An Analytical Framework to Assess Green Transition Jobs in South Africa

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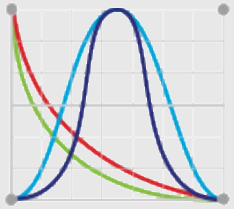


ACEIR AFRICAN CENTRE OF EXCELLENCE FOR INEQUALITY RESEARCH

SALDRU Southern Africa Labour and Development Research Unit

ARUA African Research Universities Alliance

Introduction

- A robust response to the climate crisis will mean a great deal of change including global shifts away from carbon intensive modes of production toward a greener economy.
- South Africa has committed to achieving a reduction of 350-420 million tonnes of CO_2 by 2030 which will have significant impacts on employment.
- South Africa's high unemployment, poverty and inequality rates compel the development of policy to ensure the transition is just.
- This research seeks to provide a holistic, nuanced framework for analysing and contextualising the potential employment effects of the green transition by bringing together two approaches to estimating green jobs:

1. **Bottom-up Approach**
2. **Top-down Approach**

Bottom-up Approach

- Involves estimating green employment based on whether a worker's occupation is defined as green. What is a green occupation?
- Dierdorff et al (2009)'s work on green occupations provided the foundation for the majority of work that has occurred since. They defined three categories of green transition occupations:
    1. **Green Increased Demand Occupations**: The impact of green economy activities and technologies is an increase in the employment demand for an existing occupation.
    2. **Green Enhanced Skills Occupations:** The impact of green economy activities and technologies results in a significant change to the work and worker requirements of an existing occupation.
    3. **New and Emerging Green Occupations:** The impact of green economy activities and technologies is sufficient to create the need for unique work and worker requirements, resulting in the generation of a new occupation.
- Follow up work done by these authors defined a list of green tasks performed by workers in occupations found on the Green Enhanced Skill and New and Emerging Green Occupation lists.
- This work has produced two main approaches to defining a green occupation. Definitions that centre:
    - *The impact of the green transition on occupations*
    - *The impact of the work done in occupations on the environment*

Occupational Classification Systems

Occupation classification system	Description
Organising Framework of Occupations (OFO)	• Created by the Department of Higher Education and Training (DHET) based on the 2008 version of the International Standard Classification of Occupations (ISCO). • Latest version is from 2021. • South African labour market data does not use this system to identify occupations. • Most detailed occupational codes are at the 6-digit level.
South African Standard Classification of Occupations (SASCO)	• Created by Statistics South Africa. • The 2003 version of this system is used to identify occupations in labour market data. • The SASCO 2003 version is based on the 1988 version of the ISCO. • Most detailed occupational codes are at the 4-digit level.

Methodology

	Steps	Worked Example
1	Crosswalk or match the 8-digit O*NET green transition occupations classifications to the 6-digit OFO system.	• Bus Drivers, Transit and Intercity, code 53-3021.00 is identified as a Green Increased Demand Occupation. • This can be matched to Bus Driver, code 733101, in the OFO.
2	Calculate an 'occupational greenness' measure, which is the proportion of the 6-digit OFO green occupations in the 4-digit OFO occupations.	• 733101 Bus Driver is part of the 7331 Bus and Tram Drivers minor group OFO occupation code. • This minor group occupation code has three 6-digit occupation codes in total, including Bus Drivers. • Therefore, the proportion of green transition occupations assigned to 7331 Bus and Tram Drivers is 0.333 (1/3).
3	Match 4-digit OFO occupation codes to 4-digit SASCO codes using the crosswalk developed by DHET.	• The DHET crosswalk matches 7331 Bus and Tram Drivers OFO occupation code to 8323 Bus and Tram Drivers 4-digit SASCO occupation code. • Conclude that the proportion of green transition occupations in SASCO 4-digit occupation code 8323 Bus and Tram Drivers is 0.333.
4	Multiply the greenness measure of the 4-digit SASCO code by the number of workers in that occupation to estimate the number of workers in green transition occupations within that occupation code.	• If there are 23 000 workers employed in the 8323 Bus and Tram Drivers SASCO occupation code, we estimate that there 6 900 (23 000 x 0.333) GID occupation workers within that occupation code.

Limitations

Outdated occupation classification systems:

- SASCO used for labour market data is from 2003 and is based on the ISCO 1988.

