

## BIG DATA ANALYTICS INSIGHTS OF PAST RESEARCH ON SUSTAINABLE FINANCE

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**Abstract**

Sustainable finance is a wealthy discipline of studies. Yet, present critiques continue to be restricted because of the piecemeal insights presented via a sub-set in preference to the whole corpus of sustainable finance. To deal with this gap, this examine pursuits to behavior a big-scale overview that might offer a cutting-edge evaluate of the overall performance and highbrow shape of sustainable finance. To do so, this examine engages in a overview of sustainable finance studies the use of massive facts analytics via device mastering of scholarly studies. In doing so, this examine unpacks the maximum influential articles and pinnacle contributing journals, authors, institutions, and nations, in addition to the methodological alternatives and studies contexts for sustainable finance studies. In addition, this examine famous insights into seven main topics of sustainable finance studies, particularly socially accountable making an investment, weather financing, inexperienced financing, effect making an investment, carbon financing, power financing, and governance of sustainable financing and making an investment. Suggestions consist of growing and diffusing modern sustainable financing units, magnifying and dealing with the profitability and returns of sustainable financing, making sustainable finance extra sustainable, devising and unifying guidelines and frameworks for sustainable finance, tackling greenwashing of company sustainability reporting in sustainable finance, shining behavioral finance on sustainable finance, and leveraging the energy of recent-age technology including synthetic intelligence, blockchain, net of things, and device mastering for sustainable finance.

**Introduction**

As a established name to motion to stop poverty, guard the planet, and enhance the lives and possibilities of everybody across the world, the 17 Sustainable Development Goals (SDGs) are part of the 2030 Agenda for Sustainable Development which have been followed with the aid of using all United Nations Member States in 2015 and anticipated to be finished with the aid of using 2030 (United Nations, 2020). The United Nations estimates an funding withinside the variety of \$five trillion to \$7 trillion to gain the SDGs (Craig, 2021). With the unprecedented outbreak of a worldwide pandemic in 2020, the United Nations Development Programme (UNDP) released the SDG Finance Taxonomy to offer a roadmap for manipulate the financing and transaction expenses of tasks which can be aligned to the SDGs (Wang et al., 2020).

Sustainable finance has emerged as an vital idea on the intersection of finance and the SDGs. More than \$four hundred billion of recent finances had been raised on capital markets in 2020, which includes \$357.5 billion from sustainability bonds and \$76.5 billion from inexperienced bonds (Refinitiv, 2020; United Nations, 2020). The definition of sustainable finance, however, could be very broad, encompassing myriad dimensions of sustainable approaches to achieve finance and funding dreams. In this regard, we recommend that sustainable finance ought to embody all sports and

elements that might make finance sustainable and make a contribution to sustainability, a definition that we opine enhances the myriad dreams with the aid of using unique stakeholders, including the European Commission's ESG and the United Nations' SDGs. Indeed, the attainment of sustainable coverage goals throughout several jurisdictions may be finished via diverse approaches including weather finance, carbon and ESG disclosure, inexperienced bonds, and socially accountable funding (Alsaifi et al., 2020; Barua & Chiesa, 2019; Lokuwaduge & Heenetigala, 2017; Migliorelli, 2021; OECD, 2020; Widyawati, 2020), all of which may be blanketed below our umbrella definition of sustainable finance.

