

Deep decarbonization pathways in SOUTH AFRICA

February 2024

Lessons from the EU-funded research project IMAGINE



Table of contents

Introduction, scenario framing, research objectives, and modelling architecture-----	p3
Part 1 - National overview of the transition-----	p6
Part 2 - Sectoral deep decarbonization pathways-----	p14
Key policy lessons (<i>for national and international decision makers</i>)-----	p30

Introduction

This work takes place in a context where:

- *South Africa pledged in its 2020 Long-Term Low Emissions Development Strategy (SA-LEDS) to move towards a net zero CO2 economy by 2050 in a just and equitable manner. This study explores characteristics of potential emission pathways to 2050 under varying assumptions about mitigation ambition.*
- *National climate policy making is determined and contextualized by a wide range of factors, including international commitments and consideration of potential development of the multi-lateral climate regime. In the context of this study, two hypothetical future 'worlds' have been characterised to provide a comparison for domestic pathways within different global contexts:*
 - **World A:** *a more ambitious climate world with a strong multilateral rules-based regime, with stricter policies on carbon-intensive trade, a more rapid transition to EVs, reduced demand for fossil fuels and a greater market for 'green' export trade, and greater climate support for developing countries*
 - **World B:** *a more divergent climate world, with a slower transition to clean fuels, products and technologies, and more limited or no support to developing countries. This world comes with high risks that SA and other developing countries will be subject to greater pressure to mitigate than in World A.*

In this context and under the EU-funded research project IMAGINE, we defined a set of three development pathways :

- **The Current Policies Scenario (REF) : this scenario takes place in the World B.** It does not allow to meet carbon neutrality by 2050. Shares of fossil fuels in global energy production decline moderately, but not substantially, with prices and demand following the IEA Announced Pledges Scenario (APS) projections.
- **The 9 Gigatonnes cumulative carbon budget (9GT) and 2050 net zero CO2 :** this scenario takes place in the World A. It allows to meet net zero CO2 economy wide by 2050. Fossil fuel shares of global energy production decline significantly, particularly coal, and demand and prices drop in line with the IEA Net Zero Energy scenario (NZE) projections. This scenario represents a reasonable level of ambition.
- **The 8 Gigatonnes cumulative carbon budget (8GT) and 2050 net zero CO2 :** this scenario takes place in the World A. It allows to meet net zero CO2 economy wide by 2050. Fossil fuel shares of global energy production decline significantly, particularly coal, and demand and prices drop in line with the IEA Net Zero Energy scenario (NZE) projections. This scenario represents a higher level of mitigation ambition.

Research questions for scenario framing

1) What are the additional transformations required to reach net-zero CO2 emission before 2050 in the current South African context?

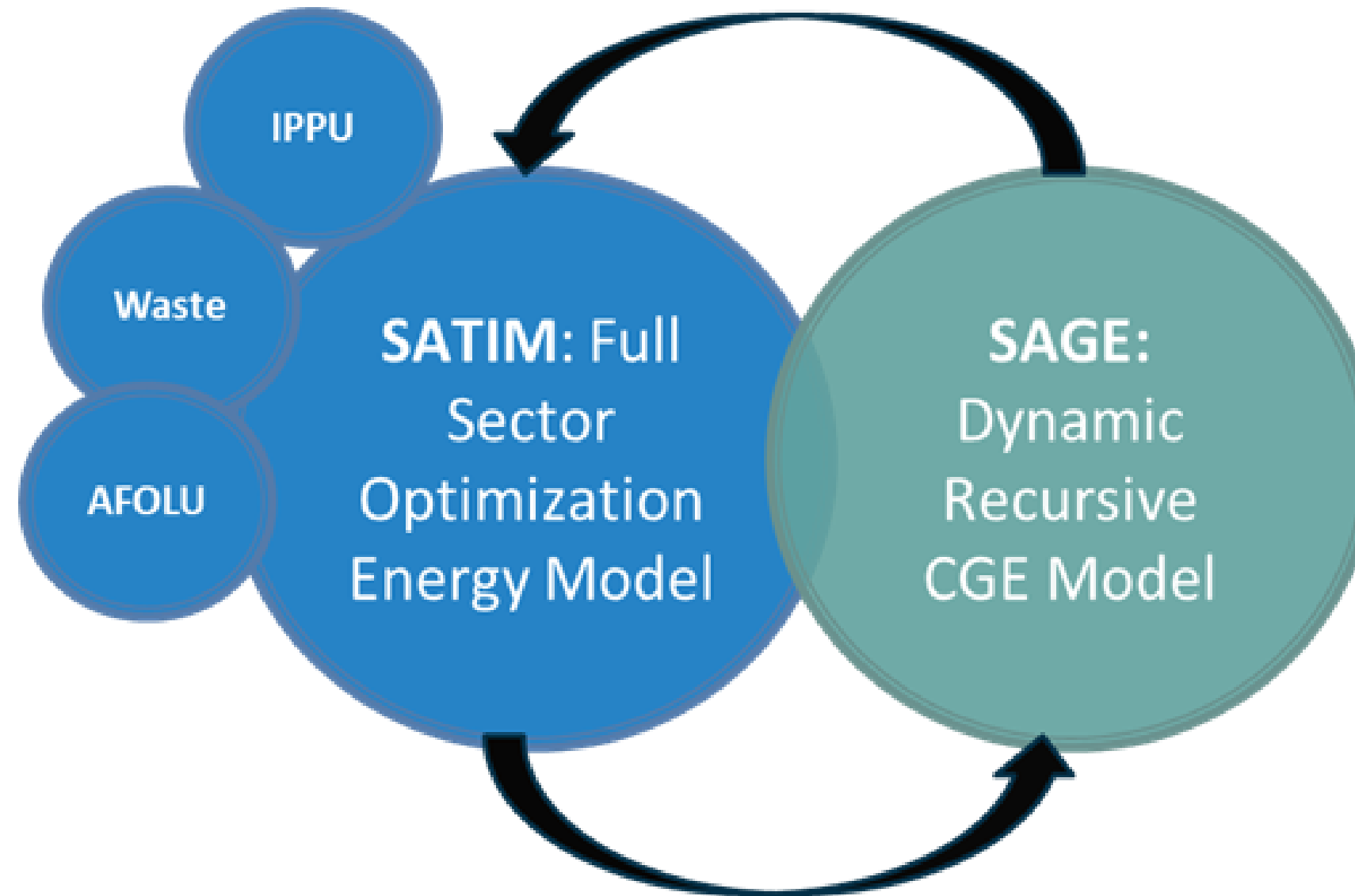
2) How to achieve this transition in an equitable manner?

The comparison of REF with 8GT will inform us on the additional transformations needed to reach carbon neutrality by 2050.

Other key country-specific questions aim to be informed by this work:

- What are the main emitting sectors and what sectors should be particularly address if we include all greenhouse gas emissions in the carbon neutrality target?
- How could this work support the revision of national development and climate policies and future UNFCCC's commitments?
- What key global and sectoral transformations must be considered to enable national Paris-compatible pathways?
- What are the key international enablers and cooperation needs for these sectoral transformations?

Modelling architecture & improvements



The modelling analysis for this study was performed using the Energy System Research Group (ESRG) SATIMGE modelling framework, which consists of two separate models – SATIM (energy) and SAGE (economy) – that are linked together and solved iteratively. Details of these models can be found in the Policy Brief on localisation

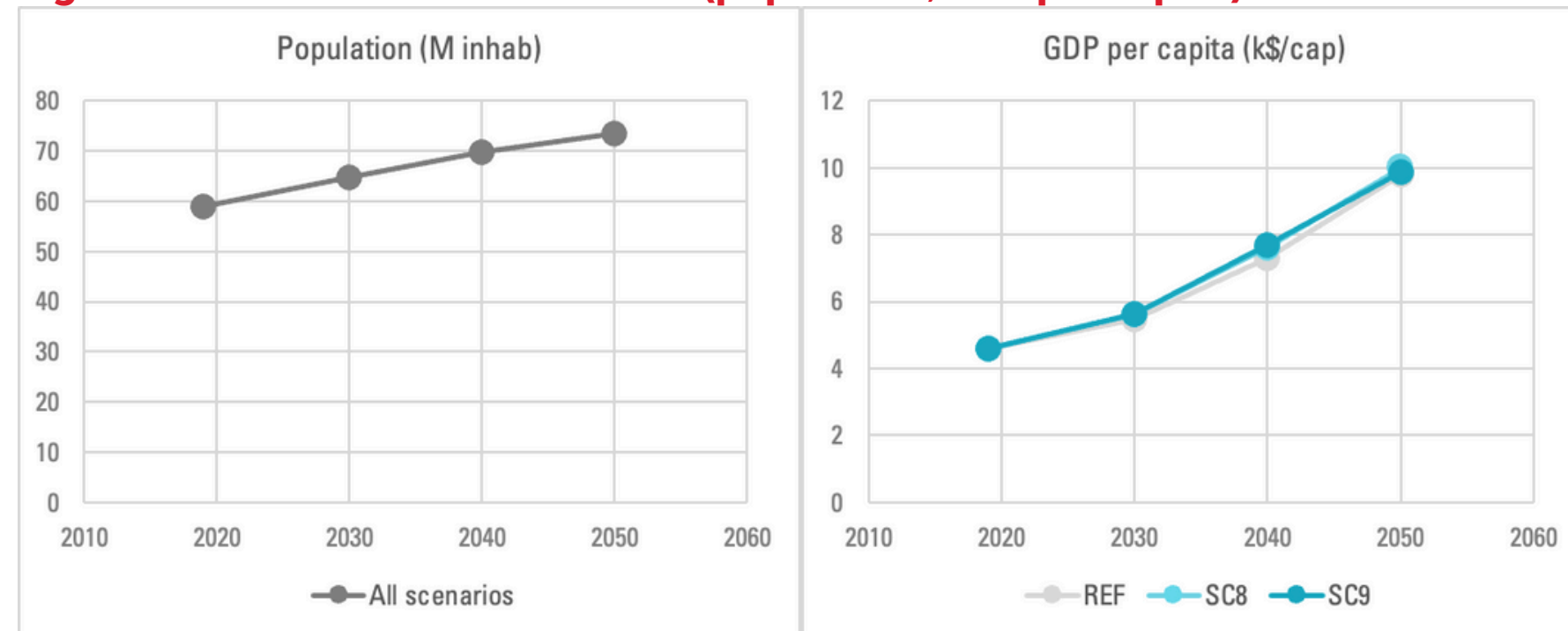
Part 1

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National overview of the deep decarbonization pathways

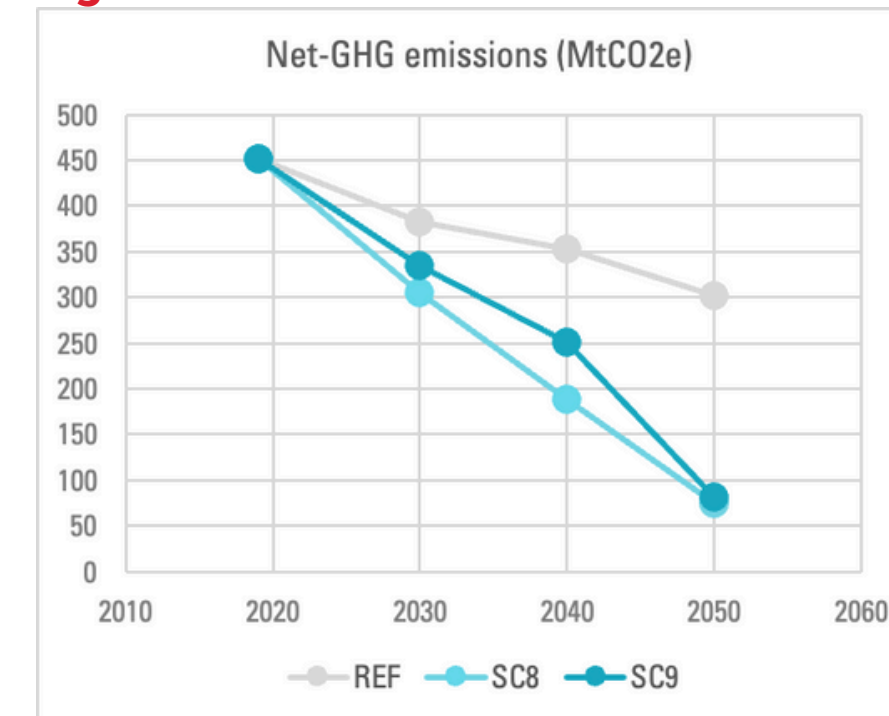
Reaching net-zero GHG emissions by 2050 is feasible, while ensuring socio-economic development

Figure 1. Socio-economic indicators (population, GDP per capita)



- The population of South Africa increases moderately, from 58.8 Million in 2019, to 73.5 Million by 2050.
- GDP per capita increases at an average pace of 2.5% pa. Unemployment declines in all scenarios as the economy grows in each scenario.
- Investment in the power sector in a 9Gt is roughly the same as the unconstrained REF scenario to mid 2030s. The 8Gt (higher ambition) scenario, requires more investment than these, starting in the late 2020s.

