Surface Mining Operations in Oil Sands
Surface Mining Operations in Oil Sands

Establishing Sustainable Development Indicators (SDIs)

C.A. Poveda
*University of Alberta, Canada*

&

M.G. Lipsett
*University of Alberta, Canada*
Contents

Preface ix

1 Introduction: sustainable development indicators 1

References .......................................................... 5

2 The surface mining process 7

2.1 Oil and gas resources: overview ............................... 7

2.2 The surface mining operations and the Canadian oil sands ........ 8

2.3 The surface mining process and SDIs ......................... 17

References .......................................................... 19

3 Environmental, economic, social impacts: oil sands, heavy oil, and surface mining projects 21

3.1 Overview .......................................................... 21

3.2 The Canadian oil sands: environmental, economic, social, health, and other impacts .............................. 23

3.2.1 Environmental impacts ...................................... 26

3.2.2 Social impacts .................................................. 32

3.2.3 Economic impacts ............................................. 33

3.2.4 Health and other impacts ................................... 35

References .......................................................... 36

4 Preselecting sustainable development indicators 39

4.1 Introduction ....................................................... 39

4.2 Governmental regulations ....................................... 39
4.3 Committees and organizations for standardization ..................... 42
4.4 Management and processes best practices ............................ 45
4.5 Surface mining industry standards and programs ..................... 48
4.6 Local, regional, national, and international organizations .......... 50
4.7 Academically and scientifically authored resources .................. 54
References ........................................................................... 57

5 Preselection process methodology and indicators .................. 63

5.1 Introduction ..................................................................... 63
5.2 Preselection process methodology description ...................... 64
5.3 Preselected SDIs for surface mining operations in the oil sands projects ......................................................... 66
  5.3.1 Preselected SDIs distribution ..................................... 66
  5.3.2 Areas of excellence and preselected SDIs ...................... 71
References ........................................................................... 72

6 Sustainable development indicators description .................. 73

6.1 Introduction ..................................................................... 73
6.2 Project and Environmental Management Excellence .............. 73
6.3 Site and Soil Resource Excellence ...................................... 75
6.4 Water Resource Excellence .............................................. 76
6.5 Atmosphere and Air Resource Excellence ............................ 78
6.6 Natural and Artificial Lighting Excellence ............................ 78
6.7 Energy Resource Excellence ............................................. 78
6.8 Resource and Materials Excellence .................................... 79
6.9 Innovation in Design and Operations Excellence .................. 79
6.10 Infrastructure and Buildings Excellence ............................. 80
6.11 Education, Research, and Community Excellence .............. 81
Reference ............................................................................. 86
7 The Canadian oil sands: sustainable development indicators and the surface mining operations 87

7.1 Introduction .................................................... 87
7.2 Applicability ................................................... 88
7.3 Usefulness ..................................................... 90
7.4 Cost ........................................................... 92
References .......................................................... 93

8 Measuring sustainability of the oil sands projects: introducing the WA-PA-SU project sustainability rating system 95

8.1 Introduction .................................................... 95
8.2 Alberta’s oil sands: brief history ............................... 97
8.3 The case for sustainability ....................................... 99
8.4 Sustainability assessments and sustainability-environmental rating systems as decision-making tools ....................... 101
8.5 The need for a sustainability rating system for the oil and gas industry ......................................................... 103
  8.5.1 Are environmental regulations enough? .................... 104
8.6 Canada: the oil sands and sustainable development .............. 104
8.7 Introducing the sustainable rating system and its benefits .......... 105
  8.7.1 Origins and definition ....................................... 107
  8.7.2 The name and logo .......................................... 107
  8.7.3 Subdivisions, areas of excellence, and criteria ............... 108
  8.7.4 Sustainability assessment methodology ..................... 110
  8.7.5 Expected benefits .......................................... 111
  8.7.6 Introduction to industry and future steps .................. 111
References .................................................................. 112

Appendix A. Definitions and acronyms 115

Index 121
Preface

The exploration and exploitation of alternative energy resources is increasing along with world energy demands. If the pace of population growth and specific energy consumption continue at the current rate, then the present level of energy generation cannot meet the needs of future generations. While some technologies for unconventional and alternative energy production are still in the research and development phase, some have been effectively implemented, although some forms of energy are not available at a price that is competitive without government subsidies. (It can of course be argued that many forms of conventional energy are subsidized directly and indirectly.) The impacts of different energy operations are still being debated, with respect to environmental, social, economic, and health effects, and there is no consensus on the overall costs to human society of particular forms of primary and secondary energy production.

The definition of sustainable development adopted by United Nations (UN) uses the expression “… meets the needs of the present …” to indicate the required development by a current generation to maintain its standard of living while minimizing environmental, economic, social impacts. A variety of challenges arise in this regard with the development of large industrial operations, including oil and gas, mining, hydroelectric projects, and other projects that have significant impact. Large projects development will affect a range of stakeholders and may entail cultural and political change. The level of impacts and their implications depends on many characteristics of the development, such as its size, production rate, duration of exploitation, processes used (including treatment of waste streams), and regulatory standards. Some technologies are readily scalable, and their impact can become globally significant, e.g., energy consumption related to computer server farms. While local communities, businesses, and surrounding areas are first expected to be impacted, certain developments can attract global attention. Canadian oil sands developments are of interest to oil producers because of the size of the proven reserves; but the scale of development and the perceived enduring impacts are of concern to different stakeholders.

