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FuturesCape Policy Brief

Potential Paths of Human Development in the Western Cape to 2040

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Executive Summary

The National Development Plan, the Provincial Strategic Plan and OneCape 2040 all emphasise that the key to reducing poverty lies in a virtuous cycle of growth and development. Every citizen should have the opportunity and 'capability' to be an active partner in his or her own development, and that of the country. As measured by the Human Development Index (HDI), human capacity has expanded in the Western Cape Province, especially since 2007. Prior to that, the HDI declined modestly due to the HIV/AIDS epidemic. Using the International Futures (IFs) model we simulated Base Case development in the province to 2040. According to our forecasts, the Western Cape is on a trajectory between 2010 and 2040 to:

- Improve average life expectancy by 13 years, reaching the level of Mexico in 2010

- Increase per capita income by ZAR 130 000, to the level of New Zealand in 2010[1]

- Increase expected years of education of school entrants by 3,5 years to an average of 14,3 years, similar to Taiwan in 2010

- Increase mean years of adult education by 3 years to 12,4 years, comparable to the USA in 2010

- Develop overall human capability to the level of Austria and the United Kingdom in 2010

This policy brief also extends beyond Base Case analysis by modelling aggressive but reasonable policy interventions. To do so, we develop an alternative scenario that gauges the potential for even further improvements in human development to 2040 for each of the three components of HDI.

Measuring human development

For several decades after World War II, the landscape of success in national development was measured almost exclusively by Gross Domestic Product per capita.[2] The United Nations Development Programme's publication of its first volume in the *Human Development Report* (HDR) series changed this paradigm significantly. Instead of focusing solely on income, this report defined human development as the "process of enlarging people's choices" through the acquisition and exercise of one's human capabilities.[3] The three pillars of human development were defined as a long and healthy life, knowledge, and a decent standard of living.

These conceptual components were operationalised into the Human Development Index (HDI). Created by Dr. Mahbub ul Haq and his chief collaborator, Dr. Amartya Sen, the HDI provides a standardised framework for quantifying national and subnational levels of human capability development, which allows for comparisons across time as well as political boundaries.[4] The HDI is computed using three separate indices – life expectancy, education, and income.[5] Its values range from 0 to 1, with higher values indicative of greater human development. The HDI has become the most widely used tool for comparing development across countries or regions.[6]

In 2010, the 20th Human Development Report introduced significant changes to the original measurement of HDI.[7] Perhaps the most consequential of these alterations was the decision to compute the Index by geometric mean instead of arithmetic mean. Computing HDI with arithmetic mean allowed for perfect substitutability between each of the component indices. Now, using the geometric mean, a balance between development in education, health and income is rewarded.

Additionally, Gross National Income (GNI) replaced Gross Domestic Product (GDP) as the index's wealth measure, as GDP does not capture the cross-border financial flows that characterise today's globalised world. For example, remittances from migrants and profits generated by domestic firms operating abroad would be reported in GNI but not in GDP.

Finally, the two knowledge sub-components, previously literacy and gross enrolment rates, have been replaced by overall educational attainment of the adult population and an estimation of expected years of education for children currently entering school.[8] Using data on mean years of schooling offers three advantages over literacy rates: it is available for more countries, it is calculated more frequently, and it has greater discriminatory power (of the 135 countries included in the 2010 Human Development Report, nearly half have reported literacy rates above 95 per cent).[9] The other new education element of HDI – expected years of education – was added in an effort to capture the potential attainment level of children in today's education system. See the appendix for a complete description of the new HDI calculation.

A tool for exploring human development: International Futures

International Futures (IFs) is a computer modelling system that represents relationships and interactions within and across key global systems for 183 countries from 2010 to 2100. IFs is an integrated assessment model, which means that it is characterised by dynamically interacting sub-systems. These sub-systems include population, economic, health, education, infrastructure, agriculture, energy, environment, governance, and international political modules.[10] The relationships modeled in IFs are structured in an interacting process that leverages a broad historical database and incorporates relevant academic literature.

IFs is also capable of using sub-national data to produce integrated forecasts at the provincial level for all nine provinces of South Africa. The Western Cape Provincial Government is currently using IFs to understand and frame key uncertainties around human development. The model allows leadership to shape reasonable expectations about long-term strategic planning initiatives aimed at promoting human development across the region.

Forecasting human development in the Western Cape

This analysis begins by coupling the Base Case with alternative scenarios for each of the sub-measures of the HDI. We explore how health, education, and income are unfolding under current assumptions (the Base Case), and then model policy-oriented interventions that would lead to more positive outcomes. Finally, we explore the Base Case development of the HDI in comparison to a scenario that integrates the three positive policy choices together to explore synergistic effects. How far could policy choices in the Western Cape improve human development as measured by the HDI?

The Base Case scenario is a central tendency scenario against which alternative scenarios can be compared. IFs produces a dynamic, endogenous forecast – as opposed to a linear extrapolation – across and within each of the key systems identified above. The Base Case formalises relationships and policy choices that reflect evidence gathered from predominant patterns over the last 20 years. This scenario assumes continued growth in technology (improving energy efficiencies, for example), no major policy shifts (no global carbon tax, for example), and no major black swans (such as a global pandemic).[11] Users can build alternative scenarios around the Base Case by changing parameters within the model, a process described in the IFs Help System.[12]

To contextualise Western Cape forecasts, we utilise a benchmarking method of analysis. For each HDI component, we identify "reference countries" which exhibit levels of development today that are similar to our forecast of future levels in the Province. For example, our 2040 forecasts for the

Western Cape will be compared to 2010 values around the world; thus ranking the Western Cape as 10th in 2040 means that the Province's level of development on a given measure in 2040 would be equivalent to that of the country ranked in 10th place in 2010. This method of analysis helps to contextualise our forecasts with the current environment of development.

The sections below are structured in the following way: we first introduce the Base Case assessment of each sub-index. Next, we model a policy-oriented intervention for that sub-measure – be it health, education, or income – and explore the implications across systems within IFs. It may be worth emphasizing the degree to which IFs is integrated: a policy intervention in health, for example, will have both positive and negative implications on other systems within the model. The extended utility of the IFs system is that it brings together multiple policy interventions to explore the degree to which trade-offs produce improved overall human development outcomes.

Education

Table 2: Expected Years of Education (Base Case)

Expected Years of Education				
	2010	**2020**	**2030**	**2040**
Western Cape (ranking in 2010)	10,7 years (126th)	13,1 years (67th)	14,7 years (40th)	14,3 years[24] (47th)
Reference Countries (2010)	Zimbabwe	Algeria	Austria	Taiwan

In Amartya Sen's capabilities approach, education is an essential part of human development. Improvement in an individual's development can be measured through "well-being achievement" – an increase in physical and mental functioning – or through "well-being freedom" – the ability to exercise personal agency in day-to-day life. Education indicators included in the HDI capture both of these categories. As a child passes through an education system, he or she can achieve better health, a fuller understanding of the world, and eventually employment possibilities.

Systems-thinking logic also identifies education as a critical part of human development. In any society, the education system exhibits linkages with demographics, economics, and health. Because education is one of the principle sources of human capital development, today's education system will significantly influence future economic growth prospects. Basic literacy and numeracy, as well as competence in social and professional skills, are acquired through primary and secondary education. Thus, poor primary or secondary education is a barrier to realising the long-term potential of human capital. If the incoming workforce lacks the necessary skills to participate in today's global information economy, productivity in the Western Cape will suffer.

A link also exists between female education and lowered fertility rates. The logic of the relationship is simple yet powerful: an education brings with it an increase in employment options, increasing the opportunity cost of pregnancy and time spent rearing children. So much academic work has been done on the subject that "evidence of the existence of a strong relationship between increasing education and lower fertility is incontrovertible."[25] And the final set of linkages, those between

education and health, may manifest in direct behavioural change and also more indirectly through spillover effects from the positive feedback loops existing between schooling and economic growth.

