



NOTE AND COMMENT

# The evolution of sustainability models, from descriptive, to strategic, to the three pillars framework for applied solutions

William H. Clune<sup>1</sup> · Alexander J. B. Zehnder<sup>2</sup>

Received: 28 August 2019 / Accepted: 18 December 2019 / Published online: 6 January 2020  
© Springer Japan KK, part of Springer Nature 2020

## Abstract

The three pillars of sustainability framework is an applied and solutions oriented approach to sustainable development, which at the broadest and most important scale supports the creation of new economic and political institutions that embed (from start to finish) the key inputs, stakeholders, and incentive structures necessary for sustainability planning and projects to be feasible and successful. The three pillars framework is based upon the key and connected roles of: (1) technology and innovation; (2) laws and governance; and (3) economics and financial incentives. Through the lens of a review of the evolution of sustainability models over the last several decades, it is proposed that the three pillars framework can more effectively help us translate complex sustainability issues into ideas and an applied focus that can be better understood and acted upon by community and economic stakeholders. This, combined with full transparency, creates the necessary, and often sufficient, foundation for successful, scalable, more rapidly deployable, and culturally acceptable sustainability solutions. As demonstrated in practice and in numerous case studies, sustainability solutions that engage all three pillars at once—good governance, technology implementation, and creating market incentives—are most effective and durable.

**Keywords** Economic development · Sustainability framework · Planning tools · Policy tools

## Introduction

Much of the best thinking about sustainability over the past 50 years was based on sustainability models that correctly outlined and described important inputs, major stakeholders, and strategic possibilities. A comprehensive look at the evolution of these sustainability models shows an important transition from frameworks trying to understand sustainability's main challenges and drivers to more refined and applied modern templates for implementing sustainability

solutions at speed and scale. Some key points to consider when reviewing the evolutionary path of sustainability models is how they support the success and implementation of specific and applied sustainability projects, how they support policy and strategy creation for developing new and feasible classes of sustainability solutions, and how they intelligently integrate at scope and scale sustainability thinking, planning, and applied solutions throughout all our economic, political, and social institutions.

A new approach—the three pillars of sustainability framework—is proposed here that relates to, but significantly extends, previous models. Specifically, the three pillars framework is more applied and solutions oriented, and at the broadest and most important scale supports the creation of new economic and political institutions that embed (from start to finish) the key inputs, stakeholders, and incentive structures necessary for sustainability planning and projects to be feasible, successful, and socially accepted. The three pillars of sustainability framework is based upon the key and connected roles of: (1) technology and innovation; (2) laws and governance; and (3) economics and financial incentives (Clune and Zehnder 2018). The three pillars are more than just required disciplinary inputs, and as will be shown they

---

Handled by Vinod Tewari, The Energy and resources Institute (TERI), India.

---

**Electronic supplementary material** The online version of this article (<https://doi.org/10.1007/s11625-019-00776-8>) contains supplementary material, which is available to authorized users.

---

✉ William H. Clune  
whclune@ntu.edu.sg

<sup>1</sup> Asian School of the Environment, Nanyang Technological University (NTU), Singapore, Singapore

<sup>2</sup> School of Biological Science, Nanyang Technological University (NTU), Singapore, Singapore

describe and focus on the institutional and market spaces where social stakeholders (consumers, citizens, and government) and other sectors (corporations and NGOs) must intersect and engage with each other to create economically and technologically feasible, as well as socially acceptable, sustainability solutions.

The three pillars framework translates complex sustainability issues into ideas and an applied focus that can be better understood and acted upon by community and economic stakeholders. As demonstrated in practice and in numerous case studies, sustainability solutions that engage all three pillars at once—good governance, technology implementation, and creating market incentives—are most effective and durable. The paper begins with a section on the evolution of sustainability models, followed by a section on the three pillars framework that extends these discussions.

## The Evolutionary Path of Sustainability Models

The Club of Rome and *The Limits to Growth* in 1972 is a good starting place in the evolution of sustainability models (Meadows et al. 1972). Although it received criticism at the time, its central thesis that the Earth's key resources are exhaustible (and being exhausted) was always (potentially) correct (Turner 2014). It is possible to irreversibly damage or destroy ecosystems with rates of use, extraction, or pollution burden that exceed replacement and renewal (Rockström et al. 2009). What was missing was the full dynamic potential of technology development and resource discovery that was hard to imagine in the 1970s. Indeed, it is now well understood that the transformative and disruptive potential of technology is crucial to meeting our sustainability and development goals (UN Commission on Science and Technology 2019).

