Growth opportunities in the low-carbon economy

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Abstract

The world is moving to cleaner forms of economic growth. With the costs of key technologies falling, countries are beginning to position themselves for the emerging green economy. Updating earlier analysis, this paper combines patent data with international trade and output data to identify the strengths, weaknesses, opportunities and threats of different countries in the low-carbon economy. Taking current output as the starting point, we use two key indicators to assess low-carbon competitiveness at the sector level: the speed at which sectors convert to low-carbon products and processes (measured by low-carbon innovation) and their ability to gain and maintain market share (measured by existing comparative advantages). We find that most countries have low-carbon growth opportunities and comparative advantages in some sectors. However, the low-carbon economy also constitutes a threat to existing comparative strengths in sectors that are slow to adopt clean products and processes.

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1. Introduction

The strategy of the UK for meeting its 2030 climate change targets is known as the Clean Growth Strategy. The strategy document opens with the proclamation that “the move to cleaner economic growth is one of the greatest industrial opportunities of our time” (BEIS 2017, p. 3). South Korea had the same insight several years earlier, and in 2009 passed a Framework Act on Low Carbon Green Growth (Ministry of Government Legislation 2010). China’s greenhouse gas targets, contained in its five-year plans, are complemented by growth targets for strategic low-carbon sectors (Stern 2011). Rwanda, one of the world’s poorest countries, has similarly expressed its climate change strategy in terms of green growth, as well as climate resilience (Republic of Rwanda 2011).

These examples are representative of a new trend. A growing number of decision makers see action against climate change no longer as an environmental constraint but as an economic opportunity. They hope that climate action will not just protect the environment, but also create new jobs, promote new technologies and open up new areas of comparative advantage. Underpinning this aspiration are rapid technological advancements in key low-carbon technologies (chiefly in renewable energy and electric vehicle technology), which make the transition to a low carbon economy, at least in those sectors, look all but inevitable. The low carbon pledges countries have made under the Paris Agreement, together with a commitment to essentially phase out greenhouse gas emissions before the end of the century, further support the view that the low-carbon revolution is now unstoppable.

The notion that economic success and environmental quality can go hand in hand is not without its detractors. In its basic form, the green growth argument is innocuous. It merely ascertains that environmental protection, that is, the correction of welfare-reducing externalities, will ultimately enhance social welfare. In its stronger manifestation, green growth theory argues that environmental protection can itself be a driver of economic growth (Jacobs 2013). This is more controversial. The possibility of green growth contradicts a long-standing belief among environmental economists that the natural environment will ultimately impose limits to growth. The notion dates back at least to the 1970s (Boulding 1966; Daly 1974,1991; Georgescu Roegen 1971) and arguably as far as the 19th century (Malthus 1798; Jevons 1865). More recently, the environmental case against economic growth has been made by Jackson (2009) and Martinez-Alier et al. (2010).

The theoretical argument for green growth rests on the possibility of resource-saving rather than resource-augmenting growth, leading ultimately to a weightless economy dominated by services and electronic products (Bowen and Hepburn 2013). The green growth literature further emphasises the dynamic benefits of clean innovation, which could trigger a Schumpeterian cycle of “creative destruction”, clean investment and economic renewal. In the short term, clean investment could also give a Keynesian boost to economies in which production factors are not fully utilised (Bowen and Fankhauser 2011).

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1 One of the long-term objectives of the Paris Agreement is to achieve a “net zero” balance between the amount of greenhouse gases released into the atmosphere and their removal into sinks.
While these arguments are appealing, the accuracy or otherwise of the green growth argument is not essential to the objectives of this paper. We are interested in low-carbon competitiveness at the level of sectors and (implicitly) firms. Our starting point is the observation that global demand is shifting from high-carbon to low-carbon goods and services. We analyse how this shift in demand will affect the producers of those goods and services. Who is likely to gain or lose market share? Whether or not the aggregate size of the economy grows as part of this shift (as the green growth literature contends) is of secondary concern.

We update an earlier study by Fankhauser et al (2013) to explore the economic prospects of selected countries and sectors in the coming green economy. Using current economic output as the starting point, we identify two key success factors for green competitiveness at the sector level: the speed at which sectors may convert to green products and processes (measured by green innovation) and their ability to gain and maintain green market share (measured by existing comparative advantages). Taken together, the two indicators paint a picture of the strengths, weaknesses, opportunities and threats of different countries and sectors in the green economy (see also Mealy and Teytelboym 2016, and Fankhauser et al 2017 for related analysis).

