Deloitte.

The Risk Intelligent energy company
Weathering the storm of climate change

Risk Intelligence series

Contents

Foreword

This publication is part of Deloitte's series on Risk Intelligence — a risk management philosophy that focuses not solely on risk avoidance and mitigation, but also on risk-taking as a means to value creation. The concepts and viewpoints presented here build upon and complement other publications in the series that span roles, industries, and business issues. To access all the white papers in the Risk Intelligence series, visit www.deloitte.com/risk.

Open communication is a key characteristic of the Risk Intelligent Enterprise™. We encourage you to share this white paper with your colleagues — executives, board members, and key managers at your company. The issues outlined herein will serve as useful points to consider and discuss in the continuing effort to increase your company's Risk Intelligence.

Preface

The energy industry has always dealt with risk. In cases where the risks are isolated to a specific business unit and risk type, traditional risk management approaches have been used with good success. However, when the scope, complexity, and interdependency of risk factors increase, or when an emerging risk simultaneously presents significant opportunities, more comprehensive and integrated approaches are necessary. Risk Intelligent Enterprises™ know that risk walks hand-in-hand with opportunity and use Enterprise Risk Management (ERM) as an effective means to identify and exploit opportunities while managing and mitigating unrewarded risks.

Climate change provides a ready example of highly interdependent risks with global impact. These risks cover a broad range of risk types (physical operations risk, regulatory risk, price risk, etc.) that have implications across an enterprise's global operations, impacting many business units. Indeed, climate change is creating significant uncertainty for energy companies as they struggle to develop strategic plans. An integrated approach to identifying opportunities and managing risk in the face of this uncertainty is needed.

Risk Intelligent energy enterprises include climate change risks and opportunities in their ERM programs, firmly embedding risk management within the strategic planning context. For enterprises without an established ERM program, the application of an ERM-type framework to climate change will be valuable.

This paper presents examples of climate change-related risks for key risk types; discusses why applying the principles of Risk Intelligence to an ERM framework is suited to management of these risks; presents our Risk Intelligent Framework as applied to climate change risk factors; and describes a way to move forward.

What risks does climate change present for the energy industry?

Before discussing the application of Risk Intelligence to climate change, it is useful to more fully understand the risks presented. The following statements underpin the discussion in this paper:

- Risks exist where there is uncertainty about future attainment of strategic objects.
- The uncertainty related to climate change spawns significant risks and can have a positive or negative impact on achievement of objectives.
- Climate change will present both opportunities and threats for energy companies. In fact, a given risk factor will be a threat for one company, but an opportunity for another company that has a different business strategy, location, or asset mix.

The following risk types have been chosen for discussion since they have a strong relation to climate change:

- Regulatory risk
- Technological risk
- Price/market risk
- Strategic risk
- Physical operations risk
- Volume risk
- Modeling/valuation risk
- Human capital risk

Driver: Climate change	
Risk factor	**Potential outcome**
Rising sea level	• Flooded facilities
Drought	• Plant shut down due to inadequate cooling water • Plant shut down due to low reservoir level • High ethanol prices due to feedstock shortages
Increased storm intensity	• Drilling platform shutdowns • Outages and damage to electricity transmission system

Definitions

Enterprise Risk Management (ERM) is a full-spectrum approach to risk management that includes identifying, assessing, measuring, monitoring, and responding to risks across the enterprise. When properly executed, ERM activities are aligned with the organization's strategic objectives and are conducted within the limits of a predefined "risk appetite." ERM addresses all major risk types including compliance, financial, hazard, operational, and strategic risks across all major business units and functions within an enterprise.

Risk Intelligent Enterprises are distinguished by several characteristics. These organizations: manage risk across the entire organization; create connections between risk management "silos"; adopt common language and measurements for assessing and addressing risk; infuse risk management practices into the corporate culture; address not just asset protection, but also risk taking for reward; emphasize intelligent risk-taking as a means to increasing shareholder value.

Risk is the potential for loss or the diminished opportunity for gain caused by factors that can adversely affect the achievement of a company's objectives.

Creeping condition is a slowly evolving or manifesting condition that increases the probability or severity of a risk factor, risk, or consequence.

Risk factors are those events or conditions that can lead to a risk. For example, global warming can lead to violent storms (a trigger event) which can lead to flooded facilities (an event) which can result in a forced outage (the risk).

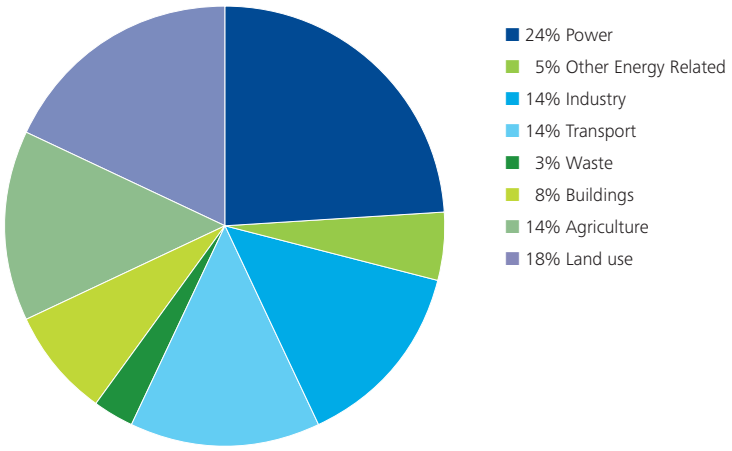
Climate change is not so much a risk in and of itself as a driver that increases the likelihood or severity of a number of risk factors as illustrated in the table on the left.

