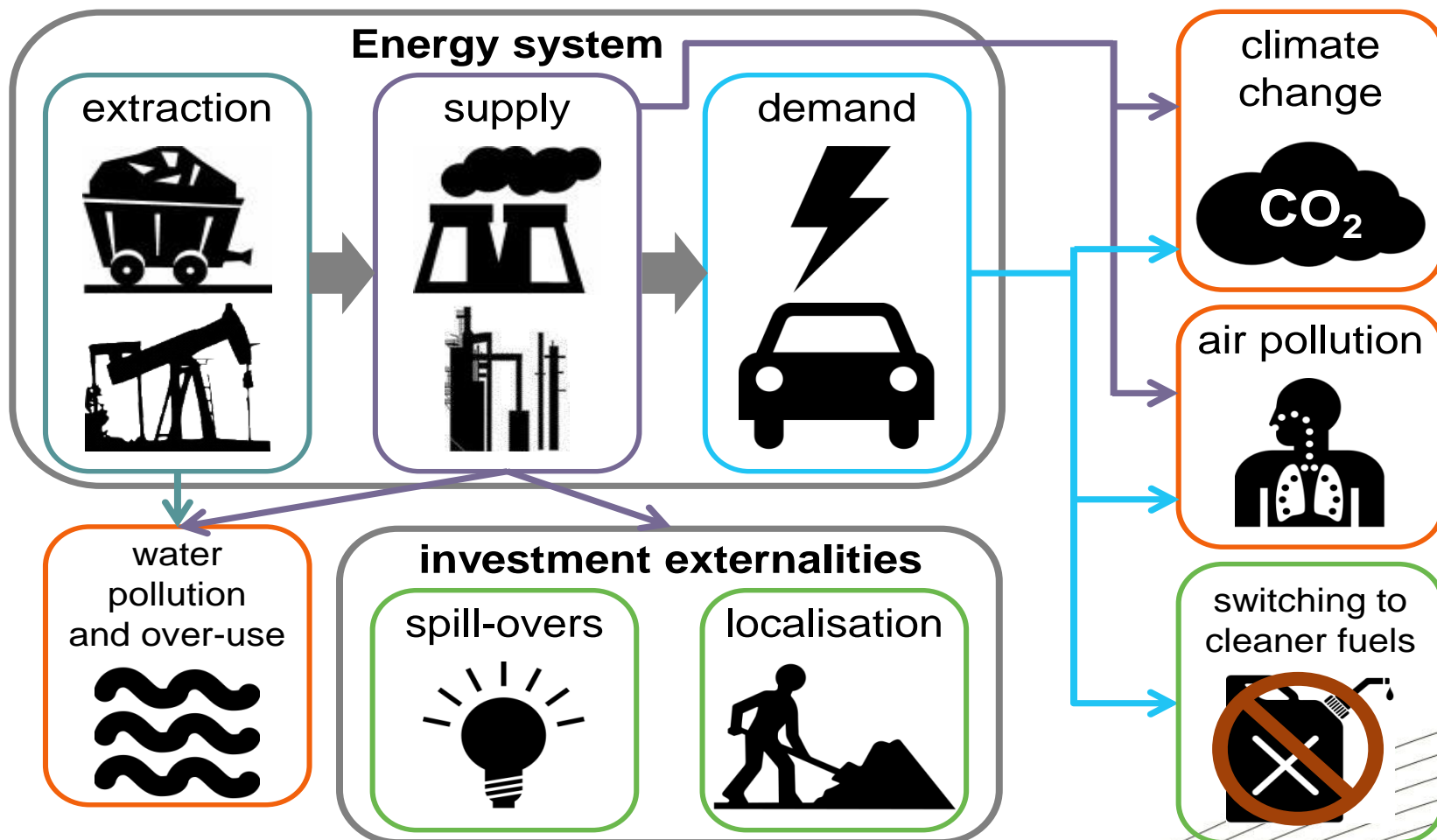
# IEP PROGRESS (JUNE 2013 - FEBRUARY 2016)

- **June 2013:** The **Draft IEP Report was approved by Cabinet for publishing** for public consultation .
- **September to November 2013:** Wide consultation through **public stakeholder workshops** in all nine provinces. Substantial input was obtained from stakeholders through the workshops and also through **written comments**.
- **January – September 2014:** An **inter-governmental policy working group** and various **multi-stakeholder sub-committees** were established to deal with more thematic and substantive issues such as policy coherence, macroeconomic impact assessment, review of demand assumptions and externalities studies.
- Representatives from industry, academia, civil society, industry associations participated in these sub-committees.
- **Based on input obtained the following further enhancements were made on the IEP**
  - Internalising of energy systems externalities (Estimation of the externality costs of different energy carriers)
  - Determination of job creation potential for different technology types (with focus on electricity generation technologies)
  - Inclusion of the “Peak-Plateau-Divide” emissions limits constraints as the Base Case
  - Additional scenarios modelled
  - Conduct a macroeconomic impact assessment on all scenarios
  - Incorporate latest assumptions data
    - Technology costs
    - Macroeconomic assumptions
- **August 2015 – February 2016:** Input obtained from the **Ministerial Advisory Committee on Energy (MACE)** and further circulated to other government departments for comments



# ENERGY SYSTEM EXTERNALITIES

*IEP Internalises Energy System Externalities (both **negative** and **positive**)*



Source: Vivid Economics 2014

# EXTERNALITY COSTS



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An externality cost is a cost imposed on society due to the activities of a third party, resulting in social, health, environmental, degradation or other costs. Externalities may however also be beneficial (e.g. a mine builds a fire break between its operations and the neighbouring farm from which the farmer then directly benefits in terms of safety and security).

In the context of the energy planning framework, negative externalities of different pollutants resulting from the production of energy were considered.

The cost of the externalities were quantified by estimating the 'cost of the damage' to society\* caused by such externalities. Examples of such factors that cause damage are: air pollution (caused by pollutants such as nitrogen oxide [NO<sub>x</sub>], sulphur oxide [SO<sub>x</sub>], particulate matter [PM] and mercury [Hg]), water contamination and soil erosion.

*\*Overall cost to society is defined as the sum of the imputed monetary value of costs to all parties involved.*

Externality	Description	Value	Unit
SO <sub>2</sub>	Sulphur dioxide	7.60	2012 Rand/kg
NO <sub>x</sub>	Nitrous oxide	4.50	2012 Rand/kg
Hg	Mercury	41 484.00	2012 Rand/kg
PM	Particulate matter	11.30	2012 Rand/kg
PM <sub>Transport</sub>	Particulates in transport sector	280.70	2012 Rand/kg

# JOB CATEGORIES CONSIDERED



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CATEGORY	DEFINITION	EXAMPLE
<b>Direct Jobs</b>	Jobs resulting from construction or operation of the technology	<ul style="list-style-type: none"> <li>• Construction workers</li> <li>• Brick layers</li> <li>• Plant operators</li> </ul>
<b>Supplier Jobs</b>	Jobs resulting from first level suppliers during construction and/or operation	<ul style="list-style-type: none"> <li>• Turbine manufactures</li> <li>• Cement producers</li> <li>• Steel manufacturers</li> </ul>
<b>Indirect Jobs</b>	Jobs resulting further down the value chain during construction and/or operation. i.e. suppliers to suppliers	<ul style="list-style-type: none"> <li>• Iron ore miners and smelters</li> </ul>
<b>Induced Jobs</b>	Jobs resulting from more money in the economy because of the project.	<ul style="list-style-type: none"> <li>• Restaurants</li> <li>• Transport services</li> <li>• Medical facilities</li> </ul>
<b>Permanent Jobs</b>	These are jobs which have a longer duration and are more permanent in nature. Services are usually established in-house within the organisation.	<ul style="list-style-type: none"> <li>• All operations jobs are considered to be permanent jobs</li> <li>• Estimated per unit of capacity installed</li> </ul>
<b>Temporary Jobs</b>	These are jobs which have a relatively short duration. Services are usually contracted.	<ul style="list-style-type: none"> <li>• All construction jobs are considered to be temporary jobs</li> <li>• Estimated per unit of energy output</li> </ul>



# LOCALISATION POTENTIAL

*(BASED ON CURRENT POLICIES AND LOCAL CAPABILITY)*

Level of difficulty to localise

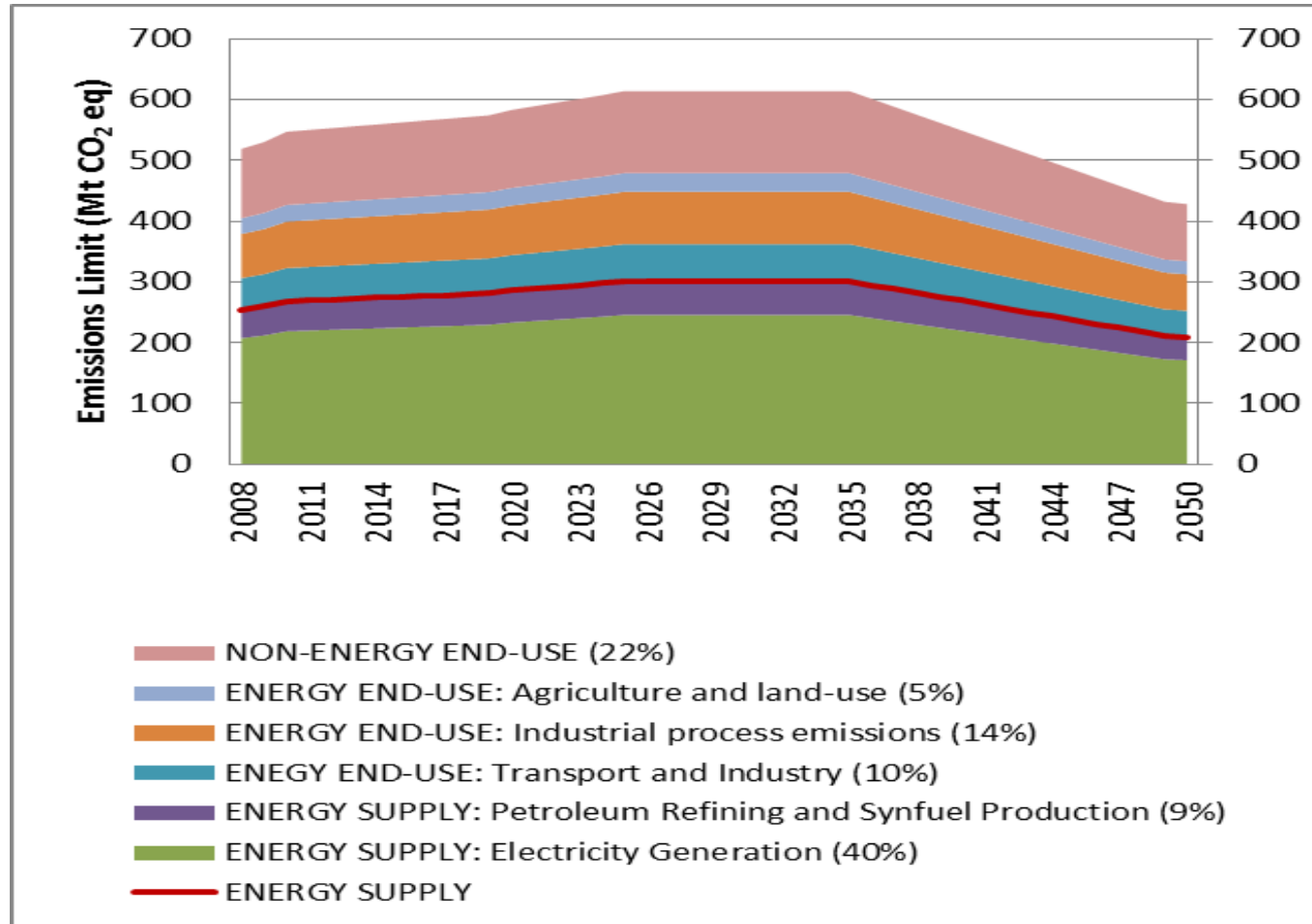
Localisation Potential	Description
Localisable	The current policy framework is conducive for localisation; local supply of the required skills set is available; and there is sufficient demand for raw material to justify local production
Potentially localisable	The current policy framework exists or could be developed and implemented within a fairly short timeframe (3-5 years)
Collaboration	The current policy and regulatory framework could be developed and implemented within five years and some targeted investments would need to be made
Significant investment required	Regional cooperation and partnerships would need to be developed in order to create demand beyond South Africa's borders
Global demand required	Some of the required technology components can be localised but South Africa would need to be competitive in exporting the technologies and services to the global market

# EMISSIONS CONSTRAINTS



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The National Climate Change Response White Paper (NCCRWP) sets emission limit targets for all sectors. The energy planning framework considers the impact of the emission limit targets for the energy supply sectors only (electricity generation and the production of petroleum products).

# IEP SCENARIOS



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INDICATORS	BASE CASE	RESOURCE CONSTRAINED	ENVIRONMENTAL AWARENESS	GREEN SHOOTS
Technology Constraints	9.6 GW New Nuclear Build enforced			
GDP	Treasury moderate GDP growth			<b>National Development High GDP Growth</b>
<b>DEMAND-SIDE INTERVENTIONS</b>				
DSM	1 million SWH		<b>5 million SWH</b>	<b>10 million SWH</b>
Energy efficiency	Business As Usual	<b>High Energy Efficiency</b>		
<b>VEHICLE EFFICIENCY (new vehicle improvement per annum)</b>				
Cars and SUVs	1.1%	<b>2.50%</b>		
Trucks and buses	0.8%	<b>1.00%</b>		
Electric vehicle penetration	20% annual rate			<b>40% annual rate</b>
Prices of Energy Commodities	Moderate	<b>High</b>	Moderate	Moderate
<b>CLIMATE CHANGE</b>				
CO <sub>2</sub> emissions limits	Upper bound "Peak-Plateau-Decline" (PPD) emission limit trajectory from the National Climate Change Response White Paper		<b>PPD lower limit</b>	PPD upper limit
CO <sub>2</sub> externality costs	<ul style="list-style-type: none"> <li>• R48-R120/t (2015 - 2019)</li> <li>• R120/t onwards</li> </ul>		<b>• R270/t 2015 - 2050</b>	<ul style="list-style-type: none"> <li>• R48-R120/t (2015- 2019)</li> <li>• R120/t onwards</li> </ul>
Carbon Tax	Embedded in the externality cost of Carbon			

# IEP SCENARIOS



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INDICATORS	BASE CASE	BIG SWH	NUCLEAR RELAXED	NO SHALE GAS
Technology Constraints	9.6 GW New Nuclear Build enforced		<b>None</b>	9.6 GW New Nuclear Build enforced
GDP	Treasury moderate GDP growth			
<b>DEMAND SIDE INTERVENTIONS</b>				
DSM	1 million SWH	<b>10 million SWH</b>	1 million SWH	
Energy efficiency	Business As Usual			
<b>VEHICLE EFFICIENCY (new vehicle improvement per annum)</b>				
Cars and SUVs	1.1%			
Trucks and buses	0.8%			
Electric vehicle penetration	20%			
Prices of Energy Commodities	Moderate			<b>Unavailable shale gas</b>
<b>CLIMATE CHANGE</b>				
CO <sub>2</sub> emissions limits	PPD upper limit			
CO <sub>2</sub> externality costs	<ul style="list-style-type: none"> <li>• R48-R120/t between 2015 and 2019</li> <li>• R120/t onwards</li> </ul>			
Carbon Tax	Embedded in the externality cost of carbon			



# IEP PROGRESS SINCE FEBRUARY 2016

## *Change in IEP development framework to enable focused approach on the critical energy sub-sectors*

### Electricity Supply

- Electricity supply is mature and well- established. Planning process is also well-developed
- Sector is highly regulated with clear legislation which interlinks development of plans with regulatory activities
- Electricity elements of the IEP to be dealt with in detail in the IRP

### Liquid Fuel Supply

- Sector is semi-regulated with planning undertaken by individual companies
- IEP to focus on more detailed analysis of liquid fuel demand and evaluate different scenarios for supply
- Liquid Fuel Roadmap to focus on logistics and specific nodal points

