# ACTIVATING THE SAFRIM MODEL IN CALCULATING THE MACRO-ECONOMIC IMPACT OF GREENHOUSE GAS MITIGATION ON THE SOUTH AFRICAN ECONOMY

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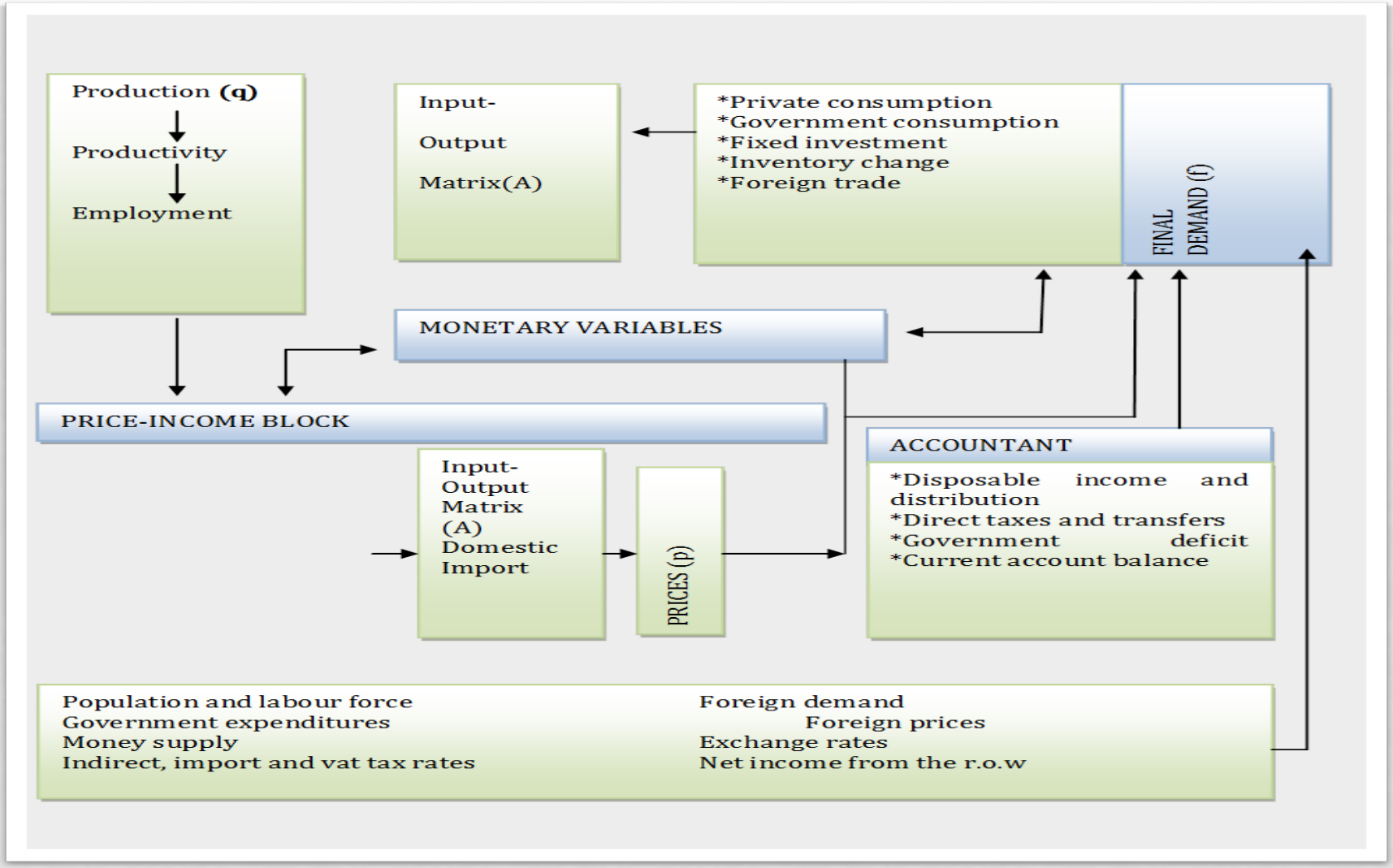
The structure of the paper is as follows:

