REPORT

IMPACT OF THE CARBON TAX ON JOBS

November 2018

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PROMETHIUM CARBON

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1 INTRODUCTION

This report was commissioned by Business Unity South Africa (BUSA) in response to a request from Public Finance and Monetary Policy Chamber of Nedlac.

A draft carbon tax bill has been introduced in Parliament earlier in 2018. During the parliamentary hearing on the bill, it was recognised that the implementation of the carbon tax bill may result in job losses in South Africa. The same applies to other carbon reduction measures. Proposals for a jobs plan to mitigate against jobs loss were also made during the parliamentary hearing.

In response to this, the Chair of the Standing Committee on Finance has requested that Business and Labour work together to develop appropriate sector job plans. He proposed that this matter is dealt with in Nedlac. At a later session in parliament the Chair requested that Nedlac look at the jobs impact of the carbon tax and to report to him.

The Public Finance and Monetary Policy Chamber of Nedlac has requested BUSA to give a presentation on the progress made with respect to the policy instruments developed by the Economic Development Department to enable Business and Labour to develop appropriate sector job loss mitigation plans.

This work is done in the context of Section 9 of the National Climate Change Response White Paper provides for two policy instruments to be developed by the Economic Development Department, to ensure that employment is not negatively affected by the introduction of instruments to reduce the carbon intensity of the economy. These instruments are:

- National Employment Vulnerability Assessment (NEVA), which will be used to establish a National Employment Vulnerability Baseline; and
- Sector Jobs Resilience Plans for sectors found to be vulnerable in terms of the above vulnerability assessment.

These are being developed to ensure that employment is not negatively affected by the introduction of instruments to reduce the economy's carbon intensity.

The objective of this report is to assess the impact of the implementation of the proposed carbon tax on jobs in the South African economy though:

- Modelling the carbon tax burden at a sector level based on available data and the draft carbon tax bill; and
- Modelling the impact of the carbon tax burden on direct, indirect and induced jobs in the various sectors due to the tax and the dependencies between the sectors.

The implementation of a carbon tax will impact the South African economy through a sequence of effects. The first is that money removed from the economy will reduce economic activity, and therefore the amount of jobs in the economy. The next is that the money will be re-introduced into the economy through the activities National Treasury has indicated as "revenue recycling" activities. This will increase the amount of economic activity in the country, and consequently have a positive impact on the number of jobs. The last effect is that the repositioning of the South African economy to a low carbon economy may serve to promote "green growth" and increase the international competitiveness of the economy. The combined effect of these 2 could potentially lead to economic growth over and above the growth the economy would have had in the absence of the switch to a low carbon economy.

It is important to note that the work done in this project focusses only on the first part of the problem as articulated above. It only considers the impact of the cost that is imposed on the economy. This cost leads to a reduction in economic activity, and hence a decline in the number of jobs required for the national economic activity. The money spent on carbon tax does however not evaporate from the economy. It is reintroduced in the economy through a number of ways. National Treasury has indicated in the explanatory memorandum for the carbon tax bill of December 2017 that: "*The carbon tax will be revenue-neutral during the first phase and revenues will be recycled by way of reducing the current electricity generation levy, credit rebate for the renewable energy premium, and a tax incentive for energy efficiency savings. Efforts will also be made to prioritise and enhance allocations for free basic electricity (or alternative energy) and funding for public transport and initiatives to move some freight from road to rail*".

The re-introduction of the money spent on carbon tax into the economy will increase the amount of economic activity, which in turn, will have a positive effect on the amount of jobs in the economy. This effect has not been modelled in this project, as it falls outside of the request from Nedlac to BUSA, and the brief from BUSA to Promethium.

2 METHODOLOGY

2.1 APPROACH

The overall approach to determining the impact of the carbon tax on jobs is illustrated in Figure *1*:

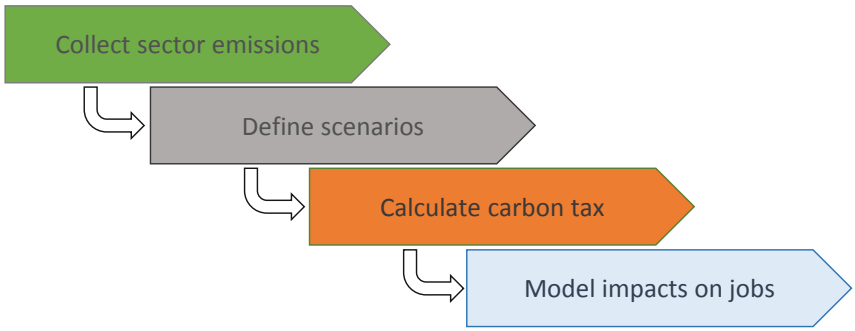


Figure 1: Approach to determining the impact of the proposed carbon tax on jobs in the South African economy

The procedure involves the following steps:

- The selection of the sectors in the economy that would be impacted by the carbon tax was pre-selected based on the request BUSA received from the Public Finance and Monetary Policy Chamber of Nedlac;
- Identification and collection of emissions data for sectors considered in the study, based on available data sources;
- Scenarios are defined to provide a context for calculating the carbon tax for each sector;
- The carbon tax is calculated for each sector for each scenario based on the structure of the proposed tax provided in the draft carbon tax bill of December 2017;
- The value of the carbon tax for each sector is then subtracted from the economic value added by the sector. This is modelled in the context of a social accounting matrix in the macroeconomic model. The model is run for each scenario. The model then determines the impact of the carbon tax on the flow of money going to labour in each sector; and
- The number of jobs impacted by the imposition of the carbon tax cost on the economy is derived from the structure of the jobs market in each sector and the labour value for the sectors.

Data sources, the carbon tax calculation and macroeconomic model are described in the following subsections. Details of the scenarios are provided in Section 2.3 below.

2.2 MODEL

The macro-economic model used to evaluate the potential impact of the proposed carbon tax on the economy is based on the following:

- **Social accounting matrix (SAM)**: A SAM is a measurement tools that can be used in determining the success of government strategies and policies. The SAM is defined by the 1993 System of National Accounts[1]. It is a presentation of the System of National Accounts in a matrix format, which elaborates on the linkages between Supply and Use tables (SU-tables) and institutional sector accounts. The SAM reflects the economic relationship between the sectors of the economy by identifying monetary transactions (expenditure and receipts) between them. It therefore allows for a study of vital issues that are of a particular interest to a country, such as 'an analysis of interrelationships between structural features of an economy and the distribution of income and expenditure among household groups. Since a SAM links traditional macro-economic indicators such as the Gross Domestic Product (GDP) to indicators of socio-economic concern, for example, population group and income distribution, it is a valuable tool to use in policy monitoring and evaluation. It achieves the socio-economic aspect by dividing households into meaningful subgroups (e.g. occupational groups and skill levels) whereby the economic significance of each group is highlighted. The SAM provides a tool for policy analysis from an analytical point of view.
- **Input-Output Tables (IOTs)**: IOTs describe the sale and purchase relationships between producers and consumers within an economy. They can either show flows of final and intermediate goods and services defined according to industry outputs (industry × industry tables) or according to product outputs (product × product tables). As labour is an important input into the economy, the Input-Output tables allow us to evaluate the relationship between changing levels of economic activity and the demand for labour in the economy.

2.3 DATA SOURCES

The macroeconomic model used to calculate the impact on jobs is based on a social accounting matrix which represents the structure of the South African economy. The model requires data at a sector level. For this reason top down data sets are used wherever possible.

2.3.1 Sectors considered

The briefing from BUSA specified the sectors to be considered in the study. These sectors are listed in *Table 1*.

[1] https://unstats.un.org/unsd/nationalaccount/sna1993.asp

Table 1: Sectors specified for jobs impact study

Sector	SIC CODE	Subsector
Energy	331	Petroleum refining
	332 and 333	Coal to Liquids and Gas to liquids
		Renewables and gas
Transport	-	-
Mining	210, 242 241, 251 & 253	Coal, Gold & Platinum, Iron ore – Ferroalloys, Stone quarrying, Clay and Sand, Quarrying non-metallic minerals
Industrial Processes	334, 335	Chemicals
	351	Iron and steel
	351, 352	Ferroalloys and non-ferroalloy smelting
	342	Cement
	323	Paper and paper products
	341	Glass
Agriculture, Forestry and Land Use	121-122	Forestry

Note: *The two level SIC codes used in modelling correspond with the SIC Codes of the National Input-Output Table published by Stats SA. This implies that the I-O Table does not always have the detailed classification of sectors outlined above. The I-O Table as data basis of sectoral transactions will allow for meaningful high level impact analysis.*

While it is understood from the briefing that the impact of the proposed carbon tax should be considered for specific sectors, the interdependence between sectors will influence jobs in all related sectors. In addition the classification of sectors varies between the data sets used. For this reason the sectors in the social accounting matrix and energy balances are mapped to those sectors listed in Table *1* so that results can be presented in terms of the above sectors wherever practicably possible. The mapping of sectors is provided in Appendix A: Sector mappings.

2.3.2 Macro-economic data

The following sector data were used in the modelling:

- Energy and emissions data by sector from the National Energy Balance, published by the Department of Energy, provides a means to allocate the emissions from fuel consumption and electricity consumption to the different sectors and to separate the petrol and diesel emissions from other direct emissions used in tax pass through calculations. The latest available dataset is 2014 data;
- Draft National GHG Inventory, published by the Department of Environmental Affairs, is the main source of information related to the emissions per sector. The latest available dataset is 2015 data;

- South African Social Accounting Matrix, published by Statistics South Africa, is used within the macroeconomic model to define the structure of the economy and the relationships between sectors. The latest available dataset is 2014 data. The SAM, as published by StatsSA, was modified for use in the model; and
- We used data from a trade exposure study commissioned by BUSA during 2018. This study provided production data used together with sector emissions data to calculate emissions intensities for comparisons against company emissions intensities.

Emissions used to calculate the carbon tax by sector are presented in Figure *2*. These are calculated from the share of emissions from the sectors in the GHG Inventory aggregated according to the sectors defined in the project brief. The majority of the emissions (76%) are from the energy sector. This is followed by the transport sector with 13% of the emissions and industrial processes, with 9%.