Use of the green transition occupations:

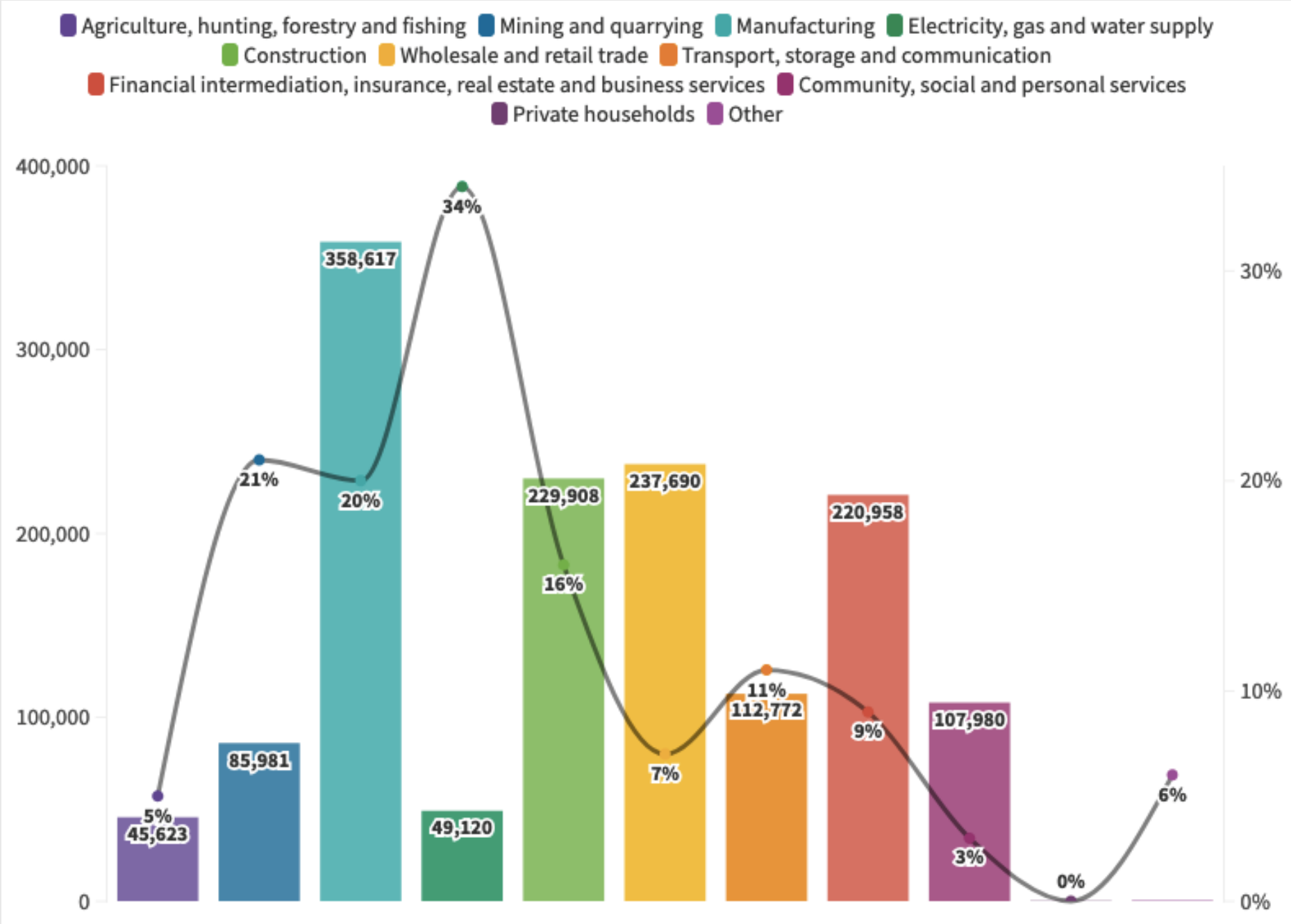
- These were developed in 2009 and for the United States labour market.
- Matching the green transition occupations to the OFO occupation codes should help to lessen the likelihood of an occupation not existing in the South African context.

An occupation's greenness will be consistent across industries and geographies:

- For example, a *logistics manager* in mining in Mpumalanga will have the same 'greenness measure' as a *logistics manager* in agriculture in the Western Cape as their occupations codes are the same despite being employed in different industries and geographies.
- This will be true irrespective of the green occupation definition used.
- Highlights that green occupations alone provide an incomplete picture.

Green Transition Employment

	Green Transition Employment	Proportion of Total Employment
Green Increased Demand	765 436	4.6%
Green New and Emerging	160 241	1.0%
Green Enhanced Skill	580 471	3.5%
Total Green Transition (adjusted)	1 449 370	8.7%


Agriculture, hunting, forestry and fishing
Mining and quarrying
Manufacturing
Electricity, gas and water supply
Construction
Wholesale and retail trade
Transport, storage and communication
Financial intermediation, insurance, real estate and business services
Community, social and personal services
Private households
Other
400,000
300,000
200,000
100,000
0
30%
20%
10%
0%
45,623
85,981
358,617
49,120
229,908
237,690
112,772
220,958
107,980
5%
21%
20%
34%
16%
7%
11%
9%
3%
0%
6%