Following the United Nations Development Programme's approach, we forecast both of the HDI's educational components – expected years of schooling and the average educational attainment of the adult population. Expected years of schooling is defined as the number of years that children entering their first year of education would be expected to complete, given current enrolment, repetition, and attrition rates across educational levels.[26] This measure captures what happens to students after they enrol for the first time, and it is an indication of the potential attainment of today's school-age population. Currently, children entering elementary school in the Western Cape are expected to complete 10 years of education, placing them on par with Zimbabwe and ranking 126th in the world. The Base Case forecast shows improvement, with the Western Cape even with today's Taiwan at 14 years in 2040.

Table 3: Mean Years of Education Adults 25+ (Base Case)

Mean Years of Education for Adults 25+				
	2010	**2020**	**2030**	**2040**
Western Cape (ranking in 2010)	9,4 years (54th)	10,2 years (35th)	11,3 years (15th)	12,4 years (4th)
Reference Countries (2010)	Italy	Switzerland	Japan	USA

Whereas expected years of education captures the attainment potential for incoming students, mean years of education is a snapshot of the average level of educational attainment achieved by the current adult population. In 2010, adults living in the Western Cape had, on average, completed 9 years of schooling – placing them 54th out of 183 countries. In 2040 the average adult will have completed 12 years of education – a level comparable to the United States today. This projected increase in human capital bodes well for individual well-being in the Western Cape.

Alternative Scenario: Education Push

At first glance, the educational story told in the Base Case forecast is overwhelmingly positive. The Western Cape appears on track to reach a level of expected years of schooling equal to Taiwan, and mean years of education comparable to the United States today. Unfortunately these positive developments would not materialise until 2040. Thirty years of slow improvement would rob many of educated futures, and the Province of the additional improvements that education provides. To put this in perspective, a primary school cycle lasts 7 years in the Province, meaning almost four generations of primary schoolers would pass through the system before the high level of education described in the Base Case was reached. Could the Western Cape realistically speed up improvements to the educational system? If so, what might the effects be? In the **Education Push** scenario, we explore the impact of potential improvements to the entire schooling system, from primary through tertiary.

Both of the educational components of HDI are quantitative measures of attainment. The most direct way to increase a population's stock of education would be to increase enrolment rates. However, enrolment rates are themselves directly driven by two factors: intake rates and "throughput" across grades, including survival to, and completion of, the final year of each level of formal education. These two factors represent leverage points for those seeking to increase enrolment rates. In creating our **Education Push** scenario we simulated increases to both children joining the education system (intake rates) and the proportion of children staying in school (survival rates).

The exercise of establishing targets for enrolment growth, though fundamentally qualitative in nature, should be informed by historical evidence. Growth patterns in primary education of 1,7 percentage points per year have been observed in Togo, Ghana, Ethiopia and Cape Verde. Exceptionally high rates of over 4 percentage points per year have been seen, but rarely enough that they appear to be outliers. Given experiences on the continent, we increase gross primary enrolment rates in the Education Push scenario by, on average, 1,5 percentage points per year beyond the Base Case to the year 2025.

Historical evidence on the continent suggests that an even more aggressive push in secondary education may be possible. At the lower secondary level, an average increase in enrolment of 1,9 percentage points per year has been observed in countries as diverse as Kenya, São Tomé and Príncipe, and Morocco. In light of these patterns, the **Education Push** scenario includes an incremental 2 percentage point average yearly increase in lower secondary gross enrolment rates to 2025. We continue our aggressive push through the system by increasing upper secondary enrolment rates by an average of 1,6 percentage points per year to the year 2025; and finally, we increase tertiary gross enrolment by an average of 0,4 percentage points per year to 2025.

The connection between education improvements in the Western Cape and human development is reflected in the Province's HDI score. At the end of our time horizon, the Western Cape's HDI has surpassed the already high value forecast in the Base Case by 0,78 per cent. Though the stock of educational attainment – mean years of education – is difficult to improve during a relatively short time horizon, the interventions made in **Education Push** would speed up the improvements to expected years of education. As forecast in the Base Case, the Western Cape reached 14,3 expected years in 2040, which is comparable to Taiwan today. In the **Education Push** scenario, the Western Cape reaches this mark in 2028 – 12 years earlier.

The effects of an aggressive education policy would be evident in the broader economy as well. Initially, public spending on education would represent a net cost. Between the Base Case and **Education Push** scenario, cumulative spending increases by ZAR 2 billion through 2025 and over ZAR 20,1 billion by 2040. It would take time, but this investment would eventually result in positive returns. Until 2020, before the enrolment and throughput initiatives take hold, GDP in the improved scenario would be lower than the Base Case forecast because the increased educational spending would come at least in part from other productive spending such as that on health. From then on, however, GDP in **Education Push** would surpass the base forecast by progressively more each year. By mid-century, the Western Cape would more than recoup all costs associated with the policy push.[27]

Educational attainment most directly affects GDP through human capital's contribution to productivity. As each year passes in the improved scenario, more and more students would enter school and stay in school longer. Each cohort taught under the improved system would exit school better equipped to participate in the work force. In the Base Case, productivity driven by human capital contributes 0,1 percentage point to total GDP in the Western Cape. Beginning from this value, productivity gains in the **Education Push** scenario increase steadily, reaching a total of 0,38 per cent of GDP, as compared to a contribution of 0,29 per cent in the Base Case.

As the investment in education begins to pay off financially, standards of living for the poorest section of society improve, though slowly. In 2020, after reforms had time to take hold, the number of people living in acute poverty would begin to decline relative to the Base Case. By 2040, 30 000 fewer citizens of the Western Cape would subsist on less than 2 dollars per day, with this trend poised to continue at an increasing rate beyond the time horizon.

Any formal modelling work on education is incomplete without a discussion about quality. The lack of reliable educational quality measures is an inherent shortcoming of any quantitative modelling exercise. In fact, the National Development Plan 2030 diagnostic report identifies educational quality as a core challenge facing the country. Trevor Manuel, the Head of the National Planning Commission, has noted that South Africa's problem lies not in enrolment, but in the lack of skills. For example, in 2010, only 68 per cent of South African students sitting for school-leaving exams passed.[28] While the interventions used to create the **Education Push** scenario do not directly address quality, they do include increases to the system's survival rate, a commonly used proxy.

Income

Table 4: Gross Domestic Product Per Capita at PPP (Base Case)

GDP per Capita in Thousand Rand[29]				
	2010	**2020**	**2030**	**2040**
Western Cape (ranking in 2010)	ZAR 148 200 (59th)	ZAR 175 200 (49th)	ZAR 220 800 (44th)	ZAR 274 200 (35th)
Reference Countries (2010)	Malaysia	Libya	Slovak Republic	New Zealand

The Western Cape has been a large economic contributor among South African provinces, accounting for roughly 15 per cent of the country's total gross domestic product.[30] Our Base Case suggests that the Province could grow to account for 19 per cent of total South African GDP by 2040. Recent growth has largely been driven by a burgeoning service sector, which currently accounts for almost 65 per cent of the Province's share of GDP.[31] Manufacturing, agriculture, and an emergent information and communications technology (ICT) sector are also responsible for the Province's past success and will continue to play a critical role in the future.

In addition to increases in capital and labour supply, sources of economic growth are also found in changes to technology and productivity. The IFs model represents four kinds of multifactor productivity. Productivity is measured in human, social, physical, and knowledge systems. Each of these systems is further broken down; for example, productivity stemming from human capital is

measured by levels of educational attainment, life expectancy, and government spending on both education and health services.

IFs finds a neutral contribution to multifactor productivity currently from human and knowledge sources in the Western Cape, indicating that the Province is performing at par in those areas relative to its level of per capita GDP. We forecast that these two productivity sectors will improve and – by 2040 – will contribute around 0,5 per cent of GDP growth per year. As a contrast, we estimate that physical capital – a measurement of ICT and traditional infrastructure – is a net drag to GDP of 0,1 per cent in 2010. We also estimate that social productivity in 2010 – measured by governance stability, perceived lack of corruption, effectiveness, inclusion, and capacity – was actually responsible for an annual negative contribution to GDP of 0,5 per cent. This poor performance stems from the existence of domestic conflict (strikes, protests, etc.), corruption, and gender empowerment at levels lower than expected relative to GDP per capita. We forecast social productivity to neutrally contribute to GDP growth by 2040 in the Base Case.

