

RISK EVALUATION FOR PROJECTS CONSIDERING SUSTAINABILITY CONCERNS DUE TO CLIMATE CHANGE The Oil Shale Case Analysis



15-04-2010

WILSON JORDÃO FILHO

Risk Evaluation for Projects Considering Sustainability Concerns due to Climate Change

The Oil Shale Case Analysis

WILSON JORDÃO FILHO

Abstract

This paper tentatively shows through a semi-qualitative approach the consequences over the risk analysis currently applied to new project implementation. Changes on business framework are now under way due to the worldwide adoption of sustainability principles stimulated by threats from climate change. The moving from the former BAU (Business as Usual) to a SD (Sustainable Development) based scenario may provide an impressive amount of adaptations to current risk analysis for new projects.

Likelihood and impacts for most of selected items of project vulnerability are moved up to different scores defining higher risks with increasing efforts for risk mitigation. The risk management then becomes a much more time and cost consuming task along all project stages of implementation deriving a total expenditure which is a much higher percentage of total project investment cost than before. Therefore business activities as well as economy are to be penalized for that reflecting on living standards and costs of products and services.

It is not a surprise if one identifies that all costs (expenditures) related to the measures for the risk management of an Oil & Gas project comply with SD principles could duplicate or even triplicate as compared to previous BAU scenario costs.

A sample project in Oil & Gas category is herein exhibited - *The Oil Shale Project* - which is in course of the beginning for worldwide exploration due to the depletion of crude oil reserves. The Oil Shale project involves mining and industrial parts forming a complex to produce shale oil and by-products from the oil shale ore using a few patent processes. Oil shale reserves are abundant on a few countries, namely US, Brazil, Estonia, Morocco, China and Jordan. As cost of production of shale oil is yet very high the postponement of the oil shale exploration era has been inevitable but now first efforts are taking place with the barrel reaching the barrier of US\$ 80.

This example reflects and endorses the UNFCCC and IPCC statements in regard to the enormous effort to be done by civilization to move the whole economy from the BAU to SD scenarios, which requires enormous investments throughout decades to mitigate future climate changes and adapt civilization to the changes already in course.

1- Introduction

Scientific consensus pushing on the fear for abrupt climate change is leading to a worldwide effort to develop new habits, education, philosophies, technologies, sciences and managerial capability to mitigate and adapt human civilization to global or regional warming.

The core of proposals are focused on the reduction of GHGs (greenhouse gases) emissions through reducing energy use, switching to cleaner energy sources, and GHGs capture and storage together with complementary measures related to recycling materials, reducing of wastes and avoiding depletion of natural resources. This resumes the basic approach to SD (Sustainable Development).

The list of possible measures or interventions configures an impressive package of attitudes demanding huge investments and a mind revolution in society and individuals.

All new projects have to be analyzed on different concerns and constraints and the previous ones have to be re-engineered to comply with sustainability practices. Regarding new projects their risk analysis, time frame, investment and operation costs will surely be affected by this new wave.

A few years ago risk analysis of new projects (green field) used to follow regular routines supported by comprehensive engineering, statistical and financial studies of the potential risks aiming their future management. Classic methodologies and risk evaluation models were available for players (shareholders and stakeholders) to define their involvement on any new venture.

The new on-going changes due to SD and CC will dramatically change the risk perception and assessment for projects, as well as will alter the number, density and effectiveness of counter measures to mitigate, reduce or transfer the risk. The two fundamental response options to the risks posed by anthropogenic climate change are *mitigation of climate change and adaptation to climate change*.

The OECD assists G20 countries in their efforts to find lasting solutions to finance action on climate change, building on the long-standing work of the organization to share country experiences and identify lessons learnt and policy recommendations for good practice. Public and private financing for climate action will need to be scaled up significantly in the coming years.

The Fourth Assessment Report of the IPCC (IPCC, 2007) gives a summary of some impacts likely to occur under varying amounts of global warming. Mapping onto this is the expected warming range for 2030 which indicates the potential impacts that adaptation will need to address. The UNFCCC report concluded that *total funding need for adaptation by 2030* could amount to US\$ 49 to 171 billion per annum globally, of which US\$27 to 66 billion would accrue in developing countries. Today these values are considered underestimated for most of people involved on the problem. Therefore the worldwide challenge for facing the threat is quite impressive.

This paper deals with a preliminary evaluation of the impact on costs of mitigation and adaptation for a new huge project of Oil Shale, considering the moving from a BAU scenario to a SD scenario. It involves a semi-qualitative multi risk matrix method which scores the likelihood into five categories (from very low to very high), assuming certain range of risk level for each. This is applicable over the selected items of project vulnerability.

Every vulnerability item is analyzed along project development stages to be subject to entrepreneurial measures aiming the risk management. A detailed sequence of sheets composing this matrix is exhibited at the end of this paper in which the red letters show the changes and increments when passing from BAU to SD scenario.

2 - Risk assessment for new projects

Efforts for risk assessment and evaluation of project implementation shall start at the earliest project stages (pre-feasibility or feasibility) and continue throughout next stages till the launching of commercial operation. Once commercial operation commences risk management should continue but with a different approach focused to on line projects and businesses (HSE on the enterprise, managerial practices, etc.) with a permanent trial and error strategy including the business continuity planning (BCP).

Risk assessment is the assessment of threats to *impacts* on and vulnerabilities of information of a project and the *likelihood* of their occurrence.

The process of risk analysis includes identifying and quantifying uncertainties, estimating their impact on outcomes that one cares about, building a risk analysis model that expresses these elements initially in qualitative form and lately in quantitative form, exploring the model through simulation and sensitivity analysis, and making risk management decisions that can help to avoid, mitigate, or otherwise deal with risk.

Values can be assigned to threat, vulnerability and asset. A measure of risk can be then determined by calculating their product. By assigning values to every listed measure for dealing with the risk management one can evaluate the overall efficiency and strategy for reducing risks of a new project. The combination of the measure of threat, vulnerability and impact on asset (outcomes), together with the application of measures will mathematically in theory reduce the exposition to risks.

The most common risks in new Oil & Gas onshore projects are well established in literature. A comprehensive checklist can be prepared for each type of project in order to identify a wide variety of relevant risks which are applicable to each case. However a peculiar oil & gas project known as Oil Shale Project has a unique situation. This project presents a different framework for the matching of the unconventional oil & gas production sector to a carbon fossil mining sector. Despite the trends to assign the higher importance to the inherent environmental and social risks there is much more involved representing an impressive package of challenging risk factors to be faced. They are mostly referred to the construction (long term construction timing in four stages), planning the operation (especially for the mining sector), market and products (pioneer trade of synthetic shale oil),

technological (effectiveness of industrial process) and entrepreneurial risks (sustainability of Oil Shale business and workability of the proposed JVC as the Owner).

The past analysis of these projects in the BAU terms (business as usual) have been drastically changed by new issues and constraints related to sustainability. They require that any new project and related entrepreneurial activities be developed in compliance to the new looks and concepts derived from the worldwide adoption of sustainability principles.

At a first glance about 64 risk factors (hazards) can be selected classified into 16 types or risks, comprising: technical / technological; operating (costs), operating (management), engineering, project completion (implementation), supply & reserves, environmental (including HSE compliance during construction), infrastructure & transportation, syndication (for the funding structure), force majeure, foreign exchange, market and commercialization, political, interests & financial (financing facility), sponsors & participants (players involved, JVC structure and relationship to contractors and suppliers), legal & institutional.

It is understood that the risk evaluation and management for their attenuation is a long process to reduce risk to an acceptable level. The proposed target considers that an average overall risk acceptable in the feasibility stage is in the range of low to medium (5%) and shall be reduced by appropriated measures to a range of very low risks by the time of the start-up of project operation (<1%). All work jointly performed by players involved (shareholders and stakeholders) must be set up on this viewpoint.

The qualitative matrix analysis is a good instrument for the start-up of the project risk analysis for offering a wide spectrum of the possible hazards and measures to mitigate them classified in several categories of risk showing changes along project stages. By comparing the previous BAU scenarios with new scenarios involving contemporary concerns of sustainability as tools for mitigation of climate change it is possible to understand the global effort which demands enormous investment and increasing on operating costs.

Later on those risks that can be sized may be translated to a scale of probabilistic values deriving a semi-qualitative method for the entire project. A great deal of risks cannot be yet measured to derive a probabilistic approach, or a full quantitative method.

3 - The changes in project risk analysis due to climate change and sustainability concerns

Over three quarters of the world's oil and gas companies believe inevitable climate change could impact their business: increasing downtime, system failures and safety. There is a need to adaptation to the new challenge, and experts report top five impacts of climate change and the industry implications.

The top six envisaged climate change impacts affecting risk analysis are:

- **Increased pressure on water resources:** Concerns were reported over changing rainfall patterns, water shortages, poor water quality, drought and flooding significantly increasing the demand for water. Growing competition for available resources could create operational problems for companies that rely heavily on

water for oil and gas production. The demand also may create conflicts with local communities and other water users throughout the world changing the risk landscape for oil and gas companies. Nearly all companies surveyed did not appear to recognize the risk landscape is changing -- only six percent reported knowledge of potential civil and geo-political risks and three percent identified adverse risks for local communities.

- **Physical asset failure:** Many existing and ongoing plants and equipment have been designed on the basis of historic climatic conditions and may not withstand changing environmental & social conditions. Fluctuating temperatures can affect efficiency and performance of physical assets leading to transport disruption, damaged buildings and increased operational delays and costs. Also disruptions to supply of raw materials and energy in off-site utilities (energy, communications, water and waste treatment) are forecasted.
- **Employee health and safety risks:** Volatile working conditions in extreme environments and physical assets that are potentially not suitable for the changing climatic conditions have the potential to impact the health and safety of employees. A massive majority of projects and their companies have not started up to incorporate climate change considerations into their health and safety risk assessments. Employer and public liability insurance cover may be compromised if companies fail to take climate change into account during health and safety risk assessments.
- **Drop in value of financial assets:** To meet the growing demand for energy, oil and gas companies need to continue securing investment for new exploration, production and manufacturing. Potential investors and stakeholders are placing greater importance on the business impacts of climate change, as the risks impact cost and revenue drivers. Insurance costs could potentially rise because of greater chances of physical plant damage due to weather events or persisting climate change. Any proved reserve may be affected by companies failing to take into account the full impact of climate change. This could result in changes to the disclosed value of reserves, which has major financial implications.
- **Damage to corporate reputation:** As knowledge and awareness of climate change grows, any failure to monitor and report the impacts of climate change on social and ecological resources is increasingly likely to harm a company's reputation. Contractual relationships that do not adequately foresee and manage risks driven by climate change may damage the company's reputation with stakeholders as the risk of parties turning to litigation increases. There is an expectation for lacks on proceeding to increase compromises with CSR values and concerns is somewhat evident when detrimental effects take place affecting balances and performance.

The main drivers for the required change on risk management are:

- **Cost/revenue drivers:** Operating costs of any oil & gas complex could increase in response to changes in asset efficiency and resilience with higher ambient air

temperatures or any severe climatologic change. Disruptions to transport links due to permafrost thaw already are having significant impacts with companies having to hold and maintain larger on-site spare parts and materials stores. Operational costs could increase in response to changes in design standards for offshore platforms, or control for all types of emissions.

- **Stakeholder pressure:** Investors and other stakeholders — including market and financial analysts, governments and regulatory agencies, research institutions, consumers, local communities and NGOs — are already starting to place greater pressure on oil and gas companies to address climate risks and opportunities.
- **New regulatory landscapes:** Although new regulatory policies are being developed in many countries, there remains a great deal of uncertainty regarding the scope, content and format of future legislation on emissions. Greater certainty about the future regulatory landscape is required to encourage companies to invest in alternatives to fossil fuels and develop cleaner and sustainable energy sources.
- **Opportunity to improve:** There is an overall concern on how important it is for the oil and gas sector to plan for a changing climate. Issues such as water shortages and changing weather patterns and temperatures will impact infrastructure, operations, revenues and costs. As a result, investors want to know how oil and gas companies are dealing with these risks and planning for them in the future.

Many questions, studies and reports have been made available to help oil and gas executives take informed steps towards building corporate resilience to inevitable climate change. To start, a company should undertake a high-level assessment of how climate change could impact their business model. Companies need to adapt reporting and performance management to incorporate risks arising from climate change. These risks often increase the number of possible hazards as well as their intensity (impact) and likelihood.

4 - The analysis of a case project: The approach to oil shale complex (mining and industrial) project

The Oil Shale projects have come up late, just after 1980. For economical reasons they have stayed standby and came up again only in the XXI century when the forecasted scarcity of crude oil, demand pressures and political attitudes have pushed prices up over US\$ 100.00/barrel.

It is herein presented an approach for a **“Road Map for Risk Assessment and Management”** proposed for an Oil Shale Project.

As any huge oil & gas project the familiarization and full understanding by shareholders and stakeholders of the inner complexity of the package of risks involved on this type of project and business is of paramount importance for the successful implementation and operation.

The proposed risk analysis is subject to an evolutive sequence of steps along the main four (4) project stages (**Commercial Feasibility, Bankable Feasibility, Pre-Construction,**

and Construction), divided into four sectors; a) **main features** defining main events subject to risk; b) **likelihood** qualitatively defining the probability to occur for each selected event; c) **impact** defining qualitatively expected consequences (impacts) on the project if the hazard occurs; d) **management** defining main actions by participants to eliminate, reduce or mitigate the risk. It is presented a sequence of sheets in tabular form, in which the transition from a higher risk zone to a lower one is taken along project implementation.

This approach is in connection to the state of art literature for the subject but adapted to the specific case of an Oil Shale project, in which mining, retorting, upgrading, logistics for transportation, utilities, huge supplies, regional planning, etc. are superimposed to the business development. The approach is not only referred to engineering and planning sectors but to all set of “hazards” that may occur involving financial, political, legal & institutional and other areas.

Following this approach in the future the risk factors that could be sizeable would allow the moving for a semi-quantitative approach using probabilistic analysis methods.

Sixteen (16) worldwide accepted risk categories have been selected: **technical/technological, operating costs, operating management, engineering, completion, supply and reserves, environmental, infrastructure, syndication of banks, force majeure, foreign exchange, market and commercialization, political, interests & funding, sponsors and participants, and legal & institutional**).

Their main features have been presented totaling **64 items** of project vulnerability for analysis. If one considers that every item is spread on 4 project stage analysis comprising **4 sectors** each, the total amount of risk issues for your appreciation is over **1,040 statements**. The number of items to be analyzed can increase with the time.

A careful judgment and criticism of each of these 1,040 issues is absolutely required as project goes on. The earlier is the involvement of all players with these matters, the higher are the chances for a successful implementation.

The main concerns in this method are:

- a) Is there some relevant factor or issue missing or exceeding?
- b) Are the descriptions in cells clear enough for the overall comprehension?
- c) Is the number of selected features per risk well balanced considering the evolution of project stages?
- d) Is the risk perception for the likelihood and impact evaluation adequate?
- e) Are the progressive propositions for the risk management along project stages realistic?

5 - Premises

At the very beginning of a large project it is customary to start-up risk analysis through a perception, assessment and management of risks using the qualitative approach. Risks are evaluated in impact and likelihood on categories as follows:

Likelihood: (% of probability for the hazard to occur during project life time)

Very low - Less than 1%

Low - 1% and 5%

Medium - 5% to 10%

High - 10% to 20%

Very High - Over 20%

Impact: (economic impact on project investment or cash flow for each selected item of vulnerability)

Very Low - Less than 0.5% of the investment and/or operational costs

Low - Between 0.5% and 1% of the investment and/or operational costs

Medium - Between 1% and 3% of the investment and/or operational costs

High - Between 3% and 5% of the investment and/or operational costs

Very High - Over 5% of the investment and/or operational costs

6 - Summary of results

Results obtained from this preliminary study have evidenced a remarkable increment on risk likelihood and economic impact to project when moving from the BAU scenario to a SD based scenario.

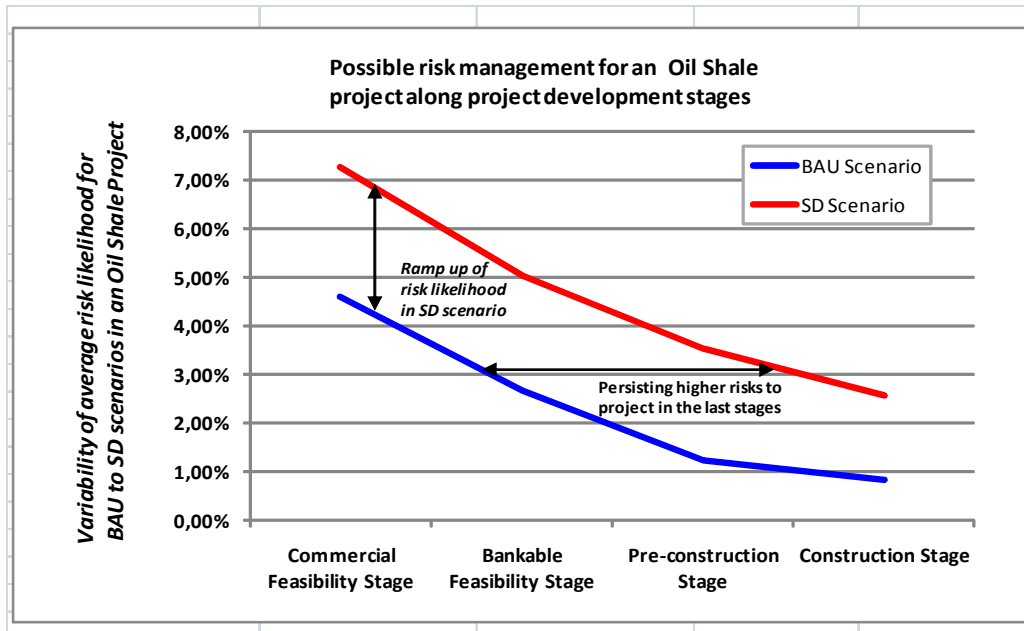
The increment on the average probability of occurrence for the set of selected possible hazards (defining the items of vulnerability) applicable to the project as well as the increasing of their impacts due to changes in the global framework are responsible for the increment of the expected total project investment costs. The managing of risks along project stages of development will surely demand much more funds, time and resources for the SD base scenario as compared to the BAU scenario. This is a common rule for all projects but it inflicts more charges to projects involved with energy & power, oil & gas, as well as all business on fossil (non-renewable) resources defining GHGs emitters.

