

# A STRATEGIC MANAGEMENT FRAMEWORK FOR THE COMMERCIALISATION OF CONCENTRATING SOLAR POWER TECHNOLOGIES IN SOUTH AFRICA

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**STERG**  
SOLAR THERMAL ENERGY  
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# Presentation Overview



1. Research introduction
2. Study objective
3. Technology commercialisation
4. Framework breakdown
5. Research findings



# Research Introduction



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## **The Problem:**

Despite the billions of dollars invested globally in RE over the past decade, RETs still contribute relatively little to global electricity supply

## **The Cause:**

A lack of technology commercialisation

But ...



# Research Introduction



- Not all components of RETs need commercialising!
  - Pumps
  - Turbines
  - Compressors
- Multi-technology Renewable Energy System (MTRES)
- Case study: CSP technologies in South Africa



# Study Objective

## The Objective:

To increase the rate of commercialisation of MTRESs:  
The case of CSP technologies in South Africa

But how?

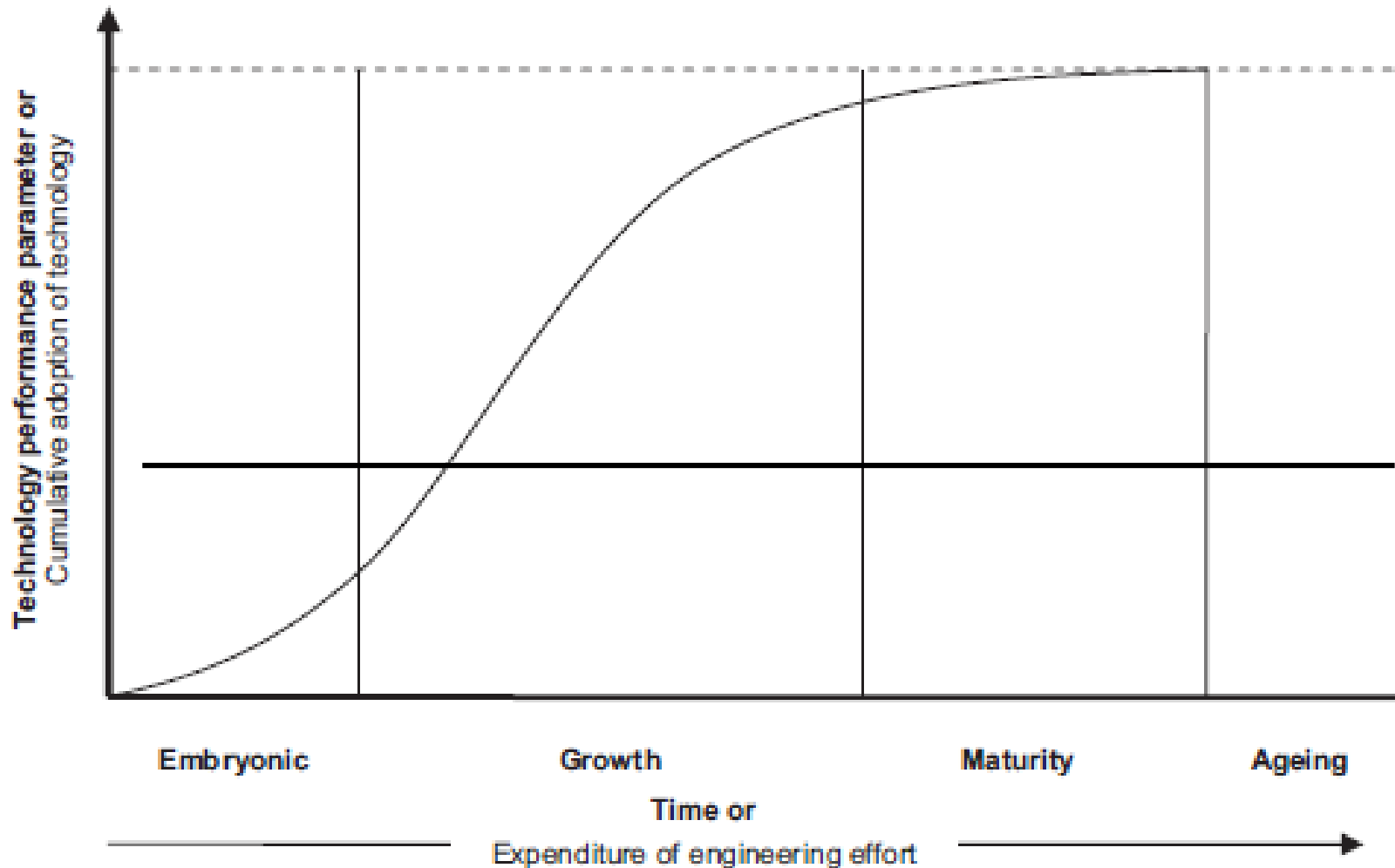


# Technology Commercialisation

- *‘The creation of self-sustaining markets that thrive - without any kind of favour - in a level playing field with other competing technologies’ - (Balachandra et al., 2010)*
- *‘The process of introducing a new product or system into the market using new or improved techniques or tools’ - (Scott, 2012)*
- Compete with other established technologies
  - Satisfy expectations relating to its performance and reliability
  - Be available at a cost the consumer is willing to pay



# Technology Commercialisation





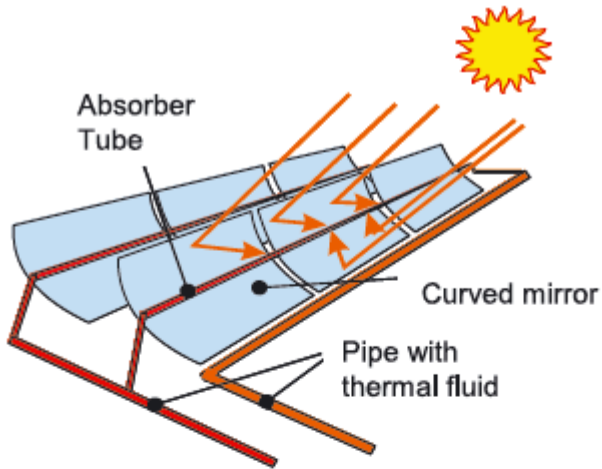
# Commercialisation of Energy Technologies

- Cost - < R1/kWh
- Always accessible - Available on demand (24/7)
- Competitive advantage - Reduction in GHG emissions
  - Infinite supply
  - Meet multiple energy needs

