Carbon Liability by Yoshihiro Fujii[1]

Abstract:

By the term 'Carbon Liability' we mean a calculation of values approximating to the economic externalities of carbon emissions in the global economy, in relation to the totality of global economic activity. As a consequences of over two centuries of industrialization, the global carbon budget and its associated global carbon balance sheet have clearly diverged from a state of natural equilibrium. Deterioration of carbon budget has affected on asset value of energy intensive companies which have huge fossil fuel reserves, called as stranded assets. Three material identifiable, types of carbon risks, 'Cap-and-trade' schemes are important economic mechanism aiding both the rectification of these imbalances and restoration of natural carbon cycle disrupted by emissions of anthropogenic greenhouse gas (GHG) in both developed and emerging countries. Such schemes establish an economic value to carbon through open market trading. They serve to quantify and to reduce carbon risk, in accordance with appropriate and efficient economic regulation. Monetizing carbon liabilities through these market mechanisms is a means to place boundaries on, and thus to mitigate, the uncertainties of carbon liability. This process of monetization may also transform market risk into an opportunity for economic exploitation.

Introduction

The Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC 2014: AR5[1]) concluded that 'human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are highest in history', and that 'warming of the climate system is unequivocal, and since the 1950s'. Certainty of the relation between increase in global average temperatures since the mid-20th century and increase in anthropogenic greenhouse gas(GHG) concentrations is defined as 'extremely likely' rather than 'very likely' in previous report (AR4, 2007) which means probability of causality increase 95~100% in AR4 to 95~100% in AR5. The report said 'Climate change will amplify existing risks and create new risks for natural and human systems. Risks are unevenly distributed and are generally greater for disadvantaged people and communities in countries at all level of development.' This means managing carbon balance sheets both in global economy and individual economic entities would be emerged critical issues.

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A. Carbon Liability as a concept in accounting and in ecology

(1) 'Carbon Liability'

This chapter focuses on the importance of these findings, in relation to the concept of 'carbon liability' and its implications. By this term it means a calculation of values related to the economic externalities of carbon emissions in the global economy, and the process of apportioning those values, both in macroeconomic terms within the global economy and micro-economically, to achieve a more true economic value for each individual emitting entity. It can be referred to these processes as 'carbon management'.

What is a "carbon liability"? Liability is a concept which arises in accounting and in law. It means a legally enforceable obligation, whether imposed contractually or unilaterally/ or by civil society. The obligation on a citizen to pay tax is an example of a unilateral liability imposed by a government. From an accounting point of view, a liability means a present obligation arising from past events. Its settlement is expected to result in an outflow of resources. International Accounting Standards Board (IASB) sets outthe accounting and disclosure requirements for provisions, contingent liabilities and contingent assets as International Accounting Standards(IAS) 37. This chapter discusses the current definition..

Carbon liability has its roots in this environment of civil obligation. In recent years, governments have introduced regulations to restrict quantified volumes of GHG (greenhouse gas) emissions by incorporated entities, a measure directed towards the public goods of controlling the unequivocal danger – an economic 'bads' - of which is global warming. Thus 'carbon liability' arises from an established tradition of state-initiated regulation.

Entities addressed by governments are required to meet the costs of their obligations using their own resources in order to comply with the demands of regulation. Liability in relation to carbon emissions differs in kind, however, from other forms of liability, in that it includes a lot of messy uncertainties about its causality & its composition. The IASB's International Financial Reporting Standards (IFRS) categorizes such instances as a 'contingent liability', in the IFRS' words, 'a possible obligation depending on whether some uncertain future event occurs' and 'a present obligation but payment is not probable or the amount cannot be measured reliably'. These characteristics correspond to the nature of carbon liability, which encompass the past, present and future responsibilities for GHG emissions.

Carbon liability belongs in addition to a broader definition of Environmental Liability. This field has already been defined legally and in accounting terms in both the USA and the European Union. The US Environmental Protection Agency (EPA) has defined "environmental liability" as an obligation in environmental law to make a future expenditure to remedy the past or ongoing manufacture, use, release, or threatened release of a particular substance, or other activities that adversely affect the environment[2]'. This regulatory stance

arose from a succession of environmental disasters in the US during the 1970s and 1980s, which resulted in asbestos exposure and soil contamination and damage to people, property and the natural environment. To prevent and remedy such damages, US legislators enacted the Comprehensive Environmental Responses, Compensation and Liability Act (CERCLA), otherwise known as the 'Superfund Act'. It was enacted in 1980, then was amended as Superfund Amendment and Reauthorization Act (SARA) in 1986. Small Business Liability Relief and Brownfields revitalization Act in 2002 respectively.

Drawing on this American legislation, the European Union constructed its own legal framework for the prevention and remediation of damages to the human and natural environment. In 2004, the EU Commission published its Directive on Environmental Liability (ELD), it came into effect in all EU states in 2008. These legal frameworks on either sides of the Atlantic share common characteristics.

Drawing on these models, the US Federal Accounting Standards Board (FASB) and the IASB have developed an accounting framework on environmental liability. The FASB issued EITF93-5, 'Accounting for Environmental Liabilities', in 1993; in 1996 it was included in the Statement of Position (SOP96-1: Environmental Remediation Liabilities) in the American Institute of Certified Public Accountants (AICPA). As noted earlier, the IASB has referred to environmental liabilities in its IAS 37 standard.

What definitions of 'the environment' are used in these legal and accounting frameworks? The concept in those frameworks is very broad. For example, the Lugano Convention (Convention on Civil Liability for Damage Resulting from Activities Dangerous to the Environment, June 1993) which laid down fundamental concepts of strict liability for environmental damages caused in EU territories considers environment to be the realm of all natural resources, both abiotic and biotic, such as air, water, soil, fauna and flora and the interaction between the same factors, property which forms part of the cultural heritage and the characteristic aspects of the landscape.

(2) Similarities and differences between the concepts of carbon liability & environmental liability

It is clear that any concept of 'carbon liability' should be considered in the context of an established corpus of environmental liabilities. Carbon emitted by corporations shares characteristics with other forms of environmental damage including, as already noted, cost of damages attributable to past or present commercial activities, including production of GHGs, and/or their release into the atmosphere. To discharge these obligations, entities must pay the expenses of remediation or reparation from their own resources. In other words, this discharge of legal responsibilities under regulation entails for corporate entities an

internalization of a type of cost-control of carbon emissions – which was previously considered as an economic externality. What these similarities in definitions demonstrate are that they can be constructed the same kind of legal and accounting framework for carbon liabilities in order to manage resulting marginal costs to the environment and to society as a whole.

Similarities notwithstanding, the concept of carbon liability also has several differences from general environmental liability. Most importantly, GHGs are not in themselves toxic. This contrasts directly with the toxic or noxious characteristics of most general pollutants specified or implicated in legislation on environmental liability, such as asbestos, sulfur dioxide, heavy metals, etc. Directly and indirectly, the latter harm human health and the ecosystem. Carbon dioxide, the most common GHG, and a primary factor in most cases of carbon liability, is not toxic in itself. It is merely one component in the atmosphere, a natural chemical byproduct of all plant & animal life. (Of course carbon monoxide (CO), which is chemically related to CO_2, is clearly toxic. In theory CO_2 itself can be poisonous in high volumes; such a danger is however never likely in naturally occurring concentrations.

In this context, concentrations of CO_2, even in the most dangerous scenario simulated in the IPCC's ARA5 toward the end of this century, will cause only *indirect* loss and damages, as part of the indirect consequences resulting from climate change. This indirect attenuated chain of causality presents serious difficulties in the calculation of carbon liability in society.

(3) Cows' Belch Can be Tradable Commodities

The planet is populated with very many agents of GHG emissions, whether animal, corporate or human. Corporations contribute GHGs by their activities in resource consumption, in production & distribution and in demand stimulation. Nature's emission processes include deforestation, volcanic eruptions, swamps & wetlands. Even ruminant livestock in agriculture add to the emissions of animals: the human population, now on the cusp of 7.0 billion, is of course the most highly polluting species of fauna. A belch from a cow or other ruminant emits methane, a GHG with 28 times the warming power of CO_2. Estimates of global warming potential by methane have increased from 21 in AR4 to 28 in AR5.

The Worldwatch Institution, independent research organization, has estimated that GHG emissions from ruminants contribute between 10% and 15% of the planet's annual GHG total from all sources[3]. The legal implication is clear: the belch of a cow might be regarded as a carbon liability for its owner. A rancher might compensate by participating in carbon trading, offsetting the wider economic cost of methane from his livestock. If he can find a way reducing methane from his cows, he trade a carbon credit on the free market linked to his animals thereby earning additional income besides selling milk or meat. Actually, Idemitsu Kosan, a

Japanese petroleum company, with Hokkaido University has developed a new food for cattle to reduce output of methane gas bovine eructation in 2007.