The structure and size of a population also contributes to overall economic output. As fertility rates fall, the ratio of young to old people shrinks, eventually leading to a bulge in the population pyramid (see below). This transformation – referred to as the "demographic dividend" – alters overall GDP in two important ways. First, the labour supply is absolutely larger and thus produces more. Second the "dependency ratio" – a measure of the old and young relative to the working age population – declines, freeing up resources for consumption and investment. Not all aspects of this demographic transition are necessarily positive: the large bulge of young adults can lead to instability if there is inadequate employment.

In the section that follows, we will present an alternative development scenario that explores the impact of the Western Cape's recently-launched Broadband Initiative.
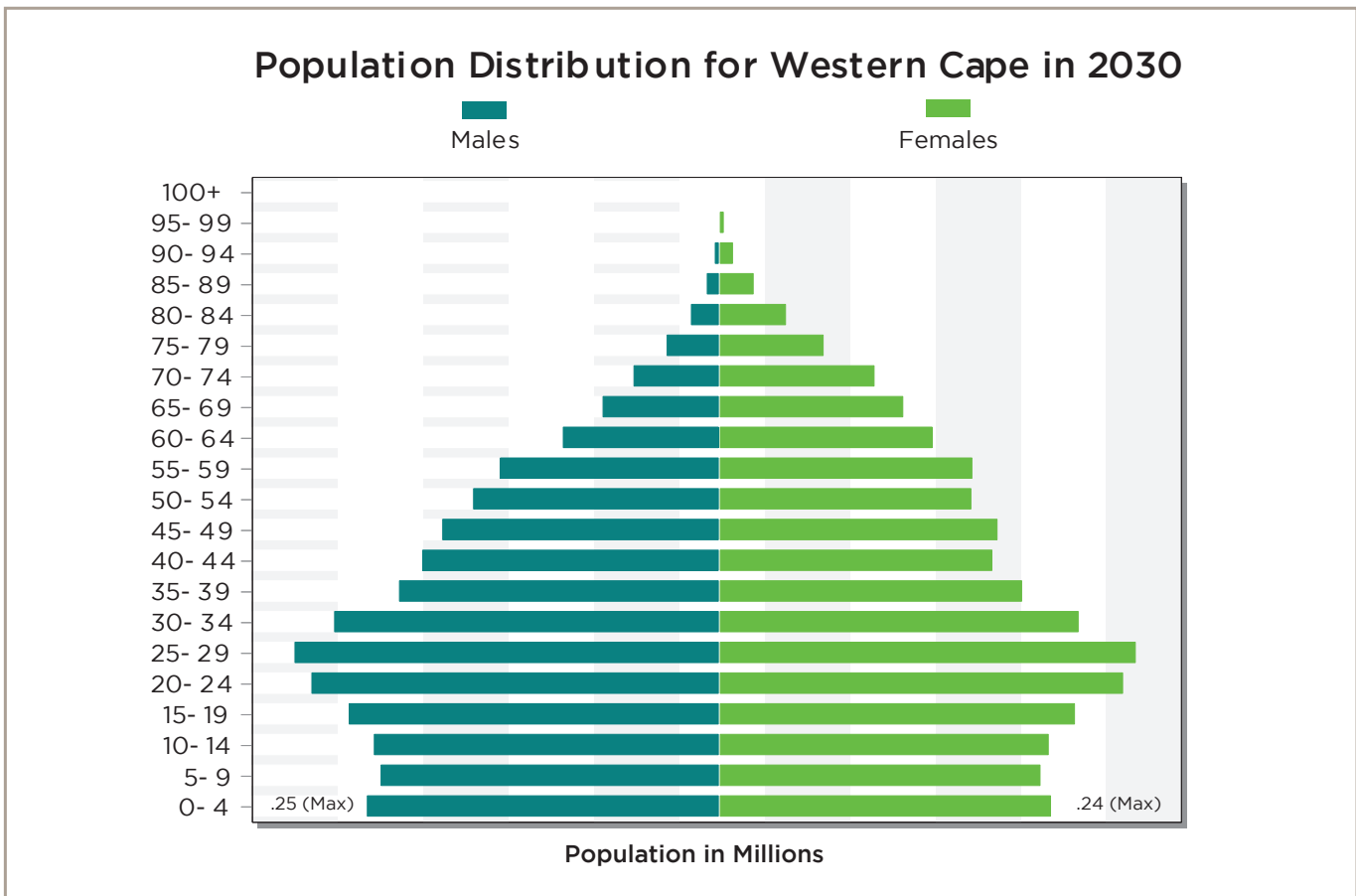

Figure 4: Population Distribution for 2030 for Western Cape

Alternative Scenario: Broadband Initiative

A stronger broadband network would be a key driver of future economic growth in the Western Cape by improving the skilled labour force and educational outcomes, attracting investment, and increasing overall economic productivity. In 2012, the Western Cape launched the Broadband Initiative to achieve universal connectivity in the metropolitan area by 2020. Progress toward universal connectivity is underway, with the Province set to achieve connectivity in 70 per cent of schools and government buildings by the end of 2014.[32]

We created a scenario that simulates the Broadband Initiative to connect the citizens and business community of the Western Cape with high-speed internet. This scenario explores the impacts of an aggressive ICT infrastructure campaign that scales up access to both fixed and mobile broadband. In **Broadband Initiative**, fixed broadband access is improved to match the achievements in growth exhibited by the world's top performers, such as Israel, Singapore, and South Korea. We also identified countries that have shown exemplary performance in mobile broadband access – including Australia, Belgium, and Japan – to benchmark the possibilities for the Western Cape.
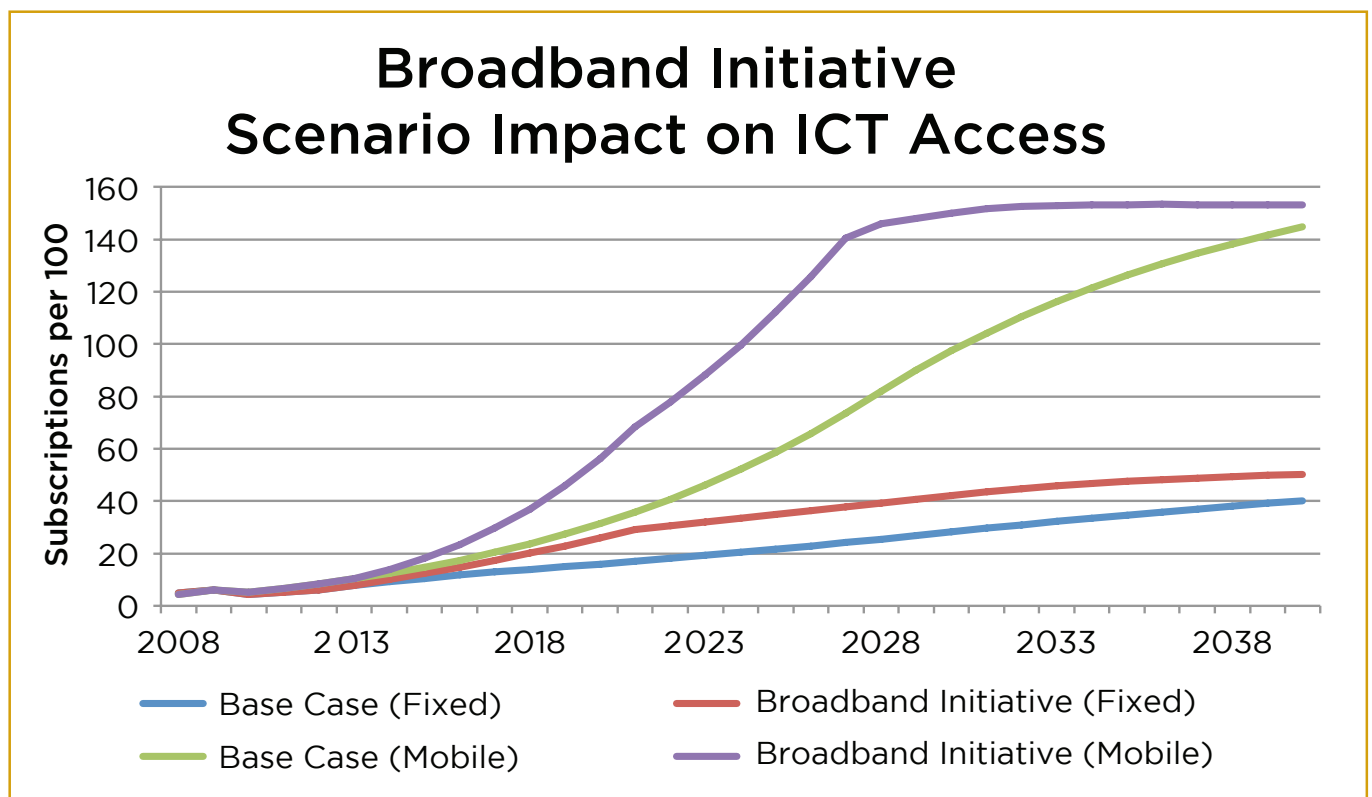

