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Avoiding climate change uncertainties in Strategic Environmental Assessment

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ABSTRACT

This article is concerned with how Strategic Environmental Assessment (SEA) practice handles climate change uncertainties within the Danish planning system. First, a hypothetical model is set up for how uncertainty is handled and not handled in decision-making. The model incorporates the strategies 'reduction' and 'resilience', 'denying', 'ignoring' and 'postponing'. Second, 151 Danish SEAs are analysed with a focus on the extent to which climate change uncertainties are acknowledged and presented, and the empirical findings are discussed in relation to the model. The findings indicate that despite incentives to do so, climate change uncertainties were systematically avoided or downplayed in all but 5 of the 151 SEAs that were reviewed. Finally, two possible explanatory mechanisms are proposed to explain this: conflict avoidance and a need to quantify uncertainty.

1. Introduction

Uncertainty in Strategic Environmental Assessment (SEA) has been a recurrent theme within the literature for well over two decades. In the early stages of SEA, for example, Lee and Walsh (1992) noted that "ensuring that uncertainty is satisfactorily handled at each stage in the assessment process" is likely to be one of the most significant challenges faced when developing and implementing SEA (Lee and Walsh, 1992, p. 135). The body of literature within the field of uncertainty in impact assessment has grown substantially since then, with theoretical and empirical work that has attempted to develop a typology of risks and uncertainty (see, for example, Slovic et al., 1981; Lipshitz and Strauss, 1997; Walker et al., 2003; van der Sluijs et al., 2005; IPCC, 2007; Refsgaard et al., 2013).

The taxonomic approach to understanding uncertainty is useful, but insufficient in and of itself. Another key component of handing uncertainty is making sense of how people communicate and perceive uncertainty, since there are often large differences between the scientific, policy making, and non-scientific communities in their understanding of risk and uncertainty (Frewer, et al., 2003; Funtowicz and Ravetz, 1990; Hellström, 1996; Kuhn, 2000; Patt and Dessai, 2005; Walker, et al. 2003; Wardekker, et al. 2008). What has emerged from the literature is a consensus that communicating uncertainty is tricky, due to the trade-offs between scientific needs for precise enumeration/qualification of the underlying unknowns and policy-making needs of simplified analysis that does not demand detailed familiarity with the underlying science basis for policy decisions.

Since SEA is concerned with future states, dealing with uncertainty is an unavoidable part of assessment processes (Tennøy et al., 2006; Thissen and Agusdinata, 2008; Wilson, 2010) — though the degree and sources might be different from case to case. As stated by Zhu et al. (2011, p. 538) "*Since the future is inherently uncertain, all exercises about the future are facing, and should cope with great uncertainty. The same situation happens to SEA*". While uncertainty is involved in prediction, we very rarely, or never, succeed in having the information required or wanted. Zhu et al. (2011) have argued that there are both internal and external uncertainties involved in SEA. Internal in terms of changes brought on by the plan and changes in the natural environment being assessed and external in terms of uncertainty in social, economic, environmental, and policy development. All of these factors combine to yield a number of possible outcomes within the complex system under assessment (Zhu et al. 2011).

Apart from considering the question of uncertainty in impact predictions, handling uncertainties also involves presentation and communication, "*especially in the documents that most often reach decision-makers, the public and other actors*" (Tennøy et al., 2006, p. 55) — such as the environmental report required by the SEA Directive (European Parliament and Council of the European Union, 2001). Handling uncertainty requires communicating uncertainties in a way "*…which both match scientific practice and can be understood by lay people*" (Petersen, 2002, p. 87).

In the European Union Directive on SEA, the provisions for the content of environmental reports state that they should include "*an outline of the reasons for selecting the alternatives dealt with, and a description of how the*

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assessment was undertaken including any difficulties (such as technical deficiencies or lack of know-how) encountered in compiling the required information" (European Parliament and Council of the European Union, 2001, Annex 1, L 197/36). One of the difficulties encountered in an assessment can be uncertainty in different forms, including the uncertainty of the consequences of climate change in relation to the plan or programme. In the recently published EU Guidance on the integration of climate change into SEA, uncertainty is mentioned as one of the challenges that must be dealt with when working with climate change in SEA (European Commission, 2013). It is important to note that consideration of climate change issues should cover not only the impacts of the plan or programme on climate change such as calculations of greenhouse gas emissions, but also the climate change induced impacts on the plan and programme themselves, for example increased flooding events (Larsen and Kørnøv, 2009). SEA is particularly well suited for taking into account climate change objectives as it allows a broader strategic scope and also better consideration of cumulative effects associated with plans and programmes in a given sector or region.

