

## SUSTAINABILITY IN THE TWENTY-FIRST CENTURY

In applying the innovative “sustainomics” framework and identifying the balanced inclusive green growth (BIGG) path to achieve sustainability, this book provides a rigorous and practical analysis of sustainable development today. Developed and applied globally over the past 25 years by world-renowned multidisciplinary expert Mohan Munasinghe, sustainomics gives us an optimistic message: although our problems are serious, we can respond effectively by making development more sustainable, but only if we begin immediately to implement the sustainable development goals. Sustainomics shows us the first practical steps in making the transition from the risky business-as-usual scenario to a safe and sustainable future for all. Some key features include: an explanation of the key principles of sustainomics, free of technical jargon; empirical case studies that are practical and policy relevant over a wide range of time scales, countries, sectors, ecosystems and circumstances; annexes that provide mathematical and additional details; and an extensive and up-to-date bibliography to aid further research.

MOHAN MUNASINGHE shared the 2007 Nobel Peace Prize as vice chair of the United Nations Intergovernmental Panel on Climate Change. He is the chairman of the Munasinghe Institute for Development (MIND), Colombo, Sri Lanka, honorary senior advisor to the Sri Lanka government, and distinguished guest professor at Peking University, China. He has implemented international development projects for four decades and is world renowned for transdisciplinary thinking. Munasinghe has taught in many major universities worldwide and won many international research awards. He has authored 110 books and over 350 research papers. He serves on the editorial boards of a dozen journals and is a fellow of many renowned science academies.

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# SUSTAINABILITY IN THE TWENTY-FIRST CENTURY

Applying Sustainomics to Implement the Sustainable  
Development Goals

MOHAN MUNASINGHE  
*Munasinghe Institute for Development*



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Munasinghe Institute for Development  
making development more sustainable (MDMS)

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It's all here! Sustainomics – everything you wanted to know about sustainable development. It's all comprehensible, and the eminent author has provided helpful examples from around the world.

*Professor Thomas Schelling, Nobel Laureate in Economics 2005.*

World-renowned Mohan Munasinghe revives hopes that the global challenge of sustainability can be met. This book clearly describes how the Sustainomics framework he launched at the 1992 Rio Earth Summit bridges disciplinary boundaries to help achieve the UN SDG. Case studies effectively link theory to practice. The bibliography is invaluable. His policy analysis contributed to two major international agreements in 2015: the UN 2030 Agenda and SDG, and the Paris Climate Agreements at COP21. The book is a must-read for all who care for the future of people and planet.

*Professor Vinod Thomas, Former Senior Vice President, The World Bank, and Visiting Professor, National University of Singapore*

This book is an impressive presentation of policy-oriented research. Professor Munasinghe effectively mobilizes a wide array of scientific theories, methods, and tools toward the goal of making development more sustainable. In a trans-disciplinary spirit, but with his feet firmly on the ground and drawing on economic, ecological and social disciplines, he presents well-chosen and eminently practical case studies. Examples ranging from global to local convincingly demonstrate the relevance of his approach.

*Professor J. B. (Hans) Opschoor, Rector, Institute of Social Studies and Professor of Environmental Economics, Free University Amsterdam, the Netherlands*

Sustainomics is a big idea . . . it is a gift, and we should do our best to try to use it well. Munasinghe provides wonderfully clear explanations and enlightening examples of actual development planning analyses . . . readers will leap with him from concept to application . . . invaluable to understand how sustainable development really works and can protect environmental, economic and social values.

*Dr. R. Reibstein, Center for Energy and Environmental Studies, Boston University, USA*

Summarizes advances in theory and practice of new analytical framework of sustainomics. Excellent and diverse case studies . . . well-presented analytical tools, real-world applications, and superb bibliography. Munasinghe is a long-standing champion of sustainable development.

*Dr. A. Seth, Country Director, The World Bank, Washington, DC, USA*

To my grandchildren, Linara (Lena) and Ayaan (Baboo), and their progeny – in the  
fond hope that they will inherit a world that is more sustainable than ours!

