



Economic infrastructure – the foundation of social and economic development

KEY POINTS

South Africa needs to maintain and expand its electricity, water, transport and telecommunications infrastructure in order to support economic growth and social development goals. Given the government's limited finances, private funding will need to be sourced for some of these investments.

The role and effectiveness of sector regulators needs to be reviewed. In addition to issuing licences and setting tariffs, regulators need to place more emphasis on stimulating market competition and promoting affordable access to quality services. This will require capacity-building in regulatory institutions.

Policy planning and decision-making often requires trade-offs between competing national goals. For instance, the need to diversify South Africa's energy mix to include more renewable energy sources, which tend to be variable in terms of production, should be balanced against the need to provide a reliable, more affordable electricity supply.

INTRODUCTION

South Africa needs to invest in a strong network of economic infrastructure designed to support the country's medium- and long-term economic and social objectives. This economic infrastructure is a precondition for providing basic services such as electricity, water, sanitation, telecommunications and public transport, and it needs to be robust and extensive enough to meet industrial, commercial and household needs.

South Africa has a relatively good core network of national economic infrastructure. The challenge is to maintain and expand it to address the demands of the growing economy. In the transport and energy sectors – dominated by state-owned enterprises –



the economy has already been constrained by inadequate investment and ineffective operation and maintenance of existing infrastructure. In the telecommunications field, policy and regulatory uncertainty and lack of capability remain barriers to infrastructure investment and to achieving affordable, quality services, especially for the poor. In the water sector, delaying critical investments may result in water shortages during a drought period.

There is some concern that the state does not have the institutional or financial capacity to implement the investment plans needed to finance infrastructure on the required scale. Other issues include the increasing cost of electricity, roll out of infrastructure to rural areas, the likely introduction of a carbon tax and the poor performance of some state-owned enterprises. Civil society has

protested against exploring shale gas in the Karoo and the envisaged nuclear-build programme, arguing that the government was focusing too much on infrastructure and too little on protecting South Africa's scarce resources, especially water.

The country needs to make large investments to propel economic activity. These investments need to be made in a structured, considered manner to prevent inappropriate initiatives, protect South Africa's resources and ensure that prioritised investments are efficiently implemented. Poor investment decisions commandeer the state's financial resources and hinder other important investments, ultimately constraining economic growth. Greater use of public-private financing is likely to bring about better decision-making and improved spending discipline, resulting in more rigorous assessment, shareholder accountability and reporting. These factors will, in turn, ensure easier access to capital.

Current investment levels are insufficient and maintenance programmes are lagging. The government needs to better coordinate collaborative investment by businesses and provincial and local government into key infrastructure projects, such as in the Waterberg/Lephalale region in Limpopo, at Coega in the Eastern Cape, and along the strategic freight corridor linking Gauteng and Durban. The formation of the presidential infrastructure coordinating committee goes some way towards achieving these goals.

Priority should be given to infrastructure programmes that contribute to regional integration. These include the African Union's north-south corridor and sector-specific projects such as enhancing border facilities, improving energy access and information and communications technology (ICT) connectivity, and revising transport links.

Programmes in underdeveloped regions, such as a proposed multipurpose development around a new dam on the Umzimvubu River, should also be prioritised since it could mobilise the natural resource advantages of an otherwise underdeveloped area.

State-owned enterprise performance may be improved by combining cooperation and competition. Mechanisms are also needed to ensure local industry remains regionally and globally competitive, while meeting domestic needs.

Access to basic electricity, water and sanitation, and public transport for many South Africans, particularly in poor rural and peri-urban communities, accessing electricity, safe water, sanitation, telecommunications and public transport is a daily challenge. Even where infrastructure is available, households can often not afford enough electricity and water to cook and stay warm, or the fares to go to town to look for work. These problems will only be resolved if their underlying causes are addressed. Most important among these are:

- Many households are too poor to pay the costs of services.
- Some municipalities are poorly managed or have limited human and financial resources to deliver services.
- In other municipalities, there is not adequate bulk infrastructure to supply all households with electricity and water services.
- Unrestrained use by some households leaves others with nothing.
- These causes are addressed by the following chapters of the plan:
- **Chapter 3** discusses how household incomes will be adequate to pay for services if there are jobs that pay enough. Where this is not the case, some form of subsidy must be available to ensure that people can access basic services.

This can be provided as a grant to the household or to the municipality to provide free services that meet people's basic needs.

- **Chapter 13** suggests ways in which municipal performance can be improved to ensure service delivery. It also suggests reviewing the way municipalities are funded and the levels of services they should provide in light of the difficulties that those serving mainly poor communities face. Where municipalities do not have the staff or the finances to provide services effectively, they should approach neighbouring municipalities, regional agencies, Eskom and their local water boards for help. They should also consider empowering local communities, particularly in scattered rural settlements, to run their own services.
- **Chapter 15**, which covers transforming society and uniting the country, discusses how communities can take action to improve their circumstances. In many places, uncontrolled water use by households at the bottom of the hill means that water never reaches those who live higher up. Similarly, uncontrolled electricity use from unmetered, unauthorised connections causes transformers to trip or burn out, cutting off whole communities. People need to come together to work out ways to maintain a fair share of services for everyone.
- **Chapter 8** addresses the need to properly locate and plan settlements. This can help improve access to adequate and affordable public transport, an area in which poor people carry an unfair burden that aggravates their poverty.

THE ROLE OF REGULATORS

While some network industries (such as power generation and ICT services) lend themselves to competition, core components such as the electricity grid itself, gas and water pipelines, and railway lines tend to form natural monopolies. With



high fixed costs and decreasing average costs of service provision as more customers join these networks, it is often difficult to stimulate meaningful competition or to encourage multiple market entrants. In such cases, effective economic regulation is essential.

Over the past two decades, independent regulatory authorities have been established worldwide to issue licences, ensure access to networks, set prices and establish technical and service standards. South Africa has dedicated regulatory agencies for electricity, gas and petroleum pipelines, telecommunications and ports. These regulators are tasked with safeguarding reliable and competitively priced services for consumers, while promoting affordable access for poor and remote households. They are supposed to ensure that utilities and operators, are efficient and financially viable so that they can invest in maintaining, refurbishing and extending their networks.

After more than 15 years of sector regulation, it is fitting to analyse the effectiveness of these regulators. Although regulators have succeeded in issuing licences, developing pricing methods and establishing technical and service standards, they have not achieved the positive outcomes initially envisaged. Based on the performance of the ICT, electricity and port sectors, South Africa is slipping down international benchmark rankings. The reliability of electricity supply has deteriorated and prices that were previously below economically viable levels are now climbing at rates that consumers are unable to absorb. Communications quality, speed and cost are significantly worse in South Africa than in comparable nations, with a similar situation in rail and port performance.

Regulators are confronted by two challenges: first, to make sure that there are adequate levels of investment to ensure customers get reliable

services, and second, to ensure that pricing levels are managed in a way that creates certainty and mitigates against shocks. This requires:

- A closer working relationship between regulators, utilities and government departments
- Better management of financing requirements through economically viable pricing levels
- A greater climate of certainty and an avoidance of economic shocks.

The institutional arrangements and design of network regulators is being reconsidered. Regulation works best where there is sufficient political will to support it; where regulators are legally independent, publicly accountable and their decision-making is transparent, and where the regulator is backed by adequate institutional, and human capacity. South Africa faces challenges in all these areas. As a result, it makes sense to initially restrain the regulatory agencies' decision-making discretion while their institutional design is reviewed, their roles and accountabilities are clarified and the related legislation and subsidiary regulations are updated.

Improved regulatory performance is vital for national development. Capacity building remains a core challenge, requiring sustained training to improve leadership and technical capabilities. The quality of regulation, however, is not just about the regulator. The state itself must have adequate capacity and capability to formulate effective policies; support the design, establishment, review and improvement of regulators; and respond to issues identified by capable regulators. A capable state (chapter 13), with functioning, well-run utilities, departments and municipalities, will help ensure efficient regulation.



Proposals to improve regulation

The following is proposed for the immediate future:

- Institute a far-reaching review of current infrastructure regulators to clarify roles, strengthen accountability, update legislation and regulations, and reform institutional design.
- Explore the possibility of further consolidation of regulators.
- Establish a monitoring and evaluation unit in the Presidency to undertake periodic regulatory impact reviews and provide advice and support to regulatory authorities.

THE ENERGY SECTOR: EMPOWERING SOUTH AFRICA

The plan envisages that, by 2030, South Africa will have an energy sector that promotes:

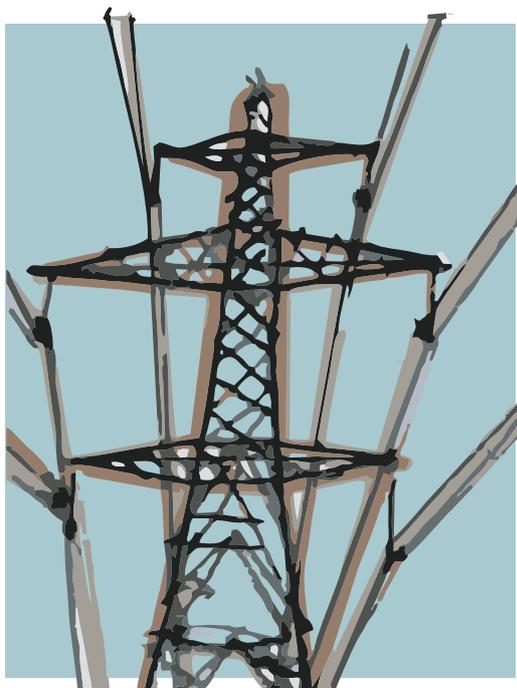
- Economic growth and development through adequate investment in energy infrastructure. The sector should provide reliable and efficient energy service at competitive rates, while supporting economic growth through job creation.
- Social equity through expanded access to energy at affordable tariffs and through targeted, sustainable subsidies for needy households.
- Environmental sustainability through efforts to reduce pollution and mitigate the effects of climate change.

More specifically, South Africa should have adequate supply security in electricity and in liquid fuels, such that economic activity, transport, and

welfare are not disrupted. Prices for energy are likely to be higher in future, but they will still be competitive compared with South Africa's major trading partners. In addition, more than 90 percent of the population should enjoy access to grid-connected or off-grid electricity within 20 years.

To realise this vision, South Africa's energy system needs to be supported by effective policies, institutions, governance systems, regulation and, where appropriate, competitive markets.

The plan sets out steps that aim to ensure that, in 20 years, South Africa's energy system looks very different to the current situation: coal will contribute proportionately less to primary-energy needs,



while gas and renewable energy resources – especially wind, solar and imported hydroelectricity – will play a much larger role. Public transport will be highly developed and imported hybrid and electric vehicles will be more widely used. The economy's energy intensity will continue to decline and energy-efficient options will be widely available and increasingly adopted. The

country's energy market will be more diverse, with greater opportunities for investors to provide innovative, sustainable energy solutions within credible and predictable regulatory frameworks.

The energy reality

South Africa is very dependent on coal. It is the country's largest economically recoverable energy resource and among its three top mineral export earners. Internationally, South Africa ranks fifth as a

South Africa has a mixed-energy economy, with varying patterns of state ownership and regulation across subsectors. The electricity sector is dominated by the vertically integrated state-owned utility Eskom (accounting for 96 percent of production) and is regulated by the National Energy Regulator of South Africa, which is also responsible for the regulation of gas and petroleum pipelines.