The table which follows summarizes the comparative analysis performed. There one can see that changes on likelihood and impacts are responsible for probable effect on incremental investment costs. The total effort for managing the risk exhibits a total accumulated incremental cost for the implementation with an upper limit of 8% in a BAU scenario, while in SD based scenario it may achieve to 15%. If one considers that the investment cost of a huge Oil Shale project for producing 250,000 barrels/day would cost US\$ 2.5 billion, the difference on moving from BAU to SD based scenarios may represent

**Risk Evaluation for Projects Considering Sustainability Concerns due to Climate Change
The Oil Shale Case Analysis**

7% to 8% difference in increment, that is about US\$ 200 million, This would be an extra cost for adapting and mitigating the project as a whole to keep on the same level of acceptable risks on a changeable and more restrictive scenario with a lot of new constraints.

Many projects do not deal with the 16 (sixteen types) of risks. It is quite recommend not ignoring the risks derived from the financial world. They are to be considered and managed in order to make project bankable. To bridge the gap between engineering and financial world is then a must. The figures of table which follows are self explanatory.



Risk Evaluation for Projects Considering Sustainability Concerns due to Climate Change
The Oil Shale Case Analysis

THE OIL SHALE PROJECT				
COMPARATIVE ANALYSIS OF IMPACTS ON INVESTMENT COSTS BY RISK MANAGEMENT PRACTICES				
"BUSINESS AS USUAL" SCENARIO	RISK ASSESSMENT - MANAGING AVERAGE RISK ALONG PROJECT STAGES			
Oil Shale Project as BAU scenario	Commercial Feasibility Stage	Bankable Feasibility Stage	Pre-construction Stage	Construction Stage
Average risk likelihood for 16 types or risks involving 64 items of vulnerability through proper management	4,59%	2,66%	1,22%	0,81%
Average impact on project investment costs for 16 types of risks involving 64 items of vulnerability	<i>medium to low</i>	<i>medium to low</i>	<i>medium to low</i>	<i>medium to low</i>
Expected probable effect on total project investment cost for managing the risks along project stages (defining incremental costs)	$x < 1\%$	$1\% < x < 2\%$	$2\% < x < 3\%$	$3\% < x < 8\%$

BUSINESS ON "SUSTAINABLE DEVELOPMENT BASIS" SCENARIO	RISK ASSESSMENT - MANAGING AVERAGE RISK ALONG PROJECT STAGES			
Oil Shale Project as SD scenario	Commercial Feasibility Stage	Bankable Feasibility Stage	Pre-construction Stage	Construction Stage
Average risk likelihood for 16 types or risks involving 64 items of vulnerability through proper management	7,24%	5,02%	3,45%	2,55%
Average impact on project investment costs for 16 types of risks involving 64 items of vulnerability	<i>medium to high</i>	<i>medium to high</i>	<i>medium to high</i>	<i>medium to high</i>
Expected probable effect on total project investment cost for managing the risks along project stages (defining incremental costs)	$x < 2\%$	$2\% < x < 3\%$	$3\% < x < 5\%$	$5\% < x < 15\%$

Commercial Feasibility = Engineering and Commercial Feasibility Studies

Bankable Feasibility = Commercial Feasibility reviewed plus all bankable documents to achieve funding

Pre-Construction Stage = Involves all steps and activities prior to contract project implementation

(Basic Design, Specifications, Procurement, Bid Documents, Calls for Tender, etc.)

Construction Stage = Involves all steps of project implementation till the start-up of the commercial operation

7 - Conclusions

A semi qualitative matrix model is a fair instrument to analyze and compare the relative project risks on implementation when moving to a BAU to a SD scenario. It is a simplified approach accessible to all professionals who can easily judge which risks are to be taken, minimized or avoided for a specific project while understanding the inner complexity and increasing of work on adopting SD principles.

For large projects whose implementation takes several years the division of risk analysis into four stages of project development is recommended ever since the earliest stages of studies. The risk assessment, evaluation, and management shall be done on a clear and comprehensive way to be reported to community evidencing the work to be done with measures for mitigation or reduction to risk exposure by all parts involved (shareholders and stakeholders).

The application of the methodology to a huge Oil Shale project has evidenced the large increment on risk exposure to project when moving from a BAU to a SD scenario. The reason for that is the impressive number of new constraints derived from sustainability concerns

which arise from SD theory and practices. The compliance to the new framework (rules, regulations, compromises, protocols, treaties, standards, etc.) becomes a much larger cost and timing consuming task than before, as the former approaches were done only on BAU basis. Sometimes it can duplicate or even triplicate previous expenditures on risk management depending on how rigid or hard will be the context in which the project is to be inserted.

The risk assessment and management considering all SD concerns involved to a new project is the best way to prepare it and the corporation for the modern trends which will prevail on business activities comprising all segments of CSSR (Corporate Sustainability and Social Responsibility) then affecting the decision making.

The recurrence to modern simulation models for risk analysis involving mathematical and probabilistic approaches through the Monte Carlo Method shall be use after the complete diagnosis and application of a semi-qualitative matrix analysis to increase the reliability and accuracy of results. The quantitative methods for risk analysis always depend on the possibility of assigning likelihood to all possible hazardous events in the list of project vulnerabilities.

The risk analysis using Monte Carlo simulation shows many possible outcomes often on Microsoft Excel spreadsheet informing how likely they are to occur. There are risk models widely used in Oil & Gas, Renewable Energy, Utilities, and Engineering Services, in simplified or complete versions demanding an impressive input data that may take a long time to be retrieved. All these tools require a lot of time to be ready for performance and so a shortcut with qualitative and semi-qualitative approaches is welcome as part of the process.

The semi-qualitative approach may help on the calibration or checking of such risk quantitative models when applied on a very complex framework in which interdependence of variables is a factor inhibiting the set up of joint probabilities for many events.

In an Oil Shale project costs for the compliance to environmental and social constraints in BAU basis could be limited to 5% of investment costs; however in SD basis it may reach 15% depending on the legal & regulatory framework and consciousness of community, institutions and authorities. At a first glance this could make project unfeasible, however as this is to be a system approach to all oil & gas projects in the early future, it is expected that changes in market prices for products and services will absorb these extra costs.

To deal with the sixteen types of risk (including those from the financial area) is a must on large projects as they depend on high amounts of capital to be implemented. At the discretion of Lenders and Investors a lot of requirements have to meet to make project bankable.

ANNEX

Following it is presented a sequence of figures and tables supporting the information released on this paper.

- Visualization of the risk assessment
- Tables for risk assessment to the Oil Shale project along project development stages in BAU and SD versions
- Summary of comparative analysis of changes in risk assessment between BAU and SD versions
- Detailed semi-qualitative matrix analysis of changes in risk assessment and measures for risk management when moving from BAU scenario to SD scenario.

Risk Evaluation for Projects Considering Sustainability Concerns due to Climate Change

The Oil Shale Case Analysis

**Risk Evaluation for Projects Considering Sustainability Concerns due to Climate Change
The Oil Shale Case Analysis**

THE OIL SHALE PROJECT - BAU (BUSINESS AS USUAL) RISK ASSESSMENT AT COMMERCIAL FEASIBILITY STAGE - FEL 1 + FEL2						THE OIL SHALE PROJECT - SD (SUSTAINABLE DEVELOPMENT SCENARIOS) RISK ASSESSMENT AT COMMERCIAL FEASIBILITY STAGE - FEL 1 + FEL2					
RISKS TO BE EVALUATED	RISK EVALUATION					RISKS TO BE EVALUATED	RISK EVALUATION				
	Very low < 1%	Low 1% to 5%	Medium 5% to 10%	High 10% to 20%	Very High >20%		Very low < 1%	Low 1% to 5%	Medium 5% to 10%	High 10% to 20%	Very High >20%
1 - OPERATING (TECHNICAL / TECHNOLOGICAL)						1 - OPERATING (TECHNICAL / TECHNOLOGICAL)					
Effectiveness of technology of industrial process for producing shale oil			X			Effectiveness of technology of industrial process for producing shale oil				X	
Petroindustrial competitiveness of oil shale process in regard to other process		X				Petroindustrial competitiveness of oil shale process in regard to other process			X		
Effectiveness for an HDT processing to upgrade shale oil				X		Effectiveness for an HDT processing to upgrade shale oil			X		
Adequacy of plant economic life		X				Adequacy of plant economic life			X		
Adequacy of plant facilities and utilities for business purposes		X				Adequacy of plant facilities and utilities for business purposes			X		
2 - OPERATING (COSTS)						2 - OPERATING (COSTS)					
Cost overruns in CAPEX (Capital expenditures)		X				Cost overruns in CAPEX (Capital expenditures)			X		
Cost overruns in ENVEX (Environmental expenditures)			X			Cost overruns in ENVEX (Environmental expenditures)			X		
Cost overruns in OPEX (Operation expenditures)		X				Cost overruns in OPEX (Operation expenditures)			X		
Cost overruns in COMEX (Commercialization expenditures)		X				Cost overruns in COMEX (Commercialization expenditures)				X	
Inflation or escalation of costs exceeding pricing for outputs		X				Inflation or escalation of costs exceeding pricing for outputs			X		
3 - OPERATING (MANAGEMENT)						3 - OPERATING (MANAGEMENT)					
Lower outputs in annual production		X				Lower outputs in annual production			X		
Shale oil shortage in production of the industrial plant		X				Shale oil shortage in production of the industrial plant		X			
Oil shale ore shortage in production of the mining plant		X				Oil shale ore shortage in production of the mining plant			X		
Disconnection between mining an industrial plants		X				Disconnection between mining an industrial plants		X			
4 - ENGINEERING						4 - ENGINEERING					
Poor engineering design, planning and budgeting	X					Poor engineering design, planning and budgeting			X		
Failure or poor performance of designed equipment and systems		X				Failure or poor performance of designed equipment and systems			X		
5 - COMPLETION (IMPLEMENTATION)						5 - COMPLETION (IMPLEMENTATION)					
Delayed start-up for the project		X				Delayed start-up for the project			X		
Interruption and non completion	X					Interruption and non completion		X			
Poor construction performance		X				Poor construction performance			X		
Stops and delays due to legal disputes on permitting		X				Stops and delays due to legal disputes on permitting				X	
6 - SUPPLY / RESERVES						6 - SUPPLY / RESERVES					
Lacks on oil shale buffering zones and stocks			X			Lacks on oil shale buffering zones and stocks			X		
Lacks on mineable resources or deficit on rate of kerogen in ore		X				Lacks on mineable resources or deficit on rate of kerogen in ore		X			
Water shortage due to conflicts on water rights or regional scarcity		X				Water shortage due to conflicts on water rights or regional scarcity			X		
Lacks on water supply		X				Lacks on water supply			X		
Lacks on power supply		X				Lacks on power supply		X			
Lacks on minor supplies contracts		X				Lacks on minor supplies contracts		X			
Lacks on gas supply		X				Lacks on gas supply			X		
7 - ENVIRONMENTAL						7 - ENVIRONMENTAL					
HSE compliance along project stages		X				HSE compliance along project stages			X		
Project blockage for unacceptable air emissions		X				Project blockage for unacceptable air emissions				X	
Project blockage for unacceptable solid wastes disposal	X					Project blockage for unacceptable solid wastes disposal				X	
Project blockage for unacceptable groundwater contamination		X				Project blockage for unacceptable groundwater contamination				X	
Project blockage for unacceptable liquid emissions			X			Project blockage for unacceptable liquid emissions				X	
Project blockage for other environmental non compliances		X				Project blockage for other environmental non compliances				X	
Disconnection of project issues to reg. development and socioeconomic growth			X			Disconnection of project issues to reg. development and socioeconomic growth			X		
8 - INFRASTRUCTURE (TRANSPORTATION)						8 - INFRASTRUCTURE (TRANSPORTATION)					
Lacks on infrastructure affecting logistics of commercialization		X				Lacks on infrastructure affecting logistics of commercialization			X		
Lacks on infrastructure affecting logistics of production		X				Lacks on infrastructure affecting logistics of production			X		

Risk Evaluation for Projects Considering Sustainability Concerns due to Climate Change
The Oil Shale Case Analysis

THE OIL SHALE PROJECT - BAU (BUSINESS AS USUAL)					
RISK ASSESSMENT AT COMMERCIAL FEASIBILITY STAGE - FEL 1 + FEL2					
RISKS TO BE EVALUATED	RISK EVALUATION				
	Very low < 1%	Low 1% to 5%	Medium 5% to 10%	High 10% to 20%	Very High >20%
9 - SYNDICATION					
Poor approach to financing for an Equity structure			x		
Poor approach to financing for a Debt structure			x		
Insufficiency or inadequacy of bankable documents			x		
10 - FORCE MAJEURE					
Civil war, war, riots, epidemics	x				
Natural catastrophs	x				
Strikes and disputes with Unions	x				
11 - FOREIGN EXCHANGE					
Country currency devaluation		x			
Country currency non convertibility		x			
Lacks on hedge and swap facilities		x			
12 - MARKET AND COMMERCIALIZATION					
Lacks on qualification and pricing for products to sale		x			
Lacks on buyers for Shale Oil and derivatives		x			
Long term price drawdown for outputs			x		
Short term price drawdown for outputs				x	
Limitation on logistics or lacks on contracts for oil transportation		x			
13 - POLITICAL					
Political disarray, economic crisis	x				
Action of activists and environmentalists		x			
Tax and ownership changes		x			
Changes on attitudes of public agencies and politicians			x		
14 - INTERESTS & FUNDING					
Unsuitable finance facility for project funding			x		
Lacks on credit insurance and securities			x		
Misbalance on Debt & Equity for funding			x		
15 - SPONSORS AND PARTICIPANTS					
Disbalance on strenght, assets & liabilities of each Sponsor			x		
Legal relationship of the JVCo with contractors and suppliers			x		
Disputes and disagreeemens in the JVCo for business development			x		
Cash flow shortage by JVCo for the Equity portion				x	
16 - LEGAL & INSTITUTIONAL					
Unfavorable policies and few incentives to Investors and Sponsors				x	
Legal framework inhibiting investments			x		
Controversy and disputes among public authorities in different levels				x	
SUM	7	35	17	5	0
RESULTING AVERAGE RISK FOR THE PROJECT AT FEL 1			4,59%		

THE OIL SHALE PROJECT - SD (SUSTAINABLE DEVELOPMENT SCENARIOS)					
RISK ASSESSMENT AT COMMERCIAL FEASIBILITY STAGE - FEL 1 + FEL2					
RISKS TO BE EVALUATED	RISK EVALUATION				
	Very low < 1%	Low 1% to 5%	Medium 5% to 10%	High 10% to 20%	Very High >20%
9 - SYNDICATION					
Poor approach to financing for an Equity structure			x		
Poor approach to financing for a Debt structure			x		
Insufficiency or inadequacy of bankable documents			x		
10 - FORCE MAJEURE					
Civil war, war, riots, epidemics	x				
Natural catastrophs	x	x			
Strikes and disputes with Unions	x				
11 - FOREIGN EXCHANGE					
Country currency devaluation		x			
Country currency non convertibility		x			
Lacks on hedge and swap facilities		x			
12 - MARKET AND COMMERCIALIZATION					
Lacks on qualification and pricing for products to sale			x		
Lacks on buyers for Shale Oil and derivatives		x			
Long term price drawdown for outputs			x		
Short term price drawdown for outputs				x	
Limitation on logistics or lacks on contracts for oil transportation			x		
13 - POLITICAL					
Political disarray, economic crisis		x			
Action of activists and environmentalists		x			
Tax and ownership changes			x		
Changes on attitudes of public agencies and politicians			x		
14 - INTERESTS & FUNDING					
Unsuitable finance facility for project funding		x			
Lacks on credit insurance and securities			x		
Misbalance on Debt & Equity for funding			x		
15 - SPONSORS AND PARTICIPANTS					
Disbalance on strenght, assets & liabilities of each Sponsor			x		
Legal relationship of the JVCo with contractors and suppliers			x		
Disputes and disagreeemens in the JVCo for business development			x		
Cash flow shortage by JVCo for the Equity portion			x		
16 - LEGAL & INSTITUTIONAL					
Unfavorable policies and few incentives to Investors and Sponsors			x		
Legal framework inhibiting investments			x		
Controversy and disputes among public authorities in different levels			x		
SUM	2	14	39	9	0
RESULTING AVERAGE RISK FOR THE PROJECT AT FEL 1			7,24%		

Risk Evaluation for Projects Considering Sustainability Concerns due to Climate Change
The Oil Shale Case Analysis

THE OIL SHALE PROJECT - BAU (BUSINESS AS USUAL)					
RISK ASSESSMENT AT BANKABLE FEASIBILITY STAGE - FEL2					
RISKS TO BE EVALUATED	RISK EVALUATION				
	Very low < 1%	Low 1% to 5%	Medium 5% to 10%	High 10% to 20%	Very High >20%
1 - OPERATING (TECHNICAL / TECHNOLOGICAL)					
Effectiveness of technology of industrial process for producing shale oil		X			
Petroindustrial competitiveness of oil shale process in regard to other		X			
Effectiveness for an HDT processing to upgrade shale oil			X		
Adequacy of plant economic life		X			
Adequacy of plant facilities and utilities for business purposes		X			
2 - OPERATING (COSTS)					
Cost overruns in CAPEX (Capital expenditures)	X				
Cost overruns in ENVEX (Environmental expenditures)		X			
Cost overruns in OPEX (Operation expenditures)		X			
Cost overruns in COMEX (Commercialization expenditures)		X			
Inflation or escalation of costs exceeding pricing for outputs		X			
3 - OPERATING (MANAGEMENT)					
Lower outputs in annual production		X			
Shale oil shortage in production of the industrial plant	X				
Oil shale ore shortage in production of the mining plant		X			
Disconnection between mining an industrial plants	X				
4 - ENGINEERING					
Poor engineering design, planning and budgeting	X				
Failure or poor performance of designed equipment and systems		X			
5 - COMPLETION (IMPLEMENTATION)					
Delayed start-up for the project		X			
Interruption and non completion	X				
Poor construction performance	X				
Stops and delays due to legal disputes on permitting		X			
6 - SUPPLY / RESERVES					
Lacks on oil shale buffering zones and stocks		X			
Lacks on mineable resources or deficit on rate of kerogen in ore	X				
Water shortage due to conflicts on water rights or regional scarcity	X				
Lacks on water supply	X				
Lacks on power supply	X				
Lacks on minor supplies contracts		X			
Lacks on gas supply	X				
7 - ENVIRONMENTAL					
HSE compliance along project stages	X				
Project blockage for unacceptable air emissions	X				
Project blockage for unacceptable solid wastes disposal		X			
Project blockage for unacceptable groundwater contamination			X		
Project blockage for unacceptable liquid emissions		X			
Project blockage for other environmental non compliances		X			
Disconnection of project issues to reg. development and socioeconomic		X			
8 - INFRASTRUCTURE (TRANSPORTATION)					
Lacks on infrastructure affecting logistics of commercialization		X			
Lacks on infrastructure affecting logistics of production		X			

