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Toward policy integration: Assessing carbon capture and storage policies in Japan and Norway

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ABSTRACT

The objective of this paper is to develop independent and systematic criteria for assessing CCS policy in terms of its level of policy integration. We believe that we should assess CCS policy in terms of the distance to an ideal integrated CCS policy in order to keep track of its trajectory toward sustainable development. After reviewing the existing literature of environmental policy integration, an assessment framework for integrated CCS policy is developed based on Arild Underdal's notion of 'integrated policy' then, its usefulness is demonstrated by applying it to CCS policies in Japan and Norway. In the final part, we summarize the findings of the cases and conclude with some observations regarding explanatory factors of the difference in terms of the achieved level of policy integration between Japan and Norway's CCS policies, and some policy implications derived from the analysis based on the framework.

1. Introduction

This article explores the idea of an 'integrated carbon capture and storage policy' (ICCSP). In this context 'integration' refers not just to a fully 'joined up' and coherent policy, but also to a policy that will ensure that the deployment of carbon capture and storage (CCS) systems to address climate change simultaneously contributes to the more general process of sustainable development. Such an ICCSP is consistent with 'environmental policy integration' (EPI) as it has come to be understood in contemporary environmental policy debates – as an effort to integrate environmental issues into basic economic, social and political decision making.

In 1987, when Gro Harlem Brundtland's World Commission on Environment and Development introduced the concept of sustainable development (SD) and promoted the goal of integrating environment and development decision making, CCS technology was no more than a technological possibility discussed by scientists and engineers. Over the past fifteen years, CCS has entered the policy domain in major developed countries, and there has been increasing debate over whether CCS will actually contribute to SD in the climate context (Langhelle and Meadowcroft, 2009; e.g., European Commission, 2008; Hansson and Bryngelsson, 2009). For example, CCS is not without (non-climate related) environmental costs and risks, with potential impacts on public safety, biodiversity degradation and freshwater pollution, should serious CO_2 leakages ever occur. Investment in CCS infrastructure on the scale contemplated by some proponents would have many other societal consequences. Implementing an ICCSP, therefore, requires policymakers not only to consider climate and energy issues but also to include other possible implications to prevent a possible 'over-deployment' of CCS at the expense of increasing human and ecological risks.

What concerns us is that, to date, much policy discussion about CCS is predicated on an imperative of securing rapid deployment (e.g., Boucher, 2009; European Commission, 2008), and policy research is largely concerned with political feasibility and smooth deployment (e.g., CCSReg Project, 2009). We believe that the dominant emphasis on rapid CCS deployment in the debate calls for research that is to some extent independent from such a pragmatic context in order to stimulate balanced deliberation about CCS – a point that others have also made (Hansson and Bryngelsson, 2009).

In recent years, environmental policy scholars have increasingly argued that environmental policy integration is essential for achieving sustainable development: "if environmental factors are not taken into consideration in the formulation and implementation of the policies that regulate economic activities and other forms of social organization, a new model of development that can be environmentally and socially sustainable in the long term cannot be achieved" (Liberatore, 1997, p. 107; see also Collier,

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1994; Lenschow, 2002; Lafferty, 2004; Jordan, 2008; Jordan and Lenschow, 2008). However, we are not going to argue that an ideal ICCSP is always the best way to go. Without any specification of the meaning of policy integration, such integration can be translated as requiring "rational-comprehensive" (Lindblom, 1959, *passim*) policymaking. The criticism that such idealistic approaches obscure the reality of policymaking processes is a long-standing and well-documented concern that we share to some extent. Nor shall we argue that we should always engage in planning for such ideal integration. As James Meadowcroft commented after reviewing criticisms of such planning in the context of SD, "[i]t is simply not possible at any particular point in time to make a single set of strategic choices, or to design once-and-for-all a set of institutions which can be guaranteed to be best suited to secure sustainable development" (Meadowcroft, 1999, p. 35). Of course, there are always cost constraints as well.

Instead, we believe that a CCS policy should be assessed in terms of its 'distance' from an ideal ICCSP in order to track its relationship with broader sustainable development goals and to ensure continuing awareness of the inherent non-rational-comprehensiveness of actual CCS policy. The most appropriate level of ICCSP cannot be judged *a priori*, but it may be achieved over time through successive iterations of policy processes and practices. Generally, if a higher level of integration is to be achieved, a more conscious integration process will be required.

To this end, we develop the idea of ICCSP to serve both as an *evaluative framework* consisting of substantive and systematic criteria for assessing CCS policies in terms of the achieved level of policy integration, and as *a diagnostic tool* which can pinpoint what is needed to achieve higher levels of ICCSP. This framework's usefulness is demonstrated by its application to CCS policies in Japan and Norway. These two countries were chosen for several reasons. They differ markedly with respect to their level of political engagement and policy development regarding CCS. Both countries are unitary states (thus we avoid the additional complexities of federal systems in which CCS-related policies might be developed by different levels of government). Adequate, accessible documentation on their CCS policies also exists, and we are familiar with it. In the final part of this article, we summarize the findings of the two cases and conclude by providing some observations regarding the sources of the differences in the levels of integration achieved by Japan's and Norway's CCS policies, as well by commenting on as some policy implications derived from our analysis based on the ICCSP framework.

