

# TRANSDISCIPLINARITY IN THE BUILT ENVIRONMENT

PROF CHRISNA DU PLESSIS  
DEPARTMENT OF ARCHITECTURE

FUTURE AFRICA 1HOPE WEBINAR SERIES PART 2

Make today matter



UNIVERSITEIT VAN PRETORIA  
UNIVERSITY OF PRETORIA  
YUNIBESITHI YA PRETORIA

Faculty of Engineering,  
Built Environment and  
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en  
Inligtingtegnologie / Lefapha la Boetšenere,  
Tikologo ya Kago le Theknolotši ya Tshedimošo



“Transdisciplinarity concerns that which is at once *between* the disciplines, *across* the different disciplines, and *beyond* any discipline”

*International Centre for Transdisciplinary Research, 1999*



Transdisciplinary research is defined by Pohl (2005:1160) as research that:

- takes into account the complexity of an issue – meaning the complex system of factors that together explain the issue’s current state and its dynamic;
- addresses both science and society’s diverse perceptions of an issue; and
- sets aside the idealised context of science in order to produce practical, relevant knowledge

Wickson *et al.* (2006) argues that transdisciplinary research is distinguished by three key themes:

- A focus on **complex, multi-dimensional real-life problems**, the solution to which the research aims to contribute.
- An “evolving methodology” developed through “an interpenetration of epistemologies” (*ibid.*:1050), **the integration of a plurality of methodologies** and an **iterative and reflective response** to the changing research context and stakeholder perspectives.
- **Collaborative knowledge generation** between researchers (who provide a fusion of knowledge from different disciplines) and stakeholders.





**GREENERY**  
Very little greenery exist for public use, except for a few exotic street trees and minimal planters. The rest of the surface coverage is a host of hardscaping and roads.

**EXOTIC STREET TREES**  
*Jacaranda mimosoides* - Jacaranda  
*Platanus acerifolia* - London Plane

**PLANTER TYPOLOGIES**



**GREENERY**



The surfaces found within the study street area is mostly hardscape with few areas of soft scaping. Surfaces differ at actually from street to street with very little repetition which make the area feel disjointed and disorient.

**SURFACE COVERAGE**

# Architecture is the ultimate transdisciplinary endeavour



**TYPE OF PUBLIC SPACE**

- 1 EFFECTIVE PUBLIC SPACE**  
Space within the public realm that encompasses different uses, activities, suitability, access, linkages, comfort and image.
- 2 INEFFECTIVE PUBLIC SPACE**  
Space that was designed for public use but is not being used for its intended purpose.
- 3 DISARTICULATED SPACE**  
Space that has been neglected.
- 4 EMPTY SPACE**  
Space that does not receive foot traffic.

**WHY?**  
These spaces were investigated to **measure the value they can have to cities** in an urban environment. All space is important but change may not be able to happen everywhere. Thus we identified areas for later review.