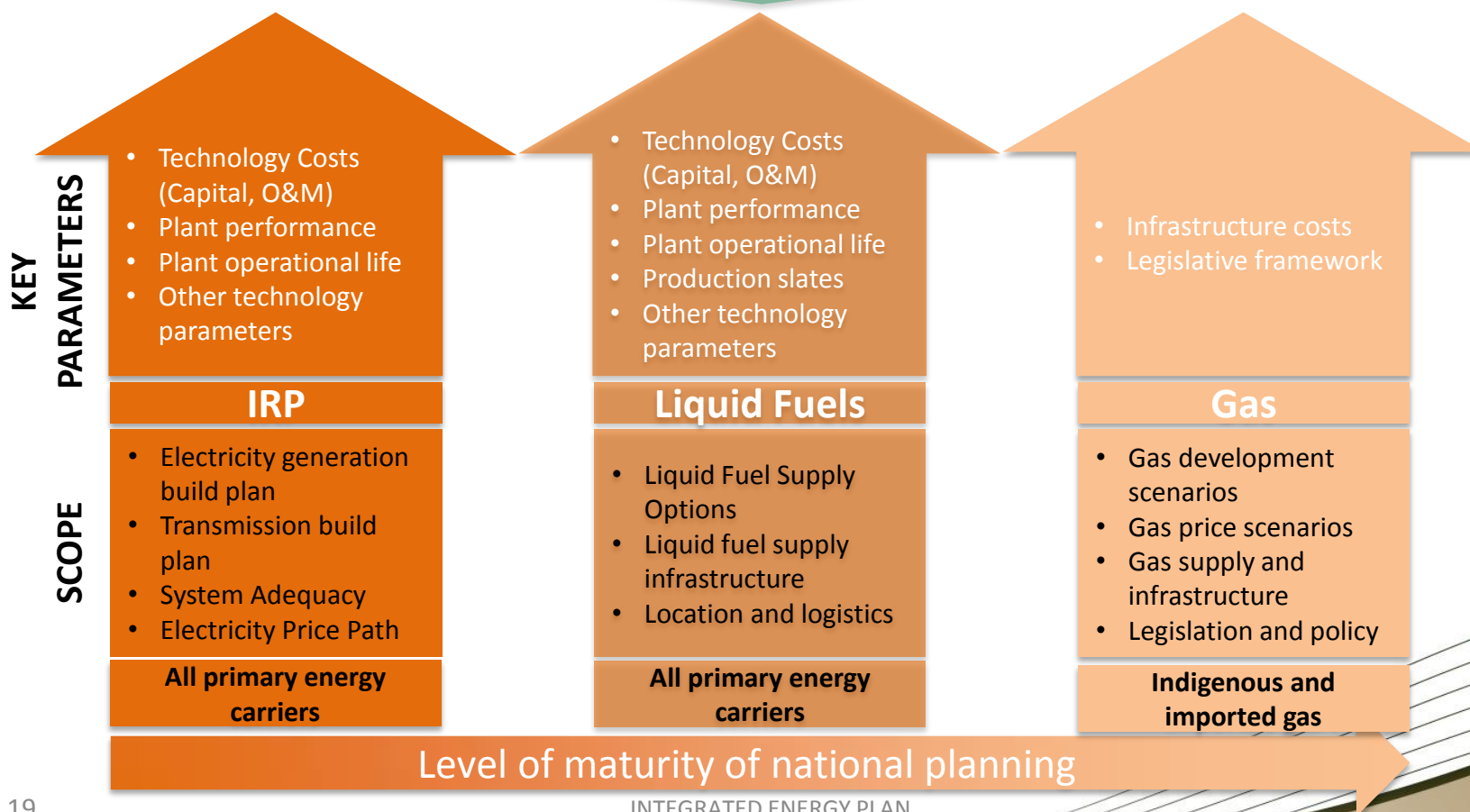
### Gas

- Gas industry in South Africa continues to be underdeveloped with significant potential for growth in the future
- A detailed framework that explores the options for successfully stimulating the off-take of a gas market in the country is required
- Guideline for the foundational elements of this sub-sector taking into account current government programmes (i.e. Operations Phakisa, Gas-to-Power programme) as well as all future considerations (i.e. Shale Gas, Mozambican Gas discoveries)



# IEP

Global Parameters (e.g. GDP, Discount rate, Exchange Rate, Fuel Costs)



# IEP LIQUID FUEL SUPPLY SCENARIOS



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INDICATORS	BASE CASE	GREEN SHOOTS	CLEANER PASTURES	RESOURCES CONSTRAINED	SECURITY OF SUPPLY
Technology Constraints	<ul style="list-style-type: none"> <li>Minimum production constraints on crude oil refineries</li> </ul>				New crude oil refinery enforced (200 000 bbl/day)
GDP	Moderate GDP Growth	High GDP Growth	Same as Base Case		
<b>VEHICLE EFFICIENCY IMPROVEMENT FOR NEW VEHICLES PER ANNUM</b>					
Cars and SUVs	1.1%	2.50%			Same as Base Case
Trucks and buses	0.8%	1.00%			Same as Base Case
New Electric vehicle penetration	20% annual rate	40% annual rate	Same as Base Case		
Prices of Energy Commodities	<ul style="list-style-type: none"> <li>Moderate commodity prices</li> <li>Shale gas available after 2025</li> </ul>	Same as Base Case	<ul style="list-style-type: none"> <li>High commodity prices</li> <li>Extraction of shale gas uneconomical</li> </ul>	Same as Base Case	
<b>ENVIRONMENTAL CONSIDERATIONS</b>					
CO <sub>2</sub> emissions limits	PPD Upper limit	Same as Base Case	PPD lower limit	Same as Base Case	
CF2	No CF2 on existing refineries		CF2 implemented on existing refineries	Same as Base Case	CF2 implemented on existing refineries
Compliance to Clean Fuels 2 (CF2) Standards and Specifications	<ul style="list-style-type: none"> <li>All new refineries are CF2 compliant</li> <li>Total refining yield is marginally reduced as a result of CF2 implementation on existing refineries</li> <li>Compensation to the Oil Industry in order to upgrade existing refineries to be CF2 complaint has not been factored</li> </ul>				
Existing refineries	<ul style="list-style-type: none"> <li>All existing crude oil refineries continue to operate throughout the planning horizon (the closure of some of the older refineries are explored in more detailed sensitivity analyses)</li> <li>The existing GTL plant ceases production after 2030 as a result of depleting gas feedstock</li> <li>The CTL plant continues to operate until 2040</li> </ul>				

# PURPOSE OF WORKSHOP



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## IEP

Share the latest assumptions for Global Parameters (e.g. GDP, Discount rate, Exchange Rate, Fuel Costs)

### IRP

- Latest technology parameters
- Presentation of model output for Base Case and first set of scenarios

### Liquid Fuels

- Presentation on model output for Base Case and first set of scenarios

### Gas

- To be developed in the future



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# DEMAND PROJECTIONS

**MOTLATSI SEOTSANYANA  
(DEMAND MODELLING SPECIALIST)**

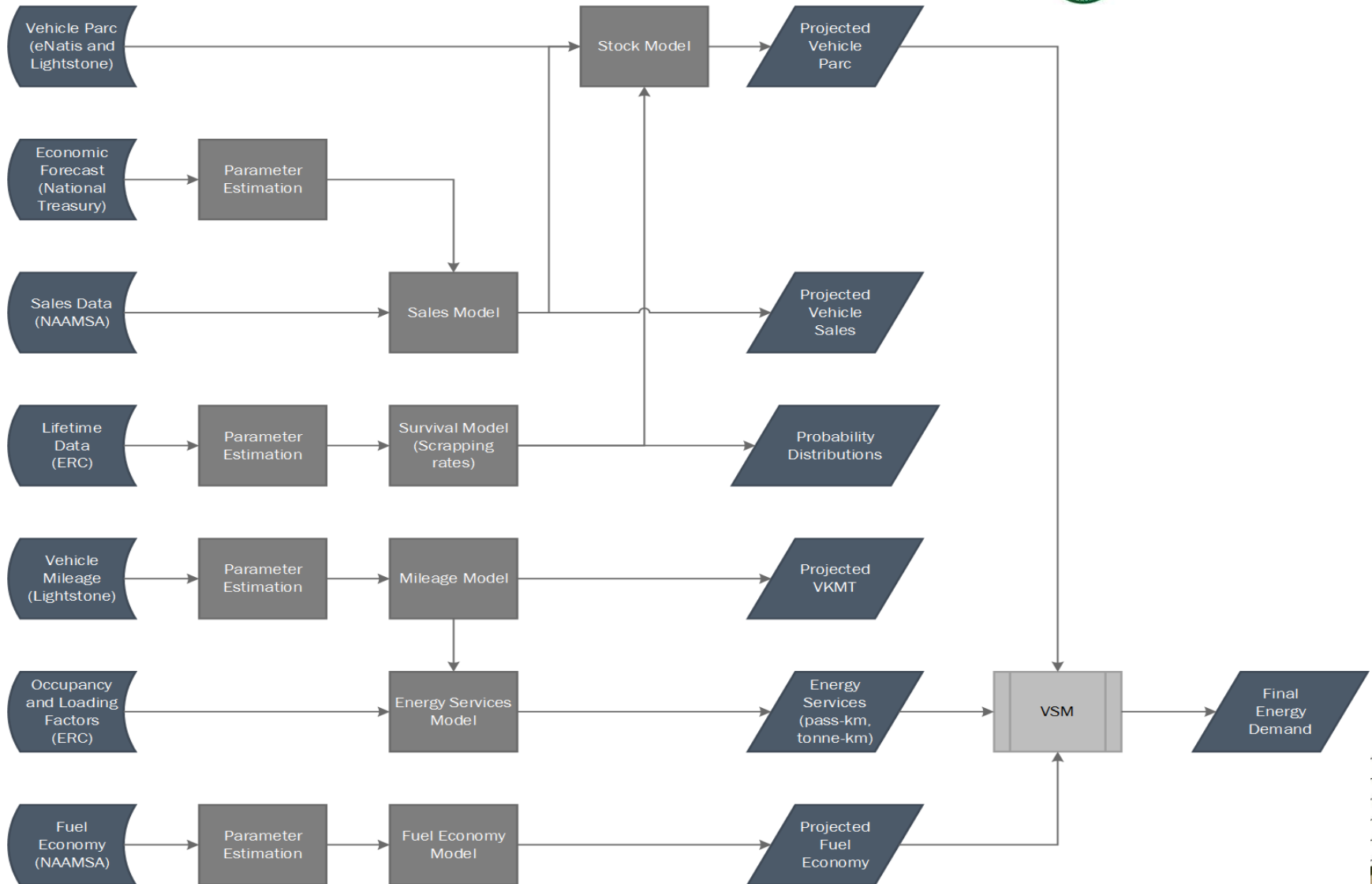


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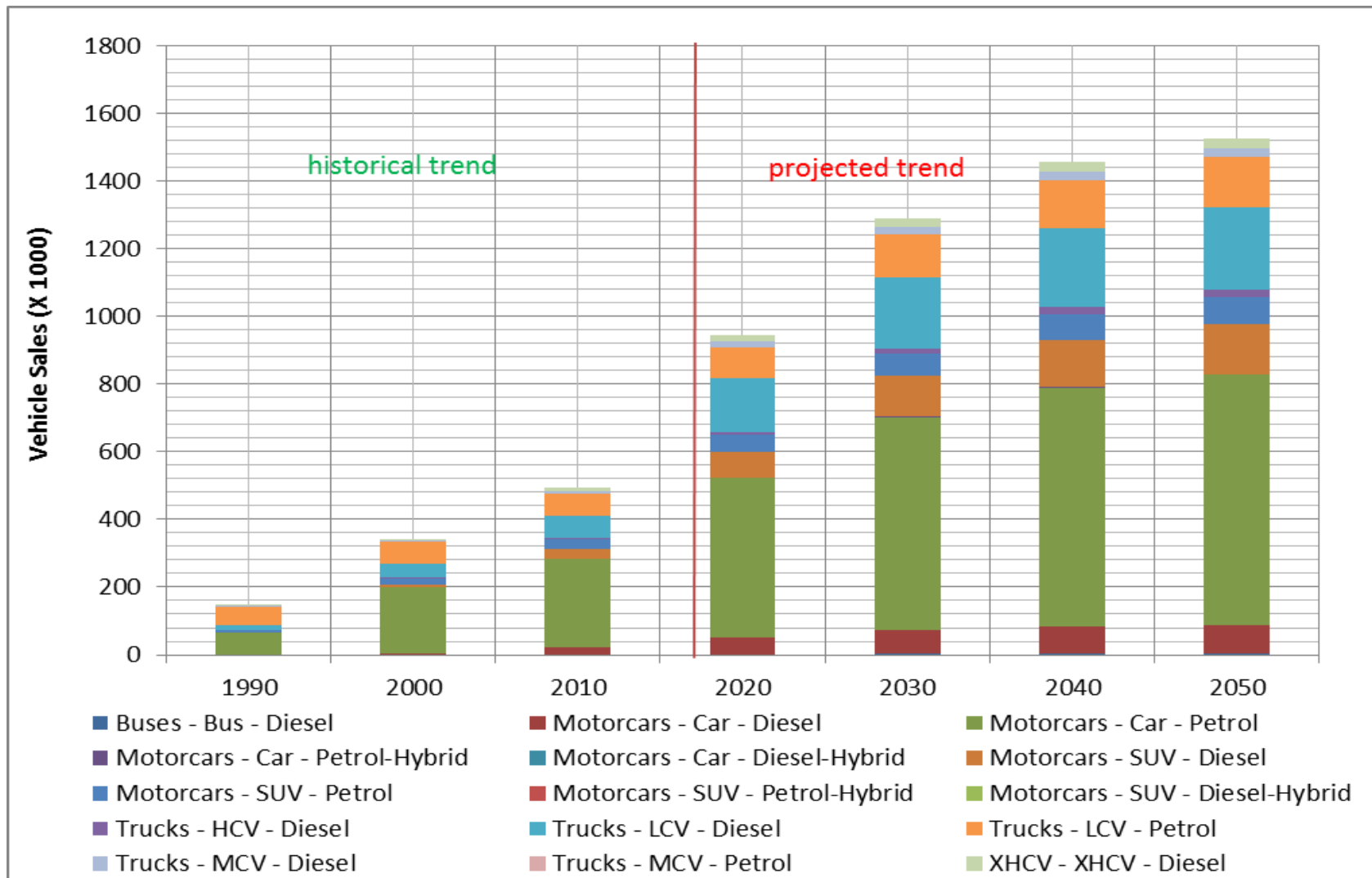
# TRANSPORT DEMAND MODELLING