The provisions of the directive have been translated directly into the Danish legislation on SEA (LBK nr 1398, 2007, Annex 1 (h)). In Denmark, they are supplemented with guidance stating that the potential impacts of a plan may be uncertain, for example due to the geographical extent of the plans and the range of activities that they may encompass. Also, it is stated that any assumptions made in the assessment should be made clear (VEJ nr 9664, 2006, pp. 45–6). From the above, it is clear that there is emphasis in the Danish guidance on uncertainty of the impacts resulting from the plan, rather than uncertainty of impacts on the plan, such as those of climate change.

Climate changes and the predictions of future climate are inherently uncertain (see for example Willows and Connell, 2003; Füssel, 2007; IPCC, 2007). According to Jenkins and Lowe (2003, p. 3), "*the climate of the future will be determined by two factors*: *the amount of man-made emissions of greenhouse gasses and other pollutants*, *and the response of the climate system to these emissions*" and both of these factors as well as impact assessments of climate changes are influenced by uncertainty (Jenkins and Lowe, 2003). For example, in the report *Impacts of Europe's Changing Climate* from the European Environment Agency, it is pointed out that there is uncertainty regarding how the climate system functions and how the driving forces of society will affect the climate system (Erhard, 2008). Specifically, future emission profiles are driven by factors such as population, economic growth, and technological development (Jenkins and Lowe, 2003). The IPCC (2005, p. 1) breaks down uncertainty into three categories:

- Unpredictability; related to unpredictable human behavior, and chaotic components of complex systems
- Structural uncertainty; related to inadequate modelling, conceptual frameworks, and system boundaries
- Value uncertainty; related to lack of data and parameters and inappropriate resolution

The uncertainty premise embedded in impact assessment is highly relevant and critical for climate change and the complex natural and social processes involved. In the European context, integration of climate change in SEA is also legally required (European Parliament and Council of the European Union, 2001). In spite of this, the 5-year monitoring review of the SEA Directive reveals that member states in general lack climate change integration and "*that much progress is still to be made to address biodiversity and climate change in SEAs*" (COWI, 2009, p. 42). In order to address this lack of integration, new guidance on climate change and impact assessment was published in 2013 (European Commission, 2013). In a Danish context, Larsen et al. (2012) find that climate change is increasingly considered in SEA, but that especially climate change adaptation is lacking attention. In an international context, however, other studies have found climate change adaptation better integrated in SEA (see for example Posas, 2011).

Based on the above considerations, this article is motivated by the perception that uncertainty is an important issue for SEA to deal with, and the authors currently see examples where uncertainty acts as a barrier for dealing with climate change. Prominently, in Denmark, climate change has been excluded as an issue in the process of preparing river basin management plans at state level based on an argument of uncertainty (Larsen, 2010). Furthermore, the Danish municipalities who are to prepare river basin management action plans state complexity, uncertainty, and long time horizons as being among the main barriers for dealing with climate change (Larsen, 2010). On this basis we find it worthwhile to explore the issue of climate change uncertainty in relation to planning through SEA as a planning and decision support tool.

The main purpose of this article is to investigate whether and how climate change uncertainties are acknowledged and presented explicitly in SEA practice in the case of Denmark. For this purpose, in Section 2 a theoretical model is developed for analysis. This model is used in Sections 3 and 4 where a document study of 151 SEA reports is presented. The final section offers two theoretical explanations for avoiding uncertainty, conflict avoidance and a perceived need to quantify uncertainty.

2. Strategies involved in uncertainty handling in decision-making

The question of how people respond to uncertainty has for decades been a focus within decision-making literature. Such literature (see e.g. Swin et al., 2009; Funtowicz and Ravetz, 1990; Dawes, 1988; Morgan and Henrion, 1990) can play an important role in our understanding of how SEA actors handle climate change uncertainty. When using the term SEA actors, we mean politicians, planners, and SEA practitioners who take part in the processes of development and implementation the SEA and thus determine how climate change uncertainty is handled. In this study, literature together with the authors' knowledge of the field is used to propose a model of strategies for how uncertainty is or is not handled in SEA. The model can be seen in Fig. 1 and is explained below.

