Perspectives on Green Growth

Background Paper No.2

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Ireland and the Climate Change Challenge: Connecting 'How Much' with 'How To'

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1. Introduction

This background paper sets out a framework for thinking about green growth. The paper is structured as follows:

- Section 2 outlines the threats posed by continued economic growth for the natural environment by exploring global trends in the period to 2050 and their implications;
- Section 3 evaluates the potential of green growth to address the resource challenges by identifying the channels through which pursuing greater environmental protection could lead to greater prosperity;
- Section 4 lists the generic framework conditions, the importance of contingencies and local specificities and the central role of the energy grid in capturing the opportunities associated with green growth; and,
- Section 5 sets out the main conclusions.

2. Resource Crunch

Since 1970, the size of the world economy has more than tripled. While this has raised living standards, the benefits have been unevenly distributed and have resulted in significant costs to the environment (OECD, 2012a: 19). By 2050, it is projected that there will be a further 2 billion people on the planet, more of whom are expected to be wealthier and living in urban locations than is currently the case. This alone means that future growth will make enormous demands on natural resources. There is already evidence that resources have been dangerously depleted: attempts to identify thresholds in the natural system that should not be passed suggest that in some cases (climate change, global nitrogen cycles, and biodiversity loss) boundaries have already been crossed (Rockström, 2009).

This section looks at projected changes to world population and incomes to 2050 and the impact on four natural resources: energy, water, land and biodiversity. The analysis suggests that business as usual is simply not possible. There is a need to find new ways of producing, distributing and consuming that are less resources intensive and use alternative resources. We return to this challenge, but first, we describe the resource crunch.

2.1 Population

By 2050, the Earth's population is expected to increase from 7 billion to over 9 billion people. Coupled with higher expected living standards across the world, global GDP is projected to almost quadruple despite the ongoing recession in some parts of the world. One of the most significant aspects is the increase in middle income groups. The middle class[1] in non-OECD economies is projected to increase from 1.85 billion in 2009 to 3.9 billion in 2030.

Populations of OECD countries are expected to live longer, with over a quarter of their people projected in 2050 to be over 65 years of age compared to about 15 per cent today. China and India are also likely to see significant population ageing, with China's workforce actually shrinking by 2050. In contrast, more youthful populations in other parts of the world, especially Africa, are expected to grow rapidly.

These demographic shifts and higher living standards imply evolving lifestyles, consumption patterns and dietary preferences, all of which will have significant consequences for the environment and the resources and services it provides.

In addition, by 2050, nearly 70 per cent of the world's population is projected to be living in urban areas. This will magnify challenges such as air pollution, transport congestion, and the management of waste and water, with serious consequences for human health. To illustrate, with growing transport and industrial air emissions, the global number of premature deaths linked to airborne particulate matter is projected to more than double to 3.6 million a year, with the majority of deaths occurring in China and India.

2.2 Energy

The OECD projects that between 2010 and 2030, GDP growth will be largely driven by the increased use of physical capital (such as buildings, machines and infrastructure), which boosts economic activity especially in the emerging economies. As physical capital and energy use largely go together in production processes, this type of growth implies substantial increases in energy demand in the near future (OECD, 2012a: 56).

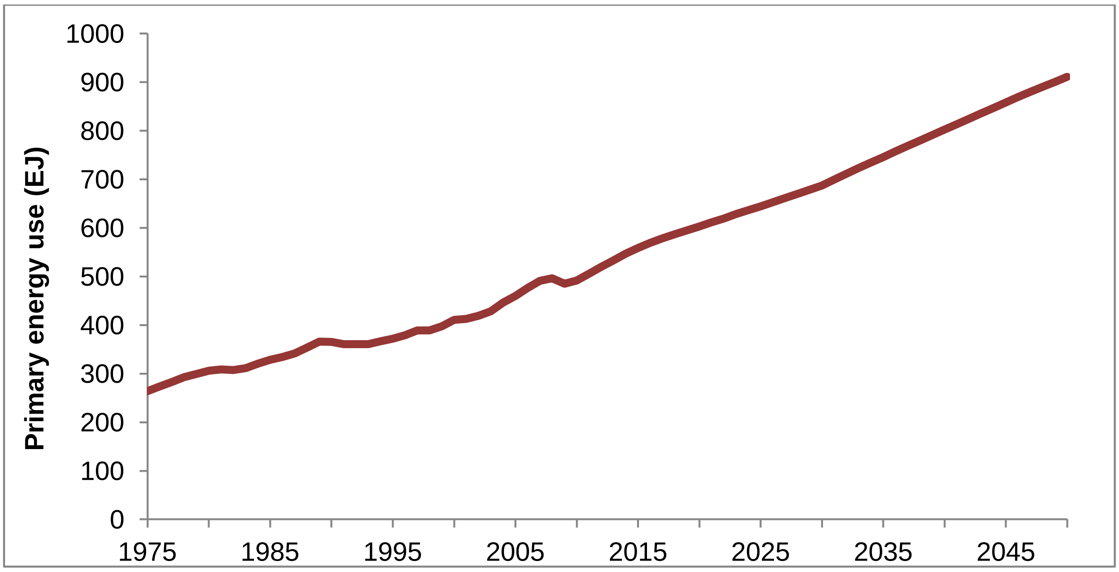
Energy use is essentially driven by economic activity and technological developments, including energy-efficiency improvements. Energy consumption patterns differ widely across the world. In OECD countries, the average person consumes 3 tons of oil equivalent of energy (toe) a year, while in low-income regions,

