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# Infrastructure in Human Settlements in South Africa

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**ABSTRACT AND KEYWORDS**

**Purpose of this paper**
The purpose of this paper is to present research that develops and tests human settlement infrastructure policy statements as input for a new White Paper on Human Settlements in South Africa.

**Design/methodology/approach**
The study develops infrastructure policy statements for human settlements. These are tested through an online survey of human settlement stakeholders. Data gathered through the survey are analysed to provide findings for the study and develop recommendations for human settlement policy.

**Findings**
The findings indicate that stakeholders think that addressing infrastructure in human settlements in South Africa is a high priority. It shows that there is strong support for alternative models for the development and operation of infrastructure in human settlements. These include increased involvement by the private sector and communities, innovative financing and the use of sustainable technologies and systems.

**What is original/value of paper**.
The study is original as it explores new approaches to addressing infrastructure backlogs in human settlements in South Africa. It contributes new thinking on how the private sector and communities can be involved, alternative delivery models developed, and how sustainable technologies may be applied in addressing these backlogs.

## 1. INTRODUCTION

Infrastructure can be defined as "the physical components of interrelated systems providing commodities and services essential to enable, sustain, or enhance societal living conditions" and maintain the surrounding environment [1]. In this study, infrastructure refers to road, cycling and walking

routes, public transport, ICT, electricity, water, sewage and stormwater networks and solid waste systems in human settlements.

Infrastructure is important for achieving an improved quality of life and where this is not present, communities experience multiple negative impacts. A lack of roads, walking and cycling routes means that people can not get to work and children cannot get to school easily. Inadequate water, electricity, and sewage networks result in the health and safety of communities being compromised. No stormwater and solid waste management can result in flooding and increased incidence of disease. In South Africa, rapid urbanisation and a lack of resources have meant that many human settlements do not have adequate infrastructure [2].

The availability of infrastructure in human settlements directly affects the fulfilment of education, health and environmental rights in the South African Constitution [3]. It also hampers the achievement of Sustainable Development Goals for health (SDG3), education (SDG4), energy (SDG7), inequality (SDG10), and sustainable cities (SDG11) [4]. Achieving minimum infrastructure and amenities in human settlements is therefore an urgent priority.

Infrastructure in human settlements is being addressed in the new White Paper developed by the Department of Human Settlements [5]. The White Paper aims to develop policy proposals which respond to infrastructure backlogs and address how these will be tackled. The policy acknowledges that current approaches are insufficient and that alternative methods are required. There is also a desire to explore more sustainable technologies and systems which can provide services more efficiently. Draft policy proposals can therefore been developed. It is important to ascertain the levels of support by stakeholders for these, particularly if alternatives approaches are proposed. This requires draft proposals to be shared with stakeholders and their views to be captured and analysed.

This study proposes human settlement policy statements that include alternative approaches. It undertakes a survey of human settlement stakeholders to evaluate levels of support for alternative approaches, including the application of sustainable technologies in developing and operating infrastructure and amenities in human settlements. The study addresses the following research questions:

- Can policy statements on infrastructure development and operation be developed that respond to the current situation and draw on alternative models to address backlogs more efficiently and sustainably?
- What levels of prioritisation should be given to addressing different types of infrastructure in human settlements?
- What levels of support are there for different models of developing and maintaining infrastructure in human settlements?
- What levels of support are there for using sustainable technologies and systems in infrastructure in human settlements?
- What levels of support are there for proposed policy statements on infrastructure in human settlements?

## 2. BACKGROUND

Globally, approximately 1.1 billion people currently live in informal settlements [4]. This is expected to increase to over 3 billion in the next 30 years [4]. Many of these settlements do not have basic infrastructure [6]. About 37% of households do not have safe drinking water, 43% do not have safe sanitation and 13% do not have access to electricity[4]. About 29%, or 2.3 billion people still rely on inefficient and polluting cooking systems which affect their health and damage the environment [4]. A billion people do not have access to all-weather roads and only half of the global population has access to public transport [4].