THE OIL SHALE PROJECT - SD (SUSTAINABLE DEVELOPMENT SCENARIOS)					
RISK ASSESSMENT AT BANKABLE FEASIBILITY STAGE - FEL 1 + FEL2					
RISKS TO BE EVALUATED	RISK EVALUATION				
	Very low < 1%	Low 1% to 5%	Medium 5% to 10%	High 10% to 20%	Very High >20%
1 - OPERATING (TECHNICAL / TECHNOLOGICAL)					
Effectiveness of technology of industrial process for producing shale oil			X		
Petroindustrial competitiveness of oil shale process in regard to other			X		
Effectiveness for an HDT processing to upgrade shale oil		X			
Adequacy of plant economic life			X		
Adequacy of plant facilities and utilities for business purposes		X			
2 - OPERATING (COSTS)					
Cost overruns in CAPEX (Capital expenditures)			X		
Cost overruns in ENVEX (Environmental expenditures)			X		
Cost overruns in OPEX (Operation expenditures)			X		
Cost overruns in COMEX (Commercialization expenditures)			X		
Inflation or escalation of costs exceeding pricing for outputs		X			
3 - OPERATING (MANAGEMENT)					
Lower outputs in annual production		X			
Shale oil shortage in production of the industrial plant		X			
Oil shale ore shortage in production of the mining plant		X			
Disconnection between mining an industrial plants	X				
4 - ENGINEERING					
Poor engineering design, planning and budgeting	X				
Failure or poor performance of designed equipment and systems		X			
5 - COMPLETION (IMPLEMENTATION)					
Delayed start-up for the project		X			
Interruption and non completion	X				
Poor construction performance		X			
Stops and delays due to legal disputes on permitting		X			
6 - SUPPLY / RESERVES					
Lacks on oil shale buffering zones and stocks		X			
Lacks on mineable resources or deficit on rate of kerogen in ore		X			
Water shortage due to conflicts on water rights or regional scarcity			X		
Lacks on water supply			X		
Lacks on power supply		X			
Lacks on minor supplies contracts			X		
Lacks on gas supply			X		
7 - ENVIRONMENTAL					
HSE compliance along project stages		X			
Project blockage for unacceptable air emissions				X	
Project blockage for unacceptable solid wastes disposal			X		
Project blockage for unacceptable groundwater contamination				X	
Project blockage for unacceptable liquid emissions			X		
Project blockage for other environmental non compliances				X	
Disconnection of project issues to reg. development and socioeconomic		X			
8 - INFRASTRUCTURE (TRANSPORTATION)					
Lacks on infrastructure affecting logistics of commercialization		X			
Lacks on infrastructure affecting logistics of production		X			

**Risk Evaluation for Projects Considering Sustainability Concerns due to Climate Change
The Oil Shale Case Analysis**

THE OIL SHALE PROJECT - BAU (BUSINESS AS USUAL) RISK ASSESSMENT AT BANKABLE FEASIBILITY STAGE - FEL2					
RISKS TO BE EVALUATED	RISK EVALUATION				
	Very low < 1%	Low 1% to 5%	Medium 5% to 10%	High 10% to 20%	Very High >20%
9 - SYNDICATION					
Poor approach to financing for an Equity structure		X			
Poor approach to financing for a Debt structure		X			
Insufficiency or inadequacy of bankable documents		X			
10 - FORCE MAJEURE					
Civil war, war, riots, epidemics	X				
Natural catastrophs	X				
Strikes and disputes with Unions		X			
11 - FOREIGN EXCHANGE					
Country currency devaluation		X			
Country currency non convertibility	X				
Lacks on hedge and swap facilities		X			
12 - MARKET AND COMMERCIALIZATION					
Lacks on qualification and pricing for products to sale		X			
Lacks on buyers for Shale Oil and derivatives		X			
Long term price drawdown for outputs			X		
Short term price drawdown for outputs		X			
Limitation on logistics or lacks on contracts for oil transportation	X				
13 - POLITICAL					
Political disarray, economic crisis	X				
Action of activists and environmentalists		X			
Tax and ownership changes	X				
Changes on attitudes of public agencies and politicians			X		
14 - INTERESTS & FUNDING					
Unsuitable finance facility for project funding		X			
Lacks on credit insurance and securities			X		
Misbalance on Debt & Equity for funding		X			
15 - SPONSORS AND PARTICIPANTS					
Disbalance on strenght, assets & liabilities of each Sponsor		X			
Legal relationship of the JVCo with contractors and suppliers			X		
Disputes and disagreements in the JVCo for business development	X				
Cash flow shortage by JVCo for the Equity portion	X				
16 - LEGAL & INSTITUTIONAL					
Unfavorable policies and few incentives to Investors and Sponsors			X		
Legal framework inhibiting investments			X		
Controversy and disputes among public authorities in different levels				X	
SUM	21	34	8	1	0
RESULTING AVERAGE RISK FOR THE PROJECT AT FEL 2			2,66%		

THE OIL SHALE PROJECT - SD (SUSTAINABLE DEVELOPMENT SCENARIOS) RISK ASSESSMENT AT BANKABLE FEASIBILITY STAGE - FEL 1 + FEL2					
RISKS TO BE EVALUATED	RISK EVALUATION				
	Very low < 1%	Low 1% to 5%	Medium 5% to 10%	High 10% to 20%	Very High >20%
9 - SYNDICATION					
Poor approach to financing for an Equity structure		X			
Poor approach to financing for a Debt structure		X			
Insufficiency or inadequacy of bankable documents		X			
10 - FORCE MAJEURE					
Civil war, war, riots, epidemics		X			
Natural catastrophs			X		
Strikes and disputes with Unions		X			
11 - FOREIGN EXCHANGE					
Country currency devaluation		X			
Country currency non convertibility		X			
Lacks on hedge and swap facilities		X			
12 - MARKET AND COMMERCIALIZATION					
Lacks on qualification and pricing for products to sale		X			
Lacks on buyers for Shale Oil and derivatives		X			
Long term price drawdown for outputs			X		
Short term price drawdown for outputs				X	
Limitation on logistics or lacks on contracts for oil transportation			X		
13 - POLITICAL					
Political disarray, economic crisis		X			
Action of activists and environmentalists		X			
Tax and ownership changes		X			
Changes on attitudes of public agencies and politicians			X		
14 - INTERESTS & FUNDING					
Unsuitable finance facility for project funding		X			
Lacks on credit insurance and securities			X		
Misbalance on Debt & Equity for funding		X			
15 - SPONSORS AND PARTICIPANTS					
Disbalance on strenght, assets & liabilities of each Sponsor		X			
Legal relationship of the JVCo with contractors and suppliers			X		
Disputes and disagreements in the JVCo for business development		X			
Cash flow shortage by JVCo for the Equity portion		X			
16 - LEGAL & INSTITUTIONAL					
Unfavorable policies and few incentives to Investors and Sponsors			X		
Legal framework inhibiting investments			X		
Controversy and disputes among public authorities in different levels				X	
SUM	3	35	21	5	0
RESULTING AVERAGE RISK FOR THE PROJECT AT FEL 2			5,02%		

Risk Evaluation for Projects Considering Sustainability Concerns due to Climate Change The Oil Shale Case Analysis

THE OIL SHALE PROJECT - BAU (BUSINESS AS USUAL)					
RISK ASSESSMENT AT PRE-CONSTRUCTION STAGE - FEL 3					
RISKS TO BE EVALUATED	RISK EVALUATION				
	Very low < 1%	Low 1% to 5%	Medium 5% to 10%	High 10% to 20%	Very High >20%
1 - OPERATING (TECHNICAL / TECHNOLOGICAL)					
Effectiveness of technology of industrial process for producing shale oil	X				
Petroindustrial competitiveness of oil shale process in regard to other process	X				
Effectiveness for an HDT processing to upgrade shale oil	X				
Adequacy of plant economic life	X				
Adequacy of plant facilities and utilities for business purposes	X				
2 - OPERATING (COSTS)					
Cost overruns in CAPEX (Capital expenditures)	X				
Cost overruns in ENVEX (Environmental expenditures)		X			
Cost overruns in OPEX (Operation expenditures)		X			
Cost overruns in COMEX (Commercialization expenditures)		X			
Inflation or escalation of costs exceeding pricing for outputs		X			
3 - OPERATING (MANAGEMENT)					
Lower outputs in annual production	X				
Shale oil shortage in production of the industrial plant	X				
Oil shale ore shortage in production of the mining plant		X			
Disconnection between mining an industrial plants	X				
4 - ENGINEERING					
Poor engineering design, planning and budgeting	X				
Failure or poor performance of designed equipment and systems	X				
5 - COMPLETION (IMPLEMENTATION)					
Delayed start-up for the project		X			
Interruption and non completion	X				
Poor construction performance	X				
Stops and delays due to legal disputes on permitting		X			
6 - SUPPLY / RESERVES					
Lacks on oil shale buffering zones and stocks		X			
Lacks on mineable resources or deficit on rate of kerogen in ore	X				
Water shortage due to conflicts on water rights or regional scarcity		X			
Lacks on water supply		X			
Lacks on power supply	X				
Lacks on minor supplies contracts	X				
Lacks on gas supply	X				
7 - ENVIRONMENTAL					
HSE compliance along project stages	X				
Project blockage for unacceptable air emissions	X				
Project blockage for unacceptable solid wastes disposal		X			
Project blockage for unacceptable groundwater contamination		X			
Project blockage for unacceptable liquid emissions	X				
Project blockage for other environmental non compliances		X			
Disconnection of project issues to reg. development and socioeconomic growth		X			
8 - INFRASTRUCTURE (TRANSPORTATION)					
Lacks on infrastructure affecting logistics of commercialization		X			
Lacks on infrastructure affecting logistics of production	X				

THE OIL SHALE PROJECT - SD (SUSTAINABLE DEVELOPMENT SCENARIOS)					
RISK ASSESSMENT AT PRE-CONSTRUCTION STAGE - FEL 3					
RISKS TO BE EVALUATED	RISK EVALUATION				
	Very low < 1%	Low 1% to 5%	Medium 5% to 10%	High 10% to 20%	Very High >20%
1 - OPERATING (TECHNICAL / TECHNOLOGICAL)					
Effectiveness of technology of industrial process for producing shale oil		X			
Petroindustrial competitiveness of oil shale process in regard to other process		X			
Effectiveness for an HDT processing to upgrade shale oil		X			
Adequacy of plant economic life			X		
Adequacy of plant facilities and utilities for business purposes		X			
2 - OPERATING (COSTS)					
Cost overruns in CAPEX (Capital expenditures)			X		
Cost overruns in ENVEX (Environmental expenditures)		X			
Cost overruns in OPEX (Operation expenditures)			X		
Cost overruns in COMEX (Commercialization expenditures)		X			
Inflation or escalation of costs exceeding pricing for outputs			X		
3 - OPERATING (MANAGEMENT)					
Lower outputs in annual production			X		
Shale oil shortage in production of the industrial plant		X			
Oil shale ore shortage in production of the mining plant		X			
Disconnection between mining an industrial plants		X			
4 - ENGINEERING					
Poor engineering design, planning and budgeting		X			
Failure or poor performance of designed equipment and systems		X			
5 - COMPLETION (IMPLEMENTATION)					
Delayed start-up for the project		X			
Interruption and non completion			X		
Poor construction performance		X			
Stops and delays due to legal disputes on permitting		X			
6 - SUPPLY / RESERVES					
Lacks on oil shale buffering zones and stocks			X		
Lacks on mineable resources or deficit on rate of kerogen in ore		X			
Water shortage due to conflicts on water rights or regional scarcity			X		
Lacks on water supply			X		
Lacks on power supply		X			
Lacks on minor supplies contracts		X			
Lacks on gas supply		X			
7 - ENVIRONMENTAL					
HSE compliance along project stages		X			
Project blockage for unacceptable air emissions			X		
Project blockage for unacceptable solid wastes disposal		X			
Project blockage for unacceptable groundwater contamination			X		
Project blockage for unacceptable liquid emissions		X			
Project blockage for other environmental non compliances		X			
Disconnection of project issues to reg. development and socioeconomic growth		X			
8 - INFRASTRUCTURE (TRANSPORTATION)					
Lacks on infrastructure affecting logistics of commercialization		X			
Lacks on infrastructure affecting logistics of production			X		

**Risk Evaluation for Projects Considering Sustainability Concerns due to Climate Change
The Oil Shale Case Analysis**

THE OIL SHALE PROJECT - BAU (BUSINESS AS USUAL) RISK ASSESSMENT AT PRE-CONSTRUCTION STAGE - FEL 3					
RISKS TO BE EVALUATED	RISK EVALUATION				
	Very low < 1%	Low 1% to 5%	Medium 5% to 10%	High 10% to 20%	Very High >20%
9 - SYNDICATION					
Poor approach to financing for an Equity structure	X				
Poor approach to financing for a Debt structure	X				
Insufficiency or inadequacy of bankable documents	X				
10 -FORCE MAJEURE					
Civil war, war, riots, epidemics	X				
Natural catastrophis	X				
Strikes and disputes with Unions	X				
11 -FOREIGN EXCHANGE					
Country currency devaluation	X				
Country currency non convertibility	X				
Lacks on hedge and swap facilities	X				
12 -MARKET AND COMMERCIALIZATION					
Lacks on qualification and pricing for products to sale	X				
Lacks on buyers for Shale Oil and derivates	X				
Long term price drawdown for outputs		X			
Short term price drawdown for outputs		X			
Limitation on logistics or lacks on contracts for oil transportation		X			
13 -POLITICAL					
Political disarray, economic crisis	X				
Action of activists and environmentalists	X	X			
Tax and ownership changes	X				
Changes on attitudes of public agencies and politicians		X			
14 -INTERESTS & FUNDING					
Unsuitable finance facility for project funding	X				
Lacks on credit insurance and securities	X				
Misbalance on Debt & Equity for funding	X				
15 - SPONSORS AND PARTICIPANTS					
Disbalance on strenght, assets & liabilities of each Sponsor	X				
Legal relationship of the JVCo with contractors and suppliers		X			
Disputes and disagreements in the JVCo for business development	X				
Cash flow shortage by JVCo for the Equity portion	X				
16 -LEGAL & INSTITUTIONAL					
Unfavorable policies and few incentives to Investors and Sponsors		X			
Legal framework inhibiting investments	X				
Controversy and disputes among public authorities in different levels		X			
SUM	41	23	0	0	0
RESULTING AVERAGE RISK FOR THE PROJECT AT FEL 3			1,22%		

THE OIL SHALE PROJECT - SD (SUSTAINABLE DEVELOPMENT SCENARIOS) RISK ASSESSMENT AT PRE-CONSTRUCTION STAGE - FEL 3					
RISKS TO BE EVALUATED	RISK EVALUATION				
	Very low < 1%	Low 1% to 5%	Medium 5% to 10%	High 10% to 20%	Very High >20%
9 - SYNDICATION					
Poor approach to financing for an Equity structure	X				
Poor approach to financing for a Debt structure	X				
Insufficiency or inadequacy of bankable documents	X				
10 -FORCE MAJEURE					
Civil war, war, riots, epidemics	X				
Natural catastrophis	X	X			
Strikes and disputes with Unions	X				
11 - FOREIGN EXCHANGE					
Country currency devaluation		X			
Country currency non convertibility	X				
Lacks on hedge and swap facilities		X			
12 - MARKET AND COMMERCIALIZATION					
Lacks on qualification and pricing for products to sale		X			
Lacks on buyers for Shale Oil and derivates			X		
Long term price drawdown for outputs		X			
Short term price drawdown for outputs			X		
Limitation on logistics or lacks on contracts for oil transportation		X			
13 - POLITICAL					
Political disarray, economic crisis	X				
Action of activists and environmentalists	X	X			
Tax and ownership changes		X			
Changes on attitudes of public agencies and politicians		X			
14 - INTERESTS & FUNDING					
Unsuitable finance facility for project funding		X			
Lacks on credit insurance and securities		X			
Misbalance on Debt & Equity for funding		X			
15 - SPONSORS AND PARTICIPANTS					
Disbalance on strenght, assets & liabilities of each Sponsor		X			
Legal relationship of the JVCo with contractors and suppliers			X		
Disputes and disagreements in the JVCo for business development		X			
Cash flow shortage by JVCo for the Equity portion		X			
16 - LEGAL & INSTITUTIONAL					
Unfavorable policies and few incentives to Investors and Sponsors		X			
Legal framework inhibiting investments		X			
Controversy and disputes among public authorities in different levels		X			
SUM	7	42	15	0	0
RESULTING AVERAGE RISK FOR THE PROJECT AT FEL 3			3,45%		

Risk Evaluation for Projects Considering Sustainability Concerns due to Climate Change
The Oil Shale Case Analysis