Figure 5: Mobile and Fixed Broadband: Base Case and Broadband Initiative Scenarios

In addition to improvements in broadband Internet access, an increase in multifactor productivity is also included in this scenario. This could represent efficiency increases triggered by the Western Cape's Integrated Development Plans, in which the Province co-ordinates local government networks more cohesively and spends public funds more effectively.

In **Broadband Initiative**, the Western Cape achieves more rapid economic growth than in the Base Case, due in part to productivity gains that come with improved broadband infrastructure as well as those from more efficient governance. Investments in fixed and mobile broadband improve physical capital's contribution to productivity. In the Base Case, physical capital contributes negatively to productivity in the Western Cape to 2040. With rapid improvements in broadband connectivity,

the Province achieves a neutral contribution to productivity from physical capital, which means that infrastructure supports the Province's level of per capita GDP.

The cumulative increase in infrastructure spending is approximately ZAR 4 billion over the Base Case by 2040. However, the potential returns from this ICT investment and productivity increase are staggering. By 2040, the Western Cape GDP grows by approximately ZAR 120 billion, and the Province reaches a per capita income level of approximately ZAR 290 000 – a growth of nearly ZAR 15 000 per capita, relative to the Base Case.[33]
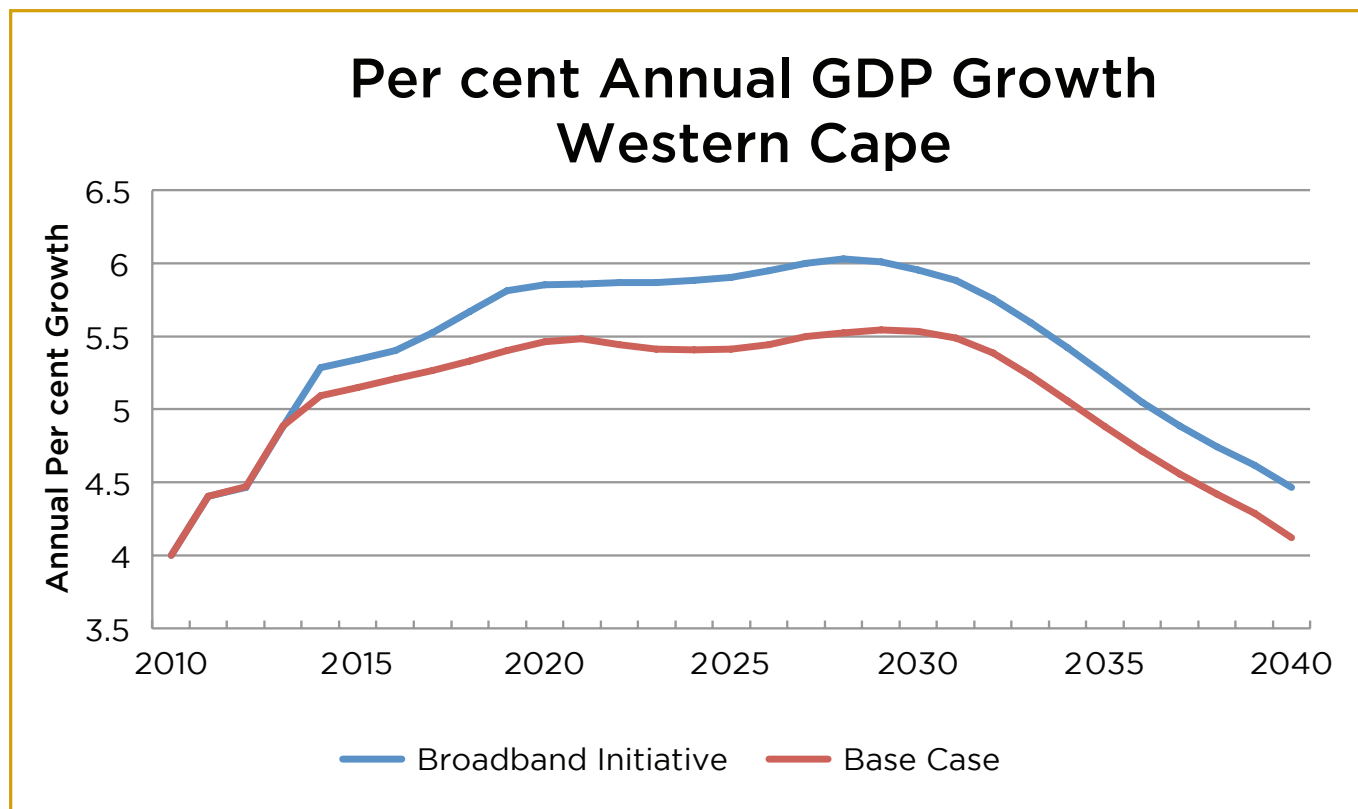
Per cent Annual GDP Growth Western Cape

Figure 6: Annual GDP Growth Rate,

Life Expectancy

Table 1: Total Life Expectancy Rankings (Base Case)

Life Expectancy				
	2010	**2020**	**2030**	**2040**
Western Cape (ranking in 2010)	65 years (135th)	69 years (118th)	74 years (79th)	78 years (40th)
Reference Countries (2010)	Yemen	Russia	Romania	Mexico

HIV/AIDS was largely to blame for a decline in life expectancy from 65 to 63 years in the Western Cape between 1995 and 2005.[13] The recent implementation of antiretroviral therapies (ARTs) on a

broader scale is now slowing this downward trend by reducing both HIV transmission and mortality. Nearly 1,8 million HIV patients received ARTs in South Africa in 2011, reflecting substantial growth in access to treatment since 2004.[14] However, the course of HIV/AIDS will remain a critical uncertainty for the Province going forward. Although the Western Cape has the lowest HIV prevalence rate among any of South Africa's provinces, the virus still poses a considerable challenge to future human development.

The HIV/AIDS epidemic also led to an increase in infant mortality in the Western Cape in the late 1990s. Recently, however, infant mortality rates have been on the decline, due in part to the implementation of ART programmes that prevent vertical transmission of HIV from mother to child.[15] Data suggest that infant mortality grew to a peak of 31 deaths per 1 000 in 2001 and had dropped to approximately 20 deaths per 1 000 in 2010.[16] The Base Case suggests that this positive trend will continue, partially driven by continued improvements in HIV/AIDS medicine.