Since the first time Europeans saw bitumen from the largest source of petroleum in Canada, almost 300 years have elapsed. A sample of bituminous oil sands is shown in Fig. 1. The Canadian oil sands represent one of the largest deposits of oil—places third after Saudi Arabia and Venezuela—with 170.4 billion barrels of
recoverable oil using available technology under current economic conditions; however, the potential recoverable oil from the deposit reaches 315 billion barrels with today's technology. About 20% of the oil sands can be extracted by mining, making the surface mining operations in Northern Canada some of the largest in the world.

Surface mining projects are complex operations with several social, economic, environmental, and health impacts. As the government and oil sands developers are turning toward increasing productivity with a more conscious sustainable development approach, a preselection of sustainable development indicators (SDIs) is required to assist further formal multicriteria selection processes.

In conjunction with the evolution in extraction practices and technologies, public perception and involvement has to drastically switch to a more environmentally conscious generation. The practices of companies developing a nonrenewable resource, and companies constructing the facilities, continuously evolve to meet stakeholder expectations. Standards and regulations are met (or exceeded) not only to satisfy government and nongovernment organizations, but also with the aim of reducing the different impacts that arise from the development of the projects. Minimizing negative impacts and guaranteeing the sustainability of a project are not assured by meeting regulatory requirements alone; and so practitioners must be supported with additional tools and set the parameters (indicators) for meeting internal targets for a balanced scorecard that meets a triple bottom line of economic, environmental, and social benefits, while meeting or exceeding the legal requirements of the jurisdiction where operations take place.

In the continuous improvement process after developers and constructors have met a set with a wide range of regulations and standards, the next step is to make an industrial facility more sustainable. Furthermore, the development of appropriate tools—which may include a set of indicators to measure the sustainability of these projects—is essential for developers and operators to meet the present and future needs of a project. This entails demonstrating compliance and excellence in performance through implementation of enhanced strategies to mitigate environmental, social, health, and economic impact.

Measuring performance is not a new concept; however, measuring sustainable development and sustainability performance has been a tough challenge for academics and practitioners. Different sets of indicators can be found to measure sustainability as result of implementation of different practices, processes, and procedures. SDIs can be found within currently existing approaches, strategies, models, appraisals, and methodologies for environmental and sustainability assessment.

Conceptually, the design and implementation of SDIs brings together different stakeholders toward finding the balance among economic, social, and environmental development. But questions surround SDIs for the assessment of sustainability
of a project (for instance, a surface mining operation) or an entire industry (such as integrated oil and gas production networks):

1. What is the correct number of SDIs to use?

2. Are the indicators truly measuring sustainability?

3. How the indicators were selected and how do you know that they are the right ones?

4. Which metrics are to be used to measure the SDIs?

In general, members of the international scientific and engineering community, practitioners, and government policy-makers are in ongoing debate regarding the principles of sustainability and its measurability. Sustainability is a concept widely known but not necessarily accepted; however, sustainability becomes a strategic concept for organizations to obtain the “social license” to operate and for government officials to demonstrate their commitment with their constituents. It is thus critical that there is common understanding of what sustainability means in a given industrial context. Often, the most sustainable technology option has high economic and social benefit while creating the least environmental impact on an overall lifecycle basis. A technology based on nonrenewable resources is, by definition, not sustainable in the broadest sense. But sustainability metrics allow improvements to occur or can at least form the basis for rational discussion.

Individual efforts have been made to establish a set of SDIs by companies that are developing large-scale technologies; and regulatory systems (in some way predecessors of SDIs) require certain levels of investment to meet a minimum level of performance, particularly on environmental grounds. But large industrial projects (such as oil sands projects, which include surface mining operations) do not have a comprehensive set of SDIs to benchmark sustainable performance and measure sustainable development. Questions remain regarding the rate at which extractive industry companies align with more sustainable practices, whether it is the applicability of SDIs, their degree of usefulness, or the costs of development and implementation of SDIs, or other factors.

The creation of the World Commission on Environment and Development (WCED)—commonly known as the Brundtland Commission—and the publication in 1987 of its report, “Our Common Future,” marked a turning point toward finding the balance among society, economy, and environment. Since then, governments have improved existing regulations (or created others); organizations for standardizations have developed new standards; management and process practices have addressed potential gaps in motivating people to consider sustainability as part of business practices; public and private organizations have taken initiative through the creation of committees and programs; and research covering all areas of
Figure 1: **Oil sands sample.** The oil sands is a naturally occurring mixture of sand (50–75%), clay or other minerals (10–30%), water (2–10%), and bitumen (3–18%), which is a heavy and extremely viscous oil that must be treated before it can be used by refineries to produce usable fuels such as gasoline and diesel. *Photo courtesy of Suncor Energy.*

sustainable development has become a priority for many academics and practitioners. These different sources serve as the basis for a preselection process of SDIs.

While some sources do not specifically address certain industries, the preselection process presented in the present work studies and analyzes each SDI’s resource and the possible applicability of already identified indicators. An assertive
set of SDIs is not solely based on regulatory systems, as measuring sustainability cannot become a bureaucratic process, and neither can any other SDI source single-handedly determine or mandate the final set of indicators, because the real objective is to assist decision-makers and effectively engage stakeholders. This book presents an analysis of six different sources for preselecting SDIs, accompanied by a methodology, and concludes with a set of SDIs offered for surface mining operations in oil sands projects.

C.A. Poveda
M.G. Lipsett