In South Africa, over three million households, about 14% of the population, live in informal settlements [2,7]. It is estimated that 12% of the population does not have access to piped water, 18% do not have improved sanitation, 16% do not have mains electricity and 35% do not have waste systems [2].

A lack of infrastructure has direct impacts on health [7]. Inadequate water and sanitation infrastructure lead to increased incidence of ill health and diseases [9]. Diseases such as cholera and filariasis are associated with flooded pit latrines, open sewers and open defecation [10,11]. These types of disease and conditions affect vulnerable households in multiple ways. Households have to bear the cost of treating diarrheal disease and other waterborne diseases [12,13, 14]. In addition, Time and earnings are lost when people have to look after sick family members [15]. Petzer and Pengpid show that living in informal settlements and a lack of basic infrastructure is associated with depression [8]. Households in areas with poor infrastructure are also more likely to be affected by climate change [16]. For instance, inadequate sanitation, water and stormwater management systems are vulnerable to being damaged by heavy rain, flooding, and mudslides[17].

Poor or non-existent infrastructure in human settlements not only results in negative impacts within the settlement but also on surrounding communities. Gqomfa et al.'s research in 2023 shows that sewer spillages from informal settlements result in high concentrations of faecal coliform and are one of the main causes of pollution in South African rivers [18]. Bianco et al. also show that faecal pollution causes eutrophication affecting water organisms and fish populations [19]. Communities without solid waste management systems may also dispose of waste by burning, or dumping it in rivers [19, 20]. The lack of stormwater management systems and the clearing of vegetation in informal settlements also causes loss of topsoil, erosion and pollution of rivers [21].

Tracking of the Sustainable Development Goals indicates that there have been improvements to infrastructure [4]. Global water use efficiency has risen by 9 per cent between 2015 and 2020[4]. There has been an increase in the proportion of renewable energy used globally, from 16% in 2015 to 19.1% in 2020 [4]. Access to mobile broadband networks has also increased rapidly and in 2022, 95 per cent of the world's population was within reach of a network [4]. Thatcher et al. and the UNDP also show how communities develop their own infrastructure, giving examples of greywater and infrastructure associated with urban agricultural systems in African cities[22,23].

Sari et al.'s work in 2024 confirm that infrastructure is a key factor in selecting residential areas and that government facilities, educational facilities, electricity infrastructure and security are important considerations[25]. Zalejska-Jonsson et al.'s research indicates that households are increasingly willing to pay a premium for housing within settlements where there is green infrastructure, such as green roofs and walls, parks, habitat for biodiversity, and sustainable urban drainage [26]. Good infrastructure also supports economic growth. Grimes et al. show how good transport links and social infrastructure have contributed to some New Zealand towns and cities growing at much more higher pace than areas with out this infrastructure[24].

## 3. METHODS AND MATERIALS

Methods and materials for the study are outlined below. This indicates how the study developes policy statements, tests these through a survey, and develops findings and recommendations.

### 3.1 Draft Policy Statements

Draft policy statements for infrastructure in human settlements were developed. These are simple statements that make proposals on how infrastructure will be addressed in human settlements. They include alternative models that aim to ensure that infrastructure can be developed more rapidly and widely, and backlogs addressed. Relevant sustainable technologies and techniques are also included.

### 3.2 Instrument Design

Draft policy statements are used as a basis for survey instrument design. The first part of the instrument includes questions on the experience, organisation and background of the respondent. The second part asks questions about the level of prioritisation that the respondent would give to developing different types of infrastructure in human settlements. The third part asks questions about the levels of support that a participant would give to alternative models of developing and maintaining infrastructure. The fourth part asks questions that aim to understand levels of support for different sustainable technologies and systems that could be used in infrastructure. The fifth part asks questions that ascertain levels of support for proposed policy statements. Examples of questions from the survey are outlined below.

- Please indicate below whether infrastructure interventions in the following areas are a high priority, moderate priority, neutral, somewhat priority, or not a priority. Interventions here include aspects such as roads, walking and cycling paths, public transport, energy and water.