While the most severe problems posed by HIV/AIDS seem to be eroding, communicable disease still remains a problem. In addition to the burden of communicable disease, the Western Cape faces an increasing burden from non-communicable disease, partially driven by an aging population. Health care systems will be increasingly strained by this "double burden" of disease.
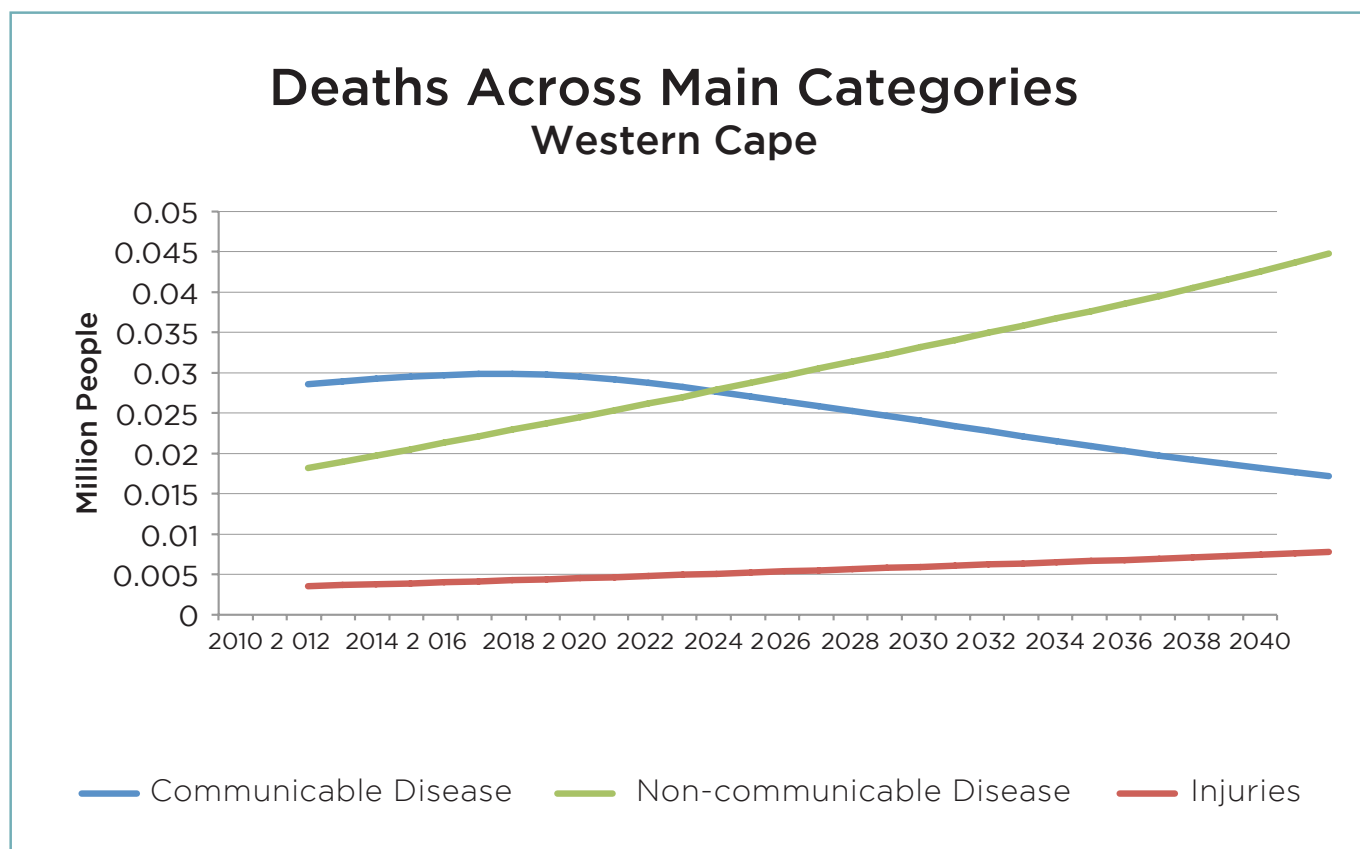

Figure 1: Forecast of Deaths by Category for Western Cape

Alternative Scenario: The End of AIDS

HIV/AIDS has been a defining health challenge for the Western Cape over the last decade. But how might the Province look if the HIV/AIDS epidemic was eradicated? Stemming the AIDS epidemic will require the attention of policymakers, public health officials, and active, responsible citizens in two key areas: promoting behaviour-change interventions to reduce the transmission of HIV through a

"whole-of-society" approach; and improving the treatment of people currently living with HIV. This scenario represents a decrease in risky sexual behaviours in the Province, as well as a continued commitment to ART programmes.

Based on recent research on the efficacy of ARTs, **The End of AIDS** simulates an increased and sustained commitment to antiretroviral therapies for those living with HIV. One recent study in KwaZulu-Natal reported a decline in AIDS mortality of 25 per cent among patients receiving antiretroviral treatment.[17] In a global study of couples with only one HIV positive patient, early initiation of ARTs reduced transmission of HIV to the non-infected partner by 96 per cent, relative to delayed establishment of therapy.[18] This groundbreaking study suggests that early initiation of ARTs can prolong lives and reduce HIV transmission rates.[19] Furthermore, the additional cost per patient is typically lower when ARTs are initiated early – before opportunistic infections devastate the immune system.[20] These studies are part of a growing movement in HIV medicine for "treatment as prevention".[21, 22]

Another critical HIV prevention method is an increased, consistent use of condoms. A recent study measured the impact of HIV treatment and prevention programmes in South Africa on disease transmission, and found condom use to be the most effective programme in HIV incidence reduction.[23] In this scenario we increase contraception use from 75 per cent to nearly 90 per cent by 2020.

In **The End of AIDS**, a sustained commitment to ARTs coupled with increased, consistent condom usage leads to a powerful reduction in HIV prevalence. Total HIV prevalence declines from 3 per cent of the population in the Base Case in 2040 to just below 0,5 per cent, and approximately 80 000 cumulative deaths are averted by 2040. Life expectancy in the Province improves by approximately one year, and over 2 million years of human life are saved by 2040, relative to the Base Case forecasts.

The positive impacts from **The End of AIDS** are also seen in the economy. Total GDP grows by ZAR 14 billion in 2040 (in real Rands). One reason for this boost in output is the increase in the size of the labour pool. With AIDS no longer robbing people of the most economically productive years of their lives, the Province's economy flourishes. Furthermore, human capital contributes more to productivity because the workforce is healthier.
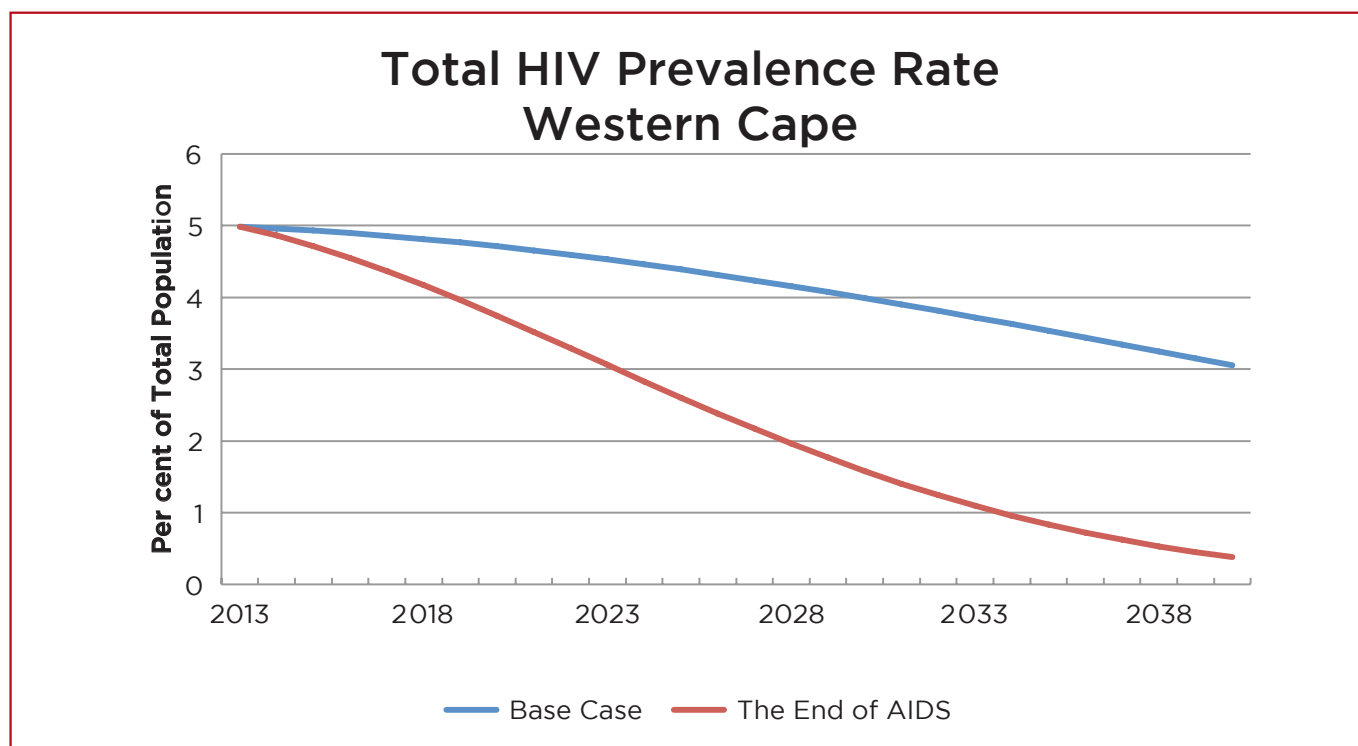

