

Sustainable Production, Life Cycle Engineering and Management
Series Editors: Christoph Herrmann, Sami Kara

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Managing Green Business Model Transformations

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Sustainable Production, Life Cycle Engineering and Management

Modern production enables a high standard of living worldwide through products and services. Global responsibility requires a comprehensive integration of sustainable development fostered by new paradigms, innovative technologies, methods and tools as well as business models. Minimizing material and energy usage, adapting material and energy flows to better fit natural process capacities, and changing consumption behaviour are important aspects of future production. A life cycle perspective and an integrated economic, ecological and social evaluation are essential requirements in management and engineering. This series will focus on the issues and latest developments towards sustainability in production based on life cycle thinking.

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Managing Green Business Model Transformations

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Chapter 5

Towards a Taxonomy of Green Business Models

As management science still lacks a universally accepted definition of business models it comes at no surprise that theoretical research on *green* business models is virtually non-existent at this point in time.

First attempts to conceptualise “sustainable business models” or “business models for sustainability” have been made (Stubbs & Cocklin 2008; Lüdeke-Freund 2009). However, a robust body of research on sustainable business models – let alone with an environmental focus – is not yet available. As this work attempts to provide managers with a practical methodology to manage Green Business Model Transformations, the question what actually distinguishes green from non-green business models has to be answered first. In addition to providing a theoretical, abstract distinction, means to recognise green business models in the real world need to be developed as well. This can also help to objectify discussions about greenwashing which is likely to continue to play a role in the coming years. A generally applicable approach to identifying green business models is thereby a worthwhile research question in its own right. However, the aim of this chapter is to start a discourse on the topic, rather than to conclude it. As will be demonstrated in the following, a taxonomy for green business models raises a number of theoretical and practical challenges whose resolution requires contributions that vastly exceed the scope of this work, including but not limited to improved methods for measuring and comparing environmental impacts as well as industry-specific examinations.

5.1 Existing Business Model Classifications

Existing business model classifications provide a starting point for developing a taxonomy of green business models. Osterwalder (2004, 26ff.) has gathered a number of business model classifications that have been created during the dot-com boom (Timmers 1998; Applegate 2001; Linder & Cantrell 2000; Tapscott et al. 2000; Weill & Vitale 2001; Rappa 2001). Although all of them, with the exception of Linder and Cantrell, created their classifications specifically against the background of e-business, the dimensions used for categorisation differ greatly (see table 5.1). The same is true for the other examples of the same table that have been collected. Some use only one, rather simple dimension (e.g., Johnson 2010, 131), while most authors use multiple, sometimes complex dimensions. The various kinds of taxonomies also differ in their level of analysis, i.e. firm vs. network (Lai et al. 2006).

Table 5.1 Categorisation dimensions of selected business model classifications

Author(s)	Categorisation dimension(s)	Resultant categories
Timmers (1998)	<ul style="list-style-type: none"> ▪ Degree of innovation ▪ Degree of functional integration (from single function to multiple functions / integrated) 	11 generic e-business models
Applegate (2001)	<ul style="list-style-type: none"> ▪ Product offering (focused distributor, portal, producer, infrastructure provider) 	4 e-business model categories plus subtypes
Linder & Cantrell (2000)	<ul style="list-style-type: none"> ▪ Core, profit making activity (providing, channel, or intermediary) ▪ Relative position on the price/value continuum (high-value, premium-priced innovations to low-priced, standardized offerings) 	9 operating business model types plus subtypes
Tapscott et al. (2000)	<ul style="list-style-type: none"> ▪ Control (hierarchical vs. self-organising) ▪ Degree of value integration 	5 types of b-webs
Rappa (2001)	<ul style="list-style-type: none"> ▪ Position in value chain and revenue source 	9 generic e-business models
Weill & Vitale (2001)	<ul style="list-style-type: none"> ▪ Main functionality / type of value 	8 atomic (modular) e-business models
Moore (2005)	<ul style="list-style-type: none"> ▪ Complex systems vs. volume operations 	2 business model types
Rajala & Westerlund (2005)	<ul style="list-style-type: none"> ▪ Degree of involvement in customer relationships ▪ Level of homogeneity of offering 	4 software industry business model types
Schweizer (2005)	<ul style="list-style-type: none"> ▪ Value chain constellation (existing vs. innovating) ▪ Market power of innovators vs. owners of complementary assets ▪ Total revenue potential 	4 business model types
Chesbrough (2006)	<ul style="list-style-type: none"> ▪ Innovation process (none, ad hoc, planned, externally supportive, connected to business model, identifies new business model) ▪ Intellectual property management (n/a, reactive, defensive, enabling asset, financial asset, strategic asset) 	6 business model types
Lai et al. (2006)	<ul style="list-style-type: none"> ▪ Type of assets involved: financial, physical, intangible, or human ▪ Type of rights being sold: creator, distributor, landlord, broker 	16 business model types (14 existing in practice)
Johnson (2010)	<ul style="list-style-type: none"> ▪ Financial logic 	19 business model types
Wirtz et al. (2010)	<ul style="list-style-type: none"> ▪ Classical business activities (on internet markets) 	4 prototypical internet business models