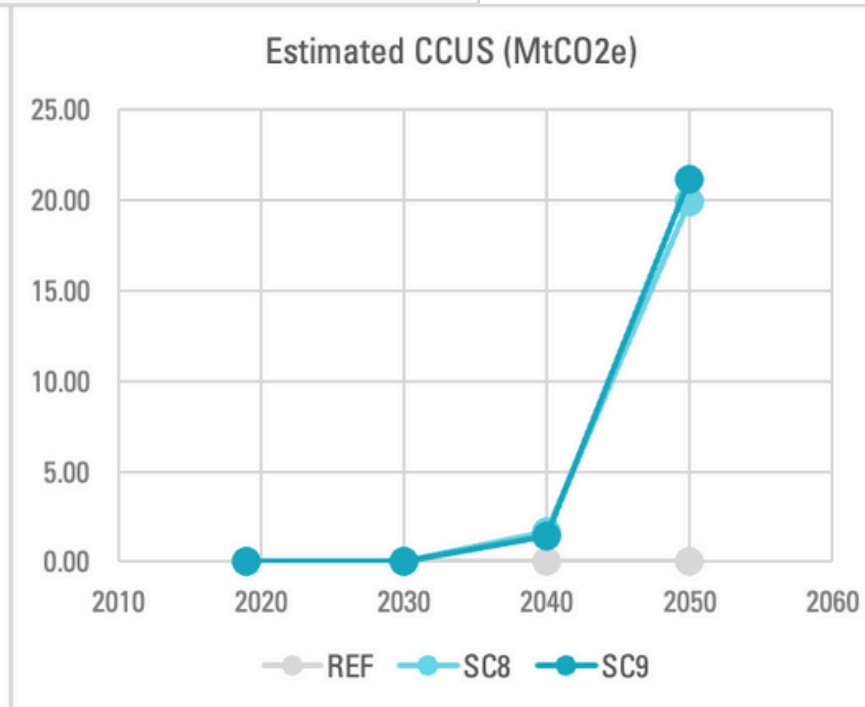
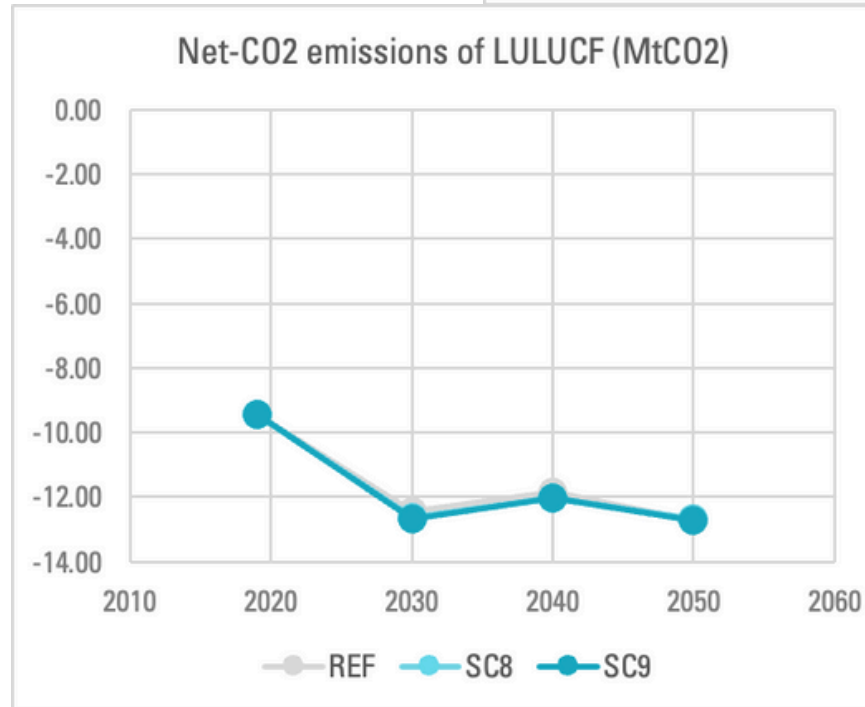
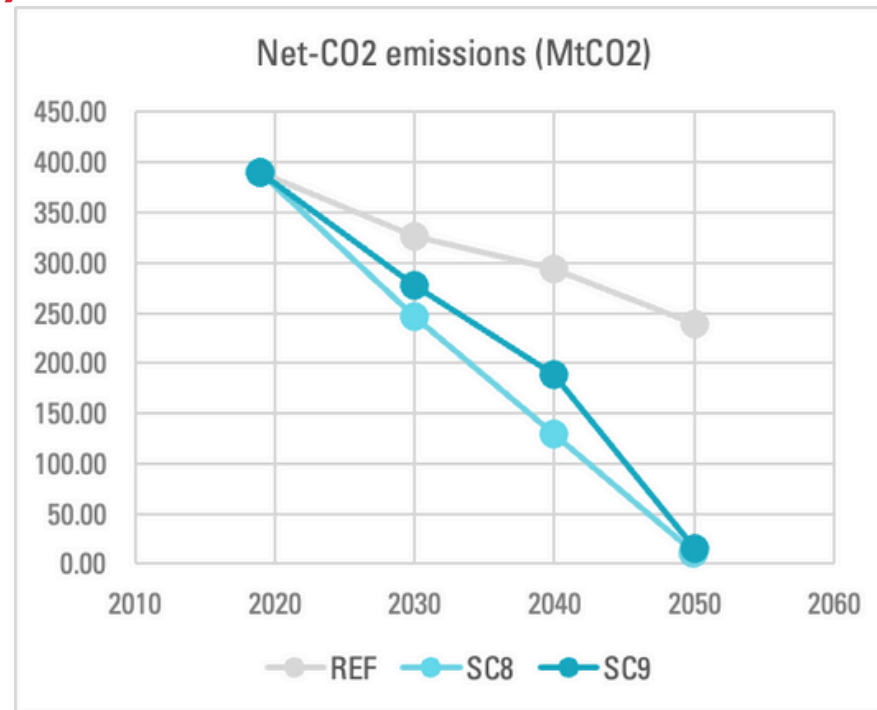
Figure 2. National net GHG emissions



- Net GHG emissions decrease in all scenarios, with wide ranges in 2030 from 412 MtCO2-eq in REF to 362 MtCO2-eq in 9GT and 331 MtCO2-eq in 8GT
- GHG emissions for both 9GT and 8GT are around 89 MtCO2-eq in 2050 (comprised of CH₄, N₂O and other non-CO₂ emissions)
- CO₂ emissions reach net zero in both 9GT and 8GT in 2050

Total net-CO2 emissions represent about 85% of all net-GHG emissions and could become slightly net-negative by 2050

Figure 3. National net-CO2 emissions. Top: net-CO2 emissions. Bottom: net-CO2 emissions of LULUCF (left) & estimated CCS (right)



More than 90% of gross CO2 emissions (excluding LULUCF) comes from fuel combustion and are mainly driven by the energy consumption and the current reliance on fossil fuels notably on coal. Emissions from industrial process represent around 7% of the gross CO2 emissions. Agriculture (excluding fuel combustion) represents 0.4% the total CO2 emissions. Waste emissions are not accounted. LULUCF sinks absorb 12% of the CO2 emissions in 2030 (8GT).

CO2 emissions sources excluding LULUCF are expected to decrease in all scenarios. The 8GT reaches carbon neutrality in 2050, with the land sink accounting for -13 MtCO2 and CCS -22 MtCO2. The REF scenario decreases to 227 net MtCO2 in 2050 (incl. LULUCF and CCS)

The main decarbonization drivers are :

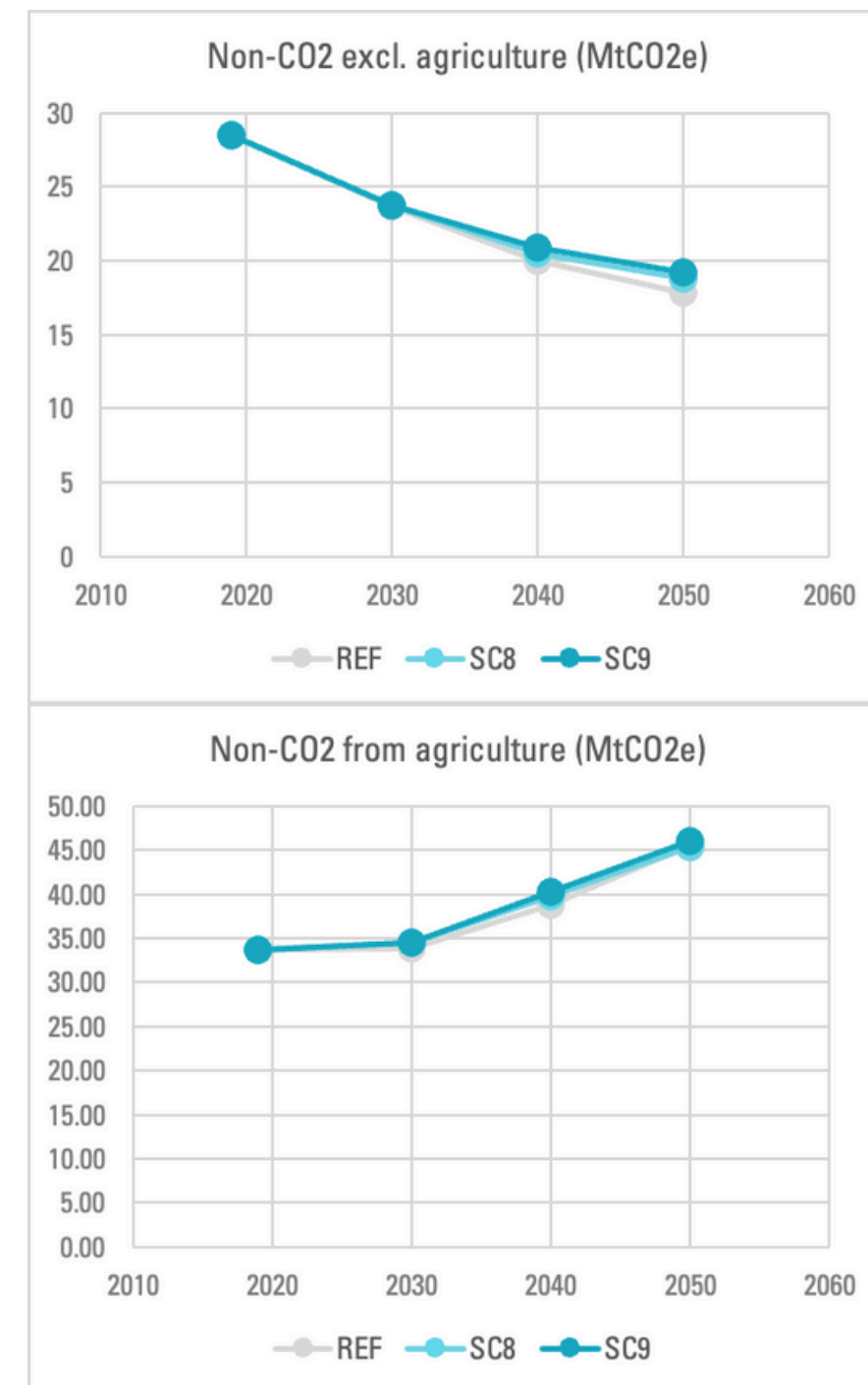
- the development of and transition to non-fossil based power production (mainly solar and wind, and a small amount of nuclear in the 2040s),
- the development of CCS infrastructures by 2040, to reach 22 MtCO2 captured in 2050 in the 8GT. It will allow to capture gas power plants' emissions and cement and chrome IPPU emissions in both 8GT and 9GT.
- Improvements in energy efficiency in industry, residential and commerce sectors, and switch to EVs (powered by low carbon electricity) in the 9GT and 8GT scenarios

Total non-CO2 emissions represent 15% of all GHG emissions and 80% of the in 2050

Figure 4. National non-CO2 emissions.

Top: Non-CO2 emissions excluding Agriculture.

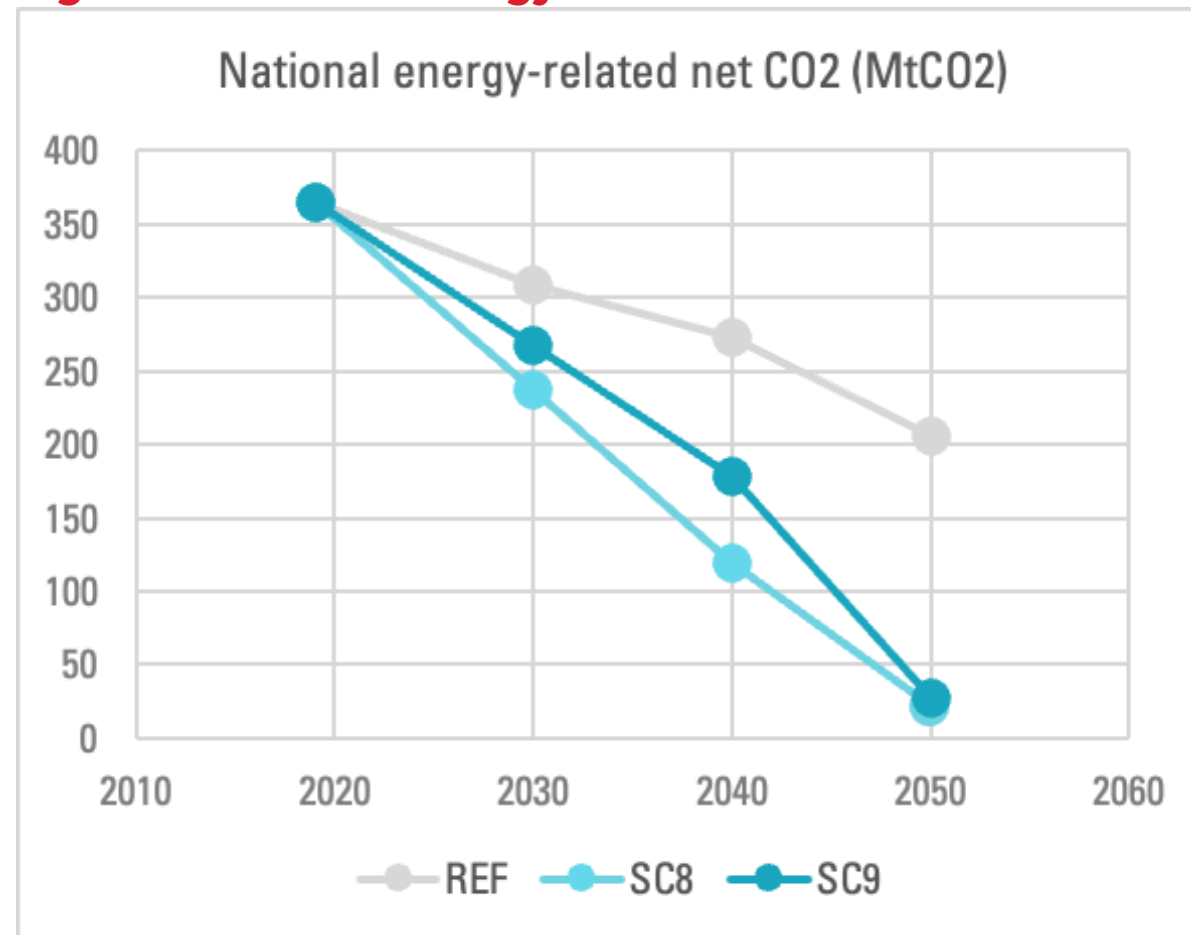
Bottom: Non-CO2 emissions of Agriculture



- Total non-CO2 emissions increase by 2% (REF) 5% (8ton), 3% (9ton) respectively in the 3 scenarios during 2020-2050. 54% of non-CO2 emissions come from agriculture in 2020, and 46% come from the waste sector in 2020. No other sector emits non-CO2 emissions in the scenarios.
- Without mitigation efforts in these sectors for non-CO2 gasses, by 2050 these gasses represent almost 80% of South Africa's GHG emissions, and these are mostly in the AFOLU sector
- Agriculture : as the population increases, and thus the overall agriculture activity, non-CO2 emissions from agriculture increase by 35% in the 8ton scenario (and increase very similarly in other scenarios).
- Waste (not shown here) : with improved waste management policies, non-CO2 emissions from waste could reduce by 34%

Total energy-related CO2 emissions represent 80% of all GHG emissions and could be reduced by 96% by 2050 (1/3)

Figure 5. National energy-related CO2 emissions



- Energy demand is expected to increase in all scenarios, and especially in mitigation scenarios where clean electricity can provide the energy for economic activity.
- With mitigation effort, South Africa's energy system and CO2 would need to decarbonize by ~24% by 2030 relative to an already decarbonizing REF trajectory.
- The 9Gt scenario represents an effort to decarbonize South Africa in line with global efforts to meet Paris Agreement goals of "less than 2C", while the 8Gt scenario could be seen to be an effort by South Africa in line with a global effort to keep 1.5C target alive. This level of effort would require much faster decarbonisation after 2030 – with additional 20% decarbonisation effort over the 9Gt.