The *Stockholm Declaration* (1972) was a powerful first step toward the modern concept of sustainability in describing key environmental goals as connected to economic development drivers, as well as in the integrated nature of the solutions path it describes. This included roles for governance, technology transfer, and sensitivity to cultural and economic differences between nations and stakeholders. Actually, from a holistic and broad perspective, this groundbreaking document got most things right, including some important recognition of sustainability's dynamic and systems-oriented nature. Yet, there was again a significant underestimation of the effects of technology, as well as the related effects of how changing culture, public policy, and economic markets together drive beneficial technology development.

To this point, parallel to advancements in policy thinking, basic environmental law and regulatory practices were

changing during the 1970s and 1980s in places such as the USA and Europe, including an understanding of the potential of harnessing economic markets and incentives for technology forcing regulations and pollution trading schemes (Sandor et al. 2015).

The framework of the *Brundtland Report* (WCED 1987) included much of the *Stockholm Declaration's* understanding of the primary challenges of economic consumption, production, and development to achieving sustainability, and of the need to bridge gaps of cooperation, financial resources, and access to technology for a more global implementation of sustainability solutions. It also described in new terms risk scenarios, food and water security, the importance of regional cooperation and governance (in addition to international efforts), and roles for environmental and ecosystem services and valuation. It roughed out the steps, or at least some key pieces, for a large-scale transition to a low-carbon global economy, including how industry could more efficiently and by deploying (and developing) new technologies start "producing more with less."

The triple bottom line framework was a natural extension of the *Brundtland Report*. It is powerfully descriptive of sustainability's potential and primary objectives (Elkington 1998). Sustainability combines the creation of a feasible and livable space for human society within environmental protection and ecological objectives, while the economic component correctly acknowledges that all of our environmental challenges and necessary (for survival) productive targets are connected to economic production and consumption. Importantly, it highlighted some of the key relationships between social, cultural, and economic institutions in relation to environmental goals. We realized we needed much more intelligent, analytical thinking about economics and markets, not less, if we wanted to achieve global sustainability.

The bombshell that changed the focus and discussion was climate change. While the scientific research and evidence regarding anthropogenic climate change had been growing since the 1960s (SCOPE-Rep. No. 13 1979), the first Intergovernmental Panel on Climate Change (McG Tegart et al. 1990) impact assessment report marks the beginning of a much broader and significant thinking about climate change across many fields, sectors, and activities. An understanding and acceptance of the inevitable scale, massive risk exposures, and adaptation costs of climate change shifted the urgency and priorities of sustainability. It highlighted exactly how interdisciplinary and integrated our efforts would need to become.

It was in the early to mid-1990s that Michael Porter and Stephan Schmidheiny opened the lens to the possibility that sustainable development was an opportunity for business, not just a cost, and was therefore a necessity for modern business strategy. Porter (1991) reconceived the "greening"

of business as a cost-reduction and profit-making proposition in several key respects, including more efficient material use (pollution as wasted resources), innovation potential (corporations as powerful responders to constraints and challenges with creativity and new solutions), and a variety of public opinion and marketing advantages (less regulatory oversight, more public trust, growing green product markets).

Stephan Schmidheiny (1992) spoke in broader (and perhaps bolder) strategic terms in *Changing Course*, which was certainly a precursor to Creating Shared Value (CSV) and other, more modern strategic sustainability paradigms (Porter and Kramer 2011). The notion that corporate practices must align with sustainability objectives was ahead of its time and speaks directly to a process of matching the scope and scale of the challenges to an equivalent scope and scale in our institutional arrangements and practices.

In fact, recognizing that sustainability was not only a project in which different stakeholders played their parts, but in which major stakeholders could actually transform the paradigm and playing field through economic markets, was a major milestone. It was no longer economy versus environment, but how we need to align economic markets and actors within and in support of the goals of sustainable development. The potential was grasped that business and economic market development would no longer be a liability to sustainability, but could become one of its most powerful drivers and foundations. In fact, sustainability is not achievable without business and the modern corporation fully engaged given their global reach, impact, and economic power (Dow Jones Sustainability Index, see cases below; Schmidheiny and Zorraquin 1996).