Private petroleum companies (with the exception of PetroSA) dominate the liquid fuels sector, and wholesale and retail prices are regulated. In contrast, coal prices are deregulated and the industry is privately owned. Private firms produce uranium, although the country's only nuclear power plant is owned by Eskom. There is a nuclear regulator (mostly addressing safety and licensing issues) and the National Ports Regulator. Through Transnet, the state also owns and operates most of the ports (except the Richard's Bay Coal Terminal and some private terminal concessions), the national rail network and the petroleum pipelines that transport petroleum crude and product to Gauteng and surrounding inland areas.

coal producer and exporter. Domestically, coal is used to produce:

- Over 70 percent of primary energy
- More than 90 percent of electricity
- A third of liquid fuels.

As a result, South Africa is a significant emitter of carbon dioxide, which contributes to climate change. Domestic electricity has historically been underpriced, resulting in mining houses investing in energy-intensive beneficiation processes. Energy intensity is one and a half to four times higher than the Organisation for Economic Cooperation and Development average (depending on whether gross domestic product is measured in nominal or purchasing-power parity terms).

Adequate supply is a key concern, especially for electricity and liquid fuels. South Africa experienced multiple power failures between 2005 and 2008, resulting in lower economic growth and widespread inconvenience. Even though the 2009 recession depressed demand, the supply-demand

balance remains tight. Similarly, the distribution of petrol, diesel and gas has not always been reliable. The prices of paraffin, liquefied petroleum gas and alternative household fuels (including biomass and renewable energy sources) are far from optimal, even though paraffin and liquefied petroleum gas prices are regulated. Too many households rely on costly inferior fuels that also pose health risks.

The quality of market competition and regulation in the energy sector has been far from optimal. The economy requires:

- Increased competition in electricity generation
- Better regulation of price, supply and quality of electricity and petroleum products
- An end to crippling transport constraints due to ineffective policy-making and regulation, especially rail. Lack of rail capacity has constrained delivery of coal to power stations as well the expansion of coal exports. The export capacity of the privately owned Richard's Bay Port is a third higher than the existing rail capacity from the coalfields.



Perhaps the most successful achievement in the energy sector over the past 15 years has been the National Electrification Programme. In the early 1990s, two out of three South Africans did not have electricity; now about three quarters of the population have access.

Key policy issues and planning priorities

South Africa needs to devise policies and plans for the following in order to improve the country's energy situation:

- Growth in coal exports needs to be balanced against the need for domestic coal-supply security.
- Gas should be explored as an alternative to coal for energy production.
- There needs to be a greater mix of energy sources and a greater diversity of independent power producers (IPPs) in the energy industry.
- Municipal electricity-distribution services need to be improved.
- Electricity pricing and access need to accommodate the needs of the poor.
- The timing and/or desirability of nuclear power and a new petrol refinery need to be considered.

These issues are addressed in detail below. This is followed by a discussion on integrated energy planning, policy trade-offs and phasing considerations to 2030.

Balance domestic coal supply security with growth in exports

Given fixed investments and low direct costs, coal will continue to be the dominant fuel in South Africa for the next 20 years. A national coal policy that takes into consideration South Africa's realistic coal reserves, the need for a sustainable supply of domestic coal for power, synthetic fuels and industrial chemicals, and the need to expand the

coal export market, is urgently required. The coal industry's development has been constrained in recent years due to regulatory uncertainty in the mining sector, too little investment in new infrastructure and a failure to maintain existing infrastructure. The policy needs to take the following into consideration:

- The changing coal-mining landscape
- The need for greater collaboration
- The need to ensure security of domestic coal supply while promoting export
- Technologies that may provide for cleaner coal use.

Rail Infrastructure For Coal

Coal reserves are declining in some areas and new ones are coming on-stream elsewhere. Two thirds of South Africa's coal reserves and resources are in the Waterberg. As coal reserves in the central basin diminish, a new heavy haul rail corridor to the Waterberg coalfield in Limpopo will need to be developed within an overall infrastructure-investment plan that also addresses additional water supplies for the Lephalale area.

Transport infrastructure for the central coal basin and the coal line to Richard's Bay also needs strengthening to match port export capacity of at least 91 million tons per year by 2020. Other possibilities include a link with Botswana coal deposits and a trans-Kalahari rail connection, linked to expanded port capacity at Walvis Bay in Namibia and/or a further rail loop around to Maputo. Private-sector participation will be essential to relieve the rail infrastructure investment burden.¹

Improved collaboration

Formal structures need to be established to foster collaboration between the government, Eskom, Transnet, Sasol, IPPs and the coal industry to optimise domestic coal use while maximising coal exports. Collaboration in the development of the

original railway from the central basin to Richard's Bay and the development of the Richard's Bay Coal Terminal offers a valuable lesson.



Collaboration is also needed to address the fragmentation that has accompanied black economic empowerment in the coal industry. Few smaller companies have the financial muscle to sign long-term take-or-pay contracts to motivate Transnet to invest in railway-line expansion. The government and private sector should work together to resolve this impasse and maximise economic value from this industry. One option is the creation of an inland coal market with appropriately located coal hubs that would gather and then supply domestic and export markets.

Ensure security of local coal supply while promoting exports

Changes in coal export markets are resulting in new challenges in securing coal for Eskom's power stations. Historically higher grade coals were

exported and lower grades were sold to Eskom. However, countries such as India are accepting lower grade coals and Eskom has been struggling to conclude new long term coal supply contracts. Washing coal to export quality also produces middlings (i.e. the middle, lower grade fraction) for Eskom. One of the problems is that if coal is washed to lower export quality (e.g. for India) less middlings are produced, also often at a lower quality. And mines are increasingly looking for higher prices for these middlings. This has led to calls for restriction of lower grade coal exports or the imposition of export permits

However, government should be cautious in applying policy measures which might have unintended consequences. For example, banning exports of coal lower than, say 5500 kcal/kg, could disincentivise investments in new multi-product mines necessary for supplying future Eskom demand, but which also depend on export earnings for their financial viability. Most of the higher grade coals in the central basin have been mined out and new mines have to deal with lower quality resources.

Rather the best initial approach should be to facilitate a win-win solution between Eskom and the Coal Miners. And this is entirely possible as the highest value option for most mines is an income stream from both exports and Eskom. Eskom, the coal miners and government need to work together to plan the optimal utilization of specific fields. The framework for this cooperation potentially exists in the Coal Road Map exercise. The National Planning Commission could also use its convening power to help resolve these issues.

If cooperation fails, then government still has the option under the security of supply provisions in the National Energy Act (2008) to "direct any state-owned entity to acquire, maintain, monitor and



manage national strategic energy feedstocks and carriers.”

The other critical intervention is the opening of the Waterberg field, as mentioned above. The latest resource and reserve estimates indicate much larger resources than previous studies. The Waterberg field yields a relatively small export fraction and a much larger Eskom fraction. New mines there are only viable if they also supply Eskom.

Innovation and technology for cleaner coal use

There is potential to increase the efficiency of coal conversion, and any new coal power investments should incorporate the latest technology. As the existing fleet of old coal-fired power stations is replaced, significant reductions in carbon emissions could be achieved. Cleaner coal technologies will be supported through research and development and technology-transfer agreements in ultra-supercritical coal power plants, fluidised-bed combustion, underground coal gasification, integrated gasification combined cycle plants, and carbon capture and storage, among others.

Gas as an alternative to coal

Substituting gas for coal will help cut South Africa's carbon intensity and greenhouse gas emissions. Possibilities include off-shore natural gas, coal-bed methane, shale gas resources in the Karoo basin and imports of liquefied natural gas, which could be used for power production, gas-to-liquid refineries and other industries.

Off-shore natural gas

New natural gas resources – enough to power at least a medium-sized power station – have been discovered off the West Coast. Further drilling may indicate that the resource is larger. The

resource should be developed for power production in a phased way. Initial units will contribute to supply security, while encouraging further drilling and development.

Regionally available natural gas could either be piped to South Africa, for example from Namibia (recent finds in Mozambique are probably too far north to pipe economically), or it could be used in regional power plants with electricity transmission lines to South Africa.

Coal-bed methane gas

Experiments are under way to assess the potential for mining coal-bed methane gas, although the overall potential of this resource for producing electricity in South Africa is probably less than previously thought. Underground coal gasification technology is also being developed.

Shale gas

According to the United States Energy Information Administration, technically recoverable shale gas resources in South Africa form the fifth largest reserve globally. Confirmation of recoverable reserves is still necessary through further drilling of test wells. Even if economically recoverable resources are much lower than currently estimated, shale gas as a transitional fuel has the potential to contribute a very large proportion of South Africa's electricity needs. For example, exploitation of a 24-trillion-cubic-foot resource will power about 20 gigawatts (GW) of combined cycle gas turbines, generating about 130 000GW-hours (GWh) of electricity per year over a 20-year period.

This is more than half of current electricity production. South Africa should seek to develop these resources, provided the overall economic and environmental costs and benefits outweigh those associated with South Africa's dependence on coal, or with the alternative of nuclear power. The

national value of this resource needs to be maximized.

Liquefied natural gas

A global market has developed for liquefied natural gas imports, the prices of which are increasingly delinked from oil prices. With South Africa needing to diversify its energy mix, liquefied natural gas imports and the associated infrastructure could provide economic and environmentally positive options for power production, gas-to-liquids production (at Moss gas) and other industrial energy uses.

Required infrastructure to re-gasify liquefied natural gas is becoming more affordable, with some ships incorporating these regasification capabilities onboard, combined with local submersible docking and pipeline facilities to deliver gas onshore. Investment should begin in liquefied natural gas infrastructure.

Diversify power sources and ownership in the electricity sector

The elements addressed below relate to reducing the carbon intensity of power sources, and the need to increase private participation and investment in this field.

Balancing supply security, affordability and climate-change mitigation

South Africa will need to meet about 29 000 megawatts (MW) of new power demand between 2012 and 2030. A further 10 900MW of old power capacity will be retired. As a result, more than 40 000MW of new power capacity needs to be built. Eskom's current committed capacity expansion programme will see more than 10 000MW of new generating capacity added to the existing system. However, there is still a clear gap between future needs and committed infrastructure investments.

Power generation plants contribute about half of South Africa's current greenhouse gas emissions. If the sector follows the proposed carbon emissions scenario of peak, plateau and decline, the balance of new capacity will need to come from gas, wind, solar, imported hydroelectricity and possibly a nuclear programme from about 2023. Programmes to curb demand will also be necessary.

The Department of Energy's Integrated Resource Plan 2010-2030 lays out these options in a policy-adjusted scenario that seeks a trade-off between least-cost investment, technology risks, water-use implications, localisation and regional imports. The plan calls for 21 500MW of new renewable energy capacity to be in place by 2030. International





bidding rounds have already been held to fast-track renewable energy procurement with positive outcomes in terms of falling prices and substantial new private investment

Further refinements and regular updates of the Integrated Resource Plan will be necessary to track demand (which could be lower because of energy-efficiency gains or a sluggish economy, or higher if economic growth accelerates) and to assess whether new generation technologies are delivering timely and affordable power. To ensure supply security, a back-up plan with flexible, incremental and rapidly implementable response measures is required. Planning capability needs to be vested in the independent system and market operator (ISMO). Improved data collection, stakeholder involvement and publication systems will be necessary for more effective planning.

Increasing diversity in South Africa's energy-production mix is important to mitigate climate change while enhancing supply security. For example, combined cycle gas turbines – a cleaner and less capital-intensive technology than coal-fired power stations – can be used to improve supply security by flexibly picking up any shortfall in supply from renewable energy sources. Developing the southern African region's hydroelectric resources, first in countries such as Zambia and Mozambique, is also a priority.

Botswana, Zimbabwe and Mozambique have considerable undeveloped coal reserves. The Southern African Development Community has very low per capita carbon emissions and these resources could be used for regional power production, providing considerable economic benefits. There is thus a prospect for accelerated economic development based on enhanced inter-regional electricity trade.