# IEP Transport Model

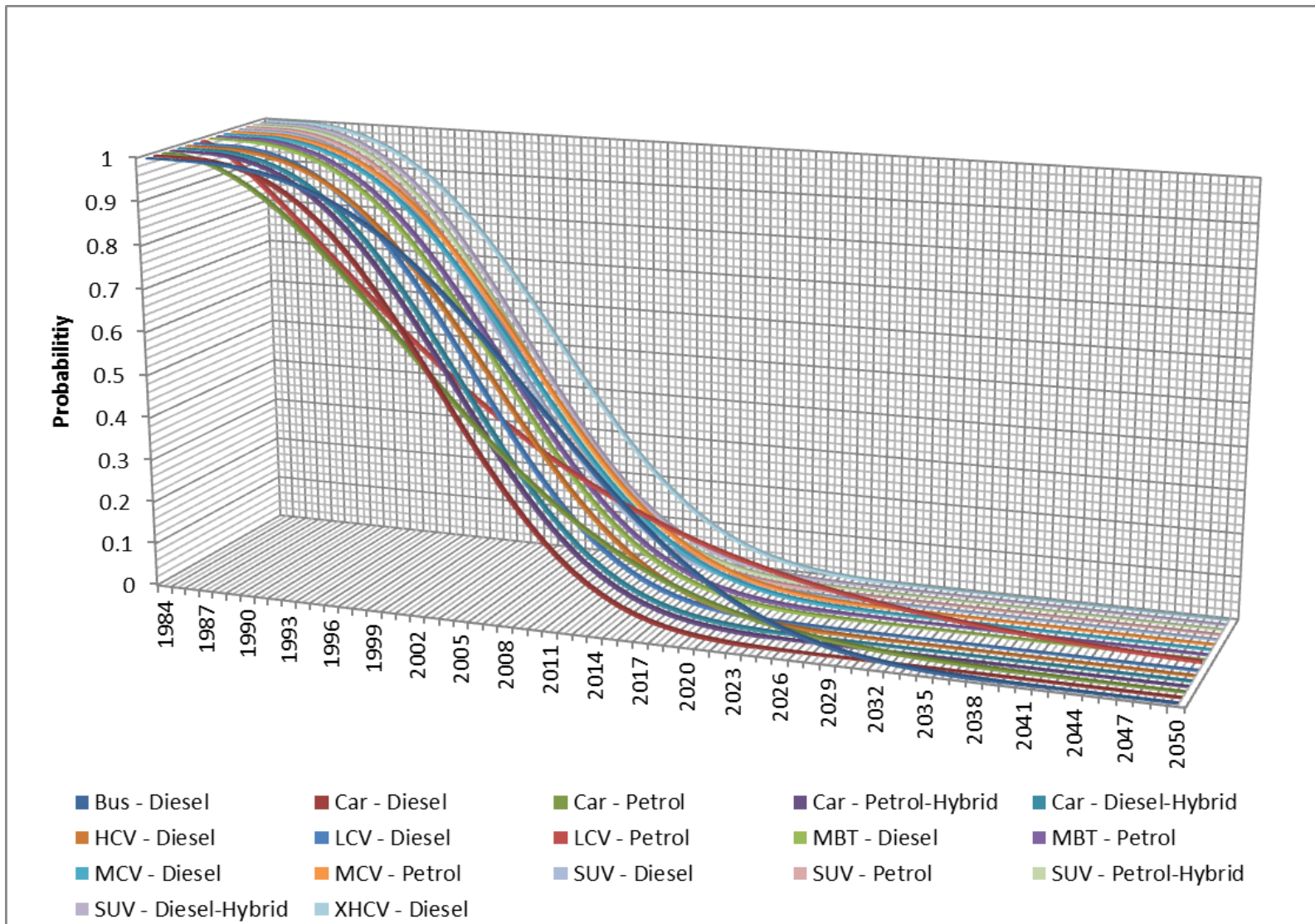




# Projected Vehicle Sales

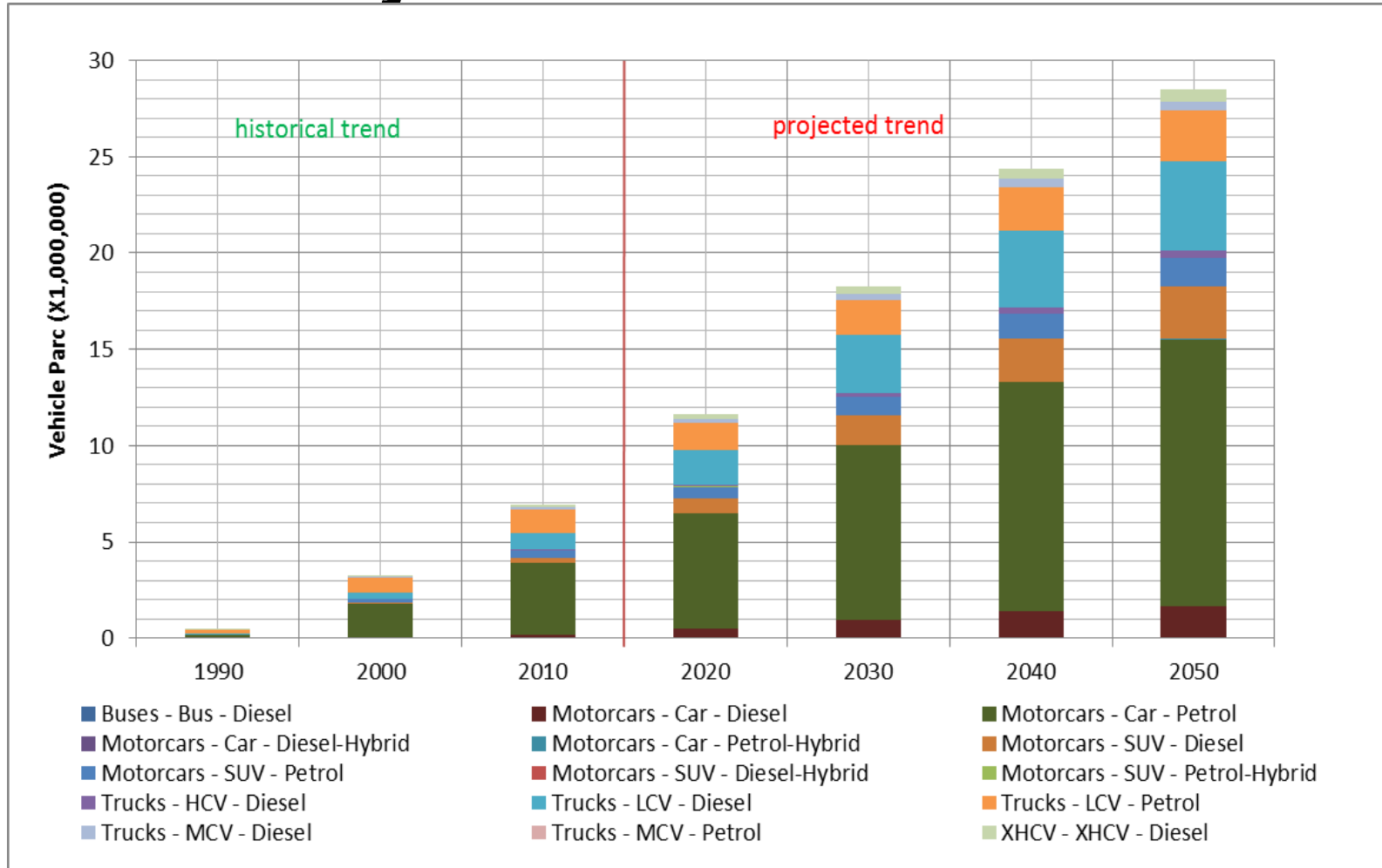


# Scrapping Curves for All Technologies



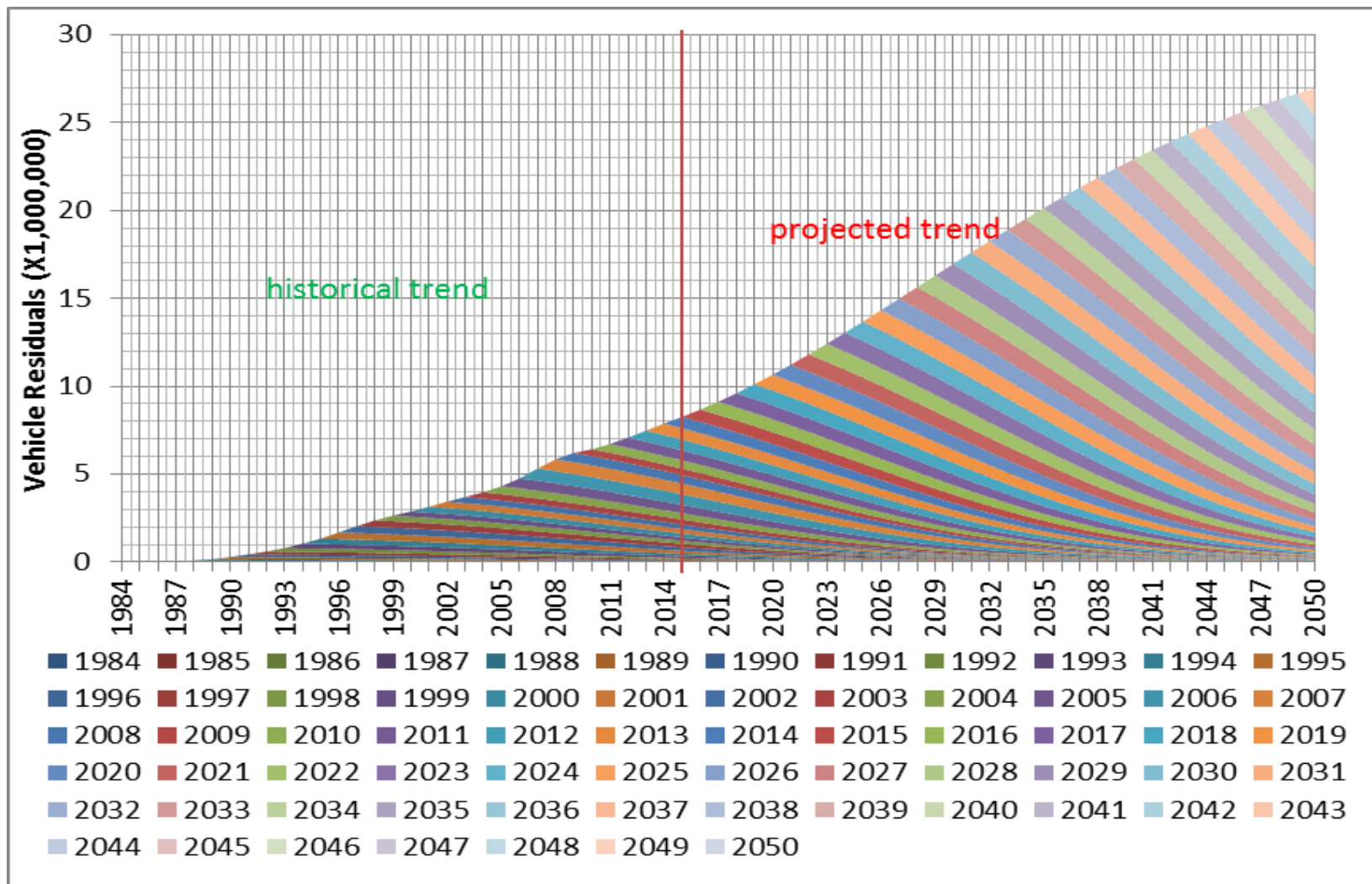


# Projected Vehicle Parc



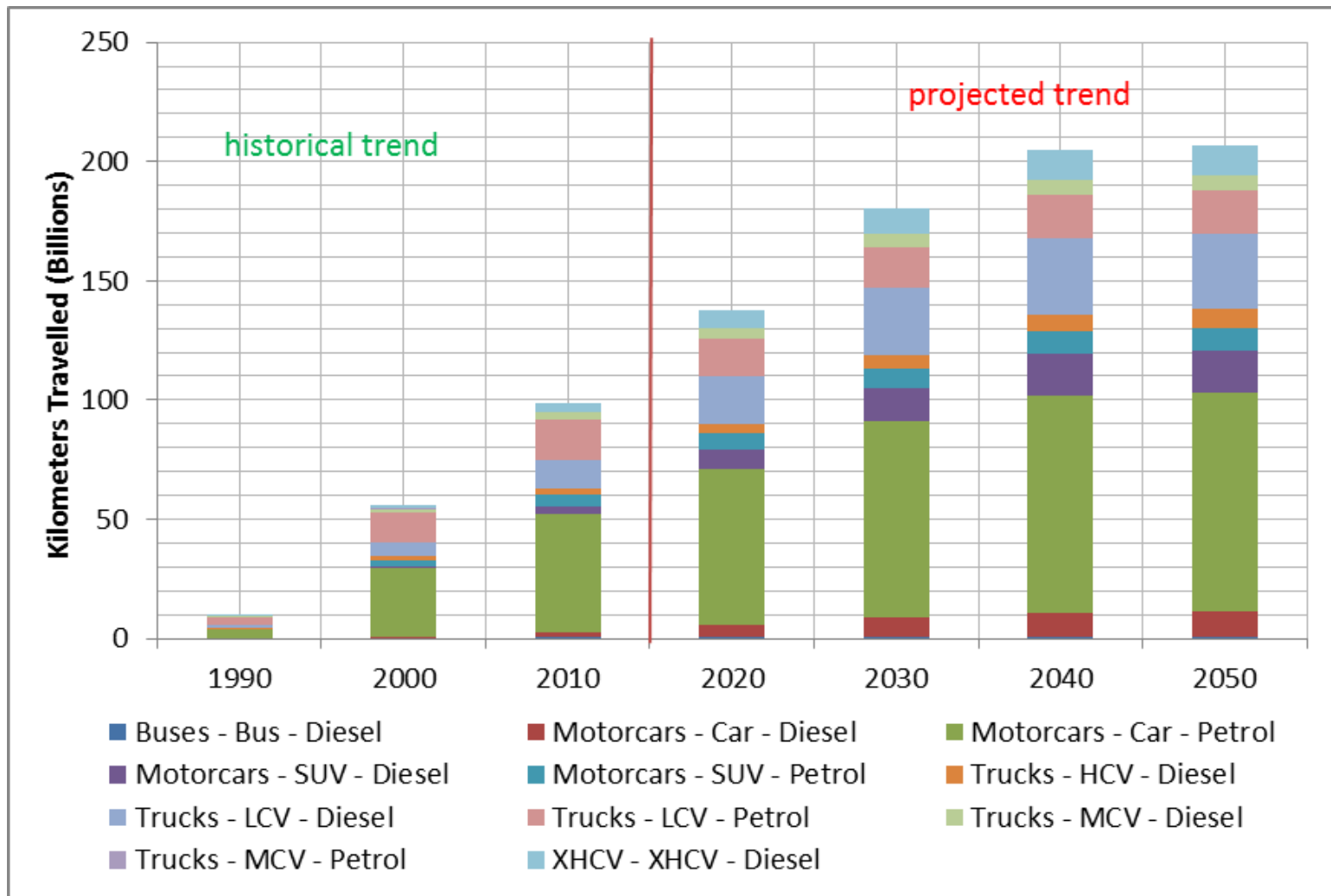


# Projected Vehicle Residuals



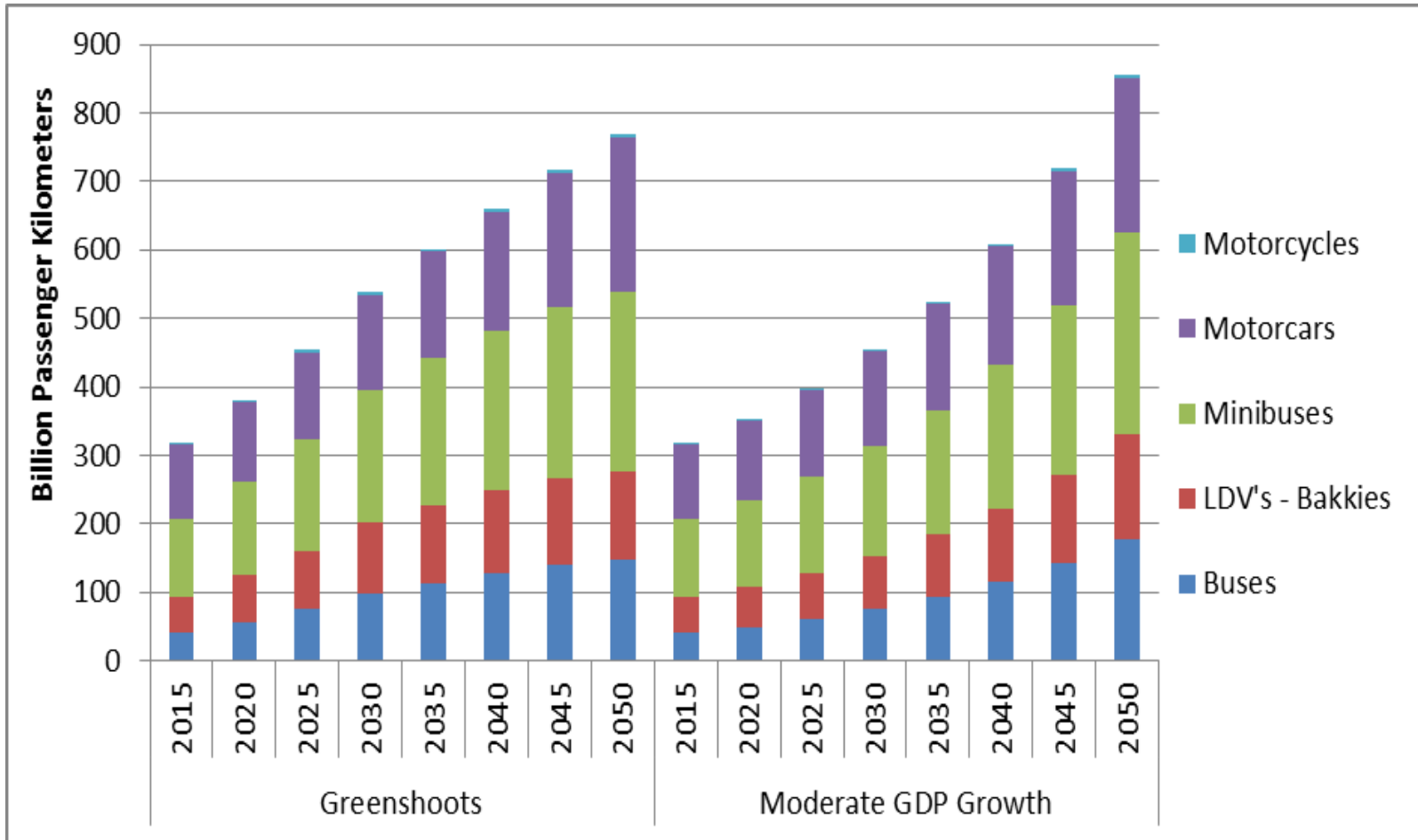


# Projected Vehicle Kilometers



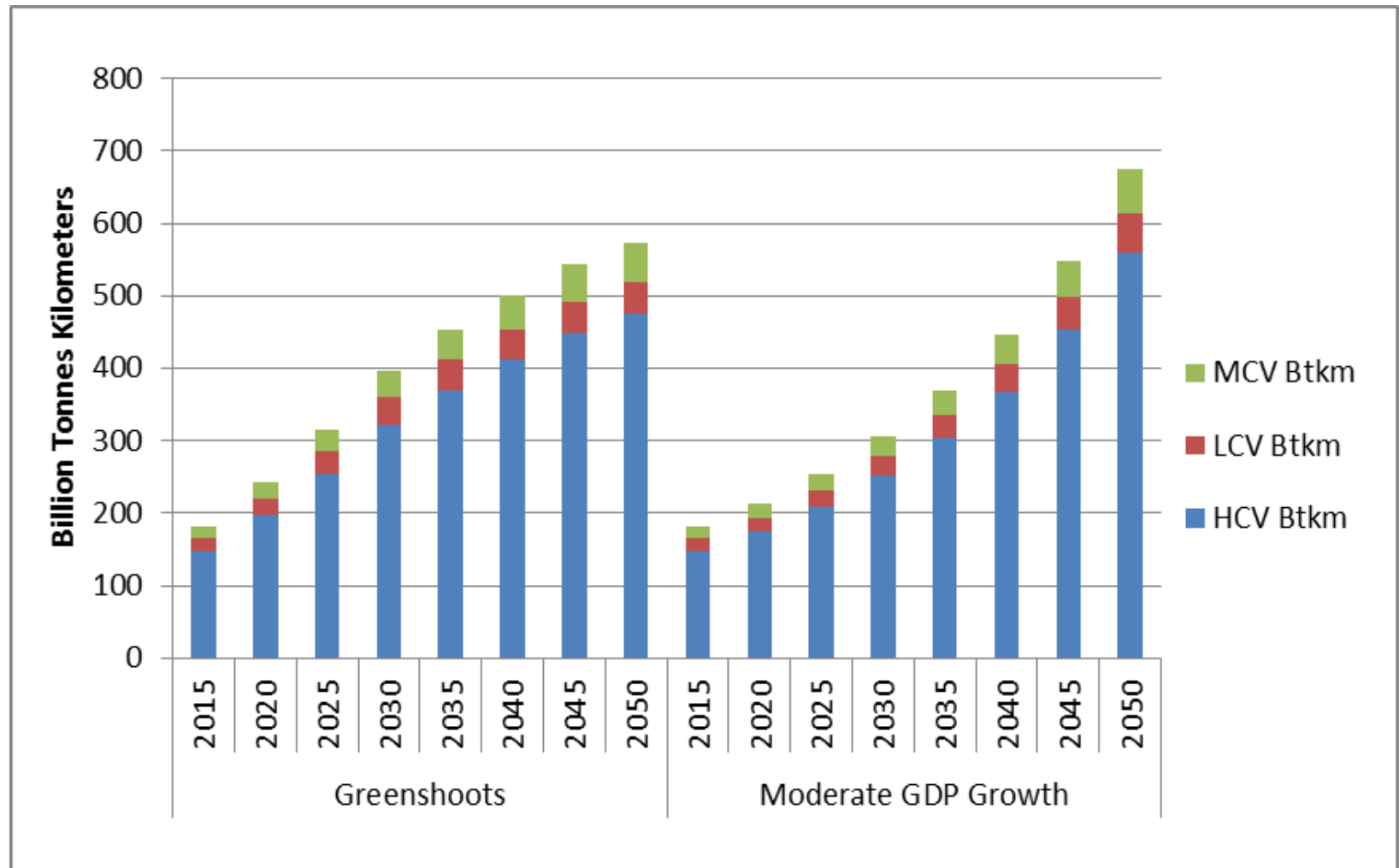


# Projected Passenger Kilometers



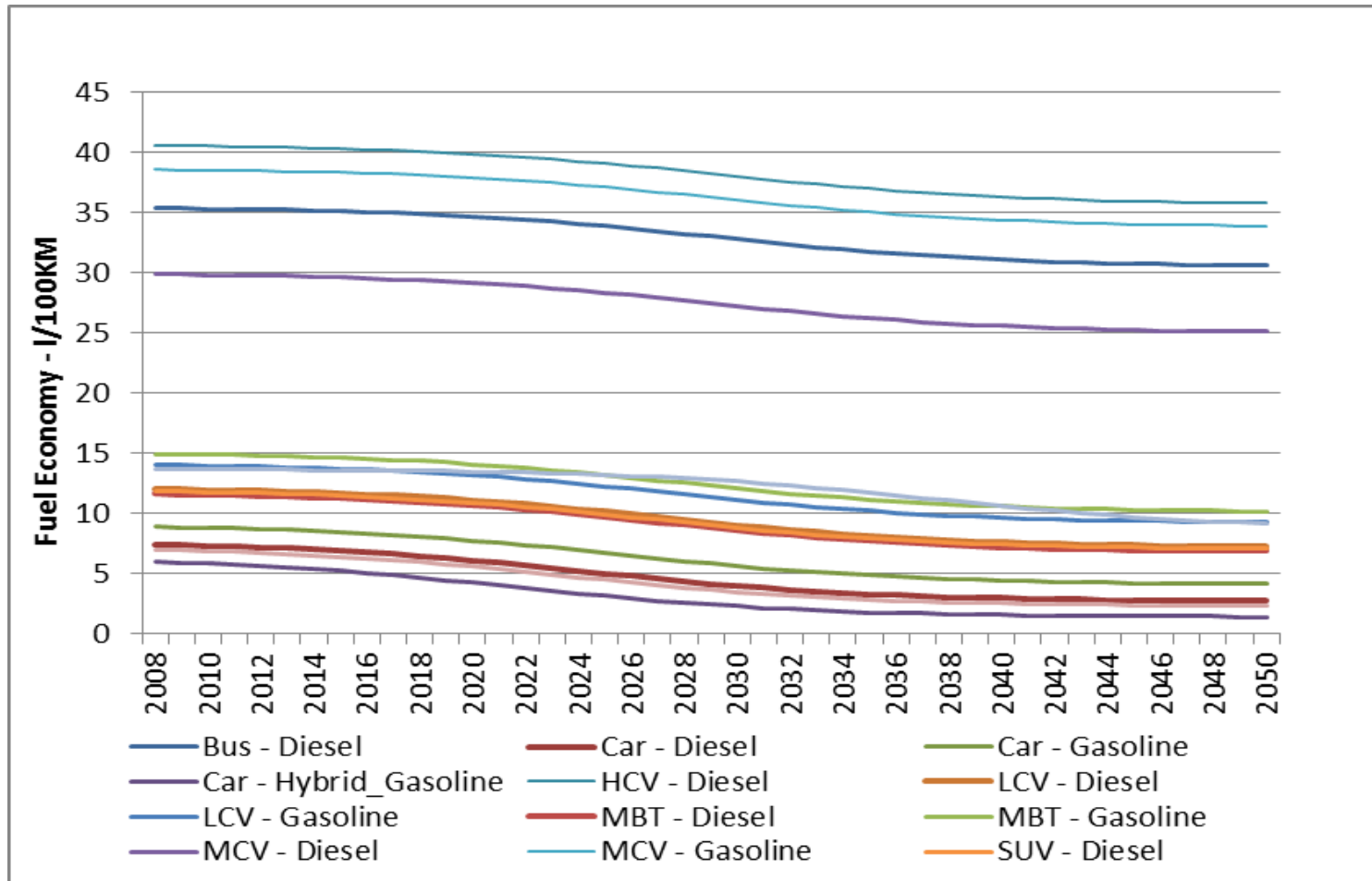


