# Green public procurement – a case study of an innovative building project in Norway

Abstract: In green public procurement (GPP), policy driven environmental requirements are introduced in the formal procurement process with the aim to reduce the environmental impact through the life cycle of the procured goods and services. In practice, formal governance and policy requirements often appear disconnected, thereby limiting the progress of GPP efforts. This case study shows that the integration of policy requirements directly into the formal governance of the project, allowed for the successful implementation of GPP in the procurement of the Visund net-zero energy building project. The context of GPP was strengthened through definable targets and functional requirements for energy use. Increased interactivity between actors in the formal procurement process gave room for innovative solutions with high environmental standards. In the construction phase elements of trust and benefits was incorporated in the supplier contracts. This combination of specificity in requirements and actor-cooperation resulted in an innovative – green – building solution and an efficient construction process. Based on the case findings, the authors propose a conceptual model to strengthen the context and process of GPP.

Keywords: Green public procurement, formal governance, policy requirements and construction sector

## 1. Introduction

The public sector is an important actor in reducing environmental impacts from products and services and creating environmental value for society. Public procurement (PP) makes up approximately 17% of the gross domestic product (GDP) in the OECD countries, giving the public sector significant potential to drive the creation of a greener economy Testa et al. (2016a).

PP is the procurement of goods, services or constructions for the benefit of society, on behalf of a public authority. The procurement process is formally governed, regulating the cooperation between the buyer and the supplier. The legislative side of PP is strong to prevent fraud, waste, corruption and local protectionism. In addition, it sets basic

standards for environmental requirements and normative references for the procurement process for governmental departments and agencies (Cees et al., 2006).

In green public procurement (GPP), policy driven efforts are included in the procurement process as contractual requirements, often based on legislation. This results in regulatory-compliance-oriented solutions, and GPP requirements tailored to comply with present procurement law. In practice, this limits the effect of GPP as a policy instrument, and often results in reactive and short-term tactical solutions and the use of non-innovative technology (Bratt et al., 2013).

In addition, the lack of financial obligations in the policy process makes the actual outcome of GPP vulnerable to budget constraints at government departments and agencies, thus reducing the chance of achieving practical environmental benefits. Without strong support from the financing actor and strong cooperation with the contractor, environmental requirements are likely to be seen as a cumbersome burden, rather than as a possibility to achieve competitive advantages and a source for innovation (Testa et al., 2016a).

Edquist and Zabala-Iturriagagoitia (2012) point to two important aspects that separate traditional and innovative PP in context and process. Contextually, traditional PP provides detailed technical characteristics for the produced goods, while innovative PP only specifies the functional requirements, thus allowing the market to select the best solutions. Processually, there is a move from more competitive procurement (traditional market-based PP) into a more cooperative process focusing on a common goal for all actors (innovative PP).

In this paper, we use results from of a case study carried out in Norway to discuss measures for a more integrated policy process in GPP. The case focuses on the procurement of an environmentally friendly office building, known as the *Visund net-zero*

*energy building project*. We propose that both contextual and processual aspects are important in the outcome in this case, and thus relate to the concept of innovative PP. Contextual aspects are activities that impose requirements on the procurement process for governing purposes. Processual aspects describe activities that influence how the different actors interact with each other through the PP process.

We especially investigate the incorporation of environmental policy factors, and study how actors cooperated on all levels while approving, designing and constructing the building.

The paper is organized as follows. First, we discuss the existing GPP literature, focusing on the context of implementing GPP requirements and process of GPP implementation. Next, we analyze how the handling of context and process has affected the procurement process of the Visund case. Considering the findings from an institutional perspective enables us to describe how increased coordination between formal governance and policy requirements can make GPP more effective. Finally, we draw conclusions, discuss benefits and limitations and suggest a direction for future research.

## 2. Theoretical background

In this section, we present a brief overview of important contributions from the GPP literature.

GPP defines a process where public authorities procure goods and services with lower environmental footprint than alternatives with comparable function and performance. Use of environmental criteria has been an element of public purchasing for several decades and many countries have implemented GPP policies and programmes. GPP has been on the European Union's agenda since the renewal of the EU public procurement directive in 2004 (Palmujoki et al., 2010), and continues to gain increasing focus within EU countries. Outside the EU, major economies of the world including China

have developed legislative interventions and implemented operational tools for GPP (Testa et al., 2016a; Zhu et al., 2013).

Even though the policy framework exists, the degree of implementation and impact are highly variable (Bratt et al., 2013; Michelsen and de Boer, 2009; Testa et al., 2016a). In the construction sector, for example, environmental considerations are increasingly taken into account during procurement, but seldom impact the outcome of the process (Varnäs et al., 2009).

While substantial effort has been directed towards setting criteria and developing tools to facilitate the implementation of GPP, less focus has been given to the contextual side of incorporating GPP in the procurement process. Brammer and Walker (2011) point to leadership and cost effectiveness as important factors for successful implementation of GPP in governmental organisations. Similar observations are made by Bratt (2013), pointing to the discrepancy between GPP statements and the reality of supply chain management and procurement practices. Testa (2016b; 2012) discusses the importance of awareness and competence among public procurers. He emphasizes the need to interact directly in the procurement process to define requirements, qualify suppliers, and identify cost-effective solutions. The general use of policy instruments, such as environmental management systems, have raised awareness of GPP. More targeted efforts on the benefits or reliefs from using these systems, for example, are warranted for increased effect and realization of GPP benefits.

