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Towards Sustainability in the Oil and Gas Sector: Benchmarking of Environmental, Health, and Safety Efforts

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ABSTRACT: The environmental, social and climate change issues that face the world today have all industries considering how they will address sustainability in the future. The purpose of this paper is to evaluate the maturity of environmental, health and safety (EHS) efforts and progress toward sustainability in the oil and gas sector. Ten major oil companies have been analyzed based on public information including their published annual reports. Companies refer to voluntary initiatives when reporting their performance yet the assessment suggests that the sector overall continues to make progress and is maturing in its sustainability efforts. Many management system gaps were found that leave companies within this sector far from sustainable production and from being leaders in EHS Management. Most companies are still using lagging metrics and this is reflected in the activities implemented by companies. The sector's EHS management status is found to be in the high middle/medium level of maturity but with significant gaps in performance.. This means that the sector has made progress from simply embracing sustainability towards a commitment to addressing sustainability issues, but still has progress to make particularly in compliance with the Clean Air Act, spill and process management.

I. KEY WORDS

Environmental Health and Safety Management, LCSP indicator framework, Leading and Lagging indicators/metrics, Oil and gas industry/sector, Sustainability, Sustainability reporting

II. INTRODUCTION

The oil and gas sector has grown significantly over recent years, making it important for the sector to implement serious changes in the way it does business. This sector is among the largest in the world, with increasing revenues and costs necessary to provide customers with the energy that they require in maintaining their style of living (American Petroleum Institute 2014). Oil and gas operations involve both upstream activities, including all processes before the raw material is refined; exploration, drilling, extraction, storage, shipping, etc., and downstream activities, which involves the refining, selling and distribution of the product. Due to the nature of these activities which engender high risks, companies work continuously to reduce the significance of their adverse impacts on the environment and people (Schneider, Vargo, & Campbell 2011). The industry has had a checkered past, evidenced by high profile issues like the Santa Barbara oil spill in 1969 in California and Deep water Horizon disaster in the Gulf of Mexico in 2010. Further, companies in the sector were behind major environmental and human rights controversies in many regions in the world. In the early of 1990s, the operations of Shell Company in the Niger Delta in Nigeria resulted in the pollution of the river and tensions with local citizens of the Ogoni region. In 2003, Indigenous residents in Ecuador filed a lawsuit against Chevron for the pollution of Amazon rainforest, and the impact of that on their health. In the last few years, the sector has made steps in advancing toward sustainability.

Companies in the sector have been reporting their sustainability efforts - also referred to as “corporate citizenship or environmental, social and governance (ESG) reporting” (IPIECA, API, & OGP 2010). This inventiveness has become an integral part of the way individual companies choose to engage stakeholders and help foster informed dialogue and understanding (IPIECA, API, & OGP 2010). Of the ten companies examined in this study, eight have membership with The Global Oil and Gas Industry Association for Environmental and Social Issues (IPIECA): British Petroleum, Chevron, ConocoPhillips, Eni, ExxonMobil, Marathon Oil, Shell Global and Total Oil Company. The other two companies included in this study are Sonatrach and Weatherford International. Therefore, our analysis examines the available information for ten of the recognized oil and gas companies. The majority of these companies were chosen based upon their large size and significant potential impact to our world. Two of these companies (Marathon Oil and Weatherford) were relatively chosen to represent the smaller concern, and to show whether regional, national concerns follow the trends in the major companies.

Although this paper focuses on the upstream operations, it is important to note that the companies engage in all phases of the oil business, which encompasses production, transportation, refining, and marketing. The companies assessed in this study are at varying levels of maturity in regards to sustainability.

Establishing the groundwork for sustainability is a task that will take discipline and commitment from all stakeholders. One of the ways to successfully implement a sustainability charter is through the effective reporting of EHS aspects and impacts. While reporting is voluntary, however, membership in oil and gas associations creates an expectation

