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ENERGY INVESTMENTS AND SUSTAINABLE DEVELOPMENT IN AFRICA

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Abstract: There is no lack of energy sources in Africa – especially fossil fuels – however many countries in Sub-Saharan Africa continue to be plagued by energy shortages. This can seriously impede productivity particularly in SME's and add to energy costs through the need for investment in own generating capacity. In addition the transmission systems are often expensive due to 'down time' and this also raises production costs. It also raises costs for households that are effectively forced to generate their own power. This chapter examines three dimensions of the energy 'gap' in the context of a number of countries. First, will investment in energy capacity lead to sustainable GDP growth? Second, would investment in renewable or 'green' energy capacity make a significant difference? And third, is energy output really such an essential prerequisite for sustainable economic growth?

Keywords: *Africa; energy; investment; GDP; economic growth.*

INTRODUCTION

This chapter examines three dimensions of the energy 'gap' in the context of a number of countries. First, will investment in energy capacity lead to sustainable GDP growth? Second, would investment in renewable or 'green' energy capacity make a significant difference? And third, is energy output really such an essential prerequisite for sustainable economic growth?

For many years the relationship between energy outputs and economic growth and energy consumption and economic growth have been examined from a number of perspectives (see for example Hannesson (2009); Wold-Rufael (2005); Lee (2005) Squalli (2007); Yui and Choi (1985). A review of these studies and others raises a fundamental problem – the evidence supporting a positive relationship between energy production or consumption and economic growth (and vice versa) is so contradictory that today we remain largely unsure of the true relationship that exists between them, if indeed a relationship exists at all.

Even where a 'relationship' is supported by the econometric models it is usually weak, has very low explanatory and predictive power and fails to demonstrate any clear direction of causality. In other words, it can only be concluded that we still do not understand to any significant extent the role of energy in promoting economic growth. Therefore calls to cut energy production and consumption in the interests of the environment may be very well intentioned but also could have a very negative effect on the

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growth of countries in SSA since we simply do not understand how growth and energy are truly related. This is very clear when we can derive from 25 years of literature on this subject essentially four (partially) competing hypotheses regarding the relationship between energy consumption and GDP growth: these are:

The growth hypothesis: energy as a factor of production is both an economic and engineering (technical) complement to both labour and capital inputs hence growth in consumption leads to growth in GDP. If energy consumption growth does not lead to GDP growth then this may be due to inefficient energy distribution systems and possibly energy acting as an economic substitute rather than an economic complement to capital and labour.

The neutrality hypothesis: the role of energy consumption in GDP growth is so limited that there is simply no causal relationship flowing from energy to GDP.

The feedback hypothesis: this states that energy and GDP are bi-directional in their relationship – in certain circumstances they generate growth from each other depending on the stage of economic development, GDP structure and the structure of energy consumption as between households and industry.

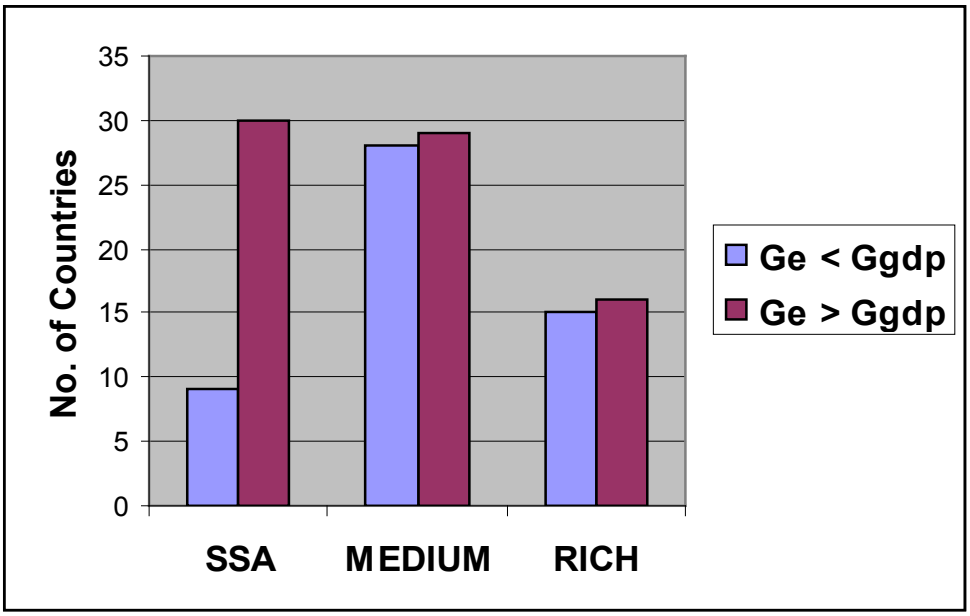
The conservation hypothesis: improvements in energy efficiency resulting in lower energy consumption growth can lead to GDP growth so that every extra 'dollar' of GDP requires less energy input.