Handling uncertainty in decision-making can happen according to different strategies. A basic premise for understanding how SEA actors handle uncertainty is to know if they are aware of the uncertainty in question and whether they accept its presence — thus whether uncertainty is acknowledged or not. If uncertainty is not acknowledged, explicit or implicit denial is a likely strategy.

The first strategy discussed is thus *denying uncertainty*. In this strategy, uncertainty is explicitly rejected either through denying that there is uncertainty or denying the relevance of the uncertain issue in question — in this case climate change. Denial can, for example, be understood in relation to "*the existence of climate change and human contribution to climate change, and could include more specific denial of the role that one's behavior or one's group's behaviors has in harming others*" (Swin et al., 2009, p. 126). According to Washington and Cook (2011, p. 1) denial is "*a refusal to believe something no matter what the evidence*". Washington and Cook point out various types of denial in relation to climate change, for example having impossible expectations such as stating that "*scientists can't even predict the weather next week, so how can they predict the climate years from now*" (Washington and Cook, 2011, p. 47). Thus in this strategy climate change or climate change uncertainty would not be considered real or relevant and would not be part of the SEA.

If, on the other hand, uncertainty is acknowledged, it is first a question of whether this is done explicitly or implicitly and thus whether uncertainty is presented or not. Funtowicz and Ravetz (1990) distinguish between three ways of presenting uncertainty: presentation of a range of results, characterisation of the methodological acceptability of results, and acknowledgement of ignorance about the system studied. In the case of