of public reporting (IPIECA 2014). Furthermore, the IPIECA in collaboration with the International Association of Oil and Gas Producers (OGP) confirms that “huge amounts of publicly available information are published by oil and gas companies on their environmental and social performance”, and that the energy sector only lagged behind the financial services sector in participation in the Global Reporting Initiative (GRI) (OGP 2012). There are many organizations that are committed to promoting the practice of sustainability reporting, that follows the IPIECA, API and OGP Oil and Gas guidance, including the African Refiners’ Association (ARA); Regional Association of Oil and Gas Companies in Latin America and the Caribbean (ARPEL); the European Association for environment, health and safety in refining and distribution (CONCAWE); Canadian Petroleum Products Institute (CPPI); and the South African Petroleum Industry Association (SAPIA) (OGP 2012). There is an inherent need for guidance on sustainability reporting to drive an industry that builds on the present and secures the future; as such, this paper examines the state of EHS Management in this sector. Our methodology seeks to understand whether those companies that profess voluntary excellence actually achieve it, and whether policies are reflected in results. Along the way, we also look for trends in word, deed and result and ask whether the sector is living up to the day to day operational expectations that we, as a society, should have for them. Thus, there is a conversation about how EHS management systems are conceived and operationalized in the oil and gas sector. The Lowell framework discerns maturity of the EHS Management systems. This will be discussed in greater detail later in the paper.

In this study, ten major oil and gas companies’ sustainability and EHS policies are analyzed. The analysis considered the EHS mission and vision statements, reported metrics and legal compliance

and related EHS actions to evaluate overall EHS maturity. Note that although GHG emissions are one of the major environmental impacts of the oil and gas sector, these impacts will not be addressed in this paper.

III. COMPANY PROFILES

In order to better understand the landscape of the sector, basic company information and the company selected actions to address EHS challenges are highlighted in this section.

III.I. BRITISH PETROLEUM

(Based in the United Kingdom, 83,900 employees, net profit = \$13.4B) (British Petroleum 2014a)

Safety: British Petroleum implemented an operating management system that incorporates the company requirements in terms of EHS, social responsibility, operational reliability, contractor management, and other relevant issues. Moreover as a result of the Deepwater Horizon internal investigation, the investigators recommended 26 tasks to reduce risks and enhance operational safety in drilling activities. By the end of 2013, British Petroleum had addressed 15 out of the 26 recommendations. (British Petroleum 2014b)

III.II. CHEVRON

(Based in the United States, 64,550 employees, net profit= \$21.4B) (Chevron 2013):

Environment: Chevron had reduced their greenhouse gas emissions intensity by 0.7 metric tons of CO₂ per 1,000 barrels at the upstream operations and by 0.4 metric tons of CO₂ at the downstream ones in 2012. However, they had recorded 232 spills with a volume of 3,092 barrels

of oil in 2012 and 274 releases in 2011. (Chevron 2013) Thus, they introduced a new certified program called WELLSAFE to keep well control processes maintained and reduces the number of spills during drilling operations.

III.III. SHELL GLOBAL

(Based in the United States, 92 thousand employees, net profit = \$16.7B) (Shell Global 2013):

Environment and technology: The Shell Company has made significant steps to improve its environmental and technological performance. As of 2013, Shell started to use a Green stream barge, which uses Liquefied Natural Gas (LNG) as fuel, to transport diesel, oil, and unleaded petrol to Netherlands, Belgium, Germany, and Switzerland. (Shell Global 2013)

III.IV. 2.4 ENI

(Based in Italy, 82,289 employees, net profit = \$11.8B) (ENI 2013)

Fatal work-related accidents: ENI has recorded a significant number of fatal accidents involving its staff and contractors in 2011 and 2012. (ENI 2013) Subsequently, the company launched the “ENI in safety” program for the training and awareness of its employees and contractors in order to achieve the zero fatalities target.

Oil spills and Remediation: Oil spills continued to character the operations of the company in Congo, Egypt, Nigeria and Algeria in 2012. To face this issue, ENI plans to improve its emergency response performance and capabilities. Many remediation activities have been already undertaken especially in Nigeria for the recovery of hazardous waste. In addition, the company is engaged in the Coastal Oil

Spill Improvement program (COSPIP) and IPIECA West, Central, and Southern Africa (WACAF) Global Initiative to develop strategies for oil spills prevention.

III.V. EXXONMOBIL

(Based in the United States, 76 thousand employees, net profit = \$32.6B) (ExxonMobil 2012)

Occupational Health & Training: In most recent times, ExxonMobil has initiated a new committee for infectious disease to control disease that may affect workers and communities such as malaria, dengue fever and cholera particularly in tropical climate countries. With regards training, the company’s Procurement Sustainability Network trained more than 200 employees about procurement sustainability in 2012. (ExxonMobil 2012)

III.VI. MARATHON OIL

(Based in the United States, 33,647 employees, net profit = \$1.75B) (Marathon Oil 2012):

Emergency Preparedness: Marathon Oil developed an internal management system named Global Performance System (GPS) to enhance its EHS and social responsibility performance and meet regulatory compliance. (Marathon Oil 2012) Although the company has regional and local response teams, it still faces challenges in placing teams in all the sites. Moreover, they admit struggle to implement the recommendations from the investigations of the past critical accidents in the drilling operations.