[1] Middle-class defined as having daily consumption per capita ranging from $10 to $100 (in purchasing power parity terms) (OECD, 2011a).

such as most of Africa and parts of Asia and Latin America, the figure is well below 1 toe. In 2009, about 1.4 billion people in low-income regions still had no access to electricity, and nearly 2.7 billion people mainly relied on traditional biomass (IEA, 2012a).

As GDP is projected to almost quadruple by 2050, total commercial energy use is also projected to increase by 80 per cent over global energy consumption in 2010 (Figure 1). Continuous improvements in energy efficiency will reduce overall energy intensity (i.e. the ratio between energy use and GDP) to about 40 per cent below current levels by 2050.

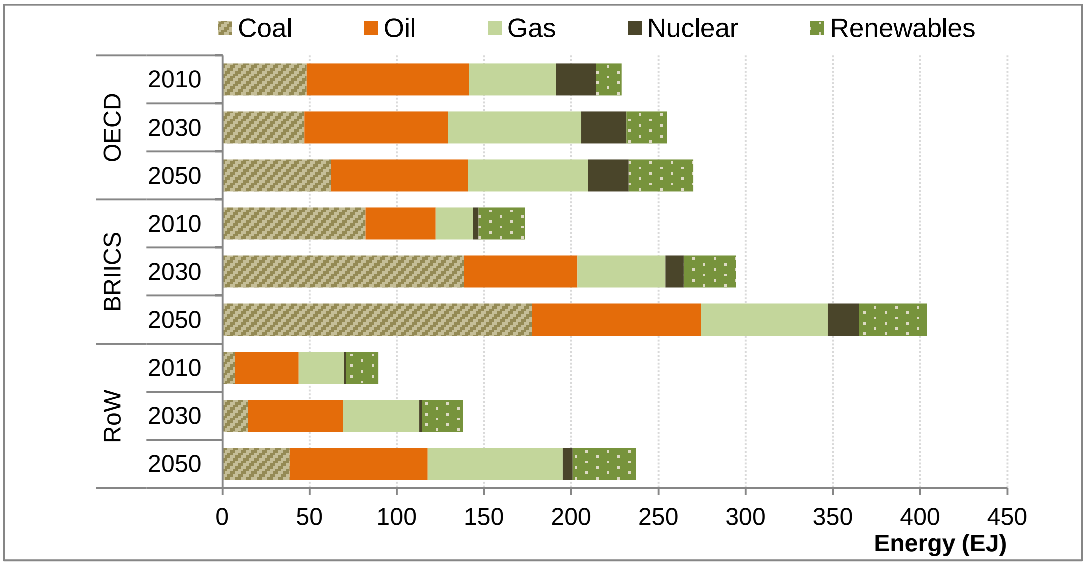
Figure 1: Global Primary Energy Demand: 1980 – 2050



Source: OECD Environmental Outlook

Assuming no change in current policies, fossil fuels are expected to retain a large market share in the period to 2050, as their average prices remain lower than those of alternative fuels in most countries. Annual average growth rates of consumption are projected to be in the order of 0.5 per cent for oil and 1.8 per cent for coal and natural gas. For oil and natural gas, depletion and resulting price increases around the middle of the 21st century are projected to lead to stabilisation or even a peak in production, which is concentrated in only a few resource-rich regions. For coal, however, resource scarcity is not projected to limit production, or even lead to price increases, in the foreseeable future. With strong economic growth in coal-rich regions, it is likely that the share of coal in the energy mix will further increase. At the same time, non-fossil energy production, including nuclear, commercial biomass and other renewables, are expected to increase steadily (see Figure 2).