- Please indicate below whether you strongly agree, agree, are neutral, disagree, or strongly disagree about the following statements on infrastructure development and maintenance. Statements here included involving the private sector and communities in developing and maintaining infrastructure.

- Please indicate below whether you strongly agree, agree, are neutral, disagree, or strongly disagree about the following policy statements on infrastructure in human settlements. Statements here included developing standards with other government departments, incorporating infrastructure planning in Integrated Development Plans (IDPs) and developing the capacity to plan and maintain infrastructure.

Questions about levels of support were based on a Likert scale and respondents were asked to confirm whether they ‘strongly agreed’, ‘agreed’, ‘neutral’, ‘disagreed’ or ‘strongly disagreed’ with statements. Similarly, questions about prioritisation were also based on a Likert scale and respondents were asked whether the aspect selected should be addressed as ‘high priority’, ’moderate priority’, ‘neutral’, ‘somewhat a priority’ and ‘low’ priority.

### 3.3 Selection of Respondents

The initial White Paper developed by the Department of Human Settlements was published for public comment in late 2023 [5]. This process provided detailed comments on different sections of the White Paper and a list of interested stakeholders. Respondents who commented on infrastructure aspects of the White Paper were selected for this study. This list included government officials, academics, people from non-government organisations and civil society. This process provided a list of 67 respondents who were emailed a link to the questionnaire. The respondents were given a deadline and a reminder and the survey

closed 3 days after being published. The short period for the completion of the survey was a result of deadlines that the Department of Human Settlements needed to meet in developing a revised White Paper.

### 3.4 Analysis of Results and Development of Findings

Results from the survey were exported to Excel for analysis. Analysis was carried out for each question in the survey and tables and graphs were prepared. Data was used to develop bar graphs shown in the Results section of this study. A review of the results was used to develop findings and recommendations in the study.

## 4. RESULTS

### 4.1 Respondents

From the 67 survey invites sent out, 21 were returned, representing a 31% response rate. Of the respondents, 47% were from government, 38% from NGOs, 5% from the private sector and 9% from Other. Respondents had the following levels of experience in human settlement infrastructure: 62% had over 10 years, 19% had between 5-10 years, 5% had between 3-4 years, 5% had between 1-2 years and 10% had below 1 years of experience.

### 4.2 Infrastructure in Human Settlement Policy Statement

Draft infrastructure in human settlement policy statements were developed and are outlined in Figure 1. The policy statement developed with the Department of Human Settlement aims to identify key policy directions related to infrastructure that will be incorporated in the new White Paper. There was a requirement for under 10 statements to be developed and that these should fit on about ½ page. The policy statements propose an integrated approach to the development of infrastructure in human settlements that builds on existing standards and systems. It proposes that minimum standards be developed to ensure that infrastructure is sustainable, affordable and accessible. Sustainable technologies and systems are included to ensure that more efficient and sustainable alternatives are considered. The policy also confirms how infrastructure should be planned for and developed, including the option to undertake Municipal Service Partnerships (MSPs). MSPs are partnerships between councils, other government departments, communities or entrepreneurs to develop and maintain infrastructure in human sttlements [27]. Alternative models for the delivery of services, such as energy, are also provided. These models include ‘product-as-a-service’ where a service entrepreneur or cooperative installs and maintains systems such as photovoltaic plant at their cost and charges fees for the provision of a service. The policy also provides for technical and financial support for alternative infrastructure delivery models and for capacity development to ensure infrastructure can be maintained locally.

### 4.3 Infrastructure in Human Settlement Prioritisation

Figure 2 shows the prioritisation given to different types of infrastructure in human settlements by respondents. This indicates that 80% of respondents thought that solid waste, sanitation and public transport should be a high priority. It also shows that 60% or more respondents thought that roads, stormwater, water, and energy should be a high priority. Less than 60% of respondents thought that ICT

and walking and cycling paths should be a high priority. Overall, over 60% of the respondents indicated that all of the different infrastructure elements identified should be a moderate or high priority.

