USING LINKED MODELS TO ADDRESS DEVELOPMENT ASPIRATIONS AND MITIGATION IN SOUTH AFRICA

ALISON HUGHES, BRUNO MERVEN, TARA CAETANO
ENERGY RESEARCH CENTRE, UCT

WholeSEM Annual Conference 2015- Hybrid Energy Modelling
6-7 July 2015

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- Approach
  - SATIM
  - e-SAGE
  - The link
  - The tweeks
  - What did we learn?
- What next?

CONTEXT

- Population
  - 53 million
- Economic
  - Upper Middle Income
  - per capita GNI in purchasing power parity terms of 12 240$US (World Bank, 2015)
  - Unemployment 34.6%
- Social
  - that 7.4% of South Africans are currently living in extreme poverty <$1.25/day (ppp) 29.2% <$2.5/day
  - Gini 0.69 (social transfers play a large role in reducing this)
  - Low skills – around 40% of the population over 20 have completed secondary school

CONTEXT

- GHG emissions – ranked amongst the top 20
- Energy
  - Coal – supplies 77 % of primary energy needs; almost 90 % of electricity generated with coal
  - Power shortages – new capacity needed
  - 85% electrified (2011)
  - over a third of South African households are energy poor
- Development policy
  - Centered on increasing economic growth - assuming trickle down and public sector jobs will alleviate poverty and increase employment- growth in 1st quarter 2015 of 2.1%, 1.5% in 2014
- Development future is uncertain
- Commitment to reducing carbon intensity of the economy

HYBRID (LINKED) MODELLING

- Economy wide CGE model , e- SAGE

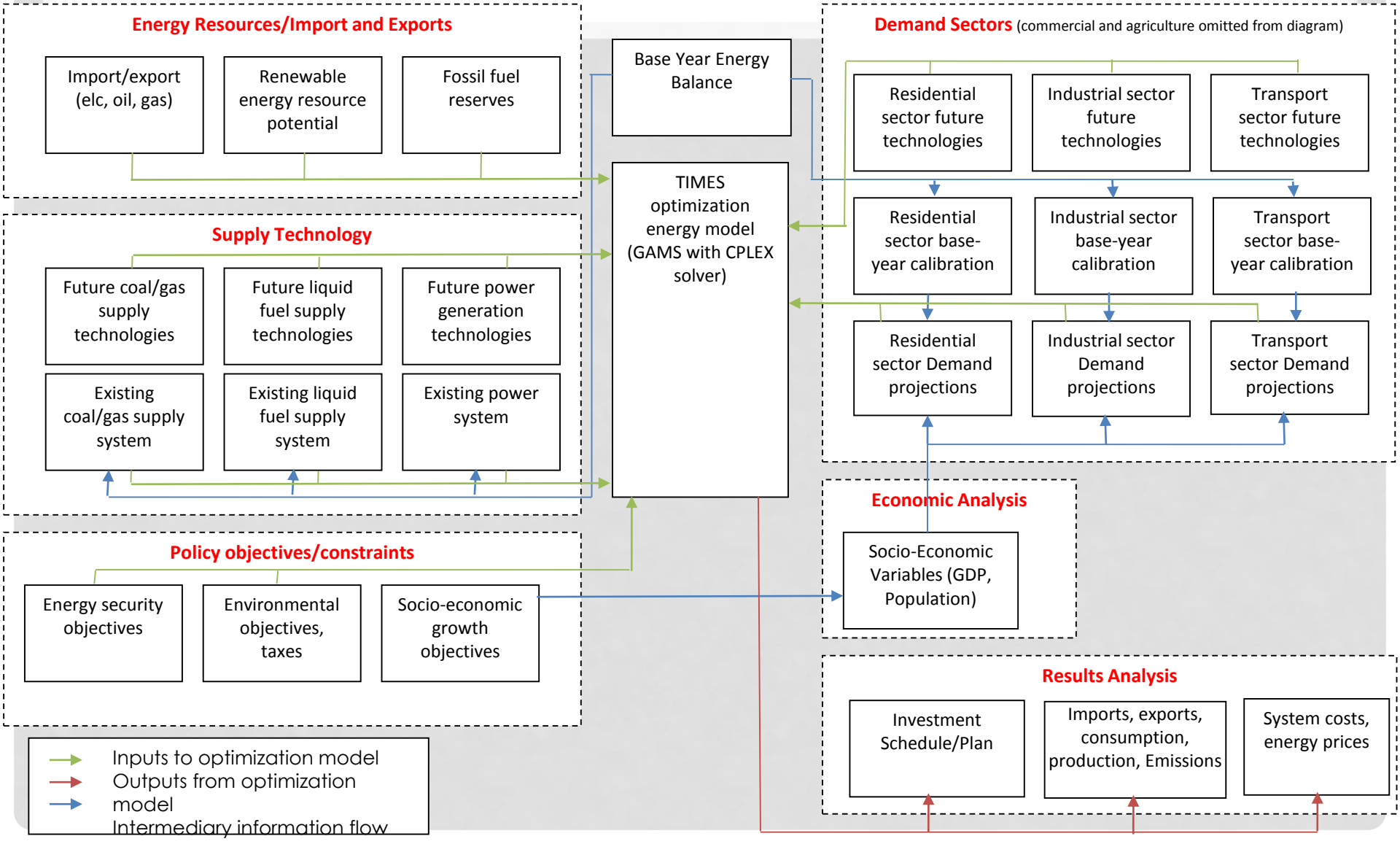
With

- SATIM – el , the South African TIMES electricity sector model

And

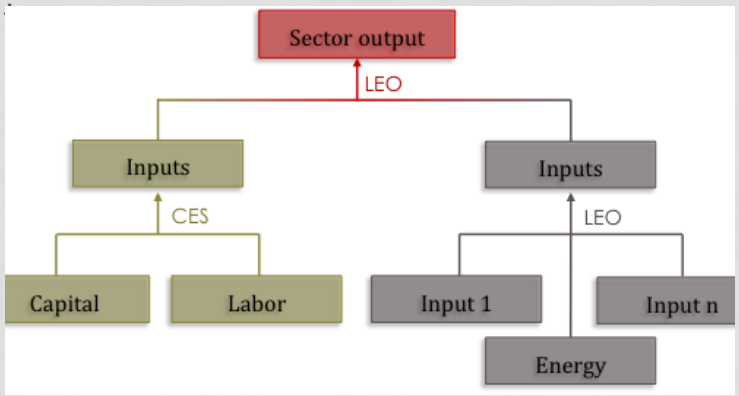
- SATIM – F , the South African TIMES full sector model

ENERGY MODEL SATIM - F

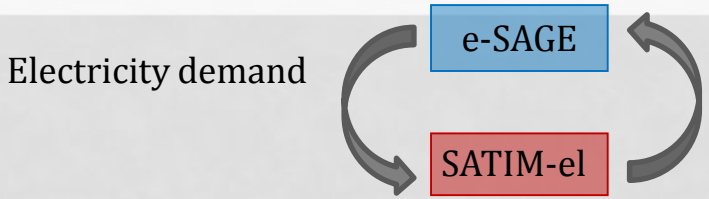


ECONOMY-WIDE MODEL: E-SAGE

- General equilibrium model of South African economy (SAGE, UNU-WIDER)
  - Recursive dynamic country-level economy-wide model
- Comprehensive representation
  - 62 industries – including disaggregation of electricity and liquid fuel supply
  - 49 products
  - 9 factors of production
  - 14 representative households
- Energy treated as an intermediate input (Leontief)
- Sectors of production can reduce their energy intensity (investing in less energy intensive technologies) in response to increasing energy prices: constrained by the rate of investment in the sec