Figure 2: Commercial Energy Production by Fuel and Region*:* 2010-2050



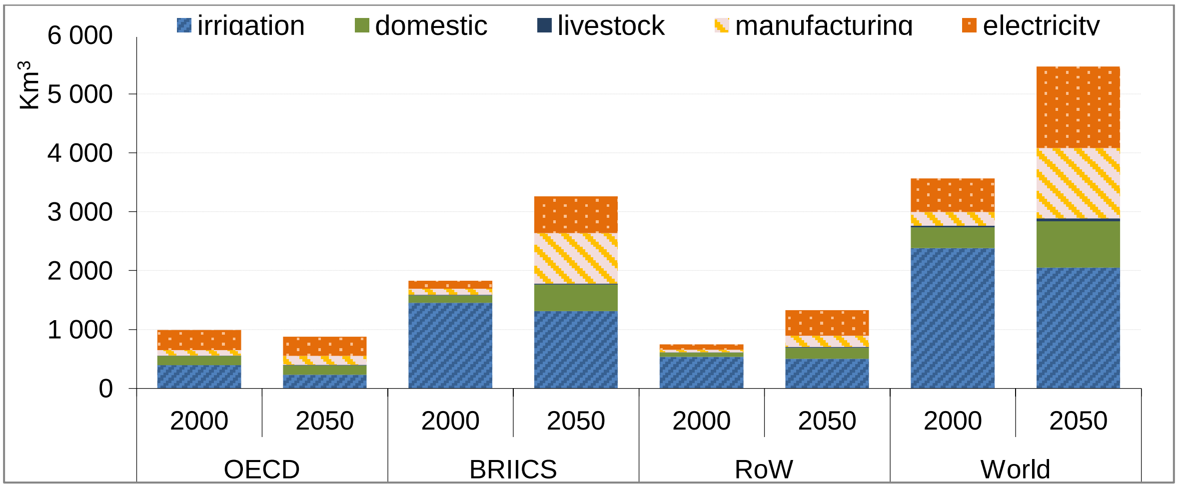
Source*:* (OECD, 2012a)

2.3 Water

The OECD projects future global water demand to increase significantly—from about 3,500 km3 in 2000 to nearly 5,500 km3 in 2050 (Figure 3), or a 55 per cent increase. This increase is primarily due to growing demand from manufacturing (+400 per cent,), electricity (+140 per cent) and domestic use (+130 per cent). Without new policies, the relative importance of uses that drive water demand is also projected to shift significantly by 2050.

Developing countries (rest of the world) are projected to see significant water demand for electricity generation. The growing demand for these uses will compete with demand for irrigation water in all regions. As a result, the share of water available for irrigation is expected to decline.

Figure 3: Global Demand for Water: 2000-2050



Source: (OECD, 2012a)

2.4 Land

Agricultural production has increased strongly over recent decades to meet rising food demand. About 80 per cent of the production increase has been achieved through higher yields from existing land, and about 20 per cent through expanding agricultural land. Between 1970 and 2010, the share of agricultural land use (crop and grazing land), expanded by about 4 percentage points, largely at the expense of forest area.

The OECD projects that competition between agricultural land use and other land uses will intensify in the coming decade under current policies (OECD 2012a). A global convergence in GDP per capita and a growing population will increase the demand for food, especially animal products. Moreover, policies that stimulate the use of biofuels also increase the demand for agricultural production and land area. Given the limited supply of land, this means that in the short run deforestation will continue, although at slower rates than in past decades (OECD, 2012a: 62).

2.5 Biodiversity

Globally, terrestrial biodiversity (measured as mean species abundance—or MSA—an indicator of the intactness of a natural ecosystem) is projected to decrease a further 10 per cent by 2050.

Primary forests, which are rich in biodiversity, are projected to shrink in area by 13 per cent, despite the increase in total forested area during this period. The main pressures driving biodiversity loss include land-use change and management (agriculture), the expansion of commercial forestry, infrastructure development, human encroachment and fragmentation of natural habitats, as well as pollution and climate change (*ibid:* 22).