Diversifying South Africa's power mix will also require enhanced investments in transmission infrastructure and control systems.

South Africa's quest for a lower carbon-emitting power sector needs to be balanced against the potentially higher costs and variable supply that come with new and renewable energy. The costs of renewable-energy technologies, such as solar, are falling, but they are still higher than conventional power technologies. Recent local renewable energy bidding rounds attracted solar prices two or three times that of coal-fired electricity.

Ultimately, South Africa's electricity plan needs to balance increased use of new and renewable energy technologies with established, cheaper energy sources that offer proven security of supply. As South Africa seeks an appropriate balance between responding to climate-change concerns and employing least-cost power-generation technologies to propel economic growth, it will adopt a least-regret approach. South Africa needs to remain competitive throughout the transition to a low-carbon future.

Widen participation and accelerate investment in electricity sector

South Africa needs a clear policy that makes explicit the electricity market structure and how it will evolve over time. New build opportunities need to be clearly divided between Eskom and IPPs. It is also important to employ effective procurement processes that initiate timely, internationally competitive bidding for new capacity and negotiate robust contracts. The government, with the cooperation of Eskom, needs to quicken its plans to establish an independent system and market operator. This operator should be tasked with procuring and contracting IPPs and, preferably, managing transmission assets. Remaining regulatory uncertainties that need to be resolved include the

question of IPPs selling to customers other than Eskom, access to Eskom's grid and rights to trade electricity.

Effort must be made to maximise debt-raising on capital markets for Eskom, backed where necessary by sovereign guarantees. However, private investment will be needed to augment public initiatives.

Improving electricity distribution

A reliable electricity supply depends on sufficient generating capacity coupled with a dependable transmission and distribution grid. Municipalities distribute about half of South Africa's electricity, with increasing local supply failures. Previous government policy required that municipal distribution assets be transferred to six new regional electricity distributors. Little progress has been made on this in the past 10 years, not least because a constitutional amendment shifting responsibility for electricity distribution from local to national government was abandoned in the face of increasing opposition. During this policy hiatus, municipal investments in infrastructure have been inadequate, with maintenance and refurbishment backlogs now exceeding R35 billion.

Proposals to address the problem are:

- **Invest in human and physical capital in the 12 largest municipal distributors**, which account for 80 percent of the electricity distributed by local government. This is a high-priority programme that needs to be driven at national level in collaboration with these municipalities. In addition, Eskom, or larger cities or towns, could take over electricity distribution functions on a voluntary basis from smaller, poorly performing municipalities. Medium-sized municipalities, performing reasonably, could continue with delivery.

- **Improve governmental support for**

combating illegal use. Electricity theft, through illegal connections and tampering of meters, is becoming an increasing problem, as is theft and vandalism of electricity cables and transformers. Eskom and municipalities are currently losing billions of rand annually. The government needs to support the electricity industry in this struggle by running a high-profile, well-resourced programme that publicises the negative effects of theft and vandalism on service delivery and encourages community-based approaches to address these issues.

- **Improve demand-side management.** The next 20 years will see smarter management of electricity grids through innovative control systems and smart meters. This will open opportunities for more distributed generation systems, both to meet local demand and to feed back into the grid.

Electricity prices

Electricity prices will have to increase to cost-reflective levels if Eskom is to be able to service its debt and fund effective operations, refurbishment and system expansion. The government is probably close to the limits of the fiscal and guarantee support it can give Eskom (given other huge infrastructure needs plus ongoing social imperatives). Eskom's access to private debt is also becoming more difficult and expensive.

There is, however, concern that a sharp price increase could dampen economic growth and development. The challenge is to find ways to stagger the pace of price increases. Investments in generation plants and transmission and distribution networks are typically capital-intensive and lumpy. Management of debt-to-equity and interest cover ratios often requires steep price increases. However, after the majority of the debt is amortised, utilities could receive significant free cash flows.



A number of related pricing issues need to be addressed:

- The regulator can **establish appropriate mechanisms to prefund capital and create a smooth price path over a longer term** so that consumers face more predictable and manageable price increases. (There are lessons in the way the Trans-Caledon Tunnel Authority smoothed water tariffs for the Gauteng area).

- **Widen access to reduced tariffs for low-income families.** Free basic electricity and cross-subsidised tariffs are already available for many low-income households. However, these need to be applied more consistently and comprehensively to shield poor consumers from high price increases. Since the costs of these subsidies will become significant in future, any increases in their level, and any proposals for a new subsidy mechanism, should be carefully assessed as part of a local government fiscal review.

- **Introduce carbon pricing with appropriate conditional exemptions.** The purpose of a carbon tax is to change investment behaviour away from carbon-intensive power generation technologies. However, given the structure of South Africa's electricity market, this is unlikely to occur without additional measures. The regulator and Eskom will be forced to pass the additional costs of a carbon tax directly to captive consumers, who do not yet have the choice of alternative, cleaner electricity supplies. The Integrated Resource Plan already incorporates a shadow carbon price: higher-cost renewable energy technologies were forced into the plan in order to reach carbon-emission mitigation targets. External factors are thus beginning to be internalised in the electricity price through the "policy-adjusted" plan.

Nevertheless, it may still make sense to have an economy-wide carbon tax, coupled with

conditional exemptions in some sectors (or rebate or recycling schemes), to send a broad signal to the industry and consumers that they are living in a carbon-constrained world. To achieve meaningful shifts in technologies for electricity generation, it is important that this tax is introduced alongside direct low-carbon policy actions. A conditional carbon tax exemption could be applied to the electricity sector, provided it progressively moves to a lower carbon generation mix, as mandated in the Integrated Resource Plan. This would significantly increase renewable energy and diversify generation sources.

National electrification and energy poverty

The energy needs of poor households are still inadequately met. Between a fifth and a quarter of South Africans still have no access to the grid. The electrification programme has slowed (annual connection rates are now half of those a decade ago) and the original goal of universal access by 2014 is not feasible. The following interventions are proposed:

- A thorough review of targets, planning, technology choices, funding and implementation.
- Subject to costs, South Africa could aim for at least 90 percent grid connection by 2030, with alternative off-grid options offered to the remaining households for whom a connection is impractical.

Develop integrated programmes to tackle energy poverty by building on research done since the 1990s around household energy use. Even poor households with access to electricity can afford to use only modest amounts and rely on other sources such as paraffin, gas and fuel wood. An integrated programme could include sustainable production of fuel wood and its safe combustion in efficient stoves in rural areas.

Reassess the timing and/or desirability of nuclear power and a new petroleum refinery

Nuclear power

○ According to the Integrated Resource Plan, more nuclear energy plants will need to be commissioned from 2023/24. Although nuclear power does provide a low-carbon base-load alternative, South Africa needs a thorough investigation on the implications of nuclear energy, including its costs, financing options, institutional arrangements, safety, environmental costs and benefits, localisation and employment opportunities, and uranium enrichment and fuel-fabrication possibilities. While some of these issues were investigated in the IRP, a potential nuclear fleet will involve a level of investment unprecedented in South Africa. An in depth investigation into the financial viability of nuclear energy is thus vital. The National Nuclear Energy Executive Coordinating Committee (NNEECC), chaired by the Deputy-President, will have to make a final "stop-go" decision on South Africa's nuclear future, especially after actual costs and financing options are revealed.

○ South Africa needs an alternative plan – 'Plan B' – should nuclear energy prove too expensive, sufficient financing be unavailable or timelines too tight. All possible alternatives need to be explored, including the use of gas, which could provide reliable base-load and mid-merit power generation through combined-cycle gas turbines. Gas turbines can be invested in incrementally to match demand growth. While their operational costs are arguably higher than those of nuclear stations, their unit capital costs are cheaper, they are more easily financed and they are more able to adjust their output to make up the shortfall from variable renewable energy sources.

○ The development of shale gas resources, if available, will still take some time. In the meantime,

West Coast gas resources should be developed and investments should be made in liquefied natural gas import infrastructure as insurance for the future.

Petroleum refinery

○ South Africa produces about 5 percent of its fuel needs from gas, about 35 percent from coal and about 50 percent from local crude oil refineries. About 10 percent is imported from refineries elsewhere in the world. South Africa has a sizeable capital stock and management capacity to produce fuel from gas.

○ The country faces several related pressures around liquid fuels over the next decade. Refined fuel products are needed to run the economy and much of the demand is on the Highveld, far from the coast. South Africa also needs to improve the standards of fuels used, for health reasons and to accommodate more efficient engines that will reduce fuel demand and carbon emissions. At the same time, undue fuel-price increases should be avoided, as they will negatively impact the economy.

○ South Africa faces the following specific challenges in the liquid fuels sector:

○ Gas stocks for the existing gas-to-liquids plant from off-shore fields are declining. South Africa should source sufficient feedstocks to support – and, ideally, increase – production. If there are no feedstock constraints, the Mossgas plant will be able to increase its production by about a third through major new investment. There are several options to secure feedstocks:

○ Invest in gas fields close or adjacent to existing fields in the southern Cape. This is the best option, as marginal costs are lower. This will also allow further exploitation of existing fields, maximising use of existing capital. PetroSA is best placed to lead this



FIG 4.1 EACH OPTION HAS DIFFERENT ADVANTAGES AND DISADVANTAGES AS INDICATED IN THE TABLE BELOW:

Options	Advantages	Disadvantages
New oil-to-liquid refinery e.g. Mthombo at Coega	-A degree of fuel security -The capacity to export -Industrial externalities (especially in plastics) arising from the concentration of refining capacity and expertise -Potential to move to cleaner fuel standards more quickly, and at lower cost.	-South Africa would probably have to export the surplus product at a loss (or with local fuel users subsidising exports). -The size of the project leads to increased risk – and the potential for significant macroeconomic implications (this would need to be about 400 barrels per day, to achieve economies of scale). -A greenfields site will need to be found in Durban – or the product will need to be transhipped from Coega to Durban, and then piped to Johannesburg, increasing costs. -Some existing refineries may need to be closed, risking loss of skills and managerial know-how.
New coal-to-liquid plant	-Would allow for use of indigenous and abundant feed stocks -Scale makes 80 000 barrels per day feasible - South Africa has technology and managerial expertise in this area.	-The process is heavily carbon intensive – and with a carbon tax of US\$25 a ton, the economics look less favourable. -It is a large capital-intensive investment in a capital-constrained country. -This will require significant government subsidies, either directly or indirectly.
Upgrade existing refineries	- Will use the present oil companies' capacity and skills set -Will allow South Africa to keep Durban as a petrochemicals hub -Will lower costs, due to new pipeline in Durban -The risk is largely borne by the private sector.	-Durban is a densely populated city – and there are already environmental concerns about the site. -Oil companies will want to pass both risks and costs on to the public sector and/or consumer. -The space for a major upgrade may not exist. -
Import refined product	-Refining margins are low at present, so this option is cheaper. -This will not consume significant capital, in the context of current capital constraints.	Fuel security is lower with this option, given dependencies. -If refining margins rise quickly, the import bill and current account deficit will be negatively affected.
Partner with Angola or Nigeria	-These countries need refined products and have the input products. -South Africa will co-finance, thereby sharing risks.	-Political risk associated with these options is high. -The cost of building in these countries is high, given limited skills, infrastructure and poor governance.

investment, given its existing capital and its management experience.