- Description of the Case Study - South Africa's Greenhouse Gas Emissions Potential Mitigation Analysis
- Overview of the South African INFORUM model (SAFRIM)
- Activating the SAFRIM model
- Results of the Case Study
- Conclusions

# GHGS IN KEY ECONOMIC SECTORS

- Energy;
- Industry;
- Buildings;
- Mining;
- Transport;
- Waste; and
- Agriculture, Forestry and Other Land Use (AFOLU)

# DYNAMIC AND INTER-RELATED WORKINGS OF THE SAFRIM MODEL



# FORECASTING THE BASELINE SCENARIO
## - FUNDAMENTAL ECONOMIC IMPERATIVES/RULES -

- There should be an acceptable measure (not exceeding ±4% of the GDP) of balance on the current account of the balance of payments;
- No fundamental obstructions to obtain foreign capital;
- Positive growth of the world economy; and
- South Africa's population growth by taking into account the negative effects of HIV/Aids.

# METHODOLOGY TO ACTIVATE THE MODEL

- **Backward Linkages**
  - A. Construction phase (investment impact)
  - B. Operational impact
  - C. Changes in the production structure
- **Forward Linkages**
  - D. Price impact
- **Balancing constraints**

# METHODOLOGY

## A. CONSTRUCTION PHASE (INVESTMENT IMPACT)

$$fdc = pcec + invc + govc + exc - imc + fdrc + trcc + capex\_tot \quad (1)$$

**Where**:

| | |
|---|---|
| fdc | = total final demand |
| pcec | = private consumption expenditure |
| invc | = investment (investment excluding investment in the mitigation measures) |
| govc | = government |
| exc | = exports |
| imc | = imports |
| fdrc | = residual |
| trcc | = transfer costs |
| capex_tot | = total net investment of the various mitigation measures |

# METHODOLOGY

## B. OPERATIONAL IMPACT

outc = (!(I-AMC) * fdc) + oper_imp (2)

**Where**:

outc = total output (production)

! (I-AMC) = inverse matrix

fdc = total final demand

oper_imp = total net operational impact of the various mitigation measures

# METHODOLOGY

## C. CHANGES IN THE PRODUCTION STRUCTURE

The A matrix, was adjusted on an annual basis to accommodate the changes in the production structure to take into account the influences of the various mitigation measures.

# METHODOLOGY

## D. PRICE IMPACT

The identity below explains were additional cost or savings are added in the model.

va = lab + gos + itprd - isprd + itprs - isprs + enviro (3)

**Where**:

| | |
|---|---|
| va | = total value added |
| lab | = compensation of employees |
| gos | = gross operating surplus |
| itprd | = indirect taxes on production |
| isprd | = indirect subsidies on production |
| itprs | = indirect taxes on products |
| isprs | = indirect subsidies on products |
| enviro | = additional costs or savings brought about in the economy by the introduction of GHG mitigation measures. |

# METHODOLOGY

## D. PRICE IMPACT (CONTINUE)

The next function shows how value added impacts on prices in the economy:

$$uc = va/outc \qquad (4)$$

**Where**:

uc = value added unit cost

va = value added

outc = output/production (constant prices)

The value added unit cost is calculated by dividing value added by the output of a sector.

# METHODOLOGY

## D. PRICE IMPACT (CONTINUE)

$$tot\_uc = impr + uc \quad (5)$$

**Where**:

tot_uc = total unit cost
impr = import unit prices
uc = total value added unit cost

This is an interim step whereby the total unit cost is calculated by adding the import unit price to the unit cost.

# METHODOLOGY

## D. PRICE IMPACT (CONTINUE)

$$ppi = (tot\_uc) * DPINV \quad (6)$$

**Where**:

ppi = producer price index

tot_uc = total unit cost

DPINV = domestic price inverse

This formula is calculating the total domestic price (ppi) by multiplying the total unit cost by the domestic price inverse.

# METHODOLOGY

## - BALANCING CONSTRAINTS -

Technical adjustment to compare scenario with base case.