Total energy-related CO2 emissions (2/3): Reducing energy-related CO2 emissions requires systemic and technological changes to improve energy efficiency and reduce the fuel carbon content

Figure 6 . Energy consumption (PJ/capita)

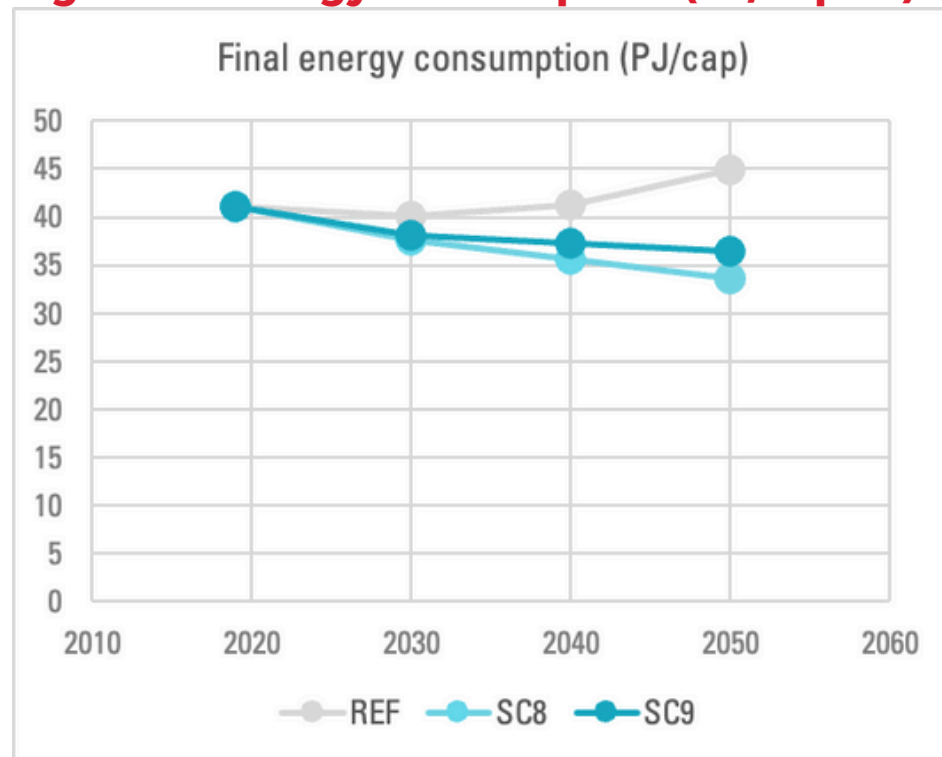


Figure 7. Energy consumption (PJ/GDP)

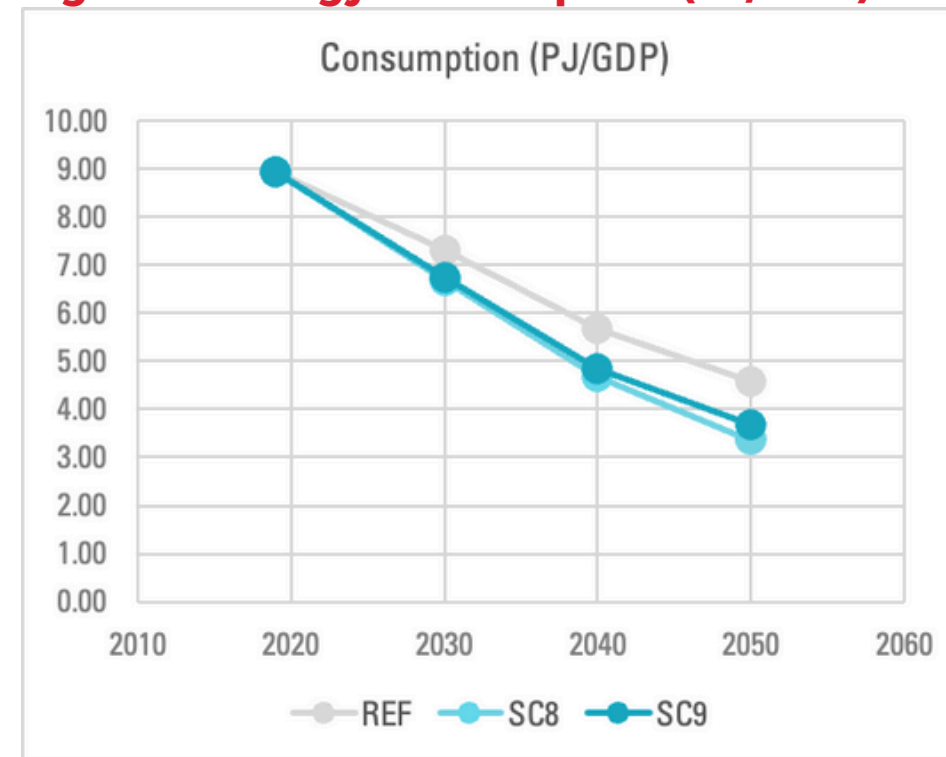
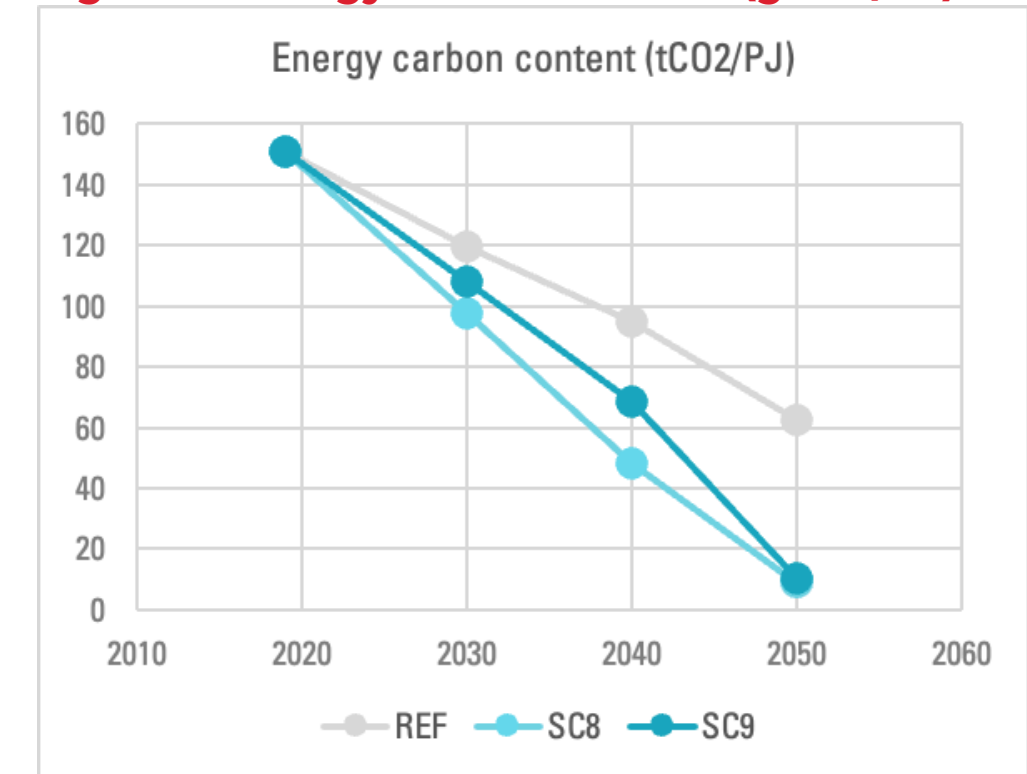


Figure 8. Energy carbon content (gCO2/PJ)

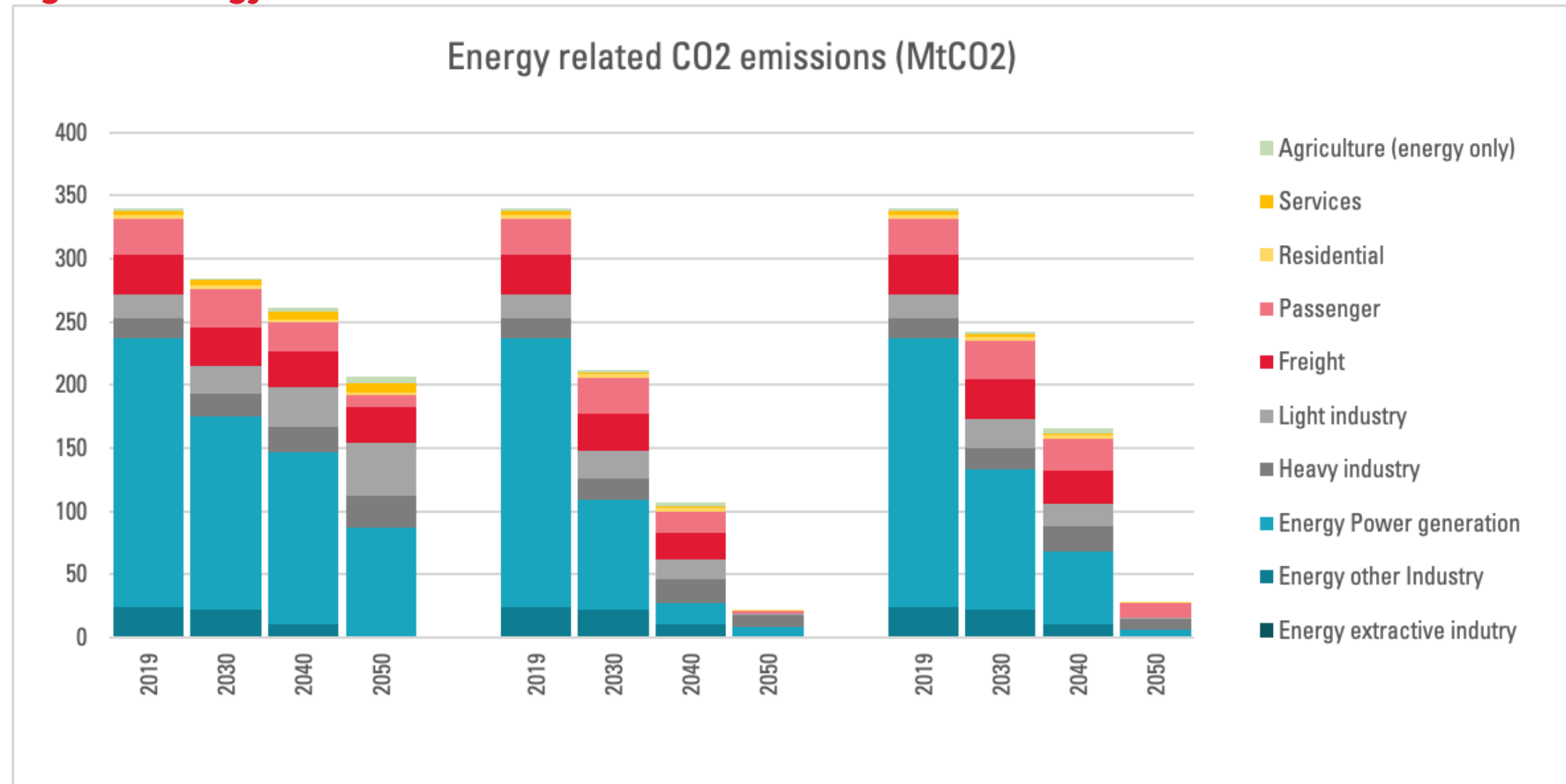


- Final energy consumption per capita increases 10% by 2050 in the REF case relative to 2019 levels, while it decreases by 14% and 16% over the same period for the 9GT and 8GT respectively. Electricity, which replaces fossil energy source, is generally more efficient to utilize to produce the same services in industry, and transportation.
- Energy intensity (measured as final energy consumption (GJ) relative to GDP (thousand 2022 ZAR) decreases across all scenarios, with a 41% reduction from 2019 to 2050 in the REF scenario and 54% and 55% reductions in 9GT and 8GT respectively.
- These results show that energy consumption becomes more efficient across all scenarios, and particularly in climate constrained scenarios where adoption of more efficient technologies is a decarbonisation driver.

- Across all three scenarios, the emissions intensity of the energy sector reduces significantly with the uptake of cost competitive renewable generation technologies, and this accelerates in the 9GT and 8GT scenarios. By 2050, emissions intensity of energy has reduced 60% below 2019 levels in the REF case. The reduction is 98% in each of the 9GT and 8GT scenarios where coal is phased out in the early to mid 2040s.

Total energy-related CO2 emissions (3/3): The key energy-related sectors for deep decarbonization are the power sector, transport, and other energy industries

Figure 9. Energy related CO2 emissions



From now until 2030, the sectors with the highest emissions are the power sector and transport, both freight and passenger and other energy industries. To get closer to the NDC objectives, the majority of the decarbonization effort is from the power sector shifting to renewables. Electric vehicle uptake in transportation sector both utilizes the cleaner electricity from the power sector, and uses less of the synthetic coal-based liquid fuels (OtherEnergy Refining).

