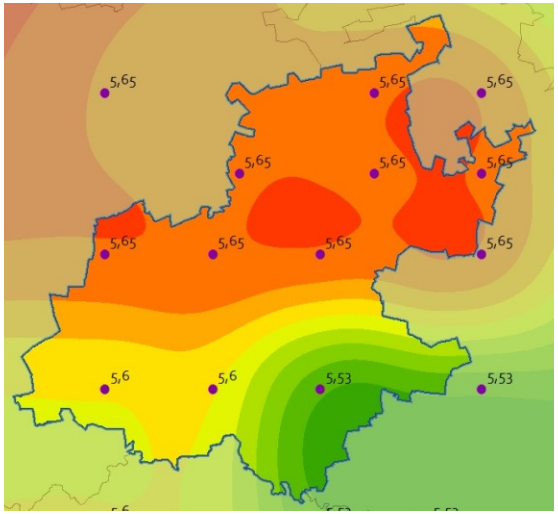
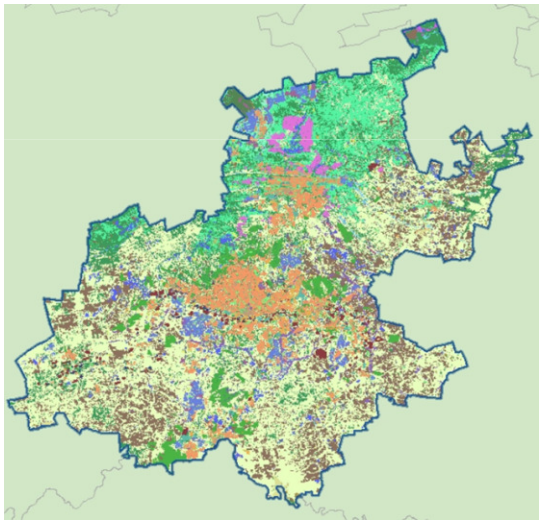
Mapping Gauteng's Renewable Energy Potential: A GIS-Based Analysis

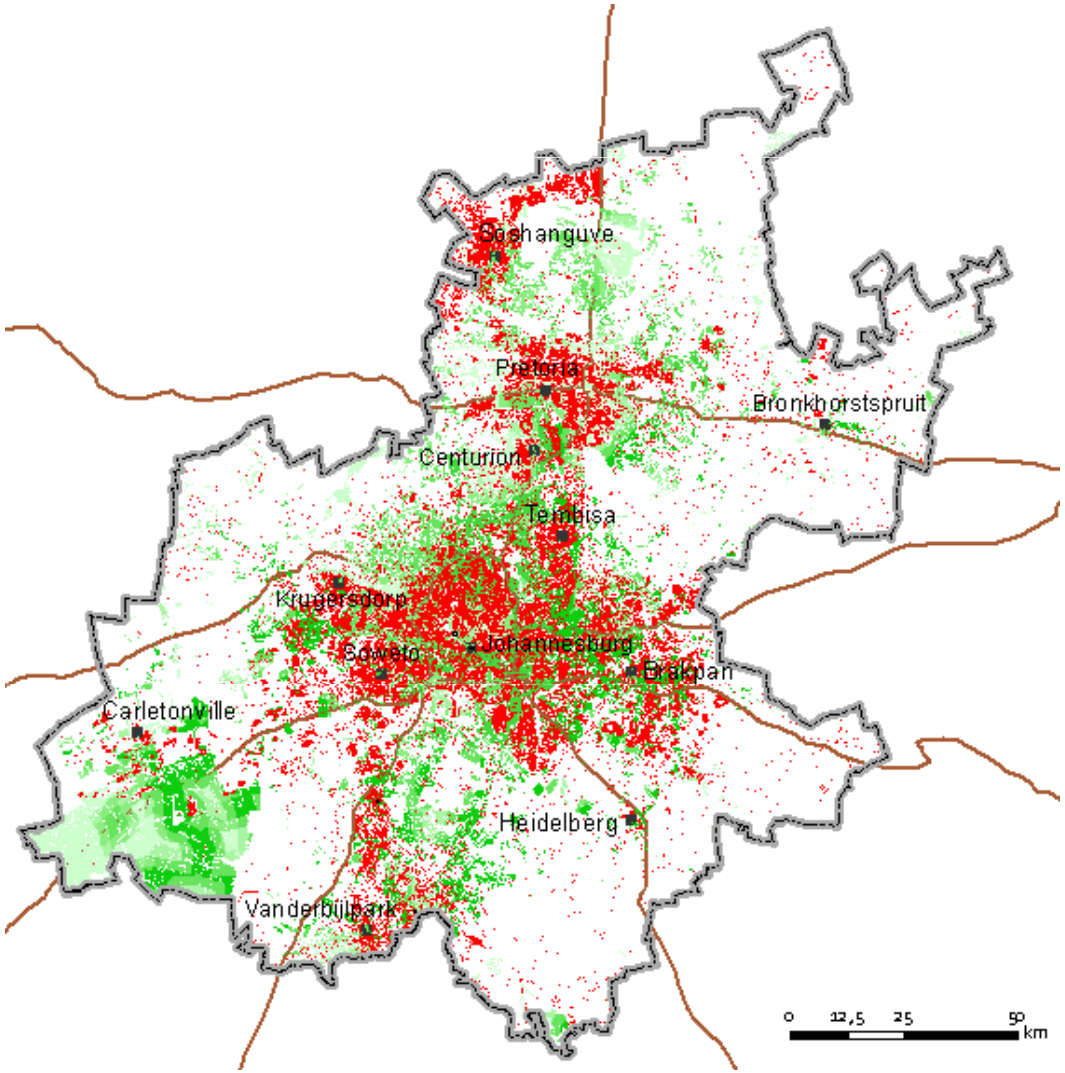
Sheetal D Marathe
Institute for Energy Economics and Rational Use of Energy (IER)
University of Stuttgart