III.VII. SONATRACH

(Based in Algeria, 59,767 employees, net profit = \$10.36B) (SONATRACH 2010):

Environmental Impacts: Sonatrach being the largest oil and gas company in Algeria and Africa, its exploitation and exploration has had increasing environmental impacts. The biggest priority for the company is reducing emissions of greenhouse gases and any other air pollutants. The company has embarked on a campaign to eliminate the majority of gas flaring since 2010, and significant investments have been made toward this target. Although the volume of produced flaring gas has quadrupled in 30 years, the ratio of associated flared gas out of produced gas has moved from 80% in 1970 to 7% in 2007. (SONATRACH 2010)

III.VIII. CONOCOPHILLIPS

(Based in the United States, 16,900 employees, net profit=\$9.2B) (ConocoPhillips 2013):

Emergency Preparedness: Oil spills are a significant issue for companies including ConocoPhillips, in the oil and gas sector. In 2011 there was the 700 barrel spill in north China's Bohai Bay. (ConocoPhillips 2013) The company advanced trained and capable emergency responders and established a Global Incident Management Assist Team (GIMAT).

III.IX. TOTAL OIL COMPANY

(Based in France, 97,126 employees, net profit=\$14.1B) (Total 2012a)

Environment: Introduced in 2009, Total Ecosolutions is a flagship program to promote smarter, more frugal energy consumption, by cutting natural resource use and/or environmental impact while providing the same level of service. In 2012, Total Ecosolutions products and services avoided 740,000 metric tons of CO₂ emissions (on the whole life cycle). (Total 2012a)

III.X. WEATHERFORD INTERNATIONAL

(Based in Switzerland, 67 thousand employees, net profit=\$8 B) (Weatherford 2012)

GEMS Project: As the number of recordable incidents continued to rise, Weatherford reviewed its management system and EHS projects such as the "Getting Everyone Managing Safety" (GEMS) program to improve their safety performance. A new version of GEMS program was introduced to change the safety culture within the company, and prevent the occurrence of injuries at work by the end of 2012. (Weatherford 2012)

IV. ANALYSIS OF EHS CORPORATE POLICIES/VISION/MISSION

An EHS policy is the foundation of the whole EHS management systems and it specifies the goals that the organization is prepared to undertake with commitment to continual improvement, compliance with laws and regulation, pollution prevention, and prevention of injury and illness.

The authors were able to access the published policy statements or vision and mission statements of six out of the ten companies assessed. These are ExxonMobil (ExxonMobil 2014), British Petroleum (British Petroleum 2014c), Weatherford (Weatherford 2007), Sonatrach (Sonatrach 2013), Marathon Oil (Marathon Oil 2012), and Shell (Shell 2009). These statements show that there are commonalities among EHS commitments of these companies. For health and safety, companies are dedicated to provide a safe workplace by protecting the employees, managing the risks, and communicating the risks to internal and external stakeholders. For example, ExxonMobil pledges to manage safety by managing operational risks and respond to emergencies, preventing incidents,

and conduct business safely. BP considers the prevention of accidents and prevention of harm to people. With regards to environment, companies seek to make their business activities compatible with the environment. For instance, Shell envisions the protection of environment, the minimization of energy and resource use, and open communication with general public. Sonatrach also considers environmental stewardship, product compatibility, resource conservation, and communication with the public. Therefore, companies in the oil and gas sector have vision and mission statements that focus on reduction and communication of all EHS risks.

V. MAPPING E, H & S LEADING AND LAGGING METRICS/INDICATORS OF SECTOR

Given the corporate policy statements described above, it is interesting to examine whether the EHS indicators and metrics of performance and related actions match the corporate policies. Indicators are measures of corporate impacts and metrics report the trajectory of such impacts, whether or not the corporation is progressing toward its targets in a particular area. This performance information is highlighted in the company's Corporate Responsibility and Sustainability Reports and in Annual Reports. Companies are adhering to the consistent recording of some of the more common metrics such as total recordable incident

Table I: Mapping EHS metrics based on those reported in 2012 Annual Corporate Responsibility Report for Each Company.