# Projected Tonne Kilometers





# Projected Fuel Economy





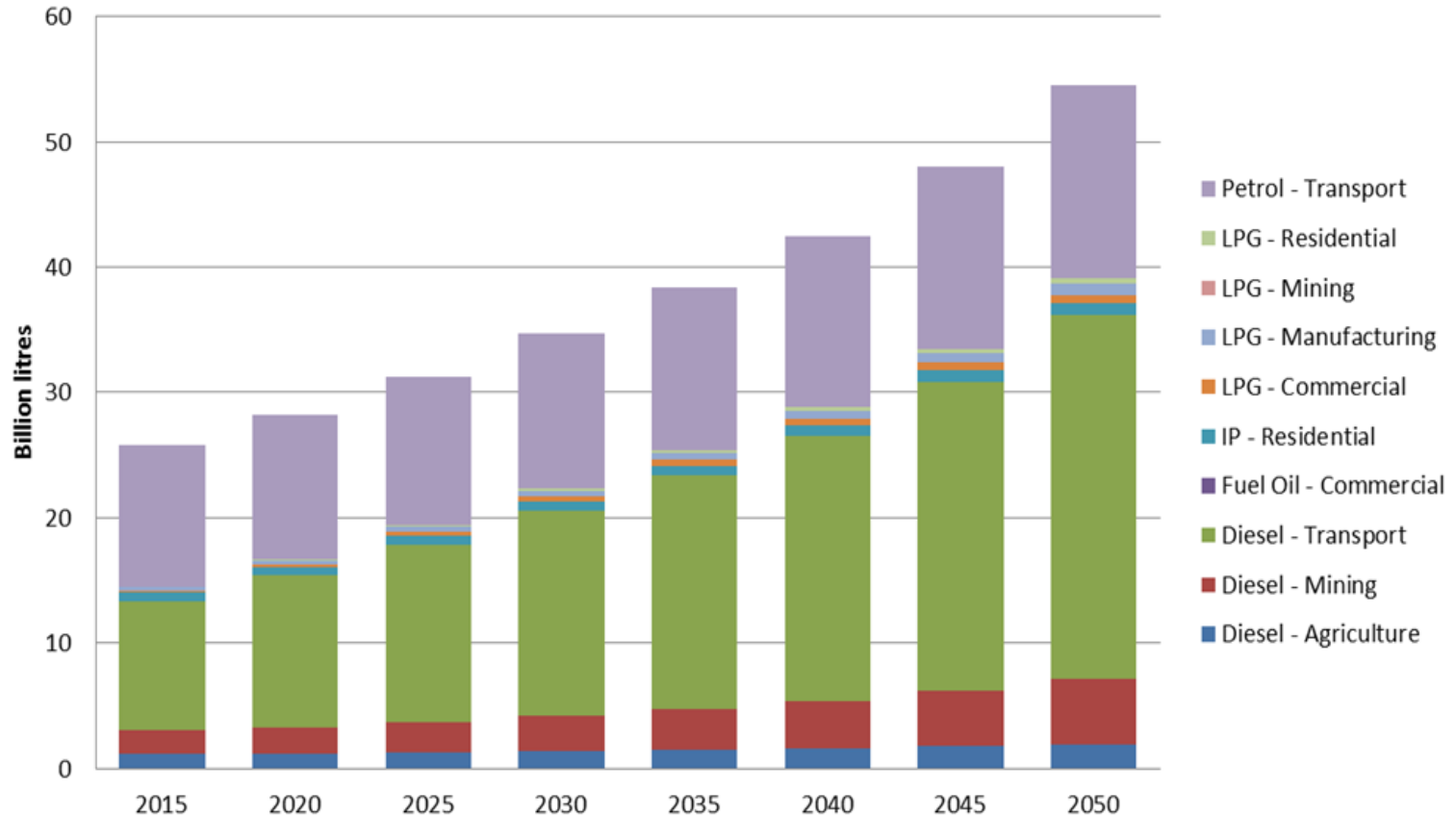
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# FINAL ENERGY DEMAND PROJECTIONS

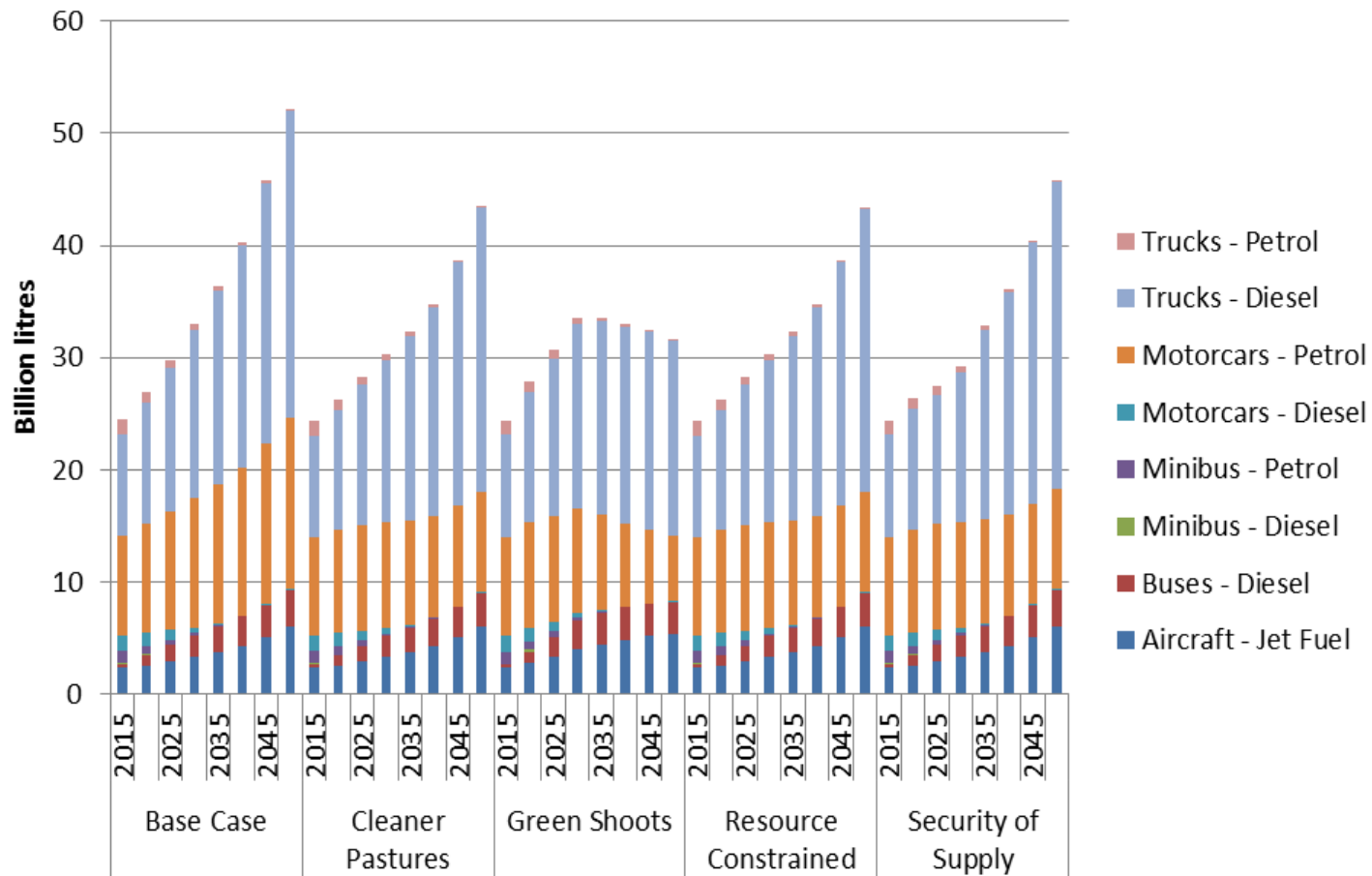


## Fuel Demand across All Sectors





## Fuel Demand by Vehicle Category





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# SCENARIOS FOR LIQUID FUELS SUPPLY

# Variables Analysed



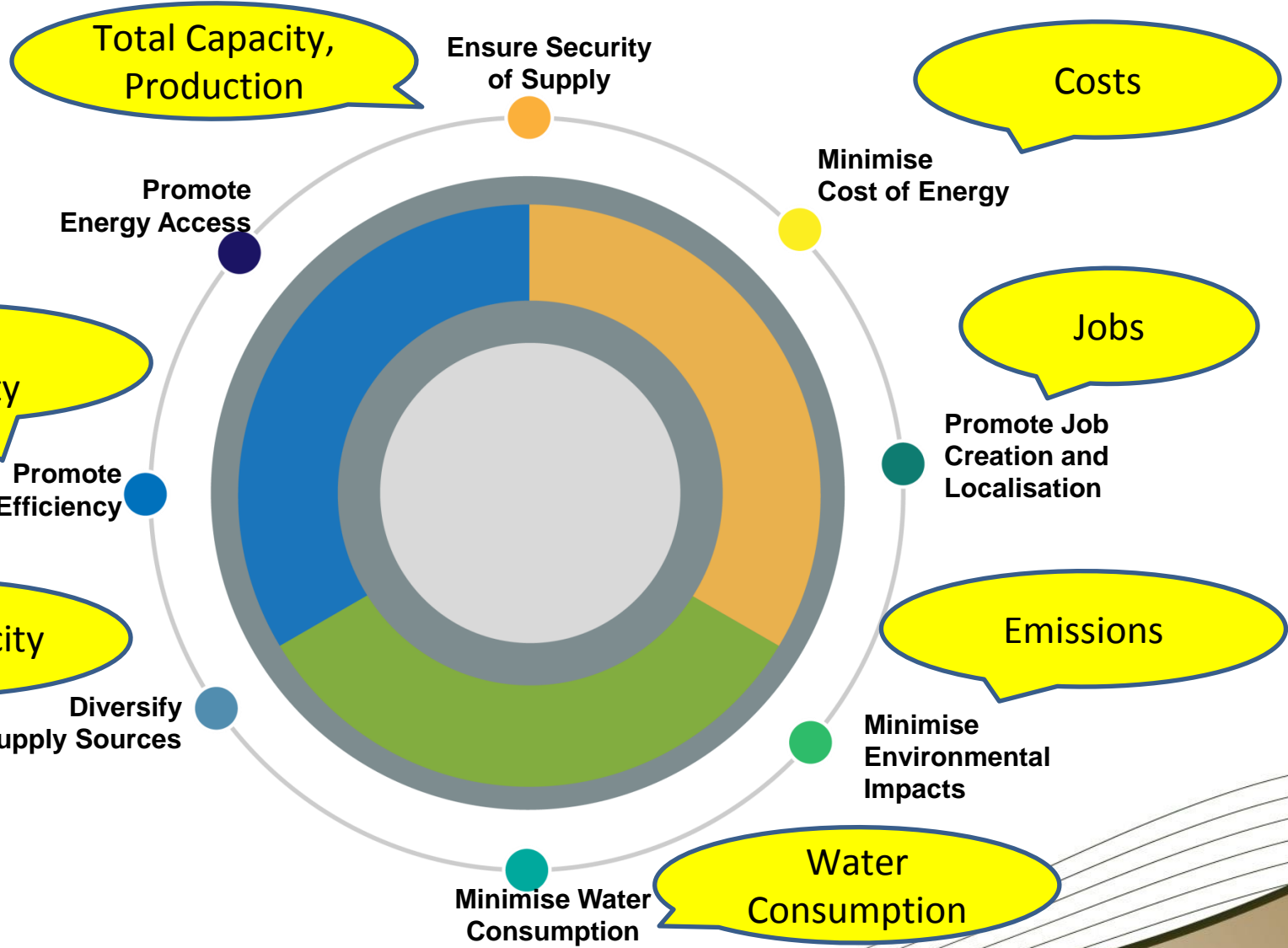
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1. Total Capacity
2. Production
3. Emissions
4. Water Consumption
5. Feedstock Consumption
6. Costs
7. Jobs