Figure 2: HIV Prevalence Rate (Total Population), Western Cape

Western Cape HDI

Table 5: Global HDI Rankings (Base Case)

Human Development Index				
	2010	**2020**	**2030**	**2040**
Western Cape (ranking in 2010)	0,68 (91st)	0,74 (62nd)	0,81 (39th)	0,85 (27th)
Reference Countries (2010)	China	Russia	Hungary and Portugal	Austria and United Kingdom

The Base Case tells a generally positive story of human development for the Western Cape to 2040. Strong macroeconomic growth over the next decade could place the Province among the ranks of today's middle income countries of Europe. Average life expectancy is forecast to increase considerably, particularly as the HIV/AIDS epidemic becomes more contained and manageable. Finally, the fundamentals are in place for positive development in the Western Cape's education system.

This encouraging story notwithstanding, the Western Cape faces a number of inequalities and human development challenges. Income inequality is well documented, but other types of inequality are similarly obstinate, including access to basic services like electricity, safe water, and improved sanitation, as well as divergent health and education outcomes among low- and high-income households. The Western Cape faces the challenge of translating macroeconomic success into development that is felt by all.

In fact, the HDI declined slightly in the Province in the recent past, due in large part to legacies of uneven development under apartheid and, more recently, the HIV/AIDS epidemic. However, a new story is being written in the Western Cape – one that further extends human capabilities by providing access to goods and services that extend longevity, knowledge, and income in the Province.
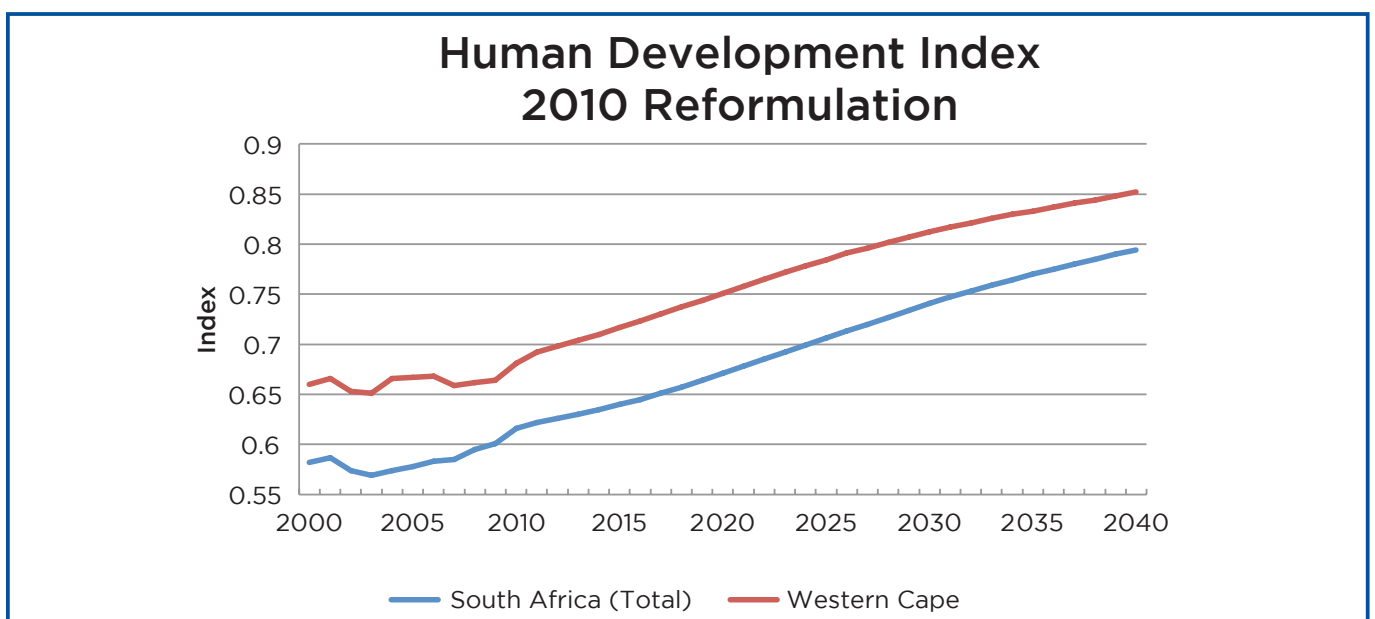

**Human Development Index
2010 Reformulation**

Legend: South Africa (Total) — Western Cape

Figure 7: Base Case Forecast of HDI, Western Cape and South Africa

While human development in the Western Cape improves steadily in the Base Case, this is just one possible future. Successful implementation of initiatives targeting components of the HDI – income, health and education – could speed up progress. Indeed, the three alternative scenarios explored in this brief represent futures marked by rapid capability development for the Western Cape's population. A final scenario, **Accelerated Development**, captures the effects of a simultaneous implementation of the policies simulated in **The End of AIDS**, **Education Push**, and **Broadband Initiative** scenarios. Figure 7 highlights the benefits of such a broad-based, cross-cutting development initiative, as well as the unique development path sketched in each of the four scenarios.
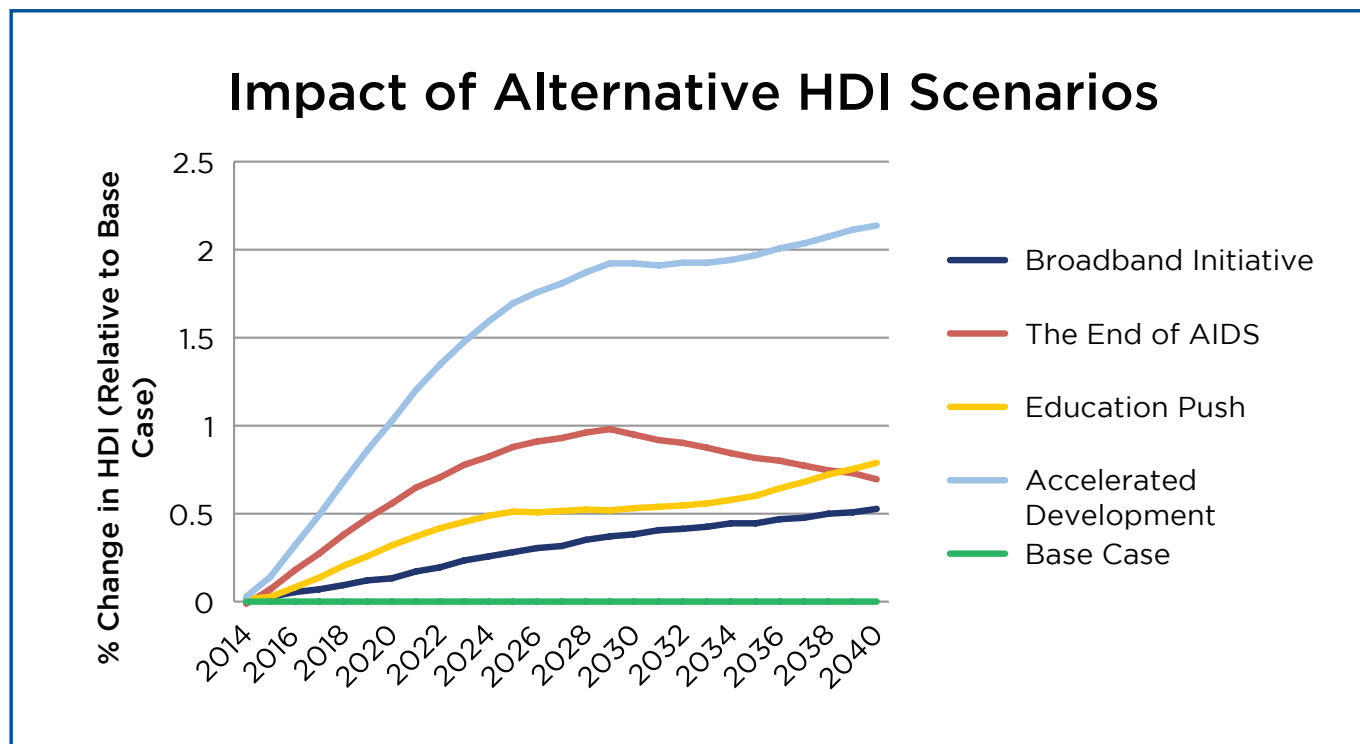

