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Subject: Green Growth's Significance to Engineering Economic Analysis

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GREEN GROWTH

1.0 INTRODUCTION

People are progressive. Ever since the human race has encountered the Industrial Revolution, there has been a challenge to accumulate the most capital. This goal involved dealing with the environment after the fact. Any problems that arose would simply be fixed by adding another solution. However, it is clear that the Earth's resources are being consumed at a high rate and in the future there will not be enough to sustain society. Fortunately, it is entirely possible and within our power to utilize natural resources at a renewable pace while enhancing our economy. This is where the concept of Green Growth and by association sustainable development comes in.

2.0 OVERVIEW AND DEFINITIONS

2.1 GREEN GROWTH

Green Growth is a preventive approach to country development. Currently, through conventional growth, people instigate end-of-pipe approaches to solving problems, in which a new 'solution' is tacked onto a problem in hopes of solving it. However, it does not get to the root of the problem (Vanderburg, 2002). For example, emissions on cars are reduced through the use of catalytic convertors and exhaust controls. The need for long-term thinking, or a preventive approach, is less costly and preferable option. In the case of a car, it could be that we use water to power it instead, creating zero operating emissions. Green Growth can be lessened to preventively building with respect to long-term development and the environment (United Nations, 2011). Many Asian and Pacific countries have adopted it as economic growth policy (ADB, 2012). In North America, we tend to turn to 'sustainable development'.

2.1.1 SUSTAINABLE DEVELOPMENT

Sustainable development is a common phrase and a subset of Green Growth. It is a concept utilised to transform cities and countries into living ecosystems, similar to those already found in society (IISD, 2012). While its intention is the same as Green Growth – to foster growth in our economy while consuming at a rate at which resources can be kept for the future – it is not a strict policy and North American countries tend to be passive in developing 'sustainably'. To build sustainably means keeping track of our natural capital and ensuring that human consumption is entirely under our control.

2.2 NATURAL CAPITAL

One of the most essential items in generating an economy is capital. Inside 'real' capital (essentially GDP) is natural capital - referring to all natural goods and services that are consumed in the creation and commoditization of a product or service. All materials are extracted from nature. One of the most pressing issues discussed in this paper is restraining the use of natural capital to levels in which it can replenish itself over the use of end capital. The concept of decoupling between Gross Domestic Product (GDP) and Carbon Dioxide (CO_2) emissions further explores this issue.

2.3 DECOUPLING

In the past there was a clear positively linear relationship between GDP and CO_2 emissions. As GDP increased so did CO_2 emissions. However, as the environment came into play as a design factor it become clear that this relationship would have to be broken. Decoupling refers to increasing GDP while inflicting a relatively low or minimal impact on the environment, whether it be measured through CO_2 emissions, natural capital stock, and the like.

3.0 ECONOMIC AND GREEN GROWTH INDICATORS

3.1 GROSS DOMESTIC PRODUCT

Much of the time the main economic indicator used to estimate a country's wealth is GDP. However, this is attained from the net sales of product and services in the country. If demand falls, a negative value is inflicted on GDP and therefore a country's prosperity is worsening, despite nothing really happening. The main fallacy with GDP is that it focuses purely on economics – it completely ignores the social factor, which is what it was designed for in the first place.

3.2 GENUINE PROGRESS INDICATOR

A new indicator to avoid this blunder is the Genuine Progress Indicator (GPI). This is a much more cohesive value as it takes into account environmental issues that come from production of goods and services, such as pollution, crime, land use, and waste, as well as human productivity and overall health.

3.3 INDICATORS OF GREEN GROWTH

Many organizations have taken to establishing a set of Green Growth indicators and encourage countries to use these indicators. Two organizations that have established sets are the Organization for Economic Cooperation and Development (OECD) and the Asian Development bank (ADB). A comprehensive list of indicators can be found in Appendices A and B for OECD and ADB respectively.