## Contents

<i>Foreword by James Gustave Speth</i>	<i>page xi</i>
<i>Preface</i>	<i>xiii</i>
<b>Part I Framework and Fundamentals</b>	<b>1</b>
1 Overview and Summary	3
1.1 Outline of the Book	4
1.2 Rationale and Motivations	10
1.3 Brief History and Summary of Sustainomics	17
1.4 SD Status and SDGs	22
2 Sustainomics Framework	26
2.1 Overview	26
2.2 Basic Concepts and Principles	26
2.3 Key Elements of the Sustainable Development Triangle	35
2.4 Integration of Economic, Social and Environmental Elements	41
2.5 BIGG to Restructure Development for Sustainability	51
2.6 Tools and Methods for Integrated Analysis and Assessment	60
3 Economics of the Environment	73
3.1 Overview	73
3.2 Human Activities and the Environment	73
3.3 Conventional Project Evaluation	74
3.4 Measuring Costs and Benefits	79
3.5 Basic Concepts for Valuing Environmental Costs and Benefits	83
3.6 Multicriteria Analysis	89
3.7 Discount Rate, Risk and Uncertainty	92
3.8 Economywide Policies and the Environment	96
Annex 3.1 Estimating and Using Shadow Prices	106
4 Environmental and Social System Links	111
4.1 Overview	111
4.2 Conceptual Framework Linking Ecological and Socioeconomic Systems	112
	vii

viii	<i>Contents</i>	
4.3	Property Rights, Governance and Ecological–Social Linkages	120
4.4	Sustainable Values and EA and SA	129
<b>Part II</b>	<b>Global and Transnational Applications</b>	<b>133</b>
5	Global Analytical Applications	135
5.1	Overview	135
5.2	Climate Change and Sustainable Development	135
5.3	Applying the Sustainomics Framework to Climate Change	138
5.4	Climate Change Adaptation and Mitigation	149
5.5	Global-Level Interactions between Climate Change and Sustainable Development	153
5.6	GHG Mitigation Prospects in Sri Lanka	158
5.7	Real-Options Framework for Carbon Trading under Uncertainty	174
6	International Process Applications: Multilevel, Multistakeholder, Transdisciplinary Dialogues	181
6.1	Overview	181
6.2	Global Transdisciplinary Scientific Dialogue on Climate Change and Sustainable Development	181
6.3	Sustainable Sri Lanka Vision 2030 Report and Building the National Consensus	186
6.4	Key Policy Actions and 2030 Outcomes	189
6.5	DDP: Multilevel, Multistakeholder Dialogue	203
6.6	DDP Evaluation Results and Conclusions	208
<b>Part III</b>	<b>National and Macroeconomic Applications</b>	<b>217</b>
7	National Economywide Applications	219
7.1	Overview	219
7.2	Historical Evolution of Ideas	220
7.3	Empirical Evidence	223
7.4	Framework for Analysis	227
7.5	Case Study of Brazil – Making Long-Term Development More Sustainable	233
8	Mathematical Macromodel Applications	250
8.1	Overview	250
8.2	Optimal Growth Models and Sustainable Development	250
8.3	Economic and Noneconomic Costs and Benefits of Growth	251
8.4	An Optimization Model: Ecol-Opt-Growth-1	253
8.5	Model Conclusions	256
8.6	Macroeconomic Policies, Second-Best Theory and Environmental Harm	263
8.7	DC Case Studies	266



*Contents*

ix

Annex 8.1	Ecol-Opt-Growth-1 Model	271
Annex 8.2	Second-Best Nature of Macroeconomic Policies When Environmental Externalities Are Present	277
9	Computable General Equilibrium Modeling Applications	280
9.1	Overview	280
9.2	Economywide Cross Effects of Social and Environmental Policies in Chile	280
9.3	Review of Economic, Social and Environmental Issues and Policies	284
9.4	Interactions between Social, Environmental and Economic Policies	292
9.5	Chile Case Study Conclusions	299
9.6	Economywide Policies and Deforestation in Costa Rica	301
9.7	Modeling Approach	304
9.8	Main Findings of the Costa Rica Study	311
Annex 9.1	ECOGEM – Chile CGE Model Summary	316
Annex 9.2	Costa Rica CGE Model Summary	319
<b>Part IV</b>	<b>Sectoral and Resource System Applications</b>	<b>323</b>
10	Energy Sector Applications	325
10.1	Overview	325
10.2	Energy and Sustainable Development	325
10.3	Framework for SED	335
10.4	Applying SED to Power Planning in Sri Lanka	347
10.5	Energy Policy Options	352
10.6	Assessing the Sustainability of Energy Policies in South Africa	357
11	Transport Sector Applications	365
11.1	Overview	365
11.2	Generic Priorities for Sustainable Transport	365
11.3	Health Costs of Air Pollution in Sri Lanka	368
11.4	Traffic Congestion – Economic and Environmental Sustainability	374
11.5	Other Options for Reducing Traffic Congestion	385
11.6	Sustainable Transport Policy in Sri Lanka	396
12	Water Resource Applications	402
12.1	Overview	402
12.2	Hydrological Cycle and Human Actions	402
12.3	Water and Development	406
12.4	Sustainable Water Resources Management and Policy	414
12.5	Management of Groundwater Depletion and Saline Intrusion in the Philippines	419
12.6	Policy Implementation Issues	425