Figure 8: Scenario Impact on HDI, Western Cape

Of the three single-issue intervention scenarios, **The End of AIDS** has the largest initial impact on HDI. Until 2030, the health intervention represents a bigger boost to human development than the **Education Push** and **Broadband Initiative** scenarios combined. This highlights the quick-acting, powerful effect that an HIV/AIDS treatment and prevention campaign could have on human development in the Western Cape. As the epidemic is brought under control, a pattern of diminishing returns sets in.

Conversely, benefits from the **Education Push** scenario are slow to materialise but increase consistently throughout the time horizon. In fact, in 2040, benefits from the aggressive education scenario come to contribute the greatest amount to HDI. Improving intake and throughput across school levels in the Western Cape represent an investment in the capabilities of the Province's young population. Financial returns on this investment increase incrementally over time, eventually more than covering costs.

Increases to Internet connectivity simulated in the **Broadband Initiative** scenario would also contribute progressively more to the Human Development Index over time. Despite triggering a significant boost to the Western Cape's economy – in 2040 GDP would be ZAR 120 billion higher than in the Base Case – the policies simulated in **Broadband Initiative** would have a weaker, though still significant, impact on human development than improvements to health and education.

Of course the future marked by the highest level of human development features all three policy initiatives occurring simultaneously, a future captured in the **Accelerated Development** scenario. In this hypothetical future, the Western Cape would experience a full 2 percentage point increase in HDI over the Base Case forecast. This total is larger – 0,1 percent – than the sum of the constituent parts, as **Accelerated Development** captures synergistic effects between the individual scenarios. For instance, including improvements to both health and education in one scenario would trigger a positive feedback loop, as the healthier children get the more time they spend in school, and the more schooling a child receives, the greater the likelihood that he or she will be able to live a healthy life. Trade-offs would undoubtedly exist between the initiatives as well. In reality, it would probably be quite difficult to muster the physical and political capital needed to enact all three initiatives at once.

The 2013 edition of the United Nations Development Programme's (UNDP) Human Development Report describes recent achievements in the global South, a region that is currently investing in its population's well-being. According to the UNDP, "the goal, as always, is to accelerate wherever possible, broad-based progress that raises standards and expands people's choices in all countries and communities in all key dimensions of human development". [34] Our Base Case forecasts show the inhabitants of the Western Cape primed to expand their choices and their capabilities dramatically, with the Province reaching in 2040 a level of HDI comparable to the United Kingdom today. The alternative scenarios outlined in this brief represent potential pathways toward even faster human development in the Western Cape.

The African Futures Project

The African Futures Project (www.issafrica.org/futures) is a collaboration between the Institute for Security Studies (www.issafrica.org) and the Frederick S. Pardee Center for International Futures (www.ifs.du.edu) at the Josef Korbel School of International Studies, University of Denver. The Institute for Security Studies is a widely recognised Pan-African think-tank specialising in issues of human security. The Pardee Center is the home of the International Futures modelling system, an integrated approach to exploring and understanding human development and the broad implications of policy choices. These organisations leverage each others' expertise to provide forward-looking, policy-relevant material that frames uncertainty around human development in Africa.

Appendix: HDI Technical Notes

The Human Development Index has changed since its creation in 1990 in hopes of more accurately capturing the story of human development around the world. This report utilises the most recent version of the Human Development Index.[35]

Each of the component indices of the HDI is normalised, which allows for comparison of values across indicators with different units. In this process, a minimum and a maximum value are assigned to each component, and the difference between the two accounts for the scale. Then, the difference between the observed value and the minimum value is taken, which essentially defines the course of development that the country has taken in that particular index. This difference is then taken as a proportion of the *scale,* which places every country on the development continuum for that index. This technique places each country on a scale from 0 to 1, with higher values being indicative of greater development.

The new HDI (NHDI) takes the geometric mean of each of the three component indices:

$$NHDI = H^{\frac{1}{3}}E^{\frac{1}{3}}I^{\frac{1}{3}}$$

Where
H = Health Index, defined as life expectancy (le) at birth:

$$(le - le_{min})/(le_{max} - le_{min})$$

E = Education Index, compiled by mean years of schooling (mys) and expected years schooling (eys):

$$\left[\left(\frac{mys - mys_{min}}{mys_{max} - mys_{min}}\right) * \left(\frac{eys - eys_{min}}{eys_{max} - eys_{min}}\right)\right]^{\frac{1}{2}}$$

Expected years of schooling (or school life expectancy), is calculated by taking the product enrolment rates from each level of schooling and the respective amount of time in each level, divided by 100:

$$\frac{PRI + SECLWR + SECUPPR + TER}{100}$$

For example, in the above equation:

PRI = gross primary enrolment $_*$ years in primary education

I = Income Index, defined as the natural log of gross national income (gni):

$$(\ln(gni) - \ln(gni_{min})/(\ln(gni_{max}) - \ln(gni_{min}))$$

The minimum values of each of the component indices are the estimated subsistence minimum;[36] maximum values are the observed maximum from the data series from 1980 to 2010. The minimum and maximum values are as follows:

$$\{le_{min}, le_{max}\} = \{20, 83.2\}$$

$$\{mys_{min}, mys_{max}\} = \{0, 13.2\}$$

$$\{eys_{min}, eys_{max}\} = \{0, 20.6\}$$

$$\{gni_{min}, gni_{max}\} = \{163, 108211\}$$

[1] In 2010 South African rand. Converted from 2005 rand using Statistics South Africa GDP deflator. Statistics South Africa. *Gross Domestic Product Statistical Release 3rd Quarter 2011 P0441.*

http://www.statssa.gov.za/publications/P0441/P04413rdQuarter2011.pdf. (Accessed March 2013).

[2] Selim Jahan. *Measuring Human Development: Evolution of the Human Development Index.* Oxford Training Course (2002). UNDP and OEH. http://hdr.undp.org/en/media/Jahan_HDI.pdf. (Accessed January 2013).

Michael P. Todaro and Stephen C. Smith. *Economic Development.* 11th ed. Boston, MA: Addison-Wesley, 2012.