3.3.1 COMPARISON BETWEEN INDICATORS

The OECD indicators tend to take more to technical terms while the ADB indicators have a more humanistic approach. For example, OECD indicators include full counts of natural assets, while ADB relates natural assets to its potential for human life – e.g. water supply, access to services or dwellings. When used in conjunction these two indicators provide a holistic look at a country's green status.

4.0 EXISTING GREEN GROWTH

As environmental issues continued to rise in numbers, various countries began to take action in reducing greenhouse gas emissions (GHG) and overall energy consumption. The Kyoto Protocol of 1997 provided a framework for this move; however, while most developed countries adopted this policy, they began to waver from it and some countries, including Canada, eventually withdrew from reaching Kyoto targets. However, a number of groups, such as the OECD and ADB, have been able to provide third party environmental support to many countries.

Many of the indicators provided by the OECD and ADB were adopted by many countries worldwide. Three examples of countries that took OECD indicators and applied them as a framework are The Netherlands, The Czech Republic, and Korea.

4.1 **THE NETHERLANDS** (Statistics Netherlands, 2012)

A study from Statistics Netherlands in cooperation with the OECD shows that many of its shortfalls now show signs of decoupling. For example, most factors in environmental efficiency, such as GHG emissions, energy efficiency, and water use show signs of decoupling with GDP. Stocks of natural assets generally show deterioration; however, timber appears to be accumulating. Health problems as a result of GHG emissions are

reduced, while government expenditure in green programs, such as energy pricing strategies and green taxes have overall increased.

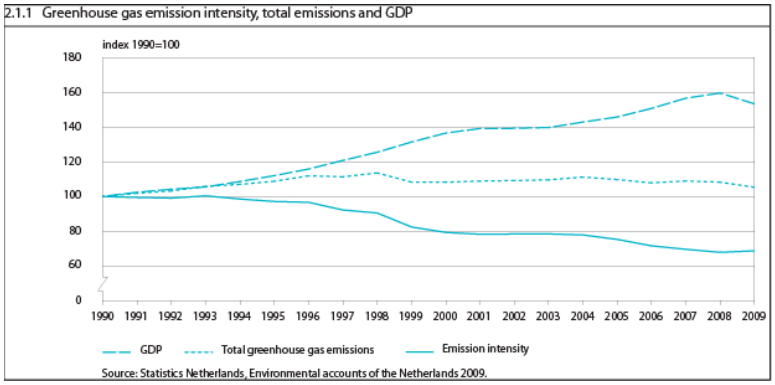

Figure 4.1.1 Relative decoupling of GDP and emissions. (Statistics Netherlands, 2012)

4.2 **CZECH REPUBLIC** (Czech Statistical Office, 2011)

The Czech Republic has known for reduced its coal stocks by up to 54% between 1990 and 2010. To mitigate this, they agreed to follow the Strategic Framework for Sustainable Development. Generally it has improved using OECD indicators. GHG emissions have reduced overall due to increased investment in renewable energy sources and increased productivity (i.e. energy not being wasted). Natural assets have shown a subpar improvement with some resources recuperated such as forest; however, they continue to depend on coal for a large amount and therefore it is still unfortunately decreasing. Health risks have not changed likely due to the coal use. However, life expectancy has increased and the area for water supply has improved.

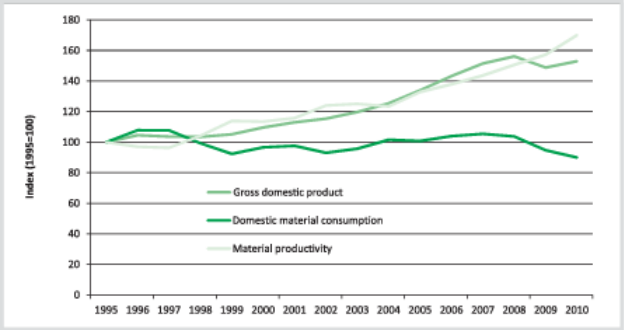

Figure 4.2.1 There is clear decoupling between GDP and domestic material consumption, while material productivity as a whole has significantly improved (Czech Statistical Office, 2011).