Furthermore, all five components of the business model framework have been used for categorisation: value propositions (e.g., Linder & Cantrell 2000), target customers (e.g., Rajala & Westerlund 2005), key resources (e.g., Lai et al. 2006), key processes (Schweizer 2005), and financial logic (e.g., Johnson 2010). Some authors use dimensions that are outside the business model framework. For example, the maturity of a business model is used as a criterion (e.g., Chesbrough 2006).

Differences in categorisation dimension can be observed both for classifications specific to the e-business domain and for general classifications. The large heterogeneity originates in part from the fact that most of the listed classifications are typologies rather than taxonomies. According to Lambert (2006, 7f.) typologies are classifications that serve specific purposes, and are usually derived deductively based on a few qualitative criteria. Taxonomies, in contrast, consider a broad range of characteristics and use a quantitative basis. As a result, taxonomies classify business models according to their similarity in all aspects, and classes may change based on empirical findings.

As the study of existing green business model candidates (some of which are documented in chapter 7) has revealed, they can differ greatly from each other and from conventional business models in numerous aspects, while they are alike in others. The levers for value creation though environmental sustainability (see 3.2.3.1) are widely distributed across virtually all business model elements. Conversely, not all components need to be inherently green to qualify the business model as a whole. As a result, no simple logic of classification reveals itself from examining real-world business models.

The only definite commonality across all green business models that can be identified at this point of the exploration is their superior environmental performance – whatever form this might take.

5.2 Basic Considerations for Developing a Taxonomy of Green Business Models

There are a number of fundamental issues that need to be dealt with in order to create a meaningful taxonomy of green business models. These include:

- **Paradigm:** The weak versus strong sustainability paradigms have to be considered.
- **Comparability:** The question which business models are to be compared, i.e. to what degree their customer need satisfaction is equivalent (substitutable).
- **Scope:** The considered scope – or system boundary – of the business model determines which environmental impacts are included in the assessment.
- **Level of abstraction:** The actual versus theoretical impact of a business model, i.e. the influence of its realisation may lead to very different conclusions in certain cases.
- **Detail of assessment:** There is a trade-off between the level of detail of the categorisation and the effort in completing the evaluation.

First, the taxonomy to be developed needs to be evaluated regarding its consistency with weak and strong sustainability. Balancing of economic versus natural capital in the sense of the weak sustainability paradigm (see Neumayer 2003) is rejected. Otherwise it could be argued, for instance, that business models with high impact like building luxury sports cars are green just because prices per unit are even higher than that of mainstream cars. Moreover, a price increase would make a business model more green if environmental impact is measured relative to monetary output (see also Verfaillie & Bidwell 2000, 17). As a result, the financial output (e.g., net sales) of business models is disregarded in this context. Conversely, this also means that policy decisions (e.g., about subsidies or tax breaks) cannot be based on the proposed green business model taxonomy alone: Even if a business model is categorised as green, there may be more economically efficient alternatives that politics should support instead. Yet, economic efficiency is still in force anyway in the sense that inefficient green business models will usually be eliminated by competition or remain niche.

On the other extreme, few if any volume business models to date satisfy the requirements of the strong sustainability paradigm, or could do so realistically. Hence, the taxonomy is not based on either of the extremes. Instead the taxonomy follows an intermittent view, possibly best described as “sustaincentric” (see Gladwin et al. 1995).

Second, the sports car example reveals another difficulty: Should the environmental impacts of the business model of a sports car producer be compared with that of other sports car producers; or with that of car producers in general, or even with that of mobility goods or service providers including, for instance, airlines, railway companies, or car sharing companies?