Company	Country	Metrics Reported																															
		Environment										Health and Safety																					
		Oil Spills (Hydrocarbon spills)	GHG Emissions	Controlled Hydrocarbon discharge	CO ₂ /NO _x /SO _x /VOC/PM Emissions	Total Hazardous waste Disposal	Freshwater consumption/withdrawal	Wildlife protected/remediation	Environmental Expenditure	Hydrocarbon flaring	Cogeneration /energy use /performance	Volume of recovered Hydrocarbon spill	Volume Wastewater treated/discharged	Recycled/reused water	recycled/reused/recovered treated hazardous waste	Volume of non & hazardous waste	Number of blow-outs	Fines and settlements	Total number of recordable incident rate (TRIR)	Days Away, Restricted and Transferred (DART)	Lost-time incident rate/frequency (LTIR)	Fatalities	Fatal accident rate	Total recordable case frequency (TRCF) injuries	Rate of occupational illnesses/professional illness reported	Days away from work rate (DAFWR)	Audits on Health and Safety	Training hours on safety	On-Time implementation of employee ideas	Lost Time injury frequency/rate(LTIF) - injuries	Motor Vehicle safety - Vehicle incidents	Tier 1,2,3 Process Safety events - number/Near misses/LOPC	
British Petroleum	United Kingdom	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Chevron	United States	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
ConocoPhillips	United States	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
ENI	Italy	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
ExxonMobil	United States	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Marathon Oil	United States	✓	✓		✓			✓	✓	✓								✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Shell Global	United States	✓	✓		✓	✓			✓	✓								✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Sonatrach	Algeria	No data available for 2012																															
Total	France	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Weatherford International	Switzerland																		✓	✓													

(*note this is not all the metrics that is available out there, but as many as was possible is provided to give an overview of some companies in the sector)

rate (TRIR), lost-time incident rate (LTIR), oil/hydrocarbon spills and the various criteria and non-criteria air emissions. Metrics used by the ten sampled companies available in their 2012 Annual Reports are summarized in Table I.

It shows that most companies have adopted their metric reporting standards based on the International Petroleum Industry Environmental Conservation Association (IPIECA), the International Oil and Gas Producers Association (OGP) and the American Petroleum Institute (API) Oil and Gas Industry Guidance on Voluntary Sustainability Reporting (2010) with additional indicators referenced from the Global Reporting Initiative (GRI) G3.1 Sustainability Reporting Guidelines (GRI 2011). There were inconsistencies in metrics reported by

the ten companies. Some companies use various metrics to report their performance in a single EHS aspect like air emissions and waste management, whereas other companies do not report any metric related to these aspects. The metrics that were frequently reported by most companies within the sector in their sustainability and annual reports are: Oil Spills, GHG Emissions, CO₂/NO_x/SO_x/VOCs. Total number of recordable incident rate (TRIR), Lost-time incident rate/frequency (LTIR), and fatal accident rate as illustrated in the Table V.

This progress marks the shift in the EHS reporting by companies from ensuring legal compliance toward sustainable production in the sector, however, there is still a focus on lagging metric reporting, even within these voluntary initiatives.

Table II: 2012-2013 Reported Common EHS Metrics (per Sustainability Report)

Company	Country	Common Metrics Reported										
		Environment							Health and Safety			
		Product Throughput	GHG Emissions	Oil Spill Volume	CO ₂ Emissions	NO _x Emissions	SO _x Emissions	VOC Emissions	Total Number of Recordable Incident Rate (TRIR)	Lost-time Incident Rate (LTIR)	Fatal Accident Rate	
British Petroleum	United Kingdom	3.1	49	4.4	41.73	0.13***	0.041***	Not Reported	0.31	0.070	0.016	
Chevron	United States	3.5	56.3	0.03	364	0.15	0.12	0.180	0.24	0.14	1.48	
ConocoPhillips	United States	1.5	33,090*	0.03	25.8	0.11	0.009	0.098	0.29	0.07	Not Reported	
ENI	Italy	1.6	47.30	7,221 Billion	47.61	0.12	0.03	0.04	1.04	0.35	0.98	
ExxonMobil	United States	5.3	22.3**	8.7	125	0.14	0.13	0.2	0.33	0.045	0.010	
Marathon Oil	United States	0.4	4.92	4.6	Not Reported	0.19	0.005	0.03	0.66	Not Reported	0	
Shell Global	United States	4	83	6.5	64.41	0.16	0.09	0.089	1.15	0.36	0.79	
Sonatrach	Algeria	2.19	Not Reported									
Total Oil	France	2.6	47	11.32	Not Reported	0.091	0.075	0.11	1.6	0.9	0.021	
Weatherford International	Switzerland	Not Reported							0.6	0.16	Not Reported	
Units: Product Throughput in million barrels of oil equivalent/day GHG Emissions in million tons CO ₂ equivalent (*) In metric tons per million metric barrel of oil. (**) In metric tons per 100 metric tons of throughput Oil Spills volume in thousand barrels of oil CO ₂ emissions in million metric tons NO _x , SO _x , and VOC emissions in million metric tons (***) in million tons CO ₂ equivalent												