Besides biology, GHGs are emitted through innumerable economic and industrial processes in manufacturing, power generation, farming, logging, transportation, and so on. These are in addition to the emissions of individual humans, of course. Consequently, it is very difficult to restrict GHG emissions from all sources. This near-universal emission by billions of agents and processes, of gases which are very often essential to life itself, presents a completely different, universally pervasive causality which is more complex than with other recognized pollutants. This difference presents a major obstacle in forming policies to reduce emissions and to manage carbon, both in macroeconomic policy and in the carbon management strategies of individual corporations.

(4)Different legal treatments of Carbon Liability

As noted above, the concept of carbon liability can be seen as an obligation like others in environmental law. Its treatment and remedies differ from jurisdiction to jurisdiction, however. Developed countries who ratified the Kyoto Protocol recognized a duty to reduce their GHG emissions from 1990 levels. On the other hand, developing countries including even major emitters such as China, India and Brazil, face only a voluntary, non-binding commitment to reduce their own emissions. These differences are called 'Common but differentiated responsibilities'.

Some additional differences remained between developed countries. Targets in GHG reductions to be achieved before 2012 under the Kyoto Protocol, range from 6% for Japan, 7% for the EU, and 8% for the USA. After promising quantified reductions, the USA failed to ratify the agreement & left for domestic political reasons. As a result, even in developed countries, there have been different types of legal measures for reducing GHG emissions. These have affected the respective impact of carbon liabilities under different jurisdictions, both in terms of global macroeconomic policy, as well as in relation to the responses & obligations of individual corporations.

In consequence, discussions on the post-Kyoto framework focused as much on the differences between the commitment and stances of developing countries, as on the importance of emerging economies such as China, India & Brazil. Through a series of COP (Conference of the Parties of UNFCCC) meetings, developed and developing countries have agreed to fill up these differences in the climate change negotiations beyond 2020. At COP17 in Durban of South Africa in 2011, they all agreed to play their part to the best of their ability and all will be able to reap the benefits of success together based on 'Common Responsibility' and some kinds of 'Burden Sharing'.

Contents of the new framework would be discussed and expected to reach the legal agreement at COP 21 in Paris at the end of 2015, although there will be still many things remained unclear.

B. Invisible to Visible

(1) Impact of potential carbon cost

What consequences do carbon liabilities carry for carbon-emitting corporations? There are a lot of works for this subjects, and one of them is renown study by Trucost which is a UK based environmental consulting firm published under the auspices of the UN's- Principles for Responsible Investment and the United Nations Environment Programme (UNEP), reveals some interesting answers. It calculates that the full cost to the world's biggest companies of GHG emissions, pollution and other environmental damage was almost $6.6 trillion in 2008. This figure is 20 % larger than the $5.4trillion decline in the value of pension funds in developed countries caused by the global financial crisis in 2007/8, and equivalent to 11% of world's GDP[4].

IPCC also estimates macroeconomic impact by carbon liability in AR5, as the aggregate economic costs of mitigation. It's mitigation scenarios that are likely to limit warming to below 2℃ through the 21st century relative to pre-industrial levels entail losses in global consumption — not including benefits of reduced climate change as well as co-benefits in global consumption—-of 1% to 4%(median: 1.7%) in 2030 and 2% to 6% (median: 3.4%) in 2050, and 3% to 11% (median:4.8%) in 2100 relative to consumption in baseline scenarios (BAU) that grows anywhere from 300% to more than 900% over the century. Monetary value of world's GDP (equivalent to global consumption) in 2012 is $72.7 trillion, which means carbon liability for mitigating cost below 2℃ would be $1.2trillion in 2030, and $2.5trillion in 2050, and $3.5 trillion. These figures would be manageable for global economy. On the contrary, carbon liability will expand from $220 trillion to $650 trillion over the century in BAU scenarios. It couldn't be manageable for all of us. This means that carbon liability is quite variable depending on policy selection.

In addition to these huge mitigation cost, we have to count adaptation cost as carbon liability. United Nations Environment Program (UNEP) estimates the cost of adapting to climate change in developing countries is likely to reach as high as $150 billion by 2025/2030 and $250-500billion per year by 2050[5]. These figures are two to three times higher than estimate in AR5 because UNEP uses latest figures.

In calculating carbon impacts over the entire global economy, it must be considered the tasks both of quantifying carbon impacts on the planet's eco-system and secondly, of monetizing these carbon liabilities. The first task, an impact assessment of GHG volumes,

can be focused on.

(2) Quantifying carbon impacts

The fast-developing science of climate change obliges all countries on this planet to cut very quickly the GHG concentrations in the atmosphere back towards sustainable levels. Based on the IPCC's AR5, although it has been already well-known in the word, concentrations of CO2 in the planet's atmosphere were approximately 390 ppm in 2011, an increase of about 100 ppm – or 40% - from levels before the Industrial Revolution began in Europe in the late eighteenth century. Over the past two centuries, the growth in GHG concentrations has averaged 1.9 ppm per year. The long-term rise in GHGs is calculated to have pushed up average global temperatures by 0.85°Celsius during 1880-2012, and to have caused sea levels to rise almost 19 ㎝ across all oceans, according to IPCC AR5.

IPCC said anthropogenic greenhouse gas emissions are mainly driven by population size, economic activities, lifestyle energy use, land-use patterns, technologies and climate policy. They have introduced new estimate methods called the "Representative Concentration Pathways (RCP)" divided into four pathways to the end of this century, which are used for making projections based on these various factors. Desirable scenario, RCP 2.6 aims to keep global warming likely below 2℃,above pre-industrial temperatures. Two intermediate scenarios (RCP4.5 and RCP6.0) and worst –scenario with very high greenhouse gas emissions is RCP8.5. Scenarios without additional efforts to constrain emissions (baseline scenarios) lead to pathways ranging between RCP6.0 and RCP8.5.

Assuming an unchanged global dependence on fossil fuels, the IPCC AR5's worst case scenario(RCP8.5) predicts a 3.7 degree rise in average temperatures by 2100 compared to 1986-2005, resulting in a 82 ㎝ rise in sea levels. Such a worst–case scenario is anticipated to result in near-cataclysmic damage, affecting all life on the planet. In order to avoid such cataclysm, and to discharge the inter-generational liability to children and to theirs, action is imperative to decrease concentrations of GHGs in the planet's atmosphere.