THE OIL SHALE PROJECT - BAU (BUSINESS AS USUAL)					
RISK ASSESSMENT AT CONSTRUCTION STAGE					
RISKS TO BE EVALUATED	RISK EVALUATION				
	Very low	Low	Medium	High	Very High
	< 1%	1% to 5%	5% to 10%	10% to 20%	>20%
1 - OPERATING (TECHNICAL / TECHNOLOGICAL)					
Effectiveness of technology of industrial process for producing shale oil	X				
Petroindustrial competitiveness of oil shale process in regard to other	X				
Effectiveness for an HDT processing to upgrade shale oil	X				
Adequacy of plant economic life	X				
Adequacy of plant facilities and utilities for business purposes	X				
2 - OPERATING (COSTS)					
Cost overruns in CAPEX (Capital expenditures)	X				
Cost overruns in ENVEX (Environmental expenditures)	X				
Cost overruns in OPEX (Operation expenditures)	X				
Cost overruns in COMEX (Commercialization expenditures)		X			
Inflation or escalation of costs exceeding pricing for outputs		X			
3 - OPERATING (MANAGEMENT)					
Lower outputs in annual production	X				
Shale oil shortage in production of the industrial plant	X				
Oil shale ore shortage in production of the mining plant		X			
Disconnection between mining an industrial plants	X				
4 - ENGINEERING					
Poor engineering design, planning and budgeting	X				
Failure or poor performance of designed equipment and systems	X				
5 - COMPLETION (IMPLEMENTATION)					
Delayed start-up for the project	X				
Interruption and non completion	X				
Poor construction performance	X				
Stops and delays due to legal disputes on permitting		X			
6 - SUPPLY / RESERVES					
Lacks on oil shale buffering zones and stocks	X				
Lacks on mineable resources or deficit on rate of kerogen in ore	X				
Water shortage due to conflicts on water rights or regional scarcity	X				
Lacks on water supply	X				
Lacks on power supply	X				
Lacks on minor supplies contracts	X				
Lacks on gas supply	X				
7 - ENVIRONMENTAL					
HSE compliance along project stages	X				
Project blockage for unacceptable air emissions	X				
Project blockage for unacceptable solid wastes disposal	X				
Project blockage for unacceptable groundwater contamination	X				
Project blockage for unacceptable liquid emissions	X				
Project blockage for other environmental non compliances		X			
Disconnection of project issues to reg. development and socioeconomic	X				
8 - INFRASTRUCTURE (TRANSPORTATION)					
Lacks on infrastructure affecting logistics of commercialization	X				
Lacks on infrastructure affecting logistics of production	X				

THE OIL SHALE PROJECT - SD (SUSTAINABLE DEVELOPMENT SCENARIOS)					
RISK ASSESSMENT AT CONSTRUCTION STAGE					
RISKS TO BE EVALUATED	RISK EVALUATION				
	Very low	Low	Medium	High	Very High
	< 1%	1% to 5%	5% to 10%	10% to 20%	>20%
1 - OPERATING (TECHNICAL / TECHNOLOGICAL)					
Effectiveness of technology of industrial process for producing shale oil		X			
Petroindustrial competitiveness of oil shale process in regard to other		X			
Effectiveness for an HDT processing to upgrade shale oil		X			
Adequacy of plant economic life		X			
Adequacy of plant facilities and utilities for business purposes		X			
2 - OPERATING (COSTS)					
Cost overruns in CAPEX (Capital expenditures)		X			
Cost overruns in ENVEX (Environmental expenditures)			X		
Cost overruns in OPEX (Operation expenditures)		X			
Cost overruns in COMEX (Commercialization expenditures)			X		
Inflation or escalation of costs exceeding pricing for outputs		X			
3 - OPERATING (MANAGEMENT)					
Lower outputs in annual production		X			
Shale oil shortage in production of the industrial plant		X			
Oil shale ore shortage in production of the mining plant		X			
Disconnection between mining an industrial plants		X			
4 - ENGINEERING					
Poor engineering design, planning and budgeting		X			
Failure or poor performance of designed equipment and systems		X			
5 - COMPLETION (IMPLEMENTATION)					
Delayed start-up for the project		X			
Interruption and non completion		X			
Poor construction performance		X			
Stops and delays due to legal disputes on permitting			X		
6 - SUPPLY / RESERVES					
Lacks on oil shale buffering zones and stocks		X			
Lacks on mineable resources or deficit on rate of kerogen in ore		X			
Water shortage due to conflicts on water rights or regional scarcity	X				
Lacks on water supply		X			
Lacks on power supply		X			
Lacks on minor supplies contracts	X				
Lacks on gas supply		X			
7 - ENVIRONMENTAL					
HSE compliance along project stages		X			
Project blockage for unacceptable air emissions		X			
Project blockage for unacceptable solid wastes disposal		X			
Project blockage for unacceptable groundwater contamination		X			
Project blockage for unacceptable liquid emissions		X			
Project blockage for other environmental non compliances		X			
Disconnection of project issues to reg. development and socioeconomic		X			
8 - INFRASTRUCTURE (TRANSPORTATION)					
Lacks on infrastructure affecting logistics of commercialization		X			
Lacks on infrastructure affecting logistics of production	X				

**Risk Evaluation for Projects Considering Sustainability Concerns due to Climate Change
The Oil Shale Case Analysis**

THE OIL SHALE PROJECT - BAU (BUSINESS AS USUAL)					
RISK ASSESSMENT AT CONSTRUCTION STAGE					
RISKS TO BE EVALUATED	RISK EVALUATION				
	Very low < 1%	Low 1% to 5%	Medium 5% to 10%	High 10% to 20%	Very High >20%
9 - SYNDICATION					
Poor approach to financing for an Equity structure	X				
Poor approach to financing for a Debt structure	X				
Insufficiency or inadequacy of bankable documents	X				
10 - FORCE MAJEURE					
Civil war, war, riots, epidemics	x				
Natural catastrophs	x				
Strikes and disputes with Unions	x				
11 - FOREIGN EXCHANGE					
Country currency devaluation	x				
Country currency non convertibility	x				
Lacks on hedge and swap facilities	x				
12 - MARKET AND COMMERCIALIZATION					
Lacks on qualification and pricing for products to sale	X				
Lacks on buyers for Shale Oil and derivatives	X				
Long term price drawdown for outputs		X			
Short term price drawdown for outputs	X				
Limitation on logistics or lacks on contracts for oil transportation	X				
13 - POLITICAL					
Political disarray, economic crisis	x				
Action of activists and environmentalists		x			
Tax and ownership changes	x				
Changes on attitudes of public agencies and politicians		x			
14 - INTERESTS & FUNDING					
Unsuitable finance facility for project funding	X				
Lacks on credit insurance and securities	X				
Misbalance on Debt & Equity for funding	X				
15 - SPONSORS AND PARTICIPANTS					
Disbalance on strenght, assets & liabilities of each Sponsor	X				
Legal relationship of the JVCo with contractors and suppliers	X				
Disputes and disagreeemens in the JVCo for business development	X				
Cash flow shortage by JVCo for the Equity portion	X				
16 - LEGAL & INSTITUTIONAL					
Unfavorable policies and few incentives to Investors and Sponsors		X			
Legal framework inhibiting investments	x				
Controversy and disputes among public authorities in different levels		X			
SUM	54	10	0	0	0
RESULTING AVERAGE RISK FOR THE PROJECT			0,81%		

THE OIL SHALE PROJECT - SD (SUSTAINABLE DEVELOPMENT SCENARIOS)					
RISK ASSESSMENT AT CONSTRUCTION STAGE					
RISKS TO BE EVALUATED	RISK EVALUATION				
	Very low < 1%	Low 1% to 5%	Medium 5% to 10%	High 10% to 20%	Very High >20%
9 - SYNDICATION					
Poor approach to financing for an Equity structure	X				
Poor approach to financing for a Debt structure	X				
Insufficiency or inadequacy of bankable documents	X				
10 - FORCE MAJEURE					
Civil war, war, riots, epidemics	x				
Natural catastrophs		x			
Strikes and disputes with Unions	x				
11 - FOREIGN EXCHANGE					
Country currency devaluation	x				
Country currency non convertibility	x				
Lacks on hedge and swap facilities	x				
12 - MARKET AND COMMERCIALIZATION					
Lacks on qualification and pricing for products to sale		x			
Lacks on buyers for Shale Oil and derivatives		x			
Long term price drawdown for outputs			x		
Short term price drawdown for outputs			x		
Limitation on logistics or lacks on contracts for oil transportation		x			
13 - POLITICAL					
Political disarray, economic crisis	x				
Action of activists and environmentalists		x			
Tax and ownership changes		x			
Changes on attitudes of public agencies and politicians		x			
14 - INTERESTS & FUNDING					
Unsuitable finance facility for project funding	X				
Lacks on credit insurance and securities	X				
Misbalance on Debt & Equity for funding	X				
15 - SPONSORS AND PARTICIPANTS					
Disbalance on strenght, assets & liabilities of each Sponsor		x			
Legal relationship of the JVCo with contractors and suppliers		x			
Disputes and disagreeemens in the JVCo for business development		x			
Cash flow shortage by JVCo for the Equity portion		x			
16 - LEGAL & INSTITUTIONAL					
Unfavorable policies and few incentives to Investors and Sponsors		x			
Legal framework inhibiting investments	x				
Controversy and disputes among public authorities in different levels		x			
SUM	11	49	5	0	0
RESULTING AVERAGE RISK FOR THE PROJECT			2,55%		

Risk Evaluation for Projects Considering Sustainability Concerns due to Climate Change
The Oil Shale Case Analysis

OIL SHALE PROJECT

SUMMARY OF RISK ANALYSIS - THE 16 MAIN TYPES OF RISKS AND RELATED 64 INDICATORS (ITEMS)

1 - OPERATING (TECHNICAL / TECHNOLOGICAL) - NEED TO ADD SUSTAINABILITY CONCERNS TO ANALYSIS		Impact of sustainability concerns in the evaluation	6 - SUPPLY / RESERVES - NEED TO ADD SUSTAINABILITY CONCERNS TO ANALYSIS		Impact of sustainability concerns in the evaluation
Effectiveness of technology on industrial processing for producing shale oil	yes, affected by changes in risk measurement and cost for mitigation		Lacks on space for buffering zones and stocks	yes, affected by changes in risk measurement and cost for mitigation	
Technological competitiveness in regard to other process	yes, affected by changes in risk measurement and cost for mitigation		Lacks on mineable resources or deficit on kerogen rate	not directly affected by sustainability concerns	
Effectiveness for an HDT to upgrade shale oil	yes, affected by changes in risk measurement and cost for mitigation		Water shortage due to conflicts or scarcity	yes, affected by changes in risk measurement and cost for mitigation	
Adequacy of Plant economic life	yes, affected by changes in risk measurement and cost for mitigation		Lacks on water supply	yes, affected by changes in risk measurement and cost for mitigation	
Adequacy of plant facilities and utilities for business	yes, affected by changes in risk measurement and cost for mitigation		Lacks on power supply	yes, affected by changes in risk measurement and cost for mitigation	
2 - OPERATING (COSTS) - NEED TO ADD SUSTAINABILITY CONCERNS TO ANALYSIS		Impact of sustainability concerns in the evaluation	Lacks on minor supplies contracts	yes, affected by changes in risk measurement and cost for mitigation	
Cost overruns in CAPEX (Capital Expenditures)	yes, affected by changes in risk measurement and cost for mitigation		Lacks on gas supply	yes, affected by changes in risk measurement and cost for mitigation	
Cost overruns in ENVEX (Environmental expenditures)	yes, affected by changes in risk measurement and cost for mitigation		7 - ENVIRONMENTAL & SOCIAL - NEED TO ADD SUSTAINABILITY CONCERNS TO ANALYSIS		Impact of sustainability concerns in the evaluation
Cost overruns in OPEX (Operation expenditures)	yes, affected by changes in risk measurement and cost for mitigation		HSE compliance along project stages	yes, affected by changes in risk measurement and cost for mitigation	
Cost overruns in COMEX (Commercialization expenditures)	yes, affected by changes in risk measurement and cost for mitigation		Project blockage for unacceptable air emissions	yes, affected by changes in risk measurement and cost for mitigation	
Escalation costs exceeding pricing for outputs	yes, affected only by changes in cost for mitigation		Project blockage for unacceptable solid wastes disposal	yes, affected by changes in risk measurement and cost for mitigation	
3 - OPERATING (MANAGEMENT) - NEED TO ADD SUSTAINABILITY AND SOCIAL RESPONSIBILITY CONCERNS TO ANALYSIS		Impact of sustainability concerns in the evaluation	Project blockage for unacceptable groundwater contamination	yes, affected by changes in risk measurement and cost for mitigation	
Lower outputs in annual production	yes, affected by changes in risk measurement and cost for mitigation		Project blockage for unacceptable liquid emissions	yes, affected by changes in risk measurement and cost for mitigation	
Oil shale shortage in production of the industrial plant	yes, affected only by changes in cost for mitigation		Project blockage for GHGs emissions	yes, affected by changes in risk measurement and cost for mitigation	
Oil Shale ore shortage in production of the mining plant	yes, affected only by changes in cost for mitigation		Disconnection to regional development and socioeconomic growth	yes, affected by changes in risk measurement and cost for mitigation	
Disconnection between mining and industrial plants	yes, affected only by changes in cost for mitigation		8 - INFRASTRUCTURE (TRANSPORTATION) - NEEDED TO ADD SUSTAINABILITY CONCERNS TO ANALYSIS		Impact of sustainability concerns in the evaluation
4 - ENGINEERING - NEED TO ADD SUSTAINABILITY CONCERNS TO ANALYSIS		Impact of sustainability concerns in the evaluation	Lacks on infrastructure & logistics for commercialization	yes, affected by changes in risk measurement and cost for mitigation	
Poor engineering design, planning and budgeting	yes, affected only by changes in cost for mitigation		Lacks on infrastructure & logistics for production	yes, affected by changes in risk measurement and cost for mitigation	
Failure or poor performance of equipment and systems	yes, affected only by changes in cost for mitigation		9 - SYNDICATION (OF BANKS)		Impact of sustainability concerns in the evaluation
5 - COMPLETION (IMPLEMENTATION) - NEED TO ADD SUSTAINABILITY CONCERNS TO ANALYSIS		Impact of sustainability concerns in the evaluation	Poor approach to financing by an Equity structure	not directly affected by sustainability concerns	
Delayed start-up of the project	yes, affected only by changes in cost for mitigation		Poor approach to financing by a Debt structure	not directly affected by sustainability concerns	
Interruption and/or non completion	yes, affected by changes in risk measurement and cost for mitigation		Insufficiency or scarcity of bankable documents	not directly affected by sustainability concerns	
Poor construction performance	yes, affected only by changes in cost for mitigation		<p>Main effects derived from the consideration of sustainability principles and concerns: a) scale up of risks likelihood and impact b) increasing costs and timing for mitigation or adaptation measures</p>		
Stops or interruption by legal disputes on Permittings	yes, affected by changes in risk measurement and cost for mitigation				

REMARK: FROM THE 64 ITEMS CONSIDERED ONLY 10 ARE NOT AFFECTED BY CHANGES IN THE APPROACH DUE TO CSSR CONCERNS AND PRINCIPLES

OIL SHALE PROJECT

SUMMARY OF RISK ANALYSIS - THE 16 MAIN TYPES OF RISKS AND RELATED 64 INDICATORS (ITEMS)

10 - FORCE MAJEURE NEED TO ADD SUSTAINABILITY CONCERNS TO ANALYSIS		14 - INTERESTS & FUNDING	15 - SPONSORS AND PARTICIPANTS NEED TO ADD SOCIAL RESPONSIBILITY CONCERNS TO ANALYSIS
Civil war, war, riots, epidemics	yes, affected by changes in risk measurement and cost for mitigation	Inadequate financial facility for project funding	yes, affected by changes in risk management and cost for mitigation
Natural catastrophis	yes, affected by changes in risk measurement and cost for mitigation	Lacks on credit insurance and securities	yes, affected by changes in risk management and cost for mitigation
Strikes and disputes with Unions	yes, affected by changes in risk measurement and cost for mitigation	Misbalance on Debt & Equity for funding	yes, affected by changes in risk management and cost for mitigation
11 - FOREIGN EXCHANGE		16 - LEGAL & INSTITUTIONAL NEED TO ADD SUSTAINABILITY CONCERNS TO ANALYSIS	
Currency devaluation or valuation in regard to a reference basket of currencies	not directly affected by sustainability concerns	Disbalance on strenght, assets & liabilities of each Sponsor	yes, affected by changes in risk management and cost for mitigation
Currency non convertibility	not directly affected by sustainability concerns	Nature of legal & commercial links of JVCo with contractors	yes, affected by changes in risk management and cost for mitigation
Lacks on hedge and swap facilities	not directly affected by sustainability concerns	Disputes or disagreements among JVCo Sponsors	yes, affected by changes in risk management and cost for mitigation
12 - MARKET AND COMMERCIALIZATION NEED TO ADD SUSTAINABILITY CONCERNS TO ANALYSIS		Inadequate JVCo By-Laws and Shareholder Agreements	yes, affected by changes in risk management and cost for mitigation
Lacks on qualification and pricing for products to sell	yes, affected by changes in risk measurement and cost for mitigation	16 - LEGAL & INSTITUTIONAL NEED TO ADD SUSTAINABILITY CONCERNS TO ANALYSIS	
Scarcity of buyers for the Shale Oil and derivates	yes, affected by changes in risk measurement	Unfavorable policies and few incentives to Investors	yes, affected by changes in risk measurement and cost for mitigation
Long term price drawdown for outputs	yes, affected by changes in risk measurement	Legal framework inhibiting investments	yes, affected by changes in risk measurement and cost for mitigation
Short term price drawdown for outputs	yes, affected by changes in risk measurement and cost for mitigation	Controversy and disputes among public authorities in different levels supported by legal framework	yes, affected by changes in risk measurement and cost for mitigation
Limitation on logistics or contracts for oil transportation	yes, affected by changes in risk measurement and cost for mitigation		
13 - POLITICAL NEED TO ADD SOCIAL RESPONSIBILITY CONCERNS TO ANALYSIS			
Political disarray, economical crisis	yes, affected by changes in risk measurement and cost for mitigation		
Action of activists and environmentalists	yes, affected by changes in risk measurement and cost for mitigation		
Tax changes and ownership alterations	yes, affected by changes in risk measurement and cost for mitigation		
Changes on attitudes by public agencies and politicians	yes, affected by changes in risk measurement and cost for mitigation		
Main effects derived from the consideration of sustainability principles and concerns: a) scale up of risks likelihood and impact b) increasing costs and timing for mitigation or adaptation measures		Main effects derived from the consideration of sustainability principles and concerns: a) scale up of risks likelihood and impact b) increasing costs and timing for mitigation or adaptation measures	