2. A brief discussion of EPI assessment

Encouraged by the Brundtland Report (1987) and Agenda 21 (adopted at the Earth Summit in 1992), the concept and practice of EPI have evolved in tandem. Taking advantage of this development, the EPI literature now offers many nuanced options for conceptualizing EPI that go a long way toward avoiding the "rational-comprehensive" criticism referred to above. Despite their conceptual diversity, these options seem to center around a core meaning of EPI, which holds that, in appropriate conditions, environmental objectives should be given "principled priority" (Lafferty and Hovden, 2003, *passim*), or defines EPI as a "first-order operational principle" (Lenschow, 2002, p. 6), in the policymaking process. Of course, turning this normative conceptualization into practice will never be straightforward. Incorporating environmental objectives into non-environmental sectors inherently involves trade-offs, or even conflict, among different objectives (Collier, 1994; Lafferty, 2002). Such complexity can also be true for CCS policy itself because, when deploying CCS, many other constraining policy objectives (for example, preventing marine pollution in the case of off-shore CCS, achieving public acceptance, etc.) are at stake. Indeed, some analysts explicitly warn against the deliberate weakening, or "dilution" (Liberatore, 1997, passim), of EPI. As in the case of CCS, the integration of CCS policy could be diluted when CCS is deployed at the expense of other societal and/or environmental objectives, including those mentioned above. Thus, some analysts emphasize the importance of understanding how EPI can be accommodated and institutionalized through policy learning, or reframing, that results in the enhanced implementation of EPI (Nilsson and Eckerberg, 2007).

Despite the fact that EPI research has been undertaken for more than 15 years, there is surprisingly little literature on how to assess systematically the level of EPI achieved (Mickwitz and Kivimaa, 2007). The accumulated knowledge on EPI assessment largely concentrates on benchmarks or indicators of facilitative measures to achieve EPI (for example, implementation of Strategic Environmental Assessment) which do not constitute a systematic framework for assessing EPI achievement (see Briassoulis, 2005 for a list of such indicators).

Although not writing in the EPI tradition, Metcalfe's general policy coordination scale (Metcalfe, 1994) does represent a systematic tool that could be applied to assess the level of EPI achieved. However, this approach is primarily focused on policy integration among different institutions (e.g., ministries and specialized agencies). As ICCSP will not necessarily be achieved through inter-institutional coordination, and we are interested in defining the substantive criteria of ICCSP, the Metcalfe scale is not the best point of departure for developing an ICCSP framework.

Substantive criteria for EPI assessment are proposed by Underdal (1980) and Kivimaa and Mickwitz (2006). The latter is concerned with assessing the present situation without reference to an optimal form of EPI and does not make any explicit normative judgments on the desired form of EPI. In contrast, the former attempts to define an ideal integrated policy based on rational choice theory. We chose Underdal (1980) as the basis to develop an ICCSP framework because it can provide the substantive criteria necessary for assessing the integration of CCS policy. However, this does not imply that we align ourselves with Underdal's preference for rational choice theory. Our intention is to use Underdal (1980) only as a conceptual basis in line with our previously described normative judgment. Moreover, given the accumulated knowledge of EPI, Underdal's framework may be viewed as rather simplistic. Nevertheless, we believe that this simplicity enhances the applicability of the ICCSP framework to diverse countries possessing multiple contexts. At the same time, our operationalization of Underdal's framework (described below) remedies this shortcoming in a way that does not constrain its applicability.

Finally, growing attention has been paid to the relationship between EPI and its policy outcomes, i.e., its contributions to actual environmental improvement (Jordan and Lenschow, 2008, 2010). However, in developing our ICCSP framework, we do not focus on policy outcomes at all primarily because of our interest in avoiding complications in the framework. Moreover, given the fact that there is, as yet, no full-scale CCS in operation, there is very limited knowledge about whether CCS can actually contribute to climate mitigation and overall environmental improvement (Working Group III of the IPCC, 2005).

3. Developing the framework of integrated CCS policy

3.1. Defining integrated CCS policy

As Underdal (1980, p. 159) pointed out, "To 'integrate' means to unify, to put parts together into a whole." This statement, of course, begs the questions of what this "whole" consists of and which parts should be integrated. Furthermore, policy integration "rests on the

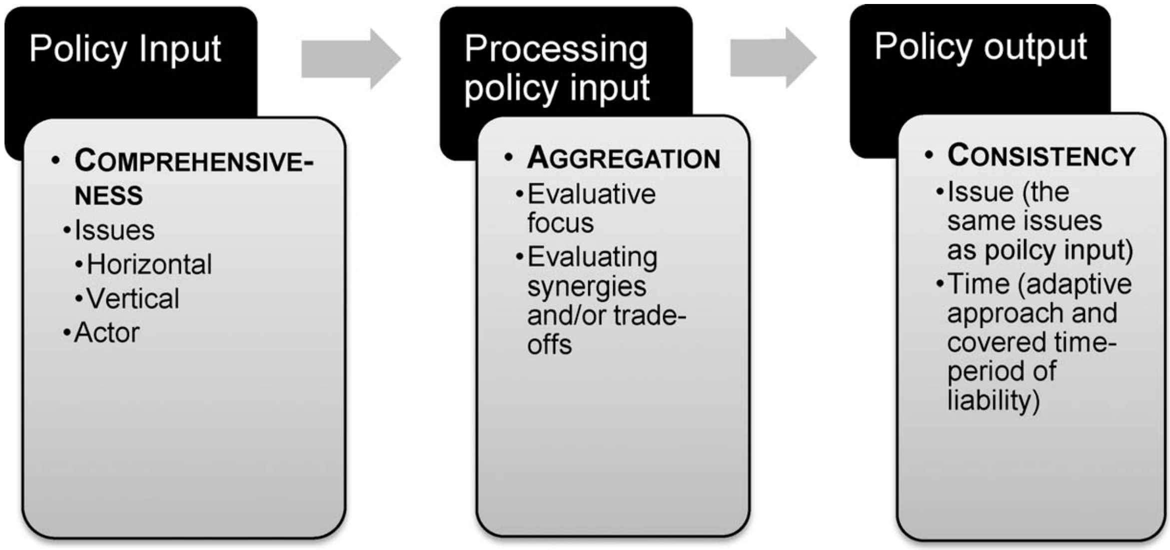

Fig. 1. The policymaking process and the corresponding requirements of policy integration incorporated into the ICCSP framework.

assumption that the elements to be integrated are somehow interdependent or linked", and "[p]olicy integration can be seen as an effort to ensure that links among issue-aspects or issue-areas are not neglected in the making of policy decisions" (Underdal, 1980, p. 164).

