

# Integrated Energy Planning (IEP) and Integrated Resource Planning (IRP) for energy democracy

a presentation  
by Richard Worthington

Constructive input towards energy planning  
with stakeholder engagement, including in the  
framing of key decisions / choices

on behalf of the

**DEMOCRACY WORKS FOUNDATION**

**IEP main focus**, as IRP is fatally flawed in ways others will elaborate (and have e.g. Chris Yelland)

‘IRP 2016’ - Irrelevant and/or highly speculative technology cost assumptions & lack of a cost-optimised base case are fatal flaws

&

The “IRP Update” does not mention Integrated Energy Planning, though it is IEP that is supposed set out the role for electricity in total energy supply in a low-carbon and climate-resilient economy.

[energy democracy](#)

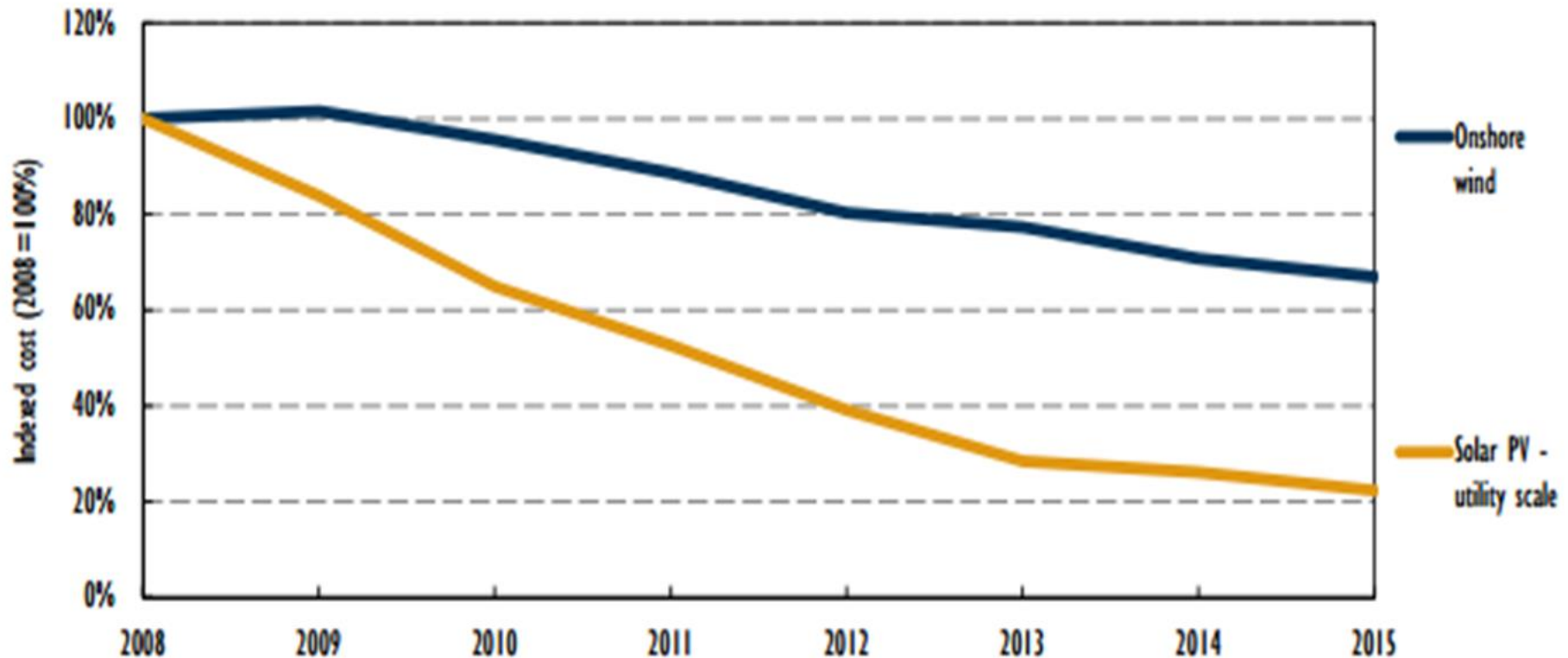
The extent to which the energy system(s) of a nation serve the people and support public health and well-being into the future is an important indicator of the functionality of democracy.

# OVERVIEW - Recommendations for IEP:

- **No. 1: Recognise Solar PV cost decline ....**  
& Update access strategy with **social equity** targets
- **Revise Resource Potential** – sp. renewables
- **Revise Transport energy demand assumptions and recommendations**
- **Include big-picture perspective**
- **Broaden scope of scenarios considered, incl.:**
  - **Increase/double the share of electricity in end use**
  - **Achieving climate change global goal**
- **Provide clear direction to IRP for an expanded role for electricity with decentralisation and decarbonisation**

# Game-changer: global cost declines

Figure 1 • Indexed cost of onshore wind and utility-scale PV



Note: Costs refer to global average of levelised cost of electricity (LCOE) with country specific assumptions on investment costs (declining over time) and cost of financing (fixed over time). Different costs per country are averaged weighted by annual capacity additions.

[http://www.carbontracker.org/report/lost\\_in\\_transition/](http://www.carbontracker.org/report/lost_in_transition/)

“The purpose of the IEP is to test the various options presented in the NDP and make firm recommendations in the form of an energy sector roadmap.” (p.29)

## National Development Plan - NDP:

### The energy sector: Empowering South Africa

#### Vision

By 2030.....:

- Economic growth and development...  
Incl: Local production of energy technology will support job creation.
- Social equity... ...targeted and sustainable subsidies...
- Environmental sustainability.... ...efforts to reduce pollution...

#### Storylines:

**In 20 years, South Africa’s energy system will look very different:**

coal will contribute much less to primary energy needs...

Electric vehicles will be widely used.

The economy’s energy intensity will continue to decline...”


## IEP recommendation – No. 1:

# Recognise Solar PV cost decline as a game-changer for energy access & Update 2013 'New Household Energy Strategy' with social equity targets

Page 182: **8.8. Energy access** [inter alia] “...distributed generation can refer to diverse energy systems that rely on renewable energy sources...

- Funding should also be allocated for the development of an Integrated Household Energy Strategy which will ensure that households which are not connected or cannot afford electricity have access to safe alternative fuels and appliances.” updating

(p.181) [includes:]

- “~~Off~~ **On**-grid or stand-alone **Solar PV** systems are a viable technology to increase electricity access to isolated communities...” 

# IEP recommendation: Revise Resource Potential

Executive Summary – re the Energy Mix (p. 18):

“**Wind:** Wind also presents an alternative source of power, however this is limited to windy areas on the coast.”

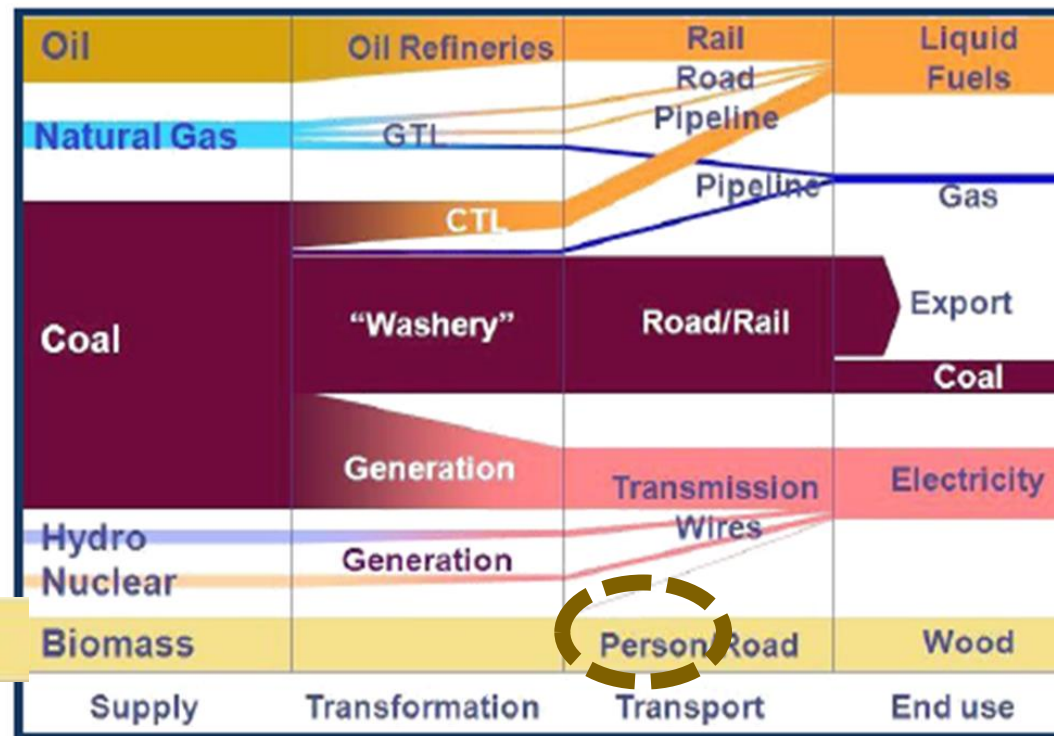
Ref.: Diab, R.D. 1995

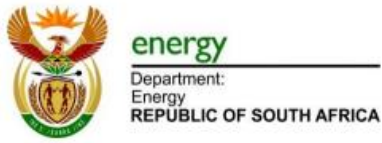
“**Biomass:** can play a role as a feedstock for cogeneration and in the provision of electricity close to the source.”

P.71: Biomass is used commercially...

**Biomass**

SOUTH AFRICAN ENERGY SYNOPSIS 2010





Empowered lives.  
Resilient nations.



**sanedi**  
South African National Energy  
Development Institute

# Revise Resource Potential



**energy**  
Department:  
Energy  
REPUBLIC OF SOUTH AFRICA



**german  
cooperation**  
DEUTSCHE ZUSAMMENARBEIT

## South African Wind Atlas (WASA) Guide

Eugène Mabille

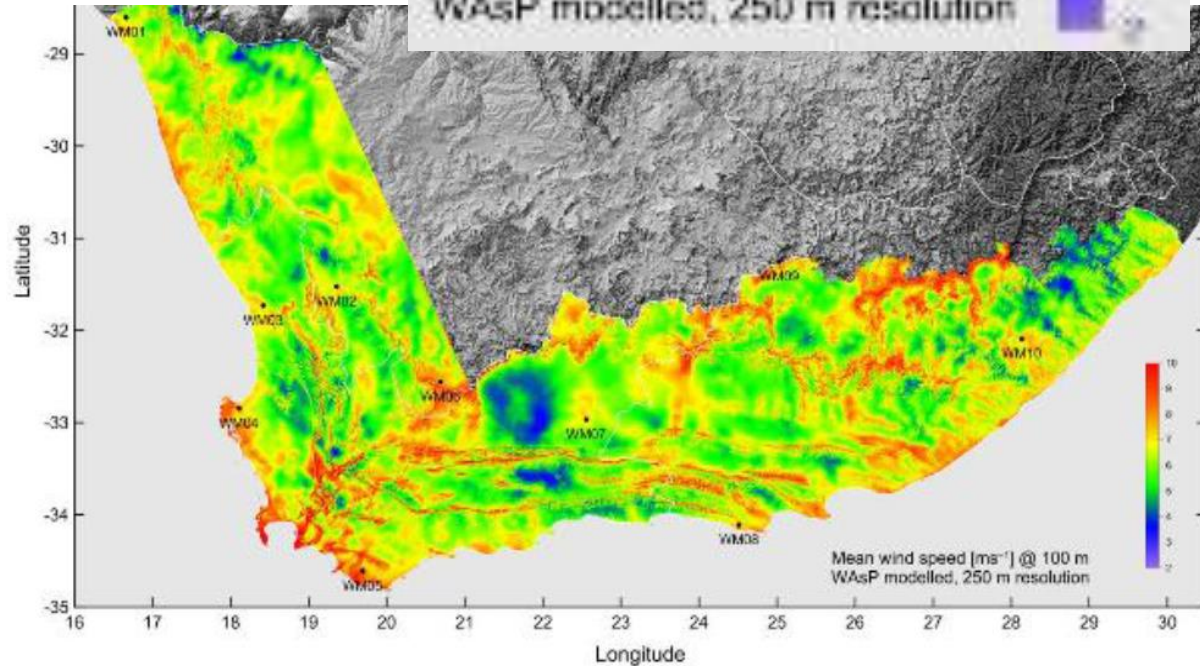
Council for Scientific and Industrial Research (CSIR)

## State of Renewable Energy in South Africa **2015**

Mean wind speed [ $\text{m s}^{-1}$ ] @ 100 m  
WAsP modelled, 250 m resolution



April 2014



# IEP recommendation:

## Revise: Transport energy demand assumptions and projections

### **National Development Plan - Storylines:**

In 20 years, South Africa's energy system will look very different:

- Electric vehicles will be widely used.