The analysis of reported metrics shows also that some companies do not set metrics that reflect their vision and mission in terms of accident and illness prevention or the protection of environment. For example, Sonatrach did not report any EHS metric although they stated in their policy that they aim to protect their human and material integrity. Weatherford did not adopt the full extent of a report to include environmental performance. Furthermore, the common metrics among the oil and gas companies studied in this work are primarily lagging indicators which would include, but not limited to, LTIR, TRIR, and GHG emissions. Therefore, more needs to be done in adopting leading indicators for this sector, and this is further discussed in the following section about EHS management maturity.

VI. COMMON EHS FINDINGS AND ISSUES IN THE OIL AND GAS SECTOR

Table III provides a synopsis of the major areas that are plaguing this sector. Significant issues include: emissions, process safety, protecting the environment and personnel, and sustainability.

Based on the reported/recorded metrics of oil and gas companies in this study (British Petroleum 2014a; Chevron 2013; Shell Global 2013; ENI 2013; ExxonMobil 2012; Marathon Oil 2012; ConocoPhillips 2013; Total oil 2012a; Weatherford 2012), it was found that they encountered issues

with the safety of their processes, and protecting the integrity of their physical and human resources, as well as the prevention of accidental discharge of hazardous and non-hazardous chemicals. Hence, companies in the sector have had to spend significant amounts on trying to manage these issues. For example, to deal with oil spills Weatherford spent in 2013 approximately 67 million USD on remediation activities and 2,500 USD as fines and penalties for non compliance with environmental regulations in the United States (Weatherford 2014). Furthermore, process safety is noted as a major concern. Further, British Petroleum, BP experienced a catastrophic accident in the Gulf of Mexico and resulted in the suspension of operations on 11/28/2012 (OSHA 2012). These EHS issues were behind many citations and legal implications for the companies in the sector, and the following section provides further details.

VII. COMPLIANCE

Companies working in the oil and gas sector have received many citations by the federal agencies in the United States, due to the noncompliance with the EHS laws and regulations. Due to the lack of data in terms of legal citations internationally, this analysis will focus only on those issued by the U.S agencies while operating in the U.S. The analysis of these citations shows that the violations vary in terms of severity and level of enforcement. Serious

Table III: EHS common issues in the oil and gas sector.

EHS management	Issues
Environmental management	Managing Hazardous and Non Hazardous Waste
	Managing air emissions
	Spills
Health management	Industrial hygiene monitoring
Safety management	Energy and Process Control Issues
	Training of the workforce (lack of follow up)
	Human injuries and incidents

violations of federal or state standards frequently result in penalties and lawsuits against companies. Table IV summarizes six citations analyzed for serious violations of the EHS laws and regulations in the United States between 2008 and 2014. The information was obtained from public listings from EPA in the Enforcement & Compliance History Online (ECHO) database and in the OSHA Establishment Search database (EPA ECHO 2014; OSHA Establishment 2014)

A review of citations in Table IV reveals that the most common citation is for non-compliance with the Clean Air Act. Non-compliance occurs when the company does not adhere to the air emissions levels prescribed by the EPA or for running facilities

without a permit. Oil spill incidents are another growing concern of this sector. It is common for companies to be fined for violations as well as be responsible for clean-up costs.

There were also serious process safety management violations as well as personnel safety citations. Some of the violations included; lock out-tag out, emergency preparedness and response, and operating procedures, industry illness prevention and respiratory protection programs. For example in 2012, BP was cited with 70,000 USD for the violation of process safety regulations in the Horizon accident. Similarly, Chevron was fined 2 million USD for the violation of the Clean Air Act.

