"Green Multi Business Models" How to Measure Green Business Models and Green Business Model Innovation?

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Abstract
Ever since the branching of the sustainable and circular literature on business models of the late 2000s and early 2010’s, academia’s, businesses and societies have been experimenting with how to measure green business models. Green Business Model design—creating, capturing, delivering, receiving and consuming TO BE Business Models, Business Model Reconfiguration—focusing on changing AS IS Business Models into becoming or being green and Green Business Model Development—focusing on the tactical parameters of Green Business Models are 3 very different areas of measuring green related to business models and business model innovation. Several tools and actions can in these cases be taken into consideration, when measuring Green Business Models and Green Business Model Innovation. However, it seems as if there is a gap in literature and practice on how to really measure these Green BM Parameters. More specifically—How to measure green related to business models and How to measure green related to business model innovation. None seems yet to be able to measure green business models in real time and none seems to offer green business model measurement on all Green Business Model Parameters in symbiosis with monetary business model parameters. One of the reasons is that there is no clear definitions of green business model parameters although numerous green certificates exist, and several consultancies capitalise heavily on the billion dollar green business model certificate ecosystem for measuring and validating transformation of “AS IS” and “TO BE” business model ecosystems, businesses and their related business models into green. Most definitions and certificates also seem to be pure static and adapted as copies of former iso measurement standards. Very few offer and use advanced technologies to measure the green business model parameters in real-time. Further there is a lack of advanced measurement technologies that are able to measure on all green business model parameters within internet time together with monetary business model parameters. The paper presents some preliminary work on green business model measuring based on data from 240 SME businesses and reports on some preliminary work on a Green Business Model Dashboard in the EU Interreg, Kask GREENBIZZ project aimed at measuring—How green a business and its related business models really are?—and in real time.

Keywords Green business model measurement · Green business model innovation · Green business model development · Green business model parameters · Green multi business model innovation

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1 Introduction

No doubt many businesses are motivated and pushed by both society and stakeholders on designing, reconfiguration and developing Green business models (GBM) [1, 2]. However, it is well known that reconfiguring existing business models (BM) are complex. It is less known that reconfiguration of BM’s is far the largest Green Business Model Innovation (GBMI) focus area today—but also the hardest challenge to solve in transforming BM into GBM’s. It is very complex and resource consuming to reconfigure the BM into efficient GBM’s and the reason is that it includes balancing monetary and non-monetary value formulas of the GBM’s in symbiosis. Further it includes innovation and development of GBM’s in symbiosis with the business entire value network and it includes GBMI on all business model dimensions and GBMI levels [3].

Point of entry for the paper is taken from a multi business model approach and viewpoint perspective and the term “Green Business Model” (GBM) and Green Business Model Parameters (GBMP) as used in our framework, terminology and vocabulary relates to the environmental dimension of green (e.g. Use of Material and Resources, Consumption of Material and Resources, Waste, Pollution, Recycling of BM, Waste and Pollution) and address at the same time the business efficiency perspective (turnover−cost = earnings) of the GBM’s and GBMI. The GBM and GBMI in our terminology focus on an input and output to AS IS and TO BE BM’s that is transformed into operative GBM’s that are both environmentally—GBMP’s—and economically sustainable (Monetary Business Model Parameters) to the business and its Business Model Ecosystem’s (BMES) throughout the entire lifecycle of the GBM’s and their related BM’s and BMES’s.

Businesses today are globally highly “motivated” to change their business to minimize environmental damage effects both in short- and longterm perspective. At the same time the businesses are also responsible to capitalize and be economically sustainable in a world of green economy and related GBM opportunities. Advanced technologies are in this case increasingly playing a part of this green transformation in these businesses and their related BMES. Advanced technologies enable the businesses to act upon the increasing demand for “greening” anything, anybody, anywhere at any time. Businesses can through their BM’s, Multi Business Model Innovation (MBMI) and related BMES’s contribute to this and support the fight on environmental challenges as e.g. higher temperatures, Co2 emission, numerous frequencies of floods and storms, lack of food and water, pressure on health care system, biodiversity both in Atmosphere, soil, in water and soon also space.

Green transformation includes reduced use of energy and non-renewable materials and resources, increased delivery of reliable renewable energy supplies called green energy. It includes investment in GBMI through digitalization of the GBM’s and GBMI process, which is one of the aims of the Greenbizz project [4]. Scientists and researchers from both businesses and academia discuss heavily how to deploy and measure GBM and GBMI in the entire GBMI Process as indicated in Fig. 1.