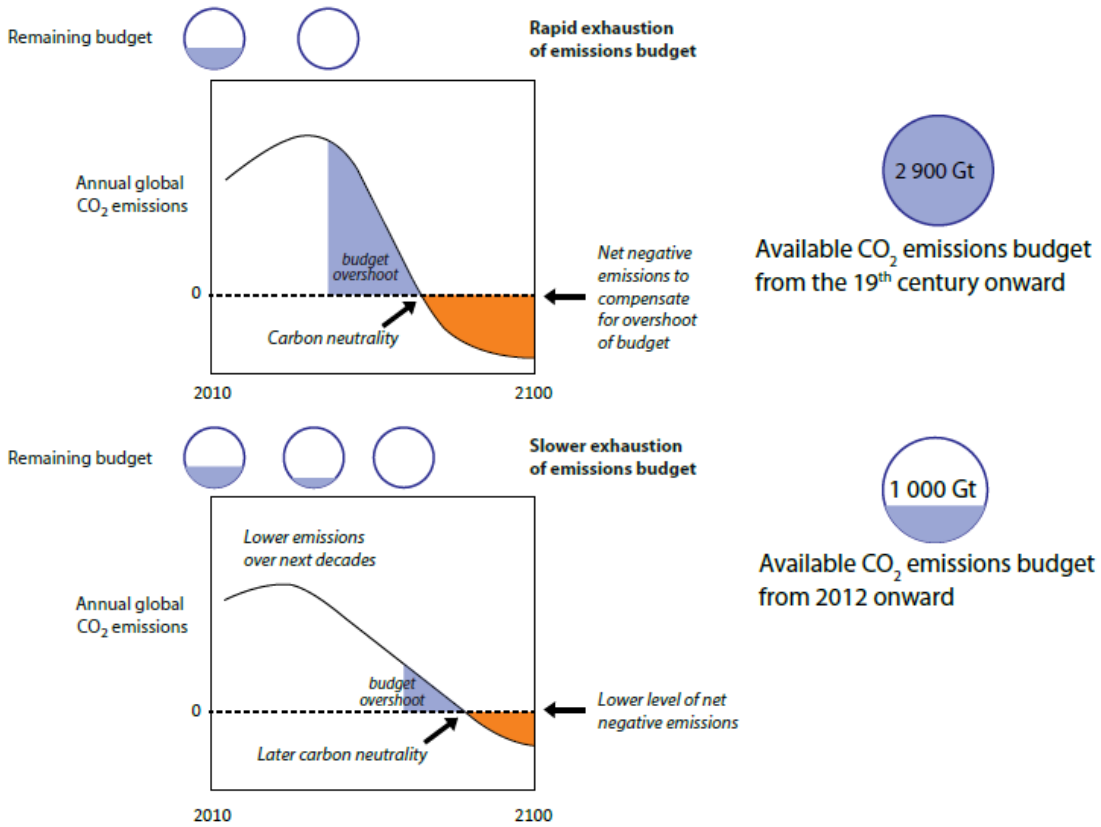
(2) Global Carbon Budget

The concentrations of GHGs which have built up through human economic activities, due primarily to more than two centuries' use of fossil fuels, have clearly harmed the earth's natural ability to sustain life. In non-scientific terms, "Mother Nature" has for billions of years supported plant, animal and human life through her generosity and tolerance. But now emissions of carbon dioxide have combined with other GHGs and sources of manmade pollution, waste and other detritus of post-Industrial economies. The effect is to exceed the

planet's inherent capacity to absorb the shocks imposed on it by humanity's weight of life, as much as by its way of life.

UNEP report[6] pointed out IPCC's estimated a total carbon dioxide budget of about 3,670 Gt CO2 for a likely chance of staying within the 2℃ limit. But since emissions began rapidly growing in the late 19th century, the world has already emitted around 1,900 Gt CO2 and so has used up a large part of this budget. Moreover, human activities also result in emissions of a variety of other substances including such as methane from our cows' belches that have an impact on global warming and these substances also reduce the total available budget to about 2,900 Gt CO2. This means there are less than about 1,000 Gt CO2 to "spend" in the future as Figure1 explains. (AR5 mentioned CO2 budget between 2011 and 2100 of about 630-1180 Gt CO2)

Figure1. Carbon neutrality



Notes: The Emissions Gap Report 2014. A UNEP Synthesis Report. November 2014

Since 1990, global emissions have grown by more than 45% and were approximately 54 Gt CO2e in 2012.About 40% of these emissions have remain in the atmosphere and the rests

have been removed from the atmosphere and stored on land and in the ocean by the earth. The ocean has absorbed about 30 % of the emitted anthropogenic, casing ocean acidification which means another carbon liability.

According to BAU scenarios like RCP8.5, GHG emissions would rise to about 59 Gt CO2e in 2020, 68 Gt CO2e in 2030 and 87 Gt CO2e in 2050. It is clear that global emissions are not expected to peak unless additional international emission reduction policies are introduced. Based on the CO2 budget approach, the levels of annual global emissions consistent with the 2℃ limit have been estimated. GHG in 2050 are around 55% below 2010 level. This means that by 2030 global emissions have already turned the corner and are more than 10% below 2010 levels after earlier peaking. It also estimates the global carbon neutrality which means staying within the 2℃ limit, or net zero emissions on the global scale which implies some remaining CO2 emissions could be compensated by the same amount of CO2 uptake (negative emissions) so long as the net input of CO2 to the atmosphere due to human activities is zero. The best estimate by AR5 is that global carbon neutrality is reached between 2055 and 2070 in order to have a likely chance of staying within the 2℃ limit.

If we fail to follow these carbon neutrality scenarios, and shift to BAU ones, the resultant rises in global temperatures will not only continue, but will speed up, following the well-established principle of positive & exponential feedback in complex natural systems. In other words, the absorptive, or 'uptake' functions of the Earth has fallen into environmental near-bankruptcy in terms of their capability to adjust to the changes humanity has made to the make-up of the atmosphere.

Before the Industrial Revolution, man-made concentrations of GHGs could be contained safely within the earth's natural capacity to absorb them. This historical fact clearly compels human beings to recover as quickly as they can the earlier successful balance of consumption and of nurture in which humans must co-exist with the planet. In economic terms, people must respect the planet's natural "uptake capacity". More broadly, they must restore the relationship between the earth and human activities. This means that they have to mitigate and decrease unabsorbed GHG concentrations.

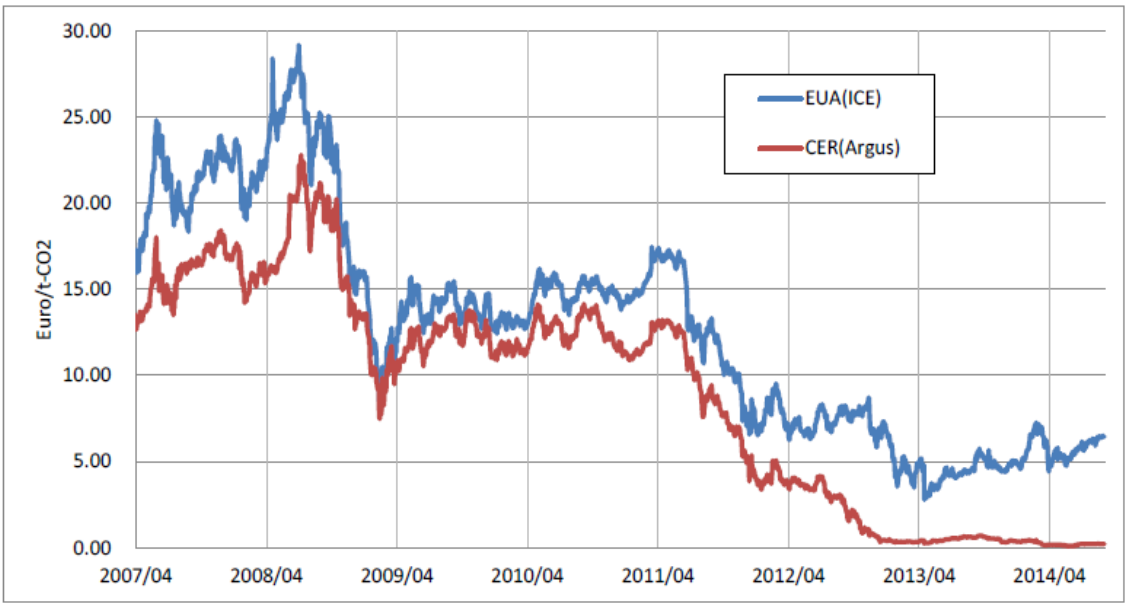
Annual imbalance in emissions toward neutrality might be referred to it as a global 'income statement of emissions', as a 'profit and loss statement', for anthropogenic GHGs. Any year's excess of GHG adds to a huge GHG accumulation in the atmosphere, built up over two centuries' use of fossil fuels.

(3)Excess cost of carbon imbalance

How can monetary values be assigned to these quantities of emissions? In the previous section, global CO2 emissions volume estimated approximately 54 Gt CO2e in 2012. Then a

monetary value can be derived for these quantities by referring to market prices for carbon in the EU's Emission Trading Scheme (EU-ETS), the world's first mandatory GHG emission trading market. But a value of EUA (European Union Allowances) has been fluctuated by supply and demand since its inception in 2005, roughly nearly €30 to below €5 per tonnes (Figure 2).

Figure 2. Price differences between EUA and CER



Note: Argus Media, ICE (2014)

In 2012, it has been traded as many as 40 million allowances per day and 7.9 billion allowances were traded yearly. Total value of carbon under the system in 2012 was €56 billion[7]. Carbon price traded in RGGI (Regional Greenhouse Gas Initiative) which is an initiative of the Northeast and Mid-Atlantic States of the USA has traded quite steady around $4-$6 per tonnes during 2014[8]. Another regional Carbon trading scheme in USA is California's Cap and Trade Program that took effect in early 2012. The price of carbon under their quarterly auction of GHG allowances for sale in 2014 was $ 11.34, almost double of the other side of the Continent[9]. If we use €30 per tonnes as historically highest price of EUA to calculate total global carbon deficit would monetize to €1.6 trillion, and €5 as lowest price of that would be €270billion annually.

The annual build-up of CO_2 in the atmosphere represents the net increase of carbon liabilities across the planet – or rather, it represents the liabilities of the human race. Huge though these carbon deficits are, they show only one side of the picture. As already mentioned,

these trends in accumulation have continued for almost two hundred years, since the start of the Industrial Revolution in the eighteenth century. What are the continuing impacts on the earth of those early and long-lasting carbon burdens? They can be considered not only as yearly increments, but also on a fully amortized, "total cost of ownership" basis, as might be used in calculating a 'global carbon balance sheet' of the planet. Sadly, these calculations are not easy, due not least to major gaps in the knowledge and in available data sets.