- ⊙ In the longer term, the Mossel Bay Refinery could use either liquefied natural gas imports or Karoo shale gas, if it becomes available.
- ⊙ Refining capacity has run out and South Africa now has to import a share of its refined fuel needs. There are five options to deal with this:
 - ⊙ Build a new oil-to-liquid refinery (for

example the proposed Mthombo project in Coega)

- ⊙ Build a new coal-to-liquid refinery
- ⊙ Upgrade the existing refineries, allow significant expansion of one or more of the existing refineries or do both
- ⊙ Import refined product
- ⊙ Build a refinery in Angola or Nigeria and buy a share of the product of that refinery.

- Each option has different advantages and disadvantages, as indicated in Fig.4.1.

The least risky and most cost-effective option is to continue importing a share of refined product until the country reaches a stage where it can absorb the output of either a new refinery or a major upgrade of an existing refinery. South Africa will therefore continue to import, taking a decision on the next step by 2016 or 2017 at the latest. Timing is important, given lead-time requirements to develop a new refinery (estimated at about eight to 10 years) that would be expected to produce output by 2025 to 2028 (if no other options are implemented). The decision will need to consider fuel security, employment, the current account, the rand, interest rates, fuel standards and competition.

Other issues related to liquid fuels:

- **Clean fuel standards:** Health issues and the advent of new, more efficient automobile engines mean that South Africa needs to migrate to international clean fuel standards. This requires major investment in upgrades and conversions of existing refineries at a time when the major oil companies are increasingly selling-off refinery assets. A mechanism has to be found to fund these upgrades. This issue is also linked to the decision around a new, modern refinery investment, which would meet these new standards.
- **Biofuels** are also a possibility in the future, but because South Africa is largely a dry country, production is likely to be located in the southern Africa region.
- **Vehicle Carbon Tax:** If South Africa adopted a consistent carbon price across the economy, and this price was around R100/t carbon, it would translate into an increase of only 5 per cent at the pump (compared to 20 per cent for the electricity sector), thus sending only a weak signal to consumers to conserve petrol or diesel. A much

more effective instrument would be a tax on vehicle sales based on their carbon-emission signatures. Such a tax would encourage consumers to opt for more fuel-efficient vehicles, thus saving liquid-fuels-based emissions.

- **Electric vehicles:** Over the next 20 years, South Africa can expect to see greater use of electric vehicles, making it even more vital that we start decarbonising electricity generation. We shall also encourage a shift to greater use of public transport, as outlined in the transport section of this chapter.

Integrated energy planning

The energy sector is primarily organised along individual supply industries. It is therefore necessary and useful to outline actions needed in these specific sectors. However, fuels may be substituted and demand-side measures have the potential to substantially reduce their consumption.

South Africa's approach to energy planning needs to become more holistic and integrated. It is difficult for the Department of Energy, on its own, to deal effectively with cross-cutting issues, which encompass institutional capacity, governance, competition, regulation, investment, spatial planning, linkages to transport, water and ICT infrastructure and economic, social and environmental impacts. The Commission can assist the DoE in defining various policy, scenario and planning options and is willing to play a facilitating role between relevant stakeholders.

Trade-offs

Trade-offs to consider when deliberating South Africa's future energy mix includes the need to:

- Balance the need for a lower carbon-intensive power-generation mix (which implies adopting higher cost and variable renewable energy



technologies) with the need for competitive electricity prices and a reliable electricity supply, which are essential for economic growth.

- Balance the need for a less energy and carbon-intensive economy with the need to take advantage of the country's mineral resources. South Africa has to explore credible ways to improve the energy efficiency of mining and minerals processing while expanding mineral extraction, beneficiation and exports. A reasonable trade-off seems possible. As stated in the chapter 5 on transitioning to a low-carbon economy, recent research indicates that the total carbon emissions from mining and producing gold, platinum-group metals, coal, iron, steel, ferro-alloy metals and aluminium (including onsite emissions and those embedded in associated electricity use) are lower than often assumed – about 15 percent of South Africa's total national carbon emissions. Projections indicate that emissions from these sectors will not grow much and may even decline due to structural changes and less carbon-intensive electricity production.
- Balance state ownership of energy enterprises with effective regulation and market reforms needed to stimulate competition and achieve greater private-sector involvement.

Phasing

The steps needed to move to a different energy context by 2030 are outlined below. They are grouped according to short-, medium- and long-term priorities.

Short term

Over the next five years, South Africa needs to:

- Develop a national coal policy and investment strategy based on a realistic estimate of coal reserves, the sustainable supply of coal for domestic needs and the sustainable expansion of coal-export markets within the context of diminishing carbon

intensity. The government further needs to forge a compact with coal-industry leaders to secure coal for domestic energy-production needs.

- Invest in a new heavy-haul rail corridor to the Waterberg coalfields in Limpopo. This should form part of an integrated infrastructure investment plan for the Lephalale area that addresses, among other factors, the additional water supplies needed.
- Strengthen rail infrastructure in the central coal basin and the coal line to Richard's Bay. The government will broker a partnership between Transnet and the private sector for these projects.
- Do exploratory drilling for economically recoverable coal seam and shale gas reserves. Full investigations into whether the use of these resources is possible will continue, taking into account environmental implications.
- Develop West-Coast off-shore gas for power production by contracting private-sector service providers.
- Promote investment in liquefied natural gas landing infrastructure.
- Commission Eskom's Medupi coal power station and Ingula pumped-storage plant. In addition, at least 3 725MW of renewable energy will be contracted from the private sector.
- Pass the Independent System and Market Operator Act, after which Eskom's system operator, planning, power procurement, purchasing and contracting functions will be transferred to an independent state-owned enterprise. Eskom's transmission assets should also be transferred to this entity. The independent operator's mandate will include procuring and contracting IPPs, including those able to provide renewable energy.

- Amend the National Energy Regulator Act (2004) and the Electricity Regulation Act (2006) to ensure a more efficient and predictable regulatory environment.
- Ring-fence the electricity-distribution businesses of the 12 largest municipalities, representing 80 percent of municipal distribution, and resolve their maintenance and refurbishment backlogs. Develop a financing plan for these municipalities that takes into consideration the need to invest in human capital.
- Develop a sustainable national electrification plan.
- While the decision has been taken in principle, further and more in-depth investigations are needed into the implications of greater nuclear energy use, including the potential costs, financing mechanisms, institutional arrangements, safety, environmental costs and benefits, localisation and employment opportunities, and the possibilities of uranium enrichment and fuel fabrication. The National Nuclear Energy Executive Coordinating Committee will make a stop-go decision after actual costs and financing options are revealed.
- Agree on a funding mechanism for upgrading of existing refineries to ensure they meet new fuel-quality standards. Imports will continue, ensuring that the growing deficit in petroleum products is met. Petroleum refiners and importers will hold stocks of sufficient size to ensure supply security.
- The Commission will work with the Department of Energy on an interdepartmental process to develop and regularly update integrated energy plans. Integrated Resource Planning capabilities (for the electricity sector) will be institutionalised in the Independent System Operator.

- Introduce a vehicle point-of-sale carbon tax based on their carbon-emission levels. This would encourage consumers to opt for more fuel-efficient vehicles, cutting emissions from liquid fuels.

- Encourage greater use of hybrid or electric vehicles and public transport. A shift to electric vehicles will increase electricity demand and will have implications for network design, smart-metering and tariff structures that encourage off-peak use. Greater use of public transport will also be encouraged, as outlined in the transport section of the plan.

Medium term

By 2020, it is envisaged that:

- Coal rail capacity will match coal export port capacity at Richard's Bay (at least 91 million tons per year).
- The Kusile coal-fired power station will be commissioned and at least 7 000MW of renewable energy will be contracted, mostly from private IPPs.
- Liquefied natural gas infrastructure will be in place to power the first combined-cycle gas turbines.
- Pro-poor electricity tariffs will be better targeted to include all qualifying electricity customers.
- Electrification coverage will reach at least 85 percent. Integrated household energy supply strategies will offer affordable access to complementary energy sources that include solar water and space heating.
- A decision will be made on whether South Africa should continue importing petroleum products or invest in a new refinery.



Long term

By 2030:

- More than 20 000MW of renewable energy will be contracted, including an increasing share from regional hydroelectricity, provided this is an affordable target.
- Rail and port capacity will be further enhanced to support increased coal exports.
- About 11 000MW of Eskom's older coal-powered stations will be decommissioned, but close to 6 000MW of new coal capacity will be contracted – part of it from other southern African countries (subject to South Africa's commitments in climate-change negotiations).
- Cleaner coal technologies will be promoted through research and development investments and technology-transfer agreements in, among others, the use of ultra-supercritical coal-power plants, fluidised-bed combustion, underground coal gasification, integrated gasification combined cycle and carbon capture and storage.
- The extent of economically recoverable coal-bed seam and shale gas reserves will be understood. Subject to acceptable environmental controls, these gas resources, supplemented by liquefied natural gas imports, will begin to supply a growing share of power production. This could avoid the need for further base-load nuclear generation.
- Rising energy prices, an economy-wide carbon tax with sector exemptions, coupled with direct action (such as the implementation of the Integrated Resource Plan in the electricity sector; scaled taxes on the sale of high-emission vehicles, equipment and building standards; and targeted energy-efficiency programmes) will drive South Africa's energy sector on a path to lower carbon and energy intensity.

- At least 90 percent of South Africans will have access to grid electricity, with the remainder meeting their energy needs from off-grid sources.

- Hybrid and electric vehicles will be more widely used.

WATER RESOURCES AND SERVICES

Water is a strategic resource critical for social and economic development and there is growing concern about the potential impact of water-related risks. South Africa ranks low – 128th of 132 countries – in Yale University's Environmental Performance Index.³ This is attributed, in part, to the poor state of its water ecosystems. South Africa also ranks 148th out of 180 countries in terms of water availability per capita, according to the 2012 World Water Development Report.⁴ Since South Africa is already a water-scarce country, greater attention will have to be paid to its management and use.

Water supply and sanitation services, which depend on adequate management, are a priority for most South African communities. Their effective and sustainable management is essential for community health, development and cohesion, and continued economic activity.

By 2030, it is envisaged that effective management of water and the services derived from it will support a strong economy and a healthy environment. The country's development will reflect an understanding of available water resources and effective water planning that cuts across different economic sectors and spheres of government. All main urban and industrial centres will have a reliable water supply to meet their needs, while increasingly efficient agricultural water use will support productive rural communities. Natural water sources will be protected to prevent excessive extraction and pollution. Water will be

recognised as a foundation for activities such as tourism and recreation, reinforcing the importance of its protection. Where rivers are shared with other countries, South Africa will ensure that it continues to respect its obligations.

Before 2030, all South Africans will have affordable, reliable access to sufficient safe water and hygienic sanitation. Service provision arrangements will vary in different parts of the country, with different approaches adopted for densely built-up urban areas and scattered rural settlements. Local governments will retain responsibility for ensuring service provision in their areas and, in many cases, will continue to manage the services directly. However, alternative solutions such as community-based management, local franchising or the use of regional water utilities will be allowed if they would be more effective. Authorities responsible for water-resource management will coordinate their activities with local service providers, and monitor and support them, as discussed in chapter 13.

The water reality

After 1994, a major infrastructure expansion programme was initiated to address a long history of underinvestment, resulting in improved access to potable water. This was complemented by a greater focus on water-resource management. However, there is still much to do.

Implementing broader water-resource policies that address equitable allocation and protection of the resource remains a challenge. Water restrictions due to drought have been limited in recent years but the threat remains due to delays in investment in infrastructure and a failure to moderate growth in demand. Backlogs in service provision in rural areas remain and there is pressure to upgrade urban service levels, which will require further investment.

There are serious concerns about the ability of the

current water administration to cope with emerging challenges. The available pool of experienced water engineers and scientists is shrinking rapidly. Administrative failures and the absence of enforcement indicate that management quality is deteriorating and institutional memory is being eroded. Delays in issuing water licences are affecting economic activity, with new farmers also being affected as the administration fails to reallocate water rights in areas where demand exceeds supply, as provided for in the National Water Act (1998).