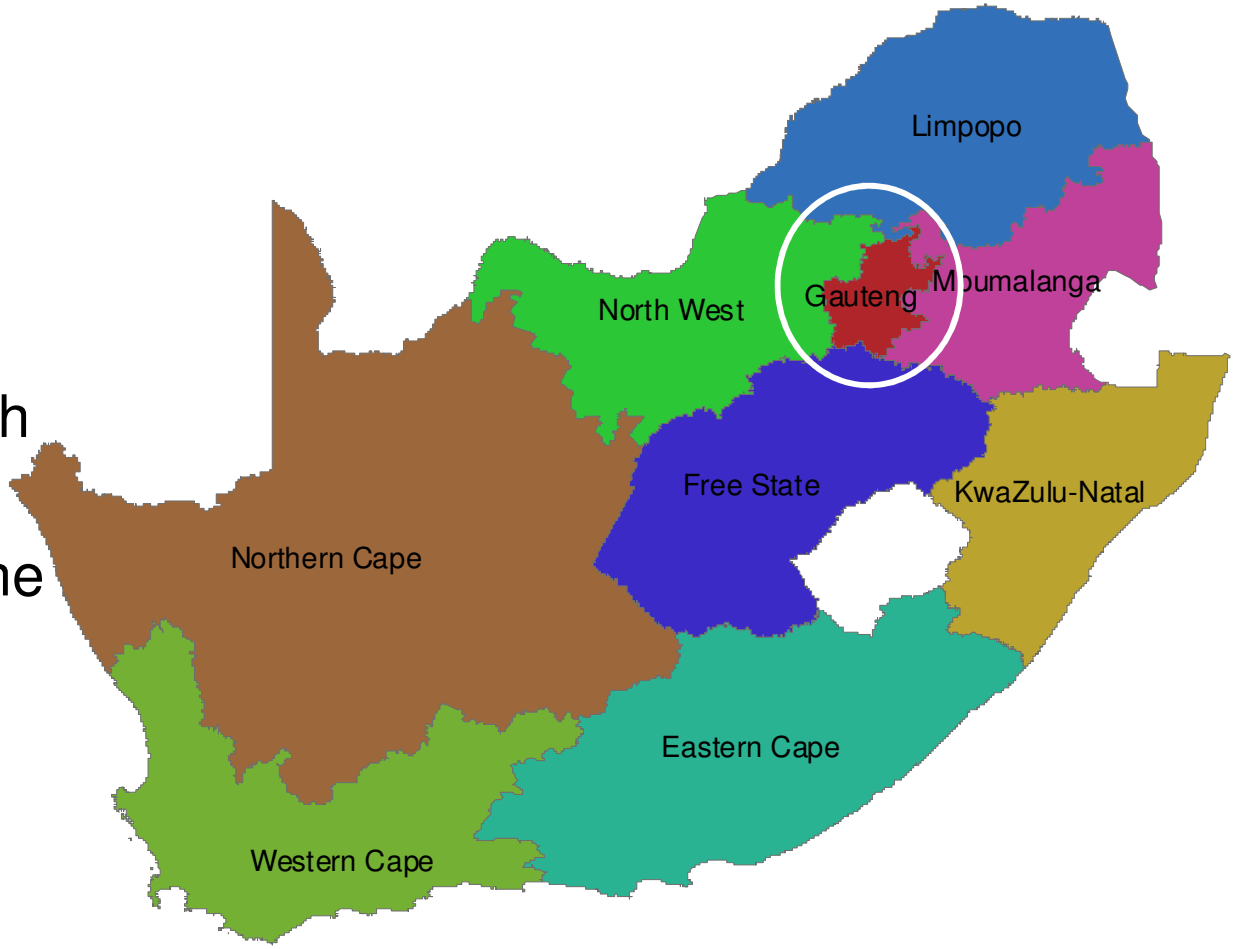
Agenda

- Background
- Current Energy situation
- Need of mapping
- Renewable energy sources
- Challenges and Conclusions



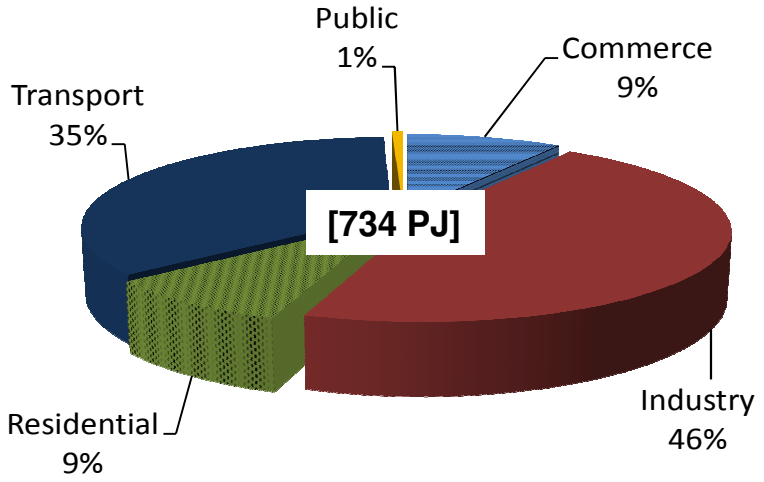
Background

- More than 12.3 M (census, 2011) inhabitants
- Smallest province in SA (1.5% of total area)
- Highest population density in South Africa
- Gauteng contributes to a third of the national GDP