For example, it cannot be reconciled the total assets and liabilities of the earth in both a monetary sense, and in a non-monetary one. It is very difficult to calculate the remaining periods of atmospheric carbon in the earth. Much recent debate in economics has focused on this topic, estimates vary from 15 years to as much as 200 years. Using 15 years as the hypothesis for the remaining period of atmospheric carbon, it must be increased by 15 times AR5's 'per year' assessment of excess liability, and monetized to € 24 trillion as a total price of carbon liabilities.

On any basis of calculation, this number will be huge. In accounting terms, it has to be concluded that, if the earth was an enterprise, she should be filing for Chapter 11 insolvency, owing to her children's persistent ecological trashing of the family home, sustained over a score of decades.

Recent studies in the economics of climate change have attempted to set fair value (market value) on human centuries of ecological vandalism. Among the varying estimates produced, the safest conclusion is that the differences between the balance sheets of manmade carbon production of the earth would be huge even in comparison to the previously mentioned annual income statements of carbon. This much is true, not least because account has to be taken of two hundred years of anthropogenic CO_2 accumulation. Huge liabilities remain, in the form of excess, unabsorbed carbon. That is the reason why it is not enough merely to stabilize the human beings' consumption of fossil fuels at current levels. People should be aggressively cutting consumption if they are to stand any chance of achieving 80 % cuts in GHG emissions by 2050.

(4)Stranded Assets

To examine on carbon budget of the earth, we should see an asset side of carbon balance sheet as well liability one. As Figure 1 explained, we could spend less than about 1,000 Gt CO2 toward 2100 in order to achieve 2℃ scenario. What does in mean on asset side of our carbon balance sheet ?

According to Carbon Tracker[b] that expected CO2 emissions from world fossil fuel reserves,

[b] Carbon Tracker is a team of financial, energy and legal experts in UK.

total of oil, gas and coal, are estimated 2860Gt CO2. It means nearly 3 times larger than 2℃ limits. They calculate only 20% of total fuel reserves can be burnt to 2050. In the absence of negative emissions technologies like CCS, the carbon budget for the second half of the century would be only 74GtCO2 to have an 80% probability of hitting 2℃ target. This is equivalent to just over two years of emissions at current levels. Carbon Tracker has named these impact of the asset side of the balance sheet of the earth as "unburnable carbon" or "stranded assets"[10].

Stranded assets are assets that have suffered from unanticipated or premature write-downs, devaluations of conversion to liabilities and therefore they can be caused by not only carbon risk but also other environment-related risks Smith School of University of Oxford pointed out these risk factors as follows[11];

- Environmental challenges (e.g. climate change , natural capital degradation)
- .Changing resource landscape (e.g. shale gas abundance, phosphate scarcity)
- New Government regulations (e.g. carbon pricing, air pollution regulation)
- Falling clean technology costs (e.g. solar PV, onshore wind, electric vehicle, carbon capture and storage)
- Evolving social norms (e.g. fossil fuel divestment campaign) and consumer behavior (e.g. certification scheme)
- Litigation (e.g. carbon liability) and changing statutory interpretations (e.g. fiduciary duty, disclosure requirements).

In their definition, the meaning of the carbon liability is limited narrowly for individual entities which have emitted CO2 or will emit future. Based on their definition, stranded assets means 60-80% of coal, oil and gas reserves of listed energy companies are unburnable. These carbon budget deficits pose a major risk for investors. Therefore listed energy companies face the litigation risk from investors.

The net lost impact of stranded assets by carbon budget was estimated amount to $3 trillion including governments, producers and consumers, during transition periods[12]. But, if innovation could spark during the transition we could get net profit from lower fuel expenses, new business return related to the innovation, some estimate $7trillion.

(5)Avoiding carbon insolvency

Continuing the "balance sheet" analogy, people must conclude that after two centuries of mass industrialization, they in mankind remain terrible managers of carbon factors of production, of carbon assets and of carbon liabilities. Judged on such universally accepted principles of accounting as "true and honest valuation" and "prudence", the history of

economic activity amounts to a disaster tantamount to 'carbon insolvency' or, at the very best, a staggering profligacy with non-renewable carbon assets.

ARA5 presents a simple benchmark for assessing the short- and long- term effects of CO_2 increase. This is the 'airborne fraction'- in other words, the increase in CO_2 concentrations in the atmosphere, as a share of all fossil fuel emissions. From 1960 to 2010, with remarkably little variation, the airborne fraction has averaged 0.44(±0.06). That means the absorptive capacity of the earth's biosphere has consistently removed the remaining 56% of fossil-derived CO_2 from the atmosphere (but there is no consensus on the trend). So the recent accelerating rate of increase in atmospheric CO_2 reflects an increased level of emissions from burning fossil fuels.

(6)The carbon break-even point'

Correcting and re-writing the global balance sheet of carbon places us in a series of double-binds, in multiple tensions between growth and the ecology, between developing and developed countries, between uncertainty and certainty, between present and future. Reconciling these oppositions is far from easy, but it has to be done. The labor of finding balancing points on each continuum depends on how resources distribution can be improved. In short, it must be identified the level of resources people should provide, appropriate both to achieving cuts in carbon emissions and to securing economic growth.

Any honest or prudent management of the planet's carbon balance sheet to keep 2℃ would oblige people to allocate to responsible agents € 1.6 trillion(maximum) or € 270billion(minimum)worth of costs of GHG reductions. If we consider future strengthening of regulation to curve GHG emissions, these monetized estimates should be increased more How would these amount of money impact on world economic balance sheet? There are famous analysis produced by Sir Nicholas Stern in his 2006 book, "The Economics of Climate Change (2006). It might be defined as the classical theory of the environmental finance like Adam Smith of conventional economics.

At that time Stern wrote that;

"If a wider range of risks and impacts [of climate change] is taken into account, the estimates of damage could rise to 20% of GDP or more. In contrast, the costs of action can be limited to around 1% of global GDP each year[13]".

Latest estimate of world GDP in 2013 amounted to $ 87.25 trillion (purchasing power parity)[14]. Under this analysis in consequence, estimates of the damage due to climate change could vary as high as $ 17.57 trillion and as low as $0.87 trillion. Comparing Stern's figures to the carbon balance sheet for staying within the 2 ℃ limit,, both of our € 1.6

trillion($1.95trillion[c]) and €270billion($330billion) estimates are regarded as the cost of action by Stern, and almost medium of between his lower figure. But Stern's estimates are approximately 10 years before, after that, lots of works have been done, The latest one by International Energy Agency (IEA) showed that z figure is almost similar to our estimate,$1.9 trillion. So it can be safely concluded that securing this value of resources for measures to cut carbon would represent the break-even point. In other words, such a resource base would constitute a "sweet spot", a point of balance favoring continued economic growth while at the same time preventing further global warming.

Besides monetizing and valuing carbon emissions into carbon liabilities, it also has to be accounted for the effects of feedbacks and positive reinforcement in the climate-carbon cycle. These feedback effects mean that global warming tends to slow down absorption of carbon dioxide by the planet's landmasses and oceans, thus increasing the fraction of emissions remaining in the atmosphere. According to one estimate, the phenomenon of positive feedback will be responsible by itself for a rise in corresponding global average warming of more than 1°C by 2100.

This assumption suggests people might reach a sustainable point of equilibrium, merely by establishing break-even points of GHG emissions. But this action would be only one step. They need to move very far and very quickly, if people are to achieve meaningful reductions in emissions and stabilize the climate by the middle of this century.

C. Measuring the valuation materiality of corporate carbon

(1) SEC guidance

The next task is clear. It must be allocated and distributed calculable amounts of cash towards reducing global GHG emissions. The most cost-effective way of achieving this allocation would be by considering both macroeconomic and microeconomic issues The issues could not affect more closely human beings own destinies and that of the earth. Nobody can escape and survive from the implications of climate change.

The microeconomic agenda including compelling corporations has emerged to apportion sufficient resources to cover climate-related carbon liabilities. The US Securities and Exchange Commission (SEC) published a guidance to companies facing responsibilities to disclose to investors the materiality of their carbon-related activities in 2010[d] .

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[c] €/$=1.22(as of December 2014)

[d] SEC; Commission Guidance Regarding Disclosure related to Climate Change, February 2010.