In what follows we first recapitulate the methodology used to assess green competitiveness (section 2), before discussing the green economy prospects of selected manufacturing sectors in 12 countries (section 3). The set of countries is broader than in the original Fankhauser et al (2013) paper, covering four leading industrialised countries (France, Germany, Japan, USA), four key emerging economies (Brazil, China, South Korea, Turkey) and four former communist countries (Hungary, Poland, Russia, Slovenia). We conclude with some policy lessons (section 4).

2. Methodology

2.1 The future size of the green economy

There is an established tradition of measuring the contribution to GDP of the environmental goods and services sector. In the definition of the OECD, environmental goods and services include all activities that measure, prevent, limit, minimise or correct environmental damage (OECD 1998). Other definitions vary, as do numerical estimates, but it is clear that according to this delineation the green economy is worth several hundred billion, and perhaps several trillion, US dollars a year globally (EBI 2012; ECORYS 2012; BIS 2011). It is one of the fastest growing sectors of the global economy (Ricardo AEA 2017).

Yet, for many of its proponents green growth is about something more radical (Bowen and Fankhauser 2011; Jacobs 2013). Green growth advocates do not see environmental management as just another economic sector alongside conventional activity. They argue that the economic changes required to combat problems like climate change are not

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2 Low-carbon products and processes is only one aspect of green growth, which is concerned with a much wider set of environmental objectives, including air, water and soil quality, climate resilience and the health of natural ecosystems. Our focus is on low-carbon, but we use the term green interchangeably (and inaccurately).
marginal, as traditional models suggest, but transformative and system-wide (Perez 2010; Fankhauser and Stern 2017).

The creation of a green economy will affect not just a few specialised sectors but the product mix and production processes of virtually the whole economy. Some sectors, such as coal mining or petrol refining, will shrink in size, while others, such as recycling or battery production, may grow. But for most sectors, the green economy is about adjusting existing products and production processes. Architects will specialise in green buildings, banks will finance low-carbon projects and car manufacturers will produce low-carbon vehicles, but generically these activities will carry over into the low-carbon economy.

Our interest is therefore in green products and processes in all sectors of the economy, and how they might evolve over time. Following Fankhauser et al (2013) we define our variable of interest, \( \Gamma_{is} \), as the share of green output in sector \( s \) and country \( i \), \( G_{is} \), relative to total global output (green and non-green) in that sector, \( Y_s = \sum_i Y_{is} \). We can further expand \( \Gamma_{is} \) as follows:

\[
\Gamma_{is} \equiv \frac{G_{is}}{Y_{is}} = \frac{G_{is}}{Y_{is}} \cdot \frac{Y_{is}}{Y_s} \tag{1}
\]

The permutation, while self-evident, brings out the two key factors which determine green output in a country-sector at any one point in time: the share of green output in total output for that country-sector (\( G_{is} / Y_{is} \)), and its global market share (\( Y_{is} / Y_s \)). To predict future green output we need indicators that foretell future trends in these two factors:

- A measure of green conversion: this indicator reflects the speed with which the green segment of the market will grow within a country-sector (e.g. the rise in electric car sales at the expense of conventional cars in the automotive sector).

- A measure of comparative advantage: this indicator reflects the ability of a country-sector to gain market share by outpacing the overall rate of growth (e.g., national versus global growth in the automotive sector).

Perhaps the most promising indicators for green conversion is green innovation. The focus on innovation, rather than investment, is consistent with the view that “creative destruction” (Schumpeter 1942) is the engine of transformative growth (Archibugi et al. 1999, Otra and Saint Jean 2009, Perez, 2002). Innovation alters products and production processes much more profoundly than does investment, although the two processes are obviously linked. While investment determines the future capital stock, innovation determines how radically different that capital stock will be. More broadly, there is a well-documented link between innovation, productivity and economic growth (Aghion and Howitt, 1998, 2009; Griliches 1979; Temple 1999), and between innovation, industrial dynamics and industry evolution (Dosi et al. 1988; Malebra 2007, 2002).
Box 1: The Green Innovation Index (GII)

To predict the probability of green conversion in a country-sector, we calculate an index of
green innovation activity. The green innovation index (GII) measures the ratio of green
patents to total (green plus non-green) patenting activity. The advantages and limitations of
patenting as a measure of innovation have been discussed at length (see Griliches, 1990;
and OECD, 2009, for a recent overview). While patents are not a complete manifestation of
innovation, they are a core output measure that features prominently even in complex
assessments of innovation performance (for example, Dutta 2012, Hollanders and Es-Sadki
2013). Patent data have been used successfully in numerous studies of green innovation
(for example, Dechezleprêtre et al. 2011; Johnstone et al. 2010; Lanjouw and Mody 1996;
Popp 2002).