4.3 **KOREA** (OECD, 2012)

Overall, Korea is one of most 'green' countries in the world, following through with most of the OECD indicators. It had completely improved its status in three of the four categories (Environmental & Resource Productivity, Environmental Quality of Life, and Policy Response & Economic Opportunities) while beginning to improve its status on the Natural Asset Base category. Trends show that from 2009 to 2010 Korea had worked on decoupling. Its energy, waste and water use had overall decreased. They show signs of increasing biodiversity, timber stocks, and fish; however, its forest area continues to decrease. Pollution is decreasing while intensification is taking place in many cities, while constructing access to water for distant areas. Lastly, expenditures in green growth by the government have overall increased.

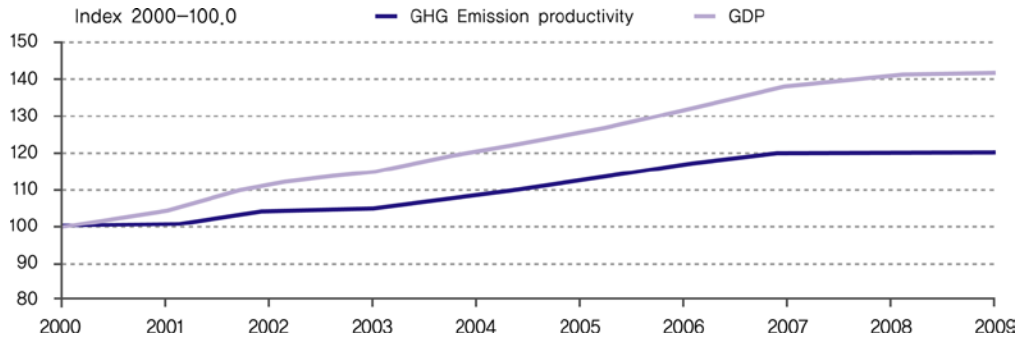

Figure 4.3.1 Decrease in GHG emissions while increasing GDP, indicating signs of decoupling. (OECD, 2011)

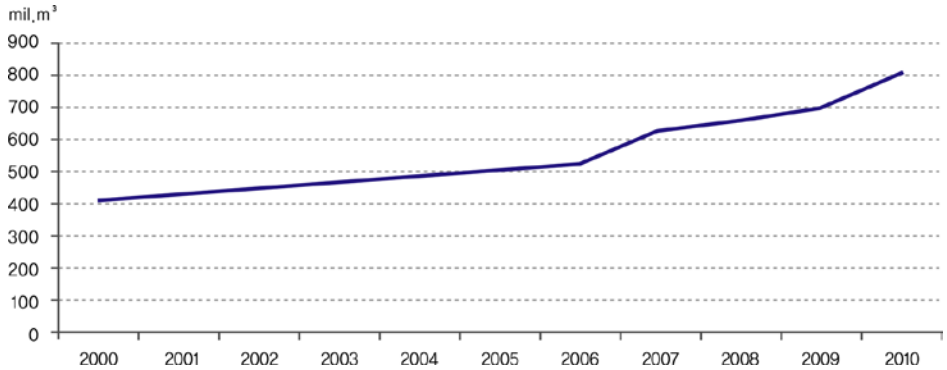

Figure 4.3.2 Example of timber stock accumulation. This trend also applies to many of its other resources. (OECD, 2011)

5.0 SOCIETY AND GREEN GROWTH

5.1 THE PUBLIC

Many people today continue to believe that natural capital can be consumed at any rate with no impacts on the environment. However, many people are warded off by the slightly higher up-front costs on purchasing a product that may be advertised as 'green'. It is unfortunate that it will be extremely difficult to cause people to 'go green' without there being some sort of monetary incentive to do so. Therefore, putting monetary values on natural capital is somewhat appropriate, as there needs to be a standard system used to regulate the transfer of goods and services.

5.2 PROFESSIONALS

Professionals today have a lot of work in front of them today: to fix the mistakes of the past while preserving the Earth for future generations. Amongst these professionals is engineering, which perhaps has the second largest impact on the landscape of the Earth (politics would likely have the largest impact, due to policy and planning).

