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**INTERNATIONALIZATION OF THE BULGARIAN ECONOMY  
THROUGH APPLICATION OF GREEN FINANCES AND GREEN MARKETING PRACTICES  
(BASED UPON THE INTEGRATED ASSESSMENT MODELS - DICE & RICE MODELS  
BY W. NORDHAUS)**

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ORCID: 0000-0001-9489-3775

**VLADIKOV Atanas Ignatov**, PhD, Associated Professor

ORCID: 0000-0003-1306-185X

**DIMITROVA Teofana Valentinova**, PhD, Associated Professor

ORCID: 0000-0002-7761-3900

**YOSIFOV Trayan Pavlov**, PhD, Head Assistant Professor

*Plovdiv University "Paisii Hilendarski"*

*(4000, Bulgaria, Plovdiv, "Tsar Asen" St., № 24, e-mail: avladikov@uni-plovdiv.bg)*

**Abstract:** In the last decade, scientific and popular science literature on a global, European and national scale has begun to raise the issue of climate change more and more clearly as an integral part of general and specific analyzes of the market environment. In practice, defining the new climate component as a prerequisite for transformation of international economic relations and processes by rethinking entrepreneurial business cycles in the context of the new generation of global and local environmental policies - turns the "green" dialogue into a "green stake". This paper makes a scientific attempt to review the readiness of the Bulgarian economy whether it can be internationalized in the coming years according to the leading Integrated Assessment Models /IAMs/ of factor components from several different areas of knowledge. Thus, theoretical impact of the models proposed by William Nordhaus - DICE and RICE on the Bulgarian economy is delivered in this paper to reason upon introduction of "green" finances and sustainable marketing practices as drivers for successful economic internationalization.

**Keywords:** internationalization, Bulgarian economy, DICE, RICE, green finances, green marketing.

**ИНТЕРНАЦИОНАЛИЗАЦИЯ ЭКОНОМИКИ БОЛГАРИИ  
ЧЕРЕЗ ПРИМЕНЕНИЕ «ЗЕЛЕННЫХ» ФИНАНСОВ И УСТОЙЧИВЫХ МАРКЕТИНГОВЫХ  
ПРАКТИК (НА ОСНОВЕ МОДЕЛЕЙ КОМПЛЕКСНОЙ ОЦЕНКИ - МОДЕЛИ «DICE & RICE»  
У. НОРДХАУСА)**

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**ВЛАДИКОВ Атанас Игнатов**, PhD, доцент  
**ДИМИТРОВА Теофана Валентинова**, PhD, доцент  
**ЙОСИФОВ Траян Павлов** PhD, гл. асистент

*Пловдивский университет им. П. Хилендарского*

*(4000, Болгария, Пловдив, ул. „Цар Асен” № 24, e-mail: avladikov@uni-plovdiv.bg)*

**Аннотация:** В последнее десятилетие научная и научно-популярная литература в глобальном, европейском и национальном масштабе все больше и больше пытается поднять вопрос об изменении климата как неотъемлемую часть общего и конкретного анализа рыночной среды. На практике определение нового климатического компонента как предпосылки для трансформации международных экономических отношений и процессов путем переосмысления предпринимательских бизнес-циклов в контексте нового поколения глобальной и местной экологической политики превращает «зеленый диалог» в «зеленый залог». В данной статье делается научная попытка проанализировать готовность болгарской экономики к интернационализации в ближайшие годы в соответствии с ведущими моделями комплексной оценки факторных компонентов из нескольких различных областей знаний. Таким образом, теоретическое влияние моделей, предложенных Уильямом Нордхаусом - DICE и RICE на болгарскую экономику, представлено в этой статье для обоснования внедрения «зеленых» финансов и устойчивых маркетинговых практик как движущих сил для успешной экономической интернационализации.

**Ключевые слова:** интернационализация, болгарская экономика, DICE, RICE, зеленые финансы, зеленый маркетинг.

**Introduction**

The Nobel Prize in Economic Sciences in 2018 was jointly awarded to William Nordhaus and Paul Romer mainly for their contribution for successful inclusion of the climate component in the general analysis of macroeconomic equilibrium. In particular, they used internationally recognized Integrated Assessment Models /IAMs/, and more specifically, W. Nordhaus reasoned upon the models: DICE and RICE, standing to mean Dynamic Integrated Climate-Economy model and Regional Integrated Climate-Economy model. In this sense, emergence of "green" finances and sustainable marketing practices in economic reality of the countries separately and jointly deserves special analytical attention to reckon whether they might be compliant motivators to drive towards successful internationalization the Bulgarian economy.