With the creation of the World Business Council for Sustainable Development (WBCSD) in the early 1990s, as a positive reaction to the *Brundtland Report* and the 1992 United Nations Conference on Environment and Development (UNCED), also known as the Rio Earth Summit, the tide had certainly turned in favor of implementing sustainability solutions that are fully integrated, involve all stakeholders working cooperatively, engage economic markets and incentive systems, and are global in scale. The WBCSD's very existence, with comprehensive corporate representation and membership, is as significant as the perspectives it develops and endorses. In terms of models, WBCSD's Circular Economy projects speak directly of transforming economic production and consumption to align with sustainable economic development, and is an evolution from earlier versions of the Factor approaches at the Wuppertal Institute in Germany (von Weizsäcker et al. 1997; Schmidt-Bleek 1997).

Without dismissing the relevance of Environmental Social and Governance (ESG) standards or Socially Responsible Investing (SRI) criteria developed and applied

in earnest in the early 2000s, these somewhat general guidelines have substantially repackaged the triple bottom line approach (UNCTAD 2015). On the other hand, the financial sector's process, for example, for making investments (or divestments), and for internal corporate governance, has always been somewhat conservative, so ESG's more general ideas and flexible roadmaps may help trigger changes in thinking and practices. The issue, however, is speed and focus in making the needed transitions, and in driving more applied, successful sustainability solutions.

The evolution of sustainability approaches and thinking more recently was greatly influenced by urbanization, with the key role for cities in addressing and supporting the concept of resilience. Rapid global urbanization is a fact. It will have major impacts on how most people live their lives, and with big implications (and opportunities) for sustainable economic development. Organizations like C40 and 100 Resilient Cities were created and grew quickly in response to the city–sustainability nexus, concentrating increasingly on resilience given the integrated, multidisciplinary, and complex reality of achieving sustainability and other major social goals.<sup>1</sup>

In the twenty-first century, Creating Shared Value (CSV) takes a fully modern and proactive approach with market actors and corporations creating positive social impacts, sustainability opportunities, and new green markets consistent with long-term profitability and survival (compact with society) strategies (Porter and Kramer 2011). Aligning business opportunities with our most pressing human needs and wants has, actually, always been a good business strategy. Now, the pressing nature of sustainability is creating a pressure (through changing culture and public opinion, its uptake by legal institutions, and resulting new consumer demand for green products) that is both a necessity and an opportunity.

The UN's Sustainable Development Goals (SDGs) are a set of universal objectives developed within a process that included civil society, academia, government, and the private sector (<https://sustainabledevelopment.un.org>). The focus on issues like poverty and gender equality recognized the large numbers of people who sustainability has left behind and failed over the years. SDG 11 focuses specifically on Sustainable Cities and Communities, which has supported and catalyzed organizations and efforts in the city space. There is no question the SDGs are now the leading organizational and planning template across many sectors and projects, and one supported in a complementary manner by the more solutions-oriented focus of the three pillars of sustainability framework.

<sup>1</sup> see C40 (<https://www.c40.org/>) and 100 Resilient Cities (<https://www.100resilientcities.org/>).

## The three pillars of sustainability framework for applied solutions

Looking at the current set of sustainability models, goals, and templates, an action-oriented strategic model or framework is still missing (Clune and Zehnder 2018). This is important if we want to integrate at scope and scale sustainability thinking, planning, and applied solutions across all of our major economic, political, and social activities and institutions. The three pillars framework fills this gap. It is an effective and pragmatic approach for translating sustainability science into action and application, and for moving from theory to practice. Sustainability solutions and effective implementations in cities and communities are what is needed now as a rapid response to our most serious global environmental impact challenges, and this is precisely what is meant by a three pillars approach that is action and application oriented.

Truly interdisciplinary, or even transdisciplinary, work is hard to do (Hirsch Hadorn et al. 2006). To overcome disciplinary boundaries, it helps to translate the issues at stake to well-defined themes, topics, and solution requirements (Burkhardt-Holm and Zehnder 2018). There are many examples of sustainability solutions with good potential that fail because one of the pillars is missing. The framework also applies more broadly to institutional and market transformation by elaborating, for example, the ways the SDGs operate and engage in ordinary and institutional practices.