5.2.1 PROFESSIONAL ENGINEERS

Engineers are responsible for most of the goods and services created in the world. For example, civil engineers are responsible for infrastructure while mechanical engineers are in charge of vehicles and propulsion equipment. It is in our best interest to design products, or services, that least changes the landscape of the Earth. For example, we should design based on the service rather than the product. We should also be investing in more renewable technologies, but not of those in which the production of an inefficient device (i.e. a solar panel) as it will require a lot more energy to construct the device over a short service life.

A good or service must cater to the needs of the people while meeting stringent environmental constraints. Natural capital use should be minimized with negative outputs minimized, while maximizing the desired output. The use of feedback loops would help engineers determine whether the product will provide the service intended with minimal undesired outputs. We should also be investing in reducing demand; for example, constructing intensified cities rather than forcing cross-town travel from suburbs.

Projects should also be specifically designed for a certain area. An example is the Air Rail Link project in Toronto, Ontario in which the design ambition calls for station architecture to make use of only locally procured materials over a stringent timeline (prior to May 2015).

5.3 GOVERNMENT INTERVENTION

As previously stated, using monetary values to regulate the use of natural capital is appropriate but only to a certain extent. There are obvious fallacies with this action as it allows, for example, the deregulation of end fuels extraction (i.e. oil), or clear-cutting forest, and continued commoditization for increased profit at a fairly low capital expenditure. However this needs to come to an end in order to allow resources to re-accumulate.

Therefore, it is only appropriate for the government to step in. Natural capital should be considered a global resource and not local in nature, and is extremely important for society to continue development. At the Rio +20 Earth Summit, it was proposed that governments can use a four-step plan to regulate natural capital use (NCD, 2012):

a) Increase private sector transparency by indicating the intention and use of natural capital resources, as well as the impact of their actions;
b) Regulate the use of natural capital such that it is difficult to make a profiteering business case using it as a base, while rewarding industries that incorporate aspects of part a);
c) Create international agreements;

d) Act as a benchmark for private sector industries through prudent use of cash flows and regulated procurement of natural capital.

Many industries currently focus on capital accumulation rather than having a holistic approach of their actions. Since they are clearly incapable of regulating their natural capital use, it is the only option that the government step in. Unfortunately, as a capital-driven society, it is very possible that politicians that propose drastic changes be 'paid off' to dismiss these ideas. Another quick solution would be to adopt the use of GPI rather than using GDP.

6.0 NATURAL CAPITAL IN ENGINEERING ECONOMICS

As time moves on, it is clear that costs to provide a good or service are also rising. The costs for natural capital also rise; this causes an exponential rise in overall cost and therefore it is much more sensitive factor in design.

Designing a product will have to take into account the amount of material and energy to build the product or service. Therefore, it is best that scope definition is as clear as possible and remain unchanged over the project schedule, as it is one of the costliest items and cause of material waste. The project schedule should also be minimized to maximize the potential use of project funding, as it will likely become more difficult to reach the payback period for the product or service if it is extended.

Lastly, it is likely that a government would fund a 'green' project as it provides comfort in saying that they are building for the environment. Engineering economics can take this into account for future projects and therefore potentially be more eligible for scarce government funding.

7.0 CONCLUSION

Unfortunately, we cannot turn heads overnight and convince everyone that Green Growth is the best way to progress into the future. To convince the public to go green without using monetary values will be a long and arduous fight. The government and private sector organizations can continue to put out as many studies as they can but the main issue lies with education. There are many skeptics that will continue to believe that there are unlimited resources and can live with a 'business as usual' case. Allow them to get involved and voice their opinions so they can be involved and have rational discussions.