### 4.4 Alternative Models for Human Settlement Infrastructure Development and Maintenance

Figure 3 indicates levels of support for different types of infrastructure development and maintenance in human settlements. It shows that over 70% of respondents strongly agreed that there should be additional innovative technical support and capacity development within the sector. There is also strong support for the increased use of Municipal Service Partnerships with other government departments and communities, with over 80% of respondents indicating they strongly agreed with this. It is interesting to note that there was less support for Municipal Service Partnerships with the private sector and that less than 50% of respondents indicated they strongly agreed with this. There is strong support for the development of new business models and innovative funding, with over 90% of respondents indicating they 'strongly agree', or 'agreed' with this proposal. There are lower levels of support for government and State Owned Enterprises (SOEs) continuing to develop and maintain infrastructure, with only about 40% strongly supporting this. The concept of product-as-a-service also has lower support, with 30% of respondents confirming they strongly support this.

### 4.5 The Integration of Sustainable Technologies and Systems in Human Settlement Infrastructure

Figure 4 shows levels of support for different types of sustainable technologies and systems in human settlement infrastructure. Solid waste recycling, composting, ecological sanitation and sustainable urban drainage, are well backed, with 80% of respondents indicating they strongly support this technologies. Support for grey water systems, biogas, smart metering, ICT, safe walking and cycling routes and non-motorised transport is also promoted, with over 60% of respondents indicating they would strongly support these technologies and systems. The lowest levels of support are for rainwater harvesting, solar hot water systems, product-as-a-service and photovoltaic systems, with 40% of respondents indicating they would strongly support these systems.

### 4.6 Human Settlement Infrastructure Policy Statements

Figure 5 indicate levels of support for human settlement policy statements. There is strong support for policy statements on integrative and collaborative approaches, minimum standards and sustainable technologies and systems, and integrating infrastructure in line with standards in Integrated Development Plans (IDPs), with over 70% of respondents indicating they strongly support these. Levels of support for policy statements on product-as-a-service, Municipal Service Partnerships, innovative funding, and capacity development are lower and between 45-55% of respondents indicate they strongly support this. Overall, the results indicate strong support for all of the policy statements, with over 55% of respondents indicating that they 'agreed' or 'strongly agreed' with the policy statements. For several policy statements, such as statements on collaborative approaches, minimum standards, sustainable technologies and systems, support goes up to 100%, with all respondents indicating that they 'strongly agreed' or 'agreed' with these statements.

*Human settlement infrastructure guidelines will be developed based on the following principles:*

- *Minimum infrastructure standards for human settlements will be developed In discussion with relevant organisations such as the Departments of Transport, Water and Sanitation, Energy and COGTA.*
- *Standards will define minimum sustainability, affordability, and accessibility requirements.*
- *High-quality, sustainable infrastructure, technologies and systems will be used to achieve minimum standards. Examples include non-motorised transport, safe walking and cycling routes, ICT, photovoltaic, micro-grid, smart and connected technologies, biogas, solar hot water, rainwater harvesting, greywater, ecological sanitation, composting and solid waste recycling systems.*
- *Local government will plan for infrastructure in line with minimum standards and include this in Integrated Development Plans (IDPs).*
- *Municipalities will develop Municipal Service Partnerships (MSPs) with local communities and service entrepreneurs to develop and manage infrastructure within human settlements.*
- *Product-as-a-service models in which service entrepreneurs install and maintain systems, such as photovoltaic plants, solar water heaters and ICT networks, at their cost and receive fees for services used, will be promoted.*
- *Development Finance Institutions (DFIs) such as the DBSA will provide finance and technical support to entrepreneurs and communities wishing to develop infrastructure and provide services through the Municipal Service Partnership (MSP) model.*
- *The Department of Higher Education, LGSETA, TVET colleges and community-based organisations will work together to provide practical, accessible infrastructure development, management and maintenance training to build local capacity*