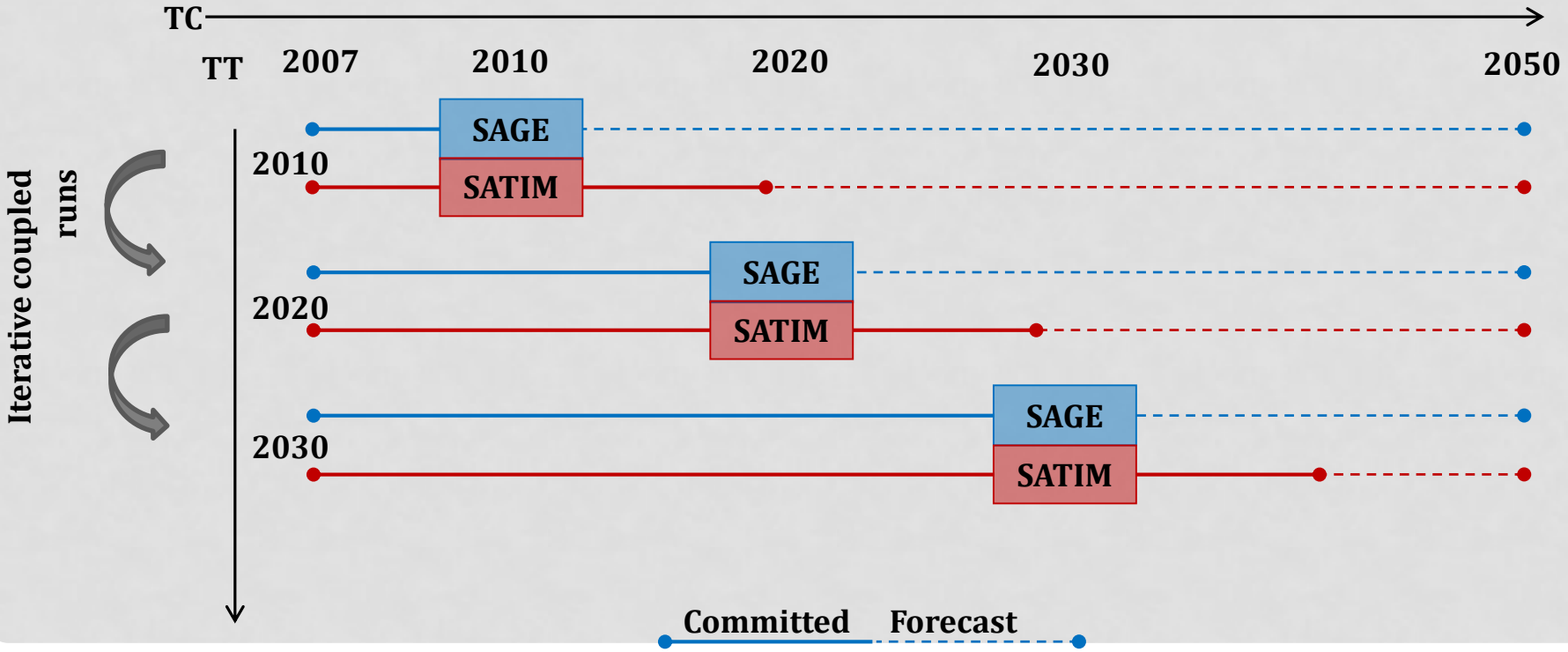


E-SAGE-SATIM-EL ITERATION PROCESS



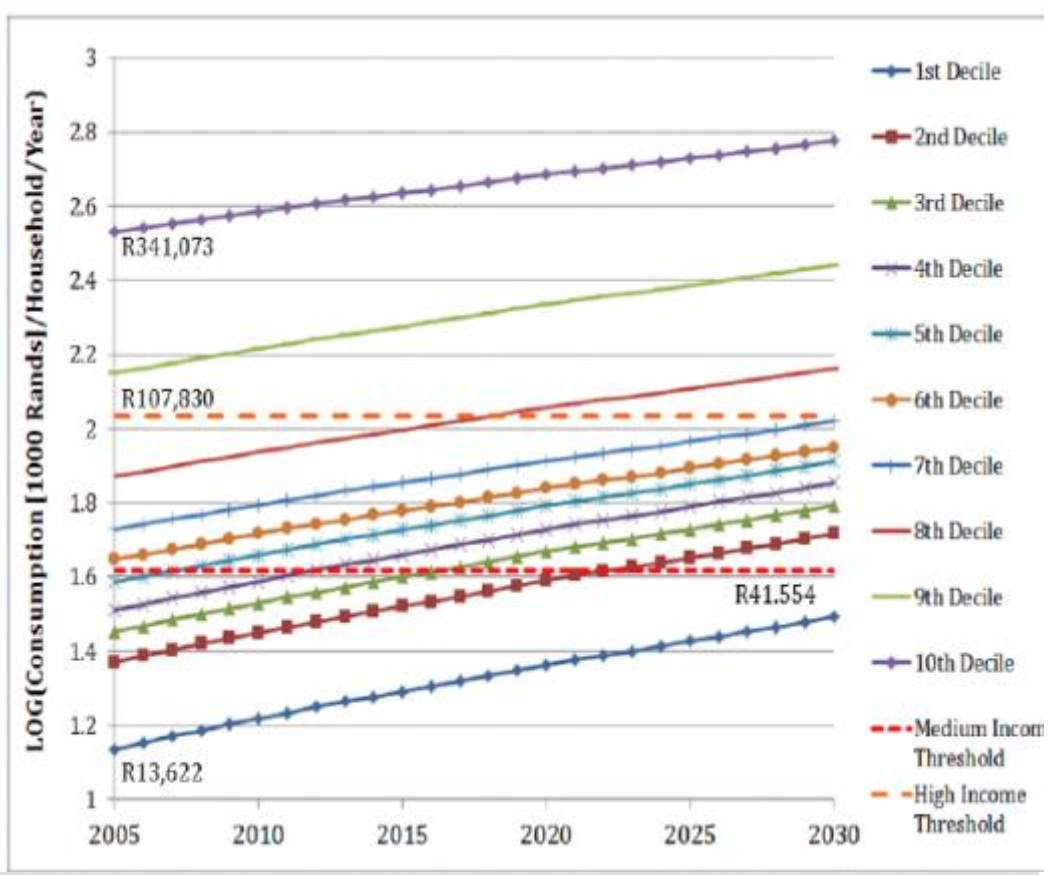
- Electricity production mix by technology/fuel
- Electricity price
- Power plant construction expenditure schedule

Emulating the Planning (IRP) process



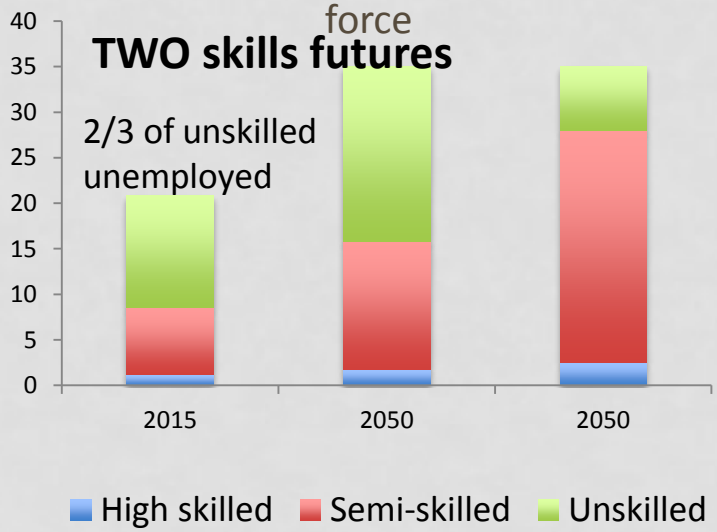
RUN CGE RESULTS IN SATIM - F

- Demand projections
  - CGE growth for the sectors
  - Household income
- Mapped to 3 income groups, low, medium and high (Percentage in each)- defines household and transport demand