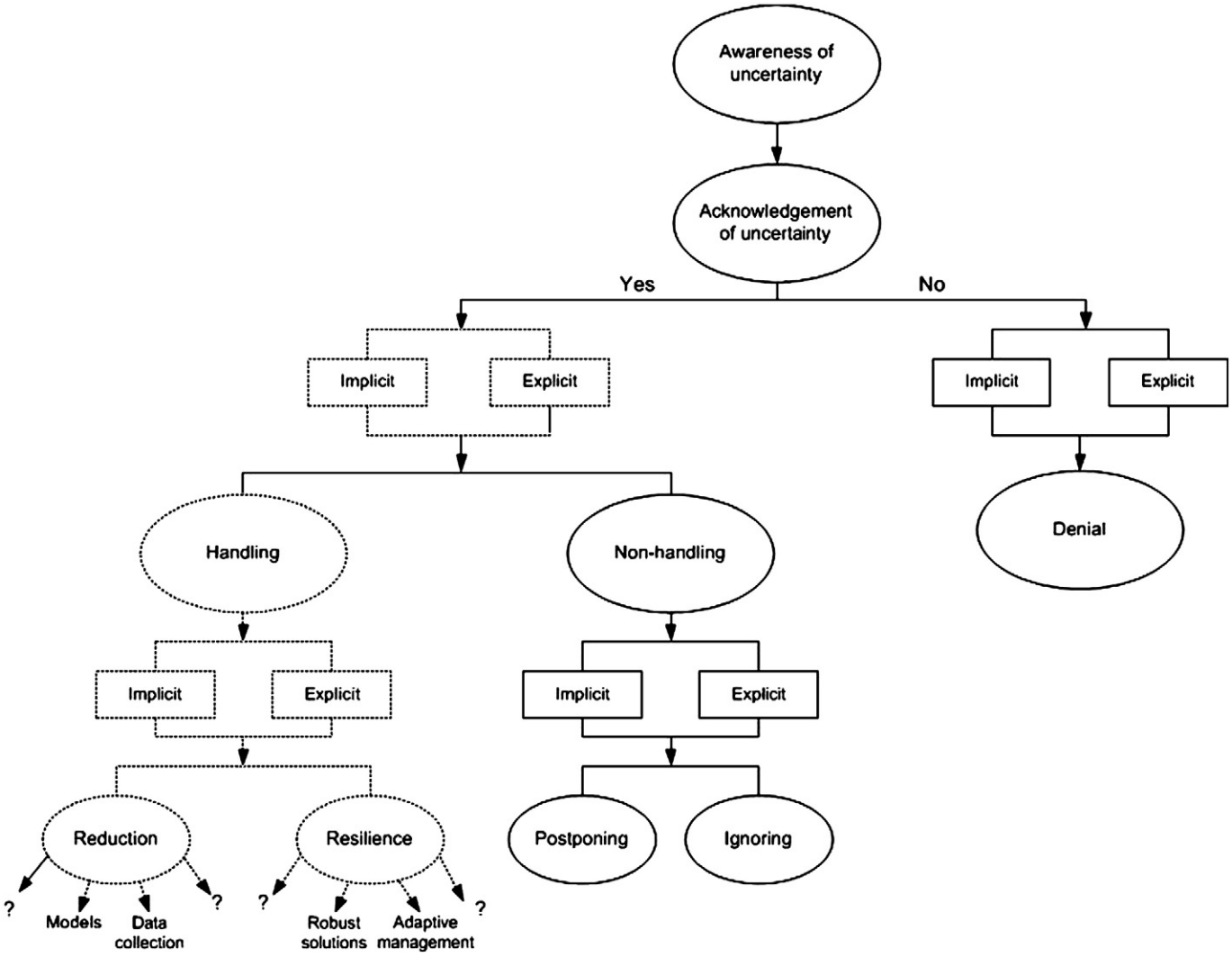

Fig. 1. A proposed model of strategies for handling climate change uncertainty in SEA.

communicating uncertainty in SEA, one can look for uncertainty presented through:

1. Presentation of a range, quantitative or qualitative, of expected CO_2 emissions or climate change impacts, such as rise in sea level or a rise in ground water level
2. Presentation of acceptability of methodology used in the SEA. For instance, the reliability of modelling sea level rise in an area
3. Acknowledgement of ignorance. It can be explicitly acknowledged that the assessment is made without integration of uncertainty, but that the latter may be relevant in the future

After acknowledging uncertainty whether it is explicitly presented or not, there are two principal paths to follow: Handling or non-handling.

A non-handling strategy is *ignoring uncertainty*, where planning and assessment is carried out without regard for uncertainty. As stated by Dawes "[*we*] *often dread uncertainty. A common way of dealing with uncertainty in life is to ignore it completely, or to invent some "higher rationale" to explain it, often a rationale that makes it more apparent than real.*" (Dawes, 1988, p. 256). As a strategy, ignoring uncertainty is historically the most common within policy analysis (Morgan and Henrion, 1990), and viewed by Quade as "*a chronic disease of planners*" (Quade, 1975).

Another non-handling strategy is *postponing uncertainty*. A strategy based on the argument that the uncertain issues will be dealt with when more and better knowledge and information is present and thus uncertainty has been reduced. An example of postponing *uncertainty* can be found in the preparation of river basin management plans in Denmark. In the process of setting goals and measures in the plans and SEAs released in 2011, the Danish state decided not to include effects of climate change on the water environment. This is based on an argument that "*for setting environmental goals, changes in run-off and leaching it is evaluated that there is not sufficient scientific basis for including this in the first river basin management plans. This is expected to be assessed in the next generation of plans*" [translated by authors] (Danish Ministry of Environment, 2011, 7). Thus the Danish State chose not to include climate change because of uncertainty, but rather postpone consideration of climate change until the next generation of plans and SEAs that are due in 2015, in the expectation that new knowledge will have reduced those uncertainties (Larsen, 2010).

In summary, three strategies have been identified to describe the non-handling of uncertainty in SEA: 1) denying uncertainty; 2) ignoring uncertainty; and 3) postponing consideration of uncertainty until more information is available.

Fig. 1 also adds a preliminary hypothesis about handling uncertainty. On the basis of work by Dessai and van der Sluijs (2007) we propose that when handling uncertainty, decision-makers can take a reduction or a resilience approach. Dessai and van der Sluijs (2007, p. 24) define a reduction approach as one that "*argues that if*

there is uncertainty about climate change then uncertainty needs to be characterised, reduced, managed and communicated". This approach might give cause to action in the form of, for example, modelling and data collection. The proponents for the resilience approach on the other hand argue for a need to "*accept that some uncertainties associated with climate change are irreducible, therefore they emphasise learning from past events*" (Dessai and van der Sluijs, 2007, p. 24). With this approach it could be relevant to consider strategies of seeking robust solutions or using adaptive management (Dessai and van der Sluijs, 2007).