Managing water resources

Managing, monitoring and protecting South Africa's water resources in a sustainable way while allowing for economic growth demands the following:

- **Effective administration.** Management of South Africa's limited water resources must become more effective. This includes involving users so that they understand and can respond to emerging constraints; systematic monitoring to ensure effective water-supply planning, development and operation; and regulating water's various uses (including for disposal of wastewater) to ensure sustainability. Effective administration requires clear and coherent legislation and policies based on strong research and development capacity and the right technical tools. As the nation's water resources are extensively interconnected – often flowing across political boundaries – oversight of their management and administration should remain national. But some decentralisation of responsibilities is necessary, because it is at local level that users can best be involved.

- **Evolving water-resource management.** Given growing uncertainty about the availability of water to meet expanding demand, the management approach must be regularly reviewed. A statutory public process for this already



exists, requiring that a national water resource strategy is produced every five years. This strategy is informed by catchment management strategies and local government's water services development plans, as outlined in their integrated development plans. If this review process is properly implemented, priority areas for intervention will be identified and implementation can be monitored.

○ **Prioritisation.** There is an urgent need for a coherent plan to ensure the protection of water resources and the environment in the Mpumalanga Highveld coalfields, upstream of the Vaal and Loskop dams, as well as in the Lephalale-Waterberg area. Given environmental pressures and development demands, current water allocations in the upper Vaal and Olifants River water-management areas urgently need to be revised. Local planning should also ensure that groundwater resources are optimally used. If properly planned and managed, groundwater can often meet local needs more effectively than large regional infrastructure projects.

Water-management strategies

The Commission proposes that the following strategies are adopted:

○ **Establish a national water-resources infrastructure agency.** The Department of Water Affairs has identified the actions necessary to reconcile the water demands of major urban and industrial centres with potential supplies up to 2030.⁵ These plans need to be translated into well-timed investment programmes to avoid supply constraints. Large investments in regional systems could be undertaken by a national water-resources infrastructure agency, perhaps modelled on the South African National Roads Agency Limited. This agency would build on the foundation provided by the Trans-Caledon Tunnel Authority, which is already supporting implementation of several large projects, and help to resolve the organisational

challenges faced by the department's Water Trading Entity. However, the national government, through the Department of Water Affairs, should continue to lead the planning process, reviewing these programmes every five years to ensure coordination with other long-term economic and infrastructure plans.

○ **Reduce demand.** Reducing growth in water demand is just as important as increasing its supply. Current planning assumes it will be possible to achieve an average reduction in water demand of 15 percent below baseline levels in urban areas by 2030. Detailed targets have been set for different areas.

Achieving demand reductions on this scale will require programmes to reduce water leakage in distribution networks and improve efficient domestic and commercial water use. The Commission proposes running a national programme to support local and sectoral initiatives to reduce water demand and improve water-use efficiency. Demand-management projects with merit should be given priority and regarded as being on par with water-supply expansion projects in terms of importance.

○ **Manage agricultural use better.** Agriculture uses the largest volume of water (even though agricultural water supplies are less reliable than those supplied to urban and industrial users). The farming sector will have to increase its water efficiency to improve production and allow for water to be transferred to new users in water-scarce areas, to compensate for the expansion of irrigated agriculture, which has high job-creation potential. The Commission proposes a dedicated national programme to provide support to local and sectoral efforts to reduce water demand and improve water-use efficiency. Water-saving and demand-management projects should be

considered as part of the overall range of water-supply investment programmes. These can be compared with supply expansion projects, and should be prioritised accordingly, based on their merits.

- **Investigate water reuse and desalination.**

There is already extensive indirect reuse of water in inland areas, where municipal and industrial wastewater is reintroduced into rivers after treatment. However, there is considerable scope for further water reuse. Many municipalities lack the technical capacity to build and manage their wastewater treatment systems. As a result, a regional approach to wastewater management may be required in certain areas.

Water infrastructure investment should include projects to treat and reuse water, selected on their merits. Research into water reuse and desalination and the skills to operate such technology should be developed, perhaps under the auspices of a national water-resource infrastructure agency (discussed below) or the Water Research Commission.

Institutional arrangements for water-resource management

The institutions that manage water resources should reflect the shared, public nature of water. Although current legislation provides an institutional framework to achieve this, implementation has been slow. This is, in part, because the growing water challenges – and the need to build institutions to deal with them – are not fully understood. Human resources are also limited.

Institutional development is particularly needed for the Olifants River, Crocodile-west subcatchments of the Limpopo, the Nkomati River and the upper and middle Vaal subcatchments, and the Umzimvubu River in the Eastern Cape, where water supplies have already reached their limit and where water allocations need to be reviewed. Such

catchment-based institutions will need strong support from national bodies, especially in terms of resource monitoring and infrastructure planning.

Water-management institutions should ensure that their operations and development align with the country's macro-development strategies and sectoral priorities. If there is capacity, the consultative process that produces the national water-resource strategy every five years could be used to ensure such alignment. The Commission should support and facilitate this alignment process.

Institutional arrangements for water services

In terms of the Constitution's allocations of powers and functions, the provision of water supply and sanitation services is the responsibility of municipalities, with support and oversight from provincial and national level. Many of the institutional challenges at this level are generic, and are dealt with in chapter 13. There are, however, a range of specific considerations on the best institutional approach to adopt in different circumstances, as well the financial arrangements to ensure sustainable, accessible services for poor communities.

Key policy issues

The following policy issues guide appropriate actions to improve the management, use and conservation of South Africa's water resources:

- Enhanced management capacity will be needed to address the increasing pressures on water resources. This capacity is in decline, partly due to institutional uncertainty. New institutional arrangements should acknowledge limited human-resource capacity and give high priority to the development and retention of the specialised staff required. Current human-resource development programmes have had limited success and must be made a strategic priority.



- Institutional arrangements for water-resource management need to be finalised, specifically the number of water-management areas to be established, the mechanisms through which users will be involved in the management of water in these areas, as well as the organisation of the management and development of major water-resource infrastructure.

- A review of existing water allocations is needed in areas where new users are seeking access, but current users already take more than can reliably be provided. There is statutory provision for these reviews, which if not undertaken, will result in a rise of illegal use and the over-allocation of the resource. This will reduce supply reliability, jeopardise existing social and economic uses and damage the environment.

- To guide water-management approaches, strategic planning decisions are needed on general economic and social development, as well as environmental protection. Geographic areas where this is needed include:

- Mpumalanga Highveld coalfields – a balance between environmental protection, agriculture, energy requirements and water resources.
- Lephalale and Waterberg areas – water requirements and sources for mining and energy investments.
- Olifants River (Limpopo/Mpumalanga) – careful consideration of the balance between mining, agriculture and nature conservation.
- Umzimvubu River (Eastern Cape) – water-resource development could support agriculture, domestic supply, hydropower production, transport and tourism if planned in a coordinated manner.
- Investments to support economic uses of water, including urban consumption, should normally be funded by users through appropriate

pricing measures, which must include arrangements to ensure that all people can afford access to basic water services. However, the challenges of sustaining service provision in poor municipalities must be recognised and addressed.

- It is likely that a substantial proportion of investments to support rural development (including agriculture and rural settlements) will have to be publicly funded. Policy is needed to guide such investments to achieve a balance between financial costs and social benefits.

- The norms and standards for basic water supply and sanitation services should guide the allocation of funds to municipalities. However, in many cases, new investments are routinely designed to exceed existing norms and standards, resulting in service provision that is financially unsustainable. An urgent review of the norms and standards, together with the financial provisions to meet these, is required.

- Many small and rural municipalities lack the financial and technical capacity to manage water services adequately. Some flexibility in approach is recommended, which could include the use of regional utilities and community management of franchise arrangements, provided municipalities retain their role as the political authority responsible for service oversight.

- Water availability and demand varies widely. This limits the usefulness of pricing as an instrument of allocation and control and increases the complexity of price-setting. At present, water price-setting aims to recover the cost of making water available, while administrative allocation methods seek to balance economic, social and environmental benefits where markets frequently fail. For water services, price-setting is regulated by municipal procedures. In this context, the need for

an independent economic regulator for water, its specific functions and the potential costs and benefits in relation to the current arrangements should be carefully assessed. This assessment could take place within the proposed cross-sectoral review of infrastructure regulators.

Trade-offs

In charting a way forward for water management, the following trade-offs and issues emerge:

- A balance has to be achieved between water allocations for industrial and urban use, with important economic implications, and for agriculture and conservation, which have important social and environmental implications.
- Greater water-use efficiency in agriculture tends to be capital- and skills-intensive, but may in turn support job creation. These gains will be difficult for new entrants to agriculture to achieve without substantial support.
- The costs associated with environmental protection (for example, those associated with enforcing pollution standards and extraction of restrictions) should be set against social and economic needs. Current legislation allows for different levels of protection, but in many cases water reserved for the environment is already used for other purposes.
- Any review of norms and standards for basic water supply and sanitation services should consider whether service provision through public infrastructure is advisable outside formal settlement areas, given the high costs associated with serving scattered rural communities. Household grants for self-supply may be considered in some areas.
- At municipal level, it is important to balance the political autonomy and exclusive service-delivery mandate granted by the Constitution with the

realities of limited financial and human-resources capacity. A flexible institutional model should allow continued political oversight of local service provision by municipalities, while taking advantage of other delivery models such as regional service providers or community management.

- A balance is needed between allocating financial resources to support investments in higher levels of service and providing services to underserved households, while also maintaining and periodically refurbishing existing infrastructure.
- In some rural areas (for example, around Sekhukhune district municipality in Limpopo and Bushbuckridge local municipality in Mpumalanga), reliable water supplies can only be made available through large and costly distribution works. Decisions about such schemes must recognise that they are unlikely to be viable without substantial ongoing operating subsidies.

Phasing

Between 2012 and 2015, the following actions are required to achieve the 2030 goals:

- The national water-resource strategy should be tabled for consultation by mid-2012 and approved by year-end to guide the development of the sector. Along with the water-resource investment programme, it should be reviewed in consultation with water users and other stakeholders every five years to ensure that it adapts to changing environmental, social and economic circumstances.
- Future institutional arrangements for water-resource management must be defined by the end of 2012, with implementation by 2015 at the latest, if institutional memory is to be retained and continuity in management ensured. The institutional arrangements could include:
 - A national water-resource infrastructure



agency that will develop and manage large economic infrastructure systems.

- ⊙ Catchment management agencies to undertake resource management on a decentralised basis, with the involvement of local stakeholders.
 - ⊙ National capacity to support research, development and operation of water reuse and desalination facilities.
 - ⊙ A dedicated national water-conservation and demand-management programme, with clear national and local targets for 2017 and 2022, and subprogrammes focused on municipalities, industry and agriculture.
- ⊙ A comprehensive investment programme for water-resource development, bulk-water supply and wastewater management must be established for major centres is being finalised and should be reviewed every five years. This programme will include the following major investment projects, with clear allocation of responsibilities for financing and implementation and set targets for completion:
- ⊙ The Lesotho Highlands Project Phase 2, which is to be completed by 2020 to supply the Vaal system.
 - ⊙ Current KwaZulu-Natal Midlands projects (eThekweni and Msunduzi municipalities and surrounds), which need to be completed and future major augmentations decided on. These augmentations could be through desalination, reuse or by building a new dam on the Mkomazi River in time for water to be available in 2022.
 - ⊙ Western Cape water-reuse and ground-water projects, which are to be completed by 2017.
 - ⊙ Regional water infrastructure investments and bulk-water supply programmes, which must be defined by the end of 2012, with clear implementation targets.
 - ⊙ The management of water services must be

strengthened and regional water and wastewater utilities established to support municipalities (including expanding mandates of existing water boards) by 2017.