**Literature Review**

Integrated Assessment Models (IAMs) began to appear in the mid-1970s, but most of them were elaborated in the early 1990s with a view to programming complex interactions of different dynamic systems: environmental, human, and on technological (Beatrice C., C. Cassen, A. Nadai,

2019). In these types of models there are different possibilities for changing research panels and configuration and reconfiguration of parameters; thus, from the standpoint of modern economics – this paper focuses on a paradigm delivered by the neoclassical economics, and specifically refers to theoretical reasoning for possible application within Bulgarian economy of the models DICE and RICE, proposed by William Nordhaus.

Since the outbreak of Covid-19 and the evolving global, European and national policies to overcome this pandemic, the countries around the world have begun to rethink and restructure their economic policies not only to tackle this global health problem, but also to force the overcoming of the negative effects of climate change. The problem is particularly acute and sensitive for Bulgaria, which has overcome a series of cascading political transformations in the last year and a half - leading to a natural loss of economic power in the country and undermining the foundations of economic confidence of market participants.

In search of a timely, accurate and adequate answer for revitalization of the Bulgarian economy - the viewpoints of W. Nordhaus seem like a possible solution. In his latest

book: "The Spirit of Green" (Nordhaus, 2021), he clearly outlines the problems at the global level related to climate change and global warming, which might also affect the functioning of the Bulgarian economy. For example, sudden heavy rains and floods in different parts of the world disrupt economic mechanisms, distort production and supply relations, unbalance the commodity-money balance in different economies and their sectors, and provoke, surely, insecurity, risk and enormous social tensions. This creates centrifugal economic forces of different magnitude and spillover effects, which affect economic sustainability of the manufacturing sectors; it distorts structuring of price conditions for delivery and marketing; and it imposes the need to combine cash flows generated by market sales with amounts allocated under various government programs to assist survival of businesses in this dynamic environment. In this sense, another main standpoint of W. Nordhaus, which is worth to be argued - is his view that these processes and relations and - more specifically, "playing" with nature can be defined as a "casino climate", which carries risk and uncertainty for all (Nordhaus, 2015).

Given that W. Nordhaus was a PhD student of Robert Solow, it is noteworthy that his models are based on the fundamental neoclassical models of economic growth of Solow and Sloan (Solow, 1956, and Swan, 1956). Nordhaus's strength is based on that it makes modeling for long-term economic growth a universal tool that takes into account both technological and climate change along with the political business cycle.

And if in the 1970s his attention was focused more on economic modeling based on carbon footprint (Nordhaus, 1974; Nordhaus, 1975; Nordhaus, 1977), then in the 1990s, he proposed a global climate change management (Nordhaus, 1994a; Nordhaus, 1994b; Nordhaus, Yang, 1996), and in the last two decades (Nordhaus, Boyer, 2000; Nordhaus, 2013; Nordhaus, 2014; Nordhaus, 2017) has managed to propose a reasoned solution for inclusion of the climate component in the economic models and to offer an original approach for assessment of the social consequences and costs of the accelerated/delayed economic development by financing public policies for change in the marketing models of the market participants.

Nordhaus's other strong standpoint is grounded onto the construct of the political business cycles and his finding of political life. In general, he claims that in the conditions of information asymmetry - policies and political attitudes before elections produce objectified solutions for correct management of the economic cycle and environmental management, which after realization of the electoral process for the most part will not happen (Nordhaus, 1972; Nordhaus, 1975; Nordhaus, 1989). The very fact that he clearly distinguishes political/governmental instruments from the results in terms of: "before" and "after" elections - shows that it is possible to create many criticisms and weaknesses in his model of political adjustment of the business cycle, and in the context of preparing a suitable design for financing public policies to overcome current market attitudes and prevailing marketing practices.

In this sense, the delving into theoretical discourses of DICE and RICE models, delivered by Nordhaus models and their possible application in the Bulgarian reality - creates the need for adequate modification and reasoning of how green finances and green marketing practices may be utilized to internationalize Bulgarian economy.