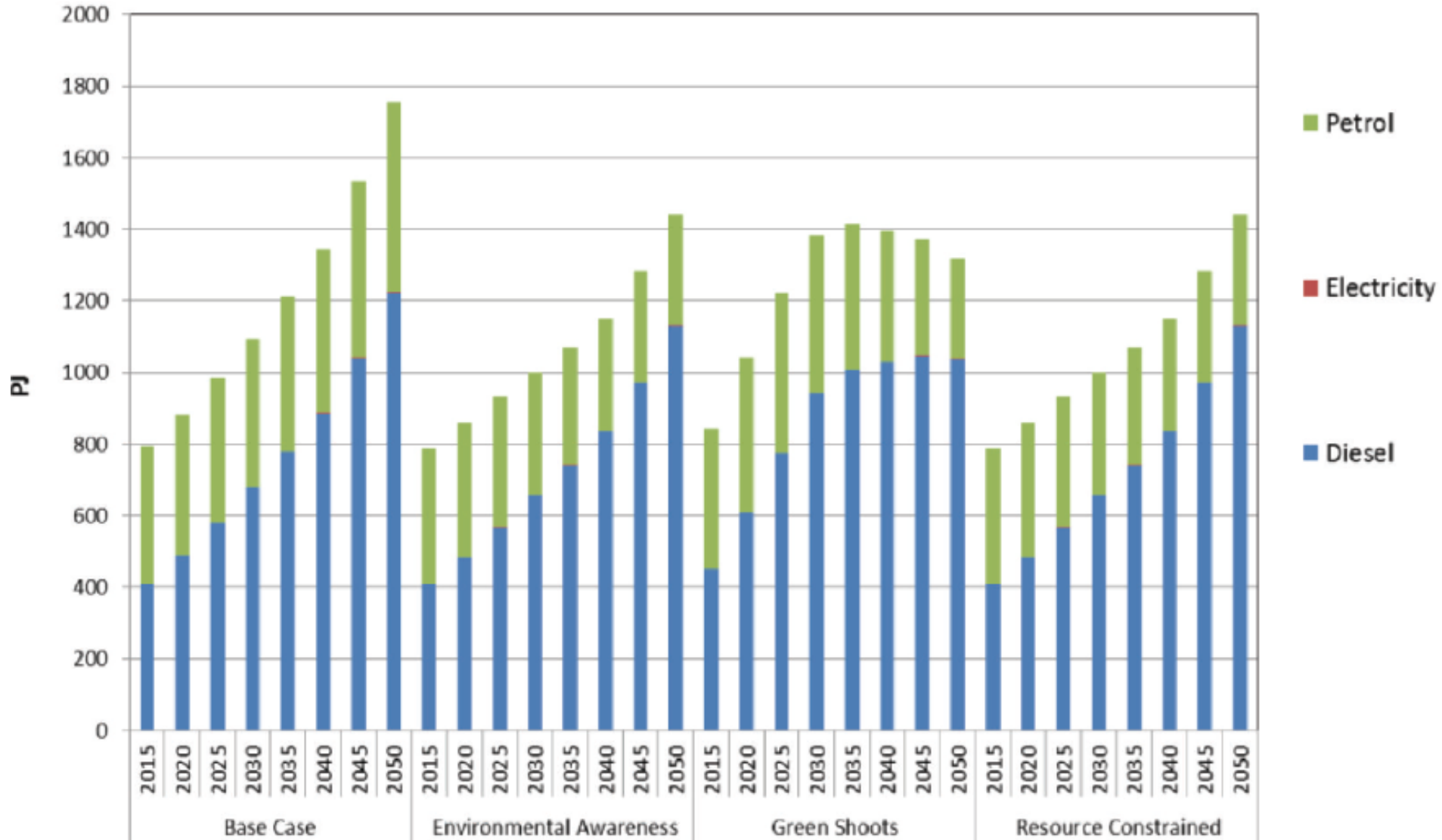
### IEP Executive Summary - Analysis of energy demand

- p.13: "Petrol and diesel vehicles will continue to be used in the foreseeable future, with electric vehicles only starting to make a significant contribution to passenger transportation after 2030."