Underdal further argues that a policy must generally fulfill three basic requirements to qualify as integrated: comprehensiveness, aggregation, and consistency. These requirements need not be fulfilled at all stages of the policymaking process. Rather, these requirements refer to three consecutive stages of policymaking: "comprehensiveness to the input stage; aggregation to the processing of inputs; and consistency to outputs" (Underdal, 1980, p. 159; Fig. 1). The policymaking process in this definition is supposed to be an official governmental process that produces a policy output. To put this definition into concrete terms and using CCS policymaking as an example, ICCSP requires policymakers to take climate policy as well as marine pollution issues into account as inputs into the policymaking process. They are then to evaluate those policy inputs in aggregation, e.g., what are the direct and indirect monetary costs and benefits of CCS in aggregated terms of climate policy and marine pollution issues, and how can those costs and benefits be compared? Finally, policymakers must produce a policy output that is consistent with the overall guidelines governing climate policy and marine pollution. We further elaborate upon each of these requirements by highlighting some of the important dimensions through which the three requirements can be measured in the CCS context.

The example above shows that the comprehensiveness requirement can be measured along the issue dimension: the more related issues policymakers take into account as policy input, the higher the level of comprehensiveness. This dimension can be further categorized into vertical and horizontal sub-dimensions (Lafferty and Hovden, 2003). The vertical sub-dimension refers to the 'internal' components of CCS policy. What constitutes such internal components depends on how we regard CCS technology. We regard it essentially as a climate mitigation measure because CCS technology would never be developed and deployed in any country in which climate change need not be mitigated. Therefore, CCS policy has internal components, such as research, development and demonstration (RD&D), public acceptance and, most broadly, climate policy. The often raised concern of lock-in (Hansson and Bryngelsson, 2009; Unruh and Carrillohermosilla, 2006) and the contribution of CCS to long-term climate mitigation targets (Working Group III of the IPCC, 2005) are included in the category of "climate policy" because they are concerned not solely with CCS but also with other elements of climate policy. The need for intensive and coordinated technological learning of CCS emphasized elsewhere (de Coninck et al., 2009; ZEP, 2008; see also Markusson et al., this issue) is a matter for RD&D.

The issues with horizontal sub-dimensions are related, but at the same time 'external', to CCS, such as marine pollution and ecological risks to biodiversity. Leakage of CO_2 stored in deep sea saline aquifers may immediately lead to serious marine pollution and acutely enhance ecological risks to deep sea biodiversity (Seibel and Walsh, 2001). Given the fact that CCS is almost always associated with energy policy, one can argue that such policy should be incorporated in ICCSP as a vertical issue. However, because CCS can also be implemented by the industrial sector apart from energy policy (de Coninck and Mikunda, 2010), we categorize it as a horizontal issue. Moreover, we conceive CCS as a climate mitigation issue and, more broadly, as an environmental issue, and the EPI literature treats energy issues as always external to the environment sector. An ideal ICCSP takes those external issues into account from the policy input stage, not as an afterthought.

Another dimension of comprehensiveness that should be highlighted concerns the actors in the CCS context. This dimension can be measured in a relatively straightforward fashion: the more the diverse perspectives of relevant actors are incorporated as inputs into CCS policymaking, the more comprehensiveness can be attributed to the resulting CCS policy. In this dimension, a CCS policy that incorporates the perspectives of both expert and local communities should be regarded as more integrated than one that incorporates only expert communities' perspectives. If the growing literature on public participation in the CCS context (e.g., Malone et al., 2009; Forbes et al., 2010) is put into practice, the level of integration will be enhanced in terms of the actor dimension of comprehensiveness.

The second requirement, aggregation, means that decisions should be based not only on the recognition of a broader scope of policy consequences, but also on some aggregate evaluation of these consequences (Underdal, 1980). It, thus, refers to "the extent to which policy alternatives are evaluated from an 'overall' perspective rather than from the perspective of each actor, sector etc." (Underdal, 1980, p. 161). Although not specified by Underdal, evaluation means a systematic analysis of the consequences of CCS policy and its alternatives based on the information brought into

the policymaking process as policy input. Such analysis need not be done by the actors directly involved in the policymaking process, but serious attention should be given to the results of such aggregated evaluation. In the context of CCS policy, for example, aggregation requires not only a recognition of the impact of CCS deployment on marine pollution and biodiversity but also an evaluation of its consequences through an assessment of total associated benefits and aggregated damage costs to society. However, suggesting a predetermined way of conducting an aggregated evaluation of a CCS policy is not only difficult; such suggestions should also be avoided because the valuation of various elements of CCS policy varies among countries. As Underdal puts it, "One important implication is that the integration of policy is not a purely technical exercise; it implies weighing interests and setting priorities" (Underdal, 1980, p. 161). Ultimately, the choice of aggregation methods is, more than anything, a *political* exercise.

However, the political nature of aggregation does not prevent us from setting some general criteria for evaluating the level of aggregation in CCS policymaking. In general, the broader the scope used to evaluate policymaking inputs, the more likely that the CCS policy in question will be based on a more aggregated evaluation and thus enjoy a higher level of integration. Evaluating the trade-offs and synergies among the evaluative criteria will also increase the level of aggregation of CCS policy, as compared with merely evaluating CCS policy based on criteria set independently of each other. One way of conducting such an evaluation is to utilize an integrated assessment model to investigate trade-offs and synergies among, for example, climate reduction targets, energy investments and CCS deployment based on various alternative scenarios. Such an evaluation of CCS by means of assessment models has already been undertaken elsewhere (Working Group III of the IPCC, 2005).