Other literature indicates that GPP has been valuable for enhancing environmental performance, but that suppliers increasingly adapt to criteria, thus reducing the effect of further improvement (Amann et al., 2014). If nearly all suppliers establish the same environmental business strategies, the effect of imposing environmental criteria to distinguish between their performance will be reduced (Igarashi et al., 2015). Clearer,

more detailed and proactive environmental purchasing criteria in calls for tenders and in contract clauses would therefore be necessary for successful differentiation (Palmujoki et al., 2010). Lundberg (2016) even finds that the isolated use of GPP as a policy instrument in public procurement may be counterproductive. This occurs if the private market or other public actors do not perceive any benefit from the signals of those implementing GPP.

Taken together, these findings point to the context of using environmental criteria as an important factor in the successful implementation of GPP. Criteria need to be clear, relevant and beneficial for the procurement, and a strategic platform is necessary for successful implementation. In addition, it is necessary to have a directly link from GPP as a policy instrument into the formal governance structure that shapes the public procurement process.

Several papers point to actor cooperation as important for successful GPP implementation. Coggburn (2004) shows in addition that a strong connection between policy making, regulation and authorization, combined with quick feedback from pilot projects, can create the necessary shared sense of benefit, and provide appropriate input to the formal procurement process for successful implementation of GPP.

Porter and Kramer (2011) point to shared value creation as a more effective way to conduct GPP in the future. Within this concept, companies attempt to enhance their competiveness and profit simultaneously by advancing the economic and societal conditions in the area in which they operate. Applied to the public sector, this could create environmental value beyond what can be accomplished with traditional GPP (Oruezabala and Rico, 2012).

Innovation is often an ambition-enhancing process, where flexibility in contractual requirements is necessary to achieve the best technical solution, thus implementing

GPP ambitions in practice (Hojem et al., 2014). Matinheikki et al. (2016) further describe the role of project organization for successful and value creating projects. Strong project organization and a well-organized interorganizational network can be effective in implementing GPP, even though policy support may be weak.

This literature review confirms the importance of allowing GPP policy to penetrate the formal procurement process. By giving "room" and incentives for actors to cooperate, for example through innovative contract forms, GPP can become an integrated part of procurement and an asset to create additional value.

## 3. **Materials and methods**

### *3.1 The Norwegian public procurement model.*

In Norway, governmental departments manage the public sector through political policy orders that direct activity allocated in the yearly budget. State agencies incorporate these policy order into societal development in infrastructure, buildings or other required services. Suppliers, mostly private companies, governed by commercial contracts, influence the actual delivery. On the one hand, PP is subject to *formal requirements;* see the left side of Figure 1. Formal requirements manage the cooperation between agencies and suppliers by commercial contracts. Environmental criteria are often included in the procurement process as contractual requirements based on legislative regulations.

[Insert Figure 1 here]

In order to balance the formal structure, there are also *policy requirements*, see the right side of Figure 1. White Papers, reports from the Norwegian government, describe the political ambitions in a specific field or future policy in a less formal way than the

resolutions and bills do. The government then translates the White Papers into guidelines for state agencies, providing them long-term governance visions. Agencies have often subjected themselves to strategies in which they state policies, objectives and goals for their environmental performance.

### *3.2 Study object*

The study describes the procurement of an office building, "Visund," for the Norwegian Defence Logistics Organization (DLO). The building is located in Bergen within the Haakonsvern Naval Base. Procurement was initiated in 2009, and the building was finally erected in 2015. The project process involved the following main actors; (i) the Norwegian Ministry of Defence (NMoD), who owns the building since its completion and allocates financing on behalf of the Government, (ii) the Norwegian Defence Estates Agency (NDEA), who managed the construction process and operates the building on behalf of the user, and (iii) the contractor, responsible for the building construction work. A time-line explaining the different steps of the involved actors is given in Table 1.

[Insert Table 1 here]

Several environmental issues were monitored in the building process, but the study is delineated to describe issues related to energy use. This is due to their central position in the project's formal requirements, and their focus in both national and international policy documents. On the Norwegian level, energy use stipulations are a compulsory requirement in the national legislative building code (MoLGM, 2016). These requirements were mirrored in the Visund contract requirements. The building code has been updated on several occasions, leading to consistently more stringent energy criteria. The present version of the code (2016) requires houses to be low-energy consumers

(Sartori and Hestnes, 2007), and NDEA has required low-energy housing requirements be evaluated for new houses since 2013.

Policy documents at the European level propose the reduction in energy use in buildings to a "near zero level" by 2020 (Hernandez and Kenny, 2010). Although there is no consistent definition of near zero emission buildings, the common understanding is that future buildings should consume near zero levels of energy during operation, or even compensate for emissions from construction, production and demolition (Marszal et al., 2011; Sartori et al., 2012). Reduction of energy use is therefore an essential policy requirement stated in both the guidelines and in the internal environmental management systems of most agencies and suppliers connected to the building industry (Li et al., 2013). The wider impact of net-zero energy concepts would therefore result in substantially reduced greenhouse gas emissions if the main energy source is based on fossil fuels (Wang et al., 2016). In comparison with a standard building, the Visund project building is predicted to have 88% lower $CO_2$ emissions from energy during its lifetime.

### *3.3 Data collection*

This research is based on the case study method asserted by Yin (2013). This entails the use of qualitative statements from interviews, and qualitative and quantitative data from textual analysis. Data was representative for both the planning and construction phases of the project. In the planning phase, principal design concepts were developed by the agency and different alternatives were evaluated according to feasibility, cost-benefit and user-specific technical requirements. The construction phase entailed detailed design and construction of the physical building.