# IEP p. 103: Figure 0-24: Total energy consumption by transport sector by fuel

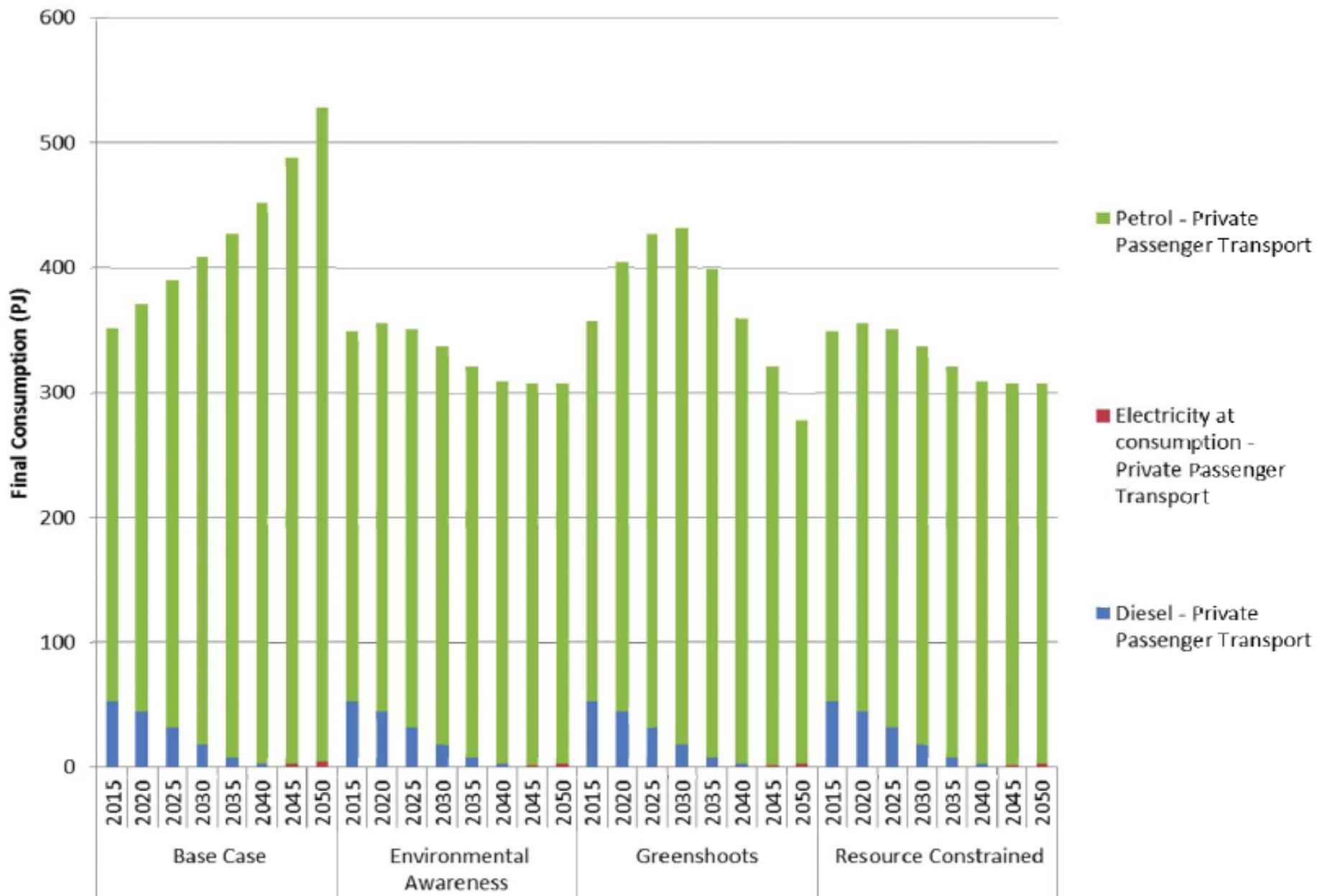
Source: DoE Analysis

## Energy Consumption by Road Transport

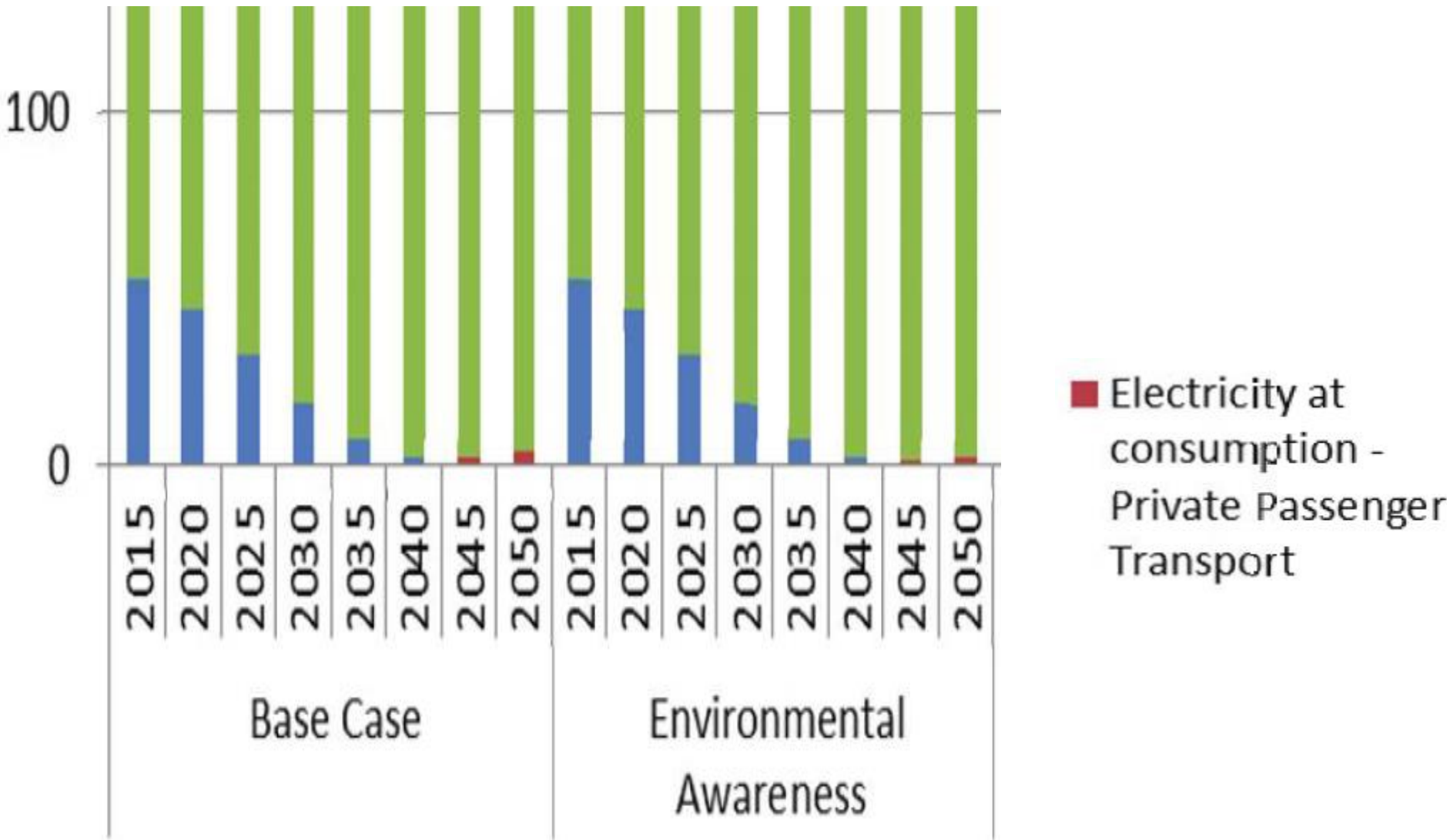


**Figure 0-26: Energy consumption by private passenger vehicles and fuel type**

### Energy Consumption by Road Transport

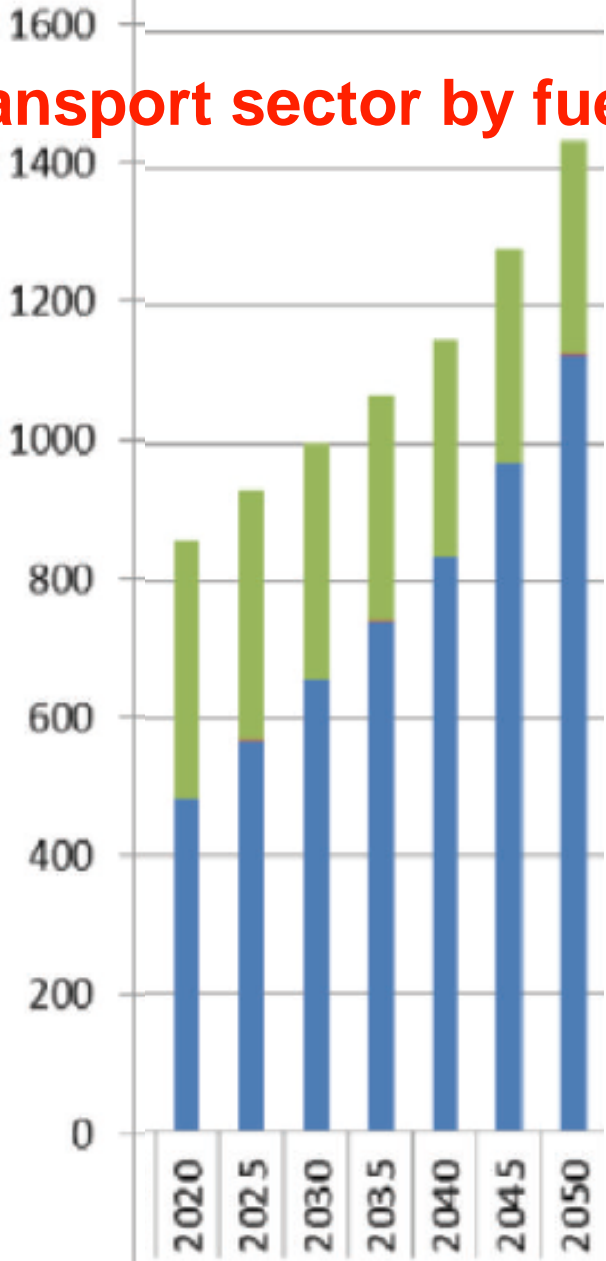


# private passenger vehicles and fuel type



# transport sector by fuel

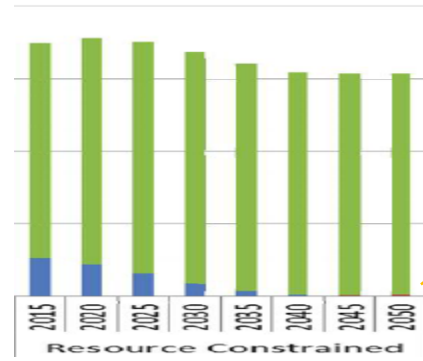
PJ



Resource Constrained

**Electrification of transport (to scale)**

## private passenger vehicles and fuel type



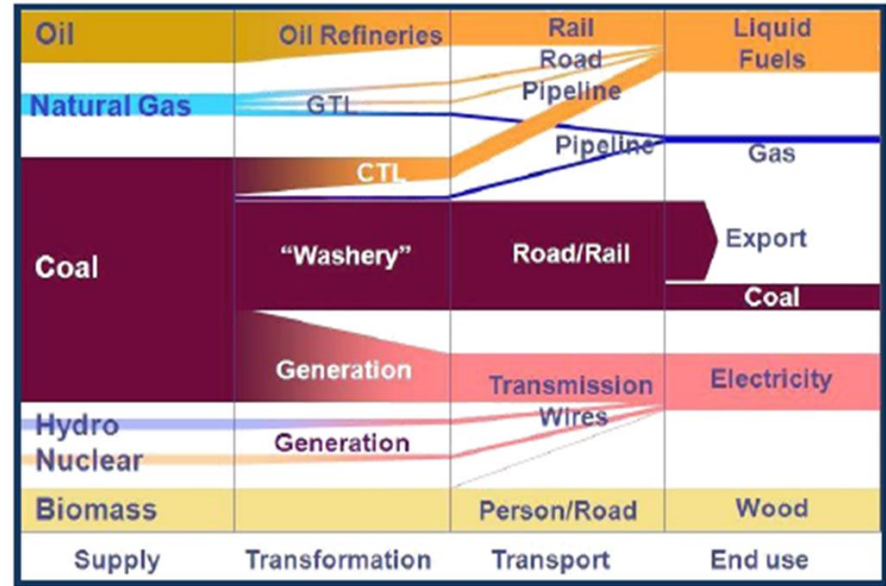
Resource Constrained

# Include big-picture perspective, e.g.:

Back to basics – a simple sketch of primary energy supply and end use (DOE):

Sankey diagram generated by the DEA's 2050 Pathway Calculator:

SOUTH AFRICAN ENERGY SYNOPSIS 2010



South Africa 2050 Calculator

Energy

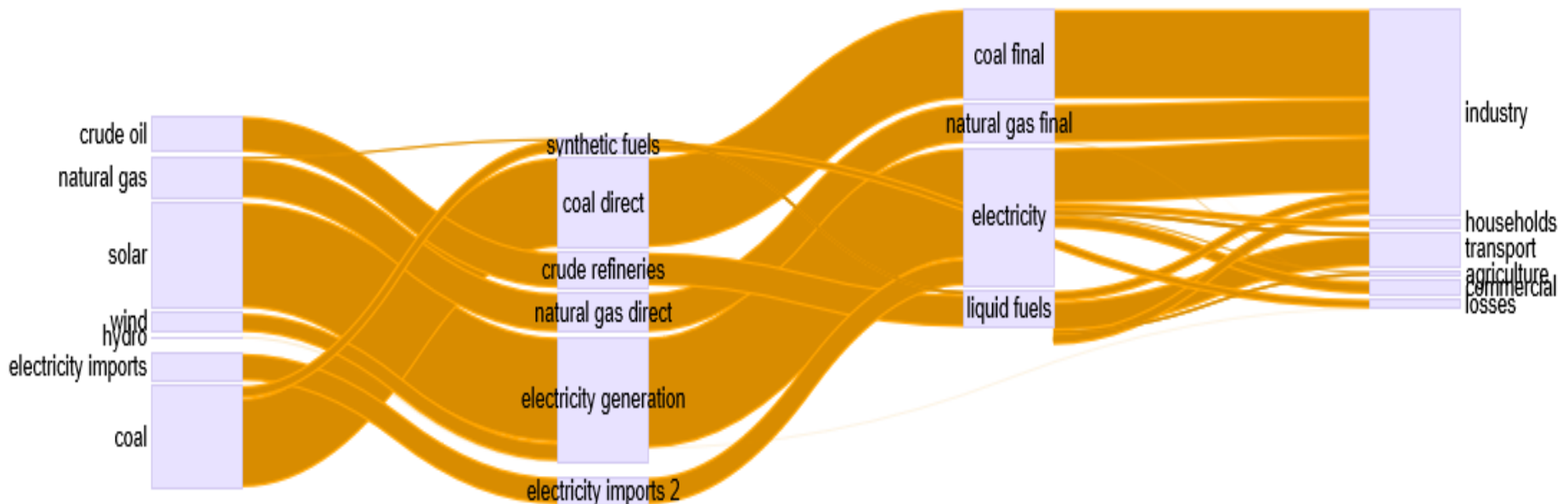
Electricity

Security

Flows

Story

Share







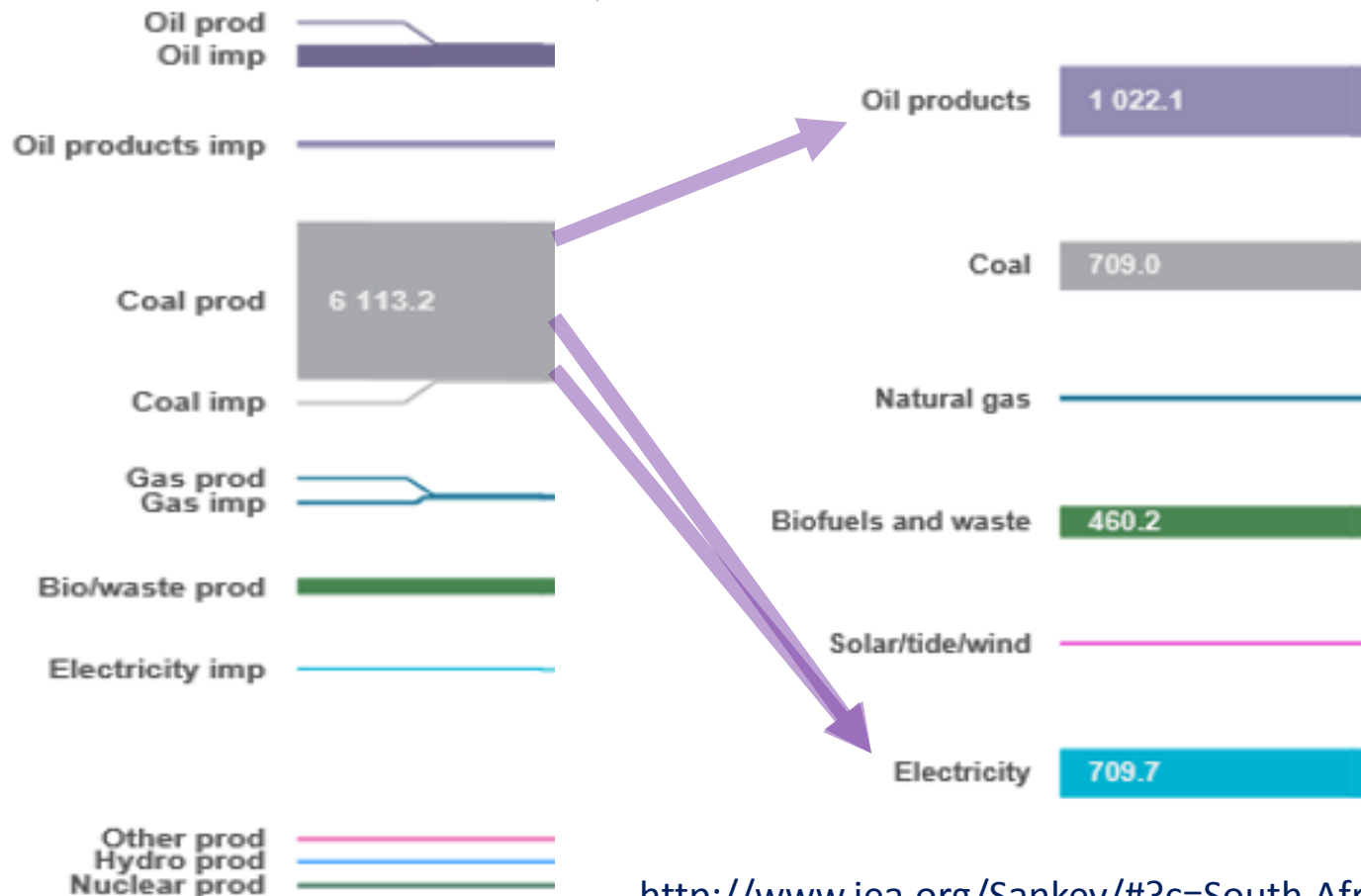
# Recent total energy supply and use –

taken from the IEA Energy Balance for South Africa for 2012 (the most recent, as also from DOE) - the primary energy input (supply mix) and final consumption:

## BALANCE (2012)

Production and imports  
(8 328.9 PJ)

Total final consumption  
(2 975.7 PJ)



# Draft 2012 IEP Report, 24 July 2013

(p. 135)      Integrated Energy Plan

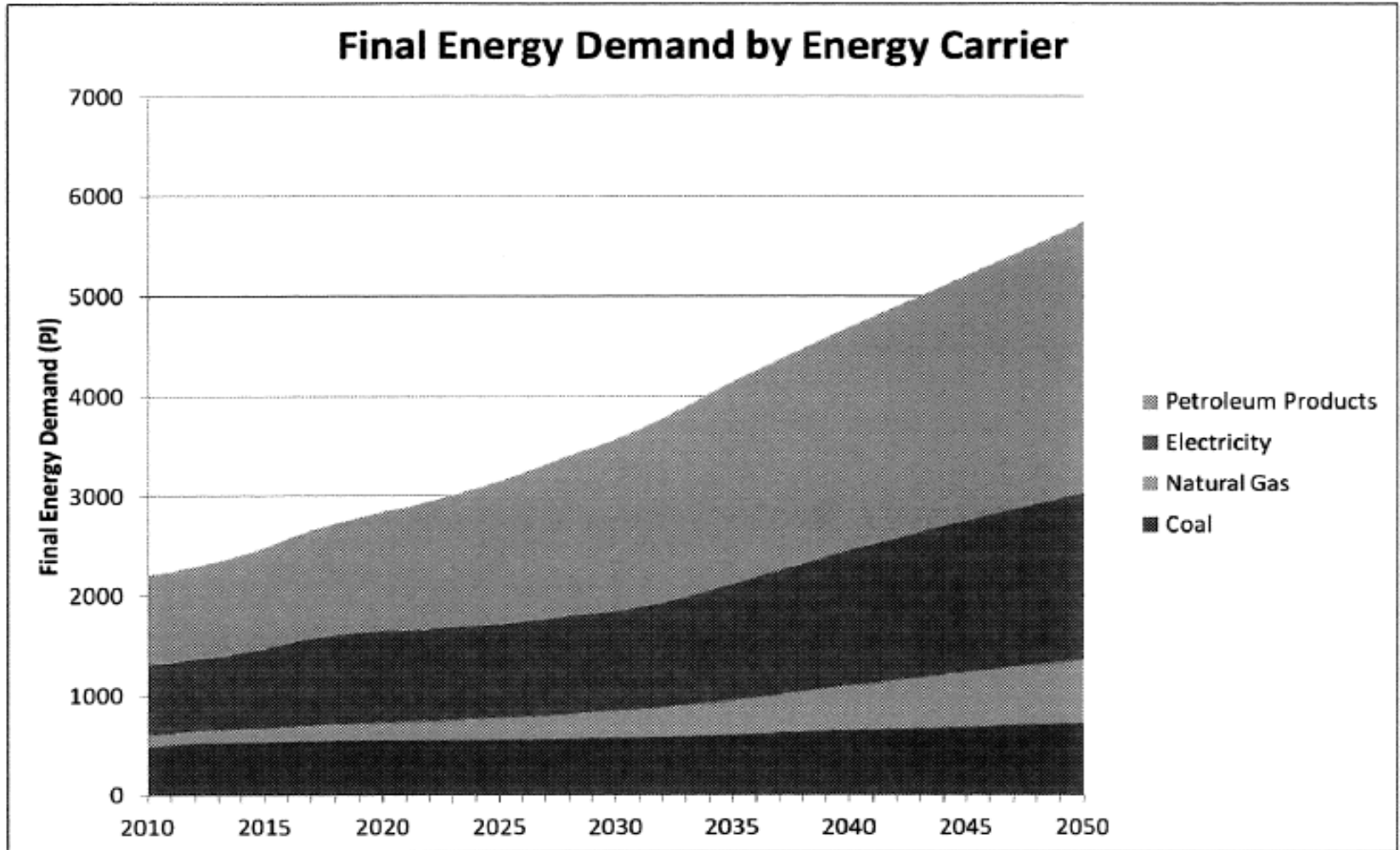


Figure 5-25: Total energy demand for different energy carriers (excluding biomass)