#### **Methodology and research methods**

The methodology of the present study includes a review of the more significant viewpoints of William Nordhaus in reference to exploring their validity for the Bulgarian economy; and more specifically - for introducing green finances and green marketing practices, in order to modernize, revitalize, and internationalize Bulgarian economy. Accounting this, the paper provides a general analytical overview of relevant information on this issue for the Bulgarian economic reality for at least two reasons. Firstly, the works of W.

Nordhaus are not well known to the general and academic publics in Bulgaria; and secondly, the research topic groups several micro-themes into a scientific amalgam of the high problems of international economic relations, avant-garde finances and new marketing techniques to promote responsible consumption and strong entrepreneurial focus on observing the planetary needs.

In methodological terms, the aim of the paper is to compare how close/distant from the international economic practices for implementation of green finances and green marketing is the economy of Bulgaria; and to propose a theoretical supplement/modification of the DICE and RICE models for Bulgaria.

The main hypothesis of the study is that Bulgarian economy needs the financial support of the EU and greater economic and business interactions with European companies to align with at least the average EU values of indicators for decent economic standards and climate change. It is assumable, that the EU dynamics may bring forward Bulgarian economic internationalization within the current 7-year programming period and provide adequate international integration and achieving European averages in terms of providing sustainable economic growth and mitigate the climate risk in the country.

#### **Results**

The authors defend the opinion that one of the possibilities for leveraging Bulgarian economy to greater international business dynamics is related to limitation of production facilities and service businesses that generate carbon emissions (pertaining to the DICE-model). It is economically reasonable to expect for the Bulgarian economy to follow the standard DICE model, and transform the national economy by adopting world-leading and EU leading business examples for reducing climate risks. Secondly, modernization of regional economy and regional businesses shall follow the standard RICE model, as there is tremendous technological backlog, accrued in a number of regional enterprises, mainly in the energy sector, which need governmental and EU combined financing to going green by "greening" their marketing policies for good business standing.

RICE model is applicable for Bulgarian reality for the 7 year programming period /2021-2027/, provided that the National Recovery and Resilience Plan is smartly construed into Bulgarian economic reality. Besides, RICE model may be fit to comply to overcome Bulgarian regional economic disbalances by gradual transition towards sustainable marketing management of all resources, including utilization of natural resources. In particular, this is related in Bulgaria to redirection of capital resources to three priority areas: (1) to introduce circular and low-carbon economy; (2) to focus on preserving and fostering biodiversity and (3) to develop sustainable agriculture. Henceforth, the issue of the Bulgarian economy is to organize a compliant pool of green financing to transform Bulgarian regional and national business practices.

It is provided by the Mechanism for Recovery and Sustainability, which is a part of the "Next Generation EU" element (2021-2024) of the European Recovery Plan. It envisages smart distribution of financial investment resources of nearly € 750 billion among the EU-27 countries, as stipulated by their National Recovery and Resilience Plans, prepared and submitted to the European Commission in 2021.

The position of the authors is that an adapted DICE model must be considered at governmental level as a tool to synchronize both political and business cycles to EU rules and regulations of expensing the financial master plan. The planned funds that Bulgaria is entitled to use under the National Recovery and Resilience Plan equal to € 6.217 billion of grants, which is to nearly 22% of the country's GDP for 2019. Of these grants, about 38.1% (the minimum provision regulation, stipulated by the European Commission is 37%) are envisioned for funding activities under the "Green Bulgaria" pillar. Moreover, there is another lump sum of € 4.549 billion of loans at favorable interest rates, which also may be

channeled into transformation of Bulgarian economy (CoM of the Republic of Bulgaria, 2021).

The following Table-1 brings DICE-model adaption for Bulgarian economy, prioritizing three areas for green transition, based on the assumption for synchronization of Bulgarian political and business cycles.

**Table 1** – Bulgarian Economy Green Transition – Priorities

- Legal environmental conditioning for accelerated introduction of renewable energy sources, including industry-related hydrogen utilization
- Stronger actions for attaining greater energy efficiency for the economy
- Going towards sustainable business mobility

Source: developed by the authors; based on governmental information (Council of Ministers, 2021)

The main goals, defined to achieve the priority targets in short-run (2021-2024) are presented in Table-2. The table illustrates accommodated DICE-model components for Bulgaria, as stipulated by national policy-makers.