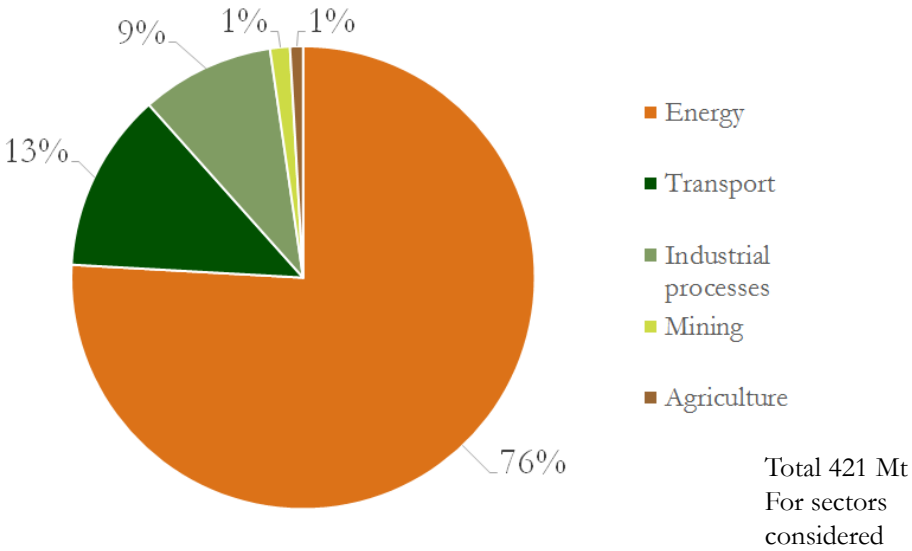


Figure 2: Share of emissions by sector

The final calculations are at a subsector level as defined in Table *1* above. Industrial process emissions are disaggregated further based on the GHG inventory and national energy balances in *Figure 3*. Structural metal, made up of structural metal products (tanks, reservoirs, window frames, metal parts etc.), represent 43% of the process emissions. This is followed by Basic Iron and Steel, made up operation of blast furnaces, steel converters, rolling and finishing mills; and the manufacture of primary iron and steel products and ferrous alloys, makes up 36% of the emissions. Non-metallic minerals, including manufacture of cement, lime and plaster, clay and other ceramic products, constitute 16% of the industrial process emissions.

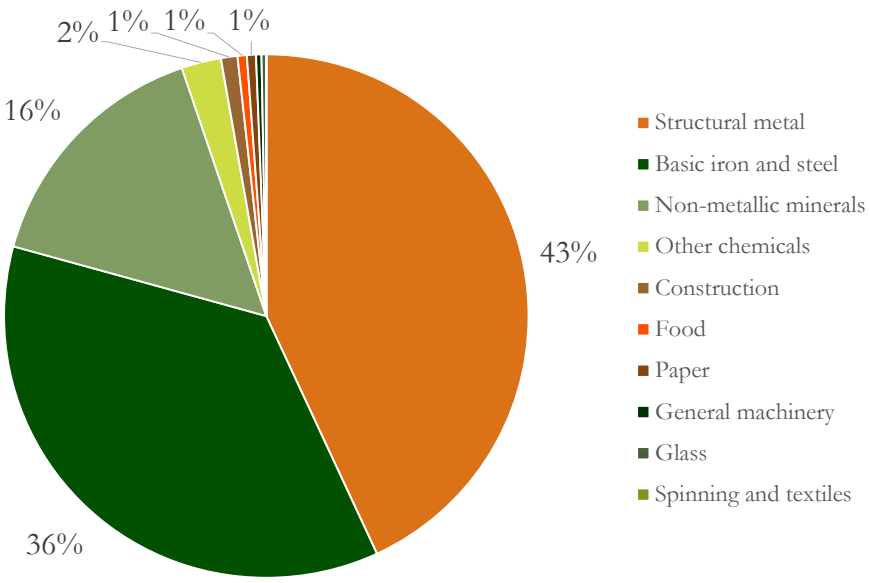


Figure 3: Break down of industrial process emissions

2.3.3 Company level data

Company level data was used to check the macro economic data in terms of carbon intensity. It was not used directly in the modelling. The calibration of the carbon intensities derived from macro-economic data was done by calculating the carbon intensity for the sectors based on emissions per unit production and comparing it to the average of the emissions per unit turnover for companies from the individual sectors. This was possible for the non-metallic minerals, basic iron and steel, and transport sectors.

The following company level data was used:

- Publically available Annual Reports – emissions and turnover; and
- Company specific emissions obtained from the respective companies.

2.4 TAX CALCULATION PROCEDURE

2.4.1 General Assumptions

The following parameters and assumptions were used for the carbon tax calculations:

- The draft carbon tax bill allows for allowances that reduce the amount of tax payable to SARS. The following allowances, as per Schedule 2 of the draft bill, were applied in the calculation of the tax liabilities of companies:
    - Basic allowance of 60% or process emissions allowance of 60% or 70%, depending on the sector;
    - Trade exposure allowance of up to 10%, applied per sector, as per the outcome of the trade exposure study commissioned by BUSA during 2017;

- Performance allowance – We modelled a 2.5% allowance based on 50% of the sector receiving the z-factor allowance of 5%;

- Low or high penetration of carbon tax within particular sectors are used to represent the share of a sector exposed to the carbon tax. This is due to the size and consumption or emissions of companies within a sector. Sectors with many small companies will have a lower exposure then sectors with few large companies;
- Carbon tax attributed to oil refineries, coal to liquids, gas to liquids and other transformation was passed through to the sectors consuming the energy carriers in relevant scenarios. We modelled 100% pass through for the electricity sector up to 2022, based on statements made by National Treasury, and 65% pass through for liquid fuels, based on communication with the South African Petroleum Industry Association: (SAPIA);
- Energy consumption data from the National Energy Balance was used for allocating the carbon tax from electricity and liquid fuels production to sectors based on their share of consumption. The carbon tax that could not be allocated to the selected sectors remains with the transformation sector. Households were included in the model because a large proportion of electricity consumed by this sector.

2.4.2 Tax calculation formula

The carbon tax liability is calculated for each subsector based on:

- The formula from the latest draft carbon tax bill (see Table 2);
- Sector emissions calculated from energy balance and GHG inventory, as described above;
- Trade exposed allowance are as per the spreadsheet provided by BUSA (see Appendix B: Allowances);
- Assumptions with respect to the fugitive and process emission allowances[2];
- The liability for emissions from the use of transport fuels are allocated to the consuming sectors at a rate of R48/t (R120/t at 60% basic allowance); and
- The costs and benefits of offsets have not been included in this study as the details will vary widely from project to project.

[2] Republic of South Africa, Explanatory Memorandum for the Carbon Tax Bill, 2017

Table 2: Carbon Tax calculation formula

Carbon Tax Calculation	
Carbon Tax = R * (E - D - S) * (1 - C) + P * (1 - J) * R + F * (1 - K) * R	
E	total fossil fuel combustion
D	petrol and diesel
S	carbon dioxide equivalent that are sequestrated
R	rate of tax
P	total industrial process and product use related greenhouse gas emissions
F	total fugitive greenhouse gas emissions
C	sum of percentages of allowances determined in terms of sections 7, 10, 11, 12, and 13 in respect of that tax period subject to section 14
J	allowances determined in terms of sections 8, 10, 11, 12 and 13 in respect of that tax period, subject to section 14
K	allowances determined in terms of sections 7, 9, 10, 11, 12 and 13 in respect of that tax period, subject to section 14

The formula in Table 2 above provides for the calculation of direct taxes applicable to emitters. The model used in this project assumes that tax on emissions from the use of petrol and diesel (D in formula above) will be levied when fuel is purchased, as part of the pump price. In the modelling, the taxes paid at the pump are added to the emissions tax of petrol and diesel consuming sectors along with the emissions tax related to direct emissions from consumption of other fuels.

2.4.3 International Carbon Pricing

South Africa ratified the Paris Agreement on 2 November 2016. The Paris Agreement provides the platform for an international market for carbon trough Internationally Transferrable Mitigation Outcome (ITMOs). The modelling done in this project considered a scenario where the domestic price of carbon is aligned with an international carbon price. A number of international carbon price scenarios were considered from the literature, and an average calculated to use in this project. The scenarios considered is shown in Figure 4:

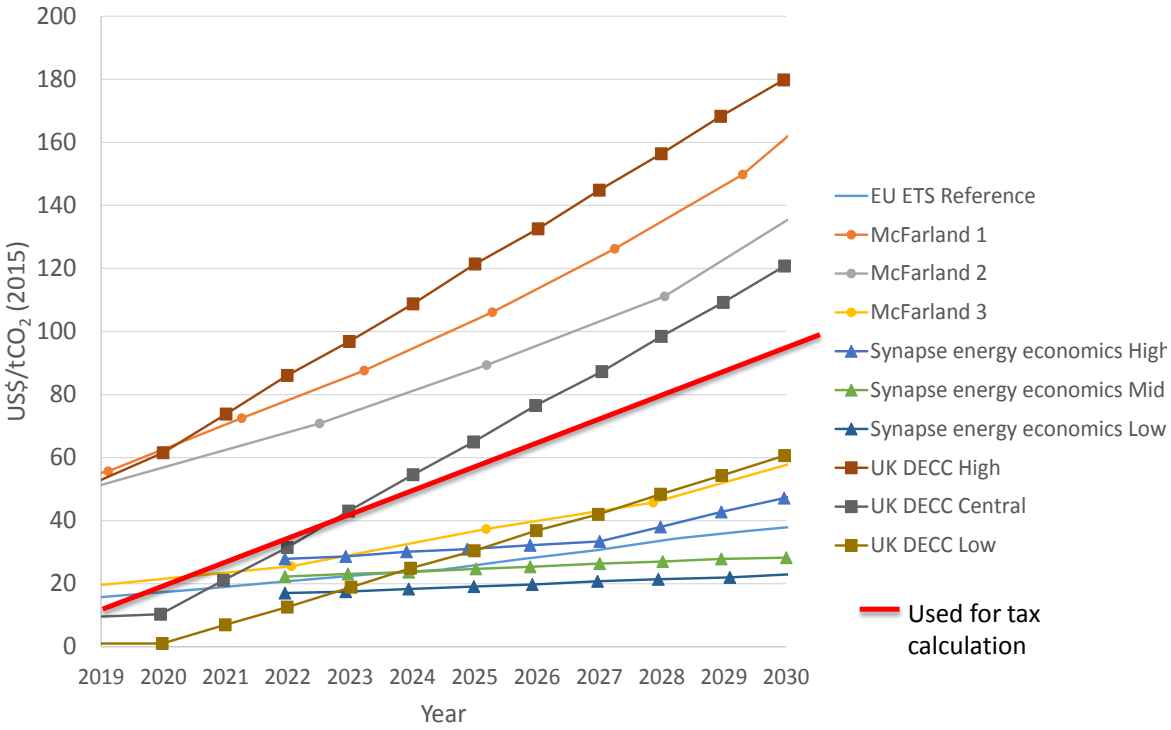


Figure 4: International carbon price scenarios

In terms of the Paris Agreement countries determine their own contribution to the global greenhouse gas mitigation effort. This is done through the submissions of each country's Nationally Determined Contribution (NDC). The total of the NDCs submitted commits the world to a temperature increase of 3.3° Celsius. The Paris Agreement provides for the ratcheting up of the ambitions of the countries. It is highly likely that this ratchet mechanism will result in higher international carbon prices, so the average presented above is viewed as conservative.

