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Ladies and Gentlemen

I want to express my sincere appreciation to both the SA Academy of Engineering and the University of Pretoria for the distinct honour of delivering this prestigious lecture.

The topic is a rather daunting one; it asks that we talk about an engineering solution, namely the design of a catalyst, to a philosophical challenge, the development and the re-ordering of society.

Let me start with a few words about what the National Planning Commission (NPC) is: After an invitation for nominations in February 2010, President Zuma selected a cadre of 25 Commissioners from outside of government and set it to

work in May 2010. The Commissioners are drawn from a variety of disciplines and are each distinguished by their contribution to society. In his address to the inaugural meeting of the Commission, President Zuma said:

> *The mandate of the Commission is to take a broad, cross-cutting and critical view of South Africa, to help define the South Africa we seek to achieve in 20 years time and to map out a path to achieve those objectives.*
>
> *The Commission is expected to put forward solid research, sound evidence and clear recommendations to government.*

By any measure that's a pretty tall order. In a democracy, the only conceivable reason why parties fight elections is for the privilege and opportunity to set the agenda based on their specific policies, to allocate resources for the attainment of those policies and then to devise implementation strategies. All else is peripheral to this in the world of politics. One of the profound difficulties in so many countries is that people are prepared to die or even to kill for the ability to thus perform. In our case, the President invites a non-descript group of professionals to undertake this task – with at least two important caveats: the NPC is not government, and nor is it a political party.

The work of the NPC is thus an attempt to meet this mandate, ever mindful of the constraints. Our place is, thankfully, not to fashion new policies, there are sufficient tomes of policy documents across the country, and we are not required to implement – that remains the responsibility of elected government in all three spheres. Our role is essentially advisory, that is to "put forward solid research, sound evidence and clear recommendations to government."

Every enterprise, such as this, needs an anchor. The NPC recognised that the only rational anchor for its output can be the Constitution of the Republic, with

a particular emphasis on the Preamble, the Founding Provisions and the Bill of Rights. Not unexpectedly, we set the benchmarks based on these, with the proviso that the NPC has the privilege of the long view to 2030, allowing whichever governments are elected to implement their programmes on this path. The benchmarks that we opted for are fairly easily understood – the elimination of poverty and the reduction of inequality. We have opted to separate the challenges of poverty and inequality because they each need separate treatments. To deal with poverty, we use a measure developed by Statistics South Africa of R 419 per person per month in 2009 Rands. About 39% of the population currently subsist below that line and the objective is that by 2030 no person should find themselves in such abject poverty. The inequality challenge is a bit more difficult and substantially more challenging. South Africa is measurably one of the most unequal countries, with a Gini Co-efficient of 0.69, and we set the objective of reducing this to 0.6 – still higher than most countries are presently, but substantially less unequal than the present.

So the first enquiry by the Commission was to identify the impediments to attaining these constitutional imperatives. We synthesized these into a diagnostic document that we released in June 2011. The 9 Challenges we raised are:

- Too few people work
- The quality of school education for black people is poor
- Infrastructure is poorly located and under-maintained
- Spatial divides hobble inclusive development
- The economy is unsustainably resource intensive

- The public health system cannot meet demand or sustain quality
- Public services are uneven and often of poor quality
- Corruption levels are high
- South Africa remains a divided society.

We then embarked on a process of intensive consultation – taking the diagnostic to all political parties in Parliament, to trade union federations, and to the public through physical town hall meetings and online discussions. Out of this process, four additional challenges were raised, namely, Social Protection, Community Safety, the Rural Economy, and the Position of South Africa in Africa and the World.

In November we released a proposed National Development Plan (NDP) based largely on these 13 areas of substantial work. For the phase of shifting from diagnostic to plan, the medics on the Commission had to cede to the will of the engineers. So each challenge had to be analysed in some detail and then flipped to present a set of implementable actions.

This process is less easy than it sounds, partly because most of us tend to focus on immediate issues. This way of thinking is compounded by a communication style than encourages participants to think to within 140 characters. So questions such as how to resolve the water problem, say in Carolina or Delmas now, or how to engineer the delivery of school books to Limpopo are the kinds of questions that abound. We have, after all, raised both resources and education as particular challenges. And so, without pleading impotence, we need to constantly remind people that our mandate is to define 2030 and then to plot a traverse to get the country there, allowing governments to implement their responsibility.

The focus of the National Development Plan is indeed on the longer term, but this does not equate to a deferment of solutions. The broad approach that the NDP takes is one that is premised on the recognition of the centrality of a "capabilities approach" to driving change. In the context, the capabilities upgrade has to be focused on people and infrastructure. There has to be a close interaction in the unfolding of these two emphases.