- High migration rates

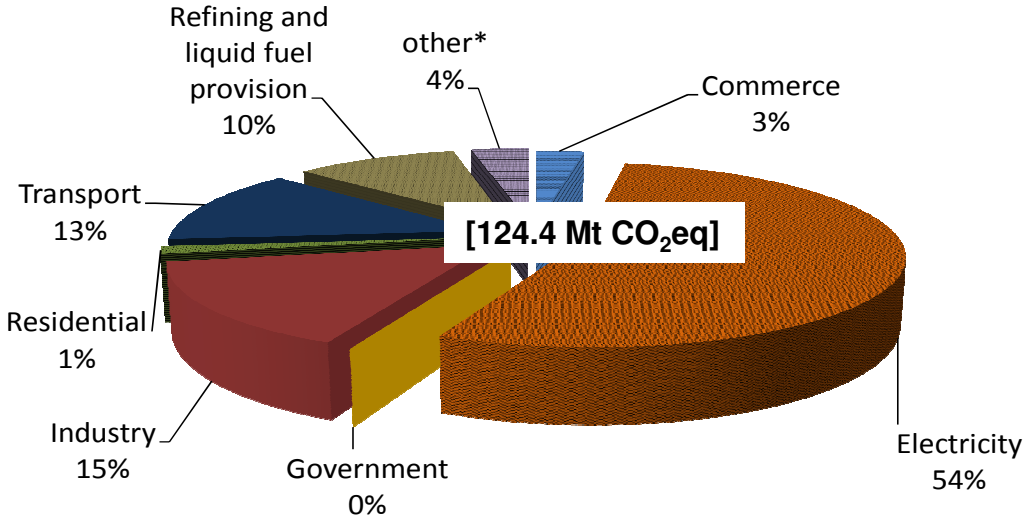


Current Energy Situation

- Electricity production (ca. 91%) is coal-based
- Frequent power cuts
- The energy consumption is highly influenced by social (income) status
- Most of the energy carriers used by low-income groups have low efficiency and come with health risks
- Abundant availability of renewable sources in the region (especially, solar and biomass)