REMARK: FROM THE 64 ITEMS CONSIDERED ONLY 10 ARE NOT AFFECTED BY CHANGES IN THE APPROACH DUE TO CSSR CONCERNS AND PRINCIPLES

Risk Evaluation for Projects Considering Sustainability Concerns due to Climate Change
The Oil Shale Case Analysis

PROJECT RISK ANALYSIS WITH NEW SUSTAINABILITY CONCERNS

QUALITATIVE MATRIX INFORMATION WITH 1,024 CELLS (16 EVALUATION x 64 RISK ITEMS)

OIL SHALE PROJECT

OIL SHALE PROJECT

SHEET 1

THE ROAD MAP FOR RISK ASSESSMENT AND MANAGEMENT

THE ROAD MAP FOR RISK ASSESSMENT AND MANAGEMENT

SHEET 1

TYPE OF RISK	Engineering and Commercial Feasibility				Bankable Feasibility				Pre-Construction Stage				Construction Stage			
	Main feature	Likelihood	Impact	Management	Main feature	Likelihood	Impact	Management	Main feature	Likelihood	Impact	Management	Main feature	Likelihood	Impact	Management
1 - OPERATING (TECHNICAL / TECHNOLOGICAL) - NEED TO ADD SUSTAINABILITY CONCERNS TO ANALYSIS	Selected main aspect for a relevant item forming risk	medium	very high	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	low	very high	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	low	very high	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	very low	very high	Selected main item for managing risk
Effectiveness of technology on industrial processing for producing shale oil	The non reliability for producing shale oil in commercial basis under constraints of sustainability principles	medium to high	very high	planning a future plant demonstration tests in large scale prototype with sustainability concerns	The non reliability for producing shale oil in commercial basis under constraints of sustainability principles	medium	very high	provide demonstration tests in process with adjustments and certificates corroborating the compliance to sustainability	The non conformity to production of shale oil in commercial basis also submitted to sustainability constraints	low	very high	install and operate a pilot plant in the project area and divulgate results in conformity to sustainability practices	The lacks on optimization of the industrial process to be attractive in commercial basis also considering the sustainability	low	very high	Continuously expand project pilot capacity and provide operation to allow for conclusions in larger scales always complying with sustainability
Petroindustrial competitiveness of oil shale process in regard to other process	Excess of consumption rates, losses in processing oil shale in retort, balance against in situ processes	medium to low	very high	make inventory from files and technical literature, collect data from industrial units, adapt them for considering sustainability	excess of consumption rates, losses in processing oil shale in retort, balance against in situ processes	medium	very high	reduce losses and consumption rates, sponsor comparative studies and inventory the state of art on this subject	excess of consumption rates, losses in processing oil shale in retort, balance against in situ processes	low	very high	keep on the follow up of competitor's processes and improve Petroindustrial standards through R & D	excess of consumption rates, losses in processing oil shale in retort, balance against in situ processes	low	very high	keep on the follow up of competitor's processes and improve Petroindustrial standards through R & D
Effectiveness for an HDT to upgrade shale oil	Inadequacy of the selected HDT to process shale oil of mines in hydrotreating aggravated by non compliance to sustainable principles	medium	very high	specific conceptual engineering studies using PDMS and Aspen K incorporating sustainability issues	Inadequacy of the selected HDT to process shale oil of mines in hydrotreating aggravated by non compliance to sustainable principles	medium to low	very high	update and improve engineering studies with data from oil shale tests from selected laboratory adapting them for considering sustainability	Inadequacy of the selected HDT to process shale oil of mines in hydrotreating aggravated by non compliance to sustainable principles	low	very high	new update with other data from new samples of oil shale laboratory tests to be obtained from extra drills always considering sustainability	Inadequacy of the selected HDT to process shale oil of mines in hydrotreating aggravated by non compliance to sustainable principles	low	very high	final tests at a research center in long term basis considering all requirements derived from sustainability compliance
Adequacy of plant economic life	Desequilibrium between economic life of mining and industrial sectors aggravated by sustainability concerns	medium	high	provide master time-schedule and planning in connection to operating characteristics of each sector subordinated to sustainability concerns	Desequilibrium between economic life of mining and industrial sectors	medium	high	improve master project schedule and planning in detail to check discrepancies and provide solution for amernization in connection to sustainability concerns	economic life of mining and industrial sectors aggravated by climate changes	low	high	critical analysis reviewing main factors and equipment inducing discrepancy on economic life of sectors and propose a compensation in connection to sustainability concerns	between economic life of mining and industrial sectors aggravated by climate changes	low	high	provide maintenance manuals and operating guide lines to fit to expected economic life by considering all aspects of sustainability and climate change
Adequacy of plant facilities and utilities for business purposes	Non optimization of facilities and utilities and lacks on their integration aggravated by the non compliance to sustainable principles	medium	medium	provide specific studies for optimization of equipment and system, and integration of solutions for business units also subordinated to sustainability rules	sectors Non optimization of facilities and utilities and lacks on their integration aggravated by the non compliance to sustainable principles	medium to low	medium	provide specific questions in regard to performance, guarantee of equipment, contract expert co. on integration of solutions	Non optimization of facilities and utilities and lacks on their integration aggravated by the non compliance to sustainable principles	medium to low	medium	Non optimization of facilities and utilities and lacks on their integration aggravated by the non compliance to sustainable principles	Non optimization of facilities and utilities and lacks on their integration aggravated by the non compliance to sustainable principles	low	medium	follow-up and constructibility review to preserve the optimized design and integration of solutions always in connection to sustainability concerns
2 - OPERATING (COSTS) - NEED TO ADD SUSTAINABILITY CONCERNS TO ANALYSIS	Selected main aspect for a relevant item forming risk	medium	medium to high	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	medium to low	medium to high	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	low	medium to high	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	very low	medium to high	Selected main item for managing risk
Cost overruns in CAPEX (Capital expenditures)	Poor cost estimates based on insufficient engineering design and planning for not considering sustainability concerns	medium to high	very high	Provide high quality engineering design and planning for the project stage considering sustainability principles	Poor cost estimates based on insufficient engineering design and planning for not considering sustainability concerns	medium	very high	Provide high quality engineering design and planning for the project stage considering sustainability principles	Poor cost estimates based on insufficient engineering design and planning for not considering sustainability concerns	medium to low	very high	Provide engineering added value for increasing economy of facilities	Poor cost estimates based on insufficient engineering design and planning for not considering sustainability concerns	medium to low	very high	Adequate project management to confirm results of pre-construction stage taking into account sustainable practices
Cost overruns in ENVEX (Environmental expenditures)	Poor cost estimates based on insufficient environmental studies and planning not considering sustainability concerns	medium to high	medium	provide high quality environmental studies and planning for the project stage considering sustainability principles	Poor cost estimates based on insufficient environmental studies and planning not considering sustainability concerns	medium	medium	provide high quality environmental studies and planning for the project stage considering sustainability principles	Poor cost estimates based on insufficient environmental studies and planning not considering sustainability concerns	medium to low	medium	provide environmental added value for increasing compliance of facilities	Poor cost estimates based on insufficient environmental studies and planning not considering sustainability concerns	low	medium	HSE compliance to the construction and exploitation stage taking into account sustainable practices
Cost overruns in OPEX (Operating expenditures)	Poor cost estimates based on insufficient environmental studies and planning not considering sustainability concerns	medium to high	medium	Provide high quality engineering design and planning for the project stage considering sustainability principles	Poor cost estimates based on insufficient environmental studies and planning not considering sustainability concerns	medium	medium	Provide high quality engineering design and planning for the project stage considering sustainability principles	Poor cost estimates based on insufficient environmental studies and planning not considering sustainability concerns	medium to low	medium	Provide engineering added value for increasing economy of facilities	Poor cost estimates based on insufficient environmental studies and planning not considering sustainability concerns	medium to low	medium	Adequate project management to confirm results of pre-construction stage considering risks derived from the sustainability compliance
Cost overruns in COMEX (Commercialization expenditures)	Poor cost estimates based on lacks of market and commercialization studies for not considering trends for sustainable trading business	medium	medium	provide high quality marketing sustainable studies and plans for the project stage	Poor cost estimates based on lacks of market and commercialization studies for not considering trends for sustainable trading business	medium	medium	provide high quality marketing sustainable studies and plans for the project stage	Poor cost estimates based on lacks of market and commercialization studies for not considering trends for sustainable trading business	medium to low	medium	provide effective access to market at the lowest cost	Poor cost estimates based on lacks of market and commercialization studies for not considering trends for sustainable trading business	low	medium	adequate marketing plan to confirm results of pre-construction stage considering risks derived from the sustainability compliance
Inflation or escalation costs exceeding pricing for outputs	Poor economic projections for price escalation for ignoring projections for the effect of sustainable practices over commodities and raw materials	medium to high	high	provide high quality economic projections for the project stage supported by sustainable economic projections	Poor economic projections for price escalation for ignoring projections for the effect of sustainable practices over commodities and raw materials	medium to low	high	provide high quality economic projections for the project stage supported by sustainable economic projections	Poor economic projections for price escalation for ignoring projections for the effect of sustainable practices over commodities and raw materials	medium to low	high	search for long-term future sale contracts for products assuring prices depending on new sustainable framework	Poor economic projections for price escalation for ignoring projections for the effect of sustainable practices over commodities and raw materials	medium to low	high	provide long-term future sale contracts for products assuring prices depending on new rules of international trading considering sustainability

Risk Evaluation for Projects Considering Sustainability Concerns due to Climate Change
The Oil Shale Case Analysis

PROJECT RISK ANALYSIS WITH NEW SUSTAINABILITY CONCERNS																			
OIL SHALE PROJECT								OIL SHALE PROJECT											
SHEET 2		THE ROAD MAP FOR RISK ASSESSMENT AND MANAGEMENT								THE ROAD MAP FOR RISK ASSESSMENT AND MANAGEMENT								SHEET 2	
TYPE OF RISK	Engineering and Commercial Feasibility				Bankable Feasibility				Pre-Construction Stage				Construction Stage						
	Main feature	Likelihood	Impact	Management	Main feature	Likelihood	Impact	Management	Main feature	Likelihood	Impact	Management	Main feature	Likelihood	Impact	Management			
3 - OPERATING (MANAGEMENT) - NEED TO ADD SUSTAINABILITY AND SOCIAL RESPONSIBILITY CONCERNS TO ANALYSIS	Selected main aspect for a relevant item forming risk	medium to low	medium	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	medium to low	medium	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	low	medium	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	very low	medium	Selected main item for managing risk			
Lower outputs in annual production	Decaying in oil production by mismanagement or entrepreneurial deficiencies also for not adequately considering sustainability	medium	medium	Prepare an adequate organization-chart and skill management requirements including to fit CSSR issues	Decaying in oil production by mismanagement or entrepreneurial deficiencies also for not adequately considering sustainability	medium	medium	Improve and detail an adequate organization-chart and skill management requirements including the fitting to CSSR issues	Decaying in oil production by mismanagement or entrepreneurial deficiencies also for not adequately considering sustainability	medium to low	medium	Select a qualified Operator with background in connection to an effective program on skill management resources, training, information exchange and smart data control system for the JVCo also fitting to CSSR issues	Decaying in oil production by mismanagement or entrepreneurial deficiencies also for not adequately considering sustainability	low	medium	Select a qualified Operator with background and provide a permanent check-in for program on development of resources and managerial methods involving CSSR methods			
Shale oil shortage in production of the industrial plant	Shortages in production of shale oil and by-products due to plant casualties or accidents also for not considering sustainability	medium to low	low	Prepare adequate and reliable HSE plans for oil production including to fit CSSR issues	Shortages in production of shale oil and by-products due to plant casualties or accidents also for not considering sustainability	medium to low	low	Improved and detail adequate and reliable HSE plans for oil production including the fitting to CSSR issues	Shortages in production of shale oil and by-products due to plant casualties or accidents also for not considering sustainability	low	low	Adopt effective program on industrial plant in HSE for accidents and unpredictable stops including CSSR procedures	Shortages in production of shale oil and by-products due to plant casualties or accidents also for not considering sustainability	low	low	Make a continuous permanent check-in for program on development of HSE industrial practices subject to CSSR constraints			
Oil Shale ore shortage in production of the mining plant	Shortages in production of oil shale ore due to plant casualties also for not considering sustainability	medium	medium	Prepare adequate and reliable HSE plans for mining including to fit CSSR issues	Shortages in production of oil shale ore due to plant casualties also for not considering sustainability	medium	medium	Improved and detail adequate and reliable HSE plans for mining including the fitting to CSSR issues	Shortages in production of oil shale ore due to plant casualties also for not considering sustainability	medium to low	medium	Adopt effective program on mining plant in HSE for accidents and unpredictable stops including CSSR procedures	Shortages in production of oil shale ore due to plant casualties also for not considering sustainability	low	medium	Make a continuous permanent check-in for program on development of HSE mining practices subject to CSSR constraints			
Disconnection between mining and industrial plants	Lacks on the overlapping and ramp-up of mining and plant activities also for not considering sustainability	low	medium	Prepare business operational linkage among mining and industrial activities, and define management for interfaces including the fitting to CSSR issues	Lacks on the overlapping and ramp-up of mining and plant activities also for not considering sustainability	low	medium	Improve and detail business operational linkages among activities and define the management of interfaces including the fitting to CSSR issues	Lacks on the overlapping and ramp-up of mining and plant activities also for not considering sustainability	low	medium	Adopt effective program on skill management resources, training, information exchange and smart data control system including CSSR procedures	Lacks on the overlapping and ramp-up of mining and plant activities also for not considering sustainability	low	medium	Make a continuous permanent check-in for program on development of skill management subject to CSSR constraints			
4 - ENGINEERING - NEED TO ADD SUSTAINABILITY CONCERNS TO ANALYSIS	Selected main aspect for a relevant item forming risk	medium to low	high	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	low	high	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	very low	high	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	very low	high	Selected main item for managing risk			
Poor engineering design, planning and budgeting	Fails on project implementation or operation for ignoring sustainability issues and constraints	medium	very high	Provide high quality engineering and consulting services for the project stage taking into account project SD concepts	Fails on project implementation or operation for ignoring sustainability issues and constraints	medium	very high	Provide high quality engineering and consulting services for the project stage taking into account project SD concepts	Fails on project implementation or operation for ignoring sustainability issues and constraints	low	very high	Provide high quality engineering and consulting services for the project stage taking into account project SD concepts	Fails on project implementation or operation for ignoring sustainability issues and constraints	low	very high	Follow-up and constructibility review to preserve the optimized design taking into account project SD concepts			
Failure or poor performance of designed equipment and systems	Fails on equipment during assembly and/or operation for ignoring sustainability issues and constraints	medium	high	Provide high quality engineering and consulting services for the project stage identified with sustainability concepts	Fails on equipment during assembly and/or operation for ignoring sustainability issues and constraints	medium	high	Provide high quality engineering and consulting services for the project stage identified with sustainability concepts	Fails on equipment during assembly and/or operation for ignoring sustainability issues and constraints	low	high	Provide high quality procurement services and reliable suppliers identified with sustainability concepts	Fails on equipment during assembly and/or operation for ignoring sustainability issues and constraints	low	high	Follow-up and constructibility review to preserve the optimum performance for equipment and systems taking into account sustainability constraints			

Remark: The red letters correspond to changes on each item for moving from BAU to SD scenario

Risk Evaluation for Projects Considering Sustainability Concerns due to Climate Change The Oil Shale Case Analysis