# Draft 2012 IEP Report, 24 July 2013

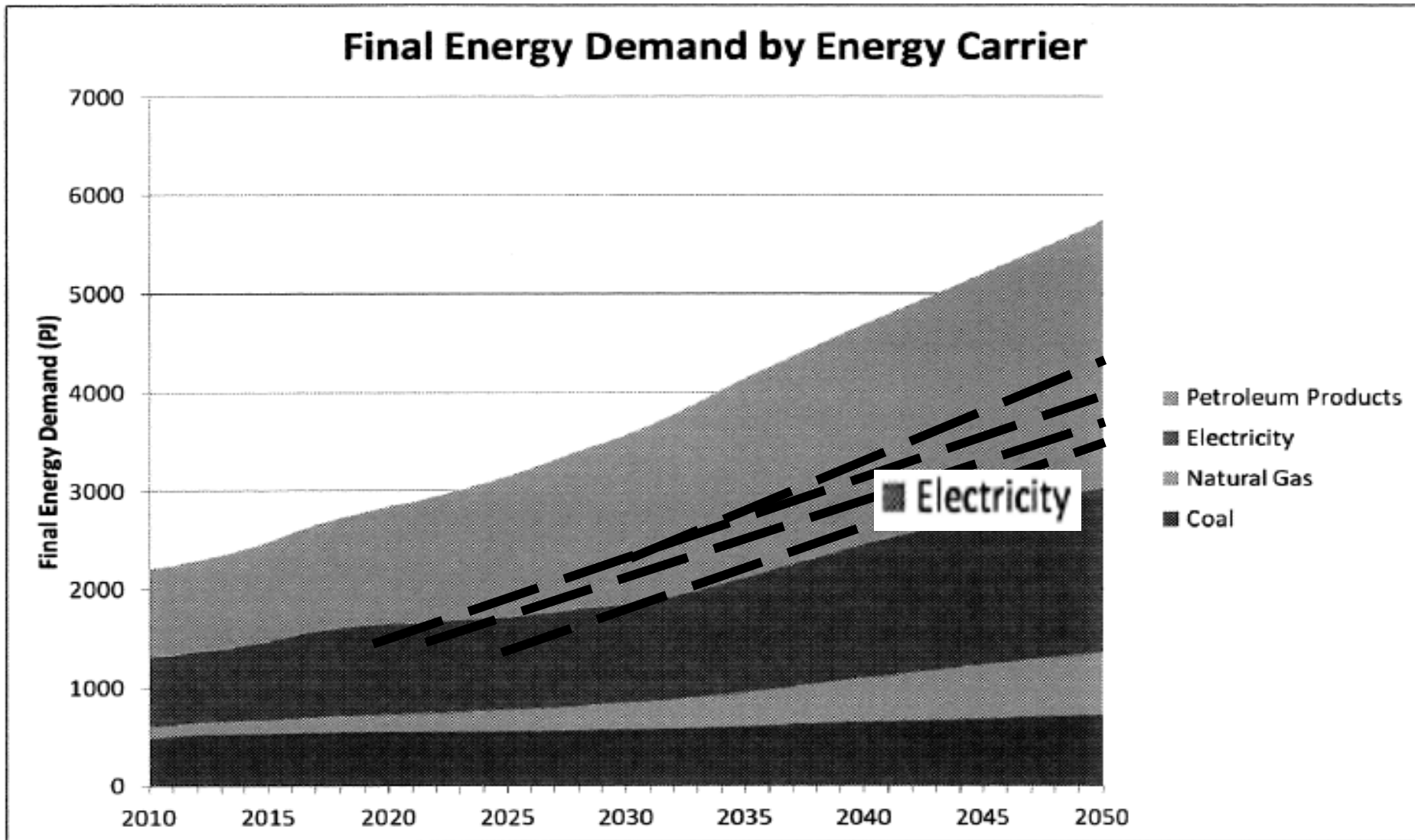


Figure 5-25: Total energy demand for different energy carriers

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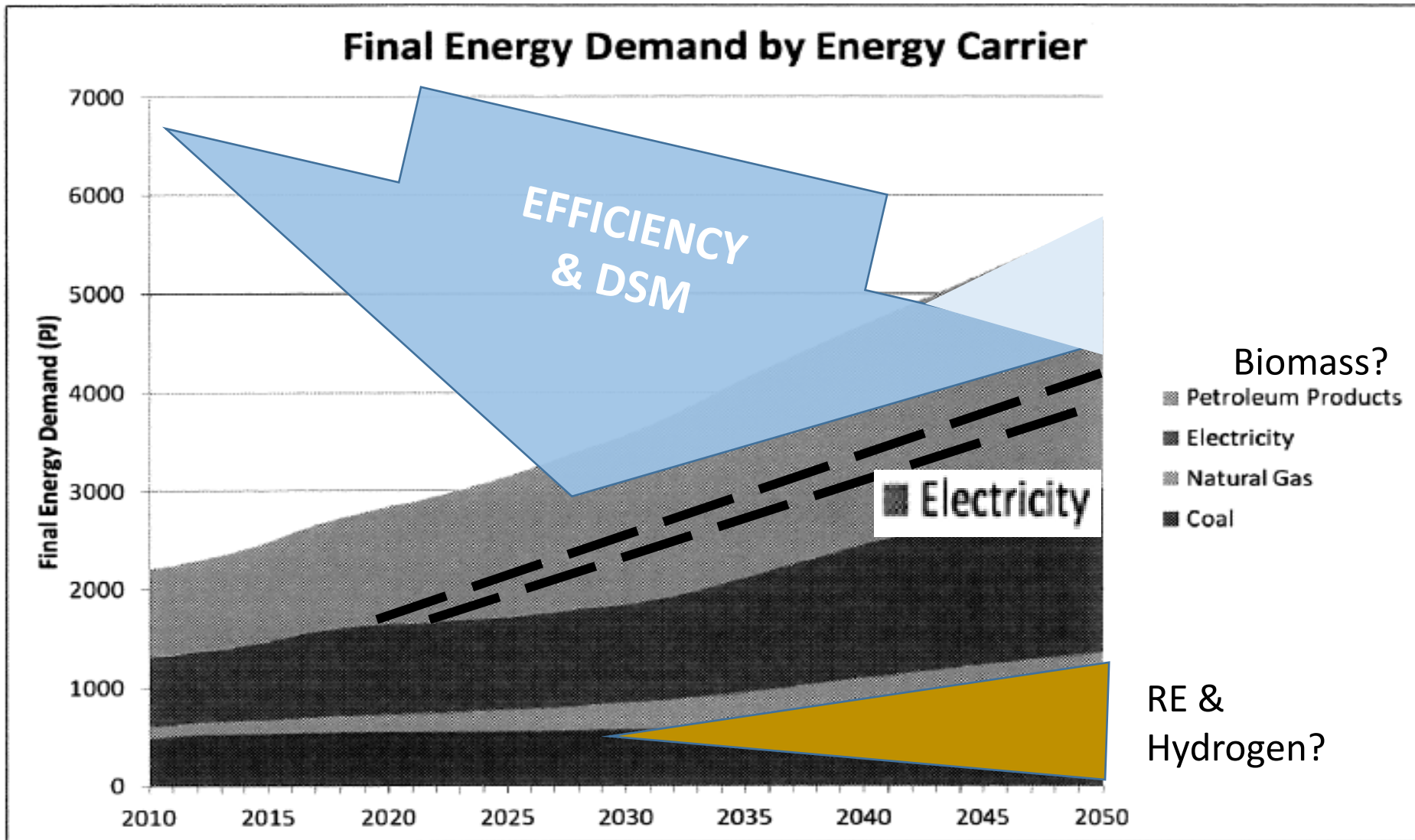
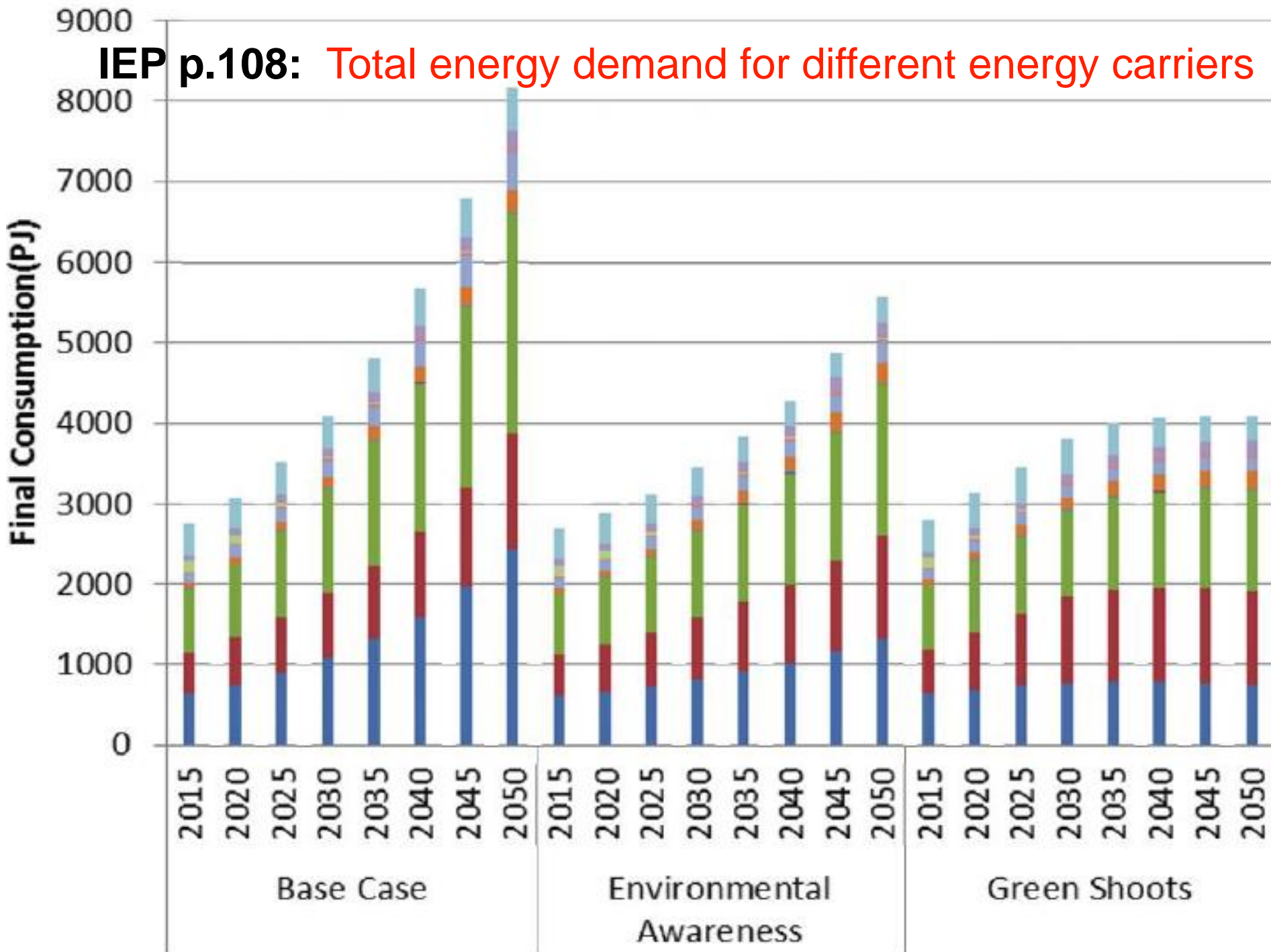


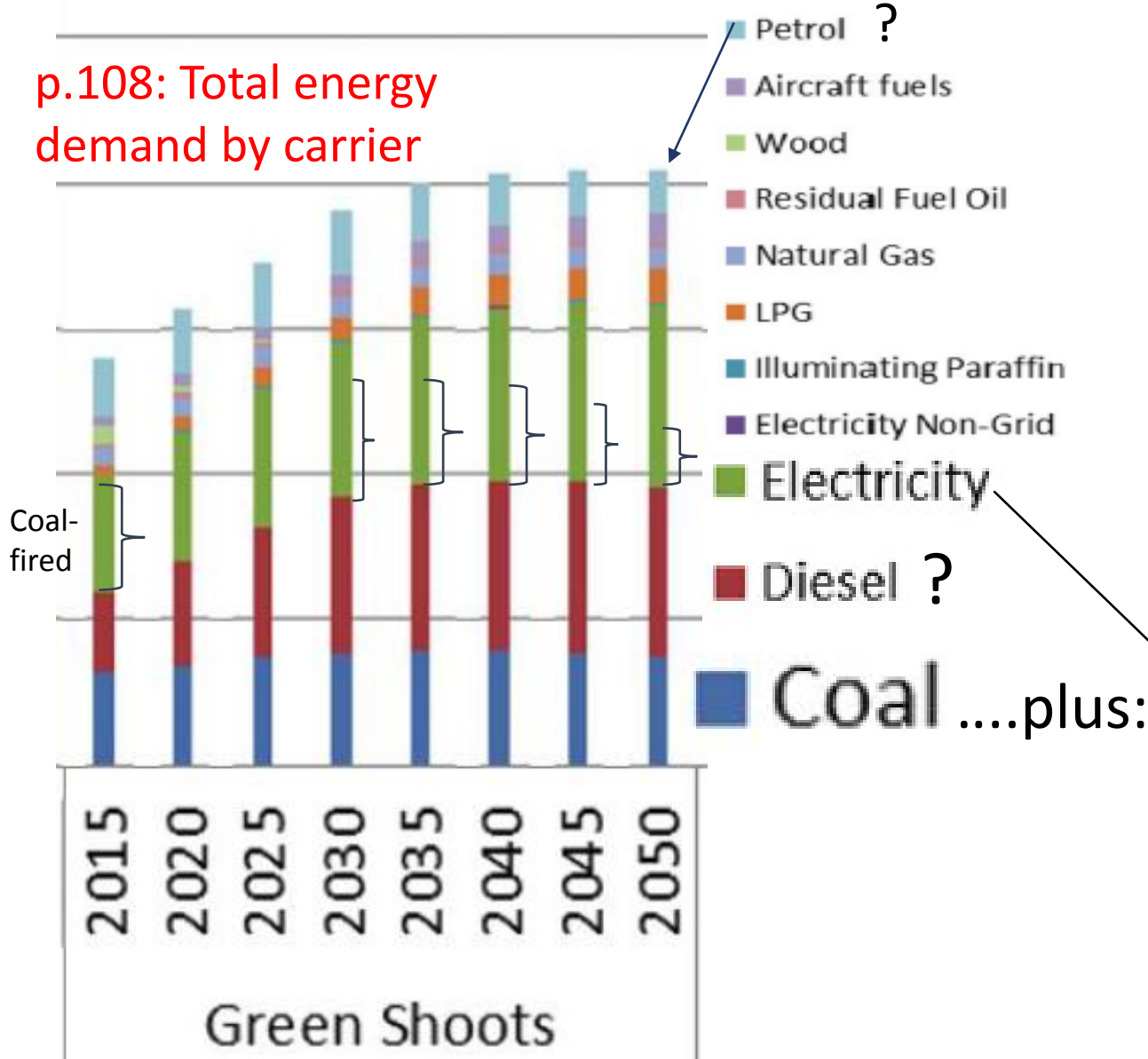
Figure 5-25: Total energy demand for different energy carriers