x	<i>Contents</i>	
	12.7 Simple Water Filtration Method for Cholera Prevention in Bangladesh	429
	Annex 12.1 Economic Costs of Producing Water	433
13	Agricultural and Land-Use Applications	436
	13.1 Overview	436
	13.2 Sustainable Management of Tropical Forests	436
	13.3 Valuing Forest Ecosystems in Madagascar	447
	13.4 Sustainable Agriculture and Climate Change	454
	13.5 Climate Impacts on Agriculture in Sri Lanka	457
	Annex 13.1 Models Used for Tropical Forest Valuation	470
14	Sustainable Pricing Policy Applications	473
	14.1 Overview	473
	14.2 SPP for Energy	473
	14.3 Extensions of the Basic Model	480
	14.4 Calculating Economically Efficient Prices Based on Strict LRMC	489
	14.5 Adjusting Efficient Prices to Meet Other Objectives	494
	14.6 Sustainable Pricing of Water Resources	499
	Annex 14.1 Optimal Energy Pricing	505
	Annex 14.2 Demand Analysis and Forecasting	511
	<b>Part V Project and Local Applications</b>	517
15	Project and Business Applications	519
	15.1 Overview	519
	15.2 Small Hydro Projects and SED in Sri Lanka	519
	15.3 Main Findings of the Small Hydro Study	524
	15.4 New and Renewable Energy Projects: Case Study of Solar pv	528
	15.5 Sustainable Rural Electrification Based on Renewable Energy	535
	15.6 Evaluating a Typical Water Supply Project in a Poor African Village	553
	15.7 Sustainable Consumption and Production	561
16	Disaster and Human Habitat Application	570
	16.1 Overview	570
	16.2 Sustainable Hazard Reduction and Disaster Management	570
	16.3 The 2004 Asian Tsunami: A Preliminary Assessment	583
	16.4 Urban Vulnerability, Natural Hazards and Environmental Degradation	595
	16.5 Urban Sustainability	600
	<i>Bibliography</i>	613
	<i>Index</i>	665

## Foreword

Sustainable development is the foremost challenge to humanity in the twenty-first century. It affects every human being on the planet, and therefore, we are all stakeholders. Traditional development has focused on material-based economic growth to overcome problems like poverty, hunger, sickness and inequality. However, despite impressive progress during the past century, especially in the Organisation for Economic Co-Operation and Development and middle-income countries, these issues have grown worse in most of the poorest countries, and even among poorer communities in the industrial world. New challenges like environmental degradation, violent conflicts, climate change and runaway globalization exacerbate existing problems and could make them unmanageable.

At the global level, the United Nations (UN) 2030 Agenda and sustainable development goals universally accepted by all countries, urge early action to reverse these alarming trends. Several thousand leading scientists in the UN Intergovernmental Panel on Climate Change (IPCC) have clearly confirmed that human activities that emit greenhouse gases are leading to potentially catastrophic global warming. Yet, the alleviation of poverty among billions (who eke out their existence on less than one dollar a day) will require continued economic growth in those areas. Maintaining this balance among economic, social and environmental needs is the essence of sustainable development.

The powerful technologies and forces we have unleashed may have increasingly unforeseeable and unmanageable consequences. We need to act with the prudence and wisdom, suggested in Antoine de Saint Exupery's *The Little Prince*:

The fox said to the little prince: Men have forgotten this truth, but you must not forget it. You remain responsible, forever, for what you have tamed.