The literature on the above is frustratingly inconclusive. Some studies lend some support to one hypothesis while others support another. We can only conclude (even so early in the Chapter) that we simply do not yet understand the fundamental relationships between energy consumption and GDP growth, energy production and energy consumption, and between energy 'inputs' and labour and capital as factors of production. This is clear from the following brief review of some of this literature.

Will investment in energy capacity lead to sustainable GDP growth?

In a recent study (Hanneson, R., 2009) argues that there is a consistent relationship between energy consumption and real GDP growth if measured over a long time scale (between 30 and 50 years) which shows a significant and positive relationship between energy use and GDP growth. However this study also points out that this relationship is only weakly consistent if countries are classified according to rich, medium and poor (in terms of their GDP per capita). Using the same data it is easy to show that there is a very large difference between the classifications in terms of the relationship between energy use and GDP growth (see Figure 1):

The time period for each country in each of the three classifications varies according to statistical availability but the range is between 51 and 30 years. It is quite clear from Figure 1 that both medium and rich countries share a common pattern – over a significant time period roughly 50 percent in each category have experienced energy consumption growth to be less than GDP per capita growth while the other 50 percent experienced the opposite! However in all SSA countries it is also very clear that the pattern is completely different – over three quarters of these countries over a substantial time period have experienced energy consumption growth greater than GDP per capita growth. Why should this be? There are a number of possible reasons:



Source: Hannesson, R. 2009 (Appendix data)

Figure 1 Energy Use and GDP Growth by GDP Classification

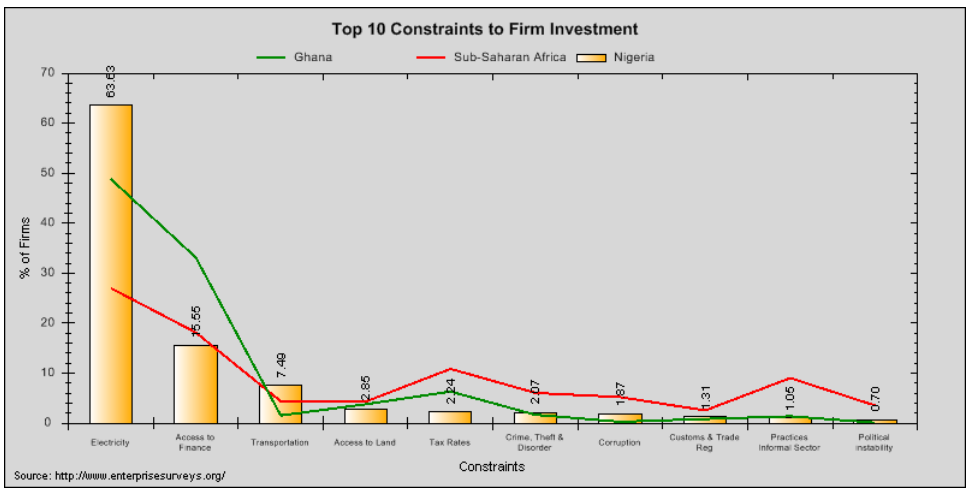
1. GDP growth rarely includes all of the output from the informal sector in many countries and hence will be higher than that reported in official statistics.
2. Factor substitution: in several countries, due to the many power outages firms substitute sub-optimal manufacturing equipment for less electricity. In these circumstances poorer capital becomes a substitute for energy rather than an engineering and economic complement.
3. Product substitution: due to unreliable (and expensive) power firms substitute less electricity intensive products for those they would prefer to produce.
4. Significant variation in climate conditions between regions will affect any 'consistency' pattern between energy and GDP growth.
5. Power outages: this inevitably results in significant production losses and hence GDP growth is constrained and explains why so many firms prefer to (eventually) switch to own generating capacity (for example in Nigeria it is about 97 percent!).
6. Power dissipation: even where electrical power is produced it is often the case that the transmission system is in disrepair resulting in substantial power losses across the grid, hence output may be rising but consumption actually falls!