	Green Increased Demand	Green New and Emerging	Green Enhanced Skill	Total Transition Green after adjustment	Total Employed Population
African/Black	72%	54%	68%	69%	75%
Coloured	11%	9%	9%	10%	10%
Indian/Asian	3%	6%	4%	4%	3%
White	13%	31%	20%	17%	12%
Male	88%	77%	81%	84%	56%
Female	12%	23%	19%	16%	44%

Top-down Approach

- Top-down approaches provide an environmental profile of employment based on **industry.**

- Typically, this involves identifying an industry as green based on **output or production processes:**
  - Production of renewable energy
  - Production of environmental goods and services

- Other strand of the literature focuses on **defining brown jobs.** Most often placing industries on a spectrum from green to brown. This can be done in various ways- we estimate two measures:
  - pollution intensity: total carbon emissions per industry
  - emissions intensity: carbon emissions per worker for each industry

Environmental Costs and Carbon Emissions

- **Short history of methodological development:**
  - Nordhaus introduced the concept of integrated assessment models (IAMs)
  - Stern Review argued that the costs of inaction on climate change would be significantly higher than the costs of mitigation.
  - Increasing interest in methodologies to estimate carbon emissions.
  - The majority of these methodologies are based around the energy use accounting framework which is only able to account for the energy component
  - More recent methodologies assess carbon emissions within the consumption and production processes of an economy.

- **This paper uses EXIOBASE 3 Tables:**
  - Uses a variant of established Input-Output Analysis models: the Multi-Region Input-Output (MRIO) Materials Flows analysis.
  - Recent innovations in data collection have allowed for the incorporation of environmental factors as inputs for production and consumption processes within the IO tables.

Extracting sectoral carbon emissions

At every time period, EXIOBASE 3 tables describe the global inter-industrial sector material flows within and across countries for *k* countries with a transaction matrix *Z*:

$$Z = \begin{pmatrix} Z_{1,1} & Z_{1,2} & \cdots & Z_{1,k} \\ Z_{2,1} & Z_{2,2} & \cdots & Z_{2,k} \\ \vdots & \vdots & \ddots & \vdots \\ Z_{k,1} & Z_{k,2} & \cdots & Z_{k,k} \end{pmatrix}$$

Each submatrix on the main diagonal $Z_{i,\,i}$ represents the domestic interactions for each industry *n*. The off-diagonal matrices $Z_{i,\,j}$ describe the trade from region *i* to region *j* (with *i, j* = 1, 2...*k*) for each industrial sector. This allows for the definition of a global demand *Y*:

$$Y = \begin{pmatrix} Y_{1,1} & Y_{1,2} & \cdots & Y_{1,k} \\ Y_{2,1} & Y_{2,2} & \cdots & Y_{2,k} \\ \vdots & \vdots & \ddots & \vdots \\ Y_{k,1} & Y_{k,2} & \cdots & Y_{k,k} \end{pmatrix}$$