Thirty-six project documents were selected and reviewed, in addition to nine in-depth interviews of selected people representing main actors in the process. The docu-

ments consisted of procedural and contractual documents, strategy documents and publically available reports. NDEA performed the primary selection of documents and candidates for interview based on discussions with the research team. Additional documents and interview candidates where selected through snow ball sampling (Atkinson and Flint, 2001) on the basis of references in the documents and responses from previous interviews. An overview of the project documents, interview guide and people interviewed is given in the appendix, Table 4 - Table 6.

The following actor categories were interviewed; i) environmental and energy advisors, ii) quality managers, iii) technical advisors, and iv) the area leader on the builder side, and v) project managers from the builder side in planning and construction phase and from the contractor side in the construction phase. The interviews were conducted in a semi-structured form, using the predefined guidelines with possibilities for follow-up questions.

### *3.4 Analysis of data*

In the results section, we present the data as a qualitative textual evaluation, making use of quantitative data and specific citations from the interviews to complement and emphasise the textual results. The analysis was conducted with the aim to explore how this project differs from a normal building project in the military sector. This means that we especially considered the contextual and processual aspects that had been important for the successful implementation of GPP. For each of the aspects we identified the specific improvements made to influence the successful implementation of GPP in the Visund case. In addition, we specifically addressed the observed benefits and possible limitations for use in subsequent projects. Based on the case findings, we discuss how the identified measures can be useful for implementing GPP in other related projects.

## 5. Results

### *5.1 The procurement process*

The roles of actors involved in the procurement of a new building or facility are outlined in Table 2. Generally, the government department, NMoD, formally initiates a project and approves a building design for realisation. This role associates financial responsibility and ownership of the building with NMoD. In this case, notably, NMoD had a more flexible role than normal, and actively set the energy targets for the project and approved novel designs outside the established energy criteria, see Table 2.

The state agency, NDEA, is responsible for conducting procurement. This involves the production of decision support documents, preparation of the tender and selection of the supplier. Normally, turnkey contracts are used where the contractor is responsible for both detailed engineering and construction of the building. NDEA additionally acts as the formal builder in the construction phase. When the building is finalized, the builder approves the solution, thus accepting the building performance and taking responsibility for its operation. Then follows a guarantee period in which the builder can complain about perceived errors.

This is usually a formal process described in the agency's quality management system. In the Visund case, however, NDEA acted more freely, still following formal procedures, but seeking contact with research institutions and proposing new contract models for use. NDEA was also far more involved in the construction design than normal, as detailed functional requirements with suggested solutions were prepared as part of the tender documents. Normally, there are limited possibilities for changes or alterations in concepts after the contract is awarded. In this case, there was room for design improvements in the design phase, as, for example, novel solutions like energy recharging elevators were introduced on the contractor's initiative.

To summarize, the procurement process was to some extent untraditional, since all actors "did more" than formally required in the procurement procedure.

In the following sections, we investigate this phenomenon further and synthesize the findings into specific contextual and processual improvements observed from the case.

### *5.2 Contextual improvements*

There were several contextual factors that set the Visund project apart from traditional PP processes. For the basis of its design, NMoD clearly expressed that *low energy demand* was a strategic policy requirement. This gave fundamental directions for the project, as seen in Table 3, and signalled to NDEA that they should aim for solutions with energy consumption as low as practically achievable. First, they decided to evaluate a solution for low energy use in the building. This low energy solution was approved for construction in the concept document, even though the investment cost for the project was approximately 5% higher than for a standardised solution. This was because it demonstrated the lowest combined investment and operational life cycle cost (LCC) of the alternatives. Within this period, the project was termed a research pilot building project, which further elevated the ambitions for energy use to the near zero level. This desire required an additional 7.5% investment cost compared to the passive house concept and had a marginally higher LCC cost, according to the revised concept document.

Nevertheless, NMoD approved the project for detailed design and construction with the argument that its realization would create a benefit for the sector and a platform of experience for subsequent projects. The ambition then grew again to create a "lighthouse" project with the objective of beaconing other projects and preparing the sector for more stringent regulations on energy demand in the future.

[Insert Table 3 here]

In the Visund project, the net-zero building had a higher investment cost since it was a pioneering concept, and was expected to push the market forward – possibly making life cycle cost comparable in the future. Stringent environmental criteria were included in the design of the building even though the LCC calculations did not clearly demonstrate the economic benefit of exceeding current regulatory requirements. One observed problem here, therefore, is that the performed LCC calculations were too rudimentary. A more holistic calculation that included both economic and environmental aspects would have been able to provide quantified support of the benefit of implementing low energy design. Our interviews supported this observation, and some argued that the LCC methodology inadequately incorporated all benefits from stricter environmental requirements:

*"Actually it (the net-zero energy design) was cheaper. Because we could not calculate the benefit of seawater power, because it was distributed on several buildings. Certain calculation rules were given."* [Advisor, Visund project]

The actual design of the Visund net-zero energy building in the construction phase was a concept that involved actors from NDEA, contractors and research institutions. A series of workshops lowered the theoretical energy use of the building from 165 $kWh/m^2$ per used working area, down to only 16 $kWh/m^2$ in the final engineering document. Although all technology used in the building was commercially available at the time, complementary competencies between actors ultimately supported the creation of the *net-zero design*. Use of clear targets for energy use and basic concepts developed in the planning phase were crucial for the success in the design phase.

The creation of a pilot project design could influence future codes and standards in Norway, and is valuable input to the ongoing global development of policy instruments for energy efficient buildings. “Lighthouse” projects may be important for technological development, but novel design can also be technologically premature and complicated to operate. These concerns were mentioned during the interviews. If such challenges are not solved adequately, operational problems may be then be associated with the design, thus becoming a barrier for developing similar solutions in the future.