The deficit on the current account of balance of payments as a percentage of the country's overall economic activity (GDP), was taken as a controlling measure demonstrating the ability of the economy to financially carry the burden of a particular mitigation option.

Balance was achieved by changing the interest rate.

# RESULTS OF CASE STUDY

## - AVERAGE GDP IMPACT OVER THE PERIOD (2010-2050) -

| Name | Incremental impact | | | | | | Dynamic impact | | Split |
|---|---|---|---|---|---|---|---|---|---|
| | Backward Linkage Impact | | | | Forward Linkage Impact | Net Incremental Impact | Dynamic impact providing for balance of payment adjustment | | |
| | Additional (Net) Investment Impact | Additional (Net) Operational Cost | Impact due to change in Production Structure | Total Backward Linkages | Impact due to Price Change | | Impact Before Balance of Payments Adjustment | After Balance of Payments Adjustment | Final dynamic impact |
| **Energy** | 23488 | 21461 | -5493 | 39456 | -8173 | 31283 | 31748 | 21745 | 45% |
| **Industry** | 4397 | 787 | 0 | 5184 | 160 | 5343 | 5403 | 2371 | 5% |
| **buildings** | 1067 | 1 | 0 | 1068 | 4350 | 5419 | 5401 | 5401 | 11% |
| **Other Mining** | 2248 | 2545 | 0 | 4793 | 2813 | 7607 | 7404 | 7404 | 15% |
| **Transport** | 13685 | -4345 | 0 | 9313 | -807 | 8506 | 8533 | 8533 | 18% |
| **Waste** | 861 | 1807 | 0 | 2668 | -888 | 1780 | 1793 | 1793 | 4% |
| **AFOLU** | 155 | 896 | 0 | 1052 | -89 | 963 | 964 | 964 | 2% |
| **Total** | 45874 | 23154 | -5493 | 63535 | -2634 | 60901 | 61246 | 48211 | 100% |