APPENDIX A: OECD INDICATORS (OECD, 2011)

Main indicator groups	Topics covered	Related OECD work
The socio-economic context and characteristics of growth		
Economic growth, productivity and competitiveness	Economic growth and structure Productivity and trade Inflation and commodity prices	• Economic outlook • Economic surveys • Going for growth • National accounts • Productivity database • Employment outlook • Education at a glance • Health at a glance • Society at a glance
Labour markets, education and income	Labour markets (employment / unemployment) Socio-demographic patterns Income and education	
Environmental and resource productivity		
Carbon and energy productivity	1. CO2 productivity (demand-based, production-based) 2. Energy productivity Resource productivity 3. Material productivity (demand-based, production-based) Non-energy materials, waste materials, nutrients 4. Water productivity Multi-factor productivity 5. Multi-factor productivity reflecting environmental services	• IEA scoreboard • CO2 emissions database • OECD input-output tables • Environmental indicators • Environmental reviews • Environmental outlook • Material flows & resource productivity • Agri-environmental indicators • Productivity database
Natural asset base		
Renewable stocks	6. Freshwater resources 7. Forest resources 8. Fish resources	• Environmental indicators • Environmental reviews • Measuring progress • Material flows & resource productivity • Environmental outlook • Agri-environmental indicators
Non-renewable stocks	9. Mineral resources	
Biodiversity and ecosystems	10. Land resources 11. Soil resources 12. Wildlife resources	
Environmental quality of life		
Environmental health and risks	13. Environmentally induced health problems and related costs 14. Exposure to natural or industrial risks and related economic losses	• Measuring progress-How's Life? • Environmental indicators • Environmental reviews • Environmental outlook
Environmental services and amenities	15. Access to sewage treatment and drinking water	
Economic opportunities and policy responses		
Technology and innovation	16. R&D of importance to GG 17. Patents of importance to GG 18. Environment related innovation	• Innovation strategy • Science, technology &industry scoreboard • Patent database • R&D database • Aid activity database • Database on environmental policy instruments • Agri-environmental indicators

APPENDIX B: ADB INDICATORS (ADB, 2012)

Poverty and Inequality

Income

1 Proportion of population living below the national poverty line
2 Proportion of population living below $2 a day at 2005 PPP $
3 Ratio of income/consumption of the top 20% to bottom 20%

Nonincome

4 Average years of total schooling (youth and adults)
5 Prevalence of underweight children under five years of age
6 Under-five mortality rate

Pillar One
Growth and Expansion of Economic Opportunity

Economic Growth and Employment

7 Growth rate of GDP per capita at PPP (constant 2005 PPP $)
8 Growth rate of average per capita income/consumption 2005 PPP $ (lowest quintile, highest quintile, and total)
9 Employment rate
10 Elasticity of total employment to total GDP (employment elasticities)
11 Number of own-account and contributing family workers per 100 wage and salaried workers

Key Infrastructure Endowments

12 Per capita consumption of electricity
13 Percentage of paved roads
14 Number of cellular phone subscriptions per 100 people
15 Depositors with other depository corporations per 1,000 adults

Pillar Two
Social Inclusion to Ensure Equal Access to Economic Opportunity

Access and Inputs to Education and Health

16 School life expectancy (primary to tertiary)
17 Pupil-teacher ratio (primary)
18 Diphtheria, tetanus toxoid, and pertussis (DTP3) immunization coverage among 1-year-olds
19 Physicians, nurses, and midwives per 10,000 population
20 Government expenditure on education as percentage of total government expenditure
21 Government expenditure on health as a percentage of total government expenditure

Access to Basic Infrastructure Utilities and Services

22 Percentage of population with access to electricity
23 Share of population using solid fuels for cooking
24 Percentage of population using improved drinking water sources
25 Percentage of population using improved sanitation facilities

Gender Equality and Opportunity

26 Gender parity in primary, secondary, and tertiary education
27 Antenatal care coverage (at least one visit)
28 Gender parity in labor force participation
29 Percentage of seats held by women in national parliament

Pillar Three
Social Safety Nets

30 Social protection and labor rating
31 Social security expenditure on health as a percentage of government expenditure on health
32 Government expenditure on social security and welfare as percentage of total government expenditure

Good Governance and Institutions

33 Voice and accountability
34 Government effectiveness
35 Corruption perceptions index

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