2.4.4 Decarbonisation of electricity generation

The decarbonisation of electricity generation is calculated from the IRP 2010 Update, presented in Figure 5. We used the System Operator's (Eskom Transmission Division) Low Growth scenario. This scenario was used for modelling in this study as it most closely represents South Africa's recent electricity demand profile and the most likely to match the IRP2018 emissions intensity. Although the draft IRP 2018 was published for public comment at the time of execution of this project, the published document did not contain sufficient data for this analysis.

The carbon intensity of electricity generation impacts on the pass through of emissions from the electricity sector to consumers of electricity in the relevant scenarios. The carbon intensity is decreasing due to the uptake of renewable energy generation and the decommissioning of coal fired power stations. Decarbonisation of electricity generation is relevant to this study because electricity generation produces the majority of the countries GHG emissions and

decarbonisation of the industry reduces the burden required by other sectors in order to meet national emissions targets.

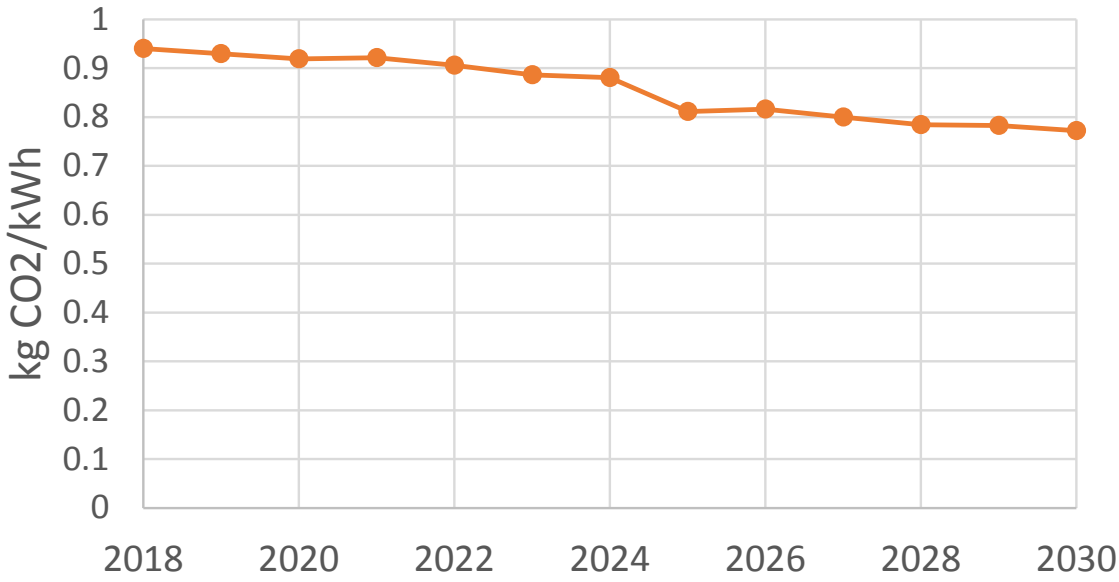


Figure 5: Electricity decarbonisation

2.5 JOBS IMPACT MODEL

The project team utilised the Social Accounting Matrix (SAM) for South Africa based on StatsSA data[3] to determine the impact that carbon tax emissions have on job losses in the South African economy. The SAM is based on an internationally and nationally accepted economic impact model known as the Input-Output Model. The model determines the impact of an intervention on the economy, representing the flow of all transactions that take place within an economy (regional or national).

The steps used to determine the impact of carbon tax on jobs is presented in Figure 6.

[3] Source: StatsSA, Input-Output Tables for South Africa, 2014, 2018. Updated by Urban-Econ to 2017. This data was the latest estimate at the time, i.e. 2017.

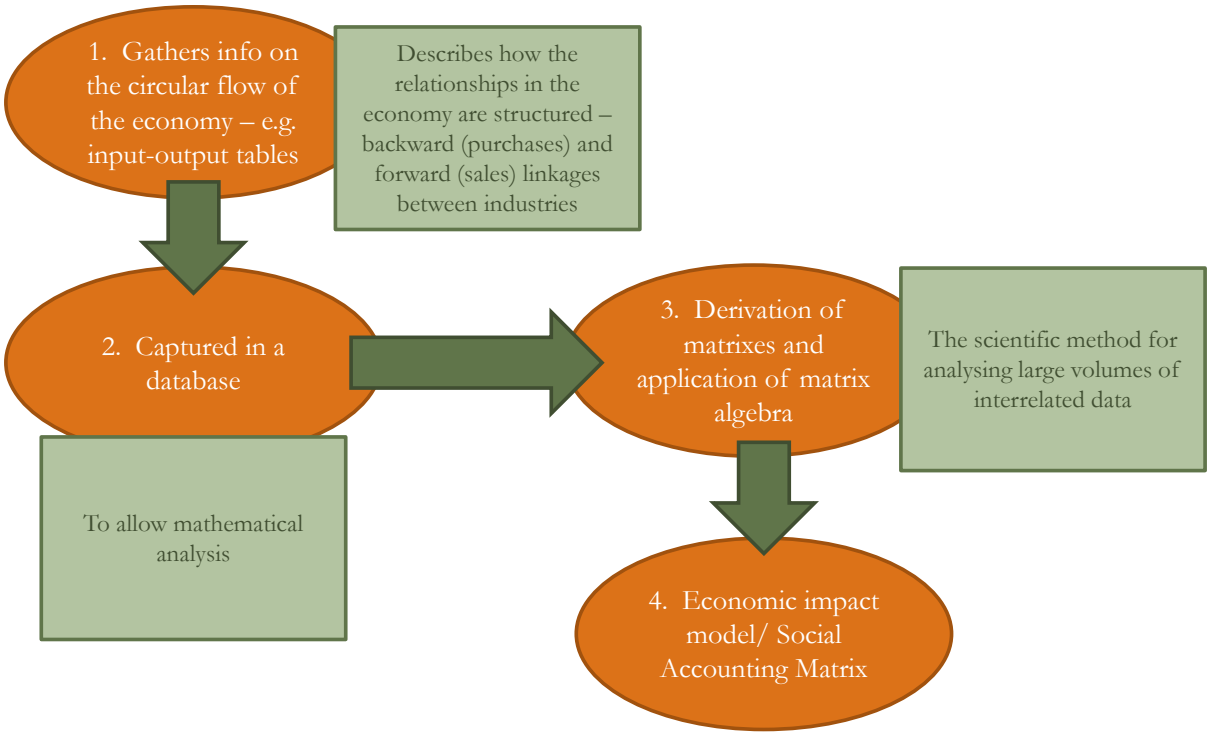


Figure 6: Steps in evaluating carbon tax impacts on jobs

The development of the SAM can further summarised as follows:

- The model was developed around the national Input-Output Table of StatsSA;
- The Input-Output Table was converted to a SAM in order to treat household expenditure internal to the economy – i.e. households as supplier of labour and consumer of goods and services;
- The next step derives Technical Coefficients and matrixes to express a change in output and production as a function of total demand; and
- Where each element of the matrix indicates the production required, directly and indirectly, from the sectors in each row to satisfy the final demand changes.

Economic impacts related to direct, indirect and induced jobs have been assessed as follows (with support of Figure 7):

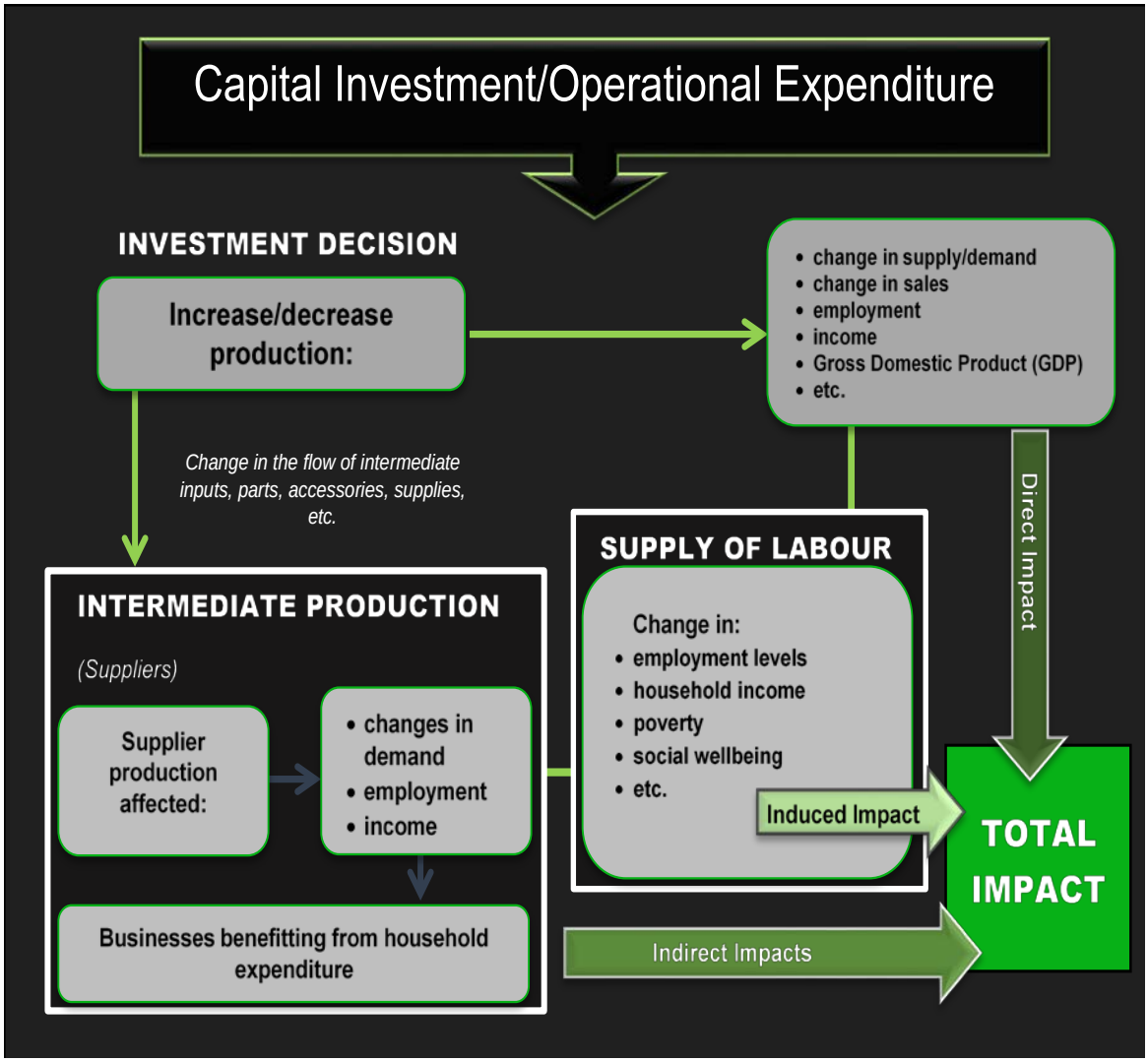


Figure 7: Evaluation of direct, indirect and induced jobs

- ***Direct impacts*** occur when a company employs people to provide goods or services. The number of direct jobs is impacted by the change in production from the business activity. For example the direct jobs for a furniture manufacturer are related to the labour required to convert raw materials into furniture.
- ***Indirect impacts*** occur when the suppliers of goods and services to the businesses or facilities experience larger markets and potential to expand. Indirect impacts result in an increase in job creation outside of the business through for example increased GDP and household income. To continue the furniture example above indirect jobs are created by increasing demand on suppliers for the raw materials going into the furniture manufacturing process and for transport services to deliver the furniture.
- ***Induced impacts*** represent further shifts in spending on food, clothing, shelter and other consumer goods and services because of the change in workers and payroll of directly and indirectly affected businesses. This leads to further business growth/decline throughout the local economy.