Our long term goal related to measurement of GBM and GBMI and work in Greenbizz project [4] is to measure on all phases of a GBM’s and GBMI projects lifecycle as shown in Fig. 1—but not just limited to the individual BM, Business and BMES but on the entire value network of BM’s. However, at a starting point we begin the measurement from the inside of the BM, Business and BMES and then increase the measurement to the entire value network.

Use of materials and resources, life Cycle analysis (LCA) [5, 6], type of energy used—black and green energy, energy efficiency, recycling of materials, waste, waste reduction,
waste construction, pollution, low carbon emission, GBMI, new collaboration types, sustainable business models [7, 8] circular business models [9], UN 17 Goals [10] are all topics and terms that are related to the discussion on GBM and GBMI. All topics are more or less being related to the term green, green economy, green business, GBM’s and green technology. Sustainable business models [7, 8] and circular business model [9] communities have tried to embed the GBM into their terms and vocabularies—however with great difficulties. Especially, when sustainable and circular business models turn out not to be green—but green washing [11]—when deeper investigated both in short and long term perspective—the GBMP and definitions can be questioned [12, 13].

As indicated in Fig. 2 sustainable and circular BM’s do not necessarily have to be green and some parts of a “claimed” GBM can when measured on a scale of GBMP in real time turn out not to be green—but e.g. green washing [11].

GBM’s are seen as solutions to fulfil the Global Societies vision, mission and goals to become a green economy. However none have organized the green discussion on a strong trusted framework of a generic acknowledge green business model—relating and defining the different business model dimensions and business model innovation levels to both the term green and the economic terms. Few have tried to bridge the GBMP’s to the Economics Parameters of GBM´s. Few have related GBMI and Green Business Model
Development (GBMD). These gaps in literature are the aims of the research in GREENBIZZ 1 [4] and future GREENBIZZ 2 project.

2 Relating Measurement of Green Parameters to Business Model Dimensions and Innovation

Previous literature study on GBM’s and GBMI shows there is not a general accepted, clear and precise definition on a GBM and GBM parameters—neither on GBMI [12, 13]. Although many talks about GBM and GBMI e.g. as related to 100% Co2 neutral business model, sustainable business models [7, 8] circular business models [9], and even claimed GBM’s [2] can and will maybe never be 100% green measured on different GBM parameters, stages of life time of BM’s and levels of GBMI?

2.1 Different Stages and Levels of Green Business Model Innovation

As sketched in Fig. 3 our findings in Greenbizz and ECSMV project are that many BMES, Businesses and BM’s will relate to GBMI by trying to do GBM reconfiguration—focusing on changing or reconfiguring [1] their existing operative AS IS BMES, Businesses and BM’s into Greener BMES, Businesses and BM’s.

Fewer businesses design [1] Green Businesses (GB) and GBM’s that are “born green” and less design new green businesses—Startup businesses—that are “born pure green”—and pure green from beginning to end of their business and BM’s life. This would be equal to a startup business built with “green gens” in its core business model—the strategic highest level of a business and following transforming all related BM’s in the business into green.

2.2 A Four Dimensional GMBMI Measurement Framework

Both to AS IS and TO BE BM’s we claim that a pure green level of GB and GBM is very radical and in some cases even disruptive to reach as seen in Fig. 4. This stage of GBMI we claim is extremely difficult and complex to fulfil, operate and reach. We observe from our case research in Greenbizz project [4] that most BMES, Businesses and BM’s experience
“the greening” of a business and its “greening” of related BM’s as “a Green Business Model Innovation Journey and Process”—“a Green Business Model Innovation transformation”—from being “black” or “half black” to becoming incrementally more green—but maybe seldom and never completely pure green as sketch in the logo of Greenbizz seen in the lower part of Fig. 3. Our research shows that pure green seems very difficult to achieve for any BMES, Business and BM—or near to impossible. To achieve this stage would include all related BMES, Businesses, BM’s at all BMI levels and all GBM parameters to be and become green—and thereby green in their BM’s entire value network of BM’s related to any BMES.

We propose that businesses BM can be designed, reconfigured and developed into green on seven different levels—BM component, BM dimensions, BM, BM portfolio, Business, BMES layer and BM/BMES Process level. GBMI can be designed or reconfigured on any of the 7 Green Multi Business Model Innovation (GMBMI) levels and can be measured related to the.