**Figure 1**. Draft Infrastructure in human settlements policy statements.

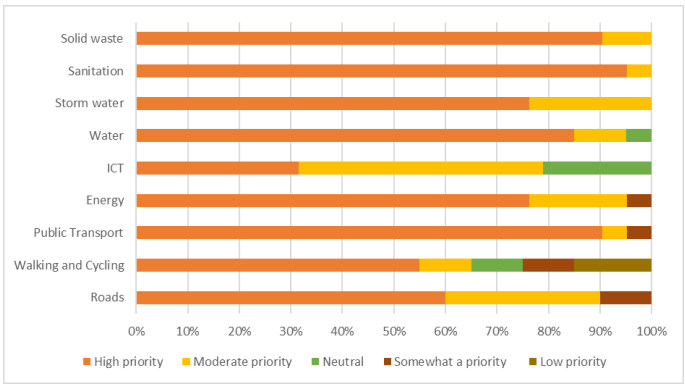


**Figure 2**. Levels of prioritisation are given to different types of infrastructure in human settlements.

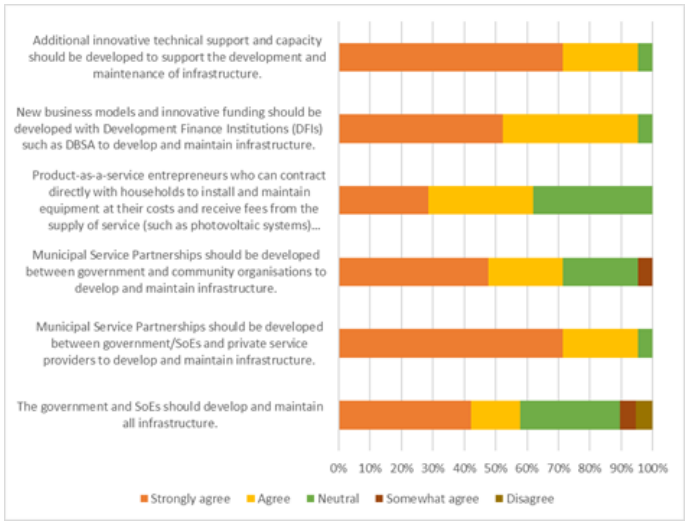


**Figure 3**. Levels of support for different infrastructure development and maintenance models in human settlement.

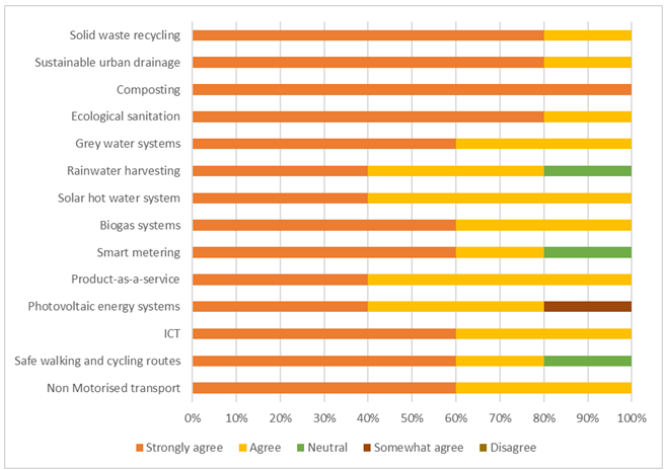


**Figure 4**. Levels of support given to different types of sustainable technologies and systems.

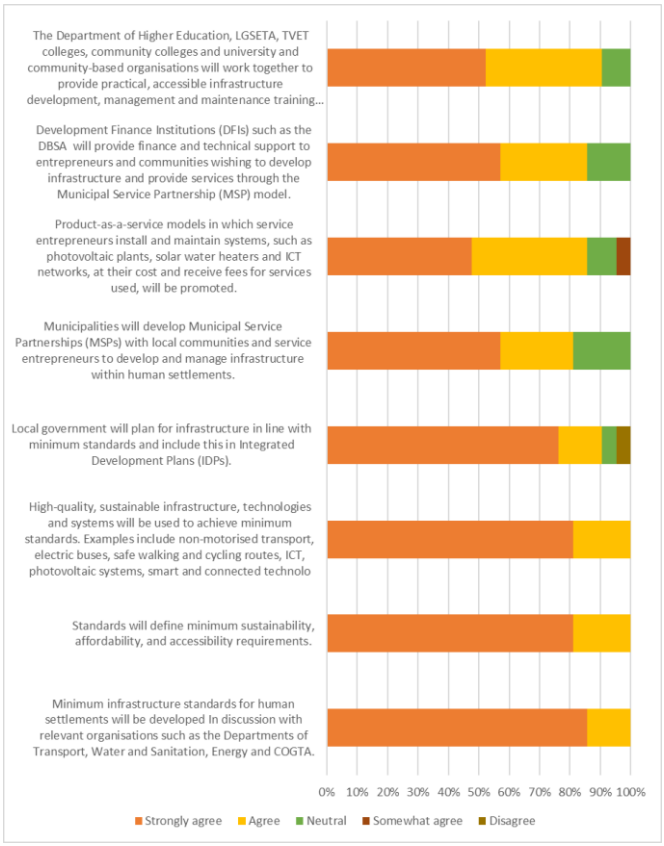


**Figure 5**. Prioritisation given to different types of infrastructure in human settlements.

## 5. DISCUSSION

The results indicate that over 60% of the respondents felt that all of the infrastructure elements identified in the study were a high or moderate priority. This suggests there is a strong awareness of backlogs and that the current infrastructure in many human settlements is inadequate and needs to be addressed. It is interesting to note that respondents gave the highest priority to public transport, solid waste management and sanitation.

There was also strong support for the alternative and innovative models proposed for developing and operating infrastructure, with 70% of respondents indicating that they strongly agreed that this was required. There was strong support for Municipal Service Partnerships and alternative finance and business models. Support for ‘business-as-usual’, with the government developing and operating infrastructure is low. This suggests that respondents have become disillusioned with current models and would like new models that may improve the delivery and operation of infrastructure in human settlements to be applied.

The results show that there is strong support for the introduction of sustainable technologies and systems in human settlement infrastructure. The strongest levels of support were for solid waste recycling, sustainable urban drainage, composting, and ecological sanitation. This prioritisation reflects recommendations made by Boadi et al. who suggest that informal settlement upgrading, waste recycling, urban agriculture and composting should be prioritised [6].