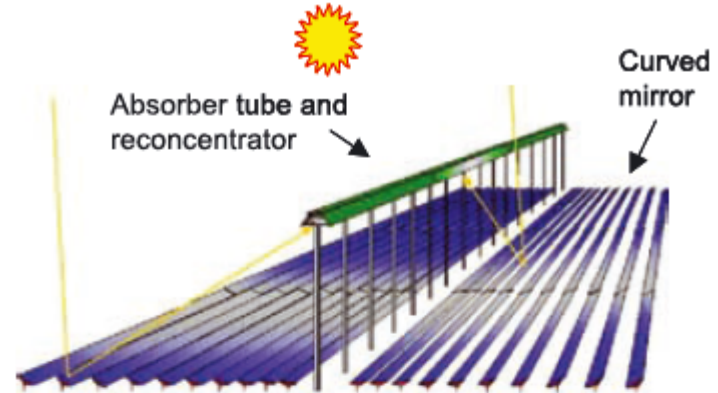




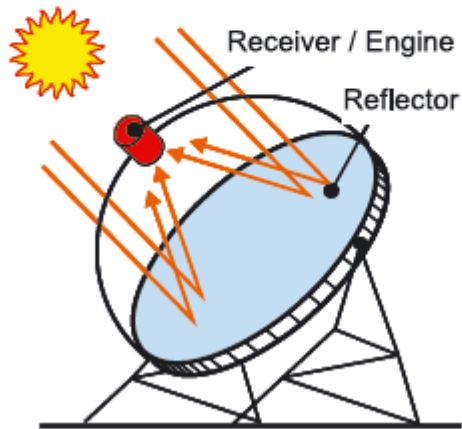
# Commercialisation of CSP



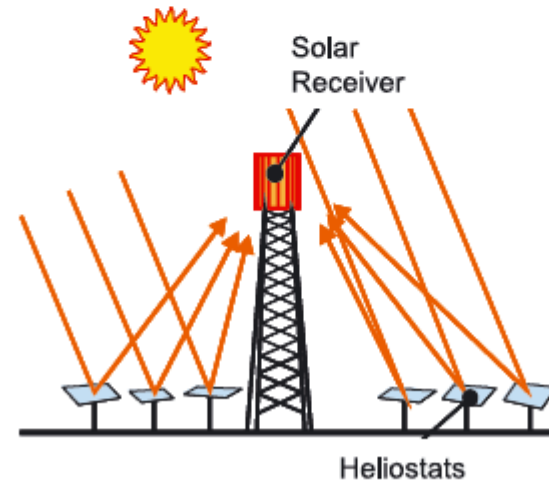
Parabolic Trough



Linear Fresnel



Dish/Engine

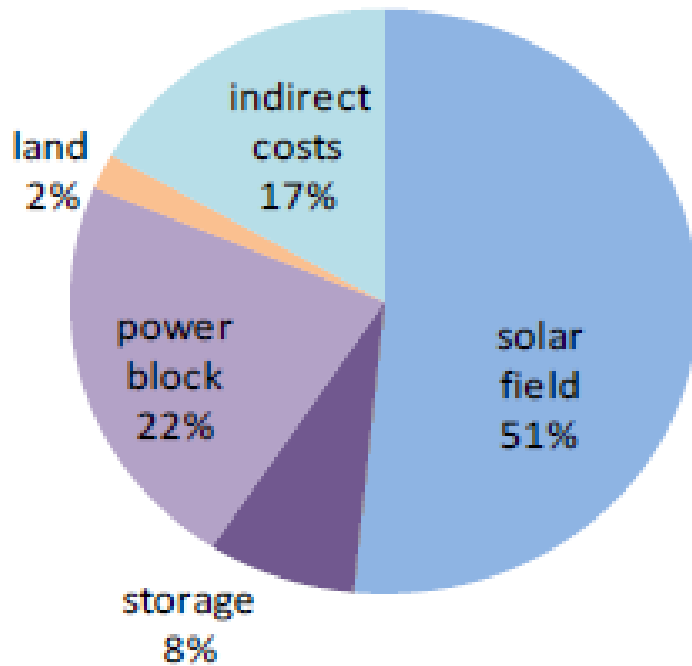


Central Receiver

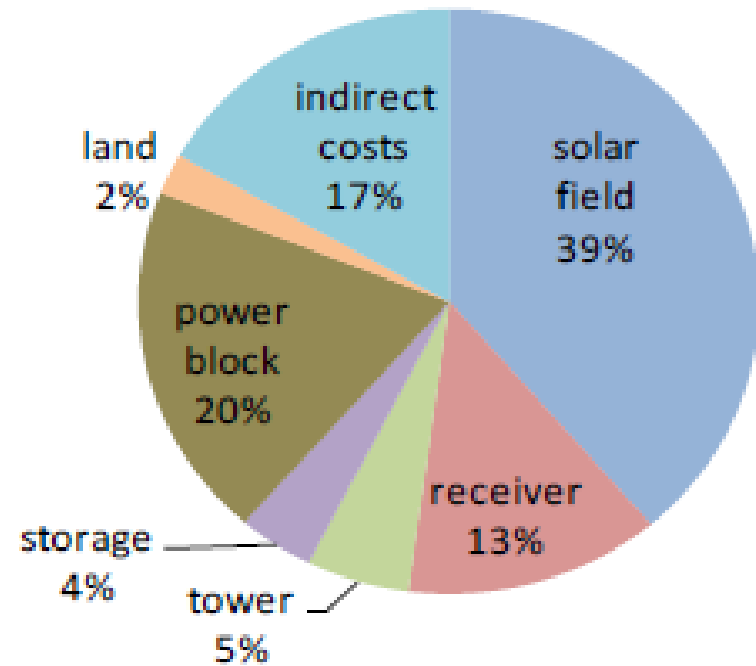


# Commercialisation of CSP

- Dispatchability
- Cost



(a) Parabolic Trough



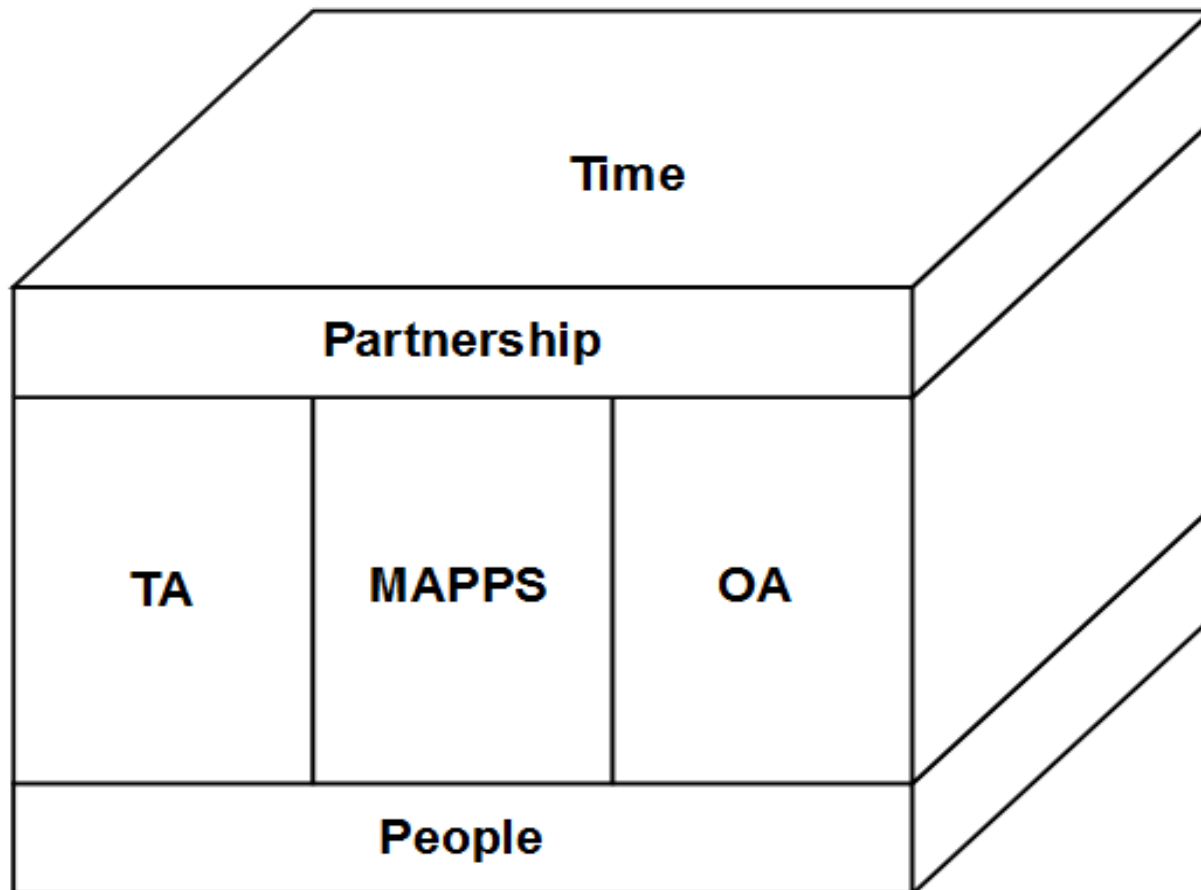
(b) Power Tower



# Strategic Management Framework

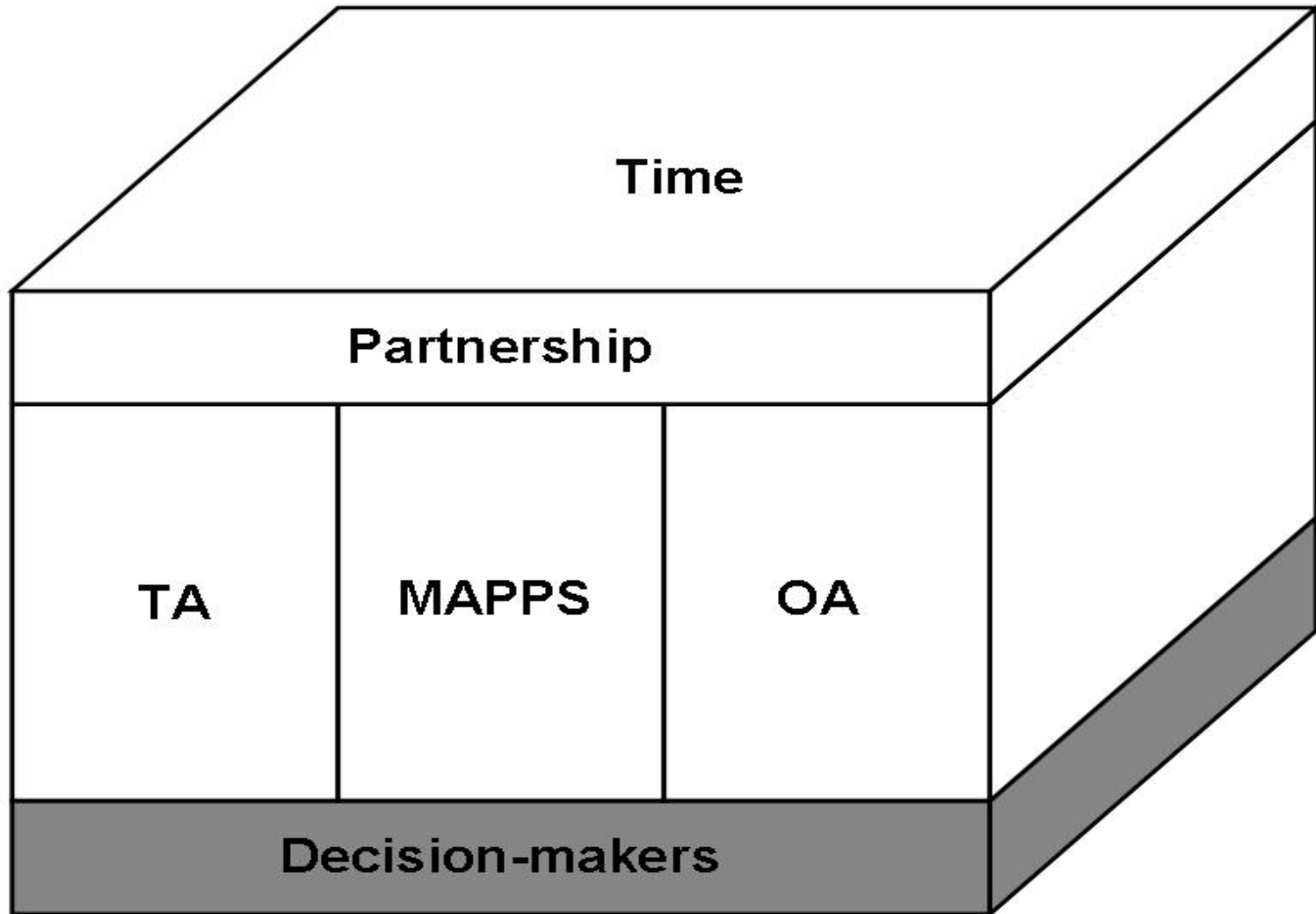


A tool for increasing the rate of commercialisation of CSP technologies in South Africa