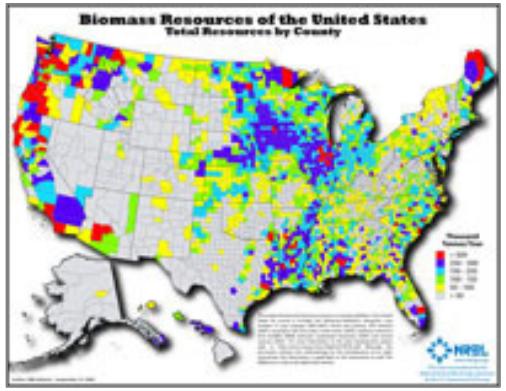
Total final energy consumption by sector 2010

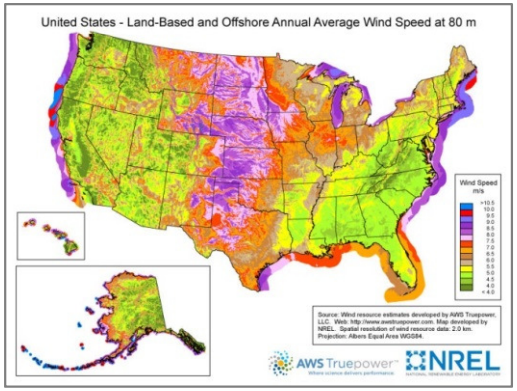


Total attributable GHG emissions by sector 2010

Need of Mapping

- Conveying data in an easy-to-understand way that is distinct from using statistics
- Realising data gaps
- Visualizing patterns
- Understanding challenges
- Visualizing correlations
- Directing further investigation





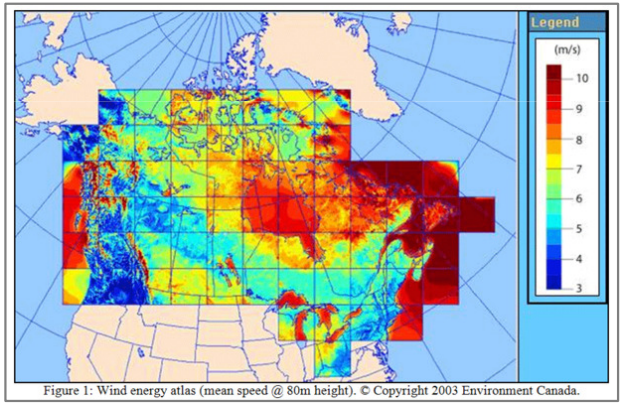
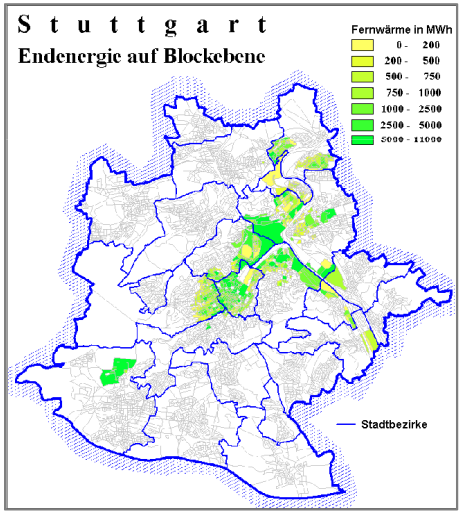