### *5.3 Processual improvements*

Specific aspects of the process also influenced the success of Visund as a GPP project. As described previously and shown in Table 2, actors from research and government energy agencies were strongly involved from the start. These actors had stakes in the ambitious project and could influence the outcome of the approval process. This improvement, which we call *adaptive project approval***,** was powerful in influencing the decision to develop more innovative design with the goal for reducing energy consumption beyond the requirements set in the building code.

Our interviews confirmed benefits from such cooperation between actors and the determination and commitment to achieve a successful outcome:

*”We were aiming for a lighthouse project. We were determined to succeed. To show that we were in the lead...There is always a benefit to include research communities because it makes the project more visible"* [Advisor, Visund project].

Actors could exchange different views, and the involvement of research institutions and other government actors directly in the decision process strengthened the link between formal governance and policy requirements.

The strong project organization and well-organized interorganisational network was important to create the momentum to implement GPP, even though the support for

interactive processes was weak in governing documents. All project organisations are different, however, and without well-founded policy support, poor actor interaction may be a barrier for environmental achievements in other projects.

The construction phase of the process includes the realisation and construction of the physical building. This project specifically required that the contractor follow detailed functional requirements on energy performance and actively improve solutions. There was also a clause in the contract to demonstrate the energy design performance for two years of operation before being awarded the full contract sum. We call this a "*hybrid" turnkey contract model* since it gives requirements that are more stringent than normal in turnkey contracts, and also requires the contractor to demonstrate building performance during operation. This contract form created a mutual understanding between NDEA and the contractor about the performance of the solution, and resulted in an efficient building process with less reconstruction due to building errors.

The value of specificity and close cooperation between the builder and contractor was highlighted in the interviews;

*"It is important to specify correctly because you get what you pay for. If you are not saying what you are aiming for, you will get a minimum solution*" [Project manager, construction phase].

*"We achieved a culture to do the best possible and to find the best solution both in energy and environment. Not only in the specific profession but for the building as a whole"* [Project manager, construction phase].

The possible problem with a more complicated contract structure and more work early in the project period, is the risk of higher cost. A turnkey contract is simple because it places all the work and responsibility on the contractor. This reduces the project cost for the building owner. A hybrid model as practiced in this case means more work

upfront and the risk of doing the design work twice. It is therefore necessary that more comprehensive work in the design phase results in improved building quality or lower operational cost.

## 6. Discussion

### *6.1 Is there a need for a new procurement model?*

We have argued that formal governance and policy requirements often appear disconnected in GPP, and that there are limited possibilities for cooperation between actors (Lundberg et al., 2016; Palmujoki et al., 2010; Testa et al., 2016a; Testa et al., 2012). To combat these limitations, we assert that contextual and processual improvements are important to elevate the chance of success in implementing GPP.

From the case we find no major conceptual differences in this procurement model compared to traditional PP. However, the alterations made within the existing framework and the flexibility shown from actors were effective in realising the ambitions of the project. This corresponds well with the literature, which argues that success in innovative PP is often a "policy mix" of different instruments (Edquist and Zabala-Iturriagagoitia, 2012; Flanagan et al., 2011).

In the following sections, we discuss the identified improvements, and explain and evaluate their importance through a conceptual model. Figure 2 summarizes the findings from the case and illustrates them in a conceptual model with the contextual (horizontal) and processual (vertical) dimensions.

[Insert Figure 2 here]

### *6.2 Contextual improvements*

To achieve enough incentive for success, it is necessary to use the core of the policy requirements to support the procurement process (horizontal arrows in the figure). In the Visund net-zero energy building project, there was clear expression of low

energy demand in the planning phase. This was substantiated in the construction phase as the need for net-zero design. The mandate to exceed the energy requirements of the existing building code (Klingenberg et al., 2016) gave a clear message to the project organisation. The conceptual model captures these improvements. First, it is necessary to incorporate defined targets from government into agencies, allowing the incorporation of tangible matters in the procurement decision. Some of these targets may be incorporated in the form of improved decision methodologies, as LCC, or supported by other quantitative analyses, like life cycle assessments (LCA) (Cabeza et al., 2014). Other issues like the near zero energy level ambition given in this case, should be clearly stated as targets.

Secondly, the agency requirements for suppliers need to be functional to encourage improved environmental performance, rather than being static and related to predefined solutions (Uyarra et al., 2014). In this case, there were no “zero-energy solutions” available on the market. On the contrary, the involvement of different competencies allowed the concept to evolve through a process. This gave room for the builder’s side to propose a solution, and for the contractor to make improvements. This flexibility stimulates the market toward environmental improvements through innovation, which creates benefit and value for all actors in the process (Porter and Kramer, 2011).

### *6.3 Processual improvements*

The other dimension in the conceptual model is the creation of increased interactivity between actors in the formal procurement process (vertical line in the model). This allowed flexibility in the budget founding process, and may allow agencies to procure innovative solutions with high environmental standards when beneficial, being more pragmatic and use standardised requirements in other projects.

In the construction phase, there is a need to incorporate elements of trust and benefits in the contract. This stimulates suppliers to be proactive in achieving environmental improvements, rather than to implement or adapt to contract criteria that has limited environmental benefit. Such corresponds well with the findings by Hojem (2014), where green projects need more "room" for social learning and improvement through innovation than what is possible in traditional turnkey contracts. Innovation is often an ambition-enhancing process, where flexibility in contractual requirements is necessary to achieve the best technical solution, thus implementing GPP ambitions in practice. The Visund case showed that the hybrid-turnkey contract contributed to both a well-functioning solution and a flawless construction period.