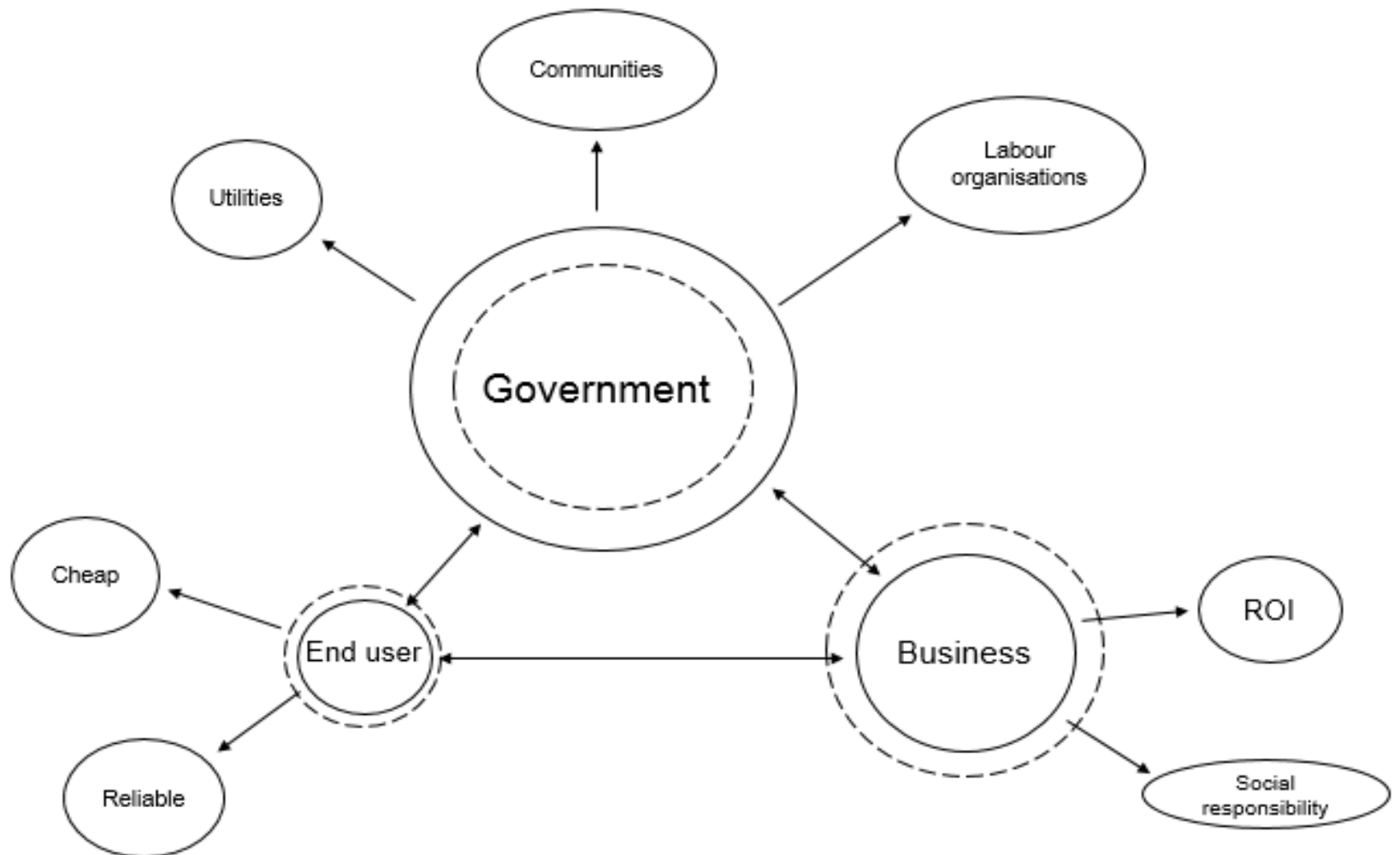


# People



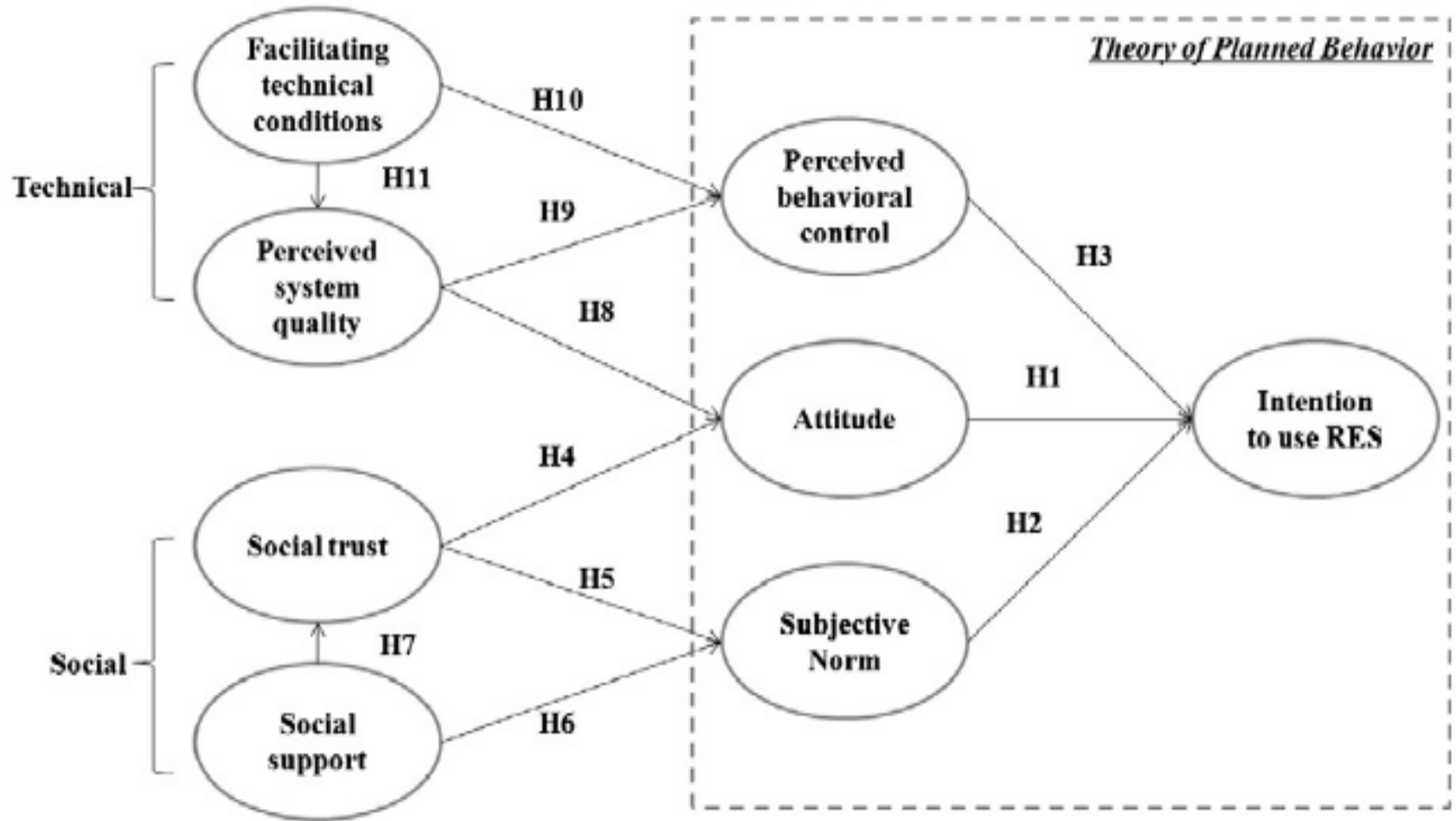


# People





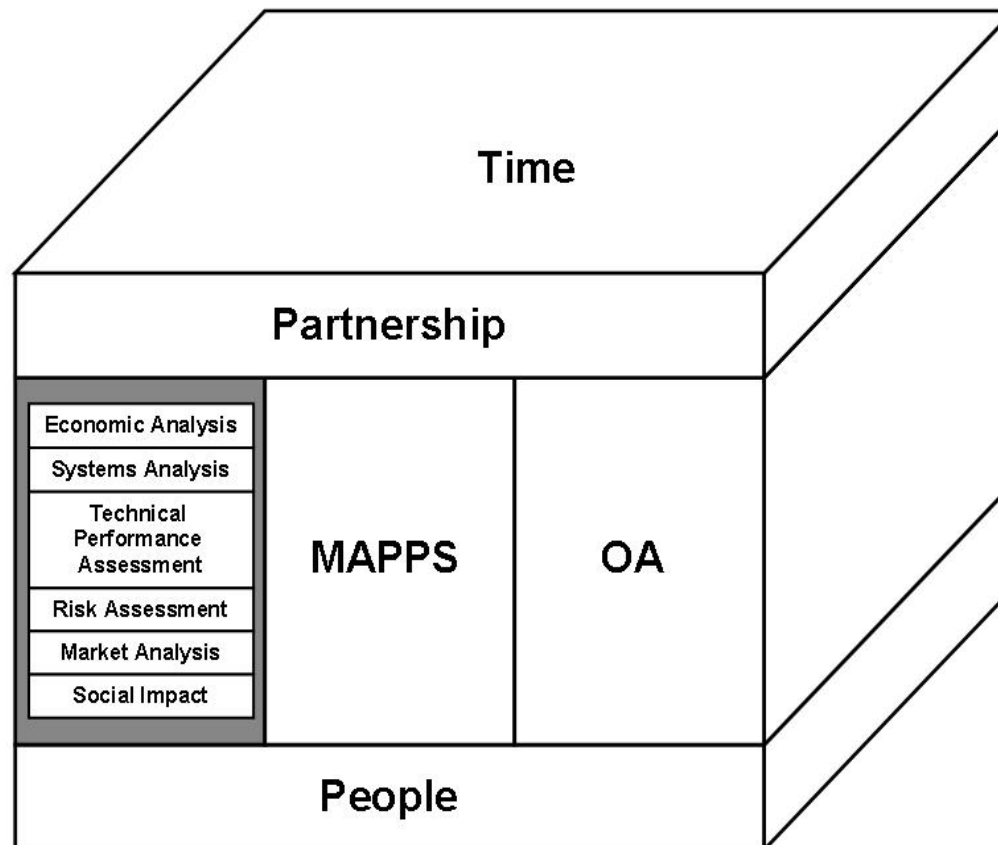
# People





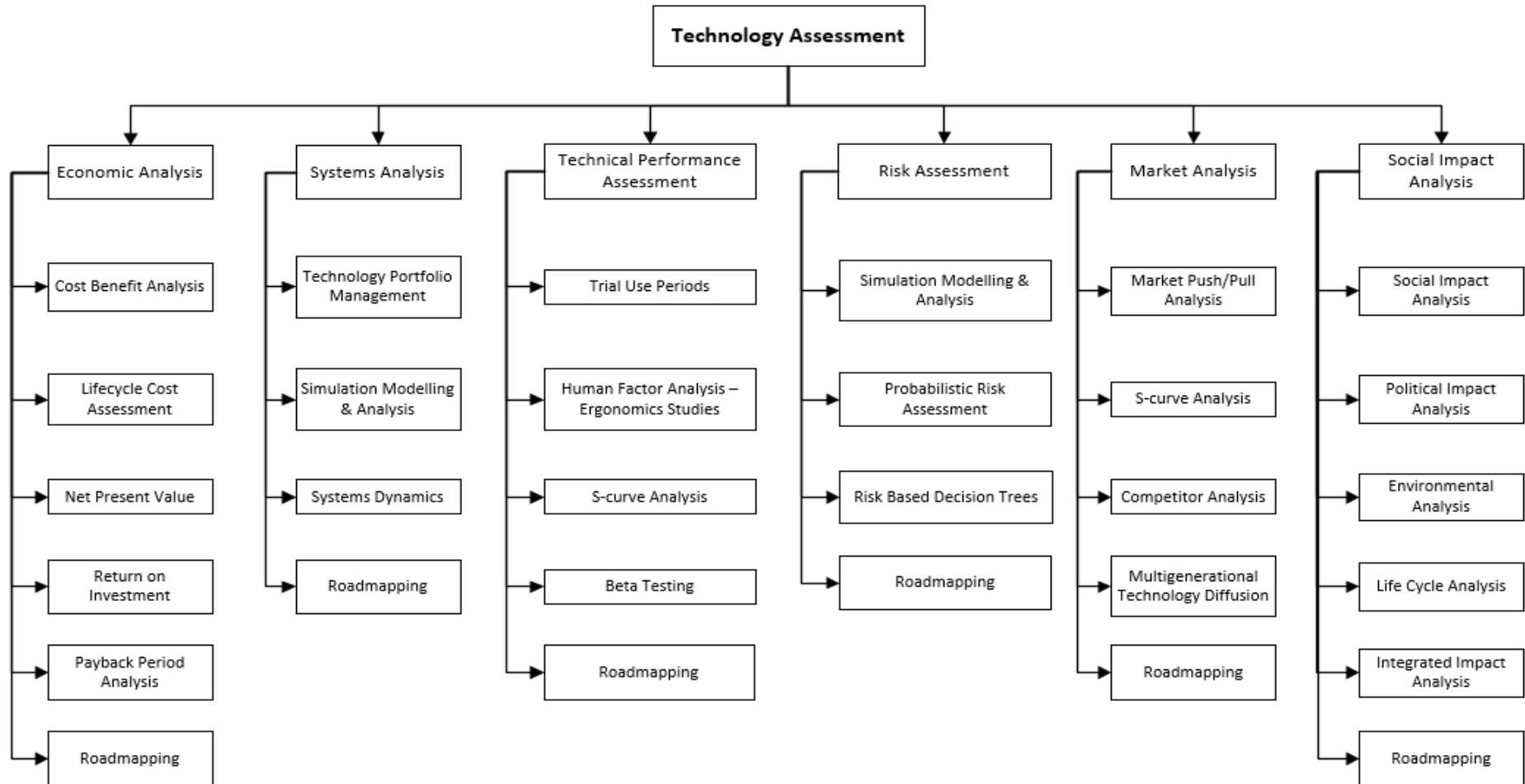
# Technology Assessment

Before you can commercialise a technology,  
you need to understand it





# Technology Assessment

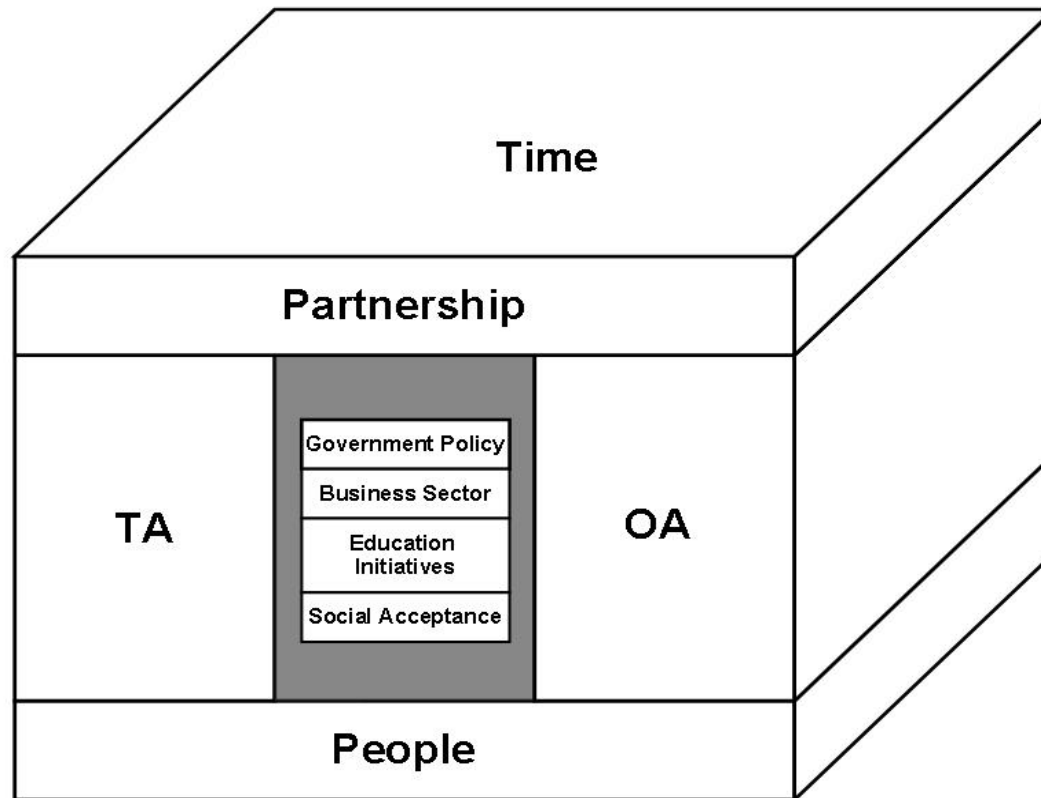






# Market Adoption, Promotion and Penetration Strategies (MAPPSs)

Building the market:  
Generating sustainable demand &  
increasing knowledge and awareness





# Market Breakdown

| Market segment       | Application  | Power Output | Temperature (°C) | Appropriate CSP technology |
|----------------------|--|--------------|------------------|----------------------------|
| <b>Residential</b>   | Self-consumption                                     | N/A          |                  | N/A                        |
| <b>Commercial</b>    | Air conditioning                                     | < 1 MW       | █                | LFC, DS                    |
|                      | Desalination   | > 1 MW       | 90 - 120         | PTC, LFC                   |
|                      | Cooling (adsorption chillers, single and double)     | > 1 MW       | 130 - 180        | PTC, LFC                   |
| <b>Industrial</b>    | Desalination (multi-stage flash (MSF) distillation)  | > 1 MW       | 90 - 120         | PTC, LFC                   |
|                      | Cooling (adsorption chillers, single and double)     | > 1 MW       | 130 - 180        | PTC, LFC                   |
|                      | Process heat   | > 1 MW       | < 250            | PTC, LFC                   |
|                      | Process heat   | > 1 MW       | < 500            | PTC, LFC                   |
|                      | Thermochemistry and fuels                            | > 1 MW       | > 750            | CR                         |