**IEP p.108: Total energy demand for different energy carriers**

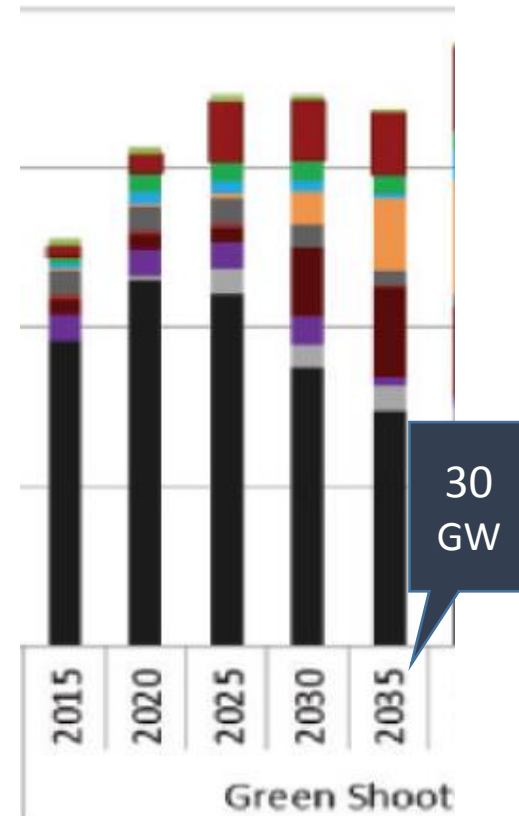


# Coal use does not decline in any scenario before 2035 – lowest in ‘Green Shoots’

p.108: Total energy demand by carrier

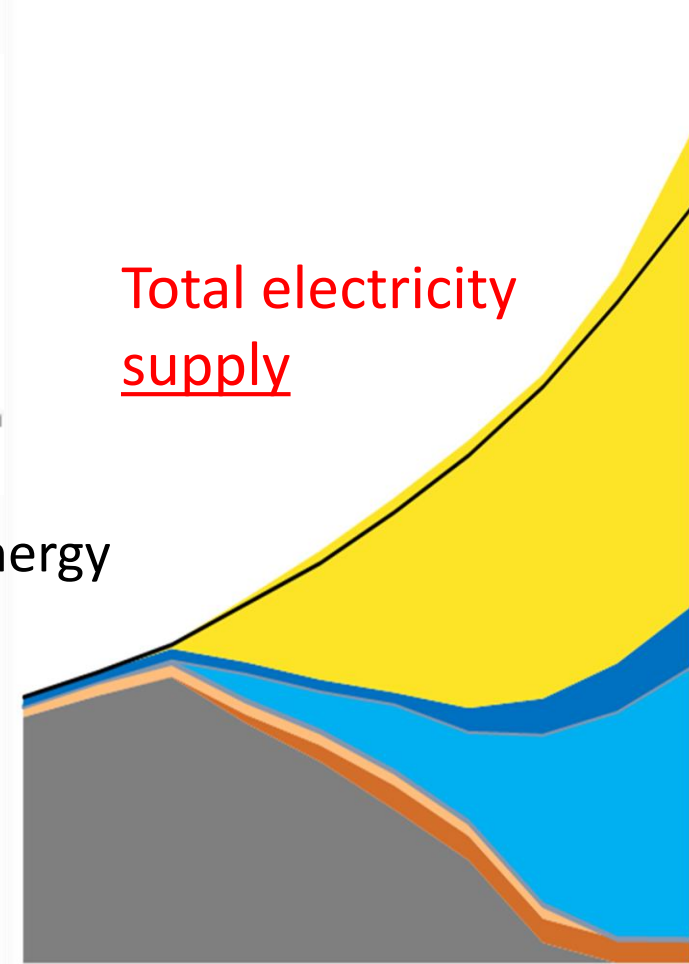
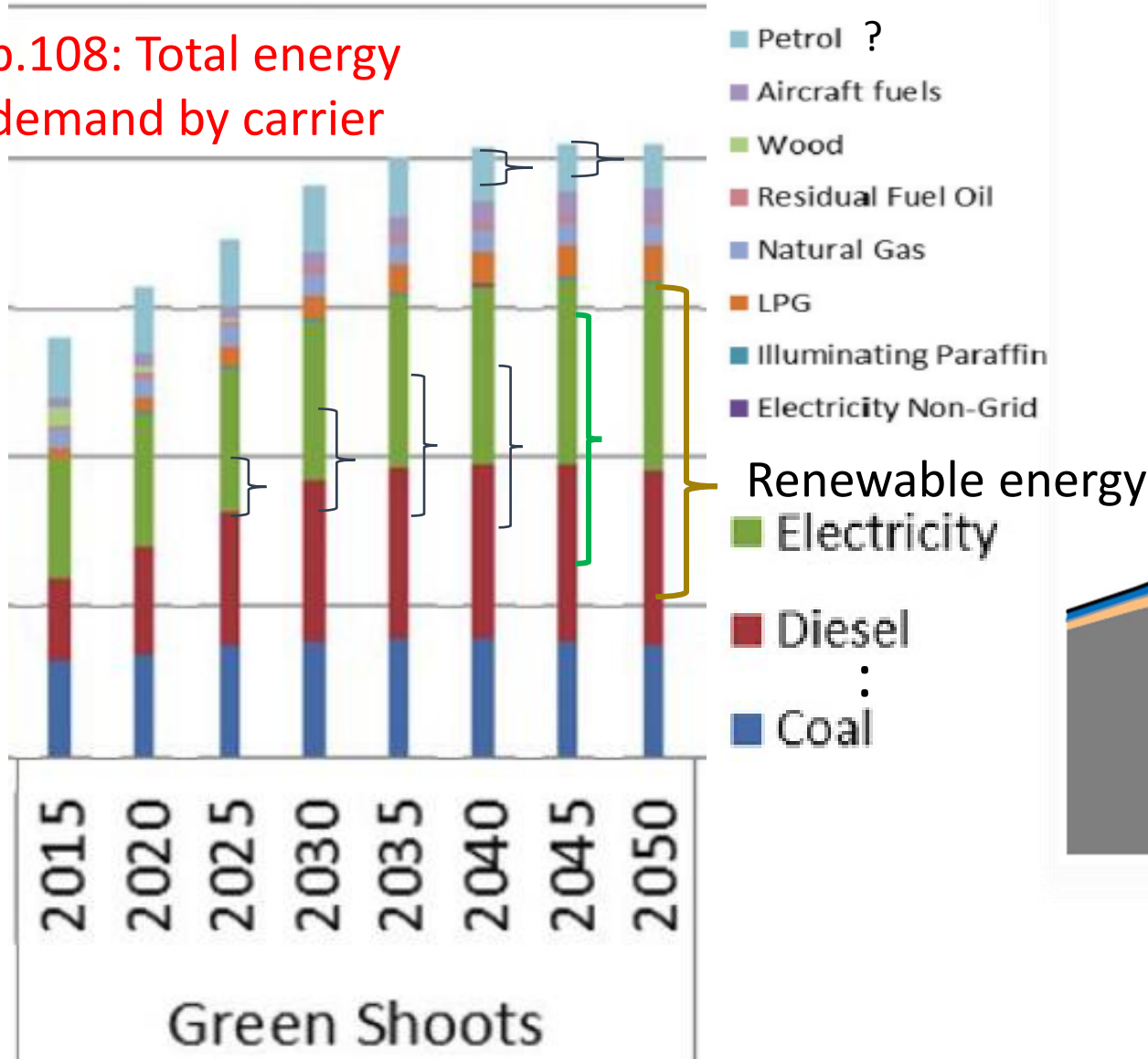


p.116: Total electricity generation capacity



# Coal use could decline well before 2035 – - decarbonise and grow electricity

p.108: Total energy demand by carrier

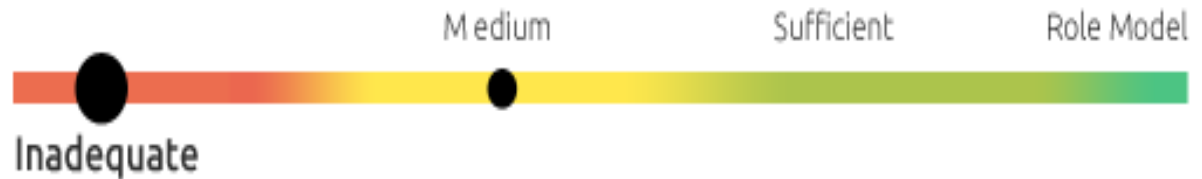


# Climate Change Response –

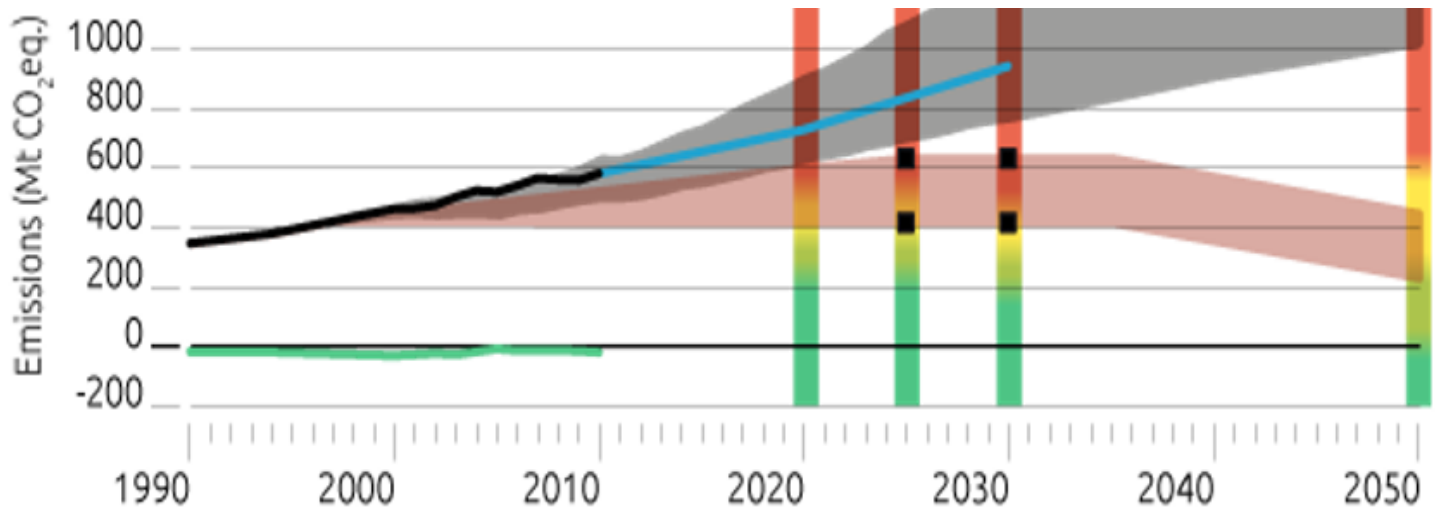
Mitigation - Adaptation is not mentioned

- **Sovereignty?** Under 'Key policy issues': the 'Peak-Plateau-Decline'  
“The extent to which this outcome can be achieved depends on the extent to which **developed countries** meet their commitment **to provide** financial, capacity-building, technology development and technology transfer support to developing countries.”