**Table 2** – Priority Goals to Sustain Climate Change Goals of EU-27 /short-run, 2021-2024/

1. Energy share of renewable sources (gross final energy consumption; in %; in 2024)	26%
2. Cumulative energy intensity reduction of the economy (in %; 2021-2024)	10%
3. Cumulative carbon intensity reduction of the economy (in %; 2021-2024)	10%

Source: developed by the authors; based on governmental information (Council of Ministers, 2021)

The funds that Bulgaria is deemed to receive within the “Green Bulgaria” pillar form the relatively largest share, compared to the planned funds for the rest targeted areas of intervention: “Innovative Bulgaria”, “Connected Bulgaria” and “Fair Bulgaria”. Having no intention to underestimate the importance that these three priority areas have in the Plan, it is reasonable to state that the high share of funds provided for the development of production facilities, vehicle by the use of renewable sources, reflect the low technological development of the Bulgarian economy. This, shall be also taken as a supplementary economic driver in an adapted DICE-model for Bulgarian economic reality.

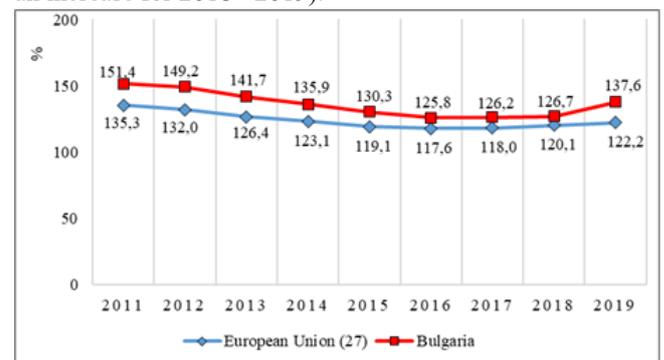
On the other hand, there are some other explanatory characteristics to such type of a national politically programmed cycle: namely, to introduce nationally specific variables at the DICE model, such as: significant sizes of initial or follow-up investments (due to rising prices of industrial equipment and to increase of construction of industrial facility layouts); “heavy” regulatory requirements and legal environment of business in transition to EU new rules and regulations to adopt the climate neutrality policy; extended period of returns of investments; unforeseen project interruptions, etc. All these objective reasons significantly limit the possibilities for financial provision for designing of successful regional businesses, which are deemed to adopt “Green Technologies”. This pertains to attributing a RICE-model variable, financially speaking, as it applies both to conventional sources of financing from commercial and investment banks to regional business, but also to some non-traditional forms offered to private regional businesses: venture capitals, green bonds, or sustainability-linked bonds, for instance. The issue of regional business financial capacity is viewed as critical to sustain the RICE-model in Bulgaria, as these green finances bring power to regional market players to overcome political risks in the business cycle and to mitigate business risks in times of political power shifts.

Due to these stated reasons, the funds for development of production activities provided by the EU budget (mainly, this applies to grants) are, practically, a ‘no-alternative opportunity’ for qualitative and significant improvement, speaking in relation to restructuring the Bulgarian economy. This is particularly valid if Bulgaria is to shift to sustainable EU and global competitiveness.

In addition, we share the view that green marketing with its specific techniques could make a significant contribu-

tion to this process of green transformation of Bulgarian regional businesses and shall be also included in an adapted RICE-model for the country. It is well known that marketing is a key business function for companies pursuing profit growth, sales and market share. That is, it is a key factor of economic growth, although often neglected in various macroeconomic literature sources, which focus mainly on growth factors such as technology, investment, human capital and others. At the same time, marketing can work with the opposite sign - e.g. to implement policy measures to fit into business cycles to reduce effectively demand of products harmful to human health (cigarettes), to promote more responsible consumption patterns (electricity, water, and fuels savvy), and to reduce waste generation by households and by businesses. There are green marketing tools, which can be applied in the RICE-model for Bulgarian regional businesses and consumers. For instance, the marketing of “pushing-to-green” to aware and reorient the targeted population to desired behavioral patterns, which comply to solving certain environmental problems; or for instance, to stimulate regional entrepreneurship to focus on achieving average values of certain environmentally friendly indicators of economic growth. This reasoning may be extended to modification of the DICE-model to include such a marketing awareness component to welcome climate change transformation into Bulgarian economy. In general, marketing goes beyond its usual micro level and conventionality to be applied at the macro level for sustainable development. It is about sustainable marketing, aimed at environmental, social and financial sustainability of the economy (Kehayova-Stoycheva et al., 2013).