OECD projections suggests that, after 2030, the area of natural land converted to agriculture globally is projected to decrease as a result of improved productivity, stabilising populations and dietary changes. This will reduce the pressure on biodiversity and ecosystems. Nevertheless, the impacts on biodiversity will continue for decades after land has ceased to be cultivated.

The rate of global deforestation has recently slowed and the projections assume no net forest loss after 2020, and an expansion in forest cover to 2050 due to regeneration, restoration, reforestation and afforestation (including plantations). However, an increase in the forested area does not necessarily mean a reduction in biodiversity loss as there will be more commercial and plantation forestry that supports less biodiversity (OECD, 2012a: 157).

In relation to fisheries, the proportion of fish stocks that are over-exploited or depleted has increased over the past few decades. In 2012, over 30 per cent of marine fish stocks are over-exploited or depleted, around 50 per cent are fully exploited and fewer than 20 per cent have the potential for increased harvests (*ibid:* 157).

3. How 'Green' Can Create Growth

Economic growth is conventionally thought of as the process through which workers, machinery and equipment, materials and new ideas and technologies contribute to producing goods and services that are increasingly valuable for individuals and society.

A green-growth framework attempts to build on this basis by also taking account of changes to all types of capital: natural (e.g. ecosystems), human (e.g. education and skills), physical (e.g. machinery and equipment), and the intangible assets that are so crucial to human progress like ideas and innovation. It attempts to incorporate the dual role played by natural capital in this process: by providing crucial inputs, but also by providing direct benefits to individuals and society (e.g. through the effect that the environment has on health, amenity value, or through provision of ecosystem services).

Green growth, according to the OECD, means 'fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our wellbeing relies' (OECD, 2012b: 9). The contribution of natural capital to production is often not priced and the contribution of natural capital to individual welfare is not appropriately valued. Traditional economic growth may, therefore, undermine the natural capital base upon which it rests, this in turn imposes costs on human well being, especially that of future generations.

Below, we first set out the channels through which ‘green’ can create growth, before presenting a generic framework that highlights some of the key considerations in creating a green-growth strategy.

While protecting the planet’s ecosystem and natural assets is not a new idea, combining this objective with economic growth is relatively new. The OECD version of green growth argues that protecting the natural asset base can actually reduce costs and give rise to economic growth in a number of ways.

Resource Efficiency*:* At the heart of a green-growth strategy is using resources more efficiently to increase productivity and reduce waste. The International Energy Agency (IEA) estimate, for example, that an additional USD 36 trillion increased investment in low-carbon technologies would result in fuel savings of USD 100 and USD 150 Trillion by (IEA, 2012b).

Others have envisaged an even more fundamental reorganisation of economic activity with the concept of resource efficiency at its core. A ‘circular economy’ aims to ‘design out’ waste —products are designed and optimised for a cycle of disassembly and reuse (See Box 1 for further discussion of what the NESC Secretariat see as a very interesting set of ideas).

Innovation*:* Policies required to protect the natural asset base will spur innovation. Existing technologies and behaviors can only play a role up to a point. There is a frontier beyond which more growth necessarily leads to environmental degradation, and innovation therefore has a key role to play in pushing this frontier outward. New and improved technologies in energy production, such as solar power, biomass, micro-hydro power and biofuels, linked with new approaches to electricity generation and distribution, could eventually reduce the costs and improve the technical feasibility of energy supply in poor developing countries and allow non-oil producing countries to become more energy self sufficient. They would also bring a range of benefits, including reduced dependence on fossil fuels, reduced poverty and lower energy bills for firms and households. What may be required is a network of innovations in order for the potential associated with green growth to be realised (Noll, 2012).

New Market Opportunities*:* Demand for green technologies and goods and services creates new market opportunities. In a survey of 300 top executives from large global corporations by Ernst & Young, more than 75 per cent of respondents project their annual clean energy technology spending to rise over the next five years (Ernst & Young, 2009).[2]

Investment*:* Governments have a central role to mobilise capital to low-carbon investment by delivering what the OECD describe as *'investment grade'* policies and frameworks. Clear signals from governments on how they are going to deal with green growth can boost investor confidence. This can be achieved through goal setting and aligning policy goals across and within levels of government; including clear, long-term vision and targets for emissions reductions and infrastructural investment**.**

Fiscal Consolidation*:* Fiscal consolidation can be enhanced through reviewing efficiency of public spending, and increasing revenues through pricing pollution can result in greater long term economic growth potential for a country.