The related question of what constitutes an ecological (green) product is helpful in finding an answer. Schaltegger & Sturm (1990, 283) argue that a green product must fulfil three criteria:

1. highest product-based ecological efficiency
2. highest functional efficiency
3. volume consumption of product does not cause permanent damage to natural systems

Product-based efficiency relates to the environmental impact (full lifecycle) of a product with a specific functionality (need fulfilment). In practical terms, one car can be more or less efficient than another car with comparable functionality. Functional efficiency only relates to the “job-to-be-done”, e.g. transporting people over a given distance and time. Here, different modes of transport would be compared (e.g., driving a car, riding a train, or flying) while assuming equivalent utilisation and technological maturity (i.e. an average car is compared with an average train, both half full). One unfortunate implication is that the same product can be green and non-green – depending on the use case. Schaltegger & Sturm (1990, 284) remark that analogous considerations are valid for production processes, too.

Business models usually consist of bundles of offerings and numerous primary processes. Hence, to make a statement about the business model as a whole, a certain degree of abstraction and aggregation is necessary. However, even individual offerings may satisfy a range of needs (e.g., short vs. long distance travels by car). To compare business models they must therefore cover a similar range of customer needs. As such, the analysis may reveal that both a producer of low-emission cars and a car sharing company using ordinary cars can both have a green business model, if their environmental impact is significantly lower compared to the average car producer and seller business model. At the same time, a bicycle manufacturer's business model is not suitable to satisfy the needs of most car buyers, and thus is not eligible for comparison in the sense above. This also implies that the relative "greenness" of business models with differing needs satisfaction profiles cannot be sensibly compared. In order to operationalise what has been referred to as "similar coverage of needs", it may be serviceable to define a set of functional characteristics that satisfy *basic functional needs* (e.g. number of seats in a car) vs. *non-basic functional needs* (e.g., motorisation). This distinction can generally be expected to be controversial no matter how it is set. Grey areas will be significant for many industry sectors, they depend on cultural attitudes, and differ between customer groups. One could argue that a Toyota Prius and a Rolls Royce fulfil equivalent basic functional needs; most owners of a Rolls Royce, however, will probably disagree. Yet, despite such issues, without such a distinction of sets of needs, basically every single product would have to be considered non-substitutable.

Third, the chosen system boundary of a business model can heavily influence the conclusion regarding its relative environmental impact. A business model may create a comparatively low impact within the company doors, but show disastrous characteristics when the whole value chain is considered. For example, the use of certain chemicals may make a production process cleaner, but produce strong additional environmental impact when the customer uses or disposes the product. Conversely, most manufacturers of environmental technology do not have low impact production methods per se – the environmental benefits of the business models are found at their customers' sites. Hence, it is sensible to argue that any meaningful approach needs to include suppliers' and customers' environmental impacts, as long as they can be attributed to the business model under examination. This may also include the suppliers' suppliers and customers' customers, and so on. This way, green claims which are based on shifting "dirty" parts of the value chain to customers, suppliers or other partners can be refuted, too.

More difficult is the question whether systemic, macro-level environmental effects should be considered. In some cases, well-meaning business models can turn into an environmental (and public relations) nightmare on a macro level. For example, biofuel producers that were once praised for providing a fuel that releases no additional CO₂ into the atmosphere got under scrutiny. Prospects of large profits led to the clearing of rainforests in order to grow biofuel crops as well as replacing food with fuel crops. As *Time* wrote in its cover story on April 7, 2008: "Hyped as an eco-friendly fuel, ethanol increases global warming, destroys forests and inflates food prices. So why are we subsidizing it?" (Grunwald 2008b).

It needs to be noted, however, that macro-level effects are very difficult to assess, let alone predict. In fact, even the detailed assessment of a business model's value chain is afflicted with significant effort and methodological difficulties as practical experiences with life cycle assessment show (Schaltegger 1997). Such assessments are associated with considerable uncertainty due to the complexity of interacting system elements, and because relevant effects often lie far in the future (Sterman 2000). What can be done, however, is to determine whether a business model has a strong tendency to lead to adverse environmental effects on a macro-level, or if these patterns are balanced or negligible, or if the business model even has ecologically beneficial macro-level characteristics. The latter can be the result of desirable behavioural changes in addition to direct environmental advantages. Hence, macro-level effects of business models will be discussed in the following, but are not part of the formal distinction of green versus non-green business models.

The fourth fundamental issue concerns the question to what degree the actual *realisation* of a business model should be considered. By definition, the business model and its implementation are two distinct matters. However, the question remains at what level of abstraction a business model should be evaluated. For example, the evaluation of a generic car sharing business model may conclude that car sharing models are green based on some assumptions about characteristics that ordinary car sharing business models have in common. However, if the car pool of a particular car sharing business model consisted of fuel-guzzling SUVs, it may be worse than the traditional car ownership business model based on some average fleet fuel efficiency.