Therefore, Professor Munasinghe should be commended for writing a comprehensive, concise and clear volume that offers an immediate and practical path for making current development more sustainable by applying the sustainomics framework. He demystifies the complexities of sustainable development with a critical and probing analysis. This book is unique in not only presenting an easily understandable and rigorous conceptual framework, but also illustrating its practical applications using a wide range of empirical case studies.

Mohan Munasinghe first set out the basic principles of sustainomics at the 1992 Earth Summit in Rio de Janeiro. This volume expands on that base, and describes the careful analysis and rigorous testing of the framework during the past 25 years. Key elements of sustainomics include the fundamental approach of “making development more sustainable” (MDMS); the balanced applications of Munasinghe’s widely recognized sustainable development triangle (with social, economic and environmental dimensions); better integration by transcending conventional boundaries (imposed by discipline, space, time, stakeholder viewpoints and operational needs); and practical application of innovative methods and tools throughout the full cycle (from data gathering to policy implementation and feedback). The methodology identifies the balanced inclusive green growth (BIGG) path to sustainability, and is elucidated with a number of practical case studies that are relevant over a wide range of geographic and time scales, countries, sectors, ecosystems and circumstances.

In this book, Munasinghe brings together a wide range of skills. As a respected and award-winning researcher, his analysis is rigorous and well-documented. As a senior decision maker and manager with almost fifty years of experience in the development arena, his advice is eminently practical. Finally, as a veteran university professor with an enviable record of publications, he presents his arguments lucidly and convincingly.

To conclude, this text written by a leading world authority on sustainable development is an invaluable resource for students, researchers, development practitioners, policy analysts, public- and private-sector decision makers and, indeed, all concerned citizens.

**Professor James Gustave Speth**

*Former Dean, School of Forestry and Environmental Studies, Yale University; and  
Former Administrator, United Nations Development Program, NY, USA.*

## Preface

This book is a comprehensively rewritten and up-to-date successor to the original volume, *Sustainable Development in Practice*, published in 2009, which had already reached a wide audience. It is used in university courses worldwide, and the practical methods set out have been applied in many sectors in a range of countries – both in the South and North.

A range of ideas about addressing the complex problems of sustainable development and poverty are set out in this text. Therefore, the reader may find some relevant background information helpful in understanding and interpreting my viewpoint. Physics and engineering were the first loves that sustained me all the way through a PhD. However, the lure of development was hard to resist and led me to concurrently pursue a postgraduate degree in development economics. This focus on the issues of poverty and development has continued ever since, and I have had no cause to regret the choice.

Early work in the development area during the early 1970s, helped me to concentrate on development planning and natural resource management (especially energy and water) – amid the “limits to growth” debate and the first oil crisis. Although the concept of sustainable development was not known at the time, much of this initial work on marginal cost pricing, integrated resource planning and macroeconomic modeling was not only based on sound economic principles, but also included important social and environmental considerations including poverty, equity and externalities. From the mid-1980s, my efforts shifted more toward environmental and natural resource issues and their links with macroeconomic policies and poverty. After the Brundtland report was published in 1987, I focused on getting a better understanding of the new concept of sustainable development.

The core framework of sustainomics was developed from around 1990, and now draws on more than 25 years of direct applications. Thus, much of this book relies on work done since 1990. At the same time, sustainomics also makes use of previous research where the issues, principles and policy options involved are still relevant. Some of the broader development insights, concepts and case studies in this volume are based on almost fifty years of professional work. During this period, hands-on involvement in designing and implementing projects and policies in a variety of countries helped to build up practical experience in development activities. Meanwhile, continuing research and teaching helped sharpen analytical insights. The basic foundation for intellectual growth was of course the

preceding two decades of formal education, as well as subconscious absorption of knowledge while growing up amid the problems of development in Sri Lanka. To summarize, I have learned about development while playing many roles – be it as a student or teacher, researcher or field practitioner, policy analyst or decision maker.