What are scientists saying?

There has been an enormous amount of scientific research related to climate change over the past decade. Consider the following quotes:

1. "There is now strong evidence that significant global warming is occurring."[1]
2. "Warming of the climate system is unequivocal …"[2]
3. "…climate change… is linked directly to human activities that emit greenhouse gases."[3]
4. "Global warming is not the only problem now facing mankind, but it is one of the most serious with which humanity has ever been confronted."[4]
5. "The greenhouse gas emissions that cause climate change are emitted mainly from burning fossil fuels such as coal, oil, and natural gas."[5]
6. "Energy creates over 57% of carbon emissions and power alone accounts for 24%."[6]
7. "Ultimately, stabilization … requires that annual emissions be brought down to more than 80% below current levels."[7]

Carbon emissions by sector, 2000



Source: World Resource Institute (2006)

[1] Joint science academies' statement: Global response to climate change, June 2005

[2] IPCC Climate Change 2007: The Physical Science Basis — Summary for Policy Makers, February 2007

[3] Pew Center on Global Climate Change, 2007

[4] United Nations Environment Programme: Our Planet — Climate Change & Economic Development, 2007

[5] World Resources Institute: Hot Climate Cool Commerce, May 2005

[6] World Resource Institute (2006)

[7] Stern Review — The Economics of Climate Change, October 2006

Regulatory risk

This risk relates to uncertainty about the nature and timing of regulation, as well as the ability of the organization to comply. For many countries, regulation is developing at both the federal, state, or provincial levels. There can be uncertainty about the form of regulation (cap and trade, absolute or intensity-based limits, or carbon tax) and whether regulation will apply just to electricity generation or include other industries. Some electric utilities have asked for a mandatory approach to emissions limits, in order to provide regulatory certainty.

"A mandatory approach is necessary to help provide regulatory certainty for decision makers as the industry plans for significant growth in demand and capital stock turnover of the generation fleet."[8]

Until regulations are published, there is uncertainty about the procedures and internal controls that will be required in order to comply with emissions verification and reporting requirements. Both the International Accounting Standards Board (IASB) and Financial Accounting Standards Board (FASB) have considered guidance for accounting for certain aspects of carbon emission rights in the past, and are currently considering this topic again as part of much more comprehensive projects that are expected to include government grants and emissions trading. A company will need to explain its accounting policies to the market to ensure that the impact of its emission rights accounting on financial performance is understood.

Enterprises that operate globally face the risk of varying regulation in different jurisdictions. Until federal regulation is enacted, many enterprises will be subject to a patchwork of state regulation and regional programs, complicating the hedging of exposures and development of emissions management and reporting systems.

As regulations are enacted, there may be an impact on the value of energy companies. For example, the introduction of cap and trade schemes will benefit companies with strong trading capabilities and systems, and those that have "learned by doing" in existing cap and trade markets. Energy desks at investment banks that are active in the European Union Emissions Trading Scheme (EU ETS), and that have extensive modeling and risk measurement capabilities, will be well positioned for cap and trade programs in other countries.

Additionally, until the regulatory framework and financial governance of carbon emissions develops, a company will lack established guidance or practices for the proper tax treatment of carbon markets and the associated fiscal activity. In order to limit potential exposure to tax risks, a company will need to carefully develop and substantiate its tax positions for all business activities impacted by the economics of carbon emissions.

Technological risk

Technological risk results from the uncertainty associated with the timing of advances in technology and their associated costs. Concern about carbon emissions may accelerate investment in alternative forms of energy including, but not limited to, nuclear, wind, solar, ethanol, and bio-diesel. Introduction of these sources and their expansion to a commercial scale, presents a risk to conventional energy sources. By contrast, the need to address climate change presents a potential opportunity for these alternative energy sources.

There are currently no technologies available at a commercial scale to mitigate carbon emissions from fossil fuelled electricity generators. There is great uncertainty about which technologies will be developed and the energy process emissions they will apply to. The U.S. federal government and electricity generating companies are committing significant funds to the research and demonstration of carbon capture and storage (CCS) and to the inventory of potential storage sites, but this technology is widely viewed to be some years from commercial application.

As new technologies come to market, there potentially will be significant impact on the value of existing infrastructure. For example, one might expect coal plants that are suited to CCS and that are located close to storage sites may retain more value relative to plants that cannot reasonably be retrofitted or that are too far from potential storage sites.

[8] Brent Dorsey, Energy Director of Corporate Environmental Programmes, as quoted in PointCarbon, March 23, 2007

Price/market risk

"Market risk is the potential that changes in the market prices of an institution's holdings may have an adverse effect on its financial condition."[9] The price of carbon in the EU ETS varied from over 31€/tonne to less than 2€/tonne during 2006. The longer-term carbon price is likely to be less volatile, but is also less transparent, particularly in jurisdictions where there is no carbon trading program. Companies that choose to participate actively in traded carbon markets must be prepared to manage the price risks.