TRANSPORT

By 2030, investments in the transport sector will:

- ⊙ Bridge geographic distances affordably, foster reliably and safely so that all South Africans can access previously inaccessible economic opportunities, social spaces and services.
- ⊙ Support economic development by allowing the transport of goods from points of production to where they are consumed. This will also facilitate regional and international trade.
- ⊙ Promote a low-carbon economy by offering transport alternatives that minimise environmental harm.

The state will oversee a transport system that takes into consideration the realities of transport in South Africa and strives to serve the interests of society. It will provide basic infrastructure where needed. Where independent service providers would best meet transport needs, the government will enable licensing within a framework of effective regulation. Crucially, the state agents responsible for transport will have the competence, information gathering and planning facilities and the necessary leadership to achieve these goals.

The transport reality

South Africa needs reliable, economical and smooth-flowing corridors linking its various modes of transport (road, rail, air, sea ports and pipelines). Currently, these corridors are dominated by outdated, malfunction-prone railway technology and poor intermodal linkages.⁶ Ports are characterised by high costs and substandard productivity relative to global benchmarks.

About 96 percent of South Africa's bulk commodity exports are transported by sea.

Although rail is the ideal mode of transport for large, uniform freight travelling further than 400km, 69 percent of all freight transport activity (measured by ton kilometres) is conveyed by road, parts of which are "rail friendly". This strains a road network already suffering from significant maintenance backlogs and contributes to poor road safety. South Africa's high accident rate places a huge burden on society, both in terms of the emotional and health costs of death and injury, and the financial costs of damaged and lost cargo.

Social and economic exclusion caused by apartheid is still evident in the long distances many people, especially the poor, travel from where they live to where they work. Providing suitable means for the safe, efficient and cost-effective transport of people and goods is crucial. Such mobility broadens social and economic access, alleviating poverty.

Recent investments have given South Africa's air-travel infrastructure the capacity to handle projected passenger volumes to 2030. However, air transport poses a challenge for wider development. In contrast to intercontinental travel, where network density and cross-subsidisation of flights keep prices down, the cost of a plane ticket to a destination within Africa is prohibitive. In future, the significant levels of carbon emissions resulting from air travel may substantially reduce travel for business and leisure and may negatively affect the tourism sector.

Strategic focus areas

South Africa needs to focus on a number of strategic focus areas if it is to reach its transportation goals by 2030.

- **Prioritisation.** Transport decisions usually involve expensive, expansive systems that take

years to build and are in place for decades. Given the financial and time commitment such decisions demand, it is important to carefully rank competing options using clear decision-making criteria. Focus should be on safety, affordability and efficacy rather than on trying to incorporate all transport options. Decisions should take South Africa's developmental goals into consideration and guard against adopting transport approaches from other nations that are not aligned with South Africa's priorities or resources.

- **Focus on transport as a system.** Instead of focusing on a particular transport mode, emphasis should be placed on the total transport network. This systemic approach will help improve transport efficiency and accessibility while reducing the overall environmental, social and economic costs. This approach should also consider transportation options that would contribute towards South Africa's decarbonisation efforts, for instance, the use of electric buses or offering companies incentives for using delivery vehicles powered by liquefied natural gas.

- **Look beyond transport.** Social and economic mobility does not necessarily depend on a transport system. Spatial planning – for example, establishing more economic opportunities where people live or creating new settlements close to work hubs – could also provide a solution. However, this is a long process. In the medium term, South Africa will probably continue to experience increasing traffic congestion.

- **Behavioural change.** Behavioural change is critical for reducing the environmental, social and economic costs associated with transport. Targeted communications campaigns and the availability of alternatives have the potential to improve South Africa's transport situation by shifting public thinking about public transport and transport that uses



alternative energy sources. For instance, while some forms of private transport, such as the car, will still be used in 2030, there will be a marked move towards public transport as more options become available to commuters.

Key policy and planning priorities

With these strategies in mind, the government needs to focus on the following policy issues going forward.

Create workable urban transit solutions

To create a streamlined and effective urban transport system, the government needs to:

- **Increase investment in public transport and resolve existing public-transport policy issues.**

This includes attracting private-sector investment. Both public and private investment should go towards extending bus services, refurbishing commuter trains, linking high-volume corridors and integrating all these into an effective service. The government needs to coordinate these investments if economies of scale are to be maximised.

Public-transport investment increased at 15 percent a year from 2006. In the short term, to harvest these investments, future asset management and increased use of existing assets must be a priority, with a focus on doing more with what the country has. It is crucial to strengthen governance of the sector and operational efficiency.

Nowhere is this more evident than in the bus rapid transport system, which has demonstrated the potential of high-quality mass transit systems while also showing it is critically important to align social interests with technical solutions. The Johannesburg bus rapid transport project incorporated taxi owners – a milestone in formalising the taxi industry as a transport operator. During 2011, however, striking drivers halted this transport system. As

public transport must be dependable, authorities will have to create reliable services by placing commuters' interests above the sectarian concerns of transport providers, while also allowing these services to be economically sustainable businesses. Fixing problems with bus rapid transport systems is a priority given the significant financial and spatial investments made to date and the potential such a system represents for qualitatively better public transport.

- **Devolve transport management to local government.**

Governmental policy is to devolve transport management to local government. This will help align the fragmented and conflicting interests of multiple transport authorities, each with separate funding sources and mandates. However, handing responsibility for transport over to municipal authorities will only succeed if it is accompanied by strengthening of institutions and alignment of legislation, policy and practice. Where metropolitan municipalities are adjacent, a regional transport authority may be appropriate to support integration, as proposed in Gauteng's 2055 strategy, which prioritises harmonising transportation efforts within its city region.

- **Provide incentives for public-transport use.**

Public-transport subsidies will increase affordability for low-income commuters. Mounting costs for private car users (tolls and projected higher fuel costs), together with prioritising flow of public-transport vehicles on roads, might encourage motorists to use public transport.

Public-transport solutions should extend services to captive transport users while winning custom from those who have options. This will require a public-transport system that has the capacity, frequency, coverage and safety performance required to compete with the benefits of having a privately owned car. The Gautrain has shown public

transport is an option for commuters who can afford to use cars. The airport link has been quickly and successfully adopted, although this is not the case on the Pretoria-Johannesburg route, which has a small reach and weaker links to commuters' departure and destination points. Authorities may need to add additional feeder services to make this link work, increasing the already considerable cost.

- **Improve road infrastructure.** Even with greatly expanded public transport, city dwellers will still use cars. Transport authorities will need to plan and invest in road and transport infrastructure construction, maintenance and oversight – and integration with public services – while using technology, such as intelligent traffic signalling, to maximise traffic flow.

- **Renew the commuter train fleet.** Even though trains provide the lowest-cost transport service in metropolitan areas, they are also often unreliable and uncomfortable, with the forced retirement of aged rolling stock placing more pressure on operations. New technology is needed to improve service levels.

Strengthen and optimise freight corridors

South Africa is a transport-intensive economy. Its advantages in terms of resources are greatly eroded by high transport costs and poor freight transport infrastructure. South Africa's mineral sector, for example, has the potential to drive economic growth in the short term, yet it is being stifled by limited capacity to transport mineral commodities, particularly coal, manganese and iron ore, on existing rail lines.

Most of South Africa's bulk freight is transported on existing national road and rail networks. Planning should prioritise improving the capacity, efficiency and sustainability of these corridors while enhancing the performance of seaports and inland terminals.

Plans should be informed by experience and the poor performance of Transnet's capacity expansion programmes. Richard's Bay Coal Terminal, for instance, is greatly underutilised because capacity on the adjacent rail link did not keep up with expansion on the terminal.

Given the magnitude of these capacity constraints and the huge financial and organisational resources needed to improve corridor performance, effective partnerships need to be developed between the public and private sector. Healthy competition between service providers is also key.

The following corridors have been identified for expansion and improvement:

- **Durban-Gauteng corridor.** By 2030, the Durban-Gauteng freight corridor should be a model for how to strengthen and optimise freight corridors. As the corridor that handles most of the country's high-value freight, it is the first priority. It is also the most strategic corridor to achieve a shift of freight from road to rail by overcoming rail's main drawback – lack of intermodal flexibility – by improving the performance of terminals on either end. It could demonstrate that the institutional model needed for corridor improvement rests with aligning the interests of cities with authorities across all tiers of government, as well as the transport operators that connect the intervening space. Transnet and its partners in this project are making progress with this emerging institutional model.

Success factors include unrestricted access into the terminals for freight, removing bottlenecks on the road and rail routes, and expanding terminal capacity. Planning priorities include new access routes into Durban's port, allowing for segregation of freight from other rail traffic, and building new hubs or inland terminals around Gauteng for improved road-rail transfers. At least three new



Gauteng hubs will replace existing inner-city hubs as they reach full capacity. Higher rail density and throughput to achieve scale economies will require rail alignment, together with upgraded technology to move and control trains. Transnet has developed plans that will address the capacity of Durban's port. Further container capacity to meet South Africa's needs over the longer term will be provided by constructing a new terminal on the site vacated by moving Durban's airport to La Mercy.

○ **Coal-transport corridors.** The Waterberg coalfields in Limpopo need to be linked both to domestic power generators and to export facilities in Richard's Bay. Planning should also take Botswana's need to access Indian Ocean ports for its own coal exports into consideration. Transnet has firm plans for capacity expansion for coal exports up to 97 Million tons per annum through Richard's Bay to be reached in stages. The needs of coal producers, domestic customers, notably Eskom, and access to export channels are at such a scale that network-wide capacity expansion is required, including a rail link through Swaziland that will give flexibility to coal transport, as well as benefit trade in timber and sugar with that country. Improvements to the coal transport corridors require strengthening lines tunnels, bridges, power supply and building new lines. The long-term economics of the coal market are difficult to predict and therefore do not give certainty to the transport market forecast. When firm commitments to expand are made prompt and economical execution will be crucial and challenging because multiple infrastructure projects could be competing for scarce resources at the same time.

○ **North-south corridor,** a Durban to Dar es Salaam transport network, linking the two major ports of the Southern African Development Community, Central and East African economic communities embracing improvements to road and

rail links through the countries.

As indicated by the Port Regulator, South African ports perform poorly, operating at levels below comparative operations at costs that are significantly higher than the global average. This is hindering the nation's development objectives. Poor performance is largely due to the absence of competition in terminal operations and Transnet's business model, which uses surplus generated by ports to fund investments elsewhere. The trade-offs obscured within the Transnet group must be addressed if port prices are to be competitive.

South Africa is also a maritime nation with a 3 000km coastline straddling a major strategic shipping route. Close to 80 percent of trade is by sea, but the country has a weak maritime industry that does not adequately complement its land and aviation national infrastructure and services. South Africa needs to reappraise the maritime sector in light of its geopolitical positioning and ask what contribution it could make to employment and regional trade.

Provide long-distance passenger transport options

Long-distance transport alternatives include travel by intercity bus, taxi, private transport, air travel and limited intercity passenger trains. In this context, where should scarce public resources be directed?

South Africa's largest single public asset is its road network. National and provincial roads are the prime means of connecting people and moving cargo from small settlements and secondary towns to the centres of economic activity. At a replacement value of R1.7 trillion, preserving it is a top priority. In the short term, before expansion can be considered, maintenance needs to be done on local and provincial government roads to prevent further deterioration.