The model developed is, like any model, a simplification of reality and thus by definition flawed. It does however serve the purpose of starting to view the handling of uncertainty in SEA more systematically. The model so far is mostly based on literature and would serve as a starting point for revisions and refinements based on more empirical studies and discussions.

3. Methodology

151 Danish SEA reports were gathered and analysed in terms of how climate change has been integrated into the assessments and how uncertainty has been identified and presented, and how the results relate to the model presented in Section 2. The reports were selected on the basis of the following parameters:

- Type of plan: covering sectorial, local and comprehensive plans
- Region of origin: covering all the regions in Denmark
- Year of publication: From 2004 to the end of 2009

The plan typology is displayed in Table 1 below.

The reports were selected to obtain a range of different characteristics. For the sake of completeness, however, all published SEA reports on both the comprehensive spatial plans and the sector plans are included in the study. Regarding the time of publication, Table 1 shows that a majority of reports are from 2008 to 2009. This is because very few reports were published in the first years after SEA became mandatory in Denmark in 2004. The decision to include all municipal spatial plans and sector plans is also relevant in this context, because the majority of these were published in 2009. SEAs for the newest generation of spatial plans will not be available until the end of 2013, due to the 4-year cycle of Danish municipal planning. While the authors recognise that since the most recent reports are from 2009, it is possible that practice may have shifted, we nonetheless assert that the results are still relevant. Specifically for the SEAs of municipal spatial plans, 2009 was the last time the Danish municipalities prepared these plans and as stated they are included in the analysis, so in these cases, the analysis is state of the art.

The SEA reports were analysed in terms of:

1. If climate change has been considered
2. Whether climate change uncertainty has been acknowledged and how it is presented
3. Which strategies have been employed

Table 1
Characteristics of the SEA reports included in the document study.

Type of plan	Regional development plan	Municipal spatial plan	Local spatial plan	Sector plan
	2	75 (all)	50	24 (all)

Region	Capital area	Zealand	South Denmark	Central Denmark	North Denmark
	36	30	25	35	25

Year of publication	2004	2005	2006	2007	2008	2009
	3	14	15	14	20	85

In practice the analysis was carried out by separately searching the documents for the keywords 'climate', 'climate change' and 'CO_2', and carefully analysing the text where these keywords were used. The results of the analysis are presented in Section 4. It is important to note that climate change uncertainty can be handled explicitly (e.g. documented in the SEA report) or implicitly (e.g. discussed by the person or group making the impact assessment, but undocumented in the report). This relates to the level of transparency in decision-making. In the current study, the authors analysed only the written documents, and are therefore not able to discuss the possible implicit handling of uncertainty, which might have taken place during the assessment process itself, as indicated in the model in Fig. 1.

4. Results

The results of the document study can be seen in Fig. 2. The figure shows that 87 SEAs, or almost 60% of the reports, include considerations of climate change. Results show that the main concern is climate change mitigation, since 78 of the reports include considerations of mitigation while 22 reports include adaptation.

Fig. 2 also demonstrates that very few environmental reports mention climate change uncertainty. Only five of the 151 analysed reports have an explicit consideration of this. The considerations are presented in detail below:

4.1. Case 1. Aalborg Municipality: Waste handling plan 2007

In the environmental report the difference in CO_2 emissions between two waste collection alternatives is calculated. The calculations are based on explicit assumptions about transport need and it is stated that "*if this assumption proves correct, an implementation of the described collection method will induce an environmental benefit in the form of energy consumption and emission of CO_2 and particles*" [translated by authors] (Aalborg Municipality, 2007, p. 65).

4.2. Case 2. Aalborg Municipality: Water supply plan 2009

In the environmental report uncertainty and lack of knowledge are addressed explicitly. Several issues are mentioned, one of them being climate change. It is stated that "*the actual climate changes and the consequences for Aalborg Municipality are difficult to predict. The environmental baseline for climate change is thus subject to uncertainty and only indicates impacts*" [translated by authors] (Aalborg Municipality, 2009, Appendix 11 p. 23). Uncertainty and reluctance connected to climate models are mentioned.