The people

Firstly, the focus on people means that we need to pay particular attention to the education challenge – from a significantly retooled Early Childhood Development (ECD) sector, through schooling and then streaming into both FET and Higher Education. We pay close attention to what needs to be fixed. In many respects, the inequalities in both access to and the quality of the ECD sector sets the mould for what happens later in life – this approach has just recently been confirmed by a World Bank study on inequality in South Africa. These trends are very visible also in the results of the Annual National Assessments conducted in English and mathematics at Grades 3, 6 and 9. In many respects, life opportunities are snuffed out early and, in the words of the World Bank Study, life circumstances are determined at birth.

So, for example, the retooling of the education system involves a number of practical steps. Included are:

1. Making early childhood development a top priority among the measures to improve the quality of education and long-term prospects of future

generations. This will require that dedicated resources are channelled towards ensuring that children are well cared for from an early age and receive appropriate emotional, cognitive and physical development stimulation.

2. Ensuring that each class has a teacher who is motivated, well trained, has mastery of the subject they teach and has the competence to teach it. Studies show that the inadequate subject knowledge by teachers or lack of ability to transmit the knowledge is a major area of weakness. Some of the measures to address this include retraining the current crop of teachers during school holidays, attracting high calibre students to teaching, introducing professional certification where newly qualified teachers need to demonstrate certain competencies before they are employed in schools and certification is renewed periodically, say every five years, and recruit foreign teachers in subjects like maths and science in short- to medium-term.

3. Improving the quality of school management by changing the process of appointing principals, introducing an entry qualification for principals and members of senior management team, requiring all candidates to sit for a competency test, and ensuring that the process of appointing principals is fair, transparent and meritocratic.

4. Going back to basics – ensuring that textbooks and workbooks are delivered on time, there is support material for teachers to move the throughput and successfully cover all aspects of the curriculum, other

teaching aids are available and that teachers are, in fact, in class and teaching.

5. Bringing all schools up to minimum infrastructure standards by targeting no-fee schools to compensate for resource deficits in communities. Schools should have well-equipped libraries, laboratories, computer and media centres to ensure that learners in no-fee schools have access to similar learning resources to their counterparts in less poor communities.

Our actions in education should be guided by the goal to improve literacy, mathematics and science outcomes; increasing the number of learners eligible to study maths and science-based degrees at university; improving performance in international comparative studies; and ensuring that up to 90 percent of learners make it to Grade 12 or its equivalent in vocational education and 80 percent succeed in their final examinations.

Attaining these goals will broaden the pipeline of people who can be trained as doctors, nurses, teachers, economists, financial managers, actuarial scientists and engineers. With schools producing high calibre graduates, higher graduation rates overall will be achieved in our universities especially in the critical areas where there are shortages. The next challenge in this regard is to find innovative ways - understanding that resources are not unlimited - to expand universities, colleges and other post school institutional capacity. The NDP proposes a 70% expansion of enrolment in universities by 2030 and a 300 percent increase in FET enrolments. The NDP carefully balances the need to expand enrolments with quality improvement.

All of these proposals are not just a list of nice things to have; they are part of a set of deliberate actions we must take to build the capabilities of our people and in turn of the national economy.

What is fundamentally important is that these are not the issues for 2029. Each one of them is immediate – what the NPC does is to project onto the "wall of 2030" and then to project back off it, recommending to government, and all of society the immediate actions necessary to attain these outcomes.

Similarly, the Infrastructure capabilities upgrade is pretty detailed.

Infrastructure

Infrastructure is not just essential for faster economic growth and higher employment. It also promotes inclusive growth, providing citizens with the means to improve their own lives and boost their incomes. Infrastructure is essential to development. It is a critical contributor to development of capabilities of individuals as well as economic capabilities.

South Africa has a relatively good core network of economic infrastructure, but needs to maintain its water, electricity, transport and telecommunications infrastructure to support economic growth and social development goals.

The infrastructure projects that we propose should be given priority are not dissimilar to those identified by the Presidential Infrastructure Coordination Committee. They include:

- Upgrading informal settlements on suitably located land.
- Public transport infrastructure and systems, including the renewal of the commuter rail fleet, supported by enhanced links with road-based services.
- Developing the Durban-Gauteng freight corridor, including a new dug-out port on the site of the old Durban airport.
- Building a new coal line to unlock coal deposits in the Waterberg, extending existing coal lines in the central basin and upgrading the iron ore line to Saldanha.
- Developing, in a timely manner, several new water schemes to supply urban and industrial centres, new irrigation systems in the Umzimvubu river basin and Makhatini Flats, and a national water conservation plan to improve water use and efficiency.
- Constructing infrastructure to import liquefied natural gas and increasing exploration to find domestic gas feedstock (including investigating shale and coal bed methane reserves) to diversify the energy mix and reduce carbon emissions.
- Procuring at least 20 000MW of renewable electricity by 2030, importing electricity from the region, decommissioning 11 000MW of ageing coal-fired power stations and stepping up investments in demand-side savings, including solar technologies and energy-efficiency improvements.
- Establishing national, regional and municipal fibre-optic networks to provide the backbone for broadband access. Private investment needs to lead the way in this area, complemented by public funds required to meet social objectives. Effective policies, regulation and institutional arrangements to achieve this are urgently required.