Part 2

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Sectoral deep decarbonization pathways in the 8GT scenario

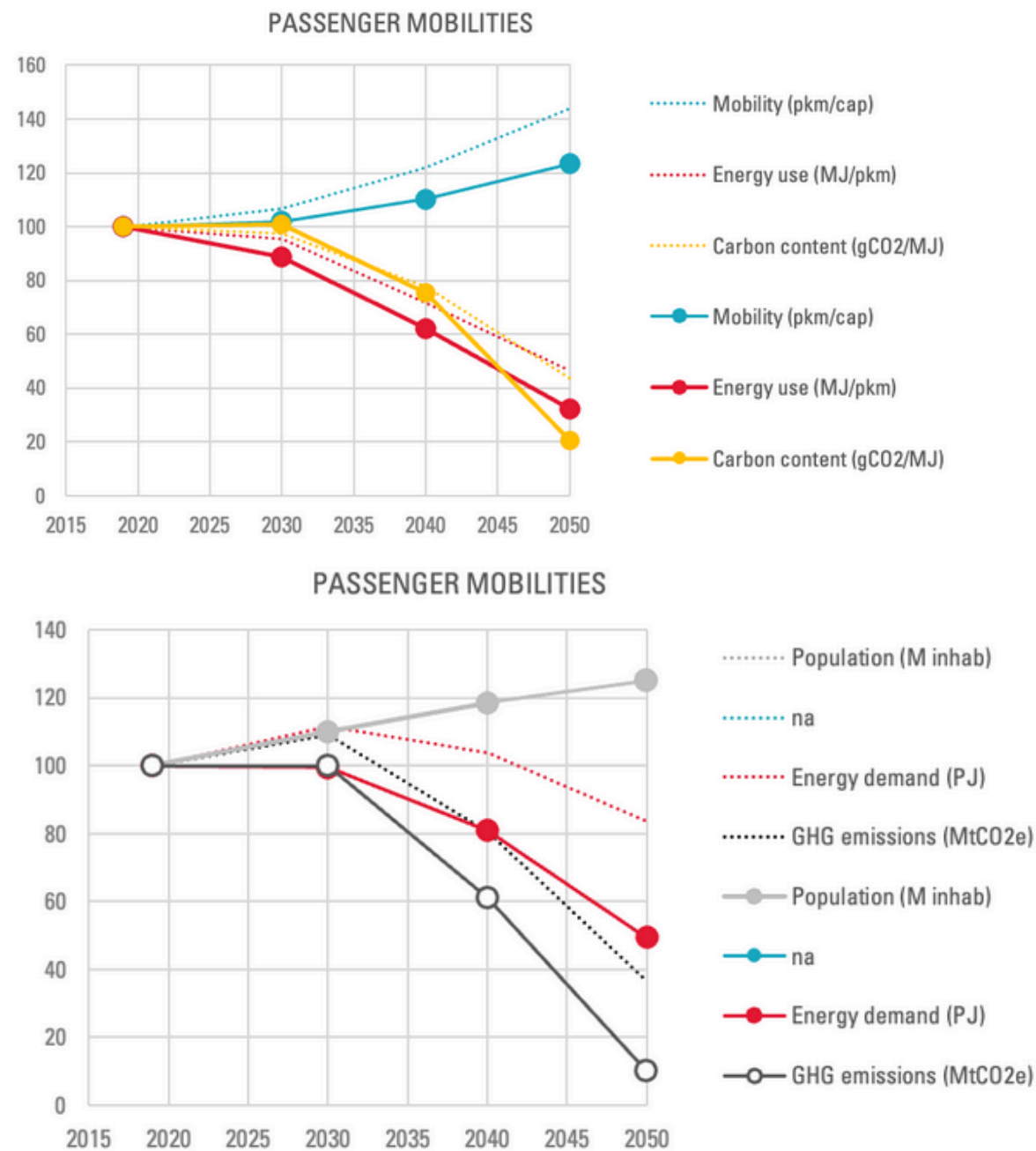
Part 2.1

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Transition of energy-related emission sectors: Transport, Buildings, non-energy producing Industries

Developing Paris-compatible PASSENGER MOBILITIES

Figure 12. Sectoral emission drivers and main aggregates (Index, 2019 base year)



Notes:

Non-motorised mobility, IWWC and national aviation are not represented in pkm/cap, but national aviation and IWWC energy and emissions are integrated.

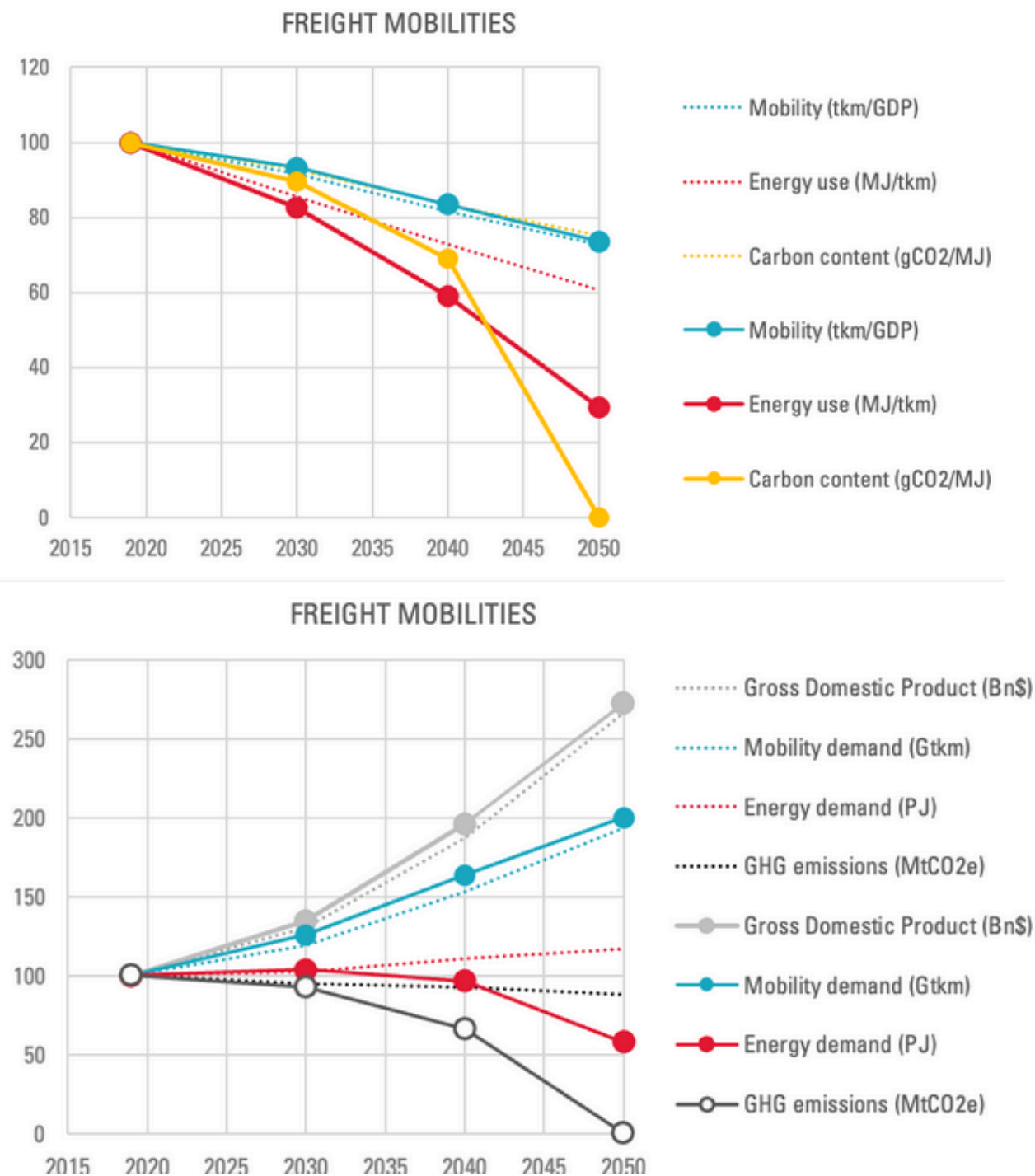
- Mobility demand and kilometers travelled are increasing in both scenarios, but lower in the 8GT scenario. In the REF, unplanned urban sprawl is expected, while urban, spatial and transport development policies are better planned in the 8GT with the long-term perspective to create more mixed-use neighbourhoods where daily necessities are within a 15-minute walk, bike ride or accessible with public transport. This improved land-use design should also reallocate space in favour of eco-friendly transport options with additional infrastructure investments in sidewalks, bicycle lanes, dedicated bus and rail tracks. It will allow to moderate the shift to individual private cars in the 8GT scenario. This approach not only addresses social issues but also contributes significantly to reducing carbon emissions, aligning with the principles of a Just Transition.

- Regarding the vehicle and fuel transition, the share of non-fossil fuels reaches up to 66% by 2050 compared to 62% in the REF with only aviation and maritime accounting for fossil fuel use. This is due to an accelerated shift towards electric and hydrogen-based vehicles. To boost EV adoption in the short-term, subsidies for non-luxury EVs are essential given their current high cost and the establishment of charging stations around all main metropolitan areas. Affordable EV segments are key to mass adoption, and government and large fleet owners can accelerate EV adoption by embracing these vehicles in their fleets with dedicated mandates. In addition, South Africa's rich mineral resources, international manufacturing standards, could make it a significant player in the Sub-Saharan Africa EV mineral supply chain, if the country adopts EV manufacturing regulations to attract investment in local EV production and transform the existing automotive industry.

- Combined these additional transformations enable to divide passenger transport energy consumption by two compared to REF. In addition, it enables to cut emissions by 90% over the period 2020-2050, while the current policies could reduce it by 63%.

Developing Paris-compatible FREIGHT MOBILITIES

Figure 13. Sectoral emission drivers and main aggregates (Index, 2019 base year)

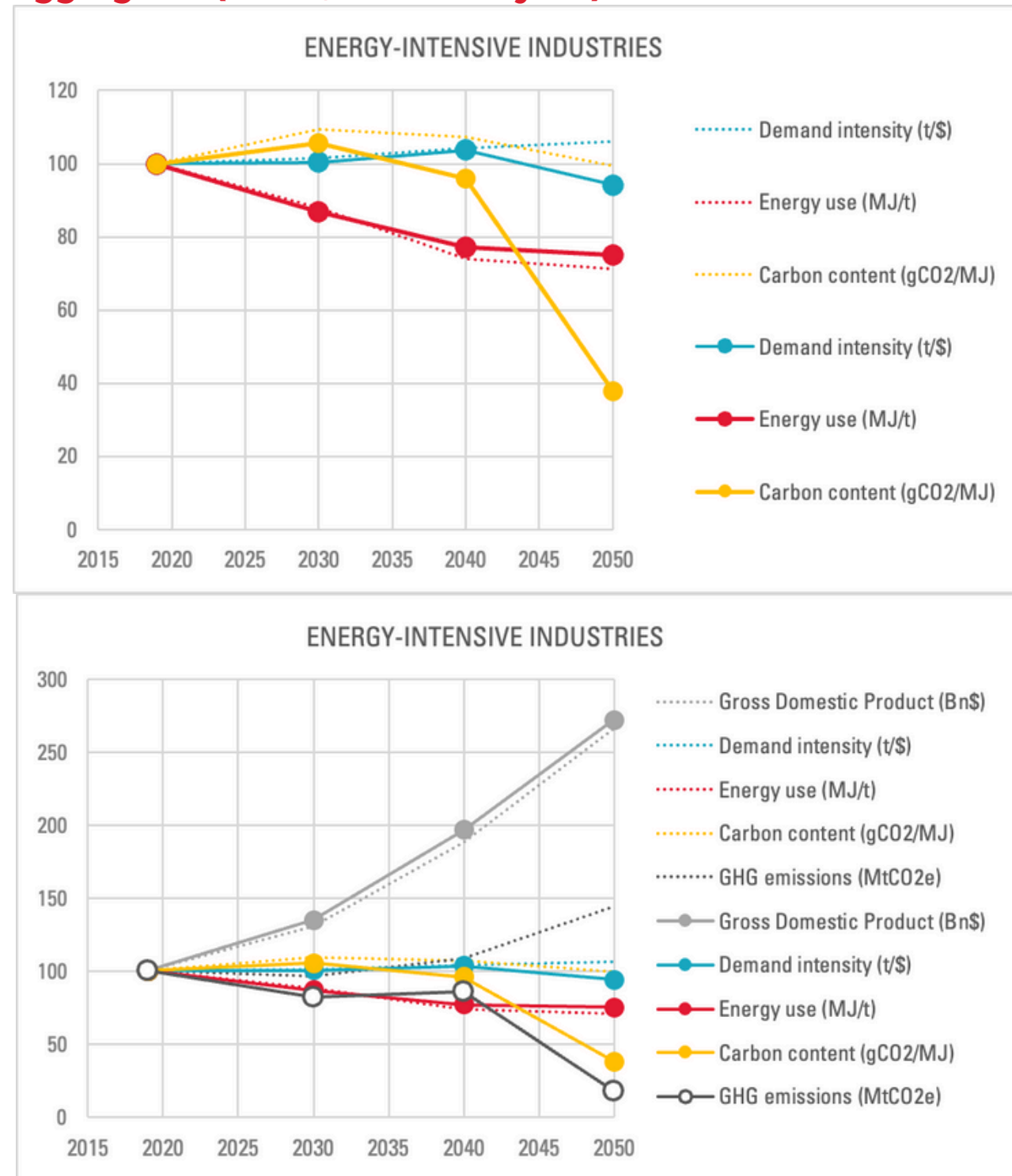


Notes: IWWC and air freight are not included.

- In both scenarios REF and 8GT, the industrial and economic system follows a similar evolution with a reducing share of non-agricultural and non-service industries in GDP over time which mostly explained a slight decrease in freight transport intensity to GDP over time. However, as real income levels increase, as well as population and overall production, this leads to an increased national consumption of goods and a doubling of freight transport demand in tonne.kilometers (tkm) over the period 2020-50.
- However, the logistics organisations are evolving differently. The industrials are increasing their use of rail freight in the 8GT scenario, which will make up to 41% of all tkm compared to 33%. But at the same time, the use of light commercial vehicles will explode driven by final consumer demand, e-commerce. While this shift could create additional traffic and congestion challenges, it also facilitate the electrification of road vehicles. Finally, the decarbonisation of fuels is accelerated compared to REF and non-fossil fuel energy represents up to 33% vs 19% of final energy consumption by 2040 and 100% vs 25% by 2050. This is mainly due to strong electrification of road vehicles
- Combined these additional transformations enable to divide freight transport energy consumption by two compared to REF. In addition, it enables to cut completely emissions over the period 2020-2050, while the current policies could only cut it by 10%.

Developing Paris-compatible ENERGY-INTENSIVE INDUSTRIES

Figure 14. Sectoral emission drivers and main aggregates (Index, 2019 base year)



The economy continues to grow, and develop, and the need for products, infrastructure, and other goods continues to grow with it. Thus industrial activity increases as well.