| <b>Utility-scale</b> | Mass electricity production for national consumption | > 10 MW      | █                | CR, PTC, LFC               |



# Government Policy Mix

| Market Pull                | Technology Push            | Interface Improvement                         |
|----------------------------|----------------------------|---|
| FIT                        | RDI subsidies and grants   | Set of certification and technical standards. |
| Tender bid programme       | RDI loans                  | Regulations                                   |
| Tax/investment incentives  | SA national CSP RDI centre | Consultancy services                          |
| Carbon tax                 | Demonstration projects     | Training and certification programmes         |
| Carbon credit market       | Equity                     | Grid expansion and integration                |
| Loans and bonds            |                            |   |
| TGCs / quota               |                            |   |
| Hybrid-wheeling agreements |                            |   |
| Time-of-day tariffs        |                            |   |



# Business Sector

- Increase demand for CSP technologies
- Finance and conduct CSP R&D
- Finance and develop CSP plants
- Operate and maintain CSP plants
- Assist the expansion and interconnection of the national grid with CSP technologies
- Establish and strengthen skills training initiatives
- Establish a local manufacturing hub(s) for CSP components
- Export CSP technologies



# Education Initiatives

Broadening the talent pipeline for the industry

| Primary  |                      | Secondary   | Public                  |
|--|----------------------|---|-------------------------|
| Basic CSP technology operation                             |                      | Integration of CSP source material into school syllabus | Demonstration projects  |