Three major international events that I attended (i.e., the 1992 United Nations [UN] Earth Summit in Rio de Janeiro, the 2002 UN World Summit on Sustainable Development [WSSD] in Johannesburg and the 2012 UN Rio+20 Earth Summit in Rio de Janeiro) provided major impetus for several seminal publications. The first paper (Munasinghe 1992a) set out the conceptual framework for sustainomics, based on the results of a major World Bank research program that I led. In the early 1990s, the vice presidency for Environmentally and Socially Sustainable Development was established in the Bank, with the sustainable development triangle as its official logo. Shortly afterwards, some senior colleagues and I presented an important policy paper on economywide policies and the environment to the Bank’s board of executive directors, proposing policy remedies to address the adverse environmental and social impacts of structural adjustment programs. In 1994, these findings were presented to the world’s finance ministers at a special seminar during the World Bank–International Monetary Fund fiftieth anniversary celebrations in Madrid. Subsequently, my second key paper at WSSD (Munasinghe 2002a) elaborated on the initial sustainomics framework – based on a range of practical applications and lessons learned during the intervening decade. The third key paper (Munasinghe 2011) summarized the decades-long effort I led as vice chair of the Intergovernmental Panel on Climate Change (IPCC) to comprehensively link climate change and sustainable development – which helped the IPCC win the 2007 Nobel Prize for Peace. The fourth paper (Munasinghe 2012) described work on the ‘Millennium Consumption Goals’ campaign that I organized leading up to the Rio+20 Earth Summit and beyond, which successfully culminated in the inclusion of sustainable development goal (SDG) 12 (sustainable consumption and production) in the UN 2030 Agenda.

This work, as well as more recent research and applications based on sustainomics, including balanced inclusive green growth (BIGG), have contributed to two crowning achievements in global policy in 2015 – the 2030 Agenda and SDGs universally accepted at the UN General Assembly (September) and the Paris Climate Agreement at UN Climate Change Conference (COP21) (December).

Clearly, sustainomics is not the creation of one person. Isaac Newton’s classic remark about “seeing further by standing on the shoulders of giants,” is most appropriate.<sup>1</sup> Thus, sustainomics is a practical transdisciplinary framework (or “transdiscipline”) that makes use of my own ideas, as well as many existing concepts, methods and tools developed by others – gladly acknowledged in the text. Such an eclectic approach is necessary because sustainable development is so broadly defined and vast in scope that it cannot possibly be dealt with by any single traditional discipline. Furthermore, there is no need to “re-invent the wheel,” when practical techniques and solutions are already at hand. Chapter 1

<sup>1</sup> Lohne, J. (1965), “Isaac Newton: The Rise of a Scientist,” *Notes and Records of the Royal Society London*, 20: 125–139.

describes the main current rationale for writing this book. However, the original motivation that led to the neologism “sustainomics” was more basic – simply the lack of a discipline or practical framework that focused explicitly on sustainable development problems in a policy-relevant manner.

The first basic principle of sustainomics – making development more sustainable – was a practical reaction to the endless (and ongoing) theoretical debate on the ultimate definition of sustainable development and the inadequate action due to poor leadership from the top. It motivates and empowers those who wish to immediately address urgent issues like poverty and hunger. The second core element – balanced treatment of the sustainable development triangle – was prompted by the lively discussions that took place in the run-up to Rio 1992, about how the “three pillars” (environment, economy and society) might be integrated within development policy. It emphasizes that the sides and interior of the triangle (representing interaction among the three pillars) are as important as the three vertices. The third basic idea of transcending traditional boundaries (of values, discipline, space, time, etc.) has been around for many years, and proved quite appropriate for sustainomics. Finally, the kit bag of sustainomics methods and models includes some key policy-focused tools like the action impact matrix (AIM), issues-policy transformation mapping (ITM) and BIGG tunneling path that were developed specifically in the context of sustainomics. Others, like sustainable development assessment (including cost–benefit analysis and environmental and social assessment), environmental valuation, green accounting, various macroeconomic and sectoral models, etc., were borrowed from other disciplines or adapted from existing material. The empirical case studies are designed to be not only rigorous applications of the theory, but also practical and policy focused. The extensive and updated bibliography should be useful to those who wish to further research specific topics.

A brief word would be appropriate here about the creation of the Munasinghe Institute for Development (MIND) in the year 2000. Working many years abroad within the UN system provided me unique opportunities and insights. Nevertheless, I felt that my understanding of, and contribution to, development would be enhanced by taking early retirement and returning to live and work in Sri Lanka. This is a key decision I do not regret, because the view from Colombo is refreshingly different from the “Washington Consensus” perspective. The outcome was MIND, a small nonprofit research center based in Sri Lanka, whose official logo is the sustainable development triangle, and whose motto is “making development more sustainable.” A balanced South–North partnership built on mutual respect and cooperation is essential to save the planet. To facilitate this process, MIND is building capacity in the South (through training programs, policy discourse, scholarships and grants) and fostering both South–South and South–North collaboration to address sustainable development issues.