- *Total impact* is the sum of the direct, indirect and induced effects for a specific variable.

Key assumptions applied in conducting the impact assessment through the SAM include:

- Production activities in the economy are grouped in homogeneous sectors;
- The SAM provides information on the absolute monetary value of, and the relationship between, each industry's outputs and inputs for a given year;
- The technical coefficients remain relatively constant for the period over which forecast projections are made. This implies that the input-output ratio remains relatively constant in the short to medium term;
- The model quantifies direct and indirect economic impacts for the period under assessment, therefore the estimates that are derived refer to the impact for a specific period (in years);
- One employment opportunity is the equivalent of one person employed full-time for one year (FTE – full-time equivalent). For example, two workers employed for six months equal to one FTE job;
- Impact on jobs lost/affected is measured across a 2019-2030 time series and reflected through the summation of total jobs affected over the 11-year period; and
- **It is assumed that carbon emission taxes negatively impact production, inducing negative downstream impacts on production, where the potential change was modelled and expressed in terms of a potential change (loss) in employment.**

3 SCENARIOS

Scenarios are used to determine the impact of different circumstances or conditions impacting on the way in which the Carbon tax may be implemented. They also provide a means to model impacts based on assumptions to compensate for policy uncertainty.

Scenarios with respect to the implementation of the carbon tax are detailed in Table *3*.

Table 3: Summary of carbon tax scenarios

	Period	Scenario				
Parameter		1 Base Case – CT Bill	2 Constant carbon tax	3 Allowances Phased out	4 Energy transformation pass through from 2023	5 International Pricing from 2023
Tax Rate Escalation	2019 - 2022	CPI + 2	R/t 120 constant	CPI + 2	CPI + 2	CPI + 2
	2023 - 2030	CPI	CPI	CPI	CPI	International Alignment (increases from 2022 tax rate to $80/t by 2030)
Allowances	2019 - 2022	Allowances effective (except for offsets)				
	2023 - 2030	Allowances effective and offsets	Allowances effective and offsets	Allowances phased out linearly to 2030	Allowances phased out linearly to 2030	Allowances phased out linearly to 2030
Pass Through Carbon Tax (electricity and liquid fuels)	2019 - 2022	No- as current environmental allowances				
	2023 - 2030	No (as current environmental allowances)	No (as current environmental allowances)	No (as current environmental allowances)	Yes (to sectors paying carbon tax)	Yes (to sectors paying carbon tax)
Sector Exposure to tax - estimate based on thresholds	2019 - 2022	Low				
	2023 - 2030	Low	Low	Low	High	High

For scenario 5 the carbon tax rate aligns with international carbon prices (required to achieve the 2 ^{0}C target from international reports) (Exchange rate used 14.3R/US$ at 26-09-2018).

4 CARBON TAX CALCULATION

The carbon tax calculated for each sector and scenario are presented in Figure 8 through Figure 12.

The carbon tax calculation by sector are provided as an input into the macroeconomic model. A sector called other sectors is used to capture carbon tax liabilities which are not part of the specified sectors. This is relevant to capturing induced jobs and is significant when considering the pass through of the liability to consumers in Scenarios 4 & 5. The calculated values are provided in Appendix C: Tabulated Carbon Tax by Sector.

Scenario 1 includes allowances for the whole period up to 2030. The total carbon tax liability of the economy increases to R18.8 billion by 2022, and declines thereafter due to the assumed decarbonisation of the South African electricity grid.

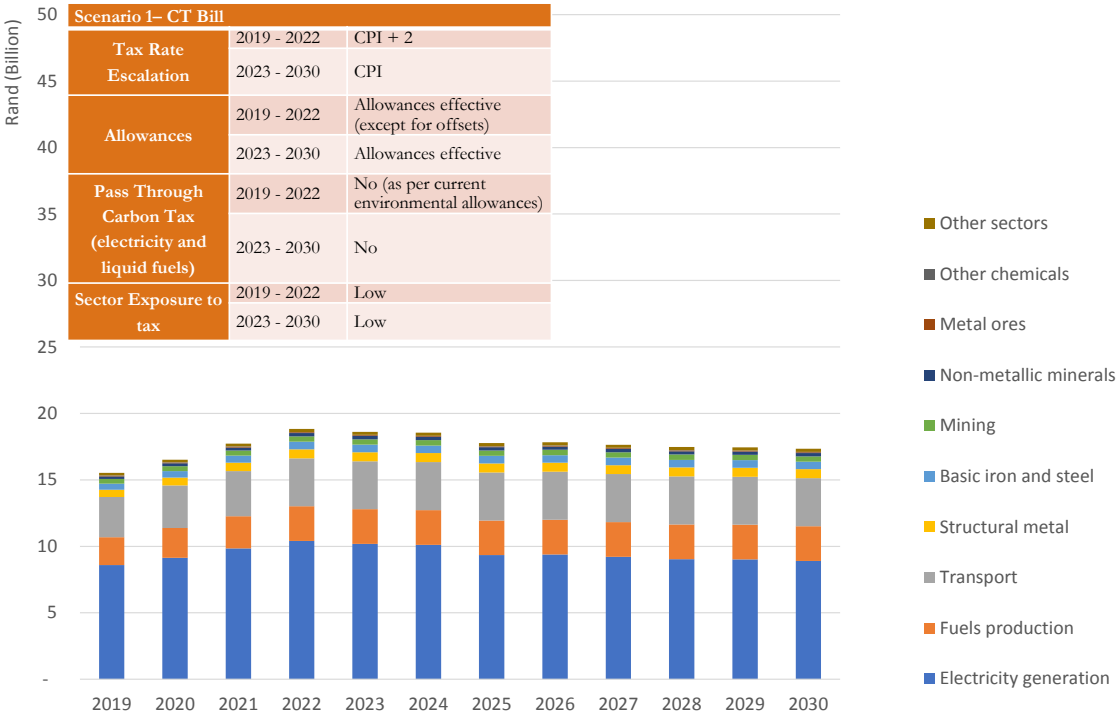


Figure 8: Carbon tax by sector over period for scenario 1

Scenarios 2 and 3 model the impact of declining allowances over the study period. The decline was modelled in response to comment by National Treasury that the allowances would be phased out after the first phase of the carbon tax in order to price carbon in a way that would approach the true social cost of carbon. In these scenarios, the carbon tax burden on the economy increase to around R45 billion by 2030.