For example, this impact may be illustrated both at regional and national levels by CO2 emissions of cars. The latest Eurostat data for 2019 show that Bulgaria ranks first among the countries with the highest average CO2 emissions per km from new passenger cars (137.6), followed by Slovakia (133.4), Luxembourg (133.0), Poland (132.0), Lithuania (132.0), Hungary (131.8), Germany (131.2), and Estonia (130.1). As it may be seen from Figure 1, this can be considered positive as the dynamics of the indicator follow the development of the average level for the EU countries. In practice, the Figure 1 demonstrates a declining trend over the last ten years. The analysis by individual countries with the highest average CO2 emissions for 2019 shows that there is a gradual increase in the value of the indicator for the period 2017 - 2019 (with the exception of Hungary, which reports an increase for 2018 - 2019).



**Figure 1** – Average CO2 emissions per km from new passenger cars, 2011 – 2019

Source: Eurostat (online data code: SDG\_12\_30)

In substantiating the argument that green marketing policies shall be considered into the business cycle as well next to green finances both on national and regional levels to help the country to internationalize are the data for hazardous waste. Eurostat’s bi-annual data show that in 2018 the EU reported a relative increase in hazardous waste of 11.9% compared to 2010, which is an increase in absolute values from 90.8 to 101.7 million tons. In 2018, the share of hazardous waste in total waste generation is below 10.00% in all of the EU Member States.

Figure 2 demonstrates that only Estonia and Bulgaria deviate from this result with 46.9% and 10.4% share of the total. The lowest value of the indicator is represented by Romania, whose share is 0.4% (which is an increase of 0.1 percentage points compared to 2010).

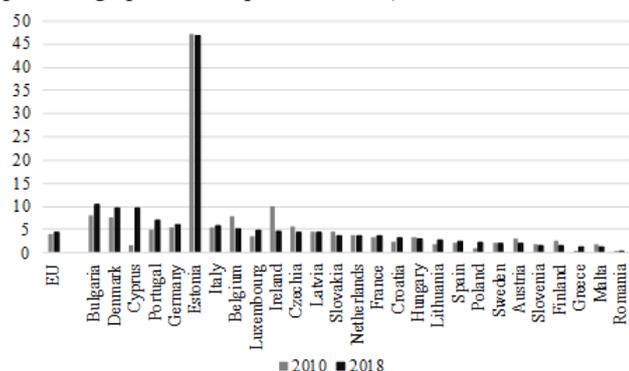


Figure 2 – Hazardous waste generated, 2010 and 2018 (% share of total waste)

Source: Eurostat (online data code: ENV\_WASGEN)

In summation, in 2018, the EU registered the highest levels of waste generated by the Waste and Water Services sector (207.6 million tons) compared to 2010 that is – a growth rate for 2018/2010 of 59.82%. Households account for 185.7 million tonnes and manufacturing activities for 180.1 million tonnes, respectively. Specifically for Bulgaria, in 2018 there is a trend to significantly increase the levels of waste from the sector “Waste Water and Water Services”, namely, more than five times the value of the “Waste collection, treatment and disposal activities; materials recovery” and almost doubled the increase in “Water collection, treatment and supply; sewerage; remediation activities and other waste management services” compared to the beginning of the analyzed period, as illustrated by Figure 3.