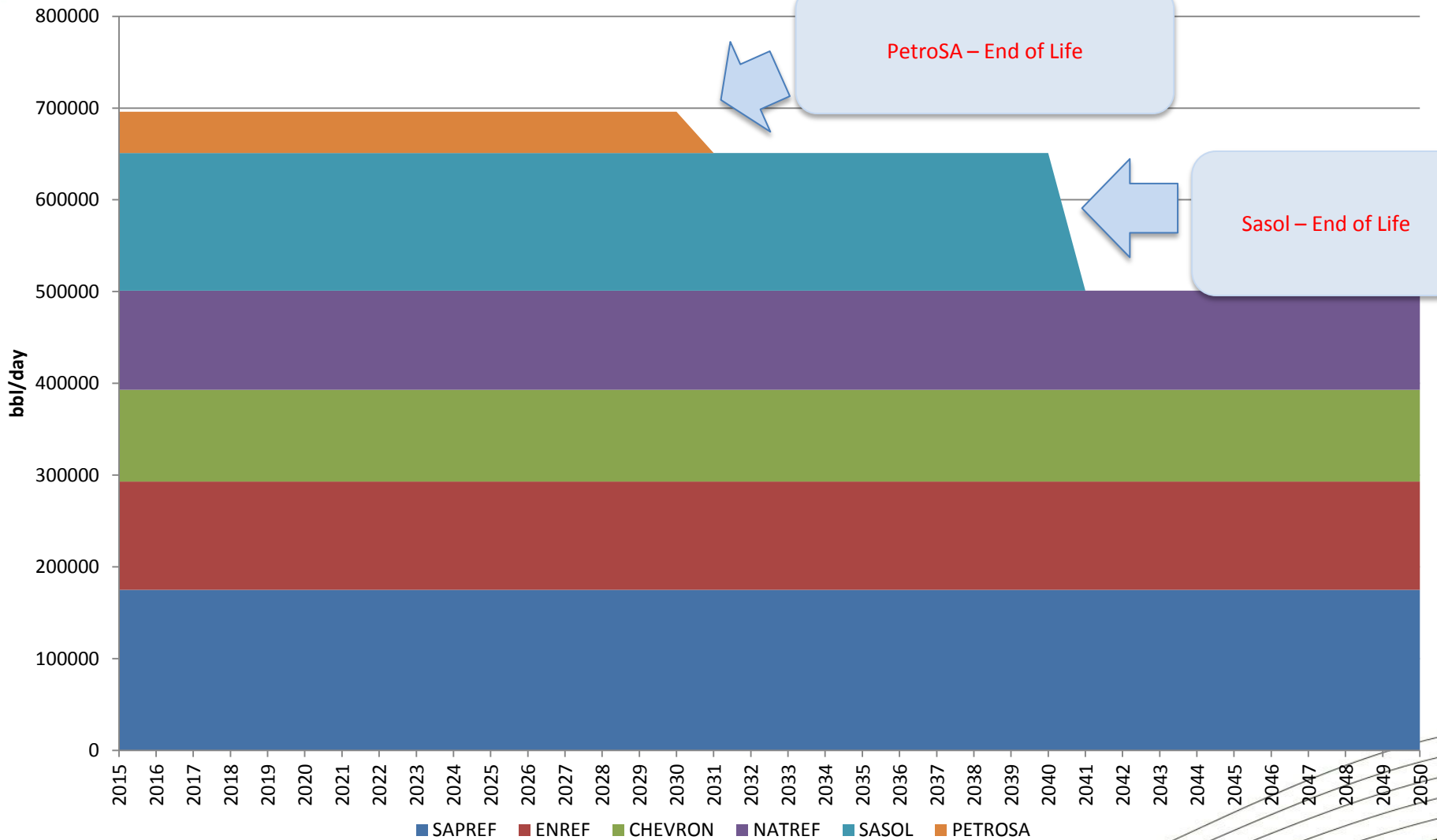


# 8 KEY OBJECTIVES



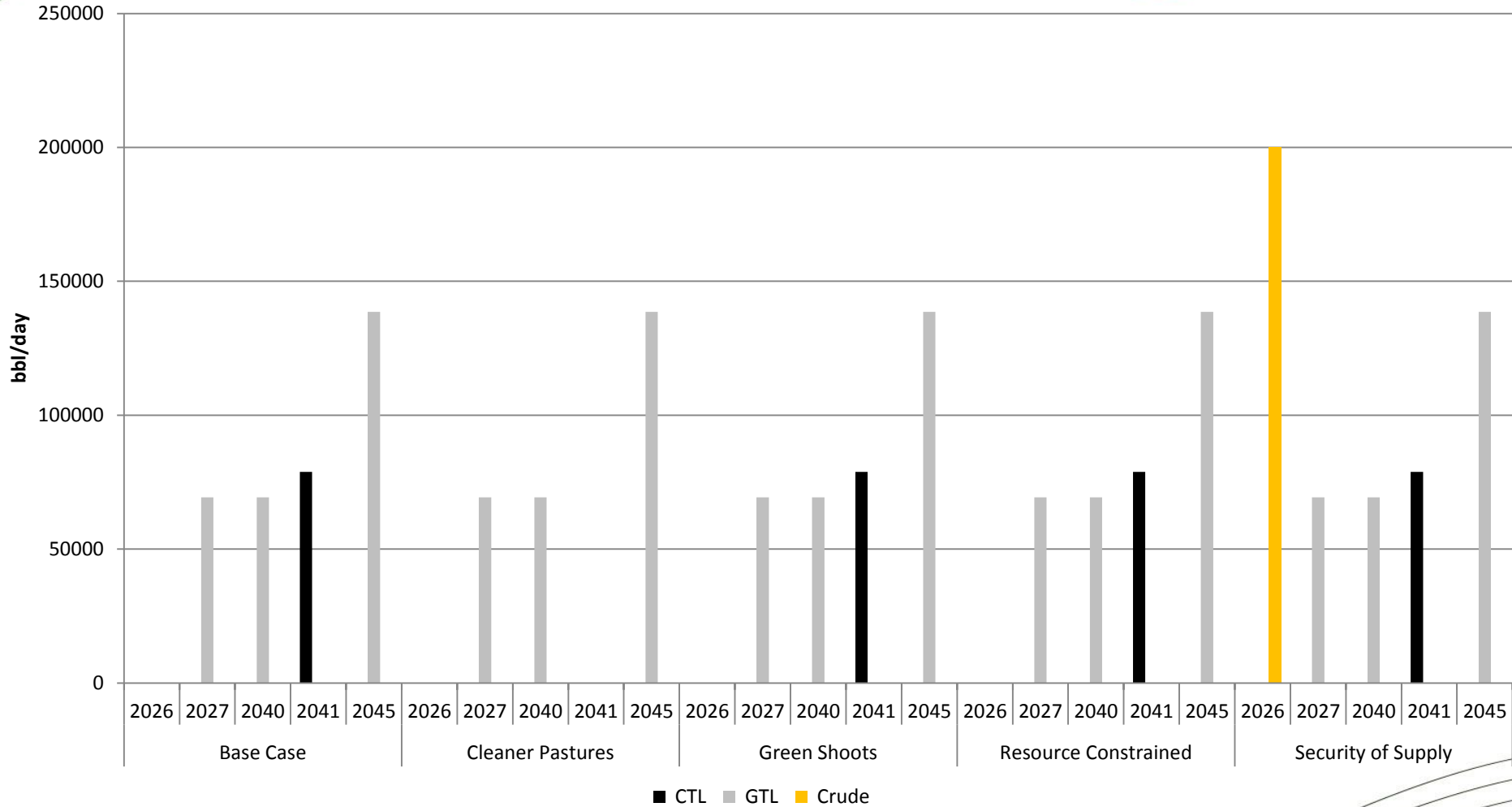


# Existing Refining Capacity



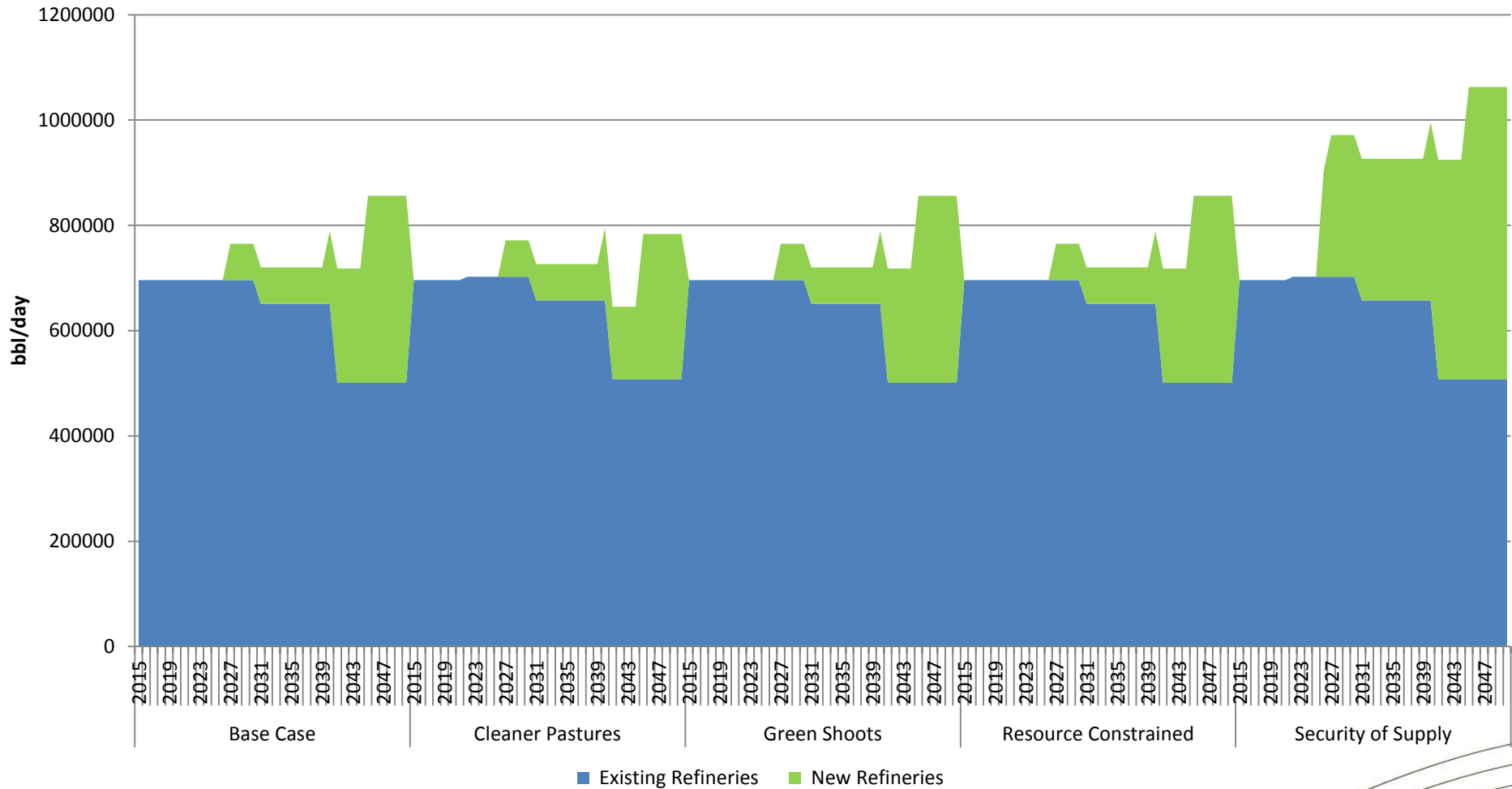


# New Refining Capacity



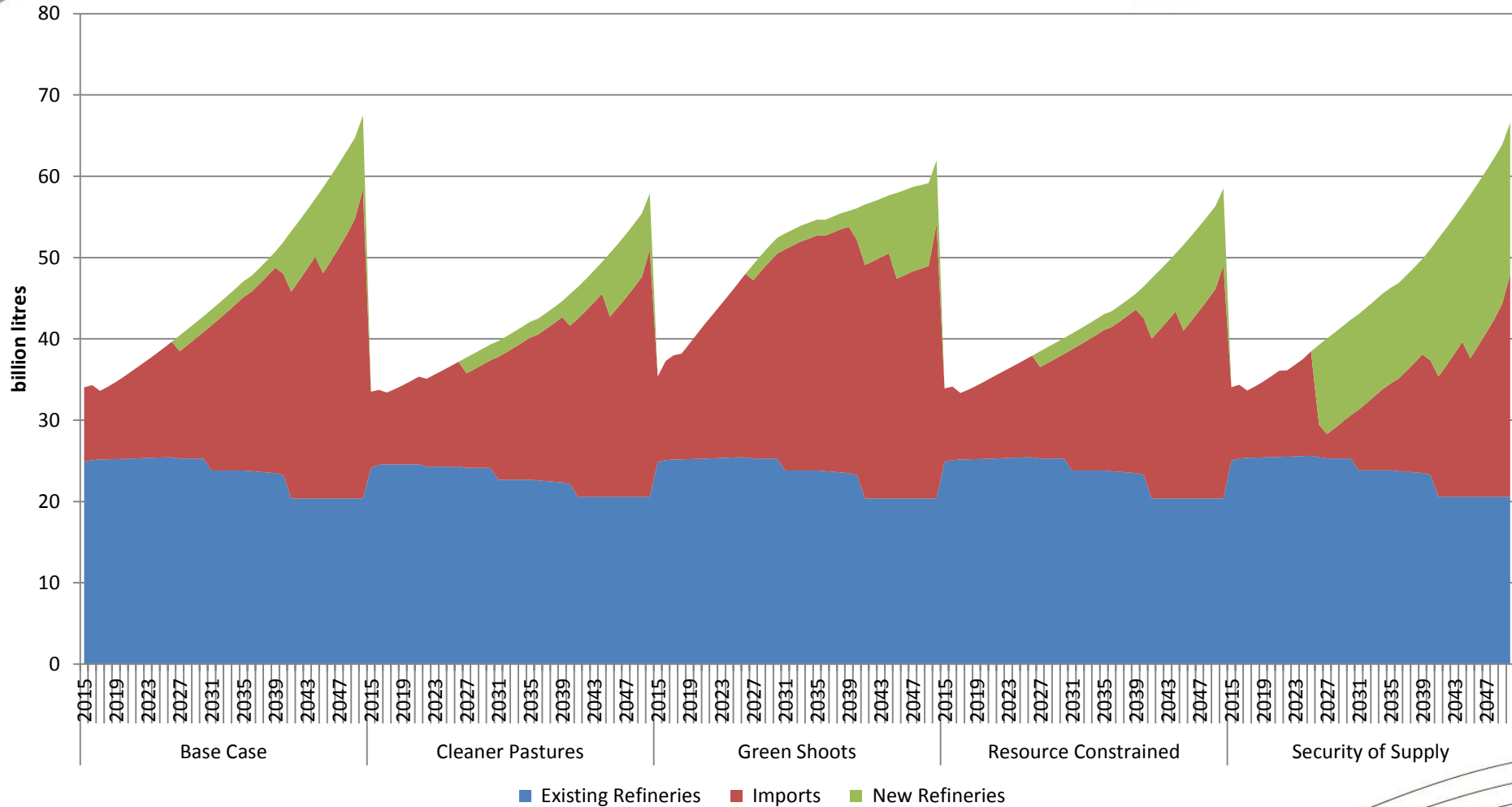


# Total Capacity



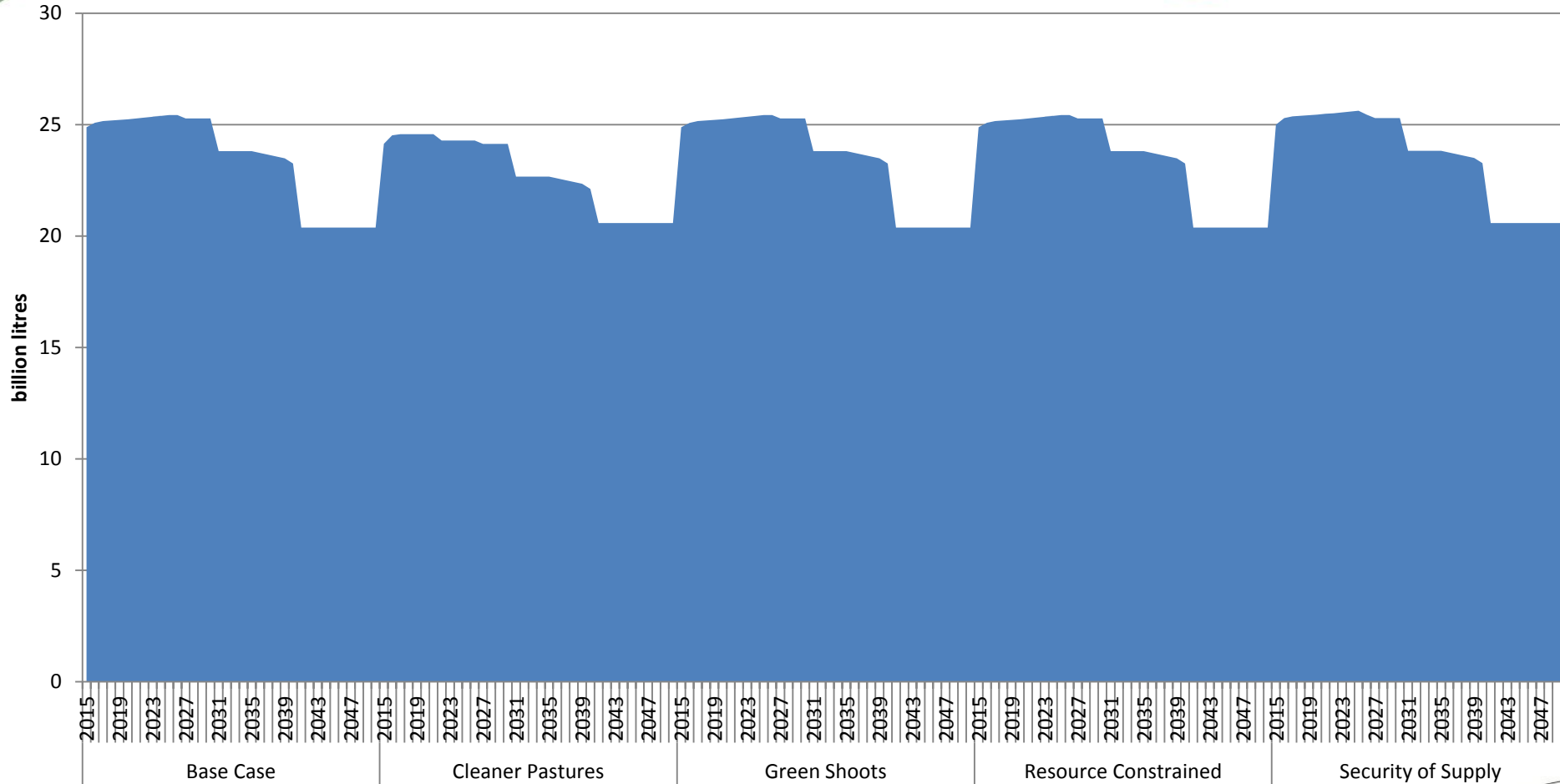


# Liquid Fuel Supply



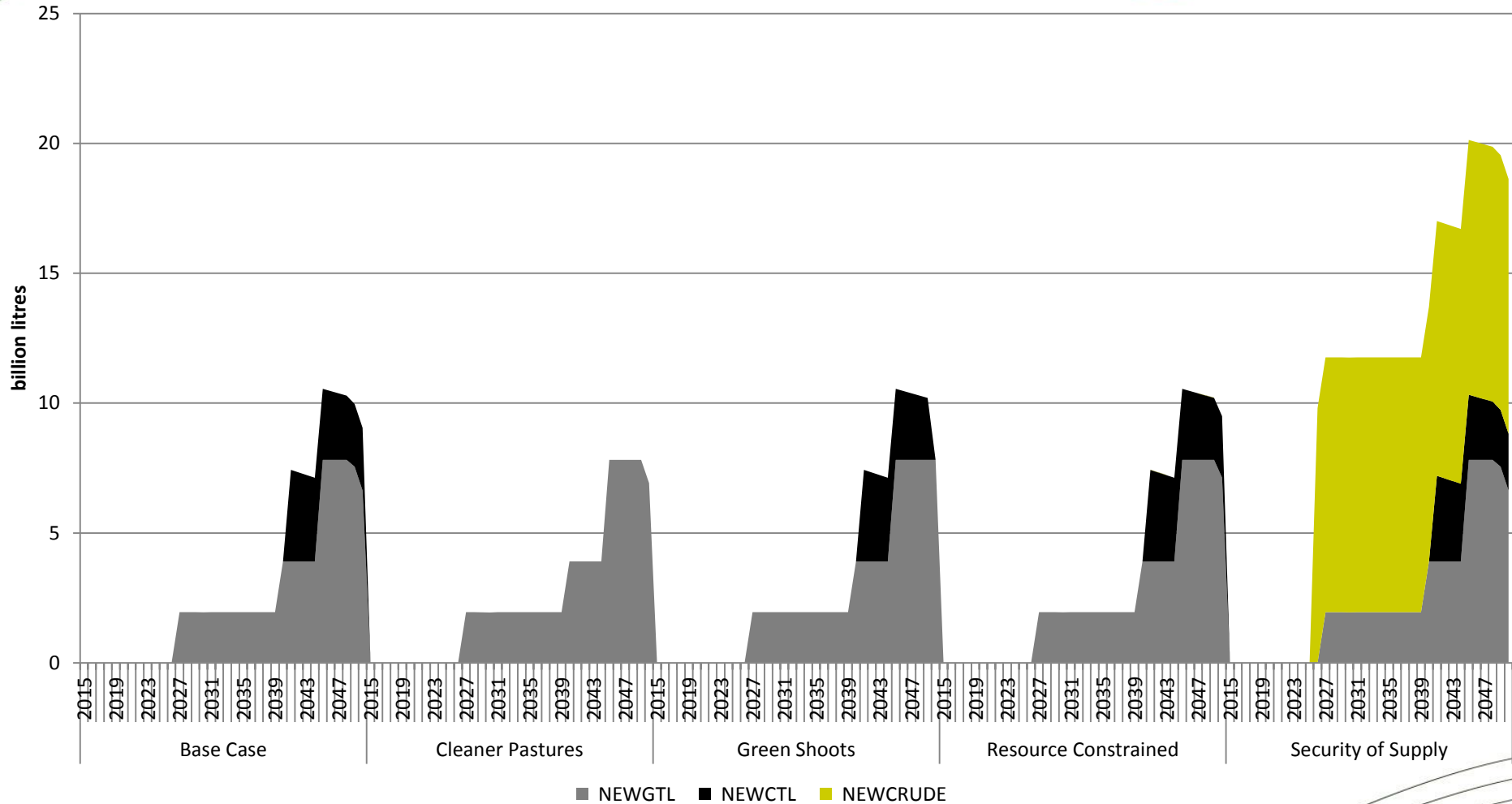


## Domestic Production – Existing Refineries



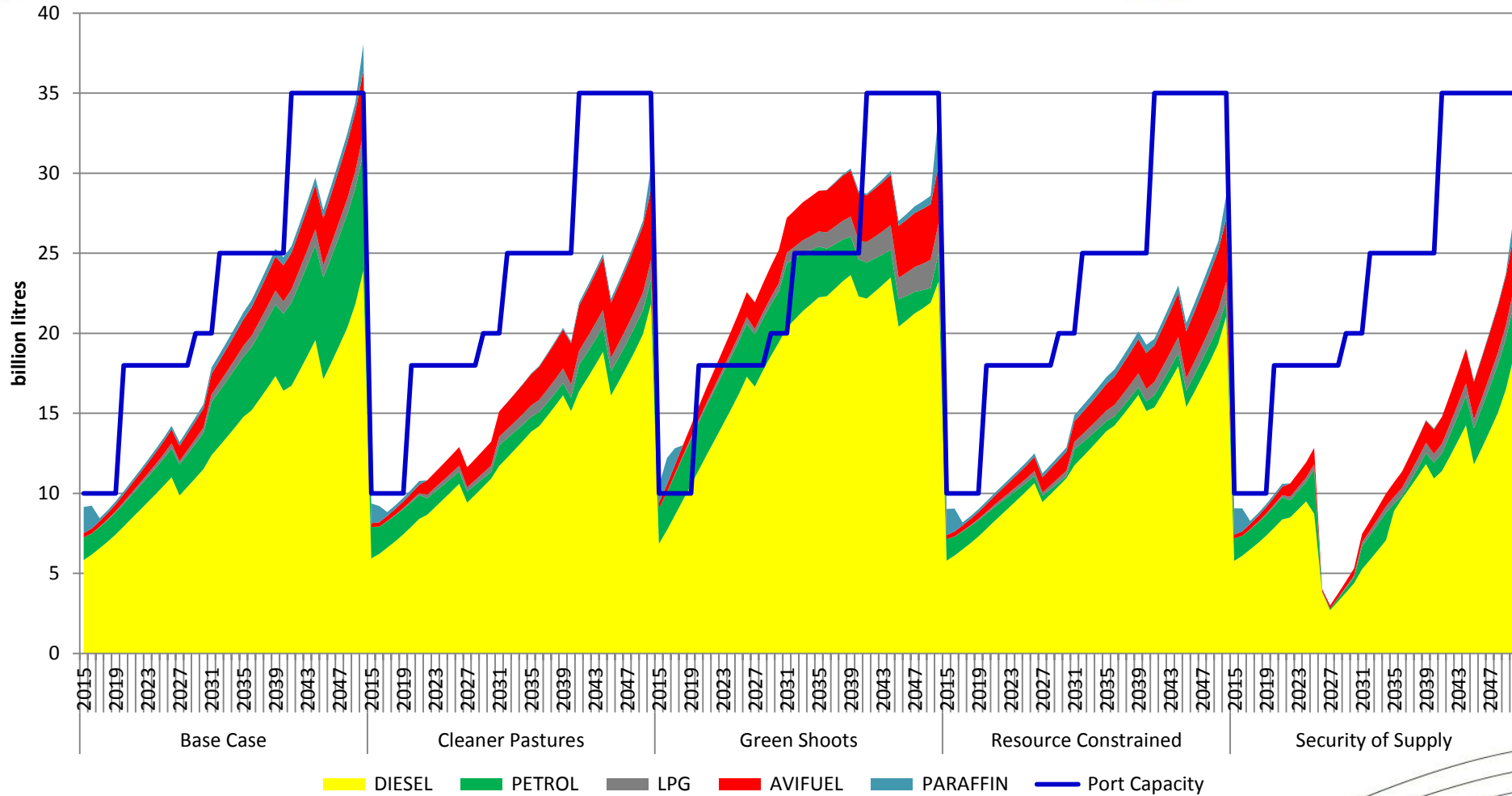


# New Refinery Production



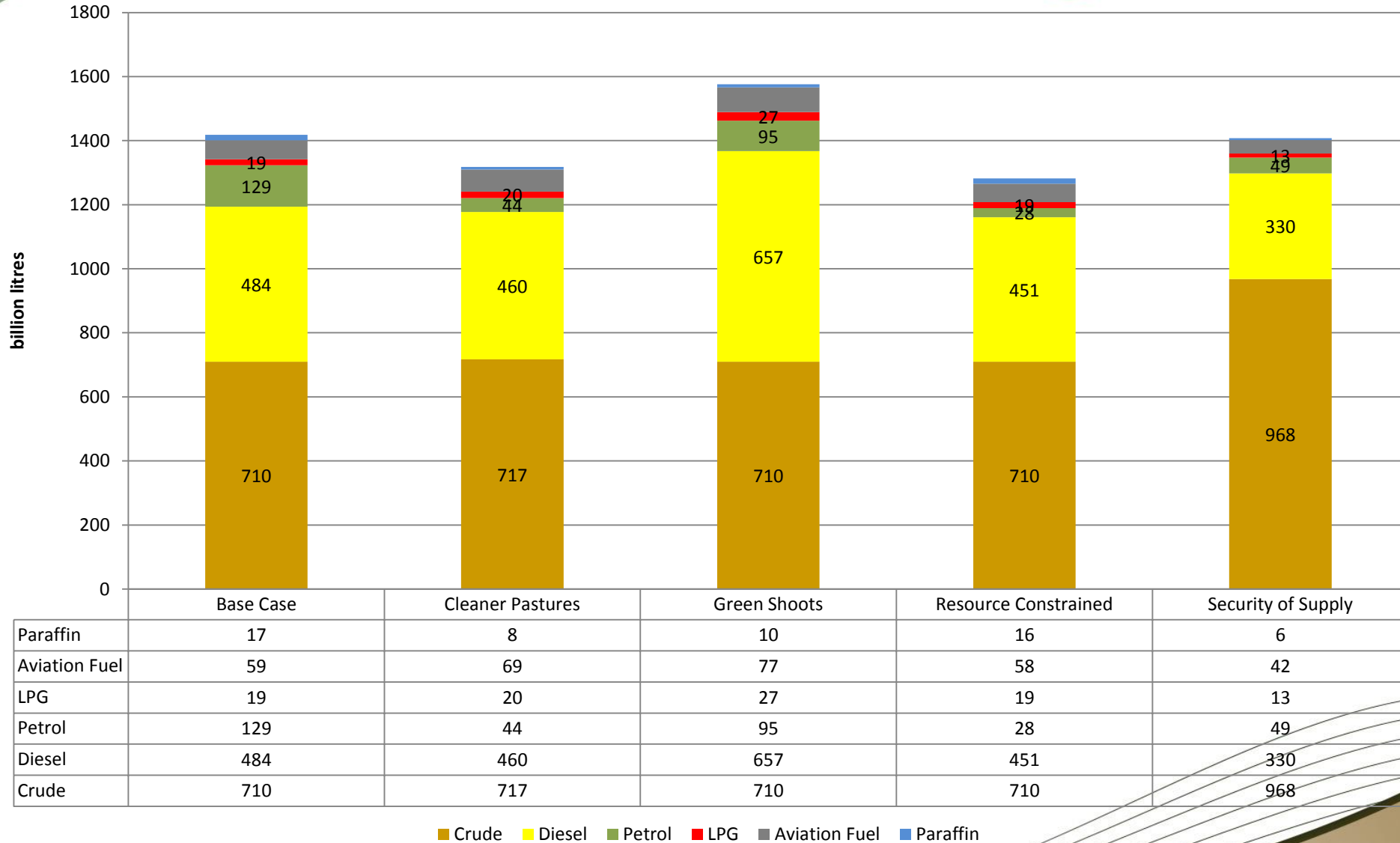


# Imports and Port Capacity Requirements



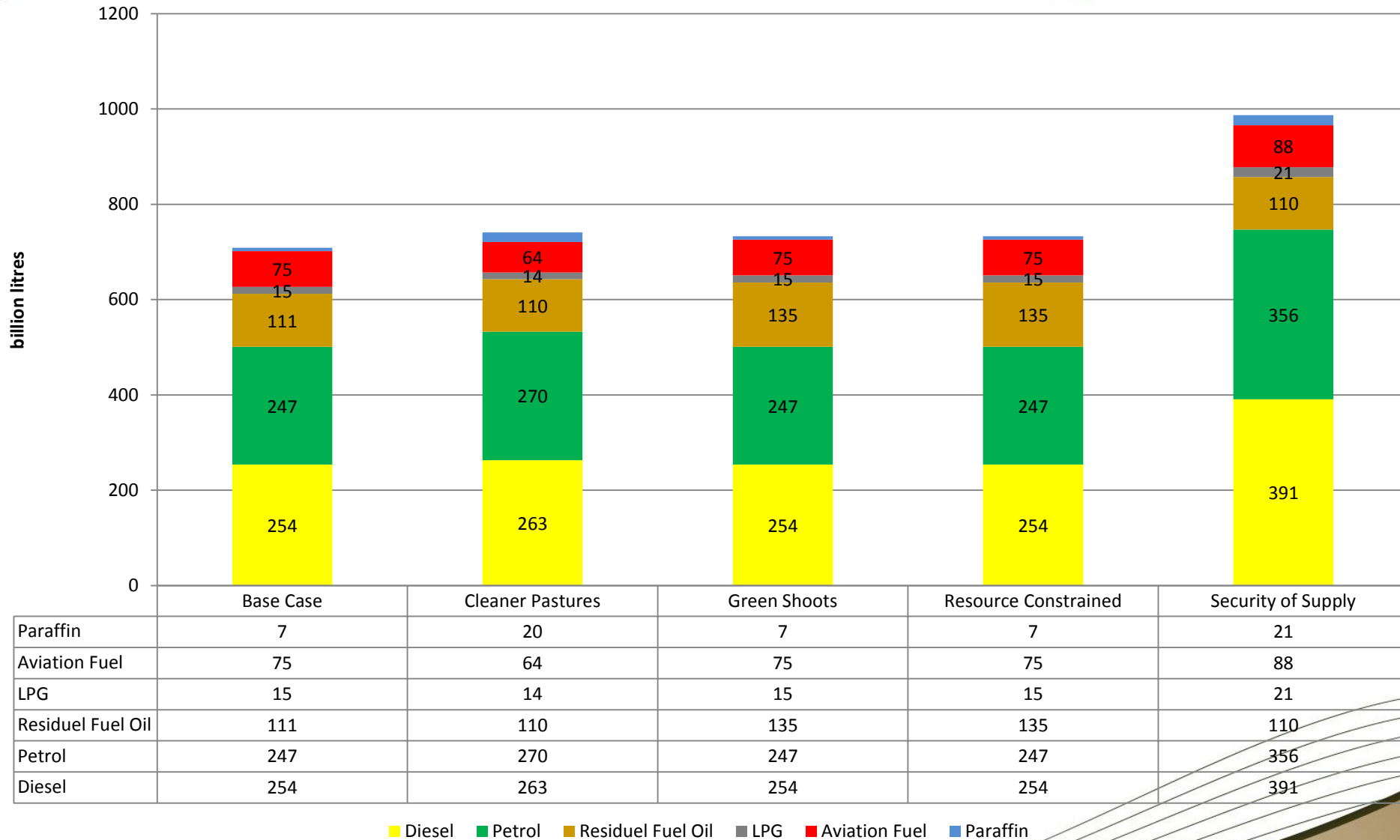