The third requirement, consistency, is defined by Underdal in the following manner: "a consistent policy is one that is in harmony with itself – one whose different components accord with each other" (Underdal, 1980, p. 161). However, this definition raises crucial questions (for example, what does "in harmony with itself" mean?) and, therefore, is too crude to provide a solid basis for ICCSP. Significant conceptual development has also taken place since the publication of Underdal (1980) (Meijers and Stead, 2004). We adopt the definition of policy consistency suggested by Jones (2002) because it is largely in agreement with the EPI literature (e.g., Collier, 1994; Lafferty and Hovden, 2003; Jordan and Lenschow, 2008). "[It] means ensuring that individual government policies are not internally contradictory, and avoiding policies that conflict with reaching for a given policy objective" (Jones, 2002, p. 391). To put consistency in the context of ICCSP, a given set of CCS policy outputs must not be internally contradictory in terms of vertical and horizontal issue areas. For an example of contradiction in terms of horizontal issue areas, if energy policy puts enhancing energy efficiency as the highest priority at the same time it incorporates planning for large-scale CCS deployment, this policy is internally contradictory because of the expected energy penalty associated with the latter.

It is important to note that consistency does not require a CCS policy to be in line with all relevant vertical and horizontal issues. Rather, we are interested in the following. First, in which other policy areas has CCS been discussed as a policy input? Second, have problems of consistency among those issue areas been addressed? Third, if the answer to the second question is yes, how have those problems been addressed? The point is that we only examine consistency among those vertical and horizontal issue areas which have been taken into account as policy inputs. For example, if only RD&D and capture issues constitute policy input, then our framework restricts the examination of consistency to those two issues. Thus, a fully consistent CCS policy signifies that there is no contradiction among vertical and horizontal issue areas constituting policy input. The more contradictions a CCS policy has among those issue areas, the more likely that a lower level of consistency will be attributed to that policy.

Underdal (1980) deems the question "whether or not consistency implies stability over time" (p. 162) of interest. Because CCS policy is in its infant stage and generally has not significantly changed, there is little opportunity to discuss the consistency of past CCS policies over time. However, given the immense technological and societal uncertainties surrounding CCS, adapting CCS policy based on learning from experience and knowledge seems a promising strategy to secure consistency over time. Indeed, the importance of learning and adaptive regulation of CCS is advocated elsewhere (de Coninck et al., 2009; CCSReg Project, 2009). Therefore, we submit that the more adaptive approaches a CCS policy explicitly adopts, the more time consistency it can claim. Moreover, we can also safely argue that lengthier periods of long-term liability for CCS storage are more likely to facilitate consistent CCS policy. Longer liability requirements tend to demand relatively more consistent policies over time than do shorter term requirements; otherwise, assuming such liability would be risky.

3.2. Operationalizing the ICCSP framework

Our definition of ICCSP is, to some extent, idealistic and all-inclusive. For example, based on the ICCSP framework, examining the level of horizontal issues by the comprehensiveness requirement may potentially require analyzing many other policy issues because CCS policy may directly or indirectly affect many issues. To operationalize the ICCSP framework, we specify the elements most likely to be the subject of consideration in the policymaking process, thereby setting initial system boundaries for the CCS policy domain. We establish these system boundaries by referring to the existing literature, most notably the IPCC Special Report on Carbon Capture and Storage (Working Group III of the IPCC, 2005). The results of this exercise are presented in Table 1.

Note that we do not attempt to weigh the vertical and horizontal issues against any criteria because this is exactly part of the politics of CCS and there is no way to prejudge how to do such weightings. Therefore, the difference in the numbers of the relevant vertical and horizontal issue areas does not automatically tell us that a country has a more *problematic* CCS policy than do others. Rather, such differences signal that countries display various levels of comprehensiveness. Furthermore, although the table indicates only the lowest and highest levels of each dimension, the actual evaluation based on the dimensions is a matter of degree. Finally, ICCSP should be applied to official governmental processes that have produced a policy output dealing with domestic CCS deployment. Accordingly, foreign policy decisions that affect domestic CCS deployment may become part of such analysis (as it is in the Norwegian case). However, foreign policy that deal with foreign deployment of CCS (through the Clean Development Mechanism[2] or technology transfer, for example) are outside the scope of such analysis because such policymaking involves significantly different decision premises than do domestic CCS deployment.

[2] The Clean Development Mechanism was developed under the auspices of the Kyoto Protocol. It enables entities in developed country parties to invest in GHG reduction projects in developing country parties and obtain the reduction credits thereby achieved. Those credits can be used to comply with the reduction targets stipulated in the Kyoto Protocol.

Table 1
System boundary of ICCSP.

Three requirements of ICCSP	Dimensions of each requirements	Evaluative criteria (lowest → highest)
Comprehensiveness in policy input	Actors	Focusing on actors listed below. The more types of actors' perspective that is incorporated in policy input, the higher level of comprehensiveness will be attributed to CCS policy • High political figures (chief executive, relevant ministers) • Bureaucrats of directly involved ministries (e.g., energy, foreign affairs, environment, land management) • Politicians • Industry • Local municipalities • NGOs • Local communities near CCS project sites • Expert communities
	Issue	Focusing on issues listed below. The more types of issues that is incorporated in policy input, the higher level of comprehensiveness will be attributed to CCS policy
	Vertical	• RD&D • capture • transport • injection • storage • monitoring • verification • inspection • long-term liability • public acceptance • insurance • safety • climate policy
	Horizontal	• Energy policy • biodiversity • marine pollution • freshwater management
Aggregation in processing policy input	–	Focus of evaluation of policy input: no evaluation → comprehensive evaluation Any evaluation of synergies and trade-offs regarding policy input? No → yes
Consistency in policy output	Issue	Any contradiction among issue areas? Full contradiction → no contradiction
	Time	• Adaptive approach adopted? No → yes • The time-period covered in liability The longer, the higher score.