Emissions in the EII's decline in the mitigation scenarios owing to technology changes, the main drivers of change are:

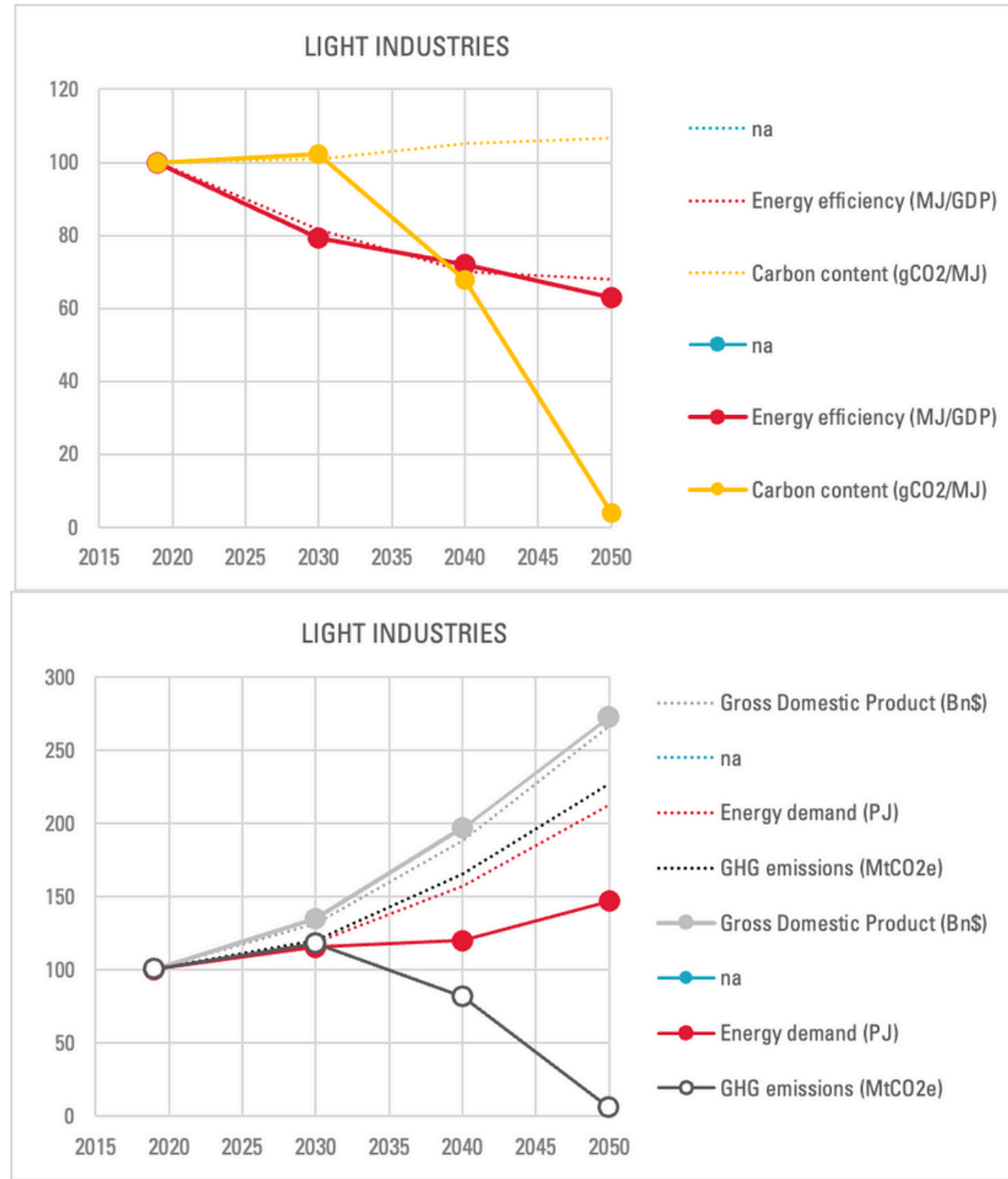
- Switching to new technologies for large EII's like hydrogen for steel production, biocarbon for other hard to abate sectors like chrome,
- the development of CCS infrastructures – notably for cement industries.
- Electrifying industries where-ever possible to electrify

Generally, for heavy industry, thermal requirements make switching to electricity more expensive than burning coal or gas, and the decarbonization in this sector (apart from steel) does not move quickly.

Energy Intensive Industries owing to the risk they are exposed to with their long investment cycles for new production facilities (technologies) will need support for investment into **new technologies** that are expensive, and not yet fully proven commercially.

Developing Paris-compatible LIGHT INDUSTRIES

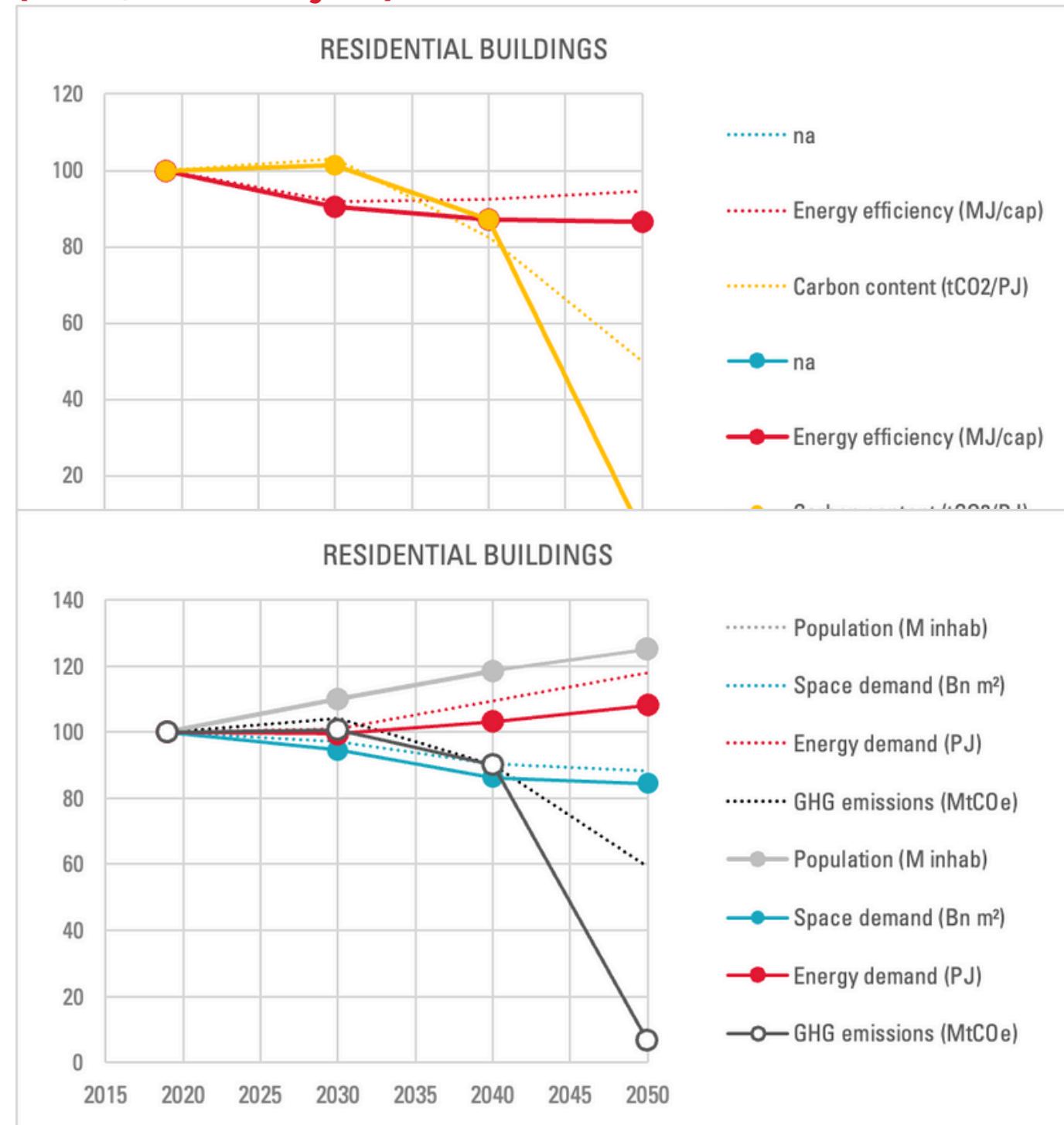
Figure 15. Sectoral emission drivers and main aggregates (Index, 2019 base year)



- Most of the emissions in light industries is from the burning of coal for heat requirements for various production processes.
- The main driver of decarbonization is electrifying these heat requirements, but this is expensive even with cheap renewable electricity generation.
- Key enablers for decarbonization in light industry will be energy efficiency measures that will be key to lowering production costs, enabling more electrification, and deployment of technologies like heat pumps, electric boilers across manufacturing, and electricity technologies for the mining industry.

Developing Paris-compatible RESIDENTIAL BUILDINGS

Figure 16. Sectoral emission drivers and main aggregates (Index, 2019 base year)



- According to the REF, surface heating is the main emission source and will make up to 72% of the sector's emission by 2050. Population and household growth, as well as assumed improvements in electrification levels and gradual reduction in the ratio of formal to informal housing applies in this scenario over both the period to 2035 as well as the period 2035 to 2050.
- The decarbonization strategy in the 8GT relies on the reduction of the carbon content mostly.

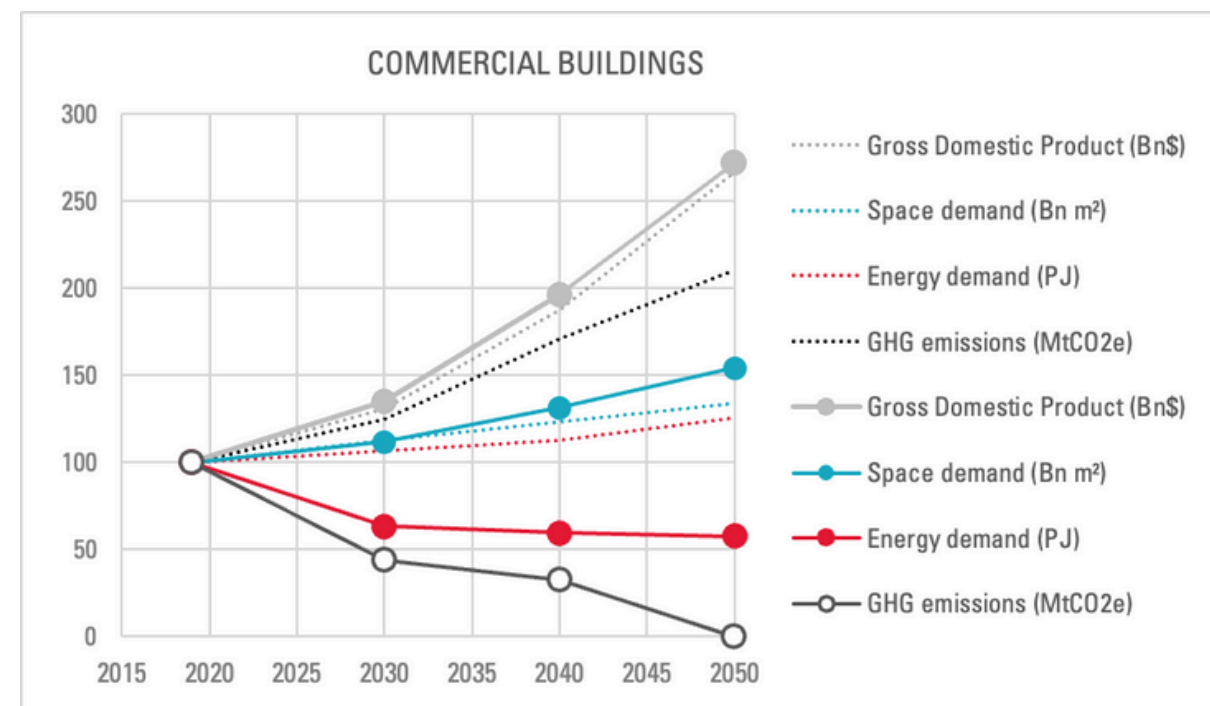
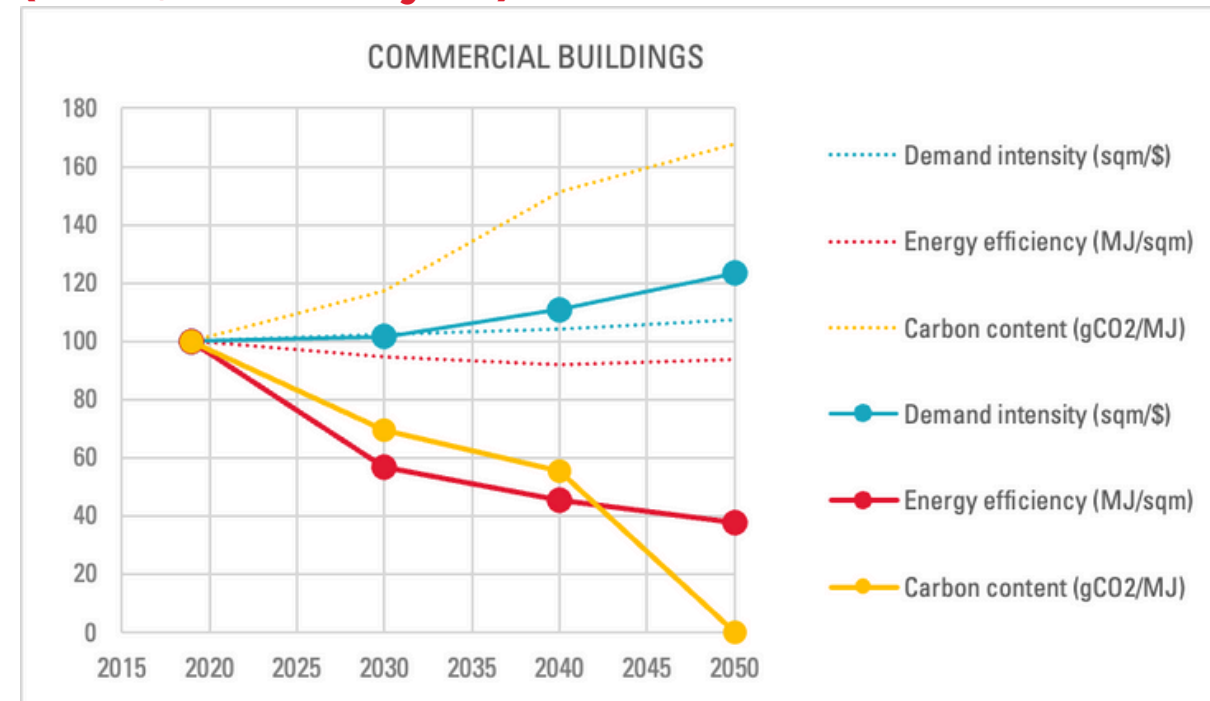
The main drivers are :

- the development of energy-efficient systems and a decrease of the energy consumption in comparison to the REF, notably in surface heating, even though the overall energy consumption is increasing.
- a massive electrification, replacing coal and other fossil-fuels notably in cooking and surface heating. there is a reduction in the use of coal by households, although wood use remains the same. Coal is used primarily by lower income households.