# Total Imports

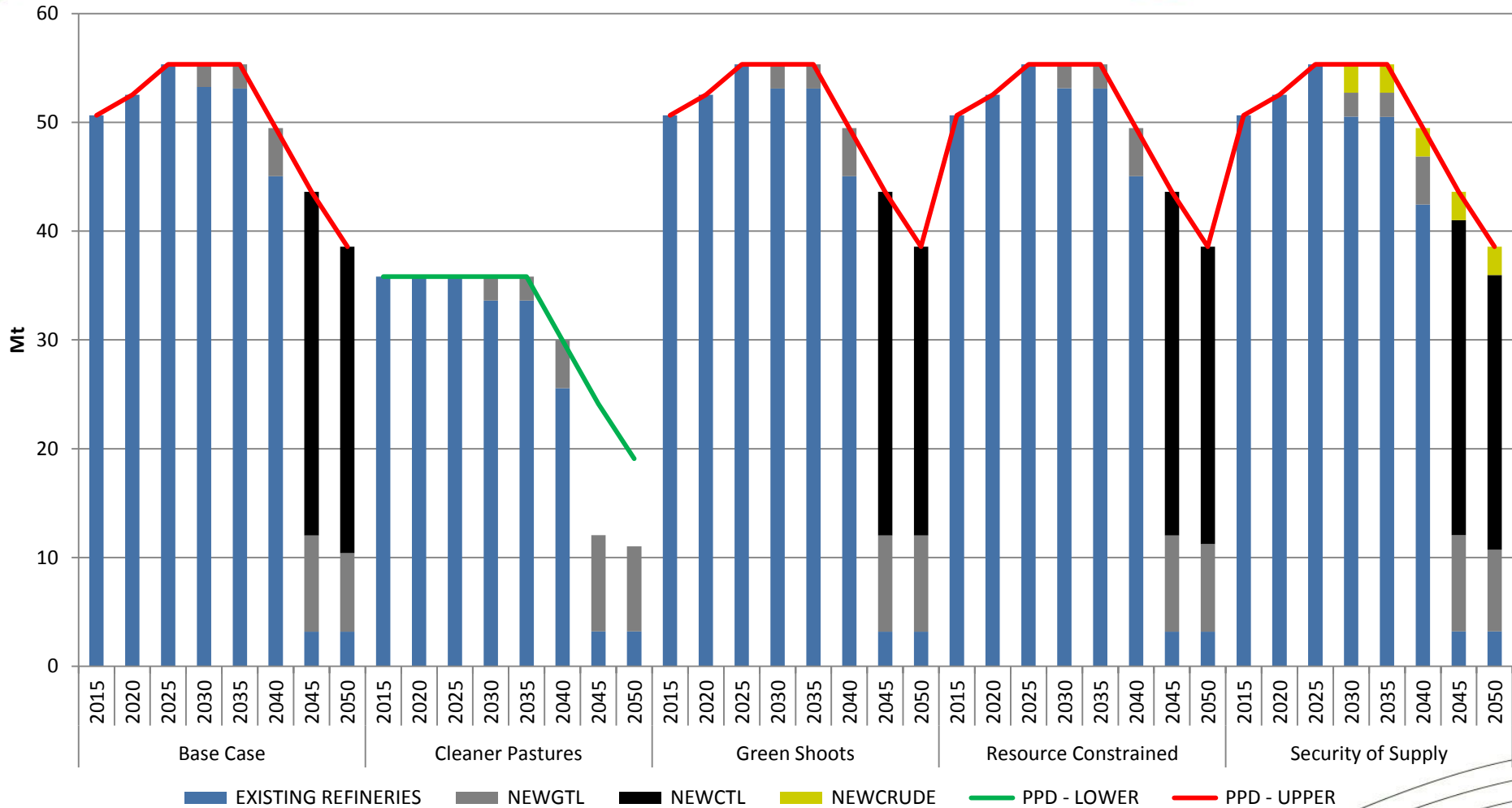




## Total Domestic Production - Crude Oil Refineries

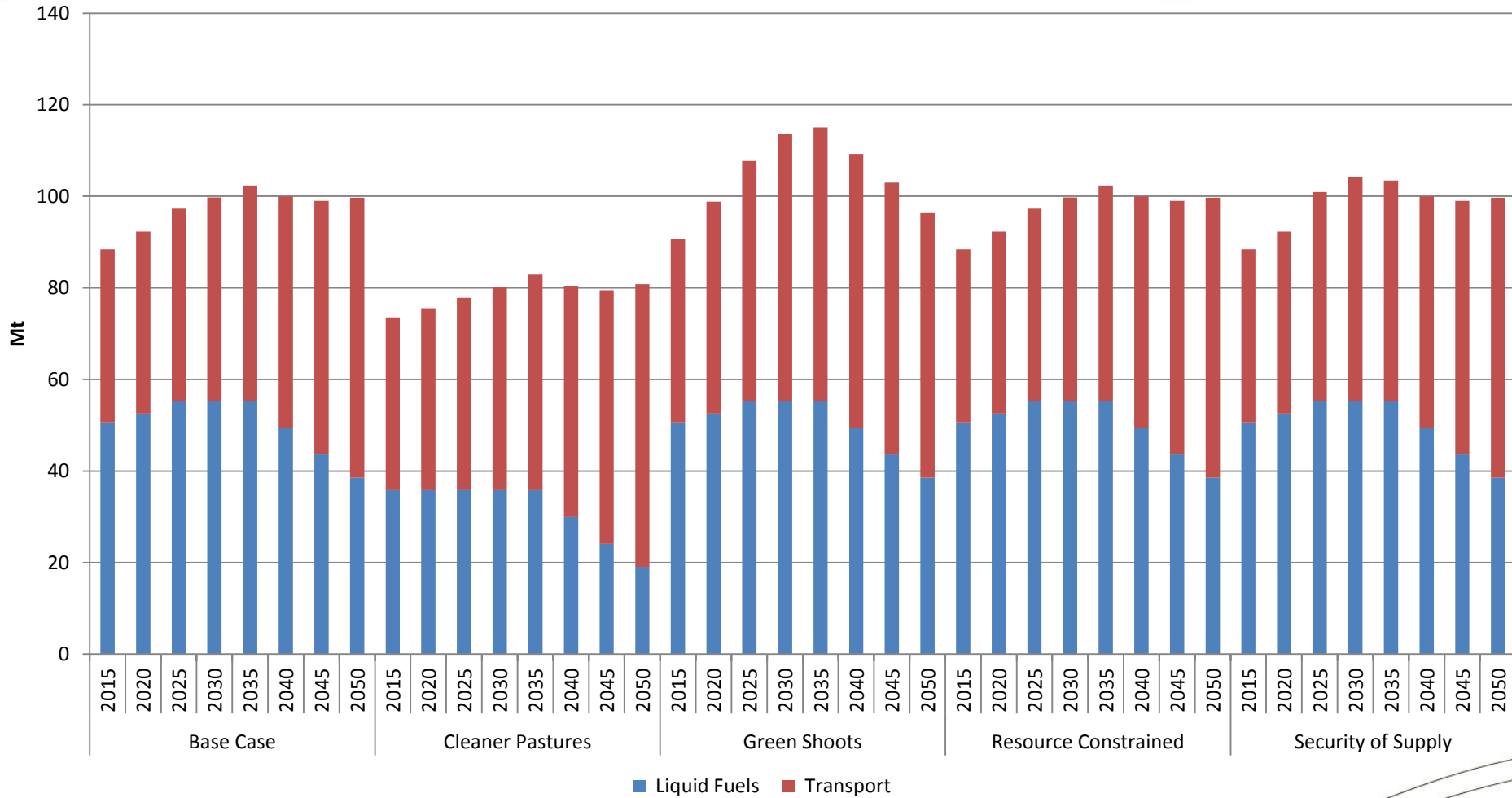


# Carbon Dioxide Emissions from Liquid Fuel Production



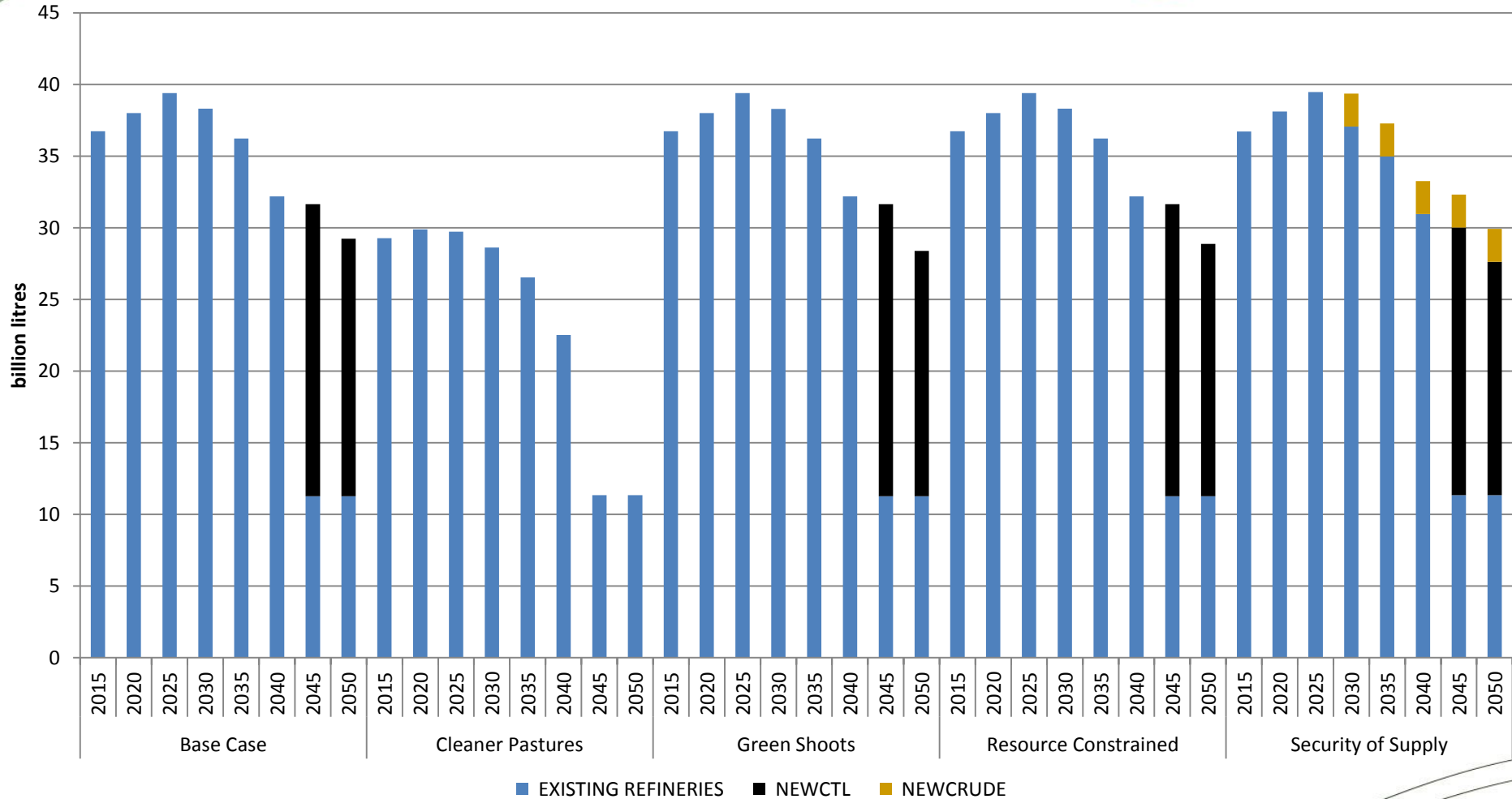


# Total Carbon Dioxide Emissions by Sector





# Water Consumption by Refinery Type





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# LIQUID FUELS SENSITIVITY SCENARIO ANALYSIS

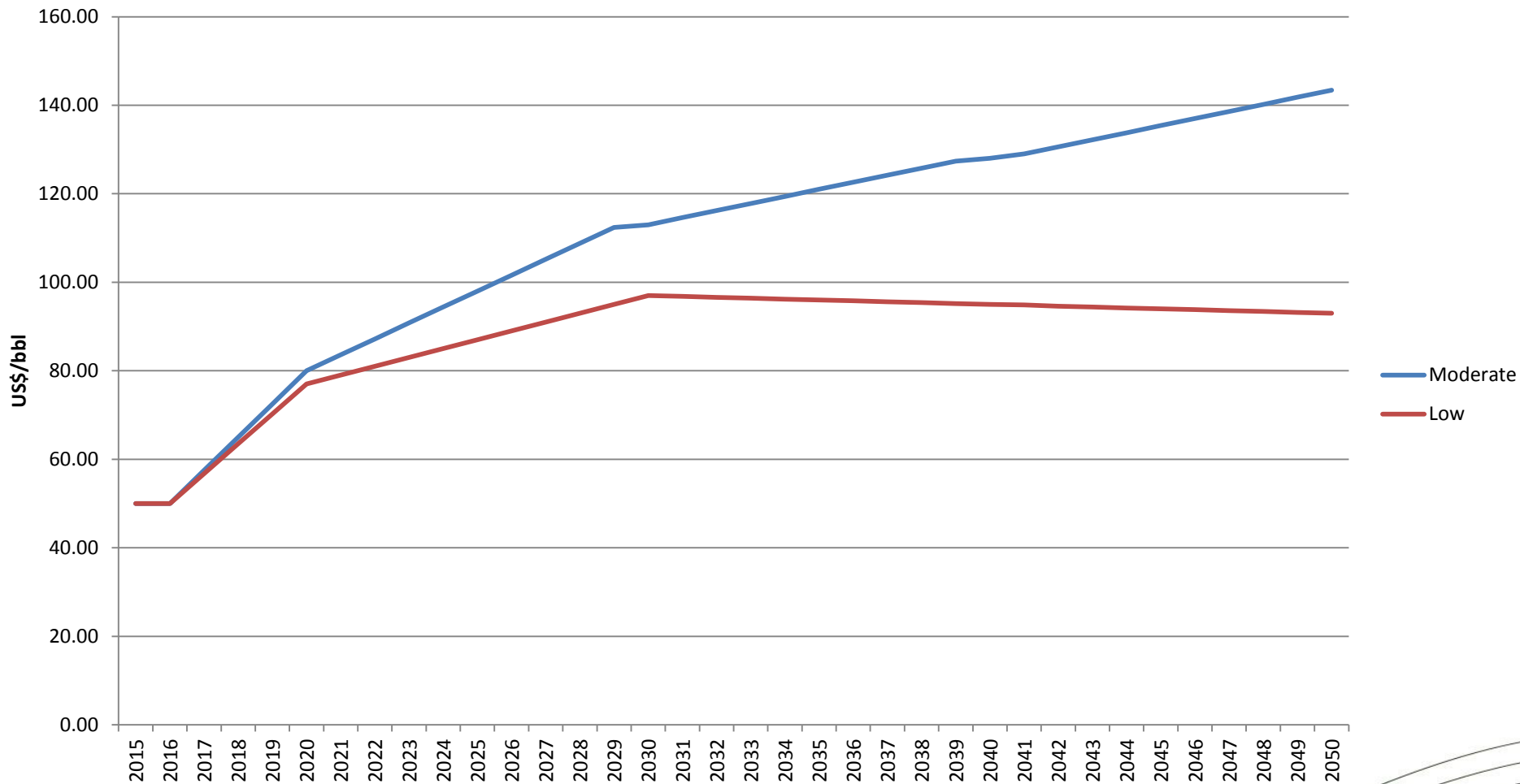
# SENSITIVITY SCENARIOS



	CF2 – No Cost Recovery (CF2_2C)	CF2 – No Cost Recovery (CF2_3C)	Low crude price (LCP)
Key Assumptions	<ol style="list-style-type: none"> <li>1. CF2 implemented</li> <li>2. No cost recovery mechanism leading to closure of 2 existing crude refineries</li> <li>3. No new build commitments</li> </ol>	<ol style="list-style-type: none"> <li>1. CF2 implemented</li> <li>2. No cost recovery mechanism leading to closure of 3 existing refineries</li> <li>3. No new build commitments</li> </ol>	<ol style="list-style-type: none"> <li>1. No CF2 implementation.</li> <li>2. Low global crude oil prices</li> </ol>
Reference Scenario	<b>Base Case</b>	<b>Base Case</b>	<b>Base Case</b>