Companies that don't actively participate in traded markets may also be affected by the price of carbon, as it will likely have implications for all segments of the energy chain. Companies may be unaffected — if they are able to pass the price of carbon on to their customers. But, if they face competitors who are not similarly regulated, they may not be able to raise prices to cover the price of carbon and they would be financially disadvantaged.

In the electricity sector, energy is often sold through a market, at the price of the most expensive bid. When the price of this most expensive bid has a larger "carbon adder" than generating units that bid a lower price, the more "carbon efficient" units (for example hydro-electric and nuclear) will earn higher profits under the carbon cap and trade scheme. This higher profit would recognize their higher value related to the currently unrecognized cost of carbon emission.

Companies making capital investment decisions face major strategic risks as future regulation, technology availability, and price of carbon are all uncertain.

Strategic risk

Strategic risks arise from an organization's inability to formulate or execute a successful business strategy. Companies making capital investment decisions face major strategic risks as future regulation, technology availability, and price of carbon are all uncertain. Climate change forces a new dimension on strategic planning and scenario analysis.

Capital investment decisions are normally based on pro forma analyses that consider a range of values for important variables. Climate change presents a wild card as the number of variables impacted and the range of values is so large.

Physical operations risk

The Committee of Chief Risk Officers (CCRO) defines operations risk as "the risks associated with physical assets or delivery of energy commodities."[10] Scientists have identified a large number of potential changes in the physical environment that may result from climate change, and many of these have the potential to create physical operations risks. Some of these changes (for example, rising sea levels and more intense storms) may present physical risks to energy infrastructure including ocean oil platforms, LNG terminals, refineries and generating stations near sea level, and transmission facilities. Like much infrastructure, electricity transmission towers and conductors have been designed based on analysis of historic weather records. If more intense winds will be experienced in the future, there is the potential that design standards will be exceeded, resulting in damage to physical assets.

Other potential changes, such as reduced snow pack, extended summer heat waves, and drought, may change the operating patterns of physical assets. Hydro-electric reservoirs may be cycled through larger ranges. Transformers may be expected to perform at design rating for longer periods. These changes in operating patterns may present a risk of damage or shortened life for physical assets.

[9] Federal Reserve System, Trading and Capital-Markets Activities Manual, September 2006

[10] CCRO, Guidelines on Establishing a Risk Management Framework and Policy, February 18, 2005

Market-based mechanism uncertainty

Clean Development Mechanism (CDM) is a policy tool implemented under the Kyoto protocol to allow companies and countries to meet emission reduction targets at the lowest possible cost. CDMs allow companies to conduct cost efficient emission reduction projects in different parts of the world and receive Certified Emission Reductions (CERs) in exchange for their investment. CERs in turn are either used to count towards a company's internal emission reduction obligations or sold on the market to companies that need to purchase credits to meet their obligations. Companies are investing significant amounts of capital in these international projects to generate emission credits. However, in comparison to traditional joint ventures, CDM projects can carry considerable risk.

The United Nations Framework Convention on Climate Change (UNFCCC) has developed strict requirements for CDM projects. CDM projects need to meet criteria designed to assure that the project would not have been developed absent the CDM financing.

Companies engaging in CDM projects experience volume risk associated with uncertainty in the number of emission reduction credits that will eventually be delivered, verified and certified as CERs.

CDM project participants also face market price risk, as many projects have structured the purchase of CERs in a forward contract at a fixed price which may be different from the market price at the time of delivery. Since the carbon market is immature, the price of CERs is highly speculative, and the liquidity of the asset is not assured.

Lastly, there is the political risk of dealing in countries where governments can refuse to certify or transfer the emission reduction units as agreed by the project sponsor or subsequently choose not to comply with its obligations under the Kyoto protocol.

Companies must learn how to structure deals in order to mitigate the unique risks related to participating in these carbon market based projects.

Volume risk

Potential changes to the physical environment may also introduce volume risk. Volume risk results from uncertainty in the volume of energy that can be produced by a generating resource or uncertainty in energy demanded.

Reduced snow pack will lead to a decrease in spring and summer runoff, which may create a challenge for hydro-electric resources in filling reservoirs. The potential for droughts may require a change in operations for hydro-electric reservoirs, particularly where the reservoirs support multiple uses such as fisheries, irrigation, and municipal water supply. Changes in the reservoir use may reduce the energy production potential resulting in a change in fuel mix for the generating company.

Changes in temperature may result in changes to demand patterns. While increased air conditioner use due to higher summer temperatures may result in higher demand for electricity generation companies and for gas companies supplying fuel, the demand may also stress the limits of installed capacity. Milder winters will reduce winter demand for oil, gas, and electricity in areas where these are used for residential heating.

Modeling and valuation risk

Modeling and valuation risk results when the models or market data used to compute the value or risk associated with assets or instruments fail to accurately capture the changes in value. Modeling and valuing derivatives have always been complex. Where carbon emission allowances are deemed to be derivatives, their valuation will be complicated by issues specific to the carbon market, such as vintage year and the volume uncertainty of project-based offsets.

The modeling of generating assets will be complicated by the need to add another "leg" to transactions to represent the emissions allowance requirement, in addition to the fuel and power costs, which are currently modeled. As the modeling of assets becomes more complex, the risk of an error also increases.