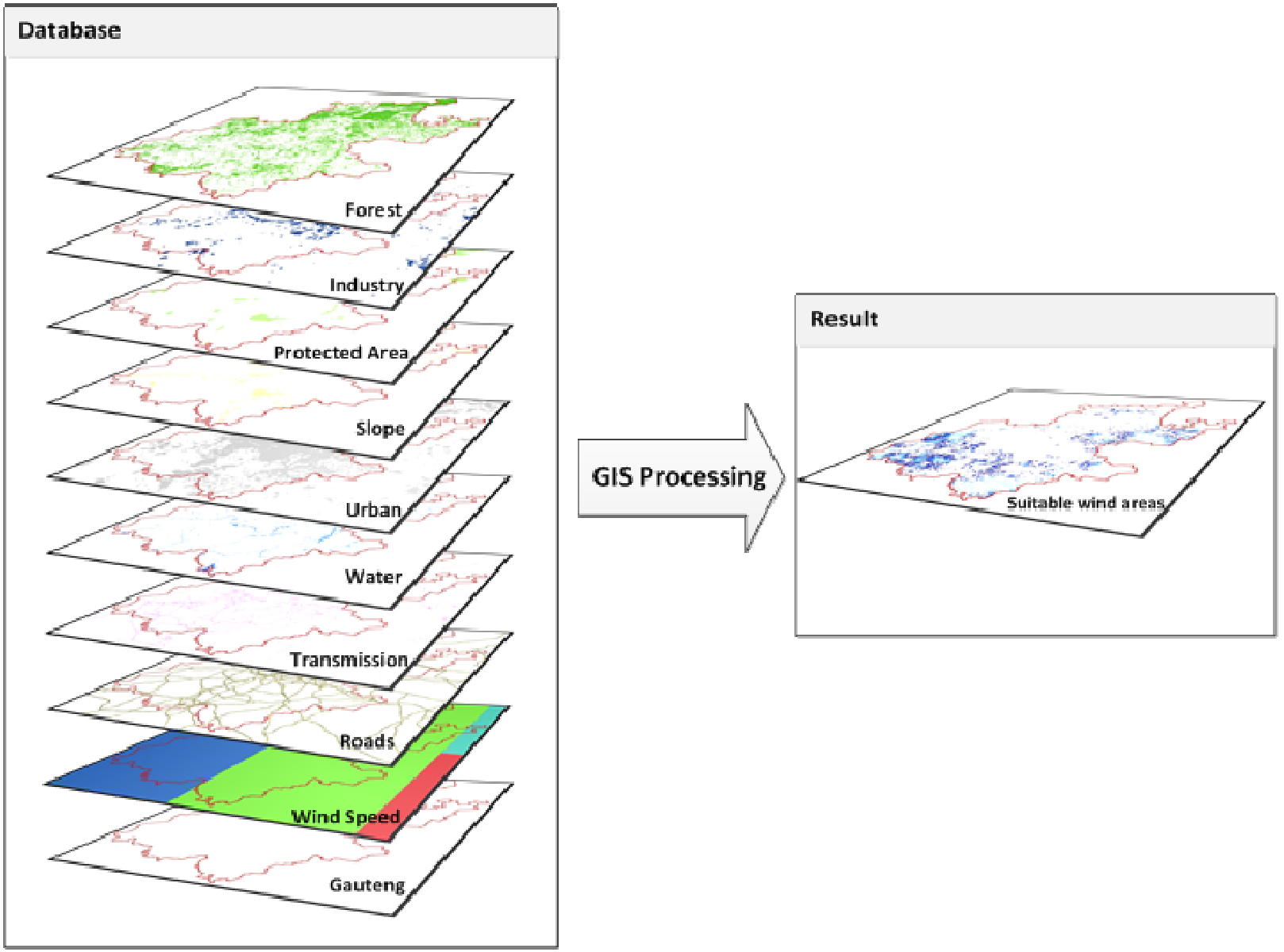
Figure 1: Wind energy atlas (mean speed @ 80m height). © Copyright 2003 Environment Canada.