Risk reduction*:* Green growth can also help manage risks such as resource bottlenecks that would otherwise require substantial investment to overcome (e.g.*:* water shortage). It can also help mitigate the risk of abrupt, profound and irreversible effects, such as those posed by climate change or to fish stocks. There is growing evidence of the costs of losses in ecosystem function (TEEB, 2010).

The OECD work therefore envisages several channels through which *'green'* can result in growth. It is optimistic that continued prosperity can be sustained while protecting the natural environment.

Zysman's work on green growth, summarised in Box 2, is somewhat more sceptical about some of the claims made by green-growth proponents. It is is useful as a prompt to critically evaluate the claims around green-growth benefits.

For example, Zysman *et al.,* are concerned that progress on green growth might be undermined by an unwillingness to recognise that some of the activity may increase costs in the short term; that productivity may not increase drastically in the short term; that job creation may be short term in certain sectors and/or reliant on stimulus packages; and that new green jobs can displace old ones leading to no net job creation.

[2] Referenced in (OECD, 2011b).

Box 1 The Circular Economy

A circular economy is an industrial system that is restorative or regenerative by intention and design. It replaces the 'end-of-life' concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models.

Such an economy is based on few simple principles. First, at its core, a circular economy aims to 'design out' waste—products are designed and optimised for a cycle of disassembly and reuse. Secondly, it introduces a strict differentiation between consumable and durable components of a product. Thirdly, the energy used should be renewable by nature, to both decrease resource dependence and increase system resilience (e.g. to oil shocks).

The circular economy envisages a new contract between businesses and their customers based on product performance. Unlike in today's 'buy-and-consume' economy, durable products are leased, rented, or shared wherever possible. For example, high-end washing machines would be accessible for most households if they were leased instead of sold—customers would save roughly a third per wash cycle, and the manufacturer would earn roughly a third more in profits. Over a 20-year period, replacing the purchase of five 2,000-cycle machines with leases to one 10,000-cycle machine would also yield almost 180 kg of steel savings and more than 2.5 tonnes of CO_2 eq savings.

This new contract between producer and user is already evident in the business models in which customers pay for the functionality or the result of the product, instead of buying the product itself. Examples include:

- Energy Saving Companies (ESCos)*:* The provider of ESCo energy optimises the energy usage of users and gets paid by part of the savings achieved. The customer does not have to pay upfront.
- Chemical Management Services (CMS)*:* A CMS company engages in a strategic, long-term contract to supply and manage the customer's chemicals and related services. The providers of CMS are typically remunerated in some form of the customers output (e.g. painted car doors).This gives the provider the incentives to reduce the input products (e.g. paint for car doors).
- Design, Build, Finance and Operate (DBFO)*:* Long term contracts involving the construction, maintenance and operation phase (typically 20-30 years) of the project (a building) give incentives to improving the quality of the construction project so that the life-cycle costs are lowered.

In these, the provider is incentivised to optimise and maintain the product to ensure life-cycle cost effectiveness, which will reduce the environmental impact. Other examples are focused on sharing in which instead of private ownership, the product is shared among a number of users whenever the individual users need access to the product. The economic benefits of this model are less evident than in the other business models, but the sharing of products may pave the way for new products to the market. One example is the Norwegian car-sharing company, Move About.

Box 2 Religion and Reality in the Search for Green Growth

Zysman *et al*., (2012), argue that if 'green growth' were to become a reality, it would have to bypass the myriad problems of climate-change mitigation—who should pay, how much, and when. They agree that if 'green growth' were possible, then the shift to a low-emissions economy would pay for itself by catalysing a wave of investment, innovation and job creation. Rich countries could re-establish economic competitiveness by developing new 'green' industries, while emerging markets could support their ongoing development on a foundation of new low-emissions technologies.

However, the authors also highlight that 'green growth' today remains more religion than reality, for a number of reasons. First, the short-term jobs and investment generated by the move to renewable energy will come at substantial cost, last only as long as the retrofit period itself, and will partially displace jobs in legacy energy sectors. Second, they argue that longer-term prospects are equally unpromising: Advanced industrial societies have fully built-out energy systems and relatively modest growth in energy demand. In addition, the scale of the energy sector points to the limits of job creation in that sector alone. For instance, Denmark obtains about 10 per cent of its overall exports from its wind energy sector. But that sector employs only 24,000 people, or about 1 per cent of the Danish workforce. They point out that in most Western economies, the total value of energy consumption runs at about 2-4 per cent of GDP; not insignificant, but also not very large compared with the economy as a whole. As such, they suggest that betting on massive job creation through renewable energy rings hollow. Third, they question the quality of those jobs. In earlier periods, the intrinsic advantages of new technologies helped offset the higher up-front labour intensity. Presently, 'green tech' lacks such advantages. Thus as a long-term employment strategy, the deployment of a low-emissions energy system appears, on its own, to have limited capacity to sustain broad employment gains or high wages in advanced industrial economies.