## Carbon Action Tracker:



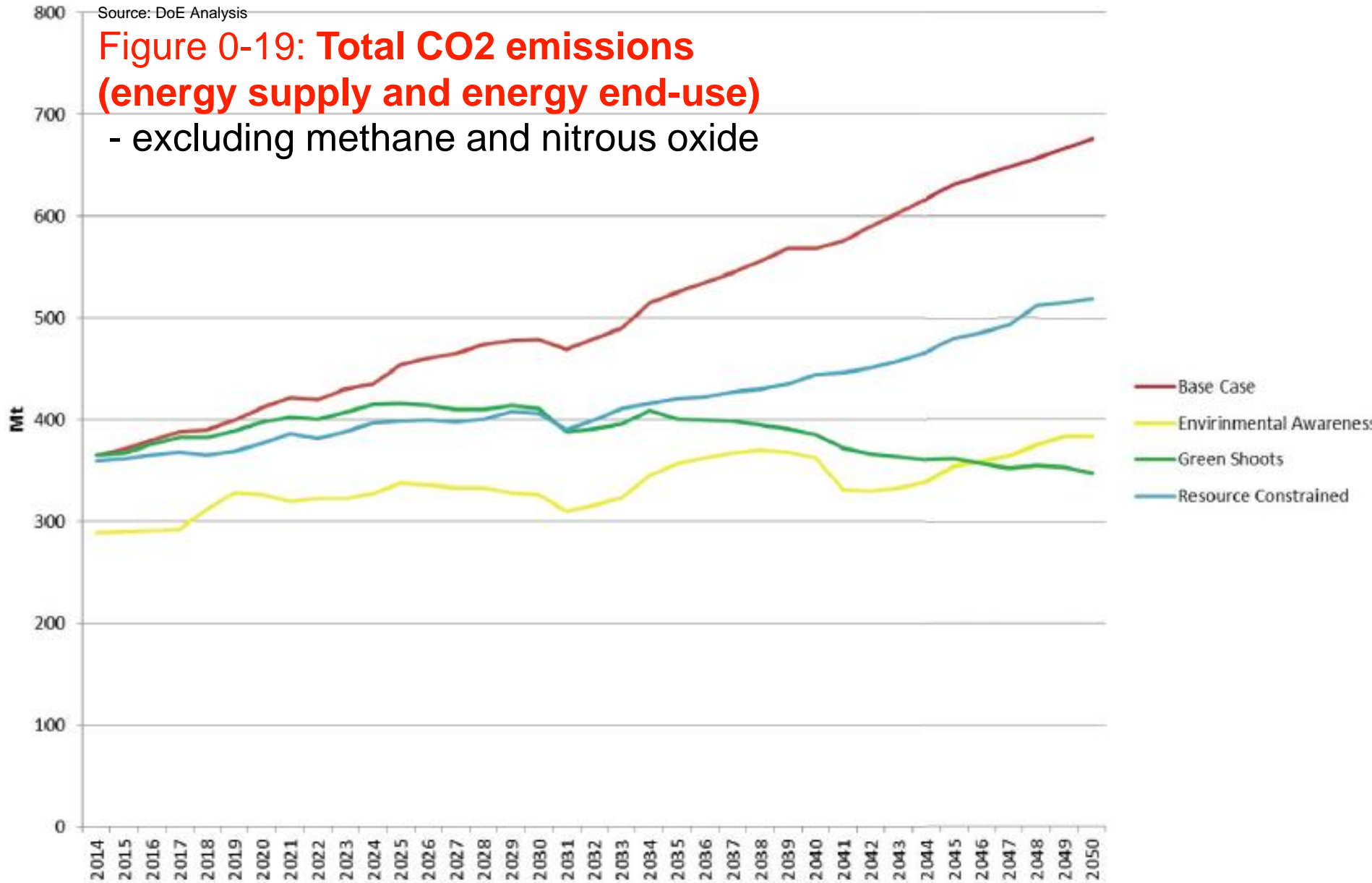
© www.climateactiontracker.org/  
Climate Analytics/Ecofys/  
NewClimate/PIK



# Total Carbon Dioxide Emissions

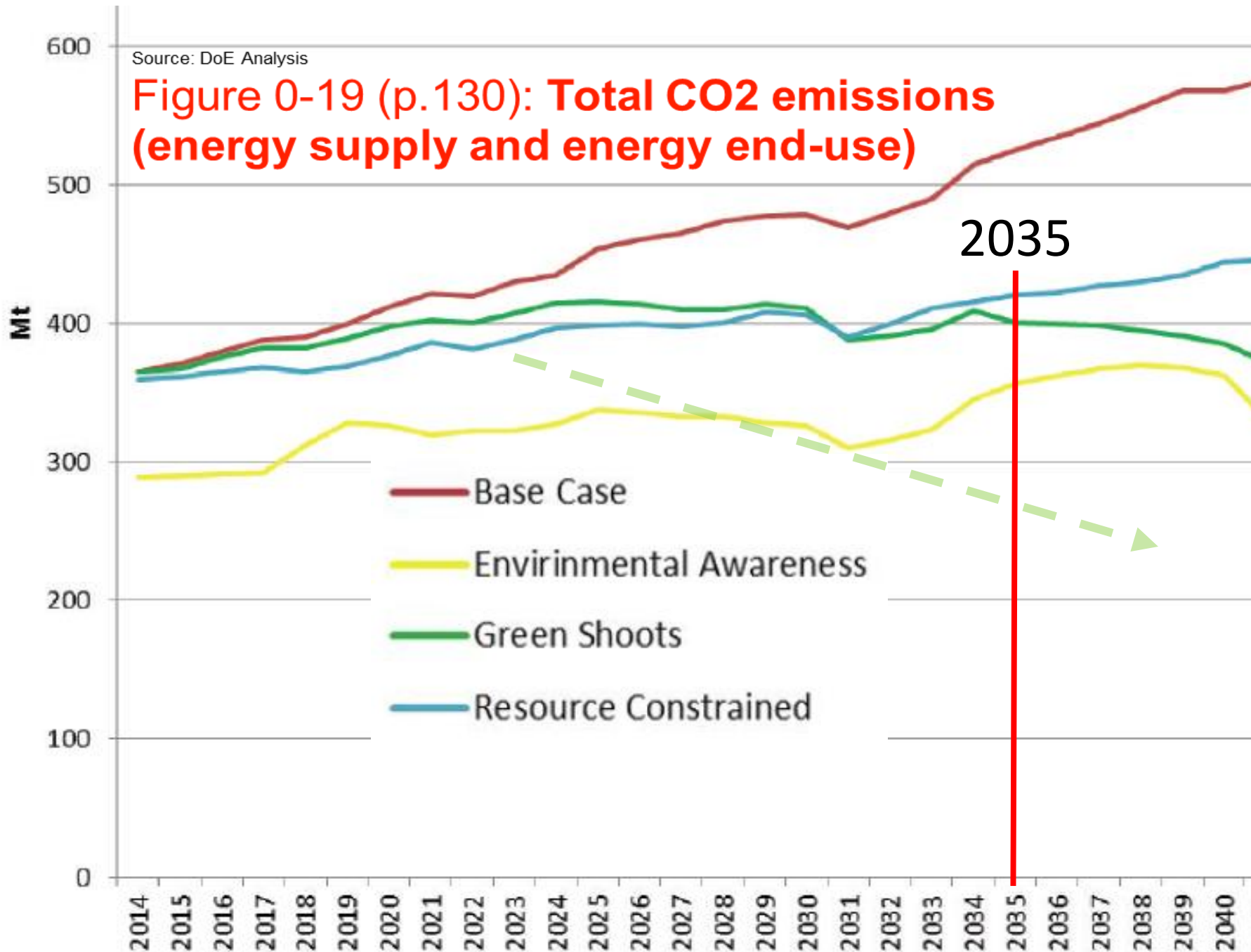
Source: DoE Analysis

**Figure 0-19: Total CO2 emissions  
(energy supply and energy end-use)  
- excluding methane and nitrous oxide**

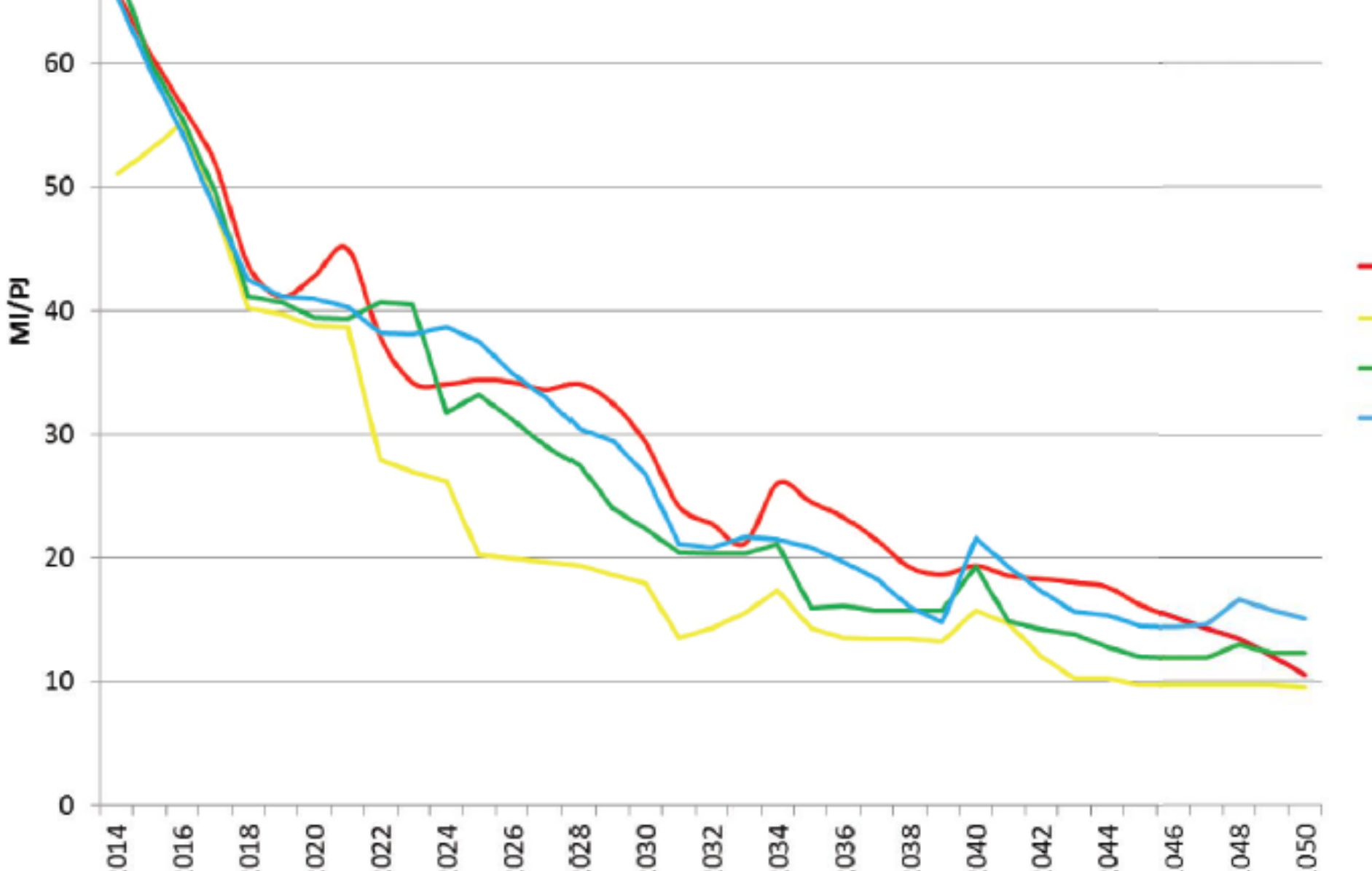


Source: DoE Analysis

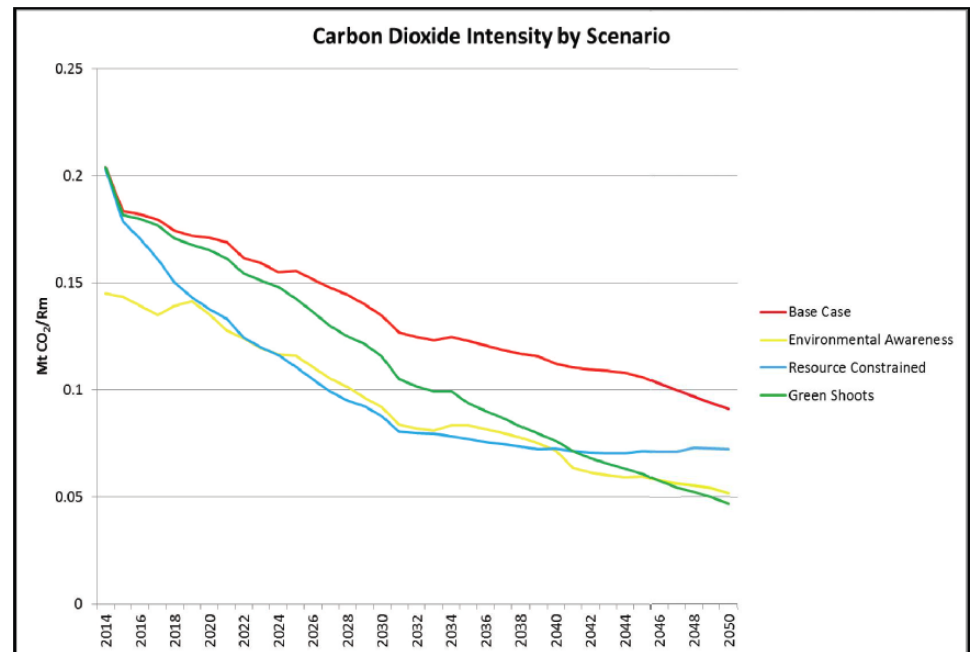
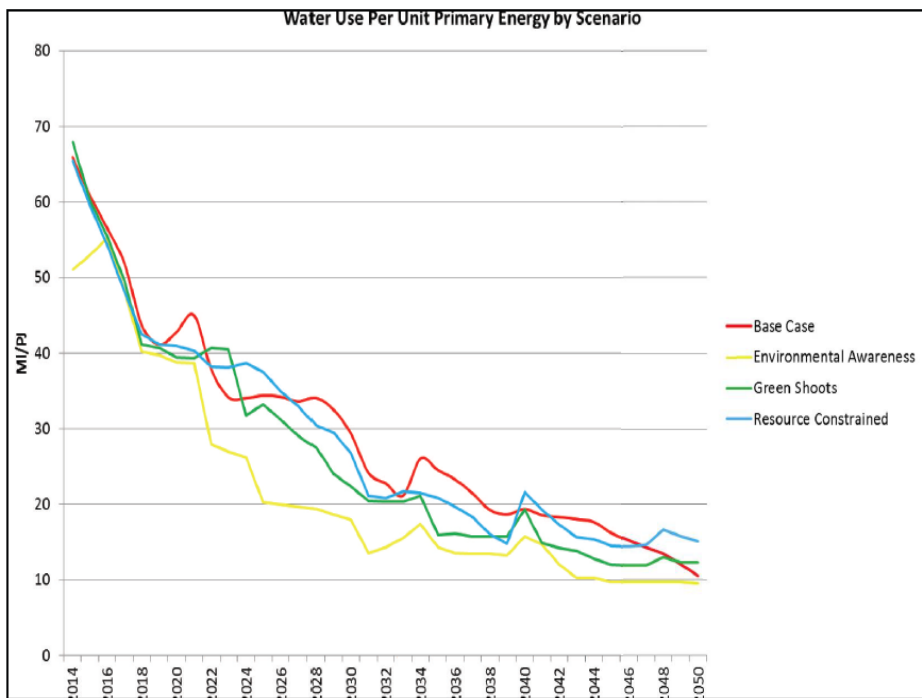
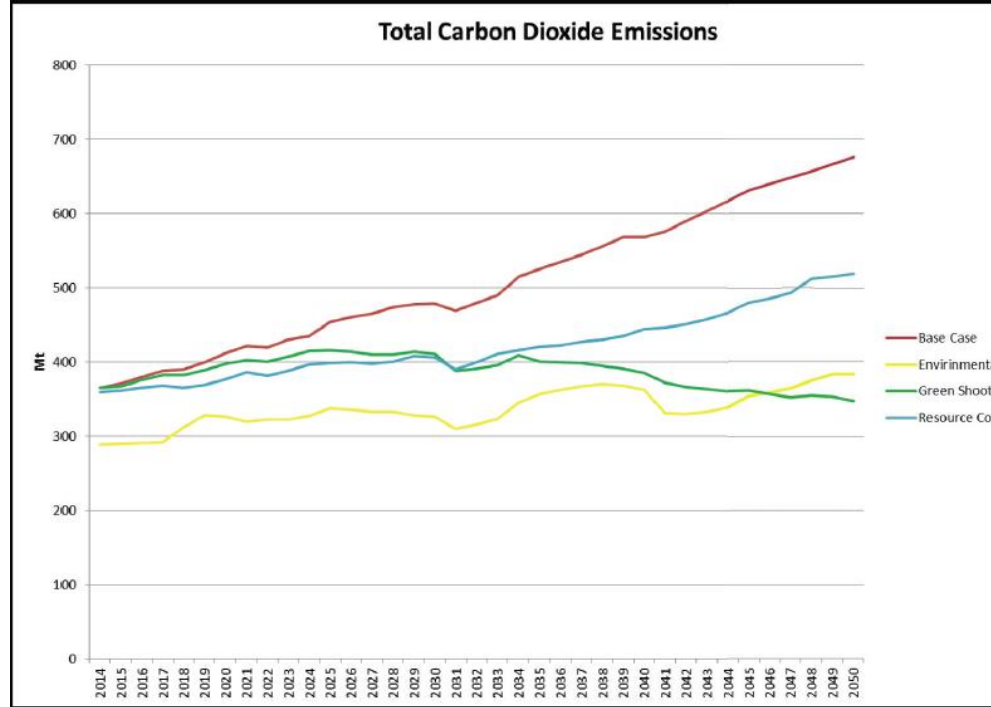
# Figure 0-19 (p.130): Total CO2 emissions (energy supply and energy end-use)