Table IV: EPA and OSHA Citations for Oil & Gas Companies in the U.S. from 2008 – 2014

Violation Date	Location	Violation Type	Penalty amount	Standard cited/ Primary Law & Section
Company: British Petroleum				
10/29/2009	Texas City, TX	Willful	\$70,000.00	29 CFR 1910.119(j)(5) Process Safety Management of Highly Hazardous Chemicals
11/30/2009	Texas City, TX	Willful	\$70,000.00	29 CFR 1910.119(d)(3)(i) Para. A-H Process Safety Management of Highly Hazardous Chemicals
11/28/2012	Houston, TX	Suspension	\$70,000.00	29 CFR 1910.119 (f)(1)(ii) Process Safety Management of Highly Hazardous Chemicals
Company: ConocoPhillips				
11/14/2011	Ponka City, OK	Serious	\$5,000.00	1910. subpart D Working Surfaces
04/20/2010	Rodeo, CA	Other	\$ 5,000.00	5189 F01 A Process Safety Management of Acutely Hazardous Materials
Company: Exxon Mobil				
03/14/2011	Baton Rouge, La.	Serious	\$126,600.00	29 CFR 1910.37(b)(4) Emergency Preparedness

Violation Date	Location	Violation Type	Penalty amount	Standard cited/ Primary Law & Section
04/04/2013	Baytown, Tx	Serious	\$7,000.00	19100147 D04 I Control of hazardous energy (lockout/tag out)
05/15/10	Honolulu	Judicial	\$2.4 million	Clean Air Act
Company: Chevron				
01/30/2013	Richmond, Cal	Serious Willful	\$70,000.00	3203(a) (2). California Injury and Illness Prevention Program
01/30/2013	Richmond, Cal	Serious Willful	\$70,000.00	8CCR 5144(c)(1)(D) California Respiratory Protection Program.
01/30/2013	Richmond, Cal	Serious Willful	\$70,000.00	8 CCR 5192(q) (2). Emergency Response to Hazardous Substance Releases.
04/15/2013	Richmond, Ca	Formal enforcement	\$2 million	Clean Air Act
Company: Shell Global				
02/27/2012	Deer Park, TX	Serious	\$5500	5A0001 OSH Act General Duty Paragraph
08/14/2012	Anacortes, WA	Serious	\$4500	0670002102 Written Operating Procedure Requirements
09/05/2013	Alaska	Enforcement action	\$710,000	Clean Air Act (CAA)
Company: Weatherford International Ltd.				
12/30/2011	Pecos, TX	Serious	\$4,000.00	19100304 G05 Wiring design and protection
11/26/2008	Santa Paula, Ca	Serious	\$22,500.00	California General Industry Safety orders, chap.13, art.199
09/05/2013	Houston, TX	Administrative / Formal enforcement action	\$2,500.00	Clean Water Act / §301/402

VIII. CONTROLS FOR COMMON EHS ISSUES

Various controls are used by companies to mitigate the impact of problems and reduce their frequency. The intent is to eliminate the root causes of those issues or minimize the exposure of humans to the hazard's sources. The human component is an essential part of operations in the oil and gas sector, so importance

for the training and competency of the workforce is stressed. Moreover, medical checks, workplace monitoring, and awareness are the controls used to prevent occupational illness. Due to intensive air emissions from the oil and gas operations, companies shift from continuous flaring processes and activities to the on-demand flaring technologies. The below table summarizes the controls implemented to mitigate the impact of the common issues in the sector.

Table V: Major EHS issues and their relevant controls in the Oil and Gas Sector

EHS	Issues	Controls
Environment	Managing Hazardous and Non-Hazardous Waste	1. Monthly waste analysis plan; 2. Inspection and audits; 3. Train the workforce.
	Managing air emissions	1. Eliminate continuous flaring processes and replace them with on-demand flaring technologies; 2. Setup controls that capture the co2 and sulfur dioxide emissions.
	Spills	1. Storage of chemicals in free of damage recipients; 2. Provision of secondary containment for tanks and storage recipients; 3. Emergency preparedness plans for the spills & training of personnel.
Health	Industrial hygiene monitoring	1. Baseline industrial hygiene survey for all activities. To determine workplace hazardous. 2. Mandatory medical check every year or before resuming work from an accident; 3. Monitoring and controlling workplace conditions (noise, heat, etc.); 4. Awareness of employees about specific health issues resulting from each activity; 5. Use of personal protective equipment.
Safety	Human injuries and incidents	1. Automation of highly hazardous tasks; 2. Setting up safety barriers on the hazardous parts of the processes; 3. Restriction of access into hazardous areas for unnecessary/unauthorized workers; 4. Training and supervision of workforce; 5. Use of personal protective equipment.
	Training of the workforce (lack of follow up)	1. Planning a training program that incorporates all workforce in individual facilities, and training refreshment 2. Implementation of competency assessment program that assess among many things, the effectiveness of training on the worker's performance using different methods of assessment (observation, simulation, written assessment, etc.
	Energy and Process Control Issues (Process safety issue)	1. Safety instrumented systems (engineering), 2. Logout tagout program 3. Training (admin), supervision