- Radicallity of green—defined as degree that the BM’s dimensions are changed into green (incremental or radical)
- Complexity of green—defined as how many dimensions of each BM are changed into green
- Reach of green—defined as the impact of the change of green the BM has to the business, vertical- and horizontal BMES [14] or the world
- Time—define as the degree of green of the BM through its entire life cycle

Related to the measurement of a BM’s green complexity, if all BM dimensions are changed Green including all BM dimensions components, then the BM could be classified as a Radical GBM. This was however not found in any case in our first investigation of 106 SME businesses GBMI projects and neither in our second investigation of another 134 SME businesses in ECSMV project [15] as seen in Table 1.

The businesses could change more than one BM dimension, which results in more incidence as seen in Table 1. The businesses in our investigation primarily focused on “greening” or innovate green on the Business Models BM competence dimension and on
| Green business model innovation related to business model dimensions and components |
|-----------------------------------------------|
| **Business Model dimensions** | **Business model innovation** |
| **Business model development** | **Business model reconfiguration** | **Business model design** |
| **Value proposition** | **Green Value Proposition Innovation** | **(0+0)** | **Green Value Proposition Reconfiguration** | **(19+81)** | **Green Value Proposition Development** |
| - Products | | | | |
| - Services | | | | |
| - Processes | | | | |
| **User and customer** | **Green User and Customer Innovation** | **(1+0)** | **Green User and Customer Reconfiguration** | **(31+52)** | **Green User and Customer Development** |
| - User | | | | |
| - Customer | | | | |
| **Value chain function** | **Green Value Chain Function Innovation** | **(0+0)** | **Green Value Chain Function Reconfiguration** | **(37+42)** | **Green Value Chain Function Development** |
| - Primary | | | | |
| - Secondary | | | | |
| **Competence** | **Green Competence Innovation** | **(11+0)** | **Green Competence Reconfiguration** | **(104+107)** | **Green Competence Development** |
| - Technologies | | | | |
| - HR | | | | |
| - Organisational Systems | | | | |
| - Culture | | | | |
| **Network** | **Green Network Innovation** | | **Green Network Reconfiguration** | **(30+26)** | **Green Network Development** |
| - Physical | | | | |
| - Digital | | | | |
| - Virtual | | | | |
| **Value formula** | **Green Value Formula Innovation** | | **Green Value Formula Reconfiguration** | **(18+34)** | **Green Value Formula Development** |
| - Monetary | | | | |
| - Other values | | | | |
| **Relations [12]** | **Green Relation Innovation** | | **Green Relation Reconfiguration** | **(1+10)** | **Green Relation Development** |
| - Tangible | | | | |
| - Intangible | | | | |

Total incidents in 106 businesses (first investigation) and 134 businesses (second investigation) and 240 Businesses

24 592 12

= No GBMI activity and investment
= Some GBMI activity and investment
the component Layer at the technology part of the BM Competence dimension as seen in Table 1 and later Table 2. The BM competence dimension consist of firstly of 4 component groups—1. Technology (product- and service technology, production technology and processes technology), 2. HR, 3. Organisational Systems and 4. Culture inspired by Prahalad and Hammel [16]. The last 3 competence component group were hardly touched upon according to our research. In general, it was further a very small component part of the BM competence dimension technology group that businesses changed and wanted to change when doing GBMI as indicated in Fig. 5.

As can be seen it is primarily product technology—energy (155 incidence), material and resources (138 incidence) consumption—that was intended to be changed. This we marked with the grey arrow in Fig. 5. However, the businesses also tried to change BM value proposition dimension product component group as they tried to innovate and hereby reduce pollution types Co2 (121 incidence). This we marked with the pink arrow in Fig. 5.

We found that there is a clear overweight to focus on innovating, investing and implementing green on the BM competence component technology—mainly reducing use of energy, water, material, consumption and changing energy type to more green energy and/or greener material/resource types. Changing into more green production technologies was also seen in the business cases—e.g. as investment in solar energy systems for renewable energy production to supply the business with more green energy. Further in some businesses cases investment in convex energy production system was seen to reuse heat from building to supply heat to the business. Waste reduction and pollution especially reduction of Co2 emission as mentioned above was further seen as focus areas for GBMI. There was also focus on recycling waste either internal the business as valuing other business models or by valuing network, user or customers business models.