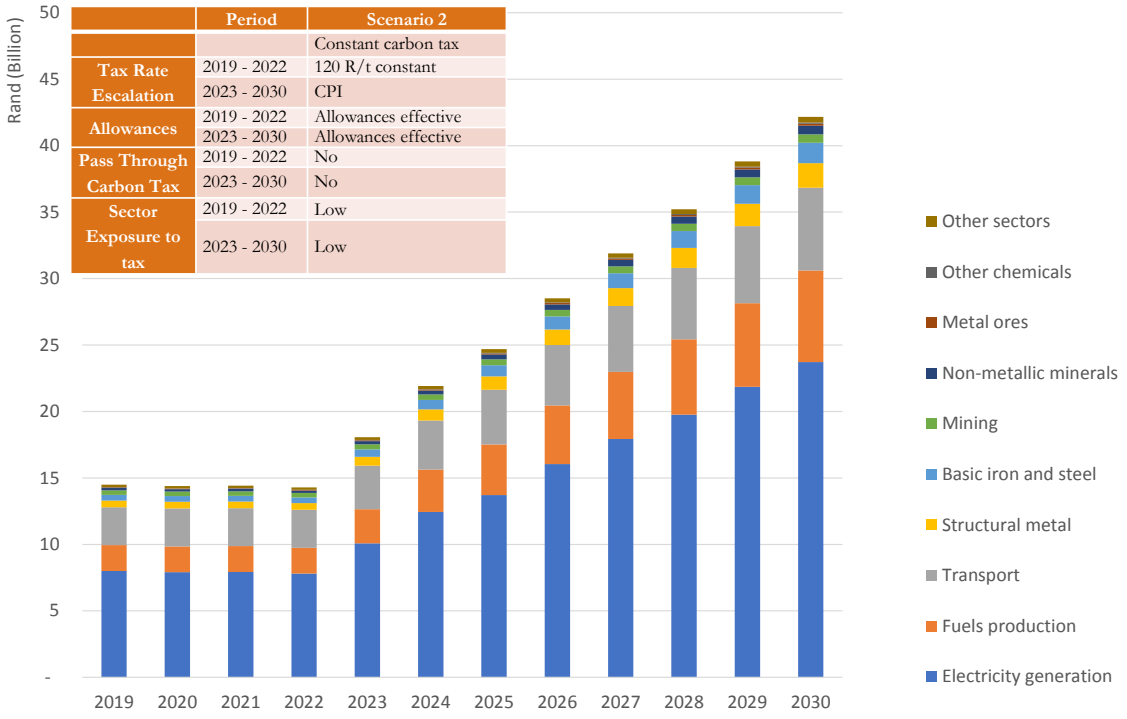


Figure 9: Carbon tax by sector over period for scenario 2

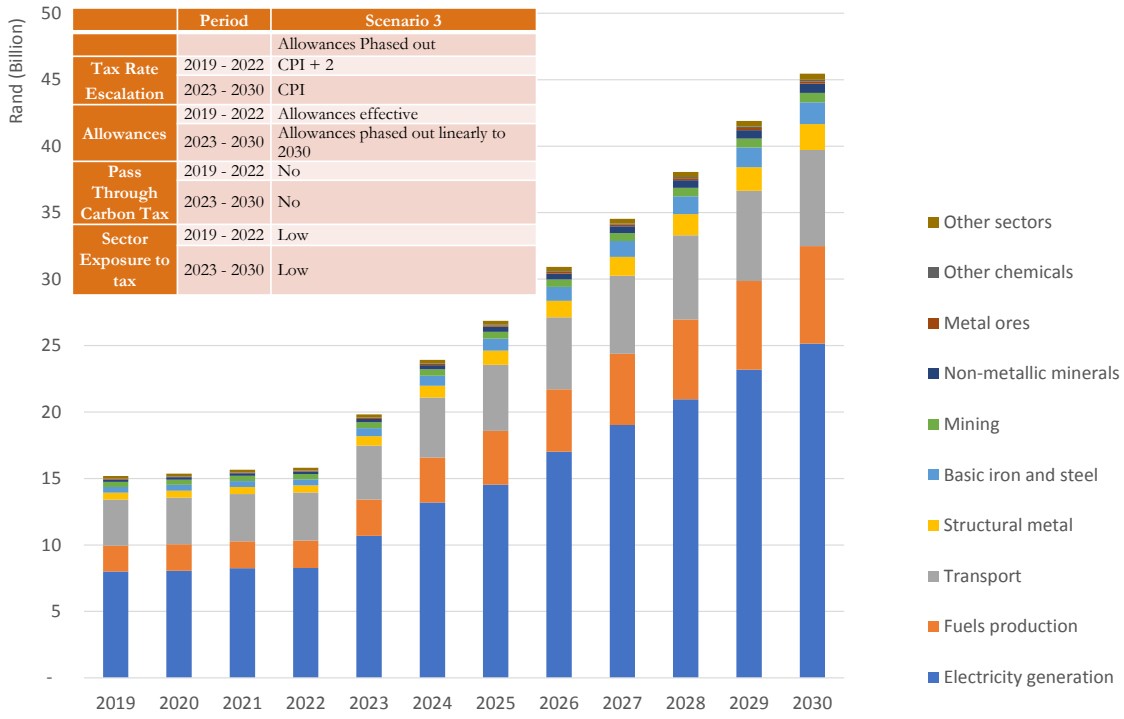
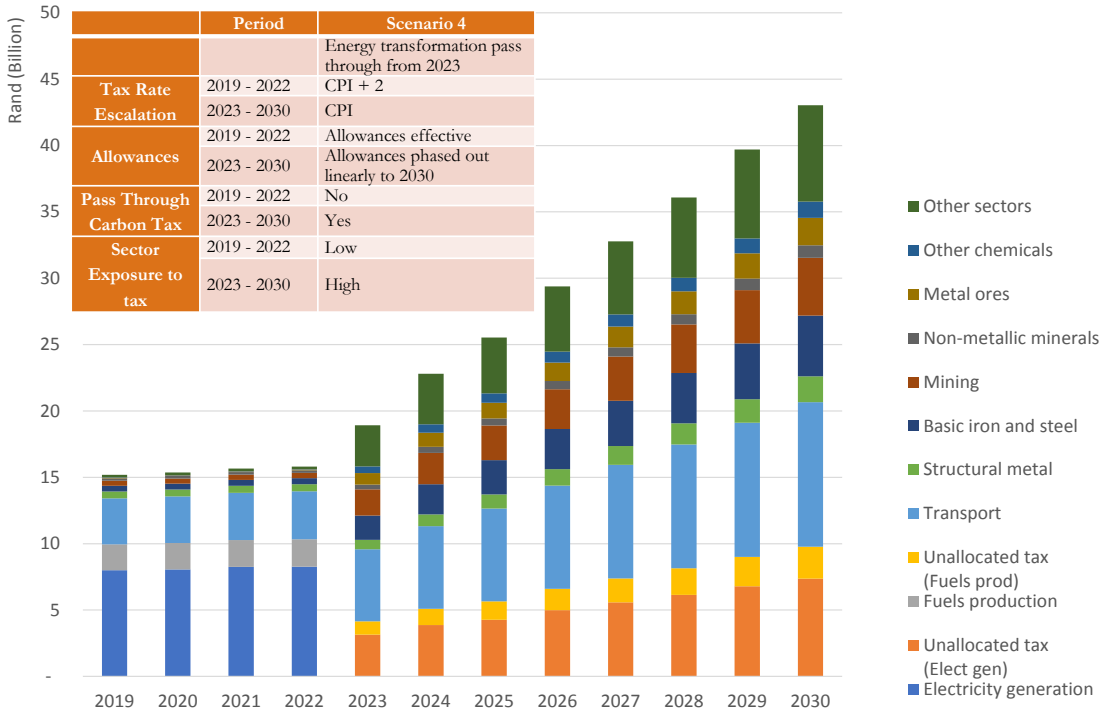


Figure 10: Carbon tax by sector over period for scenario 3

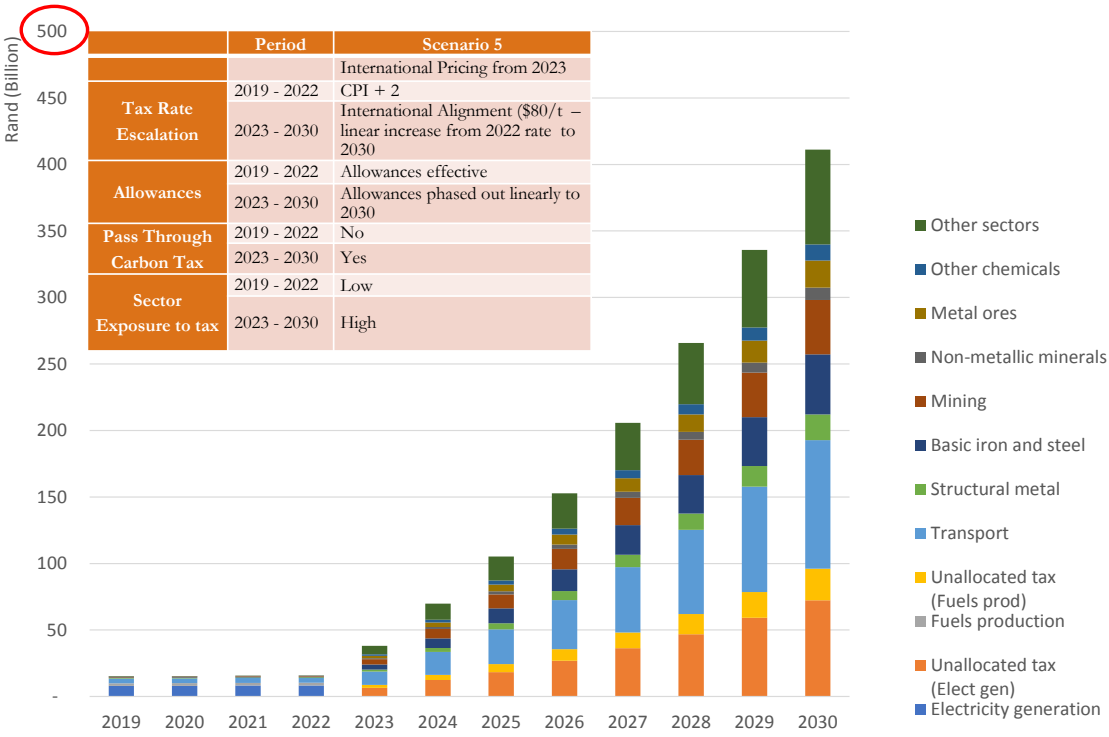
Scenarios 4 and 5 show the tax impact if the tax applied to electricity (power stations) and liquid fuels production (refineries, coal to liquids, gas to liquid fuels and other energy transformation) are passed on to consumers, with the carbon price increasing by inflation in scenario 4 and to

meet possible international prices in scenario 5. In the case of international pricing, the burden of carbon tax on the economy increase by a factor 10 to above R400 billion.



	Period	Scenario 4
		Energy transformation pass through from 2023
Tax Rate Escalation	2019 - 2022	CPI + 2
	2023 - 2030	CPI
Allowances	2019 - 2022	Allowances effective
	2023 - 2030	Allowances phased out linearly to 2030
Pass Through Carbon Tax	2019 - 2022	No
	2023 - 2030	Yes
Sector Exposure to tax	2019 - 2022	Low
	2023 - 2030	High

Figure 11: Carbon tax by sector over period for scenario 4



	Period	Scenario 5
		International Pricing from 2023
Tax Rate Escalation	2019 - 2022	CPI + 2
	2023 - 2030	International Alignment ($80/t – linear increase from 2022 rate to 2030
Allowances	2019 - 2022	Allowances effective
	2023 - 2030	Allowances phased out linearly to 2030
Pass Through Carbon Tax	2019 - 2022	No
	2023 - 2030	Yes
Sector Exposure to tax	2019 - 2022	Low
	2023 - 2030	High

Figure 12: Carbon tax by sector over period for scenario 5

5 JOB IMPACTS

The output of the macroeconomic model provides a high-level impact assessment of the sectoral effects of carbon tax on employment.

Externalities (in this case the introduction of carbon tax) may lead to a direct change in specific sectors in the economy. This change is quantified by a change in output, production or turnover, which in turn will influence the forward and backward linkages in the economy. The output of the model highlights the change in the following variables per sector:

- Production;
- Contribution to the Gross Value Added;
- Job creation; and
- Worker income.

This impact assessment identifies the effect of carbon tax on:

- a sector(direct impact);
- other sectors such as suppliers(indirect effect); and
- the impact on household consumption (induced effect).

The impact that the carbon tax have on jobs has been reflected in terms of full-time equivalents (FTE), summating impacted jobs across the 2019-2030 period for each scenario. In other words, FTE reflects the accumulated value of jobs lost over a particular period, for example: if two jobs are lost in year one, the accumulated FTE impact over a five-year period would mean that ten jobs are lost in the economy.

Results of the impact assessment have been packaged in terms of direct, indirect and induced, and total (direct + indirect + induced) FTE jobs affected by carbon tax emissions. The impacts are presented in Figure 13 through Figure 15 for the top 10 impacted sectors.