4.3. Case 3. Hjørring Municipality: Municipal spatial plan 2009

In this environmental report climate change is also mentioned in relation to the environmental baseline with roughly the same wording: "*since the actual climate changes and the consequences of these for Hjørring Municipality are difficult to predict, among these the level of sea rise, the environmental baseline for climate change is thus subject to uncertainty and only indicates impacts*" [translated by authors] (Hjørring Municipality, 2009, p. 42).

4.4. Case 4. Struer Municipality: Municipal spatial plan 2009

Like the two previous reports this environmental report addresses uncertainty of climate change consequences. It is stated that "*the actual climate changes and the consequences of these for Struer Municipality are difficult to predict*" [translated by authors] and that the quantitative uncertainty means that the environmental baseline is uncertain (Struer Municipality, 2009, pp. 29–30).

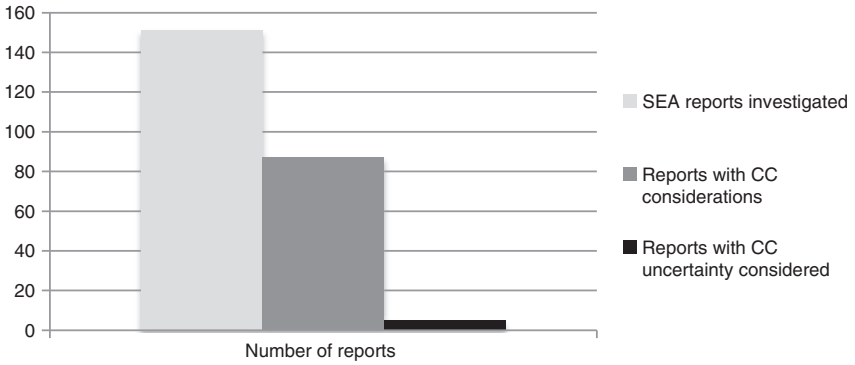

Fig. 2. Number of SEA reports that include climate change and uncertainty.

4.5. Case 5. Vesthimmerland Municipality: Municipal spatial plan 2009

In this environmental report, the same wording as in the report from Hjørring Municipality is used: "*since the actual climate changes and the consequences of these for Vesthimmerland Municipality are difficult to predict, among these the level of sea rise, the environmental baseline for climate change is thus subject to uncertainty and only indicates impacts*" [translated by authors] (Vesthimmerland Municipality, 2009, p. 30). Also, impacts on climate change in the form of CO_2 emissions are mentioned, because it was added that since these are dependent on the specific implementation, they are difficult to determine at an overall level of planning.

Interestingly, cases 2–5 are prepared by or with assistance from COWI, an engineering and planning consultancy. This may account for the similar wording. The reports contain comments on uncertainty connected to both the predictions of future climate change and to the assessment of impacts on climate change.

When viewing the results in relation to the model in Fig. 1, it is clear first of all that climate change uncertainty is only explicitly acknowledged in 5 out of the 87 reports dealing with climate change. Compared with the different ways of presenting uncertainty shown in Section 2, the representations of uncertainty found in the environmental reports are assessed as being mainly acknowledgements of ignorance i.e. statements like 'there are uncertainties and things unknown about the future consequences of climate change', without going into further detail. The exception is that in case 2, Aalborg Municipality mentions climate change models and thus touches upon the acceptability of methodologies.

None of the 5 reports that explicitly acknowledge uncertainty go beyond presenting it. Although they do not explicitly say why, none of them have tried to deal with the uncertainty. Thus following the model in Fig. 1, they choose a strategy of implicit non-handling, they could be ignoring or postponing uncertainty, but this is not clear when the strategy remains undocumented or implicit.

For the rest of the reports, climate change uncertainty is not mentioned, which could indicate a strategy of denial. However, climate change uncertainty may be acknowledged, but not documented and is thus implicit. If this is the case a strategy of implicit non-handling has been chosen, either postponing or ignoring uncertainty.