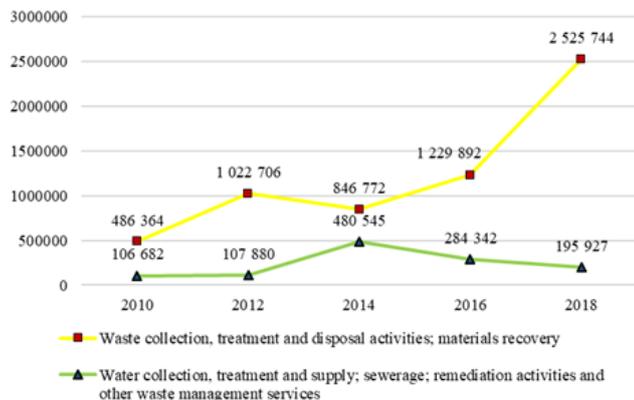


Figure 3 – Total amount of waste generated by households and businesses by categories for Bulgaria, 2010 and 2018

Source: Eurostat (online data code: ENV\_WASGEN)

These statistics demonstrate that national and regional businesses must indeed apply green marketing strategies to

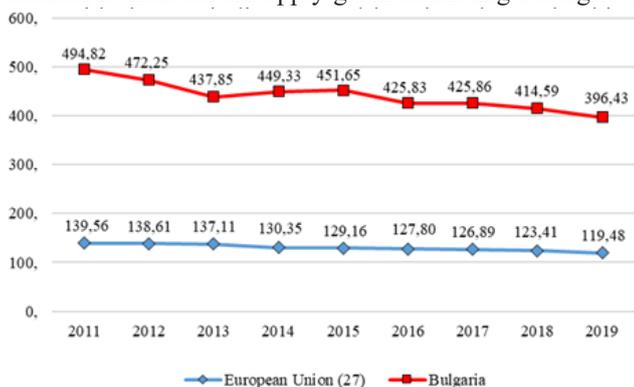


Figure 4 – Energy intensity (kilograms of oil equivalent per thousand euro), 2011 – 2019

Source: Eurostat (online data code: NRG\_IND\_EI)

Speaking of EU and its policy about achieving climate neutrality, some estimates may be delivered; there will be a need of about € 28 trillion by 2050 for EU to achieve climate neutrality (McKinsey & Co, 2020). Hence, if equally distributed among all the EU-27 countries the economic burden for each of the member states shall be about a trillion euro. Taking into account the economic structures, sizes, levels of industrialization, and technical advancement of different states in the EU, this estimates translates that EU shall play as a single economic actor to distribute evenly and fairly this economic burden through adapted DICE-models for each and every country in the EU.

Furthermore, the analysis of the presented secondary data in the aforementioned examples, demonstrates that the hypothesis formulated by us is confirmed at national level. Bulgaria may be capable of improving its internationalization of the economy through introducing utilization of green finances and green marketing practices, and they could fit into an adapted DICE model for the country. However, there are not enough data on regional level to explain whether and what the impact of these tools could be on a possible RICE model. There shall be further and extended researches on regional development to detect and explain the effects of EU funds as an investment resource to recover and sustain the average values, at least of the regional environmental and economic parameters.

The road to further investigation of this problem is to construct special survey on regional development and capacity for internationalization of regional private companies and consumers.

### Conclusions

As this present paper illustrates the issue of the day for the Bulgarian economy is to get on the right track of transforming into climate neutral economy with sustainable national and regional businesses. The theoretical IAM models of DICE and RICE shall be a cornerstone for further researchers on national and regional level to bring a legitimate neoclassical economic approach into designing public policies and national budget allocation programs to Bulgaria going green.

The Bulgarian economy shall be a subject to deeper transformative policies and rewinding the business cycle to EU indicators, standards, and benchmarks, if attainable. The forthcoming programming period /2021-2027/ could turn into a successful period of redesigning public policy making and streamlining the ecosystems and business systems of the country towards the ongoing implementation of the EU climate neutrality strategy.

Restructuring Bulgarian economic sectors and transforming national and regional public and business stakeholders must explicitly be in line with the European Green Deal. Henceforth, the theoretical standard DICE model of W. Nordhaus shall be reconsidered to employ the new variables of the EU Green Deal, on the one hand, and further adapted to reflect the national economic reality of different EU countries into the model. For economic states, which greater exacerbated economic woes, such as Bulgaria – there shall be up-sizing and reconsideration of the financial stimuli of the National Recovery and Sustainable Plan, in order to foster businesses and customers to “go green”.

In fact, carbon capture, storage and utilization from industrial, institutional, and societal point of view shall be translated into Bulgaria as adapted national DICE and regional RICE models to compensate fairly industrialists, stakeholders, public communities, and all interested parties, in general, for them to depart from old technologies and obsolete economic structures and businesses and transform them into modern societies of equal opportunities and benefits by the tools of green finances and green marketing.