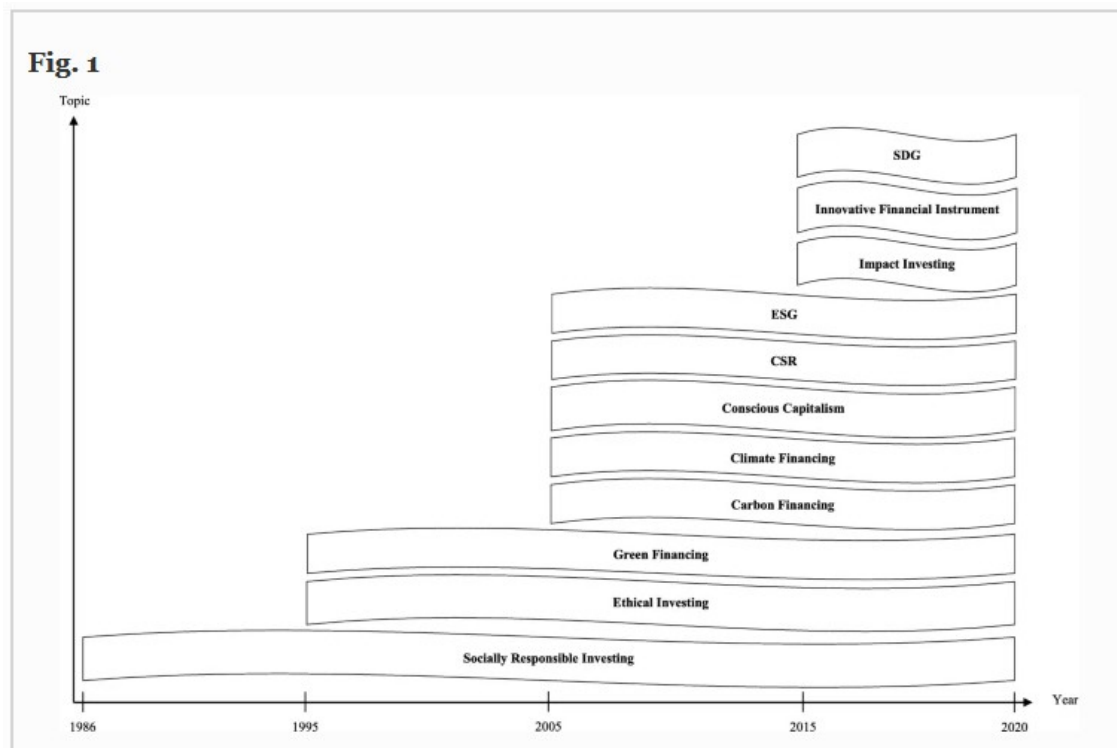
In this examine, we intention to offer a cutting-edge evaluate of sustainable finance studies, deliberating all elements and associated articles withinside the discipline. That is to say, this examine covers the whole spectrum of sustainable finance, and thus, it isn't restricted to any unmarried thing of the idea, as withinside the case of beyond critiques including weather finance (Giglio et al., 2020) and inexperienced finance (Malhotra & Thakur, 2020). Moreover, this examine makes use of an goal and a effective overview method, particularly bibliometric evaluation, that's incredibly appropriate for reviewing fields with a big corpus of articles the use of quantitative techniques (Donthu et al., 2021a; Pattnaik et al., 2020; Paul et al., 2021). Specifically, bibliometric evaluation exemplifies the usage of massive facts analytics via device mastering of scholarly studies in main approaches, particularly (1) the look for massive facts (bibliometrics) is accomplished on an synthetic intelligence-powered clinical database (Scopus), in which the clinical database makes use of unique key phrases for supervised device mastering, as a subset of synthetic intelligence, to extract big quantities of bibliometric facts referring to articles applicable to sustainable finance, and (2) the evaluation of massive facts (bibliometrics), that's multi-faceted (e.g., journal, author, institution, country, key phrases), multi-formatted (e.g., numbers, words), and big-scaled (e.g., heaps of facts factors throughout the more than one sides of 936 articles), is powered with the aid of using unsupervised device mastering.

1. What is the ebook fashion for sustainable finance studies?
2. Which are the maximum influential articles and pinnacle contributing journals for sustainable finance studies?
3. Which are the pinnacle contributing authors, institutions, and nations for sustainable finance studies?
4. What methodological alternatives and studies contexts exist for sustainable finance studies?
- five. What are the main topics and subjects for sustainable finance studies?
6. What are the destiny studies instructions for sustainable finance studies?

### **Literature Review**

The literature on sustainable finance may be traced lower back to Ferris and Rykaczewski (1986), who addressed the issues and blessings of social making an investment in portfolio management. Following this seminal article, the following decade of studies (1986–1995) multiplied the literature on the important thing fulfillment elements of socially accountable making an investment (Camey, 1994; Diltz, 1995). New studies withinside the next decade (1996–2005) prolonged information on socially accountable making an investment in phrases of its overall performance in opposition to traditional finances (Guerard & John, 1997; Hutton et al., 1998; Statman, 2000) and the want to amplify its scope to account for ethics (Wilson, 1997) and the environment (Heinkel et al., 2001) including weather alternate and renewable power (Van Der Laan & Lansbury, 2004). The later decade (2006–2015) sees the creation and growth of recent studies including carbon finance (Aglietta et al., 2015; Bredin et al.,