In summary, very few of the Danish environmental reports explicitly address climate change uncertainty even though quite a number of them deal with climate change. Only 5 reports explicitly acknowledge uncertainty, and in these cases mainly as acknowledgement of ignorance towards the meaning of uncertainty. The empirical findings generally indicate a non-handling strategy, either consciously or subconsciously followed when climate change uncertainties are avoided.

4.6. Implications of found avoidance practice

The problems with not explicitly handling climate change uncertainties can be manifold. First, carrying on as if uncertainty does not exist may make assessments appear more certain than they are to decision makers and the public.

Tennøy et al. (2006, 52) conclude from their study on environmental impact assessment (EIA) that "*EIA predictions are uncertain, but that decision-makers are not made aware of the prediction uncertainty. EIA predictions thus appear more certain than they are.*" In a study of 22 Norwegian cases of EIA, uncertainty was not mentioned in 43% of the documents, in 23% uncertainty was suggested but not explained as uncertainty, 13% indicated uncertainty without any further discussion and in only 21% uncertainty was explained or discussed at various levels. Similar findings are documented by, among others, Geneletti et al. (2003), Andrews (1988) and Dipper et al. (1998). This may be viewed as a democratic problem in terms of lack of transparency, but it can furthermore prove problematic that decisions and investments based on an outcome deemed certain may prove inexpedient and difficult to change, if events unfold differently than expected.

Fig. 3 illustrates, in a simplified manner, the connections between a SEA, a plan, and uncertainty. Here, a SEA provides knowledge about environmental impacts and problems that are to be part of the process where ideally plans and decisions are made based on the knowledge provided (see for example Therivel, 2004; Kørnøv and Christensen, 2007). There may be uncertainty associated with the predictions of environmental impacts and problems that are of importance to this process.

An example of this is from the Danish experience of developing river basin management plans. Here, it has been argued that the missing consideration of the uncertainty of climate change consequences may lead to environmental permits for farming, which must later be withdrawn or changed once climate change is integrated in the plans (Rothenborg, 2010). As for the strategy of postponing uncertainty, it is worth noting that uncertainty is not always reducible through knowledge building. As stated by Walker et al. (2003, p. 8) "*uncertainty is not simply the absence of knowledge*" and "*new information can either decrease or increase uncertainty*" since "*new knowledge on complex processes may reveal the presence of uncertainties that were previously unknown or were understated*". Thus postponing uncertainty may prove an inexpedient solution.

Whether it is a conscious choice or not, some form of strategy for avoiding climate change uncertainty is followed, the question then remains: *why* is uncertainty not identified and dealt with? This is discussed briefly in the following final section below. It should be noted that this is not based directly on the results in the previous section — the results rather provide an argument for a more general

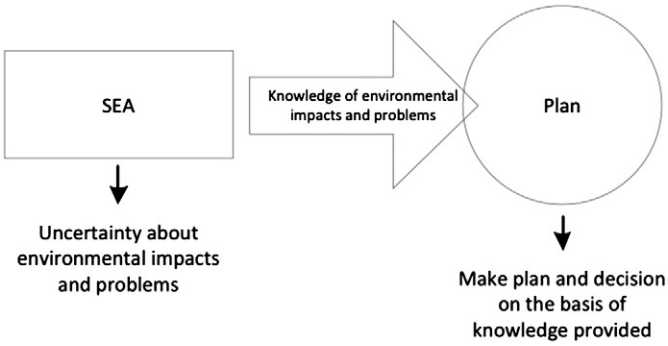

Fig. 3. The simplified relations between SEA, plan and uncertainty.

exploration of why climate change uncertainty is not explicitly acknowledged and handled.

5. Discussion and conclusion

Among the concerns dealt with in SEA, the potential effect of climate change is a relatively new one that is given increasing attention. The European Commission's evaluation from 2009 shows that in SEA "*specific attention to climate change issues appears still to be limited in many Member States*" but that there seems to be increasing attention paid to the issue (COWI, 2009, p. 116). It is further underlined by the EU Commission in April 2013 with its '*Guidance on Integrating Climate Change and Biodiversity into Strategic Environmental Assessment*' (European Commission, 2013). Wilson (2010) has examined UK sustainability appraisals and found that they do address climate change, but that development of the approach is still needed. Weiland (2010) states the German experiences that questions of climate change in SEA are not often raised. This points to climate change in SEA as an emerging issue for research and practice, but it also shows that there are challenges associated with it; among these is uncertainty.