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#### REFERENCES

1. Béatrice C., C. Cassen, A. Nadai (2019). *Organising Policy-Relevant Knowledge for Climate Action: Integrated Assessment Modelling, the IPCC, and the Emergence of a Collective Expertise on Socioeconomic Emission Scenarios*. Science & Technology Studies, Finnish Association for Science and Technology Studies, The Politics of Anticipatory Expertise, 32 (4), pp.36-57. [ff10.23987/sts.65031ff.fhal-02145310f](https://doi.org/10.23987/sts.65031ff.fhal-02145310f)
2. Kehayova-Stoycheva, M., Ivanov, S., Nedev, Y. (2013). Sustainable Marketing Activities in "Green Circle", *Sbornik: Management and Sustainable Development*, 1(38), pp. 43-48.
3. McKinsey & Company. (2020). *Europe's path to decarbonization*, <https://www.mckinsey.com/business-functions/sustainability/our-insights/how-the-european-union-could-achieve-net-zero-emissions-at-net-zero-cost>, retrieved on July 29, 2021.
4. Ministry of Economy. (2021). *Natsionalen plan za vazstanovyavane i ustoychivost na Republika Bulgaria, /In English: National Recovery and Resilience Plan/, Ver. 1.3*, <https://www.nextgeneration.bg/>, retrieved on July 27, 2021.
5. Nordhaus, W. D. (1972). *The political business cycle*, Cowles Foundation Discussion Paper No 333.
6. Nordhaus, W.D. (1974). *Resources as a Constraint on Growth*, *American Economic Review*, 64(2), pp. 22-26.
7. Nordhaus, W.D. (1975). *Can We Control Carbon Dioxide? IIASA Working Paper*, pp. 75-63, Vienna, Austria.
8. Nordhaus, W. D. (1975). *The political business cycle*, *Review of Economic Studies*, 42(2), pp. 169-190.
9. Nordhaus, W.D. (1977). *Economic Growth and Climate: The Case of Carbon Dioxide*, *American Economic Review*, 67(1), pp. 341-346.
10. Nordhaus, W. D. (1989). *Alternative approaches to the political business cycles*, *Brookings Papers on Economic Activity*, No 2, pp. 1-49.
11. Nordhaus, W.D. (1994a). *Managing the Global Commons: The Economics of Climate Change*, Cambridge, MA: MIT Press.
12. Nordhaus, W.D. (1994b). *Expert Opinion on Climate Change*, *American Scientist* 82, pp. 920-937.
13. Nordhaus, W. D. (2013). *Integrated Economic and Climate Modeling*, Chap 16, *Handbook of CGE Modeling - Vol. 1*, Amsterdam: Elsevier.
14. Nordhaus, W.D. (2014). *Estimates of the Social Cost of Carbon: Concepts and Results from the DICE-2013R Model and Alternative Approaches*, *Journal of the Association of Environmental and Resource Economists*, 1, pp. 273-312.
15. Nordhaus, W. (2015). *The Climate Casino: Risk, Uncertainty, and Economics for a Warming World*, Yale University Press.
16. Nordhaus, W.D. (2017). *Projections and Uncertainties about Climate Change in an Era of Minimal Climate Policies*, NBER Working Paper 22933.
17. Nordhaus, W D. (2018). *Evolution of Modeling of the Economics of Global Warming: Changes in the DICE model, 1992-2017*, NBER Working Paper 23319.
18. Nordhaus, W. (2021). *The Spirit of Green: The Economics of Collisions and Contagions in a Crowded World*, Princeton University Press.
19. Nordhaus W.D. and J. Boyer (2000). *Warming the World: Economic Models of Global Warming*, Cambridge, MA: MIT Press.
20. Nordhaus, W.D., Z. Yang (1996). *A Regional Dynamic General-Equilibrium Model of Alternative Climate-Change Strategies*, *American Economic Review*, 86(4), pp. 741-765.
21. Solow, R.M. (1956). *A Contribution to the Theory of Economic Growth*, *Quarterly Journal of Economics*, 70(1), pp. 65-94.
22. Swan, T. (1956). *Economic Growth and Capital Accumulation*, *Economic Record*, 32(2), pp. 334-361.
23. <http://ec.europa.eu/eurostat/data/database>

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