| Site visits (location dependent)                           | (location dependent) | Site visits (location dependent)                        | Cell phone applications |
| School presentations                                       |                      |   | Virtual reality         |
| Nationwide science & technology challenges/competitions    |                      |   |                         |
| Open Days (universities, research councils & institutions) |                      |   |                         |



# Social Acceptance

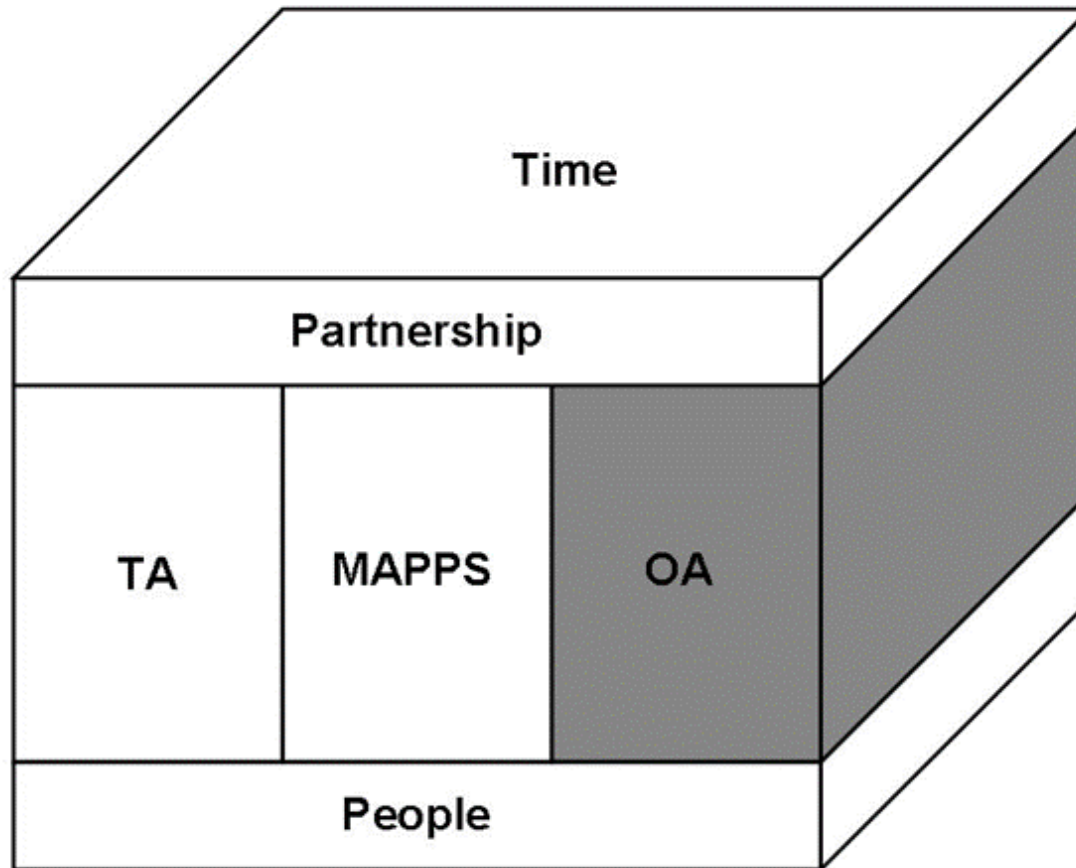
Trust → Legitimacy and Credibility in the technology

| Tools                               |  |
|-------------------------------------|--|
| Cell phone applications             | <ul style="list-style-type: none"><li>Majority of South Africans access the internet through cellular devices</li></ul>  |
| Labelling and (technical) standards | <ul style="list-style-type: none"><li>Promote trust in technology</li><li>Form with input from multiple stakeholders</li></ul>   |
| Media                               | <p>Mass</p> <ul style="list-style-type: none"><li>TV, radio, newspapers, magazines,</li><li>Public demonstrations &amp; exhibitions</li><li>Community centre posters</li></ul>   |
|                                     | <p>Social</p> <ul style="list-style-type: none"><li>Social media platforms (Facebook, Twitter, Instagram)</li><li>Public personalities and celebrity endorsements; local political, church, and community leaders</li></ul>  |
| Decision-making process             | <ul style="list-style-type: none"><li>Fair, transparent, credible, and collaborative decision-making process that includes all stakeholders</li><li>Share all relevant information between all stakeholders,</li><li>Trustworthy institutions → Solar / CSP technologies</li></ul> |



# Organisational Analysis

What capabilities are needed to commercialise a technology?