The relationship and connections between all three pillars is crucial because of the way economic, legal, political, and other semi-autonomous systems connect and interact (Clune 2011). Having all three pillars of sustainability present and engaged is prerequisite for the success of all sustainability solutions, policy implementations, and planning exercises. For illustration, we test our framework with nine cases (summarized below, and presented in detail in the Supplementary Material).

### Cases for technology and innovation

As long as a crucial technology or innovation is missing, sustainability solutions will fail, even with strong public support, sufficient economic incentives, and capable law and regulatory backing.

- Chlorofluorocarbons (CFC) contribute to the ozone depletion of the upper atmosphere. 23 nations signed a protocol to reduce CFC release. Their ban was only possible after hydrochlorofluorocarbons (HCFC) were invented.

- Since the 1960s, it was clear that phosphate was the main trigger for eutrophication of surface waters. Many nations, as well as states and localities, were ready to ban phosphate from detergents. Low phosphate detergents were also a potential economic advantage in being lower in weight and smaller in volume. But only after the invention of zeolites in the 1970s as an effective replacement for phosphates did rapid and large-scale phosphate bans occur.
- The Clean Air Act and California's vehicle emissions reduction efforts in the 1970s show how connecting regulatory baselines, economic interests, and incentives of corporate stakeholders is pivotal for creating missing or stalled technologies and innovations necessary for achieving environmental goals. In other words, the production of essential technologies not only supports new economic and regulatory options, but may often be the result of supportive legal and economic baselines.

### Cases for laws and governance

The pillar of laws and governance supports sustainability solutions by enabling implementation of projects at middle and later stages (applied projects deployed in our communities intersect with legal and regulatory requirements at many levels), or at first stages through the many ways legal institutions, regulatory baselines, and public policy create the foundations for supporting new technology development, creating new markets, and ensuring competitive, healthy economies.

- Precious Woods is a global leader in the sustainable management of tropical forests. It faced many of the typical challenges (including free rider and "race to the bottom") in its early attempts to introduce sustainable and responsible forestry. It was the creation of a governance structure in the form of the Forest Stewardship Council (FSC) guidelines that supported the deployment of all relevant technologies, and realized full economic potentials creating a virtuous cycle that incentivized other market actors and stakeholders.
- Large parts of the world's fisheries are unmanaged, despite there being both clear economic benefits and no technological impediments to more sustainable management. A lack of effective governance has often resulted in the tragedy of the commons. Individual and cooperative governance efforts, even though piecemeal and occurring over several decades, have been a good start and have played a major role in slowing resource exploitation.
- There are significant, potential sustainability and environmental advantages to using local and trustworthy green suppliers and sources for government or corporate procurement. In the EU (and other places), the ten-

sion between federal economic goals and state procurement and environmental objectives (for example, with prohibitions against state aid) is resulting in innovative approaches to law, governance, and jurisprudence to support green and competitive markets.

### Cases for economics and financial incentives

The relationship and connections between all three pillars is crucial because of the way economic markets, legal institutions, cultural trends, technology development drivers, and other semi-autonomous systems connect and interact. It often does not matter which direction the solution path follows, because working within and through existing economic markets and financial incentives helps us act quickly and at scale.

- The European Court of Justice (CJEU) upheld a German law requiring power suppliers to purchase electricity from in-state producers of renewable energy at above-market prices. The CJEU argued that EU environmental and sustainability objectives were now sufficient to support and balance this kind of state environmental program against internal market protections, including free economic movement interests.
- When the Dow Jones Sustainability Index (DJSI) was established in 1999, it clearly showed a good segregation of stock performance between sustainability leaders and laggards. Building from there, the DJSI is an excellent example of how a financial tool connected with real and underlying economic rewards can significantly influence many business sectors to be more sustainable.
- Sustainable and resilient stormwater management and flood control systems were catalyzed in US cities by better economic incentives and more progressive laws. Improving rules and regulations often relates directly to creating better economic incentives, growing consumer markets, and attracting investment capital.

### Conclusions

The three pillars framework can more effectively help us with: (i) applying and successfully implementing at scale and speed specific sustainability solutions going from theory to practice, (ii) creating strategies and policies for conceptualizing, prioritizing, and funding new sustainability solutions that are more likely to be successfully developed and deployed, and (iii) creating integrated and clear sustainability planning tools and templates to support the necessary and deeper changes we need throughout our economic, political, and social institutions. The three pillars framework translates complex sustainability issues into ideas with an applied

focus that necessarily engages, and can be better understood and acted upon by, community and economic stakeholders.