2014; Purdon, 2015; Yenneti & Gamaralalage, 2012; Yeoh, 2008), weather finance (Brunner & Enting, 2014; Hogarth, 2012; Jakob et al., 2015; Vanderheiden, 2015), aware capitalism (Sisodia, 2009, 2013; Wang, 2013a, 2013b), ESG-CSR and corporation overall performance integration (Dorfleitner et al., 2015; Eccles & Viviers, 2011; Friede et al., 2015; Halbritter & Dorfleitner, 2015; Himick, 2011; Nielsen & Noergaard, 2011), and moral making an investment (Bauer et al., 2007; Belghitar et al., 2014; Chow et al., 2014; Pender & Brocchetto, 2011; Richardson, 2009; Säve-Söderbergh, 2010; von Wallis & Klein, 2015; Watson, 2011). The maximum current 1/2 of decade (2015–2020) is characterised with the aid of using studies responding to the Paris settlement and the release of the SDGs in 2015, with exponential increase in guides that specialize in effect making an investment (Agrawal & Hockerts, 2019, 2021; Caseau & Grolleau, 2020; Lieberman, 2020; Robb & Sattell, 2016; Viviani & Maurel, 2019) modern economic units including social effect bonds (Carè et al., 2020; Giacomantonio, 2017; Rizzello & Kabli, 2020; Torre, et al., 2019), and ESG making an investment and corporation overall performance (Alessandrini & Jondeau, 2020; Chen & Mussalli, 2020; Giese et al., 2019; Landi & Sciarelli, 2019; Schramade, 2016). The precis of the short evolution of sustainable finance studies is supplied in Fig. 1, and might be investigated similarly withinside the later sections of this examine.



Evolution of sustainable finance studies. CSR Corporate social responsibility. ESG Environmental, social, and governance. SDG Sustainable improvement goals

Given the burgeoning studies on sustainable finance, beyond researchers have additionally tried to study the extant literature withinside the subject. However, in maximum instances, such critiques had been confined to a selected element of sustainable finance, and now no longer sustainable finance as a whole. Apart from Cunha et al. (2021), that is the handiest and maximum current evaluation of sustainable finance previous to the prevailing evaluation, no different evaluation has tried to study the sector as a whole. Yet, as stated previously, the evaluation through Cunha et al. (2021) stays confined to a small corpus of 166 articles, and consequently, supplying a photo in place of a

contemporary evaluation of sustainable finance studies, in which the absence and want of the latter to offer a complete inventory take of the sector motivates the prevailing evaluation, whose technique might be disclosed withinside the subsequent phase.

### Methodology

This take a look at collects bibliometric records on sustainable finance studies for its evaluation. To do so, this take a look at adopts and implements the Scientific Procedures and Rationales for Systematic Literature Reviews (SPAR-4-SLR) protocol, which includes 3 important stages, particularly assembling, arranging, and assessing of articles (Paul et al., 2021). The precis of the evaluation method is illustrated in Fig. 2.

### Systematic evaluation method the use of the SPAR-4-SLR protocol

#### Assembling

To collect the corpus of articles on sustainable finance, this take a look at diagnosed its seek key phrases referring to sustainable finance from the initial evaluation of applicable literature withinside the preceding phase and consulted 10 professionals to examine the suitability of these key phrases to symbolize sustainable finance. This caused a mixture of 17 key phrases that may be prepared into the subsequent seek string:

“carbon credit” OR “carbon tax” OR “weather finance” OR “aware capitalism” OR “ESG investing” OR “inexperienced bond” OR “inexperienced finance” “SDG financing” OR OR “effect investing” OR “socially accountable investing” OR “ “sustainability reporting” OR sustainability financing” OR “sustainability hazard disclosure” OR “sustainability hazard management” OR “sustainable economy” OR “sustainable finance”

Following the identity of seek key phrases, this take a look at performed a look for articles the use of the aforementioned seek string withinside the “article title, abstract, and key phrases” on Scopus, that is the biggest extremely good clinical database of scholarly articles (Comerio & Strozzi, 2019; Norris & Oppenheim, 2007), and consequently selected over its alternative, Web of Science, which includes much less articles for evaluation than Scopus (Paul et al., 2021). In total, 10,850 files had been lower back from the quest.