PROJECT RISK ANALYSIS WITH NEW SUSTAINABILITY CONCERNS																
OIL SHALE PROJECT																
THE ROAD MAP FOR RISK ASSESSMENT AND MANAGEMENT								THE ROAD MAP FOR RISK ASSESSMENT AND MANAGEMENT								
SHEET 3																
TYPE OF RISK	Engineering and Commercial Feasibility				Bankable Feasibility				Pre-Construction Stage				Construction Stage			
	Main feature	Likelihood	Impact	Management	Main feature	Likelihood	Impact	Management	Main feature	Likelihood	Impact	Management	Main feature	Likelihood	Impact	Management
5 - COMPLETION (IMPLEMENTATION) NEED TO ADD SUSTAINABILITY CONCERNS TO ANALYSIS	Selected main aspect for a relevant item forming risk	medium to low	high	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	medium to low	high	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	low	high	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	low	high	Selected main item for managing risk
Delayed start-up of the project	Problems on preparing engineering studies and construction documents and on procurement of suppliers also due to lacks on consideration of sustainable practices	medium	high	Provide adequate engineering studies and design in connection to inventory of suppliers to improve quality of approach considering sustainability concerns	Problems on preparing engineering construction documents and on procurement of suppliers also due to lacks on consideration of sustainable practices	medium	high	Provide adequate engineering studies and design in connection to inventory of suppliers to improve quality of approach considering sustainability concerns	Problems on preparing engineering construction documents and on procurement of suppliers also due to lacks on consideration of sustainable practices	medium to low	high	Provide adequate engineering and procurement services in connection to project development decisions to reduce chances of postponement considering sustainability concerns	Problems on preparing engineering construction documents and on procurement of suppliers also due to lacks on consideration of sustainable practices	low	high	Gather Project Manager and EPC contract staffs to prepare a common approach to project implementation, including on site reviews and re-schedules wherever needed with the Owner's Engineering acting on that considering sustainability
Interruption and/or non completion	Default by contractors or suppliers on rendering services or deliveries for not properly considering sustainable practices	medium to low	high	Prepare an affordable approach and structure to access reliable contractors during project development and implementation	Default by contractors or suppliers on rendering services or deliveries for not properly considering sustainable practices	medium to low	high	Prepare an affordable approach and structure to access reliable contractors during project development and implementation	Default by contractors or suppliers on rendering services or deliveries for not properly considering sustainable practices	medium to low	high	Build up of technical and legal packages to support main and miscellaneous contracts	Default by contractors or suppliers on rendering services or deliveries for not properly considering sustainable practices	low	high	Execute technical and legal packages to sign main and miscellaneous contracts including follow-up
Poor construction performance	Poor selection of Main Contractor and sub-contractors also for not properly considering sustainable practices	medium	high	Make a detailed inventory of reputable and qualified potential EPC contractors	Poor selection of Main Contractor and sub-contractors also for not properly considering sustainable practices	medium	high	Make a short-list of reputable and qualified EPC contractors to be considered	Poor selection of Main Contractor and sub-contractors also for not properly considering sustainable practices	medium to low	high	Investigate and select the EPC Contractor, start negotiations and structure the JVCs for the follow-up	Poor selection of Main Contractor and sub-contractors also for not properly considering sustainable practices	low	high	Make contracts and agreements for construction and supplies strongly supported by bonds to minimize consequences on performance
Stops and delays due to legal disputes on permitings	Political and social reaction against non renewable energy projects due to increasing feelings in favor to sustainability	medium to high	medium to high	Provide adequate background and action to fulfil agencies and society requirements in a timely manner	Political and social reaction against non renewable energy projects due to increasing feelings in favor to sustainability	medium to high	medium to high	Provide counter measures and comply with mitigation attitudes demanded by society	Social movements, politicians and authorities against project construction due to increasing feelings in favor to sustainability	medium	medium to high	Prepare Permits by hiring high qualified experts and consulting companies with openings in the legal & social framework	Social movements, politicians and authorities against project construction due to increasing feelings in favor to sustainability	medium to low	medium to high	Follow-up for approval of Permits in all stages
6 - SUPPLY / RESERVES - NEED TO ADD SUSTAINABILITY CONCERNS TO ANALYSIS	Selected main aspect for a relevant item forming risk	medium to low	medium	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	medium to low	medium	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	low	medium	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	very low	medium	Selected main item for managing risk
Lacks on oil shale buffering zones and stocks	Poor approach on Master Plan and General Layout by consulting engineers for discounting relevant questions on sustainability	medium	medium to low	Get adequate mapping & imagery and field surveying data taking into account sustainability issues	Poor approach on Master Plan and General Layout by consulting engineers for discounting relevant questions on sustainability	medium	medium to low	Improve detail of mapping & imagery and field surveying data in connection to GPS taking into account sustainability issues	Imprecise needs arising from deep investigation requiring project relocations also due to sustainability new constraints	medium to low	low	Provide land surveying of specific areas to confirm hypothesis taking into account sustainability issues	Imprecise needs arising from camp site works and constructibility review also due to sustainability new constraints	low	low	Provide land surveying of areas subject to earth cut and fill works taking into account sustainability issues
Lacks on mineable resources or deficit on kerogen rate	Low density of field investigation and lab tests, and unskilled geological evaluation and analysis	medium to low	medium	Provide an effective drilling program and lab tests on a sequence of work compatible to project stage	Low density of field investigation and lab tests, and unskilled geological evaluation and analysis	medium to low	medium to low	Provide an effective drilling program and lab tests on a sequence of work compatible to project stage	Inadequacy of geological and mining models applied to strata	low	medium	Provide an effective geological and mining modeling using field and lab data	Inadequacy of geological and mining models applied to strata	low	medium	using field and lab data
Water shortage due to conflicts on water rights or regional scarcity	Poor field survey or inventory of water resources and rights for not considering sustainable resources	medium	medium to high	Provide agreements and institutional solutions for prior appropriation of water in all cases taking into account sustainability issues	Poor field survey or inventory of water resources and rights for not considering sustainable resources	medium	medium to high	Provide agreements and institutional solutions for prior appropriation of water in all cases taking into account sustainability issues	Lacks on negotiation to access the appropriation for water in quality and quantity for project needs due to underestimates resulted from poor approach to sustainability	medium to low	medium to high	Sign agreements and provide institutional solutions for prior appropriation of water in quality and quantity for project needs due to underestimates resulted from poor approach to sustainability	Lacks on negotiation to access the appropriation for water in quality and quantity for project needs due to underestimates resulted from poor approach to sustainability	medium to low	medium to high	Sign agreements and provide institutional solutions for prior appropriation of water in all cases taking into account sustainability issues
Lacks on water supply	Occurrence of severe droughts or changes in regional rate of consumption of water intensified by climate change	medium	very high	Provide alternative sources or means of water supply supported by effective contracts taking into account sustainability	Occurrence of severe droughts or changes in regional rate of consumption of water intensified by climate change	medium	very high	Provide alternative sources or means of water supply supported by effective contracts taking into account sustainability	Occurrence of severe droughts or changes in regional rate of consumption of water intensified by climate change	medium to low	very high	Build, lease or own alternative sources or means of water supply taking into account sustainability concerns	Occurrence of severe droughts or changes in regional rate of consumption of water intensified by climate change	low	very high	Build, lease or own alternative sources or means of water supply taking into account sustainability concerns
Lacks on power supply	Occurrence of severe black-outs or collapse of local electric system intensified by climate change	medium to low	high	Provide alternative sources or means of energy& power supply supported by effective contracts considering sustainability new constraints	Occurrence of severe black-outs or collapse of local electric system intensified by climate change	medium to low	high	Provide alternative sources or means of energy& power supply supported by effective contracts considering sustainability new constraints	Occurrence of severe black-outs or collapse of local electric system intensified by climate change	low	high	Implement alternative sources or means of energy& power supply supported by effective contracts either as associated investment or standby operation costs considering sustainability new constraints	Occurrence of severe black-outs or collapse of local electric system intensified by climate change	low	high	Implement alternative sources or means of energy& power supply supported by effective contracts either as associated investment or standby operation costs considering sustainability new constraints
Lacks on minor supplies contracts	Occurrence of default by minor suppliers for any reason including the non compliance to sustainable practices	medium to low	medium	Provide alternative sources for minor supplies supported by effective contracts considering sustainability new constraints	Occurrence of default by minor suppliers for any reason including the non compliance to sustainable practices	medium to low	medium	Provide alternative sources for minor supplies supported by effective contracts considering sustainability new constraints	Occurrence of default by minor suppliers for any reason including the non compliance to sustainable practices	low	medium	Implement alternative sources for minor supplies by signing effective contracts considering sustainability concerns	Occurrence of default by minor suppliers for any reason including the non compliance to sustainable practices	low	medium	Use alternative minor supplies based on signed contracts complying with sustainability practices
Lacks on gas supply	Occurrence of gas shortage due to fields exhaustion or problems in pipelines including effects due to non-sustainable practices	medium	high	Provide alternative sources or means of gas supply supported by effective contracts considering sustainability new constraints	Occurrence of gas shortage due to fields exhaustion or problems in pipelines including effects due to non-sustainable practices	medium	high	Provide alternative sources or means of gas supply supported by effective contracts considering sustainability new constraints	Occurrence of gas shortage due to fields exhaustion or problems in pipelines including effects due to non-sustainable practices	medium to low	high	Implement alternative sources or means of gas supply supported by effective contracts signed either on real use or standby basis considering changes due to sustainability	Occurrence of gas shortage due to fields exhaustion or problems in pipelines including effects due to non-sustainable practices	low	high	Implement alternative sources of gas supply supported by effective contracts signed complying with sustainability practices

Risk Evaluation for Projects Considering Sustainability Concerns due to Climate Change
The Oil Shale Case Analysis

PROJECT RISK ANALYSIS WITH NEW SUSTAINABILITY CONCERNS																
OIL SHALE PROJECT																
OIL SHALE PROJECT																
THE ROAD MAP FOR RISK ASSESSMENT AND MANAGEMENT																
THE ROAD MAP FOR RISK ASSESSMENT AND MANAGEMENT																
SHEET 4																
SHEET 4																
TYPE OF RISK	Engineering and Commercial Feasibility				Bankable Feasibility				Pre-Construction Stage				Construction Stage			
	Main feature	Likelihood	Impact	Management	Main feature	Likelihood	Impact	Management	Main feature	Likelihood	Impact	Management	Main feature	Likelihood	Impact	Management
7 - ENVIRONMENTAL & SOCIAL - NEED TO ADD SUSTAINABILITY CONCERNS	Selected main aspect for a relevant item forming risk	medium to low	medium to high	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	medium to low	medium to high	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	low	medium to high	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	very low	medium to high	Selected main item for managing risk
TO ANALYSIS	Troubles on permitting for not complying with HSE standards defined for the project and area	medium to high	medium to high	Provide adequate approach to environmental baseline and industrial diagnosis to mitigate or eliminate problems and fill-up of all HSE requirements for permitings including SD issues	Troubles on permitting for not complying with HSE standards defined for the project and area	medium to high	medium to high	Provide engineering solutions for complying with all HSE requirements in a timely manner including solutions for SD issues	Troubles on permitting for not complying with HSE standards defined for the project and area	low	medium to high	Make all initiatives for the execution of HSE program very transparent and accept participation of community and institutions on checking considering new issues from climate change and SD	Troubles on permitting for not complying with HSE standards defined for the project and area	low	medium to high	Execute in a timely manner all steps for HSE compliance along implementation and prepare the J/Co for the exploitation stage considering CSSR concerns
HSE compliance along project stages	aggravated by new packages derived from climate change mitigation	medium to high	medium to high		aggravated by new packages derived from climate change mitigation	medium to high	medium to high		aggravated by new packages derived from climate change mitigation	low	medium to high		aggravated by new packages derived from climate change mitigation	low	medium to high	
Project blockage for unacceptable air emissions	Troubles on permitting for not complying with all HSE requirements	medium	high	Provide adequate approach to industrial process reconnaissance and diagnosis to mitigate or eliminate problems of air emissions including SD issues	Troubles on permitting for not complying with all HSE requirements	medium	high	Provide engineering solutions for controlling air emissions within acceptable limits including solutions for SD issues	Troubles on permitting for not complying with all HSE requirements	medium to low	high	Create a monitoring and supervision system and manuals for emissions considering new issues from climate change and SD	Troubles on permitting for not complying with all HSE requirements	low	high	Install and execute the air emission control program considering new issues from climate change and SD
Project blockage for unacceptable solid wastes disposal	Troubles on permitting for not complying with wastes disposals also due to new constraints derived from sustainability principles	medium	medium to high	Provide adequate approach to industrial process reconnaissance and diagnosis to mitigate or eliminate problems of wastes disposal including SD issues	Troubles on permitting for not complying with wastes disposals also due to new constraints derived from sustainability principles	medium	medium to high	Provide engineering solutions for controlling wastes disposals within acceptable limits including solutions for SD issues	Troubles on permitting for not complying with wastes disposals also due to new constraints derived from sustainability principles	low	medium to high	Create a monitoring and supervision system and manuals for waste disposals considering new issues from climate change and SD	Troubles on permitting for not complying with wastes disposals also due to new constraints derived from sustainability principles	low	medium to high	Install and execute the waste disposal control program considering new issues from climate change and SD
Project blockage for unacceptable groundwater contamination	Troubles on permitting for not complying with limits for groundwater contamination also due to new constraints derived from sustainability principles	medium	medium to high	Provide adequate approach to industrial process reconnaissance and diagnosis to mitigate or eliminate problems of groundwater contamination including SD issues	Troubles on permitting for not complying with limits for groundwater contamination also due to new constraints derived from sustainability principles	medium	medium to high	Provide engineering solutions for controlling groundwater contamination within acceptable limits including solutions for SD issues	Troubles on permitting for not complying with limits for groundwater contamination also due to new constraints derived from sustainability principles	medium to low	medium to high	Create a monitoring and supervision system and manuals for groundwater contamination considering new issues from climate change and SD	Troubles on permitting for not complying with limits for groundwater contamination also due to new constraints derived from sustainability principles	low	medium to high	Install and execute the groundwater contamination control program considering new issues from climate change and SD
Project blockage for unacceptable liquid emissions	Troubles on permitting for not complying with limits of liquid emissions also due to new constraints derived from sustainability principles	medium	low	Provide adequate approach to industrial process reconnaissance and diagnosis to mitigate or eliminate problems of liquid emissions including SD issues	Troubles on permitting for not complying with limits of liquid emissions also due to new constraints derived from sustainability principles	medium	low	Provide engineering solutions for controlling liquid emissions within acceptable limits including solutions for SD issues	Troubles on permitting for not complying with limits of liquid emissions also due to new constraints derived from sustainability principles	low	low	Create a monitoring and supervision system and manuals for liquid emissions considering new issues from climate change and SD	Troubles on permitting for not complying with limits of liquid emissions also due to new constraints derived from sustainability principles	low	low	Install and execute the liquid emission control program considering new issues from climate change and SD
Project blockage for other environmental non compliances	Troubles on permitting for not compensating GHGs emissions also due to new constraints derived from sustainability principles	medium	medium to high	Provide adequate approach to process evaluation and diagnosis to define GHGs emissions including SD issues	Troubles on permitting for not compensating GHGs emissions also due to new constraints derived from sustainability principles	medium	medium to high	Provide engineering solutions for compensating GHGs emissions with parallel sequestration or capture of GHGs including solutions for SD issues	Troubles on permitting for not compensating GHGs emissions also due to new constraints derived from sustainability principles	low	medium to high	Create a monitoring and supervision system and manuals for GHGs emissions considering new issues from climate change and SD	Troubles on permitting for not compensating GHGs emissions also due to new constraints derived from sustainability principles	low	medium to high	Install and execute the GHGs program investing on sequestration and capture elsewhere considering new issues from climate change and SD
Disconnection of project issues to regional development and socioeconomic growth	Unfavorable reaction of community and authorities to project due to lacks of communication or of specific studies benefiting community also focusing SD	medium to high	high	Provide early evaluation of benefits local community through the regional development derived form the project implementation and exploitation including SD issues	Unfavorable reaction of community and authorities to project due to lacks of communication or of specific studies benefiting community also focusing SD	medium	high	Prepare full and comprehensive studies for the insertion of project in the regional development including techniques of communication and solution for SD issues	Unfavorable reaction of community and authorities to project due to lacks of communication or of specific studies benefiting community also focusing SD	low	high	Create programs for social communication of project advantages to community and region considering new issues from climate change and SD	Unfavorable reaction of community and authorities to project due to lacks of communication or of specific studies benefiting community also focusing SD	low	high	Execute the program for involvement of society and regional planning considering new issues from climate change and SD
8 - INFRASTRUCTURE (TRANSPORTATION) - NEED TO ADD SUSTAINABILITY CONCERNS TO ANALYSIS	Selected main aspect for a relevant item forming risk	medium to low	medium to high	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	medium to low	medium to high	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	low	medium	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	very low	medium to low	Selected main item for managing risk
Lacks on infrastructure & logistics for commercialization	Remoteness of project in regard to consumption centers and points of delivery, or scarcity & poor quality of road & railway systems aggravated by climate change	medium	medium to high	Conceive combined solutions or associated projects to minimize negative impacts of logistics and infrastructure considering the compliance to sustainability	Remoteness of project in regard to consumption centers and points of delivery, or scarcity & poor quality of road & railway systems aggravated by climate change	medium	medium to high	Conceive combined solutions or associated projects to minimize negative impacts of logistics and infrastructure considering the compliance to sustainability	Remoteness of project in regard to consumption centers and points of delivery, or scarcity & poor quality of road & railway systems aggravated by climate change	medium to low	medium to high	Develop combined solutions or associated projects to minimize negative impacts of logistics and infrastructure considering the compliance to sustainability	Remoteness of project in regard to consumption centers and points of delivery, or scarcity & poor quality of road & railway systems aggravated by climate change	low to very low	medium to high	Implement combined solutions or associated projects to minimize negative impacts of logistics and infrastructure always considering the compliance to sustainability
Lacks on infrastructure & logistics for production	Remoteness of project in regard to consumption centers and points of delivery, or scarcity & poor quality of road & railway systems aggravated by climate change	medium	medium to high	Conceive combined solutions or associated projects to minimize negative impacts of logistics and infrastructure considering the compliance to sustainability	Remoteness of project in regard to consumption centers and points of delivery, or scarcity & poor quality of road & railway systems aggravated by climate change	medium	medium to high	Conceive combined solutions or associated projects to minimize negative impacts of logistics and infrastructure	Remoteness of project in regard to consumption centers and points of delivery, or scarcity & poor quality of road & railway systems aggravated by climate change	medium to low	medium to high	Develop combined solutions or associated projects to minimize negative impacts of logistics and infrastructure considering the compliance to sustainability	Remoteness of project in regard to consumption centers and points of delivery, or scarcity & poor quality of road & railway systems aggravated by climate change	low to very low	medium to high	Implement combined solutions or associated projects to minimize negative impacts of logistics and infrastructure always considering the compliance to sustainability

Risk Evaluation for Projects Considering Sustainability Concerns due to Climate Change
The Oil Shale Case Analysis