These last mentioned GBMP’s [2] have shown to be interrelated and have good impact on reducing pollution Co2. However, the full calculation of resources used to recycle were not seen calculated in the cases of the research. In some cases the impact on Co2 focusing on “greening” material, resources, waste and pollution reduction showed in many cases to have much higher impact on Co2 than reducing energy consumption and changing from black to green energy. Measurement of energy consumption as sketch in Fig. 6 was observed in our investigation as easier and less critical to the business to innovate green and implement in the businesses than innovating on other GBMP’s.

Greenbizz project works in this context with establishing a decentralised measurement on individual and single machines. Two new sensoring systems [17, 20] are under test in different Greenbizz businesses. The systems will enable the researchers together with the businesses to measure electricity, gas and water consumption and further now intervene with the individual BM’s consumption of resources and output of pollution.

Very few of the businesses investigated as shown above in Figs. 5 and 6 had really an overview of the Competence BM dimensions resource consumption related to different technologies, Human Resources and organisational systems serving or engaging in operations of different BM’s. Further the energy and material consumption were not split out to the different BM’s and different devices—production technologies—internal the business. Hereby it would be possible to see e.g. energy and material consumption pr. BM’s, per devices, per human resource and per organisational system. Hereby it was further not possible in most cases to see and analyse the efficiency, Return of Investment (ROI) and progress of the investment in green production technology and relate these to different BM’s. Technical there is not much challenge to measure this as advanced software and hardware technologies are available and offered by several technology providers [17–20]. If implemented, it could very much help businesses measure product technology consumption in
### Table 2  Single Green Business Model Innovation related to Business Model Innovation Levels [13]

| Green business model innovation | Business model innovation levels | Business Model Design | Business Model Reconfiguration | Business Model Development | Green business model component – |
|---------------------------------|---------------------------------|-----------------------|-------------------------------|---------------------------|---------------------------------|
|                                 |                                 | Green Business Model Component Innovation | (11+0) 11 | Green Business Model Component Reconfiguration | (104+108) 212 |
|                                 |                                 | Green Business Model Dimension Innovation | (1+16) 17 | Green Business Model Dimension Reconfiguration | Green Business Model Component Development |
|                                 |                                 | Green Business Model Innovation | (2+0) 2 | Green Business Model Reconfiguration | (46+52) 98 |
|                                 |                                 | Green Business Model Portfolio Innovation | (3+6) 9 | Green Business Model Portfolio Reconfiguration | Green Business Model Portfolio Development |
|                                 |                                 | Green Business Innovation | (3+0) 3 | Green Business Reconfiguration | (43+42) 85 |
|                                 |                                 | Green Business Model Ecosystem Innovation | (1+0) 1 | Green Business Model Ecosystem Reconfiguration | Green Business Model Ecosystem Development |
|                                 |                                 | Green Business Model Process Innovation | (2+6) 8 | Green Business Model Process Reconfiguration | Green Business Model Process Development |
| **Total incidents in 106 businesses (first investigation) and 134 businesses (second investigation)** | **Total 240 Businesses** | (8+9) 17 | (241+247) 488 | (8+0) 8 |
even close to real time. We found examples on energy consumption measured tools and software that could measure on daily, hourly and second basis as seen in Fig. 7 [17, 20]. Further several of the systems were built on non-invasive sensors, that made the installation process on cables or pipes fast and easy. Business did hereby not have to cut into existing cables, pipes, electricity boxes e.g. [20]

However, it was observed that most accounting systems at the businesses were not prepared for splitting out these Green Parameter measurements on different BM’s. Measuring the green parameters—e.g. black and green energy, water, material and resources
consumption, waste and pollution and relating them to different BM’s and economic terms are in many case not yet possible but is illustrated and sketched in Fig. 8 as an example of one of the businesses studied.