A specific non-green version of a business model should not exclude its most common occurrence from being considered green – in general. A car sharing model with SUVs is very different to the ordinary business model in many important aspects (e.g., value proposition, customer segment, physical assets) and therefore needs to be evaluated separately. This rule may seem too malleable to some observers. However, the complex nature of the task at hand requires some common sense from analysts in order to keep the approach manageable in practice.

This leads to the last of the five fundamental issues: the trade-off between accuracy and effort. Generally, the more detailed the rules and distinctions underlying the taxonomy, the more accurate it can be. However, at some point applying these rules either becomes unreasonably time-consuming or difficult (thus resulting in limited accuracy, too). On the other hand, if the chosen approach is too simplistic, the result of an assessment is of little theoretical or practical value.

There are two basic types of errors: false positives (non-green business models are declared green) and false negatives (green business models are declared non-green). Both errors are problematic: The former invites companies to greenwashing and may lead to hypocrisy. The latter would discount worthwhile efforts towards greening the economy. Since false positives could seriously harm the credibility of the proposed approach, it is designed to minimise both types of errors, yet making sure there are no glaring false positives, and that the effort remains within acceptable limits.

5.3 Four Generic Business Model Types Differentiated by Aggregated Environmental Impact

The taxonomy of green business models proposed in this work is based on the distinction of four generic types, based on their overall environmental impact compared to output. Only business models of type 2 and 3 (not type 0 and 1) are considered to be *green* in a dichotomic sense. Figure 5.1 depicts the trend of the overall environmental impact I over time (see below).

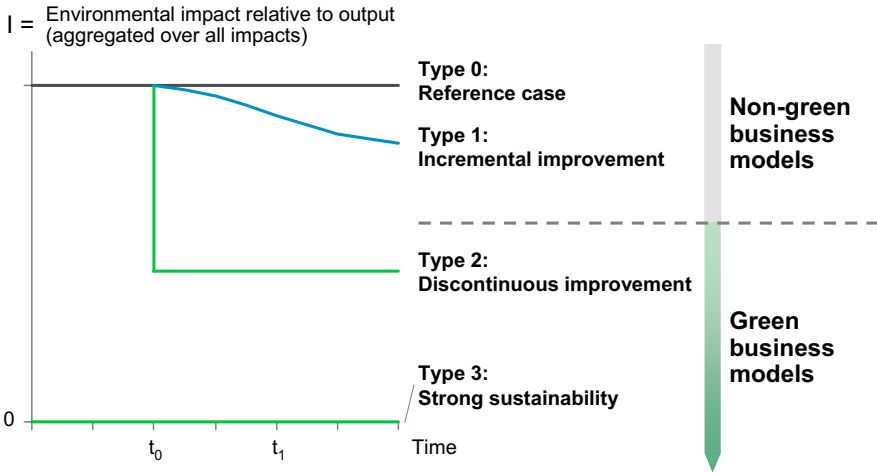


Fig. 5.1 Case-based distinction of business models related to their relative environmental impact

I is defined relative to a business model’s output over a certain period of time (e.g., one year). I consists of one or more *individual environmental impacts* i , weighted by their *relative importance* w . For each *environmental issue* k (e.g. water use, NO_x emissions, hazardous waste, etc.), $i_{k,t}$ therefore refers to the impact regarding that issue during *time period* t , as measured in *unit* u and divided by the *output* o . As explained above, o should be defined in terms of volume (e.g., number of product units sold) or function delivered (e.g., passenger-kilometers), not monetarily (see also Verfaillie & Bidwell 2000 for various issues with value indicators). For example, a utility that generates power from a mix of fossil and nuclear energy may have an environmental impact $i_{\text{CO}_2,2010} = 600 \text{ t CO}_2 \text{ per GWh}$. However, the utility’s aggregated impact I_t will also include impacts from other environmental issues like air pollution and nuclear waste. The various impacts are added by making them comparable using weights w_k (in $1/u_k$). Hence, the vertical axis of figure 5.1 is defined as

$$I_t = \sum_k w_k * i_{k,t}$$

The four business model types are explained in the following. After that, challenges of their application in practice are discussed.