The SEC issued its guidance in answer to requests from members of United States Climate Action Partnership (USCAP)[e] and other. An urgent need is being felt for a policy framework on climate change, in order to make coherent disclosures of material relevant carbon-related liabilities, for the purposes of valuing companies. The SEC guidelines stress the necessity of carbon disclosure to investors, as defined in regulations from the US Environmental Protection Authority, (EPA) especially as the rules on GHG data affect reporting by the large emitter entities, as well as the disclosure regulations contained in the EU-ETS. Currently, based on EPA rule, as of 2013, over 8,000 facilities in 9 industry sectors reported direct GHG emissions to the GHG reporting Program(GHGRP) totaled 3.18 billion metric tons CO2, which were about half of total U.S. GHG. Reporting entities are 965 suppliers, and 92 facilities reported injecting CO_2 underground[15].

(2)Regulation Risk

The SEC's guidance examines the materiality of carbon-emitting activities under three categories.

1. Regulatory risk,
2. physical risk
3. market risk

This scheme seems to be recognized generally by businesses as acceptable and workable. The SEC document begins by explaining the impact of regulatory risk on three types of companies. For some, the regulatory, legislative and other developments could have a significant effect on operating and financial decisions, chiefly decisions involving capital expenditure needed to reduce GHG emissions.

Secondly, for companies subject to 'cap and trade' legislation (not yet introduced in Japan, In the USA it has been introduced only several States under RRGI and AB32[f]), the SEC note sets out the expenses permissible to purchase emissions allowances, where reduction targets cannot be met. Thirdly, the notes describe how firms not directly affected by emissions regulation, could still be affected indirectly, through higher prices, charged by directly affected companies who need to pass on their own increased costs of compliance. One consequence is that even in jurisdictions still without a mandatory 'cap and trade' regime, companies may yet face some regulatory risk, as a consequence of international trade or cross-border procurement and supply chains.

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[e] http://www.us-cap.org/

[f] State of California introduced their owe Cap & Trade System from November 2012 under the California Global Warming Solutions Act: called as Assembly Bill No.32, AB32)

These new regulations on emissions reduction may also present new opportunities for investment. This has been the lesson from the EU-ETS and its associated carbon markets although carbon prices have been volatile in the markets. Companies with more allowances than they need, or who are eager to earn offset credits, can raise capital by selling these instruments on the markets. Companies must thus manage both sides of their own carbon balance sheets to balance their carbon assets and liabilities.

Just as important in assessing regulatory risk associated with carbon liabilities, is the necessity for companies to understand cycles of trading and regulation. Even in the EU-ETS, which was initially based on the Kyoto Protocol, trading was limited to a defined period. But then EU decided extend the trading period to the end of 2020 under the third phase of the ETS. Also beyond 2020, EU has showed further extension of the trading period toward 2030. Their political decisions concerning trading period have been welcomed in the markets, but what the trading periods are decided by the political will mean there are always regulatory risks potentially; as a result companies face uncertainty. and no clear . The SEC's guidelines are equally unclear on this point.

(3)Physical and Market Risk

Climate change presents corporations with increased physical risk. Extreme weather events such as fiercer storms, hurricanes, more frequent flooding, deeper erosion of coastlines, melting of permafrost and higher temperatures will all affect enterprises' facilities and operations. Changes in the availability or quality of water and other factors of production, are among innumerable physical challenges about to confront to businesses.

Physical changes associated with climate change may depress consumer demand for products or services. Warmer winters may cut demand for heating fuels, servicing and equipment. These effects could affect companies' operations and the value of their assets.

Market risk due to climate change may be defined as companies confronting the risk of reductions or eliminations in business opportunities, consequent upon changes in consumer demands and in society's needs. If companies have not reacted astutely in response to regulatory and physical risks, they could lose consumers' or investor's confidence. This risk is reputational, and can be considered a type of market risk.

The SEC's guidance advises that, depending on a registrant company's business and its reputation with the public, it may need to consider whether public perception of its published data on GHG emissions could expose it to potential adverse consequences to its business operations or financial condition.

The SEC emphasizes the importance of disclosing risk factors linked to climate change in companies' financial reports, even where the data's materiality may be hard to assess. The SEC notes fail to give methods for evaluating such data, neither do they provide any criteria to measure the materiality of non-financial factors. The sole quantified threshold shown is the SEC's explanation on Instruction 5 to Item 103 of Regulation S-K. This recommends citing any current or outstanding environmental litigation related to governmental regulation.

Notwithstanding the SEC's guidance on climate change, familiar questions remain. How can corporations and other carbon emitting organizations calculate the materiality of their own carbon liability? How should this be measured? There are several efforts and trials to solve these questions. Let's explain and describe them one by one.

(4)Quantitative carbon disclosure

Companies are left to their own devices in deciding how to measure the materiality of their carbon exposure, and to disclose this in financial reports. With this realization the next problem, namely, measuring a corporation's carbon liability, must be focused.

Research in corporate reporting reveals several different approaches to climate-related risk. Examples include the disclosure of a company's 'carbon budget, as described above, and its philosophy for carbon management. Firms in such carbon-intensive sectors as oil exploration, electricity, chemicals, steel & cement have been quick to adopt such approaches. This is because, they have hitherto faced the three types of carbon risks already mentioned.

Firms can no longer tuck such data away in financial reports. In its latest corporate citizenship report, ExxonMobil explains that it emitted 126million metrics tonnes on a CO2 equivalent from upstream, downstream and chemical divisions in 2013, The US oil giant publishes detailed information on its gas flaring and on its co-generation capacity, two factors with major impacts on carbon liabilities in its sector.

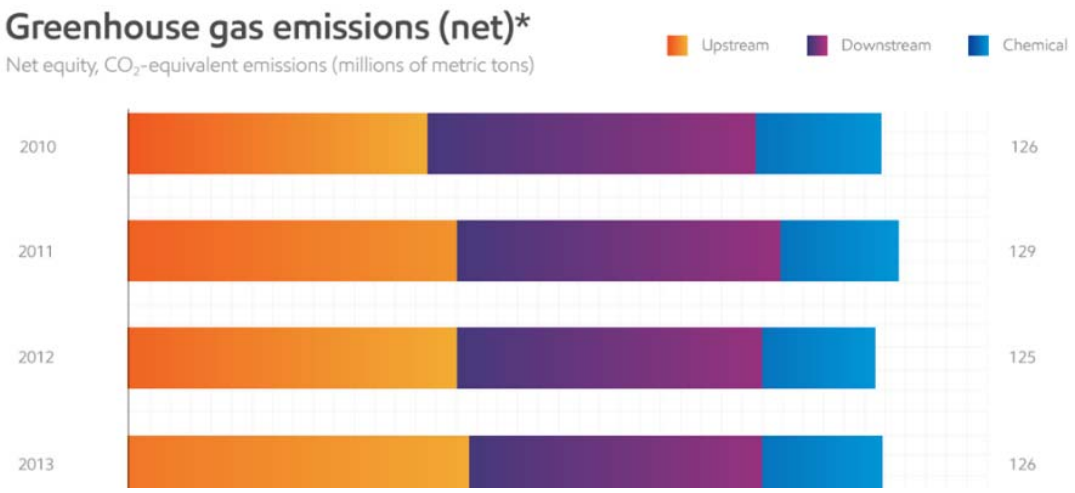
Exxon's peers Shell, Chevron, and BP also disclose their quantified data of carbon emissions. Besides, BP has faced another hugely expensive environmental liability, stemming from the huge oil spill in the Gulf Coast in April 2010. In its disclosures of quantified carbon emissions, BP emitted 64.9 million tonnes on a CO2 equivalent in 2010. But it reduced to 49.2 million tonnes in 2013, 24% reduction than 3years before, due to the result of the sale of two refineries, Texas City and Carson in the US, as part of our divestment programme.A huge volume of environmental liabilities, as well as carbon

ones,continues to disclose in BP's basic report, as it meets claims arising from the Gulf Coast accident, which is now rated as America's worst-ever oil disaster.