Based on the document study reported in this article, we assert that in spite of the relevance of identifying and presenting climate change uncertainty in SEA or plans, SEA practice does not seem to recognise, take into account, and communicate problems arising from climate change uncertainty. The analysis reveals that only 5 out of 151 environmental reports have an explicit communication pertaining to climate change uncertainties, although 87 of the reports deal with climate change. Through this study it has not been possible to determine whether uncertainty is handled implicitly within the SEA process, but not communicated in writing. If this is the case, and the handling of uncertainty is more extensive in practice, it is still considered problematic to have a SEA practice with implicit handling and no transparency regarding uncertainty. This presents an opportunity to expand the empirical studies to encompass the implicit strategies for handling uncertainty, which are not apparent from a document study. When uncertainty is included in the reports, it is in the form of acknowledged ignorance related to the possible consequences of climate change. By not communicating uncertainties in the reports, there is a risk that both politicians and the public will interpret the impact assessments as more certain than they actually are.

5.1. Reasons for non-handling of climate change uncertainty

These findings warrant a more general discussion of reasons for choosing non-handling strategies. One is a need or desire to avoid conflict, especially in already contested situations where explicit acknowledgement of uncertainty may spark further conflict and lack of trust in authority. Planners and decision-makers need to attain accountability and support for their decisions. When seen in this light, uncertainty is threatening to planners and decision-makers, and it makes them vulnerable to criticism and attack (Jaeger et al., 2001, p. 214). To avoid opening up conflicts and opposition to their decisions, planners and decision-makers could thus ignore uncertainty Dessai and van der Sluijs (2007, p. 11) point out the inexpedience of this argument of ignoring uncertainty when they state that not addressing uncertainties leaves "*…policies highly vulnerable to deconstruction in societal discourses and controversies on these policies*". Further, they stress that such vulnerability can be used in conflicts by those opposing a decision (Dessai and van der Sluijs, 2007). Part of this reasoning might be that planners and decision-makers choose to ignore uncertainty in order to more or less deliberately create a (false) sense of security and instil trust (Lipshitz and Strauss, 1997).

Another reason for uncertainty avoidance can be the perceived need for quantification of the assessment or of uncertainty. This can be part of the choice of not addressing uncertainty and uncertain issues, when quantification is not possible. Our propensity to quantify is described by Ben-Haim (2006, p. 9) and succinctly captured in the statement that "*We are an age of number-givers, and the first advice to a novice in the modern world would be: if it stands still, measure it; if it moves, clock its speed*". Dessai and van der Sluijs (2007, p. 11) propose that "[*the*] *focus on statistical and quantitative methods of uncertainty assessment leads to a tendency to ignore policy relevant uncertainty information about the deeper dimensions of uncertainty that in principle cannot be quantified*". As such, planners and decision-makers may avoid uncertainty because it does not always meet the demand for quantification. In a survey of perceptions of climate change among actors in the Baltic Sea Region one conclusion is that "*it is a popular fallacy that policy making should mainly be based on quantitative findings from science, a fallacy that hinders adequate action*" (Eisenack et al., 2007, p. 9). Thus at times, the lack of ability to quantify stands in the way of dealing appropriately with issues.

From a research perspective, the results of this study suggest that significant gaps remain in knowledge as to why uncertainty is inadequately addressed and communicated in Strategic Environmental Assessments. While it is difficult to generalise across the range of different political, institutional, and cultural contexts on the basis of the Danish experience, previous empirical work in other European contexts (see, for example, work from the UK (Posas, 2011), and The Netherlands (Wardekker et al., 2008) have come to similar conclusions.

From the perspective of practice, this study exposes a significant gap between SEA guidance and actual practice regarding the acknowledgement and handling of uncertainty of climatic considerations in Danish spatial and sector plans. As the European Union prepares to amend existing legislation for EIA and has issued new guidance for EIA and SEA to include climate change mitigation and adaptation considerations, as well as uncertainty, how to handle and communicate uncertainty should be prioritized with a particularly keen eye on the different needs of the scientific, policy, and non-scientific communities.

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