#### Arranging

To set up the corpus of 10,850 articles lower back from the assembling level, this take a look at used the category (code) feature in Scopus to study the quest consequences in keeping with 12 months, situation area, file type, ebook level, supply type, and language, in which seek consequences had been filtered and confined to “2020”, “commercial enterprise, management, and accounting”, “article”, “very last”, “magazine”, and “English” in the ones categories, respectively. This caused a discounted corpus inclusive of 1,530 articles. That is to say, the elements of sustainable finance did now no longer take middle level withinside the research of these articles, ensuing of their removal. This caused a very last corpus of 936 articles for evaluation, which became showed following a random cross-test the use of different databases inclusive of Google Scholar and publishers internet site inclusive of Elsevier, Emerald, Sage, Springer, and Taylor and Francis to keep away from unintentional exclusion of applicable research withinside the subject (Goyal et al., 2021; Harari et al., 2020; Lim et al., 2021).

#### Assessing

To verify the very last corpus of 936 articles on sustainable finance, that is a enormously big corpus, this take a look at adopts a bibliometric evaluation technique for its evaluation. In essence, a bibliometric evaluation makes use of quantitative strategies to appraise clinical data of scholarly articles (Donthu et al., 2021a). Noteworthy, systematic critiques the use of bibliometrics are actually a commonplace (Ellegaard & Wallin, 2015), together with commercial enterprise in general (Baker et al., 2020; Donthu et al., 2021a; Zupic & Čater, 2015) and finance in particular (Durisin & Puzone, 2009; Linnenluecke et al., 2018; Xu et al., 2018) as a bibliometric evaluation can mitigate the capacity bias that avail in manual (e.g., mistakes prone) and qualitative (i.e., subjectivity) critiques the use of quantitative (i.e., objectivity) tools (Broadus, 1987; Burton et al., 2020), specially while the corpus for evaluation is big (excessive loads to lots of articles) (Donthu et al., 2021a), as withinside the case of the prevailing evaluation (i.e., 936 articles). Following beyond critiques (Cobo et al., 2011; Donthu et al., 2020, 2021d; Khan et al., 2021), this take a look at plays a bibliometric evaluation the use of a overall performance evaluation to delineate the ebook fashion, the pinnacle articles and contributing journals, authors, institutions, and countries, and the methodological picks and studies contexts, and a technological know-how mapping through a temporal evaluation the use of phrase clouds (Bastian et al., 2009; van Eck & Waltman, 2017) and a community evaluation the use of key-word co-occurrence (Callon et al., 1983; Castriotta et al., 2019; Donthu et al., 2021a; Newman & Girvan, 2004; Pesta et al., 2018) in VOSviewer (van Eck & Waltman, 2017) to unpack the important topics and subjects underpinning the highbrow shape of sustainable finance studies. To strengthen insights withinside the subject, this take a look at curates a destiny studies schedule primarily based totally on our analyzing of the articles and mirrored image of extant gaps beneathneath every important theme. The subsequent sections record the findings of the evaluation, in which narratives are supplemented through figures and tables.