This case, supported by literature findings, highlights that strong cooperating project organizations and innovative contract models may be innovative aspects to facilitate this interactivity (Matinheikki et al., 2016). These findings may open for a change in contract philosophy for governmental agencies, which can provide more efficient building processes and cost efficient buildings as an impact.

### *6. 4 Benefits and limitations*

This model emphasizes the need to cement policy requirements direct into the formal procurement process. Motivation to approve innovative solutions closely connects to the belief that good examples, or “lighthouse” projects, may affect future regulation, public agencies and the market to adapt to new technology, thus lowering cost and increasing the availability in the future. This narrative is similar to what is found in other projects in the Netherlands and United Kingdom (Raven et al., 2016).

The processual benefits of more flexibility in the approval, design and construction

phases leads to increased opportunity of developing and executing improvements compared to the normal formal procurement process. In addition, excellent cooperation between actors is beneficial in avoiding errors and complaints. These leading actor attributes, trust and shared vision are similar to what Matinheikki et al. (2016) identify as "value-creating networks."

The case also identified limitations in the proposed model. The most important contextual limitation is the problem proving the economic benefits of innovative solutions. Novel design may in addition be difficult to operate, or only be possible at increased cost. This may limit the efforts to be innovative, and instead cause a lean on regulative environmental regulations that will result in traditional and approved solutions (Varnäs et al., 2009). The ability to show benefits through holistic LCC calculations, or similar methods, then becomes important (Islam et al., 2015).

The case's processual limitations are concentrated around cost and stringency in the time frame of the project. The project was developed over several years (2009-2013), thus allowing the concept to mature and develop. This luxury may be impossible for most projects. PP strives to reduce the approval procedures and the amount of work up-front in the project. Turnkey contracts are therefore popular since contractors perform most of the design work as a part of the construction phase. In addition, budget constraints often promote solutions with low investments costs, not always in accordance with high environmental standards. To avoid this problem it is important to focus on front-end management to create values, and simultaneously be effective in the planning process (Matinheikki et al., 2016).

## 7. Conclusions

This case study shows that the integration of policy requirements directly into the formal governance of the project, allowed for the successful implementation of GPP in the procurement of the Visund net-zero energy building project. It also demonstrates both contextual and processual improvements compared to the traditional GPP process. The intermediate results from cooperation between policy makers, regulators and authorizers was critical for success in the studied project and can facilitate learning and drive processes for future projects as well. In terms of the institutional perspective: there was a conscious effort to create a new standard for others in the field to mimic and follow, hopefully and ultimately raising the entire field to a new, higher level of GPP performance.

Even if the available decision methods struggled to include the benefits of environmental requirements, the project actors were successful in both identifying the benefits and approving innovative solutions. The case further demonstrates that it is possible to highlight positive impacts without needing to express less tangible matters in monetary units, such as greenhouse gas emissions and reputation, which can be a source of inconsistency and limitation (Gluch and Baumann, 2004).

In other projects where the incentives for cooperation between actors are not as obvious, implementing GPP based solely on value creation may be difficult. The procurement process must then include definable targets from the government and functional requirements from the agencies, enabling a green push from the developers to the market (Wong et al., 2016). A robust governance process, as presented in this paper, must therefore rely on both qualitative cooperation between actors, and emphasis on the implementation of quantitative targets and requirements directly into the formal governance process.

This study consists of one specific building procurement and is therefore difficult to generalize. Laws and regulations and the maturity of implementing GPP practices vary between countries. Environmental competence, project culture and forms of public governance are other factors expected to be highly variable among projects and countries. More in depth case studies of other construction projects are therefore important to be able to draw more robust conclusions.

Formal governance is rapidly changing with laws and regulations increasingly addressing environmental policy issues as legally binding requirements. This means that more and more requirements become compulsory, thus diminishing the need for voluntary initiatives. In addition, the supplier/procurer relationship is evolving due to the introduction of new sustainable business models (Witjes and Lozano, 2016). These initiatives will promote the cooperation between supplier and procurer on a broader basis, reducing the need to develop sector specific, or even project specific, models. It is therefore interesting to see how regulatory and non-regulatory changes in the procurement process will affect the gap between formal and policy oriented governance in GPP in the future.

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## Appendix

[Insert Table 4 - Table 6 here]

## References


Amann, M., K. Roehrich, J., Eßig, M., Harland, C., 2014. Driving sustainable supply chain management in the public sector. Supply Chain Management 19(3), 351.

Atkinson, R., Flint, J., 2001. Accessing hidden and hard-to-reach populations: Snowball research strategies. Social research update 33(1), 1-4.

Brammer, S., Walker, H., 2011. Sustainable procurement in the public sector: an international comparative study. International Journal of Operations & Production Management 31(4), 452-476.

Bratt, C., Hallstedt, S., Robèrt, K.H., Broman, G., Oldmark, J., 2013. Assessment of criteria development for public procurement from a strategic sustainability perspective. Journal of Cleaner Production 52, 309-316.

Cabeza, L.F., Rincón, L., Vilariño, V., Pérez, G., Castell, A., 2014. Life cycle assessment (LCA) and life cycle energy analysis (LCEA) of buildings and the building sector: A review. Renewable and Sustainable Energy Reviews 29(Supplement C), 394-416.

Cees, J.G., Paul, W.T.G., Marc, J.B., 2006. Public procurement and EU tendering directives – explaining non-compliance. International Journal of Public Sector Management 19(7), 702-714.

Edquist, C., Zabala-Iturriagagoitia, J.M., 2012. Public Procurement for Innovation as mission-oriented innovation policy. Research Policy 41(10), 1757-1769.

Flanagan, K., Uyarra, E., Laranja, M., 2011. Reconceptualising the 'policy mix' for innovation. Research Policy 40(5), 702-713.