Many other studies reveal very conflicting conclusions regarding the energy – GDP relationship. In a study of 17 African countries Wolde-Rufael (2005) argued that there is simply no agreement over the direction of causality between energy and GDP growth when we include labour and capital as additional variables. This study revealed very little support for the proposition that higher energy consumption leads to higher economic growth. Akinola (2008) also found similarly conflicting results for eleven countries.

For other regions in the world a similar pattern emerges from this type of literature: in the case of Asian countries and the USA, Chiou–Wei et al (2008) could find no consistent evidence of any strong unidirectional flow from energy to GDP or vice versa. For a group of countries in South America Chontanawat et al (2006) find conflicting support for several of the 'hypotheses'. Numerous studies of this 'question' have been undertaken for the developed countries and again the results are equally conflicting. So, the first question – will investment in energy capacity lead to sustainable economic growth in the SSA countries – remains unanswerable – we simply do not know. However the pattern over a significant period of time has been one of higher energy growth than GDP growth (see Figure 1) and this is one 'pattern' that has been consistent in over 75 percent of these countries.

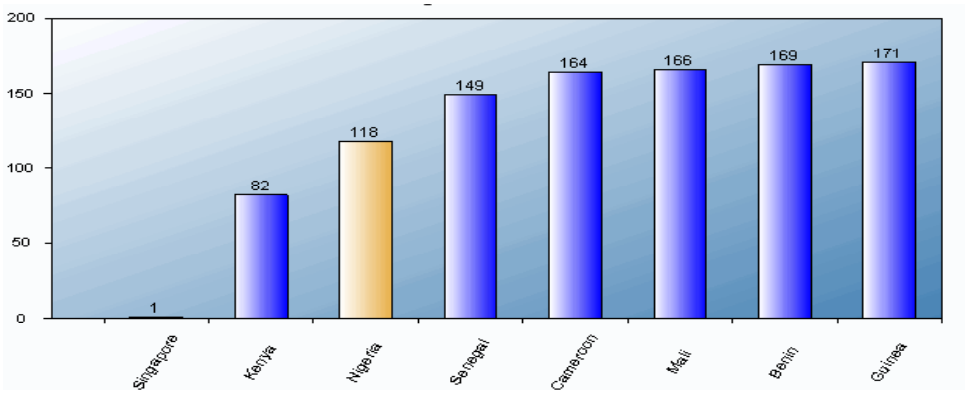
To take just three countries, the 2008-09 Global Competitiveness Report reveals Nigeria, South Africa and Ghana to be a long way down the 'list' in terms of adequate power supplies at 132nd, 101st and 103rd respectively. In the case of Nigeria the country has over 140 million people and generates about 2000 megawatts of electrical power equal to an average of 14.3W per capita. This can be compared with many developed countries in Europe where the per capita output is equal to about 570W per capita – almost 40 times more per annum! A cursory examination of the electrical output in most SSA countries reveals a similar gap when compared with developed economies. In a report from the World Bank recently it was shown that the major constraint to investment in a number of SSA countries was electrical power availability. This can be seen in Figure 2 below:

Over 60 percent of firms in Nigeria, 50 percent in Ghana and 28 percent in South Africa reported this is their number one concern that prevented further investment and expansion. It is not difficult to find higher figures for other SSA countries. In another set of reports (see Figure 3) we find that many SSA countries are ranked very low in terms of the ease of doing business and a closer look at these data reveal again that infrastructure, especially electrical



Source: World Bank Enterprise Survey Report 2008.