4. Evaluating actual CCS policy

In the following, we apply the ICCSP framework to Japan and Norway and, thereby, demonstrate the usefulness of the framework. We will trace and describe the relevant policy and political processes by providing some background information (briefly describing the relevant national context) and then assess CCS policies in the two countries based on the ICCSP framework. The emphases and styles of the case descriptions are somewhat different. The Japanese case focuses on administrative procedure and the resulting policy outcome, whereas the Norwegian case emphasizes both political and administrative processes. This distinction stems from national differences. While the Japanese policymaking process is generally technocratic, climate change and CCS issues have high political profile in Norwegian politics. The time period covered in the Japanese case extends to 2009, whereas that of Norway extends to 2010.

4.1. Japan

4.1.1. Overview of CCS policy

Despite its relatively long history (since the late 1980s) of involvement in CCS development (METI, 2006), Japan has initiated few relevant regulations. CCS is discussed predominantly in technical terms. However, there is one exception: the 2007 amendment to the Law Relating to Prevention of Marine Pollution and Maritime Disaster (LPMP). The Japanese Ministry of Environment (JMOE), which has jurisdiction over the LPMP, took the initiative to amend the LPMP to legalize injection of CO_2 into sub-seabed saline aquifers, which was intended to enact domestically the decision of the 1996 London Protocol making CO_2 disposable into the sub-seabed under certain conditions (Resolution LP.3(4) on the Amendment to Article 6 of The London Protocol). The storage potential of Japanese aquifers is estimated at 146 billion t-CO_2, which is roughly equivalent to 116 times Japan's GHG emissions in 1990 (RITE, 2006). Japan's CCS policymaking process also produced a series of "soft" policy documents. We will focus on those documents following a very brief explanation of the relevant Japanese context.

Under the Kyoto Protocol, Japan is obliged to reduce greenhouse gas (GHG) emissions by 6% from their 1990 levels. Japan's GHG emissions had been on the rise, and 2007 saw Japan's highest level of GHG emissions (about 1.37 billion t-CO_2), which makes Japan one of the highest GHG-emitting countries in the world (JMOE, 2009).[3] Poor Japanese climate policy has obviously been a cause of this rise. Japan's policy approach historically has put almost no burden on GHG-emitting actors in terms of capping GHG emissions or taxing CO_2. Rather, the policy has generally been to provide subsidies to encourage GHG reduction. An additional reason for this escalation was the increased combustion of coal in power plants (JMOE, 2009). Japan has been expanding the use of coal-fired power plants since the 1990s and is even planning to further extend the capacity of such plants. This capacity increase is encouraged because coal is a convenient resource that is relatively cheap, abundant, and available from multiple sources (e.g., Australia, China etc.). These are important considerations given that Japan relies almost totally on imported energy sources for domestic power generation.

Although the JMOE is the main actor in matters related to the LPMP, the dominant actor in Japan's CCS policymaking process is the Ministry of Economy, Trade and Industry (METI), formerly the Ministry of International Trade and Industry (MITI). METI has control over certain CCS-related public funding (one of the main policymaking arenas for CCS) and hosts the Advisory Committee for Natural Resources and Energy (ACNRE). METI also acquires expertise through its research organizations.

Since 2003, various climate policy documents (Study Forum on the Clean Coal Cycle, 2004; ACNRE, 2005) have increasingly mentioned CCS as an important technology that should be vigorously developed as an instrument for reconciling economic growth with climate change mitigation. Generally, all of the main types of CCS, including ocean sequestration, are covered. However, priority has recently been given to CO_2 storage in sub-seabed saline aquifers following the amendment of the LPMP.

[3] Recently, the 2010's Japanese GHG emissions dropped to about 4% below the 1990 levels due to the global economic downturn.

Substantive policy discussion in Japan only surfaced in the policymaking process in 2006, with the publication of "CCS 2020" by the METI (METI, 2006). This document set out initial ideas for the commercialization of CCS in Japan. "CCS 2020" states that public funding should support RD&D until such time as the actual cost of CCS deployment is approximately 1.5 times the cost of a commercially viable CCS system. The document also holds that prioritizing the relatively low-cost capture of CO_2, such as capturing it from natural gas, is an important way of overcoming cost barriers and accumulating technological experience.

Soon after this report was published, the Study Forum on CO_2 Capture and Storage Technology (SFCCS) was established under the METI to formulate policy proposals for the further promotion of CCS. However, the SFCCS could only generate a list of the steps necessary for CCS deployment and did not address details (SFCCS, 2007). These steps include preparing legislative initiatives for domestic CCS and establishing institutional arrangements for verification of injected CO_2; securing public acceptance through environmental impact and safety assessments and disclosure of risk information; examining supporting financial measures, including a risk insurance system, and taking an overall adaptive approach. The SFCCS has further discussed safety issues surrounding full-scale CCS demonstration projects and produced guidance for such projects that is almost exclusively concerned with technical and operational arrangements (SFCCS, 2009).

As previously mentioned, the MOE took the initiative to revise the LPMP to enact domestically the decision of the London Protocol in 2006. As a standard procedure, the Minister of the Environment asked the Central Environment Council (CEC) for advice on the matter. The Council subsequently set up an expert committee to discuss the issue of CO_2 injection into the sub-seabed and how to prevent such injection from impacting the marine environment. The deliberations of the expert committee lasted for six months, with a final report (CEC, 2007) issued in February 2007. The revision of the LPMP was proposed just one month after the final report was publicized, and the Diet adopted the proposal by consensus in May 2007 with no amendments.