PROJECT RISK ANALYSIS WITH NEW SUSTAINABILITY CONCERNS																
OIL SHALE PROJECT																
THE ROAD MAP FOR RISK ASSESSMENT AND MANAGEMENT																
TYPE OF RISK	Engineering and Commercial Feasibility				Bankable Feasibility				Pre-Construction Stage				Construction Stage			
	Main feature	Likelihood	Impact	Management	Main feature	Likelihood	Impact	Management	Main feature	Likelihood	Impact	Management	Main feature	Likelihood	Impact	Management
9 - SYNDICATION (OF BANKS)	Selected main aspect for a relevant item forming risk	medium	high	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	low	high	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	very low	high	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	very low	high	Selected main item for managing risk
Poor approach to financing by an Equity structure	n.a	medium	high	Structure earliest as possible the Financial Feasibility to consider criteria and premises to be imposed to approach to funding	Equity funding or terms of shareholders and investors insufficient to comfort Lenders	low	high	Provide bankable documents with satisfactory terms and condition for engagement of shareholders and investors	Equity funding or terms of shareholders and investors insufficient to comfort Lenders	very low	high	Build-up all set of JVCo and Sponsors documents to define compliance with Equity	Equity funding or terms of shareholders and investors insufficient to comfort Lenders	very low	high	Compliance with Equity by JVCo and Sponsors by the drawdown of
Poor approach to financing by a Debt structure	n.a	medium	high	Structure earliest as possible the Financial Feasibility to consider criteria and premises to be imposed to approach to funding	Inadequate selection of a syndicated loan of Lender banks by Sponsors	medium	high	Provide a reliable and effective Financial Advisor and Leader of Syndication to structure the financial facility	Inadequate selection of a syndicated loan of Lender banks by Sponsors	low	high	Build-up all set of JVCo and project documents to access lending	Inadequate selection of a syndicated loan of Lender banks by Sponsors	very low	high	Compliance with Bebt by Lenders by the drawdown of Debt funding
Insufficiency or inadequacy of bankable documents	n.a	medium	medium	Structure earliest as possible the Engineering Feasibility to consider criteria and premises to be imposed to approach to funding	Set of engineering and consulting documents insufficient for submittal to funders	low	medium	Provide high qualified and full documentation on engineering and consulting studies as well as financial covering all subjects	Set of engineering and consulting documents insufficient for submittal to funders	very low	medium		Set of engineering and consulting documents insufficient for submittal to funders	very low	medium	Follow-up to comply with duties and obligations derived from loan facilities
10 - FORCE MAJEURE - NEED TO ADD SUSTAINABILITY CONCERNS TO ANALYSIS	Selected main aspect for a relevant item forming risk	very low	medium	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	very low	medium	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	very low	medium	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	very low	medium	Selected main item for managing risk
Civil war, war, riots, epidemics	Damages and harms to project due to political and social disarrays increased by climate change	very low	medium	Conceive legal & insurance backup for future consideration of such events including new scenarios for climate change	Damages and harms to project due to political and social disarrays increased by climate change	very low	medium	Prepare legal & insurance backup for future consideration of such events including new scenarios for climate change	Damages and harms to project due to political and social disarrays increased by climate change	very low	medium	Prepare legal & insurance backup for future consideration of such events including new scenarios for climate change	Damages and harms to project due to political and social disarrays increased by climate change	very low	medium	Formalize and sign legal & insurance backup for future consideration of such events including new scenarios for climate change
Natural catastrophis	Damages and harms to project due to natural causes increased by climate change	low	medium	Conceive legal & insurance backup for future consideration of such events	Damages and harms to project due to natural causes increased by climate change	low	medium to high	Prepare legal & insurance backup for future consideration of such events including new scenarios for climate change	Damages and harms to project due to natural causes increased by climate change	low	medium	Prepare legal & insurance backup for future consideration of such events including new scenarios for climate change	Damages and harms to project due to natural causes increased by climate change	low	medium	Formalize and sign legal & insurance backup for future consideration of such events including new scenarios for climate change
Strikes and disputes with Unions	Damages and harms to project due to labor and social disarrays increased by climate change	very low	medium	Conceive legal & insurance backup for future consideration of such events	Damages and harms to project due to labor and social disarrays increased by climate change	very low	medium	Prepare legal & insurance backup for future consideration of such events including new scenarios for climate change	Damages and harms to project due to labor and social disarrays increased by climate change	very low	medium	Prepare legal & insurance backup for future consideration of such events including new scenarios for climate change	Damages and harms to project due to labor and social disarrays increased by climate change	very low	medium	Formalize and sign legal & insurance backup for future consideration of such events including new scenarios for climate change
11 - FOREIGN EXCHANGE	Selected main aspect for a relevant item forming risk	low	medium	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	low	medium	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	low	medium	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	very low	medium	Selected main item for managing risk
Country currency devaluation or valuation in regard to a reference basket of currencies	n.a	low	medium	n.a	Impacts on project cash-flow due to currency exchange variations	low	medium	Provide arrangements for contingencies and mitigation of such impacts in order to face this possibility	Impacts on project cash flow due to currency exchange variations	low	medium	Provide arrangements for contingencies and mitigation of such impacts in order to face this possibility	Impacts on project cash-flow due to currency exchange variations	low	medium	Provide arrangements for contingencies and mitigation of such impacts in order to face this possibility
Country currency non convertibility	n.a	low	medium	n.a	Impacts on project cash-flow due to currency non convertibility	low	medium	Envisage measures to contour sovereign risks to the benefit of the project	Impacts on project cash flow due to currency non convertibility	low	medium	Envisage measures to contour sovereign risks to the benefit of the project	Impacts on project cash-flow due to currency non convertibility	low	medium	Adopte and implement measures to contour sovereign risks to the benefit of the project
Lacks on hedge and swap facilities	n.a	low	medium	n.a	Impacts on project cash-flow due to impossibility of making hedge and swap operations	low	medium	Identify preliminary possibilities to hedge and swap for the receivables	Impacts on project cash flow due to impossibility of making hedge and swap operations	low	medium	Identify final possibilities to hedge and swap for the receivables	Impacts on project cash-flow due to impossibility of making hedge and swap operations	low	medium	Make arrangements to access hedge and swap for the receivables if possible

Risk Evaluation for Projects Considering Sustainability Concerns due to Climate Change The Oil Shale Case Analysis

SHEET 6	OIL SHALE PROJECT THE ROAD MAP FOR RISK ASSESSMENT AND MANAGEMENT								OIL SHALE PROJECT THE ROAD MAP FOR RISK ASSESSMENT AND MANAGEMENT								SHEET 6																																																																																				
	Engineering and Commercial Feasibility				Bankable Feasibility				Pre-Construction Stage				Construction Stage																																																																																								
	Main feature	Likelihood	Impact	Management	Main feature	Likelihood	Impact	Management	Main feature	Likelihood	Impact	Management	Main feature	Likelihood	Impact	Management																																																																																					
12 - MARKET AND COMMERCIALIZATION - NEED TO ADD																																																																																																					
SUSTAINABILITY CONCERNS TO ANALYSIS																																																																																																					
Selected main aspect for a relevant item forming risk																																																																																																					
<table border="1"> <tr> <td>Lacks on qualification and pricing for products to sale</td> <td>Problems derived from the offer of new products in market requiring pioneer commercialization and marketing efforts aggravated by the competition of biofuels</td> <td>medium</td> <td>high</td> <td>Provide tests and analysis to classify and qualify products aiming their pricing and market sales taking into consideration the new scenarios for climate change</td> <td>Problems derived from the offer of new products in market requiring pioneer commercialization and marketing efforts aggravated by the competition of biofuels</td> <td>medium</td> <td>high</td> <td>Provide certification for Shale Oil characteristics based upon tests taking into consideration the new scenarios for climate change</td> <td>Problems derived from the offer of new products in market requiring pioneer commercialization and marketing efforts aggravated by the competition of biofuels</td> <td>medium to low</td> <td>high</td> <td>Improve and extend specialized studies for supporting pricing and marketing of Shale Oil taking into consideration the new scenarios for climate change</td> <td>Problems derived from the offer of new products in market requiring pioneer commercialization and marketing efforts aggravated by the competition of biofuels</td> <td>low to very low</td> <td>high</td> <td>Develop an aggressive sales plan for Shale Oil supported by marketing and pricing studies as well as by logistics for commercialization taking into consideration the new scenarios for climate change</td> </tr> <tr> <td>Scarcity of buyers for the Shale Oil and derivatives</td> <td>Hardness to find Oil Shale buyers due to sudden changes in the oil & energy market aggravated by competition of renewable fuels</td> <td>medium</td> <td>high</td> <td>Identify potential markets for Shale Oil & By-products and provide the first reconnaissance to meet them and make forecasts for the competition of biofuels</td> <td>Hardness to find Oil Shale buyers due to sudden changes in the oil & energy market aggravated by competition of renewable fuels</td> <td>medium</td> <td>high</td> <td>Study and quantify potential markets for Shale Oil & By-products and provide competitor analysis including biofuels</td> <td>Hardness to find Oil Shale buyers due to sudden changes in the oil & energy market aggravated by competition of renewable fuels</td> <td>medium</td> <td>high</td> <td>Arrange for some Agreements for future sales of Shale Oil & By-products to support the investment to be done and provide collateral always considering the rising of biofuels</td> <td>Hardness to find Oil Shale buyers due to sudden changes in the oil & energy market aggravated by competition of renewable fuels</td> <td>medium</td> <td>high</td> <td>Provide an effective step by step strategy and procedures for selling Shale Oil & By-products in the market facing the challenge of biofuels</td> </tr> <tr> <td>Long term price drawdown for outputs</td> <td>Price fluctuations due to long term trends imposing depression in oil market also affected by renewable fuels</td> <td>medium to high</td> <td>medium</td> <td>Analyze historical price fluctuations with their causes and provide preliminary forecasted projections by experts renewable fuels</td> <td>Price fluctuations due to long term trends imposing depression in oil market also affected by renewable fuels</td> <td>medium to high</td> <td>medium</td> <td>Reanalyze historical price fluctuations with their causes and provide final forecasted projections by experts applicable to the market to be met considering the rising of biofuels and renewable energy fuels</td> <td>Price fluctuations due to long term trends imposing depression in oil market also affected by renewable fuels</td> <td>medium</td> <td>medium</td> <td>Provide specific tools for continuous follow-up of trends in oil market and review of market sales strategy considering the rising of biofuels and renewable energy</td> <td>Price fluctuations due to long term trends imposing depression in oil market also affected by renewable fuels</td> <td>medium to low</td> <td>medium</td> <td>Follow-up of trends in oil market using on line models and data bank considering the rising of biofuels and renewable energy</td> </tr> <tr> <td>Short term price drawdown for outputs</td> <td>Price fluctuations due to speculation or unpredictable facts also affected by renewable fuels</td> <td>high</td> <td>low</td> <td>Analyze historical short term price drawdown with their causes and provide preliminary forecasted of shortfalls projections by experts</td> <td>Price fluctuations due to speculation or unpredictable facts also affected by renewable fuels</td> <td>high</td> <td>low</td> <td>Reanalyze historical short term price drawdown with their causes and provide preliminary forecasted of shortfalls projections by experts</td> <td>Price fluctuations due to speculation or unpredictable facts also affected by renewable fuels</td> <td>medium</td> <td>low</td> <td>Provide specific tools for continuous follow-up of shortfalls in oil market in connection to emergency measures considering the rising of biofuels and renewable energy</td> <td>Price fluctuations due to speculation or unpredictable facts also affected by renewable fuels</td> <td>medium</td> <td>low</td> <td>Follow-up of trends for shortfalls in oil market using on line models and data bank considering the rising of biofuels and renewable energy</td> </tr> <tr> <td>Limitation on logistics or contracts for oil transportation</td> <td>Difficulties to negotiate transportation through existing infrastructure, or to use right of ways, or to build new pipe lines for the aggravation of conditions due to climate change</td> <td>medium</td> <td>high</td> <td>Make a full local and regional inventory of alternatives considering options for biofuels for competition</td> <td>Difficulties to negotiate transportation through existing infrastructure, or to use right of ways, or to build new pipe lines also for the aggravation of conditions due to climate change</td> <td>medium</td> <td>high</td> <td>Study, define and budget the selected alternative for Shale Oil transportation as well as for By-products considering options for biofuels for competition</td> <td>Difficulties to negotiate transportation through existing infrastructure, or to use right of ways, or to build new pipe lines also for the aggravation of conditions due to climate change</td> <td>medium</td> <td>high</td> <td>Set up of all sort of measures ensuring the adequate logistics for transportation and commercialization of Shale Oil and By-products considering competition and effects of climate change</td> <td>Difficulties to negotiate transportation through existing infrastructure, or to use right of ways, or to build new pipe lines also for the aggravation of conditions due to climate change</td> <td>low</td> <td>high</td> <td>Build up of works on logistics in parallel to the Oil Shale project in mining and industrial sectors considering competition and effects of climate change</td> </tr> </table>																	Lacks on qualification and pricing for products to sale	Problems derived from the offer of new products in market requiring pioneer commercialization and marketing efforts aggravated by the competition of biofuels	medium	high	Provide tests and analysis to classify and qualify products aiming their pricing and market sales taking into consideration the new scenarios for climate change	Problems derived from the offer of new products in market requiring pioneer commercialization and marketing efforts aggravated by the competition of biofuels	medium	high	Provide certification for Shale Oil characteristics based upon tests taking into consideration the new scenarios for climate change	Problems derived from the offer of new products in market requiring pioneer commercialization and marketing efforts aggravated by the competition of biofuels	medium to low	high	Improve and extend specialized studies for supporting pricing and marketing of Shale Oil taking into consideration the new scenarios for climate change	Problems derived from the offer of new products in market requiring pioneer commercialization and marketing efforts aggravated by the competition of biofuels	low to very low	high	Develop an aggressive sales plan for Shale Oil supported by marketing and pricing studies as well as by logistics for commercialization taking into consideration the new scenarios for climate change	Scarcity of buyers for the Shale Oil and derivatives	Hardness to find Oil Shale buyers due to sudden changes in the oil & energy market aggravated by competition of renewable fuels	medium	high	Identify potential markets for Shale Oil & By-products and provide the first reconnaissance to meet them and make forecasts for the competition of biofuels	Hardness to find Oil Shale buyers due to sudden changes in the oil & energy market aggravated by competition of renewable fuels	medium	high	Study and quantify potential markets for Shale Oil & By-products and provide competitor analysis including biofuels	Hardness to find Oil Shale buyers due to sudden changes in the oil & energy market aggravated by competition of renewable fuels	medium	high	Arrange for some Agreements for future sales of Shale Oil & By-products to support the investment to be done and provide collateral always considering the rising of biofuels	Hardness to find Oil Shale buyers due to sudden changes in the oil & energy market aggravated by competition of renewable fuels	medium	high	Provide an effective step by step strategy and procedures for selling Shale Oil & By-products in the market facing the challenge of biofuels	Long term price drawdown for outputs	Price fluctuations due to long term trends imposing depression in oil market also affected by renewable fuels	medium to high	medium	Analyze historical price fluctuations with their causes and provide preliminary forecasted projections by experts renewable fuels	Price fluctuations due to long term trends imposing depression in oil market also affected by renewable fuels	medium to high	medium	Reanalyze historical price fluctuations with their causes and provide final forecasted projections by experts applicable to the market to be met considering the rising of biofuels and renewable energy fuels	Price fluctuations due to long term trends imposing depression in oil market also affected by renewable fuels	medium	medium	Provide specific tools for continuous follow-up of trends in oil market and review of market sales strategy considering the rising of biofuels and renewable energy	Price fluctuations due to long term trends imposing depression in oil market also affected by renewable fuels	medium to low	medium	Follow-up of trends in oil market using on line models and data bank considering the rising of biofuels and renewable energy	Short term price drawdown for outputs	Price fluctuations due to speculation or unpredictable facts also affected by renewable fuels	high	low	Analyze historical short term price drawdown with their causes and provide preliminary forecasted of shortfalls projections by experts	Price fluctuations due to speculation or unpredictable facts also affected by renewable fuels	high	low	Reanalyze historical short term price drawdown with their causes and provide preliminary forecasted of shortfalls projections by experts	Price fluctuations due to speculation or unpredictable facts also affected by renewable fuels	medium	low	Provide specific tools for continuous follow-up of shortfalls in oil market in connection to emergency measures considering the rising of biofuels and renewable energy	Price fluctuations due to speculation or unpredictable facts also affected by renewable fuels	medium	low	Follow-up of trends for shortfalls in oil market using on line models and data bank considering the rising of biofuels and renewable energy	Limitation on logistics or contracts for oil transportation	Difficulties to negotiate transportation through existing infrastructure, or to use right of ways, or to build new pipe lines for the aggravation of conditions due to climate change	medium	high	Make a full local and regional inventory of alternatives considering options for biofuels for competition	Difficulties to negotiate transportation through existing infrastructure, or to use right of ways, or to build new pipe lines also for the aggravation of conditions due to climate change	medium	high	Study, define and budget the selected alternative for Shale Oil transportation as well as for By-products considering options for biofuels for competition	Difficulties to negotiate transportation through existing infrastructure, or to use right of ways, or to build new pipe lines also for the aggravation of conditions due to climate change	medium	high	Set up of all sort of measures ensuring the adequate logistics for transportation and commercialization of Shale Oil and By-products considering competition and effects of climate change	Difficulties to negotiate transportation through existing infrastructure, or to use right of ways, or to build new pipe lines also for the aggravation of conditions due to climate change	low	high	Build up of works on logistics in parallel to the Oil Shale project in mining and industrial sectors considering competition and effects of climate change
Lacks on qualification and pricing for products to sale	Problems derived from the offer of new products in market requiring pioneer commercialization and marketing efforts aggravated by the competition of biofuels	medium	high	Provide tests and analysis to classify and qualify products aiming their pricing and market sales taking into consideration the new scenarios for climate change	Problems derived from the offer of new products in market requiring pioneer commercialization and marketing efforts aggravated by the competition of biofuels	medium	high	Provide certification for Shale Oil characteristics based upon tests taking into consideration the new scenarios for climate change	Problems derived from the offer of new products in market requiring pioneer commercialization and marketing efforts aggravated by the competition of biofuels	medium to low	high	Improve and extend specialized studies for supporting pricing and marketing of Shale Oil taking into consideration the new scenarios for climate change	Problems derived from the offer of new products in market requiring pioneer commercialization and marketing efforts aggravated by the competition of biofuels	low to very low	high	Develop an aggressive sales plan for Shale Oil supported by marketing and pricing studies as well as by logistics for commercialization taking into consideration the new scenarios for climate change																																																																																					
Scarcity of buyers for the Shale Oil and derivatives	Hardness to find Oil Shale buyers due to sudden changes in the oil & energy market aggravated by competition of renewable fuels	medium	high	Identify potential markets for Shale Oil & By-products and provide the first reconnaissance to meet them and make forecasts for the competition of biofuels	Hardness to find Oil Shale buyers due to sudden changes in the oil & energy market aggravated by competition of renewable fuels	medium	high	Study and quantify potential markets for Shale Oil & By-products and provide competitor analysis including biofuels	Hardness to find Oil Shale buyers due to sudden changes in the oil & energy market aggravated by competition of renewable fuels	medium	high	Arrange for some Agreements for future sales of Shale Oil & By-products to support the investment to be done and provide collateral always considering the rising of biofuels	Hardness to find Oil Shale buyers due to sudden changes in the oil & energy market aggravated by competition of renewable fuels	medium	high	Provide an effective step by step strategy and procedures for selling Shale Oil & By-products in the market facing the challenge of biofuels																																																																																					
Long term price drawdown for outputs	Price fluctuations due to long term trends imposing depression in oil market also affected by renewable fuels	medium to high	medium	Analyze historical price fluctuations with their causes and provide preliminary forecasted projections by experts renewable fuels	Price fluctuations due to long term trends imposing depression in oil market also affected by renewable fuels	medium to high	medium	Reanalyze historical price fluctuations with their causes and provide final forecasted projections by experts applicable to the market to be met considering the rising of biofuels and renewable energy fuels	Price fluctuations due to long term trends imposing depression in oil market also affected by renewable fuels	medium	medium	Provide specific tools for continuous follow-up of trends in oil market and review of market sales strategy considering the rising of biofuels and renewable energy	Price fluctuations due to long term trends imposing depression in oil market also affected by renewable fuels	medium to low	medium	Follow-up of trends in oil market using on line models and data bank considering the rising of biofuels and renewable energy																																																																																					
Short term price drawdown for outputs	Price fluctuations due to speculation or unpredictable facts also affected by renewable fuels	high	low	Analyze historical short term price drawdown with their causes and provide preliminary forecasted of shortfalls projections by experts	Price fluctuations due to speculation or unpredictable facts also affected by renewable fuels	high	low	Reanalyze historical short term price drawdown with their causes and provide preliminary forecasted of shortfalls projections by experts	Price fluctuations due to speculation or unpredictable facts also affected by renewable fuels	medium	low	Provide specific tools for continuous follow-up of shortfalls in oil market in connection to emergency measures considering the rising of biofuels and renewable energy	Price fluctuations due to speculation or unpredictable facts also affected by renewable fuels	medium	low	Follow-up of trends for shortfalls in oil market using on line models and data bank considering the rising of biofuels and renewable energy																																																																																					
Limitation on logistics or contracts for oil transportation	Difficulties to negotiate transportation through existing infrastructure, or to use right of ways, or to build new pipe lines for the aggravation of conditions due to climate change	medium	high	Make a full local and regional inventory of alternatives considering options for biofuels for competition	Difficulties to negotiate transportation through existing infrastructure, or to use right of ways, or to build new pipe lines also for the aggravation of conditions due to climate change	medium	high	Study, define and budget the selected alternative for Shale Oil transportation as well as for By-products considering options for biofuels for competition	Difficulties to negotiate transportation through existing infrastructure, or to use right of ways, or to build new pipe lines also for the aggravation of conditions due to climate change	medium	high	Set up of all sort of measures ensuring the adequate logistics for transportation and commercialization of Shale Oil and By-products considering competition and effects of climate change	Difficulties to negotiate transportation through existing infrastructure, or to use right of ways, or to build new pipe lines also for the aggravation of conditions due to climate change	low	high	Build up of works on logistics in parallel to the Oil Shale project in mining and industrial sectors considering competition and effects of climate change																																																																																					