IX. EHS MANAGEMENT MATURITY OF THE SECTOR:

Corporations that have the potential for affecting the environment significantly are held to a higher standard than those that do not have a notable impact

on the environment. In the oil and gas business, companies are held to the highest standard since a catastrophic failure could result in a major disaster. An EHS policy or mission statement is only effective if the company is accountable to it. An indicator of the integrity of a company's management system is shown by how closely their actions and metrics/

indicators mirror their stated vision, mission and EHS policy.

First, it is important to compare key sector policy attributes and goals with the sector's indicators. For the purpose of evaluating the maturity level of the companies, they will be classified based upon the Lowell Center for Sustainable Production (LCSP). The five level indicator framework specifies that companies should move from a compliance (level one), and facility level indicators (level two); and challenge themselves to incorporate environmental effect (level three), supply chain (level four), and sustainable system indicators (level five) (Veleva & Ellenbecker 2001). Therefore, level one and two represent a company at a young/low maturity level. Level three corresponds to a middle/medium maturity, and levels four and five reflect a high maturity.

Based upon sufficient available information, four of the ten companies researched were analyzed to obtain their maturity level based on their integration of their vision and mission with the reported metrics that lead to sustainable production. These four companies are ExxonMobil, BP, Weatherford, and Sonatrach, and are located in four different regions in the world. ExxonMobil is considered a high maturity company and is one of the leaders in the oil and gas sector. They operate their business within or above compliance in many of its corporate policies. This is based on the company's continuous efforts to improve environmental performance, adhering to environmental laws/regulations, applying responsible standards where laws and regulations do not exist, within their operations and products (ExxonMobil 2012). For example in environmental actions, ExxonMobil reported that they piloted a framework for "characterizing marine