The revised LPMP, which has already come into effect, stipulates, among others, the following. First, the CO_2 to be disposed into the sub-seabed must be collected through an amine-based chemical absorption process, and its concentration must be over 99% in terms of volume. Second, the entity that wants to dispose of CO_2 into the sub-seabed must obtain permission from the Minister of the Environment. Third, when seeking such permission, the applicant must prove that the operation does not harm the marine environment, submit the results of appropriate environmental impact assessments and prove that the operation has sufficient ability to monitor the injected CO_2 and its potential environmental impact by submitting a monitoring plan. Fourth, the entity that receives permission must monitor the injected CO_2 and the potential environmental impact according to the submitted plan and report to the Minister of Environment in due time. Failures to monitor and report trigger the revocation of permission. So far, no entity has obtained permission to engage in such operations. The JMOE has funded development of simulation techniques for environmental impact assessment and monitoring technologies,[4] which indicate that no viable methods are yet available.

4.1.2. Assessing integration

Japan's CCS policy has been very limited in terms of comprehensiveness. Regarding the actor dimension, only industry, experts and bureaucrats are basically involved in the CCS policymaking process described above.

The issue dimension, in contrast, includes more diverse elements. The vertical issues of CCS, RD&D, capture, transport, monitoring, safety, and public acceptance are covered. Marine pollution and biodiversity are horizontal issues that were addressed during discussion of the LDPD amendment. During that discussion, however, the expert committee did not elaborate upon whether actual baseline information of the relevant deep sea ecosystems is practically available. Without such information, no environmental impact assessment of the CCS system is possible.

Evaluating the aggregation requirement is very easy. No attempt has been made to assess policy input into CCS policymaking in an aggregated fashion. Japan's policymaking system in this policy area is fragmented, reflecting the competing jurisdictions of the MOE and METI. For example, the LDPD revision process under the MOE did not consider RD&D and safety issues, but the METI's SFCCS did consider those issues.

The consistency requirement cannot be evaluated in a straightforward fashion. No discussion took place on securing consistency between Japan's biodiversity policy and CCS. Problems regarding the availability of data for relevant ecosystems remain. In addition, the incomplete status of the licensing system makes evaluation difficult. Consistency depends on how permission to deploy CCS (in conformance with the process stipulated by the revised LDPD) will mandate environmental impact assessment methodologies, the monitoring required to deploy CCS and the restoration of damage caused by leaked CO_2. However, consistency with marine pollution issues is high, as the aim of the LDPD amendment was to domesticate the London Protocol's decision.

Regarding vertical consistency, one element in particular disrupts it. The LDPD revision only allows amine-based chemical absorption to be used for CO_2 capture. Yet, the Japanese RD&D policy is not limited to amine-based chemical absorption; it also incorporates a variety of CO_2 capture methodologies. This observation is further substantiated by SFCCS's (2009) policy recommendations to expand the scope of injectable CO_2.

As for time consistency, the LDPD revision stipulates constant adjustments that appear to reflect an adaptive approach However, the presence of this provision does not automatically mean that the intended approach is adaptive. Moreover, the LDPD revision stipulates that licenses should be renewed every five years, but it contains no provision for cases in which licenses failed to be renewed. This technically means that a license holder is only liable for its CCS project for at least five years. Japan's CCS policy, therefore, receives a very low score on time consistency, especially on the criteria pertaining to the period of time for which liability is covered.

4.2. Norway

4.2.1. Overview of CCS policy

Norway is regarded as a pioneer in CCS policymaking (van Alpen et al., 2009; Langhelle and Meadowcroft, 2009; Tjernshaugen, 2010). The Norwegian government is currently planning two full-scale CCS projects in Norway: at Kårstø (a gas-fired power plant) and at Mongstad (a combined heat and power plant at Norway's major industrial refinery). The project at Mongstad is considered to be "one of the most important instruments in Norway's climate policy" (Riis-Johansen, 2009). The European CO_2 Technology Centre Mongstad is currently under construction. It will be among the first and largest facilities of its type worldwide. In the National Budget for 2010, the Norwegian Government allocated what was termed an unprecedented allocation of funds to CCS, approximately NOK 3.4 billion. These funds are to be distributed among the two planned full-scale CCS projects, a

[4] For details of the budget of the JMOE, see www.env.go.jp/guide/budget/ (last accessed 03.2010).

transport and storage solution and international activities, as well as research and development on CCS technologies.

The explanation for the keen interest in CCS in Norway can be attributed to several circumstances. First, CCS has been directly linked to a domestic conflict between climate and energy policy targets from the late 1980s onwards. Norway is both a large producer and exporter of oil and gas with growing CO_2 emissions and also a country with a relatively high level of ambition with regard to GHG emission reductions. This policy dilemma has played out as a domestic conflict over gas-fired power plants, resulting in a strong focus on CCS.

Norway is one of three countries allowed to increase its emissions under the Kyoto Protocol (a 1% increase from the 1990 levels is allowed during the period 2008–2012). Between 1990 and 2008, emissions in Norway increased by almost 8%. Between 2008 and 2009, emissions dropped substantially, primarily due to the financial crisis. In 2009, emissions were only 2.2% above 1990 emission levels (SSB, 2010). With no further measures, however, emissions are expected to increase by up to 18% above the 1990 levels by 2020 (Klif, 2010). This projection assumes full-scale CCS being in place at Mongstad and Kårstø. If these CCS projects are not realized, emissions could be higher in 2020.

In 2008, the Norwegian parliament agreed on what is referred to as the "climate compromise". The compromise included an interim target of a 20% reduction of GHG emissions by 2030 compared with 1990 levels, of which two-thirds of the reductions would be taken domestically. It also stated that Norway would over-fulfill its Kyoto obligations by 10%.

The key actors in Norway's CCS policymaking process have been the Government and the Parliament. In 1989, Norway became the first country in the world to set a target for stabilizing CO_2 emissions at the 1989 level by the year 2000 (Langhelle, 2000; Hovden and Lindseth, 2004). In the years that followed, however, the stabilization target came under increasing pressure, and it was officially abandoned by the Labor government in 1995. The fact that Norway meets virtually 100% of its electricity demand through domestic hydroelectric power left Norway with few options to compensate for the growing emissions from the oil and gas sector (Langhelle, 2000; Tjernshaugen and Langhelle, 2009).