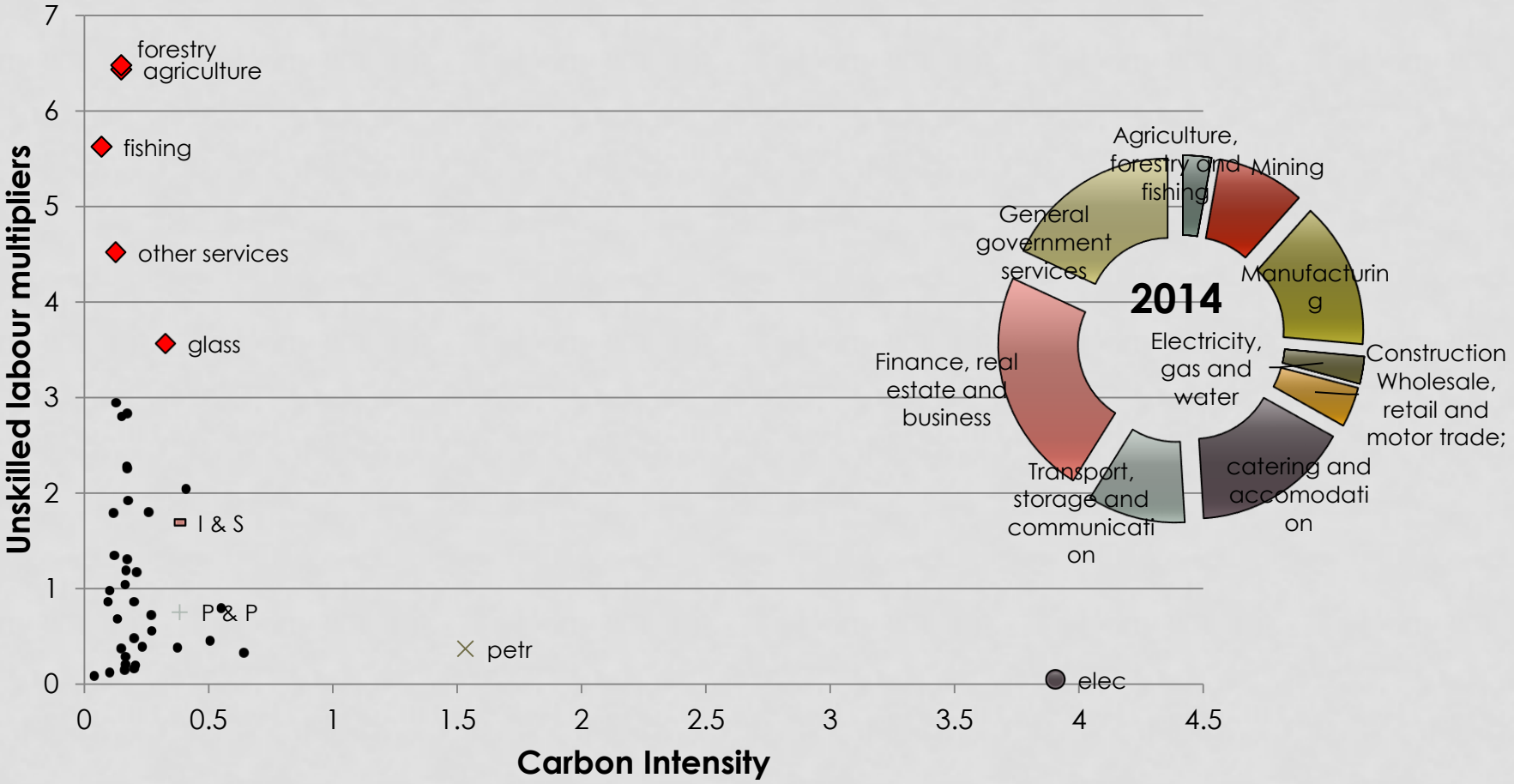


APPLICATION TO DEVELOPMENT

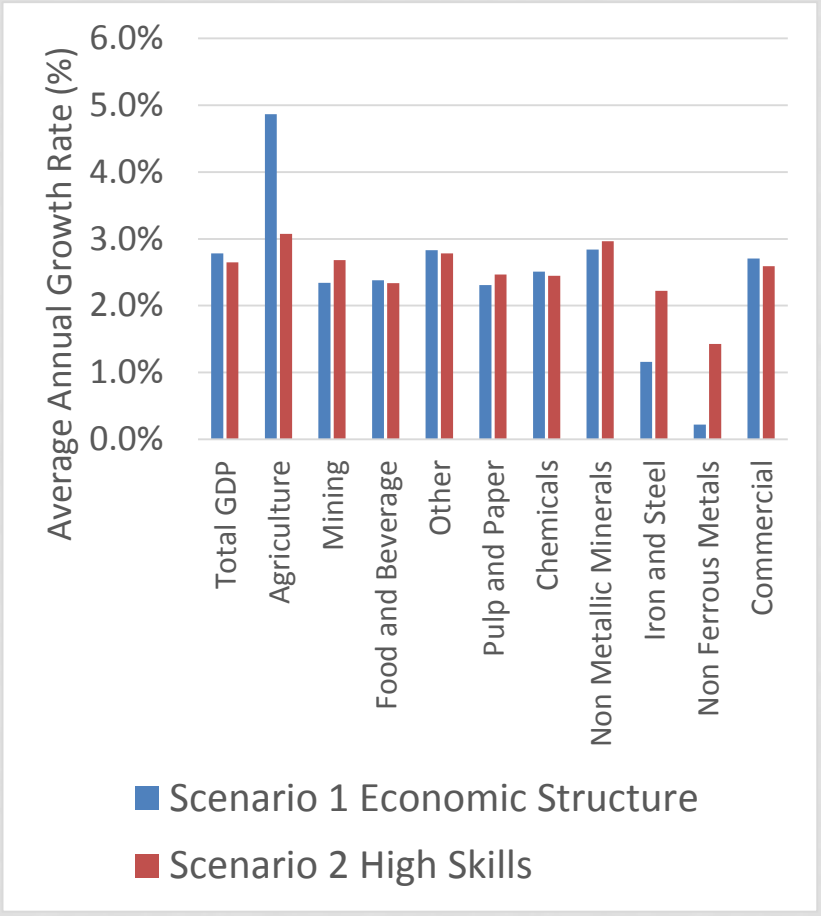
- Two scenarios to explore the challenge of achieving both employment/poverty reduction and cumulative emissions constraint (14GT)
  - Economic structure – Grow high unskilled labour absorbing low emissions sectors
    - Increased capital productivity and the rigidity between capital and labour
    - "open" exports/trade
  - Higher skills
    - From 2025 increase the number of semi-skilled and skilled people entering labour force