Human capital risk

The impacts of climate change are not limited to the inanimate; effects can also extend to the workforce. Recruitment and retention, education and training, health and safety, and other areas of human capital may come into play.

For example, if a coal-fired electric and gas utility acquires wind generation capabilities, the technical skills required of the personnel assigned to the wind assets will be different than those for workers dedicated to the traditional generating equipment. The skill sets of a gas turbine technician are not directly transferable to wind turbines; thus, the utility may need to make a significant investment in worker retraining.

People working on the front lines may be most obviously affected, but back office workers may also have skill and training issues. For instance, employees in treasury and finance will need to deal with new and evolving requirements as emissions trading schemes are adopted and revised.

Trends around the aging of the workforce present similar challenges. As older technicians retire, they will need to be replaced with workers whose training and abilities better align with evolving requirements.

Climate change also gives rise to health and safety issues. As evidenced by the significant damage to oil platforms in the Gulf of Mexico due to Hurricane Katrina, the physical location of facilities can present unique challenges in terms of protecting and, if necessary, evacuating the workforce.

As weather patterns change and storm intensity increases, energy company workers may be redeployed to other districts to assist with recovery efforts. Implications would extend into training, as workers would need to be versed in storm damage repair. Labor relations would also be affected, since hours and locations of work would vary as companies lend their people to other districts.

Potential changes, such as reduced snow pack, extended summer heat waves, and drought, may change the operating patterns of physical assets. Hydro-electric reservoirs may be cycled through larger ranges. Transformers may be expected to perform at design rating for longer periods.

Why is Risk Intelligence well suited to the treatment of climate change risks?

Progressive enterprises are applying the principles of Risk Intelligence to ERM frameworks and taking advantage of the benefits. These benefits include:

- Managing risks that exist across a number of business units.
- Managing risk factors that affect a number of risk types (e.g., regulatory, price, etc.).
- Managing risks taking correlations into account.
- Creating high-level champions and senior management involvement.

ERM enhanced by Risk Intelligence is well suited to managing risk factors that affect the business on an entity-wide basis. As a global risk, climate change has the potential for disruption across all geographic locations of the enterprise. Diverse business functions may be affected, including procurement, production, retail, commodity trading and finance.

Because climate change affects many geographically dispersed business units across a broad range of risk types, it must be addressed on an enterprise-wide basis, and a Risk Intelligent approach is effective in doing this. Dealing with risks in isolation on a business unit and risk factor basis (e.g., a commodity transacting business unit dealing with carbon price risk) can lead to undesirable outcomes. Decisions may be taken out of context, without consideration of impacts on other business units, or without knowledge of correlated effects on other risk types.

Since climate change is the common driver for a range of risk factors, it should be expected that the resulting risks will be correlated. For example:

- Price risk becomes a significant factor once regulation (e.g., a cap and trade scheme) has been enacted, and companies are required to be in the carbon market, so carbon price risk and regulatory risk are correlated.
- Physical operations risk and volume risk may be driven by the same physical events (e.g., low snow pack), so these two risks would also be correlated.

It is important that these risks are considered from a high enough level in the company that these correlations will be identified and considered.

Strategic risk is, to a large extent, a result of regulatory, price, technology, volume, and physical operations risks. All these risks need to be considered in making a decision on a new generating station investment. The decision to invest in, for example, a new coal plant will be impacted by uncertainty in:

- Government decisions to regulate carbon emissions
- Price of carbon
- Efficacy and availability of CCS technology and location relative to storage
- Plant's ability to follow new weather-driven customer load shapes
- Plant's location with respect to rising sea levels
- Availability of cooling water, given drought scenarios
- Ability of IT systems to manage and integrate emission allowance data.

A Risk Intelligent approach to ERM will elevate the management of enterprise risks to a senior level, which is appropriate when dealing with risk factors as far reaching in their impact as those related to climate change. Some risks related to climate change are creeping conditions (see Definitions, page 3) that can be anticipated. Creeping risks may not be identified by any one business unit as critical and urgent, but might more likely be addressed as the result of long-term planning by senior management.

Senior management is positioned to create a high-level champion who can organize cross business unit teams, mandate the sharing of information, and fund the integration of IT systems, which may be necessary for the effective management of climate change risk.

Energy companies are already dealing with many significant risks, and climate change adds even more. Treating climate change risks in an ad hoc and isolated manner can result in costly errors in decision making. ERM in combination with Risk Intelligence is well suited to dealing with climate change risks. It is an approach for dealing with complex, correlated risks that provides the necessary structure for identifying, measuring, prioritizing, and responding to these additional risks.