In the summer of 1994, the company Naturkraft was established to develop and run two gas-fired power plants on the western coast of Norway, at Kårstø and Kollnes. Those plants would increase domestic emissions by approximately 6%. It was in this context that CCS really entered the political stage, in a fierce political battle involving the government, parliament, industry, NGOs and labor unions. The cleavage in energy politics cut across the traditional left-right axis in Norwegian politics and, as a consequence, energy and climate change issues became controversial for all (likely) government coalitions. CCS, therefore, became an attractive possibility. CCS would open the way for large-scale domestic use of natural gas without coming into conflict with climate change targets.

The political debates during the late 1990s and the beginning of 2000 were primarily concerned with whether or not to build gas-fired power plants, with or without CCS (Ministry of Petroleum and Energy, 1998–1999, 1999). In Report to Parliament No 9 (2002–2003) (Ministry of Petroleum and Energy, 2002–2003), however, CCS is broadly discussed in terms of capture and storage challenges. In terms of the more technical CCS policy issues, the main actors have been experts, bureaucrats, industry representatives and some environmental NGOs, most notably Bellona and ZERO.

Since 1996, Statoil operates, on behalf of a group of industrial partners, the famous Sleipner project, where approximately one million tons of CO_2 per year have been separated from gas production on the Sleipner Vest field in the North Sea for storage in Utsira, a geological formation 1000 m below the seabed.[5] The key driver for the decision to capture and store CO_2 was the introduction of the Norwegian CO_2 tax on offshore oil and gas activity introduced in 1991 (Tjernshaugen and Langhelle, 2009). Though Norway had no specific legal framework for CCS at the time when the Sleipner project began, the operational Norwegian storage projects (Sleipner and Snøhvit) so far have been regulated under the existing laws (van Alpen et al., 2009).

CCS policies are primarily the responsibility of the Ministry of Petroleum and Energy and, to some extent, the Ministry of Environment. From 2002, those policies have been regulated in accordance with the Petroleum Act and the Pollution Control Act, requiring Statoil to monitor CO_2 storage and to report annually to the Norwegian Pollution Control Authority (from 2010, The Climate and Pollution Agency (Klif)) (Klif, 2002; DNV, 2006, 2008). In 2009, the authority to develop a legal framework for transport and storage of CO_2 was delegated to the Ministry of Petroleum and Energy, and safety issues were delegated to the Ministry of Labor (Lovtidend, 2009).

As part of the Sleipner project, Statoil initiated and organized a multinational and multidisciplinary research project named Saline Aquifer CO_2 Storage (SACS) to collect relevant data and to model and verify the distribution of CO_2 in the Utsira formation. The SACS program was later replaced by the CO2STORE research project, which investigates lessons learned from other storage projects. In White Paper No 9 to the Parliament, the Government argued that there was still a need to document whether different storage solutions are environmentally sound in a long-term perspective (Ministry of Petroleum and Energy, 2002–2003, p. 85). The Government also argued that it was important to establish acceptable methods for verification of secure storage solutions. In November 2005, therefore, the North Sea Basin Task Force was established between Norway and the United Kingdom (Netherlands and Germany joined in 2008). Norway was also active in the amendments made to the London Protocol in 2006 (allowing sequestration of CO_2 streams in sub-seabed geological formations under certain conditions) and the amendments to the OSPAR Convention in 2007 as well, "to ensure environmentally safe storage of carbon dioxide streams in geological formations and Guidelines for Risk Assessment and Management of that activity" (DNV, 2008).

4.2.2. Assessing integration

The comprehensiveness of Norway's CCS policy has, so far, been quite extensive, although with limitations. Due to the high profile and centrality of CCS in Norwegian climate politics, the actor dimension of CCS has included Government, Parliament, political parties, industry, NGOs and labor unions. On the more technical CCS policy issues, participation has been more expert-oriented. As one of the bureaucratic actors, the state enterprise Gassnova SF was established in July 2007 to manage governmental interests and support technology development within the area of CO_2-management (capture, transport, injection and storage of CO_2). Gassnova SF works closely with industry experts and also contributes to the implementation of the technology development program "CLIMIT" (in cooperation with the Research Council of Norway).

Concerning the issue dimension, various Norwegian Governments from the late 1990s have promoted CCS and worked to establish both a national and international framework for supporting, demonstrating and deploying CCS. van Alpen et al. (2009) argue that the Norwegian CCS system has led to "a

[5] For a brief description of the Sleipner project, see http://www.co2capture-andstorage.info/project_specific.php?project_id=26 (last accessed 12.2010).

remarkable consistent build-up of an innovation system around CCS technologies'' (van Alpen et al., 2009, p. 50) with broad international cooperation, addressing most of the vertical issue areas of the ICCSP framework. However, such issues as long-term liability remain unresolved for the moment.

In terms of the horizontal issues of CCS, biodiversity and marine pollution concerns have not played an important role. The reason is simple. CCS, to a large extent, has been considered safe, based on the premise that no leakage will occur. As the current Minister of Petroleum and Energy stated in 2009, ''Norway has long and unique experience in the field of storage of CO_2. The projects of Sleipner and Snøhvit are operational. At Sleipner CO_2 storage has been done safely, for 14 successive years'' (Riis-Johansen, 2010).

CCS development in Norway has been driven by the concern for climate change, as well as by a national interest in the domestic use of natural gas and for securing the revenues of fossil fuels for as long as possible (Langhelle and Meadowcroft, 2009). Given the fact that ''the relatively strong political support for CCS in Norway is related to the country's large oil and gas industry, and large remaining reserves of oil and gas'' (Tjernshaugen, 2010, p. 16), it is obvious that the aggregated evaluation of the two issue areas constituting the driving forces of CCS policy, described above, is given serious consideration. Based on such an evaluation, CCS policy is considered capable of realizing synergy between these drivers. At the same time, given that Norway has promoted CCS technology more strongly than it has promoted new renewable energy, some people have also raised the concern that the effort and money used for CCS have drawn attention and money away from new renewable energy technologies (Tjernshaugen and Langhelle, 2009). This concern identifies the existence of a trade-off between CCS and broader energy policies. In sum, we can say that an aggregated evaluation has been made regarding the issue areas of climate and energy policies. That evaluation, in turn, has identified several synergies and tradeoffs.