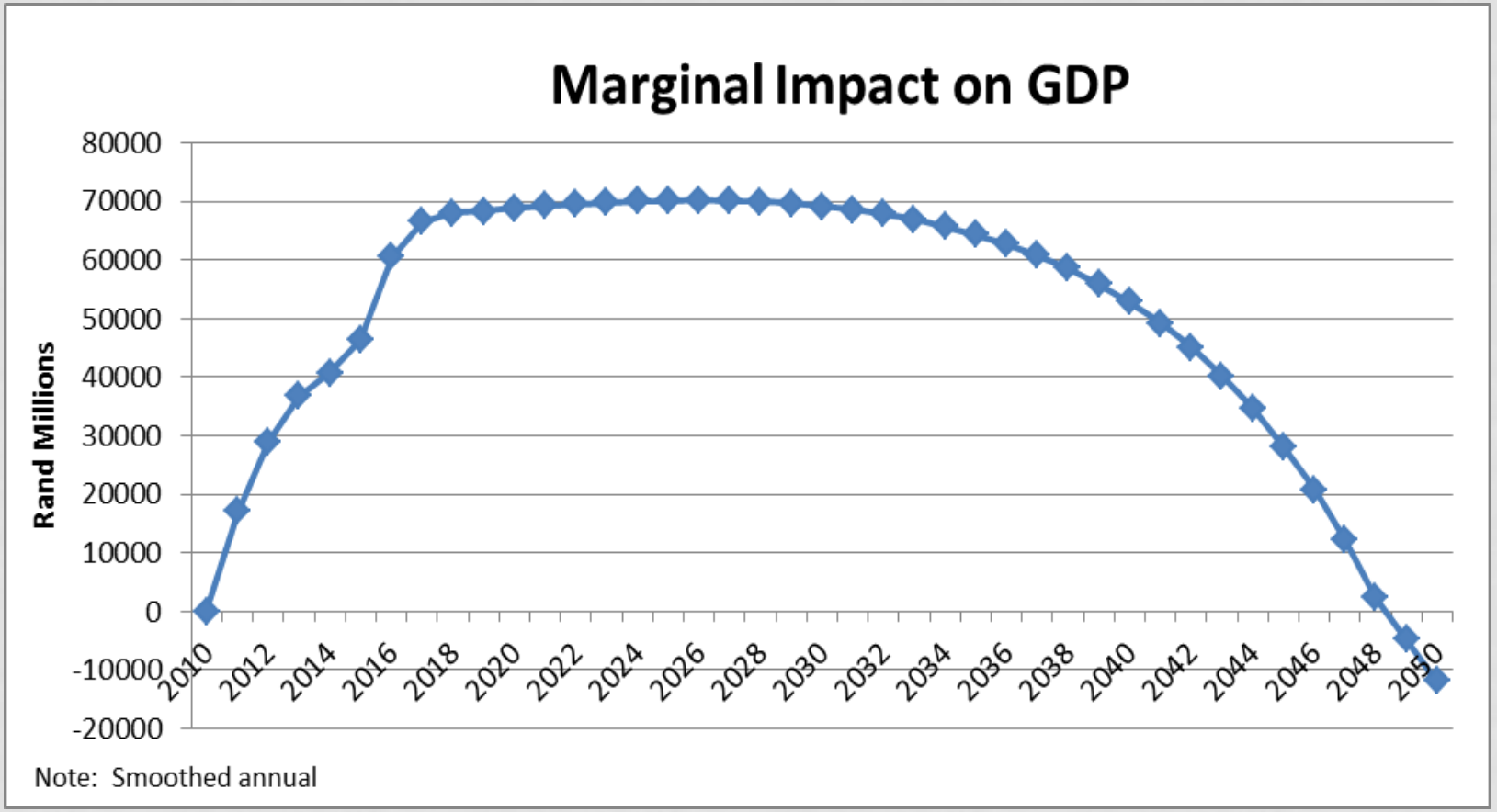
# RESULTS OF CASE STUDY

## - AVERAGE EMPLOYMENT IMPACT OVER THE PERIOD (2010-2050), CHANGE IN NUMBER OF JOBS -

| Name | Incremental impact | | | | | | Dynamic impact | | Split |
|---|---|---|---|---|---|---|---|---|---|
| | Backward Linkage Impact | | | | Forward Linkage Impact | Net Incremental Impact | Dynamic impact providing for balance of payment adjustment | | |
| | Additional (Net) Investment Impact | Additional (Net) Operational Cost | Impact due to change in Production Structure | Total Backward Linkages | Impact due to Price Change | | Impact Before Balance of Payments Adjustment | After Balance of Payments Adjustment | Final dynamic impact |
| **Energy** | 67243 | 40106 | -26299 | 81051 | -46741 | 34310 | 40510 | -12468 | -0.13 |
| **Industry** | 20271 | 5525 | 0 | 25797 | 639 | 26435 | 26760 | 10890 | 0.11 |
| **buildings** | 5914 | 7 | 0 | 5922 | 23863 | 29785 | 29687 | 29687 | 0.31 |
| **Other Mining** | 7067 | 3828 | 0 | 10895 | 14756 | 25651 | 24605 | 24605 | 0.25 |
| **Transport** | 46709 | -12211 | 0 | 34497 | -4179 | 30318 | 30455 | 30455 | 0.31 |
| **Waste** | 3719 | 4075 | 0 | 7795 | -4878 | 2916 | 2983 | 2983 | 0.03 |
| **AFOLU** | 1371 | 10000 | 0 | 11371 | -501 | 10870 | 10869 | 10869 | 0.11 |
| **Total** | 152294 | 51332 | -26299 | 177327 | -17041 | 160286 | 165868 | 97020 | 100% |