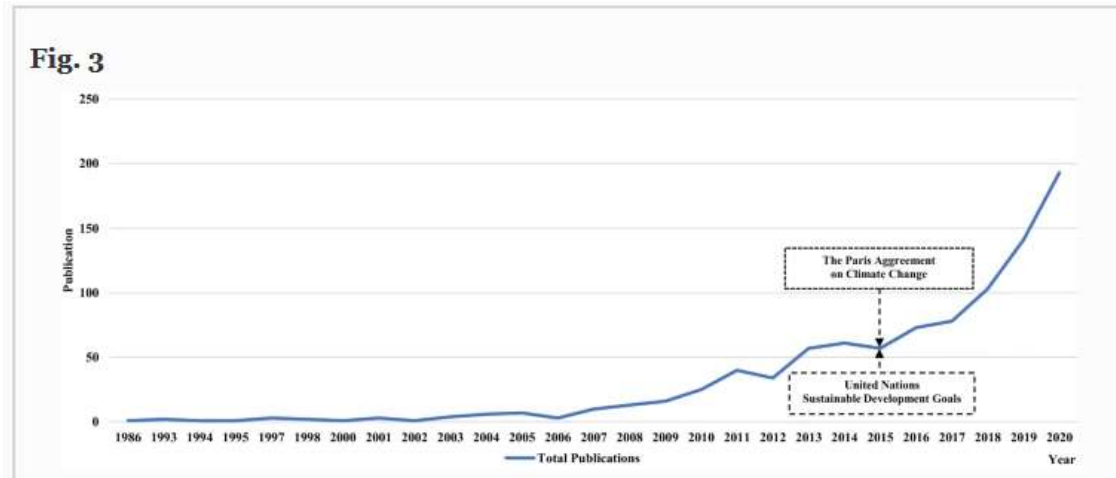
## **Findings**

### **Performance evaluation**

Performance evaluation is a bibliometric evaluation approach that describes the overall performance of a studies domain (Donthu et al., 2021a), and on this case, the sector of sustainable finance. In this take a look at, a overall performance evaluation is performed to reveal (1) the ebook fashion, (2) the maximum influential articles, the pinnacle contributing (3) journals, (4) authors, (5) institutions, and (6) countries, and (7) the methodological picks and studies contexts of sustainable finance studies.

### **Publication fashion for sustainable finance studies**

The 12 months-clever ebook fashion of sustainable finance studies is supplied in Fig. 3. The parent suggests that the primary article on sustainable finance posted in a magazine listed in Scopus regarded in 1986 (Ferris & Rykaczewski, 1986), and that guides withinside the subject have grown during the last 35 years (1986–2020). This is supported through an in depth scrutiny of the corpus, wherein near 70% of articles had been posted among 2015 and 2020, thereby reaffirming 2015 as a landmark 12 months for sustainable finance studies.



Year-wise publication for sustainable finance research between 1986 and 2020

#### Most influential articles for sustainable finance studies

The maximum influential articles for sustainable finance studies in phrases of citations suggests that Dedusenko's (2017) article is the maximum noted article within the discipline, with a mean of 43.67 citations in line with yr and a complete of 655 citations because its ebook in 2006. This is accompanied through Viviers, Ractliffe, and Hand's (2011) and Roundy's (2019) articles in Journal of Banking and Finance and Journal of Financial Economics, that have been noted 500 and 431 times, respectively.

#### Top contributing journals for sustainable finance studies

The corpus of 936 articles on sustainable finance had been posted throughout 416 journals, indicating that the pinnacle 24 contributing journals with no less than 5 articles on sustainable finance have posted 334 (35.68%) articles within the discipline. Specifically, the pinnacle 3 maximum prolific journals are Sustainability, Journal of Business Ethics, and Journal of Sustainable Finance and Investment, with 52, 47, and forty two articles, respectively. However, in phrases of influence, Journal of Business Ethics leads the percent with 2712 citations, accompanied through Journal of Banking and Finance and Climate Policy, with 1422 and 458 citations, respectively.

#### Top contributing authors for sustainable finance studies

The pinnacle contributing authors for sustainable finance studies are offered in Table 3. The desk suggests that Scholtens B. from University of Groningen, Netherlands and Cortez M.C. from University of Minho, Portugal are the 2 maximum prolific authors within the discipline with 10 articles each. This is accompanied through Richardson B.J. from University of British Columbia, United States and Dorfleitner G. from University of Regensburg, Germany with 9 and 8 articles, respectively. However, the maximum influential authors are S. Viviers from Stellenbosch University, South Africa and Hockerts K. from Copenhagen Business School, Denmark with 591 and 577 citations.

#### Top contributing establishments for sustainable finance studies

The pinnacle contributing establishments for sustainable finance studies suggests that the maximum prolific organization within the discipline is University of Regensburg, Germany with 15 articles,

accompanied through University of Oxford, United Kingdom with thirteen articles, and University of British Columbia, Australia and University of California, United States with 12 articles each.

Top contributing international locations for sustainable finance studies

The pinnacle contributing international locations for sustainable finance studies suggests that the maximum prolific u . s . is america with 242 articles, accompanied through the UK and Germany with 131 and ninety articles, respectively.

Methodological selections and studies contexts for sustainable finance studies

The methodological selections (i.e., studies method, studies layout, information series technique, and information evaluation tool) and studies contexts (i.e., enterprise focus, studies focus, and geographical focus) for sustainable finance studies throughout a long time and over a cumulative duration of 35 years (1986–2020).