Gluch, P., Baumann, H., 2004. The life cycle costing (LCC) approach: a conceptual discussion of its usefulness for environmental decision-making. Building and Environment 39(5), 571-580.

Hernandez, P., Kenny, P., 2010. From net energy to zero energy buildings: Defining life cycle zero energy buildings (LC-ZEB). Energy and Buildings 42(6), 815-821.

Hojem, T.S.M., Sørensen, K.H., Lagesen, V.A., 2014. Designing a 'green' building: expanding ambitions through social learning. Building Research & Information 42(5), 591-601.

Igarashi, M., de Boer, L., Michelsen, O., 2015. Investigating the anatomy of supplier selection in green public procurement. Journal of Cleaner Production 108, Part A, 442-450.

Islam, H., Jollands, M., Setunge, S., Bhuiyan, M.A., 2015. Optimization approach of balancing life cycle cost and environmental impacts on residential building design. Energy and Buildings 87, 282-292.

Klingenberg, K., Kernagis, M., Knezovich, M., 2016. Zero energy and carbon buildings based on climate-specific passive building standards for North America. Journal of Building Physics 39(6), 503-521.

Li, D.H.W., Yang, L., Lam, J.C., 2013. Zero energy buildings and sustainable development implications – A review. Energy 54, 1-10.

Lundberg, S., Marklund, P.-O., Strömbäck, E., 2016. Is Environmental Policy by Public Procurement Effective? Public Finance Review 44(4), 478-499.

Marszal, A.J., Heiselberg, P., Bourrelle, J.S., Musall, E., Voss, K., Sartori, I., Napolitano, A., 2011. Zero Energy Building – A review of definitions and calculation methodologies. Energy and Buildings 43(4), 971-979.

Matinheikki, J., Artto, K., Peltokorpi, A., Rajala, R., 2016. Managing inter-organizational networks for value creation in the front-end of projects. International Journal of Project Management 34(7), 1226-1241.

Michelsen, O., de Boer, L., 2009. Green procurement in Norway; a survey of practices at the municipal and county level. Journal of Environmental Management 91(1), 160-167.
MoLGM, 2016. Regulation of techncal requirements in buildings (Building regulations), in: Modernisation, M.o.L.G.a. (Ed.) FOR-2016-06-06-581. www.lovdata.no.
Oruezabala, G., Rico, J.-C., 2012. The impact of sustainable public procurement on supplier management — The case of French public hospitals. Industrial Marketing Management 41(4), 573-580.
Palmujoki, A., Parikka-Alhola, K., Ekroos, A., 2010. Green Public Procurement: Analysis on the Use of Environmental Criteria in Contracts. Review of European Community & International Environmental Law 19(2), 250-262.
Porter, M.E., Kramer, M.R., 2011. Creating shared value. Harvard business review 89(1/2), 62-77.
Raven, R., Kern, F., Verhees, B., Smith, A., 2016. Niche construction and empowerment through socio-political work. A meta-analysis of six low-carbon technology cases. Environmental Innovation and Societal Transitions 18(Supplement C), 164-180.
Sartori, I., Hestnes, A.G., 2007. Energy use in the life cycle of conventional and low-energy buildings: A review article. Energy and Buildings 39(3), 249-257.
Sartori, I., Napolitano, A., Voss, K., 2012. Net zero energy buildings: A consistent definition framework. Energy and Buildings 48, 220-232.
Testa, F., Annunziata, E., Iraldo, F., Frey, M., 2016a. Drawbacks and opportunities of green public procurement: an effective tool for sustainable production. Journal of Cleaner Production 112, Part 3, 1893-1900.
Testa, F., Heras-Saizarbitoria, I., Daddi, T., Boiral, O., Iraldo, F., 2016b. Public regulatory relief and the adoption of environmental management systems: a European survey. Journal of Environmental Planning and Management 59(12), 2231-2250.
Testa, F., Iraldo, F., Frey, M., Daddi, T., 2012. What factors influence the uptake of GPP (green public procurement) practices? New evidence from an Italian survey. Ecological Economics 82, 88-96.
Uyarra, E., Edler, J., Garcia-Estevez, J., Georghiou, L., Yeow, J., 2014. Barriers to innovation through public procurement: A supplier perspective. Technovation 34(10), 631-645.
Varnäs, A., Balfors, B., Faith-Ell, C., 2009. Environmental consideration in procurement of construction contracts: current practice, problems and opportunities in green procurement in the Swedish construction industry. Journal of Cleaner Production 17(13), 1214-1222.
Wang, T., Seo, S., Liao, P.-C., Fang, D., 2016. GHG emission reduction performance of state-of-the-art green buildings: Review of two case studies. Renewable and Sustainable Energy Reviews 56, 484-493.
Witjes, S., Lozano, R., 2016. Towards a more Circular Economy: Proposing a framework linking sustainable public procurement and sustainable business models. Resources, Conservation and Recycling 112, 37-44.
Wong, J.K.W., Chan, J.K.S., Wadu, M.J., 2016. Facilitating effective green procurement in construction projects: An empirical study of the enablers. Journal of Cleaner Production 135, 859-871.
Yin, R.K., 2013. Case study research: Design and methods. Sage publications.
Zhu, Q., Geng, Y., Sarkis, J., 2013. Motivating green public procurement in China: An individual level perspective. Journal of Environmental Management 126, 85-95.