Figure 2 Constraints on Company Investment



Source: World Bank Reports; Doing Business 2009. Country profiles

Figure 3 Ease of Doing Business: Rankings from 181 Countries

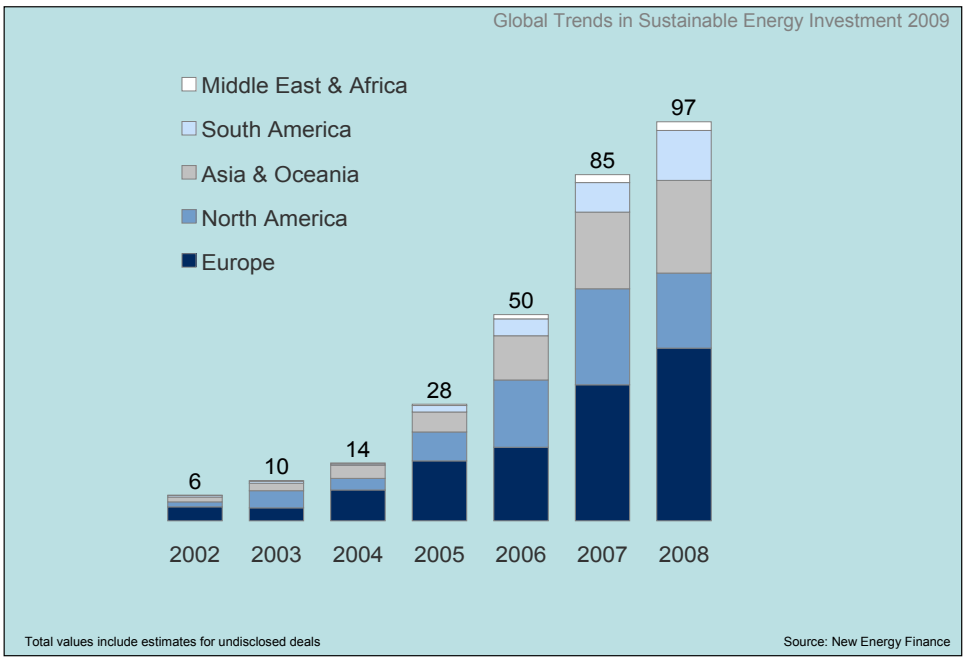
power reliability, is one of the most important weaknesses for most firms.

The gap between the power available to households and firms in the developed countries and those in the SSA countries is simply breathtaking – it is not small and it is not closing, if anything it is getting larger. But does this matter for economic growth in the SSA countries given that the evidence on the relationship between energy consumption and GDP growth is so contradictory? There is no consistent evidence whatsoever that investment in energy capacity *per se* will lead to sustainable economic growth. So, does this matter? The answer is a resounding yes – we already know that the efficiency of the electrical power systems in these countries is weak and the capacity is well below where it needs to be and this is the most likely reason that we see energy production and consumption rising faster than GDP per capita. A far more efficient distribution and transmission system would reduce the cost substantially to firms and households while raising the reliability of the system across peak, shoulder and base load daily demand. In addition it would reduce the need for households and firms to invest in relatively expensive generating capacity thus releasing resources for better uses. However today the focus is on more 'green' energy and a drive towards investment in sustainable energy sources – could this be the solution to the energy gap facing the SSA countries? I turn to this question next.

Would investment in renewable or 'green' energy capacity make a significant difference?

We have to ask a related question here – a significant difference to what? The vast majority of SSA countries (possibly all) are seriously 'under-powered' in terms of electrical output capacity. Investments in 'green' or renewable energy in the developed countries have only managed a pitiful contribution to their total energy output so the potential for these to make a significant difference to capacity in the SSA countries, within the foreseeable future, is extremely low. These energy sources may well be sustainable but in terms of the current gap between demand and supply they are simply not a practical alternative.