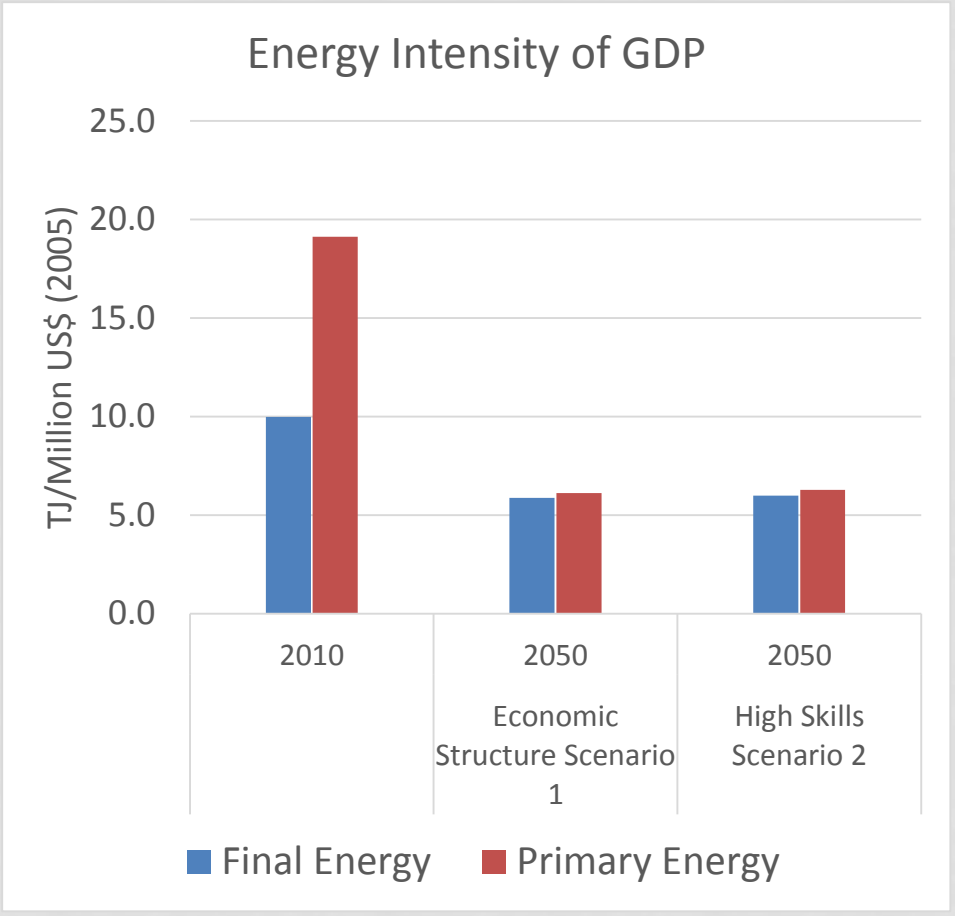


UNSKILLED LABOUR AND CARBON INTENSITY

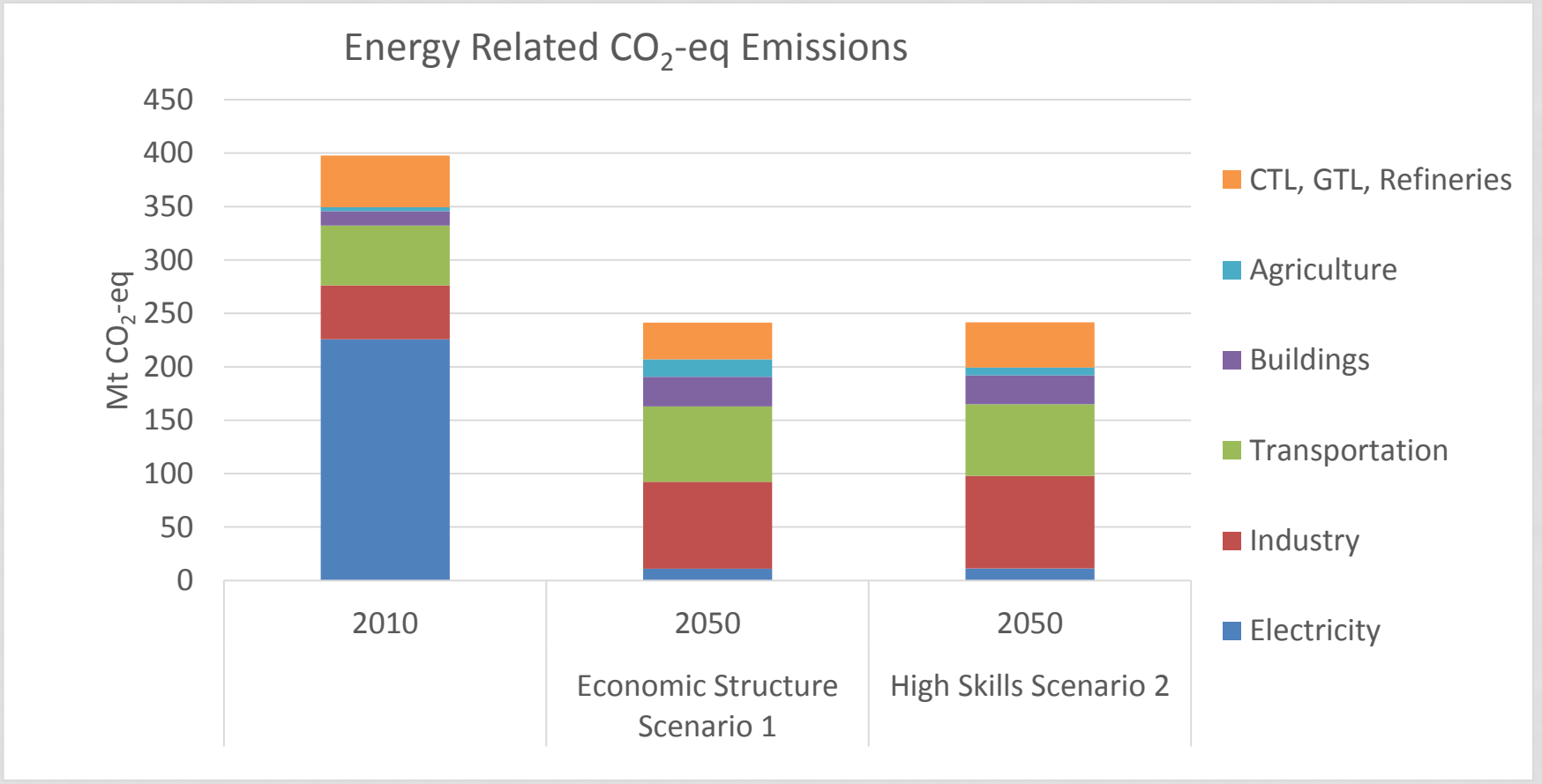


RESULTS – GDP, ENERGY INTENSITY

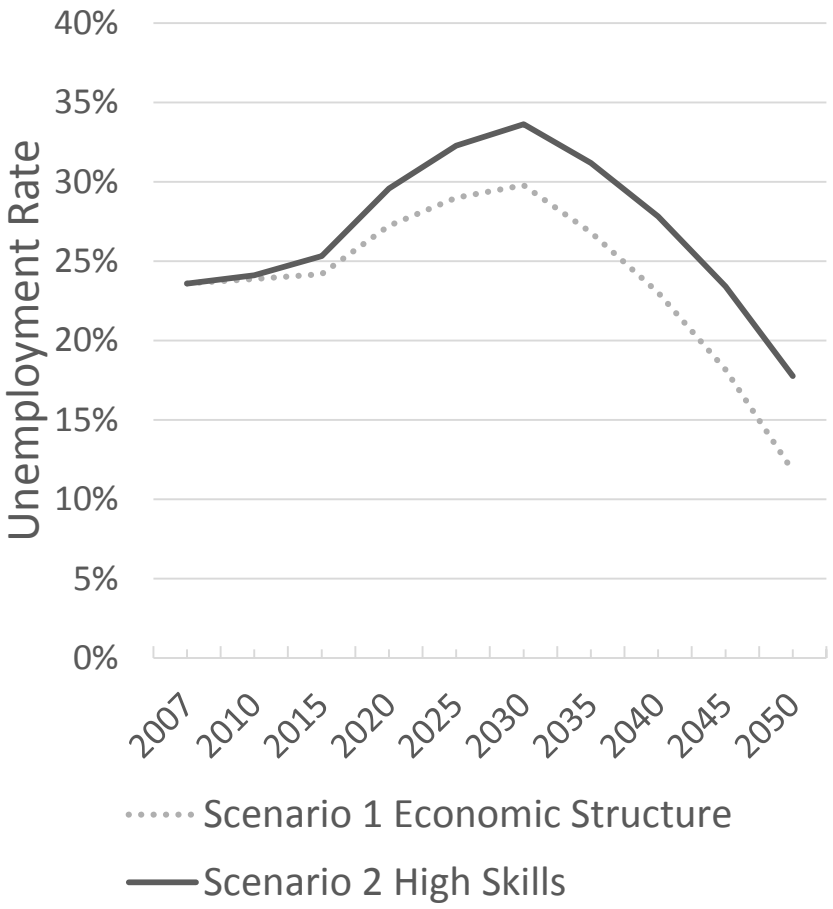


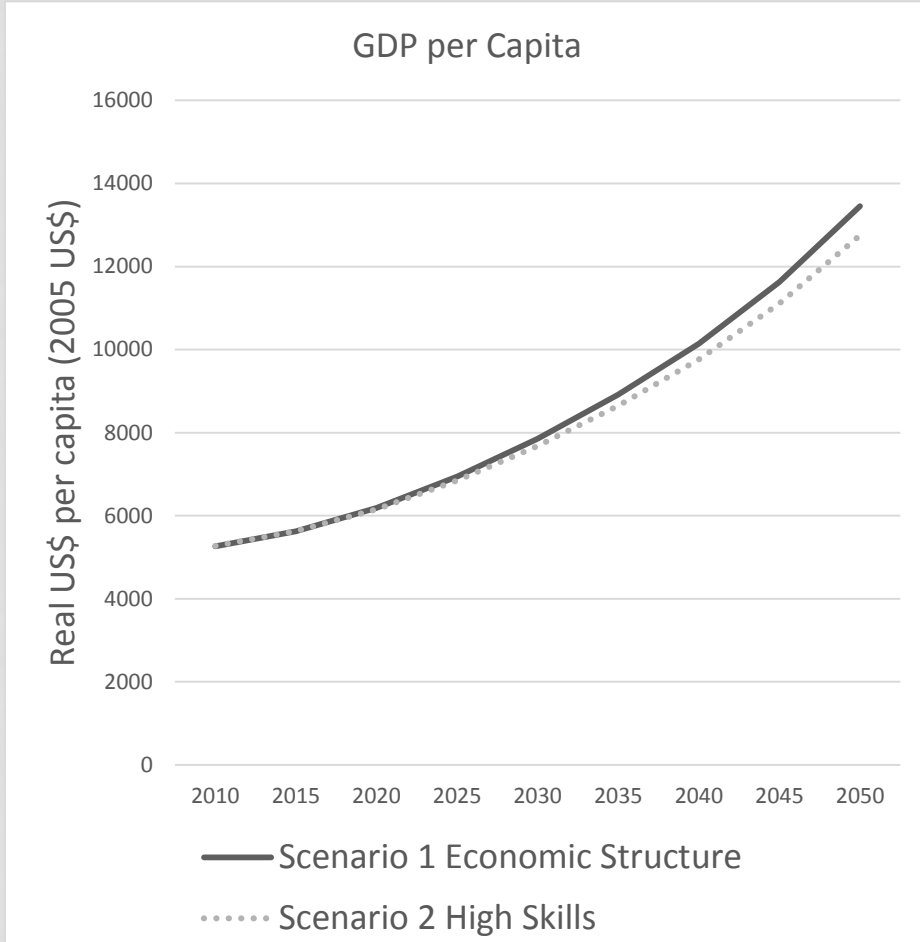


RESULTS- EMISSIONS