GII takes the form:

\[
GII_{is} = \frac{p^{G}_{is}}{p_{is}} / \sum_{i} p^{G}_{is} \tag{2}
\]

Where \( p^{G}_{is} \) is the number of green patents and \( p_{is} \) the total number of patents in sector \( s \) and
country \( i \). The index thus measures the share of green patenting in a country-sector,
compared to green patenting in that sector over the entire reference area (that is, all
countries in the sample). The normalisation against broader patenting activity is important to
correct for idiosyncrasies in patenting behaviour in particular sectors or countries.

The higher the GII for a sector and country, the higher the share of green innovation in that
sector, compared with other countries, and the more rapid (we conjecture) the conversion
from conventional to green production.

We use data from the European Patent Office (EPO) on patenting activity from 2005 to 2015
to construct an index of Green Innovation (GII). This is detailed in Box 1. GII serves as our
measure for green conversion, that is, the speed at which country-sectors are expected to
move from conventional to low-carbon products and processes.

The competitiveness literature suggests that green competitiveness is most likely to be
derived from existing comparative advantages, skills and production patterns (Hidalgo et al.
2007; Hausmann and Hidalgo, 2010). Mealy and Teytelboym (2016) further link future
comparative advantage to technological proximity and the ability to diversify into related
technologies. For example, Germany developed a comparative advantage in wind turbines
on the back of its existing expertise in high-precision machining (Huberty et al., 2011). We
therefore treat existing capabilities as a key indicator of future comparative advantage in the
green economy. This does not preclude market entry and exit at firm level. Disruptive market
entry, where new firms and new ideas drive out the old, is central to the type of
transformative growth that the green economy discourse espouses.

We use trade data for the period from 2005 to 2015 from COMTRADE to construct an Index
of revealed comparative advantage (RCA), as detailed in Box 2, which serves as our
measure of current comparative advantage.
Comparative advantages evolve slowly, which means that sectors with a competitive edge today are more likely (but not certain) to be successful in the future. We make use of this observation, although it is a strong assumption in the context of a deep structural transformation.

A widely used way to measure comparative advantage is the Balassa index (Balassa 1965). The Balassa index measures the revealed comparative advantage (RCA) of a country-sector on the world market by calculating its relative export share. There are several variants of the index, each with its own advantages and disadvantages (Iapadre 2001; Laursen 1998). We use the standard formulation, which has the following structure:

$$\text{RCA}_{is} = \frac{e_{is}}{\sum_i e_{is}} / \frac{\sum_s e_{is}}{\sum_s \sum_i e_{is}}$$  \hspace{1cm} (4)

Where $e_{is}$ is the level of exports from sector $s$ in country $i$. The numerator measures the share of exports in a country-sector, relative to total exports from that country. This is put in proportion to the same ratio (sector exports over total exports) for all countries in the sample. Unlike equation (3), which measures green innovation in absolute terms, the focus in the RCA formula is on sector exports relative to a country’s total exports, i.e. on a country’s comparative (rather than absolute) advantage.

The higher the relative share of exports in a country-sector, the higher is its RCA and the more competitive is the sector. A high RCA is an indication of the ability of a country-sector to gain and maintain market share in the future.

2.2 A SWOT analysis of green potential

The interplay between green innovation (GII) and revealed comparative advantage (RCA) allows to identify, sector by sector, the potential strengths, weaknesses, opportunities and threats a country may encounter. The structure of the ensuing SWOT analysis is introduced graphically in Figure 1.

The Figure measures on the y axis the relative performance of different sectors in a country on low-carbon innovation (as measured by GII). The x axis depicts the revealed comparative advantage of those sectors (as measured by RCA). For both indicators, a score above 1 signifies performance above the global average and a score below 1 means performance below the global average. The size of the dots measures a sector’s current contribution to national GDP.