The key additional transformations to compared to the REF should focus on accompany the lower-incomes in fuel switching away from coal.

Developing Paris-compatible COMMERCIAL BUILDINGS

Figure 17. Sectoral emission drivers and main aggregates (Index, 2019 base year)



- The urban planning we anticipate is influenced by South Africa's significant urbanisation trend. More people are relocating to urban areas in pursuit of improved economic prospects. The growth rate of new building construction is gradual, reaching its peak around 2041 with the addition of 3.82 million m² between 2040 in the REF / 4.78 million m² in the 8GT. This indicator displays a two-year temporal lag in response to fluctuations in GDP.
- The decarbonization strategy relies on the reduction of the carbon content, the improvement of the energy efficiency & the reduction of the demand intensity.

The main drivers are :

- the decreasing carbon content due to a further acceleration of sustainable designs and renewable energy solutions.
- Increased adoption of sustainable and energy-efficient designs.
- Urban planning addressing spatial inequalities and fostering social cohesion. A more compact urban planning will lead to also reduce transportation needs.

The key additional transformations to compared to the REF should focus on developing on compact urban planning, increase the access to essential utilities, and developing sustainable designs and smart grid technologies.

Part 2.2

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**Transition of energy-related emission sectors:
Power generation, Extractive energy industries,
Other energy production industries**

Decarbonizing POWER GENERATION

Figure 18. Power generation by sources (Top, in TWh) and production emissions / electricity carbon content (Bottom, in TWh/cap & gCO₂/kWh).



- Power production is expected to increase similarly in all three scenarios until 2040: the growth in electricity consumption until 2035 is primarily driven by increased industrial activity, some fuel switching, and initial electric vehicle (EV) penetration.
- After that, there is a significant increase in the 9GT & 8GT, reaching to 8,2 TWh/cap in 2050: a fivefold growth in transport is driven by a large increase in EV uptake and the phase-out of internal combustion engines (ICEs). Electrification in the industry is due to fuel switching, economic and activity growth, and a notable increase in electrolyser capacity.
- In all three scenarios we also observe a decarbonization of the carbon content, but this effect is stronger in the 9GT & 8GT, reaching 20gCO₂/TWh.

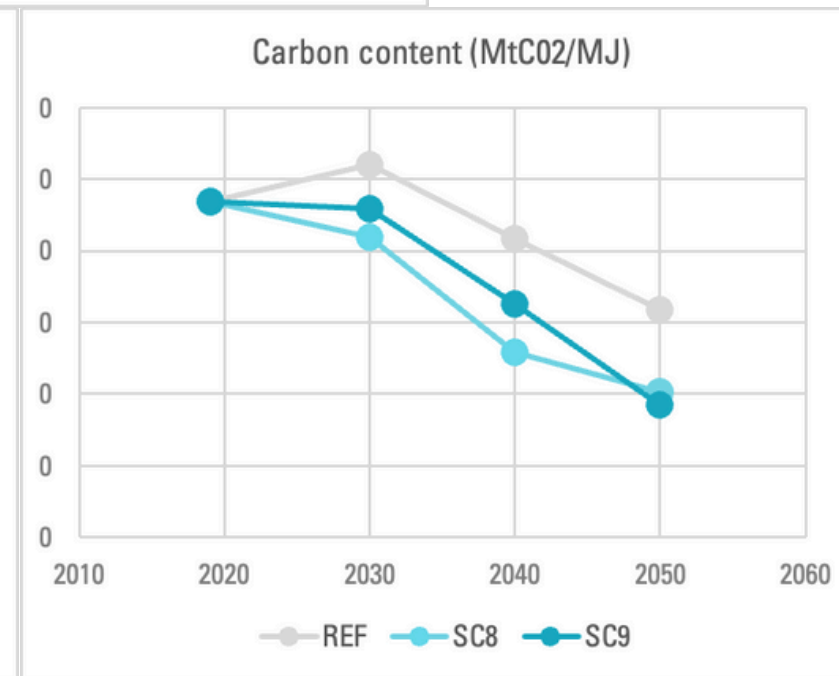
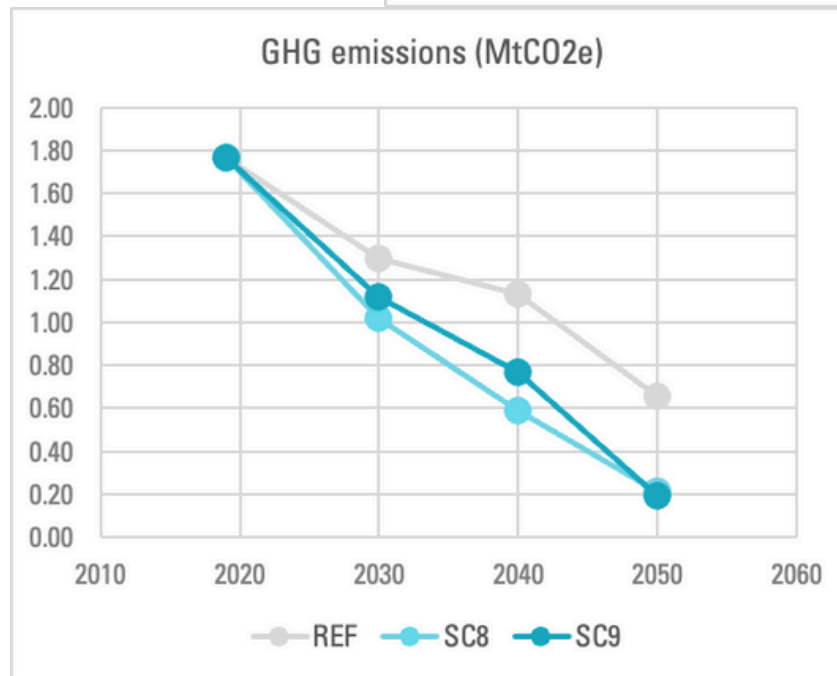
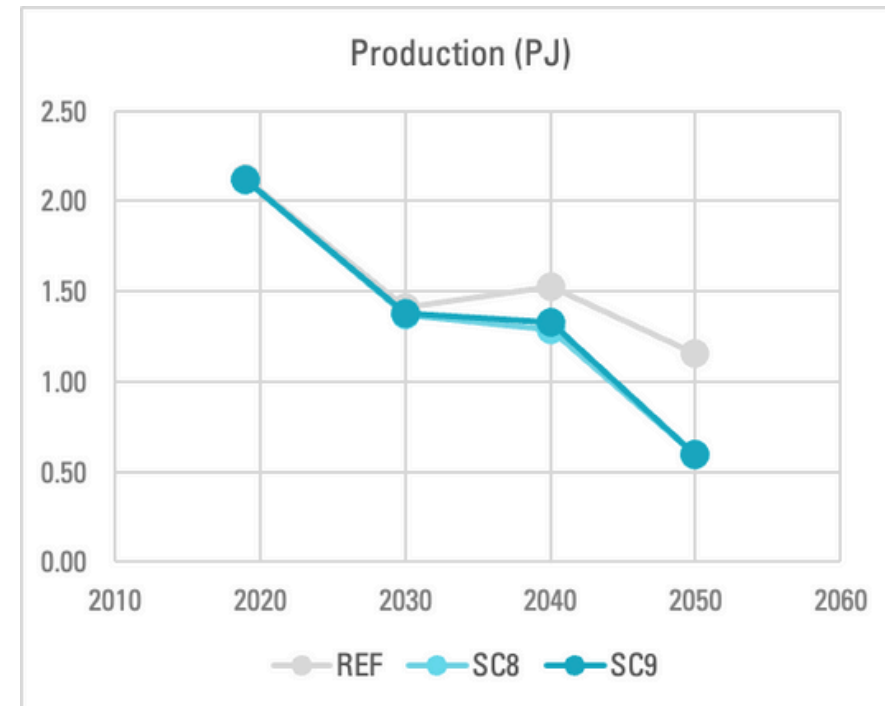
The main drivers are:

- a massive electrification, notably in residential buildings and light industries: electricity production per capita will be 40% higher in the 8GT in comparison to the REF in 2050, whereas the levels are similar in 2030.
- the decarbonization of electricity production with the decommissioning of coal power plants and large-scale deployment of non-fossil fuels: wind, and solar and nuclear power.
- the development of CCS infrastructures for gas power plants in the 2040s.

The key additional transformations compared to the REF should focus on implementing policies and regulations setting ambitious renewable energy targets, investing and advancing in renewable technologies, transitioning away from coal, enhancements in grid infrastructure, and carbon pricing to incentivize emissions reduction in the power sector.

Decarbonizing EXTRACTIVE ENERGY INDUSTRIES

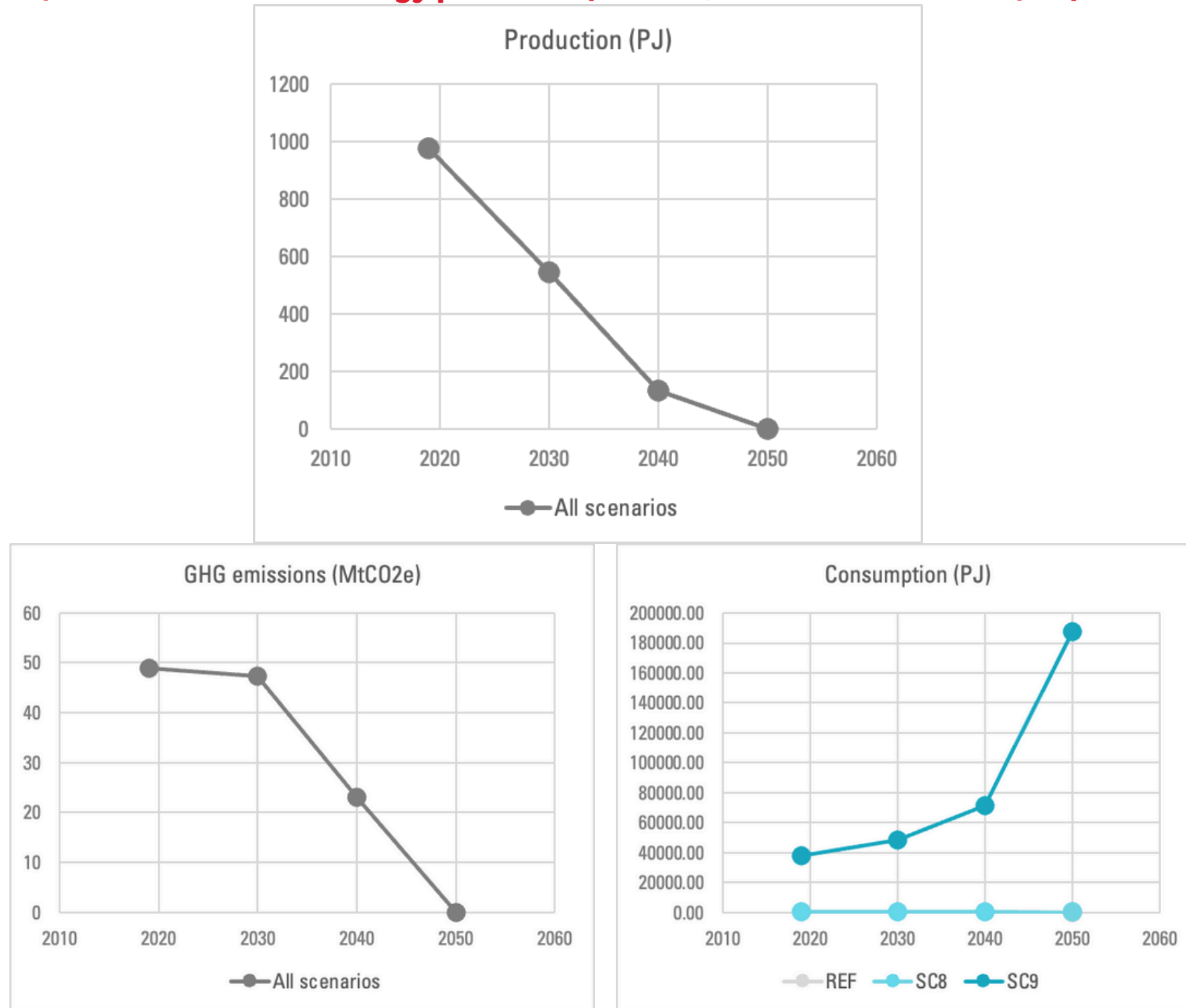
Figure 19. Coal, Oil and Gas production (Top, in PJ) and production emissions / carbon content (Bottom, in MtCO₂e & MtCO₂/MJ).



- Global production and GHG emissions are expected to decrease all scenarios : reaching 0,6 EJ& 0,2MtCO₂e in 2050 in the 8GT.
- The 8GT scenario shows a decrease in coal production, for domestic uses & exports. Coal extraction is projected to decrease by 35% from 2020 levels by 2030, with significant declines in both the power sector and exports. It will then decrease by 70% in 2050 in comparison to 2020 levels, leading to its phase-down in power generation and refineries.
- Domestic production of gas is negligible and there is no production of crude oil. Gas imports are expected to stay consistent through 2030, but imports of crude oil are anticipated to drop by approximately 50%.
- By 2050, crude oil imports will be nearly eliminated, and imports of finished petroleum products will initially increase in the 2030s then fall to about 30% of 2020 levels, whereas gas imports will increase and then decrease, but still be higher than 2030 levels, mainly due to their use in the power sector.

Decarbonizing OTHER ENERGY PRODUCTION INDUSTRIES

Figure 20. All other final fuel production (Top, in PJ) and production emissions / carbon content of energy produced (Bottom, in MtCO₂e & MtCO₂e/MJ)



- Synthetic fuels production accounts for most of the emissions from this category. Sasol, the incumbent synthetic fuels and chemicals supplier has stated they will gradually phase out their emissions: and this accounts for the decline in the emissions in all three scenarios.
- CTL production is set to decrease steadily until 2050, adhering to current policies. Crude oil refineries shutting down by 2035. Meanwhile, hydrogen electrolysis is expected to increase significantly, reaching 0.11 EJ by 2050, with biomass extraction also nearly doubling from 2030 levels, primarily for industrial use as hard to abate sectors like chrome require it. Bituminous coal extraction continues to serve the power until the coal power generation is phased out. Industrial sectors still require heat, and coal is the cheapest source of heat.
- Biomass extraction is set to triple for industrial use to replace fossil carbon for chrome smelting, and for energy in other sectors like cement and pulp and paper.
- Crude oil imports dwindles as the shift to electric vehicles takes place. This happens at a much faster pace in the decarbonizing pathways. And gas (imported) plays a role in some industries, but is most notably used for the power sector where it is used to provide stability and reliability to the largely RE based generation of electricity on the grid.