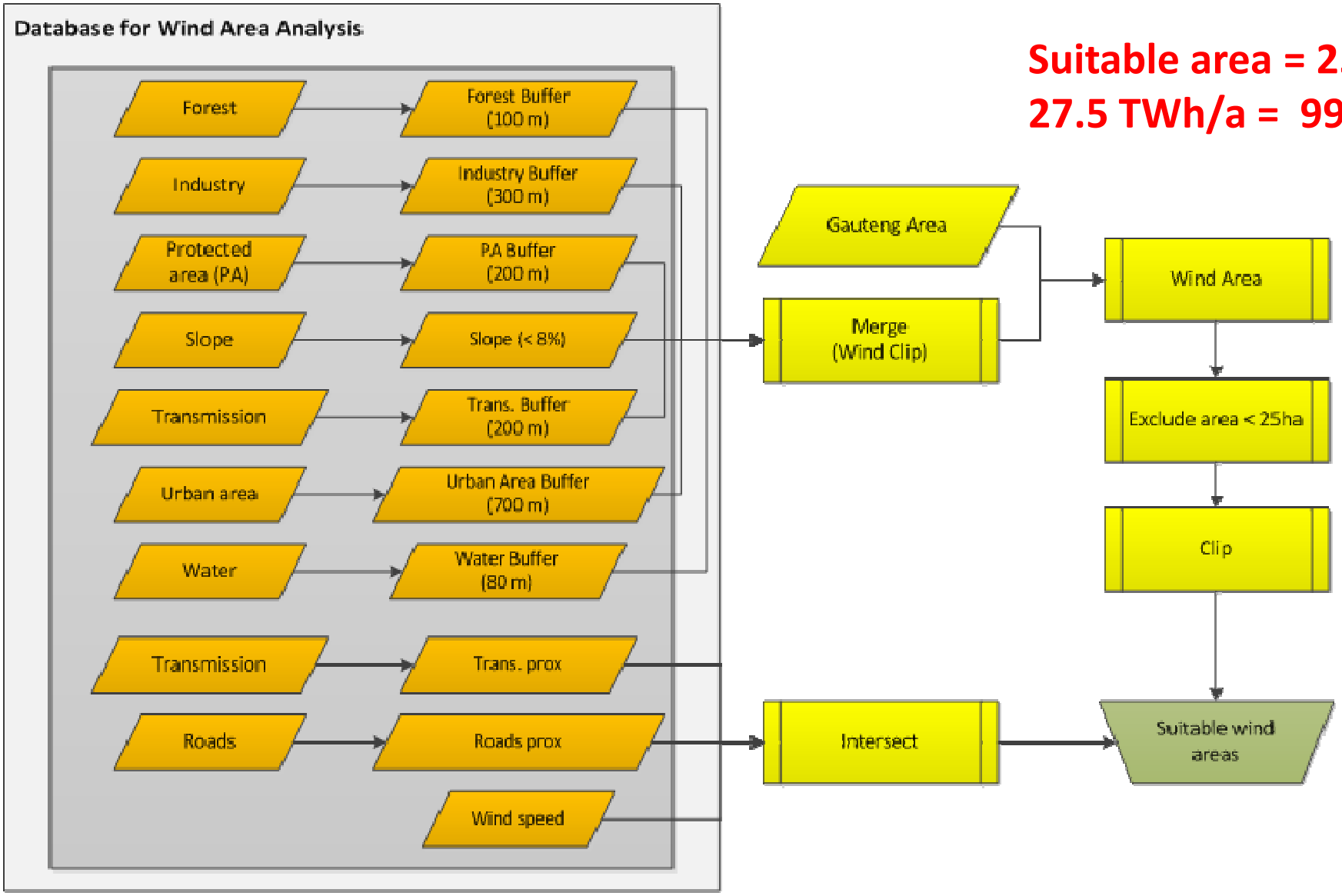
Potential Analysis in Gauteng

- Wind energy
- Solar energy
  - Photovoltaic
  - Solar water heaters
- Biomass
  - Wood
  - Energy crops