There is particularly strong support for policy statements on collaborative approaches, minimum standards and sustainable technologies and systems, where 100% of respondents indicating that they 'strongly agreed' or 'agreed' with these statements. Overall, the results suggest that respondents strongly supported all of the policy statements as over 55% of respondents indicated that they 'agreed' or 'strongly agreed' with the policy statements. This confirms that the policy statements appear to have identified the key infrastructure issues that were of concern to respondents. It also indicates that the way these issues were addressed aligns well with the respondent's views.

## 6. CONCLUSION AND RECOMMENDATIONS

The study aims to understand infrastructure priorities, models, technologies and systems for human settlements as input for the development of policy. It finds that there is a shared view that addressing infrastructure in human settlements is a high priority. The results indicate that there are concerns about all types of infrastructure in human settlements from roads and public transport to energy, water, sanitation and solid waste management systems. The data suggests that there may be a level of disillusionment with government delivery and operation of infrastructure in human settlements and there is a strong interest in alternative models. These models include the development of Municipal Service Partnerships, in which municipalities partner with other government departments, non-government and community organisations and the private sector to develop and operate infrastructure. The study also shows strong support for integrating more sustainable technologies and systems into infrastructure in human settlements. This includes strong support for solid waste recycling, composting, ecological sanitation and sustainable urban drainage systems (SUDs). Proposed policy statements that advocate a collaborative approach, the application of new models and sustainable technologies and systems and the development of capacity and new business models are also supported.

The results, therefore, suggest that the proposed policy statements developed in the study appear to address the right issues. They also suggest that the proposed approaches to tackling these issues are strongly supported. Based on these results, the study recommends that the policy statements developed for infrastructure in human settlements be incorporated in the new proposed Human Settlements White Paper.

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