5.3.1 *Type 0: Reference Case*

Type 0, the *reference case*, can be interpreted as the current standard practice within a given industry sector. For example, figures for average CO₂ emissions per generated MWh of utilities are readily available for most parts of the world (e.g., IEA 2009b). If there are large regional differences, advanced economies should serve as a reference. Some industries, however, do not have a generally accepted standard practice – at least not for all relevant environmental impacts. In such cases, it may be necessary to compare a business model to that of a key industry player; or, in the case of a transformation, to its own past performance at a given date. While there are obvious issues of comparison between different companies when using reference cases defined the latter way, it will usually be sufficient to determine whether a particular business model is to be considered green or not.

The reference case in figure 5.1 shows constant environmental impact over time (in relative terms, i.e. compared to the business model's output).

This is a simplification as normal efficiency improvements alone should usually slightly reduce the relative environmental impact over time. Hence, type 0 is supposed to represent business-as-usual developments, that is, when a company does not particularly concentrate on reducing its environmental impact. As the standard practice gets adapted from time to time, type 0 business models will thus take a staircase form with a gentle downward slope over longer periods of time. For the sake of simplicity, however, the reference case is assumed to show no improvements in the considered timeframe, and weights are considered constant.

5.3.2 *Type 1: Incremental Improvement*

By now, many if not most large companies have initiated some sort of environmental programme. The majority of these programmes as featured in corporate sustainability reports will be of an *incremental improvement* type, also referred to as *type 1* in the following. Environmental targets announced by companies sometimes sound impressive. Yet, they usually do not represent real breakthroughs, but rather reflect many small measures that add up over long periods of time. Incremental improvements of a given company can be larger or smaller than an industry's average. Over time, strong incremental improvement can lead to significant advancement compared to the reference case (that follows the industry average). However, if these additional improvements pay off financially, competitors can be expected to imitate, thus eventually raising the bar for all firms that want to stand out. The business models that car manufacturers have used from 1900 through the rest of the century provide a good example for type 1 business models: Business models have not changed much during that time, and despite all the technological advances during the 20th century, fuel economy has only improved gradually.

Therefore, each individual improvement is considered as if it was infinitesimally small (in mathematical terms). Obviously there is no such thing in reality: Every replacement of an incandescent light bulb by a compact fluorescent lamp reduces energy consumption (and thus usually also CO₂ emissions) by a non-infinitesimal quantity. However, compared to the CO₂ emissions of a utility, even the replacement of all light bulbs in buildings of the company would still be negligible and go unnoticed on a chart like that in figure 5.1. In contrast, if the utility were to equip its coal-fired power plants with Carbon Capture and Storage (CCS), the resulting reduction in CO₂ would produce a sudden drop of I_t , the graphical characteristic of a type 2 business model.

5.3.3 Type 2: Discontinuous Improvement

Type 2 represents a fundamentally different approach compared to type 1 in that it features *discontinuous improvement*. While improvements of type 1 are the result of many small steps (doing the same but better), type 2 features big leaps (doing something different). Respective business models are considered green as the improvement can be clearly distinguished conceptually from business-as-usual improvements.

In t_0 the discontinuous improvement takes effect; it represents the “big leap” in environmental performance. From t_0 onwards I_t is shown to be constant (for the purpose of conceptual clarity). However, in reality type 2 business models will generally enter a phase of incremental improvement after the discontinuous change has taken effect. In that respect, the idea of type 2 business models has some similarity with theories of punctuated equilibrium (see chapter 6.2.5).

While the distinction between type 1 and 2 seems clear in abstract terms, in practice it can be difficult to make. There may be relatively long periods during which type 1 business models have a lower actual environmental impact than immature type 2 models – it remains contested during that time whether the latter is in fact a dead end.

In addition, the expected improvement may not materialise right away as new business models will sometimes take considerable time to implement at scale – even when setting aside the maturity aspects mentioned above. The clean step of the curve representing type 2 in figure 5.1 is thus an idealisation, ignoring temporary implementation-related effects.

Furthermore, two alternative business models may have advantages in some, but disadvantages with respect to other environmental issues. For example, compact fluorescent lamps use significantly less energy than comparable incandescent light bulbs. However, the former contain lead. In these cases, determining the weights becomes critical (see 5.4.2).

An issue that has not yet been raised concerns the scope of the environmental footprint needed to qualify business models as green. It can be internal to the company (referred to as *type 2a*). Yet, many green business models have their largest lever in reducing environmental impacts outside of the boundaries of the firm (*type 2b*) – often those of their customers. For example, a utility that replaces

all fossil generation capacity with renewable energy sources applies a type 2a business model. The company that produces the utility's wind turbines applies a type 2b business model.