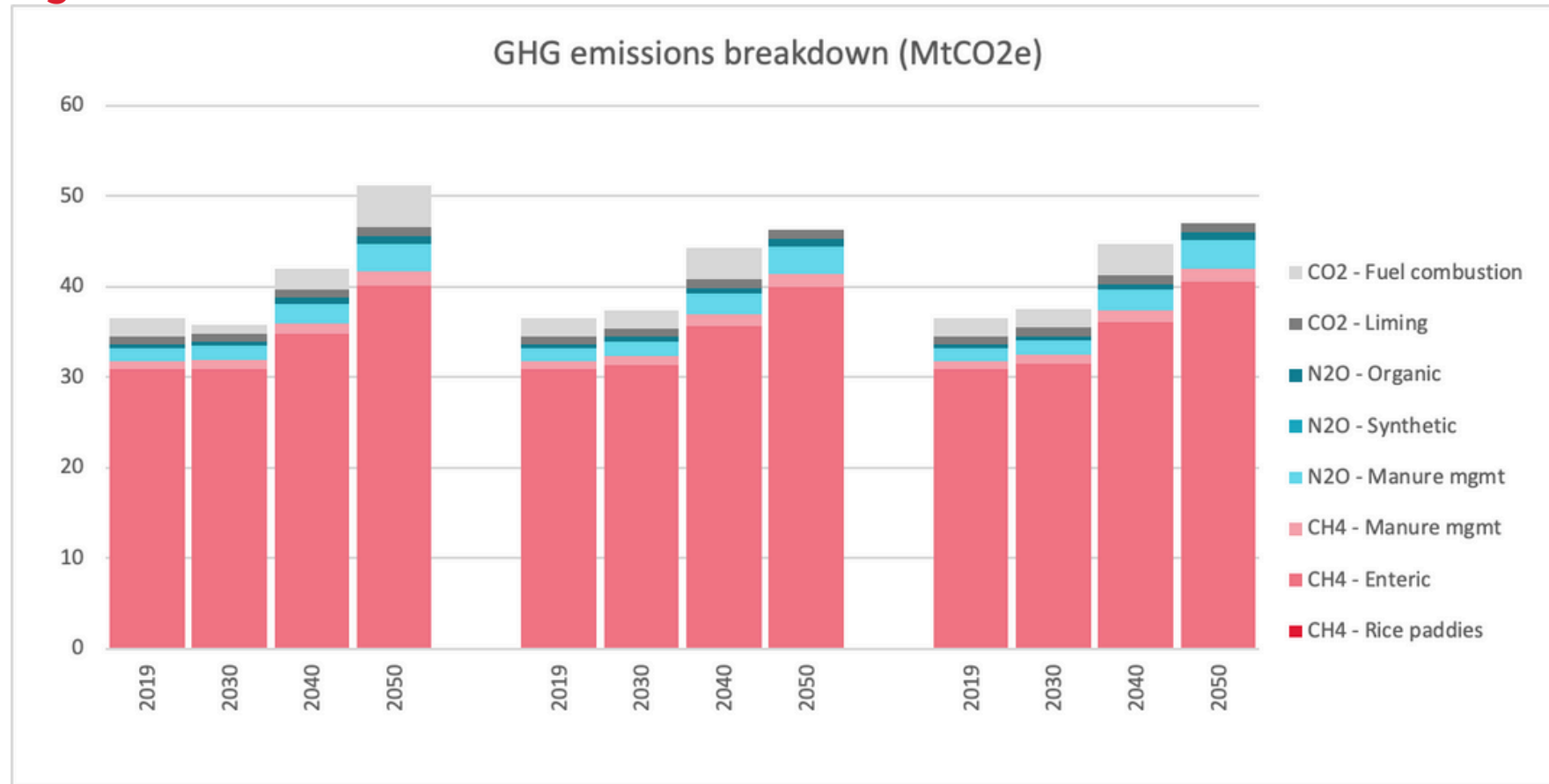
Part 2.3

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**Transition of non-energy related emission sectors:
Agriculture, Forestry and Land use change, Waste**

Developing a Paris-compatible AGRICULTURE sector

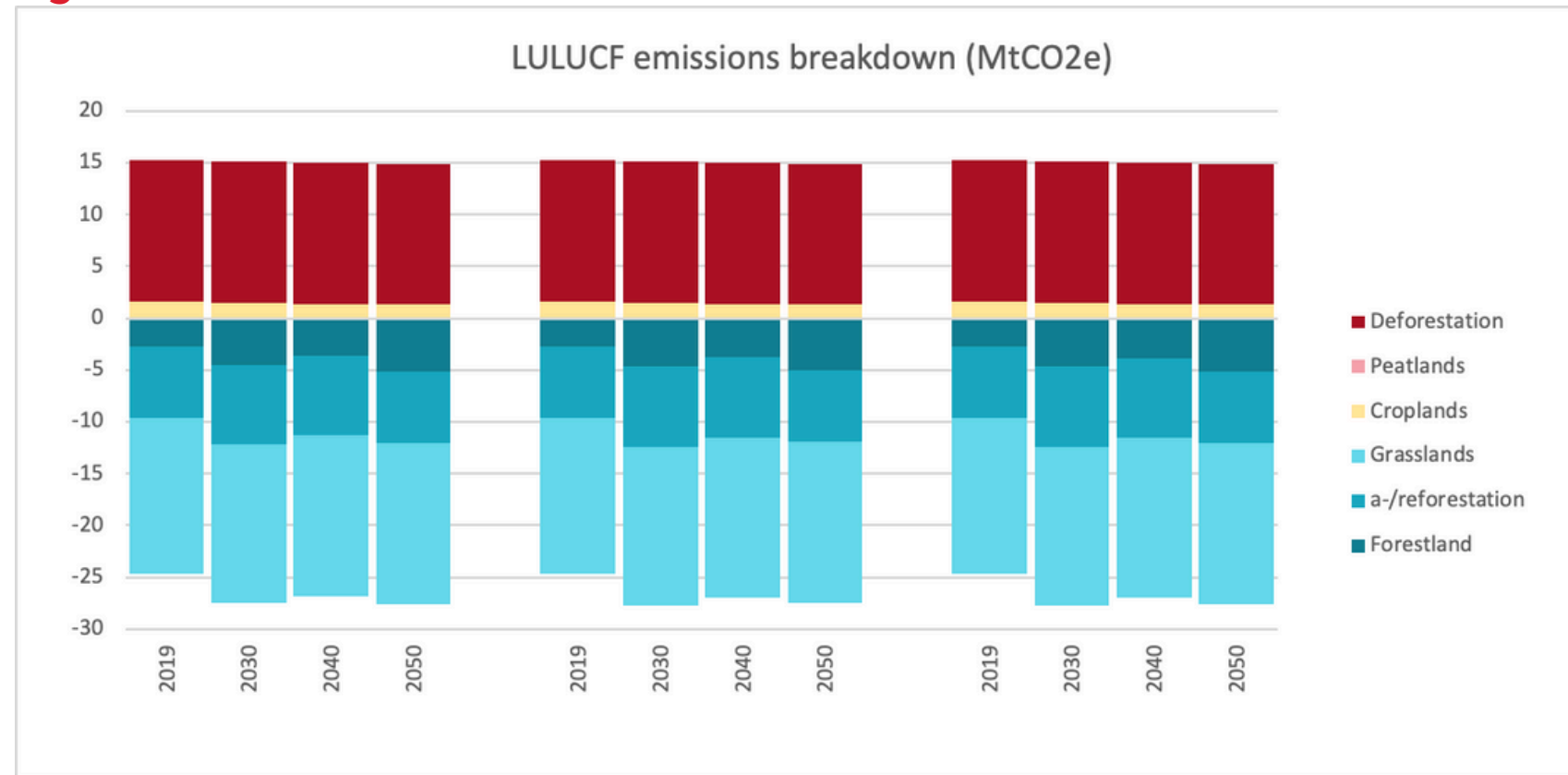
Figure 20.



- GHG emissions from agriculture increases in all scenarios, but less in the SC8 scenario (27%) and SC9 scenario (29%) than in the REF (40%).
- The main emission source is CH₄ from enteric fermentation, which accounts for the vast majority of emissions in all scenarios. The increase in enteric fermentation emissions is also the main source of the emission increase in all scenarios.
- Drivers of the emission increases include a controlled increase in meat consumption in the SC8 scenario compared to the REF scenario, where the increase is higher. Consumption of cereals and vegetables and fruits increase.
- Furthermore, demand for biomass increases energy and industrial purposes, especially for heating, and in the food and sugar industries, and pulp and paper.

Developing a Paris-compatible LULUCF sector

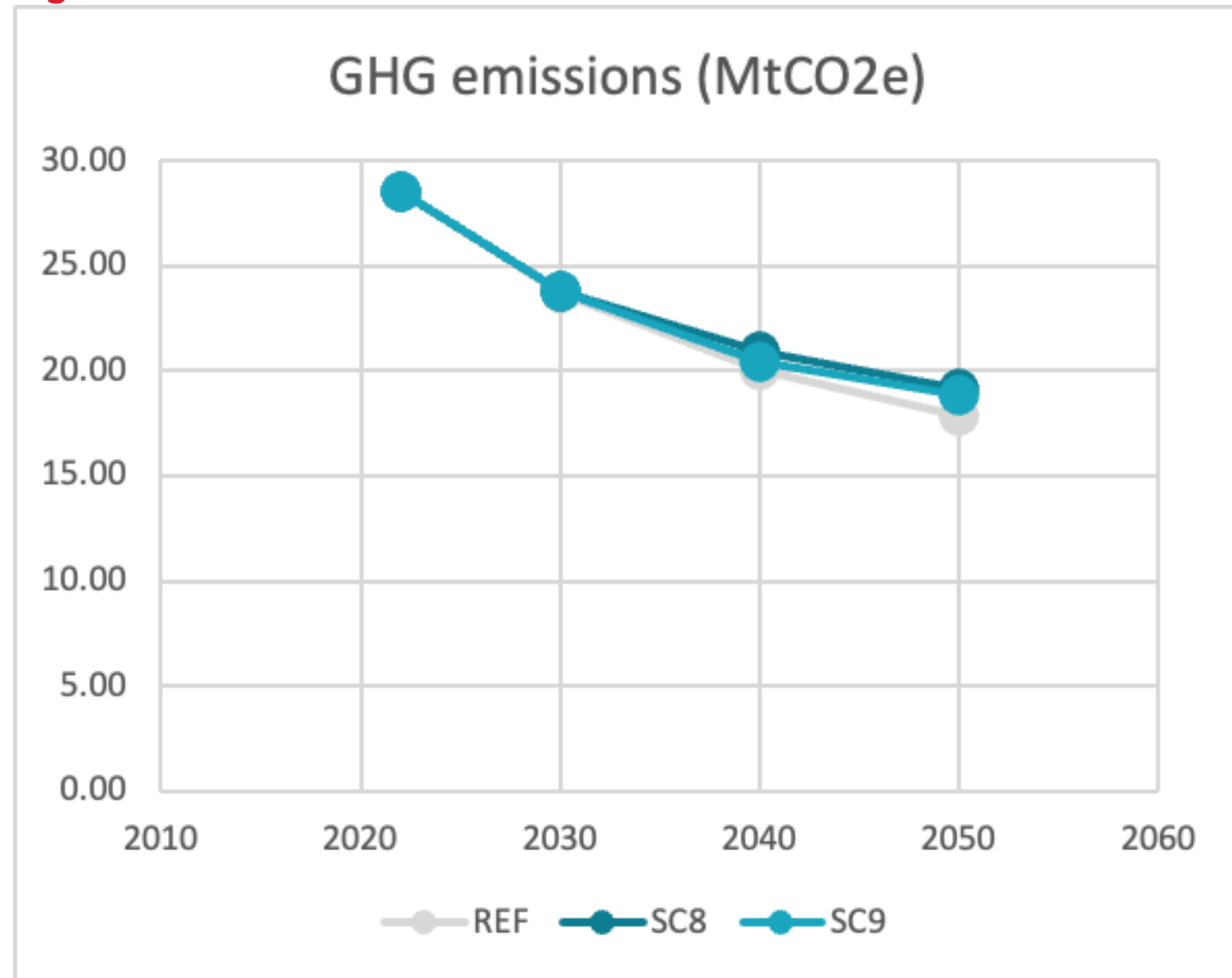
Figure 21.



- The LULUCF sector contributes as a carbon sink to South Africa's GHG inventory, and thus plays an important role in the country's future climate ambition.
- A future decarbonized South Africa will require the LULUCF sector to remain a carbon sink if not to grow in the overall amount sequestered. This will require comprehensive landuse policies integrated with agriculture sector. The role that biomass has in the energy sector also means that a bioenergy policy will also need to be considered from a LULUCF perspective, and managed accordingly.

Developing a Paris-compatible waste sector

Figure 21.