Radical success in renewable energy adoption will mean an energy system as reliable, ubiquitous and flexible as today's fossil fuel based system. Beyond lower emissions, however, 'green' electrons may provide consumers few obvious advantages over the 'brown' electrons they use today. Absent new energy capabilities or improved energy services, the possibilities for economic growth based solely in the energy sector appear very limited.

The critical issue they argue is the need for discussion of green growth to start from the premise that effective climate-change mitigation will require the transformation, rather than marginal modification, of legacy energy systems. To capture the potential of green growth they argue, first, that green growth will require a systems transformation; second, that a growth-inducing systems transformation must look beyond the energy sector; and third, that both green growth and energy systems transformation will require a range of policy interventions that go well beyond conventional prescriptions for emissions pricing and R&D subsidies.

They suggest that it is not possible to know the full growth potential associated with a low-emissions energy, but argue that any viable approach to green growth will require a strategy capable of discovering the type of opportunities that exist.

International case studies in Denmark, South Korea, California and Colorado considered by the authors suggests that opportunities and choices, in particular in relation to energy, derive from a set of idiosyncratic national goals contingent and a country's domestic resources, natural or otherwise.

4. Delivering Green Growth

Framework conditions have been identified that can be considered to prompt the greening of growth. It is important, however, to be aware of the unique characteristics of each country in designing a green-growth strategy.

4.1 Framework Conditions for Designing a Green-Growth Strategy

The OECD provide a useful generic template for developing a green-growth strategy centered on mutually reinforcing elements of economic and environmental strategy. The framework strategy is fundamentally based around taking into account the full role of natural capital as a factor of production. This involves the creation of new indicators to measure these factors. These indicators can be combined with GDP to to provide an enhanced measurement of sustainable development.

The OECD argue that designing an effective green-growth strategy involves consideration of the following elements*:*

Framework Conditions*:* Getting the framework conditions right is seen as a necessary first step. These conditions must mutually reinforce growth and conservation of natural capital, including core fiscal, taxation and competition policies that maximize efficient allocation of resources.

Efficiency and Pollution*:* Policies are needed to incentivise efficient use of natural resources and make pollution more expensive. These include a mix of price-based and other policy instruments. Pricing mechanisms tend to minimize the cost of achieving a particular objective because they encourage action where it is easiest, provide a spur to innovation and can help shift the taxation burden away from distortive corporate and personal income tax and social contributions. Taxes on energy and CO_2 can also help with fiscal consolidation. Removing perverse subsidies that encourage pollution or over-extraction of resources and place a drain on the public purse is also required.

Regulation and Technology*:* Regulatory, technology support, and information-based measures can also play an important role. As discussed in the Secretariats' Interim report (Chapter 2), pricing is not always the correct approach because societies become dependent on technologies and institutions with which they are familiar, giving rise to inertia, path dependency and the dominance of existing systems and technologies. Often well designed regulation and temporary active technology supports may also, therefore, form part of the policy mix.

Innovation*:* Innovation support can also play a role, but needs to be designed to avoid technological lock in, lack of competition or crowding out of private investment*.* Government can lend support by funding relevant research, supplying finance tailored to differing stages of technology development and using demand-side instruments such as standards, regulations and public procurement*.*

Network Infrastructure*:* Public investment in new network infrastructure in the areas of energy, water, transport and communications is also required*.*

Institutional Framework*:* A defined framework for action across government, as well for coordination with stakeholders outside government, is the final component. The objective is to integrating green growth into core economic strategies and other government policies*.*

4.2 Developing a Contingent Green-Growth Strategy

Research suggests that there is not a universal approach to green growth but that instead it is contingent on a countries characteristics*.* Zysman presents several international case studies that emphasise the different narratives and approaches around green growth and have been developed in given countries*.* These cases illustrate that the key challenge to be addressed is how to structure the technological, economic and political experimentation necessary to find new opportunities*.* They illustrate that this answer will be different for each country, reflecting idiosyncratic national objectives in relation to*:* energy security, competitiveness or emissions mitigation; the unique energy systems of each country; institutional arrangements and governance systems; existing competitive advantages; and the set of natural resources that are available*.*