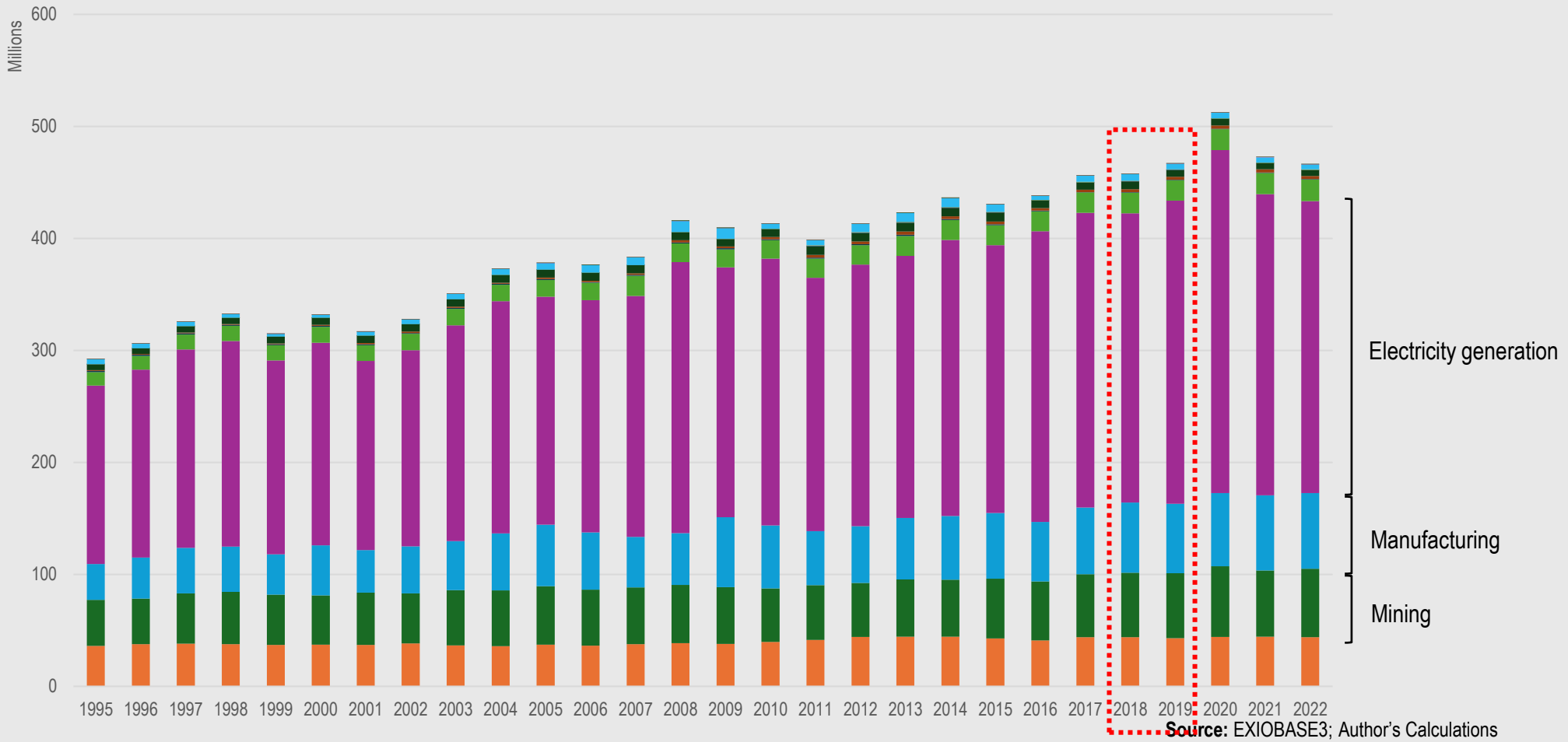
Final demand satisfied by domestic production is represented by the main diagonal $Y_{i,\,i}$ and direct import to final demand from region *i* to country *j* by $Y_{i,j}$. Again, like the transaction matrix, there are *k* industrial sectors being considered.

The global economy is then represented as *x*, where *x* is the total output for the regions considered, and *e* represents the summation vector:

$$x = Ze + Ye$$

Following the environmental cost model of IO analysis, we extract a matrix *C*, where, $C_{i,k}$ represents the net carbon emissions from the global output function *x*, *i* represents the region, and *k* represents the industrial sectors. From this matrix C, we extract the column vector where *i* represents South Africa.

Estimating SA Carbon Footprint (1995-2022)