- GHG emissions from the waste sector reduce fairly similarly in all scenarios (by -30-35%), but slightly more in the REF scenario.
- In the 8-ton scenario, mitigation actions in the waste sector includes
 - Demand side action to reduce solid waste, for instance by changing packaging
 - Increasing the share solid of waste that is recycled (including into reusable nutrients via composting)
 - Improving waste collection and disposal services
 - Programmes to improve the biological treatment of solid and liquid waste

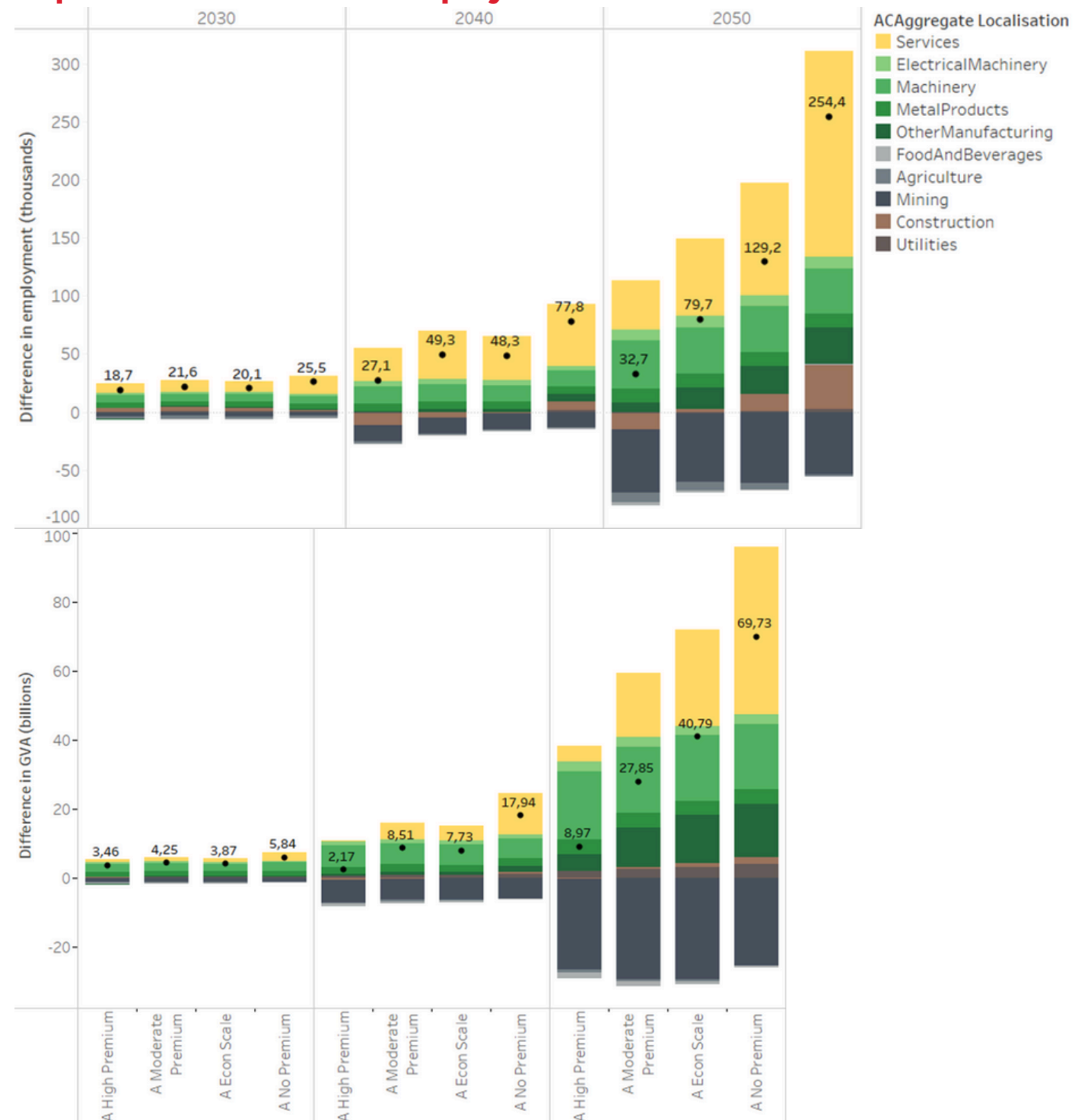
Part 2.2.1

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Deep Dive on localisation of renewable energy technologies in South Africa

Positive impact of localisation

Impact of localisation on employment and on GDP



Key considerations for this outcome are:

- A consistent rollout of renewables (demand of MWs constructed) is essential to attract investment into the factories to produce the technologies in South Africa. Government has a key role to play in ensuring that consistent demand is a certainty, as investors will not see private sector demand for renewables to be sure enough to warrant investment risk.
- The price increase of local products affects how this impacts the economy, but up to a certain point a price increase still has a positive overall impact on the economy.
- Measures are needed to help identify how to mitigate this, and support industries to keep costs down, build capacity and skills, and be competitive in the longer term.

(Please see the policy brief for the full analysis of the deep dive into localisation of renewable energy manufacturing in South Africa)

Conclusions

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Key lessons for national & international climate and development decision processes

(1 slide = 1 lesson)

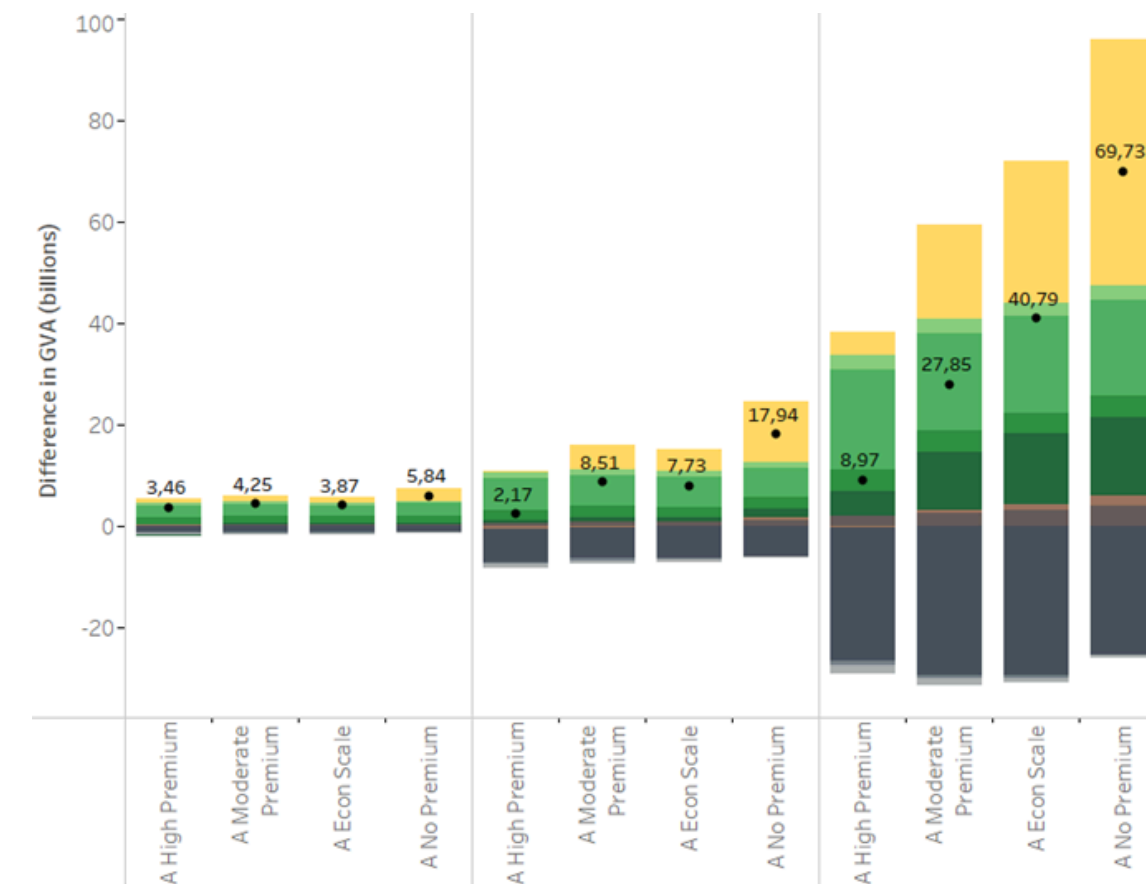
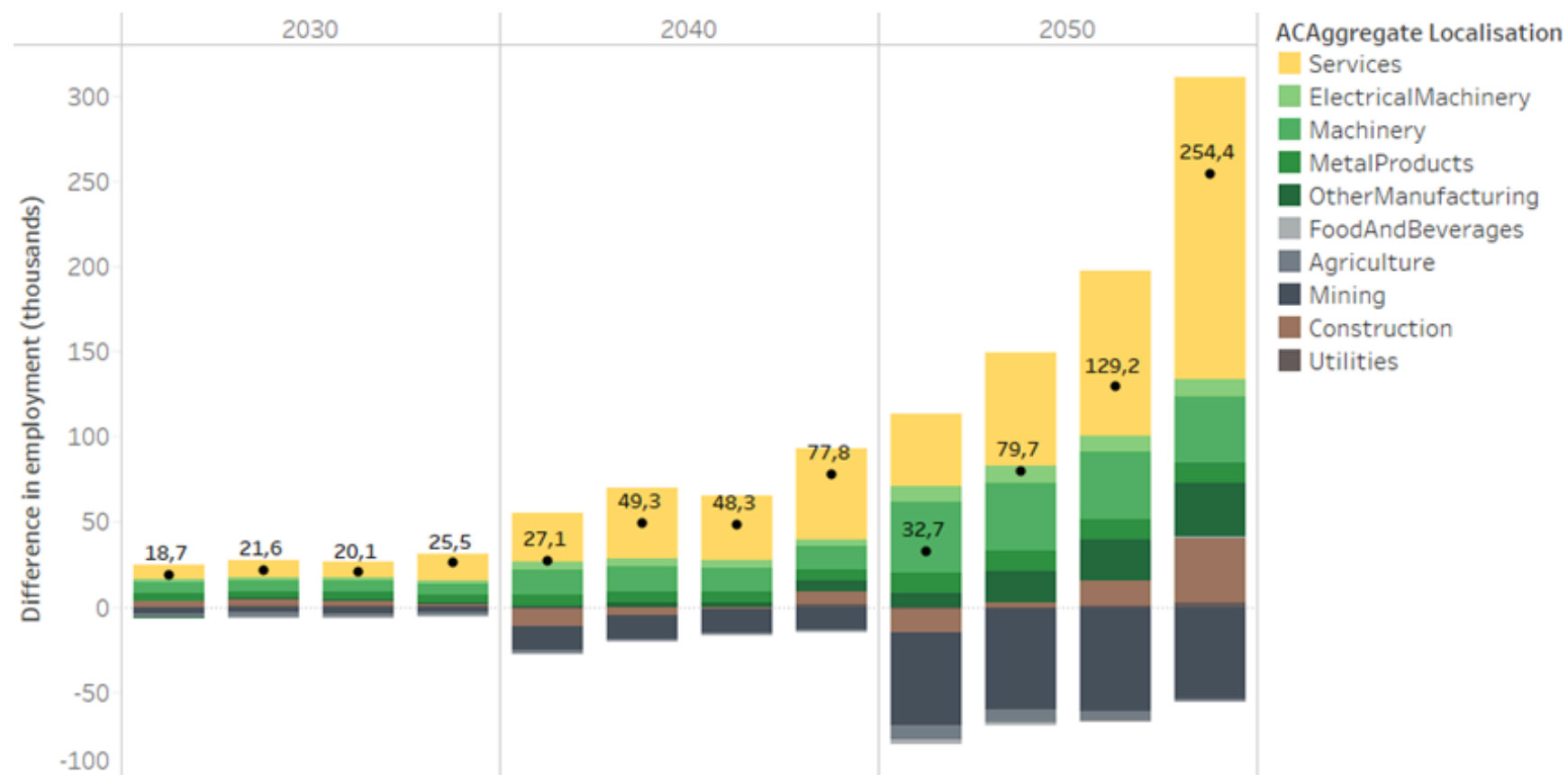
Lesson 1 - Key areas or sectors which require additional transformations

What are the long-term national pathways compatible with the collective Paris-Agreement mitigation objective and country-driven development priorities? How do these Paris-compatible pathways differ from current trends and NDCs?

- South Africa's Paris Compatible pathways analysed here, show that a transition no matter at South Africa's Paris Compatible pathways analysed here, show that a transition no matter at what pace that is, requires clean electricity from solar PV and wind generating technologies.
- An increase in long term ambition translates simply to a faster deployment of these technologies to support the rest of the economy as industries, transportation, and other sectors electrify further.
- Some sectors like transport, within increasing mitigation pressure would see faster uptake of electric vehicles to harness the mitigating effect of a decarbonising grid, while other sectors such as industry do not mitigate much faster (comparing 8Gt scenario to the 9Gt) owing to the added challenges in expensive technology transitions, and the fact that thermal requirements are still most economically met by burning coal.
- These transitions in each sector require dedicated transition plans that are just, and they need to be managed or they could negatively impact the economy and development.

Lesson 2 - Key short-term national policy packages and priorities to implement them

- A policy of supporting localisation of the manufacturing of renewable technologies within the country (technologies that the transition relies on) has been demonstrated to have economic benefits to the country through employment and economic development (See below). The benefit of a policy is evident in any pathway from now until 2050 as solar and wind technologies represent the cheapest source of electricity energy in the country; and the benefit of a localisation strategy scales with increased ambition.
- A consistent rollout of renewables (demand of MWs constructed) is essential to attract investment into the factories to produce the technologies in South Africa. Government has a key role to play in ensuring that consistent demand is a certainty, as investors will not see private sector demand for renewables to be sure enough to warrant investment risk.
- The price increase of local products affects how this impacts the economy, but up to a certain point a price increase still has a positive overall impact on the economy. Measures are needed to help identify how to mitigate this, and support industries to keep costs down, build capacity and skills, and be competitive in the longer term.



Lesson 2 - Key short-term national policy packages and priorities to implement them

- South Africa's integrated resource plan (IRP) is the document at the heart of electricity planning in the country, and the latest draft (of 2023), shows more renewables are required in the coming few years, but is not likely to adequately address the serious electricity shortages. The IRP that government should adopt will need more expansion of capacity to meet electricity requirements, and with solar and wind technologies, this would be in line with a decarbonizing future South Africa.
- Transportation decarbonization relies largely on the adoption of electric vehicles in South Africa, and a key part of this adoption is the auto-motive manufacturing industry in the country and their shift to producing EV's. The EV White Paper outlines some aspects of how the industry in South Africa can transition to producing EV's, as well as the barriers to the transition. These barriers should be addressed early to ensure a faster and more economical mass adoption of electric vehicles.
- As electricity is the core part of the future in a decarbonized South Africa, energy efficiency policies will become more and more impactful and important to implement. It reduces cost to users, and can play a role in helping the electricity system (grid). The current energy efficiency policies in South Africa are not finalized or adopted. Updating and formalizing EE strategy in South Africa is key to laying the foundation for future EE policies that will be vital in the future energy system.

Lesson 3 - Key international conditions to implement them

What key global and sectoral transformations must be considered to enable national Paris-compatible pathways? What are the key international enablers of these sectoral transformations?

- For electricity, the transition to a lower carbon future will be next to impossible without social support for it and in particular the workers in the coal industry. This social support for the transition from coal requires the JETP to be fully funded and implemented, with particular emphasis on ensuring success in Eskom's JET efforts.
- A number of these transition elements require technology that is new (and potentially risky), such as hydrogen for steel, synthetic chemicals production, or not yet commercially proven CCS. In the case of transport – it requires EV adoption, but also investment in manufacturing locally. These elements are often in the domain of large multi-national corporations that are based in other countries which means that for these transitions to happen in South Africa, favourable conditions for cooperation agreements in trade and investment is needed for companies to invest in South Africa facilities and markets.
- More broadly, underpinning all these elements of the transition in South Africa is the necessity of better and more access to finance options. For this to happen requires an international environment of multi-lateral cooperation on implementing the effort for climate mitigation is essential for this to happen. This is essential, for the transition to happen, to be just, and to be effectively managed by South Africa.