**WHAT MAKES A GREAT PLACE?**

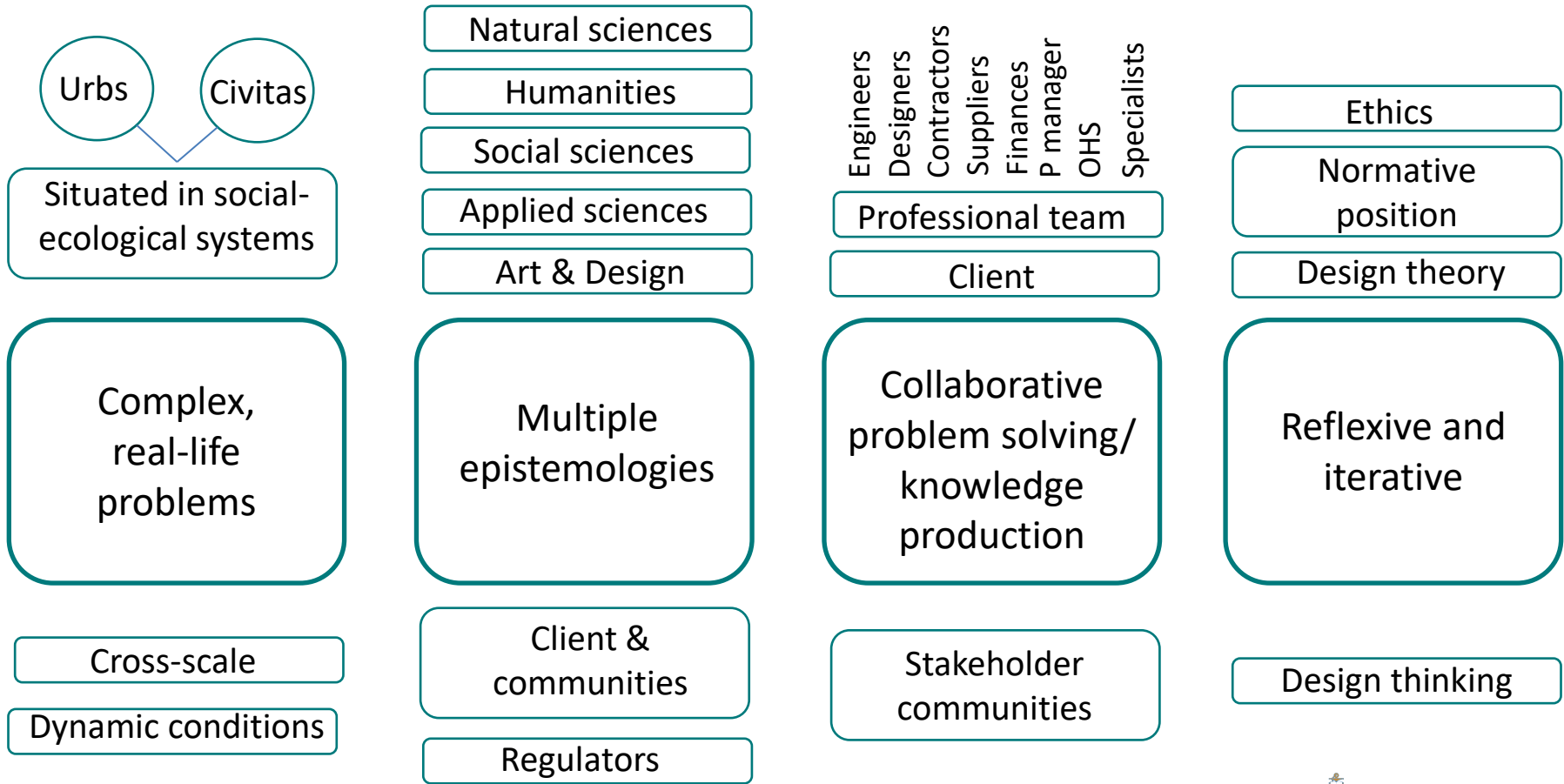


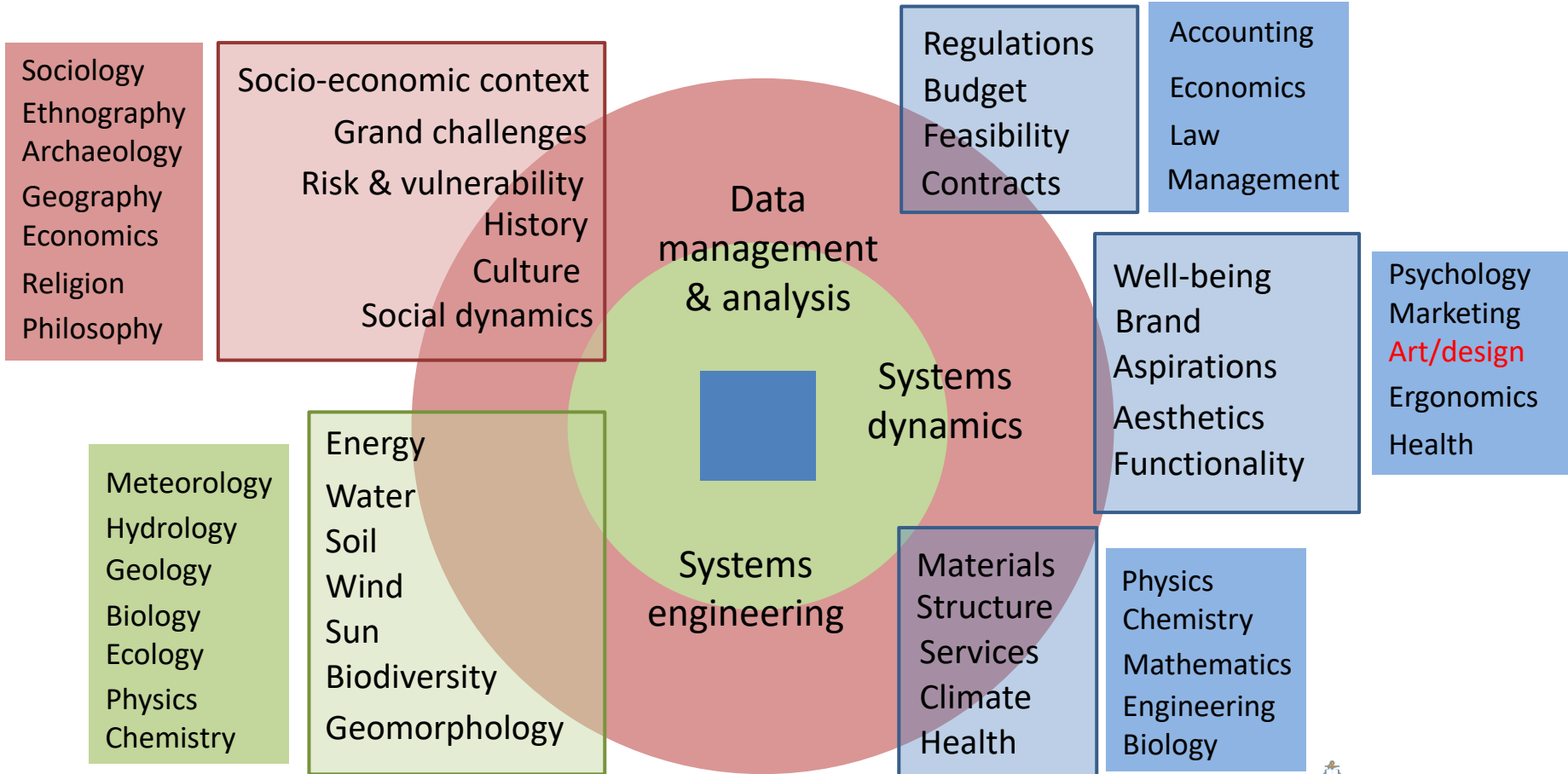
**ACCESS & LINKAGES**  
"You can judge the accessibility of a place by its connections to its surroundings, both visual and physical. A successful public space is easy to get to and get through. It is visible both from a distance and up close. The edges of a space are important as well. For instance, a row of shops along a street is more interesting and generally safer to walk by than a blank wall or empty lot. (What Makes a Successful Place?, 2018)"