At the most they may make a marginal contribution to energy capacity. But in



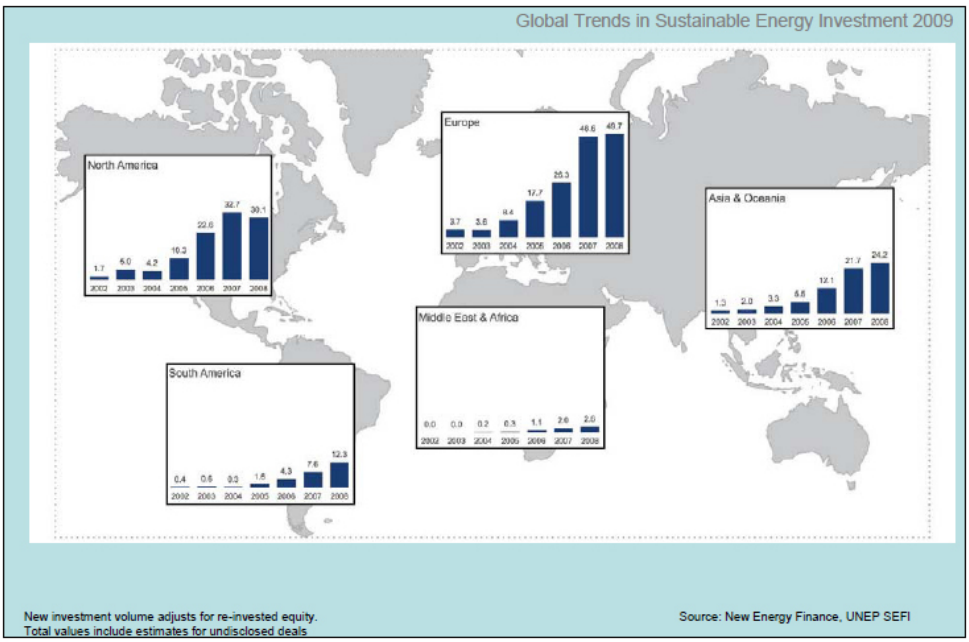
Source: UNEP (2009) Global Trends in Sustainable Investment, 2009

Figure 4 Financing New Build, by Region, 2002-2008, $ billions

terms of sufficient capacity to enable households and businesses to function most of a normal day they are simply not practical as a substitute for conventional power. Even if they were, the distribution systems in many countries are so poor that power losses would reduce their contribution to even less than marginal. Refocusing energy investment in the SSA countries towards green and renewable, especially for electrical power, would in my view be a recipe for even further deterioration in the demand – supply situation. In any case we only have to look at the record of such investments in Africa to see that they are not significant.

As Figure 4 clearly shows the share of investment in new renewable (or sustainable energy capacity) going to Africa since 2002 has been paltry to say the least – between 2002 and 2008 it amounted to less than 1 percent in every year. The vast majority of new build over this time period was in Europe and North America where the investment climate is more conducive but above all the transmission systems are far more efficient and outages and transmission losses are very small.

A clearer picture of the extreme imbalance in the distribution of such investments is given in Figure 5. Here we see by region the complete marginalisation of Africa in terms of such investments. But as discussed earlier, given that the investment attractiveness of many SSA countries is very low it is hardly surprising that private funds, even with Government support, are reticent to invest in energy capacity. An obvious reason for this is the capital intensive nature of these investments so that it is extremely difficult to liquidate assets or move them once



Source: UNEP (2009) Global Trends in Sustainable Investment, 2009

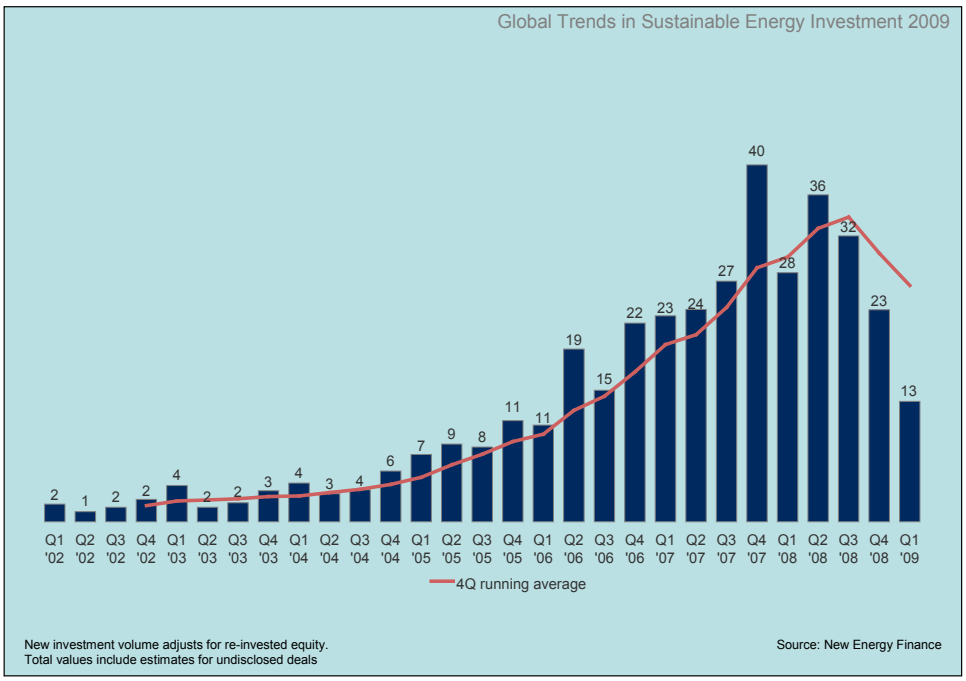
Figure 5 Financial New Investment by Region, 2002-2008, $ billions