Identifying the need to upgrade infrastructure is the easy part. The planning, financing, delivery and management of infrastructure are substantially more demanding especially for a country with a dearth of critical skills such as ours.

Many of the proposed infrastructure projects have been debated for many years with nothing much materialising. The NDP provides a different context to how these critical infrastructure projects can be realised. It gets into the black box of why there is a failure each time we want to implement these projects.

In the wake of the 2009 recession, the private sector has been reluctant to invest its healthy levels of retained earnings in productive capacity. At the same time, the public sector has favoured consumption over investment. Acknowledging this, the government has announced a shift in the composition of expenditure towards investment, a necessary precondition to breaking the stalemate.

Policy planning and decision-making often requires trade-offs between competing national goals. To illustrate, 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.

For infrastructure that supports human settlements (housing, water, sanitation, roads, parks and so on) the picture is unnecessarily complicated. The planning function is located at local level, the housing function is at provincial level, and

the responsibility for water and electricity provision is split between those responsible for bulk services and reticulation. In practice, these arrangements do not work. In general, human settlements are badly planned, with little coordination between those installing water reticulation infrastructure and those responsible for providing bulk infrastructure. Responsibility for housing should shift to the level at which planning is executed: the municipal level. The plan sets out recommendations for effective urban development.

The success of the model that was followed in preparation for the FIFA World Cup 2010, drawing on the strength of the public and private sectors, with effective coordination at all levels, is worthy of replication as we traverse the road to 2030. Coordination succeeds when it takes place at the level of implementation – with higher structures providing guidance, support and clearing blockages.

Experimentation

Included is an approach to some experimentation. Our approach to gas is replete with experimentation.

This is necessary to reduce the reliance of our economy on coal for energy generation. Coal is the country's largest economically recoverable energy resource and among its three top mineral export earners. We need to devise policies and plans to improve the country's energy situation. One of the ways to achieve this is to explore gas as an alternative to coal for energy production and diversifying the mix of energy sources and independent power producers in the energy industry.

Substituting gas for coal will help cut South Africa's carbon intensity and greenhouse gas emissions. We need to explore 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.

Now, I know that these kinds of proposals tend to induce salivation in even the hardiest engineers. It broadly supports the approaches taken in the Presidents Infrastructure Co-ordinating Council. The key challenges are sequencing and costing. More importantly, the National Development Plan encapsulates these necessary initiatives in a context.

Permit me to give a bit of attention to mining.

Mining

South Africa is endowed with significant amounts of mineral resources. We have a significant amount of platinum reserves, estimated at 70% of global reserves as well as other minerals. However, these mineral resources are worth nothing if they remain underground. The significant decline in world demand for platinum group metals poses a different set of challenges. Research and industry bodies can play a key role in finding new ways in which world demand for platinum could be stimulated. Beyond platinum and mining generally, we need to encourage innovation to find efficient ways to use our natural resources.

We need to be able to harvest the fruits of our mineral resources to pay for the upgrades in our infrastructure and our people that will take us to a better tomorrow. We need to take advantage of these resources to place the country on a different development trajectory.

The interplay between technical solutions and political realities

Modern democracies are complex and difficult to manage. Ours is a quasi-federal system. Line function departments are given specific mandate, which are codified in law but often they are limited to setting policy, norms and standards. The responsibility for implementation is assigned to provinces and local authorities.

Complex as the experience has shown this to be, it is clear in the view of the Commission that success will be achieved if the public sector works with the private sector. But the private sector is also diverse. This requires systemic re-engineering or the plumbing of decision-making.

Whether in education or the mining sector, health or agricultural sector our focus and limited resources should be channelled towards that which is broken or operating inefficiently. Clearly the inequalities in health and education, inability to capture the full benefits of our mineral endowments are indications of deep-seated inefficiencies, and they can be found in just about all sectors.

There is a real danger that if we do not attend to our challenges together and in a decisive manner, those who see what we propose as threatening the comforts they enjoy will opt out the process of finding a collective solution, there will be stand-offs and this will raise the stakes even higher.

The NDP is a catalyst for the solutions we must seek to find but we need to rebuild trust and repurpose organizations and institutions. Leadership in all sectors will need to communicate, listen, persuade and instil a sense of confidence in the proposed solution, and indeed the future.

Engineers need to be attuned to the imperatives that drive political decisions and politicians need to appreciate the implications of wrong decisions or correct decisions that unduly delayed.

We need to focus on ensuring the ownership of the solutions for the challenges and ensure that processes involve all institutions that must be involved in the decision making. All of this is ultimately what engineering aims for.

Philosophers will fulfil a useful role in thinking about these issues. Effecting change is what engineers have to plan for, commit to and see through. This may appear to fall outside the traditional role of engineers but our challenges demand it. It is not pretty but necessary.

Thank you for your kind attention.