Concerning the supply of black and green energy to a business there is still challenges, very much confusion, doubt and actual also a paradox existing. All though energy businesses sell and even in some cases guaranty supply of green energy to businesses today, reality is that e.g. green electricity and green gas—supplied and sold as Green Energy to a business—often is and can be a mix of “black and green electricity” or “black and green gas”. Even businesses gets subsidies for buying green energy on contracts although it is in reality a mix of green and black energy as no technology and energy business yet are able to verify precisely whether it is black and green energy and thereby measure and guaranty pure e.g. green electricity or gas. Only when offered in separate energy systems it can

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Fig. 7 Examples of a Green Business Modelling dashboard focused on Energy consumption and energy source types on daily, hourly and second basis—separated on supplier, black and green energy in different business model areas
of course be done but these systems are few and often expensive to establish. They also gives other challenges related to the societies and businesses energy system. It is in reality therefore impossible to businesses today to verify, document and claim that they are pure green on many of the green parameter and GBM dimension. The national energy system in Denmark and more countries often base their green energy on estimates and in some cases verify that pure green electricity and pure green gas were supplied to the system and region around the specific business—but there is in reality no actual proof of this estimate and claim. It is still an estimate and not based on measurement on actual supply. However, the blockchain technology combined with other advanced technologies might in the future be able to solve this challenge [21].

Further there is another paradox in this range and that is. that most existing energy systems today cannot adapt and store surplus of renewable energy e.g. green electricity from windmills on a stormy day [22] or green electricity from solar cells on a sunny day. This means that windmills in Denmark in average were “taken out of the wind”—stopped and taken out of production estimated 50 days in 2020. It resulted in Danish wind energy production businesses pay German and Norwegian businesses money to get rid of overproduction of green energy. But it also worked opposite as e.g. in 2018 German Windmill businesses payed Danish Windmill owners 190 mill DKK to stop the Danish Wind Energy production, because the German Businesses would receive a fine from German State if they did not stop their windmill production in Germany. In other word a GBM with a negative earning dependent on which Green BMES the businesses were related to.

The green energy BMES from wind energy is well known as being volatile and the GBM’s around green energy is known as being very difficult to manage both for energy businesses and society. Several businesses are therefore working on this GBMI challenge to find better storage system e.g. Power2X systems [23, 24] able to use surplus of wind energy to power energy heavy production of storable energy. Innovation of new battery systems, new and better energy forecast systems [25, 26] are also invested in. Several businesses profit enormous on capitalising on these fluctuations, volatility, and different regulations in BMES in the production and supply of green energy. Advanced wireless technology is and can therefore play in future a major role in this GBMI and development of Green Energy BMES.

From our investigation we also found that most GBMI investments and projects are today taking place on BM reconfiguration level as seen in Tables 1 and 2—equal to that
most GBMI investment are done on existing AS IS BM’s—BM reconfiguration. This will be a major focus in future GBM design, because new BM will be pushed to be born green so that “repair” of AS IS BM will be diminished dramatically. EU have already begun to introduce new initiatives and restrictions on finance businesses possibility to borrow money to businesses investments in e.g. BMI as these have to be proved being green [27, 28].

In this process the measurement of the GBMP’s in real time becomes even more important to secure high quality measurement, estimation and verification of the effects and progress of greening of different GBMI projects. We found that these measurement tools and technologies are still lacking some features—not implemented in most businesses although they should be relative easy to innovate and implement.

The majority of the businesses we studied were still limiting their GBMI to greening at a single business model innovation reconfiguration level as seen in Table 2—and they are still not in particular focusing on designing GBM’s. This indicates that businesses are uncertain and maybe are not confident on ROI of GBMI investments. They have therefore not yet fully adapted the GBM approach and GBMI into the entire and higher levels of the business—and the new BMI area. In other word GBMI seems still in the very early days—and are strategically not yet been embedded in to critical and larger parts/levels of the businesses.

As can be seen in both Tables 1 and 2 there is much more potential for greening the businesses BM’s, when focusing not just on the business BM’s competence dimensions—and as we found in our investigation technical part and to some extend value proposition part of GBM. None of the businesses included in our research could therefore be classified as 100% green or pure green to the business and BMES.