Applying Risk Intelligence to climate change risks

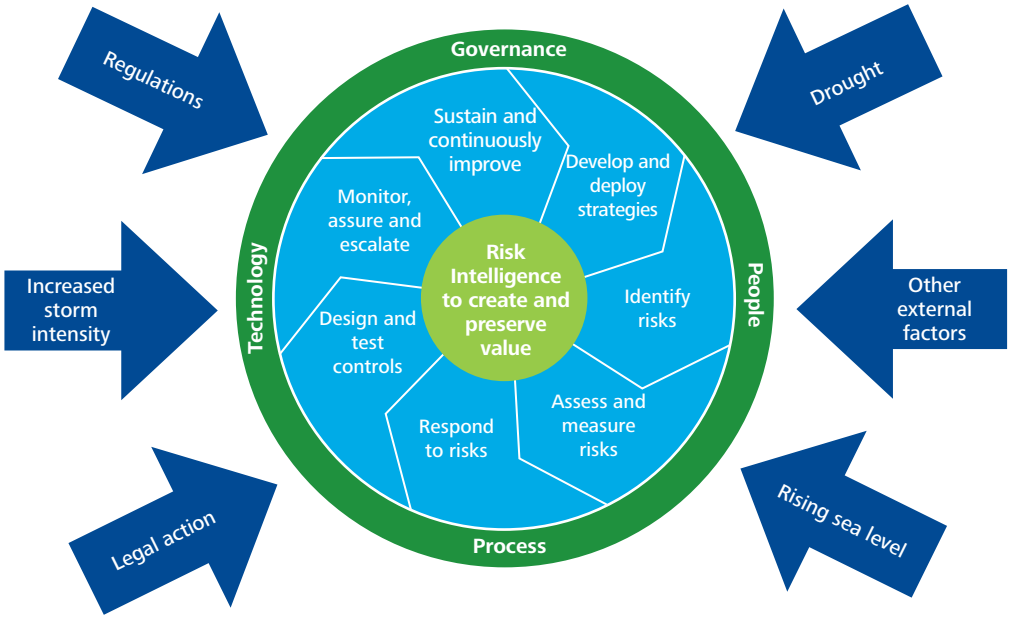
The Risk Intelligent Framework (as depicted in the diagram below) provides a conceptual device for organizing an ERM program. The outer arrows represent the external factors impacting the organization. External factors specifically relevant to climate change risk include, for example, greenhouse gas regulatory actions, introduction of disruptive technologies resulting in product substitution (new energy sources), demand destruction, physical implications of the changing climate, maturing of technologies (alternative energies become cost-effective), and entrance of new competitors.

The colored circles represent the enterprise itself. The inner yellow circle contains the Risk Intelligent Enterprise's goal of creating and preserving value. The intermediate blue circle contains the processes that must be operating. The outer green circle contains the four capabilities that must be developed when infusing Risk Intelligence into an ERM program.

Governance

The Risk Intelligent Enterprise embeds responsibility for risk oversight in the board of directors. The board ensures that a comprehensive risk management system is in place as specified in an overarching, enterprise-wide risk policy. The chief executive officer (CEO) sees that all components of ERM and Risk Intelligence are in place and operating effectively. In most large, complex enterprises such as energy companies, CEOs typically establish a risk management committee. Increasingly, such enterprises are also defining a chief risk officer (CRO) position or assigning this role to another senior executive such as the chief financial officer, general counsel, or chief compliance officer. Whether the CRO role oversees a relatively centralized or decentralized risk management function, the success of the ERM program depends upon the CRO having high stature within the organization as well as necessary resources.

The Risk Intelligent framework



Responsibility for climate change risks must be elevated beyond the health, safety, and environment function or compliance department, given the broad-reaching impacts to the enterprise.

The diverse nature of climate change-related opportunities and risks underscores the importance of incorporating responsibility for addressing climate change risk in the overall ERM program. Responsibility for climate change risks must be elevated beyond the health, safety, and environment function or compliance department, given the broad-reaching impacts to the enterprise. Awareness of the risks needs to be elevated to those levels that can evaluate the opportunities and the risks, understand the full breadth of impacts across the enterprise, and assign resources.

What makes good climate change governance?

Ceres, a network of investors working to help companies to address global climate change, provided the following best practice checklist for developing an effective Climate Change Governance Policy.

Board oversight
- Board committee has explicit oversight responsibility for environmental affairs.
- Board conducts periodic review of climate change and monitors progress in implementing strategies.

Management execution
- Chairman/CEO clearly articulates company's views on climate change and greenhouse gas (GHG) control measures.
- Executive officers are in key positions to monitor climate change and coordinate response strategies.
- Executive officers' compensation is linked to attainment of environmental goals and GHG targets.

Public disclosure
- Securities filings identify material risks, opportunities posed by climate change.
- Sustainability report offers comprehensive, transparent presentation of company response measures.

Emissions accounting
- Company calculates and registers GHG emissions savings and offsets from projects.
- Company conducts annual inventory of GHG emissions from operations and publicly reports results.
- Company has set an emissions baseline by which to gauge future GHG emissions trends.
- Company has third party verification process for GHG emissions data.

Emissions management and strategic opportunities
- Company sets absolute GHG emission reduction targets for facilities and products.
- Company participates in GHG trading programs to gain experience and maximize credits.
- Company pursues business strategies to reduce GHG emissions, minimize exposure to regulatory and physical risks, and maximize opportunities from changing market forces and emerging controls.

Source: Ceres Inc.: Corporate Governance and Climate Change — Making the Connection, March 2006

People

Risk is pervasive, and everyone in an enterprise participates in managing (or mismanaging) risk, knowingly or not. In order for an enhanced ERM program to succeed, people must understand their risk-related responsibilities in the context of their overall job activities.