Shell emitted 73 million tonnes 13 on a CO2-equivalent in 2013, which is slightly higher than 72 million tonnes in 2012. The main reasons for this increase were the ramp-up of production in Qatar and the restart of production in Iraq and so on. These increases were partially offset by reduced flaring and lower production in other places,

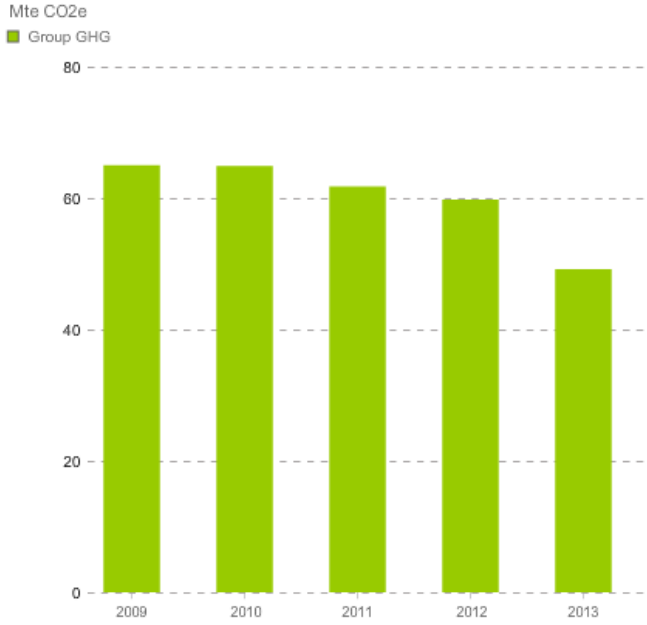
Those figures show that Exxon has almost double weight of carbon liabilities than other two competitors in absolute quantity. But monetary burdens by the carbon liability are not calculated only absolute quantity but amount of their assets and provisions to be able to offset. In addition, assets would be stranded as we have already checked.

Figure 3. Direct GHG emissions of Exxon Mobil



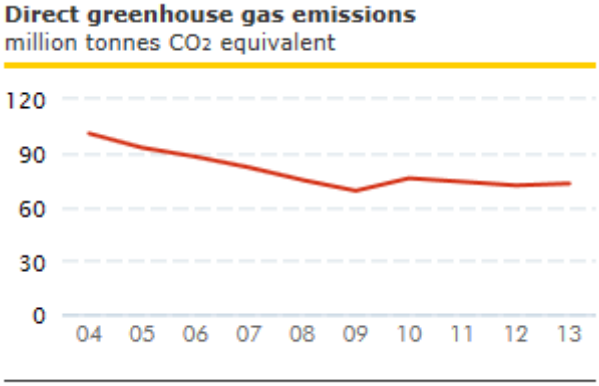
Exxon Mobil Corporate Citizenship Report 2013

Figure 4. Direct GHG emissions of BP



BP corporate citizenship report 2013

Figure 5. Direct GHG emissions of Shell



(5) The movement for quantitative carbon disclosure

Years of pressure by environmental movements have given strength to regulators seeking quantitative disclosure of CO_2 emissions by companies. Prominent among them are the UK's Carbon Disclosure Project (CDP)[g] and the Climate Disclosure Standards Board (CDSB)[h]. The CDP is a voluntary, non-profit organization which, through force of argument and through a tailored questionnaire, works to persuade global companies to measure and disclose CO_2 emissions and strategies in relation to climate change. CDP co-

[g] https://www.cdp.net/en-US/WhatWeDo/Pages/investors.aspx
[h] http://cdsb.net/

ordinates research on behalf of 767 institutional investors, with combined holdings worth in the region of $ 92 trillion in 2014. CDP reports include statistics on carbon emissions from its respondent companies plus other analysis. Open to public scrutiny, this information yields important trends and developments in corporate management of carbon emissions.

The Climate Disclosure Standards Board is composed of a pro-environment consortium of global companies, accountancy firms and accounting organizations, and non-profit lobby groups. CDSB's mission is to develop a global framework for corporate reporting on GHG emissions, with the aim of supporting, strengthening and harmonizing existing initiatives in climate-related reporting. The board seeks to enhance best practice in the form of a single consistent global framework.

Both the CDP and the CDSB claim their activities continue to raise standards of corporate accountability towards the environment, neither would claim their work is complete. Information in companies' financial reports may be useful for investors seeking to select environment-friendly companies for ESG portfolios. But quantified information in financial reports does not necessarily reflect the precise cash values associated with liabilities in relation to carbon emissions, nor the resources which companies must dedicate to meet them.

Quantified disclosure of climate- and carbon-related liabilities is gradually becoming obligation under company law. Participating companies in the EU-ETS are obliged to provide their emission data on a site-by-site basis to EU national governments. Since 2005, enterprises in Japan consuming 1,500kl per year in fossil fuels must submit emissions data, the legislation stipulates reporting of all six main greenhouse gases.

The Japanese government has published company names over a certain level of quantitative CO_2 emission, in recalculating sum of sites emission data to company basis. Companies who fail to report, face fines. In January 2012, US EPA had the first year of GHG Reporting Program (GHGRP) which data can be available to the public

(6) Carbon materiality in the Sustainable Accounting Reporting.

There are several activities to integrate environmental factors including GHG from economic entities with conventional their financial reporting processes, called as an Integrated Reporting, such as Global Reporting Initiative(GRI), International Integrated Reporting Council(IIRC)[i], Sustainability Accounting Standard(SASB)[j] and so on.

[i] International Integrated Reporting Council; http://www.theiirc.org/

[j] Sustainable Accounting Standard Board; a 501(c)3 registered non-profit organization based at San Francisco. http://www.sasb.org/

Among them, we would like to focus the SASB's activities, because they are going to set out disclosure guidance and accounting standards on sustainability issues to be included into companies' mandatory financial annual filings. GRI, IIRC and others are mainly based on voluntary reporting which accompany with mandatory filings but separate from its. SASB is independent non-profit organization in USA and is developing sustainability accounting standards for more than 80 industries in 10 sectors. Their standards are designed for the disclosure of material sustainability issues in mandatory SEC filings, such as the Form 10-K and 20-F

As we have already seen about SEC's guidance on climate change which recommends on instruction of Regulation S-K, which sets forth certain disclosure requirements associated with SEC filings, SASB has attempted to identify these sustainable information including carbon liability that may be material for all companies based on Regulation S-K and required to describe them in the Management's Discussion and Analysis of Financial Condition and Results of Operations (MD&A) section of Form 10K.

According to SASB[16], in determining whether a trend or uncertainty should be disclosed, the SEC has stated that management should use a two-part assessment based on probability and magnitude. The one is a reasonable likelihood that the known trend, demand, commitment, event or uncertainty will occur. Second part reasonable likelihood that occurrence will have a material effect on the registrant's financial condition or results of operation. These approach is a consistent with FASB's approach to entity-specific materiality determination.

When companies consider making disclosure on carbon liability including stranded assets in their mandatory financial reports, they should describe them in the MD&A, in a sub-section titled "Sustainability Accounting Standards Disclosures". In addition to the MD&A section, companies should consider disclosing sustainability information in other sections of 10-K, as relevant, such as description of business (Item 101 of S-K), legal proceedings (Item 103 of S-K), and risk factors (Item 503(c) of S-K).

SASB's approach to describe sustainable material factors on the mandatory reports is quite pragmatical. They set out and evolve fundamental concepts and procedures by themselves, but tools for reporting they recommend existing measurement or guidance developed by other standardizer entities. For instance, in case of oil & gas exploration & production Sector, SASB says companies should disclose their significant direct GHG emissions based on SASB's description, but it recommends to use various tools for accounting metrics to describe their quantitative or narrative information from other standardizer entities[17].

In case of GHG emissions from companies they describe GHG emissions should be disclosed Scope 1 level, six GHGs covered under the Kyoto Protocol, calculated them in metric tons of CO2

equivalent (CO2-e), and which facilities and equipment should be included as emission sources and so on. To disclose those quantitative and qualitative information, they select relevant tools to disclose, for instance, the Greenhouse Gas Protocol[k] as GHG Scope 1, CDP Guidance and IPIECA GHG Guidelines[l] as financial control approach, CDSB's Climate Change Reporting Framework (CCRF) as organizational boundary setting.

(7) Sectorial disclosure approach

SASB is developing sustainability accounting standards at the industry level, focusing on intractable issues that are closely tied to resource use and business models, and other factors at play in the industry that can result in unsustainable outcomes. But traditional industry classification systems do not always group together industries with common sustainability characteristics, making the determination of common sustainability issues difficult. Therefore SASB developed the Sustainable Industry Classification System (SICS), which builds on traditional ones and categorizes 10 sectors and 88 industries in accordance with their resource intensity and sustainability impact as well as their sustainability innovation potential.

One of such industry specific area is non-renewable resources sector. We can pick out oil & gas exploration & production industry as an example in the sector. Material impacts of global warming of the activities of this industry are mainly two topics, GHG emissions and reserve valuation & capital expenditures.

Many of the companies' normal operations in the industry involve the combustion of fossil fuels to produce energy, and then emit GHG. They are required to be report their GHG emissions annually to the EPA under GHGRP at the facility level when emissions of GHG exceed 25,000 metric tons. The sources of these emissions vary based on the activities in which they are engaged and the type of fuel they are using. Therefore they should monitor and disclose their use of energy input as well as their emissions of GHGs, both in accordance with applicable laws and regulations and to improve their overall balance sheets to reduce carbon liabilities.