2.3 Measuring Incremental, Radical and Disruptive Green Business Models

The degree of green of a GBM can become “more green” or what we classify as radical and disruptive green, when GBM are related to the degree of “external impact” of greening. The GBM’s impact on vertical, horizontal and/or on any BMES can transform GBM’s into radical and disruptive GBM’s. This can however not be realized without the GBM interacting with and being related to other BM’s—the Green Multi Business Model approach. If BM relations are established to other BM’s outside the BM it will enable green value propositions to flow out of one BM into other BM’s and enable receiving and consuming of GBM Value Propositions. Hereby one BM can make the other BM greener and enable other BM’s to become green together in a green value network. Radicality and complexity of green however today in many businesses and GBM projects take the viewpoint from only one single business side—the “inside in” perspective [29]. However, if all BM dimensions are changed green then the BM is totally changed green—meaning it could be classified as being in the disruptive green zone—potentially close to pure green, dependent on its impact on vertical, horizontal and any BMES. It could be classified as disruptive green as indicated in Fig. 4. The green impact on the reach axis in Fig. 4—green to whom—becomes hereby related to defining and measuring how green the BM is and the degree of impact that the GBM and GBMI in the business has—seen “from outside—in” and “outside—out” viewpoint. Hereby the “impact of green” of GBM’s on other BM’s. It is now a question to measure the change in existing BM’s—“AS IS BM” and “TO BE BM”—related to the green to the business, green to vertical BMES, green to horizontal BMES and green to any BMES—green to the world.
This transformation and measurement of green will however require very large investments to transform, operate, measure, and validate the degree of green of a BM. 6G, blockchain and beyond technologies are expected to be able to support and visualize in real time this measurement. However, businesses and society have always the final strategic say on How green they want their GBM and GBMI to be. If they do not want to measure transparently and in real time then the pure green BM, Business and BMES is not achievable.

GBMI seems therefore to be a long and strategic journey to businesses and society— with certainly a beginning but probably also a long end—if ever reached. There will always be components, dimensions, business models, business model portfolios, businesses, business model ecosystems and business model innovation processes that can be innovated green—and even more green. Society and Businesses will always learn and innovate new technics and approaches to become greener and measure GBM’s and GBMI better. GBMI is therefore strongly linked to continuous improvement, continuous innovation and not least learning. Learning will always be the raw material for any Green Multi Business Model Innovation (GMBMI). What we learned to be green yesterday is maybe not green tomorrow. Learning to become greener and building green competences into technology, HR, organisational system and culture of the BM’s and businesses to be able to innovate BM’s to become greener—we expect—will take businesses and society several iterations, “learning loops”. It will include many “fails and bugs” [30, 36, 37]. Theoretical it should be possible to measure any GBM and GMBMI on a scale of Green on all BM Dimensions and MBMI levels—not just the BM Competence and Value Proposition dimensions.

3 Towards Measurement of Green Business Models

As more and more businesses face major strategic challenges—“a green wall”—related to choosing a strategy or road for the business next green transformation step becomes even more interesting to discuss. How to measure GBM and GBMI on a scale of GBMP’s including economic (turnover, cost, earning) value parameters. GBMP’s as e.g. energy consumption, material use, waste, recycling degree, pollution of each individual BM’s are technical possible to measure but they have at the same time to be combined with the economic parameters of a BM, Business and BMES. The GBMP parameters are indicated as discussed above on the BM competence technical area:

1. BM Competence Product Technical area—Material and Resources (as e.g. all types of materials and resources, Energy, Black and Green Energy, Water and even waste from other BM’s if used as rawmaterial in the particular BM.
2. BM Value proposition area—Waste, Pollution (including e.g. Co2 and other types of pollution)

However other BM Competence Technical areas as—production and process technology areas—are just as important, when measuring GBM’s and GBMI but is just in the very beginning of being measured and implemented as measurement objectives. Typically this measurement are done by e.g. LCA measurement tools and calculation systems [5, 6].

In Table 2, we show based on our preliminary investigations in 2020/2021 of 240 Danish Small and Medium size businesses GBMI projects and processes [15] their single green business model strategies. All businesses were screened by a screening questionnaire and all data from this screening were carefully analysed, grouped and scaled into different
green categories and strategies as seen in Tables 1 and 2. Our investigation showed that most GBMI strategies in these SME’s were focused on limited numbers of Business Model dimensions Table 1 and mostly Green Business Model reconfiguration Tables 1 and 2. In GBMI research, we distinguish between Green Business Model Innovation (Green Business Model Design and Green Business Model Reconfiguration) [1, 2] and Green Business Model Development as discussed above. Green Business model development focus on implementation and introduction, growth, maturity and decline phase of the GBM with classical BM development tactical parameters, tools and actions. Green Business Model Development covers also the continuous improvement of GBM’s. We found very few GBM cases that had entered the GBM development phase [12 incidence], often because the businesses could not find enough efficiency and fast enough ROI in investing in GBM and GBMI. The businesses did not have the numbers and measurement technologies available on and for green parameters and related economy, They were not able to measure on individual BM’s—and both on AS IS BM’s and To BE BM’s. Those we found that had invested in GBM’s were primarily into the introduction phase and mostly focusing on initial promotion and improvement of GBMs. They were focusing on branding their business or BM on being green. They did not have the detailed numbers separated on the individual claimed GBM’s. In Fig. 9 we show an example on GBM’s from one anonymous business called Swedspan, that had the numbers available on elected Green BM parameters and some BM’s. They had only these numbers at a very overall business level for the economy parameters.