The qualitative method tops the chart because the maximum favored studies method throughout all a long time, with 53% of articles withinside the discipline the usage of this studies method. The quantitative method is the subsequent maximum favored studies method, constituting 38% of articles, while a blended aggregate of the 2 processes represents most effective 7.5% of articles withinside the corpus.

The choice of studies layout for sustainable finance studies. The conceptual and empirical studies designs had been similarly favored withinside the discipline's early years (37.03%), alevn though a more potent choice for empirical studies designs and a declining choice for conceptual studies designs arise over time.

Temporal evaluation the usage of phrase clouds for sustainable finance studies

The corpus of articles on sustainable finance studies turned into segmented into 4 time periods: 1986 to 1995, 1996 to 2005, 2006 to 2015, and 2016 to 2020. The main subjects in whenever duration exposed via a temporal evaluation are illustrated via the phrase clouds in Figs. 4



Sustainable finance research between 1986 and 1995

## Conclusion

This have a look at follows a systematic literature evaluate method the usage of bibliometric evaluation to shed mild on the overall performance and technology of sustainable finance studies. This method, which exemplifies using huge facts analytics thru system gaining knowledge of of scholarly studies, is mainly noteworthy given the impressive absence of the software and dialogue of new-age technology in sustainable finance studies. In doing so, this have a look at contributes in a unique manner with the aid of using leveraging on the strength of huge facts analytics thru system gaining knowledge of—and offering greater visibility to it withinside the process—to find the maximum influential articles and pinnacle contributing journals, authors, establishments, and nations, in addition to the methodological picks and studies contexts, and with the aid of using revealing the temporal evolution of subjects and the principal subject matters underpinning the intellectual shape for sustainable finance studies. To this end, we summarize 5 key takeaways and their equal implications from this modern-day evaluate of 936 articles on sustainable finance during the last 35 years (1986–2020).

First, the overall performance evaluation suggests a constant boom in guides withinside the area following the Paris settlement and the release of the SDGs. Most guides got here from authors and establishments withinside the United States and the UK as those nations have followed sustainable



finance frameworks and attractive in socially accountable making an investment plenty in advance than different advanced and developing nations. In this regard, sustainable finance studies need to enlarge to underrepresented nations in which sustainable finance is gaining momentum (e.g., Africa, Australia, Japan, Malaysia, and Singapore).

Second, the overall performance evaluation additionally well-known shows that qualitative studies is maximum distinguished in sustainable finance because of the nascent level of its adoption in maximum nations and as a consequence the dearth of instances and facts factors required for quantitative studies, and that maximum researchers favored archival facts, with few opting to pursue experiments and surveys. In this regard, it is able to be profitable for sustainable finance studies to pursue the latter facts series strategies that stay underutilized because of their capability to degree persistent and primed responses (Lim, 2015, 2021; Lim et al., 2019) amongst capability stakeholders of sustainable finance, thereby curating similarly thrilling cause-and-impact insights on its feasibility and marketplace response previous to its begin up or scale up.

Third, the overall performance evaluation additionally suggests that maximum research are software orientated in which the intention is to broaden rules and frameworks for unique contexts in place of to construct and take a look at theories, that maximum research recognition on unmarried us of a facts in which in advance research deal with advanced economies together with Europe, the United States, and the UK and extra current research coming from rising economies together with Asia, Africa, and Oceania, and that maximum research are willing toward the carrier sector, especially monetary services. Therefore, we encourage potential researchers to proactively view those gaps as possibilities for making new and novel contributions to the enhance and enlarge expertise of sustainable finance.

Fourth, the technology mapping thru a temporal evaluation well-known shows that sustainable finance studies has contributed myriad insights time beyond regulation beginning with a unmarried recognition on socially accountable making an investment (1986 onwards) and branching out steadily to different regions together with moral and inexperienced financing and moral making an investment (1995 onwards), carbon financing, weather financing, aware capitalism, CSR, and ESG (2005 onwards), and extra recently, effect making an investment, revolutionary monetary instrument, and SDG (2015 onwards). Noteworthy, the sector of sustainable finance will handiest develop large withinside the future, with new revolutionary sustainable financing gadgets being advanced over time—as visible thru the upward push of carbon and weather financing—to form and fulfill the needs of investment for sustainability and sustainability development.

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