One challenge of climate change risks and opportunities is that they are manifested in many different ways across an energy company. As such, people knowledgeable in different aspects of climate change-related impacts are distributed across the enterprise. Only a Risk Intelligence program that brings together different perspectives from different business units and functions will succeed in identifying the multitude of risks and opportunities, in defining their interactions and inter-dependencies, and in developing comprehensive risk response strategies.

Thus, a critical first step is for this knowledge of climate change and its consequences to be assimilated and incorporated into the strategic objectives and risk assessment of the enterprise. After this is accomplished, then the implications of climate change can be disseminated throughout the enterprise by building the needed risk management activities and controls into procedures and job descriptions.

Technology

Technology often poses the single largest obstacle in implementing a Risk Intelligence-infused ERM program. Typically, organizations employ a variety of software tools with ERM capabilities, addressing the areas of data management, workflow management, reporting, risk engines, capital allocation, risk and control assessment, among others. In addition, systems must be integrated with and be able to access data from disparate systems and applications operating across the enterprise, such as financial, commodity trading, scheduling, HR, event loss data, fraud risk management, and credit risk management systems. Enterprises often underestimate the data management challenges they must overcome as part of a successful system implementation. Data availability (existence), quality (completeness and accuracy) and accessibility are key technology issues that often make or break a Risk Intelligent implementation.

The ERM software market is currently dominated by component programs that perform some of the required tasks well; however, few, if any, end-to-end programs are available. The emerging nature of software to support business activities arising from climate change only compounds the situation. Software to support emissions commodity trading, to track emissions permits and credits, and to monitor and report are emerging and rapidly evolving.

Process

Processes describe how work gets done in an enterprise, whether by people or by automated systems. In order to be effective, processes must be documented, managed, and improved on an ongoing basis. The Risk Intelligent Framework defines seven processes within an ERM program that must operate effectively. These processes should be ongoing and not a one-time effort. For energy companies subject to climate change risks, the improvement and evolution of these processes will include incorporating climate change-related risks and their treatment and control into their ERM program.

Develop and deploy strategies

The feature that distinguishes Risk Intelligence from traditional, silo-based risk management approaches is the linkage between strategy setting and risk management. In the Risk Intelligent approach, the two are intertwined so thoroughly that one cannot be divorced from the other. The Develop and Deploy Strategies process recognizes that strategic opportunities come with risk, and that companies cannot make money for their shareholders without assuming risk.

In order to thrive, an enterprise must have a clear set of objectives against which performance is measured. Strategies such as revenue growth, operating margin, asset efficiency, and meeting expectations are developed to create and preserve value. The Risk Intelligent Enterprise carefully weighs the risk-adjusted return.

Climate change especially challenges enterprises to adopt this type of integrated view of strategy formulation and risk management by so demonstrably posing both opportunities and threats. By thinking creatively, companies

can choose to build new capabilities early around emerging markets (emissions trading) or technologies. Companies can then leverage superior ability to manage risks associated with these emerging capabilities to competitive advantage.

In the face of rapid technological change that could lead to the introduction of disruptive technologies and product substitution, companies can choose to be the disrupted or the disrupter. Some established oil and gas companies have made substantial investments developing alternative energy technologies. The benefits they expect to accrue include learning the business model and the technologies, building distribution channels and brand recognition, and positioning themselves as alternative energy market leaders in the event petroleum demand dissipates.

Identify risks

Risks resulting from climate change are varied in their nature and can impact many parts of an enterprise, thereby requiring a structured approach to risk identification. For each risk, the causal risk factors and the consequences must be identified. An effective "Identify Risks" process prompts enterprises to evaluate their business processes from a value chain perspective across all business units. This is especially important for vertically integrated enterprises. For example, the risk of flooding at a refinery could cause production shut-ins within the exploration and production line of business. However, this concept can be extended to a consideration of risks faced by suppliers and customers and what impacts those risks could have on any enterprise.

Assess and measure risks

In order to manage risks well, enterprises must know how much risk they face and how those risks stack up relative to the enterprise's overall risk appetite. Only when armed with this information can an enterprise make informed decisions about risk responses such as acceptance, avoidance, transfer, or mitigation.

Balancing risk and opportunity

In 1967 Suncor became the first company to commercially develop Canada's Athabasca oil sands. In comparison to traditional oil wells, extracting and separating oil from the oil sands is an energy and CO_2-intensive process. Because of the increased emissions associated with oil sands production, Suncor is vulnerable to carbon regulations and in particular emissions caps, intensity targets or the implementation of a carbon tax. Suncor recognized this and has thoroughly explored the challenges associated with climate change in an attempt to not only mitigate the risk but capitalize from the opportunity.

Suncor recognized that impending carbon regulations will drive demand for fossil free power generation, thereby increasing opportunities for investment in renewable energy. In an attempt to diversify its energy portfolio Suncor has made significant investments in wind farms across Canada. In addition, Suncor has attempted to capitalize on its experience in the oil industry by getting involved in the production and distribution of biofuels. Suncor has built a $120 million ethanol plant and has introduced biodiesel as part of its product offerings. These investments are all calculated risk mitigation responses to climate change. Suncor recognizes that as carbon regulations are enacted, risks in one business unit will be countered by opportunities in another.