RESULTS - EMPLOYMENT





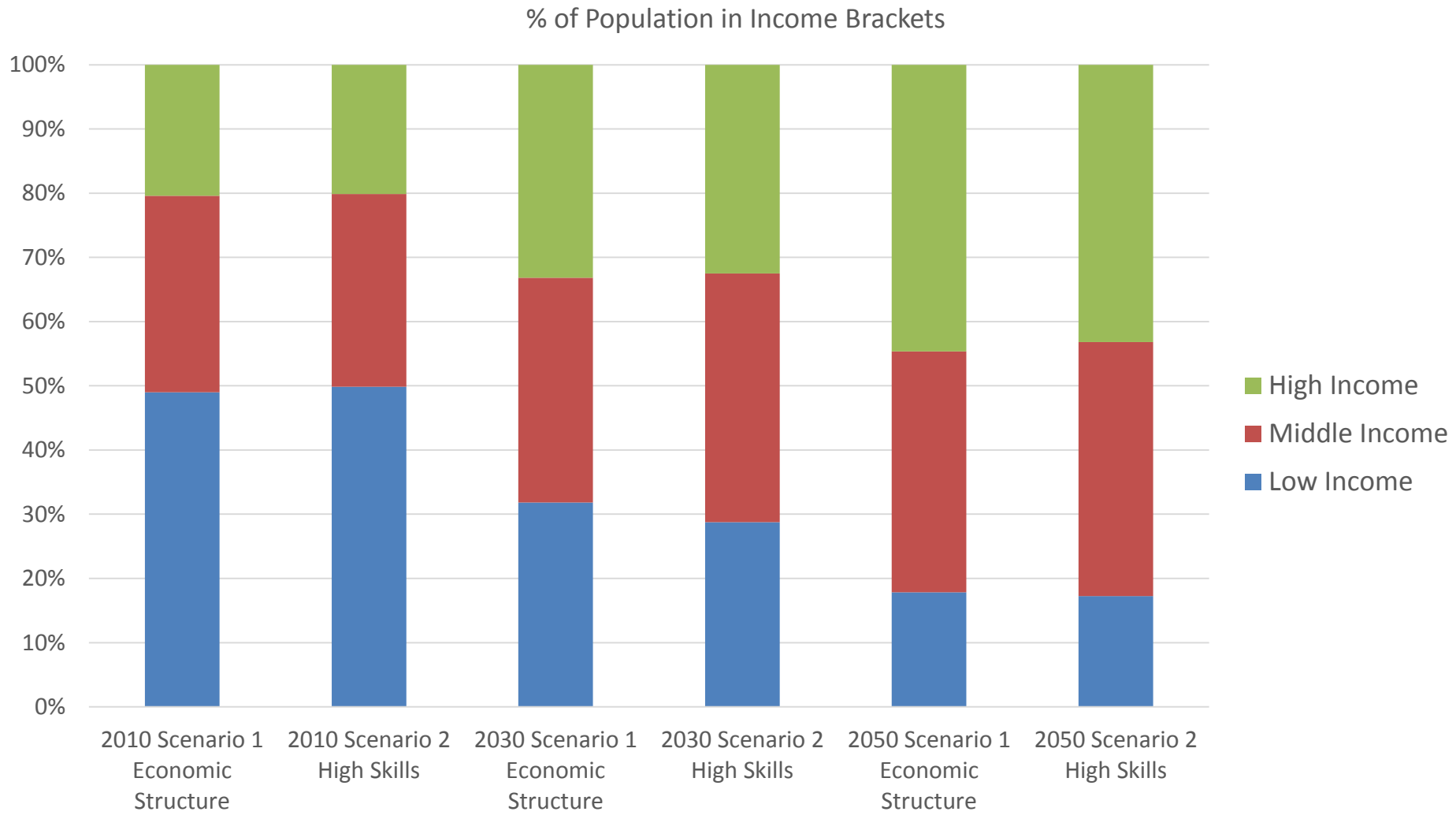
NEXT STEPS

- Complete the linking in all sectors
- MDCA with criteria from SATIM and CGE

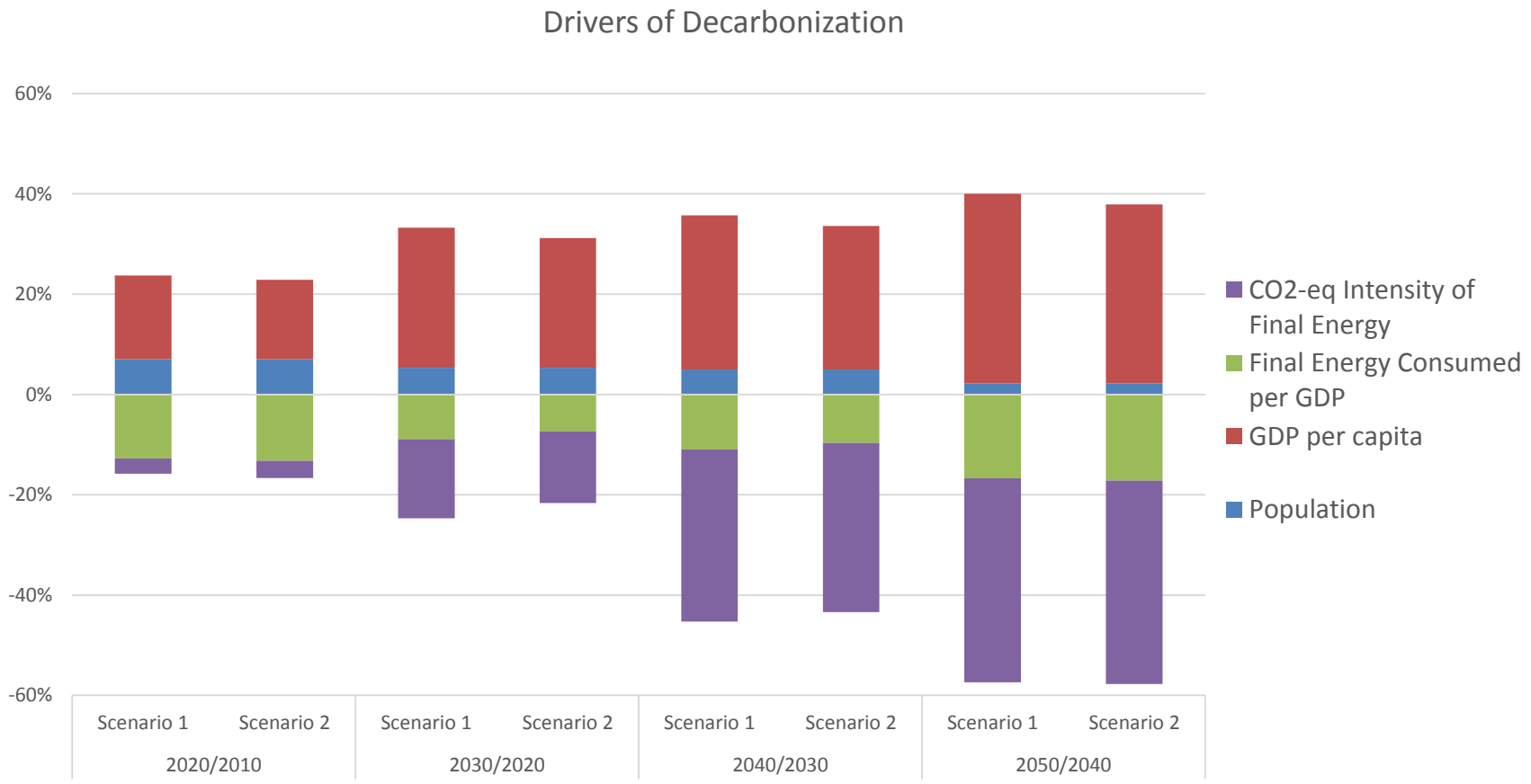
- Other ongoing work in the area of Water and Energy