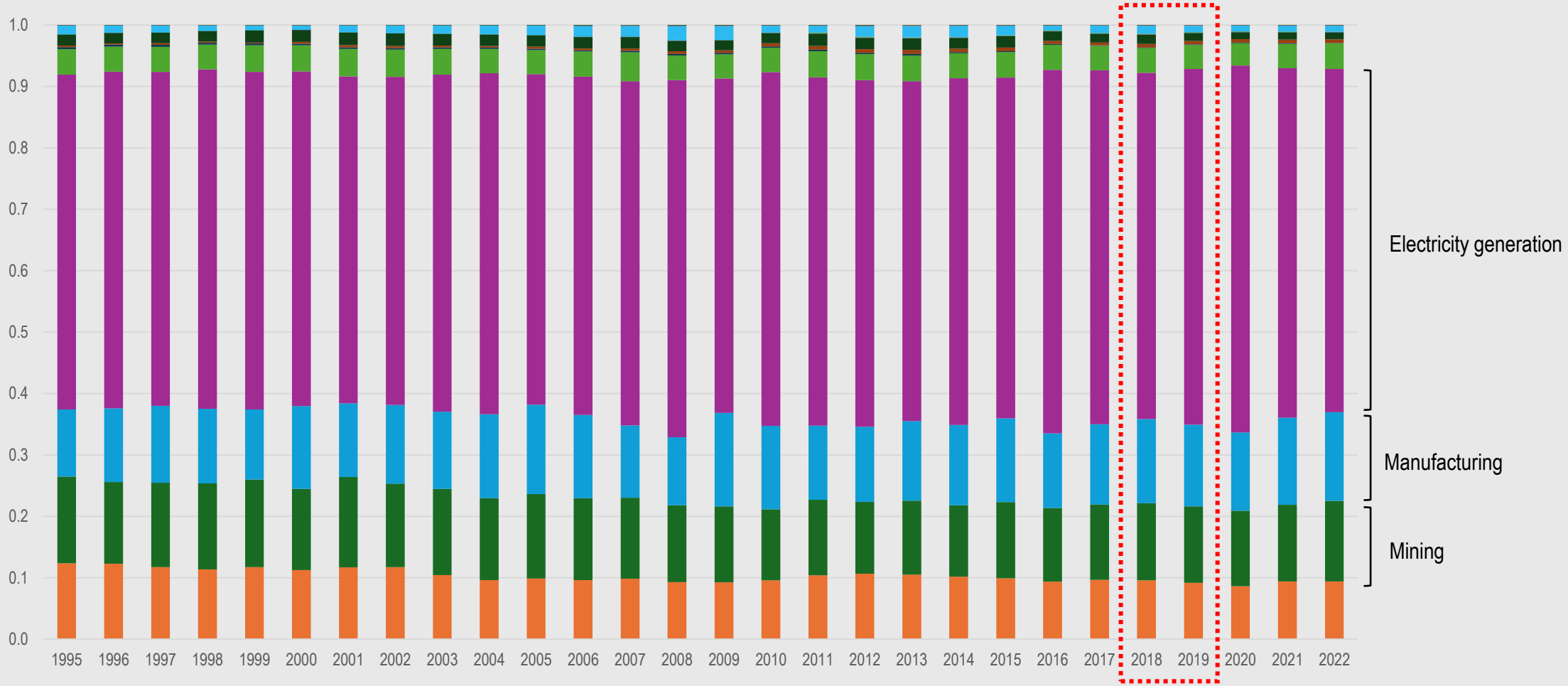


Source: EXIOBASE3; Author's Calculations

SA carbon emissions strongly linked to coal-powered electricity generation – averaging upwards of 55% of total emissions in the post-Apartheid period, peaking at ~305 mT in 2020.

…other important sectors (e.g., manufacturing, mining) show steady and stable growth in their emissions, following their relative shares of economic output.