Table 1. Timeline for the Visund net-zero energy building project.

| Project phase | Time | Activity | Responsible |
|---|---|---|---|
| Planning | September 2009 | Project establishment | NDEA |
| | December 2010 | Pre-approval | NMoD |
| | July 2011 | Preparation of concept document | NDEA |
| | November 2011 | Preparation of pre-project and tender documents | NDEA |
| | January 2013 | Project approval | NMoD |
| Construction | June 2013 | Detailed engineering | Contractor |
| | August 2014 | Start of construction | Contractor |
| | December 2015 | Finishing construction | Contractor |
| | January 2016 | DLO moves inn | NDEA |

Table 2. Analysis of the actor roles in a traditional procurement process and the additional roles observed for the Visund net-zero energy building project.

| Actor | | Role in the procurement process | |
|---|---|---|---|
| Type | Name | Traditional | Visund net-zero energy building |
| Government | NMoD | • Approve project establishment<br>• Approve project realisation based on life cycle cost | • Participate in setting environmental targets<br>• Allocate project founding for an ambitious project based on qualitative arguments |
| Agency | NDEA | • Prepare concept design and pre-project<br>• Prepare tender documents<br>• Select contractor<br>• Act as builder in the construction phase | • Facilitate use of research organisations for novel design<br>• Engage own consultants for preparing alternative design in the pre-project<br>• Initiate new contract models |
| Supplier | Contractor | • Execute detailed engineering based on tender requirements<br>• Construct and build the building | • Develop and improve the net-zero design<br>• Use of novel and untraditional solutions<br>• Be financially responsible for the energy performance of the building |

Table 3. Analysis of contextual and processual improvements, benefits and limitations observed for successful implementation of GPP in the Visund net-zero energy building project.

| Aspect | Case analysis | | |
|---|---|---|---|
| | Improvement | Benefit | Limitations |
| Contextual | Low energy demand defined as a requirement | Created a "lighthouse project" with subsequent benefits | Difficult to convince benefit in economic terms |
| | Creation of a net-zero design | Demonstrated use of innovative solutions | Novel design may create operational problems |
| Processual | Adaptive project approval | Possibilities to develop and improve the concept | Weak support for the model in governing documents |
| | "Hybrid" turnkey contract | Few complaints and errors | Costly and complicated contracts |

Table 4. Overview of interviewed persons

| Number | Function | Organisation | Medium |
|---|---|---|---|
| 1 | Environmental and energy advisor | NDEA | Lync-video |
| 2 | Area quality manager | NDEA | Face to face |
| 3 | Strategic project advisor | NDEA | Face to face |
| 4 | Project manager planning phase | NDEA | Lync-video |
| 5 | Project manager execution phase | NDEA | Lync-video |
| 6 | Area leader | NDEA | Lync-video |
| 7 | Construction manager | Contractor | Lync-video |
| 8 | Quality manager planning phase | NDEA | Face to face |
| 9 | Area leader environment | NDEA | Face to face and written |

Table 5. Overview of semi-structured interview guideline

| Topic | Aim with questions |
|---|---|
| Background | Description of background and role in project / organisation. |
| Project history | Presentation of the project history. Differences in this project compared to other projects. |
| Environmental focus in the project phases | Description of the project phases with relevance for the interviewed. Description of environmental focus, requirements and measures. |
| The role of other project partners (NDEA) | Role and function of the other project partners. |
| Environmental focus in the contract (Contractor) | Description of the tender, preparation of bid, type of contract etc. |
| Corporation | Description of type of corporation, advantages and challenges. |
| Reflection | Benefits of the project. Potential barriers. |

Table 6. Overview of the project documents used in the study

| Number | Type of document | Description |
|---|---|---|
| 1 | Quality system | Schematic overview of project procedures |
| 2 | | Schematic drawing of project procedures |
| 3 | | Document explaining project execution |
| 4 | Templates | Template project definition |
| 5 | | Template concept document |
| 6 | | Template pre-project |
| 7 | Example documents | Typical concept document (i) |
| 8 | | Typical concept document (ii) |
| 9 | | Typical pre-project (i) |
| 10 | | Typical pre-project (ii) |
| 11 | Project documents | Project management document – Visund |
| 12 | | Project definition – Visund |
| 13 | | Concept document – Visund |
| 14 | | Pre-project – Visund |
| 15 | | Project application to NMoD |
| 16 | | Greenhouse gas report – Visund |
| 17 | | Tender document engineering |
| 18 | | Tender document contractor |
| 19 | | Contractual environmental requirements |
| 20 | | Contractual environmental deliverables |
| 21 | | Procedure for procurement in NDEA |
| 22 | | Guidance for procurement NDEA |
| 23 | | Guidance on HSE requirements |
| 24 | | HSE plan |
| 25 | | Guidance on technical requirements |
| 26 | | Guide on greenhouse gas accounting |
| 27 | NDEA guidelines | Environmental guideline |
| 28 | | Digitalisation guideline |
| 29 | Strategy documents | Research policy NDEA |
| 30 | | Research guideline 2013-2016 |
| 31 | | NMoD policy guidelines on environment |
| 32 | | Mission type description to NDEA from NMoD 2016 |
| 33 | Public reports | NDEA annual report 2014 |
| 34 | | NDEA environmental report 2014 |
| 35 | | NDEA environmental strategy 2016-2020 |
| 36 | Other | Method for greenhouse gas calculations |