Figure 1 can then be interpreted as follows:

- Sectors in the top-right quadrant signify strengths: these sectors are areas of current comparative advantage (high score on the x axis) and there is substantial green innovation (high score on the y-axis), which should ease the conversion to low-carbon products and processes. The sectors are thus well positioned to remain areas of competitive strength in the low-carbon economy.

- Sectors in the top-left quadrant signify opportunities: these sectors are currently not areas of comparative advantage. However, there is significant low-carbon innovation,
which could facilitate the conversion to low-carbon products and processes. The sectors could therefore become areas of future strength, displacing less innovative incumbents.

- Sectors in the bottom-right quadrant signify **threats**: these sectors are areas of current comparative advantage, but there is insufficient low-carbon innovation. The conversion to clean products and processes may stall and market share may be lost as the low-carbon economy grows.

- Sectors in the bottom-left quadrant signify **weakness**: these sectors are neither areas of current comparative advantage, and there is insufficient low-carbon innovation to build up a new area of comparative advantage.

Figure 1: A graphical SWOT analysis for the green economy

![SWOT Analysis Diagram]

*Note:* Each bubble indicates the location of a country-sector on the GII-RCA plane. The size of the bubble indicates the size of the country sector.

*Source:* Based on Fankhauser et al. (2013).

### 3. The low-carbon credentials of different countries

#### 3.1 Overview

We apply the methodology of section 2 to the manufacturing sector of 12 countries. The analysis covers four leading industrialised countries (France, Germany, Japan, USA), four key emerging economies (Brazil, China, South Korea, Turkey) and four former communist countries (Hungary, Poland, Russia, Slovenia). For each country we initially considered the

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3 Fankhauser et al (2013) covered China, France, Germany, Italy, Japan, South Korea, UK and the US. Fankhauser et al (2016) covered China, Indonesia, Japan, Philippines, South Korea and Vietnam. India is discussed qualitatively.
50 or so sectors at the three-digit level that comprise the Manufacturing section in the ISIC Rev 3.1 industry classification (see Annex for details).\(^4\)

Figure 2 provides overview charts for all 12 countries and all sectors covered. The charts create a visual impression of each country’s expected position in the green economy by plotting the location of each country-sector on the GII-RCA plane. Sector labels are intentionally left out to underscore the graphical nature of the charts.

Without going into sectoral detail, the charts suggests a highly nuanced picture without unequivocal winners and losers. Every country has strengths and opportunities in the green economy, but most countries also face weaknesses and threats.

One striking observation is the significant number of sectors, across countries, with hardly any green innovation at all. In many countries there is a noticeable concentration of sectors with a GII score of zero at the bottom of the chart. Few of them are areas of current comparative advantage for their country, but there are important exceptions, for example in Hungary, Slovenia, Turkey and to a lesser extent Poland.

Concentrating on sectors with positive GII scores, we observe an even distribution of sectors in Brazil, France, Russia and Slovenia, suggesting a fairly equal balance between strengths, weaknesses, opportunities and threat. Hungary exhibits noticeable strengths, but also a sizeable fringe of low GII sectors. Turkey is probably the country with the least favourable profile, although Russia will also be concerned about the anaemic performance of some currently important sectors.

China, Germany, Japan, Korea and the US are best positioned to take advantage of the green economy, with a heavy concentration of strengths and opportunities. The sectors where Germany and the US currently hold a comparative advantage are also its leading green innovators, suggesting that both countries may be able to maintain their strong competitive positions.

In China, Korea and Japan the visual picture suggests promising new opportunities. Sectors that do not currently enjoy a comparative advantage are innovating strongly, potentially opening new areas of comparative advantage. It is possible therefore that Asia’s economic powerhouses may be the ultimate winner of the move to a low-carbon economy.