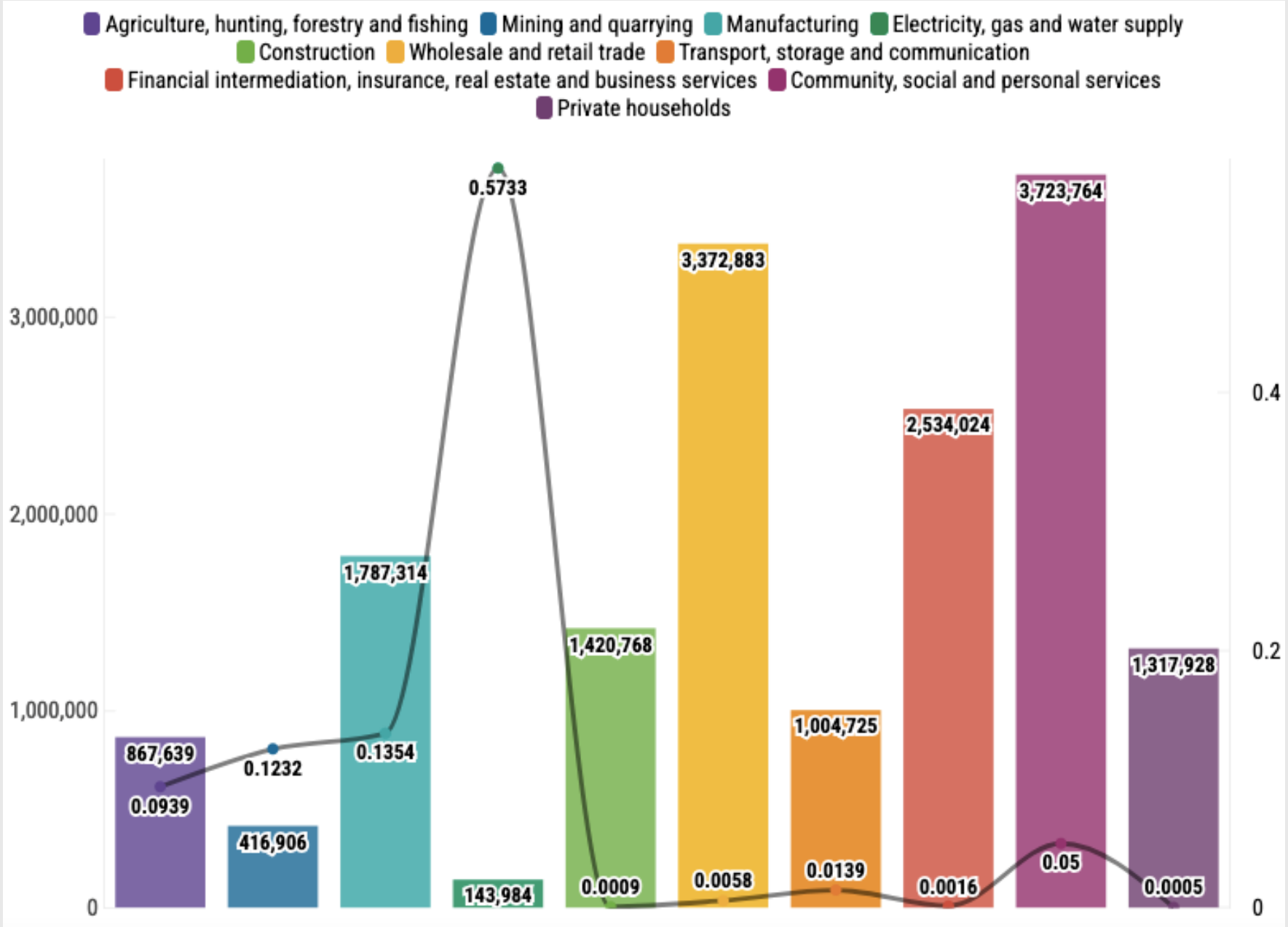
Pollution Intensity



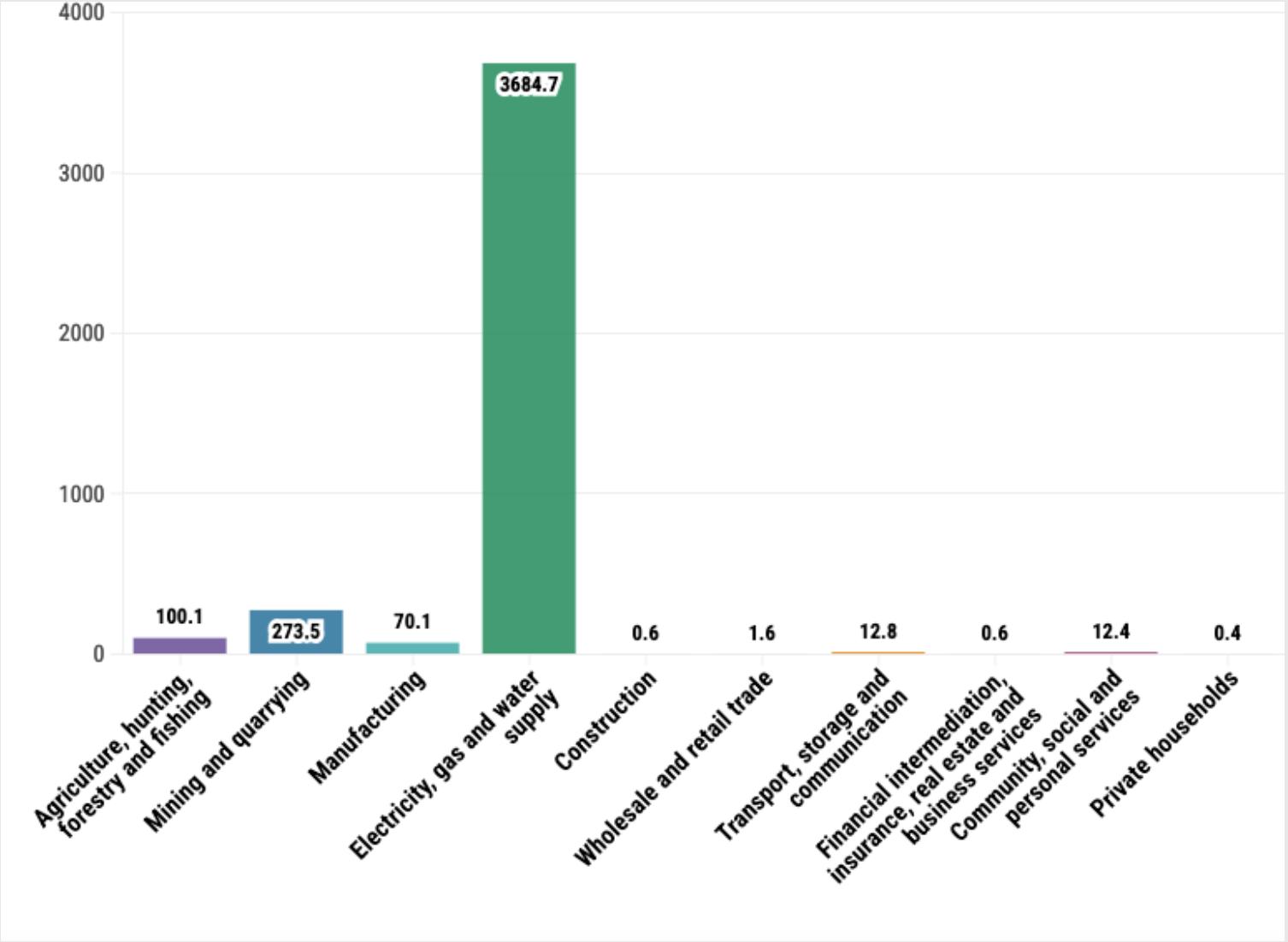
Source: EXIOBASE3; Author's Calculations

Using these estimates of carbon emissions, we calculate *pollution intensity*, defined as the sectoral share of carbon emissions – this measure this is a measure of how much damaging the sector is in relation to the rest of the economy.