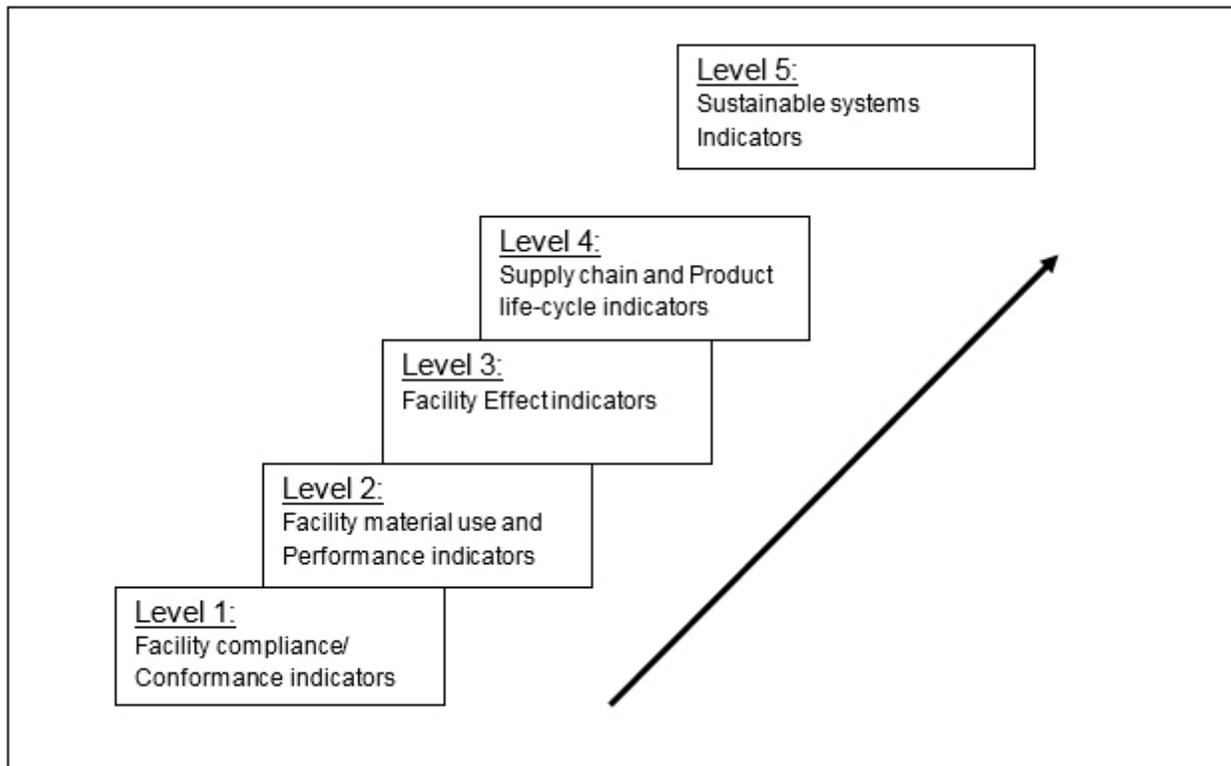


Figure 1: Lowell Center for Sustainable Production Indicator Framework

environmental sensitivities by prioritizing ecosystem services within regions of interest.” This initiative was used to inform the company among others how to further incorporate sustainability concerns in their development plans. Also, the company’s contribution to biodiversity management is a step in the right direction. In 2013 approximately US \$4 million was contributed to biodiversity protection and land conservation. There was also an indication that the company has plans to support the economic, political and social welfare wherever they conduct business by managing sustainability issues through the application of management systems. Based upon the Vesla framework, BP has a middle/medium maturity level. BP’s vision and mission statements say that they hold safety and environmental excellence in high regard. However, major disasters such as the Deepwater Horizon explosion on April 20, 2010 and a pipeline break in Alaska on July 16, 2011 put the company under continuous scrutiny by public and regulatory agencies. On the other hand, BP is subscribed to the GRI and has a structured sustainability reporting system but BP still lags other oil companies in both environment and safety performance (Mouawad 2010).

The analysis shows that Weatherford International is a young/low maturity company. They have a comprehensive vision/mission statement and have committed to incident rate (Weatherford 2012), but they fail to report their results or progress. However, as they focus seemingly on compliance EHS management, little effort is put on sustainability and corporate social responsibility because they do not subscribe to the sustainability reporting initiatives offered by GRI.

Sonatrach is also at a low maturity level, although it has a high production output for its size. The EHS mission and vision statement suggests a desire to achieve compliance with laws and regulation

without any substantive efforts to go above and beyond the minimal requirements. In addition, their 2012 Annual report does not report any metrics about their EHS performance other than the reduction in the volume of gas flaring, which is not only an EHS issue, it also impacts the production output.

X. CONCLUSION

Oil and gas companies represent a significant portion of wealth among the world’s major industries; however their efforts toward sustainability still require improvement. (Schneider, Vargo, & Campbell 2011). The ten global oil and gas companies that were analyzed in this paper shows evidence that differences still exist within the sector as it relates to environment, health, safety, and sustainability, yet the sector continues to make progress. The analysis of vision and mission statements of companies proves that they are still working toward reduction and communication of all their EHS risks, yet issues do remain. Common EHS issues were identified for the sector include emissions, process safety, protecting the environment and personnel, and sustainability. These issues need to be addressed by companies in order to allow the sector to advance towards sustainability.

Significant noncompliance with the EHS laws and regulations is common among the oil companies located in the United States, despite their ongoing efforts. The most cited violations were related to Process Safety Management and Clean Air Act. In order to address EHS issues in the sector, companies implemented different controls that vary in type between, elimination, substitution, engineering, administrative, and personal protective equipment.

Benchmarking of sustainability reporting remains difficult because of inconsistencies in reporting as Schneider, Vargo, and Campbell (2011) also found.

Inconsistencies are reflected in the number and the quality of reported metrics (Table II) and the applicable EHS laws and regulations that depend on the country where the companies conduct business. However, some common EHS metrics were found to be adopted by the majority of companies in the sector. Furthermore, the analysis of reported metrics shows also that many companies policies do not reflect the policies that they purport to vision and mission and in many cases, the metrics of performance are still lagging despite ongoing efforts to improve environmental health and safety toward sustainability.

The sector is found to be in the high middle/medium maturity (Level 3 based on LCSP framework). This means that the sector has made progress from simply embracing sustainability towards a commitment to addressing sustainability issues. The progress is aligned with the adherences to the guidelines of the GRI.

It is therefore suggested, that further studies should include other companies with different size and locations to establish additional evidence of the maturity of the sector. Hence, we can gain an added understanding about the contribution of the oil and gas sector to the economic development of the society; to include their support of local communities.

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