In Fig. 9 we divided the green BM parameters technology (material and resources)—coming in to the business (Outside in) and those value propositions GBMP’s offered by the different business models—going out from the business (inside out) to different BMES. As Swedspan is using more energy types (e.g. Electricity, Gas, Diesel) the energy input to the business is calculated in KWH and netto ton as seen in Fig. 9. Hereby we relate the Green BM parameters to the business model relation axiom quadrant 2 and 3 [29]. As Swedspan has no Green BM Parameter measurement on e.g. LCA, device specific energy consumption, LCA on production and process technology and other GBM Dimensions and GBMI levels inside the business—yellow lower triangle in Fig. 9—is not possible to comment on related to the green parameter measurement inside the BM’s related to quadrant 1 in the relations axiom [29].

We also found very few GBM in the GBM Design phase as seen in Table 1 [24 incidence] indicating that most GBMI are not focused on creating BM’s as GBM when they

Fig. 9 Green parameters “outside in” and “inside out” together with Swedspan’s total turnover, cost and earning measured at overall business level
are “born”. Further none of the GBM and GBMI projects could be related to radical or disruptive GBM and GBMI.

There is still not much validated research that document the efficiency of these GBM’s, GBMI projects and developments. Many of the GBMI and Development projects were carried out only due to subsidies [32, 33] and arguments of future energy cost savings. Indications in our preliminary research show that material and resource savings could be able to give often higher cost savings and even more value adds to the businesses. In this case Life Cycle analysis (LCA) [5, 6] of BM’s becomes important and a new but complex measurement area for GBM’s. LCA studies of a BM is a “snapshot in time” measure of burdens. The lower the burdens across the LCA of a BM or a value network of BM’s, the smaller the footprint—CO2 impact. An LCA measures burdens—what goes in (how much energy and raw materials it takes to make a BM or a network of BM), and what goes out (how much waste, water pollution and emissions to air) across the BM’s life cycle. In Greenbizz research project a LCA research group found that more LCA measurement system is available and many of these are partly based on estimates—not real data and measured in realtime.

3.1 Single Green Business Model Innovation Related to Business Model Innovation Levels

As earlier mentioned our investigation showed that the businesses primarily focus on “greening” the BM competence dimension and changing AS IS BM’s—Business Model reconfiguration—. In Table 2 we show that the GBMI is mostly taken place at the BM component level. (104-incidence Table 2). GBMI until now is much on changing technology in the AS IS BM’s as earlier mentioned.

This indicates that GBMI in the businesses investigated is still taking place at a very small, bottom and limited GBMI level area in the businesses. We found that majority of businesses are limiting their GBMI to greening a single business model (Table 2 98 incidences) and mostly reconfiguration of these single BM’s—not in particular designing GBM’s. This also indicates that businesses have not yet fully adapted the GBM approach and GBMI into the entire and higher levels of the business—and this new BMI area. It indicates that more BMI levels are not much included in the GBMI as a core of BMI in the businesses. However there is a small tendency that this is changing now. In other words, GBMI seems still in the very early days—strategically not yet embedded in to critical and larger parts/levels of the businesses. In other words we found no businesses into radical and disruptive GBMI.

4 Discussion

Green Strategic Business Model Innovation is a very new strategic BMI game and tool that can potentially be used in many businesses globally in the future. Our study showed how SME businesses strategically handle single GBMI from spring 2020—to summer 2021. The research showed clearly that GBMI by SME’s are in the very beginning of “the roll out phase”—an maybe in more cases not even carried out with a very strategic focus and approach—but more as a necessity or tricked by a “push” by society, politically and from different BMES’s [31–35]. The SME business clearly focus on competence BM dimension innovation and to some extend value proposition dimension at a BM component
level—mostly changing product and production technology into greener technology. We expect that this will expand into other BM dimensions and BMI levels as soon as businesses have penetrated the “low hanging fruits” and potential of the BM competence technology area. Then GBMI will move into more “soft” and qualitative BMI areas and levels e.g. Human Resource, organisational systems, culture and the higher business levels. This will mean that businesses will begin to “be green”—radical and maybe disruptive green. This will mean that businesses will demand related business models [29], value network including users and customers to innovate and act green. Therefore, our expectation is that GBMI and GBMD will spread out to the entire business value network and BMES´s. We are still in the process of finding measurements tools for other BM Dimension areas. Measuring these upcoming areas we expect will be more difficult and challenging to measure and will require other measurement competences than pure technical and quantitative engineering skills. We expect that the competence to network and do GBMI in network with other businesses will become an important competence—maybe a core competence [16].