Pollution Intensity

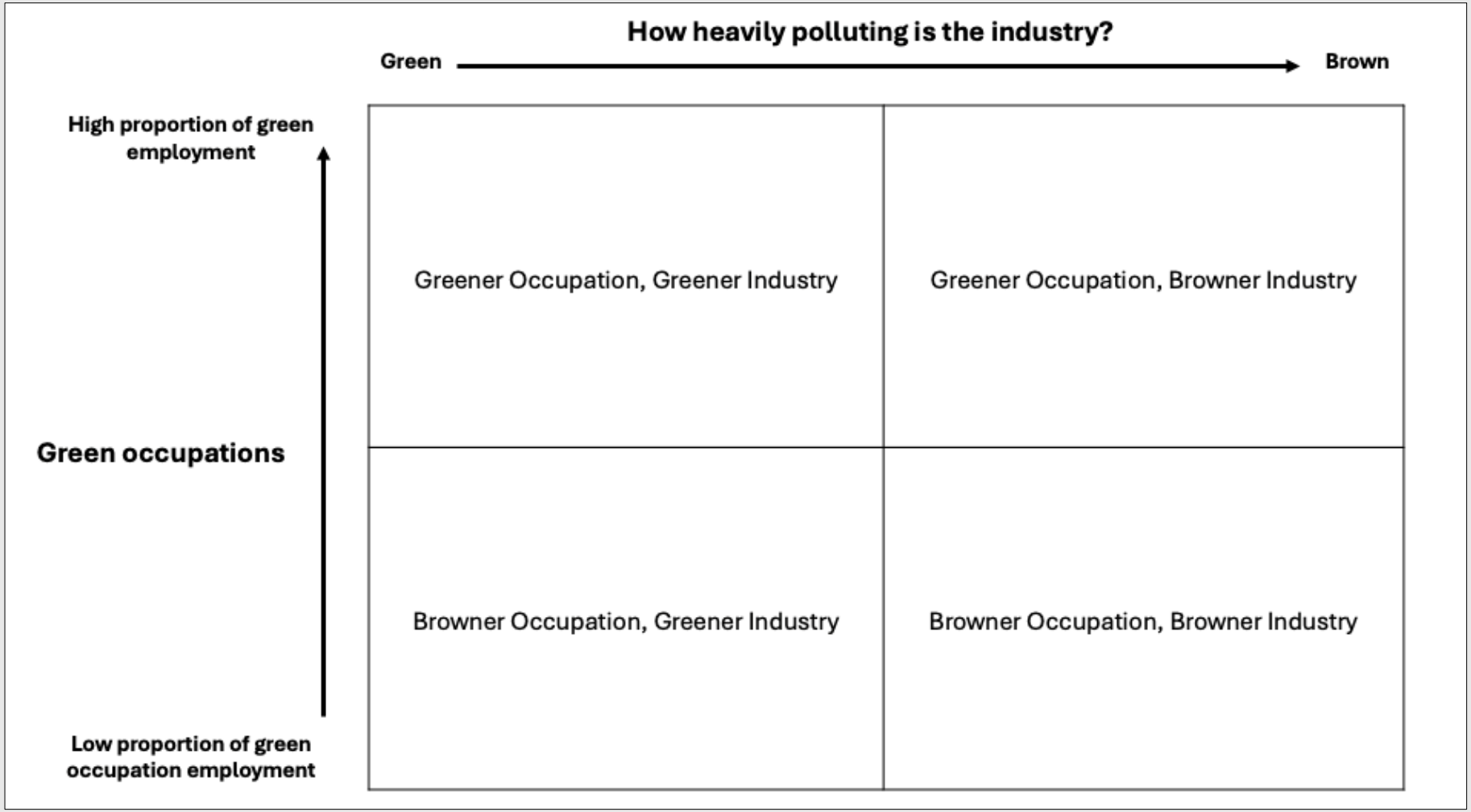


Emissions Intensity



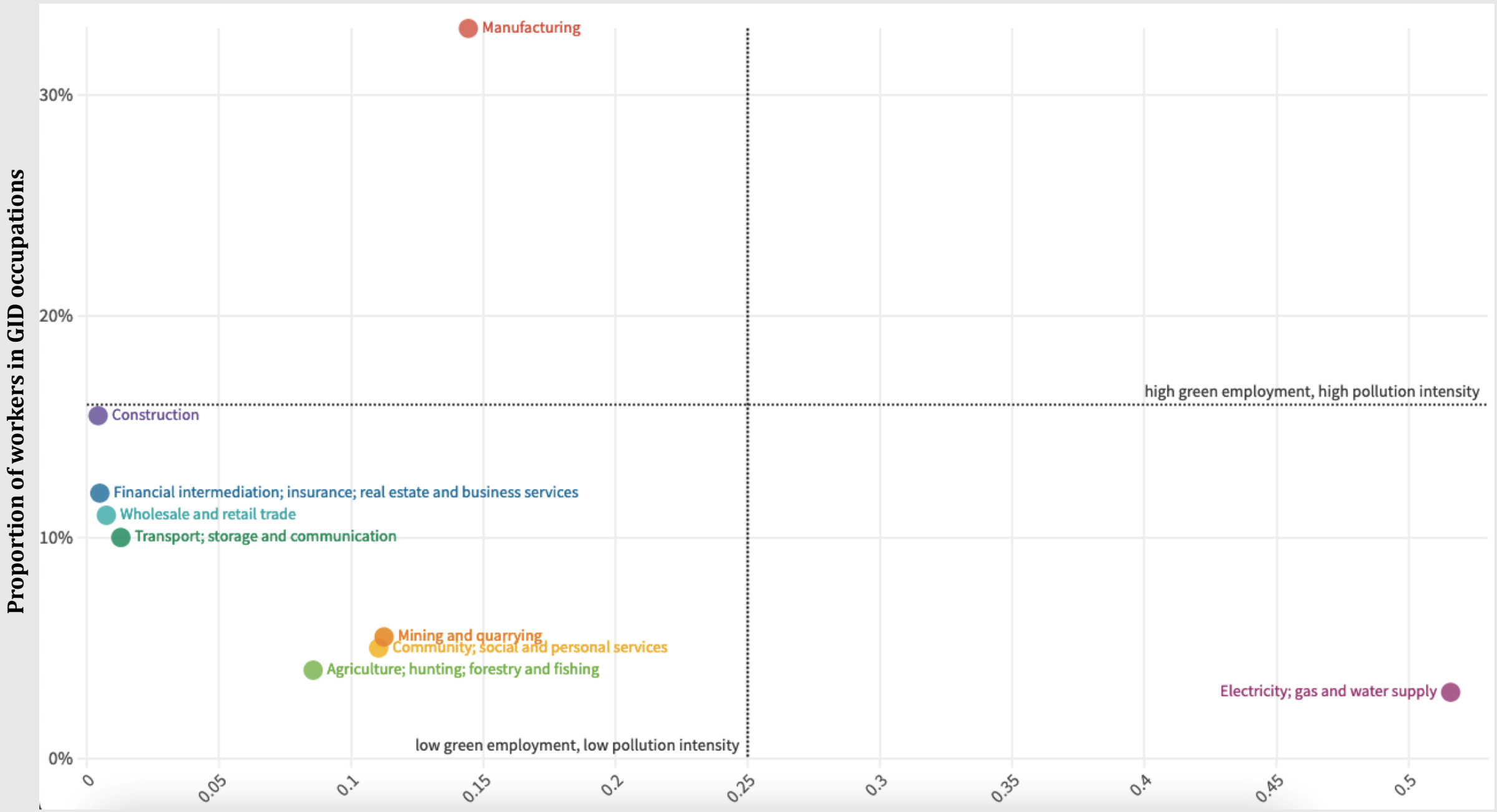
Emissions intensity, defined as a sector's emissions per worker – conceptually, this measures the environmental impact of economic activities, particularly in labour-intensive industries, highlighting how efficiently a sector is managing its emissions relative to its workforce.

The Framework



Percentage of workers by Green Increased Demand occupation and Emissions Intensity

	Below national emissions intensity	Above national emissions intensity
100% GID occupations	2%	7%
50% GID occupations	1%	2%
Below 30% GID occupations	1%	2%


Pollution intensity of the industry
Proportion of workers in GID occupations
30%
20%
10%
0%
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Manufacturing
high green employment, high pollution intensity
Construction
Financial intermediation; insurance; real estate and business services
Wholesale and retail trade
Transport; storage and communication
Mining and quarrying
Community; social and personal services
Agriculture; hunting; forestry and fishing
Electricity; gas and water supply
low green employment, low pollution intensity

Conclusions and Next Steps

- By bringing these two dimensions together, we can assess the extent to which different workers may be negatively affected by the green transition.
- Forthcoming work
  - A forthcoming paper with the HSRC to explore possibilities of spatialising the framework using Spatial Tax Panel data.
  - Public release of the crosswalk and the bottom-up approach greenness measure?
  - Indicators of green transition employment on the Explorer?
- Future work
  - Carbon emission estimates at more detailed industrial sectors.
  - Trend analysis to differentiate between consistent and once off phenomena.
  - Expand on the demographic profile of workers identified by the framework.