Remark: The red letters correspond to changes on each item for moving from BAU to SD scenario

Risk Evaluation for Projects Considering Sustainability Concerns due to Climate Change
The Oil Shale Case Analysis

PROJECT RISK ANALYSIS WITH NEW SUSTAINABILITY CONCERNS																
OIL SHALE PROJECT								OIL SHALE PROJECT								
SHEET 7								SHEET 7								
THE ROAD MAP FOR RISK ASSESSMENT AND MANAGEMENT								THE ROAD MAP FOR RISK ASSESSMENT AND MANAGEMENT								
TYPE OF RISK	Engineering and Commercial Feasibility				Bankable Feasibility				Pre-Construction Stage				Construction Stage			
	Main feature	Likelihood	Impact	Management	Main feature	Likelihood	Impact	Management	Main feature	Likelihood	Impact	Management	Main feature	Likelihood	Impact	Management
13 - POLITICAL - NEED TO ADD SOCIAL RESPONSIBILITY CONCERNS TO ANALYSIS	Selected main aspect for a relevant item forming risk	medium	medium	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	medium	medium	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	low	medium	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	low	medium	Selected main item for managing risk
Political disarray, economical crisis	Delays and interruptions of work in the design and planning stage also due to climate change	low	high	Conceive effective labor and supply schemes to mitigate any impact due to political risks to be taken including sustainability concerns	Delays and interruptions of work in the design and planning stage also due to climate change	low	high	Conceive effective labor and supply schemes to mitigate any impact due to political risks to be taken including sustainability concerns	Delays and interruptions of work in the design and planning stage also due to climate change	very low	high	Conceive effective labor and supply schemes to mitigate any impact due to political risks to be taken including sustainability concerns	Delays and interruptions of work in the construction stage also due to climate change	very low	high	Provide effective labor and supply schemes to mitigate any impact due to political risks to be taken including sustainability concerns
Action of activists and environmentalists	Reaction from the community or NGOs, pressures over government authorities against project due to the increasing feelings against GHGs	low	medium	Adopt policies in connection to environmental sensibility and concerns and make full transparency of intentions for the proposed project including compliance to sustainability	Reaction from the community or NGOs, pressures over government authorities against project due to the increasing feelings against GHGs	medium	medium	Adopt policies in connection to environmental sensibility and concerns and make full transparency of intentions for the proposed project including compliance to sustainability	Reaction from the community or NGOs, pressures over government authorities against project due to the increasing feelings against GHGs	medium	medium	Clearly define mitigation and compensatory measures through debates with the community and public audiences including sustainability concerns	Reaction from the community or NGOs, pressures over government authorities against project due to the increasing feelings against GHGs	low	medium	Execute approved plans for mitigation and compensation through a joint task force formed with the community including sustainability concerns
Tax changes and ownership alterations	Impact on cash flow due to tax change, expectation of capital returns or provision of guarantees also for being charged to a compensation for the mitigation of GHGs	medium to low	medium	Evaluate alternative scenarios for considering all possible impacts on cash flow due to tax changes and other internal and external factors	Impact on cash flow due to tax change, expectation of capital returns or provision of guarantees also for being charged to a compensation for the mitigation of GHGs	medium to low	medium	Evaluate alternative scenarios for considering all possible impacts on cash flow due to tax changes and other internal and external factors	Impact on cash flow due to tax change, expectation of capital returns or provision of guarantees also for being charged to a compensation for the mitigation of GHGs	low	medium	Define alternative scenarios and mitigation measures for impacts on cash flow due to tax changes and other factors including sustainability concerns	Impact on cash flow due to tax change, expectation of capital returns or provision of guarantees also for being charged to a compensation for the mitigation of GHGs	low	medium	Define alternative scenarios and mitigation measures for impacts on cash flow due to tax changes and other factors including sustainability concerns
Changes on attitudes by public agencies and politicians	Difficulties with the stakeholders, or political framework for project approval due to the increasing feelings against GHGs	medium	medium	Search for obtaining official positions in favor of the project in all levels of public administration including demonstration of compliance to sustainability	Difficulties with the stakeholders, or political framework for project approval due to the increasing feelings against GHGs	medium	medium	Search for obtaining official positions in favor of the project in all levels of public administration including demonstration of compliance to sustainability	Difficulties with the stakeholders, or political framework for project approval due to the increasing feelings against GHGs	low	medium	Consolidate official positions in favor of the project in all levels of public administration enrolling the approval for sustainability positions	Difficulties with the stakeholders, or political framework for project approval due to the increasing feelings against GHGs	low	medium	Use political and legal pressures in favor of the project based on the past official positioning achieved and favoring mitigation measures against GHGs
14 - INTERESTS & FUNDING	Selected main aspect for a relevant item forming risk	medium to low	high	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	medium to low	high	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	low	high	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	very low	high	Selected main item for managing risk
Unsuitable financial facility for project funding	n.a	low	high	n.a	Poor services rendered by a Financial Advisor on preparing demonstration for project financing based on cash-flow and related matters	medium to low	high	Make a good choice for a reputable and efficient Financial Advisor ever since the beginning	Poor services rendered by a Financial Advisor on preparing demonstration for project financing based on cash-flow and related matters	low	high	Make an intense dialogue and follow-up with the Financial Advisor to achieve project funding	Inadequacy or insufficiency of facility required amendments or extension in financial contracts	very low	high	Make an intense dialogue and follow-up with the Financial Advisor to achieve project funding
Lacks on credit insurance and securities	n.a	medium to low	medium to high	n.a	Qualification, reputation, experience, etc of sponsors and investors not sufficient for the banking system for funding the project	medium to low	medium to high	Provide arrangements changes in players to reinforce position to allow the project be bankable	Qualification, reputation, experience, etc of sponsors and investors not sufficient for the banking system for funding the project	low	medium to high	Fill up all requirements for creditworthiness, including insurance and securities in the way required for the financial market for the project	Qualification, reputation, experience, etc of sponsors and investors not sufficient for the banking system for funding the project	very low	medium to high	Continuous fill up of requirements by lenders along the project construction including payment of interests and provision of Equity
Misbalance on Debt & Equity for funding	n.a	medium to low	high	n.a	Uninsufficient Equity proposed by sponsors to project funding	medium to low	high	Adjust the amount of Equity to be provided by players to the standard (international)= banking practices applicable to the project case	Uninsufficient Equity proposed by sponsors to project funding	low	high	Adjust the amount of Equity to be provided by players to the standard (international)= banking practices applicable to the project case	Uninsufficient Equity proposed by sponsors to project funding	very low	high	Confirm along project implementation the amount of Equity according to contracts signed for project financing

Risk Evaluation for Projects Considering Sustainability Concerns due to Climate Change
The Oil Shale Case Analysis

PROJECT RISK ANALYSIS WITH NEW SUSTAINABILITY CONCERNS																
OIL SHALE PROJECT								OIL SHALE PROJECT								
SHEET 8								SHEET 8								
THE ROAD MAP FOR RISK ASSESSMENT AND MANAGEMENT																
TYPE OF RISK	Engineering and Commercial Feasibility				Bankable Feasibility				Pre-Construction Stage				Construction Stage			
	Main feature	Likelihood	Impact	Management	Main feature	Likelihood	Impact	Management	Main feature	Likelihood	Impact	Management	Main feature	Likelihood	Impact	Management
15 - SPONSORS AND PARTICIPANTS - NEED TO ADD SOCIAL RESPONSIBILITY CONCERNS TO ANALYSIS	Selected main aspect for a relevant item forming risk	medium	high	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	medium to low	high	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	low	high	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	very low	high	Selected main item for managing risk
Disbalance on strenght, assets & liabilities of each Sponsor	Inadequacy on the profile of Sponsor's participation in the JVCo aggravated by the non compliance to sustainable principles	medium	high	Level or reduce discrepancies among Sponsors on their qualification and phylosophy of doing business with special concern to CSSR	Inadequacy on the profile of Sponsor's participation in the JVCo aggravated by the non compliance to sustainable principles	medium	high	Re-structure the participation of Sponsors in the JVCo on realistic basis based on their CSSR perception	Inadequacy on the profile of Sponsor's participation in the JVCo aggravated by the non compliance to sustainable principles	medium to low	high	Make complementary adjustments among Sponsors to face the international financing market either in corporate or project finance basis considering pledges and collateral	Inadequacy on the profile of Sponsor's participation in the JVCo aggravated by the non compliance to sustainable principles	low	high	Provision of full legal, commercial and audit documentation to support the funding to implementation considering new requirements derived from CSSR practices
Nature of legal & commercial linkage of JVCo with Main Contractors	Unsuitability of the JVCo structuring and role in regard to all contracting profile during project implementation aggravated by sustainability constraints	medium	high	Ever since the beginning define the option for assigning implementation to an EPC on turn-key basis	Unsuitability of the JVCo structuring and role in regard to all contracting profile during project implementation aggravated by sustainability constraints	medium	high	Consolidate the engineering design and plan for implementation and adjust JVCo mission by assigning services to an EPC on turn-key basis including the CSSR practices	Unsuitability of the JVCo structuring and role in regard to all contracting profile during project implementation aggravated by sustainability constraints	medium	high	Define a full and comprehensive implementation through an EPC contractor with an Owner's Engineer by JVCo considering new requirements derived from CSSR practices	Unsuitability of the JVCo structuring and role in regard to all contracting profile during project implementation aggravated by sustainability constraints	medium	high	Contract a full and comprehensive implementation through an EPC contractor with an Owner's Engineer by JVCo considering new requirements derived from CSSR practices
Disputes or disagreements among JVCo Sponsors	Divergences or discrepancies on the approach to business development by Sponsors aggravated by different viewpoints on sustainability compliance	medium	high	Consolidate earliest as possible of a consensus base for business development and definition of responsibilities with special concern to CSSR by stakeholders	Divergences or discrepancies on the approach to business development by Sponsors aggravated by different viewpoints on sustainability compliance	medium	high	Build-up of the final shareholders composition in the JVCo to reflect the best joint capabilities, liabilities and intention for doing business including the CSSR practices	Divergences or discrepancies on the approach to business development by Sponsors aggravated by different viewpoints on sustainability compliance	medium to low	high	Define Executive and Administration Boards reflecting the pro rata of the sharing interests and entrepreneurial culture working independently from holding companies and focused to the Oil Shale business considering new requirements derived from CSSR practices	Divergences or discrepancies on the approach to business development by Sponsors aggravated by different viewpoints on sustainability compliance	low	high	Structure the current performance of Direction and Administration of the JVCo to manage the eventual conflicts that may arise during implementation considering new requirements derived from CSSR practices
Inadequate JVCo By-Laws and Shareholder Agreements	Unsuiciency or inadequacy of By-Laws or any legal instrument to support the JVCo on its mission aggravated by sustainability concerns	medium	high	Formalize earliest as possible all set of documents and obligations for common engagement to business with clear rules for all Sponsors also considering CSSR practices	Unsuiciency or inadequacy of By-Laws or any legal instrument to support the JVCo on its mission aggravated by sustainability concerns	medium	high	Contract high qualified Legal Advisor to proceed with the JVCo foundation in connection to legal departments of every Sponsor also considering CSSR practices	Unsuiciency or inadequacy of By-Laws or any legal instrument to support the JVCo on its mission aggravated by sustainability concerns	medium to low	high	Provide complementary legal documentation by Sponsors to allow JVCo apply to any financial facility for project funding considering new requirements derived from CSSR practices	Unsuiciency or inadequacy of By-Laws or any legal instrument to support the JVCo on its mission aggravated by sustainability concerns	low	high	Follow-up of all legal procedures in regard to JVCo sustainability and credentials for engagement on Oil Shale business at state and institutions considering new requirements derived from CSSR practices
16 - LEGAL & INSTITUTIONAL - NEED TO ADD SUSTAINABILITY CONCERNS TO ANALYSIS	Selected main aspect for a relevant item forming risk	medium	medium	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	medium to low	medium	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	low	medium	Selected main item for managing risk	Selected main aspect for a relevant item forming risk	low	medium	Selected main item for managing risk
Unfavorable policies and few incentives to Investors	Apathy and disregard of public administration to incentive the project issues aggravated by climate change	medium	medium	Develop a marketing plan for announcing project and get the engagement of authorities and local people with emphasis to the compliance on sustainability	Apathy and disregard of public administration to incentive the project issues aggravated by climate change	medium	medium	Develop a marketing plan for announcing project and get the engagement of authorities and local people with emphasis to the compliance on sustainability	Apathy and disregard of public administration to incentive the project issues aggravated by climate change	medium to low	medium	Start-up procedures and attitudes of the marketing plan and communication to sensibelize authorities and community always focusing sustainability	Apathy and disregard of public administration to incentive the project issues aggravated by climate change	low	medium	Execute procedures and attitudes to sensibelize authorities and community demonstrating the compliance to sustainability
Legal framework inhibiting investments	Large package of laws and regulations, as well as bureaucracy and excessive interventions creating obstacles to project implementation aggravated by climate change	medium	medium	Identifying main legal problems and possible solutions forming the basis for the legal counter measures approach to obstacles including the questions of sustainability	Large package of laws and regulations, as well as bureaucracy and excessive interventions creating obstacles to project implementation aggravated by climate change	medium	medium	Consolidate identification and sizing of main legal problems and possible solutions forming for the legal counter measures approach to obstacles including the questions of sustainability	Large package of laws and regulations, as well as bureaucracy and excessive interventions creating obstacles to project implementation aggravated by climate change	medium to low	medium	Contract a Legal Advisor to circumvent or minimize legal restrictions and formulate solutions to fit project to legislation including new issues derived from sustainability and climate change	Large package of laws and regulations, as well as bureaucracy and excessive interventions creating obstacles to project implementation aggravated by climate change	low to very low	medium	Have the Legal Advisor executing the strategy to circumvent or minimize legal restrictions and formulate solutions to fit project to legislation including new issues on sustainability and climate change
Controversy and disputes among public authorities in different levels supported by legal framework	Irremovable conflicts among different authorities and superposition of institutional powers pressuring the project aggravated by climate change	medium	medium	Identify potential conflicts among authorities in federal, state and local governments in legal framework and visualize possible solutions including sustainability concerns	Irremovable conflicts among different authorities and superposition of institutional powers pressuring the project aggravated by climate change	medium to low	medium	Identify potential conflicts among authorities in federal, state and local governments in legal framework and visualize possible solutions including sustainability concerns	Irremovable conflicts among different authorities and superposition of institutional powers pressuring the project aggravated by climate change	medium to low	medium	Make actions to attenuate or circumvent the conflicts among authorities to the benefit or project implementation including sustainability concerns	Irremovable conflicts among different authorities and superposition of institutional powers pressuring the project aggravated by climate change	low	medium	Make actions to attenuate or circumvent the conflicts among authorities to the benefit or project implementation including sustainability concerns

Author:



Wilson Jordão Filho

Civil Engineer and Business Consultant

Rio de Janeiro, Brazil

The Sustainability Crusade Observatory

wjfilho@crusus.org

wilsonjordaofilho@hotmail.com