# Organisational Capabilities

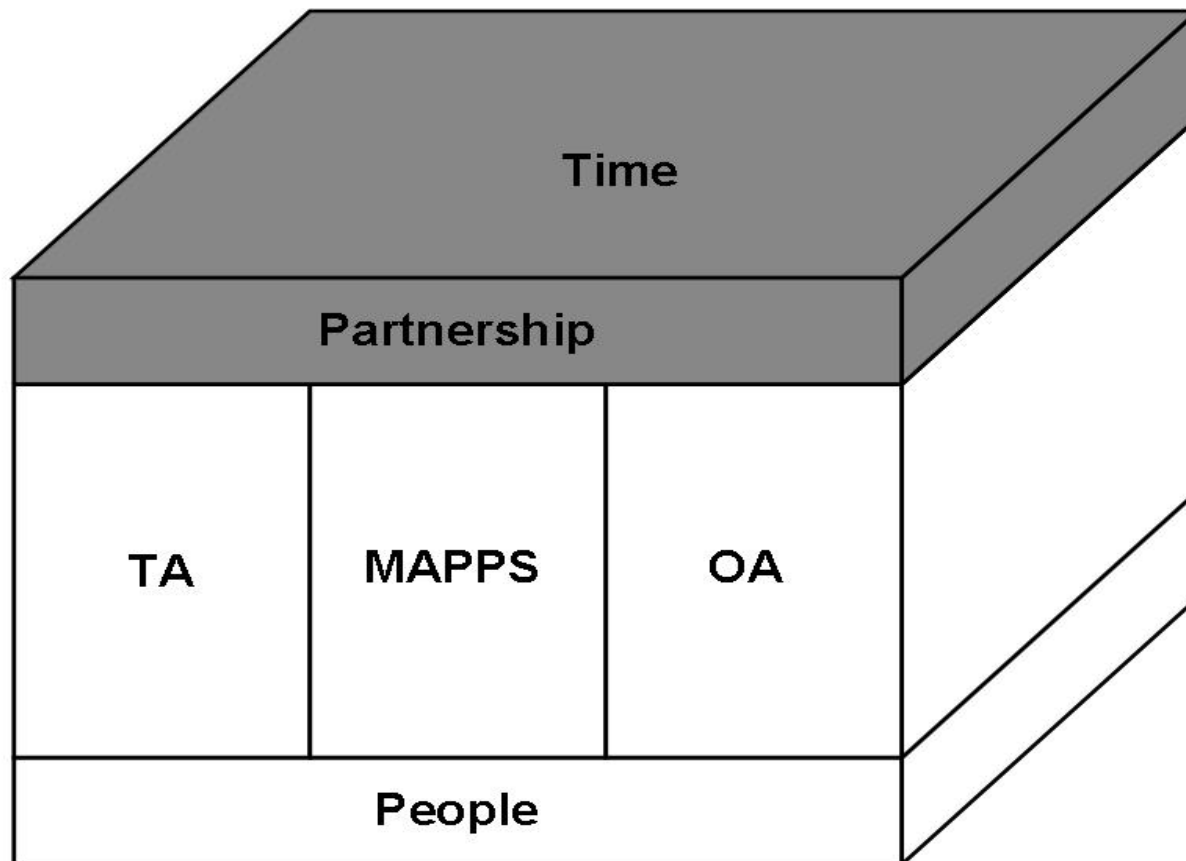
| Organisational Capability                         |                                  |                                   |
|---|----------------------------------|-----------------------------------|
| Marketing   | <b>Communication</b>             | Human resource management         |
| After-sale support / end-user involvement         | Asset management                 | Industry / supply-chain relations |
| Learning / knowledge management / skills training | Manufacturing                    | Business management & experience  |
| <b>R&amp;D</b>                                    | Services (technology-related)    | <b>Entrepreneurship</b>           |
| Technology management                             | Strategic positioning / thinking | Innovation capability             |
| Organisational structure                          | Data collection                  | Sensing capability                |
| Leadership  | Project management               | Reconfiguration capability        |
| Risk management                                   | <b>O&amp;M experience</b>        | Production management             |





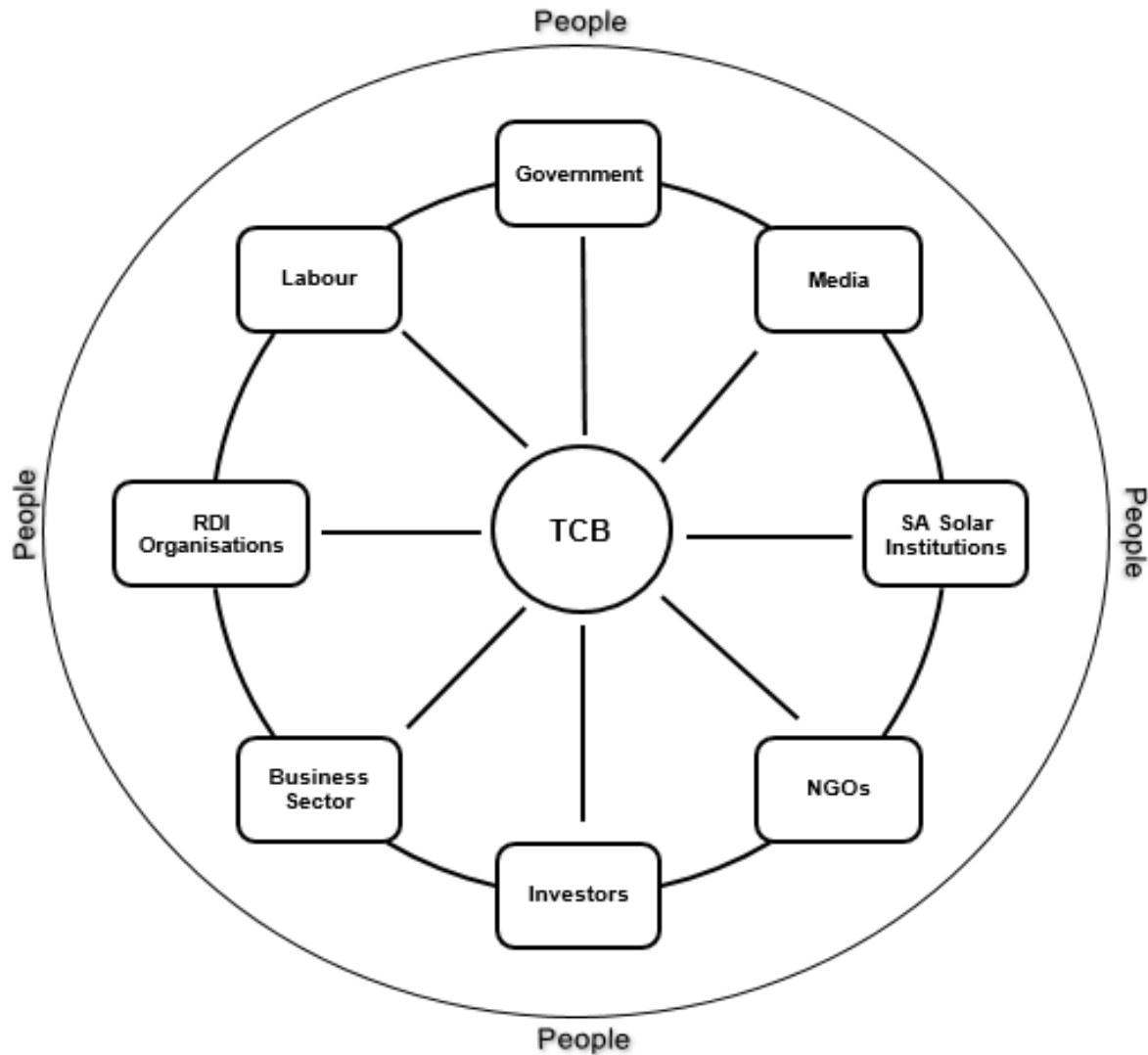
# Framework Implementation

Who is going to use this framework? And how?