The fact that today’s industrial leaders are reasonably well positioned in the green economy does not necessarily negate the expectations of a Schumpeterian process of creative destruction and low-carbon renewal, which has been put forward by green economy advocates. There are clear opportunities in many countries to penetrate new markets and build new areas of comparative advantage. Moreover, within sectors there is likely to be a restructuring process that may see incumbent firms within a country-sector lose market shares to newcomers from the same country. The US car industry, where newcomer Tesla is

\(^4\) See [https://unstats.un.org/unsd/publication/seriesm/seriesm_4rev3_1e.pdf](https://unstats.un.org/unsd/publication/seriesm/seriesm_4rev3_1e.pdf), Fankhauser et al (2013) contain analysis at the four-digit level. The higher aggregation (three-digit level) is necessary as we cover additional countries with lower patent numbers.
competing with incumbent firms, may be a case in point. However, to document these processes one would have to look at firm-level data, rather than sector-level information.

**Figure 2: Low-carbon SWOT – Overview**
Note: Each bubble indicates the location of a country-sector on the GII-RCA plane. The size of the bubble indicates the size of the country sector, using output data from UNIDO (average over the years 2004 to 2013)

Source: own calculations

3.2 A closer look at strengths, weaknesses, opportunities and threats

Figure 2 offers a deliberately visual impression of low-carbon competitiveness without going into any sector detail. To add concreteness we next focus on just eight key sectors in each country, which are important strategically in terms of patent numbers and gross value added. These more focused SWOT charts are shown in Figure 3.

Although Figure 3 adds sector specificity, it should be made clear that the charts are not forecasts. They can only offer broad indications of potential trends. Realising potential opportunities, consolidating existing strengths and warding off the threats will require determined, far-sighted management from all companies in the sectors concerned. Their actions will be influenced by the business environment in which they operate and by policy interventions that either help or hinder the low-carbon transition. Business excellence and policy performance are hard to predict. Some companies will fail despite a favourable starting point, while others might turn weakness into opportunity and eventually strengths.

The narrower analysis re-emphasises the strong strategic position of the world’s leading industrialised economies. Germany and the US in particular are well placed to preserve their industrial strengths. Important sectors such as automotives (sector code 341), machinery (291, 292) and metal products (289) feature prominently in the top-right quadrant of their country charts.

Except for Hungary and Slovenia, which have a lower patent count, only sectors with at least 60 patents were considered.
Similar strengths can be observed in Japan, South Korea and to a lesser extent France, but these three countries also have notable opportunities – areas where strong green innovation might create new comparative strengths – for example in metal products (289) and motor vehicles (341, 342) in the case of South Korea. There is a mixed pictures on chemicals (241, 242), with opportunities for some of these countries and threats for others.

Figure 3: Low-carbon SWOT – Details
Arguably country with the strongest opportunities is China, with petroleum products (232), chemicals (242), basic metals (271, 272) and special purpose machinery (292) among the sectors located in the top-left quadrant of its country chart. General machinery (291) is a rare and surprising weakness. Refined products (232) and plastic products (252) are among the main opportunities in Brazil, which also has strengths in motor vehicles (341, 343) and iron and steel (271).

Most EBRD countries file relatively few patents in the manufacturing sectors. However, a fair share of those patents are clean, creating a range of low-carbon strengths and opportunities. Poland, Russia and Hungary could have opportunities in for example in machinery (291, 292) and chemical products (241, 242), although other than basic chemicals this is also a threat to Hungary. Slovenia appears to have strengths in plastics (252), metal products (289) and other chemical products (242), but also faces threats to sectors such as non-metallic mineral products (269), domestic appliances (293) and machinery (291, 292).

A country that should worry about its competitive position in the green economy is Turkey. With over 10,000 filings, Turkey is a leading emerging market innovator. However, less than three per cent of them are classified as low-carbon. Food products (154), plastics (252), non-metallic mineral products (269), domestic appliances (293) and the automotive sector (341, 343) are among the sectors where Turkey might lose comparative advantage.

3.3 Strengths, weaknesses, opportunities and threats by sectors

To complete our analysis we next produce SWOT charts for selected sectors. That is, rather than drawing the location of different sectors on the GII-RCA plane for a country, we locate
the position of different countries on the GII-RCA plane of a global sector. Figure 4 shows the results for eight key sectors.

**Figure 4: Low-carbon SWOT – Sector Analysis**

![Graph showing the position of countries on the GII-RCA plane](image)

*Note:* See Figure 2 for further explanations.