Institutional capacity to manage road traffic also needs to be strengthened. This includes upgrading safety mechanisms, rigorously enforcing compliance with road-safety rules and wide-scale road-safety education. Success will be evident in road users changing their behaviour.

In the long term, the proposed expansion of intercity passenger rail services will need to be carefully assessed. Rail is costly and South Africa would have to practically start from scratch due to the age of its long-distance passenger fleet. Intercity passenger rail makes up a small part of the market with little patronage. It is only a significant service for low-income travellers at annual holiday peak times. Alternatives, specifically road-based options currently in service, will have to be assessed against the high costs and limited coverage of passenger rail. Given the need to fund improvements to transport services for commuter rail and bus services with a wide reach for poor people, the net benefits of passenger rail investments seem unjustified.

Rural access and mobility

To achieve a meaningful level of rural access and mobility, planning should offer different services to meet different local needs. Where population is concentrated in an area with little productive economic activity, priority should be given to enabling easy access to basic needs and state support (for example, service points for public health care and grant support). Scheduled public-transport services could be provided to ensure such access.

People tend to relocate from isolated rural homes and settle at transport nodes or along transport corridors to access services. These movements provide further opportunities for improved economies of scale for public transport. Given limited resources and urban migration, subsidised services should be limited to such places.

Phasing

Providing sustainable transport services that are efficient and inclusive is inextricably linked to the need for spatial change in South Africa's cities and improvement in related transport corridors. Users will adjust to pricing that is supported by greater transparency regarding the full costs associated with each service, including costs linked to environmental impact. Key themes are discussed below.

2010–2015: Consolidation and selective expansion

Greater emphasis will be placed on asset management, increased use of existing assets, extending economic infrastructure through joint private and public projects, and expanding public commuter rail-transit services.

Given scarce resources, some needs will have to be deferred. The state will need to maintain public confidence that improvements will spread by achieving excellence in meeting priority needs. Decisions on project selection will be driven by tightly focused criteria. Priorities include:

- **Improving streamlining of assets and institutional arrangements for public transport (including the powers and functions of role players).** Asset-use needs to be consolidated and existing assets should be used better. First, public transport and infrastructure must be managed better by removing duplicated functions, refining powers and functions, imposing accountability and enhancing governance and decision-making processes. Thereafter, streamlining institutional arrangements in metropolitan areas can be achieved by setting up regional transit authorities. It is crucial to ensure that all parts of the existing road-based commuter services function properly, as many commuters depend on bus and minibus taxi services. Large public investments have been made, offering a glimpse into how better-performing



public transport can improve people's commute. Transport authorities should focus on enforcing sector-wide compliance and encouraging contracted operators and independent service providers to invest and provide a more commuter-friendly experience.

- **Renewing the commuter rail fleet**, with a region-by-region shift to new high-capacity rolling stock, supported by station upgrades and improved facilities to enhance links to road-based services. Stabilising existing services is crucial, because complete fleet renewal could take up to 15 years.

- **Expand capacity for mineral exports**, targeting metal ores and coal. This involves improving strategic freight corridors for southern African and international trade. Private-sector partnerships (primarily with Transnet and the South African National Roads Agency Limited) are essential to upgrade corridors. Where state-owned enterprises are unable to meet demand for freight services, the state should vigorously encourage private-sector involvement. The National Ports Act (2005), which stipulates that all new developments should be concessioned, needs to be more stringently enforced so that all operators (public or private) perform or are replaced. Intensive application of information technology to transport systems will increase use and flow rates through new railway signalling and highway traffic control systems. These are strategic investments that can be deployed more rapidly than building new fleets or roads to boost the use of existing infrastructure.

- **Optimal utilisation of assets** – Port of Ngqura's modern deep-water facilities makes it attractive for container transshipment traffic.

- **Transport planning**, led by central government to formulate credible long-term plans for transport that synchronises with spatial planning and aligns

the infrastructure investment activities of provincial and local government and clearly communicates the state's transport vision to the private sector.

2016–2020: In step with evolving land-use changes

Guided by plans for the urban form, the focus will be on achieving the mutually reinforcing effect of transit-led growth. This will help increase concentration in urban settlements, while improving economies of scale for transport modes. Once the instructional reforms for public transport have been completed, regional transit authorities should be established.

2021–2025: Energy efficiency

Emphasis will be on increasing energy efficiency and the resilience of transport networks, drawing on progress in establishing renewable energy resources.

Use of lightweight materials in freight and passenger vehicles should be increasingly preferred, because of their lower lifecycle energy requirements and greater load-carrying capacity.

2026–2030: Mid-life upgrades

Reviewing progress towards the 2030 vision should guide the tactical adjustments needed to overcome problems. Planning should provide for refitting transport systems to incorporate technological improvements.

INFORMATION AND COMMUNICATIONS INFRASTRUCTURE

ICT is a critical enabler of economic activity in an increasingly networked world. As a sector, ICT may provide important direct opportunities for manufacturing, service provision and job creation, but their main contribution to economic development is to enhance communication and information flows that improve productivity and

efficiency. For this reason, a country that seeks to be globally competitive must have an effective ICT system, as this “infostructure” provides the backbone to a modern economy and its connections to the global economy. The link between ICT's contribution to economic growth only takes effect when connectivity reaches a critical point, estimated to be 40 percent for voice communications (Röller & Waverman 2001) and 20 percent for broadband (Koutroumpis 2009).⁷

An immediate policy goal is to ensure that national ICT structures adequately support the needs of the economy, allowing for parties beyond the public sector to participate. At present, there is an effective duopoly in the mobile-phone market. Telkom still dominates the telecommunications backbone and telephony markets. This dominance has been ineffectually regulated, resulting in high input costs for businesses, which has in turn resulted in an increase in the costs of services and products. It has also inhibited investment in growth areas within ICT, such as business-process outsourcing and offshore information-technology-enabled services. Telkom's monopoly has seen deterioration in fixed-line connections that will further undermine South Africa's future competitiveness unless it is addressed.

By 2030, ICT will underpin the development of a dynamic and connected information society and a vibrant knowledge economy that is more inclusive and prosperous. A seamless information infrastructure will be universally available and accessible and will meet the needs of citizens, business and the public sector, providing access to the creation and consumption of a wide range of converged services required for effective economic and social participation – at a cost and quality at least equal to South Africa's main peers and competitors. Within this vision, the underlying ICT infrastructure and institutions will be the core of a widespread

digital communications system. This ecosystem of digital networks, services, applications, content and devices, firmly integrated in the economic and social fabric, will connect public administration and the active citizen; promote economic growth, development and competitiveness; drive the creation of decent work; underpin nation building and strengthen social cohesion; and support local, national and regional integration. Public services and educational and information products will be accessible to all, and will build on the information, education and entertainment role envisaged for public broadcasting. The human development on which all this is premised will have created an e-literate (online) public able to take advantage of these technological advances and drive demand for services.

ICT will continue to reduce spatial exclusion, enabling seamless participation by the majority in the global ICT system, not simply as users but as content developers and application innovators.

The ITC reality

More South Africans use mobile phones (29 million) than listen to radio (28 million).⁸ Despite this, growth in South Africa's ICT sector has not brought affordable, universal access to the full range of communications services. The performance of most state interventions in the ICT sector has been disappointing. South Africa has lost its status as continental leader in internet and broadband connectivity.⁹ The price of services and equipment remains a significant barrier to expanding mobile-phone and fixed-line use, with limited network competition further increasing costs.

International evidence suggests that a new ICT gap is opening up between those with access to high-speed internet and those who access internet via mobile connections.¹⁰ While users cope with deteriorating fixed-line connections by switching to



mobile networks in the short term, this may lock South Africans out of global networks in the longer term as applications in other countries are increasingly based on ultra-high-speed “fibre to premises” networks.

The main constraining factors have been:

- Poor returns from the state's investment in Telkom.
- Little evidence of an effective strategy to ensure that connectivity in South Africa keeps up with its peers.
- Policy constraints, weaknesses in institutional arrangements, conflicting policies, regulatory failure and limited competition.
- The ability of the regulator, the Independent Communications Authority of South Africa, to enable a more open market. Its work has been hampered by legal bottlenecks, limited capacity and expertise, and policy direction being complicated by the constitutional guarantee of “independence”, which should only apply to broadcasting rather than to the technical areas of ICT, although this may need to be revised as broadcasting and ICTs converge.¹¹ The last comprehensive policy review was in 1996.

A single cohesive strategy is needed to ensure the diffusion of ICTs in all areas of society and the economy. Like energy and transport, ICT is an enabler – it can speed up delivery, support analysis, build intelligence and create new ways to share, learn and engage. But ineffective ICT can also disable economic and social activity.

In the very short term and well in advance of 2030, the state will need to re-establish the shape and nature of its participation in the sector. A new policy framework will be needed to realise the vision of a fully connected society. A key issue will be to decide on the role of state infrastructure interventions. These interventions will have to balance the priority goal of achieving affordable and truly universal

access to communications services, while recognising the general efficiencies that may be derived from the application of private capital in economic activity.

In future, the state's primary role in the ICT sector will be to facilitate competition and private investment, to ensure effective regulation where market failure is apparent, and to intervene directly to meet specific social goals. Direct involvement will be limited to interventions to ensure universal access and to help marginalised communities develop the capacity to use ICTs effectively.

Policies and priorities

Implement an enabling, coordinated and integrated e-strategy

To achieve its ICT goals, South Africa must have a coordinated, enabling ICT strategy and plan. The key aspects of this are:

- A national e-strategy that cuts across government departments and sectors.
- Stimulating sector growth and innovation by driving public and private ICT investment, especially in network upgrades and expansion (particularly in broadband) and development of applications and local content.
- Reviewing the market structure and analysing the benefits and costs of duplicating versus sharing infrastructure, given that the radio spectrum on which mobile networks depend is limited.
- Establishing a common carrier network, possibly by structurally separating Telkom's backbone operations from its retail services.
- At least applying open-access policies to encourage sharing of certain elements of the backbone fibre network, without discouraging private long-term investment.
- Targeted public investment, possibly through public-private partnerships.
- Developing the specialised institutional capacity to ensure that policy keeps up with the evolution of

the sector and that regulation is effective.

- Focusing on stimulating demand by promoting e-literacy, instituting ICT rebates and incentives and developing ICT applications in sectors such as health and education as well as on the supply-side infrastructure and institutions.
- Effectively engaging various institutions, including global ICT governance agencies, such as the International Telecommunications Union and the World Trade Organisation, on issues of regional integration and harmonisation.

The digital divide can be partially addressed through more competitive and efficient markets and effective regulation that enables operators to meet the demand for affordable services, reducing the number of households or individuals requiring support. Further strategies to enable access are “smart subsidies”,¹² which require a once-off intervention. These should be favoured over strategies that require permanent subsidies.¹³

The rate of change in the ICT sector means that such programmes should regularly be reviewed and refocused. This will require the state's investment and support.

Demand stimulation and job development

- **Demand-side interventions.** Improving equitable access to ICT services will require action to stimulate demand. At the most fundamental level, e-literacy needs to be improved through training in schools, at tertiary-education facilities and adult-education colleges, as well as through supplier training. A larger audience will, in turn, help stimulate market demand for multilingual, relevant local content and make it practical to develop online and mobile government-service applications.
- **Job creation and the skills challenge.** Constructing and maintaining communications networks will generate both unskilled job

opportunities in the short to medium term (such as digging trenches or spanning cables for expanding networks) and skilled work over the longer term (as networks need to be maintained, upgraded and refurbished). The education system, supported by government investment into ICT skills development, will need to prepare for this.

- **Role of the private sector.** Experience elsewhere demonstrates that private-sector participation and competition, coupled with effective regulation, have the potential to deliver lower prices and improved quality and speed of service. South Africa needs to commit to intensifying competition in the ICT sector.