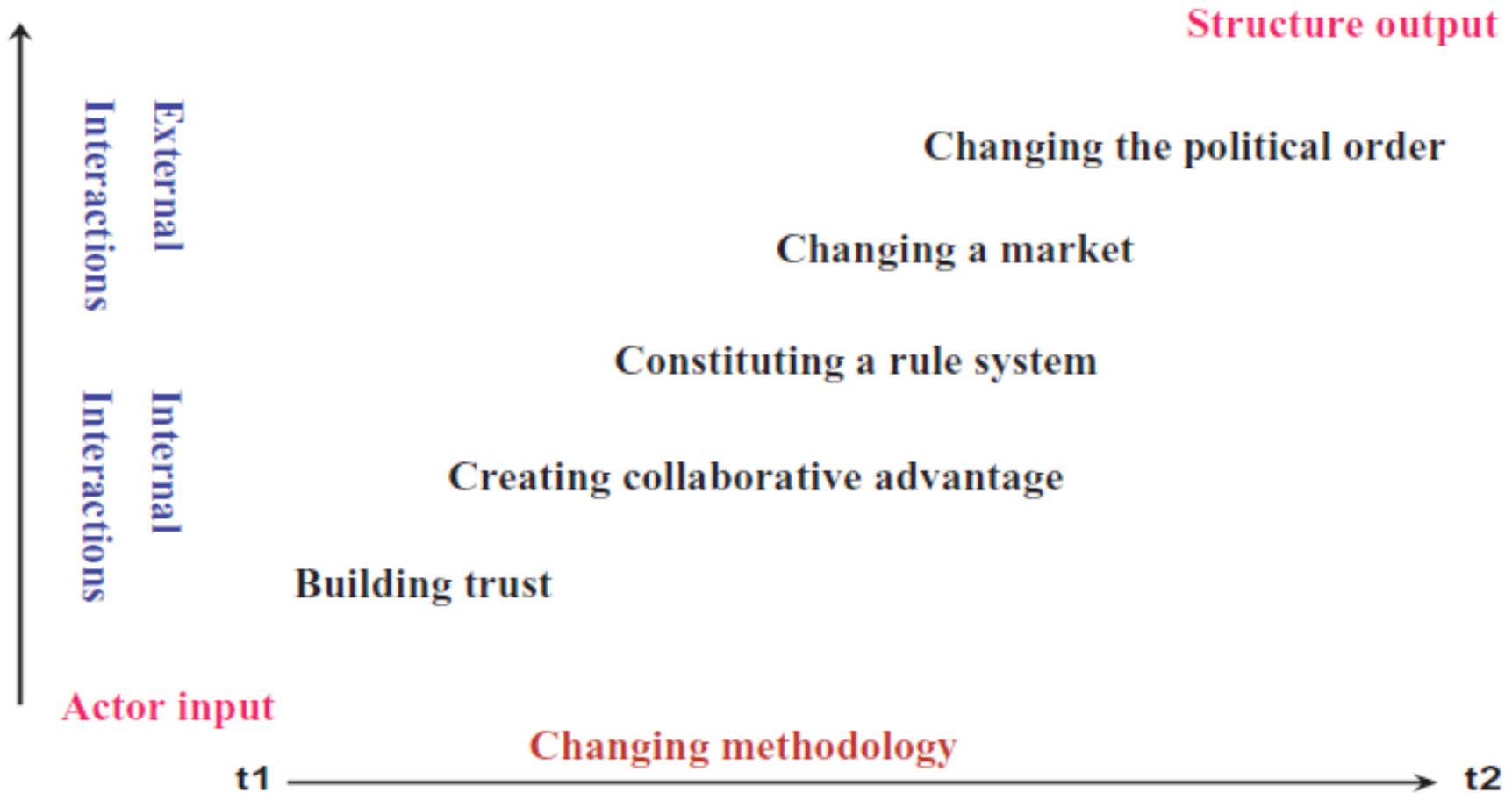


# Partnership Structure





# Partnership Formation





# Partnership Objectives

| Objective                          | Metric/KPI  | Short-term:<br>industry<br>formation<br>(0-5 years) | Medium-term:<br>industry<br>growth (5-15<br>years) | Long-term:<br>industry<br>maturity<br>(15 years+) | Data source |   |
|------------------------------------|---|---|--|---|-------------|---|
| Cost reduction                     | LCOE (R/kWh)  | CSP   | 1.50 - 1.70  | 1.20 - 1.50                                       | 0.90 - 1.20 | Annual RE / CSP reports                                   |
|                                    |   | Average   | ?  | ?   | ?           | Annual RE / CSP reports                                   |
|                                    |   | % of average LCOE                                   | 150 - 180  | 120 – 150   | 100         | Annual RE / CSP reports                                   |
| Effectiveness /<br>industry growth | Additional annual installed capacity (MW/year)            | Local   | 100  | 300   | 500+        | Annual RE / CSP reports                                   |
|                                    |   | Export  | 200  | 400   | 500+        | Annual RE / CSP reports                                   |
|                                    | Annual local electricity production (TWh)                 |   | 2 - 5  | 5 – 20  | 30+         | NERSA, annual RE / CSP reports                            |
|                                    | Number of CSP plants under construction (at any one time) |   | 2  | 5   | 8           | Annual RE / CSP reports; Single Buyer Office / IPP office |
|                                    | Plant lead time (years)                                   |   | 3 - 4  | 2 - 3   | 2 - 3       | Annual RE / CSP reports                                   |
|                                    | % contribution to South African electricity supply        |   | 1 - 5  | 5 - 15  | 15+         | Annual RE / CSP reports                                   |
|                                    | % contribution to South African energy supply             |   | 0.5 - 3  | 3 - 8   | 8 - 15      | Annual RE / CSP reports                                   |



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|------------------------------------|---|---|---|---|----------------------------|----------------------------|
| Effectiveness /<br>industry growth | Job creation<br>(construction,<br>manufacturing,<br>O&M)  | Local   | 3 020   | 9 060   | 15 100                     | Annual RE / CSP<br>reports |
|                                    |   | Export  | 6040  | 12 080  | 15 100                     | Annual RE / CSP<br>reports |
|                                    | Local content (%)   | 40  | 45  | 50+   | Annual RE / CSP<br>reports |                            |
|                                    | Number of companies                                       | 70  | 90  | 120+  | Annual RE / CSP<br>reports |                            |
|                                    | Annual level of financial<br>investment (billions ZAR)    | 3 - 10  | 20 - 30   | 35+   | Annual RE / CSP<br>reports |                            |
|                                    | Trade   | Net trade<br>balance (ZAR<br>billions)              | -   | -   | -                          | Annual RE / CSP<br>reports |
|                                    |   | Contribution to<br>GDP (ZAR<br>billions / %)        | -   | -   | -                          | Annual RE / CSP<br>reports |
|                                    | Number of international licensing<br>agreements           | -   | -   | -   | Partnership data           |                            |
|                                    | Number of international strategic<br>alliances / partners | -   | -   | -   | Partnership data           |                            |



# Partnership Objectives

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|---------------------------------------|--|---|---|---|--------------------------|------------------------------------|
| Education and<br>social acceptance    | Knowledge (%)  | 15-30   | 30-50   | 50+   | Surveys & questionnaires |                                    |
|                                       | Perception   | Positive  | Very positive   | Very positive                                     | Surveys & questionnaires |                                    |
|                                       | Fear   | Low   | Very low  | No fear   | Surveys & questionnaires |                                    |
|                                       | Effective stakeholder participation in decision-making process (%) | 80 - 100  | 90 - 100  | 90 - 100  | Surveys & questionnaires |                                    |
|                                       | Social media views, action buttons (likes, subscribes) (%)         | 10 – 20   | 20 - 50   | 50+   | Analytics                |                                    |
|                                       | Website views & visits (%)   | 10 – 20   | 20 - 50   | 50+   | Google analytics         |                                    |
|                                       | Search engine keywords (%)   | 10 - 20   | 20 – 50   | 50+   | Google Trends            |                                    |
| Legal and<br>regulatory<br>compliance | Audits   | Internal (%)  | 100   | 100   | 100                      | Partnership                        |
|                                       |  | External (%)  | 100   | 100   | 100                      | 3 <sup>rd</sup> party organisation |
|                                       | Employee training completion rate (%)                              | 100   | 100   | 100   | Partnership              |                                    |



# Partnership Objectives

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|-------------------------------------|--|---|--|---|--|--------------------------|
| Technological<br>capability         | Patents & patent citations                         | 185   | 200  | 230   | Single Buyer Office / IPP office; Companies and Intellectual Property Commission (CIPC) Office |                          |
|                                     | Annual number of scientific publications worldwide | 800 - 900   | 900 - 1000   | 1000+   | (Bibliometric) Analysis of journal articles  |                          |
|                                     | Water consumption (l/kWh)                          | 0.3   | 0.2-0.25   | <0.15   | Annual RE / CSP reports;   |                          |
|                                     | Life cycle GHG emissions (g/kWh)                   | 50  | 30   | <20   | Annual RE / CSP reports;   |                          |
|                                     | System efficiency (%)                              | PTC   | 15   | 18  | 22+  | Annual RE / CSP reports; |
|                                     |  | CR  | 10 - 15  | 15 - 20   | 20+  | Annual RE / CSP reports  |
|                                     |  | LFC   | 10   | 10 - 13   | 15+  | Annual RE / CSP reports  |
|                                     |  | DS  | 15 - 20  | 20 - 25   | 25+  | Annual RE / CSP reports  |
| Reduction in avian deaths (per GWh) | 0.35 – 1.75 (50%);<br>< 2 500                      | 0.245 – 1.225 (30%);<br>< 1 000                     | 0.049 – 0.98 (20%);<br>< 500                       | Surveys & questionnaires; Annual RE / CSP reports |  |                          |