## Moderate and Low Crude Prices



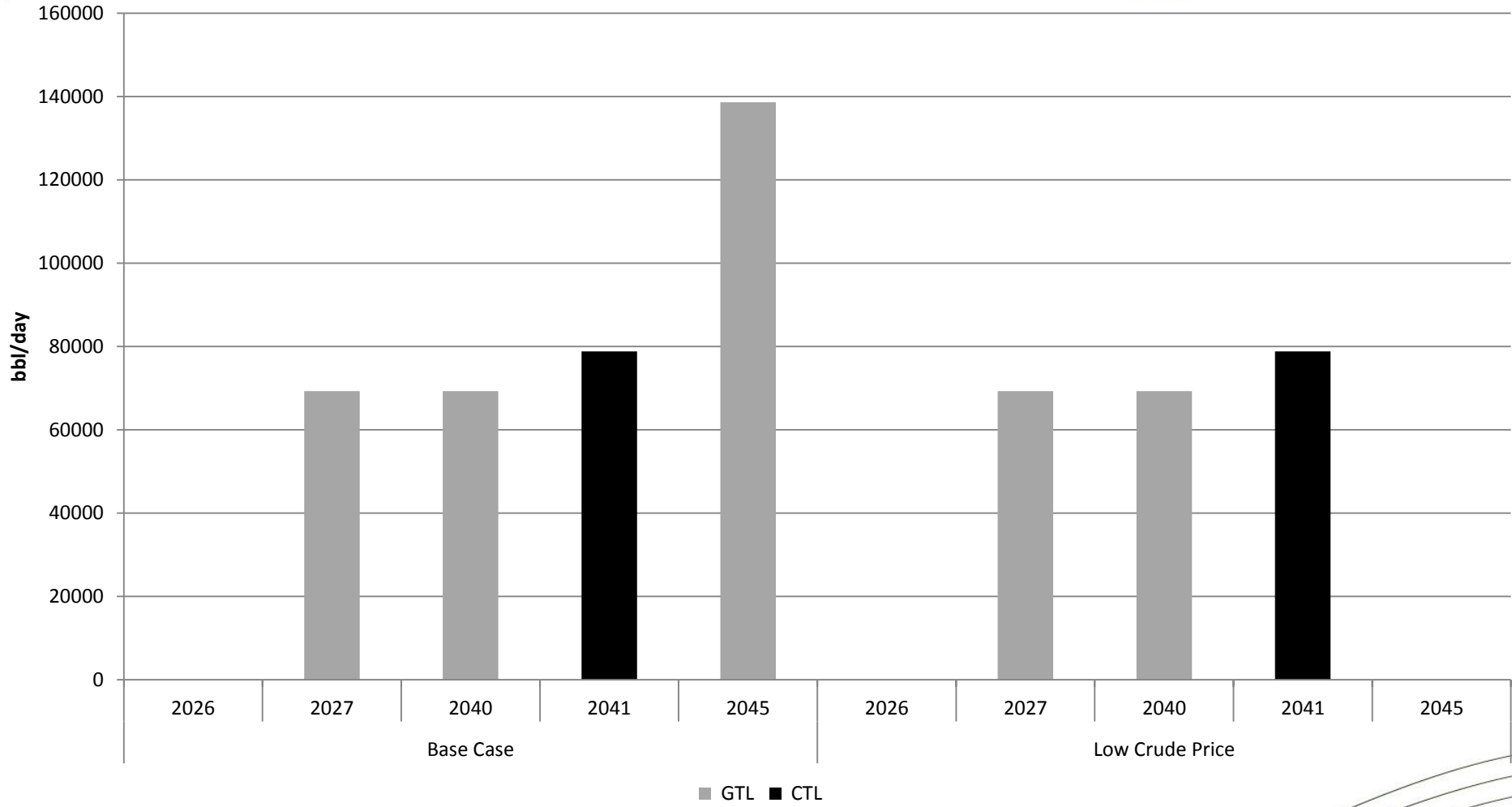
Source: IEA World Energy Outlook 2015



Sensitivity Scenario	Total Capacity	Production	Discounted Costs
<i>Base Case</i>			
Low Crude Price	<u>New Capacity ↓</u>	<u>Imports ↑</u>	<u>Costs ↓</u>
CF2_2C		<u>Imports ↑</u>	<u>Costs ↓</u>
CF2_3C		<u>Imports ↑</u>	<u>Costs ↓</u>

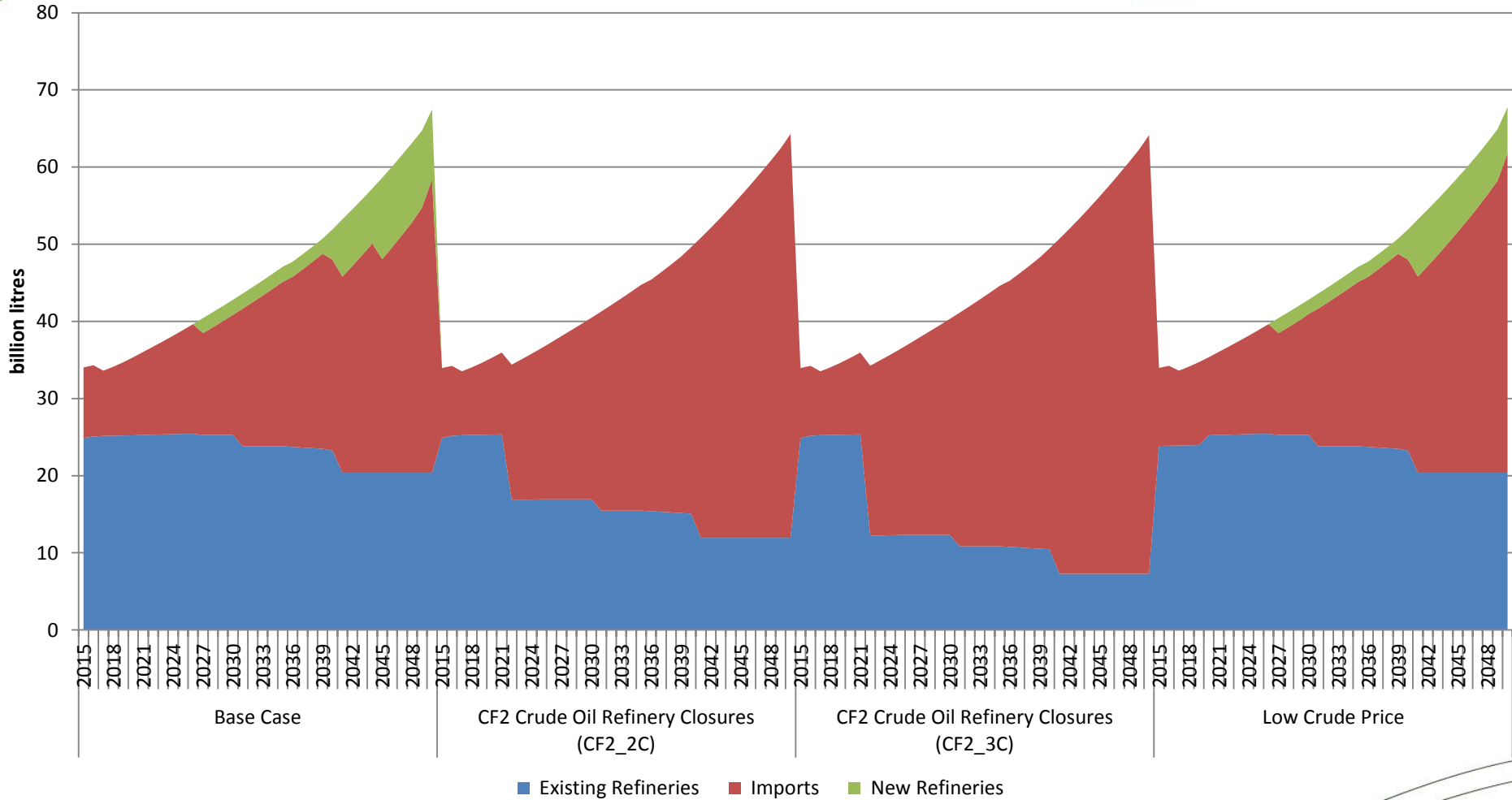


# New Refining Capacity



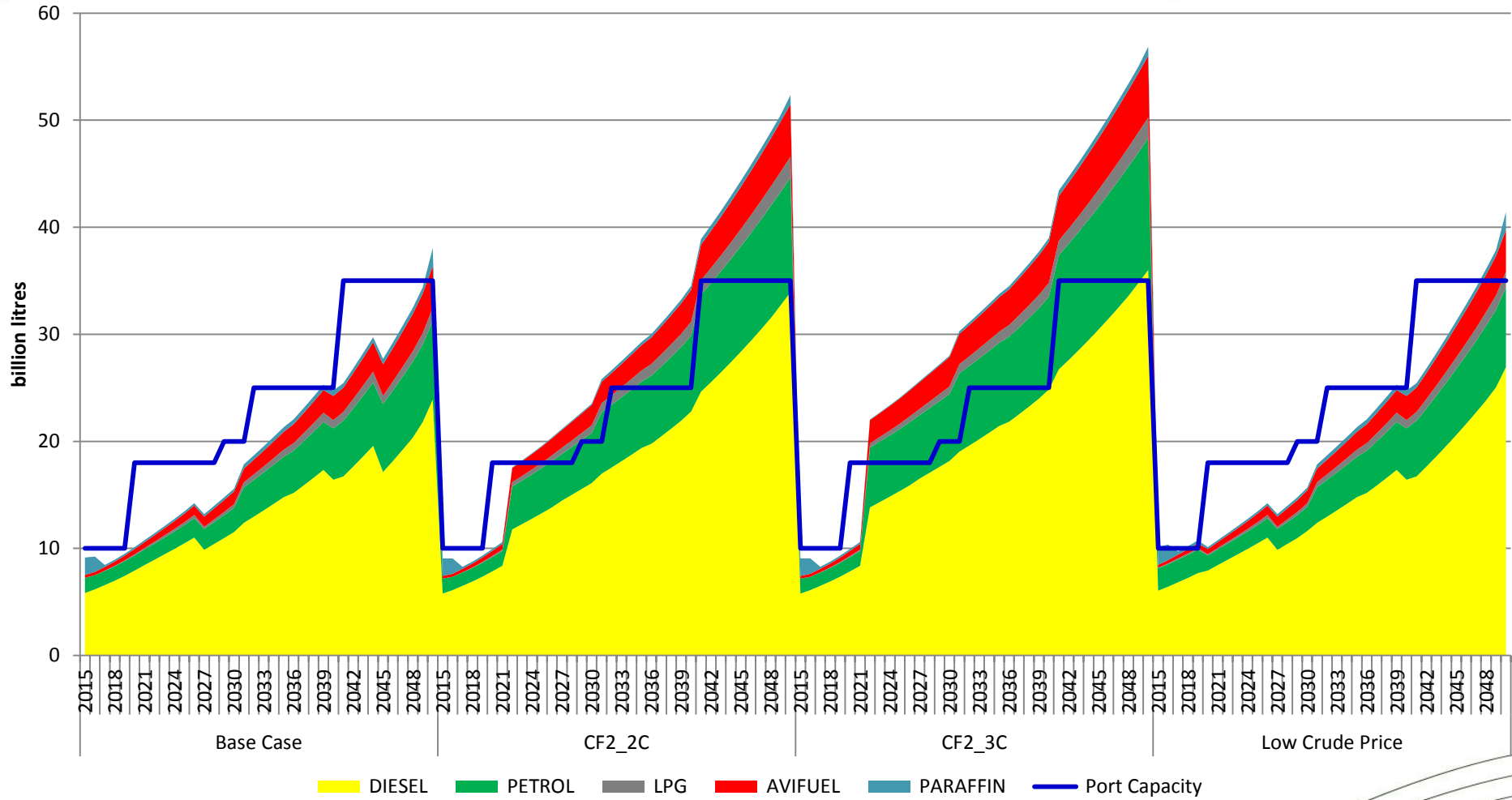


# Liquid Fuel Supply



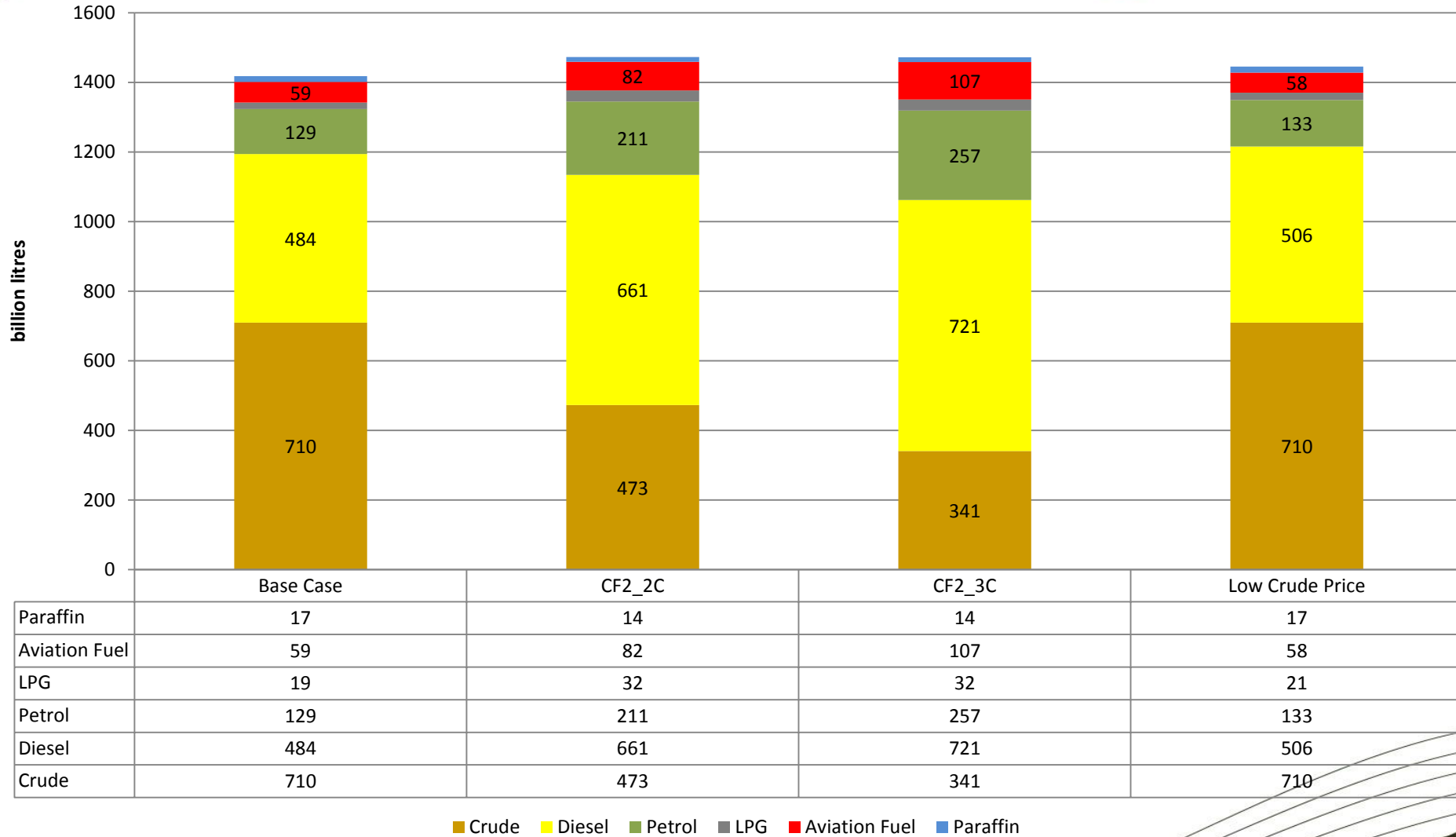


# Liquid Fuel Imports





## Total Imports





Sensitivity Scenario	Emissions	Water	Feedstock
<i>Base Case</i>			
Low Crude Price		<u>Consumption ↓</u>	<u>Coal ↑</u> <u>Gas ↓</u>
CF2_2C	<u>CO<sub>2</sub> ↓</u> <u>SO<sub>x</sub> ↓</u>	<u>Consumption ↓</u> <u>Intensity ↑</u>	<u>Crude ↓</u> <u>Coal ↓</u> <u>Gas ↓</u>
CF2_3C	<u>CO<sub>2</sub> ↓</u> <u>SO<sub>x</sub> ↓</u>	<u>Consumption ↓</u> <u>Intensity ↑</u>	<u>Crude ↓</u> <u>Coal ↓</u> <u>Gas ↓</u>



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**THANK YOU**