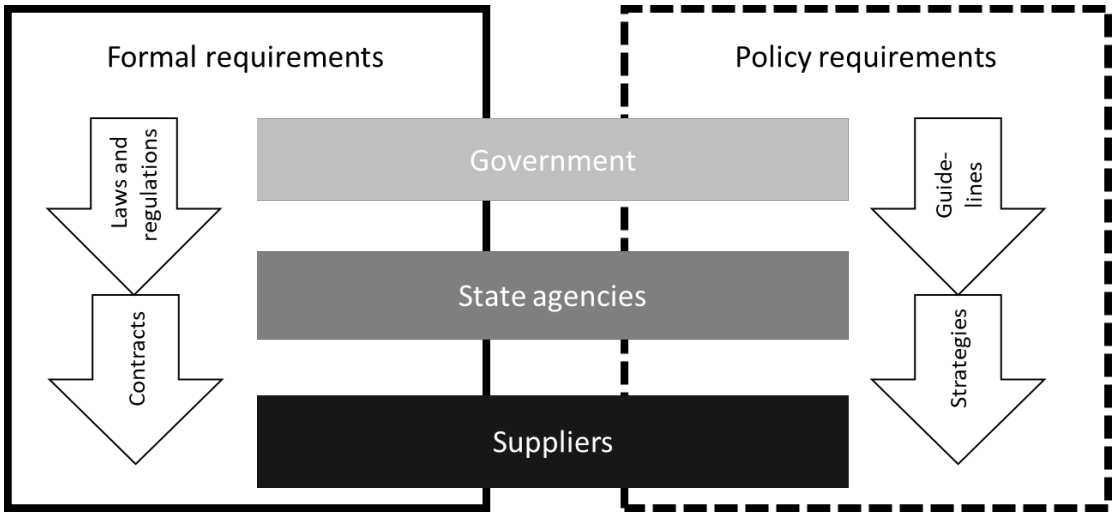


Figure 1 Generic governance model for public sector, adapted for Norwegian conditions. Light grey box represents political actors, Medium gray box is publicly governed agencies and the dark gray box is privately owned companies. Arrows describe the different pathways in which the formal and policy requirements are enacted.

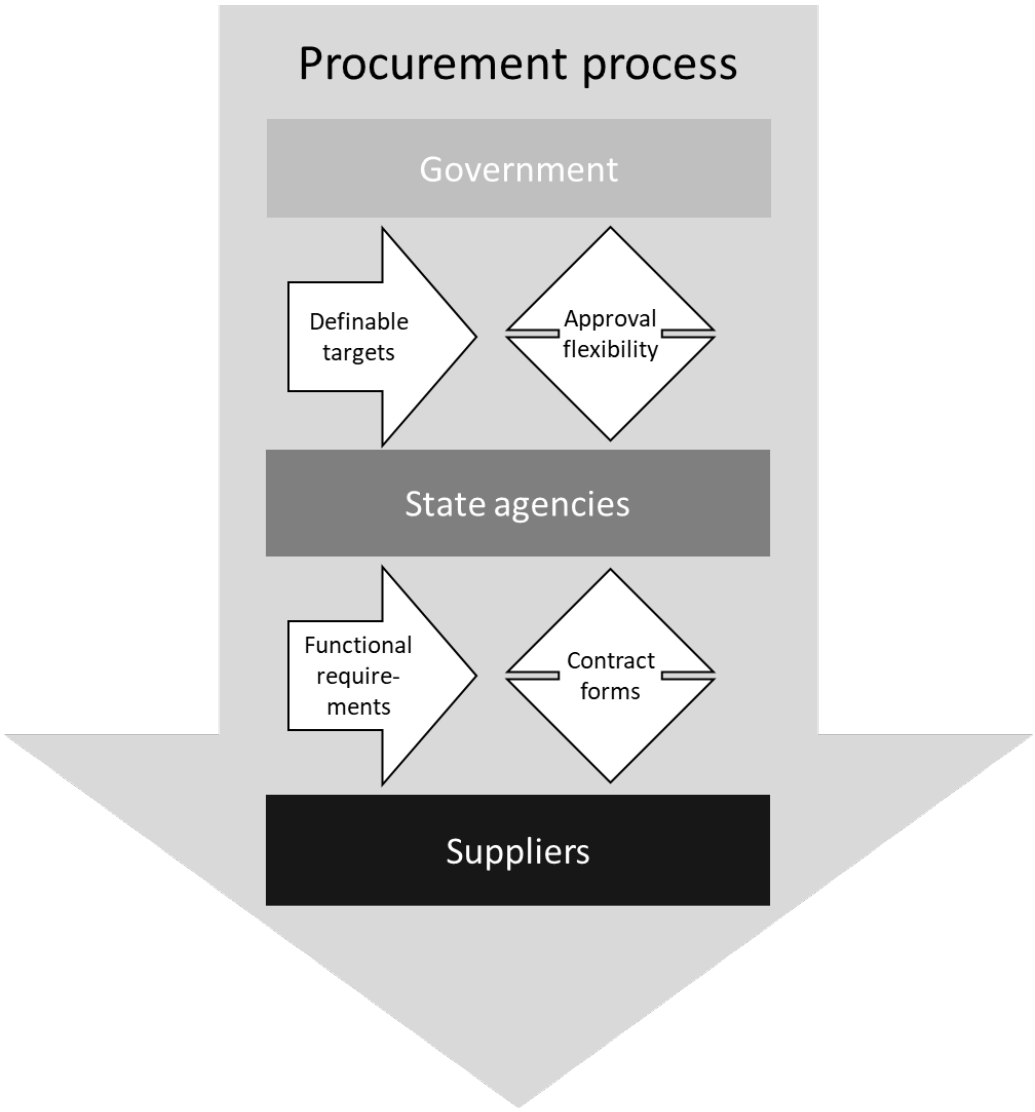


Figure 2 Summarizing the findings from the Visund green public procurement case in a conceptual model that follows the procurement process. Policy requirements in form of contextual activities were integrated in the procurement process (horizontal arrows). The formal process was optimized with processual activities (vertical arrows).