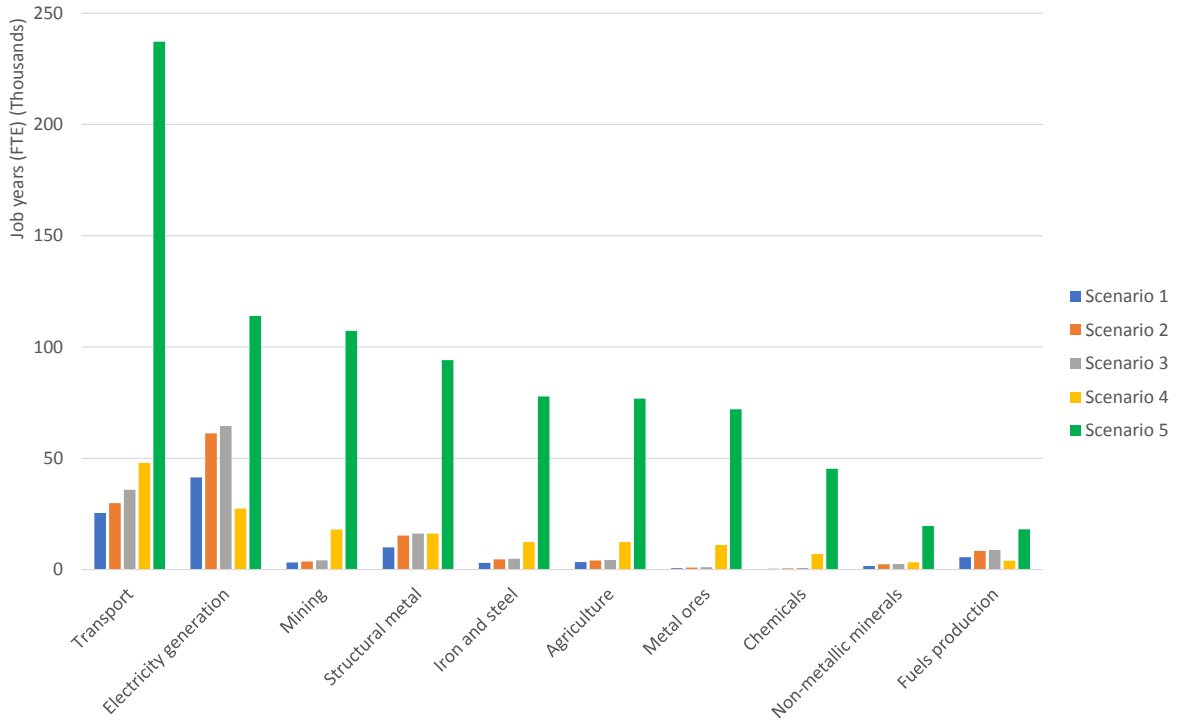


Figure 13: Carbon tax impact on direct jobs (job years)

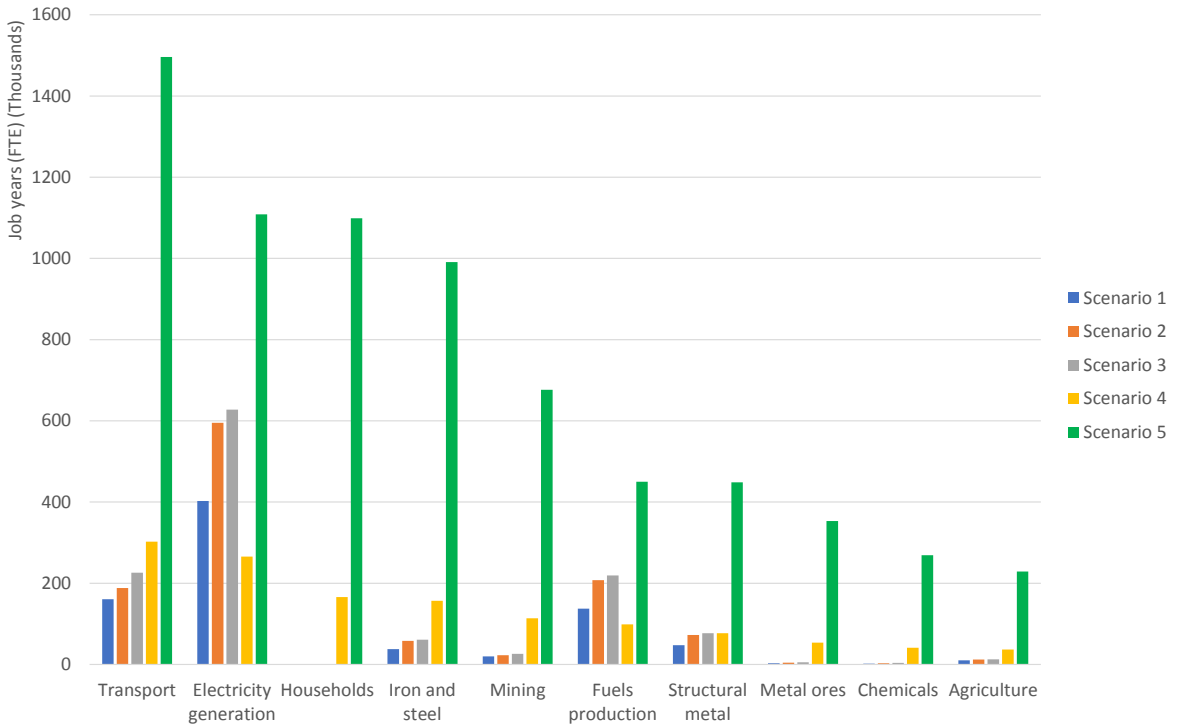


Figure 14: Carbon tax impact on indirect and induced jobs (job years)

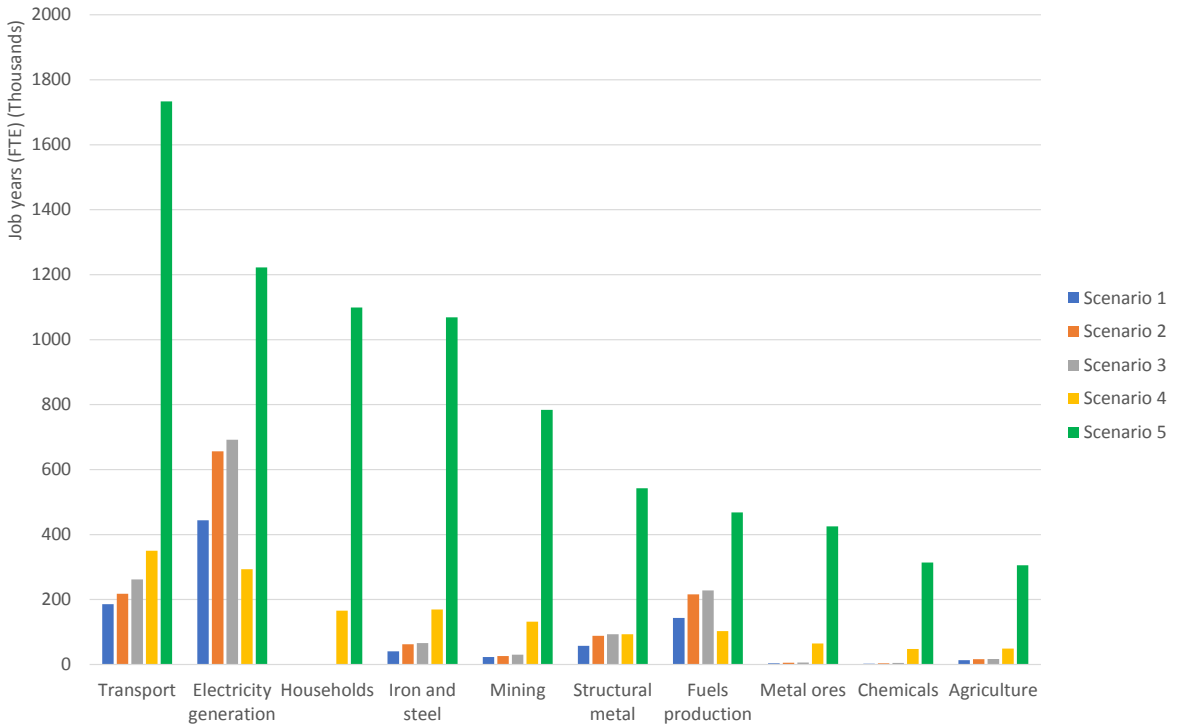


Figure 15: Carbon tax impact on direct, indirect and induced jobs (job years)

The data shown in the figures above are tabulated in Appendix D: Tabulated Job Impacts and provide a summary of the total FTE jobs lost due to carbon tax emissions over the 2019-2030 period.

The figures in the results can be interpreted as follows (using agriculture under scenario 1 as the example):

- Under scenario 1, 13 397 agricultural FTE jobs are potentially lost in the economy over the 2019-2030 period, or, 1 218 agricultural FTE jobs are lost per annum over the 11-year period;
- Inclusive of all affected economic sectors under scenario 1 over the 11-year period, 913 767 FTE jobs are lost in the overall economy.

It is important to note that the modelling presented here considers the negative impact of imposing a carbon tax burden on the economy. The money gathered by government in the implementation of the carbon tax will re-enter the economy at different levels, depending on how government implements the commitment to having the tax be carbon neutral up to 2022. Such re-introduction of the money into the economy will have a positive impact on the economy and on jobs. This positive impact has not been modelled in this project, as it fell outside the scope of the assignment.

6 SUMMARY

In the absence of the National Employment Vulnerability Assessment, which would have been developed on a sectoral basis, a high level economy wide assessment of potential employment impacts of the carbon tax was undertaken. Scenarios, as directed by the Task Team, were used based on the current structure of the economy. No revenue recycling was modelled as it is not included in the current carbon tax design.

The impact on jobs in the economy is summarised in Table 4. The impact is greatest on the electricity generation, liquid fuels production and transport sectors in the first three scenarios. When the tax burden is passed through to the consumers of electricity and liquid fuels, scenarios 4 and 5, the implications of the carbon tax are seen throughout the economy. Scenario 5, which represents alignment with an increasing global price of carbon, represents a significant risk for the whole economy.

Table 4: Total job impact (full-time equivalent job years)

Sector	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Transport	185 916	217 883	261 888	350 520	1 733 387
Electricity generation	444 212	656 193	692 129	293 280	1 222 439
Households	0	0	0	166 006	1 098 989
Iron and steel	40 725	62 524	66 028	169 138	1 068 551
Mining	23 220	26 195	30 195	131 683	783 661
Structural metal	57 432	88 174	93 116	93 116	542 490
Fuels production	143 143	216 130	228 224	102 653	468 093
Metal ores	3 475	5 335	6 260	65 005	42 5295
Chemicals	2 247	3 451	4 859	48 064	31 4264
Agriculture	13 397	16 160	17 043	49 074	30 5569
Grand Total	**913 767**	**1292045**	**139 9742**	**146 8541**	**7 962 738**

Note that the negative job impact projected in the modelling provided in this report will be offset by the recycling of revenue (if any). The positive impacts of such revenue recycling was not considered in this report.