they have been installed. Hence the risk associated with these type of investments tends to be significant.

In Figure 5 it is not unreasonable to say that Africa hardly even appears on the sustainable energy investment map. So the argument that countries should begin to consider this as a route to increasing energy capacity is simply untenable – the investment conditions are far from acceptable, the transmission systems would make many such investments effectively useless and the contribution they could make is extremely small, even over the foreseeable future.

When we consider these constraints and then add the current economic crisis we see an even more depressing picture – as UNEP has reported the investment growth in sustainable nergy sources in the developed economies has fallen very significantly during the economic crisis – so what chance is there for such investment in Africa?

Investment in sustainable energy capacity on a global scale dropped by 68 percent between the last quarter of 2007 and the first quarter of 2009. The trend also appears to be continuing downward. What does this mean for such investments in the SSA countries? First, they will continue to be very marginal, second they will not solve the energy gap in these countries and finally they simply do not have the potential to even close the gap because the gap is actually increasing! But perhaps none of this really matters if the view is taken that energy capacity in and of itself is not the prerequisite for economic growth in the SSA countries.



Source: UNEP (2009) Global Trends in Sustainable Investment, 2009

Figure 6 Global Financial New Investment QuarterlyTrend, 2002 - 2009, $B

CONCLUSION

Is energy output really such an essential prerequisite for sustainable economic growth?

As discussed in the first section of this chapter the answer to this question is, on balance, probably not. The evidence from across the globe and across 30 years is so mixed and contradictory that none of the four hypotheses of the energy – GDP relationship can be consistently supported. If anything the fundamental sources of economic growth that drove the development of the European economies remain at the heart of the matter – and these are still education, increasing total factor productivity, investment in all types of infrastructure (not just energy) and creation of an investment and operating climate that encourages risk taking, encourages wealth creation and is not hampered by ubiquitous rent seeking behaviour.

As far as energy investment itself is concerned the demand – supply gap in the next twenty years cannot possibly be narrowed to any useful extent by sustainable energy investment. The countries of SSA if they intend to invest in energy capacity will need to depend on conventional sources for many years to come while focusing much of this investment on the transmission and distribution systems. It could be argued this is not environmentally sustainable – but, it is far more efficient than the current situation where so many firms and households already use such sources for 'micro' power generation. This completely negates any economies of scale or scope in the use of conventional sources of energy and hence a

properly planned, properly maintained and modern energy production system linked to national grids will definitely increase the efficiency of both energy production and consumption in these countries. Whether it will lead to higher economic growth remains, as ever, the most elusive question.

Finally we must be very mindful of the 'politics' of 'sustainability' – and the very understandable view that is often expressed by developing countries on this matter. A particularly vociferous viewpoint but not an isolated example is that offered below:

> *"It sticks in the craw to be lectured ... on how China simply has to accept responsibility for fighting global warming ... because the factories that once polluted American skies ... have now relocated to China."*

And in the same article:

> *"It has become clear with the unfolding of the global economic crisis that ours is a world economy that can only sustain the luxurious lifestyles of the rich in developed economies so long as the rest of the world lives in poverty."*

China Daily, June 4th, 2009

I would be extremely surprised if similar sentiments are not expressed in many of the SSA countries and across the developing world as a whole – and should we be surprised if they are?