Navigating without a crystal ball

In the 1970s, Shell developed a new strategy group, called Group Planning, charged with identifying events that could impact the oil industry. The Group Planning division used scenario planning to assess mostly non-quantifiable events related to political developments and how they might affect oil prices. Shell realized that America's depleting oil reserves, coupled with growing demand and increasing anti-American sentiment in the Middle East, could leave the country susceptible to price hikes. Shell also recognized that the emerging Organization of Petroleum Exporting Countries (OPEC) was in a strong bargaining position and might insist on price increases prior to 1975, the year when oil prices were set to be negotiated.

Shell forecasted these developments and management took appropriate risk mitigation measures to respond to potential price hikes. In 1973, after the Yom Kippur war in the Middle East, oil prices skyrocketed, catching all the major oil companies unprepared. Shell however responded quickly to the changing market conditions and quickly outperformed all of its competitors. Shell expanded from being one of the smaller international oil firms before the oil crisis, to becoming the second largest and most profitable firm within years after the crisis. While it's unlikely that Shell's improved market position is entirely attributable to its enlightened risk management practices, we believe there is a clear linkage.

Shell's use of scenario planning is a good example of how this forecasting tool can be used to predict high impact events for which there are little or no historical quantitative data. Climate change related risk events such as severe hurricanes or drought are examples of low-probability, high-impact events for which the historical data are suspected to be poor predictors of probability due to changing conditions, or for which there are no historical data to extrapolate from in estimating probability and impact. For such risk events, scenario planning is suitable for forecasting plausible outcomes and providing analysis that can be used in developing risk mitigation measures.

Assessing and measuring risks involves consideration of the sources of risk, the magnitude of their positive and negative consequences, and the likelihood that those consequences may occur. Existing controls are taken into consideration. Risk quantification can be time-consuming and expensive. Therefore, a preliminary qualitative assessment can be used to prioritize all identified risks by likelihood and impact. Such a process is effective when systemically dealing with the numerous climate change-related risks facing the energy sector. Only those risks that are deemed significant will undergo a more detailed quantitative analysis.

The art and science of modeling low-probability, high-impact risks for which little historical data are either available or relevant has developed rapidly over the last few years, largely driven by responses in the insurance industry to storm-related catastrophes.

Structural simulation models have emerged as the preferred analytical technique. These models are based on explicit cause-effect relationships typically derived from both data and expert opinion. Causal relationships are represented graphically as event trees, fault trees, or other risk maps. Each cause-effect relationship is quantified using a combination of historical data and expert input. Expert input is used to fill data gaps and adjust for data that may not be representative. Given that global warming is a creeping condition, historical data may not be pertinent for estimating probabilities and loss distributions.

To the extent that expert input is uncertain, the cause-effect relationship is represented stochastically, i.e., the effect is represented as a probability distribution around a point estimate. Simulations using Monte Carlo techniques are then run to develop a range of outcomes for key variables. The output is summarized as a loss probability distribution.

Companies can devise risk response strategies such as relocating facilities to non-affected areas, transferring risks to parties more suited to mitigate or accept them, or developing crisis management and disaster recovery capabilities to lower the severity of the impacts in the event of a risk occurrence.

Respond to risks

In the Respond to Risks process, companies develop and implement cost-effective risk treatment strategies that increase benefits for the organization while reducing potential costs. This process involves identifying all risk response options (including risk acceptance, transfer, avoidance, and mitigation), performing a cost-benefit analysis to determine the optimal risk response mix and strategy, and developing appropriate risk treatment plans.

When devising a risk response strategy, it is important to understand the full spectrum of risk factors and consequences. Risk mitigation measures are usually designed to either lower the probability or severity of a risk factor, risk, or consequence. Many climate change risks are driven by external factors outside the control of the enterprise. It is easy for companies to slip into complacency, reasoning that there's nothing that can be done to prevent the risk from occurring. However, companies have control over their level of vulnerability and preparedness in the face of events. Companies can devise risk response strategies such as relocating facilities to non-affected areas, transferring risks to parties more suited to mitigate or accept them, or developing crisis management and disaster recovery capabilities to lower the severity of the impacts in the event of a risk occurrence.

Real option analysis can be a useful tool in devising risk response strategies by allowing companies to forecast the effects of risks and compare various risk responses, especially when capital-intensive projects are being evaluated. For instance, if an oil and gas enterprise were embarking on building new refining capacity, climate change risks would be considered in infrastructure planning decisions. The costs of various risk responses, such as where to locate a refinery to protect it from severe weather damage or rising sea levels would be considered. In planning the configuration of a power plant, real options considered could include a fuel switching capability, or the installation of CCS to support emissions trading activities or to comply with future regulatory requirements.

Design and test controls

A key risk response strategy is to mitigate risk factors or consequences by implementing controls. Controls are only relevant for those risk factors and consequences that can be controlled at least partially by the enterprise. Risk Intelligent Enterprises seek to implement a balance of preventive and detective controls and automate controls to the extent it is possible and economical.

As companies embark on new business activities, they will need to design and implement appropriate controls. The entire suite of controls required for any commodities trading operation will be required for emissions trading, including segregation of duties and the need to maintain audit trails for entries and data changes. Data integrity is becoming an increasingly important issue—environment compliance audits will require data quality rivalling that of financial reporting data integrity. Companies must address questions such as: Who has access to data? Where are data stored? Are data protected from changes by inappropriate parties? Is the integrity of data ensured? Inaccurate data can result in miscalculations, resulting in both direct costs and lost opportunity costs, as well as contributing to compliance risk.