Making progress on the green economy is therefore, highly contingent, and involves a process of discovery*.* It depends to a significant degree on the ability to create networks that can test new ideas and resolve and work with tensions that are likely to exist between different stakeholders*.* In this context, Zysman finds that progress requires building a broad coalition of key economic interests in favour of a low-carbon energy systems transformation (Zysman & Huberty, 2012: 146)*.* While framework conditions for consideration in developing a green-growth strategy can therefore be usefully considered, it is important to consider the individual characteristic of each country in designing a green-growth strategy.

4.3 The Central Role of the Grid

Zysman argues that most critical lever for prising open and capturing new green-growth possibilities is the electricity grid (Zysman & Huberty, 2012: 145). Past transformations, like that of ICT, pointed to the role of networks as levers —defined as change or set of changes to part of the system that, if carried out, will induce or enable complimentary changes in the rest of the system— for catalysing broad changes to the trajectory of an industry (*ibid:* 145).

In the case of the energy system, the power grid provides an excellent example of such a lever. The grid is central to choices about how to produce, distribute and use energy; and changes in the grid alter options in all three of these dimensions of the energy system. Consequently, the grid provides significant leverage for policies intent on accomplishing energy systems transformation.

We agree that the grid is a lever, and must therefore be at centre of Ireland's transition to a low-carbon economy, and that new and unpredictable economic opportunities may arise from investment in upgrading the Irish transmission and distribution system. These green-growth opportunities will be based around new technologies and new business models that will arise from the coming together of previously unrelated sectors of the economy, for example, the electrical system and the transportation system. The centrality of upgrading the transmissions system and interconnecting the Irish grid with an emerging Northern European Grid is a key theme picked up in our Final Report. We also note the central importance of deployment of the smart grid to enable renewables power sources, storage and efficiency improvements is explored in detail. Transforming today's power grids from passive means of energy transport to an active platform for innovation will require an array of technological and regulatory changes (*ibid:* 145). These issues are discussed in a background paper on Ireland's energy system..

A reservation we have is that for many companies, the grid may in fact, not be the most important lever. We are thinking here of food companies or manufacturing firms that have fine-grained systems used to deal with issues such as food safety, quality assurance and innovation. For many firms transformation towards lower carbon and lower resource use is likely to be underpinned these same systems to monitoring and improve resource use. Applying these systems to resource use is likely to bring issues such as energy costs and sustainability into view but it is also likely to result in the firm looking at whole range of issues such as haulage, suppliers and distribution. In this sense, we believe that while the grid is a key lever that in many areas the transformation will be involve energy but will not be determined by it.

5. Conclusion

There are increasing pressures on the natural resources and assets upon which economic growth is dependent. These pressures are likely to be exacerbated in the period to 2050. While energy is the resource we are primarily concerned with in this report on Ireland's climate strategy to 2050, it is important to consider the other natural assets that are also being depleted, not least because many are intrinsically linked to energy use.

There are many channels through which growth can, at least in theory, be combined with protection of the natural asset base. It is important, however, to be realistic about what can be achieved by green growth, and that its potential benefits are appraised in a balanced manner. It is likely that the global resource crunch will influence future patterns of trade —in products and services—quite significantly. It may lead to a revived role in international trade for comparative advantages for countries with strong endowments of these resources. At least two possibilities seem likely, first countries with most experience in managing with scarce resources will find that experience growing in demand; and second countries endowed with resources that are critical for production (e.g water and pharmaceuticals) may be able to increase exports or attract more foreign direct investment in these areas.

Framework conditions to enable green growth can be identified which can be applied across countries, and can be used to design a green-growth strategy for Ireland. The green growth and decarbonisation agenda are closely aligned, and the grid is a central lever in both enabling new green-growth opportunities and driving decarbonisation throughout society.

A green economy strategy needs to be designed to suit the needs of each country. It needs to be reflective of the diverse ways in which various stakeholders can contribute to the search for ways to use resources more efficiently in better and new ways, and to be built on pre-existing characteristics, strengths and competitive advantages. In Ireland, we are fortunate that the search for a uniquely adapted green-growth strategy is already underway in a number of areas.

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