BIOGRAPHY

John Adams is the Director of the China-EU Research and Development Centre based in the School of Accounting, Economics and Statistics as well as the Programme Leader at Edinburgh Napier University for the MSc in Investment Promotion and Economic Development. He has worked in East Africa at the University of Dar es Salaam Research Bureau, and in Mauritius, South Africa and Hong Kong. He has published widely in the field of economics in both national and international academic journals, is the co-author of several textbooks and an external examiner at the Universities of Dundee, Hong Kong and Sussex. He has successfully supervised 16 research degrees and also undertaken consultancy assignments for a wide range of public and private sector organisations in the UK. Professor Adams studied at the Universities of Paisley and Glasgow and graduated with a degree in Public Policy and a PhD in manpower planning.

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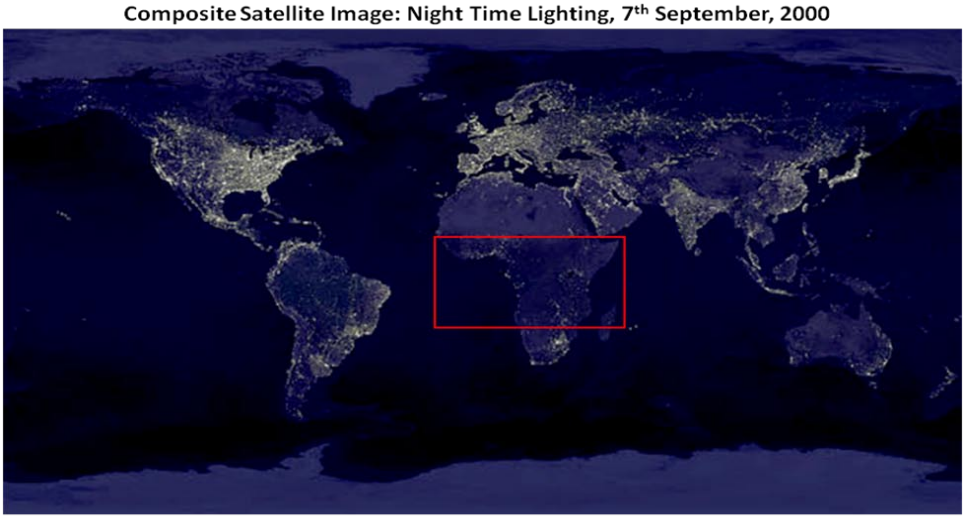
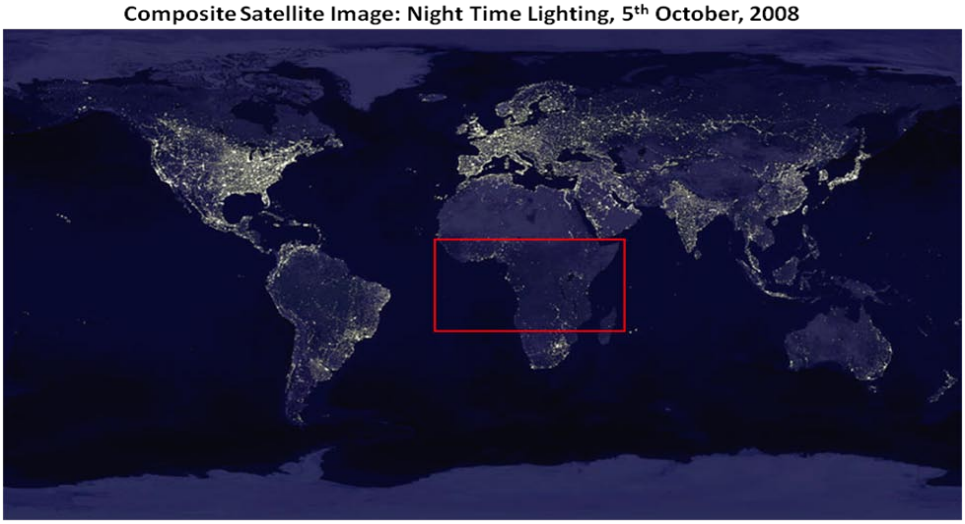
Composite Satellite Image: Night Time Lighting, 7th September, 2000



Source: NASA

Composite Satellite Image: Night Time Lighting, 5th October, 2008



Source: NASA