It can be criticized that the data used in the paper is taken up on behalf of only two Green Business projects [4, 15] in two batches. Further that these GBMI projects focus on SME’s and specific GBM Parameters [10] —e.g. energy consumption, the relation between black and green energy, material and resources and indirectly to some extent pollution—Co2, recycling and waste. This could have biased the findings on businesses focus on GBMI dimensions Table 1 and GBMI levels Table 2. However it is our clear observations also from other GBMI projects that GBMI is in the very initial stage—both at small and large businesses. However new advanced Green Business Model technologies [36] and storage systems [37] together with new GBMI knowledge is expected to make Green Business Modelling increase exponentially.

5 Conclusion

The worlds GMBMI modelist are turning into “A world of GREEN BUSINESS Models” now.

Businesses entering Green Business Modellist have to convert themselves into new ways of doing MBMI—doing business. GBMI will signal a disruption to previous conventional MBMI and MBMI processes. Businesses have to or are forced to leave their “Conventional Business Model Innovation praxis”—their comfort zone” and existing Conventional BMES and develop more green BM’s—and more Radical Green BM and Disruptive Green BM’s.

Business have to get used to enter vertical and horizontal GREEN BMES Innovation and even create new Disruptive and Diversified GREEN BMES. Advanced Technologies can support this mission.

The research builds on top of a careful review of business model and green business model literature and practice. It investigated different GBMI projects and proposed a new framework and Green Business Model dashboard embedded with and supported by advanced wireless technologies. The goal of the paper was to achieve greater understanding of how GBMI and development are carried out and pushed. GBMI and research are moving into the next step of business model innovation and advanced wireless technologies innovation will follow this movement—offering future new research directions.
The article reports on an investigation of—How to measure Green Business Models and Green Business Model Innovation? The research was carried out in 2 GBMI projects—The Nordic EU Interreg Kask Greenbizz project [4] and the Danish ECSMV project [15].

In the two projects we were able to investigate 240 SME businesses GBMI projects. The purpose was to find out—How green the businesses were? and to find out—How to measure GBM and GBMI? The investigation showed clearly that most businesses strategic approach related to GBMI is a single GBMI approach at a very low, narrow and bottom level of the GBMI potential. Most business investigated focused on BM competence dimension especially greening technologies—product technology and production technology. GBMI in the SME businesses was found mainly taking place at a very small and limited GBMI level in the businesses. Businesses seemed not yet to have adapted the GBM approach fully and GBMI were not yet carried out into higher levels of the businesses. Very few businesses had spread out their GBMI to their value network.

In the Greenbizz project we were able to investigate and innovate different GBM and GBMI measurement tools with the aim in near future to introduce a GBM and GBMI dashboard that can measure How Green a BM, Business and BMES really are—and in real-time. Especially the GBM Competence area—technology seems well investigated and close to become measured in near to realtime. Other BM dimensions competence areas as HR, Organisational systems and Culture are still in working progress. Further other BM dimensions are investigated for GBM and GBMI measurement.

The research showed that several measurement tools and technologies exists already on energy consumption, but energy is not measured out in general on all devices in the businesses. Most often measurement is also carried out only on temporally or experimental basis in the businesses. This means that businesses lack deep knowledge on which BM’s and devices consume energy and further what kind of energy—green and black they really use. Although the energy providers sell and to some extend guaranty green energy supply the energy supply is still a mix of black and green energy as no business yet can track and trace energy types today—except in separate systems.

6 Further Research

The researchers intend to investigate further Green Multi Business Model and Single Green Business Model Innovation in Nordic Countries through the EU KASK GreenBizz project. More than 60 business cases in Norway, Sweden and Denmark are investigated intensively. Further about 870 businesses in Central Region Denmark are investigated in 2021 and 2022.

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