On GHG emissions, companies should disclose gross amount of GHG Scope 1 emissions of all 6 gasses in metric tons of CO2-e. These emissions include direct emissions of GHG s from stationary or mobile sources that include but are not limited to, equipment at well sites, production facilities, refineries, chemical plants, terminals, fixed site drilling rigs, office buildings, marine vessels

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[k] Developed by the World Resources Institute and the World Business Council on Sustainable Development(WRI/WBCSD): http://www.ghgprotocol.org/

[l] Petroleum Industry Guidelines for Reporting Greenhouse Gas Emissions; http://www.ipieca.org/publication/petroleum-industry-guidelines-reporting-greenhouse-gas-emissions-2nd-edition

transporting products, tank truck fleets, mobile drilling rigs, and moveable equipment at drilling production facilities.

In addition to those gross figures, they shall provide a breakdown of its emissions by 4 classifications of hydrocarbon resources, (1) conventional oil (2) unconventional oil (3) conventional gas (4) unconventional gas. Unconventional oil includes oil shale, oil sands, heavy oil, etc. unconventional gas includes coal seam gas shale gas, etc.[18]

Table 1, Example of Integrated Disclosure

Gross Scope 1 emissions (mock data)

Year end December 31	2012	2013	2014
Gross global Scope 1 emissions (in thousands of metric tons CO2-e)	6,525	7,765	7,762
Conventional oil operations (%)	63%	47%	45%
Unconventional oil operations	2%	9%	11%
Conventional gas operations	35%	32%	31%
Unconventional gas operations	0%	12%	13%
Percentage covered under a regulatory program	3%	3%	3%

SASB Standard for Oil & Gas Exploration & Production; Example of Integrated Disclosure in Form 10-K

The bottom line of the Table 1 shows regulated emission ratio (emission covered under mandatory regulated scheme to the gross emissions they emit. Percentage of the ratio increase, operating cost may also increase.

Their emissions come from various sources as a normal byproduct of necessary operational practices. They are involved in diverse exploration and production operations. Therefore they should disclose main sources of emissions among their activities in the mandatory financial report.

Table 2. Main Sources of GHG emissions (mock data)

Thousands of metric tons CO2-e	2012	2013	2014
Combustion	5,546	6.591	6.598
Flared hydrocarbons	326	388	388
Process emissions	457	543	543
Directly vented releases	326	388	388
Fugitive emissions and leaks	196	233	237

SASB, same as the above.

Oil & gas exploration & production industry also should disclose stranded assets due to acceleration of global warming. Because they usually have huge reserve assets of oil and gas reserves and make significant investments in new reserves. Their activities generate significant direct GHG emissions, contributing to climate change and creating additional regulatory compliance costs and risks for them due to climate change mitigation policies. Also improved competitiveness of renewable energy technologies including policy supports to them through tax breaks and subsidies have the potential to significantly alter the economic value of reserves, particularly those of oil. The price and cost impacts from climate regulations and development of alternative energy can affect the net present value of proven reserves that we have already seen as stranded assets.

SASB asks companies belonging to this industry how much they have those assets under several future scenarios, such as BAU, International Energy Agency's New Policies Scenario, and 450ppm (2℃) Scenario (Table 3).

In this case, E&P companies have conducted a sensitivity analysis of its proved and probable reserves based on price scenarios outlined by IEA in its World Energy Outlook publication[19]. Under this price outlined in IEA's New Policies Scenario, company may see a small reduction in the size of its proved and probable reserves. Under the 450 Scenario, it should reduce its reserves significantly than the former case. Investor can distinguish their targeting companies to compare with these disclosed figures among peer industrial group.

Table 3. Sensitivity of reserve levels to future scenarios in which a price is charged on carbon (mock data)

Price Case	Proved Reserves		Probable Reserves	
Scenario	Oil MMbbls	Gas MMsf	Oil MMbbls	Gas MMscf
Current (base)	435	5,828	757	7,200
New Policies Scenario	415	5,400	723	6,900
450 Scenario	378	4,800	701	6,430

SASB, same as the above.

Assets value of E&P companies would be damaged not only by carbon liability but also by social factors, such as security, human rights, and rights of indigenous peoples. Companies face heightened community-related risks when operating in conflict zones where with weak or absent governance institutions, rule of law, and legislation to protect human rights or with vulnerable communities such

as indigenous peoples. SASB points out that without corresponding enhanced diligence measures to protect human rights and the rights of indigenous peoples in such area, companies could encounter difficulties in accessing reserves or significant operational disruptions with impacts on costs and liabilities[20]. We can call these assets as socially stranded assets.

D. Putting a price on carbon

(1) Difficulties in monetizing a price for carbon

Methods are evolving quickly to collect quantified data on carbon emissions from various types and sizes of corporations under various jurisdictions around the world. What are the next steps?

Measuring a corporation's carbon liability means putting a price on it, in other words, monetization. How should this be done? Carbon markets already provide an important tool to measure current prices for carbon in a free market. The emission trading schemes like the EU's exist to link sellers with buyers, in the process setting of a market-clearing price. Two types of environmental trading systems exist, 'cap and trade' and 'baseline and credit'.

In the EU's cap and trade system, carbon emission credits such as the European Union Allowance (EUA) have been traded(the above-mentioned Figure 2). A closing price for this security is reported after every day's trading. The process is identical to that for trading currencies, stocks commodities, or any other form of financial instrument.

As the biggest trading mechanism for corporate carbon credits, the EU-ETS is highly influential in setting a global price for carbon. In consequence, the prices of Certified Emission Reduction (CER) which issuing by Clean Development Mechanism (CDM) projects in developing countries admitted as one of the emission reduction tools that started under the Kyoto Protocol and have settled on arbitrage trading with EUA markets, although both of them have being struggled with keeping suitable carbon prices due to European economic turbulence after 2010. The effect of such price-setting markets has been that, in general, the more emissions a company causes through its activities, the more it must pay to cover its carbon liabilities.

Complete understanding of techniques to value carbon liabilities will be lacking, however, if they are considered merely as a mean to the end of t trading of carbon credits in the market. Three types of carbon risk exist, each presenting its own valuation issues,

namely regulatory risk, physical risk and market risk. Regrettably, a market mechanism such as trading cannot monetize all three types of risks. Let's consider why.

Firstly, regulation risks are not shared equally between all types of carbon emitters. Proof of this emerges, when it can be examined the composition of the current EU-ETS. Now in its third phase of operations, the EU-ETS expands its targeted eligible sectors in chemicals, aluminum, and aviation, in addition to have been covered heavy-emitting industries including power utilities, energy generation, iron smelting, cement and oil refining. But still not expand all of CO_2 emitting sectors.

Besides, EU-ETS has faced significant problem which they should be solved to put price on carbon. Due to economic downtown during 2010-2013, so called "European Sovereign Crisis", demand for carbon credit was fallen sharply as Figure 2 showed clearly. This means carbon credit is as same economic goods as other goods and services which value goes up and down. But without functional price setting mechanism, we can't rate carbon liability. We need to improve C&T system more functional ways and integrate fragmented C&T markets in several regions or States into wider ones.

(2) Needs for Integrated accounting standards of carbon value

We have already seen SASB's attempt to make sectorial disclosure approach on carbon value. We respect their efforts but at present it is not mandatory scheme but voluntary one, although there is some possibility of most of listed companies in USA would use SASB's disclosure standards in their financial statements as de facto standards to describe their own carbon liabilities. To create common accounting standards to calculate carbon liabilities and carbon vales, there have being repeated trial and error.

The International Financial Reporting Interpretations Committee (IFRIC) is the interpretative body of the IASB (International Accounting Standards Board). In December 2004, just as the EU launched its ETS, the IFRIC committee issued IFRIC3, its formal accounting interpretation on Emission Rights, or carbon credits. At that time it was decided that EU-ETS came into effect from 1 March 2005. In practice the IFRIC3 thus became the new accounting tool of choice for EU-ETS. But it was withdrawn after only a month, the victim of wrangles between accounting regulators and business leaders.

The allowances granted by national governments to companies participating in the ETS were at issue. According to IASB, IFRIC 3 specified the following[21]:

1) Rights (allowances) are intangible assets that should be recognized in the financial statements in accordance with IAS 38.

2) When allowances are issued to a participant by government (or government agency) for less than their fair values, the difference between the amount paid (if any) and their fair value is a government grant that is accounted for in accordance IAS 20.
3) As a participant produces emissions, it recognizes a provision for its obligation to deliver allowances in accordance with IAS 37. This provision is normally measured at the market value of the allowances needed to settle it.