In terms of consistency, there is at least some tension between CCS policy and what has been an overriding principle in Norwegian climate policy, that of cost efficiency. This principle implies that climate policy, both nationally and internationally, should be framed so that emission targets can be reached at the lowest possible societal cost. One should, therefore, seek cost-efficient solutions across nations, sectors and GHGs. In the short term, CCS violates this foundational principle. As shown in the evaluation of possible climate measures in different sectors found in KLIMAKUR 2020 (Climate and Pollution Agency, 2010), CCS is expensive and far from cost effective in the short term. In the long term, however, costs might be difficult to predict. Finally, Norwegian CCS policy exhibits limited time consistency; it adopts adaptive policy-making, yet there is no time-period for covered liability. This may change shortly, as a liability regime is expected to be developed in 2011.

5. Discussion: a brief summary of the cases

The cases are summarized in Table 2. It is clear from a brief comparison that the overall level of ICCSP is higher in Norway than in Japan. Regarding comprehensiveness, Japan's CCS policymaking process involves only a very limited number of actors, such as industry, experts and bureaucrats, and it addresses only limited range of issues. Norway's CCS policy reflects various perspectives from very diverse actors, takes more vertical issues into account in CCS policymaking than does Japan, and evaluates trade-offs and synergies of its CCS policy with a broader focus than does Japan. Norway also scores higher than Japan on the aggregation criteria. Japan has not been engaged in aggregated evaluation at all, whereas Norway has engaged in such evaluation with regard to climate and energy policies and has been able to identify synergies and trade-offs. However, Japan appears to score relatively higher on time consistency than does Norway because it has a liability regime in place (although with a very limited time-period of liability), but the liability regime in Norway still is under development.

The most striking difference is that Japan's CCS policymaking process does not have detailed information on climate policy as a policy input, whereas Norway considers climate change as the most important issue in the CCS debate. This is rather surprising

Table 2
Summary of the cases.

Requirements	Dimensions/criteria	Japan	Norway
Comprehensiveness	Actor	• Expert community • Bureaucrats • Industry	• Prime minister, Minister of Petroleum and Energy & other ministers • Politicians • Bureaucrats (including state enterprise Gassnova SF) • Industry (oil and gas companies) • Expert community • Environmental NGOs
	Vertical	• RD&D • capture • transport • storage • injection • monitoring • safety	• RD&D • capture • transport • storage (offshore) • injection • monitoring • safety • insurance • climate policy
	Horizontal	• Biodiversity (limited) • Marine pollution (very limited discussion covering issues only related to the London Protocol amendment)	• Energy policy • Biodiversity (very limited) • Marine pollution (very limited discussion covering issues only related to the London Protocol amendment)
Aggregation	Focus of evaluation	Narrow and fragmented	Climate and energy policies
	Evaluation of synergies and trade-offs	None	• Synergies, in terms of domestic use of natural gas combined with climate reductions • Trade-off's in terms of the clouding out effect on new renewable energy technologies
Consistency	Issue	Contradiction between types of CCS subject to RD&D and the types of CCS allowed by LDPD	Contradictions between aggregative policy criteria (cost efficiency) and CCS in the short term (in long term it is not predictable so far)
	Time	• Adaptive approach adopted (but not sure about its real intention because this stipulation is business-as-usual) • Very limited time-period covered in liability stipulations	• Adaptive approach adopted (but the time-frame (and delays in deployment) for CCS has been a controversial political issue) • No time-period covered in liability stipulations (liability regime expected to be developed in 2011)

because Japan has every reason to consider climate change in detail in its CCS debate, as is indicated in the climate and energy contexts sketched out above.

6. Conclusion

These cases demonstrate the usefulness of the ICCSP framework. This framework makes possible the assessment and comparison of levels of integration within CCS policies. In particular, these cases prove that this framework can be applied to extremely different political contexts. This framework also allows us to not only evaluate whether or not a policy is integrated but also to examine a policy in detail along various dimensions.

The results exhibit striking differences in terms of the level of ICCSP. To explain these differences, rigorous cross-country comparison and process tracing should be undertaken by using the ICCSP framework as a dependent variable and setting hypothetical explanatory variables. Some suggestion for such explanatory variables can be noted. Needless to say, CCS is not a ‘‘no-regrets’’ technology; it is useful only for climate mitigation. CCS is also so costly that its development is possible only by drawing upon public funding. Therefore, it could reasonably be argued that CCS policy becomes topical in the policymaking process, and thereby more vertically integrated, only when there is a climate policy stringent enough to necessitate CCS in the climate mitigation portfolio. Indeed, Norway has a higher level of vertical integration than Japan and also has a more stringent climate policy than does Japan. Norway had one of the world’s first stabilization targets and introduced a carbon tax in 1991. These developments were very important to the entry of CCS into the political mainstream in Norway. In contrast, Japan has yet to put in place a stringent climate policy, and the mandatory national reduction target was only set when the Kyoto Protocol came into force in 2007.

If we view the framework as a diagnostic tool intended to provide policy recommendations for enhancing the level of integration of CCS policies, we see that it works as intended. Japan should focus more on vertical issues such as insurance, long-term liability, public acceptance, and climate policy, and on horizontal issues such as energy policy, to address fragmentation and evaluate trade-offs and synergies and to solve the contradiction between RD&D and the LDPD licensing system. Norway must take biodiversity issues more seriously and address other climate technologies, most notably new renewable energy technologies.

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