[3] United Nations Development Programme. *Human Development Report 1990.* New York and Oxford: Oxford University Press. 10. http://hdr.undp.org/en/media/hdr_1990_en_chap1.pdf. (Accessed January 2013).

The capabilities approach to human development has its roots in Dr. Amartya Sen's work. See: Amartya Sen. *Tanner Lectures in Human Values: The Standard of Living.* 1st ed. United Kingdom: Cambridge University Press, 1987.

[4] Selim Jahan. *Measuring Human Development: Evolution of the Human Development Index.*

[5] See Appendix: HDI Technical Notes for a definitional and mathematical description of the new HDI.

[6] Michael P. Todaro and Stephen C. Smith. *Economic Development.*

[7] The original HDI equation was the sum of the three component indices. The advantage of this technique is that it rested on the foundation of perfect substitutability. Life expectancy, education, and income were each weighted equally. The 2010 revamp of HDI introduced the notion of imperfect substitution of the component indices, by taking the geometric mean of the product of each index. Some offer criticism of the new HDI calculation, because the weighting of the indices is now less explicit. See: Martin Ravallion. *Troubling Tradeoffs in the Human Development Index.* Journal of Development Economics (2012): 201-209.

[8] For a complete overview of the evolution of HDI, see Jahan or Todaro and Smith.

[9] Jeni Klugman, Francisco Rodriguez and Hyung-Jin Choi. *The HDI 2010: New Controversies, Old Critiques.* Journal of Economic Inequality 9.2 (2011): 249-288.

[10] This analysis rests on the foundation of the following works (available at http://www.ifs.du.edu/documents):

Hughes, Barry B., Mohammod T. Irfan, Haider Khan, Krishna B. Kumar, Dale S. Rothman, José R. Solórzano. *Reducing Global Poverty.* Patterns of Potential Human Progress Vol. 1 (2009). Oxford University Press and Paradigm Publishers. Pardee Center for International Futures: University of Denver.

Hughes, Barry B., Randall Kuhn, Cecilia M. Peterson, Dale S. Rothman, and José R. Solórzano. *Improving Global Health.* Patterns of Potential Human Progress Vol. 3 (2011). Oxford University Press and Paradigm Publishers. Pardee Center for International Futures: University of Denver.

Dickson, Janet R., Barry B. Hughes, and Mohammod T. Irfan. *Advancing Global Education.* Patterns of Potential Human Progress Vol. 2 (2010). Boulder, CO, and New Delhi, India: Paradigm Publishers and Oxford University Press.

[11] For further documentation of the IFs Base Case, see Hughes, Barry B.; Irfan, Mohammod T.; Moyer, Jonathan D.; Rothman, Dale S.; Solórzano, José R. "Exploring Future Impacts of Environmental Constraints on Human Development." *Sustainability* (2012): 958-994.

[12] For further information on scenario analysis, see http://www.du.edu/ifs/help/use/scenario/index.html.

[13] For the Western Cape model, data on life expectancy were obtained from Statistics South Africa; HIV prevalence figures were obtained from the Actuarial Society of South Africa.

[14] Leigh F. Johnson. *Access to Antiretroviral Treatment in South Africa, 2004 – 2011.* The Southern African Journal of HIV Medicine 13.1 (2012): 22-27.

[15] David E. Bourne, MaryLou Thompson, Linnea L. Brody, Mark Cotton, Beverly Draper, Ria Laubscher, M. Fareed Abdullah, and Jonny E. Myers. *Emergence of a Peak in Early Infant Mortality Due to HIV/AIDS in South Africa.* Aids 23.1 (2009): 101-106.

[16] Data on infant mortality obtained from the Actuarial Society of South Africa.

[17] Rifat Atun and Jacqueline Bataringaya. *Building a Durable Response to HIV/AIDS: Implications for Health Systems.* Journal of Acquired Immune Deficiency Syndromes 57 (2011): S92.

[18] Myron S. Cohen, et. al. *Prevention of HIV-1 Infection with Early Antiretroviral Therapy.* The New England Journal of Medicine 365.6 (2011): 493-505.

[19] This study was administered to HIV patients that were relatively asymptomatic, with CD4 counts ranging from 350 to 500 cells per cubic millimetre. As a point of reference, AIDS occurs when the CD4 count of a patient is less than 200 cells per cubic millimetre. In this study, early ART initiation had less of an impact on African participants, possibly due to higher viral loads of patients or a decreased use of condoms among participants.

[20] Rory Leisegang, Susan Cleary, Michael Hislop, Alistair Davidse, Leon Regensberg, Francesca Little, and Gary Maartens. *Early and Late Direct Costs in a Southern African Antiretroviral Treatment Programme: A Retrospective Cohort Analysis.* PLoS Med 6.12 (2009): e1000189.

[21] Suzanna Attia, Matthias Egger, Monika Müller, Marcel Zwahlen, and Nicola Low. *Sexual Transmission of HIV According to Viral Load and Antiretroviral Therapy: Systematic Review and Meta-analysis.* AIDS 23.11 (2009): 1397-1404.

[22] Jon Cohen. *Treatment as Prevention.* Science 334 (2011): 1628.

[23] Leigh F. Johnson, Timothy B. Hallet, Thomas M. Rehle, and Rob E. Dorrington. *The Effect of Changes in Condom Usage and Antiretroviral Treatment Coverage on Human Immunodeficiency Virus Incidence in South Africa: A Model-Based Analysis.* Journal of the Royal Society Interface 9 (2012): 1544-1554.

[24] This forecast declines between 2030 and 2040 because gross enrolment rates decline. Gross enrolment measures the number of people enrolled at a level of education relative to the number of age appropriate students and can grow beyond 100 per cent. In the Base Case, primary, lower secondary, and upper secondary gross enrolment rates are forecast to peak well above 100 per cent around 2030, before returning to around 100 per cent over time. By 2060, the measure stabilizes between 14 and 15 years.

[25] Janet Dickson, Mohammod Irfan and Barry Hughes. "Advancing Global Education." Potential Patterns of Human Progress (PPHP) Volume 2. Paradigm: 2010. Page 150.

[26] See Appendix A: HDI Technical Notes for a complete description of the expected years of schooling measurement.

[27] "The Social Outcomes of Education and Feedbacks on Growth in Africa" (2002) by Elizabeth Appiah and Walter McMahon corroborate the long payback period associated with investments in education observed in IFs.

[28] Keith Gehring, Mohammod Irfan, Patrick McClennan, Jonathan Moyer, Hopolang Selabalo and Erin Torkelson. *Knowledge Empowers Africa.* Institute for Security Studies and The Pardee Center For International Futures: 2011.

[29] Forecast converted to 2010 rand using Statistics South Africa GDP deflator. Statistics South Africa. *Gross Domestic Product Statistical Release 3rd Quarter 2011 P0441.*

[30] The International Futures (IFs) modelling system, version 6.68. IFs was initially developed by Barry B. Hughes and is based at the Frederick S. Pardee Center for International Futures, Josef Korbel School of International Studies, University of Denver, www.ifs.du.edu. Data on gross domestic product collected from Statistics South Africa. Calculation made within International Futures.

[31] Data obtained from Statistics South Africa.

[32] Excerpt taken from the 2013 State of the Western Cape Address, found at: http://politicsweb.co.za/politicsweb/view/politicsweb/en/page71654?oid=359734&sn=Detail&pid=71616   (Accessed May 2013).

[33] Forecast converted to 2010 rand using Statistics South Africa GDP deflator. Statistics South Africa. *Gross Domestic Product Statistical Release 3rd Quarter 2011 P0441.*

[34] UNDP. "Human Development Report 2013: The Rise of the South." UNDP. 2013, Page 11,

[35] Jeni Klugman, Francisco Rodriguez and Hyung-Jin Choi. *The HDI 2010: New Controversies, Old Critiques.* http://hdr.undp.org/en/reports/global/hdr2011/papers/HDRP_2011_01.pdf.   (Accessed January 2013).

[36] Ibid., 16.

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