Know your carbon lifecycle

Palm oil is an abundant, relatively inexpensive fuel easily integrated into existing power stations and appears to be an ideal choice for utilities to maximize emissions credits and reduce their carbon footprint. However, recent research on CO2 emissions from drained peat swamps in South East Asia has raised serious concerns about its suitability as a fuel alternative for electrical generation.

85% of commercial palm oil is produced in Indonesia and Malaysia,[11] where clearing and draining of peat swamps to increase production of palm oil may have increased CO2 emissions in the area by as much as 2 billion tons, or 8% of global carbon emissions. Peat is the most efficient ecosystem for trapping and storing carbon underground which, when exposed, is released back into the atmosphere through oxidation. At current deforestation and drainage rates, an estimated 600 million tons per year of trapped CO2 are being released in this way.. With an additional 1.4 billion tons released by deliberately lit forest fires for land clearing the total emissions could be three to ten times as much as the CO2 emissions from conventional fuel used to generate the same amount of energy.[12]

Following publication of the findings and a warning from a national regulatory agency, a major Northern European utility has announced it is suspending the use of palm oil as a fuel, which amounted to 10% of its sustainable energy mix, until additional research is completed. Another large European utility has dropped plans for a 10,000 MW palm oil generation facility in England.[13]

Carbon capture and storage

There is growing consensus that coal and gas will continue to be a significant part of the electricity supply equation over the next several decades. The backdrop of climate change has created an exciting environment in which several approaches are evolving to address the critical issue of carbon dioxide emissions, in particular from coal-fired power stations. Carbon Capture and Storage (CCS) is an approach to reducing emissions from coal and gas fired power plants, typically by some 90%. It is well-suited to ERM-type analysis due to the significant investments required and the complex and interdependent risks that pervade the value chain. For example, technological risk surrounds various capture methods. Due to skilled labor shortages, rapidly escalating materials costs, and the relatively small number of engineering companies that can design and build CCS facilities, energy companies embarking on CCS projects face significant price, contract, and project risk. Regulatory risk arises in ways such as the acceptance of CCS within regulated carbon markets. Long-term storage and carbon measurement, monitoring, and verification (MMV) are accompanied by a host of significant legal, physical, technological, and reputation risks across multi-generational time periods, given that leakage rate thresholds can be specified over time spans as long as 1000 years.

Deploying CCS on a broad and meaningful scale requires significant investments by multiple parties, at varying time periods, and across multiple sectors of the value chain. Allocating the burden of carbon costs, appropriately aligning risks, and developing and executing strategies remain challenging issues to overcome. Applying the Risk Intelligent Framework can help.

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[11] USDA Foreign Agricultural Service, "WAP Circular 98-11," United States Department of Agriculture, http://www.fas.usda.gov/WAP/circular/1998/98-11/wldpon.pdf

[12] Hooijer, A., Silvius, M., Wösten, H. and Page, S., "2006. PEAT-CO2, Assessment of CO2 emissions from drained peatlands in SE Asia," Delft Hydraulics report Q3943 (2006)

[13] International Herald Tribune, "Energy Companies rethink palm oil as biofuel," March 27, 2007, Health/Science section

Monitor, assure, and escalate

ERM based on the principles of Risk Intelligence is not a one-time project. It is an ongoing process with a number of dynamic elements requiring regular attention. Risk treatment plans must be monitored for progress and to assure that anticipated benefits are in fact realized. Internal loss events and near misses must be recorded and investigated. Controls must be tested and effectiveness assessed. Risks must be measured and risk tolerance threshold breaches and limit violations escalated for corrective action. Key risk indicators must be monitored and evaluated in order to anticipate and react quickly to events. Because ERM is a continuing process, it is ideal in meeting the dynamic challenges of global warming which causes a wide array of risks to develop at differing speeds. Climatic trends that are slow to develop, such as rising sea levels, are periodically monitored, while faster evolving or episodic risks, such as the passage of international carbon regulations, are continuously tracked so that planned risk responses can be adjusted appropriately.

Sustain and continuously improve

Like all processes, ERM processes must be reviewed periodically for effectiveness. A formal mechanism designating a responsible party must be implemented for an annual assessment of every aspect of risk management from the governance structure and suite of risk-related policies down to the processes, procedures, and systems making up the program. Ultimately, the CEO bears responsibility for ensuring the effective identification, measurement, monitoring, and reporting of risks. An enterprise newly embarking on an assessment of climate change risk might seize this effort as an opportunity to test how effectively its cross-enterprise risk program is working.

Moving forward

The first step companies should consider in gauging their readiness or effectiveness in addressing climate change is to assess the maturity of their overall ERM program. Deloitte & Touche LLP's ERM Capability Maturity Model is described in *The Risk Intelligent Enterprise: ERM for the Energy Industry*. See www.deloitte.com/risk. The fact that climate change risks are complex, cross business units, and exhibit correlations suggests that enterprises should strive to attain at least a comprehensive, and preferably an integrated, maturity level in order to preserve value. Risk Intelligent Enterprises will need to progress to the "strategic" maturity level in order to identify and exploit opportunities to create value.

Contact us

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