THANK YOU

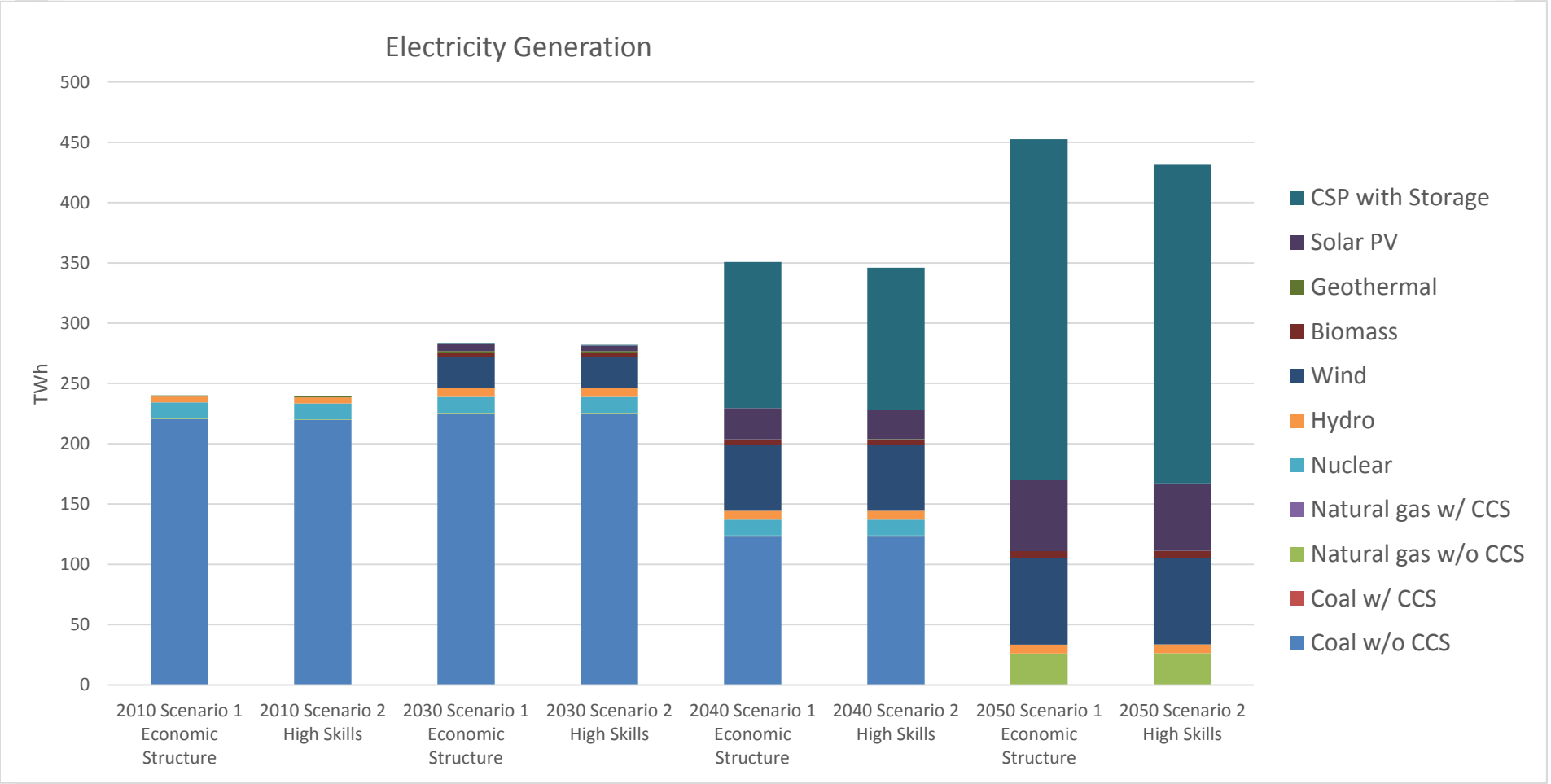
RESULTS - INCOME



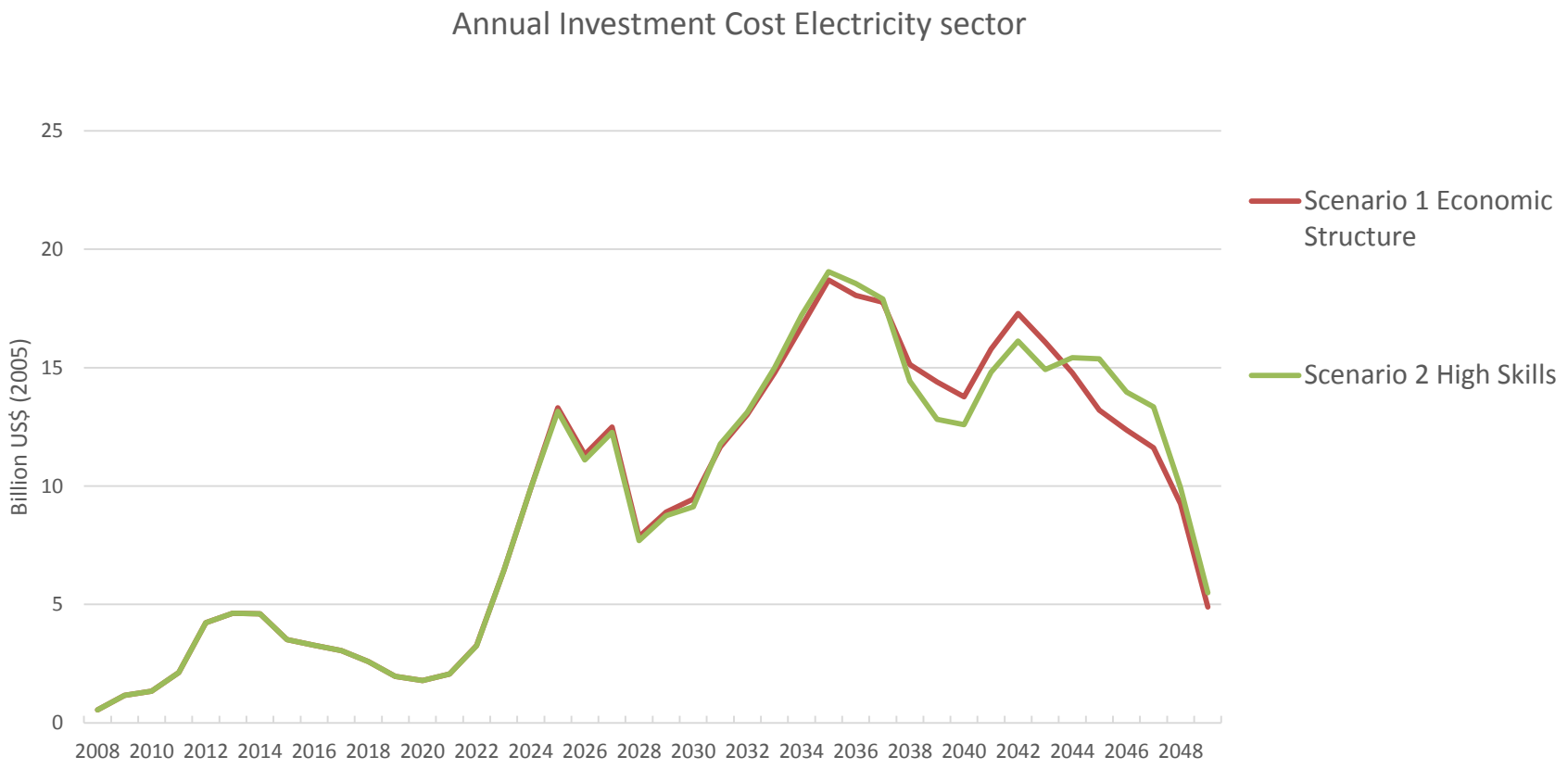
RESULTS – DRIVERS OF DECARBONIZATION



RESULTS – ELECTRICITY GENERATION



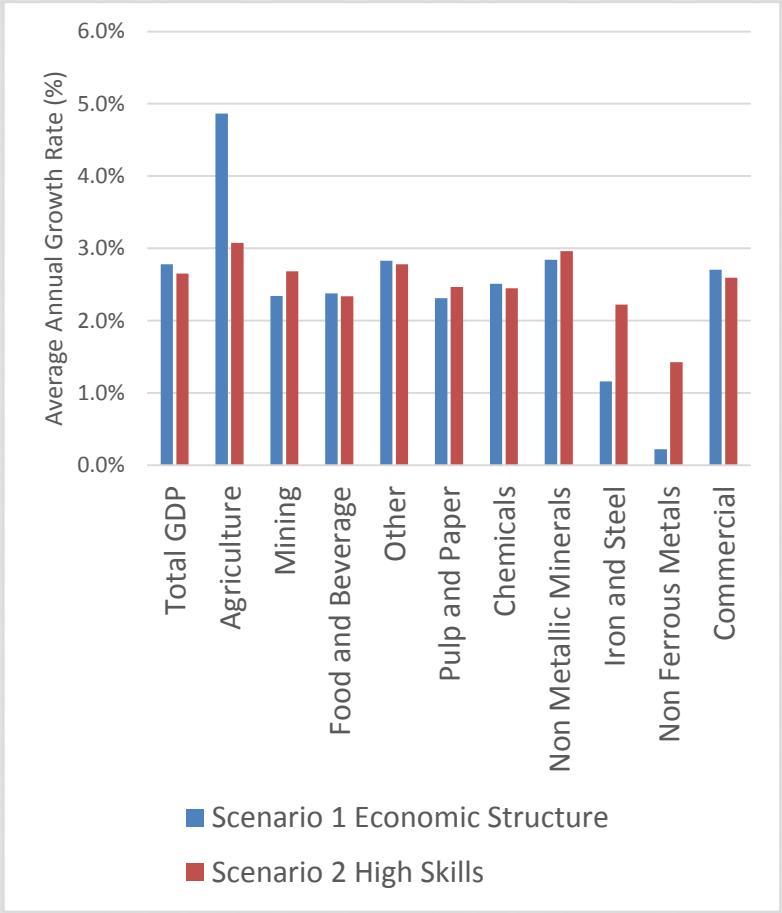
RESULTS – INVESTMENT

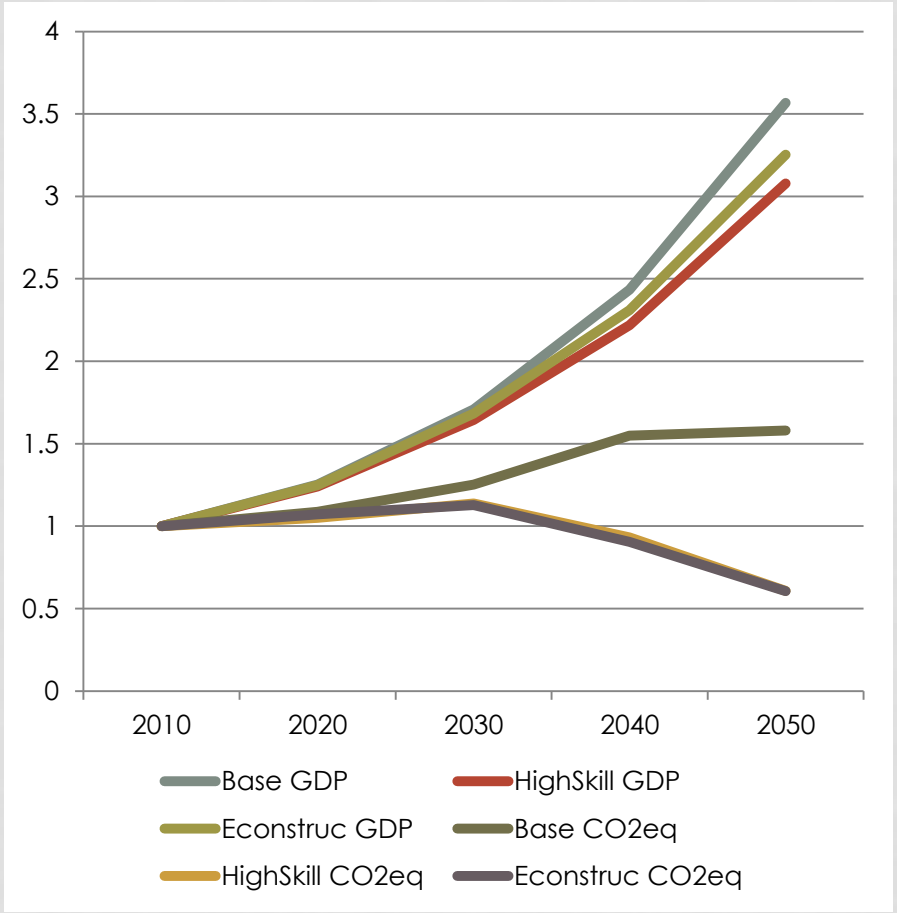


APPROACH BY SA IN THIS CONTEXT

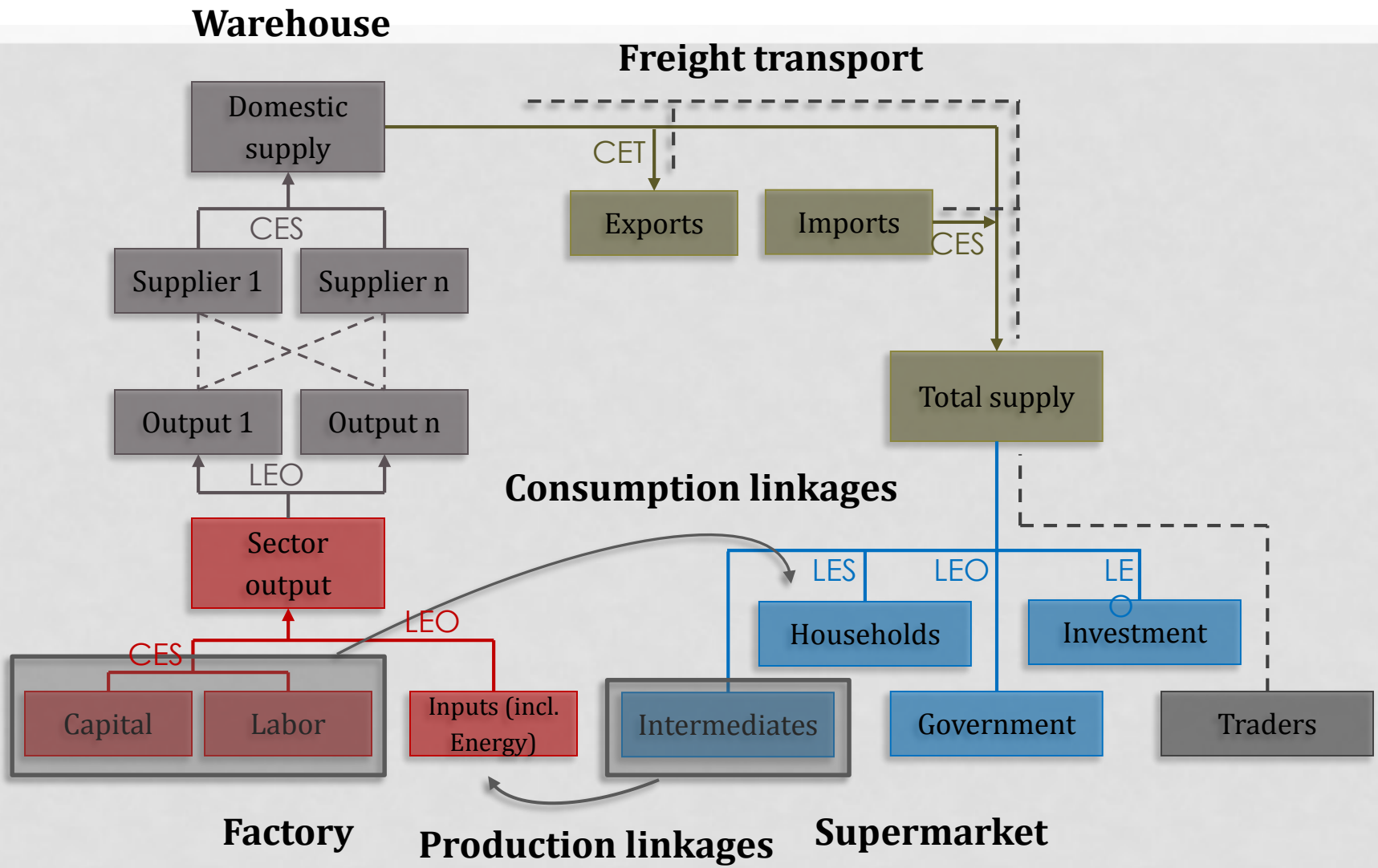
- SA resident centered approach
  - Two scenarios to explore the challenges of achieving both employment/poverty reduction and emissions constraint
    - Economic structure –
      - High unskilled labour absorbing low emissions sectors