APPENDIX A: SECTOR MAPPINGS

Table 5: Mapping social accounting matrix sectors to specified sectors

Specified sectors		Sector Social Accounting Matrix	Emissions data
Main sector	**Subsector**		
Agriculture, forestry and land use	Agriculture	Agriculture	
Agriculture, forestry and land use	Forestry	Forestry	
Other	Other	Fishing	
Mining	Mining	Coal and lignite	
Industrial processes	Metal ores	Metal ores	
Mining	Mining	Other mining	
Other	Other	Food	Food, Beverages and tobacco
Other	Other	Beverages and tobacco	
Industrial processes	Industrial processes	Spinning and textiles	Textiles and leather
Other	Other	Knitted fabrics, fur	Textiles and leather
Other	Other	Leather and luggage	Textiles and leather
Other	Other	Footwear	
Other	Other	Wood	
Industrial processes	Paper	Paper	
Other	Other	Publishing	
Energy	Fuels production	Coke oven manufacture	Coke Ovens (Transformation Sector), Refineries, Liquefaction
Energy	Fuels production	Nuclear fuel	
Industrial processes	Chemicals	Other chemicals	
Industrial processes	Rubber and plastic	Rubber	
Industrial processes	Rubber and plastic	Plastic	
Industrial processes	Glass	Glass	
Mining	Non-metallic minerals	Non-metallic minerals	
Other	Other	Furniture	
Other	Other	Recycling and NEC	
Industrial processes	Iron and steel	Basic iron and steel	
Mining	Mining	Precious metals	
Industrial processes	Structural metal	Structural metal	
Other	Other	General machinery	Machinery, Transport Equipment
Other	Other	Electrical machinery	
Other	Other	Electric valves	
Other	Other	Medical appliances	
Industrial processes	Motor vehicles	Motor vehicles	
Energy	Electricity generation	Electricity, gas and water	Electricity Plant, Autoproducer Electricity Plant
Other	Other	Distribution of water	
Other	Other	Construction	
Other	Other	Trade	
Other	Other	Hotels and restaurants	
Transport	Transport	Transport	Road, Rail, non-specified transport
Other	Other	Telecommunications	
Other	Other	Financial intermediation	
Other	Other	Insurance and pensions	
Other	Other	Auxiliary financial	
Other	Other	Real estate activities	
Other	Other	Renting of machinery	
Other	Research	Research	
Other	Other	Computer activities	
Other	Other	Other community activities	
Other	Other	Education	
Other	Other	Health and social work	
Other	Other	Other services NEC	
Households	Households	Households	

APPENDIX B: ALLOWANCES

Table 6: Allowance per sector

The following sectors had a basic allowance of 60%	The following sectors received a process emissions allowance of 60%	The following sectors received a process emissions allowance of 70%	The following sectors received a 10% trade exposure allowance	The following sectors received a 2.5% allowance based on 50% of the sector receiving the z-factor allowance of 5%
Agriculture, Forestry, Fishing, Coal and lignite, Metal ores, Other mining, Food, Beverages and tobacco, Spinning and textiles, Knitted fabrics, fur, Leather and luggage, Footwear, Wood, Paper, Publishing, Coke oven manufacture, Nuclear fuel, Other chemicals, Rubber, Plastic, Glass, Non-metallic minerals, Furniture, Recycling and NEC, Basic iron and steel, Precious metals, Structural metal, General machinery, Electrical machinery, Electric valves, Medical appliances, Motor vehicles, Electricity, gas and water, Distribution of water, Construction, Trade, Hotels and restaurants, Transport, Telecommunications, Financial intermediation, Insurance and pensions, Auxiliary financial, Real estate activities, Renting of machinery, Research, Computer activities, Other community activities, Education, Health and social work, Other services NEC, Households	Metal ores	Glass, Non-metallic minerals, Basic iron and steel	Agriculture, Forestry, Metal ores, Other mining, Food, Spinning and textiles, Paper, Coke oven manufacture, Other chemicals, Glass, Non-metallic minerals, Basic iron and steel, Structural metal, General machinery, Electricity, gas and water, Construction, Transport	Agriculture, Forestry, Fishing, Coal and lignite, Metal ores, Other mining, Food, Beverages and tobacco, Spinning and textiles, Knitted fabrics, fur, Leather and luggage, Footwear, Wood, Paper, Publishing, Coke oven manufacture, Nuclear fuel, Other chemicals, Rubber, Plastic, Glass, Non-metallic minerals, Furniture, Recycling and NEC, Basic iron and steel, Precious metals, Structural metal, General machinery, Electrical machinery, Electric valves, Medical appliances, Motor vehicles, Electricity, gas and water, Distribution of water, Construction, Trade, Hotels and restaurants, Transport, Telecommunications, Financial intermediation, Insurance and pensions, Auxiliary financial, Real estate activities, Renting of machinery, Research, Computer activities, Other community activities, Education, Health and social work, Other services NEC, Households

APPENDIX C: TABULATED CARBON TAX BY SECTOR

Table 7: Carbon Tax by Sector for Scenario 1 (Million Rand, 2017 terms)

Scenario 1	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Grand Total
Total	**15 537**	**16 538**	**17 752**	**18 858**	**18 637**	**18 571**	**17 791**	**17 843**	**17 665**	**17 494**	**17 470**	**17 356**	**211 512**
Agriculture, forestry and land use	**161**	**174**	**187**	**201**	**201**	**201**	**201**	**201**	**201**	**201**	**201**	**201**	**2 332**
Energy	**10 691**	**11 383**	**12 264**	**13 012**	**12 791**	**12 725**	**11 945**	**11 997**	**11 819**	**11 648**	**11 624**	**11 510**	**143 408**
Electricity generation	8 599	9 131	9 841	10 405	10 185	10 118	9 338	9 390	9 212	9 041	9 017	8 903	113 180
Fuels production	2 093	2 252	2 423	2 607	2 607	2 607	2 607	2 607	2 607	2 607	2 607	2 607	30 228
Industrial processes	**1 079**	**1 161**	**1 249**	**1 344**	**1 344**	**1 344**	**1 344**	**1 344**	**1 344**	**1 344**	**1 344**	**1 344**	**15 590**
Structural metal	544	585	630	678	678	678	678	678	678	678	678	678	7 857
Basic iron and steel	457	492	530	570	570	570	570	570	570	570	570	570	6 607
Metal ores	44	48	51	55	55	55	55	55	55	55	55	55	638
Other chemicals	23	25	27	29	29	29	29	29	29	29	29	29	333
Paper	7	8	8	9	9	9	9	9	9	9	9	9	102
Glass	4	4	4	5	5	5	5	5	5	5	5	5	53
Spinning and textiles													
Mining	**550**	**580**	**613**	**647**	**647**	**647**	**647**	**647**	**647**	**647**	**647**	**647**	**7 570**
Other mining	354	369	386	404	404	404	404	404	404	404	404	404	4 742
Non-metallic minerals	196	211	227	244	244	244	244	244	244	244	244	244	2 828
Other	**34**	**36**	**38**	**40**	**40**	**40**	**40**	**40**	**40**	**40**	**40**	**40**	**464**
Construction	28	29	31	33	33	33	33	33	33	33	33	33	382
Food	4	4	4	4	4	4	4	4	4	4	4	4	52
General machinery	2	2	2	3	3	3	3	3	3	3	3	3	30
Transport	**3 021**	**3 204**	**3 401**	**3 613**	**3 613**	**3 613**	**3 613**	**3 613**	**3 613**	**3 613**	**3 613**	**3 613**	**42 147**

Table 8: Carbon Tax by Sector for Scenario 2 (Million Rand, 2017 terms)

Scenario 2	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Grand Total
Total	**14 505**	**14 411**	**14 434**	**14 305**	**18 085**	**21 946**	**24 716**	**28 542**	**31 939**	**35 263**	**38 868**	**42 214**	**299 229**
Agriculture, forestry and land use	**150**	**150**	**150**	**150**	**178**	**206**	**234**	**263**	**291**	**319**	**347**	**375**	**2 813**
Energy	**9 947**	**9 853**	**9 876**	**9 747**	**12 646**	**15 627**	**17 516**	**20 462**	**22 978**	**25 422**	**28 146**	**30 611**	**212 831**
Electricity generation	8 002	7 908	7 931	7 803	10 082	12 443	13 713	16 039	17 935	19 760	21 864	23 710	167 190
Fuels production	1 945	1 945	1 945	1 945	2 564	3 184	3 803	4 423	5 043	5 662	6 282	6 901	45 642
Industrial processes	**1 003**	**1 003**	**1 003**	**1 003**	**1 334**	**1 664**	**1 995**	**2 325**	**2 656**	**2 986**	**3 317**	**3 647**	**23 935**
Structural metal	506	506	506	506	672	839	1 005	1 172	1 338	1 505	1 672	1 838	12 063
Basic iron and steel	425	425	425	425	565	705	845	985	1 125	1 265	1 406	1 546	10 143
Metal ores	41	41	41	41	55	68	82	95	109	122	136	149	979
Other chemicals	21	21	21	21	28	36	43	50	57	64	71	78	511
Paper	7	7	7	7	9	11	13	15	17	19	22	24	156
Glass	3	3	3	3	5	6	7	8	9	10	11	12	82
Spinning and textiles													
Mining	**522**	**522**	**522**	**522**	**617**	**712**	**808**	**903**	**998**	**1 093**	**1 189**	**1 284**	**9 691**
Other mining	340	340	340	340	375	411	446	481	516	552	587	622	5 350
Non-metallic minerals	182	182	182	182	242	302	362	422	482	542	602	662	4 342
Other	**32**	**32**	**32**	**32**	**37**	**42**	**47**	**52**	**57**	**62**	**67**	**72**	**564**
Construction	27	27	27	27	30	33	36	40	43	46	49	53	438
Food	3	3	3	3	4	6	7	8	9	10	11	12	80
General machinery	2	2	2	2	3	3	4	5	5	6	6	7	47
Transport	**2 851**	**2 851**	**2 851**	**2 851**	**3 273**	**3 694**	**4 116**	**4 538**	**4 960**	**5 381**	**5 803**	**6 225**	**49 394**

Table 9: Carbon Tax by Sector for Scenario 3 (Million Rand, 2017 terms)