For decision and policy makers, the three pillars framework can be used as a template for identifying and categorizing gaps, as well as for conceptualizing and introducing broader and necessary changes at deeper, institutional, socioeconomic levels. For instance, implementation and development of all of the UN SDGs will require many applied, innovative, and community-based (often urban) solutions (Cruz and Marques 2014). Specific implementations and projects will be important here, but what is really required is the creation of economic and political institutions that embed sustainability planning, design, and effective collaboration as part of their normal operating procedures. The three pillars approach also supports this transition, because it describes and focuses on the institutional and market spaces where social stakeholders (consumers, citizens, and government) and other sectors (corporations and NGOs) must intersect and engage with each other to create economically and technologically feasible, as well as socially acceptable, sustainability solutions.

Further research directions include a more substantial categorization of achievements and lessons learned from collected cases and studies, and the development of indicators or measures for tracking progress and allowing greater differentiation between cases, contributions, and inputs.

### References

- Burkhardt-Holm P, Zehnder AJB (2018) Fishnetz: assessing outcomes and impacts of a project at the interface of science and policy. *Environ Sci Pol* 82:52–59
- Clune WH (2011) A comparative law analysis of the use of state-level green procurement in the European Union and the United States. *Nordisk Miljörettslig Tidskrift/Nordic Environ Law J* 2:3–34
- Clune WH, Zehnder AJB (2018) The three pillars of sustainability framework: approaches for laws and governance. *J Environ Prot* 9:211–240
- da Cruz NF, Marques RC (2014) Scorecards for sustainable local governments. *Cities* 39:165–170
- Elkington J (1998) *Cannibals with forks: the triple bottom line of 21st century business*. New Society Publishers Gabriola Island BC, Stony Creek CT
- Hirsch Hadorn G, Bradley D, Pohl C, Rist S, Wiesmann U (2006) Implications of transdisciplinarity for sustainability research. *Ecol Econ* 60:119–128
- McG Tegart WJ, Sheldon GW, DC Griffiths (eds) (1990) *The IPCC impacts assessment: climate change*. Australian Government Publishing Service, Canberra. [https://www.ipcc.ch/site/assets/uploads/2018/03/ipcc\\_far\\_wg\\_II\\_full\\_report.pdf](https://www.ipcc.ch/site/assets/uploads/2018/03/ipcc_far_wg_II_full_report.pdf)
- Meadows DH, Meadows DL, Randers J, Behrens WW (1972) *The limits to growth—a report for the club of Rome’s project on the predicament of mankind*. Universe Books, New York
- Porter ME (1991) America’s green strategy. *Sci Am* 264(4):168
- Porter ME, Kramer MR (2011) Creating shared value. *Harv Bus Rev* 2011:62–77

- Rockström J et al (2009) Planetary boundaries: exploring the safe operating pace for humanity. *Ecol Soc* 14(2):32
- Sandor R, Kanakasabai M, Marques R, Clark N (2015) Sustainable investing and environmental markets—opportunities in a new asset class. World Scientific, Singapore
- Schmidheiny S (1992) *Changing course*. MIT Press, Cambridge
- Schmidheiny S, Zorraquin FJL (1996) *Financing change*. MIT Press, Cambridge
- Schmidt-Bleek F (1997) MIPS and factor 10 for a sustainable and profitable economy. Wuppertal Institute, Wuppertal
- SCOPE-Rep. No. 13 (1979) *The Global Carbon Cycle*. In: Bolin B, Degens ET, Kempe S, Ketner P (eds) John Wiley Chichester
- Stockholm Declaration on the Human Environment (1972), in Report of the United Nations Conference on the Human Environment, UN Doc.A/CONF.48/14, at 2 and Corr.1
- Turner G (2014) *Is Global Collapse Imminent?* MSSSI Research Paper No. 4, Melbourne Sustainable Society Institute, The University of Melbourne.
- UN Commission on Science and Technology for Development (2019) *The impact of rapid technological change on sustainable development*. Report of the Secretary-General
- UNCTAD (2015) *Investment policy framework for sustainable development*. United Nations
- Von Weizsäcker EU, Lovins AB, Lovins LH (1997) *Factor four—doubling wealth. Halving Resource Use* Earthscan, London
- WCED (1987) *World commission on environment and development*. Oxford University Press, Oxford New York

**Publisher's Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.