In some cases, it is even the explicit purpose of the business model to reduce the environmental impact of another business model (*type 2c*). That is, these business models have no purpose other than protecting the environment (wind turbines have the primary purpose of generating electricity, and pleasantly do so without pollution). Environmental technologies like pollution filters are examples for this type. In contrast to other business models, the alternative to applying them can be *not* applying them (as opposed to substitute business models). Oftentimes, type 2c business models bring about trade-offs. For example, pollution filters at coal-fired power plants not only reduce harmful air pollution, they also reduce the efficiency of the plant and thus result in higher CO₂ emissions per GWh. Whether or not certain type 2c candidates are actually green may thus be contested. Their environmental benefit, by definition, will be downstream as this is the core of their value proposition. If there is a market for a type 2c candidate, strong externalities or misaligned economic incentives must thus be present for the business model not to be green indeed.

Type 1 and type 2 have both been defined in relative terms. For each type 2 business model there will thus be a non-green version of type 1. Type 3 is different; respective business models are green in *absolute* terms.

5.3.4 Type 3: Strong Sustainability

Type 3 denotes business models that are truly sustainable, i.e. they operate without depleting the capacity of the environment to support its operation indefinitely (strong sustainability). There are very few if any such business models as of today. It would certainly need to use energy from renewable sources, apply closed-loop manufacturing, and ensure that its products do not harm the environment during usage by customers. A weaker form of such a business model can be accomplished if remaining impacts are neutralised by reducing impacts on an equivalent scale elsewhere. Hence, the sum of all impacts needs to be (close to) zero, with the relaxation that positive individual impacts $i_{k,t}$ can be compensated by negative impacts through measures like reforestation. To serve the demands of strong sustainability, however, critical natural capital (e.g., the ozone layer or biodiversity) may not be substituted (see Neumayer 2003).

5.4 Distinguishing the Four Business Model Types in Practice

As indicated above, there are several practical challenges that need to be overcome in practice in order to create robust assessments of business models regarding their categorisation: First, the considered scope of environmental impacts needs to be determined. Second, environmental issues need to be made comparable; transparently determining respective weights for this purpose can prove difficult. Finally, the critical distinction between type 1 and 2 business models needs to be formalised in a reproducible way.

5.4.1 Challenge 1: Define Scope of Environmental Impacts

The scope of assessed environmental impacts needs to be considered carefully, both in terms of business model boundaries and to what extent external environmental impacts of suppliers and customers are factored in.

Consider a steel producer that uses standard production methods. This example seems to be an obvious one for a non-green business model (type 0). However, if the steel producer produced a specialty steel that is exclusively used to build high-performance components for offshore wind parks, it suddenly becomes a type 2b business model. Similarly, if a utility produces only five percent wind energy, but sells this electricity as green energy to environmentally-minded customers, this can be considered a type 2 business model as well – the utility then operates at least two business models, one of which is green. The criterion whether environmental impacts of external value chains are included is *direct attributability*. That is, the steel must be purpose-produced for wind mills to claim the avoided CO₂ in electricity generation, and not be general purpose steel. In this sense, the specialty steel producer inherits its green status from the low-emission generation business model (and so does the wind energy equipment manufacturer). Direct attributability ends at this point, though: neither the supplier of the iron ore, nor the one that delivers the coke offers a product specifically created for building windmills.

Conversely, the CO₂ emissions and air pollution from driving a truck is directly attributable to the truck manufacturer; further impacts resulting from the purpose of using them (e.g., the transported goods) are not. Respective impacts of single-purpose transport vehicles like oil tankers, in turn, are directly attributable. For instance, the average amount and damage of oil spills (per transport volume and distance) could be compared between tankers and pipelines, or between single- and double-hulled tankers. The examples above demonstrate that deep reflections are necessary to arrive at a sound definition of scope.

A company that belongs to an industry that generates relatively low internal environmental footprints but makes products that cause enormous, directly attributable environmental impacts (e.g., car manufacturers) will hardly be a candidate for a type 2a business model. Conversely, companies with a large internal footprint and comparatively low external impacts (e.g., utilities) will have difficulties presenting convincing evidence that they operate a type 2b business model. The obvious reason is of course that the impact reduction in the external value chains will likely be insignificant compared to the overall impact of the business model. There are, of course, some well-founded exceptions as the example of the specialty steel producer above illustrates. Appendix 3 provides an overview of which industry sectors will usually be candidates for the various subtypes of type 2 business models. As a rule of thumb, external value chain segments can be left out of scope if respective environmental impacts are negligible or clearly outside the sphere of influence of the company (with the exception of type 3). For example, a utility cannot be held accountable for the environmental impacts that their customers produce by using the sold electricity.