During the course of this intellectual journey, I have benefited by associating with a wide range of people, each of whom has contributed generously to my understanding of development issues. While the core framework presented in the first few chapters of this

book are based mainly on my own papers, the case studies have benefited greatly from ideas in selected coauthored publications.

The list of names of the many erudite colleagues I have collaborated with over the years is too numerous to set out here, but among them special thanks are owed to those with whom I have had the privilege of coauthoring journal articles and books that are the sources of material on which parts of this volume are based. They range from students and researchers to eminent experts and Nobel-prize winners. Working with them has enriched my professional growth and deepened my insights into the problems of development. Their valuable contributions are explicitly acknowledged in the relevant chapters. The honor list includes: Kenneth Arrow, Caroline Clarke, Matthew Clarke, William Cline, Wilfrido Cruz, Carlos de Miguel, N. Dassanayake, Yvani Deraniyagala, Chitrupa Fernando, Claudio Ferraz, A. Gajanayake, Sardar Islam, Susan Hanna, Priyangi Jayasinghe, Paul Kleindorfer, H. Karunarathna, Randall Kramer, Isabel Loureiro, Karl-Goran Maler, Jeffrey McNeely, Peter Meier, Robert Mendelsohn, Sebastian Miller, Risako Morimoto, Raul O’Ryan, Annika Persson, V. Ralapanawe, Walter Reid, Niggol Seo, Ronaldo Seroa da Motta, Narendra Sharma, Walter Shearer, Joseph Stiglitz, Osvaldo Sunkel, Rob Swart, Jeremy Warford and Carlos Young.

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Generations of students have helped to sharpen my concepts and logical thinking over the years. I would like to express my gratitude for the valuable feedback provided by students and faculty from the following academic and research institutions where I have given courses or lectures on various aspects of sustainable development in recent years: American University, USA; Asian Institute of Technology, Thailand; Boston University,



USA; Cambridge University, UK; China Meteorological Administration, China; Colombo University, Sri Lanka; Concordia University, Canada; Darmstadt University, Germany; Federal University of Para, Brazil; Federal University of Rio de Janeiro, Brazil; Gotenberg University, Sweden; Groningen University, the Netherlands; Harvard University, USA; Imperial College, UK; Indian Institute of Management Calcutta, India; Indira Gandhi Institute of Development Research, India; Institute of Economic Growth, India; Institute of Social and Economic Research, India; Japan Development Bank, Japan; Keio University, Japan; Massachusetts Institute of Technology, USA; Moratuwa University, Sri Lanka; Oxford University, UK; Peking University, China; Peradeniya University, Sri Lanka; Ritsumeikan Asia Pacific University, Japan; Sorbonne University, France; State University of New York, USA; Stockholm University, Sweden; Tellus Institute, USA; TERI University, India; Tsinghua University, China; UN University, Japan; University College London, UK; University of Barcelona, Spain; University of Cape Town, South Africa; University of Manchester, UK; University of Minho, Portugal; University of Pennsylvania, USA; Wuppertal Institute, Germany; and Yale University, USA.

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All my generous benefactors deserve full credit for their valuable contributions to this book. Any errors, omissions, shortcomings and misinterpretations are my own responsibility. I hope that the book will appeal to a wide audience, including students, researchers, teachers, policy analysts, development practitioners, public- and private-sector decision makers, concerned citizens and stakeholders.

To conclude, sustainomics is a basic framework that needs to be fleshed out. It is like a giant jigsaw puzzle, with some gaps and pieces that do not quite fit. Nevertheless, it does seem to provide a promising and practical start, which is allowing the bigger picture to emerge. My earnest hope is that other potential “sustainomics practitioners” will step forward to rapidly correct any errors, reconcile inconsistencies and fill in the empty spaces in the framework, in the process of moving on toward the ultimate goal of sustainable

development. My final message is hopeful – i.e., although the problems are serious, an effective response can be mounted, provided we begin immediately. Sustainomics can help to show us the first practical steps in achieving the SDGs and making the transition from the risky business-as-usual scenario to a safer and more sustainable future for our children and grandchildren.