Scenario 3	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Grand Total
Total	**15 201**	**15 377**	**15 676**	**15 822**	**19 842**	**23 949**	**26 899**	**30 969**	**34 584**	**38 121**	**41 957**	**45 517**	**323 915**
Agriculture, forestry and land use	**150**	**153**	**156**	**159**	**189**	**219**	**249**	**279**	**308**	**338**	**368**	**398**	**2 967**
Energy	**9 947**	**10 047**	**10 268**	**10 334**	**13 410**	**16 574**	**18 579**	**21 705**	**24 375**	**26 968**	**29 859**	**32 475**	**224 541**
Electricity generation	8 002	8 064	8 245	8 270	10 689	13 195	14 543	17 011	19 023	20 959	23 193	25 151	176 346
Fuels production	1 945	1 984	2 023	2 064	2 721	3 379	4 036	4 694	5 351	6 009	6 666	7 324	48 196
Industrial processes	**1 015**	**1 035**	**1 056**	**1 077**	**1 432**	**1 786**	**2 141**	**2 496**	**2 851**	**3 206**	**3 561**	**3 916**	**25 571**
Structural metal	506	516	526	536	713	890	1 067	1 244	1 420	1 597	1 774	1 951	12 739
Basic iron and steel	425	434	442	451	600	748	897	1 046	1 194	1 343	1 492	1 640	10 711
Metal ores	46	47	47	48	64	80	96	112	128	144	160	176	1 149
Other chemicals	29	29	30	30	40	50	60	70	80	90	100	110	720
Paper	7	7	7	7	9	12	14	16	18	21	23	25	165
Glass	3	3	4	4	5	6	7	8	10	11	12	13	86
Spinning and textiles													
Mining	**573**	**581**	**588**	**596**	**697**	**799**	**900**	**1 001**	**1 102**	**1 204**	**1 305**	**1 406**	**10 752**
Other mining	391	395	399	403	441	478	516	553	591	629	666	704	6 167
Non-metallic minerals	182	186	189	193	257	320	384	448	511	575	638	702	4 585
Other	**39**	**40**	**40**	**41**	**47**	**54**	**60**	**66**	**72**	**79**	**85**	**91**	**714**
Construction	31	32	32	33	36	39	43	46	50	53	57	60	513
Food	5	5	5	5	7	9	11	12	14	16	18	19	127
General machinery	3	3	3	3	4	5	6	7	8	9	10	11	74
Transport	**3 476**	**3 521**	**3 567**	**3 614**	**4 066**	**4 519**	**4 971**	**5 423**	**5 875**	**6 327**	**6 779**	**7 231**	**59 370**

Table 10: Carbon Tax by Sector for Scenario 4 (Million Rand, 2017 terms)

Scenario 4	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Grand Total
Total	**15 201**	**15 377**	**15 676**	**15 822**	**19 058**	**22 972**	**25 727**	**29 602**	**33 022**	**36 366**	**40 007**	**43 373**	**312 203**
Agriculture, forestry and land use	**150**	**153**	**156**	**159**	**593**	**720**	**811**	**936**	**1 048**	**1 157**	**1 275**	**1 384**	**8 542**
Energy	**9 947**	**10 047**	**10 268**	**10 334**									**40 597**
Electricity generation	8 002	8 064	8 245	8 270									32 581
Fuels production	1 945	1 984	2 023	2 064									8 016
Households					**2 439**	**3 014**	**3 323**	**3 890**	**4 351**	**4 796**	**5 308**	**5 758**	**32 878**
Households					2 439	3 014	3 323	3 890	4 351	4 796	5 308	5 758	32 878
Industrial processes	**1 015**	**1 035**	**1 056**	**1 077**	**4 016**	**4 982**	**5 675**	**6 632**	**7 481**	**8 312**	**9 214**	**10 050**	**60 544**
Basic iron and steel	425	434	442	451	1 830	2 270	2 586	3 022	3 409	3 788	4 199	4 581	27 439
Structural metal	506	516	526	536	713	890	1 067	1 244	1 420	1 597	1 774	1 951	12 739
Metal ores	46	47	47	48	865	1 070	1 186	1 388	1 555	1 717	1 901	2 064	11 933
Other chemicals	29	29	30	30	515	637	707	827	927	1 023	1 133	1 230	7 118
Paper	7	7	7	7	81	100	112	131	147	162	180	196	1 135
Spinning and textiles					7	9	9	11	12	14	15	16	94
Glass	3	3	4	4	5	6	7	8	10	11	12	13	86
Mining	**573**	**581**	**588**	**596**	**2 329**	**2 816**	**3 134**	**3 616**	**4 031**	**4 435**	**4 883**	**5 290**	**32 874**
Other mining	391	395	399	403	1 969	2 368	2 609	3 003	3 335	3 657	4 019	4 344	26 893
Non-metallic minerals	182	186	189	193	360	448	525	613	696	778	864	946	5 981
Other	**39**	**40**	**40**	**41**	**104**	**124**	**139**	**159**	**176**	**194**	**212**	**230**	**1 499**
Construction	31	32	32	33	52	60	66	74	81	88	95	102	747
Food	5	5	5	5	45	55	62	72	81	90	99	108	633
General machinery	3	3	3	3	7	9	11	13	14	16	18	19	119
Transport	**3 476**	**3 521**	**3 567**	**3 614**	**5 429**	**6 216**	**6 985**	**7 772**	**8 551**	**9 329**	**10 112**	**10 891**	**79 463**
Unallocated emissions (Elect gen)					**3 142**	**3 869**	**4 271**	**4 987**	**5 575**	**6 142**	**6 792**	**7 365**	**42 143**
Unallocated emissions (Fuels prod)					**1 006**	**1 231**	**1 389**	**1 612**	**1 809**	**2 001**	**2 210**	**2 404**	**13 662**

Table 11: Carbon Tax by Sector for Scenario 5 (Million Rand, 2017 terms)

Scenario 5	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Grand Total
Total	**15 201**	**15 377**	**15 676**	**15 822**	**38 440**	**70 425**	**106 082**	**153 955**	**207 447**	**267 947**	**338 479**	**414 380**	**1 659 231**
Agriculture, forestry and land use	**150**	**153**	**156**	**159**	**1 247**	**2 307**	**3 496**	**5 072**	**6 836**	**8 829**	**11 144**	**13 638**	**53 189**
Energy	**9 947**	**10 047**	**10 268**	**10 334**									**40 597**
Electricity generation	8 002	8 064	8 245	8 270									32 581
Fuels production	1 945	1 984	2 023	2 064									8 016
Households					**5 105**	**9 625**	**14 269**	**21 001**	**28 305**	**36 499**	**46 280**	**56 575**	**217 660**
Industrial processes	**1 015**	**1 035**	**1 056**	**1 077**	**8 434**	**15 962**	**24 451**	**35 916**	**48 801**	**63 434**	**80 528**	**98 983**	**380 691**
Basic iron and steel	425	434	442	451	3 844	7 274	11 144	16 369	22 241	28 911	36 701	45 113	173 348
Metal ores	46	47	47	48	1 812	3 418	5 097	7 499	10 122	13 072	16 578	20 287	78 071
Structural metal	506	516	526	536	1 505	2 866	4 620	6 766	9 305	12 236	15 560	19 277	74 219
Other chemicals	29	29	30	30	1 080	2 037	3 038	4 470	6 033	7 792	9 882	12 093	46 541
Paper	7	7	7	7	169	320	481	707	956	1 237	1 570	1 923	7 390
Spinning and textiles					15	27	41	60	81	104	132	161	620
Glass	3	3	4	4	10	19	31	46	63	83	105	130	502
Mining	**573**	**581**	**588**	**596**	**4 662**	**8 565**	**12 818**	**18 666**	**25 149**	**32 469**	**41 066**	**50 261**	**195 995**
Other mining	391	395	399	403	3 904	7 124	10 549	15 339	20 599	26 516	33 501	40 922	160 043
Non-metallic minerals	182	186	189	193	759	1 440	2 269	3 327	4 551	5 953	7 565	9 339	35 952
Other	**39**	**40**	**40**	**41**	**204**	**367**	**552**	**797**	**1 073**	**1 385**	**1 747**	**2 139**	**8 424**
Food	5	5	5	5	93	176	266	391	528	684	868	1 064	4 091
Construction	31	32	32	33	95	161	240	339	451	580	725	885	3 604
General machinery	3	3	3	3	16	30	46	68	93	121	154	190	729
Transport	**3 476**	**3 521**	**3 567**	**3 614**	**10 093**	**17 295**	**26 161**	**36 836**	**49 208**	**63 301**	**79 165**	**96 722**	**392 960**
Unallocated emissions (Elect gen)					**6 582**	**12 360**	**18 348**	**26 935**	**36 276**	**46 760**	**59 232**	**72 387**	**278 881**
Unallocated emissions (Fuels prod)					**2 113**	**3 944**	**5 986**	**8 731**	**11 799**	**15 270**	**19 318**	**23 674**	**90 835**

APPENDIX D: TABULATED JOB IMPACTS

Table 12: Direct jobs impact (full-time equivalent job years)

Sector	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Transport	25444	29819	35842	47972	237231
Electricity generation	41425	61194	64545	27350	113999
Mining	3179	3587	4134	18031	107301
Structural metal	9966	15300	16158	16158	94134
Iron and steel	2964	4551	4806	12312	77782
Agriculture	3367	4061	4283	12333	76795
Metal ores	589	904	1060	11009	72029
Chemicals	324	498	701	6930	45313
Non-metallic minerals	1543	2370	2502	3264	19622
Fuels production	5527	8345	8812	3964	18074
Grand Total	**94329**	**130629**	**142844**	**159323**	**862282**

Table 13: Indirect job impact (full-time equivalent job years)

Sector	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Transport	160472	188063	226046	302548	1496156
Electricity generation	402787	594999	627584	265930	1108439
Households	0	0	0	165992	1098897
Iron and steel	37760	57972	61221	156826	990769
Mining	20041	22608	26061	113653	676360
Fuels production	137616	207785	219412	98689	450019
Structural metal	47466	72874	76958	76958	448356
Metal ores	2887	4432	5200	53995	353266
Chemicals	1923	2953	4158	41134	268951
Agriculture	10030	12099	12760	36741	228774
Grand Total	**820981**	**1163786**	**1259401**	**1312468**	**7119986**

Table 14: Total job impact (full-time equivalent job years)

Sector	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Transport	185916	217883	261888	350520	1733387
Electricity generation	444212	656193	692129	293280	1222439
Households	0	0	0	166006	1098989
Iron and steel	40725	62524	66028	169138	1068551
Mining	23220	26195	30195	131683	783661
Structural metal	57432	88174	93116	93116	542490
Fuels production	143143	216130	228224	102653	468093
Metal ores	3475	5335	6260	65005	425295
Chemicals	2247	3451	4859	48064	314264
Agriculture	13397	16160	17043	49074	305569
Grand Total	**913767**	**1292045**	**1399742**	**1468541**	**7962738**