5.4.2 Challenge 2: Determine Weights for Environmental Impacts

There is a growing body of research that deals with the question how to make different environmental impacts tangible, e.g. by representing them in financial terms (Schaltegger & Burritt 2000; Burritt et al. 2002; Schaltegger et al. 2006). Other approaches aim to measure environmental impact in terms of human welfare or years of life lost (YOLLS) (Droste-Franke 2004). Determining respective weights is a real challenge. They may be subjective considerations informed by current societal knowledge and beliefs. This leads to the unpleasant situation that a business model can be green for one group and worse than the reference case for another. However, this characteristic is not counterfactual to reality: For example, some consider nuclear power a green technology while others think it bears unacceptable risks and produces waste that is more damaging than the CO₂ from fossil power plants it substitutes. In this particular case the nuclear crisis at the Fukushima plant in Japan has apparently changed previous assessments of nuclear power by (some) governments and the public at large quite significantly (e.g., Grunwald 2008a; Kaufman 2011; The Economist 2011; Cooper & Sussman 2011).

One alternative to create weights that are less prone to ideological views could be the introduction of (virtual) prices – for example based on how much it would cost to clean up the environmental impact, or how much the used or depleted ecosystem services would be worth if they had been produced artificially. However, these prices in itself would be a matter of great uncertainty and hotly debated in most instances, too. It may well be that picking different methodologies for different industries turns out to be the most practical approach.

5.4.3 Challenge 3: Distinguish Discontinuous vs. Incremental Improvement

One central problem is the question what the term “discontinuous” means with respect to improvement compared to the reference case. For example, if a utility uses wind power to generate only a part of its electricity, the crucial question is what the threshold should be in order to distinguish between type 1 or type 2. The same is true for “pure” business models that show an improvement of $x\%$ compared to the reference – how large does x need to be? How the reference case is determined also has a big impact: One could compare to the installed base, a global average of new installations, use geographical market definitions, etc. Furthermore, a business model can offer a significant improvement for one environmental issue (compared to the most strict reference case), but this improvement gets diluted due to other issues that remain unchanged.

Again, a scientifically robust answer to the questions mentioned above may be provided by an industry-based assessment of issues and their historic incremental improvements.

5.4.4 Proposed Solution: 4-Step Assessment Procedure

No final solution to all the mentioned practical challenges can be offered here. Nevertheless, the following 4-step assessment procedure is proposed to frame the solution:

1. Identify business model boundaries:
 - A company may operate several business models in parallel, some of which are green and some of which are not.
 - Business model boundaries are determined by distinct combinations of value propositions, target groups, and the revenue model (i.e., the value capture perspective); complimentary offerings alone are no separate business model in its own right.
2. Identify components that may potentially qualify the business model as being green:
 - A necessary condition for a business model to be considered green is that at least one of its components qualifies it as type 2 (or 3).
 - The five considered business model components are: value propositions, target groups, key resources, key processes, and financial logic.
3. Confirm the significance of the green characteristics of the business model:
 - All significant, *directly attributable* environmental impacts are considered, including those of up- or downstream value chains (suppliers and customers), or partners.
 - The resulting environmental effect must relate to one or more significant environmental issue(s) of the business model's value chain system.
 - Steady state environmental performance is evaluated; temporary, implementation-related deficiencies are ignored for the assessment.
 - The environmental improvement effect on the issue(s) must be considerable compared to the reference case.
 - The reference case is the average, or most commonly used standard, that would be newly applied in the business model's reference market (i.e., new installations, not installed base; use of the business model's defined market scope).
4. Confirm that the green characteristics are fundamental to the business model:
 - In order to qualify for types 2 or 3, the respective business model components must pre-dominantly *apply* the characteristics in practice (green processes, products, etc.) that distinguish them from a reference case (i.e. beyond a reasonable threshold of x%)
 - The green characteristics must have profound implications for other elements of the business model, i.e. their removal would entail further subsequent adaptations and change the nature of the business model in general.

Commentary: A business model that satisfies rules 1 through 3 but not 4 are considered future candidates for green business models – provided that green characteristics become engrained in the business model and are widely applied.