*Source:* own calculations

Sectors can be split roughly into those where countries are concentrated in the bottom-left and top-right quadrants (that is, the GII and RCA scores are positively correlated) and those where countries are concentrated in the top-left and bottom-right quadrants (the GII-RCA correlation is negative).
Sectors in the former category include steam generators (281), metallic products (269) and most notably chemical products (242). The high prevalence of threats to some countries, combined with opportunities in others, suggests future disruptions in the market structure of those sectors, as incumbent operators lose market share to low-carbon newcomers. In the chemical sector, for example, French firms might lose market share to newcomers from Japan or China. In steam generation, China may lose market share for example to Japan.

Sectors where countries are concentrated in the top-right and bottom-left quadrants include general purpose machinery (291), electric motors, generators and transformers (311) and most notably motor vehicles (341). In those sectors the current market structure is more likely to prevail, as incumbent countries have considerable strengths and face few apparent challenges. However, as noted above, this does not preclude market entry and exit among firms within a country.

In the remaining two sectors – domestic appliances (293) and electricity distribution (312) – countries are concentrated in the two top quadrants, suggesting an intensification of competition in the green economy.

4. Conclusions

The global economy is undergoing a transition toward cleaner, less carbon-intensive products and production processes. Policy makers are interested to know which countries and sectors might particularly thrive in the green economy. This paper makes a contribution to answering this question, updating earlier analysis by Fankhauser et al. (2013).

Although they are used here, terms like “green competitiveness” should be interpreted with caution (Krugman 1994). What ultimately matters at the national level are real incomes and productivity. The countries that develop a comparative advantage in greener goods and services will benefit from improved terms of trade and thus higher real incomes as the relative demand for such products rises globally. But other countries benefit, too, if the shift in demand towards greener goods and services is met by supply from nations with a comparative advantage in producing them, keeping their relative prices lower than otherwise. This is the basic tenet of the green growth literature. Producers and consumers alike would benefit from an economy that is low-carbon, climate-resilient, resource-efficient and biodiverse (Bowen and Fankhauser 2011).

The degree of structural change required for a low-carbon economy will create both winners and losers. This is not just an issue of sectoral realignments, where plainly high-carbon sectors like coal mining will see their output fall. As important will be changes within sectors. The automobile industry may not necessarily produce fewer vehicles, for example, but manufacturers that do not switch to cleaner cars may lose market share. The demand for low-carbon products and production processes penetrates all parts of the economy.
Our analysis suggests that most countries have existing strengths and new opportunities in the low carbon economy, although most of them also face threats to some currently well-performing sectors.

The paper is silent about policy, that is, government interventions that would let countries maintain their strengths, exploit the opportunities and mitigate the threats. Our objective is purely descriptive, to identify potential shifts in comparative advantage. There are no explicit policy variables in our analysis. Given the importance of public policy in the low-carbon transition, this is perhaps an omission.

Some policy lessons can nevertheless be drawn. They are clearer on environmental regulation and innovation support than on industrial policy. The literature still disagrees on the value of industrial policy. Some authors argue that industrial policy has played only a minor part in recent industrial successes (Pack and Saggi, 2006), while others point to the need to overcome information and other externalities (e.g., Hausmann and Rodrik, 2003). There is much stronger evidence in support of clean innovation policy and its societal benefits (e.g., Dechezleprêtre et al 2014).

First and foremost, however, there is a case for strong environmental policies. The private sector will look to governments to provide a business environment – in the form of consistent, credible and effective carbon regulation – which is conducive to low-carbon investment. Many firms will also look to international financial institutions to help them finance the low carbon transition.

Consistent environmental policies (e.g., a price on carbon) with long-term credibility are essential to correct basic market failures and give environmental services a monetary value (Bowen and Fankhauser 2017). According to the Porter hypothesis (Porter 1991; Porter and van der Linde 1995), environmental regulation will also boost clean innovation, leading to improved resource efficiency and enhanced product quality and therefore higher competitiveness and ultimately higher growth. The empirical evidence in support of the Porter hypothesis, is not always conclusive (Ambec and Barla 2006), but it suggests that low-carbon competitiveness can be boosted through thoughtful environmental regulation. Economies of scale and expertise developed in the domestic market may then boost export opportunities through a home market effect (Krugman 1980; Hanson and Xiang 2004).