Data Analysis: Wind Energy

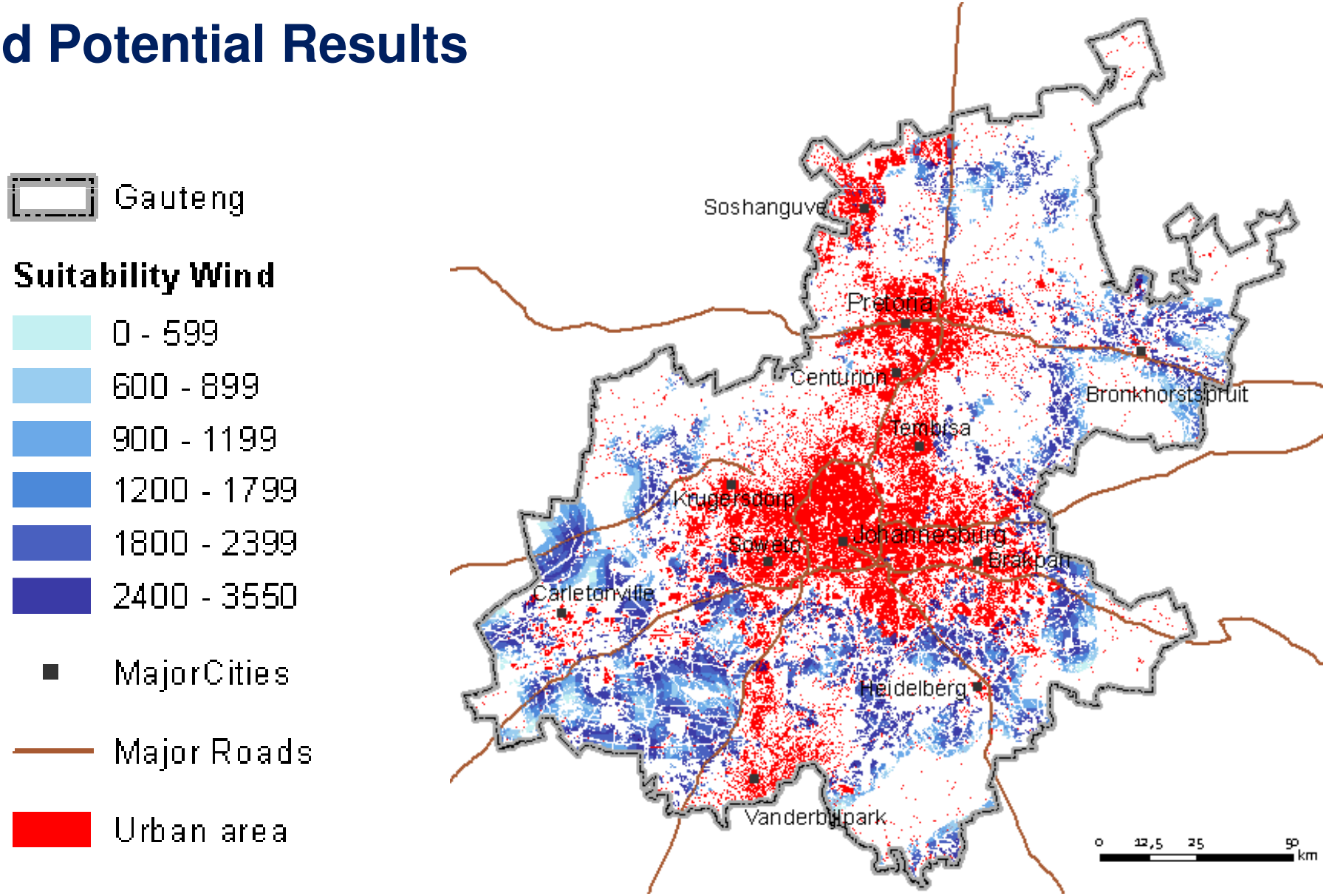


Wind Potential Analysis



Suitable area = 252 ha
27.5 TWh/a = 99 PJ/a

Wind Potential Results



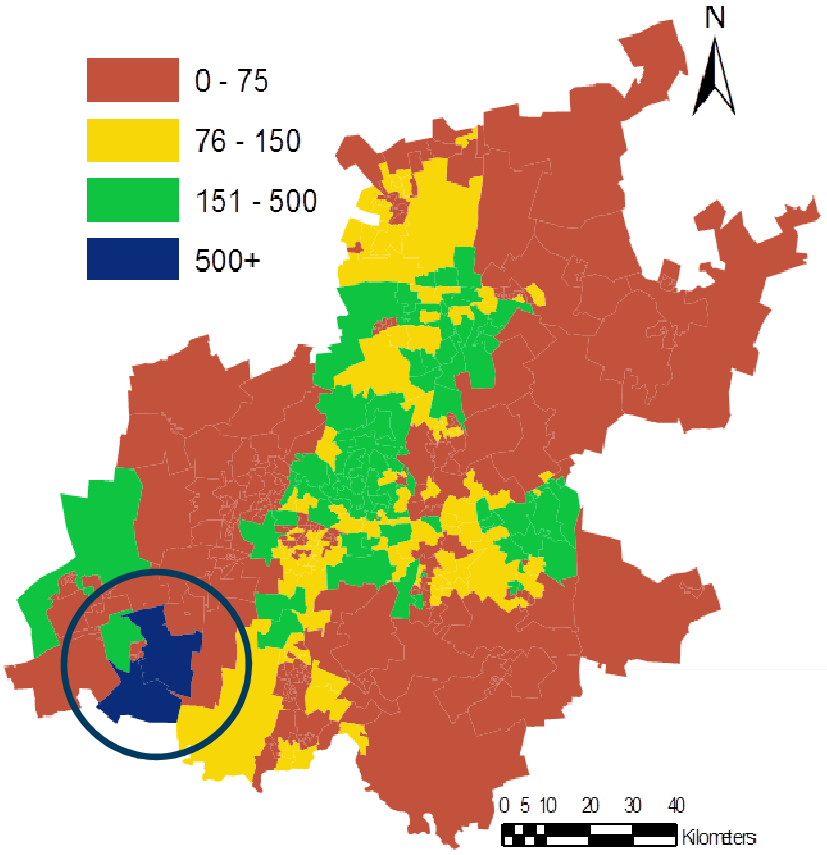
Results: Renewable Energy Potential in Gauteng (TWh/a)