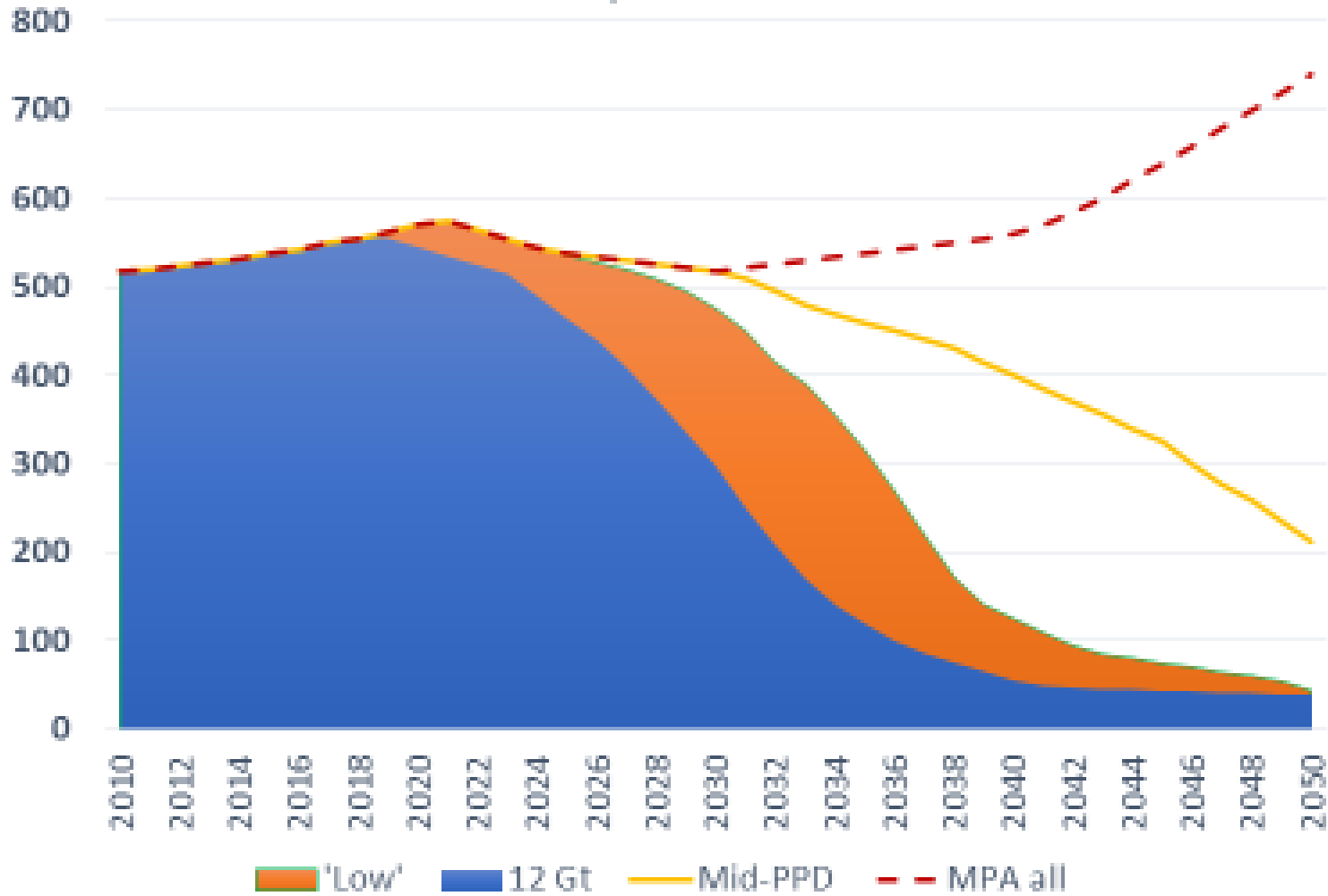
**Figure 0-23: "Total water use in the primary energy sector"**  
- water intensity per unit of energy



# Total water use in energy supply?



# South African Illustrative Trajectories with outcome required and 'fair' shares



**Southern African interior warming:**  
 Over 8 degrees  
 over 4 degrees globally

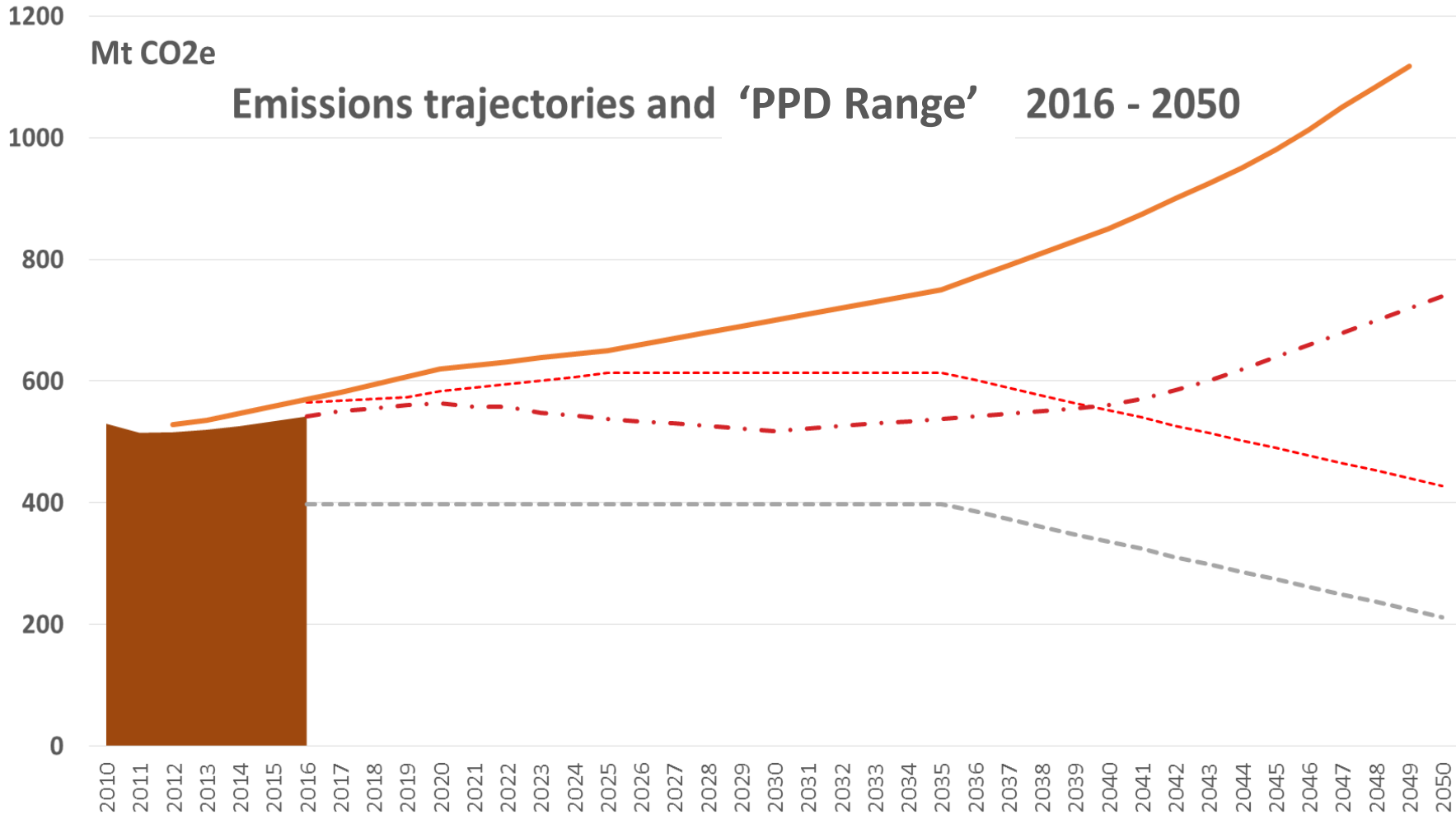
~ 5 – 6 degrees

~ 4 – 5 degrees

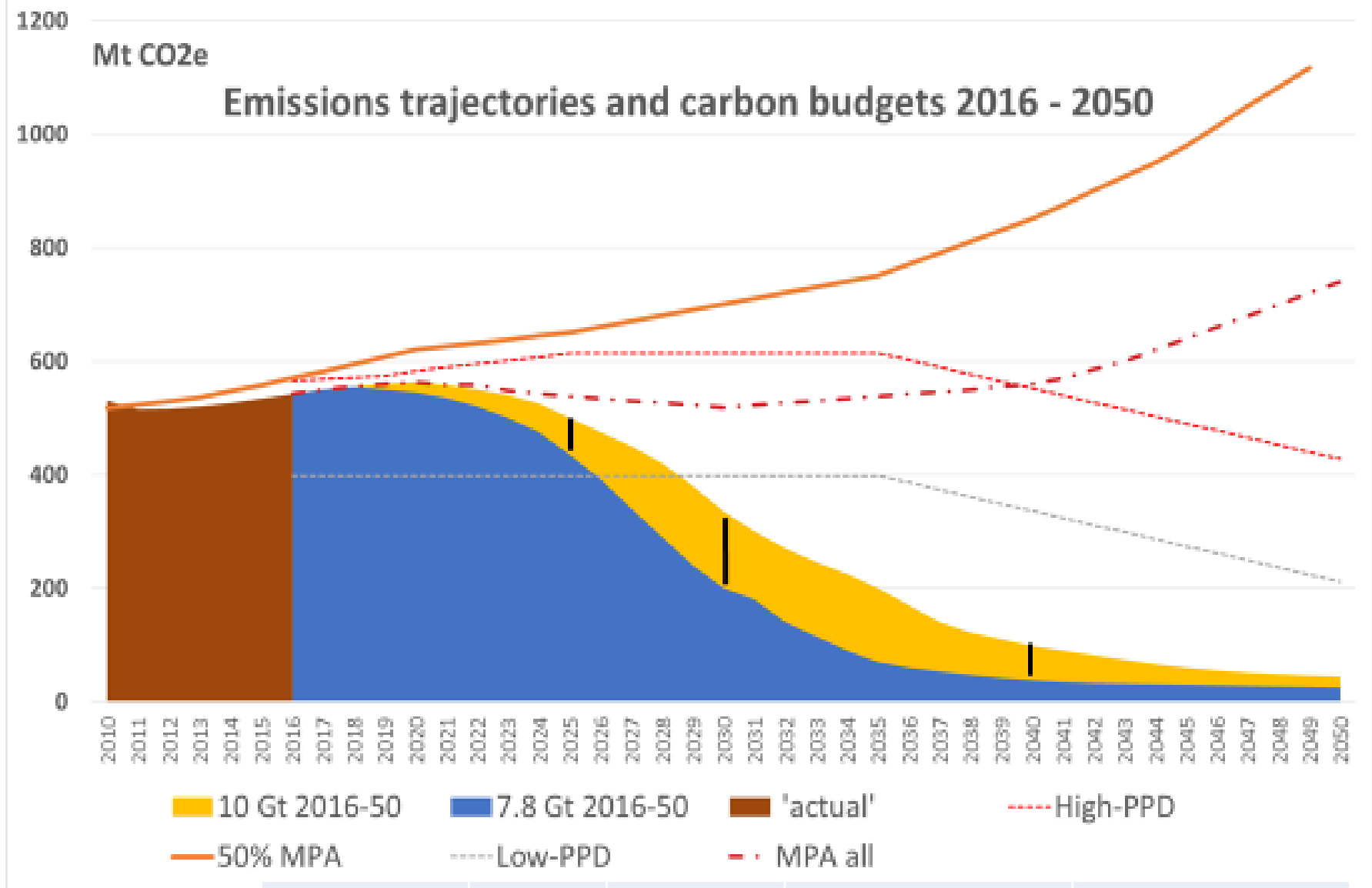
~ 3 – 4 degrees  
 below 2 globally

Mt CO2e

# Emissions trajectories and 'PPD Range' 2016 - 2050



■ 'actual'    ····· High-PPD    — 50% MPA    - - - Low-PPD    - · - MPA all



	2016 - 2050	2025	2030	2040	2050
<b>10 Gt</b>		500 Mt	335 Mt	98 Mt	44 Mt
<b>7.8 Gt</b>		435 Mt	200 Mt	38 Mt	25 Mt