Business success in the green economy depends on good and consistent public policy. Without it low-carbon businesses are at a structural disadvantage, to the detriment of both the economy and the environment.
References


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Annex: ISIC Rev 3.1 Sector Codes (Manufacturing)

Division 15 Manufacture of food products and beverages
151 Production, processing and preservation of meat, fish, fruit, vegetables, oils and fats
152 Manufacture of dairy products
153 Manufacture of grain mill products, starches and starch products, and prepared animal feeds
154 Manufacture of other food products
155 Manufacture of beverages

Division 16 Manufacture of tobacco products
160 Manufacture of tobacco products

Division 17 Manufacture of textiles
171 Spinning, weaving and finishing of textiles
172 Manufacture of other textiles
173 Manufacture of knitted and crocheted fabrics and articles

Division 18 Manufacture of wearing apparel; dressing and dyeing of fur
181 Manufacture of wearing apparel, except fur apparel
182 Dressing and dyeing of fur; manufacture of articles of fur

Division 19 Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
191 Tanning and dressing of leather; manufacture of luggage, handbags, saddlery and harness
192 1920 Manufacture of footwear

Division 20 Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
201 Sawmilling and planing of wood
202 Manufacture of products of wood, cork, straw and plaiting materials

Division 21 Manufacture of paper and paper products
210 Manufacture of paper and paper products

Division 22 Publishing, printing and reproduction of recorded media
221 Publishing
222 Printing and service activities related to printing
223 Reproduction of recorded media

Division 23 Manufacture of coke, refined petroleum products and nuclear fuel
231 Manufacture of coke oven products
232 Manufacture of refined petroleum products
233 Processing of nuclear fuel

Division 24 Manufacture of chemicals and chemical products
241 Manufacture of basic chemicals
242 Manufacture of other chemical products
243 Manufacture of man-made fibres

Division 25 Manufacture of rubber and plastics products
251 Manufacture of rubber products
252 Manufacture of plastics products

Division 26 Manufacture of other non-metallic mineral products
261 Manufacture of glass and glass products
269 Manufacture of non-metallic mineral products n.e.c.
Division 27 Manufacture of basic metals
271 Manufacture of basic iron and steel
272 Manufacture of basic precious and non-ferrous metals
273 Casting of metals

Division 28 Manufacture of fabricated metal products, except machinery and equipment
281 Manufacture of structural metal products, tanks, reservoirs and steam generators
289 Manufacture of other fabricated metal products; metalworking service activities

Division 29 Manufacture of machinery and equipment n.e.c.
291 Manufacture of general-purpose machinery
292 Manufacture of special-purpose machinery
293 Manufacture of domestic appliances n.e.c.

Division 30 Manufacture of office, accounting and computing machinery
300 Manufacture of office, accounting and computing machinery

Division 31 Manufacture of electrical machinery and apparatus n.e.c.
311 Manufacture of electric motors, generators and transformers
312 Manufacture of electricity distribution and control apparatus
313 Manufacture of insulated wire and cable
314 Manufacture of accumulators, primary cells and primary batteries
315 Manufacture of electric lamps and lighting equipment
319 Manufacture of other electrical equipment n.e.c.

Division 32 Manufacture of radio, television and communication equipment and apparatus
321 Manufacture of electronic valves and tubes and other electronic components
322 Manufacture of television and radio transmitters; apparatus for line telephony and line telegraphy
323 Manufacture of television and radio receivers, sound or video recording or reproducing apparatus, and associated goods

Division 33 Manufacture of medical, precision and optical instruments, watches and clocks
331 Manufacture of medical appliances and instruments and appliances for measuring, checking, testing, navigating and other purposes, except optical instruments
332 Manufacture of optical instruments and photographic equipment
333 Manufacture of watches and clocks

Division 34 Manufacture of motor vehicles, trailers and semi-trailers
341 Manufacture of motor vehicles
342 Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers
343 Manufacture of parts and accessories for motor vehicles and their engines

Division 35 Manufacture of other transport equipment
351 Building and repairing of ships and boats
352 Manufacture of railway and tramway locomotives and rolling stock
353 Manufacture of aircraft and spacecraft
359 Manufacture of transport equipment n.e.c.

Division 36 Manufacture of furniture; manufacturing n.e.c.
361 Manufacture of furniture
369 Manufacturing n.e.c.

Division 37 Recycling
371 Recycling of metal waste and scrap
372 Recycling of non-metal waste and scrap

Source: https://unstats.un.org/unsd/publication/seriesm/seriesm_4rev3_1e.pdf