The issue was how to treat such an allowance on the balance sheet. A consensus among businesses held that an allowance is an asset, because it is acquired at a cost, in the same way as any other factors of production such as raw materials and equipments. IFRIC agreed, however, not all business leaders did so. As the IFRC is an interpretative body of the IASB, it is bound by the IASB Framework on the Preparation and Presentation of Financial Statements ('Framework'). This framework does not assess an asset from the cost evaluation viewpoint. It defines an asset as a 'resource controlled by the entity as a result of past events and from which future economic benefits are expected to flow to the entity'[22].

As the EU-ETS began trading, the IFRIC standard recognized as an asset the allocation by EU governments of allowances to companies in their own territory. However, IASs set by IASB require assets to be measured at fair value at each reporting date. In consequence, the IFRIC interpreted allowances in an undifferentiated manner, failing to discriminate between allowances purchased from the market or granted by governments. In contrast at that time, the IASB had a long-standing proposal to amend recognition of government-allocated granting of rights in the IAS 20(Accounting for Government Grants and Disclosure of Government Assistance), this stipulated that any grant from a government could no longer be considered as income.

The dispute's implication was that any free emission allowances granted by governments would have to be recognized immediately as income. Business leaders protested that it was impractical for them to recognize fair value at the onset of the trading. Then, IASB withdraw IFRC3.

Further accounting disputes have followed, concerning the structures of the emission trading schemes, and in particular how to establish a scale of values for initial allowances and allocate them among the scheme's members. At question have been competing methods of rights allocation such as the so-called 'grandfathering approach' as used in the first phase of the EU-ETS; alternative methods also considered have included

benchmarking approaches, and allocation based on auctions of emission rights. IFRIC3's failure was a direct consequence of the 'grandfathering' approach favored by the EU.

In a statement, the Board of the IASB justified its withdrawal of IFRIC3 claiming that 'the Board decided to take the time to conduct a broader assessment of the nature of the various volatilities resulting from the application of IFRIC 3 to a cap and trade scheme and to consider whether and how it might be appropriate to amend existing standards to reduce or eliminate some of those volatilities'. The decision was taken by an overwhelmingly vote of 12 in favor, 1 against and 1 abstention.

After several years, the IASB re-started the debate on limiting free issues in emissions trading schemes. But it chose not to address the controversy surrounding accounting standards for all government grants at December 2007. In May 2008, IASB started joint discussions with the USA counterpart, FASB. But after piled up discussions between them, in December 2012, IASB announced formally reactivated this project as an IASB-only research project. They didn't explain why the joint discussions met with failure. New IASB-only research project is expected to result in the publication of a discussion paper considering the financial reporting consequences of government developed schemes designed to encourage reductions in the production of GHGs, which will include; an inventory of trading schemes, an analysis of common economic characteristics of those schemes, an initial assessment of the potential reporting solutions[23].

(3) Calculating physical risk to price

Despite long-standing discussions on setting up comprehensive and intelligible rules in carbon accounting, markets seem to provide the simplest method for setting a carbon price. Companies trading under mandatory emission trading schemes like the EU-ETS can compare carbon prices in the market with their own carbon management on issues such as raw materials purchase, investment in production equipment, identifying a development site, or in decision about production of a new product or service. As described above, accounting standards for reporting carbon values have not been decided, and none will be accepted until the new draft of' 'IFRIC α' emerges.

Carbon pricing in free markets serves well as one measurement of carbon liability. It is limited, however, in relation to regulatory risk. As described above, the concept of carbon liability comes not only from regulation but also from physical and market risk types. Physical risk may increase carbon damage to the asset side of a company's balance sheet such as stranded assets described above, as opposed to its liabilities.

Some simple examples illustrate the point. Rising sea levels pointed out by AR5 may halt or impede operation of an enterprise's factories and facilities located along coastlines. Companies face operational interruption or damage, due to fiercer storms, heavier rain, more frequent typhoons, or land erosion caused by drought. Firms will be well advised to introduce a climate contingent Business Continuity Plans (BCPs) to prevent deterioration of their fixed assets and operational interruptions caused by climate change. Introducing climate contingent BCPs could work as a form of environmental insurance against carbon impacts.

(4)Applying ARO method

As companies' struggle to calculate climate-related physical risks to their asset base, both now and in future, they have available to them a useful accounting technique. This is the accounting rule for asset retirement obligations (AROs). AROs are legal obligations associated with the retirement of a tangible long-tem asset. Such obligations result from the acquisition, construction, development, or normal operation of a long-tem tangible asset, as defined in the FAS 143 standard issued in 2002 by the FASB. This accounting rule applies a "fair value" measure of fixed assets which includes environmental damage or other future removable obligations.

For example, the owner of an asset that is subject to environmental laws such as CERCLA is required to recognize their liability as an ARO on their balance sheet in the period in which it is incurred, based on a reasonable estimate of its fair value. Even if it is not possible to estimate with precision, the liability must be recognized whenever a reasonable estimate of fair value can be made.

An ARO is not quite the same as a carbon liability associated with any fixed asset. But it can be said that the nature of the uncertainty surrounding any carbon liability might be quite similar to the processing of evaluating an ARO. Companies have to estimate fair value of a carbon obligation, against the uncertainty of future regulation framework and possibility of physical risk. FIN47 is the FASB's interpretation of FAS 143 issued in March 2005. The US-based environmental accounting consultant C Gregory Rogers[24] specifies that the fair value of an ARO may be determined based on any of the following methods:

1) The amount of the obligation embedded in the acquisition price of the asset.

2) A market quote in an active market for transfer of the obligation, or (if neither of these two situations applies).

3) Application of an expected present value technique to estimate fair value.

(5)Changing Market risk to opportunity

Setting a price on carbon liabilities associated with market risk can be very difficult, not least because this type of risk may be influenced by customers' changes in taste or in buying behavior. One solution may be to apply marketing method such as Customer Related Marketing (CRM). If companies use these carbon marketing techniques, they may persuade their customers that their products are differentiated by virtue of low impact on the environment. Perceptions can be altered by careful marketing.

It is not yet clear how many customers will value, or will react to, perceptions of low carbon positioning, rather than to traditional lower prices and higher quality. But more easily than with the other carbon risk types, market risk can be turned from a liability to into an asset and a source of competitive advantage.

Carbon management entails the full realization and declaration of all costs and liabilities arising from man-made carbon, and allocating these costs to appropriate activities both in their production, and to the final retail value of a product. In discharging this management obligation more efficiently, corporations must establish a well-planned architecture of mandatory carbon trading which minimizes regulatory risk. Equally desirable and necessary is an agreement on more accurate accounting methods, capable of producing coherent and usable valuations of carbon liabilities, as they effect materially a company's base of fixed assets and related liabilities.

In addition, companies should apply across all key audiences--customers, investors and other stakeholders-- a comprehensive, appropriately designed strategy of carbon marketing. The goal should be to request and to achieve collective changes in patterns of consumption as well production in order to safeguard the interests of future generations.

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<Key words>

AR5 (Fifth Assessment report)

ARO (Asset Retirement Obligation)

BPOs (Business Continuity Plans)

Burden Sharing

Carbon budget

Carbon Liability

Cap & Trade

Carbon Tracker

CDM (Clean Development Mechanism)

CDP (Carbon Disclosure Project)

CDSB (the Climate Disclosure Standards Board)

CER (Certified Emission Reduction)

CERCLA (Comprehensive Environmental Responses, Compensation and Liability Act)

COP (Conference of the Parties of UNFCC)

CRM (Customer Related Marketing)

ELD (Directive on Environmental Liability)

Environmental Liability

EPA (US Environmental Protection Agency)

EUA (European Union Allowances)

EU-ETS (EU's Emission Trading Scheme)

Fair value

FASB (the US Financial Accounting Standards Board)

Form 10-K

GHG Scope1

GRI (Global Reporting Initiative)

IASB (International Accounting Standards Board)

IEA (International Energy Agency)

IIRC (International Integrated Reporting Council)

IFRS (International Financial reporting Standards)

IPCC (the Intergovernmental Panel on Climate Change)

Kyoto Protocol

MD&A (Management's Discussion and Analysis of Financial Condition and Results of Operations

RCP (Representative Concentration Pathway)

Regulation S-K

RGGI (Regional Greenhouse Gas Initiative)

SASB (Sustainable Accounting Standards Board)

SARA(Superfund Amendment and Reauthorization Act)

SEC (the US Securities Exchange Commission)

Stranded Assets
UNEP (United Nations Environmental Programme)
USCAP (United States Climate Action Partnership)
Worldwatch Institution

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