- **Streamline spectrum allocation.** Spectrum allocation is perhaps the biggest regulatory bottleneck in the deployment of wireless technologies that will, in the short to medium term, meet the diverse needs of society and economy. The radio spectrum is a scarce resource that needs to be optimally allocated to meet both economic and social objectives. Significant high-capacity spectrum will become available with the shift from analogue terrestrial television broadcasting to digital terrestrial broadcasting. This should be swiftly allocated to ensure that services based on emerging technologies can expand.

Mechanisms for this allocation need to be based on clear conditions, transparent processes and limited discretion. In order to qualify for allocation, potential services providers have to meet specific conditions and clearly define the services that they will provide. The awarding process may take the form of auctions or reverse bidding,¹⁴ as long as the process is robust and transparent. The ultimate goal will be to attract appropriate investment at a low enough price to meet social and economic needs.



Once allocated, spectrum bandwidth should be fully tradable (within the original allocation criteria). Regulators should not be too restrictive in dictating which technologies should use which parts of the spectrum. They should discourage spectrum-hoarding, where licensees buy spectrum bandwidth and either fail to use it or use it only in certain geographical areas. Spectrum policy should favour competition, but incumbents should not be excluded from gaining access to bands needed for expansion or to apply new technologies. In line with global trends, spectrum licences should be technology-neutral so that they can be adapted to meet rapidly changing technological developments without high regulatory costs.

○ **Local-loop challenge.** The local loop – the fixed connection between the main telecommunications network and end users – has historically been operated by Telkom and serviced by copper wires. Internationally, the trend is to use fibre-optic cables for the local loop as they are less valuable (and therefore less vulnerable to theft) and offer far higher speeds. Telkom's copper network is deteriorating. Competitor Neotel, meanwhile, is making slow progress in rolling out fixed-line connections, relying instead on wireless connections, particularly for domestic users.

The strategic medium-term objective is to improve the quality, reduce the cost and expand the reach of the local loop. To achieve this there must be clarity about Telkom's future role and regulatory incentives to ensure that local-loop unbundling achieves its objective, which is to expand affordable access to high-quality, high-speed broadband.

Building institutional capacity and competencies

The state needs to have sufficient institutional agility and competence to make effective interventions in this rapidly changing sector. The government's primary role should be to ensure that public policy

promotes market access and creates effective institutions that ensure competition, regulate operator behaviour and address market failure.

In pursuing these goals, it will be important to address the inherent conflict of interest between the state's role as a competitive player in the market (through its enterprises, InfraCo and Sentech, as well as its majority share in Telkom) and its role as a policy-maker. Similarly, at local-government level, there is tension between the fact that municipalities both regulate access for infrastructure (through wayleaves, for example) and compete with private service providers by developing their own broadband networks to perform city management functions. A better distinction of these roles is required to avoid unintended policy outcomes. Mechanisms will have to be put in place to ensure the regulator's autonomy from the state and industry interests, and accountability will have to be ensured through transparency and specialised parliamentary oversight.

At some scales, it may be desirable to coordinate state and private investment into infrastructure to avoid costly duplication. Pragmatic regulatory approaches to facilitate this should be explored.

Trade-offs

The following trade-offs and choices apply:

○ There is a need to ensure sufficient large-scale investment (through both public and private funds) to allow for extension of ICT infrastructure that supports the economy. This must be balanced against the need to ensure that the objectives of greater inclusivity and sustainability and specific strategic goals of access and service provision are met, even in underserved areas and marginalised communities. Given that the state is capital constrained, with many urgent priorities, willing and capable private investors are needed. Creating a collaborative partnership with defined social

responsibilities may be appropriate. Alternatively, where private investment is able to create the connectivity, public investment could focus more on enabling the demand by supporting e-literacy and content delivery or reducing investment risk

- Low barriers to market entry and competitive markets require less intensive regulation and have the potential to drive down prices and improve consumer choice. However, such low barriers may also threaten the financial viability of current service providers or state-owned enterprises. Greater competition may also limit new, potentially risky investments in emerging ICT technologies.

- As broadcast and other ICT technologies converge, setting quotas for local content on television and radio promotes local production, but also has the potential to increase broadcasting costs. This could make it difficult for regulated broadcast services to compete against content providers on unregulated services such as the internet.

- Encouraging cost efficiency in the sector by regulating prices could result in job losses among present service providers. However, lower prices could swell telecommunications demand, creating other jobs elsewhere in the ICT sector and the broader economy.

- Allowing network competition to extend networks and services, with likely duplication of resources and infrastructure in a resource-constrained environment, needs to be weighed against the effects of having a single common carrier backbone that offers fair, open access to its facilities in a competitive services sector.

- Deterioration of the local loop highlights the need for strategic decisions about the future role of Telkom, which holds the local-loop monopoly and is still state controlled even if it is not entirely state

owned. While protecting the local-loop monopoly may ensure ongoing dividends for the state in the short term, the deteriorating fixed-line network may impose serious costs on society in the longer term. Structural separation of local loop and backbone activities may be required. Open Reach and British Telecom are a successful example of such a structural separation.

- Making critical spectrum available to operators to deploy new technologies to grow their business. Alternatively, waiting for a full spectrum audit and conducting comprehensive allocations or auctions of the entire reassigned spectrum with the associated losses that delays bring.

Phasing

Phasing of priorities to create an enabling ICT reality by 2030 is discussed below.

Short term: 2012–2015

There is a clear and urgent need for a full policy review, which has not been done in the ICT sector since 1995. In the next five years, South Africa needs to develop a more comprehensive and integrated e-strategy that reflects the cross-cutting nature of the ICT sector. This should link policy objectives to specific strategies. It should include plans to allocate the new spectrum that will become available with the switch to digital broadcasting, and should set out a strategy for universal internet access, with clear targets for monitoring and evaluation. In addition, it should outline interventions to promote ICT diffusion such as e-literacy programmes to stimulate demand, ICT skills development and institutional capacity-building.

Evidence suggests that affordable internet access is best achieved through effectively regulated competitive markets, complemented by targeted state intervention.



The following policy issues require attention:

- Adjust market structures and remove legal constraints to enable full competition in services.
- Develop a strategy for the local loop to ensure that quality improves, costs are reduced and fixed-line coverage is expanded to meet demand for high-speed telecommunications.
- Ensure that regulatory agencies have the resources to encourage market entry and fair competition, as well as address market failure.
- Implement a service- and technology-neutral licensing regime to allow for flexible use of resources, especially for spectrum that is urgently needed for next generation services.
- Make spectrum available on a “use it or lose it” basis to encourage efficient use, drive down costs and stimulate innovation.
- Spectrum allocation should accompany set obligations to overcome historical inequalities in the ICT sector. However, these obligations should not delay the competitive allocation of this resource.
- Ensure access to low-cost, high-speed international bandwidth with open-access policies.
- Facilitate the development of high-bandwidth backbone networks.
- Assess state-owned enterprise and municipal performance in ICT provision and decide on the future role and configuration of the state's family of ICT enterprises (Broadband InfraCo, Sentech and Telkom). Examine the market's ability to sustain infrastructure competition and whether the benefits of this outweigh the problems of duplication of facilities in a resource-constrained environment.

- Identify alternatives to infrastructure competition through structural separation of the national backbone from the services offered by Telkom to create a common carrier that offers open access to service competitors. Similarly, encourage or prescribe sharing of expensive trenching infrastructure by creating common rights of way for competing operators to lay dedicated lines.

Medium term: 2015–2020

Between 2015 and 2020, the following goals should be pursued:

- **Extend broadband penetration.** The Commission supports the Department of Communications' proposed target of 100 percent broadband penetration by 2020. All schools, health facilities and similar social institutions should be connected and individual citizens should have affordable access to information services and voice communication at appropriate locations. Broadband is currently defined as a minimum connection speed of 256 kilobytes per second, but by 2020, this will probably be at least 2 megabytes per second, with some countries aiming for 100 megabytes per second. South Africa's goals should be to remain competitive rather than to set firm numerical targets.
- **Benchmark South Africa's performance against other countries.** It is suggested that by 2020, strategic investment and regulatory guidance will result in the costs associated with internet access falling to match South Africa's peers. More generally, South Africa should aim to position itself in the top quartile of the International Telecommunications Union's ICT Development Index ranking of middle-income countries. It should also aim to regain its position as the continent's leader in both quality and cost of ICT services.

Long term: 2020–2030

Ongoing e-strategy implementation and refinement will ensure that the ICT sector supports, rather than limits, South Africa's global competitiveness and economic performers. The country will maintain or improve its International Telecommunications Union rankings.

By 2030, the government will make extensive use of ICT to engage with and provide services to citizens. All South Africans will be able to use core

ICT services and enjoy access to a wide range of entertainment, information and educational services. The e-strategy collaborations between the state, industry and academia will stimulate research and innovation, and promote local content production and multimedia hub establishment. These systems will be used to interact with the global ICT ecosystem, of which South Africa will be an integral part.

NOTES

1. The transport section contains more detail on these rail projects.
2. United States Energy Information Administration (2011). World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the US. Washington, DC: US Department of Energy.
3. Emerson JW, Hsu A, Levy MA, de Sherbinin A, Mara V, Esty DC, Jaiteh M (2012). 2012 Environmental Performance Index and Pilot Trend Environmental Performance Index. New Haven: Yale Center for Environmental Law and Policy.
4. World Water Assessment Programme (2012). The United Nations World Water Development Report 4: Managing Water under Uncertainty and Risk. Paris: UNESCO.
5. Department of Water Affairs (2010). Strategic Overview of the Water Sector in South Africa. Pretoria: Department of Water Affairs.
6. The facilities where people or goods transfer from one mode of transport to another more suited to that leg of the journey, for example the transfer of containers from rail, which is suitable for long-haul travel, to truck, which is suitable for short distance from the train station to the final delivery destination.
7. Koutroumpis P (2009). Telecommunications Policy 33(9) pp 471–485.
8. Röller L and Waverman L (2001). Telecommunications Infrastructure and Economic Development: A Simultaneous Approach. London: Centre for Economic Policy Research. Available at <http://www.cepr.org/pubs/new-dps/dps/dplist.asp?dpno=2399> (accessed May 2009).
9. Development Bank of South Africa (2011). Communications Infrastructure. Paper commissioned by the National Planning Commission, 4 April 2011. Pretoria: Development Bank of South Africa.
10. Esselaar S, Gillwald A, Moyo M and Naidoo K (2010). Towards Evidence-based ICT Policy and Regulation. South African ICT Sector Performance Review 2009/10, Volume 2, Policy Paper 6. Available at http://www.researchictafrica.net/publications/ICT_Sector_Performance_Reviews_2010/South_Africa_ICT_Sector_Performance_Review_percent20_2010_-_Vol_2_Paper_6.pdf (accessed 27 January 2011).
11. United Nations (2010). The Millennium Development Goals Report 2010. New York: United Nations.
12. Gillwald A (2011). SA Telecoms – still a way to go. Engineer IT. Available at: <http://eepublishers.co.za/article/research-act-africa.html> (accessed 7 January 2012).
13. Smart subsidies are innovative systems to reduce common problems facing subsidy programmes and extend their benefits.
14. InfoDev Regulatory Toolkit (2009). Available at <http://www.infodev.org/admin/www.ictregulationtoolkit.org> (accessed 7 January 2011).
15. Reverse bidding is a type of bidding in which the roles of buyer and seller are reversed. In ordinary bidding buyers compete to obtain a service by offering increasingly higher prices. In reverse bidding, the sellers compete to obtain business from the buyer and prices will typically decrease as the sellers undercut each other.