In conclusion, the proposed taxonomy has a number of conceptual limitations: First, it is not suitable to determine absolute greenness, or to compare non-related business models. Moreover, it neglects efficiency considerations, i.e. how cost-effective environmental improvements are compared to the reference case. The assessment is also limited to quantifiable environmental impacts. For example, food business models that differ in their characteristics regarding animal treatment will be difficult to assess meaningfully based the proposed framework.

Critics may deny that the approach even represents a taxonomy in the narrow sense as taxonomies are supposed to specify homogenous groups. For instance, taxonomies of animals distinguish between groups like fish and mammals based on a number of shared commonalities (e.g., von Linné 1806). The proposed taxonomy of green business models, however, groups otherwise diverse business models based only on their degree of greenness. This, one could argue, is equivalent to classifying animals according to their suitability as foods: some are poisonous, some are edible, and some are delicious.

In summary, a *green business model* can be defined as

a business model that represents a significant improvement (discontinuous leap) in overall environmental performance relating to its entire value chain system vis-à-vis that of conventional business models (i.e., the reference case). This improvement is directly attributable to the business model through the alternative design and configuration of business model elements.

5.5 Green Business Model Prototypes

The means that qualify business models as green are not completely arbitrary. Green business models share common mechanisms to improve environmental performance (see 3.3.3) and capture value (see 3.2.3.1). Often, several of these mechanisms are combined. They include:

- Environmental performance mechanisms: resource efficiency; renewable inputs, low pollution, smart need satisfaction, and sufficiency.
- Value capture mechanisms: cost, quality or reliability, innovativeness, design and style, health, ethics, and political support.

When combining mechanisms of the two value perspectives, prototypical business models can be derived. However, not all realisations will actually be of type 2 (or even type 3) as defined above. Table 5.2 provides a non-exhaustive list of (sometimes overlapping) prototypical business models with green potential. These also cover the business models presented in chapter 7 and others mentioned throughout the book.

Table 5.2 Examples of prototypical business models with green potential

Type	Description	Examples
Low pollution models	<ul style="list-style-type: none"> ▪ Pollution is either prevented or reduced through end-of-pipe solutions ▪ The former can also save cost, while the latter is often reliant on government incentives or other selling propositions 	Carbon capture and storage, green chemistry (use of less toxic materials), electric cars
Low waste models	<ul style="list-style-type: none"> ▪ Production processes are made more resource efficient by reducing waste, reusing, or recycling 	Remanufacturing of photocopiers, electronic waste recycling
Dematerialisation models	<ul style="list-style-type: none"> ▪ A physical product or process is replaced by a digital offering, thereby saving resources 	Video conferencing, paperless office solutions
Smart models	<ul style="list-style-type: none"> ▪ Smart, usually IT-enabled processes allow better coordinated or tailored need fulfilment 	Smart metering, virtual power plants, smart traffic systems
Servicising models (product-to-service)	<ul style="list-style-type: none"> ▪ Instead of buying a product, customers buy a function ▪ Environmental benefits from fulfilling customer needs more efficiently, e.g. by sharing physical units 	Car sharing, leasing of construction tools
Performance contracting	<ul style="list-style-type: none"> ▪ Guaranteed energy or resource savings ▪ No up-front capital needed, providers benefit from savings 	Energy performance contracting for buildings
Renewable models	<ul style="list-style-type: none"> ▪ Use of renewable energy sources (solar, wind, etc.) and materials 	Green chemistry (renewable feedstock), renewable energy
Eco consulting models	<ul style="list-style-type: none"> ▪ Firms offer their expertise in environmental protection to other firms 	Green logistics services, eco-efficiency services
Base-of-the-pyramid models	<ul style="list-style-type: none"> ▪ Needs of customers at the base of the pyramid are addressed by using adjusted product designs and delivery methods ▪ Unsustainable need fulfilment practices can be replaced 	Off-grid, solar-powered lanterns
Do-good models	<ul style="list-style-type: none"> ▪ Customers appreciate ethical conduct with respect to humans, animals and natural resources ▪ Price premiums or functional performance weaknesses 	Fair trade, sustainable fishing, socially responsible investing
Health models	<ul style="list-style-type: none"> ▪ Products contain no or less elements that are damaging to human health 	Organic food and clothes, green household cleaners
Green meta models	<ul style="list-style-type: none"> ▪ Corporate programmes that foster the creation of green business models, products, or business practices ▪ Include environmental targets, incentives, and initiatives 	GE Ecomagination

So far, sustainability in business, business models as a unit of analysis for management science and their intersection – green business models – have been covered. The theoretical part concludes with chapter 6: organisations, change, and innovation.