**COMFORT & IMAGE**  
"Comfort includes perceptions about safety, cleanliness, and the availability of places to sit - the importance of giving people the ability to sit where they want is generally underestimated. (What Makes a Successful Place?, 2018)"

**USES & ACTIVITIES**  
"Activities are the basic building blocks of great places. They are the reasons why people visit in the first place, and why they continue to return. They are also what makes a place special or unique. When there is nothing to do in a place, it will sit empty and encourage a stark edge. Encouraging needs to change. (What Makes a Successful Place?, 2018)"

**SOCIALITY**  
"When people see friends, meet and greet their neighbors, and feel comfortable interacting with strangers, they tend to feel a stronger sense of place or attachment to their community - and to the place that fosters these types of social activities. (What Makes a Successful Place?, 2018)"





USING MUNICIPAL WASTE STREAMS AS CATALYST FOR  
SUSTAINABLE REGENERATION OF SMALL RURAL TOWNS

# RESEARCH ANECDOTE





# THE PROBLEM

“South Africa’s municipal sewage system has largely collapsed. Of the 824 treatment plants, maybe only 60 release clean water. South Africa’s municipal sewage system has largely collapsed. Of the 824 treatment plants, maybe only 60 release clean water.”

## ENVIRONMENT

# 50 000 litres of sewage flow into SA’s rivers every second

Sipho Kings 21 Jul 2017



*Polluted: The Vaal Dam is choked with algae. Plants*

# THE OPPORTUNITY

Create local business opportunities based on:  
(Private sector or PPP)

Renewal of small rural towns

- Renewable energy  
(solar, algal biodiesel, biogas)
- Rural municipal service delivery  
(sanitation, water, energy)
- Intensive agriculture  
(hydroponics, aquaculture, ...)
- Light industry, agri-processing

Use an Industrial Ecology approach to:

- Create sustainable local jobs
- Assist rural municipalities to improve service delivery (especially sanitation)