# Carbon budgeting

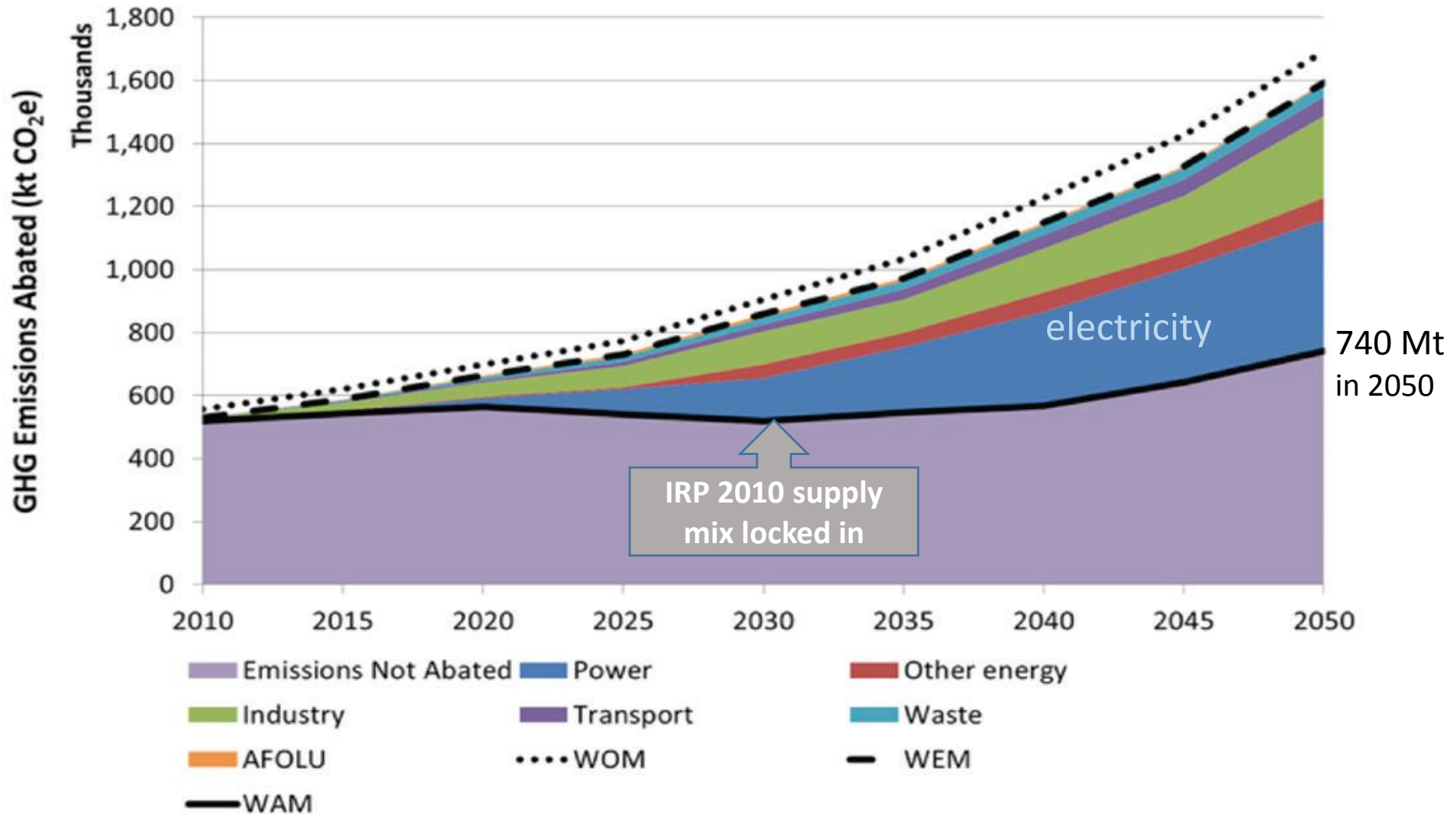
The term 'carbon budget' has a specific application within the DEA process to develop a 'Mitigation System', however

Carbon budgeting seeks to discover the optimal use of '**carbon space**' or allocation of emissions allowances, as well as how such allocation may need to change over time; it may be undertaken as an hypothetical allocation of a *proportion* of national greenhouse gas emissions into the future; it does not require setting an absolute limit.

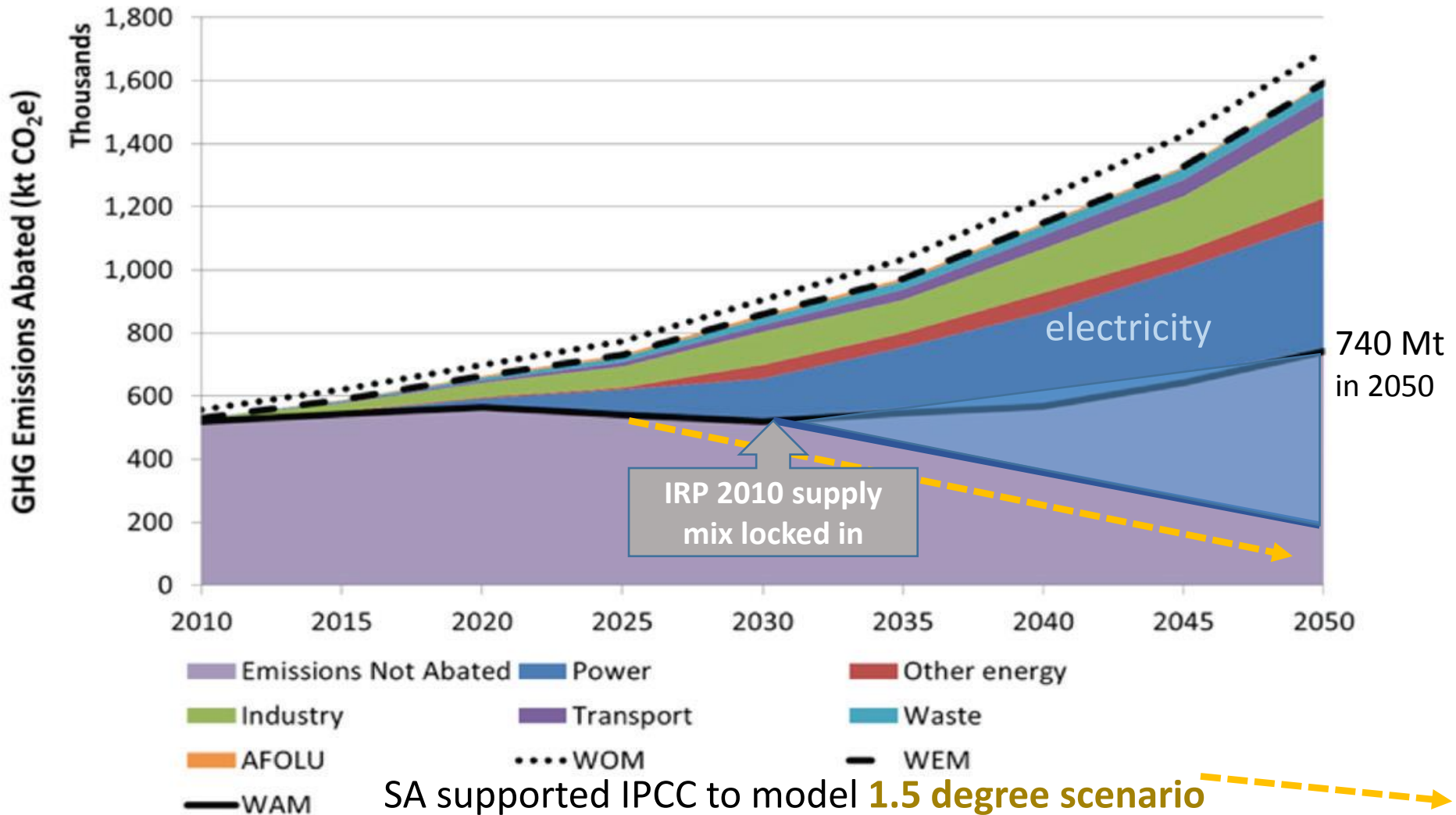
**A carbon budgeting approach is required to allow for prioritising development objectives:** energy services, welfare and macro-economic outcomes, alongside emissions objectives and above short term cost avoidance or deferral.

**Carbon budgeting ≠ imposing caps**

# Mitigation Potential Analysis: National abatement identified for detailed analysis is not the total national potential, particularly for electricity supply with fuel switching



# Mitigation Potential Analysis: National abatement identified for detailed analysis is not the total national potential, particularly for electricity supply with fuel switching



# CSIR (2016): Wind and Solar PV Resource Aggregation Study for South Africa - Public presentation of results; 3 March 2016; Dr. Stefan Bofinger, Britta Zimmermann, Ann-Katrin Gerlach – Fraunhofer IWES; Dr. Tobias Bischof-Niemz, Crescent Mushwana

## Three solar PV and three wind penetration levels defined

Overview of combination of solar PV and wind scenarios; load scaled to 500 TWh/yr total electricity

Solar PV energy penetration (one fixed spatial distribution defined)	Wind energy penetration			
	50 TWh/yr (~15 GW)	100 TWh/yr (~30 GW)	250 TWh/yr (~75 GW)	
	40 TWh/yr (~21 GWp)	<ul style="list-style-type: none"> <li>VRE Share: 18%</li> <li>9 Wind distribution scenarios</li> </ul>	<ul style="list-style-type: none"> <li>VRE Share: 28%</li> <li>9 Wind distribution scenarios</li> </ul>	<ul style="list-style-type: none"> <li>VRE Share: 58%</li> <li>9 Wind distribution scenarios</li> </ul>
	80 TWh/yr (~42 GWp)	<ul style="list-style-type: none"> <li>VRE Share: 26%</li> <li>9 Wind distribution scenarios</li> </ul>	<ul style="list-style-type: none"> <li>VRE Share: 36%</li> <li>9 Wind distribution scenarios</li> </ul>	<ul style="list-style-type: none"> <li>VRE Share: 65%</li> <li>9 Wind distribution scenarios</li> </ul>
200 TWh/yr (~104 GWp)	<ul style="list-style-type: none"> <li>VRE Share: 44%</li> <li>9 Wind distribution scenarios</li> </ul>	<ul style="list-style-type: none"> <li>VRE Share: 52%</li> <li>9 Wind distribution scenarios</li> </ul>	<ul style="list-style-type: none"> <li>VRE Share: 75%</li> <li>9 Wind distribution scenarios</li> </ul>	

Load for all scenarios:  
500 TWh/yr

Note: VRE = variable renewable energy, which is solar PV and wind (the only two variable power sources; dispatched by the weather and npt be the owner / system operator)  
VRE share is calculated on the basis of „useful VRE per total electricity demand“, i.e. curtailed VRE is not considered in these numbers

# CSIR Energy Centre on 40% RE by 2030

## 40% of the South African electricity consumption by 2030

(450 TWh/yr as per IRP2010) **from renewable resources**

- 25-30 GW of wind turbines (2-3 GW/yr)
- 25-30 GW of solar PV (2-3 GW/yr)
- 4-5 GW of biomass, biogas and CSP (300 MW/yr)

### **Prerequisites for a cost-efficient integration**

- Possibility to connect medium-sized wind and solar PV (approx. 1-30 MW per project) to existing grid
- Possibility to connect embedded generators behind customers' meters to the grid
- Creation of a procurement platform that allows cost-efficient procurement of energy/capacity, as well as reserves from a wide range of distributed sources through aggregators/Virtual Power Plants

### **Prerequisites for successful technical integration**

- Widespread spatial distribution of wind & PV to reduce short-term volatility of the aggregated profile
- Investments into grid infrastructure to unlock potential for wind integration in areas with no grid
- Flexibilisation of the existing conventional fleet to cater for increasing fluctuations of residual load
- 4-5 GW of flexible power generators from the biomass/biogas/CSP fleet in addition to the flexible gas fleet that is already planned in the IRP 2010 are sufficient to provide the required flexibility

Further cost reduction of electricity storage in form of batteries will be an added bonus to provide flexibility, however is not a necessary pre-condition for achieving a 40% renewables share by 2030

# Recommendations for IEP:

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**advance energy democracy**