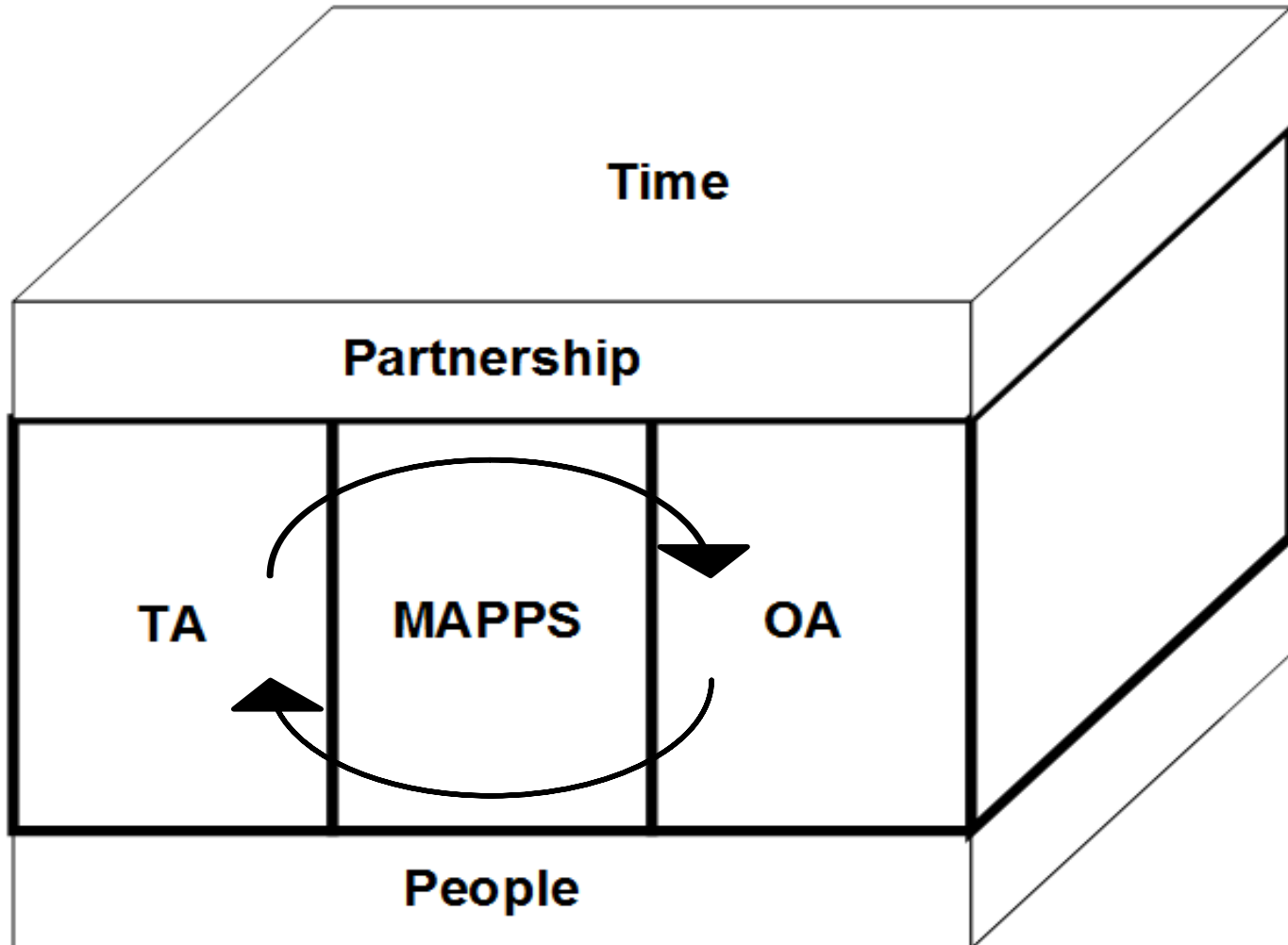
# Partnership Objectives

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|-------------------------------|--|---|---|---|---|
| Organisational<br>performance | ROI (%)  | 15 - 20   | 10 - 15   | 5 - 10  | Organisational<br>data                                |
|                               | Levelised profit of electricity<br>(LPOE) (millions ZAR) | -   | -   | -   | Annual RE / CSP<br>reports;<br>Organisational<br>data |





# Framework Interfaces





# Preliminary Research Findings



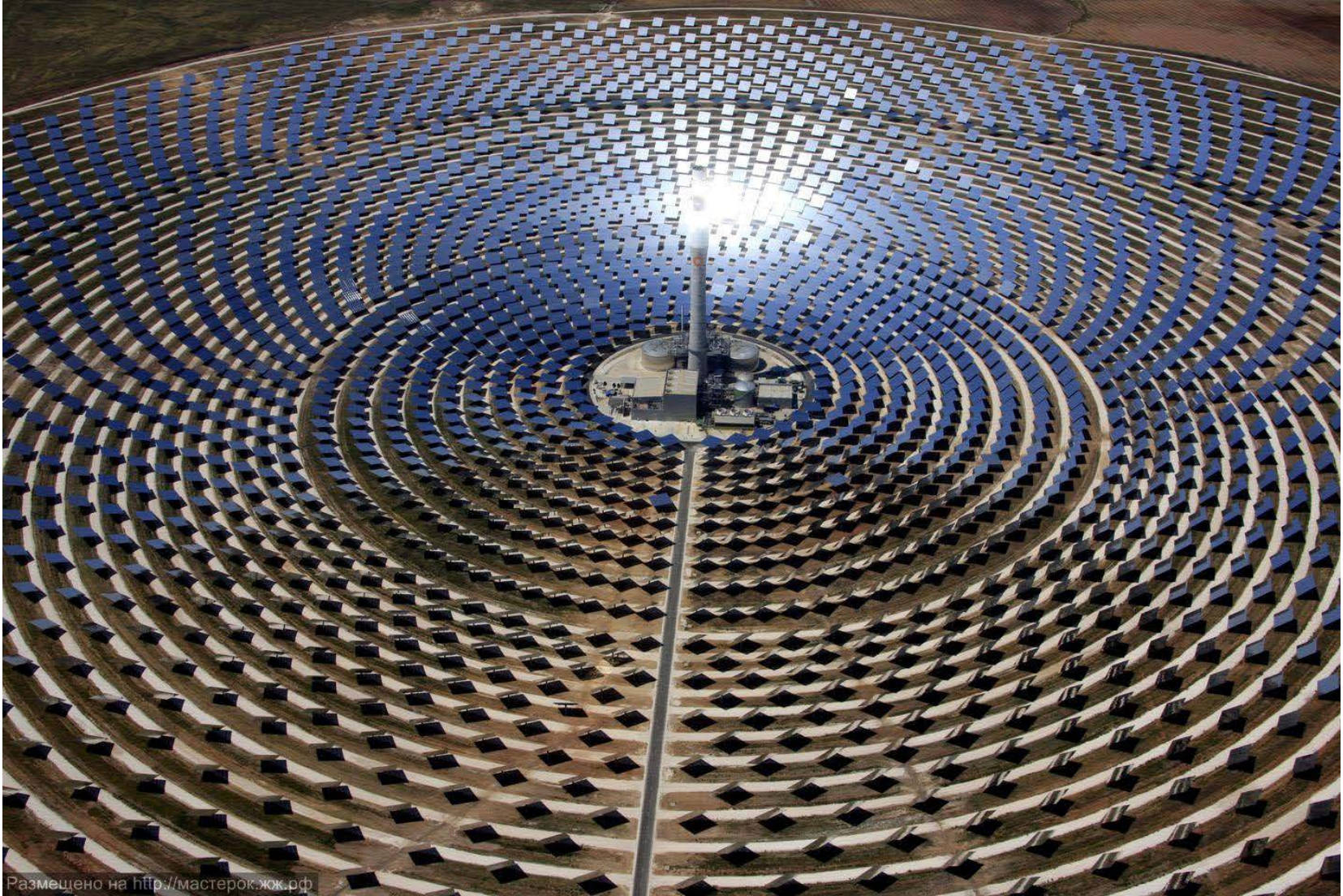
- No single or universal approach to technology commercialisation
- Value as a tool to support the development of strategies aimed at increasing the rate of commercialisation of MTRESs, such as CSP technologies
- Local South African market for complete CSP systems currently insufficient to generate the demand required  
→ hybridisation and export
- Implementation of framework needs to address the buy-in required from multiple stakeholders



# Thank you!



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