Energy carrier	Potential	Production
Wind	27.50	Electricity
Biomass-Wood	0.06	Electricity
Biomass-Energy crops	3.20	Electricity
Solar- CSP	2.17	Electricity
Solar- PV (50 MW)	4501	Electricity
Solar PV (5 MW)	5420	Electricity
Solar-SWH	37.86	Heat

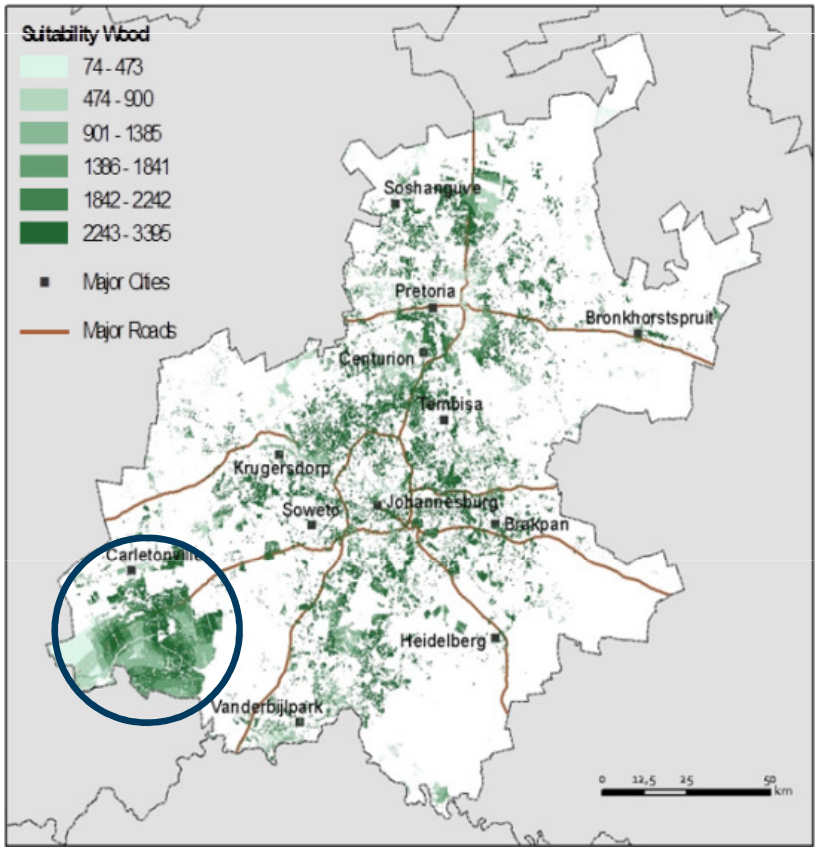
Total Potential = 9953 TWh/a

Considering area-overlap and other constraints, merely 5% of the calculated potential (497 TWh/a or 1800PJ/a) is more than enough to cover Gauteng's energy consumption

Comparing Demand and Potential



Final energy consumption (2007) [TJ/a/ward]



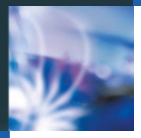
Areas with biomass-wood suitability in Gauteng

Obstacles/Problems

- Detailed data on wind speed at different heights and wind direction was not available
- The biomass potential was carried out for wood, maize and sunflower, as data for other plants was unavailable
- Finer solar radiation data was missing
- In South Africa, rules and regulation for exclusion area are yet to be defined.
- SWH potential analysis was carried out for the residential sector, industry and public/commerce sectors should also be included
- Other missing data (e.g. military, water zones, nature conservation, etc.)

Conclusions

- Opportunities available for cleaner, better energy can be easily identified
- Data analysis/mapping can be done at local/national/global level depending on the consumer
- Mapping is beneficial to the government, stakeholders, policy makers, and communities
- Small communities (including off-grid) who are unable to pay for such analysis will benefit from mapping
- The calculated potential is based on various assumption and exclusion areas
- Further criteria such as social acceptance, actual land availability (private/government), soil stability should be included



Thank you for your attention