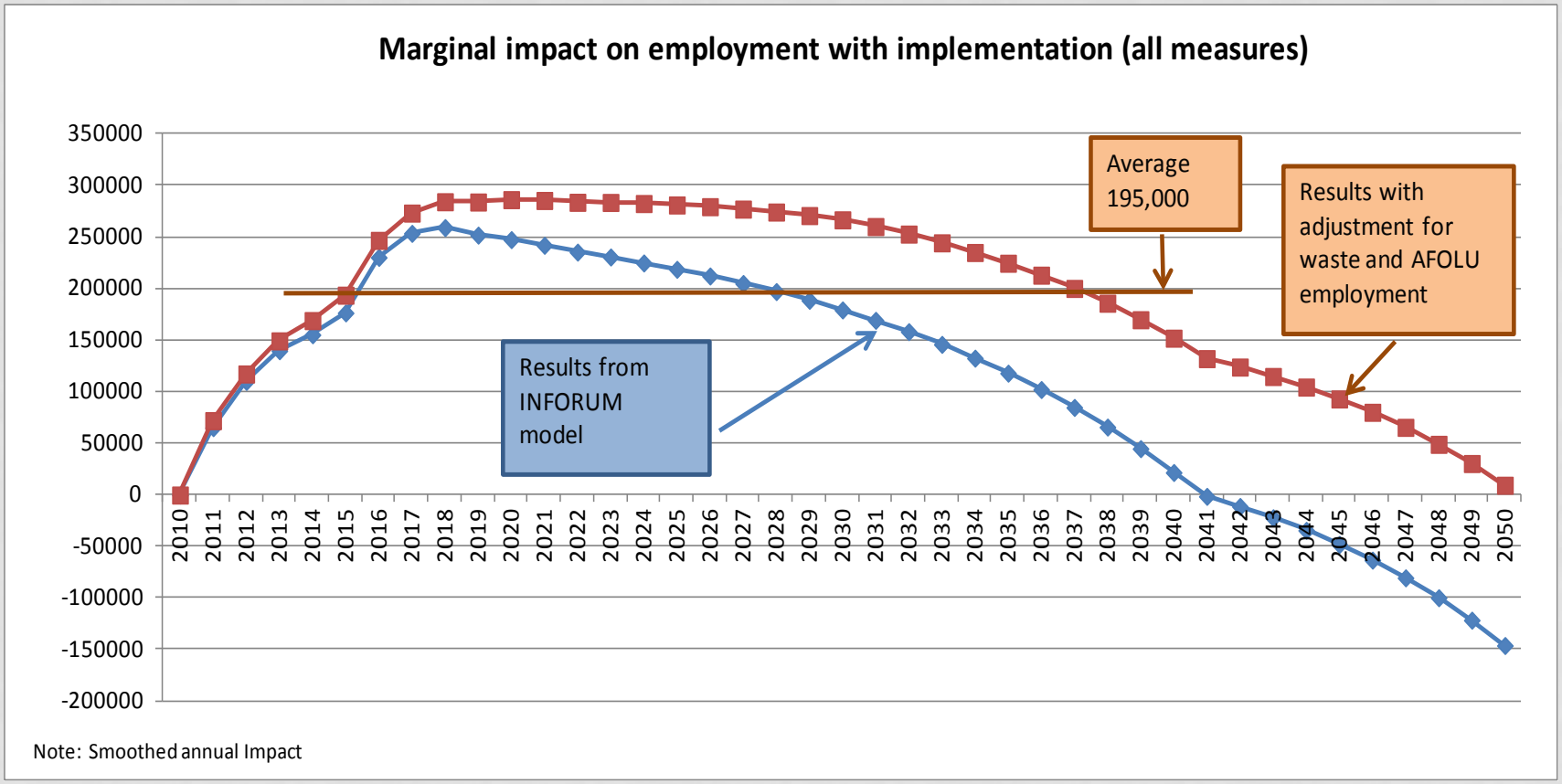
# RESULTS OF CASE STUDY

## - MARGINAL IMPACT ON GDP -



# RESULTS OF CASE STUDY

## - MARGINAL IMPACT ON EMPLOYMENT, ASSUMING ALL MITIGATION MEASURES ARE APPLIED -



# SUMMARY AND CONCLUSIONS

The main objective of this paper was to show how the macro-economic impact of a project or a programme with many facets could be quantified by the SAFRIM model. The use of the model was enhanced by making use of an actual assignment that Conningarth was part of, namely;" South African Greenhouse Gas Mitigation Potential Analysis" done for the Department of Environmental Affairs of the Republic of South Africa.

# THANK YOU

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