# THE VISION

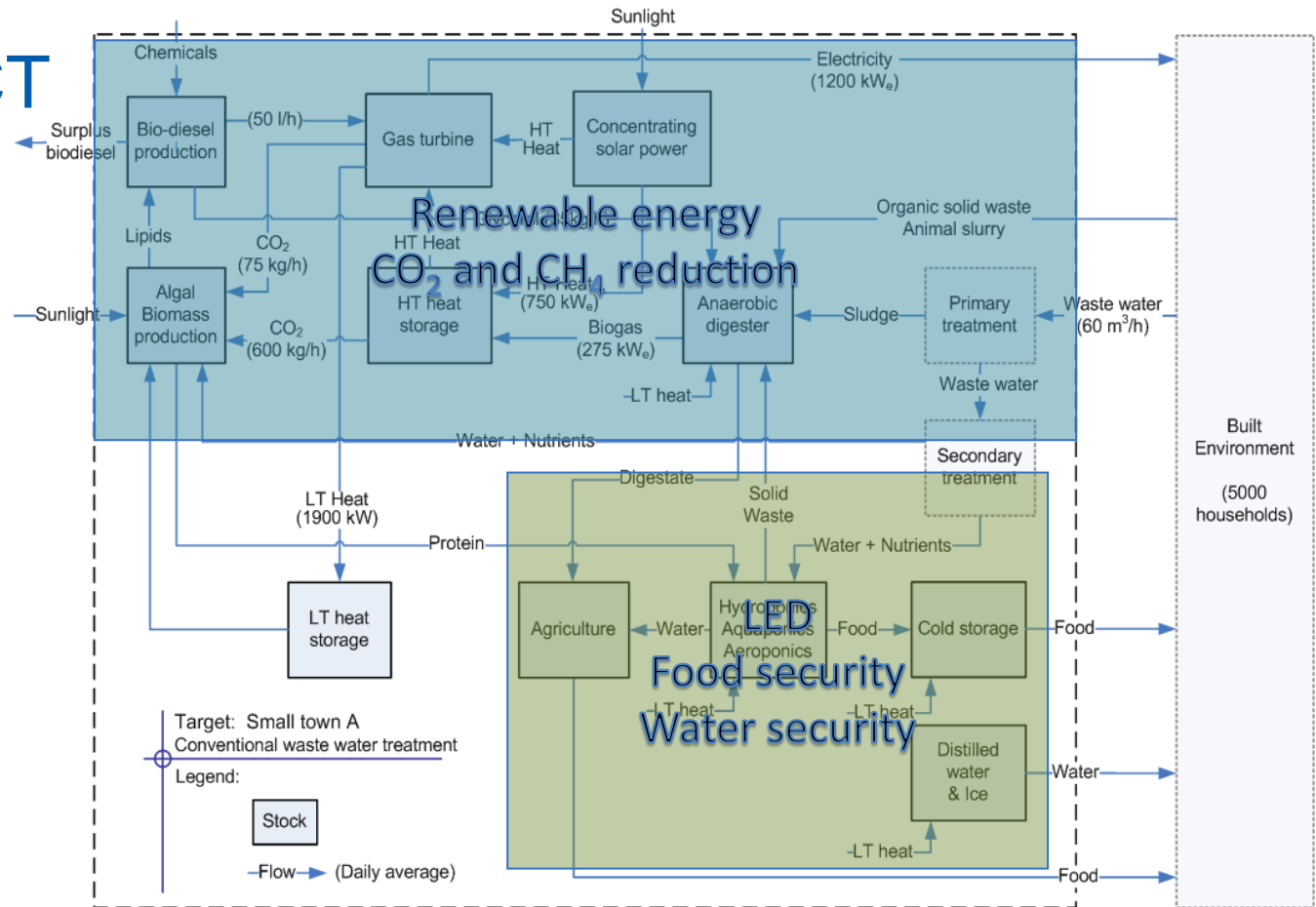
To establish Independent Power Producers  
in at least 40 rural towns in South Africa

as a catalyst for  
local economic development and  
improved municipal service delivery

# THE PROJECT

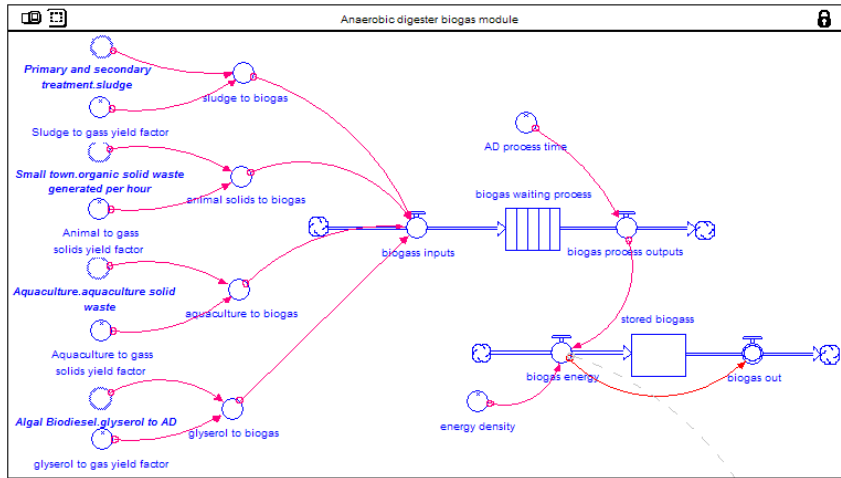
Turning municipal waste streams into:

- Clean energy
- Clean water
- Food
- Textiles
- Jobs
- Income



# THE RESOURCE MODELS

Resource flow modelling shows technical feasibility



## Electricity data

Small town electricity	
Electricity to generate per hour (W)	100000.00

Gas turbine	
High grade heat to electricity efficiency	0.30
Gas turbine CO2 released (kg/W)	0.50

## Aperture area

Aperture area (m <sup>2</sup> )	381.00
Area multiple	5.00
Total heliostat field area (m <sup>2</sup> )	1905.00

## Helio stat

Helio stat efficiency	0.75
Max heat achievable (Celsius)	950.00
Max heat fraction achievable	1.00
Net helio stat efficiency	0.75

## Waste treatment data

Small town waste production	
Organic solid waste generated per hour per household (kg/h/house)	60.00
Total organic waste generated per hour (kg/h)	300 000.00
Waste water generated per hour per household (l/h/house)	50.00
Total waste water generated per hour (l/h)	250 000.00

## Primary and secondary treatment

Waste water to sludge ratio	0.08
Waste water to treated waste water ratio	0.92
Ratio sum	1.00
Potential amount of nutrients contained in treated waste water (kg/l)	0.05

## Anaerobic digester

Anaerobic digester process time (h)	480.00
<i>Biogas</i>	
Sludge to biogas yield factor	0.50



# THE FINANCIAL MODELS

Income statement shows profitability

	Scenario 1	Scenario 2	Scenario 3
Turnover	R 22.1 million	R 26.2 million	R 34 million
Profit	R 1.47 million (7%)	R 4.4 million (17%)	R 4 million (16%)
Main source of income	Electricity (88%)	Electricity (89%)	Electricity (62%) Biodiesel (31%)
Capital cost	R 15.7 million (76%)	R 18.1 million (83%)	R 25.1 million (84%)
O&M	R 4.9 million (24%)	R 3.7 million (17%)	R 4.9 million (16%)

# THE BUSINESS CASE

- Privately operated business
  - Create local jobs
- Concessionaire/franchise model
  - Pool scarce resources
  - Provide economies of scale
- Impact on municipalities
  - Reduce municipal costs
  - Provide capacity for operations and maintenance of water treatment
  - Does not impact negatively on municipal income stream
  - Improve human and environmental health

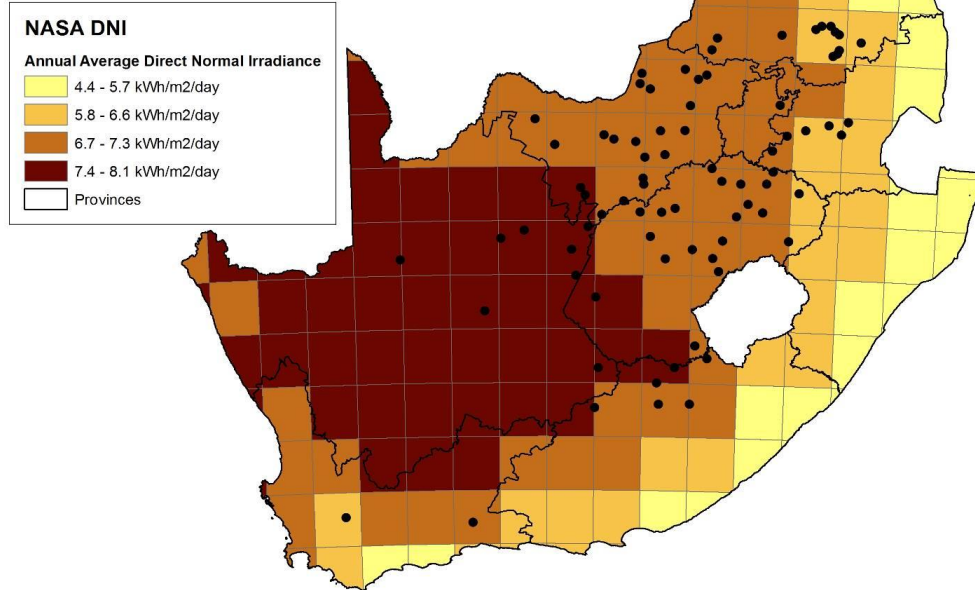
# WHY DID THIS NEVER HAPPEN?







## Candidate Small Towns



It did not suit the political agenda of the day

# THE CHALLENGE OF TRANSDISCIPLINARITY

Complexity is scary  
to people used to  
thinking in silos