        - Increased capital productivity and the rigidity between capital and labour switching- in CGE if you have high factor productivity you attract investment, so increased capital productivity in chosen sectors, if captial and labour aren't rigid then the sector only increases capital instead of maintaining the same level of labour therefore relationship inelastic
        - "open" exports/trade – changed world prices to be more optimistic in those sectors, and increased the trade elasticity, elasticiyt is there to make sure you maintain a domestic market
    - Higher skills
      - From 2025 increase the number of semi-skilled and skilled people entering labour force- for that proportion of income going to each hhld group and this is skewed to lower income hhlds.

RESULTS - GDP

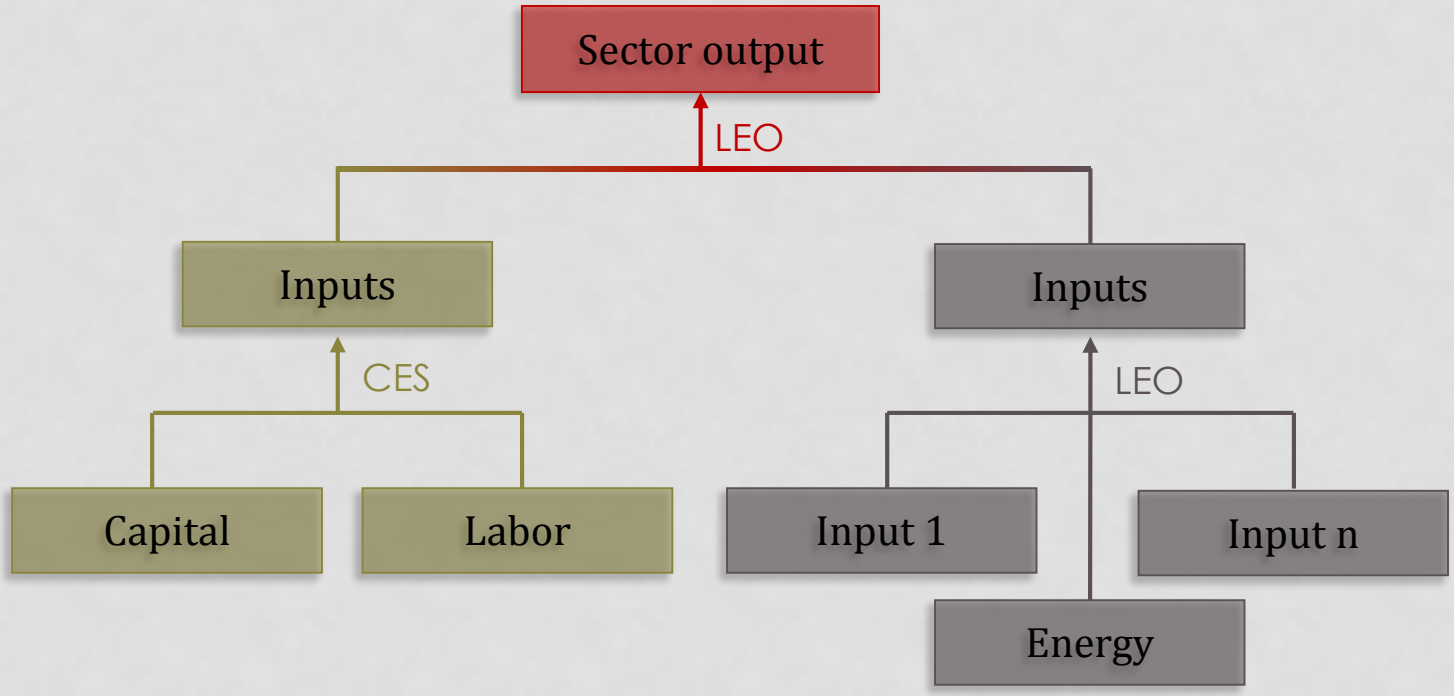

6.0%
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
Average Annual Growth Rate (%)
Total GDP
Agriculture
Mining
Food and Beverage
Other
Pulp and Paper
Chemicals
Non Metallic Minerals
Iron and Steel
Non Ferrous Metals
Commercial
Scenario 1 Economic Structure
Scenario 2 High Skills

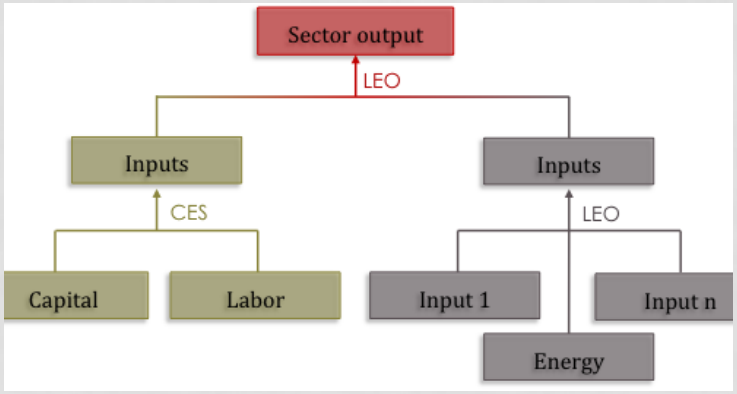

4
3.5
3
2.5
2
1.5
1
0.5
0
2010
2020
2030
2040
2050
Base GDP
HighSkill GDP
Econstruc GDP
Base CO2eq
HighSkill CO2eq
Econstruc CO2eq

OVERVIEW OF E-SAGE



ENERGY AS AN INTERMEDIATE INPUT




Sector output
LEO
Inputs
Inputs
CES
LEO
Capital
Labor
Input 1
Input n
Energy